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PID 77332/85531

APPENDIX DR-03

Cleveland Innerbelt Corridor
Storm Water Best Management Practice Report
(Reference Document)

State of Ohio
Department of Transportation
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Innerbelt Bridge
Construction Contract Group 1 (CCG1)

Revision Date: August 17, 2007

CLEVELAND INNERBELT CORRIDOR
STORM WATER BEST MANAGEMENT PRACTICE REPORT

FINAL
PID 77510

August 17, 2007

BURGESS & NIPLE
URS
STATE OF OHIO DEPARTMENT OF TRANSPORTATION

STORM WATER MANAGEMENT
the Road to Clean Water
OHIO DEPARTMENT OF TRANSPORTATION

CLEVELAND INNERBELT PLAN
OHIO DEPARTMENT OF TRANSPORTATION

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EXECUTIVE SUMMARY

The Cleveland Innerbelt Stormwater Report presents the results of the PDP Steps 6 and 7 process investigation to determine post-construction runoff control options required per ODOTs Location and Design Manual, Volume 2 during the design phase of the project. Post-construction runoff controls are required on ODOT projects in response to Ohio Environmental Protection Agency NPDES General Permit, Ohio Department of Transportation's Stormwater Management Plan, and local stormwater requirements.

The project is located within the City of Cleveland in a highly urbanized area. Approximately, 48% of the project is served by combined sewers, and the remaining portion of the project area (52%) is served by separate storm sewers or CSO outfalls. Finally, a small portion of project runoff discharges initially to roadway ditches and then either flows into separate storm sewers or into combined sewers. Both the Northeast Ohio Sewer District and the City of Cleveland maintain sewers in the project area where highway runoff currently drains.

Major water bodies in the project area include the Cuyahoga River and Lake Erie. Existing Combined Sewer Overflows and stormwater discharges occur to each of these water bodies from a broad range of land uses. A Total Maximum Daily Load (TMDL) Study has been approved for the Lower Cuyahoga River, a designated Area of Concern on the Great Lakes.

Because the area is highly urbanized, the combined sewer and local collection systems receiving stormwater runoff from the Innerbelt is extremely complex and requires considerable effort to verify system connectivity for purposes of determining drainage and BMP design options for post-construction runoff controls. This Report presents a first step towards understanding and addressing the post-construction design needs and scope elements required to meet OEPA and ODOT requirements in future PDP Steps (Step 8 Stage I Design and beyond).

The Innerbelt project is divided into six primary project areas:

- Innerbelt Curve
- Innerbelt Trench
- Central Interchange
- Interstate 77 Approach to the Central Interchange
- Central Viaduct Bridge(s)
- Southern Innerbelt Section

The completion of the preliminary drainage area assessments is organized by each of these primary project areas. Each area is further separated into drainage areas. A total of 43 preliminary drainage areas are identified which require assessment and evaluation of post-construction runoff controls. The following table summarizes the number of project drainage areas within each ODOT project area and provides a general listing of the post-construction

Best Management Practices (BMP) identified as potentially feasible for consideration during the detailed design phase of the project (Step 8 Stage 1).

TABLE ES-1 - DRAINAGE AREA AND BEST MANAGEMENT PRACTICES		
Innerbelt Corridor Project Area Name	**Number of Preliminary Drainage Areas Delineated**	**Potential Best Management Practices Identified**
Innerbelt Curve	7	Exfiltration Trench, Manufactured Treatment System, Vegetated Bioswale, Detention/retention basins, and remain connected to combined sewer system or local collection system.
Innerbelt Trench	19	Exfiltration Trench, Manufactured Treatment System, Vegetated Bioswale and remain connected to combined or local collection system.
Central Interchange	7	Exfiltration Trench, Manufactured Treatment System, Vegetated Bioswale, Detention/retention basins and remain connected to current combined or local collection systems.
Interstate 77 Approach	3	Exfiltration Trench, Manufactured Treatment System, Vegetated Bioswale and remain connected to current combined sewer system.
Central Viaduct	2	Exfiltration Trench, Manufactured Treatment System, Vegetated Bioswale, Detention/retention basins and remain connected to current combined or local collection systems.
Southern Innerbelt Section	5	Exfiltration Trench, Manufactured Treatment System, Vegetated Bioswale and remain connected to current combined or local collection system.

In identifying the drainage areas and possible BMPs, a series of steps have been completed:

- Secure available GIS and other mapping on ODOT’s, the NEORSD’s, City of Cleveland’s collection system, CSO sewershed areas (Maps 1 through 10) and ODOTs existing roadway system and corresponding drainage information.

- Assess ODOT preliminary roadway drainage areas and overland flow paths based on available information (Section 5.0).

- Determine where ODOT's project highway runoff enters NEORSD and City of Cleveland combined sewer, local collection system and/or storm system (Section 5.0).

- Determine where ODOT has stormwater only outfalls within the project right-of-way (Sections 5 and 6).

- Identify potential project areas where ODOT may improve NEORSD and the City of Cleveland collection system operation by "disconnecting" highway runoff from entering the combined sewer system and thus help reduce the number of CSO events (Section 7.0 and Tables 15 and 16).

- Assess locations and types of BMPs which will be required using the criteria developed for completion of this assessment (Section 7.0 and Tables 15 through 19).

In addition to the above, the report provides historical information on OEPA's stormwater regulations, ODOT policy development in response to the regulations, ODOT's stormwater management plan, City of Cleveland's stormwater management plan requirements, and status of NEORSD's Long Term Control Plan (LTCP) and an overview of near term and long term CSO plan and projects. This information is included to provide context for section designers to understand the ODOT policy requirements at the time the report was developed and, rationale for selection and preliminary BMP locations. Actual design and construction of some sections of the Innerbelt project will occur over a 10 to 12 year period with the likelihood that both permit, NEORSD's LTCP, and ODOT post-construction requirements will have changed and thus require a reassessment of post-construction controls within each project drainage area. The current construction schedule indicates that some sections of the project are not to be constructed until after 2020.

Finally, this report is intended to be used as a scoping tool to assist project section designers with: 1) the development of project drainage and storm sewer system design drawings in conformance with ODOT Location and Design Manual, and 2) understanding ODOT's and OEPA's post-construction requirements when designing project stormwater Best Management Practices (BMP).

Based on the findings of this assessment, extensive coordination will be required with the City of Cleveland and particularly with the NEORSD to assure that changes in roadway drainage do not impact combined sewer system functioning and comply with their applicable design requirements, standards, and District's LTCP. Also, drainage areas and locations of pipe's, regulators, and other structures identified in this report are PRELIMINARY and will require refinement and field connectivity confirmation during development of project post-construction BMP design plans and specifications in PDP Step 8 Stage I design.

SECTION 1 INTRODUCTION

The objective of the Cleveland Innerbelt Corridor Stormwater Best Management Practice Report (BMPR) is to present proposed project Stormwater Best Management Practice (BMP). This report includes the following information:

- ODOT's Cleveland Innerbelt Corridor projects with corresponding PIDs and general descriptions of the preferred project alternatives.
- Northeast Ohio Regional Sewer District (NEORSD) Interceptor, combined sewer overflow (CSO) outfall locations and regulator details and locations to determine feasibility of separating project drainage from combined sewers.
- Ohio Department of Transportation (ODOT) Location and Design, Volume 2 Manual requirements for post-construction best management practices, January 2007 (*Appendix A*).
- Ohio Environmental Protection Agency (OEPA) Authorization for Stormwater Discharges Associated with Construction Activity under the National Pollutant Discharge Elimination System (NPDES). Permit number OHC000002 (*Appendix B*) (Construction Permit) requirements.
- Preliminary project drainage areas.
- Post-Construction Stormwater BMPs that are feasible within each preliminary drainage area and areas where it is recommended to separate project stormwater runoff from the local combined sewer system.

This report does not provide any BMP design details, specifications or final BMP selection or locations with the preliminary project drainage areas. The selection and development of design details will be completed during Stage 1 design.

1.1 BACKGROUND

The Innerbelt Corridor is comprised of the Innerbelt Freeway, together with portions of the radial freeways and portions of the local street system. The definition of the Innerbelt Corridor is dynamic and recognizes the interrelationship among each of the components (Innerbelt Freeway, radial freeways and local streets). The operations performance of the Innerbelt Freeway is affected by the operational performance of the radial freeways and the local street system. In turn, the operational performance of the Innerbelt Freeway affects the operational performance of the radial freeways and local street system. Innerbelt Corridor general project descriptions are provided in Section 2.

Project stormwater runoff is conveyed by three primary system types. These three systems and the estimated percent of each type within the project area are as follows:

- Runoff enters NEORSD combined sewer system – Estimated 48% ODOT highway stormwater runoff currently enters NEORSD system and combines with sanitary flows. This includes the I-77 Approach, the Southern Innerbelt, and portions of the Central Interchange.
- Runoff enters storm sewer only pipes – Estimated 52% - ODOT highway stormwater runoff enters storm sewer system only flows. This includes the Innerbelt Curve, the Trench, and portions of the Central Interchange.

- Runoff enters road side ditches – Estimated 2% - ODOT highway stormwater runoff entering road side ditches, which may discharge to a storm only system outfall or into combined systems. If these ditches confluence with receiving streams, these are defined as outfalls under the context of the MS4 permit (*Appendix F).*

It is important for the project design engineers to understand that the project area is primarily served by a combined sewer overflow (CSO) system comprised of a series of sanitary interceptors, regulators, collection system pipes plus a series of stormwater only sewer system pipes (*Appendix D).* During daily operation and during small precipitation events, the system collects both sanitary and stormwater flows and transfers these flows to one of three wastewater treatment plants (WWTP). During large precipitation events when a large volume of stormwater enters the system, the conveyance system can not convey the larger volume fast enough and portions of the flow are diverted, receive no treatment, and flow to a combined system outfall to a nearby water body. Section 5.0 of this report will cover the CSO system in detail.

It is important for the project design engineers to note that ODOT has revised and updated ODOT's Location and Design Volume 2 Post-Construction Stormwater policy (Policy) to address OEPA recommendations during a series of OEPA/ODOT discussions conducted between mid-2004 and early-2006. Table 1 shows Policy revisions that occurred during development of this report.

Table 1 – Summary of ODOT Location and Design Manual Revisions which included Stormwater Management Revisions		
2005	**2006**	**2007**
January	January	January
April	October	
October		

As a result of these discussions, OEPA forwarded ODOT a letter on October 26, 2006 indicating acceptance of the BMPs in the L/D manual based on parameters and conditions outlined in this letter. The letter is included in *Appendix E*. OEPA and ODOT continue to work collectively to address post-construction stormwater management and BMP issues related to linear transportation and highway projects. The January 2007 version of the L/D Volume 2 Manual is included in *Appendix A*.

1.2 USE OF REPORT

This BMPR is intended to be used in conjunction with the project drainage design drawings, storm sewer system design drawings, and the most current ODOT Location and Design Manual, along with OEPA's current Construction Permit to assist in selecting and designing project recommended stormwater Best Management Practices (BMP). The report contains information collected from the following resources:

- Ohio Department of Transportation – Location and Design Manual, Volume 2- January 2007.
- ODOT – Plan drawings.
- Cleveland Innerbelt –Step 6 Engineering – Jan 2007.
- Northeast Ohio Regional Sewer District – GIS shape file coverage's (sewersheds, collection system pipe layouts)
- Ohio Environmental Protection Agency – Authorization for Stormwater Discharges Associated with Construction Activity under the National Pollutant Discharge Elimination System (NPDES). Permit number OHC000002 (*Appendix B*).
- Ohio Environmental Protection Agency – Authorization for Small Municipal Separate Storm Sewer Systems to Discharge Stormwater under the National Pollutant Discharge Elimination System. Permit number OHQ000001 (*Appendix F*).
- Northeast Ohio Regional Sewer District – Long Term Control Plan, Easterly Early Action Plan,
- Lower Cuyahoga River Total Maximum Daily Load (TMDL) Study (*Appendix G*).

The project design engineers are directed to the following ODOT references, including any and all updates issued after the date of this report:

- Location and Design Manual – Volumes 1-3:
  - Volume 1 – Roadway Design
  - Volume 2 – Drainage Design
  - Volume 3 – Highway Plans
- Construction Materials Specifications
- Construction Inspection Manual of Procedures
- ODOT – Statewide Stormwater Management Plan
- Office of Structural Engineering – NPDES Implementation Plan – www.dot.state.oh.us/se/hy/NPDES.htm
- ODOT standard water quality best management practice device drawings

1.3 REPORT ORGANIZATION

The report is organized in the following sections. A brief summary of section content is provided to clarify the information presented in each.

- Executive Summary

- Section 1.0 – Introduction: Provides information on report set up and project background

- Section 2.0 – Project Descriptions: Provides a brief summary of the preferred project alternatives and PID numbers.

- Section 3.0 – Stormwater Management Project Approach: Provides information on project drainage and stormwater information/data collected, reviewed or developed and changes to the initial approach.

- Section 4.0 – Regulatory Requirements: Provides a summary of current and proposed future regulatory issues and known schedule items.

- Section 5.0 – Northeast Ohio Regional Sewer District (NEORSD) and City of Cleveland – Conveyance Systems: Provides information on NEORSD combined sewer systems and the City of Cleveland's collection systems; and the relationship of these conveyances to ODOT's Innerbelt projects.

- Section 6.0 – Preliminary Stormwater Project Drainage Information: Provides information on drainage issues identified during development of the report. This Section also provides a discussion on each PID and the potential drainage issues.

- Section 7.0 – Project Best Management Practice (BMP) Stormwater Recommendations: Provides summary information presented in the BMP tables and provides brief discussions on how the tables are set up and how to read them. In addition, the information in this Section addresses the BMP selection rationale.

- Section 8.0 – Conclusions: Provides a summary of the recommendations

- Reference/Tables/Figures/Maps/Appendices/CDs.

The primary deliverables of this report are presented in Tables 15 and 16 and Maps 1-10:

Stormwater BMP Summary Tables - Table 15 -System Inventory and Connection/Separation Options contains the following BMP drainage area information:

- NEORSD CSO drainage area associated with each project drainage area.
- Outfall surface water body
- Information on system separation recommendations
- Drainage area information to aid drainage and BMP design.
-

Table 16 - Best Management Practice Recommendations and Selection Rational contains the following BMP drainage area information:

- Recommended BMP for the respective ODOT project drainage area.
- BMP selection rationale
- Rationale for BMPs which were not recommended or have limitations for their use in certain drainage areas.

The BMPR maps (Maps 1-10) show the following project elements:

- Color coded background areas which identify NEORSD sewershed areas.
- Project limits and preliminary drainage areas have been delineated for the purpose of evaluating potential BMPs within each project area.
- Color coded lines depicting the different types of conveyance systems.
- Known NEORSD tributary regulators and interceptor manholes.

- Known CSO and stormwater system outfalls.
- CSO sewersheds and the primary flow path from the project areas through the CSO systems

1.4 DISCLAIMER

The information contained in this BMPR is intended to provide Stormwater Best Management Practices recommendations based on current ODOT policies, OPEA requirements, and the NEORSD combined sewer system. Project design engineers will need to incorporate the most current policy and regulatory requirements. This report has incorporated copies of the recent regulatory requirements and ODOTs policy information in the appendices for reference and should be reviewed and evaluated during drainage and BMP design.

SECTION 2 PROJECT DESCRIPTIONS

The Cleveland Innerbelt is a high capacity, limited access highway extending from Cleveland's Tremont neighborhood on the West Side to the Cuyahoga River, across the Cuyahoga River valley, around the southern and eastern edges of downtown to the City's lakefront district at Burke Lakefront Airport. The Innerbelt Freeway provides access to and mobility through the City of Cleveland. Downtown Cleveland depends on the Innerbelt Freeway's ability to collect and distribute traffic between the radial freeway system and the local street system (TranSystems, 2007a).

Figure 1 – Overall Project Area View

Aerial photograph courtesy of TranSystems – Draft EIS report

2.1 SUMMARY OF DESCRIPTION OF ALTERNATIVES

The Innerbelt refers to the actual interstate roadway that is the central focus of the report. The Innerbelt begins at I-71 and West 25th Street and proceeds north along I-71 past the merger with State Route 176 (Jennings Freeway) to the I-71/I-90/I-490 interchange. From this interchange the Innerbelt proceeds north along I-90 over the Central Viaduct Bridge. From the Central viaduct, the Innerbelt (I-90) continues north along the eastern edge of downtown in a depressed section of freeway (Innerbelt Trench), through the Innerbelt Curve to where I-90 merges with State Route 2 (The Shoreway). At the end of the Innerbelt, I-90 continues to the east through Cleveland and Lake County. The Innerbelt includes all of the freeway ramp connections with the local street systems (Figure 1)

The Central Interchange (Figure 1) is the convergence of I-90 and I-77 adjacent to the Central Business District (CBD) of Cleveland. This project will reconstruct the entire interchange to improve its operation and dramatically improve safety. The project will retain the existing system ramps from I-77 NB to I-90 EB, along with the I-90 WB to I-77 SB movements. The existing I-77 NB to I-90 WB and I-90 EB to I-77 SB movements will be redirected to use I-490. As part of the I-90 mainline improvements, a new I-90 WB bridge will be constructed across the Cuyahoga River valley. This new structure, constructed north of the existing bridge, will provide for five lanes of outbound traffic from downtown Cleveland. After completion of the new I-90 WB Bridge, the existing Central Viaduct (Figure 1) will be rehabilitated and reconfigured to provide five (5) lanes of inbound traffic to downtown Cleveland. These additional lanes will enable significantly improved signage to drivers wishing to access the downtown exits. Existing Commercial Road will be relocated from the Ontario/Carnegie intersection area north of I-90 to the south of I-90. This new roadway will align with E 9th Street and provide improved access for trucks in and out of the industrial Flats.

Table 2 shows the ODOT project name, contract construction group (CCG) and Project Identification (PID) number.

Table 2 – Project PID Summary Table

ODOT Project Name	Construction Contract Group (CCG)	PID Numbers
Innerbelt Bridge New Westbound I-90	1	77332
Innerbelt – I-77 Approach	2	80406, 82338, 13567(*I-77 over I-490*)
Innerbelt Bridge – Rehabilitation of existing bridge (Eastbound – I-90)	3	80407
Innerbelt Overhead Roadway Bridges	4	79580
Innerbelt Overhead Bridges	5	80408
Innerbelt Trench	6	25795
Innerbelt Curve	7	77413
Innerbelt – New I-90 Eastbound Bridge	8	82119

The Innerbelt has a number of logical termini that were used to divide the project into sections to facilitate the development and evaluation of alternatives. These sections consist of similar physical, topographical and operation performance characteristics and issues that differ from the neighboring areas. The geographical sections of the Innerbelt from north to south are: Innerbelt Curve, Innerbelt Trench, Central Viaduct and Central Interchange, and Southern Innerbelt. The area of the Central Interchange to south of the I-77/I-490 interchange is referenced as the I-77 Approach Section. Table 3 provides an estimated schedule as to when the different construction contract groups will be sold (bid for construction).

Table 3 - Projected Project Contract Construction Group Schedule

ODOT Project Name	Contract Construction Group (CCG)	PID Numbers	Proposed Dates
Innerbelt Bridge (New Westbound I-90)	1	77332	2010, 2011, 2012
Innerbelt – I-77 Approach to Central Interchange	2A1	80406	2013
Innerbelt I-77 Bridge over I-490	2A2	82338	2009
Innerbelt Bridge – Broadway Ave. over I-77	2A3	13567	2012
Innerbelt Bridge – Rehabilitation of existing bridge (Eastbound – I-90)	3	80407	2014
Innerbelt – Overhead Roadway Bridges	4	79580	2016
Innerbelt Railroad Overhead Bridges	5	80408	2016
Innerbelt Trench	6	25795	2019
Innerbelt Curve	7	77413	2020
Innerbelt – New I-90 Eastbound Bridge	8	82119	2022

Figure 2 shows the major project areas with the project identification number (PID), Contract Construction Group (CCG) and projected dates. Only the major projects with PIDs are shown in Figure 2. There likely will be smaller construction projects split from the major project groups shown in Table 2 in the future. These will be constructed as parts of the major projects and are not identified independently in Figure 2. The following is an example of the call out box in Figure 2.

Example text box for Figure 2

Project Name/PID/Contract Construction Group/Date

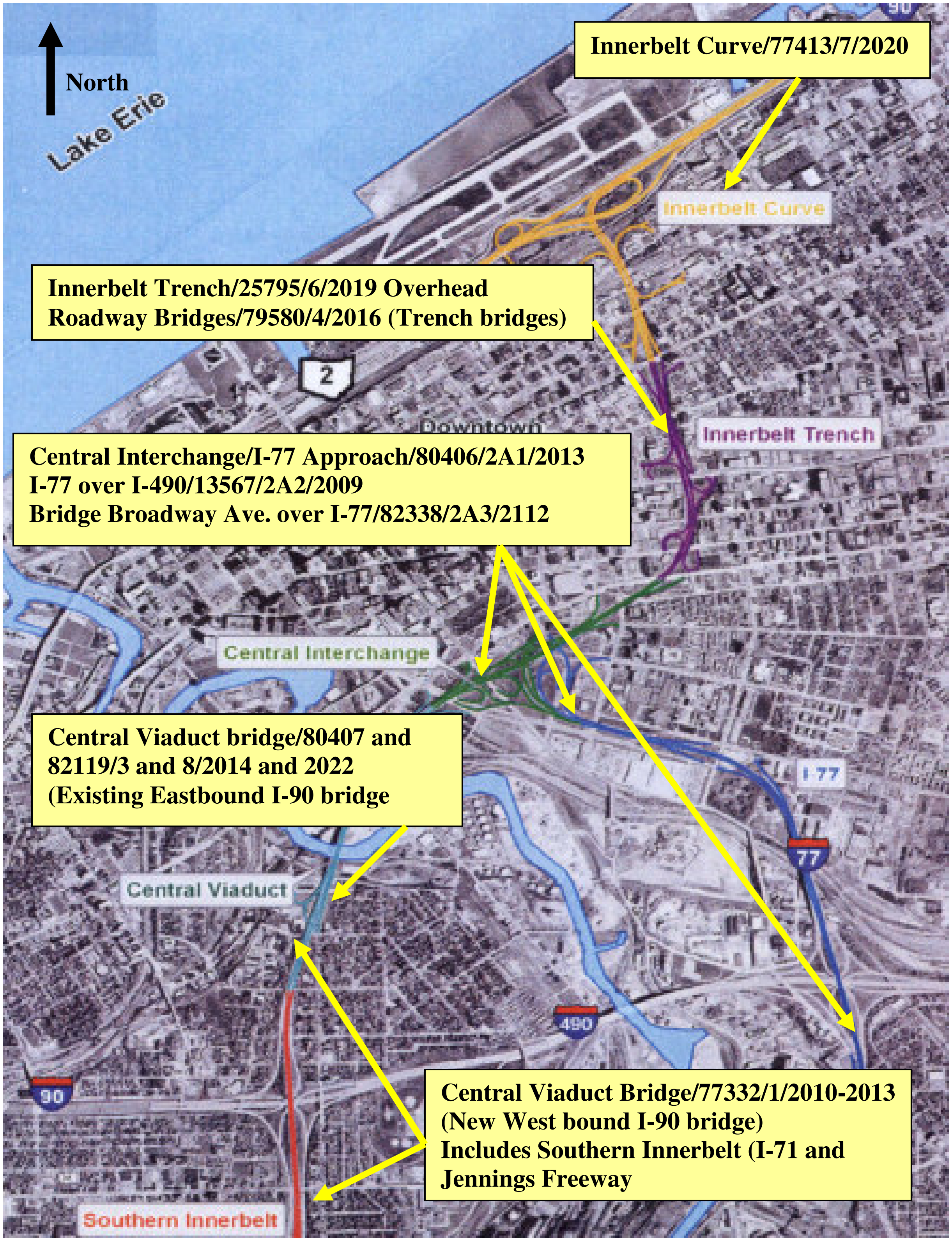


Figure 2 – Project Area PID/CCG/Dates

The Innerbelt Corridor contains a series of frontage roads which will be constructed as part of the project. These frontage roads exist in the Curve and Trench project areas. Maps 1 through 7 show the frontage roads as being part of the larger preliminary project drainage areas. The bridges which cross the Trench portion of the project have been separated and given a unique project preliminary drainage area labels. The following is a summary of the project frontage roads and the local roads that are proposed:

- Innerbelt Curve
  - East 30th Extension – Runs between Superior Ave. to St. Clair Ave. and on to Hamilton Ave.
- Innerbelt Trench
  - Frontage road (Midtown Connector road) between Chester Ave. to Euclid Ave to Prospect Ave to Carnegie Ave.

The following sections contain project descriptions of the major corridor project areas and the corresponding project identification numbers.

2.1.1 Central Interchange and Central Viaduct – PID 77332, 80406, 80407

The improvement within in the Central Interchange and the Central Viaduct Bridge are broken into three sections (Figure 2).

- **Innerbelt Bridge (New West bound I-90) PID 77332 –** New westbound I-90 bridge.

- **Innerbelt I-77 Approach to Central Interchange PID 80406**

- **Innerbelt Bridge (Eastbound I-90) Rehabilitation of existing bridge PID 80407 -** The Central Viaduct Bridge is the primary river crossing, moving Interstate traffic from the south (I-71) and west (I-90) across the Cuyahoga River to the downtown distribution system of the Central Interchange and further east to the Innerbelt Trench. There are four other river crossings available: the SR 2 Main Avenue Bridge, the U.S. 6/20 Veterans Memorial/Detroit Superior Bridge, the SR 10 Lorain Carnegie/Hope Memorial Bridge, and the I-490 bridge. Of these, only I-490 serves Interstate traffic (TranSystems, 2007a).
- **Southern Innerbelt - PID 77332** - The Southern Innerbelt Section improvements are limited to the addition of a deceleration lane from I-90 WB to SR 176 SB (Jennings Freeway) (See Figure 2).

2.1.2 Innerbelt – I-77 Approach to Central Interchange – PID 80406, 82338, 13567

The improvements on I-77 are broken out into three sections (Figure 2).

- **Broadway Ave Bridge over I-77 PID – 82338** - The existing Broadway Ave Bridge over I-77 will be replace/lengthened to improve the existing entrance ramp from I-490 EB to I-77 SB. In order to improve this ramp, the existing entrance ramp to I-77 SB from Broadway Avenue will be reconfigured as a frontage road to Pershing Ave.

Traffic from Broadway Avenue can use this frontage road to access I-77 SB from the existing Pershing Avenue entrance ramp.

- **I-77 Bridge over I-490 PID – 13567** - The existing I-77 bridge over I-490 will be replace to provide three (3) lanes of traffic in both the NB and SB directions of I-77.

- **I-77 North of I-490 PID - 80406** - The existing Kingsbury Run Bridge will be re-striped to provide four (4) lanes of traffic in both the NB and SB directions of I-77.

2.1.3 Innerbelt – Central Viaduct Bridge (New I-90 Eastbound Bridge) – PID 82119

The final projected Innerbelt project is the replacement of the existing Central Viaduct Bridge with a new I-90 EB only bridge.

2.1.4 Innerbelt – Overhead Roadway Bridges – PID 79580

This includes improvements to the City street bridges that cross the project.

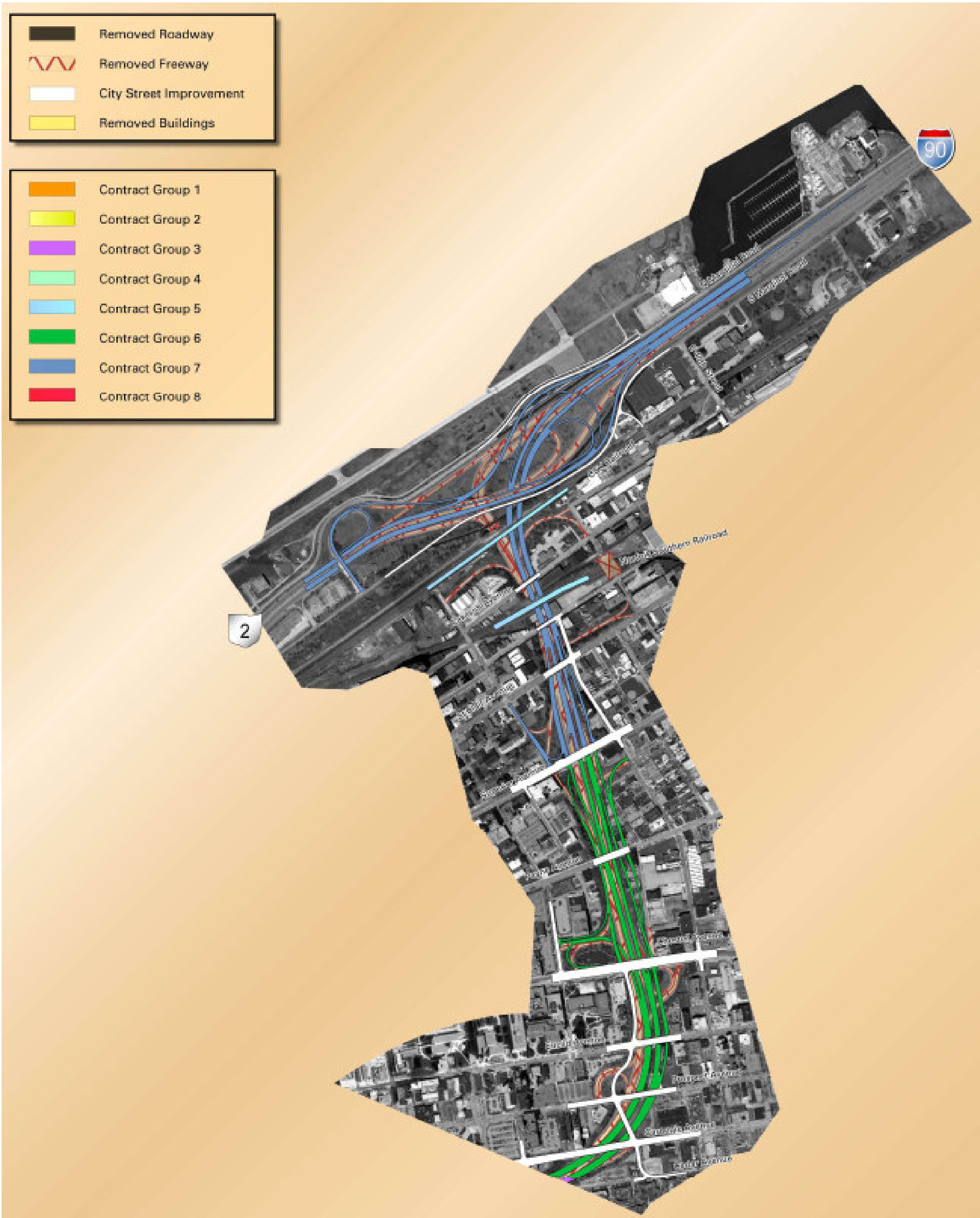
2.1.5 Innerbelt Trench – PID 25795

The Innerbelt Trench Section lies between the Innerbelt Curve Section and the Central Viaduct/Central Interchange Section. The Innerbelt Trench Section consists of I-90 from approximately East 22nd Street, through the Carnegie Curve, and to Superior Avenue. This Section of I-90 is trenched: the freeway is depressed and bordered by walls or slopes on both sides with the adjacent streets and surrounding neighborhoods on an elevation above the freeway. The existing closely spaced access points create a series of merge and weave problems which result in this location having very high crash rates. Freeway access in the Trench is consolidated to Chester and Superior. Access between Carnegie and Chester will be accommodated through the construction of one-way frontage roads on either side of I-90. The entrance and exit ramps within the Trench will be braided to eliminate the existing weave areas which currently exist.

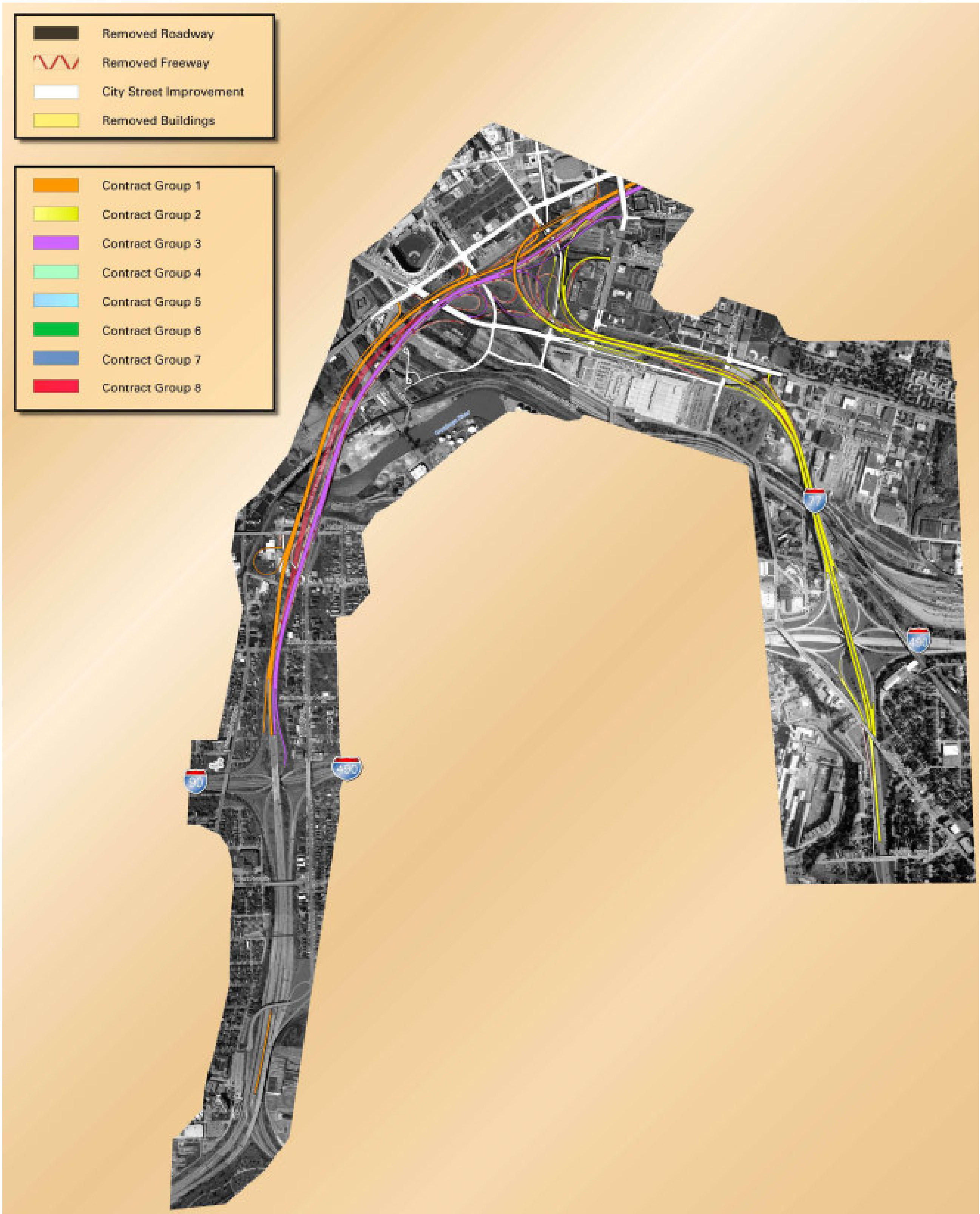
2.1.6 Innerbelt Curve - PID77413/80408

The main improvement in this Section of the corridor is the reconstruction of the existing substandard horizontal curve with a 60 MPH design speed. Three (3) thru lanes will be provided in both the east and westbound directions of I-90. The existing system interchange with SR 2 will also be reconstructed. The exit from I-90 WB to SR 2 WB will be improved to better delineate the thru movement. Additionally, the existing substandard curve from SR 2 EB to I-90 WB and will be replaced with a significantly improved ramp. The existing I-90 entrance and exit ramps in this Section will be consolidated at Superior Ave. Finally, East 30th will be extended north, from St Clair Ave to Hamilton, to better facilitate truck access into the St. Clair-Superior area.

Figure 7 – Recommended Preferred Alternatives – February 2007
3A-Northern Contract Construction Group



3B- Southern Contract Construction Group



SECTION 3 STORMWATER MANAGEMENT PROJECT APPROACH

3.1 BACKGROUND

ODOT has been working since October 2004 to develop revisions to the Location and Design Volume 2 manual in response to the OEPA's 2003 Construction General Permit (Construction Permit). Part III of this Construction Permit requires the implementation of post-construction stormwater runoff controls for projects disturbing land from one to five acres, and for five acres and greater. These controls are in the form of Best Management Practices (BMPs) and these are addressed in ODOT Policy. Table 4 shows a progression of the revisions to Construction Permit development.

Table 4 - Summary of Construction Permit Development

Permit Date	Term Date	Comments
1989	1994	OEPA updated permit
1994	1999	OEPA did not update permit
*1994	2003	OEPA updates – 1994 permit
2003	2008	OEPA due to update permit

* - 1994 permit requirements remain in effect, even through term expired.

ODOT was challenged with deciding how to approach stormwater management for the Cleveland Innerbelt Corridor project while satifisfying the requirements of the OEPA Construction Permit. The following sections summarize decisions that resulted from questions and issues that were identified during the preparation of the BMPR.

- **Question -** How to address prost-construction stormwater runoff control for the Innerbelt Corridor project?

Issue – Project has multiple contract construction groups (CCG), proposed design schedules, staggered proposed project sale dates, and unique stormwater issues for each CCG.

Decision – Determined to address specific project stormwater runoff and BMP controls on a CCG basis and not for the entire Innerbelt Corridor project as a whole.

- **Question -** How to evaluate or assess potential highway runoff (volume) issues related to runoff entering NEORSD combined sewer systems?

Issues -

1.) How to assess volume of runoff currently being contributed to CSO or local combined system drainage areas from the Innerbelt highway system?
2.) How to assess changes in the amount of runoff being contributed to CSO or local combined system drainage areas based on the selected project alignment alternatives?
3.) How to document or evaluate potential positive impacts to CSO or local combined system drainage areas should ODOT no longer discharge stormwater runoff to the CSO system?

Decisions -

1. At the time of report submission, URS collected copies of the Easterly, Southerly, and Westerly WWTP Long Term Control Plans from Metcalf and Eddy (consultant). These plans were reviewed and determined that they contained no system capacity information. Recommendation is that the project design engineers need to assess project impervious areas and estimate existing runoff volumes and document estimated runoff volumes by CSO drainage areas (if continuing a connection to the combined sewer system).

2. URS did not perform any impervious area analysis on proposed new pavement areas. Recommendation is that project design engineers will need to assess and document changes in the impervious areas per CSO drainage area and compare these values with the estimated existing runoff volumes.

3. URS worked with ODOT and the NEORSD to collect information and identify the CSO drainage areas which the combined sewer system would benefit positively from removal of ODOT stormwater runoff (See Table 5 for the identified CSOs). Recommendation is project design engineers will need to work closely with NEORSD engineers and staff to incorporate runoff volumes into NEORSD hydraulic system models on a case by case basis to ensure that:

   1. New impervious area runoff volumes do not negatively impact the CSO.

   2. Document runoff volumes removed from the CSO drainage areas, which will need to be conveyed to a post-construction BMP as recommended in Tables 15 and 16 of this report.

   3. Project design engineers will need to address the runoff volume estimates (see Section 5.6 for hydraulic design information) that will need to be input into the hydraulic system models for the NEORSD.

- **Question -** How to identify potential open areas within project limits where post-construction BMPs could be designed and constructed?

Issues

1. Ultra urban corridor, "open" space is limited at best and non-existent in some areas of the project.
2. Hydraulic separation issues exist within depressed areas of the project (Trench area).
3. Discharging stormwater only outfalls.
4. Distance needed to convey stormwater runoff is a factor.
5. NPDES Permits (ODOT Statewide MS4 Permit) and post-construction controls are required for any storm only outfalls designed and constructed as a result of addressing stormwater project runoff.

Decisions –

1. URS and ODOT identified the selected alignment alternatives where there are elevated roadways sections or where space is available for post-construction BMPs. These roadway project areas coincide with CSO drainage areas where separating stormwater runoff would be a positive CSO system benefit and ODOT would than have space for post-construction BMPs.

2. If the recommendations in Tables 15 and 16 indicate that an area should remain connected to CSO system, the project design engineers should perform the necessary impervious analysis to develop the runoff volume and work with NEORSD staff to model this area to ensure change in impervious area does not negatively impact the CSO or local combined system. . .

3. URS did not locate or design BMP's within the preliminary drainage areas. The project design engineers will need to address how and where to outlet storm sewer system outfalls. These outfalls will need to be incorporated into ODOT's MS4 permit outfall database and should be designed along with the project drainage. (Issue Items 4 and 5 addressed in Item 3). Easements may be needed for maintenance and operation of potential new storm sewer system outfalls.

The following tasks were performed during the preparation of this BMPR:

- Determine where ODOT's project highway runoff enters NEORSD combined sewer system.

- Determine where ODOT has stormwater only outfalls within the project right-of-way.

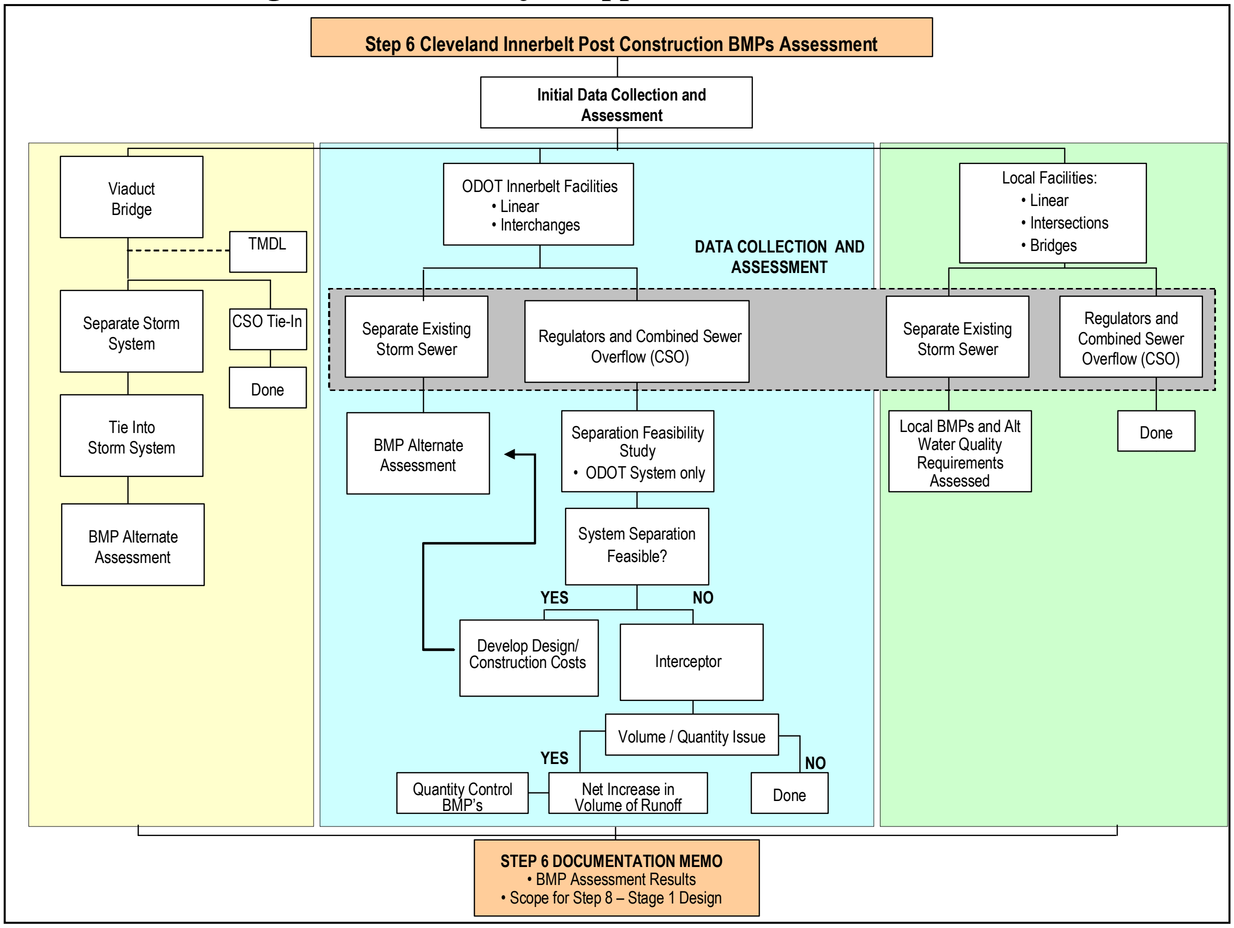
- Develop a table of recommended BMPs for each delineated project drainage area including recommendation rationale.

- Incorporate the following requirements or criteria into the BMP recommendation process:
    - FHWA safety concerns – Standing/ponding water issues
    - ODOT Policy requirements
    - OEPA regulatory requirements
    - Local Municipal Separate Storm Sewer System (MS4) program requirements
    - BMP operational and maintenance needs.

The above information framed the approach methodology which was implemented to develop the recommend BMPs, provide rationale for BMP selections and to document BMP constraints which need to be considered by the project design engineers. This information is presented in Tables 15 and 16 at the end of Section 8.

Two flowcharts have been included in this report for the project design engineer to gain a better understanding of the development of the approach methodology. The Policy changed as a result of the ODOT/OEPA decisions and the Policy requirements became better defined and clarified. Therefore the project approach changed to reflect the changing Policy. The information presented in Figure 4 (*Appendix J*) shows the approach method proposed to be implemented through October 2005. ODOT's project BMP procedural selection flowchart is included in Figure 5 (*Appendix K*). These flowcharts show the evolution of the BMP selection process between January 2005 and January 2007.

Figure 4 - Initial Project Approach for BMP Selection



ODOT/OEPA discussion decisions and subsequent Policy revisions required a change in the approach flowchart. The most significant change was that the Policy no longer required a feasibility study be performed in support of the BMP selection. In addition, the exfiltration trench concept BMP was developed between April 2005 and October 2005 by ODOT hydraulics personnel. There were no changes in the BMP process between January 2005 and April 2005. From January 2006 through October 2006, ODOT and OEPA finalized the Policy issues OEPA issued ODOT an acceptance letter in October 2006 (see *Appendix E*).

The term "Separation Feasibility Study" in Figure 4 is not the same as a Feasibility Study as discussed in ODOT's BMP selection process. The Separation Feasibility Study's purpose is to identify combined sewer system drainage areas where ODOT could separate stormwater runoff from the combined sewer system and is it feasible hydraulically and economically. The Feasibility Study referenced above in ODOT's Policy was developed to determine the feasibility of project BMPs and specific water quality needs.

3.2 PROJECT APPROACH METHODOLOGY

The project approach was developed by taking the Policy BMP selection flowchart shown in Figure 5 and modifying it to assess the feasibility of separation and BMP selection in a preliminary drainage area served exclusively by a CSO or local combined system.

Figure 5 - January 2007 ODOT BMP Selection Process

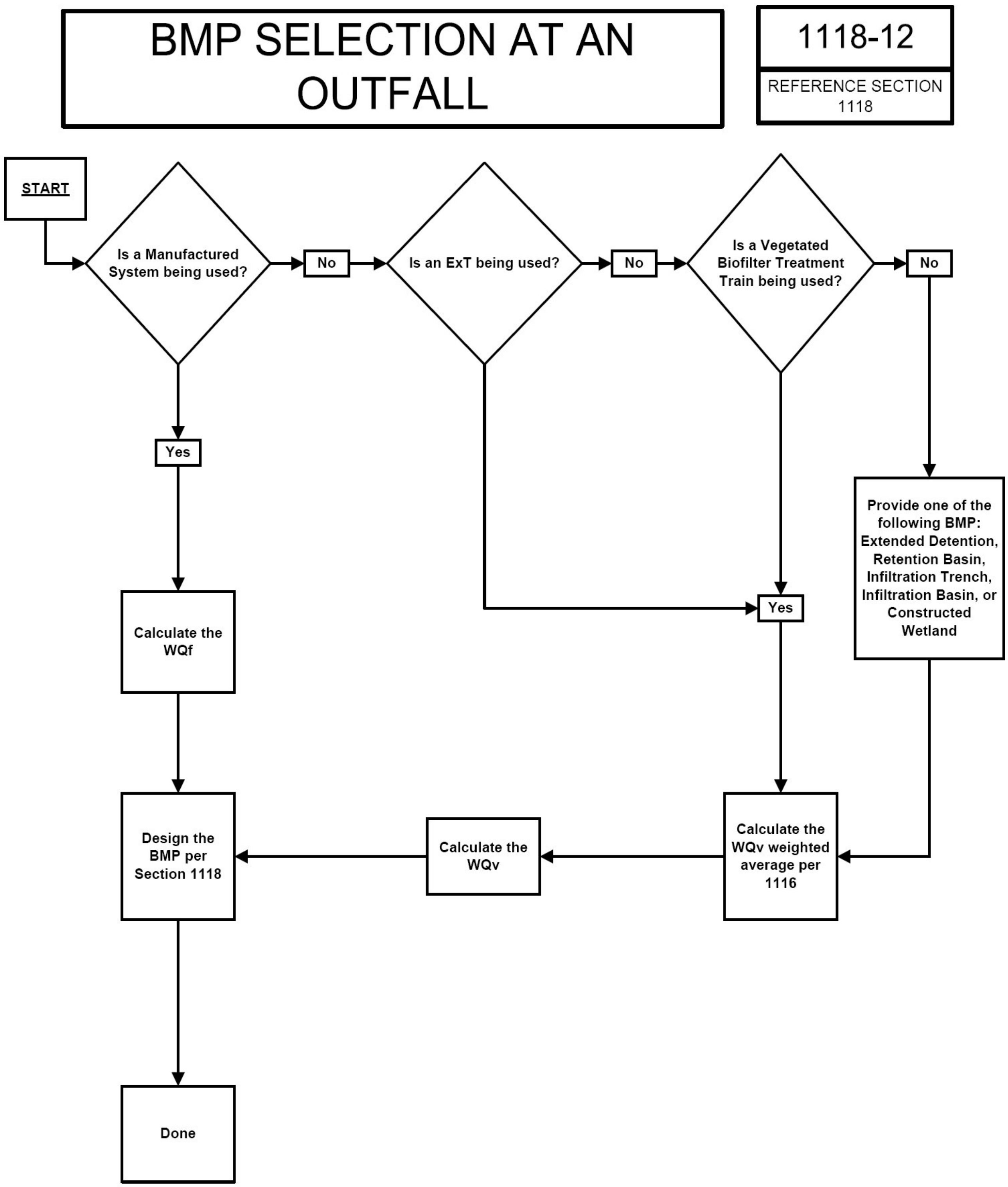
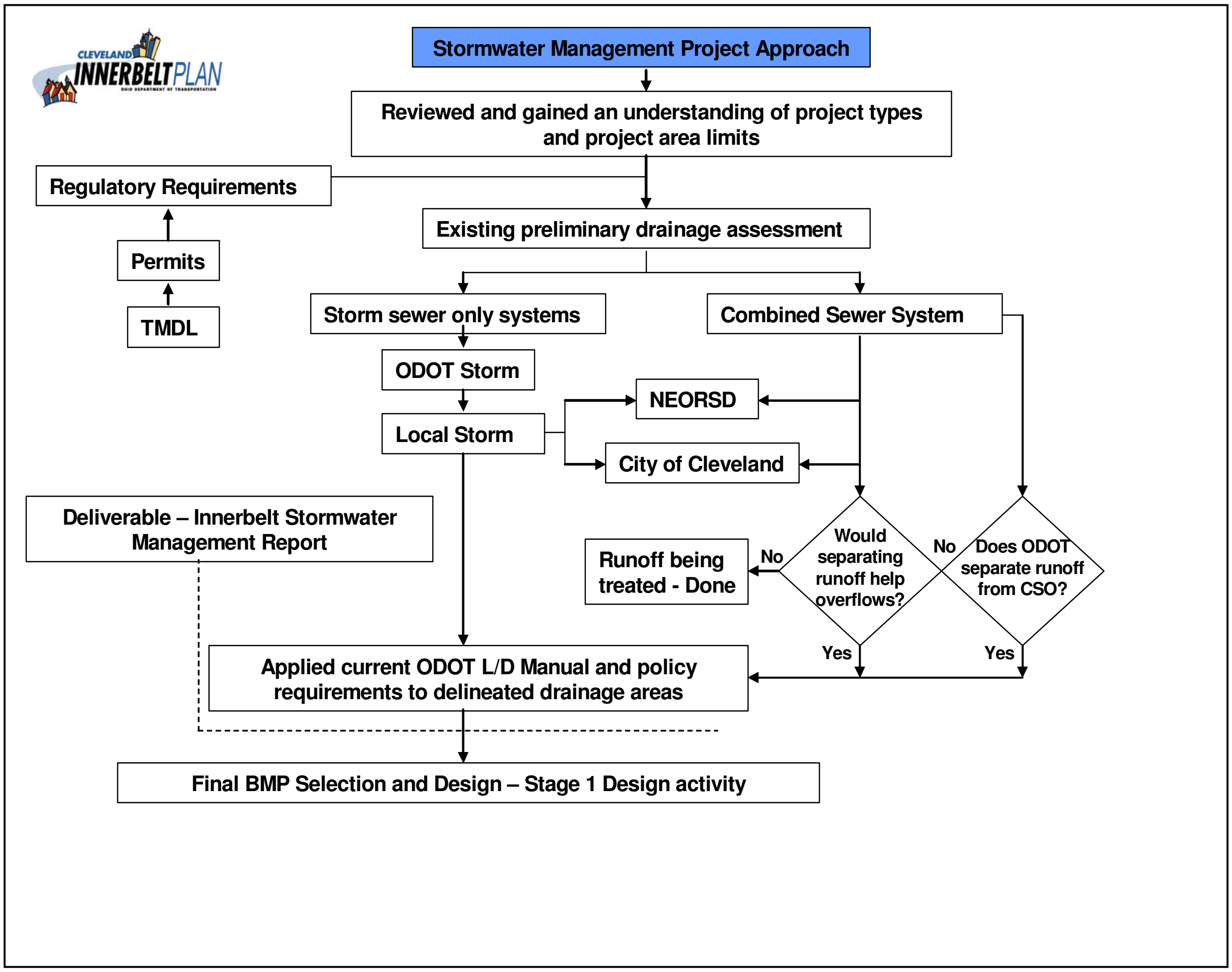


Figure 6 presents the project flow chart developed to assess the separation feasibility of stormwater runoff from CSOs or the local combined systems and to provide BMPs and selection rationale for each..

Figure 6 – Final Project Approach for BMP Selection



The following sections summarize the tasks as listed in Figure 6 that were completed during the preparation of this BMPR:

- **Reviewed project types and project area limits.** Background information was reviewed to gain insight to the type of project – roadway, bridge, interchange, and local roads (intersections, frontage roads, connectors and bridges). The importance of this information was to begin to assess where and what type of BMPs should be considered for each PID project. This was coupled with the most current project area limits so tables could be developed indicating which BMPs would be recommended for each PID.

- **Assessed existing preliminary project drainage areas.** Preliminary project drainage areas were delineated for the purpose of assessing contributing areas to

NEORSD combined sewer system and to stormwater only systems. Potential BMPs were considered for each project drainage area. The project design engineer should note that further investigation and analysis is necessary to determine the volume of runoff potentially being conveyed to NEORSD system and to review available system model information for the specific areas. CSO system details are presented in Section 5. In addition, Section 4 discusses information on both combined and storm only systems.

- **Review of regulatory requirements.** The primary permit governing the need to implement post-construction controls is OEPA's Construction General Permit. This permit is included in Appendix B. In addition, OEPA's MS4 permit was also reviewed along with ODOT's and the City of Cleveland's SWMPs to identify ODOT or City of Cleveland requirements which may be more restrictive than those which appear in the OEPA Construction Permit. None were identified. The final regulatory issue deals with the approved the Total Maximum Daily Load Study for the Lower Cuyahoga River. The TMDL study was reviewed prior to developing the BMP recommendations presented in Section 7.

- **Identified stormwater only systems and combined sewer system areas.** Information was collected on the two different types of conveyance systems in the project area - stormwater only systems and combined sewer systems. The stormwater only system consists of both closed storm sewer pipes and open roadside ditches. The combined sewer system consists of large interceptor structures (large pipes or tunnels), regulators, and local collection systems which include sanitary and storm sewer pipes (combined system). Drainage areas were delineated where runoff from the project will potentially enter the CSO system or the storm sewer only systems.

- **Applied current ODOT L/D Manual requirements.** After assessing and documenting the project drainage area and system which are :

    - Currently connected to the combined sewer system
    - Storm sewer only systems
    - Recommended to be separated

  ODOTs BMP selection process was applied to the areas which were identified as stormwater only drainage or were identified to have value to be separated from combined systems. The BMP tables in Section 7.0 developed for this report include information on the rationale behind the BMPs recommended for each delineated drainage area.

- **Existing stormwater and water quality requirements.** Local stormwater requirements were reviewed in addition to ODOTs policy requirements. The City of Cleveland's Stormwater Management Plan (SWMP) was evaluated for required runoff controls. Section 4.2 provides additional information on Cleveland's stormwater management plan runoff requirements. Also covered in more detail in Section 4.4 are the requirements associated with the Total Maximum Daily Load

Study for the Lower Cuyahoga River. No additional stormwater or water quality requirements were identified as a result of the reviews.

- **BMP selection constraints –** Tables 15 and 16 identify potential BMP constraints associated with the design and location of BMPs during ODOT Step 8 stage 1 design. The project design engineer will need to consider these constraints during drainage and BMP design.

SECTION 4 REGULATORY REQUIREMENTS

4.1 OVERVIEW

The three primary regulatory drivers for this BMPR are:

- Ohio Environmental Protection Agency – Authorization for Stormwater Discharges Associated with Construction Activity under the National Pollutant Discharge Elimination System (NPDES). Permit number OHC000002 (Construction Permit).
- Ohio Environmental Protection Agency – Authorization for Small Municipal Separate Storm Sewer Systems to Discharge Stormwater under the National Pollutant Discharge Elimination System. Permit number OHQ000001 (MS4 Permit).
- And, Lower Cuyahoga River Total Maximum Daily Load (TMDL) Study.

Each one will be discussed in the following sections. In addition, this section will also discuss the City of Cleveland's and ODOT's SWMPs and their relevancy to the project.

Figure 7 - Five Year OEPA Permit Renewal Schedule

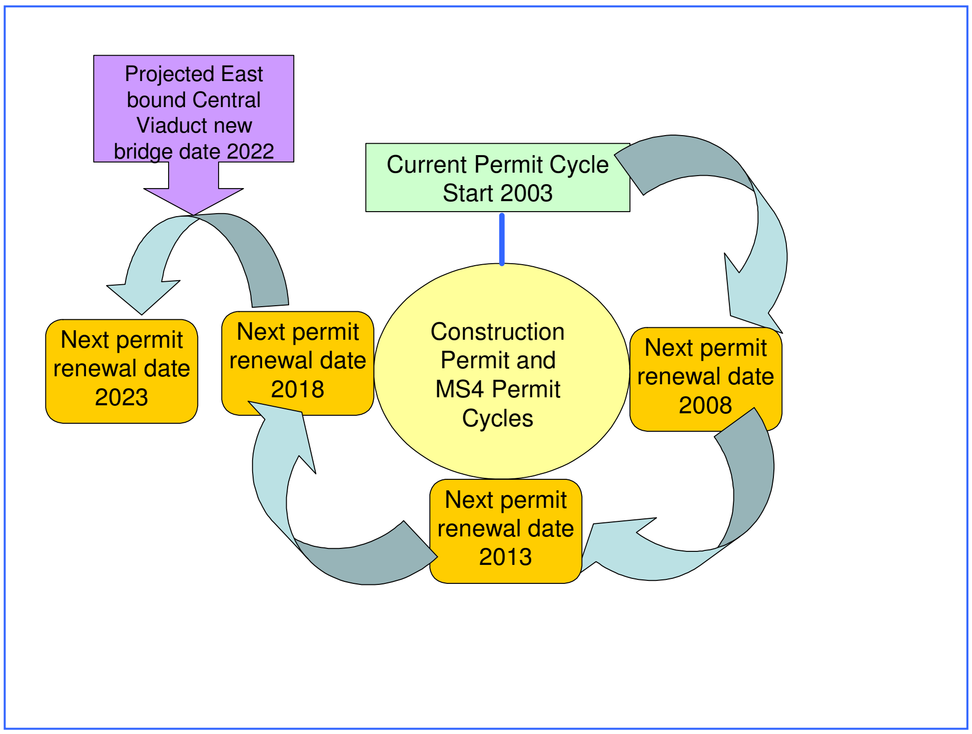


Figure 7 indicates shows the OEPA five year permit renewal schedule. OEPA historically begins the review process of each permit in the fourth year of the current permit term. OEPA is required to solicit public comments on all permit revisions. The following text provides some further details on this renewal schedule:

- OEPA will be reviewing the current Construction and MS4 Permits in late 2007.

- Public comment will be solicited in late 2007 and early 2008 (a projected date for the second term NPDES permits) with approval for the second term permits in December 2007 (MS4 Permit) and April 2008 (Construction Permit) respectively.
- Figure 7 shows that portions of the Cleveland Innerbelt Corridor projects will extend through three permit terms. The project design engineers need to review the current regulatory requirements and ODOT policy information corresponding to these requirements and incorporate these as necessary in drainage and BMP designs.

ODOT and the City of Cleveland are regulated under the MS4 Permit. ODOT and the City of Cleveland have developed SWMPs which identify Management Practices which are currently being implemented to meet the requirements of the six minimum control measures. The City of Cleveland and ODOT's SWMPs are discussed in Sections 4.2 and 4.3. The ODOT SWMP table of contents (TOC) has been included in Appendix M. The entire stormwater management plans can be downloaded from the following websites:

  - City of Cleveland – SWMP
    www.clevelandwpc.com/content/cleveland_storm_water_permit_2003.pdf

  - Ohio Department of Transportation – SWMP
    www.dot.state.oh.us/stormwater/Final_ODOT_SWMP.pdf

4.2 CITY OF CLEVELAND – STORMWATER MANAGEMENT PLAN

The City of Cleveland Water Pollution Control Agency prepared and submitted a SWMP (*Appendix O*) in fulfillment of the requirements of the MS4 Permit. The SWMP states that the storm sewer area of the Cleveland MS4 is primarily located in residential communities with limited commercial and institutional developments. The water quality concerns contained within the SWMP are:

- Increased runoff due to increases of impervious cover area,
- Sedimentation due to stream bank erosion,
- Channel modifications
- Increased flooding due to increases in Stormwater volume, and
- Habitat loss due to increased flow.

As stated in the SWMP, the City will monitor all areas equally to detect and eliminate non-stormwater discharges from the storm sewer system. The project design engineers need to consider quantity as well as quality controls for any project stormwater only systems to minimize downstream impacts and streambank erosion and flooding. Contained within the City's SWMP under post-construction stormwater management in new development and redevelopment the primary concern is increases in impervious areas. The project design engineers need to consider how to address the runoff volume associated project areas where impervious areas are increased. It is recommended that the project design engineers coordinate the selection, location, and design with the City of Cleveland when post-construction BMP are required on local roads impacted as part of the Innerbelt project. Post-construction BMPs and local impacts are addressed in the guidance provided in Appendix I.

4.3 OHIO DEPARTMENT OF TRANSPORTATION – STORMWATER MANAGEMENT PLAN

ODOT prepared a SWMP to address the MS4 Permit requirements (Figure 8). The following information is included in the SWMP report:

- Annual Report – ODOT is required to develop and submit annual reports. These reports contain information on the number of post-construction BMPs designed and installed on ODOT projects.

- ODOT is conducting research on two type of BMPs contained in the policy (Exfiltration Trench and Vegetated Bioswale). The permit requires assessment of the BMPs identified in the SWMP.

- Project Drainage – The location of any new stormwater outfalls from the ODOT MS4 need to be documented and reported to ODOT Office of Environmental Services to be added to ODOT's statewide outfall inventory database. ODOT is required by the MS4 permit to update the outfall inventory database.

- ODOT is required to operate and maintain post-construction BMPs within their right-of-way.

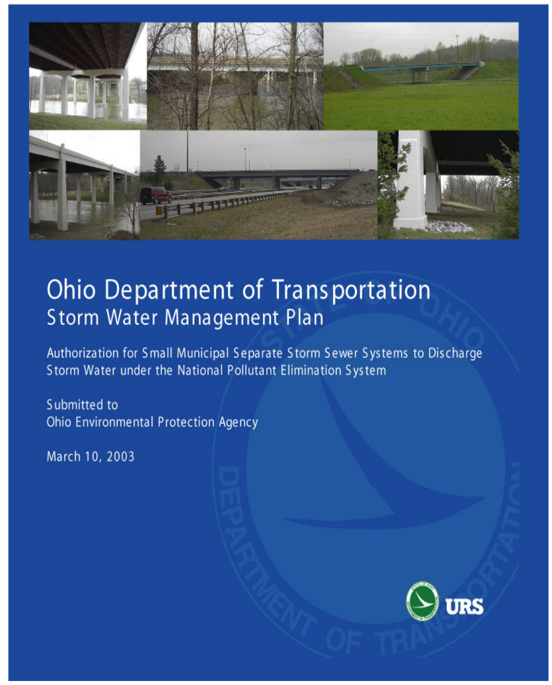


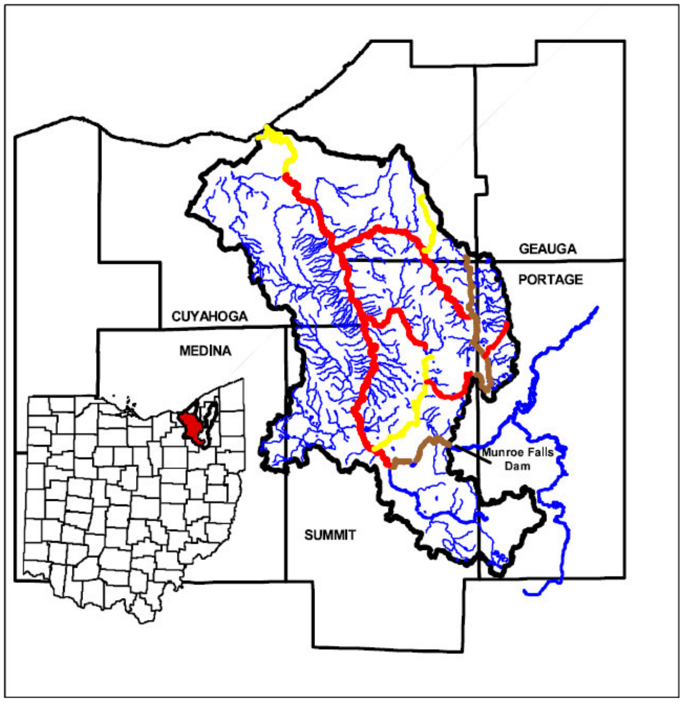
Figure 8 – ODOT SWMP Cover

Project design engineers needs to consider the following:

- BMP operation and maintenance access
- Collect of BMP location information for the control and the outlet
- Information associated with the BMP research.

4.4 LOWER CUYAHOGA RIVER TOTAL MAXIMUM DAILY LOAD (TMDL)

The Lower Cuyahoga River watershed is located in northeast Ohio (Figure 9), flowing through Summit and Cuyahoga counties on its way to Lake Erie[3]. OEPA's MS4 permit involves 83% of the watershed area and will play an essential role in water quality restoration



Basin:
Lower Cuyahoga River in the Lake Erie Basin
Study Area:
Lower 50 miles of Cuyahoga River and its tributaries.
Goal:
Attainment of the appropriate Aquatic Life Use
Major Causes:
Organic enrichment, toxicity, low dissolved oxygen, nutrients, and flow alteration
Major Sources:
Municipal discharges, combined sewer overflows, urban runoff, and industrial discharges.
Measure:
Total nitrogen, phosphorus, dissolved oxygen, bacteria, biological and habitat indices
Restoration Options:
Long term control plans for combined sewer overflows, urban runoff controls, habitat protection and restoration, septic system improvements, point source controls, and public education

Figure 9 – Lower Cuyahoga River Total Maximum Daily Load Study

in the watershed.

The Lower Cuyahoga River Total Maximum Daily Load identifies the following regulatory and non-regulatory based actions applicable to or recommended for the project area:

Regulatory:

- NPDES/OEPA Phase I and II Stormwater requirements – These include the MS4 and Construction Permit requirements.
- Riparian Ordinances
- 208 – Plans – NOACA and NEFCO updated plans
- Nine Minimum Controls for Combined Sewer Overflows (CSOs). For reference, OEPA's website where the nine minimum controls can be viewed: www.epa.state.oh.us/dsw/cso/csostrem.pdf

Non-regulatory:

- Point source control
- Stormwater management

- Riparian corridor initiatives
- Education

For additional information or to download a copy of the September 2003, *Total Maximum Daily Loads for the Lower Cuyahoga River Final Report*, use the following web address: www.epa.state.oh.us/dsw/tmdl/Cuyahoga_lower_final_report.pdf

The project design engineers should review the TMDL study report to obtain an understanding of how the and waste load allocations for the Lower Cuyahoga River may impact project drainage design.

SECTION 5 NORTHEAST OHIO REGIONAL SEWER DISTRICT (NEORSD) AND CITY OF CLEVELAND – CONVEYANCE SYSTEMS

The Cleveland Innerbelt corridor projects pass through the following NEORSD Wastewater Treatment Plant (WWTP) sewershed areas (see Maps 1-7):

- Easterly WWTP Sewershed area
- Westerly WWTP Sewershed area
- Southerly WWTP Sewershed area

The NEORSD Conveyance System has three major system components:

- Collection System – The wastewater collection system gathers wastewater and stormwater runoff from homes, businesses, public facilities, and infrastructure; and directs it to the conveyance system.
- Conveyance System – The conveyance system consists of a system of local sewers, combined sewers (stormwater and sanitary flows), inter-community relief sewers, interceptor sewers, regulators, and pump stations.
- Treatment System – The wastewater treatment system treats the combined system and sanitary flows so that they may be safely released back into the environment.

The structural sewer system components which convey combined sanitary and stormwater flows consist of:

- Interceptor Sewers – These large diameter sewer conveyances receive flow from sanitary sewer, combined sewer, and stormwater only lines and conveys flows to a WWTP. The majority of the interceptors in the sewersheds in the project vicinity are greater than 4 feet in diameter and many were constructed in deep tunnels with manhole depths that range from 20 feet to over 240 feet.
- Local Sewers – These smaller local sewers (combined, sanitary and stormwater only) are owned and maintained by the City of Cleveland. These systems transport wastewater and combined flows to NEORSD interceptors.
- Regulators – These are devices used in combined sewers to control or regulate the diversion of combined flow to WWTPs and combined system outfalls (CSOs).

5.1 GENERAL INFORMATION ON NEORSD CSO CONTROL STRATEGIES

Under the Clean Water Act, the NEORSD is required to plan, design, and construct a Long Term Combined Sewer Overflow Control Strategy (CSOCS), which is estimated to cost $1.6 billion dollars and consists of 65 projects, including adding 103 miles of additional pipes and tunnels, above and below ground storage, pump stations and WWTP upgrades. Some projects will be connecting sewers and other projects will be separating storm sewers from the combined system. The goal of CSOCS is to dramatically reduce the frequency and volume of combined sewer overflows into surrounding water bodies. The NEORSD has estimated that it will take an estimated 30 years to complete the design and construction for the 65 projects (Figure 10).

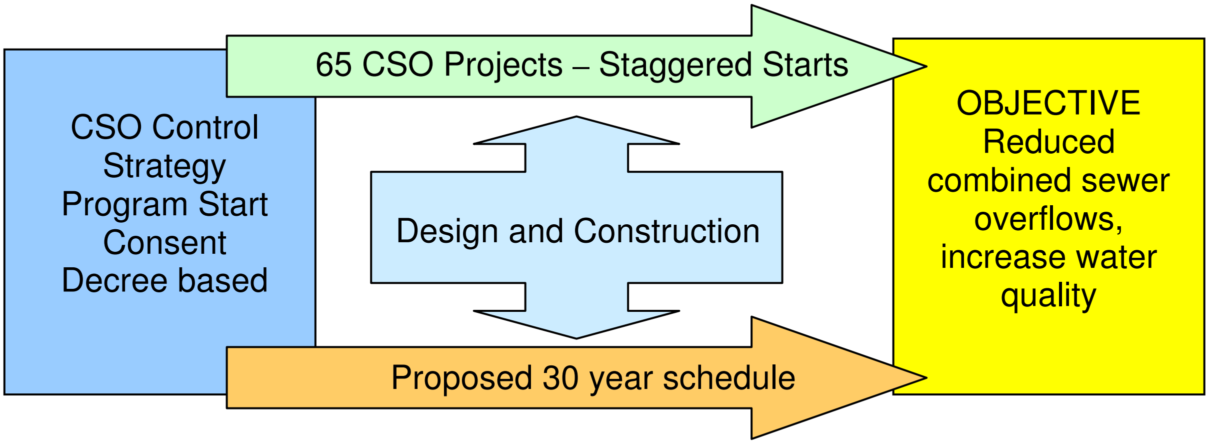


Figure 10 - CSO Control Strategy Timeline Milestones

5.2 COMBINED SEWER AND STORMWATER ONLY SYSTEM ISSUES

The Innerbelt Corridor project preliminary drainage information collected to date has identified two specific types of drainage collection systems:

- Combined Sewer systems – These systems collect and convey both sanitary and Stormwater flows in the same pipe. NPDES Permit required for CSO outfalls (Point source).
- Storm Sewer systems – These systems collect and convey stormwater runoff only. NPDES permit required to discharge stormwater runoff outfalls (Non-point source).

The following describes the evaluation process steps performed to identify the CSO drainage areas which are recommended to be separated. Key combined sewer system capacity questions assessed during completion of the evaluation were:

- Do the current NEORSD system models include runoff volumes from the ODOT highway system?
- Could the NEORSD combined system handle an increase in stormwater (runoff) flow volume?
- Could a reduction in the frequency and overall number of overflows be documented as a result of diverting ODOT runoff to storm only systems?
- Would separating the project runoff from the NEORSD combined system result in any significant highway runoff water quality concerns at the new storm only outfalls?

The following steps summarize the evaluation process used to assess the project impact on combined sewer and stormwater only systems:

- Step 1 - Current PID project configurations were reviewed (elevated ramps, open infield Sections, open right of way areas, etc.)

- Step 2 - Located CSO tributary regulators with respect to ODOT preliminary project drainage areas.

- Step 3 - Evaluated CSO tributary regulators that will receive ODOT stormwater runoff and documented the number of overflow occurrences per year.

- Step 4 - Reviewed and evaluated CSO drainage areas and the estimated percentage of ODOT preliminary project drainage areas within these drainage areas. This was performed to estimate the percentage of ODOT stormwater runoff potentially conveyed to the CSO drainage area outfall. (Note: No evaluation or system model data was assessed during development of these estimates).

- Step 5 - Reviewed ODOT Stormwater only systems where they discharge into the combined sewer system.

- Step 6 – Reviewed ODOT drainage drawings if available for the CSO drainage areas.

- Step 7 – Estimated the percentage of ODOT preliminary drainage area that intersects with the CSO drainage area.

- Step 8 – Determined if stormwater only runoff would have a positive impact on CSO overflows in the CSO drainage area.

- Step 9 – If the impact is determined to be positive, recommended BMPs based on ODOT policy.

- Step 10 – If separation is not feasible, then no BMP will be required.

Figure 6 captures the general principals of the 10 step process.

5.3 CSOs AND REGULATORS IMPACTED BY REMOVAL OF STORMWATER RUNOFF

The NEORSD combined sewer system regulators control the diversion of the combined sanitary sewer and stormwater flows during periods of wet weather and high flows. The regulators within or near the project area direct combined flows during periods of high stormwater flows to CSO outfalls located along the Lake Erie shoreline or the main branch of the Cuyahoga River.

A portion of the combined sewer flow collected and conveyed during large rain events does not go to the WWTPs and is discharged through a CSO outfall into a receiving water body (or potentially causes surface flooding, or discharges into residential, commercial or other structures). Flow data or system capacity information for the CSO system was not available for this report. Project design engineers need to work with NEORSD staff to obtain combined sewer flow data and system modeling information during project design.

Table 5 shows NEORSD CSO systems and tributary regulators identified as being positively impacted by separating or removing ODOT project stormwater runoff from entering these CSO systems and the respective project name and PID number.

Table 5 - CSO And Regulators Impacted By Removal Of Stormwater		
Innerbelt Corridor Project Name and PID	**NEORSD – Identified CSO**	**NEORSD – Tributary Regulators**
Central Interchange Area - 80406, 82338, 13567	CSO - 090, 093, 094	E-24[1], E-27
I-77 Approach to Central Interchange - 80406, 82338, 13567	CSO - 040	S-04
Innerbelt Curve – 77413 and Innerbelt Trench - 25795	CSO – 097 and 098	E-09
Central Viaduct/Southern Innerbelt – 77332,80407, 82119	CSO - 080	WR-27
Central Interchange/ I-77 (Broadway/Pershing) - 80406, 82338, 13567	CSO - 036	S-01A
Innerbelt Curve - 77413	CSO – 096, 097, 098, 099, 200	E-09
Note 1: E- Easterly regulator, S- Southerly regulator, W- Westerly regulator		

A complete set of the tributary regulators and CSO plans obtained from the NEORSD are included on a CD included at the end of this report. Table 6 shows the tributary regulators and CSO drainage areas within or near the Innerbelt project and provides the general location, and the CSO outfalls and receiving water bodies near the regulator.

Table 6 – NEORSD CSO System Regulator Locations Within or Near the Project Area				
NEORSD Tributary Regulator	**Location**	**NEORSD Sewershed and CSO Outfall**	**CSO Outfall Water Body**	**Innerbelt Project Drainage Area**
Within the project limits				
E-09	E. 30th and St. Clair Ave.	Easterly and CSO-097	Lake Erie	IC[1]
Near the project limits				
E-04	E. 40th St. and King Ave.	Easterly and CSO-200	Lake Erie	IC
E-05	E. 38th St. and King Ave.	Easterly and CSO-099	Lake Erie	IC
E-06	E. 38th St. and King Ave.	Easterly and CSO-099	Lake Erie	IC
E-07	E. 38th St. and Lakeside Ave.	Easterly and CSO-099	Lake Erie	IC
E-08	E. 33rd St. and King Ave.	Easterly and CSO-098	Lake Erie	IC
E-10	E. 33rd St. and Lakeside Ave.	Easterly and CSO -097	NA	IC
E-11	Lakeside Ave.	Easterly and	Lake Erie	IC

Table 6 – NEORSD CSO System Regulator Locations Within or Near the Project Area				
NEORSD Tributary Regulator	**Location**	**NEORSD Sewershed and CSO Outfall**	**CSO Outfall Water Body**	**Innerbelt Project Drainage Area**
		CSO-097		
E-12	E. 26th St. and Lakeside Ave.	Easterly and CSO-096	Lake Erie	IC
E-24	Ontario St. and W. Eagle Ave.	Easterly and Superior Ave. Pump Station	Cuyahoga River – Main Branch	CI
E-25	W. 3rd St. and the Cuyahoga River (north bank)	Easterly and CSO-235	Cuyahoga River – Main Branch	CI and CV
S-01A	Broadway Ave. at Gallup Ave.	Southerly and CSO-036	Cuyahoga River – Main Branch	77- C
S-06	E. 37th St. and Croton Ave.	Southerly and CSO-040	NA	77- C
S-07	E. 37th St. and Croton Ave.	Southerly and CSO -040	NA	77- C
S-08	E. 34th St. and Broadway Ave.	Southerly and CSO - 040	NA	77- C
WR-08	W. 3rd St. and the Cuyahoga River (south bank)	Westerly and CSO-082	Cuyahoga River – Main Branch	CV
WR-24	W. 15th St. and Fairfield Ave.	Westerly and CSO -081	NA	CV and SI
WR-25	W. 14th St. and Crown Ave.	Westerly and CSO -081	NA	CV
WR-27A	W. 10th St. and University Rd.	Westerly and CSO-081	Cuyahoga River – Main Branch	CV
WR-27	W. 14th St. and University Rd.	Westerly and CSO-081	Cuyahoga River – Main Branch	CV
WR-34	Pearl Rd. and Riverside Ave.	Westerly and CSO-088	Cuyahoga River – Main Branch	SI
Note 1: IC = Innerbelt Curve; CI = Central Interchange; CV = Central Viaduct Bridge; 77 = Interstate 77; and SI = Southern Innerbelt				

Table 7 shows the interceptors located within or near the Innerbelt project preliminary drainage areas and what WWTP sewershed these interceptors are located in. The sewersheds are named as follows:

- Easterly Sewershed
- Westerly Sewershed
- Southerly Sewershed

Sewershed information contained in the appendices includes tributary regulator plans, portions of the sewershed Long Term Control Plans, and maps showing system interceptors, local collection systems, tributary regulators, CSO outfalls, and system manholes. Tributary regulator details are included at the back of this report on a CD.

Table 7 - NEORSD Interceptor Locations within or Near the Project Area

NEORSD Interceptor Name	Alignment Street	Location Along Alignment Street	WWTP Served by the Interceptor	Innerbelt Project Areas
Easterly – Main Branch	Lakeside Ave.	E. 33rd St. to E. 25th St.	Easterly WWTP	IC[1]
Easterly – E 30th St. Branch	E. 30th St./St. Clair Ave.	E. 33rd St. to Euclid Ave.	Easterly WWTP	IC and TR
Easterly – E 40th St. Branch	E. 30th St.	Euclid Ave. to Community College Ave.	Easterly WWTP	TR
Walworth Run – Diversion Sewer Branch	E. 14th St.	Kennelworth Ave. to University Ave.	Westerly WWTP	CV and SI
Low Level Interceptor	University Ave.	Crown Ave. to Scranton Rd.	Westerly WWTP	CV
Walworth Run – W. 25th St. Branch	W. 30th St. and W. 25th St.	Bradwell Ave. Northward	Westerly WWTP	SI
Independence South	Dille Road	Near the Broadway Ave. intersection	Southerly WWTP	77

Note 1: IC = Innerbelt Curve; TR = Trench; CV = Central Viaduct Bridge; 77 = Interstate 77; and SI = Southern Innerbelt

Table 8 shows the CSO outfall, estimated acreage of the CSO drainage areas, tributary regulators, and general location information for regulators within the CSO drainage areas. The acreages for each CSO drainage area are compared to estimated preliminary ODOT project drainage area acreage within the respective CSO contributing drainage areas. Table 11 in Section 7 shows the comparison.

Table 8 NEORSD CSO Number and Tributary Regulator			
CSO Number	**Reported CSO Drainage Area (acres)**[1]	**Tributary Regulator**	**Location**
235	39	E-25	E. 3rd St. and the Cuyahoga River (north bank)
200	670	E-04	E. 40th St. and King Ave.
99	100	E-07	E. 38th St. and Lakeside Ave.
98	150	E-08	E. 33rd St. and King Ave.
97	110	E-11, E-09	E-11 – Lakeside Road (non-active), E-09
96	120	E-12	E. 26th St. north of Lakeside Ave.
94	450	E-18	12th St. north of Lakeside Ave.
93	140	E-20, 20A	E-20 – Ontario Ave/Lakeside Ave.
90	65	E-27	11th St. at Superior Ave. E-20A - ?
Unnamed	54	E-24, E-26	E-26 – Superior Ave/West 11th St. pump station. E-24 Superior Ave. Pump Station outfall[5]
88	N/A	WR-34	Pearl Rd. and Riverside Ave.
82	N/A	WR-08	W. 3rd St. and the Cuyahoga River (south bank)
81	N/A	WR–27, 27A, 25	WR-27 – W. 14th St. and University Ave., WR-27A-10th St. and University Ave., WR-25 – 14th St. and Crown Ave.
80	N/A	WR-27, WR-48, and WR-24	WR-27 – W. 14th St. and University Ave., WR-48 – Train Ave. south of Willey Ave, WR-24 – Fairfield Ave. east of Scranton Rd.
40	4,504	S-03, 04, 05, 06, 07, 08	S-03 – Woodhill Ave/Mount Auburn Ave., S-04 – Carton Ave @ 93rd St., S-05 – 79th St. and Garden Valley, S-06 – E. 37th St. and Croton Ave., S-07 – E 37th St. and Croton Ave., S-08 – E. 34th St. and Broadway Ave.
39	185	S-01A	Broadway Ave. at Gallup Ave.
Note 1: Acres as reported in the Long Term Control Plans developed by Metcalf and Eddy, 2000 – 2002			

The following sections present information on the NEORSD system details within each Innerbelt project area. This information was collected from the draft Long Term Control Plans, ODOT drainage drawings, and the NEORSD Geographic Information System (GIS). The areas discussed below are the project areas that have been evaluated to have the best potential positive impact resulting from the separation of ODOT stormwater runoff from the combined sewer system. As discussed above, the evaluation criteria included potential "open" areas where ODOT could design and install post-construction BMPs which could be discharged via a new stormwater outfalls or connecting to the existing stormwater only outfalls.

5.3.1 – Central Interchange Area

There are four CSO drainage areas which would be impacted by removal of stormwater only runoff:

- CSO – 90
- CSO – 94
- CSO - 95
- CSO – 235

Detailed information associated with these CSOs is presented below. Separation would benefit the CSO outfall by reducing or removing runoff discharging to the combined system during wet weather events. Therefore there would be reduced overflows at the weirs in the regulators (the point where the flow exits the combined system and is conveyed to the CSO outfall).
.
For the CSO and regulators mentioned below, no combined system capacity analysis has been performed to determine the current system capacity.

Figure 11 – Central Interchange Area

CSO – 090 Information

- ✓ Location – End of Superior Ave @ Cuyahoga River
- ✓ Regulators of interest – E-24, E-27 (Easterly sewershed)
- ✓ Estimated Annual Overflows - 34
- ✓ Proposed CSO Control Strategy – Design and construct a pump system upgrade.
- ✓ Proposed NEORSD Timeline – 6 years after CSO control program starts, 3-years for design – construction - certification.

<u>CSO – 094 Information</u>

- ✓ Location – North of E12th @ Lakeside (USS Cod)
- ✓ Regulators of interest – E-18 (Easterly sewershed)
- ✓ Estimated Annual Overflows - 35
- ✓ Proposed CSO Control Strategy – Conveyance designed and constructed to discharge flow to the Shoreline Tunnel
- ✓ Proposed NEORSD Timeline – Starts 10 years after CSO control program starts, 7- years for design – construction - certification

<u>CSO – 095 Information</u>

- ✓ Location – North of E20th @Lakeside Ave.
- ✓ Regulators of interest – E-14 (Easterly sewershed)
- ✓ Estimated Annual Overflows - 56
- ✓ Proposed CSO Control Strategy – Conveyance designed and constructed to discharge flow to the Shoreline Tunnel
- ✓ Proposed NEORSD Timeline – Starts 10 years after CSO control program starts, 7- years for design – construction - certification

<u>CSO – 235 Information</u>

- ✓ Location – W. 3rd. @ Canal Rd., East side of Cuyahoga River
- ✓ Regulators of interest – E-25 (Easterly sewershed)
- ✓ Estimated Annual Overflows - 27
- ✓ Proposed CSO Control Strategy – The Easterly Early Action Plan (EEAP) identified this CSO but did not identify any proposed improvements.
- ✓ Proposed NEORSD Timeline – N/A

5.3.2 I-77 Approaches to Central Interchange

The CSO control strategy recommends separating the I-77 stormwater runoff upstream of S-04 and conveying the stormwater only runoff to Kingsbury Run.

Figure 12 – Central Interchange/I-77 Approach

.

CSO – 040 Information

- ✓ Location – Kingsbury Run @ Cuyahoga River, North of Jefferson Road
- ✓ Regulators of interest – S-04 (Southerly sewershed)
- ✓ Estimated Annual Overflows - 79
- ✓ Proposed CSO Control Strategy – Facilities plan recommends removal of I-77 stormwater runoff. Discharge/outlet to Kingsbury Run stormwater culvert downstream of S-04.
- ✓ Proposed NEORSD Timeline – Starts 7 years after CSO control program starts, 3 years for design-construction-certification.

CSO – 039 Information

- ✓ Location – Cuyahoga River turning basin, 400’ West of Independence Rd.
- ✓ Regulators of interest – S-04 (Southerly sewershed)
- ✓ Estimated Annual Overflows - 51
- ✓ Proposed CSO Control Strategy – Southerly Tunnel
- ✓ Proposed NEORSD Timeline – Starts 14 years after CSO control program starts, 22 years for design-construction-certification.
- ✓ Preliminary ODOT storm only information indicates that Interstate stormwater currently enters CSO-039 downstream of regulator S-01A. Based on this information, the proposed Innerbelt project will not impact the CSO Control Strategy for CSO–039

5.3.3 Innerbelt Curve (CSOs – 096, 097, 098, 099, 200)

Figure 13 – Innerbelt Curve Area

The CSO control strategy for the Innerbelt Curve and portions of the Innerbelt Trench area are associated with CSOs 097 and 098 and regulator E-09. Information was collected and evaluated through data collection, review of NEORSD and ODOT drawings and meetings with NEORSD personnel. The draft Long Term Control Plan (LTCP) for CSO-097 and modified tributary regulator E-09 is the plan identifies a high likelihood that CSO-97 will become a stormwater only discharge outfall and flow will be conveyed from E-09 to either CSO – 98 or directly to the shoreline tunnel as part of the shoreline tunnel project.

CSO – 097 Information

- ✓ Location – North of I-71/I-90
- ✓ Regulators of interest – E-09 (Easterly sewershed)
- ✓ Estimated Annual Overflows - 8
- ✓ Proposed CSO Control Strategy – Shoreline Tunnel – Portion of this strategy would be to convey regulator E-09 overflows to CSO – 098, thus potentially converting CSO-097 to storm only system north of E-09, discharging into Lake Erie.
- ✓ Proposed NEORSD Timeline – Proposed 10 years after CSO control program start, 7 years for design – construction - certification

Additional information collected during NEORSD meetings, which is specific to CSO-097 and regulator E-09 details:

- Easterly Early Action Plan (EEAP) – NEORSD indicated that contained within this plan are 30% design drawings for the Shoreline Tunnel project which includes CSO-097 and modified E-09 regulator.
- Under this scenario, the CSO Control Strategy recommends that the overflow from E-09 be conveyed to CSO–098, instead of being conveyed to CSO-097 and the Shoreline Tunnel as stated above. This presents ODOT with the following storm only system strategy options:
  - Allow combined flows from E-09 to continue to CSO-097. To do this ODOT and design team will need to account for combined flow volumes (need system capacity information from NEORSD) in any Innerbelt drainage design in this area.
  - Provide separate storm only pipes and E-09 overflow pipe within I-90 LA. Review possibility of tying ODOT storm pipes with E-09 pipe north of I-90.
  - Provide storm only pipe for Innerbelt stormwater. NEORSD would need to determine how to convey flows to the Shoreline Tunnel.
  - ODOT will need to evaluate ownership and maintenance responsibilities for CSO–097 should this become storm only. This would also become a new outfall for ODOT under the MS4 program and would need to be added to the MS4 outfall database. If flow is transferred from CSO-097 to CSO-098 as part of the shoreline tunnel project, then CSO-097 will no longer be a CSO outfall. Recommendation here is for ODOT to take over this outfall as a storm only discharge and revise the current NEORSD held NPDES permit for this outfall. Coordination with Burke Lakefront Airport on ownership and maintenance responsibilities for this outfall north of I-90.. The current NEORSD CSO-097 permit is included in *Appendix U*.

In addition to CSO- 97, CSOs 96, 98, 99 and 200 are detailed below. These are presented here for reference. These have not been targeted for separation and removal of highway stormwater runoff from discharging to them. CSO – 98 as discussed above may receive the diverted overflow form E-09 as part of the Shoreline Tunnel, but at the time of report submission no confirmation of this was documented.

CSO – 096, 097, 098, 099 and 200 Information

- ✓ Location CSO – 096 – North of E. 26th. St and Lakeside Ave.
  CSO – 097 – North of I-71/I-90
  CSO – 098 – North of E. 33rd. St. and Lakeside Ave
  CSO – 099 – North of 38th. St. and Lakeside Ave.
  CSO – 200 – North of E. 40th. St. /King Ave, North of Aviation High school
- ✓ Regulators of interest – E-09 Easterly sewershed
- ✓ Estimated Annual Overflows – CSO–096 – 14
  CSO–097 – 8
  CSO–098 – 64
  CSO–099 - 70
  CSO–200 – 80
- ✓ Proposed CSO Control Strategy – Shoreline Tunnel
- ✓ Proposed NEORSD Timeline – Proposed 10 years after CSO control program start, 7 years for design – construction - certification

5.3.4 Central Viaduct/Southern Innerbelt

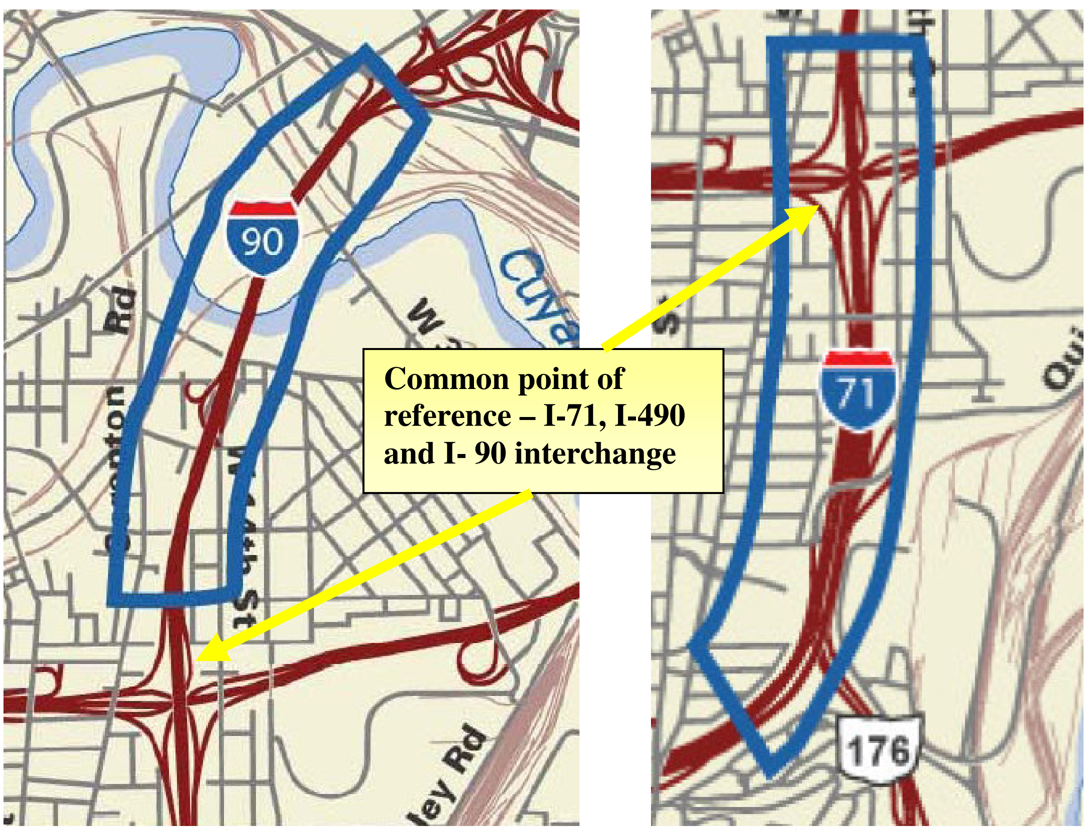


Figure 14 – Central Viaduct **Figure 14A –Southern Innerbelt Area**

The CSO control strategy for the Central Viaduct/Southern Innerbelt areas is associated with CSO-080 and regulator WR-27 (west Bank - Cuyahoga River). The preferred alternative for the Central Viaduct Bridge has resulted in ODOT acquiring right of way on the East bank of the Cuyahoga River. The BMP tables at the end of Section 7 (Tables 15 and 16) provide recommended BMPs and their recommendation rationale. ODOT is currently addressing slope stability issues on the West Bank of the Central Viaduct bridge crossing. Given this current condition issue, the recommended BMPs for the bridge are proposed for the north side (east bank) of the crossing. This allows the most flexibility for potential BMP locations, innovative approaches and space for water quality controls and project stormwater management.

CSO – 080 Information

- ✓ Location – University Road, southeast of 2065 Scranton Road
- ✓ Regulators of interest – WR-27 (Westerly sewershed)
- ✓ Estimated Annual Overflows - 43
- ✓ Proposed CSO Control Strategy – Westerly CSO Tunnel
- ✓ Proposed NEORSD Timeline – Proposed 25 years after CSO control program start, 5 years for design – construction - certification

5.4 CITY OF CLEVELAND DIVISION OF WATER POLLUTION CONTROL SYSTEM

The local (collection) systems within the City of Cleveland, including combined sewers and storm sewers, are owned and maintained by the Cleveland Division of Water Pollution Control (Cleveland WPC). These local combined sewers capture Stormwater at the road surface via storm drain inlets. These local sewers transport Stormwater and wastewater to the NEORSD regulators or interceptors, which direct a portion of the combined flow to both a CSO outfall and to a NEORSD WWTP. The local combined sewer lines are shown in orange on maps 1 through 7 at the end of section 7.

The Cleveland WPC is responsible for the network of sewers conveying sanitary sewage and industrial waste in the City of Cleveland from their point of origin to the NEORSD regulator or interceptor and ultimately the sewage processing facilities for treatment and disposal. The Cleveland WPC division maintains, cleans, repairs, and improves the sewers and their appendages. In areas of combined sewer systems, such as the project area, the jurisdiction of the WPC also includes Stormwater drainage and discharges. The Cleveland WPC is also charged with managing and supervising matters relating to the elimination, control and regulation of water pollution within the city limits. The project area lies entirely within the area served by the local combined sewer overflow system as maintained by the Cleveland WPC.

5.5 OUTFALL DISCHARGE LOCATION DISCUSSION

This Section covers information on the location of the CSO outfalls. Table 6 NEORSD CSO System Regulator Locations Within or Near the Project Area contains information on the receiving water body where the CSOs discharge. As discussed in Section 4.0, there is a TMDL completed for the Lower Cuyahoga River, any storm only sewer system which is designed as a result of separation from the combined system will need to address the following:

- Post-Construction runoff controls
- Specific pollutant requirements outlined in the Lower Cuyahoga River TMDL Study report. (See Section 4.4).
- Operations and Maintenance of any new post-construction or stormwater controls.

In addition, there are several CSO discharges into Lake Erie. These will also need to address post-construction and stormwater management controls should these areas include ODOT storm only system and system outfalls as a result of separating from the combined system. As mentioned in Section 5.0, CSO 097 could be become a storm only outfall, all post-construction and stormwater control requirements would apply even though this previously was an NPDES permitted CSO outfall.

5.6 DESIGN METHOD AND CRITERIA COMPARISON SUMMARY

This section covers the key hydraulic design differences which have been identified to exist between NEORSD design criteria and ODOT design criteria. Table 9 summarizes the key design components and shows the differences in a side by side comparison. The project design engineers will need to address project areas that are recommended to remain connected to the combined system that have documented increased impervious areas. The project design engineers will need to work with NEORSD engineers in these areas, to address system specific hydraulic modeling capacity issues. These issues include:

- New stormwater outfall locations
- Storm only system elevation and flow issues
- Outfall downstream channel or streambank erosion issues
- Access for operation and maintenance
- Runoff volume analysis for current and new impervious areas to be incorporated in to NEORSDs model.
- Hydraulic jumps and velocity control issues.
- Safety
- Urban flooding related to increased impervious areas
- Different design criteria and methods

This list is not intended to be all inclusive, but rather a starting point for project design engineers to begin looking at project drainage, stormwater runoff and design differences to be considered with project BMPs and drainage designs.

The following section summarizes the key design requirements for the NEORSD. Table 9 compares the NEORSD design criteria with ODOT design criteria.

5.6.1 Northeast Ohio Regional Sewer District and City of Cleveland – CSO and Stormwater Design Information

There are no documented or published NEORSD wide design standards. The following information was documented during report development:

- Permission to tie into a district line is all dependent upon the capacity available or built into the line in question – every potential sewer tap is done on a case-by-case basis. NEORSD engineering is responsible for approving the design and supporting capacity analysis.
- CSO Control Program design criteria summary – Typical year storms derived from Cleveland Hopkins International Airport rainfall data (46 years worth of data collected). The NEORSD evaluates this data and documents the fifth highest storm (5^{th} largest storm would be less than the 5 year 1 hour storm, this storm is related to a 6 month +/- storm) and this storm is then used as the basis for design. As the design advances, there will be a detailed hydraulic model developed to assess system operation. The assessment is used to determine how the tunnels operate and where and when the these tunnels are "closed off" from further rainfall or surface runoff input, this then leads to surface water discharges. Storm surges within tunnels, hydraulic grade lines coming above ground are design issues which are addressed during the hydraulic modeling of specific systems. The majority of the consolidation (local collection pipes) pipes which convey flow to the tunnels are typically designed and sized for the 5-year storm peak discharge.
- There are multiple regulator designs (see *Appendix E* for tributary regulator details).
  - Perpendicular
  - Sidespill
  - Relief pipe
  - Leaping weir
  - Gate
  - Fabridam

Table 9 - Summary of Hydraulic Design Requirements			
Design Criteria	**Common Design Elements**	**Ohio Department of Transportation (ODOT)***	**Northeast Ohio Regional Sewer District (NEORSD)****
Methodology			
Statistical Method		X	N/A
Rational Method		X	N/A
Rainfall Intensity			
Zone A	X	X	X
Hydraulic Grade line			
5 year		N/A	X
10 year		N/A	N/A
25 year		X	N/A
50 year (sags only)		X	N/A
Design Frequency Storm			
Ditch Design			
5 year		X	N/A
10 year		X	N/A
Combined Sewer			
2 year		N/A	N/A
**5 year		N/A	X
10 year		N/A	N/A
Storm Sewer			
2 year		N/A	N/A
5 year		N/A	N/A
10 year		X	N/A
Safety Issues			
Ponding/Hydroplaining		X	N/A
FHWA requirements		X	N/A

* - ODOT's Location and Design Manual, Volume 2, January 2007
** - NEORSD – Design information

The results of the table comparison show one commonality in the design methodologies - rainfall intensity. This creates the following two design scenarios for the project design engineers:

- For runoff or drainage that will continue to be discharged into the combined system, ODOT is required to work with NEORSD to model these project drainage areas and evaluate the current and proposed runoff volumes being discharges into the system. In these project areas, the governing design method will be NEORSDs design criteria.
- For project areas where ODOT is separating runoff from NEORSD CSO drainage areas, ODOTs drainage design methods and criteria will govern.

SECTION 6 PRELIMINARY BMP STORMWATER PROJECT DRAINAGE INFORMATION

Preliminary drainage areas were delineated within the current ODOT project area limits. The project area limits were delineated into preliminary drainage areas which were labeled based on the PID for that specific project area. For example, preliminary drainage areas in the Innerbelt Curve area were labeled IC. This naming convention is utilized in Tables 15 and 16 (the BMP report tables) and the remaining sections of this report. The preliminary drainage basins were evaluated and delineated using the following information:

- Current project area limits
- NEORSD Sewershed areas: Provided by Metcalf & Eddy
- Cleveland area GIS coverage
- Proposed roadway, highway, and interstate coverage, and right-of-way information provided by ODOT and Burgess and Niple
- Contour information – 10 foot contour, Source – USGS 7.5 minute quad map, 2 foot contours, Source – GIS coverage
- NEORSD GIS map coverage – Combined sewer system (Collection system, outfalls, regulators, pump/lift stations, known storm only pipes)
- Step 6 ODOT plans
- Field survey storm sewer system information
- Existing ODOT plan and profile sheets and drainage plans.

The above information was reviewed, organized, and placed on the Preliminary ODOT BMP Project Drainage Area Maps (Maps 1 through 7); and presented in tables throughout the report. The preliminary drainage areas were delineated for the purpose of evaluating and developing BMPs for each PID drainage area and to assess the potential impacts of separating current highway stormwater runoff from the combined sewer systems.

The following sections present a summary of preliminary drainage information. Information that appears in the appendices is noted. In some cases the information might have been too large to incorporate in it's entirety in the appendix therefore only the title and/or cover page is included.

6.1 CENTRAL VIADUCT PRELIMINARY DRAINAGE

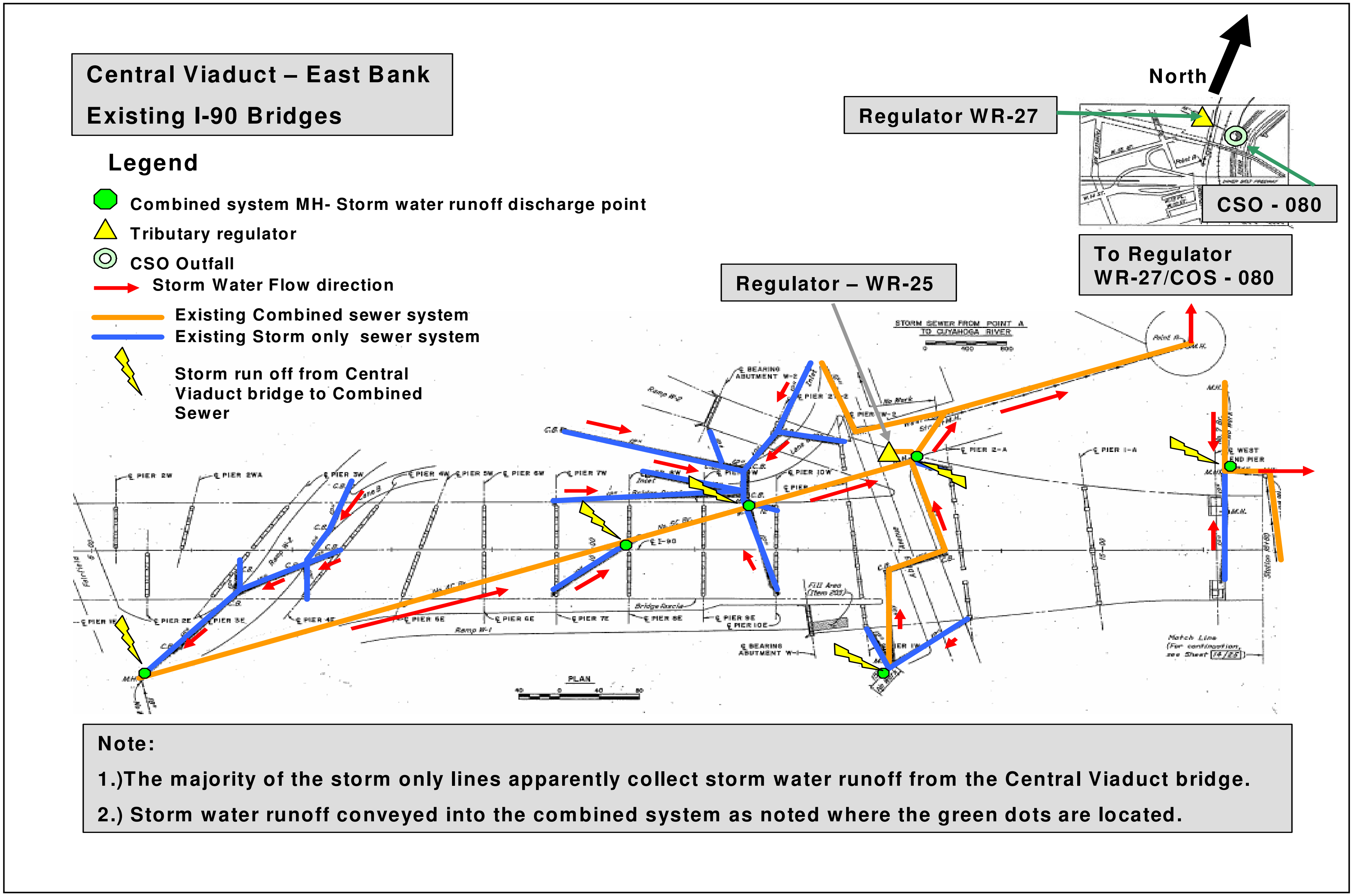
Figure 15, shows the southern Central Viaduct bridge area. The southern end (West bank) approach of the new central viaduct bridge and the existing central viaduct bridge are in the NEORSDs Westerly sewershed. The northern end (East Bank) approaches for the new and existing bridge are located in NEOSRDs Easterly sewershed. The project design engineer will need to consider bridge drainage and runoff discharge when considering or recommending separation from the combined system within both of these sewersheds. Figure 15 also shows the existing stormwater only pipes in blue, intersection points with the existing combined sewer in green, existing combined sewer in orange, yellow triangles represent tributary regulators, green circles represent CSO outfalls and yellow lightening represents bridge stormwater runoff collection storm only pipes. Table 11 shows the CSO drainage areas and ODOT preliminary project drainage areas within the CSO drainage area. The table shows the estimated percentage of ODOT's area within the CSO area as an initial step at assessing the potential volume ODOT can expect to remove from that particular CSO drainage area. As mentioned above, the strategic importance of these estimated volumes is to work with NEORSD as part of the Innerbelt reconstruction to remove stormwater runoff volume where hydraulically and economically feasible; and where water quality controls can be designed, implemented, operated, and maintained.

For the new northern Central Viaduct Bridge to be constructed, ODOT will purchase right-of-way to construct, operate, and maintain the new Central Viaduct Bridge. With the right-of-way purchase, ODOT has area available on the north side (east bank) of the Cuyahoga River where stormwater management controls can be implemented. ODOT will need to address several key issues which include working with adjacent property owners and businesses on right of way and access issues, potentially establishing easements between the piers for access. Tables 15 and 16 identify the BMPs recommended for use in this project area.

Included in Appendix R are the following NEORSD Easterly CSO Phase II Facilities plans, maps, and figures (*Northeast Ohio Regional Sewer District Easterly CSO Phase II Facilities Plan, June 2002*, prepared by Metcalf and Eddy and CH2M Hill):

- Figure 2-1 - Interceptors in Easterly District
- Figure 2-3 - Easterly Interceptor Branches
- Figure 2-9 - Cuyahoga River CSO outfalls
- Figure 2-10 - Lake Erie CSO outfalls 093 through 099, and 200

Figure 15 – (Substructure) Identification and Underground Drainage System – I-90 Central Viaduct Bridge (West side of Cuyahoga River)



6.2 CENTRAL INTERCHANGE PRELIMINARY DRAINAGE

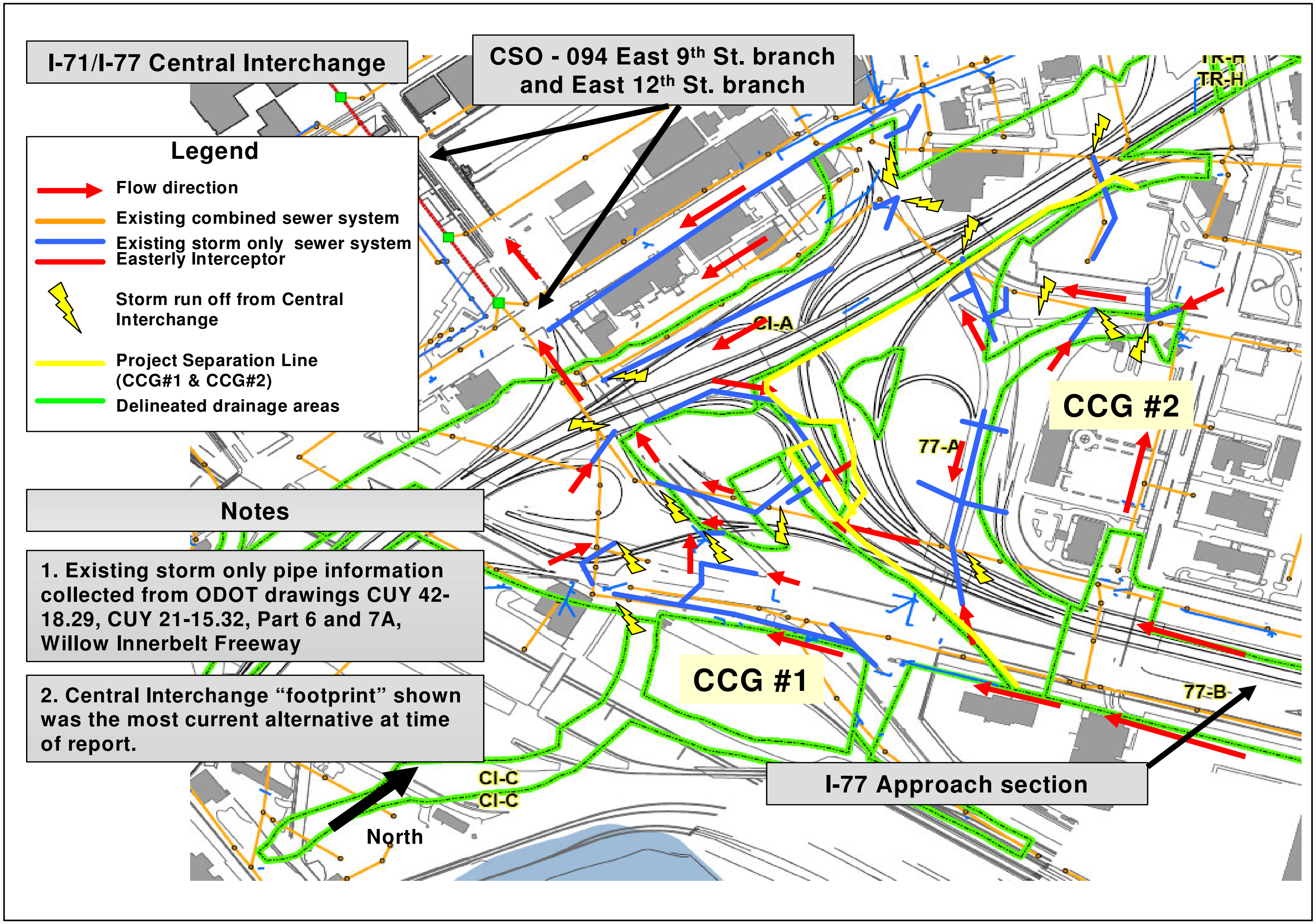
The Central Interchange preferred alternative provides ODOT with stormwater management opportunities under the elevated roadway sections and in the in-field areas. The flexibility exists within the Central Interchange is centered on the potential areas under the elevated structures and the in-field areas to incorporate stormwater BMPs. These BMPs would need to meet water quality and safety requirements for the OEPA and FHWA respectively. The FHWA requirements include BMPs which would minimize impounding and detaining a permanent surface water elevation for any extended periods of time and protecting the traveling public. Tables 15 and 16, provide the recommended BMPs and selection rationale in addition to design considerations for the future Project design engineer to address in the BMP and drainage designs. Included in (*Appendix S)* are the following drawings:

- CUY 42-18.29 – Willow Innerbelt Freeway Part 6
- CUY 42-18.42, CUY 21-15.32 – Willow Innerbelt Freeway Part 7A.

Figure 16 shows Central Interchange/I-77 Approach area in the Easterly sewershed. The stormwater only pipes are shown in blue, intersection points with the combined sewer are shown as yellow “lightening” strikes, and combined sewer is shown in orange, yellow triangles represent tributary regulators, red lines indicate interceptor sewers and green lines indicate delineated preliminary drainage areas. Included in Table 11 are CSO drainage areas and ODOT project areas within the CSO drainage area. The table shows the estimated percentage of ODOT’s area within the CSO area as an initial step at assessing the potential volume ODOT can expect to remove from that particular CSO drainage area.

Figure 16 shows the existing ODOT storm only pipes and the approximate location these storm pipes connect to the existing combined sewer system. Similar to Figure 6, the lightning strikes indicate where the approximate connections are. . An estimate as to the amount of runoff potentially removed from the combined system is recommended to be developed and documented. Any storm sewer separations are recommended to be confirmed by as-built drawings for future use and will incorporate Post Construction BMPs..

Figure 16 – (Substructure) Identification and Underground Drainage System – Central Interchange



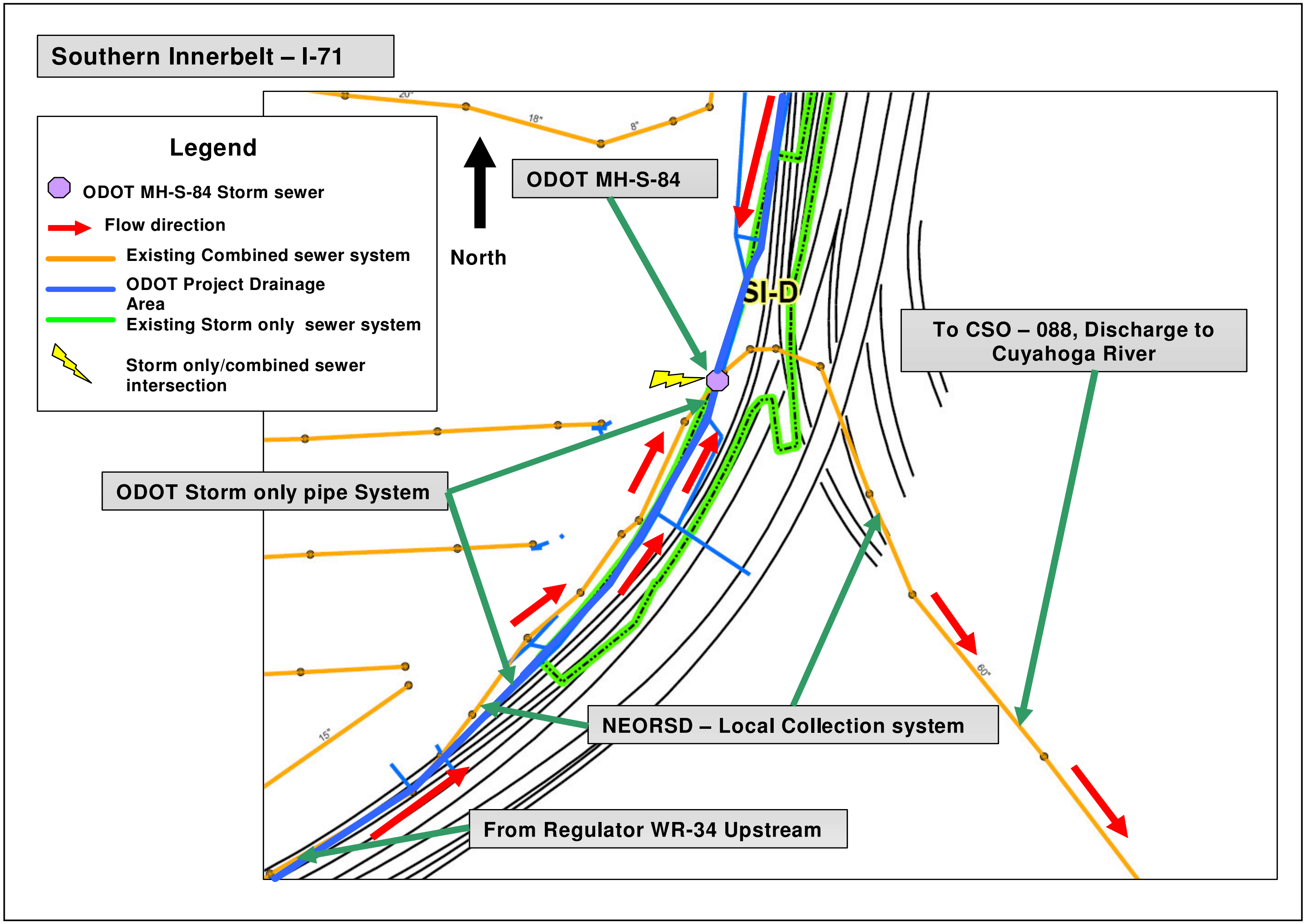
6.3 SOUTHERN INNERBELT (I-71 AT JENNINGS FREEWAY) PRELIMINARY DRAINAGE

Figure 17 shows the I-71 Southern Innerbelt/Jennings Freeway area, in the NEORSD Westerly sewershed. This figure also shows the following:

- Stormwater only pipes in blue - existing ODOT Storm pipes
- Combined sewer is shown in orange – existing Local collection systems
- Stormwater only pipe connectivity summary (Source: *ODOT CUY-71-17.83/CUY-176-12.76- Appendix I*)
    - Storm sewer pipe from ODOT manhole S-111 to S-84. 48" storm sewer flowing from north to south.
    - Storm sewer pipe from ODOT manhole S-222 to S-84 84" storm sewer flowing south to north.
    - Both storm line converge at manhole S-84 which is connected to the local collection system/combined sewer which consists of tributary WR-34 and is in the CSO-088 drainage area. CSO-088 discharges to the Cuyahoga River.
- ODOT stormwater runoff enters the combined system downstream of tributary regulator WR-34. This is important because ODOTs runoff enters the combined sewer system below the controlling regulator and therefore, ODOT is not contributing to volume to this regulator adding to the overflows. This is also important because ODOTs runoff is not being treated and ODOT needs to design and install BMPs for the purpose of addressing the post-construction runoff requirements.
- The north and south storm sewer systems continue in their respective directions; however no additional pipe size information was collected for this report. The drawings indicate that the northern storm system terminates at ODOT manhole S-175. No end manhole could be determined from the southern storm sewer system.
- Included in Table 11 are NEORSD CSO drainage areas overlaid with ODOT project drainage areas within the CSO drainage area. Map 10, shows the Southern Innerbelt project area, CSO-088 drainage area has been revised to incorporate the northern end of the ODOT drainage area SI-D to show the storm only run off being conveyed to the combined system at ODOT manhole S-84.

Table 11 shows the estimated percentage of ODOTs area within the CSO area as an initial step towards assessing the potential volume ODOT can expect to remove from that particular CSO drainage area. The *Westerly CSO Phase II Facilities* Plan did not include any support mapping to be included in this report.

Figure 17 – (Substructure) Identification and Underground Drainage System – I-71/Jennings Freeway- Southern Innerbelt Area



6.4 CENTRAL INTERCHANGE/I-77 APPROACH/I-77 DRAINAGE

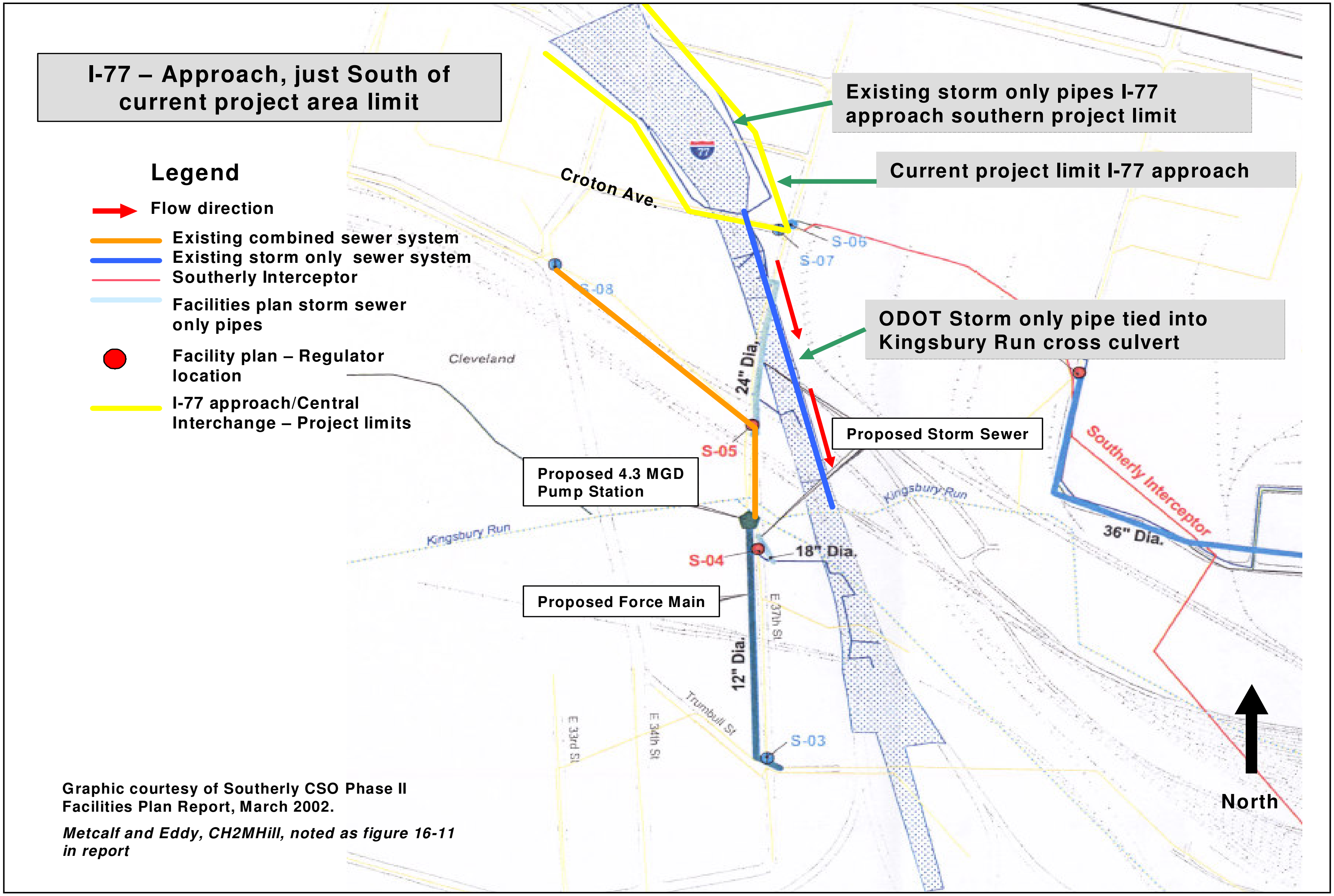
Figure 18 shows the southern end of I-77 (Kingsbury Run) portion of the project area. This project is located in NEORSDs Southerly sewershed. Figure 18 also shows the following:

- Existing stormwater only pipes are shown in blue
- Existing combined sewer is shown in orange – Local collection systems
- NEORSD completed system upgrades in this area include – New pump stations, forces main and 24" Stormwater which conveys flow from the north to tributary S-05. The 24" storm sewer connectivity will need to be confirmed prior to BMP designs for this CSO drainage.
- Review of ODOT drainage information indicates that proposed storm only pipes will convey flow from portions of I-77 and discharge into Kingsbury Run.

Included in (*Appendix T)* are the following NEORSD Easterly CSO Phase II Facilities Plan, maps and figures. This information has been collected from the *Northeast Ohio Regional Sewer District Southerly CSO Phase II Hydraulic Modeling Report, May 2002*, prepared by Metcalf and Eddy and CH2MHill:

- Figure 1-1a Southerly CSO Study Area
- Figure 1-1b Southerly CSO Study Area
- Figure 2-1 Interceptors in Southerly
- Figure 2-2 Inceptors in Southerly
- Figure 2-4 Cuyahoga River CSO Outfalls

Figure 18 – (Substructure) Identification and Underground Drainage System – I-77 Approach/Kingsbury Run Area



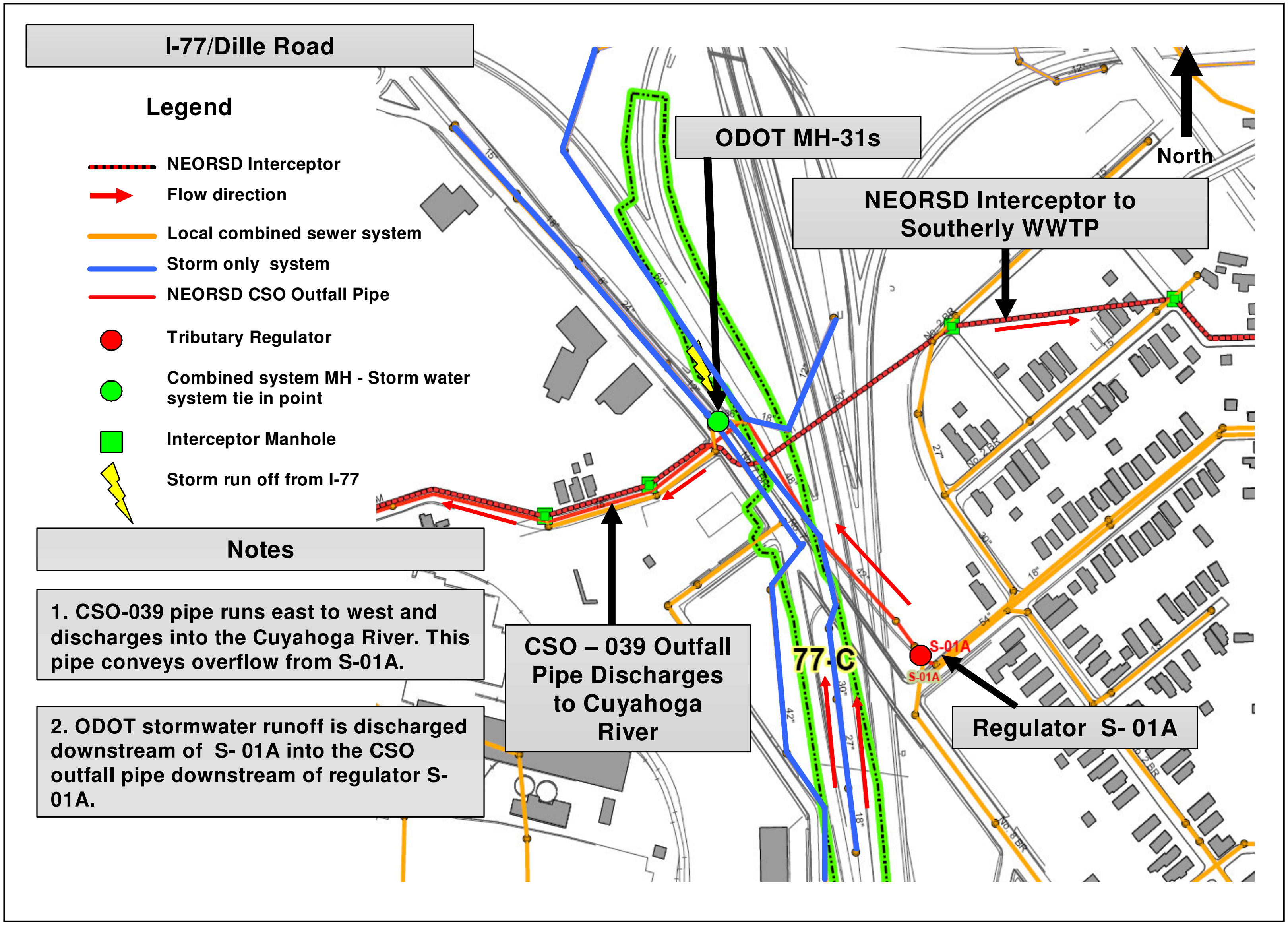
6.5 I-77/DILLE ROAD PRELIMINARY DRAINAGE

Figure 19 shows Southern end of I-77 and Dille Road area. This project is located in NEORSDs Southerly sewershed. Figure 19 also shows the following:

- Existing stormwater only pipes are shown in blue,
- Existing combined sewer is shown in orange – Local collection systems
- Intersection points with the combined sewer are indicated by “lightning” strikes.
- CSO – 036 outfall conveys overflow from tributary S-01A to the Cuyahoga River.
- Interceptor pipe flows in the opposite directions, intersects and collects ODOT runoff from the 77-C ODOT preliminary drainage area of the project below tributary regulator S-01a. This is important because ODOTs runoff enters the combined sewer system below the controlling regulator and therefore, ODOT is not contributing to volume to this regulator adding to the overflows. This is also important because ODOTs runoff is not being treated and ODOT needs to design and install BMPs for the purpose of addressing the post-construction runoff requirements.

Figure 19 shows the Stormwater only pipe system which ties into the inceptor sewer below regulator S-01A. ODOT drawings for this area as provided in *Appendix Q* (I-77/Dille Road drawings). This project area is in the Southerly sewershed.

Figure 19 – (Substructure) Identification and Underground Drainage System – I-77/Dille



SECTION 7 PROJECT BEST MANAGEMENT PRACTICES (BMPs), STORMWATER RECOMMENDATIONS, RATIONALE AND DESIGN CONSIDERATIONS

This section presents project drainage area stormwater BMP recommendations. The information is organized into the following sections:

- Summary of System Conveyance Components
- System Evaluation Summary
- Design Considerations
- BMP Recommendations and Supporting Selection Rationale

7.1 SUMMARY OF SYSTEM CONVEYANCE COMPONENTS

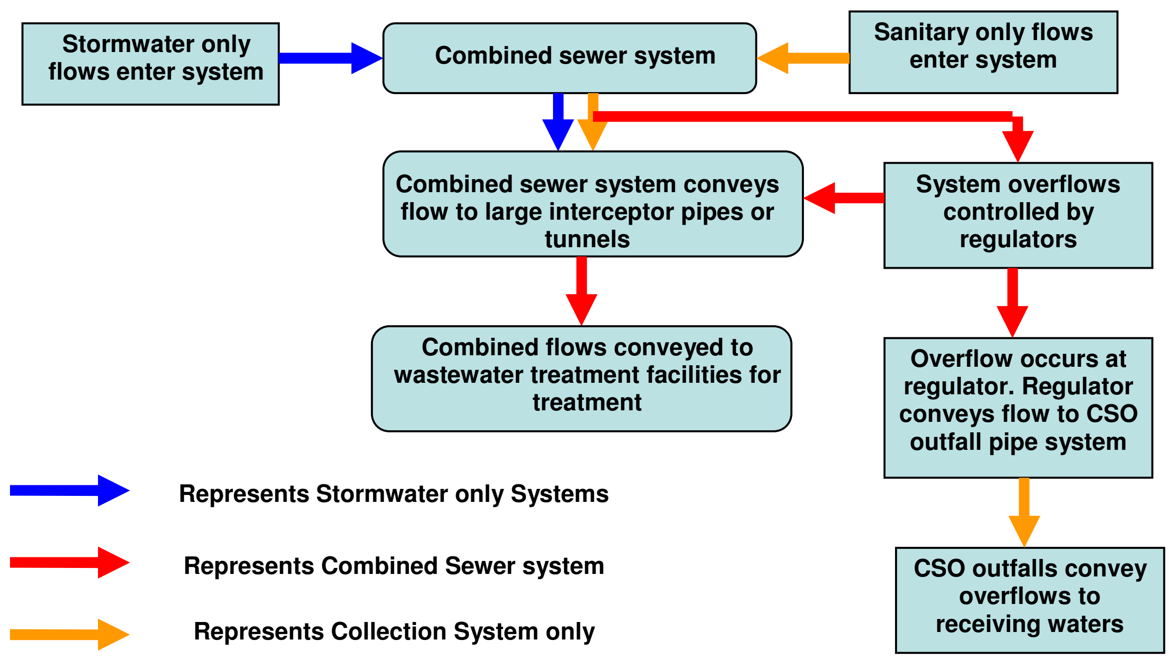
This section addresses the NEORSD system structural system components functions and interaction with stormwater runoff.

Discharges to the combined sewer system consist of stormwater flows and sanitary flows. There are five types of combined system components in the CSO system near the project area. These systems are summarized as follow:

- Local collection systems – These systems collect and convey both sanitary and stormwater flows to the larger interceptor pipes and tunnels.
- Stormwater only pipes – These pipes collect and convey stormwater runoff only. These pipes can discharge into a local collection system, into an interceptor pipe, or into a receiving water body.
- Regulators – The NEORSD regulators serve to control flows within the collection system. Regulators convey combined flow to the WWTP during periods of normal flow, and to CSO outfalls and the WWTP during periods of high flow.
- Interceptors – Interceptors receive flow from collection system pipes, regulator controlled collection system pipes, and stormwater only pipes. The flow is conveyed to the WWTP for treatment during normal flow conditions.
- Combined Sewer Outfalls – These pipe systems convey overflow directed by the regulators and discharge this overflow into the receiving waters.

Figure 20 shows the interaction and connection of these systems.

Figure 20 - Sanitary and Surface Water Flow Diagram In a Combined System



7.2 SYSTEM EVALUATION SUMMARY

This section summarizes the factors considered in identifying the preliminary drainage areas and the BMPs. Table 10 presents the data from the system evaluation and provides a "Yes" or "No" answer to the following discharge options and design concerns considered for each preliminary drainage area:

- Wastewater Treatment Plant Capacity a Concern?
- Water Quantity Detention or BMPs Required?
- ODOT Water Quality BMPs needed?
- Cleveland Stormwater Management Plan Governs?
- Capacity of Existing Local System a Concern?
- Potential for Increased Combined Overflows?

In addition, the following discharge options were identified and included in Table 10:

- Discharges to Local Combined System
- Discharges into a System Upstream of a NEORSD Regulator
- Discharges to NEORSD Interceptor
- Discharges to NEORSD CSO Outfall
- Discharges to Separate Storm Drain System
- Discharges Directly to Surface Water Body

- Potential Water Volume Runoff Credit for Removal

Table 10 - Design Concerns for Each Potential Discharge Option						
ODOT Stormwater Discharge Options	**WWTP Capacity a Concern ?**	**System Capacity Analysis or BMPs Required?**	**ODOT Water Quality BMPs Needed?**	**Cleveland SWMP Governs?**	**Capacity of Existing Local System a Concern?**	**Potential for Increased Combined Overflows?**
Discharge to local combined system	Yes	Yes	No	No	Yes	Yes
Discharge into a system upstream of a NEORSD regulator	No	Possibly	No	No	No	Yes
Discharge to NEORSD interceptors	Yes	Yes	No	No	No	Yes
Discharge to NEORSD CSO combined sewer outfall	No	Possibly	Yes	Yes	No	No
Discharge to a separate storm only system	No	Possibly	Yes	Yes	No	No
Discharge directly to surface water body	No	Possibly	Yes	Yes	No	No

The following key questions were identified and addressed during the system evaluation for each design option:

- **Where do the storm only pipes connect to the combined system?**: Maps 1 through 7 identify the current known stormwater only pipes within and/or near the project limits.

- **What is the conveyance system and location of outfall/discharge point downstream of the NEORSD regulators?:** Maps 1 through 7 show the local collection system pipes in orange and controlling tributary regulator as a red circle. The Collection System and Interceptor Flow Direction Maps 8 through 10 show the CSO outfalls and regulators within the project limits and adjacent to the project area. Also shown on Maps 8 through 10 are arrows that show the flow direction from the project areas through the downstream conveyance systems and known combined sewer pipe sizes.

- **Which regulators and CSO outfalls continue to have recurring overflow events?:** This was a significant factor in addressing potential areas where ODOT could have a positive impact within the combined system (i.e. potentially reduce the number of overflow events). Appendix C lists NEORSD CSO outfall location and number of discharges.

- **What is NEORSDs system connection criteria and what will ODOT project design engineers need to address to continue to discharge ODOT runoff to the local collection system?:** To continue to discharge to the combined system, ODOT project design engineers will need to analyze the current volume of runoff being conveyed and assess the proposed increase in runoff volume based on the change in the project impervious area. The NEORSD connection criterion requires an analysis of the hydraulic capacity of the combined system at and downstream of the existing and proposed new connections. ODOT project design engineers will need to work with NEORSD engineers to address the capacity issues for each existing and proposed connection and complete the necessary system modeling.

- **What does the preferred alternative project footprint look like in the areas identified to be potentially separated from the combined system? Are there areas below elevated portions of the projects where BMPs could be considered? Will right-of-way be purchased and can any of this right-of-way be used for BMPs?**

These questions are addressed in the comments portion of the BMP tables (Tables 15 and 16).

7.3 EVALUATION OF CSO DRAINAGE AREAS AND ODOT PROJECT DRAINAGE AREAS

The sewershed areas for each of the NEORSD CSO outfalls were delineated based on system conveyance network information provided by the NEORSD GIS Department. The limits of these CSO sewersheds show the contributing areas to each CSO. Maps 1- 7 show the system pipe sizes that were available at the time of this report. It is understood that a portion of the combined flow from these sewersheds may be directed outside of the sewershed boundaries to one of the WWTPs during periods of high flow. It should be noted that some of the conveyance system pipes overlap along the perimeters of these sewersheds, and that the sewershed boundaries have been delineated without field confirmation (dye testing, review of NEORSD system video), extensive conveyance system plan research, and system model assessment.

Maps 8 through 10 show the interceptors and local collection system flow pathways from the ODOT project areas to each CSO outfall, the estimated delineated sewershed boundary for each CSO outfall, and the boundary of the ODOT project within each delineated CSO outfall sewershed. Table 11 lists NEORSD CSO sewershed areas that intersect the preliminary project drainage areas. The estimated CSO outfall sewershed area is approximated based on the Long Term Control Plans developed by Metcalf and Eddy. These estimated areas were not confirmed by NEORSD GIS coverages.

Table 11 also presents the area of the ODOT preliminary project drainage areas within each of the CSO sewersheds. It is estimated that overall the ODOT Innerbelt Projects encompass 2.4% of the total CSO outfall sewersheds areas that lie within or will receive flow/runoff from estimated project drainage areas.

Table 11 - CSO/ODOT Drainage Area Comparison

CSO Outfall ID	Estimated CSO Outfall Sewershed Area (acres)	Estimated ODOT Preliminary Project Drainage Area Within the CSO Outfall Sewershed Area (acres)	Percentage of ODOT Preliminary Project Drainage Areas Within the CSO Outfall Sewershed Area (acres)
CSO-201	1375.4	4.0	0.3%
CSO-200	23.6	4.0	16.3%
CSO-099	159.7	11.3	7.1%
CSO–098	294.6	23.4	7.8%
CSO–097	97.6	45.4	46.5%
CSO-096	197.1	14.0	7.1%
CSO-095	454.9	18.1	3.9%
CSO-094	525.6	74.0	14.0%
CSO-090	185.0	23.2	12.5%
CSO-235	50.9	8.4	16.4%

CSO-080	680.4	27.0	4.0%
CSO-081	156.6	1.4	0.91%
CSO-088	467.9	4.3	0.93%
CSO-036	2334.0	0.7	0.03%
CSO-039	235.0	7.2	3.1%
CSO- 040	3841.2	9.0	0.23%
CSO-088	349.0	2.4	0.7%
Total	**11,427**	**277.8**	**2.4%**

Table 12 provides a summary of the delineated preliminary project drainage areas in acres.

Table 12 – Project Drainage Area Size (Acres)	
Project Drainage Area Name	**Project Drainage Area – Size (Acres)**
IC-A	4.43
IC-B	14.61
IC-C	12.67
IC-D	5.84
IC-E	11.36
IC-F	15.47
IC-G	1.78
TR-A	9.10
TR-B	0.57
TR-C	10.59
TR-D	1.06
TR-E	0.94
TR-F	1.50
TR-G	3.19
TR-H	1.03
TR-I	1.31
TR-J	0.73
TR-K	2.43
TR-L	1.02
TR-M	0.60
TR-N	0.50
TR-O	3.02
TR-P	1.16
TR-Q	0.86
TR-R	4.27
TR-S	0.59
CI-A	44.09
CI-B	3.47
CI-C	7.12
CI-D	4.17
CV-A	16.52

Table 12 – Project Drainage Area Size (Acres)	
Project Drainage Area Name	**Project Drainage Area – Size (Acres)**
CV-B	10.67
77-A	18.30
77-B	35.34
77-C	7.73
SI-A	6.77
SI-B	0.49
SI-C	5.35
SI-D	0.44
SI-E	4.44
Total Delineated Project Drainage Area	**277.8**

Table 13 provides a summary of the size of pipes present in the CSO conveyance system near the project limits and at the point of discharge from each CSO affected by the project. This information is also shown on Maps 1 through 10. Project design engineers will need to field verify these diameters since no "As-Built" plans were obtained or reviewed.

Table 13 – CSO Pipe Diameter Sizes		
CSO Outfall ID	**Pipe Diameter Near the Project Limits (inches)**	**Pipe Diameter Near the CSO Outfall (width x height)(inches)**
CSO-201	20	135 x 81
CSO-200	72	150
CSO-099	70w x 89h	76 x 97
CSO–098	48w x 61h	108
CSO–097	60	72
CSO-096	40w x 50h	114
CSO-095	40w x 50h	144
CSO-094	76w x 97h	80
CSO-090	20	50
CSO-235	23w x 27h	54
CSO-080	60	194
CSO-040	N/A	N/A
CSO-O39	72	N/A
CSO-036	60	194 x 75
CSO-088	60	60

Project drainage areas TR-E, TR-F, TR-I, TR-J and TR-N are associated with the Midtown connector. Map 2 shows the project drainage areas for the west and east side one way connector roads. The drainage from the Midtown connector roads will need to be coordinated with the Trench bridge crossings for Chester, Euclid, Prospect, Carnegie, and Cedar Avenues as these are city streets. Coordination with Cleveland will determine if these roadways should be tired into the existing combined sewer system or connected to the I-90 storm only trunk sewer. Table 13 provides information on CSO interceptor pipe sizes at the project limits or at the CSO outfall.

7.4 DESIGN CONSIDERATIONS AND CONSTRAINTS

The following are ODOT design considerations and constraints that need to be considered during the project BMP design:

- **Safety** – BMPs shall be designed with safety of the traveling public as a priority in accordance with FHWA and ODOT safety requirements. There are requirements to remove water off high speed roadways due to hydroplaning concerns, and concerns over ponding water adjacent to a high speed facility.

- **BMP Operation and Maintenance Design Issues** – Operation and maintenance requirements for each BMP needs to be considered. These could include ingress and egress, frequency of maintenance required, proper disposal areas, haul off, and location information for ODOT district maintenance personnel.

- **Local Road Impacts and Post Construction BMP Requirements** – The Trench project includes frontage roads on the top and parallel to the Trench. These frontages roads are included in the preliminary drainage areas presented in Tables 15 and 16. The bridges crossing the Trench and Innerbelt Curve project area have been delineated separately because these areas have the potential to make a storm only discharge or tie into the combined sewer system. BMPs could be challenging on these bridge decks. *Appendix I* provides guidance on how to address post-construction controls associated with these local road impacts.

- **Stormwater Only Outfalls Discharging To A Local Surface Receiving Water Body** – In the areas where ODOT can separate stormwater from the combined sewer system, the stormwater only pipes systems and outfalls need BMPs to meet the OEPA permit requirements. Tables 15 and 16 provide recommendations on the type of BMP for required for any separated areas (and new outfalls that might be created). The project design engineer should be aware of downstream issues and be aware of any existing receiving water body water quality requirements such as the Lower Cuyahoga River Total Maximum Daily Load Study discussed in Section 4.

- **BMP Feasibility Issues** – Table 16 presents the preliminary project drainage areas and their recommended BMPs and the BMP selection rationale. The following issues were evaluated, assessed, reviewed and incorporated into BMP selection:

    - Potential OEPA BMP approval for certain BMP types on a case-by-case basis.
    - Depressed roadway areas and elevation issues related to BMP hydraulics.
    - Potential need to evaluate BMP performance or effectiveness, see October 20, 2006- *Appendix E*.
    - Frequency of maintenance including Maintenance of Traffic requirements related to BMP maintenance.
    - BMP outlet or discharge to combined system, stormwater only system or receiving water.
    - Space limitations.

7.5 OVERVIEW OF THE STORMWATER BMP SUMMARY TABLES

Tables 15 and 16 provide information for project design engineers in the following areas:

- Preliminary BMP project drainage areas and drainage area information
- CSO drainage areas within each BMP project drainage area
- Receiving water body
- Information on separation options
- Recommended BMP(s) for each project drainage area
- BMP selection rationale
- BMP non-selection rationale

The purpose of the additional information in this section is to support and supplement the information provided in the tables.

7.5.1 General Map Background Information

The project area has been divided into preliminary project drainage areas based upon**:**

- Topography of the project area,
- Configuration of local combined sewer lines,
- Configuration of existing storm drain lines,
- Presence of existing Stormwater discharge options within or near the project area.

The drainage areas have been delineated separately within each PID Section and have been labeled following an acronym that identifies the PID Section (i.e. – the drainage areas of the PID 79580 – Innerbelt Curve have been labeled IC-A through IC-G). Maps 1 through 7 (located at the end of Section 8) show the delineated drainage areas for each of the PID sections and a drainage area label for each area. The following is provided to clarify the map features and color codes related to the report maps.

- **Local Combined Sewer System (Conveyed to WWTP)** – These lines are maintained by the City of Cleveland and are shown in orange. These locally maintained lines convey combined sewer and Stormwater flow to the NEORSD maintained interceptor lines. NEORSD tributary regulators present along the local combined sewer lines allow combined flow during periods of high stormwater runoff flows to overflow and discharge directly to a nearby surface water body through the NEORSD CSO outfall.

- **NEORSD Interceptor (Conveyed to WWTP)** – The interceptor lines are maintained by the NEORSD and are shown as a dashed red line. The NEORSD interceptors receive flow from the local combined sewer system lines and ultimately they discharge the combined flow to one of the three NEORSD WWTPs that service the project area. NEORSD tributary regulators present along the interceptors allow combined flow during periods of high stormwater flow to overflow and discharge directly to a nearby surface water body through a NEORSD CSO outfall.

- **NEORSD CSO Outfall** – The NEORSD maintained CSO outfalls near the project area are shown in red. These outfalls discharge overflows of combined sewer and stormwater to a nearby surface water body during periods of high flow. In some areas, such as near Lake Erie, the CSO outfalls receive stormwater only flow from tributary pipe systems downstream of the nearest NEORSD tributary regulator. The identification number of the CSO outfall downstream of each drainage area is provided. The alpha-numeric identification number represents the sewershed (E- Easterly, S- Southerly and WR- Westerly) followed by the number.

- **Contributes to Wastewater Treatment Plant (WWTP) Flow** – The information in this column identifies whether the preliminary drainage area contributes flow to a WWTP via a local collection system or a CSO interceptor system. Increased flow to these systems may present system capacity issues and require further capacity analysis.

- **ODOT Runoff Enters CSO Pipe Downstream of Regulator –** This column identifies if ODOT runoff enters downstream of a NEORSD system regulator. In these areas, ODOT will need to design, construct, and maintain a BMP since runoff entering below the regulator will not receive any treatment.

7.5.2 Supplemental Information for System Inventory and Connection/Separation Options (Table 15)

The following is a summary of the existing combined or storm sewer only systems identified within the preliminary drainage areas and as shown in Table 15 under *Connection/Separation Options*. The following is a summary of each table column:

- **Recommend Remain Connected to Combined Sewer System to WWTP -** The information in this column identifies project preliminary drainage areas that are recommended to remain connected to the local collection system. These areas will therefore continue to discharge stormwater runoff to the combined sewer system, be treated at the WWTP, and require no BMP, since the WWTP is acting as the BMP. The rationale for this recommendation is included in Table 16.

- **Recommend Remain Connected to Combined Sewer System CSO Outfall** – The information in this column identifies project preliminary drainage areas that will remain connected to the combined sewer system and therefore continue to discharge stormwater runoff to the combined sewer system downstream of a regulator or any connection to a WWTP. BMPs are required prior to the CSO outfall. The rationale associated with this recommendation is included in Table 16.

- **Recommend Separation from Combined Sewer System** – This column indicates which preliminary drainage areas that will be separated from a connection to the local combined sewer system.

- **Recommend Creating ODOT Storm Only Outfall(s) –** This column indicates the drainage areas where ODOT will need to design and construct stormwater only outfalls along with the appropriate/recommended BMPs.

The following criteria was applied to assist in determining and documenting whether project stormwater runoff can be separated from the surrounding combined system:

- Availability of right-of-way area for BMP use.
- Ability to divert project runoff to local storm sewer conveyance system.
- Ability to locate, purchase easements and construct necessary storm sewer conveyances to a reasonable outfall location.
- Impacts on local road systems as a result of Innerbelt project work.
- Ability to construct and install Post-Construction controls in drainage areas determined to be separated from the combined sewer system.
- Ability to provide a positive impact on the combined sewer overflows and system capacity issues with the existing combined sewer systems.
- Are their potential hydrologic/hydraulic issues with locating, separating, or designing BMPs.
- Would separation compliment NEORSD Long Term Control Plans, completed studies, Early Action Plans, or NEORSD NPDES permit(s) for CSO outfalls?
- What Cuyahoga River Total Maximum Daily Load requirements need to be addressed and/or incorporated into BMP recommendations?
- What City of Cleveland MS4 SWMP BMPs should be considered?
- What ODOT MS4 SWMP should to be considered?
- Where Post-Construction BMPs are recommended, how will these be accessed for operations and maintenance service?
- Based on the OEPA's letter *Update on Alternative Post-Construction Stormwater Best Management Practices (BMPs)* (October 26, 2006), what BMPs may require sampling or monitoring?
- Project areas where right-of-way is being considered to be purchased for constructing the preferred alternatives, could portions of the right of way areas be used for post-construction controls? If yes, recommendation to consider potential innovative BMP options.
- Ability to identify areas where offsite stormwater entering the project limits is an issue. Can this be collected/diverted or bypassed off the project?
- Ability to incorporate BMPs under project elevated highway sections.

- Ability to relocate current storm sewer only system connections with the combined sewer system to points downstream of regulators, pump stations or other CSO system structures. This approach would aid and provide a positive impact on the CSO drainage areas. ODOT would still need BMPs for these drainage areas per permit requirements.
- Section 5, discussed preliminary NEORSD project timelines. The project design engineer will need to verify the NEORSD time table for the CSO projects to coordinate ODOT project drainage and BMP design and construction.

Table 14 summarizes the project bridge crossings (over or under passes), the project area, CSO drainage area and whether the crossing is an overpass or underpass. Table 14 provides a listing of project bridges and general local collection system or CSO system information as background to address drainage decisions which will need to be made concerning how runoff will be conveyed and where the runoff will be discharged. The runoff conveyance and discharge determination is important for BMP sizing, location and outfalls. The project design engineer will need to coordinate bridge runoff drainage with connector drainage and work with the City of Cleveland on stormwater management post-construction BMP selection and locations. The connector roads will become the City of Cleveland operations and maintenance responsibility. The ODOT Bridge Design Manual (ODOT, 2007b) requires the design engineer to remove or minimize bridge scuppers in the design where possible.

Table 14 - Project Roadway Bridges				
Roadway Bridge Name	**Project Drainage Area ID**	**CSO Drainage Area**	**Crossing Type**	**Summary of Local and CSO System Pipe Information Associated with Project Bridge Drainage**
Lakeside Ave.	IC-F	CSO-98/97/96	Overpass	1. West side – Runoff goes to CSO-96, Local collection system pipe size 15". 2. East side – Runoff goes to CSO-98, Local collection system pipe size 20". Should bridge runoff be conveyed to I-90 Trunk sewer, runoff goes to CSO-97.
Hamilton Ave.	IC-F	CSO-98/97/96	Overpass	1. West side – Runoff goes to CSO-96, Local collection system pipe size – 27" x 23". 2. East side – Runoff goes to CSO-98, Local collection system pipe size – 15". Should bridge runoff be conveyed to I-90 Trunk sewer, runoff goes to CSO-97.
St. Clair Ave.	IC-F	CSO- 97	Overpass	1. West Side – None, 2. East Side – Runoff goes to CSO-98, Interceptor pipe size – 44" x 35". Should bridge runoff be conveyed to I-90 Trunk sewer, runoff goes to CSO-97.
Superior Ave.	IC-F and TR-A	CSO-97/96	Overpass	1. West side – Runoff goes to CSO-96, Local collection system pipe size – 33" x 27". 2. East Side – Runoff goes to CSO-98, Local collection system pipe size – 15". (Note: Maps 1 and 2 show bridge area in 2 project areas). Should bridge runoff be conveyed to I-90 Trunk sewer, runoff goes to CSO-97.
Payne Ave	TR-B	CSO–98/97/96	Overpass	1. West side – Runoff goes to CSO-96, Local collection system pipe size 12". 2. East side – Runoff goes to CSO-98, Local collection system pipe size – 39" x 30". Should bridge runoff be conveyed to I-90 Trunk sewer, runoff goes to CSO-97.
Chester Ave.	TR-D	CSO-98/97/96	Overpass	1. West side – Runoff goes to CSO-96, Local collection system pipe size – 24". 2. East side – Runoff goes to CSO-98, Local collection system pipe size – 27" x 23". Should bridge runoff be conveyed to I-90 Trunk sewer, runoff goes to CSO-97.
Euclid Ave.	TR-H	CSO-201/97/96	Overpass	1. West side – Runoff goes to CSO-96, Local collection system pipe size 33" x 27". 2. East side – Runoff goes to CSO – 201, Local

Table 14 - Project Roadway Bridges				
Roadway Bridge Name	**Project Drainage Area ID**	**CSO Drainage Area**	**Crossing Type**	**Summary of Local and CSO System Pipe Information Associated with Project Bridge Drainage**
				collection system pipe size 18". Should bridge runoff be conveyed to I-90 Trunk sewer, runoff goes to CSO-97.
Prospect Ave	TR-L	CSO-201/97/95	Overpass	1. West Side – Runoff goes to CSO-95, Local collection system pipe size 39" x30". 2. East side – Runoff goes to CSO-201, Local collection system pipe size 24". Should bridge runoff be conveyed to I-90 Trunk sewer, runoff goes to CSO-97.
Carnegie Ave.	TR-P	CSO-201/97/95	Overpass	1. West side- Runoff goes to CSO-95, Local collection system pipe size 27"x23". 2. East side – Runoff goes to CSO-201, Local collection system pipe size 24". Should bridge runoff be conveyed to I-90 Trunk sewer, runoff goes to CSO-97.
Midtown Connector	TR-M	CSO-201/97/95	Overpass	1. Local collection systems are located along the local roads at both ends of the Midtown connector in drainage area M. 2. Discharge to I-90 mainline trunk sewer.
East 22nd Street	TR-S	CSO-201/97/95	Overpass	1. West side – Runoff goes to CSO-95, Local collection system pipe size – unknown. 2. East side – Runoff goes to CSO-201, Local collection system pipe size – Unknown. Should bridge runoff be conveyed to I-90 Trunk sewer, runoff goes to CSO-97.
East 9th Street	CI-A	CSO-94	Underpass	1. West side - Runoff goes to CSO-94, Local collection system pipe size – No.47 brick. 2. East Side – Runoff goes to CSO-94, Local collection system pipe size 24"..
Ontario Street	CI-A	CSO – 94/90	Underpass	1. West side – Runoff goes to CSO-90, Local collection system pipe size 33"x 27". 2. East Side runoff goes to CSO- 94, Local collection system pipe size 33" x 27". All NEORSD and Local collection system pipes size will be field verified.
West 3rd Street	CV-A/CV-B	CSO - 90	Underpass	1. West side – Runoff goes to CSO-90, Local collection system pipe size 20". 2. East side – Runoff goes to CSO-90, Local collection system pipe size 18". All NEORSD and Local collection system pipes

Table 14 - Project Roadway Bridges				
Roadway Bridge Name	**Project Drainage Area ID**	**CSO Drainage Area**	**Crossing Type**	**Summary of Local and CSO System Pipe Information Associated with Project Bridge Drainage**
				size will be field verified.
University Ave	CV-A/CV-B	CSO-80/81	Underpass	1. West side – Runoff goes to CSO-80, NEORSD Interceptor pipe size 24”. 2. East side – Runoff goes to CSO-81, Local collection system Pipe size 18”. Local collection system pipe size 33” x 27”. All NEORSD and Local collection system pipes size will be field verified.
Abbey Ave	CV-A/CV-B	CSO-80/81	Underpass	1. West side – Runoff goes to CSO-81, Local collection system pipe size 12”. 2. East side – None. Local collection system pipe size 33” x 27”. All NEORSD and Local collection system pipes size will be field verified.
Fairfield Ave.	CV-A/CV-B	CSO-80	Underpass	1. West side – Runoff goes to CSO- 80, NEORSD system pipe size 24”. 2. East side – Runoff goes to CSO-80, Local collection system pipe size – 12”. Local collection system pipe size 33” x 27”. All NEORSD and Local collection system pipes size will be field verified.
East 30th Street	I-77B	CSO-94	Underpass	1. West side – Runoff goes to CSO-94, Local collection system pipe size – North end – 50” x 40”, south end – 33”x 27”. 2. East side - Runoff goes to CSO-94, Local collection system pipe size – North end – 50” x 40”, south end – 33”x 27”. All NEORSD and Local collection system pipes size will be field verified.
Kenilworth Ave.	SI-B	CSO-80	Underpass	1. West side – Runoff goes to CSO -80, Local collection system pipe size – N/A, NEORSD pipe Size – 50” x 40”.2. East side - Runoff goes to CSO -80, Local collection system pipe size – N/A, NEORSD pipe Size – 50” x 40”. Local collection system pipe size 33” x 27”. All NEORSD and Local collection system pipes size will be field verified.
Starkweather Ave.	SI-D	CSO-80	Underpass	1. West side - Runoff goes to CSO -80, Local collection system pipe size – 15” 2. East side - Runoff goes to CSO -80, Local collection system pipe size – 15”. Local collection system pipe size 33” x 27”. All NEORSD and Local collection system pipes size will be field

Table 14 - Project Roadway Bridges				
Roadway Bridge Name	**Project Drainage Area ID**	**CSO Drainage Area**	**Crossing Type**	**Summary of Local and CSO System Pipe Information Associated with Project Bridge Drainage**
				verified.
Broadway Ave.	I-77C	CSO-39	Underpass	1. West side – Runoff goes to CSO-39, Local collection system pipe size 18". 2. East side – NEORSD interceptor pipe size 48".

Notes:

1. Drainage Option 1 – Connect to local collection system – Confirm bridge deck runoff volume and minimize scuppers as per ODOT Bridge Design Manual (ODOT, 2007b).
2. Drainage Option 2 – Connect to ODOT storm only sewer.
3. Project design engineers need to work with ODOT, City of Cleveland to determine how and where to convey the bridge runoff.

7.5.3 Supplemental Information for BMP Recommendations and Selection Rationale (Table 16):

Table 16 provides a summary of the BMP recommendations and selection rationale used to identify the recommended BMPs for each preliminary project drainage area. The primary objective of Table 16 was to provide rationale for recommending BMPs under one of the following drainage runoff scenarios described in Table 15:

- Scenario 1: ODOT remains connected to the local collection system or the combined sewer system and a BMP is not required.
- Scenario 2: ODOT disconnects from the existing local collection system or the combined sewer system and a BMP is recommended.
- Scenario 3: ODOT remains connected to the existing system however ODOT may need to design and construct BMPs to mitigate quantity increases to the NEORSD system.

The scenarios outlined above formed the basis for developing Table 16. The overall objective of the report is to provide project design engineers and others recommendations on BMPs for each preliminary drainage area. The table is set up to provide the designer information on the following:

- Recommended feasible BMP for each preliminary contributing drainage area (CDA) and supporting rationale and comments for the recommendation.
- BMPs which have limited feasibility for each CDA have also been identified with supporting rationale and potential constraints within the drainage area which limit this BMPs functionality, or design constructability.
- BMPs which have been determined to be not feasible for each CDA with supporting rationale and potential constraints within the drainage area which restricts their use.

Table 16 mentions general physical and hydraulic constraints, but due to space limitation they are not documented in Table 16. These were identified during review of the Step 6 Engineering submittal drawings (January 2007, Burgess and Niple - included on a CD at the end of the report) for the purpose of developing BMP recommendations for each CDA. The physical and hydrologic constraints are identified are listed below:

- Physical space and/or Right of way available to actually construct a BMP
- Potential locations to discharge BMP treated runoff. This could include actual distance to connect to a storm only system, construction of a storm only system to convey treated runoff and current capacity issues related to the potential system which ODOT would connect to
- Federal Aviation Agency (FAA) regulations governing open or standing water impoundments within specified distance from active runways
- Federal Highway Administration (FHWA) regulations governing safety issues related to standing water impoundment type runoff controls
- Slope steepness and limited space at toe of the slopes
- Ingress and egress for operations and maintenance

- Hydraulic issues associated with differences in elevation
- Backwater issues associated with submerged deepwater outfalls

This list of potential BMP recommendation constraints is not intended to be comprehensive. These were the constraints identified during CDA review and BMP recommendation evaluation for each CDA. The section designer will need to consider these constraints and others during BMP and drainage design.

Table 16 includes four structural BMPs which are being considered for use on the Corridor projects. Table 16 also includes one structural BMP which does not appear in ODOT L/D Volume 2 manual. The following are the identified BMPs and a brief description of the BMP as described in ODOT's policy:

- Exfiltration Trench (ExT) – Captures roadway runoff/drainage at the outside edge of shoulder through the use of permeable concrete surface. The permeable concrete surface is placed parallel to the roadway within a concrete structure.
- Manufactured Systems – Consist of an underground structure that treat the water quality volume (WQv) by removing particulate matter through settlement. These are placed in an off line configuration with manholes for maintenance and hydraulic performance.
- Vegetated Biofilter – Is a BMP treatment train that filters stormwater runoff through vegetation. The biofilter consists of the vegetated portion of the graded shoulder, vegetated slope, vegetated ditch and energy protection area.
- Extended Detention or Retention Basin - Extended detention captures runoff and slowly releases the captured runoff over a period of time. Detention basin is a dry pond that detains stormwater runoff for quantity and limited quality control. Retention basin is a "wet" pond that has a minimum surface water elevation between storms that is defined as a permanent pool.
- Remain connected to NEORSD combined system – In the drainage areas where this has been recommended ODOTs runoff is being treated. For this reason, this becomes a BMP (key design criteria will be ability to remove stormwater effectively form high speed roadway during large design/check storms (10-year to 50-year)).

Table 17 provides information on the BMPs which ODOT has included in the L/D policy, but have been determined to not be feasible up front and therefore have not been included in Table 16. Table 17 provides these BMPs and the support rationale for the non-feasibility of recommending these as part of this project. One BMP which is discussed in the report is Bioretention Cells or sometimes referred to as "Raingardens". Modified and enlarged versions of these BMPs have been identified as innovative stormwater management BMPs for project drainage areas associated with the Central Viaduct bridge areas. These are referred to in Tables 15 and 16 as innovative approaches.

Table 17 ODOT Policy BMPs Not Included in Report	
BMP Type	**Not Feasible Rationale**
Bioretention Cell/Rain Gardens	Physical constraints – Space and issues associated with location of outfall. Portions of the project contain elevated roadway segments. Permeable soils are required and are limited in the project area
Infiltration Trench	Not practical in elevated and depressed roadway sections. Winter weather deicing activities would require increased maintenance to the point where this would not be practical. In addition, discharging runoff from this BMP requires permeable soil and these are limited in the project area.
Infiltration Basin	Tends to require a larger footprint, similar to the detention or retention BMP types space requirements is the physical limitation along with permeable soil types necessary to allow runoff to infiltrate into the soil.
Constructed Wetlands	Physical constraints size necessary to address runoff for drainage area. Potential permitting and long term maintenance for stormwater wetlands is an issue, both cost and the regulatory issues continue to change regarding maintaining these BMP types.

SECTION 8 - CONCLUSIONS

This section summarizes the project outfall drainage areas, the potential for separating the ODOT project stormwater runoff from discharging into NEORSD systems, and the recommended post-construction stormwater BMPs that could be considered by the project design engineers for each preliminary drainage area within the project limits.

Table 18 – Separation or Connection Conclusion Table				
Preliminary Drainage Area	**Remain Connected to Existing Combined Sewer Outfall (CSO)**	**Separate and Create New ODOT Storm Only Outfall**	**Remain Connected to Existing Combined Sewer System to WWTP**	**Conclusions**
IC-A (CSO-200)	X			ODOT runoff enters a CSO outfall below the last system regulator. ODOT will need a BMP for treatment but discharge location currently exists.
IC-B (CSO-099)	X			ODOT runoff enters a CSO outfall below the last system regulator. ODOT will need a BMP for treatment but discharge location currently exists.
IC-C (CSO-098)	X			ODOT runoff enters a CSO outfall below the last system regulator. ODOT will need a BMP for treatment but discharge location currently exists.
IC-D (CSO-097)	X			1. ODOT runoff enters a CSO outfall below the last system regulator. ODOT will need a BMP for treatment but discharge location currently exists. 2. Based on NEORSD LTCP, CSO-97 may revert to storm only conveyance.
IC-E (CSO-096)	X			ODOT runoff enters a CSO outfall below the last system regulator. ODOT will need a

Table 18 – Separation or Connection Conclusion Table				
Preliminary Drainage Area	**Remain Connected to Existing Combined Sewer Outfall (CSO)**	**Separate and Create New ODOT Storm Only Outfall**	**Remain Connected to Existing Combined Sewer System to WWTP**	**Conclusions**
				BMP for treatment but discharge location currently exists.
IC-F (CSO-097)	X			ODOT runoff enters a CSO outfall below the last system regulator. ODOT will need a BMP for treatment but discharge location currently exists.
IC-G[1] (30th Extension, CSO-097)	X		X	1. ODOT runoff enters a CSO outfall below the last system regulator. ODOT will need a BMP for treatment but discharge location currently exists. 2. Based on NEORSD LTCP, CSO-97 may revert to storm only conveyance. 3. Design options: Tie into I-90 mainline trunk or Local collection system (top of trench).
TR-A (CSO-097)	X			1. ODOT runoff enters a CSO below the last system regulator. ODOT will need a BMP for treatment but discharge location currently exists. 2. Based on NEORSD LTCP, CSO-97 may revert to storm only conveyance.
TR-B[1] (Payne Ave. Bridge, CSO-098 and CSO-096)	X		X	1. ODOT runoff enters a CSO below the last system regulator. ODOT will need a BMP for treatment but discharge location currently exists. 2. Based on NEORSD LTCP, CSO-97 may revert to storm only conveyance.

Table 18 – Separation or Connection Conclusion Table				
Preliminary Drainage Area	**Remain Connected to Existing Combined Sewer Outfall (CSO)**	**Separate and Create New ODOT Storm Only Outfall**	**Remain Connected to Existing Combined Sewer System to WWTP**	**Conclusions**
				Convey bridge runoff to local system above trench or convey to mainline and combined CSO-97 system below bridge. 3. Design options: Tie into I-90 mainline trunk sewer or local collection system (top of trench).
TR-C (CSO-097)	X			1. ODOT runoff enters a CSO outfall below the last system regulator. ODOT will need a BMP for treatment but discharge location currently exists. 2. Based on NEORSD LTCP, CSO-97 may revert to storm only conveyance.
TR-D[1] (Chester Ave. Bridge, CSO-098 and CSO-096	X		X	1. ODOT runoff enters a CSO outfall below the last system regulator. ODOT will need a BMP for treatment but discharge location currently exists. 2. Based on NEORSD LTCP, CSO-97 may revert to storm only conveyance. 3. Design options: Tie into I-90 mainline trunk sewer or local combined sewer system (top of trench).
TR-E[1] (Midtown Connector, CSO-097)	X		X	1. ODOT runoff enters a CSO outfall below the last system regulator. ODOT will need a BMP for treatment but discharge location currently exists. 2. Based on NEORSD LTCP, CSO-97 may revert to storm only conveyance. 3. Design options: Tie into I-90

Table 18 – Separation or Connection Conclusion Table				
Preliminary Drainage Area	**Remain Connected to Existing Combined Sewer Outfall (CSO)**	**Separate and Create New ODOT Storm Only Outfall**	**Remain Connected to Existing Combined Sewer System to WWTP**	**Conclusions**
				mainline trunk sewer or local combined sewer system (top of trench).
TR-F[1] (Midtown Connector, CSO-097)	X		X	1. ODOT runoff enters a CSO outfall below the last system regulator. ODOT will need a BMP for treatment but discharge location currently exists. 2. Based on NEORSD LTCP, CSO-97 may revert to storm only conveyance. 3. Design options: Connect to local combined system (top of trench) or tie into I-90 mainline trunk sewer
TR-G (CSO-097)	X			1. ODOT runoff enters a CSO outfall below the last system regulator. ODOT will need a BMP for treatment but discharge location currently exists. 2. Based on NEORSD LTCP, CSO-97 may revert to storm only conveyance.
TR-H[1] (Euclid Ave. Bridge, CSO-096 and CSO-201)	X		X	1. ODOT runoff enters a CSO below the last system regulator. ODOT will need a BMP for treatment but discharge location currently exists. 2. Based on NEORSD LTCP, CSO-97 may revert to storm only conveyance. 3. Design options: Connect to local combined sewer system (top of trench) or tie into I-90 mainline trunk sewer.
TR-I[1] (Midtown	X		X	1. ODOT runoff enters a CSO outfall below the LAST

Table 18 – Separation or Connection Conclusion Table				
Preliminary Drainage Area	**Remain Connected to Existing Combined Sewer Outfall (CSO)**	**Separate and Create New ODOT Storm Only Outfall**	**Remain Connected to Existing Combined Sewer System to WWTP**	**Conclusions**
Connector, CSO-097)				SYSTEM regulator. ODOT will need a BMP for treatment but discharge location currently exists. 2. Based on NEORSD LTCP, CSO-97 may revert to storm only conveyance. 3. Design options: connect to local combined sewer system (top of trench) or tie into I-90 mainline trunk sewer.
TR-J[1] (Midtown Connector, CSO-097)	X		X	1. ODOT runoff enters a CSO outfall below the last system regulator. ODOT will need a BMP for treatment but discharge location currently exists. 2. Based on NEORSD LTCP, CSO-97 may revert to storm only conveyance. 3. Design options: connect to local combined sewer system (top of trench) or tie into I-90 mainline trunk sewer.
TR-K (CSO-097)	X			1. ODOT runoff enters a CSO outfall below the last system regulator. ODOT will need a BMP for treatment but discharge location currently exists. 2. Based on NEORSD LTCP, CSO-97 may revert to storm only conveyance.
TR-L[1] (Prospect Ave. Bridge, CSO-095 and CSO-201)	X		X	1. ODOT runoff enters a CSO outfall pipe and enters below the regulator. ODOT will need a BMP for treatment but discharge location currently exists. 2. Based on NEORSD

Table 18 – Separation or Connection Conclusion Table				
Preliminary Drainage Area	**Remain Connected to Existing Combined Sewer Outfall (CSO)**	**Separate and Create New ODOT Storm Only Outfall**	**Remain Connected to Existing Combined Sewer System to WWTP**	**Conclusions**
				LTCP, CSO-97 may revert to storm only conveyance. 3. Design options: Connect to local combined sewer system (top of trench) or tie into I-90 mainline trunk sewer.
TR-M[1] (Midtown Connector, CSO-097)	X		X	1. ODOT runoff enters a CSO outfall pipe and enters below the regulator. ODOT will need a BMP for treatment but discharge location currently exists. 2. Based on NEORSD LTCP, CSO-97 may revert to storm only conveyance. 3. Design options: Connect to local combined sewer system (top of trench) or tie into I-90 mainline trunk sewer.
TR-N[1] (Midtown Connector, CSO-097)	X		X	1. ODOT runoff enters a CSO outfall below the last system regulator. ODOT will need a BMP for treatment but discharge location currently exists. 2. Based on NEORSD LTCP, CSO-97 may revert to storm only conveyance. 3. Design options: Connect to local combined sewer system (top of trench) or tie into I-90 mainline trunk sewer
TR-O (CSO-097)	X			1. ODOT runoff enters a CSO outfall below the last system regulator. ODOT will need a BMP for treatment but discharge location currently exists. 2. Based on NEORSD LTCP, CSO-97 may revert to

Table 18 – Separation or Connection Conclusion Table				
Preliminary Drainage Area	**Remain Connected to Existing Combined Sewer Outfall (CSO)**	**Separate and Create New ODOT Storm Only Outfall**	**Remain Connected to Existing Combined Sewer System to WWTP**	**Conclusions**
				storm only conveyance.
TR-P[1] (Carnegie Ave. Bridge, CSO -210 and CSO-095)	X		X	1. ODOT runoff enters a CSO outfall below the last system regulator. ODOT will need a BMP for treatment but discharge location currently exists. 2. Based on NEORSD LTCP, CSO-97 may revert to storm only conveyance. 3. Design options: Connect to local combined sewer system (top of trench) or tie into I-90 mainline trunk sewer.
TR-Q[1] (Cedar Ave Connection, CSO -098)	X		X	1. ODOT runoff enters a CSO outfall below the last system regulator. ODOT will need a BMP for treatment but discharge location currently exists. 2. Based on NEORSD LTCP, CSO-97 may revert to storm only conveyance. 3. Design options: Connect to local combined sewer system (top of trench) or tie into I-90 mainline trunk sewer
TR-R (CSO -097)	X			1. ODOT runoff enters a CSO outfall below the last system regulator. ODOT will need a BMP for treatment but discharge location currently exists. 2. Based on NEORSD LTCP, CSO-97 may revert to storm only conveyance.
TR-S[1] (E. 22nd St. Bridge, CSO 095)	X		X	1. ODOT runoff enters a CSO outfall below the last system regulator. ODOT will need a BMP for treatment but

Table 18 – Separation or Connection Conclusion Table				
Preliminary Drainage Area	**Remain Connected to Existing Combined Sewer Outfall (CSO)**	**Separate and Create New ODOT Storm Only Outfall**	**Remain Connected to Existing Combined Sewer System to WWTP**	**Conclusions**
				discharge location currently exists. 2. Based on NEORSD LTCP, CSO-97 may revert to storm only conveyance. 3. Design options: Connect to local combined sewer system (top of trench) or tie into I-90 mainline trunk sewer.
CI-A		X		Separating from the combined system is recommended based on the following: 1. Separating would have a positive impact on the combined CSO drainage area and potentially aid in the reduction of CSO area regulator overflows. 2. Distance and potential locations exist where ODOT can design and install a storm only system to discharge to the Cuyahoga River. ODOT will include BMPs on all ODOT storm only systems.
CI-B		X		Separating from the combined system is recommended based on the following: 1. Separating would have a positive impact on the combined CSO drainage area and potentially aid in the reduction of CSO area regulator overflows. 2. Distance and potential locations exist where ODOT can design and install a storm only system to discharge to the Cuyahoga River. ODOT will include BMPs on all ODOT

Table 18 – Separation or Connection Conclusion Table				
Preliminary Drainage Area	**Remain Connected to Existing Combined Sewer Outfall (CSO)**	**Separate and Create New ODOT Storm Only Outfall**	**Remain Connected to Existing Combined Sewer System to WWTP**	**Conclusions**
				storm only systems.
CI-C (commercial road relocation)		X		Separating from the combined system is recommended based on the following: 1. Separating would have a positive impact on the combined CSO drainage area and potentially aid in the reduction of CSO area regulator overflows. 2. Distance and potential locations exist where ODOT can design and install a storm only system to discharge to the Cuyahoga River. ODOT will include BMPs on all ODOT storm only systems. 3. Will be City of Cleveland road at the end of the project. Design options: to separate or connect to local combined system.
CI-D		X		Separating from the combined system is recommended based on the following: 1. Separating would have a positive impact on the combined CSO drainage area and potentially aid in the reduction of CSO area regulator overflows. 2. Distance and potential locations exist where ODOT can design and install a storm only system to discharge to the Cuyahoga River. ODOT will include BMPs on all ODOT

Table 18 – Separation or Connection Conclusion Table				
Preliminary Drainage Area	**Remain Connected to Existing Combined Sewer Outfall (CSO)**	**Separate and Create New ODOT Storm Only Outfall**	**Remain Connected to Existing Combined Sewer System to WWTP**	**Conclusions**
				storm only systems.
CV-A		X		Separating from the combined system is recommended based on the following: 1. Separating would have a positive impact on the combined CSO drainage area and potentially aid in the reduction of CSO area regulator overflows. 2. Distance and potential locations exist where ODOT can design and install a storm only system to discharge to the Cuyahoga River. ODOT will include BMPs on all ODOT storm only systems. 3. Slope stability on the west bank may limit the BMP solutions in this area.
CV-B		X		Separating from the combined system is recommended based on the following: 1. Separating would have a positive impact on the combined CSO drainage area and potentially aid in the reduction of CSO area regulator overflows. 2. Distance and potential locations exist where ODOT can design and install a storm only system to discharge to the Cuyahoga River. ODOT will include BMPs on all ODOT storm only systems. 3. Slope stability on the west

Table 18 – Separation or Connection Conclusion Table				
Preliminary Drainage Area	**Remain Connected to Existing Combined Sewer Outfall (CSO)**	**Separate and Create New ODOT Storm Only Outfall**	**Remain Connected to Existing Combined Sewer System to WWTP**	**Conclusions**
				bank may limit the BMP solutions in this area.
77-A		X		Separating from the combined system is recommended based on the following: 1. Separating would have a positive impact on the combined CSO drainage area and potentially aid in the reduction of CSO area regulator overflows. 2. Distance and potential locations exist where ODOT can design and install a storm only system to discharge to the Cuyahoga River. ODOT will include BMPs on all ODOT storm only systems.
77-B			X	Remain connected to the local combined sewer.
77-C (CSO-039)	X			Remain connected to the existing CSO-039 outfall pipe.
SI-A		X		Separating from the combined system is recommended based on the following: 1. Separating would have a positive impact on the combined CSO drainage area and potentially aid in the reduction of CSO area regulator overflows. 2. Distance and potential locations exist where ODOT can design and install a storm only system to discharge to the Cuyahoga River. ODOT will include BMPs on all ODOT

Table 18 – Separation or Connection Conclusion Table				
Preliminary Drainage Area	**Remain Connected to Existing Combined Sewer Outfall (CSO)**	**Separate and Create New ODOT Storm Only Outfall**	**Remain Connected to Existing Combined Sewer System to WWTP**	**Conclusions**
				storm only systems. 3. Slope stability on the west bank may limit the BMP solutions in this area.
SI-B (Kennelworth Ave. Bridge)		X		Separating from the combined system is recommended based on the following: 1. Separating would have a positive impact on the combined CSO drainage area and potentially aid in the reduction of CSO area regulator overflows. 2. Distance and potential locations exist where ODOT can design and install a storm only system to discharge to the Cuyahoga River. ODOT will include BMPs on all ODOT storm only systems. 3. Slope stability on the west bank may limit the BMP solutions in this area.
SI-C		X		Separating from the combined system is recommended based on the following: 1. Separating would have a positive impact on the combined CSO drainage area and potentially aid in the reduction of CSO area regulator overflows. 2. Distance and potential locations exist where ODOT can design and install a storm only system to discharge to the Cuyahoga River. ODOT will

Table 18 – Separation or Connection Conclusion Table				
Preliminary Drainage Area	**Remain Connected to Existing Combined Sewer Outfall (CSO)**	**Separate and Create New ODOT Storm Only Outfall**	**Remain Connected to Existing Combined Sewer System to WWTP**	**Conclusions**
				include BMPs on all ODOT storm only systems. 3. Slope stability on the west bank may limit the BMP solutions in this area.
SI-D (Starkweather Ave. Bridge)		X		Separating from the combined system is recommended based on the following: 1. Separating would have a positive impact on the combined CSO drainage area and potentially aid in the reduction of CSO area regulator overflows. 2. Distance and potential locations exist where ODOT can design and install a storm only system to discharge to the Cuyahoga River. ODOT will include BMPs on all ODOT storm only systems. 3. Slope stability on the west bank may limit the BMP solutions in this area.
SI-E (CSO-088)	X			SI-E conveys runoff to CSO-088 drainage area and runoff enters downstream of regulator WR-34. ODOT will need to design and construct BMPs for this drainage area.
Note: 1) BMP only required for I-90 mainline trunk sewer connection				

Table 19 presents conclusions for each preliminary drainage area and the recommended BMPs should ODOTs stormwater runoff be separated from the combined system. The BMP conclusion table includes the drainage areas, BMP types and indicates which BMP is recommended. An "**X**" followed by the word "Limited" indicates that this BMP has limited feasibility in this drainage area based on physical or hydraulic constraints and should be considered by the design engineer as a potential alternative.

Table 19 - Recommended BMPs by Drainage Area Conclusions					
	BMP Types				
Drainage Area	**Exfiltration Trench**	**Manufactured Treatment Systems**	**Vegetated Bioswale**	**Extended Detention or Retention Systems**	**Connection to Combined Sewer System**
IC-A	**X**		**X-Limited**		
IC-B	**X**	**X-Limited**	**X-Limited**		
IC-C	**X**	**X-Limited**	**X**		
IC-D	**X**	**X-Limited**	**X**		
IC-E	**X**	**X-Limited**	**X**		
IC-F	**X**	**X-Limited**	**X-Limited**		
IC-G	**X**	**X**	**X-Limited**		**X**
TR-A	**X**	**X-Limited**	**X-Limited**		
TR-B (Bridge)	**X**	**X-Limited**			**X**
TR-C	**X**	**X-Limited**	**X-Limited**	**X-Limited**	
TR-D (Bridge)	**X**	**X-Limited**			**X**
TR-E	**X**	**X-Limited**	**X-Limited**		**X**
TR-F	**X**	**X-Limited**	**X-Limited**		**X**
TR-G	**X**	**X-Limited**	**X-Limited**		**X**
TR-H (Bridge)	**X**	**X-Limited**			**X**
TR-I	**X**	**X-Limited**	**X-Limited**	**X-Limited**	
TR-J	**X**				
TR-K	**X**	**X-Limited**	**X-Limited**	**X-Limited**	
TR-L (Bridge)	**X**				**X**
TR-M	**X**				
TR-N	**X**		**X-Limited**		**X**
TR-O	**X**	**X-Limited**	**X-Limited**		
TR-P (Bridge)	**X**	**X-Limited**		**X-Limited**	**X**

Table 19 - Recommended BMPs by Drainage Area Conclusions					
	BMP Types				
Drainage Area	Exfiltration Trench	Manufactured Treatment Systems	Vegetated Bioswale	Extended Detention or Retention Systems	Connection to Combined Sewer System
TR-Q	X		X-Limited	X-Limited	X
TR-R	X		X-Limited		
TR-S (Bridge)	X	X-Limited	X-Limited	X-Limited	X
CI-A	X	X-Limited	X-Limited	X-Limited	
CI-B	X - Limited	X-Limited	X-Limited	X-Limited	
CI-C	X	X-Limited	X-Limited	X	
CI-D	X - Limited	X-Limited	X-Limited	X	
CV-A		X-Limited	X-Limited	X	
CV-B		X-Limited	X-Limited	X	
77-A	X - Limited	X-Limited	X-Limited	X	X
77-B	X	X-Limited	X-Limited	X	X
77-C	X	X-Limited	X-Limited	X	
SI-A	X	X-Limited	X-Limited		X[1]
SI-B (Bridge)	X	X-Limited	X-Limited		X[1]
SI-C	X	X-Limited	X-Limited	X-Limited	X[1]
SI-D (Bridge)	X	X-Limited			X[1]
SI-E	X	X-Limited			X
Note: 1 – ODOT recommendation is to create a storm only system.					

The conclusions presented in the two tables above have been developed as a result of information, drawings, meetings, studies and materials reviewed to prepare this report. The recommendations contained in Table 16 need to be assessed and integrated with overall project drainage design for functionally, compatibility and operation/maintenance needs. The section designer needs to understand the information in this report, work with City of Cleveland, NEORSD and ODOT personnel to incorporate the recommended BMPs into the project drainage design. The following is list of design conclusions which are recommended to be addressed during design:

- Address stormwater run-on from adjacent properties.
- Field verify system attribute information presented in the report as necessary.
- Perform impervious area analysis as necessary to develop existing and proposed stormwater runoff volumes for local collection system modeling input.
- Work in conjunction with City and Sewer district as necessary.
- Document all design assumptions during BMP design.
- As mentioned in the report, NEORSD Long Term Control Plan indicated a potential for CSO- 97 to divert to a storm only conveyance system. ODOT will work with NEORSD to promote this recommendation.
- In the Central Interchange – Innovative and practical BMP alternatives are recommended based on the number of elevated roadway sections.
- The Central Viaduct Bridge - Innovative and practical BMP alternatives are recommended based on the elevated roadway sections and additional right of way required for the Westbound lanes of I-90.

The information as summarized in Tables 17 and 18 indicate the following:

- All but three drainage areas recommend the exfiltration trench as the BMP. This is true for the Trench area bridges since runoff can be conveyed below to I-90 mainline via some type of storm water conveyance/pipe system.
- The drainage areas north of East 22nd are recommended to remain connected to the storm water only system, primarily based on the likelihood of CSO-97 being converted to storm only outfall.
- The Central Interchange and 77-A drainage areas are recommended to be separated to aid in potentially reducing CSO overflows and due to the proximity of the Cuyahoga River.

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Table 15 – System Inventory and Connection/Separation Options

Table 15 - System Inventory and Connection/Separation Options

Drainage Area	Local Combined Sewer System (Conveyed to WWTP)	NEORSD Interceptor (Conveyed to WWTP)	NEORSD CSO Outfall	NEORSD Reported CSO-Number of Overflows/year [F]	Outfall Surface Water Body	Contributes to WWTP Flow	ODOT Runoff Enters CSO Pipe Downstream of Regulator	Recommend Remain Connected to Combined Sewer System to WWTP	Recommend Remain Connected to Combined Sewer CSO Outfall	Recommend Separation From Combined Sewer System	Recommend Create ODOT Storm Only Outfall(s)	Project Drainage Area Comments
	Systems and Connections Present Within Project Drainage Area							Connection/Separation Options				
Innerbelt Curve - PIDs 77413/ 80408												
IC-A[A]	N	N	CSO-200	80	Lake Erie	N	Y	_	Y	N/A	N	IC-A drainage area informaiton: A.) ODOT project drainage area lies downstream of regulator E-04. B.) CSO 200 outfall contains storm water only flow from local sources including ODOTs- Innerbelt highway system, Burke Lakefront Airport and overflow from E-04. C.) Section Designer must review proposed storm water quantity changes per hydraulic criteria
IC-B[A]	N	N	CSO-99	70	Lake Erie	N	Y	_	Y	N/A	N	IC-B drainage area information: A.) ODOT project drainage area lies downstream of regulator E-07. B.) CSO -99 outfall contains storm water only flow from local sources including ODOTs- Innerbelt highway system, Burke Lakefront Airport and overflow from E-07. C.) Section Designer must review proposed storm water quantity changes per hydraulic criteria.
IC-C[A]	N	N	CSO-98	64	Lake Erie	N	Y	_	Y	NA	N	IC-C drainage area information: A.) ODOT project drainage area lies downstream of regulator E-08. B.) CSO -98 outfall contains storm water only flow from local sources including ODOTs- Innerbelt highway system, Burke Lakefront Airport and overflow from E-08. C.) Section Designer must review proposed storm water quantity changes per hydraulic criteria.
IC-D	N	N	CSO-97[B]	8	Lake Erie	N	Y	_	N	N/A	N[D]	IC-D drainage area informaiton: A.) ODOT project drainage area lies downstream of regulator E-09. B.) CSO -97 outfall contains storm water only flow from local sources including ODOTs- Innerbelt highway system, Burke Lakefront Airport and overflow from E-09. C.) Regulator E-11 has been bulk headed off (See report sections 5 and 6 for more detail).
IC-E[A]	N	N	CSO-96	14	Lake Erie	N	Y	_	Y	N/A	N	IC-E drainage area information: A.) ODOT project drainage area lies downstream of regulator E-12. B.) CSO -96 outfall contains storm water only flow from local sources including ODOTs- Innerbelt highway system, Burke Lakefront Airport and overflow from E-12. C.) Section Designer must review proposed storm water quantity changes. per hydraulic criteria.
IC-F	N	N	CSO-97[B]	8	Lake Erie	N	Y	_	N	N/A	N[D]	IC-F drainage area information: A.) ODOT project drainage area includes regulator E-09, the drainage area does not contribute flow to the Easterly WWTP. B.) CSO -97 outfall contains storm water only flow from local sources including ODOTs- Innerbelt highway system, Burke Lakefront Airport and overflow from E-09. C.) Regulator E-11 has been bulk headed off (See report sections 5 and 6 for more detail).
IC-G East 30th Extension	N	Y (Easterly - E 25th Branch)	CSO-97[B]	8	Lake Erie	Y	Y	N	_	Y/N[C]	Y[D]/N	IC-G drainage area information: A.) ODOT project drainage area lies upstream of regulator E-09. B.) CSO -97 outfall contains storm water only flow from local sources including ODOTs- Innerbelt highway system, Burke Lakefront Airport and overflow from E-09. C.) Design options - Coordinate with City of Cleveland on proposed outfall during detail design. City maintenance.

Table 15 - System Inventory and Connection/Separation Options

	Systems and Connections Present Within Project Drainage Area							Connection/Separation Options				
Drainage Area	Local Combined Sewer System (Conveyed to WWTP)	NEORSD Interceptor (Conveyed to WWTP)	NEORSD CSO Outfall	NEORSD Reported CSO-Number of Overflows/year[F]	Outfall Surface Water Body	Contributes to WWTP Flow	ODOT Runoff Enters CSO Pipe Downstream of Regulator	Recommend Remain Connected to Combined Sewer System to WWTP	Recommend Remain Connected to Combined Sewer CSO Outfall	Recommend Separation From Combined Sewer System	Recommend Create ODOT Storm Only Outfall(s)	Project Drainage Area Comments
Trench - PIDs 25795, 79580												
TR-A	N	N	CSO-97[B]	8	Lake Erie	N	Y	_	Y[B]	N/A	N[B]	TR-A project drainage area information: A.) Drainage and BMP design associated with the storm only trunk sewer along I-90 need to be addressed. B.) Project drainage area runoff enters downstream of regulater E-09.
TR-B (Payne Ave.) [I]	N	N	CSO-98/96	64/14	Lake Erie	N	Y/N	_	Y/N	Y/N[C]	N[B/C]	Payne Ave. Bridge over I-90: A.) East side bridge runoff to local collection system pipe size - 39x30 to CSO -98, West Side bridge runoff to local collection system pipe size - 12" to CSO - 96. I-90 Trunk line below bridge conveys flow to CSO 97. Section designer to confirm bridge deck runoff volume and flow direction.
TR-C	N	N	CSO-97[B]	8	Lake Erie	N	Y	_	Y[B]	N/A	N[B]	TR-C project drainage area information: A.) Drainage and BMP design associated with the storm only trunk sewer along I-90 need to be addressed. B.) I-90 trunk sewer Storm only) pipe size ranges from 36" to 72". C.) No local roads included in project drainage area TR-C.
TR-D (Chester Ave.) [I]	N	N	CSO-98/96	64/14	Lake Erie	N	Y/N	_	Y/N	Y/N[C]	N[B/C]	Chester Ave. Bridge over I-90: A.) East side bridge runoff to local collection system pipe size - 27 x 23 to CSO -98, West Side bridge runoff to local collection system pipe size - 18" to CSO - 96. I-90 Trunk line below bridge conveys flow to CSO 97. Section designer to confirm bridge deck runoff volume and flow direction.
TR-E (Mid-Town Connector)	N	N	CSO-97[B]	8	Lake Erie	N	Y/N	_	Y/N[B]	Y/N[C]	N[B]	Mid-Town Connector elevated above I-90 trench area: A.) I-90 Trunk line below connector conveys flow to CSO 97. Section designer to confirm connector runoff volume and flow direction and discharge locations. . Design options include tie into local system or I-90 mainline trunk sewer.
TR-F(Mid-Town Connector)	N	N	CSO-97[B]	8	Lake Erie	N	Y/N	_	Y/N[B]	Y/N[C]	N[B]	Mid-Town Connector elevated above I-90 trench area: A.) I-90 Trunk line below connector conveys flow to CSO 97. Section designer to confirm connector runoff volume and flow direction and discharge locations. Design options include tie into local system or I-90 mainline trunk sewer.
TR-G	N	N	CSO-97[B]	8	Lake Erie	N	Y	_	Y[B]	N/A	N[B]	TR-G project drainage area information: A.) Drainage and BMP design associated with the storm only trunk sewer along I-90 need to be addressed. B.) I-90 trunk sewer (Storm only) pipe size ranges from 36" to 72". C.) No local roads included in project drainage area TR-G.
TR-H (Euclid Ave.) [I]	N	N	CSO-96/201	14/24	Lake Erie	N	Y/N	-	Y/N	Y/N[C]	N[B/C]	Euclid Ave. Bridge over I-90: A.) East side bridge runoff to local collection system pipe size - 18" to CSO -201, West Side bridge runoff to local collection system pipe size - 33x27 to CSO - 96. I-90 Trunk line below bridge conveys flow to CSO 97. Section designer to confirm bridge deck runoff volume and flow direction and discharge locations.
TR-I (Mid-Town Connector)	N	N	CSO-97[B]	8	Lake Erie	N	Y/N	_	Y/N[B]	Y/N[C]	N[B]	Mid-Town Connector elevated above I-90 trench area: A.) I-90 Trunk line below connector conveys flow to CSO 97. Section designer to confirm connector runoff volume and flow direction and discharge locations.
TR-J (Mid-Town Connector)	N	N	CSO-97[B]	8	Lake Erie	N	Y/N	_	Y/N[B]	Y/N[C]	N[B]	Mid-Town Connector elevated above I-90 trench area: A.) I-90 Trunk line below connector conveys flow to CSO 97. Section designer to confirm connector runoff volume and flow direction and discharge locations.
TR-K	N	N	CSO-97[B]	8	Lake Erie	N	Y	_	Y/N[B]	N	N[B]	TR-K project drainage area information: A.) Drainage and BMP design associated with the storm only trunk sewer along I-90 need to be addressed. B.) I-90 trunk sewer (Storm only) pipe size ranges from 36" to 72". C.) No local roads included in project drainage area TR-K.

Table 15 - System Inventory and Connection/Separation Options

	Systems and Connections Present Within Project Drainage Area							Connection/Separation Options				
Drainage Area	Local Combined Sewer System (Conveyed to WWTP)	NEORSD Interceptor (Conveyed to WWTP)	NEORSD CSO Outfall	NEORSD Reported CSO-Number of Overflows/year[F]	Outfall Surface Water Body	Contributes to WWTP Flow	ODOT Runoff Enters CSO Pipe Downstream of Regulator	Recommend Remain Connected to Combined Sewer System to WWTP	Recommend Remain Connected to Combined Sewer CSO Outfall	Recommend Separation From Combined Sewer System	Recommend Create ODOT Storm Only Outfall(s)	Project Drainage Area Comments
TR-L Prospect Ave.)[I]	N	N	CSO-95/ 201	56/24	Lake Erie	N	Y	-	Y	Y/N[C]	N[B/C]	Prospect Ave. Bridge over I-90: A.) East side bridge runoff to local collection system pipe size - 24" to CSO -201, West Side bridge runoff to local collection system pipe size - 39x30 to CSO - 95. I-90 Trunk line below bridge conveys flow to CSO 97. Section designer to confirm bridge deck runoff volume and flow direction and discharge locations.
TR-M (Mid-Town Connector)	N	N	CSO-97[B]	8	Lake Erie	N	Y/N	_	Y[B]	Y/N[C]	N[B]	Mid-Town Connector elevated above I-90 trench area: A.) I-90 Trunk line below connector conveys flow to CSO 97. Section designer to confirm connector runoff volume, flow direction and discharge locations. Design options include tie into local system with City coordination of I-90 mainline trunk sewer.
TR-N (Mid-Town Connector)	N	N	CSO-97[B]	8	Lake Erie	N	Y/N	_	Y[B]	Y/N[C]	N[B]	Mid-Town Connector elevated above I-90 trench area: A.) I-90 Trunk line below connector conveys flow to CSO 97. Section designer to confirm connector runoff volume, flow direction discharge locations. Design options include tie into local system of I-90 mainline trunk sewer.
TR-O	N	N	CSO-97[B]	8	Lake Erie	N	Y	_	Y[B]	N	N[B]	TR-O project drainage area information: A.) Drainage and BMP design associated with the combined or storm only trunk sewer along I-90 need to be addressed. B.) I-90 trunk sewer (Combined or Storm only) pipe size ranges from 36" to 72". C.) No local roads included in project drainage area TR-O.
TR-P (Carnegie Ave.)[I]	N	N	CSO-201/95	24/56	Lake Erie	N	Y/N	-	Y	Y/N[C]	N[B/C]	Carnegie Ave. Bridge over I-90: A.) East side bridge runoff to local collection system pipe size - 20" to CSO -201, West Side bridge runoff to local collection system pipe size - 27x23 to CSO - 95. I-90 Trunk line below bridge conveys flow to CSO 97. Section designer to confirm bridge deck runoff volume, flow direction. Design options include tie into local system with City coordination of I-90 mainline trunk sewer.
TR-Q (Mid-Town Connector)	Y	N	CSO-98	64	Lake Erie	Y	Y/N	Y/N	Y/N	Y/N[C]	N[B/C]	Mid-Town Connector elevated above I-90 trench area: A.) I-90 Trunk line below connector conveys flow to CSO 97. B) Portions of connector drain to local collection system pipe size - 27x23 to CSO-98. Section designer to confirm connector runoff volume, flow direction and discharge locations. Design options include tie into local system with City coordination of I-90 mainline trunk sewer.
TR-R	N	N	CSO-97[B]	8	Lake Erie	N	Y	_	Y[B]	N/A	N[B]	TR-R project drainage area information: A.) Drainage and BMP design associated with the combined or storm only trunk sewer along I-90 need to be addressed. B.) I-90 trunk sewer (Combined or Storm only) pipe size ranges from 36" to 72". C.) No local roads included in project drainage area TR-R.
TR-S (E 22 St.)[I]	N	N	CSO-95	56	Lake Erie	N	Y/N	-	Y	Y/N[C]	N[B/C]	E 22nd St. Bridge over I-90: A).bridge runoff to local collection system pipe size - 27x23 to CSO - 95. I-90 Trunk line below bridge conveys flow to CSO 97. Section designer to confirm bridge deck runoff volume ,flow direction Design options include tie into local system with City coordination of I-90 mainline trunk sewer.

Table 15 - System Inventory and Connection/Separation Options

Drainage Area	Systems and Connections Present Within Project Drainage Area							Connection/Separation Options				Project Drainage Area Comments
	Local Combined Sewer System (Conveyed to WWTP)	NEORSD Interceptor (Conveyed to WWTP)	NEORSD CSO Outfall	NEORSD Reported CSO-Number of Overflows/year [F]	Outfall Surface Water Body	Contributes to WWTP Flow	ODOT Runoff Enters CSO Pipe Downstream of Regulator	Recommend Remain Connected to Combined Sewer System to WWTP	Recommend Remain Connected to Combined Sewer CSO Outfall	Recommend Separation From Combined Sewer System	Recommend Create ODOT Storm Only Outfall(s)	
Central Interchange - PIDs 77332												
CI-A [A]	Y	N	CSO - 94/90	35/34	Lake Erie/ Cuyahoga River	Y	N	N	N	Y	Y	CI-A project drainage area information: A.) CI-A drainage area attributes - 1. Elevated roadways sections, 2. Interchange infield open space, 3.Elevated roadway runoff collection and discharge will need to be coordinated with BMP design and location. B.) CI-A drainage area conveys runoff to 2 separate CSO drainages areas 94 and 90 respectively. An estimated 85% goes to CSO- 94 and 15% goes to CSO- 90. Proposed new ODOT storm water only outfall is recommended discharging to the Cuyahoga River.
CI-B	Y	N	CSO - 235/90/94	27/34/35	Lake Erie/ Cuyahoga River	Y	N	N	N	Y	Y	CI-B project drainage area information: A.) CI-B drainage area attributes - 1. Primarily elevated bridge sections, 2. Elevated roadway runoff collection and discharge will need to be coordinated with BMP design and location. 3. Right of Way has been purchased for the new southbound bridge on the east side of the river - Location for BMPs will be incorporated as part of drainage design. B.) CI-B drainage area conveys runoff to 3 separate CSO drainages areas 235, 90 and 94 repspectively. An estimated 10% goes to CSO- 235 and 10% goes to CSO- 90 and 80% goes to CSO -90. CSO - 90 and 235 discharge into the Cuyahoga River, CSO - 94 conveys runoff discharge into Lake Erie. Proposed new ODOT outfall to discharge to Cuyahoga River. Section designer will assess recommended BMPs selected for drainage areas CI-A, CI-C and CV-A to determine if combining or connecting these drainage areas is feasible from a BMP, cost and hydraulic perspective.
CI-C	Y	N	CSO- 235/94	27/35	Cuyahoga River/ Lake Erie	Y	Y	N	_	Y	Y	CI-C project drainage are information: A.) CI-C drainage area attributes - 1. Construction of new local roadway to be owned and maintained by City of Cleveland. 2. City of Cleveland coordination required with final BMP design and location. 3.) Commercial Road relocation - BMP design and location will need to be coordinated with City of Cleveland. 4. BMP design and location will consider strategic location that could address the BMP requirements for drainage areas CI-B, CI-D and portions of CI-A. B.) CI-C project drainage area crosses 2 CSO drainage areas 235 and 94 respectively. An estimated 80 % of runoff goes to CSO-235 and enters downstream of regulator E-25 (See map 8) and 20% goes to CSO-94. CSO-235 discharges runoff to the Cuyahoga River and CSO-94 discharges runoff to Lake Erie. Proposed new ODOT storm water only outfall is recommended discharging to the Cuyahoga River.
CI-D	Y	N	CSO - 235/90	27/34	Cuyahoga River	Y	Y	N	_	Y	Y	CI-D project drainage area information: A.) CI-D drainage area attributes - 1. Primarily elevated bridge sections, 2. Elevated roadway runoff collection and discharge will need to be coordinated with BMP design and location.3. Right of Way will be purchased for the new westbound bridge - BMP recommendations include connecting existing R/W with new R/W to generate an area for innoative storm water management BMPs. 5. Section designer will need to asses feasiblity of designing BMPs which will accept runoff from drainage areas CI-B and portions of CI-A, innovative and creative uses of this right of way area is encouraged for stormwater management. B.) CI-D project drainage area crosses 2 CSO drainage areas 235 and 90 respectively. An estimated 50% ofthe runoff goes to CSO-235 and enters downstream of regulator E-25 (See map 8)and 50% of runoff goes to CSO-90. Both CSOs discharge to the Cuyahoga River. .Proposed new ODOT storm water only outfall is recommended discharging to the Cuyahoga River.

Table 15 - System Inventory and Connection/Separation Options

Drainage Area	Systems and Connections Present Within Project Drainage Area: Local Combined Sewer System (Conveyed to WWTP)	NEORSD Interceptor (Conveyed to WWTP)	NEORSD CSO Outfall	NEORSD Reported CSO-Number of Overflows/year [F]	Outfall Surface Water Body	Contributes to WWTP Flow	ODOT Runoff Enters CSO Pipe Downstream of Regulator	Connection/Separation Options: Recommend Remain Connected to Combined Sewer System to WWTP	Recommend Remain Connected to Combined Sewer CSO Outfall	Recommend Separation From Combined Sewer System	Recommend Create ODOT Storm Only Outfall(s)	Project Drainage Area Comments
I-77 Access - PIDs 80406, 13567 and 82338												
77-A[A]	Y	N	CSO - 94	35	Lake Erie	Y	N	N	_	Y	Y	I-77A project drainage area information: A.) I-77A drainage area attributes - 1. Elevated roadways sections, 2. Interchange infield open space, 3.Elevated roadway runoff collection and discharge will need to be coordinated with BMP design and location. B.) I-77A drainage area conveys runoff to CSO drainages areas 94. CSO-94 discharges runoff to Lake Erie. C.) Section designer is recommended to evaluate recommended BMPs for CI-A to assess feasibility of centrally locating a BMP to serve both project drainage areas. Proposed new ODOT storm water only outfall is recommended discharging to the Cuyahoga River.
77-B	Y	N	CSO-94/40	35/79	Lake Erie Cuyahoga River	Y	N	Y	_	N	N	I-77B project drainage area informaiton: A.) I-77B drainage area conveys runoff to 2 separate CSO drainage areas, 94 and 40 respectively. An estimated 85% of runoff goes to CSO -94, which conveys runoff to Lake Erie and 15% of runoff goes to CSO-40, which conveys runoff to the Cuyahoga River. B.) Section designer must review proposed storm water quantity changes. Should quantity change (increase) be a concern, part or all of the runoff could be included in Central Interchange storm water only outfall. Should runoff be included in Central Interchange, proposed outfall discharge would be to Cuyahoga River.
77-C	N	N	CSO - 39	51	Cuyahoga River	N	Y	N	Y	N	N	I-77C project drainage area information: A.) I-77C drainage area conveys runoff to CSO-39. The diversion manhole at Broadway and Dilley Ave. diverts flow to CSO -39 and CSO-36. Section designer will need to obtain a copy of manhole detail No. 31s (See appendix Q). B.) ODOT Storm water runoff enters downstream of regulator S-01A C.) Section designer must review proposed storm water quantity changes. Should quantity change (increase) be a hydraulic concern then separation should be considered. If necessary separate I-77 North/South of Broadway Ave. (Combined Sewer or Storm only),(See Drainage Study for PID 13567)..
Central Viaduct Bridge - PID 77332												
CV-A (New I-90 Bridge)	Y	Y (Westerly Division Branch)	CSO - 80/90	43/34	Cuyahoga River	Y	N	_	N	Y	Y	CV-A project drainage area informaiton: A.) CV-A drainage area conveys runoff to 2 separate CSO drainage areas CSO 80 and 90 respectively. An estimated 25% of runoff goes into CSO - 80 drainage area and 75% of runoff goes to CSO - 90 drainage area. B.) East side of river - Easterly sewershed, CSO -90, West side of River - Westerly Sewershed, CSO -80, controlled by tributary regulator WR-27 and ODOT runoff enters upstream of this regulator. C.) ODOT will acruire right of way on the east side of the Cuyahoga River for the new bridge crossing. D.) Overall bridge drainage and runoff should, where practical, be conveyed to the northern side of the river to incorporate BMPs and stormwater management controls within the right of way acquired. E.) Section designer will assess feasiblity of designing BMPs which will accept runoff from drainage areas CI-B and CI-D, innovative and creative uses of this right of way area is encouraged for stormwater management. F.) ODOT continues to address slope stability issues along the west bank of the Cuyahoga River under the Central Viaduct.

Table 15 - System Inventory and Connection/Separation Options

	Systems and Connections Present Within Project Drainage Area							Connection/Separation Options				
Drainage Area	**Local Combined Sewer System (Conveyed to WWTP)**	**NEORSD Interceptor (Conveyed to WWTP)**	**NEORSD CSO Outfall**	**NEORSD Reported CSO-Number of Overflows/year [F]**	**Outfall Surface Water Body**	**Contributes to WWTP Flow**	**ODOT Runoff Enters CSO Pipe Downstream of Regulator**	**Recommend Remain Connected to Combined Sewer System to WWTP**	**Recommend Remain Connected to Combined Sewer CSO Outfall**	**Recommend Separation From Combined Sewer System**	**Recommend Create ODOT Storm Only Outfall(s)**	**Project Drainage Area Comments**
CV-B (Existing I-90 Bridge)	Y	Y (Westerly Division Branch)	CSO - 80/81 and 90	43/5/34	Cuyahoga River	Y	N	_	N	Y	Y	CV-B project drainage area informaiton: A.) CV-B drainage area conveys runoff to 3 separate CSO drainage areas CSO 80,81 and 90 respectively. An estimated 25% of runoff goes into CSO - 80 drainage area, 10% goes into CSO-81 and 65% of runoff goes to CSO - 90 drainage area. B.) East side of river - Easterly sewershed, CSO -90, West side of River - Westerly Sewershed, CSO -81, controlled by tributary regulator WR-27A and ODOT runoff enters upstream of this regulator. C.) ODOT will acquire right of way on the east side of the Cuyahoga River for the new bridge crossing. D.) Overall bridge drainage and runoff should, where practical, be conveyed to the northern side of the river to incorporate BMPs and stormwater management controls within the right of way acquired. E.) Section designer will assess feasiblity of designing BMPs which will accept runoff from drainage areas CI-B and CI-D, innovative and creative uses of this right of way area is encouraged for stormwater management. F.) ODOT continues to address slope stability issues along the west bank of the Cuyahoga River under the Central Viaduct.

Table 15 - System Inventory and Connection/Separation Options

Drainage Area	Systems and Connections Present Within Project Drainage Area							Connection/Separation Options				
	Local Combined Sewer System (Conveyed to WWTP)	**NEORSD Interceptor (Conveyed to WWTP)**	**NEORSD CSO Outfall**	**NEORSD Reported CSO- Number of Overflows/year [F]**	**Outfall Surface Water Body**	**Contributes to WWTP Flow**	**ODOT Runoff Enters CSO Pipe Downstream of Regulator**	**Recommend Remain Connected to Combined Sewer System to WWTP**	**Recommend Remain Connected to Combined Sewer CSO Outfall**	**Recommend Separation From Combined Sewer System**	**Recommend Create ODOT Storm Only Outfall(s)**	**Project Drainage Area Comments**
Southern Innerbelt - PID 77332												
SI-A	Y	N	CSO - 80	43	Cuyahoga River	Y	N	Y	_	Y	Y	SI-A drainage area information: A.) ODOT project drainage area discharges to CSO drainage area - 80, runoff enter upstream of tributary regulator WR-27. B.) Section designer must review proposed storm water quantity changes. Should quantity change (increase) be a concern, part or all of the runoff could be included in the storm water only outfall for drainage area CV-A or CV-B on the West side of river.
SI-B (Kennelworth Ave)	Y	Y	CSO - 80	43	Cuyahoga River	Y	N	Y	_	Y	Y	SI-B (Kennelworth Ave underpass) - drainage area information Overpass - A.) SI-B conveys runoff to CSO- 80 drainage area, runoff enters upstream of regulator WR-27. B.) Section designer must review proposed storm water quantity changes. Should quantity change (increase) be a concern, part or all of the runoff could be included in the storm water only outfall for drainage area SI-A, CV-A or CV-B on the West side of river. Likely to stay connected to local sewer/city street.
SI-C	Y	N	CSO - 80	43	Cuyahoga River	Y	N	Y	_	Y	Y	SI-C drainage area information: A.) ODOT project drainage area discharges to CSO drainage area - 80, runoff enter upstream of tributary regulator WR-27. B.) Section designer must review proposed storm water quantity changes. Should quantity change (increase) be a concern, part or all of the runoff could be included in the storm water only outfall for drainage area CV-A or CV-B on the West side of river.
SI-D (Starkweather Ave.)	Y	Y	CSO - 80	43	Cuyahoga River	Y	Y	Y	_	Y	Y	SI-D (Starkweather Ave underpass) - drainage area information Overpass - A.) SI-D conveys runoff to CSO- 80 drainage area, runoff enters upstream of regulator WR-27. B.) Section designer must review proposed storm water quantity changes. Should quantity change (increase) be a concern, part or all of the runoff could be included in the storm water only outfall for drainage area SI-A, SI-C, CV-A or CV-B on the West side of river. Likely to stay connected to local sewer/city street.
SI-E	N	N	CSO-88	44	Cuyahoga River	N	Y	N	_	N	N	SI-E drainage area information: A.) SI-E conveys runoff to CSO- 88 drainage area, runoff enters downstream of regulator WR-34. B.) ODOT runoff combines with local collection combined flow at ODOT manhole S-84. C.) The combined flow does not get treated and ODOT will need to design and construct BMPs for this drainage area.

GENERAL NOTES:

A. ODOT right-of-way exists within project limits, but not identified as part of the Innebrbelt project. These areas are recommended to be considered for post-construction BMP locations.

B. NEORSD may redirect CSO discharge from E-09 to CSO - 098 as part of the CSO control program. In this scenario, CSO - 097 may revert to storm only pipe.

C. The Y/N refers to project local road extension and connectors which will be dedicated as city streets. Drainage options: A.) Collect runoff from bridge and convey storm only flow to the trunk sewer along I-90 (CSO-97) and B.) Collect runoff from bridge and convey to local collection system (City of Cleveland). During final drainage and BMP design, ODOT will have to engage city to determine drainage connections and discharge locations.

D. Should CSO- 097 revert to storm only, ODOT would investigate ownership, maintenance and permit responsibility. No project outfall designed or constructed by ODOT would be required for this outfall.

E. CSO X/Y represents runoff could be discharged into 2 different CSOs.

F. A/B represents corresponding CSO overflows from previous column (See Appendix C)

G. If section designers determine quantity issues exist with continued connection to local combined sewer system, then consideration will have to be given to separating area to discharge to Cuyahoga River with storm only outfall.

H. Known CSO pipes sizes can be located in Section 7, Table 11.

I. Options exist to tie local combined system or tie into I-90 mainine trunk sewer (City Streets or overhead bridges)

Denotes bridge over Innerbelt Trench area

Table 16 – BMP Recommendations and Selection Rationale

Drainage Area	BMP Type	BMP Selection Rationale	BMP Recommended (Y/N)	BMP Limited Feasibility Rationale	BMP Limited Feasibility (Y/N)	BMP Not Feasible Rationale	BMP Not Feasible (Y/N)	Drainage Area and BMP Comments
Innerbelt Curve - PID Numbers - 77413, 80408								
IC-A	**Exfiltration Trench (ExT)**	Exits are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole.	Yes		No		No	ODOT storm water runoff enters the CSO downstream of regulator E-04. Recommendation is for ODOT to remain connected to this outfall pipe and will need to design and install BMPs to treat runoff prior to discharge. T
IC-A	**Manufactured Treatment Devices**	Identified as limited or not feasible for this drainage area	No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	No	BMP not feasible due to physical and hydraulic constraints	Yes	Requires reserved area from 15' x 30' to 25' x 37', I-90 median area estimated to not be wide enough for the reserved area footprint.
IC-A	**Vegetated Bioswales**		No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For the drainage area, I-90 EB is a potential roadside ditch location.	Yes/Limited		No	Proposed vegetated biofilter must fit between I-90 and south marginal road and satisfy safety grading criteria.
IC-A	**Extended Detention or Retention Basin**	Identified as limited or not feasible for this drainage area	No	BMP not feasible due to physical and hydraulic constraints	No	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes	1. Drainage area includes limited open space for extended detention/retention basin. 2. Proximity to Burke Lakefront airport - FAA requirements related to standing or open water impoundments within close proximity to an airport. 3. Underground detention - Due to proximity of Lake Erie and known submerged lake outfalls under Burke Lakefront airport, therefore underground detention is considered to be not feasible for this drainage area.
IC-B	**Exfiltration Trench (ExT)**	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole.	Yes		No		No	ODOT storm water runoff enters the CSO downstream of regulator E-06A. Recommendation is for ODOT to remain connected to this outfall pipe. ODOT will need to design and install BMPs to treat runoff prior to discharge.
IC-B	**Manufactured Treatment Devices**		No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	Yes/Limited		No	Requires reserved area from 15' x 30' to 25' x 37', I-90 median area estimated to not be wide enough. Area between I-90 and ramp F4[1] would provide sufficient area to install.
IC-B	**Vegetated Bioswales**		No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For the drainage area, I-90EB, infield area for ramp E1 and the in field are between ramp E2 and I-90 EB offer potential locations in this drainage area.	Yes/Limited		No	Proposed vegetated biofilter must fit between I-90 and south marginal road or between I-90 EB, ramp E2 or east side of ramp F4 and satisfy safety grading criteria
IC-B	**Extended Detention or Retention Basin**	Identified as limited or not feasible for this drainage area	No	BMP not feasible due to physical and hydraulic constraints	No	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes	1. Drainage area includes limited open space for extended detention/retention basin. 2. Proximity to Burke Lakefront airport - FAA requirements related to standing or open water impoundments within close proximity to an airport. 3. Underground detention - Due to proximity of Lake Erie and known submerged lake outfalls under Burke Lakefront airport, underground detention is considered to be not feasible for this drainage area.
IC-C	**Exfiltration Trench (ExT)**	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole.	Yes		No		No	ODOT storm water runoff enters the CSO downstream of regulator E-06A (CSO-99) and E-08 (CSO-98), Recommendation is for ODOT to remain connected to this outfall pipe and will need to design and install BMPs to treat runoff prior to discharge. T
IC-C	**Manufactured Treatment Devices**		No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	Yes/Limited		No	Requires reserved area from 15' x 30' to 25' x 37', I-90 median area estimated to not be wide enough. Area between Ramp F4 and E1, Area between Ramp E4 and I-90 WB and area between I-90 WB and ramp F3 would provide sufficient areas to install.
IC-C	**Vegetated Bioswales**	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For this drainage area, in-field ramp areas E1, F3 and F4 offer potential locations within the drainage area.	Yes		No		No	Proposed vegetated biofilters: The following areas have been identified as having sufficient area for these BMP types: 1. Open area between ramps F3/G5 and F4. 2. Open are between ramps E1 and F4. 3. North of Airport access road - City of Cleveland needs to be involved in BMP selection /design. Potential limitations include - discharge locations.
IC-C	**Extended Detention or Retention Basin**	Identified as limited or not feasible for this drainage area	No	BMP not feasible due to physical and hydraulic constraints	No	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes	1. Drainage area includes open space within the infield of the ramp, however, proximity to Burke Lakefront airport - FAA requirements related to standing or open water impoundments within close proximity to an airport may not allow these type of BMPs. 2. Underground detention - Due to proximity of Lake Erie and known submerged lake outfalls under Burke Lakefront airport, therefore underground detention is considered to be not feasible for this drainage area. 3. FHWA safety requirements may also not allow these BMPs to be installed within ramp in-field area.

Table 16 - BMP Recommendations and Selection Rationale Table

Drainage Area	BMP Type	BMP Selection Rationale	BMP Recommended (Y/N)	BMP Limited Feasibility Rationale	BMP Limited Feasibility (Y/N)	BMP Not Feasible Rationale	BMP Not Feasible (Y/N)	Drainage Area and BMP Comments
IC-D	**Exfiltration Trench (ExT)**	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole.	Yes		No		No	ODOT storm water runoff enters the CSO downstream of regulator E-09 (CSO-97) Recommendation is for ODOT to remain connected to this outfall pipe and ODOT will need to design and install BMPs to treat runoff prior to discharge.
	Manufactured Treatment Devices	Identified as limited or not feasible for this drainage area	No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	Yes/Limited		Yes	Requires reserved area from 15' x 30' to 25' x 37', the following are potential limited areas within the drainage area which would provide sufficient areas to install: 1. Area between ramps F3/G5 and F4. 2. Area north of ramp F3/G5.
	Vegetated Bioswales	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For this drainage area, in-field ramp areas F3/G5, F4 and North of G5 offer potential BMP locations. SR2 median area not estimated to be wide enough for these BMP types.	Yes		No		No	Proposed vegetated biofilters: The following areas have been identified as having sufficient area for these BMP types: 1. Open area between ramps F3/G5 and F4. 2. Open area north of ramp G5 and south of North marginal road. Potential limitations include - discharge locations.
	Extended Detention or Retention Basin	Identified as limited or not feasible for this drainage area	No	BMP not feasible due to physical and hydraulic constraints	No	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes	1. Drainage area includes open space within the infield of ramps F3/G5 and F4 or north of ramp G5, however, proximity to Burke Lakefront airport - FAA requirements related to standing or open water impoundments within close proximity to an airport may not allow these type of BMPs. 2. Underground detention - Due to proximity of Lake Erie and known submerged lake outfalls under Burke Lakefront airport, therefore underground detention is considered to be not feasible for this drainage area. 3. FHWA safety requirements may also not allow these BMPs to be installed within ramp F3/G5 and F4 in-field area.
IC-E	**Exfiltration Trench (ExT)**	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole.	Yes		No		No	ODOT storm water runoff enters the CSO downstream of regulator E-12 (CSO-96) Recommendation is for ODOT to remain connected to this outfall pipe and ODOT will need to design and install BMPs to treat runoff prior to discharge.
	Manufactured Treatment Devices		No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	Yes/Limited		No	Requires reserved area from 15' x 30' to 25' x 37', the following are potential areas within the drainage area which would provide sufficient areas to install: 1. In-field area of ramp G6. 2. Between ramp G5 and SR 2 WB. 3. Between SR2 EB and South marginal road ramp.
	Vegetated Bioswales	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For this drainage area, in-field ramp areas at the toe of the slope for ramp G6.	Yes		No		No	Proposed vegetated biofilters: The following areas have been identified as having sufficient area for these BMP types: 1. In-field are for ramp G6. 2. open area between ramp G5 and SR2 WB.
	Extended Detention or Retention Basin	Identified as limited or not feasible for this drainage area	No	BMP not feasible due to physical and hydraulic constraints	No	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes	1. Drainage area includes open space within the infield of ramps G6 and between G6 and SR 2 WB however, proximity to Burke Lakefront airport - FAA requirements related to standing or open water impoundments within close proximity to an airport may not allow these type of BMPs. 2. Underground detention - Due to proximity of Lake Erie and known submerged lake outfalls under Burke Lakefront airport, therefore underground detention is considered to be not feasible for this drainage area. 3. FHWA safety requirements may also not allow these BMPs to be installed within ramp G6 in-field area.
IC-F	**Exfiltration Trench (ExT)**	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole.	Yes		No		No	ODOT storm water runoff enters the CSO downstream of regulator E-09 (CSO-97) Recommendation is for ODOT to remain connected to this outfall pipe and ODOT will need to design and install BMPs to treat runoff prior to discharge.
	Manufactured Treatment Devices	Identified as limited or not feasible for this drainage area	No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	Yes/Limited		No	Requires reserved area from 15' x 30' to 25' x 37',I-90 median area estimated to not be wide enough for the reserved area footprint. The limited space between I-90 WB, ramp D3 and ramp D1 Space has been estimated to be available between I-90WB and D3 at or near the Superior Ave. Bridge.
	Vegetated Bioswales		No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For this drainage area, the open areas between I-90 WB and EB and the CSX RR (North) and Superior Ave. (South) between I-90 mainline and the right of way. Slopes and potential runoff discharge locations need to be addressed.within these areas where the designer should consider placement of these BMPs.	Yes/Limited		No	Proposed vegetated biofilters: The following areas have been identified as having space for these BMP types: I-90 WB and EB between CSX RR (North) and Superior Ave. (South) between I-90 mainline and the right of way. Slopes and potential runoff discharge locations need to be addressed.
	Extended Detention or Retention Basin	Identified as limited or not feasible for this drainage area	No	BMP not feasible due to physical and hydraulic constraints	No	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes	One potential area exists where this BMP types could be considered. The section designer will need to work with the city of Cleveland to determine the potential of designing and construction a BMP in this location and the City would be responsible for O/M. The space identified in this drainage area is location North of ramp D2 between East 26th. Street and D1/D2.

Table 16 - BMP Recommendations and Selection Rationale Table

Drainage Area	BMP Type	BMP Selection Rationale	BMP Recommended (Y/N)	BMP Limited Feasibility Rationale	BMP Limited Feasibility (Y/N)	BMP Not Feasible Rationale	BMP Not Feasible (Y/N)	Drainage Area and BMP Comments
IC-G (E 30th Extension) (City street)	**Exfiltration Trench (ExT)**	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole.	Yes		No		No	1. Project design engineer will need to work with City of Cleveland to identify a location for the ExT. ExTs are not recommended to be placed on inclined ramp areas. 2. City of Cleveland will assume O/M responsibilities once constructed. Recommended location between ramp C5 (ODOT) and 30th street extension (City of Cleveland).
	Manufactured Treatment Devices	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	Yes		No		No	1. Project design engineer will need to work with City of Cleveland to select location. and assume O/M responsibilities once constructed. 3. Locations within this drainage are directly off Superior Ave, adjacent to the C5 ramp, Intersection of C5 and Superior Ave. 4. Road profiles and slopes need to be evaluated to determine grade and location for BMP functionality and effectiveness.
	Vegetated Bioswales	Roadway will likely be curb and gutter per City standards	No	Roadway will likely be curb and gutter per City standards	No		No	Proposed vegetated biofilters: 1. The following areas have been identified along ramp C5 east or west side and west of E30th Street extension. will need to be identified prior to selecting. 2. Slopes, potential runoff discharge locations and O/M needs to be addressed. 3. Project design engineer will need to work with City of Cleveland to select location. and assume O/M responsibilities once constructed. Recommended location between ramp C5 (ODOT) and 30th street extension (City of Cleveland).
	Extended Detention or Retention Basin		No	Detention/retention type controls are very effective when space is available to install. For this drainage area space is potentially available for this BMP type.	Yes/Limited		No	1. For this drainage area the area available is North of Superior Ave, West of the E 30th Street extension and East of ramp C5. 2. Section designer will need to work with City of Cleveland to select location. and assume O/M responsibilities once constructed. 3. Slope, soil types, old building foundations, BMP discharge location and maintenance access need to be accounted for in BMP design
	Note: BMP design needs to incorporate City of Cleveland decisions related to Operation and maintenance, location, outfall or tie ins to local storm systems.							
Innerbelt Trench - PID Numbers - 25795								
TR-A	**Exfiltration Trench (ExT)**	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole.	Yes		No		No	ODOT storm water runoff enters the CSO downstream of regulator E-09 (CSO-97). Recommendation is for ODOT to remain connected to this outfall pipe. ODOT is recommended to design and install BMPs to treat runoff prior to discharge into the CSO.
	Manufactured Treatment Devices		No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	Yes/Limited		No	Requires reserved area from 15' x 30' to 25' x 37', I-90 median area estimated to not be wide enough for the reserved area footprint. In this drainage area , estimated space is available as follows: 1. I-90 WB between mainline and ramp D5, close to mainline. 2. I-90 EB - between ramp C2, C3 and Superior Ave. Located at the ramp C2/C3 split.
	Vegetated Bioswales		No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For this drainage area, the area bounded by ramp C3, C2 and Superior Ave.	Yes/Limited		No	For this drainage area, the area adjacent to ramps C2 and C3 should be evaluated for this BMP. Slope, elevation change and location where runoff would be discharged will be considered during design.
	Extended Detention or Retention Basin	Identified as limited or not feasible for this drainage area	No	BMP not feasible due to physical and hydraulic constraints	No	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes	I-90 median area and outside shoulders are estimated to not be wide enough for the proposed retention/detention size necessary for this control.
TR-B (Payne Ave.)	**Exfiltration Trench (ExT)**	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole. Should bridge runoff be conveyed to I-90 mainline under bridge.	Yes		No		No	Project design engineer will need to work with the City of Cleveland to evaluate bridge drainage options. Convey bridge runoff down to I-90 mainline. ODOT storm water runoff enters the CSO downstream of regulator E-09 (CSO-97).
	Manufactured Treatment Devices	Identified as limited or not feasible for this drainage area	No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	Yes/Limited		No	Requires reserved area from 15' x 30' to 25' x 37, I-90 median area and outside shoulders are estimated to not be wide enough under Payne Ave. bridge for the reserved area footprint. No space to locate on Payne Ave. overhead bridge area. Potential location - between ramps C2 and C4 under Payne Ave. bridge.
	Vegetated Bioswales	Identified as limited or not feasible for this drainage area	No	BMP not feasible due to physical and hydraulic constraints	No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For this drainage area - No space identified.	Yes	For this drainage area no space exists for this BMP.
	Extended Detention or Retention Basin	Identified as limited or not feasible for this drainage area	No	BMP not feasible due to physical and hydraulic constraints	No	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes	I-90 median area and outside shoulders are estimated to not be wide enough for the proposed retention/detention size necessary for this control.
	Note: If bridge drainage tied to local combined system, no BMPs required. Coordination with City of Cleveland recommended.							

Table 16 - BMP Recommendations and Selection Rationale Table

Drainage Area	BMP Type	BMP Selection Rationale	BMP Recommended (Y/N)	BMP Limited Feasibility Rationale	BMP Limited Feasibility (Y/N)	BMP Not Feasible Rationale	BMP Not Feasible (Y/N)	Drainage Area and BMP Comments
TR-C	**Exfiltration Trench (ExT)**	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole.	Yes		No		No	ODOT storm water runoff enters the CSO downstream of regulator E-09 (CSO-97) Recommendation is for ODOT to remain connected to this outfall pipe. ODOT is recommended to design and install BMPs to treat runoff prior to discharge.
	Manufactured Treatment Devices		No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	Yes/Limited		No	Requires reserved area from 15' x 30' to 25' x 37, I-90 median areas are not wide enough for the reserved footprint. Potential locations: 1. I-90 WB - between mainline and ramp D3. 2. I-90 EB between ramp mainline and ramps C2 and C4.
	Vegetated Bioswales		No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For this drainage area,	Yes/Limited		No	Potential locations include: 1. I-90 WB at the toe of slope for ramp D3 and D4. 2. Along ramp D6. 3. I-90 EB at the toe of slope for ramp C4 or C2 4. Project design engineer needs to verify slope and location to discharge treated runoff.
	Extended Detention or Retention Basin		No	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes/Limited		No	Potential location w/in this drainage area: 1. In-field area for ramp D6. 2. Open area between west side of ramp D6 and R/W for E24th. Street. 3. FHWA safety requirements associated with standing water, permanent water surface elevation in proximity to the traveling public will need to be addressed.
TR-D (Chester Ave.)	**Exfiltration Trench (ExT)**	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole. Should bridge runoff be conveyed to I-90 mainline under bridge.	Yes		No		No	Project design engineer will need to work with the City of Cleveland to evaluate bridge drainage options: Option 1 - Connect Chester Ave. bridge runoff into local collection system. Option 2 - Convey bridge runoff down to I-90 mainline. ODOT storm water runoff enters the CSO downstream of regulator E-09 (CSO-97). Recommendation is for ODOT to remain connected to this outfall pipe. ODOT is recommended to design and install BMPs to treat runoff prior to discharge.
	Manufactured Treatment Devices	Identified as limited or not feasible for this drainage area	No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	Yes/Limited		No	Requires reserved area from 15' x 30' to 25' x 37, I-90 median area and outside shoulders are estimated to not be wide enough under Chester Ave. bridge for the reserved area footprint. No space to locate on Chester Ave. overhead bridge area. Potential location - between I-90 mainline and ramp C4 at or under bridge.
	Vegetated Bioswales	Identified as limited or not feasible for this drainage area	No	BMP not feasible due to physical and hydraulic constraints	No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For this drainage area - No space identified.	Yes	For this drainage area no space exists for this BMP.
	Extended Detention or Retention Basin	Identified as limited or not feasible for this drainage area	No	BMP not feasible due to physical and hydraulic constraints	No	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes	I-90 median area and outside shoulders are estimated to not be wide enough for the reserved area footprint.
	Note: If bridge drainage tied to local combined system, no BMPs required. Coordination with City of Cleveland recommended.							
TR-E (Mid-Town Connector Between Chester and Euclid- I-90 WB)	**Exfiltration Trench (ExT)**	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole.	Yes		No		No	Project design engineer will need to work with the City of Cleveland to address drainage and stormwater runoff BMPs. The connector road will be the City of Cleveland's to O/M once constructed. BMP design will need to address discharge location.
	Manufactured Treatment Devices		No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	Yes/Limited		No	Requires reserved area from 15' x 30' to 25' x 37, I-90 median areas are not wide enough for the reserved footprint. Potential locations: 1. Along the edge of the connector road. Location dependant on O/M and discharge location.
	Vegetated Bioswales		No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For this drainage area,	Yes/Limited		No	Potential locations include: 1. Along toe of slope of connector road. 2. Along toe of slope for ramp D6. 3. Slope and runoff discharge location need to be addressed in BMP design. 3. A retaining wall will be located between the connector and I-90.
	Extended Detention or Retention Basin	Identified as limited or not feasible for this drainage area	No	BMP not feasible due to physical and hydraulic constraints	No	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes	Potential location w/in this drainage area: None
	Note: If Midtown connector drainage is tied to local combined system, no BMPs required. Coordination with City of Cleveland recommended.							
TR-F (Mid-Town Connector	**Exfiltration Trench (ExT)**	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole.	Yes		No		No	Project design engineer will need to work with the City of Cleveland to address drainage and stormwater runoff BMPs. The connector road will be the City of Cleveland's to O/M once constructed. BMP design will need to address discharge location.
	Manufactured Treatment Devices		No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	Yes/Limited		No	Requires reserved area from 15' x 30' to 25' x 37, I-90 median areas are not wide enough for the reserved footprint. Potential locations: 1. Along the edge of the connector road. Location dependant on O/M and discharge location

Table 16 - BMP Recommendations and Selection Rationale Table

Drainage Area	BMP Type	BMP Selection Rationale	BMP Recommended (Y/N)	BMP Limited Feasibility Rationale	BMP Limited Feasibility (Y/N)	BMP Not Feasible Rationale	BMP Not Feasible (Y/N)	Drainage Area and BMP Comments
Connector Between Chester and Euclid I-90 EB)	**Vegetated Bioswales**		No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For this drainage area,	Yes/Limited		No	Potential locations include: 1. Along toe of slope of connector road. 2. Along toe of slope for ramp C4. 3. Slope and runoff discharge location need to be addressed in BMP design. 4. There will be retaining walls on both sides of the roadway. (Note - *Mid-Town connector is located between ramp C1 and ramp C4/I-90 EB mainline.)*
	Extended Detention or Retention Basin	Identified as limited or not feasible for this drainage area	No	BMP not feasible due to physical and hydraulic constraints	No	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes	Potential location w/in this drainage area: None
	Note: If Midtown Connector drainage is tied to local combined system, no BMPs required. Coordination with City of Cleveland recommended**.**							
TR-G (Includes ramp C1 to the East of Mid-town connector between Chester and Euclid)	**Exfiltration Trench (ExT)**	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole.	Yes		No		No	ODOT storm water runoff enters the CSO downstream of regulator E-09 (CSO-97). Recommendation is for ODOT to remain connected to this outfall pipe. ODOT is recommended to design and install BMPs to treat runoff prior to discharge into the CSO.
	Manufactured Treatment Devices		No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	Yes/Limited		No	Requires reserved area from 15' x 30' to 25' x 37, I-90 median areas are not wide enough for the reserved footprint. Potential locations: 1. I-90 WB - between mainline and ramp D6 and connector road. 2. I-90 EB between ramp C4/I-90 mainline and connector road near Euclid Ave. bridge.
	Vegetated Bioswales		No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For this drainage area,	Yes/Limited		No	Potential locations include: 1. I-90 WB at the toe of slope for ramp D6. 2. I-90 EB at the toe of slope for ramp C4, between C4 and connector road 3. No space between connector road and ramp C1. 4. Section designer needs to verify slope and location to discharge treated runoff.
	Extended Detention or Retention Basin	Identified as limited or not feasible for this drainage area	No	BMP not feasible due to physical and hydraulic constraints	No	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes	Potential location w/in this drainage area: None
	Note: If bridge drainage tied to local combined system, no BMPs required. Coordination with City of Cleveland recommended**.**							
TR-H (Euclid Ave.)	**Exfiltration Trench (ExT)**	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole. Should bridge runoff be conveyed to I-90 mainline under bridge.	Yes		No		No	Project design engineer will need to work with the City of Cleveland to evaluate bridge drainage options. Convey bridge runoff down to I-90 mainline. ODOT storm water runoff enters the CSO downstream of regulator E-09 (CSO-97).
	Manufactured Treatment Devices	Identified as limited or not feasible for this drainage area	No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	Yes/Limited		No	Requires reserved area from 15' x 30' to 25' x 37, I-90 median area and outside shoulders are estimated to not be wide enough under Euclid Ave. bridge for the reserved area footprint. No space to locate on Euclid Ave. overhead bridge area. Potential locations: 1. I-90 WB between ramp D6 and connector road under Euclid Ave. bridge. 2. I-90 EB between ramp connector road/ramp C1 under Euclid Ave. bridge.
	Vegetated Bioswales	Identified as limited or not feasible for this drainage area	No	BMP not feasible due to physical and hydraulic constraints	No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For this drainage area - No space identified.	Yes	For this drainage area no space exists for this BMP.
	Extended Detention or Retention Basin	Identified as limited or not feasible for this drainage area	No	BMP not feasible due to physical and hydraulic constraints	No	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes	I-90 median area and outside shoulders are estimated to not be wide enough for the reserved area footprint.
	Note: If bridge drainage tied to local combined system, no BMPs required. Coordination with City of Cleveland recommended**.**							
TR-I (Mid-Town Connector Between Euclid and Prospect- I-90 WB)	**Exfiltration Trench (ExT)**	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole.	Yes		No		No	Project design engineer will need to work with the City of Cleveland to address drainage and stormwater runoff BMPs. The connector road will be the City of Cleveland's to O/M once constructed. BMP design will need to address discharge location.
	Manufactured Treatment Devices		No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	Yes/Limited		No	Requires reserved area from 15' x 30' to 25' x 37, I-90 median areas are not wide enough for the reserved footprint. Potential locations: 1. Along the edge of the connector road. Location dependant on O/M and discharge location.2. Not recommended for ramps given the elevation changes.
	Vegetated Bioswales		No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For this drainage area,	Yes/Limited		No	Potential locations include: 1. Along toe of slope of connector road. 2. Along toe of slope for I-90 WB. 3. Slope and runoff discharge location need to be addressed in BMP design.

Table 16 - BMP Recommendations and Selection Rationale Table

Drainage Area	BMP Type	BMP Selection Rationale	BMP Recommended (Y/N)	BMP Limited Feasibility Rationale	BMP Limited Feasibility (Y/N)	BMP Not Feasible Rationale	BMP Not Feasible (Y/N)	Drainage Area and BMP Comments
	Extended Detention or Retention Basin		No	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes/Limited		No	Potential location w/in this drainage area: 1. Between connector road to the west and I-90 WB to the east. 2. FHWA safety requirements associated with standing water, permanent water surface elevation in proximity to the traveling public will need to be addressed.
	Note: If Midtown Conncector drainage is tied to local combined system, no BMPs required. Coordination with City of Cleveland recommended.							
TR-J (Mid-Town Connector Between Euclid and Prospect I-90 EB- Bridge)	**Exfiltration Trench (ExT)**	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole.	Yes		No		No	Project design engineer will need to work with the City of Cleveland to address drainage and stormwater runoff BMPs. The connector road will be the City of Cleveland's to O/M once constructed. BMP design will need to address discharge location.
	Manufactured Treatment Devices	Identified as limited or not feasible for this drainage area	No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	No	BMP not feasible due to physical and hydraulic constraints	Yes	Requires reserved area from 15' x 30' to 25' x 37, I-90 median areas are not wide enough for the reserved footprint. Potential locations: 1. Below connector road bridge, between ramp C1 and I-90 EB mainline. 2. Not recommended for ramps given the slopes associated with the ramps.
	Vegetated Bioswales	Identified as limited or not feasible for this drainage area	No	BMP not feasible due to physical and hydraulic constraints	No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For this drainage area,	Yes	Potential locations include: None
	Extended Detention or Retention Basin	Identified as limited or not feasible for this drainage area	No	BMP not feasible due to physical and hydraulic constraints	No	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes	Potential location w/in this drainage area: None
	Note: If Midtown Connector drainage is tied to local combined system, no BMPs required. Coordination with City of Cleveland recommended.							
TR-K (Includes ramp C1 to the East of Mid-town connector passing under the connector prior to Prospect Ave. between Euclid and Prospect)	**Exfiltration Trench (ExT)**	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole.	Yes		No		No	ODOT storm water runoff enters the CSO downstream of regulator E-09 (CSO-97). Recommendation is for ODOT to remain connected to this outfall pipe. ODOT is recommended to design and install BMPs to treat runoff prior to discharge into the CSO.
	Manufactured Treatment Devices		No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	Yes/Limited		No	Requires reserved area from 15' x 30' to 25' x 37, I-90 median areas are not wide enough for the reserved footprint. Potential locations: 1. I-90 WB - between mainline connector road. 2. I-90 EB between mainline and ramp C1 under Mid-town connector bridge.
	Vegetated Bioswales		No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For this drainage area,	Yes/Limited		No	Potential locations include: 1. I-90 WB at the toe of slope for I-90 mainline or the connector road toe of slope. 2. I-90 EB at the toe of slope for ramp C1 or I-90 mainline toe of slope. 3. Project design engineer needs to verify slope and location to discharge treated runoff.
	Extended Detention or Retention Basin		No	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes/Limited		No	Potential location w/in this drainage area: 1. Between connector road to the west and I-90 WB to the east. 2. FHWA safety requirements associated with standing water, permanent water surface elevation in proximity to the traveling public will need to be addressed. 3. Mainline pavement elevations make this BMP unlikely.
	Note: Drainage for this area enters the I-90 trunk sewer (CSO-97), BMPs will be required.							
TR-L (Prospect Ave.)	**Exfiltration Trench (ExT)**	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole. Should bridge runoff be conveyed to I-90 mainline under bridge.	Yes		No		No	Project design engineer will need to work with the City of Cleveland to evaluate bridge drainage options. ODOT storm water runoff enters the CSO downstream of regulator E-09 (CSO-97). Recommendation is for ODOT to remain connected to this outfall pipe. ODOT is recommended to design and install BMPs to treat runoff prior to discharge.
	Manufactured Treatment Devices	Identified as limited or not feasible for this drainage area	No	BMP not feasible due to physical and hydraulic constraints	No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	Yes	Requires reserved area from 15' x 30' to 25' x 37, I-90 median area and outside shoulders are estimated to not be wide enough under Prospect Ave. bridge for the reserved area footprint. No space to locate on Prospect Ave. overhead bridge area. Potential locations: 1. I-90 WB - None. 2. I-90 EB -None
	Vegetated Bioswales	Identified as limited or not feasible for this drainage area	No	BMP not feasible due to physical and hydraulic constraints	No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For this drainage area - No space identified.	Yes	For this drainage area no space exists for this BMP.
	Extended Detention or Retention Basin	Identified as limited or not feasible for this drainage area	No	BMP not feasible due to physical and hydraulic constraints	No	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes	I-90 median area and outside shoulders are estimated to not be wide enough for the reserved area footprint.
	Note: If bridge drainage tied to local combined system, no BMPs required. Coordination with City of Cleveland recommended.							

Table 16 - BMP Recommendations and Selection Rationale Table

Drainage Area	BMP Type	BMP Selection Rationale	BMP Recommended (Y/N)	BMP Limited Feasibility Rationale	BMP Limited Feasibility (Y/N)	BMP Not Feasible Rationale	BMP Not Feasible (Y/N)	Drainage Area and BMP Comments
TR-M (Mid-Town Connector over I-90 between Prospect and Carnegie)	**Exfiltration Trench (ExT)**	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole. Should bridge runoff be conveyed to I-90 mainline under bridge.	Yes		No		No	Project design engineer will need to work with the City of Cleveland to evaluate bridge drainage options. ODOT storm water runoff enters the CSO downstream of regulator E-09 (CSO-97). Recommendation is for ODOT to remain connected to this outfall pipe. ODOT is recommended to design and install BMPs to treat runoff prior to discharge. Potential locations inculde under bridge on I-90 in shoulder area or on upper bridge deck area off the bridge or near approach slab areas. Not recommended to be placed on or in bridge deck.
	Manufactured Treatment Devices	Identified as limited or not feasible for this drainage area	No	BMP not feasible due to physical and hydraulic constraints	No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	Yes	Requires reserved area from 15' x 30' to 25' x 37, I-90 median area and outside shoulders are estimated to not be wide enough under Mid-town connector bridge over I-90 for the reserved area footprint. No space to locate on Prospect Ave. Potential locations: 1. I-90 WB - None. 2. I-90 EB -None
	Vegetated Bioswales	Identified as limited or not feasible for this drainage area	No	BMP not feasible due to physical and hydraulic constraints	No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For this drainage area - No space identified.	Yes	For this drainage area no space exists for this BMP.
	Extended Detention or Retention Basin	Identified as limited or not feasible for this drainage area	No	BMP not feasible due to physical and hydraulic constraints	No	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes	I-90 median area and outside shoulders are estimated to not be wide enough for the reserved area footprint.
	Note: If bridge drainage tied to local combined system, no BMPs required. Coordination with City of Cleveland recommended.							
TR-N (Mid-Town Connector Between Prospect and Carnegie)	**Exfiltration Trench (ExT)**	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole.	Yes		No		No	Project design engineer will need to work with the City of Cleveland to address drainage and stormwater runoff BMPs. The connector road will be the City of Cleveland's to O/M once constructed. BMP design will need to address discharge location.
	Manufactured Treatment Devices		No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	Yes		NO	Requires reserved area from 15' x 30' to 25' x 37, I-90 median areas are not wide enough for the reserved footprint. Potential locations: 1. I-90 EB Between Mid-town connector and ramp C1. 2. Placed on the East side of Mid-town connector road. 3. Sector designer will need to work with the City of Cleveland to locate, design and O/M these BMPs.
	Vegetated Bioswales		No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For this drainage area,	Yes/Limited		No	Potential locations include: 1. East side of ramp C1 at toe of slope. 2. East or west side of connector road at toe of slope. 3. Project design engineer will need to work with the City of Cleveland to locate, design and identify outfall locations these BMPs.Operations and maintenance considerations included during final design with City of Cleveland.
	Extended Detention or Retention Basin	Identified as limited or not feasible for this drainage area	No	BMP not feasible due to physical and hydraulic constraints	No	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes	Potential location w/in this drainage area: None
	Note: If Midtown Connector drainage is tied to local combined system, no BMPs required. Coordination with City of Cleveland recommended.							
TR-O (Includes ramp C1 between Prospect and Carnegie, EB I-90)	**Exfiltration Trench (ExT)**	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole.	Yes		No		No	ODOT storm water runoff enters the CSO downstream of regulator E-09 (CSO-97). Recommendation is for ODOT to remain connected to this outfall pipe. ODOT is recommended to design and install BMPs to treat runoff prior to discharge.
	Manufactured Treatment Devices		No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	Yes/Limited		No	Requires reserved area from 15' x 30' to 25' x 37, I-90 median areas are not wide enough for the reserved footprint. Potential locations: 1. East of ramp C1 and Mid-town connector
	Vegetated Bioswales		No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For this drainage area,	Yes/Limited			Potential locations include: 1. I-90 EB at the toe of slope for ramp C1 between C1 and connector road. 2. Project design engineer needs to verify slope and location to discharge treated runoff.
	Extended Detention or Retention Basin	Identified as limited or not feasible for this drainage area	No	BMP not feasible due to physical and hydraulic constraints	No	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes	Potential location w/in this drainage area: None
	Note: Drainage for this area enters the I-90 trunk sewer (CSO-97), BMPs will be required.							
TR-P (Carnegie Ave.)	**Exfiltration Trench (ExT)**	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole. Should bridge runoff be conveyed to I-90 mainline under bridge.	Yes		No		No	Project design engineer will need to work with the City of Cleveland to evaluate bridge drainage options. ODOT storm water runoff enters the CSO downstream of regulator E-09 (CSO-97).
	Manufactured Treatment Devices		No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	Yes/Limited		No[3]	Requires reserved area from 15' x 30' to 25' x 37, I-90 median area and outside shoulders are estimated to not be wide enough under Carnegie Ave. bridge for the reserved area footprint. No space to locate on Carnegie Ave. overhead bridge area. Potential locations: 1. I-90 WB - Between I-90 WB and Mid-town connector.

Table 16 - BMP Recommendations and Selection Rationale Table								
Drainage Area	**BMP Type**	**BMP Selection Rationale**	**BMP Recommended (Y/N)**	**BMP Limited Feasibility Rationale**	**BMP Limited Feasibility (Y/N)**	**BMP Not Feasible Rationale**	**BMP Not Feasible (Y/N)**	**Drainage Area and BMP Comments**
	Vegetated Bioswales	Identified as limited or not feasible for this drainage area	No	Identified as limited or not feasible for this drainage area	No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For this drainage area - No space identified.	Yes[3]	For this drainage area no space exists for this BMP.
	Extended Detention or Retention Basin	Identified as limited or not feasible for this drainage area	No	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes/Limited	BMP not feasible due to physical and hydraulic constraints directly at the bridge. Runoff could be conveyed to adjacent area suitable for this control.	No[3]	Potential location w/in this drainage area: Between I-90 WB and Mid-town connector north or south of Carnegie road bridge. Existing infield area of previous alignment. Project design engineer needs to verify slope, soil and location to discharge treated runoff. Bridge runoff would need to be directed and conveyed to this control
	Note: If bridge drainage tied to local combined system, no BMPs required. Coordination with City of Cleveland recommended.							
TR-Q (Cedar Ave. Connector)	**Exfiltration Trench (ExT)**	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole.	Yes		No		No	Project design engineer will need to work with the City of Cleveland to address drainage and stormwater runoff BMPs. The connector road will be the City of Cleveland's to O/M once constructed. BMP design will need to address discharge location.
	Manufactured Treatment Devices	Identified as limited or not feasible for this drainage area	No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	Yes/Limited		No	Requires reserved area from 15' x 30' to 25' x 37. Potential locations: 1. East or west side of Cedar road connector. 2. Project design engineer will need to work with the City of Cleveland to locate, design and O/M these BMPs.
	Vegetated Bioswales		No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For this drainage area,	Yes/Limited		No	Potential locations include: 1. East or west side of connector road at toe of slope. 2. Project design engineer will need to work with the City of Cleveland to locate, design and O/M these BMPs.
	Extended Detention or Retention Basin		No	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes/Limited		No	Potential location w/in this drainage area: Open areas resulting from building demolition associated with constructing Cedar Ave. connector.
	Note: If Cedar Ave conncector drainage is tied to local combined system, no BMPs required. Coordination with City of Cleveland recommended.							
TR-R (Between Carnegie Ave and E.22nd. Street)	**Exfiltration Trench (ExT)**	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole.	Yes		No		No	ODOT storm water runoff enters the CSO downstream of regulator E-09 (CSO-97). Recommendation is for ODOT to remain connected to this outfall pipe. ODOT is recommended to design and install BMPs to treat runoff prior to discharge.
	Manufactured Treatment Devices	Identified as limited or not feasible for this drainage area	No	BMP not feasible due to physical and hydraulic constraints	No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	Yes	Potential location within this drainage area - I-90 in depressed trench with retaining walls.
	Vegetated Bioswales		No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For this drainage area,	Yes/Limited		No	Potential locations include: 1. I-90 EB at the toe of slope. 2. I-90 WB - at toe of slope. 3. Project design engineer needs to verify slope and location to discharge treated runoff.
	Extended Detention or Retention Basin	Identified as limited or not feasible for this drainage area	No	BMP not feasible due to physical and hydraulic constraints	No	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes	Potential location w/in this drainage area: None
	Note: Drainage for this area enters the I-90 trunk sewer (CSO-97), BMPs will be required.							
TR-S (E. 22nd Street)	**Exfiltration Trench (ExT)**	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole. Should bridge runoff be conveyed to I-90 mainline under bridge.	Yes		No		No	Project design engineer will need to work with the City of Cleveland to evaluate bridge drainage options. ODOT storm water runoff enters the CSO downstream of regulator E-09 (CSO-97). Recommendation is for ODOT to remain connected to this outfall pipe. ODOT is recommended to design and install BMPs to treat runoff prior to discharge.
	Manufactured Treatment Devices		No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	Yes/Limited	BMP not feasible due to physical and hydraulic constraints	No	Requires reserved area from 15' x 30' to 25' x 37, I-90 median area and outside shoulders are estimated to not be wide enough under E 22 and Street. bridge for the reserved area footprint. No space to locate on E. 22nd Street overhead bridge area. Potential locations: 1. Between ramp B6, i-90 EB and E. 22 and Street. 2. Project design engineer will need to work with the City of Cleveland to locate, design and O/M these BMPs. 3. Utilities can impact the feasibility of this BMP.
	Vegetated Bioswales		No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For this drainage area - No space identified.	Yes/Limited		No	Potential drainage area locations: 1. Toe of slope for bridge fill areas. 2. Ramp B6 toe of slope area. 3. Project design engineer will need to work with the City of Cleveland to locate, design and O/M these BMPs.
	Extended Detention or Retention Basin		No	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes/Limited		No	Potential location w/in this drainage area: Between I-90 EB, ramp C6 and E 22nd. Street. Project design engineer will need to work with the City of Cleveland to locate, design and O/M these BMPs.
	Note: If bridge drainage tied to local combined system, no BMPs required. Coordination with City of Cleveland recommended.							
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Table 16 - BMP Recommendations and Selection Rationale Table

Drainage Area	BMP Type	BMP Selection Rationale	BMP Recommended (Y/N)	BMP Limited Feasibility Rationale	BMP Limited Feasibility (Y/N)	BMP Not Feasible Rationale	BMP Not Feasible (Y/N)	Drainage Area and BMP Comments
CI-A (Between E 22nd. Street and East 14 the. Street)[2]	**Exfiltration Trench (ExT)**	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole.	Yes		No		No	CI-A between E22nd and E14th is comprised of several ramps B6, A1 and A2 and I-90 EB/WB. Potential locations within drainage area: 1. I-90 EB or WB 2. On the flat area for on and off ramp transitions to I-90 mainline. 3. Outfall discharge locations or connection to storm sewer systems will need to be addressed.
CI-A (Between E 22nd. Street and East 14 the. Street)[2]	**Manufactured Treatment Devices**		No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	Yes/Limited		No	Requires reserved area from 15' x 30' to 25' x 37, I-90 median area are estimated to not be wide enough for the reserved area footprint. Potential locations within drainage area: 1. Between ramp B6 and I-90 EB. 2. Between ramp H5 and I-90 EB. 3. Between ramp A2 and I-90 WB.
CI-A (Between E 22nd. Street and East 14 the. Street)[2]	**Vegetated Bioswales**		No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For this drainage area - No space identified.	Yes/Limited		No	Potential locations within drainage area: 1. Toe of the slope for ramp B6, H5, A1. Limited space exists along I-90 East and West bound adjacent to E. 14th Street bridge area. 2. Project design engineer will need to address runoff discharge locations.
CI-A (Between E 22nd. Street and East 14 the. Street)[2]	**Extended Detention or Retention Basin**	Identified as limited or not feasible for this drainage area	No	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	No	BMP not feasible due to physical and hydraulic constraints	Yes	Potential locations within drainage area: 1. Space between E.22nd Street and ramp B6 and ramp H5. 2. FHWA safety requirements associated with standing water, permanent water surface elevation in proximity to the traveling public will need to be addressed.
CI-A (Between E. 14th St. and E. 9th Street)[2]	**Exfiltration Trench (ExT)**		No	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole.	Yes limited		No	CI-A between E 14th and E 9th contain several ramps (A2, A3, B5, J1, J2 and I-90 EB/WB. Several ramps in this area are elevated. Potential locations within drainage area: 1. I-90 EB/WB, non-elevated roadway sections. 2. Ramp A2 - flat ramp section areas. 3. Outfall Discharge locations or connections to storm sewer systems will need to be addressed.
CI-A (Between E. 14th St. and E. 9th Street)[2]	**Manufactured Treatment Devices**	Identified as limited or not feasible for this drainage area	No	BMP not feasible due to physical and hydraulic constraints	Yes/Limited	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	No	Requires reserved area from 15' x 30' to 25' x 37, I-90 median area are estimated to not be wide enough for the reserved area footprint. Potential locations within drainage area: 1. Between I-90 EB exit ramp B5. 2. North side of ramp A3. 3. Section designer will need to address runoff discharge locations.
CI-A (Between E. 14th St. and E. 9th Street)[2]	**Vegetated Bioswales**		No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For this drainage area - Limited space identified.	Yes/Limited		No	Potential locations within drainage area: 1. Toe of slope for ramp A3 and B6. 2. I-90 EB/WB toe of foreslope area 3. Project design engineer will need to address runoff discharge locations.
CI-A (Between E. 14th St. and E. 9th Street)[2]	**Extended Detention or Retention Basin**	Detention/retention type controls are very effective when space is available to install.	Yes		No		No	Potential locations within this drainage area: 1. Infield for ramp B5. 2. Under elevated ramps - J3, B6, A2 and B5. 3. Project design engineer will need to convey runoff from elevated roadways sections to I-90 mainline under elevated roadway sections. 4. FHWA safety requirements associated with standing water, permanent water surface elevation in proximity to the traveling public will need to be addressed.
CI-A (Between E. 9th and Ontario Street)[2]	**Exfiltration Trench (ExT)**		No	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole.	Yes/limited		No	CI-A between E 9th and Ontario Street contain several ramps (B3, B4 and Elevated I-90 EB/WB roadway sections. Several ramps in this area are elevated. Potential locations within drainage area: 1. I-90 EB/WB, non-elevated roadway sections. 2. Ramp A3, A4 and B3 - flat ramp section areas. 3. Outfall discharge locations or connections to storm sewer systems will need to be addressed.
CI-A (Between E. 9th and Ontario Street)[2]	**Manufactured Treatment Devices**	Identified as limited or not feasible for this drainage area	No	BMP not feasible due to physical and hydraulic constraints	Yes/limited	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	No	Requires reserved area from 15' x 30' to 25' x 37, I-90 median area are estimated to not be wide enough for the reserved area footprint. Potential locations within drainage area: 1. North side of A3. 2. Between A4 and I-90 EB. 3. Project design engineer will need to address runoff discharge locations.
CI-A (Between E. 9th and Ontario Street)[2]	**Vegetated Bioswales**		No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For this drainage area - Limited space identified.	Yes/Limited		No	Potential locations within drainage area: 1. Toe of slope for ramp A3, B4, B3 and E. 9th St. and Ontario St. realignments.
CI-A (Between E. 9th and Ontario Street)[2]	**Extended Detention or Retention Basin**	Detention/retention type controls are very effective when space is available to install.	Yes		No		No	Potential locations within this drainage area: 1. Infield for ramp B3. 2. Under elevated ramps A3, B3 and adjacent to the intersection of the re-aligned E. 9th St. and Ontario St. intersection, NW corner. 3. Project design engineer will need to convey runoff from elevated roadways sections to I-90 mainline under elevated roadway sections. 4. FHWA safety requirements associated with standing water, permanent water surface elevation in proximity to the traveling public will need to be addressed.
	Exfiltration Trench (ExT)	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole.	Yes		No		No	CI-A Local street grid realignment - E. 9th street, E. 14th Street, Ontario Street and Broadway Avenue under elevated sections of ramps and mainline roadway sections for Central Interchange. Potential locations within drainage area - 1. Within right of way for locals realigned roads. 2. Discharging locations and/or connections into storm systems will need to be addressed. 3. Project design engineer will need to work with the City of Cleveland to locate, design and O/M these BMPs for city streets.

Table 16 - BMP Recommendations and Selection Rationale Table

Drainage Area	BMP Type	BMP Selection Rationale	BMP Recommended (Y/N)	BMP Limited Feasibility Rationale	BMP Limited Feasibility (Y/N)	BMP Not Feasible Rationale	BMP Not Feasible (Y/N)	Drainage Area and BMP Comments
CI-A (Local street realignment for E. 9th and Ontario St.)[2]	**Manufactured Treatment Devices**		No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	Yes/Limited		No	Requires reserved area from 15' x 30' to 25' x 37' : 1. Project design engineer will need to work with the City of Cleveland to locate, design and O/M these BMPs for city streets. 2. Section designer will need to address runoff discharge locations.
	Vegetated Bioswales		No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure.	Yes/Limited		No	Potential locations within drainage area: 1. Toe of slope areas for E. 9th St., Ontario St., E. 14th Street and Broadway Ave. realignments. 2. Project design engineer will need to work with the City of Cleveland to locate, design and O/M these BMPs for city streets.
	Extended Detention or Retention Basin	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes		No		No	Potential locations within this drainage area: 1. Location consideration given to areas under elevated ramps, roadways and bridges within Central Interchange 2. Project design engineer will need to convey runoff from elevated roadways sections to I-90 Mainline under elevated roadway sections. 3. Project design engineer will need to work with the City of Cleveland to locate, design and O/M these BMPs for city streets.
	Note: If roadway drainage is tied to local combined system, no BMPs required. Coordination with City of Cleveland recommended.							
CI-B	**Exfiltration Trench (ExT)**	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole.	Yes		Yes/Limited		No	CI-B - I-90 WB mainline - elevated roadway. Project design engineer will need to address discharge locations and I-90 median area is not recommended of locating these BMPs. Ramps A5 and A4 are potential locations - ramp slopes need to be reviewed and project design engineer will need to determine potential locations on ramp sections.
	Manufactured Treatment Devices		No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	Yes/Limited		No	Requires reserved area from 15' x 30' to 25' x 37' : 1. I-90 WB elevated roadway section. 2. Location on I-90 mainline would require BMPs to be located below or under the elevated roadway area. 2. Potential location between ramp A4, A5 and Carnegie Ave.
	Vegetated Bioswales	Identified as limited or not feasible for this drainage area	No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For this drainage area - limited space identified.	Yes/Limited		No	Potential locations include toe of the slope areas for ramps A4 and A5. Project design engineer will need to ramp slope issues related runoff. I-90 WB mainline- Not recommended for this BMP type. Runoff would need to be conveyed below elevated roadway sections. Swales may be functional for local roadway below elevated roadway sections.
	Extended Detention or Retention Basin	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes		No		Nio	Potential locations include: 1. Between ramp A5, Carnegie Ave, ramp A4 and Ontario Street. 2. Between ramp A5, Carnegie Ave. and E. 9th Street. .3. FHWA safety requirements associated with standing water, permanent water surface elevation in proximity to the traveling public will need to be addressed.
CI-C (E. 9th Street between Ontario Street and Broadway Ave. and Commercial Road Hill Connector)	**Exfiltration Trench (ExT)**	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole.	Yes		No		No	CI-C: 1. Project design engineer will need to work with the City of Cleveland to locate, design and O/M these BMPs. 2. Section designer will need to address runoff discharge locations.
	Manufactured Treatment Devices		No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	Yes/Limited		No	Requires reserved area from 15' x 30' to 25' x 37' : 1. Section designer will need to work with the City of Cleveland to locate, design and O/M these BMPs. 2. Project design engineer will need to address runoff discharge locations.
	Vegetated Bioswales		No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure.	Yes/Limited		No	Vegetated bioswale locations include toe of slope areas. Project design engineer will need to address runoff discharge locations. Section designer will need to work with the City of Cleveland to locate, design and O/M these BMPs.
	Extended Detention or Retention Basin	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes		No		No	Potential locations include: 1. Island areas to be considered for raingarden type BMP controls. 2. Section designer will need to address runoff discharge locations. 3. Project design engineer will need to work with the City of Cleveland to locate, design and O/M these BMPs.
	Note: If bridge drainage tied to local combined system, no BMPs required. Coordination with City of Cleveland recommended.							
	Exfiltration Trench (ExT)	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole.	No		Yes/Limited		No	CI-B - I-90 EB mainline - elevated roadway. Project design engineer will need to address discharge locations and I-90 median area is not recommended of locating these BMPs, Ramp B4 are potential locations.
	Manufactured Treatment Devices		No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	Yes/Limited		No	Requires reserved area from 15' x 30' to 25' x 37' : 1. I-90 EB elevated roadway section. 2. Location on I-90 mainline would require BMPs to be located below or under the elevated roadway area. 2. Potential location between ramp B4 and I-90 WB.

Table 16 - BMP Recommendations and Selection Rationale Table

Drainage Area	BMP Type	BMP Selection Rationale	BMP Recommended (Y/N)	BMP Limited Feasibility Rationale	BMP Limited Feasibility (Y/N)	BMP Not Feasible Rationale	BMP Not Feasible (Y/N)	Drainage Area and BMP Comments
CI-D	**Vegetated Bioswales**		No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For this drainage area.	Yes/Limited		No	Potential locations include toe of the slope areas for ramp B4. Not recommended for this BMP type. Runoff would need to be conveyed below elevated roadway sections. Swales may be functional for local roadway below elevated roadway sections.
	Extended Detention or Retention Basin	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes		No		No	Potential locations include: 1. Area vacated by existing Broadway Ave ramp. Location between vacated Ontario Street ramp, ramp B3 (New Ontario Street ramp and Ontario Street). 2. Location between railroad and Ontario Street under elevated roadway sections. 3. FHWA safety requirements associated with standing water, permanent water surface elevation in proximity to the traveling public will need to be addressed.
Interstate 77 - PID Numbers 80406, 13567, 82338								
77-A	**Exfiltration Trench (ExT)**		No	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole.	Yes/Limited		No	Drainage area contains the following ramps - B5, J1, J3, H4, H5, H6. East 14th Street realignment through the Central Interchange. Potential locations within drainage area include: 1. E. 14th. Street local road system. 2. Project design engineer will need to work with the City of Cleveland to locate, design and O/M these BMPs for city streets within drainage area. 3. Section designer will need to address runoff discharge locations. 4. Ramps in this drainage area are elevated and ExT's should be located on non elevated sections.
77-A	**Manufactured Treatment Devices**	Identified as limited for this drainage area	No	Identified as limited for this drainage area	Yes/Limited	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	No	Requires reserved area from 15' x 30' to 25' x 37' limited or no reserved footprint space is available.
77-A	**Vegetated Bioswales**		No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For this drainage area.	Yes/Limited		No	Potential vegetated swale locations within the drainage area include: 1. Toe of the slope areas for the elevated ramps. 2. Project design engineer will need to address runoff discharge locations. 3. Local road grid (E. 14th. Street) roadside ditches associated with the realignment of E. 14th. Street. 3. Project design engineer will need to work with the City of Cleveland to locate, design and O/M these BMPs for city streets within drainage area.
77-A	**Extended Detention or Retention Basin**	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes		No		No	Potential locations include: 1. Open space between ramps B5 and J3. 2. Space between ramps B5 and under elevated ramp J1. 3. Between ramp H4 and relocated E. 14 the. Street. 4. North of ramp H6 where existing ramp has been vacated and removed. 5. FHWA safety requirements associated with standing water, permanent water surface elevation in proximity to the traveling public will need to be addressed. 6. Project design engineer will need to address runoff discharge locations.
	Note: If roadway drainage is tied to local combined system, no BMPs required. Coordination with City of Cleveland and NEORSD is recommended.							
77-B	**Exfiltration Trench (ExT)**	Option 1 - ODOT stormwater runoff to remain connected to local collection system. Project design engineer will need to determine runoff volume for existing and proposed ODOT project areas and work with the City of Cleveland and NEORSD to determine if local collection system can accept the increase in flow. Option 2 - ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole.	Yes		No		No	Project design engineer will need to work with the City of Cleveland to evaluate drainage options which include BMP types, drainage design alternatives which would allow ODOT to separate storm water runoff from city raodway drainage and local collection systems, the following are options to be considered during design:: Option 1 - Remain connected to local collection system and perform necessary runoff collection system capacity analysis and system modeling. Option 2 - Potential Locations within drainage area include: a. I-77 NB/SB mainline inside or outside shoulder areas. b. Non-elevated portions of ramps H1, H2 and H3 (I-77 NB). c. Project design engineer will need to address discharge locations. d. Project design engineer will need to work with the City of Cleveland staff should connections to local storm sewer be proposed.
77-B	**Manufactured Treatment Devices**		No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	Yes/Limited		No	Requires reserved area from 15' x 30' to 25' x 37' I-77 median area are estimated to not be wide enough for the reserved area footprint. Potential locations within the drainage area include: 1. Non-elevated portions of ramps H1, H2 and H3. 2. Outside shoulder areas for I-77 NB/SB mainline.
77-B	**Vegetated Bioswales**		No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For this drainage area.	Yes/Limited		No	Potential vegetated swale locations within the drainage area include: 1. Toe of the slope areas for the elevated ramps (H2 and H3). 2. Toe of slope for ramp H1 west side of ramp. 3. E. 30th. Street between Woodlawn and Orange Ave. - Project design engineer to consider modifying local street curb and gutter desing to allow this BMP. 4. Project design engineer will need to address runoff discharge locations. 5. Project design engineer will need to work with the City of Cleveland to locate and design these BMPs

Table 16 - BMP Recommendations and Selection Rationale Table

Drainage Area	BMP Type	BMP Selection Rationale	BMP Recommended (Y/N)	BMP Limited Feasibility Rationale	BMP Limited Feasibility (Y/N)	BMP Not Feasible Rationale	BMP Not Feasible (Y/N)	Drainage Area and BMP Comments
	Extended Detention or Retention Basin	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes		No		No	Potential locations include: 1. Open space between ramp H1, Woodland Ave. and ramp H2. Existing ramps have been removed in this area. 2. Between I-77 NB, Woodland Ave and E. 22nd. Street. 3. Between I-77 SB, E. 30th. Street and ramp J4. This area has been 4. FHWA safety requirements associated with standing water, permanent water surface elevation in proximity to the traveling public will need to be addressed. 5. Project design engineer will need to address runoff discharge locations.
77-C	**Exfiltration Trench (ExT)**	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole.	Yes		No		No	Potential Locations within drainage area include: a. I-77 NB/SB mainline inside or outside shoulder areas. b. Non-elevated portions of ramp J5 (I-77 SB). c. Project design engineer will need to address discharge locations.
77-C	**Manufactured Treatment Devices**		No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	Yes/Limited		No	Requires reserved area from 15' x 30' to 25' x 37' I-77 median area are estimated to not be wide enough for the reserved area footprint. Potential locations within the drainage area include: 1. Between I-77 SB and ramp J5. 2. I-77 SB mainline outside shoulder area.
77-C	**Vegetated Bioswales**		No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For this drainage area.	Yes/Limited		No	Potential vegetated swale locations within the drainage area include: 1. Toe of slope areas associated with ramp J5 and I-77 SB mainline. 2. Project design engineer will need to address discharge locations.
77-C	**Extended Detention or Retention Basin**	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes		No		No	Potential locations within drainage area include: 1. Space between I-77 SB and ramp J5. 2. FHWA safety requirements associated with standing water, permanent water surface elevation in proximity to the traveling public will need to be addressed. 3. Project design engineer will need to address runoff discharge locations.
Central Viaduct Bridge - PID Numbers 77332								
CV-A (I-90 WB New bridge)	**Exfiltration Trench (ExT)**	Identified as limited or not feasible for this drainage area	No	BMP not feasible due to physical and hydraulic constraints	No	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole.	Yes	ExTs are not recommended for any elevated structures. The ExTs could be incorporated into local roads impacted by the project below the bridge structure and would require the City of Cleveland to agree to maintain and operate the BMPs on these local roads.
CV-A (I-90 WB New bridge)	**Manufactured Treatment Devices**		No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices. Elevated sections of roadway limit the use of manufactured system.	Yes/Limited		No	Requires reserved area from 15' x 30' to 25' x 37', I-90 elevated roadway section, potential locations within drainage area include: 1. Locate the MTD's below bridge and convey runoff to BMPs, prior to discharge into river. Recommended for north side of river only. Should BMP be located off ODOT right of way, Project design engineer to work with City of Cleveland staff to identify location and runoff discharge points.
CV-A (I-90 WB New bridge)	**Vegetated Bioswales**	Identified as limited or not feasible for this drainage area	No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure is the primary rationale for selecting and implementation this BMP. These would be implemented below the bridge structure and associated with the local road grids roadside ditches.	Yes/Limited		No	Potential vegetated bioswale locations within drainage area: 1. No specific locations available on local roads impacted by bridge work. 2. Vegetated bioswales are recommended to be used in combination with potential detention/retention BMPs recommended for use in the right of way area ODOT acquired for the new I-90 WB bridge.
CV-A (I-90 WB New bridge)	**Extended Detention or Retention Basin**	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type. A.) ODOT has acquired right of way on the east side of the Cuyahoga River for the new I-90 WB bridge B.) Overall bridge drainage and runoff should, where practical, be conveyed to the northern side of the river to incorporate BMPs and stormwater management controls within the right of way acquired. C.) Project design engineer will assess feasibility of designing BMPs which will accept runoff from drainage areas CI-B and CI-D, innovative and creative uses of this right of way area is encouraged for stormwater management. D.) ODOT continues to address slope stability issues along the west bank of the Cuyahoga River under the Central Viaduct. E) Project design engineer will have to address geotechnical issues.	Yes		No		No	Potential drainage area design comments: 1. BMP footprint size is a significant design issue. 2. Elevation issues associated with outlet control structures will need to be addressed and evaluated during design hydraulic assessment. 3. Frequency of maintenance and operation. 4. Access for O/M. 5. Infield area for ramp A6 should be considered as a potential location. 6. Project design engineer will need to address runoff discharge locations.
	Exfiltration Trench (ExT)	Identified as limited or not feasible for this drainage area	No	BMP not feasible due to physical and hydraulic constraints	No	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole.	Yes	ExTs are not recommended for any elevated structures. The ExTs could be incorporated into local roads impacted by the project below the bridge structure and would require the City of Cleveland to agree to maintain and operate the BMPs on these local roads.

Table 16 - BMP Recommendations and Selection Rationale Table									
Drainage Area	**BMP Type**	**BMP Selection Rationale**	**BMP Recommended (Y/N)**	**BMP Limited Feasibility Rationale**	**BMP Limited Feasibility (Y/N)**	**BMP Not Feasible Rationale**	**BMP Not Feasible (Y/N)**	**Drainage Area and BMP Comments**
CV-B (I-90 new EB bridge)	**Manufactured Treatment Devices**		No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices. ODOT project drainage area encompasses the existing Central Viaduct Bridge which will be subject only to a modification of the lane configuration and no new impervious area is proposed. Elevated sections of roadway limit the use of manufactured systems.	Yes/Limited		No	Requires reserved area from 15' x 30' to 25' x 37', I-90 elevated roadway section, potential locations within drainage area include: 1. Locate the MTD's below bridge and convey runoff to BMPs, prior to discharge into river. Recommended for north side of river only.
	Vegetated Bioswales	Identified as limited or not feasible for this drainage area	No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure is the primary rationale for selecting and implementation this BMP. These would be implemented below the bridge structure and associated with the local road grid and roadside ditches.	Yes/Limited		No	Potential vegetated bioswale locations within drainage area: 1. No specific locations available on local roads impacted by bridge work. 2. Vegetated bioswales are recommended to be used in combination with potential detention/retention BMPs recommended for use in the right of way area ODOT acquired for the new I-90 WB bridge.
	Extended Detention or Retention Basin	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type. A.) ODOT has acquired right of way on the east side of the Cuyahoga River for the new I-90 WB bridge B.) Overall bridge drainage and runoff should, where practical, be conveyed to the northern side of the river to incorporate BMPs and stormwater management controls within the right of way acquired. C.) Project design engineer will assess feasibility of designing BMPs which will accept runoff from drainage areas CI-B and CI-D, innovative and creative uses of this right of way area is encouraged for stormwater management. D.) ODOT continues to address slope stability issues along the west bank of the Cuyahoga River under the Central Viaduct. E) Project design engineer will have to address geotechnical issues.	Yes		No		No	Potential drainage area design comments: 1. BMP footprint size is a significant design issue. 2. Elevation issues associated with outlet control structures will need to be addressed and evaluated during design hydraulic assessment. 3. Frequency of maintenance and operation. 4. Access for O/M. 5. Project design engineer will need to address runoff discharge locations.
SI-A (Between Fairfield Ave and Keniworth Ave.)	**Exfiltration Trench (ExT)**	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole.	Yes		No		No	Potential locations with the drainage area include: 1. I-90 WB/EB outside shoulder area on non-elevated roadway sections. 2. Project design engineer will need to address runoff discharge locations.
	Manufactured Treatment Devices		No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	Yes/Limited		No	Requires reserved area from 15' x 30' to 25' x 37',I-90 median area estimated to not be wide enough for the reserved area footprint. Potential locations within the drainage area include: 1. I-90 WB/EB outside shoulder area. 2. Project design engineer will need to address runoff discharge locations.
	Vegetated Bioswales		No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For this drainage area, the open areas between I-90 WB and EB between I-90 and the right of way are area the designer should consider placement of these BMPs.	Yes/Limited		No	Proposed vegetated biofilters: The following areas have been identified as having space for these BMP types: 1. Toe of foreslope areas associated with I-90 WB/EB. 2. Project design engineer will need to address runoff discharge locations.
	Extended Detention or Retention Basin		No	BMP not feasible due to physical and hydraulic constraints	No	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes	Potential areas within drainage area include: None identified.
	Note: If roadway drainage is tied to local combined system, no BMPs required. Coordination with City of Cleveland and NEORSD is recommended.							
SI-B (Kenilworth Ave)	**Exfiltration Trench (ExT)**	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole.	Yes		No		No	ODOT storm water runoff enters the CSO upstream of regulator WR-48 (CSO-80). 2. Connect BMP discharge to storm only system.
	Manufactured Treatment Devices		No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	Yes/Limited		No	Requires reserved area from 15' x 30' to 25' x 37, I-90 median area and outside shoulders are estimated to not be wide enough under Kenilworth Ave. bridge for the reserved area footprint. No space to locate on Kenilworth Ave. overhead bridge area. Potential locations: Space between R/W line, I-90 WB/EB and either North of South side of Kenilworth Ave.
	Vegetated Bioswales		No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure.	Yes/Limited		No	Potential drainage area locations: 1.No space identified

Table 16 - BMP Recommendations and Selection Rationale Table

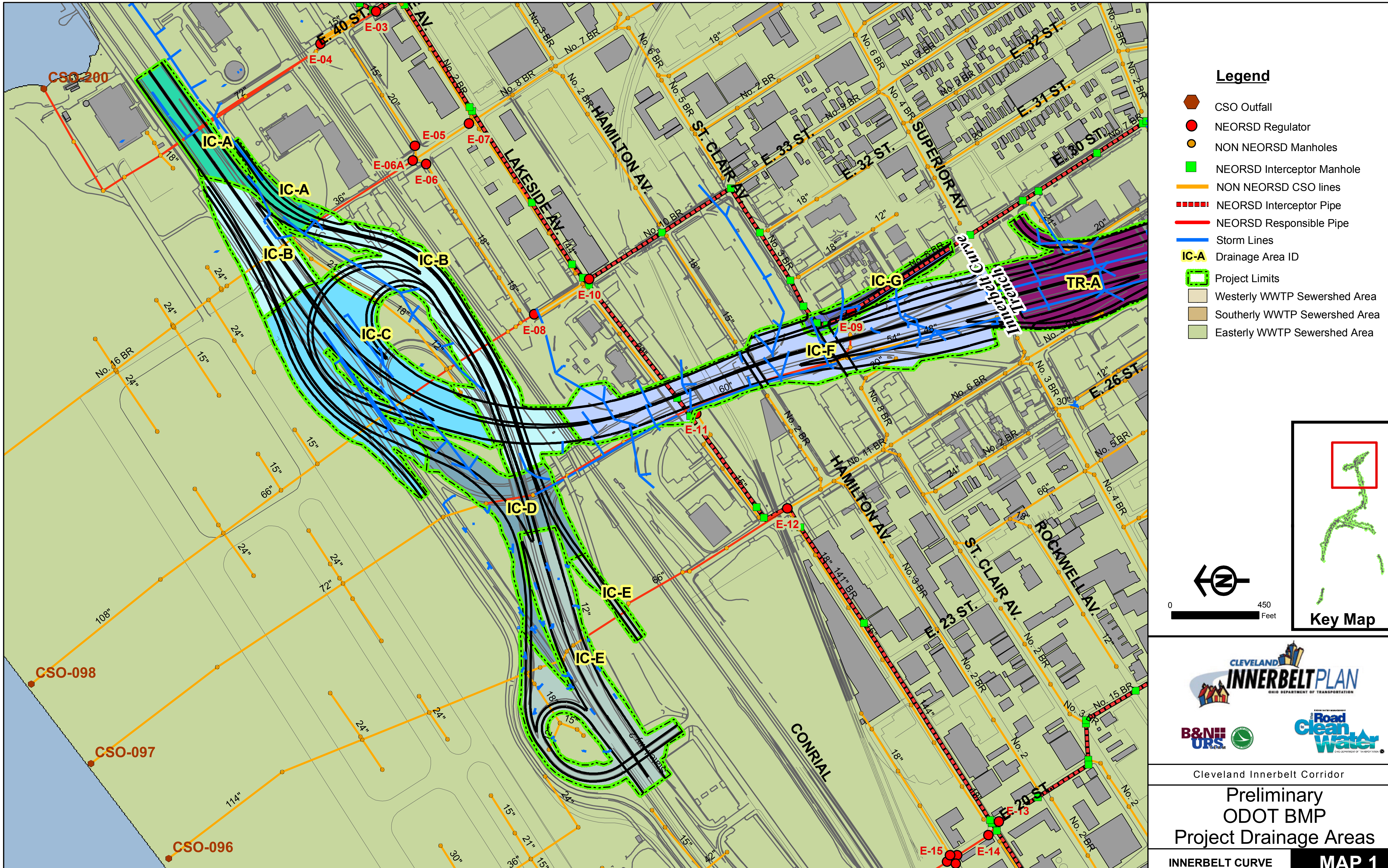
Drainage Area	BMP Type	BMP Selection Rationale	BMP Recommended (Y/N)	BMP Limited Feasibility Rationale	BMP Limited Feasibility (Y/N)	BMP Not Feasible Rationale	BMP Not Feasible (Y/N)	Drainage Area and BMP Comments
	Extended Detention or Retention Basin	Identified as limited or not feasible for this drainage area	No	BMP not feasible due to physical and hydraulic constraints	No	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes	Potential areas within drainage area include: None identified.
	Note: If bridge drainage tied to local combined system, no BMPs required. Coordination with City of Cleveland and NEORSD is recommended.							
SI-C (Between Kenliworth Ave. and Starkweather Ave. and below Starkweather Ave.to Auburn Ave.)	**Exfiltration Trench (ExT)**	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole.	Yes		No		No	Potential locations with the drainage area include: 1. I-90 WB/EB outside shoulder area on non-elevated roadway sections. 2. Project design engineer will need to address runoff discharge locations.
	Manufactured Treatment Devices		No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	Yes/Limited		No	Requires reserved area from 15' x 30' to 25' x 37',I-90 median area estimated to not be wide enough for the reserved area footprint. Potential locations within the drainage area include: 1. I-90 WB/EB outside shoulder area. 2. Space between ramp B1 and (-90 EB or A7 and I-90 WB.
	Vegetated Bioswales		No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For this drainage area, the open areas between I-90 WB and EB between I-90 and the right of way are area the designer should consider placement of these BMPs.	Yes/Limited		No	Proposed vegetated biofilters: The following areas have been identified as having space for these BMP types: 1. Toe of foreslope areas associated with I-90 WB/EB. 2. Project design engineer will need to address runoff discharge locations.
	Extended Detention or Retention Basin			Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes/Limited		No	Potential areas within drainage area: 1. Space between I-90 WB and ramp A7. 2. FHWA safety requirements associated with standing water, permanent water surface elevation in proximity to the traveling public will need to be addressed. 3. Project design engineer will need to address runoff discharge locations.
	Note: If roadway drainage is tied to local combined system, no BMPs required. Coordination with City of Cleveland and NEORSD is recommended.							
SI-D (Starkweather Ave)	**Exfiltration Trench (ExT)**	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole.	Yes		No		No	Project design engineer will need to work with the City of Cleveland to evaluate bridge drainage options. 1) - Connect Kennelworth Ave. bridge runoff into local collection system.
	Manufactured Treatment Devices		No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	Yes/Limited		No	Requires reserved area from 15' x 30' to 25' x 37, I-90 median area and outside shoulders are estimated to not be wide enough under Starkweather Ave. bridge for the reserved area footprint. No space to locate on Starkweather Ave. overhead bridge area. Potential locations: 1. Space between I-90 WB and rampo A7 under Starkweather Ave. bridge.
	Vegetated Bioswales	Identified as limited or not feasible for this drainage area	No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For this drainage area - No space identified.	No	BMP not feasible due to physical and hydraulic constraints	Yes	Potential drainage area locations: 1.No space identified
	Extended Detention or Retention Basin	Identified as limited or not feasible for this drainage area	No	BMP not feasible due to physical and hydraulic constraints	No	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes	Potential areas within drainage area include: None identified.
	Note: If bridge drainage tied to local combined system, no BMPs required. Coordination with City of Cleveland and NEORSD is recommended.							
SI-E (I-71 at Jennings Freeway)	**Exfiltration Trench (ExT)**	ExTs are designed to be installed where space is limited, little elevation change and shoulder widths will allow ExTs to be constructed up against curb and gutter sections or Jersey barrier wall sections. In addition, traffic can be maintained during maintenance. These BMPs are to be outletted into the downstream storm sewer catch basin or manhole.	Yes		No		No	Project design engineer will need to address runoff discharge locations. Project design engineer to check downstream capacity of storm sewer system.
	Manufactured Treatment Devices	Identified as limited or not feasible for this drainage area	No	MTDs are useful where space is limited and the primary pollutants of concern are particulate in nature. The MTDs are recommended to be designed as off line systems. The limited feasibility is associated with the frequency of maintenance associated with these devices.	Yes/Limited		No	Requires reserved area from 15' x 30' to 25' x 37'.
	Vegetated Bioswales	Identified as limited or not feasible for this drainage area	No	Roadside ditches with minor slopes and space to install a wide shallow conveyance structure. For this drainage area - No space identified.	No	BMP not feasible due to physical and hydraulic constraints	Yes	Potential Location w/in drainage area: None identified.

Table 16 - BMP Recommendations and Selection Rationale Table

Drainage Area	BMP Type	BMP Selection Rationale	BMP Recommended (Y/N)	BMP Limited Feasibility Rationale	BMP Limited Feasibility (Y/N)	BMP Not Feasible Rationale	BMP Not Feasible (Y/N)	Drainage Area and BMP Comments
	Extended Detention or Retention Basin	Identified as limited or not feasible for this drainage area	No	BMP not feasible due to physical and hydraulic constraints	No	Detention/retention type controls are very effective when space is available to install. For this drainage area space is limited to install this BMP type.	Yes	Potential Location w/in drainage area: None identified.

NOTES:
1. Plans showing ramp numbering are included in Appendix Y.
2. * - CI-A is broken into 4 areas for discussion purposes.
3. Urban Design/Aethetics subcommittee considering potential freeway capping, especially between E. 22nd and Euclid Ave. Freeway caps would significantly impact storm water and BMP design.
BMP Operations and Maintenance resposibilitiy is ODOT's unless mentioned otherwise.

Maps 1 through 10



Cleveland Innerbelt Corridor

Preliminary
ODOT BMP
Project Drainage Areas

INNERBELT CURVE

MAP 1

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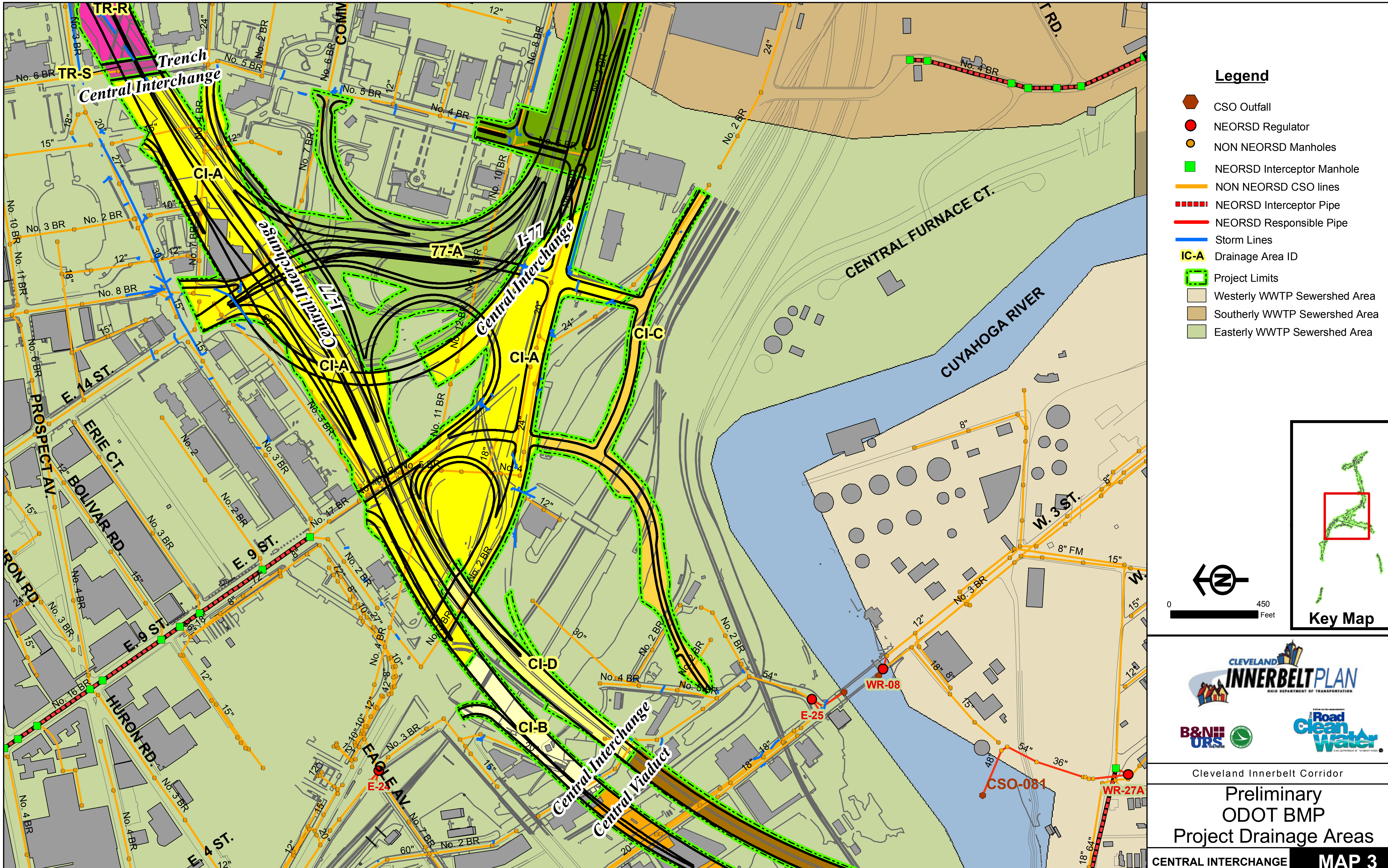

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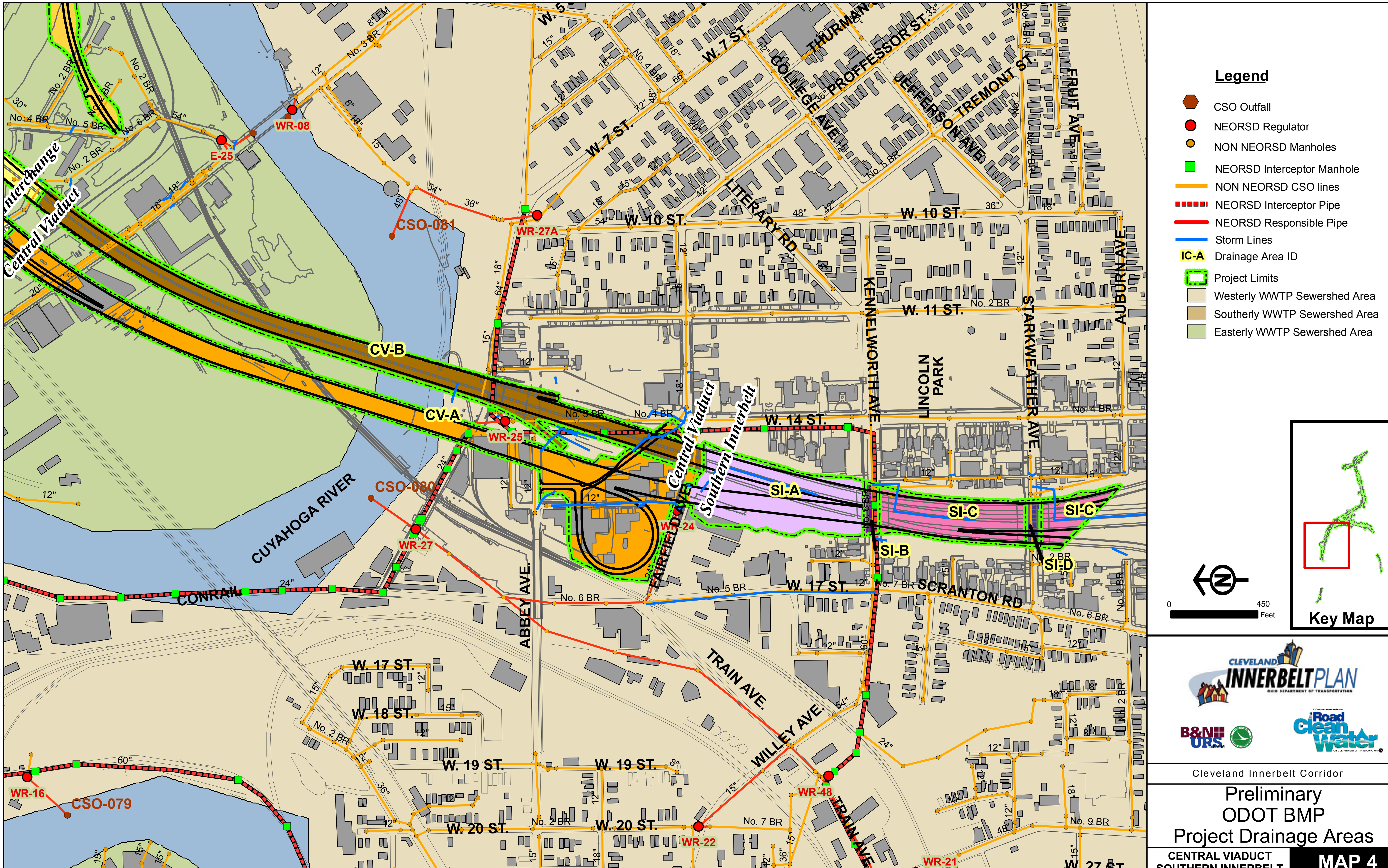

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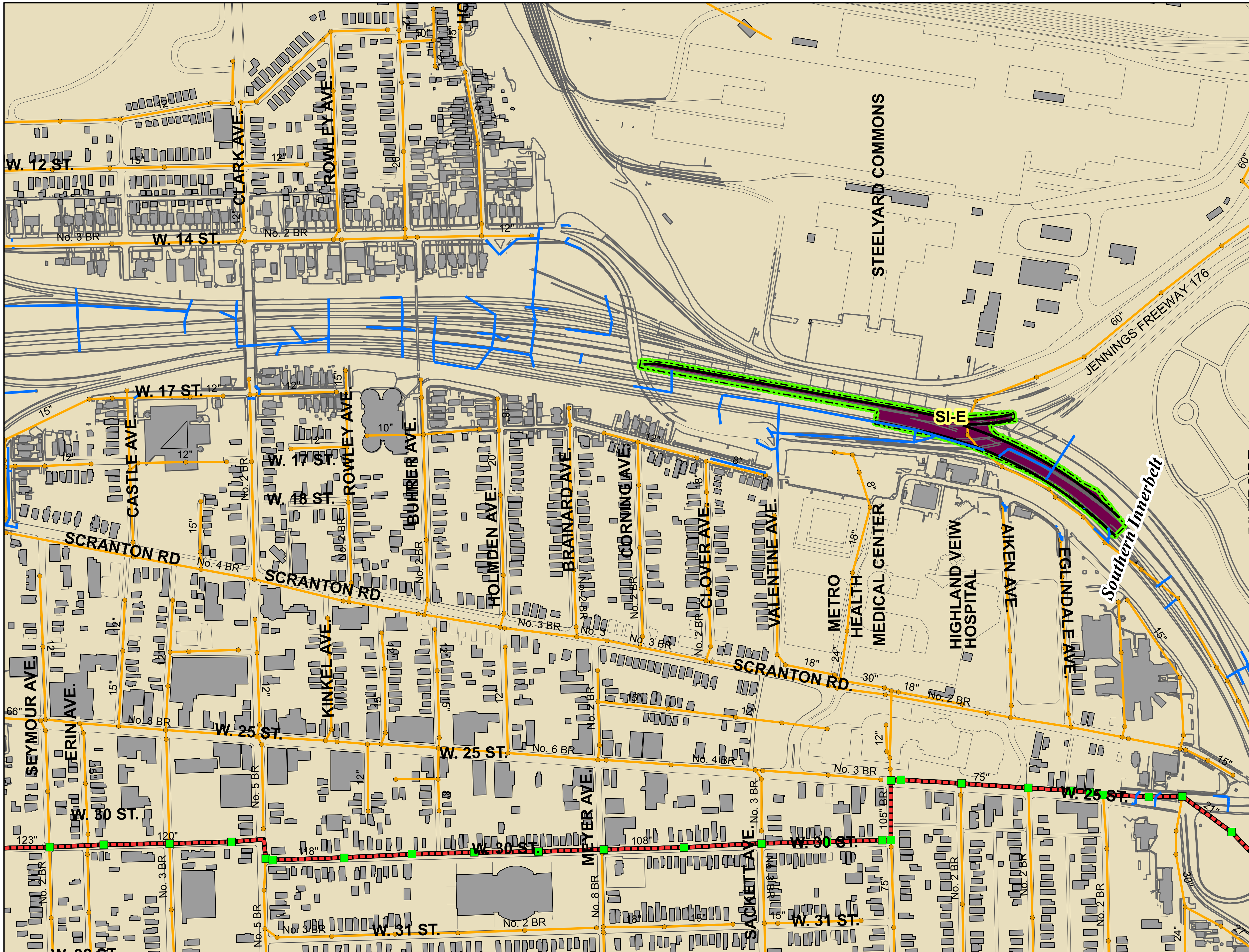
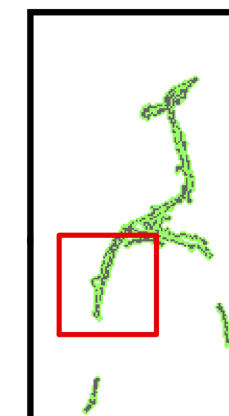


Legend

- CSO Outfall
- NEORSD Regulator
- NON NEORSD Manholes
- NEORSD Interceptor Manhole
- NON NEORSD CSO lines
- NEORSD Interceptor Pipe
- NEORSD Responsible Pipe
- Storm Lines
- IC-A Drainage Area ID
- Project Limits
- Westerly WWTP Sewershed Area
- Southerly WWTP Sewershed Area
- Easterly WWTP Sewershed Area

0 450 Feet



Key Map

CLEVELAND INNERBELT PLAN

OHIO DEPARTMENT OF TRANSPORTATION

B&N URS

Road to Clean Water

Cleveland Innerbelt Corridor

Preliminary
ODOT BMP
Project Drainage Areas

SOUTHERN INNERBELT | MAP 5

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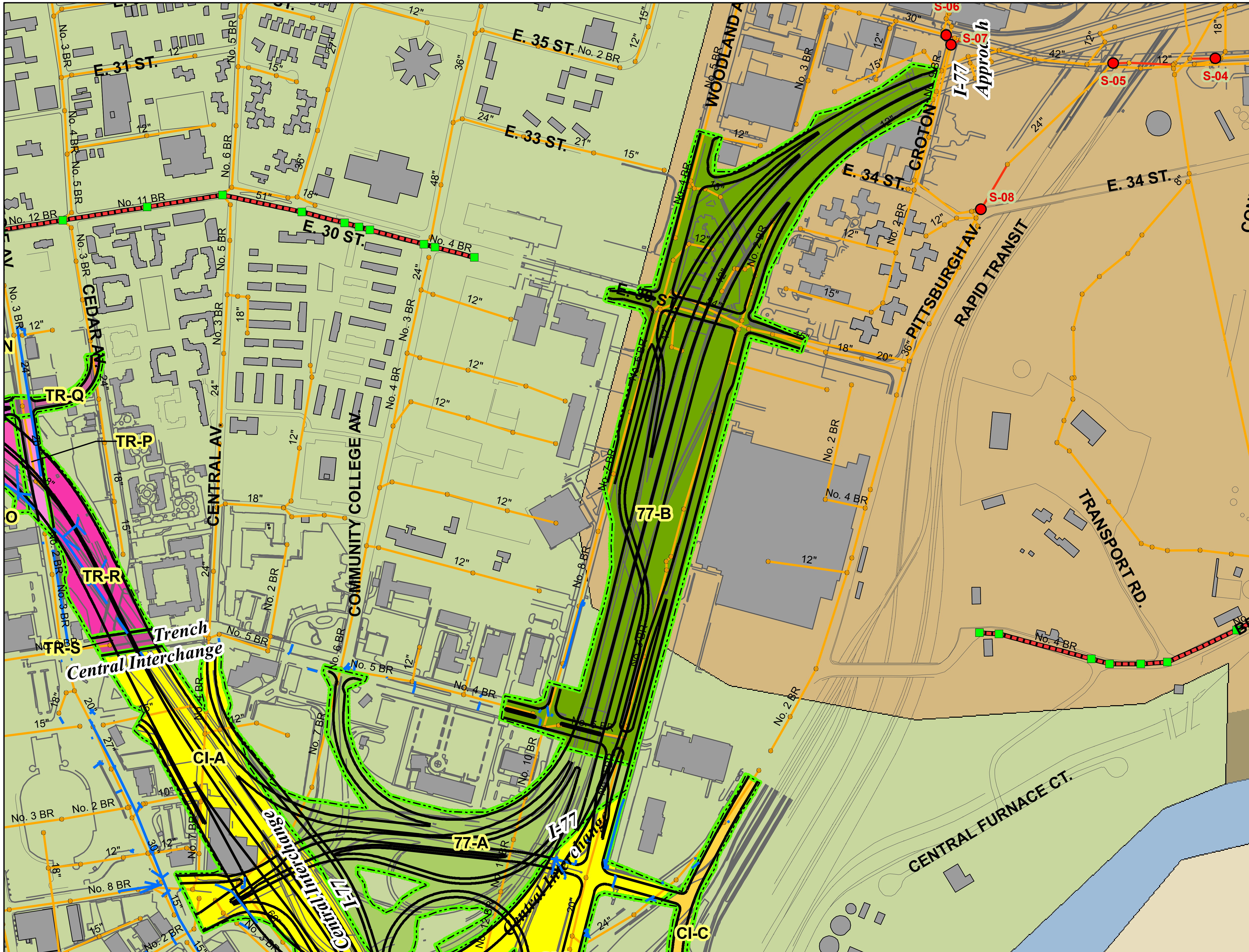

Legend

- CSO Outfall
- NEORSD Regulator
- NON NEORSD Manholes
- NEORSD Interceptor Manhole
- NON NEORSD CSO lines
- NEORSD Interceptor Pipe
- NEORSD Responsible Pipe
- Storm Lines
- IC-A Drainage Area ID
- Project Limits
- Westerly WWTP Sewershed Area
- Southerly WWTP Sewershed Area
- Easterly WWTP Sewershed Area

0 450 Feet

CLEVELAND INNERBELT PLAN

Cleveland Innerbelt Corridor

Preliminary
ODOT BMP
Project Drainage Areas

I-77 MAP 6

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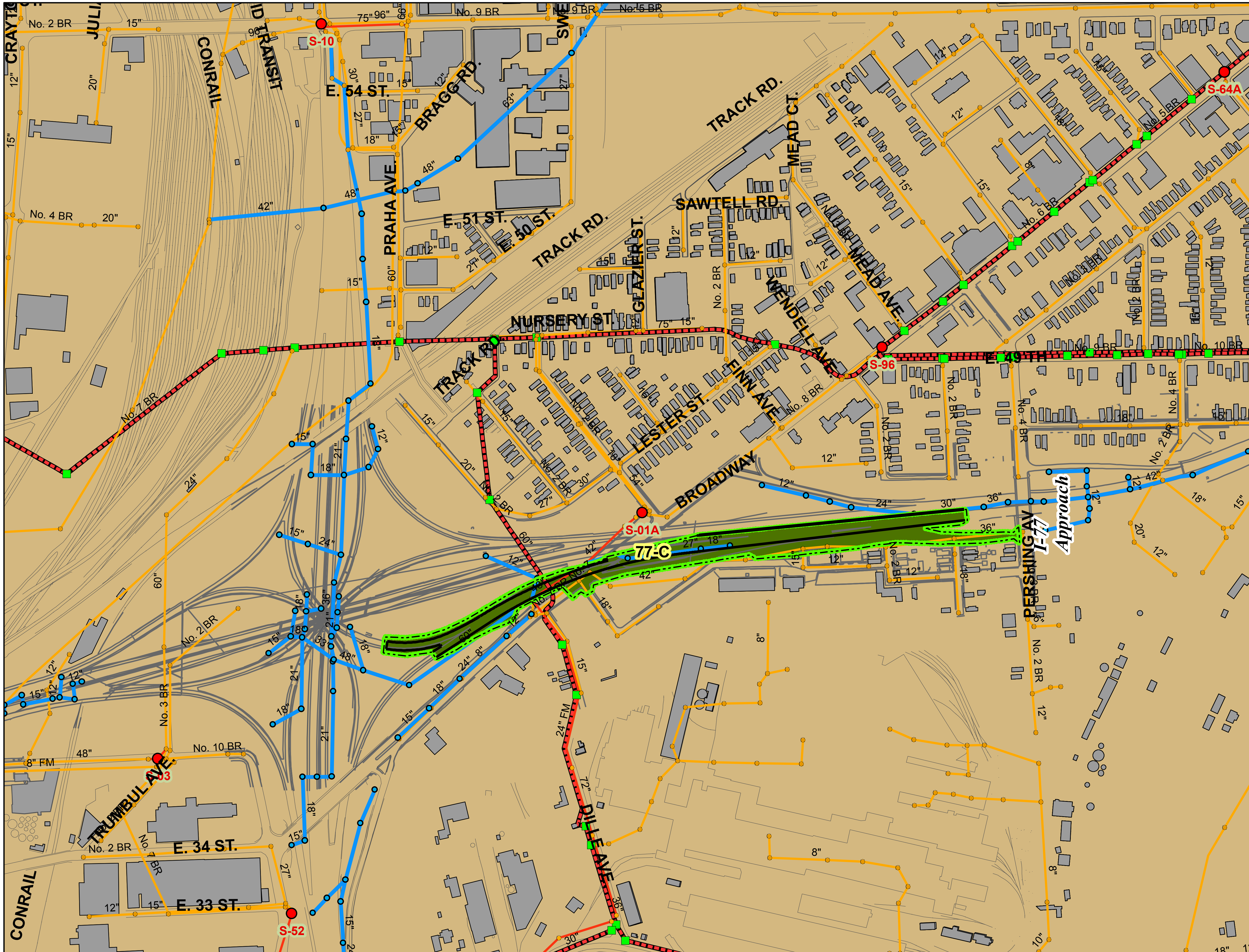

Legend

- CSO Outfall
- NEORSD Regulator
- NON NEORSD Manholes
- NON NEORSD Storm Manholes
- NEORSD Interceptor Manhole
- NON NEORSD CSO lines
- NEORSD Interceptor Pipe
- NEORSD Responsible Pipe
- Storm Lines
- IC-A Drainage Area ID
- Project Limits
- Westerly WWTP Sewershed Area
- Southerly WWTP Sewershed Area
- Easterly WWTP Sewershed Area

0 450 Feet

Key Map

CLEVELAND INNERBELT PLAN

Cleveland Innerbelt Corridor

Preliminary ODOT BMP Project Drainage Areas

I-77 | MAP 7

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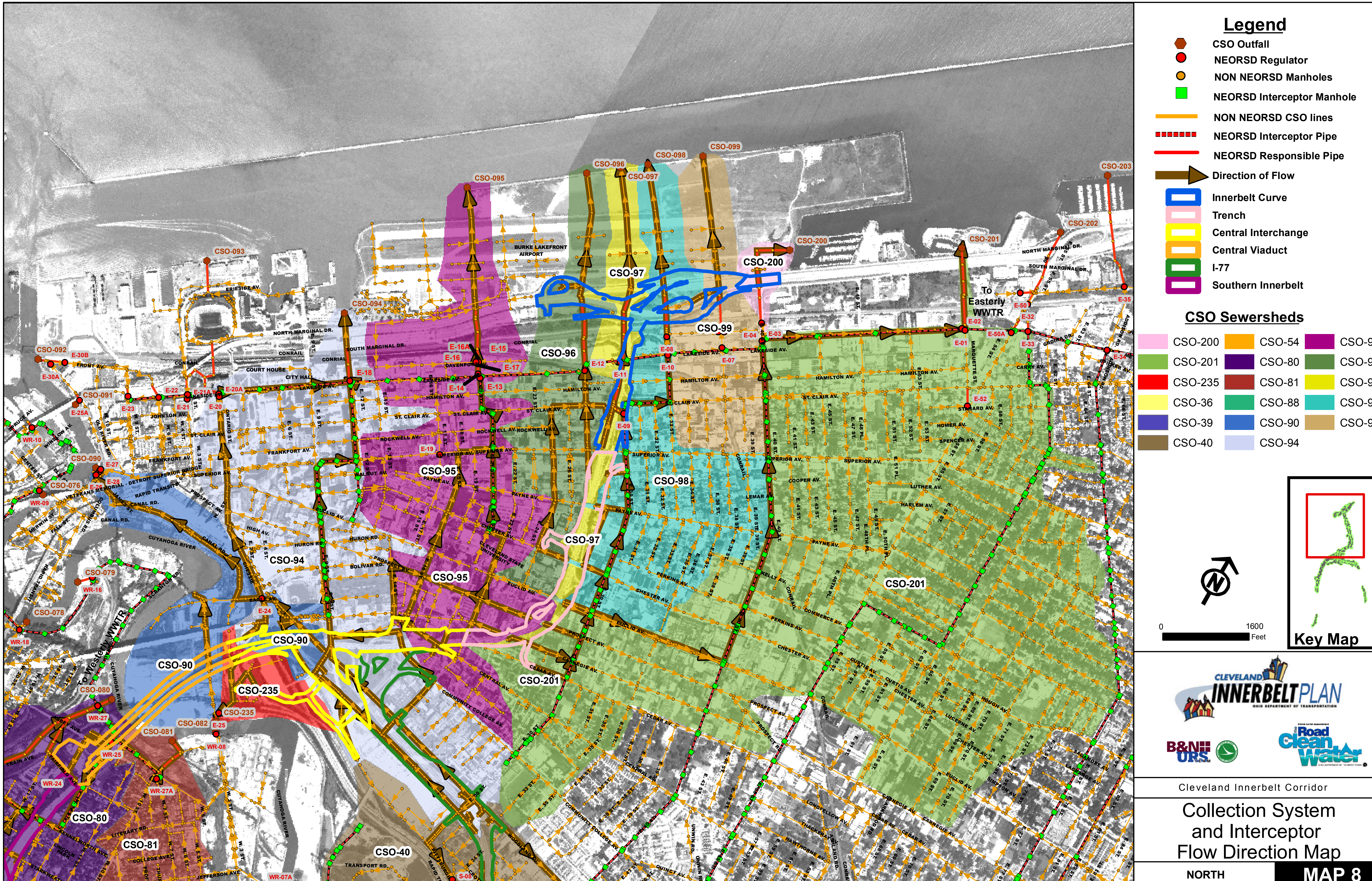

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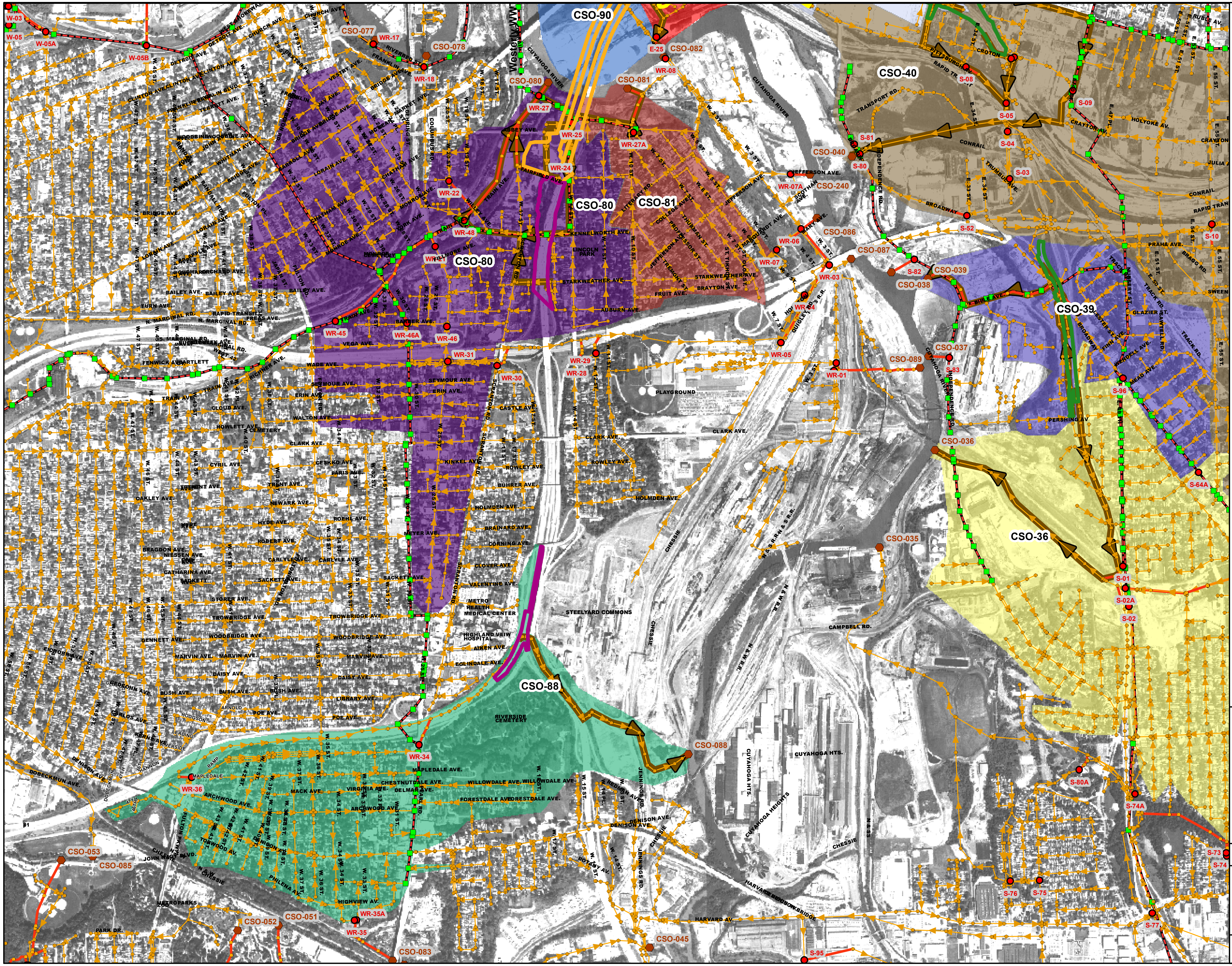


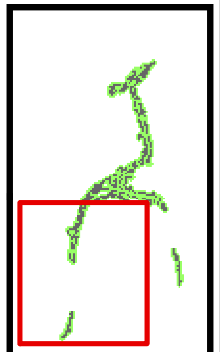
Legend

- CSO Outfall
- NEORSD Regulator
- NON NEORSD Manholes
- NEORSD Interceptor Manhole
- NON NEORSD CSO lines
- NEORSD Interceptor Pipe
- NEORSD Responsible Pipe
- Direction of Flow
- Innerbelt Curve
- Trench
- Central Interchange
- Central Viaduct
- I-77
- Southern Innerbelt

CSO Sewersheds

CSO-200	CSO-54	CSO-95
CSO-201	CSO-80	CSO-96
CSO-235	CSO-81	CSO-97
CSO-36	CSO-88	CSO-98
CSO-39	CSO-90	CSO-99
CSO-40	CSO-94	

0 1600 Feet



Key Map

Cleveland Innerbelt Corridor

Collection System and Interceptor Flow Direction Map

WEST

MAP 9

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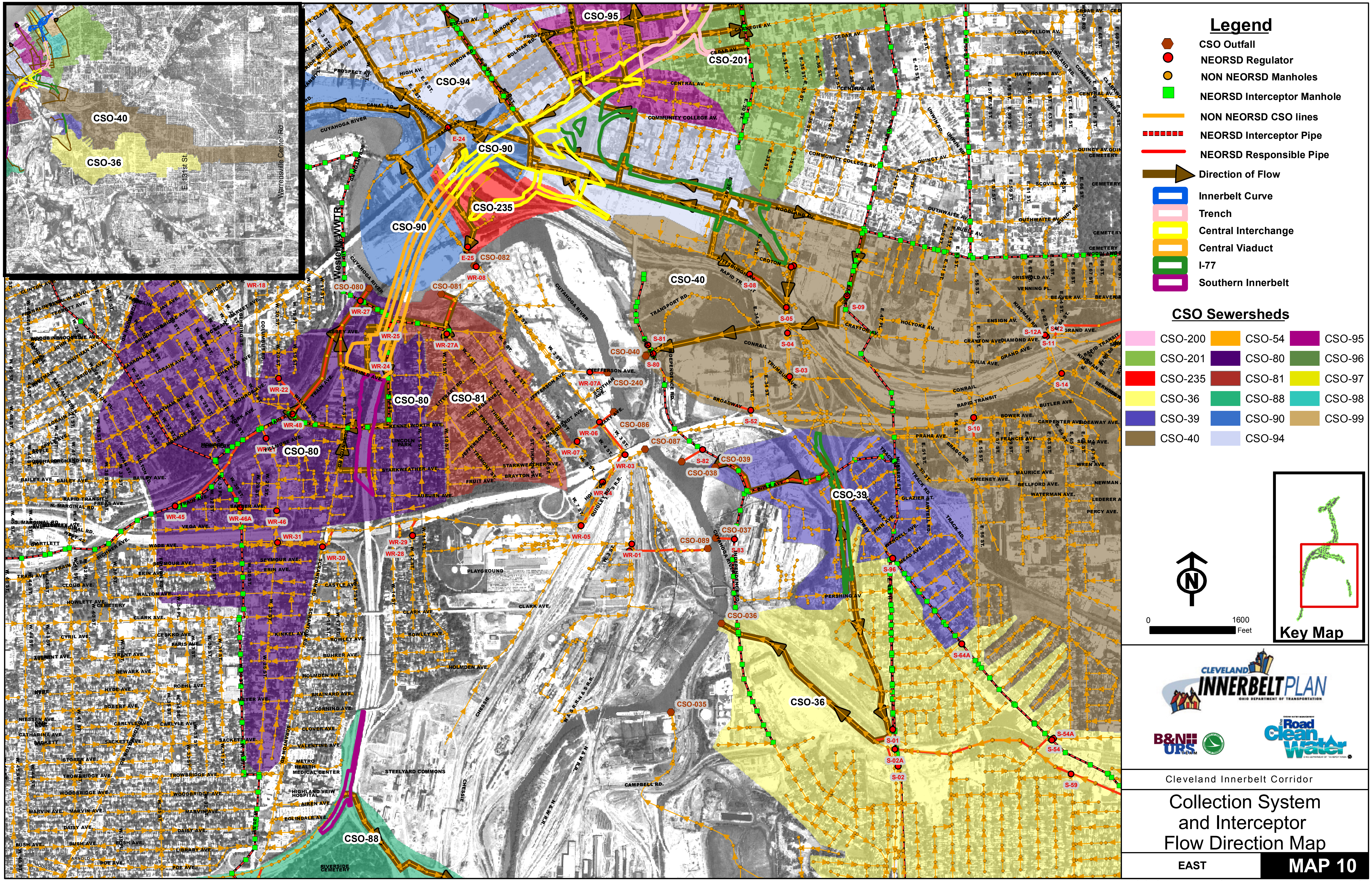

CLEVELAND INNERBELT PLAN

Cleveland Innerbelt Corridor

Collection System and Interceptor Flow Direction Map

EAST

MAP 10

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Appendix A

ODOT – Location and Design Manual, Volume 2, January 2007

Table of Contents
(Revised January 2007)

1100 Drainage Design Procedures

1100 Drainage Design Procedures

1101 Estimating Design Discharge

1101.1 General

In order to properly design highway drainage facilities, it is essential that a reasonable estimate be made of the design and check discharges. Some of the more important factors affecting runoff are duration, intensity and frequency of rainfall; and the size, imperviousness, slope, and shape of the drainage area.

Suitable topographic mapping shall be utilized to determine the contributing drainage area. For drainage areas over 100 acres, a 7.5 minute U.S. Geological Survey Quadrangle will ordinarily suffice. For smaller areas, or where discharges are calculated using the rational method, smaller scale maps (1"=50' to 1"=800') may be more appropriate.

A proper evaluation should be made of the land use throughout the drainage area. Changes in land use within the drainage area which will occur in the immediate future shall be taken into account when determining design discharges. However, probable land use changes beyond this should not be assumed when determining design discharges. It is the responsibility of the local permitting/zoning agency to ensure proper land and water management techniques are utilized. These techniques will minimize the adverse affects of a change in land use.

1101.2 Procedures

1101.2.1 Statistical Methods

The statistical methods developed by the U.S. Geological Survey and published in USGS Reports 89-4126, 93-135 and 93-4080 shall be used to estimate runoff from larger drainage areas. A description and the limitations of these methods are described in Section 1003.

1101.2.2 Rational Method

The rational method is considered to be more reliable for estimating runoff from small drainage areas, less than the acreage for the USGS Regions; and for areas that contribute overland flow and shallow concentrated flow to the roadway ditch or pavement. The design discharge "Q" is obtained from the equation:

$$Q = CiA$$

where:

Q = Discharge in cubic feet per second

C = Coefficient of runoff

I = Average rainfall intensity in inches per hour, for a given storm frequency and for a duration equal to the time of concentration.

A = Drainage area in acres

The time of concentration is the time required for runoff to flow from the most remote point of the drainage area to the point of concentration. The point of concentration could be a culvert, catch basin or the checkpoint in a roadway ditch used to determine the need for velocity protection. Time of concentration is designated by "t_c" and is the summation of the time of overland flow "t_o", the time of shallow concentrated flow "t_s" and the time of pipe or open channel flow "t_d".

Overland flow is that flow which is not carried in a discernible channel and maintains a uniform depth across the sloping surface. It is often referred to as sheet flow. The time of overland flow may be obtained from Figure 1101-1, a similar overland flow chart, or from the equation:

$$t_o \approx \frac{1.8(1.1-C)\,(L)^{(1/2)}}{(s)^{(1/3)}}$$

where:

t_o = Time of overland flow in minutes

C = Coefficient of runoff

L = Distance to most remote location in drainage area in feet

s = Overland slope (percent)

These methods should not be used to determine the time of travel for gutter, swale, or ditch flow.

This equation and Figure 1101-1 assume a homogeneous drainage area. Where the overland flow area is composed of segments with varying cover and/or slopes, the summation of the time of concentration for each segment will tend to over-estimate the overland flow time, "t_o". In this case it may be more appropriate to use an average runoff coefficient "C" and an average ground slope in the Overland Flow Chart.

Sheet flow is assumed to occur for no more than 300 feet after which water tends to concentrate in rills and then gullies of increasing proportion. This type of flow is classified as shallow concentrated flow. The velocity of shallow concentrated flow can be estimated using the following relationship:

$$V = 3.281ks^{0.5}$$

where:

V = Velocity in fps

k = Intercept coefficient (see Table 1101-1)

s = Overland slope (percent)

Table 1101-1

Types of Surface	Intercept Coefficient "k"
Forest with heavy ground litter	0.076
Min. tillage cultivated; woodland	0.152
Short grass pasture	0.213
Cultivated straight row	0.274
Poor grass; untilled	0.305
Grassed waterways	0.457
Unpaved area; bare soil	0.491
Paved area	0.619

Shallow concentrated flow generally empties into pipe systems, drainage ditches, or natural channels. The velocity of flow in an open channel or pipe can be estimated using the Manning's equation.

The travel time for both shallow concentrated flow and open channel or pipe flow is calculated as follows:

$$t_s \text{ or } t_d = \frac{L}{60V}$$

where:

t_s = Travel time for shallow concentrated flow in minutes

t_d = Travel time for open channel or pipe flow in minutes

L = Flow length in feet

V = Velocity in fps

Where a contributing drainage area has its steepest slope and/or highest "C" value in the sub-area nearest the point of concentration, the rational method discharge for this sub-area may be greater than if the entire contributing drainage area is considered. The maximum runoff rate for a sub-area should be considered only if greater than that for the entire area.

1101.2.3 Coefficient of Runoff

The coefficient of runoff is a dimensionless decimal value that estimates the percentage of rainfall that becomes runoff. The recommended values for the coefficient of runoff for various contributing surfaces are shown in Table 1101-2. Where two values are shown, the higher value ordinarily applies to the steeper slopes.

For Residential areas, lot size should also be considered in choosing the appropriate value for the coefficient of runoff. Generally, a higher value should be associated with smaller lots and a lower value should be associated with larger lot sizes. The selected coefficient should be based upon an estimation of the typical slope, lot size, and lot development.

The total width contributing flow to a given point usually consists of surfaces having a variable land cover and thereby requires a weighted coefficient of runoff "C". The weighted coefficient is obtained by averaging the coefficients for the different types of contributing surfaces, as noted in the following example:

Table 1101-2

Types of Surface	Coefficient of Runoff "C"
Pavement & paved shoulders	0.9
Berms and slopes 4:1 or flatter	0.5
Berms and slopes steeper than 4:1	0.7
Contributing areas	
Residential (single family)	0.3-0.5
Residential (multi-family)	0.4-0.7
Woods	0.3
Cultivated	0.3-0.6

Contributing Width "W"	Land Use	"C"	"CW"
20 feet	Paved Area	0.9	18
40 feet	Earth Berms & Slopes	0.7	28
140 feet	Residential Area	0.6	84
200 feet	Summations		130

Weighted "C" = 130/200 = 0.65

Contributing Width "W"	Land Use	"C"	"CW"
6.1 meters	Paved Area	0.9	5.5
6.2 meters	Earth Berms & Slopes	0.7	4.3
42.7 meters	Residential Area	0.6	25.6
55 meters	Summations		35.4

Weighted "C" = 35.4/55 = 0.64

1101.2.4 Rainfall Intensity

The average rainfall intensity "i" in inches per hour may be obtained from the Intensity-Duration-Frequency curves shown on Figure 1101-2. Each set of curves applies to a specific geographic area, A, B, C, or D as shown on the Rainfall Intensity Zone Map, Figure 1101-3. The geographic areas were established from an analysis of rainfall records obtained from Weather Bureau stations in Ohio. Some political subdivisions may have developed curves for their specific area similar to Figure 1101-2. Such curves may be based on a much longer period of record and provide more reliable information. Any local curves proposed by the designer should be cleared with the Hydraulic Section, Office of Structural Engineering prior to incorporating that information in the drainage calculations.

1102 Open Water Carriers

1102.1 General

Open water carriers generally provide the most economical means for collecting and conveying surface water contributing to the roadway. The required capacity of a water carrier involves a determination of the velocity and depth of flow for a given discharge. These characteristics can best be obtained from charts that are based on Manning's equation. Channel flow charts have been prepared for all the common water carrier shapes and are included in the Drainage Design Aids. A ditch computation sheet similar to that provided in the Appendix shall be used to perform or summarize ditch calculations. As a guideline, the desirable minimum roadway ditch grades should be 0.50% with a recommended absolute minimum of 0.25%. Lower grades may be used on large channels as necessary. Open water carriers should maintain a constant slope wherever possible. The proper location of a ditch outfall is quite important. Existing drainage patterns should be perpetuated insofar as practicable. Care should be taken to not capture an existing stream with the roadside ditch. If this is necessary, the designed ditch shall be in accordance to Section 1102.2.4.

1102.2 Types of Carriers

1102.2.1 Standard Roadway (Roadside) Ditches

The various roadside ditches shown in Volume I, Roadway Design, have proven to be safe and to provide adequate flow capacity. A ditch is considered to be standard when the centerline is parallel to the edge of the pavement and the flowline is a uniform distance below the edge of pavement. A modification of the above is required when the grade of the pavement is too flat to provide acceptable ditch flow, thereby creating the need for a special ditch. Channel charts, Drainage Design Aid Figures 1100-1 through 1100-10, are included for use in determining velocity and depth of flow for standard ditches having variable side slopes.

1102.2.2 Special Ditches

Special ditches other than the modified standard roadway ditch described in Section 1102.2.1 above, include the following:

A. The steep ditch beyond the toe of the embankment used to carry the flow from a cut section to the valley floor.

B. Toe of fill ditch which is separated from the toe of fill by a minimum 10 foot wide bench, having a minimum transverse slope of ½ inch per foot toward the ditch.

C. Deep parallel side ditches separated from the pavement by a wide bench or earth barrier.

The special ditches described in A, B and C above are ordinarily trapezoidal in shape and appropriate charts for the hydraulic analysis are included in this section of the manual or in the FHWA publication "Design Charts for Open Channel Flow"' Hydraulic Design Series No. 3. It is required that the calculated flowline elevation be shown on each special ditch cross section.

1102.2.3 Median Ditches

The median ditches that are an integral part of all earth medians have the same shape and capacity features as the standard roadside radius ditch and the appropriate ditch chart is applicable for the hydraulic analysis. The fully depressed earth median provides adequate hydraulic capacity and the appropriate flow charts in the Drainage Design Aid Figures 1100-11, 1100-12 and 1100-13 have been developed for that shape. The rounding shown on the charts varies from 8 feet to 4 feet, depending on the width of the median. The slight discrepancy in the rounding from that shown in Volume I, Roadway Design, is not considered to affect the accuracy of the charts.

1102.2.4 Channel Relocations

Major channel relocations should be avoided. However, if it becomes necessary to relocate a channel adhere to the following:

The design year frequency used for channel relocations shall be that given in Section 1004.2. All channel relocations shall carefully be designed to preclude erosion or unreasonable changes in the environment.

Whenever possible, channel relocations shall be restricted to the downstream end of proposed culverts.

The relocated channel shall be of a similar cross-section. Where the existing channel exhibits a two-stage cross section morphology, it shall be replaced with like kind. The two-stage channel is comprised of two distinct areas. The first of these is a meandering bankfull width that carries the channel-forming discharge. The second area is the flood plain width. See Figure 1102-2 for a graphical representation of the major channel features.

The proposed channel should be designed such that it matches the existing channel as closely as possible in regards to existing geomorphic conditions (e.g., channel slope and length, velocity, depth of flow, cross-sectional geometry, channel sinuosity, energy dissipation, etc.). The existing channel geometry and physical characteristics should be established from reference reaches and idealized geometry. The reference reaches should be selected from stable channel reaches close to the relocated section or in locations with similar watershed and valley conditions.

The relocated channel should be designed to duplicate the existing hydraulic properties for the bankfull design frequency. The flood clearance criteria given in Section 1005 should also be met.

Additional information on the design of relocated channels can be found in the United States Department of Agriculture publication, "Stream Corridor Restoration: Principles, Practices and Processes". The principals given in this publication utilize idealized channel geometry. The actual design should be refined using the channel geometry and physical characteristics of reference reaches.

1102.2.5 Channel Linings and Bank Stabilization

The use of soil bioengineering should be used to stabilize banks for relocated or impacted channels when practicable. Native plant species should be used when feasible.

Bank stabilization using bioengineering is covered in the previously referenced USDA publication as well as the AASHTO Model Drainage Manual and the USDA Engineering Field Handbook, chapter 16, part 650. The design procedures and methods for determining the effectiveness of the traditional channel linings are covered in the Federal Highway Administration Hydraulic Engineering Circular No. 15 "Design of Stable Channels With Flexible Linings".

1102.3 Ditch Design Criteria - Design Traffic Exceeding 2000 ADT

1102.3.1 Design Frequency

A 10-year frequency storm shall be used to determine the depth of flow, and a 5-year frequency shall be used to determine the shear stress and the width of ditch lining where needed. Where a flexible ditch lining is required for calculated stresses exceeding the allowable for seed, the minimum width of the lining shall be 7.5 feet. The depth of flow shall be limited to an elevation 1 foot below the edge of pavement for the design discharge. The depth of flow in toe of slope ditches shall be further limited such that the design year discharge does not overtop the ditch bank.

1102.3.2 Ditch Protection

The shear stress for the five-year frequency storm shall not exceed the values shown in Table 1102-1 for the various flexible linings.

Table 1102-1

Allowable Shear Stress	
Permanent Protection	
Protective Lining	Allowable Shear Stress (psf)
Seed (659)	0.40
Sod (660)	1.0
Temporary Protection	
Ditch Erosion Protection Mat Type___ (670)	
A	1.25
B	1.50
C	2.0
E	2.25
F	0.45
G	1.75

The allowable shear stress (τ_a) will need to be greater than or equal to the actual shear stress (τ_{ac}). The temporary linings will degrade over time to reach a value of 1.0 psf upon vegetation establishment. The temporary lining shear stress values in Table 1102-1 should only be used on a temporary basis (6 months or less).

Actual shear stress is calculated by the following equation:

$$\tau_{ac} = 62.4 \cdot D \cdot S$$

D= Water surface depth ft
S = Channel slope ft/ft
τ_{ac} = Actual shear stress lbs/ft^2

If the calculated shear stress exceeds that shown in the table then use the following within the stated limitations:

A. Seeding and Erosion Control with Turf Reinforcing Mat (Supplemental Specification 836) where the ditch slope is less than 10% and maximum velocities are as follows:

Turf Reinforcing Mat Type	Maximum Shear Stress (psf)
Type 1	2.00
Type 2	3.00
Type 3	5.00

B. Type B, C or D Rock Channel Protection may be used to line the ditch if the nearest point of the lining is outside the design clear zone or located behind guardrail or barrier. The actual shear stress is based upon the parameters of the channel slope and depth of flow for the 5-year discharge. The shear equation if valid for discharges less than 50 cfs with slopes less than 10% when evaluating Rock Channel Protection.

Allowable Shear Stress

RCP Type	τ_a lbs/ft^2
B	6
C	4
D	2

C. Type B or C RCP may be utilized for lining ditches on steep grades (slopes from 10%-25%) that carry flow from the end of a cut section down to the valley floor. HEC-15 procedures for steep gradient channels (refer to HEC-15) shall be used with a safety factor of 1.5.
Contact the Office of Structural Engineering, Hydraulics Section for further guidance of RCP usage for 5-year discharges greater than or equal to 50 cfs.

D. Tied concrete block mat protection (601) may be used for channels with 2:1 or flatter side slopes with profile grades at 5% or less. The matting may be used within the clearzone provided that the top of the blocks are flush with the finished grade. Backfill and anchor the block mat per the manufactures recommendations. The allowable shear stress for each type is shown in table 1102-2.

Table 1102-2

CONCRETE BLOCK MAT SHEAR STRESS

Type	Allowable Shear Stress (psf)
1	3
2	5
3	7

E. A concrete lining should be considered only as a last resort.

1102.3.3 Roughness

Suggested values for Manning's Roughness Coefficient "n" for the various types of open water carriers are listed in Table 1102-3.

Table 1102-3

Type of Lining	Roughness Coefficient
Bare Earth	0.02
Seeded	0.03
Sod	0.04
Item 670	0.04
Erosion Control Matting	0.04
Concrete	0.015
Bituminous	0.015
Grouted Riprap	0.02
Tied Concrete Block Mat	0.03
Rock Channel	0.06 for ditches
Protection	0.04 for large channels

1102.3.4 Catch Basin Types

The Standard No. 4, 5, and 8 Catch Basins are suitable for the standard roadside designs covered in Volume I, Roadway Design. The tilt built into the basin top provides a self-cleaning feature when the basins are used on continuous grades and the wide bar spacing minimizes clogging possibilities, thereby resulting in an efficient design. The bases of the 4, 5 and 8 Catch Basins can be expanded to accommodate larger diameter conduits by specifying Standard Construction Drawing CB-3.4. The bar spacing can be decreased, when desirable for safety reasons, by specifying Grate "E" for the No. 4 and Grate "B" for the No. 5. The following catch basin types are generally recommended based on the size and shape of the ditch.

A. Standard No. 4 for depressed medians wider than 40 feet.

B. Standard No. 5 for 40 foot radius roadside or median ditches. (Use Grate "B" where pedestrian traffic may be expected.)

C. Standard No. 8 for 20 foot radius roadside or depressed medians 40 feet or less in width.

D. Standard No. 2-2-A may be used in trapezoidal toe ditches where the basin is located in a rural area. The basin should also be located outside the design clear zone or behind guardrail where the protruding feature of the basin is not objectionable. The capacity of the side inlet catch basin window, for unsubmerged conditions, may be determined by the standard weir equation:

$$Q=CLH^{3/2}$$

where C is a weir coefficient, generally 3.0, L is the length of opening in feet, H is the distance from the bottom of the window to the surface of the design flow in feet. The catch basin grate is considered as an access point for the storm sewer and its capacity to admit flow is ignored for continuous grades.

E. Standard No. 2-2-B should be used where minor, non-clogging flows are involved such as yard sections and the small triangular area created by the guardrail treatment for a depressed median at bridge terminals. Standard No. 2-3 through No. 2-6 catch basins should be provided where a larger base is required to accommodate pipes larger than 21 inches in span or sewer junctions, or where a No. 2-2-B catch basin will not provide adequate access to the sewer.

F. In urban areas, Standard Side Ditch Inlets should be used to drain small areas of trapped water behind curbs and/or between driveways.

1102.3.5 Calculated Catch Basin Spacing

Catch basins must be provided to intercept flow from open water carriers when the depth of flow or velocity exceeds the maximum allowable for the design storm for all highway classifications. The standard ditch catch basins, designated Catch Basin No. 4, Catch Basin No. 5, and Catch Basin No. 8, include an earth dike. The dike is approximately 12 inches above the flowline of the grate, immediately downstream from the catch basin and serves to block the flow on continuous grades and create a sump condition.

When the calculated depth of flow or velocity exceeds the maximum allowable at the checkpoint in the ditch, a catch basin or ditch lining will be required. However, the capacity of the catch basin may be less than the capacity of the ditch and thereby control the catch basin spacing. Figure 1102-1 may be used to check the capacity of a catch basin grate in a sump. To use Figure 1102-1, the calculated discharge at the ditch checkpoint shall be doubled to compensate for possible partial clogging of the grate.

In cut sections, the accumulated ditch flow shall be carried as far as the capacity, allowable depth, or velocity of flow will permit. The first catch basin in the roadside or median ditch will determine the need for a storm sewer system required for the remainder of the cut. Velocity control should be extended as far as inexpensive flexible ditch linings will permit.

Consideration should also be given to providing positive outlets for underdrains and providing access to longitudinal sewer systems when locating ditch catch basins.

1102.3.6 Arbitrary Maximum Catch Basin Spacing

Catch basins are required at the low point of all sags and the earth dike noted in Section 1102.3.5 shall be omitted. The maximum distance between catch basins in depressed medians in fill sections shall be as shown in Table 1102-4. Where underdrains are utilized, catch basins shall be provided at a maximum spacing of 1000 feet [300 meters] (500 feet [150 meters] with free draining base) to provide a positive outlet for underdrains.

Table 1102-4

Depressed Median Catch Basin Spacing (Fill Sections)

Median Width	Desirable Spacing	Maximum Spacing
84 feet	1250 feet	1500 feet
60 feet	1000 feet	1250 feet
40 feet	800 feet	1000 feet

1102.4 Ditch Design Criteria - Design Traffic of 2000 ADT or Less

1102.4.1 Design Frequency

A 5-year frequency storm shall be used to determine the depth of flow, and a 2-year frequency to determine the shear stress of flow and width of ditch lining, where needed. The depth of flow shall be limited to an elevation 9 inches below the edge of pavement for the design discharge. The depth of flow in toe of slope ditches shall be further limited such that the design year discharge does not overtop the ditch bank. The minimum width of lining shall be in accordance with Section 1102.3.1.

1102.4.2 Shear Stress Protection

Shear stress protection shall be in accordance with 1002.3.2 except that a 2-year frequency event shall be used.

1102.4.3 Roughness

The roughness used for the hydraulic analysis shall be based on the Manning's Roughness Coefficient values shown in Table 1102-3.

1102.4.4 Catch Basin Types

Standard No. 5 Catch Basins, No. 2-2-A Catch Basin (within their safety limitations as discussed in Section 1102.3.4(D)) and No. 2-2-B Catch Basins should be considered for the lower ADT highways. Standard No. 4 Catch Basins should be used where additional capacity is required.

1102.5 Design Aids for Ditch Flow Analysis

1102.5.1 Earth Channel Charts

Standard radius roadside ditch charts have been prepared, based on the Manning's equation, to facilitate the hydraulic analysis of ditch flow and are included in the Drainage Design Aids. Some of the more commonly used trapezoidal channel charts are also included.

Other trapezoidal channel charts (with 2:1 - 2:1 side slopes and bottom widths varying from 2 feet to 20 feet are available in the Federal Highway Administration publication referenced in section 1102.2.2.

All earth channel charts have been prepared using a Manning's Coefficient of Roughness of 0.03, which is recommended for a seed lining (Construction and Material Specifications Item 659). Q_n and V_n scales have been included on all channel charts so that the channel flow may be analyzed for any value of "n" depending on the roughness of the channel or lining.

1102.5.2 Rectangular Channel Charts

Vertical side channel charts that can be used to analyze the open channel flow in box culverts are included in the Federal Highway Administration publication "Design Charts for Open Channel flow," previously referred to.

1103 Pavement Drainage

1103.1 General

When curbs are provided at the edge of pavement or paved shoulder, (primarily in urban areas), t is necessary to determine the proper type of pavement inlet (or catch basin) to control the spread of water and depth of flow on the pavement. Present day geometric design has resulted in relatively flat transverse and longitudinal pavement slopes. These slopes require more pavement inlets (or catch basins) and consequently result in an appreciable increase in the drainage cost. To alleviate the above, where curb is permissible, standard curb and gutter should be used adjacent to the pavement. Where standard curb and gutter cannot be provided, the outside lanes of a muli-lane pavement should maintain a transverse slope of 1/4 inch per foot (0.02).

If paved shoulders are provided, the drainage cost will be decreased appreciably due to the large volume of flow that can be carried on the pavement shoulder without exceeding the allowable depth of 1 inch below the top of curb or a maximum of 5 inches; a maximum depth of 6 inches is permissible where a barrier shape is provided adjacent to the pavement.

Furnish a drainage design that will reduce the need for bridge scuppers. If bridge scuppers are required contact the Hydraulic Section, Office of Structural Engineering.

A pavement drainage computation sheet similar to that provided in the Appendix shall be used to perform or summarize necessary computations.

Additional information concerning pavement drainage can be obtained from the Federal Highway Administration Hydraulic Engineering Circular No. 22, "Urban Drainage Design Manual."

1103.2 Design Frequency

Pavement inlets (or catch basins) shall be spaced to limit the spread of flow on the traveled lane (considered to be 12 feet wide) as shown in Table 1103-1. The allowable spread may be increased slightly for streets carrying predominantly local traffic and with design speeds less than 45 mph. Design shall be based upon the following frequencies:

Freeways	10 Years
High volume highways (over 6000 ADT Rural or 9000 ADT Urban) ...	5 Years
All other highways	2 Years

For underpasses or other depressed roadways where ponded water can be removed only through the storm sewer system, the spread shall be checked for a 50-year storm for Freeways and high volume highways as defined above, and for a 25-year storm for other highways. The ponding will be permitted to cover all but one through lane of a multiple lane pavement. The depth of flow at the curb shall not exceed 1 inch below the top of the curb for the design discharge regardless of the type of highway. A maximum depth of 6 inches is permissible where a barrier shape is provided adjacent to the pavement.

Table 1103-1

Allowable Pavement Spread

Freeways		0 feet
High Volume Highways (Over 6000 ADT rural or 9000 ADT urban)		
High Speed (45 mph)		4 feet
Low Speed (< 45mph)	2 lanes	6 feet
	4 lanes	8 feet
All other Highways	2 lanes	6 feet
	4 lanes	8 feet

1103.3 Estimating Design Discharge

Runoff contributing to curbed pavements shall be estimated by the rational method, as explained in Sections 1101.2.2, 1101.2.3 and 1101.2.4.

The time of concentration "t_c" shall be the actual time of concentration calculated according to Section 1101.2.2 with an absolute minimum time of 10 minutes.

In urban areas, where justifiable (e.g. contributing drainage area would be difficult to determine), the "strip method" may be used to determine contributing drainage areas. The strip method assumes a contributing drainage area of 150 feet taken on each side of the roadway centerline.

1103.4 Capacity of Pavement Gutters

A pavement gutter has a right triangular shape, with the curb forming the vertical leg and the straight pavement slope, the gutter plate of a curb and gutter, or a paved shoulder forming the hypotenuse. A standard curb and gutter adjacent to a straight pavement slope, or paved shoulder, forms a composite gutter section which complicates the flow analysis. In most cases, the top width of the water surface in a pavement gutter far exceeds the height of the curb. The hydraulic radius does not accurately describe the gutter cross section in this situation, thereby requiring a modification to the Manning's equation to analyze the gutter flow. The accepted modification results in the following equation:

$$Q = 0.56 \frac{Z}{n} S^{1/2} d^{8/3}$$

where:

Q	=	Discharge in cubic feet per second
Z	=	Reciprocal of the pavement cross
n	=	Manning's Coefficient of Roughness (Table 1102-3)
s	=	Longitudinal pavement slope
d	=	Depth of flow in gutter section at curb in feet

Figure 1103-1 provides a graphical solution for the above equation and its use is comparatively simple for straight transverse pavement slopes. However, the use of the nomograph to determine depth of flow at the curb and resulting spread on the pavement for composite sections is much more involved.

1103.5 Pavement Flow Charts

Charts have been prepared for the more commonly used curbed pavement typical sections, and they are included in the Drainage Design Aids. The charts are particularly helpful for determining the flow for composite pavement sections where the spread can be read directly from the appropriate Pavement Flow Chart.

To use the charts, enter with a predetermined design discharge (total flow) Q in the gutter in cubic feet per second and proceed vertically to intersect the longitudinal gutter slope line. At that intersection, read the spread in feet shown on the diagonal spread lines.

The spread of flow will generally control the pavement inlet or catch basin spacing, where the transverse and longitudinal slope of the pavement is relatively flat. The above is prevalent in long flat sag vertical curves, where a flanking inlet (or catch basin) should arbitrarily be provided on both sides of the low point in a pavement sag. This is particularly so for Freeways. Three inlets or catch basins in a sag can be justified only on the basis of need for other highway classifications. Usually a Standard 6 foot pavement inlet or No. 3A catch basin will be adequate, and they should be placed where the grade elevation is approximately 0.20 feet higher than at the low point. Furnish a CB-No. 3 at the sump.

Inlets or catch basins should arbitrarily be placed upstream of all intersections, bridges and pedestrian ramps. When justified, inlets (or catch basins) should be located a minimum of 10 feet off drive aprons, intersection return radii, pedestrian ramps or curb termini.

1103.6 Bypass Charts for Continuous Pavement Grades

Bypass charts are included for the standard pavement inlets and catch basins in the Drainage Design Aids. Bypass for a given structure can be read directly from the chart (At the intersection of the spread, determined in Section 1103.5, and the longitudinal gutter slope, read the bypass flow Q_b on the abscissa). Experience has proven that, for greater efficiency, inlets should be sized to bypass a minimum of 10% to 15% of the design discharge. This criterion should be used to determine the type or length of inlet to be used in a given location. It is not intended to establish the required spacing. The most efficient design maintains the allowable spread on continuous grades and at the sag.

The bypass for a catch basin or inlet should be added to the total flow in the adjacent downstream gutter section.

1103.6.1 Curb Opening Inlets

The flow bypassing a standard curb opening inlet, for pavement transverse slopes or combination of slopes differing from the charts included in the Drainage Design Aids, may be obtained from Figure 1103-2. The use of curb opening inlets should be avoided where bicycle traffic is expected.

1103.6.2 Grate or Combination Grate and Curb Opening Inlet

The standard pavement catch basin in this category is considered to intercept all the flow over the grate when used on continuous grades. A portion of the flow outside of the edge of the grate will also be intercepted, the amount varying with the depth of flow "y" along the edge of the grate. The depth "y" can be determined from Figure 1103-1, and the resulting flow spilling over the edge of the grate from Figure 1103-2, using a ½ inch local depression for straight transverse pavement slopes, or no local depression for a composite gutter section. The curb opening of a combination catch basin on a continuous grade will admit some flow, particularly if there is a partial clogging of the grate; however, the additional capacity should be considered as a factor of safety only.

1103.7 Grate Catch Basins and Curb Opening Inlets In Pavement Sags

The spread determined from the pavement flow charts need not be checked any closer than 25 to 50 feet on either side of the sag, well beyond the limits of the local depression. The spread in the sag should be determined from the depth of flow at the edge of grate using Figure 1103-3 and should include the total flow (contributions from each side of the sag vertical curve) reaching the inlet or catch basin.

Standard No. 3 catch basins should be used in pavement sags. The capacity of the grates to admit flow is based on the depth of ponding around the grates. The capacity of the grates shown in Figure 1103-3 is based on weir flow over the edge of the grate, up to a depth of 0.4 feet. For greater depths, the total area of grate opening is considered, with no deduction made for possible clogging. When evaluating the spread in a depressed sag for a 25-year or 50-year event, the capacity of the window shall be considered. This capacity may be obtained from Figure 1103-4. The curb opening capacity should be added to the grate capacity for submerged conditions.
Where the low point of a sag vertical curve occurs in a drive, a No. 6 catch basin should be provided at the low point with flanking No. 3A catch basins as per Section 1103.5.

No. 6 catch basins may be used along curbed roadways and medians provided that the grate capacity is not exceeded.

1104 Storm Sewers

1104.1 General

Storm sewer systems are designed to collect and carry storm water runoff from the first pavement or ditch inlet, or catch basin to the predetermined outlet. (Further reference to inlets infers either inlets or catch basins). Long cut sections often result in the need for longitudinal trunk sewers to accept the flow from a series of inlets. The proper location of a sewer outlet is quite important. Existing drainage patterns should be perpetuated insofar as practicable. Careful consideration should be given to the possibility of actionable damage for the diversion of substantial volumes of flow. Long fill sections requiring median or pavement drains may best be served by transverse sewers that outlet independently at the toe of fill ditch.

Storm sewer systems shall be sized to convey the current flow from areas naturally contributing to the highway or from intercepting existing storm sewers. Storm sewer systems may be oversized at the request of a local government entity to convey flow from areas beyond those considered highway responsibility or increased flows from anticipated development with the approval of the Hydraulic Section, Office of Structural Engineering. The additional cost to construct the increased sized storm sewer system will be the responsibility of the local government. The proration of project funds and local government funds will be determined from estimated construction costs. The project funding participation will be determined as a percentage of the total cost of the affected plan items. The percentage will be computed by dividing the estimated cost to construct a highway responsibility system only by the estimated cost to construct the oversized system. The affected plan items and participation percentage will be noted in the plan general summary.

Type B conduit shall be specified for storm sewers under pavement, paved shoulders and commercial or industrial drives and Type C conduits for storm sewers beyond those limits. However, the type of conduit shall not be changed for a short run of conduit which would ordinarily require a change in conduit type.

As an example of the above, Type B should be used for a transverse conduit that is required to drain an earth median catch basin in an embankment section under the pavement to a point approximately 10 feet from the embankment slope. A concrete collar, as per Standard Construction Drawing DM-1.1, should be provided to connect the Type B and a Type F Conduit, located back of, and parallel to, the embankment slope. Type F conduit, 707.05 or 707.21 Type C, shall be provided for the pipe specials required to negotiate the bend at the top and bottom of the embankment.

The Construction and Material Specifications stipulate the permissible pipe shapes and materials. Storm sewer designs will be based on round pipe, and the choice of the permissible material types for the conduit specified will be the contractor's option. Extensions of existing pipes should typically be made using like kind material. The length of conduit to be paid for will be the actual number of linear feet, measured from center-to-center of appurtenant small structures. No deduction will be made for catch basins, inlets or manholes that are 6 feet or less across, measured in the direction of flow.

1104.2 Design Considerations

1104.2.1 Storm Sewer Depth

From a cost standpoint, it is desirable to keep a storm sewer system as shallow as possible, consistent with the following controls:

A. A minimum cover of 9 inches from the top of a rigid pipe to the bottom of the pavement subbase (12 inches to 24 inches for a flexible pipe, see Section 1008).

B. A minimum cover of at least 18 inches for standard strength pipe, where permitted.

C. A sufficient depth to permit the use of precast inlets, catch basins and manholes. Refer to the Standard Construction Drawings for this information.

D. A sufficient depth to avoid interference with existing utilities such as sanitary sewers, the grade of which cannot be changed.

E. A sufficient depth to provide a positive outlet for underdrains. It is desirable to maintain the underdrain outlet 12 inches above the flow line of the outlet structure with 6 inches as a minimum.

F. Sufficient slope to provide a desirable minimum velocity of 3 feet per second, for self-cleansing. This velocity is calculated using the "just full" Manning's Equation.

G. The crown of a smaller upstream pipe in a longitudinal trunk sewer should match the crown of the adjacent downstream pipe.

Where proposed highway storm sewers or ditches will interfere with existing private drains carrying treated or untreated sanitary flow, the names and addresses of the affected property owners shall be submitted to the District Deputy Director. The above information shall be obtained well in advance of the Field Drainage Review so the appropriate provisions of Directive No. 22-A can be followed.

1104.2.2 Storm Sewer Access

Most standard catch basins and pavement inlets will provide sufficient access to small shallow sewers. Catch basin or pavement inlets can be used to negotiate changes in sewer sizes or minor horizontal or vertical direction changes within the size limitation of the structure, but more pronounced changes may require manholes.

It may be necessary, or desirable to locate longitudinal trunk sewers away from the curb to provide for a utility strip between the curb and the sidewalk and to avoid a conflict with the underdrain system. This will require properly spaced manholes in the sewer line. Small sewers (under 36 inches in diameter) located under or near the edge of pavement, should be accessible at intervals not to exceed 300 feet. For sewers sized 36 to 60 inches manholes should be spaced every 500 feet maximum. Manholes should be provided every 750 to 1000 feet maximum for larger sewers.

1104.3 Layout Procedure

1104.3.1 Plan

A print of the plan sheets involved should be used to spot catch basins and inlets that are required to drain the project and satisfy maximum allowable depth and/or spread of flow. A strip map showing the delineated drainage area and topography is required. The map will provide the designer with a means of determining the drainage area and the weighted coefficient of runoff for the individual areas contributing flow to the required storm sewer system.

1104.3.2 Profile

A profile of the existing and proposed pavement or ground line over the proposed sewer location should be plotted. On the same profile, plot the locations of catch basins, inlets and manholes, along with a tentative storm sewer system.

1104.4 Storm Sewer Design Criteria

1104.4.1 Design Frequency

All storm sewers shall be sized to flow just full (i.e. depth of flow for maximum discharge) for a 10-year frequency storm. The size is determined by working downstream from the first sewer run. It will be acceptable to use a discharge of a more frequent occurrence if consistent with local policy (depending upon the design ADT of the roadway) or to avoid extensive replacement of an existing downstream drainage system.

1104.4.2 Hydraulic Grade Line

Starting at the storm sewer system outlet and working upstream, the elevation of the hydraulic grade line at the upper end of each sewer run should be determined using a 25-year frequency. It will be acceptable to use a discharge of a more frequent occurrence if consistent with local policy (depending upon the design ADT of the roadway) or to avoid extensive replacement of an existing downstream drainage system. Ordinarily, the hydraulic grade line will be above the top of the pipe, causing the system to operate under pressure. If, however, any run in the system does not flow full, (pipe slope steeper than the friction slope) the hydraulic grade line will follow the friction slope until it reaches the normal depth of flow in the steep run. From that point, the hydraulic grade line will coincide with the normal depth of flow until it reaches a run flatter than the friction slope for that run.

The starting elevation for the hydraulic grade line determination should be the higher of either: the downstream tail water channel water surface elevation or (dc+D)/2 at the system outlet. Section 1105.6.1

The intensity "i" in the rational equation Q=CiA [Q=CiA/360] used to determine the check discharge (25-year frequency) shall be the same for all sewer runs as that calculated for the last, or downstream run, in a continuous sewer system.

The hydraulic grade line shall not exceed the following for any roadway with greater than 2000 ADT:

A. 12 inches below the edge of pavement for sections without curb.

B. The elevation of a curb opening inlet or grate elevation of a pavement catch basin.

Consideration shall be given to a reduction in the design frequency and to more liberal hydraulic grade line controls for less important highways than those noted above.

The check discharge, to determine the elevation of the hydraulic grade line for highways having depressed sags that must be drained by storm sewers, shall be based on a 50-year frequency. One directional lane of a multiple lane highway or one-half of a lane on a 2-lane highway should be passable when the sewer system is discharging the 50-year storm.
Storm sewers for all highways shall satisfy a 50-year check to preclude flooding of buildings or extensive flooding of private property.

If the hydraulic grade line exceeds the limits noted above, the controlling sewer size shall be increased. (These criteria are not intended to lower existing high water elevations)

1104.4.3 Coefficient of Runoff

The weighted coefficient of runoff shall be determined as explained in Section 1101.2.3

1104.4.4 Time of Concentration

The time shall be determined as explained in Section 1101.2.2. A minimum time of concentration of 15 minutes to the first ditch catch basin and 10 minutes to the first pavement inlet shall be used. The actual calculated time of concentration shall be used when values greater than these minimums occur.

1104.4.5 Pipe Roughness Coefficient

A Manning's "n" of 0.015 shall be used for sewers 60 inches in diameter and under, and 0.013 for larger sewers. The basic "n" value for smooth pipe, concrete, vitrified clay, bituminous lined corrugated steel or thermoplastic is 0.012. The increased values are recommended for sewers to compensate for minor head losses incurred at catch basins, inlets and manholes located in a storm sewer system.

1104.4.6 Minimum Storm Sewer Pipe Size

A minimum pipe diameter of 15 inches shall be used for Freeways and Freeway ramps (Where an existing storm sewer is to remain in service, it is not necessary to replace, hydraulically adequate pipes to meet this criterion) and 12 inches for other highways.

1104.5 Hydraulic Design Procedure

With the layout suggested in Section 1104.3, start with the upper catch basin or inlet and determine the value of CA for the contributing flow (CA is the product of the weighted coefficient of runoff and the drainage area). Next, determine the time of concentration for the first area and the corresponding rainfall intensity "i" from the proper curve shown on Figure 1101-2. The design discharge "Q" to use to determine the required size of the first sewer from MH No. 1 to MH No. 2 is the product of Ca x i [0.0028CA x i]. At manhole No. 2, determine the value of CA for the additional area contributing at that point and add to the CA for MH No. 1.

Compute the time of flow in the storm sewer from MH No.1 to MH No. 2 in minutes and add to the time of concentration at MH No. 1. Check the time of concentration for the area contributing to MH No. 2, and use the larger of the two as the duration for the new value of rainfall intensity for computing the design flow from MH No. 2 to MH No. 3.

It is obvious that the process is quite involved, and a storm sewer computation sheet similar to that provided in the Appendix shall be used to tabulate the required information. The calculations for lateral connections to the longitudinal trunk sewer should be tabulated separately from the trunk sewer calculations.

1105 Roadway Culverts

1105.1 General

A culvert generally carries a natural stream under the highway embankment. The culvert horizontal and vertical alignment matches the natural channel horizontal and vertical alignment. Ensure the upstream invert is not below the natural channel unless the culvert has depressed inverts, a paved depressed approach apron, or an improved inlet. Optimum culvert design (i.e., best hydraulic performance and least environmental impacts) occurs when the roadway alignment is normal to the flow in the channel and is located on a relatively straight and stable section of the channel. Roadway alignment needs to be considered early in the design process to provide optimum culvert design. The proposed roadway should avoid stream confluences. Culverts should not be placed on skews in excess of 45° or as further limited in Section 1008.

A single-cell round pipe should be the designer's first choice. In cases where required cover or discharge precludes a round pipe, consideration should be given to a single-cell elliptical concrete, metal pipe-arch, prefabricated box culvert or three-sided structure, in order of preferred use. For justification of multiple cell culverts, see Section 1105.2.4.

Culvert location should perpetuate existing drainage patterns insofar as practicable. Diversion of substantial volumes of flow requires consideration of possible actionable damage.

1105.2 Stream Protection

Stream protection ensures the stream will not degrade due to incision caused by down-cutting, or head-cutting. Stream protection best management practices (BMP) are as follows:

- Bankfull discharge design
- Depressed culvert inverts
- Flood plain culverts
- Multiple cell culverts
- Paved depressed approach apron
- Improved inlets
- Energy control structures

Provide stream protection BMP for all culverts. Each BMP has use restrictions.

1105.2.1 Bankfull Discharge Design

Culverts that are required to convey the bankfull discharge will match the existing channel conditions with the proposed channel conditions.

All culverts require a bankfull discharge design except for those culverts that meet any of the following conditions:

- The culvert is a replacement structure.
- The culvert is 30" in diameter or rise, or less.
- The culvert is not covered under a Nationwide Permit Number 14

This BMP will ensure existing stream channel conditions are maintained.

If multiple cell culverts are provided, ensure only one culvert conveys the bankfull discharge. Place the invert of additional culverts at the water surface elevation generated by the bankfull discharge.

Use the following design steps when performing a bankfull discharge design:

1. Determine the bankfull discharge using USGS report 2005-5153, "Bankfull Characteristics of Ohio Streams and Their Relation To Peak Streamflows". Use the regression equation that utilizes USGS map-based explanatory variables. The report can be obtained from USGS at: http://pubs.usgs.gov/sir/2005/5153/.
2. Determine the culvert size from traditional culvert hydraulic design.
3. Depress the culvert invert if required (see section 1105.2.2).
4. Determine the depth of flow for the pre-developed channel using the bankfull discharge at: 25 feet before the culvert entrance and 25 feet beyond the culvert exit.
5. Determine the depth of flow for the post-developed condition using the bankfull discharge at the same locations in step 5.
6. Compare the depth of flow from step 4 to step 5. Increase the culvert rise until the flow depth in step 5 is lower than or equal to the flow depth in step 4.
7. Add flood plain culverts if required (see section 1105.2.3).
8. Determine if the culvert meets the required hydraulic design. Upsize the culvert as required.

The proposed culvert will minimize the impact to the stream channel by closely matching the existing depth of flow with the proposed depth of flow for the bankfull discharge.

Determine the depth of flow for the bankfull discharge by one of the following methods:

- A standard step-backwater water-surface profile model such as HEC-RAS using field-obtained stream cross-sections
- Mannings equation using field-obtained stream cross-sections.

1105.2.2 Depressed Culvert Inverts

All culverts are required to have depressed inverts except for those that meet any of the following conditions:

- The culvert is a replacement structure.
- The culvert does not convey a water of the United States.
- The culvert conveys an ephemeral stream.
- The culvert is 30" in diameter or rise, or less.
- The culvert is not covered under a Nationwide Permit Number 14.
- The culvert has a natural channel bottom (3-sided precast structure).

This BMP will produce a natural channel bottom within the culvert. The natural channel bottom provides a substrate for passage of migratory species.

The depressed culvert will fill naturally, such that the channel bed in the culvert will be continuous with the adjacent channel sections.

Use the following design steps when designing depressed culvert inverts:

1. Determine the culvert size from traditional culvert hydraulic design.

2. Increase the culvert rise or diameter by one size.

3. Depress the culvert per table 1105-2.

4. Determine if the culvert meets the required hydraulic design. Upsize the culvert as required.

End treatments consist of Item 601 Riprap, 6" Reinforced Concrete Slab with a cutoff wall on both inlet and outlet ends. See standard construction drawing DM-1.1 for details.

Depress the culvert invert per the following table:

Table 1105-2

Type A Conduit Invert Depression

Pipe Diameter or Rise	Depression
<36"	None
36"-60"	6"
66"-120"	12"
126"-180"	18"
186"-252"	24"
>252"	30"

Modifications to the standard headwalls are not necessary for the depression depths noted above.

1105.2.3 Flood Plain Culverts

All culverts are required to have flood plain culverts except for those that meet any of the following conditions:

- The culvert is a replacement structure.
- The flood plain width is less than two (2) times the width produced by the bankfull discharge design.
- The culvert does not convey a water of the United States.
- The culvert conveys an ephemeral stream.
- The culvert is 30" in diameter or rise, or less.
- The culvert is not covered under a Nationwide Permit Number 14.

Flood plain culverts are used to minimize the effects of a single culvert within a wide flood plain. The installation of a single culvert can concentrate the flow. Flood plain culverts will reduce the concentrated flow by reducing the hydraulic load of the single culvert by spreading the discharge throughout the flood plain.

Flood plain culverts are installed adjacent to the single culvert. Place flood plain culvert inverts at the water surface elevation that is generated by the bankfull discharge design. Locate the flood plain culverts within the flood plain at a location well beyond the single culvert. Provide a minimum of two flood plain culverts.

Flood plain culverts are not hydraulically designed or accounted for in the hydraulic design of the single culvert. Use Figure 1002-1 ("other" column) to determine the required diameter. The line and grade of the culvert should approximate that of the natural flood plain.

1105.2.4 Multiple Cell Culverts

A single-cell culvert should be the designer's first choice within practical limitations. If flood plain culverts are provided, do not use multiple cell culverts.

Occasionally, low headwater requirements, high fills, or bankfull design will create the need for multiple cells. For these cases, it is desirable to limit the number of cells to two. Experience has proven that multiple cells well aligned with a relatively straight channel, will operate satisfactory. However, a bend in the immediate upstream channel may cause the inside cell to collect debris during normal periods of runoff and thereby substantially reduce the capacity of the culvert.

1105.2.5 Paved Depressed Approach Apron

Culverts may require a paved depressed approach apron. Do not provide a paved depressed approach apron for the following:

- The culvert is a replacement structure.
- The culvert is 30" in diameter or rise, or less.
- The culvert is not covered under a Nationwide Permit Number 14.
- Natural channel bottom structure (3-sided precast structure).

- The culvert inverts are depressed.

This BMP will improve the operation of the culvert by depressing the flowline at the entrance below the channel flowline. The drop-down will alleviate a minimum cover condition, provide for additional headwater depth, and decrease the culvert outlet velocity by reducing the culvert slope.

The abrupt change in natural channel slope is effected with a short length of concrete paving. The dimensions of the slab are site specific. However, for ease of construction, a 2:1 downslope (4:1 preferred) should be used as the maximum descending slope. A 3 foot length of paving should be provided along the natural channel slope prior to the drop-down. A cut-off wall must be provided at the upstream end.

Drop-down entrances should generally be limited to 4 feet, or one pipe diameter or rise, whichever is greater.

The Federal Highway Administration has conducted extensive research and studies of paved depressed approach aprons, and recommended design procedures are included in Hydraulic Engineering Circular No. 5, "Hydraulic Design of Highway Culverts."

1105.2.6 Improved Inlets

Culverts may require an improved inlet. Do not provide an improved inlet for the following:

- The culvert is a replacement structure.
- The culvert does not convey a water of the United States.
- The culvert conveys an ephemeral stream.
- The culvert is 30" in diameter or rise, or less.
- The culvert is not covered under a Nationwide Permit Number 14.
- Natural channel bottom structure (3-sided precast structure)
- The culvert inverts are depressed.
- Paved drop-down culvert entrance

This BMP will improve the operation of the culvert by depressing the flowline at the entrance below the channel flowline. The drop-down will alleviate a minimum cover condition, provide for additional headwater depth, and decrease the culvert outlet velocity by reducing the culvert slope.
Two general types of inlets should be considered in the following order:

Culverts on relatively steep slopes and controlled by inlet control can see a reduction in the culvert size by furnishing an improved inlet. The improved inlet will control the headwater by the entrance configuration for a given barrel size.

A. Side-taper, which is a tapered end section from a round to an oval shape for a pipe, or a square to a rectangular shape for a prefabricated box. The length of the taper section is usually made 1.5 times the diameter or rise of the culvert.

B. Slope-taper, which is a combination of side-taper preceded by a drop in the culvert flow line. The drop can be similar to a paved drop-down entrance or a more sophisticated reinforced concrete drop provided by a formed cast-in-place section with vertical sides.

The improved inlet has the advantage of admitting more flow and thereby tending to fill the culvert barrel and reduce the culvert outlet velocity. The savings in culvert cost must justify the additional cost of the improved inlet.

The Federal Highway Administration has conducted extensive research and studies of improved inlets, and recommended design procedures are included in Hydraulic Engineering Circular No. 13, "Hydraulic Design of Improved Inlets for Culverts."

1005.2.7 Energy Control Structures

All culverts are required to have an energy control structure.

An energy control structure reduces the amount of erosive energy generated by a culvert. Use the following for an energy control structure:

- Broken-Back Culvert
- Rock Channel Protection
- Energy dissipater (Riprap Basin)
- Drop Structure

An energy dissipater is required when the outlet velocity exceeds the values shown in Figure 1107-1. Energy dissipaters create a forced hydraulic jump within the structure or immediately downstream of the structure, thus reducing the flow velocity. FHWA Hydraulic Engineering Circular No. 14 provides design guidance and procedures for various energy dissipaters. The preferred energy dissipater is the riprap basin.

Contact the Office of Structural Engineering, Hydraulics Section prior to using an energy dissipater.

1105.3 Types of Culvert Flow

Laboratory tests sponsored by the FHWA have established two general types of culvert flow: (1) flow with inlet control, or (2) flow with outlet control. Nomographs have been prepared for use in the determination of culvert headwater for the appropriate control.

Under inlet control, the headwater "HWI" is directly related to the cross-sectional area of the culvert barrel and the inlet geometry. Under outlet control, the headwater "HWO" is further influenced by tailwater depth in the outlet channel and the slope, length and roughness of the culvert barrel. As shown in Figure 1105-1, culverts operate with a free water surface if the headwater is equal to or less than 1.2D, and with a submerged entrance if the headwater is greater than 1.2D, where D is the diameter or rise of the pipe.

1105.4 Design Procedure

1105.4.1 General

The design of a culvert involves a determination of the appropriate design and check discharges. The process begins with a delineation of the drainage area, in acres [hectares], on a suitable topographic map.

The design discharge "Q" for most culvert drainage areas will be obtained by procedures described in USGS Reports 89-4126 and 93-135, applying the limitations covered in Section 1003.1.2 of this manual. The Rational method should be used to obtain the discharge from small and other unusual drainage areas as noted in Section 1101.2.2

A representative cross-section of the embankment at the proposed culvert site, along with a profile of the natural stream or ground line, will be required to determine the approximate length and slope of the culvert.

1105.4.2 Hydraulic Analysis

The hydraulic analysis of a culvert, including a determination of the headwater depth and outlet velocity for the design discharge, is simplified by the use of Pipe Flow Charts and the headwater and head nomographs noted in Section 1105.4. The charts are included with the Drainage Design Aids, beginning with Figure 1100-200.

To preclude the need for a determination of the probable type of flow under which a culvert will operate for a given set of conditions, the headwater depths may be computed using the nomographs for both inlet and outlet control. The size of pipe is then selected by using the control giving the higher headwater limitation.

The relationship of the headwater to the diameter or height of the culvert "HW/D" is read directly from the inlet control nomograph and the HWI equals that value multiplied by D. HWO is computed by the equation HWO=H+ho - SoL. The loss of head "H" is read from the flowing-full nomograph and the tailwater depth "ho", is the greater of either the normal depth of flow in the outlet channel or the depth as flow passes through the outlet of the pipe, calculated as (dc+D)/2. D is the diameter or rise of the culvert and dc is the critical depth of flow which may be read from the critical depth curve shown on each Pipe Flow Chart.

The above procedure is reasonably accurate for the majority of culvert flow conditions. For culverts operating with outlet control (see Figure 1105-1, Class 1-A and 1-B), where the calculated headwater (using the appropriate nomograph) is less than 0.75D, a backwater analysis can be justified and is recommended.

A culvert analysis sheet similar to that provided in the Appendix shall be used to tabulate all the pertinent factors required to determine the controlling headwater for each culvert type being considered for a given location. The analysis sheet includes other information valuable to the reviewer and it is to be included with other supporting data for required review submissions.

Hydraulic analysis of culverts may also be performed utilizing the Federal Highway Administration Hydraulic Design Series No. 5, Hydraulic Design of Highway Culverts. Computer programs such as FHWA HY-8 or ODOT's CDSS software package may be used. CDSS may be downloaded from the Hydraulics website.

For replacement projects, an analysis of the existing structure shall be performed. If appropriate (usually depending upon whether the structure is operating with a free water surface at its entrance), it is preferable that the same analysis method be used to compare the existing and proposed structures. For bridge replacements, acceptable methods of hydraulic analyses are listed numerically in preferred order as follows (the limitations of the method used shall be investigated prior to selecting it for use):

1. Computer Program HEC-2 (HEC-RAS)

2. Computer Program HY-7 (WSPRO)

3. Hydraulic Design Series No. 1, "Hydraulics of Bridge Waterways", Federal Highway Administration, and computer program HY-4.

1105.5 Use of Nomographs

1105.5.1 Outlet Control

To determine the loss of head "H" for a given concrete pipe culvert with a grove-end entrance and discharge "Q", proceed as follows: By straight line, connect culvert size with ke=0.2 (length scale) and obtain a point on the turning line. Connect the turning line point with the computed discharge "Q" and read the head loss "H". Follow the same procedure for a corrugated metal pipe except using ke=0.9 (length scale). The k_e value for additional shapes can be found in the Federal Highway Administration publication referenced in Section 1105.3.1.

Should the roughness coefficient "n" of the proposed pipe differ from that shown on the chart, adjust the measured culvert length by the length factor given on Design Aid Figure 1100-247. For an example, see Drainage Design Aid Figure 1100-247.

The Federal Highway Administration publication referenced in Section 1105.3.1 offers nomographs for culvert shapes not available in the Drainage Design Aids. Their use is recommended for special culvert shapes.

1105.5.2 Inlet Control

To determine the headwater "HW" for a given discharge "Q", size and type of culvert, proceed as follows using appropriate Figures 1100-245, 1100-246 (Drainage Design Aids). Use Figure 1100-245 for a round corrugated metal pipe culvert and Figure 1100-246 for a round smooth-lined pipe culvert. By a straight line, connect the culvert size with the discharge "Q", extend a diagonal line to Scale (1) and thence by horizontal line to Scale (3). Based on a groove-end entrance and a Standard HW-2.1 headwall recommended for concrete pipe culverts, the HW/D relationship is obtained by an average of the (2) and (3) Scale values. Follow the same procedure for a corrugated metal pipe with a Standard HW-2.2 headwall, where HW/D is the average values read from Scales (1) and (3). Use Scale (2) for the HW/D relationship for concrete box culverts.

1105.6 Design Criteria

1105.6.1 Design Frequency

The design frequency shall be as stated in Section 1004.2
It should be noted that a Flood Hazard Evaluation using a check discharge based on the 100-year flood frequency shall be made for all culverts as noted in Section 1005.2.1.

1105.6.2 Maximum Allowable Headwater

See Section 1006.

1105.6.3 Method Used to Estimate Storm Discharge

See Sections 1003 and 1101.

1105.6.4 Scale of Topographic Mapping Used to Delineate Contributing Drainage Areas

See Section 1101.1

1105.6.5 Manning's Roughness Coefficient "n"

The "n" values for corrugated metal pipe are given in Figure 1105-2. The "n" value for all smooth flow pipe is 0.012. Use a weighted Manning's n for bankfull designed culverts or analyzing older culverts with sediment deposition.

1105.6.6 Entrance Loss Coefficient "k_e"

See Table 1105-1 or Appendix D of Federal Highway Hydraulic Design Series No. 5, "Hydraulic Design of Roadway Culverts.

1105.6.7 Minimum Cover

See Section 1008

1105.6.8 Maximum Cover

See Section 1008

1105.6.9 Maximum Allowable Outlet Velocity

See Figure 1107-1

Table 1105-1

Type A Conduit
Entrance Loss Coefficient k_e

Type of Pipe	Headwall Type Full	One-Half	None
Concrete, Vitrified (thick wall) *	0.2	0.2	0.2
Corrugated Metal (thin wall)	0.25**	0.9	0.9

* groove end entrance
** with beveled entrance

1105.6.10 Headwall Type

See Section 1106.2

1105.6.11 Contacts With County Engineer

Contact shall be made with the County Engineer at the beginning of the design process to ascertain ditch cleanout grades and watersheds, and the design shall be based on that information. Form LD-33 (available in the Appendix) shall be used to document approval.

1105.6.12 Minimum Pipe Size

As specified in Section 1002.3.1

1105.7 Special Considerations

The following are special conditions that will be encountered in the hydraulic design of culverts that warrant clarification.

1105.7.1 Tailwater

Tailwater at a culvert outlet can greatly affect the size of culvert required at a specific site. For this reason a proper evaluation shall be made of the outlet channel so that a reasonable estimate of the tailwater can be calculated.

A determination of the normal depth of flow in the outlet channel, when the culvert is discharging the design flow, normally establishes the culvert tailwater. A close examination of the downstream channel may however, reveal a temporary or permanent obstruction that will control the operation of the culvert. In some cases, the culvert will outlet near a river or other fluctuating water surface stream that could control its operation.

Where that drainage area of the culvert is very much less than the receiving watercourse (i.e. 100 times) the effect of the receiving watercourse generally may be disregarded.

Where the drainage areas of the culvert and receiving watercourse are nearly equal, concurrent flood peaks may be assumed.

Where there is a significant, but not excessive, difference in the drainage area of the culvert and receiving stream, the following design procedure should be used and the culvert sized using the combination that results in the highest headwater.

A. Compute the culvert headwater using the proper design frequency for the culvert and a lesser frequency for the receiving stream water surface elevation (i.e. culvert tailwater elevation) depending upon the difference in drainage areas; say a 25-year culvert and a 10-year stream.

B. Use 10-year frequency for the culvert and 25-year for the stream.

In some locations, a high tailwater will control the operation of a culvert to such an extent that a substantial increase in pipe size will be required for a negligible decrease in the headwater elevation. For this case, the culvert size should be based on a practical tailwater elevation (e.g. [dc+D]/2).

1106 End Treatments

1106.1 General

Headwalls, or other approved end finishes, shall be provided at the open ends of all Type A, B and C conduits. Headwalls should also be provided for Type D conduits greater than 24 inches in diameter or rise. Generally, headwalls are not recommended for Type E and F conduits.

In order to reduce the entrance loss in culverts, the bell end should be located upstream and the spigot end should be located downstream. Details shown in the plan should convey this to the Contractor when necessary. Figures 1106-2 and 1106-3 show typical end details for a concrete box culvert.

1106.1.1 Usage

The selection of the headwall type is based on safety and economics. Standard HW-2.1 and 2.2 half-height headwalls are recommended for round, elliptical, or pipe arch culverts where a clear zone is provided. Full height headwalls should be provided where a significant reduction in culvert length can be realized with large-span culverts (10 feet or greater) with foreslopes flatter than 2:1 or where right-of-way limits the culvert length. Full-height headwalls shall be provided for prefabricated box culverts and three-sided structures.

The use of special end treatments may be required by Section 602.6 of Volume 1, Roadway Design. Details are available from the Hydraulic Section, Office of Structural Engineering. Justification for the use of this type of end treatment shall accompany the request for details. Miter-cut (step-bevel) end sections, when required, shall be shown on the Culvert Detail Sheet.

When half-height headwalls are provided, they should be built perpendicular to the end of the conduit to eliminate the need for a skew cut. In addition to the required headwall, the upper, or exposed, half of conduits having a diameter or rise greater than or equal to 126 inches shall be miter-cut (step-bevel) to fit the embankment slope.

1106.1.2 End Treatment Grading

The prevailing embankment slope shall be projected to the back edge of the top of the headwall to establish the required culvert length as shown in Figure 1106-1. When the roadway foreslopes are flatter than 2:1, a 2:1 slope shall be provided from the back edge of the top of the headwall to a minimum of 1 foot , with 2 feet preferred, above the top of the culvert. The change in embankment slope shall be warped on each side of the conduit to fit the prevailing slope. In no case shall the distance from the pavement edge to the point where the embankment slope changes to 2:1 be less than the design clear zone width (see Section 601, Volume 1, Roadway Design) unless guardrail is provided.

Clear zone grading should only be provided at culverts when the requirements of Section 307.21 of Volume 1, Roadway Design are met.

The prevailing embankment slope shall be warped on either side of a skewed culvert to assure equivalent soil loading and proper side support of the pipe. This is especially true for flexible pipes with large skews and/or large diameters.

1106.2 Headwall Types

1106.2.1 Half-Height Headwalls

If the size of the conduit exceeds that shown in the Standard Construction Drawing HW-2.1 and HW-2.2 tables, the dimensions shown in the tables may be expanded to accommodate the larger size conduits. Payment for half-height headwalls shall be on a cubic yard basis for Item 602, Concrete Masonry. Masonry quantities for standard half-height headwalls may be obtained from the appropriate standard construction drawing. The quantity of concrete masonry provided in the plans shall be based on the pipe alternate requiring the largest quantity of concrete masonry.

1106.2.2 Full-Height Headwalls

The appropriate full-height headwall for round pipes shown on Standard Construction Drawing HW-1.1 may be considered at the entrance end, when the savings in the reduced size and length of the conduit will offset the additional cost of the headwall. This will most likely apply where corrugated steel pipe is specified, due to cover or size requirements, and the bevel provided for the full-height headwall will substantially reduce the entrance loss. Dimensions of full-height headwalls may be expanded to accommodate pipe sizes larger than 84 inches.

The design of full-height headwalls for box and 3-sided culverts shall be as per Section 300 of the Bridge Design Manual and the latest “AASHTO Standard Specifications for Highway Bridges.” Payment for non-standard full-height headwalls shall be on a cubic yard basis for Item 511, Class C Concrete. The Class C Concrete shall be further subdivided into individual pay items for Class C Concrete for Footing, Class C Concrete for Wingwall.

Appropriate plan notes from Section 6 of the Bridge Design Manual shall be included in the project plans.

An investigation of the supporting foundation material shall be conducted and the bearing capacity of the foundation material estimated. The level of detail required for the foundation investigation shall be commensurate with the importance of the structure. Such information shall be submitted for all proposed full-height headwall installations and submitted prior to the Stage 3 review.

The inlet wingwall footings of full-height headwalls shall be armored with Type B rock channel protection, with filter, to preclude scour.

1106.3 Concrete Apron

Provide a reinforced concrete riprap cutoff wall, as shown on Standard Construction Drawings DM-1.1 when the depth of the rock channel protection (if necessary), including the 6 inch granular filter, exceeds the depth of the headwall.

Provide concrete riprap at the inlet end of the culvert where the existing culvert has been undercut. Concrete riprap shall be in accordance with Section 1105.6.3. Concrete riprap is not necessary at the inlet of culverts with full height headwalls that have a footing toe extending 3.5 feet or more below proposed channel grade.

1107 Rock Channel Protection

1107.1 General

Rock channel protection is used to control erosion at the outlet of culverts and storm sewers, or for lining ditches on steep grades. It is used as a scour countermeasure at the inlet wingwalls of full-height headwalls and along the footings of 3-sided structures.

1107.2 Types

There are four types of rock channel protection (RCP) that are used in various situations. The use of the proper type at culvert and storm sewer outlets can be determined from Figure 1107-1. Type A is generally used beyond the outlet of the larger conduits having outlet velocities in excess of 12 feet per second and Type B and C for conduits having an aggregate filter where the protected slope is steeper than 3:1. A filter should always be specified to prevent soil piping through the rock. A fabric filter is preferred in most cases. An aggregate filter should be used when the RCP is under water. The cost of the filter is included in the unit bid price for Item 601 Rock Channel Protection with Filter.

1108 Agricultural Drainage

1108.1 Farm Drain Crossings

Where it is necessary to continue an existing farm drain crossing under the highway, the pipe shall be Type B Conduit, one commercial size larger than the existing farm drain within the right-of-way limits.

Occasionally, it will be desirable to provide a farm drain crossing under a highway on new location to satisfy the future need for adequate farm drainage. It is recognized that the required length of a Type B Conduit will provide a betterment for the property owner, but it does preclude the need for a much more expensive crossing after the highway is built. Such a crossing is considered a "blind" and the cost of the installation, including suitable terminal markings at the right-of-way lines, will generally not be eligible for federal participation.

1108.2 Farm Drain Outlets

Existing farm drains that outlet through the backslope of the roadway ditch shall terminate with a minimum length of 10 feet of equivalent size Type F conduit. When outletting existing plastic farm drains, one size larger Type F conduit shall be used. An Animal Guard and Erosion Control Pad as shown on Standard Construction Drawing DM-1.1 shall be provided. To provide for possible sedimentation, the invert of the Type F conduit shall be a minimum of 6 inches, with 12 inches being desirable, above the ditch flow line.

1109 Longitudinal Sewer Location

1109.1 Under Pavement

Longitudinal sewers will not be permitted under the pavement of a limited or controlled access facility. Also, the length of transverse sewers under pavements shall be held to a minimum, with no manholes allowed in the pavement.

For other facilities, storm sewers should be located outside the limits of the pavement. However, in locations where this would create conflicts with existing utilities (e.g. waterlines, sanitary sewers, gas lines, etc.) the storm sewer may be located under the pavement. Care should be taken to avoid placing manholes in vehicle wheel-paths or within an intersection.

The center of the curb lane is the preferred manhole location.

Where an out-to-out clearance of 5 feet cannot be provided between parallel storm and sanitary sewers, premium joints shall be provided on the storm sewer.

1109.2 Under Paved Shoulder

The above shall also apply to paved shoulder areas, unless it is determined that the cost of any other possible location is prohibitive.

1109.3 Approval

Exceptions to the above shall be submitted in the early stages of the design to the Hydraulic Section, Office of Structural Engineering for review and approval.

1110 Reinforced Concrete Radius Pipe and Box Sections

1110.1 General

To comply with the capabilities of manufacturers to provide satisfactory and economical radius pipe or box sections, a minimum radius of 100 feet shall be specified.

The method of manufacturing the radius pipe or box sections will be an option of the producer, subject to inspection and approval by the Ohio Department of Transportation, Office of Materials Management.

As an alternate to radius pipe, pipe specials may be specified to negotiate the specified radius, provided they do not reduce the hydraulic performance established by the initial design. The bends shall be located so that they shall closely follow the alignment of the radius pipe.

1111 Sanitary Sewers

1111.1 General

Any sanitary sewer, whether new or relocated, shall be constructed using resilient and flexible gasket joints, in accordance with Construction and Material Specification 706.11 for circular concrete pipe or 706.12 for clay pipe. Permissible thermoplastic pipes shall also be specified.

Discharges of treated sanitary flow from abutting property into highway drainage systems are only permitted if the discharge is authorized by the Local Health Department.

1111.2 Manholes

All new manholes for sanitary sewer lines shall be built in accordance with the Standard Construction Drawings. Precast manholes shall have joints in accordance with 706.11 of the Construction and Material Specifications.

1112 Notice of Intent (NOI)

1112.1 General

A NOI will be submitted by ODOT for all plans, which include Project Earth Disturbing Activities. Maintenance Projects, as defined by Section 1112.2, do not require a NOI.

The Total Earth Disturbing Activity acreage should be estimated, which includes the Project Earth Disturbing Activity acreage (area within the work limits) and the Contractor Earth Disturbing Activity acreage such as: field offices, batch plants, and borrow/waste pits. The location and size of the Contractor Activities can be estimated using the NOI Acreage Calculation Form (Figure 1112-1).

The calculated acreage's shall be used for the Project Site Plan as required by Location and Design, Volume 3, section 1308.

1112.2 Maintenance Project

A Maintenance Project is one in which all of the Project Earth Disturbing Activities are routine operations that do not change the line, grade, or the hydraulic capacity of the facility and are limited to Earth Disturbance acreage less than 5 acres. Permanent erosion control items shall be included in the plans if required. Contact the Office of Structural Engineering, Hydraulics Section for an approved list of activities.

Post construction storm water best management practices are not required for maintenance projects that do not increase the impervious drainage area.

1113 Erosion Control at Bridge Ends

1113.1 General

For the purpose of reducing problems of erosion in the vicinity of bridge ends, details as shown on Standard Construction Drawing DM-4.1 shall be followed. At locations where the design flow exceeds 0.75 cubic feet per second, catch basins should generally be provided.

1113.2 Corner Cone

Item 670 Slope Erosion Protection shall be placed on all bridge approach embankment corner cones, beginning at the edge of the crushed aggregate or concrete slope protection.

1114 Temporary Sediment and Erosion Control

1114.1 General

Temporary sediment and erosion control is required on all projects that have Earth Disturbing Activities as outlined in Supplemental Specification 832. A Storm Water Pollution Prevention Plan (SWPPP) is required for all projects that require a NOI (See section 1112) The SWPPP requirements are outlined in Supplemental Specification 832.

1114.2 Cost Estimate for Temporary Sediment and Erosion Control

For all projects that require temporary sediment and erosion control furnish an amount to be encumbered in the project final package. Use the temporary sediment and erosion control estimator located in the Design Reference Resource Center to develop this amount. Furnish the calculations with the final plan package.

1115 Post Construction Storm Water Structural Best Management Practices

1115.1 General

Post Construction Storm Water Best Management Practices (BMP) are provided for perpetual management of runoff quality and quantity so that a receiving stream's physical, chemical and biological characteristics are protected and stream functions are maintained.

BMP are required for all projects within ODOT right-of-way that have ODOT maintenance responsibility and disturb 1 acre or more. Maintenance projects as outlined in section 1112.2 do not require BMP.

BMP are protected and located in accordance with Location and Design, Volume 1.

If discharging into a roadway ditch that conveys a captured stream, separate the drainage by using curbing or barrier. Treat impervious drainage areas with a BMP.

Furnish a drainage design that will reduce the need for bridge scuppers. If bridge scuppers are required, contact the Office of Structural Engineering, Hydraulic Section.

All Type A culverts will have stream protection per section 1105 Roadway Culverts.

1115.2 Land Disturbance Limits

Land disturbance (LD) is defined as an area of Earth Disturbing Activities (EDA) as outlined in Supplemental Specification 832 or an area where pavement is being removed to the sub-grade.

For non-maintenance projects with less than 1 acre of LD, BMP are not required but are recommended.

For non-maintenance projects with 1 acre or more but less than 5 acres of LD, BMP are required. Choose from the following list and maximize the design to the extent practicable:

- Exfiltration trench
- Manufactured systems
- Vegetated Biofilter
- Extended detention
- Retention Basin
- Bioretention Cell
- Infiltration Trench
- Infiltration Basin
- Constructed Wetlands

For all projects with five or more acres of LD or projects that are a part of a larger common plan of development which will have five or more acres of LD, BMP shall be incorporated into the permanent drainage system for the site. Choose from the following list:

- Exfiltration trench
- Manufactured systems
- Vegetated Biofilter
- Extended detention
- Retention Basin
- Bioretention Cell
- Infiltration Trench
- Infiltration Basin
- Constructed Wetlands

1115.3 Drainage Area

For projects that are located in multiple drainage areas, provide BMP based on the total acres of project LD.

For projects with drainage areas that are less than or equal to 0.25 acres when in a sump or at an intersection per figure 1116-1, a BMP is not required.

1116 Water Quality Volume

1116.1 Water Quality Volume Calculation

The following equation shall be used to calculate the water quality volume:

WQv= T(P*A*Cq)/12

Where,

WQv = Water Quality Volume (Ac-ft)

T= Treatment Percent (see 1116.2)

P = Precipitation (0.75 inches)

A = Contributing Drainage Area to an outfall (acres)

Cq = $0.858i^3-0.78i^2+0.774i+0.04$
(see figure 1116-2)

i=impervious area divided by the total area

Cq = 0.9 when all drainage area is impervious.

1116.2 Treatment Percent

A contributing drainage area to an outfall that has both existing and new impervious areas requires a weighted average calculation to determine the percent of treatment required. Existing impervious area requires treatment of 20% of the area. New impervious area requires treatment of 100% of the area. This percent is multiplied by the calculated WQv or the ExT length to determine the amount of treatment. Use the following equation to determine the percent of treatment:

Treatment = [(Aix * 20)+(Ain * 100)] / (Aix+Ain)

Where,

Treatment= Treatment percent (%)

Aix= Existing impervious area (acres)

Ain= New impervious area (acres)

1116.3 Structural BMP Using the WQv

The water quality volume (WQv) is the treatment volume required for post construction BMP. Use the WQv for the following BMP:

- Exfiltration Trench
- Vegetated Biofilter
- Extended Detention
- Retention Basin
- Bioretention Cell
- Infiltration Trench
- Infiltration Basin
- Constructed Wetlands

Once an area has been treated, remove this area from the next downstream WQv calculation.

1117 Water Quality Flow

1117.1 Water Quality Flow Calculation

The water quality flow (WQf) is the discharge that is produced by using an intensity of 0.65 in/hr in the rational equation (section 1101.2.2). Use the entire contributing drainage for the WQf calculation. Once an area has been treated, remove this area from the next downstream WQf calculation.

1117.2 Structural BMP Using the WQf

Use the WQf for the following BMP:

- Manufactured System

1118 BMP Toolbox

1118.1 Exfiltration Trench

An exfiltration trench (ExT) captures roadway drainage at the outside edge of shoulder through the use of a permeable concrete surface. The permeable concrete surface is placed parallel to the roadway within a concrete structure. The ExT is placed 15 feet (min) prior to any drainage inlet, pavement catch basin (see figure 1118-1), or curb cut. The ExT width is 8 inches wide and the length is determined by the following equation:

Lt = T(A*Cq)/68,900

Where,

T= Treatment Percent (1116.2)
Lt= Required Impervious Length of Trench (ft)
Use a minimum length of 4 feet
Length is in increments of 4 feet
A= Total Contributing Area (square feet) as determined by the Strip Method per section 1103.3.

Cq= $0.858i^3-0.78i^2+0.774i+0.04$
(see figure 1116-2)

i=impervious area divided by the total area

Storm water is filtered until it reaches a 4 inch perforated conduit connected to a 4 inch non-perforated outlet conduit. The 4 inch outlet conduit may discharge into a drainage structure or onto the slope using a reinforced concrete outlet. The following criteria are used for payment for the ExT:

- Payment for the ExT shall be: Item 835 - Exfiltration Trench, Type ___ – L.F.
    - Use a Type A for curb and gutter, Type 2.
    - Use a Type B for barrier and non-6 inch curb.
    - Use a Type C for 6 inch curb without gutter.
- Payment for the 4 inch perforated conduit is: 605 4 inch Shallow Pipe Underdrains 707.31.
- Payment for the 4 inch outlet conduit is: 603 4 inch conduit, Type B 707.33.
- Payment for the precast reinforced concrete outlet is Item 604 precast reinforced concrete outlet.

The following criteria are used for designing an ExT:

- Do not use the ExT in tapers, parking areas, on a radius, or within a driveway.
- Do not use the ExT on the high side of a super elevated roadway.
- Do not use the ExT with shoulder widths less than 2 feet.

1118.2 Manufactured Systems

Manufactured systems consist of underground structures that treat the WQf by removing particulate matter through settlement. Supplemental Specification 895 covers the material and performance criteria for these devices. They are placed in an off-line configuration with manholes to allow for routine maintenance procedures (see figure 1118-2).

Provide a No. 3 Manhole, With ___" Base ID and ___" Weir at this location. Furnish two lengths of 603, Type B Conduit placed perpendicular to the inflowing trunk sewer (see reserved area table for the total length required). Use the following table when placing a Manufactured System:

Manufactured Systems			
Type	**WQf (cfs)**	**No. 3 Manhole Base ID (inches)**	**603-Type B Conduit Diameter (inches)**
1	1	84	12
2	2	90	15
3	3	96	18
4	6	108	24

Reserve an area (as measured from the centerline of the No. 3 Manhole) according to the following table:

Reserved Area for Manufactured System				
Type	**Width (feet)**	**Length (feet)**	**603-Type B Total Conduit Length (feet)**	**Weir Height (inches)**
1	15	30	20	6
2	20	32	30	8
3	25	33	40	9
4	25	37	40	12

Center the length of the area at the No. 3 Manhole. If this area is not attainable, contact the Office of Structural Engineering, Hydraulics Section for further guidance. Ensure this area is void of all utilities and is accessible for routine cleanout and maintenance.

1118.3 Vegetated Biofilter

A Vegetated Biofilter (VBF) is a BMP treatment train that filters storm water through vegetation. The treatment train consists of the vegetated portion of the graded shoulder, vegetated slope, vegetated ditch, and an energy protection area.

When widening existing ditches, consider the following before purchasing new right-of-way:

- Reducing the foreslope of the ditch.
- Reducing the backslope of the ditch.
- Reducing the bench width to a minimum of 4 feet.

1118.3.1 Vegetated Ditch Design Process

For projects furnishing new ditches provide an outside ditch width located in fill sections according the following:

A. Calculate the width of the ditch according to section 1102 by one of the following:
1. Radius Ditch width equals the length of the arc
2. Rounding ditch width equals the rounding length
3. Trapezoid ditch width equals the bottom width

B. Calculate the Enhanced Bankfull Width (EBW) in feet using the following equation:

$$EBW = 5.4A^{0.356}$$

A= Total drainage area to the ditch (Ac)

C. Compare the ditch width found in Section 1118.3.1.A to the EBW found in Section 1118.3.1.B and determine the plan ditch width by choosing one of the following:

1. If the EBW is less than or equal to the width found in Section 1118.3.1.A, furnish Section 1118.3.1.A width in the plans.
2. If the EBW is greater than the width found in Section 1118.3.1.A and is less than or equal to 10 feet, furnish the EBW width in the plans.
3. If the EBW exceeds the width found in Section 1118.3.1.A and is more than 10 feet and the EBW will not require the purchase of additional right-of-way, furnish the EBW in the plans.
4. If the EBW exceeds the width found in Section 1118.3.1.A and is more than 10 feet and the EBW will require the purchase of additional right-of-way, furnish a Conveyance Ditch for Offsite Drainage Area according to Section 1118.3.2.

For projects using existing ditches where the EBW is greater than the existing ditch width as determined in Section 1118.3.1.A, maximize the existing ditch width to the extent that does not require the purchase of additional right-of-way.

Ditch width is to be calculated every 100 linear feet of ditch and at points where offsite runoff is accepted to provide the minimum required ditch width. Begin ditch width calculations at the outfall and move upstream through the drainage area.

1118.3.2 Conveyance Ditch for Offsite Drainage Area

A conveyance ditch is a 10 foot wide ditch with an earth berm (EB) that separates the conveyance of the roadway runoff from offsite runoff for the first flush flows. The EB is placed longitudinally in the ditch at a determined location.

Figures 1118-13 through 1118-18 detail common design scenarios for conveyance ditches. Calculate the conveyance ditch for the offsite drainage area using figures 1118-13 through 1118-18. If the offsite ditch design falls outside of the criteria used in figures 1118-13 through 1118-18, manually design the ditch using figure 1118-

19. A design example is detailed in figure 1118-4.

If the EB location is greater than 9 feet, contact the Office of Structural Engineering, Hydraulics Section.

Payment for the earth berm is per Item 203

1118.3.3 Energy Protection Area

An energy protection area provides energy reduction to the ditch flow prior to discharging into a water body. It is a constructed channel that has a 15 foot wide bottom with a layer of rock channel protection. The use of an EB is truncated at the upstream end of the energy protection area. Use the following criteria when providing an energy protection area:

A. Provide 50 feet length (see figure 1118-5).

B. Provide a 12 inch thick layer of Item 601 RCP, Type D with filter or as required per section 1102 (if larger RCP is necessary).

C. Locate all energy protection areas in the outside roadway ditch.

D. The energy protection area is required on the upstream location of culverts. It is optional on the downstream location of culverts.

E. Provide energy protection areas as existing right-of-way permits for redevelopment projects. If any amount of right-of-way is purchased for the project, an energy protection area is required.

1118.4 Extended Detention

Extended detention is a method that captures storm water during rain events and slowly releases the captured volume over a period of time. The WQv is used to determine the storage volume of the detention basin. The WQv is discharged over a 48 hour time frame. Increase the WQv by 20% when sizing the BMP to allow for sedimentation to occur. Detention can be either above or below ground. Detention basins that are above ground are the preferred choice and should be used when feasible. However, when project site parameters dictate, an underground system may be the optimum choice.

1118.4.1 Detention Basin

A detention basin is a dry pond that detains storm water for quality and quantity. The following criteria apply when designing a detention basin:

A. Allow for 1 foot of freeboard above the storage volume.

B. Furnish a micro pool when feasible (see figure 1118-6)

C. Use side slopes of 4:1 (max).

D. Ensure the design check discharge will safely pass through the structure (section 1118.4.3).

E. Vegetate the sides of the basin with Item 670 Slope Erosion Protection.

F. Furnish a 6 inch layer of Item 601 Detention Basin Aggregate on the bottom of the basin.

G. Embankment work to create the impoundment will be constructed and paid for as Item 203 Embankment, Using Natural Soils, 703.16.A.

H. Consider vehicle access to the basin for periodic maintenance.

I. Do not locate on uncompacted fill or steep slopes (2:1 or more) or where infiltrating ground water could adversely impact slope stability.

J. Furnish an anti-seep collar around the outlet pipe.

K. Furnish gravel pack protection at the outlet structure (see SCD WQ1.1).

L. Place channel protection (RCP or Concrete Mat) at the entrance of the basin to minimize erosion and sediment resuspension.

M. Furnish a forebay that is approximately 7% of the total design volume.

N. Furnish a Water Quality Basin, Detention per section 1118.4.1.1

1118.4.1.1 Water Quality Basin and Weir

Furnish an outlet structure that fully drains the WQv within 48 hours or more. The outlet requires a flow control structure such as a perforated riser pipe to restrict the drainage discharge. Details of a perforated riser pipe outlet structure can be found on standard drawing WQ1.1.

Furnish a perforated riser pipe for detention basins. The outlet structure consists of a catch basin with a perforated riser pipe on the inlet side and a conduit on the outlet side. The perforated riser pipe is used for flow control to achieve the required discharge time. A gravel envelope surrounds the perforated riser pipe along the inlet side of the catch basin to prevent blockage of the orifice holes in the pipe. The catch basin and riser pipe are paid for as Item 604, Water Quality Basin, Detention.

Furnish a weir to allow the design check discharge to bypass the structure without damage to the detention basin or embankment of the basin. The design check discharge shall be determined per 1118.4.3.

The equation for a single orifice is:

$$Q = A \cdot C \cdot \sqrt{64.4H}$$

Where,

A = Area of orifice (ft^2)

H = Head on orifice as measured to the centerline of the orifice (ft)

C = Orifice coefficient

Orifice Coefficient Guidance

C	Description
0.66	Use for thin materials where the thickness is equal to or less than the orifice diameter.
0.80	Use when the material is thicker than the orifice diameter.

From CALTRANS, Storm Water Quality Handbooks, Project Planning and Design Guide, September 2002.

A hydrograph curve for the outlet will be required to calculate the discharge time of the WQv and the design check discharge (see 1118.4.3). The discharge time should correspond to the minimum of 48 hours.

Generally, it is easier to model the outlet structure and discharge time using software such as Pond Pak or HydroCad to develop the hydrograph.

1118.4.1.2 Anti-Seep Collar Design

An anti-seep collar shall be installed on conduits through earth fills where water is being detained. The following criteria applies to anti-seep collars:

A. Spacing between adjacent collars shall be 5 feet with the first collar being a minimum of 5 feet from the inlet.

B. Furnish a minimum of 2 collars per outlet conduit.

C. All anti-seep collars and their connections shall be watertight.

D. Minimum thickness shall be 6 inches.

E. Payment for the collar shall be Item 602 Concrete Masonry (see standard construction drawing WQ-1.2).

To determine the dimensions of the collar refer to the following:

Anti-Seep Collar Size

Maximum Water Depth	Collar Size (ftxft)
2	3x3
4	4x4
6	5x5

1118.4.2 Underground Detention

Underground detention areas are made up of a series of conduits. They range from an oversized storm sewer to a series of conduits that are specifically used for storm water detention. The following criteria apply when designing underground detention:

A. Ensure the Hydraulic Grade Line design of the storm sewer will pass through the structure and meet the requirements of 1104.4.2.

B. Consider access to the conduits for periodic maintenance.

C. If practical, provide pretreatment of the storm water with a vegetated strip.

D. Payment for the conduit shall be: Item 603 ____" Conduit, Type____, for underground detention.

1118.4.3 Design Check Discharge

A design check discharge with the frequency of a 10-year event shall be used as calculated by the Rational Equation. Use the entire drainage area that contributes to the BMP to calculate the design check discharge.

1118.5 Retention Basin

A retention basin is a "wet" pond that has a minimum water surface elevation between storms that is defined as the permanent pool. Above the permanent pool is a detention pool that provides storage for 75% of the WQv and discharges within 24 hours or more. The full storage water depth is typically between 3-6 feet and the volume is less than 15 Ac-ft. The permanent pool is sized to provide storage for 75% of the WQv. A retention basin is ideal for large tributaries, but it may require a large amount of space. Consider the following when designing a retention basin:

A. Use RCP at the inlet of the basin to provide energy dissipation and erosion control.

B. Allow for 1 foot freeboard above the WQv.

C. Use side slopes of 4:1 (max).

D. Ensure the design check discharge will safely pass through the structure (section 1118.4.3).

E. Use a length to width ratio of at least 3:1 to prevent short-circuiting.

F. Vegetate the sides of the basin with Item 670 Slope Erosion Protection.

G. Furnish a 6 inch layer of Item 601 Detention Basin Aggregate on the bottom of the basin.

H. Furnish a forebay (7-10% of the total retention volume) to extend the service life of the BMP when feasible.

I. Furnish an anti-seep collar around the outlet pipe (see section 1118.4.1.2).

J. Furnish a trash rack at the outlet structure.

K. The underlying soils should be compacted to prevent infiltration of the permanent pool or an impervious liner should be used.

L. Consider vehicle access to the basin for periodic maintenance.

M. Retention basin must be greater than 10,000 feet from a municipal airport runway.

N. Embankment work to create the impoundment will be constructed and paid for as Item 203 Embankment, Using Natural Soils, 703.16.A.

O. Furnish a Water Quality Basin, Retention per 1118.5.1.

1118.5.1 Water Quality Basin and Weir

A retention basin outlet structure is designed similar to the outlet structure for a detention basin. The difference is that 75% of the WQv should be discharged out of the basin in 24 hours or more. The outlet structures are of a similar type, except the openings will be set at a high enough elevation to maintain 0.75% of the WQv in the permanent pool (see standard construction drawing WQ-1.1). The catch basin and riser pipe is paid for as Item 604, Water Quality Basin, Retention.

1118.6 Bioretention Cell

Bioretention Cells consist of depressed low-lying areas that treat storm water through evapotranspiration and filtering through a planting soil. As the storm water passes through the soil it is filtered. An underlying perforated storm sewer or underdrain captures the treated storm water and carries it to an outlet. Extensive vegetation assists in the filtration of the storm water prior to filtering through the soil. Vegetation should consist of shrubs or grasses that are native to the area.

The existing soil must be removed and replaced when constructing a bioretention cell. The bioretention planting soil (plan note WQ101) should consist of a mixture of sand, topsoil, and compost.

A bioretention cell is sized to store the WQv prior to filtration. Total filtration should occur in 40 hours or more. Use the following equation to determine the minimum surface area of the bioretention invert:

$$A = \frac{WQv \cdot D}{3600 \cdot K \cdot T \cdot (h + D)}$$

Where,

WQv= Water quality volume (see section 1116) (Acre-feet)

T= Drain time of the cell, 40 hours

K= permeability of the planting soil (Use 3.3 x 10^-5 ft/sec)

A= Top surface area of the trench (Ac)

D= Depth of the planting soil (ft) (4.0 feet minimum)

h=Maximum depth of water above the cells top layer for the WQv (use 1 foot).

The following criteria apply when designing a bioretention BMP:

A. Do not place where snow may be stored.

B. Furnish 10 feet or less width between 4 inch underdrain laterals.

C. Furnish bypass or overflow for the design check discharge. Use a catch basin(s) in conjunction with an overflow weir as needed.

D. Furnish pretreatment of the storm water via vegetation.

E. Ensure the water table or bedrock is below the invert of the bioretention area.

F. Use side slopes of 4:1 (max).

G. Furnish a length to width ratio of 2:1 (min).

H. Use a minimum depth of 4 feet of planting soil. Provide at least 4 inches of depth deeper than the largest root ball.

I. Furnish an organic or mulching layer at the top of the planting soil.

J. Furnish a maximum depth of 1 foot to the riser pipe or catch basin outlet from the mulching layer for storage of the WQv.

K. Furnish a bioretention cell as Item 203-Special - Bioretention Cell.

1118.7 Infiltration

Infiltration techniques treat storm water through the interaction of a filtering substrate that consists of soil, sand, or gravel. This technique discharges the treated storm water into the ground water rather than into surface waters. Infiltration methods require an extensive investigation of the existing soils and geology to ensure success. The investigation should begin with a preliminary soil evaluation of the project site early in the design process. In situ testing is not anticipated during the preliminary evaluation process. Available soil and geology data found in the Soil and Water Conservation maps, United States Geological Survey (USGS), adjacent projects, or estimations from a geotechnical engineer should be used. Material property tables for infiltration, permeability, and porosity have been provided for the preliminary evaluation (table 1118-1 & 1118-2).

If the preliminary evaluation yields favorable results a more detailed evaluation should be performed. The detailed evaluation will require a geotechnical investigation of the underlying soils and geology. Soil borings should be performed to a maximum depth of 20 feet (or refusal) with samples taken every 5 feet for laboratory testing. The number and location of soil borings should correspond with the approximate size (as determined in the preliminary evaluation) of the infiltration BMP and should be recommended by the geotechnical engineer.

If the detailed evaluation yields favorable results, the ground water depth must be verified. The geotechnical engineer shall provide the seasonal high ground water depth. In some cases, observation wells may be installed and static water levels may be observed over a dry and wet season for verification.

The infiltration and permeability rate of the soil shall be tested in the detailed soil evaluation at the discretion of the geotechnical engineer. In some cases, insitu testing at the proposed location of the infiltration BMP may be required.

The following criteria apply to infiltration methods and must be met to be considered a feasible alternative:

A. Design using the WQv as per Section 1116.

B. Do not place infiltration BMP where snow may be stored.

C. The appropriate soil type must be present:

   1. Infiltration must be greater than 0.50 in/hr and no greater than 2.4 in/hr.

   2. Soils must have less than 30% clay or 40% of clay and silt combined.

D. The invert of the structure must be at least 4 feet above the seasonal high water table and any impervious layer.

E. Infiltration techniques are not suitable on fill soil, compacted soil, or steep slopes (greater than 4:1). Consideration should be given to the long term impacts upon hillside stability if applicable.

F. Pretreatment shall be provided to remove large debris, trash and suspended sediment to extend the service life. Examples of this may be the use of vegetated filter strip.

1118.7.1 Infiltration Trench

An infiltration trench is an excavated trench that has been lined with a geotextile fabric and backfilled with aggregate. The storm water is filtered through the aggregate and is stored within the pore volume of the backfill material. It is allowed to percolate through the sides and bottom of the trench. The drawdown time of the WQv is 24 hours or more. Consider the following when designing an Infiltration trench:

A. The minimum acceptable permeability of the surrounding soil is =6.5*10^-5 ft/sec (see table 1118-1).

B. Design using the WQv as per Section 1116.

C. Long and deep infiltration trenches are most efficient (3 feet bottom width and 3-6 feet deep).

D. Furnish a 6 inch layer of Item 601 Infiltration Basin Aggregate on the top of the trench.

E. The geometric shape of the trench is a trapezoid with sides at a 1:1 (H:V) slope due to constructability. The top width is calculated as:

Top Width = Bottom Width + (2 * Depth)

F. Pretreatment using a vegetated strip shall be provided to ensure longevity of the infiltration trench.

G. An observation well shall be provided to facilitate ground water level inspection.

H. Locate the infiltration trench at least 1,000 feet from any municipal water supply well and at least 100 feet from any private well, septic tank, or field tile drains.

I. Ensure the bottom of the trench is below the frost line (2.5 feet)

The length of the trench depends upon the depth and the bottom width. The required length is calculated by assuming a depth and bottom width. The length is calculated based upon the inflow (WQv) and the outflow (ground water recharge). The following equation calculates the required length in feet:

$$L_t = \frac{43560 \cdot WQv}{3600 \cdot K \cdot T \cdot (b + 2\,D) + 0.4\left[D^2 + (b \cdot D)\right]}$$

Where,

WQv= Water quality volume (see section 1116) (Acre-feet)

T= Drain time through the sides of the trench, 24 hours

K= permeability of the surrounding soil (ft/sec) (table 1118-1)

D= Trench depth (ft)

b= Bottom width of the trench (ft)

Table 1118-1

Permeability of Soil (K)

Soil Type	Rate (K) (ft/sec)
Gravel	$3.3x10^{-3}$ to $3.3x10^{-1}$
Sand	$3.3x10^{-5}$ to $3.3x10^{-2}$
Silt	$3.3x10^{-9}$ to $3.3x10^{-5}$
Clay (saturated)	< $3.3x10^{-9}$
Till	$3.3x10^{-10}$ to $3.3x10^{-6}$

From Urban Runoff Quality Management WEF Manual of Practice No. 23, 1998, published jointly by the WEF and ASCE, chapter five

1118.7.2 Infiltration Basin

An infiltration basin is an open surface pond that uses infiltration into the ground as the release mechanism. It is designed to store the WQv.

Depending on the soil permeability, it may be used to treat from 5 to 50 acres. Lower permeable soils may require an underdrain system as an additional outlet. The drawdown time of the WQv should be between 24-48 hours. The following criteria apply when designing an infiltration basin:

A. Use an energy dissipater at the inlet.

B. Allow for 1 foot (min) freeboard above the WQv.

C. Vegetate the sides of the basin with Item 670 Slope Erosion Protection.

D. Furnish a 6 inch layer of Item 601 Infiltration Basin Aggregate on the bottom of the basin.

E. Use side slopes of 4:1 (max).

F. Use a length to width ratio of 3:1

G. Furnish bypass or overflow for the design check discharge (see section 1118.4.3).

H. Consider vehicle access to the basin for periodic maintenance.

I. Locate basin at least 1,000 feet from any municipal water supply well and at least 100 feet from any private well, septic tank, or drain field.

J. Furnish 10 feet or less width between 4 inch underdrain laterals (if used in the design).

K. Do not locate the basin where infiltrating ground water may adversely impact slope stability.

L. Ensure the invert of any underdrain in the basin is below the frost line (2.5 feet).

M. Embankment work to create the impoundment will be constructed and paid for as Item 203 Embankment, Using Natural Soils, 703.16.A.

The invert area of the infiltration basin can be calculated by the following equation:

$$A=(WQv * S.F. * 12)/(k * t)$$

Where,

A= area of invert of the basin (Acres)

WQv= Water Quality Volume (see section 1116) (Acre-feet)

S.F.= Safety Factor of 1.5
k= Infiltration Rate (in/hr) (table 1118-2)

t= Drawdown time of 48 hours

The required depth of the infiltration basin can be calculated by the following equation:

$$D= WQv/A$$

Where,

A= area of invert of the basin (Acres)

WQv= Water Quality Volume (Ac-ft)

D= Required depth of the basin (ft)

Table 1118-2

NRCS Soil Type (from soil maps)	HSG Classification	Rate (k)
		(in/hr)
Sand	A	8.0
Loamy Sand	A	2.0
Sandy Loam	B	1.0
Loam	B	0.5
Silt Loam	C	0.25
Sandy Clay Loam	C	0.15
Clay Loam & Silty Clay Loam	D	< 0.09
Clays	D	< 0.05

Infiltration Rate (k)
From Urban Runoff Quality Management WEF Manual of Practice No. 23, 1998, published jointly by the WEF and ASCE, chapter five

1118.8 Constructed Wetlands

Constructed wetlands treat storm water through bio-retention. They are depressed, heavily planted areas that are designed to maintain a dry weather flow depth ranging between 0.5 to 2 feet. The surface area required for a wetland is usually quite large due to the limited allowable depth. The area is usually on the magnitude of 1% of the entire drainage area. They are designed in a similar manner as a retention basin. The wetland is sized to provide storage for the WQv for a time frame of at least 24 hours (above the permanent pool) while providing a bypass or overflow for larger design check discharge (see section 1118.4.3). The water depth should be maintained by an outlet structure capable of providing the required water depth with the provision of a one foot freeboard. The following criteria apply when designing a wetland:

A. Do not place on a steep or unstable slope or at a location, which could induce short-term or long-term instability.
B. Wetlands must be greater than 10,000 feet from a municipal airport runway.

C. Base flow must be present to maintain the constant water depth (such as ground water).

D. Furnish a forebay that is 7% of the total required volume at a depth between 3-6 feet to settle out sediments.

E. Furnish side slopes of 4:1 (max).

F. Consider access for maintenance to the forebay and the outlet structure.
G. Vegetate the sides and bottom with grass

H. Furnish an impervious liner. Use a compacted clay bottom or a geotextile fabric to prevent infiltration of the storm water.

I. Furnish a length to width ratio of 3:1 (min) to prevent short-circuiting.

1100 Drainage Design Procedures – List of Figures

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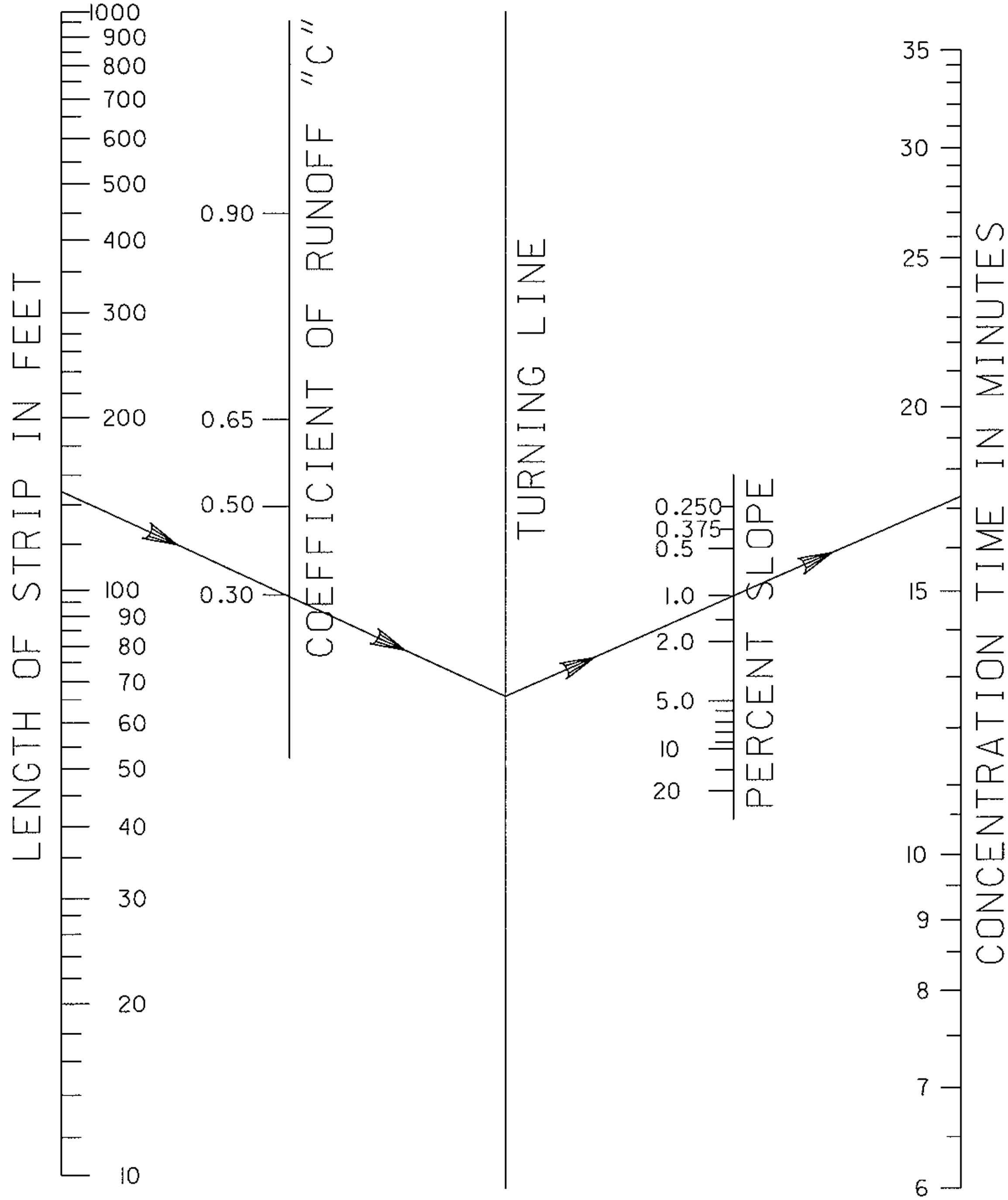
Revised July, 1999

OVERLAND FLOW CHART	1101-1
	REFERENCE SECTION 1101.2.2



General Notes – Figures 1101-2 through 1101-3

The Rainfall Intensity-Duration-Frequency curves are based upon data obtained from United States Weather Service Technical Paper No. 40 Rainfall Frequency Atlas of The United States.

Federal Highway Administration Hydraulic Engineering Circular No. 12 Appendix A offers a methodology for converting I-D-F data points to an equation of the general form:

$$i = a/(t+b)^c$$

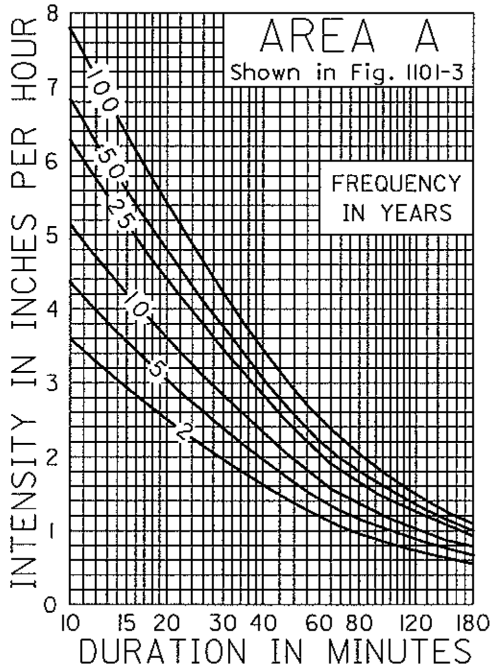
Where: i = rainfall intensity (inches/hour)
t = time of concentration (minutes)
a = constant
b = constant
c = constant

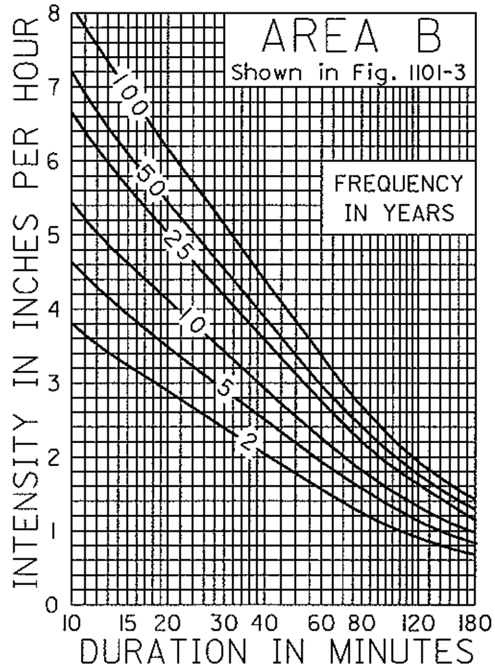
Using the above referenced methodology the curves in Figure 1101-2 can be expressed using the above general equation utilizing the constants shown below.

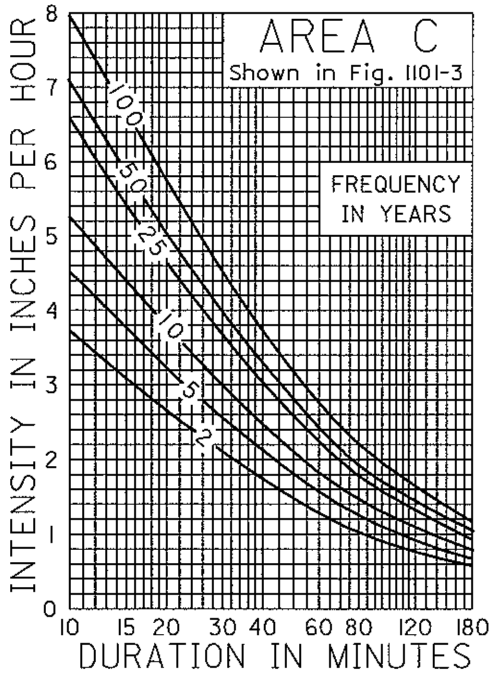
Intensity Zone (Figure 1101-3)	Frequency (Years)	Constant "a"	Constant "b"	Constant "c"
A	2	44.150	8.900	0.853
	5	150.271	18.400	1.062
	10	70.474	10.200	0.874
	25	96.280	11.100	0.899
	50	51.622	5.100	0.747
	100	85.930	8.000	0.834
B	2	140.596	25.099	1.015
	5	81.276	18.800	0.855
	10	275.649	29.499	1.070
	25	294.909	28.099	1.044
	50	117.148	16.700	0.849
	100	293.888	26.699	1.000
C	2	64.387	14.300	0.896
	5	184.940	21.699	1.075
	10	83.828	12.500	0.887
	25	58.733	7.400	0.771
	50	79.945	9.300	0.818
	100	196.039	16.300	0.978
D	2	85.568	16.500	0.950
	5	118.822	18.700	0.969
	10	112.172	16.800	0.923
	25	198.920	19.300	1.004
	50	206.025	19.600	0.990
	100	355.551	23.199	1.076

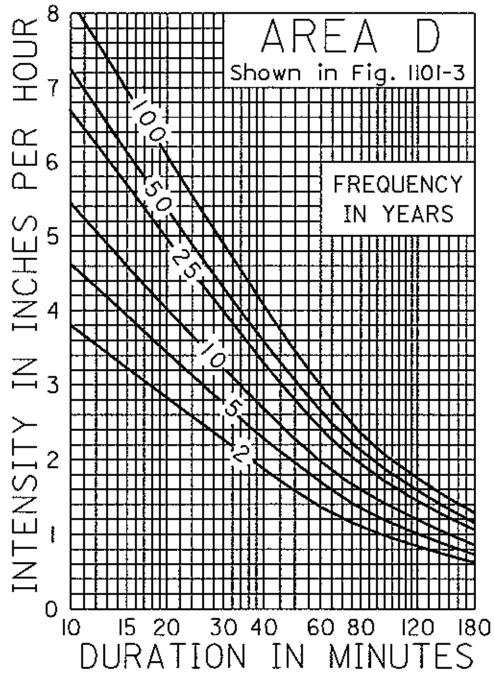
RAINFALL INTENSITY-FREQUENCY-DURATION CURVES	1101-2
	REFERENCE SECTION 1101.2.4

RAINFALL INTENSITY-FREQUENCY-DURATION CURVES





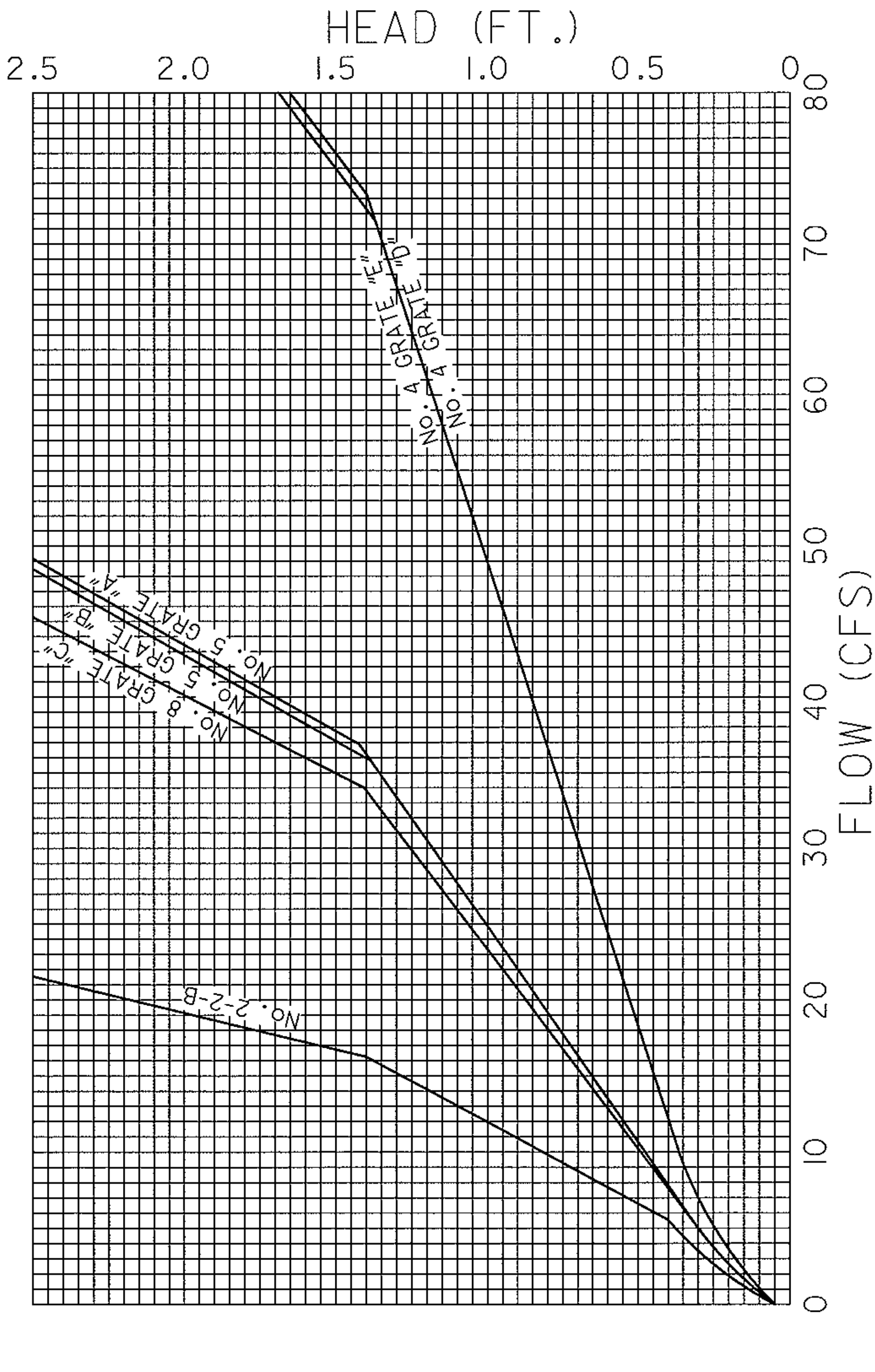




RAINFALL INTENSITY ZONE MAP	1101-3
	REFERENCE SECTION 1101.2.4

CAPACITY OF A GRATE CATCH BASIN IN A SUMP

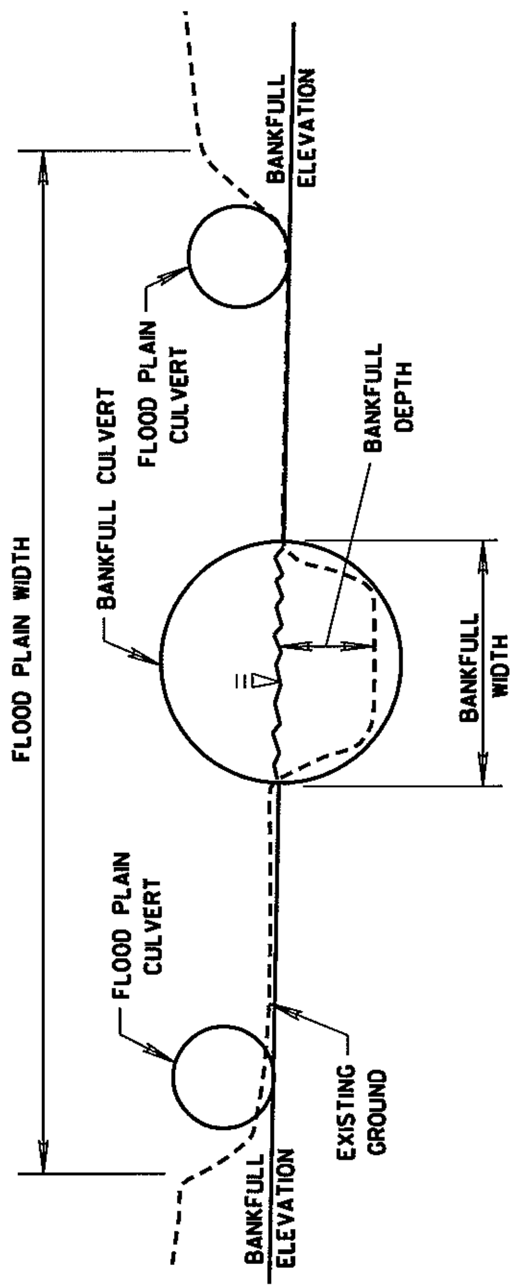
1102-1
REFERENCE SECTION 1102.3.5



CAPACITY OF A GRATE CATCH BASIN IN A SUMP
(WATER PONDED ON THE GRATE)

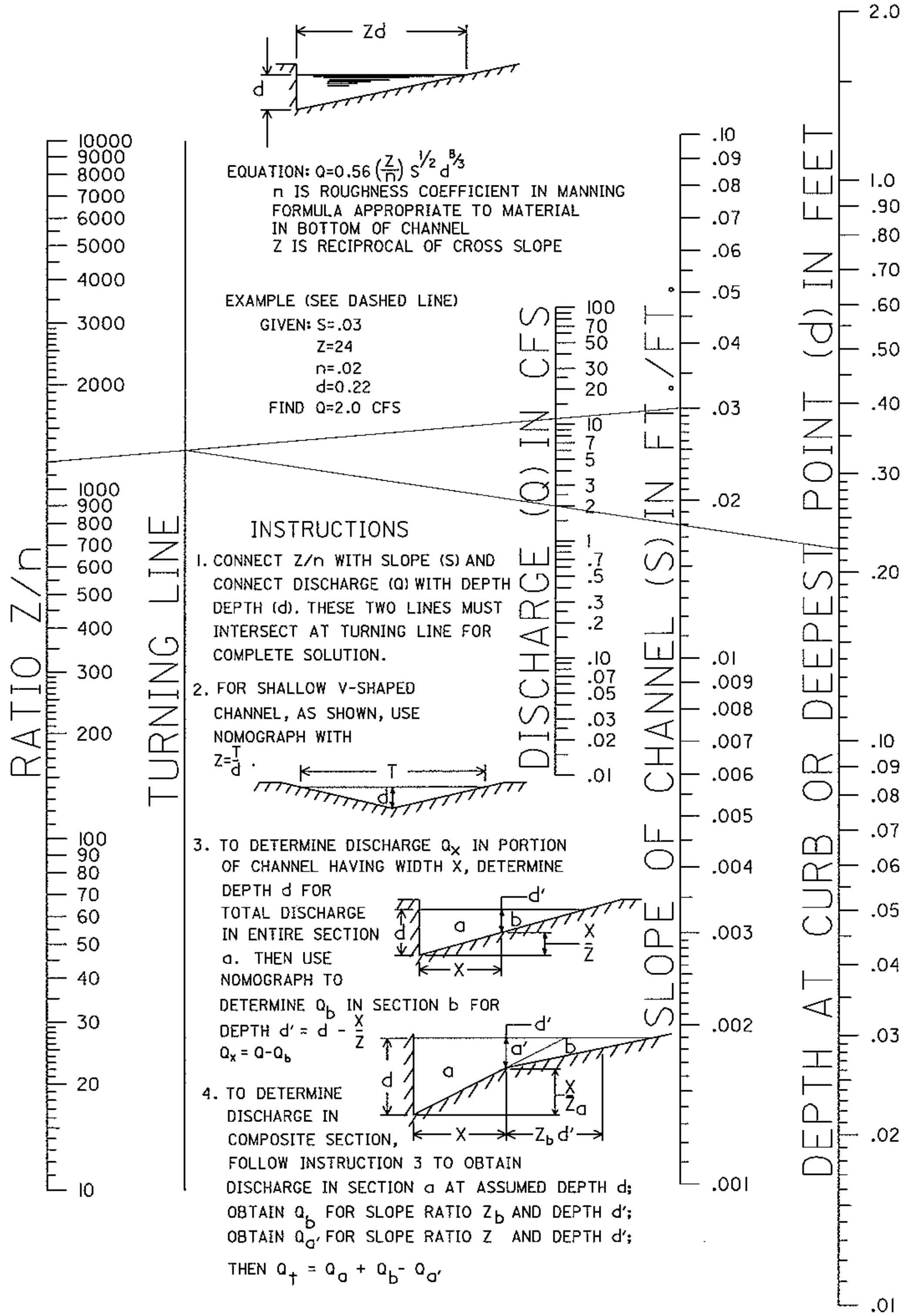
JULY 2002

CHANNEL FEATURES	1102-2
	REFERENCE SECTION 1102.2.4

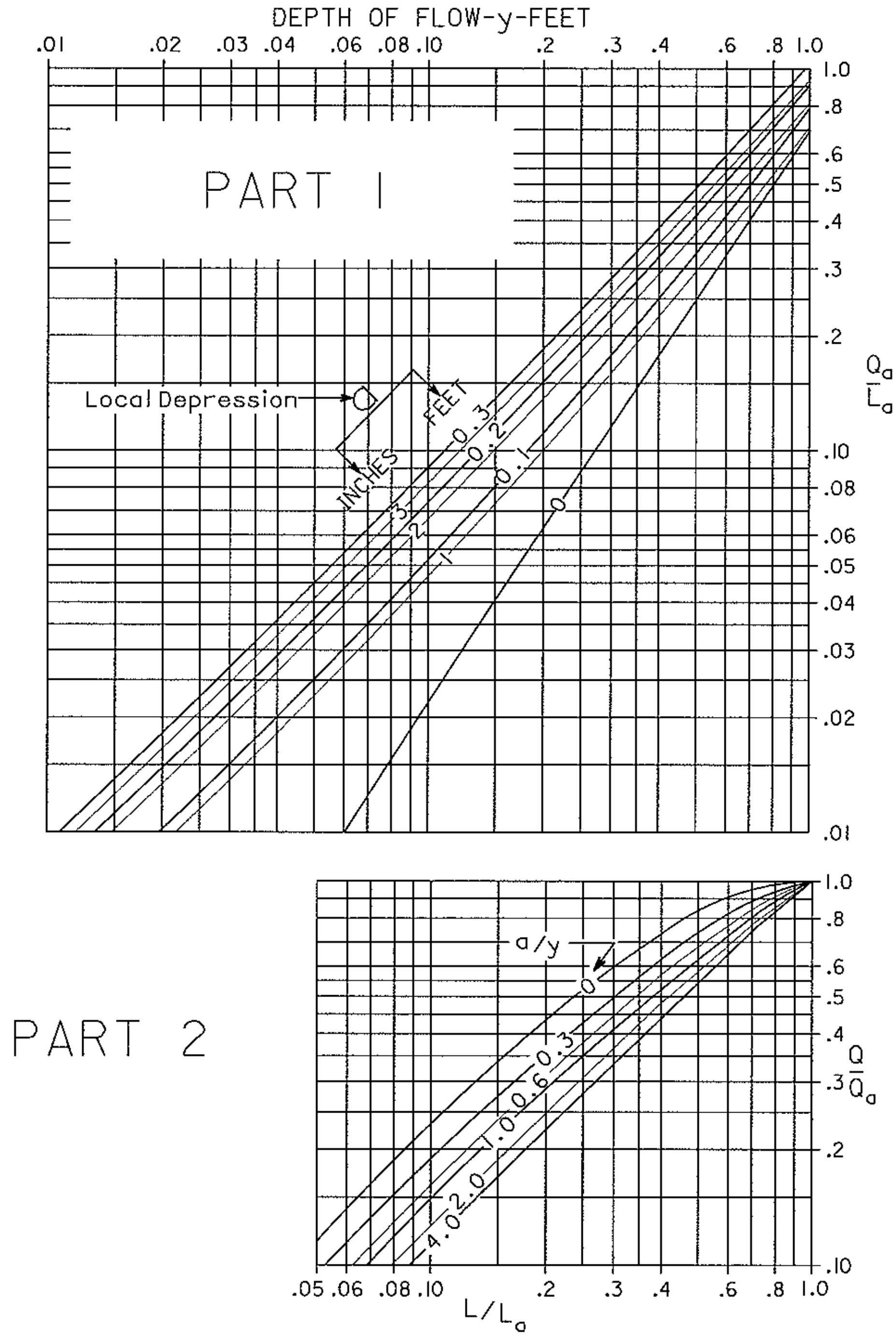


Revised July, 1999

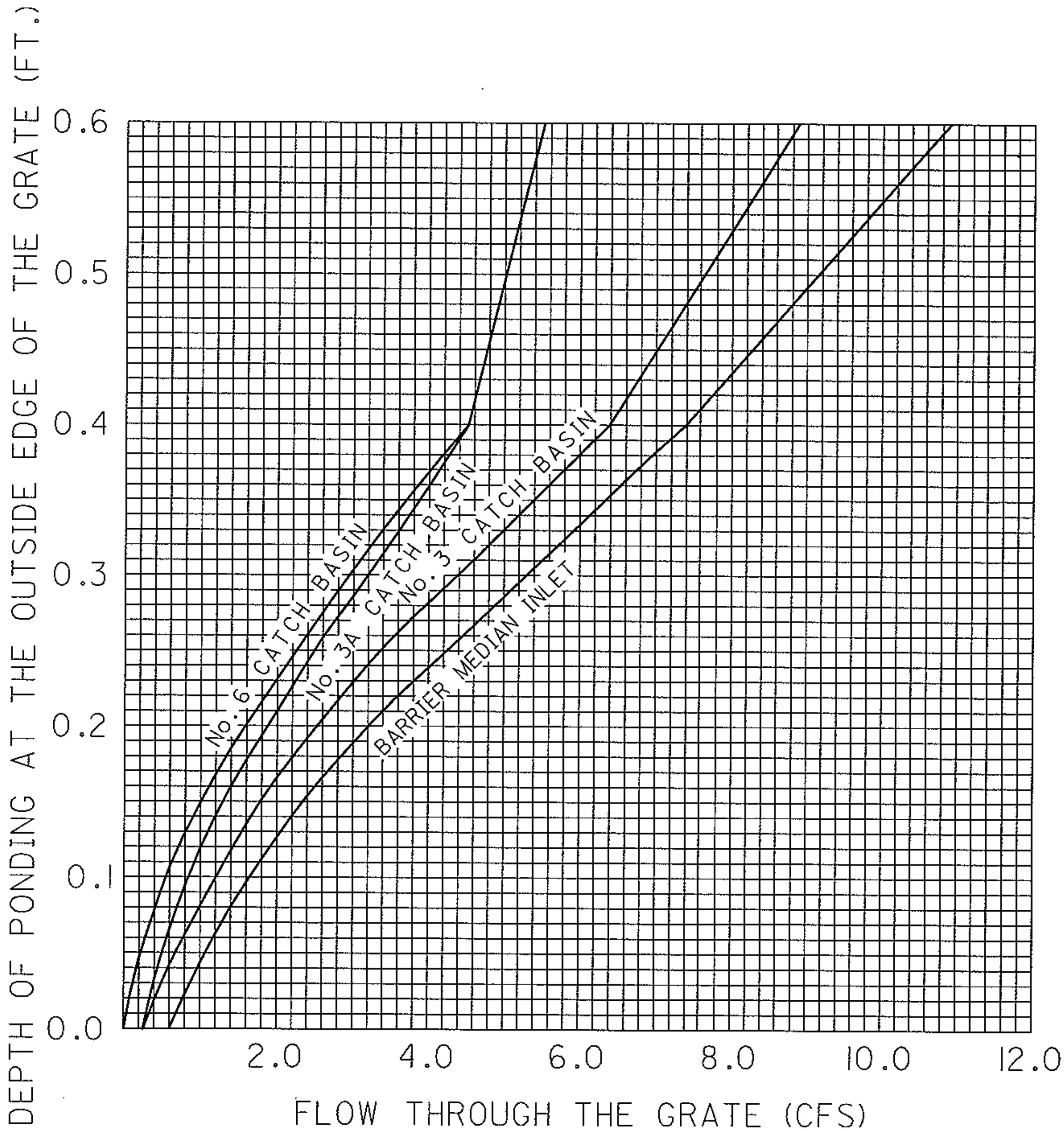
NOMOGRAPH FOR FLOW IN TRIANGULAR CHANNELS	1103-1
	REFERENCE SECTION 1103.4



CAPACITY OF CURB OPENING INLETS ON CONTINUOUS GRADE	1103-2
	REFERENCE SECTION 1103.6

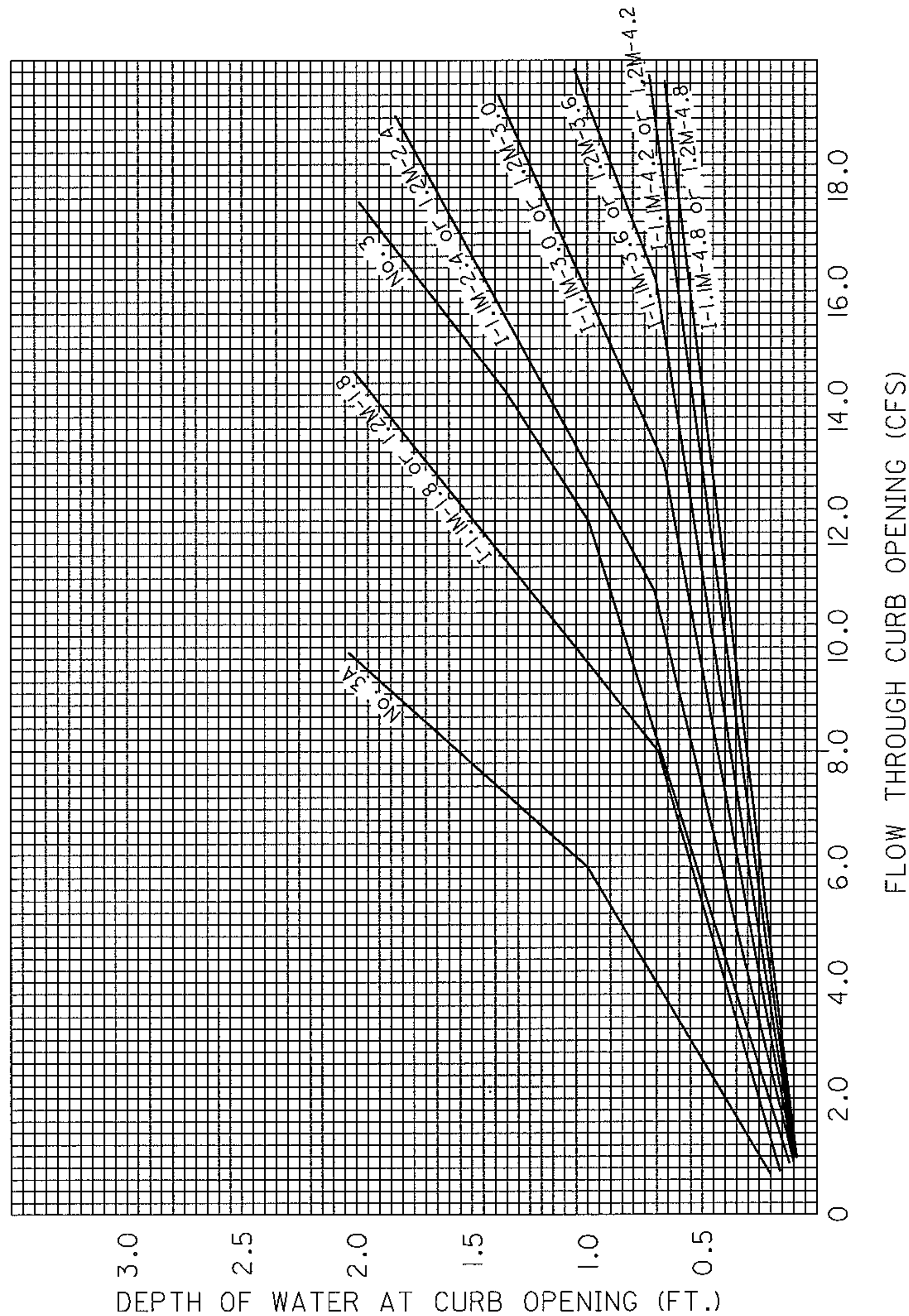


CAPACITY OF STANDARD CATCH BASIN GRATES IN PAVEMENT SAGS	1103-3
	REFERENCE SECTION 1103.6, 1103.7



Revised July, 1999

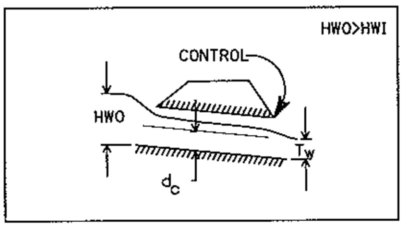
CAPACITY OF STANDARD INLETS AND CATCH BASINS IN PAVEMENT SAGS	1103-4
	REFERENCE SECTION 1103.7



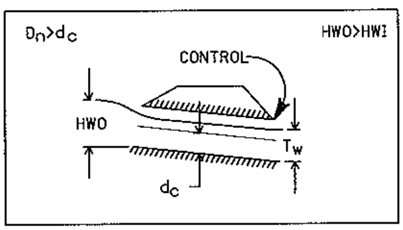
CLASSIFICATION OF FLOW IN CULVERTS

1105-1
REFERENCE SECTION 1105.2

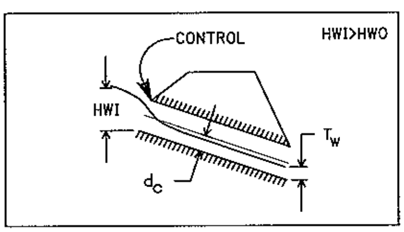
CLASS 1 OPERATION
FREE WATER SURFACE
HWI OR HWO $\leqq$ 1.2D



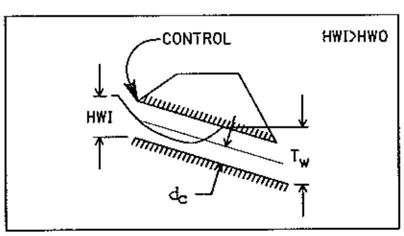
1A



1B

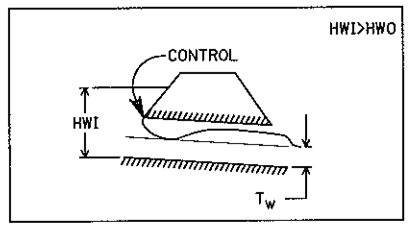


1C

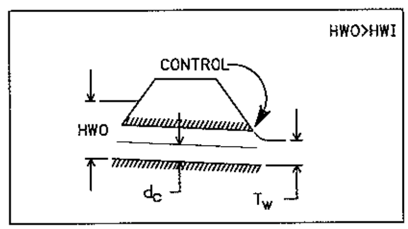


1D

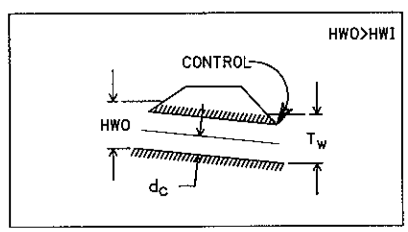
CLASS 2 OPERATION
SUBMERGED ENTRANCE
HWI OR HWO > 1.2D



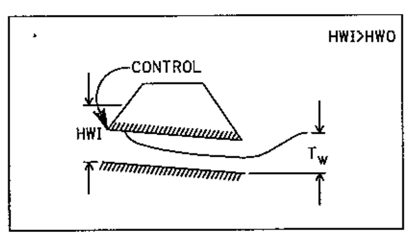
2E



2F



2G



2H

HWO indicates headwater based on outlet control
HWI indicates headwater based on inlet control
D = Height of culvert d_c = critical depth

Revised July, 1999

CORRUGATED METAL PIPE SIZES AND "n" VALUES FOR TYPE A CONDUIT	1105-2
	REFERENCE SECTION 1105.5.5

Corrugated Metal Pipe Sizes and "n" Values for Type A Conduit

½″ corrugations

Diameter in Feet	
1.25	.0250
1.50	.0249
1.75	.0248
2.0	.0247
2.5	.0244
3.0	.0241
3.5	.0237
4.0	.0235
4.5	.0233
5.0	.0232
5.5	.0231
6.0	.0229
6.5	.0228
7.0	.0227
7.5	.0226
8.0	.0225

1″ corrugations

Diameter in Feet	
3.0	.0281
3.5	.0278
4.0	.0275
4.5	.0273
5.0	.0271
5.5	.0269
6.0	.0267
6.5	.0266
7.0	.0265
7.5	.0263
8.0	.0263
8.5	.0262
9.0	.0261
9.5	.0260
10.0	.0260

2″ corrugations

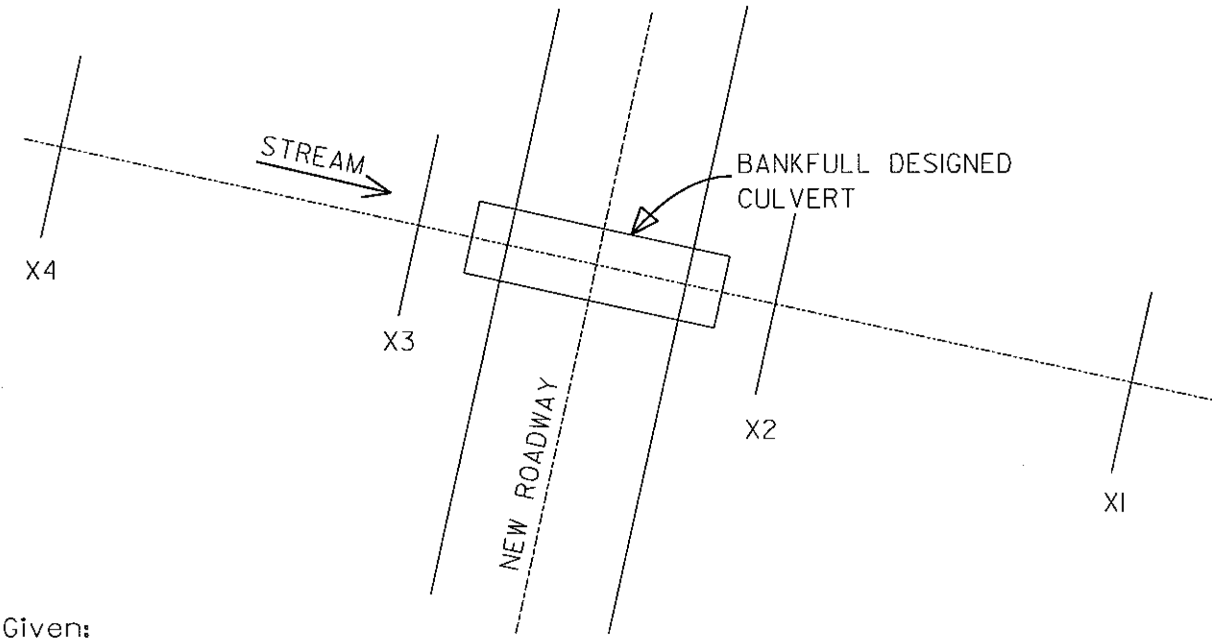
Diameter in Feet	n*
5.0	.0332
5.5	.0330
6.0	.0327
6.5	.0325
7.0	.0323
7.5	.0321
8.0	.0320
8.5	.0318
9.0	.0317
9.5	.0315
10.0	.0314
10.5	.0313
11.0	.0312
11.5	.0311
12.0	.0310
12.5	.0309
13.0	.0308
13.5	.0307
14.0	.0307
14.5	.0306
15.0	.0305
15.5	.0305
16.0	.0304
16.5	.0304
17.0	.0303
17.5	.0303
18.0	.0302
18.5	.0302
19.0	.0301
19.5	.0301
20.0	.0300
20.5	.0300
21.0	.0300

2½″ corrugations

Diameter in Feet	n*
5.0	.035
5.5	.035
6.0	.034
6.5	.034
7.0	.034
7.5	.034
8.0	.034
8.5	.034
9.0	.033
9.5	.033
10.0	.033
10.5	.033
11.0	.033
11.5	.033
12.0	.033
12.5	.033
13.0	.033
13.5	.033
14.0	.032
14.5	.032
15.0	.032
15.5	.032
16.0	.032
16.5	.032
17.0	.032
17.5	.032
18.0	.032
18.5	.032
19.0	.032
19.5	.032
20.0	.032
20.5	.032
21.0	.031

* All field paved structural plate pipe shall have an "n" value equal to 0.026

EXAMPLE BANKFULL DISCHARGE CULVERT DESIGN



Given:

Use a Box Conduit
Max Height of Box = 8 feet

1. According to Table 1105-2, culvert invert is to be buried by 12 inches.

2. Use Hec-Ras to determine the following table:

2-Year Frequency Water Surface Elevations

	Existing	12′ x 8′ Box	14′ x 8′ Box	16′ x 8′ Box	20′ x 8′ Box
X1	790.67	790.67	790.67	790.67	790.67
X2	791.07	791.07	791.07	791.07	791.07
X3	791.47	791.88	791.81	791.74	791.65
X4	791.87	791.98	791.94	791.91	791.88

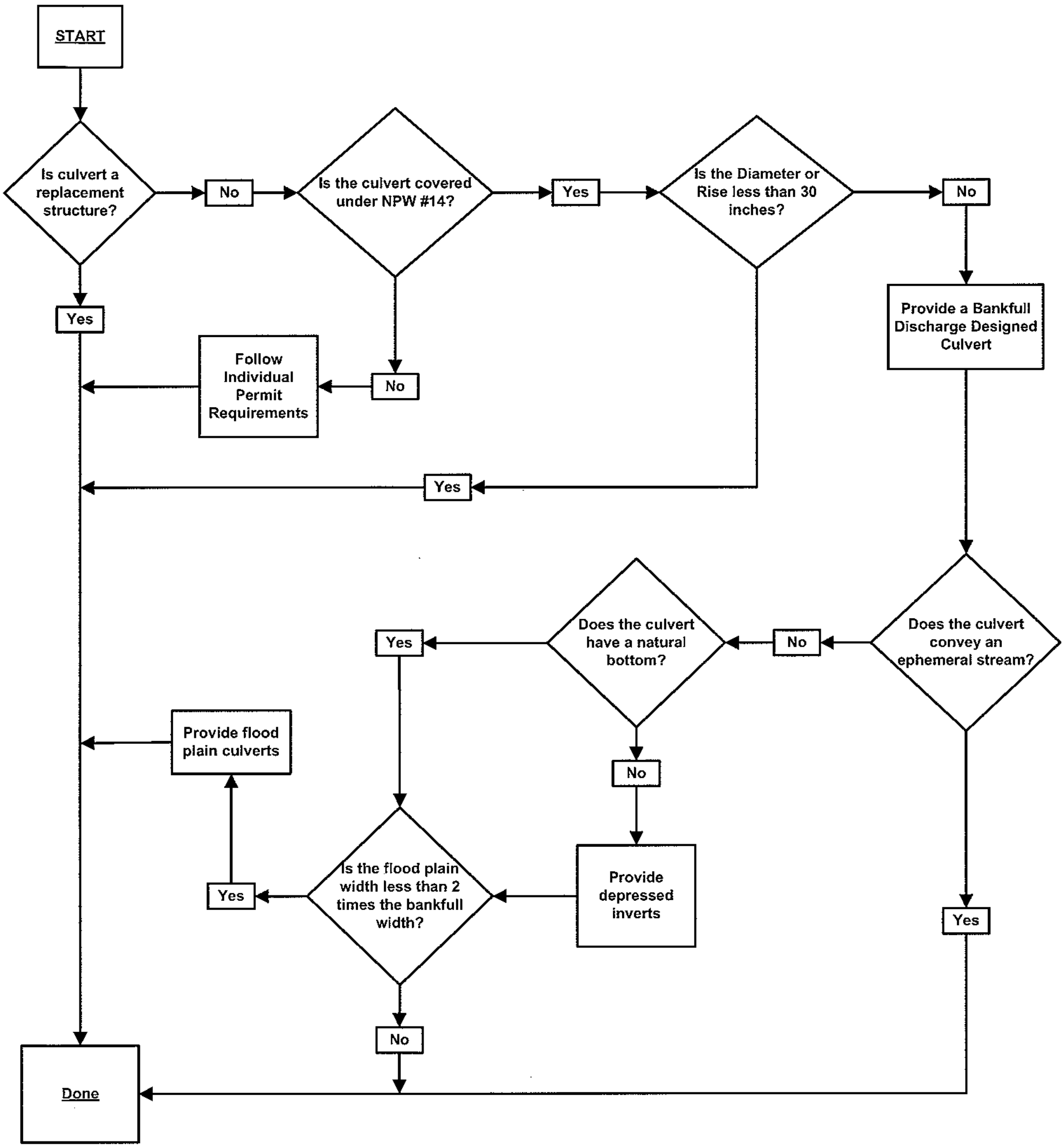
3. Will provide a 20′ x 8′ box with a 12 " burial depth due to its smallest impact on the adjoining stream sections.

4. Ensure the design and check headwaters meet requirements of L&D, Section 1105.

REQUIRED STREAM PROTECTION AT CULVERTS

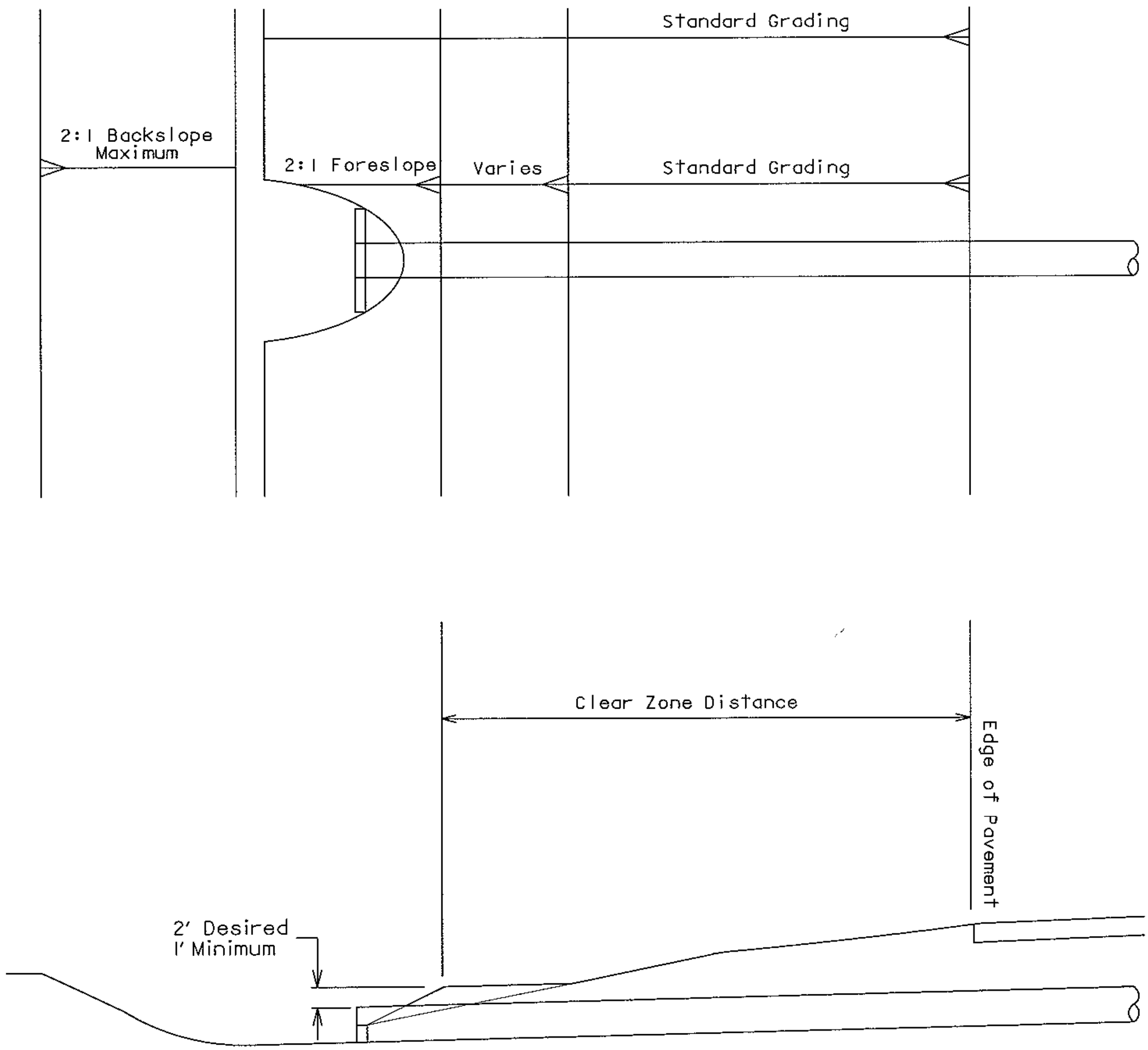
1105-4

REFERENCE SECTION 1105



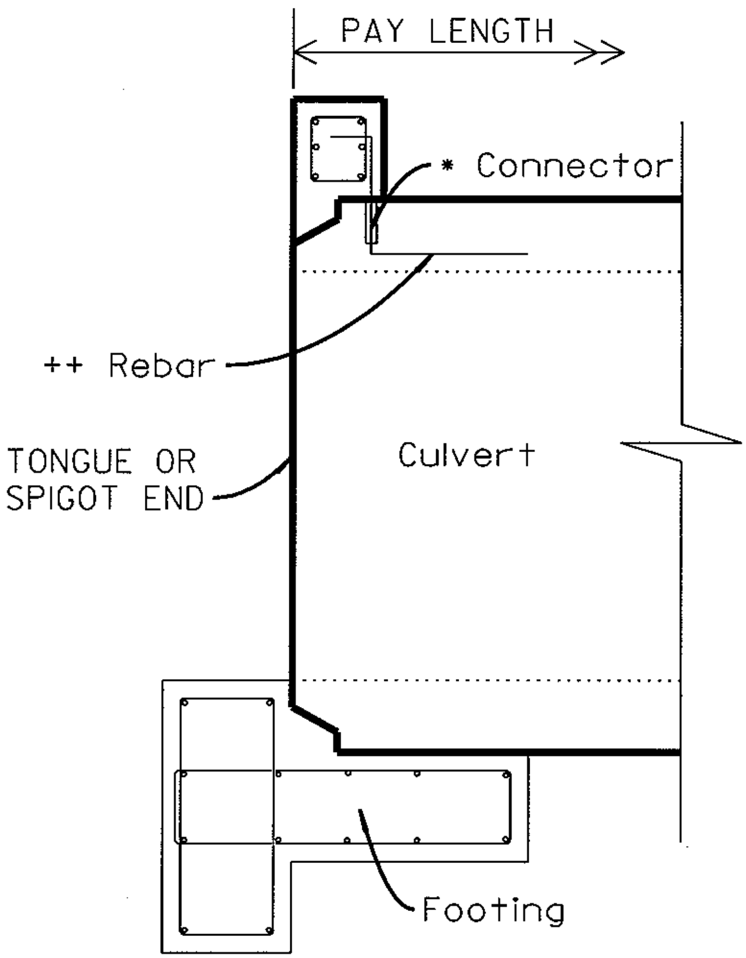
Traditional design methods that use an Improved Inlet or a Paved Depressed Approach Apron are not shown on this flow chart.

END TREATMENT GRADING DETAIL	1106-1
	REFERENCE SECTION 1106.1



JANUARY 2003

BOX CULVERT OUTLET DETAIL	1106-2 **REFERENCE SECTION** 1106



<u>* Anchoring Methods</u>

1. Mechanical connector embedded into precast box culvert.

2. Partial depth resin-bonded anchoring system may be used as per GR-2.2.

3. Threaded inserts. **

4. Ferrule loops. ***

OUTLET DETAIL (NTS)

Notes:

The anchoring system needs to be specified along with the required diameter needed.

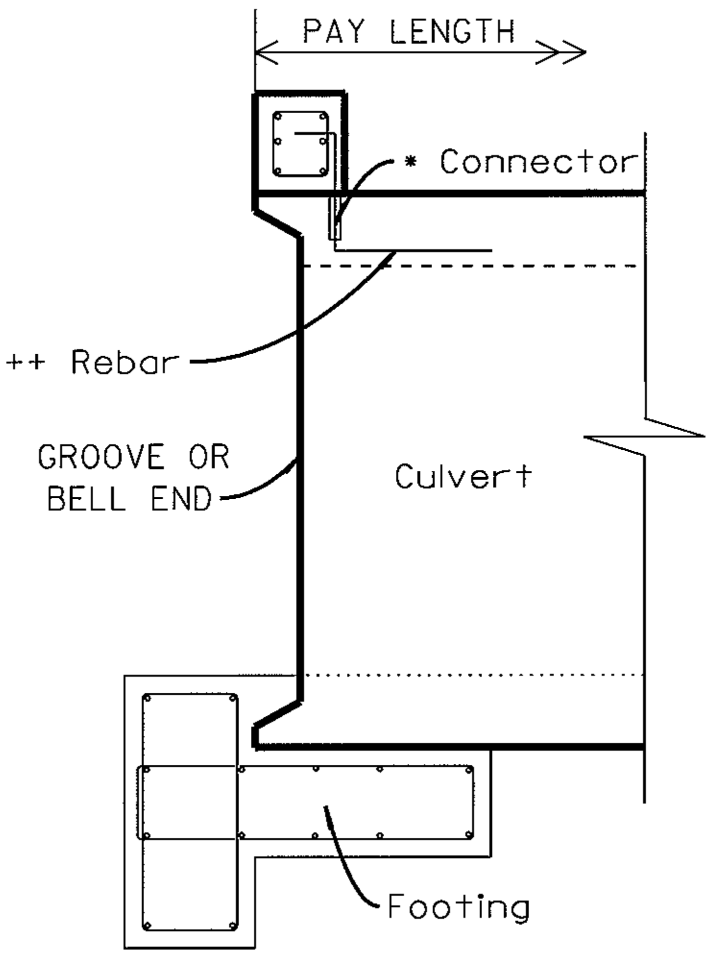
++ For use with the mechanical connector.

** Threaded inserts need to have a specified pull out strength.

*** For use with wet cast boxes only.

JANUARY 2003

BOX CULVERT INLET DETAIL	1106-3 **REFERENCE SECTION** 1106



INLET DETAIL (NTS)

* Anchoring Methods

1. Mechanical connector embedded into precast box culvert.

2. Partial depth resin-bonded anchoring system may be used as per GR-2.2.

3. Threaded inserts. **

4. Ferrule loops. ***

Notes:

The anchoring system needs to be specified along with the required diameter needed.

++ For use with the mechanical connector.

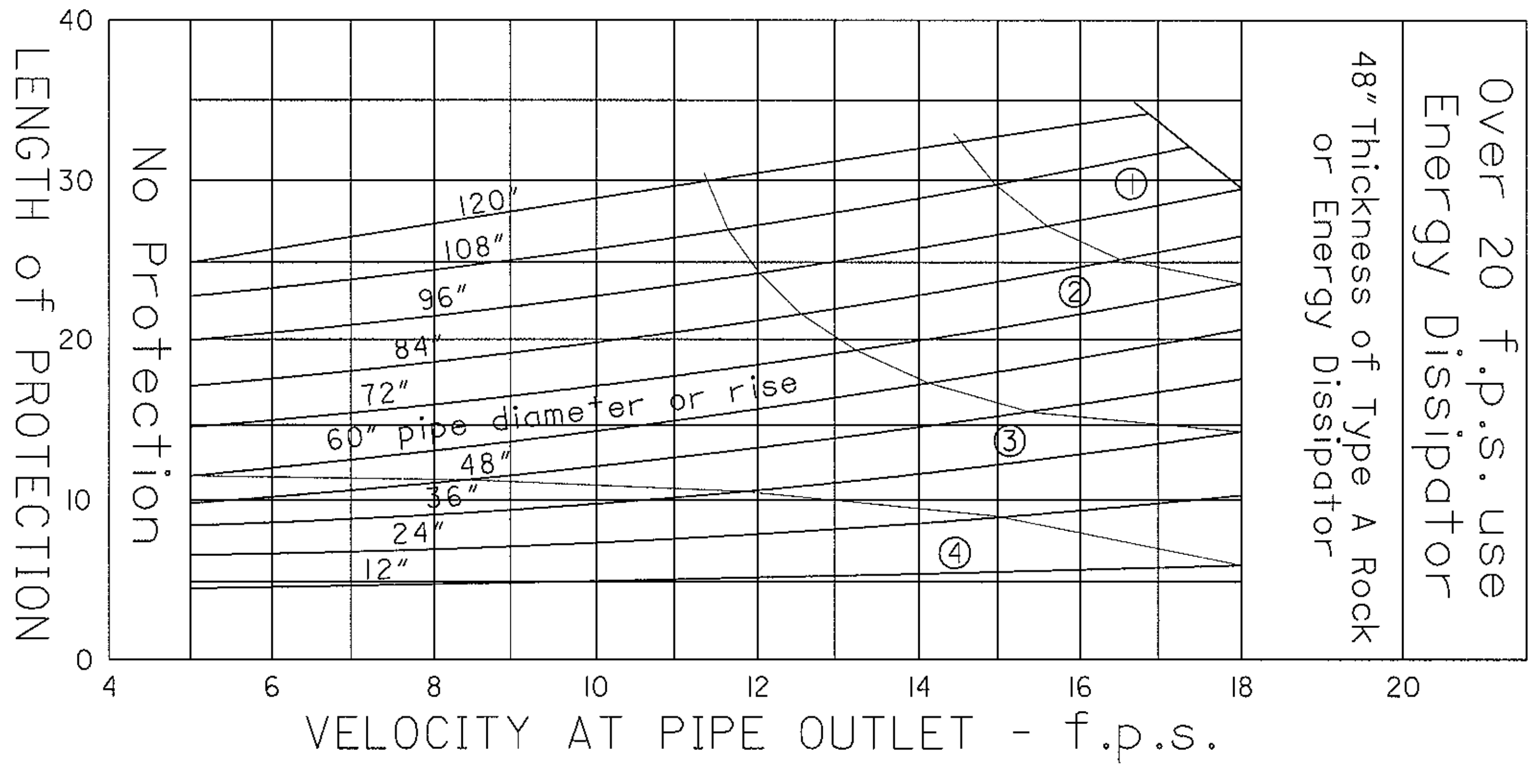
** Threaded inserts need to have a specified pull out strength.

*** For use with wet cast boxes only.

ROCK CHANNEL PROTECTION AT CULVERT AND STORM SEWER OUTLETS

1107-1

REFERENCE SECTION
1107.2



NOTES

Rock size (6", 12", 18") indicates the square opening on which 85% of the material, by weight, will be retained.

The width of protection shall be the width of the headwall, with 4' being the minimum.

(Where a stream bed will withstand the calculated velocity without erosion, no rock channel protection will be required.)

LEGEND	ROCK TYPE
① 48" of 18" rock	A
② 36" of 18" rock	A
③ 30" of 12" rock	B
④ 18" of 6" rock	C

Revised April, 2003

NOTICE OF INTENT (NOI) ACREAGE CALCULATION FORM	1112-1
	Reference Section 1112

		Area (acres)
Project Earth Disturbing Activities	a	
If line a = 0 or the project is a Maintenance Project, an NOI is not required. STOP	b	
If line a > 0, an NOI is required, continue to line d	c	
Field Office	d	
Enter 0.125 for Type A; 0.25 for Type B; or 1.00 for Type C	e	
Batch Plant Yes = 2.0; No = 0	f	
Off-Project Waste / Borrow Pit	g	
Add 1.0 acre per 15,000 CY of waste or borrow	h	
Miscellaneous Other Off-Project Areas	i	
Off-Project staging areas, stock yards, etc.	j	
Contractor Earth Disturbing Activities (add lines e, f, h and j) **Subtotal**	k	
Total Earth Disturbing Activities (add line a to line k) **TOTAL**	l	
NOI Earth Disturbing Activities (minimum = 4.9 acres) **TOTAL**	m	

Project Earth Disturbing Activities. Enter the area of disturbed earth for the project activities. Include shoulder grading, cut and fill areas, anticipated contractor-used areas within State right of way, etc.

Field Office. These sizes were determined with regard to size of the trailer, parking, and some stock area for equipment and materials.

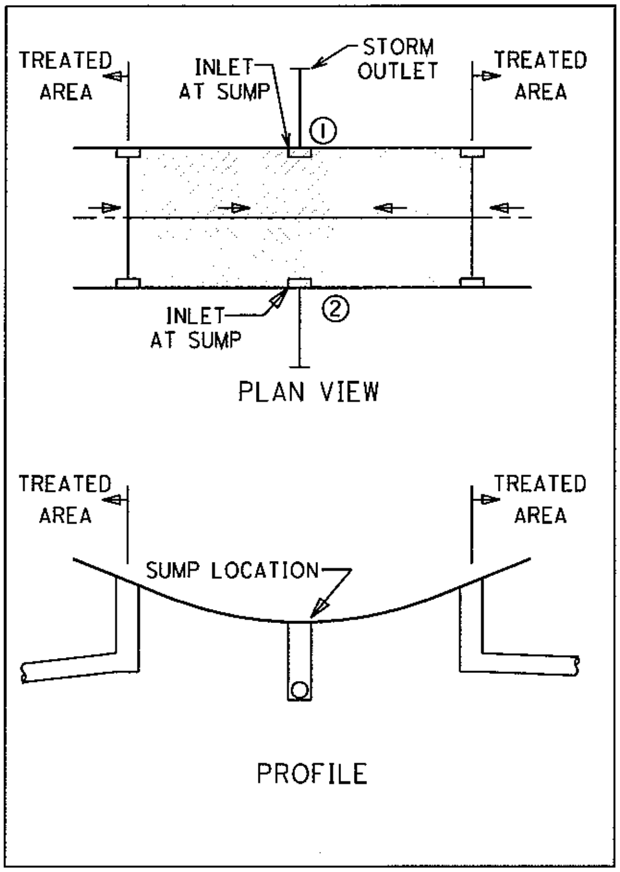
Batch Plant. It is assumed that a typical batch plant would occupy 2 acres of ground. The designer should investigate the location of the project relative to existing plants, facilities, etc. to estimate whether a batch plant might be used by the Contractor. This is not needed for existing plants, it is only for plants set up for the specific project.

Off-Project Waste / Borrow. The specified estimation is based on approximately 10 feet of depth or fill over 1 acre. The designer may choose a different value based on knowledge of the project area, bedrock elevations, previous projects, etc. Consideration should be given for grindings, as well.
(10ft. x 43560 s.f. / 27 = 16,133 c.y. ~ say 15,000 c.y.)

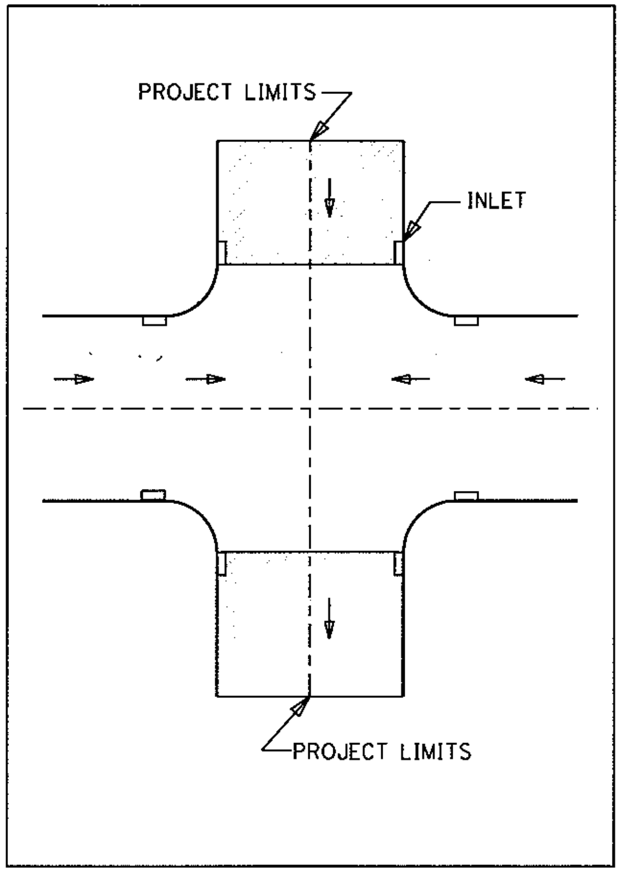
NOI Earth Disturbing Activities (enter total acreage from line l or 4.9 acres, whichever is greater). This value is to be submitted for the NOI. All projects with Project Earth Disturbing Activity greater than zero will be submitted for coverage up to 4.9 acres minimum.

Maintenance activity consists of projects that do not change the line, grade, or hydraulic capacity of the existing condition and have less than 5 acres of earth disturbing activities (see section 1112.2).

EXEMPT OUTFALLS	1116-1
	REFERENCE SECTION 1116



INLETS OR SCUPPERS IN SUMPS



INLETS AT INTERSECTIONS

Contributing Drainage Area 1

Contributing Drainage Area 2

If the contributing drainage areas to drainage structures #1 or #2 are less than 0.25 acres, Water Quality Treatment is not required.

The above example shows areas that are each less than 0.25 acres.

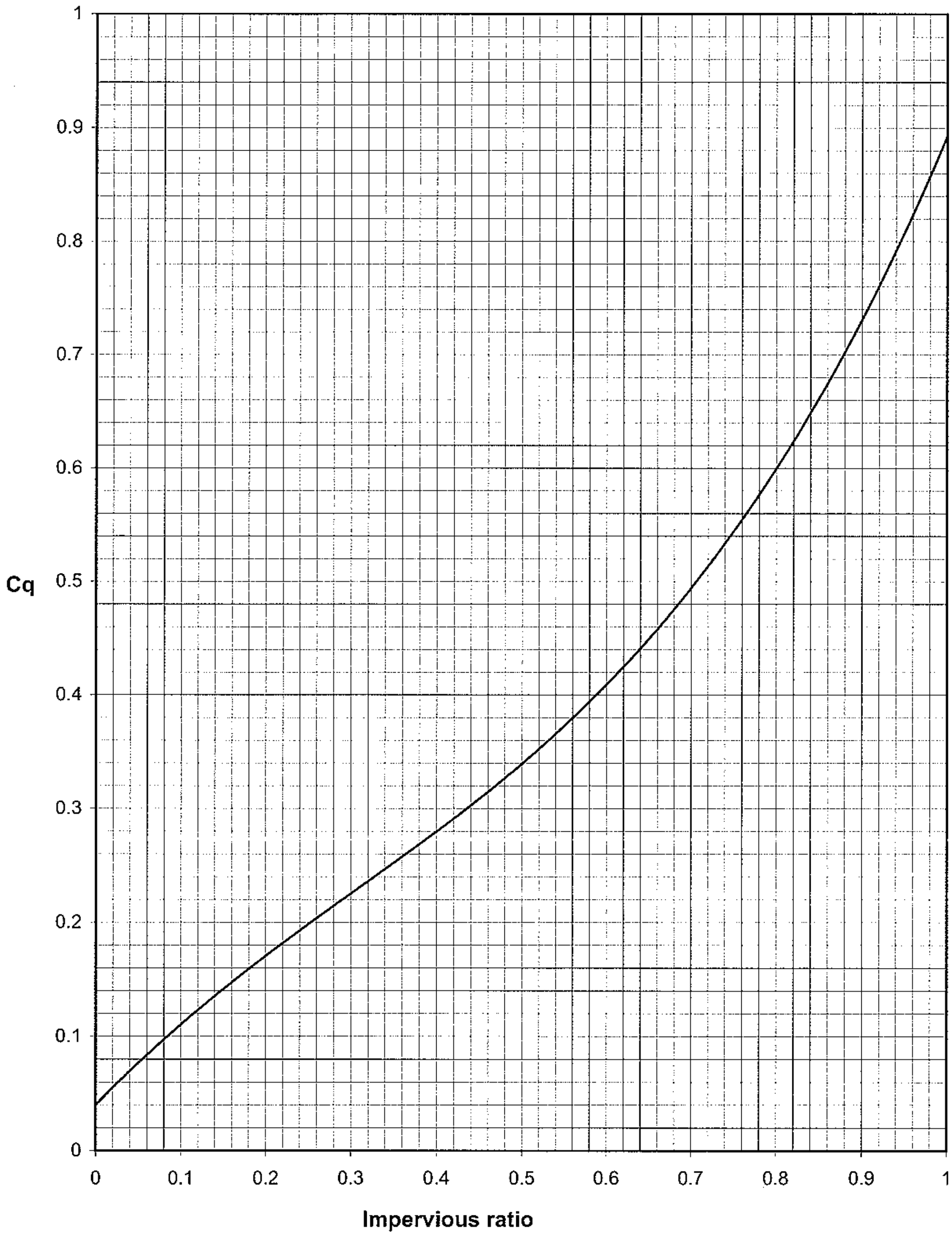
Treatment is required for the drainage areas tributary to the flanking inlets.

If the drainage area within the project limits is less than 0.25 acres, then no Water Quality Treatment is required.

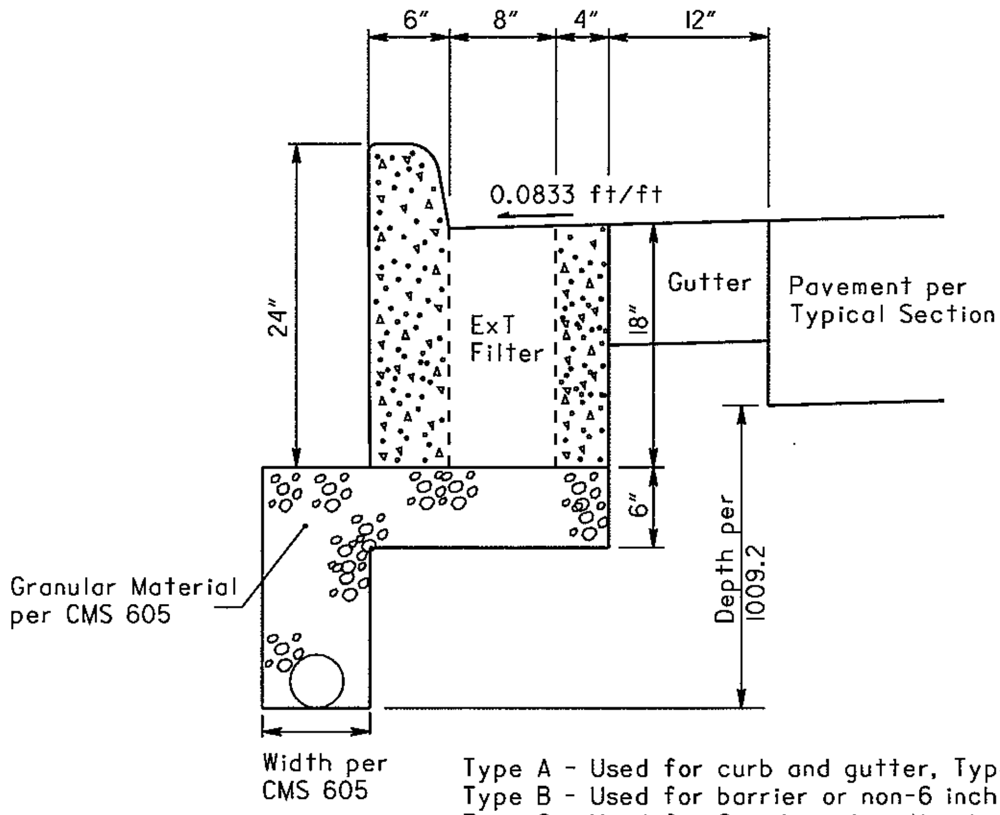
The hatched areas above indicate that treatment is not required.

Treatment is required on the through street.

WATER QUALITY Cq	1116-2
	REFERENCE SECTION 1116

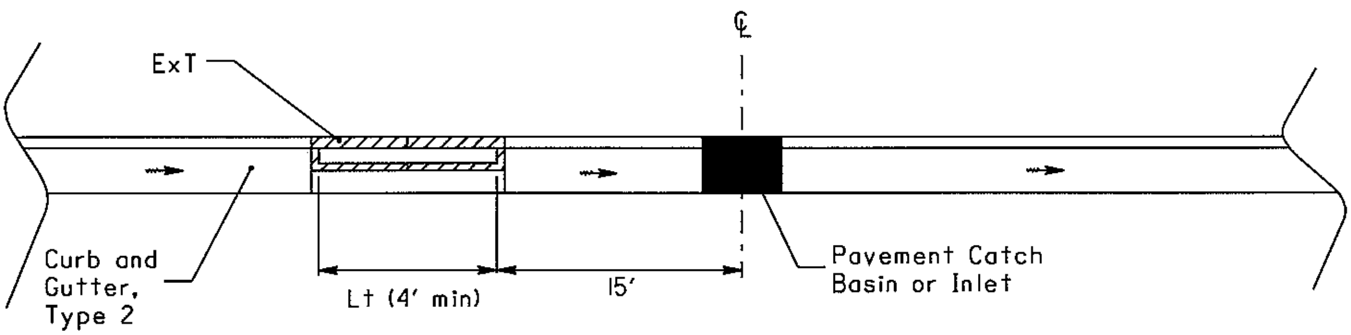


EXFILTRATION TRENCH DETAIL	1118-1
	REFERENCE SECTION 1118



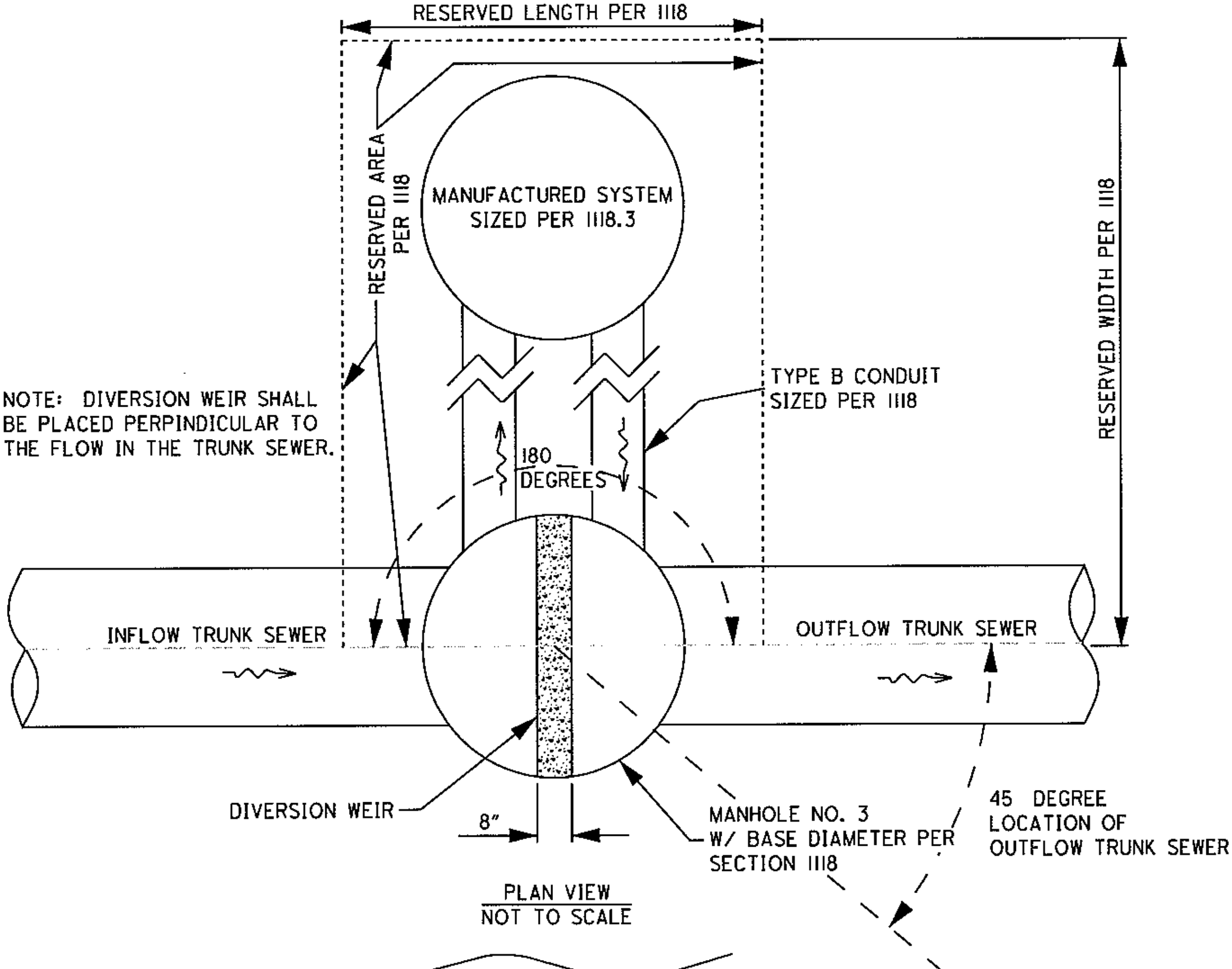
Type A - Used for curb and gutter, Type 2 (shown)
Type B - Used for barrier or non-6 inch curb
Type C - Used for 6 inch curb without gutter

Sectional View (NTS)

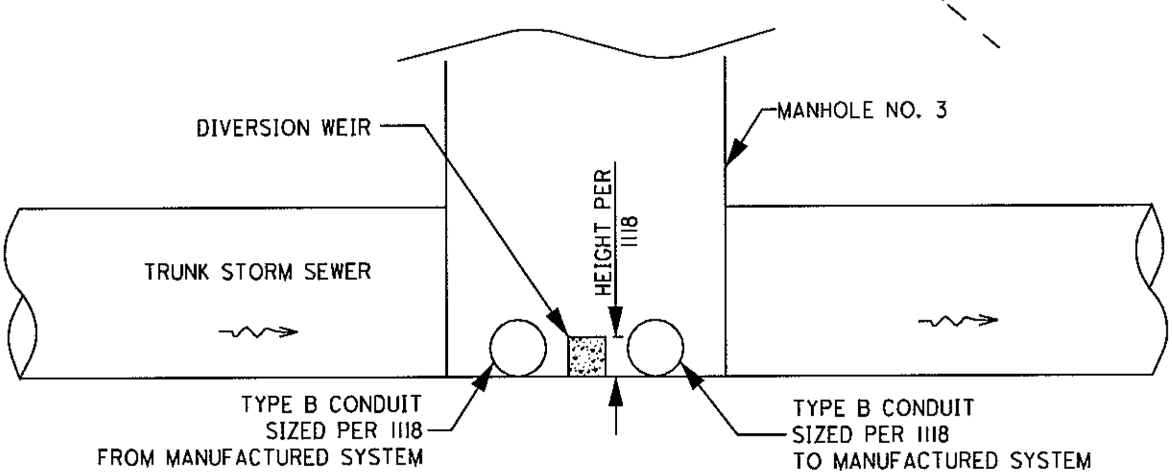


Plan View (NTS)

MANUFACTURED SYSTEM DETAIL	1118-2 **REFERENCE SECTION** 1118



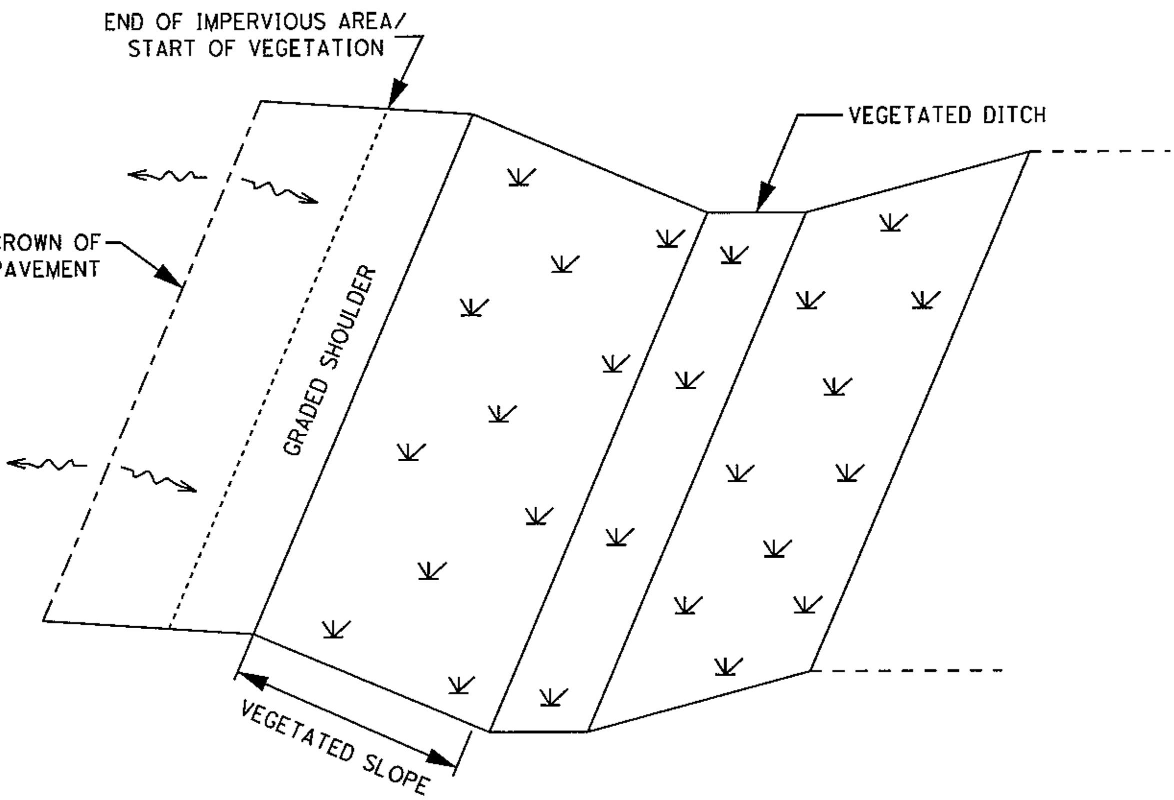
PLAN VIEW
NOT TO SCALE



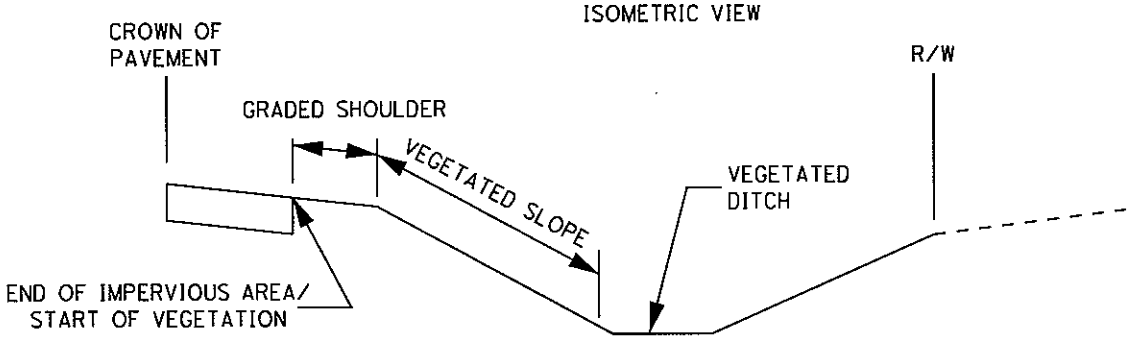
PROFILE
NOT TO SCALE

January 2006

VEGETATED BIOFILTER DETAIL	1118-3 **REFERENCE SECTION** 1118



ISOMETRIC VIEW



CROSS-SECTION VIEW

January 2007

VEGETATED DITCH DESIGN EXAMPLE

1118-4
REFERENCE SECTION 1118

Given:

Roadside Ditch Foreslope = 4:1
Roadside Ditch Backslope = 2:1
Roadside Ditch Width = 4 feet (min)
Roadside Ditch Slope= 0.02 ft/ft
ODOT Pavement Drainage Area = 0.65 acres
Offsite Drainage Area=15 acres

EBW:

EBW $= 5.4 \times (15.65)^{0.356} = 14.4$ feet
EBW is greater than 10 feet => provide a seperate offsite conveyance ditch .

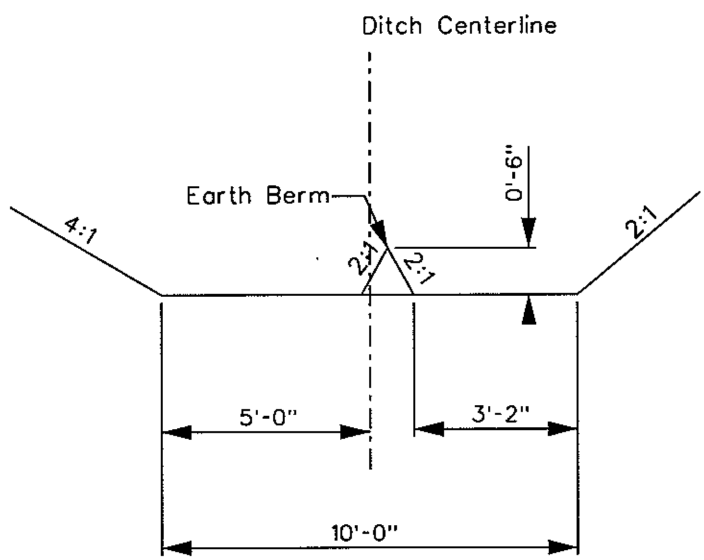
Design:

-Use Figure 1118-17 or 1118-18 to determine the minimum berm height and location that will satisify the design.

-Figure 1118-17 => use a 1:1 Berm at 6" high with an offsite conveyance ditch width of 4'-2" because the point falls within Area B. Begin the berm at 2" left of the ditch centerline.

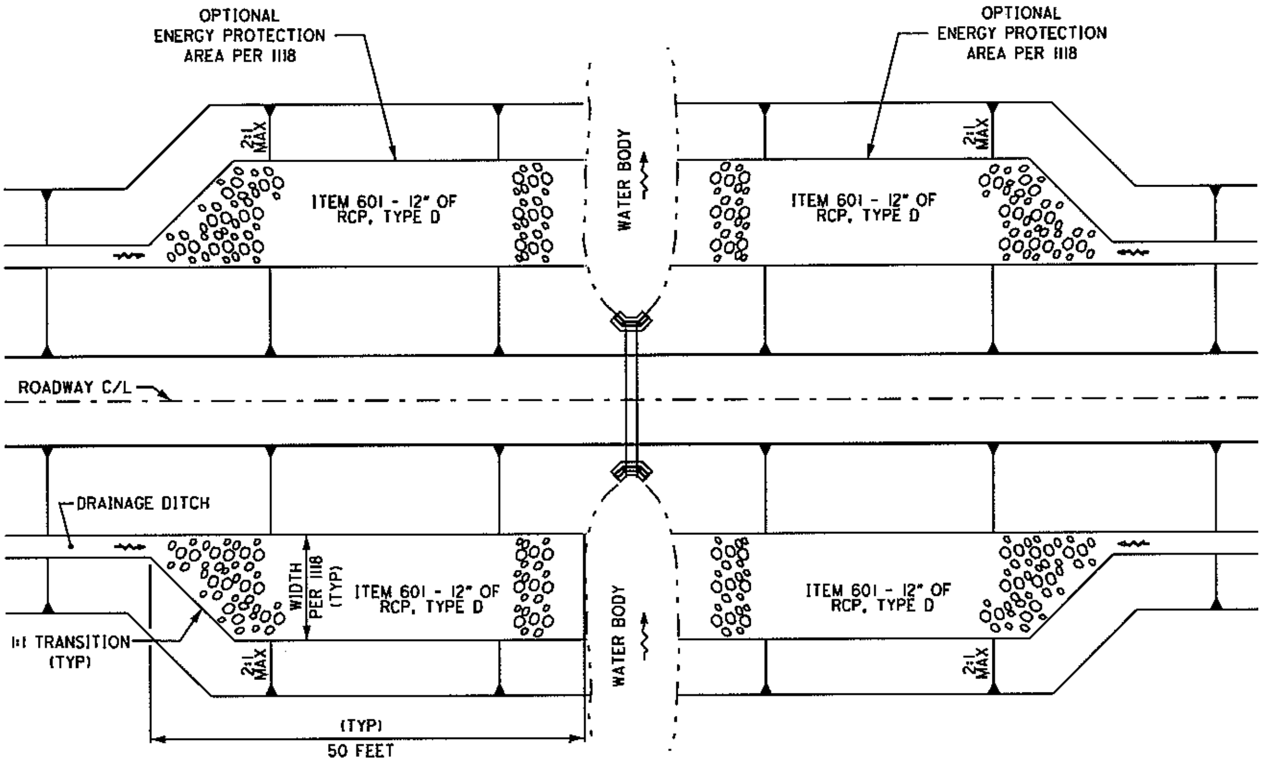
-Figure 1118-18 => use a 2:1 Berm at 6" high with an offsite conveyance ditch width of 3'-2" because the point falls within Area B. Begin the berm at 2" left of the ditch centerline.

-Will use 2:1 Berm at 6" height per Figure 1118-18.

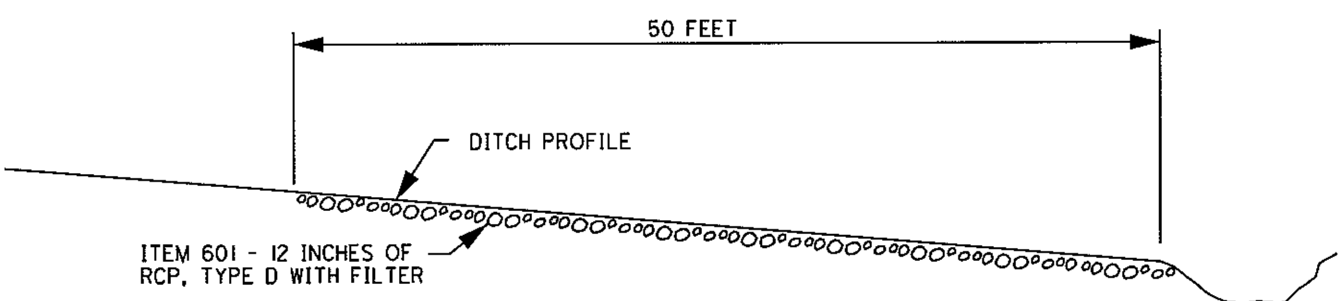


January 2006

ENERGY PROTECTION AREA DETAIL	1118-5
	REFERENCE SECTION 1118



PLAN VIEW
NOT TO SCALE



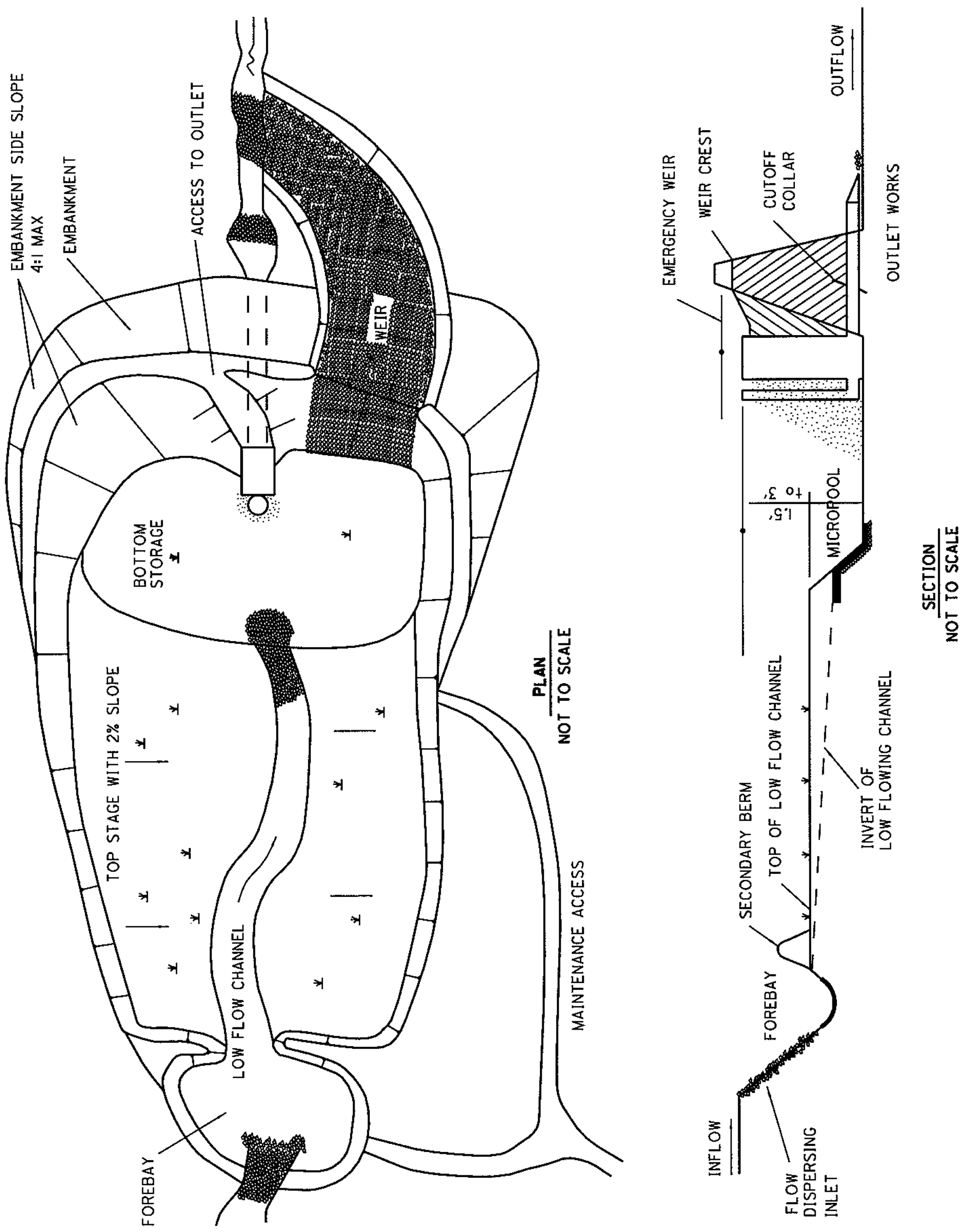
PROFILE
NOT TO SCALE

January 2006

CONCEPTUAL LAYOUT FOR DETENTION (DRY) BASIN FOR WATER QUALITY

1118-6

REFERENCE SECTION
1118



THE MICROPOOL IS TYPICALLY SIZED TO HOLD 10% OF THE TOTAL WQv.

EXTENDED DETENTION BASIN EXAMPLE

GIVEN:

Overflow Discharge (Q10) = 20 cfs
WQv = 0.55 Ac-ft
Drain time = 48 hours

- Calculate 20% increase of WQv:
  =1.20 x 0.55=0.66 Ac-ft

- Calculate the forebay size and subtract from the total required size:

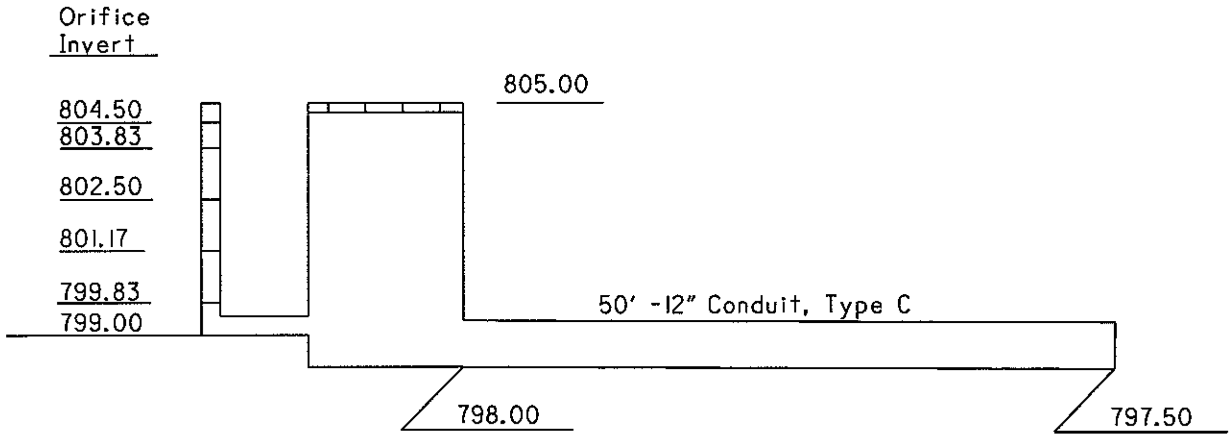
  Size = 0.10 x 0.66 Ac-ft = 0.066 Ac-ft
  Total required size= 0.66 - 0.066 = 0.60 Ac-ft

- Size the outlet structure to discharge WQv (not 20% WQv) within 48 hours:

Will try using a peforated riser pipe (6 inches diameter) into a catch basin (2-3) with 5 rows of 12 openings with a diameter of 1/2-inch as specified.

The outlet catch basin will be a no. 2-3 catch basin with grate elevation = 805.00.

Will try using an outlet culvert equal to 12 inches in diameter.
Will try using a broad crested weir 20' x 5' for emergency overflow @ 806.00



Note: 20% of the WQv is held in permanent storage below the lowest orifice opening.

- Use design software (i.e. HydroCAD) to develop outlet rating curve and discharge time.

EXTENDED DETENTION BASIN EXAMPLE (CONTINUED)

1118-7

REFERENCE SECTION
1118

Stage Discharge Curve

Stage (Elev.)	Discharge (cfs)
799.00	0.00
799.20	0.0
799.40	0.00
799.60	0.00
799.80	0.00
800.00	0.03
800.20	0.05
800.40	0.06
800.60	0.08
800.80	0.08
801.00	0.09
801.20	0.11
801.40	0.15
801.60	0.17
801.80	0.19
802.00	0.21
802.20	0.22
802.40	0.23
802.60	0.27
802.80	0.30
803.00	0.33
803.20	0.35
803.40	0.37
803.60	0.39
803.80	0.41
804.00	0.46
804.20	0.49
804.40	0.52
804.60	0.57
804.80	0.62
805.00	0.66
805.20	2.15
805.40	4.85
805.60	6.57
805.80	7.50
806.00	8.32

Hydrograph for Draining of WQv

Time (Hours)	Storage (Ac-ft)	Elevation (Elev.)	Discharge (cfs)
4	0.55	805.00	0.66
6	0.46	804.02	0.46
8	0.40	803.30	0.36
10	0.34	802.71	0.29
12	0.30	802.26	0.22
14	0.27	801.89	0.20
16	0.24	801.56	0.17
18	0.21	801.29	0.13
20	0.19	801.10	0.10
22	0.18	800.93	0.09
24	0.16	800.77	0.08
26	0.15	800.63	0.08
28	0.14	800.50	0.07
30	0.13	800.38	0.06
32	0.12	800.27	0.06
34	0.11	800.18	0.05
36	0.10	800.10	0.04
38	0.09	800.03	0.04
40	0.09	799.97	0.03
42	0.08	799.92	0.02
44	0.08	799.89	0.01
46	0.08	799.87	0.01
48	0.08	799.85	0.01

NOTES:

Discharge time of basin is 48 hours.

Maximum discharge = 8.32 cfs @ 806.00

RETENTION BASIN EXAMPLE	1118-8
	REFERENCE SECTION 1118

GIVEN:

Overflow Discharge (Q10) = 27 cfs
WQv = 0.55 Ac-ft
Drain time = 24 hours (for 75% of WQv)

- Determine the wet and dry retention volumes required:

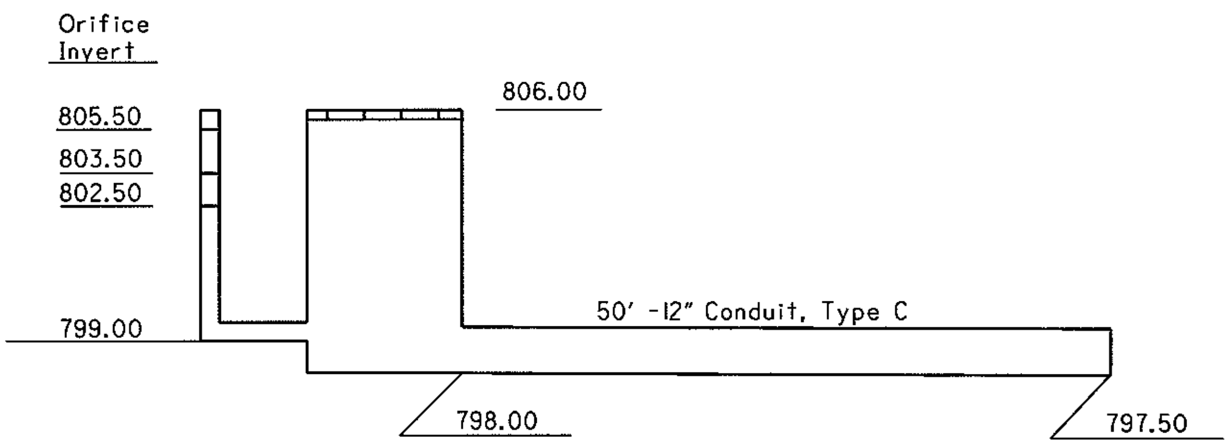
  Size = 0.75 x 0.55 Ac-ft = 0.38 Ac-ft

- Size the outlet structure:

Will try using a peforated riser pipe (8 inches diameter) into a catch basin (2-3) with 3 rows of 8 openings with a diameter of 1 inch as specified.

The outlet catch basin will be a no. 2-3 catch basin with grate elevation = 806.00.

Will try using an outlet culvert equal to 12 inches in diameter.
Will try using a broad crested weir 20' x 5' for emergency overflow @ 807.00



- Use design software (i.e. HydroCAD) to develop outlet rating curve and discharge time.

RETENTION BASIN EXAMPLE (CONTINUED)

Stage Discharge Curve

Stage (Elev.)	Discharge (cfs)
802.50	0.00
802.60	0.06
802.80	0.12
803.00	0.16
803.20	0.19
803.40	0.21
803.60	0.29
803.80	0.38
804.00	0.44
804.20	0.49
804.40	0.53
804.60	0.57
804.80	0.61
805.00	0.64
805.20	0.67
805.40	0.71
805.60	0.79
805.80	0.88
806.00	0.95
806.20	2.47
806.40	5.20
806.60	6.94
806.80	7.88
807.00	8.72

Hydrograph for Draining of 75% of WQv

Time (Hours)	Storage (Ac-ft)	Elevation (Elev.)	Discharge (cfs)
5	0.76	806.00	0.95
7	0.64	804.87	0.62
9	0.55	804.06	0.45
11	0.49	803.52	0.24
13	0.46	803.20	0.19
15	0.43	802.95	0.15
17	0.41	802.75	0.11
19	0.39	802.62	0.06
21	0.39	802.55	0.03
23	0.38	802.53	0.01
25	0.38	802.52	0.00

NOTES:

Discharge time of basin is 25 hours.
Maximum discharge = 8.72 cfs @ 807.00

BIORETENTION CELL EXAMPLE

GIVEN:

$WQ_v = 0.20$ AC-FT

$K = 3.3 \times 10^{-5}$ FT/SEC

$D = 4.0$ FT

$h = 1$ FT

$Q_{10} = 23$ CFS

$T = 40$ HOURS

- SOLVE FOR REQUIRED AREA

$$A = \frac{(0.20\text{AC-FT})\ (4.0\text{ FT})}{3600(3.3\times10^{-5}\text{ FT/SEC})(40\text{ HOURS})(1+4.0)} = 0.03\text{ AC}$$

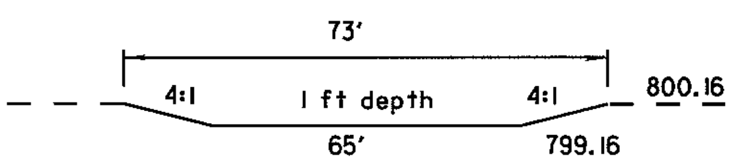
- ASSUME 20 FT. WIDTH. SOLVE FOR LENGTH

$$0.03\text{AC} = \frac{20\ L}{43560} \Longrightarrow L = 65\text{ FT}$$

- PROVIDE STORAGE FOR AT WQ_v PRIOR TO FILTRATION:

$$0.03\text{ AC-FT} = 1{,}307\text{ FT}^3$$

USE TRAPEZOIDAL SECTION @ 20 FT WIDTH X 65 FT LONG X 12 INCHES DEPTH



VOLUME = 1,661 CF > 1,307 CF => O.K.
(Used Visual Urban software from FHWA)

BIORETENTION CELL EXAMPLE (CONT.)

- CHECK FOR Q_{10} BYPASS THROUGH BIORETENTION CELL

Q_{10} = 23 CFS FIGURE 1102-1 SHOW GRATE CAPACITY OF No. 2-2B CATCH BASIN = 6.5 CFS @ 0.5 FT HEAD (ELEVATION 800.66)

2 BASINS ⟹ 2X6.5 = 13 CFS < 23 CFS ⟹ DESIGN WEIR FOR 23-13 CFS=10 CFS

TRAPEZOIDAL WEIR EQUATION (ASSUME 15' BASE WITH 4:1 SIDE SLOPES):

Q= 3.367 X B X H^(3/2) ⟹ 10= 3.367 X 15' X H^(3/2), SOLVING FOR H=0.34 FT

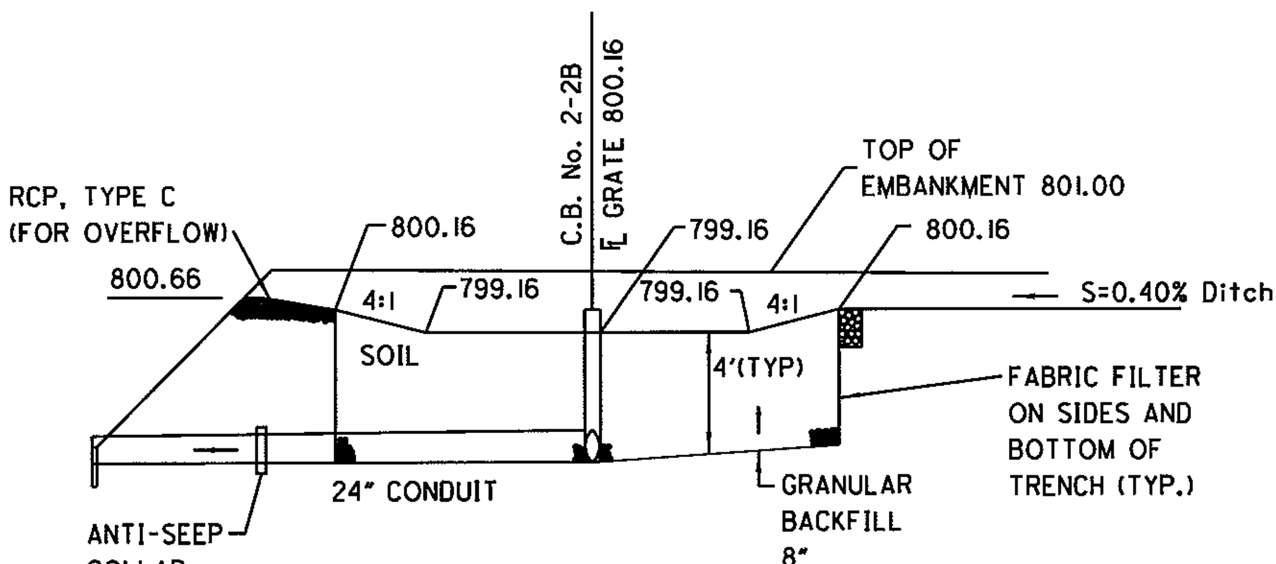
⟹ TOP OF EMBANKMENT SHOULD BE AT LEAST 0.34' + 800.66=801.00

@ ELEVATION 801.00, TOTAL DISCHARGE IN CATCH BASINS = 20 CFS (FIGURE 1102-1 AT 0.84 FT HEAD.) 10 CFS EACH

- DESIGN STORM SEWER FOR Q_{10} FLOW ASSUME CB 1 & 2 TAKE 10 CFS EACH USING MANNINGS EQUATION:

1 TO 2 ⟹ USE 21" CONDUIT @ 0.68%

2 TO 3 ⟹ USE 24" CONDUIT @ 1.1%

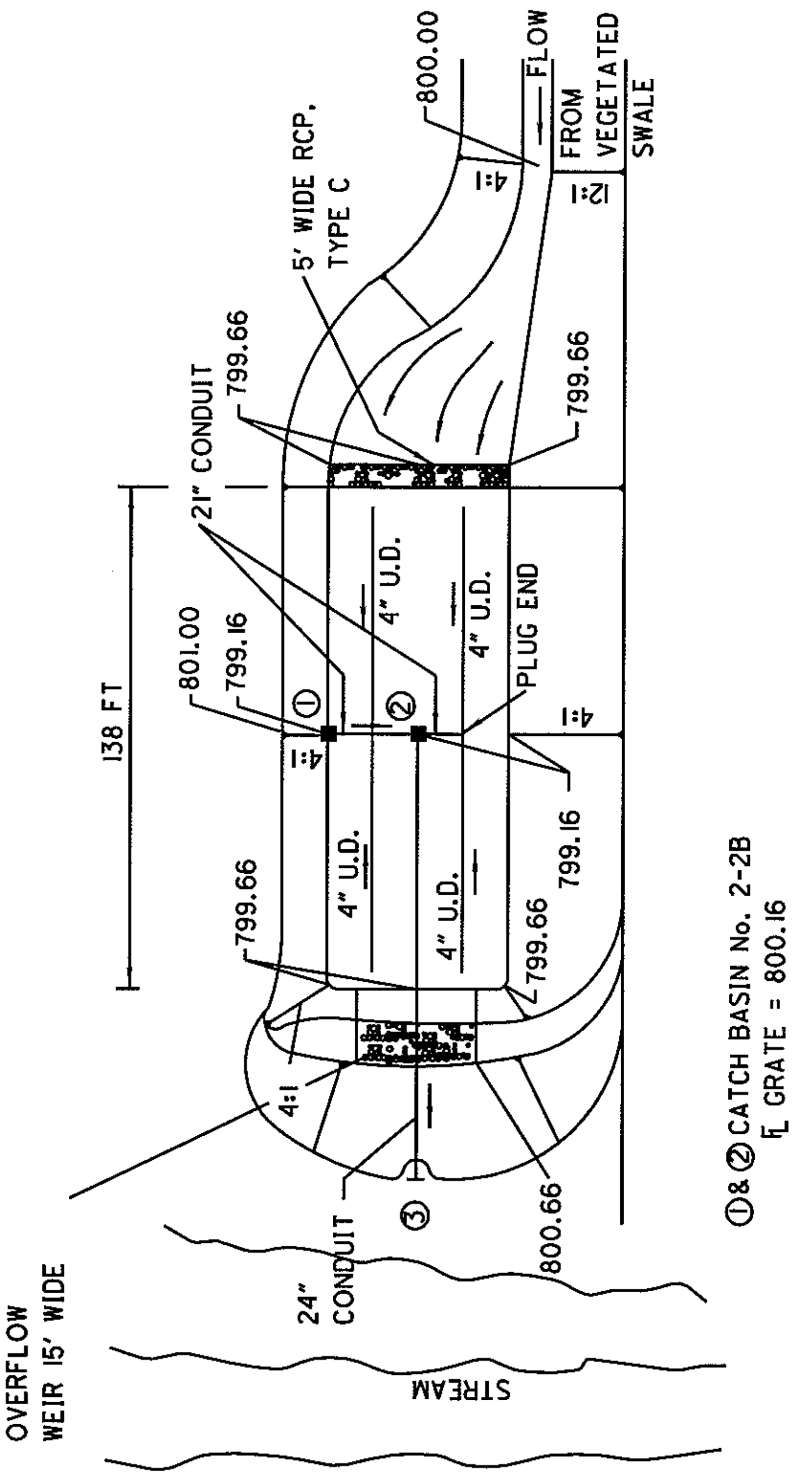


PROFILE VIEW

NTS

January 2006

BIORETENTION CELL EXAMPLE (CONT.)	1118-9
	REFERENCE SECTION 1118



PLAN VIEW

NTS

NOTES:

4" U.D. BLIND TAPS INTO THE 21" COLLECTOR PIPE

0.5' WIDE RCP USED TO SPREAD THE FLOW ACROSS THE CELL

AREA TO BE MULCHED AND PLANTED W/TREES, SHRUBS, AND GRASSES NATIVE TO THE AREA.

INFILTRATION TRENCH EXAMPLE	1118-10
	REFERENCE SECTION 1118

GIVEN:

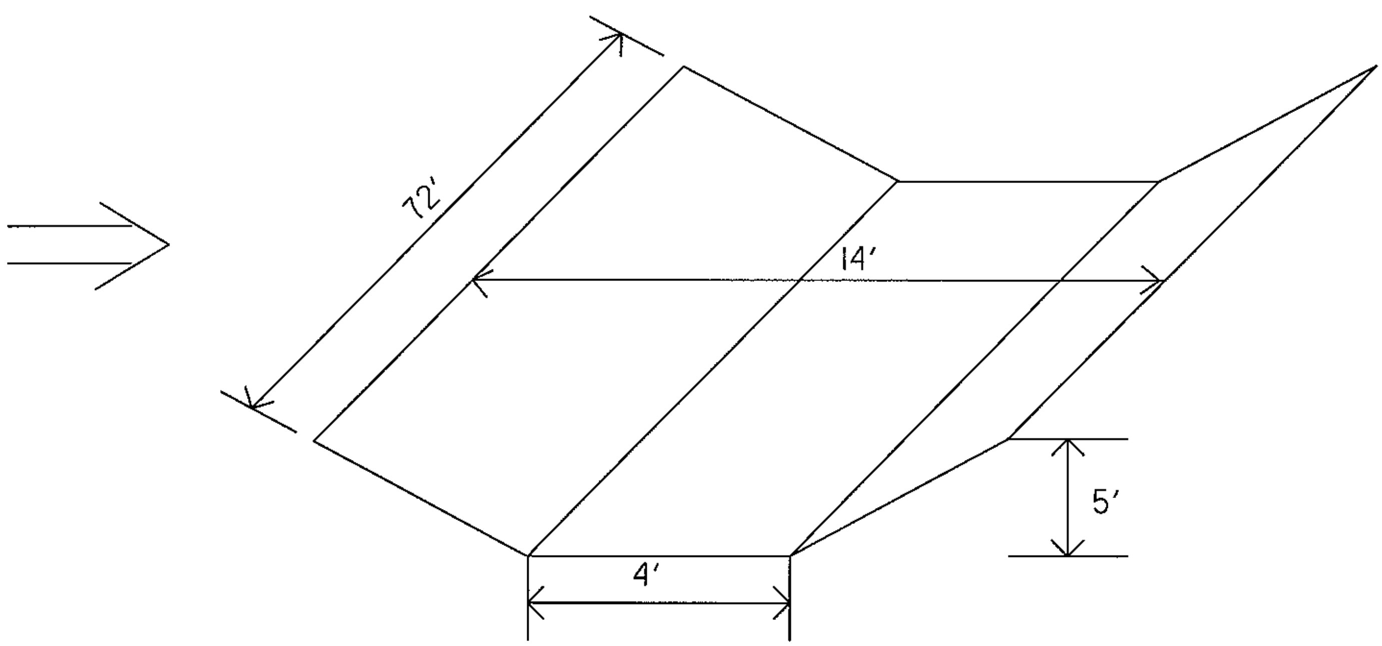
WQv = 0.16 Ac-ft
Trench Backfill = uniform sized gravel (p=0.40)
Surrounding Soil Permeability (K) = 0.000065 ft/sec
Drain time = 24 hours

- Assume depth = 5.0 feet
- Assume bottom width = 4.0 feet
- Calculate the required length:

$$L = \frac{43560 \times (0.16 \text{ Ac-ft})}{3600 \times (0.000065 \text{ ft/sec}) \times (24)(4+2(5)) + 0.40 \times (5 + (4)(5))}$$

L= 72 ft.

TOP WIDTH = 4+(2)(5) = 14 FEET



INFILTRATION BASIN EXAMPLE

GIVEN:

Sandy Loam Soil (infiltration rate (k) = 1.0 in/hr)

WQv = 0.25 Ac-ft

Surrounding Soil Permeability (K) = 0.000065 ft/sec

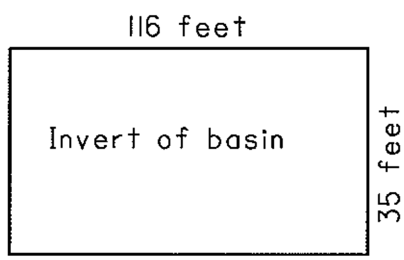
Drain time = 48 hours

- Calculate the required surface area of the basin invert:

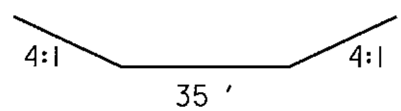
$$A = \frac{0.25 \text{ Ac-ft} \times 1.5 \times 12}{1.0 \text{ in/hr} \times 48 \text{ hours}} = 0.093 \text{ Ac} = 4{,}084 \text{ sf}$$

- Will try a 35 foot wide basin:

$$\text{Length} = \frac{4{,}084 \text{ sf}}{35 \text{ ft}} = 116 \text{ feet}$$



Plan



Cross Section

- Calculate the depth of the basin:

Will assume that only basin invert infiltrates storm water

Therefore, depth = WQv/Invert Area = 0.25 Ac-ft/0.093 Ac = 2.68 feet

Add one foot for freeboard requirement => Depth = 3.68 feet

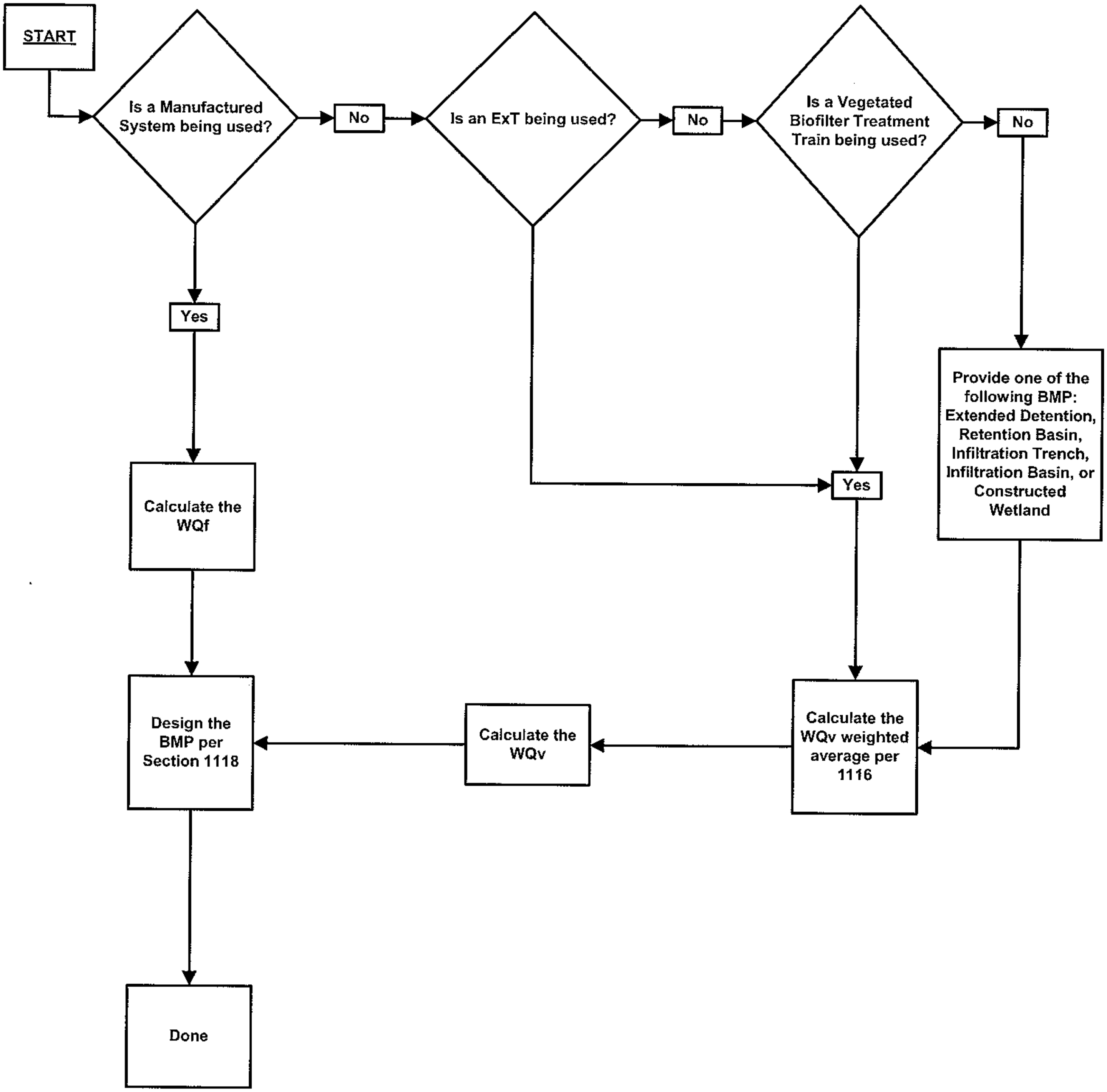
- Therefore, dimensions of the basin are:

116 feet x 35 feet x 3.68 feet with 4:1 slopes

BMP SELECTION AT AN OUTFALL

1118-12

REFERENCE SECTION 1118

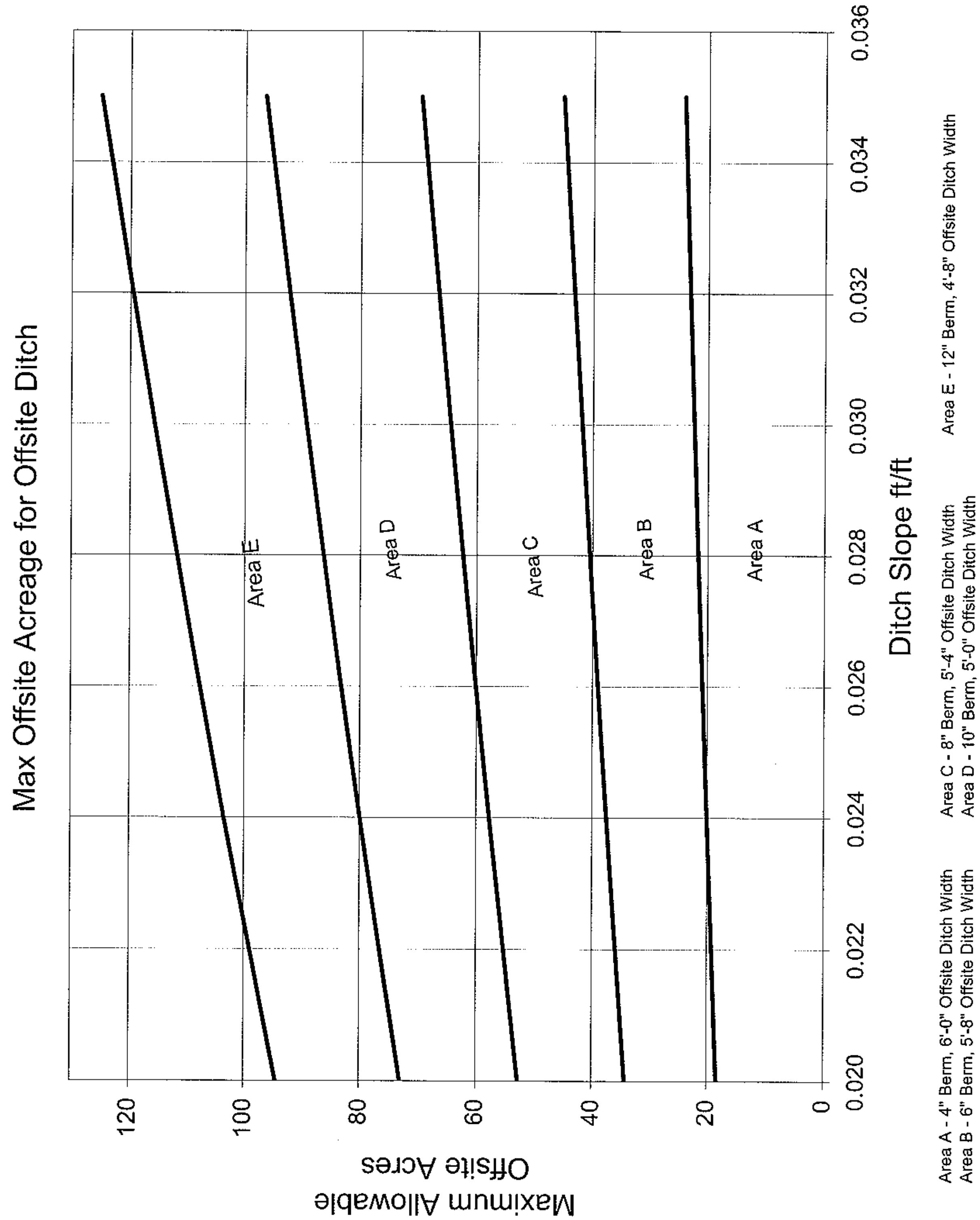


CONVEYANCE DITCH DESIGN -

PVMT=0.25 ACRES, 1:1 BERM SLOPE,
BEGIN BERM AT 1'-8" LEFT OF DITCH CENTERLINE

1118-13

REFERENCE SECTION
1118



Appendix B

Ohio EPA Construction General Permit – OEPA OHC000002

Ohio EPA Permit No.: OHC000002
Effective Date: April 21, 2003
Expiration Date: April 20, 2008

OHIO ENVIRONMENTAL PROTECTION AGENCY

AUTHORIZATION FOR STORM WATER DISCHARGES ASSOCIATED WITH CONSTRUCTION ACTIVITY UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the federal Water Pollution Control Act, as amended (33 U.S.C. Section 1251 et. seq. hereafter referred to as "the Act") and the Ohio Water Pollution Control Act [Ohio Revised Code ("ORC") Chapter 6111], dischargers of storm water from sites where construction activity is being conducted, as defined in Part I.B of this permit, are authorized by the Ohio Environmental Protection Agency, hereafter referred to as "Ohio EPA," to discharge from the outfalls at the sites and to the receiving surface waters of the state identified in their Notice of Intent ("NOI") application form on file with Ohio EPA in accordance with the conditions specified in Parts I through VII of this permit.

This permit is conditioned upon payment of applicable fees, submittal of a complete NOI application form and written approval of coverage from the director of Ohio EPA in accordance with Ohio Administrative Code ("OAC") Rule 3745-38-06.

Original signed by Christopher Jones

Christopher Jones
Director

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PART I. COVERAGE UNDER THIS PERMIT

A. Permit Area.

This permit covers the entire State of Ohio.

B. Eligibility.

1. Construction activities covered. Except for storm water discharges identified under Part I.B.2, this permit may cover all new and existing discharges composed entirely of storm water discharges associated with construction activity that enter surface waters of the state or a storm drain leading to surface waters of the state.

   For the purposes of this permit, construction activities include any clearing, grading, excavating, grubbing and/or filling activities that disturb the threshold acreage described in the next paragraph. Discharges from trench dewatering are also covered by this permit as long as the dewatering activity is carried out in accordance with the practices outlined in Part III.G.2.g.iv of this permit.

   Prior to March 10, 2003, only construction activities disturbing five or more acres of total land were required to obtain NPDES construction storm water permit coverage. On and after March 10, 2003, construction activities disturbing one or more acres of total land will be eligible for coverage under this permit. The threshold acreage includes the entire area disturbed in the larger common plan of development or sale.

   This permit also authorizes storm water discharges from support activities (e.g., concrete or asphalt batch plants, equipment staging yards, material storage areas, excavated material disposal areas, borrow areas) provided:

   a. The support activity is directly related to a construction site that is required to have NPDES permit coverage for discharges of storm water associated with construction activity;

   b. The support activity is not a commercial operation serving multiple unrelated construction projects and does not operate beyond the completion of the construction activity at the site it supports;

   c. Appropriate controls and measures are identified in a storm water pollution prevention plan (SWP3) covering the discharges from the support activity; and

   d. The support activity is on or contiguous with the property defined in the NOI;

Part I.B

2. Limitations on coverage. The following storm water discharges associated with construction activity are not covered by this permit:

   a. Storm water discharges that originate from the site after construction activities have been completed, including any temporary support activity, and the site has achieved final stabilization. Industrial post-construction storm water discharges may need to be covered by an NPDES permit;

   b. Storm water discharges associated with construction activity that the director has shown to be or may reasonably expect to be contributing to a violation of a water quality standard; and

   c. Storm water discharges authorized by an individual NPDES permit or another NPDES general permit;

3. Waivers. After March 10, 2003, sites whose larger common plan of development or sale have at least one, but less than five acres of land disturbance, which would otherwise require permit coverage for storm water discharges associated with construction activities, may request that the director waive their permit requirement. Entities wishing to request such a waiver must certify in writing that the construction activity meets one of the two the waiver conditions:

   a. **Rainfall erosivity waiver.** For a construction site to qualify for the rainfall erosivity waiver, the cumulative rainfall erosivity over the project duration must be five or less and the site must be stabilized with at least a 70 percent vegetative cover or other permanent, non-erosive cover. The rainfall erosivity must be calculated according to the method in U.S. EPA Fact Sheet 3.1 Construction Rainfall Erosivity Waiver dated January 2001. If it is determined that a construction activity will take place during a time period where the rainfall erosivity factor is less than five, a written waiver certification must be submitted to Ohio EPA at least 21 days before construction activity is scheduled to begin. If the construction activity will extend beyond the dates specified in the waiver certification, the operator must either: (a) recalculate the waiver using the original start date with the new ending date (if the R factor is still less than five, a new waiver certification must be submitted) or (b) submit an NOI application form and fee for coverage under this general permit at least seven days prior to the end of the waiver period (see Attachment A); or

Part I.B.3

b. **TMDL (Total Maximum Daily Load) waiver.** Storm water controls are not needed based on a TMDL approved or established by U.S. EPA that addresses the pollutant(s) of concern or, for non-impaired waters that do not require TMDLs, an equivalent analysis that determines allocations for small construction sites for the pollutant(s) of concern or that determines that such allocations are not needed to protect water quality based on consideration of existing in-stream concentrations, expected growth in pollutant contributions from all sources, and a margin of safety. The pollutant(s) of concern include sediment or a parameter that addresses sediment (such as total suspended solids, turbidity or siltation) and any other pollutant that has been identified as a cause of impairment of any water body that will receive a discharge from the construction activity. The operator must certify to the director of Ohio EPA that the construction activity will take place, and storm water discharges will occur, within the drainage area addressed by the TMDL or equivalent analysis. A written waiver certification must be submitted to Ohio EPA at least 21 days before the construction activity is scheduled to begin.

4. Prohibition on non-storm water discharges. All discharges covered by this permit must be composed entirely of storm water with the exception of the following: discharges from fire fighting activities; fire hydrant flushings; potable water sources including waterline flushings; irrigation drainage; lawn watering; routine external building washdown which does not use detergents; pavement washwaters where spills or leaks of toxic or hazardous materials have not occurred (unless all spilled material has been removed) and where detergents are not used; air conditioning condensate; springs; uncontaminated ground water from trench or well point dewatering and foundation or footing drains where flows are not contaminated with process materials such as solvents. Dewatering activities must be done in compliance with Part III.G.2.g.iv of this permit. Discharges of material other than storm water or the authorized non-storm water discharges listed above must comply with an individual NPDES permit or an alternative NPDES general permit issued for the discharge.

   Except for flows from fire fighting activities, sources of non-storm water listed above that are combined with storm water discharges associated with construction activity must be identified in the SWP3. The SWP3 must identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

Part I.B

5. Spills and unintended releases (Releases in excess of Reportable Quantities). This permit does not relieve the permittee of the reporting requirements of 40 CFR Part 117 and 40 CFR Part 302. In the event of a spill or other unintended release, the discharge of hazardous substances in the storm water discharge(s) from a construction site must be minimized in accordance with the applicable storm water pollution prevention plan for the construction activity and in no case, during any 24-hour period, may the discharge(s) contain a hazardous substance equal to or in excess of reportable quantities.

   40 CFR Part 117 sets forth a determination of the reportable quantity for each substance designated as hazardous in 40 CFR Part 116. The regulation applies to quantities of designated substances equal to or greater than the reportable quantities, when discharged to surface waters of the state. 40 CFR Part 302 designates under section 102(a) of the Comprehensive Environmental Response, Compensation and Liability Act of 1980, those substances in the statutes referred to in section 101(14), identifies reportable quantities for these substances and sets forth the notification requirements for releases of these substances. This regulation also sets forth reportable quantities for hazardous substances designated under section 311(b)(2)(A) of the Clean Water Act (CWA).

C. Requiring an individual NPDES permit or an alternative NPDES general permit.

1. The director may require an alternative permit. The director may require any operator eligible for this permit to apply for and obtain either an individual NPDES permit or coverage under an alternative NPDES general permit in accordance with OAC Rule 3745-38-04. Any interested person may petition the director to take action under this paragraph.

   The director will send written notification that an alternative NPDES permit is required. This notice shall include a brief statement of the reasons for this decision, an application form and a statement setting a deadline for the operator to file the application. If an operator fails to submit an application in a timely manner as required by the director under this paragraph, then coverage, if in effect, under this permit is automatically terminated at the end of the day specified for application submittal.

Part I.C

2. Operators may request an individual NPDES permit. Any owner or operator eligible for this permit may request to be excluded from the coverage of this permit by applying for an individual permit. The owner or operator shall submit an individual application with reasons supporting the request to the director in accordance with the requirements of 40 CFR 122.26. If the reasons adequately support the request, the director shall grant it by issuing an individual NPDES permit.

3. When an individual NPDES permit is issued to an owner or operator otherwise subject to this permit or the owner or operator is approved for coverage under an alternative NPDES general permit, the applicability of this permit to the individual NPDES permittee is automatically terminated on the effective date of the individual permit or the date of approval for coverage under the alternative general permit, whichever the case may be.

D. Permit requirements when portions of a site are sold

If an operator obtains a permit for a development, and then the operator (permittee) sells off lots or parcels within that development, permit coverage must be continued on those lots until a Notice of Termination (NOT) in accordance with Part IV.B is submitted. For developments which require the use of centralized sediment and erosion controls (i.e., controls that address storm water runoff from one or more lots) for which the conveyance of permit coverage for a portion of the development will either prevent or impair the implementation of the controls and therefore jeopardize compliance with the terms and conditions of this permit, the permittee will be required to maintain responsibility for the implementation of those controls. For developments where this is not the case, it is the permittee's responsibility to temporarily stabilize all lots sold to individual lot owners unless an exception is approved in accordance with Part III.G.4. In cases where permit coverage for individual lot(s) will be conveyed, the permittee shall inform the individual lot owner of the obligations under this permit and ensure that the Individual Lot NOI application is submitted to Ohio EPA.

Part I

E. Authorization

1. Obtaining authorization to discharge. Operators that discharge storm water associated with construction activity must submit an NOI application form in accordance with the requirements of Part II of this permit to obtain authorization to discharge under this general permit. As required under OAC Rule 3745-38-06(E), the director, in response to the NOI submission, shall notify the applicant in writing that he/she has been granted general permit coverage to discharge storm water associated with construction activity under the terms and conditions of this permit or that the applicant must apply for an individual NPDES permit or coverage under an alternate general NPDES permit as described in Part I.C.1.

2. No release from other requirements. No condition of this permit shall release the permittee from any responsibility or requirements under other environmental statutes or regulations. Other permit requirements commonly associated with construction activities include, but are not limited to, section 401 water quality certifications, isolated wetland permits, permits to install sanitary sewers or other devices that discharge or convey polluted water, permits to install drinking water lines, single lot sanitary system permits and disturbance of land which was used to operate a solid or hazardous waste facility (i.e., coverage under this NPDES general permit does not satisfy the requirements of OAC Rule 3745-27-13 or ORC Section 3734.02(H)). This permit does not relieve the permittee of other responsibilities associated with construction activities such as contacting the Ohio Department of Natural Resources, Division of Water, to ensure proper well installation and abandonment of wells.

Part II. NOTICE OF INTENT REQUIREMENTS

A. Deadlines for notification.

Initial coverage: Operators who intend to obtain initial coverage for a storm water discharge associated with construction activity under this general permit must submit a complete and accurate NOI application form and appropriate fee at least 21 days prior to the commencement of construction activity. If more than one operator, as defined in Part VII of this general permit, will be engaged at a site, each operator shall seek coverage under this general permit. Where one operator has already submitted an NOI prior to other operator(s) being identified, the additional operator shall request modification of coverage to become a co-permittee. In such instances, the co-permittees shall be covered under the same facility permit number. No additional permit fee is required.

Part II.A

Individual lot transfer of coverage: Operators must each submit an individual lot notice of intent (Individual Lot NOI) application form (no fee required) to Ohio EPA at least seven days prior to the date that they intend to accept responsibility for permit requirements for their portion of the original permitted development from the previous permittee. The original permittee may submit an Individual Lot NOT at the time the Individual Lot NOI is submitted. Transfer of permit coverage is not granted until an approval letter from the director of Ohio EPA is received by the applicant.

B. Failure to notify.

Operators who fail to notify the director of their intent to be covered and who discharge pollutants to surface waters of the state without an NPDES permit are in violation of ORC Chapter 6111. In such instances, Ohio EPA may bring an enforcement action for any discharges of storm water associated with construction activity.

C. Where to submit an NOI.

Operators seeking coverage under this permit must submit a signed NOI form, provided by Ohio EPA, to the address found in the associated instructions.

D. Additional notification.

The permittee shall make NOIs and SWP3s available upon request of the director of Ohio EPA, local agencies approving sediment and erosion control plans, grading plans or storm water management plans, local governmental officials, or operators of municipal separate storm sewer systems (MS4s) receiving drainage from the permitted site. Each operator that discharges to an NPDES permitted MS4 shall provide a copy of its Ohio EPA NOI submission to the MS4 in accordance with the MS4's requirements, if applicable.

E. Renotification.

Upon renewal of this general permit, the permittee is required to notify the director of his intent to be covered by the general permit renewal. Permittees covered under the previous NPDES general permit for storm water discharges associated with construction activity (NPDES permit number OHR100000) shall have continuing coverage under this permit. The permittees covered under OHR100000 shall submit a letter within 90 days of receipt of written notification by Ohio EPA expressing their intent that coverage be continued. There is no fee associated with these letters of intent for continued coverage. Permit coverage will be terminated after the 90-day period if the letter is not received by Ohio EPA. Ohio EPA will provide instructions on the contents of the letter and where it is to be sent within the notification letter.

PART III. STORM WATER POLLUTION PREVENTION PLAN (SWP3)

A. Storm Water Pollution Prevention Plans.

A SWP3 shall be developed for each site covered by this permit. For a multi-phase construction project, a separate NOI shall be submitted when a separate SWP3 will be prepared for subsequent phases. SWP3s shall be prepared in accordance with sound engineering and/or conservation practices by a professional experienced in the design and implementation of standard erosion and sediment controls and storm water management practices addressing all phases of construction. The SWP3 shall identify potential sources of pollution which may reasonably be expected to affect the quality of storm water discharges associated with construction activities. In addition, the SWP3 shall describe and ensure the implementation of best management practices (BMPs) that reduce the pollutants in storm water discharges during construction and pollutants associated with post-construction activities to ensure compliance with ORC Section 6111.04, OAC Chapter 3745-1 and the terms and conditions of this permit.

B. Timing

A SWP3 shall be completed prior to the timely submittal of an NOI and updated in accordance with Part III.D. Upon request and good cause shown, the director may waive the requirement to have a SWP3 completed at the time of NOI submission. If a waiver has been granted, the SWP3 must be completed prior to the initiation of construction activities. The SWP3 must be implemented upon initiation of construction activities.

Permittees continuing coverage from the previous generation of this permit (OHR100000) that have initiated construction activity prior to the receipt of written notification from Ohio EPA to submit a letter of intent to continue coverage, as required in Part II.E, are not required to update their SWP3 as a result of this renewal (OHC000002). All permittees developing sites with coverage under OHR100000 that seek continuation of coverage do not need to update the post-construction section of their SWP3 as required in Part III.G.2.e of this permit.

C. SWP3 Signature and Review.

1. <u>Plan Signature and Retention On Site</u>. The SWP3 shall be signed in accordance with Part V.G. and retained on site during working hours.

2. <u>Plan Availability</u>

   a. On-site: The plan shall be made available immediately upon request of the director or his authorized representative during working hours. A copy of the NOI and letter granting permit coverage under this general permit also shall be made available at the site.

Part III.C.2

b. By written request: The permittee must provide a copy of the SWP3 within 10 days upon written request of any of the following:

   i. The director or the director's authorized representative;

   ii. A local agency approving sediment and erosion plans, grading plans or storm water management plans; or

   iii. In the case of a storm water discharge associated with construction activity which discharges through a municipal separate storm sewer system with an NPDES permit, to the operator of the system.

c. To the public: All NOIs, general permit approval for coverage letters, and SWP3s are considered reports that shall be available to the public in accordance with the Ohio Public Records law. The permittee shall make documents available to the public upon request or provide a copy at public expense, at cost, in a timely manner. However, the permittee may claim to Ohio EPA any portion of an SWP3 as confidential in accordance with Ohio law.

3. Plan Revision. The director or authorized representative, may notify the permittee at any time that the SWP3 does not meet one or more of the minimum requirements of this part. Within 10 days after such notification from the director, (or as otherwise provided in the notification) or authorized representative, the permittee shall make the required changes to the SWP3 and, if requested, shall submit to Ohio EPA the revised SWP3 or a written certification that the requested changes have been made.

D. Amendments

The permittee shall amend the SWP3 whenever there is a change in design, construction, operation or maintenance, which has a significant effect on the potential for the discharge of pollutants to surface waters of the state or if the SWP3 proves to be ineffective in achieving the general objectives of controlling pollutants in storm water discharges associated with construction activity. Amendments to the SWP3 may be reviewed by Ohio EPA in the same manner as Part III.C.

Part III

E. Duty to inform contractors and subcontractors

The permittee shall inform all contractors and subcontractors not otherwise defined as "operators" in Part VII of this general permit, who will be involved in the implementation of the SWP3, of the terms and conditions of this general permit. The permittee shall maintain a written document containing the signatures of all contractors and subcontractors involved in the implementation of the SWP3 as proof acknowledging that they reviewed and understand the conditions and responsibilities of the SWP3. The written document shall be created and signatures shall be obtained prior to commencement of work on the construction site.

F. Total Maximum Daily Load (TMDL) allocations

If a TMDL is approved for any waterbody into which the permittee's site discharges and requires specific BMPs for construction sites, the director may require the permittee to revise his/her SWP3.

G. SWP3 Requirements

Operations that discharge storm water from construction activities are subject to the following requirements and the SWP3 shall include the following items:

1. Site description. Each SWP3 shall provide:

    a. A description of the nature and type of the construction activity (e.g., low density residential, shopping mall, highway, etc.);

    b. Total area of the site and the area of the site that is expected to be disturbed (i.e., grubbing, clearing, excavation, filling or grading, including off-site borrow areas);

    c. A calculation of the runoff coefficients for both the pre-construction and post construction site conditions;

    d. An estimate of the impervious area and percent imperviousness created by the construction activity;

    e. Existing data describing the soil and, if available, the quality of any discharge from the site;

    f. A description of prior land uses at the site;

Part III.G.1

g. An implementation schedule which describes the sequence of major construction operations (i.e., grubbing, excavating, grading, utilities and infrastructure installation) and the implementation of erosion, sediment and storm water management practices or facilities to be employed during each operation of the sequence;

h. The name and/or location of the immediate receiving stream or surface water(s) and the first subsequent named receiving water(s) and the areal extent and description of wetlands or other special aquatic sites at or near the site which will be disturbed or which will receive discharges from disturbed areas of the project;

i. For subdivided developments where the SWP3 does not call for a centralized sediment control capable of controlling multiple individual lots, a detail drawing of a typical individual lot showing standard individual lot erosion and sediment control practices.

   This does not remove the responsibility to designate specific erosion and sediment control practices in the SWP3 for critical areas such as steep slopes, stream banks, drainage ways and riparian zones.

j. Location and description of any storm water discharges associated with dedicated asphalt and dedicated concrete plants covered by this permit and the best management practices to address pollutants in these storm water discharges;

k. A copy of the permit requirements (attaching a copy of this permit is acceptable); and

l. Site map showing:

   i. Limits of earth-disturbing activity of the site including associated off-site borrow or spoil areas that are not addressed by a separate NOI and associated SWP3;

   ii. Soils types should be depicted for all areas of the site, including locations of unstable or highly erodible soils;

   iii. Existing and proposed contours. A delineation of drainage watersheds expected during and after major grading activities as well as the size of each drainage watershed, in acres;

Part III.G.1.l

iv. Surface water locations including springs, wetlands, streams, lakes, water wells, etc., on or within 200 feet of the site, including the boundaries of wetlands or stream channels and first subsequent named receiving water(s) the permittee intends to fill or relocate for which the permittee is seeking approval from the Army Corps of Engineers and/or Ohio EPA;

v. Existing and planned locations of buildings, roads, parking facilities and utilities;

vi. The location of all erosion and sediment control practices, including the location of areas likely to require temporary stabilization during the course of site development;

vii. Sediment and storm water management basins noting their sediment settling volume and contributing drainage area;

viii. Permanent storm water management practices to be used to control pollutants in storm water after construction operations have been completed.

ix. Areas designated for the storage or disposal of solid, sanitary and toxic wastes, including dumpster areas, areas designated for cement truck washout, and vehicle fueling;

x. The location of designated construction entrances where the vehicles will access the construction site;

xi. The location of any in-stream activities including stream crossings;

2. Controls. The SWP3 must contain a description of the controls appropriate for each construction operation covered by this permit and the operator(s) must implement such controls. The SWP3 must clearly describe for each major construction activity identified in Part III.G.1.g: (a) appropriate control measures and the general timing (or sequence) during the construction process that the measures will be implemented; and (b) which contractor is responsible for implementation (e.g., contractor A will clear land and install perimeter controls and contractor B will maintain perimeter controls until final stabilization). Ohio EPA recommends that the erosion, sediment, and storm water management practices used to satisfy the conditions of this permit, should meet the standards and specifications in the current edition of Ohio's Rainwater and Land Development (see definitions) manual or other standards acceptable to Ohio EPA. The controls shall include the following minimum components:

Part III.G.2

a. **Non-Structural Preservation Methods.** The SWP3 must make use of practices which preserve the existing natural condition as much as feasible. Such practices may include: preserving riparian areas adjacent to surface waters of the state, preserving existing vegetation and vegetative buffer strips, phasing of construction operations in order to minimize the amount of disturbed land at any one time and designation of tree preservation areas or other protective clearing or grubbing practices. The recommended buffer that operators should leave undisturbed along a surface water of the state is 25 feet as measured from the ordinary high water mark of the surface water.

b. **Erosion Control Practices.** The SWP3 must make use of erosion controls that are capable of providing cover over disturbed soils unless an exception is approved in accordance with Part III.G.4. A description of control practices designed to restabilize disturbed areas after grading or construction shall be included in the SWP3. The SWP3 must provide specifications for stabilization of all disturbed areas of the site and provide guidance as to which method of stabilization will be employed for any time of the year. Such practices may include: temporary seeding, permanent seeding, mulching, matting, sod stabilization, vegetative buffer strips, phasing of construction operations, use of construction entrances and the use of alternative ground cover.

   i. **Stabilization.** Disturbed areas must be stabilized as specified in the following tables below. Permanent and temporary stabilization are defined in Part VII.

Table 1: Permanent Stabilization

Area requiring permanent stabilization	Time frame to apply erosion controls
Any areas that will lie dormant for one year or more	Within seven days of the most recent disturbance
Any areas within 50 feet of a stream and at final grade	Within two days of reaching final grade
Any other areas at final grade	Within seven days of reaching final grade within that area

Part III.G.2.b.i

Table 2: Temporary Stabilization

Area requiring temporary stabilization	Time frame to apply erosion controls
Any disturbed areas within 50 feet of a stream and not at final grade	Within two days of the most recent disturbance if the area will remain idle for more than 21 days
For all construction activities, any disturbed areas that will be dormant for more than 21 days but less than one year, and not within 50 feet of a stream	Within seven days of the most recent disturbance within the area For residential subdivisions, disturbed areas must be stabilized at least seven days prior to transfer of permit coverage for the individual lot(s).
Disturbed areas that will be idle over winter	Prior to the onset of winter weather

Where vegetative stabilization techniques may cause structural instability or are otherwise unobtainable, alternative stabilization techniques must be employed.

ii. **Permanent stabilization of conveyance channels**. Operators shall undertake special measures to stabilize channels and outfalls and prevent erosive flows. Measures may include seeding, dormant seeding (as defined in the 1996 edition of the Rainwater and Land Development manual), mulching, erosion control matting, sodding, riprap, natural channel design with bioengineering techniques or rock check dams.

c. **Runoff Control Practices.** The SWP3 shall incorporate measures which control the flow of runoff from disturbed areas so as to prevent erosion from occurring. Such practices may include rock check dams, pipe slope drains, diversions to direct flow away from exposed soils and protective grading practices. These practices shall divert runoff away from disturbed areas and steep slopes where practicable.

d. **Sediment Control Practices.** The plan shall include a description of structural practices that shall store runoff allowing sediments to settle and/or divert flows away from exposed soils or otherwise limit runoff from exposed areas. Structural practices shall be used to control erosion and trap sediment from a site remaining disturbed for more than 14 days. Such practices may include, among others: sediment settling ponds, silt fences, earth diversion dikes or channels which direct runoff to a sediment settling pond and storm drain inlet protection. All sediment control practices must be capable of ponding runoff in order to be considered functional. Earth diversion dikes or channels alone are not considered a sediment control practice unless those are used in conjunction with a sediment settling pond.

Part III.G.2.d

The SWP3 must contain detail drawings for all structural practices.

i. Timing. Sediment control structures shall be functional throughout the course of earth disturbing activity. Sediment basins and perimeter sediment barriers shall be implemented prior to grading and within seven days from the start of grubbing. They shall continue to function until the up slope development area is restabilized. As construction progresses and the topography is altered, appropriate controls must be constructed or existing controls altered to address the changing drainage patterns.

ii. Sediment settling ponds. Concentrated storm water runoff and runoff from drainage areas, which exceed the design capacity of silt fence or inlet protection, shall pass through a sediment settling pond. For common drainage locations that serve an area with 10 or more acres disturbed at one time, a temporary (or permanent) sediment settling pond must be provided until final stabilization of the site. The permittee may request approval from Ohio EPA to use alternative controls if it can demonstrate the alternative controls are equivalent in effectiveness to a sediment settling pond. It is recommended for drainage locations serving less than 10 acres, smaller sediment basins and/or sediment traps should be used.

The sediment settling pond shall be sized to provide at least 67 cubic yards of storage per acre of total contributing drainage area. When determining the total contributing drainage area, off-site areas and areas which remain undisturbed by construction activity must be included unless runoff from these areas is diverted away from the sediment settling pond and is not co-mingled with sediment-laden runoff. The depth of the sediment settling pond must be less than or equal to five feet. The configuration between inlets and the outlet of the basin must provide at least two units of length for each one unit of width (> 2:1 length:width ratio). Sediment must be removed from the sediment settling pond when the design capacity has been reduced by 40 percent (This is typically reached when sediment occupies one-half of the basin depth). When designing sediment settling ponds, the permittee must consider public safety, especially as it relates to children, as a design factor for the sediment basin and alternative sediment controls must be used where site limitations would preclude a safe design. The use of a combination of sediment and erosion control measures in order to achieve maximum pollutant removal is encouraged.

Part III.G.2.d

iii. Silt Fence and Diversions. Sheet flow runoff from denuded areas shall be intercepted by silt fence or diversions to protect adjacent properties and water resources from sediment transported via sheet flow. Where intended to provide sediment control, silt fence shall be placed on a level contour. This permit does not preclude the use of other sediment barriers designed to control sheet flow runoff. The relationship between the maximum drainage area to silt fence for a particular slope range is shown in the table below.

Maximum drainage area (in acres) to 100 linear feet of silt fence	**Range of slope for a particular drainage area (in percent)**
0.5	< 2%
0.25	≥ 2% but < 20%
0.125	≥ 20% but < 50%

Storm water diversion practices shall be used to keep runoff away from disturbed areas and steep slopes where practicable. Such devices, which include swales, dikes or berms, may receive storm water runoff from areas up to 10 acres.

iv. Inlet Protection. Other erosion and sediment control practices shall minimize sediment laden water entering active storm drain systems, unless the storm drain system drains to a sediment settling pond.

v. Stream Protection. If construction activities disturb areas adjacent to streams, structural practices shall be designed and implemented on site to protect all adjacent streams from the impacts of sediment runoff. No structural sediment controls (e.g., the installation of silt fence or a sediment settling pond in-stream) shall be used in a stream. For all construction activities immediately adjacent to surface waters of the state, it is recommended that a setback of at least 25-feet, as measured from the ordinary high water mark of the surface water, be maintained in its natural state as a permanent buffer. Where impacts within this setback area are unavoidable due to the nature of the construction activity (e.g., stream crossings for roads or utilities), the project shall be designed such that the number of stream crossings and the width of the disturbance within the setback area are minimized.

vi. Modifying Controls. If periodic inspections or other information indicates a control has been used inappropriately or incorrectly, the permittee must replace or modify the control for site conditions.

Part III.G.2

e. **Post-Construction Storm Water Management Requirements.** So that receiving stream's physical, chemical, and biological characteristics are protected and stream functions are maintained, post-construction storm water practices shall provide perpetual management of runoff quality and quantity. To meet the post-construction requirements of this permit, the SWP3 must contain a description of the post-construction BMPs that will be installed during construction for the site and the rationale for their selection. The rationale must address the anticipated impacts on the channel and floodplain morphology, hydrology, and water quality.

Detail drawings and maintenance plans must be provided for all post-construction BMPs. Maintenance plans shall be provided by the permittee to the post-construction operator of the site (including homeowner associations) upon completion of construction activities (prior to termination of permit coverage). For sites located within a community with a regulated municipal separate storm sewer system (MS4), the permittee, land owner, or other entity with legal control of the property may be required to develop and implement a maintenance plan to comply with the requirements of the MS4. Maintenance plans must ensure that pollutants collected within structural post-construction practices, be disposed of in accordance with local, state, and federal regulations. Permittees, except for those regulated under the small MS4 program, are not responsible under this permit for operation and maintenance of post-construction practices once coverage under this permit is terminated.

This permit does not preclude the use of innovation or experimental post-construction storm water management technologies. However, the director may require discharges from such structures to be monitored to ensure compliance with Part III.G.2.e of this permit. The installation of structural controls in certain scenarios may also require a separate permit under section 404 of the CWA. Permittees are only responsible for the installation and maintenance of storm water management measures prior to final stabilization of the site and are not responsible for maintenance after storm water discharges associated with construction activity have been eliminated from the site. However, post-construction storm water BMPs that discharge pollutants from point sources once construction is completed, may in themselves, need authorization under a separate NPDES permit.

Linear construction projects, (e.g., pipeline or utility line installation), which do not result in the installation of impervious surface, are not required to comply with the conditions of Part III.G.2.e of this permit. However, linear construction projects must be designed to minimize the number of stream crossings and the width of disturbance.

Part III.G.2.e

Large Construction Activities. For all large construction activities (involving the disturbance of five or more acres of land or will disturb less than five acres, but is a part of a larger common plan of development or sale which will disturb five or more acres of land), the post construction BMP(s) chosen must be able to detain storm water runoff for protection of the stream channels, stream erosion control, and improved water quality. Structural (designed) post-construction storm water treatment practices shall be incorporated into the permanent drainage system for the site. The BMP(s) chosen must be sized to treat the water quality volume (WQ_v) and ensure compliance with Ohio's Water Quality Standards in OAC Chapter 3745-1. The WQ_v shall be equivalent to the volume of runoff from a 0.75-inch rainfall and shall be determined according to one of the two following methods:

i. Through a site hydrologic study approved by the local municipal permitting authority that uses continuous hydrologic simulation and local long-term hourly precipitation records or

ii. Using the following equation:

$WQ_v = C * P * A / 12$

where:

WQ_v = water quality volume in acre-feet

C = runoff coefficient appropriate for storms less than 1 inch (see Table 1)

P = 0.75 inch precipitation depth

A = area draining into the BMP in acres

Table 1

Runoff Coefficients Based on the Type of Land Use

Land Use	Runoff Coefficient
Industrial & Commercial	0.8
High Density Residential (>8 dwellings/acre)	0.5
Medium Density Residential (4 to 8 dwellings/acre)	0.4
Low Density Residential (<4 dwellings/acre)	0.3
Open Space and Recreational Areas	0.2

Where the land use will be mixed, the runoff coefficient should be calculated using a weighted average. For example, if 60% of the contributing drainage area to the storm water treatment structure is Low Density Residential, 30% is High Density Residential, and 10% is Open Space, the runoff coefficient is calculated as follows (0.6)(0.3) + (0.3)(0.5) + (0.1)(0.2) = 0.35.

Part III.G.2.e

An additional volume equal to 20 percent of the WQ_v shall be incorporated into the BMP for sediment storage and/or reduced infiltration capacity. Ohio EPA recommends that BMPs be designed according to the methodology included in the Rainwater and Land Development manual or in another design manual acceptable for use by Ohio EPA.

BMPs shall be designed such that the drain time is long enough to provide treatment, but short enough to provide storage available for successive rainfall events as described in Table 2 below.

Table 2
Target Draw Down (Drain) Times for Structural Post-Construction Treatment Control Practices

Best Management Practice	Drain Time of WQ_v
Infiltration	24 - 48 hours
Vegetated Swale and Filter Strip	24 hours
Extended Detention Basin (Dry Basins)	48 hours
Retention Basins (Wet Basins)*	24 hours
Constructed Wetlands (above permanent pool)	24 hours
Media Filtration, Bioretention	40 hours

* Provide both a permanent pool and an extended detention volume above the permanent pool, each sized at 0.75 * WQ_v

The permittee may request approval from Ohio EPA to use alternative structural post-construction BMPs if the permittee can demonstrate that the alternative BMPs are equivalent in effectiveness to those listed in Table 2 above. Construction activities shall be exempt from this condition if it can be demonstrated that the WQ_v is provided within an existing structural post-construction BMP that is part of a larger common plan of development or if structural post-construction BMPs are addressed in a regional or local storm water management plan. Public entities (i.e., the state, counties, townships, cities, or villages) shall comply with the post-construction storm water management requirements of Part III.G.2.e for roadway construction projects initiated after March 10, 2006 and where practicable for projects initiated as of the effective date of this permit and thereafter.

For redevelopment projects (i.e., developments on previously developed property), post-construction practices shall either ensure a 20 percent net reduction of the site impervious area, provide for treatment of at least 20 percent of the WQ_v, or a combination of the two.

Part III.G.2.e

Small Construction Activities. For all small land disturbance activities (which disturb one or more, but less than five acres of land and is not a part of a larger common plan of development or sale which will disturb five or more acres of land), a description of measures that will be installed during the construction process to control pollutants in storm water discharges that will occur after construction operations have been completed must be included in the SWP3. Structural measures should be placed on upland soils to the degree attainable.

i. Such practices may include, but are not limited to: storm water detention structures (including wet basins); storm water retention structures; flow attenuation by use of open vegetated swales and natural depressions; infiltration of runoff onsite; and sequential systems (which combine several practices). The SWP3 shall include an explanation of the technical basis used to select the practices to control pollution where flows exceed pre-development levels.

ii. Velocity dissipation devices shall be placed at discharge locations and along the length of any outfall channel to provide non-erosive flow velocity from the structure to a water course so that the natural physical and biological characteristics and functions are maintained and protected (e.g., no significant changes in the hydrological regime of the receiving water).

f. **Surface Water Protection.** If the project site contains any streams, rivers, lakes, wetlands or other surface waters, certain construction activities at the site may be regulated under the CWA and/or state isolated wetland permit requirements. Sections 404 and 401 of the Act regulate the discharge of dredged or fill material into surface waters and the impacts of such activities on water quality, respectively. Construction activities in surface waters which may be subject to CWA regulation and/or state isolated wetland permit requirements include, but are not limited to: sewer line crossings, grading, backfilling or culverting streams, filling wetlands, road and utility line construction, bridge installation and installation of flow control structures. If the project contains streams, rivers, lakes or wetlands or possible wetlands, the permittee must contact the appropriate U.S. Army Corps of Engineers District Office. (CAUTION: Any area of seasonally wet hydric soil is a potential wetland - please consult the Soil Survey and list of hydric soils for your County, available at your county's Soil and Water Conservation District. If you have any questions about Section 401 water quality certification, please contact the Ohio Environmental Protection Agency, Section 401 Coordinator.)

Part III.G.2.f

U.S. Army Corps of Engineers (Section 404 regulation):
Huntington, WV District (304) 529-5210 (Muskingum, Hocking and Scioto River Basin)
Buffalo, NY District (716) 879-4329 (Lake Erie Basin)
Pittsburgh, PA District (412) 395-7152 (Mahoning River Basin)
Louisville, KY District (502) 315-6678 (Little & Great Miami River Basin)

Ohio Environmental Protection Agency (Section 401 regulation):
Columbus, OH (614) 644-2001 (all of Ohio)

g. **Other controls.**

i. **Non-Sediment Pollutant Controls.** No solid (other than sediment) or liquid waste, including building materials, shall be discharged in storm water runoff. The permittee must implement all necessary BMPs to prevent the discharge of non-sediment pollutants to the drainage system of the site or surface waters of the state. Under no circumstance shall concrete trucks wash out directly into a drainage channel, storm sewer or surface waters of the state. No exposure of storm water to waste materials is recommended.

ii. **Off-site traffic.** Off-site vehicle tracking of sediments and dust generation shall be minimized.

iii. **Compliance with other requirements.** The SWP3 shall be consistent with applicable State and/or local waste disposal, sanitary sewer or septic system regulations, including provisions prohibiting waste disposal by open burning and shall provide for the proper disposal of contaminated soils to the extent these are located within the permitted area.

iv. **Trench and ground water control**. There shall be no turbid discharges to surface waters of the state resulting from dewatering activities. If trench or ground water contains sediment, it must pass through a sediment settling pond or other equally effective sediment control device, prior to being discharged from the construction site. Alternatively, sediment may be removed by settling in place or by dewatering into a sump pit, filter bag or comparable practice. Ground water dewatering which does not contain sediment or other pollutants is not required to be treated prior to discharge. However, care must be taken when discharging ground water to ensure that it does not become pollutant-laden by traversing over disturbed soils or other pollutant sources.

Part III.G.2

h. **Maintenance.** All temporary and permanent control practices shall be maintained and repaired as needed to ensure continued performance of their intended function. All sediment control practices must be maintained in a functional condition until all up slope areas they control are permanently stabilized. The SWP3 shall be designed to minimize maintenance requirements. The applicant shall provide a description of maintenance procedures needed to ensure the continued performance of control practices.

i. **Inspections.** At a minimum, procedures in an SWP3 shall provide that all controls on the site are inspected at least once every seven calendar days and within 24 hours after any storm event greater than one-half inch of rain per 24 hour period. The permittee shall assign qualified inspection personnel (those with knowledge and experience in the installation and maintenance of sediment and erosion controls) to conduct these inspections to ensure that the control practices are functional and to evaluate whether the SWP3 is adequate and properly implemented in accordance with the schedule proposed in Part III.G.1.g of this permit or whether additional control measures are required. Disturbed areas and areas used for storage of materials that are exposed to precipitation shall be inspected for evidence of or the potential for, pollutants entering the drainage system. Erosion and sediment control measures identified in the SWP3 shall be observed to ensure that those are operating correctly. Discharge locations shall be inspected to ascertain whether erosion and sediment control measures are effective in preventing significant impacts to the receiving waters. Locations where vehicles enter or exit the site shall be inspected for evidence of off-site vehicle tracking.

The permittee shall maintain for three years following the submittal of a notice of termination form, a record summarizing the results of the inspection, names(s) and qualifications of personnel making the inspection, the date(s) of the inspection, major observations relating to the implementation of the SWP3 and a certification as to whether the facility is in compliance with the SWP3 and the permit and identify any incidents of non-compliance. The record and certification shall be signed in accordance with Part V.G. of this permit.

i. **When practices require repair or maintenance.** If the inspection reveals that a control practice is in need of repair or maintenance, with the exception of a sediment settling pond, it must be repaired or maintained within three days of the inspection. Sediment settling ponds must be repaired or maintained within 10 days of the inspection.

ii. **When practices fail to provide their intended function.** If the inspection reveals that a control practice fails to perform its intended function and that another, more appropriate control practice is required, the SWP3 must be amended and the new control practice must be installed within 10 days of the inspection.

iii. **When practices depicted on the SWP3 are not installed.** If the inspection reveals that a control practice has not been implemented in accordance with the schedule contained in Part III.G.1.g of this permit, the control practice must be implemented within 10 days from the date of the inspection. If the inspection reveals that the planned control practice is not needed, the record must contain a statement of explanation as to why the control practice is not needed.

3. **Approved State or local plans.** All dischargers regulated under this general permit must comply, except those exempted under state law, with the lawful requirements of municipalities, counties and other local agencies regarding discharges of storm water from construction activities. All erosion and sediment control plans and storm water management plans approved by local officials shall be retained with the SWP3 prepared in accordance with this permit. Applicable requirements for erosion and sediment control and storm water management approved by local officials are, upon submittal of a NOI form, incorporated by reference and enforceable under this permit even if they are not specifically included in an SWP3 required under this permit. When the project is located within the jurisdiction of a regulated municipal separate storm sewer system (MS4), the permittee must certify that the SWP3 complies with the requirements of the storm water management program of the MS4 operator.

4. **Exceptions.** If specific site conditions prohibit the implementation of any of the erosion and sediment control practices contained in this permit or site specific conditions are such that implementation of any erosion and sediment control practices contained in this permit will result in no environmental benefit, then the permittee shall provide justification for rejecting each practice based on site conditions. Exceptions from implementing the erosion and sediment control standards contained in this permit will be approved or denied on a case-by-case basis.

PART IV. NOTICE OF TERMINATION REQUIREMENTS

A. Failure to notify.

The terms and conditions of this permit shall remain in effect until a signed Notice of Termination (NOT) form is submitted. Failure to submit an NOT constitutes a violation of this permit and may affect the ability of the permittee to obtain general permit coverage in the future.

B. When to submit an NOT

1. Permittees wishing to terminate coverage under this permit must submit an NOT form in accordance with Part V.G. of this permit. Compliance with this permit is required until an NOT form is submitted. The permittee's authorization to discharge under this permit terminates at midnight of the day the NOT form is submitted.

2. All permittees must submit an NOT form within 45 days of completing all permitted land disturbance activities. Enforcement actions may be taken if a permittee submits an NOT form without meeting one or more of the following conditions:

   a. Final stabilization (see definition in Part VII) has been achieved on all portions of the site for which the permittee is responsible (including, if applicable, returning agricultural land to its pre-construction agricultural use);

   b. Another operator(s) has assumed control over all areas of the site that have not been finally stabilized;

   c. For residential construction only, temporary stabilization has been completed and the lot, which includes a home, has been transferred to the homeowner. (Note: individual lots without housing which are sold by the developer must undergo final stabilization prior to termination of permit coverage.); or

   d. An exception has been granted under Part III.G.4.

C. How to submit an NOT

Permittees must use Ohio EPA's approved NOT form. The form must be completed and mailed according to the instructions and signed in accordance with Part V.G of this permit.

PART V. STANDARD PERMIT CONDITIONS.

A. Duty to comply.

1. The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of ORC Chapter 6111. and is grounds for enforcement action.

2. Ohio law imposes penalties and fines for persons who knowingly make false statements or knowingly swear or affirm the truth of a false statement previously made.

B. Continuation of an expired general permit.

An expired general permit continues in force and effect until a new general permit is issued.

C. Need to halt or reduce activity not a defense.

It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

D. Duty to mitigate.

The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

E. Duty to provide information.

The permittee shall furnish to the director, within 10 days of written request, any information which the director may request to determine compliance with this permit. The permittee shall also furnish to the director upon request copies of records required to be kept by this permit.

F. Other information.

When the permittee becomes aware that he or she failed to submit any relevant facts or submitted incorrect information in the NOI, SWP3, NOT or in any other report to the director, he or she shall promptly submit such facts or information.

Part V

G. Signatory requirements.

All NOIs, NOTs, SWP3s, reports, certifications or information either submitted to the director or that this permit requires to be maintained by the permittee, shall be signed.

1. These items shall be signed as follows:

   a. For a corporation: By a responsible corporate officer. For the purpose of this section, a responsible corporate officer means:

      i. A president, secretary, treasurer or vice-president of the corporation in charge of a principal business function or any other person who performs similar policy or decision-making functions for the corporation; or

      ii. The manager of one or more manufacturing, production or operating facilities, provided, the manager is authorized to make management decisions which govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations and initiating and directing other comprehensive measures to assure long-term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures;

   b. For a partnership or sole proprietorship: By a general partner or the proprietor, respectively; or

   c. For a municipality, State, Federal or other public agency: By either a principal executive officer or ranking elected official. For purposes of this section, a principal executive officer of a Federal agency includes (1) the chief executive officer of the agency or (2) a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrators of U.S. EPA).

2. All reports required by the permits and other information requested by the director shall be signed by a person described in Part V.G.1 of this permit or by a duly authorized representative of that person. A person is a duly authorized representative only if:

Part V.G.2

a. The authorization is made in writing by a person described in Part V.G.1 of this permit and submitted to the director;

b. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of manager, operator of a well or well field, superintendent, position of equivalent responsibility or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position); and

c. The written authorization is submitted to the director.

3. Changes to authorization. If an authorization under Part V.G.2 of this permit is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of Part V.G.2 of this permit must be submitted to the director prior to or together with any reports, information or applications to be signed by an authorized representative.

H. Certification.

Any person signing documents under this section shall make the following certification:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

I. Oil and hazardous substance liability.

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities or penalties to which the permittee is or may be subject under section 311 of the CWA or 40 CFR Part 112. 40 CFR Part 112 establishes procedures, methods and equipment and other requirements for equipment to prevent the discharge of oil from non-transportation-related onshore and offshore facilities into or upon the navigable surface waters of the State or adjoining shorelines.

Part V

J. Property rights.

The issuance of this permit does not convey any property rights of any sort, nor any exclusive privileges, nor does it authorize any injury to private property nor any invasion of personal rights, nor any infringement of Federal, State or local laws or regulations.

K. Severability.

The provisions of this permit are severable and if any provision of this permit or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances and the remainder of this permit shall not be affected thereby.

L. Transfers.

Ohio NPDES general permit coverage is transferable. Ohio EPA must be notified in writing sixty days prior to any proposed transfer of coverage under an Ohio NPDES general permit. The transferee must inform Ohio EPA it will assume the responsibilities of the original permittee transferor.

M. Environmental laws.

No condition of this permit shall release the permittee from any responsibility or requirements under other environmental statutes or regulations.

N. Proper operation and maintenance.

The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit and with the requirements of SWP3s. Proper operation and maintenance requires the operation of backup or auxiliary facilities or similar systems, installed by a permittee only when necessary to achieve compliance with the conditions of the permit.

O. Inspection and entry.

The permittee shall allow the director or an authorized representative of Ohio EPA, upon the presentation of credentials and other documents as may be required by law, to:

Part V.O

1. Enter upon the permittee's premises where a regulated facility or activity is located or conducted or where records must be kept under the conditions of this permit;

2. Have access to and copy at reasonable times, any records that must be kept under the conditions of this permit; and

3. Inspect at reasonable times any facilities or equipment (including monitoring and control equipment).

PART VI. REOPENER CLAUSE

A. If there is evidence indicating potential or realized impacts on water quality due to any storm water discharge associated with construction activity covered by this permit, the permittee of such discharge may be required to obtain coverage under an individual permit or an alternative general permit in accordance with Part I.C of this permit or the permit may be modified to include different limitations and/or requirements.

B. Permit modification or revocation will be conducted according to ORC Chapter 6111.

PART VII. DEFINITIONS

A. "Act" means Clean Water Act (formerly referred to as the Federal Water Pollution Control Act or Federal Water Pollution Control Act Amendments of 1972) Pub. L. 92-500, as amended Pub. L. 95-217, Pub. L. 95-576, Pub. L. 96-483, Pub. L. 97-117 and Pub. L. 100-4, 33 U.S.C. 1251 et. seq.

B. "Best management practices (BMPs)" means schedules of activities, prohibitions of practices, maintenance procedures and other management practices (both structural and non-structural) to prevent or reduce the pollution of surface waters of the state. BMP's also include treatment requirements, operating procedures and practices to control plant and/or construction site runoff, spillage or leaks, sludge or waste disposal or drainage from raw material storage.

C. "Commencement of construction" means the initial disturbance of soils associated with clearing, grubbing, grading, placement of fill or excavating activities or other construction activities.

D. "Concentrated storm water runoff" means any storm water runoff which flows through a drainage pipe, ditch, diversion or other discrete conveyance channel.

E. "Director" means the director of the Ohio Environmental Protection Agency.

Part VII

F. "Discharge" means the addition of any pollutant to the surface waters of the state from a point source.

G. "Disturbance" means any clearing, grading, excavating, filling, or other alteration of land surface where natural or man-made cover is destroyed in a manner that exposes the underlying soils.

H. "Final stabilization" means that either:

1. All soil disturbing activities at the site are complete and a uniform perennial vegetative cover (e.g., evenly distributed, without large bare areas) with a density of at least 70 percent cover for the area has been established on all unpaved areas and areas not covered by permanent structures or equivalent stabilization measures (such as the use of mulches, rip-rap, gabions or geotextiles) have been employed. In addition, all temporary erosion and sediment control practices are removed and disposed of and all trapped sediment is permanently stabilized to prevent further erosion; or

2. For individual lots in residential construction by either:

   a. The homebuilder completing final stabilization as specified above or

   b. The homebuilder establishing temporary stabilization including perimeter controls for an individual lot prior to occupation of the home by the homeowner and informing the homeowner of the need for and benefits of, final stabilization. (Homeowners typically have an incentive to put in the landscaping functionally equivalent to final stabilization as quick as possible to keep mud out of their homes and off sidewalks and driveways.); or

3. For construction projects on land used for agricultural purposes (e.g., pipelines across crop or range land), final stabilization may be accomplished by returning the disturbed land to its pre-construction agricultural use. Areas disturbed that were previously used for agricultural activities, such as buffer strips immediately adjacent to surface waters of the state and which are not being returned to their pre-construction agricultural use, must meet the final stabilization criteria in (1) or (2) above.

I. "Individual Lot NOI" means a Notice of Intent for an individual lot to be covered by this permit (see parts I and II of this permit).

J. "Larger common plan of development or sale"- means a contiguous area where multiple separate and distinct construction activities may be taking place at different times on different schedules under one plan.

Part VII

K. "MS4" means municipal separate storm sewer system which means a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels or storm drains) that are:

1. Owned or operated by the federal government, state, municipality, township, county, district(s) or other public body (created by or pursuant to state or federal law) including special district under state law such as a sewer district, flood control district or drainage districts or similar entity or a designated and approved management agency under section 208 of the act that discharges into surface waters of the state; and

2. Designed or used for collecting or conveying solely storm water,

3. Which is not a combined sewer and

4. Which is not a part of a publicly owned treatment works.

L. "National Pollutant Discharge Elimination System (NPDES)" means the national program for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing permits and enforcing pretreatment requirements, under sections 307, 402, 318 and 405 of the CWA. The term includes an "approved program."

M. "NOI" means notice of intent to be covered by this permit.

N. "NOT" means notice of termination.

O. "Operator" means any party associated with a construction project that meets either of the following two criteria:

1. The party has operational control over construction plans and specifications, including the ability to make modifications to those plans and specifications; or

2. The party has day-to-day operational control of those activities at a project which are necessary to ensure compliance with an SWP3 for the site or other permit conditions (e.g., they are authorized to direct workers at a site to carry out activities required by the SWP3 or comply with other permit conditions).

As set forth in Part II.A, there can be more than one operator at a site and under these circumstances, the operators shall be co-permittees.

P. "Owner or operator" means the owner or operator of any "facility or activity" subject to regulation under the NPDES program.

Part VII

Q. "Permanent stabilization" means the establishment of permanent vegetation, decorative landscape mulching, matting, sod, rip rap and landscaping techniques to provide permanent erosion control on areas where construction operations are complete or where no further disturbance is expected for at least one year.

R. "Percent imperviousness" means the impervious area created divided by the total area of the project site.

S. "Point source" means any discernible, confined and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel or the floating craft from which pollutants are or may be discharged. This term does not include return flows from irrigated agriculture or agricultural storm water runoff.

T. "Rainwater and Land Development" is a manual describing construction and post-construction best management practices and associated specifications. A copy of the manual may be obtained by contacting the Ohio Department of Natural Resources, Division of Soil & Water Conservation.

U. "Riparian area" means the transition area between flowing water and terrestrial (land) ecosystems composed of trees, shrubs and surrounding vegetation which serve to stabilize erodible soil, improve both surface and ground water quality, increase stream shading and enhance wildlife habitat.

V. "Runoff coefficient" means the fraction of total rainfall that will appear at the conveyance as runoff.

W. "Sediment settling pond" means a sediment trap, sediment basin or permanent basin that has been temporarily modified for sediment control, as described in the latest edition of the Rainwater and Land Development manual.

X. "State isolated wetland permit requirements" means the requirements set forth in Sections 6111.02 through 6111.029 of the ORC.

Y. "Storm water" means storm water runoff, snow melt and surface runoff and drainage.

Z. "Surface waters of the state" or "water bodies" means all streams, lakes, reservoirs, ponds, marshes, wetlands or other waterways which are situated wholly or partially within the boundaries of the state, except those private waters which do not combine or effect a junction with natural surface or underground waters. Waters defined as sewerage systems, treatment works or disposal systems in Section 6111.01 of the ORC are not included.

Part VII

AA. "SWP3" means storm water pollution prevention plan.

BB. "Temporary stabilization" means the establishment of temporary vegetation, mulching, geotextiles, sod, preservation of existing vegetation and other techniques capable of quickly establishing cover over disturbed areas to provide erosion control between construction operations.

CC. "Water Quality Volume (WQ_v)" means the volume of storm water runoff which must be captured and treated prior to discharge from the developed site after construction is complete. WQ_v is based on the expected runoff generated by the mean storm precipitation volume from post-construction site conditions at which rapidly diminishing returns in the number of runoff events captured begins to occur.

Appendix A

ODOT – Location and Design Manual, Volume 2, January 2007

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(Revised January 2007)

1100 Drainage Design Procedures

1100 Drainage Design Procedures

1101 Estimating Design Discharge

1101.1 General

In order to properly design highway drainage facilities, it is essential that a reasonable estimate be made of the design and check discharges. Some of the more important factors affecting runoff are duration, intensity and frequency of rainfall; and the size, imperviousness, slope, and shape of the drainage area.

Suitable topographic mapping shall be utilized to determine the contributing drainage area. For drainage areas over 100 acres, a 7.5 minute U.S. Geological Survey Quadrangle will ordinarily suffice. For smaller areas, or where discharges are calculated using the rational method, smaller scale maps (1"=50' to 1"=800') may be more appropriate.

A proper evaluation should be made of the land use throughout the drainage area. Changes in land use within the drainage area which will occur in the immediate future shall be taken into account when determining design discharges. However, probable land use changes beyond this should not be assumed when determining design discharges. It is the responsibility of the local permitting/zoning agency to ensure proper land and water management techniques are utilized. These techniques will minimize the adverse affects of a change in land use.

1101.2 Procedures

1101.2.1 Statistical Methods

The statistical methods developed by the U.S. Geological Survey and published in USGS Reports 89-4126, 93-135 and 93-4080 shall be used to estimate runoff from larger drainage areas. A description and the limitations of these methods are described in Section 1003.

1101.2.2 Rational Method

The rational method is considered to be more reliable for estimating runoff from small drainage areas, less than the acreage for the USGS Regions; and for areas that contribute overland flow and shallow concentrated flow to the roadway ditch or pavement. The design discharge "Q" is obtained from the equation:

$$Q = CiA$$

where:

Q = Discharge in cubic feet per second

C = Coefficient of runoff

I = Average rainfall intensity in inches per hour, for a given storm frequency and for a duration equal to the time of concentration.

A = Drainage area in acres

The time of concentration is the time required for runoff to flow from the most remote point of the drainage area to the point of concentration. The point of concentration could be a culvert, catch basin or the checkpoint in a roadway ditch used to determine the need for velocity protection. Time of concentration is designated by "t_c" and is the summation of the time of overland flow "t_o", the time of shallow concentrated flow "t_s" and the time of pipe or open channel flow "t_d".

Overland flow is that flow which is not carried in a discernible channel and maintains a uniform depth across the sloping surface. It is often referred to as sheet flow. The time of overland flow may be obtained from Figure 1101-1, a similar overland flow chart, or from the equation:

$$t_o \approx \frac{1.8(1.1-C)\,(L)^{(1/2)}}{(s)^{(1/3)}}$$

where:

t_o = Time of overland flow in minutes

C = Coefficient of runoff

L = Distance to most remote location in drainage area in feet

s = Overland slope (percent)

These methods should not be used to determine the time of travel for gutter, swale, or ditch flow.

This equation and Figure 1101-1 assume a homogeneous drainage area. Where the overland flow area is composed of segments with varying cover and/or slopes, the summation of the time of concentration for each segment will tend to over-estimate the overland flow time, "t_o". In this case it may be more appropriate to use an average runoff coefficient "C" and an average ground slope in the Overland Flow Chart.

Sheet flow is assumed to occur for no more than 300 feet after which water tends to concentrate in rills and then gullies of increasing proportion. This type of flow is classified as shallow concentrated flow. The velocity of shallow concentrated flow can be estimated using the following relationship:

$$V = 3.281ks^{0.5}$$

where:

V = Velocity in fps

k = Intercept coefficient (see Table 1101-1)

s = Overland slope (percent)

Table 1101-1

Types of Surface	Intercept Coefficient "k"
Forest with heavy ground litter	0.076
Min. tillage cultivated; woodland	0.152
Short grass pasture	0.213
Cultivated straight row	0.274
Poor grass; untilled	0.305
Grassed waterways	0.457
Unpaved area; bare soil	0.491
Paved area	0.619

Shallow concentrated flow generally empties into pipe systems, drainage ditches, or natural channels. The velocity of flow in an open channel or pipe can be estimated using the Manning's equation.

The travel time for both shallow concentrated flow and open channel or pipe flow is calculated as follows:

$$t_s \text{ or } t_d = \frac{L}{60V}$$

where:

t_s = Travel time for shallow concentrated flow in minutes

t_d = Travel time for open channel or pipe flow in minutes

L = Flow length in feet

V = Velocity in fps

Where a contributing drainage area has its steepest slope and/or highest "C" value in the sub-area nearest the point of concentration, the rational method discharge for this sub-area may be greater than if the entire contributing drainage area is considered. The maximum runoff rate for a sub-area should be considered only if greater than that for the entire area.

1101.2.3 Coefficient of Runoff

The coefficient of runoff is a dimensionless decimal value that estimates the percentage of rainfall that becomes runoff. The recommended values for the coefficient of runoff for various contributing surfaces are shown in Table 1101-2. Where two values are shown, the higher value ordinarily applies to the steeper slopes.

For Residential areas, lot size should also be considered in choosing the appropriate value for the coefficient of runoff. Generally, a higher value should be associated with smaller lots and a lower value should be associated with larger lot sizes. The selected coefficient should be based upon an estimation of the typical slope, lot size, and lot development.

The total width contributing flow to a given point usually consists of surfaces having a variable land cover and thereby requires a weighted coefficient of runoff "C". The weighted coefficient is obtained by averaging the coefficients for the different types of contributing surfaces, as noted in the following example:

Table 1101-2

Types of Surface	Coefficient of Runoff "C"
Pavement & paved shoulders	0.9
Berms and slopes 4:1 or flatter	0.5
Berms and slopes steeper than 4:1	0.7
Contributing areas	
Residential (single family)	0.3-0.5
Residential (multi-family)	0.4-0.7
Woods	0.3
Cultivated	0.3-0.6

Contributing Width "W"	Land Use	"C"	"CW"
20 feet	Paved Area	0.9	18
40 feet	Earth Berms & Slopes	0.7	28
140 feet	Residential Area	0.6	84
200 feet	Summations		130

Weighted "C" = 130/200 = 0.65

Contributing Width "W"	Land Use	"C"	"CW"
6.1 meters	Paved Area	0.9	5.5
6.2 meters	Earth Berms & Slopes	0.7	4.3
42.7 meters	Residential Area	0.6	25.6
55 meters	Summations		35.4

Weighted "C" = 35.4/55 = 0.64

1101.2.4 Rainfall Intensity

The average rainfall intensity "i" in inches per hour may be obtained from the Intensity-Duration-Frequency curves shown on Figure 1101-2. Each set of curves applies to a specific geographic area, A, B, C, or D as shown on the Rainfall Intensity Zone Map, Figure 1101-3. The geographic areas were established from an analysis of rainfall records obtained from Weather Bureau stations in Ohio. Some political subdivisions may have developed curves for their specific area similar to Figure 1101-2. Such curves may be based on a much longer period of record and provide more reliable information. Any local curves proposed by the designer should be cleared with the Hydraulic Section, Office of Structural Engineering prior to incorporating that information in the drainage calculations.

1102 Open Water Carriers

1102.1 General

Open water carriers generally provide the most economical means for collecting and conveying surface water contributing to the roadway. The required capacity of a water carrier involves a determination of the velocity and depth of flow for a given discharge. These characteristics can best be obtained from charts that are based on Manning's equation. Channel flow charts have been prepared for all the common water carrier shapes and are included in the Drainage Design Aids. A ditch computation sheet similar to that provided in the Appendix shall be used to perform or summarize ditch calculations. As a guideline, the desirable minimum roadway ditch grades should be 0.50% with a recommended absolute minimum of 0.25%. Lower grades may be used on large channels as necessary. Open water carriers should maintain a constant slope wherever possible. The proper location of a ditch outfall is quite important. Existing drainage patterns should be perpetuated insofar as practicable. Care should be taken to not capture an existing stream with the roadside ditch. If this is necessary, the designed ditch shall be in accordance to Section 1102.2.4.

1102.2 Types of Carriers

1102.2.1 Standard Roadway (Roadside) Ditches

The various roadside ditches shown in Volume I, Roadway Design, have proven to be safe and to provide adequate flow capacity. A ditch is considered to be standard when the centerline is parallel to the edge of the pavement and the flowline is a uniform distance below the edge of pavement. A modification of the above is required when the grade of the pavement is too flat to provide acceptable ditch flow, thereby creating the need for a special ditch. Channel charts, Drainage Design Aid Figures 1100-1 through 1100-10, are included for use in determining velocity and depth of flow for standard ditches having variable side slopes.

1102.2.2 Special Ditches

Special ditches other than the modified standard roadway ditch described in Section 1102.2.1 above, include the following:

A. The steep ditch beyond the toe of the embankment used to carry the flow from a cut section to the valley floor.

B. Toe of fill ditch which is separated from the toe of fill by a minimum 10 foot wide bench, having a minimum transverse slope of ½ inch per foot toward the ditch.

C. Deep parallel side ditches separated from the pavement by a wide bench or earth barrier.

The special ditches described in A, B and C above are ordinarily trapezoidal in shape and appropriate charts for the hydraulic analysis are included in this section of the manual or in the FHWA publication "Design Charts for Open Channel Flow"' Hydraulic Design Series No. 3. It is required that the calculated flowline elevation be shown on each special ditch cross section.

1102.2.3 Median Ditches

The median ditches that are an integral part of all earth medians have the same shape and capacity features as the standard roadside radius ditch and the appropriate ditch chart is applicable for the hydraulic analysis. The fully depressed earth median provides adequate hydraulic capacity and the appropriate flow charts in the Drainage Design Aid Figures 1100-11, 1100-12 and 1100-13 have been developed for that shape. The rounding shown on the charts varies from 8 feet to 4 feet, depending on the width of the median. The slight discrepancy in the rounding from that shown in Volume I, Roadway Design, is not considered to affect the accuracy of the charts.

1102.2.4 Channel Relocations

Major channel relocations should be avoided. However, if it becomes necessary to relocate a channel adhere to the following:

The design year frequency used for channel relocations shall be that given in Section 1004.2. All channel relocations shall carefully be designed to preclude erosion or unreasonable changes in the environment.

Whenever possible, channel relocations shall be restricted to the downstream end of proposed culverts.

The relocated channel shall be of a similar cross-section. Where the existing channel exhibits a two-stage cross section morphology, it shall be replaced with like kind. The two-stage channel is comprised of two distinct areas. The first of these is a meandering bankfull width that carries the channel-forming discharge. The second area is the flood plain width. See Figure 1102-2 for a graphical representation of the major channel features.

The proposed channel should be designed such that it matches the existing channel as closely as possible in regards to existing geomorphic conditions (e.g., channel slope and length, velocity, depth of flow, cross-sectional geometry, channel sinuosity, energy dissipation, etc.). The existing channel geometry and physical characteristics should be established from reference reaches and idealized geometry. The reference reaches should be selected from stable channel reaches close to the relocated section or in locations with similar watershed and valley conditions.

The relocated channel should be designed to duplicate the existing hydraulic properties for the bankfull design frequency. The flood clearance criteria given in Section 1005 should also be met.

Additional information on the design of relocated channels can be found in the United States Department of Agriculture publication, "Stream Corridor Restoration: Principles, Practices and Processes". The principals given in this publication utilize idealized channel geometry. The actual design should be refined using the channel geometry and physical characteristics of reference reaches.

1102.2.5 Channel Linings and Bank Stabilization

The use of soil bioengineering should be used to stabilize banks for relocated or impacted channels when practicable. Native plant species should be used when feasible.

Bank stabilization using bioengineering is covered in the previously referenced USDA publication as well as the AASHTO Model Drainage Manual and the USDA Engineering Field Handbook, chapter 16, part 650. The design procedures and methods for determining the effectiveness of the traditional channel linings are covered in the Federal Highway Administration Hydraulic Engineering Circular No. 15 "Design of Stable Channels With Flexible Linings".

1102.3 Ditch Design Criteria - Design Traffic Exceeding 2000 ADT

1102.3.1 Design Frequency

A 10-year frequency storm shall be used to determine the depth of flow, and a 5-year frequency shall be used to determine the shear stress and the width of ditch lining where needed. Where a flexible ditch lining is required for calculated stresses exceeding the allowable for seed, the minimum width of the lining shall be 7.5 feet. The depth of flow shall be limited to an elevation 1 foot below the edge of pavement for the design discharge. The depth of flow in toe of slope ditches shall be further limited such that the design year discharge does not overtop the ditch bank.

1102.3.2 Ditch Protection

The shear stress for the five-year frequency storm shall not exceed the values shown in Table 1102-1 for the various flexible linings.

Table 1102-1

Allowable Shear Stress	
Permanent Protection	
Protective Lining	Allowable Shear Stress (psf)
Seed (659)	0.40
Sod (660)	1.0
Temporary Protection	
Ditch Erosion Protection Mat Type___ (670)	
A	1.25
B	1.50
C	2.0
E	2.25
F	0.45
G	1.75

The allowable shear stress (τ_a) will need to be greater than or equal to the actual shear stress (τ_{ac}). The temporary linings will degrade over time to reach a value of 1.0 psf upon vegetation establishment. The temporary lining shear stress values in Table 1102-1 should only be used on a temporary basis (6 months or less).

Actual shear stress is calculated by the following equation:

$$\tau_{ac} = 62.4 \cdot D \cdot S$$

D= Water surface depth ft
S = Channel slope ft/ft
τ_{ac} = Actual shear stress lbs/ft^2

If the calculated shear stress exceeds that shown in the table then use the following within the stated limitations:

A. Seeding and Erosion Control with Turf Reinforcing Mat (Supplemental Specification 836) where the ditch slope is less than 10% and maximum velocities are as follows:

Turf Reinforcing Mat Type	Maximum Shear Stress (psf)
Type 1	2.00
Type 2	3.00
Type 3	5.00

B. Type B, C or D Rock Channel Protection may be used to line the ditch if the nearest point of the lining is outside the design clear zone or located behind guardrail or barrier. The actual shear stress is based upon the parameters of the channel slope and depth of flow for the 5-year discharge. The shear equation if valid for discharges less than 50 cfs with slopes less than 10% when evaluating Rock Channel Protection.

Allowable Shear Stress

RCP Type	τ_a lbs/ft^2
B	6
C	4
D	2

C. Type B or C RCP may be utilized for lining ditches on steep grades (slopes from 10%-25%) that carry flow from the end of a cut section down to the valley floor. HEC-15 procedures for steep gradient channels (refer to HEC-15) shall be used with a safety factor of 1.5.
Contact the Office of Structural Engineering, Hydraulics Section for further guidance of RCP usage for 5-year discharges greater than or equal to 50 cfs.

D. Tied concrete block mat protection (601) may be used for channels with 2:1 or flatter side slopes with profile grades at 5% or less. The matting may be used within the clearzone provided that the top of the blocks are flush with the finished grade. Backfill and anchor the block mat per the manufactures recommendations. The allowable shear stress for each type is shown in table 1102-2.

Table 1102-2

CONCRETE BLOCK MAT SHEAR STRESS

Type	Allowable Shear Stress (psf)
1	3
2	5
3	7

E. A concrete lining should be considered only as a last resort.

1102.3.3 Roughness

Suggested values for Manning's Roughness Coefficient "n" for the various types of open water carriers are listed in Table 1102-3.

Table 1102-3

Type of Lining	Roughness Coefficient
Bare Earth	0.02
Seeded	0.03
Sod	0.04
Item 670	0.04
Erosion Control Matting	0.04
Concrete	0.015
Bituminous	0.015
Grouted Riprap	0.02
Tied Concrete Block Mat	0.03
Rock Channel Protection	0.06 for ditches 0.04 for large channels

1102.3.4 Catch Basin Types

The Standard No. 4, 5, and 8 Catch Basins are suitable for the standard roadside designs covered in Volume I, Roadway Design. The tilt built into the basin top provides a self-cleaning feature when the basins are used on continuous grades and the wide bar spacing minimizes clogging possibilities, thereby resulting in an efficient design. The bases of the 4, 5 and 8 Catch Basins can be expanded to accommodate larger diameter conduits by specifying Standard Construction Drawing CB-3.4. The bar spacing can be decreased, when desirable for safety reasons, by specifying Grate "E" for the No. 4 and Grate "B" for the No. 5. The following catch basin types are generally recommended based on the size and shape of the ditch.

A. Standard No. 4 for depressed medians wider than 40 feet.

B. Standard No. 5 for 40 foot radius roadside or median ditches. (Use Grate "B" where pedestrian traffic may be expected.)

C. Standard No. 8 for 20 foot radius roadside or depressed medians 40 feet or less in width.

D. Standard No. 2-2-A may be used in trapezoidal toe ditches where the basin is located in a rural area. The basin should also be located outside the design clear zone or behind guardrail where the protruding feature of the basin is not objectionable. The capacity of the side inlet catch basin window, for unsubmerged conditions, may be determined by the standard weir equation:

$$Q=CLH^{3/2}$$

where C is a weir coefficient, generally 3.0, L is the length of opening in feet, H is the distance from the bottom of the window to the surface of the design flow in feet. The catch basin grate is considered as an access point for the storm sewer and its capacity to admit flow is ignored for continuous grades.

E. Standard No. 2-2-B should be used where minor, non-clogging flows are involved such as yard sections and the small triangular area created by the guardrail treatment for a depressed median at bridge terminals. Standard No. 2-3 through No. 2-6 catch basins should be provided where a larger base is required to accommodate pipes larger than 21 inches in span or sewer junctions, or where a No. 2-2-B catch basin will not provide adequate access to the sewer.

F. In urban areas, Standard Side Ditch Inlets should be used to drain small areas of trapped water behind curbs and/or between driveways.

1102.3.5 Calculated Catch Basin Spacing

Catch basins must be provided to intercept flow from open water carriers when the depth of flow or velocity exceeds the maximum allowable for the design storm for all highway classifications. The standard ditch catch basins, designated Catch Basin No. 4, Catch Basin No. 5, and Catch Basin No. 8, include an earth dike. The dike is approximately 12 inches above the flowline of the grate, immediately downstream from the catch basin and serves to block the flow on continuous grades and create a sump condition.

When the calculated depth of flow or velocity exceeds the maximum allowable at the checkpoint in the ditch, a catch basin or ditch lining will be required. However, the capacity of the catch basin may be less than the capacity of the ditch and thereby control the catch basin spacing. Figure 1102-1 may be used to check the capacity of a catch basin grate in a sump. To use Figure 1102-1, the calculated discharge at the ditch checkpoint shall be doubled to compensate for possible partial clogging of the grate.

In cut sections, the accumulated ditch flow shall be carried as far as the capacity, allowable depth, or velocity of flow will permit. The first catch basin in the roadside or median ditch will determine the need for a storm sewer system required for the remainder of the cut. Velocity control should be extended as far as inexpensive flexible ditch linings will permit.

Consideration should also be given to providing positive outlets for underdrains and providing access to longitudinal sewer systems when locating ditch catch basins.

1102.3.6 Arbitrary Maximum Catch Basin Spacing

Catch basins are required at the low point of all sags and the earth dike noted in Section 1102.3.5 shall be omitted. The maximum distance between catch basins in depressed medians in fill sections shall be as shown in Table 1102-4. Where underdrains are utilized, catch basins shall be provided at a maximum spacing of 1000 feet [300 meters] (500 feet [150 meters] with free draining base) to provide a positive outlet for underdrains.

Table 1102-4

Depressed Median Catch Basin Spacing (Fill Sections)

Median Width	Desirable Spacing	Maximum Spacing
84 feet	1250 feet	1500 feet
60 feet	1000 feet	1250 feet
40 feet	800 feet	1000 feet

1102.4 Ditch Design Criteria - Design Traffic of 2000 ADT or Less

1102.4.1 Design Frequency

A 5-year frequency storm shall be used to determine the depth of flow, and a 2-year frequency to determine the shear stress of flow and width of ditch lining, where needed. The depth of flow shall be limited to an elevation 9 inches below the edge of pavement for the design discharge. The depth of flow in toe of slope ditches shall be further limited such that the design year discharge does not overtop the ditch bank. The minimum width of lining shall be in accordance with Section 1102.3.1.

1102.4.2 Shear Stress Protection

Shear stress protection shall be in accordance with 1002.3.2 except that a 2-year frequency event shall be used.

1102.4.3 Roughness

The roughness used for the hydraulic analysis shall be based on the Manning's Roughness Coefficient values shown in Table 1102-3.

1102.4.4 Catch Basin Types

Standard No. 5 Catch Basins, No. 2-2-A Catch Basin (within their safety limitations as discussed in Section 1102.3.4(D)) and No. 2-2-B Catch Basins should be considered for the lower ADT highways. Standard No. 4 Catch Basins should be used where additional capacity is required.

1102.5 Design Aids for Ditch Flow Analysis

1102.5.1 Earth Channel Charts

Standard radius roadside ditch charts have been prepared, based on the Manning's equation, to facilitate the hydraulic analysis of ditch flow and are included in the Drainage Design Aids. Some of the more commonly used trapezoidal channel charts are also included.

Other trapezoidal channel charts (with 2:1 - 2:1 side slopes and bottom widths varying from 2 feet to 20 feet are available in the Federal Highway Administration publication referenced in section 1102.2.2.

All earth channel charts have been prepared using a Manning's Coefficient of Roughness of 0.03, which is recommended for a seed lining (Construction and Material Specifications Item 659). Q_n and V_n scales have been included on all channel charts so that the channel flow may be analyzed for any value of "n" depending on the roughness of the channel or lining.

1102.5.2 Rectangular Channel Charts

Vertical side channel charts that can be used to analyze the open channel flow in box culverts are included in the Federal Highway Administration publication "Design Charts for Open Channel flow," previously referred to.

1103 Pavement Drainage

1103.1 General

When curbs are provided at the edge of pavement or paved shoulder, (primarily in urban areas), t is necessary to determine the proper type of pavement inlet (or catch basin) to control the spread of water and depth of flow on the pavement. Present day geometric design has resulted in relatively flat transverse and longitudinal pavement slopes. These slopes require more pavement inlets (or catch basins) and consequently result in an appreciable increase in the drainage cost. To alleviate the above, where curb is permissible, standard curb and gutter should be used adjacent to the pavement. Where standard curb and gutter cannot be provided, the outside lanes of a muli-lane pavement should maintain a transverse slope of 1/4 inch per foot (0.02).

If paved shoulders are provided, the drainage cost will be decreased appreciably due to the large volume of flow that can be carried on the pavement shoulder without exceeding the allowable depth of 1 inch below the top of curb or a maximum of 5 inches; a maximum depth of 6 inches is permissible where a barrier shape is provided adjacent to the pavement.

Furnish a drainage design that will reduce the need for bridge scuppers. If bridge scuppers are required contact the Hydraulic Section, Office of Structural Engineering.

A pavement drainage computation sheet similar to that provided in the Appendix shall be used to perform or summarize necessary computations.

Additional information concerning pavement drainage can be obtained from the Federal Highway Administration Hydraulic Engineering Circular No. 22, "Urban Drainage Design Manual."

1103.2 Design Frequency

Pavement inlets (or catch basins) shall be spaced to limit the spread of flow on the traveled lane (considered to be 12 feet wide) as shown in Table 1103-1. The allowable spread may be increased slightly for streets carrying predominantly local traffic and with design speeds less than 45 mph. Design shall be based upon the following frequencies:

Freeways	10 Years
High volume highways (over 6000 ADT Rural or 9000 ADT Urban) ...	5 Years
All other highways	2 Years

For underpasses or other depressed roadways where ponded water can be removed only through the storm sewer system, the spread shall be checked for a 50-year storm for Freeways and high volume highways as defined above, and for a 25-year storm for other highways. The ponding will be permitted to cover all but one through lane of a multiple lane pavement. The depth of flow at the curb shall not exceed 1 inch below the top of the curb for the design discharge regardless of the type of highway. A maximum depth of 6 inches is permissible where a barrier shape is provided adjacent to the pavement.

Table 1103-1
Allowable Pavement Spread

Freeways		0 feet
High Volume Highways (Over 6000 ADT rural or 9000 ADT urban)		
High Speed (45 mph)		4 feet
Low Speed (< 45mph)	2 lanes	6 feet
	4 lanes	8 feet
All other Highways	2 lanes	6 feet
	4 lanes	8 feet

1103.3 Estimating Design Discharge

Runoff contributing to curbed pavements shall be estimated by the rational method, as explained in Sections 1101.2.2, 1101.2.3 and 1101.2.4.

The time of concentration "t_c" shall be the actual time of concentration calculated according to Section 1101.2.2 with an absolute minimum time of 10 minutes.

In urban areas, where justifiable (e.g. contributing drainage area would be difficult to determine), the "strip method" may be used to determine contributing drainage areas. The strip method assumes a contributing drainage area of 150 feet taken on each side of the roadway centerline.

1103.4 Capacity of Pavement Gutters

A pavement gutter has a right triangular shape, with the curb forming the vertical leg and the straight pavement slope, the gutter plate of a curb and gutter, or a paved shoulder forming the hypotenuse. A standard curb and gutter adjacent to a straight pavement slope, or paved shoulder, forms a composite gutter section which complicates the flow analysis. In most cases, the top width of the water surface in a pavement gutter far exceeds the height of the curb. The hydraulic radius does not accurately describe the gutter cross section in this situation, thereby requiring a modification to the Manning's equation to analyze the gutter flow. The accepted modification results in the following equation:

$$Q = 0.56\,\frac{Z}{n}\,S^{1/2}\,d^{8/3}$$

where:

Q = Discharge in cubic feet per second

Z = Reciprocal of the pavement cross

n = Manning's Coefficient of Roughness (Table 1102-3)

s = Longitudinal pavement slope

d = Depth of flow in gutter section at curb in feet

Figure 1103-1 provides a graphical solution for the above equation and its use is comparatively simple for straight transverse pavement slopes. However, the use of the nomograph to determine depth of flow at the curb and resulting spread on the pavement for composite sections is much more involved.

1103.5 Pavement Flow Charts

Charts have been prepared for the more commonly used curbed pavement typical sections, and they are included in the Drainage Design Aids. The charts are particularly helpful for determining the flow for composite pavement sections where the spread can be read directly from the appropriate Pavement Flow Chart.

To use the charts, enter with a predetermined design discharge (total flow) Q in the gutter in cubic feet per second and proceed vertically to intersect the longitudinal gutter slope line. At that intersection, read the spread in feet shown on the diagonal spread lines.

The spread of flow will generally control the pavement inlet or catch basin spacing, where the transverse and longitudinal slope of the pavement is relatively flat. The above is prevalent in long flat sag vertical curves, where a flanking inlet (or catch basin) should arbitrarily be provided on both sides of the low point in a pavement sag. This is particularly so for Freeways. Three inlets or catch basins in a sag can be justified only on the basis of need for other highway classifications. Usually a Standard 6 foot pavement inlet or No. 3A catch basin will be adequate, and they should be placed where the grade elevation is approximately 0.20 feet higher than at the low point. Furnish a CB-No. 3 at the sump.

Inlets or catch basins should arbitrarily be placed upstream of all intersections, bridges and pedestrian ramps. When justified, inlets (or catch basins) should be located a minimum of 10 feet off drive aprons, intersection return radii, pedestrian ramps or curb termini.

1103.6 Bypass Charts for Continuous Pavement Grades

Bypass charts are included for the standard pavement inlets and catch basins in the Drainage Design Aids. Bypass for a given structure can be read directly from the chart (At the intersection of the spread, determined in Section 1103.5, and the longitudinal gutter slope, read the bypass flow Q_b on the abscissa). Experience has proven that, for greater efficiency, inlets should be sized to bypass a minimum of 10% to 15% of the design discharge. This criterion should be used to determine the type or length of inlet to be used in a given location. It is not intended to establish the required spacing. The most efficient design maintains the allowable spread on continuous grades and at the sag.

The bypass for a catch basin or inlet should be added to the total flow in the adjacent downstream gutter section.

1103.6.1 Curb Opening Inlets

The flow bypassing a standard curb opening inlet, for pavement transverse slopes or combination of slopes differing from the charts included in the Drainage Design Aids, may be obtained from Figure 1103-2. The use of curb opening inlets should be avoided where bicycle traffic is expected.

1103.6.2 Grate or Combination Grate and Curb Opening Inlet

The standard pavement catch basin in this category is considered to intercept all the flow over the grate when used on continuous grades. A portion of the flow outside of the edge of the grate will also be intercepted, the amount varying with the depth of flow "y" along the edge of the grate. The depth "y" can be determined from Figure 1103-1, and the resulting flow spilling over the edge of the grate from Figure 1103-2, using a ½ inch local depression for straight transverse pavement slopes, or no local depression for a composite gutter section. The curb opening of a combination catch basin on a continuous grade will admit some flow, particularly if there is a partial clogging of the grate; however, the additional capacity should be considered as a factor of safety only.

1103.7 Grate Catch Basins and Curb Opening Inlets In Pavement Sags

The spread determined from the pavement flow charts need not be checked any closer than 25 to 50 feet on either side of the sag, well beyond the limits of the local depression. The spread in the sag should be determined from the depth of flow at the edge of grate using Figure 1103-3 and should include the total flow (contributions from each side of the sag vertical curve) reaching the inlet or catch basin.

Standard No. 3 catch basins should be used in pavement sags. The capacity of the grates to admit flow is based on the depth of ponding around the grates. The capacity of the grates shown in Figure 1103-3 is based on weir flow over the edge of the grate, up to a depth of 0.4 feet. For greater depths, the total area of grate opening is considered, with no deduction made for possible clogging. When evaluating the spread in a depressed sag for a 25-year or 50-year event, the capacity of the window shall be considered. This capacity may be obtained from Figure 1103-4. The curb opening capacity should be added to the grate capacity for submerged conditions.
Where the low point of a sag vertical curve occurs in a drive, a No. 6 catch basin should be provided at the low point with flanking No. 3A catch basins as per Section 1103.5.

No. 6 catch basins may be used along curbed roadways and medians provided that the grate capacity is not exceeded.

1104 Storm Sewers

1104.1 General

Storm sewer systems are designed to collect and carry storm water runoff from the first pavement or ditch inlet, or catch basin to the predetermined outlet. (Further reference to inlets infers either inlets or catch basins). Long cut sections often result in the need for longitudinal trunk sewers to accept the flow from a series of inlets. The proper location of a sewer outlet is quite important. Existing drainage patterns should be perpetuated insofar as practicable. Careful consideration should be given to the possibility of actionable damage for the diversion of substantial volumes of flow. Long fill sections requiring median or pavement drains may best be served by transverse sewers that outlet independently at the toe of fill ditch.

Storm sewer systems shall be sized to convey the current flow from areas naturally contributing to the highway or from intercepting existing storm sewers. Storm sewer systems may be oversized at the request of a local government entity to convey flow from areas beyond those considered highway responsibility or increased flows from anticipated development with the approval of the Hydraulic Section, Office of Structural Engineering. The additional cost to construct the increased sized storm sewer system will be the responsibility of the local government. The proration of project funds and local government funds will be determined from estimated construction costs. The project funding participation will be determined as a percentage of the total cost of the affected plan items. The percentage will be computed by dividing the estimated cost to construct a highway responsibility system only by the estimated cost to construct the oversized system. The affected plan items and participation percentage will be noted in the plan general summary.

Type B conduit shall be specified for storm sewers under pavement, paved shoulders and commercial or industrial drives and Type C conduits for storm sewers beyond those limits. However, the type of conduit shall not be changed for a short run of conduit which would ordinarily require a change in conduit type.

As an example of the above, Type B should be used for a transverse conduit that is required to drain an earth median catch basin in an embankment section under the pavement to a point approximately 10 feet from the embankment slope. A concrete collar, as per Standard Construction Drawing DM-1.1, should be provided to connect the Type B and a Type F Conduit, located back of, and parallel to, the embankment slope. Type F conduit, 707.05 or 707.21 Type C, shall be provided for the pipe specials required to negotiate the bend at the top and bottom of the embankment.

The Construction and Material Specifications stipulate the permissible pipe shapes and materials. Storm sewer designs will be based on round pipe, and the choice of the permissible material types for the conduit specified will be the contractor's option. Extensions of existing pipes should typically be made using like kind material. The length of conduit to be paid for will be the actual number of linear feet, measured from center-to-center of appurtenant small structures. No deduction will be made for catch basins, inlets or manholes that are 6 feet or less across, measured in the direction of flow.

1104.2 Design Considerations

1104.2.1 Storm Sewer Depth

From a cost standpoint, it is desirable to keep a storm sewer system as shallow as possible, consistent with the following controls:

A. A minimum cover of 9 inches from the top of a rigid pipe to the bottom of the pavement subbase (12 inches to 24 inches for a flexible pipe, see Section 1008).

B. A minimum cover of at least 18 inches for standard strength pipe, where permitted.

C. A sufficient depth to permit the use of precast inlets, catch basins and manholes. Refer to the Standard Construction Drawings for this information.

D. A sufficient depth to avoid interference with existing utilities such as sanitary sewers, the grade of which cannot be changed.

E. A sufficient depth to provide a positive outlet for underdrains. It is desirable to maintain the underdrain outlet 12 inches above the flow line of the outlet structure with 6 inches as a minimum.

F. Sufficient slope to provide a desirable minimum velocity of 3 feet per second, for self-cleansing. This velocity is calculated using the "just full" Manning's Equation.

G. The crown of a smaller upstream pipe in a longitudinal trunk sewer should match the crown of the adjacent downstream pipe.

Where proposed highway storm sewers or ditches will interfere with existing private drains carrying treated or untreated sanitary flow, the names and addresses of the affected property owners shall be submitted to the District Deputy Director. The above information shall be obtained well in advance of the Field Drainage Review so the appropriate provisions of Directive No. 22-A can be followed.

1104.2.2 Storm Sewer Access

Most standard catch basins and pavement inlets will provide sufficient access to small shallow sewers. Catch basin or pavement inlets can be used to negotiate changes in sewer sizes or minor horizontal or vertical direction changes within the size limitation of the structure, but more pronounced changes may require manholes.

It may be necessary, or desirable to locate longitudinal trunk sewers away from the curb to provide for a utility strip between the curb and the sidewalk and to avoid a conflict with the underdrain system. This will require properly spaced manholes in the sewer line. Small sewers (under 36 inches in diameter) located under or near the edge of pavement, should be accessible at intervals not to exceed 300 feet. For sewers sized 36 to 60 inches manholes should be spaced every 500 feet maximum. Manholes should be provided every 750 to 1000 feet maximum for larger sewers.

1104.3 Layout Procedure

1104.3.1 Plan

A print of the plan sheets involved should be used to spot catch basins and inlets that are required to drain the project and satisfy maximum allowable depth and/or spread of flow. A strip map showing the delineated drainage area and topography is required. The map will provide the designer with a means of determining the drainage area and the weighted coefficient of runoff for the individual areas contributing flow to the required storm sewer system.

1104.3.2 Profile

A profile of the existing and proposed pavement or ground line over the proposed sewer location should be plotted. On the same profile, plot the locations of catch basins, inlets and manholes, along with a tentative storm sewer system.

1104.4 Storm Sewer Design Criteria

1104.4.1 Design Frequency

All storm sewers shall be sized to flow just full (i.e. depth of flow for maximum discharge) for a 10-year frequency storm. The size is determined by working downstream from the first sewer run. It will be acceptable to use a discharge of a more frequent occurrence if consistent with local policy (depending upon the design ADT of the roadway) or to avoid extensive replacement of an existing downstream drainage system.

1104.4.2 Hydraulic Grade Line

Starting at the storm sewer system outlet and working upstream, the elevation of the hydraulic grade line at the upper end of each sewer run should be determined using a 25-year frequency. It will be acceptable to use a discharge of a more frequent occurrence if consistent with local policy (depending upon the design ADT of the roadway) or to avoid extensive replacement of an existing downstream drainage system. Ordinarily, the hydraulic grade line will be above the top of the pipe, causing the system to operate under pressure. If, however, any run in the system does not flow full, (pipe slope steeper than the friction slope) the hydraulic grade line will follow the friction slope until it reaches the normal depth of flow in the steep run. From that point, the hydraulic grade line will coincide with the normal depth of flow until it reaches a run flatter than the friction slope for that run.

The starting elevation for the hydraulic grade line determination should be the higher of either: the downstream tail water channel water surface elevation or (dc+D)/2 at the system outlet. Section 1105.6.1

The intensity "i" in the rational equation Q=CiA [Q=CiA/360] used to determine the check discharge (25-year frequency) shall be the same for all sewer runs as that calculated for the last, or downstream run, in a continuous sewer system.

The hydraulic grade line shall not exceed the following for any roadway with greater than 2000 ADT:

A. 12 inches below the edge of pavement for sections without curb.

B. The elevation of a curb opening inlet or grate elevation of a pavement catch basin.

Consideration shall be given to a reduction in the design frequency and to more liberal hydraulic grade line controls for less important highways than those noted above.

The check discharge, to determine the elevation of the hydraulic grade line for highways having depressed sags that must be drained by storm sewers, shall be based on a 50-year frequency. One directional lane of a multiple lane highway or one-half of a lane on a 2-lane highway should be passable when the sewer system is discharging the 50-year storm.
Storm sewers for all highways shall satisfy a 50-year check to preclude flooding of buildings or extensive flooding of private property.

If the hydraulic grade line exceeds the limits noted above, the controlling sewer size shall be increased. (These criteria are not intended to lower existing high water elevations)

1104.4.3 Coefficient of Runoff

The weighted coefficient of runoff shall be determined as explained in Section 1101.2.3

1104.4.4 Time of Concentration

The time shall be determined as explained in Section 1101.2.2. A minimum time of concentration of 15 minutes to the first ditch catch basin and 10 minutes to the first pavement inlet shall be used. The actual calculated time of concentration shall be used when values greater than these minimums occur.

1104.4.5 Pipe Roughness Coefficient

A Manning's "n" of 0.015 shall be used for sewers 60 inches in diameter and under, and 0.013 for larger sewers. The basic "n" value for smooth pipe, concrete, vitrified clay, bituminous lined corrugated steel or thermoplastic is 0.012. The increased values are recommended for sewers to compensate for minor head losses incurred at catch basins, inlets and manholes located in a storm sewer system.

1104.4.6 Minimum Storm Sewer Pipe Size

A minimum pipe diameter of 15 inches shall be used for Freeways and Freeway ramps (Where an existing storm sewer is to remain in service, it is not necessary to replace, hydraulically adequate pipes to meet this criterion) and 12 inches for other highways.

1104.5 Hydraulic Design Procedure

With the layout suggested in Section 1104.3, start with the upper catch basin or inlet and determine the value of CA for the contributing flow (CA is the product of the weighted coefficient of runoff and the drainage area). Next, determine the time of concentration for the first area and the corresponding rainfall intensity "i" from the proper curve shown on Figure 1101-2. The design discharge "Q" to use to determine the required size of the first sewer from MH No. 1 to MH No. 2 is the product of Ca x i [0.0028CA x i]. At manhole No. 2, determine the value of CA for the additional area contributing at that point and add to the CA for MH No. 1.

Compute the time of flow in the storm sewer from MH No.1 to MH No. 2 in minutes and add to the time of concentration at MH No. 1. Check the time of concentration for the area contributing to MH No. 2, and use the larger of the two as the duration for the new value of rainfall intensity for computing the design flow from MH No. 2 to MH No. 3.

It is obvious that the process is quite involved, and a storm sewer computation sheet similar to that provided in the Appendix shall be used to tabulate the required information. The calculations for lateral connections to the longitudinal trunk sewer should be tabulated separately from the trunk sewer calculations.

1105 Roadway Culverts

1105.1 General

A culvert generally carries a natural stream under the highway embankment. The culvert horizontal and vertical alignment matches the natural channel horizontal and vertical alignment. Ensure the upstream invert is not below the natural channel unless the culvert has depressed inverts, a paved depressed approach apron, or an improved inlet. Optimum culvert design (i.e., best hydraulic performance and least environmental impacts) occurs when the roadway alignment is normal to the flow in the channel and is located on a relatively straight and stable section of the channel. Roadway alignment needs to be considered early in the design process to provide optimum culvert design. The proposed roadway should avoid stream confluences. Culverts should not be placed on skews in excess of 45° or as further limited in Section 1008.

A single-cell round pipe should be the designer's first choice. In cases where required cover or discharge precludes a round pipe, consideration should be given to a single-cell elliptical concrete, metal pipe-arch, prefabricated box culvert or three-sided structure, in order of preferred use. For justification of multiple cell culverts, see Section 1105.2.4.

Culvert location should perpetuate existing drainage patterns insofar as practicable. Diversion of substantial volumes of flow requires consideration of possible actionable damage.

1105.2 Stream Protection

Stream protection ensures the stream will not degrade due to incision caused by down-cutting, or head-cutting. Stream protection best management practices (BMP) are as follows:

- Bankfull discharge design
- Depressed culvert inverts
- Flood plain culverts
- Multiple cell culverts
- Paved depressed approach apron
- Improved inlets
- Energy control structures

Provide stream protection BMP for all culverts. Each BMP has use restrictions.

Drainage Design Procedures

1105.2.1 Bankfull Discharge Design

Culverts that are required to convey the bankfull discharge will match the existing channel conditions with the proposed channel conditions.

All culverts require a bankfull discharge design except for those culverts that meet any of the following conditions:

- The culvert is a replacement structure.
- The culvert is 30" in diameter or rise, or less.
- The culvert is not covered under a Nationwide Permit Number 14

This BMP will ensure existing stream channel conditions are maintained.

If multiple cell culverts are provided, ensure only one culvert conveys the bankfull discharge. Place the invert of additional culverts at the water surface elevation generated by the bankfull discharge.

Use the following design steps when performing a bankfull discharge design:

1. Determine the bankfull discharge using USGS report 2005-5153, "Bankfull Characteristics of Ohio Streams and Their Relation To Peak Streamflows". Use the regression equation that utilizes USGS map-based explanatory variables. The report can be obtained from USGS at: http://pubs.usgs.gov/sir/2005/5153/.
2. Determine the culvert size from traditional culvert hydraulic design.
3. Depress the culvert invert if required (see section 1105.2.2).
4. Determine the depth of flow for the pre-developed channel using the bankfull discharge at: 25 feet before the culvert entrance and 25 feet beyond the culvert exit.
5. Determine the depth of flow for the post-developed condition using the bankfull discharge at the same locations in step 5.
6. Compare the depth of flow from step 4 to step 5. Increase the culvert rise until the flow depth in step 5 is lower than or equal to the flow depth in step 4.
7. Add flood plain culverts if required (see section 1105.2.3).
8. Determine if the culvert meets the required hydraulic design. Upsize the culvert as required.

The proposed culvert will minimize the impact to the stream channel by closely matching the existing depth of flow with the proposed depth of flow for the bankfull discharge.

Determine the depth of flow for the bankfull discharge by one of the following methods:

- A standard step-backwater water-surface profile model such as HEC-RAS using field-obtained stream cross-sections
- Mannings equation using field-obtained stream cross-sections.

1105.2.2 Depressed Culvert Inverts

All culverts are required to have depressed inverts except for those that meet any of the following conditions:

- The culvert is a replacement structure.
- The culvert does not convey a water of the United States.
- The culvert conveys an ephemeral stream.
- The culvert is 30" in diameter or rise, or less.
- The culvert is not covered under a Nationwide Permit Number 14.
- The culvert has a natural channel bottom (3-sided precast structure).

This BMP will produce a natural channel bottom within the culvert. The natural channel bottom provides a substrate for passage of migratory species.

The depressed culvert will fill naturally, such that the channel bed in the culvert will be continuous with the adjacent channel sections.

Use the following design steps when designing depressed culvert inverts:

1. Determine the culvert size from traditional culvert hydraulic design.

2. Increase the culvert rise or diameter by one size.

3. Depress the culvert per table 1105-2.

4. Determine if the culvert meets the required hydraulic design. Upsize the culvert as required.

End treatments consist of Item 601 Riprap, 6" Reinforced Concrete Slab with a cutoff wall on both inlet and outlet ends. See standard construction drawing DM-1.1 for details.

Depress the culvert invert per the following table:

Table 1105-2

Type A Conduit
Invert Depression

Pipe Diameter or Rise	Depression
<36"	None
36"-60"	6"
66"-120"	12"
126"-180"	18"
186"-252"	24"
>252"	30"

Modifications to the standard headwalls are not necessary for the depression depths noted above.

1105.2.3 Flood Plain Culverts

All culverts are required to have flood plain culverts except for those that meet any of the following conditions:

- The culvert is a replacement structure.
- The flood plain width is less than two (2) times the width produced by the bankfull discharge design.
- The culvert does not convey a water of the United States.
- The culvert conveys an ephemeral stream.
- The culvert is 30" in diameter or rise, or less.
- The culvert is not covered under a Nationwide Permit Number 14.

Flood plain culverts are used to minimize the effects of a single culvert within a wide flood plain. The installation of a single culvert can concentrate the flow. Flood plain culverts will reduce the concentrated flow by reducing the hydraulic load of the single culvert by spreading the discharge throughout the flood plain.

Flood plain culverts are installed adjacent to the single culvert. Place flood plain culvert inverts at the water surface elevation that is generated by the bankfull discharge design. Locate the flood plain culverts within the flood plain at a location well beyond the single culvert. Provide a minimum of two flood plain culverts.

Flood plain culverts are not hydraulically designed or accounted for in the hydraulic design of the single culvert. Use Figure 1002-1 ("other" column) to determine the required diameter. The line and grade of the culvert should approximate that of the natural flood plain.

1105.2.4 Multiple Cell Culverts

A single-cell culvert should be the designer's first choice within practical limitations. If flood plain culverts are provided, do not use multiple cell culverts.

Occasionally, low headwater requirements, high fills, or bankfull design will create the need for multiple cells. For these cases, it is desirable to limit the number of cells to two. Experience has proven that multiple cells well aligned with a relatively straight channel, will operate satisfactory. However, a bend in the immediate upstream channel may cause the inside cell to collect debris during normal periods of runoff and thereby substantially reduce the capacity of the culvert.

1105.2.5 Paved Depressed Approach Apron

Culverts may require a paved depressed approach apron. Do not provide a paved depressed approach apron for the following:

- The culvert is a replacement structure.
- The culvert is 30" in diameter or rise, or less.
- The culvert is not covered under a Nationwide Permit Number 14.
- Natural channel bottom structure (3-sided precast structure).

- The culvert inverts are depressed.

This BMP will improve the operation of the culvert by depressing the flowline at the entrance below the channel flowline. The drop-down will alleviate a minimum cover condition, provide for additional headwater depth, and decrease the culvert outlet velocity by reducing the culvert slope.

The abrupt change in natural channel slope is effected with a short length of concrete paving. The dimensions of the slab are site specific. However, for ease of construction, a 2:1 downslope (4:1 preferred) should be used as the maximum descending slope. A 3 foot length of paving should be provided along the natural channel slope prior to the drop-down. A cut-off wall must be provided at the upstream end.

Drop-down entrances should generally be limited to 4 feet, or one pipe diameter or rise, whichever is greater.

The Federal Highway Administration has conducted extensive research and studies of paved depressed approach aprons, and recommended design procedures are included in Hydraulic Engineering Circular No. 5, "Hydraulic Design of Highway Culverts."

1105.2.6 Improved Inlets

Culverts may require an improved inlet. Do not provide an improved inlet for the following:

- The culvert is a replacement structure.
- The culvert does not convey a water of the United States.
- The culvert conveys an ephemeral stream.
- The culvert is 30" in diameter or rise, or less.
- The culvert is not covered under a Nationwide Permit Number 14.
- Natural channel bottom structure (3-sided precast structure)
- The culvert inverts are depressed.
- Paved drop-down culvert entrance

This BMP will improve the operation of the culvert by depressing the flowline at the entrance below the channel flowline. The drop-down will alleviate a minimum cover condition, provide for additional headwater depth, and decrease the culvert outlet velocity by reducing the culvert slope.
Two general types of inlets should be considered in the following order:

Culverts on relatively steep slopes and controlled by inlet control can see a reduction in the culvert size by furnishing an improved inlet. The improved inlet will control the headwater by the entrance configuration for a given barrel size.

A. Side-taper, which is a tapered end section from a round to an oval shape for a pipe, or a square to a rectangular shape for a prefabricated box. The length of the taper section is usually made 1.5 times the diameter or rise of the culvert.

B. Slope-taper, which is a combination of side-taper preceded by a drop in the culvert flow line. The drop can be similar to a paved drop-down entrance or a more sophisticated reinforced concrete drop provided by a formed cast-in-place section with vertical sides.

The improved inlet has the advantage of admitting more flow and thereby tending to fill the culvert barrel and reduce the culvert outlet velocity. The savings in culvert cost must justify the additional cost of the improved inlet.

The Federal Highway Administration has conducted extensive research and studies of improved inlets, and recommended design procedures are included in Hydraulic Engineering Circular No. 13, "Hydraulic Design of Improved Inlets for Culverts."

1005.2.7 Energy Control Structures

All culverts are required to have an energy control structure.

An energy control structure reduces the amount of erosive energy generated by a culvert. Use the following for an energy control structure:

- Broken-Back Culvert
- Rock Channel Protection
- Energy dissipater (Riprap Basin)
- Drop Structure

An energy dissipater is required when the outlet velocity exceeds the values shown in Figure 1107-1. Energy dissipaters create a forced hydraulic jump within the structure or immediately downstream of the structure, thus reducing the flow velocity. FHWA Hydraulic Engineering Circular No. 14 provides design guidance and procedures for various energy dissipaters. The preferred energy dissipater is the riprap basin.

Contact the Office of Structural Engineering, Hydraulics Section prior to using an energy dissipater.

1105.3 Types of Culvert Flow

Laboratory tests sponsored by the FHWA have established two general types of culvert flow: (1) flow with inlet control, or (2) flow with outlet control. Nomographs have been prepared for use in the determination of culvert headwater for the appropriate control.

Under inlet control, the headwater "HWI" is directly related to the cross-sectional area of the culvert barrel and the inlet geometry. Under outlet control, the headwater "HWO" is further influenced by tailwater depth in the outlet channel and the slope, length and roughness of the culvert barrel. As shown in Figure 1105-1, culverts operate with a free water surface if the headwater is equal to or less than 1.2D, and with a submerged entrance if the headwater is greater than 1.2D, where D is the diameter or rise of the pipe.

1105.4 Design Procedure

1105.4.1 General

The design of a culvert involves a determination of the appropriate design and check discharges. The process begins with a delineation of the drainage area, in acres [hectares], on a suitable topographic map.

The design discharge "Q" for most culvert drainage areas will be obtained by procedures described in USGS Reports 89-4126 and 93-135, applying the limitations covered in Section 1003.1.2 of this manual. The Rational method should be used to obtain the discharge from small and other unusual drainage areas as noted in Section 1101.2.2

A representative cross-section of the embankment at the proposed culvert site, along with a profile of the natural stream or ground line, will be required to determine the approximate length and slope of the culvert.

1105.4.2 Hydraulic Analysis

The hydraulic analysis of a culvert, including a determination of the headwater depth and outlet velocity for the design discharge, is simplified by the use of Pipe Flow Charts and the headwater and head nomographs noted in Section 1105.4. The charts are included with the Drainage Design Aids, beginning with Figure 1100-200.

To preclude the need for a determination of the probable type of flow under which a culvert will operate for a given set of conditions, the headwater depths may be computed using the nomographs for both inlet and outlet control. The size of pipe is then selected by using the control giving the higher headwater limitation.

The relationship of the headwater to the diameter or height of the culvert "HW/D" is read directly from the inlet control nomograph and the HWI equals that value multiplied by D. HWO is computed by the equation HWO=H+ho - SoL. The loss of head "H" is read from the flowing-full nomograph and the tailwater depth "ho", is the greater of either the normal depth of flow in the outlet channel or the depth as flow passes through the outlet of the pipe, calculated as (dc+D)/2. D is the diameter or rise of the culvert and dc is the critical depth of flow which may be read from the critical depth curve shown on each Pipe Flow Chart.

The above procedure is reasonably accurate for the majority of culvert flow conditions. For culverts operating with outlet control (see Figure 1105-1, Class 1-A and 1-B), where the calculated headwater (using the appropriate nomograph) is less than 0.75D, a backwater analysis can be justified and is recommended.

A culvert analysis sheet similar to that provided in the Appendix shall be used to tabulate all the pertinent factors required to determine the controlling headwater for each culvert type being considered for a given location. The analysis sheet includes other information valuable to the reviewer and it is to be included with other supporting data for required review submissions.

Hydraulic analysis of culverts may also be performed utilizing the Federal Highway Administration Hydraulic Design Series No. 5, Hydraulic Design of Highway Culverts. Computer programs such as FHWA HY-8 or ODOT's CDSS software package may be used. CDSS may be downloaded from the Hydraulics website.

For replacement projects, an analysis of the existing structure shall be performed. If appropriate (usually depending upon whether the structure is operating with a free water surface at its entrance), it is preferable that the same analysis method be used to compare the existing and proposed structures. For bridge replacements, acceptable methods of hydraulic analyses are listed numerically in preferred order as follows (the limitations of the method used shall be investigated prior to selecting it for use):

1. Computer Program HEC-2 (HEC-RAS)

2. Computer Program HY-7 (WSPRO)

3. Hydraulic Design Series No. 1, "Hydraulics of Bridge Waterways", Federal Highway Administration, and computer program HY-4.

1105.5 Use of Nomographs

1105.5.1 Outlet Control

To determine the loss of head "H" for a given concrete pipe culvert with a grove-end entrance and discharge "Q", proceed as follows: By straight line, connect culvert size with ke=0.2 (length scale) and obtain a point on the turning line. Connect the turning line point with the computed discharge "Q" and read the head loss "H". Follow the same procedure for a corrugated metal pipe except using ke=0.9 (length scale). The k_e value for additional shapes can be found in the Federal Highway Administration publication referenced in Section 1105.3.1.

Should the roughness coefficient "n" of the proposed pipe differ from that shown on the chart, adjust the measured culvert length by the length factor given on Design Aid Figure 1100-247. For an example, see Drainage Design Aid Figure 1100-247.

The Federal Highway Administration publication referenced in Section 1105.3.1 offers nomographs for culvert shapes not available in the Drainage Design Aids. Their use is recommended for special culvert shapes.

1105.5.2 Inlet Control

To determine the headwater "HW" for a given discharge "Q", size and type of culvert, proceed as follows using appropriate Figures 1100-245, 1100-246 (Drainage Design Aids). Use Figure 1100-245 for a round corrugated metal pipe culvert and Figure 1100-246 for a round smooth-lined pipe culvert. By a straight line, connect the culvert size with the discharge "Q", extend a diagonal line to Scale (1) and thence by horizontal line to Scale (3). Based on a groove-end entrance and a Standard HW-2.1 headwall recommended for concrete pipe culverts, the HW/D relationship is obtained by an average of the (2) and (3) Scale values. Follow the same procedure for a corrugated metal pipe with a Standard HW-2.2 headwall, where HW/D is the average values read from Scales (1) and (3). Use Scale (2) for the HW/D relationship for concrete box culverts.

1105.6 Design Criteria

1105.6.1 Design Frequency

The design frequency shall be as stated in Section 1004.2
It should be noted that a Flood Hazard Evaluation using a check discharge based on the 100-year flood frequency shall be made for all culverts as noted in Section 1005.2.1.

1105.6.2 Maximum Allowable Headwater

See Section 1006.

1105.6.3 Method Used to Estimate Storm Discharge

See Sections 1003 and 1101.

1105.6.4 Scale of Topographic Mapping Used to Delineate Contributing Drainage Areas

See Section 1101.1

1105.6.5 Manning's Roughness Coefficient "n"

The "n" values for corrugated metal pipe are given in Figure 1105-2. The "n" value for all smooth flow pipe is 0.012. Use a weighted Manning's n for bankfull designed culverts or analyzing older culverts with sediment deposition.

1105.6.6 Entrance Loss Coefficient "k_e"

See Table 1105-1 or Appendix D of Federal Highway Hydraulic Design Series No. 5, "Hydraulic Design of Roadway Culverts.

1105.6.7 Minimum Cover

See Section 1008

1105.6.8 Maximum Cover

See Section 1008

1105.6.9 Maximum Allowable Outlet Velocity

See Figure 1107-1

Table 1105-1

Type A Conduit
Entrance Loss Coefficient k_e

Type of Pipe	Headwall Type Full	One-Half	None
Concrete, Vitrified (thick wall) *	0.2	0.2	0.2
Corrugated Metal (thin wall)	0.25**	0.9	0.9

* groove end entrance
** with beveled entrance

1105.6.10 Headwall Type

See Section 1106.2

1105.6.11 Contacts With County Engineer

Contact shall be made with the County Engineer at the beginning of the design process to ascertain ditch cleanout grades and watersheds, and the design shall be based on that information. Form LD-33 (available in the Appendix) shall be used to document approval.

1105.6.12 Minimum Pipe Size

As specified in Section 1002.3.1

1105.7 Special Considerations

The following are special conditions that will be encountered in the hydraulic design of culverts that warrant clarification.

1105.7.1 Tailwater

Tailwater at a culvert outlet can greatly affect the size of culvert required at a specific site. For this reason a proper evaluation shall be made of the outlet channel so that a reasonable estimate of the tailwater can be calculated.

A determination of the normal depth of flow in the outlet channel, when the culvert is discharging the design flow, normally establishes the culvert tailwater. A close examination of the downstream channel may however, reveal a temporary or permanent obstruction that will control the operation of the culvert. In some cases, the culvert will outlet near a river or other fluctuating water surface stream that could control its operation.

Where that drainage area of the culvert is very much less than the receiving watercourse (i.e. 100 times) the effect of the receiving watercourse generally may be disregarded.

Where the drainage areas of the culvert and receiving watercourse are nearly equal, concurrent flood peaks may be assumed.

Where there is a significant, but not excessive, difference in the drainage area of the culvert and receiving stream, the following design procedure should be used and the culvert sized using the combination that results in the highest headwater.

A. Compute the culvert headwater using the proper design frequency for the culvert and a lesser frequency for the receiving stream water surface elevation (i.e. culvert tailwater elevation) depending upon the difference in drainage areas; say a 25-year culvert and a 10-year stream.

B. Use 10-year frequency for the culvert and 25-year for the stream.

In some locations, a high tailwater will control the operation of a culvert to such an extent that a substantial increase in pipe size will be required for a negligible decrease in the headwater elevation. For this case, the culvert size should be based on a practical tailwater elevation (e.g. [dc+D]/2).

1106 End Treatments

1106.1 General

Headwalls, or other approved end finishes, shall be provided at the open ends of all Type A, B and C conduits. Headwalls should also be provided for Type D conduits greater than 24 inches in diameter or rise. Generally, headwalls are not recommended for Type E and F conduits.

In order to reduce the entrance loss in culverts, the bell end should be located upstream and the spigot end should be located downstream. Details shown in the plan should convey this to the Contractor when necessary. Figures 1106-2 and 1106-3 show typical end details for a concrete box culvert.

1106.1.1 Usage

The selection of the headwall type is based on safety and economics. Standard HW-2.1 and 2.2 half-height headwalls are recommended for round, elliptical, or pipe arch culverts where a clear zone is provided. Full height headwalls should be provided where a significant reduction in culvert length can be realized with large-span culverts (10 feet or greater) with foreslopes flatter than 2:1 or where right-of-way limits the culvert length. Full-height headwalls shall be provided for prefabricated box culverts and three-sided structures.

The use of special end treatments may be required by Section 602.6 of Volume 1, Roadway Design. Details are available from the Hydraulic Section, Office of Structural Engineering. Justification for the use of this type of end treatment shall accompany the request for details. Miter-cut (step-bevel) end sections, when required, shall be shown on the Culvert Detail Sheet.

When half-height headwalls are provided, they should be built perpendicular to the end of the conduit to eliminate the need for a skew cut. In addition to the required headwall, the upper, or exposed, half of conduits having a diameter or rise greater than or equal to 126 inches shall be miter-cut (step-bevel) to fit the embankment slope.

1106.1.2 End Treatment Grading

The prevailing embankment slope shall be projected to the back edge of the top of the headwall to establish the required culvert length as shown in Figure 1106-1. When the roadway foreslopes are flatter than 2:1, a 2:1 slope shall be provided from the back edge of the top of the headwall to a minimum of 1 foot , with 2 feet preferred, above the top of the culvert. The change in embankment slope shall be warped on each side of the conduit to fit the prevailing slope. In no case shall the distance from the pavement edge to the point where the embankment slope changes to 2:1 be less than the design clear zone width (see Section 601, Volume 1, Roadway Design) unless guardrail is provided.

Clear zone grading should only be provided at culverts when the requirements of Section 307.21 of Volume 1, Roadway Design are met.

The prevailing embankment slope shall be warped on either side of a skewed culvert to assure equivalent soil loading and proper side support of the pipe. This is especially true for flexible pipes with large skews and/or large diameters.

1106.2 Headwall Types

1106.2.1 Half-Height Headwalls

If the size of the conduit exceeds that shown in the Standard Construction Drawing HW-2.1 and HW-2.2 tables, the dimensions shown in the tables may be expanded to accommodate the larger size conduits. Payment for half-height headwalls shall be on a cubic yard basis for Item 602, Concrete Masonry. Masonry quantities for standard half-height headwalls may be obtained from the appropriate standard construction drawing. The quantity of concrete masonry provided in the plans shall be based on the pipe alternate requiring the largest quantity of concrete masonry.

1106.2.2 Full-Height Headwalls

The appropriate full-height headwall for round pipes shown on Standard Construction Drawing HW-1.1 may be considered at the entrance end, when the savings in the reduced size and length of the conduit will offset the additional cost of the headwall. This will most likely apply where corrugated steel pipe is specified, due to cover or size requirements, and the bevel provided for the full-height headwall will substantially reduce the entrance loss. Dimensions of full-height headwalls may be expanded to accommodate pipe sizes larger than 84 inches.

The design of full-height headwalls for box and 3-sided culverts shall be as per Section 300 of the Bridge Design Manual and the latest "AASHTO Standard Specifications for Highway Bridges." Payment for non-standard full-height headwalls shall be on a cubic yard basis for Item 511, Class C Concrete. The Class C Concrete shall be further subdivided into individual pay items for Class C Concrete for Footing, Class C Concrete for Wingwall.

Appropriate plan notes from Section 6 of the Bridge Design Manual shall be included in the project plans.

An investigation of the supporting foundation material shall be conducted and the bearing capacity of the foundation material estimated. The level of detail required for the foundation investigation shall be commensurate with the importance of the structure. Such information shall be submitted for all proposed full-height headwall installations and submitted prior to the Stage 3 review.

The inlet wingwall footings of full-height headwalls shall be armored with Type B rock channel protection, with filter, to preclude scour.

1106.3 Concrete Apron

Provide a reinforced concrete riprap cutoff wall, as shown on Standard Construction Drawings DM-1.1 when the depth of the rock channel protection (if necessary), including the 6 inch granular filter, exceeds the depth of the headwall.

Provide concrete riprap at the inlet end of the culvert where the existing culvert has been undercut. Concrete riprap shall be in accordance with Section 1105.6.3. Concrete riprap is not necessary at the inlet of culverts with full height headwalls that have a footing toe extending 3.5 feet or more below proposed channel grade.

1107 Rock Channel Protection

1107.1 General

Rock channel protection is used to control erosion at the outlet of culverts and storm sewers, or for lining ditches on steep grades. It is used as a scour countermeasure at the inlet wingwalls of full-height headwalls and along the footings of 3-sided structures.

1107.2 Types

There are four types of rock channel protection (RCP) that are used in various situations. The use of the proper type at culvert and storm sewer outlets can be determined from Figure 1107-1. Type A is generally used beyond the outlet of the larger conduits having outlet velocities in excess of 12 feet per second and Type B and C for conduits having an aggregate filter where the protected slope is steeper than 3:1. A filter should always be specified to prevent soil piping through the rock. A fabric filter is preferred in most cases. An aggregate filter should be used when the RCP is under water. The cost of the filter is included in the unit bid price for Item 601 Rock Channel Protection with Filter.

1108 Agricultural Drainage

1108.1 Farm Drain Crossings

Where it is necessary to continue an existing farm drain crossing under the highway, the pipe shall be Type B Conduit, one commercial size larger than the existing farm drain within the right-of-way limits.

Occasionally, it will be desirable to provide a farm drain crossing under a highway on new location to satisfy the future need for adequate farm drainage. It is recognized that the required length of a Type B Conduit will provide a betterment for the property owner, but it does preclude the need for a much more expensive crossing after the highway is built. Such a crossing is considered a "blind" and the cost of the installation, including suitable terminal markings at the right-of-way lines, will generally not be eligible for federal participation.

1108.2 Farm Drain Outlets

Existing farm drains that outlet through the backslope of the roadway ditch shall terminate with a minimum length of 10 feet of equivalent size Type F conduit. When outletting existing plastic farm drains, one size larger Type F conduit shall be used. An Animal Guard and Erosion Control Pad as shown on Standard Construction Drawing DM-1.1 shall be provided. To provide for possible sedimentation, the invert of the Type F conduit shall be a minimum of 6 inches, with 12 inches being desirable, above the ditch flow line.

1109 Longitudinal Sewer Location

1109.1 Under Pavement

Longitudinal sewers will not be permitted under the pavement of a limited or controlled access facility. Also, the length of transverse sewers under pavements shall be held to a minimum, with no manholes allowed in the pavement.

For other facilities, storm sewers should be located outside the limits of the pavement. However, in locations where this would create conflicts with existing utilities (e.g. waterlines, sanitary sewers, gas lines, etc.) the storm sewer may be located under the pavement. Care should be taken to avoid placing manholes in vehicle wheel-paths or within an intersection.

The center of the curb lane is the preferred manhole location.

Where an out-to-out clearance of 5 feet cannot be provided between parallel storm and sanitary sewers, premium joints shall be provided on the storm sewer.

1109.2 Under Paved Shoulder

The above shall also apply to paved shoulder areas, unless it is determined that the cost of any other possible location is prohibitive.

1109.3 Approval

Exceptions to the above shall be submitted in the early stages of the design to the Hydraulic Section, Office of Structural Engineering for review and approval.

1110 Reinforced Concrete Radius Pipe and Box Sections

1110.1 General

To comply with the capabilities of manufacturers to provide satisfactory and economical radius pipe or box sections, a minimum radius of 100 feet shall be specified.

The method of manufacturing the radius pipe or box sections will be an option of the producer, subject to inspection and approval by the Ohio Department of Transportation, Office of Materials Management.

As an alternate to radius pipe, pipe specials may be specified to negotiate the specified radius, provided they do not reduce the hydraulic performance established by the initial design. The bends shall be located so that they shall closely follow the alignment of the radius pipe.

1111 Sanitary Sewers

1111.1 General

Any sanitary sewer, whether new or relocated, shall be constructed using resilient and flexible gasket joints, in accordance with Construction and Material Specification 706.11 for circular concrete pipe or 706.12 for clay pipe. Permissible thermoplastic pipes shall also be specified.

Discharges of treated sanitary flow from abutting property into highway drainage systems are only permitted if the discharge is authorized by the Local Health Department.

1111.2 Manholes

All new manholes for sanitary sewer lines shall be built in accordance with the Standard Construction Drawings. Precast manholes shall have joints in accordance with 706.11 of the Construction and Material Specifications.

1112 Notice of Intent (NOI)

1112.1 General

A NOI will be submitted by ODOT for all plans, which include Project Earth Disturbing Activities. Maintenance Projects, as defined by Section 1112.2, do not require a NOI.

The Total Earth Disturbing Activity acreage should be estimated, which includes the Project Earth Disturbing Activity acreage (area within the work limits) and the Contractor Earth Disturbing Activity acreage such as: field offices, batch plants, and borrow/waste pits. The location and size of the Contractor Activities can be estimated using the NOI Acreage Calculation Form (Figure 1112-1).

The calculated acreage's shall be used for the Project Site Plan as required by Location and Design, Volume 3, section 1308.

1112.2 Maintenance Project

A Maintenance Project is one in which all of the Project Earth Disturbing Activities are routine operations that do not change the line, grade, or the hydraulic capacity of the facility and are limited to Earth Disturbance acreage less than 5 acres. Permanent erosion control items shall be included in the plans if required. Contact the Office of Structural Engineering, Hydraulics Section for an approved list of activities.

Post construction storm water best management practices are not required for maintenance projects that do not increase the impervious drainage area.

1113 Erosion Control at Bridge Ends

1113.1 General

For the purpose of reducing problems of erosion in the vicinity of bridge ends, details as shown on Standard Construction Drawing DM-4.1 shall be followed. At locations where the design flow exceeds 0.75 cubic feet per second, catch basins should generally be provided.

1113.2 Corner Cone

Item 670 Slope Erosion Protection shall be placed on all bridge approach embankment corner cones, beginning at the edge of the crushed aggregate or concrete slope protection.

1114 Temporary Sediment and Erosion Control

1114.1 General

Temporary sediment and erosion control is required on all projects that have Earth Disturbing Activities as outlined in Supplemental Specification 832. A Storm Water Pollution Prevention Plan (SWPPP) is required for all projects that require a NOI (See section 1112) The SWPPP requirements are outlined in Supplemental Specification 832.

1114.2 Cost Estimate for Temporary Sediment and Erosion Control

For all projects that require temporary sediment and erosion control furnish an amount to be encumbered in the project final package. Use the temporary sediment and erosion control estimator located in the Design Reference Resource Center to develop this amount. Furnish the calculations with the final plan package.

1115 Post Construction Storm Water Structural Best Management Practices

1115.1 General

Post Construction Storm Water Best Management Practices (BMP) are provided for perpetual management of runoff quality and quantity so that a receiving stream's physical, chemical and biological characteristics are protected and stream functions are maintained.

BMP are required for all projects within ODOT right-of-way that have ODOT maintenance responsibility and disturb 1 acre or more. Maintenance projects as outlined in section 1112.2 do not require BMP.

BMP are protected and located in accordance with Location and Design, Volume 1.

If discharging into a roadway ditch that conveys a captured stream, separate the drainage by using curbing or barrier. Treat impervious drainage areas with a BMP.

Furnish a drainage design that will reduce the need for bridge scuppers. If bridge scuppers are required, contact the Office of Structural Engineering, Hydraulic Section.

All Type A culverts will have stream protection per section 1105 Roadway Culverts.

1115.2 Land Disturbance Limits

Land disturbance (LD) is defined as an area of Earth Disturbing Activities (EDA) as outlined in Supplemental Specification 832 or an area where pavement is being removed to the sub-grade.

For non-maintenance projects with less than 1 acre of LD, BMP are not required but are recommended.

For non-maintenance projects with 1 acre or more but less than 5 acres of LD, BMP are required. Choose from the following list and maximize the design to the extent practicable:

- Exfiltration trench
- Manufactured systems
- Vegetated Biofilter
- Extended detention
- Retention Basin
- Bioretention Cell
- Infiltration Trench
- Infiltration Basin
- Constructed Wetlands

For all projects with five or more acres of LD or projects that are a part of a larger common plan of development which will have five or more acres of LD, BMP shall be incorporated into the permanent drainage system for the site. Choose from the following list:

- Exfiltration trench
- Manufactured systems
- Vegetated Biofilter
- Extended detention
- Retention Basin
- Bioretention Cell
- Infiltration Trench
- Infiltration Basin
- Constructed Wetlands

1115.3 Drainage Area

For projects that are located in multiple drainage areas, provide BMP based on the total acres of project LD.

For projects with drainage areas that are less than or equal to 0.25 acres when in a sump or at an intersection per figure 1116-1, a BMP is not required.

1116 Water Quality Volume

1116.1 Water Quality Volume Calculation

The following equation shall be used to calculate the water quality volume:

$$WQv = T(P*A*Cq)/12$$

Where,

WQv = Water Quality Volume (Ac-ft)

T= Treatment Percent (see 1116.2)

P = Precipitation (0.75 inches)

A = Contributing Drainage Area to an outfall (acres)

$Cq = 0.858i^3 - 0.78i^2 + 0.774i + 0.04$
(see figure 1116-2)

i=impervious area divided by the total area

Cq = 0.9 when all drainage area is impervious.

1116.2 Treatment Percent

A contributing drainage area to an outfall that has both existing and new impervious areas requires a weighted average calculation to determine the percent of treatment required. Existing impervious area requires treatment of 20% of the area. New impervious area requires treatment of 100% of the area. This percent is multiplied by the calculated WQv or the ExT length to determine the amount of treatment. Use the following equation to determine the percent of treatment:

Treatment = [(Aix * 20)+(Ain * 100)] / (Aix+Ain)

Where,

Treatment= Treatment percent (%)

Aix= Existing impervious area (acres)

Ain= New impervious area (acres)

1116.3 Structural BMP Using the WQv

The water quality volume (WQv) is the treatment volume required for post construction BMP. Use the WQv for the following BMP:

- Exfiltration Trench
- Vegetated Biofilter
- Extended Detention
- Retention Basin
- Bioretention Cell
- Infiltration Trench
- Infiltration Basin
- Constructed Wetlands

Once an area has been treated, remove this area from the next downstream WQv calculation.

1117 Water Quality Flow

1117.1 Water Quality Flow Calculation

The water quality flow (WQf) is the discharge that is produced by using an intensity of 0.65 in/hr in the rational equation (section 1101.2.2). Use the entire contributing drainage for the WQf calculation. Once an area has been treated, remove this area from the next downstream WQf calculation.

1117.2 Structural BMP Using the WQf

Use the WQf for the following BMP:

- Manufactured System

1118 BMP Toolbox

1118.1 Exfiltration Trench

An exfiltration trench (ExT) captures roadway drainage at the outside edge of shoulder through the use of a permeable concrete surface. The permeable concrete surface is placed parallel to the roadway within a concrete structure. The ExT is placed 15 feet (min) prior to any drainage inlet, pavement catch basin (see figure 1118-1), or curb cut. The ExT width is 8 inches wide and the length is determined by the following equation:

$$Lt = T(A*Cq)/68{,}900$$

Where,

T= Treatment Percent (1116.2)
Lt= Required Impervious Length of Trench (ft)
Use a minimum length of 4 feet
Length is in increments of 4 feet
A= Total Contributing Area (square feet) as determined by the Strip Method per section 1103.3.

$Cq= 0.858i^3-0.78i^2+0.774i+0.04$
(see figure 1116-2)

i=impervious area divided by the total area

Storm water is filtered until it reaches a 4 inch perforated conduit connected to a 4 inch non-perforated outlet conduit. The 4 inch outlet conduit may discharge into a drainage structure or onto the slope using a reinforced concrete outlet. The following criteria are used for payment for the ExT:

- Payment for the ExT shall be: Item 835 - Exfiltration Trench, Type ___ – L.F.
    - Use a Type A for curb and gutter, Type 2.
    - Use a Type B for barrier and non-6 inch curb.
    - Use a Type C for 6 inch curb without gutter.
- Payment for the 4 inch perforated conduit is: 605 4 inch Shallow Pipe Underdrains 707.31.
- Payment for the 4 inch outlet conduit is: 603 4 inch conduit, Type B 707.33.
- Payment for the precast reinforced concrete outlet is Item 604 precast reinforced concrete outlet.

The following criteria are used for designing an ExT:

- Do not use the ExT in tapers, parking areas, on a radius, or within a driveway.
- Do not use the ExT on the high side of a super elevated roadway.
- Do not use the ExT with shoulder widths less than 2 feet.

1118.2 Manufactured Systems

Manufactured systems consist of underground structures that treat the WQf by removing particulate matter through settlement. Supplemental Specification 895 covers the material and performance criteria for these devices. They are placed in an off-line configuration with manholes to allow for routine maintenance procedures (see figure 1118-2).

Provide a No. 3 Manhole, With ___" Base ID and ___" Weir at this location. Furnish two lengths of 603, Type B Conduit placed perpendicular to the inflowing trunk sewer (see reserved area table for the total length required). Use the following table when placing a Manufactured System:

Manufactured Systems			
Type	**WQf (cfs)**	**No. 3 Manhole Base ID (inches)**	**603-Type B Conduit Diameter (inches)**
1	1	84	12
2	2	90	15
3	3	96	18
4	6	108	24

Reserve an area (as measured from the centerline of the No. 3 Manhole) according to the following table:

Reserved Area for Manufactured System				
Type	Width (feet)	Length (feet)	603-Type B Total Conduit Length (feet)	Weir Height (inches)
1	15	30	20	6
2	20	32	30	8
3	25	33	40	9
4	25	37	40	12

Center the length of the area at the No. 3 Manhole. If this area is not attainable, contact the Office of Structural Engineering, Hydraulics Section for further guidance. Ensure this area is void of all utilities and is accessible for routine cleanout and maintenance.

1118.3 Vegetated Biofilter

A Vegetated Biofilter (VBF) is a BMP treatment train that filters storm water through vegetation. The treatment train consists of the vegetated portion of the graded shoulder, vegetated slope, vegetated ditch, and an energy protection area.

When widening existing ditches, consider the following before purchasing new right-of-way:

- Reducing the foreslope of the ditch.
- Reducing the backslope of the ditch.
- Reducing the bench width to a minimum of 4 feet.

1118.3.1 Vegetated Ditch Design Process

For projects furnishing new ditches provide an outside ditch width located in fill sections according the following:

A. Calculate the width of the ditch according to section 1102 by one of the following:
1. Radius Ditch width equals the length of the arc
2. Rounding ditch width equals the rounding length
3. Trapezoid ditch width equals the bottom width

B. Calculate the Enhanced Bankfull Width (EBW) in feet using the following equation:

$$EBW = 5.4A^{0.356}$$

A= Total drainage area to the ditch (Ac)

C. Compare the ditch width found in Section 1118.3.1.A to the EBW found in Section 1118.3.1.B and determine the plan ditch width by choosing one of the following:

1. If the EBW is less than or equal to the width found in Section 1118.3.1.A, furnish Section 1118.3.1.A width in the plans.

2. If the EBW is greater than the width found in Section 1118.3.1.A and is less than or equal to 10 feet, furnish the EBW width in the plans.

3. If the EBW exceeds the width found in Section 1118.3.1.A and is more than 10 feet and the EBW will not require the purchase of additional right-of-way, furnish the EBW in the plans.

4. If the EBW exceeds the width found in Section 1118.3.1.A and is more than 10 feet and the EBW will require the purchase of additional right-of-way, furnish a Conveyance Ditch for Offsite Drainage Area according to Section 1118.3.2.

For projects using existing ditches where the EBW is greater than the existing ditch width as determined in Section 1118.3.1.A, maximize the existing ditch width to the extent that does not require the purchase of additional right-of-way.

Ditch width is to be calculated every 100 linear feet of ditch and at points where offsite runoff is accepted to provide the minimum required ditch width. Begin ditch width calculations at the outfall and move upstream through the drainage area.

1118.3.2 Conveyance Ditch for Offsite Drainage Area

A conveyance ditch is a 10 foot wide ditch with an earth berm (EB) that separates the conveyance of the roadway runoff from offsite runoff for the first flush flows. The EB is placed longitudinally in the ditch at a determined location.

Figures 1118-13 through 1118-18 detail common design scenarios for conveyance ditches. Calculate the conveyance ditch for the offsite drainage area using figures 1118-13 through 1118-18. If the offsite ditch design falls outside of the criteria used in figures 1118-13 through 1118-18, manually design the ditch using figure 1118-

19. A design example is detailed in figure 1118-4.

If the EB location is greater than 9 feet, contact the Office of Structural Engineering, Hydraulics Section.

Payment for the earth berm is per Item 203

1118.3.3 Energy Protection Area

An energy protection area provides energy reduction to the ditch flow prior to discharging into a water body. It is a constructed channel that has a 15 foot wide bottom with a layer of rock channel protection. The use of an EB is truncated at the upstream end of the energy protection area. Use the following criteria when providing an energy protection area:

A. Provide 50 feet length (see figure 1118-5).

B. Provide a 12 inch thick layer of Item 601 RCP, Type D with filter or as required per section 1102 (if larger RCP is necessary).

C. Locate all energy protection areas in the outside roadway ditch.

D. The energy protection area is required on the upstream location of culverts. It is optional on the downstream location of culverts.

E. Provide energy protection areas as existing right-of-way permits for redevelopment projects. If any amount of right-of-way is purchased for the project, an energy protection area is required.

1118.4 Extended Detention

Extended detention is a method that captures storm water during rain events and slowly releases the captured volume over a period of time. The WQv is used to determine the storage volume of the detention basin. The WQv is discharged over a 48 hour time frame. Increase the WQv by 20% when sizing the BMP to allow for sedimentation to occur. Detention can be either above or below ground. Detention basins that are above ground are the preferred choice and should be used when feasible. However, when project site parameters dictate, an underground system may be the optimum choice.

1118.4.1 Detention Basin

A detention basin is a dry pond that detains storm water for quality and quantity. The following criteria apply when designing a detention basin:

A. Allow for 1 foot of freeboard above the storage volume.

B. Furnish a micro pool when feasible (see figure 1118-6)

C. Use side slopes of 4:1 (max).

D. Ensure the design check discharge will safely pass through the structure (section 1118.4.3).

E. Vegetate the sides of the basin with Item 670 Slope Erosion Protection.

F. Furnish a 6 inch layer of Item 601 Detention Basin Aggregate on the bottom of the basin.

G. Embankment work to create the impoundment will be constructed and paid for as Item 203 Embankment, Using Natural Soils, 703.16.A.

H. Consider vehicle access to the basin for periodic maintenance.

I. Do not locate on uncompacted fill or steep slopes (2:1 or more) or where infiltrating ground water could adversely impact slope stability.

J. Furnish an anti-seep collar around the outlet pipe.

K. Furnish gravel pack protection at the outlet structure (see SCD WQ1.1).

L. Place channel protection (RCP or Concrete Mat) at the entrance of the basin to minimize erosion and sediment resuspension.

M. Furnish a forebay that is approximately 7% of the total design volume.

N. Furnish a Water Quality Basin, Detention per section 1118.4.1.1

1118.4.1.1 Water Quality Basin and Weir

Furnish an outlet structure that fully drains the WQv within 48 hours or more. The outlet requires a flow control structure such as a perforated riser pipe to restrict the drainage discharge. Details of a perforated riser pipe outlet structure can be found on standard drawing WQ1.1.

Furnish a perforated riser pipe for detention basins. The outlet structure consists of a catch basin with a perforated riser pipe on the inlet side and a conduit on the outlet side. The perforated riser pipe is used for flow control to achieve the required discharge time. A gravel envelope surrounds the perforated riser pipe along the inlet side of the catch basin to prevent blockage of the orifice holes in the pipe. The catch basin and riser pipe are paid for as Item 604, Water Quality Basin, Detention.

Furnish a weir to allow the design check discharge to bypass the structure without damage to the detention basin or embankment of the basin. The design check discharge shall be determined per 1118.4.3.

The equation for a single orifice is:

$$Q = A \cdot C \cdot \sqrt{64.4H}$$

Where,

A = Area of orifice (ft^2)

H = Head on orifice as measured to the centerline of the orifice (ft)

C = Orifice coefficient

Orifice Coefficient Guidance

C	Description
0.66	Use for thin materials where the thickness is equal to or less than the orifice diameter.
0.80	Use when the material is thicker than the orifice diameter.

From CALTRANS, Storm Water Quality Handbooks, Project Planning and Design Guide, September 2002.

A hydrograph curve for the outlet will be required to calculate the discharge time of the WQv and the design check discharge (see 1118.4.3). The discharge time should correspond to the minimum of 48 hours.

Generally, it is easier to model the outlet structure and discharge time using software such as Pond Pak or HydroCad to develop the hydrograph.

1118.4.1.2 Anti-Seep Collar Design

An anti-seep collar shall be installed on conduits through earth fills where water is being detained. The following criteria applies to anti-seep collars:

A. Spacing between adjacent collars shall be 5 feet with the first collar being a minimum of 5 feet from the inlet.

B. Furnish a minimum of 2 collars per outlet conduit.

C. All anti-seep collars and their connections shall be watertight.

D. Minimum thickness shall be 6 inches.

E. Payment for the collar shall be Item 602 Concrete Masonry (see standard construction drawing WQ-1.2).

To determine the dimensions of the collar refer to the following:

Anti-Seep Collar Size

Maximum Water Depth	Collar Size (ftxft)
2	3x3
4	4x4
6	5x5

1118.4.2 Underground Detention

Underground detention areas are made up of a series of conduits. They range from an oversized storm sewer to a series of conduits that are specifically used for storm water detention. The following criteria apply when designing underground detention:

A. Ensure the Hydraulic Grade Line design of the storm sewer will pass through the structure and meet the requirements of 1104.4.2.

B. Consider access to the conduits for periodic maintenance.

C. If practical, provide pretreatment of the storm water with a vegetated strip.

D. Payment for the conduit shall be: Item 603 ____" Conduit, Type____, for underground detention.

1118.4.3 Design Check Discharge

A design check discharge with the frequency of a 10-year event shall be used as calculated by the Rational Equation. Use the entire drainage area that contributes to the BMP to calculate the design check discharge.

1118.5 Retention Basin

A retention basin is a "wet" pond that has a minimum water surface elevation between storms that is defined as the permanent pool. Above the permanent pool is a detention pool that provides storage for 75% of the WQv and discharges within 24 hours or more. The full storage water depth is typically between 3-6 feet and the volume is less than 15 Ac-ft. The permanent pool is sized to provide storage for 75% of the WQv. A retention basin is ideal for large tributaries, but it may require a large amount of space. Consider the following when designing a retention basin:

A. Use RCP at the inlet of the basin to provide energy dissipation and erosion control.

B. Allow for 1 foot freeboard above the WQv.

C. Use side slopes of 4:1 (max).

D. Ensure the design check discharge will safely pass through the structure (section 1118.4.3).

E. Use a length to width ratio of at least 3:1 to prevent short-circuiting.

F. Vegetate the sides of the basin with Item 670 Slope Erosion Protection.

G. Furnish a 6 inch layer of Item 601 Detention Basin Aggregate on the bottom of the basin.

H. Furnish a forebay (7-10% of the total retention volume) to extend the service life of the BMP when feasible.

I. Furnish an anti-seep collar around the outlet pipe (see section 1118.4.1.2).

J. Furnish a trash rack at the outlet structure.

K. The underlying soils should be compacted to prevent infiltration of the permanent pool or an impervious liner should be used.

L. Consider vehicle access to the basin for periodic maintenance.

M. Retention basin must be greater than 10,000 feet from a municipal airport runway.

N. Embankment work to create the impoundment will be constructed and paid for as Item 203 Embankment, Using Natural Soils, 703.16.A.

O. Furnish a Water Quality Basin, Retention per 1118.5.1.

1118.5.1 Water Quality Basin and Weir

A retention basin outlet structure is designed similar to the outlet structure for a detention basin. The difference is that 75% of the WQv should be discharged out of the basin in 24 hours or more. The outlet structures are of a similar type, except the openings will be set at a high enough elevation to maintain 0.75% of the WQv in the permanent pool (see standard construction drawing WQ-1.1). The catch basin and riser pipe is paid for as Item 604, Water Quality Basin, Retention.

1118.6 Bioretention Cell

Bioretention Cells consist of depressed low-lying areas that treat storm water through evapotranspiration and filtering through a planting soil. As the storm water passes through the soil it is filtered. An underlying perforated storm sewer or underdrain captures the treated storm water and carries it to an outlet. Extensive vegetation assists in the filtration of the storm water prior to filtering through the soil. Vegetation should consist of shrubs or grasses that are native to the area.

The existing soil must be removed and replaced when constructing a bioretention cell. The bioretention planting soil (plan note WQ101) should consist of a mixture of sand, topsoil, and compost.

A bioretention cell is sized to store the WQv prior to filtration. Total filtration should occur in 40 hours or more. Use the following equation to determine the minimum surface area of the bioretention invert:

$$A = \frac{WQv \cdot D}{3600 \cdot K \cdot T \cdot (h + D)}$$

Where,

WQv= Water quality volume (see section 1116) (Acre-feet)

T= Drain time of the cell, 40 hours

K= permeability of the planting soil (Use 3.3 x 10^-5 ft/sec)

A= Top surface area of the trench (Ac)

D= Depth of the planting soil (ft) (4.0 feet minimum)

h=Maximum depth of water above the cells top layer for the WQv (use 1 foot).

The following criteria apply when designing a bioretention BMP:

A. Do not place where snow may be stored.

B. Furnish 10 feet or less width between 4 inch underdrain laterals.

C. Furnish bypass or overflow for the design check discharge. Use a catch basin(s) in conjunction with an overflow weir as needed.

D. Furnish pretreatment of the storm water via vegetation.

E. Ensure the water table or bedrock is below the invert of the bioretention area.

F. Use side slopes of 4:1 (max).

G. Furnish a length to width ratio of 2:1 (min).

H. Use a minimum depth of 4 feet of planting soil. Provide at least 4 inches of depth deeper than the largest root ball.

I. Furnish an organic or mulching layer at the top of the planting soil.

J. Furnish a maximum depth of 1 foot to the riser pipe or catch basin outlet from the mulching layer for storage of the WQv.

K. Furnish a bioretention cell as Item 203-Special - Bioretention Cell.

1118.7 Infiltration

Infiltration techniques treat storm water through the interaction of a filtering substrate that consists of soil, sand, or gravel. This technique discharges the treated storm water into the ground water rather than into surface waters. Infiltration methods require an extensive investigation of the existing soils and geology to ensure success. The investigation should begin with a preliminary soil evaluation of the project site early in the design process. In situ testing is not anticipated during the preliminary evaluation process. Available soil and geology data found in the Soil and Water Conservation maps, United States Geological Survey (USGS), adjacent projects, or estimations from a geotechnical engineer should be used. Material property tables for infiltration, permeability, and porosity have been provided for the preliminary evaluation (table 1118-1 & 1118-2).

If the preliminary evaluation yields favorable results a more detailed evaluation should be performed. The detailed evaluation will require a geotechnical investigation of the underlying soils and geology. Soil borings should be performed to a maximum depth of 20 feet (or refusal) with samples taken every 5 feet for laboratory testing. The number and location of soil borings should correspond with the approximate size (as determined in the preliminary evaluation) of the infiltration BMP and should be recommended by the geotechnical engineer.

If the detailed evaluation yields favorable results, the ground water depth must be verified. The geotechnical engineer shall provide the seasonal high ground water depth. In some cases, observation wells may be installed and static water levels may be observed over a dry and wet season for verification.

The infiltration and permeability rate of the soil shall be tested in the detailed soil evaluation at the discretion of the geotechnical engineer. In some cases, insitu testing at the proposed location of the infiltration BMP may be required.

The following criteria apply to infiltration methods and must be met to be considered a feasible alternative:

A. Design using the WQv as per Section 1116.

B. Do not place infiltration BMP where snow may be stored.

C. The appropriate soil type must be present:

   1. Infiltration must be greater than 0.50 in/hr and no greater than 2.4 in/hr.

   2. Soils must have less than 30% clay or 40% of clay and silt combined.

D. The invert of the structure must be at least 4 feet above the seasonal high water table and any impervious layer.

E. Infiltration techniques are not suitable on fill soil, compacted soil, or steep slopes (greater than 4:1). Consideration should be given to the long term impacts upon hillside stability if applicable.

F. Pretreatment shall be provided to remove large debris, trash and suspended sediment to extend the service life. Examples of this may be the use of vegetated filter strip.

1118.7.1 Infiltration Trench

An infiltration trench is an excavated trench that has been lined with a geotextile fabric and backfilled with aggregate. The storm water is filtered through the aggregate and is stored within the pore volume of the backfill material. It is allowed to percolate through the sides and bottom of the trench. The drawdown time of the WQv is 24 hours or more. Consider the following when designing an Infiltration trench:

A. The minimum acceptable permeability of the surrounding soil is =6.5*10^-5 ft/sec (see table 1118-1).

B. Design using the WQv as per Section 1116.

C. Long and deep infiltration trenches are most efficient (3 feet bottom width and 3-6 feet deep).

D. Furnish a 6 inch layer of Item 601 Infiltration Basin Aggregate on the top of the trench.

E. The geometric shape of the trench is a trapezoid with sides at a 1:1 (H:V) slope due to constructability. The top width is calculated as:

Top Width = Bottom Width + (2 * Depth)

F. Pretreatment using a vegetated strip shall be provided to ensure longevity of the infiltration trench.

G. An observation well shall be provided to facilitate ground water level inspection.

H. Locate the infiltration trench at least 1,000 feet from any municipal water supply well and at least 100 feet from any private well, septic tank, or field tile drains.

I. Ensure the bottom of the trench is below the frost line (2.5 feet)

The length of the trench depends upon the depth and the bottom width. The required length is calculated by assuming a depth and bottom width. The length is calculated based upon the inflow (WQv) and the outflow (ground water recharge). The following equation calculates the required length in feet:

$$L_t = \frac{43560 \cdot WQv}{3600 \cdot K \cdot T \cdot (b + 2\ D) + 0.4 \left[D^2 + (b \cdot D) \right]}$$

Where,

WQv= Water quality volume (see section 1116) (Acre-feet)

T= Drain time through the sides of the trench, 24 hours

K= permeability of the surrounding soil (ft/sec) (table 1118-1)

D= Trench depth (ft)

b= Bottom width of the trench (ft)

Table 1118-1

Permeability of Soil (K)

Soil Type	Rate (K) (ft/sec)
Gravel	$3.3x10^{-3}$ to $3.3x10^{-1}$
Sand	$3.3x10^{-5}$ to $3.3x10^{-2}$
Silt	$3.3x10^{-9}$ to $3.3x10^{-5}$
Clay (saturated)	$< 3.3x10^{-9}$
Till	$3.3x10^{-10}$ to $3.3x10^{-6}$

From Urban Runoff Quality Management WEF Manual of Practice No. 23, 1998, published jointly by the WEF and ASCE, chapter five

1118.7.2 Infiltration Basin

An infiltration basin is an open surface pond that uses infiltration into the ground as the release mechanism. It is designed to store the WQv.

Depending on the soil permeability, it may be used to treat from 5 to 50 acres. Lower permeable soils may require an underdrain system as an additional outlet. The drawdown time of the WQv should be between 24-48 hours. The following criteria apply when designing an infiltration basin:

A. Use an energy dissipater at the inlet.

B. Allow for 1 foot (min) freeboard above the WQv.

C. Vegetate the sides of the basin with Item 670 Slope Erosion Protection.

D. Furnish a 6 inch layer of Item 601 Infiltration Basin Aggregate on the bottom of the basin.

E. Use side slopes of 4:1 (max).

F. Use a length to width ratio of 3:1

G. Furnish bypass or overflow for the design check discharge (see section 1118.4.3).

H. Consider vehicle access to the basin for periodic maintenance.

I. Locate basin at least 1,000 feet from any municipal water supply well and at least 100 feet from any private well, septic tank, or drain field.

J. Furnish 10 feet or less width between 4 inch underdrain laterals (if used in the design).

K. Do not locate the basin where infiltrating ground water may adversely impact slope stability.

L. Ensure the invert of any underdrain in the basin is below the frost line (2.5 feet).

M. Embankment work to create the impoundment will be constructed and paid for as Item 203 Embankment, Using Natural Soils, 703.16.A.

The invert area of the infiltration basin can be calculated by the following equation:

$$A=(WQv * S.F. * 12)/(k * t)$$

Where,

A= area of invert of the basin (Acres)

WQv= Water Quality Volume (see section 1116) (Acre-feet)

S.F.= Safety Factor of 1.5
k= Infiltration Rate (in/hr) (table 1118-2)

t= Drawdown time of 48 hours

The required depth of the infiltration basin can be calculated by the following equation:

$$D= WQv/A$$

Where,

A= area of invert of the basin (Acres)

WQv= Water Quality Volume (Ac-ft)

D= Required depth of the basin (ft)

Table 1118-2

NRCS Soil Type (from soil maps)	HSG Classification	Rate (k)
		(in/hr)
Sand	A	8.0
Loamy Sand	A	2.0
Sandy Loam	B	1.0
Loam	B	0.5
Silt Loam	C	0.25
Sandy Clay Loam	C	0.15
Clay Loam & Silty Clay Loam	D	< 0.09
Clays	D	< 0.05

Infiltration Rate (k)

From Urban Runoff Quality Management WEF Manual of Practice No. 23, 1998, published jointly by the WEF and ASCE, chapter five

1118.8 Constructed Wetlands

Constructed wetlands treat storm water through bio-retention. They are depressed, heavily planted areas that are designed to maintain a dry weather flow depth ranging between 0.5 to 2 feet. The surface area required for a wetland is usually quite large due to the limited allowable depth. The area is usually on the magnitude of 1% of the entire drainage area. They are designed in a similar manner as a retention basin. The wetland is sized to provide storage for the WQv for a time frame of at least 24 hours (above the permanent pool) while providing a bypass or overflow for larger design check discharge (see section 1118.4.3). The water depth should be maintained by an outlet structure capable of providing the required water depth with the provision of a one foot freeboard. The following criteria apply when designing a wetland:

A. Do not place on a steep or unstable slope or at a location, which could induce short-term or long-term instability.
B. Wetlands must be greater than 10,000 feet from a municipal airport runway.

C. Base flow must be present to maintain the constant water depth (such as ground water).

D. Furnish a forebay that is 7% of the total required volume at a depth between 3-6 feet to settle out sediments.

E. Furnish side slopes of 4:1 (max).

F. Consider access for maintenance to the forebay and the outlet structure.

G. Vegetate the sides and bottom with grass

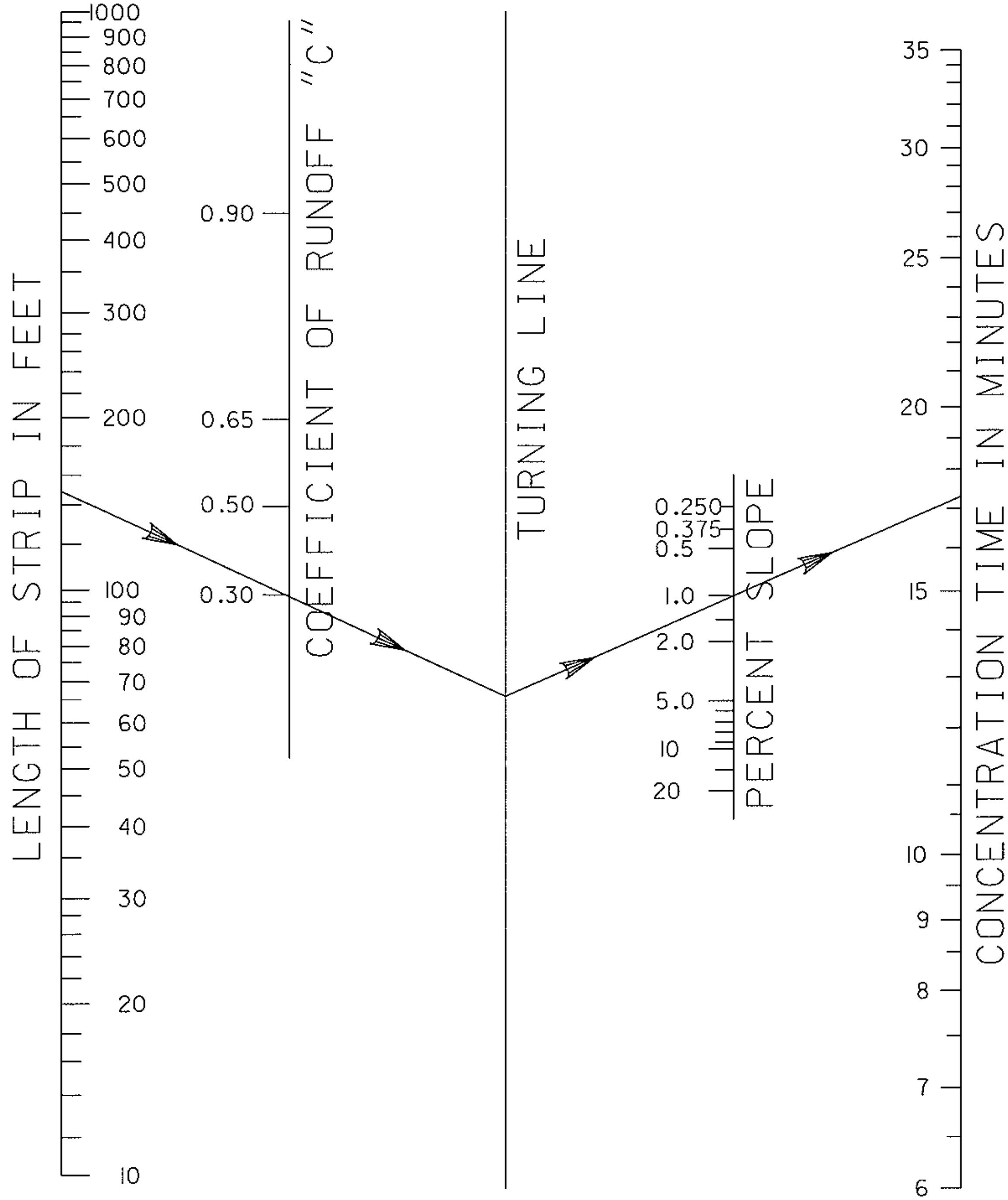
H. Furnish an impervious liner. Use a compacted clay bottom or a geotextile fabric to prevent infiltration of the storm water.

I. Furnish a length to width ratio of 3:1 (min) to prevent short-circuiting.

1100 Drainage Design Procedures – List of Figures

Revised July, 1999

OVERLAND FLOW CHART	1101-1
	REFERENCE SECTION 1101.2.2



General Notes – Figures 1101-2 through 1101-3

The Rainfall Intensity-Duration-Frequency curves are based upon data obtained from United States Weather Service Technical Paper No. 40 Rainfall Frequency Atlas of The United States.

Federal Highway Administration Hydraulic Engineering Circular No. 12 Appendix A offers a methodology for converting I-D-F data points to an equation of the general form:

i= a/(t+b)^c

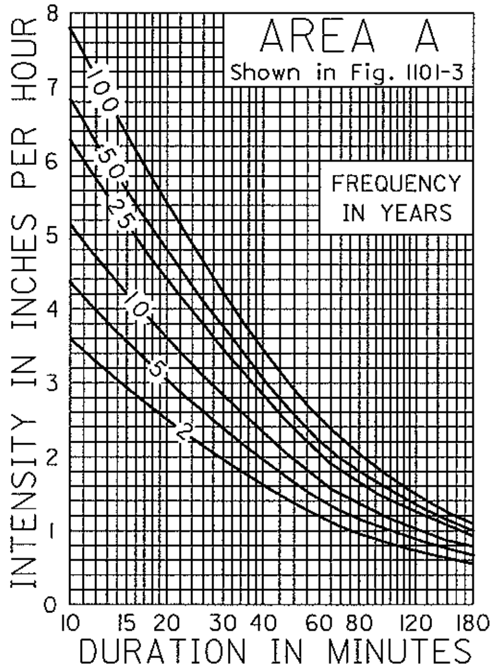
Where: i = rainfall intensity (inches/hour)
t = time of concentration (minutes)
a = constant
b = constant
c = constant

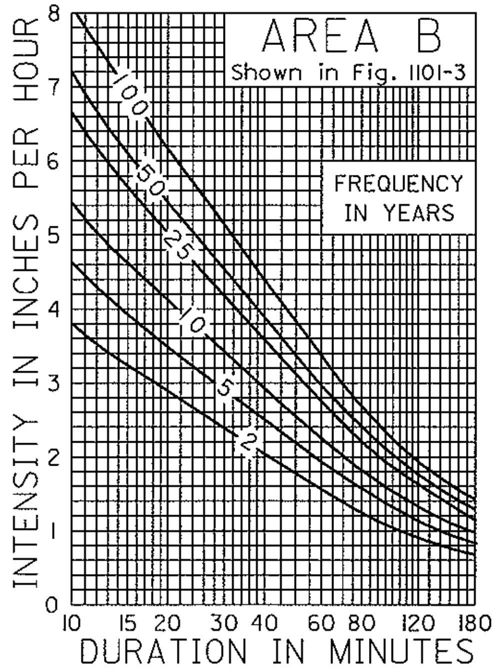
Using the above referenced methodology the curves in Figure 1101-2 can be expressed using the above general equation utilizing the constants shown below.

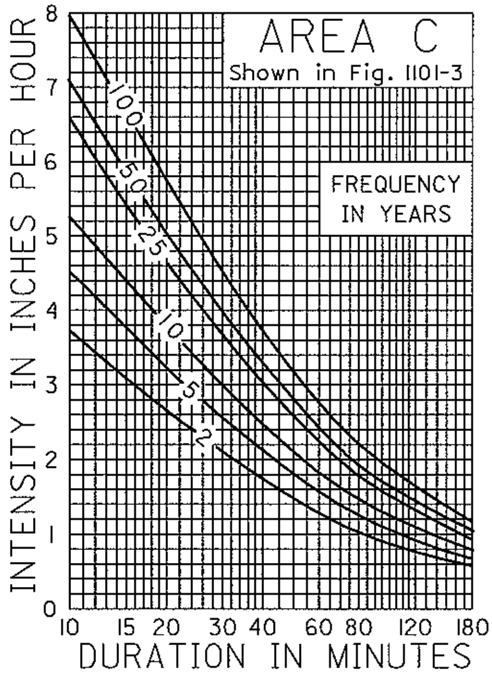
Intensity Zone (Figure 1101-3)	Frequency (Years)	Constant "a"	Constant "b"	Constant "c"
A	2	44.150	8.900	0.853
	5	150.271	18.400	1.062
	10	70.474	10.200	0.874
	25	96.280	11.100	0.899
	50	51.622	5.100	0.747
	100	85.930	8.000	0.834
B	2	140.596	25.099	1.015
	5	81.276	18.800	0.855
	10	275.649	29.499	1.070
	25	294.909	28.099	1.044
	50	117.148	16.700	0.849
	100	293.888	26.699	1.000
C	2	64.387	14.300	0.896
	5	184.940	21.699	1.075
	10	83.828	12.500	0.887
	25	58.733	7.400	0.771
	50	79.945	9.300	0.818
	100	196.039	16.300	0.978
D	2	85.568	16.500	0.950
	5	118.822	18.700	0.969
	10	112.172	16.800	0.923
	25	198.920	19.300	1.004
	50	206.025	19.600	0.990
	100	355.551	23.199	1.076

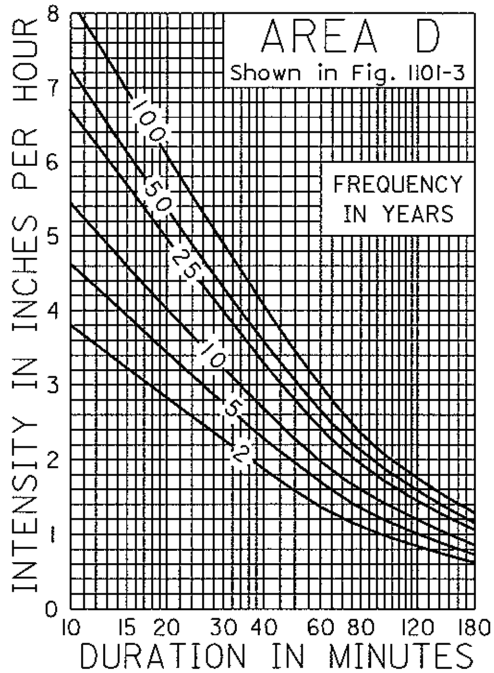
RAINFALL INTENSITY-FREQUENCY-DURATION CURVES	1101-2
	REFERENCE SECTION 1101.2.4

RAINFALL INTENSITY-FREQUENCY-DURATION CURVES



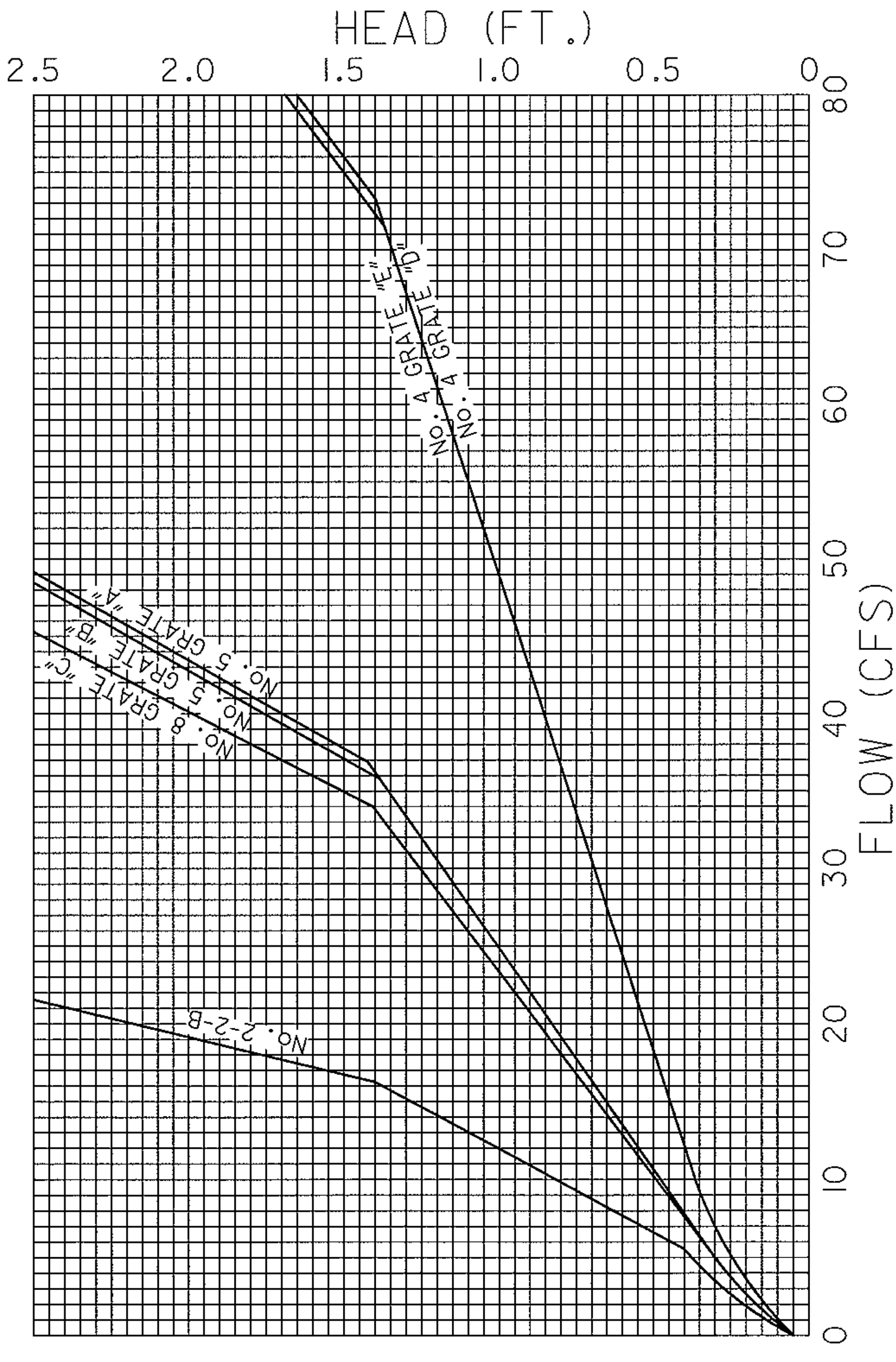






RAINFALL INTENSITY ZONE MAP	1101-3
	REFERENCE SECTION 1101.2.4

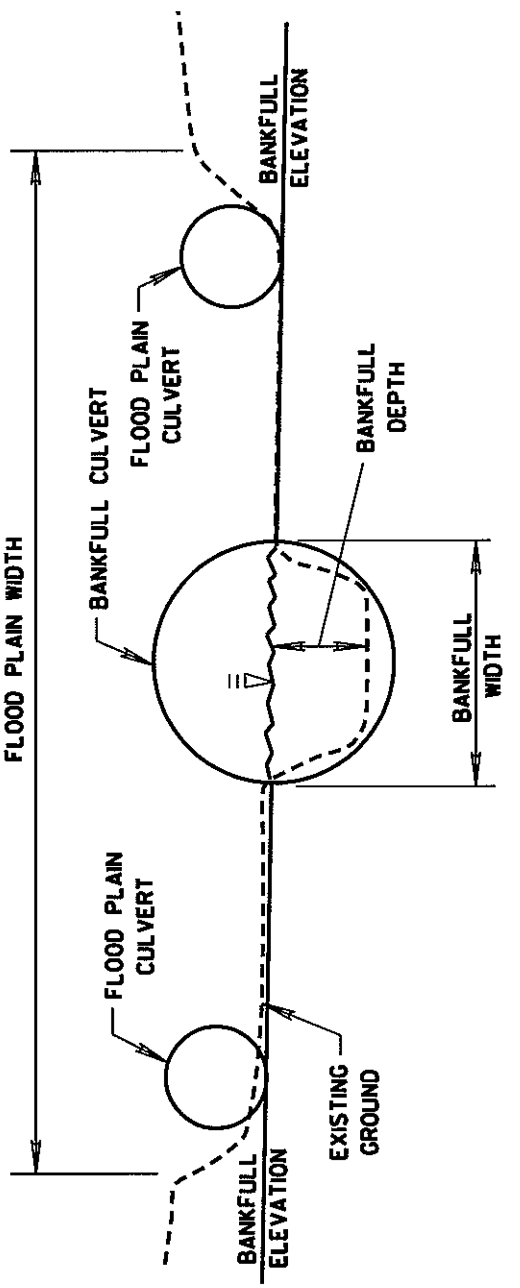
CAPACITY OF A GRATE CATCH BASIN IN A SUMP	1102-1
	REFERENCE SECTION 1102.3.5



CAPACITY OF A GRATE CATCH BASIN IN A SUMP
(WATER PONDED ON THE GRATE)

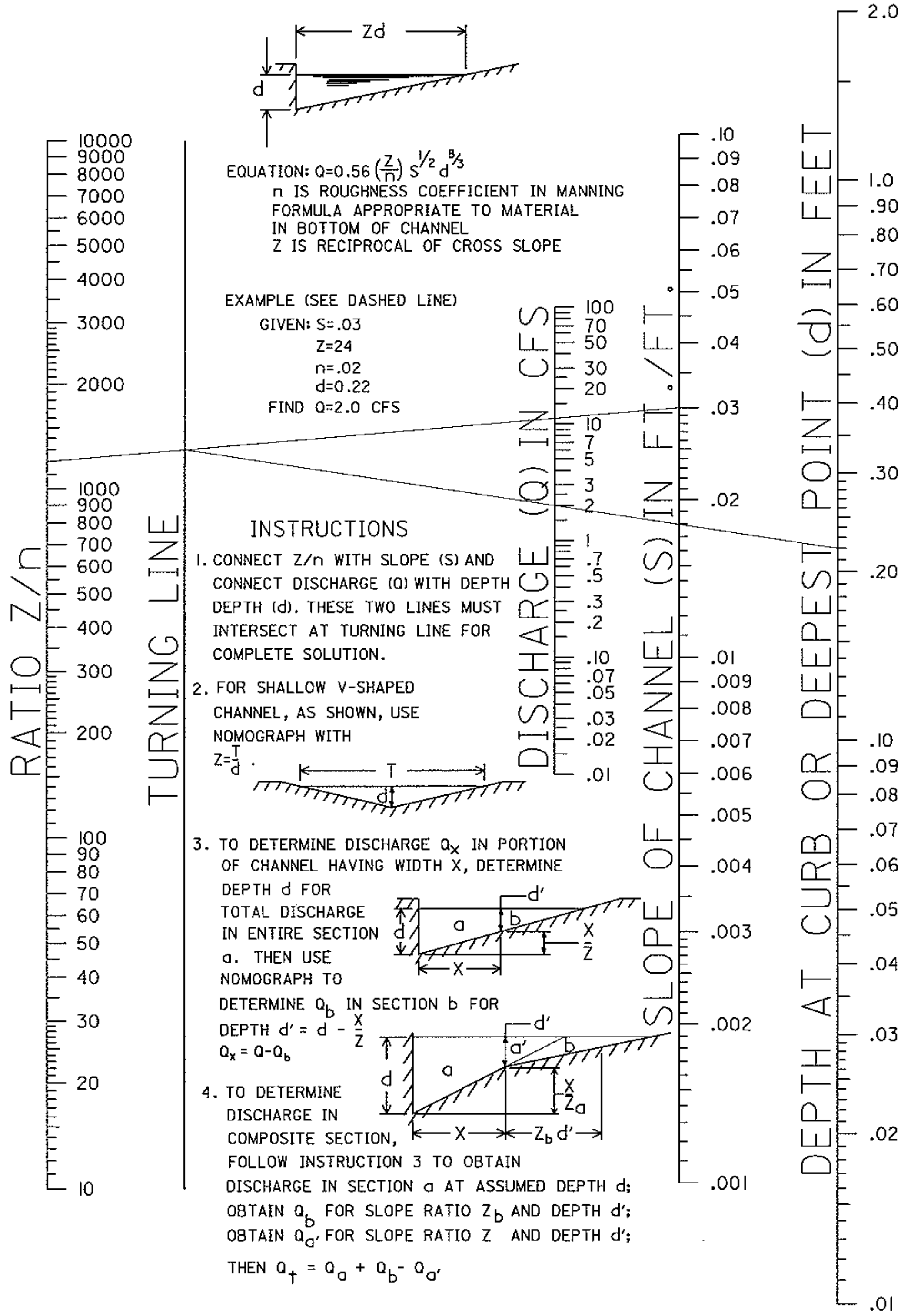
JULY 2002

CHANNEL FEATURES	1102-2
	REFERENCE SECTION 1102.2.4

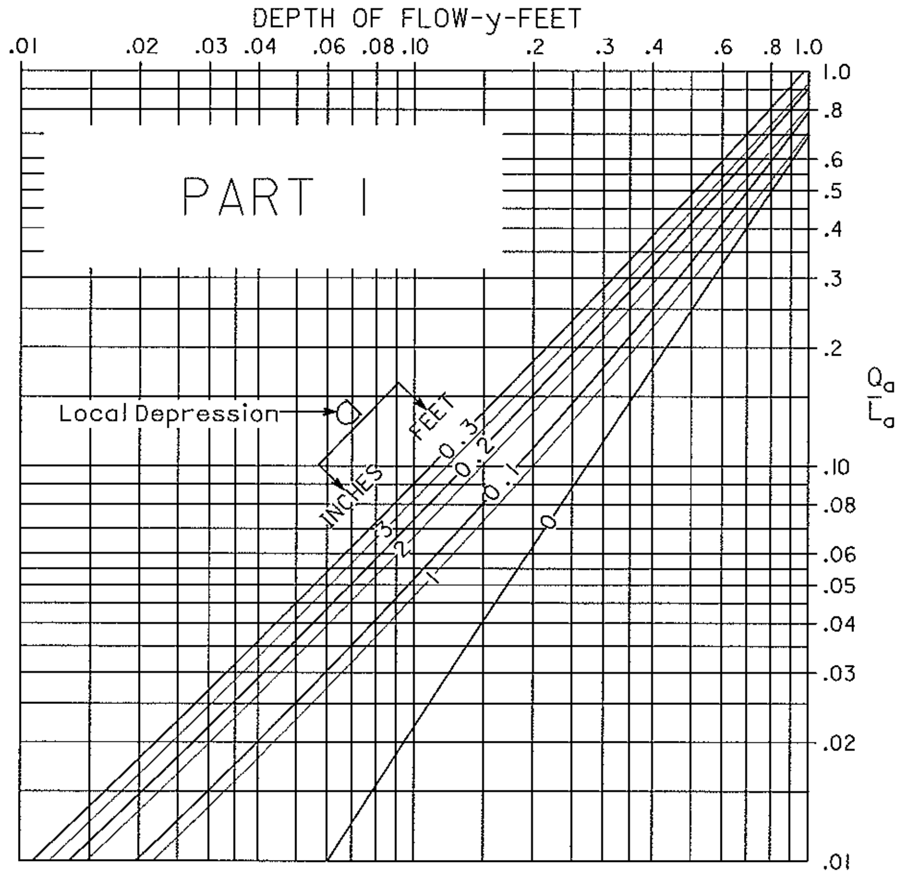


Revised July, 1999

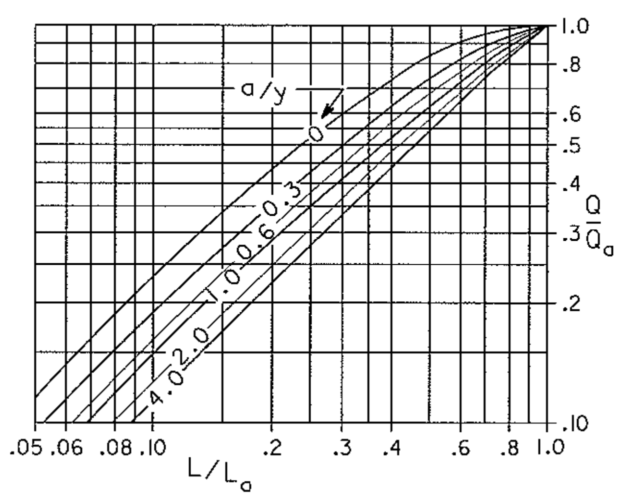
NOMOGRAPH FOR FLOW IN TRIANGULAR CHANNELS	1103-1
	REFERENCE SECTION 1103.4



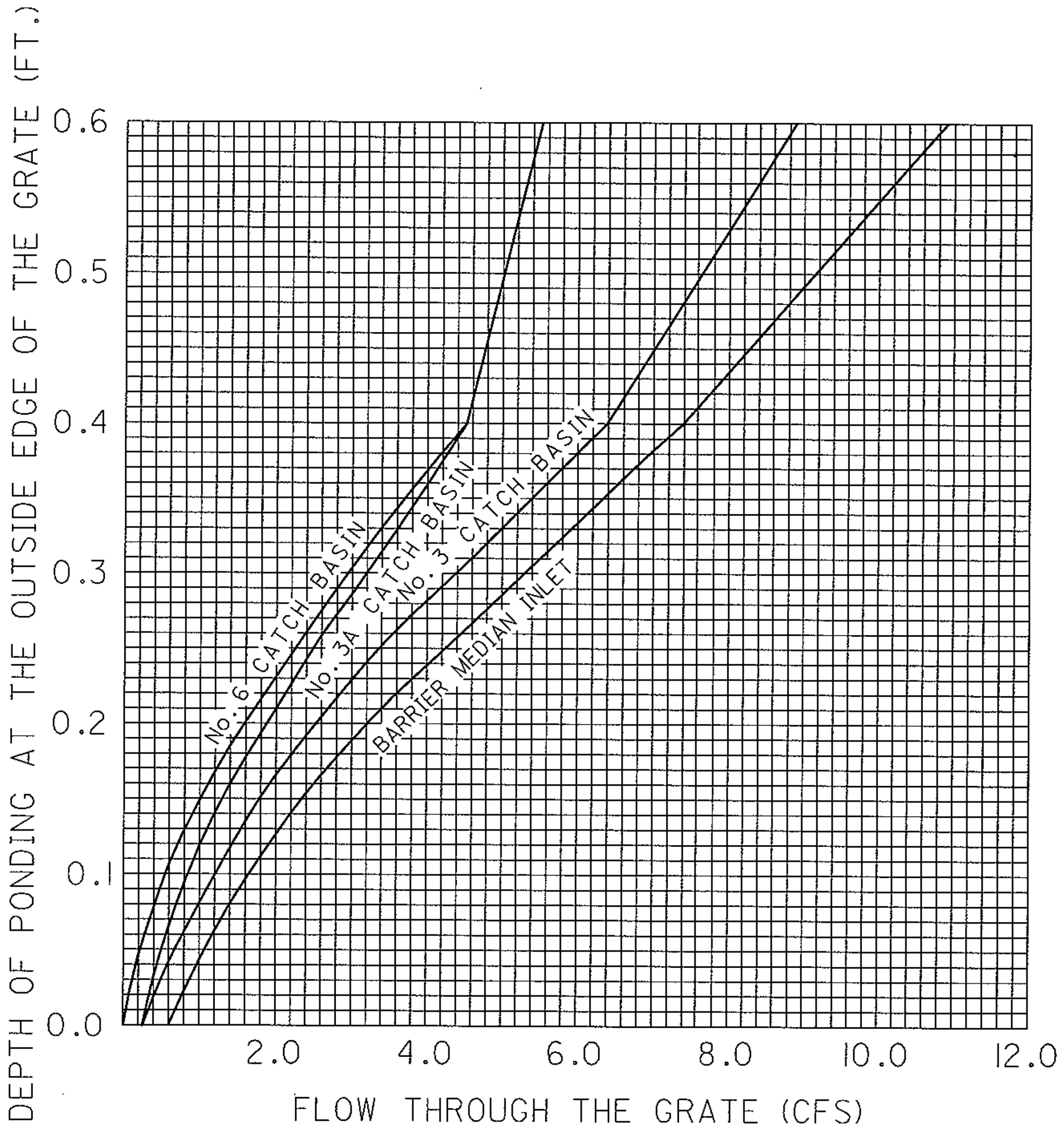
CAPACITY OF CURB OPENING INLETS ON CONTINUOUS GRADE	1103-2
	REFERENCE SECTION 1103.6



PART 2

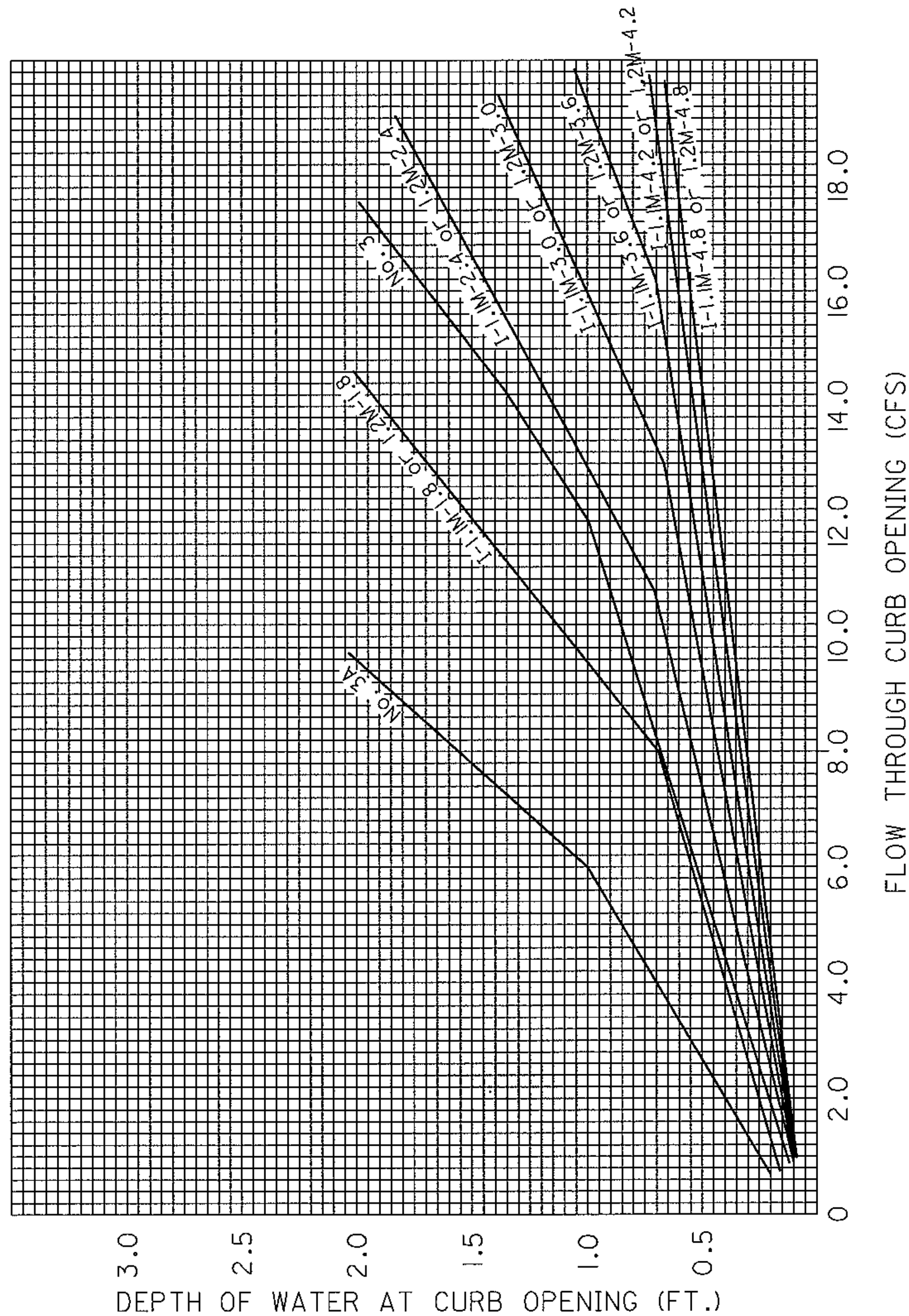


CAPACITY OF STANDARD CATCH BASIN GRATES IN PAVEMENT SAGS	1103-3
	REFERENCE SECTION 1103.6, 1103.7



Revised July, 1999

CAPACITY OF STANDARD INLETS AND CATCH BASINS IN PAVEMENT SAGS	1103-4
	REFERENCE SECTION 1103.7

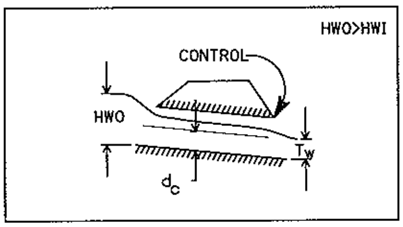


CLASSIFICATION OF FLOW IN CULVERTS

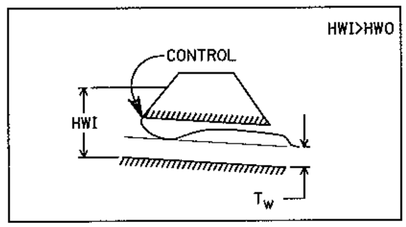
1105-1	REFERENCE SECTION 1105.2

CLASS 1 OPERATION
FREE WATER SURFACE
HWI OR HWO ≦ 1.2D

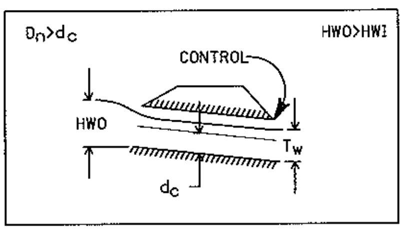
CLASS 2 OPERATION
SUBMERGED ENTRANCE
HWI OR HWO > 1.2D



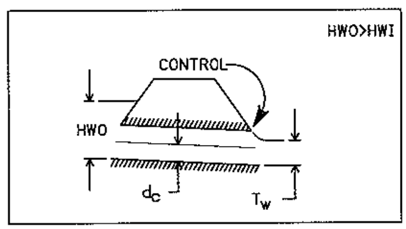
1A



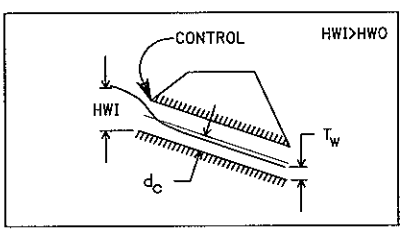
2E



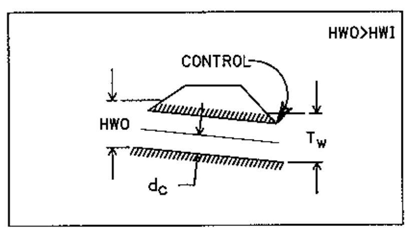
1B



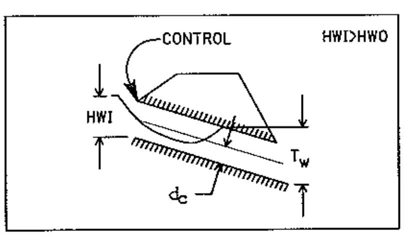
2F



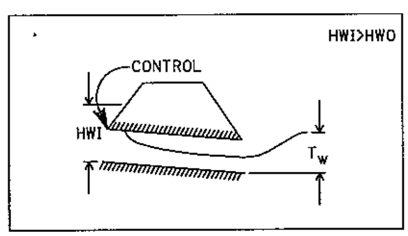
1C



2G



1D



2H

HWO indicates headwater based on outlet control
HWI indicates headwater based on inlet control
D = Height of culvert d_c = critical depth

Revised July, 1999

CORRUGATED METAL PIPE SIZES AND "n" VALUES FOR TYPE A CONDUIT	1105-2
	REFERENCE SECTION 1105.5.5

Corrugated Metal Pipe Sizes and "n" Values for Type A Conduit

½" corrugations

Diameter in Feet	
1.25	.0250
1.50	.0249
1.75	.0248
2.0	.0247
2.5	.0244
3.0	.0241
3.5	.0237
4.0	.0235
4.5	.0233
5.0	.0232
5.5	.0231
6.0	.0229
6.5	.0228
7.0	.0227
7.5	.0226
8.0	.0225

1" corrugations

Diameter in Feet	
3.0	.0281
3.5	.0278
4.0	.0275
4.5	.0273
5.0	.0271
5.5	.0269
6.0	.0267
6.5	.0266
7.0	.0265
7.5	.0263
8.0	.0263
8.5	.0262
9.0	.0261
9.5	.0260
10.0	.0260

2" corrugations

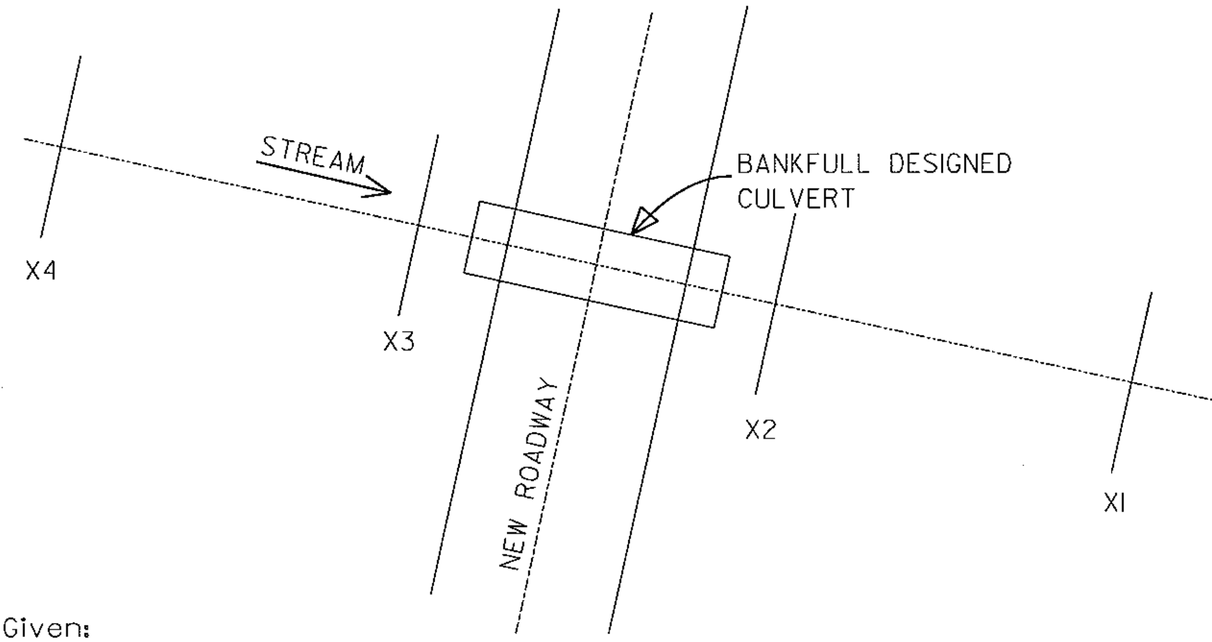
Diameter in Feet	n*
5.0	.0332
5.5	.0330
6.0	.0327
6.5	.0325
7.0	.0323
7.5	.0321
8.0	.0320
8.5	.0318
9.0	.0317
9.5	.0315
10.0	.0314
10.5	.0313
11.0	.0312
11.5	.0311
12.0	.0310
12.5	.0309
13.0	.0308
13.5	.0307
14.0	.0307
14.5	.0306
15.0	.0305
15.5	.0305
16.0	.0304
16.5	.0304
17.0	.0303
17.5	.0303
18.0	.0302
18.5	.0302
19.0	.0301
19.5	.0301
20.0	.0300
20.5	.0300
21.0	.0300

2½" corrugations

Diameter in Feet	n*
5.0	.035
5.5	.035
6.0	.034
6.5	.034
7.0	.034
7.5	.034
8.0	.034
8.5	.034
9.0	.033
9.5	.033
10.0	.033
10.5	.033
11.0	.033
11.5	.033
12.0	.033
12.5	.033
13.0	.033
13.5	.033
14.0	.032
14.5	.032
15.0	.032
15.5	.032
16.0	.032
16.5	.032
17.0	.032
17.5	.032
18.0	.032
18.5	.032
19.0	.032
19.5	.032
20.0	.032
20.5	.032
21.0	.031

* All field paved structural plate pipe shall have an "n" value equal to 0.026

EXAMPLE BANKFULL DISCHARGE CULVERT DESIGN



Given:

Use a Box Conduit
Max Height of Box = 8 feet

1. According to Table 1105-2, culvert invert is to be buried by 12 inches.

2. Use Hec-Ras to determine the following table:

2-Year Frequency Water Surface Elevations

	Existing	12′ x 8′ Box	14′ x 8′ Box	16′ x 8′ Box	20′ x 8′ Box
X1	790.67	790.67	790.67	790.67	790.67
X2	791.07	791.07	791.07	791.07	791.07
X3	791.47	791.88	791.81	791.74	791.65
X4	791.87	791.98	791.94	791.91	791.88

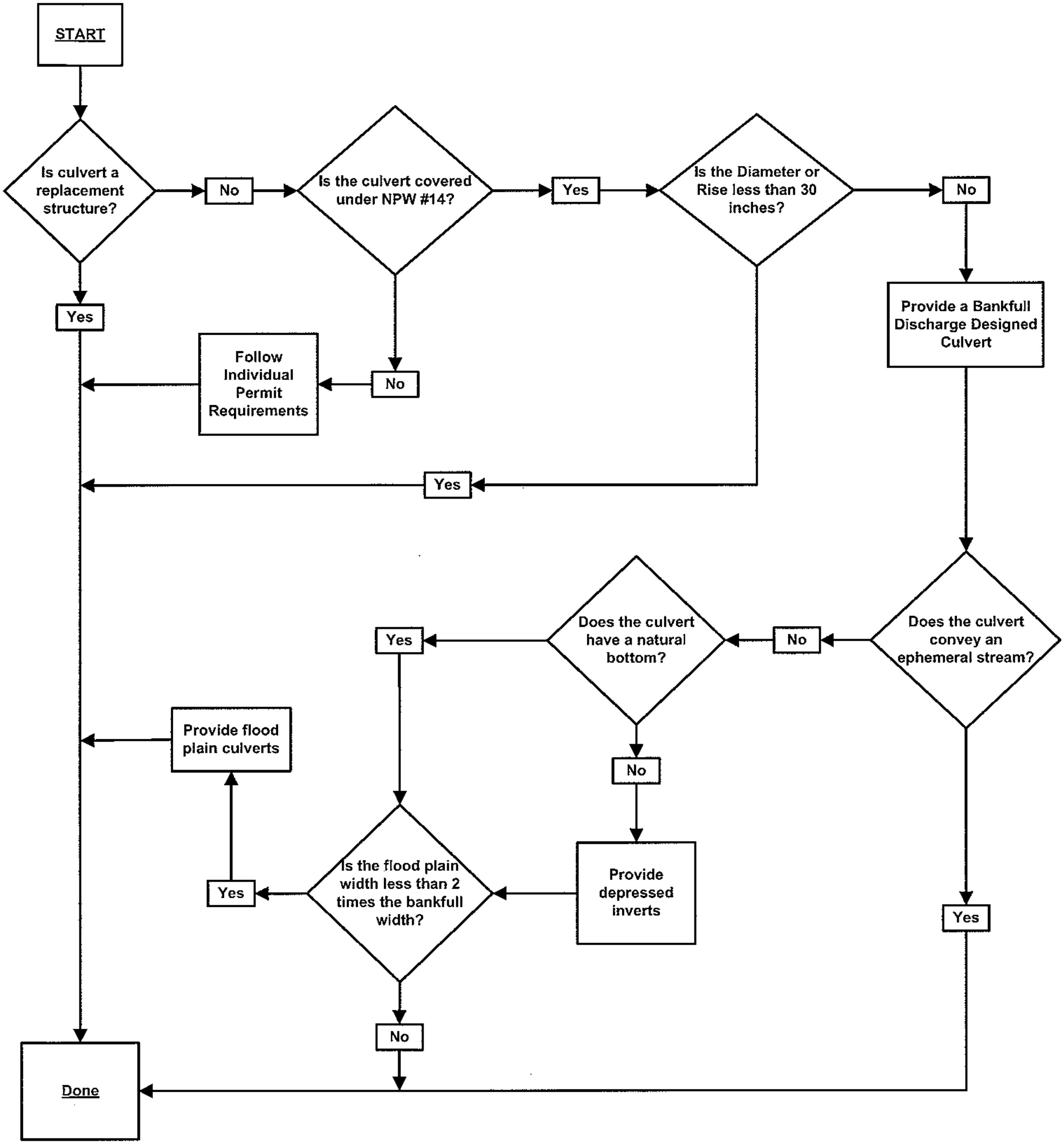
3. Will provide a 20′ x 8′ box with a 12 " burial depth due to its smallest impact on the adjoining stream sections.

4. Ensure the design and check headwaters meet requirements of L&D, Section 1105.

REQUIRED STREAM PROTECTION AT CULVERTS

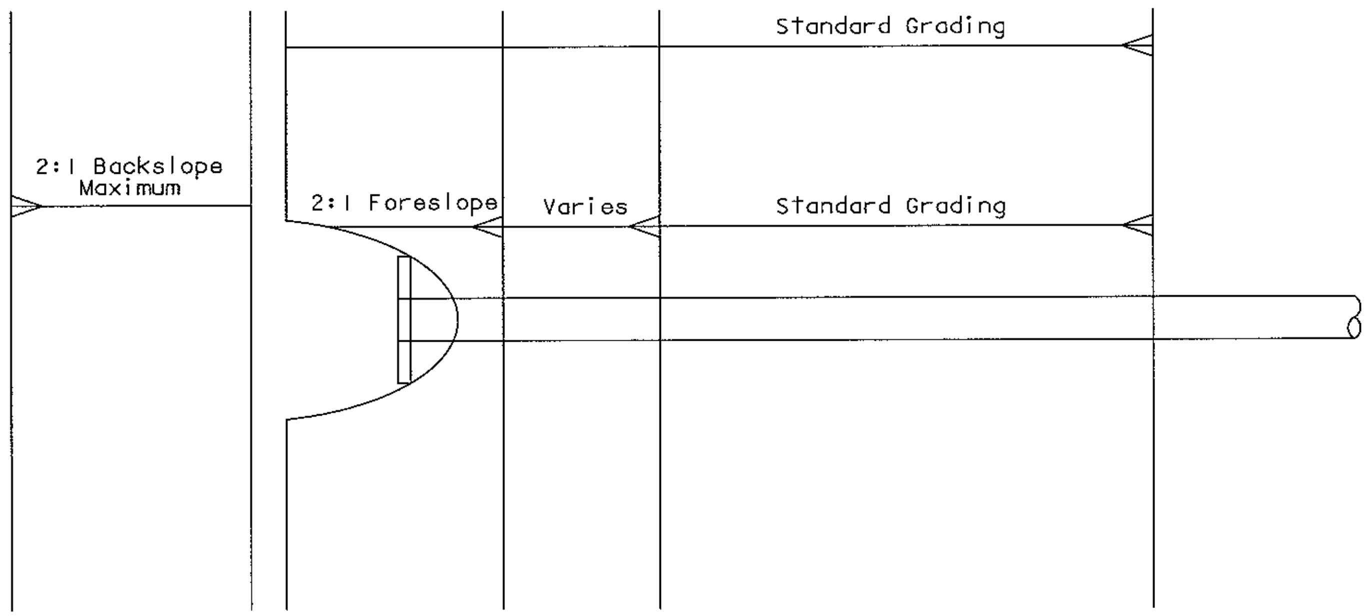
1105-4

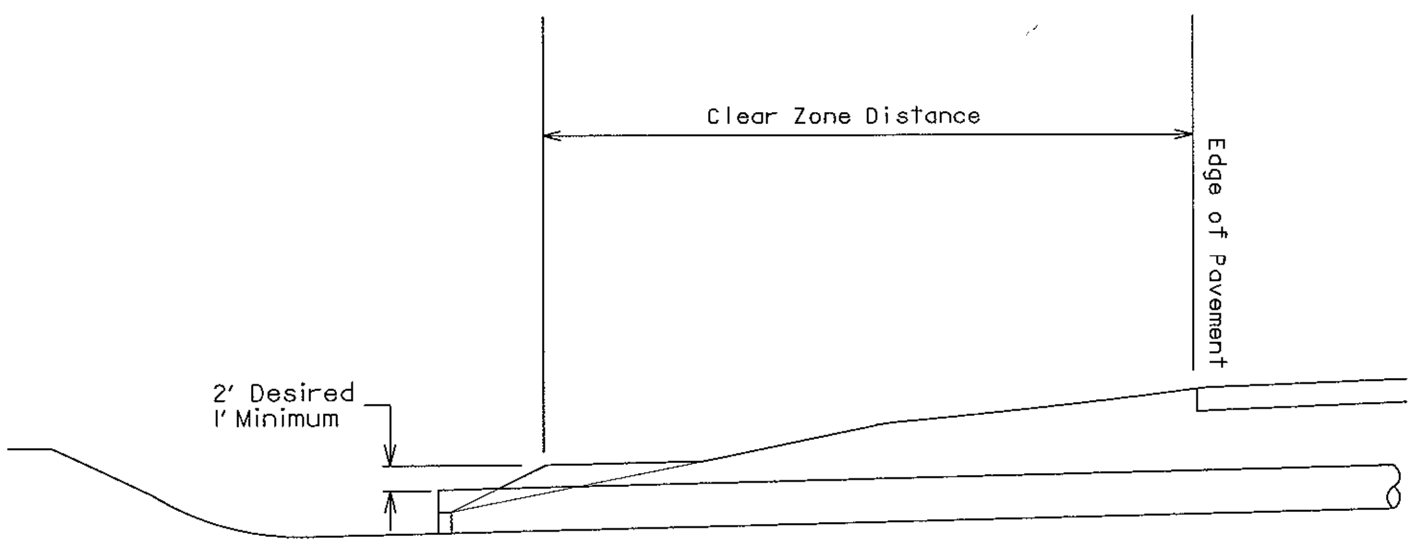
REFERENCE SECTION 1105



Traditional design methods that use an Improved Inlet or a Paved Depressed Approach Apron are not shown on this flow chart.

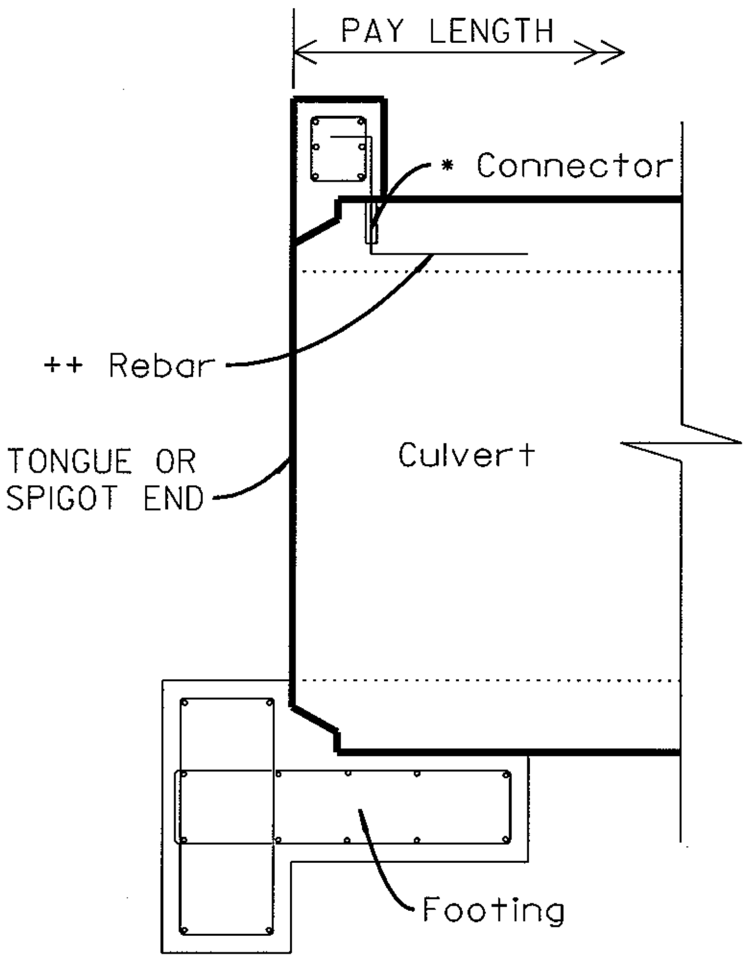
END TREATMENT GRADING DETAIL	1106-1
	REFERENCE SECTION 1106.1





JANUARY 2003

BOX CULVERT OUTLET DETAIL	1106-2 **REFERENCE SECTION** 1106



* Anchoring Methods

1. Mechanical connector embedded into precast box culvert.

2. Partial depth resin-bonded anchoring system may be used as per GR-2.2.

3. Threaded inserts. **

4. Ferrule loops. ***

OUTLET DETAIL (NTS)

Notes:

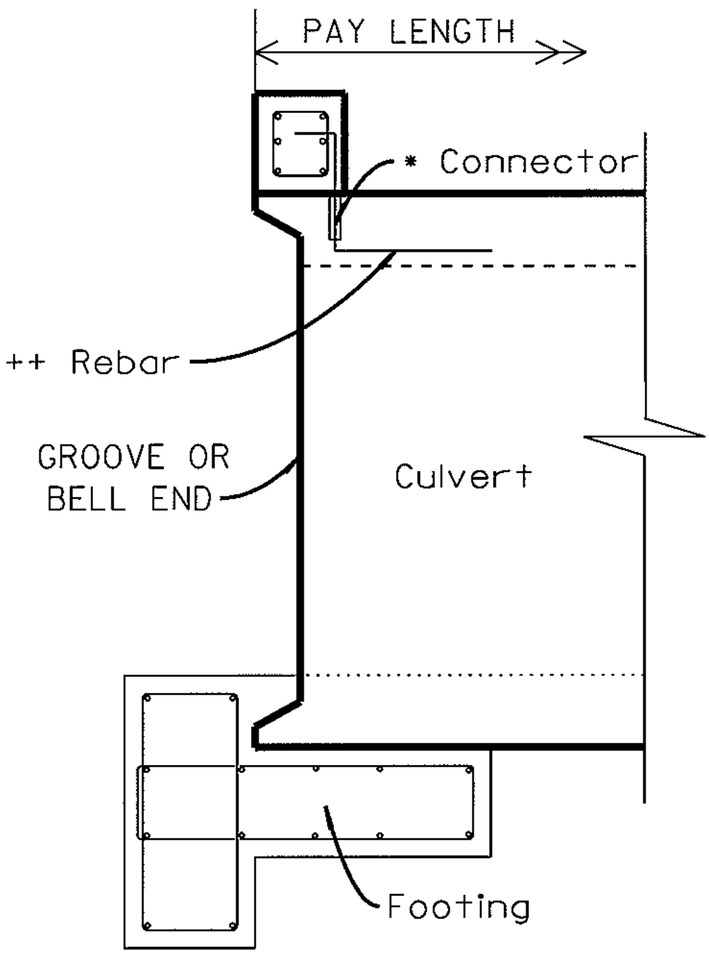
The anchoring system needs to be specified along with the required diameter needed.

++ For use with the mechanical connector.

** Threaded inserts need to have a specified pull out strength.

*** For use with wet cast boxes only.

BOX CULVERT INLET DETAIL	1106-3
	REFERENCE SECTION 1106



INLET DETAIL (NTS)

* Anchoring Methods

1. Mechanical connector embedded into precast box culvert.

2. Partial depth resin-bonded anchoring system may be used as per GR-2.2.

3. Threaded inserts. **

4. Ferrule loops. ***

Notes:

The anchoring system needs to be specified along with the required diameter needed.

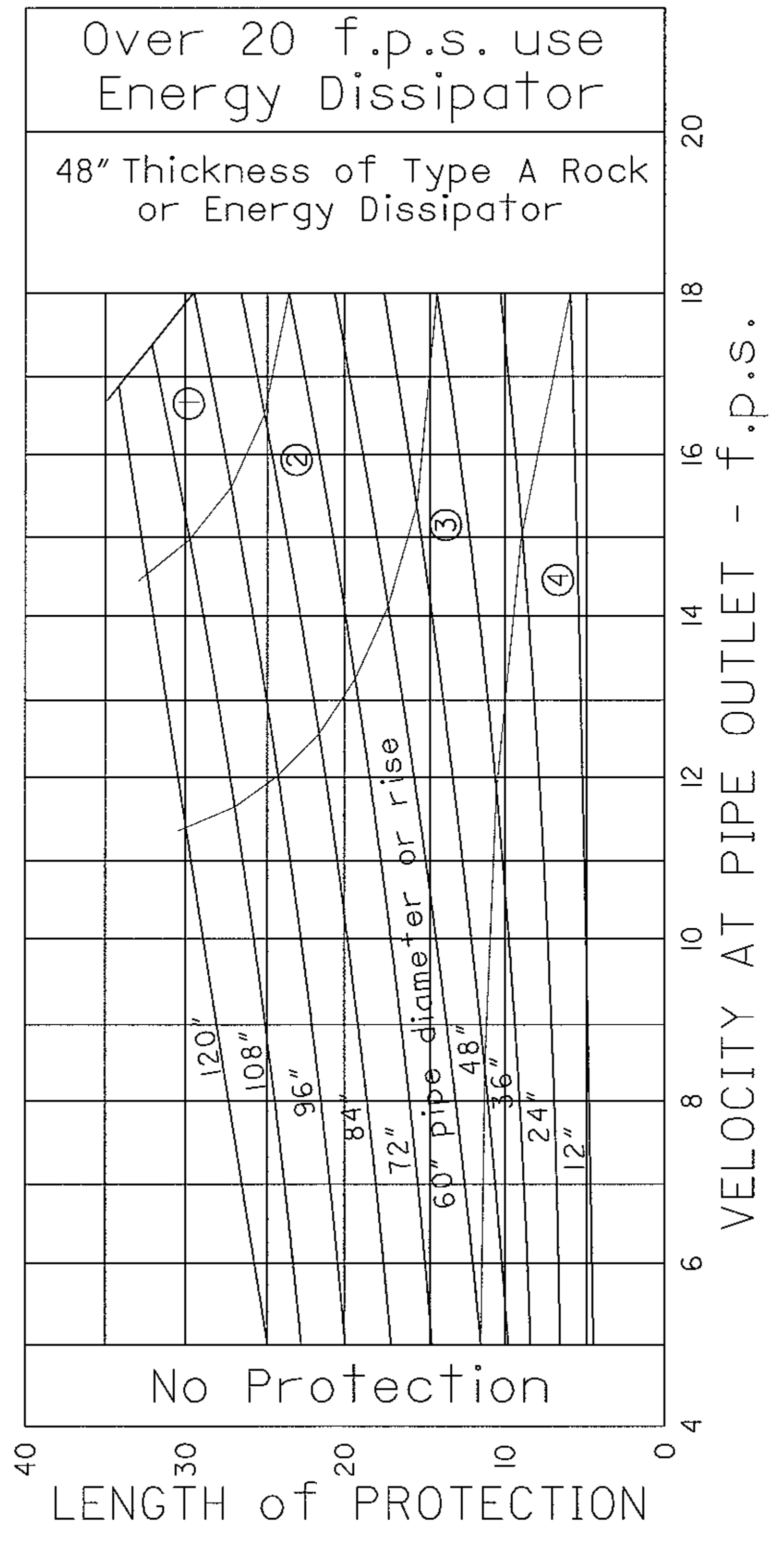
++ For use with the mechanical connector.

** Threaded inserts need to have a specified pull out strength.

*** For use with wet cast boxes only.

ROCK CHANNEL PROTECTION AT CULVERT AND STORM SEWER OUTLETS

1107-1
REFERENCE SECTION
1107.2



LEGEND	ROCK TYPE
① 48" of 18" rock	A
② 36" of 18" rock	A
③ 30" of 12" rock	B
④ 18" of 6" rock	C

NOTES

Rock size (6", 12", 18") indicates the square opening on which 85% of the material, by weight, will be retained.

The width of protection shall be the width of the headwall, with 4' being the minimum.

(Where a stream bed will withstand the calculated velocity without erosion, no rock channel protection will be required.)

Revised April, 2003

NOTICE OF INTENT (NOI) ACREAGE CALCULATION FORM	1112-1
	Reference Section 1112

		Area (acres)
Project Earth Disturbing Activities	a	
If line a = 0 or the project is a Maintenance Project, an NOI is not required. STOP	b	
If line a > 0, an NOI is required, continue to line d	c	
Field Office	d	
Enter 0.125 for Type A; 0.25 for Type B; or 1.00 for Type C	e	
Batch Plant Yes = 2.0; No = 0	f	
Off-Project Waste / Borrow Pit	g	
Add 1.0 acre per 15,000 CY of waste or borrow	h	
Miscellaneous Other Off-Project Areas	i	
Off-Project staging areas, stock yards, etc.	j	
Contractor Earth Disturbing Activities (add lines e, f, h and j) **Subtotal**	k	
Total Earth Disturbing Activities (add line a to line k) **TOTAL**	l	
NOI Earth Disturbing Activities (minimum = 4.9 acres) **TOTAL**	m	

Project Earth Disturbing Activities. Enter the area of disturbed earth for the project activities. Include shoulder grading, cut and fill areas, anticipated contractor-used areas within State right of way, etc.

Field Office. These sizes were determined with regard to size of the trailer, parking, and some stock area for equipment and materials.

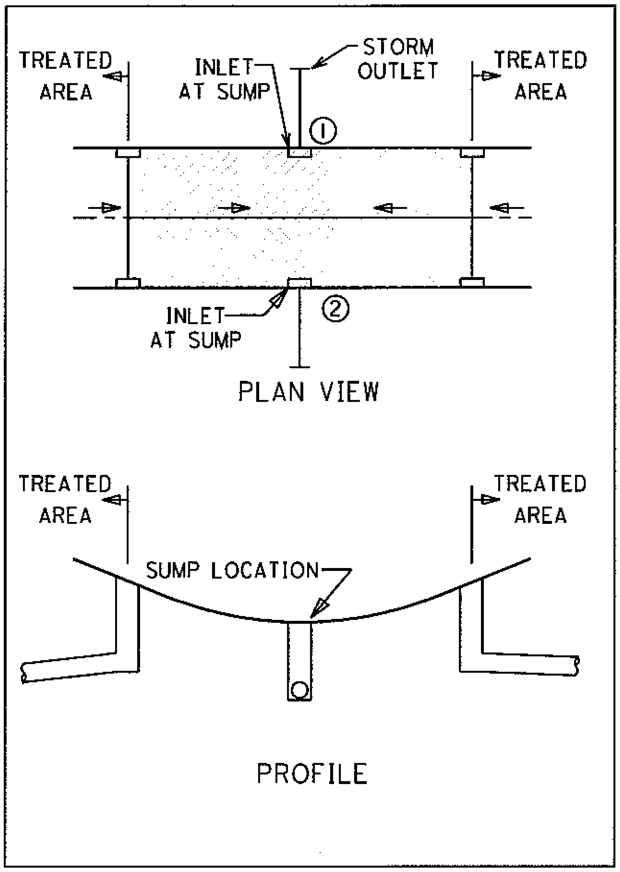
Batch Plant. It is assumed that a typical batch plant would occupy 2 acres of ground. The designer should investigate the location of the project relative to existing plants, facilities, etc. to estimate whether a batch plant might be used by the Contractor. This is not needed for existing plants, it is only for plants set up for the specific project.

Off-Project Waste / Borrow. The specified estimation is based on approximately 10 feet of depth or fill over 1 acre. The designer may choose a different value based on knowledge of the project area, bedrock elevations, previous projects, etc. Consideration should be given for grindings, as well.
(10ft. x 43560 s.f. / 27 = 16,133 c.y. ~ say 15,000 c.y.)

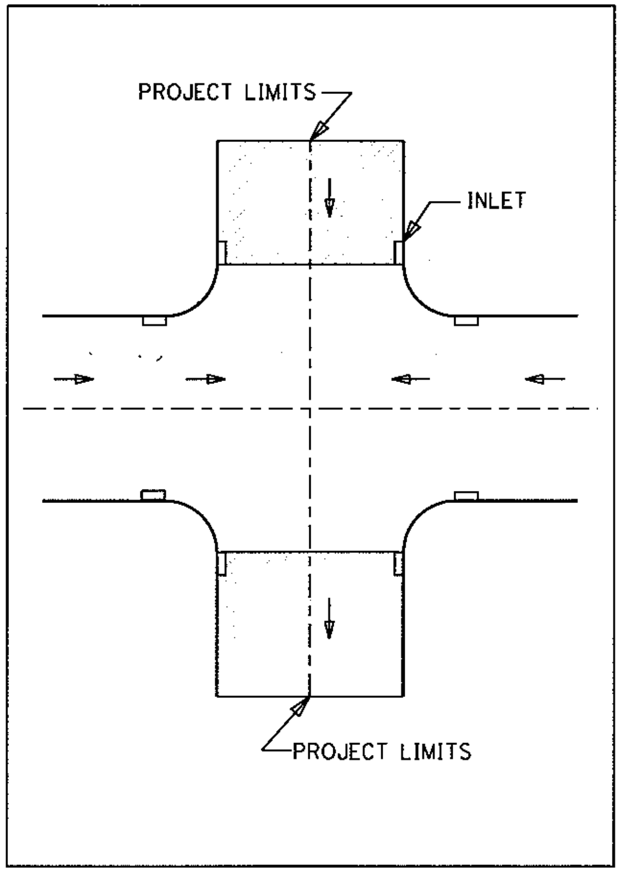
NOI Earth Disturbing Activities (enter total acreage from line l or 4.9 acres, whichever is greater). This value is to be submitted for the NOI. All projects with Project Earth Disturbing Activity greater than zero will be submitted for coverage up to 4.9 acres minimum.

Maintenance activity consists of projects that do not change the line, grade, or hydraulic capacity of the existing condition and have less than 5 acres of earth disturbing activities (see section 1112.2).

# EXEMPT OUTFALLS	1116-1
	REFERENCE SECTION 1116



INLETS OR SCUPPERS IN SUMPS



INLETS AT INTERSECTIONS

Contributing Drainage Area 1

Contributing Drainage Area 2

If the contributing drainage areas to drainage structures #1 or #2 are less than 0.25 acres, Water Quality Treatment is not required.

The above example shows areas that are each less than 0.25 acres.

Treatment is required for the drainage areas tributary to the flanking inlets.

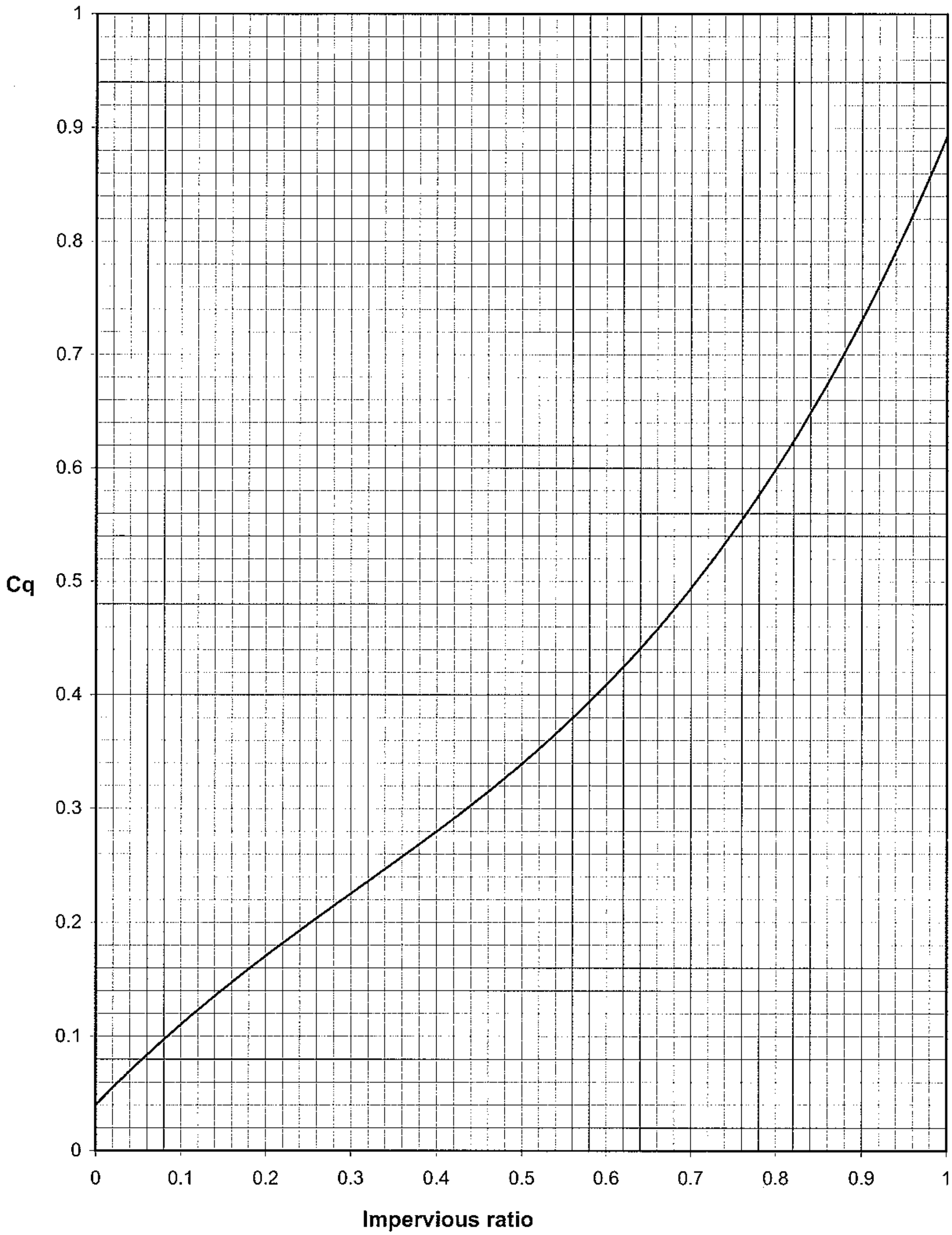
If the drainage area within the project limits is less than 0.25 acres, then no Water Quality Treatment is required.

The hatched areas above indicate that treatment is not required.

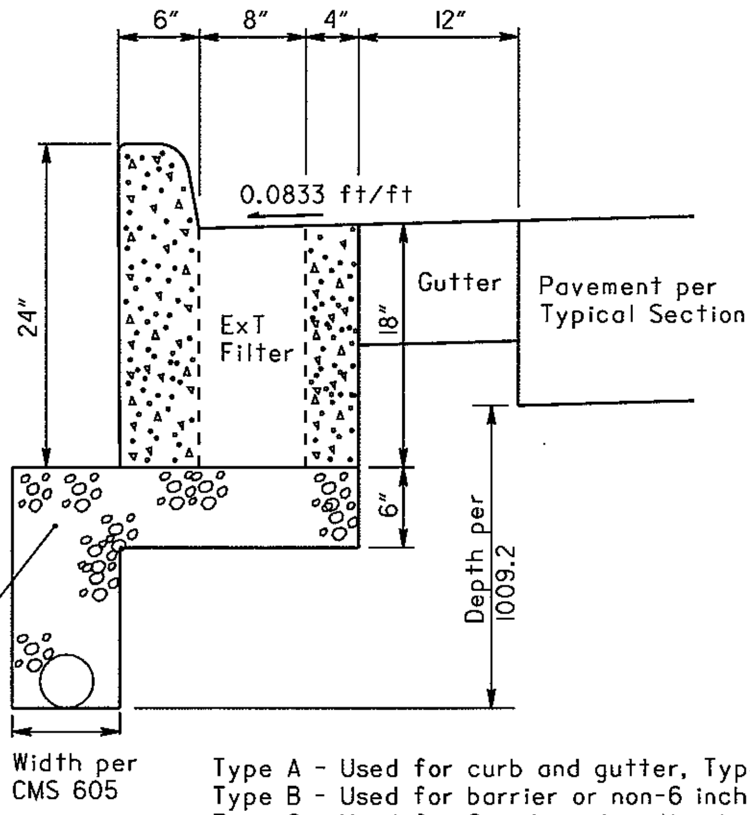
Treatment is required on the through street.

January 2006

WATER QUALITY Cq	1116-2
	REFERENCE SECTION 1116

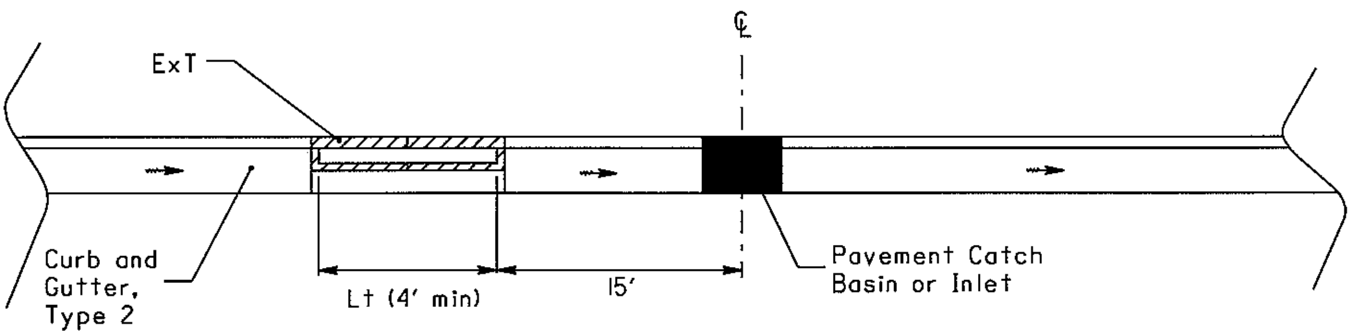


EXFILTRATION TRENCH DETAIL	1118-1
	REFERENCE SECTION 1118



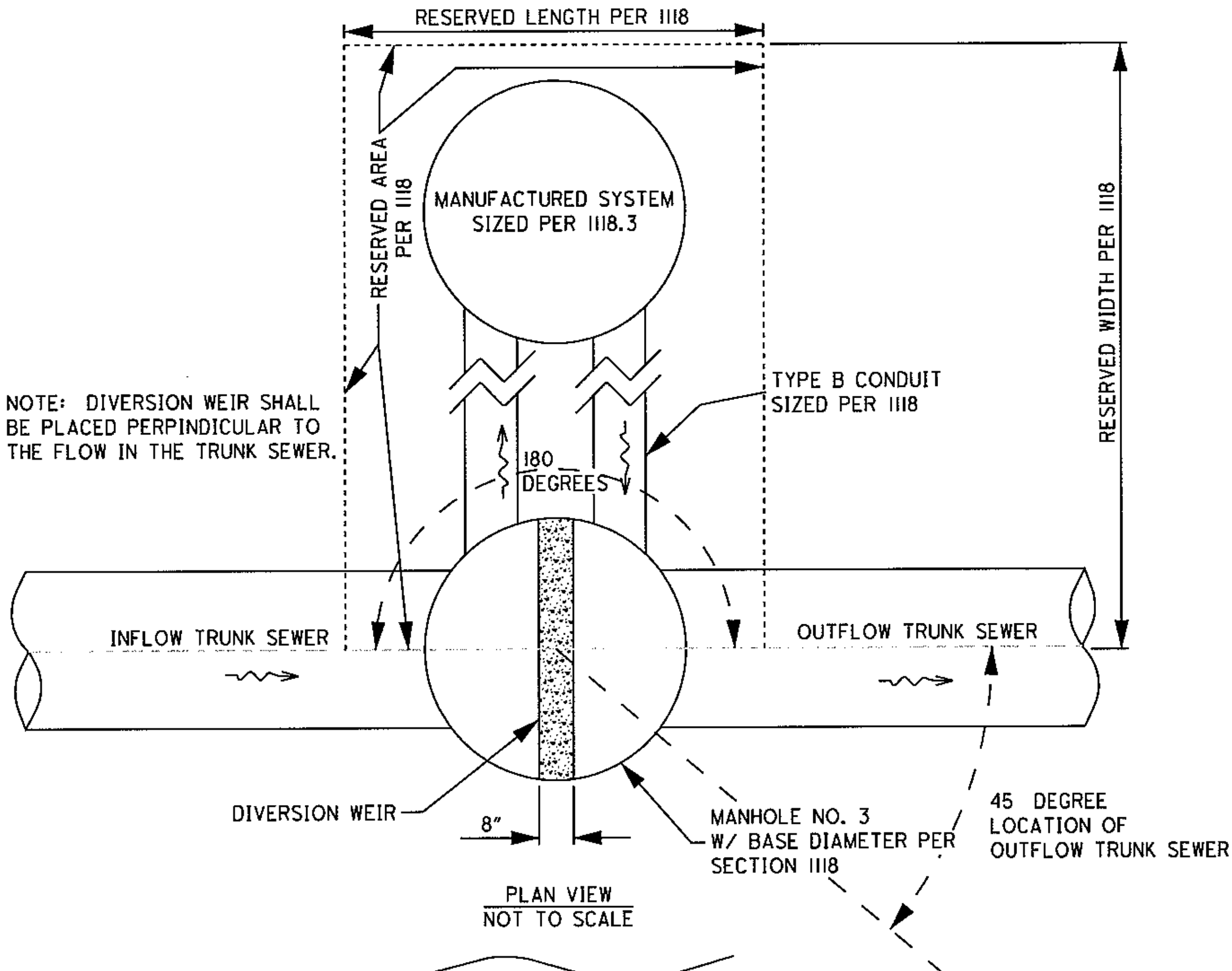
Type A - Used for curb and gutter, Type 2 (shown)
Type B - Used for barrier or non-6 inch curb
Type C - Used for 6 inch curb without gutter

Sectional View (NTS)

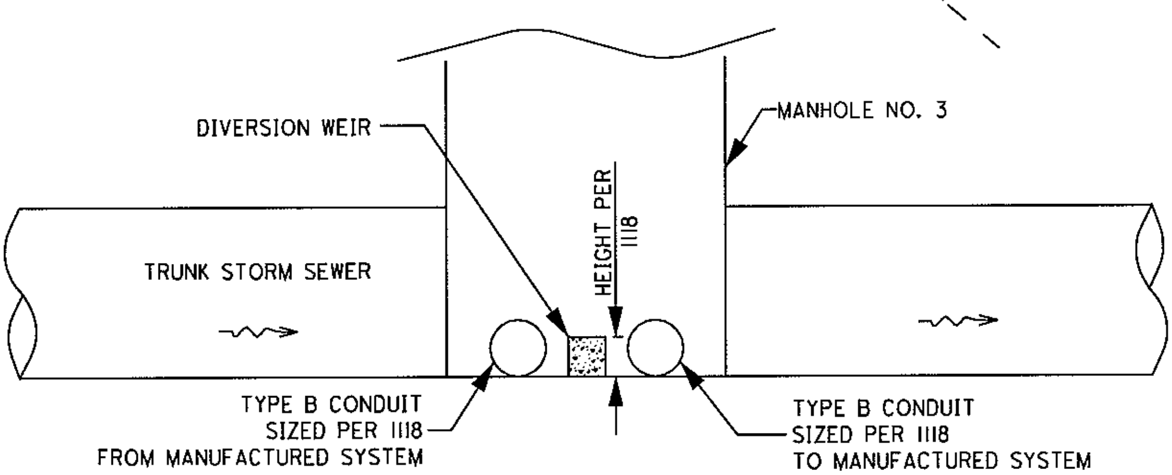


Plan View (NTS)

MANUFACTURED SYSTEM DETAIL	1118-2
	REFERENCE SECTION 1118

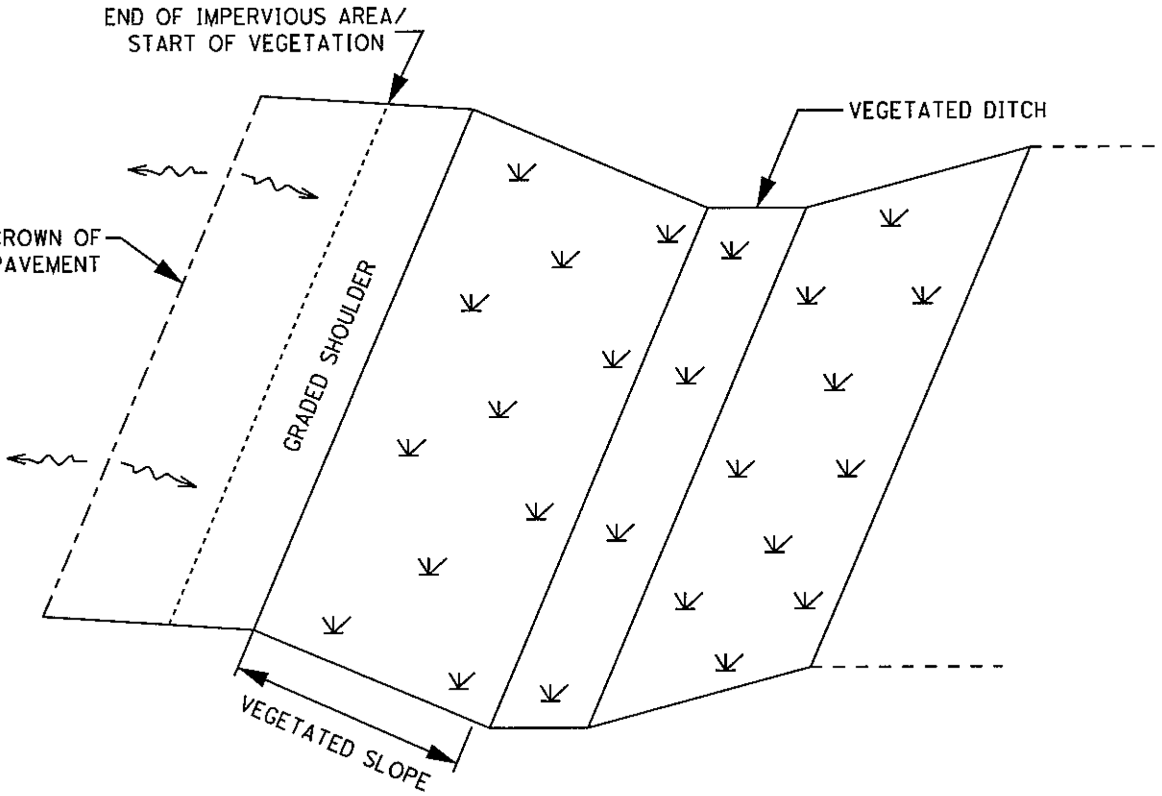


PLAN VIEW
NOT TO SCALE

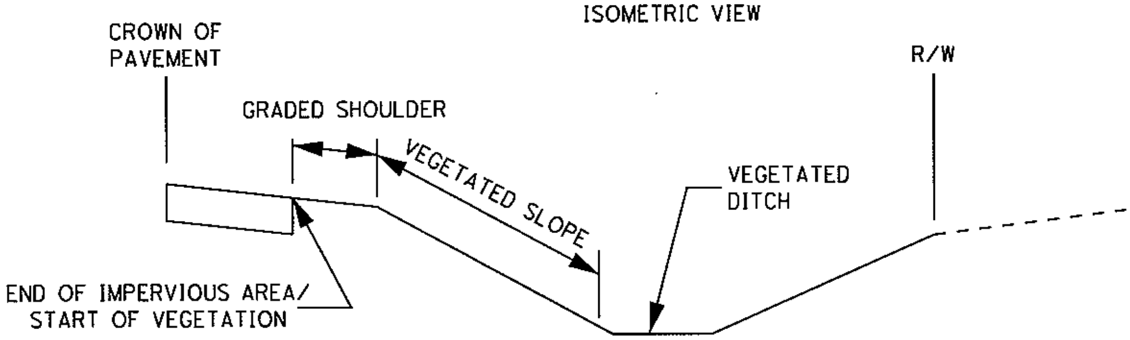


PROFILE
NOT TO SCALE

VEGETATED BIOFILTER DETAIL	1118-3 **REFERENCE SECTION** 1118



ISOMETRIC VIEW



CROSS-SECTION VIEW

VEGETATED DITCH DESIGN EXAMPLE

Given:

Roadside Ditch Foreslope = 4:1
Roadside Ditch Backslope = 2:1
Roadside Ditch Width = 4 feet (min)
Roadside Ditch Slope= 0.02 ft/ft
ODOT Pavement Drainage Area = 0.65 acres
Offsite Drainage Area=15 acres

EBW:

$EBW = 5.4 \times (15.65)^{0.356} = 14.4$ feet
EBW is greater than 10 feet => provide a seperate offsite conveyance ditch .

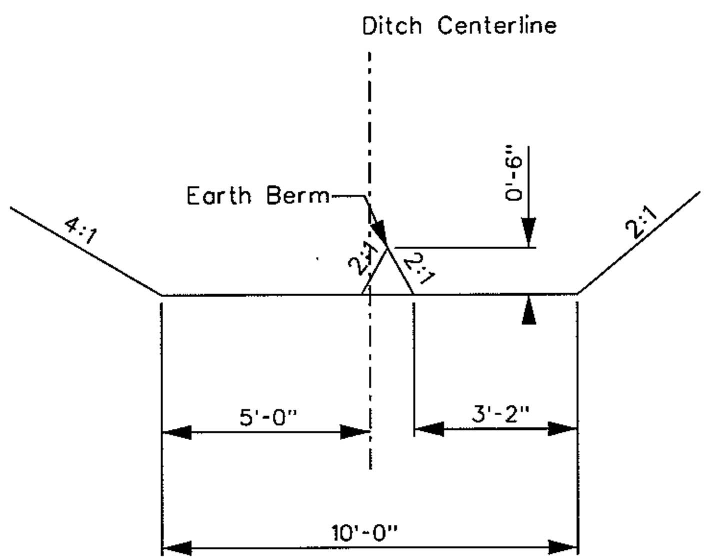
Design:

-Use Figure 1118-17 or 1118-18 to determine the minimum berm height and location that will satisify the design.

-Figure 1118-17 => use a 1:1 Berm at 6" high with an offsite conveyance ditch width of 4'-2" because the point falls within Area B. Begin the berm at 2" left of the ditch centerline.

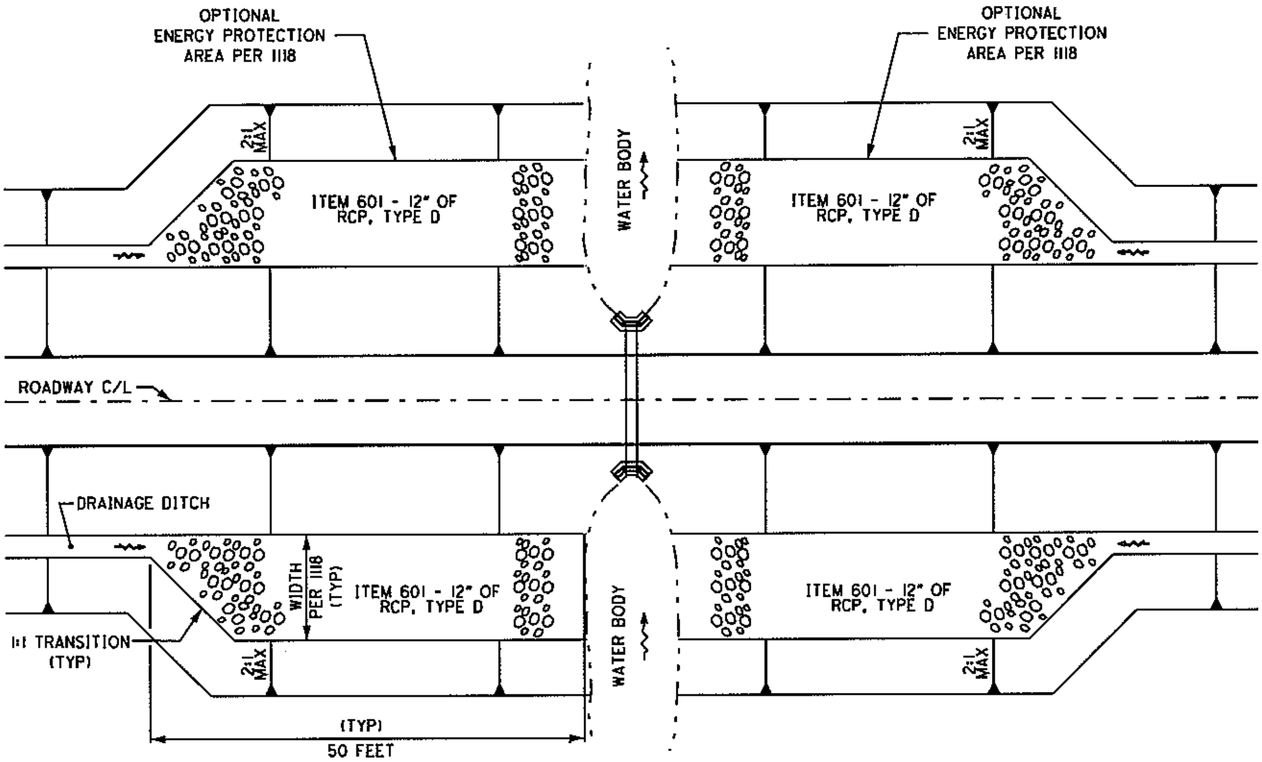
-Figure 1118-18 => use a 2:1 Berm at 6" high with an offsite conveyance ditch width of 3'-2" because the point falls within Area B. Begin the berm at 2" left of the ditch centerline.

-Will use 2:1 Berm at 6" height per Figure 1118-18.

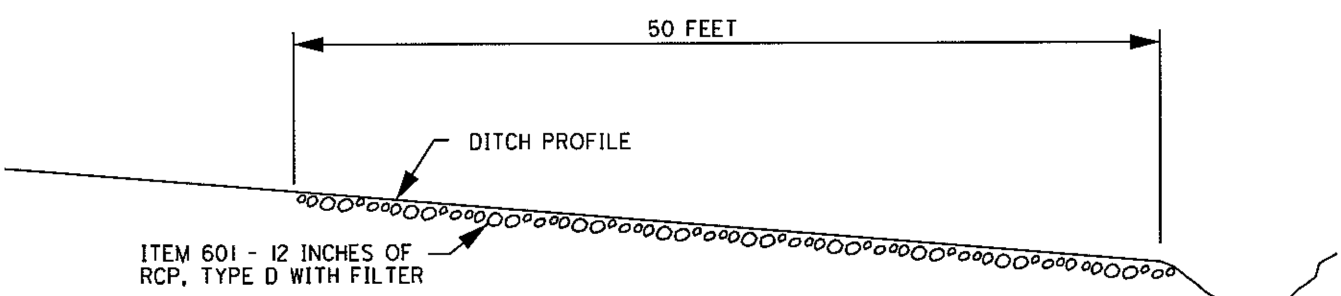


January 2006

ENERGY PROTECTION AREA DETAIL	1118-5
	REFERENCE SECTION 1118



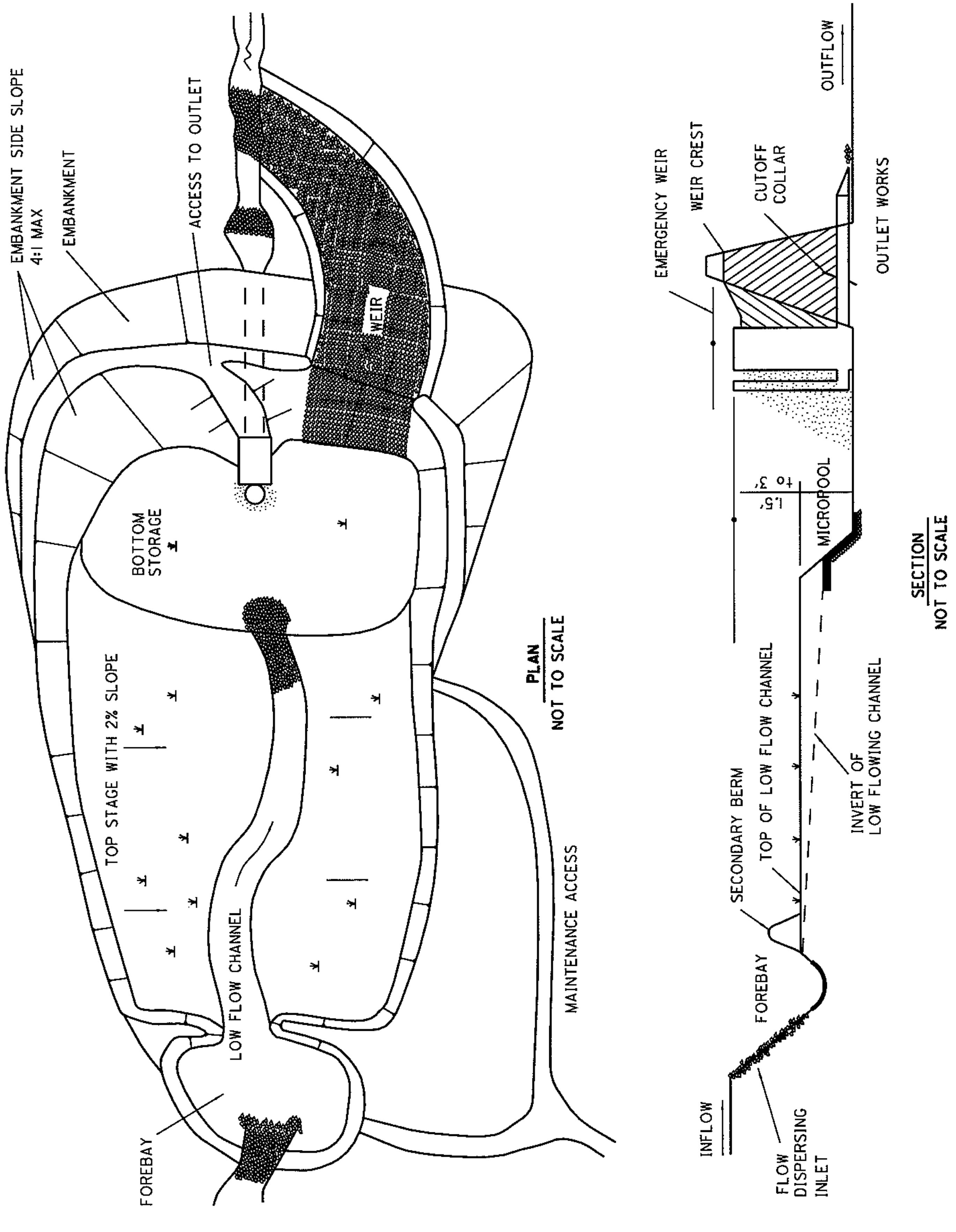
PLAN VIEW
NOT TO SCALE



PROFILE
NOT TO SCALE

January 2006

CONCEPTUAL LAYOUT FOR DETENTION (DRY) BASIN FOR WATER QUALITY	1118-6
	REFERENCE SECTION 1118



THE MICROPOOL IS TYPICALLY SIZED TO HOLD 10% OF THE TOTAL WQv.

January 2006

EXTENDED DETENTION BASIN EXAMPLE

1118-7

REFERENCE SECTION
1118

GIVEN:

Overflow Discharge (Q10) = 20 cfs
WQv = 0.55 Ac-ft
Drain time = 48 hours

- Calculate 20% increase of WQv:
  =1.20 x 0.55=0.66 Ac-ft

- Calculate the forebay size and subtract from the total required size:

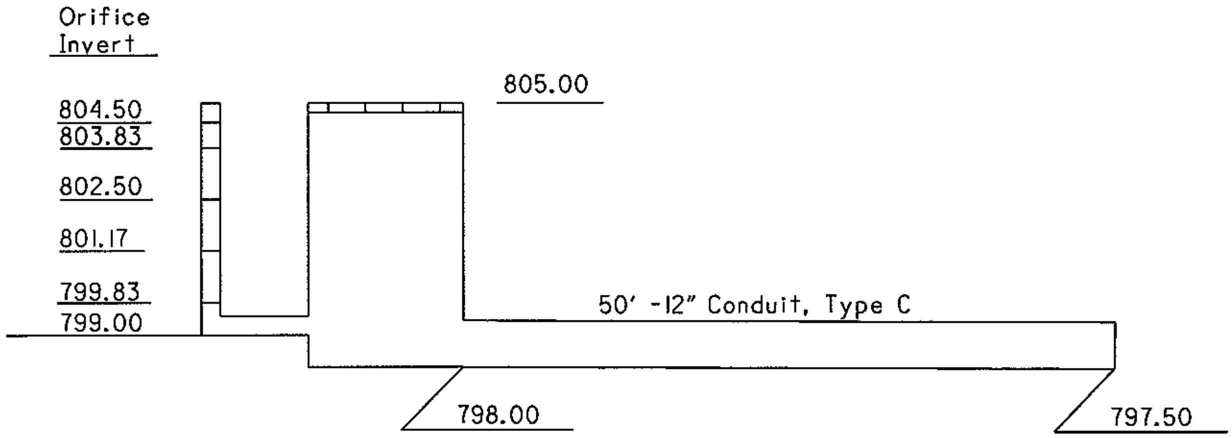
  Size = 0.10 x 0.66 Ac-ft = 0.066 Ac-ft
  Total required size= 0.66 - 0.066 = 0.60 Ac-ft

- Size the outlet structure to discharge WQv (not 20% WQv) within 48 hours:

Will try using a peforated riser pipe (6 inches diameter) into a catch basin (2-3) with 5 rows of 12 openings with a diameter of 1/2-inch as specified.

The outlet catch basin will be a no. 2-3 catch basin with grate elevation = 805.00.

Will try using an outlet culvert equal to 12 inches in diameter.
Will try using a broad crested weir 20' x 5' for emergency overflow @ 806.00



Note: 20% of the WQv is held in permanent storage below the lowest orifice opening.

- Use design software (i.e. HydroCAD) to develop outlet rating curve and discharge time.

EXTENDED DETENTION BASIN EXAMPLE (CONTINUED)

Stage Discharge Curve

Stage (Elev.)	Discharge (cfs)
799.00	0.00
799.20	0.0
799.40	0.00
799.60	0.00
799.80	0.00
800.00	0.03
800.20	0.05
800.40	0.06
800.60	0.08
800.80	0.08
801.00	0.09
801.20	0.11
801.40	0.15
801.60	0.17
801.80	0.19
802.00	0.21
802.20	0.22
802.40	0.23
802.60	0.27
802.80	0.30
803.00	0.33
803.20	0.35
803.40	0.37
803.60	0.39
803.80	0.41
804.00	0.46
804.20	0.49
804.40	0.52
804.60	0.57
804.80	0.62
805.00	0.66
805.20	2.15
805.40	4.85
805.60	6.57
805.80	7.50
806.00	8.32

Hydrograph for Draining of WQv

Time (Hours)	Storage (Ac-ft)	Elevation (Elev.)	Discharge (cfs)
4	0.55	805.00	0.66
6	0.46	804.02	0.46
8	0.40	803.30	0.36
10	0.34	802.71	0.29
12	0.30	802.26	0.22
14	0.27	801.89	0.20
16	0.24	801.56	0.17
18	0.21	801.29	0.13
20	0.19	801.10	0.10
22	0.18	800.93	0.09
24	0.16	800.77	0.08
26	0.15	800.63	0.08
28	0.14	800.50	0.07
30	0.13	800.38	0.06
32	0.12	800.27	0.06
34	0.11	800.18	0.05
36	0.10	800.10	0.04
38	0.09	800.03	0.04
40	0.09	799.97	0.03
42	0.08	799.92	0.02
44	0.08	799.89	0.01
46	0.08	799.87	0.01
48	0.08	799.85	0.01

NOTES:

Discharge time of basin is 48 hours.

Maximum discharge = 8.32 cfs @ 806.00

RETENTION BASIN EXAMPLE

GIVEN:

Overflow Discharge (Q10) = 27 cfs
WQv = 0.55 Ac-ft
Drain time = 24 hours (for 75% of WQv)

- Determine the wet and dry retention volumes required:

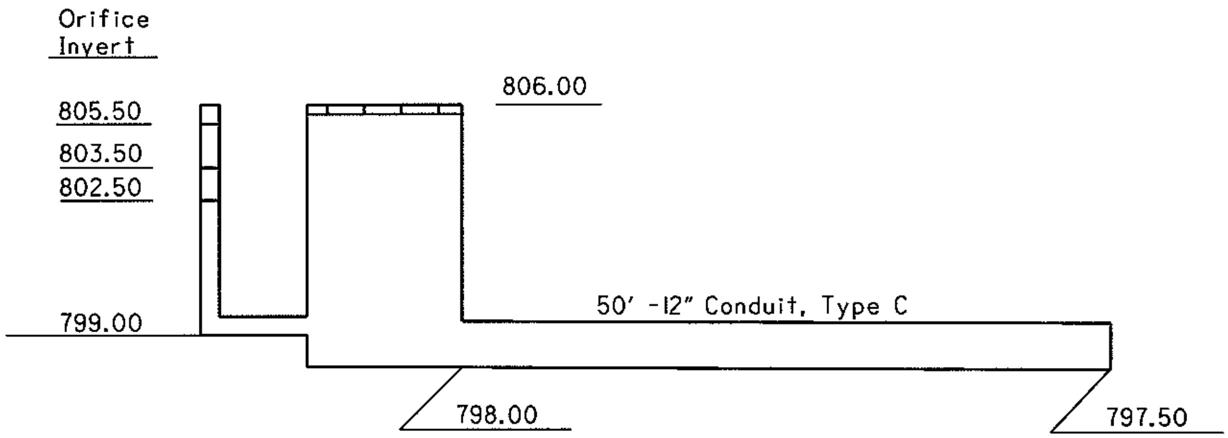
  Size = 0.75 x 0.55 Ac-ft = 0.38 Ac-ft

- Size the outlet structure:

Will try using a peforated riser pipe (8 inches diameter) into a catch basin (2-3) with 3 rows of 8 openings with a diameter of 1 inch as specified.

The outlet catch basin will be a no. 2-3 catch basin with grate elevation = 806.00.

Will try using an outlet culvert equal to 12 inches in diameter.
Will try using a broad crested weir 20' x 5' for emergency overflow @ 807.00



- Use design software (i.e. HydroCAD) to develop outlet rating curve and discharge time.

RETENTION BASIN EXAMPLE (CONTINUED)

Stage Discharge Curve

Stage (Elev.)	Discharge (cfs)
802.50	0.00
802.60	0.06
802.80	0.12
803.00	0.16
803.20	0.19
803.40	0.21
803.60	0.29
803.80	0.38
804.00	0.44
804.20	0.49
804.40	0.53
804.60	0.57
804.80	0.61
805.00	0.64
805.20	0.67
805.40	0.71
805.60	0.79
805.80	0.88
806.00	0.95
806.20	2.47
806.40	5.20
806.60	6.94
806.80	7.88
807.00	8.72

Hydrograph for Draining of 75% of WQv

Time (Hours)	Storage (Ac-ft)	Elevation (Elev.)	Discharge (cfs)
5	0.76	806.00	0.95
7	0.64	804.87	0.62
9	0.55	804.06	0.45
11	0.49	803.52	0.24
13	0.46	803.20	0.19
15	0.43	802.95	0.15
17	0.41	802.75	0.11
19	0.39	802.62	0.06
21	0.39	802.55	0.03
23	0.38	802.53	0.01
25	0.38	802.52	0.00

NOTES:

Discharge time of basin is 25 hours.

Maximum discharge = 8.72 cfs @ 807.00

BIORETENTION CELL EXAMPLE

GIVEN:

WQv=0.20AC-FT

$K=3.3\times10^{-5}$ FT/SEC

D=4.0 FT

h=1 FT

Q_{10} =23 CFS

T=40 HOURS

- SOLVE FOR REQUIRED AREA

$$A= \frac{(0.20AC\text{-}FT)\ (4.0\ FT)}{3600(3.3\times10^{-5}\ FT/SEC)(40\ HOURS)(1+4.0)} =0.03\ AC$$

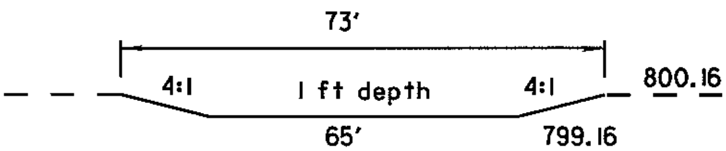
- ASSUME 20 FT. WIDTH. SOLVE FOR LENGTH

$$0.03AC= \frac{20\ L}{43560} \Longrightarrow L=65\ FT$$

- PROVIDE STORAGE FOR AT WQv PRIOR TO FILTRATION:

0.03 AC-FT = 1,307 FT^3

USE TRAPEZOIDAL SECTION @ 20 FT WIDTH X 65 FT LONG X 12 INCHES DEPTH



VOLUME = 1,661 CF > 1,307 CF => O.K.
(Used Visual Urban software from FHWA)

BIORETENTION CELL EXAMPLE (CONT.)	1118-9
	REFERENCE SECTION 1118

- CHECK FOR Q_{10} BYPASS THROUGH BIORETENTION CELL

Q_{10} = 23 CFS FIGURE 1102-1 SHOW GRATE CAPACITY
OF No. 2-2B CATCH BASIN = 6.5 CFS @ 0.5 FT HEAD (ELEVATION 800.66)

2 BASINS $\Rightarrow$ 2X6.5 = 13 CFS < 23 CFS $\Rightarrow$ DESIGN WEIR FOR 23-13 CFS=10 CFS

TRAPEZOIDAL WEIR EQUATION (ASSUME 15' BASE WITH 4:1 SIDE SLOPES):

Q= 3.367 X B X H^(3/2) $\Rightarrow$ 10= 3.367 X 15' X H^(3/2), SOLVING FOR H=0.34 FT

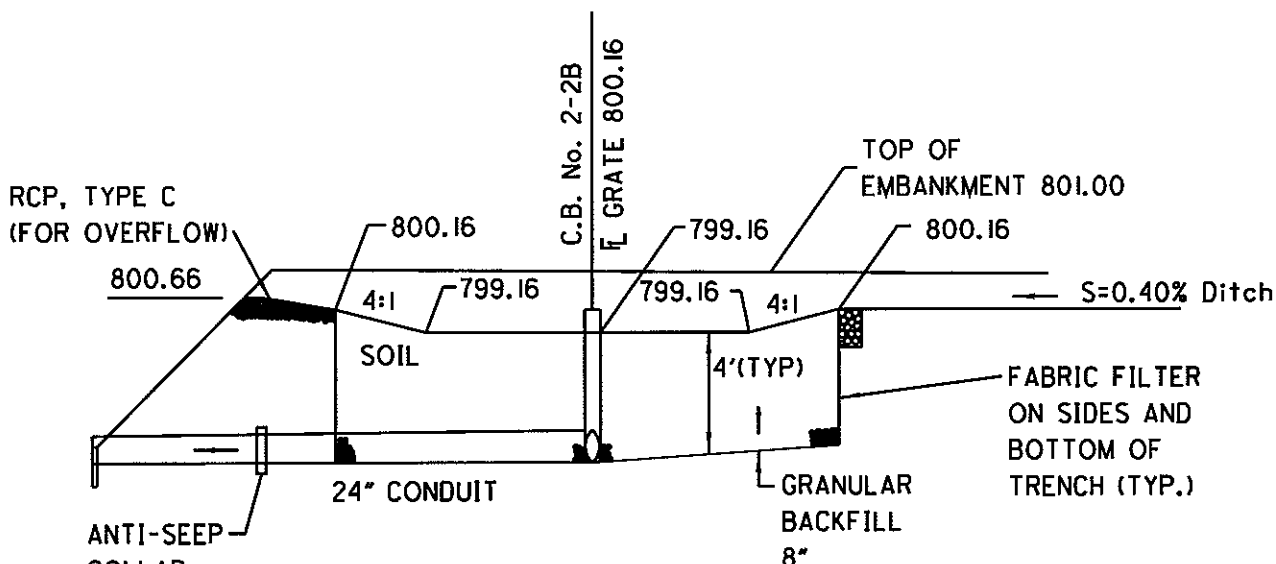
$\Rightarrow$ TOP OF EMBANKMENT SHOULD BE AT LEAST 0.34' + 800.66=801.00

@ ELEVATION 801.00, TOTAL DISCHARGE IN CATCH BASINS = 20 CFS (FIGURE 1102-1 AT 0.84 FT HEAD.)
10 CFS EACH

- DESIGN STORM SEWER FOR Q_{10} FLOW ASSUME CB 1 & 2
TAKE 10 CFS EACH USING MANNINGS EQUATION:

1 TO 2 $\Rightarrow$ USE 21" CONDUIT @ 0.68%

2 TO 3 $\Rightarrow$ USE 24" CONDUIT @ 1.1%

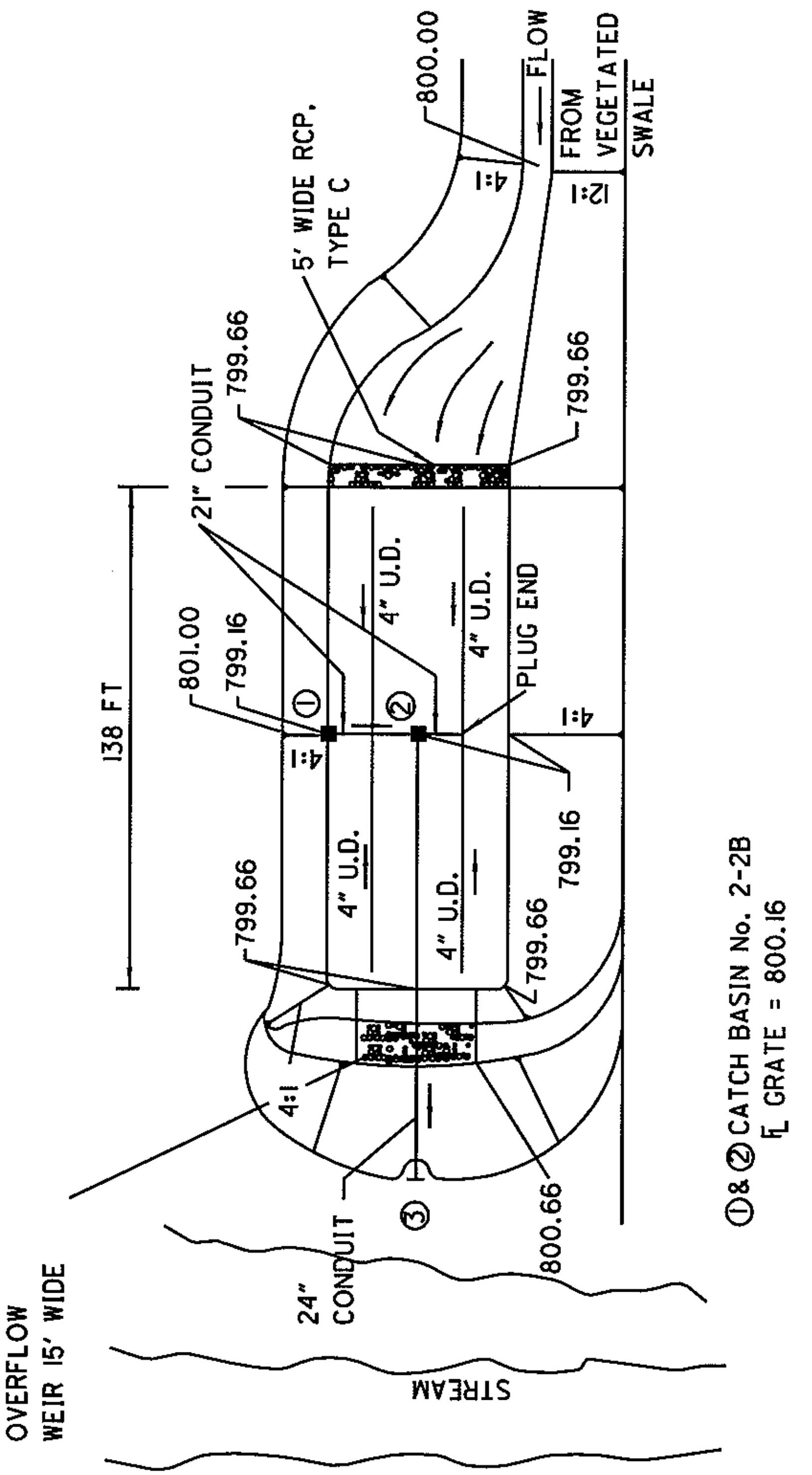


PROFILE VIEW

NTS

January 2006

BIORETENTION CELL EXAMPLE (CONT.)	1118-9
	REFERENCE SECTION 1118



PLAN VIEW

NTS

NOTES:
4" U.D. BLIND TAPS INTO THE 21" COLLECTOR PIPE

0.5' WIDE RCP USED TO SPREAD THE FLOW ACROSS THE CELL

AREA TO BE MULCHED AND PLANTED W/TREES, SHRUBS, AND GRASSES NATIVE TO THE AREA.

January 2006

INFILTRATION TRENCH EXAMPLE

1118-10

REFERENCE SECTION

1118

GIVEN:

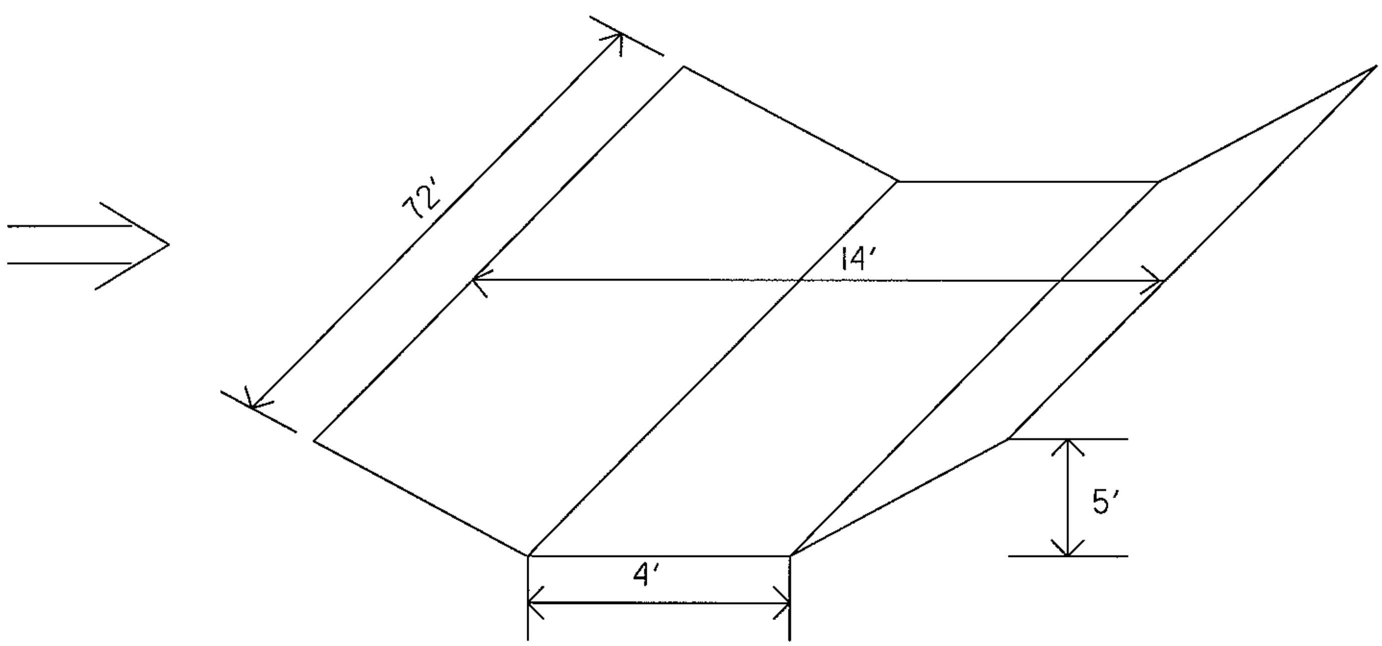
WQv = 0.16 Ac-ft
Trench Backfill = uniform sized gravel (p=0.40)
Surrounding Soil Permeability (K) = 0.000065 ft/sec
Drain time = 24 hours

- Assume depth = 5.0 feet
- Assume bottom width = 4.0 feet
- Calculate the required length:

$$L = \frac{43560 \times (0.16\ \text{Ac-ft})}{3600 \times (0.000065\ \text{ft/sec}) \times (24)(4+2(5)) + 0.40 \times (5 + (4)(5))}$$

L= 72 ft.

TOP WIDTH = 4+(2)(5) = 14 FEET



January 2006

INFILTRATION BASIN EXAMPLE

1118-11

REFERENCE SECTION
1118

GIVEN:

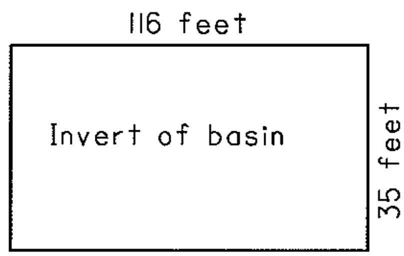
Sandy Loam Soil (infiltration rate (k) = 1.0 in/hr)
WQv = 0.25 Ac-ft
Surrounding Soil Permeability (K) = 0.000065 ft/sec
Drain time = 48 hours

- Calculate the required surface area of the basin invert:

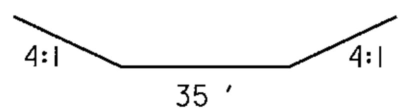
$$A = \frac{0.25 \text{ Ac-ft} \times 1.5 \times 12}{1.0 \text{ in/hr} \times 48 \text{ hours}} = 0.093 \text{ Ac} = 4{,}084 \text{ sf}$$

- Will try a 35 foot wide basin:

$$\text{Length} = \frac{4{,}084 \text{ sf}}{35 \text{ ft}} = 116 \text{ feet}$$



Plan



Cross Section

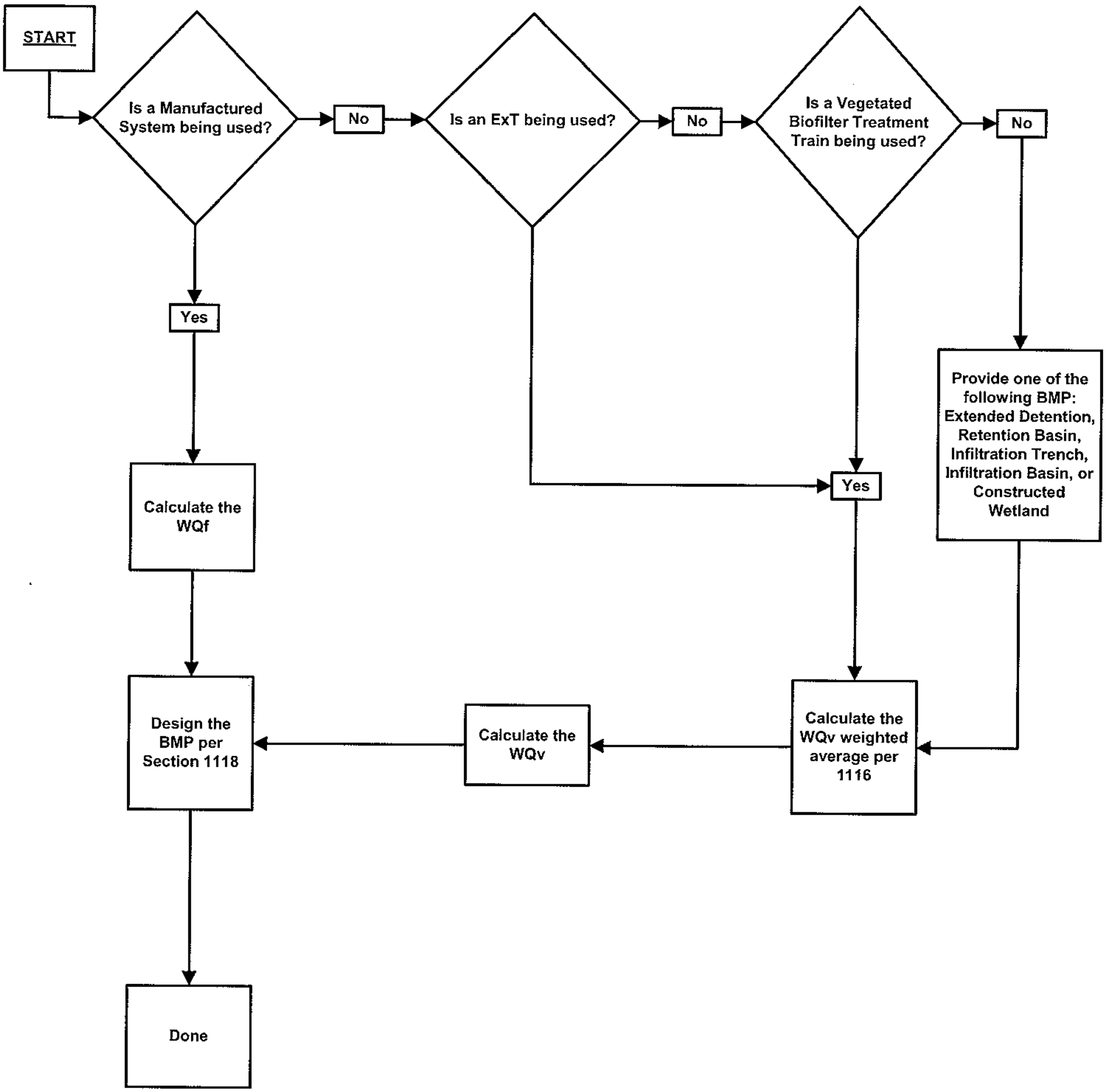
- Calculate the depth of the basin:

Will assume that only basin invert infiltrates storm water
Therefore, depth = WQv/Invert Area = 0.25 Ac-ft/0.093 Ac = 2.68 feet
Add one foot for freeboard requirement => Depth = 3.68 feet

- Therefore, dimensions of the basin are:

116 feet x 35 feet x 3.68 feet with 4:1 slopes

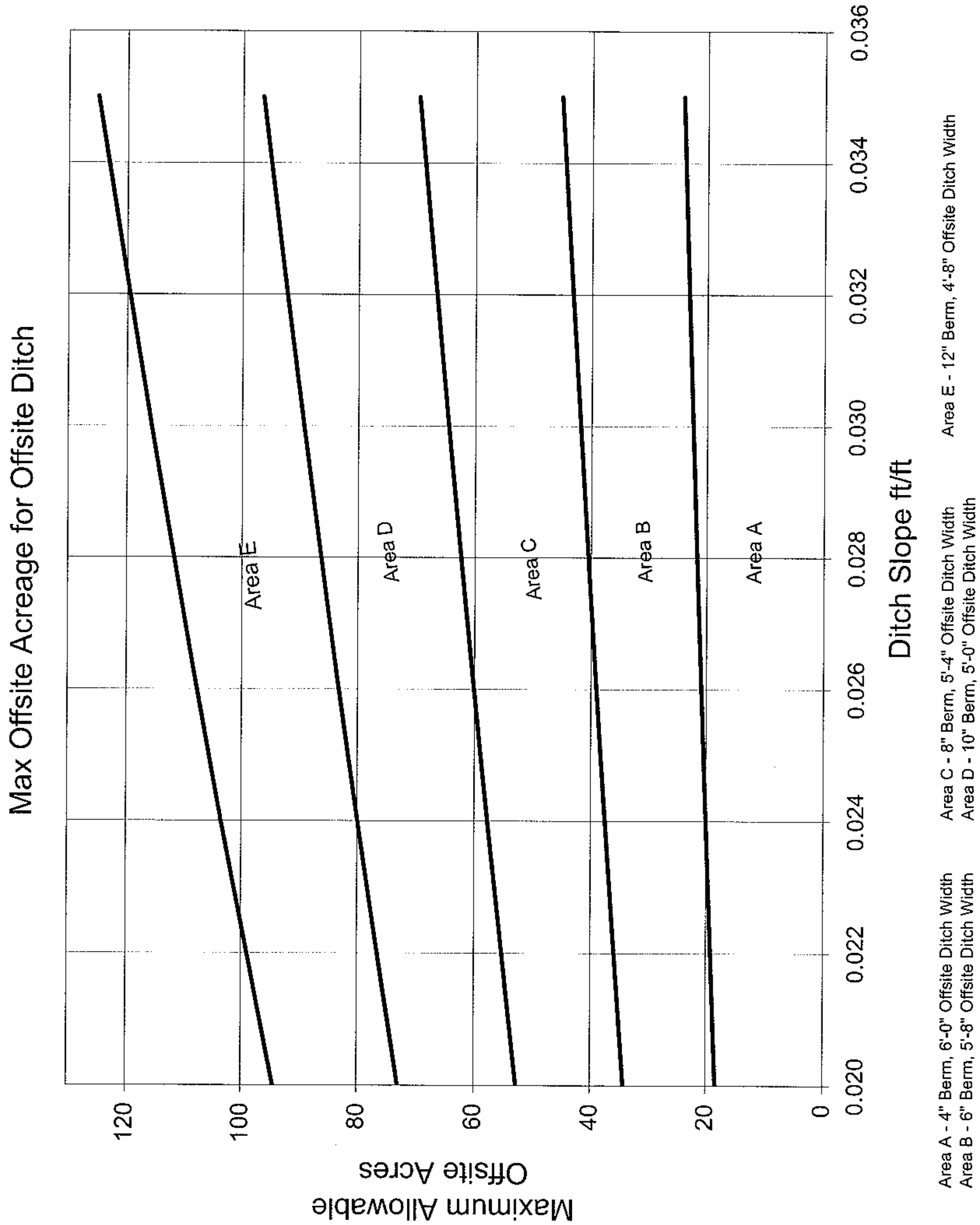
BMP SELECTION AT AN OUTFALL



CONVEYANCE DITCH DESIGN -

PVMT=0.25 ACRES, 1:1 BERM SLOPE,
BEGIN BERM AT 1'-8" LEFT OF DITCH CENTERLINE

1118-13
REFERENCE SECTION 1118



Appendix B

Ohio EPA Construction General Permit – OEPA OHC000002

Ohio EPA Permit No.: OHC000002
Effective Date: April 21, 2003
Expiration Date: April 20, 2008

OHIO ENVIRONMENTAL PROTECTION AGENCY

AUTHORIZATION FOR STORM WATER DISCHARGES ASSOCIATED WITH CONSTRUCTION ACTIVITY UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the federal Water Pollution Control Act, as amended (33 U.S.C. Section 1251 et. seq. hereafter referred to as "the Act") and the Ohio Water Pollution Control Act [Ohio Revised Code ("ORC") Chapter 6111], dischargers of storm water from sites where construction activity is being conducted, as defined in Part I.B of this permit, are authorized by the Ohio Environmental Protection Agency, hereafter referred to as "Ohio EPA," to discharge from the outfalls at the sites and to the receiving surface waters of the state identified in their Notice of Intent ("NOI") application form on file with Ohio EPA in accordance with the conditions specified in Parts I through VII of this permit.

This permit is conditioned upon payment of applicable fees, submittal of a complete NOI application form and written approval of coverage from the director of Ohio EPA in accordance with Ohio Administrative Code ("OAC") Rule 3745-38-06.

Original signed by Christopher Jones

Christopher Jones
Director

TABLE OF CONTENTS

PART I. COVERAGE UNDER THIS PERMIT

A. Permit Area.

This permit covers the entire State of Ohio.

B. Eligibility.

1. Construction activities covered. Except for storm water discharges identified under Part I.B.2, this permit may cover all new and existing discharges composed entirely of storm water discharges associated with construction activity that enter surface waters of the state or a storm drain leading to surface waters of the state.

   For the purposes of this permit, construction activities include any clearing, grading, excavating, grubbing and/or filling activities that disturb the threshold acreage described in the next paragraph. Discharges from trench dewatering are also covered by this permit as long as the dewatering activity is carried out in accordance with the practices outlined in Part III.G.2.g.iv of this permit.

   Prior to March 10, 2003, only construction activities disturbing five or more acres of total land were required to obtain NPDES construction storm water permit coverage. On and after March 10, 2003, construction activities disturbing one or more acres of total land will be eligible for coverage under this permit. The threshold acreage includes the entire area disturbed in the larger common plan of development or sale.

   This permit also authorizes storm water discharges from support activities (e.g., concrete or asphalt batch plants, equipment staging yards, material storage areas, excavated material disposal areas, borrow areas) provided:

   a. The support activity is directly related to a construction site that is required to have NPDES permit coverage for discharges of storm water associated with construction activity;

   b. The support activity is not a commercial operation serving multiple unrelated construction projects and does not operate beyond the completion of the construction activity at the site it supports;

   c. Appropriate controls and measures are identified in a storm water pollution prevention plan (SWP3) covering the discharges from the support activity; and

   d. The support activity is on or contiguous with the property defined in the NOI;

Part I.B

2. Limitations on coverage. The following storm water discharges associated with construction activity are not covered by this permit:

   a. Storm water discharges that originate from the site after construction activities have been completed, including any temporary support activity, and the site has achieved final stabilization. Industrial post-construction storm water discharges may need to be covered by an NPDES permit;

   b. Storm water discharges associated with construction activity that the director has shown to be or may reasonably expect to be contributing to a violation of a water quality standard; and

   c. Storm water discharges authorized by an individual NPDES permit or another NPDES general permit;

3. Waivers. After March 10, 2003, sites whose larger common plan of development or sale have at least one, but less than five acres of land disturbance, which would otherwise require permit coverage for storm water discharges associated with construction activities, may request that the director waive their permit requirement. Entities wishing to request such a waiver must certify in writing that the construction activity meets one of the two the waiver conditions:

   a. **Rainfall erosivity waiver.** For a construction site to qualify for the rainfall erosivity waiver, the cumulative rainfall erosivity over the project duration must be five or less and the site must be stabilized with at least a 70 percent vegetative cover or other permanent, non-erosive cover. The rainfall erosivity must be calculated according to the method in U.S. EPA Fact Sheet 3.1 Construction Rainfall Erosivity Waiver dated January 2001. If it is determined that a construction activity will take place during a time period where the rainfall erosivity factor is less than five, a written waiver certification must be submitted to Ohio EPA at least 21 days before construction activity is scheduled to begin. If the construction activity will extend beyond the dates specified in the waiver certification, the operator must either: (a) recalculate the waiver using the original start date with the new ending date (if the R factor is still less than five, a new waiver certification must be submitted) or (b) submit an NOI application form and fee for coverage under this general permit at least seven days prior to the end of the waiver period (see Attachment A); or

Part I.B.3

b. **TMDL (Total Maximum Daily Load) waiver.** Storm water controls are not needed based on a TMDL approved or established by U.S. EPA that addresses the pollutant(s) of concern or, for non-impaired waters that do not require TMDLs, an equivalent analysis that determines allocations for small construction sites for the pollutant(s) of concern or that determines that such allocations are not needed to protect water quality based on consideration of existing in-stream concentrations, expected growth in pollutant contributions from all sources, and a margin of safety. The pollutant(s) of concern include sediment or a parameter that addresses sediment (such as total suspended solids, turbidity or siltation) and any other pollutant that has been identified as a cause of impairment of any water body that will receive a discharge from the construction activity. The operator must certify to the director of Ohio EPA that the construction activity will take place, and storm water discharges will occur, within the drainage area addressed by the TMDL or equivalent analysis. A written waiver certification must be submitted to Ohio EPA at least 21 days before the construction activity is scheduled to begin.

4. <u>Prohibition on non-storm water discharges</u>. All discharges covered by this permit must be composed entirely of storm water with the exception of the following: discharges from fire fighting activities; fire hydrant flushings; potable water sources including waterline flushings; irrigation drainage; lawn watering; routine external building washdown which does not use detergents; pavement washwaters where spills or leaks of toxic or hazardous materials have not occurred (unless all spilled material has been removed) and where detergents are not used; air conditioning condensate; springs; uncontaminated ground water from trench or well point dewatering and foundation or footing drains where flows are not contaminated with process materials such as solvents. Dewatering activities must be done in compliance with Part III.G.2.g.iv of this permit. Discharges of material other than storm water or the authorized non-storm water discharges listed above must comply with an individual NPDES permit or an alternative NPDES general permit issued for the discharge.

   Except for flows from fire fighting activities, sources of non-storm water listed above that are combined with storm water discharges associated with construction activity must be identified in the SWP3. The SWP3 must identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

Part I.B

5. Spills and unintended releases (Releases in excess of Reportable Quantities). This permit does not relieve the permittee of the reporting requirements of 40 CFR Part 117 and 40 CFR Part 302. In the event of a spill or other unintended release, the discharge of hazardous substances in the storm water discharge(s) from a construction site must be minimized in accordance with the applicable storm water pollution prevention plan for the construction activity and in no case, during any 24-hour period, may the discharge(s) contain a hazardous substance equal to or in excess of reportable quantities.

   40 CFR Part 117 sets forth a determination of the reportable quantity for each substance designated as hazardous in 40 CFR Part 116. The regulation applies to quantities of designated substances equal to or greater than the reportable quantities, when discharged to surface waters of the state. 40 CFR Part 302 designates under section 102(a) of the Comprehensive Environmental Response, Compensation and Liability Act of 1980, those substances in the statutes referred to in section 101(14), identifies reportable quantities for these substances and sets forth the notification requirements for releases of these substances. This regulation also sets forth reportable quantities for hazardous substances designated under section 311(b)(2)(A) of the Clean Water Act (CWA).

C. Requiring an individual NPDES permit or an alternative NPDES general permit.

1. The director may require an alternative permit. The director may require any operator eligible for this permit to apply for and obtain either an individual NPDES permit or coverage under an alternative NPDES general permit in accordance with OAC Rule 3745-38-04. Any interested person may petition the director to take action under this paragraph.

   The director will send written notification that an alternative NPDES permit is required. This notice shall include a brief statement of the reasons for this decision, an application form and a statement setting a deadline for the operator to file the application. If an operator fails to submit an application in a timely manner as required by the director under this paragraph, then coverage, if in effect, under this permit is automatically terminated at the end of the day specified for application submittal.

2. Operators may request an individual NPDES permit. Any owner or operator eligible for this permit may request to be excluded from the coverage of this permit by applying for an individual permit. The owner or operator shall submit an individual application with reasons supporting the request to the director in accordance with the requirements of 40 CFR 122.26. If the reasons adequately support the request, the director shall grant it by issuing an individual NPDES permit.

3. When an individual NPDES permit is issued to an owner or operator otherwise subject to this permit or the owner or operator is approved for coverage under an alternative NPDES general permit, the applicability of this permit to the individual NPDES permittee is automatically terminated on the effective date of the individual permit or the date of approval for coverage under the alternative general permit, whichever the case may be.

D. Permit requirements when portions of a site are sold

If an operator obtains a permit for a development, and then the operator (permittee) sells off lots or parcels within that development, permit coverage must be continued on those lots until a Notice of Termination (NOT) in accordance with Part IV.B is submitted. For developments which require the use of centralized sediment and erosion controls (i.e., controls that address storm water runoff from one or more lots) for which the conveyance of permit coverage for a portion of the development will either prevent or impair the implementation of the controls and therefore jeopardize compliance with the terms and conditions of this permit, the permittee will be required to maintain responsibility for the implementation of those controls. For developments where this is not the case, it is the permittee's responsibility to temporarily stabilize all lots sold to individual lot owners unless an exception is approved in accordance with Part III.G.4. In cases where permit coverage for individual lot(s) will be conveyed, the permittee shall inform the individual lot owner of the obligations under this permit and ensure that the Individual Lot NOI application is submitted to Ohio EPA.

Part I

E. Authorization

1. Obtaining authorization to discharge. Operators that discharge storm water associated with construction activity must submit an NOI application form in accordance with the requirements of Part II of this permit to obtain authorization to discharge under this general permit. As required under OAC Rule 3745-38-06(E), the director, in response to the NOI submission, shall notify the applicant in writing that he/she has been granted general permit coverage to discharge storm water associated with construction activity under the terms and conditions of this permit or that the applicant must apply for an individual NPDES permit or coverage under an alternate general NPDES permit as described in Part I.C.1.

2. No release from other requirements. No condition of this permit shall release the permittee from any responsibility or requirements under other environmental statutes or regulations. Other permit requirements commonly associated with construction activities include, but are not limited to, section 401 water quality certifications, isolated wetland permits, permits to install sanitary sewers or other devices that discharge or convey polluted water, permits to install drinking water lines, single lot sanitary system permits and disturbance of land which was used to operate a solid or hazardous waste facility (i.e., coverage under this NPDES general permit does not satisfy the requirements of OAC Rule 3745-27-13 or ORC Section 3734.02(H)). This permit does not relieve the permittee of other responsibilities associated with construction activities such as contacting the Ohio Department of Natural Resources, Division of Water, to ensure proper well installation and abandonment of wells.

Part II. NOTICE OF INTENT REQUIREMENTS

A. Deadlines for notification.

Initial coverage: Operators who intend to obtain initial coverage for a storm water discharge associated with construction activity under this general permit must submit a complete and accurate NOI application form and appropriate fee at least 21 days prior to the commencement of construction activity. If more than one operator, as defined in Part VII of this general permit, will be engaged at a site, each operator shall seek coverage under this general permit. Where one operator has already submitted an NOI prior to other operator(s) being identified, the additional operator shall request modification of coverage to become a co-permittee. In such instances, the co-permittees shall be covered under the same facility permit number. No additional permit fee is required.

Part II.A

Individual lot transfer of coverage: Operators must each submit an individual lot notice of intent (Individual Lot NOI) application form (no fee required) to Ohio EPA at least seven days prior to the date that they intend to accept responsibility for permit requirements for their portion of the original permitted development from the previous permittee. The original permittee may submit an Individual Lot NOT at the time the Individual Lot NOI is submitted. Transfer of permit coverage is not granted until an approval letter from the director of Ohio EPA is received by the applicant.

B. Failure to notify.

Operators who fail to notify the director of their intent to be covered and who discharge pollutants to surface waters of the state without an NPDES permit are in violation of ORC Chapter 6111. In such instances, Ohio EPA may bring an enforcement action for any discharges of storm water associated with construction activity.

C. Where to submit an NOI.

Operators seeking coverage under this permit must submit a signed NOI form, provided by Ohio EPA, to the address found in the associated instructions.

D. Additional notification.

The permittee shall make NOIs and SWP3s available upon request of the director of Ohio EPA, local agencies approving sediment and erosion control plans, grading plans or storm water management plans, local governmental officials, or operators of municipal separate storm sewer systems (MS4s) receiving drainage from the permitted site. Each operator that discharges to an NPDES permitted MS4 shall provide a copy of its Ohio EPA NOI submission to the MS4 in accordance with the MS4's requirements, if applicable.

E. Renotification.

Upon renewal of this general permit, the permittee is required to notify the director of his intent to be covered by the general permit renewal. Permittees covered under the previous NPDES general permit for storm water discharges associated with construction activity (NPDES permit number OHR100000) shall have continuing coverage under this permit. The permittees covered under OHR100000 shall submit a letter within 90 days of receipt of written notification by Ohio EPA expressing their intent that coverage be continued. There is no fee associated with these letters of intent for continued coverage. Permit coverage will be terminated after the 90-day period if the letter is not received by Ohio EPA. Ohio EPA will provide instructions on the contents of the letter and where it is to be sent within the notification letter.

PART III. STORM WATER POLLUTION PREVENTION PLAN (SWP3)

A. Storm Water Pollution Prevention Plans.

A SWP3 shall be developed for each site covered by this permit. For a multi-phase construction project, a separate NOI shall be submitted when a separate SWP3 will be prepared for subsequent phases. SWP3s shall be prepared in accordance with sound engineering and/or conservation practices by a professional experienced in the design and implementation of standard erosion and sediment controls and storm water management practices addressing all phases of construction. The SWP3 shall identify potential sources of pollution which may reasonably be expected to affect the quality of storm water discharges associated with construction activities. In addition, the SWP3 shall describe and ensure the implementation of best management practices (BMPs) that reduce the pollutants in storm water discharges during construction and pollutants associated with post-construction activities to ensure compliance with ORC Section 6111.04, OAC Chapter 3745-1 and the terms and conditions of this permit.

B. Timing

A SWP3 shall be completed prior to the timely submittal of an NOI and updated in accordance with Part III.D. Upon request and good cause shown, the director may waive the requirement to have a SWP3 completed at the time of NOI submission. If a waiver has been granted, the SWP3 must be completed prior to the initiation of construction activities. The SWP3 must be implemented upon initiation of construction activities.

Permittees continuing coverage from the previous generation of this permit (OHR100000) that have initiated construction activity prior to the receipt of written notification from Ohio EPA to submit a letter of intent to continue coverage, as required in Part II.E, are not required to update their SWP3 as a result of this renewal (OHC000002). All permittees developing sites with coverage under OHR100000 that seek continuation of coverage do not need to update the post-construction section of their SWP3 as required in Part III.G.2.e of this permit.

C. SWP3 Signature and Review.

1. Plan Signature and Retention On Site. The SWP3 shall be signed in accordance with Part V.G. and retained on site during working hours.

2. Plan Availability

   a. On-site: The plan shall be made available immediately upon request of the director or his authorized representative during working hours. A copy of the NOI and letter granting permit coverage under this general permit also shall be made available at the site.

Part III.C.2

b. By written request: The permittee must provide a copy of the SWP3 within 10 days upon written request of any of the following:

   i. The director or the director's authorized representative;

   ii. A local agency approving sediment and erosion plans, grading plans or storm water management plans; or

   iii. In the case of a storm water discharge associated with construction activity which discharges through a municipal separate storm sewer system with an NPDES permit, to the operator of the system.

c. To the public: All NOIs, general permit approval for coverage letters, and SWP3s are considered reports that shall be available to the public in accordance with the Ohio Public Records law. The permittee shall make documents available to the public upon request or provide a copy at public expense, at cost, in a timely manner. However, the permittee may claim to Ohio EPA any portion of an SWP3 as confidential in accordance with Ohio law.

3. Plan Revision. The director or authorized representative, may notify the permittee at any time that the SWP3 does not meet one or more of the minimum requirements of this part. Within 10 days after such notification from the director, (or as otherwise provided in the notification) or authorized representative, the permittee shall make the required changes to the SWP3 and, if requested, shall submit to Ohio EPA the revised SWP3 or a written certification that the requested changes have been made.

D. Amendments

The permittee shall amend the SWP3 whenever there is a change in design, construction, operation or maintenance, which has a significant effect on the potential for the discharge of pollutants to surface waters of the state or if the SWP3 proves to be ineffective in achieving the general objectives of controlling pollutants in storm water discharges associated with construction activity. Amendments to the SWP3 may be reviewed by Ohio EPA in the same manner as Part III.C.

Part III

E. Duty to inform contractors and subcontractors

The permittee shall inform all contractors and subcontractors not otherwise defined as "operators" in Part VII of this general permit, who will be involved in the implementation of the SWP3, of the terms and conditions of this general permit. The permittee shall maintain a written document containing the signatures of all contractors and subcontractors involved in the implementation of the SWP3 as proof acknowledging that they reviewed and understand the conditions and responsibilities of the SWP3. The written document shall be created and signatures shall be obtained prior to commencement of work on the construction site.

F. Total Maximum Daily Load (TMDL) allocations

If a TMDL is approved for any waterbody into which the permittee's site discharges and requires specific BMPs for construction sites, the director may require the permittee to revise his/her SWP3.

G. SWP3 Requirements

Operations that discharge storm water from construction activities are subject to the following requirements and the SWP3 shall include the following items:

1. Site description. Each SWP3 shall provide:

   a. A description of the nature and type of the construction activity (e.g., low density residential, shopping mall, highway, etc.);

   b. Total area of the site and the area of the site that is expected to be disturbed (i.e., grubbing, clearing, excavation, filling or grading, including off-site borrow areas);

   c. A calculation of the runoff coefficients for both the pre-construction and post construction site conditions;

   d. An estimate of the impervious area and percent imperviousness created by the construction activity;

   e. Existing data describing the soil and, if available, the quality of any discharge from the site;

   f. A description of prior land uses at the site;

Part III.G.1

g. An implementation schedule which describes the sequence of major construction operations (i.e., grubbing, excavating, grading, utilities and infrastructure installation) and the implementation of erosion, sediment and storm water management practices or facilities to be employed during each operation of the sequence;

h. The name and/or location of the immediate receiving stream or surface water(s) and the first subsequent named receiving water(s) and the areal extent and description of wetlands or other special aquatic sites at or near the site which will be disturbed or which will receive discharges from disturbed areas of the project;

i. For subdivided developments where the SWP3 does not call for a centralized sediment control capable of controlling multiple individual lots, a detail drawing of a typical individual lot showing standard individual lot erosion and sediment control practices.

   This does not remove the responsibility to designate specific erosion and sediment control practices in the SWP3 for critical areas such as steep slopes, stream banks, drainage ways and riparian zones.

j. Location and description of any storm water discharges associated with dedicated asphalt and dedicated concrete plants covered by this permit and the best management practices to address pollutants in these storm water discharges;

k. A copy of the permit requirements (attaching a copy of this permit is acceptable); and

l. Site map showing:

   i. Limits of earth-disturbing activity of the site including associated off-site borrow or spoil areas that are not addressed by a separate NOI and associated SWP3;

   ii. Soils types should be depicted for all areas of the site, including locations of unstable or highly erodible soils;

   iii. Existing and proposed contours. A delineation of drainage watersheds expected during and after major grading activities as well as the size of each drainage watershed, in acres;

Part III.G.1.l

iv. Surface water locations including springs, wetlands, streams, lakes, water wells, etc., on or within 200 feet of the site, including the boundaries of wetlands or stream channels and first subsequent named receiving water(s) the permittee intends to fill or relocate for which the permittee is seeking approval from the Army Corps of Engineers and/or Ohio EPA;

v. Existing and planned locations of buildings, roads, parking facilities and utilities;

vi. The location of all erosion and sediment control practices, including the location of areas likely to require temporary stabilization during the course of site development;

vii. Sediment and storm water management basins noting their sediment settling volume and contributing drainage area;

viii. Permanent storm water management practices to be used to control pollutants in storm water after construction operations have been completed.

ix. Areas designated for the storage or disposal of solid, sanitary and toxic wastes, including dumpster areas, areas designated for cement truck washout, and vehicle fueling;

x. The location of designated construction entrances where the vehicles will access the construction site;

xi. The location of any in-stream activities including stream crossings;

2. Controls. The SWP3 must contain a description of the controls appropriate for each construction operation covered by this permit and the operator(s) must implement such controls. The SWP3 must clearly describe for each major construction activity identified in Part III.G.1.g: (a) appropriate control measures and the general timing (or sequence) during the construction process that the measures will be implemented; and (b) which contractor is responsible for implementation (e.g., contractor A will clear land and install perimeter controls and contractor B will maintain perimeter controls until final stabilization). Ohio EPA recommends that the erosion, sediment, and storm water management practices used to satisfy the conditions of this permit, should meet the standards and specifications in the current edition of Ohio's Rainwater and Land Development (see definitions) manual or other standards acceptable to Ohio EPA. The controls shall include the following minimum components:

Part III.G.2

a. **Non-Structural Preservation Methods.** The SWP3 must make use of practices which preserve the existing natural condition as much as feasible. Such practices may include: preserving riparian areas adjacent to surface waters of the state, preserving existing vegetation and vegetative buffer strips, phasing of construction operations in order to minimize the amount of disturbed land at any one time and designation of tree preservation areas or other protective clearing or grubbing practices. The recommended buffer that operators should leave undisturbed along a surface water of the state is 25 feet as measured from the ordinary high water mark of the surface water.

b. **Erosion Control Practices.** The SWP3 must make use of erosion controls that are capable of providing cover over disturbed soils unless an exception is approved in accordance with Part III.G.4. A description of control practices designed to restabilize disturbed areas after grading or construction shall be included in the SWP3. The SWP3 must provide specifications for stabilization of all disturbed areas of the site and provide guidance as to which method of stabilization will be employed for any time of the year. Such practices may include: temporary seeding, permanent seeding, mulching, matting, sod stabilization, vegetative buffer strips, phasing of construction operations, use of construction entrances and the use of alternative ground cover.

   i. **Stabilization.** Disturbed areas must be stabilized as specified in the following tables below. Permanent and temporary stabilization are defined in Part VII.

Table 1: Permanent Stabilization

Area requiring permanent stabilization	Time frame to apply erosion controls
Any areas that will lie dormant for one year or more	Within seven days of the most recent disturbance
Any areas within 50 feet of a stream and at final grade	Within two days of reaching final grade
Any other areas at final grade	Within seven days of reaching final grade within that area

Part III.G.2.b.i

Table 2: Temporary Stabilization

Area requiring temporary stabilization	Time frame to apply erosion controls
Any disturbed areas within 50 feet of a stream and not at final grade	Within two days of the most recent disturbance if the area will remain idle for more than 21 days
For all construction activities, any disturbed areas that will be dormant for more than 21 days but less than one year, and not within 50 feet of a stream	Within seven days of the most recent disturbance within the area For residential subdivisions, disturbed areas must be stabilized at least seven days prior to transfer of permit coverage for the individual lot(s).
Disturbed areas that will be idle over winter	Prior to the onset of winter weather

Where vegetative stabilization techniques may cause structural instability or are otherwise unobtainable, alternative stabilization techniques must be employed.

ii. **Permanent stabilization of conveyance channels**. Operators shall undertake special measures to stabilize channels and outfalls and prevent erosive flows. Measures may include seeding, dormant seeding (as defined in the 1996 edition of the <u>Rainwater and Land Development</u> manual), mulching, erosion control matting, sodding, riprap, natural channel design with bioengineering techniques or rock check dams.

c. **Runoff Control Practices.** The SWP3 shall incorporate measures which control the flow of runoff from disturbed areas so as to prevent erosion from occurring. Such practices may include rock check dams, pipe slope drains, diversions to direct flow away from exposed soils and protective grading practices. These practices shall divert runoff away from disturbed areas and steep slopes where practicable.

d. **Sediment Control Practices.** The plan shall include a description of structural practices that shall store runoff allowing sediments to settle and/or divert flows away from exposed soils or otherwise limit runoff from exposed areas. Structural practices shall be used to control erosion and trap sediment from a site remaining disturbed for more than 14 days. Such practices may include, among others: sediment settling ponds, silt fences, earth diversion dikes or channels which direct runoff to a sediment settling pond and storm drain inlet protection. All sediment control practices must be capable of ponding runoff in order to be considered functional. Earth diversion dikes or channels alone are not considered a sediment control practice unless those are used in conjunction with a sediment settling pond.

Part III.G.2.d

The SWP3 must contain detail drawings for all structural practices.

i. Timing. Sediment control structures shall be functional throughout the course of earth disturbing activity. Sediment basins and perimeter sediment barriers shall be implemented prior to grading and within seven days from the start of grubbing. They shall continue to function until the up slope development area is restabilized. As construction progresses and the topography is altered, appropriate controls must be constructed or existing controls altered to address the changing drainage patterns.

ii. Sediment settling ponds. Concentrated storm water runoff and runoff from drainage areas, which exceed the design capacity of silt fence or inlet protection, shall pass through a sediment settling pond. For common drainage locations that serve an area with 10 or more acres disturbed at one time, a temporary (or permanent) sediment settling pond must be provided until final stabilization of the site. The permittee may request approval from Ohio EPA to use alternative controls if it can demonstrate the alternative controls are equivalent in effectiveness to a sediment settling pond. It is recommended for drainage locations serving less than 10 acres, smaller sediment basins and/or sediment traps should be used.

The sediment settling pond shall be sized to provide at least 67 cubic yards of storage per acre of total contributing drainage area. When determining the total contributing drainage area, off-site areas and areas which remain undisturbed by construction activity must be included unless runoff from these areas is diverted away from the sediment settling pond and is not co-mingled with sediment-laden runoff. The depth of the sediment settling pond must be less than or equal to five feet. The configuration between inlets and the outlet of the basin must provide at least two units of length for each one unit of width (> 2:1 length:width ratio). Sediment must be removed from the sediment settling pond when the design capacity has been reduced by 40 percent (This is typically reached when sediment occupies one-half of the basin depth). When designing sediment settling ponds, the permittee must consider public safety, especially as it relates to children, as a design factor for the sediment basin and alternative sediment controls must be used where site limitations would preclude a safe design. The use of a combination of sediment and erosion control measures in order to achieve maximum pollutant removal is encouraged.

iii. Silt Fence and Diversions. Sheet flow runoff from denuded areas shall be intercepted by silt fence or diversions to protect adjacent properties and water resources from sediment transported via sheet flow. Where intended to provide sediment control, silt fence shall be placed on a level contour. This permit does not preclude the use of other sediment barriers designed to control sheet flow runoff. The relationship between the maximum drainage area to silt fence for a particular slope range is shown in the table below.

Maximum drainage area (in acres) to 100 linear feet of silt fence	**Range of slope for a particular drainage area (in percent)**
0.5	< 2%
0.25	≥ 2% but < 20%
0.125	≥ 20% but < 50%

Storm water diversion practices shall be used to keep runoff away from disturbed areas and steep slopes where practicable. Such devices, which include swales, dikes or berms, may receive storm water runoff from areas up to 10 acres.

iv. Inlet Protection. Other erosion and sediment control practices shall minimize sediment laden water entering active storm drain systems, unless the storm drain system drains to a sediment settling pond.

v. Stream Protection. If construction activities disturb areas adjacent to streams, structural practices shall be designed and implemented on site to protect all adjacent streams from the impacts of sediment runoff. No structural sediment controls (e.g., the installation of silt fence or a sediment settling pond in-stream) shall be used in a stream. For all construction activities immediately adjacent to surface waters of the state, it is recommended that a setback of at least 25-feet, as measured from the ordinary high water mark of the surface water, be maintained in its natural state as a permanent buffer. Where impacts within this setback area are unavoidable due to the nature of the construction activity (e.g., stream crossings for roads or utilities), the project shall be designed such that the number of stream crossings and the width of the disturbance within the setback area are minimized.

vi. Modifying Controls. If periodic inspections or other information indicates a control has been used inappropriately or incorrectly, the permittee must replace or modify the control for site conditions.

e. **Post-Construction Storm Water Management Requirements.** So that receiving stream's physical, chemical, and biological characteristics are protected and stream functions are maintained, post-construction storm water practices shall provide perpetual management of runoff quality and quantity. To meet the post-construction requirements of this permit, the SWP3 must contain a description of the post-construction BMPs that will be installed during construction for the site and the rationale for their selection. The rationale must address the anticipated impacts on the channel and floodplain morphology, hydrology, and water quality.

Detail drawings and maintenance plans must be provided for all post-construction BMPs. Maintenance plans shall be provided by the permittee to the post-construction operator of the site (including homeowner associations) upon completion of construction activities (prior to termination of permit coverage). For sites located within a community with a regulated municipal separate storm sewer system (MS4), the permittee, land owner, or other entity with legal control of the property may be required to develop and implement a maintenance plan to comply with the requirements of the MS4. Maintenance plans must ensure that pollutants collected within structural post-construction practices, be disposed of in accordance with local, state, and federal regulations. Permittees, except for those regulated under the small MS4 program, are not responsible under this permit for operation and maintenance of post-construction practices once coverage under this permit is terminated.

This permit does not preclude the use of innovation or experimental post-construction storm water management technologies. However, the director may require discharges from such structures to be monitored to ensure compliance with Part III.G.2.e of this permit. The installation of structural controls in certain scenarios may also require a separate permit under section 404 of the CWA. Permittees are only responsible for the installation and maintenance of storm water management measures prior to final stabilization of the site and are not responsible for maintenance after storm water discharges associated with construction activity have been eliminated from the site. However, post-construction storm water BMPs that discharge pollutants from point sources once construction is completed, may in themselves, need authorization under a separate NPDES permit.

Linear construction projects, (e.g., pipeline or utility line installation), which do not result in the installation of impervious surface, are not required to comply with the conditions of Part III.G.2.e of this permit. However, linear construction projects must be designed to minimize the number of stream crossings and the width of disturbance.

Part III.G.2.e

Large Construction Activities. For all large construction activities (involving the disturbance of five or more acres of land or will disturb less than five acres, but is a part of a larger common plan of development or sale which will disturb five or more acres of land), the post construction BMP(s) chosen must be able to detain storm water runoff for protection of the stream channels, stream erosion control, and improved water quality. Structural (designed) post-construction storm water treatment practices shall be incorporated into the permanent drainage system for the site. The BMP(s) chosen must be sized to treat the water quality volume (WQ_v) and ensure compliance with Ohio's Water Quality Standards in OAC Chapter 3745-1. The WQ_v shall be equivalent to the volume of runoff from a 0.75-inch rainfall and shall be determined according to one of the two following methods:

i. Through a site hydrologic study approved by the local municipal permitting authority that uses continuous hydrologic simulation and local long-term hourly precipitation records or

ii. Using the following equation:

$$WQ_v = C * P * A / 12$$

where:
WQ_v = water quality volume in acre-feet
C = runoff coefficient appropriate for storms less than 1 inch (see Table 1)
P = 0.75 inch precipitation depth
A = area draining into the BMP in acres

Table 1
Runoff Coefficients Based on the Type of Land Use

Land Use	Runoff Coefficient
Industrial & Commercial	0.8
High Density Residential (>8 dwellings/acre)	0.5
Medium Density Residential (4 to 8 dwellings/acre)	0.4
Low Density Residential (<4 dwellings/acre)	0.3
Open Space and Recreational Areas	0.2

Where the land use will be mixed, the runoff coefficient should be calculated using a weighted average. For example, if 60% of the contributing drainage area to the storm water treatment structure is Low Density Residential, 30% is High Density Residential, and 10% is Open Space, the runoff coefficient is calculated as follows (0.6)(0.3) + (0.3)(0.5) + (0.1)(0.2) = 0.35.

Part III.G.2.e

An additional volume equal to 20 percent of the WQ_v shall be incorporated into the BMP for sediment storage and/or reduced infiltration capacity. Ohio EPA recommends that BMPs be designed according to the methodology included in the Rainwater and Land Development manual or in another design manual acceptable for use by Ohio EPA.

BMPs shall be designed such that the drain time is long enough to provide treatment, but short enough to provide storage available for successive rainfall events as described in Table 2 below.

Table 2
Target Draw Down (Drain) Times for Structural Post-Construction Treatment Control Practices

Best Management Practice	Drain Time of WQ_v
Infiltration	24 - 48 hours
Vegetated Swale and Filter Strip	24 hours
Extended Detention Basin (Dry Basins)	48 hours
Retention Basins (Wet Basins)*	24 hours
Constructed Wetlands (above permanent pool)	24 hours
Media Filtration, Bioretention	40 hours

* Provide both a permanent pool and an extended detention volume above the permanent pool, each sized at 0.75 * WQ_v

The permittee may request approval from Ohio EPA to use alternative structural post-construction BMPs if the permittee can demonstrate that the alternative BMPs are equivalent in effectiveness to those listed in Table 2 above. Construction activities shall be exempt from this condition if it can be demonstrated that the WQ_v is provided within an existing structural post-construction BMP that is part of a larger common plan of development or if structural post-construction BMPs are addressed in a regional or local storm water management plan. Public entities (i.e., the state, counties, townships, cities, or villages) shall comply with the post-construction storm water management requirements of Part III.G.2.e for roadway construction projects initiated after March 10, 2006 and where practicable for projects initiated as of the effective date of this permit and thereafter.

For redevelopment projects (i.e., developments on previously developed property), post-construction practices shall either ensure a 20 percent net reduction of the site impervious area, provide for treatment of at least 20 percent of the WQ_v, or a combination of the two.

Part III.G.2.e

Small Construction Activities. For all small land disturbance activities (which disturb one or more, but less than five acres of land and is not a part of a larger common plan of development or sale which will disturb five or more acres of land), a description of measures that will be installed during the construction process to control pollutants in storm water discharges that will occur after construction operations have been completed must be included in the SWP3. Structural measures should be placed on upland soils to the degree attainable.

i. Such practices may include, but are not limited to: storm water detention structures (including wet basins); storm water retention structures; flow attenuation by use of open vegetated swales and natural depressions; infiltration of runoff onsite; and sequential systems (which combine several practices). The SWP3 shall include an explanation of the technical basis used to select the practices to control pollution where flows exceed pre-development levels.

ii. Velocity dissipation devices shall be placed at discharge locations and along the length of any outfall channel to provide non-erosive flow velocity from the structure to a water course so that the natural physical and biological characteristics and functions are maintained and protected (e.g., no significant changes in the hydrological regime of the receiving water).

f. **Surface Water Protection.** If the project site contains any streams, rivers, lakes, wetlands or other surface waters, certain construction activities at the site may be regulated under the CWA and/or state isolated wetland permit requirements. Sections 404 and 401 of the Act regulate the discharge of dredged or fill material into surface waters and the impacts of such activities on water quality, respectively. Construction activities in surface waters which may be subject to CWA regulation and/or state isolated wetland permit requirements include, but are not limited to: sewer line crossings, grading, backfilling or culverting streams, filling wetlands, road and utility line construction, bridge installation and installation of flow control structures. If the project contains streams, rivers, lakes or wetlands or possible wetlands, the permittee must contact the appropriate U.S. Army Corps of Engineers District Office. (CAUTION: Any area of seasonally wet hydric soil is a potential wetland - please consult the Soil Survey and list of hydric soils for your County, available at your county's Soil and Water Conservation District. If you have any questions about Section 401 water quality certification, please contact the Ohio Environmental Protection Agency, Section 401 Coordinator.)

Part III.G.2.f

U.S. Army Corps of Engineers (Section 404 regulation):
Huntington, WV District (304) 529-5210 (Muskingum, Hocking and Scioto River Basin)
Buffalo, NY District (716) 879-4329 (Lake Erie Basin)
Pittsburgh, PA District (412) 395-7152 (Mahoning River Basin)
Louisville, KY District (502) 315-6678 (Little & Great Miami River Basin)

Ohio Environmental Protection Agency (Section 401 regulation):
Columbus, OH (614) 644-2001 (all of Ohio)

g. **Other controls.**

i. **Non-Sediment Pollutant Controls.** No solid (other than sediment) or liquid waste, including building materials, shall be discharged in storm water runoff. The permittee must implement all necessary BMPs to prevent the discharge of non-sediment pollutants to the drainage system of the site or surface waters of the state. Under no circumstance shall concrete trucks wash out directly into a drainage channel, storm sewer or surface waters of the state. No exposure of storm water to waste materials is recommended.

ii. **Off-site traffic.** Off-site vehicle tracking of sediments and dust generation shall be minimized.

iii. **Compliance with other requirements.** The SWP3 shall be consistent with applicable State and/or local waste disposal, sanitary sewer or septic system regulations, including provisions prohibiting waste disposal by open burning and shall provide for the proper disposal of contaminated soils to the extent these are located within the permitted area.

iv. **Trench and ground water control**. There shall be no turbid discharges to surface waters of the state resulting from dewatering activities. If trench or ground water contains sediment, it must pass through a sediment settling pond or other equally effective sediment control device, prior to being discharged from the construction site. Alternatively, sediment may be removed by settling in place or by dewatering into a sump pit, filter bag or comparable practice. Ground water dewatering which does not contain sediment or other pollutants is not required to be treated prior to discharge. However, care must be taken when discharging ground water to ensure that it does not become pollutant-laden by traversing over disturbed soils or other pollutant sources.

Part III.G.2

h. **Maintenance.** All temporary and permanent control practices shall be maintained and repaired as needed to ensure continued performance of their intended function. All sediment control practices must be maintained in a functional condition until all up slope areas they control are permanently stabilized. The SWP3 shall be designed to minimize maintenance requirements. The applicant shall provide a description of maintenance procedures needed to ensure the continued performance of control practices.

i. **Inspections.** At a minimum, procedures in an SWP3 shall provide that all controls on the site are inspected at least once every seven calendar days and within 24 hours after any storm event greater than one-half inch of rain per 24 hour period. The permittee shall assign qualified inspection personnel (those with knowledge and experience in the installation and maintenance of sediment and erosion controls) to conduct these inspections to ensure that the control practices are functional and to evaluate whether the SWP3 is adequate and properly implemented in accordance with the schedule proposed in Part III.G.1.g of this permit or whether additional control measures are required. Disturbed areas and areas used for storage of materials that are exposed to precipitation shall be inspected for evidence of or the potential for, pollutants entering the drainage system. Erosion and sediment control measures identified in the SWP3 shall be observed to ensure that those are operating correctly. Discharge locations shall be inspected to ascertain whether erosion and sediment control measures are effective in preventing significant impacts to the receiving waters. Locations where vehicles enter or exit the site shall be inspected for evidence of off-site vehicle tracking.

The permittee shall maintain for three years following the submittal of a notice of termination form, a record summarizing the results of the inspection, names(s) and qualifications of personnel making the inspection, the date(s) of the inspection, major observations relating to the implementation of the SWP3 and a certification as to whether the facility is in compliance with the SWP3 and the permit and identify any incidents of non-compliance. The record and certification shall be signed in accordance with Part V.G. of this permit.

i. **When practices require repair or maintenance.** If the inspection reveals that a control practice is in need of repair or maintenance, with the exception of a sediment settling pond, it must be repaired or maintained within three days of the inspection. Sediment settling ponds must be repaired or maintained within 10 days of the inspection.

ii. **When practices fail to provide their intended function.** If the inspection reveals that a control practice fails to perform its intended function and that another, more appropriate control practice is required, the SWP3 must be amended and the new control practice must be installed within 10 days of the inspection.

iii. **When practices depicted on the SWP3 are not installed.** If the inspection reveals that a control practice has not been implemented in accordance with the schedule contained in Part III.G.1.g of this permit, the control practice must be implemented within 10 days from the date of the inspection. If the inspection reveals that the planned control practice is not needed, the record must contain a statement of explanation as to why the control practice is not needed.

3. **Approved State or local plans.** All dischargers regulated under this general permit must comply, except those exempted under state law, with the lawful requirements of municipalities, counties and other local agencies regarding discharges of storm water from construction activities. All erosion and sediment control plans and storm water management plans approved by local officials shall be retained with the SWP3 prepared in accordance with this permit. Applicable requirements for erosion and sediment control and storm water management approved by local officials are, upon submittal of a NOI form, incorporated by reference and enforceable under this permit even if they are not specifically included in an SWP3 required under this permit. When the project is located within the jurisdiction of a regulated municipal separate storm sewer system (MS4), the permittee must certify that the SWP3 complies with the requirements of the storm water management program of the MS4 operator.

4. **Exceptions.** If specific site conditions prohibit the implementation of any of the erosion and sediment control practices contained in this permit or site specific conditions are such that implementation of any erosion and sediment control practices contained in this permit will result in no environmental benefit, then the permittee shall provide justification for rejecting each practice based on site conditions. Exceptions from implementing the erosion and sediment control standards contained in this permit will be approved or denied on a case-by-case basis.

PART IV. NOTICE OF TERMINATION REQUIREMENTS

A. Failure to notify.

The terms and conditions of this permit shall remain in effect until a signed Notice of Termination (NOT) form is submitted. Failure to submit an NOT constitutes a violation of this permit and may affect the ability of the permittee to obtain general permit coverage in the future.

B. When to submit an NOT

1. Permittees wishing to terminate coverage under this permit must submit an NOT form in accordance with Part V.G. of this permit. Compliance with this permit is required until an NOT form is submitted. The permittee's authorization to discharge under this permit terminates at midnight of the day the NOT form is submitted.

2. All permittees must submit an NOT form within 45 days of completing all permitted land disturbance activities. Enforcement actions may be taken if a permittee submits an NOT form without meeting one or more of the following conditions:

   a. Final stabilization (see definition in Part VII) has been achieved on all portions of the site for which the permittee is responsible (including, if applicable, returning agricultural land to its pre-construction agricultural use);

   b. Another operator(s) has assumed control over all areas of the site that have not been finally stabilized;

   c. For residential construction only, temporary stabilization has been completed and the lot, which includes a home, has been transferred to the homeowner. (Note: individual lots without housing which are sold by the developer must undergo final stabilization prior to termination of permit coverage.); or

   d. An exception has been granted under Part III.G.4.

C. How to submit an NOT

Permittees must use Ohio EPA's approved NOT form. The form must be completed and mailed according to the instructions and signed in accordance with Part V.G of this permit.

PART V. STANDARD PERMIT CONDITIONS.

A. Duty to comply.

1. The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of ORC Chapter 6111. and is grounds for enforcement action.

2. Ohio law imposes penalties and fines for persons who knowingly make false statements or knowingly swear or affirm the truth of a false statement previously made.

B. Continuation of an expired general permit.

An expired general permit continues in force and effect until a new general permit is issued.

C. Need to halt or reduce activity not a defense.

It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

D. Duty to mitigate.

The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

E. Duty to provide information.

The permittee shall furnish to the director, within 10 days of written request, any information which the director may request to determine compliance with this permit. The permittee shall also furnish to the director upon request copies of records required to be kept by this permit.

F. Other information.

When the permittee becomes aware that he or she failed to submit any relevant facts or submitted incorrect information in the NOI, SWP3, NOT or in any other report to the director, he or she shall promptly submit such facts or information.

Part V

G. Signatory requirements.

All NOIs, NOTs, SWP3s, reports, certifications or information either submitted to the director or that this permit requires to be maintained by the permittee, shall be signed.

1. These items shall be signed as follows:

   a. For a corporation: By a responsible corporate officer. For the purpose of this section, a responsible corporate officer means:

      i. A president, secretary, treasurer or vice-president of the corporation in charge of a principal business function or any other person who performs similar policy or decision-making functions for the corporation; or

      ii. The manager of one or more manufacturing, production or operating facilities, provided, the manager is authorized to make management decisions which govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations and initiating and directing other comprehensive measures to assure long-term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures;

   b. For a partnership or sole proprietorship: By a general partner or the proprietor, respectively; or

   c. For a municipality, State, Federal or other public agency: By either a principal executive officer or ranking elected official. For purposes of this section, a principal executive officer of a Federal agency includes (1) the chief executive officer of the agency or (2) a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrators of U.S. EPA).

2. All reports required by the permits and other information requested by the director shall be signed by a person described in Part V.G.1 of this permit or by a duly authorized representative of that person. A person is a duly authorized representative only if:

Part V.G.2

a. The authorization is made in writing by a person described in Part V.G.1 of this permit and submitted to the director;

b. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of manager, operator of a well or well field, superintendent, position of equivalent responsibility or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position); and

c. The written authorization is submitted to the director.

3. Changes to authorization. If an authorization under Part V.G.2 of this permit is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of Part V.G.2 of this permit must be submitted to the director prior to or together with any reports, information or applications to be signed by an authorized representative.

H. Certification.

Any person signing documents under this section shall make the following certification:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

I. Oil and hazardous substance liability.

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities or penalties to which the permittee is or may be subject under section 311 of the CWA or 40 CFR Part 112. 40 CFR Part 112 establishes procedures, methods and equipment and other requirements for equipment to prevent the discharge of oil from non-transportation-related onshore and offshore facilities into or upon the navigable surface waters of the State or adjoining shorelines.

Part V

J. Property rights.

The issuance of this permit does not convey any property rights of any sort, nor any exclusive privileges, nor does it authorize any injury to private property nor any invasion of personal rights, nor any infringement of Federal, State or local laws or regulations.

K. Severability.

The provisions of this permit are severable and if any provision of this permit or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances and the remainder of this permit shall not be affected thereby.

L. Transfers.

Ohio NPDES general permit coverage is transferable. Ohio EPA must be notified in writing sixty days prior to any proposed transfer of coverage under an Ohio NPDES general permit. The transferee must inform Ohio EPA it will assume the responsibilities of the original permittee transferor.

M. Environmental laws.

No condition of this permit shall release the permittee from any responsibility or requirements under other environmental statutes or regulations.

N. Proper operation and maintenance.

The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit and with the requirements of SWP3s. Proper operation and maintenance requires the operation of backup or auxiliary facilities or similar systems, installed by a permittee only when necessary to achieve compliance with the conditions of the permit.

O. Inspection and entry.

The permittee shall allow the director or an authorized representative of Ohio EPA, upon the presentation of credentials and other documents as may be required by law, to:

Part V.O

1. Enter upon the permittee's premises where a regulated facility or activity is located or conducted or where records must be kept under the conditions of this permit;

2. Have access to and copy at reasonable times, any records that must be kept under the conditions of this permit; and

3. Inspect at reasonable times any facilities or equipment (including monitoring and control equipment).

PART VI. REOPENER CLAUSE

A. If there is evidence indicating potential or realized impacts on water quality due to any storm water discharge associated with construction activity covered by this permit, the permittee of such discharge may be required to obtain coverage under an individual permit or an alternative general permit in accordance with Part I.C of this permit or the permit may be modified to include different limitations and/or requirements.

B. Permit modification or revocation will be conducted according to ORC Chapter 6111.

PART VII. DEFINITIONS

A. "Act" means Clean Water Act (formerly referred to as the Federal Water Pollution Control Act or Federal Water Pollution Control Act Amendments of 1972) Pub. L. 92-500, as amended Pub. L. 95-217, Pub. L. 95-576, Pub. L. 96-483, Pub. L. 97-117 and Pub. L. 100-4, 33 U.S.C. 1251 et. seq.

B. "Best management practices (BMPs)" means schedules of activities, prohibitions of practices, maintenance procedures and other management practices (both structural and non-structural) to prevent or reduce the pollution of surface waters of the state. BMP's also include treatment requirements, operating procedures and practices to control plant and/or construction site runoff, spillage or leaks, sludge or waste disposal or drainage from raw material storage.

C. "Commencement of construction" means the initial disturbance of soils associated with clearing, grubbing, grading, placement of fill or excavating activities or other construction activities.

D. "Concentrated storm water runoff" means any storm water runoff which flows through a drainage pipe, ditch, diversion or other discrete conveyance channel.

E. "Director" means the director of the Ohio Environmental Protection Agency.

Part VII

F. "Discharge" means the addition of any pollutant to the surface waters of the state from a point source.

G. "Disturbance" means any clearing, grading, excavating, filling, or other alteration of land surface where natural or man-made cover is destroyed in a manner that exposes the underlying soils.

H. "Final stabilization" means that either:

1. All soil disturbing activities at the site are complete and a uniform perennial vegetative cover (e.g., evenly distributed, without large bare areas) with a density of at least 70 percent cover for the area has been established on all unpaved areas and areas not covered by permanent structures or equivalent stabilization measures (such as the use of mulches, rip-rap, gabions or geotextiles) have been employed. In addition, all temporary erosion and sediment control practices are removed and disposed of and all trapped sediment is permanently stabilized to prevent further erosion; or

2. For individual lots in residential construction by either:

   a. The homebuilder completing final stabilization as specified above or

   b. The homebuilder establishing temporary stabilization including perimeter controls for an individual lot prior to occupation of the home by the homeowner and informing the homeowner of the need for and benefits of, final stabilization. (Homeowners typically have an incentive to put in the landscaping functionally equivalent to final stabilization as quick as possible to keep mud out of their homes and off sidewalks and driveways.); or

3. For construction projects on land used for agricultural purposes (e.g., pipelines across crop or range land), final stabilization may be accomplished by returning the disturbed land to its pre-construction agricultural use. Areas disturbed that were previously used for agricultural activities, such as buffer strips immediately adjacent to surface waters of the state and which are not being returned to their pre-construction agricultural use, must meet the final stabilization criteria in (1) or (2) above.

I. "Individual Lot NOI" means a Notice of Intent for an individual lot to be covered by this permit (see parts I and II of this permit).

J. "Larger common plan of development or sale"- means a contiguous area where multiple separate and distinct construction activities may be taking place at different times on different schedules under one plan.

Part VII

K. "MS4" means municipal separate storm sewer system which means a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels or storm drains) that are:

1. Owned or operated by the federal government, state, municipality, township, county, district(s) or other public body (created by or pursuant to state or federal law) including special district under state law such as a sewer district, flood control district or drainage districts or similar entity or a designated and approved management agency under section 208 of the act that discharges into surface waters of the state; and

2. Designed or used for collecting or conveying solely storm water,

3. Which is not a combined sewer and

4. Which is not a part of a publicly owned treatment works.

L. "National Pollutant Discharge Elimination System (NPDES)" means the national program for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing permits and enforcing pretreatment requirements, under sections 307, 402, 318 and 405 of the CWA. The term includes an "approved program."

M. "NOI" means notice of intent to be covered by this permit.

N. "NOT" means notice of termination.

O. "Operator" means any party associated with a construction project that meets either of the following two criteria:

1. The party has operational control over construction plans and specifications, including the ability to make modifications to those plans and specifications; or

2. The party has day-to-day operational control of those activities at a project which are necessary to ensure compliance with an SWP3 for the site or other permit conditions (e.g., they are authorized to direct workers at a site to carry out activities required by the SWP3 or comply with other permit conditions).

As set forth in Part II.A, there can be more than one operator at a site and under these circumstances, the operators shall be co-permittees.

P. "Owner or operator" means the owner or operator of any "facility or activity" subject to regulation under the NPDES program.

Part VII

Q. "Permanent stabilization" means the establishment of permanent vegetation, decorative landscape mulching, matting, sod, rip rap and landscaping techniques to provide permanent erosion control on areas where construction operations are complete or where no further disturbance is expected for at least one year.

R. "Percent imperviousness" means the impervious area created divided by the total area of the project site.

S. "Point source" means any discernible, confined and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel or the floating craft from which pollutants are or may be discharged. This term does not include return flows from irrigated agriculture or agricultural storm water runoff.

T. "Rainwater and Land Development" is a manual describing construction and post-construction best management practices and associated specifications. A copy of the manual may be obtained by contacting the Ohio Department of Natural Resources, Division of Soil & Water Conservation.

U. "Riparian area" means the transition area between flowing water and terrestrial (land) ecosystems composed of trees, shrubs and surrounding vegetation which serve to stabilize erodible soil, improve both surface and ground water quality, increase stream shading and enhance wildlife habitat.

V. "Runoff coefficient" means the fraction of total rainfall that will appear at the conveyance as runoff.

W. "Sediment settling pond" means a sediment trap, sediment basin or permanent basin that has been temporarily modified for sediment control, as described in the latest edition of the Rainwater and Land Development manual.

X. "State isolated wetland permit requirements" means the requirements set forth in Sections 6111.02 through 6111.029 of the ORC.

Y. "Storm water" means storm water runoff, snow melt and surface runoff and drainage.

Z. "Surface waters of the state" or "water bodies" means all streams, lakes, reservoirs, ponds, marshes, wetlands or other waterways which are situated wholly or partially within the boundaries of the state, except those private waters which do not combine or effect a junction with natural surface or underground waters. Waters defined as sewerage systems, treatment works or disposal systems in Section 6111.01 of the ORC are not included.

Part VII

AA. "SWP3" means storm water pollution prevention plan.

BB. "Temporary stabilization" means the establishment of temporary vegetation, mulching, geotextiles, sod, preservation of existing vegetation and other techniques capable of quickly establishing cover over disturbed areas to provide erosion control between construction operations.

CC. "Water Quality Volume (WQ_v)" means the volume of storm water runoff which must be captured and treated prior to discharge from the developed site after construction is complete. WQ_v is based on the expected runoff generated by the mean storm precipitation volume from post-construction site conditions at which rapidly diminishing returns in the number of runoff events captured begins to occur.

Appendix C

Outfall Graphic

(From NEORSD – June 2007)

CSO Identification number	CSO Location - Description	Number of overflows per year (ESTIMATE)
001	STORM OVERFLOW @ EASTERLY WWTP	27
002	OVERFLOW @ WESTERLY WWTP FROM CSOTF	14
007	BANCROFT AVE., WEST OF WARNER RD., BEHIND 7414 BANCROFT AVE.	65
013	100' WEST OF WEST END OF MARYLAND AVE.	16
014	LAUMAR AVE., WEST OF E. 77TH ST, WEST OF 7684 LAUMAR AVE	35
017	DOWN GRAVEL RD. @ DORVER AVE. & E. 77TH ST., EAST OF RR TRACKS	21
019	UNDER WARNER RD. BRIDGE @, BROADWAY RD., ACCESS THRU WEBBS TERRACE RD.	52
020	ALONG MILL CREEK, WEST OF EXIT RAMP FROM WARNER RD. TO BROADWAY AVE.	14
021	WEST OF E. 94TH ST. & BROADWAY AVE. INTERSECTION, EAST SIDE OF CREEK	33
022	EAST BLVD. BRIDGE, 130' NORTH OF CRANWOOD PUMP STATION	20
025	E. 131ST ST., SOUTH OUTFALL @ CRANWOOD PARK	16
027	SOUTH SIDE OF JOHNSTON RD., NEAR THE FITNESS TRAIL	2
028	LOCATED BETWEEN ENDS OF KOLLIN AVE. & E. 173RD ST.	63
030	EAST 88TH ST. & SOUTH HIGHLAND AVE., BEHIND 5138 EAST 88TH ST.	46
031	WEST OF E. 81ST ST. & VISTA AVE., SOUTH OF DIRT ROAD	70
032	LOCATED IN GARFIELD PARK RESERVATION, ALONG WOLF CREEK, ACROSS FROM NATURE CENTER	58
033	INTERSECT. OF HARVARD AVE. & DENISON AVE., SOUTH OF ALCOA GATE #5	6
035	BURKE BROOK @ CUYAHOGA RIVER	80
036	MORGANA RUN @ CUYAHOGA RIVER, WEST OF CAMPBELL RD. & INDEPENDENCE INTERSECTION	68
037	1500' NORTH OF MORGANA RUN @ CUYAHOGA RIVER [SOUTHERNMOST PIPE]	0
038	600' SOUTHWEST OF E.26TH ST & INDEPENDENCE RD.	0
039	AT CUYAHOGA RIVER TURNING BASIN 400' WEST OF INDEPENDENCE RD.	51
040	KINGSBURY RUN @ CUYAHOGA R., APPROX. 100' NORTH OF JEFFERSON RD.	79
043	EAST OF INTERSECTION OF TARLTON AVE. & W. 15TH ST.	2
044	NORTH OF INTERSECTION OF IRVING AVE. & SOUTH HILLS DR.	5
045	NORTHEAST OF INTERSECTION OF JENNINGS AVE. & VALLEY AVE.	12
049	NORTH OF INTERSECTION OF W. 23RD ST. & SNYDER AVE.	52
050	EAST SIDE OF OLD BRIDGE, UNDER W.25TH ST BRIDGE	9
051	MAIN ENTRANCE OF METROPARK ZOO @ BROOKSIDE DR. AT MOUTH OF TRIPLE CULVERT	18
052	BIG CREEK CULVERT BENEATH MAIN ENTRANCE PARKING LOT @ METROPARK ZOO	1
053	INTERSECTION OF JOHN NAGY BLVD. & W. 57TH ST., SOUTH SIDE OF CREEK	56
054	NORTH OF JOHN NAGY BLVD., JUST WEST OF RIDGE RD. BRIDGE	13
055	UNDER BRIDGE EAST OF BELLAIRE RD. & KENSINGTON RD.	5
056	UNDER BRIDGE EAST OF BELLAIRE RD. & KENSINGTON RD.	64
057	MEMPHIS & I-71, UNDER INTERSTATE	47
058	W. 114TH ST. & PEONY AVE., BEHIND 3628 W. 114TH ST.	61
059	SPRING RD. @ JENNINGS RD.	15
062	MID-POINT OF PURITAS RD. HILL INTO METROPARKS.	
063	SOUTHEAST OF BROOKPARK RD. & W. 10TH ST. INTERSECTION	76
064	END OF LARCHWOOD AVE., WEST OF INTERSECTION WITH RIVEREDGE RD..	4
065	NORTH OF OLD LORAIN RD. BRIDGE OVER ROCKY RIVER	1
066	END OF W. 178TH ST., BEHIND 17810 ALLIEN AVE., HIGH ON HILLSIDE	0

CSO Identification number	CSO Location - Description	Number of overflows per year (ESTIMATE)
067	WEST OF 3870 ROCKY RIVER DR. IN NORTHWEST CORNER OF KAMM'S PLAZA	6
068	OFF HOGSBACK LANE, SOUTHWEST OF INTERSECTION WITH RIVERSIDE DR.	47
069	UPPER EDGEWATER PARK, APPROX. 300 YDS WEST OF BATHING BEACH	0
071	HARBORVIEW DR. & W. 117TH ST., BEHIND 11644 HARBORVIEW DR.	0
072	ACCESS THRU HARVARD REFUSE INC. @ FINNEY RD. & E. 78TH ST., ALONG MILL CREEK	7
073	GIDDINGS BROOK @ DOAN BROOK, NORTHEAST OF INTERSECTION @ BALDWIN RD. & FAIRHILL RD.	33
074	W. 45TH ST. @ OLD RIVER BED	76
075	RIVER RD. & ELM ST.	8
076	CENTER ST. & CUYAHOGA RIVER ON WEST SIDE OF RIVER	11
078	COLUMBUS RD. & CUYAHOGA RIVER ON WEST SIDE OF RIVER	31
079	CARTER RD. @ ALPHA CONCRETE ON EAST SIDE OF RIVER	4
080	UNIVERSITY RD., SOUTHEAST OF 2065 SCRANTON RD.	43
081	DOWNSTREAM OF W. 3RD ST. BRIDGE	5
082	W. 3RD ST. & CUYAHOGA RIVER UNDER BRIDGE ON SOUTH SIDE OF RIVER	9
083	W. 25TH ST. BRIDGE & BIG CREEK, WEST OF BRIDGE ON NORTH SIDE OF CREEK	8
084	1000' EAST OF RIDGE RD. & ASSOCIATE AVE.	0
085	W. 56TH ST., SOUTH OF DENISON AVE., BEHIND PALMER SUPPLY CO.	53
086	MARY ST., EAST OF W. 3RD ST. @ CUYAHOGA RIVER	79
087	EAST OF HOUSTON AVE. & QUIGLEY RD. @ CUYAHOGA RIVER	29
088	LOCATED ON LTV STEEL PROPERTY, NORTH OF W & LE RR BRIDGE, ON WEST SIDE OF RIVER	44
089	EAST OF W. 3RD ST. PUMP STATION	11
090	END OF SUPERIOR AVE. @ CUYAHOGA RIVER	34
091	OLD RIVER RD. & MAIN AVE., ON EAST SIDE OF RIVER	1
092	INTERSECTION OF OLD RIVER RD. & FRONT AVE., @ CUYAHOGA RIVER	26
093	NORTH OF MUNICIPAL STADIUM	66
094	NORTH OF E. 12TH ST. & LAKESIDE AVE. @ USS COD	35
095	NORTH OF E. 20TH ST. & LAKESIDE AVE.	56
096	NORTH OF E. 26TH ST. & LAKESIDE AVE.	14
097	NORTH OF I-71 & I-90	8
098	NORTH OF E. 33RD ST. & LAKESIDE AVE.	64
099	NORTH OF E. 38TH ST. & KING AVE.	70
200	NORTH OF E. 40TH ST. & KING AVE., NORTH OF AVIATION HIGH SCHOOL	80
201	FOREST CITY YACHT CLUB @ MARQUETTE ST. & NORTH MARGINAL DR.	26
202	E. 55TH ST. @ LAKE ERIE	52
203	EAST OF E. 55TH ST., NORTH OF CLEVELAND LAKEFRONT STATE PARK MARINA	14
204	GORDON PARK WEST OF E. 72ND ST. @ LAKE ERIE	48
205	NORTHWEST OF E. 88TH ST. & CARR AVE.	56
206	NORTH END OF E. 156TH ST. @ LAKE ERIE	63
207	NORTHWEST OF E. 156TH ST. & LAKESHORE BLVD. [GREEN CREEK]	0
208	NORTH OF NEFF RD. & EAST PARK DR. INTERSECTION	26
209	WEST SIDE OF EUCLID CREEK @ LAKESHORE BLVD.	50
210	UNDER ST. CLAIR AVE. BRIDGE, EAST OF NOTTINGHAM RD. & ST. CLAIR AVE.	43

CSO Identification number	CSO Location - Description	Number of overflows per year (ESTIMATE)
211	NINE-MILE CREEK, EAST OF COIT RD., BETWEEN RR TRACKS	77
212	BELVOIR BLVD. OPPOSITE QUILLIAMS AVE.[EAST SIDE OF CREEK]	32
214	BEHIND AMERICAN STEEL SUPPLIES @ SARANAC RD. & E. 170TH ST. ALONG RR TRACKS	63
215	WEST SIDE OF DOAN BROOK @ ST. CLAIR AVENUE	0
216	WEST OF PARKGATE AVE. & EAST BLVD., EAST SIDE OF DOAN BROOK	0
217	WEST OF MARTIN LUTHER KING BLVD. & E. 98TH ST., EAST SIDE OF DOAN BROOK	53
218	EAST SIDE OF DOAN BROOK, SOUTH OF SUPERIOR AVENUE	39
219	WEST SIDE OF DOAN BROOK, NORTH OF SUPERIOR AVENUE	35
220	ACROSS FROM INTERSECTION OF EAST BLVD. & ASHBURY BLVD. ON EAST SIDE OF DOAN BROOK	31
221	E. 105TH ST. & HOUGH AVE.	30
222	E. 105TH ST. & DOAN BROOK ON SOUTH SIDE OF DOAN BROOK	29
223	NORTH OF E. 107TH ST. & PARKLANE RD., BEHIND ART MUSEUM	44
224	NORTH OF E. 107TH ST. & PARKLANE RD., BEHIND ART MUSEUM WHERE DOAN BROOK LEAVES CULVERT	*
225	NORTH OF KEMPER RD. & FAIRHILL RD. @ DOAN BROOK	0
226	ALONG CREEK NORTH OF LARCHMERE & COVENTRY RD. INTERSECTION, DOWNSTREAM OF BRIDGE OVER CREEK	16
230	DUGWAY BROOK, APPROX. 600' UPSTREAM OF LAKESHORE BLVD.	76
231	DUGWAY BROOK, APPROX. 600' UPSTREAM OF LAKESHORE BLVD.	77
232	SOUTH SIDE OF I-90, EAST OF EDDY RD. @ SHAW BROOK	82
233	W. 150TH ST., SOUTH OF INDUSTRIAL PKWY, UNDER BRIDGE OVER BIG CREEK	72
234	DOAN BROOK BETWEEN MARTIN LUTHER KING BLVD. & E. 105TH ST., [EAST SIDE OF CULVERT]	40
235	W. 3RD ST. @ CANAL RD. , EAST SIDE OF CUYAHOGA RIVER	27
236	SPRING BROOK @ DOAN BROOK, BEHIND POND @ MARTIN LUTHER KING BLVD. & HOUGH AVE.	0
238	NORTH SIDE OF APT. PARKING LOT @ ROCKY RIVER RD. & FAIRWAY AVE.	20
239	EAST SHORE OF EUCLID CREEK @ LAKESHORE BLVD.	39
240	JEFFERSON AVE., EAST OF W. 3RD ST.	17
241	I-71 UNDER EATON CORP. SIGN	0
242	E. 142ND ST. & LAKESHORE BLVD.	14
243	IN RAVINE, WEST OF WARNER RD., SOUTH OF GARFIELD RD.	33
245	EDGEPARK DR. @ E. 117TH ST. [NORTH]	51
246	BROADWAY AVE. @ MILL CREEK, EAST WALL OF BRIDGE	0
247	EAST BLVD. @ CRANWOOD CREEK, NORTH OF THORNHURST AVE.	1
249	450' EAST OF E. 119TH ST. & 250' NORTH OF MCCRACKEN RD.	6
250	ALONG CUYAHOGA RIVER, 370' SOUTH OF CANAL RD., EAST SIDE OF I-77 BRIDGE	13
251	ALONG B&O RR TRACKS, 2200' NORTH OF CANAL RD.	49
252	BETWEEN E. 71ST ST. & I-77, SOUTH OF BUILDING @ 4620 E. 71ST ST.	14

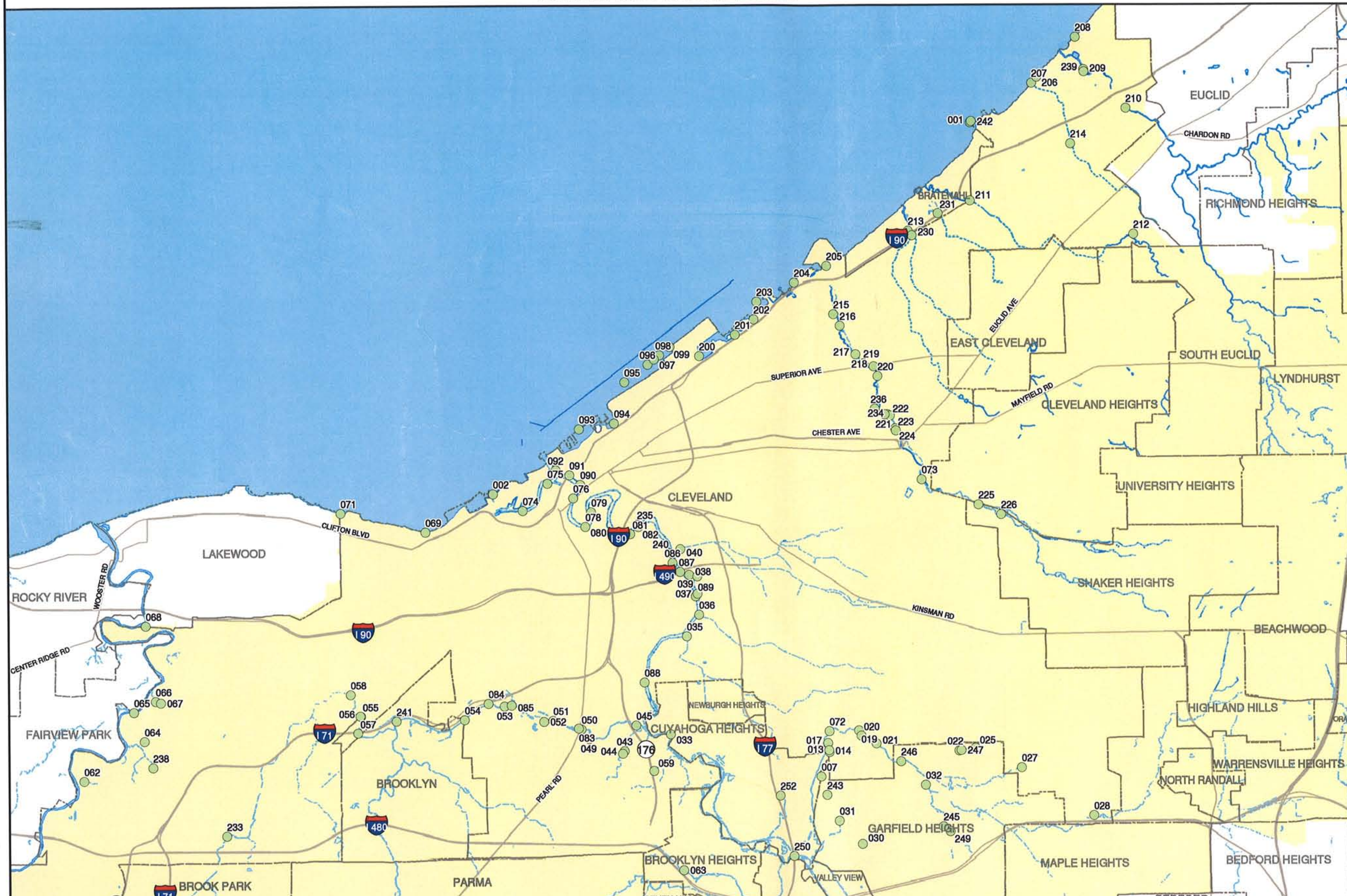
Appendix D

Combined Sewer Graphic (NEORSD graphic)

Northeast Ohio Regional Sewer District

Combined SewerOverflow Locations

Northeast Ohio Regional Sewer District
Protecting Your Health and Environment



Legend

- CSO Outfalls
- Major Roads
- Rivers and Streams
- Culverted Stream
- Service Area Boundaries
- Community

7,600
Feet

Appendix E

OEPA letter – Update on Alternative Post-Construction Stormwater Best Management Practices (BMPs), October 26, 2006

OhioEPA

State of Ohio Environmental Protection Agency

STREET ADDRESS:

Lazarus Government Center
122 S. Front Street
Columbus, Ohio 43215

TELE: (614) 644-3020 FAX: (614) 644-3184
www.epa.state.oh.us

MAILING ADDRESS:

P.O. Box 1049
Columbus, OH 43216-1049

October 26, 2006

Mr. Tony Vogel
Deputy Director of Highway Operations
Ohio Department of Transportation
1980 West Broad Street
Columbus, OH 43216-0899

Re: Update on Alternative Post-Construction Storm Water Best Management Practices (BMPs)

Dear Mr. Vogel;

I am writing to provide you with a status report of where Ohio EPA believes our two departments are regarding ODOT projects and alternative post-construction BMPs.

As you are aware, our staffs, in conjunction with representatives of ODNR-Division of Soil and Water Conservation, have been meeting routinely for some time on the issue of post-construction requirements and how to apply those to roadway projects. It has been quite an effort to learn each others terminology and appreciate one another's perspectives on this matter. There were some missteps and mis-communications along the way, but I believe all parties have reached consensus on alternative BMPs that are believed practical for roadway projects as well as being equivalent in effectiveness to those prescribed in Part III.G.2.e. of our standard storm water construction general permit (CGP), permit #OHC000002. Therefore, Ohio EPA will accept the use of ODOT's alternative BMPs including parabolic overwide water quality channels (when trapezoidal channels are infeasible) to comply with projects covered by our standard construction general permit. Our acceptance of the alternative BMPs is conditioned, as previously discussed and in accordance with the CGP and on ODOT performing monitoring to confirm that its alternative BMPs are equivalent in effectiveness to those in the permit. Our staffs will need to continue to meet, and we hope ODNR-Soil and Water Conservation staff would continue to participate, to work out the details of a monitoring program. If an agreed upon monitoring program does not confirm the equivalency of the alternative BMPs, then ODOT would either have to use the prescribed CGP BMPs in the future or suggest other alternatives.

I request that ODOT's Location & Design (L&D) manual be revised, as quickly as possible, to include the overwide channel BMP and that we be given an opportunity to review those revisions. In addition, we believe the L&D manual requires revision regarding redevelopment projects. Section 1115.1 states that a BMP is not required if there is no increase in impervious area on a project. As mentioned in my July 6, 2006, letter to Mr. David Riley that is incorrect. Part III.G.2.e. of the CGP does require post-construction BMPs for redevelopment projects, but only for 20% of the water quality volume. Given that

ODOT projects disturbing 1 to 5 acres are considered, for the most part, maintenance projects not requiring a permit, this requirement would seem to only impact ODOT redevelopment projects disturbing 5 or more acres. Therefore, I would appreciate ODOT revising the manual accordingly at its earliest convenience.

Another issue regarding ODOT and the storm water program has recently come to our attention. In the last couple of weeks we have received inquiries regarding municipal separate storm sewer system (MS4) operators ability to inspect ODOT construction projects in their jurisdictions. Apparently some localities have been told by ODOT officials that MS4s have no authority over ODOT projects. As the Phase II MS4 program implementation deadline of 2008 approaches we suspect this issue will be raised again so I believe now is a good time for Ohio EPA to be fully informed on this topic.

My staff remembers from meetings with ODOT staff several years ago, that ODOT stated under Ohio law neither counties or townships have authority over ODOT construction projects in regards to storm water. My staff believes they were told this was conditioned upon ODNR-Soil and Water Conservation approving ODOT's soil and erosion control specifications. We would appreciate all relevant documentation you can provide us on localities ability to regulate ODOT projects regarding storm water as it relates to our program, including post-construction requirements. I think having such documentation will reduce confusion on the part of Ohio EPA staff and MS4 operators.

I very much appreciate ODOT's efforts in regards to our storm water construction program. I truly believe through open communication we can come to agreement in a way that both departments can fulfill their missions. We look forward to receiving your revised L&D manual. Unless I hear from you to the contrary, we will continue to view David Riley as our point of contact. We will be contacting Mr. Riley shortly to arrange a meeting regarding monitoring of the alternative BMPs. If you would like to discuss anything I have mentioned, please contact me at: 614-644-2023.

Sincerely,

Mark Mann, Manager
Storm Water & Enforcement Section

cc: Mr. David Riley, ODOT
Mr. John Mathews, ODNR
Mr. Dan Mecklenburg, ODNR
Mr. Harry Kallipolitis , OEPA
Mr. Mike Joseph, OEPA
Mr. John Morrison, OEPA

Appendix F

Ohio EPA Municipal Separate Storm Sewer System – OEPA OHQ000001

NPDES Permit No.: OHQ000001

Effective Date: December 27, 2002

Expiration Date: December 26, 2007

OHIO ENVIRONMENTAL PROTECTION AGENCY

AUTHORIZATION FOR SMALL MUNICIPAL SEPARATE STORM SEWER SYSTEMS TO DISCHARGE STORM WATER UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the Federal Water Pollution Control Act, as amended (33 U.S.C. 1251 et. seq. hereafter referred to as "the Act"), and the Ohio Water Pollution Control Act (Ohio Revised Code Chapter 6111), dischargers of storm water from Small Municipal Separate Storm Sewer Systems, as defined in Part 7 of this permit, are authorized by the Ohio Environmental Protection Agency, hereafter referred to as "Ohio EPA," to discharge from the outfalls and to the receiving surface waters of the state identified in their Notices of Intent (NOI) Application form on file with Ohio EPA in accordance with the conditions specified in this permit.

Granting of general permit coverage is conditioned upon payment of applicable fees, submittal of a complete NOI Application form and storm water management program (SWMP), and written approval of coverage from the director of Ohio EPA.

Original signed by Christopher Jones

Christopher Jones
Director

Table of Contents

1 Coverage Under this Permit

1.1 Permit Area

This permit covers the State of Ohio

1.2 **Eligibility** - All small municipal separate storm sewer systems (MS4s) unless the director of Ohio EPA has given written notification to an MS4 that coverage under this general permit is inappropriate.

1.2.1 This permit authorizes discharges of storm water from small MS4s, as defined in Part 6 of this permit. You are authorized to discharge under the terms and conditions of this general permit if you:

1.2.1.1 Operate a small MS4 within the permit area described in Part 1.1 of this permit,

1.2.1.2 Are not a "large" or "medium" MS4 as defined in Part 6 of this permit, and

1.2.1.3 Submit a Notice of Intent (NOI) in accordance with Part 2 of this permit, and

1.2.1.4 Are located fully or partially within an urbanized area as determined by the 2000 Decennial Census by the Bureau of Census, or

1.2.1.5 Are designated for permit authorization by Ohio EPA.

1.2.2 The following are types of authorized discharges:

1.2.2.1 *Storm water discharges.* This permit authorizes storm water discharges to surface waters of the State from the small MS4s identified in Part 1.2.1, except as excluded in Part 1.3.

1.2.2.2 *Non-storm water discharges.* You are authorized to discharge the following non-storm water sources provided that Ohio EPA has not determined, and notified you in writing, these sources are substantial contributors of pollutants to your MS4:

S Waterline flushing
S Landscape irrigation
S Diverted stream flows
S Rising ground waters
S Uncontaminated ground water infiltration (infiltration is defined as water other than wastewater that enters a sewer system, including sewer service connections and foundation drains, from the ground through such means as defective pipes, pipe joints, connections, or manholes. Infiltration does not include, and is distinguished from, inflow.)
S Uncontaminated pumped ground water
S Discharges from potable water sources
S Foundation drains
S Air conditioning condensate
S Irrigation water
S Springs
S Water from crawl space pumps
S Footing drains
S Lawn watering
S Individual residential car washing
S Flows from riparian habitats and wetlands
S Dechlorinated swimming pool discharges
S Street wash water
S Discharges or flows from fire fighting activities

1.3 Limitations on Coverage

This permit does not authorize:

1.3.1 Discharges that are mixed with sources of non-storm water unless such non-storm water discharges are:

- S In compliance with a separate National Pollutant Discharge Elimination System (NPDES) permit, or
- S Determined by Ohio EPA not to be a substantial contributor of pollutants to surface waters of the State.

1.3.2 Storm water discharges associated with industrial activity as defined in 40 CFR §122.26(b)(14)(i)-(ix) and (xi) that are not in compliance with a separate in force NPDES permit.

1.3.3 Storm water discharges associated with construction activity as defined in 40 CFR §122.26(b)(14)(x) or 40 CFR §122.26(b)(15) that are not in compliance with a separate in force NPDES permit.

1.3.4 Storm water discharges currently covered under another permit.

1.3.5 Discharges that would cause or contribute to in-stream exceedances of water quality standards. Ohio EPA may require additional actions or an application for an individual permit or alternative general permit if an MS4 is determined to cause an in-stream exceedance of water quality standards.

1.3.6 Discharges of any pollutant into any water for which a Total Maximum Daily Load (TMDL) has been approved by U.S. EPA (this information can be obtained from Ohio EPA) unless your discharge is consistent with that TMDL. This eligibility condition applies at the time you submit an NOI for coverage. If conditions change after you have permit coverage, you may remain covered by the permit provided you comply with the applicable requirements of the TMDL. For discharges that cannot comply with TMDL requirements under this permit, you will be instructed by Ohio EPA to apply for an individual or other applicable general NPDES permit.

1.3.7 Discharges that do not comply with Ohio EPA's anti-degradation policy for water quality standards.

1.4 Obtaining Authorization

1.4.1 To be authorized to discharge storm water from small MS4s, you must submit an NOI and your Storm Water Management Program (SWMP) in accordance with the deadlines presented in Part 2.1 of this permit.

1.4.2 Your NOI, to be completed on a form furnished by Ohio EPA, must be signed and dated in accordance with Part 5.7 of this permit.

1.4.3 Until notified in writing by Ohio EPA, dischargers who submit an NOI in accordance with the requirements of this permit are not covered by this permit. The Agency may deny coverage under this permit and require submittal of an application for an individual NPDES permit or alternative general permit based on a review of the NOI or other information (see Part 5.16).

1.4.4 Where an operator is added or removed after submittal of an NOI under Part 2 of this permit, a new NOI must be submitted in accordance with Part 2 prior to the change.

2 Notice of Intent Requirements

2.1 Deadlines for Notification

2.1.1 If you are automatically designated under 40 CFR §122.32(a)(1) to obtain coverage under this permit, then you are required to submit an NOI and your SWMP or apply for an individual permit by March 10, 2003.

2.1.2 *Additional designations.* If you are designated by Ohio EPA, then you are required to submit an NOI and your SWMP to Ohio EPA within 180 days of notice.

2.1.3 *Submitting a Late NOI.* You are not prohibited from submitting an NOI after the dates provided in Part 2.1 of this permit. If a late NOI is submitted, your authorization is only for discharges that occur after permit coverage is granted. Ohio EPA reserves the right to take appropriate enforcement actions against MS4s that have not submitted a timely NOI.

2.2 Where to Submit

You are to submit your NOI, signed in accordance with the signatory requirements of Part 5.7 of this permit, to Ohio EPA at the following address:

Ohio EPA
Office of Fiscal Administration
P.O. Box 1049
122 South Front Street
Columbus, Ohio 43216-1049

2.3 Co-Permittees Under a Single NOI

You may partner with other MS4s to develop and implement your SWMP. You may also jointly submit an NOI with one or more MS4s. Your SWMP must clearly describe which permittees are responsible for implementing each of the control measures.

3 Storm Water Management Programs

3.1 Requirements

3.1.1 You must develop, implement, and enforce an SWMP designed to reduce the discharge of pollutants from your small MS4 to the maximum extent practicable (MEP), to protect water quality, and to satisfy the appropriate water quality requirements of Ohio Revised Code (ORC) 6111. and the Clean Water Act. The SWMP should include management practices; control techniques and system, design, and engineering methods; and shall be modified to include provisions as Ohio EPA determines appropriate after its review of the program for the control of such pollutants. Your SWMP must include the following information for each of the six minimum control measures described in Part 3.2 of this permit:

3.1.1.1 The best management practices (BMPs) that you or another entity will or already does implement for each of the storm water minimum control measures;

3.1.1.2 For each BMP identified, statements indicating whether you believe you have the legal authority to implement said BMP.

3.1.1.3 The measurable goals for each of the BMPs, the ones you believe you have the authority to implement, including, as appropriate, the months and years in which you will undertake required actions, including interim milestones and the frequency of the action; and

3.1.1.4 The person or persons, including position title or titles, responsible for implementing or coordinating the BMPs for your SWMP.

3.1.2 In addition to the requirements listed above, you must provide a rationale for how and why you selected each of the BMPs and measurable goals for your SWMP. You must develop and implement your program within five years of when your coverage under this general permit was granted.

3.2 Minimum Control Measures

The six minimum control measures that must be included in your SWMP are:

3.2.1 Public Education and Outreach on Storm Water Impacts

3.2.1.1 *Permit requirement.* You must implement a public education program to distribute educational materials to the community or conduct equivalent outreach activities about the impacts of storm water discharges on water bodies and the steps that the public can take to reduce pollutants in storm water runoff. In the case of non-traditional MS4s (e.g., ODOT, universities, hospitals, prisons, military bases, and other government complexes), you are only required to provide educational materials and outreach to your employees, on-site contractors, and individuals using your facilities.

3.2.1.2 *Decision process.* You must document your decision process for the development of a storm water public education and outreach program. Your rationale statement must address both your overall public education program and the individual BMPs, measurable goals and responsible persons for your program. The rationale statement must include the following information, at a minimum:

3.2.1.2.1 How you plan to inform individuals and households about the steps they can take to reduce storm water pollution.

3.2.1.2.2 How you plan to inform individuals and groups on how to become involved in the storm water program (with activities such as local stream and beach restoration activities).

3.2.1.2.3 Who are the target audiences for your education program who are likely to have significant storm water impacts (including commercial, industrial and institutional entities) and why those target audiences were selected.

3.2.1.2.4 What are the target pollutant sources your public education program is designed to address.

3.2.1.2.5 What is your outreach strategy, including the mechanisms (e.g., printed brochures, newspapers, media, workshops, etc.) you will use to reach your target audiences, and how many people do you expect to reach by your outreach strategy over the permit term.

3.2.1.2.6 Who (person or department) is responsible for overall management and implementation of your storm water public education and outreach program and, if different, who is responsible for each of the BMPs identified for this program.

3.2.1.2.7 How will you evaluate the success of this minimum measure, including how you selected the measurable goals for each of the BMPs.

3.2.2 Public Involvement/Participation

3.2.2.1 *Permit requirement.* You must at a minimum, comply with State and local public notice requirements when implementing a public involvement/participation program. In the case of non-traditional MS4s (e.g., ODOT, universities, hospitals, prisons, military bases, and other government complexes), you are required to involve employees, on-site contractors, and individuals using your facilities.

3.2.2.2 *Decision process.* You must document your decision process for the development of a storm water public involvement/participation program. Your rationale statement must address both your overall public involvement/participation program and the individual BMPs, measurable goals, and responsible persons for your program. The rational statement must include the following information, at a minimum:

3.2.2.2.1 Have you involved the public in the development and submittal of your NOI and SWMP description.

3.2.2.2.2 What is your plan to actively involve the public in the development and implementation of your program.

3.2.2.2.3 Who are the target audiences for your public involvement program, including a description of the types of ethnic and economic groups engaged. You are encouraged to actively involve all potentially affected stakeholder groups, including commercial and industrial businesses, trade associations, environmental groups, homeowners associations, and educational organizations, among others.

3.2.2.2.4 What are the types of public involvement activities included in your program. Where appropriate, consider the following types of pubic involvement activities:

3.2.2.2.4.1 Citizen representatives on a storm water management panel

3.2.2.2.4.2 Public hearings

3.2.2.2.4.3 Working with citizen volunteers willing to educate others about the program

3.2.2.2.4.4 Volunteer monitoring or stream/beach clean-up activities

3.2.2.2.5 Who (person or department) is responsible for the overall management and implementation of your storm water public involvement/participation program and, if different, who is responsible for each of the BMPs identified for this program.

3.2.2.2.6 How you will evaluate the success of this minimum measure, including how you selected the measurable goals for each of the BMPs.

3.2.3 Illicit Discharge Detection and Elimination

3.2.3.1 *Permit requirement.* You must:

3.2.3.1.1 Develop, implement and enforce a program to detect and eliminate illicit discharges, as defined Part 6 of this permit, into your small MS4 (for illicit discharges to your MS4 via an adjacent, outside of your jurisdiction, interconnected MS4, you are only required to inform the neighboring MS4 and Ohio EPA in your annual report submission, of their existence);

3.2.3.1.2 Develop, if not already completed, a storm sewer system map, showing the location of all outfalls and the names and location of all surface waters of the State that receive discharges from those outfalls;

3.2.3.1.2.1 Within five years of when your coverage under this general permit was granted, you must submit the following to Ohio EPA:

3.2.3.1.2.1.1 A list of all on-site sewage disposal systems connected to discharge to your MS4 (a.k.a. home sewage treatment systems (HSTSs)) including the addresses; and

3.2.3.1.2.1.2 A storm sewer map showing the location of all HSTSs connected to your MS4. This map shall include details on the type and size of conduits/ditches in your MS4 that receive discharges from HSTSs, as well as the water bodies receiving the discharges from your MS4.

3.2.3.1.3 To the extent allowable under State or local law, effectively prohibit, through ordinance, or other regulatory mechanism, illicit discharges into your storm sewer system and implement appropriate enforcement procedures and actions;

3.2.3.1.4 Develop and implement a plan to detect and eliminate non-storm water discharges, including illegal dumping, to your system;

3.2.3.1.5 Inform public employees, businesses, and the general public of hazards associated with illegal discharges and improper disposal of waste; and

3.2.3.1.6 Address the following categories of non-storm water discharges or flows (i.e., illicit discharges) only if you identify them as significant contributors of pollutants to your small MS4: water line flushing, landscape irrigation, diverted stream flows, rising ground waters, uncontaminated ground water infiltration (as defined at 40 CFR §35.2005(20)), uncontaminated pumped ground water, discharges from potable water sources, foundation drains, air conditioning condensation, irrigation water, springs, water from crawl space pumps, footing drains, lawn watering, individual residential car washing, flows from riparian habitats and wetlands, dechlorinated swimming pool discharges, street wash water, and discharges or flows from fire fighting activities (by definition, not an illicit discharge).

3.2.3.1.7 You may also develop a list of other similar occasional incidental non-storm water discharges (e.g., non-commercial or charity car washes, etc.) that will not be addressed as illicit discharges. These non-storm water discharges must not be reasonably expected (based on information available to the permittees) to be significant sources of pollutants to the MS4, because of either the nature of the discharges or conditions you have established for allowing these discharges to your MS4 (e.g., a charity car wash with appropriate controls on frequency, proximity to sensitive water bodies, BMPs on the wash water, etc.). You must document in your SWMP any local controls or conditions placed on the discharges. You must include a provision prohibiting any individual non-storm water discharge that is determined to be contributing significant amounts of pollutants to your MS4.

3.2.3.2 *Decision process.* You must document your decision process for the development of a storm water illicit discharge detection and elimination program. Your rationale statement must address both your overall illicit discharge detection and elimination program and the individual BMPs, measurable goals, and responsible persons for your program. The rational statement must include the following information, at a minimum:

3.2.3.2.1 How you will develop a storm sewer map showing the location of all outfalls and the names and location of all receiving waters. Describe the sources of information you used for the maps, and how you plan to verify the outfall locations with field surveys. If already completed, describe how you developed this map. Also, describe how your map will be regularly updated.

3.2.3.2.2 The mechanism (ordinance or other regulatory mechanism) you will use to effectively prohibit illicit discharges into the MS4 and why you chose that mechanism. If you need to develop this mechanism, describe your plan and a schedule to do so. If your ordinance or regulatory mechanism is already developed, include a copy of the relevant sections with your program.

3.2.3.2.3 Your plan to ensure through appropriate enforcement procedures and actions that your illicit discharge ordinance (or other regulatory mechanism) is implemented.

3.2.3.2.4 Your plan to detect and address illicit discharges to your system, including discharges from illegal dumping and spills. Your plan must include dry weather field screening for non-storm water flows and Ohio EPA recommends field tests of selected chemical parameters as indicators of discharge sources. Your plan must also address on-site sewage disposal systems (including failing on-lot HSTSs and off-lot discharging HSTSs) that flow into your storm drainage system. Your description must address the following, at a minimum:

3.2.3.2.4.1 Procedures for locating priority areas which include areas with higher likelihood of illicit connections (e.g., areas with older sanitary sewer lines, for example) or ambient sampling to locate impacted reaches;

3.2.3.2.4.2 Procedures for tracing the source of an illicit discharge, including the specific techniques you will use to detect the location of the source;

3.2.3.2.4.3 Procedures for removing the source of the illicit discharge; and

3.2.3.2.4.4 Procedures for program evaluation and assessment.

3.2.3.2.5 How you plan to inform public employees, businesses, and the general public of hazards associated with illegal discharges and improper disposal of waste. Include in your description how this plan will coordinate with your public education minimum measure and your pollution prevention/good housekeeping minimum measure programs.

3.2.3.2.6 Who is responsible for overall management and implementation of your storm water illicit discharge detection and elimination program and, if different, who is responsible for each of the BMPs identified for this program.

3.2.3.2.7 How you will evaluate the success of this minimum measure, including how you selected the measurable goals for each of the BMPs.

3.2.4 Construction Site Storm Water Runoff Control

3.2.4.1 *Permit requirement.* You must develop, implement, and enforce a program to reduce pollutants in any storm water runoff to your small MS4 from construction activities that result in a land disturbance of greater than or equal to one acre. Reduction of pollutants in storm water discharges from construction activity disturbing less than one acre must be included in your program if that construction activity is part of a larger common plan of development or sale that would disturb one acre or more. If Ohio EPA waives requirements for storm water discharges associated with small construction from a specific site(s), you are not required to enforce your program to reduce pollutant discharges from such site(s). Your program must include the development and implementation of, at a minimum:

3.2.4.1.1 An ordinance or other regulatory mechanism to require erosion and sediment controls, as well as sanctions to ensure compliance, to the extent allowable under State or local law;

3.2.4.1.2 Requirements for construction site operators to implement appropriate erosion and sediment control BMPs;

3.2.4.1.3 Requirements for construction site operators to control waste such as discarded building materials, concrete truck washout, chemicals, litter, and sanitary waste at the construction site that may cause adverse impacts to water quality;

3.2.4.1.4 Procedures for site plan review which incorporate consideration of potential water quality impacts;

3.2.4.1.5 Procedures for receipt and consideration of information submitted by the public; and

3.2.4.1.6 Procedures for site inspection and enforcement of control measures.

3.2.4.2 *Decision process.* You must document your decision process for the development of a construction site storm water control program. Your rationale statement must address both your overall construction site storm water control program and the individual BMPs, measurable goals, and responsible persons for your program. The rationale statement must include the following information, at a minimum:

3.2.4.2.1 The mechanism (ordinance or other regulatory mechanism) you will use to require erosion and sediment controls at construction sites and why you chose that mechanism. If you need to develop this mechanism, describe your plan and a schedule to do so. If your ordinance or regulatory mechanism is already developed, include a copy of the relevant sections with your SWMP description;

3.2.4.2.2 Your plan to ensure compliance with your erosion and sediment control regulatory mechanism, including the sanctions and enforcement mechanisms you will use to ensure compliance. Describe your procedures for when you will use certain sanctions. Possible sanctions include non-monetary penalties (such a stop work orders), fines, bonding requirements, and/or permit denials for non-compliance;

3.2.4.2.3 Your requirements for construction site operators to implement appropriate erosion and sediment control BMPs and control waste at construction sites that may cause adverse impacts to water quality. Such waste includes discarded building materials, concrete truck washouts, chemicals, litter, and sanitary waste;

3.2.4.2.4 Your procedures for site plan review, including the review of pre-construction site plans, which incorporate consider of potential water quality impacts. Describe your procedures and the rationale for how you will identify certain sites for site plan review, if not all plans are reviewed. Describe the estimated number and percentage of site that will have pre-construction site plans reviewed;

3.2.4.2.5 Your procedures for receipt and consideration of information submitted by the public. Consider coordinating this requirement with your public education program;

3.2.4.2.6 Your procedures for site inspection and enforcement of control measures, including how you will prioritize sites for inspection;

3.2.4.2.7 Who is responsible for overall management and implementation of your construction site storm water control program and, if different, who is responsible for each of the BMPs identified for this program; and

3.2.4.2.8 Describe how you will evaluate the success of this minimum measure, including how you selected the measurable goals for each of the BMPs.

3.2.5 Post-Construction Storm Water Management in New Development and Redevelopment

3.2.5.1 *Permit requirement.* You must:

3.2.5.1.1 Develop, implement, and enforce a program to address storm water runoff from new development and redevelopment projects that disturb greater than or equal to one acre, including projects less than one acre that are part of a larger common plan of development or sale, that discharge into your small MS4. Your program must ensure that controls are in place that would prevent or minimize water quality impacts;

3.2.5.1.2 Develop and implement strategies which include a combination of structural and/or non-structural BMPs appropriate for your community;

3.2.5.1.3 Use an ordinance or other regulatory mechanism to address post-construction runoff from new development and redevelopment projects to the extent allowable under State or local law; and

3.2.5.1.4 Ensure adequate long-term operation and maintenance of BMPs.

3.2.5.2 *Decision process.* You must document your decision process for the development of a post-construction SWMP. Your rationale statement must address both your overall post-construction

SWMP and the individual BMPs, measurable goals, and responsible persons for your program. The rational statement must include the following information, at a minimum:

3.2.5.2.1 Your program to address storm water runoff from new development and redevelopment projects. Include in this description any specific priority areas for this program.

3.2.5.2.2 How your program will be specifically tailored for your local community, minimize water quality impacts, and attempt to maintain pre-development runoff conditions.

3.2.5.2.3 Any non-structural BMPs in your program, including, as appropriate:

3.2.5.2.3.1 Policies and ordinances that provide requirements and standards to direct growth to identified areas, protect sensitive areas such as wetlands and riparian areas, maintain and/or increase open space (including a dedicated funding source for open space acquisition), provide buffers along sensitive water bodies, minimize impervious surfaces, and minimize disturbance of soils and vegetation;

3.2.5.2.3.2 Policies or ordinances that encourage infill development in higher density urban areas, and areas with existing storm sewer infrastructure;

3.2.5.2.3.3 Education programs for developers and the public about project designs that minimize water quality impacts; and

3.2.5.2.3.4 Other measures such as minimization of the percentage of impervious area after development, use of measures to minimize directly connected impervious areas, and source control measures often thought of as good housekeeping, preventive maintenance and spill prevention.

3.2.5.2.4 Any structural BMPs in your program, including, as appropriate:

3.2.5.2.4.1 Storage practices such as wet ponds and extended-detention outlet structures;

3.2.5.2.4.2 Filtration practices such as grassed swales, bioretention cells, sand filters and filter strips; and

3.2.5.2.4.3 Infiltration practices such as infiltration basins and infiltration trenches.

3.2.5.2.5 What are the mechanisms (ordinance or other regulatory mechanisms) you will use to address post-construction runoff from new developments and redevelopments and why you chose that mechanism. If you need to develop a mechanism, describe your plan and a schedule to do so. If your ordinance or regulatory mechanism is already developed, include a copy of the relevant sections with your program.

3.2.5.2.6 How you will ensure the long-term operation and maintenance (O&M) of your selected BMPs. Options to help ensure that future O&M responsibilities are clearly identified include an agreement between you and another party such as the post-development landowners or regional authorities.

3.2.5.2.7 Who is responsible for overall management and implementation of your post-construction SWMP and, if different, who is responsible for each of the BMPs identified for this program.

3.2.5.2.8 How you will evaluate the success of this minimum measure, including how you selected the measurable goals for each of the BMPs.

3.2.6 Pollution Prevention/Good Housekeeping for Municipal Operations

3.2.6.1 *Permit requirement.* You must:

3.2.6.1.1 Develop and implement an operation and maintenance program that includes a training component and has the ultimate goal of preventing or reducing pollutant runoff from municipal operations; and

3.2.6.1.2 Using training materials that are available from Ohio EPA or other organizations, your program must include employee training to prevent and reduce storm water pollution from activities such as park and open space maintenance, fleet and building maintenance, new construction and land disturbances, and storm water system maintenance.

3.2.6.2 *Decision process.* You must document your decision process for the development of a pollution prevention/good housekeeping program for municipal operations. Your rationale statement must address both your overall pollution prevention/good housekeeping program and the individual BMPs, measurable goals, and responsible persons for your program. The rationale statement must include the following information, at a minimum:

3.2.6.2.1 Your operation and maintenance program to prevent or reduce pollutant runoff from your municipal operations. Your program must specifically list the municipal operations that are impacted by this operation and maintenance program. You must also include a list of industrial facilities you own or operate that are subject to Ohio EPA's Industrial Storm Water General Permit or individual NPDES permits for discharges of storm water associated with industrial activity that ultimately discharge to your MS4. Include the Ohio EPA permit number or a copy of the Industrial NOI form for each facility.

3.2.6.2.2 Any government employee training program you will use to prevent and reduce storm water pollution from activities such as park and open space maintenance, fleet and building maintenance, new construction and land disturbances, and storm water system maintenance. Describe any existing, available materials you plan to use. Describe how this training program will be coordinated with the outreach programs developed for the public information minimum measure and the illicit discharge minimum measure.

3.2.6.2.3 Your program description must specifically address the following areas:

3.2.6.2.3.1 Maintenance activities, maintenance schedules, and long-term inspection procedures for controls to reduce floatables and other pollutants to your MS4.

3.2.6.2.3.2 Controls for reducing or eliminating the discharge of pollutants from streets, roads, highways, municipal parking lots, maintenance and storage yards, waste transfer stations, fleet or maintenance shops with outdoor storage areas, and salt/sand storage locations and snow disposal areas you operate.

3.2.6.2.3.3 Procedures for the proper disposal of waste removed from your MS4 and your municipal operations, including dredge spoil, accumulated sediments, floatables, and other debris.

3.2.6.2.3.4 Procedures to ensure that new flood management projects are assessed for impacts on water quality and existing projects are assessed for incorporation of additional water quality protection devices or practices.

3.2.6.2.4 Who is responsible for overall management and implementation of your pollution prevention/good housekeeping program and, if different, who is responsible for each of the BMPs identified for this program.

3.2.6.2.5 How you will evaluate the success of this minimum measure, including how you selected the measurable goals for each of the BMPs.

3.3 Sharing Responsibility

Implementation of one or more of the minimum measures may be shared with another entity, or the entity may fully take over the measure. You may rely on another entity only if:

3.3.1 The other entity, in fact, implements all or part of the control measure;

3.3.2 The particular control measure, or component of that measure, is at least as stringent as the corresponding permit requirement; and

3.3.3 The other entity agrees to implement the control measure on your behalf. There must be written acceptance of this obligation. This obligation must be maintained as part of your SWMP. If the other entity agrees to report on the minimum measure, you must supply the other entity with the reporting requirements contained in Part 4.3 of this permit. If the other entity fails to implement the control measure on your behalf, then you remain liable for any discharges due to that failure to implement.

3.4 Reviewing and Updating Storm Water Management Programs

3.4.1 *SWMP Review:* You must do an annual review of your SWMP in conjunction with preparation of the annual report required under Part 4.3 of this permit.

3.4.2 *SWMP Update:* You may change your SWMP during the life of the permit in accordance with the following procedures:

3.4.2.1 Changes adding (but not subtracting or replacing) components, controls, or requirements to the SWMP may be made at any time upon written notification to Ohio EPA.

3.4.2.2 Changes replacing an ineffective or infeasible BMP specifically identified in the SWMP with an alternate BMP may be requested at any time. Unless denied by Ohio EPA, changes proposed in accordance with the criteria below shall be deemed approved and may be implemented 60 days from submittal of the request. If the request is denied, Ohio EPA will send you a written response giving a reason for the decision. Your modification requests must include the following:

3.4.2.2.1 An analysis of why the BMP is ineffective or infeasible (including cost prohibitive),

3.4.2.2.2 Expectations on the effectiveness of the replacement BMP, and

3.4.2.2.3 An analysis of why the replacement BMP is expected to achieve the goals of the BMP to be replaced.

3.4.2.3 Change requests or notifications must be made in writing and signed in accordance with Part 5.7 of this permit.

3.4.3 *SWMP Updates Required by Ohio EPA*: Ohio EPA may require changes to the SWMP as needed to:

3.4.3.1 Address impacts on receiving water quality caused, or contributed to, by discharges from the MS4;

3.4.3.2 Include more stringent requirements necessary to comply with new Federal statutory or regulatory requirements; or

3.4.3.3 Include such other conditions deemed necessary by Ohio EPA to comply with the goals and requirements of ORC 6111. and the Clean Water Act.

3.4.3.4 Changes requested by Ohio EPA will be made in writing, set forth the time schedule for you to develop the changes, and offer you the opportunity to propose alternative program changes to meet the objective of the requested modification. All changes required by Ohio EPA will be made in accordance with Ohio Administrative Code (OAC) 3745-47.

3.4.4 *Transfer of Ownership, Operational Authority, or Responsibility for SWMP Implementation:* You must implement the SWMP on all new areas added to your portion of the MS4 (or for which you become responsible for implementation of storm water quality controls) as expeditiously as practicable, but not later than one year from addition of the new areas. Implementation may be accomplished in a phased manner to allow additional time for controls that cannot be implemented immediately.

3.4.4.1 Within 90 days of a transfer of ownership, operational authority, or responsibility for SWMP implementation, you must have a plan for implementing your SWMP on all affected areas. The plan may include schedules for implementation. Information on all new annexed areas and any resulting updates required to the SWMP must be included in the annual report.

3.4.4.2 Only those portions of the SWMPs specifically required as permit conditions shall be subject to modification. Addition of components, controls, or requirements by the permittee(s) and replacement of an ineffective or infeasible BMP implementing a required component of the SWMP with an alternate BMP expected to achieve the goals of the original BMP shall be considered minor changes to the SWMP and not modifications to the permit.

4 Evaluating, Record keeping, and Reporting

4.1 Evaluating

4.1.1 You must evaluate program compliance, the appropriateness of identified BMPs, and progress toward achieving identified measurable goals.

4.2 Record keeping

4.2.1 You must retain copies of all reports required by this permit, a copy of the NPDES permit, and records of all data used to complete the NOI application for this permit, for a period of at least three years from the date of the report or application, or for the term of this permit, whichever is longer. This period may be extended by request of Ohio EPA at any time.

4.2.2 You must submit your records to Ohio EPA only when specifically asked to do so. You must retain the SWMP required by this permit (including a copy of the permit language) at a location accessible to Ohio EPA. You must make your records, including the NOI and the SWMP, available to the public if requested to do so in writing.

4.3 Reporting

You must submit annual reports to the director starting one year after the date Ohio EPA has granted your general permit coverage. The report must include:

4.3.1 The status of your compliance with permit conditions, an assessment of the appropriateness of the identified BMPs, progress toward achieving the statutory goal of reducing the discharge of pollutants to the MEP, and the measurable goals for each of the minimum control measures;

4.3.2 Results of information collected and analyzed, if any, during the reporting period, including monitoring data used to assess the success of the program at reducing the discharge of pollutants to the MEP;

4.3.3 A summary of the storm water activities you plan to undertake during the next reporting cycle (including an implementation schedule);

4.3.4 Proposed changes to your SWMP, including changes to any BMPs or any identified measurable goals that apply to the program elements; and

4.3.5 Notice that you are relying on another government entity to satisfy some of your permit obligations (if applicable).

5 Standard Permit Conditions

5.1 Duty to Comply

You must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of ORC 6111. and is grounds for enforcement action.

5.2 Continuation of the Expired General Permit

An expired general permit continues in force and effect until a new general permit is issued.

5.3 Need to Halt or Reduce Activity Not a Defense

It shall not be a defense for you in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

5.4 Duty to Mitigate

You shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

5.5 Duty to Provide Information

You shall furnish to the director, within seven days or as indicated in the written request, any information which the director may request to determine compliance with this permit. You shall also furnish to the director upon request copies of records required to be kept by this permit.

5.6 Other Information

If you become aware that you failed to submit any relevant facts or submitted incorrect information in the NOI, SWMP, or in any other report to the director, you shall promptly submit such facts or information.

5.7 Signatory Requirements

All NOIs, SWMPs, reports, certifications or information submitted to the director shall be signed.

5.7.1 These items shall be signed as follows:

5.7.1.1 For a corporation: By a responsible corporate officer. For the purpose of this section, a responsible corporate officer means:

5.7.1.1.1 A president, secretary, treasurer or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation; or

5.7.1.1.2 The manager of one or more manufacturing, production or operating facilities, provided, the manager is authorized to make management decisions which govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations, and initiating and directing other comprehensive measures to assure long-term environmental compliance with environmental laws and regulations; the manager can assure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures;

5.7.1.2 For a partnership or sole proprietorship: By a general partner or the proprietor, respectively; or

5.7.1.3 For a municipality, State, Federal or other public agency; by either a principal executive officer or ranking elected official. For purposes of this section, a principal executive officer of a Federal agency includes: (1) the chief executive officer of the agency, or (2) a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrators of U.S. EPA).

5.7.2 All reports required by the permits and other information requested by the director shall be signed by a person described in Part 5.7.1 of this permit or by a duly authorized representative of that person. A person is a duly authorized representative only if:

5.7.2.1 The authorization is made in writing by a person described in Part 5.7.1 of this permit and submitted to the director;

5.7.2.2 The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, operator of a well or well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position); and

5.7.2.3 The written authorization is submitted to the director.

5.7.3 Changes to authorization. If an authorization under Part 5.7.2 of this permit is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of Part 5.7.2 of this permit must be submitted to the director prior to or together with any reports, information or applications to be signed by an authorized representative.

5.7.4 Certification.

Any person signing documents under Parts 5.7.1 or 5.7.2 of this permit shall make the following certification:

> *"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."*

5.7.5 Falsification.

Ohio law imposes penalties and fines for persons who knowingly make false statements or knowingly swear or affirm the truth of a false statement previously made.

5.8 Property Rights

The issuance of this permit does not convey any property rights of any sort, nor any exclusive privilege, nor does it authorize any injury to private property nor any invasion of personal rights, nor any infringement of Federal, State or local laws or regulations.

5.9 Proper Operation and Maintenance

You must, at all times, properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by you to achieve compliance with the conditions of this permit and with the conditions of your SWMP. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. Proper operation and maintenance requires the operation of backup or auxiliary facilities or similar systems, installed by you only when the operation is necessary to achieve compliance with the conditions of this permit.

5.10 Inspection and Entry

You must allow Ohio EPA or an authorized representative upon the presentation of credentials and other documents as may be required by law, to do any of the following:

5.10.1 Enter your premises at reasonable times where a regulated facility or activity is located or conducted or where records must be kept under the conditions of this permit;

5.10.2 Have access to and copy at reasonable times, any records that must be kept under the conditions of this permit;

5.10.3 Inspect at reasonable times any facilities or equipment (including monitoring and control equipment) practices, or operations regulated or required under this permit; and

5.10.4 Sample or monitor at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by the CWA, any substances or parameters at any location.

5.11 Permit Actions

This permit may be modified, revoked and reissued, or terminated for cause.

5.12 Permit Transfers

Permit transfers shall be in accordance with OAC 3745-38-09.

5.13 Anticipated Noncompliance

You must give advance notice to Ohio EPA of any planned changes in the permitted small MS4 or activity which may result in noncompliance with this permit.

5.14 State Environmental Laws

No condition of this permit shall release you from any responsibility or requirements under other environmental statutes or regulations.

5.15 Severability

The provisions of this permit are severable, and if any provision of this permit or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit shall not be affected thereby.

5.16 Procedures for Modification or Revocation

Permit modification or revocation will be conducted in accordance with OAC Chapter 3745-38.

5.17 Requiring an Individual Permit or an Alternative General Permit

5.17.1 *Request by permitting authority.* Ohio EPA may require any person authorized by this permit to apply for and/or obtain either an individual NPDES permit or coverage under an alternative NPDES general permit. Any interested person may petition Ohio EPA to take action under this paragraph. Where Ohio EPA requires you to apply for an individual NPDES permit or coverage under an alternative NPDES general permit, Ohio EPA will notify you in writing that a permit application is required. This notification shall include a brief statement of the reasons for this decision, an application form, a statement setting a deadline for you to file the application, and a statement that on the effective date of issuance or denial of the individual NPDES permit or the alternative NPDES general permit coverage as it applies to the individual permittee, coverage under this general permit shall automatically terminate. Ohio EPA may grant additional time to submit the application upon request of the applicant. If you fail to submit in a timely manner an individual NPDES permit application or an NOI for coverage under an alternative NPDES general permit as required by Ohio EPA under this paragraph, then the applicability of this permit to you is automatically terminated at the end of the day specified by Ohio EPA for application submittal.

5.17.2 *Request by permittee.* Any discharger authorized by this permit may request to be excluded from the coverage of this permit by applying for an individual permit. In such cases, you must submit an individual application in accordance with the requirements of OAC Chapter 3745-33, with reasons supporting the request, to Ohio EPA at the address for the appropriate Regional Office. The request may be granted by issuance of any individual permit or an alternative general permit if the reasons cited by you are adequate to support the request.

5.17.3 *General permit termination.* When an individual NPDES permit is issued to a discharger otherwise subject to this permit, or you are authorized to discharge under an alternative NPDES general permit, the applicability of this permit to the MS4 is automatically terminated on the effective date of the individual permit or the date of authorization of coverage under the alternative general permit, whichever the case may be. When an individual NPDES permit is denied to an operator otherwise subject to this permit, or the operator is denied for coverage under an alternative NPDES general permit, the applicability of this permit to the MS4 is automatically terminated on the date of such denial, unless otherwise specified by Ohio EPA.

6 Definitions

All definition contained in Section 502 of the Act and 40 CFR 122 shall apply to this permit and are incorporated herein by reference. For convenience, simplified explanations of some regulatory/statutory definitions have been provided, but in the even of a conflict, the definition found in the Statute or Regulation takes precedence.

Best Management Practices (BMPs) means schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of surface waters of the State. BMPs also include treatment requirements, operating procedures, and practices to control runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

Control Measure as used in this permit, refers to any Best Management Practice or other method used to prevent or reduce the discharge of pollutants to surface waters of the State.

CWA or The Act means the Clean Water Act (formerly referred to as the Federal Water Pollution Control Act or Federal Water Pollution Control Act Amendments of 1972) Pub.L. 92-500, as amended Pub. L. 95-217, Pub. L. 95-576, Pub. L. 96-483 and Pub. L. 97-117, 33 U.S.C. 1251 et.seq.

director means the director of the Ohio Environmental Protection Agency.

Discharge, when used without a qualifier, refers to "discharge of a pollutant" as defined at 40 CFR 122.2.

Illicit Connection means any man-made conveyance connecting an illicit discharge directly to a municipal separate storm sewer.

Illicit Discharge is defined at 40 CFR 122.26(b)(2) and refers to any discharge to a municipal separate storm sewer that is not entirely composed of storm water, except discharges authorised under an NPDES permit (other than the NPDES permit for discharges from the MS4) and discharges resulting from fire fighting activities.

Large MS4 means all municipal separate storm sewer systems that are located in an incorporated place with a population of two hundred fifty thousand or more as determined by the 1990 census by the United States bureau of census.

Larger Common Plan of Development or Sale means a contiguous area where multiple separate and distinct construction activities may be taking place at different times on different schedules under one plan.

Medium MS4 means all municipal separate storm sewer systems that are located in an incorporated place with a population of one hundred thousand or more, but less than two hundred fifty thousand as determined by the 1990 census by the United States bureau of census.

MEP is an acronym for "Maximum Extent Practicable," the technology-based discharge standard for Municipal Separate Storm Sewer Systems to reduce pollutants in storm water discharges that was established by CWA §402(p). A discussion of MEP as it applies to small MS4s is found at 40 CFR 122.34.

MS4 means municipal separate storm sewer system which means a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains) that are:

S Owned or operated by the federal government, state, municipality, township, county, district, or other public body (created by or pursuant to state or federal law) including special district under state law such as a sewer district, flood control district or drainage districts, or similar entity, or a designated and approved management agency under section 208 of the act that discharges into surface waters of the state; and

S Designed or used for collecting or conveying solely storm water,

S Which is not a combined sewer, and

S Which is not a part of a publicly owned treatment works.

NOI is an acronym for "Notice of Intent" which means the mechanism used to "register" for coverage under a general permit.

Non-traditional MS4 means systems similar to separate storm sewer systems in municipalities, such as systems at military bases, hospitals, public universities or prison complexes, and highways and other thoroughfares. The term does not include separate storm sewer systems in very discrete areas such as individual buildings.

Off-Lot Home Sewage Treatment System (HSTS) means a system designed to treat home sewage on-site and discharges treated wastewater off-lot.

Ohio EPA means the Ohio Environmental Protection Agency.

On-Lot Home Sewage Treatment System (HSTS) means a system designed to treat home sewage on-lot with no discharges leaving the lot.

Small MS4 means all municipal separate storm sewer systems that are neither a large MS4 nor a medium MS4.

Storm Water is defined at 40 CFR 122.26(b)(13) and means storm water runoff, snow melt runoff, and surface runoff and drainage.

Storm Water Management Program (SWMP) refers to a comprehensive program to manage the quality of storm water discharged from the municipal separate storm sewer system.

Surface Waters of the State means all streams, lakes, reservoirs, ponds, marshes, wetlands, or other waterways which are situated wholly or partly within the boundaries of the State, except those private waters which do not combine or affect a junction with a surface water. Waters defined as sewerage systems, treatment works, or disposal systems in Section 6111.01 of the ORC are not included.

SWMP is an acronym for "Storm Water Management Program."

"You" and "Your" as used in this permit is intended to refer to the permittee, the operator, or the discharger as the context indicates and that party's responsibilities (e.g., the city, the country, the flood control district, the U.S. Air Force, etc.).

Appendix G

Lower Cuyahoga River Total Maximum Daily Load Study (Cover + Table of Contents only)

Total Maximum Daily Loads for the Lower Cuyahoga River

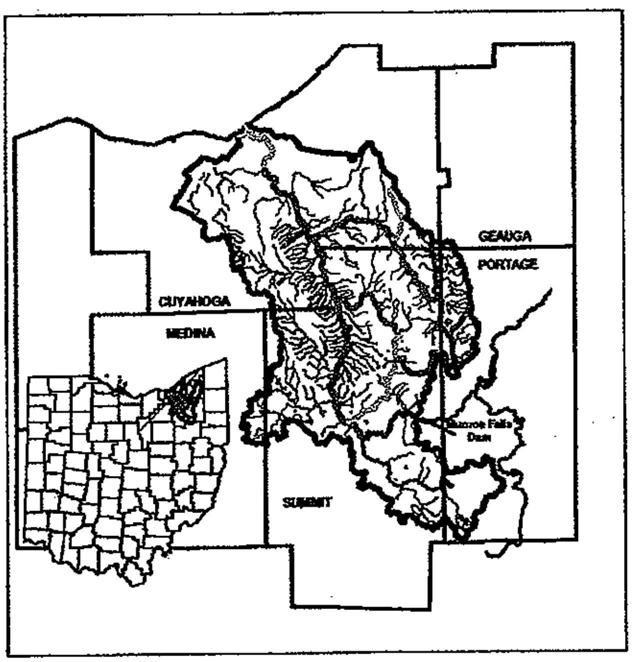
Final Report

prepared by

Ohio Environmental Protection Agency
Division of Surface Water

September 2003

The TMDL in Brief:



Basin:
Lower Cuyahoga River in the Lake Erie Basin
Study Area:
Lower 50 miles of Cuyahoga River and its tributaries.
Goal:
Attainment of the appropriate Aquatic Life Use
Major Causes:
Organic enrichment, toxicity, low dissolved oxygen, nutrients, and flow alteration
Major Sources:
Municipal discharges, combined sewer overflows, urban runoff, and industrial discharges.
Measure:
Total nitrogen, phosphorus, dissolved oxygen, bacteria, biological and habitat indices
Restoration Options:
Long term control plans for combined sewer overflows, urban runoff controls, habitat protection and restoration, septic system improvements, point source controls, and public education

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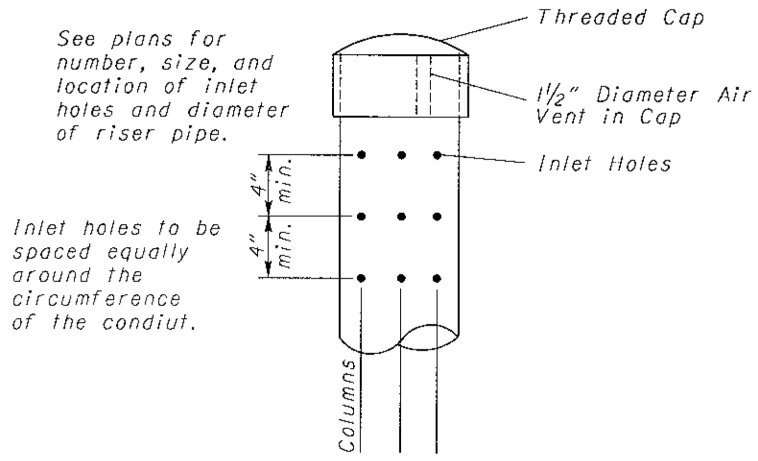
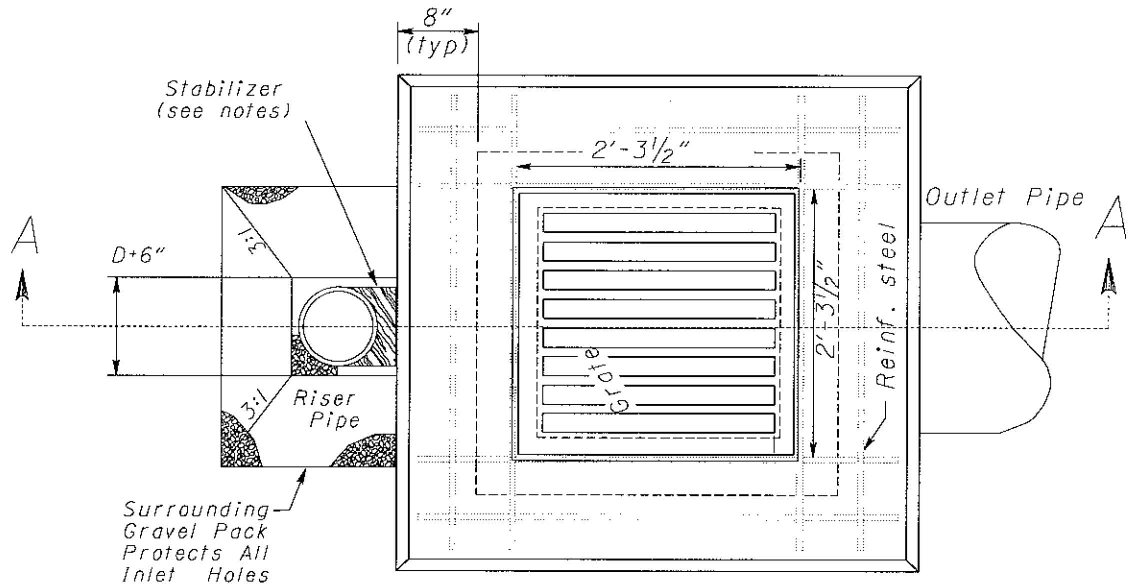
(continued)

Appendix H

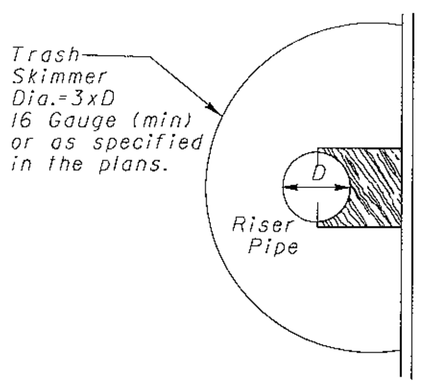
ODOT Post – Construction BMP standard drawings – WQ 1.1, 1.2



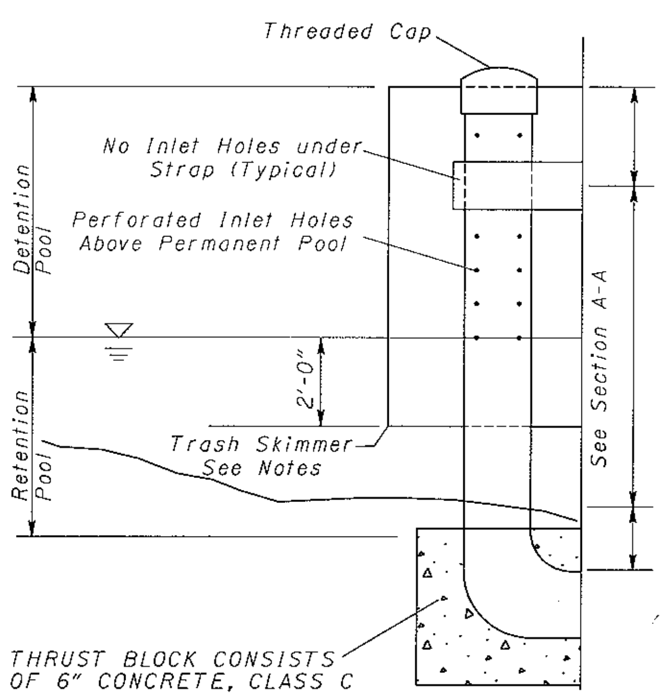
PERFORATED RISER
NOT TO SCALE



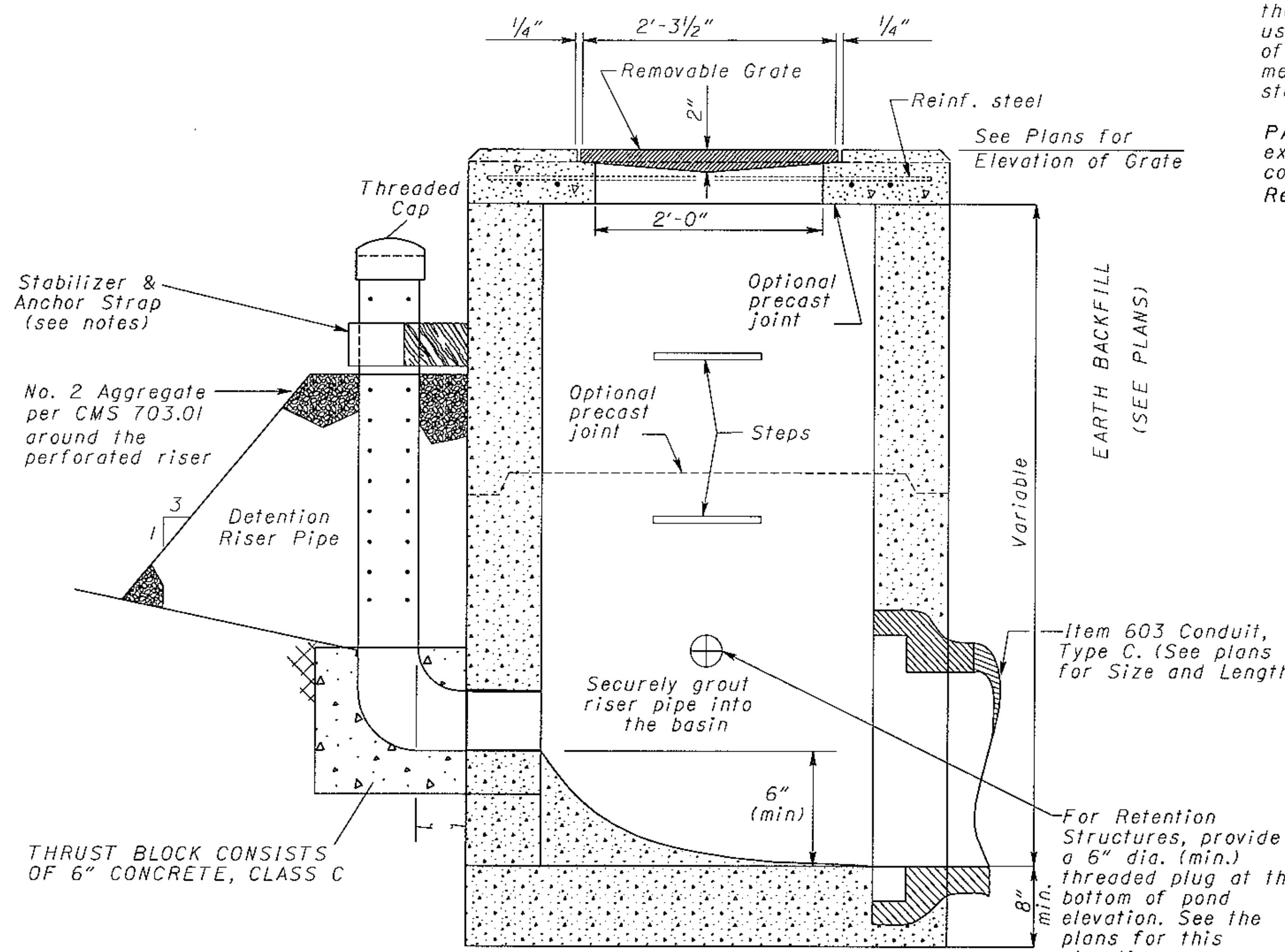
PLAN VIEW (DETENTION SHOWN)
NOT TO SCALE



PLAN VIEW (RETENTION SHOWN)
NOT TO SCALE



RETENTION RISER PIPE
NOT TO SCALE



SECTION A-A (DETENTION SHOWN)
NOT TO SCALE

NOTES

LOCATION AND ELEVATION: When given on the plans, the location and the elevation are at the top center of the grate. The orifice holes should be placed at the elevations as shown on the plans.

BASIN MATERIALS: The basin dimensions, materials, and grate to be per CB-1.2 except as detailed herein. Side inlet windows shall not be used.

All aggregate shown shall meet **CMS 203.02.H, NATURAL GRANULAR MATERIALS** and specified gradations.

RISER PIPE: Use schedule 40 Polyvinyl Chloride Conduit. Perforations shall be only as detailed in the plans.

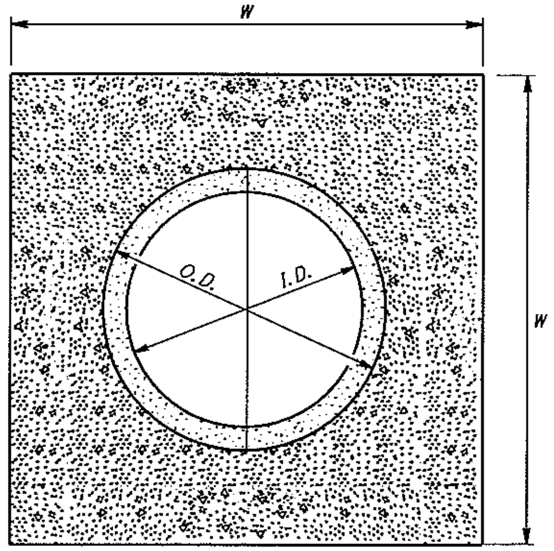
TRASH SKIMMER: Use trash skimmer screens to protect the perforated riser. It must extend from the top of the riser to 2' below the permanent pool level and be open at the top and bottom. The radius of the trash skimmer shall be 3 times the diameter of the riser pipe or as shown on the plans. Trash skimmer shall be stainless steel or galvanized steel per CMS 711.02. Maximum perforation size shall be 2 inches. Securely fasten trash skimmer to the basin using hardware galvanized per CMS 711.02.

STABILIZER AND ANCHOR STRAP: Securely fasten the riser pipe to the basin in the vertical position using a stabilizer and anchor strap that consists of a universal clamp or a strap and a block. All metal components shall be galvanized or stainless steel. All other materials shall be rot resistant.

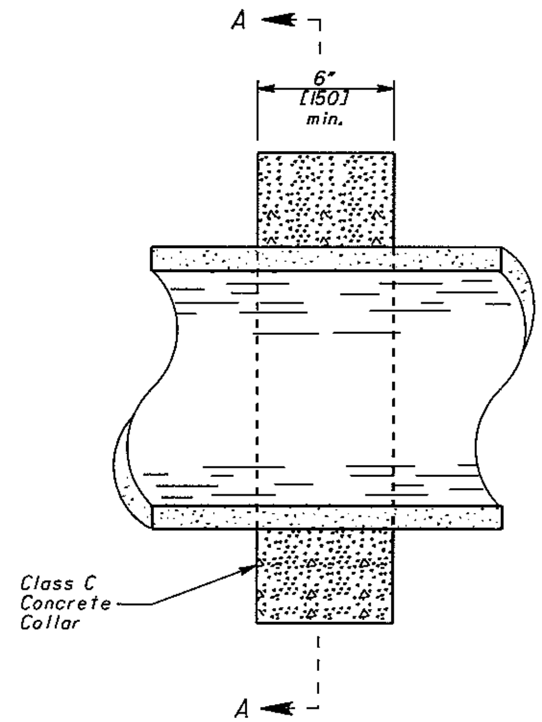
PAYMENT: All materials and labor, including excavation and backfill, shall be paid for at the contract price for **Item 604 - Water Quality Basin, Retention (Detention)**

MAXIMUM NUMBER OF PERFORATED COLUMNS				
RISER DIAMETER (in.)	HOLE DIAMETER, INCHES			
	¼"	½"	¾"	1"
4	8	8	--	--
6	12	12	9	
8	16	16	12	8
10	20	20	14	10
12	24	24	18	12

OHIO DEPARTMENT OF TRANSPORTATION
ENGINEER OF BRIDGES
DATE 04-16-04
HYDRAULIC ENGINEER J. Syar
OFFICE OF STRUCTURAL ENGINEERING
STANDARD HYDRAULIC CONSTRUCTION DRAWING
WATER QUALITY BASINS
NUMBER WQ-1.1
1/1



SECTION A-A
(NTS)



ANTI-SEEP COLLAR
(NTS)

DIAMETER (I.D.)	CONCRETE - C.Y.		
	DIMENSION OF COLLAR W X W (FT.)		
(FT.)	3X3	4X4	5X5
1	0.15	0.28	0.45
2	N/A	0.24	0.40
3	N/A	N/A	0.33

NOTES

ANTI-SEEP COLLARS: An anti-seep collar shall be provided as shown in the plans. Payment for the collar shall be at the contract price for **ITEM 602, CONCRETE MASONRY.**

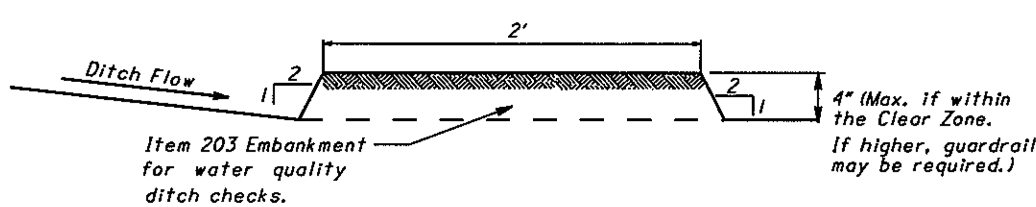
WATER QUALITY DITCH CHECK: A water quality ditch check shall be placed as shown in the plans. All embankment used shall conform to CMS 703.16.A. Payment for this work shallbe at the contract price for **ITEM 203, EMBANKMENT, FOR WATER QUALITY DITCH CHECK.**

WATER QUANTITY DITCH CHECK: A water quantity ditch check shall be placed as shown in the plans. All embankment used shall conform to CMS 703.16.A. Payment for this work shall be at the contract price for **ITEM 203, EMBANKMENT and ITEM 601, TIED CONCRETE BLOCK MAT FOR WATER QUANTITY SWALE.**

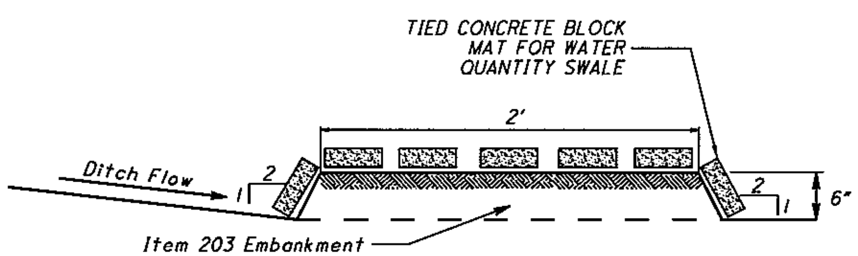
OBSERVATION WELL: The observation well shall be constructed to a depth & location as shown in the plans. All materials and labor including excavation and backfill shall be paid for at the contract price for **ITEM 604 OBSERVATION WELL.**

INFILTRATION TRENCH: The infiltration trench shall be constructed to the dimensions shown on the plan. The top 6 inch covering shall be paid for at the contract price for **ITEM 601 INFILTRATION BASIN AGGREGATE.**

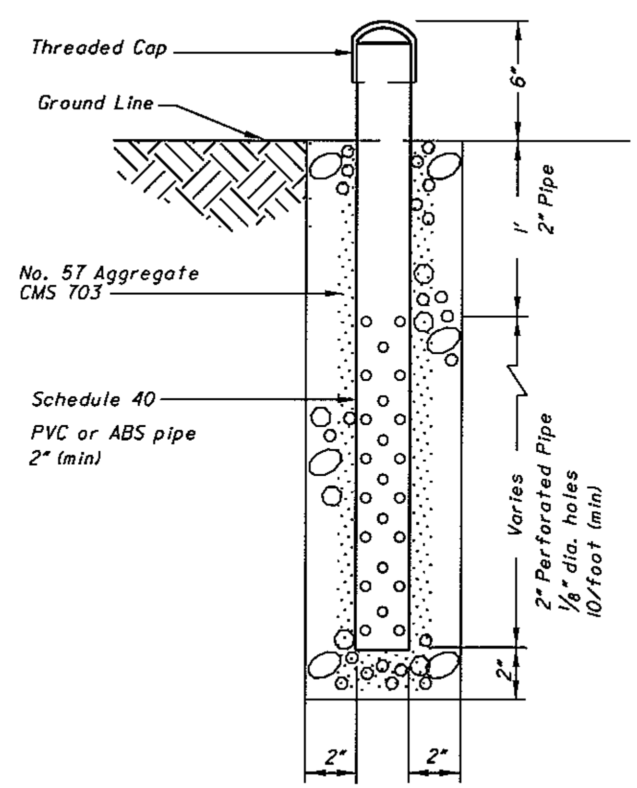
All other materials and labor, including excavation, geotextile fabric, and backfill shall be paid for at the contract price for **ITEM 203 SPECIAL, INFILTRATION TRENCH.**



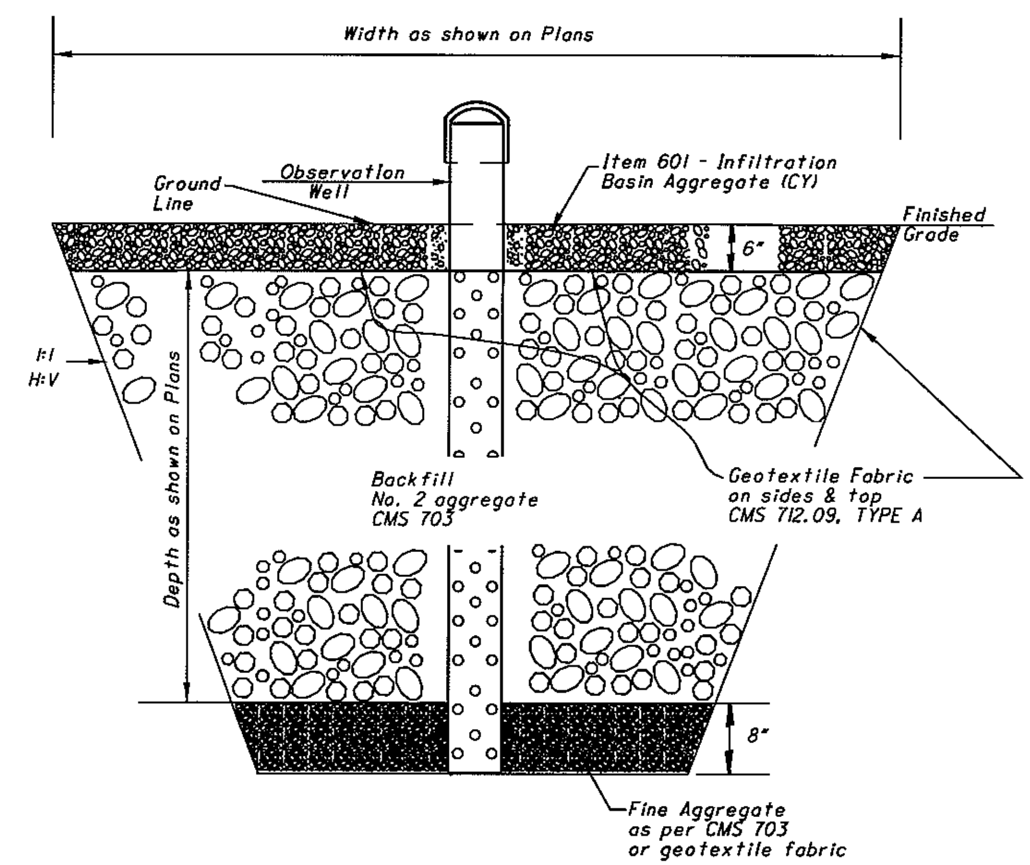
WATER QUALITY DITCH CHECK
(NTS)



WATER QUANTITY DITCH CHECK
(NTS)



OBSERVATION WELL
NO SCALE



INFILTRATION TRENCH
NO SCALE

OHIO DEPARTMENT OF TRANSPORTATION
Tim Keller
ENGINEER OF BRIDGES

DATE
1-20-06
4-21-06

HYDRAULIC ENGINEER
M. Nowaszkiewicz

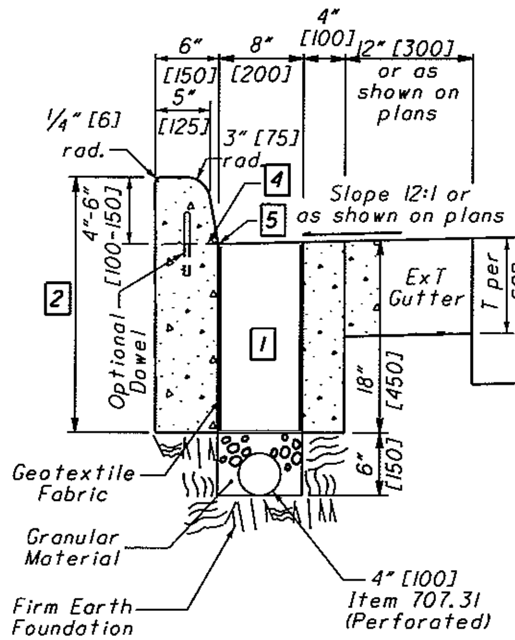
ALL METRIC DIMENSIONS [IN BRACKETS []] ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

OFFICE OF STRUCTURAL ENGINEERING

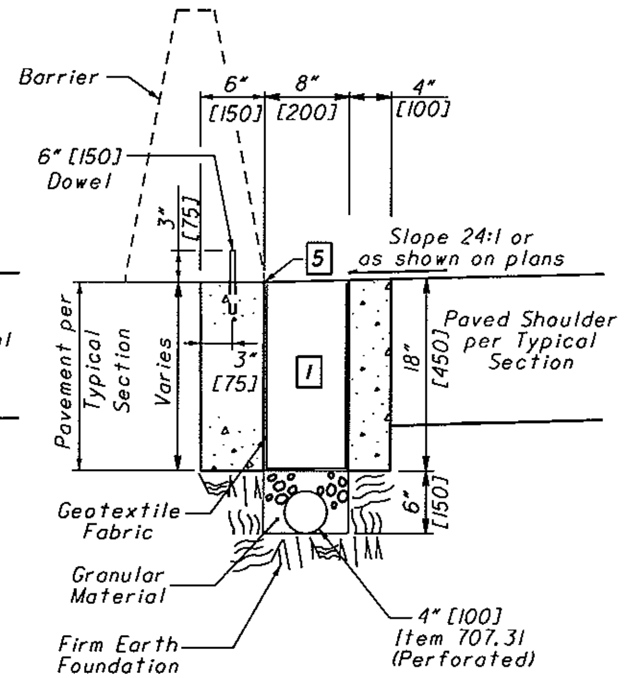
STANDARD HYDRAULIC CONSTRUCTION DRAWING
WATER QUALITY- MISCELLANEOUS

NUMBER
WQ-1.2

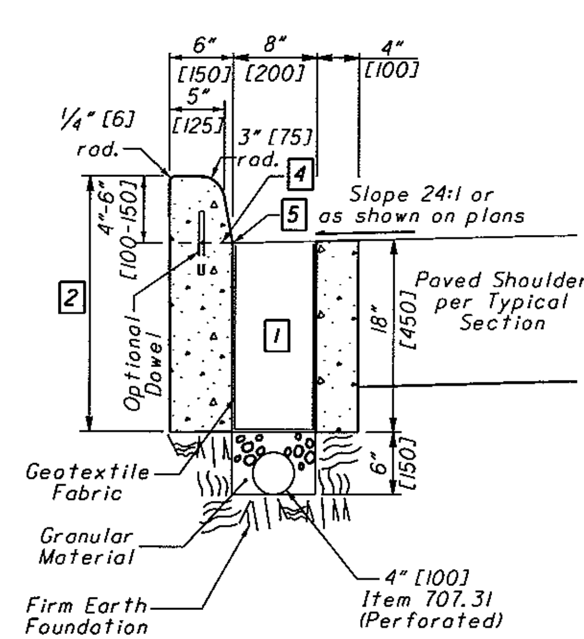
1/2



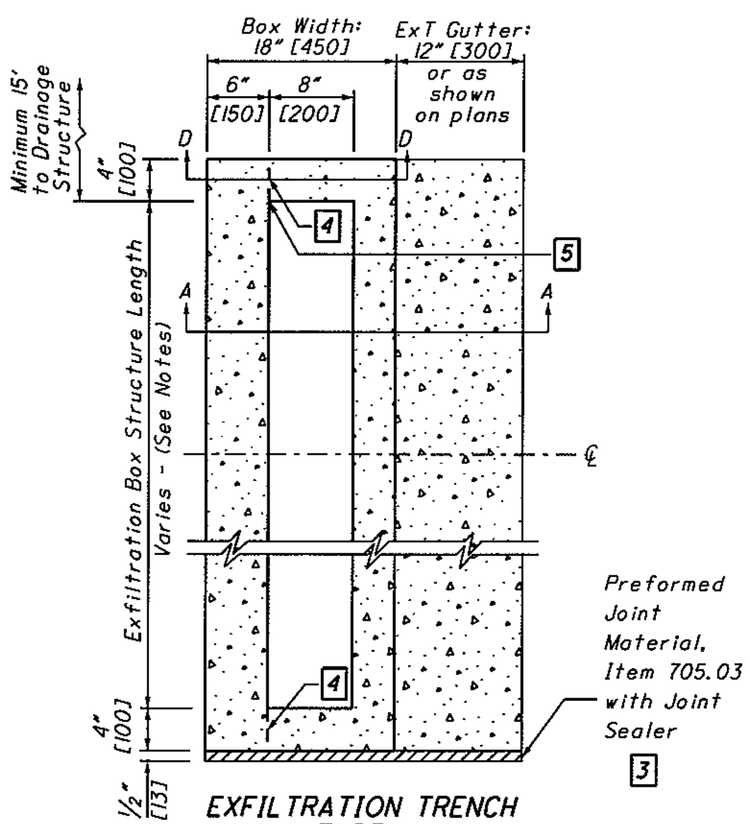
EXFILTRATION TRENCH
TYPE A - Section A-A
Curb and Gutter Application
(NTS)



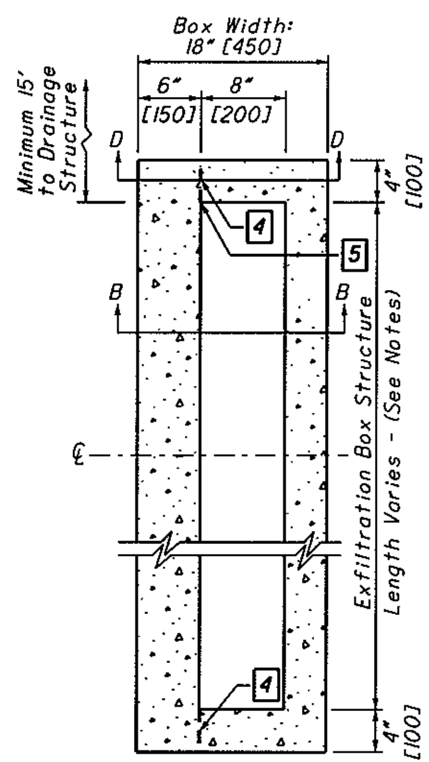
EXFILTRATION TRENCH
TYPE B - Section B-B
Barrier Application
(NTS)



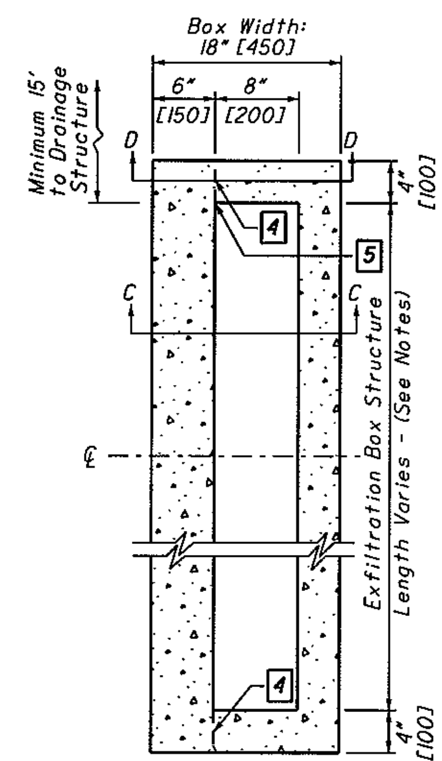
EXFILTRATION TRENCH
TYPE C Section C-C
Various Curb Application
(NTS)



EXFILTRATION TRENCH
TYPE A
Plan View
(NTS)



EXFILTRATION TRENCH
TYPE B
Plan View
(NTS)



EXFILTRATION TRENCH
TYPE C
Plan View
(NTS)

NOTES

EXFILTRATION TRENCH (ExT): The exfiltration box structure shall be located as shown on the plans.

The exfiltration box structure may be precast, cast in the field or a combination of precast and cast in the field. The minimum length of a precast exfiltration box structure is 4' [1.25]. More than 1 precast section may be provided to meet the required length shown in the plans.

Exfiltration box structure concrete shall conform to CMS 511.

If the exfiltration box structure is precast, furnish reinforcing steel conforming to CMS 509.02 and CMS 709.00 for the precast structure in a sufficient amount to permit shipping and placement without damage.

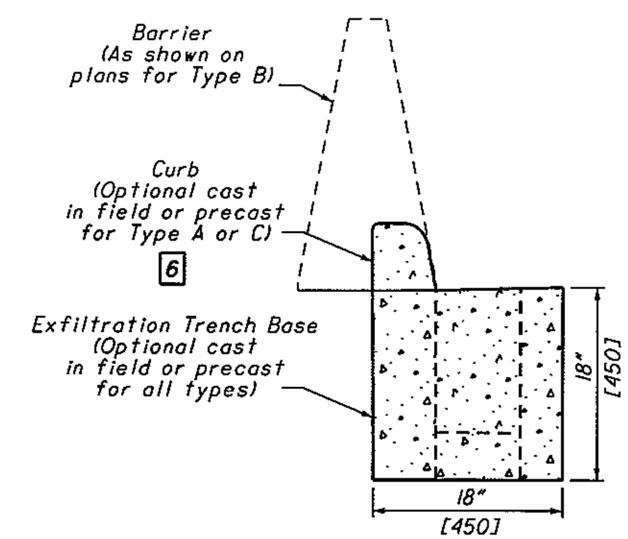
For precast structures, reduce the height of all walls excluding the back wall where barrier or curb will be set by 2" [50]. When placing the top layer of filter material for the precast structure, fill the final 2" [50] of the walls with Cement Treated Free Draining Base according to CMS 306 for the entire length and width of the wall. Maintain the slope as shown on the Standard Construction Drawing or as shown on the plans. Additional variations in dimensions from the Standard Construction Drawing for precast exfiltration box structures may occur. Variances for precast structure dimensions must be approved by the Office of Structural Engineering, Hydraulics Section.

Furnish 6" [150] epoxy coated #4 reinforcing bars, conforming to CMS 509.02 and 709.00, to be used as dowels to connect proposed barrier or field cast curb to the top of the exfiltration box structure. Space dowels every 12" [300] on center for the length of the exfiltration box structure.

Concrete for 12" [300] exfiltration trench gutter for Exfiltration Trench Type A shall conform to CMS 609. Cost for the concrete shall be included in the price of Item 835 - Exfiltration Trench, Type A.

All materials and labor, including excavation and backfill shall be paid for at the contract price for **ITEM 835 - EXFILTRATION TRENCH, TYPE ___.**

1. Exfiltration Trench Filter Media (See SS835)
2. 22" [550] for 4" Curb and Gutter and 24" [600] for 6" Curb and Gutter.
3. Furnish expansion joint material according to SCD BP-5.1 when abutting Item 609 - Combination Curb and Gutter.
4. Optional Construction Joint
5. Location for Station and Offset. Elevation according to Typical Section.
6. If curb portion is to be cast in field, furnish dowels as shown for Type A and C. For 4" and 6" curb height, extend the dowels 2" and 3", respectively, above the exfiltration trench base.



EXFILTRATION TRENCH - Section D-D
(NTS)

OHIO DEPARTMENT OF TRANSPORTATION

ENGINEER OF BRIDGES

DATE 1-20-06 4-21-06

HYDRAULIC ENGINEER M. Woeszkiewicz

ALL METRIC DIMENSIONS (IN BRACKETS [ ]) ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

OFFICE OF STRUCTURAL ENGINEERING

STANDARD HYDRAULIC CONSTRUCTION DRAWING
WATER QUALITY- MISCELLANEOUS

NUMBER WQ-1.2

2/2

Appendix I

ODOT Post-Construction Stormwater BMP Requirement Guidelines per Project Scenarios

ODOT Post Construction[1] Storm Water BMP Requirement Guidelines[2] per Project Scenarios

Part V, Section J of the NPDES General Construction Permit states:

Issuance of the permit does not convey any property rights of any sort, nor any exclusive privileges, nor does it authorize any injury to private property.

This section covers all projects which have the following funding scenarios:

- ODOT funds;
- ODOT funds and Federal funds;
- Local funds and Federal funds;
- ODOT funds, Federal funds, and Local funds; and
- Permit work on ODOT Right-of-Way.

I. DEFINITIONS:

Private Ownership Authority (POA): Private property that has no local maintenance responsibility.

ODOT Ownership Authority (OOA): ODOT owns the property and has 100% maintenance responsibility.

Local Ownership Authority (LOA): Local government (including cities, villages, townships and counties) may or may not own the property but has100% maintenance responsibility.

Permit: NPDES Construction General Permit

II. SCENARIOS:

A. Projects that ODOT has funded and where ODOT has oversight for the project using federal dollars.

1) Only OOA Areas of project work (e.g., work on I-71).

Permit requires post construction storm water BMP's on the OOA area.

2) OOA and LOA areas of project work (e.g., work on I-71 and local government feeder route to interchange).

---

1 These Guidelines are not meant to direct activities for SWMP3 during construction, <u>only</u> post construction.

2 These Guidelines have been reviewed and approved by the Office of Hydraulics, the Division of Planning, and the Office of Chief Legal.

Permit requires post construction storm water BMP's on the OOA area. Post construction storm water BMP's are NOT required in the LOA area

If the Local does not request post construction storm water BMP's on the LOA area, ODOT is not required to provide post construction storm water BMP's in this area. However if the Local requests post construction storm water BMP's on the LOA area, ODOT can accommodate BMP's at the discretion of the District via funding formulas. These BMP's can be accomplished independent of or in conjunction with the Local. The Local may be required to fund BMP's that are deemed excessive in the view of the ODOT District Office i.e. those outside the Location and Design Manual Volume II.

3) Only LOA areas of project work with 100% Local maintenance responsibility (e.g., work on a state highway SR 40 inside local government limits where the local government has 100% maintenance responsibility).

Permit requires post construction storm water BMP's on the LOA area. However if the Local requests post construction storm water BMP's on the LOA area, that are not part of the Location and Design Manual Volume II BMP's, then ODOT can accommodate this at the discretion of the District via funding formulas that are independent of or in conjunction with the LOA.

4) Only LOA areas of project work with shared maintenance responsibility (e.g., work on a state highway SR 40 inside village limits where ODOT and the village share maintenance responsibility).

Permit requires post construction storm water BMP's on the LOA area. However if the Local requests post construction storm water BMP's on the LOA area, that are not part of the Location and Design Manual Volume II BMP's, then ODOT can accommodate this at the discretion of the District via funding formulas that are independent of or in conjunction with the LOA.

B. Local-let and ODOT-let LPA Projects that are Local funded where ODOT has oversight for the project via federal dollars.

ODOT will request the local project agreement to include the following language:

"The [LPA shall] provide a letter indicating the proposed BMP's to be utilized for post construction storm water management in accordance with the Ohio EPA NPDES Construction General Permit. If no BMP's are proposed, a letter stating concurrence is required from the Ohio EPA."

The District Office will review the BMP's presented in the letter from the LPA. As stated above, if the letter indicates that no BMP's are being proposed, ODOT will require a letter from the Ohio EPA granting an exemption from the Permit. The LPA may be required to fund BMP's with local funds that are deemed excessive in the view of the ODOT District Office i.e. those outside the Location and Design Manual Volume II.

1) Projects that are Local funded and only have LOA area of project work (e.g., work on a local government street or state highway where the local government has 100% maintenance responsibility or both).

Permit requires post construction storm water BMP's on the LOA area or the exemption letter as described above.

2) Projects that are Local funded and have both LOA and OOA areas of project work (e.g., work on a local government street in the LOA area and ODOT permitted work on an Interstate Highway).

Permit requires post construction storm water BMP's on the LOA area or the exemption letter as described above. Post construction storm water BMP's are NOT required on the OOA area.

If ODOT does request post construction storm water BMP's as a condition of the permit to work within ODOT's right-of-way, then the Local must furnish post construction storm water BMP's as outlined in the Location and Design Manual Volume II for project funding.

3) Projects that are Local funded and have both LOA and POA areas of project work (e.g., work on a local government street, and work on an adjacent private drive).

Permit requires post construction storm water BMP's on the LOA area only or the exemption letter as described above for both areas.

If the private property owner does not request post construction storm water BMP's on the POA area, Local is not required to provide post construction storm water BMP's in this area. However if the private property owner requests post construction storm water BMP's on the POA area, Local can accommodate BMP'S at the discretion of the District. These BMP's can be accomplished independent of or in conjunction with the Local. The Local may be required to fund BMP's that are deemed excessive in the view of the ODOT District Office i.e. those outside the Location and Design Manual Volume II.

4) Projects that are Local funded and have LOA and non-funding LOA areas of project work (e.g., work on a local government street that is inside the respective LOA municipality, and work on another local government's street that is not inside the funding LOA's jurisdiction).

Permit requires post construction storm water BMP's on the funding LOA area, or the exemption letter as described above. Post construction storm water BMP's are NOT required on the non-funding LOA area.

If the non-funding LOA does not request post construction storm water BMP's on their LOA area, Local is not required to provide post construction storm water BMP's in this area. However if the non-funding LOA requests post construction storm water BMP'S on their LOA area, Local can accommodate BMP's at the discretion of the District. These BMP's can be accomplished independent of or in conjunction with the Local. The Local may be required to fund BMP's that are deemed excessive in the view of the ODOT District Office i.e. those outside the Location and Design Manual Volume II.

C. Projects that are jointly funded by ODOT and a Local.

1) Projects have OOA and LOA areas of project work AND where ODOT and the Local are joint permitees (e.g., work on an Interstate Highway and work on a local government street).

Permit requires post construction storm water BMP's on the OOA and LOA areas.

D. Projects that are funded by a private developer. Projects where ODOT has permit responsibility. There is no project federal dollars

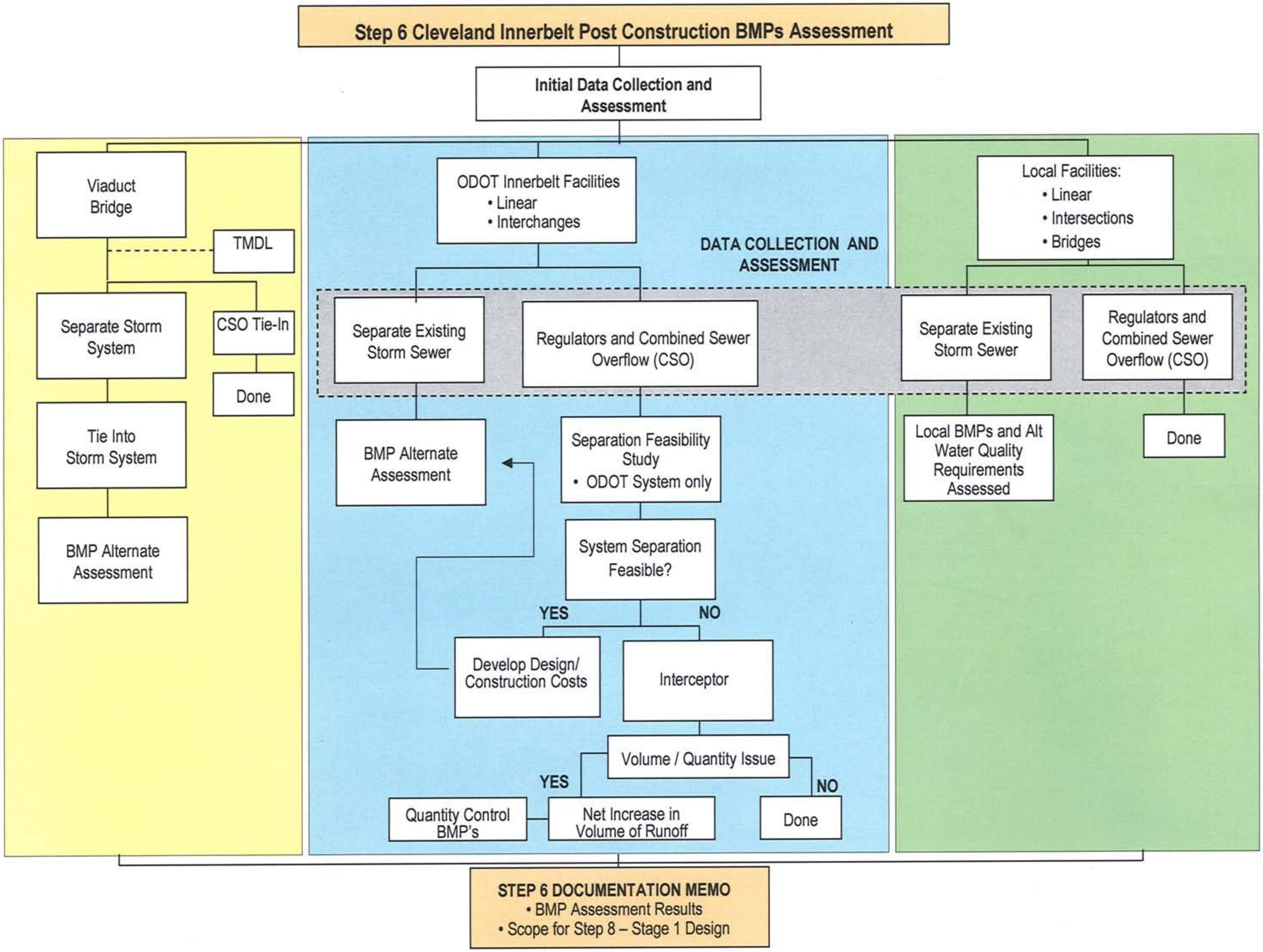
1) Projects that have work on private developer property and some work on OOA area (e.g., work by a developer on the developer's land but some work on a state highway or interstate. OOA area).

Permit requires post construction storm water BMP's on the developer's land. Post construction storm water BMP's is NOT required on the OOA area.

If ODOT does request post construction storm water BMP's then the developer must furnish post construction storm water BMP's as outlined in the Location and Design Manual Volume II at their cost as a ODOT permit condition.

Appendix J

Original Approach (Flowchart)

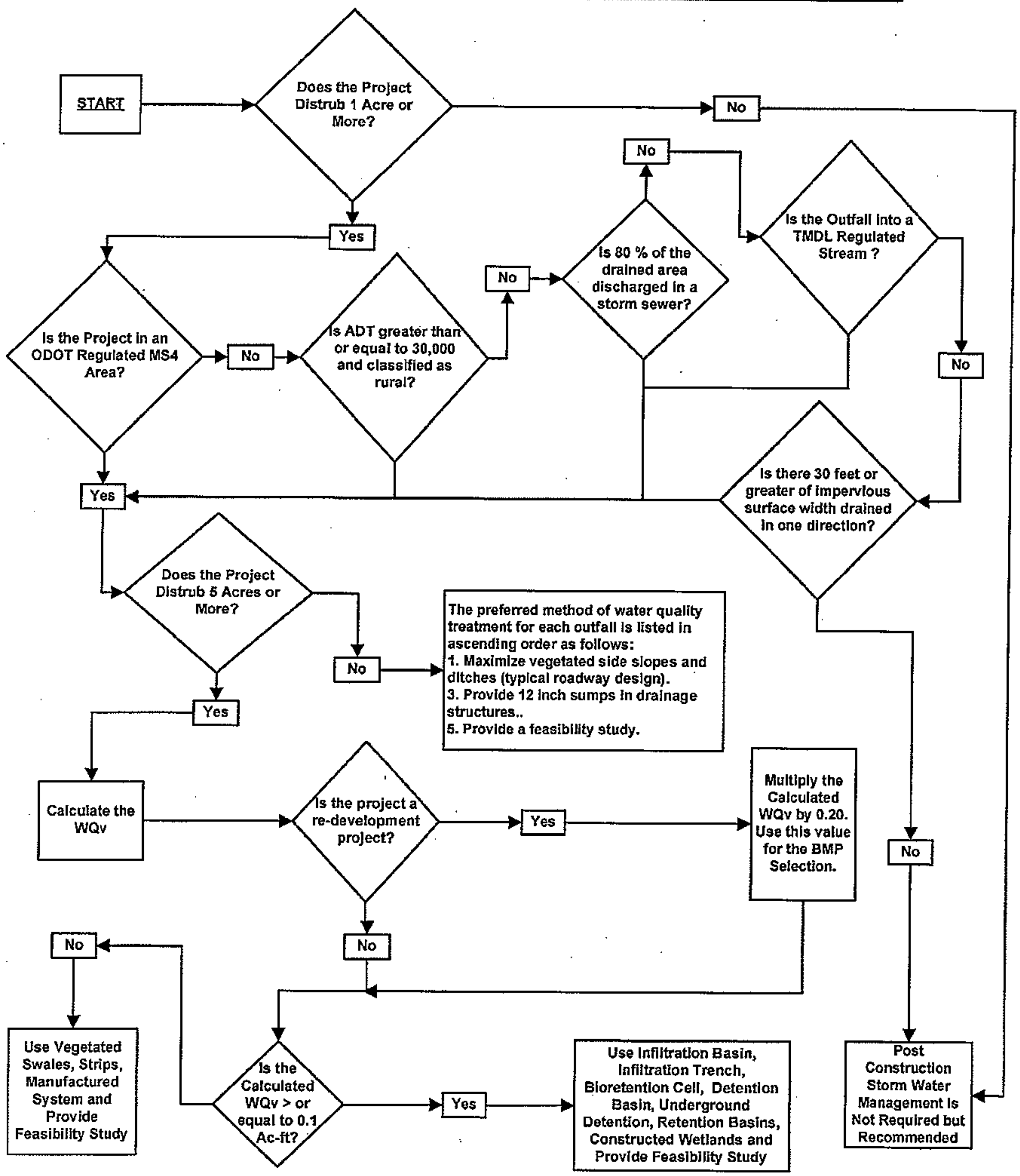


Step 6 Cleveland Innerbelt Post Construction BMPs Assessment
Initial Data Collection and Assessment
Viaduct Bridge
TMDL
Separate Storm System
CSO Tie-In
Done
Tie Into Storm System
BMP Alternate Assessment
ODOT Innerbelt Facilities
• Linear
• Interchanges
DATA COLLECTION AND ASSESSMENT
Separate Existing Storm Sewer
Regulators and Combined Sewer Overflow (CSO)
BMP Alternate Assessment
Separation Feasibility Study
• ODOT System only
System Separation Feasible?
YES
NO
Develop Design/ Construction Costs
Interceptor
Volume / Quantity Issue
YES
NO
Quantity Control BMP's
Net Increase in Volume of Runoff
Done
Local Facilities:
• Linear
• Intersections
• Bridges
Separate Existing Storm Sewer
Regulators and Combined Sewer Overflow (CSO)
Local BMPs and Alt Water Quality Requirements Assessed
Done
STEP 6 DOCUMENTATION MEMO
• BMP Assessment Results
• Scope for Step 8 – Stage 1 Design

Appendix K

ODOT BMP Selection Process Flowcharts 2005-2006

BMP SELECTION	1115 1
	REFERENCE SECTION 1115

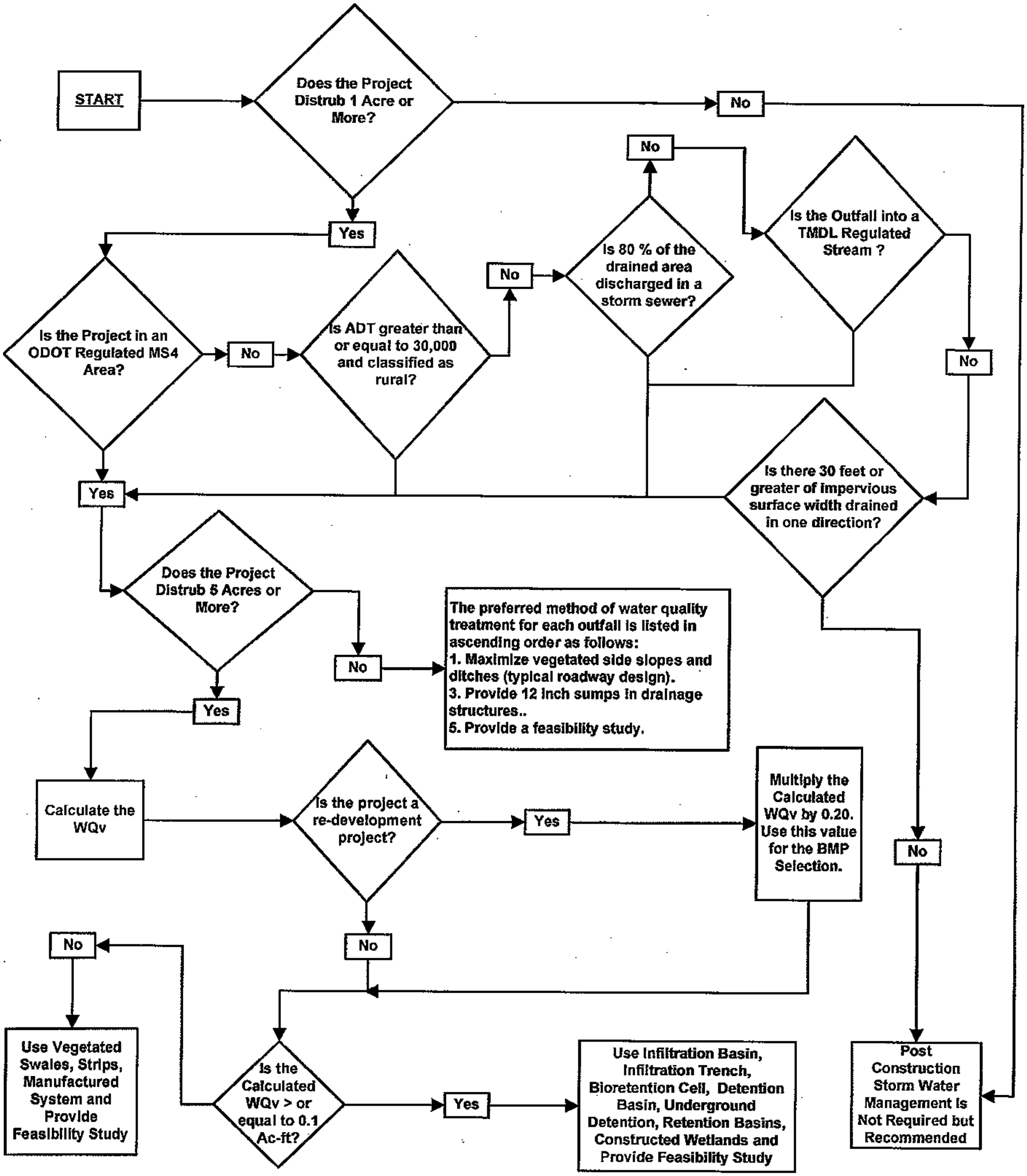


January 2005

BMP SELECTION

1115 1

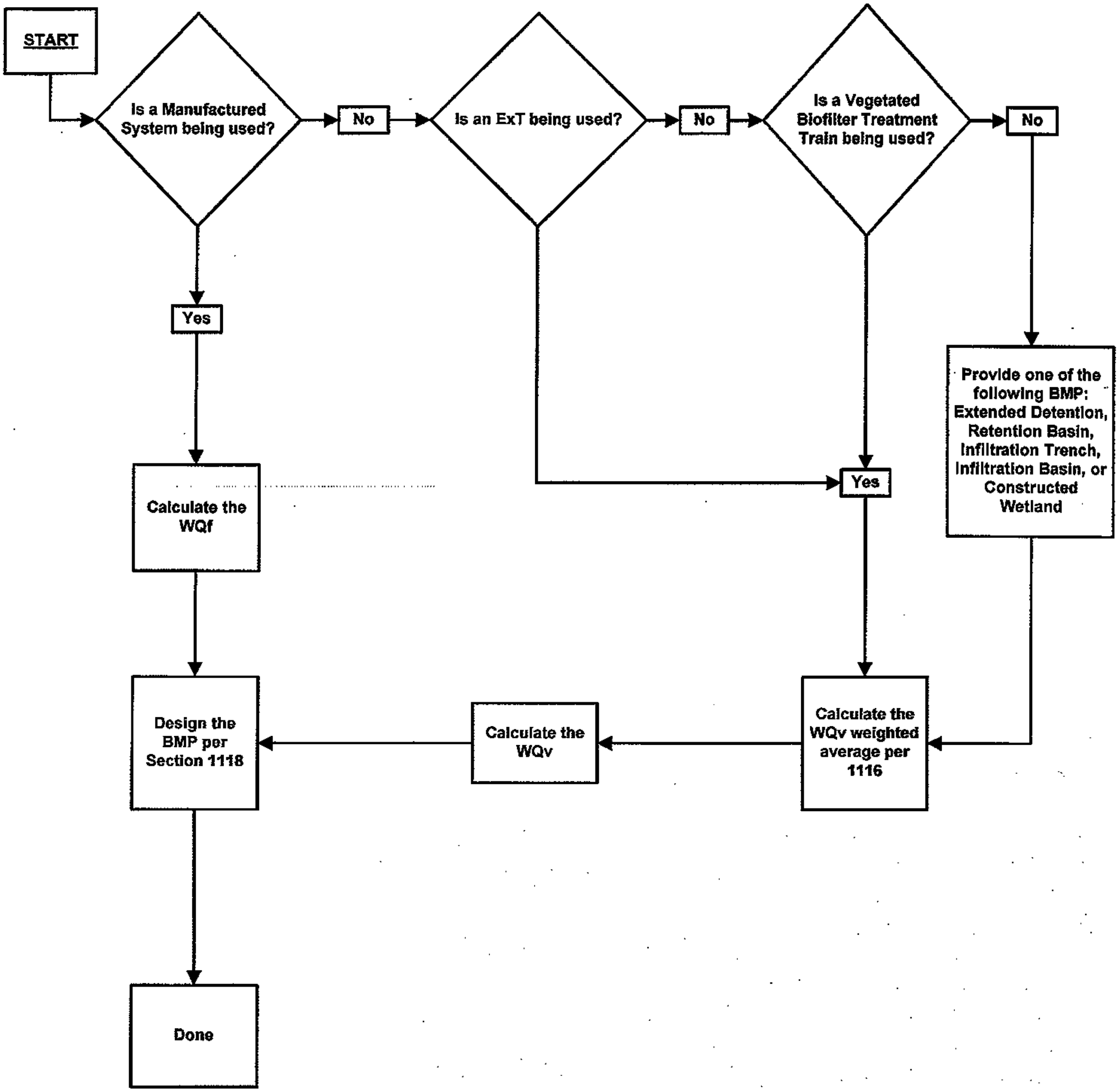
REFERENCE SECTION 1115



BMP SELECTION AT AN OUTFALL

1118-12

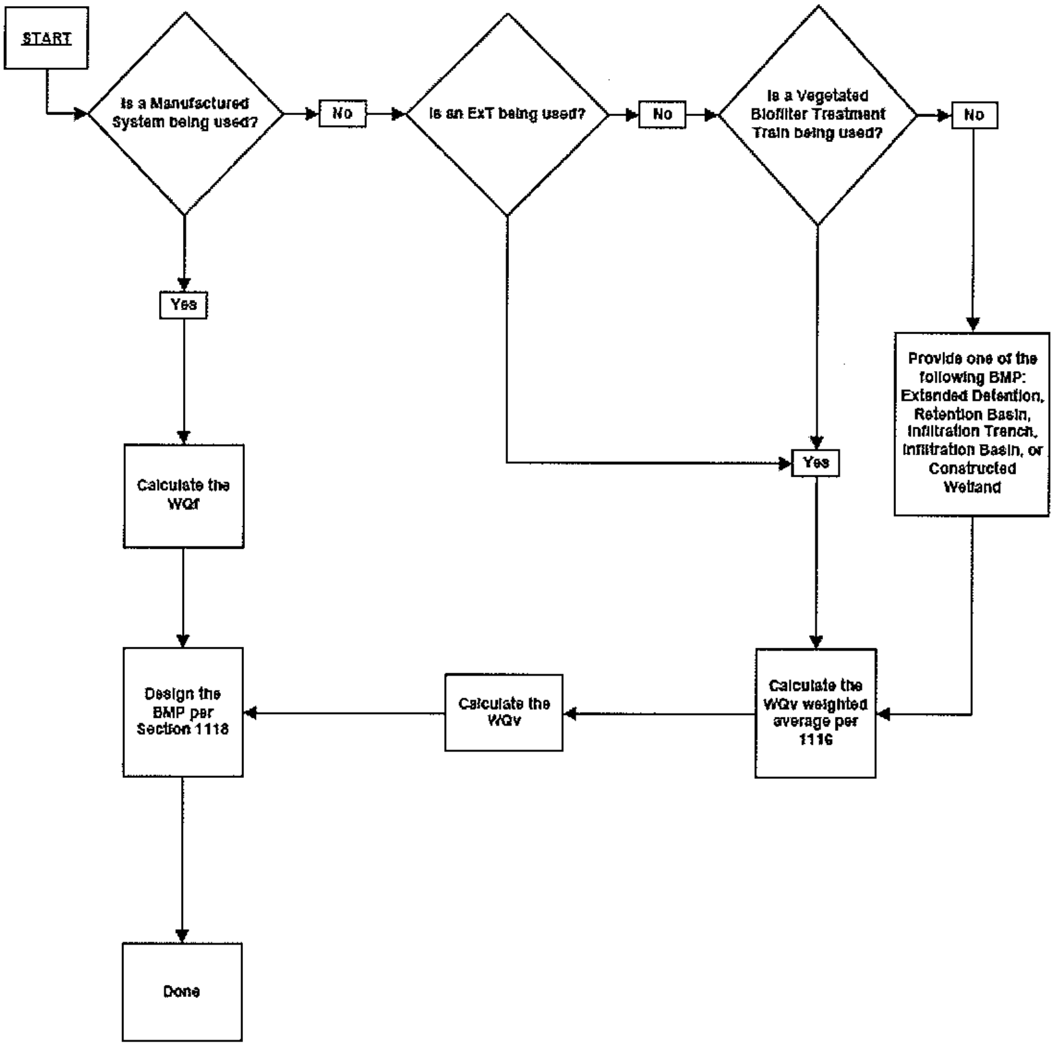
REFERENCE SECTION 1118



BMP SELECTION AT AN OUTFALL

1118-12

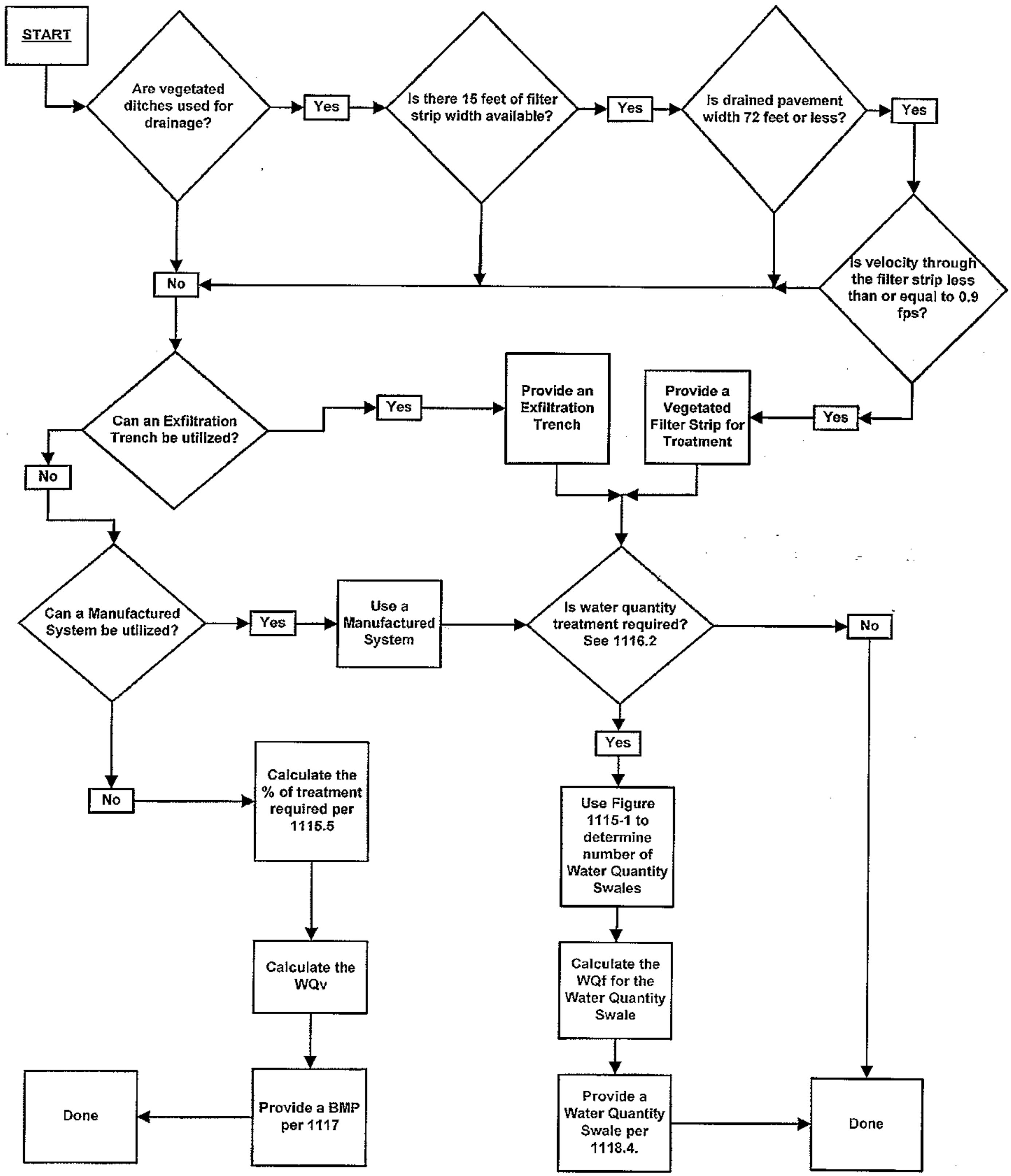
REFERENCE SECTION 1118



BMP SELECTION AT AN OUTFALL

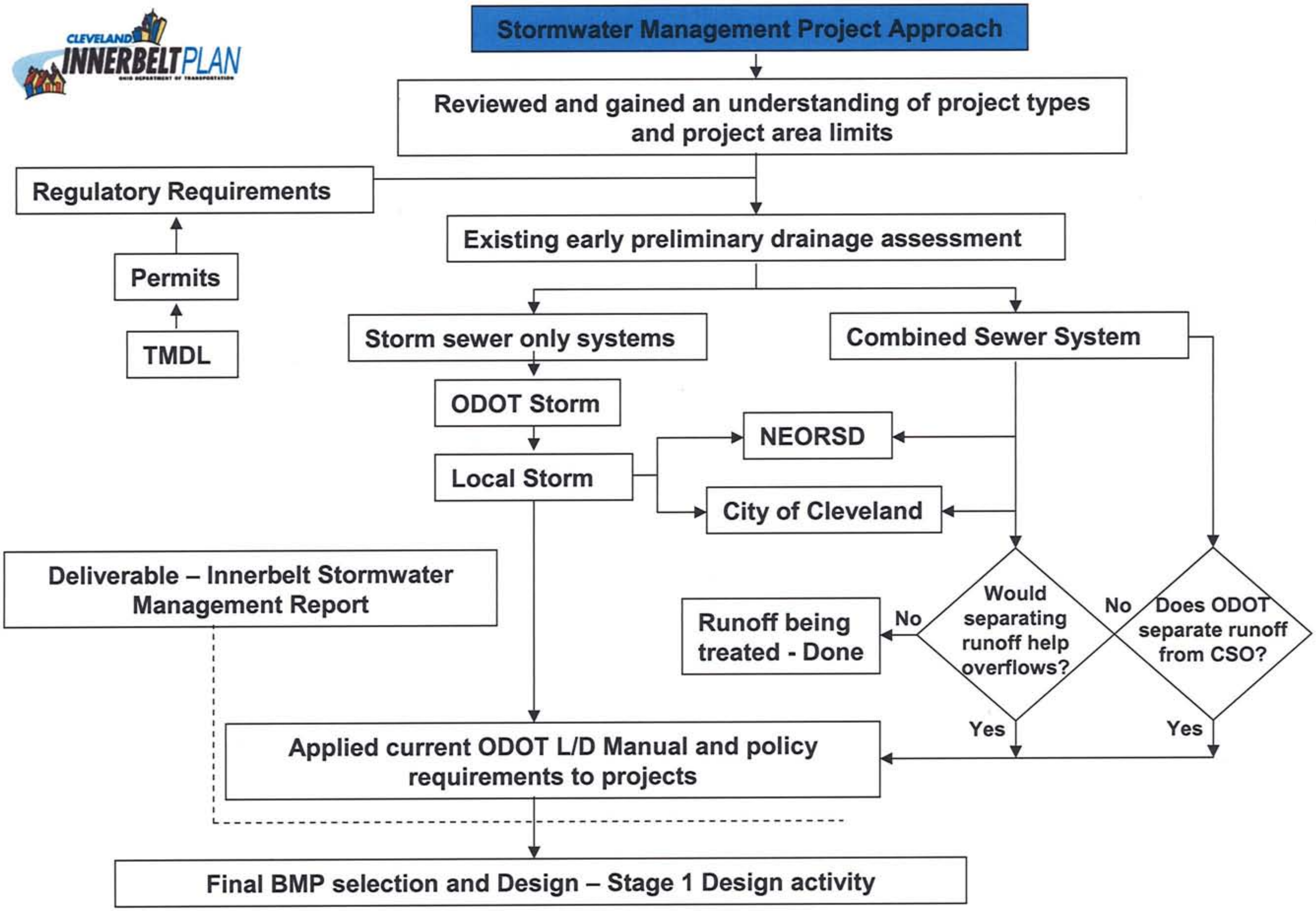
1118-14

REFERENCE SECTION 1115



Appendix L

Revised Approach (Flowchart)



Stormwater Management Project Approach
Reviewed and gained an understanding of project types and project area limits
Regulatory Requirements
Permits
TMDL
Existing early preliminary drainage assessment
Storm sewer only systems
Combined Sewer System
ODOT Storm
Local Storm
NEORSD
City of Cleveland
Would separating runoff help overflows?
Does ODOT separate runoff from CSO?
No
No
Yes
Yes
Runoff being treated - Done
Deliverable – Innerbelt Stormwater Management Report
Applied current ODOT L/D Manual and policy requirements to projects
Final BMP selection and Design – Stage 1 Design activity

Appendix M

Ohio Department of Transportation – Stormwater Management Plan – Table of Contents

Ohio Department of Transportation
Storm Water Management Plan

Authorization for Small Municipal Separate Storm Sewer Systems to Discharge Storm Water under the National Pollutant Elimination System

Submitted to
Ohio Environmental Protection Agency

March 10, 2003

URS

Ohio Department of Transportation

Storm Water Management Plan

Authorization for Small Municipal Separate Storm Sewer Systems to Discharge Storm Water Under The National Pollutant Discharge Elimination System

Submitted to:
Ohio Environmental Protection Agency

Prepared by:

URS

March 10, 2003

TABLE OF CONTENTS

I. Appendices

LIST OF TABLES

Appendix N

OEPA – Notice of Intent (NOI) form

Notice of Intent (NOI) For Coverage Under Ohio Environmental Protection Agency General Permit

(Read accompanying instructions carefully before completing this form)

Submission of this NOI constitutes notice that the party identified in Section I of this form intends to be authorized to discharge into state surface waters under Ohio EPA's NPDES general permit program. Becoming a permittee obligates a discharger to comply with the terms and conditions of the permit. Complete all required information as indicated by the instructions. Forms transmitted by fax will not be accepted. A check for the proper amount must accompany this form and be made payable to "Treasurer, State of Ohio." (See the fee table in Attachment D of the NOI instructions for the appropriate processing fee)

I. Applicant Information/Mailing Address

Company (Applicant) Name: ______

Mailing (Applicant) Address: ______

City: ______ State: ______ Zip Code: ______

Contact Person: ______ Phone: ______ Fax: ______

Contact E-Mail Address: ______

II. Facility/Site Location Information

Facility Name: ______

Facility Address/Location: ______

City: ______ State: ______ Zip Code: ______

County(ies): ______ Township(s): ______

Facility Contact Person: ______ Phone: ______ Fax: ______

Facility Contact E-Mail Address: ______

Quarter: ______ Section(s): ______ Range: ______

Receiving Stream or MS4: ______

If aware of a state nature preserve within 1,000 feet of the facility/site, check here: ☐

Enter river code here, if discharge is to a river designated scenic, wild, or recreational, or to a tributary within 1,000 feet (see instructions): ______

General Permit Number: OH ______ Initial Coverage: ☐ Renewal Coverage: ☐

Type of Activity: ______

SIC Code(s): - ______ - ______ - ______ - ______

Existing NPDES Permit Number: ______

ODNR Coal Mining Application Number: ______

Outfall	Design Flow (MGD)	Latitude	Longitude

For Ohio EPA Use Only

Check ID (OFA): ______

Person: ______

Place: ______

DOC #: ______

ORG #: ______

Rev. ID #: ______

Other DSW Permits Required: ______

Proposed Project Start Date (MO DY YR): ______ Estimated Completion Date: (MO DY YR): ______

Total Land Disturbance (Acres): ______ MS4 Drainage Area (Square Miles): ______

Payment Information: Check # ______ Check Amount: ______ Date of Check: ______

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Applicant Name: ______ Title: ______

Applicant Signature: ______ Date: ______

EPA 4494 (Rev. 4/07)

FOR CONSTRUCTION STORM WATER, ATTACH LOCATION MAP

Click to clear all entered information CLEAR

Ohio EPA Notice of Intent (NOI) Application form - For Requesting Coverage
Instructions Under An Ohio Environmental Protection Agency General Permit

**** IMPORTANT****
DO NOT COMPLETE THE NOI WITHOUT FIRST READING THESE INSTRUCTIONS.

What is a NOI Application Form?

NOI stands for Notice of Intent. It is a one-page application form to request initial coverage or to renew coverage under a general permit. The applicant must certify their intention to comply with a general permit by submitting a complete NOI. The application shall be submitted to Ohio EPA's Central Office.

Who Must File a NOI Application Form?

Any discharge of water, with certain exceptions for storm water, from a point source must be covered by a permit from Ohio EPA. Federal regulations at 40 CFR 122 and the Ohio Revised Code at section 6111.04 prohibit point source discharges to waters of the state without first obtaining a National Pollutant Discharge Elimination System (NPDES) permit. This includes point source discharges of storm water associated with industrial and construction activity and certain municipal separate storm sewer systems (MS4s).

There are two types of NPDES permits; 1) individual permits and 2) general permits. A facility with a discharge must apply for one of these permits using either this NOI application form (for general permit coverage, assuming a general permit exists for the type of discharge) **OR** Form 1 and the appropriate supplementary forms (for an individual permit, which can be written for any type of discharge). If a facility applies for coverage under a general permit, and if all of the eligibility requirements of the general permit are not met, the facility will be required to submit an application for an individual permit. If a facility is eligible to be covered under the general permit and has additional waste streams that are not covered by the general permit, it is preferred that all discharges be covered by one permit (i.e., the individual permit).

Each applicant must meet the requirements found in the general permits regarding eligibility and applicability. **Do not** submit the NOI application form unless you meet **all** of those requirements.

These instructions may be used for coverage under the following general permits. Please note that these names are shortened versions of the actual names on the general permits.

General Permit Authorization to Discharge:	General Permit Number:
1. Coal Surface Mining Activities	OHM000001
2. Construction Site Storm Water	OHC000002
3. Construction Site SW - Big Darby Cr Watershed	OHC100001
4. Household Sewage Treatment Systems	OHK000001
5. Industrial Storm Water	OHR000004
6. Non-contact Cooling Water	OHN000003
7. Petroleum Bulk Storage Facilities	OHB000001
8. Petroleum-related Corrective Actions	OHU000004
9. Small MS4 - Baseline	OHQ000001
10. Small MS4 - Rapidly Developing Watershed	OHQ100000
11. Small Sanitary Dischargers	OHS000002
12. Small Sanitary Dischargers (not BADCT)	OHV000001
13. Temporary Wastewater Discharges	OHT000001
14. Water Treatment Plants	OHW000002

Where to file NOI Application Form

NOIs must be sent to the following address:

Ohio Environmental Protection Agency
Office of Fiscal Administration
P.O. Box 1049
Columbus, OH 43216-1049

**** IMPORTANT ****

Responses must be typewritten or printed legibly in the spaces provided. NOIs transmitted by FAX will not be accepted. Incomplete NOI application forms, including those submitted without the application fee, will be returned to the applicant for resubmission.

Completing the Form

All responses must be typewritten or printed legibly in the appropriate areas only. Please place each character slightly above the appropriate line on the NOI application form. If necessary, abbreviate to stay within the space allowed for each item. Use only one space for breaks between words. If the requested information does not apply to your facility, leave it blank. Do not include any symbols or punctuation marks unless otherwise noted in these instructions. Each NOI application form must be accompanied by a check for payment of the proper application fee. **Be sure to read the instructions printed at the top of NOI application form before completing the form.**

I. Applicant Information/Mailing Address

Company Name: Fill in the legal name of the firm, person, public organization, or other entity that operates the facility or site described in this application. The name of the operator may or may not be the same as the facility. The company name is the name of the responsible party that is the legal entity that controls the facility's operation rather than the plant or site manager. For construction activities, the responsible party is the operator (e.g., owner or general contractor).

Mailing Address: Enter the complete mailing address; including street address, city, state, and zip code. The permit and any correspondence will be mailed to this address.

Contact Person: Give the name of a contact person who is responsible for addressing NPDES requirements.

Phone and Fax: Provide the contact person's phone and fax numbers as: <u>area code exchange numbers</u>.

E-Mail Address: Enter the contact person's e-mail address, if available.

II. Facility/Site Location Information

Facility Name: Enter the facility or site's official or legal name. The facility/site is the location of the operation and discharge to be covered by the general permit. Do not use a colloquial name.

Facility Address/Location: **Do NOT** enter P.O. Box numbers. Do **ONE** of the following:

1. Enter the facility's or site's complete physical address, including number and street, city/township, state, zip code, county, **OR**
2. If the facility lacks a street address, indicate the quarter, sections, county, township, and range (to the nearest quarter section) of the approximate center of the facility. If a site is located in more than one township and/or section, please list all townships/sections. The first listed township/section should be the

one that contains the main entrance to the facility. (If there is not adequate space provided on the NOI form, please provide an additional sheet of paper with this information.)

Facility Contact Person: Give the name of the person who is responsible for the facility/site.

Phone and Fax: Provide facility contact person's phone and fax numbers as: area code exchange numbers.

Facility Contact E-mail Address: Provide the facility contact person's e-mail address, if available.

IN THE CASE OF CONSTRUCTION ACTIVITY, attach an 8 1/2" x 11" site map to each NOI. The map shall clearly show the location of the project with its perimeter outlined and existing adjacent identifiable roads. The perimeter of the project are the boundaries that ground disturbance will occur within and for which a storm water pollution prevention plan has been developed. Provide the facility contact person and project name on the map.

IN THE CASE OF COAL SURFACE MINING OPERATIONS, provide quarter, sections, county, township, and range. Coal surface mine applicants are to attach to NOIs an 8 1/2" x 11" site map [using 7.5 min. United States Geological Survey (USGS) topo map]; the map shall clearly show the affected area and location of treatment ponds with outfalls labeled 001, 002, etc. Also, the map shall indicate whether the ponds are existing or proposed. The map shall be labeled with its USGS topo map name. For proposed ponds at new mine sites, the NOI will serve as a Permit-to-Install application. USGS maps are available from:

1. Map Distribution, US Geological Survey, Building 41, Box 25286, Federal Center, Denver, Colorado 80225;
2. Their website at http://mapping.usgs.gov
3. By calling USGS at 1 (888) ASK-USGS
4. Commercial map dealers, which would be listed in the phone book; or
5. A public library.

Quarter/Section Range: These must be completed if the facility or site does not have a street address. Please refer to the section above entitled "Facility Address/Location" for further explanation.

Receiving Stream or MS4: If a facility discharges directly to receiving water(s), enter the name of the receiving water. If the initial receiving water(s) does not have a name, then write as "unnamed tributary to" first subsequent water that has a name. It is important that the name of the receiving waterbody where the discharge directly goes is listed. If a facility discharges to more than one receiving stream, list all receiving streams (if necessary, attach a separate sheet of paper). An MS4 is defined as "a conveyance that is owned or operated by a state, city, town, township, county, district, association, or other public entity that is designed or used for collecting or conveying storm water." If you discharge storm water to an MS4, then enter the name of the operator of the municipal separate storm sewer system (MS4) (e.g. municipality name, county name,...).

"State Nature Preserve": If you are aware of a state nature preserve, in accordance with Ohio Revised Code 1517.05, within 1,000 feet of the boundaries of your facility/site, then place an "X" in the associated space. Otherwise, leave the space blank.

"River Code": If the facility's discharge is to a river designed as scenic, wild, or recreational, or to a tributary within 1,000 feet of one of these segments, enter the appropriate river code in this space. Please refer to Attachment A of these instructions for a list of river segments. Enter the appropriate code in this space. If a river code does not apply to the facility's receiving stream, leave the space blank.

General Permit Number: Enter the general permit number for which coverage is being sought (i.e. in the case of renewing coverage, do not use your current general permit number). The first two spaces of the number are "OH" and have already been placed on the NOI; fill in the remaining characters. Please refer to the above section entitled "Who Must File a NOI Form?" (front page of these instructions) for a list of general permit names and associated permit numbers. Do not enter any number in this space other than the general permit number for which coverage is being sought.

Initial/Renewal Coverage: The NOI form may be submitted to initiate first-time coverage under a general permit or to continue coverage under a renewed general permit. Place an "X" in the appropriate space.

Type of Activity: In the case of non-industrial storm water and construction site storm water discharges, enter the title of the general permit for which you are applying for coverage. Please refer to the above section entitled "Who Must File a NOI Form?" for a list of general permit names and numbers. Please note the names listed in that section are shortened versions of the actual names on the general permits.

1. Non-contact cooling water discharges **AND** Petroleum corrective actions: According to Part I.C.3. of these general permits, the applicant may request a waiver from the "limitations of coverage" if the applicant has an effluent monitoring requirement or limitation in their individual permit that is not in the applicable general permit. In order to request a waiver, enter "WAIVER REQUESTED" after the title of the general permit. Otherwise, as stated under Part I.C.2. of the permits, an applicant is not eligible for general permit coverage..
2. Industrial storm water discharges: For industrial facilities, enter "Ind SW" and for those included due to SIC codes, enter the description of the SIC code. This should be the primary activity of the facility. For industrial activities identified in 40 CFR 122.26(b)(14)(i)-(ix) and (xi) by narrative description, use the following 2-character codes in the space provided:
   HZ = Hazardous waste treatment, storage, or disposal facilities, including those that are operating under interim status or a permit under subtitle C of RCRA (40 CFR 122.26(b)(14)(iv));
   SE = Steam electric power generating facilities, including coal handling sites (40 CFR 122.26(b)(14)(vii)); or
   TW = Treatment works treating domestic sewage or any other sewage sludge or wastewater treatment device or system used in the storage, treatment, recycling, and reclamation of municipal or domestic sewage (40 CFR 122.26(b)(14)(ix)).

SIC Code(s): Industrial applicants must list (excluding construction activity storm water discharges), in descending order of significance, up to four 4-digit standard industrial classification (SIC) codes that best describe the principal product or services provided at the facility identified in Section II of this application. For storm water discharges defined in 40 CFR 122.26(b)(14)(i)-(ix) and (xi) that do not have SIC codes that accurately describe the principal products produced or services provided, leave the space blank. SIC code numbers may be found in the "Standard Industrial Classification Manual" prepared by the Executive Office of the President, Office of Management and Budget. This text may be found in a public library or may be ordered from the US Government Printing Office, 200 North High Street, Columbus, Ohio 43215, (614) 469-6955. Another source is the following website provided by the Occupational Health and Safety Administration: http://www.osha.gov/oshstats/sicser.html

Existing NPDES Permit Number(s): If the facility identified in Section II of this application has ever been issued an individual NPDES permit and/or general permit coverage(s), enter the (facility specific) permit number(s) here. In the case of an individual NPDES permit, give the permit number (e.g. 3IA00555*AD). In the case where general permit coverage is being renewed, it is *extremely important* to give the individual Ohio EPA general permit identification number assigned in the previous approval for coverage letter received from Ohio EPA. Examples of such numbers are: 0GR009876 (industrial storm water) and 0GN009876 (non-contact cooling water).

ODNR Coal Surface Mining Application Number: For coal surface mining activity general permit applicants only. Enter the **O**hio **D**epartment of **N**atural **R**esources coal mining permit application number here. You must obtain this number from ODNR before submitting this application.

Outfall: This item does not apply to construction, industrial, small MS4, or coal surface mining general permit applicants. List the numbers of the outfalls for which you desire permit coverage. Please enter the outfall numbers as three digits (e.g. 001, 002, etc.). If you have five or more outfalls, please list the additional outfalls on an additional sheet. An outfall is the point source discharge of wastewater leaving your site that will be entering a surface water body and does not enter a sewer system tributary to a publicly-owned sewage treatment plant. An outfall could be a pipe, ditch, channel, or other conveyance leaving your site.

Design Flow: This item does not apply to construction, industrial, small MS4, or coal surface mining general permit applicants. For the corresponding outfall, please indicate in **m**illion **g**allons per **d**ay (MGD) the average design flow of each outfall or each outfall's treatment system (e.g. 100,000 gallons per day (gpd) = 0.1 million gallons per day (MGD); in this case, enter 0.1 in the space provided). Facilities applying for coverage under the small sanitary general permit shall submit their design flow and an estimated sewage flow rate in gallons per day. The sewage flow rate should be estimated, using Attachment B., and entered on the NOI form on the line directly underneath the design flow.

Latitude/Longitude: This item does not apply to construction, industrial, small MS4, or coal surface mining general permit applicants. Please indicate the latitude and longitude of the point of discharge (outfall) to the nearest 15 seconds (provide coordinates as: degrees minutes seconds using 2 digits in each space; e.g. latitude 40 15 35, longitude 80 41 22; do not use symbols). Latitude/longitude is available from USGS topographical maps (see "Facility Address/Location: IN CASE OF COAL SURFACE MINING OPERATIONS," above, for information on obtaining USGS maps).

Other DSW Permits Required: Identify other Division of Surface Water (DSW) permits that are either pending with DSW or for which you are aware that you need to apply for the facility/site identified on the NOI. This is of particular importance for construction storm water sites. Indicate the type of permit (NPDES, PTI, or 401) and whether it's "pending" with DSW or "yet to apply."

Project Start/Completion Dates: For construction activity and coal surface mining applicants, enter the project approximate start date and estimated completion date for the entire development plan or for final bond release. Provide dates as: month day year using two digits in each space (e.g. September 28, 1994 = 09 28 94); do not use symbols or letters. Applicants for coverage under the small sanitary discharger general permit should include the date that the facility commenced discharging in the space entitled "Project Start Date."

Total Land Disturbance (Acres): For construction activity and coal surface mining applicants only, provide an estimate of the total number of acres of land that will be disturbed during the life of the project. In the case of construction activity, the total area disturbed is to be addressed by the storm water pollution prevention plan which is to have been developed by the time the NOI is submitted to Ohio EPA. Disturbed land is land in which vegetation has been cleared and soils are exposed to storm water.

MS4 Drainage Area (square miles): For MS4 general permit applicants only, provide, in square miles, the area served by the MS4. This information will be used to determine an MS4 operator's annual discharge fee (which will be due annually starting January 30, 2004). The fee is $100 per square mile of MS4 permitted with a maximum fee of $10,000 [per Ohio Revised Code 3745.11(L)(6)]. Ohio will send an annual notification regarding an MS4's specific fee prior to it being due.

Payment Information

A check made payable to "Treasurer, State of Ohio" must accompany all NOI applications. The check number, check amount, and check date must be on the NOI to ensure complete processing. Provide dates as: month day year using two digits in each space (e.g. September 28, 1994 = 09 28 94); do not use symbols. For the appropriate NOI application fee, see Attachment D below.

Certification

Type or print the name and title of the person who will sign the form. Next, sign and date the form. Federal and State statutes provide for severe penalties for submitting false information on this application form. In the case of co-permittees, attach a separate sheet of paper re-stating the NOI certification statement and each co-permittee is to provide the individual's name, title, name of the entity represented, signature, and date. Federal regulations require this application to be signed as follows:

For a corporation: by a responsible corporate officer, which means: (1) a president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision making functions for the corporation; or (2) the manager of one or more manufacturing, production, or operating facilities, provided, the manager is authorized to make management decisions which govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations and initiating and directing other comprehensive measures to assure long term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.

For a partnership or sole proprietorship: by a general partner or the proprietor; respectively, or

For a municipality, state, or other public facility; by either a principal executive officer, the ranking elected official, or other duly authorized employee.

For facilities applying for coverage under the Small Sanitary General permit attach, on a separate sheet of paper, a list of the parameters and limits included in the existing individual NPDES permit. Also, indicate the type of treatment used at the facility (extended aeration, lagoon (controlled or continuous discharge) etc.) and whether or not the facility has a requirement to be under the supervision of a certified operator.

Facilities applying for coverage under either small MS4 general permit are required to submit the original NOI and a copy of their storm water management program (SWMP) to Ohio EPA's Central Office, Office of Fiscal Administration, P.O. Box 1049, Columbus, Ohio 43216-1049 and a copy of the NOI and SWMP to the Ohio EPA at the appropriate district office, DSW - Storm Water (see page 10 for the appropriate district office and mailing address).

Operators applying for coverage under the Construction Activity Located within the Big Darby Creek Watershed general permit are required to include a copy of their storm water pollution prevention plan (SWPPP) with NOI submittal for approval at least 45 days prior to the commencement of construction activity.

Attachment A

If the discharge is to one of the following named river segments or to a tributary within 1,000 feet of one of the segments, enter the river code in the space provided on the form.

River/Stream Segment Code	River/Stream Segment
	Little Miami River
S01	- Clermont County line at Loveland to headwaters, including North Fork
S02	- Clermont County line at Loveland to confluence with East Fork
S03	- From confluence with East Fork to Ohio River
	Sandusky River
S11	- U.S. Route 30 in Upper Sandusky to Roger Young Memorial Park in Fremont
	Olentangy River
S21	- Delaware Dam to Wilson Bridge Road in Worthington
	Little Beaver Creek
W31	- West Fork from 1/4 mile downstream from Township Road 914 to confluence with Middle Fork
W32	- North Fork from Township Road 952 to confluence with Little Beaver Creek
W33	- Little Beaver Creek from confluence of West and Middle Forks downstream to 3/4 mile north of Grimm's Bridge
S31	- North Fork from Ohio-Pennsylvania line downstream to Jackman Road
S32	- Middle Fork from Elkton road (Township Road 901) downstream to confluence with West Fork
S33	- Little Beaver Creek from 3/4 mile north of Grimm's Bridge downstream to Harpersfield covered bridge
	Grand River
W41	- From Harpersfield covered bridge downstream to Norfolk and Western Railroad trestle south of Painesville
S41	- From State Route 322 bridge in Astabula County downstream to Harpersfield covered bridge
	Upper Cuyahoga River
S51	- Troy-Burton Township line in Geauga County to US Route 14
	Maumee River
S61	- Ohio-Indiana line to State Route 24 bridge west of Defiance
R61	- State Route 24 bridge west of Defiance to US Route 25 bridge near Perrysburg
	Stillwater River System
R71	- Englewood Dam to confluence with Great Miami River
S71	- Stillwater River from Riffle Road bridge in Darke County to Englewood Dam
S72	- Greenville Creek from the Ohio-Indiana line to the confluence with the Stillwater
	Chagrin River
S81	- Aurora Branch from State Route 82 bridge downstream to confluence with Chagrin
S82	- Chagrin River from confluence with Aurora Branch downstream to State Route 6 bridge
S83	- East Branch from Heath Road bridge downstream to confluence with Chagrin
	Big and Little Darby Creeks
S91	- Big Darby Creek from the Champaign-Union County line downstream to the Conrail railroad trestle and from the confluence with the Little Darby Creek downstream to the Scioto River
S92	- Little Darby Creek from the Lafayette-Plain City Road bridge downstream to within 0.8 mile from the confluence with Big Darby Creek

Attachment B

ESTIMATING SEWAGE FLOW RATE

These estimated flows are empirical and are intended for estimating average flow rates

PLACE	ESTIMATED SEWAGE FLOW (Gallons Per Day)
Apartments	250 one-bedroom 300 two- bedroom 350 three-bedroom
Assembly Halls[a]	2 per seat
Beauty Shop, Styling Salon	200 per basin
Bowling Alleys (no food service)[a]	75 per lane
Churches (small)[a]	3-5 per sanctuary seat
Churches (large with kitchen)[b]	5-7 per sanctuary seat
Country Clubs	50 per member
Dance Halls[a]	2 per person
Doctors/Dentists	75 per doctor 20 per employee 10 per patient
Drive-Inn Theaters	5 per car space
Factories (no showers)	25 per employee
Factories (with showers)	35 per employee
Food Service Operations Ordinary Restaurant (not 24-hour) 24-Hour Restaurant Banquet Rooms Restaurant Along Freeway Tavern (very little food service) Curb Service (drive-in) Vending Machine Restaurants	 35 per seat at 400 ppm BOD_5 50 per seat at 400 ppm BOD_5 5 per seat at 400 ppm BOD_5 100 per seat at 400 ppm BOD_5 35 per seat at 400 ppm BOD_5 50 per car space at 400 ppm BOD_5 100 per seat at 200 ppm BOD_5
Homes in Subdivision	400 per dwelling
Hospitals (no resident personnel)[b]	300 per bed
Institutions (residents)[b]	100 per person
Non-Industrial Laundries (coin-operated)	400 per standard size machine
Marinas (restrooms and showers only)	15 per boat mooring/slip/dock
Migrant Labor Camps[c]	50 per person

PLACE	ESTIMATED SEWAGE FLOW (Gallons Per Day)
Mobile Home Parks	300 per mobile home space
Motels	100 per unit
Nursing and Rest Homes[b]	200 per patient at 300 ppm BOD_5 100 per resident employee 50 per non-resident employee
Office Buildings	20 per employee
Recreational Vehicle Dumping Stations	Consult District Office
Recreational Vehicle Parks and Camps	Consult District Office
Retail Stores	20 per employee
Schools — Elementary[b] — High and Junior High[b]	15 per pupil 20 per pupil
Service Stations	1000 first bay or pump island 500 additional bay or pump island
Shopping Centers (no food service/laundries)[d]	0.2 per sq.ft. of floor space
Swimming Pools (average) (with hot water showers)	3-5 per swimmer (design load) 5-7 per swimmer (design load)
Vacation Cottages	50 per person
Veterinarians and Animal Hospitals[e]	10 per run 10 per cage 20 per employee
Youth and Recreation Camps[b]	50 per person

[a] Food service waste not included.
[b] Food service waste included, but without garbage grinders.
[c] 20 gallons per day if vault latrine is used for toilet wastes.
[d] All laundries or other high flow or high strength uses.
[e] Assumes manual hosing and solids (food droppings, etc.) removal prior to hosing.

OhioEPA

DISTRICT OFFICES

CDO **Central District Office**
50 West Town Street, Suite 700
Columbus, Ohio 43215
(614) 728-3778

NEDO **Northeast District Office**
2110 East Aurora Road
Twinsburg, Ohio 44087
(330) 936-1200

NWDO **Northwest District Office**
347 North Dunbridge Road
Bowling Green, Ohio 43402
(419) 352-8461

SEDO **Southeast District Office**
2195 Front Street
Logan, Ohio 43138
(740) 385-8501

SWDO **Southwest District Office**
401 East Fifth Street
Dayton, Ohio 45402
(937) 285-6357

Attachment D

As of July 1, 2001, the industrial storm water NOI fee is $350. The construction storm water and Big Darby Creek Watershed construction storm water NOI fee is $200 plus $20 per whole disturbed acre (do not round-up) above 5 whole acres, with a maximum disturbed acreage fee of $300. Under this fee schedule, a site with twenty or more disturbed acres would pay the maximum fee of $500. These fees can be found in paragraph (S)(1) of Ohio Revised Code (ORC) Section 3745.11.

GENERAL PERMIT NOI FEES				
Industrial Storm Water NOI	**Total Fee Due = $350.00**			
Construction SW / Big Darby Creek Watershed Construction SW NOI				
Disturbed Acreage	**Base Fee**	**Additional Acreage Fee**	**Total Fee Due**	
1 - 5.99 acres	$200	$0	$200	
6 - 6.99 acres	200	20	220	
7 - 7.99 acres	200	40	240	
8 - 8.99 acres	200	60	260	
9 - 9.99 acres	200	80	280	
10 - 10.99 acres	200	100	300	
11 - 11.99 acres	200	120	320	
12 - 12.99 acres	200	140	340	
13 - 13.99 acres	200	160	360	
14 - 14.99 acres	200	180	380	
15 - 15.99 acres	200	200	400	
16 - 16.99 acres	200	220	420	
17 - 17.99 acres	200	240	440	
18 - 18.99 acres	200	260	460	
19 - 19.99 acres	200	280	480	
20 acres and up	200	300	500	**MAXIMUM FEE**
All other NOIs	**Total Fee Due = $200.00**			

Appendix O

City of Cleveland - Phase II Stormwater Management Plan, March 2003

City of Cleveland

USEPA PHASE II

Storm Water Management Program

March 2003

TABLE OF CONTENTS

I. Legal Authorities to Implement the Storm Water Management Program

The City of Cleveland (City) has the legal authority to implement the following Storm Water Management Program (SWMP) under Article XVIII, Section 3 of the Ohio Constitution granting municipalities the authority to adopt land use and control measures for promoting the peace, health, safety, and general welfare of their citizens.

II. Financial Ability to Implement the Storm Water Management Program

In 2003 the City of Cleveland will fund the additional activities necessary to implement its SWMP through dollars from the general fund. In 2004 the City of Cleveland Storm Water Committee will evaluate the costs of implementing the SWMP and, if necessary, suggest alternative funding arrangements.

III. Overview of Community Storm Water System

The City of Cleveland is located in the Lake Erie Drainage Basin which includes the Rocky River Watershed, Big Creek Watershed, Mill Creek Watershed, Doan Brook Watershed, and Euclid Creek Watershed. Cleveland also includes Morgan Run Watershed, Dugway Brook Watershed, Shaw Brook Watershed, Nine Mile Creek Watershed, Green Creek Watershed, Kingsbury Run Watershed, and Walworth Run Watershed that are located in combined sewer areas. City of Cleveland is 75.6 square miles of which approximately 6.8 square miles drains into natural watercourses (See attached maps). The community is sewered 91 % combined sewers and 9 % separate sewers.

IV. Description of Permit Development and Decision Process

To develop its SWMP, the City of Cleveland followed the steps detailed below:

1. **Assigned staff to participate in the Euclid Creek Watershed Program-Storm Water Management Work Groups:** These work groups, the Storm Water Ordinance Task Force and Public Involvement/Public Education Work Group included representatives from each watershed community. The groups met monthly in 2002. Our community's representatives include Darnell Brown, Commissioner of Water Pollution Control and Thomas Marsalis, Deputy Commissioner of Water Pollution Control. Working with Euclid Creek Watershed Council, the Committee reviewed the general requirements of each Minimum Control Measure (MCM) and discussed Best Management Practices (BMPs) to meet these general requirements.

   Two public meetings were held in June 2002. Approximately 75 residents attended to learn more about the work of the Euclid Creek Watershed Council and NPDES Phase II. These residents were also given an opportunity to discuss water quality concerns and possible actions to correct the problems.

   On September 18, 2002 a meeting was held for elected officials, engineers, and service directors in the watershed to discuss the permit process and to present recommended Best Management Practices (BMP's) being suggested for the six MCM's.

   The same community representatives were also involved in the Northeast Ohio Area Wide Coordinating Agency Phase II Strom Water Task Force. We worked in the illicit discharge and best management practices work groups. We prepared the draft compliant sections for the

USEPA Phase II Storm Water Permit Requirements.

2. **Reviewed the specific requirements of the Ohio EPA draft NPDES Phase II permit:** After reviewing the general Phase II requirements and inventorying our existing BMPs with each of the City of Cleveland Departments and Divisions involved, we examined the specific requirements under each MCM. We determined the extent to which our current activities meet these specific requirements and selected additional BMPs to fill any shortfalls in our existing programs. Our BMPs were selected based on our financial and legal ability to implement these practices as well as their suitability for our community.

3. **Selected measurable goals and assigned responsible parties:** After BMPs were selected; we assigned these to specific staff and set dates for implementation.

4. **Finalized Storm Water Management Program:** Using the Draft developed by the Euclid Creek Watershed Council, we finalized our Storm Water Management Program.

5. **Held Public Hearings:** A public meeting was held on March 6, 2003 to make residents aware of the plan. This meeting was video taped by Channel 35 for subsequent broadcasting. The City of Cleveland Storm Water Management Committee that includes public participation reviewed the Storm Water Management Program.

6. **Approved:** The Storm Water Management Plan was approved and signed by the Mayor.

V. Storm Water Management Program

A. Public Education and Outreach on Storm Water Impacts and Public Involvement/Participation (MCM #1 and #2)

1. The Permit Requirement (per Ohio EPA draft NPDES Permit)

a) 3.2.1.1 Implement a public education program to distribute educational materials to the community or conduct equivalent outreach activities about the impacts of storm water discharges on water bodies and steps that the public can take to reduce pollutants in storm water runoff.

b) 3.2.2.1 Comply with State and local public notice requirements when implementing a public involvement/participation program.

2. Public Involvement and Education Plan

The City of Cleveland has agreed to work in unison with the other communities in the various watersheds on a comprehensive, Public Involvement and Public Education (PIPE) Program. Given the similarity of these two MCMs, the Euclid Creek Watershed Council, along with a watershed coordinator and citizen volunteers has developed a unified PIPE Program. This program is being expanded across all of our watersheds. The BMPs, measurable goals, and responsible parties in this PIPE Plan are detailed in Table 1.

In addition to Table 1, per Ohio EPA NPDES permit requirement 3.2.1.2 and 3.2.2.2, we are documenting our decision process with the following information required by the draft permit.

There were a series of public meetings to discuss the applicability of numerous public involvement and public education programs. These selected MCM's were then reviewed by the City of Cleveland Storm Water Committee. After review by the Storm Water Committee, the proposed minimum control measures were submitted to the Mayor.

3.2.1.2.1 & 3.2.1.2.2 How you plan to inform individuals and households about the steps they can take to reduce storm water pollution and how to become involved in the storm water management program.

As presented in Table 1, we will inform our residents about the steps they can take to reduce storm water pollution and ways to get involved in our Storm Water Management Program through a combination of workshops, community activities, and print media including newsletters, brochures and fact sheets, new resident outreach, and web site postings, aimed at reaching the diverse audiences within the city.

Our community has been involved in many activities in the past year (Attached is a list of those activities). We have also participated in a number of events where literature has been distributed to residents. The number of events is subject to change each year. We will be upgrading our website to include information about Storm Water Issues and public participation.

3.2.1.2.3 & 3.2.2.2.3 Who are the target audiences for your Public Involvement and Education plan who are likely to have significant storm water impacts and why those

target audiences were selected? Include a description of the types of ethnic and environmental groups engaged and steps to involve all potentially affected stakeholders including businesses, trade associations, environmental groups, homeowners associations, and educational organizations.

Every attempt is being made to link to as many people, young, old, of varied ethnic and racial backgrounds, in all of the City of Cleveland watersheds as possible. Information will be available at City Hall and will be distributed through internal channels, website, and community events. These events provide opportunities for participation from a large variety of groups and businesses. Outreach to school children in the watershed will help educate a diverse student body and also provide opportunities for further involvement.

Riparian landowners have received targeted mailings about stream stewardship and pollution prevention practices. Watershed activities will also include public meetings with residents and businesses to raise awareness of storm water issues.

3.2.1.2.4 What are the target pollutant sources your public education plan is designed to address?

We will target pollutant sources common in the City of Cleveland's various watersheds, including sediment pollution from stream bank erosion and improperly controlled construction sites; habitat alteration due to land use changes and improper disposal of household hazardous wastes.

Because the majority of these pollution problems are caused by increases in impervious cover and the resulting increases in storm water volume and velocity, we will focus our PIPE Program on increasing public awareness of the links between land use practices and storm water pollution. Topics may include lawn and garden care, pesticide management, proper disposal of household hazardous wastes and stream stewardship.

3.2.1.2.5 What is your outreach strategy, including mechanisms (e.g. printed brochures, newspapers, media, workshops, ect.) you will use to reach your target audiences, and how many people you expect to reach with the outreach strategy over the permit term?

Our outreach strategy is to work with the other communities in the various Watershed to 1) raise awareness of watershed issues, 2) involve citizens in water quality discussions, 3) help change behaviors, and 4) encourage citizen participation in BMPs. With the assistance of the Watershed Coordinators, we will implement the activities outlined in Table 1. Outreach mechanisms will be varied in an effort to reach diverse audiences. These mechanisms will include an exhibit for community events, brochures, articles, electronic information, school programs and community events. The media will be used to help promote programs and to report on the progress being made to address storm water concerns.

3.2.2.2.1 How have you involved the public in the development and submittal of your NOI and SWMP.

Throughout 2002 the Euclid Creek Watershed Council work groups, which were open to the public, met to discuss the permit requirements, and potential BMPs. Two public meetings were held in June 2002. Also a public meeting targeted to city engineers, mayors, councilpersons and service directors was held in September 2002 to provide an update about the planning process and to outline recommended BMP's in the Euclid Creek watershed. Members of the public are included on our Storm Water Management Committee. Presentations on the Storm Water Management Plan and BMP's were given to the affected city divisions and departments. A public meeting was held on March 6, 2003 to make residents aware of the plan. This meeting was video taped by Channel 35 for subsequent broadcast.

3.2.2.2.2 What is your plan to actively involve the public in the development and implementation of your plan?

The public was invited to participate in the planning process. Work groups met on a regular basis, and community meetings and events were held to keep citizens informed. Information was also dispersed at our events.

The final BMPs were presented by the work groups to the Euclid Creek Watershed Council, including engineers and service personnel, City Council, and our city Storm Water Management Committee for their approval. The Commissioner of Water Pollution Control will oversee the program during the permit time. The watersheds coordinators in each area will assist coordinating work groups to help plan initiatives and outreach activities on an annual basis. The Storm Water Management Committee will review the process and activities.

3.2.2.2.4 What types of public involvement activities are included in your plan? Where appropriate consider the following types of public involvement activities:

3.2.2.2.4.1 Citizen Representatives on storm water management panel.

As detailed in Table 1, The Commissioner of Water Pollution Control was appointed to facilitate/manage the development of our SWMP and its implementation during the permit term. The program will be relevant to the entire community. Citizen representation in the PIPE activities has been encouraged. City of Cleveland representatives serve on the PIPE Work Groups. Community residents will participate.

3.2.2.2.4.2 Public Hearings.

A number of public meetings related to storm water were held in 2002 (See the attached list of public meetings). A public meeting was held on March 6, 2003 to make residents aware of the plan. This meeting was video taped by Channel 35 for subsequent broadcast.

3.2.2.2.4.3 Working with citizen volunteers willing to educate others about the program.

The watershed coordinator will work with the public to develop awareness of the programs so they can, in turn, become information and education sources. The City will provide additional information as the program is developed.

3.2.2.2.4.4 Volunteer monitoring or stream clean-up activities.

The City will implement stream cleanup and monitoring programs after determining their viability in each watershed. More information will be provided as the program is developed.

3.2.1.2.6 & 3.2.2.2.5 Who is responsible for overall management and implementation of your Pubic Involvement and Education Plan?

The Commissioner of Water Pollution Control is responsible for the overall management and implementation of our PIPE Plan. The Commissioner will have resources of assistance from the City of Cleveland staff, and the watershed coordinators for Euclid Creek and Doan Brook, Storm Water Management Committee, Northeast Ohio Area Wide Coordinating Agency, Cuyahoga County Soil and Water Conservation District, Northeast Ohio Regional Sewer District, and other sources to be determined. To assist the City in implementing its activities under the PIPE Plan, the City has entered into a Partnership Agreement with Euclid Creek and Doan Brook watersheds partnerships. The City will enter into a Memorandum of Understanding with the Cuyahoga Soil and Water Conservation District to assist in implementation of our programs throughout the City of Cleveland.

3.2.1.2.7 & 3.2.2.2.6 How will you evaluate the success of this minimum measure, including how you selected the measurable goals for each of the BMPs?

The Storm Water Management Committee will adhere to the list of BMPs (see table 1). The coordinators will facilitate activities with assistance from the PIPE Work Group. Goals were established with assistance from the PIPE work group and are based on community needs.

Table 1 includes examples of BMPs, measurable goals, and responsible parties for the PIPE Plan. This Table summarizes the plan.

Table 1: CITY OF CLEVELAND PIPE PROGRAM-NPDES PHASE I

MANAGEMENT PRACTICE	STRATEGY	MEASURABLE GOALS	TIME FRAME
Community Storm Water Manager	The Commissioner of Water Pollution Control is designated as the Community Storm Water Manager with the assistance of the Storm Water Management Committee will oversee the implementation of the entire storm water management plan for the community. The Commissioner will delegate duties to responsible staff, track progress, assemble and submit annual report to the OEPA.	- Assign/appoint tasks to various parties for implementation - Prepare and submit annual progress report for compliance purposes to the OEPA	Annually
Euclid Creek and Doan Brook Watershed Program (Committee)	The City has joined the Euclid Creek and Doan Brook Watershed Programs, which serve as the oversight committees for public involvement and education initiatives in these watersheds. Committee members will work with the watershed coordinators who facilitate the Watershed Program and coordinate the PIPE activities with input and assistance from the PIPE Committee members.	- Assign a person(s) to be the community representative on the watershed PIPE committee - Develop annual work plan Submit progress reports to the Storm Water Management Committee	Establish in 2003. Participate annually.
Community Improvement Day	Offer opportunities to get public active in visible pollution control. Host annual clean ups or watershed improvement days. Activities may include, but are not limited to, stream clean ups; beautification days and hazardous waste collection day. PIPE Committee members will determine date, activity locations and disperse information through city channels.	- Organize activities; publicize; train volunteers - Number of activities - Where and how advertised - Number participants	Establish in 2003. Maintain annually
Storm Water Website Page	Create a page on the City's website to address storm water concerns for the community. Information may include current PIPE activities, storm water/water quality information, and links to other sites. Advertise Website in city publications and/or local media outlets.	- Storm Water Web page - Update regularly - Save copy of updated file - Record # of hits	Establish in 2003. Maintain regularly.
Brochures and Fact Sheets	Publish brochures, fact sheets on the following topics: • Municipal sewer system or watersheds • Lawn and garden care-pesticide management • Proper disposal of Household hazardous wastes • Stream Stewardship or Riparian guide	- Record number of brochures published and distributed.	Establish in 2003. Maintain annually
Public Meetings	Host annual meetings to educate stakeholders about water quality issues, best management practices and potential improvement actions. PIPE Committee will work with the Watershed Coordinator to determine appropriate topics, dates and to assist in dispersing information to the public.	- Coordinate and schedule meeting; arrange speakers; - Record meeting times, dates, advertisements - Record attendees - Record stakeholder comments	Establish in 2003. Maintain annually

B. **Illicit Discharge Detection and Elimination (MCM #3)**

1. **The Permit Requirement (per Ohio EPA draft NPDES Permit)**

    a) **3.2.3.1.1 & 3.2.3.1.4 Develop, implement, and enforce a program to detect and eliminate illicit discharges into your small MS4 (for illicit discharges to your MS4 via a neighboring interconnected MS4, you are only required to inform the neighboring MS4 and the Ohio EPA in your annual report submission, of their existence).**

    b) **3.2.3.1.2 Develop a storm sewer system map showing the location of all outfalls and the names and locations of all surface waters of the State that receive discharges from those outfalls.**

    c) **3.2.3.1.2.1 Within three years of when your coverage under this general permit is granted, you must submit the following to Ohio EPA:**
        1. **3.2.3.1.2.1.1 A list of all on-site sewage disposal systems connected to discharge to your MS4 (a.k.a. home sewage treatment systems (HSTS)) including addresses.**

        2. **3.2.3.1.2.1.2 A storm sewer map showing the location of all HSTS connected to your MS4. This map shall include details on the type and size of conduits/ditches in your MS4 that receive discharges from HSTSs, as well as the water bodies receiving the discharges from your MS4.**

    d) **3.2.3.1.3 To the extent allowable under State or local law, effectively prohibit through ordinance or other regulatory mechanism illicit discharges to your storm sewer system and implement appropriate enforcement procedures and actions.**

    e) **3.2.3.1.5 Inform public employees, businesses, and the general public of hazards associated with illegal discharges and improper disposal of waste.**

2. **Illicit Discharge Detection and Elimination Plan**

The BMPs, measurable goals, and responsible parties in this Illicit Discharge Detection and Elimination Plan are detailed in Table 2. In addition to Table 2, per Ohio EPA draft NPDES permit requirement 3.2.3.2, we are documenting our decision process with the following information required by the draft permit.

3.2.3.2.1 How you will develop a storm sewer map showing the location of all outfalls and the names and location of all receiving waters. Describe the sources of information you used for the maps, and how you plan to verify the outfall locations with field surveys. Describe how your map will be regularly updated.

The City will use the maps that have already been developed. The City of Cleveland is a developed city; we do not expect new outfalls to be installed. If a new outfall is constructed, it will be added to the map.

3.2.3.2.2 The mechanism (ordinance or other regulatory mechanism) you will use to prohibit illicit discharges and why you chose that mechanism. If you need to develop this mechanism, describe your plan and a schedule to do so. If your ordinance or regulatory mechanism is already developed, include a copy of the relevant sections with your program.

The City of Cleveland has ordinances that prohibit illegal discharges and establishes the process for dealing with these discharges. (Refer to section 541 of the Codified Ordinances of the City of Cleveland see attached). The Commissioner of Water Pollution Control will monitor this activity. The Storm Water Management Committee will review the results of these activities at least annually.

3.2.3.2.3 Your plan to ensure through appropriate enforcement procedures and actions that your illicit discharge regulation is implemented.

The Storm Water Management Committee will review the list of all illegal discharges, supporting documentation of the City of Cleveland's investigation, action, and the corrective action performed.

3.2.3.2.4 Your plan to detect and address illicit discharges to your system, including discharges from illegal dumping and spills. Your plan must include dry weather field screening for non-storm water flows and field tests of selected chemical parameters as indicators of discharge sources. Your plan must also address on-site sewage disposal systems (including failing on-lot HSTS and off-lot discharging HSTS) that flow into your storm drainage system. Your description must address the following at a minimum:

3.2.3.2.4.1 Procedures for locating priority areas which includes areas with higher likelihood of illicit connections (e.g. areas with older sanitary sewer lines, for example) or ambient sampling to locate impacted reaches.

All separate storm sewer areas in the City of Cleveland are similar. The City will monitor all areas equally. The City does not have any known HSTS that discharge off-lot.

3.2.3.2.4.2 Procedures for tracing the source of an illicit discharge, including specific techniques you will use to detect the location of the source.

If a dry weather discharge is observed, the City will trace the discharge source from manhole to manhole and, if necessary, video inspect the sewer to determine the source. When appropriate, the City may also have the discharge tested using appropriate tests to determine the quality of the discharge. In the case of a sanitary discharge, we may dye testing to assist in determining the source of the discharge.

3.2.3.2.4.3 Procedures for removing the source of an illicit discharge.

We will follow the procedures for citing the property owner as stated in section 541.97 of the Codified Ordinances of the City of Cleveland.

3.2.3.2.4.4 Procedures for program evaluation and assessment.

All storm water outlets will be checked at least once a year to check for dry weather flow. If dry weather flow is observed at any storm water outlet, then we will investigate to determine the source of the flow, and if the flow is a legal or illicit discharge. This procedure may involve laboratory or dye testing.

3.2.3.2.5 How you plan to inform public employees, businesses, and the general public of the hazards associated with illegal discharges and improper disposal of waste. Include in your description how this plan will coordinate with your public education minimum measure and your pollution prevention/good housekeeping minimum measure.

Employees, businesses, and the general public will be educated on the hazards of illicit discharge and the proper disposal of materials through the public education portion of this plan.

3.2.3.2.6 Who is responsible for overall management and implementation of your storm water illicit discharge detection and elimination plan and, if different, who is responsible for each of the BMPs identified for this plan.

The Commissioner of Water Pollution Control is responsible for overseeing the plan and monitoring of BMP's. The Strom Water Management Committee will review the activities under each BMP.

3.2.3.2.7 How will you evaluate the success of this minimum measure, including how you selected the measurable goals for each of the BMPs.

Table 2 includes the BMPs, measurable goals, and responsible parties for our Illicit Discharge Detection and Elimination Plan.

Table 2: Illicit Discharge Detection and Elimination Plan

Best Management Practice	Schedule and Measurable Goals	Responsible Party
Map storm sewer system: Map storm sewer system with: 1. Location of outfalls. 2. Names and location of surface waters to which outfalls discharge.	Maps are currently available.	Commissioner of Water Pollution Control
Develop program to detect and eliminate illicit discharges: Develop a program to proactively determine if there are dry weather flows in storm sewer system, the source of these flows, and possible methods to eliminate their sources.	Program submitted with Storm Water Management Program in March 2003. Program implemented in 2003 and refined throughout permit term.	**Division of Water Pollution Control:** Inspect outfalls for dry weather flows determining source and elimination options.
Adopt ordinance prohibiting illicit discharges: Prohibit illicit discharges to storm sewer system and implement enforcement procedures as necessary.	Ordinances are already in effect	Commissioner of Water Pollution Control

C. Construction Site Storm Water Runoff Control (MCM #4)-

1. The Permit Requirement (per Ohio EPA draft NPDES Permit)

a) 3.2.4.1 Develop, implement, and enforce a program to reduce pollutants in any storm water runoff to your small MS4 from construction sites that result in a land disturbance of greater than or equal to 1 acre. Reduction of storm water discharges from construction activity disturbing less than 1 acre must be included in your program if that construction activity is part of a larger common plan of development or sale that would disturb 1 or more acres. Your program must include the development and implementation of, at a minimum:

1. 3.2.4.1.1 An ordinance or other regulatory mechanism to require erosion and sediment controls, as well as sanctions to ensure compliance, to the extent allowable under State or local law.

2. 3.2.4.1.2 Requirements for construction site operators to implement appropriate erosion and sediment control BMPs.

3. 3.2.4.1.3 Requirements for construction site operators to control waste such as discarded building materials, concrete truck washout, chemicals, litter, and sanitary wastes at the construction site that may cause adverse impacts to water quality.

4. 34.2.4.1.4 Procedures for site plan review which incorporate consideration of potential water quality impacts.

5. 3.2.4.1.5 Procedures for receipt and consideration of information submitted by the public.

6. 3.2.4.1.6 Procedures for site inspections and enforcement of control measures.

2. Construction Site Storm Water Control Plan

The BMPs, measurable goals, and responsible parties in this Construction Site Storm Water Runoff Control Plan are detailed in Table 3. In addition to Table 3, per Ohio EPA draft NPDES permit requirement 3.2.4.2, The City is documenting our decision process with the following information required by the draft permit.

The City of Cleveland has been involved in the preparation of draft ordinances as a part of the Euclid Creek Watershed Ordinance Task Force and the NOACA Storm Water Task Force. The ordinances have been made available to the public at public meetings. The operating divisions of the City of Cleveland and the Law Department are reviewing the draft ordinances. The City of Cleveland Storm Water Management Committee with public membership is also reviewing the ordinance. After the draft is properly reviewed, it will be submitted to City Council and the Mayor for passage into law.

3.2.4.2.1 The regulatory mechanism you will use to require E&SC at construction sites

and why you chose that mechanism. If you need to develop this mechanism, describe your plan and schedule to do so. If your mechanism is already developed, include a copy of the relevant sections with your SWMP.

The Euclid Creek Storm Water Ordinance Work Group developed model ordinances. The City Law Department and operating departments are reviewing the ordinance in 2003 with the intention of City Council and the Mayor passing the ordinances by December 2003.

3.2.4.2.2 Your plan to ensure compliance with your E&SC regulatory mechanism, including the sanctions and enforcement mechanisms you will use to ensure compliance. Describe your procedures for when you will use certain sanctions. Possible sanctions include non-monetary penalties (such as a stop work order), fines, bonding requirements, and/or permit denials for non-compliance.

The ordinance will be incorporated as a part of the building permit process in 2004. The Department of Building and Housing will report annually their activities to the Storm Water Management Committee for review, monitoring and recommendation of action as required.

3.2.4.2.3 Your requirements for construction site operators to implement E&SC BMPs and control waste at construction sites that may cause adverse impacts on water quality. Such waste includes discarded building materials, concrete truck washouts, chemicals, litter, and sanitary waste.

The Euclid Creek Storm Water Ordinance Work Group developed model ordinances. The City Law Department and operating department are reviewing the ordinance in 2003 with the intention of City Council and the Mayor passing the ordinances by December 2003.

3.2.4.2.4 Your procedures for site plan review, including the review of pre-construction site plans, which incorporate considerations of potential water quality impacts. Describe your procedures and the rationale for how you will identify certain sites for site plan review, if not all plans will be reviewed. Describe the estimated number and percentage of sites that will have pre-construction site plan review.

The Department of Building and Housing reviews all construction plans. The ordinance will be incorporated as a part of the building permit process in 2004. The Department of Building and Housing will issue a report annually of its plan review activities to the Storm Water Management Committee.

3.2.4.2.5 Your procedures for receipt and consideration of information submitted by the public. Consider coordinating this requirement with your Public Involvement and Education plan.

The City of Cleveland has several phone lines for receiving complaints from the public about construction sites. These numbers include the Mayor's Action Center, Building Housing, Water Pollution Control Customer Service Complaint lines and the Police Department Illegal Dumping hot line. Staff will inspect the site and issue written notification regarding sediment and erosion control needs at the site. Builders and developers will be required to remedy the problem within the time frame stated in the ordinance.

3.2.4.2.6 Your procedures for site inspection and enforcement of control measures,

including how you will prioritize sites for inspection.

The procedures for site inspections will be determined once the ordinance is passed. All sites will be inspected as provided for in the ordinance.

3.2.4.2.7 Who is responsible for the overall management and implementation of your construction site storm water control plan, and if different, who is responsible for each of the BMPs identified in this plan.

The responsibility for implementation will be identified in the ordinance. The record of implementation will be reported annually to the Storm Water Management Committee.

3.2.4.2.8 Describe how you will evaluate the success of this minimum measure, including how you selected the measurable goals for each BMP.

Table 3 includes BMPs, measurable goals, and responsible parties for Construction Site Storm Water Runoff Control Plan. This Table summarizes the Plan. The record of implementation will be reported annually to the Storm Water Management Committee.

Table 3: Construction Site Storm Water Control Plan

Best Management Practice	Schedule and Measurable Goals	Responsible Party
Adopt erosion and sediment control ordinance.	Adopt ordinance by December 2003.	**Commissioner of Water Pollution Control Department of Building and Housing:** Review model, tailor to community needs, and recommend adoption to Council. **Council:** Adopt ordinance.
Review site plans: The City will review site plans of construction sites.	Plans for regulated sites reviewed prior to granting permits starting in 2004.	**Department of Building and Housing:** Review E&SC
Inspect active sites: The City will inspect active construction sites.	Inspections begin after ordinance adopted and training complete in 2004.	**Department of Building and Housing:** Inspect active sites.
Enforcement actions: When inspection reveals that work is not proceeding in accordance with approved E&SC plan, the City may issue a stop work order halting construction until problems are corrected.	Enforcement actions will be outlined in the ordinance and start in 2004.	**Department of Building and Housing** Determine necessary enforcement and issue stop work orders and corrective action requirements.
Respond to public complaints regarding construction activities: In addition to regular inspections of active construction sites, the City will advertise through the newsletter and on the web site a phone number for residents concerned about specific construction activities.	Publicize phone numbers (Mayor's Action Center and Building Housing complaint line) in 2004 and include on print media under Public Involvement and Education Program.	**Department of Building and Housing:** Review complaints and respond appropriatelyto cause corrective action.

D. **Post-Construction Storm Water Management in New Development & Redevelopment (MCM #5)**

1. **The Permit Requirement (Per Ohio EPA draft NPDES Permit)**

    a) **3.2.5.1.1 Develop, implement, and enforce a program to address storm water runoff from new development and redevelopment projects that disturb greater than or equal to 1 acre, including projects less than 1 acre that are part of a larger common plan of development or sale, that discharge into your small MS4. Your program must ensure that controls are in place that would prevent or minimize water quality impacts.**

    b) **3.2.5.1.2 Develop and implement strategies which include a combination of structural and/or non-structural BMPs appropriate for you community.**

    c) **3.2.5.1.3 Use an ordinance or other regulatory mechanism to address post-construction runoff from new development and redevelopment projects to the extent allowable under State or local law.**

    d) **3.2.5.1.4 Ensure adequate long-term operation and maintenance of BMPs**

2. **Post-Construction Storm Water Management in New Development and Redevelopment Plan**

The BMPs, measurable goals, and responsible parties in this Post-Construction Storm Water Management Plan are detailed in Table 4. In addition to Table 4, per Ohio EPA draft NPDES permit requirement 3.2.5.2, The City is documenting our decision process with the following information.

The City of Cleveland has been involved in the preparation of draft ordinances as a part of the Euclid Creek Watershed Ordinance Task Force and the NOACA Storm Water Task Force. The ordinances have been made available to the public at public meetings. The operating divisions of the City of Cleveland and the Law Department are reviewing the draft ordinances. The City of Cleveland Storm Water Management Committee with public membership is also reviewing the ordinance. After the draft ordinances are properly reviewed, they will be submitted to City Council and the Mayor for passage into law.

3.2.5.2.1 Your program to address storm water runoff from new development and redevelopment projects. Include in this description any specific priority areas for this program.

As detailed in Table 4, the City will use a combination of planning activities, education, and non-structural and structural practices to address storm water runoff from new development and redevelopment projects. Cleveland is a developed community, therefore this program will be primarily for redevelopment of areas.

3.2.5.2.2 How your program will be specifically tailored for you local community, minimize water quality impacts, and attempt to maintain pre-development runoff conditions.

The storm sewer area of the City of Cleveland is primarily located in residential communities with limited commercial and institutional developments. Our water quality concerns are those related to increases in storm water runoff as impervious area increases and includes sedimentation due to stream bank erosion, increased flooding due to increases in storm water volume, and habitat loss due to increased flow.

The City will adopt an improved storm water management regulation that addresses both storm water quality and quantity and encourages the use of non-structural storm water management techniques. This ordinance will also encourage the use of low impact development practices on our commercial and institutional areas.

These BMP's represent significant changes in storm water management in Northeast Ohio, education for landowners, developers, planners, engineers, and others is necessary to support their implementation. Watershed Programs will provide such educational opportunities during the permit term and will apply to the entire city. The City will continue to support this education through membership in Euclid Creek Watershed Program, Doan Brook Watershed Partnership, Mill Creek Watershed Partnership, Soil and Water Conservation District, Northeast Area Wide Coordinating Agency, Northeast Ohio Regional Sewer District and Chevrolet Branch of Big Creek Partners.

3.2.5.2.3 Any non-structural BMPs in your program, including, as appropriate:

3.2.5.2.3.1 Polices and ordinances that provide requirements and standards to direct growth to identified areas, protect sensitive areas such as wetlands and riparian areas, maintain and/or increase open space (including dedicated funding source for open space acquisition), provide buffers along sensitive water bodies, minimize impervious surfaces, and minimize disturbance of soils and vegetation.

In 2005 The City will inventory properties that are yet to be developed which may be suitable for special protection in the zoning code as sensitive areas such as wetlands and riparian areas. Where appropriate the City will explore the benefit of establishing conservation, public access, historic preservation or scenic easements either through the City's regulatory powers or through acquisition.

3.2.5.2.3.2 Policies or ordinances that encourage infill development in higher density urban areas, and areas with existing storm sewer infrastructure.

The City aggressively encourages infill development in higher density urban areas through an aggressive land reutilization program, tax abatements, low interest mortgage subsides and development grants.

3.2.5.2.3.3 Education programs for developers and the public about project designs that minimize water quality impacts.

Through participation in Euclid Creek Watershed Partnership, Doan Brook Watershed partnership, Mill Creek Watershed Partnership, Soil and Water Conservation District and NOACA, The City will conduct workshops on storm water management.

3.2.5.2.3.4 Other measures such as minimization of the percentage of impervious area after development, use of measures to minimize directly connected impervious areas and source control measures often thought of as a good housekeeping, preventable maintenance and spill prevention.

The City will explore the implementation of these practices through our process to consider adopting an improved storm water management regulation in 2005.

3.2.5.2.4 Any structural BMPs in your program, including, as appropriate:

3.2.5.2.4.1 Storage practices such as wet ponds and extended-detention outlet structures.

The City currently requires redeveloped properties to control their storm water quantity through the use of detention facilities where appropriate. In 2003 we will explore various options to add water quality measures to the detention requirements.

3.2.5.2.4.2 Filtration practices such as grassed swales, bioretention cells, sand filters and filter strips.

The City will explore the implementation of these practices through the process to consider adopting an improved storm water management regulation in 2005.

3.2.5.2.4.3 Infiltration practices such as infiltration basins and infiltration trenches.

We will explore the implementation of these practices through our process to consider adopting an improved storm water management regulation in 2004.

3.2.5.2.5 What are the mechanisms (ordinance or other regulatory mechanisms) you will use to address post-construction runoff from new developments and redevelopments and why you chose that mechanism. If you need to develop a mechanism, describe your plan and a schedule to do so. If your ordinance or regulatory mechanism is already developed, include a copy of the relevant sections with your program.

The City chose these mechanisms that address our water quality concerns related to increases in storm water runoff as land is developed. These mechanisms will provide flexibility to landowners, while ensuring that new impervious cover is minimize; the flood and erosion control, and water quality functions of the watercourses and wetlands are maintained; and when storm water is increased, it is managed for both quality and quantity.

3.2.5.2.6 How will you ensure the long-term operation and maintenance (O&M) of your selected BMPs. Options to help ensure that future operation and maintenance responsibilities are clearly identified include an agreement between you and another party such as a post-development landowners or regional authorities.

Structural BMP's created through the improved storm water management regulation will be maintained by post-development landowners. If landowners do not complete necessary operation and maintenance, the City of Cleveland will reserve the right to make correction or issue citations pursuant to the Codified Ordinances of the City of Cleveland.

3.2.5.2.7 Who is responsible for overall management and implementation for your post-construction plan and, if different, who is responsible for each of the BMPs identified for this program.

The responsible parties for each component of the Post-Construction Storm Water Management Plan will be identified in the ordinance.

3.2.5.2.8 How will you evaluate the success of this minimum measure, including how you selected the measurable goals for each of the BMPs.

The City will evaluate the success of this minimum measure through our ability to successfully implement improved storm water management by 2004. If these practices are not adopted, we will consider additional BMPs to achieve similar outcomes.

Further explanation of our goals and measurement is included in table 4.

Table 4: Post-Construction Storm Water Management Plan

·ment Practice	Schedule and Measurable Goals	Responsible Party
ive Land Use Plan The City will inventory t are yet to be developed which may be suitable otection in our zoning code as sensitive areas such nd riparian areas.	Completed by 2005	**City Planning Director:** Ensure plan executed and coordinated with mapping activities under MCM #3.
preservation: Where appropriate the City will enefit of establishing conservation, public access, rvation or scenic easements either through the ory powers or through acquisition	Parcels identified in 2005.	**City Planning Director:** Include parcel identification in Land Use Plan. **Storm Water Management Committee:** Work with others to identify future funding options to permanently preserve these parcels.
ducing impervious cover: The City currently perviousness of residential and commercial lots.	Continue existing programs.	**City Engineer:** Ensure impervious cover limitations are enforced on new development and redevelopment projects.
l Wetland Setbacks: The City will inventory t are yet to be developed which may be suitable otection in the zoning code as sensitive areas such nd riparian areas. Where appropriate, the City he benefit of establishing conservation, public ic preservation or scenic easements either through ulatory powers or through acquisition	Determine applicability of BMP by 2005.	**City Planning Director:** Include parcel identification in Land Use Plan.
r Management Ordinance: Adopt a storm water ordinance. This ordinance includes provisions for velopment and redevelopment activities.	Adopt by 2004.	**Mayor & Council**

E. **Pollution Prevention / Good Housekeeping for Community Operations (MCM #6)**

1. **The Permit Requirement (per Ohio EPA draft NPDES Permit)**

   a) 3.2.6.1.1 Develop and implement an operation and maintenance program that includes a training component and has the ultimate goal of preventing or reducing pollutant runoff from community operations; and

   b) 3.2.6.1.2 Using training materials that are available from Ohio EPA, NOACA, Euclid Creek Watershed partnership, Doan Brook Watershed Partnership, Soil and Water Conservation District, NEORSD and other organizations, our program will include employee training to prevent and reduce storm water pollution from activities such as park and open space maintenance, building maintenance, new construction and land disturbances, and storm water system maintenance.

2. **Pollution Prevention and Good Housekeeping Plan**

The BMPs, measurable goals, and responsible parties in this Pollution Prevention and Good Housekeeping Plan are detailed in Table 5. In addition to Table 5, per Ohio EPA draft NPDES permit requirement 3.2.6.2, we are documenting our decision process with the following information required by the draft permit.

The City was involved in the NOACA Storm Water Management Committee and the Euclid Creek Watershed Partnership, Doan Brook Watershed Partnership, and The Mill Creek Watershed Partnership. The City has used the draft plan by Ohio EPA and evaluated the potential BMP's that apply to the urban area. The City then held meetings with the various City of Cleveland Divisions and Departments to determine all locations and types of activities that potentially discharge to a storm sewer and ultimately the environment.

The BMP's were presented to the city's Storm Water Management Committee for their review and approval. The lists of BMP's were presented to the Council President and Utilities Committee Chairperson. The Storm Water Committee then submitted the BMP's to the Mayor. During the permit term the program will be overseen by the Commissioner of Water Pollution Control and reviewed by the Storm Water Management Committee.

3.2.6.2.1 Your operation and maintenance program to prevent or reduce pollutant runoff from your community operations. Your program must specifically list the community operations that are impacted by this operation and maintenance program. You must also include a list of industrial facilities your community owns or operates that are subject to the Ohio EPA's Industrial Storm Water General Permit or individual NPDES permits for discharges of storm water associated with industrial activity that ultimately discharge to your MS4. Include the Ohio EPA permit number or a copy of the Industrial NOI for each facility.

The program of Best Management Practices is as indicated in Table 5.

3.2.6.2.2 Any government employee training program you will use to prevent and reduce storm water pollution from activities such as park and open space maintenance, fleet and building maintenance, new construction and land disturbances, and storm water system maintenance. Describe any existing, available materials you plan to use. Describe how this

training program will be coordinated with the outreach program developed for the Public Involvement and Education minimum measure and the illicit discharge minimum measure.

The plan to perform employee training is as listed in Table 5. The City also expects to improve our employee training programs and evaluate the training each year.

3.2.6.2.3 Your program description must specifically address the following areas:

3.2.6.2.3.1 Maintenance activities, schedules, and long-term inspection procedures for controls to reduce floatables and other pollutants in your MS4.

The City will continue to use and require all catch basins have a sumped area to collect solids and a trap to prevent floatables from going to the environment. The City's program of BMP's is as outlined in Table 5.

3.2.6.2.3.2 Controls for reducing or eliminating the discharge of pollutants from streets, community parking lots, maintenance and storage yards, waste transfer stations, fleet maintenance shops with outdoor storage areas, and salt/sand storage locations and snow disposal areas you operate.

The program of BMP's is as outlined in Table 5. There are no Waste Transfer Stations or snow disposal areas in any area served by storm sewers.

3.2.6.2.3.3 Procedures for the proper disposal of waste removed from your MS4 and your community operations, including dredge spoil, accumulated sediments, floatables, and other debris.

Wastes from the City of Cleveland are disposed at the appropriate type of landfill. The City's program of Best Management Practices is as outlined in Table 5.

3.2.6.2.3.4 Procedures to ensure that new community flood management projects are assessed for impacts on water quality and that existing projects are assessed for incorporation of additional water quality protection devices and practices.

Flood management projects are designed to create water quality improvement. the program of Best Management Practices is as outlined in Table 5.

3.2.6.2.4 Who is responsible for overall management and implementation of your pollution prevention/good housekeeping program and, if different, who is responsible for each BMP identified in this program.

The Director of Public Service will be responsible for overseeing all areas of these BMP's.

3.2.6.2.5 How you will evaluate the success of this minimum measure, including how you selected the measurable goals for each of the BMPs.

Effectiveness of the program will be evaluated using the guidelines set forth in Table 5.

Table 5: Pollution Prevention and Good Housekeeping Plan

Best Management Practice	Schedule and Measurable Goals	Responsible Party
Operation and maintenance program to prevent or reduce storm water pollution from community operations.	Develop program in 2003. Implement program in 2004.	**Storm Water Management Committee:** Working with Operating deparments develop an O&M program. **Operating Divisions:** Assist in O&M program development. Implement O&M program.
City employee education program on pollution prevention.	Continue to distribute pollution prevention literature at community events.(list and literature attached. Develop additional program(s) in 2003 Implement program in 2004	**Storm Water Management Committee:** Working with Directors/Commissioners will assist in education program development. Implement education program.
Street Sweeping and Catch Basin Cleaning: The City will continue current street sweeping and catch basin cleaning program.	Main streets are swept once every month and residential streets are swept every other month, weather permitting. 10,000 Catch basins are cleaned per year.	**Director of Public Utilities/ Commissioner of Water Pollution Control** **Director of service/Commissioner of Streets**
Salt Storage and Applications: The City uses an average of 80,000 tons per season. Used 35,000 tons in 2001. Do not pre-salt unless conditions warrant. Reduced usage in residential areas.	Current practices will be continued. Review salt application/storage for pollution prevention options in 2003.	**Service Director/Commissioner of Streets**
Disposal of Waste Collected through City Operations: Collected leaves are composted at the Cty composting facility that discharges to a combined sewer. Used motor oil, paint, petroleum products, herbicides, tar mercury, antifreeze, etc. are collected for recycling.	Continue existing activities. Review waste disposal for pollution prevention in 2003	**Service Director/Commissioner of Waste Collection and Commissioner of Streets**
Fleet Maintenance: The City will continue use facilities that have oil separators. All barrels are stored on spill collection pads. Waste oils and other vehicle wastes are stored and recycled.	Continue existing activities. Review fleet maintenance for additional pollution prevention in 2003	**Director of service/Commissioner OF motor Vehicle Maintenance**

VI. Monitoring, Recordkeeping, and Reporting

The Storm Water Committee will monitor the program. Each Division or Department will submit their work records showing compliance to the Storm Water Management Committee annually for their review.

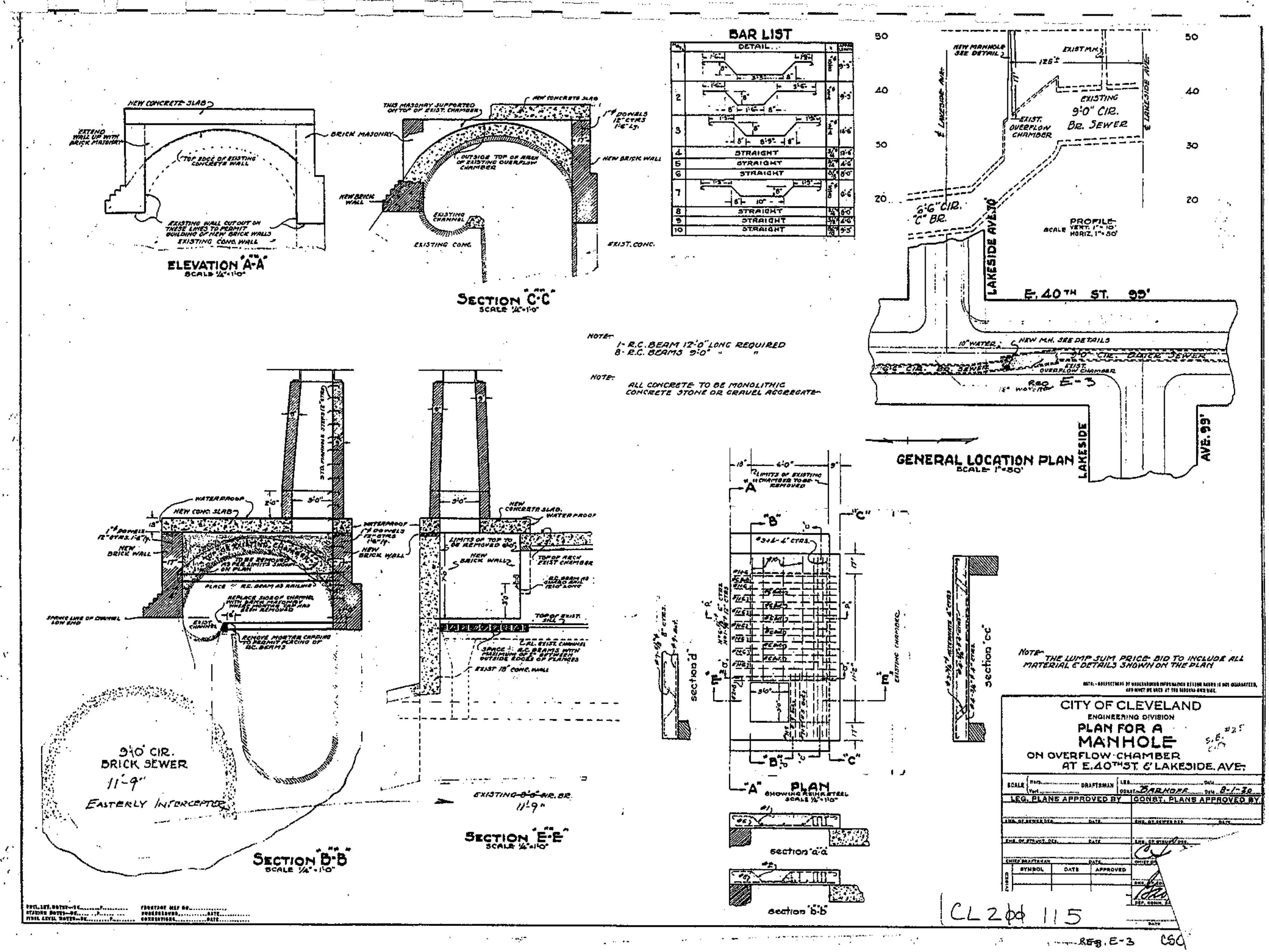
VII. Appendices & Sharing Responsibility

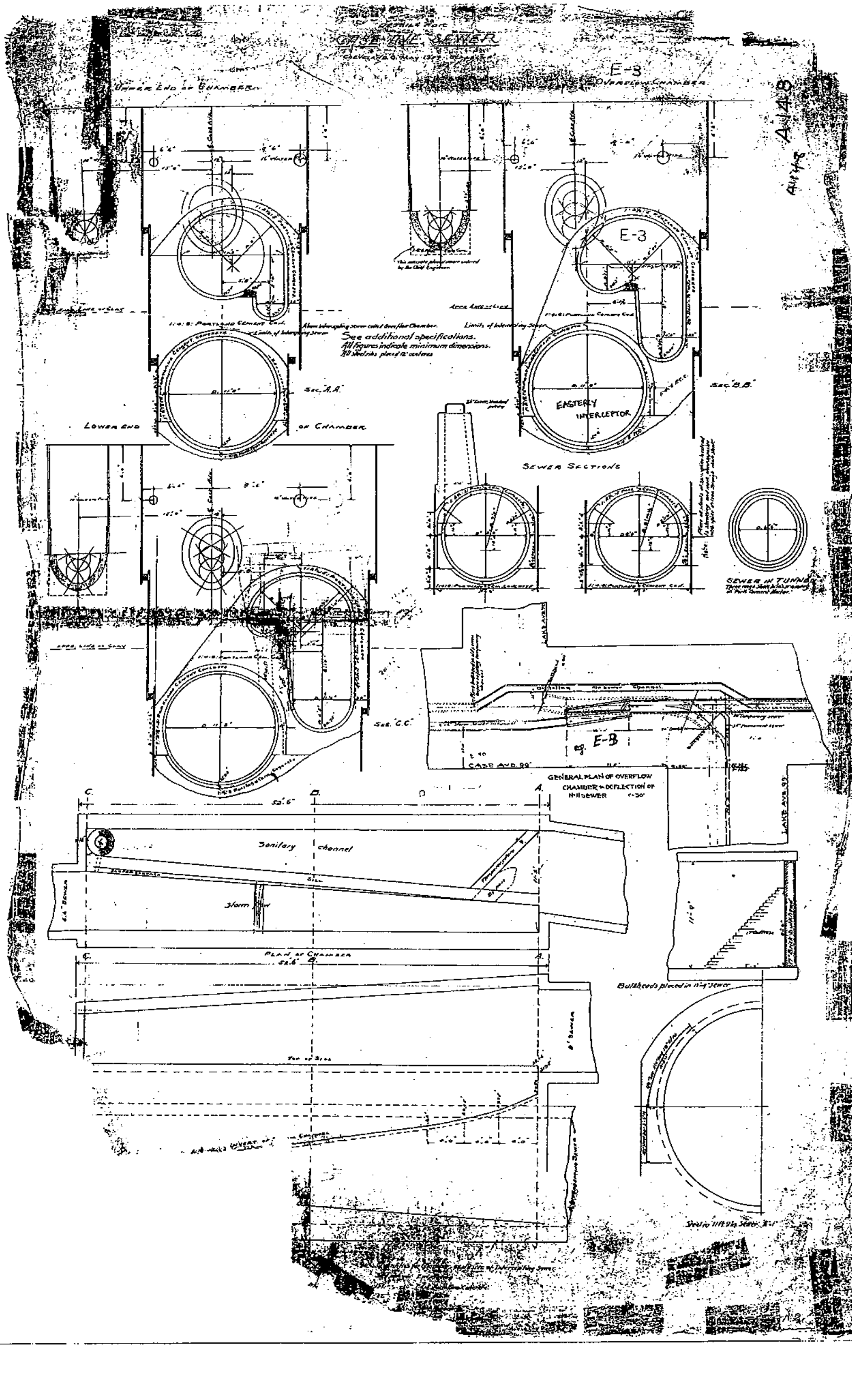
The City's Storm Water Management Program relies on other organizations to assist in implementing BMP's. The City already hs partnerships with, the Soil and Water Conservation District, Euclid Creek Watershed Partnership, Doan Brook Watershed Partnership, NEORSD, NOACA.

Appendix P

NEORSD Regulator Plans

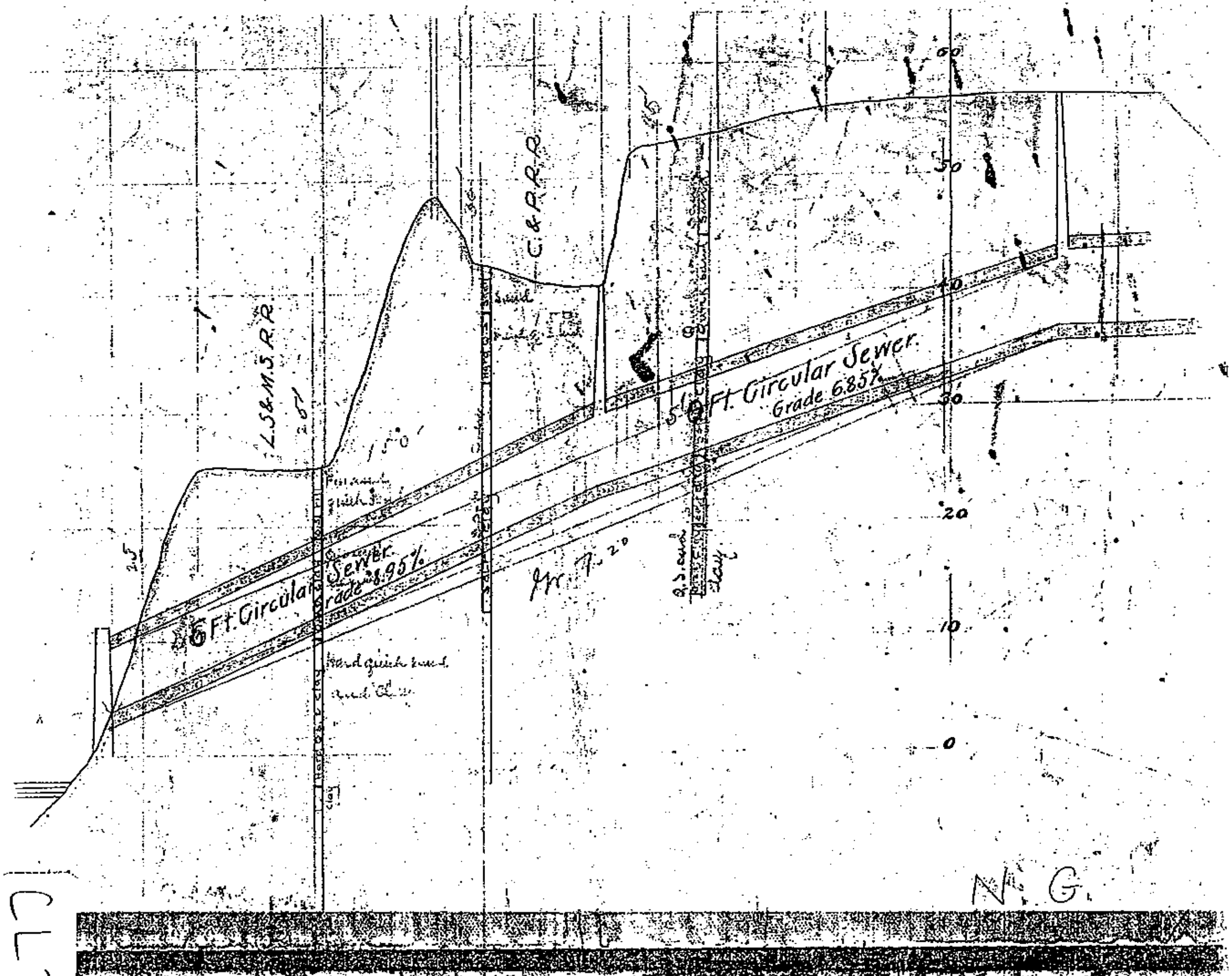
Regulators E-03, E-04, and CSO-200


ELEVATION "A-A"
SCALE 1/4"=1'-0"
NEW CONCRETE SLAB
BRICK MASONRY
EXISTING WALL CUT OUT ON THESE LINES TO PERMIT BUILDING OF NEW BRICK WALLS
EXISTING CONC. WALL
SECTION "C-C"
SCALE 1/4"=1'-0"
THIS MASONRY SUPPORTED ON TOP OF EXIST. CHAMBER
NEW CONCRETE SLAB
NEW BRICK WALL
EXISTING CHANNEL
EXISTING CONC.
EXIST. CONC.
BAR LIST
DETAIL
STRAIGHT
NOTE- 1- R.C. BEAM 12'-0" LONG REQUIRED
8- R.C. BEAMS 9'-0" " "
NOTE- ALL CONCRETE TO BE MONOLITHIC CONCRETE STONE OR GRAVEL AGGREGATE
NEW MANHOLE SEE DETAIL
EXIST. M.H.
EXISTING 9'-0" CIR. BR. SEWER
EXIST. OVERFLOW CHAMBER
6'-6" CIR. "C" BR.
℄ LAKESIDE AVE.
PROFILE
SCALE VERT. 1"=10' HORIZ. 1"=50'
LAKESIDE AVE. 70'
E. 40TH ST. 99'
NEW M.H. SEE DETAILS
9'-0" CIR. BRICK SEWER
EXIST. OVERFLOW CHAMBER
LAKESIDE
AVE. 99'
GENERAL LOCATION PLAN
SCALE 1"=50'
WATERPROOF
NEW CONC. SLAB
NEW BRICK WALL
SECTION "B-B"
SCALE 1/4"=1'-0"
9'-0" CIR. BRICK SEWER
11'-9"
EASTERLY INTERCEPTOR
SECTION "E-E"
SCALE 1/4"=1'-0"
EXISTING 9'-0" CIR. BR. 11'-9"
PLAN
SHOWING REINF. STEEL
SCALE 1/2"=1'-0"
section "a-a"
section "b-b"
section "c-c"
section "d"
EXISTING CHAMBER
NOTE- THE LUMP SUM PRICE BID TO INCLUDE ALL MATERIAL & DETAILS SHOWN ON THE PLAN
CITY OF CLEVELAND
ENGINEERING DIVISION
PLAN FOR A MANHOLE
ON OVERFLOW CHAMBER
AT E. 40TH ST. & LAKESIDE AVE.
BARHOFF
8-1-30
LEG. PLANS APPROVED BY
CONST. PLANS APPROVED BY
CL 200 115
REF. E-3
CSO



CL260 125
CSO 200

CL200105

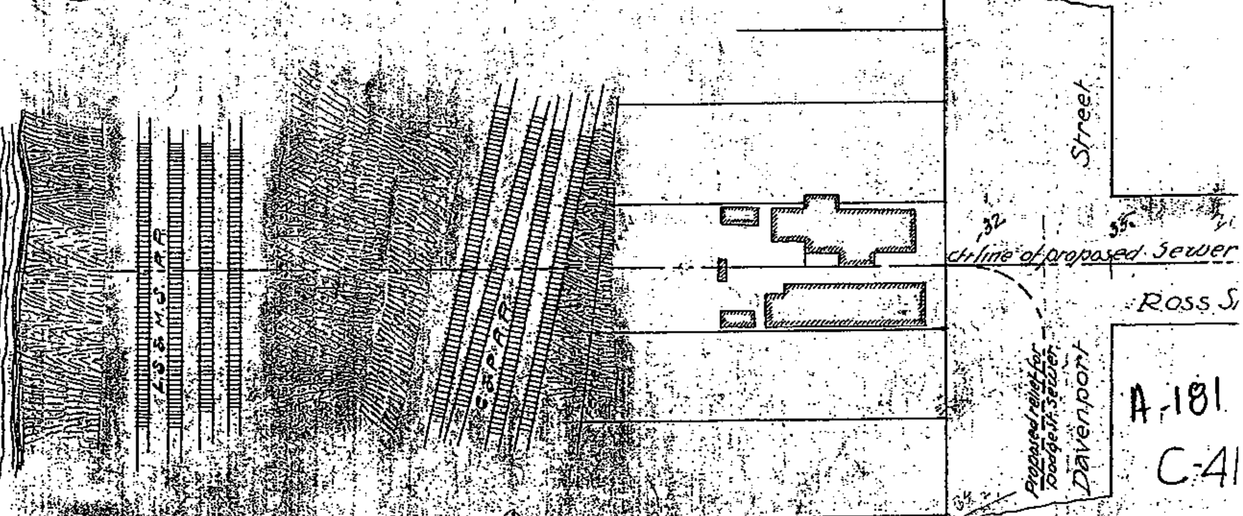


PLAN AND PROFILE
on line of
PROPOSED SEWER
between
(E 20th) ROSS ST. and LAKE ERIE

C-41

Exhibit "A"

C50-200

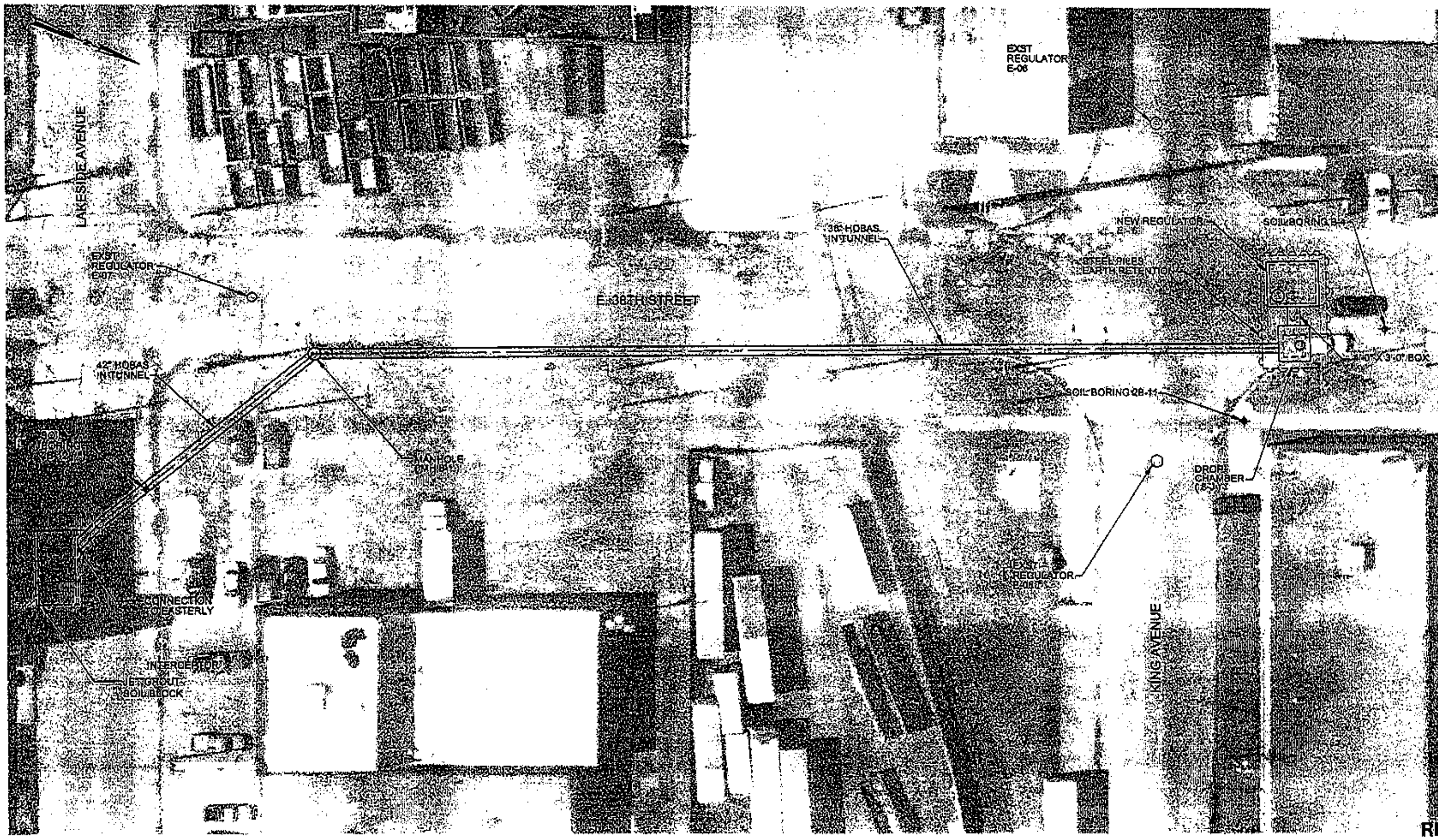


Regulator E-06A and CSO-099

SURVEY INFORMATION

BEARINGS ARE BASED UPON THE CUYAHOGA COUNTY REGIONAL GEODETIC SURVEY MONUMENTS O.M. 1030 AND O.M. 0117

ELEVATIONS ARE BASED UPON THE CUYAHOGA COUNTY REGIONAL GEODETIC SURVEY MONUMENT O.M. 1030



THE GEOTECHNICAL DATA REPORT (GDR) SHALL BE THE SOLE SOURCE OF SOIL BORING DATA.

RECORD DRAWINGS

Revisions Drawn by DOC Date 01/27/06

THESE RECORD DRAWINGS HAVE BEEN PREPARED, IN PART, ON THE BASIS OF INFORMATION COMPILED BY OTHERS. THEY ARE NOT INTENDED TO REPRESENT IN DETAIL THE EXACT LOCATION, TYPE OF COMPONENT NOR MANNER OF CONSTRUCTION. THE ENGINEER WILL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS WHICH HAVE BEEN INCORPORATED INTO THE RECORD DRAWINGS.

DSGN	D.M.COX					
DR	P.YOUNG					
CHK	T.P.O'ROURKE		01/06	RECORD DRAWINGS	DOC	DMC
APVD	T.P.O'ROURKE	NO.	DATE	REVISION	BY	APVD

VERIFY SCALE — BAR IS ONE INCH ON ORIGINAL DRAWING. 0 — 1" IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

CH2MHILL

SEWER DISTRICT

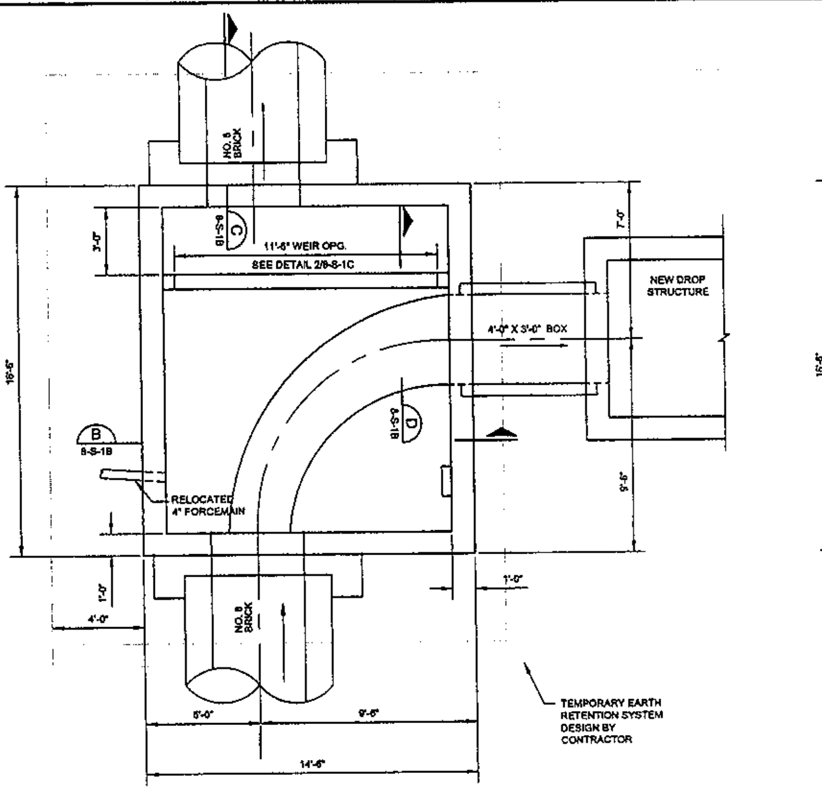
NORTHEAST OHIO REGIONAL SEWER DISTRICT
CLEVELAND, OHIO
EASTERLY CSO PHASE 2
EARLY ACTION PROJECTS

PROJECT 8
OVERALL SITE PLAN
EAST 38TH STREET BETWEEN KING AVENUE AND LAKESIDE AVENUE

DWG 8-C-1
DATE OCTOBER 2001
PROJ 160589

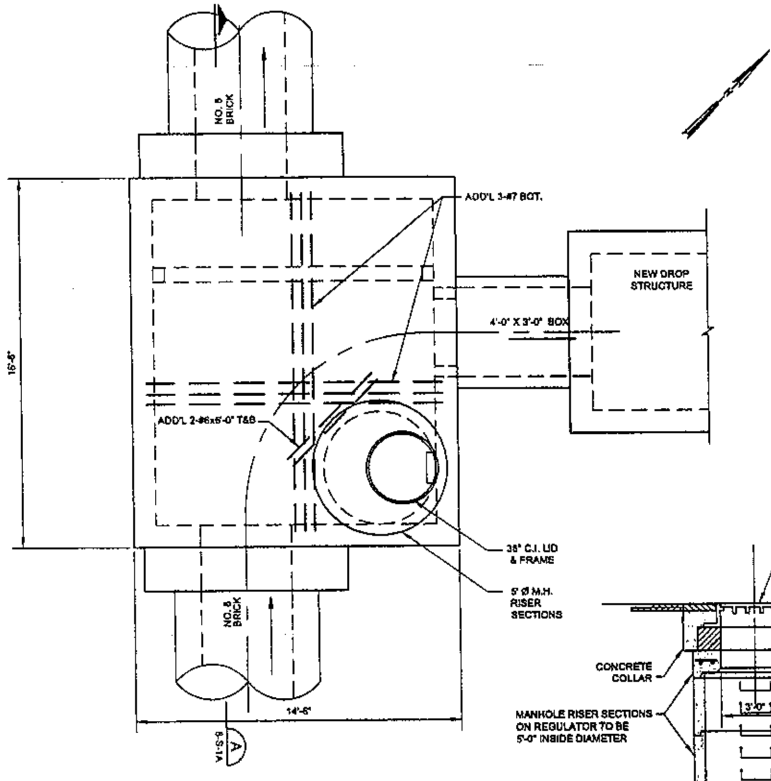
FILENAME: eeaph08.dwg PLOT DATE: 01-Jul-2001 PLOT TIME: 14:42:55

Z:\NORTHEASTOHREGSEWERD\168139\EEAPH08.DWG, 12/20/2006 7:15:27 PM, COREILLY



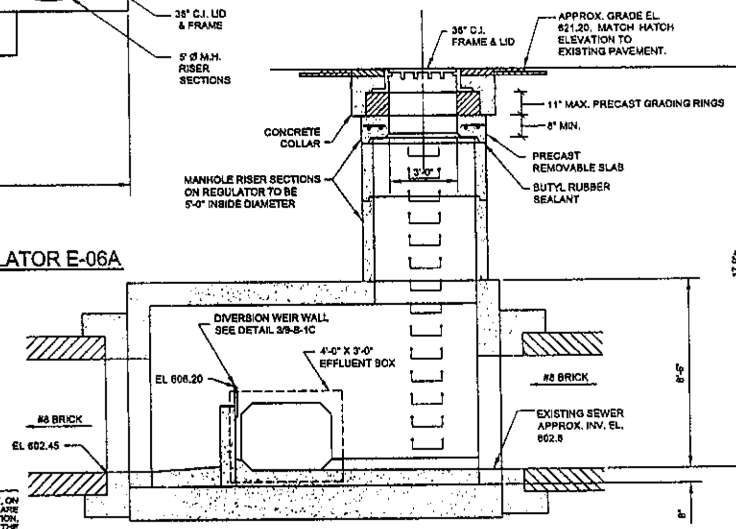
PLAN - NEW REGULATOR E-06A

3/8" = 1'-0"



TOP PLAN - NEW REGULATOR E-06A

3/8" = 1'-0"



SECTION (A)

3/8" = 1'-0" 8-S-1A

GENERAL NOTES FOR REGULATOR STRUCTURE

1. ALL STRUCTURAL CONCRETE SHALL HAVE A MINIMUM 7 DAY COMPRESSIVE STRENGTH OF f'c = 3500 PSI AND SHALL CONTAIN MICROSILICA. MINIMUM 28 DAY COMPRESSIVE STRENGTH SHALL BE f'c = 5000 PSI.

2. ALL REINFORCING STEEL SHALL BE ASTM A615 GRADE 60. MINIMUM CONCRETE COVER FOR ALL REINFORCEMENT SHALL BE 3".

3. ALL WEIR PLATE AND ORIFICE PLATE COMPONENTS SHALL BE TYPE 316L STAINLESS STEEL.

4. SLEEVES FOR BRICK SEWERS SHALL BE TYPE 316 STAINLESS STEEL. THE CONTRACTOR IS RESPONSIBLE FOR FABRICATING SLEEVES SO THAT THEY FIT INTO SEWERS WITH NO MORE THAN A 1" ANNULAR SPACE ALL AROUND. PROVIDE TEMPORARY INTERNAL STIFFENERS AS NECESSARY.

5. THE CONTRACTOR IS RESPONSIBLE FOR SEQUENCING THE CONSTRUCTION OF THE CONCRETE COLLARS (SEE SECTION 'C') AROUND THE EXISTING BRICK SEWERS SO AS TO PREVENT RAVELLING OF THE BRICKS WHICH ARE TO REMAIN IN PLACE.

6. THE TEMPORARY EARTH RETENTION SYSTEM SHALL CONSIST OF INTER-LOCKING STEEL SHEETING WITH WALES AND STRUTS PLACED BASED ON THE SYSTEM DESIGNED BY THE CONTRACTOR IN ACCORDANCE WITH SECTION 02296 OF THE SPECIFICATION. THE STEEL SHEETING SHALL BE DRIVEN SO THAT ITS TOE IS AT ELEVATION 623.0 FEET OR DEEPER. THE EXCAVATION SHALL NOT PROCEED DEEPER THAN ELEVATION 626.0 FEET WITHOUT THE ENGINEER'S APPROVAL.

RECORD DRAWINGS

Revisions Drawn by DOC Date 01/29/08

THESE RECORD DRAWINGS HAVE BEEN PREPARED, IN PART, ON THE BASIS OF INFORMATION COMPILED BY OTHERS. THEY ARE NOT INTENDED TO REPRESENT IN DETAIL THE EXACT LOCATION, TYPE OF COMPONENT NOR MANNER OF CONSTRUCTION. THE ENGINEER WILL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS WHICH HAVE BEEN INCORPORATED INTO THE RECORD DRAWINGS.

DSGN D.RITTMEYER						VERIFY SCALE
DR J.ASHBROOKE						BAR IS ONE INCH ON ORIGINAL DRAWING. 0 — 1"
CHK D.RITTMEYER		01/08	RECORD DRAWINGS	DOC	DMC	IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.
APVD T.P.O'ROURKE	NO.	DATE	REVISION	BY	APVD	

CH2MHILL

M&E Metcalf & Eddy

Northeast Ohio Regional SEWER DISTRICT

NORTHEAST OHIO REGIONAL SEWER DISTRICT
CLEVELAND, OHIO
EASTERLY CSO PHASE 2
EARLY ACTION PROJECTS

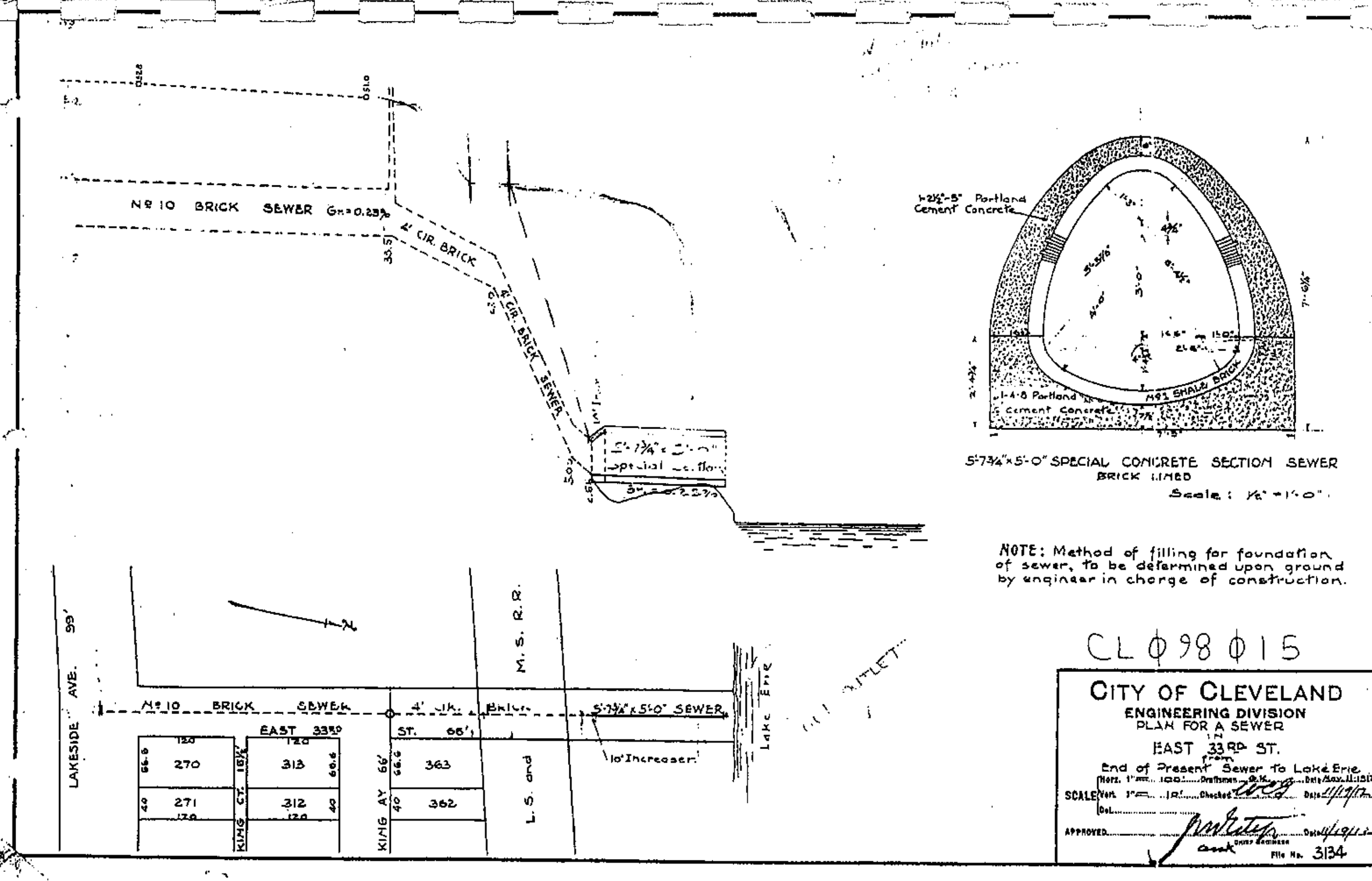
PROJECT 8

NEW REGULATOR E-06A
PLAN, SECTIONS AND DETAILS

DWG	8-S-1A
DATE	SEPTEMBER 2001
PROJ	160589

FILENAME: 8SD001.dwg PLOT DATE: 08-Sep-2001 PLOT TIME: 16:56:51

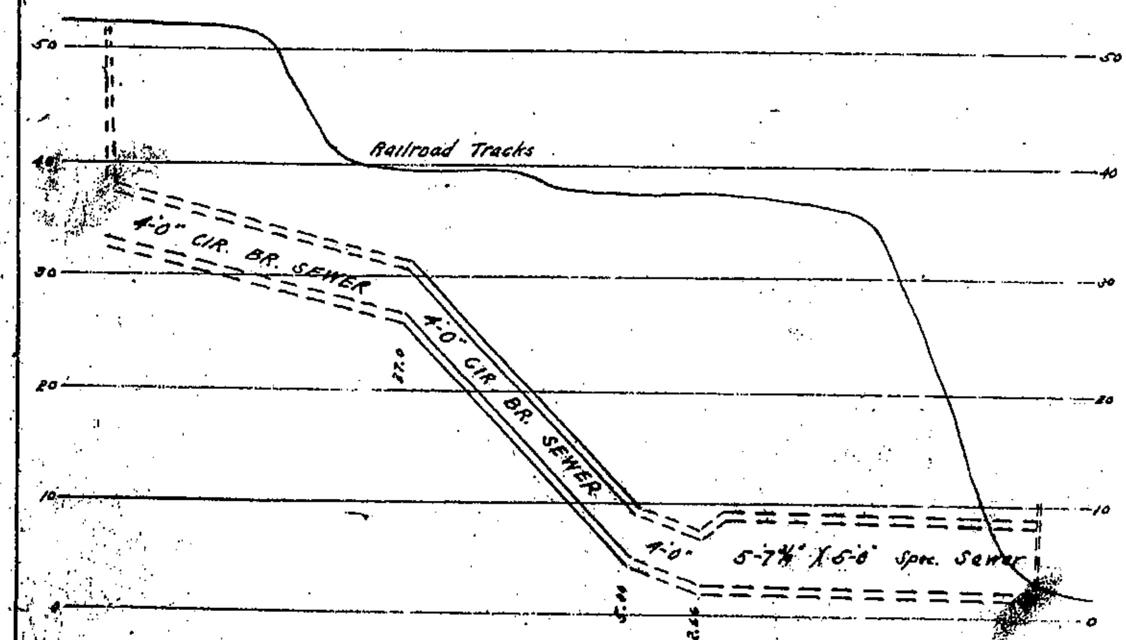
Regulator E-08 and CSO-098

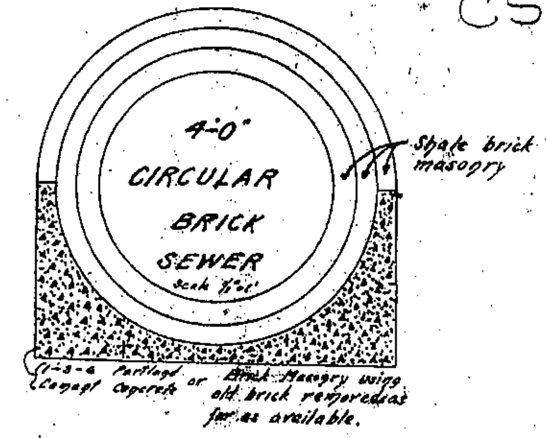

Nº 10 BRICK SEWER Gr.=0.23%
4' CIR. BRICK
4' CIR. BRICK SEWER
1-2½-5" Portland Cement Concrete
1-4-8 Portland Cement Concrete
Nº 2 SHALE BRICK
5'-7¾"x5'-0" SPECIAL CONCRETE SECTION SEWER
BRICK LINED
Scale: ½" = 1'-0"
NOTE: Method of filling for foundation of sewer, to be determined upon ground by engineer in charge of construction.
CL Φ98 Φ15
LAKESIDE AVE. 99'
Nº 10 BRICK SEWER
EAST 33RD ST. 66'
4' CIR. BRICK
5'-7¾"x5'-0" SEWER
10' Increaser
KING CT. 18½'
KING AV. 66'
M. S. R. R.
L. S. and
Lake Erie
270
271
313
312
363
362
CITY OF CLEVELAND
ENGINEERING DIVISION
PLAN FOR A SEWER
IN
EAST 33RD ST.
from
End of Present Sewer to Lake Erie
SCALE
APPROVED
CHIEF ENGINEER
File No. 3134

CSO 098

EAST 33rd ST.

CSO 098

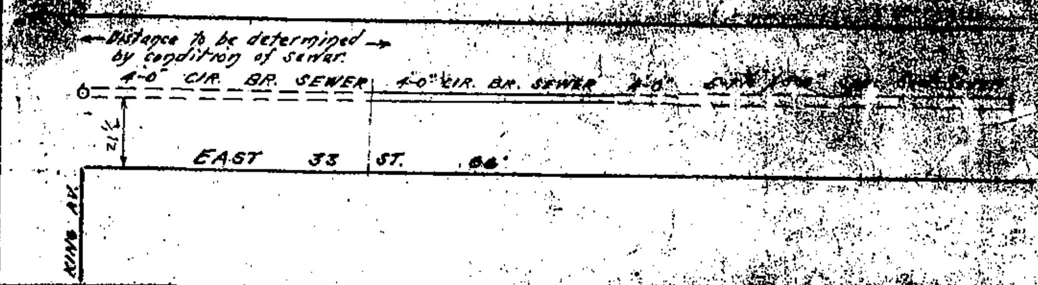




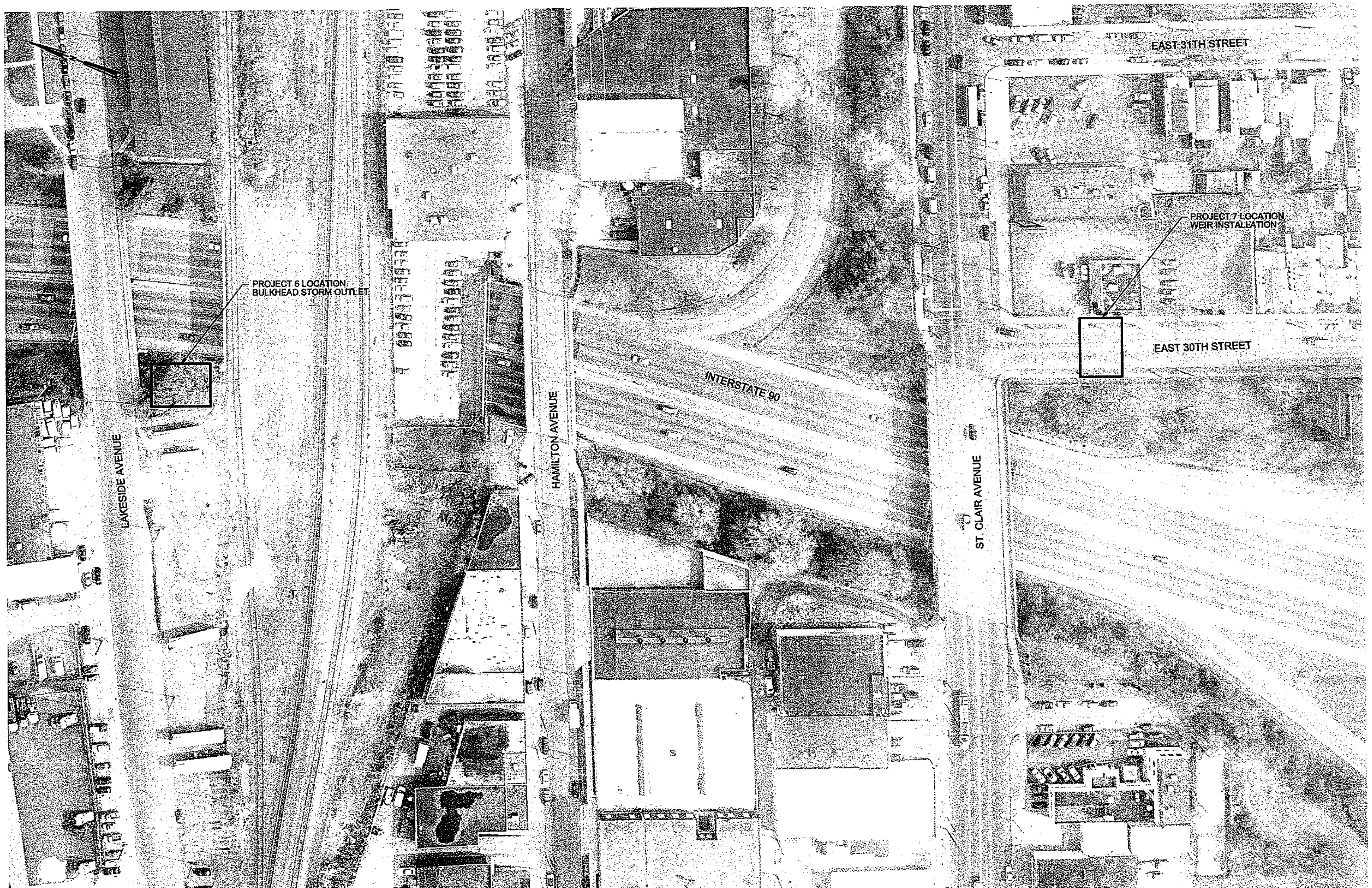
NOTE:

The sewer to be reconstructed is to be built entirely in tunnel operating thru shaft at south side of railroad tracks. The material and workmanship to be in accordance with the general specification of the City of Cleveland. All old material wasted may be deposited in the [illegible] at outlet of sewer.

CL098020



Regulators E-09, E-11, and CSO-097



RECORD DRAWINGS

Revisions Drawn by MEP Date 01/28/06

THESE RECORD DRAWINGS HAVE BEEN PREPARED, IN PART, ON THE BASIS OF INFORMATION COMPILED BY OTHERS. THEY ARE NOT INTENDED TO REPRESENT IN DETAIL THE EXACT LOCATION, TYPE OF COMPONENT NOR MANNER OF CONSTRUCTION. THE ENGINEER WILL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS WHICH HAVE BEEN INCORPORATED INTO THE RECORD DRAWINGS.

DSGN	D.M.COX					
DR	P.YOUNG					
CHK	T.P.O'ROURKE		01/06	RECORD DRAWINGS	MEP	DMC
APVD	T.P.O'ROURKE	NO.	DATE	REVISION	BY	APVD

VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING.

0 1"

IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

CH2MHILL

Northeast Ohio Regional SEWER DISTRICT

NORTHEAST OHIO REGIONAL SEWER DISTRICT
CLEVELAND, OHIO
EASTERLY CSO PHASE 2
EARLY ACTION PROJECTS

PROJECTS 6 AND 7

OVERALL SITE PLAN
LAKESIDE AVENUE AND INTERSTATE 90
ST CLAIR AVENUE AND EAST 30TH STREET

DWG	6/7-C-1
DATE	OCTOBER 2001
PROJ	160589

FILENAME: eeaph067.dwg PLOT DATE: 01-Jul-2001 PLOT TIME: 15:56:11

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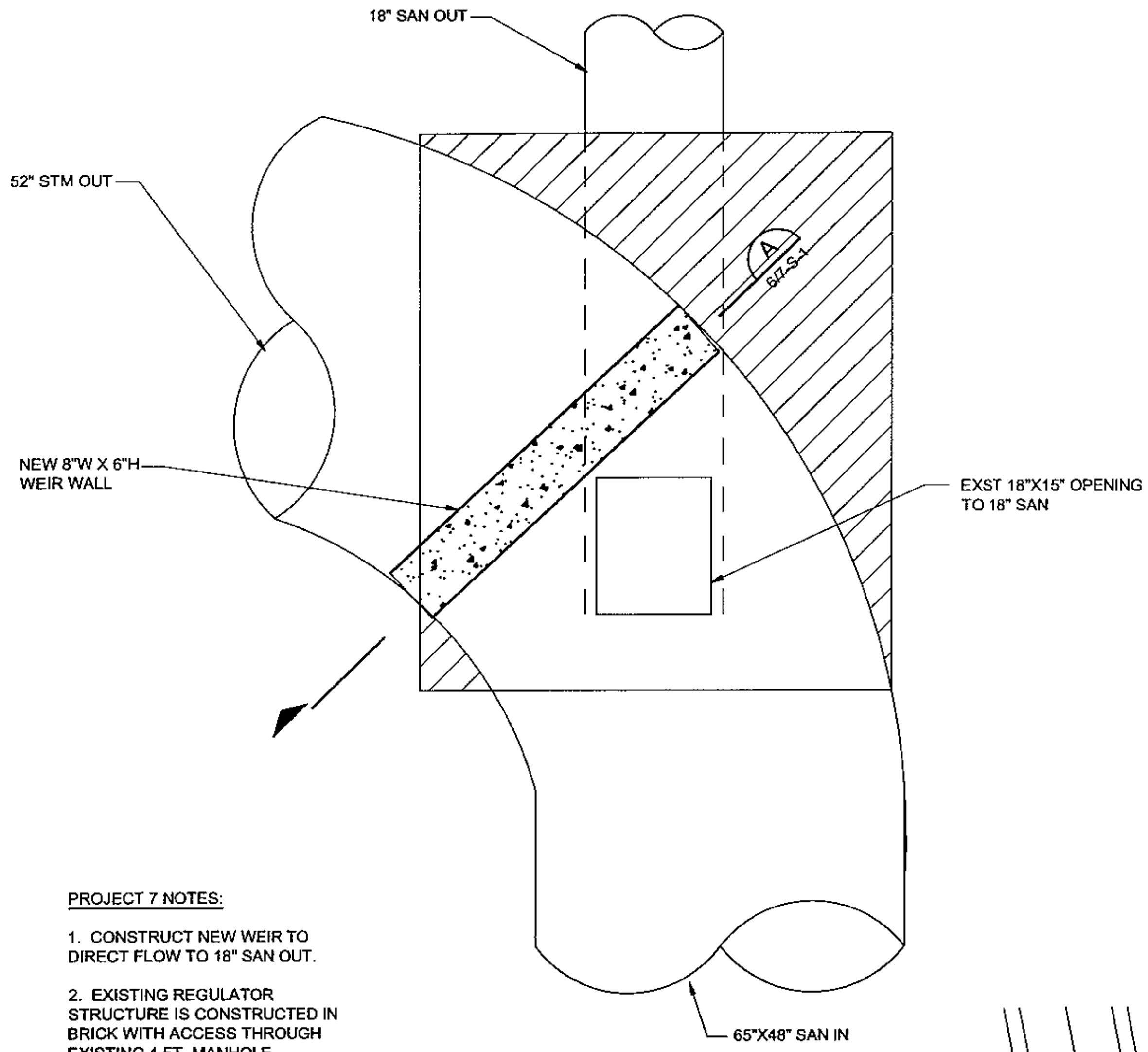
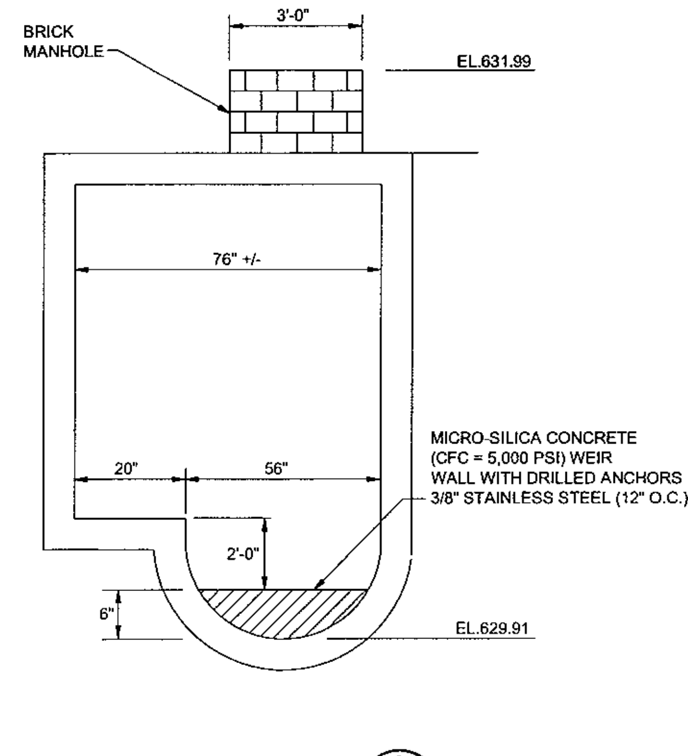


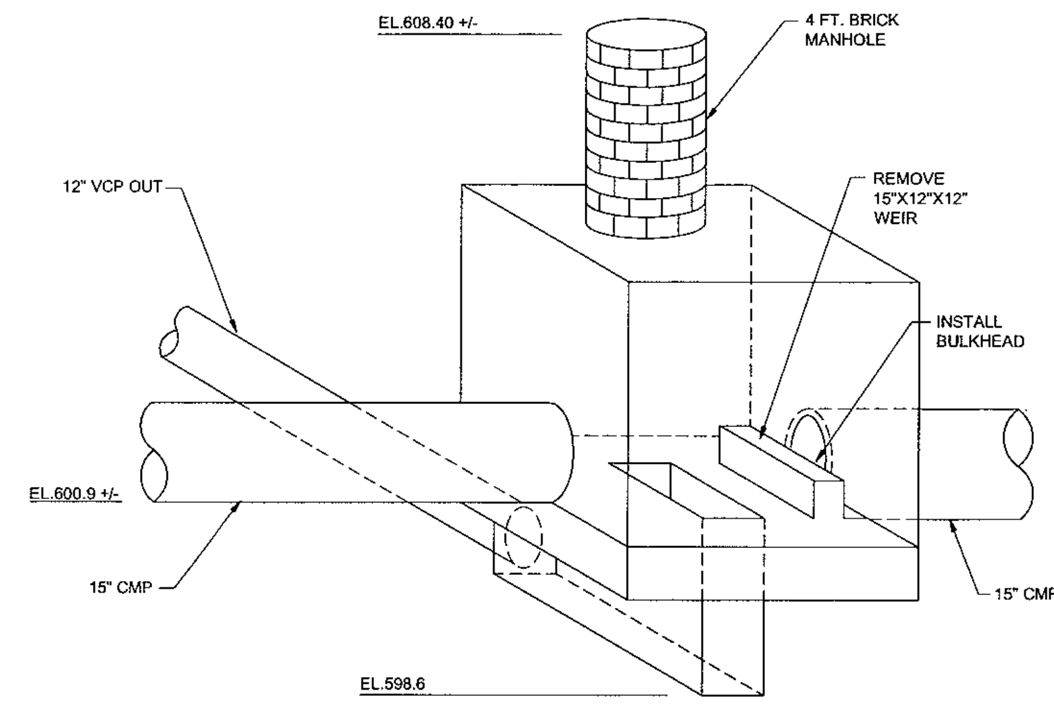
PROJECT 7 NOTES:

1. CONSTRUCT NEW WEIR TO DIRECT FLOW TO 18" SAN OUT.
2. EXISTING REGULATOR STRUCTURE IS CONSTRUCTED IN BRICK WITH ACCESS THROUGH EXISTING 4 FT. MANHOLE.

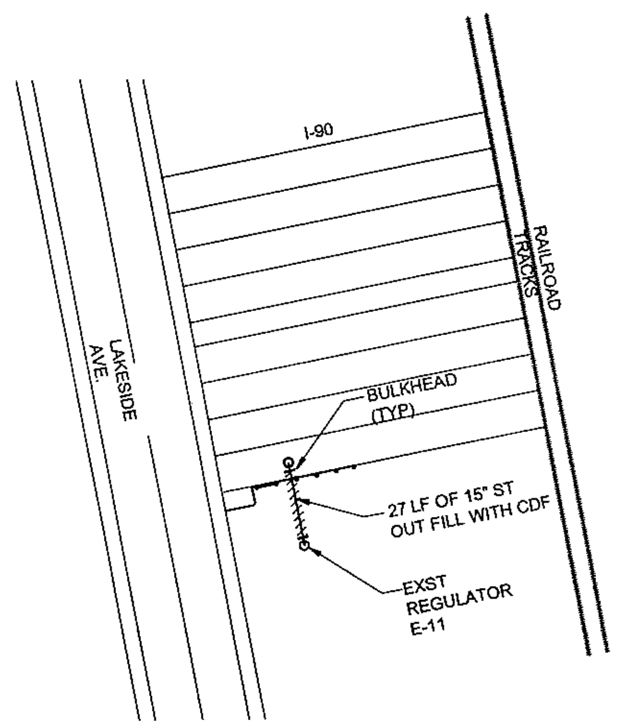
PROJECT 7 - REGULATOR E-09
NTS



SECTION A
NTS 6/7-S-1



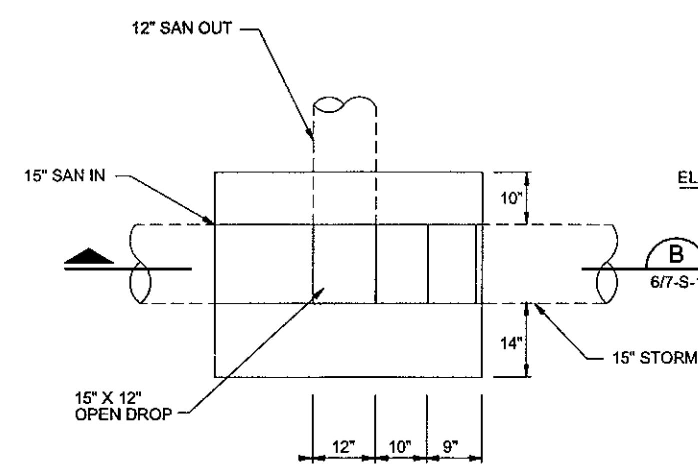
PROJECT 6 - REGULATOR E-11
NTS

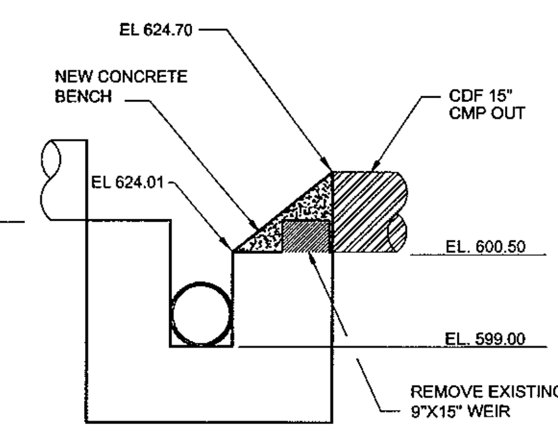


PROJECT 6 SITE PLAN
1/32" = 1'-0"

PROJECT 6 NOTES:

1. REMOVE WEIR AND BULKHEAD EXISTING 15" CMP.
2. EXISTING REGULATOR STRUCTURE IS CONSTRUCTED IN BRICK WITH ACCESS THROUGH EXISTING 4 FT. MANHOLE.
3. ONLY THE I-90 RIGHT SHOULDER CAN BE CLOSED DURING WORK ACTIVITIES. CONTRACTOR MUST PERFORM WORK SUCH THAT NO LANE CLOSURE IS REQUIRED.
4. WORK HOURS FOR PROJECT 6 WILL BE RESTRICTED TO 7 P.M. TO 5 A.M.. NO WORK SHALL BE ALLOWED DURING SPECIAL EVENTS, INCLUDING BUT NOT LIMITED TO, CLEVELAND TEAM SPORTING EVENTS (BROWNS, INDIANS, CAVALIERS, ETC.) AND DOWNTOWN SPECIAL EVENTS (AIR SHOW, FESTIVALS, PARADES, ETC.).
5. ALL WORK TO BE DONE DURING DRY WEATHER.





SECTION B
NTS 6/7-S-1

RECORD DRAWINGS

Revisions Drawn by DOC Date 01/26/06

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DSGN D.M.COX					
DR P.YOUNG					
CHK T.P.O'ROURKE		01/06	RECORD DRAWINGS	DOC	DMC
APVD T.P.O'ROURKE	NO.	DATE	REVISION	BY	APVD

VERIFY SCALE: BAR IS ONE INCH ON ORIGINAL DRAWING. 0 — 1". IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

CH2MHILL

Northeast Ohio Regional SEWER DISTRICT

NORTHEAST OHIO REGIONAL SEWER DISTRICT
CLEVELAND, OHIO
EASTERLY CSO PHASE 2
EARLY ACTION PROJECTS

PROJECT 6 AND 7

REGULATOR E-09 AND E-11
SECTIONS AND DETAILS

DWG	6/7-S-1
DATE	SEPTEMBER 2001
PROJ	160589

FILENAME: prj6&790.dwg PLOT DATE: 12-Sep-2001 PLOT TIME: 13:22:02

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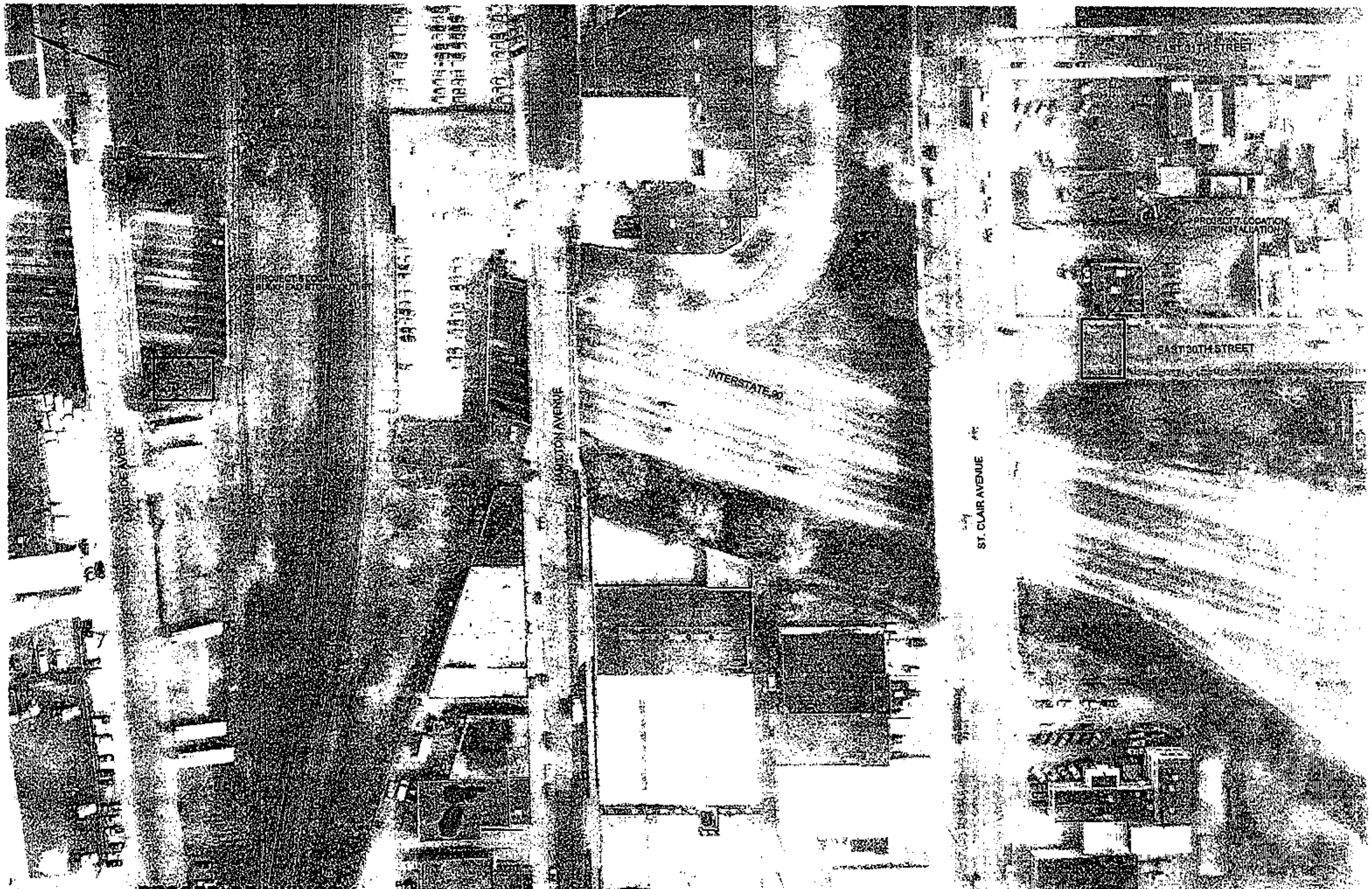

RECORD DRAWINGS

Revisions Drawn by MEP Date 01/25/06

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DSGN	D.M.COX					
DR	P.YOUNG					
CHK	T.P.O'ROURKE	01/06	RECORD DRAWINGS	MEP	DMC	
APVD	T.P.O'ROURKE	NO.	DATE	REVISION	BY	APVD

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

CH2MHILL

Northeast Ohio Regional SEWER DISTRICT

NORTHEAST OHIO REGIONAL SEWER DISTRICT
CLEVELAND, OHIO
EASTERLY CSO PHASE 2
EARLY ACTION PROJECTS

PROJECTS 6 AND 7
OVERALL SITE PLAN
LAKESIDE AVENUE AND INTERSTATE 90
ST CLAIR AVENUE AND EAST 30TH STREET

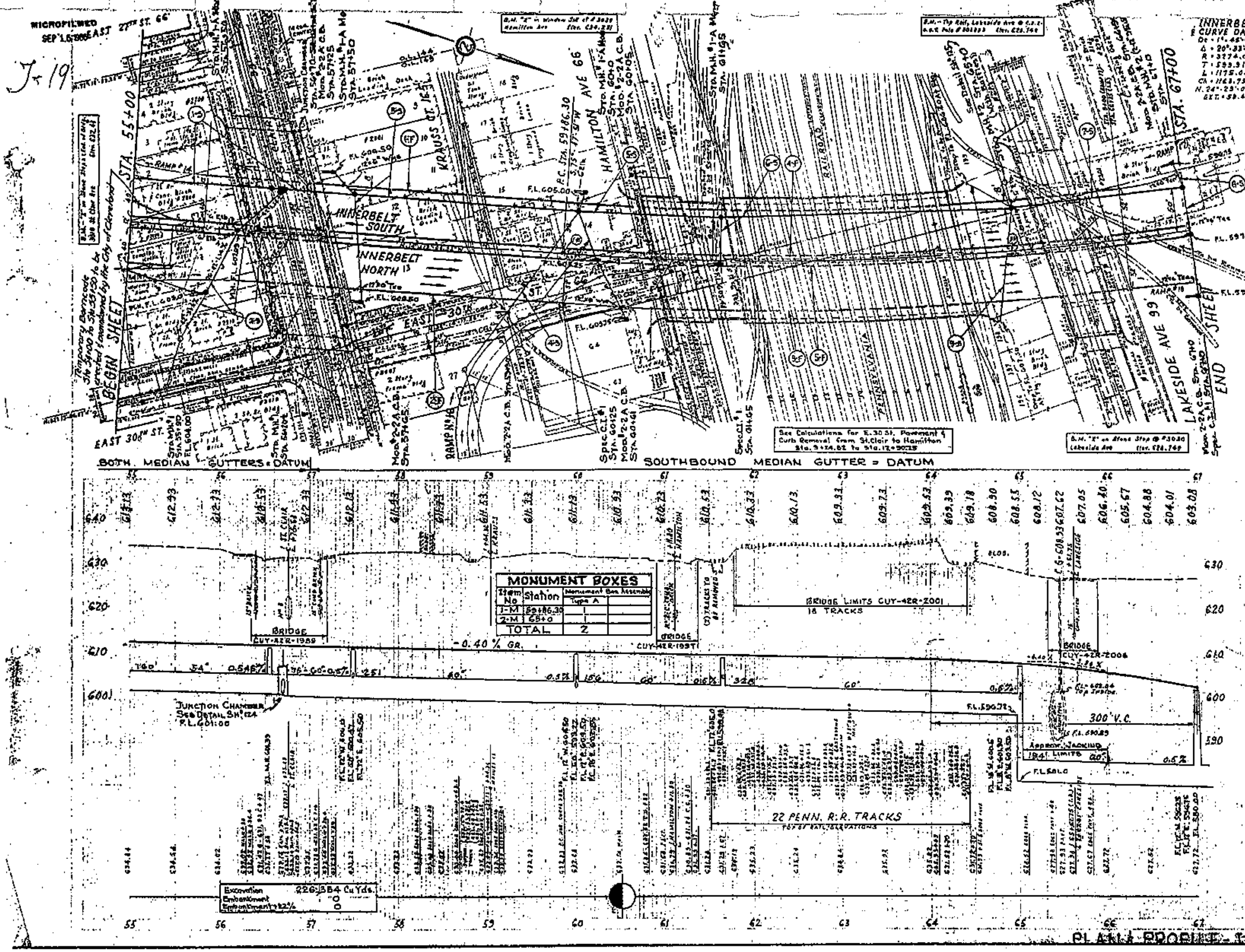
DWG 6/7-C-1
DATE OCTOBER 2001
PROJ 160589

FILENAME: eeaph067.dwg PLOT DATE: 01-Jul-2001 PLOT TIME: 15:56:11

26
243

CUYAHOGA COUNTY
CUY-42R-19.78

PENNSYLVANIA RAILROAD
PROPOSED STRUCTURE
TYPE: Steel girder bridge with reinf. concrete substructure.
SPANS: 2@63'-9" clear (normal to ℄ highway)
WIDTH: 18 Tracks, 269' ± (along ℄ highway)
LOADING: Coopers E-72
SKEW: Varies



Item No.	Station	Monument Box Assembly Type A
1-M	59+86.30	1
2-M	65+0	1
TOTAL		2

6" UNDERDRAINS

Ref No.	Station From	Station To	Side Rt. or Lt.	I-4 Lin. Ft. Curb 5'-0" Deep	I-4 Lin. Ft. Curb 3'-9" Deep	I-4 Lin. Ft. 5'-0" Deep	Outlets For Underdrains	I-5 Each Pipe Specials 6" Elbow
1-F	55+82	64+25	L			1038	12	2
2-F	56+48	59+50	R	50		290		
3-F	60+90	67+0	R			610		
4-F	55+0	67+0	L		1196		5	1
5-F	55+0	67+0	R		1194		5	1
TOTALS				50	2390	1938	22	4-6" SPEC

STORM SEWERS

Ref No.	Station From	Station To	Side Rt. or Lt.	Spec. Paved Gutter	I-2 Lin. Ft. 42" Cl. "B"	Under Pavement 12" Cl. "A"	12" Cl. "B"	18" Cl. "B"	42" Cl. "B"	54" Cl. "B"	60" Cl. "B"	60" Cl. "B" (Jacking)	12"	I-8 Each Std. C.B. 2A	Std. M.H. 1-A	Spec. M.H.	Spec. C.I. #1	Std. M.H. #2	Std. M.H. #2 with Baffles	Junction Chamber	I-5 Each Pipe Specials Mule Tee	Elb	Location of Structures
1-S	55+0	57+50	L		54					60	75					1				1			56+50; 56+76
2-S	55+65	56+0	L/R			144			136						12	1							55+60; 55+74
3-S	57+25	60+0	L/R	20		72	56	138			251			2	1	1	1				1	1	57+25; 57+50; 57+45
4-S	59+30	60+56	L/R	30		20								2		1					1		59+30; 60+25; 60+61
5-S	60+0	61+65	L	10			30				156			1		1							60+0; 60+05
6-S	61+65	65+0	L/R								328										1		2 @ 61+65
7-S	65+60	67+0	L									194		2			1	1	1				65+0
8-S	64+95	67+0	L/R	20		94	50						178								3	4	64+95; 38+40
9-S	Bridge Drains		L/R																				
TOTALS				80	54	330	156	138	139	160	810	194	178	7	2	4	3	1	1	1	4-8" Spec. 1-12" Spec.		

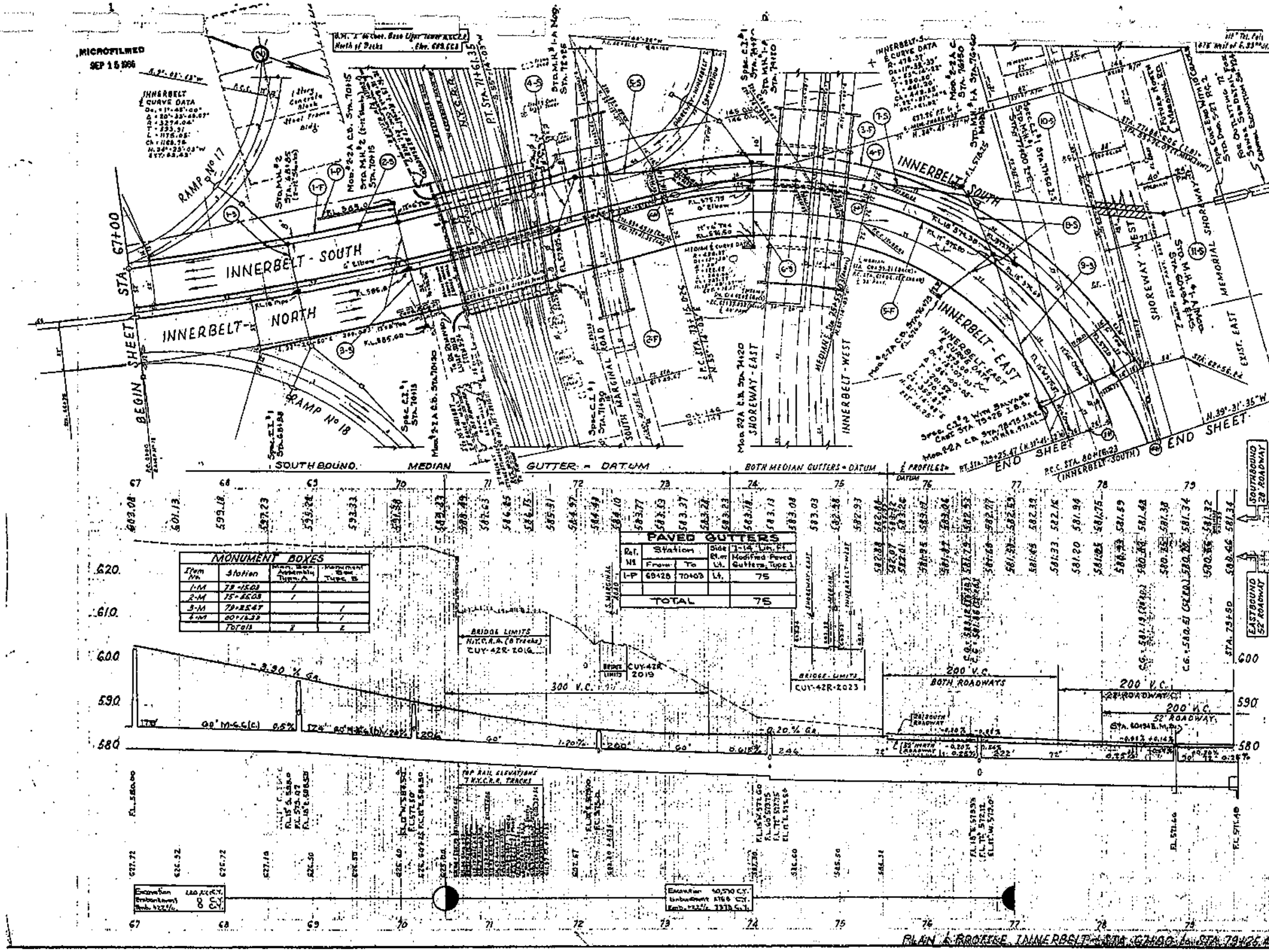
PLAN & PROFILE - INNERBELT - STA. 55+00 to STA. 67+00

CL097030 C30
097

CUYAHOGA COUNTY
CUY-42R-19.78

N.Y.C.R.R.-INNERBELT PROPOSED STRUCTURE
TYPE: Steel girder bridge with reinf. conc. superstructure.
SPANS: Two @ 64'-0" clear (normal to ℄ highway)
WIDTH: 8 Tracks & 10' Roadway, 115' along ℄ highway.
CLEARANCE: 15'-0" minimum.
LOADING: Coopers E-72
SKEW: Varies

For I-4 Underdrain Table See Sh.# 28



MONUMENT BOXES			
Item No.	Station	Mon. Box Assembly Type A	Monument Box Type B
1-M	73+15.03	/	
2-M	75+85.03	/	
3-M	79+25.47		/
4-M	80+16.23		/
	Totals	2	2

PAVED GUTTERS				
Ref. No.	Station From	Station To	Side Rt. or Lt.	I-14 Lin. Ft. Modified Paved Gutters, Type 1
1-P	69+28	70+03	Lt.	75
TOTAL				75

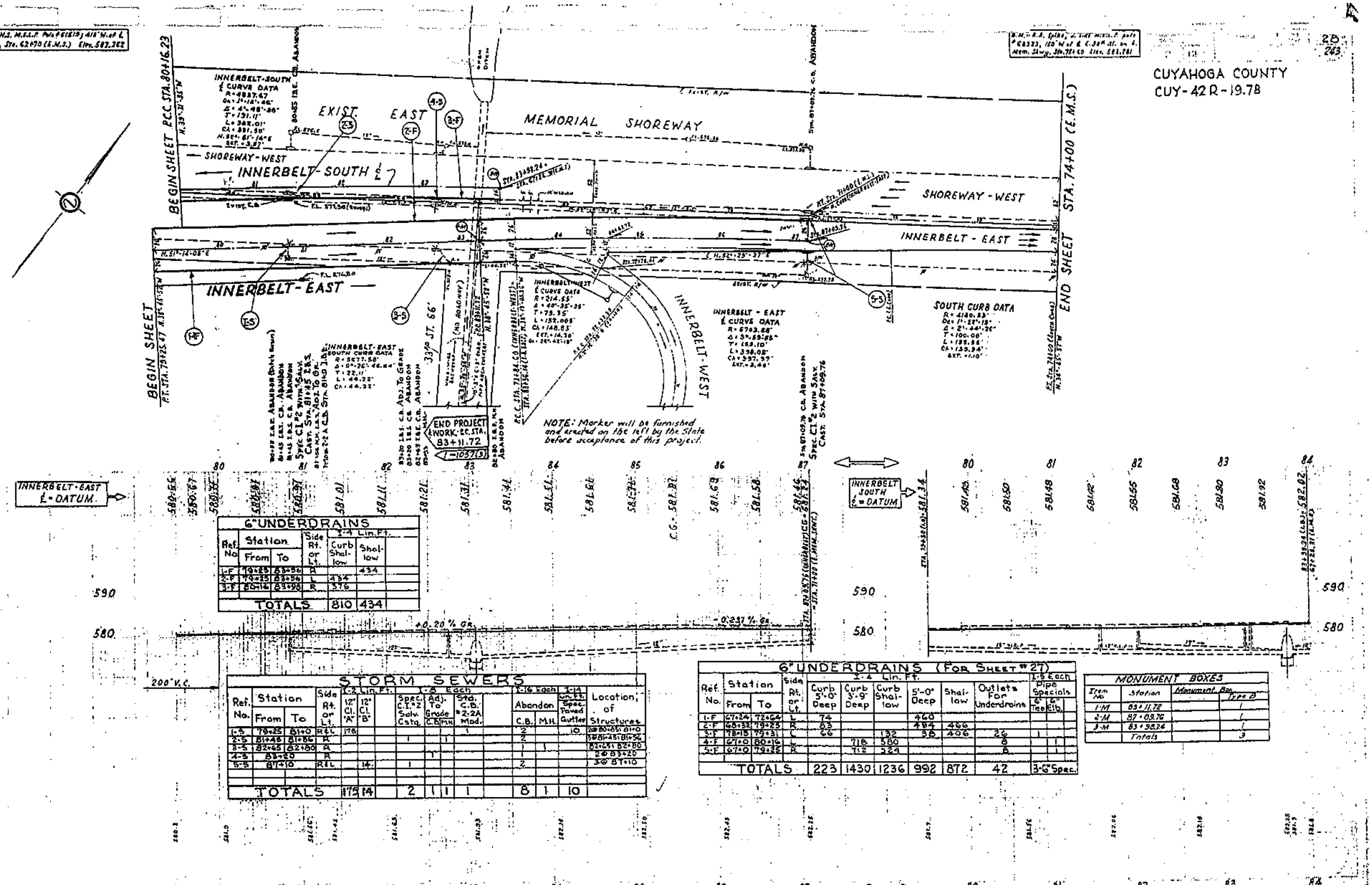
STORM SEWERS

Ref. No.	Station From	Station To	Side Rt. or Lt.	I-2 Lin. Ft. 12" Cl. 'A'	I-2 Lin. Ft. 17" Cl. 'B'	Under Pavement 12" Cl. 'A'	Under Pavement 12" Cl. 'B'	Under Pavement 15" Cl. 'B'	Under Pavement 18" Cl. 'B'	Under Pavement 60" Cl. 'B'	Under Pavement 60" Cl. 'B' M-66 (b)	Under Pavement 60" Cl. 'B' M-66 (c)	Under Pavement 72" Cl. 'B'	S-1 Cu. Yd. Class 'E' Conc.	I-6 Each Std. M.H. #1	I-6 Each Std. MH Mod.	I-6 Each Std. MH #2	I-6 Each Spec. C.I. #1	I-6 Each Std. C.B. #22A Mod.	I-6 Each Spec. C.I. #2 Sctv. Cstg.	I-14 Lin. Ft. Spec. Paved Gutter	I-5 Each Pipe Specials	Location of Structures	E-8 Sq. Yds. Removal of Existing Pavt.	T-71 Sq. Yds. 9" Reinf. Conc. Pavt.
1-S	67+0	68+88	L&R						54			178						1					68+88		
2-S	68+85	70+15	L			18	54				124						1		1		10	1	68+85; 70+15		
3-S	70+15	70+20	L&R			64	64			206								1	1		10	1	70+15; 70+20		
4-S	70+15	72+25	L&R							200							1	1	1				70+15; 71+90		
5-S	72+25	74+20	L													1							72+25		
6-S	74+20		L&R			74	16											1	1		10	1	2@74+20		
7-S	74+20	76+00.14	L	8					70				246			1			1		10		74+20; 76+50		
8-S	76+15.14	77+50.5	L&R		25	76									1			1			10		76+15; 77+50		
9-S	77+0	79+25	L&R	42	37		50	182								2			1	1	20	2	78+15; 79+25		
10-S	76+60	80+94.5	L	.									222										76+60; 80+94.5	93.3	93.3
11-S	80+94	E.M.S.	L										70	55											
TOTALS				50	62	232	184	182	124	406	124	178	538	55	1	4	2	5	6	1	70	5-12 Spec.		93.3	93.3

PLAN & PROFILE INNERBELT-SOUTH STA. 67+00 to STA. 79+25.47 INNERBELT EAST & STA. 80+16.23 INNERBELT-SOUTH

CL 097 035

CUYAHOGA COUNTY
CUY-42R-19.78



6" UNDERDRAINS				I-4 Lin. Ft.		
Ref. No.	Station From	Station To	Side Rt. or Lt.	Curb Shallow	Shallow	
1-F	79+25	83+56	R		434	
2-F	79+25	83+56	L	434		
3-F	80+16	83+98	R	376		
TOTALS				810	434	

STORM SEWERS				I-2 Lin. Ft.			I-8 Each					I-16 Each		I-14 Lin. Ft.	
Ref. No.	Station From	Station To	Side Rt. or Lt.	12" Cl. "A"	12" Cl. "B"		Spec. C.I. #2 Salv. Cstg.	Adj. To Grade C.B.	Adj. To Grade M.H.	Std. C.B. #2-2A Mod.		Abandon C.B.	Abandon M.H.	Spec. Paved Gutter	Location of Structures
1-S	79+25	81+0	R&L	178						1		2		10	2@80+85; 81+0
2-S	81+48	81+86	R				1		1			2			3@81+45; 81+56
3-S	82+65	82+80	R									1	1		82+65; 82+80
4-S	83+20		R					1				1			2@83+20
5-S	87+10		R&L		14		1					2			3@87+10
TOTALS				175	14		2	1	1	1		8	1	10	

6" UNDERDRAINS (FOR SHEET #27)				I-4 Lin. Ft.						I-5 Each Pipe Specials		
Ref. No.	Station From	Station To	Side Rt. or Lt.	Curb 5'-0" Deep	Curb 3'-9" Deep	Curb Shallow	5'-0" Deep	Shallow	Outlets For Underdrains	6" Tee	6" Elb.	
1-F	67+24	72+64	L	74			460					
2-F	68+32	79+25	R	83			494	466			1	
3-F	78+15	79+31	L	66		132	38	406	26	1	1	
4-F	67+0	80+16	L		718	580			8		1	
5-F	67+0	79+25	R		712	524			8		1	
TOTALS				223	1430	1236	992	872	42	3-6" Spec.		

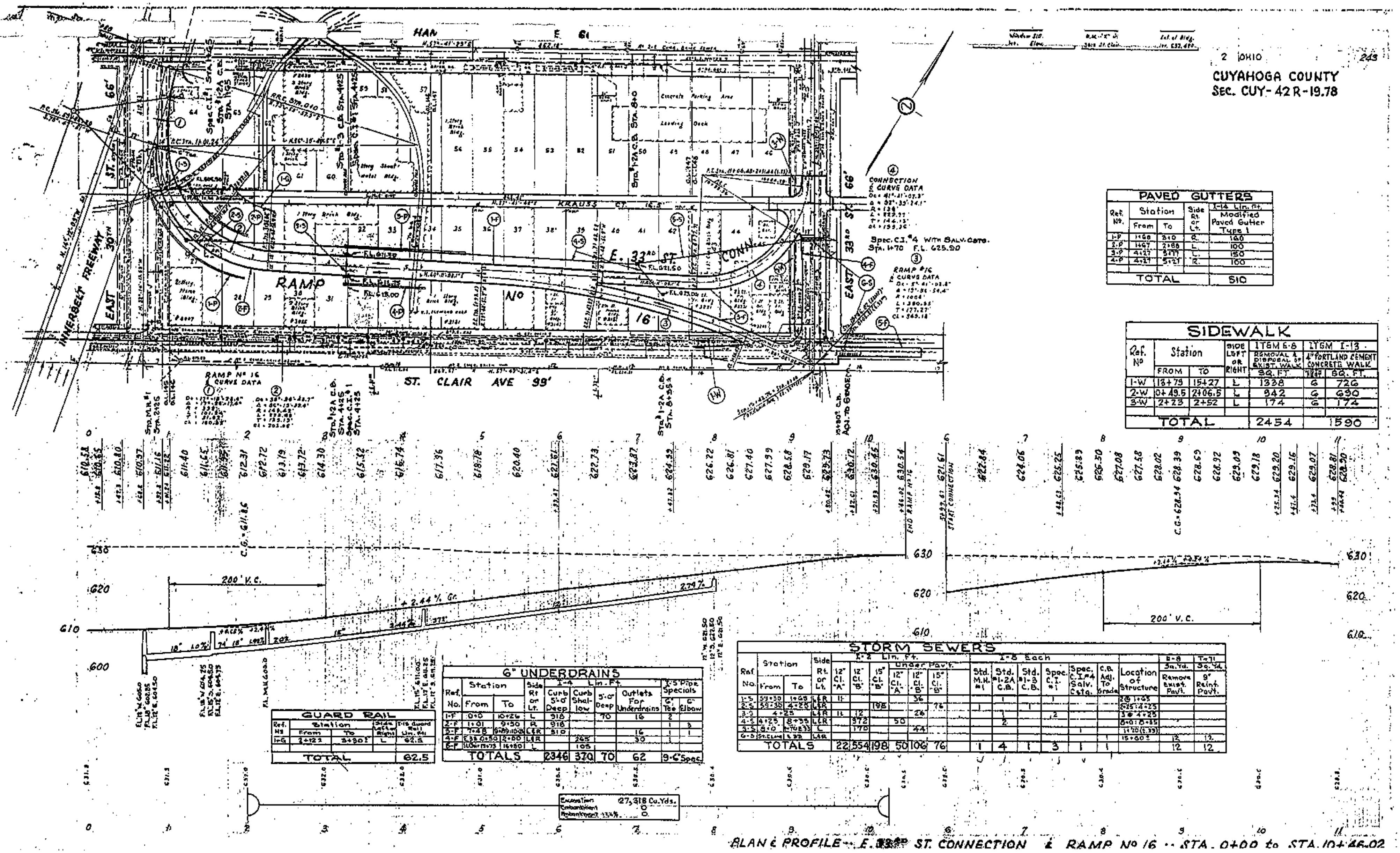
MONUMENT BOXES			
Item No.	Station	Monument Box	Type B
1-M	83+11.72		1
2-M	87+09.76		1
3-M	83+98.24		1
	Totals		3

PLAN & PROFILE -- INNERBELT SOUTH -- STA. 80+16.23 to STA. 83+98.24 ℄ INNERBELT-EAST -- STA. 79+25.47 to STA. 87+09.76=STA. 78+00

CL 097 040

2 OHIO 243

CUYAHOGA COUNTY
SEC. CUY-42R-19.78



PAVED GUTTERS				
Ref. No.	Station From	Station To	Side Rt. or Lt.	I-14 Lin. Ft. Modified Paved Gutter Type 1
1-P	1+60	3+0	R.	160
2-P	1+67	2+88	L.	100
3-P	4+27	5+77	L.	150
4-P	4+27	5+27	R.	100
TOTAL				510

SIDEWALK						
Ref. No	Station FROM	Station TO	Side Left or Right	ITEM 6-8 Removal & Disposal of Exist. Walk SQ. FT.	ITEM I-13 4" Portland Cement Concrete Walk Width Feet	ITEM I-13 SQ. FT.
1-W	13+79	15+27	L	1338	6	726
2-W	0+49.5	2+06.5	L	942	6	690
3-W	2+23	2+52	L	174	6	174
TOTAL				2454		1590

GUARD RAIL				
Ref. No	Station From	Station To	Side Left or Right	I-15 Guard Rail Lin. Ft.
1-G	2+12?	3+80?	L	62.5
TOTAL				62.5

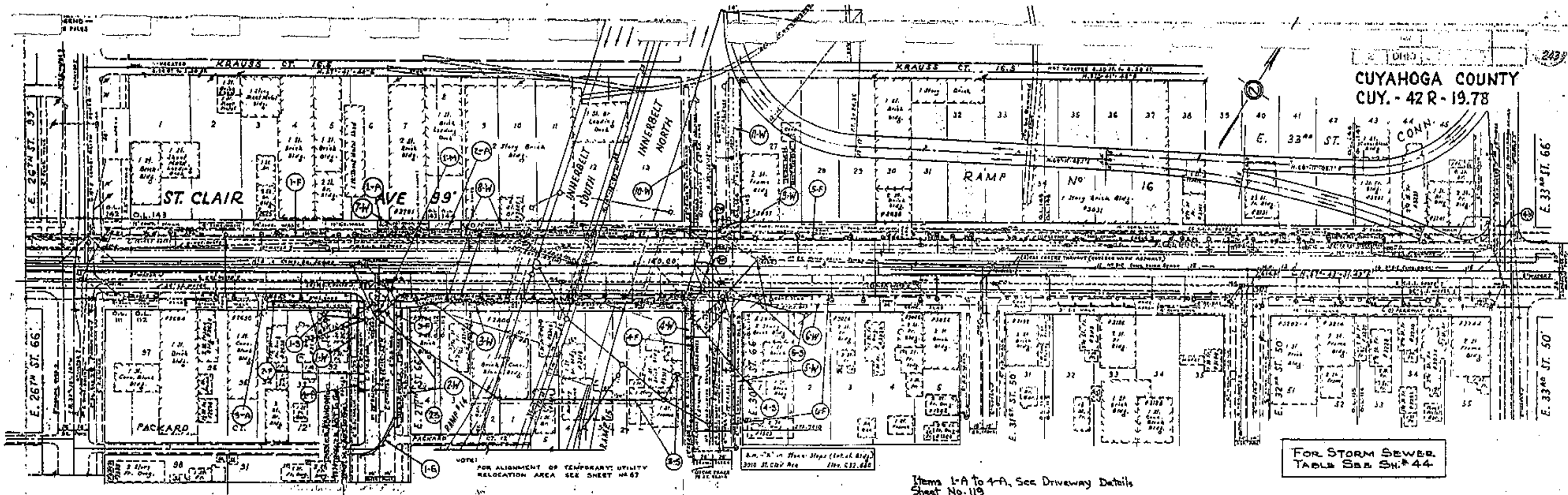
6" UNDERDRAINS									
Ref. No.	Station From	Station To	Side Rt or Lt.	I-4 Lin. Ft. Curb 5'-0" Deep	Curb Shallow	5'-0" Deep	Outlets For Underdrains	I-5 Pipe Specials 6" Tee	6" Elbow
1-F	0+0	10+26	L	918		70	16	2	
2-F	1+01	9+50	R	918				1	3
3-F	7+48	9+89.10(E)	L&R	510			16	1	1
4-F	E.33 0+50	2+00	L&R		265		30	1	
5-F	St.Clair 15+75	16+80	L		105				
TOTALS				2346	370	70	62	9-6" Spec.	

STORM SEWERS																		
Ref. No.	Station From	Station To	Side Rt. or Lt.	I-2 Lin. Ft. 12" Cl. "A"	12" Cl. "B"	15" Cl. "B"	Under Pav't. 12" Cl. "A"	Under Pav't. 12" Cl. "B"	Under Pav't. 15" Cl. "B"		I-8 Each Std. M.H. #1	Std. #1-2A C.B.	Std. #1-3 C.B.	Spec. C.I. #1	Spec. C.I. #4 Salv. Grtg.	C.B. Adj. To Grade	Location of Structure	6-8 Sq. Yd. Remove Exist. Pav't.	T-11 Sq. Yd. 9" Reinf. Pav't.
1-S	59+30	1+65	L&R	11				36				1		1			2@ 1+65		
2-S	59+30	4+25	L&R			198			76		1		1				2+25, 4+25		
3-S	4+25		L&R	11	12			26				1		2			3@ 4+25		
4-S	4+25	8+35	L&R		372		50					2					8+0, 8+35		
5-S	8+0	14+70(E.33)	C		170			44							1		14+70 (E.33)		
6-S	St. Clair	1.33	L&R													1	15+60±	12	12
TOTALS				22	554	198	50	106	76		1	4	1	3	1	1		12	12

PLAN & PROFILE -- E. 33RD ST. CONNECTION & RAMP No 16 -- STA. 0+00 to STA. 10+46.02

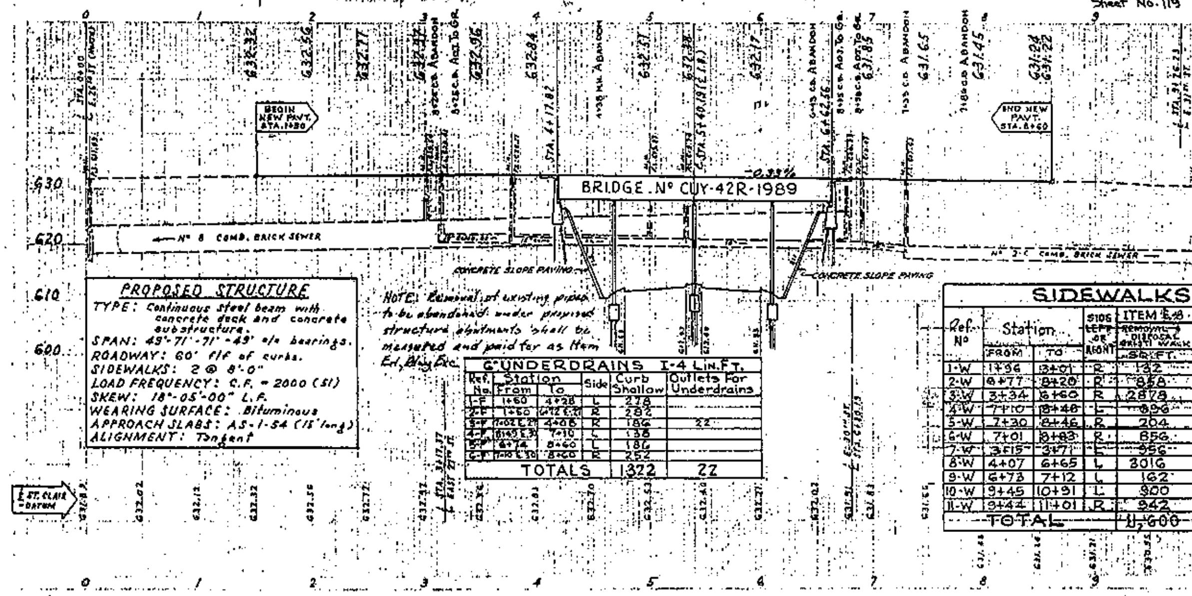
CL097045

CUYAHOGA COUNTY
CUY. - 42 R - 19.78



FOR STORM SEWER TABLE SEE SH. # 44

Items 1-A to 4-A, See Driveway Details Sheet No. 119



PROPOSED STRUCTURE

TYPE: Continuous steel beam with concrete deck and concrete substructure.
SPAN: 49'-71'-71'-49' c/c bearings.
ROADWAY: 60' f/f of curbs.
SIDEWALKS: 2 @ 8'-0"
LOAD FREQUENCY: C.F. = 2000 (SI)
SKEW: 18°-05'-00" L.F.
WEARING SURFACE: Bituminous
APPROACH SLABS: AS-1-54 (15' long)
ALIGNMENT: Tangent

NOTE: Removal of existing pipes to be abandoned under proposed structure abutments shall be measured and paid for as Item Ex, Bldg Exc.

6" UNDERDRAINS I-4 Lin. Ft.

Ref. No.	Station From	Station To	Side	Curb Shallow	Outlets For Underdrains
1-F	1+60	4+28	L	278	
2-F	1+60	4+12 E.27	R	282	
3-F	1+02 E.27	4+06	R	186	22
4-F	8+49 E.30	7+10	L	138	
5-F	6+74	8+60	L	186	
6-F	7+10 E.30	8+60	R	252	
TOTALS				1322	22

SIDEWALKS

Ref. No	Station From	Station To	Side Left or Right	ITEM E-8 Removal & Disposal Exist. Walk SQ. FT.	ITEM I-13 4" Portland Cement Concrete Walk Width Feet	ITEM I-13 SQ. FT.
1-W	1+96	3+01	R	132	6'	1014
2-W	6+77	8+20	R	858		
3-W	3+34	6+60	R	2878	VAR	525
4-W	7+10	8+48	L	896	6'	971
5-W	7+30	8+46	R	204	8'-6	934
6-W	7+01	8+83	R	856	19	2932
7-W	3+15	3+71	L	956	10-19	956
8-W	4+07	6+65	L	3016	VAR	290
9-W	6+73	7+12	L	162	VAR	388
10-W	9+45	10+91	L	900		
11-W	9+44	11+01	R	942		
TOTAL				11,600		8010

DRIVEWAY QUANTITIES

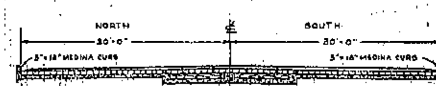
Station	E-8 Removal & Disposal Exist. Drive Pavts.	E-1 Embankment to Replace Pavt.	E-8 Removal & Disposal Exist. Curb	I-11 6"x18" S.F. Curb 1" Bullnose	L-9 Seeding & Sodding
	SQ. YDS.	CU. YDS.	LIN. FT.	LIN. FT.	SQ. YDS.
N. Side St. Clair 8+63 to 14+30	112	18.7	141	141	112
TOTAL	112	18.7	141	141	112

GUARD RAIL

Ref. No	Station From	Station To	Side Left or Right	I-15 Guard Rail Lin. Ft.
1-G	3+07 ± on ℄ Packard Ct.	4+07 ± on ℄ E. 27 St.	R	63.5
TOTAL				63.5

MONUMENT BOXES

Item No.	Station	Monument Box Type A	Monument Box Type B	Monument Box Assembly Type A
1-M	St. Clair & E.27		1	
2-M	St. Clair & E.30			1
3-M	St. Clair & E.30		1	
4-M	St. Clair & E.33		1	
	Totals		3	1



MINIMUM 2½" T-35 ASPHALTIC CONCRETE SURFACE COURSE OVER 5" MEDINA BLOCK PAVEMENT. (CAR TRACKS UNDER T-35) 6" CONCRETE BASE

ADJOINING PAVEMENT
ST. CLAIR AVE
SCALE 1/8" = 1'-0"

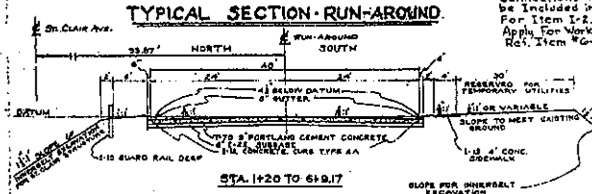
PLAN & PROFILE ST. CLAIR AVE ··· E. 26TH ST. to E. 33RD ST.

CL0970050

CUYAHOGA COUNTY
CUY. 42 - 19.78

Note: *
Drop South Curb of Temporary Run-Around From 8" To 2" Between East and West Curbs of E.27th St.

TYPICAL SECTION · RUN-AROUND



STA. 1+20 TO 6+9.17

Note:
Removal of Exist. 18" Br. Sewer in North Side of St. Clair Ref. Item #2-5 and Reconnecting any Exist. Connections to New Sewer Shall be Included in the Unit Price Bid For Item I-2. The Above Shall Also Apply For Work in Connection With Ref. Item #6-5.

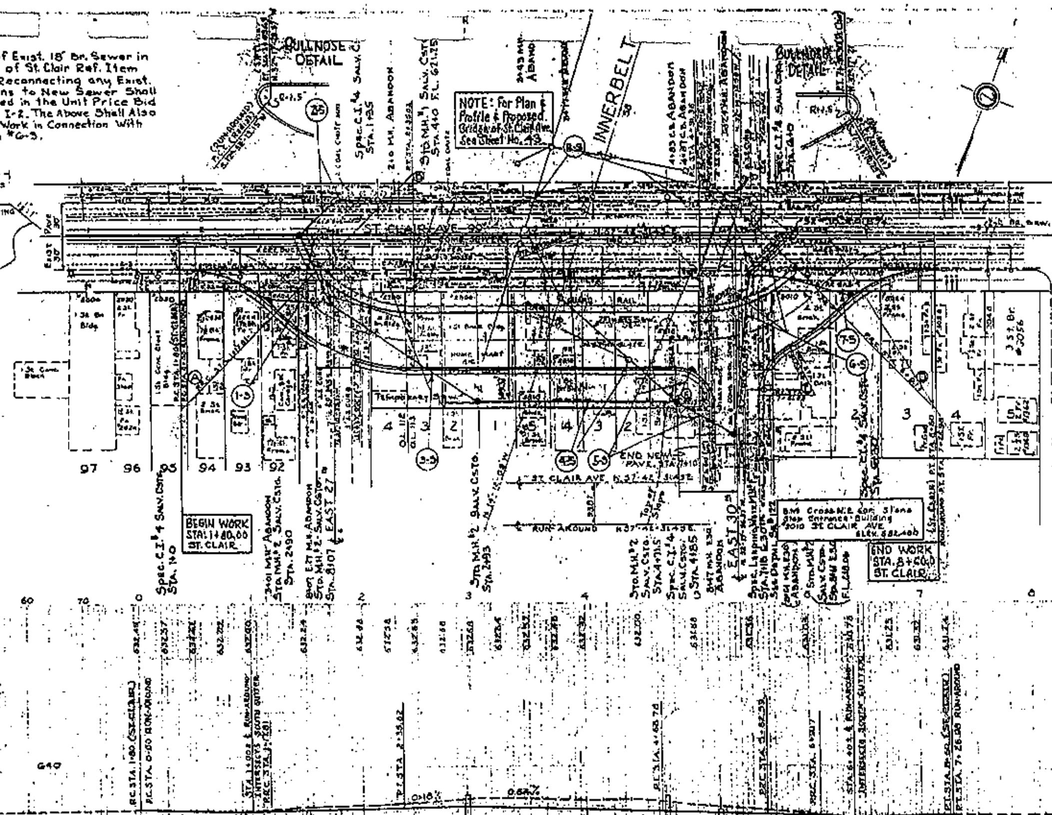
STORM SEWERS - For SH. #43											
Ref. No.	Station From	Station To	Side Rt. or Lt.	I-2 Lin.Ft. Under Pav't. 12" Cl."B"	I-16 Each Abandon C.B.	I-16 Each Abandon M.H	I-9 Ea. Adj. To Grade C.B.	I-9 Ea. Adj. To Grade M.H	E-12 Lin.Ft. 54" Pipe Removed For Storage		Location of Structure
1-5	2+59	8+24 E.30	R		2		1				2+55:8+06:8+24
2-5	8+25 E.27	4+38	R	22			1	1	156		8+07:8+25
3-5	4+38	6+43	R		1	1			176		4+38:6+43
4-5	8+35	8+66	R&L	44			2				8+35:8+38
5-5	7+39	7+86	R		2			1			7+88:7+86:7+39
TOTALS				66	5	1	4	2	332		

¢ CURVE DATA Ⓐ,Ⓑ,Ⓒ,Ⓓ
Δ = 45°-00'
R = 150'
L = 117.81'
Ch = 114.81'
T = 62.13'
D = 38°-11'-50"

CURB CURVE DATA Ⓔ
Δ = 62°-49'-58"
R = 50'
L = 54.83'
Ch = 52.12'
T = 30.54'
D = 114°-35'-30"

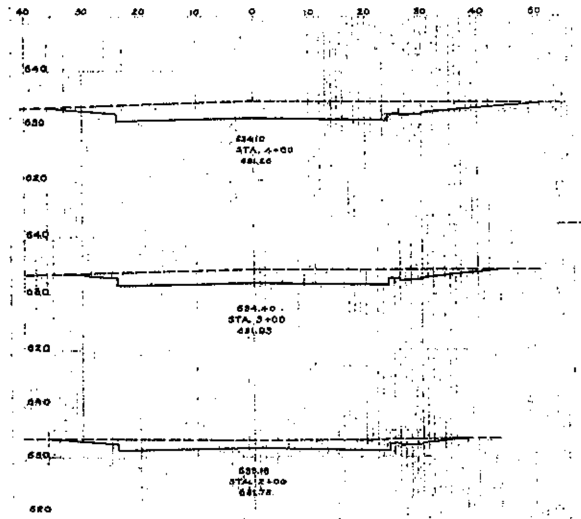
CURB CURVE DATA Ⓕ
Δ = 89°-57'-32"
R = 35'
L = 54.95'
Ch = 49.48'
T = 34.97'
D = 163°-42'-09"

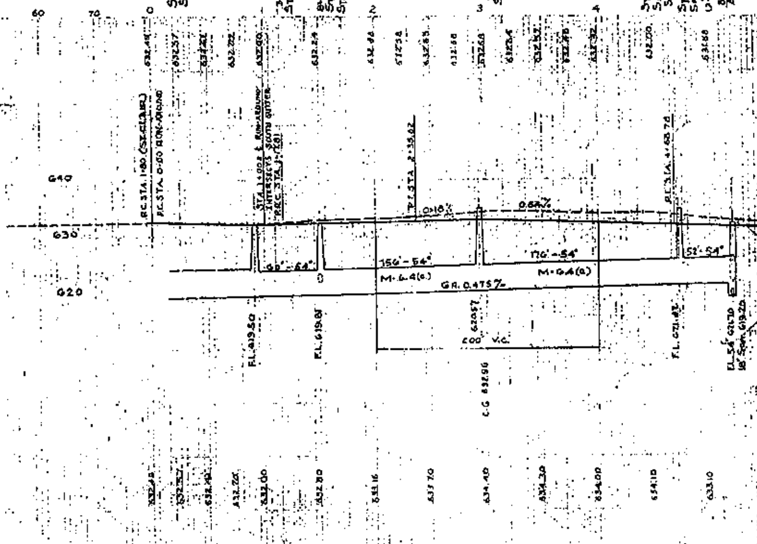
(2) BULLNOSE CURB DATAS
R = 1.5'
Δ = 134°-44'-18"
L = 3.53'



See Sheet No. 67 For Larger Scale Detail.

NOTE: All Items needed to construct Temporary Run-Around shall be included in the lump sum price for Item S-15, Except Sewer Work Items. ITEM S-15 TO INCLUDE PAV'T REMOVAL FROM STA. 7+50 TO STA. 8+36.43 ON E.27th AND STA. 7+10 TO STA. 8+64.02 ON E.30th





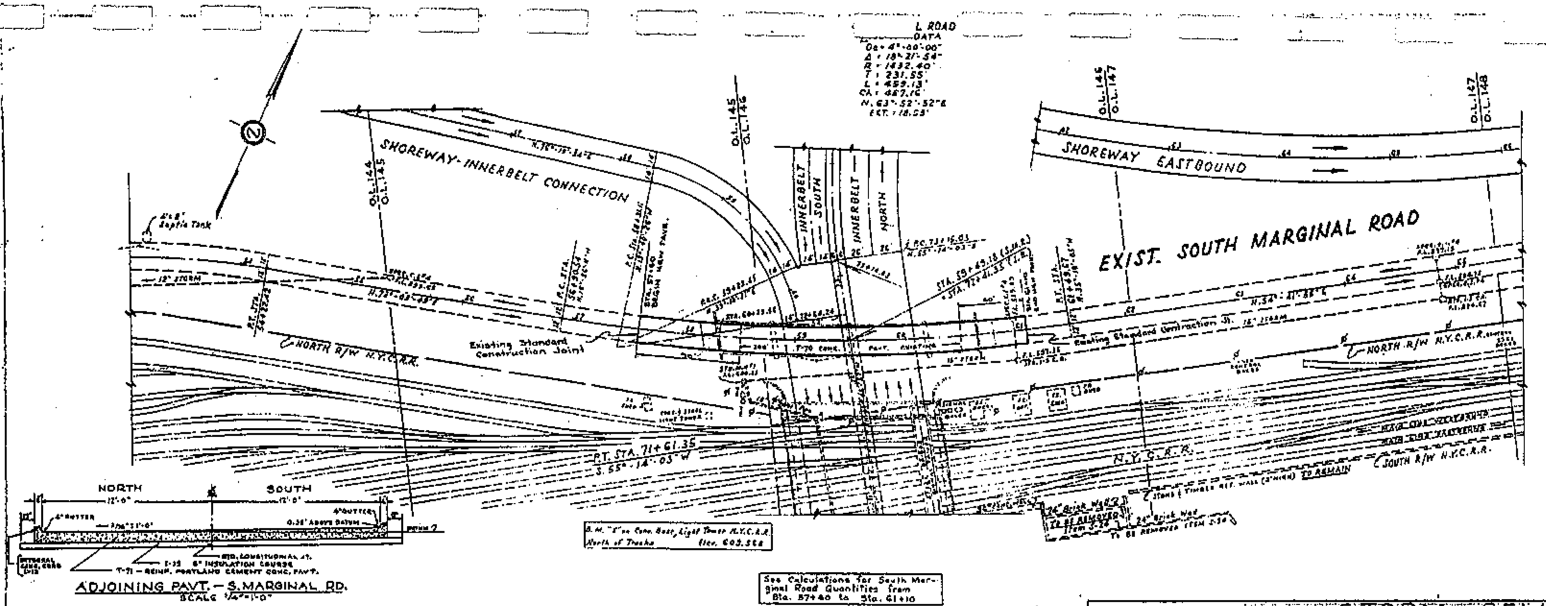
STORM SEWERS																				
Ref. No.	Station From	Station To	Side Rt. or Lt.	I-2 Lin.Ft. Class "B" Pipe 12"	54" M-6.4(a)	Under Pav't. 12"	M-6.8(b) 15"	M-6.8(b) 18"	54"	54" M-6.4(b)	I-8 Each Std. M.H. with Salv. Catg #1	Std. M.H. with Salv. Catg #2	Spec. C.I.#4 Salv. Catg	Spec. M.H. #1	I-16 Each Abandon M.H.	Abandon C.B.	*	*	Location of Structure
1-5	1+0	8+07 E.27	L&R			44			60			1	1		1		44	44	1+0:2+90:1+10
2-5	2+90 St.C	4+0 St.C	L				118				1								4+0
3-5	1+35	2+93	L&R			14				156		1	1		2				[illegible]
4-5	2+93	4+71.5	L&R		176							1			1				2+93:4+77
5-5	4+71.5	7+16 E.30	L&R	28					52			1	1			1			[illegible]
6-5	7+16 E.30	8+61 E.30	L&R					134				1		1	2		32	32	[illegible]
7-5	5+46	6+30	L&R	56		56							2						6+0:2+30
8-5	5+45	6+24	L												2				[illegible]
TOTALS				64	176	114	118	194	112	156	1	14	5	1	8	2	76	76	

* Sanitary Work - No State Participation (City of Cleveland)

TEMPORARY RUN-AROUND FOR ST. CLAIR AVE.

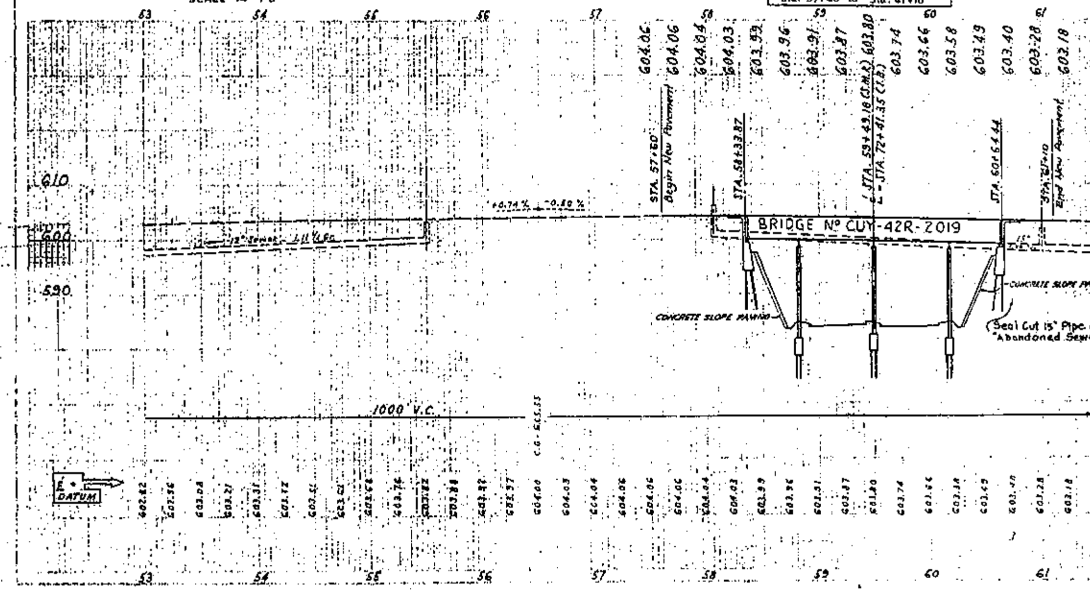
CL017060

CUYAHOGA COUNTY
CUY-42R-19.78



PROPOSED STRUCTURE

TYPE: Cont. steel beams with reinf. conc. deck and concrete substructure.
SPANS: 45'-68'-68'-45' ctr. to ctr. bearings.
ROADWAY: 24'-0" F/F, 2'-0" safety curbs.
LOAD FREQUENCY: CF = 400 (SI)
SKEW: 7°-29'-00" at ℄ of bridge.
SURFACE COURSE: 1" Monolithic Concrete
APPROACH SLABS: AS-1-54 (15' long)
ALIGNMENT: 4°-00 left curve
SUPERELEVATION: 3/16" per foot.



STORM SEWERS FOR SHEET #46

Ref. No.	Station From	Station To	Side Rt. or Lt.	I-2 Lin. Ft. Cl. "B" 12" M-6.4 (d)	15" M-6.4 (d)	Under Pav't. 12"	Under Pav't. 18" M-6.4(d)	15"		I-8 Each Std. M.H. #2	Spec. M.H. #2	Spec. C.B. #4 with Salv. Casting	Rebuild M.H.	Adj. To Grade C.B.	Adj. To Grade M.H.	R-12 Lin. Ft. 15" Pipe Removed for Storage	I-16 Each Abandon C.B.	Abandon M.H.	E-8 Sq. Yds. Removal & Disp. Exist. Pav't.	T-7 Sq. Yds. 5" Reinf. Conc. Pav't.		Location of Structure
1-8	1+55	2+01	Lt.														2					[illegible]
2-3	5+96	5+82	Lt.											1		222		1				[illegible]
3-3	5+96	6+26	Rt.				56							1	1							[illegible]
4-5	6+26	6+10	Rt.	*20	48			24		1	1											[illegible]
5-5	7+97	8+81	Rt.										*1				1	1				[illegible]
6-8	8+10	8+52	Lt.														1	1				[illegible]
7-3	9+07	9+40	Rt.&L.			66						2										[illegible]
8-8	9+75	10+80	Lt.														2					[illegible]
9-8	14+80	15+10	Lt.			58						1					1		26	26		[illegible]
TOTALS				*20	48	104	36	24		1	1	3	*1	2	1	222	7	3	26	26		

* SANITARY WORK - NO STATE PARTICIPATION (CITY OF CLEVELAND)

STORM SEWER (For Temporary Sewer, Sheet Nº 47)

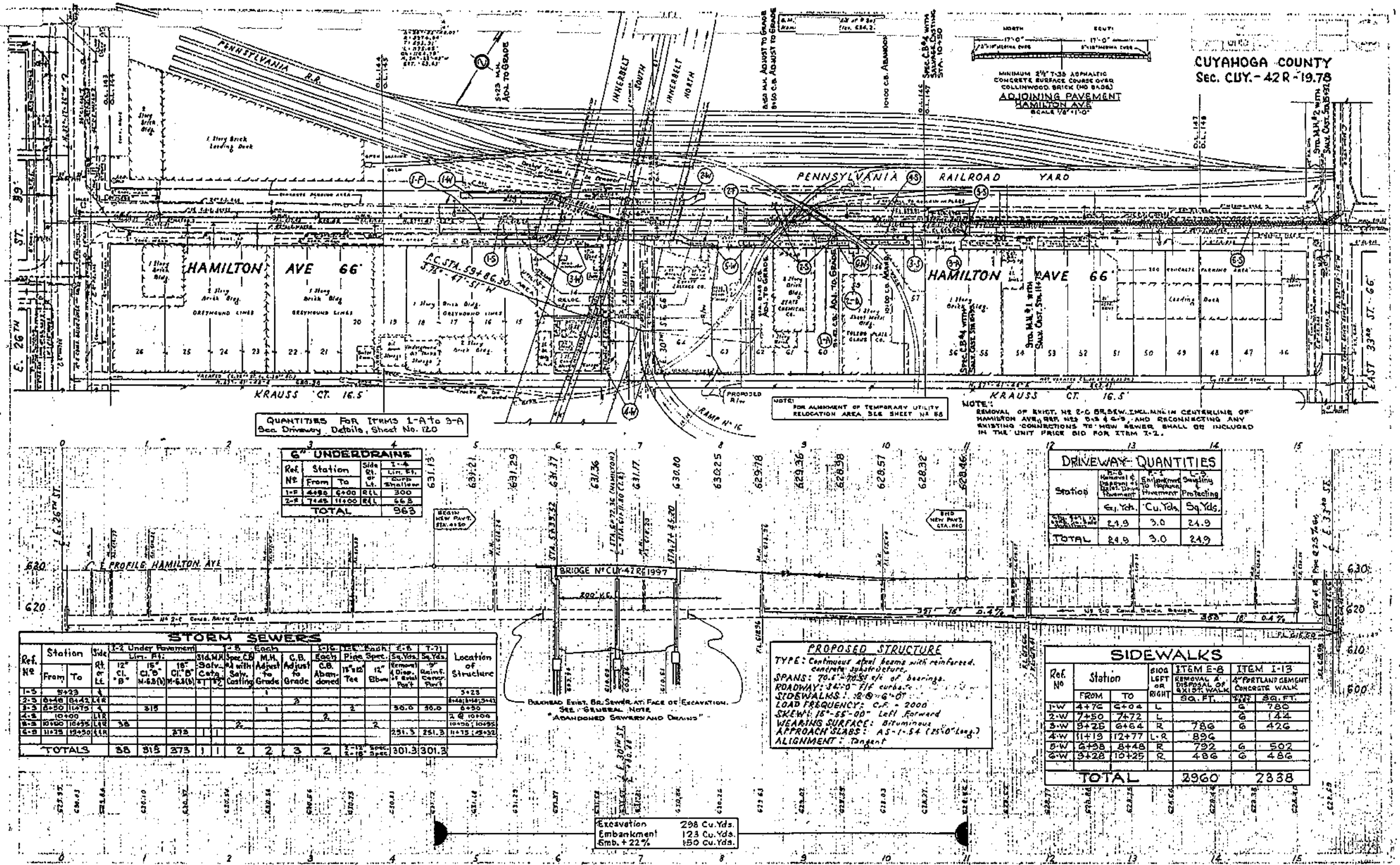
Ref. Nº	Station From	Station To	Side Rt. or Lt.	I-2 Lin. Ft.	15" Cl. "B" M 6.4 (d)	Under Pav't. 12" CL. "B"	Under Pav't. 18" CL. "B" M-6.4(d)	I-8 Each Spec. C.I. #4	Std. M.H. #2	E-8 Sq. Yds. Removal & Disposal of Exist. Pave.	T-71 Sq. Yds. 9" Reinf. Conc. Pav't.		Location of Structure
1-5	1+45 Lakeside	1+7	L&R			74		2		14	14		0+75 : 1+15
2-5	6+15 Lakeside	9+40 Lakeside	L.		330		56		3	30	30		6+60 : 8+87 : 9+40 Lakeside
3-5	9+40 Lakeside	10+80	L.			100		2		19	19		9+70 : 10+80
TOTALS					380	174	56	4	3	63	63		

PLAN & PROFILE -- SOUTH MARGINAL ROAD -- STA. 53+00 to STA. 66+00

CL097075

PLAN & PROFILE -- HAMILTON AVE -- E. 26TH ST. to E. 33RD ST.

CUYAHOGA COUNTY
Sec. CUY.-42R-19.78



QUANTITIES FOR ITEMS 1-A to 3-A
See Driveway Details, Sheet No. 120

NOTE:
FOR ALIGNMENT OF TEMPORARY UTILITY RELOCATION AREA SEE SHEET No 56

NOTE:
REMOVAL OF EXIST. No 2-C BR. SEW. INCL. MH. IN CENTERLINE OF HAMILTON AVE., REF. Nos 5-S & 6-S, AND RECONNECTING ANY EXISTING CONNECTIONS TO NEW SEWER SHALL BE INCLUDED IN THE UNIT PRICE BID FOR ITEM I-2.

6" UNDERDRAINS

Ref. No	Station From	Station To	Side Rt. or Lt.	I-4 Lin. Ft. Curb Shallow
1-F	4+96	6+00	R&L	300
2-F	7+45	11+00	R&L	663
TOTAL				963

DRIVEWAY QUANTITIES

Station	E-8 Removal & Disposal of Exist. Drive Pavement	F-1 Embankment to Replace Pavement	L-9 Seeding & Protecting
	Sq. Yds.	Cu. Yds.	Sq. Yds.
[illegible]	24.9	3.0	24.9
TOTAL	24.9	3.0	24.9

STORM SEWERS

Ref. No	Station From	Station To	Side Rt. or Lt.	I-2 Under Pavement Lin. Ft. 12" Cl. "B"	15" Cl. "B" M-6.8(b)	18" Cl. "B" M-6.8(b)	Std. M.H. Salv. Castg. #1	#2	I-8 Each Spec. C.B. #4 with Salv. Casting	M.H. Adjust to Grade	C.B. Adjust to Grade	I-16 Each C.B. Abandoned	I-20 Each Pipe Spec. 15"x12" Tee	12" Elbow	E-8 Sq. Yds. Removal & Disp. of Exist. Pav't	T-71 Sq. Yds. 9" Reinf. Concr. Pav't	Location of Structure
1-S	5+23		L							1							5+23
2-S	8+40	8+42	L&R								3						8+40; 8+40; 8+42
3-S	8+50	11+75	L		315					1			2		50.0	50.0	8+50
4-S	10+00		L&R									2					2 @ 10+00
5-S	10+90	10+95	L&R	38					2					2			10+90; 10+95
6-S	11+75	15+50	L&R			373	1	1							251.3	251.3	11+75; 15+32
TOTALS				38	315	373	1	1	2	2	3	2	2-12" Spec. 2-15" Spec.		301.3	301.3	

PROPOSED STRUCTURE

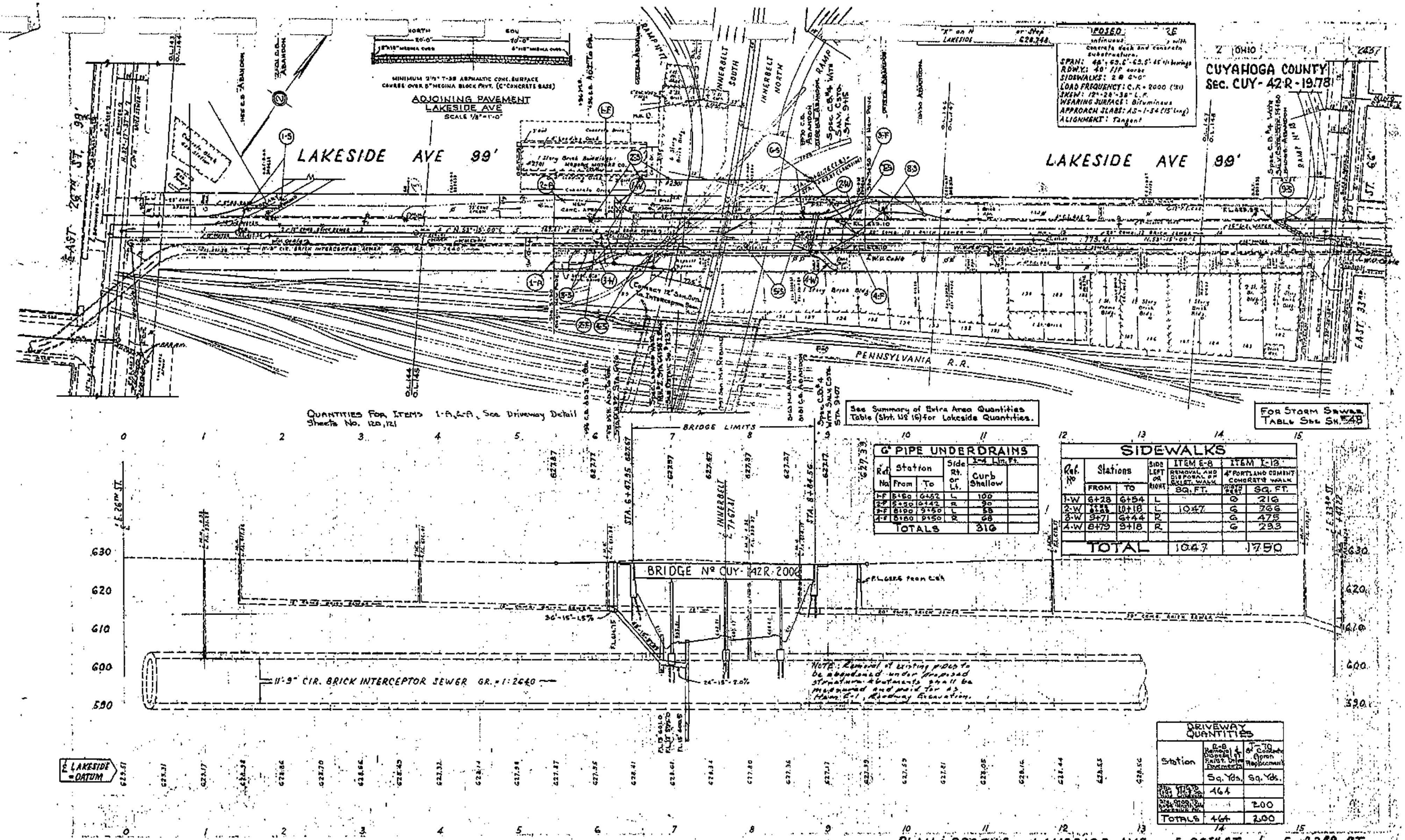
TYPE: Continuous steel beams with reinforced concrete substructure.
SPANS: 70.5'-70.55' c/c of bearings.
ROADWAY: 34'-0" F/F curbs.
SIDEWALKS: 2 @ 6'-0"
LOAD FREQUENCY: C.F. = 2000
SKEW: 15°-55'-00" Left Forward
WEARING SURFACE: Bituminous
APPROACH SLABS: AS-1-54 (25'0" Long)
ALIGNMENT: Tangent

SIDEWALKS

Ref. No	Station From	Station To	Side Left or Right	Item E-8 Removal & Disposal of Exist. Walk Sq. Ft.	Item I-13 4" Portland Cement Concrete Walk Width Type	Sq. Ft.
1-W	4+76	6+04	L		6	780
2-W	7+50	7+72	L		6	144
3-W	5+26	6+64	R	786	6	426
4-W	11+19	12+77	L-R	896		
5-W	6+98	8+48	R	792	6	502
6-W	9+28	10+25	R	486	6	486
TOTAL				2960		2338

Excavation	298 Cu. Yds.
Embankment	123 Cu. Yds.
Emb. + 22%	150 Cu. Yds.

CL097055



Quantities For Items 1-A, 2-A, See Driveway Detail Sheets No. 120, 121

See Summary of Extra Area Quantities Table (Sht. No 16) for Lakeside Quantities.

For Storm Sewer Table See Sh. 48

6" PIPE UNDERDRAINS					
Ref. No.	Station From	Station To	Side Rt. or Lt.	I-4 Lin. Ft. Curb Shallow	
1-F	5+60	6+52	L	100	
2-F	5+50	6+42	R	90	
3-F	8+90	9+50	L	58	
4-F	8+80	9+50	R	68	
TOTALS				316	

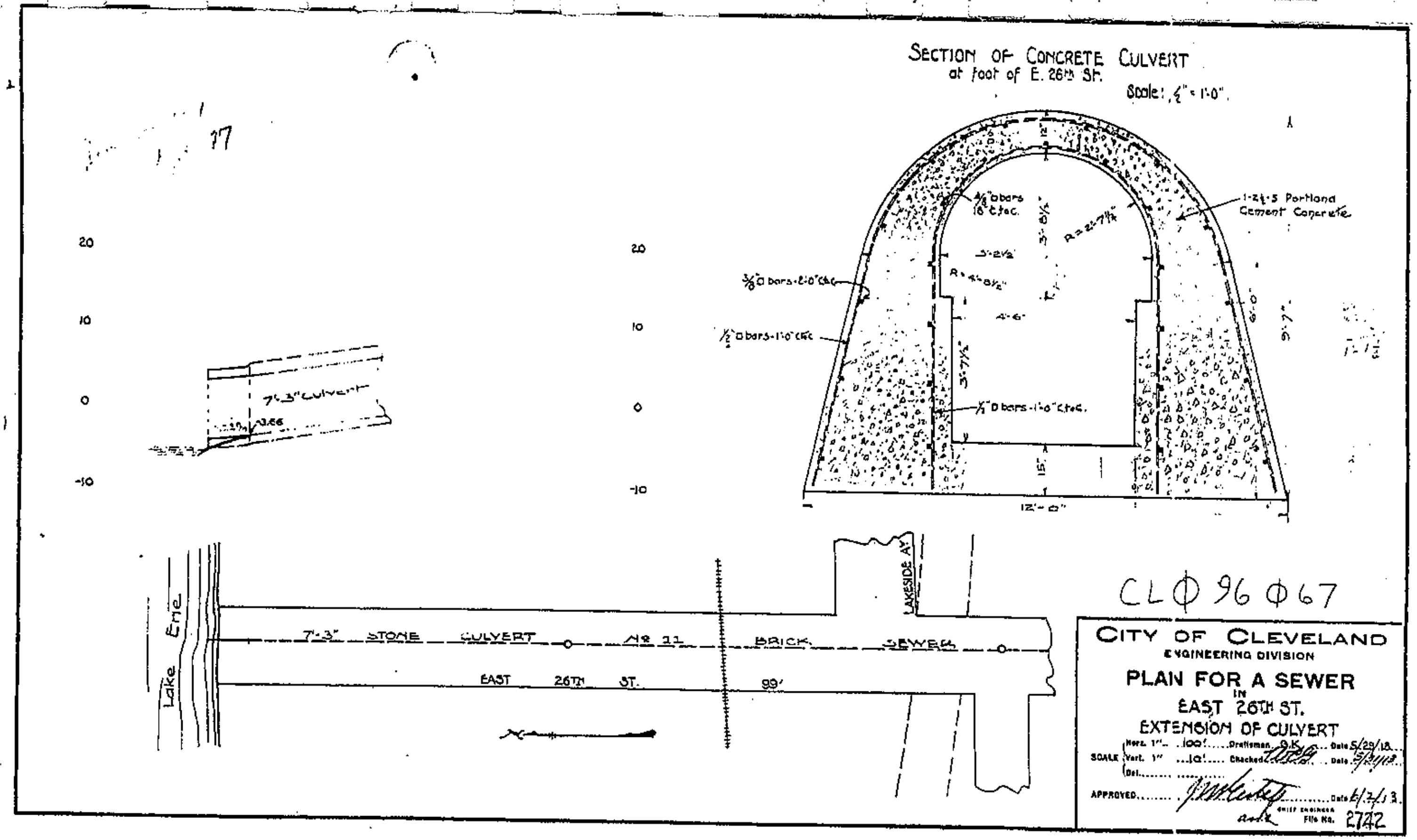
SIDEWALKS						
Ref. No	Stations FROM	Stations TO	Side Left or Right	ITEM E-8 Removal and Disposal of Exist. Walk SQ. FT.	ITEM I-13 4" Portland Cement Concrete Walk Width Feet	ITEM I-13 4" Portland Cement Concrete Walk SQ. FT.
1-W	6+28	6+54	L		6	216
2-W	[illegible]	10+18	L	1047	6	766
3-W	9+71	6+44	R		6	475
4-W	8+79	9+18	R		6	293
TOTAL				1047		1750

DRIVEWAY QUANTITIES		
Station	E-8 Removal & Disposal of Exist. Drive Pavements Sq. Yds.	I-70 6" Concrete Apron Replacement Sq. Yds.
[illegible]	464	
[illegible]		200
TOTALS	464	200

PLAN & PROFILE ·· LAKESIDE AVE ·· E. 26TH ST. to E. 33RD ST.

CL097065

Regulator E-12, and CSO-096



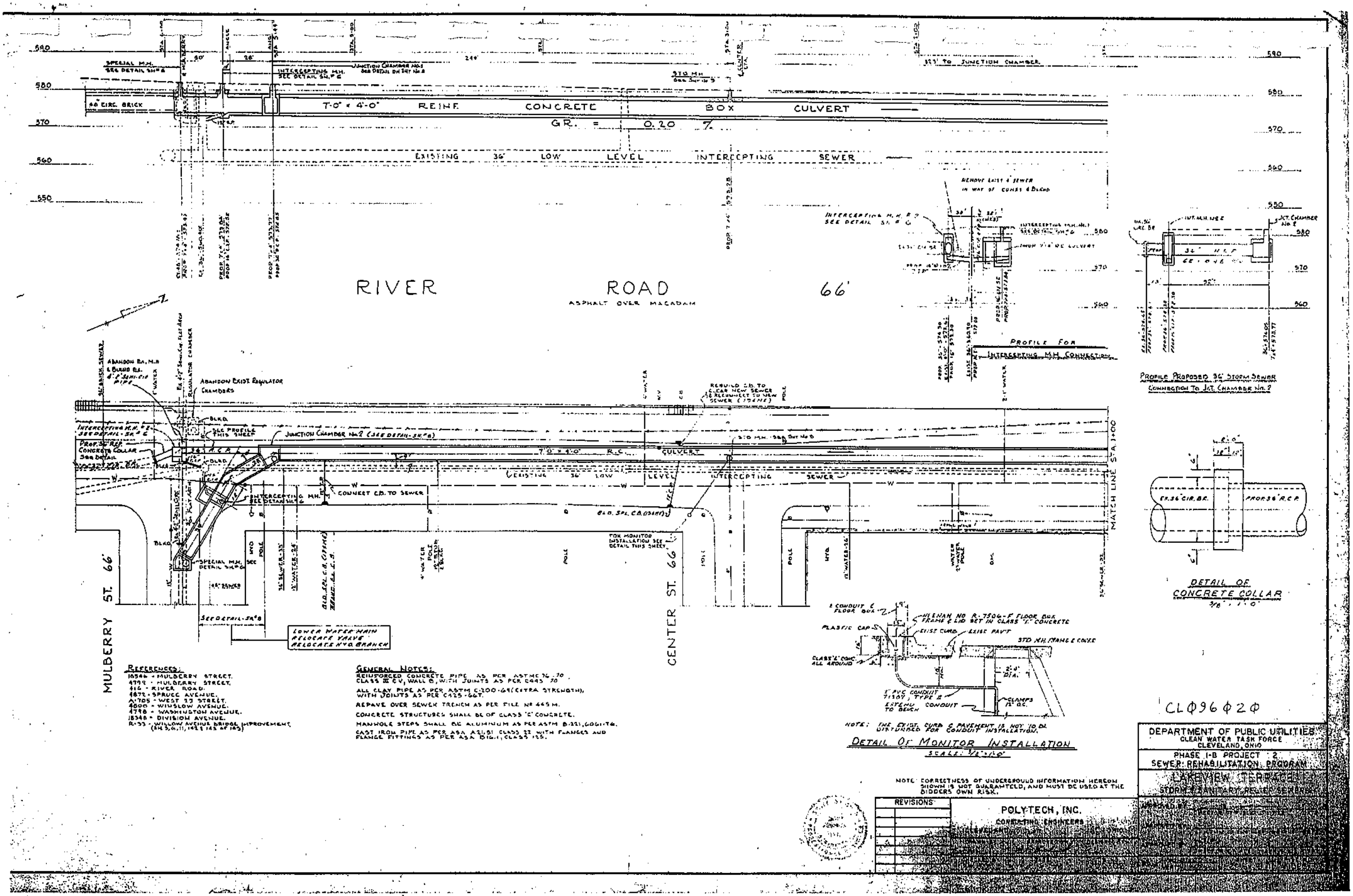
CL 096067

CITY OF CLEVELAND
ENGINEERING DIVISION

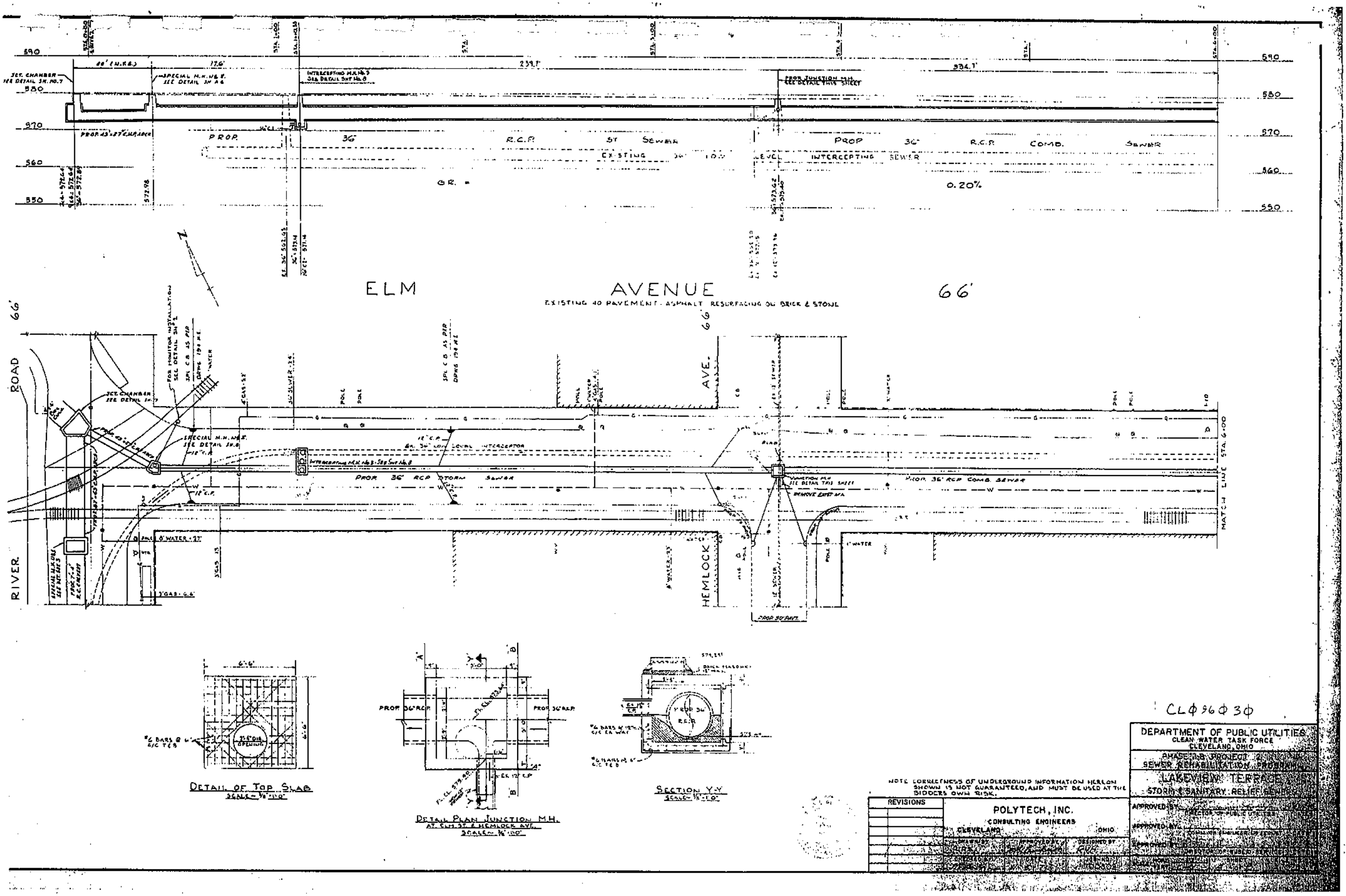
PLAN FOR A SEWER
IN
EAST 26TH ST.
EXTENSION OF CULVERT

SCALE Horz. 1" = 100'. Draftsman G.K. Date 5/29/13.
Vert. 1" = 10'. Checked ... Date 5/31/13.
Det. ...

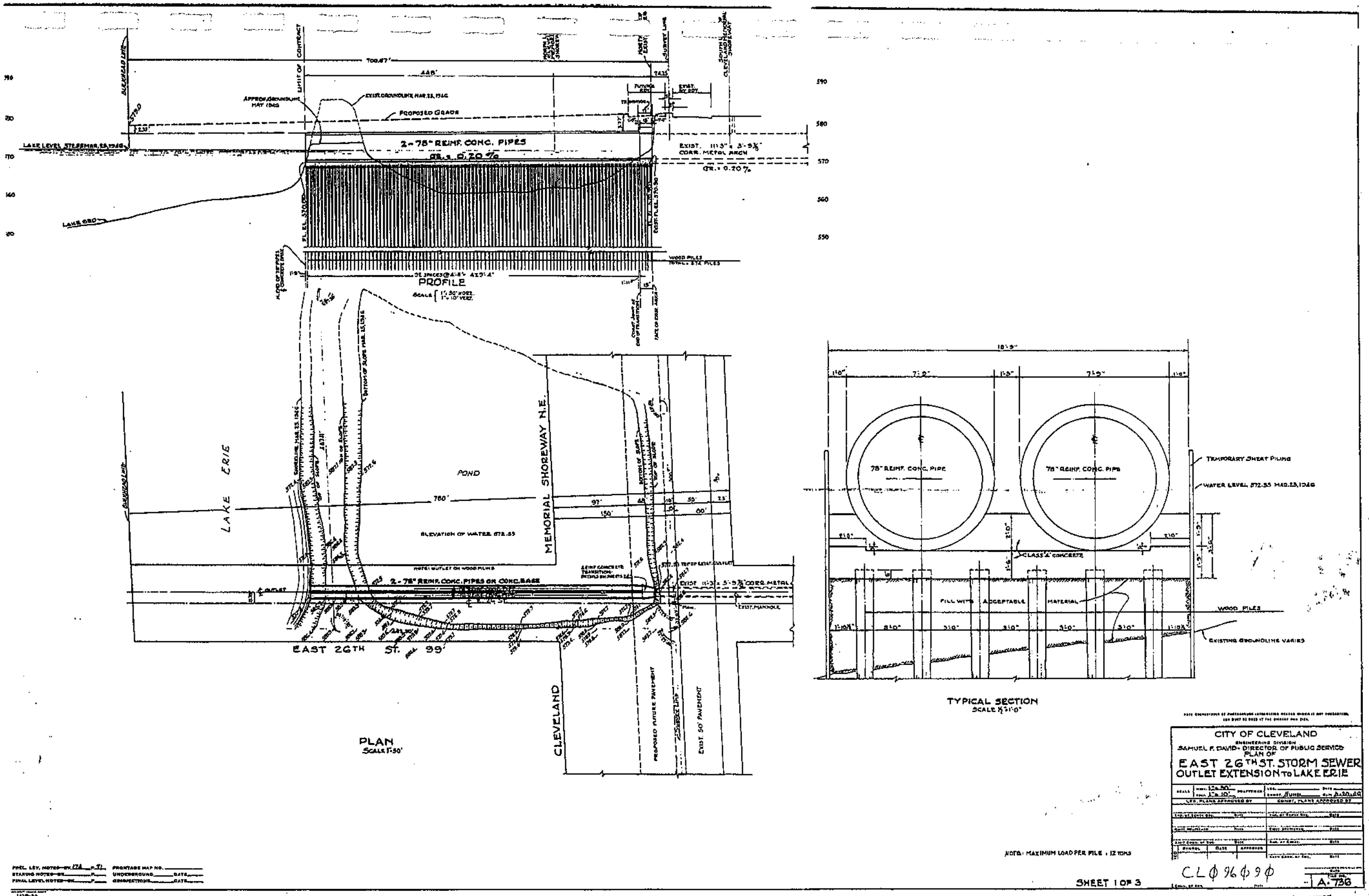
APPROVED ... Date 6/7/13.
CHIEF ENGINEER
File No. 2742

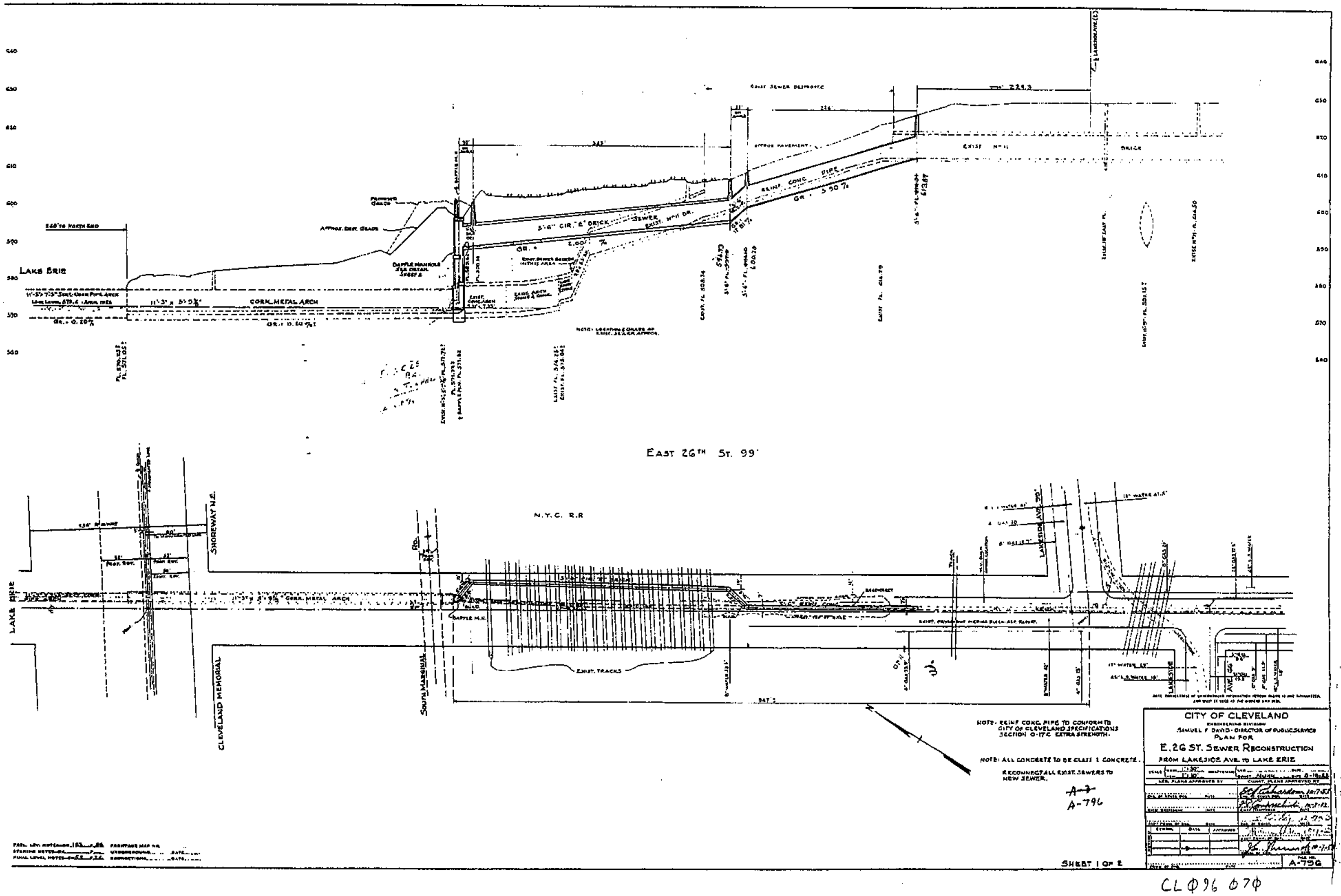


7'-0" x 4'-0" REINF. CONCRETE BOX CULVERT
GR. = 0.20 %
EXISTING 36" LOW LEVEL INTERCEPTING SEWER
RIVER ROAD 66'
ASPHALT OVER MACADAM
MULBERRY ST. 66'
CENTER ST. 66'
MATCH LINE STA. 1+00
JUNCTION CHAMBER No. 2 (SEE DETAIL-SH. 8)
INTERCEPTING MH.
CONNECT C.B. TO SEWER
ABANDON EXIST. REGULATOR CHAMBERS
LOWER WATER MAIN
RELOCATE VALVE
RELOCATE HYD. BRANCH
PROFILE FOR INTERCEPTING M.H. CONNECTION
PROFILE PROPOSED 36" STORM SEWER CONNECTION TO JCT. CHAMBER No. 2
DETAIL OF CONCRETE COLLAR
DETAIL OF MONITOR INSTALLATION
NOTE: THE EXIST. CURB & PAVEMENT IS NOT TO BE DISTURBED FOR CONDUIT INSTALLATION.
REFERENCES:
16546 - MULBERRY STREET.
4792 - MULBERRY STREET.
416 - RIVER ROAD.
4872 - SPRUCE AVENUE.
A-705 - WEST 33 STREET.
4800 - WINSLOW AVENUE.
4798 - WASHINGTON AVENUE.
18348 - DIVISION AVENUE.
R-33 - WILLOW AVENUE BRIDGE IMPROVEMENT (SH 5,6,11,142 & 143 OF 145)
GENERAL NOTES:
REINFORCED CONCRETE PIPE AS PER ASTM C76-70, CLASS III C.V., WALL B, WITH JOINTS AS PER C443-70
ALL CLAY PIPE AS PER ASTM C-200-69 (EXTRA STRENGTH), WITH JOINTS AS PER C425-66T.
REPAVE OVER SEWER TRENCH AS PER FILE No 445 M.
CONCRETE STRUCTURES SHALL BE OF CLASS "C" CONCRETE.
MANHOLE STEPS SHALL BE ALUMINUM AS PER ASTM B-221, 6061-T6.
CAST IRON PIPE AS PER ASA A21.51 CLASS 22 WITH FLANGES AND FLANGE FITTINGS AS PER ASA B16.1, CLASS 125.
NOTE: CORRECTNESS OF UNDERGROUND INFORMATION HEREON SHOWN IS NOT GUARANTEED, AND MUST BE USED AT THE BIDDERS OWN RISK.
CL096020
DEPARTMENT OF PUBLIC UTILITIES
CLEAN WATER TASK FORCE
CLEVELAND, OHIO
PHASE I-B PROJECT 2
SEWER REHABILITATION PROGRAM
LAKEVIEW TERRACE
STORM & SANITARY RELIEF SEWERS
REVISIONS
POLY-TECH, INC.
CONSULTING ENGINEERS



ELM AVENUE 66'
EXISTING 40 PAVEMENT - ASPHALT RESURFACING ON BRICK & STONE
HEMLOCK AVE. 66'
RIVER ROAD 66'
PROP. 36" R.C.P. ST SEWER
EXISTING
PROP 36" R.C.P. COMB. SEWER
INTERCEPTING SEWER
0.20%
GR.
SPECIAL M.H. No 8. SEE DETAIL SH. No 6
INTERCEPTING M.H. No 3 SEE DETAIL SHT No. 8
PROP JUNCTION M.H. SEE DETAIL THIS SHEET
PROP. 36" RCP STORM SEWER
PROP. 36" RCP COMB. SEWER
MATCH LINE STA. 6+00
POLE
PROP 30" PAVT.
6" WATER
Detail of Top Slab
Scale ⅜"=1'-0"
Detail Plan Junction M.H.
At Elm St. & Hemlock Ave.
Scale ⅜"=1'-0"
Section Y-Y
Scale ⅜"=1'-0"
CL Φ96Φ3Φ
NOTE CORRECTNESS OF UNDERGROUND INFORMATION HEREON SHOWN IS NOT GUARANTEED, AND MUST BE USED AT THE BIDDERS OWN RISK.
REVISIONS
POLYTECH, INC.
CONSULTING ENGINEERS
CLEVELAND OHIO
DEPARTMENT OF PUBLIC UTILITIES
CLEAN WATER TASK FORCE
CLEVELAND, OHIO
LAKEVIEW TERRACE

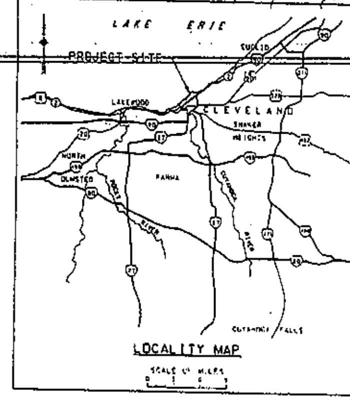

2-78" REINF. CONC. PIPES
GR. = 0.20 %
EXIST. 11'-3" x 5'-9⅜" CORR. METAL ARCH
GR. = 0.20 %
LIMIT OF CONTRACT
SURVEY LINE
BULKHEAD LINE
PROPOSED GRADE
EXIST. GROUNDLINE MAR. 25, 1946
APPROX. GROUNDLINE MAY 1940
LAKE LEVEL 572.55 MAR. 25, 1946
LAKE BED
WOOD PILES
PROFILE
LAKE ERIE
POND
ELEVATION OF WATER 572.55
MEMORIAL SHOREWAY N.E.
2-78" REINF. CONC. PIPES ON CONC. BASE
EAST 26TH ST. 99'
CLEVELAND
PROPOSED FUTURE PAVEMENT
EXIST. 50' PAVEMENT
EXIST. MANHOLE
PLAN
SCALE 1"=50'
78" REINF. CONC. PIPE
78" REINF. CONC. PIPE
TEMPORARY SHEET PILING
WATER LEVEL 572.55 MAR. 25, 1946
CLASS "A" CONCRETE
FILL WITH ACCEPTABLE MATERIAL
WOOD PILES
EXISTING GROUNDLINE VARIES
TYPICAL SECTION
SCALE ½"=1'-0"
NOTE: MAXIMUM LOAD PER PILE : 12 TONS
CITY OF CLEVELAND
ENGINEERING DIVISION
SAMUEL P. DAVID - DIRECTOR OF PUBLIC SERVICE
PLAN OF
EAST 26TH ST. STORM SEWER
OUTLET EXTENSION TO LAKE ERIE
SHEET 1 OF 3
CL096090
A-736



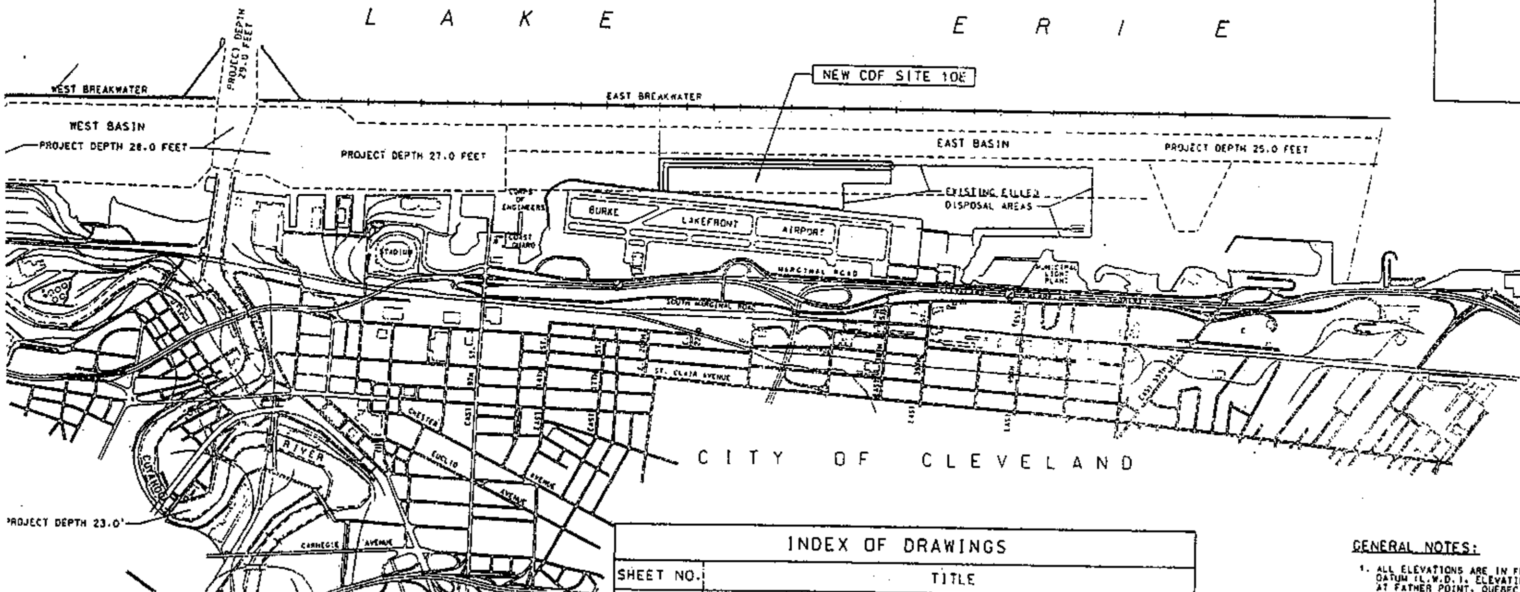
CITY OF CLEVELAND
ENGINEERING DIVISION
SAMUEL F DAVID · DIRECTOR OF PUBLIC SERVICE
PLAN FOR
E. 26 ST. SEWER RECONSTRUCTION
FROM LAKESIDE AVE. TO LAKE ERIE
A-796
SHEET 1 OF 2
NOTE: REINF. CONC. PIPE TO CONFORM TO CITY OF CLEVELAND SPECIFICATIONS SECTION O-17C EXTRA STRENGTH.
NOTE: ALL CONCRETE TO BE CLASS 1 CONCRETE.
RECONNECT ALL EXIST. SEWERS TO NEW SEWER.
A-796
EAST 26TH ST. 99'
LAKE ERIE
CORR. METAL ARCH
5'-6" CIR. 8" BRICK SEWER
REINF. CONC. PIPE
BAFFLE MANHOLE SEE DETAIL SHEET 2
APPROX. EXIST. GRADE
PROPOSED GRADE
APPROX. PAVEMENT
EXIST. SEWER DEPRESSED
N.Y.C. R.R.
EXIST. TRACKS
SHOREWAY N.E.
CLEVELAND MEMORIAL
SOUTH MARGINAL RD.
LAKESIDE AVE.

CL096 070

CLEVELAND HARBOR, OHIO
CONFINED DISPOSAL FACILITY
SITE 10B



LOCALITY MAP



GENERAL PLAN

SCALE: 1" = 1000'

1000' 0 1000' 2000'

ABBREVIATIONS

&	-	AND
@	-	AT
BLA	-	BURKE LAKEFRONT AIRPORT
B.M.	-	BENCHMARK
℄	-	BASELINE
℄	-	CENTERLINE
CL	-	CLEARANCE
CDF	-	CONFINED DISPOSAL FACILITY
CSP	-	CORRUGATED STEEL PIPE
CSPA	-	CORRUGATED STEEL PIPE ARCH
CSPSPA	-	CORRUGATED STRUCTURAL PLATE STEEL PIPE ARCH
DIA.	-	DIAMETER
EL.	-	ELEVATION
EW	-	EACH WAY
FAA	-	FEDERAL AVIATION ADMINISTRATION
GA	-	GAUGE
GALV.	-	GALVANIZED
H	-	HORIZONTAL
IGLD	-	INTERNATIONAL GREAT LAKES DATUM
INV.	-	INVERT
L.W.D.	-	LOW WATER DATUM
MAX.	-	MAXIMUM
MIN.	-	MINIMUM
O.C.	-	ON CENTER
PL	-	PLATE
P.O.L.	-	POINT ON LINE
R	-	RADIUS
ST.	-	STREET
STA.	-	STATION
TYP.	-	TYPICAL
V	-	VERTICAL
W.W.F.	-	WELDED WIRE FABRIC

INDEX OF DRAWINGS

SHEET NO.	TITLE
1	GENERAL PLAN
2	PLAN OF SUBSURFACE EXPLORATIONS AND SOUNDINGS
3	GEOLOGIC PROFILE A-A
4	GEOLOGIC PROFILES B-B, C-C, D-D AND E-E
5	GEOLOGIC PROFILE F-F AND GEOLOGIC SECTIONS G-G, H-H AND I-I
6	SITE PLAN
7	DIKE CROSS-SECTIONS
8	MARINE MATTRESS AND MISCELLANEOUS DETAILS
9	OVERFLOW WEIR FACILITY - SITE PLAN AND SECTIONS
10	OVERFLOW WEIR FACILITY - PLAN, SECTIONS AND DETAILS
11	OVERFLOW WEIR FACILITY - ELEVATIONS, SECTIONS AND DETAILS
12	EAST 33RD STREET SEWER EXTENSION
13	EAST 30TH STREET SEWER EXTENSION
14	EAST 26TH STREET SEWER EXTENSION
15	BURKE AIRPORT AND EAST 22ND STREET SEWER EXTENSIONS - PLAN, PROFILES AND DETAILS
16	BURKE AIRPORT AND EAST 22ND STREET SEWER EXTENSIONS - TRENCH AND MANHOLE SECTIONS AND DETAILS
17	EAST 20TH STREET SEWER EXTENSION
18	LIMITS OF WORK AND SURVEY CONTROL
19	SETTLEMENT PLATES - PLANS AND SECTIONS
20	CONSTRUCTION SAFETY/PHASING PLAN

GENERAL NOTES:

1. ALL ELEVATIONS ARE IN FEET AND ARE REFERRED TO LOW WATER DATUM (L.W.D.), ELEVATION 568.6 FEET ABOVE MEAN WATER LEVEL AT FATHER POINT, QUEBEC (IGLD 1955).
2. ELEVATIONS ABOVE L.W.D. ARE PRECEDED BY A PLUS SIGN (E.G. +6.0'). DEPTHS BELOW L.W.D. ARE PRECEDED BY A MINUS SIGN OR WITHOUT ANY SIGN (E.G. -8.0' OR 8.0').
3. LAND ACCESS TO THE PROJECT SITE IS THROUGH BURKE LAKEFRONT AIRPORT (BLA) PROPERTY. THE CONTRACTOR SHALL ENTER AND LEAVE THE PROPERTY THROUGH THE GATE AT FAR EAST END. THE ACCESS ROUTE SHOWN ON SHEET 18 IS APPROXIMATE AND SUBJECT TO CHANGE BY THE BLA. UNLESS SPECIFICALLY REQUIRED BY THIS CONTRACT, ALL BLA PROPERTY DISTURBED BY THE CONTRACTOR SHALL BE RETURNED TO ITS PRECONSTRUCTION CONDITION BY THE CONTRACTOR TO THE SATISFACTION OF THE CONTRACTING OFFICER.
4. DESCRIPTIONS OF HORIZONTAL AND VERTICAL SURVEY CONTROL ARE PROVIDED ON SHEET 18.
5. ACTUAL WATER SURFACE ELEVATIONS WILL VARY AND WILL LIKELY BE SEVERAL FEET HIGHER THAN THE 0.0 L.W.D. WATER SURFACE SHOWN ON THE VARIOUS CROSS-SECTIONS. SEE "PHYSICAL DATA" SPECIAL CONTRACT REQUIREMENT IN THE SPECIFICATIONS FOR FURTHER INFORMATION REGARDING WATER SURFACES.
6. THESE CONTRACT DRAWINGS GENERALLY SHOW THE CONSTRUCTION DETAILS REQUIRED FOR THE RUBBLEMOUND STONE ALTERNATIVE. IF THE MARINE MATTRESS ALTERNATIVE IS SELECTED, THE CONTRACTOR WILL BE REQUIRED TO PROVIDE ANY ADDITIONAL CONSTRUCTION DRAWINGS AS DIRECTED BY THE CONTRACTING OFFICER.

SAFETY PAYS

FILE: /proj/clv/dike10b/sheet1.dgn
DATE: 14-Mar-96 11:53

SYMBOL	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207-3199

CLEVELAND HARBOR, OHIO
CONFINED DISPOSAL FACILITY, SITE 10B

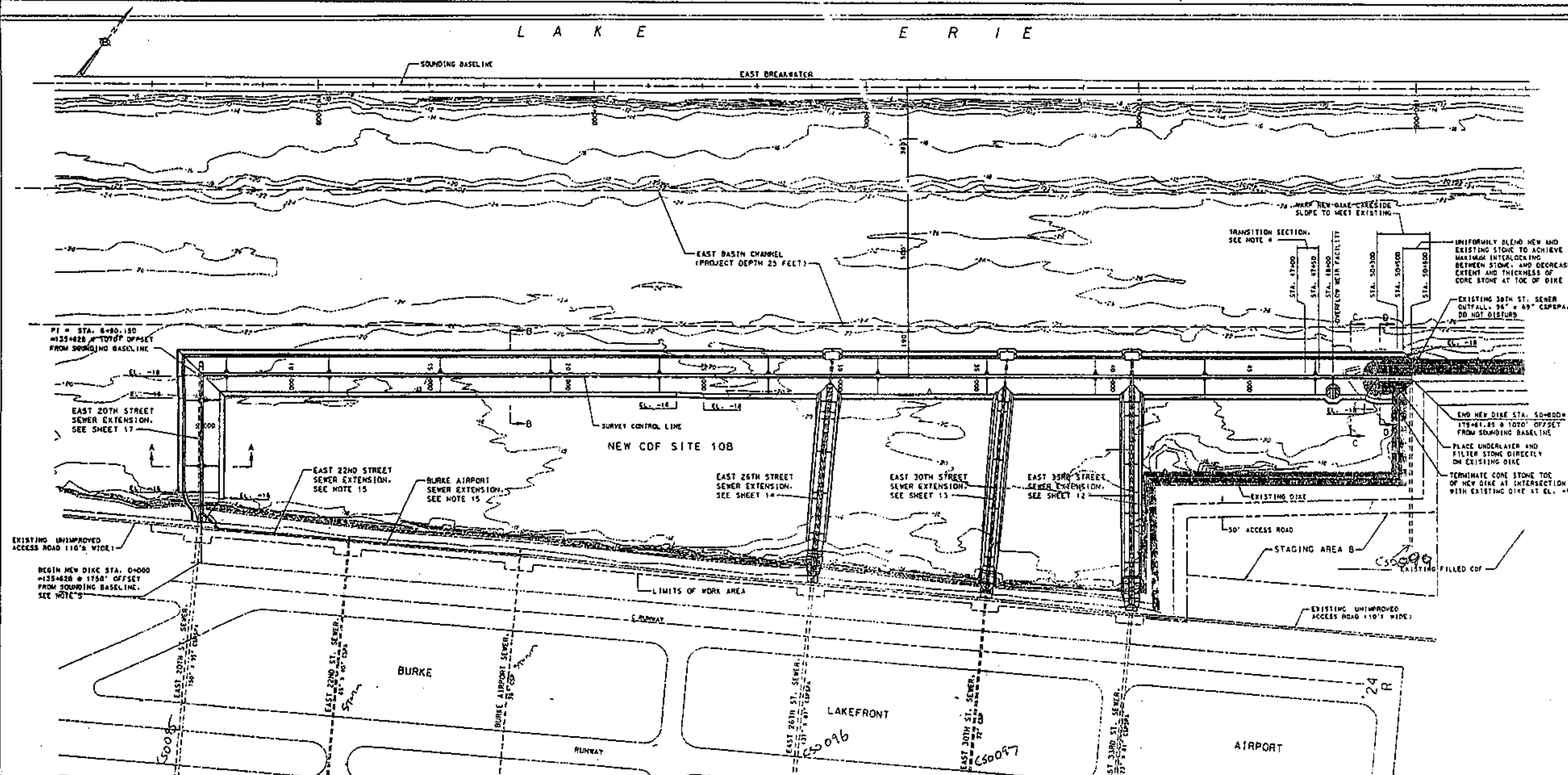
GENERAL PLAN

SCALE: AS SHOWN

TO ACCOMPANY SPECIFICATIONS SERIAL NO. DACW 49-96-B-0002

DRAWING NUMBER 96-CLV-1/1
SHEET 1 OF 20

CL095100



SITE PLAN

SCALE: 1" = 150'

150' 0 150' 300'

NOTES:

1. FOR GENERAL NOTES, SEE SHEET 1.
2. ALL DEBRIS AND VEGETATION SHALL BE REMOVED FROM THE EXISTING DIKE IN AREAS WHERE THE DIKE OVERLAPS WITH THE EAST END OF THE NEW DIKE. THIS MATERIAL SHALL BE BURIED WITHIN THE LIMITS OF STAGING AREA A. SEE NOTE 3 ON SHEET 18.
3. EXCESS EXCAVATED MATERIAL FROM ON SHORE SEWERLINE CONSTRUCTION SHALL BE PLACED ALONG THE LANDWARD SIDE OF THE EXISTING DIKE IN THE VICINITY OF STAGING AREA B. THE MATERIAL SHALL BE PLACED AND ROUGH GRADED AS DIRECTED BY THE CONTRACTING OFFICER.
4. IF THE MARINE MATTRESS ALTERNATIVE IS SELECTED BY THE CONTRACTOR, THE TYPICAL DIKE CROSS SECTION SHALL VARY UNIFORMLY FROM SECTION B-B TO SECTION C-C WITHIN THE LIMITS SHOWN.
5. THE CONTRACTOR SHALL ESTABLISH A PERMANENT SURVEY MONUMENT FLUSH WITH THE GROUND AT THIS LOCATION AND FURNISH VERTICAL AND HORIZONTAL CONTROL INFORMATION TO THE CONTRACTING OFFICER.
6. FOR TYPICAL DIKE SECTIONS, SEE SHEET 7.
7. FOR OVERFLOW WEIR FCILITY, SEE SHEETS 9, 10 AND 11.

SAFETY PAYS

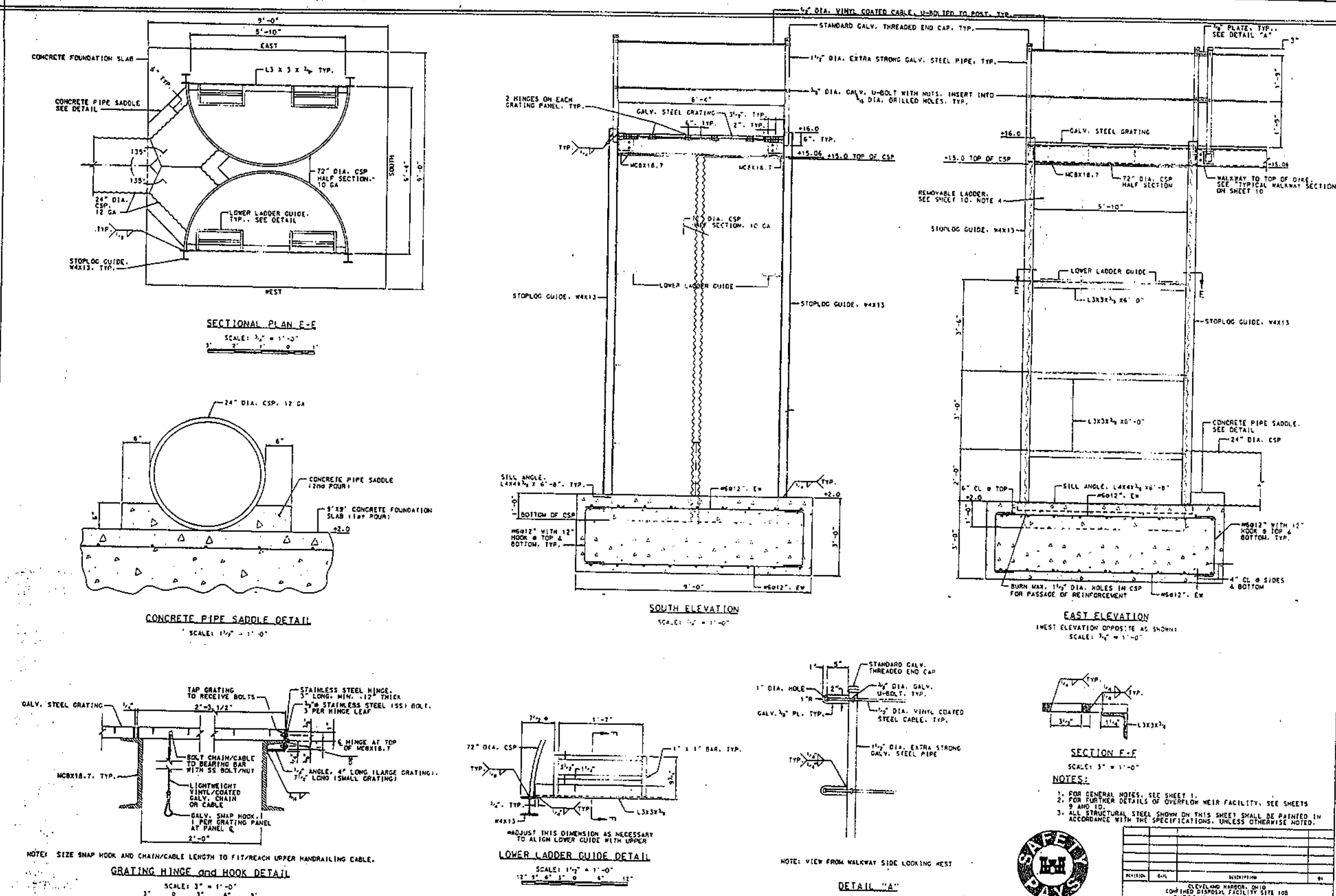
FILE: /proj1/civ/dike108/site.dgn
DATE: 16-Nov-98 17:56

REVISION	DATE	DESCRIPTION	BY

CLEVELAND HARBOR, OHIO
CONFINED DISPOSAL FACILITY SITE 108
SITE PLAN

DRAWN BY:	PJE	DRAWING NUMBER 96-CLV-1/6
DESIGNED BY:	JNE	
CHECKED BY:	FTL	SHEET 6 OF 19

CLΦ95125



NOTES:

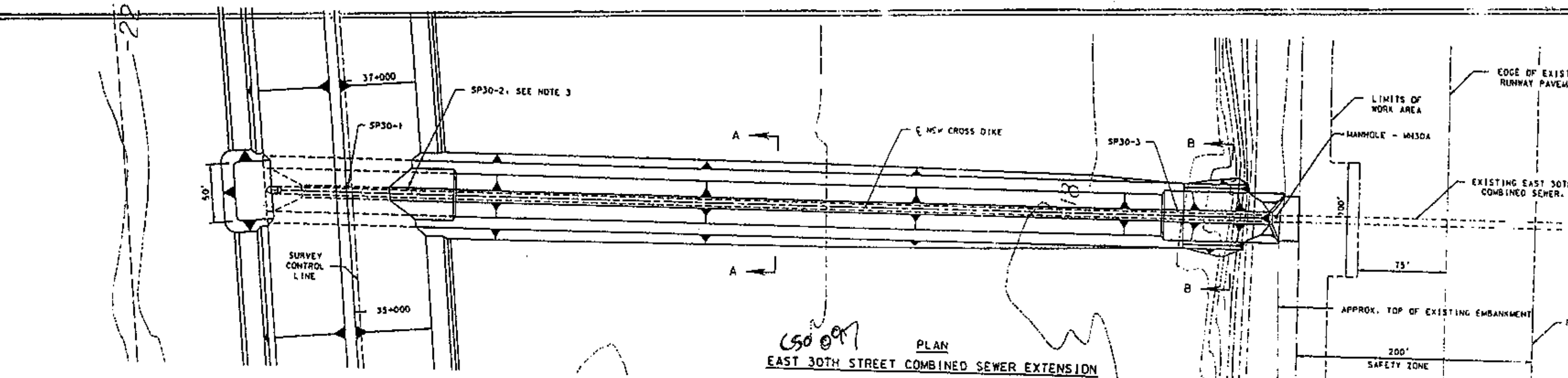
1. FOR GENERAL NOTES, SEE SHEET 1.
2. FOR FURTHER DETAILS OF OVERFLOW WEIR FACILITY, SEE SHEETS 9 AND 10.
3. ALL STRUCTURAL STEEL SHOWN ON THIS SHEET SHALL BE PAINTED IN ACCORDANCE WITH THE SPECIFICATIONS, UNLESS OTHERWISE NOTED.

REVISION	DATE	DESCRIPTION	BY

CLEVELAND HARBOR, OHIO
CONFINED DISPOSAL FACILITY SITE 10B
OVERFLOW WEIR FACILITY
ELEVATIONS, SECTIONS and DETAILS

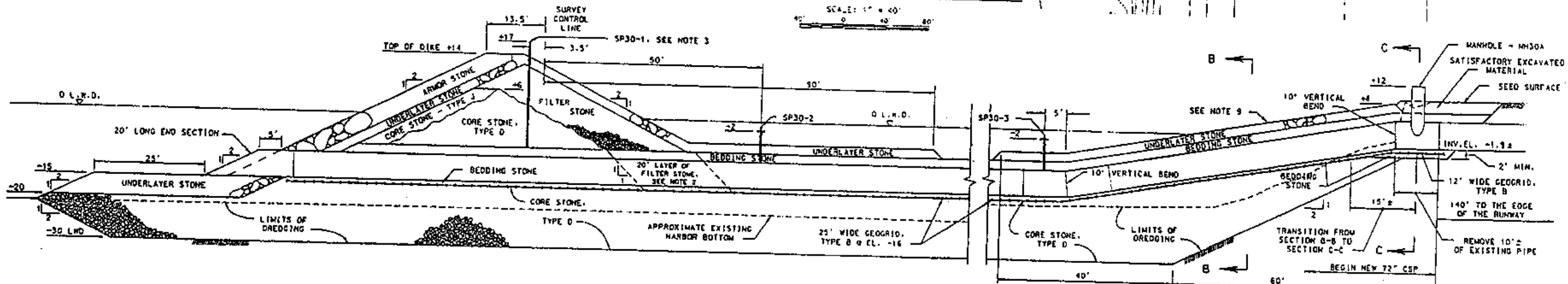
DRAWING NUMBER
96-CLV-1/11
SHEET 11 OF 20

CLΦ95150

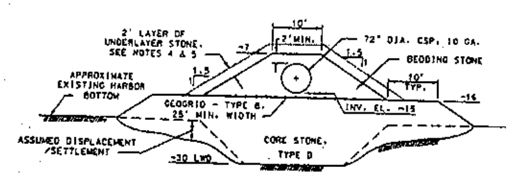


CS0 097

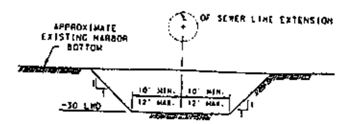
PLAN
EAST 30TH STREET COMBINED SEWER EXTENSION
SCALE: 1" = 40'



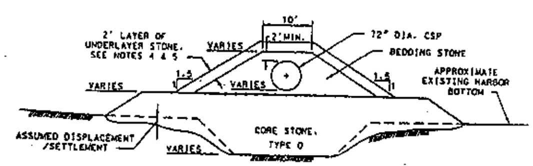
PROFILE ALONG 72" DIA. CMP CENTERLINE
SCALE: 1" = 10'



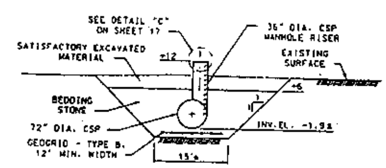
SECTION A-A
SCALE: 1" = 10'



TYPICAL DREDGING SECTION
SCALE: 1" = 10'



SECTION B-B
SCALE: 1" = 10'



SECTION C-C
SCALE: 1" = 10'

NOTES:

1. FOR GENERAL NOTES, SEE SHEET 1.
2. TYPICAL CROSS DIKE SECTION A-A SHALL EXTEND THROUGH THE MAIN DIKE SECTION EXCEPT AS NOTED ON CENTERLINE PROFILE.
3. FOR DETAILS OF SETTLEMENT PLATES SP30-1, SP30-2 AND SP30-3, SEE SHEET 19.
4. A MARINE MATTRESS MAY BE USED AS AN ALTERNATIVE TO THE UNDERLAYER STONE ON THE CROSS DIKES. SEE SHEET 8.
5. THE UNDERLAYER STONE/MARINE MATTRESS SHALL ONLY BE CONSTRUCTED WITHIN THE LIMITS SHOWN ON THE CENTERLINE PROFILE.
6. AREAS OF EXISTING BANK AND/OR HARBOR BOTTOM THAT HAVE BEEN EXPOSED BY CHANNEL DREDGING AND MANHOLE EXCAVATION SHALL BE PROTECTED WITH A 2 FOOT MINIMUM LAYER OF UNDERLAYER STONE.
7. THE LOCATIONS AND ELEVATIONS SHOWN FOR THE EXISTING SEWERLINE ARE APPROXIMATE. THE CONTRACTOR SHALL MAKE ADJUSTMENTS, AS NECESSARY, TO SUIT ACTUAL CONDITIONS.
8. FOR DETAILS OF CORRUGATED STEEL CONNECTING BANDS. SEE SHEET 6.
9. A 10 FOOT WIDE AREA ALONG TOP SURFACE OF UNDERLAYER STONE SHALL BE CHINKED WITH FILTER STONE BETWEEN LWD AND MANHOLE RISER.

SAFETY PAYS

FILE: /proj1/clv/dike10b/3.dgn
DATE: 18-Mar-96 15:46

REVISION	DATE	DESCRIPTION	BY

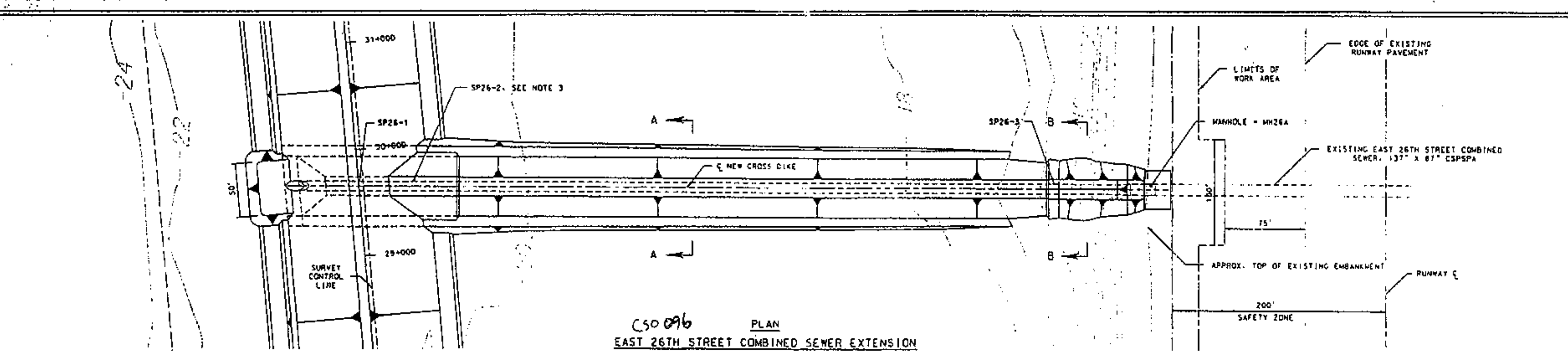
CLEVELAND HARBOR, OHIO
CONFINED DISPOSAL FACILITY SITE 10B
EAST 30TH STREET SEWER EXTENSION

DESIGNED BY: G.D.S.
DRAWN BY: J.N.E.
CHECKED BY: F.T.L.

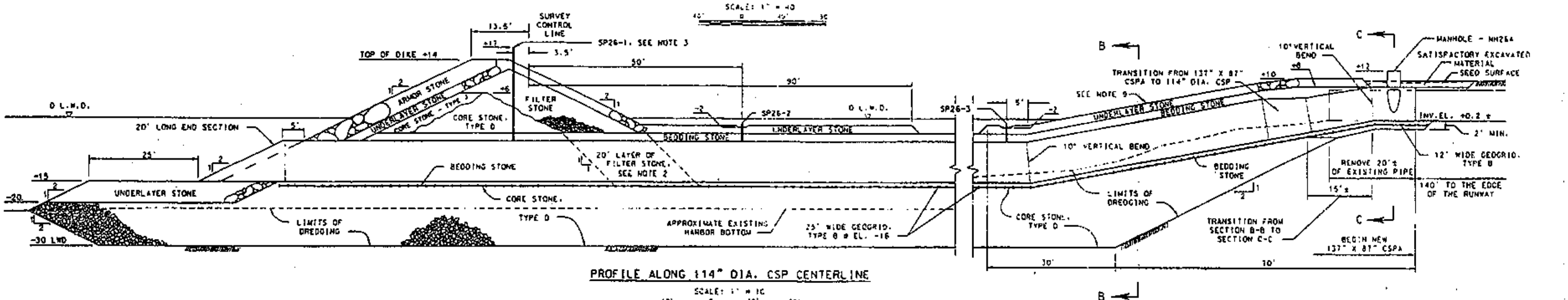
DRAWING NUMBER
96-CLV-1/13
SHEET 13 OF 20

CL095160

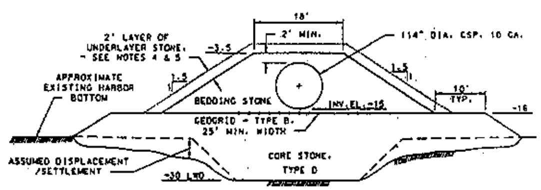
CS0096



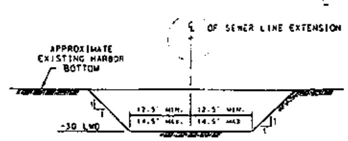
PLAN
EAST 26TH STREET COMBINED SEWER EXTENSION
SCALE: 1" = 40



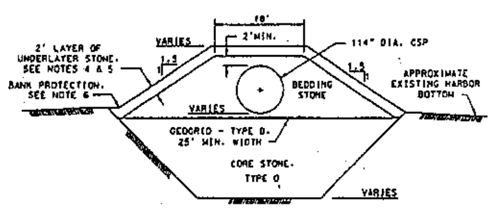
PROFILE ALONG 114" DIA. CSP CENTERLINE
SCALE: 1" = 10



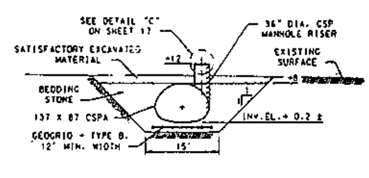
SECTION A-A
SCALE: 1" = 10'



TYPICAL DREDGING SECTION
SCALE: 1" = 10'



SECTION B-B
SCALE: 1" = 10'



SECTION C-C
SCALE: 1" = 10'

NOTES:

1. FOR GENERAL NOTES, SEE SHEET 1.
2. TYPICAL CROSS DIKE SECTION A-A SHALL EXTEND THROUGH THE MAIN DIKE SECTION EXCEPT AS NOTED ON CENTERLINE PROFILE.
3. FOR DETAILS OF SETTLEMENT PLATES SP26-1, SP26-2 AND SP26-3, SEE SHEET 19.
4. A MARINE MATTRESS MAY BE USED AS AN ALTERNATIVE TO THE UNDERLAYER STONE ON THE CROSS DIKES. SEE SHEET 8.
5. THE UNDERLAYER STONE/MARINE MATTRESS SHALL ONLY BE CONSTRUCTED WITHIN THE LIMITS SHOWN ON THE CENTERLINE PROFILE.
6. AREAS OF EXISTING BANK AND/OR HARBOR BOTTOM THAT HAVE BEEN EXPOSED BY CHANNEL DREDGING AND MANHOLE EXCAVATION SHALL BE PROTECTED WITH A 2 FOOT MINIMUM LAYER OF UNDERLAYER STONE.
7. THE LOCATIONS AND ELEVATIONS SHOWN FOR THE EXISTING SEWERLINE ARE APPROXIMATE. THE CONTRACTOR SHALL MAKE ADJUSTMENTS, AS NECESSARY, TO SUIT ACTUAL CONDITIONS.
8. FOR DETAILS OF CORRUGATED STEEL CONNECTING BANDS, SEE SHEET 8.
9. A 10 FOOT WIDE AREA ALONG TOP SURFACE OF UNDERLAYER STONE SHALL BE CHINKED WITH FILTER STONE BETWEEN LWD AND MANHOLE RISER.

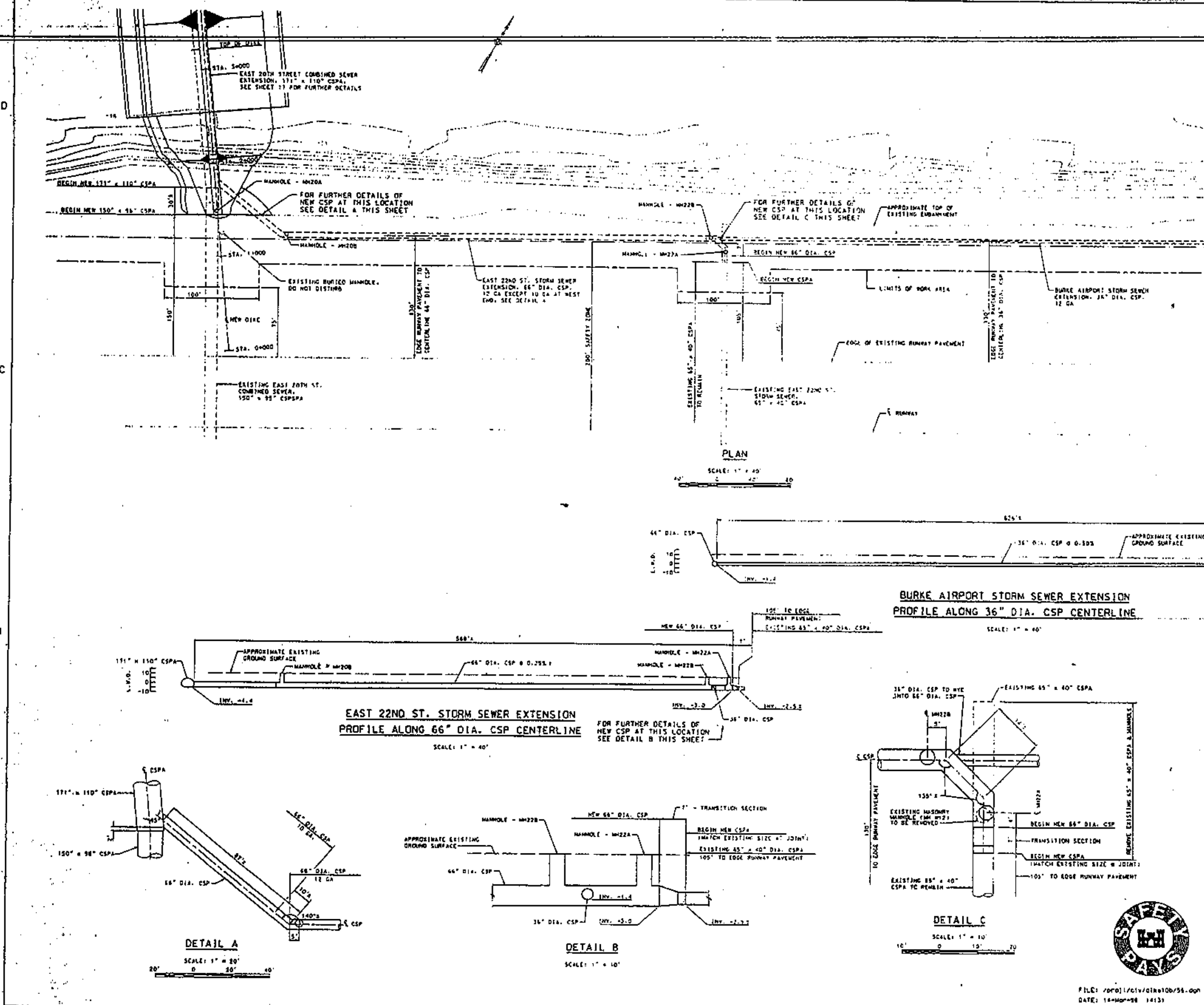
FILE: /proj1/clv/dike100/4.dgn
DATE: 15-Mar-96 07:51

REVISION	DATE	DESCRIPTION	BY

CLEVELAND HARBOR, OHIO
CONFINED DISPOSAL FACILITY SITE 100
EAST 26TH STREET SEWER EXTENSION

DRAWN BY: C.D.S.	DRAWING NUMBER 96-CLV-1/14
DESIGNED BY: J.N.E.	
CHECKED BY: F.F.L.	SHEET 14 OF 20

CL095165



NOTES:

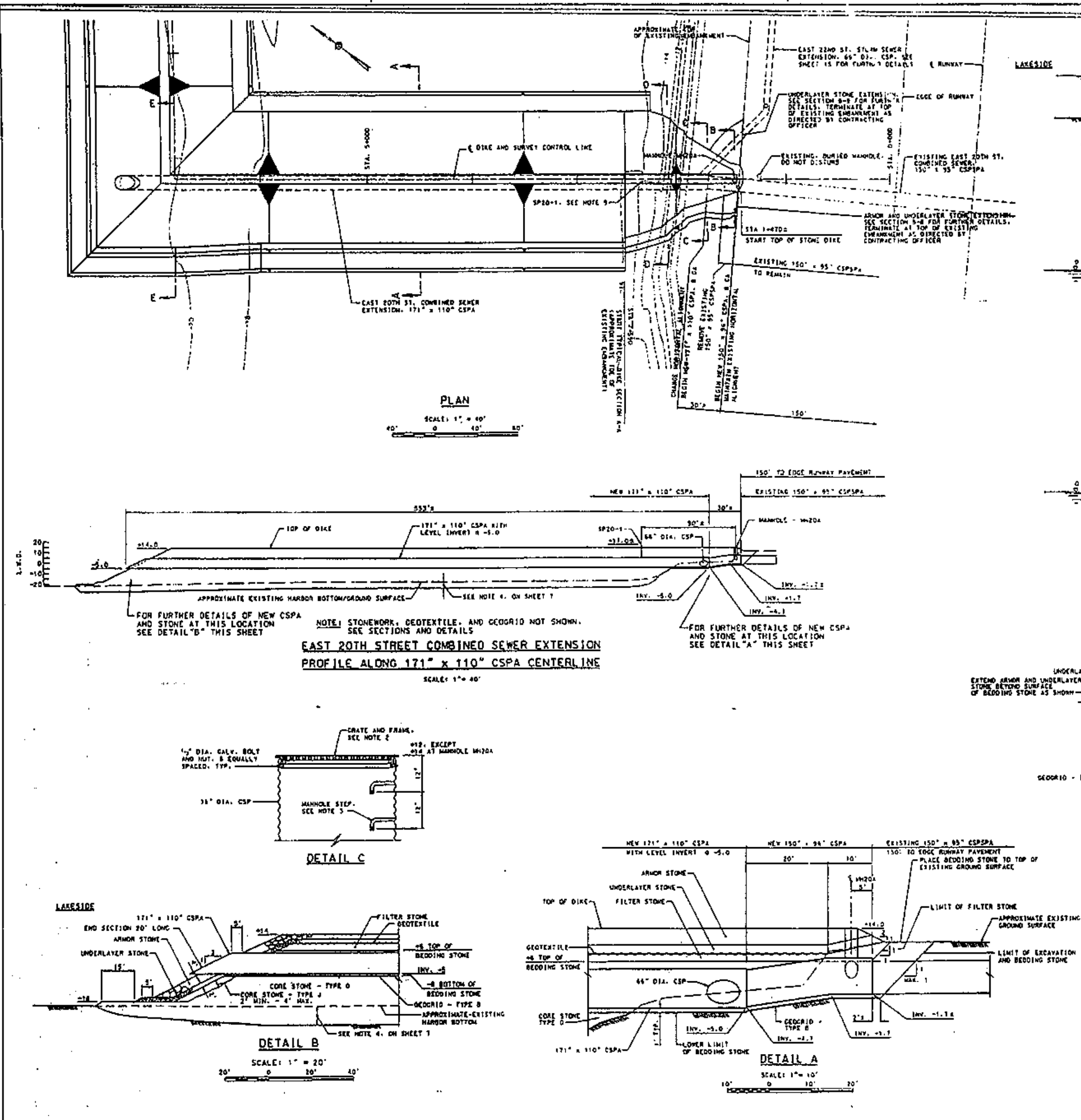
1. FOR GENERAL NOTES, SEE SHEET 1.
2. LOCATIONS AND ELEVATIONS SHOWN FOR EXISTING SEWERLINES ARE APPROXIMATE. CONTRACTOR SHALL MAKE ADJUSTMENTS AS NECESSARY TO SUIT ACTUAL CONDITIONS.
3. DISTANCES AND ANGLES SHOWN ON THIS SHEET WITH ± ARE APPROXIMATE. CONTRACTOR IS RESPONSIBLE FOR DETERMINING EXACT VALUES AS NECESSARY TO CONSTRUCT SEWERLINE EXTENSIONS AS SHOWN ON THIS SHEET.
4. FOR CSP, TRENCH, AND MANHOLE SECTIONS AND DETAILS, SEE SHEET 16.
5. FOR DETAILS OF CORRUGATED STEEL CONNECTING BANDS, SEE SHEET 4.

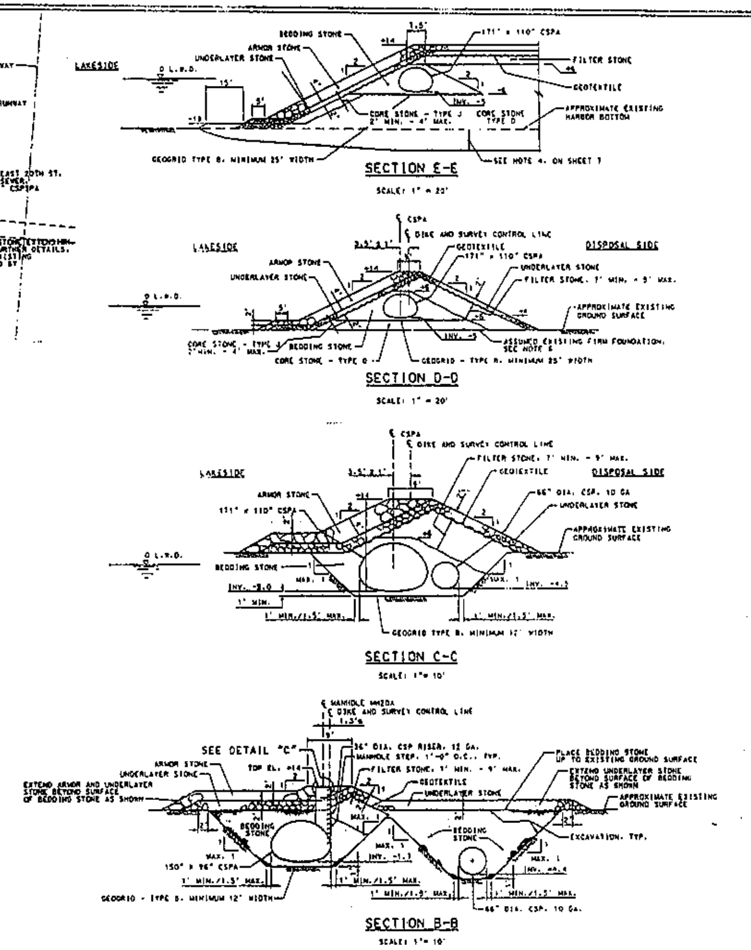
FILE: /projl/civ/clne10b/56.dgn

CLEVELAND HARBOR, OHIO
CONFINED DISPOSAL FACILITY SITE 10B
BURKE AIRPORT & E. 22ND ST. SEWER EXTENSIONS
PLAN, PROFILES & DETAILS

DRAWN BY	PJE	DRAWING NUMBER 96-CLV-1/15
DESIGNED BY	PJL	
CHECKED BY	JHE	SHEET 15 OF 20

CL005170





NOTES:

1. FOR GENERAL NOTES, SEE SHEET 1.
2. FRAME AND GRATE FOR MANHOLE MH20A, MH26A, MH30A, AND MH33A SHALL BE EQUAL TO FRAME AND GRATE, CATALOG NUMBER R-5901-H AS MANUFACTURED BY THE NEENAH FOUNDRY COMPANY OF NEENAH, WI.
3. MANHOLE STEPS SHALL BE IDENTICAL TO THOSE SPECIFIED FOR MANHOLES MH8A, MH22A AND MH22B. SEE SHEET 16 FOR DETAILS.
4. GEOGRID SHALL BE CENTERED UNDER CSPA.
5. ENTIRE LENGTHS FO NEW 150" X 96" CSPA AND 171" x 110" CSPA SHALL BE 8 GUAGE.
6. CONTRACTOR MAY BE DIRECTED BY CONTRACTING OFFICER TO EXTEND TYPICAL DIKE SECTION LANDWARD OF STA. 2+550 AND/OR PERFORM ADDITIONAL EXCAVATION UNDER DIKE IF POOR FOUNDATION CONDITIONS ARE ENCOUNTERED ALONG EXISTING EMBANKMENT.
7. LANDWARD OF STA. 2+000, GEOGRID SHALL HAVE MINIMUM 12' WIDTH. LAKEWARD OF STA. 2+000, GEOGRID SHALL HAVE MINIMUM 25' WIDTH.
8. FOR SECTION A-A (TYPICAL DIKE SECTION), SEE SHEET 7.
9. FOR DETAILS OF SETTLEMENT PLATE SP20-1, SEE SHEET 19.
10. FOR DETAILS OF CORRUGATED STEEL CONNECTING BANDS, SEE SHEET 8.

SAFETY PAYS

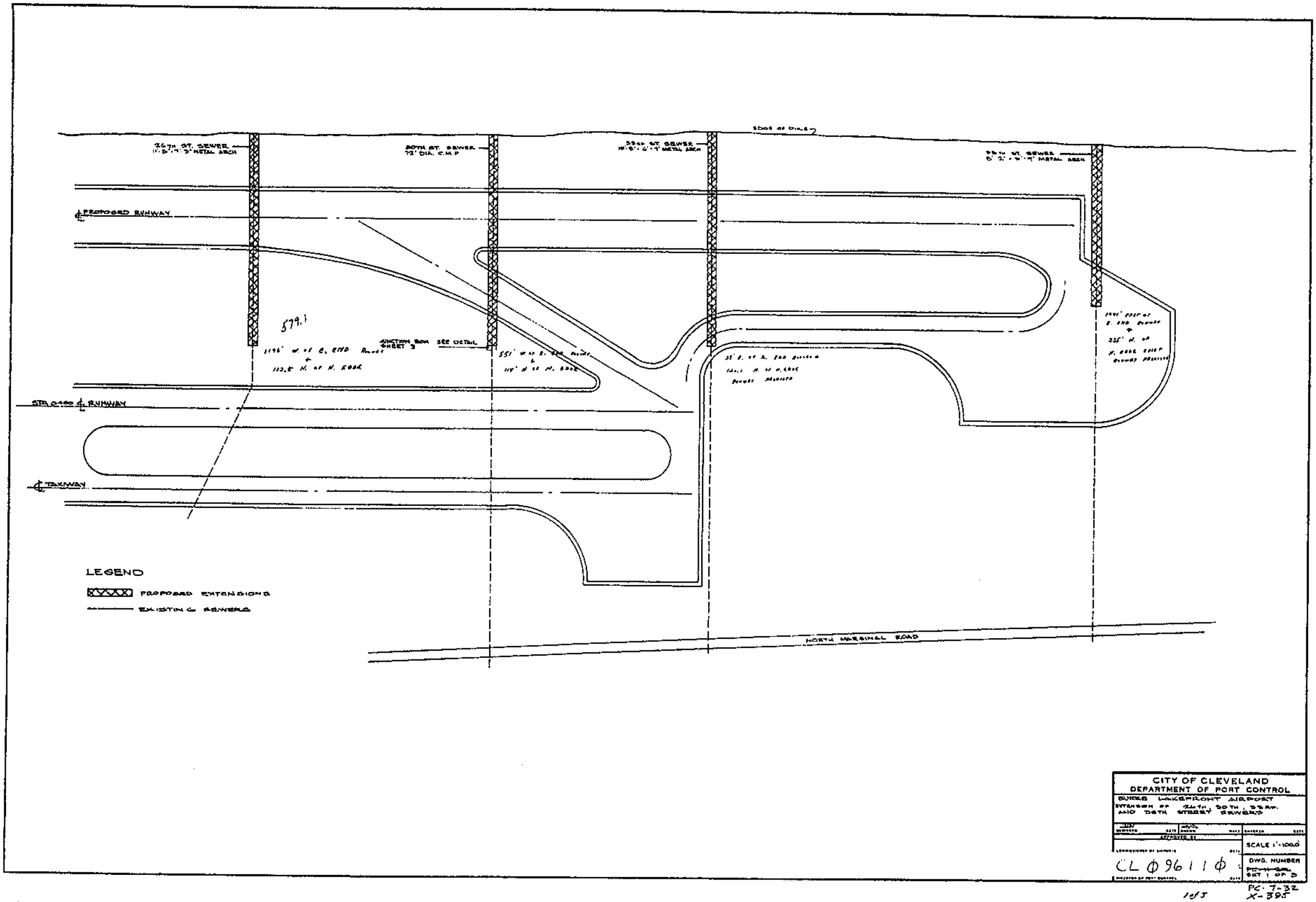
FILE: /proj1/clv/dike10b/7.dgn
DATE: 18-Mar-96 07:32

REVISION	DATE	DESCRIPTION	BY

CLEVELAND HARBOR, OHIO
CONFINED DISPOSAL FACILITY SITE 10B
EAST 20TH STREET SEWER EXTENSION

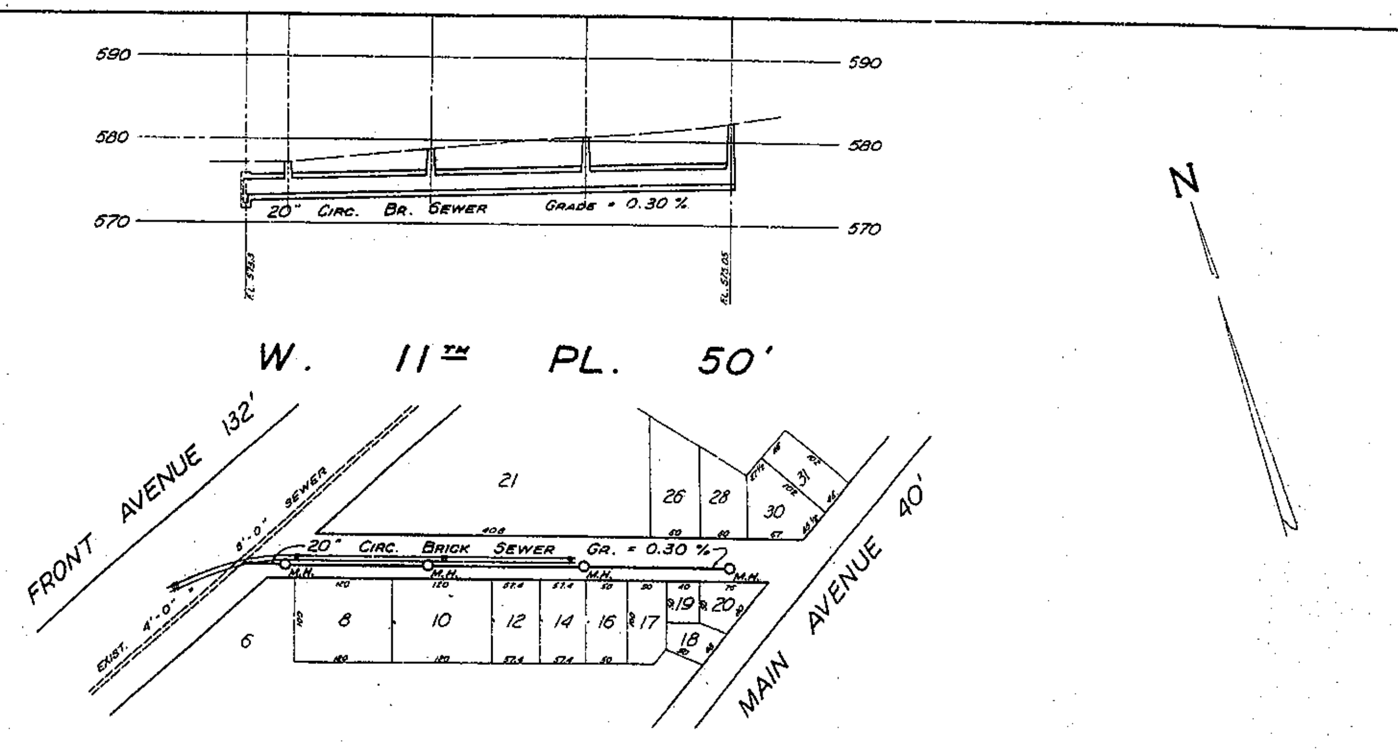
DRAWN BY	PJE	-	DRAWING NUMBER 96-CLV-1/17
DESIGNED BY	FTL		
CHECKED BY	JHE		SHEET 17 OF 20

1 CL095180



OUTFALL EXTENSIONS FOR 096, 097, 098, 099

Regulators E-25 and CSO-235



W. 11TH PL.

BETWEEN

FRONT AVE. & MAIN AVE.

CONSTRUCTED-1906

REDRAWN BY: W.J.YATES DATE: 5-7-69

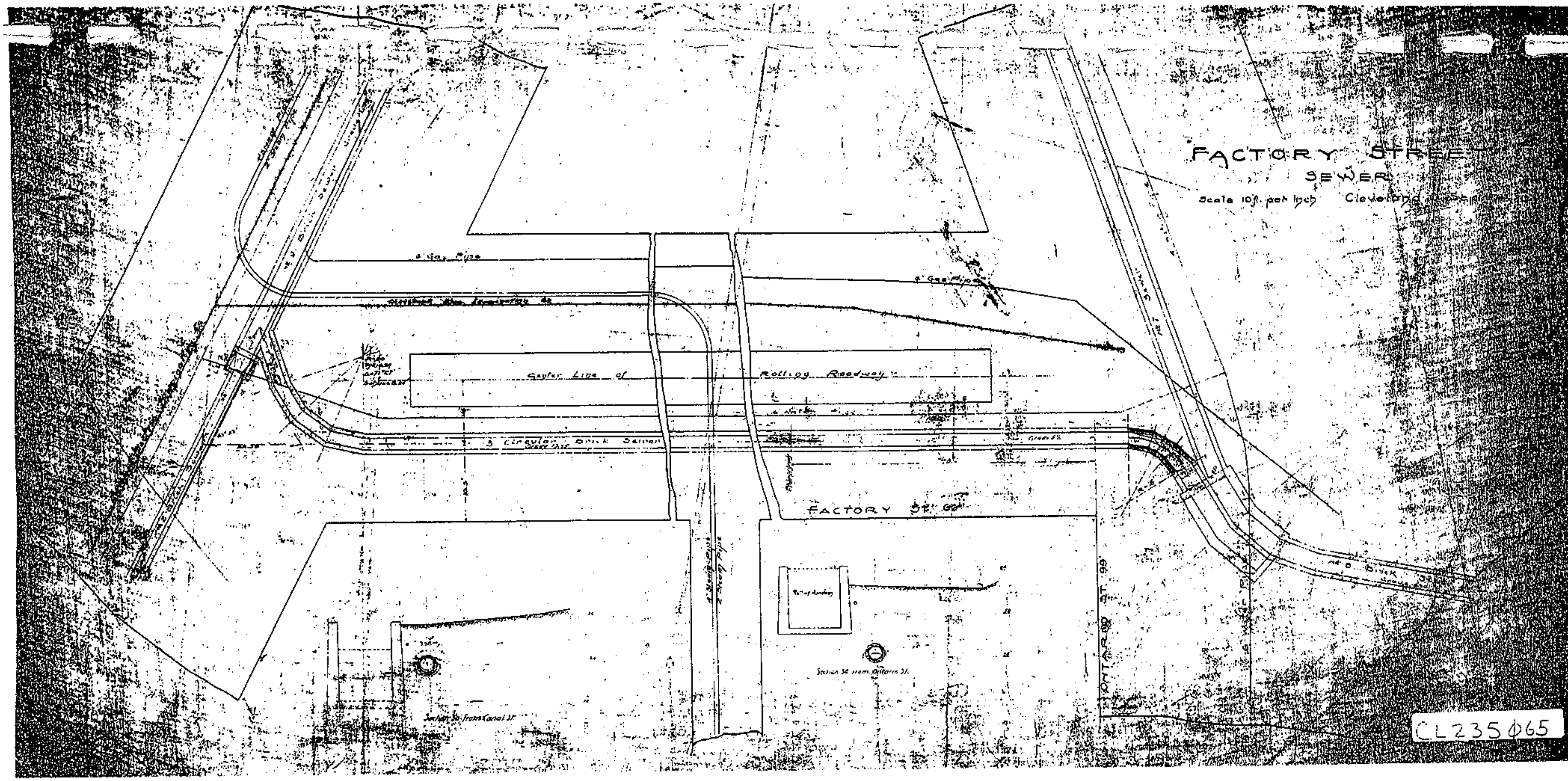
SCALE: 1" = 100'

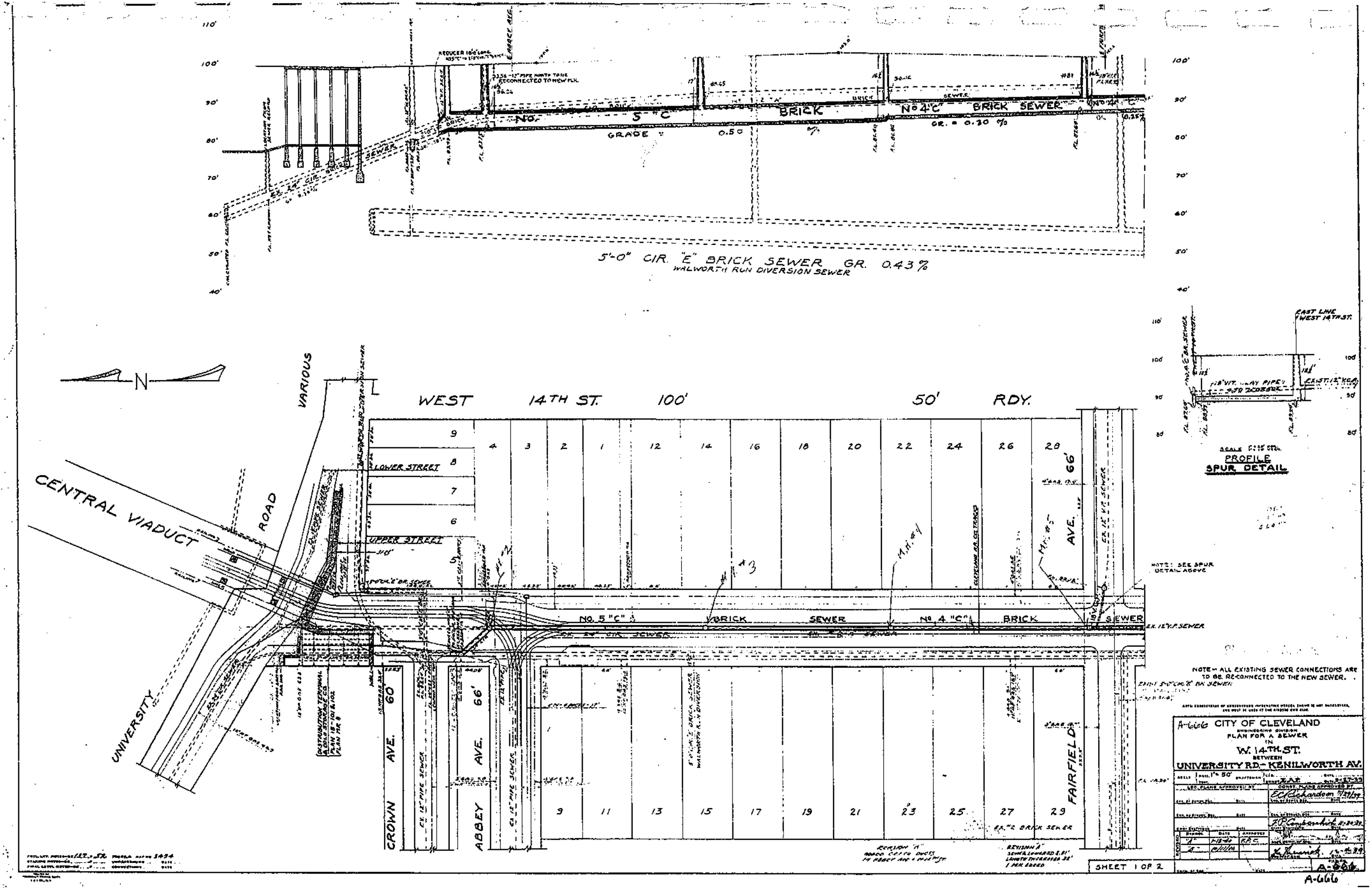
SEWER RECORD VOL. 1 PG. 160
SEWER RECORD VOL. 15 PG. 265
NO CURB RECORD
LEVEL NOTES VOL. 45 PG. 23

FILE Nº 1940

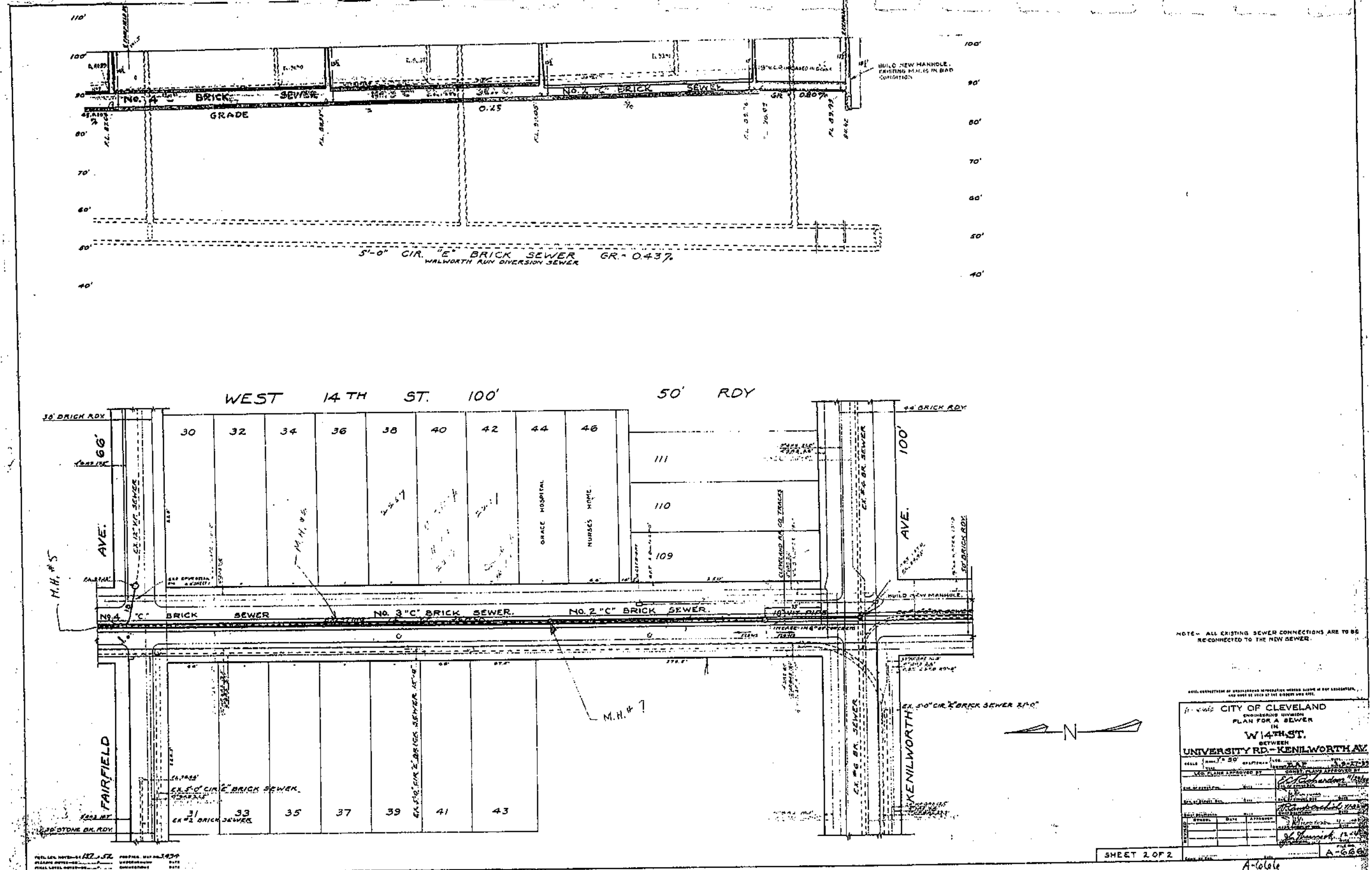
CL235ΦΦ5

CS0235


FACTORY STREET
SEWER
Scale 10 ft. per Inch Cleveland
Center Line of Rolling Roadway
Circular Brick Sewer
FACTORY ST.
ONTARIO ST.
Gas Pipe
CL235065



5'-0" CIR. "E" BRICK SEWER GR. 0.43%
WALWORTH RUN DIVERSION SEWER
No. 5 "C" BRICK
No 4 "C" BRICK SEWER
GR. = 0.20 %
GRADE
0.50
PROFILE
SPUR DETAIL
EAST LINE WEST 14TH ST.
NOTE: SEE SPUR DETAIL ABOVE
NOTE - ALL EXISTING SEWER CONNECTIONS ARE TO BE RE-CONNECTED TO THE NEW SEWER.
WEST 14TH ST. 100' 50' RDY.
VARIOUS
LOWER STREET
UPPER STREET
CENTRAL VIADUCT
ROAD
UNIVERSITY
No. 5 "C" BRICK SEWER No 4 "C" BRICK SEWER
CROWN AVE. 60
ABBEY AVE. 66'
FAIRFIELD AVE. 66'
EX. 12" PIPE SEWER
DISTRIBUTION TERMINAL & COLD STORAGE CO.
A-666 CITY OF CLEVELAND
ENGINEERING DIVISION
PLAN FOR A SEWER
IN
W. 14TH ST.
BETWEEN
UNIVERSITY RD. - KENILWORTH AV.
SHEET 1 OF 2
A-666



No. 4 "C" BRICK SEWER
No. 2 "C" BRICK SEWER
GRADE
0.25
GR. 0.807%
BUILD NEW MANHOLE. EXISTING M.H. IS IN BAD CONDITION
5'-0" CIR. "E" BRICK SEWER GR. 0.437%
WALWORTH RUN DIVERSION SEWER
110'
100'
90'
80'
70'
60'
50'
40'
WEST 14TH ST. 100'
50' RDY
30' BRICK RDY.
66'
AVE.
FAIRFIELD
30' STONE BR. RDY.
EX. 12" V.P. SEWER
M.H. #5
M.H. #6
M.H. #7
No. 4 "C" BRICK SEWER
No. 3 "C" BRICK SEWER.
No. 2 "C" BRICK SEWER.
BUILD NEW MANHOLE.
30 32 34 36 38 40 42 44 46
111
110
109
GRACE HOSPITAL
NURSES HOME
CLEVELAND RR. CO. TRACKS
31 33 35 37 39 41 43
EX. 5'-0" CIR. "E" BRICK SEWER.
EX. #2 BRICK SEWER
EX. 5'-0" CIR. "E" BRICK SEWER 15'-0"
EX. #6 BR. SEWER
EX. #4 BR. SEWER
44' BRICK RDY.
100'
AVE.
50' BRICK RDY.
KENILWORTH
EX. 5'-0" CIR. "E" BRICK SEWER 21'-0"
N
NOTE — ALL EXISTING SEWER CONNECTIONS ARE TO BE RE-CONNECTED TO THE NEW SEWER.
CITY OF CLEVELAND
ENGINEERING DIVISION
PLAN FOR A SEWER
IN
W 14TH ST.
BETWEEN
UNIVERSITY RD.-KENILWORTH AV.
SHEET 2 OF 2
A-666

Regulator WR-27

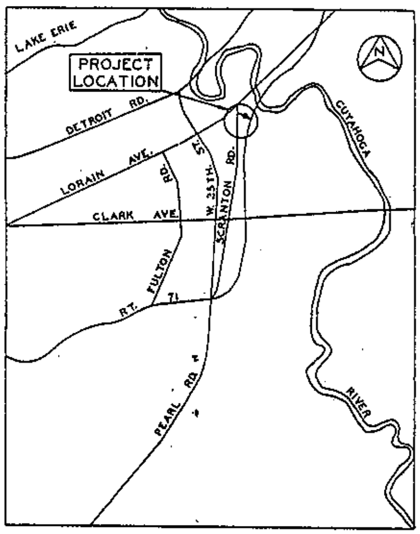
CITY OF CLEVELAND

DEPARTMENT OF PUBLIC UTILITIES

WALWORTH RUN DIVERSION

SEWER REHABILITATION PROGRAM

SEPTEMBER 1970



LOCATION PLAN
SCALE: 1"= 3000'

CARL B. STOKES, MAYOR

CLARENCE L. JAMES, JR.		DIRECTOR, DEPT. OF LAW
PHILIP H. DEARBORN		DIRECTOR, DEPT. OF FINANCE
WILLIAM S. GASKILL		DIRECTOR, DEPT. OF PUBLIC UTILITIES
W. KIELY CRONIN		DIRECTOR, DEPT. OF PORT CONTROL
RALPH C. TYLER		DIRECTOR, DEPT. OF PUBLIC SERVICE
E. FRANK ELLIS, M.D.		DIRECTOR, DEPT. OF PUBLIC HEALTH AND WELFARE
GEORGE W. O'CONNOR		DIRECTOR, DEPT. OF PUBLIC SAFETY
EDWARD J. BAUGH		DIRECTOR, DEPT. OF PUBLIC PROPERTIES
RICHARD R. GREEN		DIRECTOR, DEPT. OF COMMUNITY DEVELOPMENT
JACK KRAUSKOPF	ACTING -	DIRECTOR, DEPT. OF HUMAN RESOURCES AND ECONOMIC DEVELOPMENT

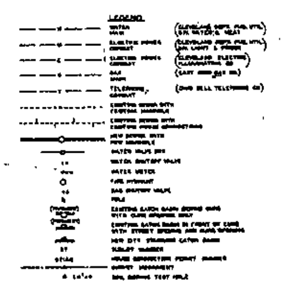
CITY COUNCIL
ANTHONY J. GARDFOLI - COUNCIL PRESIDENT

ANTHONY R. STRINGER	WARD 1	JOHN W. KELLOGG	WARD 18
JOSEPH A. LOMBARDO	WARD 2	ANTHONY J. GARDFOLI	WARD 19
MICHAEL ZONE	WARD 3	MRS. CARRIE CAIN	WARD 20
FRANCIS E. GAUL	WARD 4	EDWARD F. KATALINAS	WARD 21
SAM BROOKS	WARD 5	JOHN D. CIMPERMAN	WARD 22
THEODORE E. SLIWA	WARD 6	EDMUND J. TURK	WARD 23
DENNIS J. KUCINICH	WARD 7	MRS. MARY YATES	WARD 24
MRS. MARGARET McCAFFERY	WARD 8	VIRGIL E. BROWN	WARD 25
RICHARD M. HARMODY	WARD 9	LAWRENCE V. DUGGAN	WARD 26
WILLIAM FRANKLIN	WARD 10	GEORGE L. FORBES	WARD 27
JAMES H. BELL	WARD 11	PAUL T. HAGGARD	WARD 28
WARREN GILLIAM	WARD 12	MRS. JAYNE M. ZBOROWSKY	WARD 29
ROBERT C. McCALL	WARD 13	CLARENCE R. THOMPSON	WARD 30
JOSEPH M. KOWALSKI	WARD 14	GERALD T. McFAUL	WARD 31
RALPH J. PERK, JR.	WARD 15	JOHN J. PRINCE	WARD 32
JACK P. RUSSELL	WARD 16	GEORGE L. BLAHA	WARD 33
CHARLES V. CARR	WARD 17	MRS. MERCEDES COTNER	CLERK

JOSEPH L. STAMPS, ACTING - COMMISSIONER, DIVISION OF ENGINEERING AND CONSTRUCTION
DR. EDWARD J. MARTIN DIRECTOR, CLEAN WATER TASK FORCE

INDEX TO DRAWINGS

PROJECT PLANS A-1015	SHEET NO.
TITLE SHEET, LOCATION PLAN & INDEX	1 OF 6
PLAN AND PROFILE	2 OF 6
OVERFLOW STRUCTURE, PLAN AND SECTIONS	3 OF 6
OVERFLOW STRUCTURE, ENLARGED PLAN & SECTIONS	4 OF 6
DIVERSION CHAMBER, PLATFORM PLAN, SECTION & DETAILS	5 OF 6
METER BUILDING PLANS AND SECTIONS, ELECTRICAL SCHEMATIC DIAGRAM AND DUCT DETAILS	6 OF 6



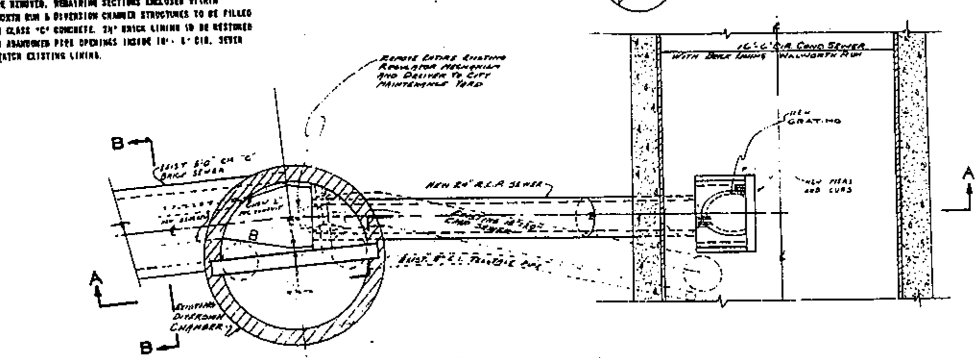
HAVENS AND EMERSON, LTD.

CONSULTING ENGINEERS
CLEVELAND, OHIO

A-1015

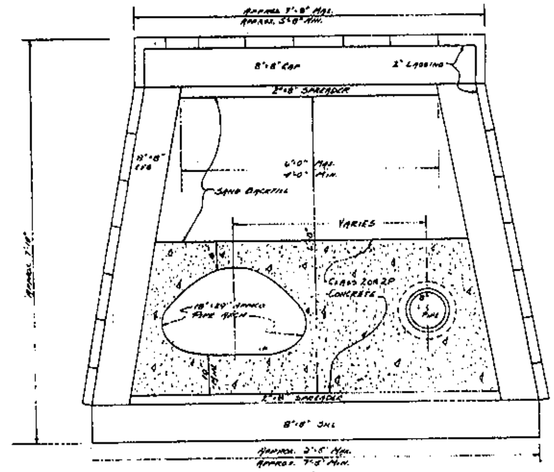
NOTES:

1. OPEN CUT FOR INSTALLATION OF 24" RCP SEWER IS REQUIRED. FULL SHEETING, LEFT IN PLACE SHALL BE PAID FOR UNDER THE APPLICABLE FIXED PRICE ITEM AND SHOULD NOT BE INCLUDED IN THE BID ITEM FOR INSTALLATION OF 24" RCP SEWER.
2. ALL SECTIONS OF 18" & 21" CMP SEWER & 6" C.I. TELLTALE PIPE OUTSIDE WALWORTH RUN & DIVERSION CHAMBER STRUCTURES TO BE REMOVED. REMAINING SECTIONS ENCLOSED WITHIN WALWORTH RUN & DIVERSION CHAMBER STRUCTURES TO BE FILLED WITH CLASS "C" CONCRETE. 2½" BRICK LINING TO BE RESTORED OVER ABANDONED PIPE OPENINGS INSIDE 16'-6" DIA. SEWER TO MATCH EXISTING LINING.

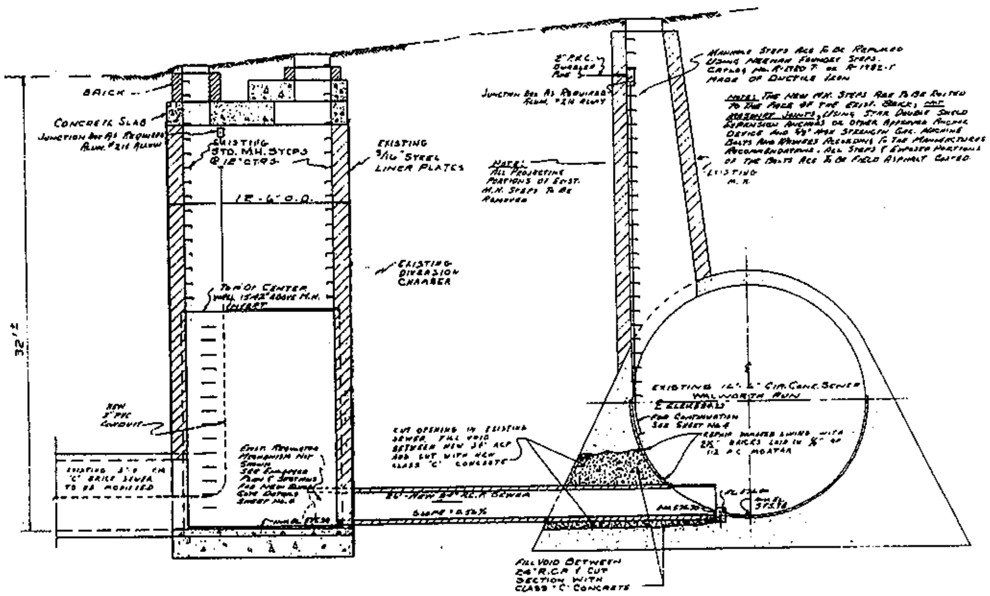


SECTIONAL PLAN

Scale: ¼"=1'-0"

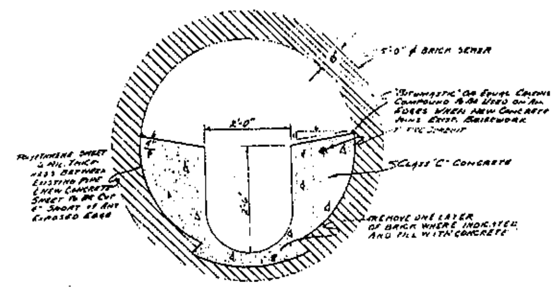


CROSS SECTION OF POSSIBLE EXISTING SEWER CONSTRUCTION



SECTION A - A

Scale: ¼"=1'-0"



SECTION B - B

Scale: ¾"=1'-0"

UNDERGROUND FACILITIES, STRUCTURES AND UTILITIES HAVE BEEN PLOTTED FROM AVAILABLE SURVEYS AND DRAWINGS FROM VARIOUS SOURCES, AND THEREFORE, THEIR LOCATION MUST BE CONSIDERED APPROXIMATE ONLY. ALSO, THERE MAY BE OTHERS, THE EXISTENCE OF WHICH ARE NOT PRESENTLY KNOWN. THE CITY OF CLEVELAND AND HAVENS AND EMERSON, LIMITED, EXPRESSLY DISCLAIM ANY RESPONSIBILITY FOR THE ACCURACY AND COMPLETENESS OF INFORMATION GIVEN REGARDING UNDERGROUND UTILITIES.

DATE		
12/14/70	[signature]	DIRECTOR OF PUBLIC UTILITIES
4/17/70	[signature]	CLEAN WATER TASK FORCE
10-21-70	[signature]	DIRECTOR OF PUBLIC SERVICE
	[signature]	DESIGN ENGINEER
	[signature] HAVENS AND EMERSON, LTD.	CONSULTING ENGINEER

REVISIONS

DEPARTMENT OF PUBLIC UTILITIES
CLEAN WATER TASK FORCE
CLEVELAND, OHIO

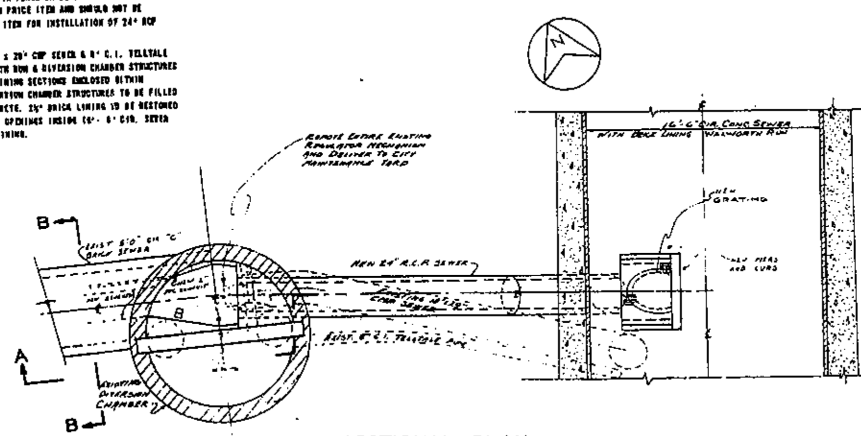
CONTRACT I-A
SEWER REHABILITATION PROGRAM

PROJECT 8
WALWORTH RUN DIVERSION
OVERFLOW STRUCTURE
PLAN AND SECTIONS

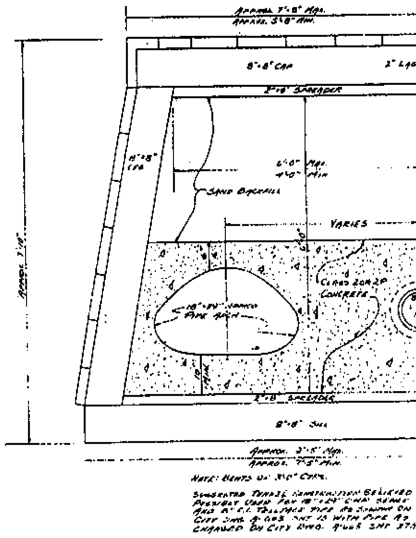
DRAWN BY: TAW	SCALE HOR. As Shown	SHEET 3 OF 6
TRACED BY: TAW	VERT.	NO. A-1015
CHECKED BY:	DATE	

NOTES:

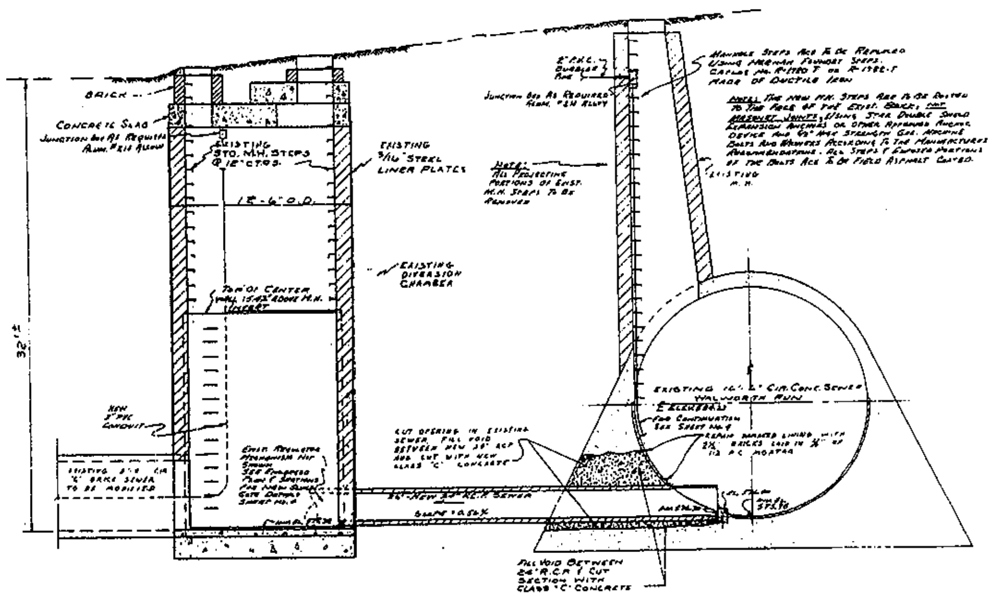
1. OPEN CUT FOR INSTALLATION OF 24" RCP. SEWER IS REQUIRED. FULL SHEETING, LEFT IN PLACE SHALL BE PAID FOR UNDER THE APPLICABLE FIXED PRICE ITEM AND SHOULD NOT BE INCLUDED IN THE BID ITEM FOR INSTALLATION OF 24" RCP SEWER.
2. ALL SECTIONS OF 19" x 29" CMP SEWER & 8" C.I. TELLTALE PIPE OUTSIDE WALWORTH RUN & DIVERSION CHAMBER STRUCTURES TO BE REMOVED. REMAINING SECTIONS ENCLOSED WITHIN WALWORTH RUN & DIVERSION CHAMBER STRUCTURES TO BE FILLED WITH CLASS "C" CONCRETE. 2¼" BRICK LINING IS TO BE RESTORED OVER ABANDONED PIPE OPENINGS INSIDE 16'-6" CIR. SEWER TO MATCH EXISTING LINING.



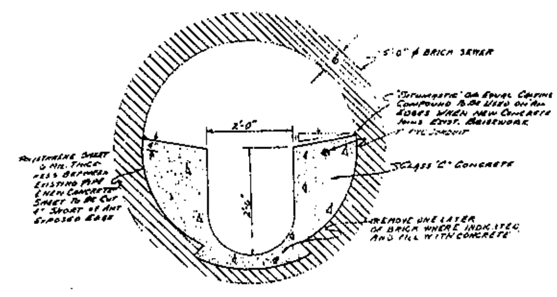
SECTIONAL PLAN
Scale: ¼"=1'-0"



CROSS SECTION
OF POSSIBLE
EXISTING SEWER
CONSTRUCTION



SECTION A - A
Scale: ⅛"=1'-0"



SECTION B - B
Scale: ⅛"=1'-0"

UNDERGROUND FACILITIES, STRUCTURES AND UTILITIES HAVE BEEN PLOTTED FROM AVAILABLE SURVEYS AND DRAWINGS FROM VARIOUS SOURCES, AND THEREFORE, THEIR LOCATION MUST BE CONSIDERED APPROXIMATE ONLY. ALSO, THERE MAY BE OTHERS, THE EXISTENCE OF WHICH ARE NOT PRESENTLY KNOWN. THE CITY OF CLEVELAND AND HAVENS AND EMERSON, LIMITED, EXPRESSLY DISCLAIM ANY RESPONSIBILITY FOR THE ACCURACY AND COMPLETENESS OF INFORMATION GIVEN REGARDING UNDERGROUND UTILITIES.

DATE		
10/14/70		DIRECTOR OF PUBLIC UTILITIES
4/17/70		CLEAN WATER TASK FORCE
10-21-70		DIRECTOR OF PUBLIC SERVICE
		DESIGN ENGINEER
	HAVENS AND EMERSON, LTD.	CONSULTING ENGINEER

REVISIONS

DEPARTMENT OF PUBLIC UTILITIES
CLEAN WATER TASK FORCE
CLEVELAND, OHIO

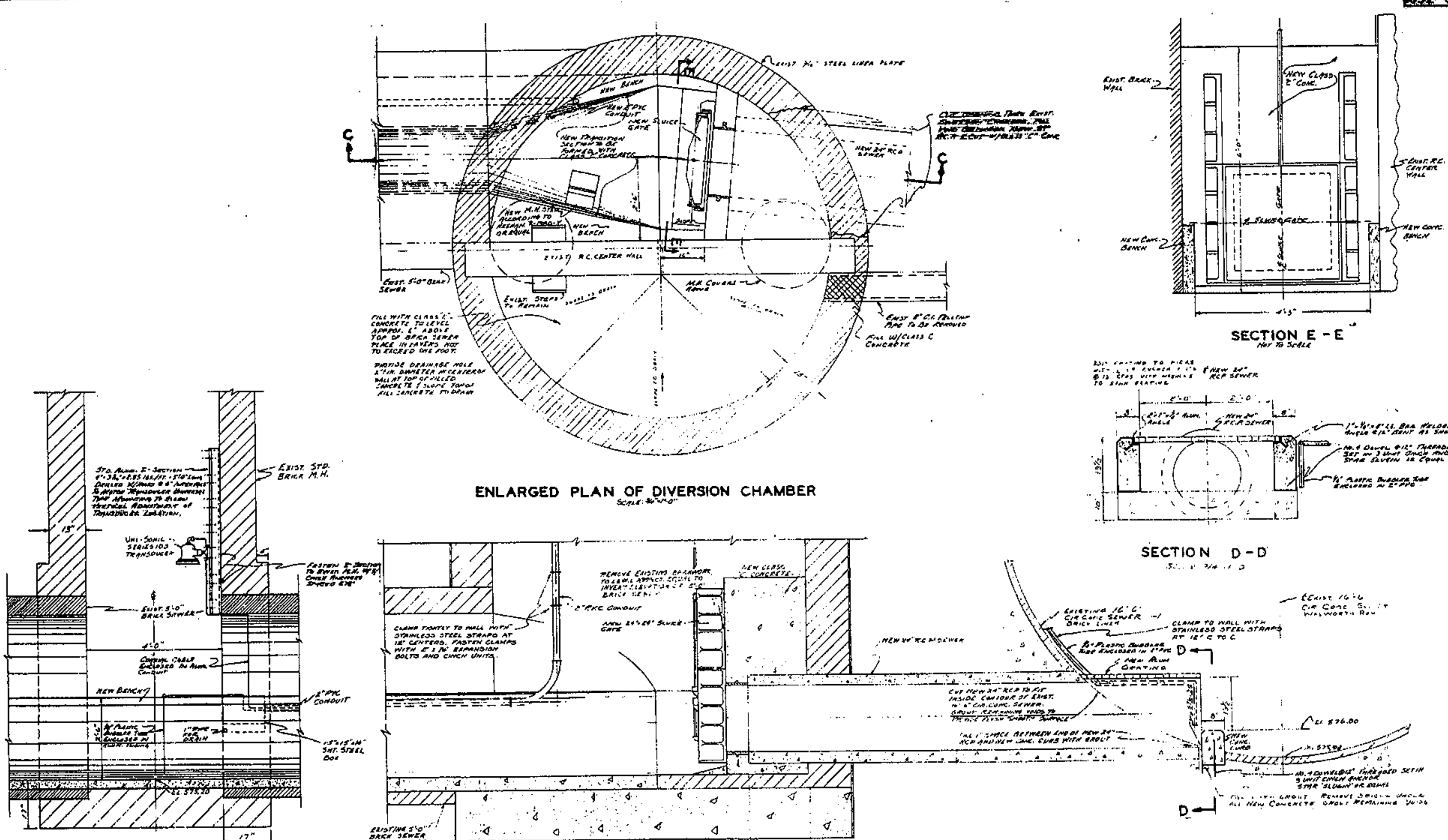
CONTRACT I-A
SEWER REHABILITATION PROGRAM

PROJECT 8
WALWORTH RUN DIVERSION
OVERFLOW STRUCTURE
PLAN AND SECTIONS

DRAWN BY: TAW — TRACED BY: TAW — CHECKED BY:
SCALE: HOR. As Shown — VERT. — DATE

SHEET 3 OF 6
NO. A-1015

1052-01



ENLARGED PLAN OF DIVERSION CHAMBER
SCALE: 3/4"=1'-0"

SECTION E - E
NOT TO SCALE

SECTION D - D

ENLARGED SECTION OF M. H.
SEWER STA: 0+00

SECTION C-C
SCALE: 3/4"=1'-0"

UNDERGROUND FACILITIES, STRUCTURES AND UTILITIES HAVE BEEN PLOTTED FROM AVAILABLE SURVEYS AND DRAWINGS FROM VARIOUS SOURCES, AND THEREFORE, THEIR LOCATION MUST BE CONSIDERED APPROXIMATE ONLY. ALSO, THERE MAY BE OTHERS, THE EXISTENCE OF WHICH ARE NOT PRESENTLY KNOWN. THE CITY OF CLEVELAND AND HAVENS AND EMERSON, LIMITED, EXPRESSLY DISCLAIM ANY RESPONSIBILITY FOR THE ACCURACY AND COMPLETENESS OF INFORMATION GIVEN REGARDING UNDERGROUND UTILITIES.

DATE		
12/4/70	[signature]	DIRECTOR OF PUBLIC UTILITIES
11/12/70	[signature]	CLEAN WATER TASK FORCE
10-21-70	[signature]	DIRECTOR OF PUBLIC SERVICE
	[signature]	DESIGN ENGINEER
	[signature] HAVENS AND EMERSON, LTD.	CONSULTING ENGINEER

REVISIONS

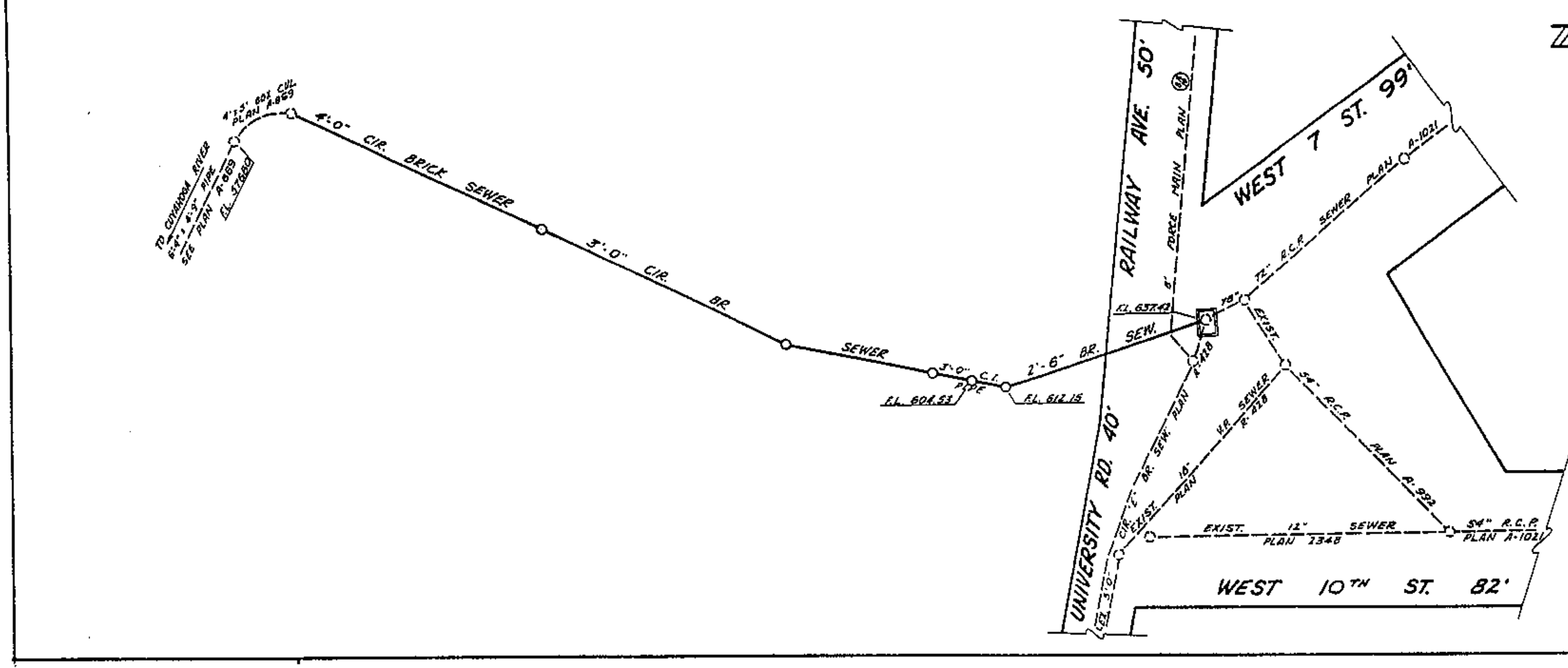
DEPARTMENT OF PUBLIC UTILITIES
CLEAN WATER TASK FORCE
CLEVELAND, OHIO

CONTRACT I-A
SEWER REHABILITATION PROGRAM

PROJECT B
WALWORTH RUN DIVERSION
OVERFLOW STRUCTURE
ENLARGED PLAN AND SECTIONS

DRAWN BY: TAW | SCALE HOR. AS SHOWN | SHEET 4 OF 6
TRACED BY: TAW | VERT.
CHECKED BY: | DATE | NO. A-1015

Regulator WR-27A



CUYAHOGA AVE.

BETWEEN

MAHONING AVE. & W. 7TH ST.

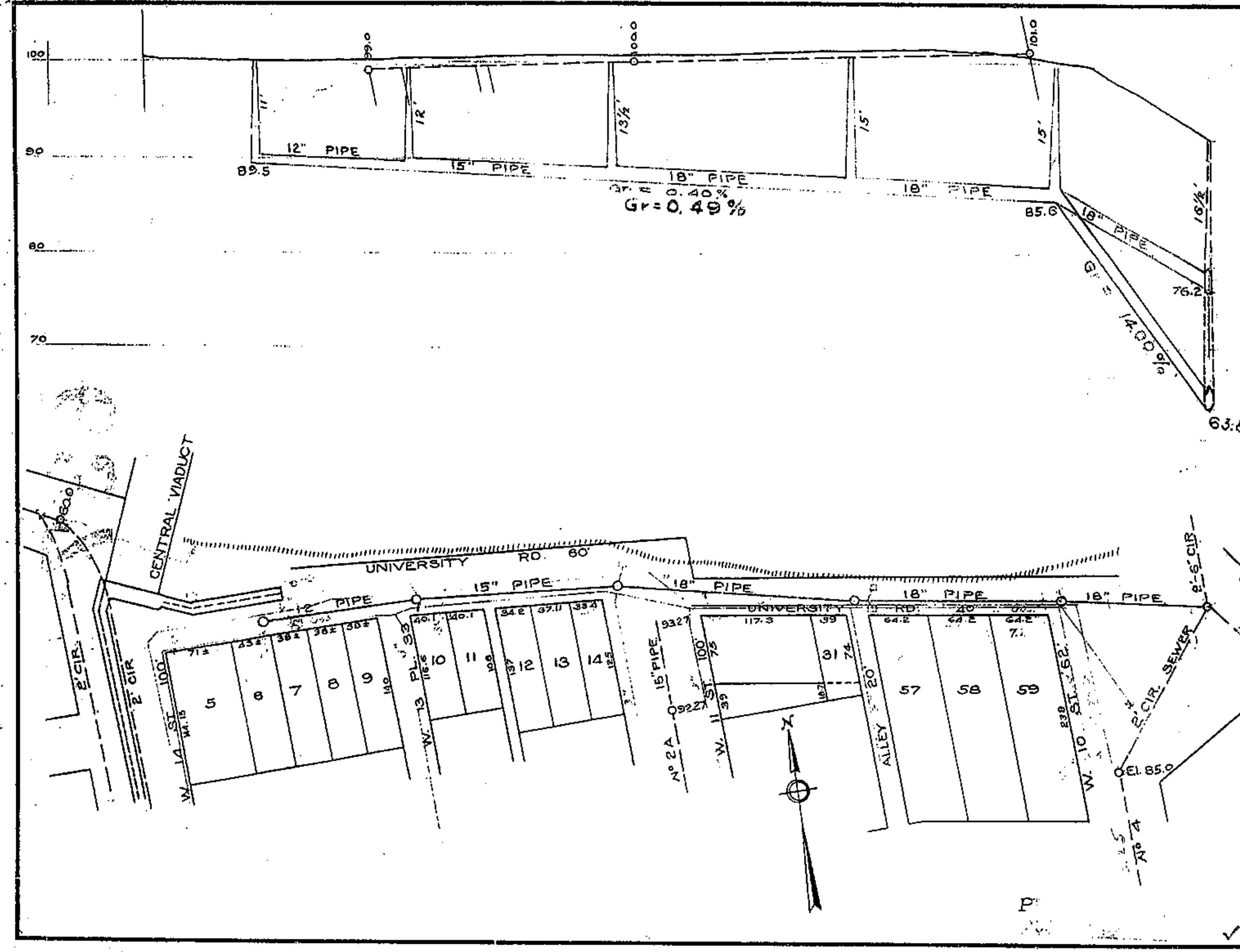
CONSTRUCTED 1873

REDRAWN BY RUSNAK 15 MAR 71

SCALE: 1"=50'

SEWER RECORD VOL. 1 PG. 304

FILE № 202



Checked by H.E.S. 11-18-19

CITY OF CLEVELAND
ENGINEERING DIVISION

PLAN FOR A SEWER

IN

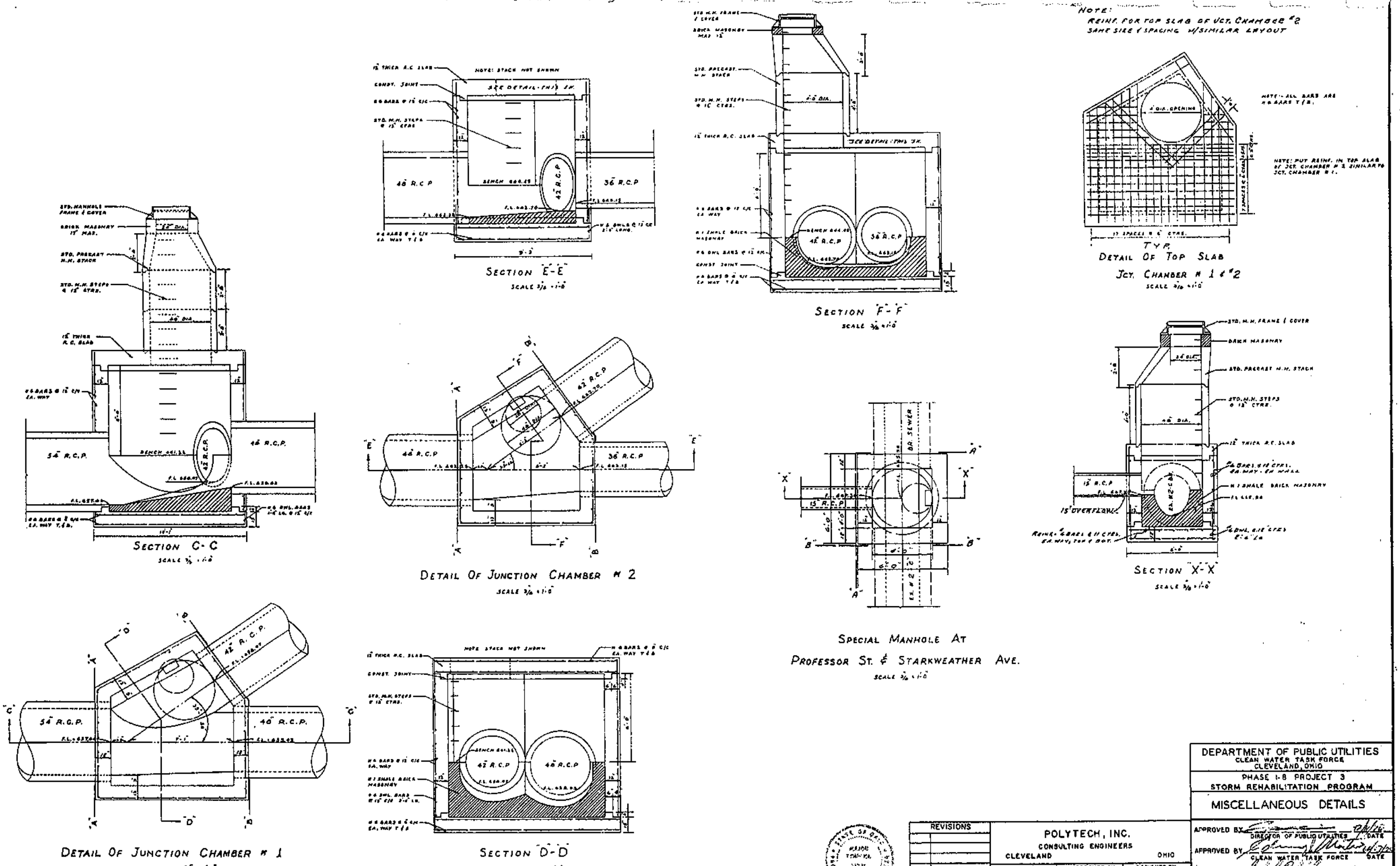
UNIVERSITY RD.

BETWEEN

W. 7 St & W. 14 St

SCALE { Horz. 1" = 100' Draftsman G.J.S. Date 6-30-14
Vert. 1" = 10' Checked [illegible] Date 7/16/14
Del. }

APPROVED. [signature] Date 7/23/14
Chief Engineer
File No. 4611



DEPARTMENT OF PUBLIC UTILITIES
CLEAN WATER TASK FORCE
CLEVELAND, OHIO

PHASE I-8 PROJECT 3
STORM REHABILITATION PROGRAM

MISCELLANEOUS DETAILS

REVISIONS

POLYTECH, INC.
CONSULTING ENGINEERS
CLEVELAND OHIO

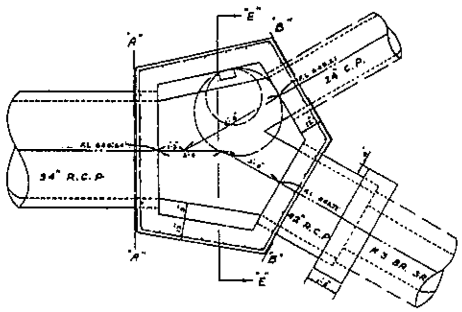
DRAWN BY	APPROVED BY	DESIGNED BY
R.S.	[signature]	H.B.K.
CHECKED BY	DATE	JOB NO.
RVH	10-13-70	700303

APPROVED BY [signature] DIRECTOR OF PUBLIC UTILITIES DATE

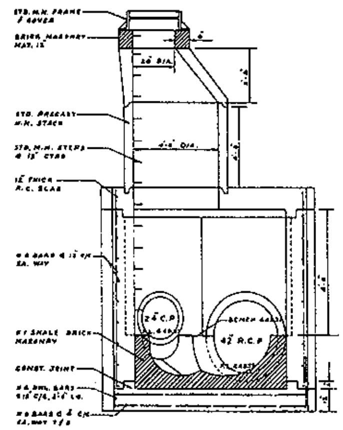
APPROVED BY [signature] CLEAN WATER TASK FORCE DATE

APPROVED BY [signature] DIRECTOR OF PUBLIC SERVICE DATE

SCALE HORZ. AS SHOWN VERT. — SHEET 9 OF 10 — FILE NO. A-1021



PLAN OF JCT. MANHOLE AT
W. 7 ST. & STARKWEATHER AVE.
SCALE 3/8" = 1'-0"



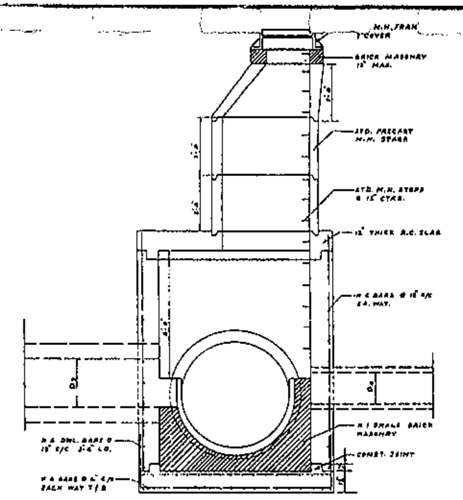
SECTION "E"-"E"
SCALE 3/8" = 1'-0"

SCHEDULE - JCT. MANHOLE TYPE "A"

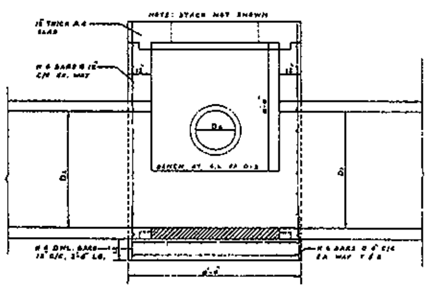
LOCATION	Δ	PIPE DIA.(IN.) D-1	PIPE DIA.(IN.) D-2	PIPE DIA.(IN.) D-3	FLOW LINE (F.L.) D-1	FLOW LINE (F.L.) D-2	FLOW LINE (F.L.) D-3	APPROX. DEPTH F.L. D-2 TO PAVT.
W. 7 ST. & HERSCHEL CT.	72°	66	66	21	643.51	643.71	644.00	19'-0"
W. 7 ST. & MARQUARDT AVE.	90°	34	40	24	647.60	647.55	648.44	16'-0"
W. 7 ST. AT N. OF STARKWEATHER AVE.	79°	54	54	30	648.10	648.50	650.56	15'-3"
W. 10 ST. & LITERARY RD.	48°	40	46	15	661.12	661.12	664.01	17'-10"
PROFESSOR ST. & COLLEGE AVE.	68°	34	42	12	662.66	662.21	665.36	16'-0"
W. 7 ST. & COLLEGE AVE.	50°	66	66	18	645.49	644.69	648.00	20'-9"

SCHEDULE - JCT. MANHOLE TYPE "B"

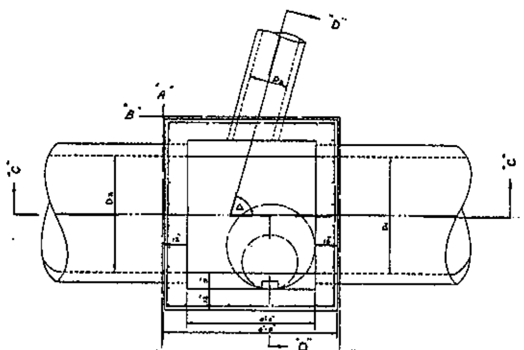
LOCATION	Δ-3	Δ-4	PIPE DIA.(IN.) D-1	PIPE DIA.(IN.) D-2	PIPE DIA.(IN.) D-3	PIPE DIA.(IN.) D-4	FLOW LINE (F.L.) D-1	FLOW LINE (F.L.) D-2	FLOW LINE (F.L.) D-3	FLOW LINE (F.L.) D-4	APPROX. DEPTH F.L. D-2 TO PAVT.
W. 7 ST. & LITERARY RD.	35°	56°	66"	72"	46"	24"	643.36	643.51	644.60	644.51	19'-3"
W. 7 ST. & JEFFERSON AVE.	74°-30'	77°-30'	60"	66"	27"	18"	645.44	645.39	645.65	646.40	18'-5"



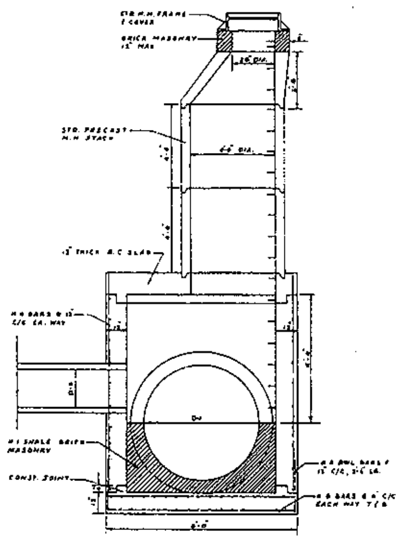
SECTION "F"-"F"
SCALE 3/8" = 1'-0"



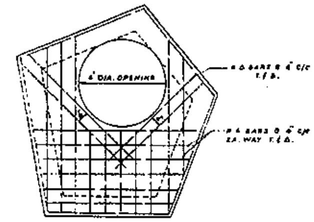
SECTION "C"-"C"
SCALE 3/8" = 1'-0"



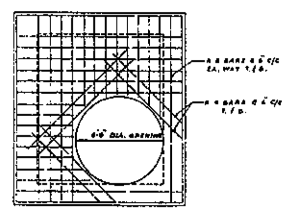
TYPICAL DETAIL OF
JCT. MANHOLE TYPE "A"
SCALE 3/8" = 1'-0"



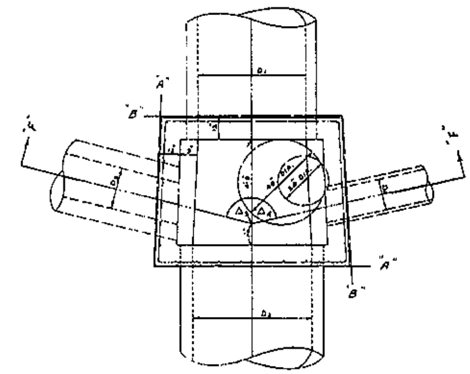
SECTION "D"-"D"
SCALE 3/8" = 1'-0"



DETAIL OF TOP SLAB FOR
JCT. M.H. AT W. 7 ST. & STARKWEATHER AVE.
SCALE 3/8" = 1'-0"



DETAIL OF TOP SLAB
JCT. M.H. - TYPE A & B
SCALE 3/8" = 1'-0"



TYPICAL DETAIL OF
JCT. MANHOLE TYPE "B"
SCALE 3/8" = 1'-0"

REVISIONS	POLYTECH, INC. CONSULTING ENGINEERS CLEVELAND OHIO		
	DRAWN BY R.S.	APPROVED BY [signature]	DESIGNED BY H.A.K.
	CHECKED BY RVH	DATE 10-13-70	JOB NO. 700303

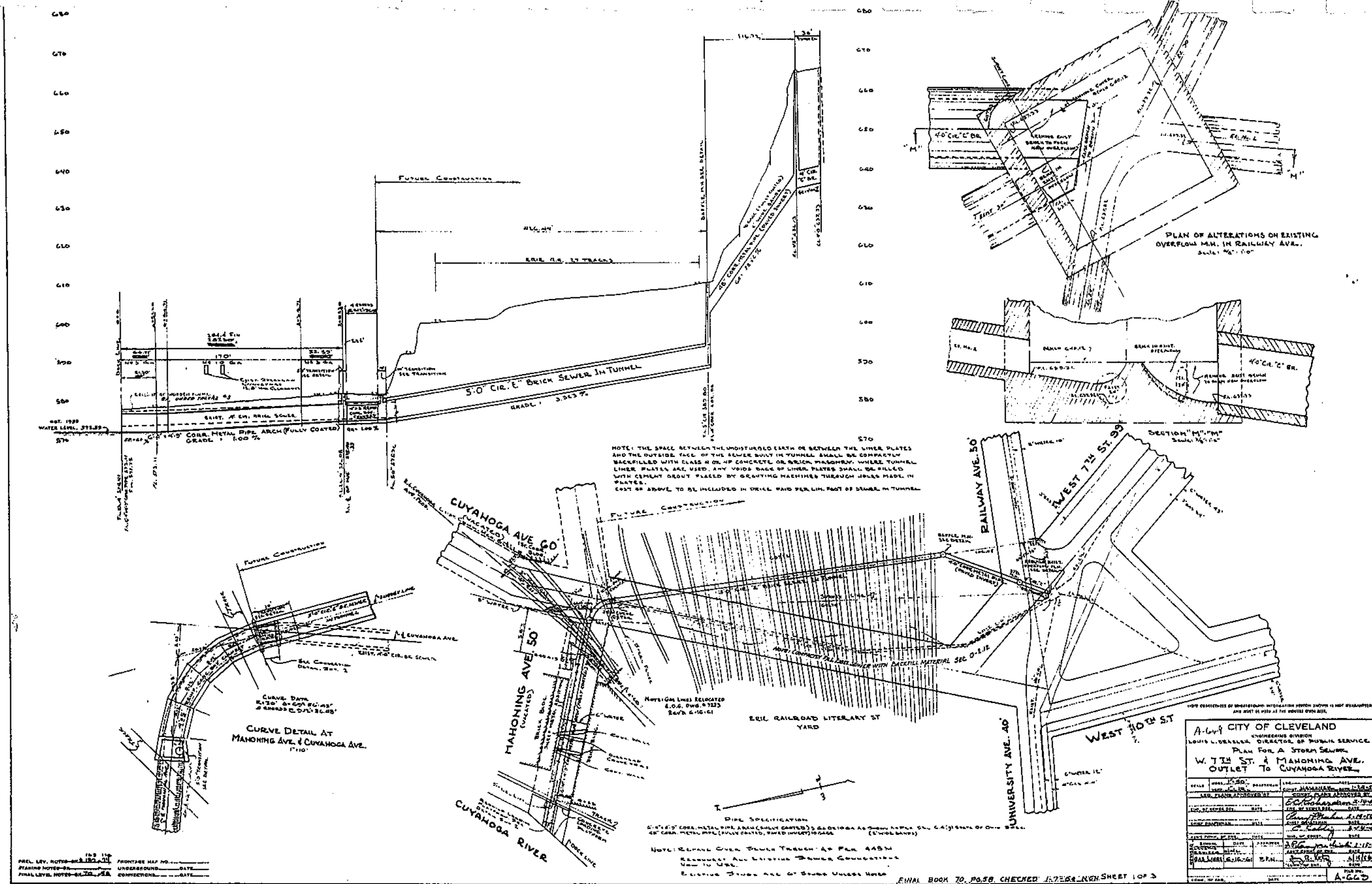
DEPARTMENT OF PUBLIC UTILITIES
CLEAN WATER TASK FORCE
CLEVELAND, OHIO

PHASE I-B PROJECT 3
SEWER REHABILITATION PROGRAM

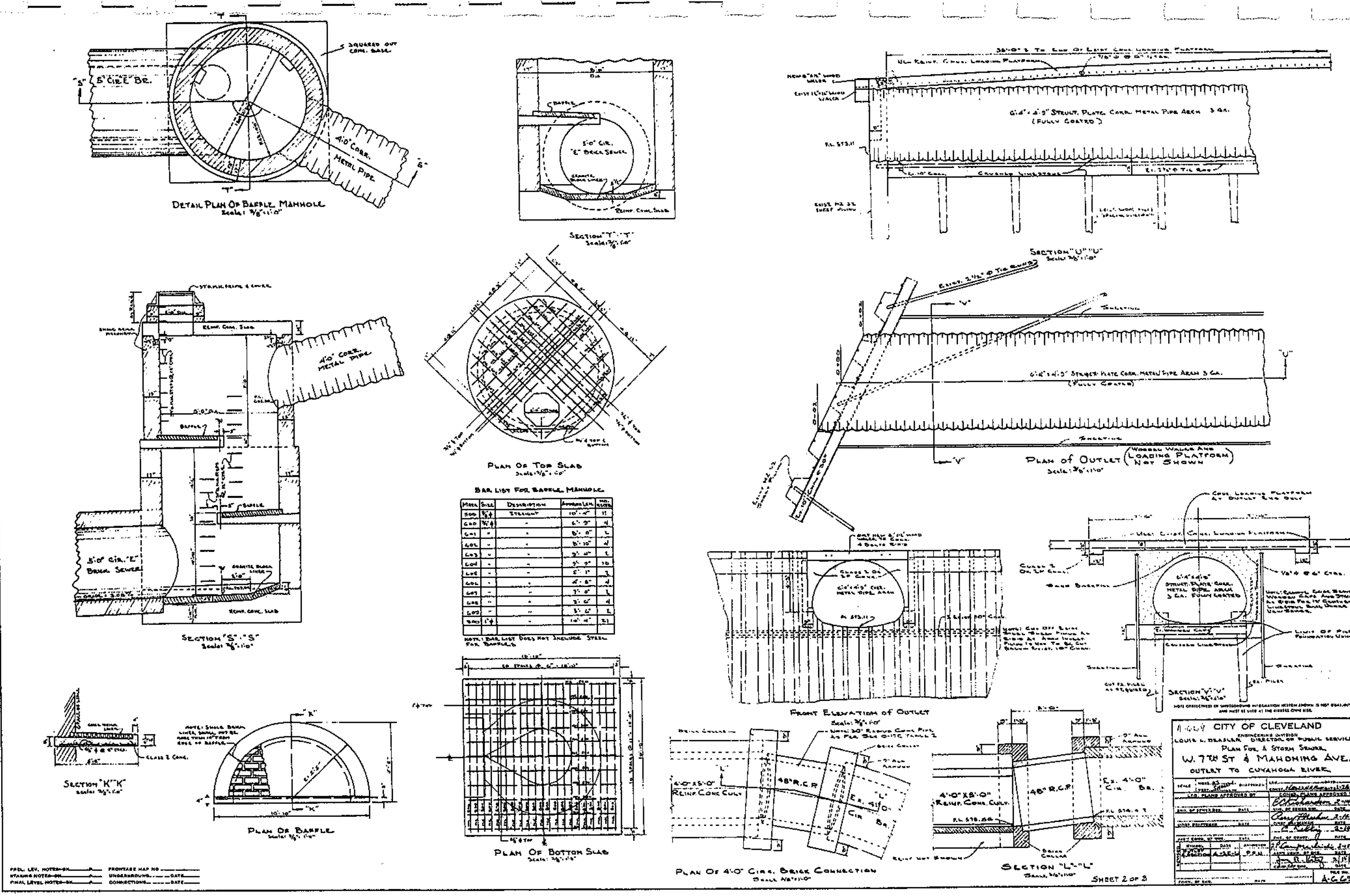
MISCELLANEOUS DETAILS

APPROVED BY [signature] DIRECTOR OF PUBLIC UTILITIES DATE
APPROVED BY [signature] CLEAN WATER TASK FORCE DATE
APPROVED BY [signature] DIRECTOR OF PUBLIC SERVICE DATE

SCALE HORZ. AS SHOWN VERT. — SHEET 10 OF 10 — FILE NO. A-1021



5'0" CIR. "E" BRICK SEWER IN TUNNEL
GRADE 3.323%
CORR. METAL PIPE ARCH (FULLY COATED)
GRADE 1.00%
FUTURE CONSTRUCTION
ERIE R.R. 27 TRACKS
BAFFLE M.H. SEE DETAIL
PLAN OF ALTERATIONS ON EXISTING
OVERFLOW M.H. IN RAILWAY AVE.
SECTION "M"-"M"
4'0" CIR. "C" BR.
NOTE: THE SPACE BETWEEN THE UNDISTURBED EARTH OR BETWEEN THE LINER PLATES AND THE OUTSIDE FACE OF THE SEWER BUILT IN TUNNEL SHALL BE COMPACTLY BACKFILLED WITH CLASS A OR 4P CONCRETE OR BRICK MASONRY. WHERE TUNNEL LINER PLATES ARE USED, ANY VOIDS BACK OF LINER PLATES SHALL BE FILLED WITH CEMENT GROUT PLACED BY GROUTING MACHINES THROUGH HOLES MADE IN PLATES.
COST OF ABOVE TO BE INCLUDED IN PRICE PAID PER LIN. FOOT OF SEWER IN TUNNEL.
CUYAHOGA AVE. 60'
RAILWAY AVE. 50'
WEST 7TH ST. 99'
WEST 10TH ST
UNIVERSITY AVE. 40'
MAHONING AVE. 50' (VACATED)
CUYAHOGA RIVER
ERIE RAILROAD LITERARY ST YARD
NOTE: GAS LINES RELOCATED
CURVE DETAIL AT
MAHONING AVE. & CUYAHOGA AVE.
1"=10'
PIPE SPECIFICATION
NOTE: REPAVE OVER SEWER TRENCH AS PER 445 M
A-669 CITY OF CLEVELAND
ENGINEERING DIVISION
DIRECTOR OF PUBLIC SERVICE
PLAN FOR A STORM SEWER
W. 7TH ST. & MAHONING AVE.
OUTLET TO CUYAHOGA RIVER
FINAL BOOK 70, PG.58. CHECKED
SHEET 1 OF 3
A-669

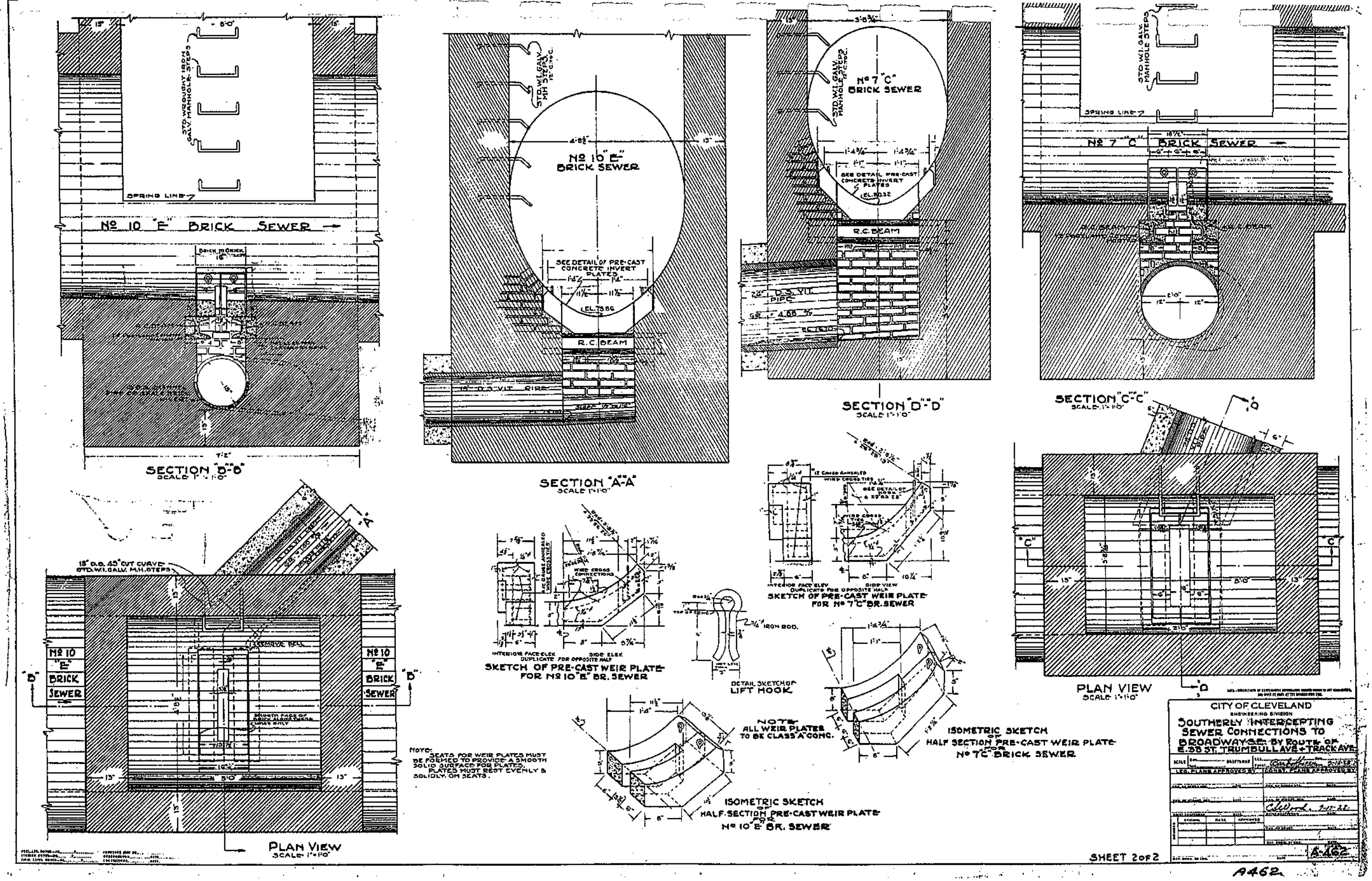


Bar List For Baffle Manhole

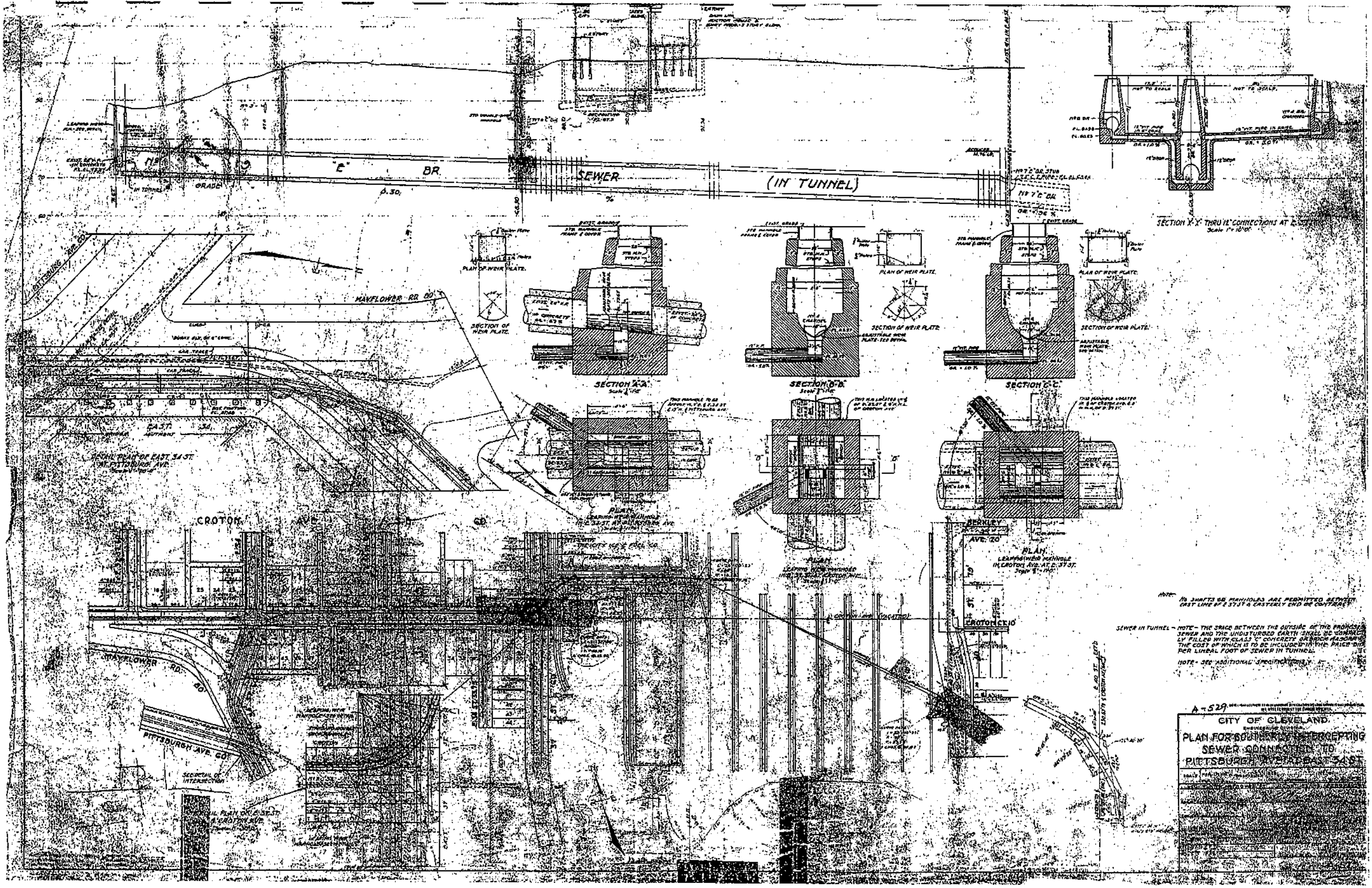
Mark	Size	Description	Approx. Len.	No. Req'd
500	5/8" ϕ	Straight	10'-4"	11
600	3/4" ϕ	"	6'-3"	4
601	"	"	8'-0"	2
602	"	"	8'-10"	4
603	"	"	3'-4"	2
604	"	"	3'-9"	10
605	"	"	5'-1"	2
606	"	"	4'-8"	4
607	"	"	7'-0"	2
608	"	"	3'-6"	4
609	"	"	3'-6"	2
900	1" ϕ	"	10'-4"	21

Note: Bar List Does Not Include Steel For Baffles

Regulators S-07 and S-08

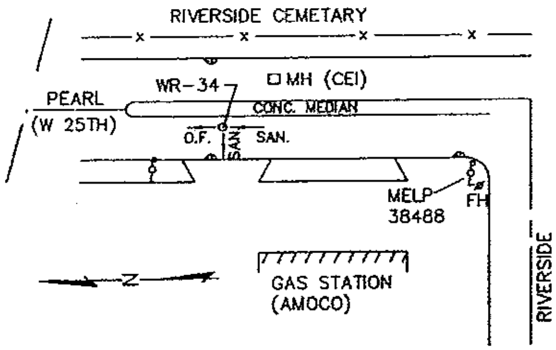


Nº 10 "E" BRICK SEWER
SPRING LINE
STD. WROUGHT IRON GALV. MANHOLE STEPS
SECTION "B"-"B"
SCALE 1" = 1'-0"
Nº 10 "E" BRICK SEWER
STD. W.I. GALV. M.H. STEPS 12" C. TO C.
SEE DETAIL OF PRE-CAST CONCRETE INVERT PLATES
EL. 73.86
R.C. BEAM
15" D.S. VIT. PIPE
SECTION "A"-"A"
SCALE 1" = 1'-0"
Nº 7 "C" BRICK SEWER
STD. W.I. GALV. MANHOLE STEPS 12" C. TO C.
SEE DETAIL PRE-CAST CONCRETE INVERT PLATES
EL. 80.32
R.C. BEAM
D.S. VIT. PIPE
SECTION "D"-"D"
SCALE 1" = 1'-0"
STD. W.I. GALV. MANHOLE STEPS
SPRING LINE
Nº 7 "C" BRICK SEWER
R.C. BEAM
SECTION "C"-"C"
SCALE 1" = 1'-0"
18" O.G. 45° CUT CURVE
STD. W.I. GALV. M.H. STEPS
Nº 10 "E" BRICK SEWER
"B"
PLAN VIEW
SCALE 1" = 1'-0"
NOTE:
SEATS FOR WEIR PLATES MUST BE FORMED TO PROVIDE A SMOOTH SOLID SURFACE FOR PLATES. PLATES MUST REST EVENLY & SOLIDLY ON SEATS.
INTERIOR FACE ELEV.
DUPLICATE FOR OPPOSITE HALF
SIDE ELEV.
WIRE CROSS CONNECTIONS
SKETCH OF PRE-CAST WEIR PLATE FOR Nº 10 "E" BR. SEWER
2 3/4" IRON ROD
DETAIL SKETCH OF LIFT HOOK
NOTE
ALL WEIR PLATES TO BE CLASS "A" CONC.
ISOMETRIC SKETCH OF HALF-SECTION PRE-CAST WEIR PLATE FOR Nº 10 "E" BR. SEWER
INTERIOR FACE ELEV.
SIDE VIEW
DUPLICATE FOR OPPOSITE HALF
SKETCH OF PRE-CAST WEIR PLATE FOR Nº 7 "C" BR. SEWER
ISOMETRIC SKETCH OF HALF SECTION PRE-CAST WEIR PLATE FOR Nº 7 "C" BRICK SEWER
"C"
"D"
PLAN VIEW
SCALE 1" = 1'-0"
CITY OF CLEVELAND
ENGINEERING DIVISION
SOUTHERLY INTERCEPTING SEWER CONNECTIONS TO BROADWAY SE. BY ROUTE OF E. 38 ST. TRUMBULL AVE. + TRACK AVE.
LEG. PLANS APPROVED BY
CONST. PLANS APPROVED BY
SHEET 2 OF 2
A-462
A462

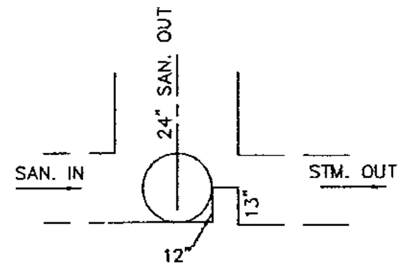

"E" BR. SEWER (IN TUNNEL)
GRADE
SECTION X-X THRU 12 CONNECTIONS AT E.
PLAN OF WEIR PLATE.
SECTION OF WEIR PLATE.
SECTION A-A.
SECTION B-B.
SECTION C-C.
PLAN
LEAPING WEIR MANHOLE IN CROTON AVE. AT E. 37 ST.
MAYFLOWER RD. 60
PITTSBURGH AVE. 60
CROTON AVE. 60
BERKLEY AVE. 20
EAST 34 ST.
NOTE - NO SHAFTS OR MANHOLES ARE PERMITTED BETWEEN EAST LINE OF E. 37 ST. & EASTERLY END OF CONTRACT.
SEWER IN TUNNEL - NOTE - THE SPACE BETWEEN THE OUTSIDE OF THE PROPOSED SEWER AND THE UNDISTURBED EARTH SHALL BE COMPACTLY FILLED WITH CLASS "C" CONCRETE OR BRICK MASONRY THE COST OF WHICH IS TO BE INCLUDED IN THE PRICE BID PER LINEAL FOOT OF SEWER IN TUNNEL.
NOTE - SEE ADDITIONAL SPECIFICATIONS.
A-529
CITY OF CLEVELAND
PLAN FOR SOUTHERLY INTERCEPTING SEWER CONNECTION TO PITTSBURGH AVE. & EAST 34 ST.

Regulator WR-34

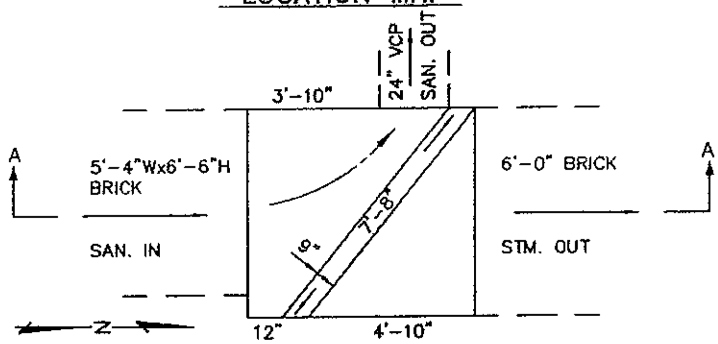
REGULATOR
WR-34
PEARL(W 25TH) NORTH OF RIVERSIDE



LOCATION MAP



SECTION A-A



PLAN VIEW

SECTION B-B

IDENTIFICATION AND DESCRIPTION

OVERFLOW REGULATOR No. (DISTRICT)	WR-34
OVERFLOW REGULATOR No. (OLD H&E)	3074
DOWNSTREAM OUTFALL No.	088
RECEIVING WATER	CUY. RIVER
OVERFLOW REGULATOR TYPE	PERPENDICULAR
IS REGULATOR VISIBLE FROM SURFACE ?	YES
LENGTH OF WEIR	92"
HEIGHT OF WEIR	12"
LENGTH OF STORM WATER OUTLET PIPE MAINTAINED BY NEORSD	-

MATERIALS OF CONSTRUCTION

MANHOLE	BRICK
INLET PIPE	BRICK
OUTLET PIPE	VCP
STORM WATER OUTLET	BRICK

LOCATION

LOCATION PEARL(W 25TH) NORTH OF RIVERSIDE

COORDINATES : N. 73625 E. 84145

COORDINATES : LONG. - LAT. -

CLEVELAND REGIONAL MAP SHEET No. 87

CUYAHOGA COUNTY MAP INDEX No. 67.03

COMMUNITY CLEVELAND

W.W.T.P. SERVICE AREA WESTERLY

MEASUREMENTS

MH RIM TO INVERT(S) (FT. OR IN.) 16'-0" SAN.
OVERFLOW OPENING (IN.) 60" / DEPTH OF FLOW (IN.) -
INLET SEWER SIZE (IN.) 64" x 78 DEPTH OF FLOW (IN.) 10"
OUTLET SEWER SIZE (IN.) 24" / DEPTH OF FLOW (IN.) 10"
STORM WATER OUTLET SIZE (FT.) 6.0' / DEPTH OF FLOW (IN.) -
TOP OF LID ELEV. 686.29
INVERT ELEV.(S) 670.29

COMMENTS

ANY STRUCTURAL PROBLEMS NOTICEABLE ? NO
DOES THE REGULATOR NEED OPERATIONAL IMPROVEMENTS ? NO
DOES THE REGULATOR SEEM TO BE REGULARLY MAINTAINED ? YES
WHO IS RESPONSIBLE FOR MAINTENANCE ? NEORSD
ANY CURRENT BLOCKAGE ? NO
DOES THE REGULATOR SEEM TO BE PERFORMING WELL ? YES
ANY DRY WEATHER OVERFLOW PRESENT ? NO HOW MUCH ? -
ANY DRY WEATHER OVERFLOW POTENTIAL ? NO
COMMENTS: STEPS GONE
-
-

NOTES

SITE REQUIREMENTS TRAFFIC ZONE
-

FILM ROLL No. 21
PHOTO No.'s 1

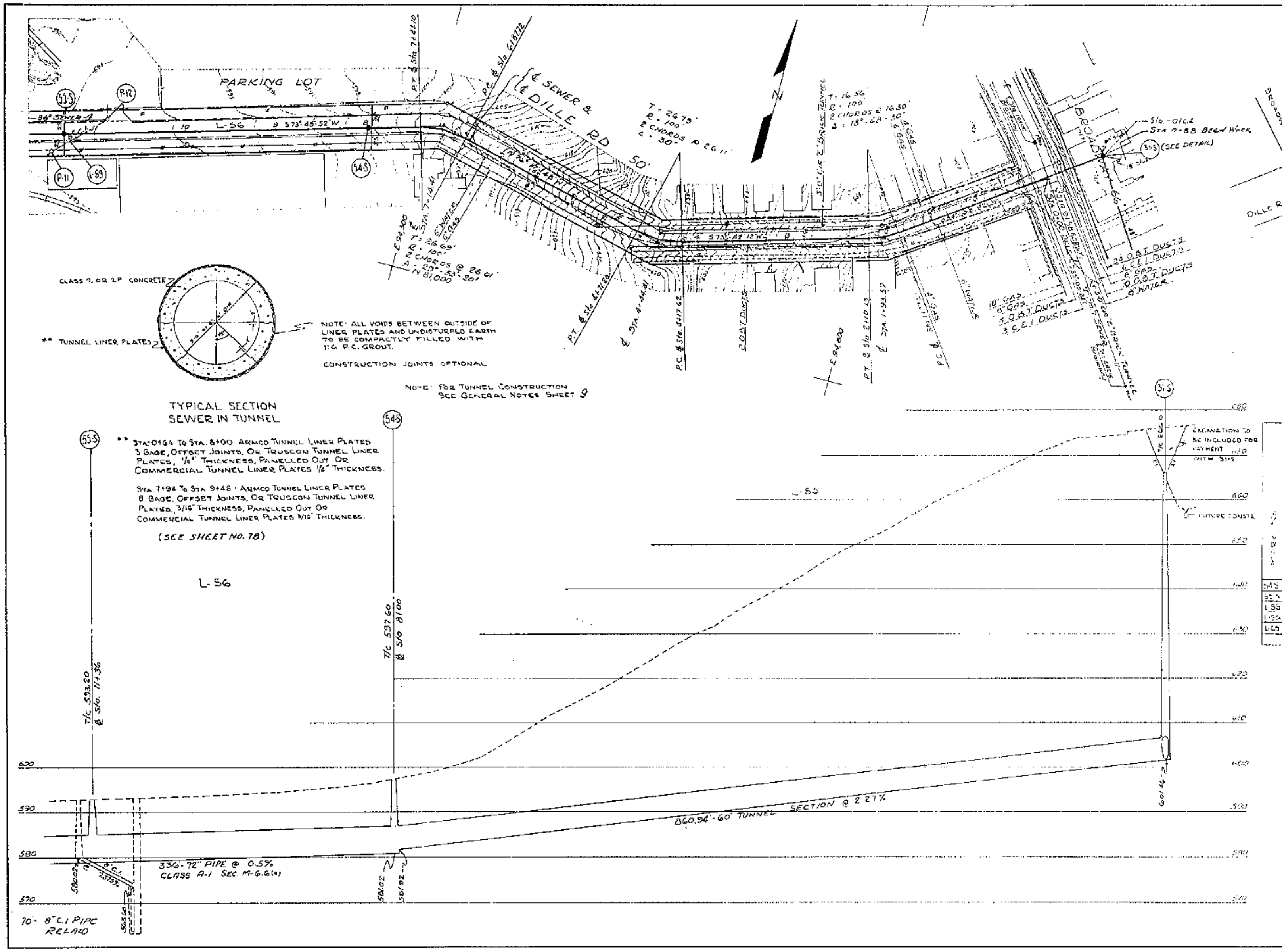
Appendix Q

I-77/Dille Road ODOT drawings

FED. RD. DIVISION	STATE	PROJECT	
2	OHIO		

77 / 204

CUYAHOGA COUNTY
CUY—21—(13.77)-(14.94)



SOIL BORINGS NO. B-81 & B-82 HAVE BEEN TAKEN IN THE VICINITY OF THIS SEWER. THIS INFORMATION IS AVAILABLE AT THE OHIO STATE HIGHWAY TESTING LABORATORY, 1620 W. BROAD ST., COLUMBUS 15, OHIO.

DRAINAGE QUANTITIES

No.	LOCATION	I-8 MANHOLE SPECIAL TYPE C AS PER PLAN EACH	I-1 72" PIPE CLASS A-1 SEC M-6.6(a) LIN FT	SPL 60" PIPE TUNNEL SECTION AS PER PLAN LIN FT	I-6 RELAYING 8" C.I. PIPE AS PER PLAN LIN FT
54-S	Dille Rd. STA 8+00 €	1			
55-S	Dille Rd. STA 11+36 €	1			
L-55	From 31-S To 54-S			861	
L-56	From 54-S To 55-S		336		
L-65	From P-11 To P-12				70
	TOTAL	2	336	861	70

NOTE: WORK THIS SHEET WITH SHEET 78

TRYGVE HOFF & ASSOCIATES
ENGINEERS
1932 EAST 107TH STREET CLEVELAND, OHIO

STORM SEWER
DILLE ROAD

SCALE 1" = 50' HORZ. 1" = 10' VERT.

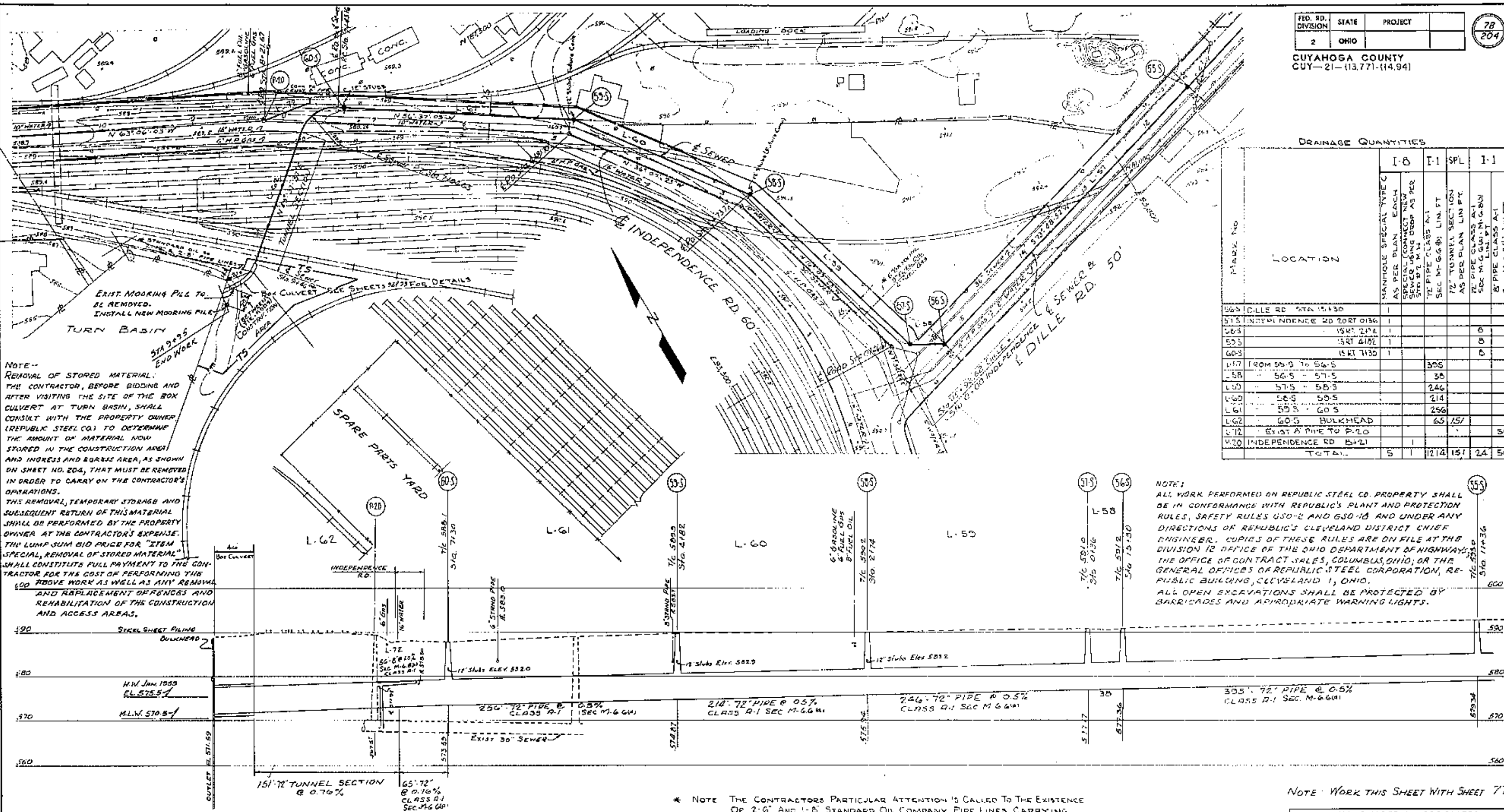
DESIGNED	DRAWN	TRACED	CHECKED	REVIEWED	DATE	DATE	REVISED
	C.E.		RMR				

CONT. NO. 58019 SHEET ACCT. NO. 6138

FED. RD. DIVISION	STATE	PROJECT	
2	OHIO		

78/204

CUYAHOGA COUNTY
CUY—21—(13.77)-(14.94)



DRAINAGE QUANTITIES

MARK NO.	LOCATION	I-8 MANHOLE SPECIAL TYPE C AS PER PLAN EACH	I-8 SPECIAL (CONNECT NEW SEWER USING DROP AS PER STD #2 M.H.	I-1 72" PIPE CLASS A-1 SEC M-6.6(B) LIN. FT	SPL 72" TUNNEL SECTION AS PER PLAN LIN FT.	I-1 12" PIPE CLASS A-1 SEC M-6.6(B)-M-6.8(B) LIN. FT	I-1 8" PIPE CLASS A-1 SEC M-6.8(B) LIN. FT
56-S	DILLE RD STA 15+30	1					
57-S	INDEPENDENCE RD 20 RT 0136	1					
58-S	15 RT 2174	1				8	
59-S	15 RT 4182	1				8	
60-S	15 RT 7130	1				8	
L-57	FROM 55-S TO 56-S			305			
L-58	" 56-S " 57-S			38			
L-59	" 57-S " 58-S			246			
L-60	" 58-S " 59-S			214			
L-61	" 59-S " 60-S			256			
L-62	" 60-S BULKHEAD			65	151		
L-72	" EXIST 8" PIPE TO P-20						56
P-20	INDEPENDENCE RD B+21		1				
	TOTAL	5	1	1214	151	24	56

NOTE:
ALL WORK PERFORMED ON REPUBLIC STEEL CO. PROPERTY SHALL BE IN CONFORMANCE WITH REPUBLIC'S PLANT AND PROTECTION RULES, SAFETY RULES GSO-2 AND GSO-18 AND UNDER ANY DIRECTIONS OF REPUBLIC'S CLEVELAND DISTRICT CHIEF ENGINEER. COPIES OF THESE RULES ARE ON FILE AT THE DIVISION 12 OFFICE OF THE OHIO DEPARTMENT OF HIGHWAYS; THE OFFICE OF CONTRACT SALES, COLUMBUS, OHIO; OR THE GENERAL OFFICES OF REPUBLIC STEEL CORPORATION, REPUBLIC BUILDING, CLEVELAND 1, OHIO.
ALL OPEN EXCAVATIONS SHALL BE PROTECTED BY BARRICADES AND APPROPRIATE WARNING LIGHTS.

NOTE--
REMOVAL OF STORED MATERIAL:
THE CONTRACTOR, BEFORE BIDDING AND AFTER VISITING THE SITE OF THE BOX CULVERT AT TURN BASIN, SHALL CONSULT WITH THE PROPERTY OWNER (REPUBLIC STEEL CO.) TO DETERMINE THE AMOUNT OF MATERIAL NOW STORED IN THE CONSTRUCTION AREA AND INGRESS AND EGRESS AREA, AS SHOWN ON SHEET NO. 204, THAT MUST BE REMOVED IN ORDER TO CARRY ON THE CONTRACTOR'S OPERATIONS.
THE REMOVAL, TEMPORARY STORAGE AND SUBSEQUENT RETURN OF THIS MATERIAL SHALL BE PERFORMED BY THE PROPERTY OWNER AT THE CONTRACTOR'S EXPENSE. THE LUMP SUM BID PRICE FOR "ITEM SPECIAL, REMOVAL OF STORED MATERIAL" SHALL CONSTITUTE FULL PAYMENT TO THE CONTRACTOR FOR THE COST OF PERFORMING THE ABOVE WORK AS WELL AS ANY REMOVAL AND REPLACEMENT OF FENCES AND REHABILITATION OF THE CONSTRUCTION AND ACCESS AREAS.

NOTE: WORK THIS SHEET WITH SHEET 77

* NOTE THE CONTRACTORS PARTICULAR ATTENTION IS CALLED TO THE EXISTENCE OF 2-6" AND 1-8" STANDARD OIL COMPANY PIPE LINES CARRYING FUEL OIL AND GASOLINE IN THE VICINITY OF INDEPENDENCE ROAD AND DILLE ROAD. ALSO 2-12" AND 2-8" STANDARD OIL COMPANY PIPE LINES NEAR THE CUYAHOGA RIVER TURN BASIN. CONTRACTOR SHALL NOTIFY STANDARD OIL COMPANY 24 HOURS IN ADVANCE OF PERFORMING ANY WORK IN THESE AREAS AND SHALL USE SUCH PRECAUTIONARY MEASURES THAT ARE NECESSARY TO PROTECT THESE AND OTHER EXISTING LINES.
THE COST OF THIS OPERATION SHALL BE INCLUDED IN THE UNIT PRICE FOR THE PERTINENT ITEM.

NOTE: SEE SHEET 77 FOR TUNNEL SECTION

SHEET	LOCATION	TRENCH WIDTH	E-8 REMOVAL & DISPOSAL OF EXISTING PAVEMENT	I-22 6" SUBBASE	B-70 9" PORTLAND CEMENT CONCRETE BASE COURSE	T-35 1½" ASPHALTIC CONCRETE SURFACE COURSE	T-30 BITUMINOUS TACK COAT 0.10 GAL/SY.
			S.Y.	C.Y.	C.Y.	C.Y.	GAL.
77&78	54 S – 55 S	9.66'	361	60	90	12	36
78	55 S – 56 S	9.66'	424	71	106	15	42
78	56 S – EDGE	9.66'	19	3	5	1	2
78	59 S – 60 S	VARIES	157	26	39	6	16
	TOTAL		961	160	240	34	96

TRYGVE HOFF & ASSOCIATES
ENGINEERS
1922 EAST 107TH STREET CLEVELAND, OHIO

STORM SEWER
DILLE ROAD

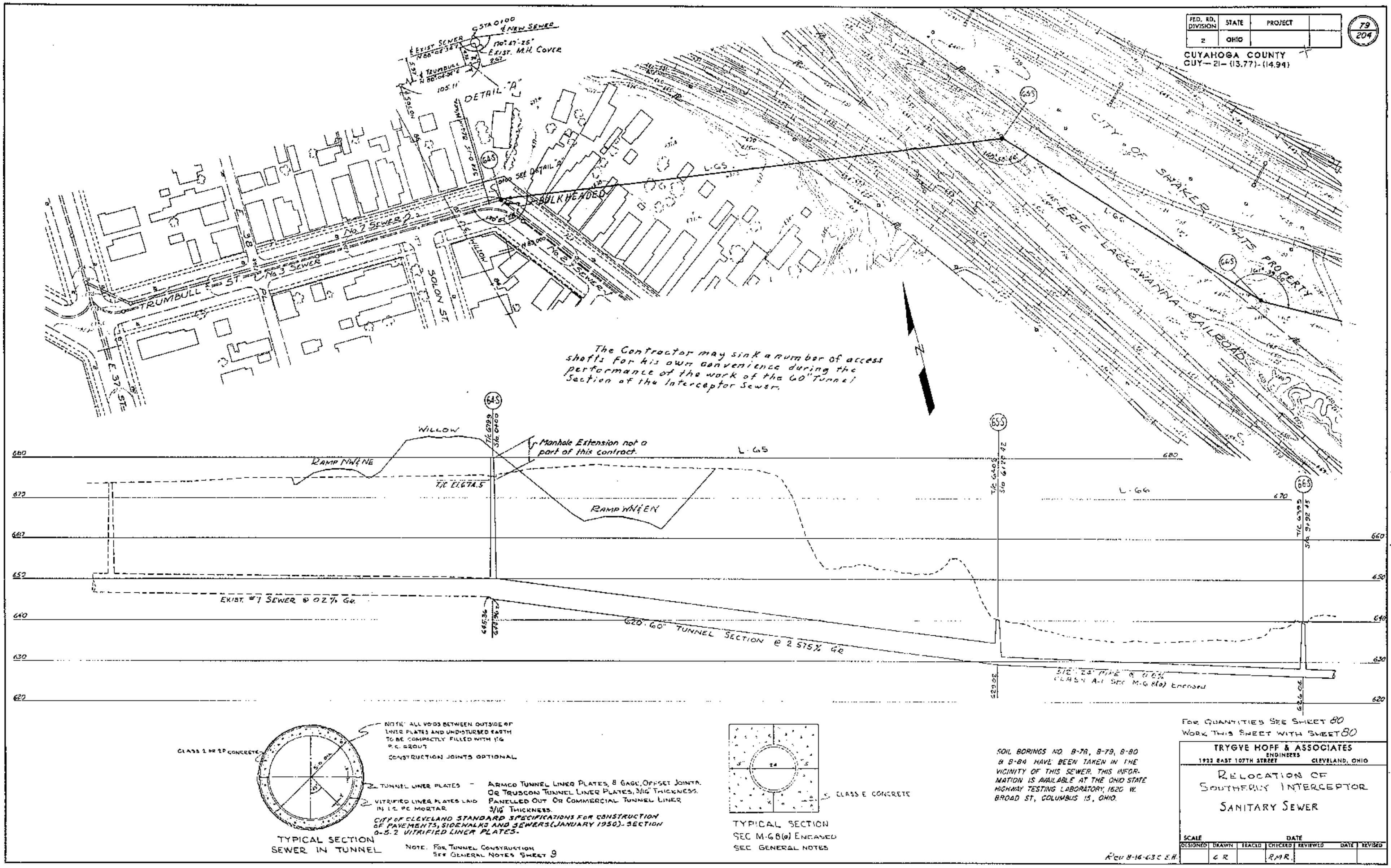
SCALE 1" = 50' HORZ.
1" = 10' VERT.

DESIGNED	DRAWN	TRACED	CHECKED	REVIEWED	DATE	REVISED

REV. 5-20-63

CONT. NO. 58019 SHEET ACCT. No. 6137

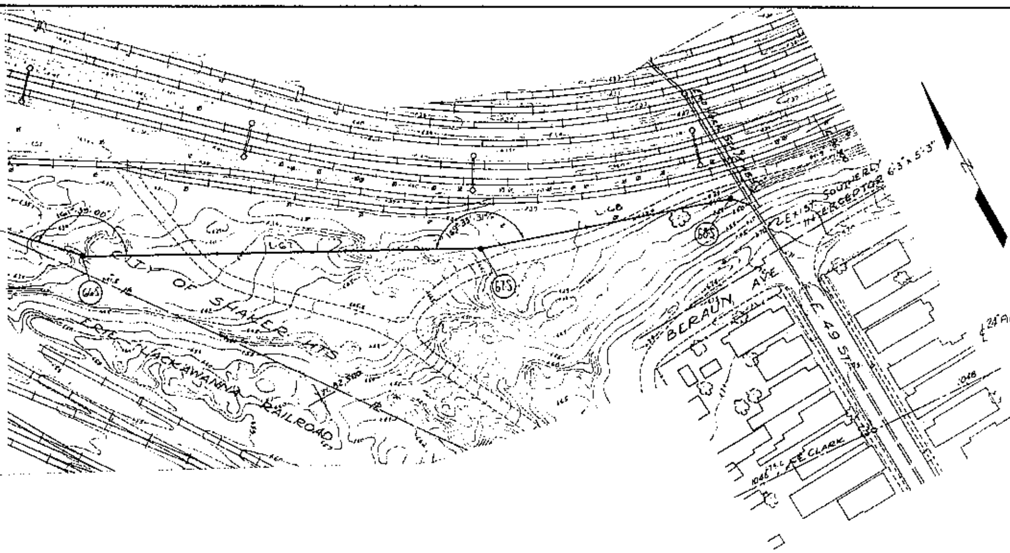
CONT. No. 58019 SHEET ACCT. No. 6134

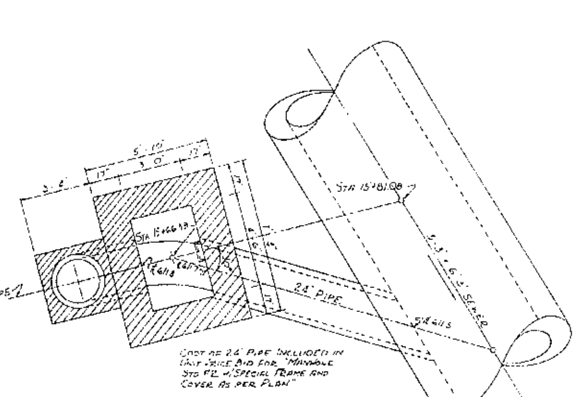


FED. RD. DIVISION	STATE	PROJECT		
2	OHIO			

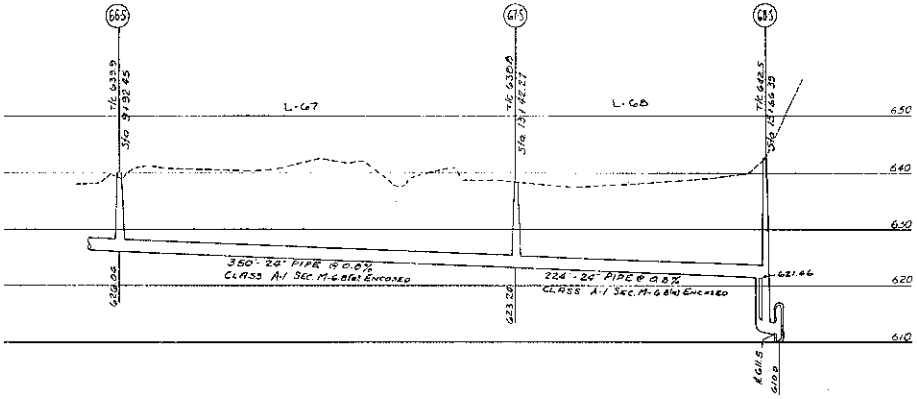
80/204

CUYAHOGA COUNTY
CUY—21—(13.77)-(14.94)





DETAIL OF MANHOLE AT STA 15+66.39
AND CONNECTION TO SOUTHERLY INTERCEPTOR



DRAINAGE QUANTITIES

MARK No	LOCATION	I-8: MANHOLE STD #2 W/SPECIAL FRAME & COVER AS PER PLAN WITHOUT DROP EACH	I-8: JUNCTION MANHOLE AS PER PLAN EACH	I-8: MANHOLE STD #2 W/SPECIAL FRAME & COVER AS PER PLAN EACH	I-1: 24" PIPE CLASS A-1 SEC. M-6 B(a) ENCASED AS PER PLAN LIN. FT.	SPL: 60" PIPE TUNNEL SECTION AS PER PLAN LIN. FT.
64.5	SOUTHERLY INTERCEPTOR STA. 0+00		1			
65.5	STA 64+20		1			
66.5	" STA 9+92	1				
67.5	" STA 13+42	1				
68.5	" STA 15+66			1		
L-65	FROM 64.5 TO 65.5					620
L-66	FROM 65.5 TO 66.5				372	
L-67	FROM 66.5 TO 67.5				350	
L-68	FROM 67.5 TO 68.5				224	
	TOTAL	2	2	1	946	620

WORK THIS SHEET WITH SHEET 79

TRYGVE HOFF & ASSOCIATES
ENGINEERS
1922 EAST 107TH STREET CLEVELAND, OHIO

RELOCATION OF
SOUTHERLY INTERCEPTOR
SANITARY SEWER

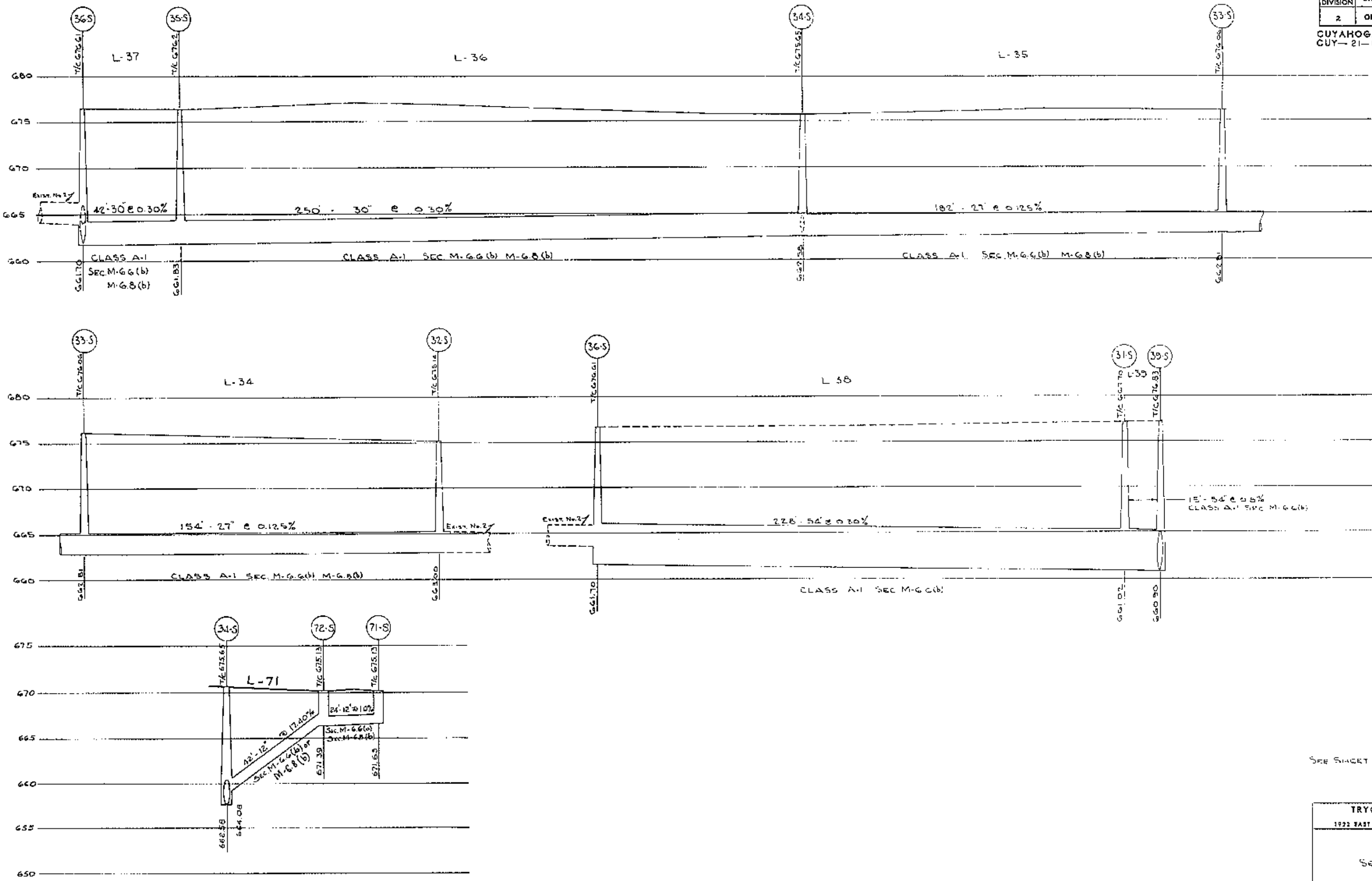
SCALE			DATE			
DESIGNED	DRAWN	TRACED	CHECKED	REVIEWED	DATE	REVISED
	C.R.		K.M.R.			

CONT. No. 58019 SHEET ACCT. No. 6135

FED. RD. DIVISION	STATE	PROJECT	
2	OHIO		

81/204

CUYAHOGA COUNTY
CUY—21—(13.77)-(14.94)



See Sheet 55 & 76 for Plan

TRYGVE HOFF & ASSOCIATES
ENGINEERS
1922 EAST 107TH STREET CLEVELAND, OHIO

SEWER PROFILE
ROAD "A"

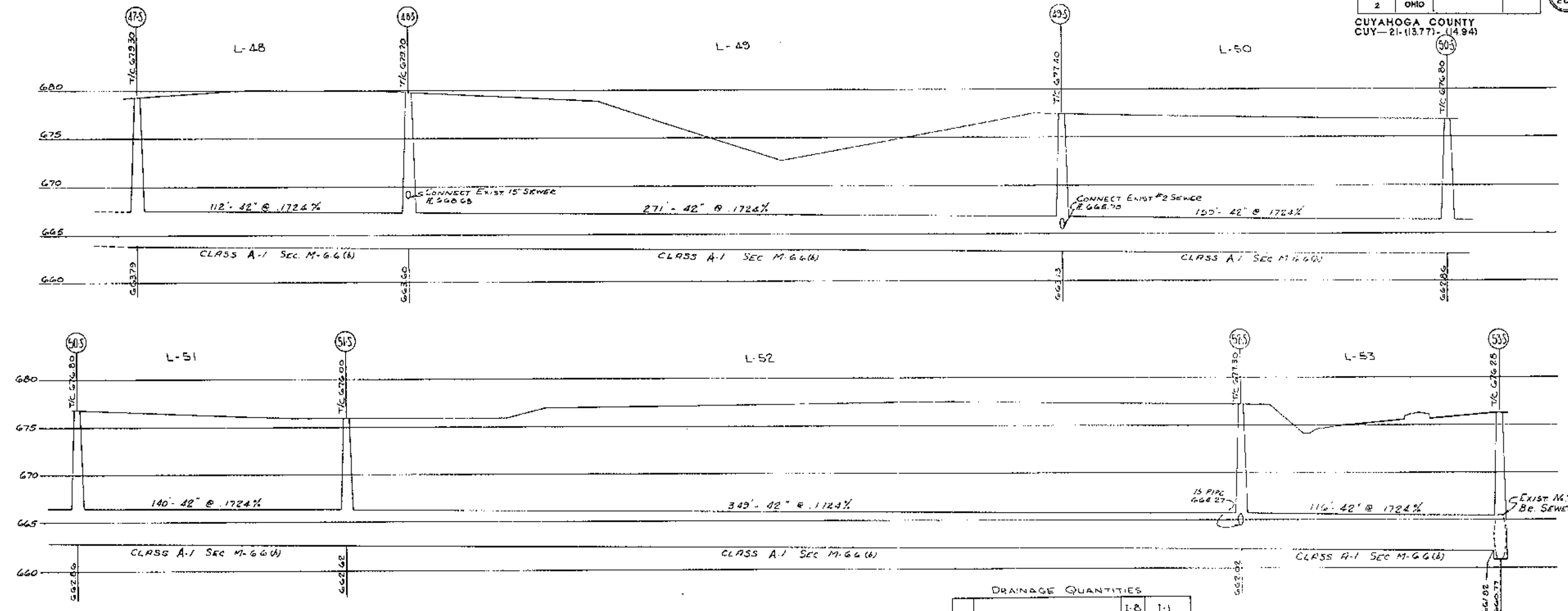
SCALE			DATE			
DESIGNED	DRAWN	TRACED	CHECKED	REVIEWED	DATE	REVISED
	C.K.		R.M.R.			

CONT. No 58019 SHEET No. 6310

FED. RD. DIVISION	STATE	PROJECT	
2	OHIO		

82/204

CUYAHOGA COUNTY
CUY—21-(13.77)-(14.94)



DRAINAGE QUANTITIES

MARK No	LOCATION	I-8 MANHOLE SPECIAL TYPE B AS PER PLAN EACH	I-1	42" PIPE CLASS A-1 SEC M-6.6(b) LIN FT
47-S	Ramp B-S 47 LT STA 13+06	1		
48-S	Ramp B-S 50 LT STA 14+19	1		
49-S	Ramp B-S 54 LT STA 16+96	1		
50-S	Ramp B-S 25 LT STA 18+53	1		
51-S	Ramp B-S 71 LT STA 19+86	1		
52-S	Ramp B-S 44 LT STA 23+34	1		
53-S	Broadway ℄ STA 64+70	1		
L-48	From 47-S To 48-S			112
L-49	From 48-S To 49-S			271
L-50	From 49-S To 50-S			150
L-51	From 50-S To 51-S			140
L-52	From 51-S To 52-S			349
L-53	From 52-S To 53-S			116
	TOTAL	7		1147

SEE SHEET 25 FOR PLANS

TRYGVE HOFF & ASSOCIATES
ENGINEERS
1922 EAST 107TH STREET CLEVELAND, OHIO

SEWER PROFILES

SCALE DATE

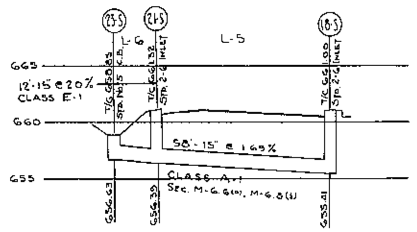
DESIGNED	DRAWN	TRACED	CHECKED	REVIEWED	DATE	REVISED
	C.R.		K.M.R.			

CONT. No. 58019 SHEET ACCT. No. 6304

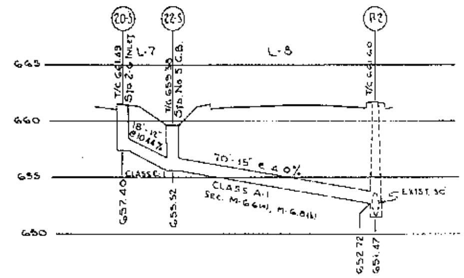
FED. RD. DIVISION	STATE	PROJECT	
2	OHIO		

B3
204

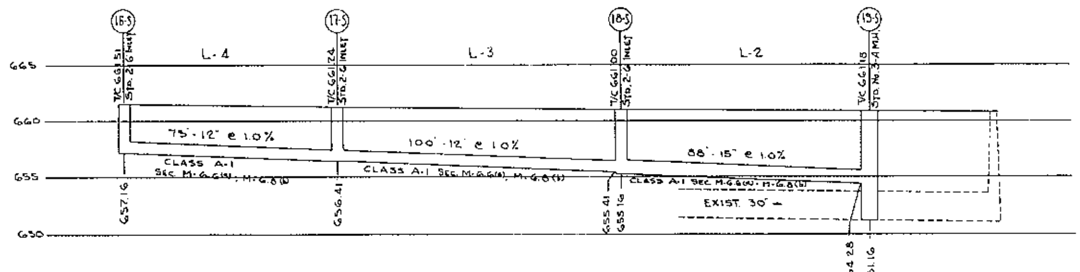
CUYAHOGA COUNTY
CUY— 21— (13.77)-(14.94)



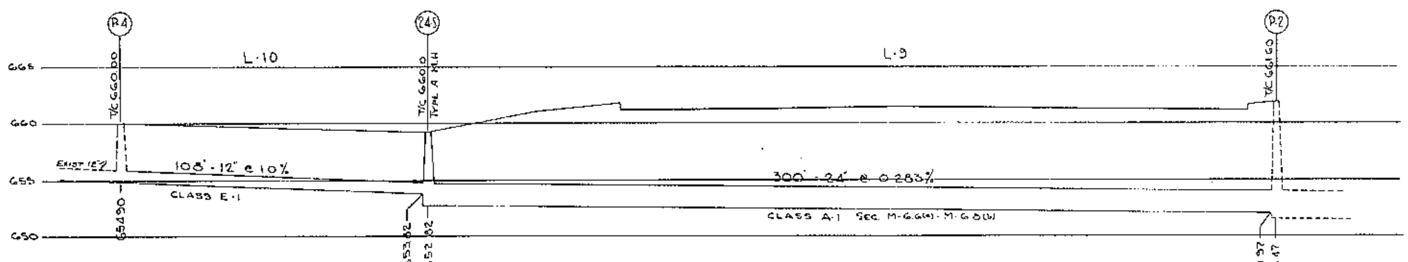
SEE SHEET 17 FOR PLAN



SEE SHEET 17 FOR PLAN



SEE SHEET 17 FOR PLAN



SEE SHEET 17 FOR PLAN

TRYGVE HOFF & ASSOCIATES
ENGINEERS
1922 EAST 107TH STREET CLEVELAND, OHIO

SEWER PROFILES

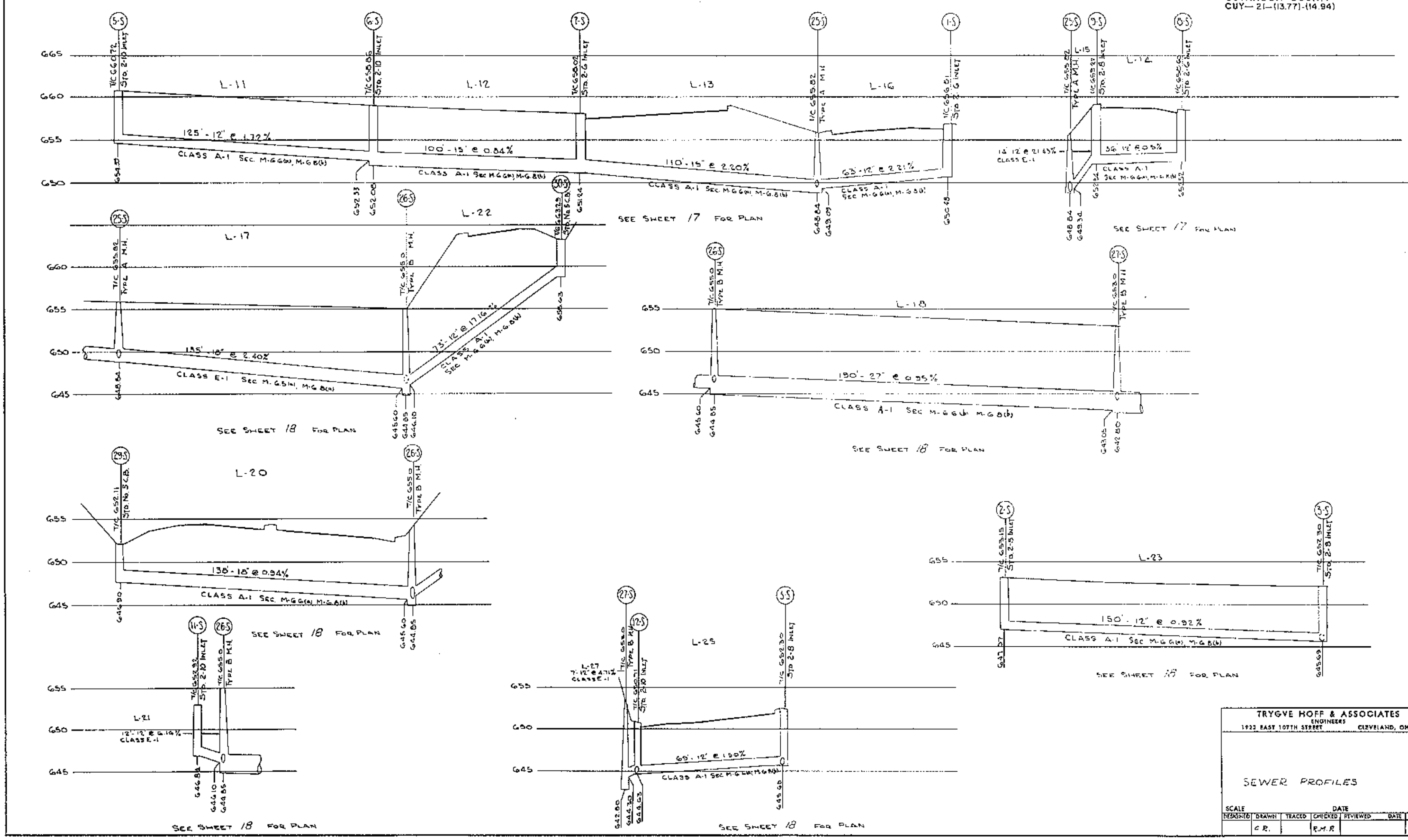
SCALE				DATE		
DESIGNED	DRAWN	TRACED	CHECKED	REVIEWED	DATE	REVISED
	C.R.		R.M.R.			

CONT. No. 58019 SHEET ACCT. No. 63-14

FED. RD. DIVISION	STATE	PROJECT
2	OHIO	

84/204

CUYAHOGA COUNTY
CUY— 21—(13.77)-(14.94)



TRYGVE HOFF & ASSOCIATES
ENGINEERS
1922 EAST 107TH STREET CLEVELAND, OHIO

SEWER PROFILES

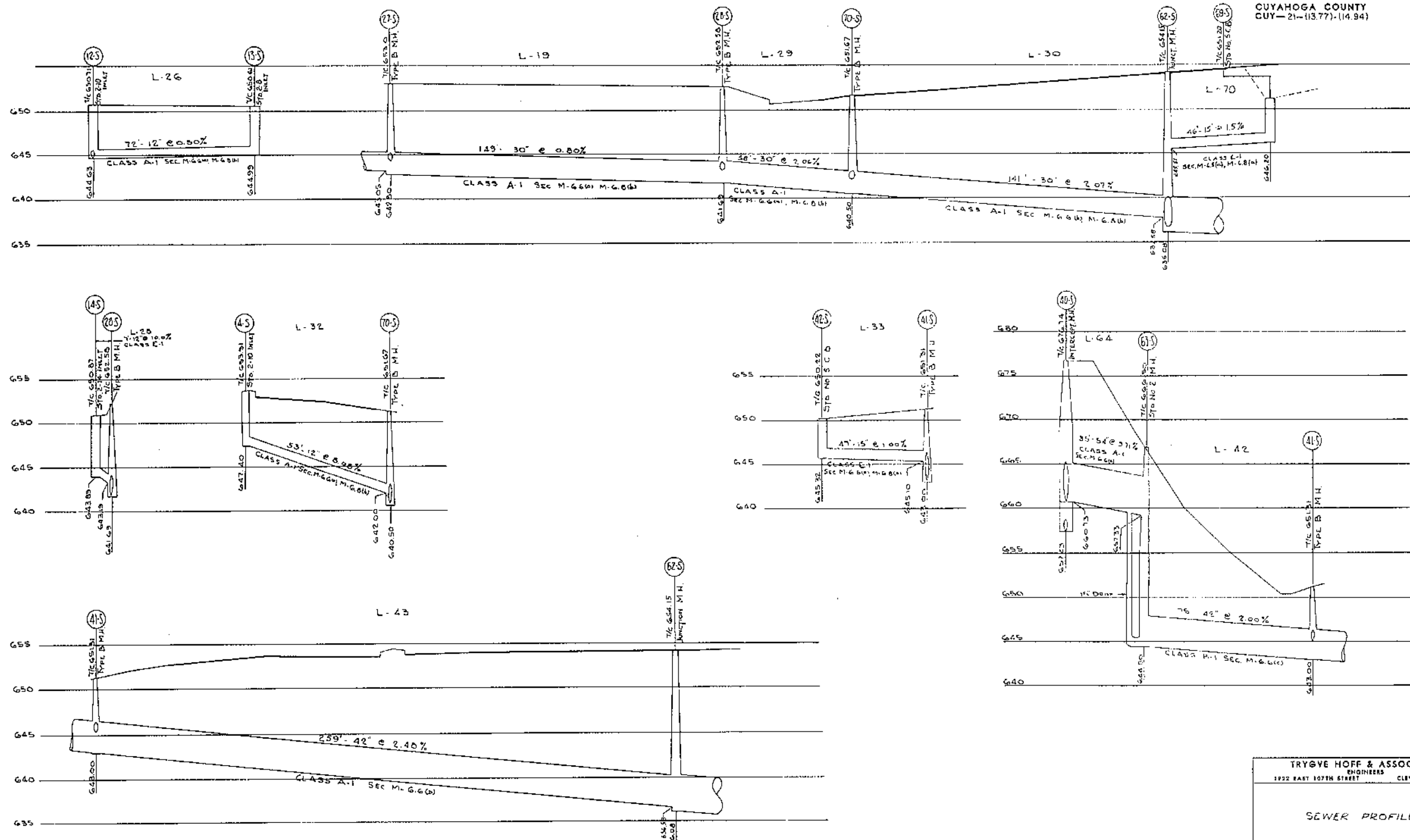
SCALE					DATE	
DESIGNED	DRAWN	TRACED	CHECKED	REVIEWED	DATE	REVISED
	C.R.		R.M.R.			

CONT. No. 58019 SHEET 2021 of 2305

FED. RD. DIVISION	STATE	PROJECT	
2	OHIO		

85/204

CUYAHOGA COUNTY
CUY—21—(13.77)-(14.94)



See Sheet 13 for Plan

TRYGVE HOFF & ASSOCIATES
ENGINEERS
1932 EAST 107TH STREET CLEVELAND, OHIO

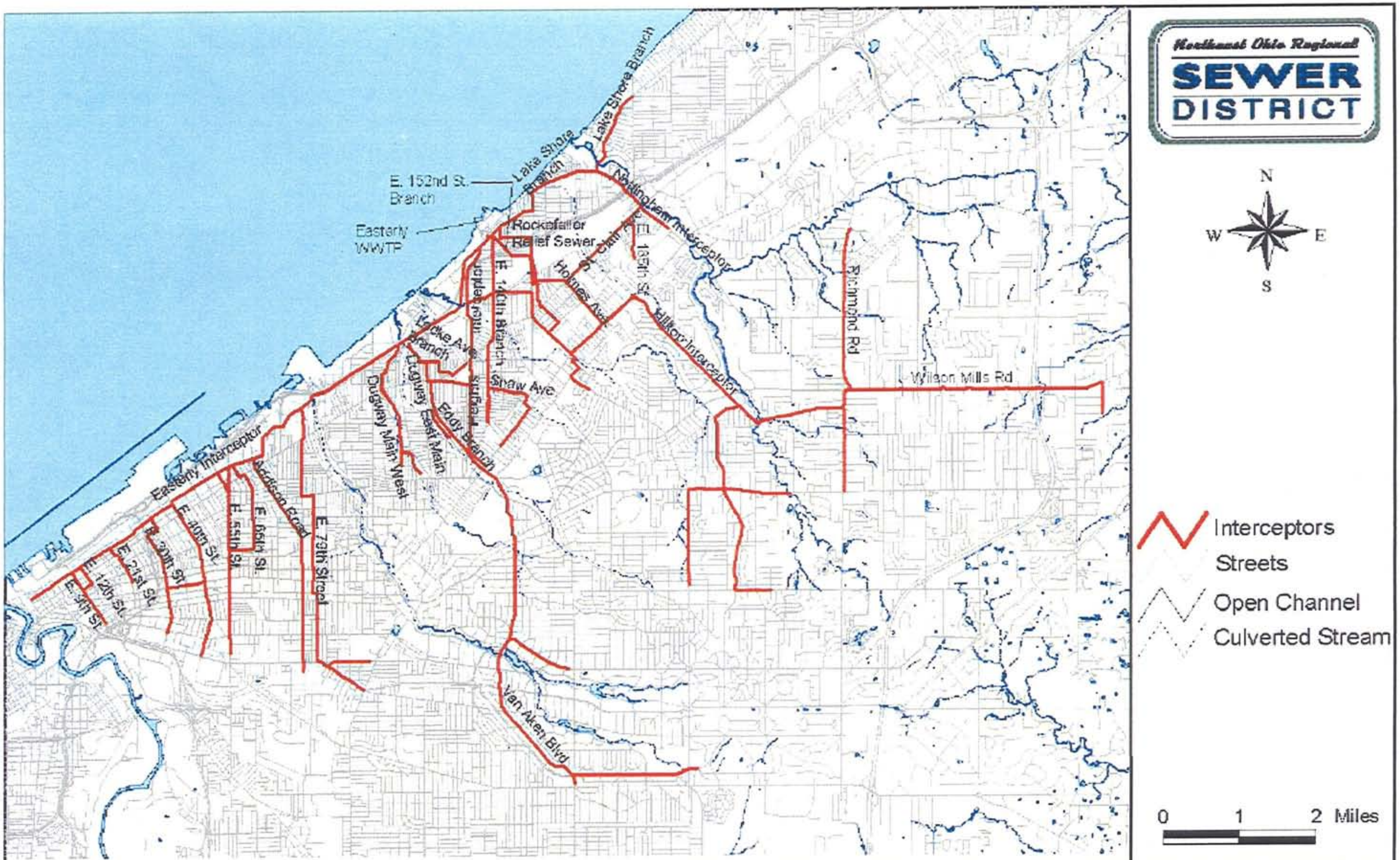
SEWER PROFILES

SCALE			DATE			
DESIGNED	DRAWN	TRACED	CHECKED	REVIEWED	DATE	REVISED
	G.R.		R.M.R.			

CERT. No. 58019 SHE ACCT. No. 6315

Appendix R

Northeast Ohio Regional Sewer District Easterly CSO Phase II Facilities Plan, **June 2009.**
Report Figures 2-1, 2-3, 2-9, and 2-10.

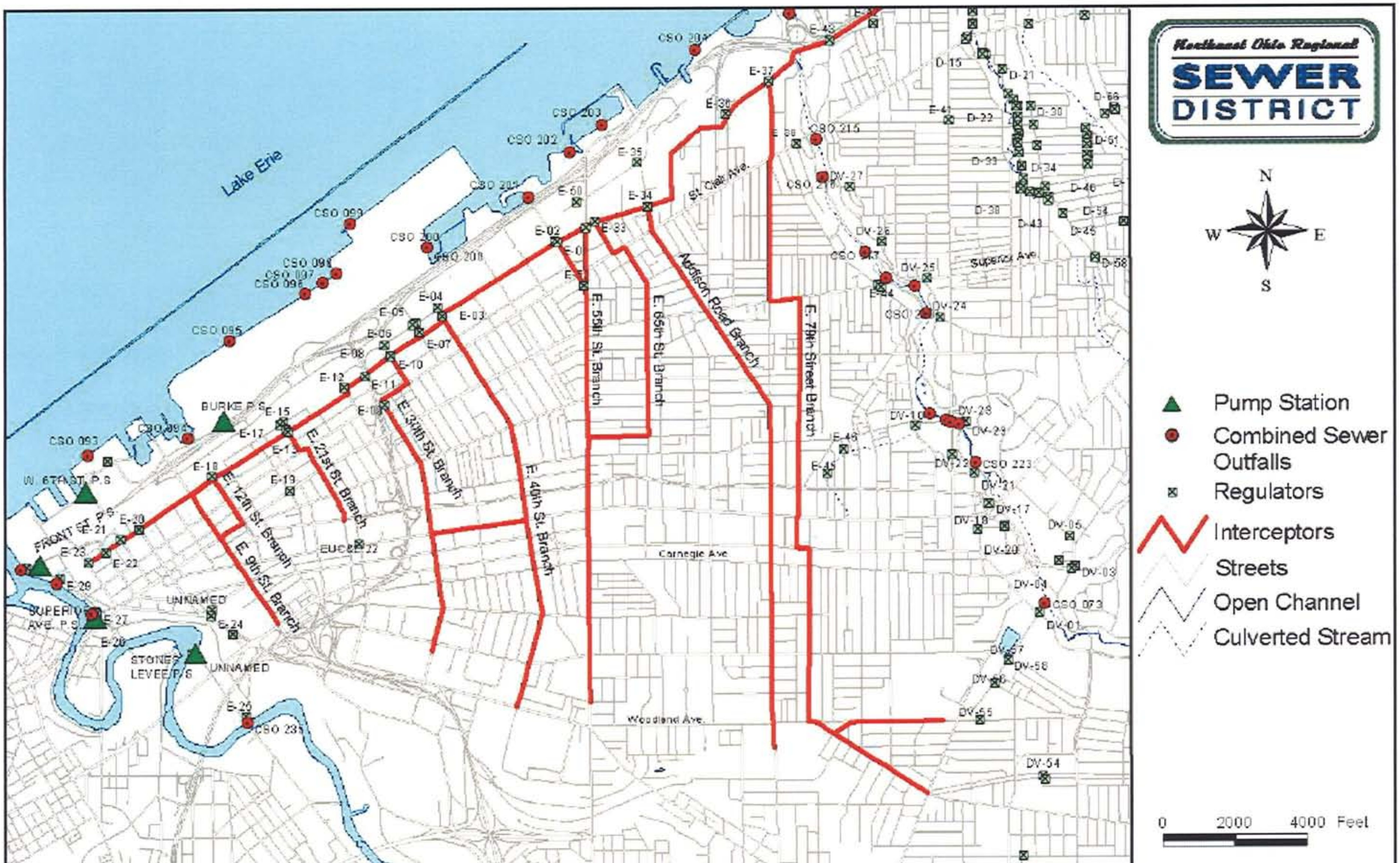


Metcalf & Eddy

Easterly CSO Hydraulic Modeling Report

CH2MHILL

Figure 2-1. Interceptors in Easterly District

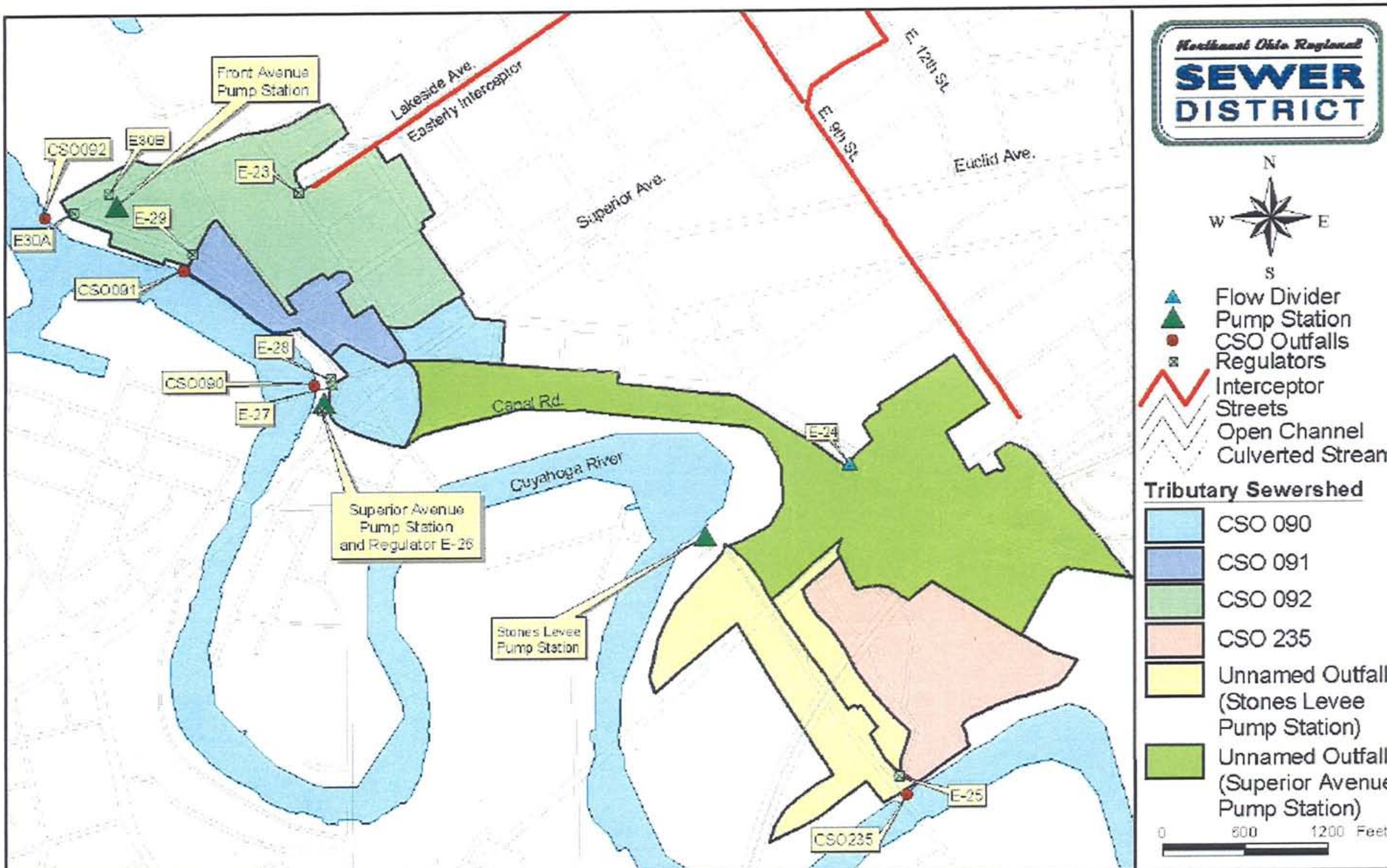


Easterly CSO Hydraulic Modeling Report

Figure 2-3. Easterly Interceptor Branches

Metcalf & Eddy

CH2MHILL

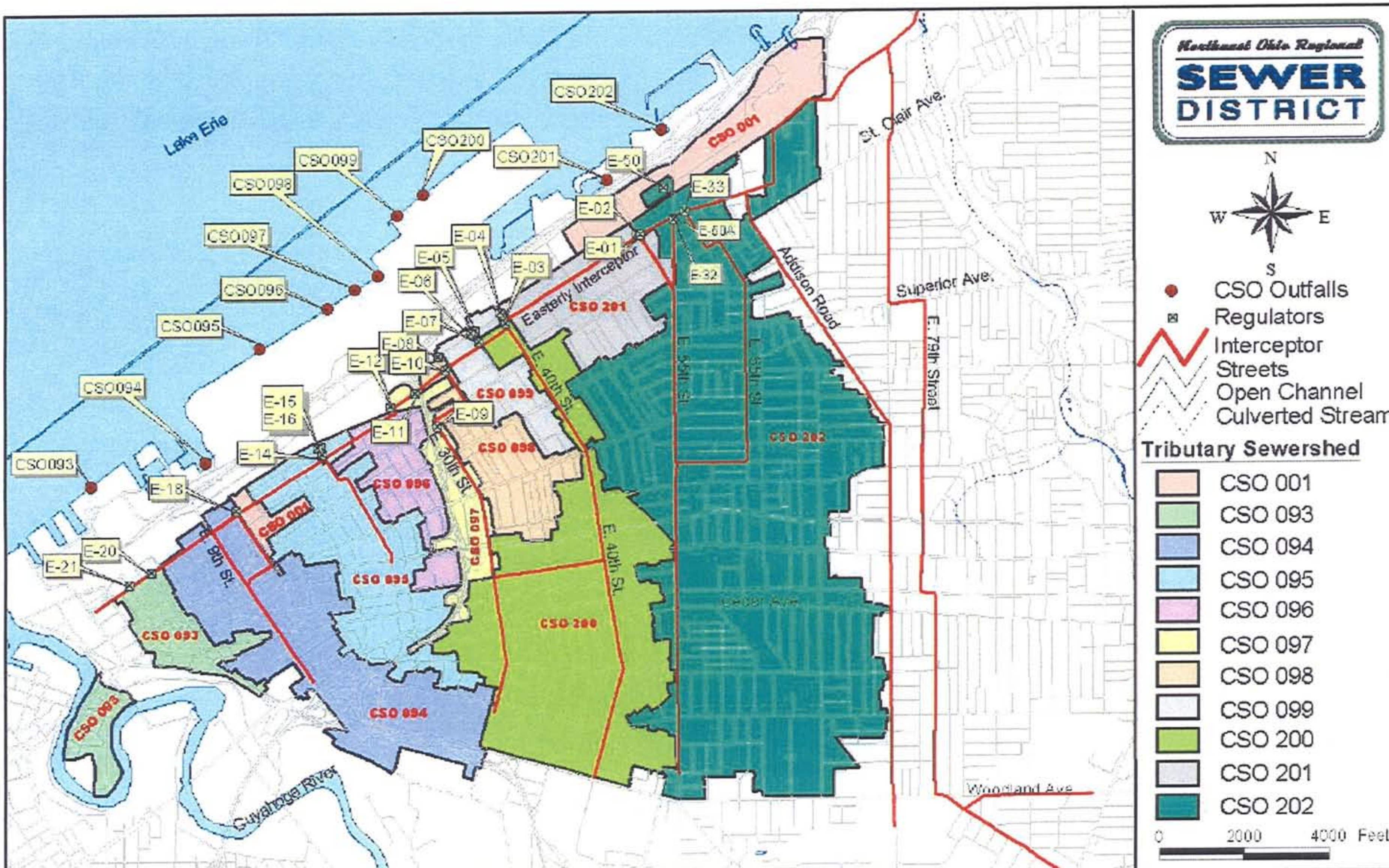


Metcalf & Eddy

Easterly CSO Hydraulic Modeling Report

CH2MHILL

Figure 2-9. Cuyahoga River CSO Outfalls



Metcalf & Eddy

Easterly CSO Hydraulic Modeling Report

CH2MHILL

Figure 2-10.
Lake Erie CSO
Outfalls 093-202

Appendix S

Ohio Department of Transportation – CUY 42-18.29 (Willow Innerbelt Freeway Part 6) and CUY 42-18.24 (Willow Innerbelt Freeway Part 7A)

CUY-90-16.37± CUY-77-15.62±

210

S

THIS IMPROVEMENT IS ESPECIALLY DESIGNED FOR THROUGH TRAFFIC AND HAS BEEN DECLARED A LIMITED ACCESS HIGHWAY OR FREEWAY BY ACTION OF THE DIRECTOR OF HIGHWAYS IN ACCORDANCE WITH THE PROVISIONS OF SECTION 5511.02 REVISED CODE OF OHIO.

STATE OF OHIO
DEPARTMENT OF HIGHWAYS
CUY - 21 - 15.32
CUY - 42 - 18.42
CUYAHOGA COUNTY
CITY OF CLEVELAND
WILLOW INNERBELT FREEWAY
PART 7-A

NOTE: Since the Construction Plans for PART No 6, PART No 7-A and PART No 7-B are now Combined into ONE CONTRACT and PROJECT, the General Notes and Traffic Maintenance Notes of each of the aforesaid PARTS, shall apply in the general execution and completion of this COMBINED PROJECT.

FED. ROAD DIV. NO.	STATE	FEDERAL AID PROJECT NO.	TYPE FUNDS
2	OHIO	I-71-5(8)248 I-77-5(1)162	

1 / 181

CUY-21-15.32
CUY-42-18.42

MICROFILMED JUL 3 1995

I - 71 - 5(8) 248
I - 77 - 5(1) 162
LIMITED ACCESS

PART 7-A

For Part 6, see plans for CUY-42-18.29
For Part 7-B, see plans for CUY-42-18.77

COMBINED LINE DATA

LENGTH OF PROJECT PART 6 [I-71-5(6)247]	= 668.53'	= 0.124 MILE
LENGTH OF PROJECT PART 7-A [I-77-5(1)162]	= 1203.24'	= 0.227 MILE
LENGTH OF PROJECT PARTS 7-A&B [I-71-5(8)248]	= 4643.78'	= 0.879 MILE
TOTAL LENGTH OF PROJECTS	= 6,515.55'	= 1.234 MILES
LENGTH OF WORK PART 6 [I-71-5(6)247]	= 3885.53'	= 0.735 MILE
LENGTH OF WORK PART 7-A [I-77-5(1)162]	= 1895.12'	= 0.358 MILE
LENGTH OF WORK PARTS 7-A&B [I-71-5(8)248]	= 10,577.65'	= 2.003 MILES
TOTAL LENGTH OF WORK	= 16,358.30'	= 3.098 MILES

INDEX OF SHEETS

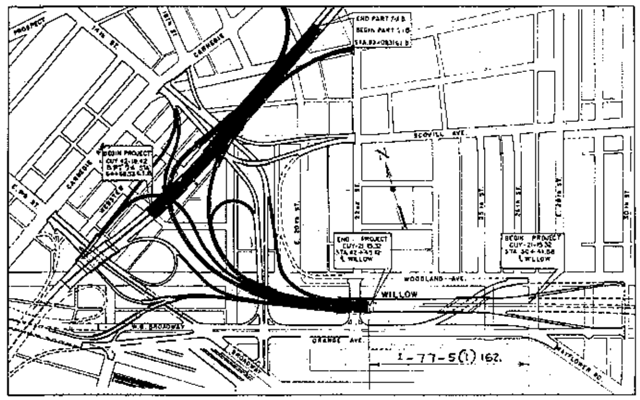
LINE DATA

LENGTH OF PROJECT

CUY-21-15.32 (WILLOW) I-77-5(1)162	STA 30+41.88 TO STA 42+45.12	= 1,203.24	= 0.227 MILE
CUY-42-18.42 (INNER BELT) Part 7-A	STA. 64+68.53 TO STA. 83+09.31	= 1,840.78'	
CUY-42-18.77 (INNER BELT) Part 7-B	STA 0-200 TO STA. 24+03	= 2303.00	
	TOTAL I-71-5(8)248	= 4643.78'	= 0.879 MILE

LENGTH OF WORK

CUY-21-15.32 (WILLOW) I-77-5(1)162	STA. 23+50 To STA. 42+45.12	= 1895.12'	= 0.358 MILE
CUY-42-18.42 (INNER BELT) Part 7-A	STA. 64+68.53 To STA. 83+09.31	= 1840.78'	
(E-15)	STA. 10+38 To STA. 13+29.43	= 291.03'	
(E-16)	STA. 12+57.31 To STA. 17+48.32	= 483.11'	
(WILLOW)	STA. 48+73.11 To STA. 42+45.12	= 641.57'	
CUY-42-18.77 (INNER BELT) Part 7-B	STA. 0-200 To STA. 70+56	= 7236.00'	
Add for Equation	STA 27+09.07 BL = STA. 26+61.13 AH	= 47.74'	
	TOTAL I-71-5(8)248	= 10,577.65' = 2.003 MILES	



DELIVERY POINT - N.Y.C. ST.L. R.R. BROADWAY TEAM TRACKS

AVERAGE HAUL 1/2 MILE

LOCATION PLAN

CONVENTIONAL SIGNS

PAVEMENT PLANS	SHEET 15
DRAINAGE PLANS	SHEET 31
LIGHTING PLANS	SHEET 43
EXISTING UTILITIES	SHEET 53

0 400 800 1200 1600
SCALE IN FEET

PORTION TO BE IMPROVED
OTHER HIGHWAYS & STREETS

THE STANDARD SPECIFICATIONS OF THE STATE OF OHIO DEPARTMENT OF HIGHWAYS, INCLUDING CHANGES AND SUPPLEMENTAL SPECIFICATIONS LISTED IN THE PROPOSAL SHALL GOVERN THIS IMPROVEMENT.

I HEREBY APPROVE THESE PLANS AND DECLARE THAT THE MAKING OF THIS IMPROVEMENT WILL NOT REQUIRE THE CLOSING TO TRAFFIC OF THE HIGHWAY AND THAT PROVISIONS FOR THE MAINTENANCE AND SAFETY OF TRAFFIC WILL BE AS SET FORTH IN THE PLANS AND ESTIMATES.

THE RIGHT OF WAY FOR THIS IMPROVEMENT WILL BE PROVIDED BY THE STATE OF OHIO.

APPROVED DATE 2/18/59 — Louis L. Drassler — DIRECTOR OF PUBLIC SERVICE, CITY OF CLEVELAND
APPROVED DATE 12/12/59 — Wm. B. Henry — DIVISION DEPUTY DIRECTOR
APPROVED DATE 3-11-60 — DEPUTY DIRECTOR OF PLANNING AND PROGRAMMING
APPROVED DATE 3-4-60 — ENGINEER OF BRIDGES
APPROVED DATE 3-9-60 — ENGINEER OF LOCATION AND DESIGN
APPROVED DATE 3-9-60 — C.W. McCaughey — DEPUTY DIRECTOR OF DESIGN AND CONSTRUCTION
APPROVED DATE 3-9-60 — G.L. Berry — FIRST ASSISTANT DIRECTOR
APPROVED DATE 3-9-60 — DIRECTOR OF HIGHWAYS

SCALES

PLAN	1" = 50'
PROFILE HORIZONTAL	1" = 100'
" VERTICAL	1" = 10'
CROSS SECTIONS	1" = 10'

Sheets 116, 131, 132, 133 & 175 revised 6-17-60.
Sheets 109, 110, 111, 125, 126, 127 & 128 revised 6-20-60.
Sheets 141, 153 & 171 revised 7-22-60.
Sheet 12 revised 8-12-60 REC.
Sheets 146, 147, 150, 155, 156 & 171 revised 7-21-60.
Sheet 162 revised 12-6-60.
Sheet 144 revised 1-12-61.

STANDARD DRAWINGS

NUMBER	DATE	NUMBER	DATE
DR-1	3-55	I.H.S. No. 1	11-3-58
AP-1-57	2-2-59	I-15 No. 6	7-1-59
		I-15 No. 1	8-21-59
L-3	4-1-50	F-3	9-1-59
L-3-A	4-1-50	I-15 NO. 2A	5-21-59
RI-1	7-15-58	BT-50-70-71 (NO)	10-1-47
B-T-71 R	3-2-53	AS-1-54	12-1-54
LJ NO. 1	7-1-55	G-7.07	6-1-56
I-1, 2, 3, 4, & 5	4-24-58	F-1	9-1-59
I-RCB 2-2 & 6	3-2-59	I-12	7-1-54
I-8CB NO. 9-A	1-26-59	L-1	4-1-50
I-8CB NO. 6	1-26-59	LJ	5-1-56
I-8 MH NO. 1	1-26-59	T-35	1-2-56
I-8 MH NO. 2	1-26-59	I-14G	1-22-52
I-15 NO. 1	5-21-59	I-21-23	8-1-56
I-8CB NO. 3	1-26-59	I-8CB NO. 7	3-2-59
I-8CB NO. 3-A	1-26-59	I-8 I NO. 2-A	4-23-59
I-RMH NO. 1-A	1-26-59	I-8 I NO. 2	4-23-59
I-9 2B 2-3 & 2-4	7-26-59		
RD 1-55	2-?-59	RW-45	3-?-47

PREPARED AND RECOMMENDED BY
HOWARD, NEEDLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY CLEVELAND NEW YORK

H.G. SOURS
ASSOCIATE
COLUMBUS

00124

SUPPLEMENTAL SPECIFICATIONS

NUMBER	DATE	NUMBER	DATE
S-101	12-2-59	S-207	4-28-55
M-106.60 Rev.	4-1-58	B-219 Rev.	3-12-59
M-206.14	7-15-49	18 Rev.	6-15-59

FILE NO.	CUYAHOGA COUNTY SEC. CUY-21-15.32 & CUY-42-18.42 DATE OF LETTING 116 CONTRACT NO.

DEPARTMENT OF COMMERCE
BUREAU OF PUBLIC ROADS

APPROVED:

DIVISION ENGINEER DATE

MAR 22 1963

FED. ROAD DIV. NO.	STATE	FEDERAL AID PROJECT NO.	TYPE FUNDS

2
31

CUYAHOGA COUNTY
CITY OF CLEVELAND
CUY-42-18.42
CUY-21-15.32
SCHEMATIC PLAN

Note: Federal Aid Markers will be furnished and erected by State Forces on the Right at Beginning of each Project and on the Left at End of each Project prior to acceptance of this improvement.

Note: Typical Section of adjoining pavement is the same as the proposed construction.

MICROFILMED
JUL 8 1965

CUY-42-1843 — BRIDGE NUMBER 3

TYPE: Continuous welded steel girder with reinforced concrete deck and substructure.
SPANS: 90'-0", 123'-8½" & 89'-9" (along ℄ I.B.F.)
ROADWAY: 102'-0" f.f. parapets
LOADING: CF 2000 - Adequate for A.A.S.H.O. alternate loading
SKEW: Varies
SURFACE COURSE: 1" Monolithic Concrete
ALIGNMENT: 1°30' Curve left
APPROACH SLABS: AS-1-54 (25' Long)
SUPERELEVATION: .03' per ft.

CUY-21-1573 — BRIDGE NUMBER 9

TYPE: Continuous steel beam with reinforced concrete deck and substructure.
SPANS: 37'-4 1/16", 42'-1 9/16", 53'-1 11/16", & 32'-0 7/8" along ℄ E-15.
ROADWAY: Varies
LOADING: CF 2000 - Adequate for A.A.S.H.O. alternate loading.
SKEW: 6°43'20"
SURFACE: 1" Monolithic Concrete
ALIGNMENT: Tangent
APPROACH SLABS: AS-1-54 (25' Long)
SUPERELEVATION: Varies

CUY-21-1544 — BRIDGE NUMBER 11

TYPE: Continuous steel beam with reinforced concrete deck and substructure.
SPANS: 56'-0", 93'-0" & 56'-0"
ROADWAY: 112'-0" (Normal) f/f parapets
LOADING: CF 2000 - Adequate for A.A.S.H.O. alternate loading.
SURFACE COURSE: 1" Monolithic concrete
ALIGNMENT: Tangent
APPROACH SLABS: AS-1-54 (25' long)
SUPERELEVATION: None
SKEW: 56°00'

CUY-42-1854 — BRIDGE NUMBER 4

TYPE: Continuous welded steel girder with reinforced concrete deck and substructure.
SPANS: 55'-0", 88'-6", 99'-0", & 60'-0" along ℄ I.B.
ROADWAY: Varies
LOADING: CF 2000 - Adequate for A.A.S.H.O. alternate loading.
SKEW: Varies
SURFACE: 1" Monolithic Concrete
ALIGNMENT: 1°-30' Left Tangent
APPROACH SLABS: AS-1-54 (25' Long)
SUPERELEVATION: Varies

CUY-21-1559 — BRIDGE NUMBER 10

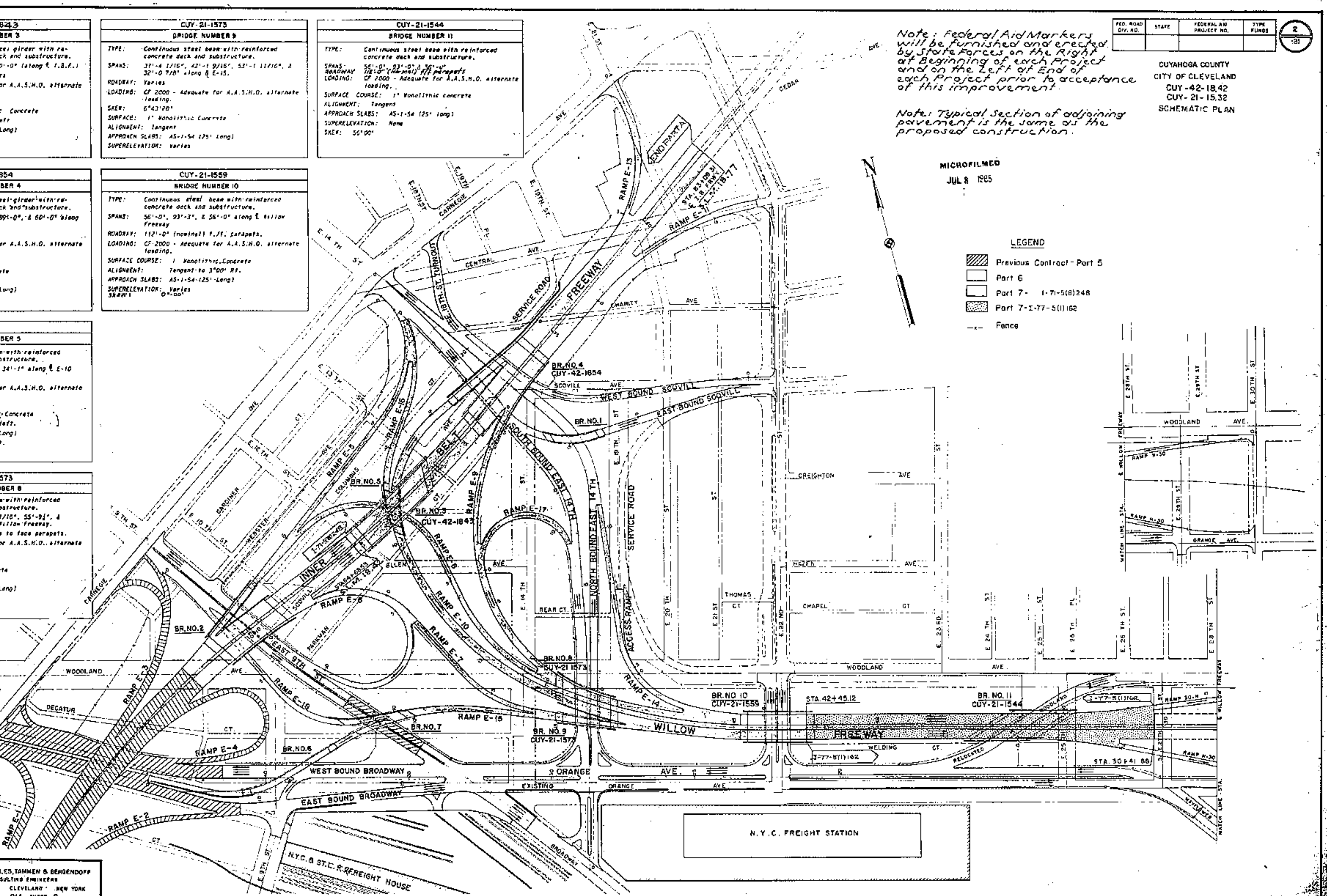
TYPE: Continuous steel beam with reinforced concrete deck and substructure.
SPANS: 56'-0", 93'-3", & 56'-0" along ℄ Willow Freeway
ROADWAY: 112'-0" (nominal) f.f. parapets.
LOADING: CF 2000 - Adequate for A.A.S.H.O. alternate loading.
SURFACE COURSE: 1" Monolithic Concrete
ALIGNMENT: Tangent to 3°00' Rt.
APPROACH SLABS: AS-1-54 (25' Long)
SUPERELEVATION: Varies
SKEW: 0°-00'

BRIDGE NUMBER 5

TYPE: Continuous steel beam with reinforced concrete deck and substructure.
SPANS: 31'-0 3/8", 48'-2½", 34'-1" along ℄ E-10
ROADWAY: Varies
LOADING: CF 2000 - Adequate for A.A.S.H.O. alternate loading.
SKEW: Varies
SURFACE-COURSE: 1" Monolithic Concrete
ALIGNMENT: 14°30' Curve left.
APPROACH SLABS: AS-1-54 (25' Long)
SUPERELEVATION: .00 ft. per ft.

CUY-21-1573 — BRIDGE NUMBER 8

TYPE: Continuous steel beam with reinforced concrete deck and substructure.
SPANS: 38'-7 5/16", 43'-10 1/16", 55'-9½", & 33'-11 3/8" along ℄ Willow Freeway.
ROADWAY: 84'-0" (nominal) face to face parapets.
LOADING: CF 2000 - Adequate for A.A.S.H.O. alternate loading.
SKEW: Varies
SURFACE: 1" Monolithic Concrete
ALIGNMENT: 3°00'00" Rt.
APPROACH SLABS: AS-1-54 (25' Long)
SUPERELEVATION: .05 ft./ft.



LEGEND

- Previous Contract - Part 5
- Part 6
- Part 7 - I-71-5(8)248
- Part 7 - I-77-5(I)162
- Fence

SCALE 1" = 150'
D'SGN. JES DATE 9/11/58
TR'CD. ___ DATE ___
CK'D. JLC DATE 3/3/59

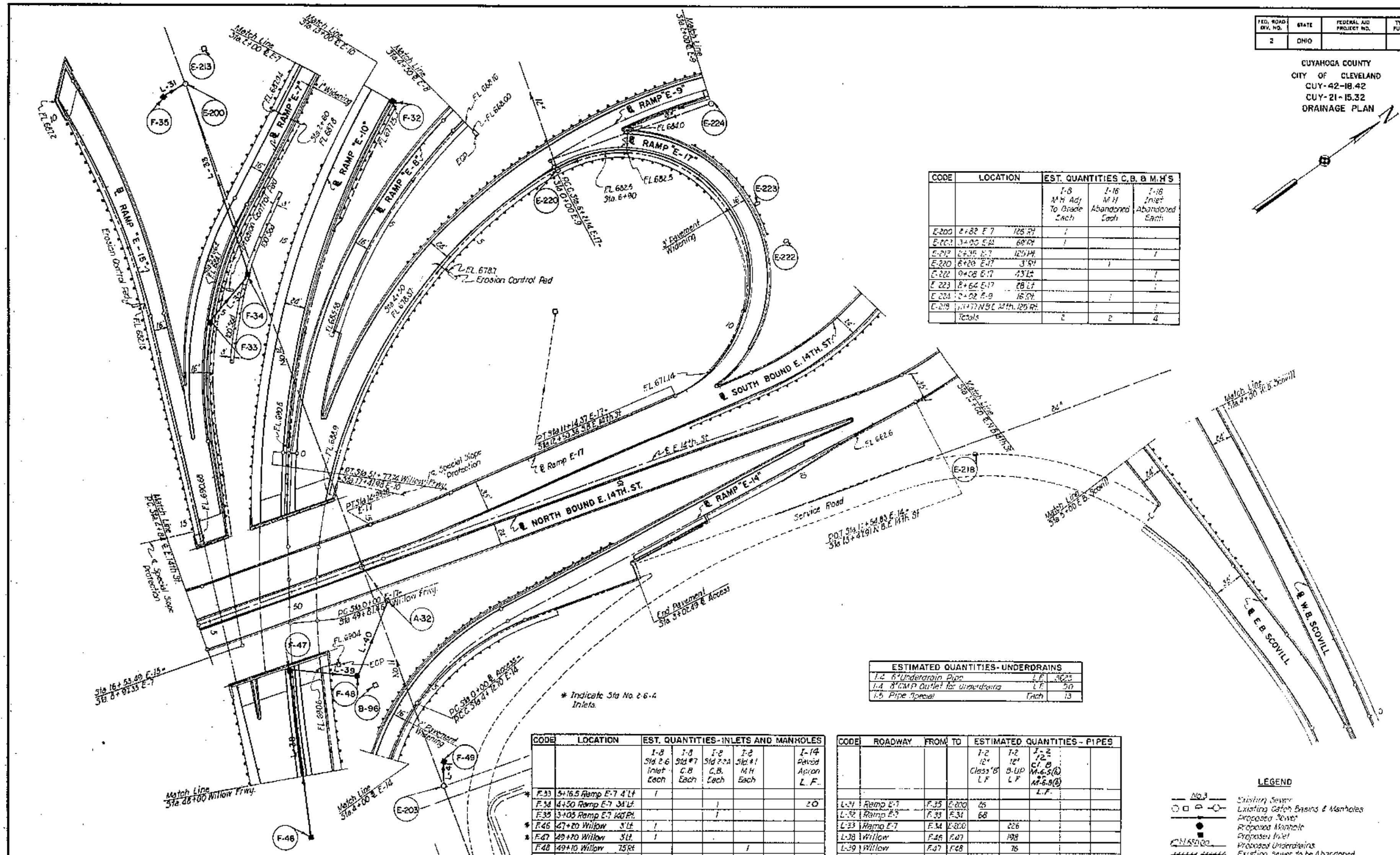
HOWARD, NEEDLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY CLEVELAND NEW YORK
914 SHEET 2

Rev. F.S.J. 12-18-59

FED. ROAD DIV. NO.	STATE	FEDERAL AID PROJECT NO.	TYPE FUNDS
2	OHIO		

33
181

CUYAHOGA COUNTY
CITY OF CLEVELAND
CUY-42-18.42
CUY-21-15.32
DRAINAGE PLAN



CODE	LOCATION	EST. QUANTITIES C.B. & M.H'S I-8 M.H. Adj. To Grade Each	I-16 M.H. Abandoned Each	I-16 Inlet Abandoned Each
E-200	2+82 E-7 125' Rt.	1		
E-203	3+00 E-14 69' Rt.	1		
E-213	2+35 E-7 125' Rt.			1
E-220	6+20 E-17 3' Rt.		1	
E-222	9+08 E-17 43' Lt.			1
E 223	8+64 E-17 28' Lt.			1
E 224	2+02 E-9 16' Rt.		1	
E-219	11+77 N.B.E. 14th. 125' Rt.			1
	Totals	2	2	4

ESTIMATED QUANTITIES - UNDERDRAINS		
I-4 6" Underdrain Pipe	L.F.	3625
I-4 8" C.M.P. Outlet for Underdrains	L.F.	50
I-5 Pipe Special	Each	13

* Indicate Std. No. 2-6-4 Inlets.

CODE	LOCATION	EST. QUANTITIES - INLETS AND MANHOLES I-8 Std. 2-6 Inlet Each	I-8 Std. #7 C.B. Each	I-2 Std. 2-2A C.B. Each	I-2 Std. #1 M.H. Each		I-14 Paved Apron L.F.
* F-33	5+16.5 Ramp E-7 4' Lt.	1					
F-34	4+50 Ramp E-7 34' Lt.			1			20
F-35	3+05 Ramp E-7 140' Rt.			1			
* F-46	47+20 Willow 3' Lt.	1					
* F-47	49+20 Willow 3' Lt.	1					
F-48	49+10 Willow 75' Rt.				1		
F-49	2+25 Ramp E-14 50' Rt.		1				
TOTAL CUY-42-18.42		3*	1	2	1		20

CODE	ROADWAY	FROM	TO	ESTIMATED QUANTITIES - PIPES I-2 12" Class "B" L.F.	I-2 12" B-UP L.F.	I-2 12" Cl. B M-6.5(b) or M-6.8(b) L.F.		
L-31	Ramp E-7	F-35	E-200	25				
L-32	Ramp E-7	F-33	F-34	68				
L-33	Ramp E-7	F-34	E-200		226			
L-38	Willow	F-46	F-47		198			
L-39	Willow	F-47	F-48		76			
L-40	Willow	F-48	A-32			92		
L-41	Ramp E-14	F-49	E-203	26				
TOTAL CUY-42-18.42				120	500	92		

LEGEND

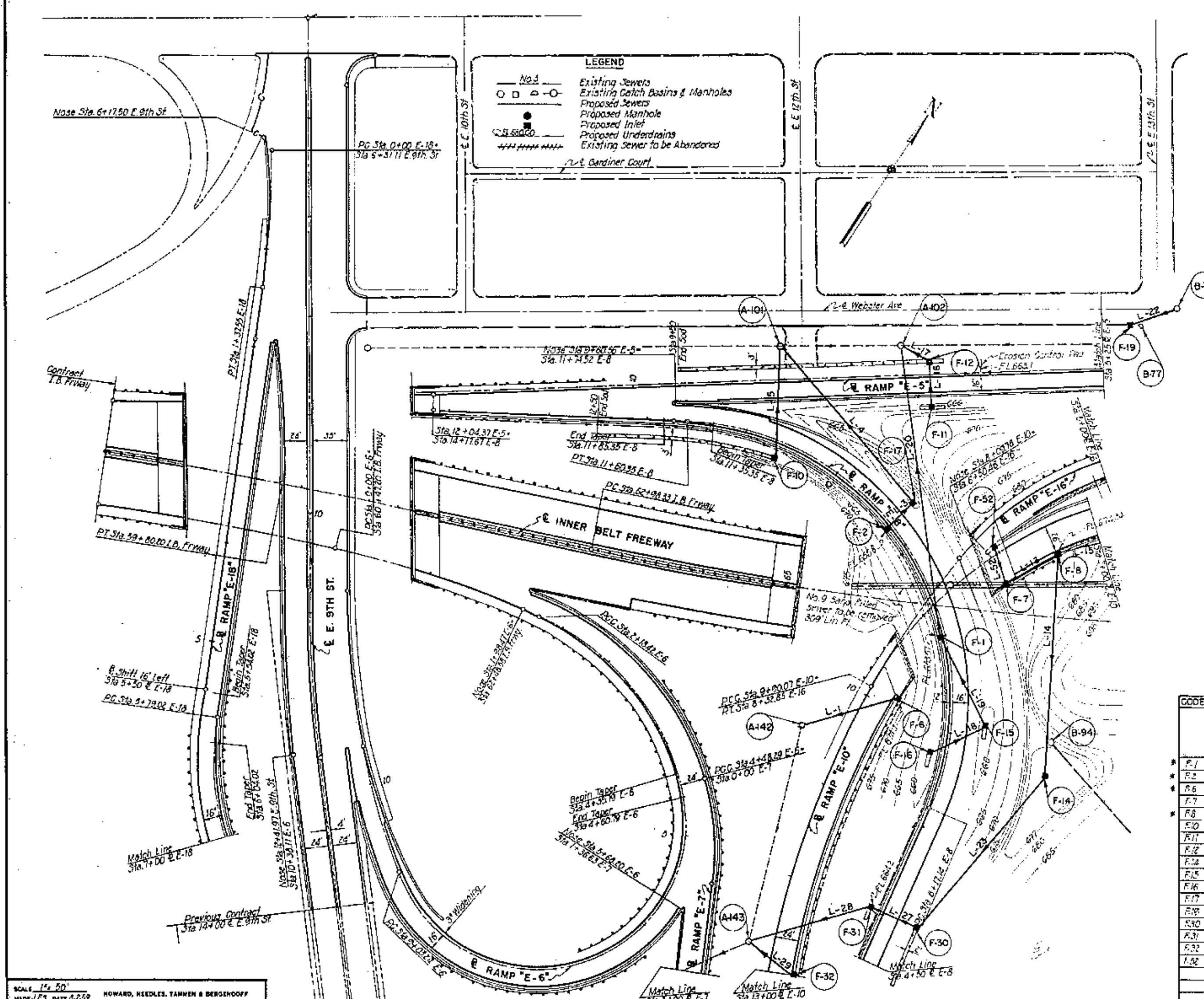
- No. 3 — Existing Sewer
- Existing Catch Basins & Manholes
- Proposed Sewer
- Proposed Manhole
- Proposed Inlet
- Proposed Underdrains
- Existing Sewer to be Abandoned
- E — Existing Drainage Structure
- F — Proposed Drainage Structure
- L — Proposed Sewer
- A — Proposed Drainage Structure, Part 6
- B — Existing Drainage Structure, Part 6

SCALE 1" = 30'
MADE [illegible] DATE [illegible]
TRCD. [illegible] DATE [illegible]
CKD. [illegible] DATE [illegible]

HOWARD, NEEDLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY CLEVELAND NEW YORK
914 SHEET 33

FED. ROAD DIV. NO.	STATE	FEDERAL AID PROJECT NO.	TYPE FUNDS	34 / 161
2	OHIO			

CUYAHOGA COUNTY
CITY OF CLEVELAND
CUY-42-18.42
CUY-21-15.32
DRAINAGE PLAN



ESTIMATED QUANTITIES-UNDERDRAINS		
I-4 6" Underdrain Pipe	L.F.	2025
I-4 6" CMP Outlet for Underdrains	L.F.	20
I-5 Pipe Special	Each	2

CODE	ROADWAY	FROM	TO	ESTIMATED QUANTITIES, PIPES						
				I-2 12" Class B L.F.	I-2 12" B-UP L.F.	I-2 15" Class B L.F.	I-2 15" B-UP L.F.	I-2 15" B-UP M-6.6(c) L.F.	I-2 12" Cl. B M-6.5(b) M-6.8(b)	I-2 18" B-UP M-6.6(c) L.F.
L-1	Ramp E-10	F-6	A-142		100					
L-3	Ramp E-5	F-2	F-17		34					
L-4	Ramp E-5	F-17	A-101					204		
L-5	Ramp E-8	F-10	A-101		110					
L-13	Ramp E-10	F-7	F-8		56					
L-14	I-B Freeway	F-8	F-14			222				
L-15	Ramp E-10	F-52	F-8	116						
L-16	Ramp E-5	F-11	F-12		46					
L-17	Ramp E-5	F-12	A-102						30	
L-18	Ramp E-8	F-16	F-15		56					
L-19	Ramp E-6	F-15	F-1				100			
L-20	Ramp E-8	F-1	A-102					296		
L-22	Ramp E-5	F-19	B-79		46					
L-23	Ramp E-8	F-14	F-30			200				
L-27	Ramp E-8	F-30	F-31				47			
L-28	Ramp E-10	F-31	A-143							124
L-29	Ramp E-10	F-32	A-143		54					
L-52	Ramp E-16	F-52	F-7		36					
TOTAL CUY-42-18.42				116	520	422	147	500	30	124

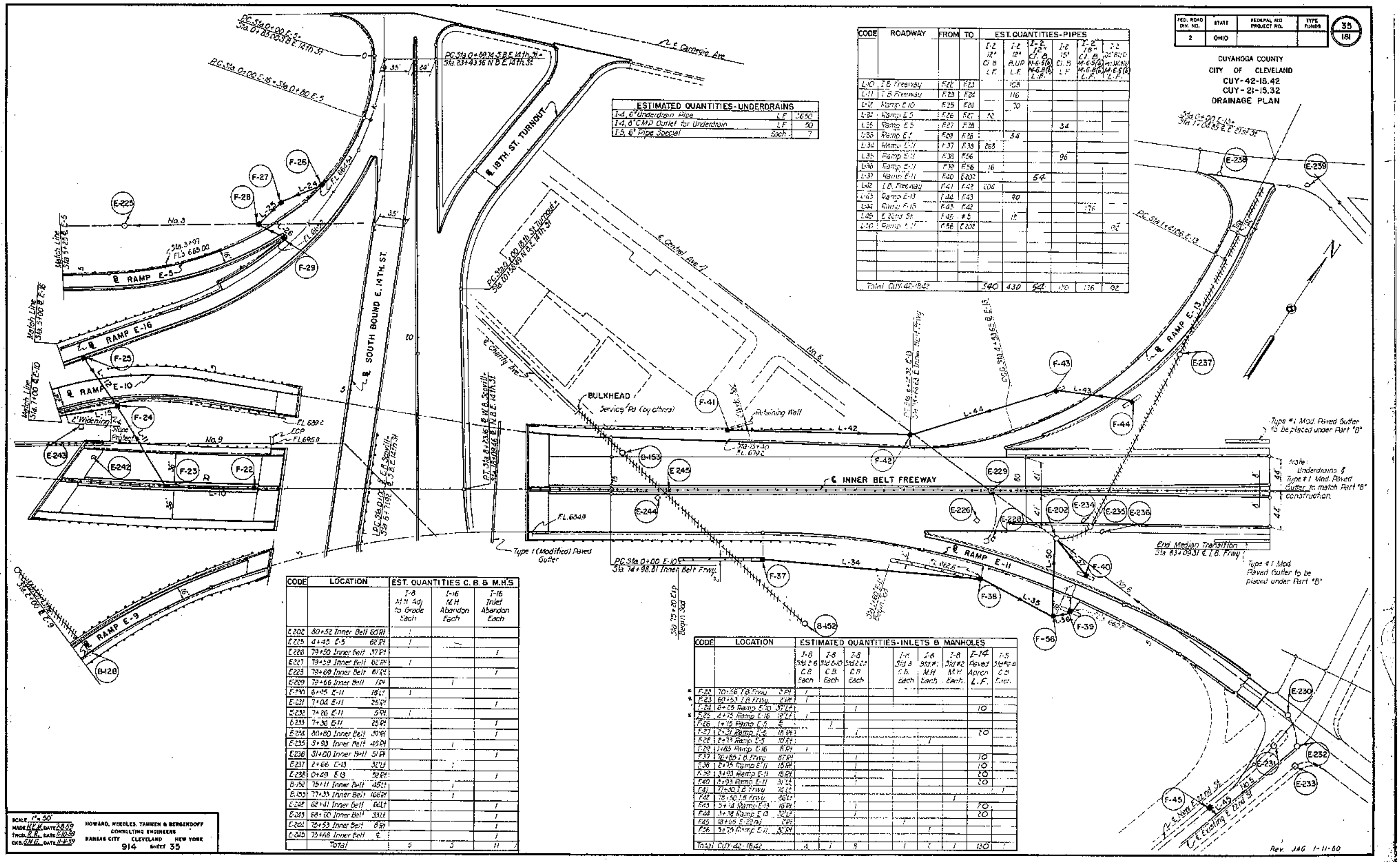
CODE	LOCATION	EST. QUANTITIES, CATCH BASINS, INLETS & M.H'S						
		I-8 Std 2-6 Inlet Each	I-8 Std 2-8 C.B. Each	I-8 Std 2-7A C.B. Each		I-8 Std #3 C.B. Each		I-14 Paved Apron L.F.
* F-1	2+95 Ramp E-8 5' Lt	1						
* F-2	9+85 Ramp E-5 5' Lt	1						
* F-6	9+85 Ramp E-10 29' Lt		1					
F-7	8+10 Ramp E-10 29' Lt	1						
* F-8	7+50 Ramp E-10 29' Lt	1						
F-10	10+65 Ramp E-8 18' Lt			1				10
F-11	6+97 Ramp E-5 30' Lt			1				20
F-12	6+97 Ramp E-5 18' Lt			1				20
F-14	5+78 Ramp E-8 100' Rt			1				
F-15	7+10 Ramp E-8 32' Rt			1				10
F-16	5+25 Ramp E-8 18' Lt			1				10
F-17	9+30 Ramp E-8 30' Rt			1				10
F-19	4+95 Ramp E-5 47' Rt					1		
F-30	5+00 Ramp E-8 37' Rt			1				10
F-31	5+00 Ramp E-8 15' Lt			1				10
F-32	13+00 Ramp E-10 17' Lt	1						
F-52	6+40 Ramp E-16 18' Lt	1						
TOTAL CUY-42-18.42		6	1	4		1		100

Note: Asterisked inlets are to be Std. 2-A inlets as per Standard drawing I-8 I & A 4-23-59.

Rev. A.E.K. 1-11-60

SCALE 1" = 50'
MADE J.F.S. DATE 8-2-59
TRCD. R.P. DATE 8-18-59
CKD. J.L.C. DATE 11-5-59

HOWARD, NEEDLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY CLEVELAND NEW YORK
914 SHEET 34



FED. ROAD DIV. NO.	STATE	FEDERAL AID PROJECT NO.	TYPE FUNDS
2	OHIO		

35 / 181

CUYAHOGA COUNTY
CITY OF CLEVELAND
CUY-42-18.42
CUY-21-15.32
DRAINAGE PLAN

ESTIMATED QUANTITIES-UNDERDRAINS		
I-4, 6" Underdrain Pipe	L.F.	3650
I-4, 6" CMP Outlet for Underdrain	L.F.	50
I-5, 6" Pipe Special	Each	7

CODE	ROADWAY	FROM	TO	EST. QUANTITIES-PIPES I-2 12" Cl. B L.F.	I-2 12" B.UP L.F.	I-2 12" Cl. B M-6.5(b) M-6.8(b) L.F.	I-2 15" Cl. B L.F.	I-2 18" Cl. B M-6.5(b) M-6.8(b) L.F.	I-2 24" B.UP M-6.6(b) L.F.
L-10	I.B. Freeway	F22	F23		105				
L-11	I.B. Freeway	F23	F26		116				
L-12	Ramp E-10	F25	F24		30				
L-24	Ramp E-5	F26	F27	32					
L-25	Ramp E-5	F27	F28				34		
L-26	Ramp E-5	F29	F26		34				
L-34	Ramp E-11	F37	F38	268					
L-35	Ramp E-11	F38	F56				96		
L-36	Ramp E-11	F39	F56	16					
L-37	Ramp E-11	F40	E202			54			
L-42	I.B. Freeway	F41	F42	208					
L-43	Ramp E-13	F44	F43		90				
L-44	Ramp E-13	F43	F42					176	
L-45	E. 22nd St.	F45	#5		12				
L-50	Ramp E-11	F56	E202						92
Total CUY-42-18.42				340	430	54	120	176	92

CODE	LOCATION	EST. QUANTITIES C.B. & M.H.S I-8 M.H. Adj. to Grade Each	I-16 M.H. Abandon Each	I-16 Inlet Abandon Each
E-202	80+52 Inner Belt 60'Rt	1		
E-225	4+45 E-5 62'Rt	1		
E-226	79+50 Inner Belt 37'Rt			1
E-227	79+59 Inner Belt 62'Rt	1		
E-228	79+69 Inner Belt 61'Rt			1
E-229	79+66 Inner Belt 1'Rt		1	
E-230	6+95 E-11 18'Lt	1		
E-231	7+04 E-11 25'Rt			1
E-232	7+26 E-11 5'Rt	1		
E-233	7+30 E-11 25'Rt			1
E-234	80+80 Inner Belt 37'Rt			1
E-235	81+93 Inner Belt 45'Rt		1	
E-236	81+00 Inner Belt 51'Rt			1
E-237	2+66 E-13 32'Lt		1	
E-238	0+49 E-13 52'Rt			1
B-152	75+11 Inner Belt 45'Lt		1	
E-153	77+33 Inner Belt 106'Rt		1	
E-242	62+41 Inner Belt 66'Lt			1
E-243	68+60 Inner Belt 33'Lt			1
E-244	75+53 Inner Belt 8'Rt			1
E-245	75+68 Inner Belt ℄			1
	Total	5	5	11

CODE	LOCATION	ESTIMATED QUANTITIES-INLETS & MANHOLES I-8 Std 2-6 C.B. Each	I-8 Std 2-10 C.B. Each	I-8 Std 2-2 C.B. Each		I-8 Std 3 C.B. Each	I-8 Std #1 M.H. Each	I-8 Std #2 M.H. Each	I-14 Paved Apron L.F.	I-5 Std C.B. Each
* F-22	70+56 I.B. Frwy 2'Rt	1								
* F-23	69+53 I.B. Frwy 2'Rt	1								
F-24	6+25 Ramp E-10 37'Lt			1					10	
* F-25	4+75 Ramp E-16 12'Lt	1								
F-26	1+75 Ramp E-5 ℄		1							
F-27	2+31 Ramp E-5 18'Rt			1					20	
F-28	2+73 Ramp E-5 10'Rt						1			
F-29	1+85 Ramp E-16 8'Rt	1								
F-37	76+85 I.B. Frwy 87'Rt			1					10	
F-38	2+75 Ramp E-11 18'Rt			1					10	
F-39	3+93 Ramp E-11 18'Rt			1					20	
F-40	3+93 Ramp E-11 31'Lt			1					20	
F-41	77+30 I.B. Frwy 74'Lt									1
F-42	78+50 I.B. Frwy 86'Lt							1		
F-43	3+14 Ramp E-13 16'Rt			1					70	
F-44	3+38 Ramp E-13 32'Lt			1					20	
F-45	18+65 E. 22nd 2'Rt					1				
F-56	3+75 Ramp E-11 30'Rt						1			
Total CUY-42-18.42		4	1	9		1	2	1	130	1

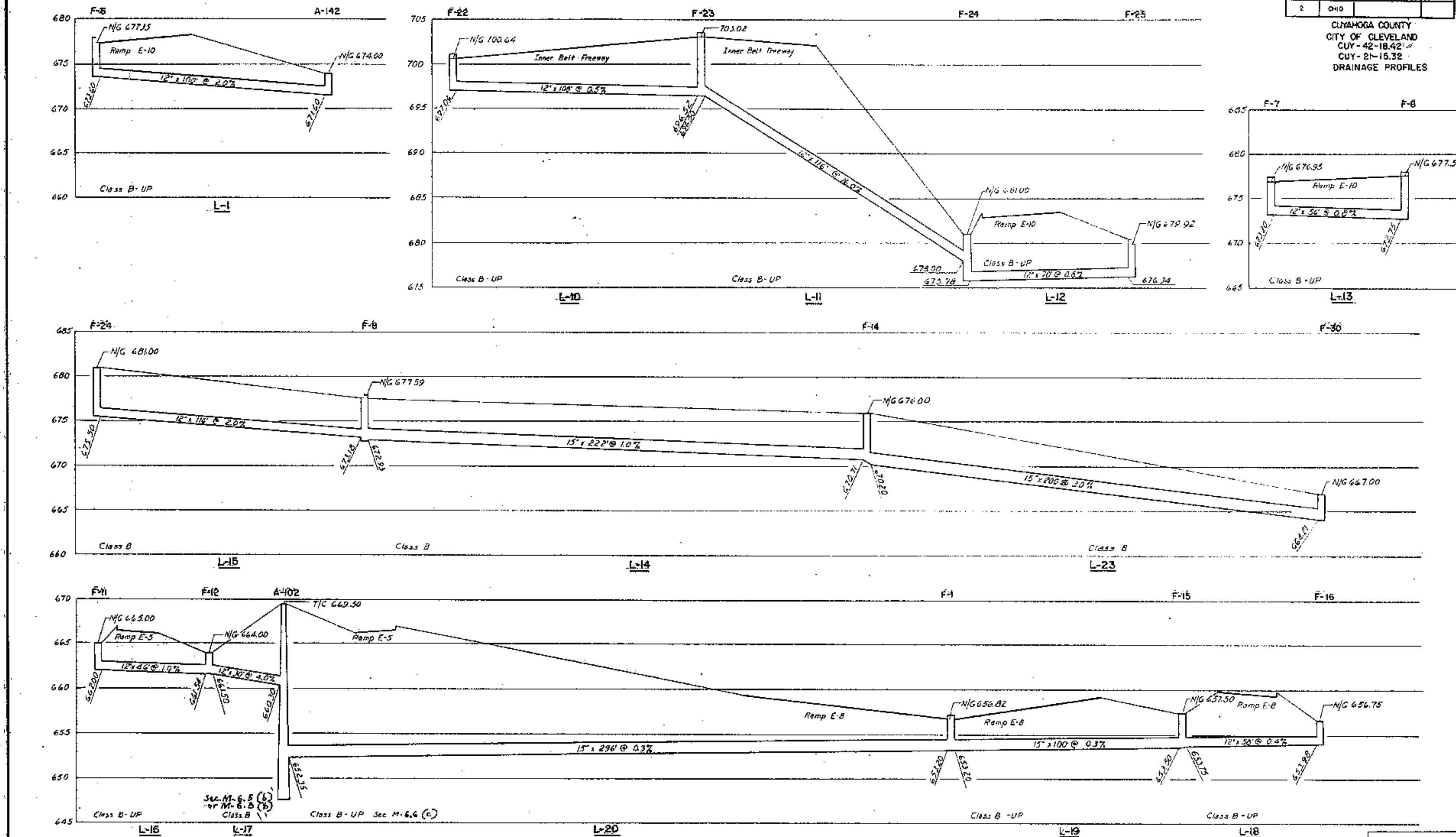
SCALE 1" = 50'
MADE H.T.M. DATE 7-8-59
TRCD. R.R. DATE 11-10-59
CKD. G.M.G. DATE 11-11-59

HOWARD, NEEDLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY CLEVELAND NEW YORK
914 SHEET 35

FED. ROAD DIV. NO.	STATE	FEDERAL AID PROJECT NO.	TYPE FUNDS
2	OHIO		

36
181

CUYAHOGA COUNTY
CITY OF CLEVELAND
CUY-42-18.42
CUY-21-15.32
DRAINAGE PROFILES



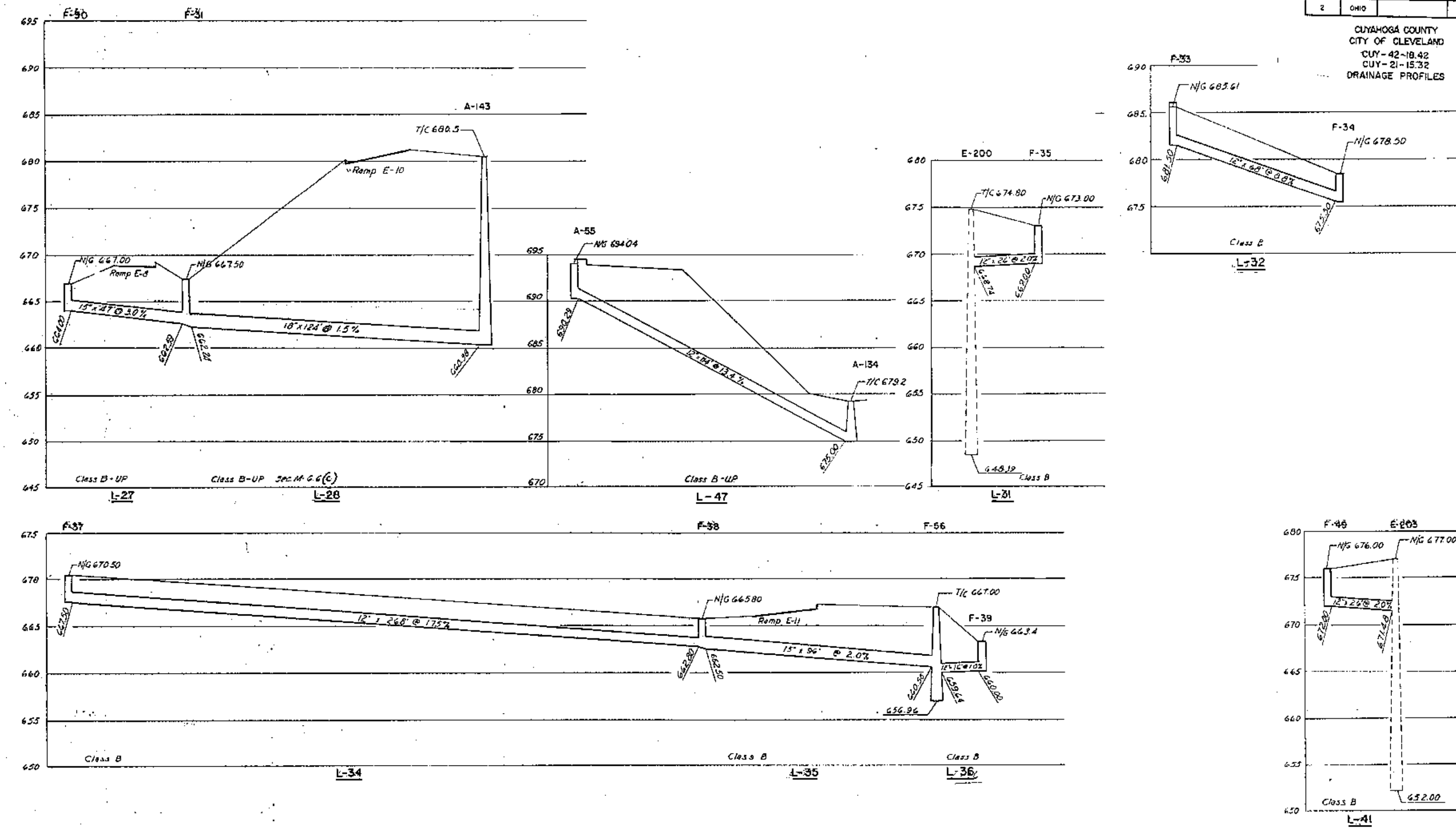
PROFILES
L-1, L-10 TO L-20, & L-23

SCALE Ver. 1" = 5'
MADE R.H. DATE 7-8-59
TRCD. DATE
CKD. H.K.M. DATE 8-8-59

HOWARD, NEEDLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY CLEVELAND NEW YORK
914 SHEET 36

FED. ROAD DIV. NO.	STATE	FEDERAL AID PROJECT NO.	TYPE FUNDS	37/181
2	OHIO			

CUYAHOGA COUNTY
CITY OF CLEVELAND
CUY-42-18.42
CUY-21-15.32
DRAINAGE PROFILES



PROFILES
L-27, L-28, L-31, L-32
L-34, L-35, & L-41
L-36
L-47

Rev. RJK 1-11-60

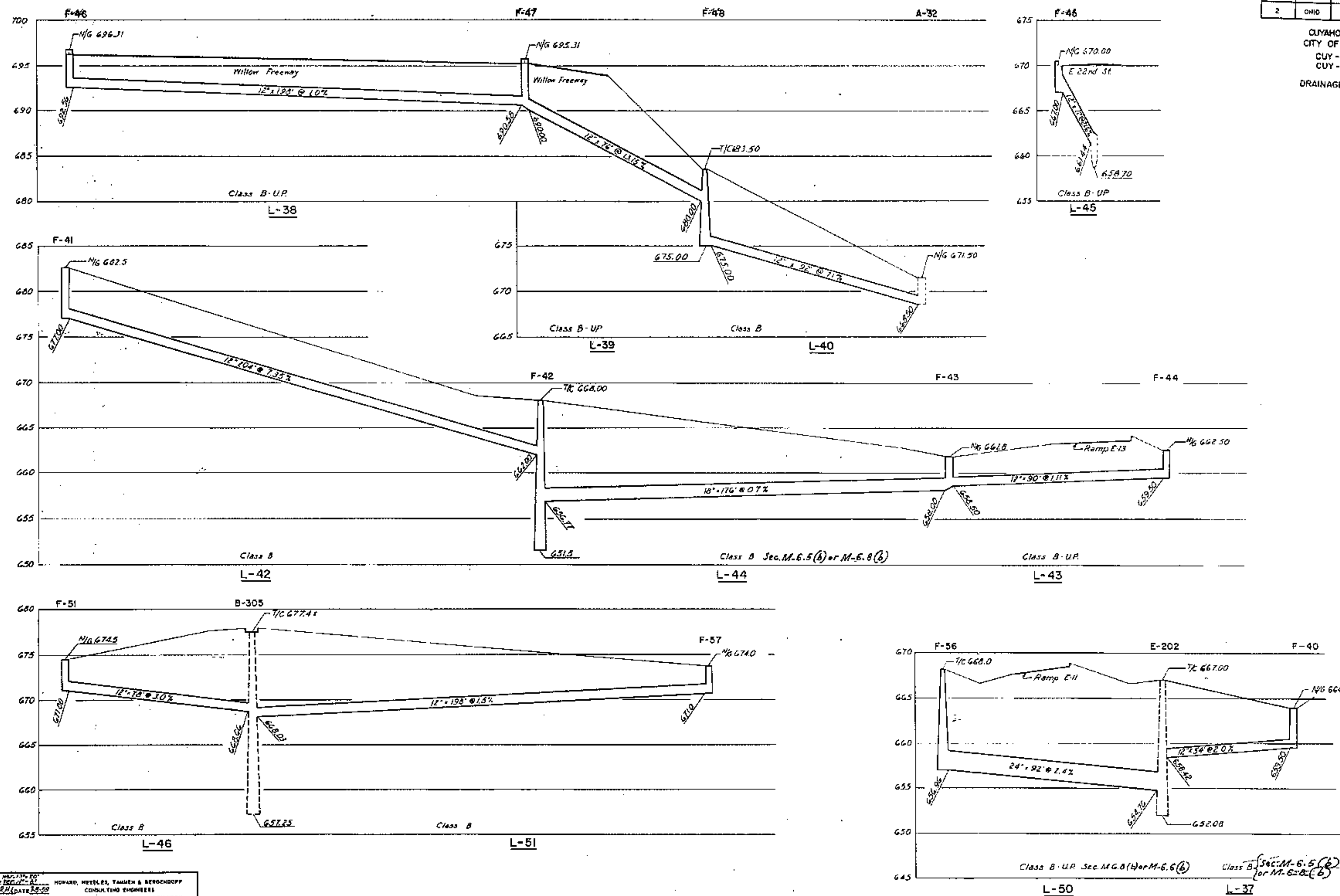
HOWARD, NEEDLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY CLEVELAND NEW YORK
914 SHEET 37

FED. ROAD DIV. NO.	STATE	FEDERAL AID PROJECT NO.	TYPE FUNDS
2	OHIO		

38 / 181

CUYAHOGA COUNTY
CITY OF CLEVELAND
CUY-42-18.42
CUY-21-15.32

DRAINAGE PROFILES



PROFILES

L-38 TO L-40
L-42 TO L-46
L-50 TO L-51
L-37

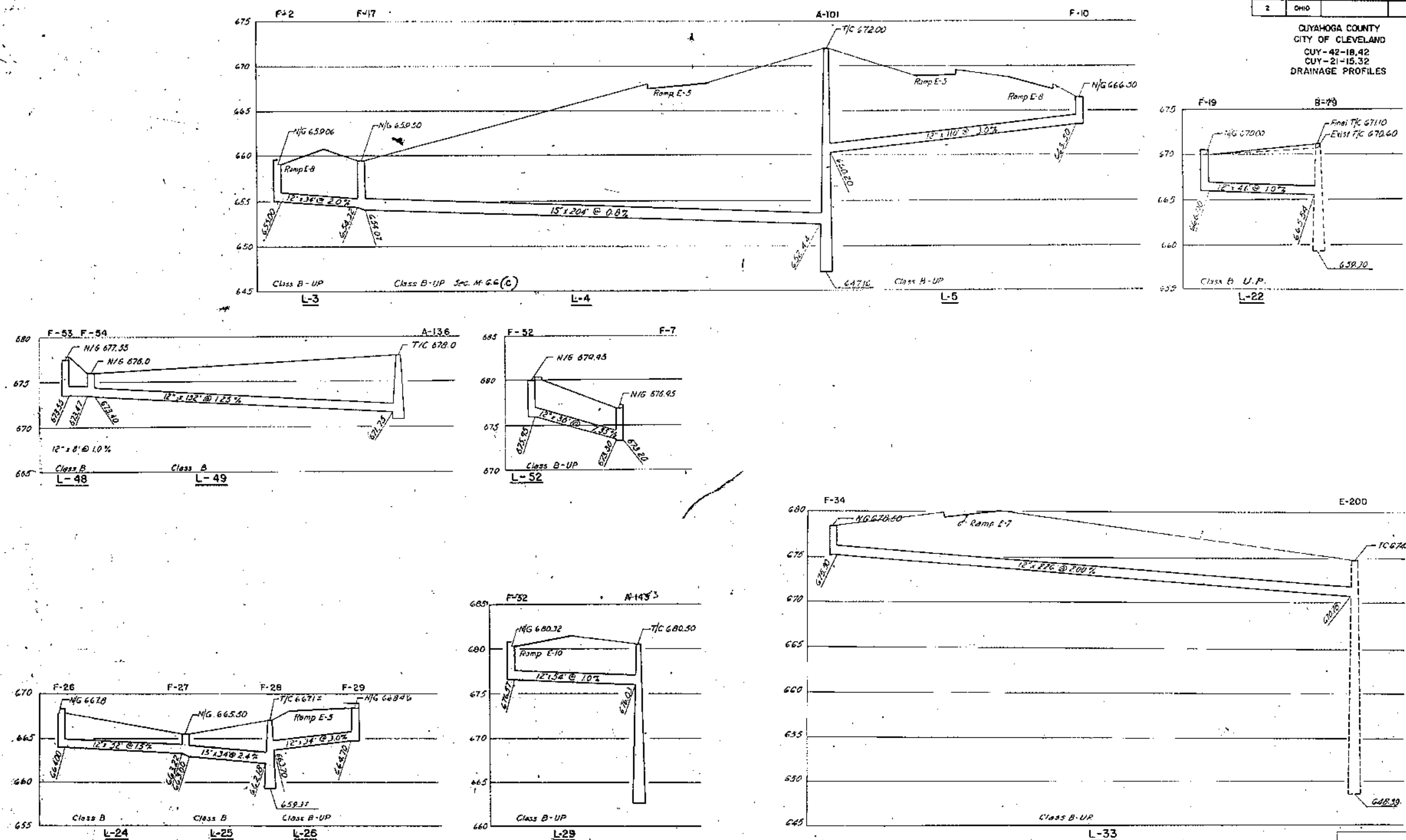
Rev RJK 1-11-60

HOWARD, NEEDLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY CLEVELAND NEW YORK
914 SHEET 38

FED. ROAD DIV. NO.	STATE	FEDERAL AID PROJECT NO.	TYPE FUNDS
2	OHIO		

39
181

CUYAHOGA COUNTY
CITY OF CLEVELAND
CUY-42-18.42
CUY-21-15.32
DRAINAGE PROFILES



PROFILES
L-3 TO L-5
L-22
L-24 TO L-26
L-29 & L-33
L-48 TO L-49 & L-52

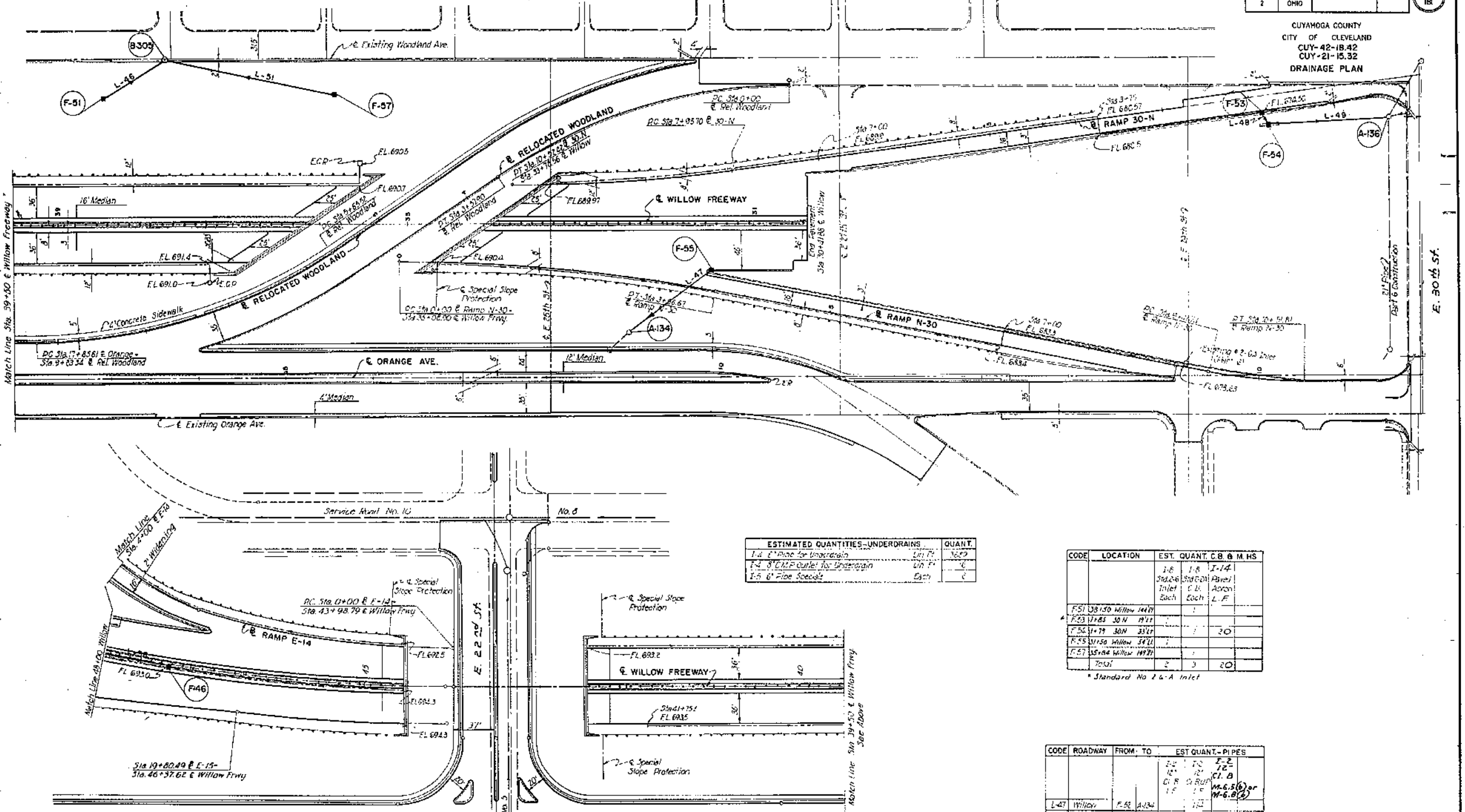
Rev. JAG 1-11-60

SCALE Vert. 1"=10' Hor. 1"=5'
MADE EHL DATE 7-11-59
TRCD ___ DATE ___
CKD HKU DATE 11-1-59
HOWARD, NEEDLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY CLEVELAND NEW YORK
914 SHEET 39

FED. ROAD DIV. NO.	STATE	FEDERAL AID PROJECT NO.	TYPE FUNDS
2	OHIO		

32
181

CUYAHOGA COUNTY
CITY OF CLEVELAND
CUY-42-18.42
CUY-21-15.32
DRAINAGE PLAN



ESTIMATED QUANTITIES-UNDERDRAINS		QUANT.
I-4 6" Pipe for Underdrain	Lin Ft	3652
I-4 8" C.M.P. Outlet for Underdrain	Lin Ft	[illegible]
I-5 6" Pipe Specials	Each	[illegible]

CODE	LOCATION	EST. QUANT. C.B. & M.HS			
		I-8 Std.2-6 Inlet Each	I-8 Std.C-OA C.B. Each	I-14 Paved Apron L.F.	
F-51	38+50 Willow 144'Rt		1		
* F-53	1+85 30-N 19'Lt	1			
F-54	1+79 30N 33'Lt		1	20	
F-55	31+50 Willow 54'Lt	1			
F-57	35+84 Willow 149'Rt		1		
	Total	2	3	20	

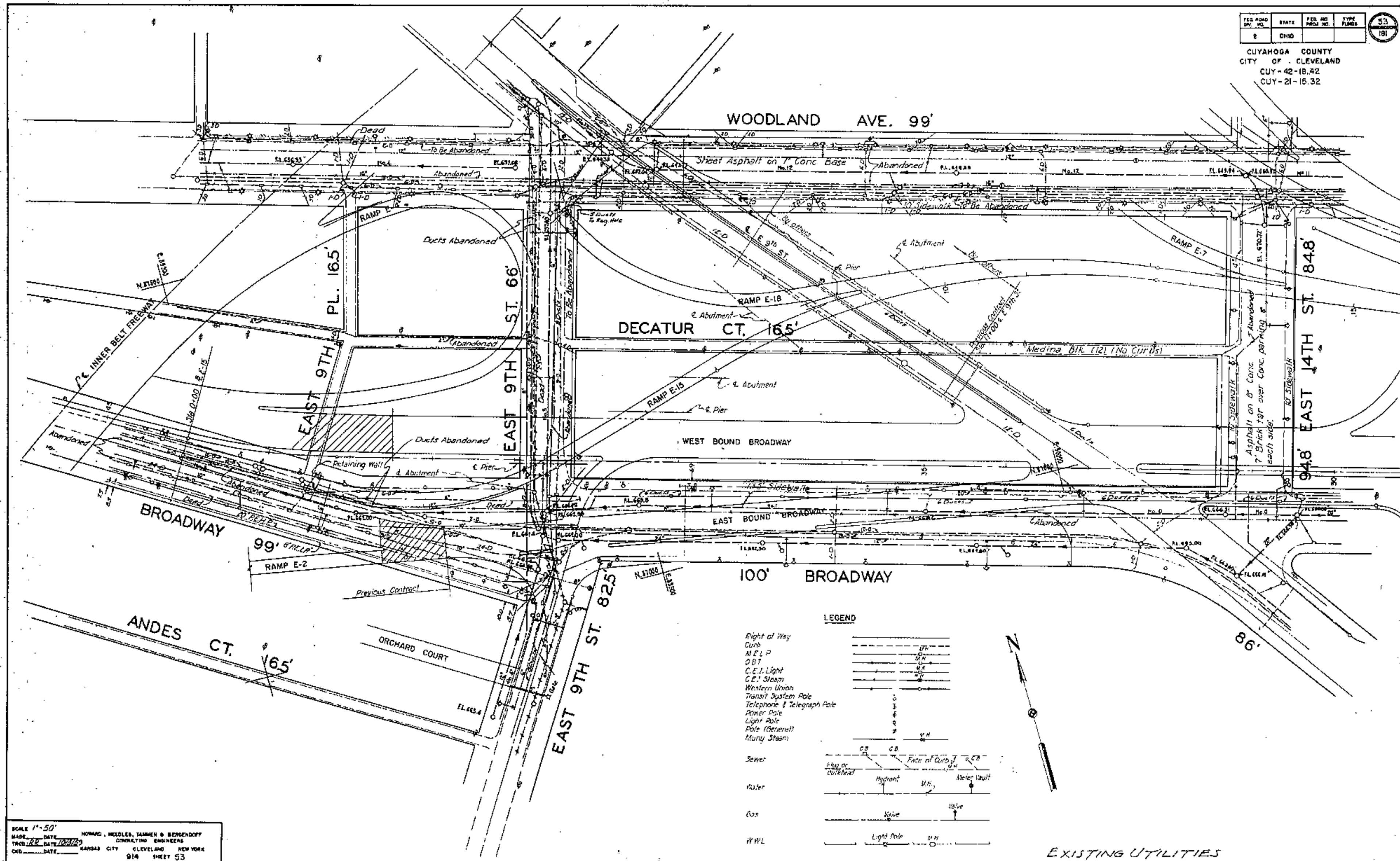
* Standard No 2-4-A Inlet

CODE	ROADWAY	FROM	TO	EST QUANT.-PIPES			
				I-2 12" Cl. B L.F.	I-2 12" Cl. B [illegible] L.F.	I-2 12" Cl. B M-6.5(b) or M-6.8(b)	
L-47	Willow	F-55	A-134		[illegible]		
L-48	Ramp 30-N	F-53	F-54	8			
L-49	Ramp 30-N	F-54	A-136	[illegible]			
L-46	Woodland	F-51	B 305			78	
L-51	Woodland	F-57	B 305			198	
	Total			140	[illegible]	276	

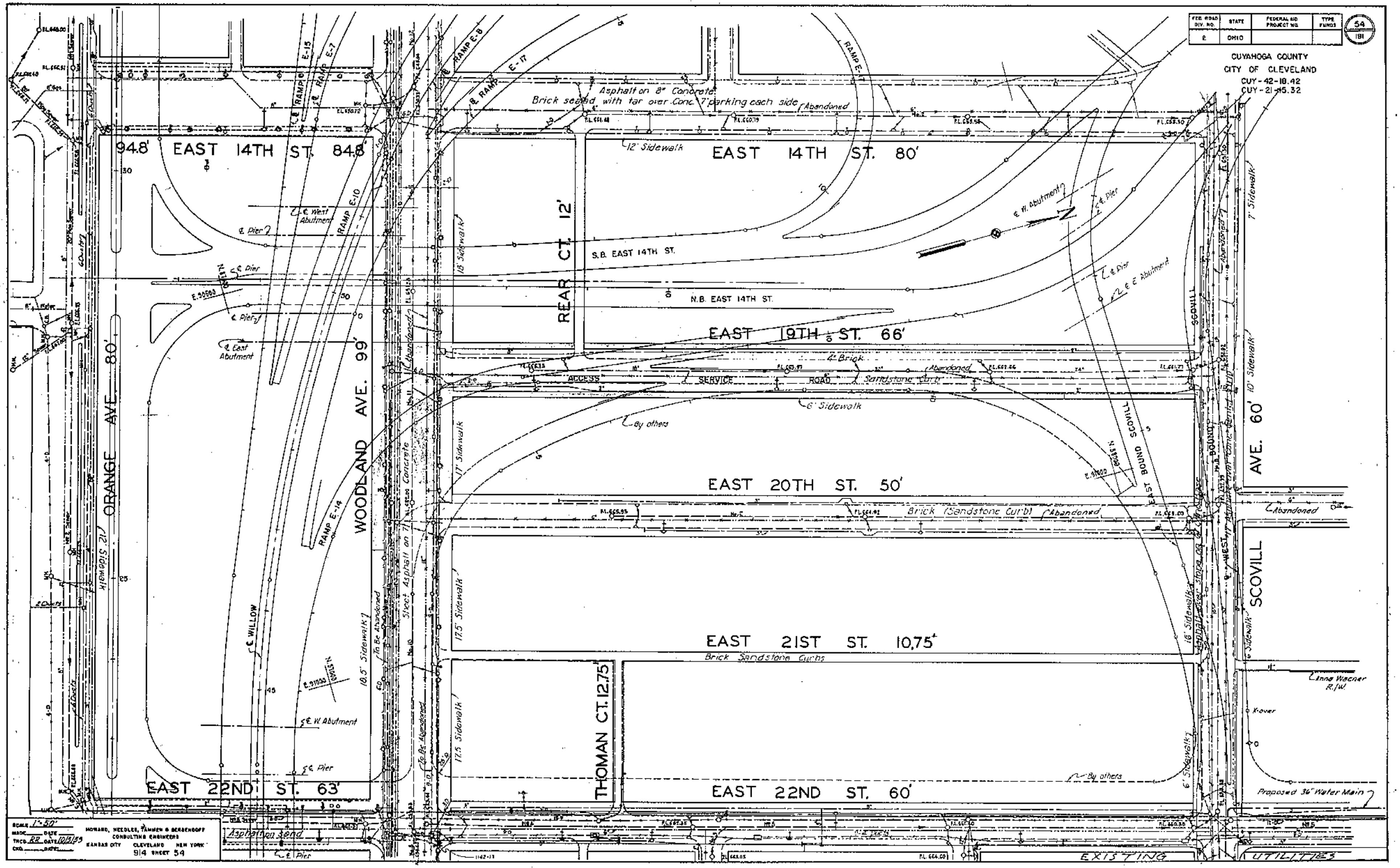
SCALE 1"=20'
MADE [illegible] DATE [illegible]
TRCD. [illegible] DATE [illegible]
CKD. [illegible] DATE [illegible]

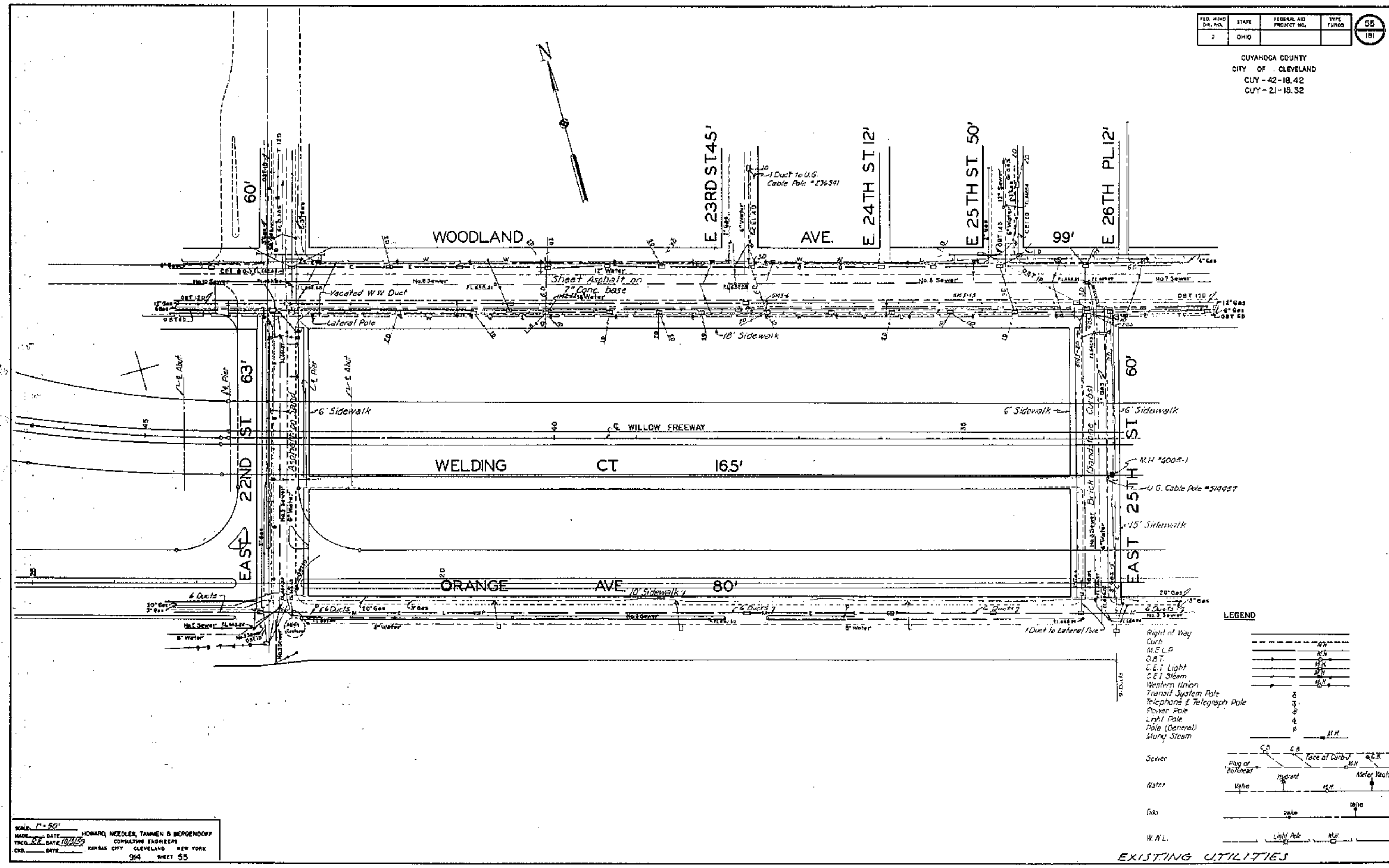
HOWARD, NEEDLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY CLEVELAND NEW YORK
914 SHEET 32

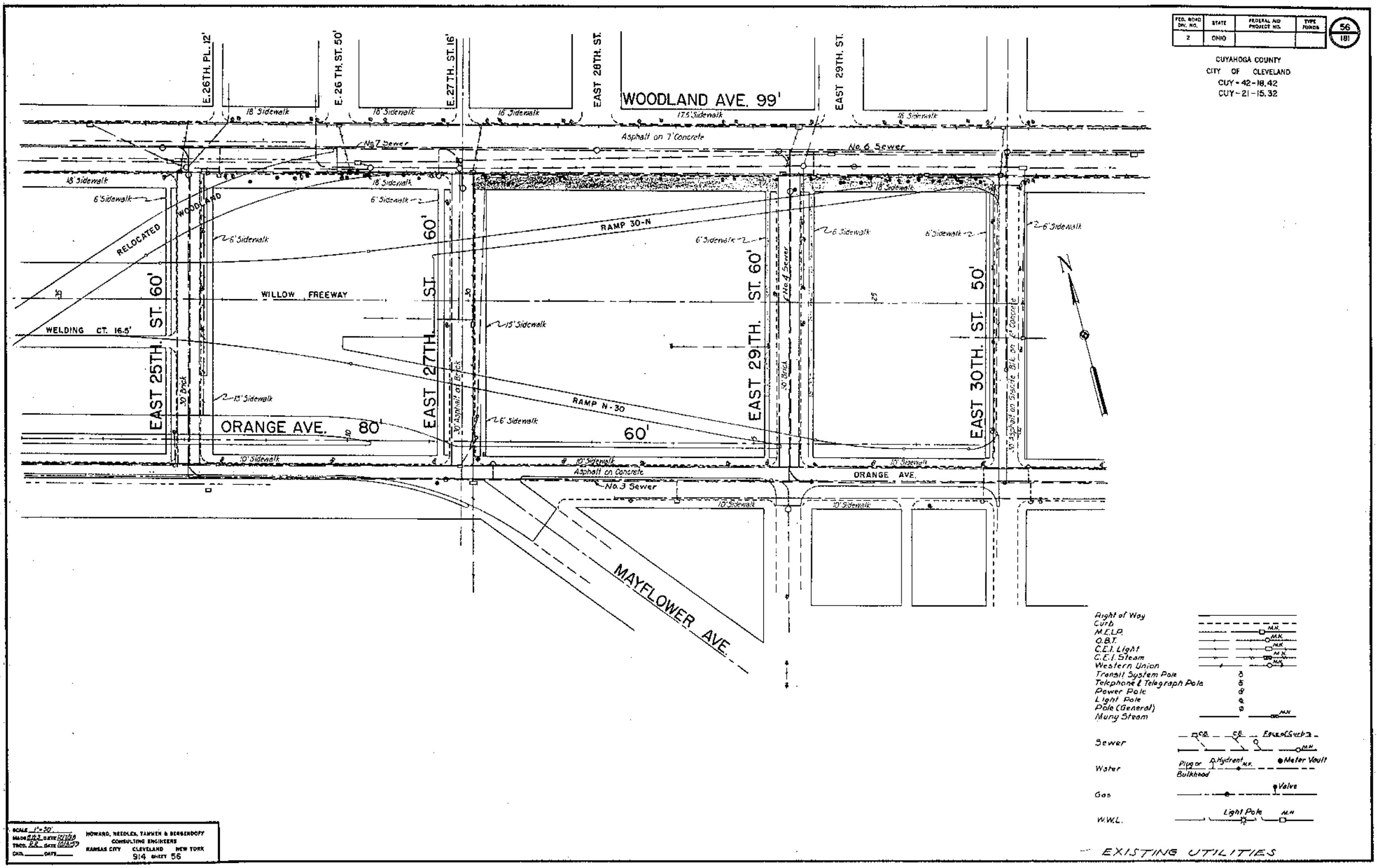
Rev. A.L.K. 1-11-60



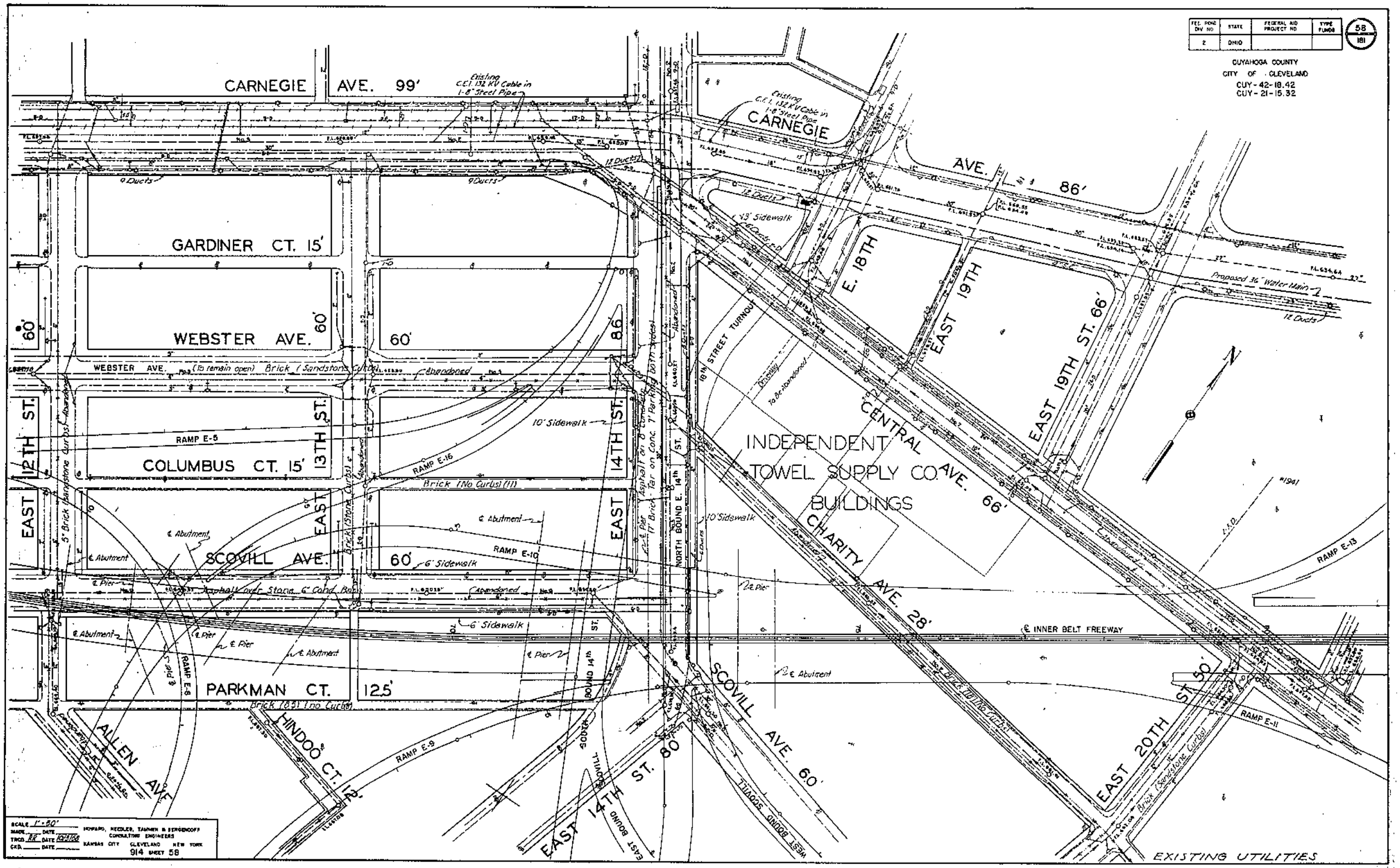
FED. ROAD DIV. NO. 2
STATE OHIO
53
181
CUYAHOGA COUNTY
CITY OF CLEVELAND
CUY-42-18.42
CUY-21-15.32
WOODLAND AVE. 99'
Sheet Asphalt on 7" Conc Base
DECATUR CT. 165'
EAST 9TH ST. 66'
EAST 9TH PL. 165'
EAST 14TH ST. 84.8'
94.8'
Asphalt on 8" Conc.
7" Brick tar over Conc parking
each side.
Medina Blk. (12) (No Curbs)
WEST BOUND BROADWAY
EAST BOUND BROADWAY
100' BROADWAY
BROADWAY
99'
86'
EAST 9TH ST. 82.5'
ANDES CT. 165'
ORCHARD COURT
INNER BELT FREEWAY
RAMP E-7
RAMP E-18
RAMP E-15
RAMP E-2
Ducts Abandoned
Retaining Wall
Previous Contract
Abandoned
To Be Abandoned
Dead
LEGEND
Right of Way
Curb
M.E.L.P.
O.B.T.
C.E.I. Light
C.E.I. Steam
Western Union
Transit System Pole
Telephone & Telegraph Pole
Power Pole
Light Pole
Pole (General)
Muny Steam
Sewer
Water
Gas
WWL
Face of Curb
Hydrant
Meter Vault
Valve
Light Pole
EXISTING UTILITIES
SCALE 1"=50'
HOWARD, NEEDLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY CLEVELAND NEW YORK
914 SHEET 53


FED. ROAD DIV. NO. 2
STATE OHIO
FEDERAL AID PROJECT NO.
TYPE FUNDS
54
181
CUYAHOGA COUNTY
CITY OF CLEVELAND
CUY-42-18.42
CUY-21-15.32
EAST 14TH ST. 80'
94.8' EAST 14TH ST. 84.8'
REAR CT. 12'
S.B. EAST 14TH ST.
N.B. EAST 14TH ST.
EAST 19TH ST. 66'
ACCESS SERVICE ROAD
EAST 20TH ST. 50'
EAST 21ST ST. 10.75'
THOMAN CT. 12.75'
EAST 22ND ST. 60'
EAST 22ND ST. 63'
ORANGE AVE. 80'
WOODLAND AVE. 99'
SCOVILL AVE. 60'
EAST BOUND SCOVILL
Asphalt on 8" Concrete
Brick sealed with tar over Conc. 7' parking each side
Abandoned
12' Sidewalk
18' Sidewalk
17' Sidewalk
17.5' Sidewalk
10.5' Sidewalk
6' Sidewalk
16' Sidewalk
7' Sidewalk
10' Sidewalk
Brick (Sandstone Curb)
Brick Sandstone Curbs
Sheet Asphalt on 7" Concrete
By others
RAMP E-17
RAMP E-15
RAMP E-7
RAMP E-8
RAMP E-10
RAMP E-14
℄ WILLOW
℄ West Abutment
℄ W. Abutment
℄ E. Abutment
℄ East Abutment
℄ Pier
To Be Abandoned
Anna Wagner R/W
X-over
Proposed 36" Water Main
Asphalt on Sand
EXISTING UTILITIES
SCALE 1"=50'
TRCD. RR DATE 10/3/59
HOWARD, NEEDLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY CLEVELAND NEW YORK
914 SHEET 54

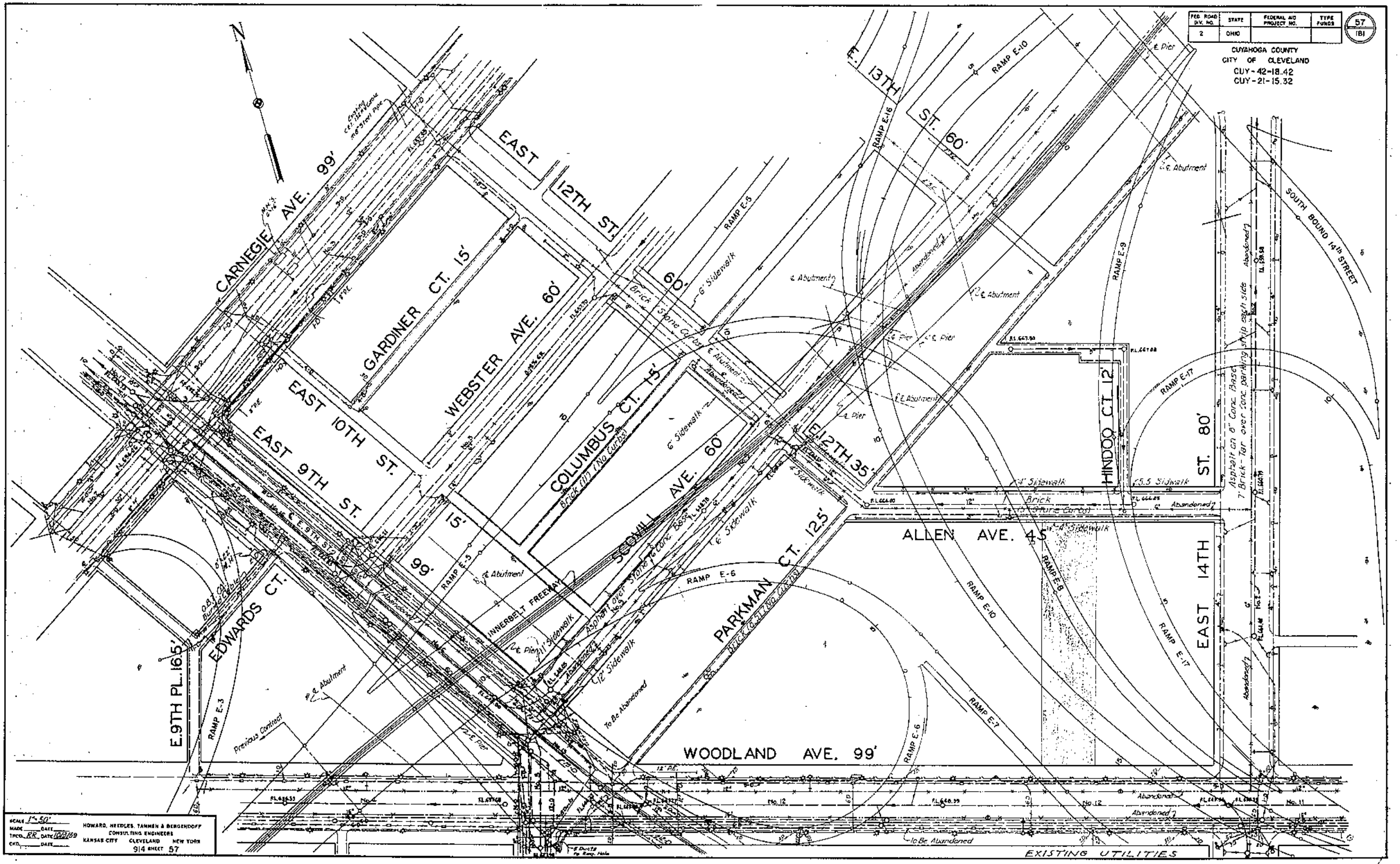

FED. ROAD DIV. NO. 2
STATE OHIO
FEDERAL AID PROJECT NO.
TYPE FUNDS
55
181
CUYAHOGA COUNTY
CITY OF CLEVELAND
CUY-42-18.42
CUY-21-15.32
N
WOODLAND AVE.
E 23RD ST 45'
E 24TH ST 12'
E 25TH ST 50'
E 26TH PL 12'
99'
60'
EAST 22ND ST 63'
EAST 25TH ST 60'
WELDING CT 16.5'
ORANGE AVE. 80'
℄ WILLOW FREEWAY
Sheet Asphalt on 7" Conc. base
18' Sidewalk
6' Sidewalk
15' Sidewalk
10' Sidewalk
Vacated W.W. Duct
Lateral Pole
1 Duct to U.G. Cable Pole #E36541
M.H. #6005-1
U.G. Cable Pole #514057
1 Duct to Lateral Pole
6 Ducts
LEGEND
Right of Way
Curb
M.E.L.P.
O.B.T.
C.E.I. Light
C.E.I. Steam
Western Union
Transit System Pole
Telephone & Telegraph Pole
Power Pole
Light Pole
Pole (General)
Muny Steam
Sewer
Water
Gas
W.W.L.
SCALE 1" = 50'
HOWARD, NEEDLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY CLEVELAND NEW YORK
914 SHEET 55
EXISTING UTILITIES



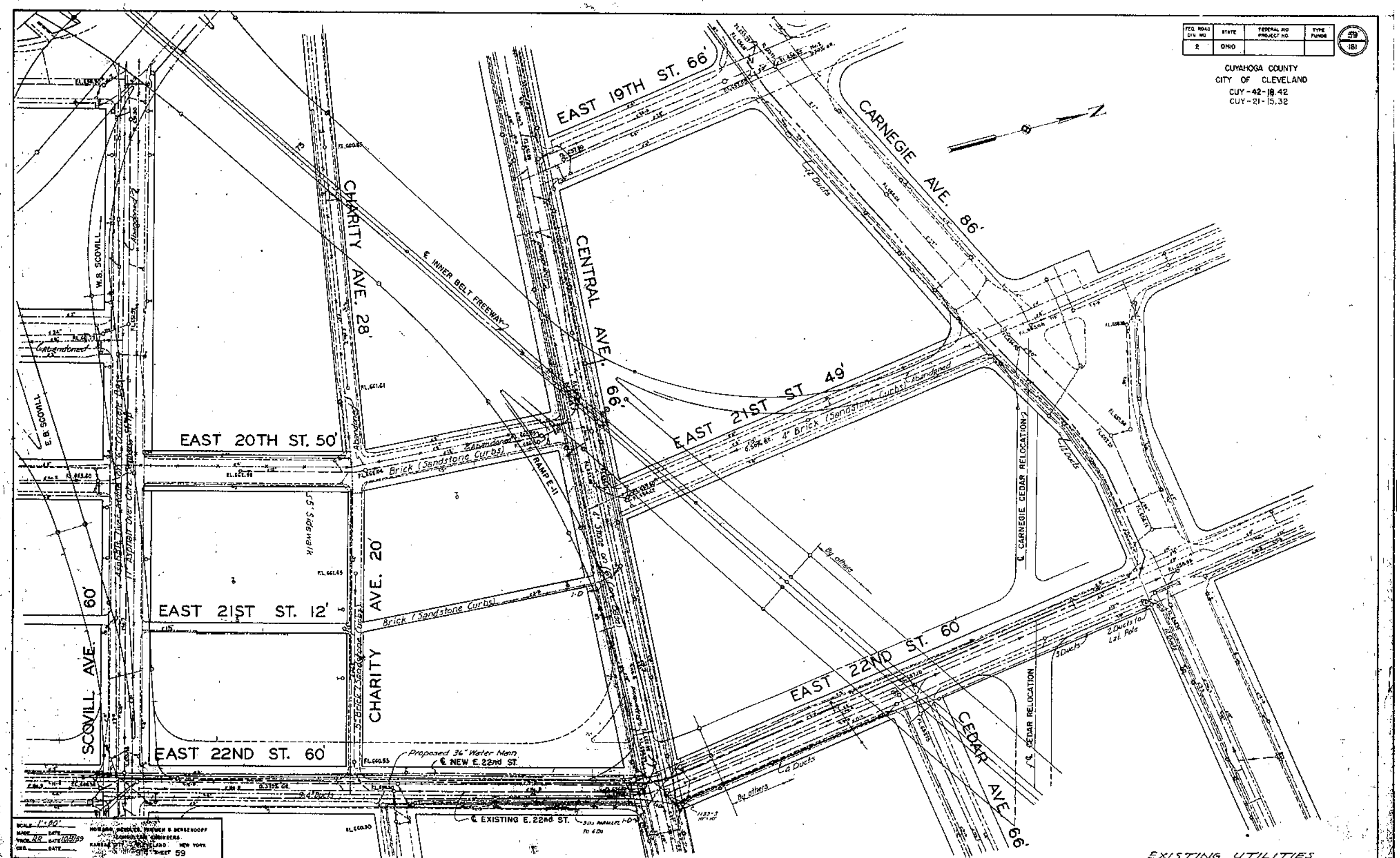
FED. ROAD DIV. NO. 2
STATE OHIO
FEDERAL AID PROJECT NO.
TYPE FUNDS
56
181
CUYAHOGA COUNTY
CITY OF CLEVELAND
CUY-42-18.42
CUY-21-15.32
WOODLAND AVE. 99'
E.26TH. PL. 12'
E.26 TH. ST. 50'
E.27TH. ST. 16'
EAST 28TH. ST.
EAST 29TH. ST.
EAST 25TH. ST. 60'
EAST 27TH. ST. 60'
EAST 29TH. ST. 60'
EAST 30TH. ST. 50'
ORANGE AVE. 80'
ORANGE AVE.
60'
MAYFLOWER AVE.
WILLOW FREEWAY
RELOCATED WOODLAND
WELDING CT. 16.5'
RAMP 30-N
RAMP N-30
Asphalt on 7' Concrete
No.7 Sewer
No.6 Sewer
No.4 Sewer
No.3 Sewer
Asphalt on Concrete
30' Brick
30' Asphalt on Brick
30' Asphalt on Granite Blk. on 6" Concrete
18' Sidewalk
17.5' Sidewalk
15' Sidewalk
10' Sidewalk
6' Sidewalk
Right of Way
Curb
M.E.L.P.
O.B.T.
C.E.I. Light
C.E.I. Steam
Western Union
Transit System Pole
Telephone & Telegraph Pole
Power Pole
Light Pole
Pole (General)
Muny Steam
Sewer
Water
Gas
W.W.L.
Face of Curb
Plug or Bulkhead
Hydrant
Meter Vault
Valve
Light Pole
M.H.
EXISTING UTILITIES
SCALE 1" = 50'
HOWARD, NEEDLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY CLEVELAND NEW YORK
914 SHEET 56



FED. ROAD DIV. NO. 2
STATE OHIO
FEDERAL AID PROJECT NO.
TYPE FUNDS
58
181
CUYAHOGA COUNTY
CITY OF CLEVELAND
CUY-42-18.42
CUY-21-15.32
CARNEGIE AVE. 99'
CARNEGIE AVE. 86'
GARDINER CT. 15'
WEBSTER AVE. 60'
WEBSTER AVE. (To remain open) Brick (Sandstone Curbs)
COLUMBUS CT. 15'
SCOVILL AVE. 60'
PARKMAN CT. 125'
HINDOO CT. 12'
ALLEN AVE.
EAST 12TH ST. 60'
EAST 13TH ST. 60'
EAST 14TH ST. 86'
EAST 14TH ST. 80'
NORTH BOUND E. 14th ST.
SOUTH BOUND 14th ST.
E. 18TH
EAST 19TH
EAST 19TH ST. 66'
EAST 20TH ST. 50'
CENTRAL AVE. 66'
CHARITY AVE. 28'
SCOVILL AVE. 60'
WEST BOUND SCOVILL
EAST BOUND SCOVILL
18th STREET TURNOUT
INDEPENDENT TOWEL SUPPLY CO. BUILDINGS
℄ INNER BELT FREEWAY
RAMP E-5
RAMP E-6
RAMP E-9
RAMP E-10
RAMP E-11
RAMP E-13
RAMP E-16
Existing C.E.I. 132 KV Cable in 1-8" Steel Pipe
Proposed 36" Water Main
12 Ducts
9 Ducts
10' Sidewalk
6' Sidewalk
13' Sidewalk
Abandoned
Brick (No Curbs) (11)
Brick (Stone Curbs)
Brick (Sandstone Curbs)
5' Brick (Sandstone Curbs) Abandoned
Asphalt over Stone 6" Cond. Bas.
Asphalt on 8" Concrete 1" Brick Tar on Conc. 7' Parking both sides
℄ Abutment
℄ Pier
SCALE 1" = 50'
HOWARD, NEEDLES, TAMMEN & BERGENDOFF CONSULTING ENGINEERS
KANSAS CITY CLEVELAND NEW YORK
914 SHEET 58
EXISTING UTILITIES

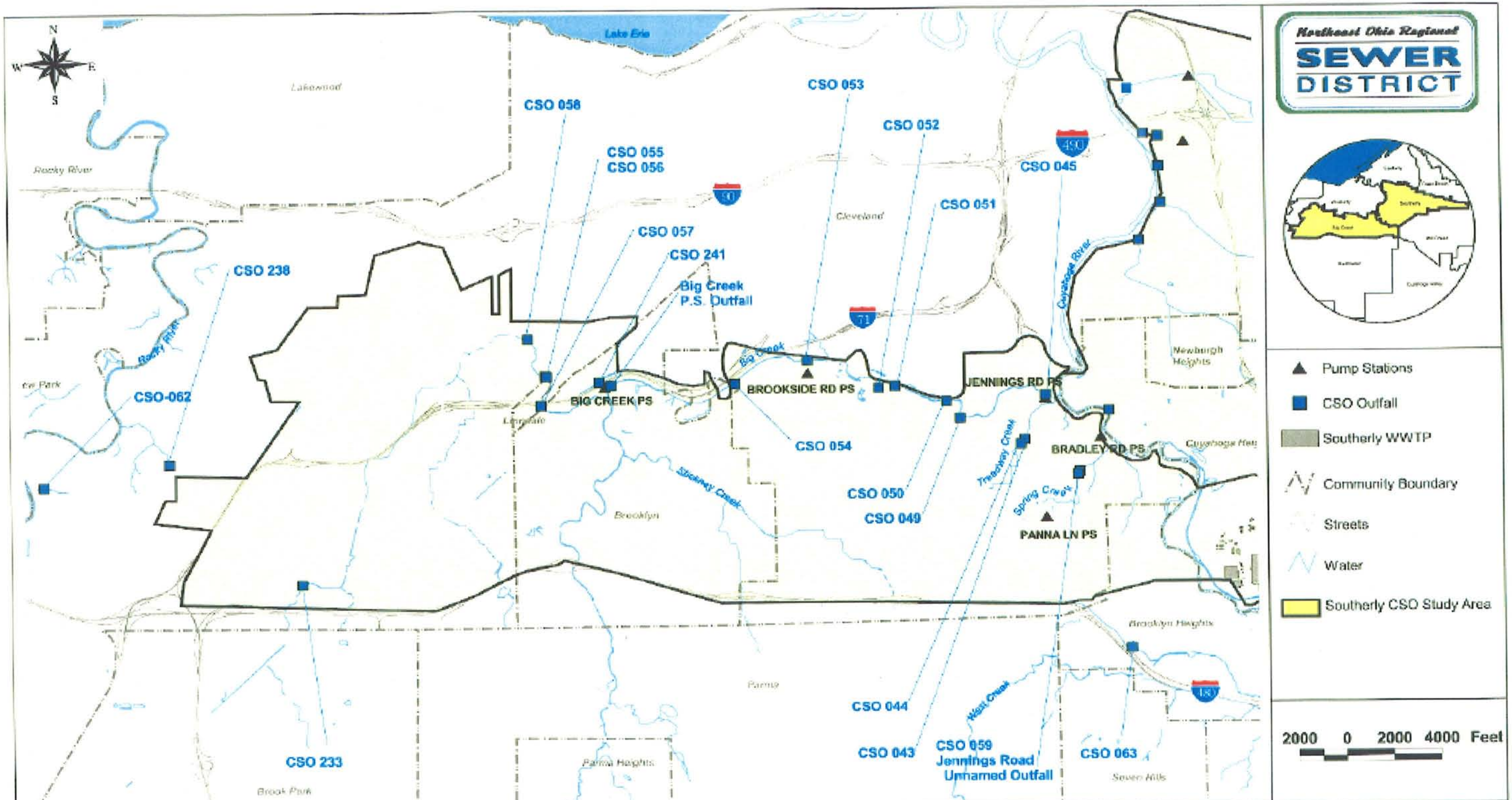


FED. ROAD DIV. NO. 2
STATE OHIO
FEDERAL AID PROJECT NO.
TYPE FUNDS
57 (81)
CUYAHOGA COUNTY
CITY OF CLEVELAND
CUY-42-18.42
CUY-21-15.32
N
CARNEGIE AVE. 99'
EAST 12TH ST.
E. 13TH ST. 60'
SOUTH BOUND 14th STREET
GARDINER CT. 15'
WEBSTER AVE. 60'
EAST 10TH ST.
EAST 9TH ST.
COLUMBUS CT. 15'
Brick (?) (No Curbs)
SCOVILL AVE. 60'
E.12TH 35'
HINDOO CT. 12'
ST. 80'
EAST 14TH
ALLEN AVE. 45'
PARKMAN CT. 12.5'
WOODLAND AVE. 99'
EDWARDS CT.
E.9TH PL. 16.5'
INNERBELT FREEWAY
RAMP E-3
RAMP E-5
RAMP E-6
RAMP E-7
RAMP E-8
RAMP E-9
RAMP E-10
RAMP E-16
RAMP E-17
Asphalt on 6" Conc. Base
7" Brick-Tar over Conc. parking strip each side
Abandoned
To Be Abandoned
Previous Contract
6' Sidewalk
4' Sidewalk
5.5' Sidewalk
12' Sidewalk
Brick
Stone Curbs
℄ Abutment
℄ Pier
EXISTING UTILITIES
SCALE 1"=50'
MADE ___ DATE ___
TRCD. RR DATE 10/21/69
CKD. ___ DATE ___
HOWARD, NEEDLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY CLEVELAND NEW YORK
914 SHEET 57


FED. ROAD DIV. NO. 2
STATE OHIO
FEDERAL AID PROJECT NO.
TYPE FUNDS
59
181
CUYAHOGA COUNTY
CITY OF CLEVELAND
CUY-42-18.42
CUY-21-15.32
N
CARNEGIE AVE. 86'
EAST 19TH ST. 66'
CENTRAL AVE. 66'
EAST 21ST ST 49'
EAST 22ND ST. 60
CEDAR AVE 66'
℄ CARNEGIE CEDAR RELOCATION
℄ CEDAR RELOCATION
CHARITY AVE. 28'
CHARITY AVE. 20'
EAST 20TH ST. 50'
EAST 21ST ST. 12'
EAST 22ND ST. 60
SCOVILL AVE. 60'
W.B. SCOVILL
E.B. SCOVILL
℄ INNER BELT FREEWAY
RAMP E-11
Brick (Sandstone Curbs)
4" Brick (Sandstone Curbs) Abandoned
5' Sidewalk
Proposed 36" Water Main
℄ NEW E. 22nd ST.
℄ EXISTING E. 22nd ST.
By others
12 Ducts
5 Ducts
4 Ducts
2 Ducts to Lt. Pole
Abandoned
EXISTING UTILITIES
SCALE 1"=50'
HOWARD, NEEDLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY CLEVELAND NEW YORK
SHEET 59

Appendix T

***Northeast Ohio Regional Sewer District Southerly CSO Phase II Hydraulic Modeling Report*, May 2002. Report Figures 1-1a, 1-1b, 2-1, 2-2, and 2-4.**

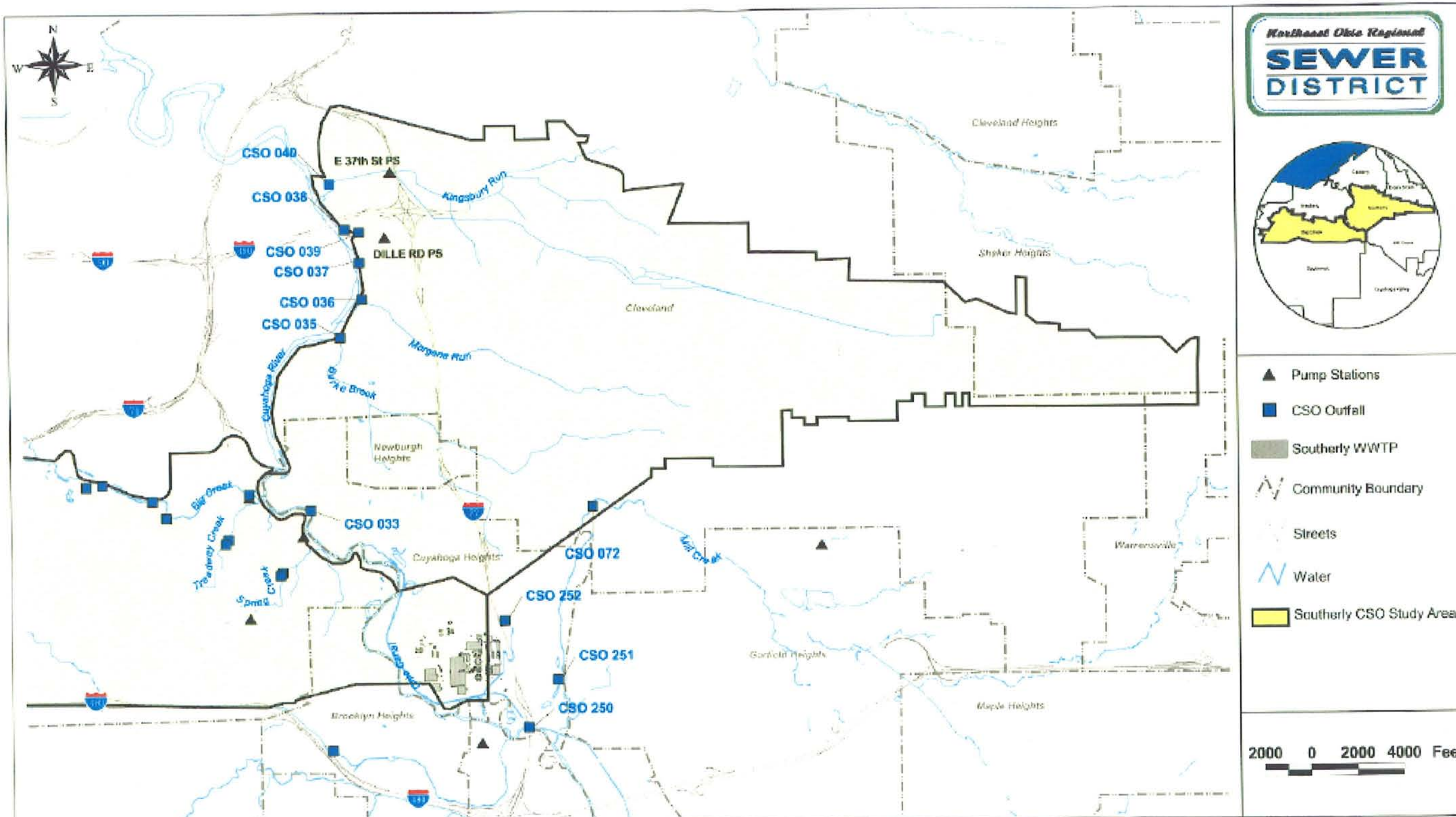


Metcalf & Eddy

Southerly CSO Phase II Facilities Plan

CH2MHILL

Figure 1-1a. Southerly CSO Study Area

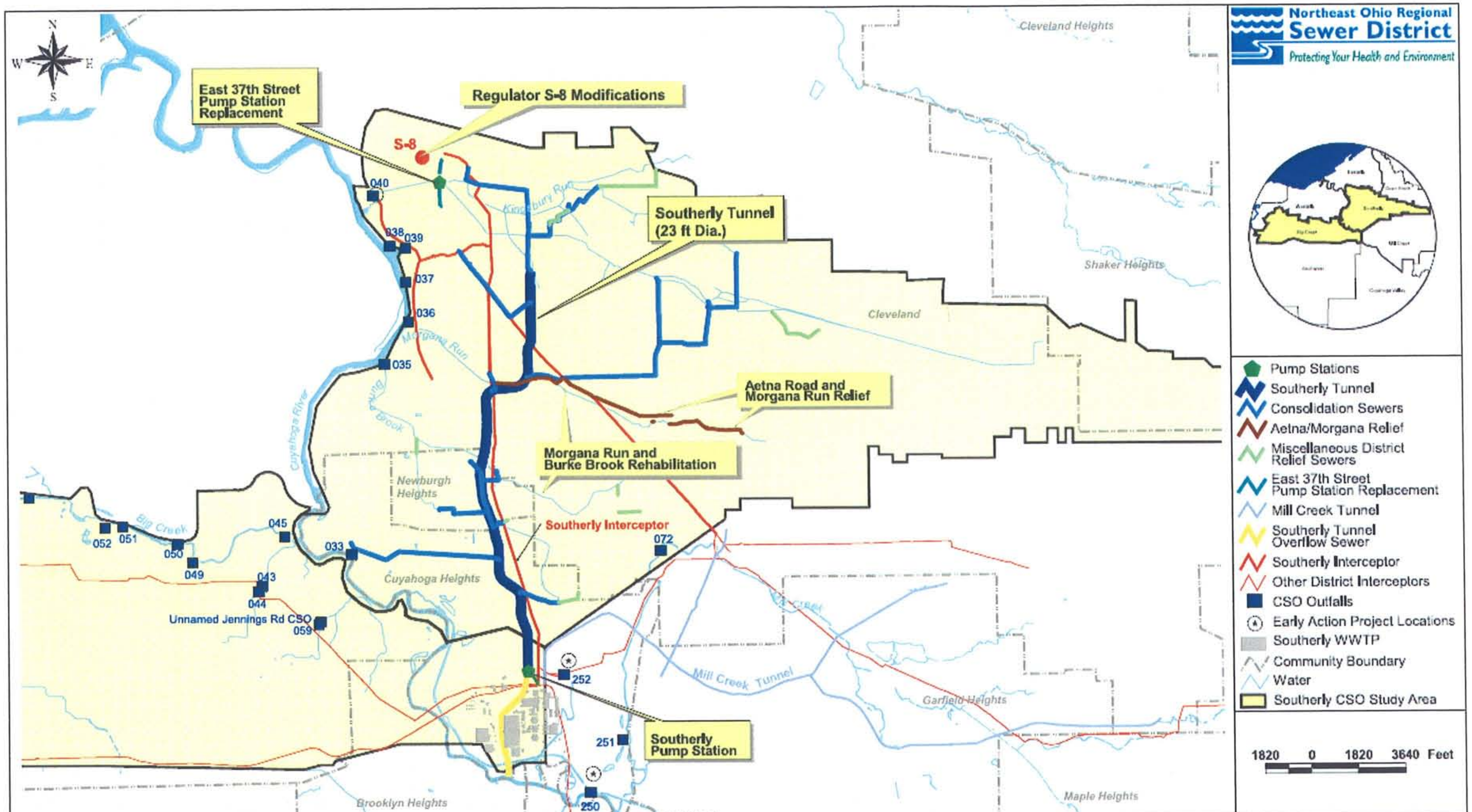


Metcalf & Eddy

Southerly CSO Phase II Facilities Plan

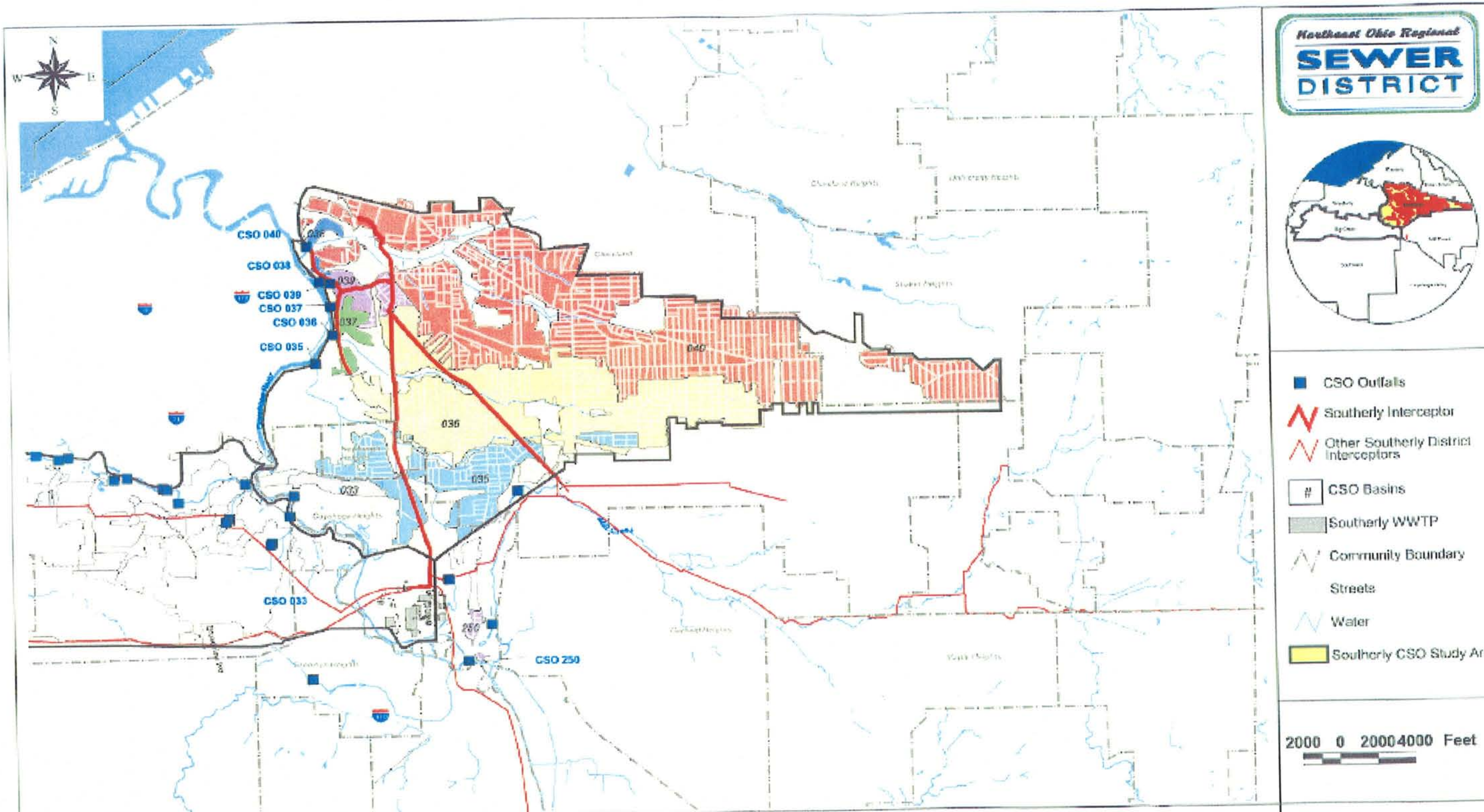
CH2MHILL

Figure 1-1b. Southerly CSO Study Area



Southerly CSO Phase II Facilities Plan

Figure 5-7b. Southerly Tunnel System Improvements

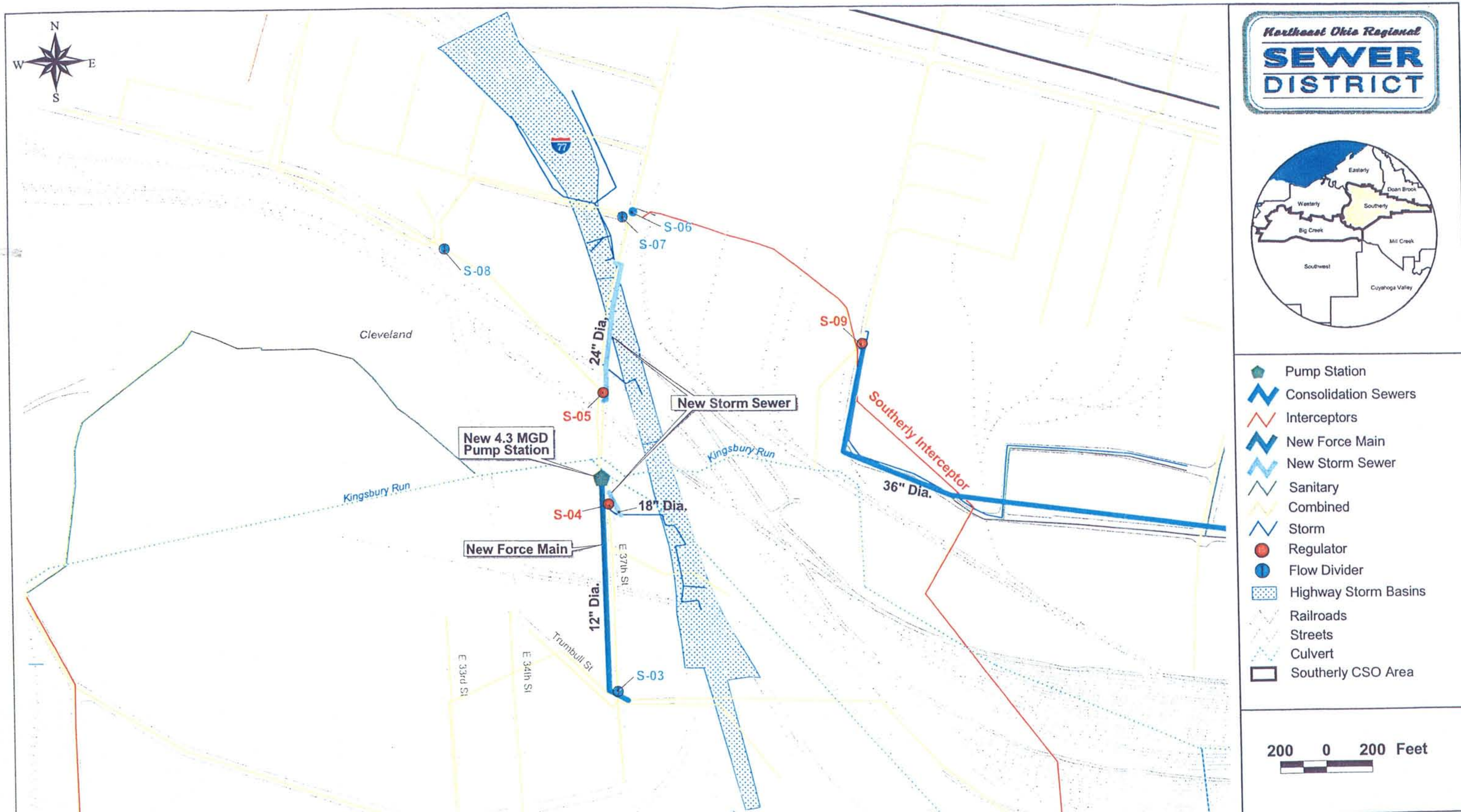


Metcalf & Eddy

Southerly CSO
Hydraulic Modeling Report

CH2MHILL

Figure 2-4.
Cuyahoga River CSO Outfalls



M&E Metcalf & Eddy

Southerly CSO Phase II Facilities Plan

CH2MHILL

Figure 16-11. East 37th Street Pump Station Replacement

M&E Metcalf & Eddy

Southerly CSO Phase II Facilities Plan

CH2MHILL

Figure 16-11a.
East 37th Street
Pump Station Detail

Appendix U

NEORSD CSO-097 NPDES Permit

OhioEPA
State of Ohio Environmental Protection Agency

STREET ADDRESS:
1800 WaterMark Drive
Columbus, OH 43215-1099

TELE: (614) 644-3020 FAX: (614) 644-2329

MAILING ADDRESS:
P.O. Box 1049
Columbus, OH 43216-1049

March 13, 1997

Re: NPDES Permit No. 3PA00002*FD

Northeast Ohio Regional Sewer District
3826 Euclid Avenue
Cleveland, Ohio 44115

Ladies and Gentlemen:

After further review of your permit, an administrative error was found. We have revised your permit number from 3PA00002*ED to 3PA00002*FD. Enclosed is a revised copy of NPDES Permit Number 3PA00002*FD for your use. Please discard the previous copy sent on February 24, 1997.

Thank you for your cooperation in this matter. If you have any questions, please do not hesitate to call me at (614) 644-2001.

Sincerely,

Martha D. Spurbeck

Martha D. Spurbeck, Supervisor
Permit Processing Unit
Division of Surface Water

MDS/kep

Enclosure

CERTIFIED MAIL

18/NE

Application No. OH0043991

Issue Date: February 24, 1997

Effective Date: April 1, 1997

Expiration Date: March 28, 2002

Ohio Environmental Protection Agency

Authorization to Discharge Under the

National Pollutant Discharge Elimination System

In compliance with the provisions of the Federal Water Pollution Control Act, as amended (33 U.S.C. 1251 et. seg., hereafter referred to as "the Act"), and the Ohio Water Pollution Control Act (Ohio Revised Code Section 6111),

Northeast Ohio Regional Sewer District

is authorized by the Ohio Environmental Protection Agency, hereafter referred to as "Ohio EPA," to discharge from the combined sewer overflows located in the NEORSD Service Area as identified in the NPDES application submitted by the NEORSD, only during wet weather periods when flow exceeds the maximum capacity of the sewer system in accordance with the conditions specified in Parts II, and III of this permit.

This permit is conditioned upon payment of applicable fees as required by Section 3745.11 of the Ohio Revised Code.

This permit and the authorization to discharge shall expire at midnight on the expiration date shown above. In order to receive authorization to discharge beyond the above date of expiration, the permittee shall submit such information and forms as are required by the Ohio EPA no later than 180 days prior to the above date of expiration.

Donald R Schregardus

Donald R. Schregardus
Director

PART II, OTHER REQUIREMENTS

A. During the period beginning on the effective date of this permit and lasting until the expiration date NEORSD is authorized to discharge from the following combined sewer overflows only during wet weather periods when the flow in the sewer system exceeds the capacity of the sewer system. Also see PART III, Item 11.

Permit No.	Location	Receiving Water
3PA00002001	Storm overflow @ Easterly	Lake Erie
3PA00002002	Overflow @ Westerly from CSOTF.	Lake Erie
3PA00002007	Bancraft Ave, W of Warner Rd, behind 7414 Bancroft Ave.	Mill Creek
3PA00002013	100 feet W of West end of Maryland Ave.	Mill Creek
3PA00002014	Laumar Ave, W of E 77th St, W of 7684 Laumar Ave.	Mill Creek
3PA00002015	Force Ave, W of E 77th St, behind Red Bar @ 4344 Force Ave.	Mill Creek
3PA00002016	W of Goodman Ave & E 77th St.	Mill Creek
3PA00002017	Down Gravel Rd @ Dorver Ave & E 77th St, E of RR Tracks.	Mill Creek
3PA00002018	Broadway Ave, S of Miles Park, N of Warner Rd Bridge, Across RR Tracks	Mill Creek
3PA00002019	Under Warner Rd Bridge @ Broadway Rd access thru Webbs Terrace Rd	Mill Creek
3PA00002020	Along Mill Creek, W of exit ramp from Warner Rd to Broadway Ave	Mill Creek
3PA00002021	W of E 94th St & Broadway Ave Intersection, E side of creek	Mill Creek
3PA00002022	E Blvd Bridge, 130 feet N of Cranwood Pump Station.	Mill Creek
3PA00002023	E Blvd Bridge, N of Thornhurst Dr	Mill Creek
3PA00002024	E 131st St, N Outfall @ Cranwood Park	Mill Creek
3PA00002025	E 313st St, S Outfall @ Cranwood Park	Mill Creek
3PA00002026	E 131st SW Outfall @ Cranwood Park.	Mill Creek
3PA00002027	South side of Johnston Rd, near the Fitness Trail	Mill Creek
3PA00002028	Between ends of Kollin Ave & E 173rd St	Mill Creek
3PA00002030	E 88th St & S Highland Ave behind 5138 E 88th St.	Mill Creek
3PA00002031	W of E 81st St & Vista Ave, S of Dirt Rd.	Mill Creek
3PA00002032	Garfield Park Reservation, along Wolf Creek, across from Nature Center.	Mill Creek via Wolf Creek
3PA00002033	Intersection of Harvard Ave & Dennison Ave, S of Alcoa Gate #5.	Cuyahoga River
3PA00002035	Burke Brook @ Cuyahoga River.	Cuyahoga River
3PA00002036	Morgana Run @ Cuyahoga River, W of Campbell Rd & Independence Intersection	Cuyahoga River
3PA00002037	1500 feet N of Morgana Run @ Cuyahoga River (Southernmost Pipe)	Cuyahoga River
3PA00002038	600 feet SW of E 26th St & Independence Rd.	Cuyahoga River
3PA00002039	At Cuyahoga River turning basin 400' W of Independence Rd	Cuyahoga River
3PA00002040	Kingsbury Run @ Cuyahoga River, approx. 100'N of Jefferson Rd	Cuyahoga River
3PA00002043	E of Intersection of Tarlton Ave & W 15th St.	Treadway Creek
3PA00002044	N of Intersection of Irving Ave & S Hills Dr.	Treadway Creek
3PA00002045	NE of Intersection of Jennings Ave & Valley Ave	Big Creek
3PA00002049	N of Intersection of W 23rd St & Snyder Ave	Big Creek
3PA00002050	E side of old bridge, under W 25th St bridge.	Big Creek

PART II, OTHER REQUIREMENTS (continued)

A. Continued.

Permit No.	Location	Receiving Water
3PA00002051	Main entrance of Metropark Zoo @ Brookside Dr at mouth of triple culvert.	Big Creek
3PA00002052	Big Creek culvert beneath main entrance parking lot @ Metropark Zoo	Big Creek
3PA00002053	Intersection of John Nagy Blvd & W 57th St, S side of creek	Big Creek
3PA00002054	N of John Nagy Blvd just W of Ridge Rd bridge	Big Creek
3PA00002055	Under bridge E of Bellaire Rd & Kensington Rd	Big Creek
3PA00002056	Under bridge E of Bellaire Rd & Kensington Rd	Big Creek
3PA00002057	Memphis & 1-71, under interstate.	Big Creek Culvert
3PA00002058	W 114th St & Peony Ave, behind 3628 W 114th St.	West Branch of Big Creek
3PA00002059	Spring Rd @ Jennings Rd	Spring Creek
3PA00002062	Mid-point of Puritas Rd Hill into Metroparks.	Rocky River
3PA00002063	SE of Brookpark Rd & W 10th St Intersection	West Creek
3PA00002064	End of Larchwood Ave, W of Intersection with Riveredge Rd.	Rocky River
3PA00002065	N of Old Lorain Rd bridge over Rocky River.	Rocky River
3PA00002066	End of W 178th St, behind 17810 Allien Ave, high on hillside	Rocky River
3PA00002067	W of 3870 Rocky River Dr, in NW Corner of Kamm's Plaza.	Rocky River
3PA00002068	Off Hogsback Ln, SW of Intersection w/ Riverside Dr	Rocky River
3PA00002069	Upper Edgewater Park, approx 300 yds W of bathing beach	Lake Erie
3PA00002071	Harborview Dr & W 117th St, behind 11644 Harborview Dr.	Lake Erie
3PA00002072	Access thru Harvard Refuse Inc @ Finney Rd & E 78th St, along Mill Creek.	Mill Creek
3PA00002073	Giddings Brook @ Doan Brook, NE of Intersection @ Baldwin Rd & Fairhill Rd.	Doan Brook
3PA00002074	W 45th St @ Old River Bed	Old Riverbed - Cuyahoga River
3PA00002075	River Rd & Elm St	Old Riverbed - Cuyahoga River
3PA00002076	Center St @ Cuyahoga River on W side of river	Cuyahoga River
3PA00002077	Downstream of Columbus Rd on W side of river.	Cuyahoga River
3PA00002078	Columbus Rd @ Cuyahoga River on W side of river	Cuyahoga River
3PA00002079	Carter Rd @ Alpha Concrete on E side of river	Cuyahoga River
3PA00002080	University Rd, SE of 2065 Scranton Rd	Cuyahoga River
3PA00002081	Downstream of W 3rd St bridge	Cuyahoga River
3PA00002082	W 3rd St & Cuyahoga River under bridge on S side of river.	Cuyahoga River
3PA00002083	W 25th St bridge & Big Creek, W of bridge on N side of creek.	Big Creek
3PA00002084	1000 feet E of Ridge Rd & Associate Ave	Big Creek
3PA00002085	W 56th St S of Dennison Ave behind Palmer Supply Co	Barberton Creek
3PA00002086	Mary St E of W 3rd St @ Cuyahoga River.	Cuyahoga River
3PA00002087	E of Houston Ave & Quigley Rd @ Cuyahoga River.	Cuyahoga River
3PA00002088	Located on LTV Steel property, N of W & LE RR bridge, on W side of river.	Cuyahoga River

PART II, OTHER REQUIREMENTS (continued)

A. Continued.

Permit No.	Location	Receiving Water
3PA00002089	E of W 3rd St Pump Station.	Cuyahoga River
3PA00002090	End of Superior Ave @ Cuyahoga River.	Cuyahoga River
3PA00002091	Old River Rd & Main Ave on E side of river.	Cuyahoga River
3PA00002092	Intersection of Old River Rd & Front Ave @ Cuyahoga River.	Cuyahoga River
3PA00002093	North of Municipal Stadium.	Lake Erie
3PA00002094	North of E 12th St & Lakeside Ave @ USS COD	Lake Erie
3PA00002095	N of E 20th St & Lakeside Ave	Lake Erie
3PA00002096	N of E 26th St & Lakeside Ave	Lake Erie
3PA00002097	N of 1-71 & 1-90.	Lake Erie
3PA00002098	N of E 33rd St & Lakeside Ave	Lake Erie
3PA00002099	N of E 38th St & King Ave	Lake Erie
3PA00002200	N of E 40th St & King Ave, N of Aviation High School. .	Lake Erie
3PA00002201	Forest City Yacht Club @ Marquette St & N Marginal Dr .	Lake Erie
3PA00002202	E 55th St @ Lake Erie	Lake Erie
3PA00002203	E of E 55th St, N of Cleveland Lakefront State Park Marina.	Lake Erie
3PA00002204	Gordon Park W of E 72nd St @ Lake Erie.	Lake Erie
3PA00002205	NW of E 88th St & Carr Ave.	Doan Brook
3PA00002206	N end of E 156th St @ Lake Erie	Lake Erie
3PA00002207	NW of E 156th St & Lakeshore Blvd (Green Creek)	Lake Erie
3PA00002208	N of Neff Rd & E Park Dr Intersection	Lake Erie
3PA00002209	W side of Euclid Creek @ Lakeshore Blvd	Euclid Creek
3PA00002210	Under St Clair Ave bridge, E of Nottingham Rd & St Clair Ave.	Euclid Creek
3PA00002211	Nine-Mile Creek, E of Coit Rd, between RR tracks. . . .	Nine Mile Creek
3PA00002212	Belvoir Blvd opposite Quilliams Ave (E side of Creek) .	Nine Mile Creek
3PA00002214	Behind American Steel Supplies @ Saranac Rd & E 170th St along RR tracks.	Green Creek
3PA00002215	W side of Doan Brook @ St. Clair Ave.	Doan Brook
3PA00002216	W of Parkgate Ave & East Blvd, East side of Doan Brook.	Doan Brook
3PA00002217	W of Martin Luther King Blvd & E 98th St E side of Doan Brook.	Doan Brook
3PA00002218	E side of Doan Brook, S of Superior Ave	Doan Brook
3PA00002219	W side of Doan Brook, N of Superior Ave	Doan Brook
3PA00002220	Across from Intersection of E Blvd & Ashbury Blvd on E side of Doan Brook.	Doan Brook
3PA00002221	E 105th St & Hough Ave.	Doan Brook
3PA00002222	E 105th St & Doan Brook on S side of Doan Brook	Doan Brook
3PA00002223	N of E 107th St & Parklane Rd behind art museum	Doan Brook
3PA00002224	N of E 107th St & Parklane Rd, behind art museum where Doan Brook leaves culvert	Doan Brook
3PA00002225	N of Kemper Rd & Fairhill Rd @ Doan Brook	Doan Brook
3PA00002226	Along creek N of Larchmere & Coventry Rd Intersection downstream of Bridge Over Creek	Doan Brook East Branch

PART II, OTHER REQUIREMENTS (continued)

A. Continued.

Permit No.	Location	Receiving Water
3PA00002230	Dugway Brook, Approx 600 feet upstream of Lakeshore Blvd.	Dugway Brook, (West Branch)
3PA00002231	Dugway Brook, approx 600 feet upstream of Lakeshore Blvd.	Dugway Brook (East Branch)
3PA00002232	S side of I-90, E of Eddy Rd @ Shaw Brook	Shaw Brook
3PA00002233	W 150th St, S of Industrial Pkwy under bridge over Big Creek.	Big Creek
3PA00002234	Doan Brook between Martin Luther King Blvd & E 105th St (E side of culvert).	Doan Brook
3PA00002235	W 3rd St @ Canal Rd, E side of Cuyahoga River	Cuyahoga River (East Side)
3PA00002236	Spring Brook @ Doan Brook, behind pond @ Martin Luther King Blvd & Hough Ave.	Doan Brook
3PA00002238	N side of Apt Pkg lot @ Rocky River Rd & Fairway Ave	Rocky River
3PA00002239	E shore of Euclid Creek at Lakeshore Blvd	Euclid Creek
3PA00002240	Jefferson Ave, E of W 3rd St.	Cuyahoga River
3PA00002241	1-71 under Eaton Corporation Sign	Big Creek
3PA00002242	E 142nd St and Lakeshore Blvd	Lake Erie
3PA00002243	In ravine, W of Warner Rd, S of Garfield Rd	Mill Creek
3PA00002245	Edgepark Dr @ E 117th St (North).	Wolf Creek
3PA00002246	Broadway Ave @ Mill Creek, E wall of bridge	Mill Creek
3PA00002247	East Blvd @ Cranwood Creek, N of Thornhurst Ave	Mill Creek Branch
3PA00002249	450 feet E of E 119th St & 250 feet N Of McCracken Rd	Wolf Creek
3PA00002250	Along Cuyahoga River, 370 feet S of Canal Rd, E side of 1-77 bridge	Cuyahoga River
3PA00002251	Along B&O RR tracks, 2200 feet N Canal Rd	Mill Creek
3PA00002252	Between E 71st St & 1-77, S of building @ 4620 E 71st St	Ohio Canal

B. NEORSD shall continue to implement the minimum control measures for CSOs that are applicable to its system. The controls are as follows.

1. Proper operation and regular maintenance programs for the sewer system and CSO points;
2. Maximum use of the collection system for storage of wet weather flow prior to allowing overflows;
3. Review and modification of pretreatment program to minimize the impact of nondomestic discharges from CSOs;
4. Maximization of flow to POTW for treatment;
5. Prohibition of dry weather overflows;
6. Control of solid and floatable materials in CSO discharges;
7. Required inspection, monitoring and reporting of CSOs;
8. Pollution prevention programs that focus on reducing the level of contaminants in CSOs; and

PART II, OTHER REQUIREMENTS (continued)

B. (continued)

9. Public notification for any areas affected by CSOs, especially beach areas and areas where contact recreation occurs. (Ohio EPA expects NEORSD to develop and implement an effective public advisory system that informs the public of the possible health and environmental impacts associated with CSOs, and advises against contact recreation when elevated bacteria levels may endanger public health.)

C. Within 6 months of the effective date of this permit or by October 1, 1997, NEORSD shall submit a report to the Ohio EPA Northeast District Office on regulators to which structural modifications have been completed or planned since the Phase I CSO Facilities Plan was completed.

D. Within 6 months of the effective date of this permit or by October 1, 1997, NEORSD shall submit to the Ohio EPA Northeast District Office for review and comment 2 copies of a public participation plan. The plan will outline the steps the permittee has taken and will take to ensure that members of the public affected by the development and implementation of the CSO control program have opportunities to participate in the process. This includes participation in the evaluation and selection of controls, when appropriate, in determining the value that the community places on recreation opportunities that are impacted by CSO discharges, and in setting priorities for CSO control projects.

E. Within 12 months of the effective date of this permit or by April 1, 1998, NEORSD shall develop and submit to the Northeast District Office for approval two copies of a Combined Sewer System Operational Plan. The Plan shall outline in detail the procedures used to ensure that the entire wastewater treatment system (the collection system and the treatment plant) is operated and maintained so that the total loading of pollutants discharged during wet weather is minimized. Items included in Ohio EPA's "Checklist for Adequacy of Combined Sewer System Operational Plans" (9-22-94) must be considered in developing the Plan and addressed if they are applicable. The degree of detail that is required in a Plan is variable, depending on the complexity of the combined sewer system. Section IV of the checklist applies specifically to the nine minimum controls.

The Plan shall include a specific section that provides documentation on the actions NEORSD is taking to implement each of the nine minimum controls. If a minimum control is not applicable, this must be explained. If the permittee is not fully implementing a minimum control, the documentation shall include a fixed date compliance schedule leading to complete implementation of the control.

During the time between submission of the Plan and its approval by Ohio EPA, NEORSD shall continue implementation of the minimum controls as outlined in the Plan. When the Plan is approved, NEORSD shall operate and maintain the entire wastewater treatment system in accordance with the approved plan.

F. NEORSD shall submit to the Ohio EPA Northeast District Office, the following information in accordance with the following compliance schedule:

1. Within 12 months of the effective date of this permit or by April 1, 1998, NEORSD shall submit for approval a facilities plan for the Mill Creek CSO planning area. The goal of the facilities plan is that the discharges from combined sewer overflows shall not cause or significantly contribute to violations of water quality standards or impairment of designated uses. The facilities plan shall include:

PART II, OTHER REQUIREMENTS (continued)

F. Continued.

a) Characterization of the collection system and overflows using the tools of monitoring and modeling - The monitoring program will provide adequate data to characterize and model the collection system and overflows; support development and implementation of the minimum control measures; support development and implementation of a long-term control plan; and allow the effectiveness of control measures to be evaluated.

b) A description of the selected method for controlling and treating combined sewer overflow for a storm event established during the cost/performance analysis.

c) A date for submission of a detailed construction schedule if necessary. Once approved by the Director of Ohio EPA, the construction schedule shall be incorporated into this permit by reference.

d) The permittee shall conduct macroinvertebrate sampling at the mouth of Mill Creek. The purpose of the sampling shall be to establish baseline stream conditions and to monitor stream improvements resulting from NEORSD CSO control projects. The baseline sampling shall be conducted prior to initiation of CSO control projects. Sampling shall be conducted annually thereafter.

2. Within 18 months of the effective date of this permit or by October 1, 1998, NEORSD shall submit for approval a facilities plan for installation of facilities to store and/or treat excess combined sewer overflow from the Easterly WWTP that is otherwise discharged untreated to Lake Erie. The facilities plan shall include:

a) Characterization of the overflows using the tools of monitoring and modeling - The monitoring program will provide adequate data to characterize and model the overflows; support development and implementation of the minimum control measures; support development and implementation of a long-term control plan; and allow the effectiveness of control measures to be evaluated.

b) A description of the selected method for controlling and treating the combined sewer overflow.

c) A date for submission of a detailed construction schedule if necessary. Once approved by the Director of Ohio EPA, the construction schedule shall be incorporated into this permit by reference.

G. Within 60 months of the effective date of this permit or by March 28, 2002, NEORSD shall develop and submit for approval to the Northeast District Office two copies of a Combined Sewer System Long-Term Control Plan for the Easterly service area and portions of the Southerly service area not covered under F.1. The goal of the long term plan is that discharges from combined sewer overflows shall not cause or significantly contribute to violations of water quality standards or impairment of designated uses. The plan shall address, as a minimum, the following:

1. NEORSD shall characterize its collection system and overflows using the tools of monitoring and modeling. A monitoring program will be proposed that provides adequate data to characterize and model the collection system and overflows; supports development and implementation of the minimum control measures; supports development and implementation of a long-term control plan; and allows the effectiveness of control measures to be evaluated.

PART II, OTHER REQUIREMENTS (continued)

G. Continued.

2. NEORSD shall conduct macroinvertebrate sampling at the mouths of Doan Brook and Euclid Creek (Easterly service area) and Big Creek (Southerly service area). The purpose of the sampling shall be to establish baseline stream conditions and to monitor stream improvements resulting from NEORSD CSO control projects. The baseline sampling shall be conducted prior to initiation of CSO control projects. Sampling shall be conducted annually thereafter.

3. NEORSD shall identify CSO discharges to State Resource Waters (OAC 3745-1-05), Bathing Waters [OAC 3745-1-07(B)(4)], and all surface waters within 500 yards of an existing public water supply intake and designate these discharges as the highest priority for elimination, relocation or treatment. Overflows to these waters shall be eliminated or relocated whenever physically and economically achievable, except when this would cause unacceptable water quality impacts elsewhere in the system. If elimination or relocation is not possible, then treatment must be provided that will result in attainment of water quality standards and designated uses.

   Discretion may be exercised regarding the priority given to elimination, relocation or treatment of CSOs that discharge to State Resource Waters, Bathing Waters, and Public Water Supplies. This is particularly true if the CSO discharging to a priority water is not causing or significantly contributing to water quality standard violations or designated use impairment. Based on factors such as the nature and severity of water quality impacts, the type of receiving water, and potential public health risks, priority may be given to controlling CSOs that discharge to other receiving waters. As part of developing the long-term control plan, NEORSD should discuss with Ohio EPA cases where severe water quality impacts to other waters justify priority consideration of the same level given State Resource Waters, Bathing Waters, and Public Water Supplies.

4. NEORSD shall develop and implement an effective notification program that informs the public of the possible health and environmental impacts associated with CSOs, and advises against contact recreation when elevated bacteria levels may endanger public health.

5. NEORSD shall consider the "presumption" and/or the "demonstration" approach included in U.S. EPA's National Combined Sewer Overflow Policy (April 19, 1994). Elimination of overflows shall always be evaluated as a control option and shall be implemented if it is cost effective, economically achievable, and does not cause new or significantly increased overflows elsewhere in the system.

6. NEORSD shall conduct cost/performance analyses to determine where the increment of CSO abatement achieved diminishes compared to the increased costs.

7. When necessary, NEORSD shall propose revisions to the Combined Sewer System Operational Plan necessary to implement long term controls.

8. NEORSD shall propose an implementation schedule for proposed actions based on the following: The relative magnitude of adverse impacts on water quality standards and designated uses, the community's financial capabilities, the relative cost/performance evaluations of individual projects, the priorities developed through public participation, and previous efforts to control CSOs.

H. This permit may be modified to include fixed date compliance schedules for the implementation of CSO control projects.

PART II, OTHER REQUIREMENTS (continued)

I. The macroinvertebrate sampling required at F.1(d) and G.2 shall be established and conducted in accordance with procedures outlined in "Reporting and Testing Guidance for Biomonitoring Required by the Ohio Environmental Protection Agency" (October, 1991, or latest revision; Division of Surface Water) and the requirements cited in the Ohio Water Quality Standards at OAC 3745-1-03. Sampling shall be conducted between the months of May and September of each year, and results submitted to the Ohio EPA Northeast District Office no later than December 31 of each year when sampling is conducted.

J. NEORSD shall comply with following schedule for design and construction of CSO control facilities in the Westerly District:

1. As expeditiously as possible, but not later than September 1, 1999, NEORSD shall submit for approval a facilities plan for the Westerly CSO planning area as established in project "D-II - Westerly District CSO Phase II Facilities Plan Study". The facilities plan shall include an implementation schedule for the CSO control projects.

2. As expeditiously as possible, but not later than October 1, 1999, NEORSD shall initiate detailed design of CSO control facilities necessary to adequately control and treat CSO discharges in the Westerly service area as established in the Westerly WWTP service area Phase II project "D-III - Westerly District CSO Control Facilities Design and Construction".

3. NEORSD shall notify the Ohio EPA Northeast District Office within 7 days of initiating the detailed design.

4. As expeditiously as possible, but not later than October 31, 2002, NEORSD shall submit for approval to the Ohio EPA Northeast District Office the detailed design of CSO facilities in the Westerly WWTP service area.

5. As expeditiously as possible, but not later than October 31, 2001, NEORSD shall initiate construction of CSO facilities identified in the Phase II study for the Westerly WWTP Service Area.

6. As expeditiously as possible, but not later than December 31, 2008, NEORSD shall complete construction of the CSO facilities.

7. NEORSD shall notify the Ohio EPA Northeast District Office within 7 days of completing construction.

K. NEORSD shall comply with following schedule for design and construction of CSO control facilities in the Edgewater area:

1. As expeditiously as possible, but not later than December 31, 1996, NEORSD shall complete construction of CSO improvements in the Edgewater area.

2. NEORSD shall notify the Ohio EPA Northeast District Office within 7 days of completing construction.

L. As expeditiously as possible, but not later than 24 months from the effective date of this permit or by April 1, 1999, NEORSD shall submit to the Ohio EPA Northeast District Office for approval a plan to treat for floatable material at the CSO outfalls at East 55th Street (Station 3PA00002202) and Kingsbury Run (Station 3PA00002040). The plan shall include, at a minimum, the proposed method of treatment at each location, a schedule for submitting detailed plans for the treatment systems, a schedule for final installation of the treatment systems, and a plan for a one year study to evaluate the effectiveness of the treatment systems.

PART II, OTHER REQUIREMENTS (continued)

M. During dry weather conditions, NEORSD shall not intentionally divert waste streams from any portion of a treatment facility, i.e. bypass, except in accordance with 40 CFR 122.41(m).

N. As soon as practicable, NEORSD shall notify Ohio EPA in writing of combined sewer overflows not listed in Part II. Item A of this permit that are discovered during field investigations, during routine operation and maintenance inspections, or through other means. Also, NEORSD shall, as soon as practicable, notify Ohio EPA in writing of combined sewer overflows listed in Part II, Item A of this permit that during field investigations, during routine operation and maintenance inspections, or through other means are determined not to be combined sewer overflows.

PART III - GENERAL CONDITIONS

1. DEFINITIONS

"daily load limitations" is the total discharge by weight during any calendar day. If only one sample is taken during a day, the weight of pollutant discharge calculated from it is the daily load.

"daily concentration limitation" means the arithmetic average (weighted by flow) of all the determinations of concentration made during the day. If only one sample is taken during the day, its concentration is the daily concentration. Coliform bacteria limitations compliance shall be determined using the geometric mean.

"7-day load limitation" is the total discharge by weight during any 7-day period divided by the number of days in that 7-day period that the facility was in operation. If only one sample is taken in a 7-day period, the weight of pollutant discharge calculated from it is the 7-day load. If more than one sample is taken during the 7-day period, the 7-day load is calculated by determining the daily load for each day sampled, totaling the daily loads for the 7-day period, and dividing by the number of days sampled.

"7-day concentration limitation" means the arithmetic average (weighted by flow) of all the determinations of daily concentration limitation made during the 7-day period. If only one sample is taken during the 7-day period, its concentration is the 7-day concentration limitation for that 7-day period. Coliform bacteria limitations compliance shall be determined using the geometric mean.

"30-day load limitation" is the total discharge by weight during any 30-day period divided by the number of days in the 30-day period that the facility was in operation. If only one sample is taken in a 30-day period, the weight of pollutant discharge calculated from it is the 30-day load. If more than one sample is taken during one 30-day period, the 30-day load is calculated by determining the daily load for each day sampled, totaling the daily loads for the 30-day period and dividing by the number of days sampled.

"30-day concentration limitation" means the arithmetic average (weighted by flow) of all the determinations of daily concentration made during the 30-day period. If only one sample is taken during the 30-day period, its concentration is the 30-day concentration for that 30-day period. Coliform bacteria limitations compliance shall be determined using the geometric mean.

"85 percent removal limitations" means the arithmetic mean of the values for effluent samples collected in a period of 30 consecutive days shall not exceed 15 percent of the arithmetic mean of the values for influent samples collected at approximately the same times during the same period.

"Absolute Limitations" Compliance with limitations having descriptions of "shall not be less than," "nor greater than," "shall not exceed," "minimum," or "maximum" shall be determined from any single value for effluent samples and/or measurements collected.

"Net concentration" shall mean the difference between the concentration of a given substance in a sample taken of the discharge and the concentration of the same substances in a sample taken at the intake which supplies water to the given process. For the purpose of this definition, samples that are taken to determine the net concentration shall always be 24-hour composite samples made up of at least six increments taken at regular intervals throughout the plant day.

"Net load" shall mean the difference between the load of a given substance as calculated from a sample taken of the discharge and the load of the same substance in a sample taken at the intake which supplies water to given process. For purposes of this definition, samples that are taken to determine the net loading shall always be 24-hour composite samples made up of at least six increments taken at regular intervals throughout the plant day.

"MGD" means million gallons per day.

"mg/l" means milligrams per liter.

"µg/l" means micrograms per liter.

"Reporting Code" is a five digit number used by the Ohio EPA in processing reported data. The reporting code does not imply the type of analysis used nor the sampling techniques employed.

"Quarterly sampling frequency" means the sampling shall be done in the months of March, June, August, and December.

"Yearly sampling frequency" means the sampling shall be done in the month of September.

"Semi-annual sampling frequency" means the sampling shall be done during the months of June and December.

"Winter" shall be considered to be the period from November 1 through April 30.

"Bypass" means the intentional diversion of waste streams from any portion of the treatment facility.

"Summer" shall be considered to be the period from May 1 through October 31.

"Severe property damage" means substantial physical damage to property, damage to the treatment facilities which would cause them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

PART III - GENERAL CONDITIONS (continued)

"Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

2. GENERAL EFFLUENT LIMITATIONS

The effluent shall, at all times, be free of substances:

A. In amounts that will settle to form putrescent, or otherwise objectionable, sludge deposits; or that will adversely affect aquatic life or water fowl;

B. Of an oily, greasy, or surface-active nature, and of other floating debris, in amounts that will form noticeable accumulations of scum, foam or sheen;

C. In amounts that will alter the natural color or odor of the receiving water to such degree as to create a nuisance;

D. In amounts that either singly or in combination with other substances are toxic to human, animal, or aquatic life;

E. In amounts that are conducive to the growth of aquatic weeds or algae to the extent that such growths become inimical to more desirable forms of aquatic life, or create conditions that are unsightly, or constitute a nuisance in any other fashion;

F. In amounts that will impair designated instream or downstream water uses.

3. FACILITY OPERATION AND QUALITY CONTROL

All wastewater treatment works shall be operated in a manner consistent with the following:

A. At all times, the permittee shall maintain in good working order and operate as efficiently as possible all treatment or control facilities or systems installed or used by the permittee necessary to achieve compliance with the terms and conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems which are installed by a permittee only when the operation is necessary to achieve compliance with conditions of the permit.

B. The permittee shall effectively monitor the operation and efficiency of treatment and control facilities and the quantity and quality of the treated discharge.

C. Maintenance of wastewater treatment works that results in degradation of effluent quality shall be scheduled during non-critical water quality periods and shall be carried out in a manner approved by the Ohio EPA as specified in the Paragraph in this PART III entitled, "UNAUTHORIZED DISCHARGES".

4. REPORTING

A. Monitoring data required by this permit shall be reported on the Ohio EPA report form (4500) on a monthly basis. Individual reports for each sampling station for each month are to be received no later than the 15th day of the next month. The original plus first copy of the report form must be signed and mailed to:

Ohio Environmental Protection Agency
Division of Surface Water
Enforcement Section, ES/MOR
P.O. Box 1049
Columbus, Ohio 43266-0149

B. If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved analytical methods as specified below, the results of such monitoring shall be included in the calculation and reporting of the values required in the reports specified above.

C. Analyses of pollutants not required by this permit, except as noted in the preceding paragraph, shall not be reported on Ohio EPA report form (4500) but records shall be retained as specified in the paragraph entitled "RECORDS RETENTION".

5. SAMPLING AND ANALYTICAL METHODS

Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored flow. Test procedures for the analysis of pollutants shall conform to regulation 40 CFR 136, "Test Procedures For The Analysis of Pollutants" unless other test procedures have been specified in this permit. The permittee shall periodically calibrate and perform maintenance procedures on all monitoring and analytical instrumentation at intervals to insure accuracy of measurements.

PART III - GENERAL CONDITIONS (continued)

6. RECORDING OF RESULTS

For each measurement or sample taken pursuant to the requirements of this permit, the permittee shall record the following information:

A. The exact place and date of sampling; (time of sampling not required on EPA 4500)

B. The person(s) who performed the sampling or measurements;

C. The date the analyses were performed on those samples;

D. The person(s) who performed the analyses;

E. The analytical techniques or methods used; and

F. The results of all analyses and measurements.

7. RECORDS RETENTION

The permittee shall retain all of the following records for the wastewater treatment works for a minimum of three years, including:

A. All sampling and analytical records (including internal sampling data not reported);

B. All original recordings for any continuous monitoring instrumentation;

C. All instrumentation, calibration and maintenance records;

D. All plant operation and maintenance records;

E. All reports required by this permit; and

F. Records of all data used to complete the application for this permit for a period of at least three years from the date of the sample, measurement, report, or application.

These periods will be extended during the course of any unresolved litigation, or when requested by the Regional Administrator or the Ohio EPA. The three year period for retention of records shall start from the date of sample, measurement, report, or application.

8. AVAILABILITY OF REPORTS

Except for data determined by the Ohio EPA to be entitled to confidential status, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the appropriate district offices of the Ohio EPA. Both the Clean Water Act and Section 6111.05 Ohio Revised Code state that effluent data and receiving water quality data shall not be considered confidential. Knowingly making any false statement on any such report may result in the imposition of criminal penalties as provided for in Ohio Revised Code Section 6111.99.

9. DUTY TO PROVIDE INFORMATION

The permittee shall furnish to the Director, within a reasonable time, any information which the Director may request to determine whether cause exists for modifying, revoking, and reissuing, or terminating the permit, or to determine compliance with this permit. The permittee shall also furnish to the Director, upon request, copies of records required to be kept by this permit.

10. RIGHT OF ENTRY

The permittee shall allow the Director, or an authorized representative upon presentation of credentials and other documents as may be required by law to;

A. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit.

B. Have access to and copy, at reasonable times, any records that must be kept under the conditions of the permit.

C. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit.

D. Sample or monitor at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by the Clean Water Act, any substances or parameters at any location.

11. UNAUTHORIZED DISCHARGES

A. Bypassing or diverting of wastewater from the treatment works is prohibited unless:

1. Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

PART III - GENERAL CONDITIONS (continued)

2. There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of downtime. This condition is not satisfied if adequate back up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and

3. The permittee submitted notices as required under paragraph D. of this section.

B. If the permittee knows in advance of the need for a bypass, it shall submit prior notice, if possible at least ten days before the date of the bypass.

C. The Director may approve an unanticipated bypass, after considering its adverse effects, if the Director determines that it has met the three conditions listed in paragraph 11.A. of this section.

D. The permittee shall submit notice of an unanticipated bypass as required in section 12.

E. The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded if that bypass is for essential maintenance to assure efficient operation.

12. NONCOMPLIANCE NOTIFICATION

A. The permittee shall by telephone report any of the following within twenty-four (24) hours of discovery at (toll free) 1-800-282-9378:

1. Any noncompliance which may endanger health or the environment;

2. Any unanticipated bypass which exceeds any effluent limitation in the permit; or

3. Any upset which exceeds any effluent limitation in the permit.

4. Any violation of a maximum daily discharge limitation for any of the pollutants listed by the Director in the permit.

B. For the telephone reports required by Part 12.A., the following information must be included:

1. The times at which the discharge occurred, and was discovered;

2. The approximate amount and the characteristics of the discharge;

3. The stream(s) affected by the discharge;

4. The circumstances which created the discharge;

5. The names and telephone numbers of the persons who have knowledge of these circumstances;

6. What remedial steps are being taken; and

7. The names and telephone numbers of the persons responsible for such remedial steps.

C. These telephone reports shall be confirmed in writing within five days of the discharge and submitted to the appropriate Ohio EPA district office. The report shall include the following:

1. The limitation(s) which has been exceeded;

2. The extent of the exceedance(s);

3. The cause of the exceedance(s);

4. The period of the exceedance(s) including exact dates and times;

5. If uncorrected, the anticipated time the exceedance(s) is expected to continue, and

6. Steps being taken to reduce, eliminate, and/or prevent recurrence of the exceedance(s).

D. Compliance Schedule Events:

If the permittee is unable to meet any date for achieving an event, as specified in the schedule of compliance, the permittee shall submit a written report to the appropriate district office of the Ohio EPA within 14 days of becoming aware of such situation. The report shall include the following:

1. The compliance event which has been or will be violated;

2. The cause of the violation;

3. The remedial action being taken;,

4. The probable date by which compliance will occur; and

PART III - GENERAL CONDITIONS (continued)

5. The probability of complying with subsequent and final events as scheduled.

E. The permittee shall report all instances of noncompliance not reported under paragraphs A, B, or C of this section, at the time monitoring reports are submitted. The reports shall contain the information listed in paragraphs B and C of this section.

F. Where the permittee becomes aware that it failed to submit any relevant application or submitted incorrect information in a permit application or in any report to the director, it shall promptly submit such facts or information.

13. RESERVED

14. DUTY TO MITIGATE

The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

15. AUTHORIZED DISCHARGES

All discharges authorized herein shall be consistent with the terms and conditions of this permit. The discharge of any pollutant identified in this permit more frequently than, or at a level in excess of, that authorized by this permit shall constitute a violation of the terms and conditions of this permit. Such violations may result in the imposition of civil and/or criminal penalties as provided for in Section 309 of the Act and Ohio Revised Code Sections 6111.09 and 6111.99.

16. DISCHARGE CHANGES

The following changes must be reported to the appropriate Ohio EPA district office as soon as practicable.

A. For all treatment works, any significant change in character of the discharge which the permittee knows or has reason to believe has occurred or will occur which would constitute cause for modification or revocation and reissuance. The permittee shall give advance notice to the Director of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements. Notification of permit changes or anticipated noncompliance does not stay any permit condition.

B. For publicly owned treatment works:

1. Any proposed plant modification, addition, and/or expansion that will change the capacity or efficiency of the plant;

2. The addition of any new significant industrial discharge; and

3. Changes in the quantity or quality of the wastes from existing tributary industrial discharges which will result in significant new or increased discharges of pollutants.

C. For non-publicly owned treatment works, any proposed facility expansions, production increases, or process modifications, which will result in new, different, or increased discharges of pollutants.

Following this notice, modifications to the permit may be made to reflect any necessary changes in permit conditions, including any necessary effluent limitations for any pollutants not identified and limited herein. A determination will also be made as to whether a National Environmental Policy Act (NEPA) review will be required. Sections 6111.44 and 6111.45, Ohio Revised Code, require that plans for treatment works or improvements to such works be approved by the Director of the Ohio EPA prior to initiation of construction.

D. In addition to the reporting requirements under 40 CFR 122.41(1) and per 40 CFR 122.42(a), all existing manufacturing, commercial, mining, and silvicultural dischargers must notify the Director as soon as they know or have reason to believe:

1. That any activity has occurred or will occur which would result in the discharge on a routine or frequent basis of any toxic pollutant which is not limited in the permit. If that discharge will exceed the highest of the "notification levels" specified in 40 CFR Sections 122.42(a)(1)(i) through 122.42(a)(1)(iv).

2. That any activity has occurred or will occur which would result in any discharge, on a non-routine or infrequent basis, of a toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the "notification levels" specified in 122.42(a)(2)(i) through 122.42(a)(2)(iv).

17. TOXIC POLLUTANTS

The permittee shall comply with effluent standards or prohibitions established under Section 307 (a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that establish these standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement. Following establishment of such standards or prohibitions, the Director shall modify this permit and so notify the permittee.

PART III - GENERAL CONDITIONS (continued)

18. PERMIT MODIFICATION OR REVOCATION

A. After notice and opportunity for a hearing, this permit may be modified or revoked, by the Ohio EPA, in whole or in part during its term for cause including, but not limited to, the following:

1. violation of any terms or conditions of this permit;

2. obtaining this permit by misrepresentation or failure to disclose fully all relevant facts; or

3. change in any condition that requires either a temporary or permanent reduction or elimination of the permitted discharge.

B. Pursuant to rule 3745-33-06, Ohio Administrative Code, the permittee may at any time apply to the Ohio EPA for modification of any part of this permit. The filing of a request by the permittee for a permit modification or revocation does not stay any permit condition. The application for modification should be received by the appropriate Ohio EPA district office at least ninety days before the date on which it is desired that the modification become effective. The application shall be made only on forms approved by the Ohio EPA.

19. TRANSFER OF OWNERSHIP OR CONTROL

This permit cannot be transferred or assigned nor shall a new owner or successor be authorized to discharge from this facility, until the following requirements are met:

A. The permittee shall notify the succeeding owner or successor of the existence of this permit by a letter, a copy of which shall be forwarded to the appropriate Ohio EPA district office. The copy of that letter will serve as the permittee's notice to the Director of the proposed transfer. The copy of that letter shall be received by the appropriate Ohio EPA district office sixty days prior to the proposed date of transfer;

B. A written agreement containing a specific date for transfer of permit responsibility and coverage between the current and new permittee (including acknowledgement that the existing permittee is liable for violations up to that date, and that the new permittee is liable for violations from that date on) shall be submitted to the appropriate Ohio EPA district office within sixty days after receipt by the district office of the copy of the letter from the permittee to the succeeding owner;

C. The Director does not exercise his right within thirty days after receipt of the written agreement to notify the current permittee and the new permittee of his or her intent to modify or revoke the permit and to require that a new application be filed; and

D. The new owner or successor receives written confirmation and approval of the transfer from the Director of the Ohio EPA.

At anytime during the sixty (60) day period between notification of the proposed transfer and the effective date of the transfer, the Director may prevent the transfer if he concludes that such transfer will jeopardize compliance with the terms and conditions of the permit.

20. OIL AND HAZARDOUS SUBSTANCE LIABILITY

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the Act.

21. SOLIDS DISPOSAL

Collected screenings, slurries, sludges, and other solids shall be disposed of in such a manner as to prevent entry of those wastes into waters of the state. For publicly owned treatment works, these shall be disposed of in accordance with the approved Ohio EPA Sludge Management Plan.

22. CONSTRUCTION AFFECTING NAVIGABLE WATERS

This permit does not authorize or approve the construction of any onshore or offshore physical structures or facilities or the undertaking of any work in any navigable waters.

23. CIVIL AND CRIMINAL LIABILITY

Except as exempted in the permit conditions on UNAUTHORIZED DISCHARGES or UPSETS, nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance.

24. STATE LAWS AND REGULATIONS

Nothing in this permit shall be construed to preclude the institution of any legal action nor relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable state law or regulation under authority preserved by Section 510 of the Act.

PART III - GENERAL CONDITIONS (continued)

25. PROPERTY RIGHTS

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, state, or local laws or regulations.

26. UPSET

The provisions of 40 CFR Section 122.41(n), relating to "Upset," are specifically incorporated herein by reference in their entirety. For definition of "upset," see Part 1, DEFINITIONS.

27. SEVERABILITY

The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

28. SIGNATORY REQUIREMENTS

All applications submitted to the Director shall be signed and certified in accordance with the requirements of 40 CFR 122.22(b) and (c).

All reports submitted to the Director shall be signed and certified in accordance with the requirements of 40 CFR Section 122.22(b) and (c).

29. OTHER INFORMATION

A. Where the permittee becomes aware that it failed to submit any relevant facts in a permit application or submitted incorrect information in a permit application or in any report to the Director, it shall promptly submit such facts or information.

B. ORC 6111.99 provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $25,000 per violation.

C. ORC 6111.99 states that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit including monitoring reports or reports of compliance or noncompliance shall, upon conviction, be punished by a fine of not more than $25,000 per violation.

D. ORC 6111.99 provides that any person who violates Sections 6111.04, 6111.042., 6111.05., or division (A) of Section 6111.07 of the Revised Code shall be fined not more than twenty-five thousand dollars or imprisoned not more than one year, or both.

30. NEED TO HALT OR REDUCE ACTIVITY

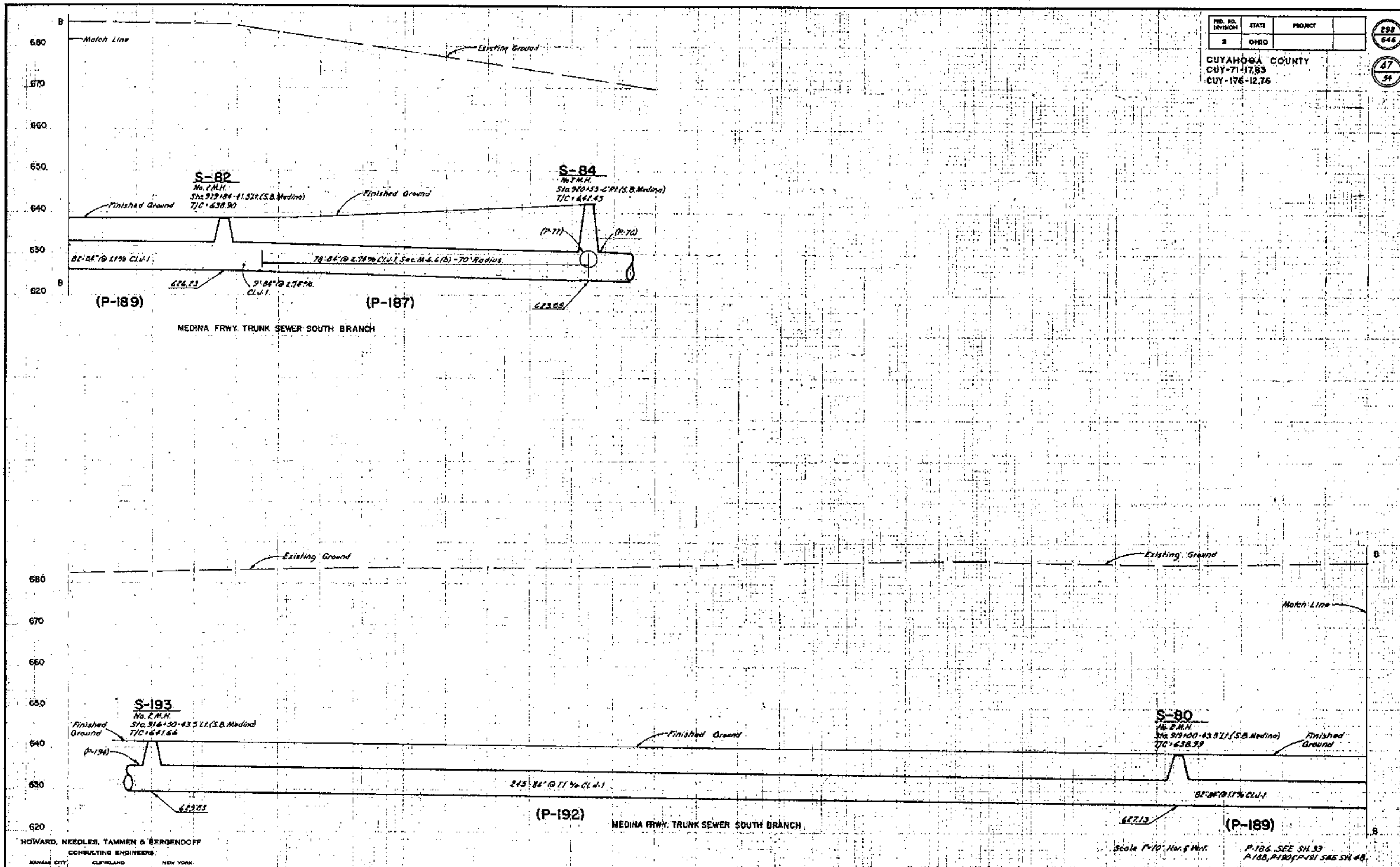
40 CFR 122.41(c) states that it shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with conditions of this permit.

31. APPLICABLE FEDERAL RULES

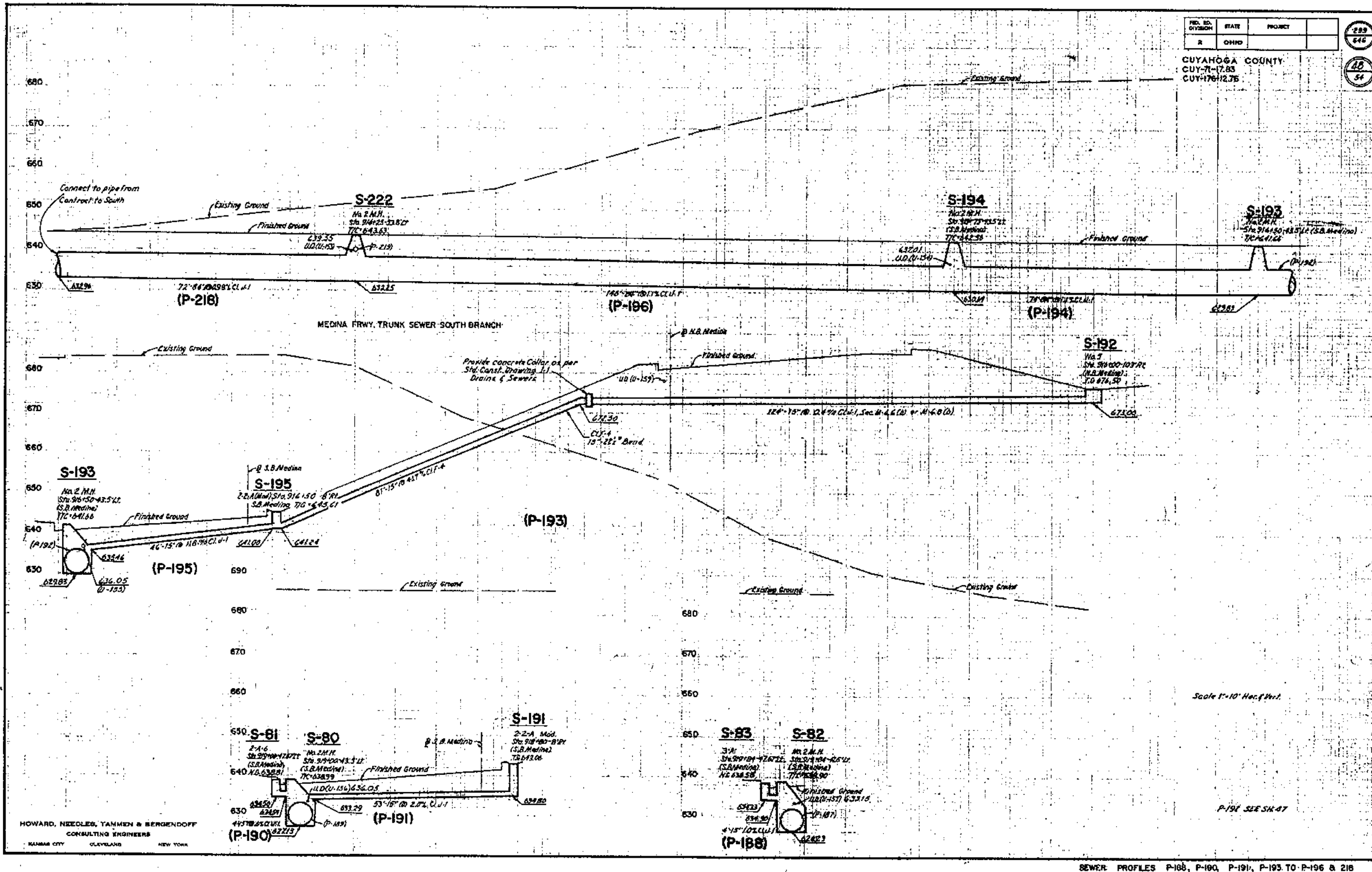
All references to 40 CFR in this permit mean the version of 40 CFR which is effective as of the effective date of this permit.

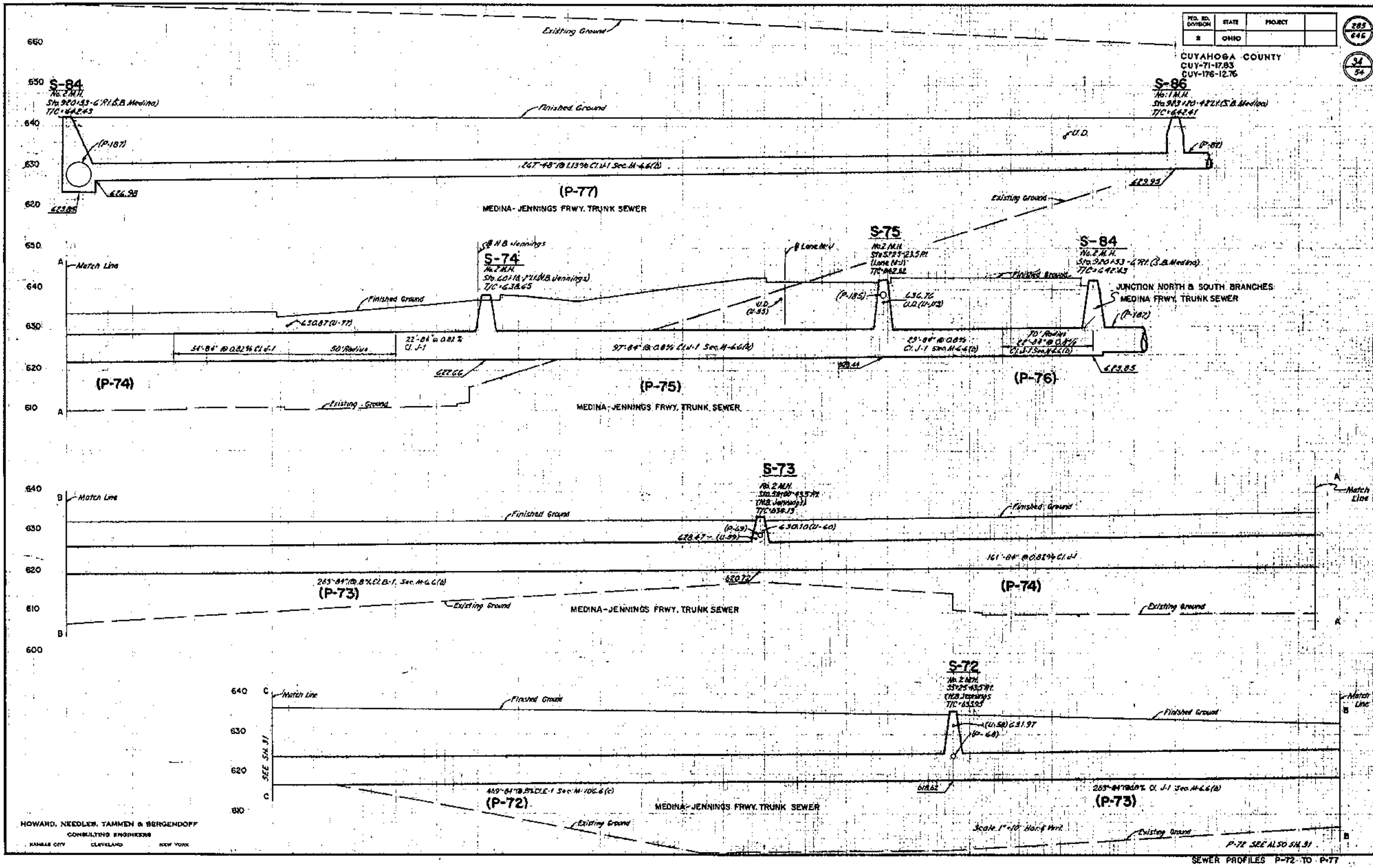
Appendix V

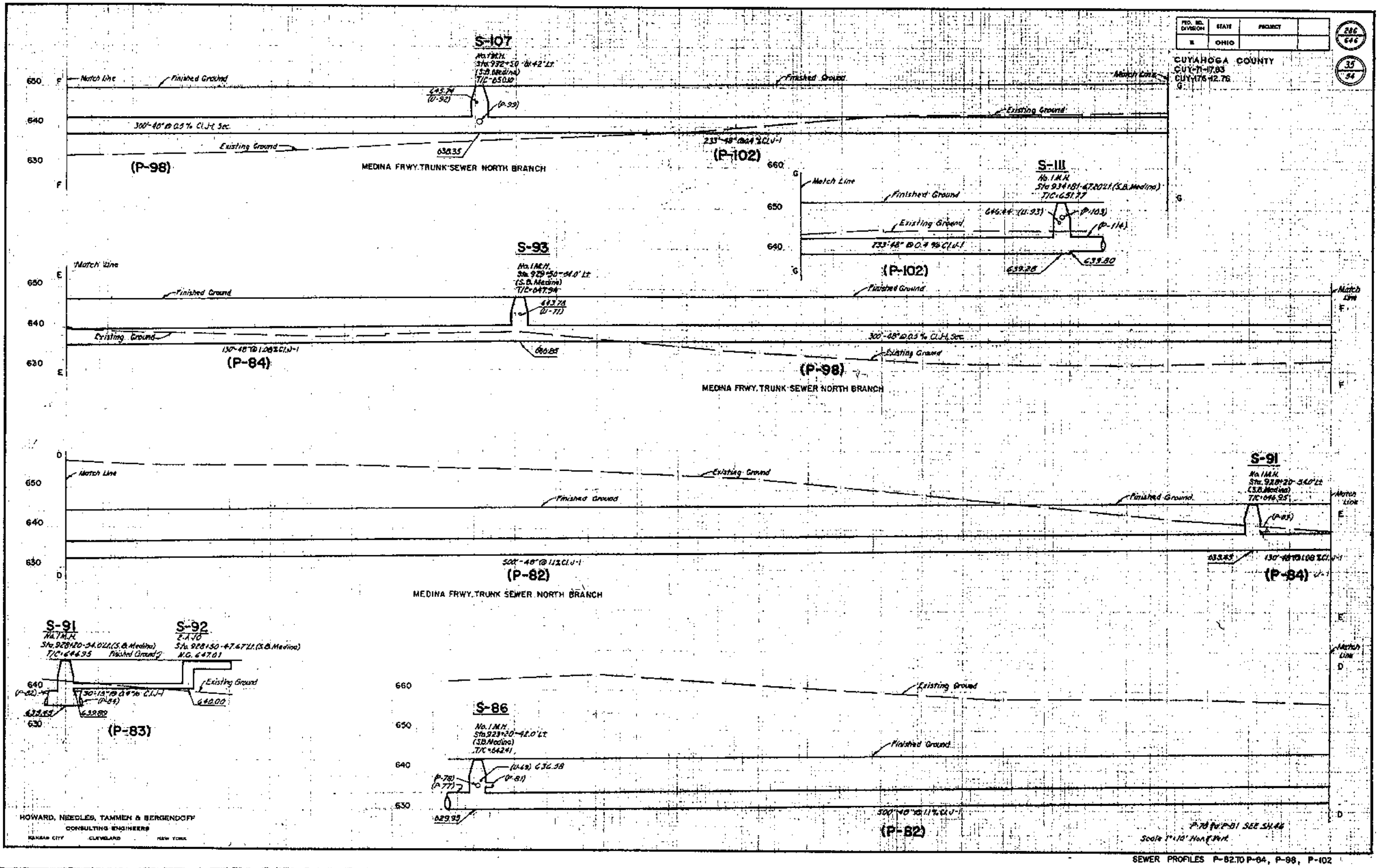
I-71/Jennings Freeway ODOT drawings



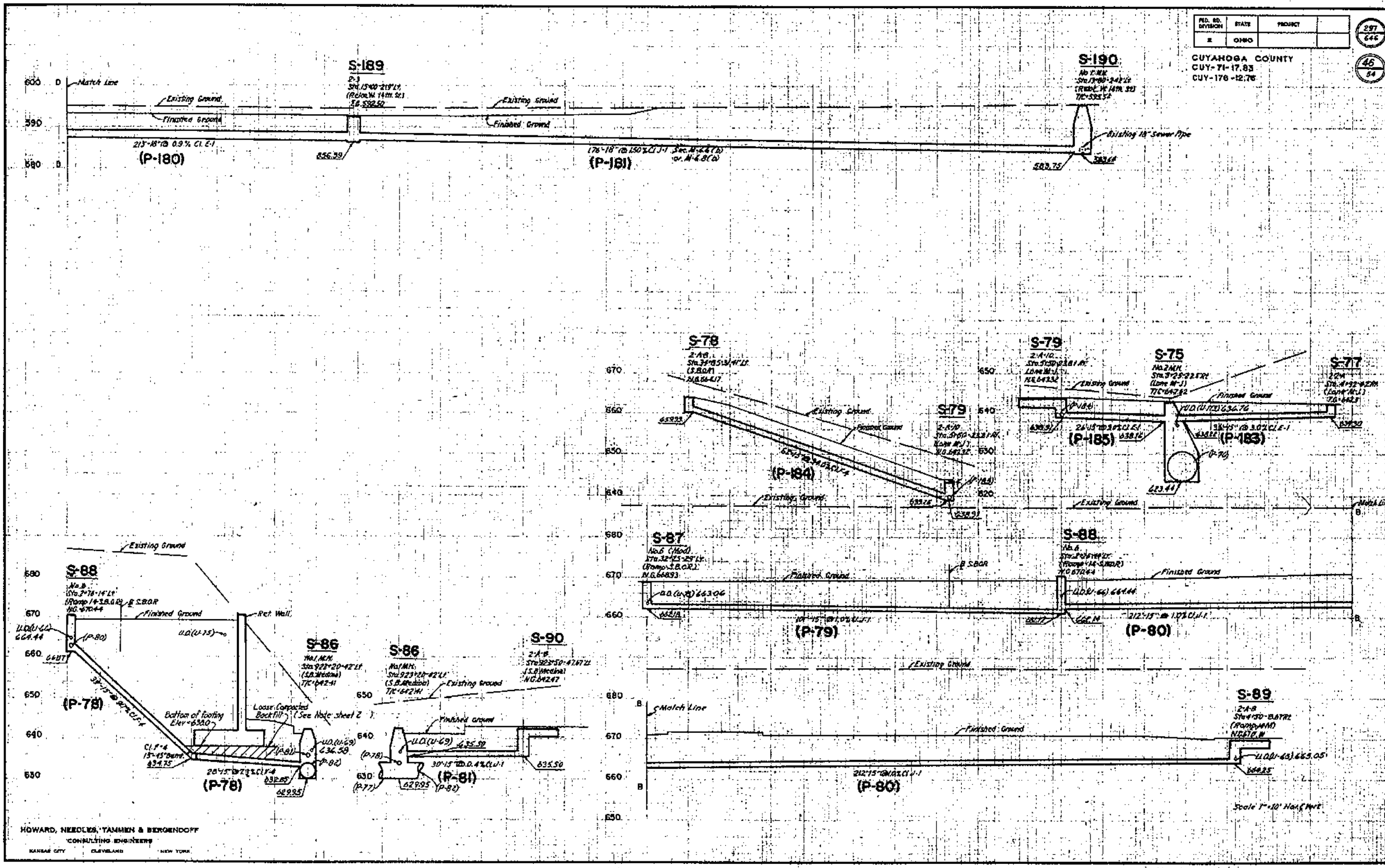
SEWER PROFILES P-187, P-189, P-192


CUYAHOGA COUNTY
CUY-71-17.83
CUY-176-12.75
OHIO
MEDINA FRWY. TRUNK SEWER SOUTH BRANCH
S-222
S-194
S-193
S-192
S-195
S-191
S-81
S-80
S-83
S-82
(P-218)
(P-196)
(P-194)
(P-193)
(P-195)
(P-191)
(P-190)
(P-188)
Existing Ground
Finished Ground
Connect to pipe from Contract to South
Provide concrete Collar as per Std. Const. Drawing L1 Drains & Sewers
Scale 1"=10' Hor. & Vert.
P-192 SEE SH. 47
HOWARD, NEEDLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY CLEVELAND NEW YORK
SEWER PROFILES P-188, P-190, P-191, P-193 TO P-196 & 218

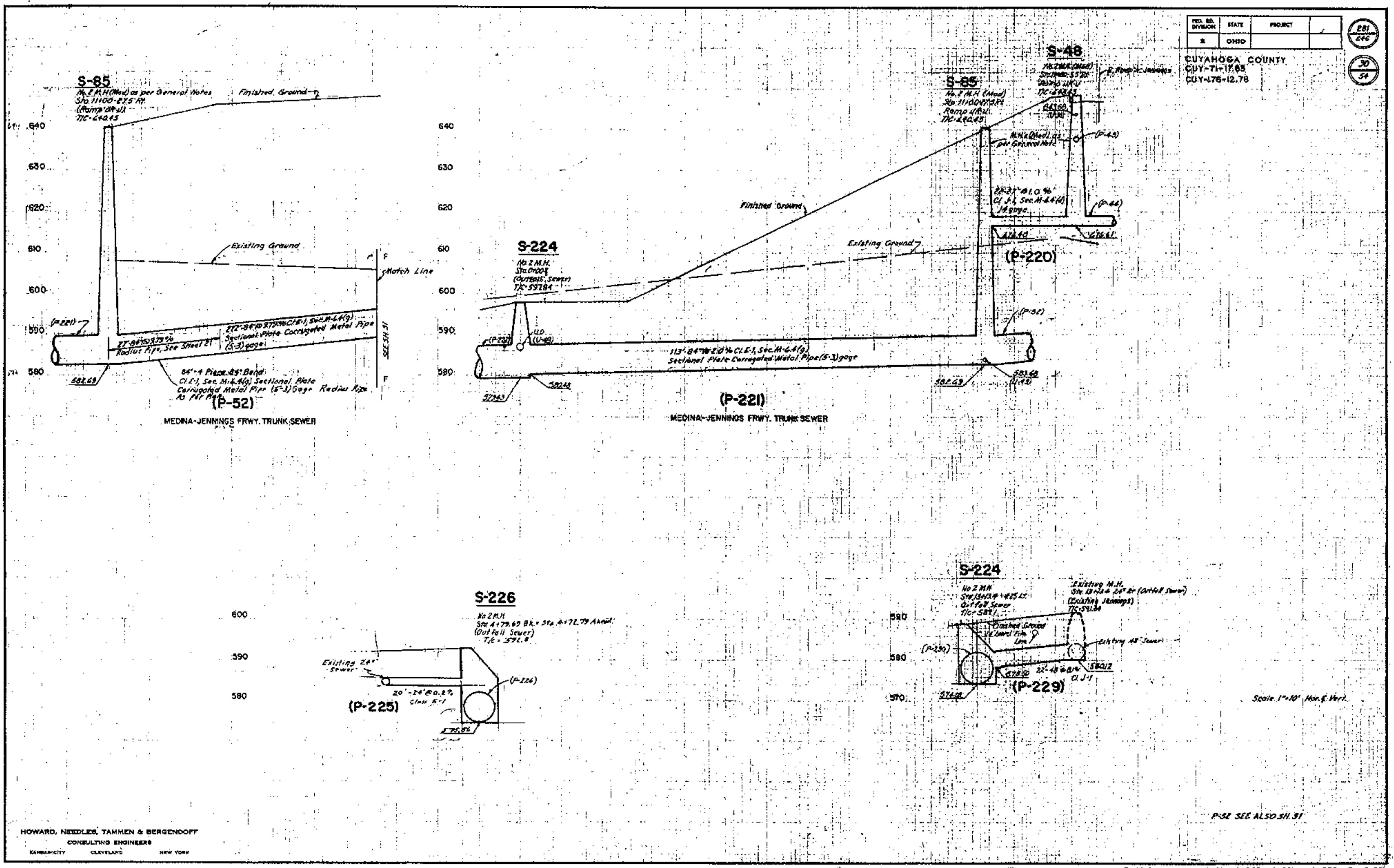

CUYAHOGA COUNTY
CUY-71-17.83
CUY-176-12.76
FED. RD. DIVISION
STATE
PROJECT
2
OHIO
S-84
S-86
S-74
S-75
S-73
S-72
Finished Ground
Existing Ground
Match Line
(P-77)
(P-74)
(P-75)
(P-76)
(P-73)
(P-72)
MEDINA-JENNINGS FRWY. TRUNK SEWER
JUNCTION NORTH & SOUTH BRANCHES MEDINA FRWY. TRUNK SEWER
50' Radius
70' Radius
SEE SH. 31
HOWARD, NEEDLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY
CLEVELAND
NEW YORK
P-72 SEE ALSO SH. 31
SEWER PROFILES P-72 TO P-77



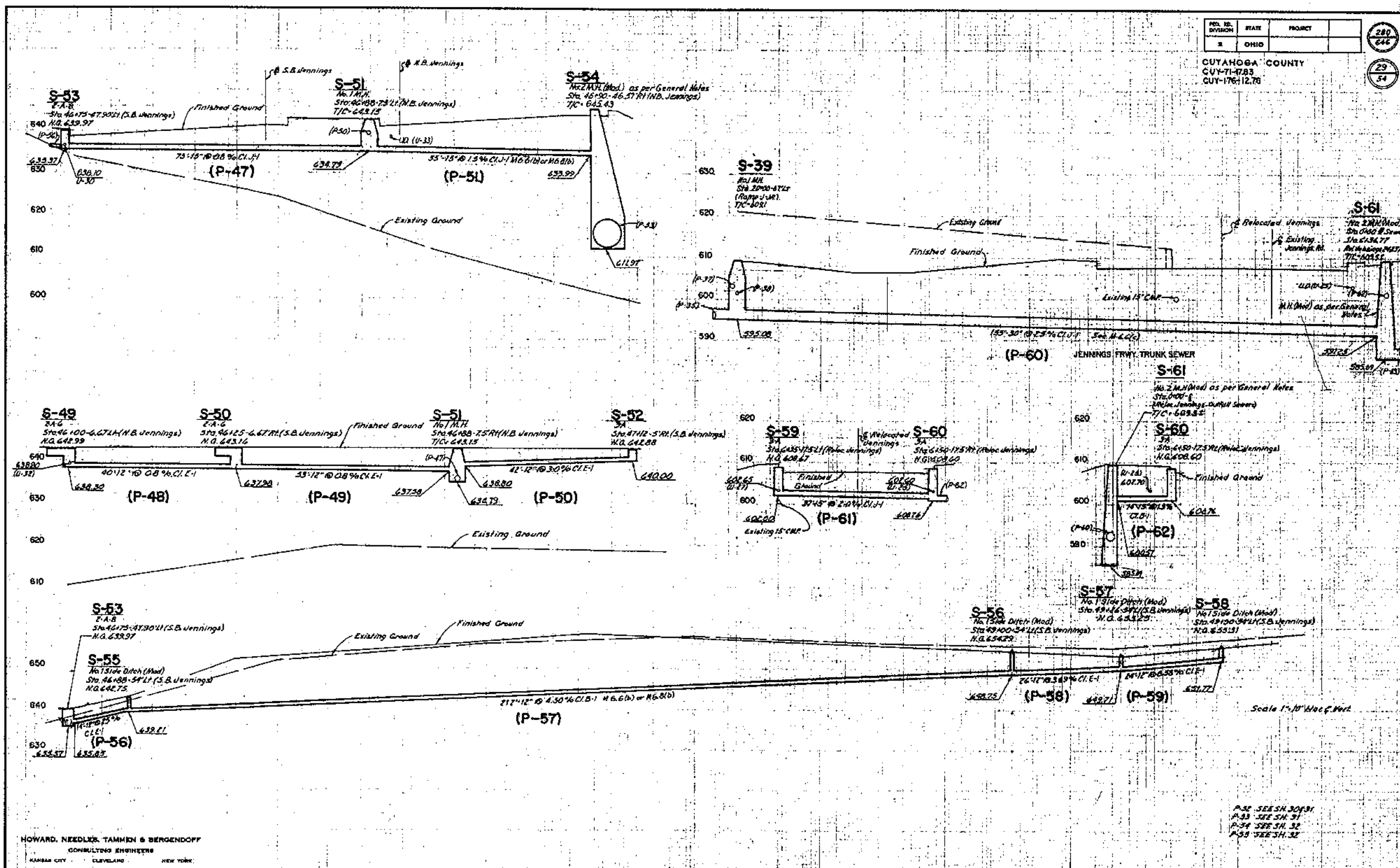
CUYAHOGA COUNTY
CUY-71-17.83
CUY-176-12.76
OHIO
S-107
MEDINA FRWY. TRUNK SEWER NORTH BRANCH
(P-98)
(P-102)
S-111
S-93
(P-84)
S-91
(P-82)
S-92
(P-83)
S-86
Match Line
Finished Ground
Existing Ground
HOWARD, NEEDLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY CLEVELAND NEW YORK
SEWER PROFILES P-82 TO P-84, P-98, P-102



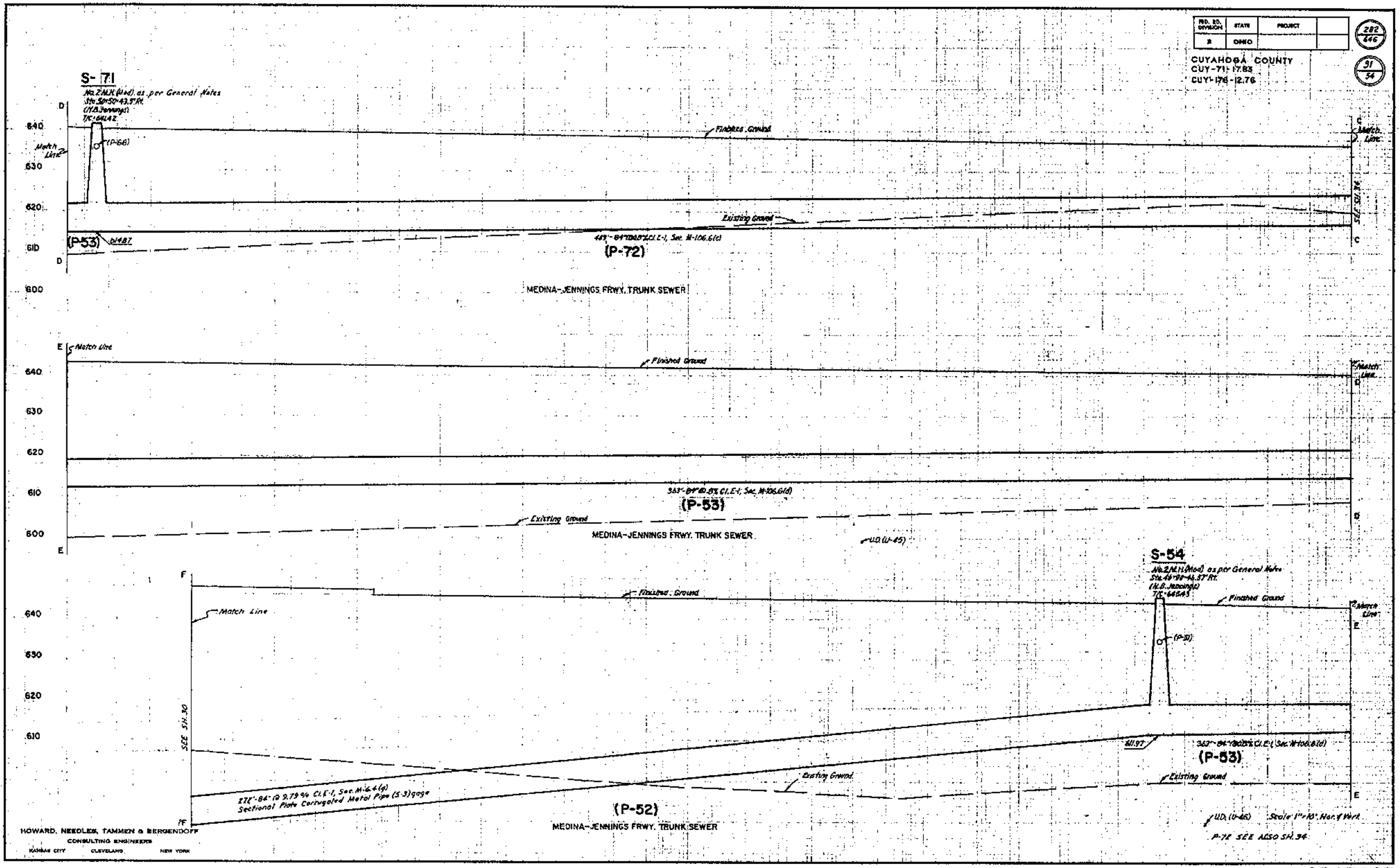
SEWER PROFILES P-78 TO P-81, P-180, P-181 & P-183 TO P-185



SEWER PROFILES P-52, P-220, P-221, P-225 & P-229



CUYAHOGA COUNTY
CUY-71-17.83
CUY-176-12.78
OHIO
S-53
S-51
S-54
(P-47)
(P-51)
Finished Ground
Existing Ground
S-39
S-61
(P-60)
JENNINGS FRWY. TRUNK SEWER
S-49
S-50
S-52
(P-48)
(P-49)
(P-50)
S-59
S-60
(P-61)
(P-62)
S-55
S-56
S-57
S-58
(P-56)
(P-57)
(P-58)
(P-59)
Scale 1"=10' Hor. & Vert.
HOWARD, NEEDLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY CLEVELAND NEW YORK
SEWER PROFILES P-47 TO P-51 & P-56 TO P-62



SEWER PROFILES P-52, P-53 & P-72

DIVISION			
2	OHIO	I-71-5(33) 244 US-1463(2)	

646

STATE OF OHIO
DEPARTMENT OF HIGHWAYS
CUY-71-17.83
CUY-176-12.76
CUYAHOGA COUNTY
CITY OF CLEVELAND

CUYAHOGA COUNTY
CUY-71-17.83
CUY-176-12.76

LIMITED ACCESS

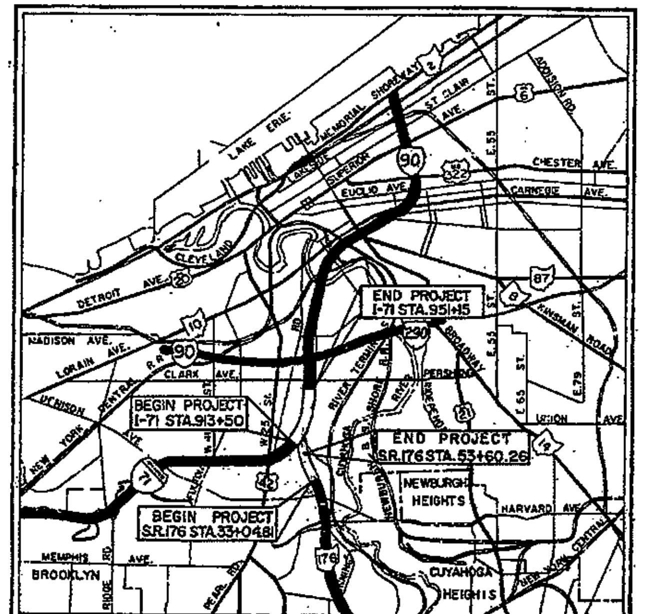
This improvement is especially designed for through traffic, and has been declared a limited access highway by action of the Director of Highways in accordance with the provisions of Section 5511.02, Revised Code of Ohio.

Part 1 ~ For Part 2
See CUY-80-9.08

I-71-5(33)244
US-1463(2)

CONVENTIONAL SIGNS

Property Line
Existing Right of Way
Limited Access Line — L A
Right of Way Line — R/W
Temporary Right of Way — T
Center Line
Work Agreement Line
Fence Line — x
Guard Rail (Existing)
Guard Rail (Proposed)
Railroad
Power Poles
Telephone Poles
Power & Telephone Poles
Light Poles
Trees (Existing)
Water Line
Gas Line — G
Telephone Conduit — T
Sewer (Existing) — S
Oil Line — O
Electrical Tower
Fire Hydrant
Manhole (Sewer)
Manhole (Telephone)
Catch Basin or Inlet
Underground Elect. Conduit
Original Twp. Lot Line
Subdivision Line
Sublot Line



DELIVERY POINT NYC R.R. LOCATION MAP AVERAGE HAUL ½ MILE

SCALE IN MILES
0 1 2

Portion to be improved
State Roads
Other Roads

SCALE
PLAN 1" = 20' & 50'
PROFILE: Horizontal 1" = 100'
PROFILE: Vertical 1" = 10'
CROSS SECTIONS 1" = 10'-8

N

The standard specifications of the State of Ohio, Department of Highways, including changes and supplemental specifications listed in the proposal shall govern this improvement.

The right of way for this improvement will be provided by the State of Ohio.

I hereby approve these plans and declare that the making of this improvement will not require the closing of the highway to traffic and that provisions for the maintenance and safety of traffic will be as set forth on the plans and estimates.

Approved Date 1/25/65 Louis L. [signature] Director of Public Service, City of Cleveland
Approved Date 1-22-65 Charles M. Yurick Divison Deputy Director
Approved Date 2-11-65 [signature] Engineer of Location and Design
Approved Date 2-11-65 [signature] Deputy Director of Design and Construction
Approved Date 2-2-65 [signature] Deputy Director of Right of Way
Approved Date 2-25-65 [signature] Deputy Director of Planning and Programming
Approved Date 2-10-65 [signature] Engineer of Bridges
Approved Date ____ First Assistant Director
Approved Date 2/26/65 [signature] Director of Highways

Sheet Nos. 375 and 376 revised 3-10-66
Sheet No. 357A added 3-10-66
Sheet Nos. 306 and 418 revised 6-2-65
Sheet No. 457 revised 7-30-65
Sheet Nos. 42 and 306-313 incl. revised 12-9-65
Sheet Nos. 314-319 incl. deleted 12-9-65
Sheet Nos. 307A and 309A added 12-9-65
Sheets 559, 560, 579 & 582 revised 12-28-65 C.E.H.
Sheets 17, 35, 613, 638 & 639 revised 2-18-66 C.E.H.
Sheet No. 582 revised 3-25-66 C.E.H.

INDEX OF SHEETS

DELETED ~ SHEET 43

PREPARED AND RECOMMENDED BY

HOWARD NEEDLES TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY CLEVELAND NEW YORK

H. G. SOURS
ASSOCIATE
COLUMBUS

Carl L. Erb

STATE OF OHIO CARL L. ERB, JR. 18368 REGISTERED PROFESSIONAL ENGINEER

FILE NO. 00326
CUYAHOGA COUNTY CUY-71-17.83 CUY-176-12.76
DATE OF LETTING ____196__
CONTRACT NO. ____

SUPPLEMENTAL SPECIFICATIONS

NUMBER	DATE	NUMBER	DATE
		S-407	12-21-62
I-129	Rev. 4-5-61	CE-101.04	5-22-56
S-307	Rev. 10-1-64	L-120	Rev. 1-2-62
S-101	7-12-62	I-212	Rev. 6-23-61
M-106.11	1-26-61	T-335	10-28-63
M-106.6 (C)	2-17-59	M-106.6(d)	Rev. 4-1-58

LINE DATA

CUY-71-17.83 (I-71-5(33)244)
I-71 STA. 913+50.00 TO STA. 951+15.00 3,765.00 L.F.
NET LENGTH OF PROJECT 0.713 MILES
ADD FOR APPROACHES
I-71 STA. 908+18.00 TO STA. 913+50.00 = 532.00 L.F.
I-71 STA. 951+15.00 TO STA. 955+15.00 = 400.00 L.F.
DETOUR ROAD STA. 10+00 TO 121+32.8 = 11,132.80 L.F.
OUTFALL SEWER STA. 0+00 TO 23+30 2,330.00 L.F.
NET LENGTH OF WORK 18,159.80 L.F. or 3.439 MILES
CUY-176-12.76 (US-1463(2))
S.R.176 STA. 33+04.81 TO STA. 53+60.26 = 2,055.45 L.F.
NET LENGTH OF PROJECT = 0.389 MILES
ADD FOR APPROACHES
S.R.176-STA. 25+23.00 TO STA. 33+04.81 = 781.81 L.F.
NET LENGTH OF WORK = 2,837.26 L.F. = 0.537 MILES
Part 1 TOTAL LENGTH OF PROJECT 5,820.45 L.F. = 1.102 MILES
TOTAL LENGTH OF WORK 20,997.06 L.F. = 3.976 MILES
Part 2 LENGTH OF PROJECT & WORK 5,808.00 L.F. = 1.100 MILE

TOTAL LENGTH OF PROJECT 11,628.45 L.F. = 2.202 MILES
TOTAL LENGTH OF WORK 26,805.06 L.F. = 5.076 MILES

STANDARD DRAWINGS

NUMBER	DATE	NUMBER	DATE
		I-8 C.B. 1-2-A & B	2-1-63
B-T-70-71	11-15-60	F-1	2-1-63
B-T-71R	3-2-53	F-3	2-1-63
FACI-1	2-25-64	L-1	4-1-50
FACI-2	2-25-64	L-3A	4-1-50
G-207	4-1-64	I-15 NO.6	2-1-63
I-1	11-15-60	I-15 NO. 2-A	8-17-60
I-8 C.B. 2-2A & 2B	2-1-63	T-35	1-2-56
I-15 No. 1	11-15-60	I-21-23	3-10-64
I-12	2-1-63	I-8 C.B. 2-3 & 2-4	2-1-63
LJ NO.1	7-1-55	I-8 C.B. NO. 3	2-1-63
RI-1	3-1-64	I-8 C.B. NO. 3-A	2-1-63
T.J.	9-12-60	I-8 C.B. NO.5	2-1-63
I-14G	1-22-52	I-8 C.B. NO.6	2-1-63
RB-1-55	2-2-59	I-8 I. NO.1	2-1-63
AR-1-57	4-2-62	I-8 I. NO. 2-A	2-1-63
L-3	4-1-50	I-8 M.H. NO.1	2-1-63
SD-1-63 SHTS. 1-A	11-12-63	I-8 M.H. NO.1-A	2-1-63
SP-53	6-30-61	I-8 M.H. NO.2	2-1-63
FSB-1-62	1-15-63	I-8 C.B. NO.7	2-1-63
L-2	4-1-50	AS-1-64	7-5-62

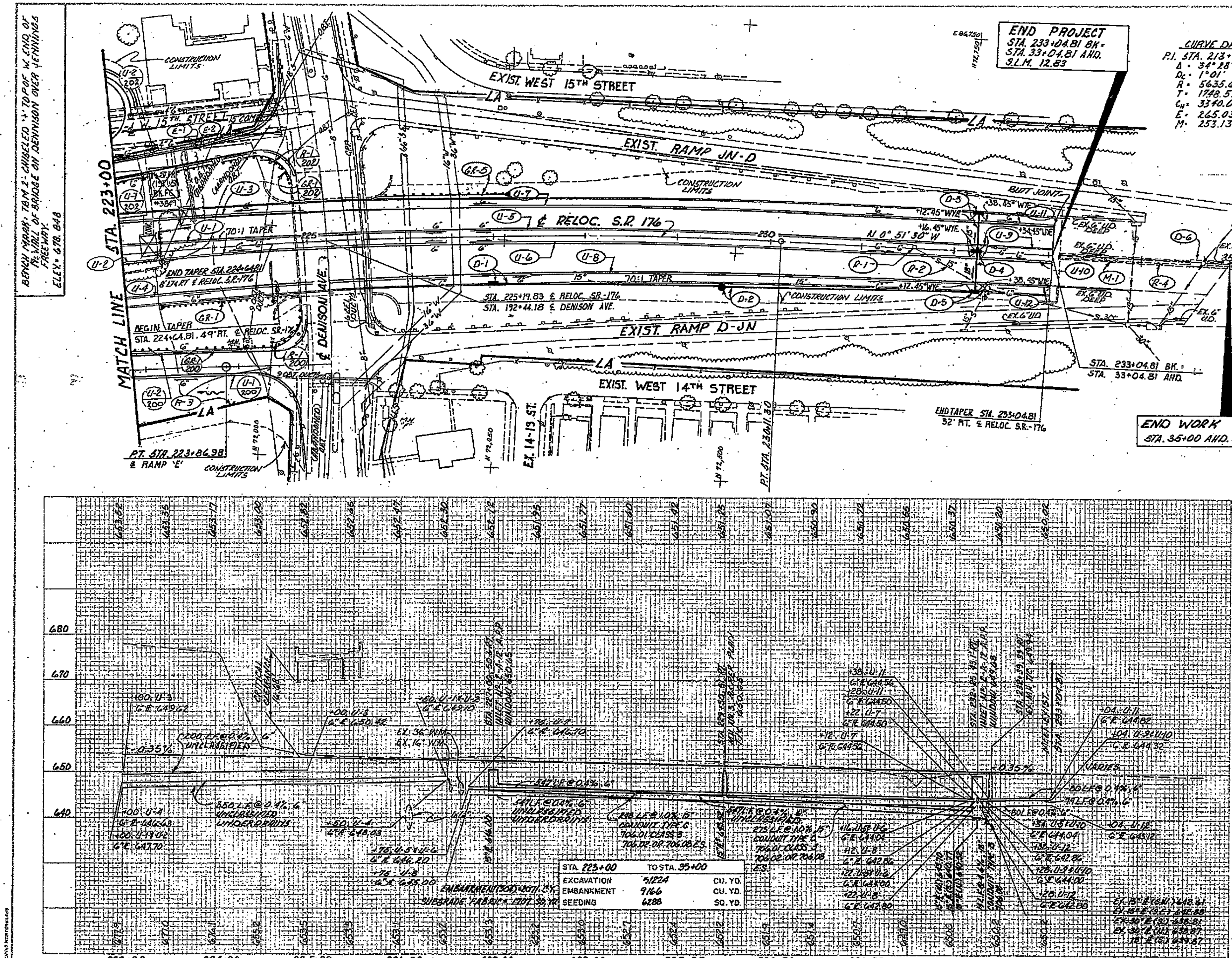
DEPARTMENT OF COMMERCE
BUREAU OF PUBLIC ROADS

APPROVED
DIVISION ENGINEER DATE

(SR176 & I71 Interchange area)

ARCHIVE # 000289
Main Trunk Sewer outfall to Cuy River

CALC. ____ DATE ____ CHKD. ____ DATE ____	CUYAHOGA COUNTY CUY - 176 - 10.88	OHIO F.H.W.A. REGION 5	76 / 557



DRAINAGE STRUCTURE DATA

(D-1) STA. 227+00, 50.6' RT
INLET Nº. 2-A-12
WINDOW ELEV. 650.65

(D-2) STA. 229+50, 51' RT.
MH Nº.3, AS PER PLAN
T/C - 650.65

(D-3) STA. 232+25, 42' LT.
INLET Nº. 2-A-12
WINDOW ELEV. 649.69

(D-4) STA. 232+25, ℄
INLET Nº. 3B50
T/G 649.81

(D-5) STA. 232+25, 43.1' RT.
INLET Nº. 2-A-12
WINDOW ELEV. 649.68

(D-6) STA. 34+70, ℄
INLET Nº 3B50 A.P.P.
6" U.D. EL.= 642.9
15" EL.= 639.9
T/G = 648.81

NOTE (R-3) IS AN ESTIMATE OF ALL FENCE THAT MUST BE REMOVED WITHIN LIMITS OF CONSTRUCTION FROM STA. 223+00 TO STA. 233+04.81

REFERENCES	SHEET NUMBERS
QUANTITIES FOR REFERENCED ITEMS	77
PAVEMENT DETAILS	222-224
RAMP "E" PLAN & PROFILE	200
RAMP "F" PLAN & PROFILE	202
RETAINING WALL DETAILS D-3, D-4 & D-5	117
GRADING PLAN	80

NOTE: (GR-2), (GR-3) & (R-5) IS SHOWN ON SHEET 302, BUT THE QUANTITIES FOR THEIR ITEMS WILL BE CARRIED TO SHEET 77.

NOTE: (GR-4) IS SHOWN ON SHEET 304, BUT THE QUANTITIES ARE CARRIED TO SHEET 77.

RELOC. SR.-176

RELOC. SR.-176 PLAN & PROFILE STA. 223+00 TO STA. 233+04.81

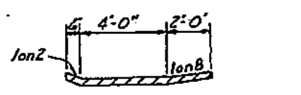
SR176 Construction 1998± - complete SR176 south from here

FED. RD. DIVISION	STATE	PROJECT	
2	OHIO		

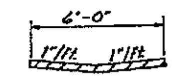
258/646

8/54

CUYAHOGA COUNTY
CUY-71-17.83
CUY-176-12.76

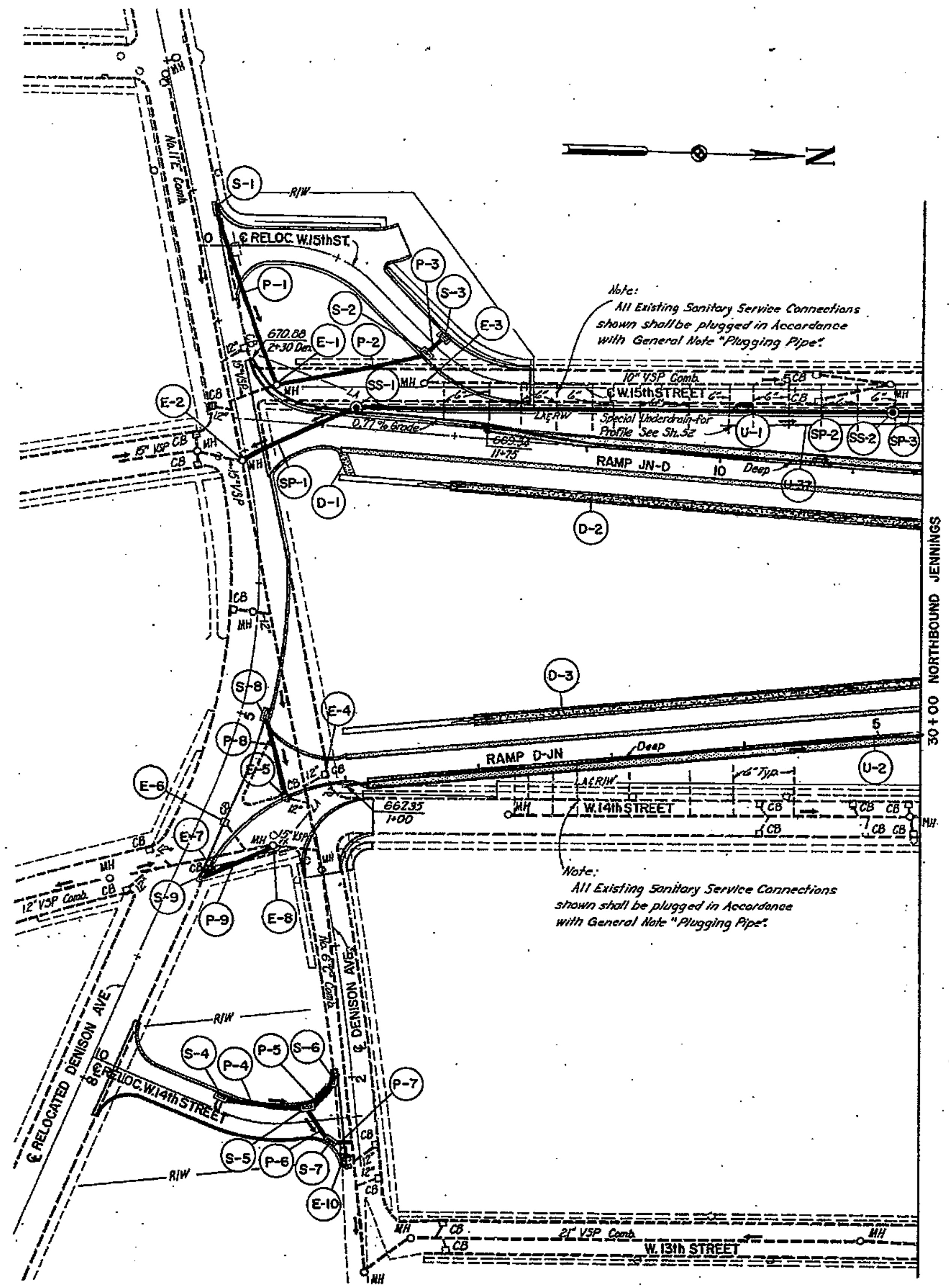


SECTION OF SODDED DITCH D-2 & D-3
D-2 Sta. 8+50 to 12+00 Lt. Ramp JN-D
D-3 Sta. 2+00 to 5+30 Lt. Ramp D-JN



SECTION OF SODDED FLUME D-1
D-1 Sta. 12+83 Lt. Ramp JN-D

M.H. ADJUSTED TO GRADE		
Ref. No.	Existing T/C Elev.	Adjusted T/C Elev.
E-1	677.17	677.6
E-3	675.63	676.0
E-8	673.64	674.7



100 50 0 50 100
SCALE IN FEET

DRAINAGE LEGEND

- PROPOSED STORM SEWER MANHOLE
- PROPOSED SANITARY MANHOLE
- PROPOSED PAVED SHOULDER INLET
- PROPOSED DITCH CATCH BASIN
- PROPOSED PAVEMENT CATCH BASIN
- PROPOSED STORM OR SANITARY SEWER
- EXISTING MANHOLE
- EXISTING CATCH BASIN
- EXISTING STORM OR SANITARY SEWER
- JUTE MATTING
- SODDED DITCH

CODE IDENTIFICATION

- P STORM SEWER PIPE
- S STORM SEWER STRUCTURE
- SP SANITARY OR COMBINED SEWER PIPE
- SS SANITARY SEWER STRUCTURE
- E EXISTING STRUCTURE OF SEWER PIPE
- U UNDERDRAIN PIPE
- D DITCH PROTECTION

DRAINAGE QUANTITIES

CODE	LOCATION	I-1				I-8		I-16	L-10
		Cl.I-3 Deep 6"	Cl.I-3 M6.4(h) 6"	Cl.E-1 M6.8(b) 21"	Cl.J-1 M6.8(b) Encased 21"	Std. No.2 MH W/O Drop Mod.	MH. Adjusted to Grade	C.B. Abond.	Sodding
	UNDERDRAINS	Lin. Ft.				Each	Each		Sq. Yd.
U-1	Ramp JN-D Rt. 8+50 to 2+30 Den.	520							
U-2	Ramp D-JN Rt. 1+00 to 5+30	430							
U-37	Ramp JN-D Rt. 8+50 to 10+00		150						
	EXISTING STRUCTURES								
E-1	Reloc. Denison Ave.						1		
E-3	Reloc. West 15th. St.						1		
E-4	Reloc. Denison Ave.							1	
E-5	Reloc. Denison Ave.							1	
E-6	Reloc. Denison Ave.							1	
E-7	Reloc. Denison Ave.							1	
E-8	Reloc. Denison Ave.						1		
E-10	Reloc. Denison Ave.							1	
	DITCH PROTECTION								
D-1	Ramp JN-D Lt.								13
D-2	Ramp JN-D Lt.								253
D-3	Ramp D-JN Lt.								239
	SANITARY SEWERS								
SP-1	Ramp JN-D				90				
SP-2	Ramp JN-D Rt.			402					
SP-3	Ramp JN-D Rt.			23					
SS-1	Ramp JN-D Rt.					1			
SS-2	Ramp JN-D Rt.					1			
						1			
	TOTAL	950	150	425	90	2	3	5	505

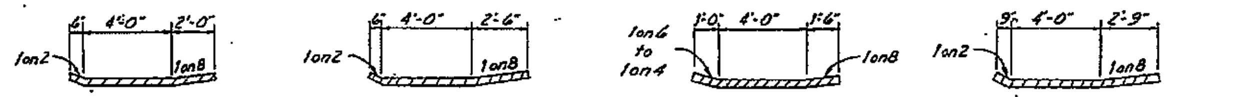
E-4, E-6, E-7 & E-10 Seal Pipe at Catch Basin
E-5 Connect Pipe through Catch Basin
For Sanitary Sewer Profiles See Sh. 54.
For Sewer Pipe & Drainage Structure Quantities See Sh. 3 to 7.

SCALE 1"=50'
MADE DDS DATE 6-7-64
TRCD. RDJ DATE 8-10-64
CKD. RJT DATE 10-13-64

HOWARD, NEEDLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY CLEVELAND NEW YORK

DRAINAGE PLAN

CUYAHOGA COUNTY
CUY-71-17.83
CUY-176-12.76



SECTION OF SODDED DITCH D-4 & D-5
D-4 Sta. 8+10 to 8+50 Lt. Ramp JN-D
D-5 Sta. 5+30 to 5+65 Lt. Ramp D-JN

SECTION OF SODDED DITCH D-8
D-8 Sta. 7+00 to 7+60 Ramp J-JR Rt.

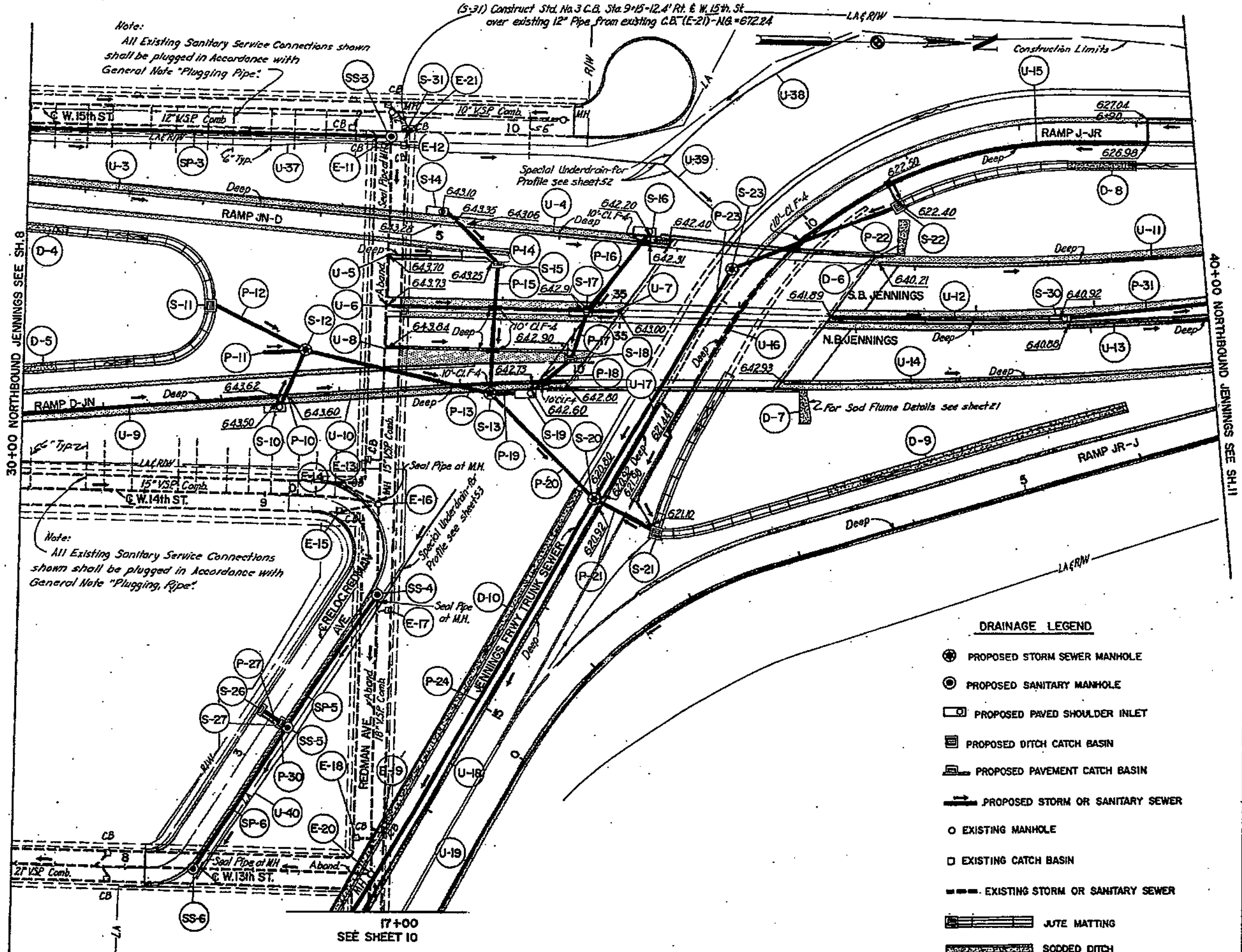
SECTION OF SODDED DITCH D-9
Sta. 3+38 to 6+00 Lt. Ramp JR-J

SECTION OF SODDED DITCH D-10
Sta. 13+00 to 17+00 Rt. Ramp J-JR

M.H. ADJUSTED TO GRADE

Ref. No.	Existing T/C Elev.	Adjusted T/C Elev.
E-16*	672.96	672.45

*Reconstructed to grade



DRAINAGE QUANTITIES

CODE	LOCATION	I-1 Cl. E-1 M6.8(b) 18"	I-1 Cl. E-1 M6.8(b) 21"	I-8 Std. No. 1 M.H. Mod.	I-8 M.H. Reconst. to Grade	I-16 C.B. Aband.	I-16 MH Aband.	L-10 Sodding	L-10 Sodding Spec. Slope & Berm Protection
		Lin. Ft.		Each				Sq. Yd.	
	EXISTING STRUCTURES								
E-11	Redman Ave.					1			
E-12	Redman Ave.					1			
E-13	Redman Ave.					1			
E-14	West 14th St.					1			
E-15	West 14th St.					1			
E-16	Redman Ave.				1				
E-17	Redman Ave.					1			
E-18	Redman Ave.					1			
E-19	Redman Ave.					1			
E-20	Redman Ave.						1		
E-21	Redman Ave.					1			
	DITCH PROTECTION								
D-4	Ramp JN-D Lt.							29	
D-5	Ramp D-JN Lt.							25	
D-6	S.B. Jennings Frwy. Lt.								25
D-7	N.B. Jennings Frwy. Rt.								25
D-8	Ramp J-JR Lt.							47	
D-9	Ramp JR-J Lt.							189	
D-10	Ramp J-JR Rt.							334	
	SANITARY SEWERS								
SP-3	Ramp JN-D Rt.		304						
SP-5	Reloc. Redman Ave.	135							
SP-6	Reloc. Redman Ave.	149							
SS-3	Ramp JN-D Rt.			1					
SS-4	Reloc. Redman Ave.			1					
SS-5	Reloc. Redman Ave.			1					
SS-6	Reloc. Redman Ave.			1					
	TOTAL	284	304	4	1	9	1	624	50

E-12, 14 & E-15 Seal Pipe at Catch Basin
For Sanitary Sewer Profiles See Sh. 54

DRAINAGE QUANTITIES

CODE	LOCATION	I-1 Cl. F-4 6"	I-1 Cl. I-3 Deep 6"	I-1 Cl. I-3 M6.4(h) 6"	I-1 Cl. J-1 6"	I-1 Cl. F-4 M6.4(c) 6"	I-5 Cl. F-4 25° Bend 6"	I-5 Cl. I-3 60° Bend 6"	I-5 Cl. I-3 90° Bend 6"	I-5 Cl. I-3 Tee 6"x6"x6"	I-5 Cl. I-3 M6.4(h) 90° Wye 6"x6"x6"
		Lin. Ft.					Each				
	UNDERDRAINS										
U-3	Ramp JN-D Rt. 4+87 to 8+50	7	365							1	
U-4	Ramp JN-D Rt. 3+10 to 4+83	17	163							1	
U-5	S.B. Jennings Frwy. Lt. 33+00 to 33+95	10	85					1			
U-6	S.B. Jennings Frwy. Rt. 33+00 to 34+70	20	150								
U-7	S.B. Jennings Frwy. Rt. 34+70 to 35+00	10	20								
U-8	N.B. Jennings Frwy. Rt. 33+00 to 34+60	20	140					1			
U-9	Ramp D-JN Rt. 5+30 to 7+50	7	220						1		
U-10	Ramp D-JN Rt. 7+57 to 9+87	27	210							1	
U-11	S.B. Jennings Frwy. Lt. 37+15 to 39+95		280								
U-12	S.B. Jennings Frwy. Rt. 36+80 to 38+25	10	185								
U-13	N.B. Jennings Frwy. Lt. 38+75 to 40+00		125								
U-14	N.B. Jennings Frwy. Rt. 36+40 to 40+00		360								
U-15	Ramp J-JR Rt. & Lt. 8+55 to 9+25	10	280		21				3		
U-16	Ramp J-JR Lt. 9+27 to 13+00	20	370					3			
U-17	Ramp J-JR Rt. 12+00 to 12+98	7	98					1			
U-18	Ramp J-JR Rt. 13+02 to 17+00		398								
U-19	Ramp JR-J Rt. 16+70(J-JR) to 6+70		820								
U-37	Ramp JN-D Rt. 3+20 to 8+50			530							1
U-38	Ramp J-JR Rt. 9+00 to 10+50			200							
U-39	Ramp J-JR Rt. 10+50	87				8	2				
U-40	Ramp J-JR Rt. 13+50 to 17+00			360							
	TOTAL	252	4249	1090	21	8	2	6	4	3	1

SCALE 1"=50'
MADE DDS DATE 8-12-64
TRCD. R.D.J. DATE 8-16-64
CKD. R.J.T. DATE 10-14-64

HOWARD, NEEDLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY CLEVELAND NEW YORK

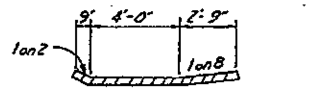
DRAINAGE PLAN

FED. RD. DIVISION	STATE	PROJECT	
2	OHIO		

260/646

CUYAHOGA COUNTY
CUY-71-17.83
CUY-176-12.76

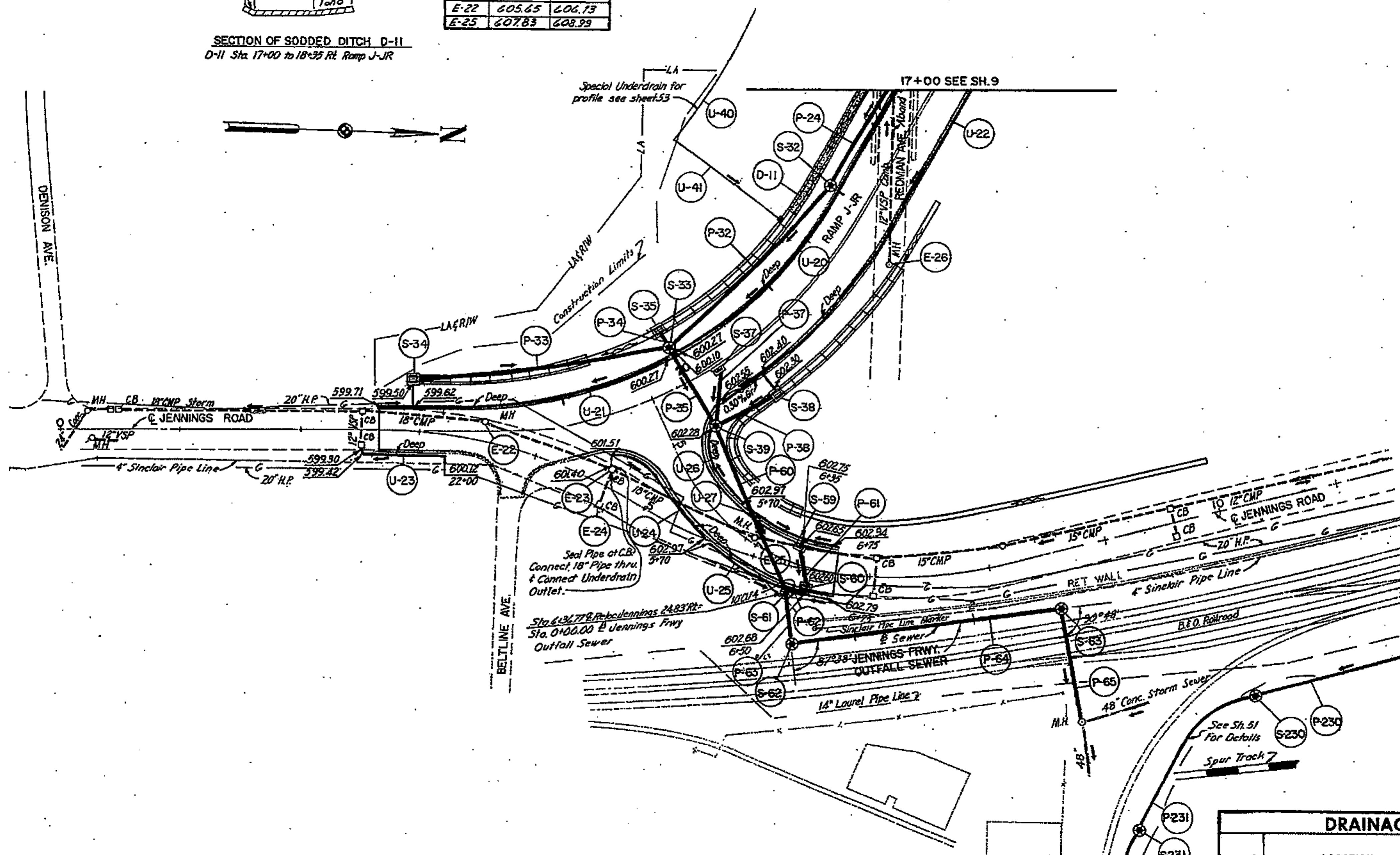
10/54



SECTION OF SODDED DITCH D-11
D-11 Sta. 17+00 to 18+35 Rt. Ramp J-JR

M.H. ADJUSTED TO GRADE

Ref. No.	Existing T/C Elev.	Adjusted T/C Elev.
E-22	605.65	606.73
E-25	607.83	608.99



DRAINAGE LEGEND

- PROPOSED STORM SEWER MANHOLE
- PROPOSED SANITARY MANHOLE
- PROPOSED PAVED SHOULDER INLET
- PROPOSED DITCH CATCH BASIN
- PROPOSED PAVEMENT CATCH BASIN
- PROPOSED STORM OR SANITARY SEWER
- EXISTING MANHOLE
- EXISTING CATCH BASIN
- EXISTING STORM OR SANITARY SEWER
- JUTE MATTING
- SODDED DITCH

DRAINAGE QUANTITIES

CODE	LOCATION	I-16 M.H. Aband.	I-16 C.B. Aband.	I-8 M.H. Adjusted to Grade	L-10 Sodding
	EXISTING STRUCTURES	Each			Sq. Yd.
E-22	Jennings Rd.			1	
E-23	Jennings Rd.		1		
E-24	Jennings Rd.		1		
E-25	Jennings Rd.			1	
E-26	Redman Ave.	1			
	DITCH PROTECTION				
D-11	Ramp J-JR Rt.				113
	TOTAL	1	2	2	113.

E-24 Seal Pipe at C.B.
E-23 Connect 18" Pipe through C.B.

DRAINAGE QUANTITIES

CODE	LOCATION	I-1 Cl. F-4 6"	I-1 Cl. I-3 Deep 6"	I-1 Cl. I-3 M.6.40(h) 6"	I-1	I-1 Cl. F-4 M.6.4(c) 8"	I-5 Cl. F-4 25° Bend 6"	I-5 Cl. F-4 90° Bend 6"	I-5 Cl. I-3 60° Bend 6"	I-5 Cl. I-3 90° Bend 6"	I-5 Cl. I-3 Tee 6"x6"x6"
	UNDERDRAINS	Lin. Ft.					Each				
U-20	Ramp J-JR Rt. 17+00 to 20+00	10	290						1		
U-21	Ramp J-JR Rt. 20+04 to 22+55	10	265								1
U-22	Ramp J-JR Lt. 16+70 to 19+85	10	352								1
U-23	Ramp J-JR Lt. 22+00 to 22+70	8	64						1		
U-24	Rel. Jennings Rd. Rt. 20+95 J-JR to 5+70	10	115							1	
U-25	Rel. Jennings Rd. Rt. 5+70 to 6+75	14	110								1
U-26	Rel. Jennings Rd. Lt. 20+00 J-JR to 5+70	10	65								
U-27	Rel. Jennings Rd. Lt. 5+70 to 6+75	4	90								1
U-40	Ramp J-JR Rt. 17+00 to 18+50			131							
U-41	Ramp J-JR Rt. 18+50	116				10	1	1			
	TOTAL	192	1351	131		10	1	1	2	1	4

SCALE 1"=50'
MADE DDS DATE 6-16-64
TRCD. RDJ DATE 6-17-64
CKD. RJT DATE 6-17-64

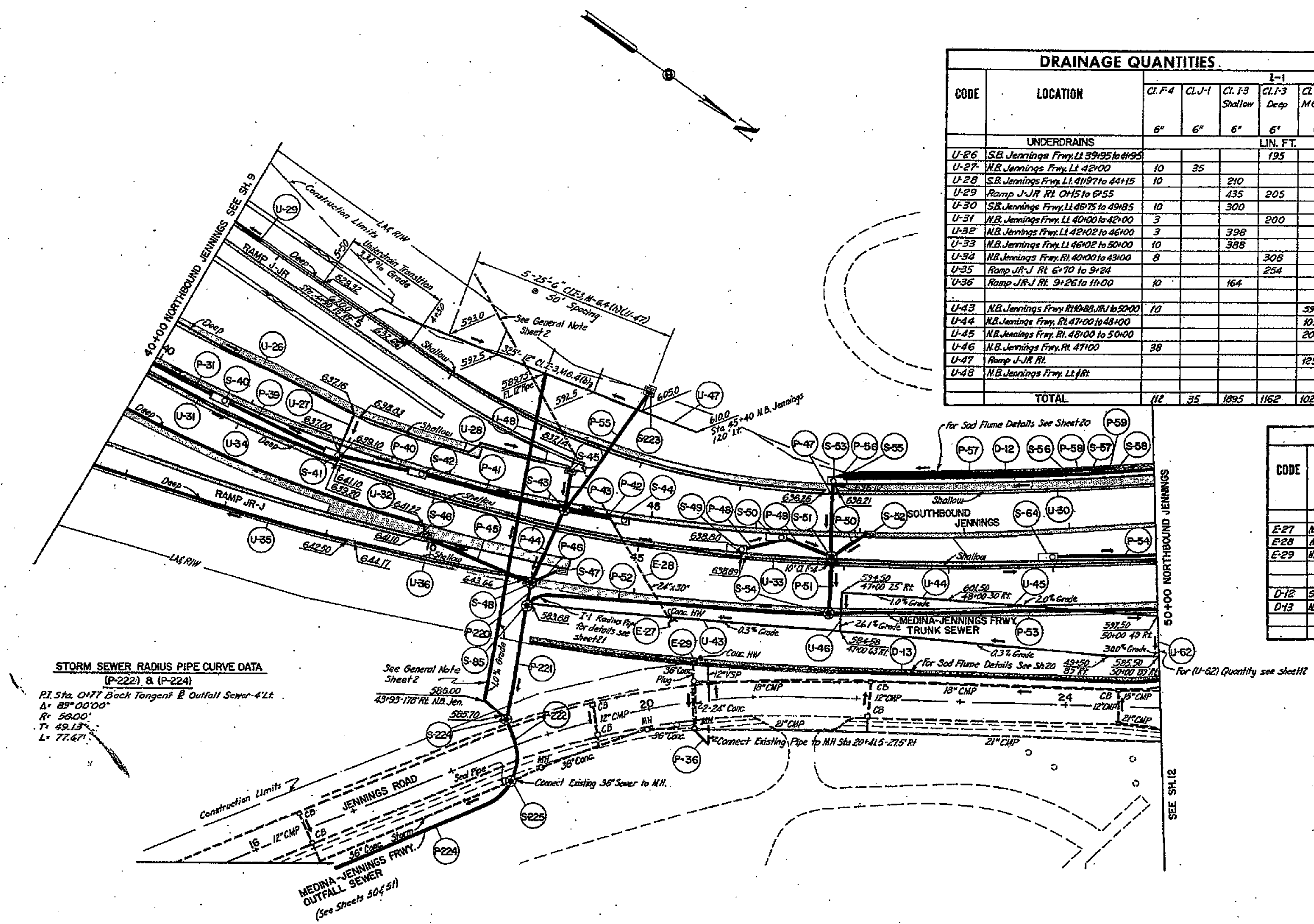
HOWARD, NEEDLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY CLEVELAND NEW YORK

100 50 0 50 100
SCALE IN FEET

DRAINAGE PLAN

DRAINAGE QUANTITIES

CODE	LOCATION	I-1 Cl. F-4 6"	I-1 Cl. J-1 6"	I-1 Cl. I-3 Shallow 6"	I-1 Cl. I-3 Deep 6"	I-1 Cl. I-3 M6.4(h) 6"	I-1 Cl. I-3 M6.4(b) 12"	I-1 Cl. J-1 M6.4(d) 12 gage 24"		I-5 Cl. I-3 60°Bend 6"	I-5 Cl. I-3 90°Bend 6"	I-5 Cl. I-3 M-6.4(h) 90°Bend 6"	I-5 Cl. I-3 M-6.4(h) Tee 6"x6"x6"	I-5 Cl. J-1 M6.4(d) 60°Bend 24"	I-5 Cl. J-1 M6.4(d) Tee 12"x12"x24"	I-5 Cl. I-3 M6.4(b) Tee 6"x6"x12"
	UNDERDRAINS	LIN. FT.								EACH						
U-26	S.B. Jennings Frwy. Lt. 39+95 to 41+95				195						1					
U-27	N.B. Jennings Frwy. Lt. 42+00	10	35													
U-28	S.B. Jennings Frwy. Lt. 41+97 to 44+15	10		210						2						
U-29	Ramp J-JR Rt. 0+15 to 6+55			435	205											
U-30	S.B. Jennings Frwy. Lt. 46+75 to 49+85	10		300						1						
U-31	N.B. Jennings Frwy. Lt. 40+00 to 42+00	3			200						1					
U-32	N.B. Jennings Frwy. Lt. 42+02 to 46+00	3		398							1					
U-33	N.B. Jennings Frwy. Lt. 46+02 to 50+00	10		388												
U-34	N.B. Jennings Frwy. Rt. 40+00 to 43+00	8			308						1					
U-35	Ramp JR-J Rt. 6+70 to 9+24				254											
U-36	Ramp JR-J Rt. 9+26 to 11+00	10		164												
U-43	N.B. Jennings Frwy. Rt. 10+88 JR-J to 50+00	10				598						1	1			
U-44	N.B. Jennings Frwy. Rt. 47+00 to 48+00					103						1				
U-45	N.B. Jennings Frwy. Rt. 48+00 to 50+00					200										
U-46	N.B. Jennings Frwy. Rt. 47+00	38														
U-47	Ramp J-JR Rt.					125	325									5
U-48	N.B. Jennings Frwy. Lt. & Rt.							355						1	1	
	TOTAL	112	35	1895	1162	1026	325	355		3	4	2	1	1	1	5



STORM SEWER RADIUS PIPE CURVE DATA
(P-222) & (P-224)

P.I. Sta. 0+77 Back Tangent ℄ Outfall Sewer-4' Lt.
Δ= 89°00'00"
R= 50.00'
T= 49.13'
L= 77.67'

DRAINAGE QUANTITIES

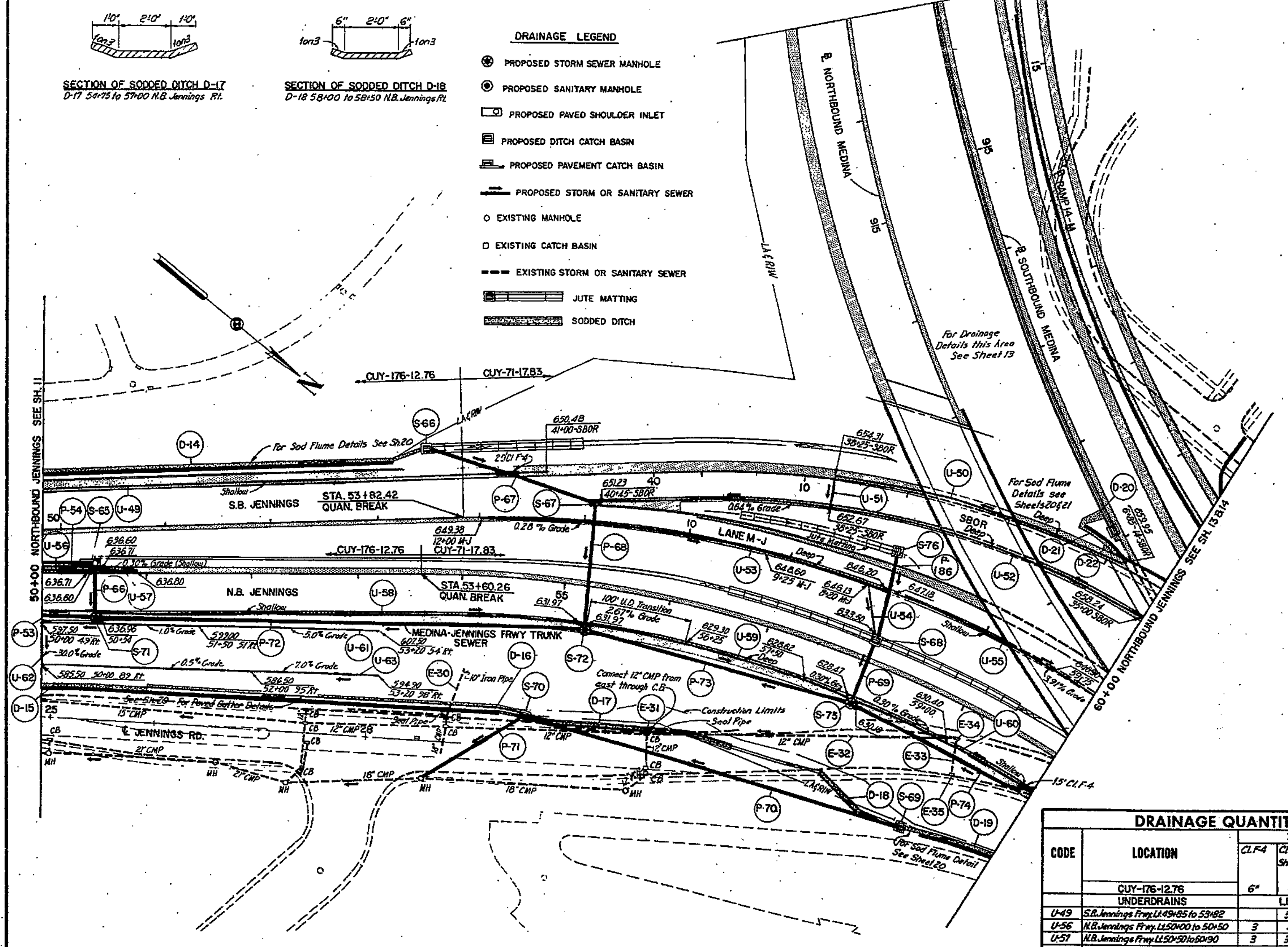
CODE	LOCATION	E-12 Pipe Removed over 15"	S-24 Removal of Existing Struct.	L-10 Sodding
	EXISTING STRUCTURES	LIN. FT.	LUMP	SQ. YDS
E-27	N.B. Jennings Frwy. Rt. 45+40		Lump	
E-28	N.B. Jennings Frwy. Lt. & Rt. 44+90	330		
E-29	N.B. Jennings Frwy. Rt. 45+65		Lump	
	DITCH PROTECTION			
D-12	S.B. Jennings Frwy. Lt. 46+88 to 49+85			99
D-13	N.B. Jennings Frwy. Rt. 44+20 to 50+00			202
	TOTAL	330	Lump	301

DRAINAGE LEGEND

- PROPOSED STORM SEWER MANHOLE
- PROPOSED SANITARY MANHOLE
- PROPOSED PAVED SHOULDER INLET
- PROPOSED DITCH CATCH BASIN
- PROPOSED PAVEMENT CATCH BASIN
- PROPOSED STORM OR SANITARY SEWER
- EXISTING MANHOLE
- EXISTING CATCH BASIN
- EXISTING STORM OR SANITARY SEWER
- JUTE MATTING
- SODDED DITCH

SCALE 1"=50'	HOWARD, NEEDLES, TAMMEN & BERGENDOFF
MADE DDS DATE 8-17-64	CONSULTING ENGINEERS
TRCD. R.D.J. DATE 8-19-64	KANSAS CITY CLEVELAND NEW YORK
CKD. R.J.T. DATE 10-14-64	

100 50 0 50 100
SCALE IN FEET



CODE	LOCATION	I-1 Cl. F-4	I-1 Cl. I-3 Shallow	I-1 Cl. I-3 Deep	I-1 Cl. J-1	I-5 Cl. I-3 90° Bend	I-5 Cl. I-3 Tee	I-5 Cl. I-3 60° Wye
	CUY-71-17.83	6"	6"	6"	6"	6"	6"x6"x6"	6"x6"x6"
	UNDERDRAINS	LIN. FT.				EACH		
U-49	S.B. Jennings Frwy. Lt. 53+82 to 41+00 SBOR	20	60					
U-50	SBOR Rt. 6+85 14-SBOR to 38+25			287				
U-51	SBOR 38+25				30	1	1	
U-52	SBOR Lt. 35+00 to 40+45	10		535				
U-53	Lane M-J Lt. 8+05 to 12+00			398				
U-54	Lane M-J Lt. 8+20	10		45				1
U-55	Lane M-J Lt. 5+80 to 7+95		215					
U-58	N.B. Jennings Rt. 53+60 to 55+25	10	150					
U-59	N.B. Jennings Rt. 55+28 to 58+00	10		255				
U-60	N.B. Jennings Rt. 58+03 to 60+00	25	165					
	TOTAL	85	590	1520	30	1	1	1

CODE	LOCATION	E-12 Pipe Removed 15" and Under	I-16 C.B. Aband.	L-10 Sodding	L-10 Sodding Special Slope & Berm Protection
	CUY-71-17.83				
	EXISTING STRUCTURES	LIN. FT.	EACH	SQ. YDS.	
E-31	N.B. Jennings Frwy. Rt. 56+00		1		
E-32	N.B. Jennings Frwy. Rt. 56+00 to 59+10	300			
E-33	N.B. Jennings Frwy. Rt. 59+10	35			
E-34	N.B. Jennings Frwy. Rt. 59+10		1		
E-35	N.B. Jennings Frwy. Rt. 59+35		1		
	DITCH PROTECTION				
D-17	N.B. Jennings Frwy. Rt.			89	
D-18	N.B. Jennings Frwy. Rt.			17	
D-19	N.B. Jennings Frwy. Rt. 59+00 to 60+00			31	
D-20	Ramp 14-SBOR Rt. 7+35				17
D-21	Ramp 14-SBOR Rt. 6+95 to 7+35			17	
D-22	Ramp 14-SBOR Rt. 7+05				8
	TOTAL	335	3	154	25

CODE	LOCATION	I-1 Cl. F-4	I-1 Cl. I-3 Shallow	I-1 Cl. I-3 M6.4(h)	I-5 Cl. I-3 60° Bend	I-5 Cl. I-3 M6.4(h) Tee
	CUY-176-12.76	6"	6"	6"	6"	6"x6"x6"
	UNDERDRAINS	LIN. FT.			EACH	
U-49	S.B. Jennings Frwy. Lt. 49+85 to 53+82		397			
U-56	N.B. Jennings Frwy. Lt. 50+00 to 50+50	3	45		1	
U-57	N.B. Jennings Frwy. Lt. 50+50 to 50+90	3	35		1	
U-58	N.B. Jennings Frwy. Rt. 50+54 to 53+60		306			
U-61	N.B. Jennings Frwy. Rt. 50+00 to 53+20			320		
U-62	N.B. Jennings Frwy. Rt. 50+00	40				2
U-63	N.B. Jennings Frwy. Rt. 50+00 to 53+20			320		
	TOTAL	46	783	640	2	2

CODE	LOCATION	E-12 Pipe Removed 15" and Under	I-14 Special Paved Gutter	L-10 Sodding
	CUY-176-12.76			
	EXISTING STRUCTURES	LIN. FT.		SQ. YDS.
E-30	N.B. Jennings Frwy. Rt. 54+00	50		
	DITCH PROTECTION			
D-14	S.B. Jennings Frwy. Lt. 49+85 to 53+50			122
D-15	N.B. Jennings Frwy. Rt. 50+00 to 51+00			34
D-16	N.B. Jennings Frwy. Rt. 51+00 to 54+75		360	63
	TOTAL	50	360	219

SCALE 1" = 50'
MADE DDS DATE 10-2-64
TRCD. JEN DATE 10-12-64
CKD. RJT DATE 10-13-64

HOWARD, NEEDLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY CLEVELAND NEW YORK

100 50 0 50 100
SCALE IN FEET

DRAINAGE PLAN

FED. RD. DIVISION	STATE	PROJECT	
2	OHIO		

263/646

CUYAHOGA COUNTY
CUY.-71-17.83, 176-12.76

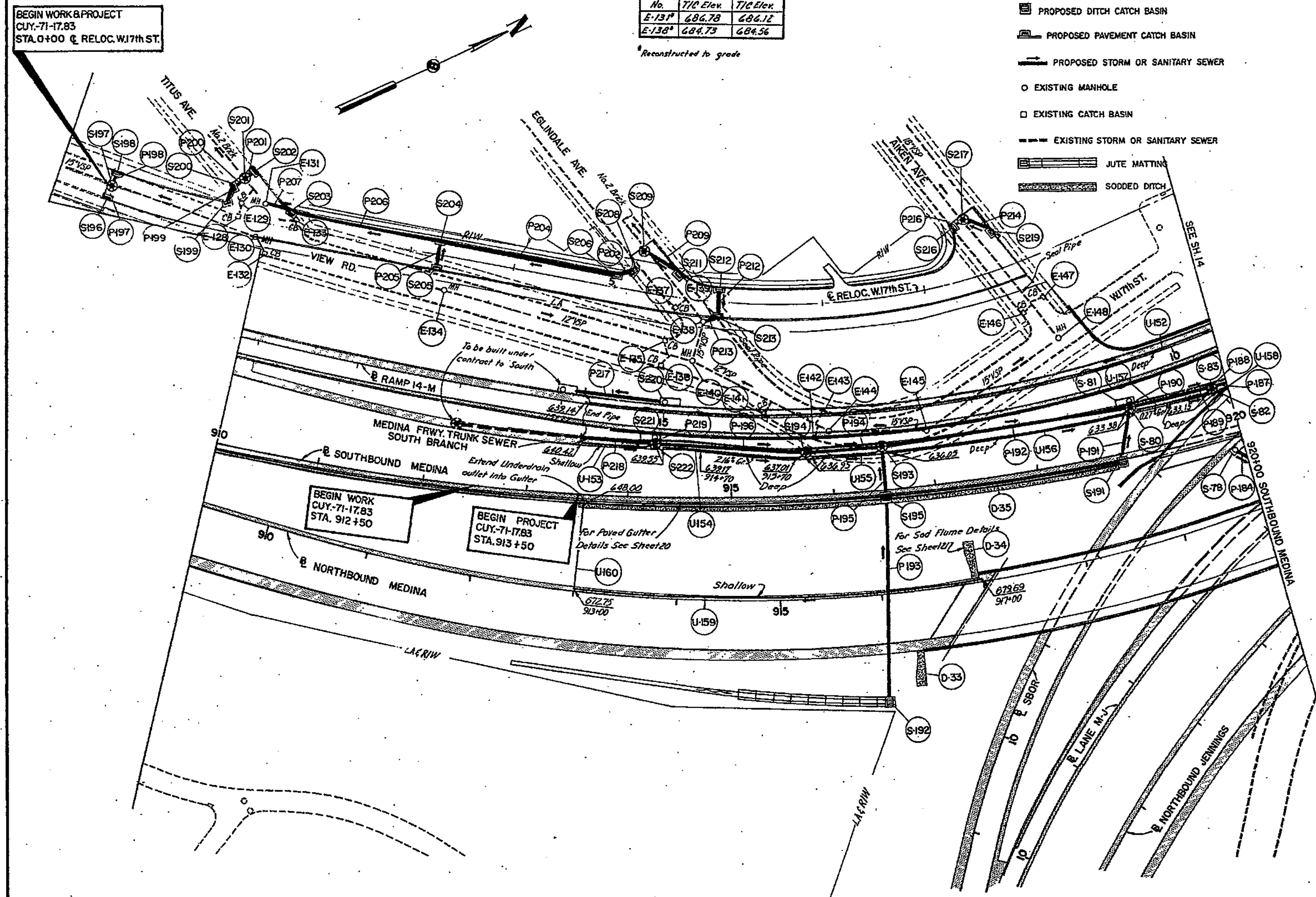
13/54

DRAINAGE LEGEND

- PROPOSED STORM SEWER MANHOLE
- PROPOSED SANITARY MANHOLE
- PROPOSED PAVED SHOULDER INLET
- PROPOSED DITCH CATCH BASIN
- PROPOSED PAVEMENT CATCH BASIN
- PROPOSED STORM OR SANITARY SEWER
- EXISTING MANHOLE
- EXISTING CATCH BASIN
- EXISTING STORM OR SANITARY SEWER
- JUTE MATTING
- SODDED DITCH

M.H. ADJUSTED TO GRADE		
Ref. No.	Existing T/C Elev.	Adjusted T/C Elev.
E-131*	686.78	686.12
E-138*	684.73	684.56

*Reconstructed to grade



100 50 0 50 100
SCALE IN FEET

DRAINAGE QUANTITIES						
CODE	LOCATION	I-1 Cl. F-4 6"	I-1 Cl. I-3 Shallow 6"	I-1 Cl. I-3 Deep 6"	I-5 Cl. I-3 60° Bend 6"	I-5 Cl. I-3 25° Bend 6"
	UNDERDRAINS	Lin. Ft.			Each	
U-152	Ramp 14-M Rt. 9+58 to 15+77			619		
U-153	S.B. Medina Lt. 913+50 to 914+25	5	65		1	
U-154	S.B. Medina Lt. 914+30 to 915+75	5	35	100	1	
U-155	S.B. Medina Lt. 915+80 to 916+50	5		65	1	
U-156	S.B. Medina Lt. 916+55 to 919+00	5		235	1	
U-157	S.B. Medina Lt. 919+05 to 919+84	5		70	1	
U-158	S.B. Medina Lt. 919+84 to 920+00	5		10	1	
U-159	N.B. Medina Lt. 913+00 to 917+00		400			
U-160	N.B. Medina Lt. 913+00	10	78			1
	Total	40	578	1099	6	1

DRAINAGE QUANTITIES							
CODE	LOCATION	I-8 M.H. Reconst. To Grade	I-14 Paved Gutter Type 1 Mod.	I-16 M.H. Aband.	I-16 C.B. Aband.	L-10 Sodding	L-10 Sodding Spec. Slope & Berm Protection
	EXISTING STRUCTURES	Each	Lin. Ft.	Each		Sq. Yds.	
E-128	Reloc. W. 17th St. Lt. 1+30				1		
E-129	Reloc. W. 17th St. Lt. 1+30				1		
E-130	Reloc. W. 17th St. Rt. 1+50			1			
E-131	Reloc. W. 17th St. Lt. 1+55	1					
E-132	Reloc. W. 17th St. Rt. 1+60				1		
E-133	Reloc. W. 17th St. Lt. 1+85				1		
E-134	Reloc. W. 17th St. Rt. 3+40			1			
E-135	Reloc. W. 17th St. Rt. 5+60				1		
E-136	Reloc. W. 17th St. Rt. 5+60				1		
E-137	Reloc. W. 17th St. Rt. 5+65				1		
E-138	Reloc. W. 17th St. Rt. 5+90	1					
E-139	Reloc. W. 17th St. Rt. 6+00				1		
E-140	Reloc. W. 17th St. Rt. 5+85			1			
E-141	Ramp 14-M Rt. 14+05				1		
E-142	Ramp 14-M Lt. 13+55				1		
E-143	Ramp 14-M Rt. 13+45				1		
E-144	Ramp 14-M Lt. 13+40			1			
E-145	Ramp 14-M Lt. 12+50			1			
E-146	Ramp 14-M Rt. 11+35				1		
E-147	Ramp 14-M Rt. 11+10				1		
E-148	Ramp 14-M Rt. 11+05			1			
	DITCH PROTECTION						
D-33	N.B. Medina Rt. 916+30						30
D-34	N.B. Medina Lt. 916+95						30
D-35	S.B. Medina Rt. 913+50 to 918+80		530			89	
	Total	2	530	6	13	89	60

E-128, E-129, E-133 & E-137 Seal Pipe at Catch Basin
E-130 Seal Pipe at Manhole.

SCALE 1" = 50'
MADE D.D.S. DATE 10-20-69
TRCD. R.D.J. DATE 10-21-69
CKD. R.J.T. DATE 10-22-69

HOWARD, NEEBLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY CLEVELAND NEW YORK

DRAINAGE PLAN

FED. RD. DIVISION	STATE	PROJECT	
2	OHIO		

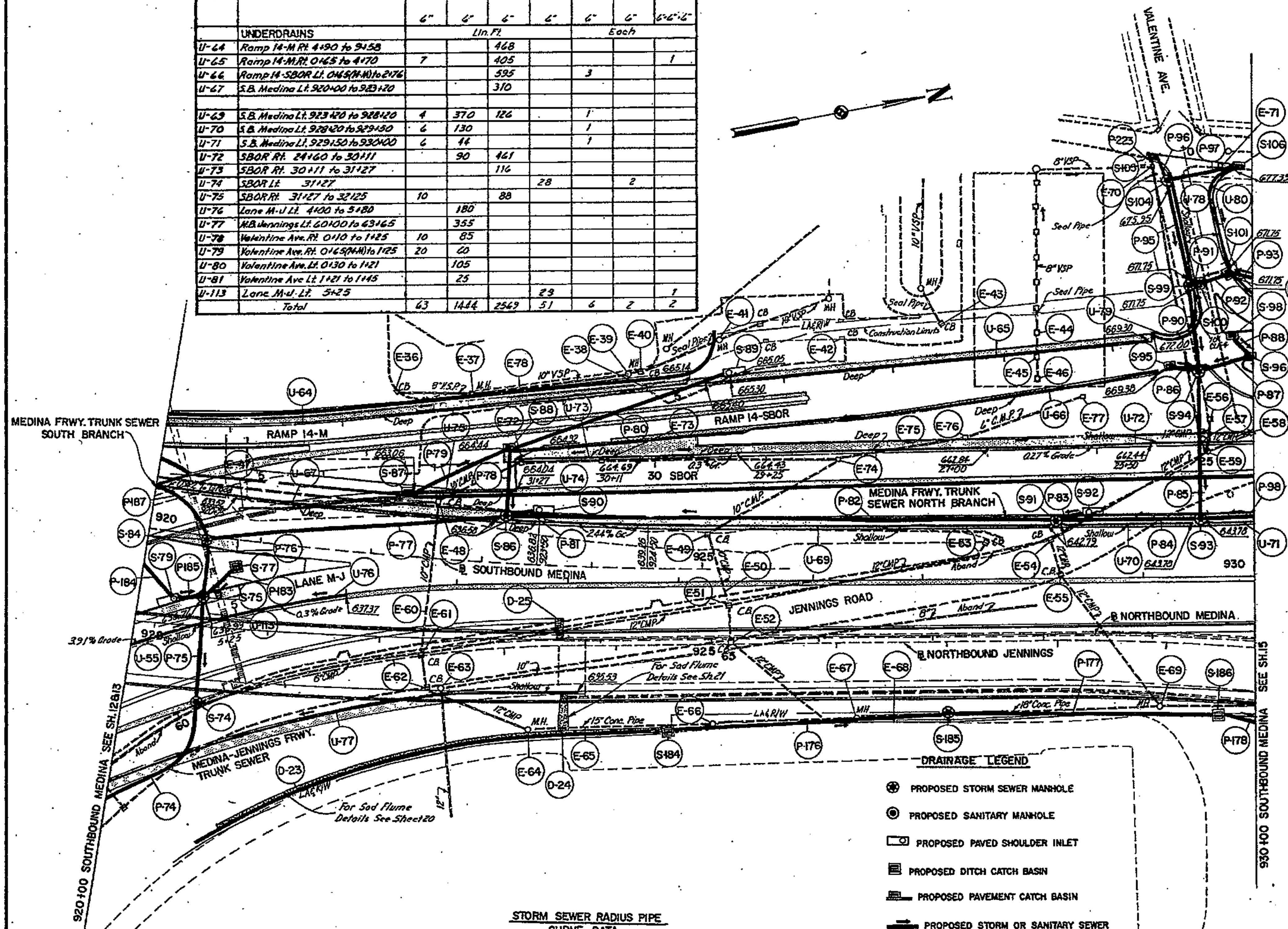
264/646

14/54

CUYAHOGA COUNTY
CUY.-71-17.83
CUY-176-12.76

DRAINAGE QUANTITIES

CODE	LOCATION	I-1 Cl. F-4 6"	I-1 Cl. I-3 Shallow 6"	I-1 Cl. I-3 Deep 6"	I-1 Cl. J-1 6"	I-5 Cl. I-3 60°Bend 6"	I-5 Cl. I-3 90°Bend 6"	I-5 Cl. I-3 Tee 6"-6"-6"
	UNDERDRAINS	Lin. Ft.				Each		
U-64	Ramp 14-M Rt. 4+90 to 9+58			468				
U-65	Ramp 14-M Rt. 0+65 to 4+70	7		405				1
U-66	Ramp 14-SBOR Lt. 0+65(M-M) to 2+76			595		3		
U-67	S.B. Medina Lt. 920+00 to 923+20			310				
U-69	S.B. Medina Lt. 923+20 to 928+20	4	370	126		1		
U-70	S.B. Medina Lt. 928+20 to 929+50	6	130			1		
U-71	S.B. Medina Lt. 929+50 to 930+00	6	44			1		
U-72	SBOR Rt. 24+60 to 30+11		90	461				
U-73	SBOR Rt. 30+11 to 31+27			116				
U-74	SBOR Lt. 31+27				28		2	
U-75	SBOR Rt. 31+27 to 32+25	10		88				
U-76	Lane M-J Lt. 4+00 to 5+80		180					
U-77	N.B. Jennings Lt. 60+00 to 63+65		355					
U-78	Valentine Ave. Rt. 0+10 to 1+25	10	85					
U-79	Valentine Ave. Rt. 0+65(M-M) to 1+25	20	60					
U-80	Valentine Ave. Lt. 0+30 to 1+21		105					
U-81	Valentine Ave Lt. 1+21 to 1+45		25					
U-113	Lane M-J Lt. 5+25				23			1
	Total	63	1444	2549	51	6	2	2



DRAINAGE LEGEND

- PROPOSED STORM SEWER MANHOLE
- PROPOSED SANITARY MANHOLE
- PROPOSED PAVED SHOULDER INLET
- PROPOSED DITCH CATCH BASIN
- PROPOSED PAVEMENT CATCH BASIN
- PROPOSED STORM OR SANITARY SEWER
- EXISTING MANHOLE
- EXISTING CATCH BASIN
- EXISTING STORM OR SANITARY SEWER
- JUTE MATTING
- SODDED DITCH

STORM SEWER RADIUS PIPE
CURVE DATA

(P-76) & (P-187)
P.I. Sta. 920+53 ℄ S.B. Medina -34' Lt.
Δ = 82°00'00"
R = 70.00'
T = 60.85'
L = 100.18'

(P-74)
P.I. Sta. 60+00 ℄ N.B. Jennings -47' Rt.
Δ = 62°00'00"
R = 50.00'
T = 30.04'
L = 54.10'

E-36 & E-71 Seal Pipe at Catch Basin

100 50 0 50 100
SCALE IN FEET

SCALE 1" = 50'
MADE D.D.S. DATE 10-6-64
TRCD. R.D.J. DATE 10-13-64
CKD. R.J.T. DATE 11-12-64

HOWARD, NEEDLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY CLEVELAND NEW YORK

DRAINAGE QUANTITIES

CODE	LOCATION	E-12 Pipe Removed 15" & Under	E-12 Pipe Removed over 15"	I-16 M.H. Aband.	I-16 C.B. Aband.	L-10 Sodding	L-10 Sodding Spec. Slope & Berm Protection
	EXISTING STRUCTURES	Lin. Ft.		Each		Sq. Yds.	
E-36	Ramp 14-M Rt. 7+50				1		
E-37	Ramp 14-M Rt. 6+80			1			
E-38	Ramp 14-M Rt. 5+25				1		
E-39	Ramp 14-M Rt. 5+40			1			
E-40	Ramp 14-M Rt. 5+28				1		
E-41	Ramp 14-M Rt. 4+55			1			
E-42	Ramp 14-M Rt. 3+45				1		
E-43	Ramp 14-M Rt. 2+50				1		
E-44	Ramp 14-M Rt. 1+70				1		
E-45	Ramp 14-M Lt. 1+70				1		
E-46	Ramp 14-M Lt. 1+73				1		
E-47	S.B. Medina Lt. 920+80				1		
E-48	S.B. Medina Lt. 922+50				1		
E-49	S.B. Medina Lt. 925+05				1		
E-50	S.B. Medina 925+25 to 28+35 SBOR	203					
E-51	S.B. Medina Rt. 925+25				1		
E-52	S.B. Medina Rt. 925+28				1		
E-53	S.B. Medina Lt. 27+55				1		
E-54	S.B. Medina Lt. 28+15				1		
E-55	S.B. Medina Lt. 28+25				1		
E-56	SBOR Rt. 25+00				1		
E-57	SBOR Rt. 25+05			1			
E-58	SBOR Rt. 24+60				1		
E-59	SBOR Lt. 25+00				1		
E-60	S.B. Medina 922+55	140					
E-61	N.B. Jennings Lt. 62+25				1		
E-62	N.B. Jennings Rt. 62+25				1		
E-63	N.B. Jennings Rt. 62+40			1			
E-64	N.B. Jennings Rt. 63+20			1			
E-65	N.B. Jennings Rt. 63+70 to 66+15	300					
E-66	N.B. Jennings Rt. 64+90			1			
E-67	N.B. Jennings Rt. 66+15			1			
E-68	N.B. Jennings Rt. 66+15 to 68+95		275				
E-69	N.B. Jennings Rt. 68+95			1			
E-70	Valentine Ave. Rt. 0+15				1		
E-71	Valentine Ave. Lt. 0+20				1		
E-72	SBOR 31+20				1		
E-73	SBOR 30+50				1		
E-74	SBOR Lt. 28+35				1		
E-75	SBOR Lt. (Rt. 920+80 S.B. Med.) to 26+10	785					
E-76	SBOR Rt. 27+20				1		
E-77	SBOR Rt. 26+10				1		
E-78	Ramp 14-M 4+55 to 7+50	300					
	DITCH PROTECTION						
D-23	N.B. Jennings Rt. 60+00 to 64+50					140	
D-24	N.B. Jennings Rt. 63+53						30
D-25	N.B. Jennings Lt. 63+50						16
	Total	1728	275	9	28	140	46

DRAINAGE PLAN

FED. RD. DIVISION	STATE	PROJECT
7	OHIO	

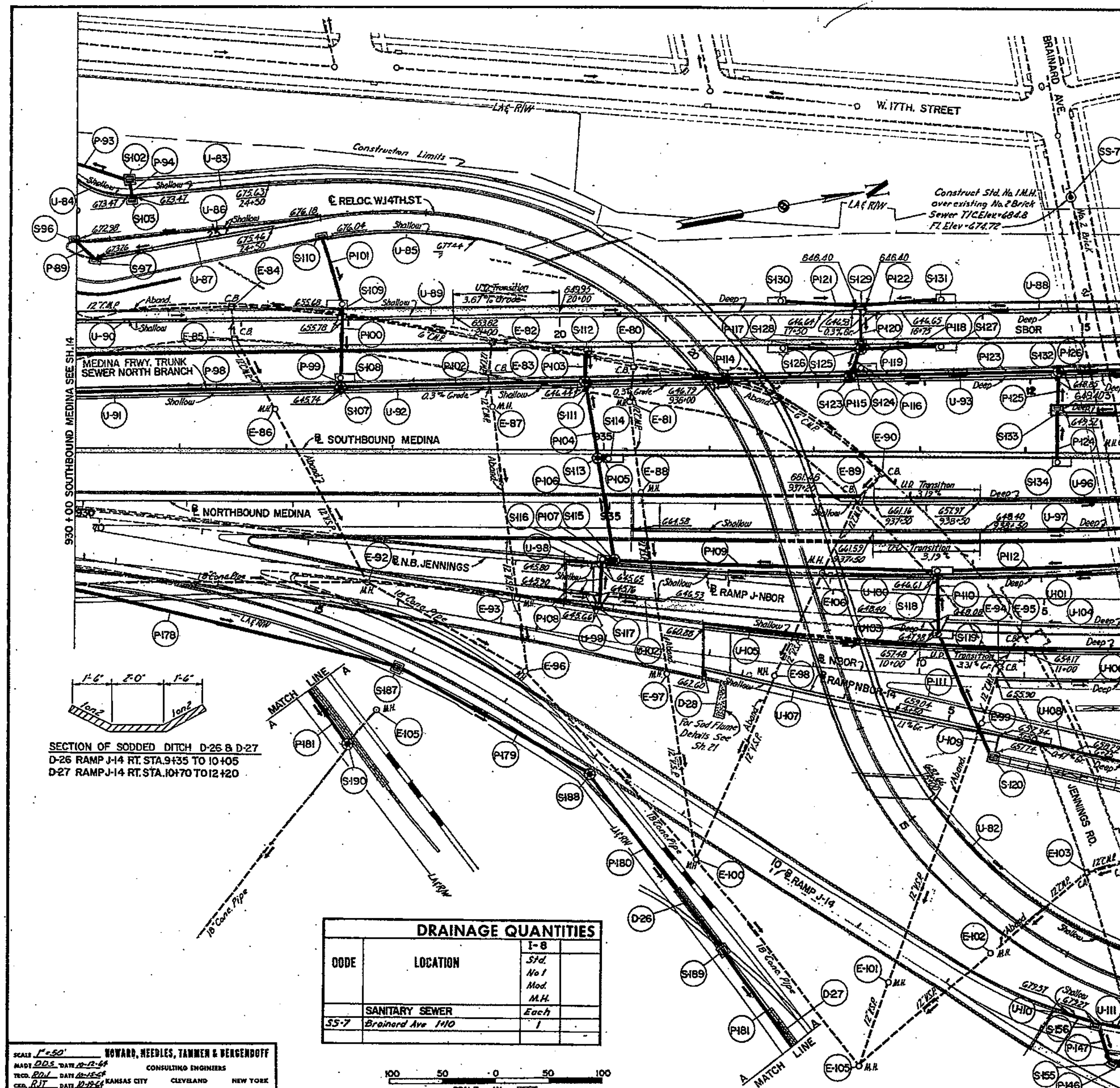
265/646

15/54

CUYAHOGA COUNTY
CUY.-71-17.83
CUY-176-12.76

DRAINAGE LEGEND

- PROPOSED STORM SEWER MANHOLE
- PROPOSED SANITARY MANHOLE
- PROPOSED PAVED SHOULDER INLET
- PROPOSED DITCH CATCH BASIN
- PROPOSED PAVEMENT CATCH BASIN
- PROPOSED STORM OR SANITARY SEWER
- EXISTING MANHOLE
- EXISTING CATCH BASIN
- EXISTING STORM OR SANITARY SEWER
- JUTE MATTING
- SODDED DITCH



DRAINAGE QUANTITIES

CODE	LOCATION	I-8 Std. No 1 Mod. M.H.
	SANITARY SEWER	Each
SS-7	Brainard Ave 1+10	1

SCALE 1"=50'
MADE DDS DATE 10-12-64
TRCD. RDJ DATE 10-15-64
CKD. RJT DATE 10-19-64

HOWARD, NEEDLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY CLEVELAND NEW YORK

When Manhole or Catch Basin shown on this sheet are to be abonded and are not removed entirely seal pipe of structure

DRAINAGE QUANTITIES

CODE	LOCATION	E-12 Pipe Removed 15" & Over	I-16 M.H. Abond.	I-16 C.B. Abond	L-10 Sodding	L-10 Sodding Spec Slope & Berm Protection
	EXISTINGS STRUCTURES	Lin. Ft.	Each		Sq. Yds.	
E-79	S.B. Medina Lt & Rt. 939+95	240				
E-80	S.B. Medina Lt. 935+30			1		
E-81	S.B. Medina Lt. 935+27		1			
E-82	SBOR Lt. 20+65			1		
E-83	SBOR Lt. 20+70			1		
E-84	SBOR Rt. 23+10			1		
E-85	SBOR Lt. 23+07			1		
E-86	S.B. Medina Lt. 931+90		1			
E-87	S.B. Medina Lt. 933+95		1			
E-88	N.B. Medina Lt. 935+30		1			
E-89	N.B. Medina Lt. 937+35			1		
E-90	N.B. Medina Lt. 937+57			1		
E-91	S.B. Medina Lt. 939+92		1			
E-92	N.B. Jennings Rt. 72+60		1			
E-93	N.B. Jennings Rt. 74+05		1			
E-94	NBOR Lt. 10+75			1		
E-95	NBOR Lt. 10+95			1		
E-96	NBOR Rt. 6+30		1			
E-97	NBOR Rt. 7+65		1			
E-98	NBOR Rt. 8+65		1			
E-99	Ramp NBOR-14 Lt. 5+30		1			
E-100	Ramp J-14 Rt. 9+35		1			
E-101	Ramp J-14 Rt. 11+50		1			
E-102	Ramp J-14 Lt. 12+20		1			
E-103	Reloc. W. 14th St. Rt. 13+25			1		
E-104	Reloc. W. 14th St. Rt. 12+95			1		
E-105	Ramp J-14 Rt. 11+75		1			
E-106	Ramp J-NBOR Lt. 2+95		1			
	DITCH PROTECTION					
D-26	Ramp J-14				42	
D-27	Ramp J-14				87	
D-28	Ramp NBOR-14 Rt. 2+85					30
	Total	240	16	11	129	30

DRAINAGE QUANTITIES

CODE	LOCATION	I-1 Cl. F-4 6"	I-1 Cl. I-3 Shallow 6"	I-1 Cl. I-3 Deep 6"	I-5 Cl. I-3 60° Bend 6"	I-5 Cl. I-3 Tee 6"×6"×6"
	UNDERDRAINS	Lin. Ft.			Each	
U-82	Rel. W. 14th St. Rt. 12+40 to 15+00		237			
U-83	Rel. W. 14th St. Rt. 24+50 to 25+75		130			
U-84	Rel. W. 14th St. Rt. 25+80 to 26+30		52			
U-85	Rel. W. 14th St. Lt. 22+50 to 24+00		150			
U-86	Rel. W. 14th St. Lt. 24+00 to 26+34		235			
U-87	N.B. Rel. W. 14th St. 24+50 to 26+16		166			
U-88	SBOR Rt. 14+60 to 17+14	9		250	1	
U-89	SBOR Rt. 17+14 to 22+00	9	100	381	1	
U-90	SBOR Rt. 22+05 to 24+58	10	248		1	
U-91	S.B. Medina Lt. 930+00 to 932+50	5	245		1	
U-92	S.B. Medina Lt. 932+50 to 934+81	5	226		1	
U-93	S.B. Medina Lt. 934+81 to 939+25	5		440	1	
U-94	SBOR-M Rt. 11+05 to 11+67	5		57	1	
U-95	S.B. Medina Lt. 939+30 to 940+00	9		65	1	
U-96	N.B. Medina Lt. 937+20 to 939+90		30	240		
U-97	N.B. Medina Rt. 935+25 to 939+90		225	240		
U-98	N.B. Jennings Lt. 74+50 to 74+80	4	25		1	
U-99	N.B. Jennings Rt. 74+55 to 74+80	10	20		1	
U-100	N.B. Jennings Lt. 74+80 to 78+00	4	310		1	
U-101	N.B. Jennings Lt. 78+00 to 79+85	4		180	1	
U-102	N.B. Jennings Rt. 74+80 to 75+40	10	55		1	
U-103	Ramp J-NBOR Rt. 3+60 to 4+00	10		35	1	
U-104	Ramp J-NBOR Rt. 4+00 to 5+80	10		175	1	
U-105	NBOR Lt. 7+95 to 12+00		205	200		
U-106	NBOR Rt. 10+75 to 12+00			125		
U-107	Ramp NBOR-14 Rt. 2+65 to 5+50		185	100		
U-108	Ramp NBOR-14 Rt. 5+50 to 6+75			125		
U-109	Ramp NBOR-14 Rt. 5+50	10		13		1
U-110	Ramp J-14 Lt. 13+20 to 13+50		30			
U-111	Ramp J-14 Lt. 13+50 to 13+80			30		
U-112	Ramp A Lt. 13+75 to 13+85		10			
	Total	119	2884	2656	15	1

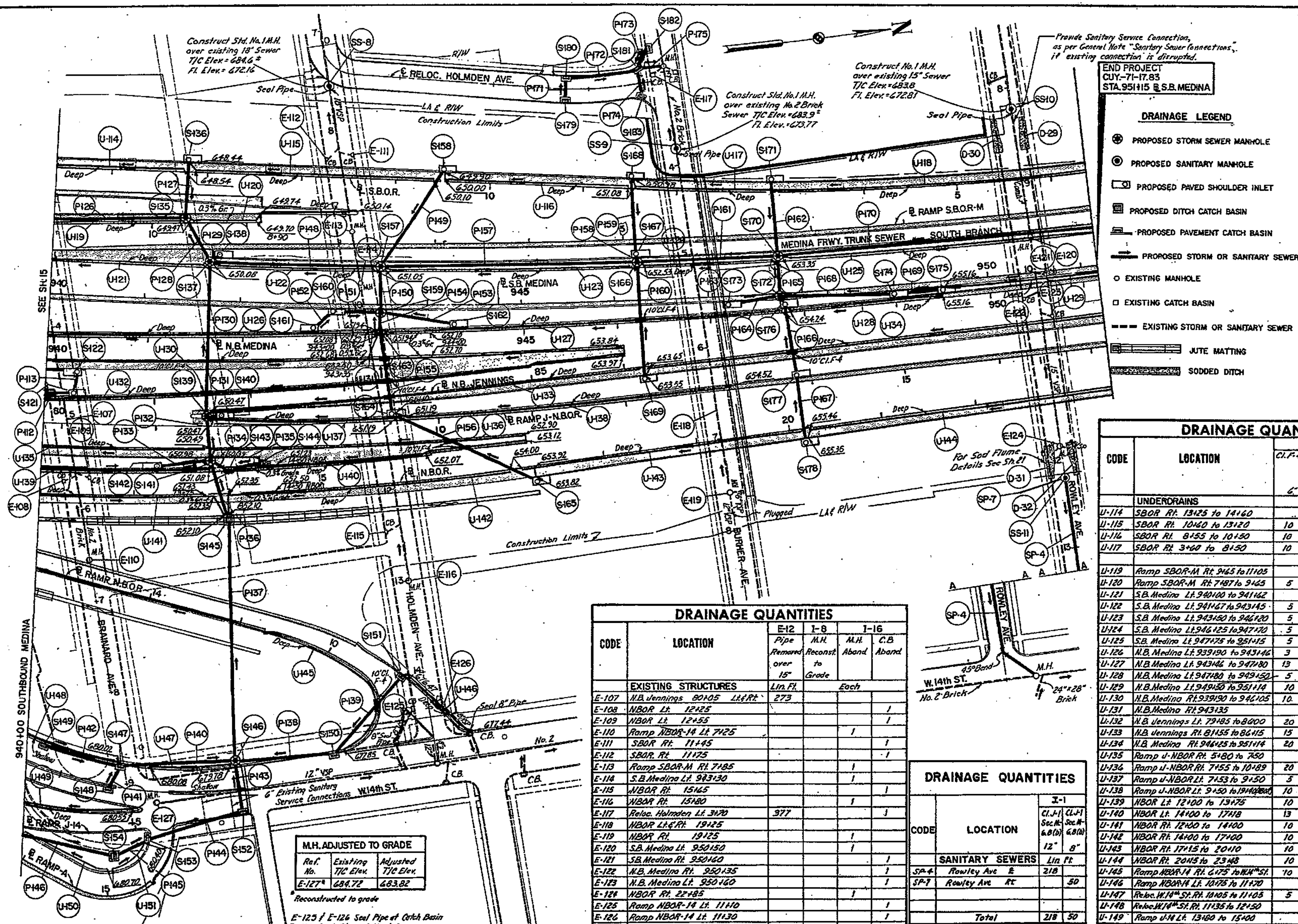
DRAINAGE PLAN

FED. RD. DIVISION	STATE	PROJECT	
2	OHIO		

266 / 646

CUYAHOGA COUNTY
CUY.-71-17.83
CUY-176-12.76

16 / 54



DRAINAGE QUANTITIES

CODE	LOCATION	I-5 Cl. J-1 Sec. M-6.8(b) 45° Bend 12"	I-8 Std. No. 1 Mod. M.H.	L-10 Sodding Spec. Shps. & Berm Protection
	DITCH PROTECTION		Each	Sq. Yds.
D-29	SBOR Rt. 4+25			30
D-30	SBOR Rt. 4+50			30
D-31	NBOR Rt. 22+70			30
D-32	NBOR Rt. 22+95			30
	SANITARY SEWERS			
SS-8	Holmden Ave. 7+60		1	
SS-9	Burher Ave. 3+83		1	
SS-10	Rowley Ave. 8+23		1	
SS-11	Rowley Ave 12+25	1	1	
	Total	1	4	120

DRAINAGE QUANTITIES

CODE	LOCATION	I-1 Cl. F-4 6"	I-1 Cl. I-3 Shallow 6"	I-1 Cl. I-3 Deep 6"	I-1 Cl. U-1 6"	I-5 Cl. I-3 60° Bend 6"	I-5 Cl. I-3 90° Bend 6"	I-5 Cl. I-3 60° Wye 6x6x6"	I-5 Cl. I-3 Tee 6x6x6"
	UNDERDRAINS	Lin. Ft.				Each			
U-114	SBOR Rt. 13+25 to 14+60			135					
U-115	SBOR Rt. 10+60 to 13+20	10		255		1			
U-116	SBOR Rt. 8+55 to 10+50	10		195			1		
U-117	SBOR Rt. 3+60 to 8+50	10	475			1			
U-119	Ramp SBOR-M Rt. 9+65 to 11+05			135					
U-120	Ramp SBOR-M Rt. 7+87 to 9+65	5		175		2			
U-121	S.B. Medina Lt. 940+00 to 941+62			162					
U-122	S.B. Medina Lt. 941+67 to 943+45	5		173		1			
U-123	S.B. Medina Lt. 943+50 to 946+20	5		265		1			
U-124	S.B. Medina Lt. 946+25 to 947+70	5		140		1			
U-125	S.B. Medina Lt. 947+75 to 951+15	5		335		1			
U-126	N.B. Medina Lt. 939+90 to 943+46	3		353		1			
U-127	N.B. Medina Lt. 943+46 to 947+80	13		421		1			
U-128	N.B. Medina Lt. 947+80 to 949+50	5		165		1			
U-129	N.B. Medina Lt. 949+50 to 951+14	10		154					
U-130	N.B. Medina Rt. 939+90 to 946+05	10		605				1	
U-131	N.B. Medina Rt. 943+35				32				
U-132	N.B. Jennings Lt. 79+85 to 86+00	20		595		2			
U-133	N.B. Jennings Rt. 81+55 to 86+15	15		445		1			
U-134	N.B. Medina Rt. 946+25 to 951+14	20		480		1			
U-135	Ramp J-NBOR Rt. 5+80 to 7+50			170					
U-136	Ramp J-NBOR Rt. 7+55 to 10+89	20		325		1			
U-137	Ramp J-NBOR Lt. 7+53 to 9+50	5		195		1			
U-138	Ramp J-NBOR Lt. 9+50 to 19+40 (NBOR)	10		345		1			
U-139	NBOR Lt. 12+00 to 13+75	10		175			1		
U-140	NBOR Lt. 14+00 to 17+18	13		310		3			
U-141	NBOR Rt. 12+00 to 14+00	10		205		1			
U-142	NBOR Rt. 14+00 to 17+00	10		315			1		
U-143	NBOR Rt. 17+15 to 20+10	10		300					1
U-144	NBOR Rt. 20+15 to 23+48	10		332		1			
U-145	Ramp NBOR-14 Rt. 6+75 to W.14th St.	10		455					
U-146	Ramp NBOR-14 Lt. 10+75 to 11+70			100		1			
U-147	Reloc. W.14th St. Rt. 10+05 to 11+05	5	90						
U-148	Reloc. W.14th St. Rt. 11+35 to 12+50		105						
U-149	Ramp J-14 Lt. 13+80 to 15+00			118					
U-150	Ramp-A Lt. 13+85 to 15+00		100						
U-151	Ramp-A Lt. 15+00 to 16+00		70						
	Total	264	840	8533	32	25	3	1	1

DRAINAGE QUANTITIES

CODE	LOCATION	E-12 Pipe Removed over 15"	I-8 M.H. Reconst. to Grade	I-16 M.H. Aband.	I-16 C.B. Aband.
	EXISTING STRUCTURES	Lin. Ft.	Each		
E-107	N.B. Jennings 80+05 Lt. & Rt.	273			
E-108	NBOR Lt. 12+25				1
E-109	NBOR Lt. 12+55				1
E-110	Ramp NBOR-14 Lt. 7+25			1	
E-111	SBOR Rt. 11+45				1
E-112	SBOR. Rt. 11+75				1
E-113	Ramp SBOR-M Rt. 7+85			1	
E-114	S.B. Medina Lt. 943+30			1	
E-115	NBOR Rt. 15+65				1
E-116	NBOR Rt. 15+80			1	
E-117	Reloc. Holmden Lt. 3+70	377			1
E-118	NBOR Lt. & Rt. 19+25				
E-119	NBOR Rt. 19+25			1	
E-120	S.B. Medina Lt. 950+50			1	
E-121	S.B. Medina Rt. 950+60				1
E-122	N.B. Medina Rt. 950+35				1
E-123	N.B. Medina Lt. 950+60				1
E-124	NBOR Rt. 22+85			1	
E-125	Ramp NBOR-14 Lt. 11+10				1
E-126	Ramp NBOR-14 Lt. 11+30				1
E-127	Reloc. W.14th St. Lt. 10+95		1		
	Total	650	1	7	11

DRAINAGE QUANTITIES

CODE	LOCATION	I-1 Cl. J-1 Sec. M-6.8(b) 12"	I-1 Cl. J-1 Sec. M-6.8(b) 8"
	SANITARY SEWERS	Lin. Ft.	
SP-4	Rowley Ave ℄	218	
SP-7	Rowley Ave Rt.		50
	Total	218	50

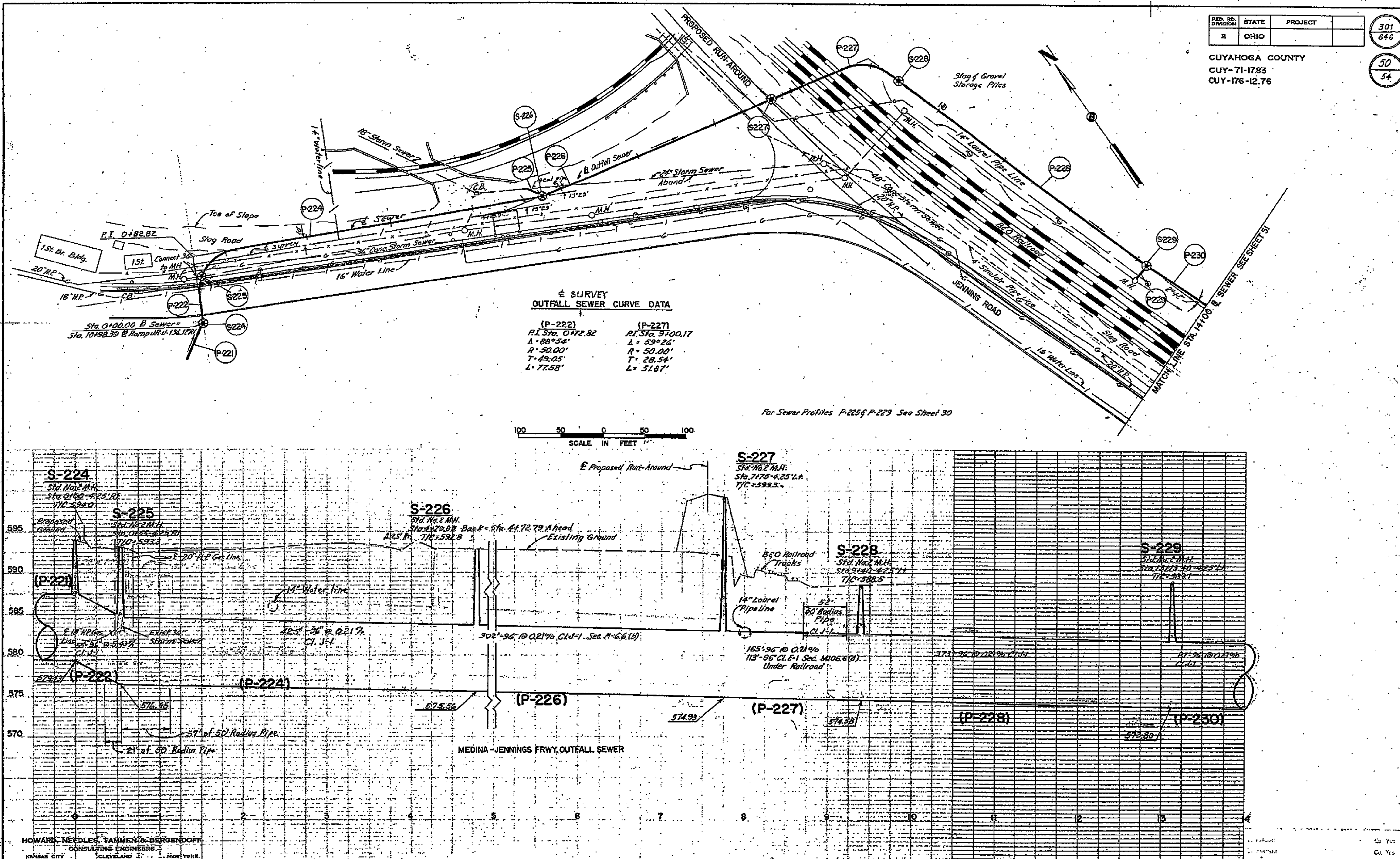
M.H. ADJUSTED TO GRADE		
Ref. No.	Existing T/C Elev.	Adjusted T/C Elev.
E-127*	684.72	683.82

*Reconstructed to grade

E-125 & E-126 Seal Pipe at Catch Basin
E-116 Seal Pipe at Manhole

SCALE 1" = 50'
HOWARD, NEEDLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY CLEVELAND NEW YORK
MADE D.D.S. DATE 9-6-64
TRCD. R.D.J. DATE 9-10-64
CKD. RJT DATE 10-19-64

DRAINAGE PLAN



P-222 & P-224 TO P-230 OUTFALL SEWER STA. 0+00 TO STA. 14+00

FED. RD. DIVISION	STATE	PROJECT
2	OHIO	

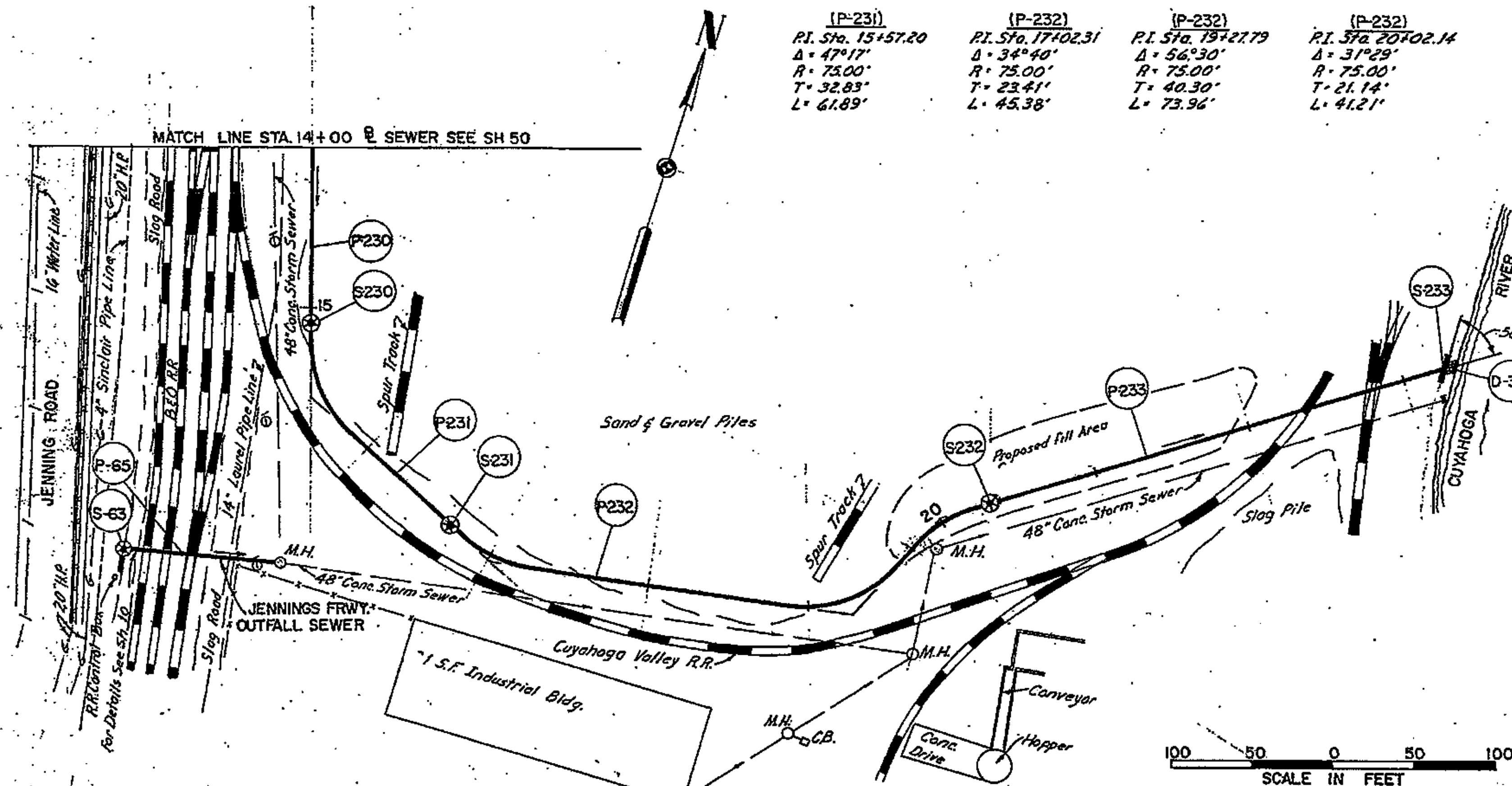
302/646

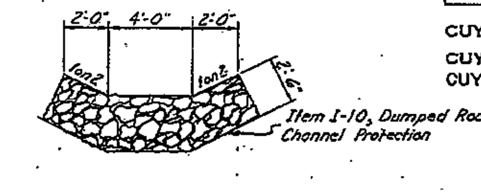
51/54

CUYAHOGA COUNTY
CUY-71-17.83
CUY-176-12.76

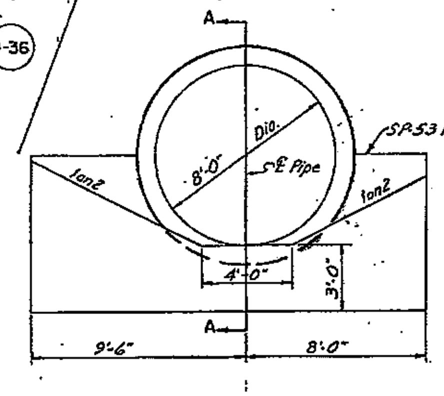
OUTFALL SEWER CURVE DATA

(P-231)	(P-232)	(P-232)	(P-232)
P.I. Sta. 15+57.20	P.I. Sta. 17+02.31	P.I. Sta. 19+27.79	P.I. Sta. 20+02.14
Δ = 47°17'	Δ = 34°40'	Δ = 56°30'	Δ = 31°29'
R = 75.00'	R = 75.00'	R = 75.00'	R = 75.00'
T = 32.83'	T = 23.41'	T = 40.30'	T = 21.14'
L = 61.89'	L = 45.38'	L = 73.96'	L = 41.21'

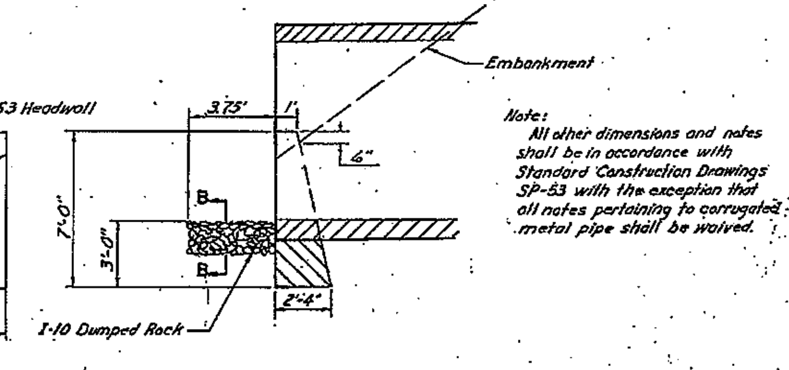




SECTION B-B



HEADWALL DETAIL
Scale 1/4" = 1'-0"

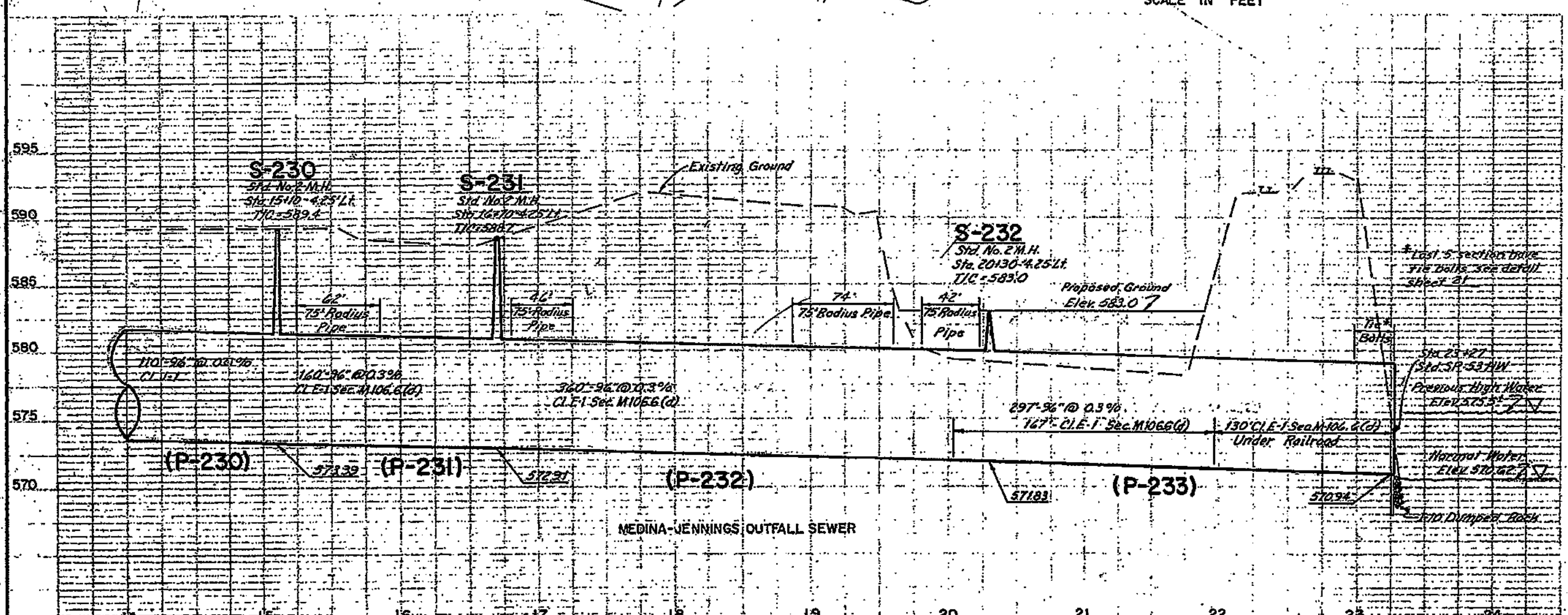


Note:
All other dimensions and notes shall be in accordance with Standard Construction Drawings SP-53 with the exception that all notes pertaining to corrugated metal pipe shall be waived.

SECTION A-A

CODE	LOCATION	I-2 Masonry Cu. Yds.	I-10 Dumped Rock Channel Protection Cu. Yds.
S-233	23+27 ℄ Sewer	6.3	
D-36	23+27 ℄ Sewer		28

DRAINAGE QUANTITIES



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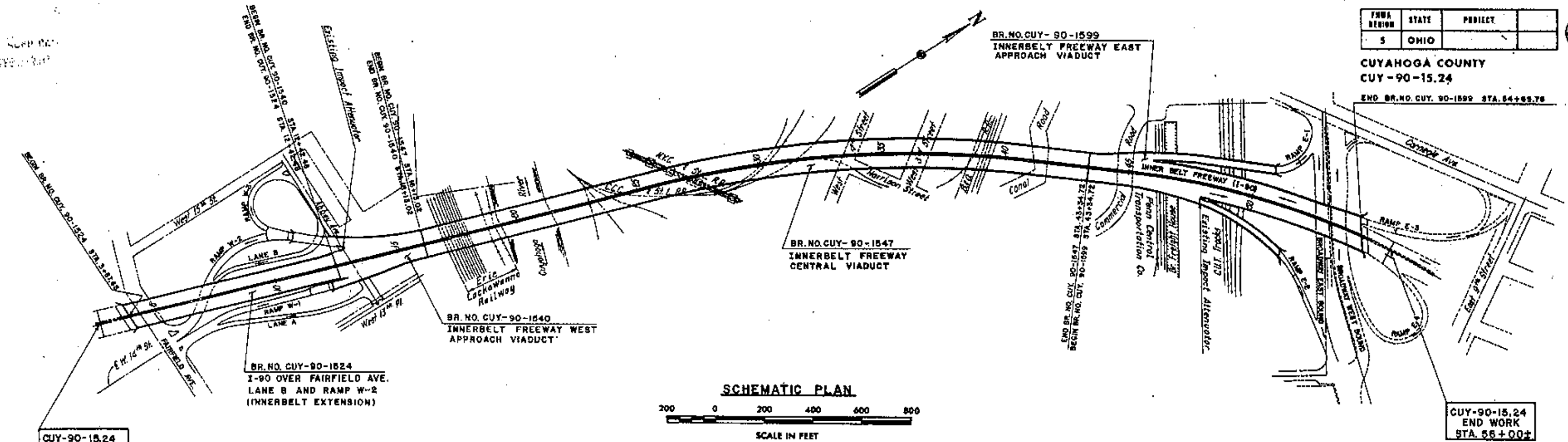
KANSAS CITY CLEVELAND NEW YORK

P-230 TO P-233 OUTFALL SEWER STA. 14+00 TO STA. 23+27

FHWA REGION	STATE	PROJECT	
5	OHIO		

4 / 30

CUYAHOGA COUNTY
CUY-90-15.24



SCHEMATIC PLAN

200 0 200 400 600 800
SCALE IN FEET

EXISTING STRUCTURE BR. NO. CUY-90-1524 (CUY-42-1467)
TYPE: Units 1W and 1E - Continuous welded steel girder with reinforced concrete deck and substructure. Units 2W, 3W and 2E - Continuous steel beam with reinforced concrete deck and substructure.
SPANS: Unit 1W 64'-0", 70'-6", 65'-6", 8'-0" Cantilever. Unit 2W 63'-0", 90'-0", 79'-6", 64'-0", 6'-0" Cantilever. Unit 3W 66'-0", 3 @ 72'-0", 61'-11¾" Unit 1E 64'-0", 102'-0", 103'-0", 90'-0", 79'-6", 64'-0", 6'-0" Cantilever. Unit 2E 66'-0", 3 @ 72'-0", 61'-11¾"
ROADWAY: 2 @ 53'-0" curb to curb with barrier safety curbs and concrete barrier median.
LOAD FREQUENCY: CF2000(57) adequate for A.A.S.H.T.O. alternate loading.
SKEW: Varies
WEARING SURFACE: 2" Asphalt Concrete
APPROACH SLAB: AS-1-54 (25' Long)
ALIGNMENT: Tangent

EXISTING STRUCTURE BR. NO. CUY-90-1540 (CUY-42R-1743)
TYPE: Continuous steel beams and girders with concrete deck and substructure.
SPAN: Varies (see General Plan)
ROADWAY: 2 @ 52'-0" with barrier safety curbs and concrete barrier median.
LOADING: CF 2000
SKEW: Varies
WEARING SURFACE: 2¼" Asphalt Concrete
APPROACH SLABS: AS-1-54 (25' Long)
ALIGNMENT: Tangent

EXISTING STRUCTURE BR. NO. CUY-90-1547 (CUY-42R-1750)
TYPE: Steel deck trusses with reinforced concrete deck and substructure.
SPANS: Varies (see General Plans)
ROADWAYS: 2 @ 52'-0" curb to curb with barrier safety curbs and concrete barrier median.
LOADING: CF 2000, adequate for A.A.S.H.T.O. alternate loading.
SKEW: Varies
WEARING SURFACE: 2¼" Asphalt Concrete
ALIGNMENT: Tangent, 1°30' Curve Right, Tangent.

EXISTING STRUCTURE BR. NO. CUY-90-1599 (CUY-42-1750)
TYPE: Continuous steel beams and girders with concrete deck and substructure.
SPAN: Varies (see General Plans)
ROADWAY: 2 @ 52'-0" with barrier safety curbs and concrete barrier median.
LOADING: CF 2000, adequate for A.A.S.H.T.O. alternate loading.
SKEW: Varies
WEARING SURFACE: 2¼" Asphalt Concrete
APPROACH SLAB: AS-1-54 (25' Long)
ALIGNMENT: 2° Curve Right

SEQUENCE OF WORK

Of the items listed in PROPOSED WORK, the following items shall be performed in the order listed before remaining items are performed.

1. #21
2. #2
3. #5
4. #6
5. #1

PROPOSED WORK

1. Cleanout entire bridge drainage system, see Sheets 3/25 thru 12/25 and 17/25 thru 21/25.
2. Cleanout underground sewer system to the Cuyahoga River see Sheets 13/25 thru 16/25.
3. Provide additional flashing plates at the Central Viaduct deck expansion joints, see Sheets 18/25 and 19/25.
4. Remove all dirt and debris from bridge seats.
5. Provide drain holes in the columns of the End Piers and Piers 2 thru 8 of the Central Viaduct, see Sheet 20/25.
6. Provide drain pipes in the columns of Piers 1N and 1S, see Sheets 14/25 and 20/25.
7. Paint the handrail between the columns of Piers 1B and 2B.
8. Provide 6"ϕ wood guard posts adjacent to Piers 2B, 3B and 1E2, see Sheets 16/25 and 24/25.
9. Coat the exposed concrete surfaces of the East Approach piers with a cement-epoxy coating, see Sheet 16/25.
10. Coat the underside of the bridge deck of the East Approach where spalling has occurred, see Sheets 11/25 and 12/25.
11. Replace Abutment W-1 backwall full depth within the approximate limits of each safety curb, see Sheet 22/25.
12. Replace Abutment W-2 backwall full depth within the approximate limits of each safety curb and trim expansion joint, see Sheet 22/25.
13. Replace approximately the top 1.3 ft. of the southbound roadway Abutment 1B backwall, see Sheet 23/25.
14. Shim abutment bearings at Abutment 1B, see Sheet 23/25.
15. Remove and replace the asphalt concrete on the approach slab at Abutment W-2, see Sheet 24/25.
16. Repair substructure deterioration, see Sheets 13/25 thru 16/25.
17. Fill as required in front of Abutment W-1 and Abutment E-1 and at Pier 2E1, see Sheets 13/25 and 16/25.
18. Repair eroded area in the vicinity of Piers 1N and 1S, see Sheet 14/25.
19. Install pressure relief joints on all approach roadways, see Sheets 3/25, 5/25 and 12/25.
20. Repair of cracks, see Sheet 25/25.
21. Replace 24" Storm Sewer between Pier 3 and Pier 4, see Sheet 14/25.
22. Furnish bolt down castings for existing manholes, see Sheet GN-2.

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KANSAS CITY CLEVELAND NEW YORK

SCHEMATIC PLAN

BR. NO. CUY.-90-1524
90-1540
90-1547
90-1599
STA. 2+65±
STA. 56+00±
CUYAHOGA COUNTY OHIO

DRAWN CZB	TRACED S/S	CHECKED WEB	REVIEWED	REVISED
DATE 6-17-74	DATE 5-18-74	DATE 6-25-74	DATE	SHEET 1/25

FHWA REGION	STATE	PROJECT	
5	OHIO		

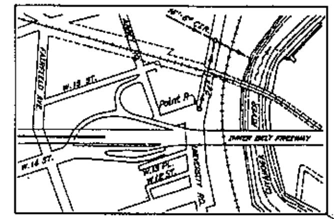
16/30

CUYAHOGA COUNTY
CUY-90-15.24

ESTIMATED REPAIR QUANITIES				
LOCATION	ITEM 519	ITEM 520	REPAIR OF CRACKS	ITEM 203
	Sq. Ft.	Sq. Ft.	Lin. Ft.	Cu. Yds.
Abut. W-1 and W.W.	6	12		*28
Abut. W-2 and W.W.	5			
Pier 1-A, Pier 2-A, Pier 1W-2, Pier 2W-2, and Pier 1W-1		5		
West End Pier (S)		6	36	
West End Pier (N)		10		
TOTAL	11	33	36	*28

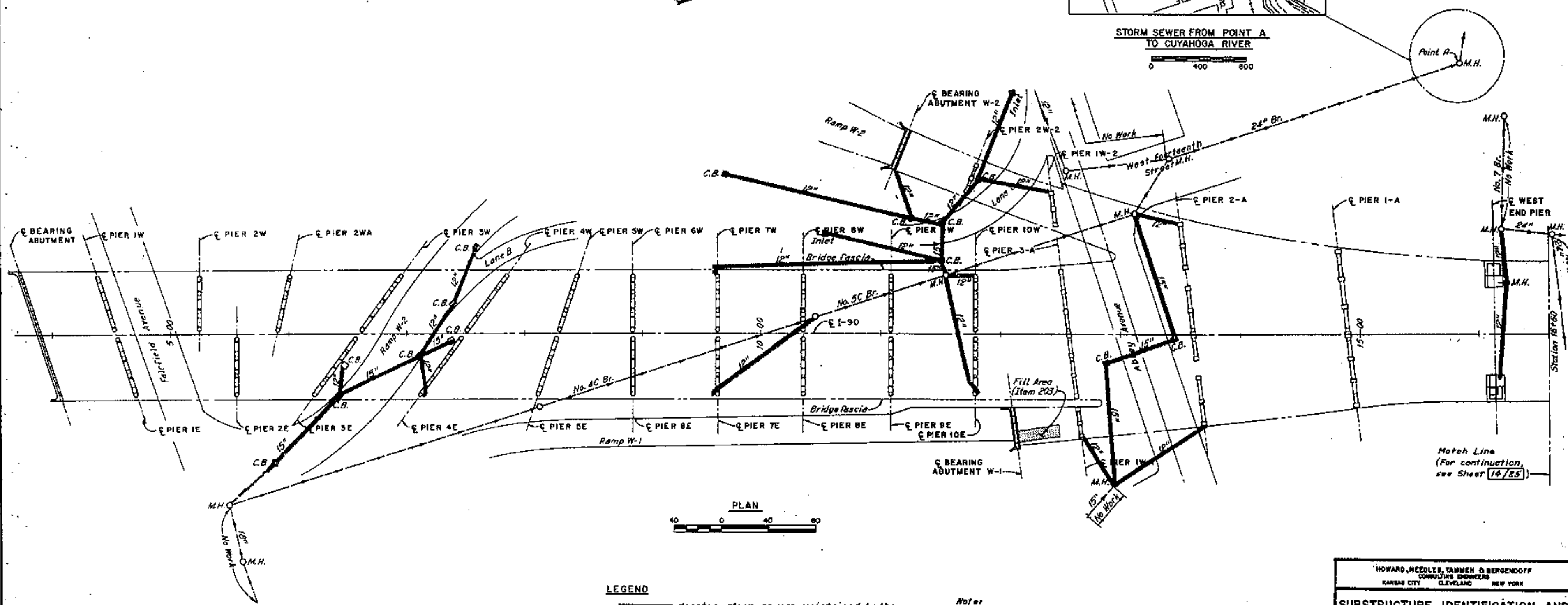
* Abutment W-1 only

ESTIMATED STORM SEWER CLEAN OUT QUANTITIES AS SHOWN ON THIS DRAWING		
PIPE SIZE	MAINTAINED BY STATE OF OHIO	MAINTAINED BY CITY OF CLEVELAND
	Lin. Ft.	Lin. Ft.
12" φ	1445	
15" φ	571	
24" φ		794
No. 4		530
No. 5		345



STORM SEWER FROM POINT A TO CUYAHOGA RIVER

0 400 800



LEGEND

- denotes storm sewers maintained by the State of Ohio
- denotes storm sewers maintained by the City of Cleveland

Note:
The information shown on this drawing concerning type and location of underground utilities is not guaranteed to be accurate or all inclusive. The Contractor is responsible for making his own determinations as to the type and location of underground utilities as may be necessary to avoid damage thereto.

HOWARD, NEEDLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY CLEVELAND NEW YORK

SUBSTRUCTURE IDENTIFICATION AND UNDERGROUND DRAINAGE SYSTEM

BR. NO. CUY.-90-1524
90-1540
90-1547
90-1599

STA. 2+65±
STA. 56+00±

CUYAHOGA COUNTY OHIO

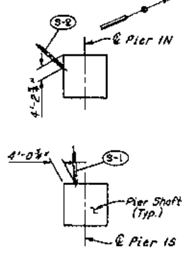
DRAWN D.L.A. DATE 7-16-74 | TRACED D.L.A. DATE 7-16-74 | CHECKED DATE | REVIEWED DATE | REVISED | SHEET 15/25

FHWA REGION	STATE	PROJECT	
5	OHIO		

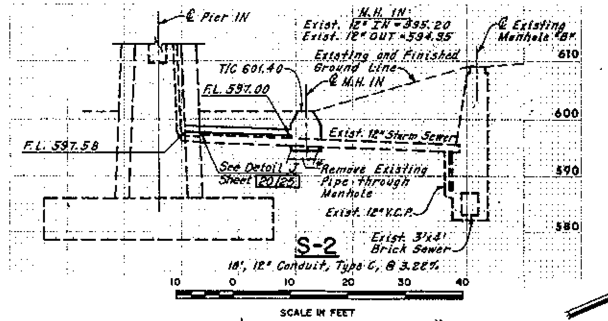
17/30

CUYAHOGA COUNTY
CUY-90-15.24

Note:
The location of the (S-1) and (S-2) conduits as shown on the "Pipe Location Plan" are based on original plan drawings and serve as a guide for the Contractor to meet the requirements as set forth on Sheet 20/25



PIPE LOCATION PLAN



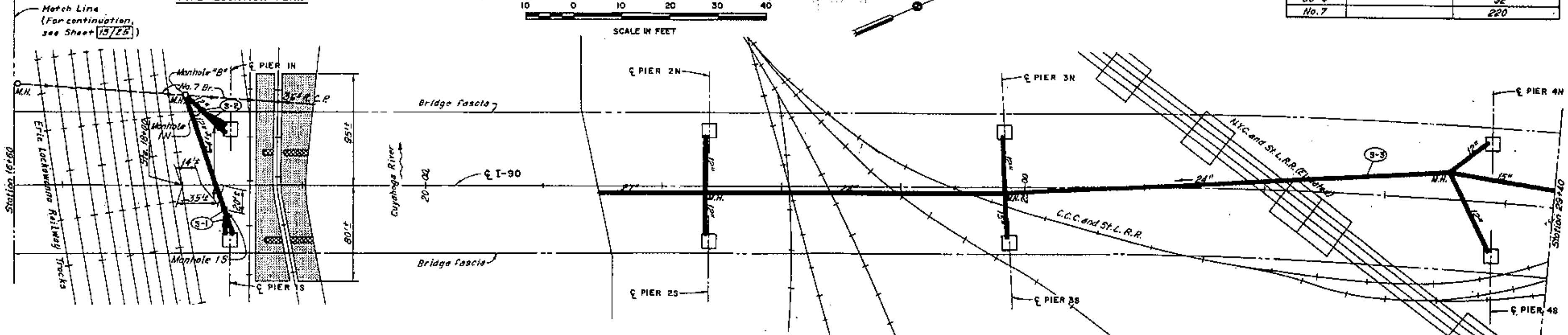
S-2
18', 12" Conduit, Type C, @ 3.22%

SCALE IN FEET

ESTIMATED REPAIR QUANTITIES			
LOCATION	ITEM 519	ITEM 520	REPAIR OF CRACKS
	Sq. Ft.	Sq. Ft.	Lin. Ft.
Pier 1S		36	
Pier 1N		32	
Pier 2S		24	
Pier 2N		75	
Pier 3S		13	
Pier 3N		100	
Pier 4S		120	72
Pier 4N		63	12
TOTAL		463	84

ESTIMATED STORM SEWER CLEAN OUT QUANTITIES AS SHOWN ON THIS DRAWING		
PIPE SIZE	MAINTAINED BY STATE OF OHIO	MAINTAINED BY CITY OF CLEVELAND
	Lin. Ft.	Lin. Ft.
12" φ	417	
15" φ	128	
24" φ	254	
27" φ	90	
36" φ		32
No. 7		220

Match Line
(For continuation, see Sheet 13/25)



Note:
Indicates Erosion Repair Limits.
Indicates Major Erosion areas as identified in Field 5-1-75

Note:
The underground drainage system construction under this Contract consists of (S-1), (S-2) and (S-3) only.

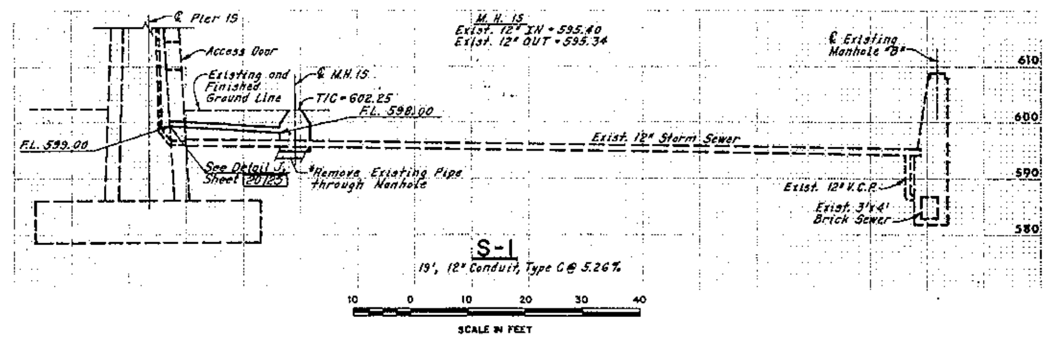
Note:
Dimensions to locate proposed manholes are approximate only. It shall be the Contractor's responsibility to field locate the existing pipes.

PLAN
SCALE IN FEET

LEGEND
denotes storm sewers maintained by the State of Ohio
denotes storm sewers maintained by the City of Cleveland

Match Line
(For continuation, see Sheet 15/25)

Note:
The 24" Conduit for (S-3) shall be so constructed to meet the line and grade of the existing 24" storm sewer. It is also intended that the existing pipe sections which enter and exit the existing manholes should remain, if determined to be in satisfactory condition by the Engineer, and re-used in the construction of the new sewer.



S-1
19', 12" Conduit, Type C @ 5.26%

SCALE IN FEET

*Flow in the existing 12" storm sewer shall be maintained at all times. Removal of part of the existing 12" storm sewer and maintaining flow in the sewer shall be included with Item 604, Standard No. 1 Manhole, for payment.

▲ 706.01, 706.02, or 706.08

DRAINAGE QUANTITIES			
Ref. No.	603 12" Conduit Type C▲	603 24" Conduit Type C as per plan	604 Standard No. 1 M.H.
	Lin. Ft.	Lin. Ft.	Each
S-1	19		1
S-2	18		1
S-3		373	
Total	37	373	2

Note:
The information shown on this drawing concerning type and location of underground utilities is not guaranteed to be accurate or all inclusive. The Contractor is responsible for making his own determinations as to the type and location of underground utilities as may be necessary to avoid damage thereto.

HOWARD, NEEDLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY CLEVELAND NEW YORK

SUBSTRUCTURE IDENTIFICATION AND UNDERGROUND DRAINAGE SYSTEM

BR. NO. CUY.-90-1524
90-1540
90-1547
90-1599

STA. 2+65±
STA. 56+00±

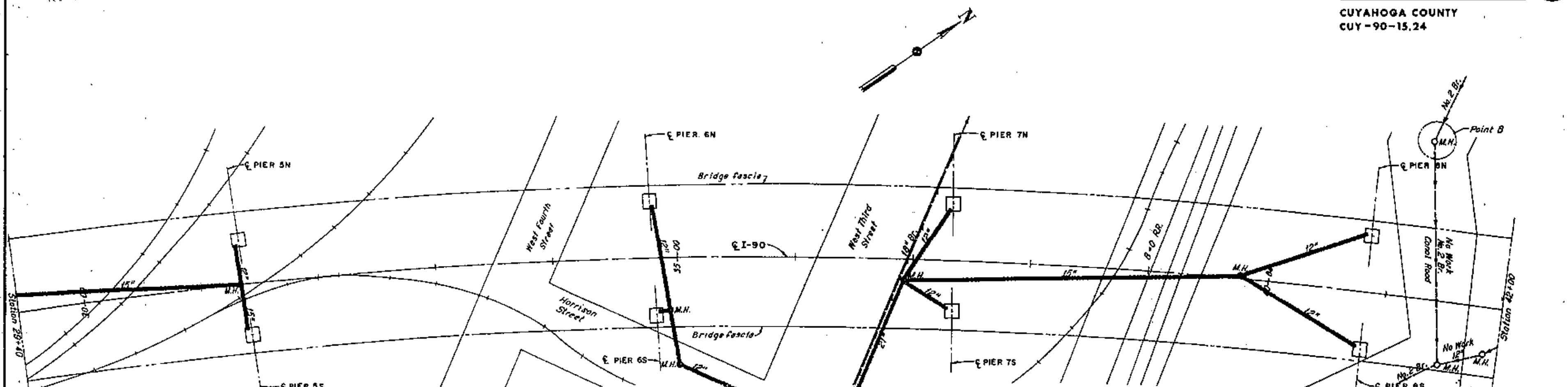
CUYAHOGA COUNTY OHIO

SHEET 14/25

FHWA REGION	STATE	PROJECT		
5	OHIO			

18/30

CUYAHOGA COUNTY
CUY-90-15.24



LEGEND

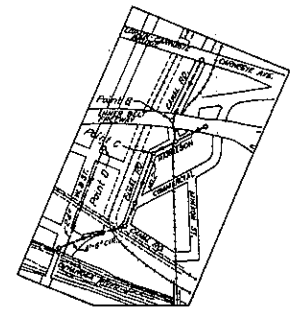
denotes storm sewers maintained by the State of Ohio

denotes storm sewers maintained by the City of Cleveland

PLAN

40 0 40 80

SCALE IN FEET



STORM SEWER FROM POINTS B, C AND D TO CUYAHOGA RIVER

0 400 800

ESTIMATED REPAIR QUANTITIES

LOCATION	ITEM 519 Sq. Ft.	ITEM 520 Sq. Ft.	REPAIR OF CRACKS Lin. Ft.
Pier 5S		34	
Pier 5N		18	
Pier 6S		173	24
Pier 6N		22	
Pier 7S		50	
Pier 7N		5	
Pier 8S		4	
Pier 8N		3	
TOTAL		309	24

ESTIMATED STORM SEWER CLEAN OUT QUANTITIES AS SHOWN ON THIS DRAWING

PIPE SIZE	MAINTAINED BY STATE OF OHIO Lin. Ft.	MAINTAINED BY CITY OF CLEVELAND Lin. Ft.
12" ϕ	686	
15" ϕ	512	
21" ϕ	144	
24" ϕ	810	

Note:
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HOWARD, NEEDLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY CLEVELAND NEW YORK

SUBSTRUCTURE IDENTIFICATION AND UNDERGROUND DRAINAGE SYSTEM

BR. NO. CUY.-90-1524
90-1540
90-1547
90-1599

STA. 2+65±
STA. 56+00±

CUYAHOGA COUNTY OHIO

DRAWN DLA DATE 7-16-74 | TRACED DLA DATE 7-16-74 | CHECKED DATE | REVIEWED DATE | REVISED SHEET 15/25

FHWA REGION	STATE	PROJECT		19/30
5	OHIO			

CUYAHOGA COUNTY
CUY-90-15.24

LEGEND

—— denotes storm sewers maintained by the State of Ohio
-·-·- denotes storm sewers maintained by the City of Cleveland

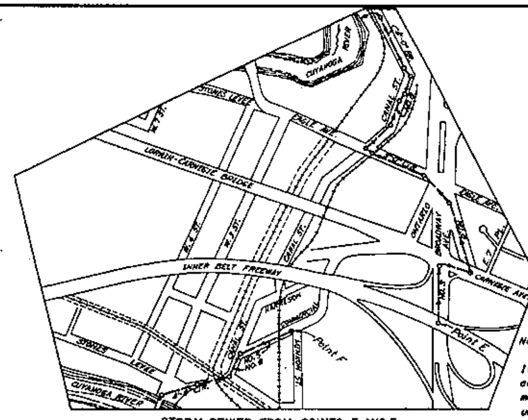
ESTIMATED REPAIR QUANTITIES				
LOCATION	ITEM 519	ITEM 520	REPAIR OF CRACKS	ITEM 203
	Sq. Ft.	Sq. Ft.	Lin. Ft.	Cu. Yds.
East End Pier (S)		57		
East End Pier (N)		66		
Abut. E-2 and W.W.	5	8	30	
Abut. E-1 and W.W.			8	195
Abut. 1B and W.W.	120	60		
Pier 1B				
Pier 2B		12		
Pier 3B		12	3	
Pier 2E1				153
Pier 1E2		96	3	
Pier 4B	6			
Pier 4E1		3	5	
Pier 2E2				
Pier 3E1				
Pier 5B				
Pier 6B				
Pier 7B				
Pier 8B		90		
Pier 9B		6		
TOTAL	131	420	49	348

ESTIMATED STORM SEWER CLEAN OUT QUANTITIES AS SHOWN ON THIS DRAWING		
PIPE SIZE	MAINTAINED BY STATE OF OHIO	MAINTAINED BY CITY OF CLEVELAND
	Lin. Ft.	Lin. Ft.
12"ϕ	940	103
30"ϕ		575
36"ϕ		450
48"ϕ		550
54"ϕ		530
No. 3		850
No. 4		597
No. 5		400
No. 6		180
No. 8		1480

Note:

All exposed concrete portions of the following Piers shall be coated with a cement epoxy coating:

PIER	QUANTITY Sq. Ft.
1B	8,375
2B	6,415
3B	6,550
4B	11,061
5B	2,920
6B	2,753
7B	2,825
8B	2,778
9B	2,809
2E1	1,895
3E1	2,675
4E1	1,120
1E2	1,940
2E2	1,825
TOTAL	55,941

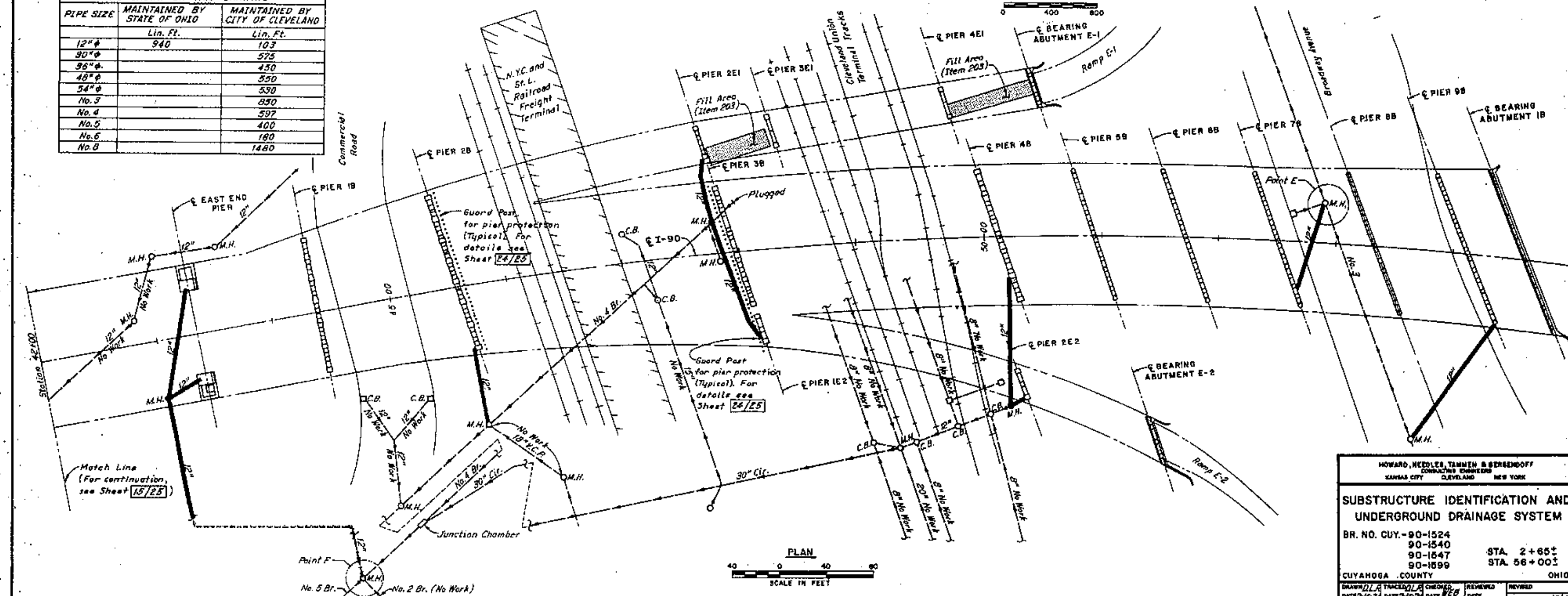


STORM SEWER FROM POINTS E AND F TO CUYAHOGA RIVER

0 400 800

Note:

The information shown on this drawing concerning type and location of underground utilities is not guaranteed to be accurate or all inclusive. The Contractor is responsible for making his own determinations as to the type and location of underground utilities as may be necessary to avoid damage thereto.



PLAN

40 0 40 80
SCALE IN FEET

HOWARD, NEEDLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY CLEVELAND NEW YORK

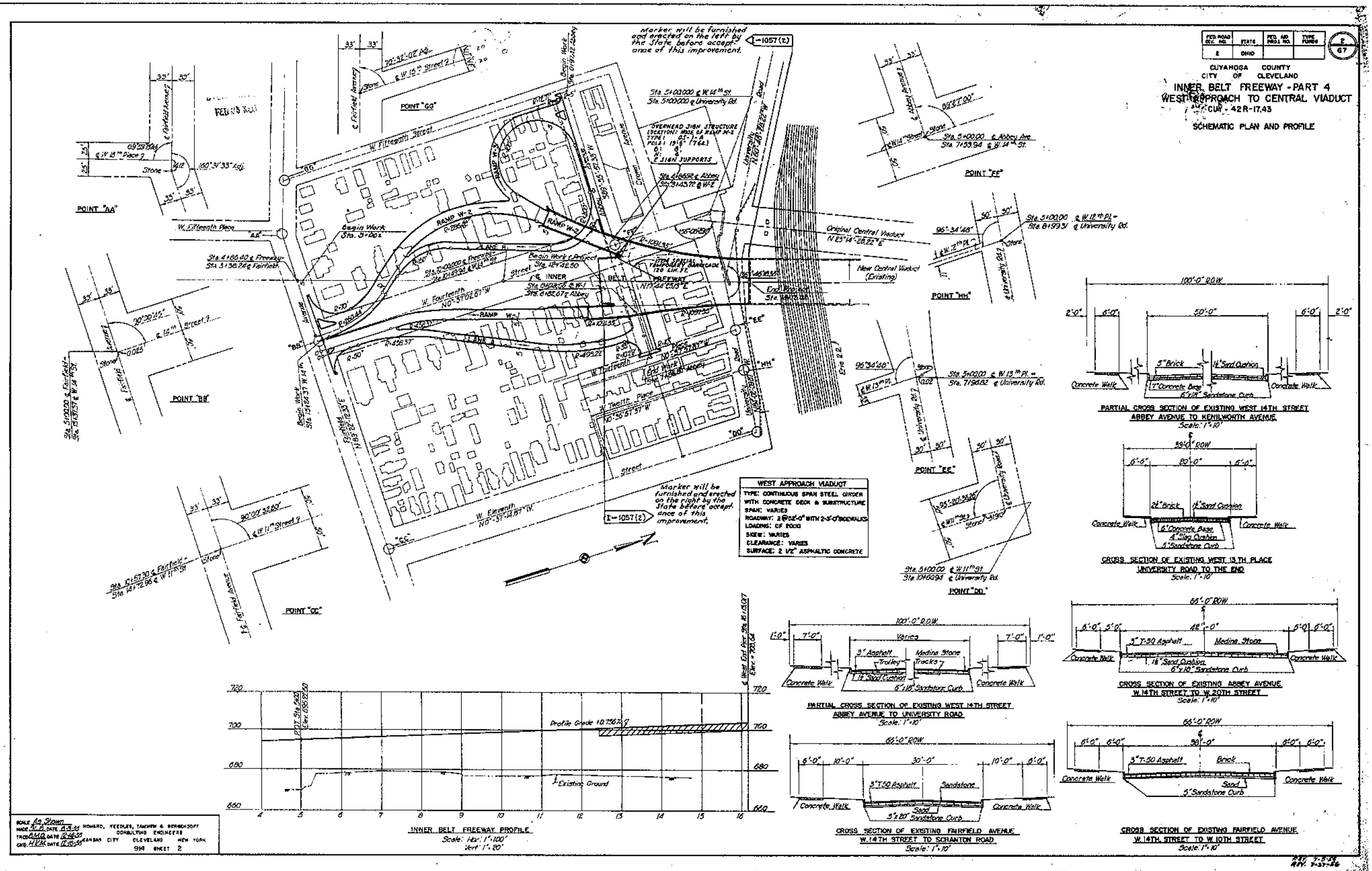
SUBSTRUCTURE IDENTIFICATION AND UNDERGROUND DRAINAGE SYSTEM

BR. NO. CUY.-90-1524
90-1540
90-1547
90-1599

STA. 2+65±
STA. 56+00±

CUYAHOGA COUNTY OHIO

DRAWN D.L.R. DATE 7-16-74	TRACED D.L.R. DATE 7-16-74	CHECKED DATE	REVIEWED DATE	REVISED SHEET 16/25

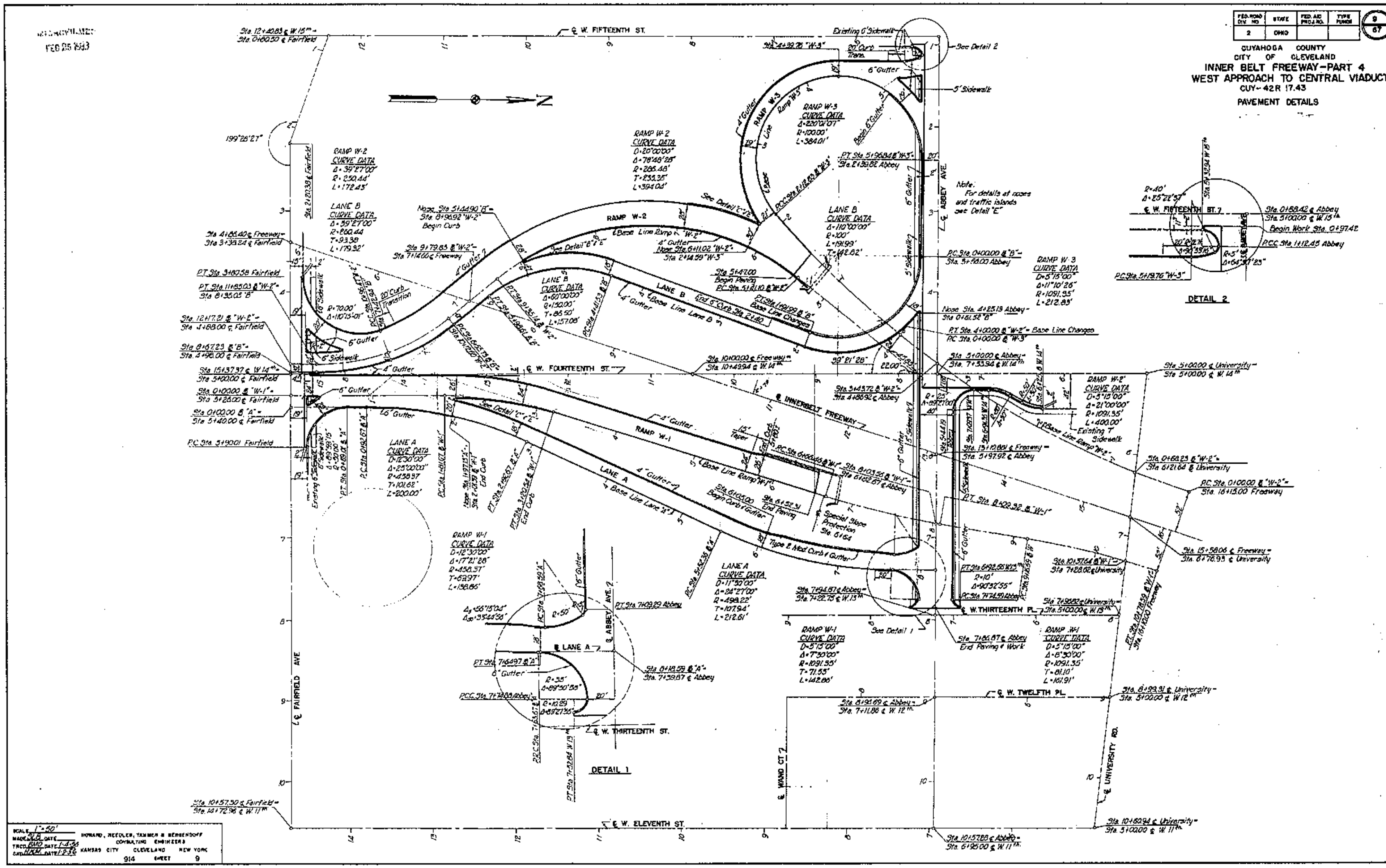

FED. ROAD DIV. NO. 2 | STATE OHIO | FED. AID PROJ. NO. | TYPE FUNDS
2
67
CUYAHOGA COUNTY
CITY OF CLEVELAND
INNER BELT FREEWAY - PART 4
WEST APPROACH TO CENTRAL VIADUCT
CUY - 42R-17.43
SCHEMATIC PLAN AND PROFILE
WEST APPROACH VIADUCT
TYPE: CONTINUOUS SPAN STEEL GIRDER WITH CONCRETE DECK & SUBSTRUCTURE
SPAN: VARIES
ROADWAY: 2@52'-0" WITH 2-3'-0" SIDEWALKS
LOADING: CF 2000
SKEW: VARIES
CLEARANCE: VARIES
SURFACE: 2 1/2" ASPHALTIC CONCRETE
Marker will be furnished and erected on the left by the State before acceptance of this improvement.
Marker will be furnished and erected on the right by the State before acceptance of this improvement.
POINT "AA"
POINT "BB"
POINT "CC"
POINT "DD"
POINT "EE"
POINT "FF"
POINT "GG"
POINT "HH"
Original Central Viaduct
New Central Viaduct (Existing)
Erie R.R.
INNER BELT FREEWAY PROFILE
Scale: Hor. 1"=100' Vert. 1"=20'
Profile Grade
Existing Ground
PARTIAL CROSS SECTION OF EXISTING WEST 14TH STREET ABBEY AVENUE TO KENILWORTH AVENUE
Scale: 1"=10'
CROSS SECTION OF EXISTING WEST 13TH PLACE UNIVERSITY ROAD TO THE END
Scale: 1"=10'
PARTIAL CROSS SECTION OF EXISTING WEST 14TH STREET ABBEY AVENUE TO UNIVERSITY ROAD
Scale: 1"=10'
CROSS SECTION OF EXISTING ABBEY AVENUE W.14TH STREET TO W.20TH STREET
Scale: 1"=10'
CROSS SECTION OF EXISTING FAIRFIELD AVENUE W.14TH STREET TO SCRANTON ROAD
Scale: 1"=10'
CROSS SECTION OF EXISTING FAIRFIELD AVENUE W.14TH STREET TO W.10TH STREET
Scale: 1"=10'
SCALE As Shown
HOWARD, NEEDLES, TAMMEN & BERGENDOFF CONSULTING ENGINEERS
KANSAS CITY CLEVELAND NEW YORK
914 SHEET 2

FED. ROAD DIV. NO.	STATE	FED. AID PROJ. NO.	TYPE FUNDS
2	OHIO		

9 / 67

CUYAHOGA COUNTY
CITY OF CLEVELAND
INNER BELT FREEWAY–PART 4
WEST APPROACH TO CENTRAL VIADUCT
CUY-42R 17.43

PAVEMENT DETAILS



SCALE 1"=50'
HOWARD, NEEDLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY CLEVELAND NEW YORK
914 SHEET 9

FED. ROAD DIV. NO.	STATE	FED. AID PROJ. NO.	TYPE FUNDS
2	OHIO		

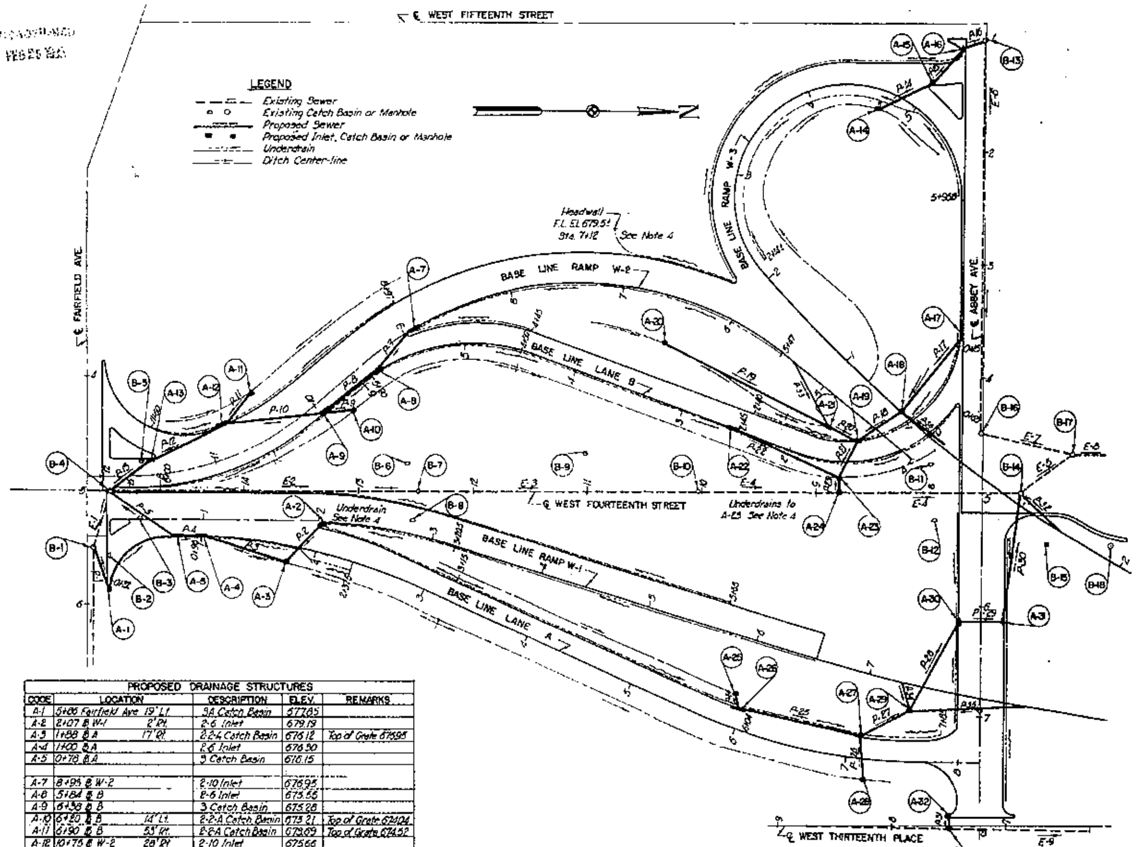
17 / 67

CUYAHOGA COUNTY
CITY OF CLEVELAND

INNER BELT FREEWAY - PART 4
WEST APPROACH TO CENTRAL VIADUCT

CUY- 42 R -17.43

DRAINAGE PLAN



GENERAL NOTES

Sewers are designed by the Rational Formula based on a 10-year storm frequency flowing full.

Minimum Velocity of flow is 3.0 F.P.S. for main lines and 2.5 F.P.S. for laterals.

All stubs for bridge drainage are to be 12-inch diameter concrete pipe, set on line and grade as specified on the profiles and on the bridge plans. The stubs shall extend a minimum distance of 1 foot 0 inch outside the drainage structures.

Pipe sewers connected to existing catch basins are not shown on the plans. Where sewer pipes not shown are encountered during construction, the pipes shall be cut at the limits of construction and plugged to the satisfaction of the Engineer. Payment for cutting and plugging shall be included in the unit price bid for Item E-1, "Excavation."

Payment for the removal and/or abandoning of pipe outlets necessitated by the abandoning of existing catch-basins or manholes, will be included in the unit price bid for Item I-16, "Manholes, Catch Basins, or Inlets Abandoned", unless payment is otherwised authorized specifically under other items in the plans.

Where it is necessary under Item I-8, "Manholes adjusted to grade" to replace unsatisfactory manhole frame and cover castings, payment for the new castings shall be made at the contract unit price bid per each for Item I-8 "Manhole Frame and Cover (Light)" and Item I-8 "Manhole Frame and Cover (Heavy)". Payment shall constitute full compensation for furnishing, hauling and placing all castings and any incidentals necessary to complete the item to the satisfaction of the Engineer.

PROPOSED DRAINAGE STRUCTURES

CODE	LOCATION		DESCRIPTION	ELEV.	REMARKS
A-1	5+86 Fairfield Ave	19' Lt.	3A Catch Basin	677.85	
A-2	2+07 ℄ W-1	2' Rt.	2-6 Inlet	679.19	
A-3	1+88 ℄ A	17' Rt.	2-2-A Catch Basin	676.12	Top of Grate 675.95
A-4	1+00 ℄ A		2-6 Inlet	676.30	
A-5	0+78 ℄ A		3 Catch Basin	676.15	
A-7	8+93 ℄ W-2		2-10 Inlet	676.95	
A-8	5+84 ℄ B		2-6 Inlet	675.55	
A-9	6+38 ℄ B		3 Catch Basin	675.28	
A-10	6+20 ℄ B	14' Lt.	2-2-A Catch Basin	673.21	Top of Grate 674.04
A-11	6+90 ℄ B	53' Rt.	2-2-A Catch Basin	673.69	Top of Grate 674.52
A-12	10+75 ℄ W-2	28' Rt	2-10 Inlet	675.66	
A-13	11+55 ℄ W-2	14' Rt.	3A Catch Basin	676.20	
A-14	4+70 ℄ W-3	17' Rt.	2-2-A Catch Basin	675.17	Top of Grate 676.00
A-15	5+08 ℄ W-3	24.5' Lt.	3A Catch Basin	677.98	
A-16	1+11 Abbey Ave.	20' Rt. of ℄	3A Catch Basin	678.55	
A-17	0+10 ℄ B		2-10 Inlet	676.02	
A-18	1+00 ℄ B	11.5' Rt	2-2-A Catch Basin	673.50	Top of Grate 674.33
A-19	1+48 ℄ B		3 Catch Basin	674.58	
A-20	3+35 ℄ B	49.5' Rt.	2-2-A Catch Basin	670.90	Top of Grate 671.73
A-21	1+75 ℄ B	11' Rt.	2-2-A Catch Basin	673.61	Top of Grate 674.94
A-22	2+50 ℄ B		2-10 Inlet	675.44	
A-23	1+62 ℄ B	32' Lt.	2-2-A Catch Basin	672.97	Top of Grate 673.80
A-24	1+61.5 ℄ B	45'± Lt.	2 Manhole	673.80	Top of Cover
A-25	5+90 ℄ A	30' Lt.	2-2-A Catch Basin	675.78	Top of Grate 676.61
A-26	6+00 ℄ A	17' Lt.	2-10 Inlet	675.97	
A-27	7+10 ℄ A	19' Lt.	3 Catch Basin	674.11	
A-28	7+18 ℄ A	18' Rt.	2-2-A Catch Basin	672.67	Top of Grate 673.50
A-29	7+55 ℄ A	45' Lt.	1 Manhole	676.01	Top of Cover
A-30	6+14.52 Abbey Ave.	20' Rt. of ℄	3A Catch Basin	674.26	
A-31	6+14.52 Abbey Ave.	20' Lt. of ℄	3A Catch Basin	674.26	
A-32	7+49 W. 13th Pl.	10' Rt. of ℄	3A Catch Basin	675.61	
A-33	7+49 W. 13th Pl.	3' Rt. of ℄	1 Manhole	675.10±	Top of Cover

EXISTING DRAINAGE STRUCTURES

CODE	LOCATION		DESCRIPTION	ELEV.	REMARKS
B-1	5+50 Fairfield Ave.	6' Lt. ℄	Manhole		Undisturbed
B-2	5+57 Fairfield Ave.	18' Lt. ℄	Catch Basin		Abandon
B-3	14+92 W. 14th St.	22' Lt. ℄	Catch Basin		Abandon
B-4	5+00 Fairfield	19' Lt. ℄	Manhole	676.7±	Adjust to Grade
B-5	14+92 W. 14th St.	25' Rt. ℄	Catch Basin		Abandon
B-6	12+58 W. 14th St.	25' Rt. ℄	Catch Basin		Abandon
B-7	12+49 ℄ W. 14th St.		Manhole		Abandon
B-8	12+54 W. 14th St.	25' Lt. ℄	Catch Basin		Abandon
B-9	11+01 W. 14th St.	33' Rt. ℄	Manhole (Sanitary)	675.8±	Adjust to Grade
B-10	10+03 ℄ W. 14th St.		Manhole	676.2±	Adjust to Grade
B-11	7+97 W. 14th St.	25' Rt. ℄	Catch Basin		Abandon
B-12	8+00 W. 14th St.	25' Lt. ℄	Catch Basin		Abandon
B-13	1+01 ℄ Abbey Ave.		Manhole		Undisturbed
B-14	7+20 ℄ W. 14th St.		Manhole		Undisturbed
B-15	6+98 W. 14th St.	45' Lt. ℄	Catch Basin		Abandon
B-16	4+49 Abbey Ave.	1'± Rt. ℄	Manhole		Undisturbed
B-17	6+76 W. 14th St.	33' Rt. ℄	Manhole		Undisturbed
B-18	6+40 W. 14th St.	48' Lt. ℄	Manhole	675.1±	Adjust to Grade

EXISTING SEWERS

CODE	LOCATION			SIZE	LENGTH	REMARKS
	STREET	FROM	TO			
E-1	Fairfield	B-1	B-4	18	48	Undisturbed
E-2	W. Fourteenth	B-4	B-7	No. 4C	264	Undisturbed
E-3	W. Fourteenth	B-7	B-10	No. 4C	241	Undisturbed
E-4	W. Fourteenth	B-10	B-14	No. 5C	278	Undisturbed
E-5	W. Fourteenth	B-14	B-17	No. 5C	51	Undisturbed
E-6	Abbey Ave.	B-13	B-16	12	345	Undisturbed
E-7	W. Fourteenth	B-16	B-17	12	78	Undisturbed
E-8	W. Fourteenth	B-17	North	24		Undisturbed
E-9	W. Thirteenth	A-31	North	12		Undisturbed

PROPOSED SEWERS

CODE	LOCATION			ITEM I-2 LIN. FT. CLASS A 12"	CLASS A 15"	CL. A U.P. 12"	CL. A U.P. 15"	CLASS B 12"	CLASS B 15"	CL. B U.P. 12"	CL. B U.P. 15"
	STREET	FROM	TO								
P-1	Fairfield Ave.	A-1	B-1							55	
P-2	Lane A	A-2	A-3							42	
P-3	Rt. of Lane A	A-3	A-4					65			
P-4	Lane A	A-4	A-5							19	
P-5	Lane A - Ramp W-1	A-5	B-4							65	
P-7	Lane B	A-7	A-8							46	
P-8	Lane B	A-8	A-9							51	
P-9	Left of Lane B	A-10	A-9	21							
P-10	Lane B - Ramp W-2	A-9	A-12								85
P-11	Right of Ramp W-2	A-11	A-12	29							
P-12	Ramp W-2	A-12	A-13								72
P-13	Ramp W-2 - Lane B	A-13	B-4								45
P-14	Ramp W-3	A-14	A-15			52					
P-15	Ramp W-3	A-15	A-16								37
P-16	Abbey Ave.	A-16	B-13								19
P-17	Rt. of Lane B	A-17	A-18					81			
P-18	Rt. of Lane B	A-18	A-19					44			
P-19	Rt. of Lane B	A-20	A-21	157							
P-20	Rt. of Lane B	A-21	A-19	26							
P-21	Lane B	A-19	A-23								54
P-22	Lt. of Lane B	A-22	A-23					96			
P-23	Lt. of Lane B	A-23	A-24						10		
P-24	Lt. of Lane A	A-25	A-26	14							
P-25	Lane A	A-26	A-27							102	
P-26	Lane A	A-28	A-27			37					
P-27	Lt. of Lane A	A-27	A-29						47		
P-28	Rt. of Abbey Ave.	A-29	A-30						88		
P-29	Abbey Ave.	A-30	A-31								58
P-30	Lt. of Abbey Ave.	A-31	B-14								112
P-31	West 13th Pl.	A-32	A-33							10	
P-32	West 14th St.	Pier 2A	B-14							33	
P-33	Abutment W-2		A-21					30			
P-34	Lt. of Lane A	HW-1	A-29					26			
P-35	Abbey Ave.	Pier 2A	A-29							90	
P-36	Lane B	I-W-2	A-18							50	

NOTES

1. Abbreviations:
   - Rt. - Right
   - Lt. - Left
   - U.P. - Under Pavement

   Directions are noted as: E, W, So. & No.

2. Call-Letters:
   Drainage structures and pipes are prefixed with the following call letters.
   - A - Proposed Structures
   - P - Proposed Pipe Sewers
   - B - Existing Structures
   - E - Existing Pipe Sewers

   For sewer profiles see Sheets 18 and 19.
   The direction of sewer flow is indicated by arrows.

3. Elevations:
   Elevations shown in the tables are normal grade or gutter elevations for the center-line of the structure at the curb face for 3, and 3A catch basins; normal ditch and center of structure for 2-2-A catch basins; top of cover at the center for manholes; normal grade at the intersection of the center-line of cover and at curb face for all 2-6 and 2-10 inlets.

4. Underdrain Connections:
   For details of Pipe Underdrain Outlet see Standard Construction Drawings I-1, 2, 3, 4 & 5

SCALE 1" = 50'
MADE SK DATE 1-19-56
TRCD. BMD DATE 2-15-56
CKD. HKM DATE 2-16-56

HOWARD, NEEDLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY, CLEVELAND, NEW YORK
914 SHEET 17

FED. ROAD DIV. NO.	STATE	FED. AID PROJ. NO.	TYPE FUNDS
2	OHIO		

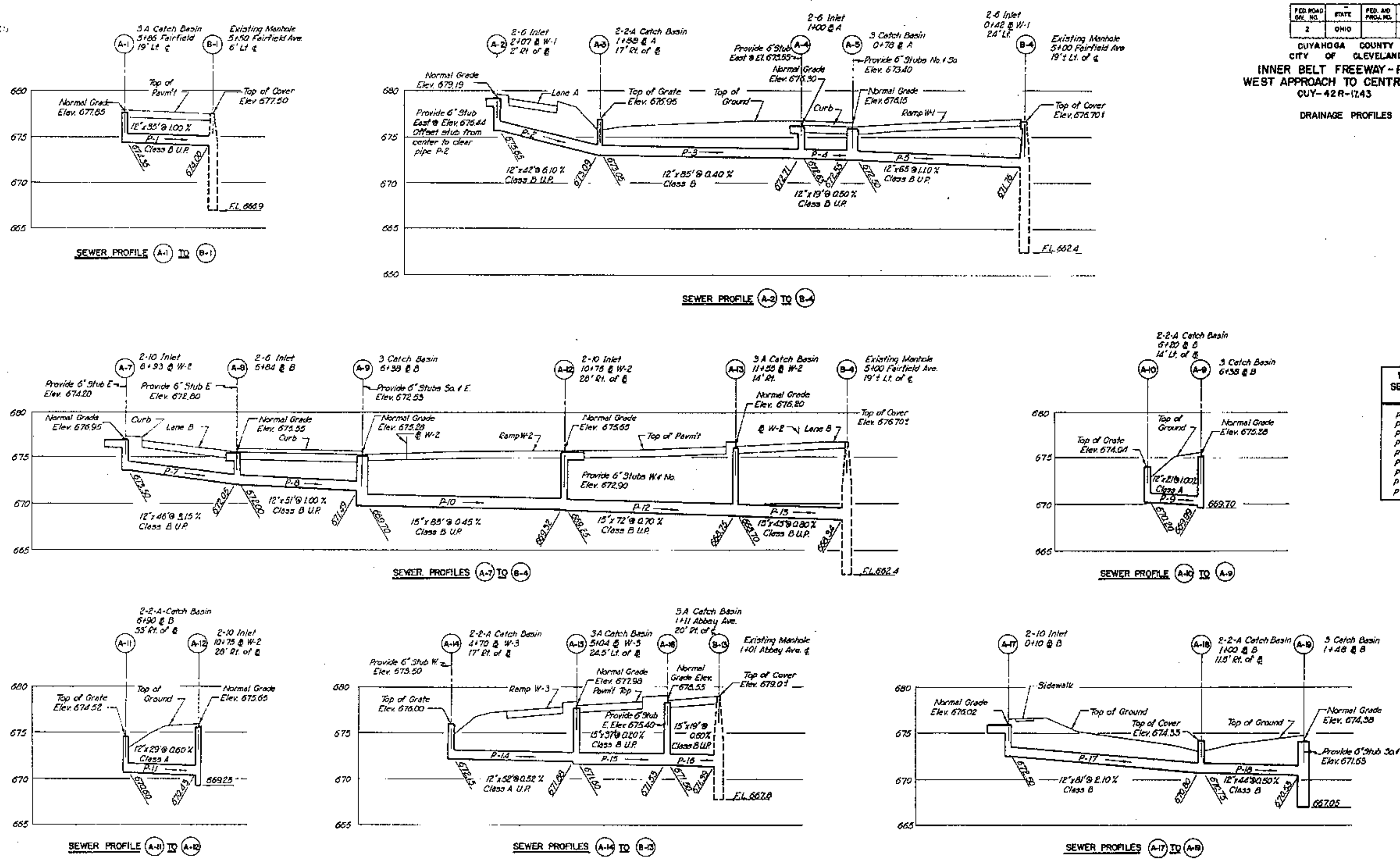
18
87

CUYAHOGA COUNTY
CITY OF CLEVELAND

INNER BELT FREEWAY - PART 4
WEST APPROACH TO CENTRAL VIADUCT

CUY-42 R-17.43

DRAINAGE PROFILES



LIST OF SEWER PROFILES On This Sheet	
P-1	P-10
P-2	P-11
P-3	P-12
P-4	P-13
P-5	P-14
P-6	P-15
P-7	P-16
P-8	P-17
P-9	P-18

Note:
Scales: Horz. 1"=20'
Vert. 1"=5'

SCALE See Note
MADE SV DATE 2-5-56
TRACED RMO DATE 2-8-56
CKD. HAM DATE 2-9-56

HOWARD, NEEDLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY CLEVELAND NEW YORK
914 SHEET 18

FED. ROAD DIV. NO.	STATE	FED. AID PROJ. NO.	TYPE FUNDS
3	OHIO		

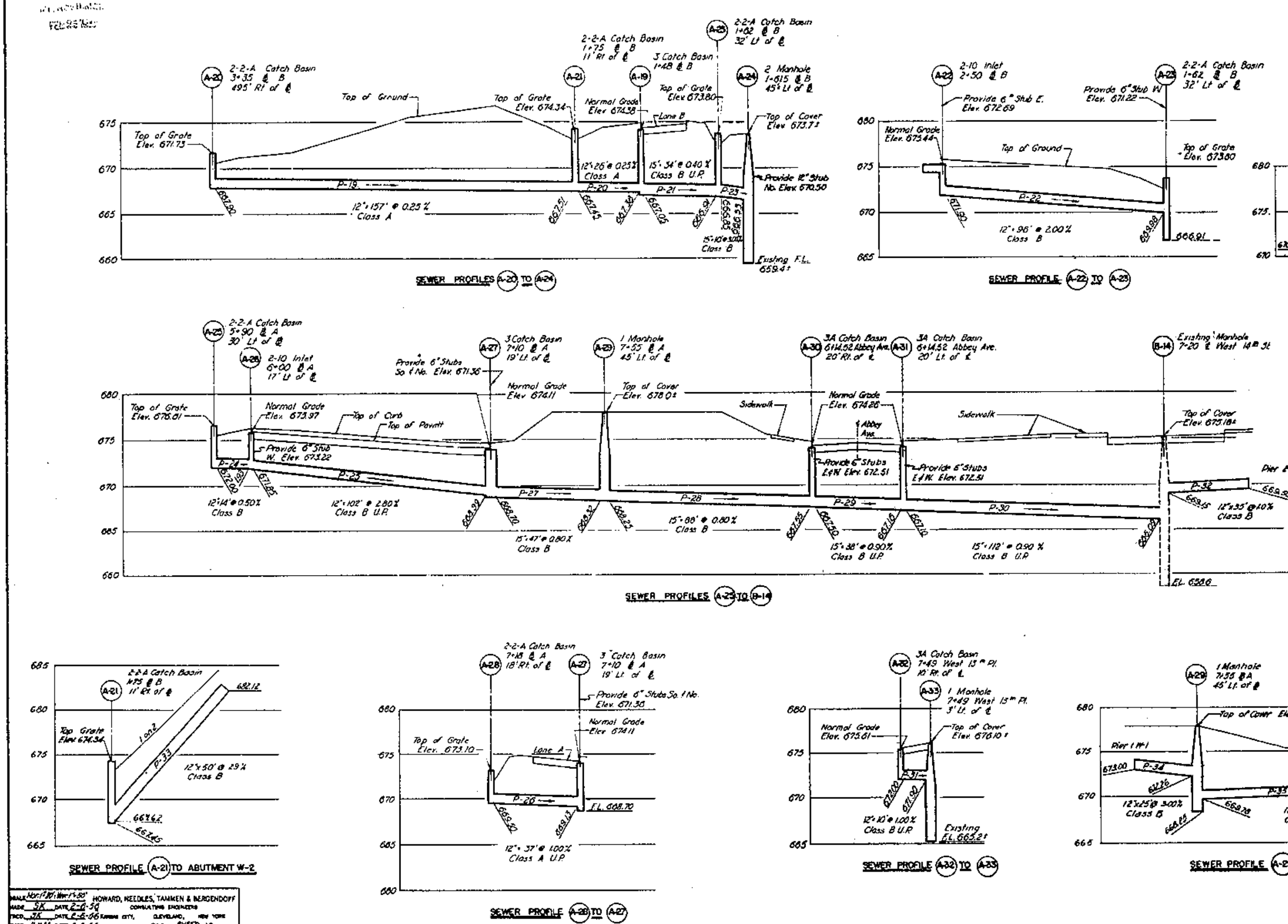
19 / 67

CUYAHOGA COUNTY
CITY OF CLEVELAND

INNER BELT FREEWAY - PART 4
WEST APPROACH TO CENTRAL VIADUCT

CUY-42 R-17.43

DRAINAGE PROFILES



LIST OF SEWER PROFILES ON THIS SHEET	
P-19	P-25
P-20	P-26
P-21	P-27
P-22	P-28
P-23	P-29
P-24	P-30
	P-31
	P-32
	P-33
	P-34
	P-35
	P-36

HOWARD, NEEDLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY, CLEVELAND, NEW YORK
MADE SK DATE 2-6-56
TRCD. SK DATE 2-6-56
CHKD. DATE 2-8-56
914 SHEET: 19

Appendix W

ODOT Letter to NEORSD Summarizing Stormwater Coordination Activities Associated With Potential Stormwater Runoff Discharge Removal from CSO Drainage areas.

OHIO DEPARTMENT OF TRANSPORTATION

DISTRICT 12, 5500 TRANSPORTATION BLVD., GARFIELD HEIGHTS, OHIO 44125

May 29, 2007

Mr. Frank Greenland, P.E.
Northeast Ohio Regional Sewer District
3900 Euclid Avenue
Cleveland, Ohio 44115

RE: CUY-Innerbelt Corridor, PID 77510; Storm Water Coordination

Dear Mr. Greenland:

Thank you for meeting with us on April 26, 2007. This meeting was extremely beneficial in furthering our understanding of the technical interaction between the existing combined sewer system and the proposed Cleveland Innerbelt project.

As noted in our November 20, 2006 letter, the Department is pursuing a storm water separation strategy for this project, as hydraulically appropriate. This strategy will include the installation of storm water quality best management practices (BMPs) along the corridor which:

- Will address water quality requirements on existing storm water only sewer systems within the corridor
- Will address water quality requirements on storm water only systems which may need to be designed and constructed as a result of separating highway runoff from discharging into the existing combined sewer system.

The following is a summary of NEORSD Combined Sewer Overflow (CSO) locations that receive highway storm water runoff within the Innerbelt corridor. As we advance in the design of this project, we will continue to work closely with your agency to identify any additional CSO's which may receive highway storm water. As noted at our meeting, the dates provided for your CSO Control Strategy are from the start of the program. Due to your on-going negotiations with the USEPA, the exact time frame of your program start is unknown. We thought this summary might be useful as you further develop your CSO control strategy and program. Additionally, ODOT will work with your office to provide existing highway plan information for areas which your GIS mapping is missing information.

Central Interchange Area – CSO 090, 093, and 094

CSO-090 (end of Superior Ave @ Cuyahoga River) – Regulators E-24 and E-27

- Current Predicted Overflow Frequency: From NEORSD website (5/01/07)-Estimated 34 overflows/year
- CSO Control Strategy – Pump System Upgrade
    - Time Frame – Proposed start 6 years after program start, estimate 3 years for design-construction-certification

CSO-093 (North of Municipal Stadium) – Regulator E-20A

- Current Predicted Overflow Frequency: From NEORSD website (5/01/07)-Estimated 66 overflows/year
- CSO Control Strategy – Addressed by Easterly Early Action Plan (EEAP)

CSO-094 (North of E12th at Lakeside (USS Cod) - Regulator E-18

- Current Predicted Overflow Frequency: From NEORSD website (5/01/07)-Estimated 35 overflows/year
- CSO Control Strategy – Shoreline Tunnel
  - Time Frame – Proposed start 10 years after program start, estimate 7 years for design-construction-certification

I-77 Approach to Central Interchange Area – CSO 040

CSO-040 (Kingsbury Run @ Cuyahoga River, Approx 100' North of Jefferson Rd) – Regulator S-04

- Current Predicted Overflow Frequency: From NEORSD website (5/01/07)-Estimated 79 overflows/year
- CSO Control Strategy – The Southerly District Combined Sewer Overflow, Phase II Facilities Plan, March 2002 (Metcalf and Eddy with CH2MHill), recommends removal of I-77 storm water. The report recommends connecting the storm-only I-77 system to the Kingsbury Run storm only culvert, downstream of regulator S04;
  - Time Frame – Proposed start 7 years after program start, estimate 3 years for design-construction-certification

Interstate storm water currently enters CSO-039 downstream of Regulator S-01A. The proposed Innerbelt project will not impact the proposed CSO Control Strategy for this CSO.

CSO 039 (At Cuyahoga River Turning Basin, 400' West of Independence Rd) – Regulator S-01A

- Current Predicted Overflow Frequency: From NEORSD website (3/27/07)-Estimated 51 overflows/year
- CSO Control Strategy – Southerly Tunnel
  - Time Frame – Proposed start 14 years after program start, estimate 22 years for design-construction-certification

Central Viaduct/Southern Innerbelt - CSO 080

CSO-080 (University Road, southeast of 2065 Scranton Road) – Regulator WR-27

- Current Predicted Overflow Frequency: From NEORSD website (3/27/07)-Estimated 43 overflows/year
- CSO Control Strategy – Westerly CSO Tunnel
  - Time Frame – Proposed start 25 years after program start, estimate 5 years for design-construction-certification

The above geographic regions of the Innerbelt (Central Interchange, I-77 approach, and the Central Viaduct/Southern Innerbelt) are currently funded for construction in State Fiscal Years 2010-2014. Because of this near term time frame, the removal of Innerbelt stormwater from these CSOs could have a positive impact on the regions existing combined sewer overflows in the next 4-8 years with respect to reductions in CSO volume/frequency.

<u>Innerbelt Trench & Curve - CSO 097</u>
As explained at our meeting, Regulator E-09 has been modified recently to reduce the combined sewer overflows to CSO-097. The current long term strategy for CSO-097 is to divert these CSOs to CSO-098 as part of the Shoreline Tunnel project. It is our understanding that this strategy will likely keep the E-09 CSO separate from the normal I-90 storm runoff. Additional coordination will be necessary between our organizations in the future depending on which project (Innerbelt Curve reconstruction or Shoreline Tunnel) gets constructed first. As noted, ODOT currently intends to continue the use of this existing outfall (CSO-097) for the reconstructed I-90 storm only sewer system.

<u>CSO-097 (North of I-71 and I-90) – Regulator E-09</u>
- Current Predicted Overflow Frequency: From NEORSD website (5/1/07)-Estimated 8 overflows/year
- CSO Control Strategy – Easterly Early Action Plan/Shoreline Tunnel
    - Time Frame – Easterly Early Action Plan – Completed; Shoreline Tunnel - Proposed start 10 years after program start, estimate 7 years for design-construction-certification

We look forward to continuing our cooperative relationship on these important regional infrastructure projects.

Respectfully,

David R. Lastovka, P.E.
Transportation Engineer

c: Lester Stumpe, NEORSD
Mark McCabe, URS
Bruce Mansfield, B&N
David Riley, ODOT Central Office - Hydraulics
Tim Hill, ODOT Central Office – Office of Environmental Services
Larry Hoffman, ODOT Central Office – Office of Environmental Services
Bill Cody, ODOT Central Office – Office of Environmental Services
Dale Schiavoni, ODOT D-12 Planning
John Motl, ODOT D-12 Planning
Mike Kubek, ODOT D-12 Production
Craig Hebebrand, ODOT D-12 Production
file (PID 77510)

Appendix X

***Northeast Ohio Regional Sewer District Westerly CSO Phase II Facilities Plan* – Collection System Model Development Final Report, February 2000, Figure 3-7a – Westerly District – East Recommended CSO Control Plan.**

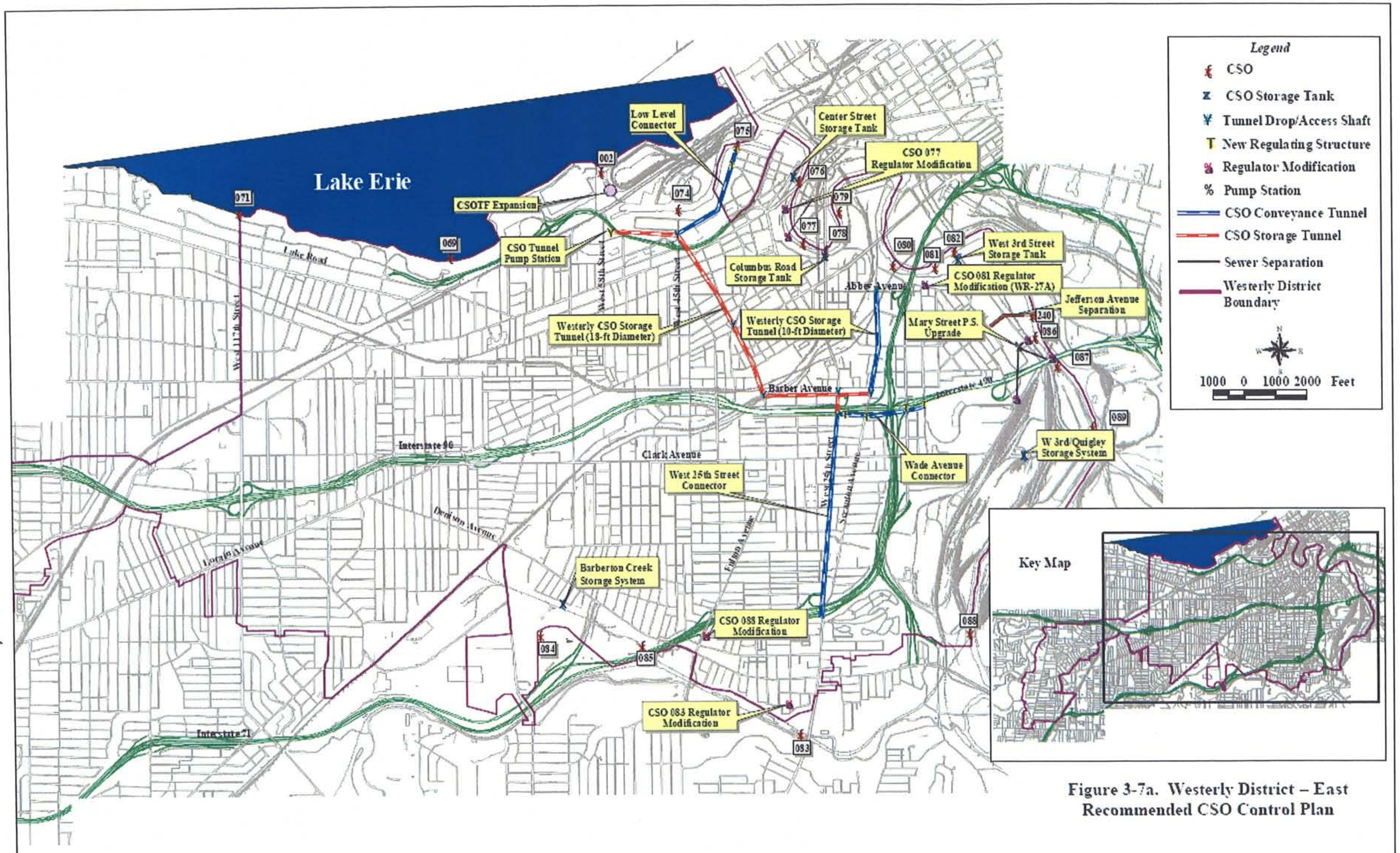
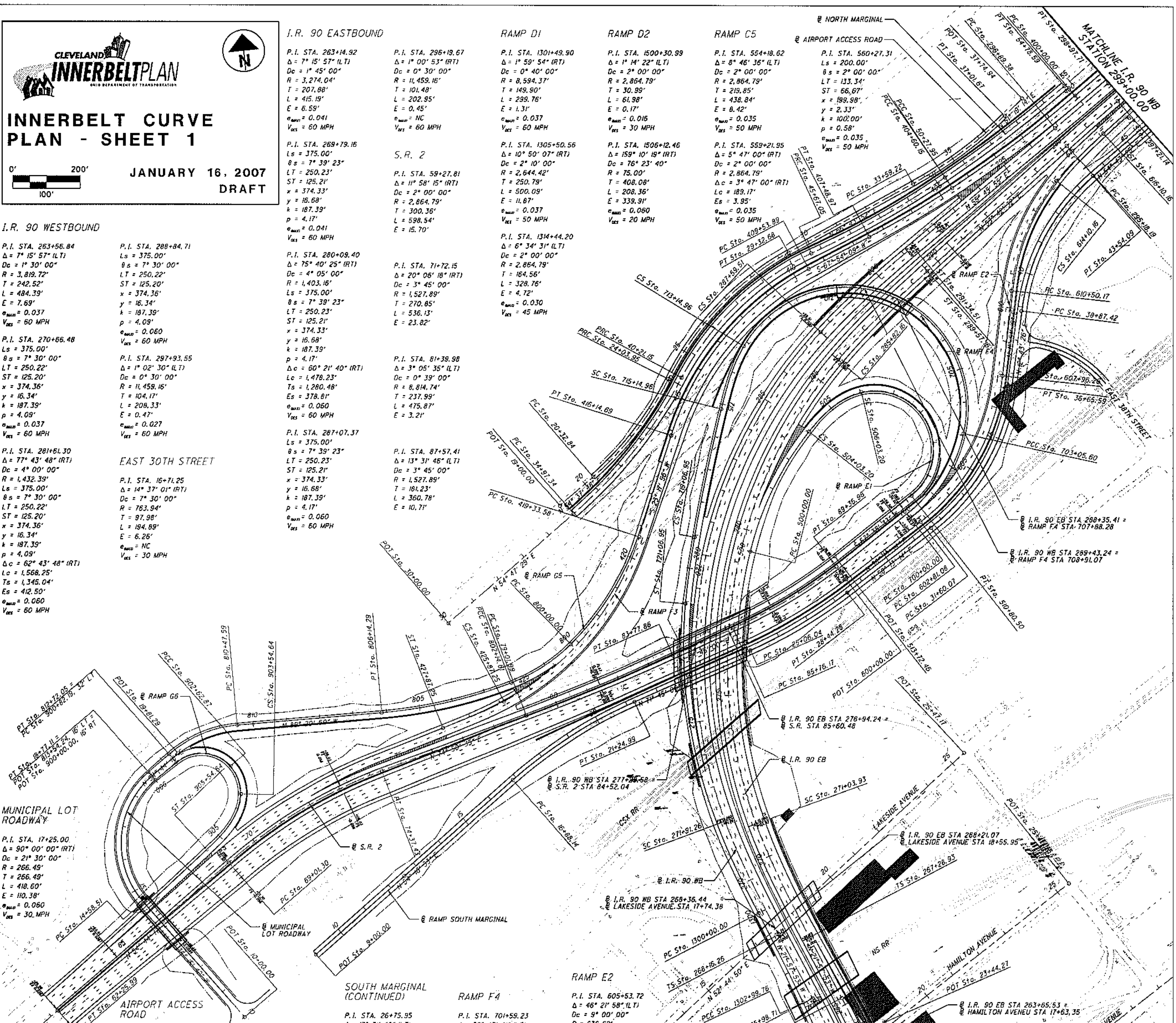


Figure 3-7a. Westerly District – East Recommended CSO Control Plan

Appendix Y

ODOT Step 6 Innerbelt Submittal Drawings (January 2007)



I.R. 90 WESTBOUND

P.I. STA. 263+56.84
Δ = 7° 15' 57" (LT)
Dc = 1° 30' 00"
R = 3,819.72'
T = 242.52'
L = 484.39'
E = 7.69'
e_{max} = 0.037
V_{des} = 60 MPH

P.I. STA. 270+66.48
Ls = 375.00'
θs = 7° 30' 00"
LT = 250.22'
ST = 125.20'
x = 374.36'
y = 16.34'
k = 187.39'
p = 4.09'
e_{max} = 0.037
V_{des} = 60 MPH

P.I. STA. 281+61.30
Δ = 77° 43' 48" (RT)
Dc = 4° 00' 00"
R = 1,432.39'
Ls = 375.00'
θs = 7° 30' 00"
LT = 250.22'
ST = 125.20'
x = 374.36'
y = 16.34'
k = 187.39'
p = 4.09'
Δc = 62° 43' 48" (RT)
Lc = 1,568.25'
Ts = 1,345.04'
Es = 412.50'
e_{max} = 0.060
V_{des} = 60 MPH

P.I. STA. 288+84.71
Ls = 375.00'
θs = 7° 30' 00"
LT = 250.22'
ST = 125.20'
x = 374.36'
y = 16.34'
k = 187.39'
p = 4.09'
e_{max} = 0.060
V_{des} = 60 MPH

P.I. STA. 297+93.55
Δ = 1° 02' 30" (LT)
Dc = 0° 30' 00"
R = 11,459.16'
T = 104.17'
L = 208.33'
E = 0.47'
e_{max} = 0.027
V_{des} = 60 MPH

EAST 30TH STREET

P.I. STA. 16+71.25
Δ = 14° 37' 01" (RT)
Dc = 7° 30' 00"
R = 763.94'
T = 97.98'
L = 194.89'
E = 6.26'
e_{max} = NC
V_{des} = 30 MPH

I.R. 90 EASTBOUND

P.I. STA. 263+14.92
Δ = 7° 15' 57" (LT)
Dc = 1° 45' 00"
R = 3,274.04'
T = 207.88'
L = 415.19'
E = 6.59'
e_{max} = 0.041
V_{des} = 60 MPH

P.I. STA. 269+79.16
Ls = 375.00'
θs = 7° 39' 23"
LT = 250.23'
ST = 125.21'
x = 374.33'
y = 16.68'
k = 187.39'
p = 4.17'
e_{max} = 0.041
V_{des} = 60 MPH

P.I. STA. 280+09.40
Δ = 75° 40' 25" (RT)
Dc = 4° 05' 00"
R = 1,403.16'
Ls = 375.00'
θs = 7° 39' 23"
LT = 250.23'
ST = 125.21'
x = 374.33'
y = 16.68'
k = 187.39'
p = 4.17'
Δc = 60° 21' 40" (RT)
Lc = 1,478.23'
Ts = 1,280.48'
Es = 378.81'
e_{max} = 0.060
V_{des} = 60 MPH

P.I. STA. 287+07.37
Ls = 375.00'
θs = 7° 39' 23"
LT = 250.23'
ST = 125.21'
x = 374.33'
y = 16.68'
k = 187.39'
p = 4.17'
e_{max} = 0.060
V_{des} = 60 MPH

P.I. STA. 296+19.67
Δ = 1° 00' 53" (RT)
Dc = 0° 30' 00"
R = 11,459.16'
T = 101.48'
L = 202.95'
E = 0.45'
e_{max} = NC
V_{des} = 60 MPH

S.R. 2

P.I. STA. 59+27.81
Δ = 11° 58' 15" (RT)
Dc = 2° 00' 00"
R = 2,864.79'
T = 300.36'
L = 598.54'
E = 15.70'

P.I. STA. 71+72.15
Δ = 20° 06' 18" (RT)
Dc = 3° 45' 00"
R = 1,527.89'
T = 270.65'
L = 536.13'
E = 23.82'

P.I. STA. 81+39.98
Δ = 3° 05' 35" (LT)
Dc = 0° 39' 00"
R = 8,814.74'
T = 237.99'
L = 475.87'
E = 3.21'

P.I. STA. 87+57.41
Δ = 13° 31' 45" (LT)
Dc = 3° 45' 00"
R = 1,527.89'
T = 181.23'
L = 360.78'
E = 10.71'

RAMP D1

P.I. STA. 1301+49.90
Δ = 1° 59' 54" (RT)
Dc = 0° 40' 00"
R = 8,594.37'
T = 149.90'
L = 299.76'
E = 1.31'
e_{max} = 0.037
V_{des} = 60 MPH

P.I. STA. 1305+50.56
Δ = 10° 50' 07" (RT)
Dc = 2° 10' 00"
R = 2,644.42'
T = 250.79'
L = 500.09'
E = 11.87'
e_{max} = 0.037
V_{des} = 50 MPH

P.I. STA. 1314+44.20
Δ = 6° 34' 31" (LT)
Dc = 2° 00' 00"
R = 2,864.79'
T = 164.56'
L = 328.76'
E = 4.72'
e_{max} = 0.030
V_{des} = 45 MPH

RAMP D2

P.I. STA. 1500+30.99
Δ = 1° 14' 22" (LT)
Dc = 2° 00' 00"
R = 2,864.79'
T = 30.99'
L = 61.98'
E = 0.17'
e_{max} = 0.016
V_{des} = 30 MPH

P.I. STA. 1506+12.46
Δ = 159° 10' 19" (RT)
Dc = 76° 23' 40"
R = 75.00'
T = 408.08'
L = 208.36'
E = 339.91'
e_{max} = 0.060
V_{des} = 20 MPH

RAMP C5

P.I. STA. 564+18.62
Δ = 8° 46' 36" (LT)
Dc = 2° 00' 00"
R = 2,864.79'
T = 219.85'
L = 438.84'
E = 8.42'
e_{max} = 0.035
V_{des} = 50 MPH

P.I. STA. 569+21.95
Δ = 5° 47' 00" (RT)
Dc = 2° 00' 00"
R = 2,864.79'
Δc = 3° 47' 00" (RT)
Lc = 189.17'
Es = 3.95'
e_{max} = 0.035
V_{des} = 50 MPH

AIRPORT ACCESS ROAD

P.I. STA. 560+27.31
Ls = 200.00'
θs = 2° 00' 00"
LT = 133.34'
ST = 66.67'
x = 199.98'
y = 2.33'
k = 100.00'
p = 0.58'
e_{max} = 0.035
V_{des} = 50 MPH

MUNICIPAL LOT ROADWAY

P.I. STA. 17+25.00
Δ = 90° 00' 00" (RT)
Dc = 21° 30' 00"
R = 266.49'
T = 266.49'
L = 418.60'
E = 110.38'
e_{max} = 0.060
V_{des} = 30 MPH

AIRPORT ACCESS ROAD

P.I. STA. 22+20.77
Δ = 22° 16' 00" (LT)
Dc = 6° 00' 00"
R = 954.93'
T = 187.93'
L = 371.11'
E = 18.32'
e_{max} = NC
V_{des} = 30 MPH

P.I. STA. 26+76.54
Δ = 34° 22' 03" (RT)
Dc = 6° 30' 00"
R = 881.47'
T = 272.59'
L = 528.73'
E = 41.19'
e_{max} = NC
V_{des} = 30 MPH

P.I. STA. 35+31.48
Δ = 15° 24' 38" (LT)
Dc = 4° 30' 00"
R = 1,273.24'
T = 172.27'
L = 342.45'
E = 11.60'
e_{max} = NC
V_{des} = 30 MPH

RAMP F3

P.I. STA. 402+30.35
Δ = 6° 54' 08" (RT)
Dc = 1° 30' 00"
R = 3,819.72'
T = 230.35'
L = 460.15'
E = 6.94'
e_{max} = 0.028
V_{des} = 50 MPH

P.I. STA. 406+04.68
Δ = 5° 46' 36" (RT)
Dc = 2° 00' 00"
R = 2,864.79'
T = 144.54'
L = 288.83'
E = 3.64'
e_{max} = 0.035
V_{des} = 50 MPH

P.I. STA. 413+02.05
Δ = 44° 36' 13" (LT)
Dc = 6° 45' 00"
R = 848.83'
T = 348.16'
L = 660.79'
E = 68.63'
e_{max} = 0.060
V_{des} = 50 MPH

P.I. STA. 423+39.82
Δ = 50° 52' 21" (RT)
Dc = 6° 45' 00"
R = 848.83'
Δc = 44° 07' 21" (RT)
Lc = 653.67'
Es = 92.20'
e_{max} = 0.060
V_{des} = 50 MPH

P.I. STA. 426+54.00
Ls = 200.00'
θs = 6° 45' 00"
LT = 133.43'
ST = 66.75'
x = 199.72'
y = 7.85'
k = 99.95'
p = 1.96'
e_{max} = 0.060
V_{des} = 50 MPH

RAMP E1

P.I. STA. 502+04.65
Δ = 24° 11' 30" (RT)
Dc = 6° 00' 00"
R = 954.93'
T = 204.65'
L = 403.20'
E = 21.68'
e_{max} = 0.030
V_{des} = 25 MPH

P.I. STA. 505+29.84
Ls = 200.00'
θs = 38° 30' 00"
LT = 126.65'
ST = 80.48'
x = 189.64'
y = 50.10'
k = 98.51'
p = 7.63'
e_{max} = 0.030
V_{des} = 25 MPH

P.I. STA. 508+41.85
Δ = 155° 07' 24" (RT)
Dc = 32° 30' 00"
R = 176.29'
T = 799.28'
L = 477.30'
E = 642.20'
e_{max} = 0.058
V_{des} = 25 MPH

NORTH MARGINAL

P.I. STA. 37+62.20
Δ = 20° 57' 09" (LT)
Dc = 4° 00' 00"
R = 1,432.39'
T = 264.87'
L = 523.81'
E = 24.28'
e_{max} = NC
V_{des} = 40 MPH

P.I. STA. 43+03.91
Δ = 36° 50' 54" (RT)
Dc = 6° 45' 00"
R = 848.83'
T = 282.76'
L = 545.90'
E = 45.86'
e_{max} = NC
V_{des} = 40 MPH

P.I. STA. 47+98.00
Δ = 9° 13' 05" (LT)
Dc = 2° 00' 00"
R = 2,864.79'
T = 230.95'
L = 460.90'
E = 9.29'
e_{max} = NC
V_{des} = 40 MPH

P.I. STA. 52+53.53
Δ = 6° 45' 35" (LT)
Dc = 1° 30' 00"
R = 3,819.72'
T = 225.58'
L = 450.64'
E = 6.66'
e_{max} = NC
V_{des} = 40 MPH

SOUTH MARGINAL

P.I. STA. 19+08.28
Δ = 17° 28' 27" (RT)
Dc = 4° 00' 00"
R = 1,432.39'
T = 220.14'
L = 436.85'
E = 16.82'
e_{max} = NC
V_{des} = 40 MPH

SOUTH MARGINAL (CONTINUED)

P.I. STA. 26+75.95
Δ = 13° 31' 46" (LT)
Dc = 4° 00' 00"
R = 1,432.39'
T = 169.91'
L = 338.23'
E = 10.04'
e_{max} = NC
V_{des} = 40 MPH

P.I. STA. 34+27.01
Δ = 45° 29' 48" (LT)
Dc = 9° 00' 00"
R = 636.62'
T = 266.93'
L = 505.52'
E = 53.70'
e_{max} = NC
V_{des} = 40 MPH

P.I. STA. 41+31.80
Δ = 41° 59' 59" (RT)
Dc = 9° 00' 00"
R = 636.62'
T = 244.37'
L = 466.66'
E = 45.29'
e_{max} = NC
V_{des} = 40 MPH

RAMP G5

P.I. STA. 801+06.95
Δ = 23° 37' 46" (RT)
Dc = 11° 00' 00"
R = 520.87'
T = 108.95'
L = 214.81'
E = 11.27'
e_{max} = 0.060
V_{des} = 30 MPH

P.I. STA. 804+15.85
Δ = 15° 58' 44" (RT)
Dc = 4° 00' 00"
R = 1,432.39'
T = 201.04'
L = 399.48'
E = 14.04'
e_{max} = 0.060
V_{des} = 30 MPH

P.I. STA. 811+63.64
Δ = 35° 54' 53" (LT)
Dc = 16° 00' 00"
R = 358.10'
T = 116.06'
L = 224.47'
E = 18.34'
e_{max} = 0.060
V_{des} = 30 MPH

RAMP F4

P.I. STA. 701+59.23
Δ = 39° 43' 41" (LT)
Dc = 13° 00' 00"
R = 440.74'
T = 159.23'
L = 305.60'
E = 27.86'
e_{max} = 0.058
V_{des} = 35 MPH

P.I. STA. 708+10.28
Δ = 161° 29' 49" (LT)
Dc = 16° 00' 00"
R = 358.10'
T = 2,198.45'
L = 1,009.36'
E = 1,869.33'
e_{max} = 0.060
V_{des} = 35 MPH

P.I. STA. 713+86.14
Ls = 200.00'
θs = 17° 00' 00"
LT = 130.07'
ST = 71.18'
x = 198.14'
y = 20.81'
k = 99.71'
p = 4.35'
e_{max} = 0.058
V_{des} = 35 MPH

P.I. STA. 717+11.03
Δ = 3° 55' 12" (LT)
Dc = 1° 00' 00"
R = 5,729.58'
T = 196.07'
L = 391.99'
E = 3.35'
e_{max} = 0.020
V_{des} = 50 MPH

P.I. STA. 720+26.74
Ls = 200.00'
θs = 4° 54' 04"
LT = 119.79'
ST = 60.32'
x = 199.82'
y = 6.86'
k = 99.98'
p = 0.84'
e_{max} = 0.020
V_{des} = 50 MPH

RAMP E2

P.I. STA. 605+53.72
Δ = 46° 21' 58" (LT)
Dc = 9° 00' 00"
R = 636.62'
T = 272.63'
L = 515.18'
E = 55.92'
e_{max} = 0.060
V_{des} = 45 MPH

P.I. STA. 612+94.88
Δ = 41° 23' 56" (RT)
Dc = 9° 00' 00"
R = 636.62'
Δc = 32° 23' 56" (RT)
Lc = 359.99'
Es = 45.34'
e_{max} = 0.060
V_{des} = 45 MPH

P.I. STA. 614+76.99
Ls = 200.00'
θs = 9° 00' 00"
LT = 133.51'
ST = 66.82'
x = 199.51'
y = 10.45'
k = 99.92'
p = 2.62'
e_{max} = 0.060
V_{des} = 45 MPH

RAMP G6

P.I. STA. 901+97.23
Δ = 90° 01' 06" (RT)
Dc = 49° 49' 21"
R = 115.00'
T = 115.04'
L = 180.68'
E = 47.65'
e_{max} = 0.060
V_{des} = 30 MPH

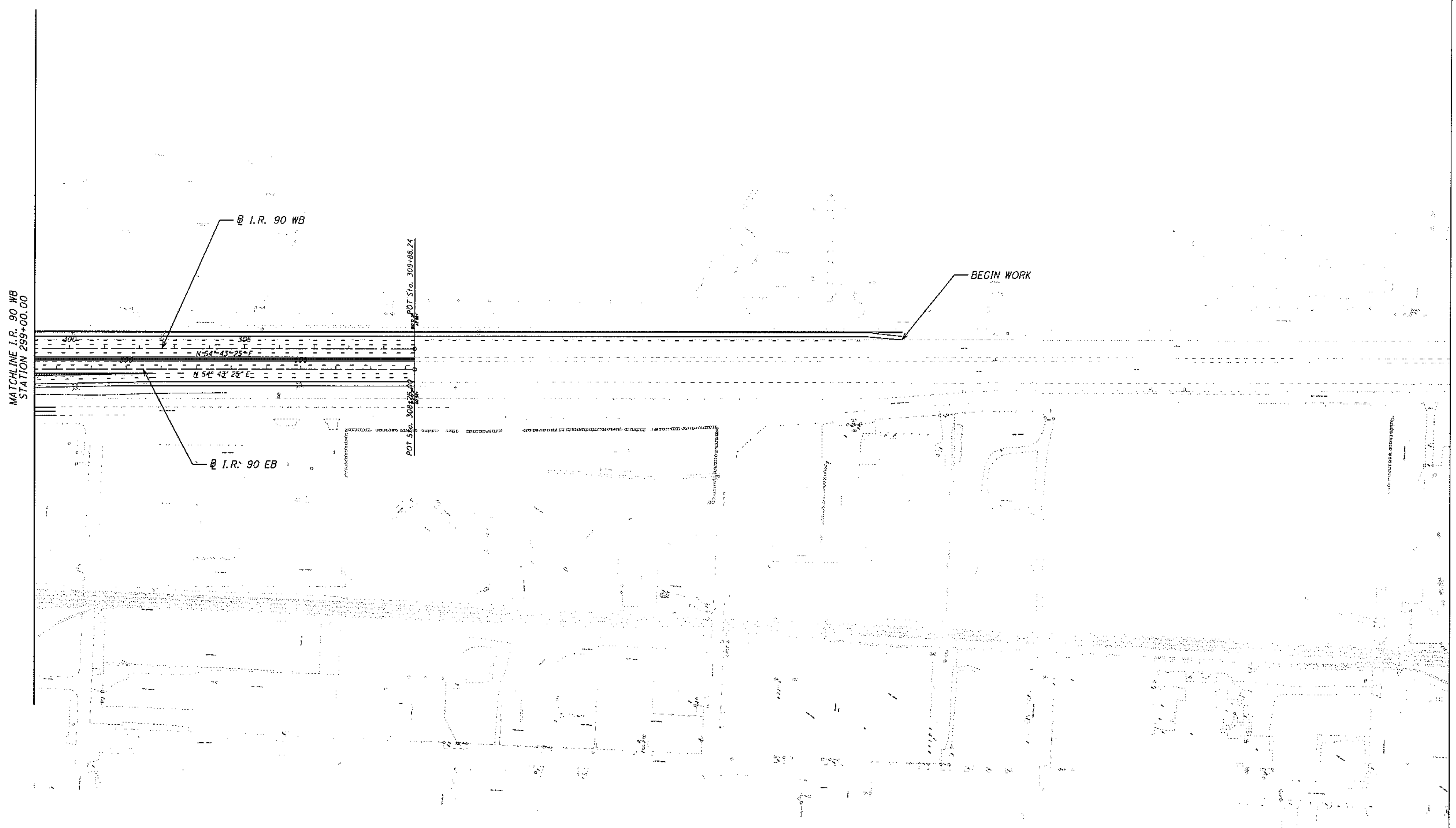
P.I. STA. 903+10.93
Δ = 42° 03' 54" (RT)
Dc = 45° 50' 12"
R = 125.00'
T = 48.06'
L = 91.77'
E = 8.92'
e_{max} = 0.060
V_{des} = 30 MPH

P.I. STA. 904+25.66
Ls = 200.00'
θs = 45° 50' 12"
LT = 138.10'
ST = 71.02'
x = 187.57'
y = 50.94'
k = 97.90'
p = 13.03'
e_{max} = 0.060
V_{des} = 30 MPH

INNERBELT CURVE PLAN

JANUARY 16, 2007
DRAFT

0' 100' 200'



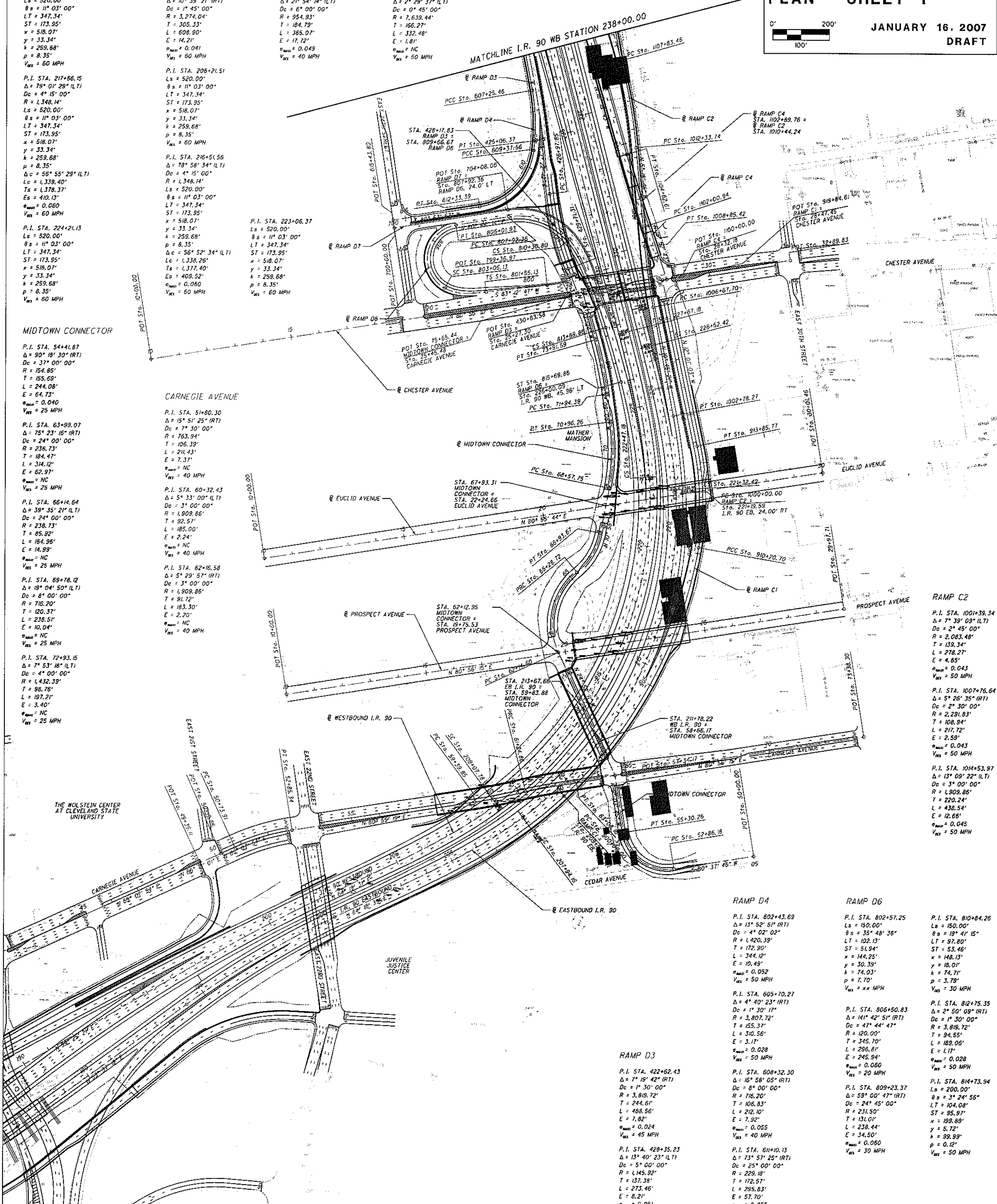
INNERBELT TRENCH PLAN - SHEET 1

CLEVELAND INNERBELTPLAN

JANUARY 16, 2007

DRAFT

0' 100' 200'



I.R. 90 WESTBOUND

P.I. STA. 199+92.47
Δ = 4° 54' 12" (RT)
Dc = 1° 00' 00"
R = 5,729.58'
T = 245.32'
L = 490.33'
E = 5.25'
e_{max} = 0.027
V_{des} = 60 MPH

P.I. STA. 207+35.12
Ls = 520.00'
θs = 11° 03' 00"
LT = 347.34'
ST = 173.95'
x = 518.07'
y = 33.34'
k = 259.68'
p = 8.35'
V_{des} = 60 MPH

P.I. STA. 217+66.15
Δ = 79° 01' 29" (LT)
Dc = 4° 15' 00"
R = 1,348.14'
Ls = 520.00'
θs = 11° 03' 00"
LT = 347.34'
ST = 173.95'
x = 518.07'
y = 33.34'
k = 259.68'
p = 8.35'
Δc = 56° 55' 29" (LT)
Lc = 1,339.40'
Ts = 1,378.37'
Es = 410.13'
e_{max} = 0.060
V_{des} = 60 MPH

P.I. STA. 224+21.13
Ls = 520.00'
θs = 11° 03' 00"
LT = 347.34'
ST = 173.95'
x = 518.07'
y = 33.34'
k = 259.68'
p = 8.35'
V_{des} = 60 MPH

I.R. 90 EASTBOUND

P.I. STA. 182+37.94
Δ = 13° 41' 43" (LT)
Dc = 1° 30' 10"
R = 3,812.72'
T = 457.86'
L = 911.35'
E = 27.39'
e_{max} = 0.037
V_{des} = 60 MPH

P.I. STA. 197+34.35
Δ = 10° 39' 21" (RT)
Dc = 1° 45' 00"
R = 3,274.04'
T = 305.33'
L = 608.90'
E = 14.21'
e_{max} = 0.041
V_{des} = 60 MPH

P.I. STA. 206+21.51
Ls = 520.00'
θs = 11° 03' 00"
LT = 347.34'
ST = 173.95'
x = 518.07'
y = 33.34'
k = 259.68'
p = 8.35'
V_{des} = 60 MPH

P.I. STA. 216+51.56
Δ = 78° 58' 34" (LT)
Dc = 4° 15' 00"
R = 1,348.14'
Ls = 520.00'
θs = 11° 03' 00"
LT = 347.34'
ST = 173.95'
x = 518.07'
y = 33.34'
k = 259.68'
p = 8.35'
Δc = 56° 52' 34" (LT)
Lc = 1,338.26'
Ts = 1,377.40'
Es = 409.52'
e_{max} = 0.060
V_{des} = 60 MPH

P.I. STA. 223+06.37
Ls = 520.00'
θs = 11° 03' 00"
LT = 347.34'
ST = 173.95'
x = 518.07'
y = 33.34'
k = 259.68'
p = 8.35'
V_{des} = 60 MPH

RAMP C1

P.I. STA. 905+28.42
Δ = 36° 34' 30" (LT)
Dc = 3° 35' 00"
R = 1,598.95'
T = 528.42'
L = 1,020.70'
E = 85.05'
e_{max} = 0.049
V_{des} = 50 MPH

P.I. STA. 912+05.49
Δ = 21° 54' 14" (LT)
Dc = 6° 00' 00"
R = 954.93'
T = 184.79'
L = 365.07'
E = 17.72'
e_{max} = 0.049
V_{des} = 40 MPH

RAMP C4

P.I. STA. 1103+31.80
Δ = 2° 37' 00" (RT)
Dc = 1° 00' 00"
R = 5,729.58'
T = 130.86'
L = 261.66'
E = 1.49'
e_{max} = 0.017
V_{des} = 45 MPH

P.I. STA. 1109+49.72
Δ = 2° 29' 37" (LT)
Dc = 0° 45' 00"
R = 7,639.44'
T = 166.27'
L = 332.48'
E = 1.81'
e_{max} = NC
V_{des} = 50 MPH

MIDTOWN CONNECTOR

P.I. STA. 54+41.67
Δ = 90° 18' 30" (RT)
Dc = 37° 00' 00"
R = 154.85'
T = 155.69'
L = 244.08'
E = 64.73'
e_{max} = 0.040
V_{des} = 25 MPH

P.I. STA. 63+99.07
Δ = 75° 23' 16" (RT)
Dc = 24° 00' 00"
R = 238.73'
T = 184.47'
L = 314.12'
E = 62.97'
e_{max} = NC
V_{des} = 25 MPH

P.I. STA. 66+14.64
Δ = 39° 35' 21" (LT)
Dc = 24° 00' 00"
R = 238.73'
T = 85.92'
L = 164.96'
E = 14.99'
e_{max} = NC
V_{des} = 25 MPH

P.I. STA. 69+78.12
Δ = 19° 04' 50" (LT)
Dc = 8° 00' 00"
R = 716.20'
T = 120.37'
L = 238.51'
E = 10.04'
e_{max} = NC
V_{des} = 25 MPH

P.I. STA. 72+93.15
Δ = 7° 53' 18" (LT)
Dc = 4° 00' 00"
R = 1,432.39'
T = 98.76'
L = 197.21'
E = 3.40'
e_{max} = NC
V_{des} = 25 MPH

CARNEGIE AVENUE

P.I. STA. 51+80.30
Δ = 15° 51' 25" (RT)
Dc = 7° 30' 00"
R = 763.94'
T = 106.39'
L = 211.43'
E = 7.37'
e_{max} = NC
V_{des} = 40 MPH

P.I. STA. 60+32.43
Δ = 5° 33' 00" (LT)
Dc = 3° 00' 00"
R = 1,909.86'
T = 92.57'
L = 185.00'
E = 2.24'
e_{max} = NC
V_{des} = 40 MPH

P.I. STA. 62+16.58
Δ = 5° 29' 57" (RT)
Dc = 3° 00' 00"
R = 1,909.86'
T = 91.72'
L = 183.30'
E = 2.20'
e_{max} = NC
V_{des} = 40 MPH

RAMP C2

P.I. STA. 1001+39.34
Δ = 7° 39' 09" (LT)
Dc = 2° 45' 00"
R = 2,083.48'
T = 139.34'
L = 278.27'
E = 4.65'
e_{max} = 0.043
V_{des} = 50 MPH

P.I. STA. 1007+76.64
Δ = 5° 26' 35" (RT)
Dc = 2° 30' 00"
R = 2,291.83'
T = 108.94'
L = 217.72'
E = 2.59'
e_{max} = 0.043
V_{des} = 50 MPH

P.I. STA. 1014+53.97
Δ = 13° 09' 22" (LT)
Dc = 3° 00' 00"
R = 1,909.86'
T = 220.24'
L = 438.54'
E = 12.66'
e_{max} = 0.045
V_{des} = 50 MPH

RAMP D4

P.I. STA. 602+43.69
Δ = 13° 52' 51" (RT)
Dc = 4° 02' 02"
R = 1,420.39'
T = 172.90'
L = 344.12'
E = 10.49'
e_{max} = 0.052
V_{des} = 50 MPH

P.I. STA. 605+70.27
Δ = 4° 40' 23" (RT)
Dc = 1° 30' 17"
R = 3,807.72'
T = 155.37'
L = 310.56'
E = 3.17'
e_{max} = 0.028
V_{des} = 50 MPH

P.I. STA. 608+32.30
Δ = 16° 58' 05" (RT)
Dc = 8° 00' 00"
R = 716.20'
T = 106.83'
L = 212.10'
E = 7.92'
e_{max} = 0.055
V_{des} = 40 MPH

P.I. STA. 611+10.13
Δ = 73° 57' 25" (RT)
Dc = 25° 00' 00"
R = 229.18'
T = 172.57'
L = 295.83'
E = 57.70'
e_{max} = 0.055
V_{des} = 25 MPH

RAMP D6

P.I. STA. 802+57.25
Ls = 150.00'
θs = 35° 48' 36"
LT = 102.13'
ST = 51.94'
x = 144.25'
y = 30.35'
k = 74.03'
p = 7.70'
V_{des} = xx MPH

P.I. STA. 806+50.83
Δ = 141° 42' 51" (RT)
Dc = 47° 44' 47"
R = 120.00'
T = 345.70'
L = 296.81'
E = 245.94'
e_{max} = 0.060
V_{des} = 20 MPH

P.I. STA. 809+23.37
Δ = 59° 00' 47" (RT)
Dc = 24° 45' 00"
R = 231.50'
T = 131.01'
L = 238.44'
E = 34.50'
e_{max} = 0.060
V_{des} = 30 MPH

P.I. STA. 810+84.26
Ls = 150.00'
θs = 19° 41' 15"
LT = 97.80'
ST = 53.46'
x = 148.13'
y = 18.01'
k = 74.71'
p = 3.79'
V_{des} = 30 MPH

P.I. STA. 812+75.35
Δ = 2° 50' 09" (RT)
Dc = 1° 30' 00"
R = 3,819.72'
T = 94.55'
L = 189.06'
E = 1.17'
e_{max} = 0.028
V_{des} = 50 MPH

P.I. STA. 814+73.94
Ls = 200.00'
θs = 3° 24' 56"
LT = 104.08'
ST = 95.97'
x = 199.89'
y = 5.72'
k = 99.99'
p = 0.12'
V_{des} = 50 MPH

RAMP D3

P.I. STA. 422+62.43
Δ = 7° 19' 42" (RT)
Dc = 1° 30' 00"
R = 3,819.72'
T = 244.61'
L = 488.56'
E = 7.82'
e_{max} = 0.024
V_{des} = 45 MPH

P.I. STA. 428+35.23
Δ = 13° 40' 23" (LT)
Dc = 5° 00' 00"
R = 1,145.92'
T = 137.38'
L = 273.46'
E = 8.21'
e_{max} = 0.051
V_{des} = 45 MPH

CLEVELAND INNERBELTPLAN

INNERBELT TRENCH PLAN - SHEET 2

0' 100' 200'

JANUARY 16, 2007

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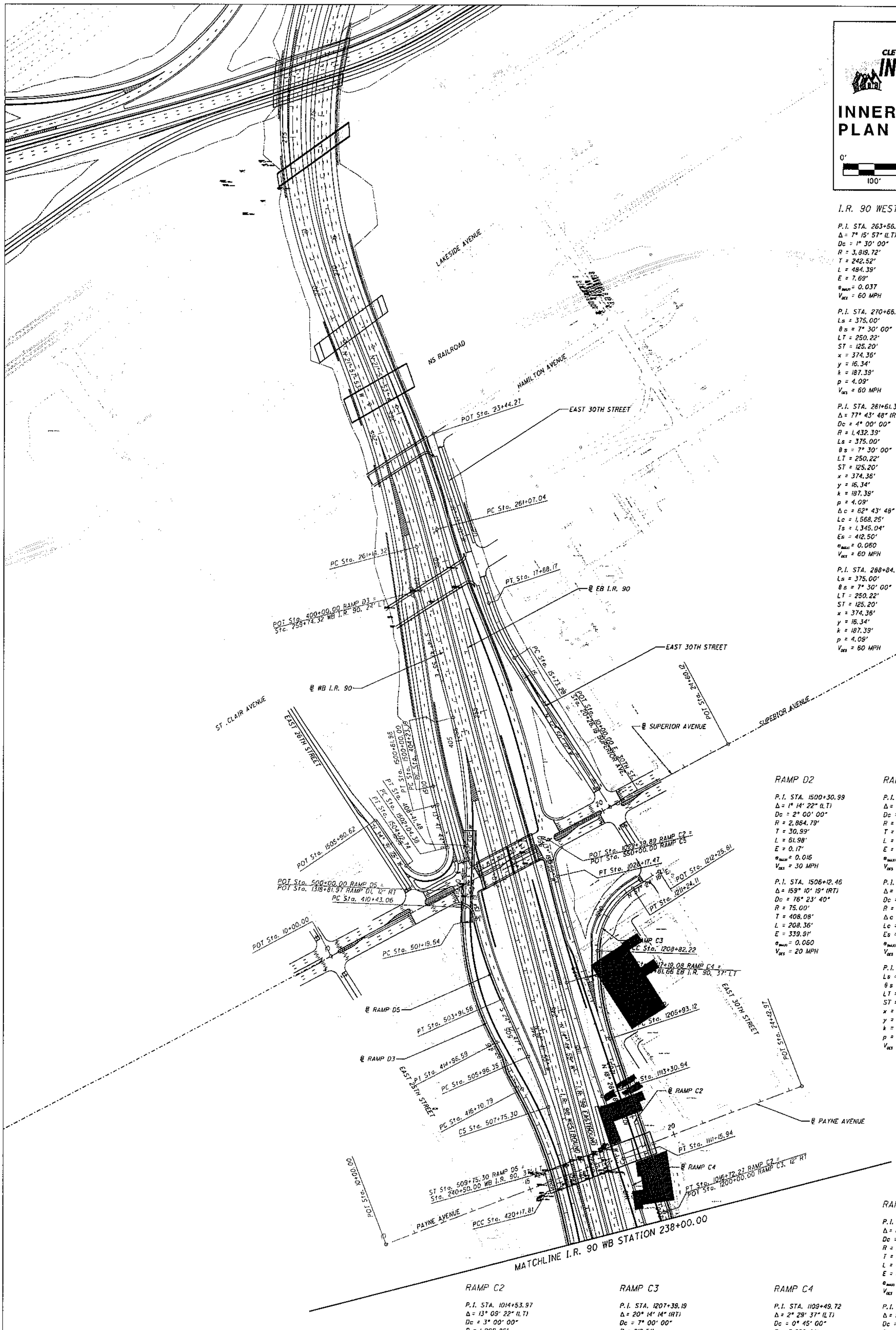

I.R. 90 WESTBOUND

P.I. STA. 263+56.84
Δ = 7° 15' 57" (LT)
Dc = 1° 30' 00"
R = 3,819.72'
T = 242.52'
L = 484.39'
E = 7.69'
e_{max} = 0.037
V_{des} = 60 MPH

P.I. STA. 270+66.48
Ls = 375.00'
θs = 7° 30' 00"
LT = 250.22'
ST = 125.20'
x = 374.36'
y = 16.34'
k = 187.39'
p = 4.09'
V_{des} = 60 MPH

P.I. STA. 281+61.30
Δ = 77° 43' 48" (RT)
Dc = 4° 00' 00"
R = 1,432.39'
Ls = 375.00'
θs = 7° 30' 00"
LT = 250.22'
ST = 125.20'
x = 374.36'
y = 16.34'
k = 187.39'
p = 4.09'
Δc = 62° 43' 48" (RT)
Lc = 1,568.25'
Ts = 1,345.04'
Es = 412.50'
e_{max} = 0.060
V_{des} = 60 MPH

P.I. STA. 288+84.71
Ls = 375.00'
θs = 7° 30' 00"
LT = 250.22'
ST = 125.20'
x = 374.36'
y = 16.34'
k = 187.39'
p = 4.09'
V_{des} = 60 MPH

I.R. 90 EASTBOUND

P.I. STA. 263+14.92
Δ = 7° 15' 57" (LT)
Dc = 1° 45' 00"
R = 3,274.04'
T = 207.88'
L = 415.19'
E = 6.59'
e_{max} = 0.041
V_{des} = 60 MPH

P.I. STA. 269+79.16
Ls = 375.00'
θs = 7° 39' 23"
LT = 250.23'
ST = 125.21'
x = 374.33'
y = 16.68'
k = 187.39'
p = 4.17'
V_{des} = 60 MPH

P.I. STA. 280+09.40
Δ = 75° 40' 25" (RT)
Dc = 4° 05' 00"
R = 1,403.16'
Ls = 375.00'
θs = 7° 39' 23"
LT = 250.23'
ST = 125.21'
x = 374.33'
y = 16.68'
k = 187.39'
p = 4.17'
Δc = 60° 21' 40" (RT)
Lc = 1,478.23'
Ts = 1,280.48'
Es = 378.81'
e_{max} = 0.060
V_{des} = 60 MPH

P.I. STA. 287+07.37
Ls = 375.00'
θs = 7° 39' 23"
LT = 250.23'
ST = 125.21'
x = 374.33'
y = 16.68'
k = 187.39'
p = 4.17'
V_{des} = 60 MPH

RAMP D2

P.I. STA. 1500+30.99
Δ = 1° 14' 22" (LT)
Dc = 2° 00' 00"
R = 2,864.79'
T = 30.99'
L = 61.98'
E = 0.17'
e_{max} = 0.016
V_{des} = 30 MPH

P.I. STA. 1506+12.46
Δ = 159° 10' 19" (RT)
Dc = 76° 23' 40"
R = 75.00'
T = 408.08'
L = 208.36'
E = 339.91'
e_{max} = 0.060
V_{des} = 20 MPH

RAMP D5

P.I. STA. 502+55.96
Δ = 10° 52' 51" (LT)
Dc = 4° 00' 00"
R = 1,432.39'
T = 136.42'
L = 272.02'
E = 6.48'
e_{max} = 0.028
V_{des} = 30 MPH

P.I. STA. 507+42.07
Δ = 8° 22' 07" (RT)
Dc = 3° 00' 00"
R = 1,909.86'
Δc = 5° 22' 07" (RT)
Lc = 178.95'
Es = 5.55'
e_{max} = 0.039
V_{des} = 45 MPH

P.I. STA. 508+41.99
Ls = 200.00'
θs = 3° 00' 00"
LT = 133.35'
ST = 66.68'
x = 199.95'
y = 3.49'
k = 99.99'
p = 0.87'
V_{des} = 45 MPH

RAMP D3

P.I. STA. 406+33.83
Δ = 16° 43' 55" (RT)
Dc = 4° 00' 00"
R = 1,432.39'
T = 210.65'
L = 418.30'
E = 15.41'
e_{max} = 0.052
V_{des} = 50 MPH

P.I. STA. 412+75.38
Δ = 30° 36' 46" (LT)
Dc = 6° 45' 00"
R = 848.83'
T = 232.31'
L = 453.52'
E = 31.22'
e_{max} = 0.060
V_{des} = 50 MPH

P.I. STA. 418+45.16
Δ = 13° 52' 51" (RT)
Dc = 4° 00' 00"
R = 1,432.39'
T = 174.37'
L = 347.02'
E = 10.57'
e_{max} = 0.046
V_{des} = 45 MPH

P.I. STA. 422+62.43
Δ = 7° 19' 42" (RT)
Dc = 1° 30' 00"
R = 3,819.72'
T = 244.61'
L = 488.56'
E = 7.82'
e_{max} = 0.024
V_{des} = 45 MPH

EAST 30TH STREET

P.I. STA. 16+71.25
Δ = 14° 37' 01" (RT)
Dc = 7° 30' 00"
R = 763.94'
T = 97.98'
L = 194.89'
E = 6.26'
e_{max} = NC
V_{des} = 30 MPH

RAMP C2

P.I. STA. 1014+53.97
Δ = 13° 09' 22" (LT)
Dc = 3° 00' 00"
R = 1,909.86'
T = 220.24'
L = 438.54'
E = 12.66'
e_{max} = 0.045
V_{des} = 50 MPH

P.I. STA. 1026+46.36
Δ = 5° 08' 13" (RT)
Dc = 1° 30' 00"
R = 3,819.72'
T = 171.34'
L = 342.46'
E = 3.84'
e_{max} = 0.020
V_{des} = 40 MPH

RAMP C3

P.I. STA. 1207+39.19
Δ = 20° 14' 14" (RT)
Dc = 7° 00' 00"
R = 818.51'
T = 146.07'
L = 289.10'
E = 12.93'
e_{max} = 0.053
V_{des} = 40 MPH

P.I. STA. 1210+13.66
Δ = 55° 38' 11" (RT)
Dc = 23° 00' 00"
R = 249.11'
T = 131.44'
L = 241.90'
E = 32.55'
e_{max} = 0.060
V_{des} = 30 MPH

RAMP C4

P.I. STA. 1109+49.72
Δ = 2° 29' 37" (LT)
Dc = 0° 45' 00"
R = 7,639.44'
T = 166.27'
L = 332.48'
E = 1.81'
e_{max} = NC
V_{des} = 45 MPH

P.I. STA. 1115+25.05
Δ = 2° 54' 40" (RT)
Dc = 0° 45' 00"
R = 7,639.44'
T = 194.11'
L = 388.14'
E = 2.47'
e_{max} = NC
V_{des} = 50 MPH

RAMP C5

P.I. STA. 554+18.62
Δ = 8° 46' 36" (LT)
Dc = 2° 00' 00"
R = 2,864.79'
T = 219.85'
L = 438.84'
E = 8.42'
e_{max} = 0.035
V_{des} = 50 MPH

P.I. STA. 559+21.95
Δ = 5° 47' 00" (RT)
Dc = 2° 00' 00"
R = 2,864.79'
Δc = 3° 47' 00" (RT)
Lc = 189.17'
Es = 3.95'
e_{max} = 0.035
V_{des} = 50 MPH

P.I. STA. 560+27.31
Ls = 200.00'
θs = 2° 00' 00"
LT = 133.34'
ST = 66.67'
x = 199.98'
y = 2.33'
k = 100.00'
p = 0.58'
V_{des} = 50 MPH

RAMP D1

P.I. STA. 1301+49.90
Δ = 1° 59' 54" (RT)
Dc = 0° 40' 00"
R = 8,594.37'
T = 149.90'
L = 299.76'
E = 1.31'
e_{max} = 0.037
V_{des} = 60 MPH

P.I. STA. 1305+50.56
Δ = 10° 50' 07" (RT)
Dc = 2° 10' 00"
R = 2,644.42'
T = 250.79'
L = 500.09'
E = 11.87'
e_{max} = 0.037
V_{des} = 50 MPH

P.I. STA. 1314+44.20
Δ = 6° 34' 31" (LT)
Dc = 2° 00' 00"
R = 2,864.79'
T = 164.56'
L = 328.76'
E = 4.72'
e_{max} = 0.030
V_{des} = 45 MPH

WESTBOUND CENTRAL INTERCHANGE PLAN - SHEET 1

CLEVELAND INNERBELTPLAN
OHIO DEPARTMENT OF TRANSPORTATION

0' 100' 200'

JANUARY 16, 2007
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RAMP A6

P.I. STA. 802+84.13
Ls = 200.00'
θ_s = 31° 00' 00"
LT = 135.44'
ST = 68.58'
x = 194.22'
y = 35.32'
k = 99.03'
p = 8.92'
e_{MAX} = 0.058
V_{DES} = 25 MPH

P.I. STA. 803+26.75
Δ = 249° 55' 29" (LT)
Dc = 31° 00' 00"
R = 184.83'
Ls = 200.00'
θ_s = 31° 00' 00"
LT = 135.44'
ST = 68.58'
x = 194.22'
y = 35.32'
k = 99.03'
p = 8.92'
Δc = 187° 55' 29" (LT)
Lc = 606.21'
Ts = 178.06'
Es = 24.42'
e_{MAX} = 0.058
V_{DES} = 25 MPH

P.I. STA. 810+23.49
Ls = 200.00'
θ_s = 31° 00' 00"
LT = 135.44'
ST = 68.58'
x = 194.22'
y = 35.32'
k = 99.03'
p = 8.92'
e_{MAX} = 0.058
V_{DES} = 25 MPH

P.I. STA. 816+15.13
Δ = 2° 49' 03" (LT)
Dc = 1° 30' 00"
R = 3,819.72'
T = 93.94'
L = 187.83'
E = 1.15'
e_{MAX} = 0.028
V_{DES} = 50 MPH

RAMP A7

P.I. STA. 1001+01.85
Δ = 3° 03' 17" (RT)
Dc = 1° 30' 00"
R = 3,819.72'
T = 101.85'
L = 203.66'
E = 1.36'
e_{MAX} = 0.028
V_{DES} = 50 MPH

P.I. STA. 1005+92.11
Δ = 7° 07' 43" (LT)
Dc = 2° 00' 00"
R = 2,864.79'
T = 178.45'
L = 356.44'
E = 5.55'
e_{MAX} = 0.035
V_{DES} = 50 MPH

P.I. STA. 1009+68.38
Δ = 1° 11' 31" (RT)
Dc = 0° 18' 02"
R = 19,063.98'
T = 198.29'
L = 396.56'
E = 1.03'
e_{MAX} = 0.016
V_{DES} = 45 MPH

P.I. STA. 1015+01.79
Δ = 9° 06' 08" (RT)
Dc = 5° 12' 18"
R = 1,100.80'
T = 87.62'
L = 174.88'
E = 3.48'
e_{MAX} = 0.040
V_{DES} = 35 MPH

P.I. STA. 1016+56.94
Δ = 13° 02' 22" (RT)
Dc = 9° 38' 40"
R = 594.08'
T = 67.89'
L = 135.20'
E = 3.87'
e_{MAX} = 0.045
V_{DES} = 30 MPH

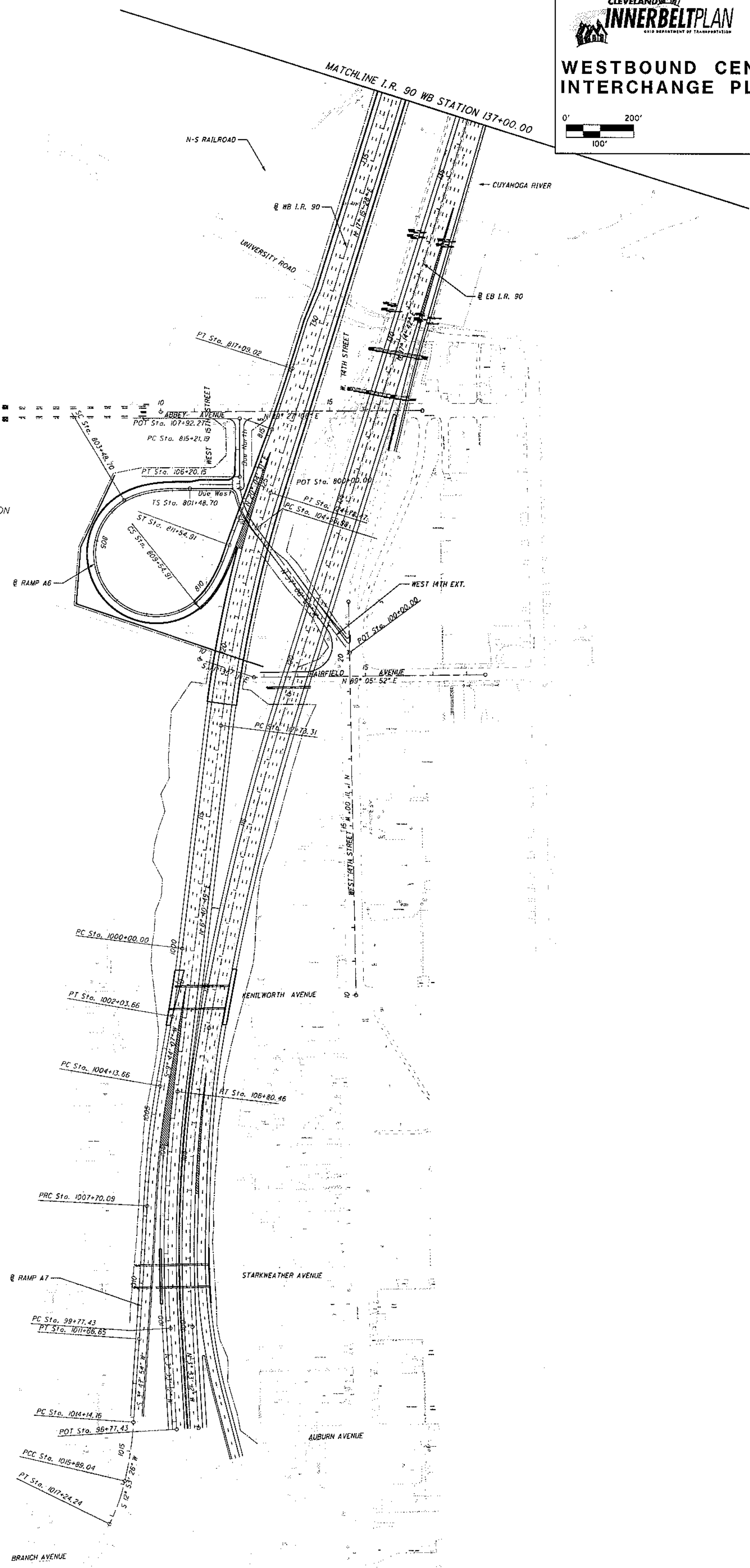
I.R. 90 WESTBOUND

P.I. STA. 103+29.88
Δ = 10° 14' 02" (RT)
Dc = 1° 27' 20"
R = 3,936.03'
T = 352.45'
L = 703.03'
E = 15.75'
e_{MAX} = 0.037
V_{DES} = 60 MPH

P.I. STA. 121+26.89
Δ = 10° 34' 39" (RT)
Dc = 1° 30' 00"
R = 3,819.72'
T = 353.58'
L = 705.16'
E = 16.33'
e_{MAX} = 0.037
V_{DES} = 60 MPH

W14TH EXTENSION

P.I. STA. 105+41.54
Δ = 37° 06' 00" (RT)
Dc = 22° 44' 11"
R = 252.00'
T = 84.56'
L = 163.17'
E = 13.81'
e_{MAX} = 0.016
V_{DES} = 25 MPH



CLEVELAND INNERBELTPLAN

WESTBOUND CENTRAL INTERCHANGE PLAN - SHEET 2

0' 100' 200'

JANUARY 16, 2007

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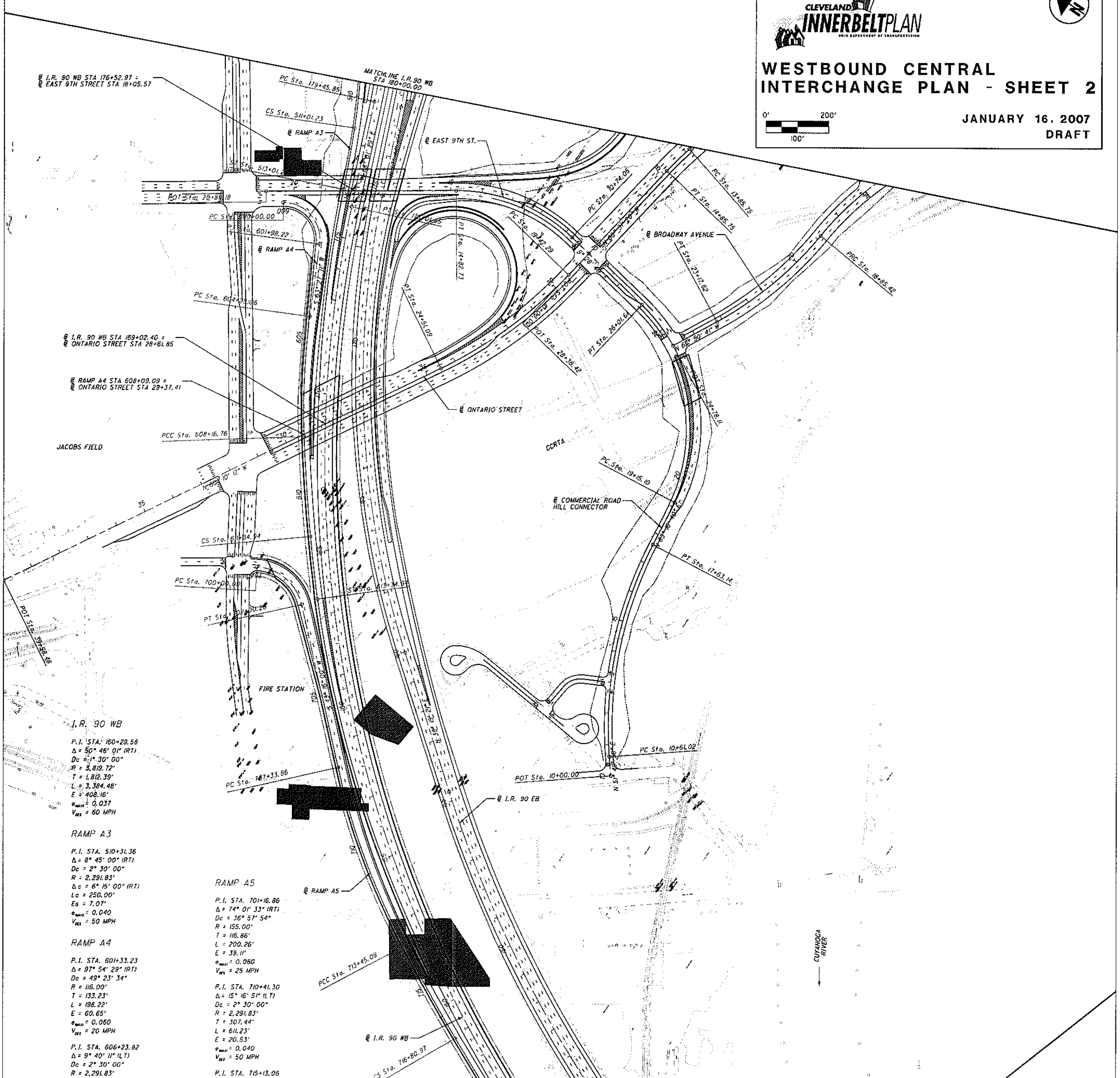

I.R. 90 WB

P.I. STA. 160+29.58
Δ = 50° 46' 01" (RT)
Dc = 1° 30' 00"
R = 3,819.72'
T = 1,812.39'
L = 3,384.48'
E = 408.16'
e_{max} = 0.037
V_{des} = 60 MPH

RAMP A3

P.I. STA. 510+31.36
Δ = 8° 45' 00" (RT)
Dc = 2° 30' 00"
R = 2,291.83'
Δc = 6° 15' 00" (RT)
Lc = 250.00'
Es = 7.07'
e_{max} = 0.040
V_{des} = 50 MPH

RAMP A4

P.I. STA. 601+33.23
Δ = 97° 54' 29" (RT)
Dc = 49° 23' 34"
R = 116.00'
T = 133.23'
L = 198.22'
E = 60.65'
e_{max} = 0.060
V_{des} = 20 MPH

P.I. STA. 606+23.82
Δ = 9° 40' 11" (LT)
Dc = 2° 30' 00"
R = 2,291.83'
T = 193.86'
L = 386.79'
E = 8.18'
e_{max} = 0.040
V_{des} = 50 MPH

P.I. STA. 609+75.89
Δ = 3° 10' 55" (LT)
Dc = 1° 00' 00"
R = 5,729.58'
T = 159.13'
L = 318.19'
E = 2.21'
e_{max} = 0.020
V_{des} = 50 MPH

ONTARIO STREET

P.I. STA. 14+35.79
Δ = 5° 00' 00" (LT)
Dc = 5° 00' 00"
R = 1,145.92'
T = 50.03'
L = 100.00'
E = 1.09'
e_{max} = NC
V_{des} = 30 MPH

P.I. STA. 21+99.39
Δ = 20° 21' 07" (RT)
Dc = 4° 00' 00"
R = 1,432.39'
T = 257.11'
L = 508.80'
E = 22.89'
e_{max} = NC
V_{des} = 30 MPH

RAMP A5

P.I. STA. 701+16.86
Δ = 74° 01' 33" (RT)
Dc = 36° 57' 54"
R = 155.00'
T = 116.86'
L = 200.26'
E = 39.11'
e_{max} = 0.060
V_{des} = 25 MPH

P.I. STA. 710+41.30
Δ = 15° 16' 51" (LT)
Dc = 2° 30' 00"
R = 2,291.83'
T = 307.44'
L = 611.23'
E = 20.53'
e_{max} = 0.040
V_{des} = 50 MPH

P.I. STA. 715+13.06
Δ = 2° 31' 09" (LT)
Dc = 0° 45' 00"
R = 7,639.44'
T = 167.97'
L = 335.88'
E = 1.85'
e_{max} = NC
V_{des} = 45 MPH

BROADWAY AVENUE

P.I. STA. 12+29.03
Δ = 2° 52' 47" (LT)
Dc = 2° 00' 00"
R = 2,864.79'
T = 72.01'
L = 143.98'
E = 0.90'
e_{max} = NC
V_{des} = 30 MPH

P.I. STA. 17+02.01
Δ = 22° 17' 40" (LT)
Dc = 6° 00' 00"
R = 954.93'
T = 188.17'
L = 371.58'
E = 18.36'
e_{max} = NC
V_{des} = 30 MPH

P.I. STA. 21+04.12
Δ = 21° 36' 37" (RT)
Dc = 5° 00' 00"
R = 1,145.92'
T = 218.70'
L = 432.21'
E = 20.68'
e_{max} = NC
V_{des} = 30 MPH

COMMERCIAL ROAD HILL CONNECTOR

P.I. STA. 14+21.25
Δ = 31° 35' 42" (RT)
Dc = 4° 30' 00"
R = 1,273.24'
T = 360.23'
L = 702.11'
E = 49.98'
e_{max} = NC
V_{des} = 25 MPH

P.I. STA. 23+15.28
Δ = 73° 48' 00" (LT)
Dc = 10° 45' 00"
R = 532.98'
T = 400.18'
L = 686.51'
E = 133.51'
e_{max} = NC
V_{des} = 25 MPH

EAST 9TH ST.

P.I. STA. 12+89.03
Δ = 43° 55' 58" (LT)
Dc = 10° 45' 00"
R = 532.98'
T = 214.98'
L = 408.68'
E = 41.72'
e_{max} = NC
V_{des} = 30 MPH

CLEVELAND INNERBELTPLAN

WESTBOUND CENTRAL INTERCHANGE PLAN - SHEET 3

0' 100' 200'

JANUARY 16, 2007

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I.R. 90 WB

P.I. STA. 183+38.73
Δ = 15° 37' 04" (LT)
Dc = 2° 00' 00"
R = 2,864.79'
T = 392.88'
L = 780.89'
E = 26.81'
e_{max} = 0.045
V_{des} = 60 MPH

P.I. STA. 196+43.69
Δ = 11° 55' 09" (RT)
Dc = 1° 00' 00"
R = 5,729.58'
T = 598.11'
L = 1,191.91'
E = 31.13'
e_{max} = 0.027
V_{des} = 60 MPH

P.I. STA. 207+35.12
Ls = 520.00'
θs = 11° 03' 00"
LT = 347.34'
ST = 173.95'
x = 518.07'
y = 33.34'
k = 259.68'
p = 8.35'
e_{max} = 0.027
V_{des} = 60 MPH

RAMP A2

P.I. STA. 403+96.44
Δ = 2° 38' 33" (LT)
Dc = 0° 20' 00"
R = 17,188.73'
T = 396.44'
L = 792.75'
E = 4.57'
e_{max} = NC
V_{des} = 50 MPH

P.I. STA. 421+19.73
Δ = 89° 35' 47" (LT)
Dc = 8° 30' 00"
R = 674.07'
T = 669.34'
L = 1,054.08'
E = 275.87'
e_{max} = 0.060
V_{des} = 45 MPH

P.I. STA. 430+61.40
Δ = 47° 15' 00" (LT)
Dc = 4° 30' 00"
R = 1,273.24'
T = 556.93'
L = 1,050.00'
E = 116.47'
e_{max} = 0.049
V_{des} = 45 MPH

RAMP A3

P.I. STA. 502+18.94
Δ = 89° 37' 36" (RT)
Dc = 26° 00' 00"
R = 220.37'
T = 218.94'
L = 344.72'
E = 90.27'
e_{max} = 0.056
V_{des} = 25 MPH

P.I. STA. 510+31.36
Δ = 8° 45' 00" (RT)
Dc = 2° 30' 00"
R = 2,291.83'
Δc = 6° 15' 00" (RT)
Lc = 250.00'
Es = 7.07'
e_{max} = 0.035
V_{des} = 45 MPH

P.I. STA. 511+67.91
Ls = 200.00'
θs = 2° 30' 00"
LT = 133.35'
ST = 66.68'
x = 199.96'
y = 2.91'
k = 99.99'
p = 0.73'
e_{max} = 0.035
V_{des} = 45 MPH

RAMP A1

P.I. STA. 301+93.40
Δ = 70° 30' 41" (RT)
Dc = 39° 30' 52"
R = 145.00'
T = 102.50'
L = 178.45'
E = 32.57'
e_{max} = 0.060
V_{des} = 25 MPH

EAST 18TH STREET

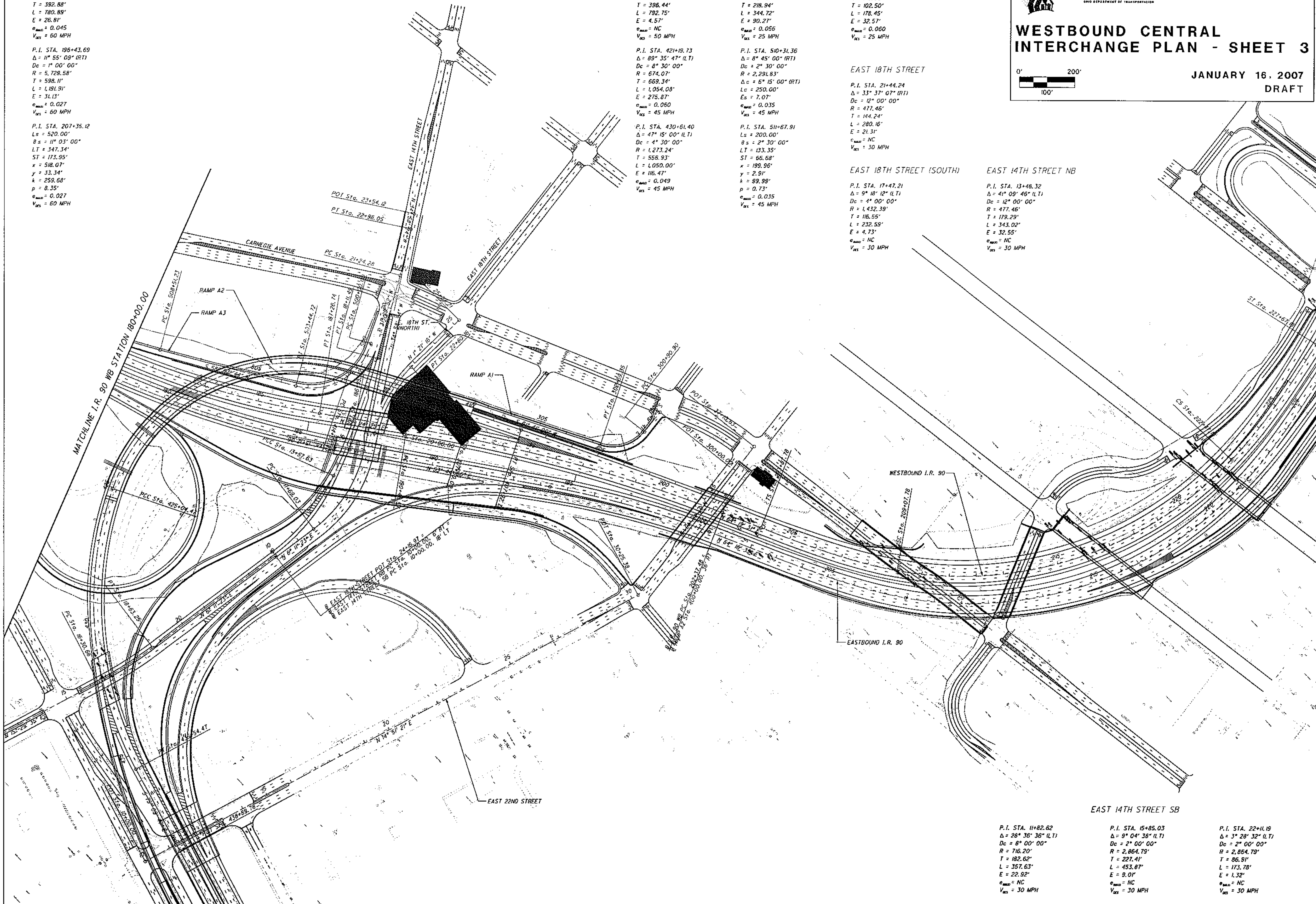
P.I. STA. 21+44.24
Δ = 33° 37' 07" (RT)
Dc = 12° 00' 00"
R = 477.46'
T = 144.24'
L = 280.16'
E = 21.31'
e_{max} = NC
V_{des} = 30 MPH

EAST 18TH STREET (SOUTH)

P.I. STA. 17+47.21
Δ = 9° 18' 12" (LT)
Dc = 4° 00' 00"
R = 1,432.39'
T = 116.55'
L = 232.59'
E = 4.73'
e_{max} = NC
V_{des} = 30 MPH

EAST 14TH STREET NB

P.I. STA. 13+46.32
Δ = 41° 09' 46" (LT)
Dc = 12° 00' 00"
R = 477.46'
T = 179.29'
L = 343.02'
E = 32.55'
e_{max} = NC
V_{des} = 30 MPH

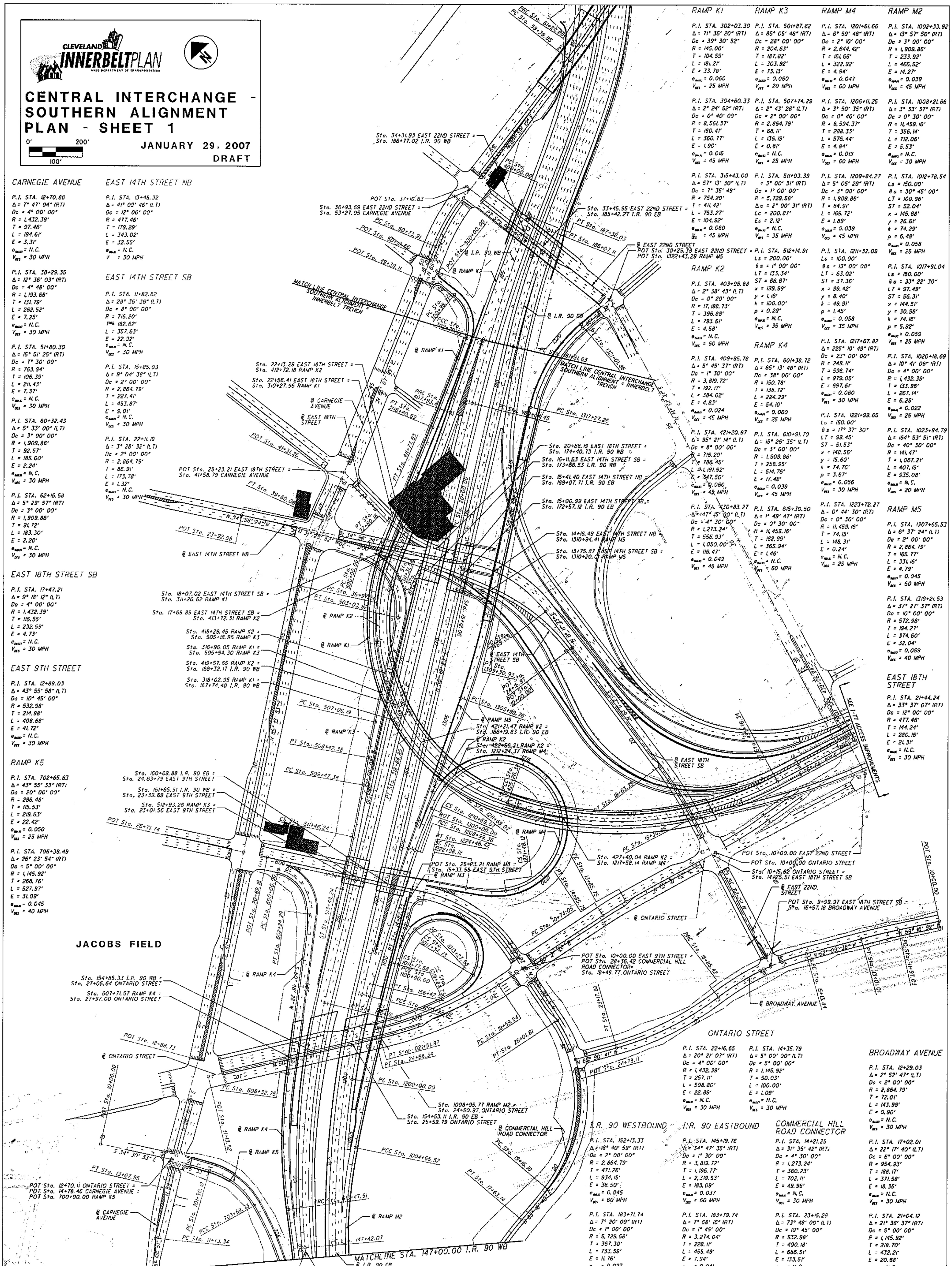


EAST 14TH STREET SB

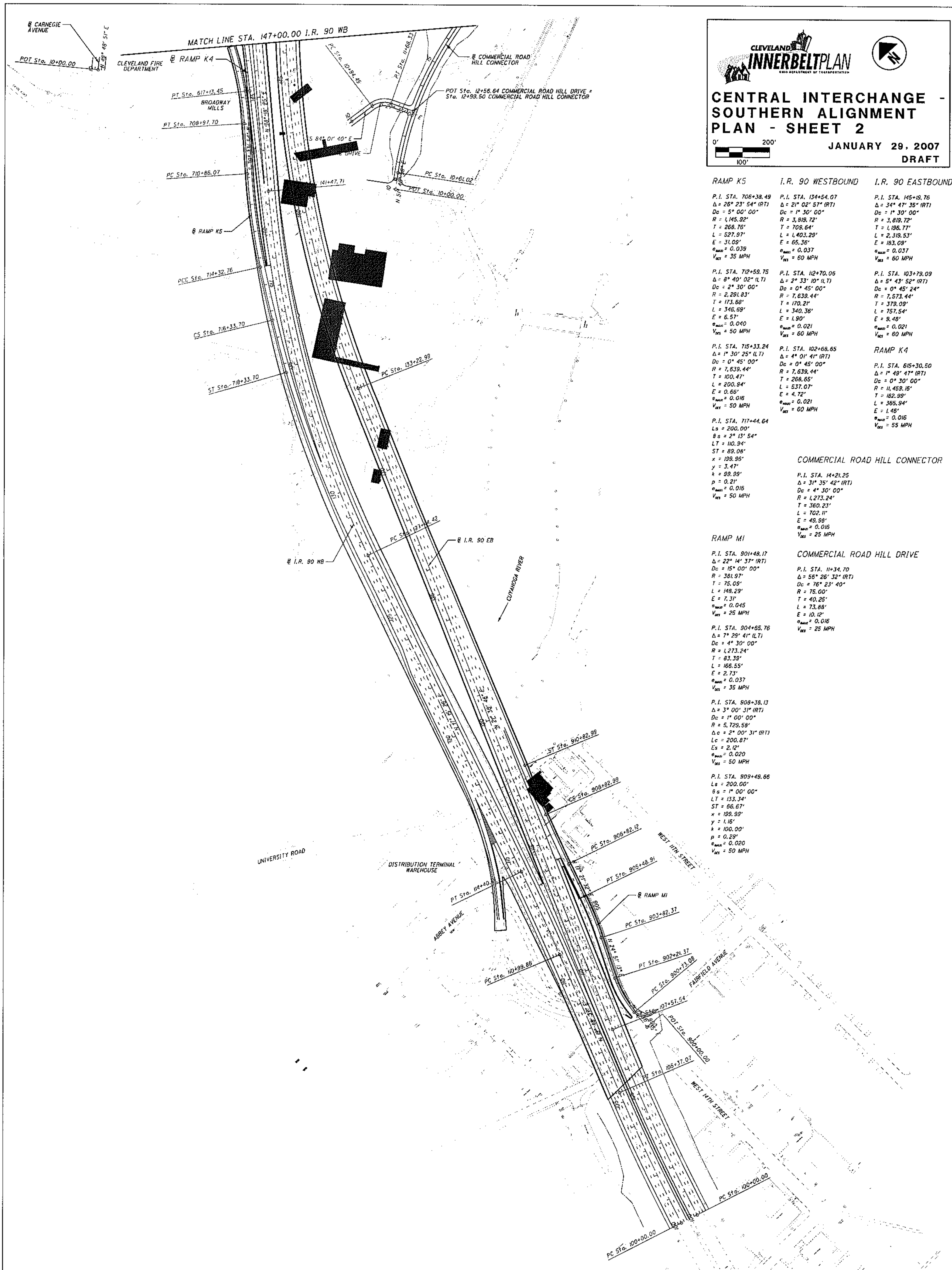
P.I. STA. 11+82.62
Δ = 28° 36' 36" (LT)
Dc = 8° 00' 00"
R = 716.20'
T = 182.62'
L = 357.63'
E = 22.92'
e_{max} = NC
V_{des} = 30 MPH

P.I. STA. 15+85.03
Δ = 9° 04' 38" (LT)
Dc = 2° 00' 00"
R = 2,864.79'
T = 227.41'
L = 453.87'
E = 9.01'
e_{max} = NC
V_{des} = 30 MPH

P.I. STA. 22+11.19
Δ = 3° 28' 32" (LT)
Dc = 2° 00' 00"
R = 2,864.79'
T = 86.91'
L = 173.78'
E = 1.32'
e_{max} = NC
V_{des} = 30 MPH



CLEVELAND INNERBELTPLAN
CENTRAL INTERCHANGE - SOUTHERN ALIGNMENT
PLAN - SHEET 1
0' 100' 200'
JANUARY 29, 2007
DRAFT
CARNEGIE AVENUE
EAST 14TH STREET NB
EAST 14TH STREET SB
EAST 18TH STREET SB
EAST 9TH STREET
RAMP K5
RAMP K1
RAMP K3
RAMP M4
RAMP M2
RAMP K2
RAMP K4
RAMP M5
EAST 18TH STREET
SEE I-77 ACCESS IMPROVEMENTS
JACOBS FIELD
ONTARIO STREET
BROADWAY AVENUE
I.R. 90 WESTBOUND
I.R. 90 EASTBOUND
COMMERCIAL HILL ROAD CONNECTOR
MATCHLINE STA. 147+00.00 I.R. 90 WB
MATCH LINE CENTRAL INTERCHANGE SOUTHERN ALIGNMENT = INNERBELT TRENCH



CLEVELAND INNERBELTPLAN
OHIO DEPARTMENT OF TRANSPORTATION

CENTRAL INTERCHANGE - SOUTHERN ALIGNMENT PLAN - SHEET 2

0' 100' 200'

JANUARY 29, 2007

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RAMP K5

P.I. STA. 706+38.49
Δ = 26° 23' 54" (RT)
Dc = 5° 00' 00"
R = 1,145.92'
T = 268.76'
L = 527.97'
E = 31.09'
e_{max} = 0.039
V_{des} = 35 MPH

P.I. STA. 712+59.75
Δ = 8° 40' 02" (LT)
Dc = 2° 30' 00"
R = 2,291.83'
T = 173.68'
L = 346.69'
E = 6.57'
e_{max} = 0.040
V_{des} = 50 MPH

P.I. STA. 715+33.24
Δ = 1° 30' 25" (LT)
Dc = 0° 45' 00"
R = 7,639.44'
T = 100.47'
L = 200.94'
E = 0.66'
e_{max} = 0.016
V_{des} = 50 MPH

P.I. STA. 717+44.64
Ls = 200.00'
θs = 2° 13' 54"
LT = 110.94'
ST = 89.08'
x = 199.96'
y = 3.47'
k = 99.99'
p = 0.21'
e_{max} = 0.016
V_{des} = 50 MPH

I.R. 90 WESTBOUND

P.I. STA. 134+54.07
Δ = 21° 02' 57" (RT)
Dc = 1° 30' 00"
R = 3,819.72'
T = 709.64'
L = 1,403.29'
E = 65.36'
e_{max} = 0.037
V_{des} = 60 MPH

P.I. STA. 112+70.06
Δ = 2° 33' 10" (LT)
Dc = 0° 45' 00"
R = 7,639.44'
T = 170.21'
L = 340.36'
E = 1.90'
e_{max} = 0.021
V_{des} = 60 MPH

P.I. STA. 102+68.65
Δ = 4° 01' 41" (RT)
Dc = 0° 45' 00"
R = 7,639.44'
T = 268.65'
L = 537.07'
E = 4.72'
e_{max} = 0.021
V_{des} = 60 MPH

I.R. 90 EASTBOUND

P.I. STA. 145+19.76
Δ = 34° 47' 35" (RT)
Dc = 1° 30' 00"
R = 3,819.72'
T = 1,196.77'
L = 2,319.53'
E = 183.09'
e_{max} = 0.037
V_{des} = 60 MPH

P.I. STA. 103+79.09
Δ = 5° 43' 52" (RT)
Dc = 0° 45' 24"
R = 7,573.44'
T = 379.09'
L = 757.54'
E = 9.48'
e_{max} = 0.021
V_{des} = 60 MPH

RAMP K4

P.I. STA. 615+30.50
Δ = 1° 49' 47" (RT)
Dc = 0° 30' 00"
R = 11,459.16'
T = 182.99'
L = 365.94'
E = 1.46'
e_{max} = 0.016
V_{des} = 55 MPH

COMMERCIAL ROAD HILL CONNECTOR

P.I. STA. 14+21.25
Δ = 31° 35' 42" (RT)
Dc = 4° 30' 00"
R = 1,273.24'
T = 360.23'
L = 702.11'
E = 49.98'
e_{max} = 0.016
V_{des} = 25 MPH

RAMP M1

P.I. STA. 901+48.17
Δ = 22° 14' 37" (RT)
Dc = 15° 00' 00"
R = 381.97'
T = 75.09'
L = 148.29'
E = 7.31'
e_{max} = 0.045
V_{des} = 25 MPH

P.I. STA. 904+65.76
Δ = 7° 29' 41" (LT)
Dc = 4° 30' 00"
R = 1,273.24'
T = 83.39'
L = 166.55'
E = 2.73'
e_{max} = 0.037
V_{des} = 35 MPH

P.I. STA. 908+38.13
Δ = 3° 00' 31" (RT)
Dc = 1° 00' 00"
R = 5,729.58'
Δc = 2° 00' 31" (RT)
Lc = 200.87'
Es = 2.12'
e_{max} = 0.020
V_{des} = 50 MPH

P.I. STA. 909+49.66
Ls = 200.00'
θs = 1° 00' 00"
LT = 133.34'
ST = 66.67'
x = 199.99'
y = 1.16'
k = 100.00'
p = 0.29'
e_{max} = 0.020
V_{des} = 50 MPH

COMMERCIAL ROAD HILL DRIVE

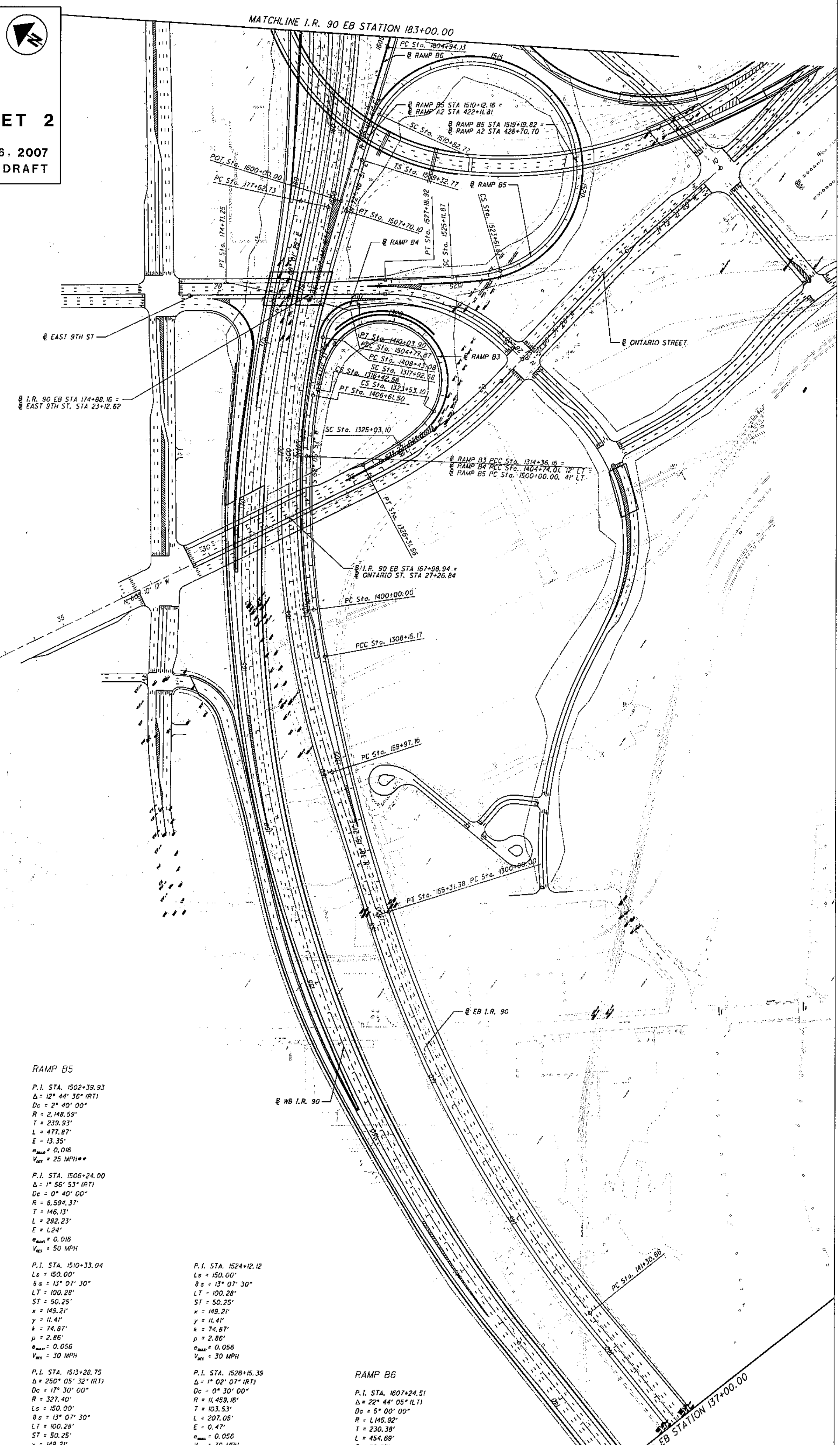
P.I. STA. 11+34.70
Δ = 56° 26' 32" (RT)
Dc = 76° 23' 40"
R = 75.00'
T = 40.25'
L = 73.88'
E = 10.12'
e_{max} = 0.016
V_{des} = 25 MPH

CLEVELAND INNERBELT PLAN

EASTBOUND CENTRAL INTERCHANGE PLAN - SHEET 2

0' 200' 100'

JANUARY 16, 2007
DRAFT



I.R. 90 EASTBOUND

P.I. STA. 148+38.97
Δ = 21° 00' 39" (RT)
Dc = 1° 30' 00"
R = 3,819.72'
T = 708.32'
L = 1,400.73'
E = 65.12'
e_{max} = 0.037
V_{DES} = 60 MPH

P.I. STA. 167+50.91
Δ = 29° 28' 54" (RT)
Dc = 2° 00' 00"
R = 2,864.79'
T = 753.75'
L = 1,474.09'
E = 97.50'
e_{max} = 0.045
V_{DES} = 60 MPH

P.I. STA. 182+31.35
Δ = 13° 59' 20" (LT)
Dc = 1° 30' 00"
R = 3,819.72'
T = 468.63'
L = 932.59'
E = 28.64'
e_{max} = 0.037
V_{DES} = 60 MPH

RAMP B3

P.I. STA. 1304+08.11
Δ = 7° 07' 31" (RT)
Dc = 0° 52' 27"
R = 6,554.83'
T = 408.11'
L = 815.17'
E = 12.69'
e_{max} = MATCH EXISTING
V_{DES} = 50 MPH

P.I. STA. 1311+26.95
Δ = 12° 42' 30" (RT)
Dc = 2° 02' 47"
R = 2,799.79'
T = 311.78'
L = 620.99'
E = 17.31'
e_{max} = 0.035
V_{DES} = 50 MPH

P.I. STA. 1315+39.55
Δ = 8° 15' 23" (RT)
Dc = 4° 00' 00"
R = 1,432.39'
T = 103.38'
L = 206.41'
E = 3.73'
e_{max} = 0.040
V_{DES} = 40 MPH

P.I. STA. 1317+38.09
Ls = 150.00'
θs = 26° 15' 00"
LT = 95.52'
ST = 56.84'
x = 146.50'
y = 25.14'
k = 74.48'
p = 4.39'
e_{max} = 0.058
V_{DES} = 40 MPH

P.I. STA. 1323+53.10
Δ = 173° 45' 47" (RT)
Dc = 31° 00' 00"
R = 184.83'
T = 3,392.41'
L = 560.53'
E = 3,212.61'
e_{max} = 0.058
V_{DES} = 25 MPH

P.I. STA. 1324+09.95
Ls = 150.00'
θs = 26° 15' 00"
LT = 95.52'
ST = 56.84'
x = 146.50'
y = 25.14'
k = 74.48'
p = 4.39'
e_{max} = 0.058
V_{DES} = 25 MPH

P.I. STA. 1325+67.37
Δ = 5° 08' 18" (RT)
Dc = 4° 00' 00"
R = 1,432.39'
T = 64.27'
L = 128.46'
E = 1.44'
e_{max} = 0.022
V_{DES} = 25 MPH

RAMP B4

P.I. STA. 1402+37.57
Δ = 9° 39' 32" (RT)
Dc = 2° 02' 16"
R = 2,811.79'
T = 237.57'
L = 474.01'
E = 10.02'
e_{max} = 0.035
V_{DES} = 50 MPH

P.I. STA. 1405+67.89
Δ = 7° 26' 15" (RT)
Dc = 3° 58' 00"
R = 1,444.39'
T = 93.88'
L = 187.49'
E = 3.05'
e_{max} = 0.040
V_{DES} = 40 MPH

P.I. STA. 1409+37.90
Δ = 76° 12' 14" (RT)
Dc = 47° 23' 03"
R = 120.92'
T = 94.82'
L = 160.82'
E = 32.74'
e_{max} = 0.060
V_{DES} = 20 MPH

RAMP B5

P.I. STA. 1502+39.93
Δ = 12° 44' 36" (RT)
Dc = 2° 40' 00"
R = 2,148.59'
T = 239.93'
L = 477.87'
E = 13.35'
e_{max} = 0.016
V_{DES} = 25 MPH**

P.I. STA. 1506+24.00
Δ = 1° 56' 53" (RT)
Dc = 0° 40' 00"
R = 8,594.37'
T = 146.13'
L = 292.23'
E = 1.24'
e_{max} = 0.016
V_{DES} = 50 MPH

P.I. STA. 1510+33.04
Ls = 150.00'
θs = 13° 07' 30"
LT = 100.28'
ST = 50.25'
x = 149.21'
y = 11.41'
k = 74.87'
p = 2.86'
e_{max} = 0.056
V_{DES} = 30 MPH

P.I. STA. 1513+28.75
Δ = 250° 05' 32" (RT)
Dc = 17° 30' 00"
R = 327.40'
Ls = 150.00'
θs = 13° 07' 30"
LT = 100.28'
ST = 50.25'
x = 149.21'
y = 11.41'
k = 74.87'
p = 2.86'
Δc = 223° 50' 32" (RT)
Lc = 1,279.10'
Ts = 395.99'
Es = 133.24'
e_{max} = 0.056
V_{DES} = 30 MPH

P.I. STA. 1524+12.12
Ls = 150.00'
θs = 13° 07' 30"
LT = 100.28'
ST = 50.25'
x = 149.21'
y = 11.41'
k = 74.87'
p = 2.86'
e_{max} = 0.056
V_{DES} = 30 MPH

P.I. STA. 1526+15.39
Δ = 1° 02' 07" (RT)
Dc = 0° 30' 00"
R = 11,459.16'
T = 103.53'
L = 207.05'
E = 0.47'
e_{max} = 0.056
V_{DES} = 30 MPH

RAMP B6

P.I. STA. 1607+24.51
Δ = 22° 44' 05" (LT)
Dc = 5° 00' 00"
R = 1,145.92'
T = 230.38'
L = 454.69'
E = 22.93'
e_{max} = 0.051
V_{DES} = 45 MPH

** DESIGN SPEED IS CONSTRAINED DUE TO CONSTRUCTABILITY OF THE NEW ALTERNATIVE WITH THE EXISTING VIADUCT STRUCTURE.

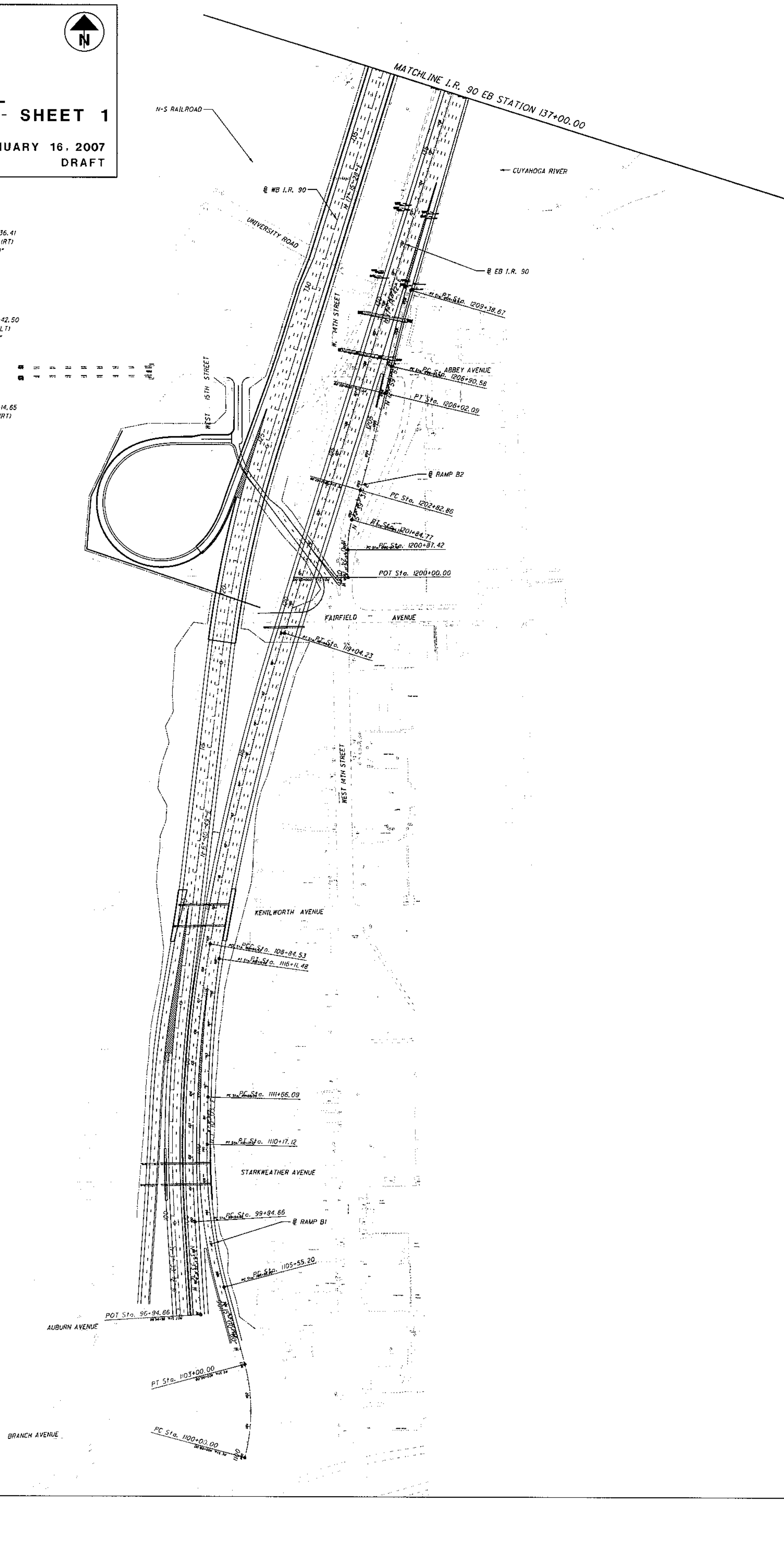
EASTBOUND CENTRAL INTERCHANGE PLAN - SHEET 1

CLEVELAND INNERBELT PLAN

0' 100' 200'

JANUARY 16, 2007

DRAFT



RAMP B1

P.I. STA. 1101+53.49
Δ = 29° 51' 54" (LT)
Dc = 9° 57' 18"
R = 575.54'
T = 153.49'
L = 300.00'
E = 20.12'
e_{max} = 0.0xx
V_{des} = xx MPH

P.I. STA. 1107+87.70
Δ = 16° 10' 02" (RT)
Dc = 3° 30' 00"
R = 1,637.02'
T = 232.50'
L = 461.92'
E = 16.43'
e_{max} = 0.0xx
V_{des} = xx MPH

P.I. STA. 1113+89.03
Δ = 6° 39' 11" (RT)
Dc = 1° 29' 37"
R = 3,835.75'
T = 222.95'
L = 445.39'
E = 6.47'
e_{max} = 0.0xx
V_{des} = xx MPH

RAMP B2

P.I. STA. 1201+36.41
Δ = 16° 03' 43" (RT)
Dc = 16° 30' 00"
R = 347.25'
T = 48.99'
L = 97.35'
E = 3.44'
e_{max} = 0.0xx
V_{des} = xx MPH

P.I. STA. 1204+42.50
Δ = 2° 39' 37" (LT)
Dc = 0° 50' 00"
R = 6,875.49'
T = 159.65'
L = 319.24'
E = 1.85'
e_{max} = 0.0xx
V_{des} = xx MPH

P.I. STA. 1208+14.65
Δ = 3° 06' 04" (RT)
Dc = 1° 15' 00"
R = 4,583.66'
T = 124.07'
L = 248.09'
E = 1.68'
e_{max} = 0.0xx
V_{des} = xx MPH

I.R. 90 EASTBOUND

P.I. STA. 104+41.56
Δ = 13° 09' 03" (RT)
Dc = 1° 28' 40"
R = 3,877.03'
T = 446.90'
L = 889.87'
E = 25.67'
e_{max} = 0.037
V_{des} = 60 MPH

P.I. STA. 113+95.14
Δ = 7° 38' 52" (RT)
Dc = 0° 45' 00"
R = 7,639.44'
T = 510.61'
L = 1,019.70'
E = 17.05'
e_{max} = 0.021
V_{des} = 60 MPH

EASTBOUND CENTRAL INTERCHANGE PLAN - SHEET 3

CLEVELAND INNERBELT PLAN

JANUARY 16, 2007

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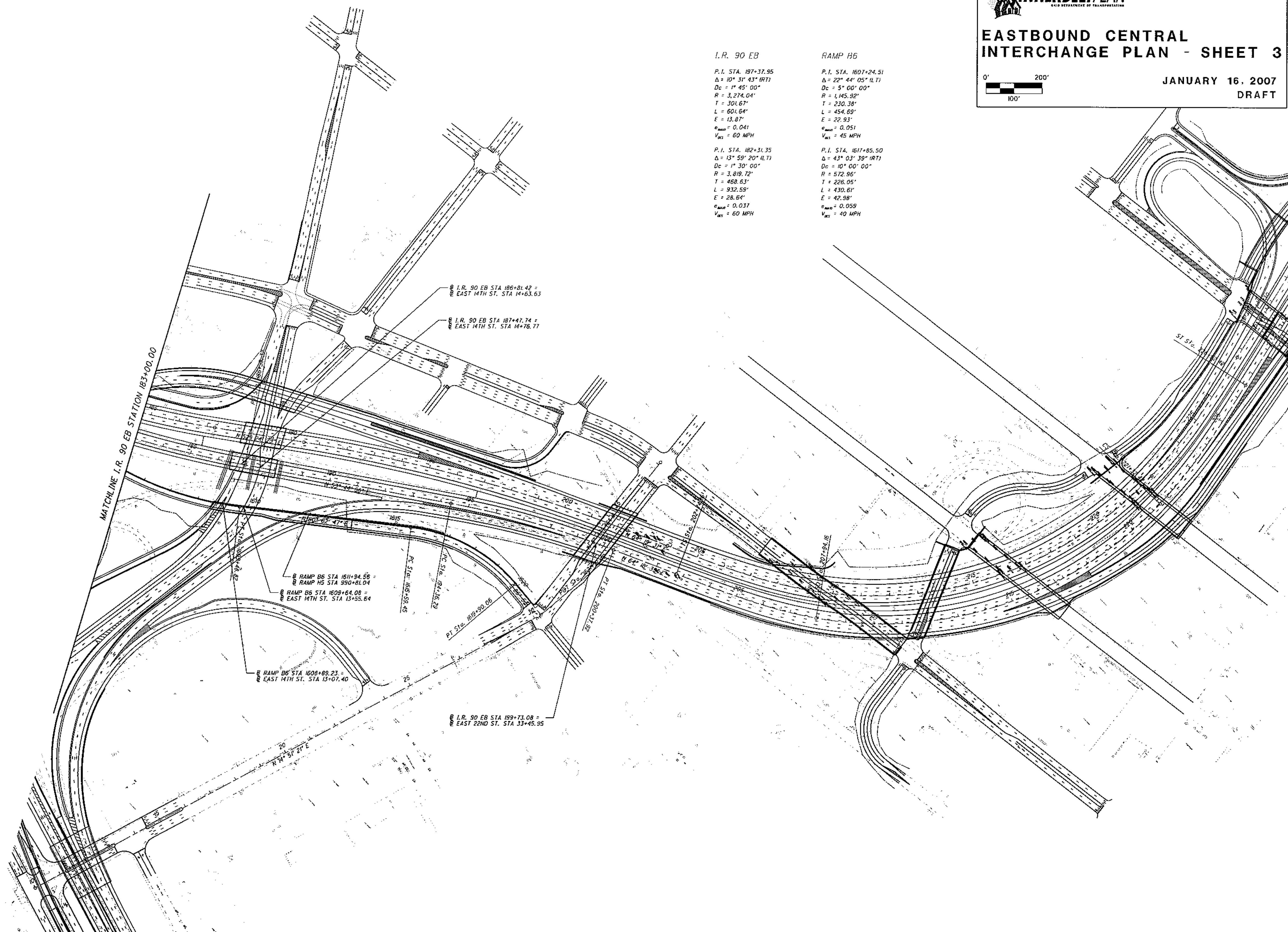
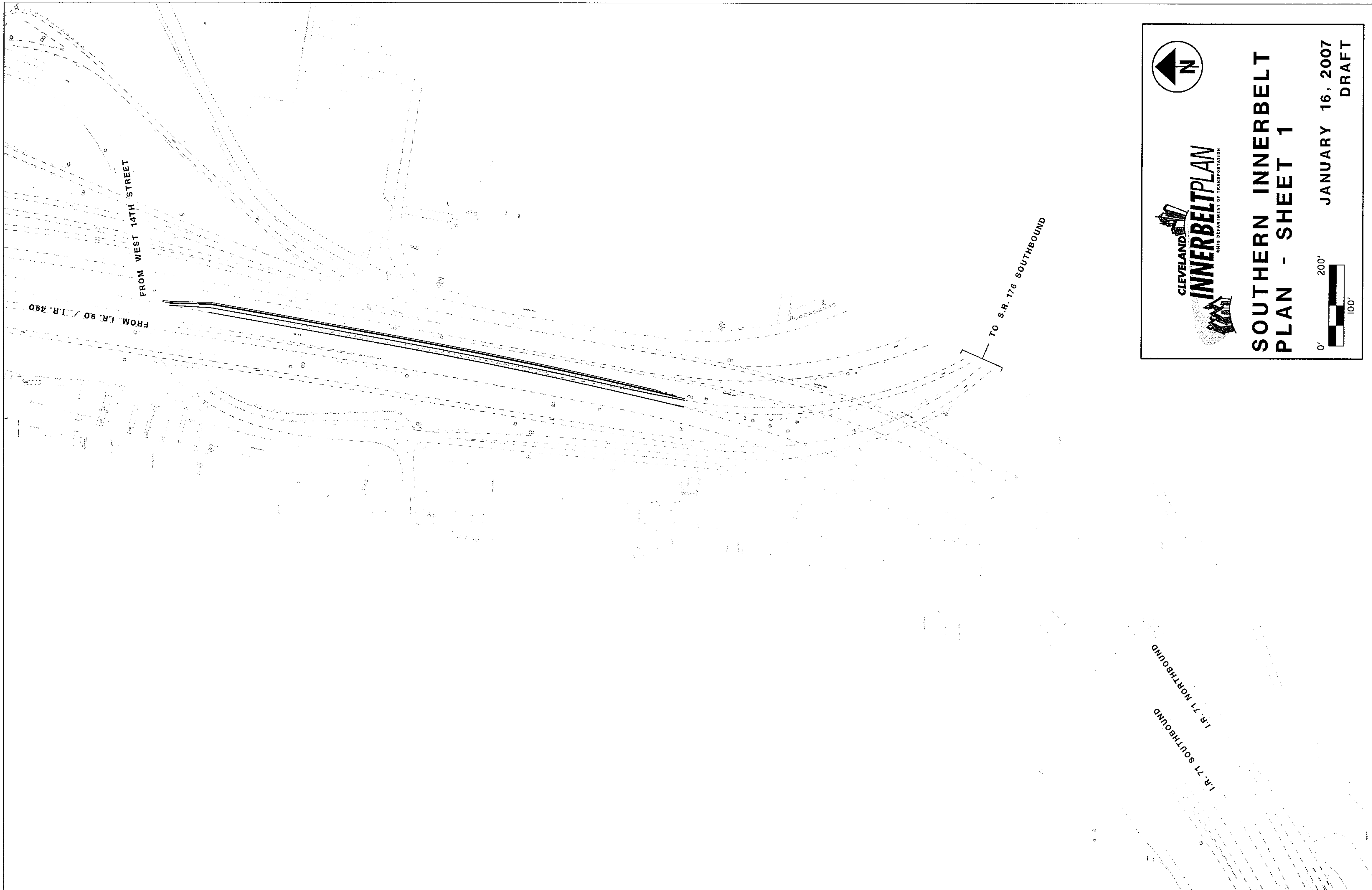
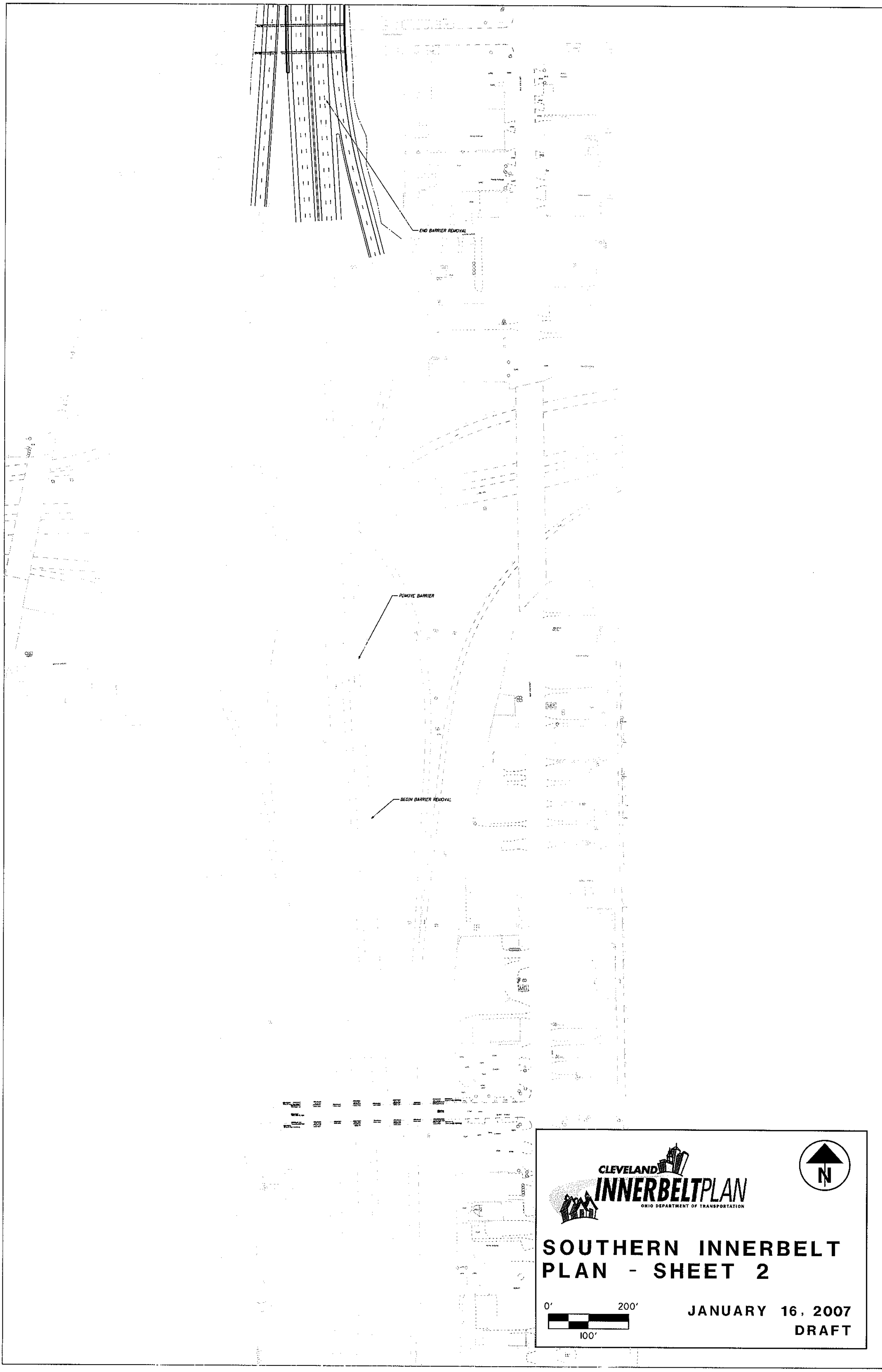
I.R. 90 EB	RAMP B6
P.I. STA. 197+37.95	P.I. STA. 1607+24.51
Δ = 10° 31' 43" (RT)	Δ = 22° 44' 05" (LT)
Dc = 1° 45' 00"	Dc = 5° 00' 00"
R = 3,274.04'	R = 1,145.92'
T = 301.67'	T = 230.38'
L = 601.64'	L = 454.69'
E = 13.87'	E = 22.93'
e_{max} = 0.041	e_{max} = 0.051
V_{des} = 60 MPH	V_{des} = 45 MPH
P.I. STA. 182+31.35	P.I. STA. 1617+85.50
Δ = 13° 59' 20" (LT)	Δ = 43° 03' 39" (RT)
Dc = 1° 30' 00"	Dc = 10° 00' 00"
R = 3,819.72'	R = 572.96'
T = 468.63'	T = 226.05'
L = 932.59'	L = 430.61'
E = 28.64'	E = 42.98'
e_{max} = 0.037	e_{max} = 0.059
V_{des} = 60 MPH	V_{des} = 40 MPH





FROM WEST 14TH STREET
FROM I.R. 90 / I.R. 490
TO S.R. 176 SOUTHBOUND
I.R. 71 NORTHBOUND
I.R. 71 SOUTHBOUND
N
CLEVELAND INNERBELT PLAN
OHIO DEPARTMENT OF TRANSPORTATION
SOUTHERN INNERBELT
PLAN - SHEET 1
0'
100'
200'
JANUARY 16, 2007
DRAFT



CLEVELAND INNERBELTPLAN
OHIO DEPARTMENT OF TRANSPORTATION

SOUTHERN INNERBELT PLAN - SHEET 2

0' 100' 200'

JANUARY 16, 2007
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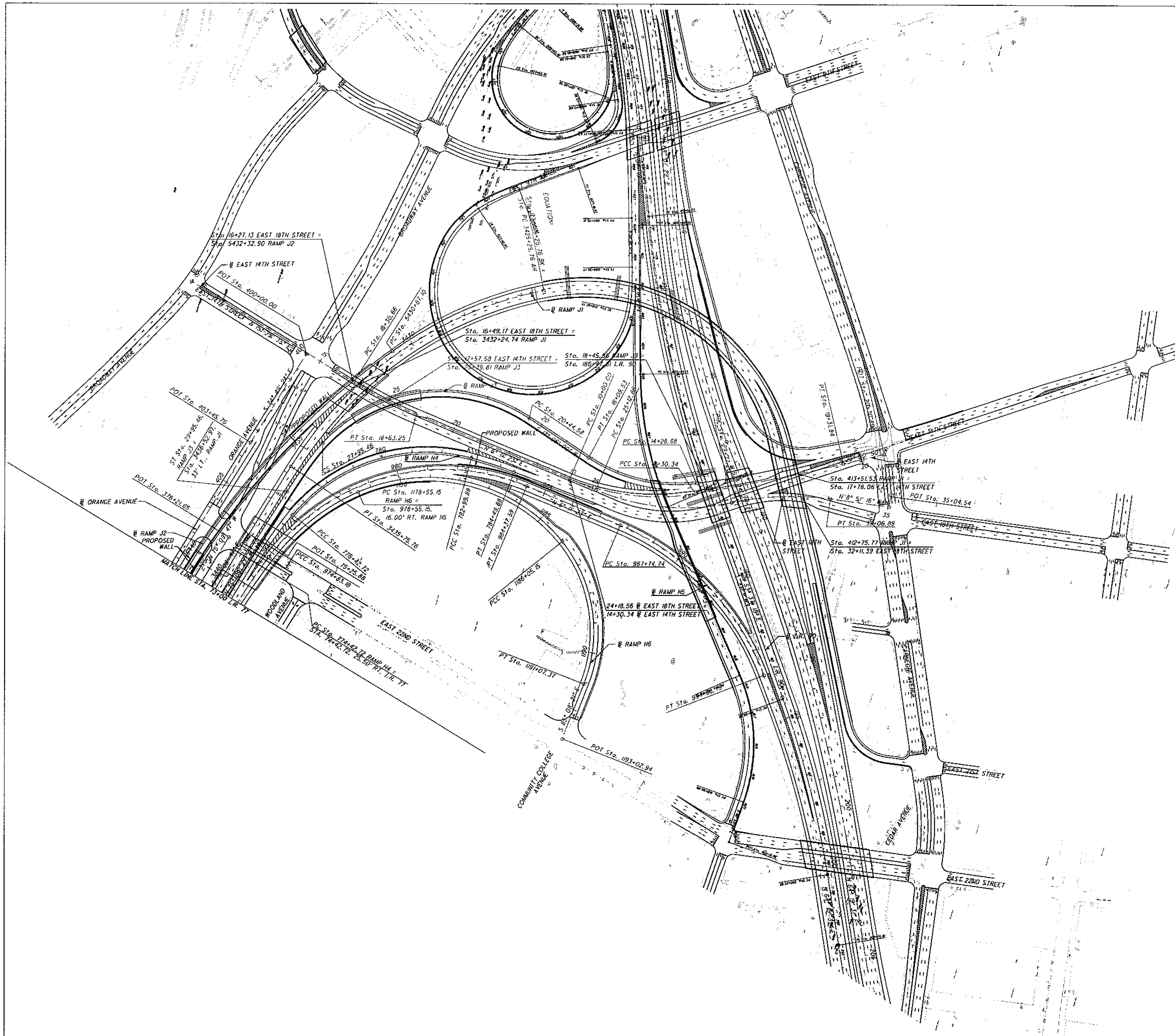

CLEVELAND INNERBELT PLAN

INTERSTATE 77
SHEET 4

0' 100' 200'

JANUARY 16, 2007

DRAFT

RAMP H4

P.I. STA. 775+42.88
Δ = 8° 00' 00" (RT)
Dc = 4° 00' 00"
R = 1,432.39'
T = 100.16'
L = 200.00'
E = 3.50'
e_{max} = 0.055
V_{des} = 40 MPH

P.I. STA. 780+12.79
Δ = 65° 42' 59" (RT)
Dc = 10° 00' 00"
R = 572.96'
T = 370.07'
L = 657.16'
E = 109.12'
e_{max} = 0.053
V_{des} = 35 MPH

P.I. STA. 783+74.95
Δ = 6° 00' 00" (RT)
Dc = 4° 00' 00"
R = 1,432.39'
T = 75.07'
L = 150.00'
E = 1.97'
e_{max} = 0.034
V_{des} = 35 MPH

RAMP H5

P.I. STA. 973+83.24
Δ = 5° 00' 00" (RT)
Dc = 2° 30' 00"
R = 2,291.83'
T = 100.06'
L = 200.00'
E = 2.18'
e_{max} = 0.051
V_{des} = 60 MPH

P.I. STA. 980+46.29
Δ = 76° 21' 09" (RT)
Dc = 8° 00' 00"
R = 716.20'
T = 563.11'
L = 954.41'
E = 194.86'
e_{max} = 0.060
V_{des} = 45 MPH

P.I. STA. 991+52.66
Δ = 46° 24' 48" (RT)
Dc = 6° 30' 00"
R = 881.47'
T = 377.92'
L = 714.05'
E = 77.60'
e_{max} = 0.058
V_{des} = 45 MPH

RAMP H6

P.I. STA. 1182+94.80
Δ = 75° 00' 00" (RT)
Dc = 10° 00' 00"
R = 572.96'
T = 439.65'
L = 750.00'
E = 149.24'
e_{max} = 0.059
V_{des} = 40 MPH

P.I. STA. 1188+82.29
Δ = 60° 15' 57" (RT)
Dc = 12° 00' 00"
R = 477.46'
T = 277.14'
L = 502.22'
E = 74.61'
e_{max} = 0.057
V_{des} = 35 MPH

RAMP J1

P.I. STA. 3430+61.40
Δ = 47° 15' 00" (LT)
Dc = 4° 30' 00"
R = 1,273.24'
T = 556.93'
L = 1,050.00'
E = 116.47'
e_{max} = 0.054
V_{des} = 50 MPH

RAMP J2

P.I. STA. 5435+61.54
Δ = 23° 06' 15" (LT)
Dc = 2° 15' 00"
R = 2,546.48'
T = 520.50'
L = 1,026.85'
E = 52.65'
e_{max} = 0.030
V_{des} = 40 MPH

RAMP J3

P.I. STA. 16+27.64
Δ = 40° 56' 29" (RT)
Dc = 10° 45' 00"
R = 532.98'
T = 198.96'
L = 380.85'
E = 35.93'
e_{max} = 0.055
V_{des} = 40 MPH

P.I. STA. 25+94.53
Δ = 91° 28' 11" (LT)
Dc = 10° 45' 00"
R = 532.98'
Δc = 80° 43' 11" (LT)
Lc = 750.88'
Es = 232.87'
e_{max} = 0.060
V_{des} = 40 MPH

P.I. STA. 28+62.35
Ls = 200.00'
θs = 10° 45' 00"
LT = 133.58'
ST = 66.89'
x = 199.30'
y = 12.48'
k = 99.88'
p = 3.12'
V_{des} = 55 MPH

I.R. 77

P.I. STA. 37+53.40
Δ = 9° 00' 20" (LT)
Dc = 2° 15' 00"
R = 2,546.48'
T = 200.54'
L = 400.25'
E = 7.88'
e_{max} = 0.051
V_{des} = 60 MPH

P.I. STA. 46+86.03
Δ = 41° 59' 20" (LT)
Dc = 3° 00' 00"
R = 1,909.86'
T = 732.91'
L = 1,399.63'
E = 135.80'
e_{max} = 0.055
V_{des} = 60 MPH

P.I. STA. 55+53.28
Δ = 9° 00' 20" (LT)
Dc = 2° 15' 00"
R = 2,546.48'
T = 200.54'
L = 400.25'
E = 7.88'
e_{max} = 0.051
V_{des} = 60 MPH

RAMP H1

P.I. STA. 142+24.94
Δ = 9° 43' 30" (LT)
Dc = 1° 30' 00"
R = 3,819.72'
T = 324.94'
L = 648.33'
E = 13.80'
e_{max} = 0.028
V_{des} = 50 MPH

P.I. STA. 149+01.59
Δ = 26° 38' 01" (RT)
Dc = 12° 00' 00"
R = 477.46'
T = 113.02'
L = 221.95'
E = 13.19'
e_{max} = 0.041
V_{des} = 25 MPH

RAMP H2

P.I. STA. 342+16.95
Δ = 11° 58' 09" (LT)
Dc = 2° 15' 00"
R = 2,546.48'
T = 266.95'
L = 531.97'
E = 13.95'
e_{max} = 0.040
V_{des} = 50 MPH

P.I. STA. 345+86.80
Ls = 200.00'
θs = 5° 15' 00"
LT = 104.83'
ST = 95.31'
x = 199.74'
y = 8.72'
k = 99.97'
p = 0.22'
V_{des} = 50 MPH

P.I. STA. 352+79.76
Δ = 34° 45' 39" (LT)
Dc = 3° 00' 00"
R = 1,909.86'
T = 597.80'
L = 1,158.70'
E = 91.37'
e_{max} = 0.039
V_{des} = 45 MPH

P.I. STA. 364+85.42
Δ = 32° 54' 00" (LT)
Dc = 14° 00' 00"
R = 409.26'
T = 120.84'
L = 235.00'
E = 17.47'
e_{max} = 0.059
V_{des} = 35 MPH

P.I. STA. 369+49.04
Δ = 32° 52' 46" (RT)
Dc = 14° 00' 00"
R = 409.25'
T = 120.76'
L = 234.85'
E = 17.44'
e_{max} = 0.059
V_{des} = 35 MPH

RAMP H3

P.I. STA. 557+38.34
Δ = 30° 42' 44" (RT)
Dc = 15° 30' 00"
R = 369.65'
T = 101.51'
L = 198.14'
E = 13.69'
e_{max} = 0.055
V_{des} = 30 MPH

P.I. STA. 562+75.31
Δ = 3° 06' 07" (RT)
Dc = 1° 00' 00"
R = 5,729.58'
Δc = 2° 06' 07" (RT)
Lc = 210.21'
Es = 2.25'
e_{max} = 0.020
V_{des} = 50 MPH

P.I. STA. 563+91.67
Ls = 200.00'
θs = 1° 00' 00"
LT = 133.34'
ST = 66.67'
x = 199.99'
y = 1.16'
k = 100.00'
p = 0.29'
V_{des} = 50 MPH

RAMP H5

P.I. STA. 973+83.24
Δ = 5° 00' 00" (RT)
Dc = 2° 30' 00"
R = 2,291.83'
T = 100.06'
L = 200.00'
E = 2.18'
e_{max} = 0.051
V_{des} = 60 MPH

RAMP J2

P.I. STA. 5435+61.54
Δ = 23° 06' 15" (LT)
Dc = 2° 15' 00"
R = 2,546.48'
T = 520.50'
L = 1,026.85'
E = 52.65'
e_{max} = 0.030
V_{des} = 40 MPH

P.I. STA. 5443+40.09
Δ = 4° 00' 32" (RT)
Dc = 2° 00' 00"
R = 2,864.79'
T = 100.26'
L = 200.44'
E = 1.75'
e_{max} = 0.025
V_{des} = 40 MPH

P.I. STA. 5447+36.17
Δ = 3° 59' 38" (LT)
Dc = 2° 00' 00"
R = 2,864.79'
T = 99.89'
L = 199.70'
E = 1.74'
e_{max} = 0.025
V_{des} = 40 MPH

RAMP J4

P.I. STA. 243+19.60
Ls = 200.00'
θs = 4° 55' 45"
LT = 133.39'
ST = 66.71'
x = 199.85'
y = 5.73'
k = 99.98'
p = 1.43'
V_{des} = 55 MPH

P.I. STA. 247+03.29
Δ = 39° 37' 47" (LT)
Dc = 4° 55' 45"
R = 1,162.38'
Δc = 34° 42' 02" (LT)
Lc = 703.99'
Es = 73.92'
e_{max} = 0.051
V_{des} = 45 MPH

CLEVELAND INNERBELTPLAN

INTERSTATE 77
SHEET 3

0' 100' 200'

JANUARY 16, 2007
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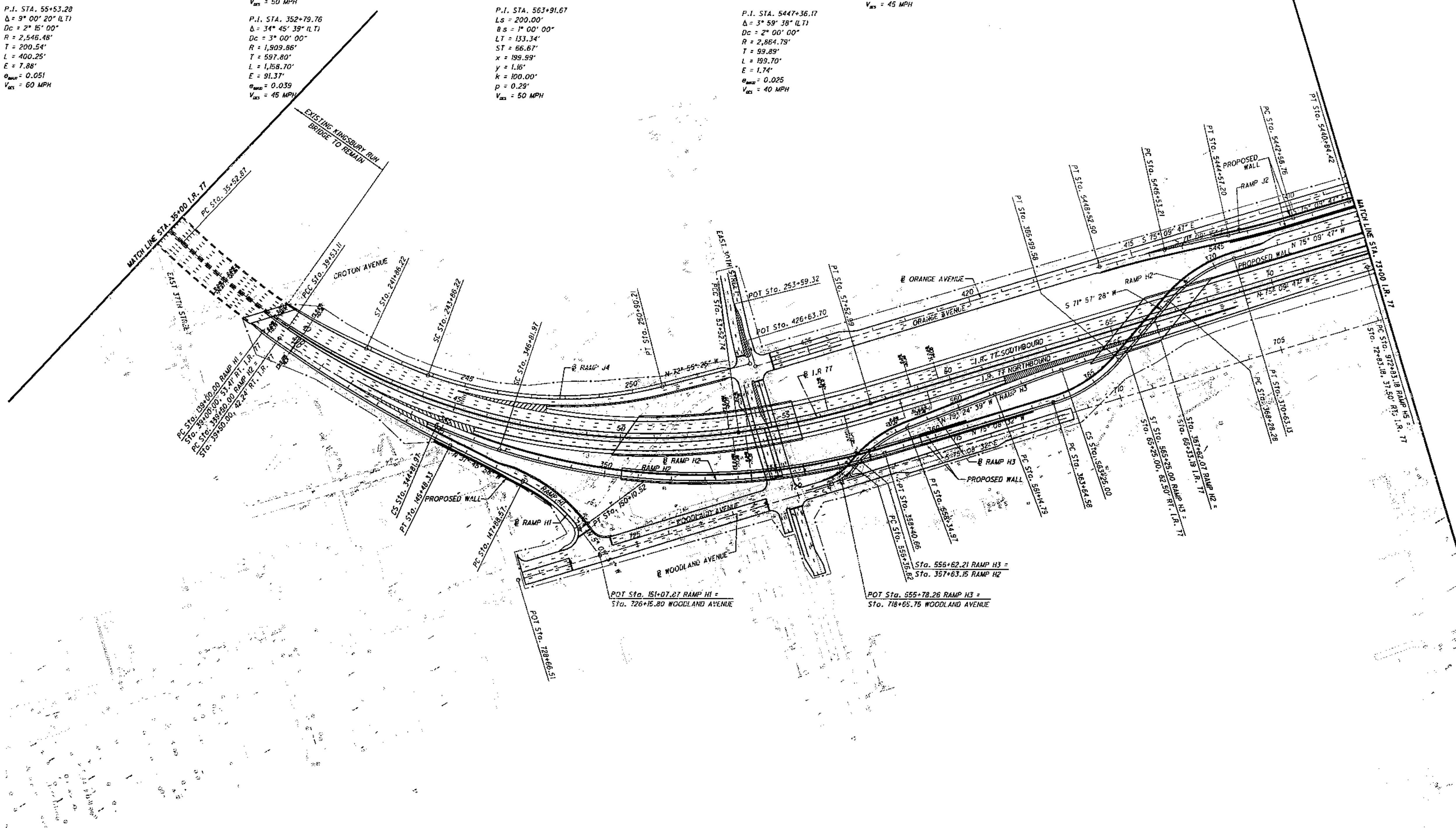

I.R. 77

P.I. STA. 995+20.27
Δ = 9° 36′ 59″ (LT)
Dc = 1° 00′ 00″
R = 5,729.58′
T = 481.94′
L = 961.63′
E = 20.23′
e_{max} = 0.027
V_{des} = 60 MPH

RAMP J5

P.I. STA. 991+71.35
Ls = 200.00′
θs = 2° 45′ 00″
LT = 133.35′
ST = 66.68′
x = 199.95′
y = 3.20′
k = 99.99′
p = 0.80′
V_{des} = 50 MPH

P.I. STA. 996+22.04
Δ = 26° 14′ 35″ (LT)
Dc = 2° 45′ 00″
R = 2,083.48′
Δc = 23° 29′ 35″ (LT)
Lc = 854.30′
Es = 56.27′
e_{max} = 0.047
V_{des} = 50 MPH

RAMP J6

P.I. STA. 801+93.76
Δ = 6° 00′ 00″ (RT)
Dc = 4° 00′ 00″
R = 1,432.39′
T = 75.07′
L = 150.00′
E = 1.97′
e_{max} = 0.037
V_{des} = 35 MPH

P.I. STA. 804+96.09
Δ = 48° 07′ 19″ (RT)
Dc = 11° 15′ 00″
R = 509.30′
T = 227.40′
L = 427.75′
E = 48.46′
e_{max} = 0.056
V_{des} = 35 MPH

CLEVELAND INNERBELTPLAN

INTERSTATE 77
SHEET 2

0′ 100′ 200′

JANUARY 16, 2007
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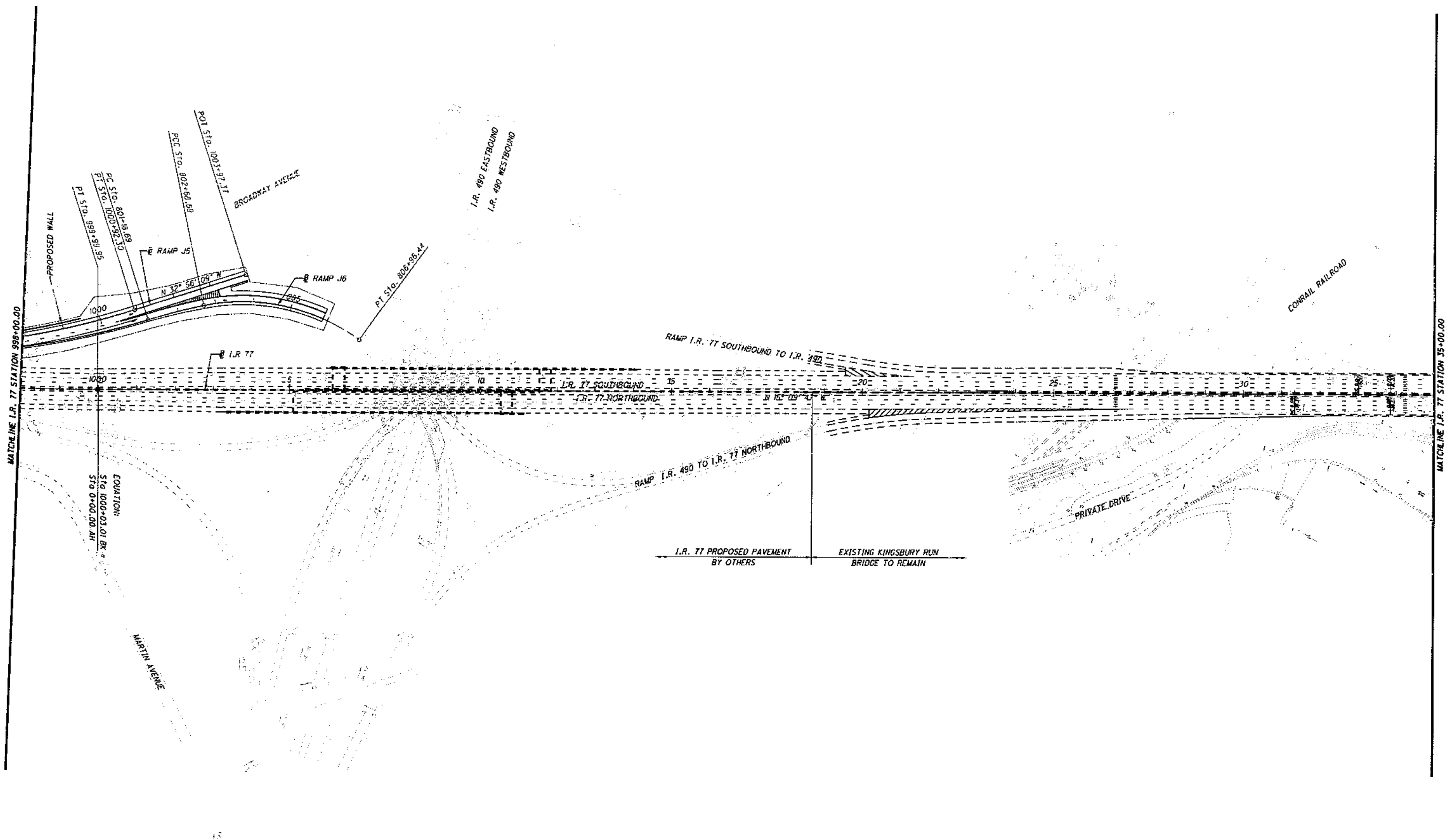

CLEVELAND INNERBELTPLAN

INTERSTATE 77
SHEET 1

0' 100' 200'

JANUARY 16, 2007

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I.R. 77

P.I. STA. 956+64.99
Δ = 12° 03' 23" (LT)
Dc = 1° 30' 00"
R = 3,819.72'
T = 403.37'
L = 803.76'
E = 21.24'
e_{max} = 0.037
V_{DES} = 60 MPH

P.I. STA. 969+34.19
Δ = 15° 46' 13" (RT)
Dc = 2° 00' 00"
R = 2,864.79'
T = 396.76'
L = 788.51'
E = 27.34'
e_{max} = 0.045
V_{DES} = 60 MPH

P.I. STA. 995+20.27
Δ = 9° 36' 59" (LT)
Dc = 1° 00' 00"
R = 5,729.58'
T = 481.94'
L = 961.63'
E = 20.23'
e_{max} = 0.027
V_{DES} = 60 MPH

RAMP J5

P.I. STA. 991+71.35
Ls = 200.00'
θs = 2° 45' 00"
LT = 133.35'
ST = 66.68'
x = 199.95'
y = 3.20'
k = 99.99'
p = 0.80'
V_{DES} = 50 MPH

P.I. STA. 996+22.04
Δ = 26° 14' 35" (LT)
Dc = 2° 45' 00"
R = 2,083.48'
Δc = 23° 29' 35" (LT)
Lc = 854.30'
Es = 56.27'
e_{max} = 0.047
V_{DES} = 50 MPH

FRONTAGE ROAD

P.I. STA. 12+48.63
Δ = 9° 00' 51" (RT)
Dc = 6° 00' 00"
R = 954.93'
T = 75.27'
L = 150.24'
E = 2.96'
e_{max} = 0.016
V_{DES} = 35 MPH

P.I. STA. 15+83.93
Δ = 11° 46' 24" (LT)
Dc = 6° 00' 00"
R = 954.93'
T = 98.46'
L = 196.22'
E = 5.06'
e_{max} = 0.016
V_{DES} = 35 MPH

P.I. STA. 22+33.99
Δ = 2° 45' 10" (LT)
Dc = 1° 00' 00"
R = 5,729.58'
T = 137.66'
L = 275.27'
E = 1.65'
e_{max} = 0.016
V_{DES} = 35 MPH

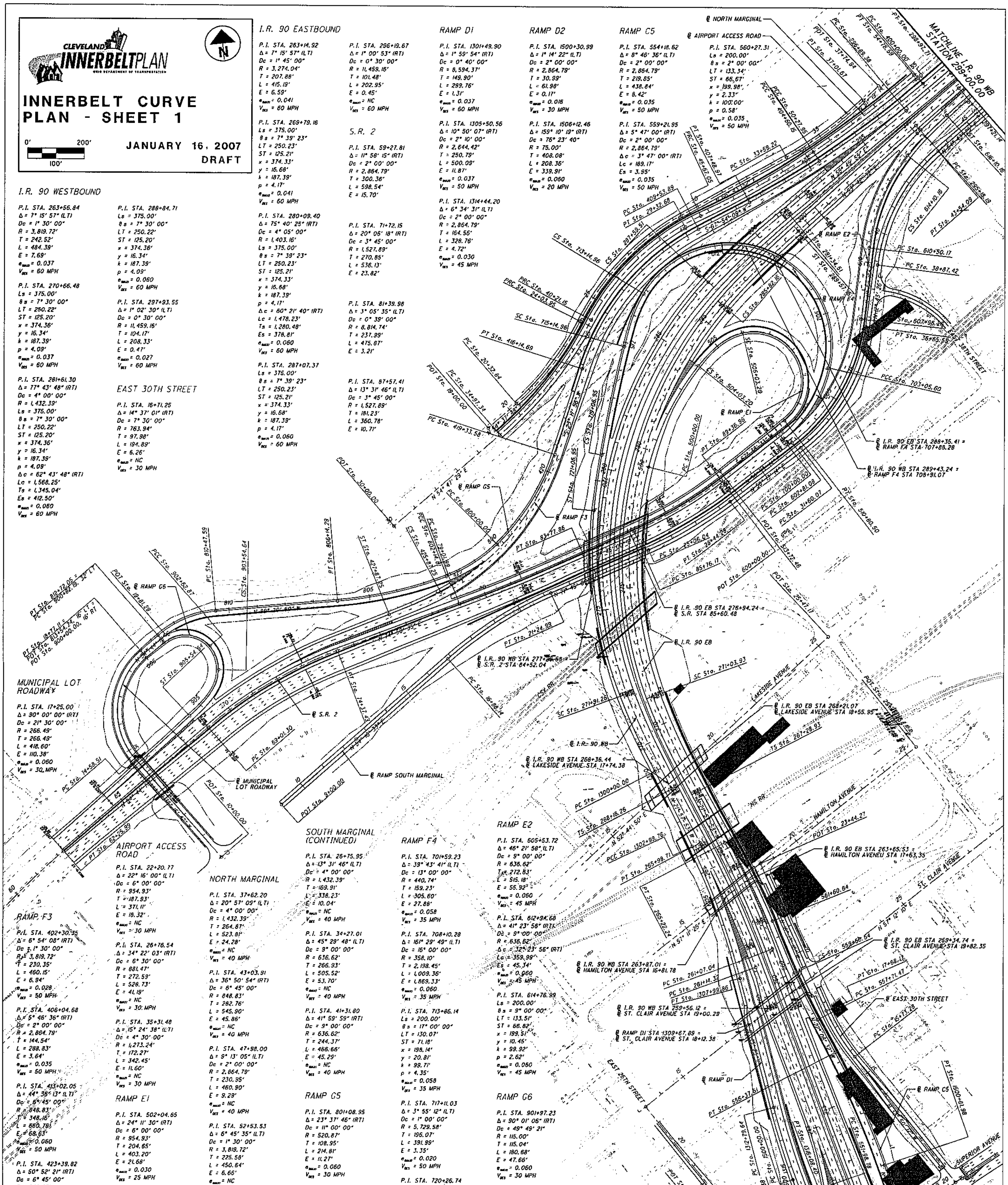
INNERBELT CURVE PLAN - SHEET 1

CLEVELAND INNERBELT PLAN
OHIO DEPARTMENT OF TRANSPORTATION

0' 100' 200'

JANUARY 16, 2007
DRAFT

N



I.R. 90 EASTBOUND

P.I. STA. 263+14.92
Δ = 7° 15' 57" (LT)
Dc = 1° 45' 00"
R = 3,274.04'
T = 207.88'
L = 415.19'
E = 6.59'
e_{max} = 0.041
V_{des} = 60 MPH

P.I. STA. 269+79.16
Ls = 375.00'
θs = 7° 39' 23"
LT = 250.23'
ST = 125.21'
x = 374.33'
y = 16.68'
k = 187.39'
p = 4.17'
e_{max} = 0.041
V_{des} = 60 MPH

P.I. STA. 280+09.40
Δ = 75° 40' 25" (RT)
Dc = 4° 05' 00"
R = 1,403.16'
Ls = 375.00'
θs = 7° 39' 23"
LT = 250.23'
ST = 125.21'
x = 374.33'
y = 16.68'
k = 187.39'
p = 4.17'
Δc = 60° 21' 40" (RT)
Lc = 1,478.23'
Ts = 1,280.48'
Es = 378.81'
e_{max} = 0.060
V_{des} = 60 MPH

P.I. STA. 287+07.37
Ls = 375.00'
θs = 7° 39' 23"
LT = 250.23'
ST = 125.21'
x = 374.33'
y = 16.68'
k = 187.39'
p = 4.17'
e_{max} = 0.060
V_{des} = 60 MPH

P.I. STA. 296+19.67
Δ = 1° 00' 53" (RT)
Dc = 0° 30' 00"
R = 11,459.16'
T = 101.48'
L = 202.95'
E = 0.45'
e_{max} = NC
V_{des} = 60 MPH

S.R. 2

P.I. STA. 59+27.81
Δ = 11° 58' 15" (RT)
Dc = 2° 00' 00"
R = 2,864.79'
T = 300.36'
L = 598.54'
E = 15.70'

P.I. STA. 71+72.15
Δ = 20° 06' 18" (RT)
Dc = 3° 45' 00"
R = 1,527.89'
T = 270.85'
L = 536.13'
E = 23.82'

P.I. STA. 81+39.98
Δ = 3° 05' 35" (LT)
Dc = 0° 39' 00"
R = 8,814.74'
T = 237.99'
L = 475.87'
E = 3.21'

P.I. STA. 87+57.41
Δ = 13° 31' 46" (LT)
Dc = 3° 45' 00"
R = 1,527.89'
T = 181.23'
L = 360.78'
E = 10.71'

RAMP D1

P.I. STA. 1301+49.90
Δ = 1° 59' 54" (RT)
Dc = 0° 40' 00"
R = 8,594.37'
T = 149.90'
L = 299.76'
E = 1.31'
e_{max} = 0.037
V_{des} = 60 MPH

P.I. STA. 1305+50.56
Δ = 10° 50' 07" (RT)
Dc = 2° 10' 00"
R = 2,644.42'
T = 250.79'
L = 500.09'
E = 11.87'
e_{max} = 0.037
V_{des} = 50 MPH

P.I. STA. 1314+44.20
Δ = 6° 34' 31" (LT)
Dc = 2° 00' 00"
R = 2,864.79'
T = 164.56'
L = 328.76'
E = 4.72'
e_{max} = 0.030
V_{des} = 45 MPH

RAMP D2

P.I. STA. 1500+30.99
Δ = 1° 14' 22" (LT)
Dc = 2° 00' 00"
R = 2,864.79'
T = 30.99'
L = 61.98'
E = 0.17'
e_{max} = 0.016
V_{des} = 30 MPH

P.I. STA. 1506+12.46
Δ = 159° 10' 19" (RT)
Dc = 76° 23' 40"
R = 75.00'
T = 408.08'
L = 208.36'
E = 339.91'
e_{max} = 0.060
V_{des} = 20 MPH

RAMP C5

P.I. STA. 554+18.62
Δ = 8° 46' 36" (LT)
Dc = 2° 00' 00"
R = 2,864.79'
T = 219.85'
L = 438.84'
E = 8.42'
e_{max} = 0.035
V_{des} = 50 MPH

P.I. STA. 559+21.95
Δ = 5° 47' 00" (RT)
Dc = 2° 00' 00"
R = 2,864.79'
Δc = 3° 47' 00" (RT)
Lc = 189.17'
Es = 3.95'
e_{max} = 0.035
V_{des} = 50 MPH

P.I. STA. 560+27.31
Ls = 200.00'
θs = 2° 00' 00"
LT = 133.34'
ST = 66.67'
x = 199.98'
y = 2.33'
k = 100.00'
p = 0.58'
e_{max} = 0.035
V_{des} = 50 MPH

I.R. 90 WESTBOUND

P.I. STA. 263+56.84
Δ = 7° 15' 57" (LT)
Dc = 1° 30' 00"
R = 3,819.72'
T = 242.52'
L = 484.39'
E = 7.69'
e_{max} = 0.037
V_{des} = 60 MPH

P.I. STA. 270+66.48
Ls = 375.00'
θs = 7° 30' 00"
LT = 250.22'
ST = 125.20'
x = 374.36'
y = 16.34'
k = 187.39'
p = 4.09'
e_{max} = 0.037
V_{des} = 60 MPH

P.I. STA. 281+61.30
Δ = 77° 43' 48" (RT)
Dc = 4° 00' 00"
R = 1,432.39'
Ls = 375.00'
θs = 7° 30' 00"
LT = 250.22'
ST = 125.20'
x = 374.36'
y = 16.34'
k = 187.39'
p = 4.09'
Δc = 62° 43' 48" (RT)
Lc = 1,568.25'
Ts = 1,345.04'
Es = 412.50'
e_{max} = 0.060
V_{des} = 60 MPH

P.I. STA. 288+84.71
Ls = 375.00'
θs = 7° 30' 00"
LT = 250.22'
ST = 125.20'
x = 374.36'
y = 16.34'
k = 187.39'
p = 4.09'
e_{max} = 0.060
V_{des} = 60 MPH

P.I. STA. 297+93.55
Δ = 1° 02' 30" (LT)
Dc = 0° 30' 00"
R = 11,459.16'
T = 104.17'
L = 208.33'
E = 0.47'
e_{max} = 0.027
V_{des} = 60 MPH

EAST 30TH STREET

P.I. STA. 16+71.25
Δ = 14° 37' 01" (RT)
Dc = 7° 30' 00"
R = 763.94'
T = 97.98'
L = 194.89'
E = 6.26'
e_{max} = NC
V_{des} = 30 MPH

MUNICIPAL LOT ROADWAY

P.I. STA. 17+25.00
Δ = 90° 00' 00" (RT)
Dc = 21° 30' 00"
R = 266.49'
T = 266.49'
L = 418.60'
E = 110.38'
e_{max} = 0.060
V_{des} = 30 MPH

RAMP F3

P.I. STA. 402+30.35
Δ = 6° 54' 08" (RT)
Dc = 1° 30' 00"
R = 3,819.72'
T = 230.35'
L = 460.15'
E = 6.94'
e_{max} = 0.028
V_{des} = 50 MPH

P.I. STA. 406+04.68
Δ = 5° 46' 36" (RT)
Dc = 2° 00' 00"
R = 2,864.79'
T = 144.54'
L = 288.83'
E = 3.64'
e_{max} = 0.035
V_{des} = 50 MPH

P.I. STA. 413+02.05
Δ = 44° 36' 13" (LT)
Dc = 6° 45' 00"
R = 848.83'
T = 348.16'
L = 660.78'
E = 68.63'
e_{max} = 0.060
V_{des} = 50 MPH

P.I. STA. 423+39.82
Δ = 50° 52' 21" (RT)
Dc = 6° 45' 00"
R = 848.83'
Δc = 44° 07' 21" (RT)
Lc = 653.67'
Es = 92.20'
e_{max} = 0.060
V_{des} = 50 MPH

P.I. STA. 426+54.00
Ls = 200.00'
θs = 6° 45' 00"
LT = 133.43'
ST = 66.75'
x = 199.72'
y = 7.85'
k = 99.95'
p = 1.96'
e_{max} = 0.060
V_{des} = 50 MPH

AIRPORT ACCESS ROAD

P.I. STA. 22+20.77
Δ = 22° 16' 00" (LT)
Dc = 6° 00' 00"
R = 954.93'
T = 187.93'
L = 371.11'
E = 18.32'
e_{max} = NC
V_{des} = 30 MPH

P.I. STA. 26+76.54
Δ = 34° 22' 03" (RT)
Dc = 6° 30' 00"
R = 881.47'
T = 272.59'
L = 528.73'
E = 41.19'
e_{max} = NC
V_{des} = 30 MPH

P.I. STA. 35+31.48
Δ = 15° 24' 38" (LT)
Dc = 4° 30' 00"
R = 1,273.24'
T = 172.27'
L = 342.45'
E = 11.60'
e_{max} = NC
V_{des} = 30 MPH

RAMP E1

P.I. STA. 502+04.65
Δ = 24° 11' 30" (RT)
Dc = 6° 00' 00"
R = 954.93'
T = 204.65'
L = 403.20'
E = 21.68'
e_{max} = 0.030
V_{des} = 25 MPH

P.I. STA. 505+29.84
Ls = 200.00'
θs = 38° 30' 00"
LT = 126.65'
ST = 80.48'
x = 189.64'
y = 50.10'
k = 98.51'
p = 7.63'
e_{max} = 0.030
V_{des} = 25 MPH

P.I. STA. 508+41.85
Δ = 155° 07' 24" (RT)
Dc = 32° 30' 00"
R = 176.29'
T = 799.28'
L = 477.30'
E = 642.20'
e_{max} = 0.058
V_{des} = 25 MPH

NORTH MARGINAL

P.I. STA. 37+62.20
Δ = 20° 57' 09" (LT)
Dc = 4° 00' 00"
R = 1,432.39'
T = 264.87'
L = 523.81'
E = 24.28'
e_{max} = NC
V_{des} = 40 MPH

P.I. STA. 43+03.91
Δ = 36° 50' 54" (RT)
Dc = 6° 45' 00"
R = 848.83'
T = 282.76'
L = 545.90'
E = 45.86'
e_{max} = NC
V_{des} = 40 MPH

P.I. STA. 47+98.00
Δ = 9° 13' 05" (LT)
Dc = 2° 00' 00"
R = 2,864.79'
T = 230.95'
L = 460.90'
E = 9.29'
e_{max} = NC
V_{des} = 40 MPH

P.I. STA. 52+53.53
Δ = 6° 45' 35" (LT)
Dc = 1° 30' 00"
R = 3,819.72'
T = 225.58'
L = 450.64'
E = 6.66'
e_{max} = NC
V_{des} = 40 MPH

SOUTH MARGINAL

P.I. STA. 19+08.28
Δ = 17° 28' 27" (RT)
Dc = 4° 00' 00"
R = 1,432.39'
T = 220.14'
L = 436.85'
E = 16.82'
e_{max} = NC
V_{des} = 40 MPH

SOUTH MARGINAL (CONTINUED)

P.I. STA. 26+75.95
Δ = 13° 31' 46" (LT)
Dc = 4° 00' 00"
R = 1,432.39'
T = 169.91'
L = 338.23'
E = 10.04'
e_{max} = NC
V_{des} = 40 MPH

P.I. STA. 34+27.01
Δ = 45° 29' 48" (LT)
Dc = 9° 00' 00"
R = 636.62'
T = 266.93'
L = 505.52'
E = 53.70'
e_{max} = NC
V_{des} = 40 MPH

P.I. STA. 41+31.80
Δ = 41° 59' 59" (RT)
Dc = 9° 00' 00"
R = 636.62'
T = 244.37'
L = 466.66'
E = 45.29'
e_{max} = NC
V_{des} = 40 MPH

RAMP G5

P.I. STA. 801+08.95
Δ = 23° 37' 46" (RT)
Dc = 11° 00' 00"
R = 520.87'
T = 108.95'
L = 214.81'
E = 11.27'
e_{max} = 0.060
V_{des} = 30 MPH

P.I. STA. 804+15.85
Δ = 15° 58' 44" (RT)
Dc = 4° 00' 00"
R = 1,432.39'
T = 201.04'
L = 399.48'
E = 14.04'
e_{max} = 0.060
V_{des} = 30 MPH

P.I. STA. 811+63.64
Δ = 35° 54' 53" (LT)
Dc = 16° 00' 00"
R = 358.10'
T = 116.06'
L = 224.47'
E = 18.34'
e_{max} = 0.060
V_{des} = 30 MPH

RAMP F4

P.I. STA. 701+59.23
Δ = 39° 43' 41" (LT)
Dc = 13° 00' 00"
R = 440.74'
T = 159.23'
L = 305.60'
E = 27.88'
e_{max} = 0.058
V_{des} = 35 MPH

P.I. STA. 708+10.28
Δ = 161° 29' 49" (LT)
Dc = 16° 00' 00"
R = 358.10'
T = 2,198.45'
L = 1,009.36'
E = 1,869.33'
e_{max} = 0.060
V_{des} = 35 MPH

P.I. STA. 713+86.14
Ls = 200.00'
θs = 17° 00' 00"
LT = 130.07'
ST = 71.18'
x = 198.14'
y = 20.81'
k = 99.71'
p = 4.35'
e_{max} = 0.058
V_{des} = 35 MPH

P.I. STA. 717+11.03
Δ = 3° 55' 12" (LT)
Dc = 1° 00' 00"
R = 5,729.58'
T = 196.07'
L = 391.99'
E = 3.35'
e_{max} = 0.020
V_{des} = 50 MPH

P.I. STA. 720+26.74
Ls = 200.00'
θs = 4° 54' 04"
LT = 119.79'
ST = 80.32'
x = 199.82'
y = 6.86'
k = 99.98'
p = 0.84'
e_{max} = 0.020
V_{des} = 50 MPH

RAMP E2

P.I. STA. 605+53.72
Δ = 46° 21' 58" (LT)
Dc = 9° 00' 00"
R = 636.62'
T = 272.53'
L = 515.18'
E = 55.92'
e_{max} = 0.060
V_{des} = 45 MPH

P.I. STA. 612+94.68
Δ = 41° 23' 56" (RT)
Dc = 9° 00' 00"
R = 636.62'
Δc = 32° 23' 56" (RT)
Lc = 359.99'
Es = 45.34'
e_{max} = 0.060
V_{des} = 45 MPH

P.I. STA. 614+76.99
Ls = 200.00'
θs = 9° 00' 00"
LT = 133.51'
ST = 66.82'
x = 199.51'
y = 10.45'
k = 99.92'
p = 2.62'
e_{max} = 0.060
V_{des} = 45 MPH

RAMP G6

P.I. STA. 901+97.23
Δ = 90° 01' 06" (RT)
Dc = 49° 49' 21"
R = 115.00'
T = 115.04'
L = 180.68'
E = 47.66'
e_{max} = 0.060
V_{des} = 30 MPH

P.I. STA. 903+10.93
Δ = 42° 03' 54" (RT)
Dc = 45° 50' 12"
R = 125.00'
T = 48.06'
L = 91.77'
E = 8.92'
e_{max} = 0.060
V_{des} = 30 MPH

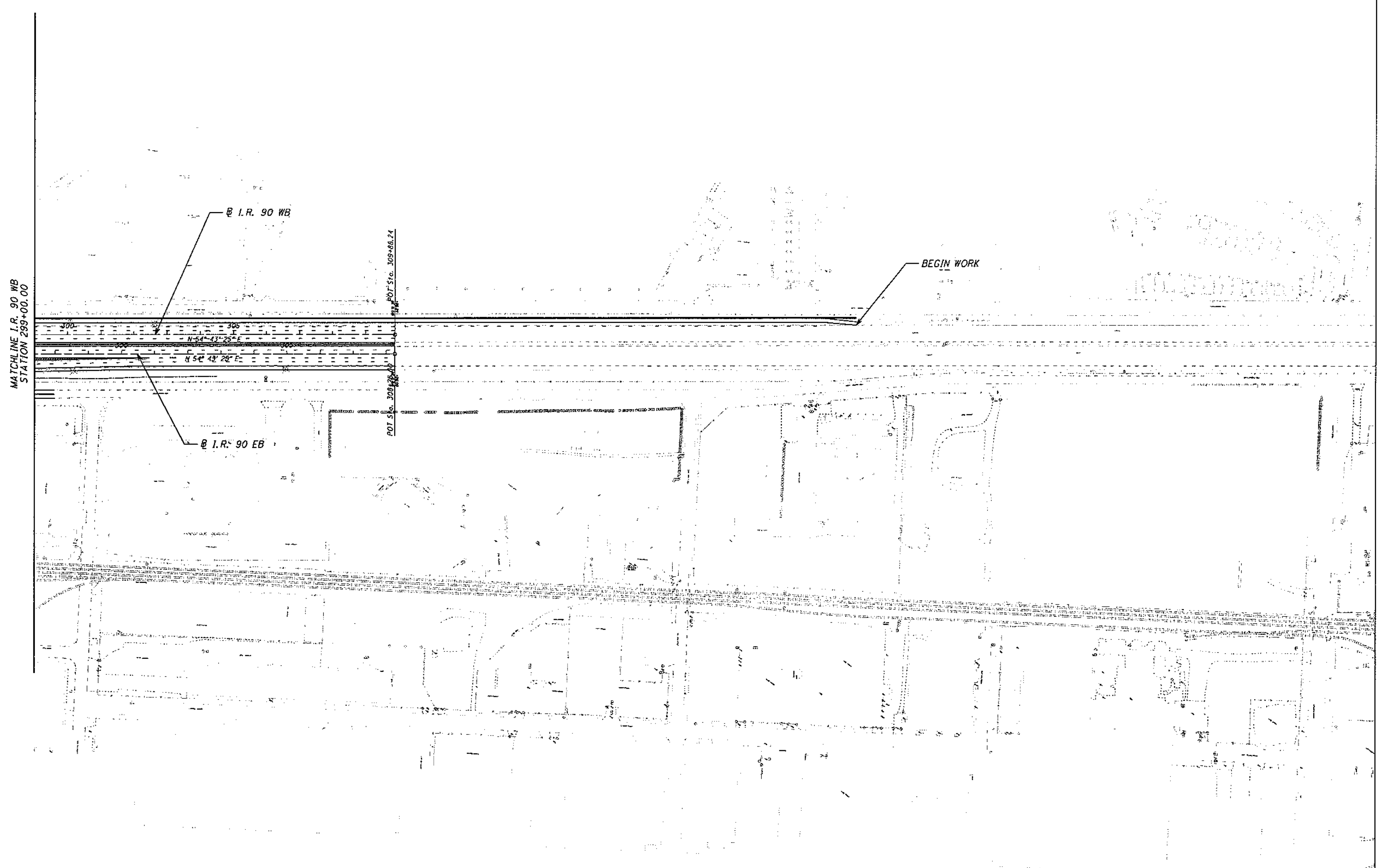
P.I. STA. 904+25.66
Ls = 200.00'
θs = 45° 50' 12"
LT = 138.10'
ST = 71.02'
x = 187.57'
y = 50.94'
k = 97.90'
p = 13.03'
e_{max} = 0.060
V_{des} = 30 MPH

CLEVELAND INNERBELTPLAN

INNERBELT CURVE PLAN

0' 200' 100'

JANUARY 16, 2007
DRAFT



CLEVELAND INNERBELTPLAN

INNERBELT TRENCH PLAN - SHEET 1

0' 100' 200'

JANUARY 16, 2007

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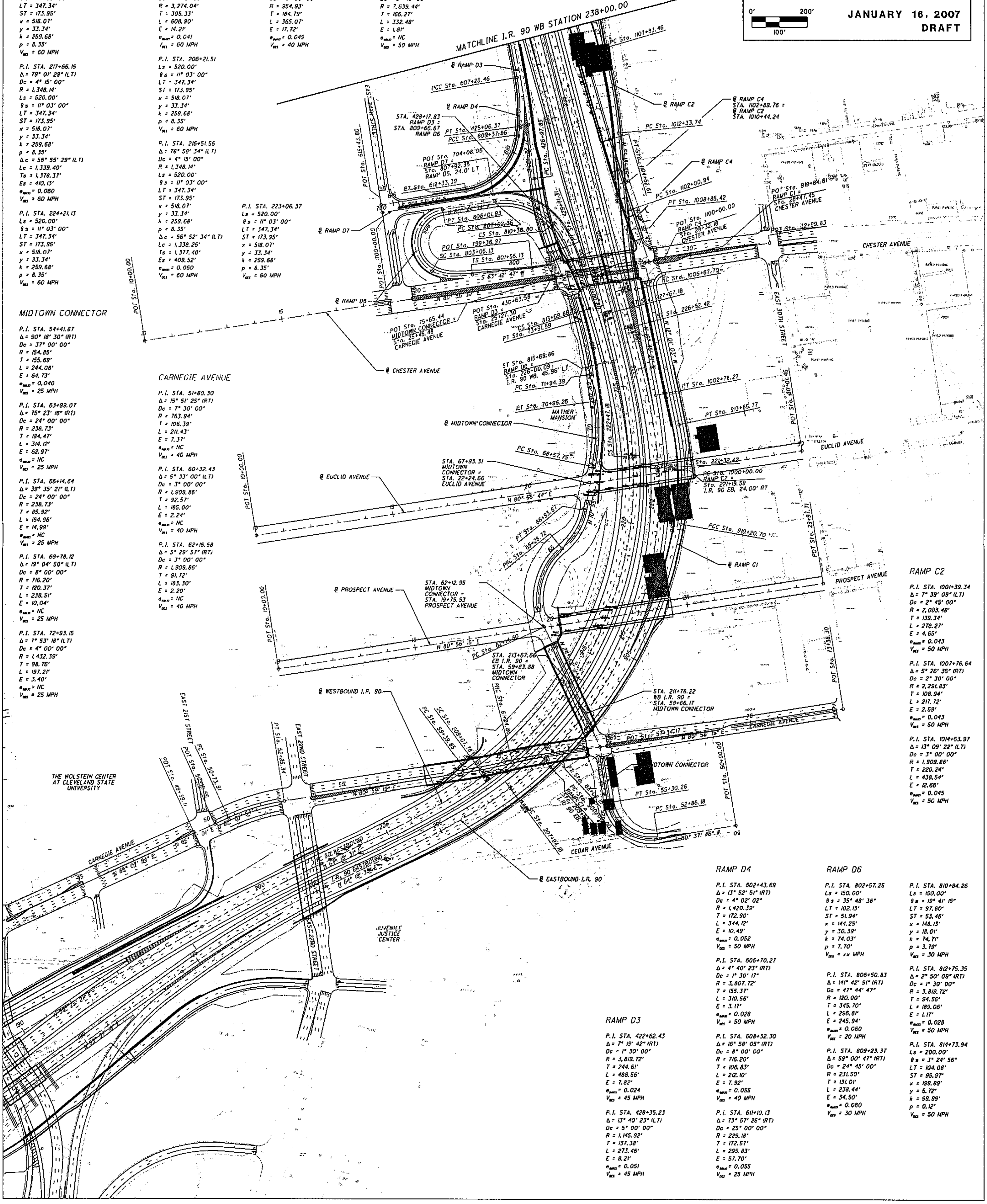


I.R. 90 WESTBOUND

P.I. STA. 199+92.47
Δ = 4° 54' 12" (RT)
D_c = 1° 00' 00"
R = 5,729.58'
T = 245.32'
L = 490.33'
E = 5.25'
e_{max} = 0.027
V_{des} = 60 MPH

P.I. STA. 207+35.12
Ls = 520.00'
θs = 11° 03' 00"
LT = 347.34'
ST = 173.95'
x = 518.07'
y = 33.34'
k = 259.68'
p = 8.35'
V_{des} = 60 MPH

P.I. STA. 217+66.15
Δ = 79° 01' 29" (LT)
D_c = 4° 15' 00"
R = 1,348.14'
Ls = 520.00'
θs = 11° 03' 00"
LT = 347.34'
ST = 173.95'
x = 518.07'
y = 33.34'
k = 259.68'
p = 8.35'
Δc = 56° 55' 29" (LT)
Lc = 1,339.40'
Ts = 1,378.37'
Es = 410.13'
e_{max} = 0.060
V_{des} = 60 MPH

P.I. STA. 224+21.13
Ls = 520.00'
θs = 11° 03' 00"
LT = 347.34'
ST = 173.95'
x = 518.07'
y = 33.34'
k = 259.68'
p = 8.35'
V_{des} = 60 MPH

I.R. 90 EASTBOUND

P.I. STA. 182+37.94
Δ = 13° 41' 43" (LT)
D_c = 1° 30' 10"
R = 3,812.72'
T = 457.86'
L = 911.35'
E = 27.39'
e_{max} = 0.037
V_{des} = 60 MPH

P.I. STA. 197+34.35
Δ = 10° 39' 21" (RT)
D_c = 1° 45' 00"
R = 3,274.04'
T = 305.33'
L = 608.90'
E = 14.21'
e_{max} = 0.041
V_{des} = 60 MPH

P.I. STA. 206+21.51
Ls = 520.00'
θs = 11° 03' 00"
LT = 347.34'
ST = 173.95'
x = 518.07'
y = 33.34'
k = 259.68'
p = 8.35'
V_{des} = 60 MPH

P.I. STA. 216+51.56
Δ = 78° 56' 34" (LT)
D_c = 4° 15' 00"
R = 1,348.14'
Ls = 520.00'
θs = 11° 03' 00"
LT = 347.34'
ST = 173.95'
x = 518.07'
y = 33.34'
k = 259.68'
p = 8.35'
Δc = 56° 52' 34" (LT)
Lc = 1,338.26'
Ts = 1,377.40'
Es = 409.52'
e_{max} = 0.060
V_{des} = 60 MPH

P.I. STA. 223+06.37
Ls = 520.00'
θs = 11° 03' 00"
LT = 347.34'
ST = 173.95'
x = 518.07'
y = 33.34'
k = 259.68'
p = 8.35'
V_{des} = 60 MPH

RAMP C1

P.I. STA. 905+28.42
Δ = 36° 34' 30" (LT)
D_c = 3° 35' 00"
R = 1,598.95'
T = 528.42'
L = 1,020.70'
E = 85.05'
e_{max} = 0.049
V_{des} = 50 MPH

P.I. STA. 912+05.49
Δ = 21° 54' 14" (LT)
D_c = 6° 00' 00"
R = 954.93'
T = 184.79'
L = 365.07'
E = 17.72'
e_{max} = 0.049
V_{des} = 40 MPH

RAMP C4

P.I. STA. 1103+31.80
Δ = 2° 37' 00" (RT)
D_c = 1° 00' 00"
R = 5,729.58'
T = 130.86'
L = 261.66'
E = 1.49'
e_{max} = 0.017
V_{des} = 45 MPH

P.I. STA. 1109+49.72
Δ = 2° 29' 37" (LT)
D_c = 0° 45' 00"
R = 7,639.44'
T = 166.27'
L = 332.48'
E = 1.81'
e_{max} = NC
V_{des} = 50 MPH

MIDTOWN CONNECTOR

P.I. STA. 54+41.87
Δ = 90° 18' 30" (RT)
D_c = 37° 00' 00"
R = 154.85'
T = 155.69'
L = 244.08'
E = 64.73'
e_{max} = 0.040
V_{des} = 25 MPH

P.I. STA. 63+99.07
Δ = 75° 23' 16" (RT)
D_c = 24° 00' 00"
R = 238.73'
T = 184.47'
L = 314.12'
E = 62.97'
e_{max} = NC
V_{des} = 25 MPH

P.I. STA. 66+14.64
Δ = 39° 35' 21" (LT)
D_c = 24° 00' 00"
R = 238.73'
T = 85.92'
L = 164.96'
E = 14.99'
e_{max} = NC
V_{des} = 25 MPH

P.I. STA. 69+78.12
Δ = 19° 04' 50" (LT)
D_c = 8° 00' 00"
R = 716.20'
T = 120.37'
L = 238.51'
E = 10.04'
e_{max} = NC
V_{des} = 25 MPH

P.I. STA. 72+93.15
Δ = 7° 53' 18" (LT)
D_c = 4° 00' 00"
R = 1,432.39'
T = 98.76'
L = 197.21'
E = 3.40'
e_{max} = NC
V_{des} = 25 MPH

CARNEGIE AVENUE

P.I. STA. 51+80.30
Δ = 15° 51' 25" (RT)
D_c = 7° 30' 00"
R = 763.94'
T = 106.39'
L = 211.43'
E = 7.37'
e_{max} = NC
V_{des} = 40 MPH

P.I. STA. 60+32.43
Δ = 5° 33' 00" (LT)
D_c = 3° 00' 00"
R = 1,909.86'
T = 92.57'
L = 185.00'
E = 2.24'
e_{max} = NC
V_{des} = 40 MPH

P.I. STA. 62+16.58
Δ = 5° 29' 57" (RT)
D_c = 3° 00' 00"
R = 1,909.86'
T = 91.72'
L = 183.30'
E = 2.20'
e_{max} = NC
V_{des} = 40 MPH

RAMP C2

P.I. STA. 1001+39.34
Δ = 7° 39' 09" (LT)
D_c = 2° 45' 00"
R = 2,083.48'
T = 139.34'
L = 278.27'
E = 4.65'
e_{max} = 0.043
V_{des} = 50 MPH

P.I. STA. 1007+76.64
Δ = 5° 26' 35" (RT)
D_c = 2° 30' 00"
R = 2,291.83'
T = 108.94'
L = 217.72'
E = 2.59'
e_{max} = 0.043
V_{des} = 50 MPH

P.I. STA. 1014+53.97
Δ = 13° 09' 22" (LT)
D_c = 3° 00' 00"
R = 1,909.86'
T = 220.24'
L = 438.54'
E = 12.66'
e_{max} = 0.045
V_{des} = 50 MPH

RAMP D3

P.I. STA. 422+62.43
Δ = 7° 19' 42" (RT)
D_c = 1° 30' 00"
R = 3,819.72'
T = 244.61'
L = 488.56'
E = 7.82'
e_{max} = 0.024
V_{des} = 45 MPH

P.I. STA. 428+35.23
Δ = 13° 40' 23" (LT)
D_c = 5° 00' 00"
R = 1,145.92'
T = 137.38'
L = 273.46'
E = 8.21'
e_{max} = 0.051
V_{des} = 45 MPH

RAMP D4

P.I. STA. 602+43.69
Δ = 13° 52' 51" (RT)
D_c = 4° 02' 02"
R = 1,420.39'
T = 172.90'
L = 344.12'
E = 10.49'
e_{max} = 0.052
V_{des} = 50 MPH

P.I. STA. 605+70.27
Δ = 4° 40' 23" (RT)
D_c = 1° 30' 17"
R = 3,807.72'
T = 155.37'
L = 310.56'
E = 3.17'
e_{max} = 0.028
V_{des} = 50 MPH

P.I. STA. 608+32.30
Δ = 16° 58' 05" (RT)
D_c = 8° 00' 00"
R = 716.20'
T = 106.83'
L = 212.10'
E = 7.92'
e_{max} = 0.055
V_{des} = 40 MPH

P.I. STA. 611+10.13
Δ = 73° 57' 25" (RT)
D_c = 25° 00' 00"
R = 229.18'
T = 172.57'
L = 295.83'
E = 57.70'
e_{max} = 0.055
V_{des} = 25 MPH

RAMP D6

P.I. STA. 802+57.25
Ls = 150.00'
θs = 35° 48' 36"
LT = 102.13'
ST = 51.94'
x = 144.25'
y = 30.39'
k = 74.03'
p = 7.70'
V_{des} = xx MPH

P.I. STA. 806+50.83
Δ = 141° 42' 51" (RT)
D_c = 47° 44' 47"
R = 120.00'
T = 345.70'
L = 296.81'
E = 245.94'
e_{max} = 0.060
V_{des} = 20 MPH

P.I. STA. 809+23.37
Δ = 59° 00' 47" (RT)
D_c = 24° 45' 00"
R = 231.50'
T = 131.01'
L = 238.44'
E = 34.50'
e_{max} = 0.060
V_{des} = 30 MPH

P.I. STA. 810+84.26
Ls = 150.00'
θs = 19° 41' 15"
LT = 97.80'
ST = 53.46'
x = 148.13'
y = 18.01'
k = 74.71'
p = 3.79'
V_{des} = 30 MPH

P.I. STA. 812+75.35
Δ = 2° 50' 09" (RT)
D_c = 1° 30' 00"
R = 3,819.72'
T = 94.55'
L = 189.06'
E = 1.17'
e_{max} = 0.028
V_{des} = 50 MPH

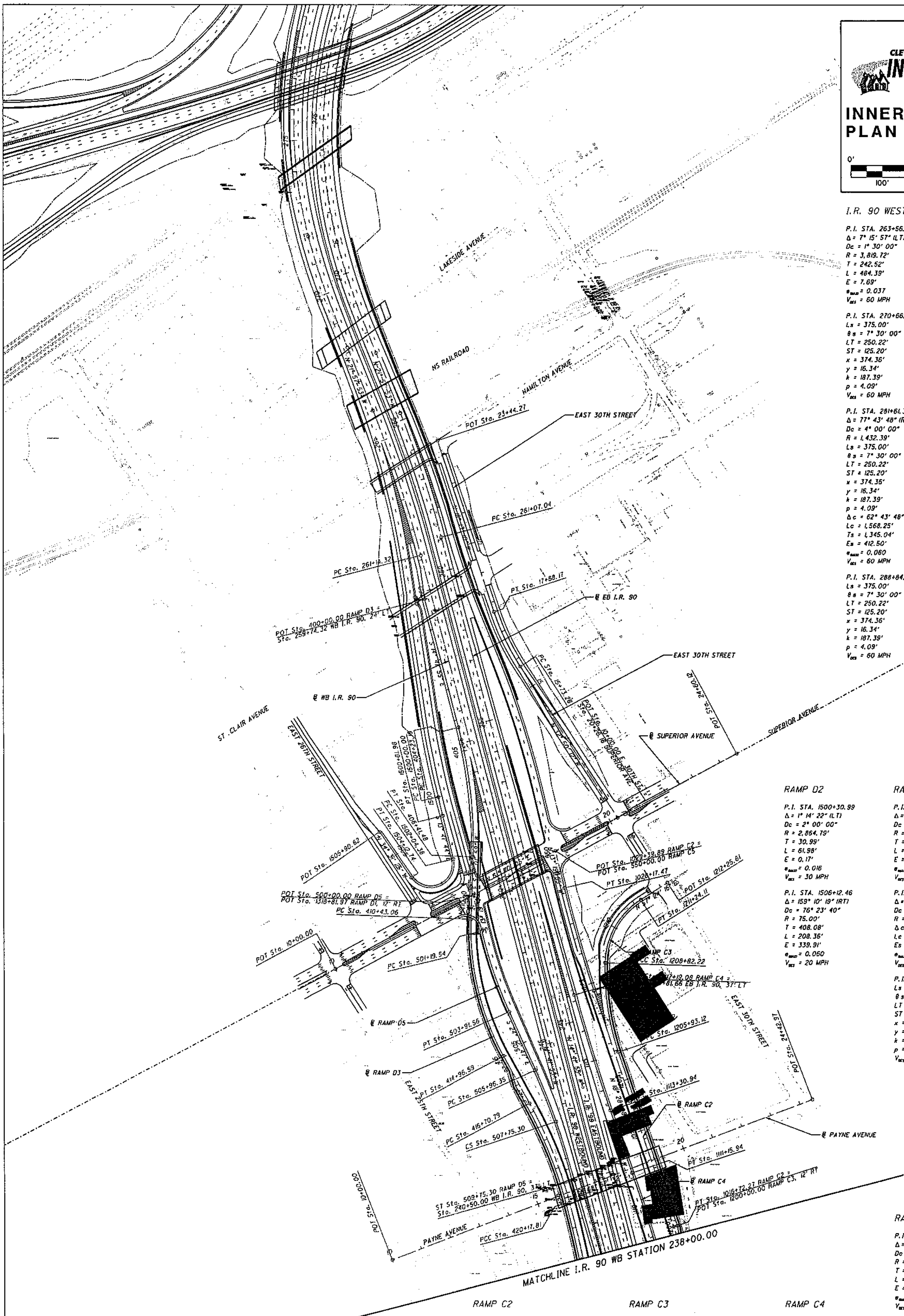
P.I. STA. 814+73.94
Ls = 200.00'
θs = 3° 24' 56"
LT = 104.08'
ST = 95.97'
x = 199.89'
y = 5.72'
k = 99.99'
p = 0.12'
V_{des} = 50 MPH

INNERBELT TRENCH PLAN - SHEET 2

CLEVELAND INNERBELT PLAN

0' 100' 200'

JANUARY 16, 2007
DRAFT



I.R. 90 WESTBOUND

P.I. STA. 263+56.84
Δ = 7° 15' 57" (LT)
Dc = 1° 30' 00"
R = 3,819.72'
T = 242.52'
L = 484.39'
E = 7.69'
e_{max} = 0.037
V_{des} = 60 MPH

P.I. STA. 270+66.48
Ls = 375.00'
θs = 7° 30' 00"
LT = 250.22'
ST = 125.20'
x = 374.36'
y = 16.34'
k = 187.39'
p = 4.09'
V_{des} = 60 MPH

P.I. STA. 281+61.30
Δ = 77° 43' 48" (RT)
Dc = 4° 00' 00"
R = 1,432.39'
Ls = 375.00'
θs = 7° 30' 00"
LT = 250.22'
ST = 125.20'
x = 374.36'
y = 16.34'
k = 187.39'
p = 4.09'
Δc = 62° 43' 48" (RT)
Lc = 1,568.25'
Ts = 1,345.04'
Es = 412.50'
e_{max} = 0.060
V_{des} = 60 MPH

P.I. STA. 288+84.71
Ls = 375.00'
θs = 7° 30' 00"
LT = 250.22'
ST = 125.20'
x = 374.36'
y = 16.34'
k = 187.39'
p = 4.09'
V_{des} = 60 MPH

I.R. 90 EASTBOUND

P.I. STA. 263+14.92
Δ = 7° 15' 57" (LT)
Dc = 1° 45' 00"
R = 3,274.04'
T = 207.88'
L = 415.19'
E = 6.59'
e_{max} = 0.041
V_{des} = 60 MPH

P.I. STA. 269+79.16
Ls = 375.00'
θs = 7° 39' 23"
LT = 250.23'
ST = 125.21'
x = 374.33'
y = 16.68'
k = 187.39'
p = 4.17'
V_{des} = 60 MPH

P.I. STA. 280+09.40
Δ = 75° 40' 25" (RT)
Dc = 4° 05' 00"
R = 1,403.16'
Ls = 375.00'
θs = 7° 39' 23"
LT = 250.23'
ST = 125.21'
x = 374.33'
y = 16.68'
k = 187.39'
p = 4.17'
Δc = 60° 21' 40" (RT)
Lc = 1,478.23'
Ts = 1,280.48'
Es = 378.81'
e_{max} = 0.060
V_{des} = 60 MPH

P.I. STA. 287+07.37
Ls = 375.00'
θs = 7° 39' 23"
LT = 250.23'
ST = 125.21'
x = 374.33'
y = 16.68'
k = 187.39'
p = 4.17'
V_{des} = 60 MPH

RAMP D3

P.I. STA. 406+33.83
Δ = 16° 43' 55" (RT)
Dc = 4° 00' 00"
R = 1,432.39'
T = 210.65'
L = 418.30'
E = 15.41'
e_{max} = 0.052
V_{des} = 50 MPH

P.I. STA. 412+75.38
Δ = 30° 36' 46" (LT)
Dc = 6° 45' 00"
R = 848.83'
T = 232.31'
L = 453.52'
E = 31.22'
e_{max} = 0.060
V_{des} = 50 MPH

P.I. STA. 418+45.16
Δ = 13° 52' 51" (RT)
Dc = 4° 00' 00"
R = 1,432.39'
T = 174.37'
L = 347.02'
E = 10.57'
e_{max} = 0.046
V_{des} = 45 MPH

P.I. STA. 422+62.43
Δ = 7° 19' 42" (RT)
Dc = 1° 30' 00"
R = 3,819.72'
T = 244.61'
L = 488.56'
E = 7.82'
e_{max} = 0.024
V_{des} = 45 MPH

RAMP D2

P.I. STA. 1500+30.99
Δ = 1° 14' 22" (LT)
Dc = 2° 00' 00"
R = 2,864.79'
T = 30.99'
L = 61.98'
E = 0.17'
e_{max} = 0.016
V_{des} = 30 MPH

P.I. STA. 1506+12.46
Δ = 159° 10' 19" (RT)
Dc = 76° 23' 40"
R = 75.00'
T = 408.08'
L = 208.36'
E = 339.91'
e_{max} = 0.060
V_{des} = 20 MPH

RAMP D5

P.I. STA. 502+55.96
Δ = 10° 52' 51" (LT)
Dc = 4° 00' 00"
R = 1,432.39'
T = 136.42'
L = 272.02'
E = 6.48'
e_{max} = 0.028
V_{des} = 30 MPH

P.I. STA. 507+42.07
Δ = 8° 22' 07" (RT)
Dc = 3° 00' 00"
R = 1,909.86'
Δc = 5° 22' 07" (RT)
Lc = 178.95'
Es = 5.55'
e_{max} = 0.039
V_{des} = 45 MPH

P.I. STA. 508+41.99
Ls = 200.00'
θs = 3° 00' 00"
LT = 133.35'
ST = 66.68'
x = 199.95'
y = 3.49'
k = 99.99'
p = 0.87'
V_{des} = 45 MPH

RAMP C5

P.I. STA. 554+18.62
Δ = 8° 46' 36" (LT)
Dc = 2° 00' 00"
R = 2,864.79'
T = 219.65'
L = 438.84'
E = 8.42'
e_{max} = 0.035
V_{des} = 50 MPH

P.I. STA. 559+21.95
Δ = 5° 47' 00" (RT)
Dc = 2° 00' 00"
R = 2,864.79'
Δc = 3° 47' 00" (RT)
Lc = 189.17'
Es = 3.95'
e_{max} = 0.035
V_{des} = 50 MPH

P.I. STA. 560+27.31
Ls = 200.00'
θs = 2° 00' 00"
LT = 133.34'
ST = 66.67'
x = 199.98'
y = 2.33'
k = 100.00'
p = 0.58'
V_{des} = 50 MPH

RAMP D1

P.I. STA. 1301+49.90
Δ = 1° 59' 54" (RT)
Dc = 0° 40' 00"
R = 8,594.37'
T = 149.90'
L = 299.76'
E = 1.31'
e_{max} = 0.037
V_{des} = 60 MPH

P.I. STA. 1305+50.56
Δ = 10° 50' 07" (RT)
Dc = 2° 10' 00"
R = 2,644.42'
T = 250.79'
L = 500.09'
E = 11.87'
e_{max} = 0.037
V_{des} = 50 MPH

P.I. STA. 1314+44.20
Δ = 6° 34' 31" (LT)
Dc = 2° 00' 00"
R = 2,864.79'
T = 164.56'
L = 328.76'
E = 4.72'
e_{max} = 0.030
V_{des} = 45 MPH

RAMP C2

P.I. STA. 1014+53.97
Δ = 13° 09' 22" (LT)
Dc = 3° 00' 00"
R = 1,909.86'
T = 220.24'
L = 438.54'
E = 12.66'
e_{max} = 0.045
V_{des} = 50 MPH

P.I. STA. 1026+46.36
Δ = 5° 08' 13" (RT)
Dc = 1° 30' 00"
R = 3,819.72'
T = 171.34'
L = 342.46'
E = 3.84'
e_{max} = 0.020
V_{des} = 40 MPH

RAMP C3

P.I. STA. 1207+39.19
Δ = 20° 14' 14" (RT)
Dc = 7° 00' 00"
R = 818.51'
T = 146.07'
L = 289.10'
E = 12.93'
e_{max} = 0.053
V_{des} = 40 MPH

P.I. STA. 1210+13.66
Δ = 55° 38' 11" (RT)
Dc = 23° 00' 00"
R = 249.11'
T = 131.44'
L = 241.90'
E = 32.55'
e_{max} = 0.060
V_{des} = 30 MPH

RAMP C4

P.I. STA. 1109+49.72
Δ = 2° 29' 37" (LT)
Dc = 0° 45' 00"
R = 7,639.44'
T = 166.27'
L = 332.48'
E = 1.81'
e_{max} = NC
V_{des} = 45 MPH

P.I. STA. 1115+25.05
Δ = 2° 54' 40" (RT)
Dc = 0° 45' 00"
R = 7,639.44'
T = 194.11'
L = 388.14'
E = 2.47'
e_{max} = NC
V_{des} = 50 MPH

EAST 30TH STREET

P.I. STA. 16+71.25
Δ = 14° 37' 01" (RT)
Dc = 7° 30' 00"
R = 763.94'
T = 97.98'
L = 194.89'
E = 6.26'
e_{max} = NC
V_{des} = 30 MPH

WESTBOUND CENTRAL INTERCHANGE PLAN - SHEET 1

CLEVELAND INNERBELTPLAN

0' 100' 200'

JANUARY 16, 2007

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RAMP A6

P.I. STA. 802+84.13
L_s = 200.00'
θ_s = 31° 00' 00"
LT = 135.44'
ST = 68.58'
x = 194.22'
y = 35.32'
k = 99.03'
p = 8.92'
e_{max} = 0.058
V_{des} = 25 MPH

P.I. STA. 803+26.75
Δ = 249° 55' 29" (LT)
Dc = 31° 00' 00"
R = 184.83'
L_s = 200.00'
θ_s = 31° 00' 00"
LT = 135.44'
ST = 68.58'
x = 194.22'
y = 35.32'
k = 99.03'
p = 8.92'
Δc = 187° 55' 29" (LT)
Lc = 606.21'
Ts = 178.06'
Es = 24.42'
e_{max} = 0.058
V_{des} = 25 MPH

P.I. STA. 810+23.49
L_s = 200.00'
θ_s = 31° 00' 00"
LT = 135.44'
ST = 68.58'
x = 194.22'
y = 35.32'
k = 99.03'
p = 8.92'
e_{max} = 0.058
V_{des} = 25 MPH

P.I. STA. 816+15.13
Δ = 2° 49' 03" (LT)
Dc = 1° 30' 00"
R = 3,819.72'
T = 93.94'
L = 187.83'
E = 1.15'
e_{max} = 0.028
V_{des} = 50 MPH

RAMP A7

P.I. STA. 1001+01.85
Δ = 3° 03' 17" (RT)
Dc = 1° 30' 00"
R = 3,819.72'
T = 101.85'
L = 203.66'
E = 1.36'
e_{max} = 0.028
V_{des} = 50 MPH

P.I. STA. 1005+92.11
Δ = 7° 07' 43" (LT)
Dc = 2° 00' 00"
R = 2,864.79'
T = 178.45'
L = 356.44'
E = 5.55'
e_{max} = 0.035
V_{des} = 50 MPH

P.I. STA. 1009+68.38
Δ = 1° 11' 31" (RT)
Dc = 0° 18' 02"
R = 19,063.98'
T = 198.29'
L = 396.56'
E = 1.03'
e_{max} = 0.016
V_{des} = 45 MPH

P.I. STA. 1015+01.79
Δ = 9° 06' 08" (RT)
Dc = 5° 12' 18"
R = 1,100.80'
T = 87.62'
L = 174.88'
E = 3.48'
e_{max} = 0.040
V_{des} = 35 MPH

P.I. STA. 1016+56.94
Δ = 13° 02' 22" (RT)
Dc = 9° 38' 40"
R = 594.08'
T = 67.89'
L = 135.20'
E = 3.87'
e_{max} = 0.045
V_{des} = 30 MPH

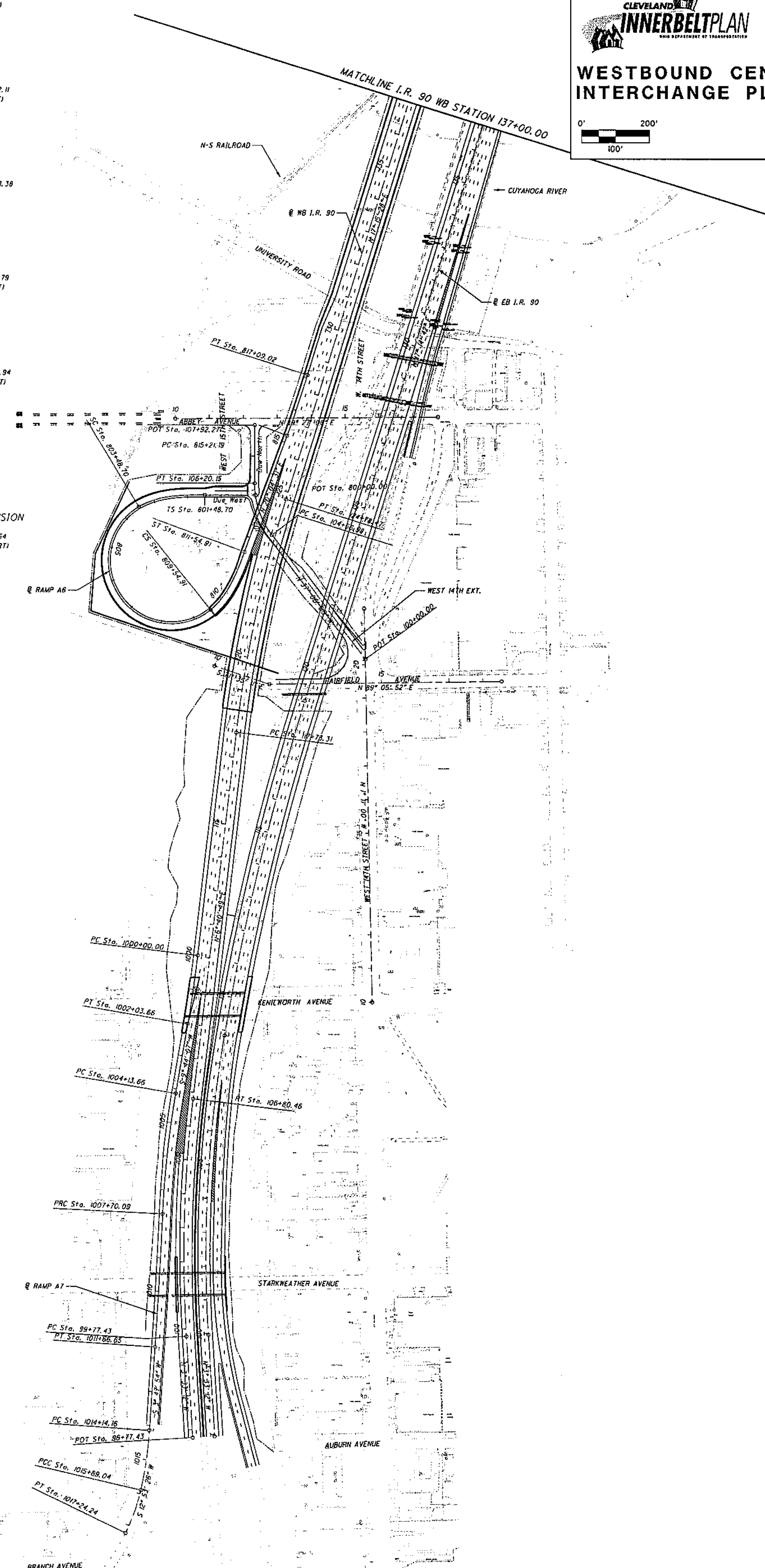
I.R. 90 WESTBOUND

P.I. STA. 103+29.88
Δ = 10° 14' 02" (RT)
Dc = 1° 27' 20"
R = 3,936.03'
T = 352.45'
L = 703.03'
E = 15.75'
e_{max} = 0.037
V_{des} = 60 MPH

P.I. STA. 121+26.89
Δ = 10° 34' 39" (RT)
Dc = 1° 30' 00"
R = 3,819.72'
T = 353.58'
L = 705.16'
E = 16.33'
e_{max} = 0.037
V_{des} = 60 MPH

W14TH EXTENSION

P.I. STA. 105+41.54
Δ = 37° 06' 00" (RT)
Dc = 22° 44' 11"
R = 252.00'
T = 84.56'
L = 163.17'
E = 13.81'
e_{max} = 0.016
V_{des} = 25 MPH



WESTBOUND CENTRAL INTERCHANGE PLAN - SHEET 2

JANUARY 16, 2007

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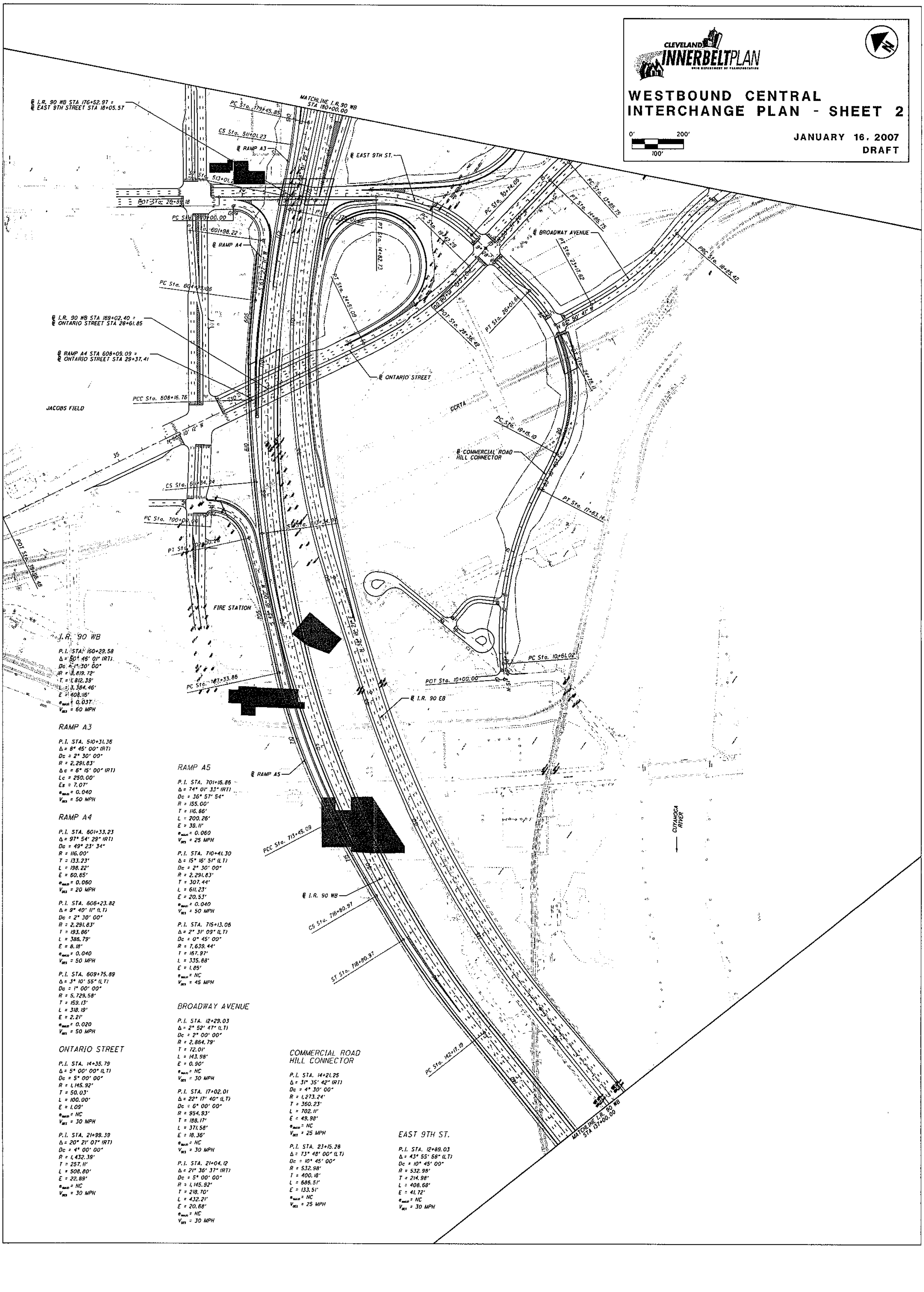

CLEVELAND INNERBELTPLAN

WESTBOUND CENTRAL INTERCHANGE PLAN - SHEET 3

0' 100' 200'

JANUARY 16, 2007

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I.R. 90 WB

P.I. STA. 183+38.73
Δ = 15° 37' 04" (LT)
Dc = 2° 00' 00"
R = 2,864.79'
T = 392.88'
L = 780.89'
E = 26.81'
e_{max} = 0.045
V_{des} = 60 MPH

P.I. STA. 196+43.69
Δ = 11° 55' 09" (RT)
Dc = 1° 00' 00"
R = 5,729.58'
T = 598.11'
L = 1,191.91'
E = 31.13'
e_{max} = 0.027
V_{des} = 60 MPH

P.I. STA. 207+35.12
Ls = 520.00'
θs = 11° 03' 00"
LT = 347.34'
ST = 173.95'
x = 518.07'
y = 33.34'
k = 259.68'
p = 8.35'
e_{max} = 0.027
V_{des} = 60 MPH

RAMP A2

P.I. STA. 403+96.44
Δ = 2° 38' 33" (LT)
Dc = 0° 20' 00"
R = 17,188.73'
T = 396.44'
L = 792.75'
E = 4.57'
e_{max} = NC
V_{des} = 50 MPH

P.I. STA. 421+19.73
Δ = 89° 35' 47" (LT)
Dc = 8° 30' 00"
R = 674.07'
T = 669.34'
L = 1,054.08'
E = 275.87'
e_{max} = 0.060
V_{des} = 45 MPH

P.I. STA. 430+61.40
Δ = 47° 15' 00" (LT)
Dc = 4° 30' 00"
R = 1,273.24'
T = 556.93'
L = 1,050.00'
E = 116.47'
e_{max} = 0.049
V_{des} = 45 MPH

RAMP A3

P.I. STA. 502+18.94
Δ = 89° 37' 36" (RT)
Dc = 26° 00' 00"
R = 220.37'
T = 218.94'
L = 344.72'
E = 90.27'
e_{max} = 0.056
V_{des} = 25 MPH

P.I. STA. 510+31.36
Δ = 8° 45' 00" (RT)
Dc = 2° 30' 00"
R = 2,291.83'
Δc = 6° 15' 00" (RT)
Lc = 250.00'
Es = 7.07'
e_{max} = 0.035
V_{des} = 45 MPH

P.I. STA. 511+67.91
Ls = 200.00'
θs = 2° 30' 00"
LT = 133.35'
ST = 66.68'
x = 199.96'
y = 2.91'
k = 99.99'
p = 0.73'
e_{max} = 0.035
V_{des} = 45 MPH

RAMP A1

P.I. STA. 301+93.40
Δ = 70° 30' 41" (RT)
Dc = 39° 30' 52"
R = 145.00'
T = 102.50'
L = 178.45'
E = 32.57'
e_{max} = 0.060
V_{des} = 25 MPH

EAST 18TH STREET

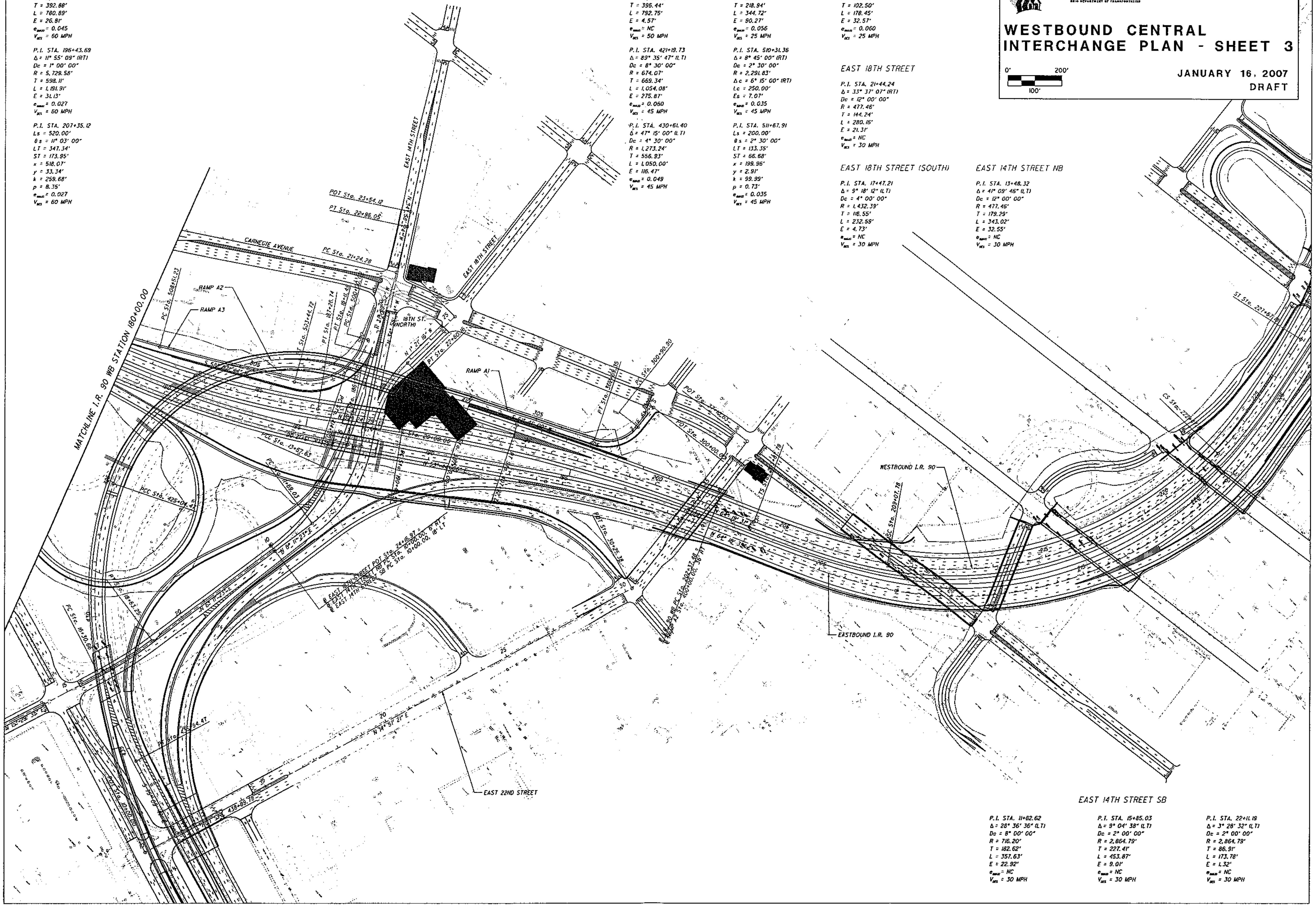
P.I. STA. 21+44.24
Δ = 33° 37' 07" (RT)
Dc = 12° 00' 00"
R = 477.46'
T = 144.24'
L = 280.16'
E = 21.31'
e_{max} = NC
V_{des} = 30 MPH

EAST 18TH STREET (SOUTH)

P.I. STA. 17+47.21
Δ = 9° 18' 12" (LT)
Dc = 4° 00' 00"
R = 1,432.39'
T = 116.55'
L = 232.59'
E = 4.73'
e_{max} = NC
V_{des} = 30 MPH

EAST 14TH STREET NB

P.I. STA. 13+48.32
Δ = 41° 09' 46" (LT)
Dc = 12° 00' 00"
R = 477.46'
T = 179.29'
L = 343.02'
E = 32.55'
e_{max} = NC
V_{des} = 30 MPH

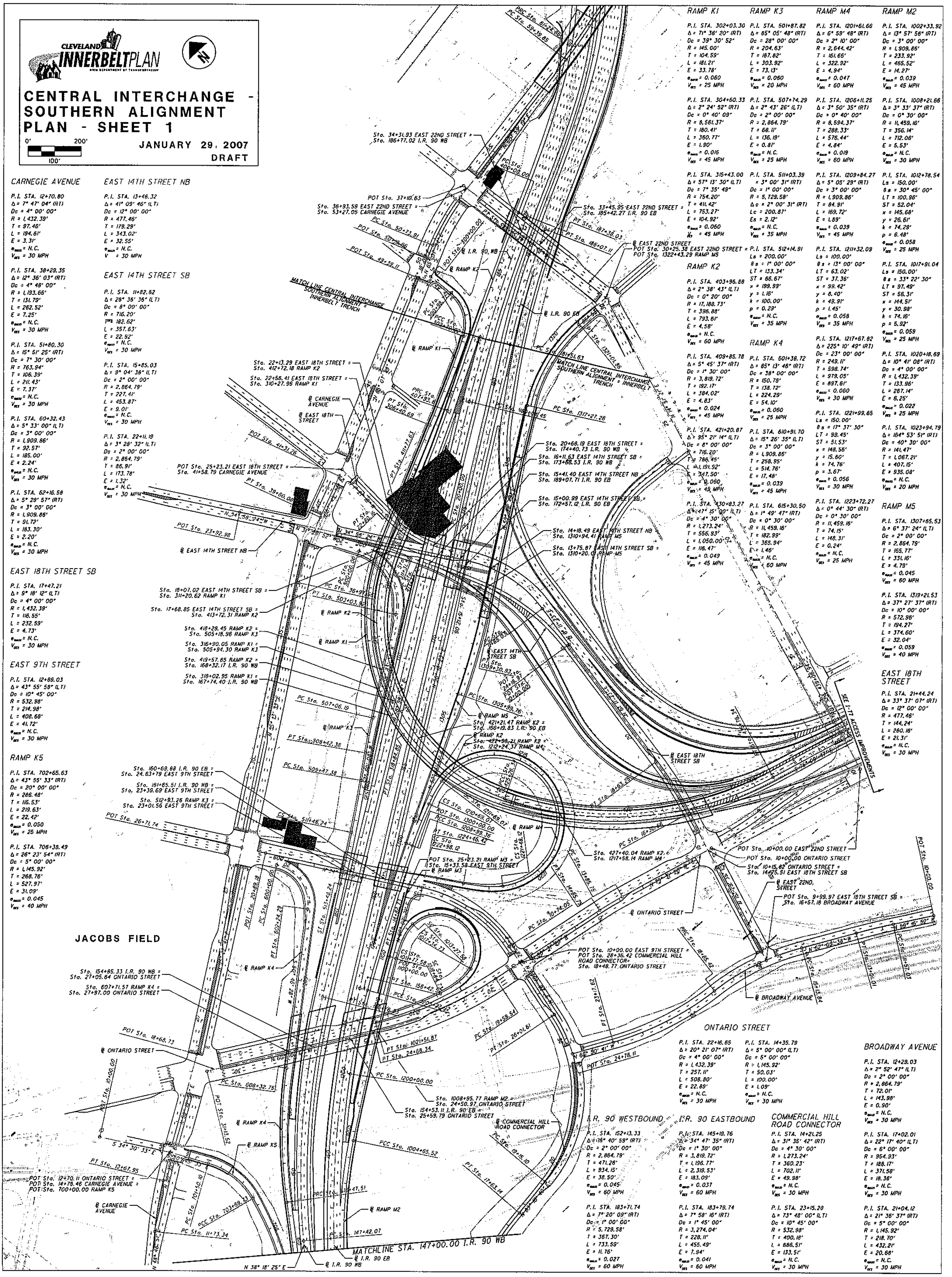


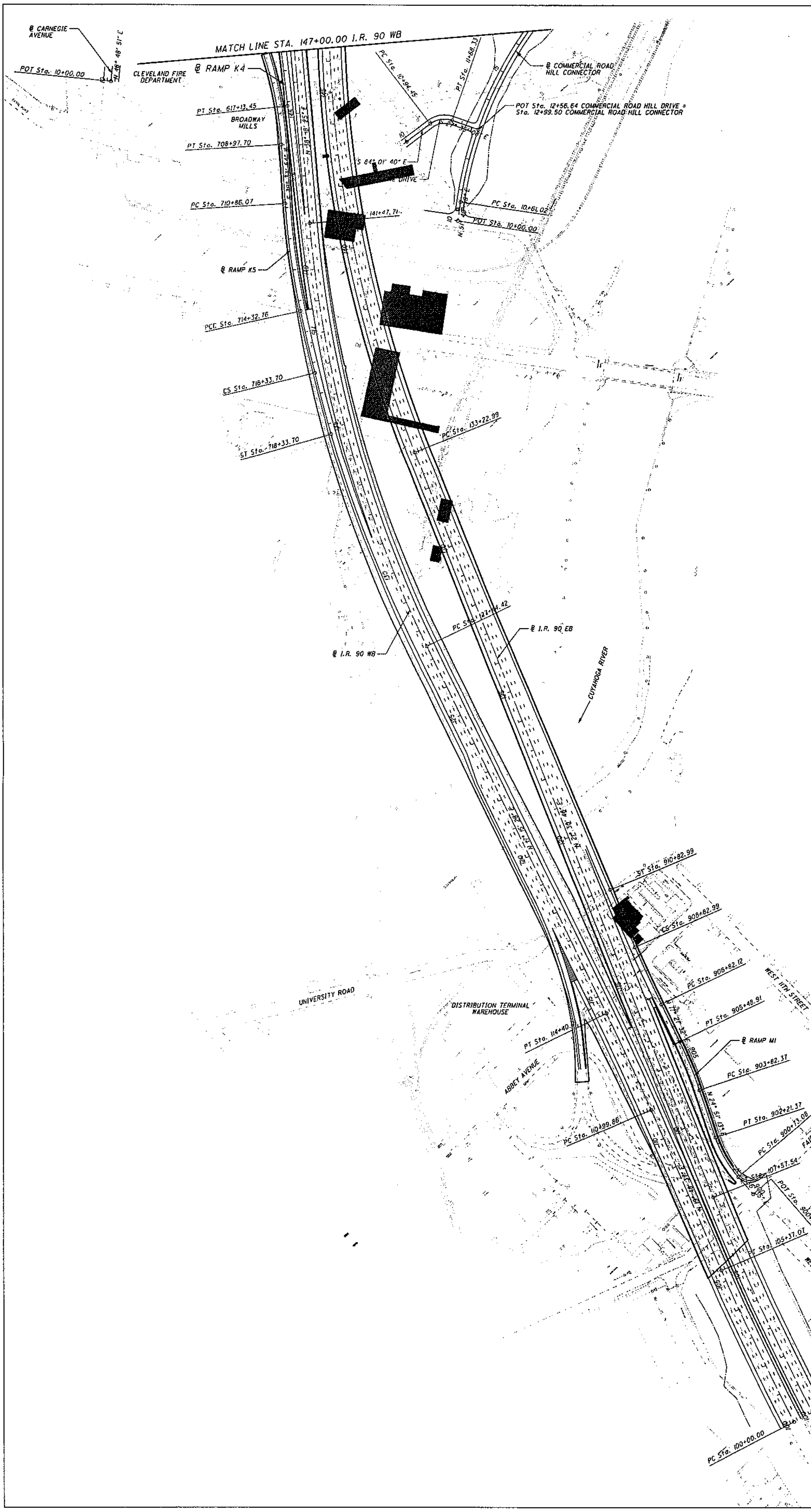
EAST 14TH STREET SB

P.I. STA. 11+82.62
Δ = 28° 36' 36" (LT)
Dc = 8° 00' 00"
R = 716.20'
T = 182.62'
L = 357.63'
E = 22.92'
e_{max} = NC
V_{des} = 30 MPH

P.I. STA. 15+85.03
Δ = 9° 04' 38" (LT)
Dc = 2° 00' 00"
R = 2,864.79'
T = 227.41'
L = 453.87'
E = 9.01'
e_{max} = NC
V_{des} = 30 MPH

P.I. STA. 22+11.19
Δ = 3° 28' 32" (LT)
Dc = 2° 00' 00"
R = 2,864.79'
T = 86.91'
L = 173.78'
E = 1.32'
e_{max} = NC
V_{des} = 30 MPH


CLEVELAND INNERBELTPLAN
CENTRAL INTERCHANGE - SOUTHERN ALIGNMENT
PLAN - SHEET 1
0' 200'
100'
JANUARY 29, 2007
DRAFT
CARNEGIE AVENUE
EAST 14TH STREET NB
EAST 14TH STREET SB
EAST 18TH STREET SB
EAST 9TH STREET
RAMP K5
RAMP K1
RAMP K3
RAMP M4
RAMP M2
RAMP K2
RAMP K4
RAMP M5
EAST 18TH STREET
JACOBS FIELD
ONTARIO STREET
BROADWAY AVENUE
I.R. 90 WESTBOUND
I.R. 90 EASTBOUND
COMMERCIAL HILL ROAD CONNECTOR
SEE I-77 ACCESS IMPROVEMENTS
MATCHLINE STA. 147+00.00 I.R. 90 WB



CLEVELAND INNERBELT PLAN

CENTRAL INTERCHANGE - SOUTHERN ALIGNMENT PLAN - SHEET 2

0' 100' 200'

JANUARY 29, 2007

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RAMP K5

P.I. STA. 706+38.49
Δ = 26° 23' 54" (RT)
Dc = 5° 00' 00"
R = 1,145.92'
T = 268.76'
L = 527.97'
E = 31.09'
e_{max} = 0.039
V_{des} = 35 MPH

P.I. STA. 712+59.75
Δ = 8° 40' 02" (LT)
Dc = 2° 30' 00"
R = 2,291.83'
T = 173.68'
L = 346.69'
E = 6.57'
e_{max} = 0.040
V_{des} = 50 MPH

P.I. STA. 715+33.24
Δ = 1° 30' 25" (LT)
Dc = 0° 45' 00"
R = 7,639.44'
T = 100.47'
L = 200.94'
E = 0.66'
e_{max} = 0.016
V_{des} = 50 MPH

P.I. STA. 717+44.64
Ls = 200.00'
θs = 2° 13' 54"
LT = 110.94'
ST = 89.08'
x = 199.96'
y = 3.47'
k = 99.99'
p = 0.21'
e_{max} = 0.016
V_{des} = 50 MPH

I.R. 90 WESTBOUND

P.I. STA. 134+54.07
Δ = 21° 02' 57" (RT)
Dc = 1° 30' 00"
R = 3,819.72'
T = 709.64'
L = 1,403.29'
E = 65.36'
e_{max} = 0.037
V_{des} = 60 MPH

P.I. STA. 112+70.06
Δ = 2° 33' 10" (LT)
Dc = 0° 45' 00"
R = 7,639.44'
T = 170.21'
L = 340.36'
E = 1.90'
e_{max} = 0.021
V_{des} = 60 MPH

P.I. STA. 102+68.65
Δ = 4° 01' 41" (RT)
Dc = 0° 45' 00"
R = 7,639.44'
T = 268.65'
L = 537.07'
E = 4.72'
e_{max} = 0.021
V_{des} = 60 MPH

I.R. 90 EASTBOUND

P.I. STA. 145+19.76
Δ = 34° 47' 35" (RT)
Dc = 1° 30' 00"
R = 3,819.72'
T = 1,196.77'
L = 2,319.53'
E = 183.09'
e_{max} = 0.037
V_{des} = 60 MPH

P.I. STA. 103+79.09
Δ = 5° 43' 52" (RT)
Dc = 0° 45' 24"
R = 7,573.44'
T = 379.09'
L = 757.54'
E = 9.48'
e_{max} = 0.021
V_{des} = 60 MPH

RAMP K4

P.I. STA. 615+30.50
Δ = 1° 49' 47" (RT)
Dc = 0° 30' 00"
R = 11,459.16'
T = 182.99'
L = 365.94'
E = 1.46'
e_{max} = 0.016
V_{des} = 55 MPH

COMMERCIAL ROAD HILL CONNECTOR

P.I. STA. 14+21.25
Δ = 31° 35' 42" (RT)
Dc = 4° 30' 00"
R = 1,273.24'
T = 360.23'
L = 702.11'
E = 49.98'
e_{max} = 0.016
V_{des} = 25 MPH

RAMP M1

P.I. STA. 901+48.17
Δ = 22° 14' 37" (RT)
Dc = 15° 00' 00"
R = 381.97'
T = 75.09'
L = 148.29'
E = 7.31'
e_{max} = 0.045
V_{des} = 25 MPH

P.I. STA. 904+65.76
Δ = 7° 29' 41" (LT)
Dc = 4° 30' 00"
R = 1,273.24'
T = 83.39'
L = 166.55'
E = 2.73'
e_{max} = 0.037
V_{des} = 35 MPH

P.I. STA. 908+38.13
Δ = 3° 00' 31" (RT)
Dc = 1° 00' 00"
R = 5,729.58'
Δc = 2° 00' 31" (RT)
Lc = 200.87'
Es = 2.12'
e_{max} = 0.020
V_{des} = 50 MPH

P.I. STA. 909+49.66
Ls = 200.00'
θs = 1° 00' 00"
LT = 133.34'
ST = 66.67'
x = 199.99'
y = 1.16'
k = 100.00'
p = 0.29'
e_{max} = 0.020
V_{des} = 50 MPH

COMMERCIAL ROAD HILL DRIVE

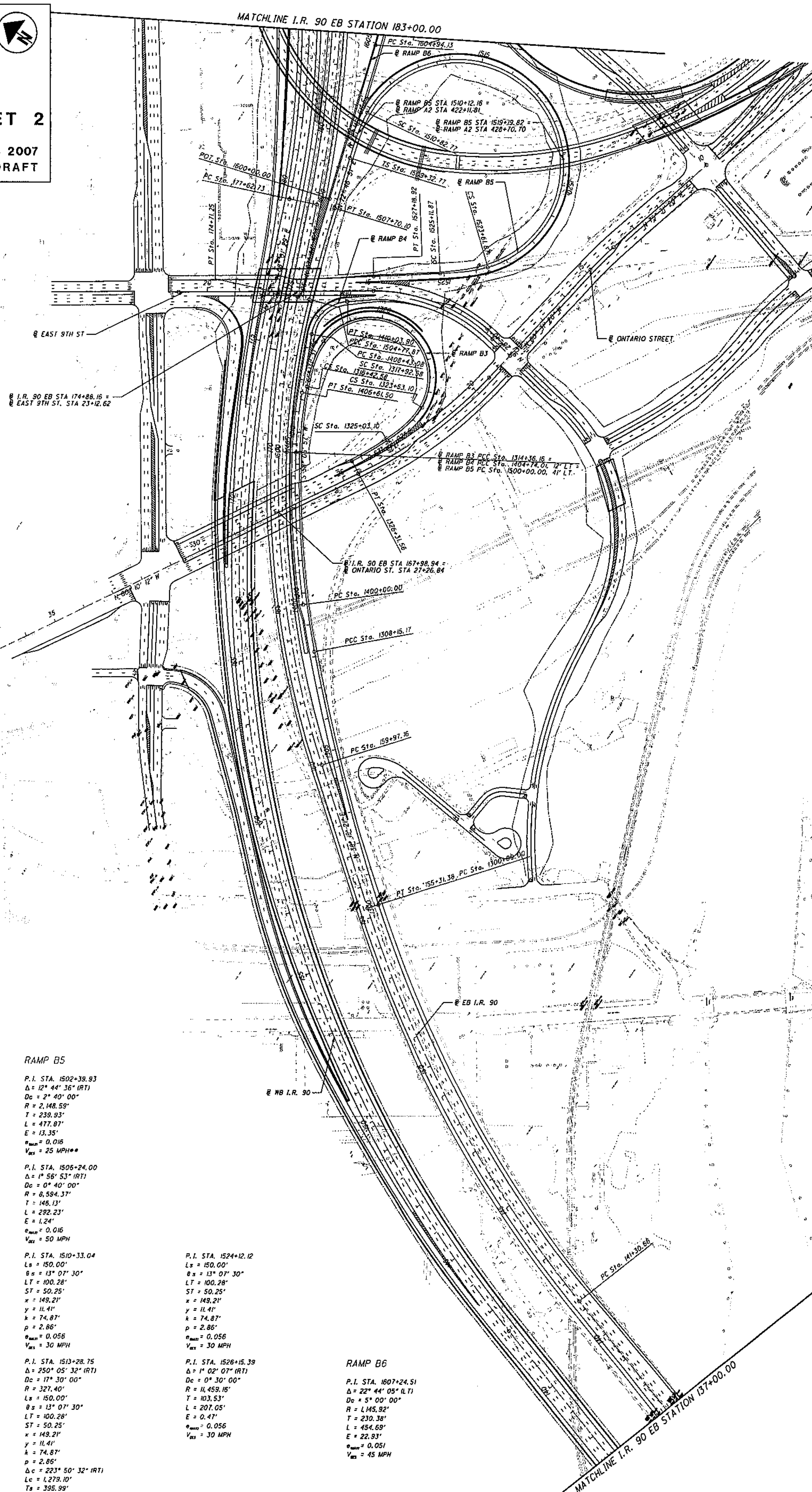
P.I. STA. 11+34.70
Δ = 56° 26' 32" (RT)
Dc = 76° 23' 40"
R = 75.00'
T = 40.25'
L = 73.88'
E = 10.12'
e_{max} = 0.016
V_{des} = 25 MPH

CLEVELAND INNERBELT PLAN

EASTBOUND CENTRAL INTERCHANGE PLAN - SHEET 2

0' 100' 200'

JANUARY 16, 2007
DRAFT



I.R. 90 EASTBOUND

P.I. STA. 148+38.97
Δ = 21° 00' 39" (RT)
Dc = 1° 30' 00"
R = 3,819.72'
T = 708.32'
L = 1,400.73'
E = 65.12'
e_{max} = 0.037
V_{des} = 60 MPH

P.I. STA. 167+50.91
Δ = 29° 28' 54" (RT)
Dc = 2° 00' 00"
R = 2,864.79'
T = 753.75'
L = 1,474.09'
E = 97.50'
e_{max} = 0.045
V_{des} = 60 MPH

P.I. STA. 182+31.35
Δ = 13° 59' 20" (LT)
Dc = 1° 30' 00"
R = 3,819.72'
T = 468.63'
L = 932.59'
E = 28.64'
e_{max} = 0.037
V_{des} = 60 MPH

RAMP B3

P.I. STA. 1304+08.11
Δ = 7° 07' 31" (RT)
Dc = 0° 52' 27"
R = 6,554.83'
T = 408.11'
L = 815.17'
E = 12.69'
e_{max} = MATCH EXISTING
V_{des} = 50 MPH

P.I. STA. 1311+26.95
Δ = 12° 42' 30" (RT)
Dc = 2° 02' 47"
R = 2,799.79'
T = 311.78'
L = 620.99'
E = 17.31'
e_{max} = 0.035
V_{des} = 50 MPH

P.I. STA. 1315+39.55
Δ = 8° 15' 23" (RT)
Dc = 4° 00' 00"
R = 1,432.39'
T = 103.38'
L = 206.41'
E = 3.73'
e_{max} = 0.040
V_{des} = 40 MPH

P.I. STA. 1317+38.09
Ls = 150.00'
θs = 26° 15' 00"
LT = 95.52'
ST = 56.84'
x = 146.50'
y = 25.14'
k = 74.48'
p = 4.39'
e_{max} = 0.058
V_{des} = 40 MPH

P.I. STA. 1323+53.10
Δ = 173° 45' 47" (RT)
Dc = 31° 00' 00"
R = 184.83'
T = 3,392.41'
L = 560.53'
E = 3,212.61'
e_{max} = 0.058
V_{des} = 25 MPH

P.I. STA. 1324+09.95
Ls = 150.00'
θs = 26° 15' 00"
LT = 95.52'
ST = 56.84'
x = 146.50'
y = 25.14'
k = 74.48'
p = 4.39'
e_{max} = 0.058
V_{des} = 25 MPH

P.I. STA. 1325+67.37
Δ = 5° 08' 18" (RT)
Dc = 4° 00' 00"
R = 1,432.39'
T = 64.27'
L = 128.46'
E = 1.44'
e_{max} = 0.022
V_{des} = 25 MPH

RAMP B4

P.I. STA. 1402+37.57
Δ = 9° 39' 32" (RT)
Dc = 2° 02' 16"
R = 2,811.79'
T = 237.57'
L = 474.01'
E = 10.02'
e_{max} = 0.035
V_{des} = 50 MPH

P.I. STA. 1405+67.89
Δ = 7° 26' 15" (RT)
Dc = 3° 58' 00"
R = 1,444.39'
T = 93.88'
L = 187.49'
E = 3.05'
e_{max} = 0.040
V_{des} = 40 MPH

P.I. STA. 1409+37.90
Δ = 76° 12' 14" (RT)
Dc = 47° 23' 03"
R = 120.92'
T = 94.82'
L = 160.82'
E = 32.74'
e_{max} = 0.060
V_{des} = 20 MPH

RAMP B5

P.I. STA. 1502+39.93
Δ = 12° 44' 36" (RT)
Dc = 2° 40' 00"
R = 2,148.59'
T = 239.93'
L = 477.87'
E = 13.35'
e_{max} = 0.016
V_{des} = 25 MPH**

P.I. STA. 1506+24.00
Δ = 1° 56' 53" (RT)
Dc = 0° 40' 00"
R = 8,594.37'
T = 146.13'
L = 292.23'
E = 1.24'
e_{max} = 0.016
V_{des} = 50 MPH

P.I. STA. 1510+33.04
Ls = 150.00'
θs = 13° 07' 30"
LT = 100.28'
ST = 50.25'
x = 149.21'
y = 11.41'
k = 74.87'
p = 2.86'
e_{max} = 0.056
V_{des} = 30 MPH

P.I. STA. 1513+28.75
Δ = 250° 05' 32" (RT)
Dc = 17° 30' 00"
R = 327.40'
Ls = 150.00'
θs = 13° 07' 30"
LT = 100.28'
ST = 50.25'
x = 149.21'
y = 11.41'
k = 74.87'
p = 2.86'
Δc = 223° 50' 32" (RT)
Lc = 1,279.10'
Ts = 395.99'
Es = 133.24'
e_{max} = 0.056
V_{des} = 30 MPH

P.I. STA. 1524+12.12
Ls = 150.00'
θs = 13° 07' 30"
LT = 100.28'
ST = 50.25'
x = 149.21'
y = 11.41'
k = 74.87'
p = 2.86'
e_{max} = 0.056
V_{des} = 30 MPH

P.I. STA. 1526+15.39
Δ = 1° 02' 07" (RT)
Dc = 0° 30' 00"
R = 11,459.16'
T = 103.53'
L = 207.05'
E = 0.47'
e_{max} = 0.056
V_{des} = 30 MPH

RAMP B6

P.I. STA. 1607+24.51
Δ = 22° 44' 05" (LT)
Dc = 5° 00' 00"
R = 1,145.92'
T = 230.38'
L = 454.69'
E = 22.93'
e_{max} = 0.051
V_{des} = 45 MPH

** DESIGN SPEED IS CONSTRAINED DUE TO CONSTRUCTABILITY OF THE NEW ALTERNATIVE WITH THE EXISTING VIADUCT STRUCTURE.

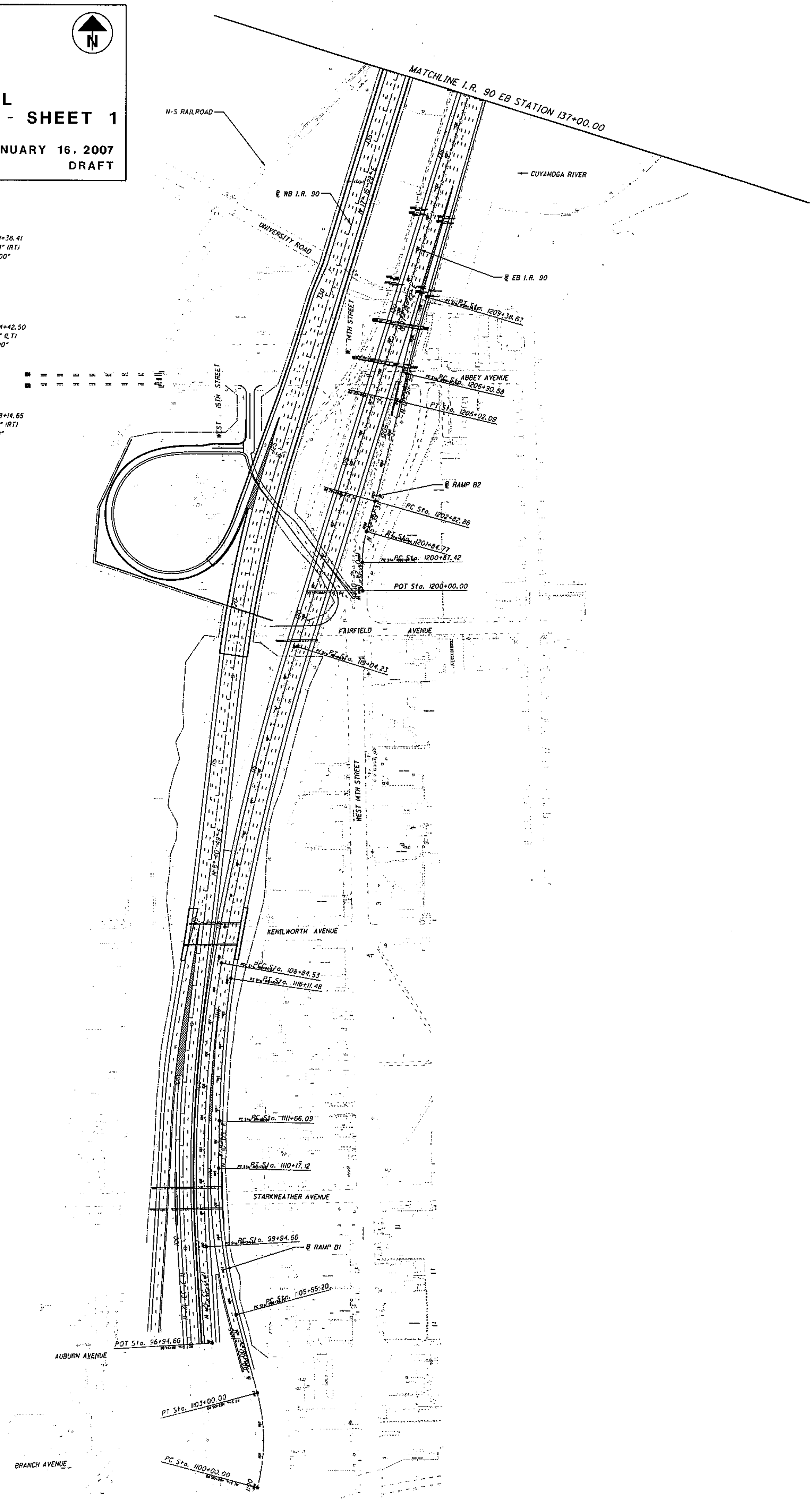
CLEVELAND INNERBELT PLAN

EASTBOUND CENTRAL INTERCHANGE PLAN - SHEET 1

0' 100' 200'

JANUARY 16, 2007

DRAFT



RAMP B1

P.I. STA. 1101+53.49
Δ = 29° 51' 54" (LT)
Dc = 9° 57' 18"
R = 575.54'
T = 153.49'
L = 300.00'
E = 20.12'
e_{max} = 0.0xx
V_{DES} = xx MPH

P.I. STA. 1107+87.70
Δ = 16° 10' 02" (RT)
Dc = 3° 30' 00"
R = 1,637.02'
T = 232.50'
L = 461.92'
E = 16.43'
e_{max} = 0.0xx
V_{DES} = xx MPH

P.I. STA. 1113+89.03
Δ = 6° 39' 11" (RT)
Dc = 1° 29' 37"
R = 3,835.75'
T = 222.95'
L = 445.39'
E = 6.47'
e_{max} = 0.0xx
V_{DES} = xx MPH

RAMP B2

P.I. STA. 1201+36.41
Δ = 16° 03' 43" (RT)
Dc = 16° 30' 00"
R = 347.25'
T = 48.99'
L = 97.35'
E = 3.44'
e_{max} = 0.0xx
V_{DES} = xx MPH

P.I. STA. 1204+42.50
Δ = 2° 39' 37" (LT)
Dc = 0° 50' 00"
R = 6,875.49'
T = 159.65'
L = 319.24'
E = 1.85'
e_{max} = 0.0xx
V_{DES} = xx MPH

P.I. STA. 1208+14.65
Δ = 3° 06' 04" (RT)
Dc = 1° 15' 00"
R = 4,583.66'
T = 124.07'
L = 248.09'
E = 1.68'
e_{max} = 0.0xx
V_{DES} = xx MPH

I.R. 90 EASTBOUND

P.I. STA. 104+41.56
Δ = 13° 09' 03" (RT)
Dc = 1° 28' 40"
R = 3,877.03'
T = 446.90'
L = 889.87'
E = 25.67'
e_{max} = 0.037
V_{DES} = 60 MPH

P.I. STA. 113+95.14
Δ = 7° 38' 52" (RT)
Dc = 0° 45' 00"
R = 7,639.44'
T = 510.61'
L = 1,019.70'
E = 17.05'
e_{max} = 0.021
V_{DES} = 60 MPH

CLEVELAND INNERBELTPLAN

EASTBOUND CENTRAL INTERCHANGE PLAN - SHEET 3

0' 100' 200'

JANUARY 16, 2007

DRAFT

I.R. 90 EB

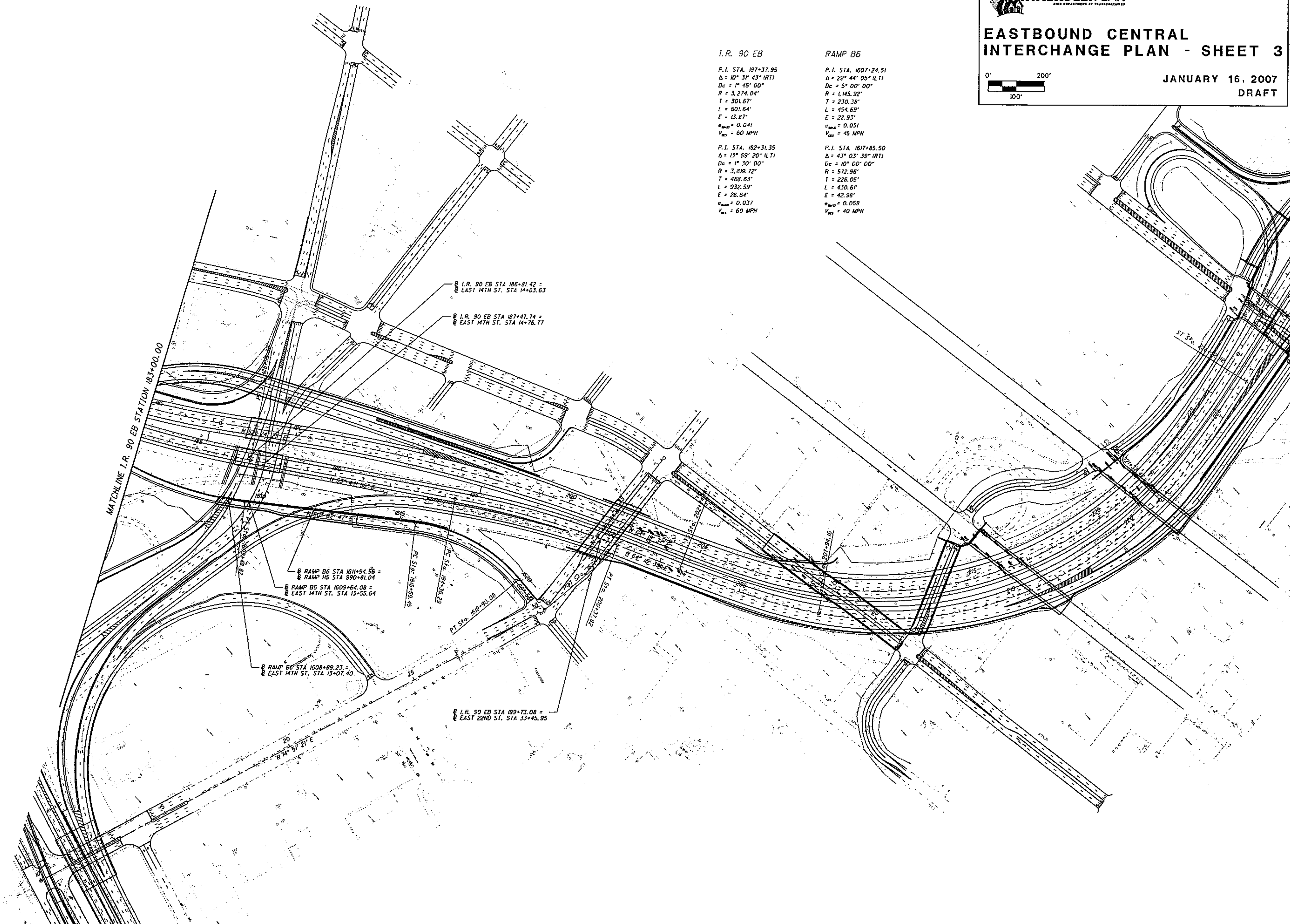
P.I. STA. 197+37.95
Δ = 10° 31' 43" (RT)
Dc = 1° 45' 00"
R = 3,274.04'
T = 301.67'
L = 601.64'
E = 13.87'
e_{max} = 0.041
V_{DES} = 60 MPH

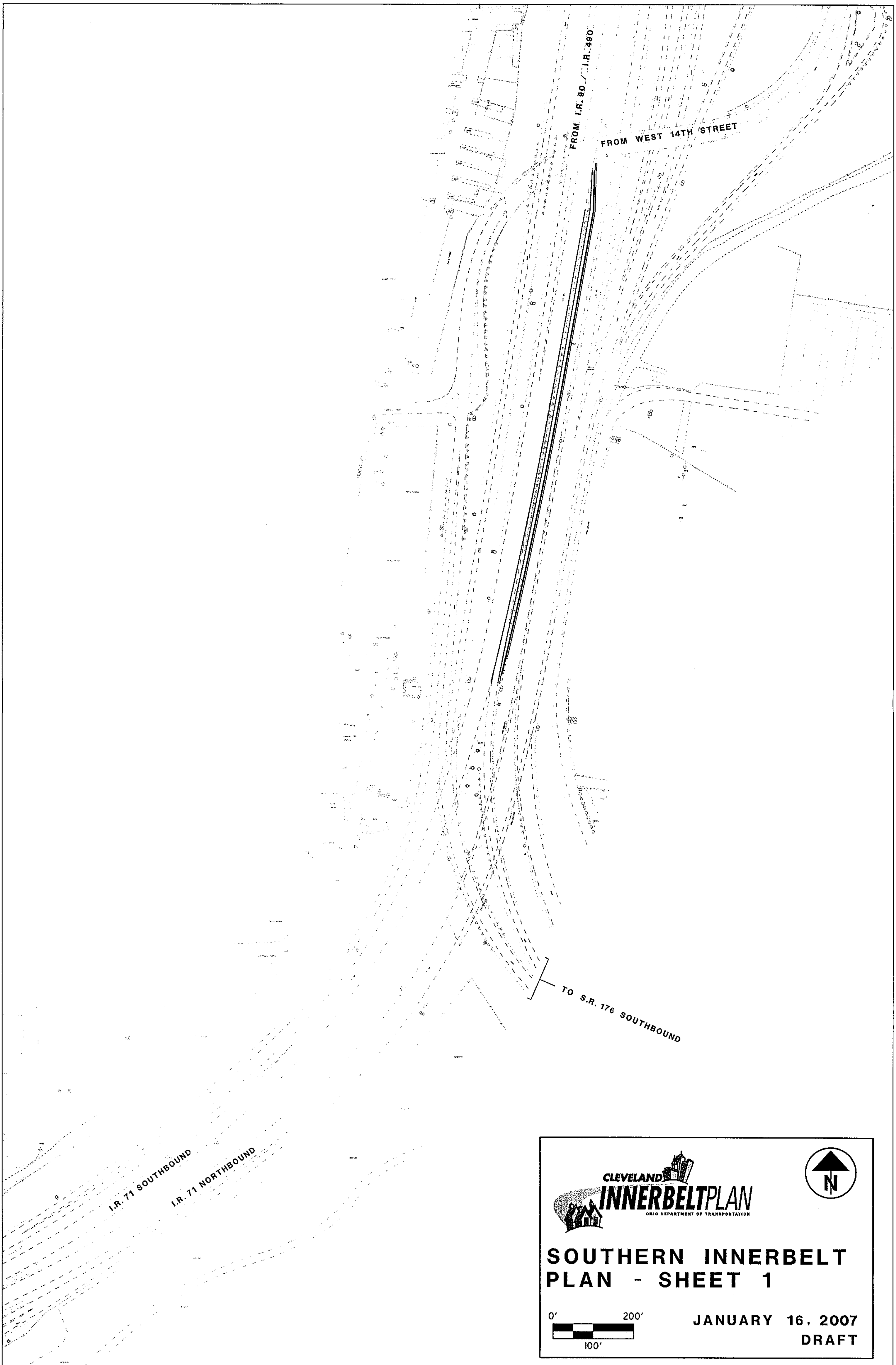
P.I. STA. 182+31.35
Δ = 13° 59' 20" (LT)
Dc = 1° 30' 00"
R = 3,819.72'
T = 468.63'
L = 932.59'
E = 28.64'
e_{max} = 0.037
V_{DES} = 60 MPH

RAMP B6

P.I. STA. 1607+24.51
Δ = 22° 44' 05" (LT)
Dc = 5° 00' 00"
R = 1,145.92'
T = 230.38'
L = 454.69'
E = 22.93'
e_{max} = 0.051
V_{DES} = 45 MPH

P.I. STA. 1617+85.50
Δ = 43° 03' 39" (RT)
Dc = 10° 00' 00"
R = 572.96'
T = 226.05'
L = 430.61'
E = 42.98'
e_{max} = 0.059
V_{DES} = 40 MPH





CLEVELAND INNERBELTPLAN
OHIO DEPARTMENT OF TRANSPORTATION

SOUTHERN INNERBELT PLAN - SHEET 1

0' 100' 200'

JANUARY 16, 2007
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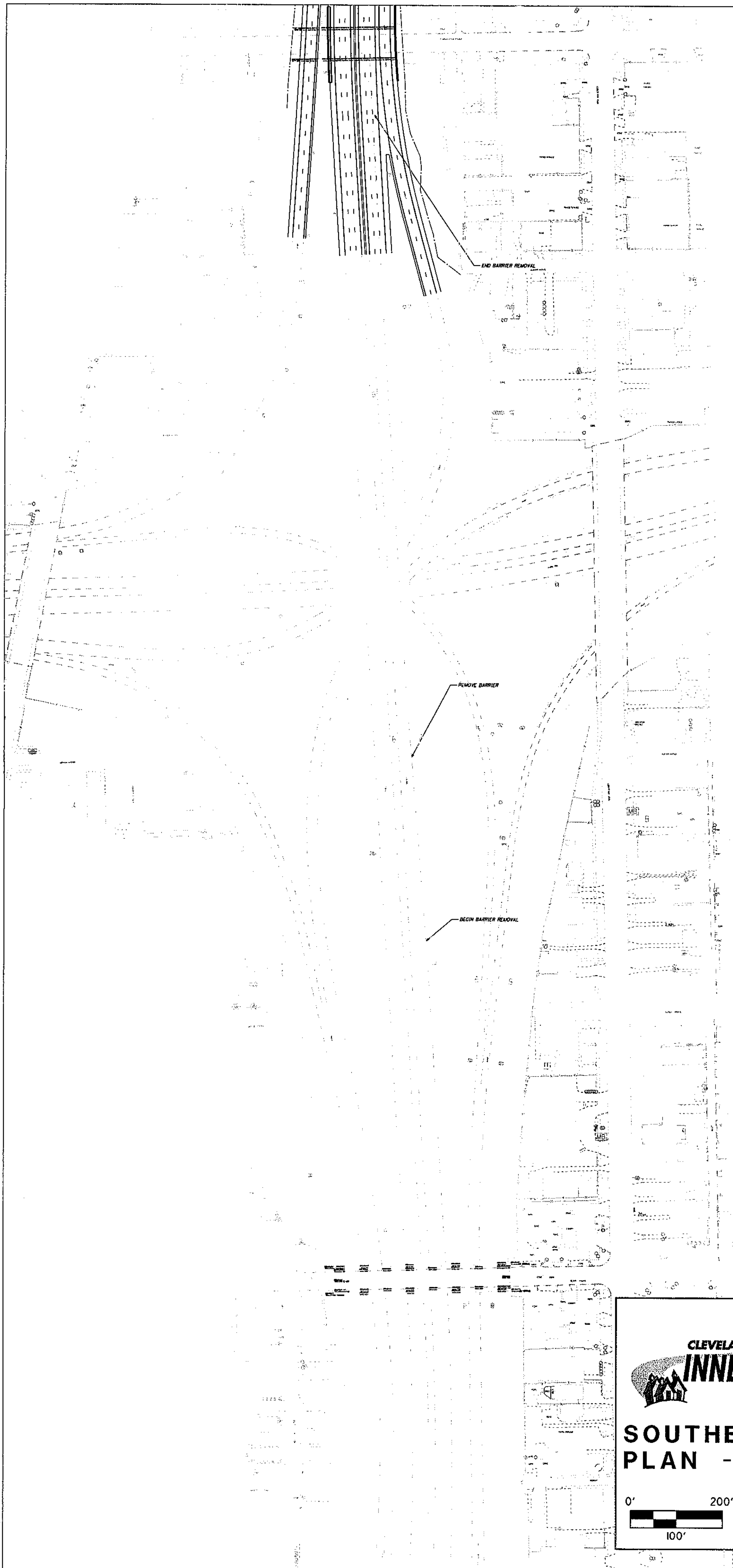

CLEVELAND INNERBELTPLAN
OHIO DEPARTMENT OF TRANSPORTATION

SOUTHERN INNERBELT PLAN - SHEET 2

0' 100' 200'

JANUARY 16, 2007
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CLEVELAND INNERBELTPLAN

OHIO DEPARTMENT OF TRANSPORTATION

INTERSTATE 77
SHEET 4

0' 100' 200'

JANUARY 16, 2007

DRAFT

RAMP H4

P.I. STA. 775+42.88
Δ = 8° 00' 00" (RT)
Dc = 4° 00' 00"
R = 1,432.39'
T = 100.16'
L = 200.00'
E = 3.50'
e_{max} = 0.055
V_{des} = 40 MPH

P.I. STA. 780+12.79
Δ = 65° 42' 59" (RT)
Dc = 10° 00' 00"
R = 572.96'
T = 370.07'
L = 657.16'
E = 109.12'
e_{max} = 0.053
V_{des} = 35 MPH

P.I. STA. 783+74.95
Δ = 6° 00' 00" (RT)
Dc = 4° 00' 00"
R = 1,432.39'
T = 75.07'
L = 150.00'
E = 1.97'
e_{max} = 0.034
V_{des} = 35 MPH

RAMP H5

P.I. STA. 973+83.24
Δ = 5° 00' 00" (RT)
Dc = 2° 30' 00"
R = 2,291.83'
T = 100.06'
L = 200.00'
E = 2.18'
e_{max} = 0.051
V_{des} = 60 MPH

P.I. STA. 980+46.29
Δ = 76° 21' 09" (RT)
Dc = 8° 00' 00"
R = 716.20'
T = 563.11'
L = 954.41'
E = 194.86'
e_{max} = 0.060
V_{des} = 45 MPH

P.I. STA. 991+52.66
Δ = 46° 24' 48" (RT)
Dc = 6° 30' 00"
R = 881.47'
T = 377.92'
L = 714.05'
E = 77.60'
e_{max} = 0.058
V_{des} = 45 MPH

RAMP H6

P.I. STA. 1182+94.80
Δ = 75° 00' 00" (RT)
Dc = 10° 00' 00"
R = 572.96'
T = 439.65'
L = 750.00'
E = 149.24'
e_{max} = 0.059
V_{des} = 40 MPH

P.I. STA. 1188+82.29
Δ = 60° 15' 57" (RT)
Dc = 12° 00' 00"
R = 477.46'
T = 277.14'
L = 502.22'
E = 74.61'
e_{max} = 0.057
V_{des} = 35 MPH

RAMP J1

P.I. STA. 3430+61.40
Δ = 47° 15' 00" (LT)
Dc = 4° 30' 00"
R = 1,273.24'
T = 556.93'
L = 1,050.00'
E = 116.47'
e_{max} = 0.054
V_{des} = 50 MPH

RAMP J2

P.I. STA. 5435+61.54
Δ = 23° 06' 15" (LT)
Dc = 2° 15' 00"
R = 2,546.48'
T = 520.50'
L = 1,026.85'
E = 52.65'
e_{max} = 0.030
V_{des} = 40 MPH

RAMP J3

P.I. STA. 16+27.64
Δ = 40° 56' 29" (RT)
Dc = 10° 45' 00"
R = 532.98'
T = 198.96'
L = 380.85'
E = 35.93'
e_{max} = 0.055
V_{des} = 40 MPH

P.I. STA. 25+94.53
Δ = 91° 28' 11" (LT)
Dc = 10° 45' 00"
R = 532.98'
Δc = 80° 43' 11" (LT)
Lc = 750.88'
Es = 232.87'
e_{max} = 0.060
V_{des} = 40 MPH

P.I. STA. 28+62.35
Ls = 200.00'
θs = 10° 45' 00"
LT = 133.58'
ST = 66.89'
x = 199.30'
y = 12.48'
k = 99.88'
p = 3.12'
V_{des} = 55 MPH

I.R. 77

P.I. STA. 37+53.40
Δ = 9° 00' 20" (LT)
Dc = 2° 15' 00"
R = 2,546.48'
T = 200.54'
L = 400.25'
E = 7.88'
e_{max} = 0.051
V_{des} = 60 MPH

P.I. STA. 46+86.03
Δ = 41° 59' 20" (LT)
Dc = 3° 00' 00"
R = 1,909.86'
T = 732.91'
L = 1,399.63'
E = 135.80'
e_{max} = 0.055
V_{des} = 60 MPH

P.I. STA. 55+53.28
Δ = 9° 00' 20" (LT)
Dc = 2° 15' 00"
R = 2,546.48'
T = 200.54'
L = 400.25'
E = 7.88'
e_{max} = 0.051
V_{des} = 60 MPH

RAMP H1

P.I. STA. 142+24.94
Δ = 9° 43' 30" (LT)
Dc = 1° 30' 00"
R = 3,819.72'
T = 324.94'
L = 648.33'
E = 13.80'
e_{max} = 0.028
V_{des} = 50 MPH

P.I. STA. 149+01.59
Δ = 26° 38' 01" (RT)
Dc = 12° 00' 00"
R = 477.46'
T = 113.02'
L = 221.95'
E = 13.19'
e_{max} = 0.041
V_{des} = 25 MPH

RAMP H2

P.I. STA. 342+16.95
Δ = 11° 58' 09" (LT)
Dc = 2° 15' 00"
R = 2,546.48'
T = 266.95'
L = 531.97'
E = 13.95'
e_{max} = 0.040
V_{des} = 50 MPH

P.I. STA. 345+86.80
Ls = 200.00'
θs = 5° 15' 00"
LT = 104.83'
ST = 95.31'
x = 199.74'
y = 8.72'
k = 99.97'
p = 0.22'
V_{des} = 50 MPH

P.I. STA. 352+79.76
Δ = 34° 45' 39" (LT)
Dc = 3° 00' 00"
R = 1,909.86'
T = 597.80'
L = 1,158.70'
E = 91.37'
e_{max} = 0.039
V_{des} = 45 MPH

P.I. STA. 364+85.42
Δ = 32° 54' 00" (LT)
Dc = 14° 00' 00"
R = 409.26'
T = 120.84'
L = 235.00'
E = 17.47'
e_{max} = 0.059
V_{des} = 35 MPH

P.I. STA. 369+49.04
Δ = 32° 52' 46" (RT)
Dc = 14° 00' 00"
R = 409.25'
T = 120.76'
L = 234.85'
E = 17.44'
e_{max} = 0.059
V_{des} = 35 MPH

RAMP H3

P.I. STA. 557+38.34
Δ = 30° 42' 44" (RT)
Dc = 15° 30' 00"
R = 369.65'
T = 101.51'
L = 198.14'
E = 13.69'
e_{max} = 0.055
V_{des} = 30 MPH

P.I. STA. 562+75.31
Δ = 3° 06' 07" (RT)
Dc = 1° 00' 00"
R = 5,729.58'
Δc = 2° 06' 07" (RT)
Lc = 210.21'
Es = 2.25'
e_{max} = 0.020
V_{des} = 50 MPH

P.I. STA. 563+91.67
Ls = 200.00'
θs = 1° 00' 00"
LT = 133.34'
ST = 66.67'
x = 199.99'
y = 1.16'
k = 100.00'
p = 0.29'
V_{des} = 50 MPH

RAMP H5

P.I. STA. 973+83.24
Δ = 5° 00' 00" (RT)
Dc = 2° 30' 00"
R = 2,291.83'
T = 100.06'
L = 200.00'
E = 2.18'
e_{max} = 0.051
V_{des} = 60 MPH

RAMP J2

P.I. STA. 5435+61.54
Δ = 23° 06' 15" (LT)
Dc = 2° 15' 00"
R = 2,546.48'
T = 520.50'
L = 1,026.85'
E = 52.65'
e_{max} = 0.030
V_{des} = 40 MPH

P.I. STA. 5443+40.09
Δ = 4° 00' 32" (RT)
Dc = 2° 00' 00"
R = 2,864.79'
T = 100.26'
L = 200.44'
E = 1.75'
e_{max} = 0.025
V_{des} = 40 MPH

P.I. STA. 5447+36.17
Δ = 3° 59' 38" (LT)
Dc = 2° 00' 00"
R = 2,864.79'
T = 99.89'
L = 199.70'
E = 1.74'
e_{max} = 0.025
V_{des} = 40 MPH

RAMP J4

P.I. STA. 243+19.60
Ls = 200.00'
θs = 4° 55' 45"
LT = 133.39'
ST = 66.71'
x = 199.85'
y = 5.73'
k = 99.98'
p = 1.43'
V_{des} = 55 MPH

P.I. STA. 247+03.29
Δ = 39° 37' 47" (LT)
Dc = 4° 55' 45"
R = 1,162.38'
Δc = 34° 42' 02" (LT)
Lc = 703.99'
Es = 73.92'
e_{max} = 0.051
V_{des} = 45 MPH

CLEVELAND INNERBELTPLAN

INTERSTATE 77
SHEET 3

0' 200'
100'

JANUARY 16, 2007
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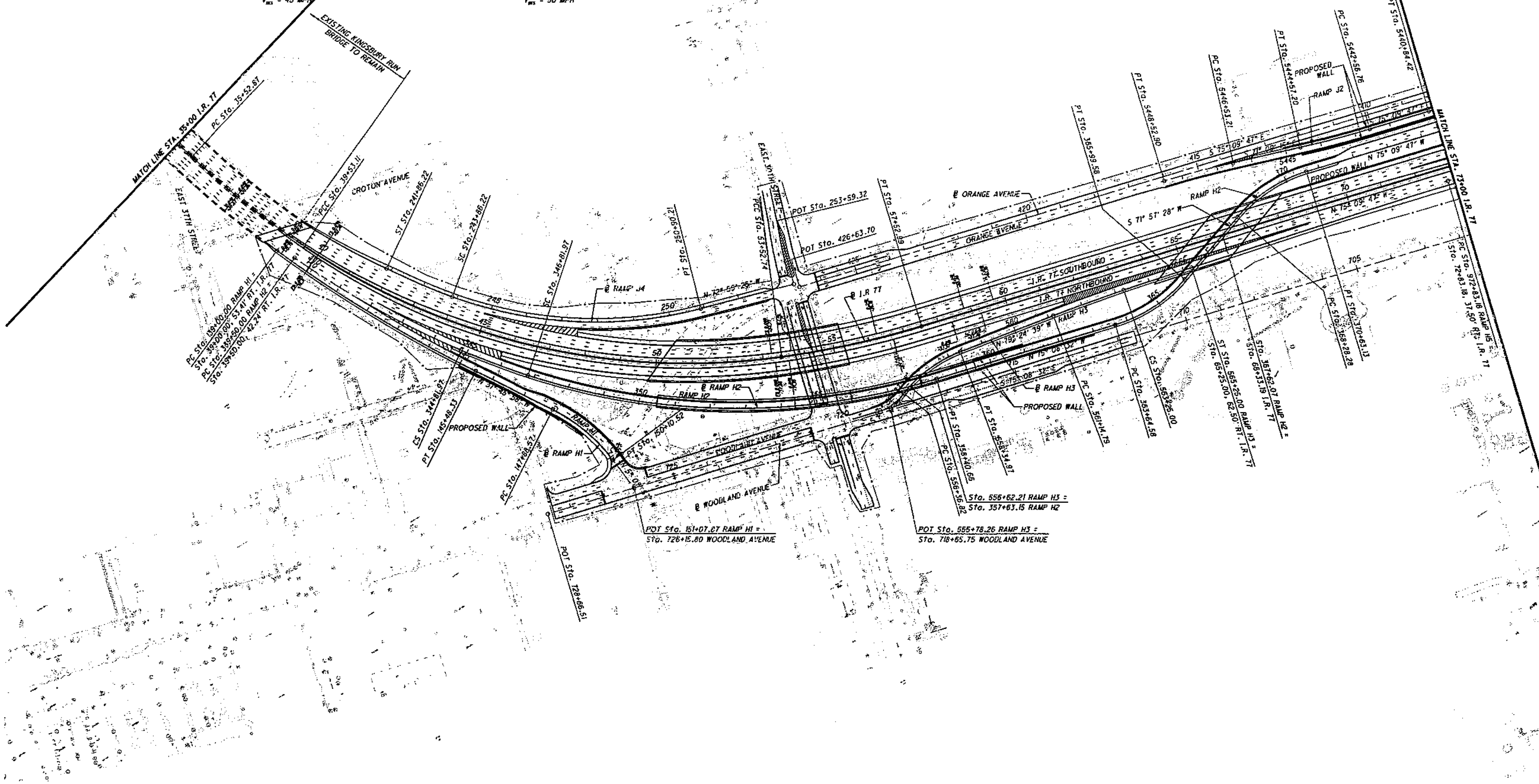


I.R. 77

P.I. STA. 995+20.27
Δ = 9° 36' 59" (LT)
Dc = 1° 00' 00"
R = 5,729.58'
T = 481.94'
L = 961.63'
E = 20.23'
e_{max} = 0.027
V_{des} = 60 MPH

RAMP J5

P.I. STA. 991+71.35
Ls = 200.00'
θs = 2° 45' 00"
LT = 133.35'
ST = 66.68'
x = 199.95'
y = 3.20'
k = 99.99'
p = 0.80'
V_{des} = 50 MPH

P.I. STA. 996+22.04
Δ = 26° 14' 35" (LT)
Dc = 2° 45' 00"
R = 2,083.48'
Δc = 23° 29' 35" (LT)
Lc = 854.30'
Es = 56.27'
e_{max} = 0.047
V_{des} = 50 MPH

RAMP J6

P.I. STA. 801+93.76
Δ = 6° 00' 00" (RT)
Dc = 4° 00' 00"
R = 1,432.39'
T = 75.07'
L = 150.00'
E = 1.97'
e_{max} = 0.037
V_{des} = 35 MPH

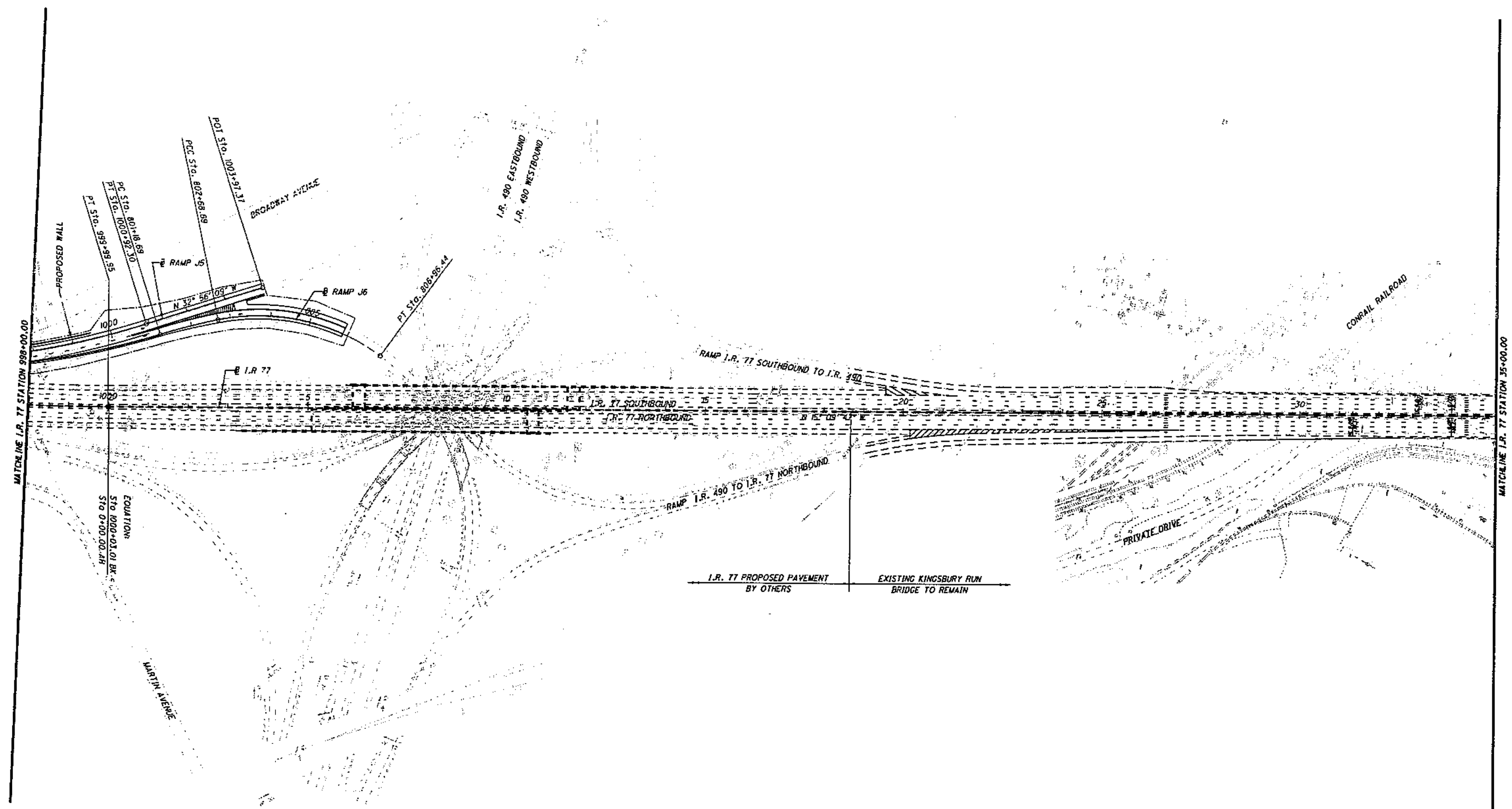
P.I. STA. 804+96.09
Δ = 48° 07' 19" (RT)
Dc = 11° 15' 00"
R = 509.30'
T = 227.40'
L = 427.75'
E = 48.46'
e_{max} = 0.056
V_{des} = 35 MPH

CLEVELAND INNERBELTPLAN

INTERSTATE 77
SHEET 2

0' 100' 200'

JANUARY 16, 2007
DRAFT



CLEVELAND INNERBELT PLAN

INTERSTATE 77
SHEET 1

0' 100' 200'

JANUARY 16, 2007

DRAFT

I.R. 77

P.I. STA. 956+64.99
Δ = 12° 03' 23" (LT)
Dc = 1° 30' 00"
R = 3,819.72'
T = 403.37'
L = 803.76'
E = 21.24'
e_{max} = 0.037
V_{des} = 60 MPH

P.I. STA. 969+34.19
Δ = 15° 46' 13" (RT)
Dc = 2° 00' 00"
R = 2,864.79'
T = 396.76'
L = 788.51'
E = 27.34'
e_{max} = 0.045
V_{des} = 60 MPH

P.I. STA. 995+20.27
Δ = 9° 36' 59" (LT)
Dc = 1° 00' 00"
R = 5,729.58'
T = 481.94'
L = 961.63'
E = 20.23'
e_{max} = 0.027
V_{des} = 60 MPH

RAMP J5

P.I. STA. 991+71.35
Ls = 200.00'
θs = 2° 45' 00"
LT = 133.35'
ST = 66.68'
x = 199.95'
y = 3.20'
k = 99.99'
p = 0.80'
V_{des} = 50 MPH

P.I. STA. 996+22.04
Δ = 26° 14' 35" (LT)
Dc = 2° 45' 00"
R = 2,083.48'
Δc = 23° 29' 35" (LT)
Lc = 854.30'
Es = 56.27'
e_{max} = 0.047
V_{des} = 50 MPH

FRONTAGE ROAD

P.I. STA. 12+48.63
Δ = 9° 00' 51" (RT)
Dc = 6° 00' 00"
R = 954.93'
T = 75.27'
L = 150.24'
E = 2.96'
e_{max} = 0.016
V_{des} = 35 MPH

P.I. STA. 15+83.93
Δ = 11° 46' 24" (LT)
Dc = 6° 00' 00"
R = 954.93'
T = 98.46'
L = 196.22'
E = 5.06'
e_{max} = 0.016
V_{des} = 35 MPH

P.I. STA. 22+33.99
Δ = 2° 45' 10" (LT)
Dc = 1° 00' 00"
R = 5,729.58'
T = 137.66'
L = 275.27'
E = 1.65'
e_{max} = 0.016
V_{des} = 35 MPH