Canada U.S. Department of Transportation Federal Highway Administration Ontario MDOT Michigan Department of Transportation

Canada-United States-Ontario-Michigan
Border Transportation Partnership

Practical Alternatives Evaluation Assessment Report

Stormwater Management Plan

July 2007
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Preface

The Detroit River International Crossing (DRIC) Environmental Assessment Study is being conducted by a partnership of the federal, state and provincial governments in Canada and the United States in accordance with the requirements of the Canadian Environmental Assessment Act (CEAA), the Ontario Environmental Assessment Act (OEAA), and the U.S. National Environmental Policy Act (NEPA). In 2006, the Canadian and U.S. Study Teams completed an assessment of illustrative crossing, plaza and access road alternatives. This assessment is documented in two reports: *Generation and Assessment of Illustrative Alternatives Report - Draft November 2006)* (Canadian side) and *Evaluation of Illustrative Alternatives Report (December 2006)* (U.S. side). The results of this assessment led to the identification of an Area of Continued Analysis (ACA) as shown in Exhibit 1.

Within the ACA, practical alternatives were developed for the crossings, plazas and access routes alternatives. The evaluation of practical crossing, plaza and access road alternatives is based on the following seven factors:

- Changes to Air Quality
- Protection of Community and Neighbourhood Characteristics
- Consistency with Existing and Planned Land Use
- Protection of Cultural Resources
- Protection of the Natural Environment
- Improvements to Regional Mobility
- Cost and Constructability

This report pertains to the Cost and Constructability factor and is one of several reports that will be used in support of the evaluation of practical alternatives and the selection of the technically and environmentally preferred alternative. This report will form a part of the environmental assessment documentation for this study.

Additional documentation pertaining to the evaluation of practical alternatives is available for viewing/downloading at the study website (www.partnershipborderstudy.com).

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1. Introduction

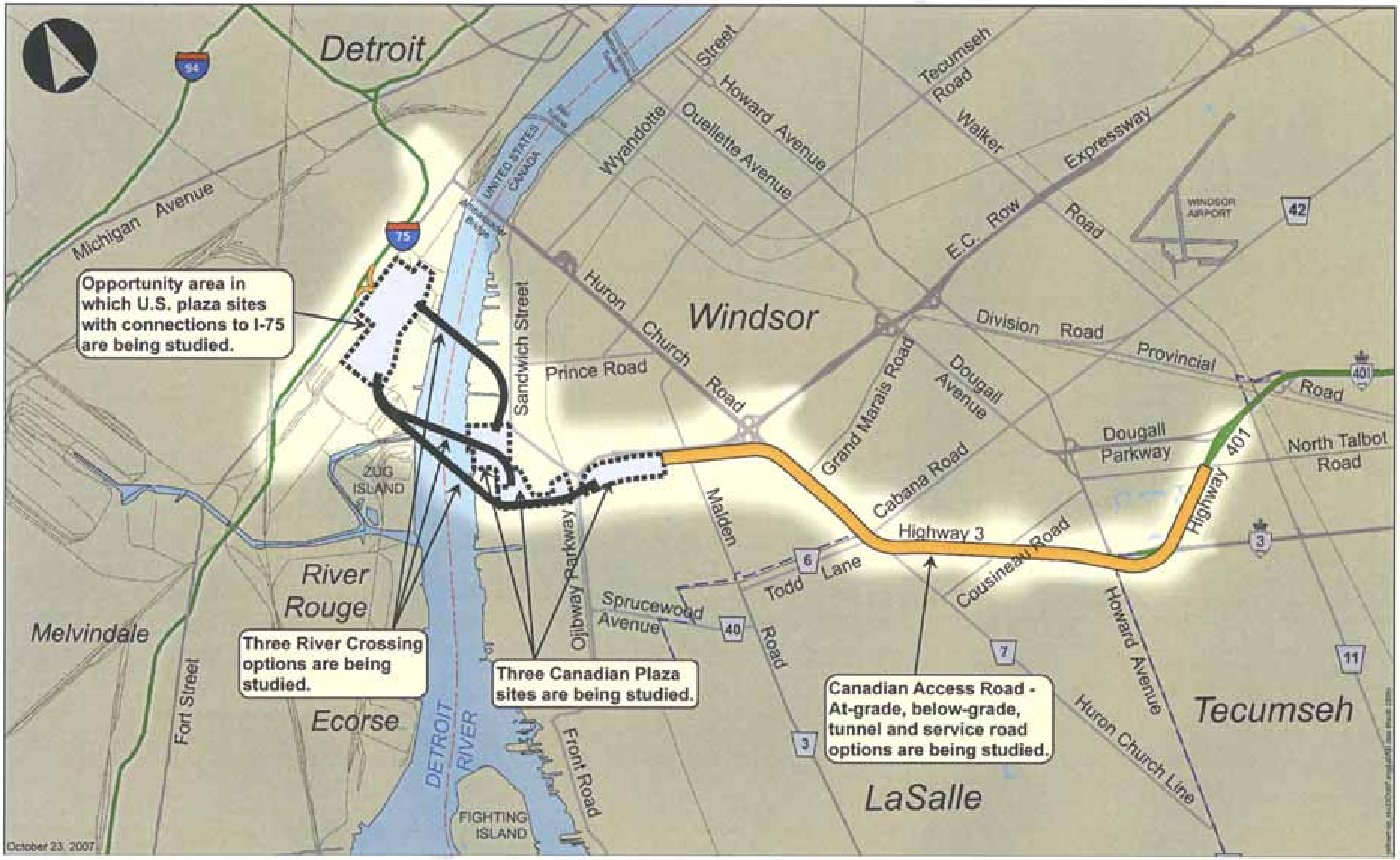
The Canada-U.S.-Ontario-Michigan Border Transportation Partnership (The Partnership) composed of Transport Canada (TC), the Ontario Ministry of Transportation (MTO), United States Federal Highway Administration (FHWA) and the Michigan Department of Transportation (MDOT) is undertaking an Environmental Assessment Study for the proposed Detroit River International Crossing (DRIC).

The Detroit River International Crossing (DRIC) study is a bi-national planning study that will lead to the identification of a single technically and environmentally preferred alternative for access roads, plazas and a new river crossing. The study is being conducted in accordance with the requirements of the Ontario Environmental Assessment Act (OEAA) and the Canadian Environmental Assessment Act (CEAA) in Canada and the U.S. National Environmental Policy Act (NEPA) in the United States.

The Ontario Ministry of Transportation (MTO) is leading the Canadian work program in coordination with Transport Canada (TC). The Michigan Department of Transportation (MDOT), in coordination with the United States Federal Highway Administration (FHWA) is leading the U.S. work program.

The Partnership retained URS Canada Inc. to assist the government in undertaking the Canadian side Environmental Assessment Study for the expanded Detroit River International Crossing. As part of the Environmental Assessment Study, a stormwater management analysis has been completed for the access road and plaza alternatives to address the highway drainage and potential impact of the proposed Highway 401 to the nearby watercourses and drainage crossings. This report identifies the stormwater management plan prepared for the various roadway alternatives extending from Ojibway Parkway to North Talbot Road and Canadian plaza alternatives. The study limit is shown on Figure 1-1. A stormwater management analysis for the International bridge crossing will be completed separately.

FIGURE 1-1: STUDY LIMIT



2. Background Review

Several studies have been previously conducted within the study area. These were reviewed to obtain information on the existing drainage condition and stormwater management practices within the study area. Relevant information obtained from these studies was used as input data to assist in the identification and analyses of stormwater management alternatives for the proposed Highway 401.

The following reports were reviewed as part of the preparatory investigations. The pertinent information extracted from each document is also identified.

Functional Design Report
Lennon Drain - Talbot Road to Avon Drive

Prepared by La Fontaine, Cowie, Buratto & Associates Limited, March 1993

- Based on this report, Lennon Drain catchment area is approximately 1,200 acres (485 ha) that extends easterly from Talbot Road. It is bounded to the north by Cabana Road, to the east by Concession Line, to the south by Highway 401 and by Cousineau Road to the west.
- Lennon Drain within the study area is a trapezoidal channel with a 10 ft. wide low flow channel and was designed to provide online storage. The online storage has a total capacity of 23,500 m^3 for the 100-year storm. The existing 100-year storm flow is conveyed within the improved channel.
- With the online storage the 100-year flow was restricted to 229.6 cubic feet per second (6.5 m^3/s).

Stormwater Management Alternatives
for the Turkey Creek Watershed within the City of Windsor

Prepared by Maclaren Engineers – Lavalin, June 1989

- This report proposed two basic stormwater management strategies for the Turkey Creek watershed, namely: stormwater detention facilities to control future runoff from new development to present levels and channel improvements to contain the existing 100-year flood.
- On-site detention was recommended for new industrial and commercial developments.
- The study identified peak flows at major intersections as follows:

Location	Drainage Area (ha)	100-year Peak Flows (m^3/s)	
		Present	Future
Grand Marias Drain at Huron-Church Line	2837	39.5	62.6
Outlet of Basin Drain	173	4.7	8.1
Lennon Drain at Huron Church Line	353	8.3	11
Cahill Drain at Huron Church Line	676	12.1	27.6

- The study also identified the requirement for further studies to recalculate flood levels along the major watercourses based on the significantly revised flood flows determined during the study.

Master Drainage Plan
Township of Sandwich South

N.K. Becker and Associates Ltd., October 1986

- The plan identified present and future storm drainage problems and improvements to the drainage system to maintain storm runoff at pre-development levels. The plan also includes stormwater management policies for new developments.
- Included in the study area is a tributary of Wolfe Drain located east of Highway 401 and north of Highway 3 (Talbot Road). This tributary outlets to Cahill Drain and ultimately to Turkey Creek.
- Wolfe Drainage catchment is approximately 200 hectares, identified in the report as Sub-catchment 201. The 100-year peak flow was computed to be 8.1 m^3/s.
- The master plan recommended improvement to Wolfe Drain with on-site runoff controls. All new development is required to implement on-site stormwater management controls.

Based on the review of the previously published studies as summarized above, it is concluded that the peak flows as identified in the 1989 Mclarenn report would still be appropriate for use in the conceptual design of a stormwater management plan for the various alternative roadways. It is noted that the watershed studies would have to be updated at the preliminary design stage of the preferred roadway alternative.

3. Existing Storm Drainage Condition

Within the study area there are eight (8) recipient drainage systems that would receive runoff from the proposed Highway 401. They are identified as Titcombe Drain, Basin Drain, Marentette Mangin Drain, Turkey Creek, Lennon Drain, Cahill Drain West Tributary Drain and Wolfe Drain. The location of the streams relative to Highway 401 are shown on Figure 3-1. All of the drainage systems are part of the Turkey Creek which outlets to the Detroit River. Turkey Creek the Cahill Drain and the Wolfe Drains have been significantly altered as a result of urbanization. All of the existing drainage systems have been impacted upon by urbanization. Along Turkey Creek, as an example, sections of the channel have been concrete lined. A number of hydrologic and hydraulic investigations have been completed on the existing drainage systems however updates are required in order to refine the peak flows associated with each. The updated models would include the flow attenuation benefits associated with stormwater management plans that have been implemented in support of development. For the Practical Alternative phase of the DRIC study the previously computed and approved flows have been considered appropriate for use. New hydrologic analyses would be required at all stream crossings to confirm the sizing of required conveyance facilities. Fluvial geomorphologic investigations would also be required to confirm the sensitivity of the drainage systems to erosion and to establish target erosion flow rates for the use in design of future stormwater management plans.

4. Stormwater Design Criteria

4.1. Storm Drainage

The proposed Highway 401will be classified as a freeway with a design speed of 120 km/hr. Culverts over 6.0 m span, according to MTO Directive B-100, for the proposed Highway 401 are to be designed based on a 100-year design flow (refer to Table 4.1)

TABLE 4.1: DRAINAGE CRITERIA

Road Classification	Bridges and Culverts			
	Total span up to 6.0 m	**Freeboard Requirement**	**Total span over 6.0 m**	**Freeboard Requirement**
Freeway	50-year	No overtopping	100-year	No overtopping
Urban Arterial	50-year	1m freeboard from crown	100-year	1m freeboard from soffit
Rural Arterial Collector Road	25-year	1m freeboard from crown	50 year	1m freeboard from soffit
Local Road	10-year	1m freeboard from crown	25 year	1m freeboard from soffit

* Source: MTC Design Flood Criteria, Ministry Directive B-100, Issued 80-10-16

The minor system associated with the new roadway would be designed to capture and convey the 10-year storm. Where the roadway is below grade, the new sewer system would be designed to capture the 100-year event. In areas where the major system cannot be maintained to a reasonable outlet, the minor system should convey the 100-year storm without flooding to the traveled four inside lanes.

For areas with a drainage area greater than 125 ha, structures are to be sized to convey the Regional Storm with no significant increase in the flood level from that of the existing condition. Based on discussions with the Essex Region Conservation Authority, the Regional Storm for the study area is equivalent to the 100-year event.

4.2. Stormwater Management

The MNR and the MOE have both published specific criteria regarding water quality and flood flow control. For this project, Level 1 protection would be provided for water quality.

Runoff to Turkey Creek and other adjacent watercourses would be controlled to the pre-development levels for all storm events up to and including the 100-year return period.

5. Stream Crossing Impact Assessment

A total of six (6) alternative roadway alignments and profiles for Highway 401 have been established for consideration. They are identified as Alternatives 1A, 1B, 2A, 2B, 2B-Revised and 3. The details of each are described in the following section of this report. From a surface water resource perspective each alternative has a varying degree of impact on the existing flow conveyance features (i.e. watercourses, drains etc.). Where impacts are considered to be significant, those impacts must be mitigated by the implementation of appropriate flow conveyance improvement measures.

The proposed Highway 401 Alternatives consider three options for the roadway profile. They include the following:

- **At Grade** – the proposed road profile follows that of the existing ground. New stream crossings would be sized based on MTO Directive B100.
- **Below Grade** – the proposed road profile is below the existing ground. This would potentially result in the new roadways potentially obstructing the flow associated with the natural drainage systems that they cross.
- **Tunnel** – the proposed road profile is below the invert of the existing stream systems. With this option the new roadway would have minimal impact on the existing drainage systems.

The following describes the impact assessments completed for each of the six roadway alternatives considered and details of the recommended mitigation plan. Table 5.1 provides a summary of the proposed drainage improvements.

TABLE 5.1: SUMMARY OF STREAM CROSSING ALTERNATIVES

Location	Roadway Alternative					
	1A	1B	2A	2B	2B Revised	3
	At Grade	Below Grade	At Grade	Below Grade	Modified Below Grade	Tunnel
	Replace Existing Roadways		Alignment Offset from Existing Roadways			
Titcombe Drain	Storm Sewer or 1200 mmØ Culvert	Storm Sewer or 1200 mmØ Culvert	Storm Sewer or 1200 mmØ Culvert	Storm Sewer or 1200 mmØ Culvert	Storm Sewer or 1200 mmØ Culvert	Storm Sewer or 1200 mmØ Culvert
Basin Drain	2.1 m x 1.5 m Box Culvert	2.1 m x 1.5 m Box Culvert	2.1 m x 1.5 m Box Culvert	2.1 m x 1.5 m Box Culvert	2.1 m x 1.5 m Box Culvert	2.1 m x 1.5 m Box Culvert
Marentette Mangin Drain	Storm Sewer	Storm Sewer	Storm Sewer	Storm Sewer	Storm Sewer	There will be no long-term impacts
Turkey Creek	Bridge Extension	Syphon 25 m x 2 m Box or Tunnel Roadway	New Bridge	Syphon 25 m x 2 m Box or Tunnel Roadway	New 3 Cell 10 m x 2 m Box or Equivalent	There will be no long-term impacts
Lennon Drain	Extension of Existing 2.6 m x 1.2 m culvert	3 m x 1.5 m Syphon	Extension of Existing 2.6 m x 1.2 m culvert	3 m x 1.5 m Syphon	3 m x 1.5 m Syphon	There will be no long-term impacts
Cahill West Tributary	1200 mmØ or Diversion to Cahill Drain	1200 mmØ or Diversion to Cahill Drain	1200 mmØ or Diversion to Cahill Drain	1200 mmØ or Diversion to Cahill Drain	1200 mmØ or Diversion to Cahill Drain	There will be no long-term impacts
Cahill Drain Crossing	Replacement of Existing Culvert with a 4.5m x 1.5m Box Culvert	4.5 m x 1.5 m Syphon or Tunnel	New 4.5 m x 1.5 m Box Culvert	4.5 m x 1.5 m Syphon or Tunnel	4.5 m x 1.5 m Syphon or Tunnel	There will be no long-term impacts
Cahill Drain/Wolfe Drainage	Re-aligned Open Drain or 4.5 m x 1.5 m Closed System	Re-aligned Open Drain or 4.5 m x 1.5 m Closed System	Retain Existing Channel	Retain Existing Channel	Retain Existing Channel	There will be no long-term impacts

The following provides a summary of the options considered to mitigate potential impacts of the new roadway on the existing drainage system.

5.1. Alternative 1A - At Grade

With this alternative both the extension of flow conveyance facilities and the construction of new facilities would be required. All replacement / new structures would be designed in accordance with MTO Directive B-100. The following provides a description of the proposed modifications at each of the major watercourse crossings. A plan, profile and typical section of the new roadway are provided in Figures 6-1, 6-2 and 6-3 respectively.

i) Titcombe Drain

Runoff from the catchment area associated with Titcombe Drain would be picked up by the storm sewer system being constructed to accommodate runoff from the new Highway 401. This would allow for the potential quality treatment of all runoff from the Titcombe Drain upstream of the new roadway. If it is found that when more detailed topographic information is available that the grades do not permit the capture of flow within the new storm sewer, then a 1200 mmØ culvert would be provided for in the design of the new roadway to safely convey flow.

ii) Basin Drain

A new 2.1 m x 1.5 m concrete box culvert would be constructed to convey the 100-year flow from the Basin Drain catchment area. Given the close proximity of the new culvert with the existing structure under E.C. Row Expressway, consideration could be given to connecting both facilities. If the system is to remain open between the two culverts than realignment of Basin Drain should be considered to improve the hydraulic efficiency of the system at both the inlet and outlet Results of the hydraulic analysis are provided in Appendix A.1

iii) Marentette Mangin Drain

With Alternative 1A the proposed Highway 401 would be below in the area of the drain. As a result of this all flows upstream of the new roadway would have to be collected by the new storm sewer system and pumped downstream. Based on the available information there is very little catchment area associated with the drain upstream of the proposed Highway 401 which will have to be captured. By intercepting the upstream runoff there is the possibility of providing quality treatment for all of the flow as part of the Highway 401 stormwater management plan.

iv) Turkey Creek

Alternative 1A would utilize the existing Turkey Creek bridge structure. An extension of the existing structure would be required in order to accommodate the additional proposed lanes.

v) Lennon Drain

At the Lennon Drain crossing the proposed roadway would follow the alignment and profile of the existing structure. The existing 2.6 m x 1.2 m box culvert would have to be extended to accommodate the extra lanes. As previously noted, an update of the watershed model is required in order to confirm the design flows and the need for replacement. As a minimum, extension of the existing culvert would be required to accommodate the additional lanes. The hydraulic analysis associated with the new culvert design is included in Appendix A.1

vi) Cahill Drain West Tributary

The proposed road profile at the crossing is approximately 2 m above that of the existing roadway. Replacement of the existing culvert with a 1200 mmØ concrete pipe is proposed to provide an improved level of flow hazard protection. An alternative approach is to redirect the West Tributary in an easterly direction approximately 150 m to outlet to the Cahill Drain main channel. Both options are considered to be viable. The hydraulic analysis associated with the new culvert design is included in Appendix A.1.

vii) Cahill Drain

The proposed roadway at the existing Cahill Drain crossing will be below by approximately 6 m. As a result of this, the new roadway would impede surface runoff. The developed proposal is to relocate the crossing in a westerly direction by approximately 170 m. This would allow Cahill Drain to continue to flow by gravity past the new roadway. The new box culvert would have an opening size of approximately of 4.5 m x 1.5 m. If the Cahill Drain West Tributary is diverted to the new crossing the opening size would have to increased in order to handle the additional flow. As previously noted, the subject watershed model must be updated to confirm peak outflows and required culvert sizes. The hydraulic analysis associated with the proposed culvert alternative is included in Appendix A.1.

viii) Cahill / Wolfe Drain

With Alternative 1A Cahill / Wolfe Drain would be realigned in a northerly direction and run parallel to the new service road. The existing cross sectional area of the channel would be maintained in order to provide the required 100-year flow conveyance. It is noted that the new alignment of the Drain must also be adjusted to accommodate any stormwater management requirements (ponds).

An alternative to having an open drain is to provide a closed conveyance system located under the northbound service Road. To accommodate the 100-year flow a 4.5 m x 1.5 m box culvert is required. Providing a closed drainage system would have the least impact on the adjacent lands as it would continue to accommodate direct access to the residential lands to the north from the Northbound service road. With the open channel option each private driveway would require a culvert to cross the drain. A typical cross section of each option is given in Figure 6-3. Results of the detailed hydraulic analysis for the proposed enclosed conveyance system are provided in Appendix A.1.

5.2. Alternative 1B – Below Grade

Alternative 1B has a similar alignment to that of Option 1A, however the roadway is below grade for much of its length. This below roadway results in a number of the watercourse crossings potentially being obstructed. This would necessitate the introduction of syphons to convey flow below the new roadway or alternatively the roadway tunneled under the subject drainage systems. A plan, profile and typical roadway section of Alternative 1B are provided in Figures 6-4, 6-5 and 6-6 respectively. The following provides a description of the proposed improvements required at the major stream crossings.

i) Titcombe Drain

Runoff from the catchment area associated with Titcombe Drain would be picked up by the storm sewer system being constructed to accommodate runoff from the new Highway 401 right-of-way. This would allow for the potential quality treatment of all runoff from the Titcombe Drain catchment area. If grades do not permit the capture of flow within the new storm sewer, then a 1200 mmØ culvert would be provided for in the design of the new roadway. The Flow Master analysis output for the new structure is given in Appendix A.2.1.

ii) Basin Drain

A new 2.1 m x 1.5 m concrete box culvert would be constructed to convey the 100-year flow from the Basin Drain catchment area. Given the close proximity of the new culvert with the existing structure consideration could be given to connecting both facilities. If the system is to remain open between the two culverts than realignment of Basin Drain should be considered to improve the hydraulic efficiency of the system. The Culvert Master hydraulic analysis output is given in Appendix A.2.2.

iii) Marentette Mangin Drain

With Alternative 1A the proposed Highway 401 would be below in the area of the drain. As a result of this all flows upstream of the new roadway would have to be collected by the new storm sewer system and pumped downstream. Based on the available information there is very little catchment area associated with the drain upstream of the proposed Highway 401 which will have to be interrupted. By intercepting the upstream runoff there is the possibility of providing quality treatment, as part of the Highway 401 stormwater management plan.

iv) Turkey Creek

Two options were considered to convey flow past Highway 401. The first option would include the construction of a syphon that would capture and convey the 100-year flow below the new below roadway. Based on the use of the PCSWM model and assuming that there would be no significant increase in the 100-year flood level upstream of the roadway a 25 m wide by 2 m high structure would be required with its invert approximately 12 m below the existing invert of Turkey Creek. The sloped entrance and exit to this syphon would extend approximately 25 m upstream and downstream of the actual crossing. The inlet structure would be specially designed to address potential ice and debris jams that would affect the conveyance capacity of the structure. An emergency overflow structure would be included in the design to ensure that the required capture capacity is maintained with no increase in flood hazard potential upstream. With the syphon alternative the inlet would have to be maintained on a regular basis and all debris captured at the inlet grate removed. A detailed PCSWM support analysis output is provided in Appendix A.2.4.1.

An alternative to the construction of a syphon is a lowering of the proposed Highway 401 roadway profile at the stream crossing by an additional 4 m. This would allow the roadway to be tunneled under Turkey Creek. Although Turkey Creek would be affected initially as a result of the construction of the roadway there would be no long term impacts on the stream.

v) Lennon Drain

To convey flow past the new roadway a 3 m wide by 1.5 m high syphon is proposed. A separate flow control 2.6 m x 1.2 m concrete culvert would have to be constructed upstream in order to maintain the flood attenuation benefits associated with the existing online pond. As the lands immediately upstream of the roadway, west of the drain are developed special consideration must be given to the design of the inlet structure. Consideration must also be given to the effects of ice and debris jams upstream of the syphon inlet structure. The provision of floodproofing measures such as flood control berms etc. must be considered in the development of the overall strategy to safely convey flow past the below Highway 401 and provide appropriate flood proofing benefits to the upstream urbanized area. The detailed PCSWM syphon analysis output is given in Appendix A.2.4.2.

vi) Cahill Drain West Tributary

The diversion of this tributary in an easterly direction to Cahill Drain is proposed. Detailed topographic surveys are required to confirm the feasibility of this approach. Alternatively the system could be syphoned below the new roadway.

vii) Cahill Drain

Cahill Drain is the second largest drainage system that crosses the new highway. With the below roadway two options are being considered. They include construction of a syphon to take the channel below the roadway or lowering the roadway profile below that of the existing drainage system. If a syphon is to be constructed, it will require a 4.5 m x 1.5 m opening. Results of PCSWM syphon analysis for Cahill Drain crossing is provided in Appendix A.2.4.3.5 Urbanization has significantly encroached onto Cahill Drain. Any changes to how the system functions may as a result have a significant impact on the efficiency of the upstream collection system. Of the two options considered, tunnelling under the watercourse would have the least impact on the flow conveyance of the system. This is of particular importance as consideration is being given to the potential enclosing of Wolfe Drain.

viii) Cahill Drain / Wolfe Drain

As proposed for Alternative 1A there are two options available, realignment of the channel or the construction of a new 4.5 m x 1.5 m closed system. The Flow Master was used to establish the preliminary size of the new closed system. Its output is included in Appendix A.2.3. Of the two options considered, construction of an enclosed system would have the least impact on the existing landuse.

5.3. Alternative 2A – At Grade

Alternative 2A has similar characteristics to that of Alternative 1A. The new roadway however would run south of and parallel to the existing Highway 3, Huron Church Road and E.C. Row Expressway, as opposed to utilizing the existing road right of ways. By offsetting the new roadway, the existing Northbound service road would continue to be used to service the existing development. Plan, profile and typical roadway section are provided in Figures 6-7, 6-8 and 6-9 respectively.

The primary differences between Alternative 2A and 1A are summarized as follows:

- New bridge provided at Turkey Creek crossing with similar characteristics to that of the existing structure.
- Existing Cahill / Wolfe Drain is left as an open channel following its existing alignment.

The hydraulic analysis output for all stream crossings and drainage associated with Alternative 2A is given in Appendix A.3.

5.4. Alternative 2B – Below Grade

Alternative 2B has an alignment similar to that of Alternative 2A but with the roadway now being below. The primary difference in stream crossing improvements between Alternative 2B and 2A is the potential realignment of Wolfe Drain in a northerly direction to accommodate a stormwater management facility (see Section 6.0). A plan, profile and typical cross section of the proposed roadway are provided in Figures 6-10, 6-11 and 6-12 respectively.

As discussed in Section 5.3, there are two options being considered for the crossing of Cahill Drain, they include the construction of a syphon and tunneling. The hydraulic analysis output for Alternative 2B is given in Appendix A.4. The syphon analysis output for Cahill Drain is included in Appendix A.2.4.3

5.5. Alternative 2B Revised – Modified Below Grade

Alternative 2B Revised is a modified Alternative 2B. A plan, profile and typical roadway section are provided in Figures 6-13, 6-14 and 6-15 respectively. As opposed to a syphon or tunnel being constructed at the Turkey Creek crossing, this alternative recommends raising the road profile above the channel. A new three cell 10 m x 2.0 m box culvert or equivalent would be constructed to maintain the existing 100-year flood hazard condition. With this alternative, the new roadway would have minimal impact on either the form or function of Turkey Creek.

The hydraulic analysis output for Titcombe and Basin Drain crossings is given in Appendix A.5.1 and A.5.2 respectively. The PCSWM syphon analysis output for Lennon Drain and Cahill crossing are provided in Appendix A.2.4.2 and Appendix A.2.4.3 respectively. The detailed HEC-RAS analysis output for Turkey Creek for the pre and post development conditions are provided in Appendices A.5.3.1 and A.5.3.2 respectively.

5.6. Alternative 3 - Tunnel

Alternative 3 has the least impact on the existing drainage systems as the new roadway would be constructed below the existing natural drainage features. Any impacts would be short term, related to the construction technique. A plan, profile and typical roadway section are provided in Figures 6-16, 6-17 and 6-18 respectively.

A complete summary of the stream crossing options for each of the Roadway Altemative is given in Table 5.1.

6. Stormwater Management Plan

6.1. Screening of Alternatives

A list of stormwater management practices (SWMP's) was screened, along with the "do nothing" alternative, with consideration of the general advantages and disadvantages, experience, and practical feasibility for the site-specific conditions, such as:

- Integration with the standard type of drainage (storm sewers and outside ditches);
- Space available (within the proposed right-of-way), and practical outlet points;
- Impact to existing landuse.

Although the "do nothing" alternative was initially considered, it was determined that this is not an acceptable course of action. The proposed increase in pavement area and the associated potential increase in pollutant loading to the receiving watercourses would result in negative effects such as reduced stream water quality, degraded aquatic habitat, flooding, and in-stream erosion, which necessitates provision of appropriate mitigation measures.

The list of SWMP's reviewed for appropriateness included:

1) Storage SWMP's such as wet ponds, dry ponds, constructed wetlands and underground storage tanks;
2) Infiltration SWMP's such as infiltration basins, infiltration trenches, sand filters and porous pavement;
3) Vegetative SWMP's such as buffer strips, grassed swales and filter strips;
4) Soft SWMP's such as conservation/restoration and source controls; and
5) Special purpose SWMP's such as oil/grit separators and filter devices.

Based on an initial screening of SWMP's, it was concluded that:

- Storage SWMP's (e.g. ponds) can be effective in providing combined quality/quantity control where drainage areas are sufficient and space is available.
- SWMP's based on infiltration can be effective in treating stormwater runoff, but their effectiveness is limited with respect to flooding and erosion control. Disadvantages include the high level of maintenance required and the potential for clogging. It should also be noted that the relatively high salt concentration associated with a highway would be infiltrated directly into the groundwater, which is not considered acceptable.
- Vegetative SWMP's such as grassed swales provide water quality treatment primarily by filtering out fine sediments and promoting infiltration, but can also be used to provide secondary erosion control. Filtering of highway runoff can also be accomplished with vegetative buffers and filter strips. Grassed swales are primarily designed to provide water quality control by limiting flow velocities and increasing the wetted perimeter, while enhanced grass swales have permanent rock check dams to detain water during small events and/or flat bottoms to increase storage and contact. Vegetative SWMP's can be readily applied to highway situations, and are relatively inexpensive and particularly

effective for small catchment areas. Given the limited availability of land this option was not considered appropriate.

- The implementation of soft SWMP's such as conservation/restoration and source control of pollutants such as de-icing salt are beyond the scope of this study and are addressed through MTO's policies and guidelines for roadway maintenance.
- Oil/grit separators are used to trap and retain oil and/or sediment in detention chambers, usually located below ground. They are often used as spill controls, pre-treatment devices or end of pipe controls as part of a multi-component approach for water quality control. They are usually used for small sites.

Based on the results of the screening process and the site conditions, the solutions retained for further analysis were storage SWMP's and oil/grit separators. The storage SWMP's will provide quality treatment, erosion control and quantity control for the upstream catchment area. Storage SWMP's will be utilized to match existing peak flow conditions to the receiving watercourses in an effort to emulate existing conditions within the watersheds. Oil/grit separators will provide quality treatment to the upstream catchment areas, and will be utilized only for small catchment areas such as highway ramps.

For future studies, it is recommended that continued research and analysis be conducted toward utilizing a treatment train approach for providing quality treatment. This would consist of using multiple SWMP's in series, such as vegetated SWMP's in addition to oil/grit separators or storage SWMP's.

6.2. Fish Habitat

As part of the overall Detroit River International Crossing Study, a report entitled "*Practical Alternatives Evaluation Working Paper, Natural Heritage*" dated July 2007, was conducted to determine potential impacts the proposed development will have on the area. The report includes potential impacts on vegetation, wildlife, and fish habitat, as well as fishery habitat classification. Information on fish habitat for the receiving watercourses is integrated with the design of stormwater management facilities, as adequate stormwater quality treatment from the proposed development will be required for watercourses with sensitive fishery habitat.

From this report, all watercourses within the Study Area are classified as warmwater fishery habitat, either supporting sportfish communities or baitfish communities. The only exception is the Detroit River, which supports coldwater fishery habitat, in addition to warmwater fish habitat. Table 6.1 provides a summary of the Natural Heritage Study findings with regards to fish habitat classification of the receiving watercourses.

TABLE 6.1: SUMMARY OF RECEIVING WATERCOURSE FISH HABITAT

Receiving Watercourse *	Fishery Habitat	Fishery Classification
Detroit River	Coldwater/Warmwater	Important Fish Habitat
McKee Drain	Warmwater	Important Fish Habitat
Titcombe Drain	Warmwater	Important Fish Habitat
Basin Drain	Warmwater	Marginal Fish Habitat
Marentette Mangin Drain	No Fish Habitat	No Fish Habitat
Turkey Creek	Warmwater	Marginal Fish Habitat
Lennon Drain	Warmwater	Important Fish Habitat
Cahill Drain	Warmwater	Important Fish Habitat
Wolfe Drain	Warmwater	Marginal Fish Habitat

* Refer to Figure 3-1 for location

6.3. Proposed Stormwater Management Plans – Roadway Design

The proposed stormwater management strategy developed for Alternative 1A, 1B, 2A, 2B, 2B Revised and 3 consists of utilizing oil/grit separators and stormwater management facilities to provide quality and quantity control. Plan, profiles and typical roadway sections for each Alternative are included in Figures 6-1 to 6-8 inclusive.

It is noted that because of the terrain and the consideration of using below roadways, pumping stations will be required in order to maintain drainage to the existing natural features. The developed stormwater management plan is based on the premise that the existing flow characteristics and water balance will be maintained.

Based on the established road profiles for each roadway alternative, catchment areas were identified and peak flows determined using the Rational Method. The existing condition was modeled as completely undeveloped with an assumed runoff coefficient of 0.30. The proposed condition was considered to be completely impervious, therefore a runoff coefficient of 0.90 was assumed. Preliminary storm sewer profiles were established in order to confirm the potential need for pumping stations. The conceptual storm sewer profiles are shown on the previously referenced drawings. Once the preferred roadway alternative has been established, then a detailed hydrologic and hydraulic analyses will be completed to confirm catchment areas, sewer design details, pond area requirements etc. Where possible the number of proposed stormwater management facilities and pumping stations and land area requirements will be minimized.

In order to achieve the quality treatment required for the receiving watercourses, Enhanced Protection Level quality treatment will be provided. Stormwater management wet ponds located upstream of the receiving watercourses will provide the highest quality treatment to overland runoff, while providing quantity control to prevent downstream erosion and flooding. Wetponds have been designed following the MOE Stormwater Management Planning and Design Manual (2003) to provide quality protection level as well as quantity control for up to the 100-year design storm. The permanent pool requirements for the wetponds were sized based on the Enhanced Protection Level criteria, providing 80% long-term suspended solids removal, as provided in Table 3.2 of the MOE Stormwater Management Planning and Design Manual (2003), for 85% Imperviousness. In the case of the Proposed Highway 401, the required permanent pool storage volume would be 210 m^3/ha (250 m^3/ha for 85% Imperviousness minus 40m^3/ha for extended detention). For determining the permanent pool storage requirements, the upstream drainage area considered for each pond consisted of the proposed Highway Extension ROW only.

Extended detention for the wet ponds was determined based on the greater of the extended detention requirements as set by the MOE Stormwater Management Planning and Design Manual (2003), or the 25 mm erosion storm released over 24 hours. The 25 mm erosion storm storage requirements were calculated using the runoff from the 25 mm storm over the proposed Highway Extension ROW area. The release rate for the erosion storm storage volume was based on an average release over 24 hours. In all cases, requirements for the 25 mm erosion storm were greater than the MOE extended detention requirements. In addition, providing a steady release of the erosion storm over an extended period of time will provide a net-benefit to the baseflow of the receiving watercourses. This will be particularly beneficial to watercourses that have fishery habitat, but experience intermittent baseflow.

Quantity requirements for the stormwater management wet ponds were determined to able to provide storage for the 2-year through 100-year storms. Release rates for the wet ponds within the site were based on matching the existing conditions peak flows from the proposed Highway Extension ROW area. Specific details of the pond designs will be provided in the Preliminary design.

The following provides a description of the stormwater management plan prepared for each of the Highway 401 alternatives.

6.3.1. Alternative 1A – At Grade

The proposed Highway 401 – Alternative 1A Preliminary Stormwater Management Plan is identified in Figure 6-1. A typical roadway and sewer profile is given in Figure 6-2. The total drainage area for this alternative is in the order of 41 ha. Runoff from the proposed development will drain to Cahill drain, Lennon Drain, Marintette Mangin Drain, Basin Drain and Titcombe Drain, all tributaries of the Turkey Creek Watershed.

The proposed approach to providing quality and quantity control for Alternative 1A is to construct a Stormwater Management Facility downstream of each of the drainage catchments. The SWM facilities will provide Enhanced Level quality treatment as well as quantity control from the 25mm erosion storm up to the 100-year storm to pre-development conditions.

In addition to these facilities, the feasibility of utilizing onsite controls such as enhanced swales and oil grit separators were also investigated. The suitability of using enhanced swales as a conveyance control will be examined in more detail when a Highway option is chosen. The oil/grit separator for Drainage Area 107 was considered as an alternate approach along with underground storage.

As discussed in Section 5.1, two possible options are being considered for the handling of runoff along Cahill and Wolfe Drains. Under Option 1, Cahill and Wolfe Drains would be realigned north of the new 2-lane service road. From Drainage Area 107 (refer to Figure 6-1 will have to be directed first to SWM Pond 1A-P8 treated and then released to Wolfe Drain. Under Option 2, replacement of the existing trapezoidal channel by a 4.5 m x 1.50 m reinforced concrete box culvert under the proposed northbound service road, there is no opportunity to construct a Stormwater Management Facility in the existing residential area. An alternative to the pond would be to construct an underground storage facility below the northbound service road and discharge to Wolfe Drain. This structure would be designed to control all outflows up to the 100-year event to the pre-development condition. Oil/grit separators would also be required for quality control. With this option Wolfe Drain would not have to be realigned. The new underground storage facility would be constructed immediately south of the enclosed Wolfe Drain and would outlet to Wolfe Drain.

Table 6.2 provides a summary of the preliminary stormwater management plan prepared for Alternative 1A. Figure 6-1 identifies the Stormwater Management Plan showing the possible location of stormwater management facilities. The existing and proposed condition hydrologic analysis output for Alternative 1A drainage areas are provided in Appendix B.1 and B.2 respectively. Stormwater management computations associated with pond sizing are given in Appendix C.1

TABLE 6.2: ALTERNATIVE 1A – STORMWATER MANAGEMENT PLAN

Drainage Area ID	Drainage Area (ha)	100-year Peak Flow (m^3/s)		Stormwater Management Facility Req't				Recipient Drainage System
				Facility ID	Storage Volume (m^3)		Pond Area (m^2)	
		Existing	Proposed		Quality	Quantity		
100	6.36	0.37	2.40	1A-P1	1,590	2,400	6,100	Titcombe Drain
101	2.53	0.16	0.99	1A-P2	633	1,000	4,700	Basin Drain
102	5.60	0.68	2.12	1A-P3	1,400	1,400	5,700	Marentette Mangin Drain
103	2.60	0.16	1.02	1A-P4	650	1,000	4,300	Turkey Creek
104	2.50	0.21	1.14	1A-P5	625	800	4,200	Lennon Drain
105	2.50	0.18	1.06	1A-P6	625	900	4,200	Lennon Drain
106	5.60	0.34	2.17	1A-P7	1,400	2,100	5,700	Cahill Drain
*107	3.10	0.18	1.16	1A-P8	775	1,200	4,500	Wolfe Drain
108	3.96	0.23	1.50	1A-P9	990	1,500	5,000	Wolfe Drain
109	6.60	0.27	1.91	1A-P9	1,650	2,900	6,100	Wolfe Drain

* Alternate stormwater management measure, underground storage and oil-grit separator

More specific details of the proposed stormwater management facilities will be provided at the preliminary design stage. It is noted that lowest points of Drainage Areas 102, 104, 106, and 108 as identified on Figure 6-1 are located approximately 7m below the existing grade. Pumping of stormwater runoff to the proposed Stormwater Management Facility is required. Table 6.3 summarizes the pumping station locations and requirements for Alternative 1A. Preliminary storm sewer profiles are provided in Figure 6-2.

TABLE 6.3: ALTERNATIVE 1A – SUMMARY OF PUMPING REQUIREMENTS

Drainage ID	Pumping Station	100-year Peak Flow (m^3/s)	Drainage Outlet
102	13+746	2.12	SWM Pond 1A-P3
104	10+085	1.14	SWM Pond 1A-P5
106	11+733	2.17	SWM Pond 1A-P7
108	10+030	1.50	SWM Pond 1A-P9

* Refer to Figure 6-1 for location

6.3.2. Alternative 1B – Below Grade

The proposed Highway 401 – Alternative 1B Preliminary Stormwater Management Plan is identified in Figure 6-4. The total drainage area for this alternative is in the order of 41 ha. Runoff from the proposed development will drain to Cahill Drain, Lennon Drain, Marentette Mangin Drain, Basin Drain and Titcombe Drain, all tributaries of the Turkey Creek Watershed.

The proposed approach to providing quality and quantity control for Alternative 1B is to construct a Stormwater Management Facility downstream of each of the drainage catchment as shown on Drawing 6-4. The SWM facilities will provide Enhanced Level quality treatment as well as quantity control from the 25mm erosion storm up to the 100-year storm to pre-development conditions. An alternate approach was considered for Drainage Area 107, utilizing underground storage to provide quantity control and an oil/grit separator to provide quality treatment.

An alternate option for Drainage Areas 102 and 103 is to direct the flow into one stormwater management facility (SWM Pond 1BP3 and 1BP4 combined) and drain the treated and controlled flow to Turkey Creek as shown in Figure 6-4. The feasibility of this option would be dependent on the alternative selected for the roadway profile below Turkey Creek.

As with Alternative 1A, there will be two alternate stormwater management measures for Drainage Area 106, depending on which of the Cahill and Wolfe Drain drainage options are selected. Under Option 1, Cahill and Wolfe Drain would be realigned north of the new 2-lane service road, runoff from Catchment 106 will be directed first to SWM Pond 1A-P7 and the controlled outflow released to Wolfe Drain. Under Option 2, replacement of the existing trapezoidal channel by a 4.5 m x 1.50 m reinforced concrete box culvert under the proposed northbound service road, there is no opportunity to construct a Stormwater Management Facility in the existing residential area. Underground storage is necessary to control the 100-year peak flows to predevelopment level and treat the outflows via oil/grit separator. Figure 6-6 gives a typical roadway section that shows the two flow conveyance options for Wolfe Drain.

Table 6.4 provides a summary of the preliminary stormwater management plan for Alternative 1B – Below Grade with pond area requirements. Figure 6-4 identifies the Stormwater Management Plan showing the possible location of stormwater management facilities.

TABLE 6.4: ALTERNATIVE 1B – STORMWATER MANAGEMENT PLAN

**Drainage Area ID	Drainage Area (ha)	100-year Peak Flow (m^3/s)		Stormwater Management Facility Req't				Recipient Drainage System
				Facility	Storage Volume (m^3)		Pond Area (m^2)	
		Existing	Proposed	ID	Quality	Quantity		
100	6.36	0.36	2.37	IA-P1	1,600	2,400	6,100	Titcombe Drain
101	2.70	0.20	1.18	1A-P2	700	900	4,400	Basin Drain
102	5.38	0.34	2.16	1A-P3	1,400	2,000	5,600	Marentette Mangin Drain
103	4.50	0.26	1.70	1A-P4	1,200	1,700	5,200	Turkey Creek
104	2.74	0.21	1.20	1A-P5	700	900	4,400	Lenon Drain
105	7.21	0.38	2.57	1A-P6	1,800	2,800	6,400	Cahill Drain
*106	6.17	0.27	1.90	1A-P7	1,600	2,600	5,600	Wolfe Drain
107	6.56	0.27	1.90	1A-P8	1,700	2,900	6,100	Wolfe Drain

* Alternate stormwater management measure, underground storage and oil/grit separator

** Refer to Figure 6-4 for location

Details of the proposed stormwater management facilities will be provided at the preliminary design stage. Stormwater Management Computations for pond sizing are provided in Appendix C.2. Rational Method calculations for existing and proposed conditions are provided in Appendix B.1 and B.2 respectively.

It is noted that Drainage Areas 102 to 106 of the proposed Highway 401 will be located approximately 15 m below the existing ground elevation. As a result, pumping of stormwater runoff to the proposed Stormwater Management Facilities will be required. Preliminary profiles of the storm sewer systems are given in Figure 6-5. Table 6.5 summarizes the pumping station locations and requirements for Alternative 1B.

TABLE 6.5: ALTERNATIVE 1B – SUMMARY OF PUMPING REQUIREMENTS

Drainage ID	Pumping Station	100-year Peak Flow (m^3/s)	Drainage Outlet
102	13+752	2.16	SWM Pond 1B-P3
103	15+112	1.70	SWM Pond 1B-P4
104	10+650	1.20	SWM Pond 1B-P5
105	11+420	2.57	SWM Pond 1B-P6
106	13+165	1.90	SWM Pond 1B-P7

6.3.3. Alternative 2A – At Grade

The proposed stormwater management plan for Alternative 2A is shown on Figure 6-7. A preliminary storm sewer profile required to service the area and a typical roadway section are provided in Figures 6-8 and 6-9 respectively.

Based on the established road profile as provided in Figure 6-8, eight drainage areas have been defined. Their limits are shown in Figure 6-7. The estimated 100-year peak flows from each of these areas under existing and proposed conditions are summarized in Table 6.6. The Rational Method computations for the pre and post development conditions are given in

Appendices B.1 and B.2 respectively.

The proposed approach to providing quality and quantity control for Alternative 2A is to construct a Stormwater Management Facility downstream of each of the drainage catchments.

TABLE 6.6: ALTERNATIVE 2A – STORMWATER MANAGEMENT PLAN

*Drainage Area ID	Drainage Area (ha)	100-year Peak Flow (m^3/s)		Stormwater Management Facility Req't				Recipient Drainage System
		Existing	Proposed	Facility ID	Storage Volume (m^3) Quality	Storage Volume (m^3) Quantity	Pond Area (m^2)	
100	6.36	0.36	2.37	2A – P1	1700	3700	6700	Titcombe Drain
101	1.69	0.13	0.73	2A – P2	540	1000	4000	Basin Drain
102	5.19	0.30	1.96	2A – P3	1400	3000	5600	Marentette Mangin Drain
103	3.31	0.21	1.30	2A – P4	840	1900	4600	Turkey Creek
104	4.93	0.34	2.07	2A – P5	1100	2800	5000	Lennon Drain
105	2.61	0.19	1.11	2A – P6	450	1500	3700	Cahill Drain
106	5.30	0.29	1.92	2A – P7	1600	3100	5900	Cahill Drain
107	7.06	0.38	2.53	2A – P8	1800	4100	6200	Wolfe Drain

* Refer to Figure 6-7 for location

As shown in Table 6.6, eight wet ponds are required in order to address the stormwater management requirements. Their locations are shown on Figure 6-7. Runoff from Drainage Areas 100, 101, 103 and 105 will discharge directly to the ponds via storm sewer. The stormwater from Drainage Areas 101, 104, 106, and 107 will have to be pumped to the ponds. Table 6.7 summarizes the pumping requirements associated with this alternative.

The estimated pond areas associated with the new facilities are summarized in Table 6.6. The SWM facilities will provide Enhanced Level quality treatment as well as quantity control from the 25mm erosion storm up to the 100-year storm to pre-development conditions. The stormwater management pond computations are provided in Appendix C. The suitability of using enhanced swales in conjunction with the stormwater management facilities will be examined in more detail when a Highway option is chosen.

TABLE 6.7: ALTERNATIVE 2A – SUMMARY OF PUMPING REQUIREMENTS

Drainage ID	Pumping Station	100-year Peak Flow (m^3/s)	Drainage Outlet
100	11+500	2.37	SWM Pond 2A – P1
101	12+693	0.73	SWM Pond 2A – P2
102	13+727	1.96	SWM Pond 2A – P3
103	14+300	1.30	SWM Pond 2A – P4
104	10+367	2.07	SWM Pond 2A – P5
105	11+150	1.11	SWM Pond 2A – P6
106	12+150	1.92	SWM Pond 2A – P7
107	10+000	2.53	SWM Pond 2A – P8

* Refer to Figure 6-7 for location

6.3.4. Alternative 2B – Below Grade

The proposed stormwater management plan for Alternative 2B is shown in Figure 6-10. A Preliminary storm sewer required to service the area and a typical roadway section are provided in Figures 6-11 and 6-12 respectively.

Based on the established road profile as given in Figure 6-11, seven drainage areas have been defined. Their limits are shown on Figure 6-10. The estimated 100-year peak flows from these areas under existing and proposed conditions are summarized in Table 6.8. The Rational Method output for the pre and post development con is included in Appendices B.1 and B.2 respectively.

As summarized in Table 6.8, seven wet ponds are being proposed to address the stormwater management requirements of the site. The stormwater from Drainage Areas 100 and 101 will be discharged to the proposed ponds via storm sewer directly. The stormwater from Drainage Areas 102, 103, 104, 105, and 106 will have to be pumped to the ponds. Table 6.9 summarizes the pumping requirements associated with this alternative. All stormwater from the wet ponds will be drained to the watercourse by the gravity.

The required pond areas and storage volumes to address quality and quantity requirements are summarized in Table 6.8. The SWM facilities will provide Enhanced Level quality treatment as well as quantity control from the 25mm erosion storm up to the 100-year storm to pre-development conditions. The stormwater management computations associated with the pond sizing are included in Appendix C.

TABLE 6.8: ALTERNATIVE 2B – SUMMARY OF STORMWATER MANAGEMENT PLAN

*Drainage Area ID	Drainage Area (ha)	100-year Peak Flow (m^3/s)		Stormwater Management Facility Req't				Recipient Drainage System
				Facility ID	Storage Volume (m^3)		Pond Area (m^2)	
		Existing	Proposed		Quality	Quantity		
100	6.36	0.36	2.37	2B – P1	1,700	3,700	6,700	Titcombe Drain
101	2.13	0.16	0.92	2B – P2	500	1,200	4,000	Basin Drain
102	6.54	0.37	2.44	2B – P3	1,700	3,800	6,100	Pump to Marentette Mangin Drain
103	7.21	0.32	2.25	2B – P4	2,100	4,300	6,700	Pump to Turkey Creek
104	2.34	0.18	1.04	2B – P5	700	1,300	4,200	Pump to Lennon Drain
105	5.77	0.27	1.84	2B – P6	1,500	3,400	5,800	Pump to Cahill Drain
106	9.32	0.49	3.32	2B – P7	2,400	5,400	7,200	Pump to Wolfe Drain

* Refer to Figure 6-10 for location

TABLE 6.9: ALTERNATIVE 2B – SUMMARY OF PUMPING REQUIREMENT

Drainage ID	Pumping Station	100-year Peak Flow (m^3/s)	Drainage Outlet
100	11+450	2.37	SWM Pond 2B - P1
101	12+693	0.92	SWM Pond 2B – P2
102	14+000	2.44	SWM Pond 2B – P3
103	14+264	2.25	SWM Pond 2B – P4
104	10+500	1.04	SWM Pond 2B – P5
105	11+500	1.84	SWM Pond 2B – P6
106	10+000	3.32	SWM Pond 2B – P7

6.3.5. Alternative 2B Revised – Modified Below Grade

Alternative 2B Revised has a similar alignment to that of Alternative 2B. The road profile however has now been revised to include a minimum slope of 0.5% as opposed to 0.3%. At Turkey Creek the Highway 401 proposed profile now goes overtop of the watercourse as opposed to going underneath. With this alternative the number of potential stormwater management facilities has also been minimized. This, however, has resulted in the storm sewer system being lower than that required for Alternative 2B. At the final design stage, economic and social impact assessments will have to be completed to confirm which approach is the preferred. A plan, profile and typical road section for Alternative 2B – Revised is given in Figures 6-13, 6-14 and 6-15 respectively.

Based on the new road profile, four drainage areas have been defined. They are identified on Figure 6-13. For each area the 100-year peak outflow has been computed for the pre and post development condition based on the use of the Rational Method. For the post development condition the computed peak flows were based on the preliminary profile of the storm sewer system as given in Figure 6-14. Results of the Rational Method analyses are summarized in Table 6.10. The Rational method output for the pre and post development conditions are included in Appendices B.1 and B.2 respectively.

As shown in Table 6.10, four wet ponds are being proposed to address the stormwater management requirements. Their locations are identified on Figure 6-13. The stormwater from Drainage Area 100 will be discharged directly to the pond via a storm sewer. The stormwater from Drainage Area 101, 102, and 103 will have to be pumped to the ponds. Table 6.11 summarizes the pumping requirements. All stormwater from the wet ponds will be drained to the adjacent watercourse by gravity. The SWM facilities will provide Enhanced Level quality treatment as well as quantity control from the 25mm erosion storm up to the 100-year storm to pre-development conditions.

The required pond areas and quality and quantity storage volume requirements are summarized in Table 6.10. The stormwater management computations associated with the pond sizing are included in Appendix C.5.

TABLE 6.10: ALTERNATIVE 2B REVISED PROFILE – SUMMARY OF STORMWATER MANAGEMENT PLAN

*Drainage Area ID	Drainage Area (ha)	100-year Peak Flow (m^3/s)		Stormwater Management Facility Req't				Recipient Drainage System
		Existing	Proposed	Facility ID	Storage Volume (m^3) Quality	Storage Volume (m^3) Quantity	Pond Area (m^2)	
100	6.36	0.37	2.54	2BR-P4	2100	3700	6700	Drain to Titcombe Drain
101	8.67	0.42	3.12	2BR-P3	2200	5100	6900	Pump to Basin Drain
102	6.22	0.32	1.55	2BR-P2	1600	3600	5900	Pump to Lennon Drain
103	19.43	0.57	4.89	2BR-P1	4900	12000	10000	Pump to Cahill Drain

* Refer to Figure 6-13 for location

TABLE 6.11: ALTERNATIVE 2B REVISED – PUMPING REQUIREMENTS

Drainage ID	Pumping Station	100-year Peak Flow (m^3/s)	Drainage Outlet
100	11+470	2.54	SWM Pond 2BR – P4
101	13+000	3.12	SWM Pond 2BR – P3
102	15+100	1.55	SWM Pond 2BR – P2
103	11+580	4.89	SWM Pond 2BR – P1

6.3.6. Alternative 3 – Tunnel

This alternative would involve the construction of a tunnel along a significant length (approximately 6.75 km) of the new roadway. A plan, profile and typical section of the tunnel alternative is given in Figures 6-16, 6-17 and 6-18 respectively.

A preliminary stormwater management plan was prepared for this alternative and is given in Figure 6-16. The proposed approach is to provide three wetpond facilities for the larger catchments which includes Drainage Areas 100, 101, 108 and 109. They are identified as facilities 3-P1, 3-P2 and 3-P3 on Figure 6-16 respectively. The quality and quantity storage volumes to be provided by each facility are summarized in Table 6.12. The SWM facilities will provide Enhanced Level quality treatment as well as quantity control from the 25mm erosion storm up to the 100-year storm to pre-development conditions. The stormwater management computations associated with the pond sizing are included in Appendix C.

There are a number of smaller catchment areas within the study area, associated with the ramps, that would drain to the new tunnel. Those areas are identified as Drainage Areas 102, 103, 104, 105, 106 and 107 on Figure 6-16. It is anticipated that the 100-year flow from these areas would be accommodated by the storm sewer system that will service the length of roadway within the tunnel. A profile of the new sewers is given in Figure 6-17. Based on the conceptual storm sewer design there would be two pumping stations required within the tunnel, one to discharge to Cahill Drain and the second to Turkey Creek. Two oil/grit separators would be required to treat all flow pumped from the tunnel. The oil/grit separators should also take into consideration the treatment of any spill conditions. The 100-year flow from Drainage Areas 102 and 103 would drain to the pumping station located at Chainage 14+300 located within the tunnel. The 100-year flow from Drainage Areas 104, 105, 106 and 107 would drain to the pumping station located at Chainage 11+500.

The computed pre and post development 100-year peak flows for all catchments drainage to the tunnel are summarized in Table 6.12. The Rational Method output is included in Appendices B.1 and B.2 respectively.

Alternative 3 also includes the requirement for the pumping of the 100-year runoff from Drainage Areas 101 to SWM Pond 3-P2 and Drainage Area 108 to SWM Pond 3-P3. A complete summary of the pumping requirements associated with Alternative 3 is given in Table 6.13.

TABLE 6.12: ALTERNATIVE 3 – STORMWATER MANAGEMENT PLAN

Drainage Area ID	Drainage Area (ha)	100-year Peak Flow (m^3/s)		Stormwater Management Facility Req't				Recipient Drainage System
		Existing	Proposed	Facility ID	Storage Volume (m^3) Quality	Storage Volume (m^3) Quantity	Pond Area (m^2)	
100	6.36	0.37	2.40	3-P1	1,600	2,400	6,100	Titcombe Drain
101	2.80	0.17	1.08	3-P2	700	1,100	4,500	Titcombe Drain
102	0.34	0.03	0.16	Oil/Grit Separator	-	-	-	Tunnel Storm Sewer Outfall Station 14+300, Turkey Creek
103	0.34	0.03	0.16		-	-	-	
104	0.14	0.02	0.07	Oil/Grit Separator	-	-	-	Tunnel Storm Sewer Outfall Station 11+500, Cahill Drain
105	0.19	0.02	0.10		-	-	-	
106	0.17	0.02	0.09		-	-	-	
107	0.19	0.02	0.09		-	-	-	
108	2.16	0.13	0.84	3-P3	600	800	10,200	Wolfe Drain
109	6.56	0.27	1.90	3-P3	1,700	2,900		

TABLE 6.13: ALTERNATIVE 3 – SUMMARY OF PUMPING REQUIREMENTS

Drainage ID	Pumping Station	100-year Peak Flow (m^3/s)	Drainage Outlet
101	13+000	1.08	Pond 3 – P2
108	10+095	0.84	Pond 3 – P3
Tunnel Storm Sewer Outfall	11+500	0.35	Oil / grit separator to Cahill Drain
Tunnel Storm Sewer Outfall	14+300	0.32	Oil / grit separator to Turkey Creek

A comparison of the stormwater management requirements associated with each of the roadway alternatives is given in Table 6.14.

TABLE 6.14: SUMMARY OF STORMWATER MANAGEMENT PLAN

Roadway Alternative	No. of Stormwater Management Facilities	Estimated No. of Pumping Stations
1A – At Grade	10	4
1B – Below Grade	8	5
2A – At Grade	8	4
2B – Below Grade	7	5
2B Revised – Below Grade	4	3
3 - Tunnel	3	4

7. Plaza Options

7.1. Stormwater Management Plan

Several Plaza options have been designed to provide primary and secondary inspection and toll collection along with associated queuing lanes, parking, and buildings. There are three potential sites identified for the construction of the Plaza to service the international bridge. Their locations are shown on Figure 7.1. Each of the Plaza options are between 33 ha to 43 ha in size, consisting mostly of asphalt pavement and building rooftops. The principle concern for large sites with a high imperviousness and vehicular traffic is providing stormwater treatment for frequent vehicular pollutants (oil, coolant, gasoline, etc), roadside grit and garbage (gravel, sand, cigarette butts), infrequent pollutant spills, and controlling the increase of overland runoff to the receiving watercourses. In addition, Enhanced Quality treatment will be required in accordance to the MOE document "*Stormwater Management Planning and Design Guidelines*", dated 2003, which states removal of a minimum of 80% total suspended solids (TSS), as well as quantity control to the 100-year storm, where appropriate.

Therefore, due to the overall size of the project sites and treatment required, stormwater management for each of the Plaza Options will consist primarily of stormwater management ponds and/or oil grit separators. Preliminary stormwater management block sizes are identified on the prepared conceptual plans for each of the Plaza Options. The established size, location and configuration of the blocks for each of the options will be refined at the preliminary design stage once specific details of the site plans associated with each of the Plaza Options have been refined. Where proposed stormwater management facilities outlet to natural features, downstream constraints will have to be assessed, the results of which used to confirm the operational characteristics of the stormwater management plan. Although conceptual in detail, careful consideration has been given to establishing approaches in design that addresses the grading constraints that are inherent with the existing natural attributes of the subject sites. It is noted that because of the flat topography and potential distance from the proposed facilities to a suitable outlet, significant fill maybe required in order to service the site. Alternatively, consideration could be given to the possibility of providing a pumping station to control the water level within the proposed stormwater management facilities. For each site a stormwater management plan has been prepared based on a review of the topographical features, environmental and urban constraints and the requirements for providing quality and quantity control.

There may be opportunities to incorporate alternative stormwater solutions, including permeable pavers, perforated storm sewer pipes, Green Roof systems, and infiltration basins into the Plaza designs. Permeable Pavers provide quantity treatment through storing and infiltrating stormwater runoff under the Plaza, however quality treatment requirements cannot be accurately measured. In addition, a study will be required to determine the extent of infiltration within the native soils receiving the runoff to ensure full effectiveness. Green Roof systems provide quality treatment in addition to a natural water balance through infiltration and evapotranspiration of stormwater runoff on building rooftops. Many alternative stormwater solutions will be explored further in the preliminary design stage, as increased data on the preferred Plaza Option will be available. Once the preferred Plaza Option is selected, the best and most current SWM practices will be utilized to provide quality treatment, including on-site treatments and source control treatments.

Selection of the preferred Plaza Option is dependent on a number of considerations, the most significant of which is the location of the new Detroit River crossing. The three identified crossing sites are shown on Figure 7.1. Once the river crossing location has been established than the preferred location of the Plaza associated with that alternative can be confirmed and a comparative assessment of the technical and environmental merits associated with each can be completed.

The following provides conceptual details of the preferred stormwater management plan prepared for each of the Plaza Options considered.

7.1.1. Plaza Option 'A"

The Plaza Option "A" as shown on Figure 7.2 is located in the southeast corner of the intersection of the Ojibway Parkway and the Essex Terminal Railway. The site is rectangular in shape, has an area of approximately 37 hectares and parallels the E.C.ROW Expressway for a distance of approximately 1500m. The easterly limit of the site is Malden Road. At the west limit of the site the new Plaza would intercept Matchette Road. That roadway would have to be terminated at the E.C.ROW Expressway to accommodate the Plaza.

Runoff from the site is accommodated by three drainage systems, the most significant one being Titcombe Drain. That system traverses the site approximately 300m west of Plaza Option "A's easterly boundary. All of the subject property east of Matchette Road drains in a southerly direction eventually out letting to Titcombe Drain. West of Matchette Road a small area drains northerly towards the Objibway Parkway. The remaining lands drain southerly approximately 800m following the Ojibway Parkway to a manmade drain. That drain intercepts the overland flow and directs it in a westerly direction to the Detroit River.

With the subject site having very little topographic relief from east to west and the site being in excess of 1500m in length, servicing the property without the requirement for significant fill will be a challenge. The development stormwater management plan as shown on Figure 7.2 includes the construction of a linear wetpond feature that parallels the south boundary of the site. With this type of facility the invert of the storm outfalls required to service the development area would be the same at the west limit of the site as at the east limit. This would significantly reduce the fill requirements of the site associated with its servicing needs. The proposed sewer system, a conceptual layout of which is given in Figure 7.2, includes a series of lateral trunks that would outlet to the proposed stormwater management facility at various locations along its length. At each of the outlets a forebay would be provided to capture the sediment being carried by the sewer flow. An access road would be provided to each of the forebays to facilitate cleanout. Between each forebay the wetpond feature would narrow to encourage sediment deposition within the constructed forebay but would still be wide enough to function as a flow conveyance facility. A conceptual plan of the facility is given in Figure 7.2.Outflow from the Plaza Option "A" can be directed either to Titcombe Drain that traverses the subject site or alternatively a new outlet provided to the Detroit River. With either alternative, flow would still have to be maintained to Titcombe Drain in order to ensure that the proposed works do not negatively impact the ecological condition of the recipient drainage system. If the primary outflow from the Plaza Option "A" is to the Titcombe Drain, the release rates would be based on matching the predevelopment condition.

If the primary outflow is to the Detroit River than there are two potential options, they include a new storm sewer following Broadway Street or alternatively enhancement of an existing drainage system that currently conveys flow form the Ojibway Parkway to the Detroit River. The potential locations of the outlet conveyance facilities are shown on Figure 7.3. Based on a review of the potential technical and environmental impacts associated with the outlet options the preferred approach is to direct flow from Plaza "A" directly to Titcombe Drain.

The proposed wetpond facility would provide both quality and quantity control. In the event of a contaminant spill (ie. Oil, chemical, etc.) within the Plaza, a shut-off valve or alternative damming procedure will be required within the pond. This will be determined during the detailed design stage, but must be considered throughout the design process.

A secondary location for a stormwater management facility is proposed immediately north of the Plaza, as shown on Figure 7.2. This location provides adequate land area to accommodate a stormwater management facility to provide treatment for the Plaza, and is located immediately adjacent to the Titcombe Drain, providing access to an outfall location. In addition, as the Titcombe Drain is a sensitive fish habitat, the alternate location for the stormwater management facility will help minimize the proposed impact on the watercourse. However, this location is not preferred due to the grading requirements attributed with a single facility, previously discussed. In addition to the additional fill required for the storm sewer grading requirements, the pond location is at the upstream portion of the Titcombe Drain, increasing the stormwater management permanent pool elevation, therefore increasing the initial grades of the storm sewers.

7.1.2. Plaza Option "B" and "B1"

The Plaza Option "B" is approximately 35 ha, consisting primarily of pavement and commercial buildings. The proposed Highway 401 enters from the east, with the roadway to the new bridge extending to the north. Stormwater management for the Plaza Option "B" requires quality, quantity and erosion controls for the peak flows from the Plaza, as the increase in impervious area will increase the overall peak flows from the site, as well as the overall pollutant loading. This would lead to erosion issues downstream of the site, as well as impacts to the ecological condition of the Detroit River.

Stormwater management for the Plaza Option "B" can be provided in the lands directly west of the proposed site. Currently, the lands are open space adjacent to the Detroit River, as shown in Figure 7.4. Stormwater management options for this open space could consist of a single wetpond or wetland to provide quality, quantity, and erosion treatment for the Plaza; or create a wetland system to provide quality and erosion control, with peak flows from rare events discharging directly to the Detroit River. Providing limited quantity control is not considered to be an unreasonable approach from the technical perspective given the close proximity of the wetpond facility to the Detroit River.

The proposed stormwater management plan as shown on Figure 7.4 includes drainage corridors along both the north and south boundaries of the proposed wetland facility. These corridors would convey the overland flow in excess of the 5 year storm event around the facility. This would minimize the potential for resuspension of the deposited sediment and ensure that the facility continues to function as designed. In the event of a contaminant spill (ie. Oil, chemical, etc.) within the Plaza, a shut-off valve or alternative damming procedure will be required within the pond. This will be determined during the detailed design stage, but must be considered throughout the design process.

For the Plaza Option "B", it is our recommendation to explore using a stormwater management facility to provide only quality and erosion treatment, with higher peak events discharging directly to the Detroit River using an engineered channel and outlet structure.

The Plaza Option "B1" is approximately 33 ha, consisting primarily of pavement and commercial buildings. The proposed Highway 401 enters from the east, with the roadway to the new bridge exiting to the north. Stormwater management for the Plaza Option "B1" will require quality, quantity and erosion controls for the peak flows from the Plaza, as the increase in impervious area will increase the overall peak flows from the site, as well as the overall pollutant loading. This would lead to erosion issues downstream of the site, as well as impacts to the ecological condition of the Detroit River.

There are two alternative approaches for stormwater management for the Plaza Option "B1". Stormwater management Alternative 1 consists of creating two ponds in the green spaces south of the proposed plaza, as shown in Figure 7.5. These green spaces can be converted to stormwater management facilities utilizing the existing drain to connect the facilities, discharging to the Detroit River via an outlet channel. The two pond system provides closer outlets for the sewer system, lowering the overall grading requirements of the Plaza. The two major ponds would be connected by a linear wetland/wetpond feature. The linear feature would be designed such that there would always be an open portion to ensure that there is no restriction to the conveyance of flow from one pond to the other. The two pond system would function as one with one outlet structure that would control the release rate to the Detroit River. In the event of a contaminant spill (ie. Oil, chemical, etc.) within the Plaza, a shut-off valve or alternative damming procedure will be required within the pond. This will be determined during the detailed design stage, but must be considered throughout the design process.

Stormwater management Alternative 2 consists of a single stormwater management pond located at the southwest corner of the site, adjacent to the tollbooths, to provide quality, quantity, and erosion treatment to the Plaza Option "B1". This facility will have a shorter easement to the Detroit River; as well require less land for construction. However, as the overall length of the Plaza Option "B1" is approximately 1000m, the storm sewer system collecting overland runoff will require a considerable grade difference to service the entire site (a grade difference of approximately 6m). This would greatly increase the construction cost due to fill requirements, as well as present geotechnical complications in order to provide structural support for the additional fill load.

For the Plaza Option "B1", the preferred stormwater management plan, based on engineering considerations would be associated with Alternative 1. This alternative helps to minimize the fill requirements of the site, needed to service the property. In addition by reducing the amount of surcharging associated with the placement of fill on the site, the geotechnical issues and timing for proper compaction would be greatly reduced.

7.1.3. Plaza Option " C"

The Plaza Option "C" is approximately 43 hectares in area and is bounded by Sandwich Street to the east, the Detroit River to the west and the Windsor Salt Property to the north. Of the various Plaza options considered Plaza Option "C" is one of the closest to the Detroit

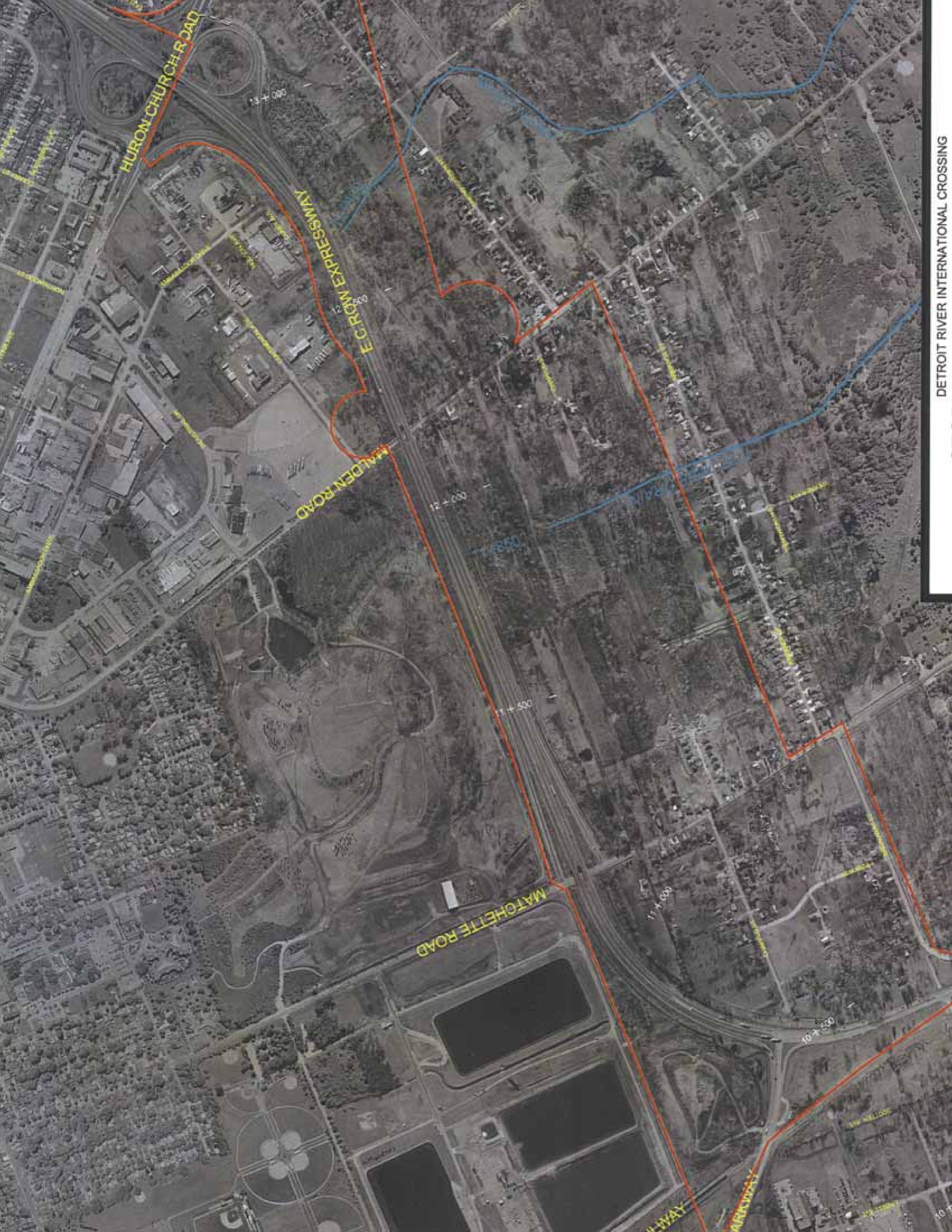
River. A conceptual plan of the Plaza and its relative location to the Detroit River is given in Figure 7.6.

Although it is recognized that current stormwater management guidelines as adopted by the approval agencies includes both quality and quantity control the close proximity of the subject Plaza to a significant drainage system (Detroit River) would suggest that quantity control would not be a component of the design. The safe conveyance of the flow to the Detroit River for all storms up to and including the 100 year event would be the primary quantity control objective associated with the stormwater management plan. Public safety as it relates to flood hazard condition would also be an issue to be addressed by the design.

As shown on Figure 7.6 the minor system flows from the subject site would be accommodated by storm sewer systems that would outlet to a stormwater management facility located north of Prospect Ave. Although the storm sewers would be designed to accommodate the 5-year flow, the proposed stormwater management plan would not include provision for any significant flow attenuation. Potential discharge locations to the Detroit River for the major system flows would follow Prospect Ave, and are shown in Figure 7.6. Depending on the final grades of the site and the fill requirements to provide positive overland drainage, consideration could be given to designing the new storm sewer system to accommodate the 100-year peak flow. Uncontrolled outflows from the proposed facilities would be conveyed directly to the Detroit River via storm sewer system (see Figure 7.6).

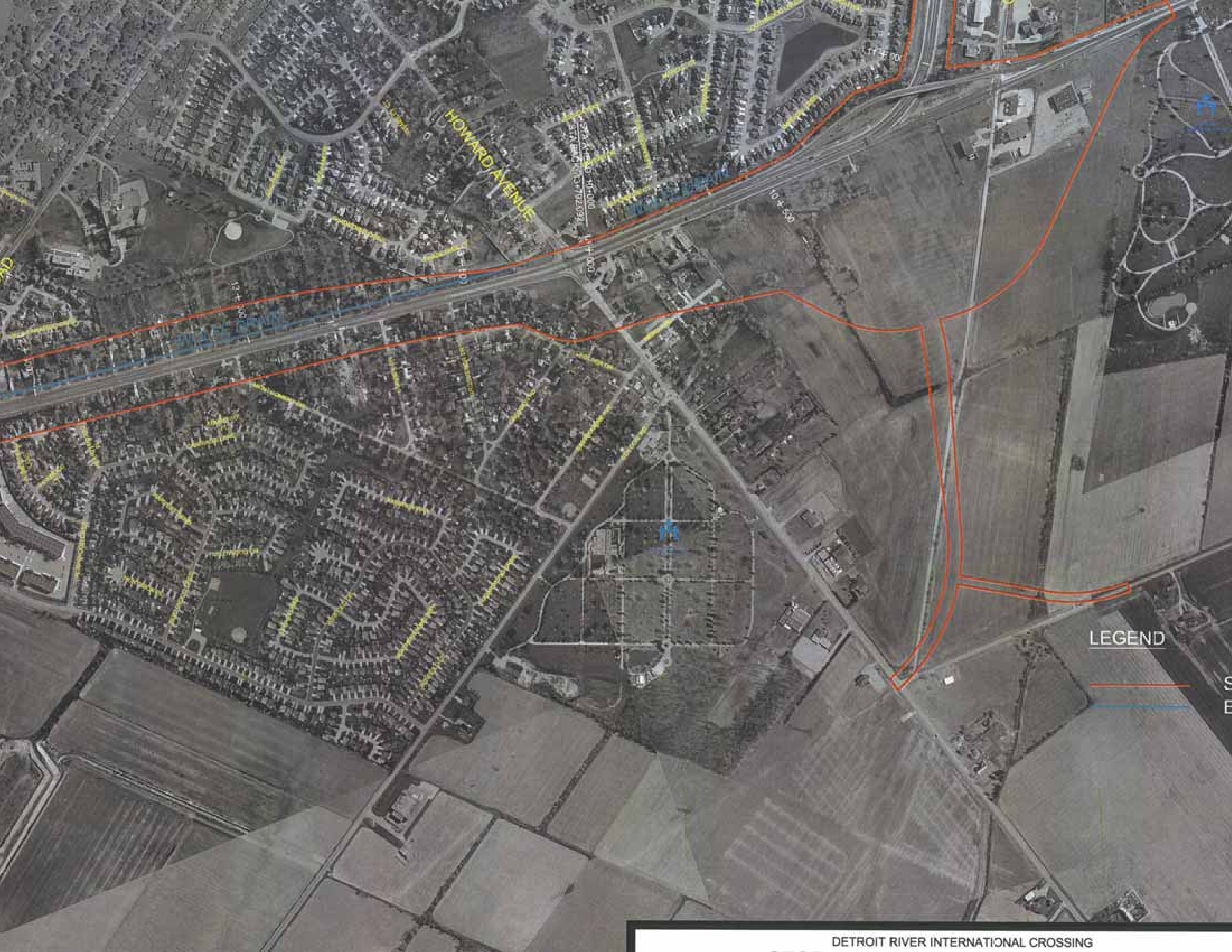
Quality control would be provided by the proposed wetpond facility, providing an enhanced level of quality treatment. However, due to the grading requirements associated with a single wetpond location, alternative outlets may be required. In an effort to decrease the overall grading, the southern portion of the Plaza may have to outlet directly to the Detroit River, with quality treatment provided by alternative best management practices such as oil/grit separators. However, it should be noted that mechanical measures to provide quality treatment, such as oil/grit separators, would require regular maintenance in the form of vacuum truck clean-outs. Maintenance would occur approximately twice each year, or based on overall pollutant loading.

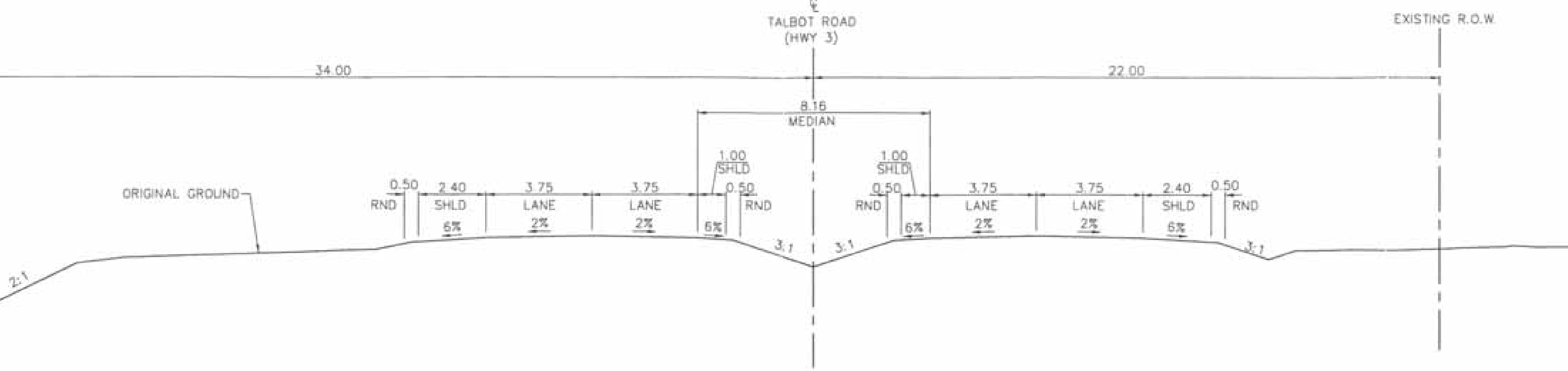
In the event of a contaminant spill (i.e. Oil, chemical, etc.) within the Plaza, a shut-off valve or alternative damming procedure will be required upstream of all outlets to the Detroit River. This will be determined during the detailed design stage, but must be considered throughout the design process.



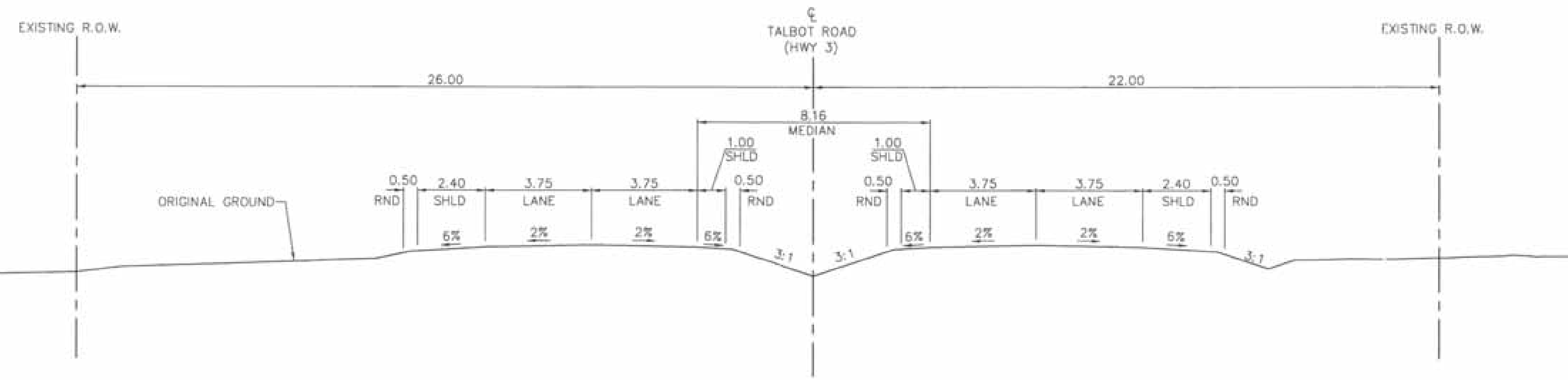
DETROIT RIVER INTERNATIONAL CROSSING
HURON CHURCH ROAD
E.C. ROW EXPRESSWAY
MALDEN ROAD
MATCHETTE ROAD
13 + 000
12 + 500
12 + 000
11 + 500
11 + 000
10 + 500

DETROIT RIVER INTERNATIONAL CROSSING
STORMWATER MANAGEMENT STUDY

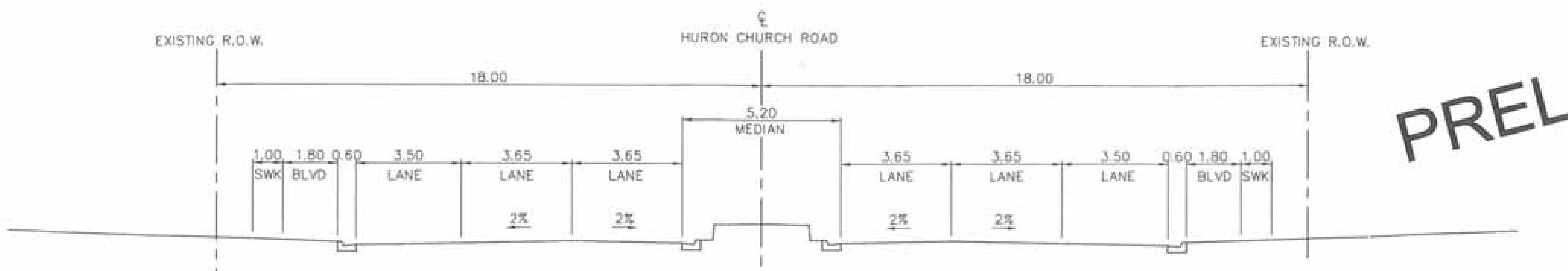

HOWARD AVENUE
STA AHEAD 10+000
STA BACK 13+792.092
10+000
10+500
11+000
13+000
13+500
LEGEND
DETROIT RIVER INTERNATIONAL CROSSING



EXISTING TYPICAL SECTION - TALBOT ROAD



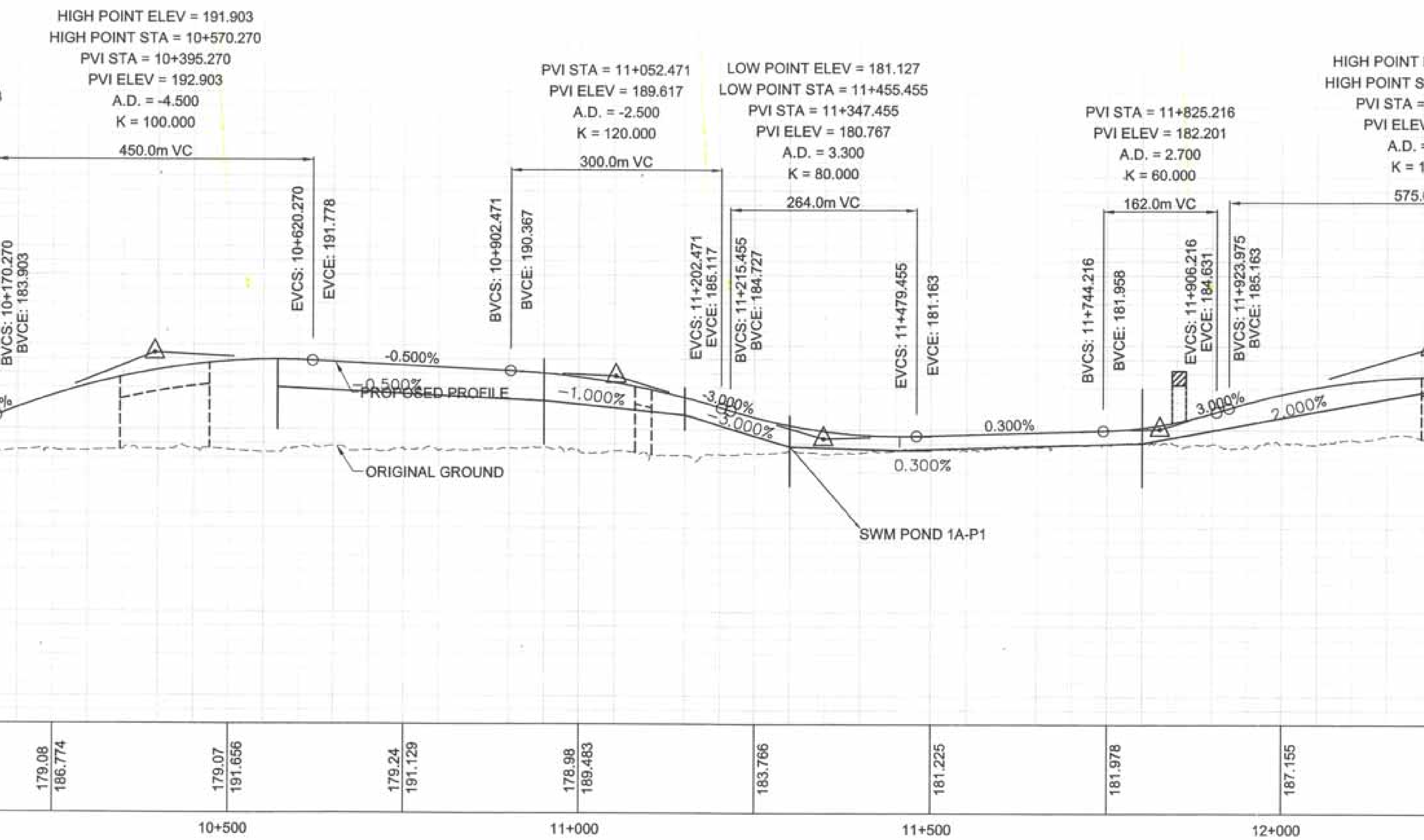
EXISTING TYPICAL SECTION - HURON CHURCH ROAD



PROPOSED HIGHWAY 401 ALONG THE TALBOT ROAD/ HURON CHURCH ROAD CORRIDOR

PROPOSED HIGHWAY 401 ALONG THE TALBOT ROAD/ HURON CHURCH ROAD CORRIDOR

PROPOSED HIGHWAY 401 ALONG THE TALBOT ROAD/ HURON CHURCH ROAD CORRIDOR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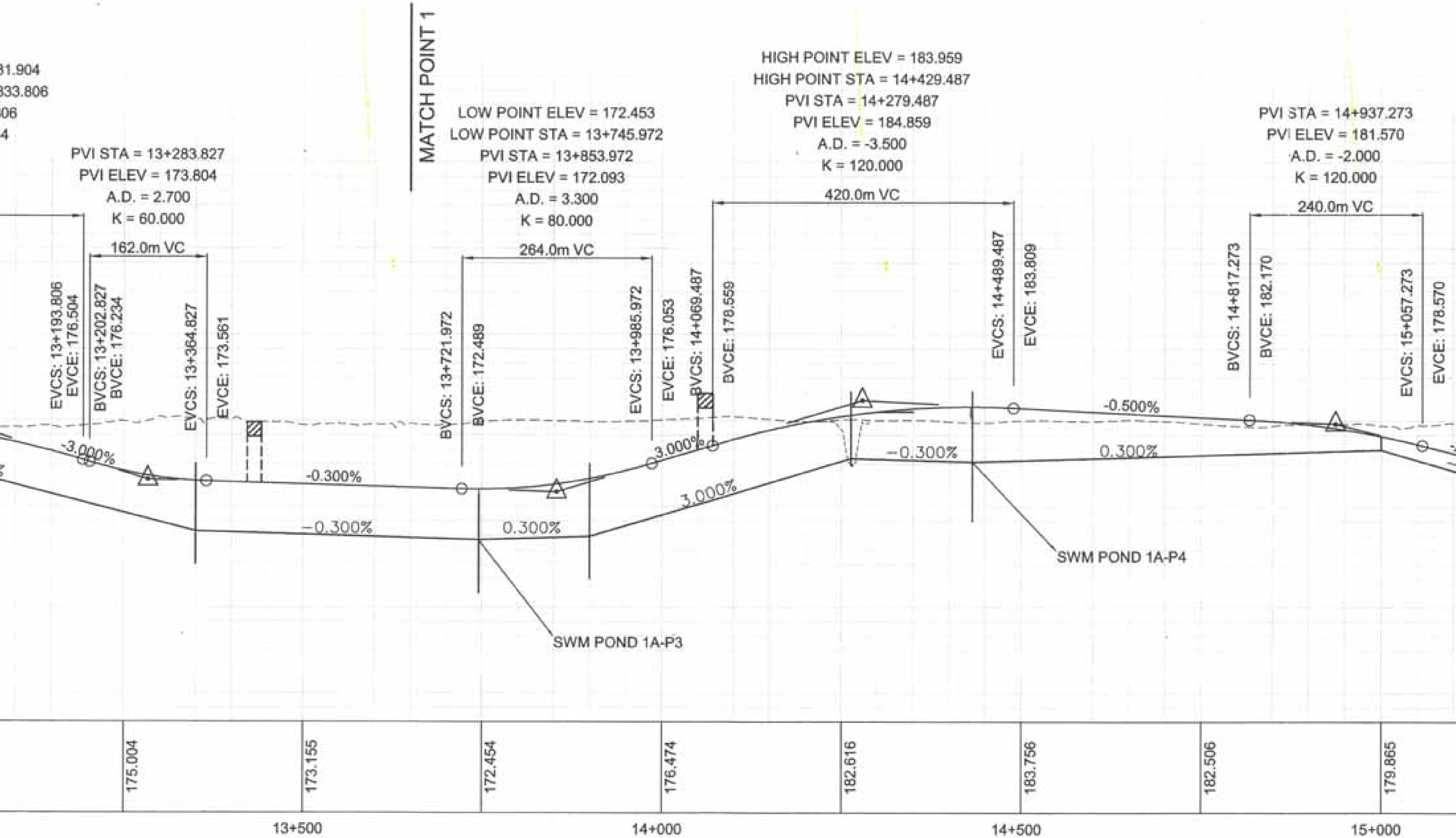
PVI STA = 10+395.270
PVI ELEV = 192.903
A.D. = -4.500
K = 100.000
450.0m VC
BVCS: 10+170.270
BVCE: 183.903
EVCS: 10+620.270
EVCE: 191.778
PVI STA = 11+052.471
PVI ELEV = 189.617
A.D. = -2.500
K = 120.000
300.0m VC
BVCS: 10+902.471
BVCE: 190.367
EVCS: 11+202.471
EVCE: 185.117
LOW POINT ELEV = 181.127
LOW POINT STA = 11+455.455
PVI STA = 11+347.455
PVI ELEV = 180.767
A.D. = 3.300
K = 80.000
264.0m VC
BVCS: 11+215.455
BVCE: 184.727
EVCS: 11+479.455
EVCE: 181.163
PVI STA = 11+825.216
PVI ELEV = 182.201
A.D. = 2.700
K = 60.000
162.0m VC
BVCS: 11+744.216
BVCE: 181.958
EVCS: 11+906.216
EVCE: 184.631
BVCS: 11+923.975
BVCE: 185.163
HIGH POINT
HIGH POINT S
PVI STA =
PVI ELEV
A.D. =
K = 1
575.
-0.500%
-0.500%
PROPOSED PROFILE
-1.000%
-3.000%
-3.000%
0.300%
0.300%
3.000%
2.000%
ORIGINAL GROUND
SWM POND 1A-P1
179.08
186.774
179.07
191.656
179.24
191.129
178.98
189.483
183.766
181.225
181.978
187.155
10+500
11+000
11+500
12+000


MATCH POINT 1
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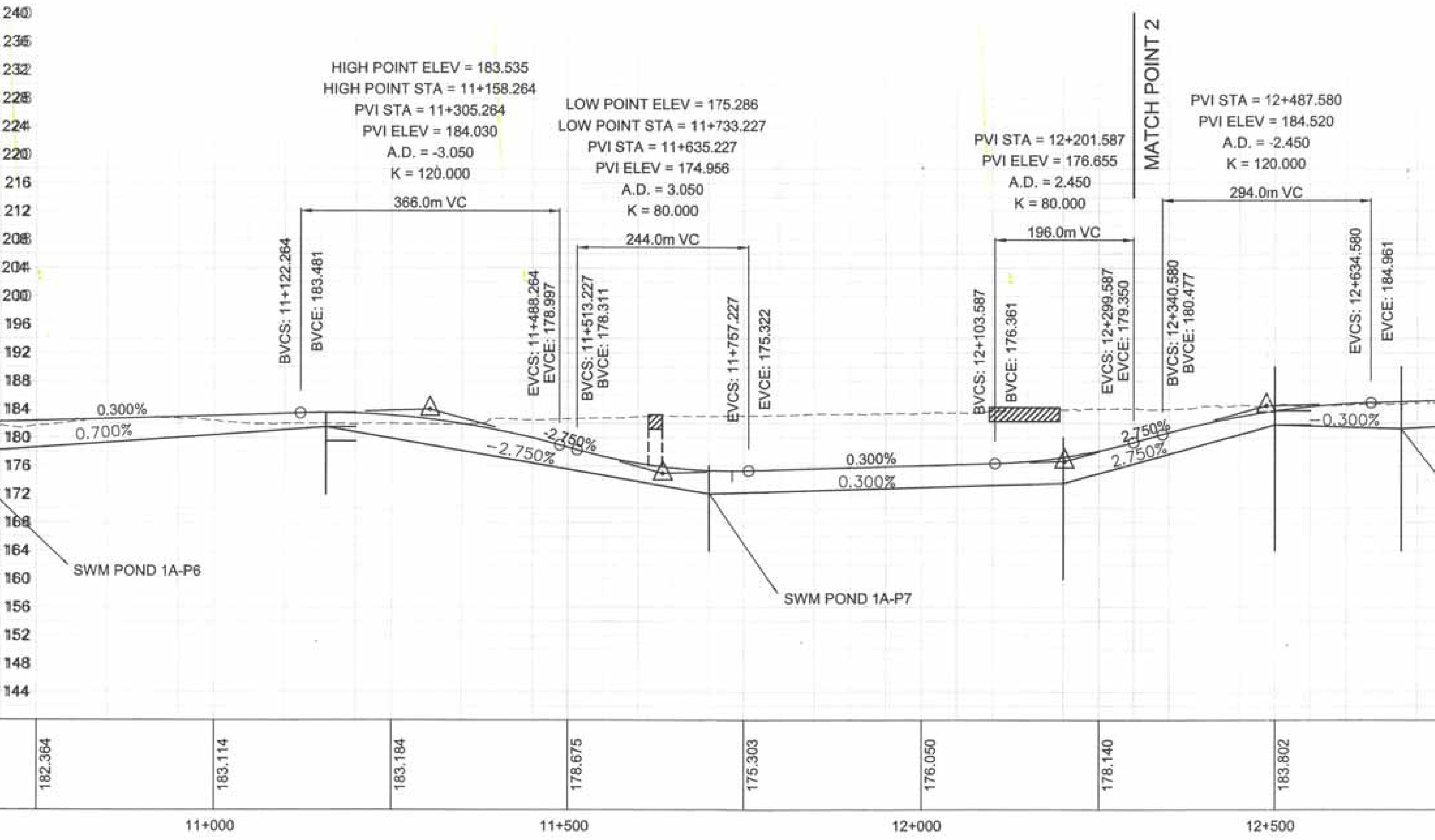
PVI ELEV = 173.804
A.D. = 2.700
K = 60.000
162.0m VC
EVCS: 13+193.806
EVCE: 176.504
BVCS: 13+202.827
BVCE: 176.234
EVCS: 13+364.827
EVCE: 173.561
-3.000%
-0.300%
-0.300%
LOW POINT ELEV = 172.453
LOW POINT STA = 13+745.972
PVI STA = 13+853.972
PVI ELEV = 172.093
A.D. = 3.300
K = 80.000
264.0m VC
BVCS: 13+721.972
BVCE: 172.489
EVCS: 13+985.972
EVCE: 176.053
0.300%
3.000%
3.000%
SWM POND 1A-P3
HIGH POINT ELEV = 183.959
HIGH POINT STA = 14+429.487
PVI STA = 14+279.487
PVI ELEV = 184.859
A.D. = -3.500
K = 120.000
420.0m VC
BVCS: 14+069.487
BVCE: 178.559
EVCS: 14+489.487
EVCE: 183.809
-0.300%
-0.500%
0.300%
SWM POND 1A-P4
PVI STA = 14+937.273
PVI ELEV = 181.570
A.D. = -2.000
K = 120.000
240.0m VC
BVCS: 14+817.273
BVCE: 182.170
EVCS: 15+057.273
EVCE: 178.570
175.004
173.155
172.454
176.474
182.616
183.756
182.506
179.865
13+500
14+000
14+500
15+000



MATCH POINT 2
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HIGH POINT STA = 11+158.264
PVI STA = 11+305.264
PVI ELEV = 184.030
A.D. = -3.050
K = 120.000
366.0m VC
LOW POINT ELEV = 175.286
LOW POINT STA = 11+733.227
PVI STA = 11+635.227
PVI ELEV = 174.956
A.D. = 3.050
K = 80.000
244.0m VC
PVI STA = 12+201.587
PVI ELEV = 176.655
A.D. = 2.450
K = 80.000
196.0m VC
PVI STA = 12+487.580
PVI ELEV = 184.520
A.D. = -2.450
K = 120.000
294.0m VC
BVCS: 11+122.264
BVCE: 183.481
EVCS: 11+488.264
EVCE: 178.997
BVCS: 11+513.227
BVCE: 178.311
EVCS: 11+757.227
EVCE: 175.322
BVCS: 12+103.587
BVCE: 176.361
EVCS: 12+299.587
EVCE: 179.350
BVCS: 12+340.580
BVCE: 180.477
EVCS: 12+634.580
EVCE: 184.961
0.300%
0.700%
-2.750%
-2.750%
0.300%
0.300%
2.750%
2.750%
-0.300%
SWM POND 1A-P6
SWM POND 1A-P7
240
236
232
228
224
220
216
212
208
204
200
196
192
188
184
180
176
172
168
164
160
156
152
148
144
182.364
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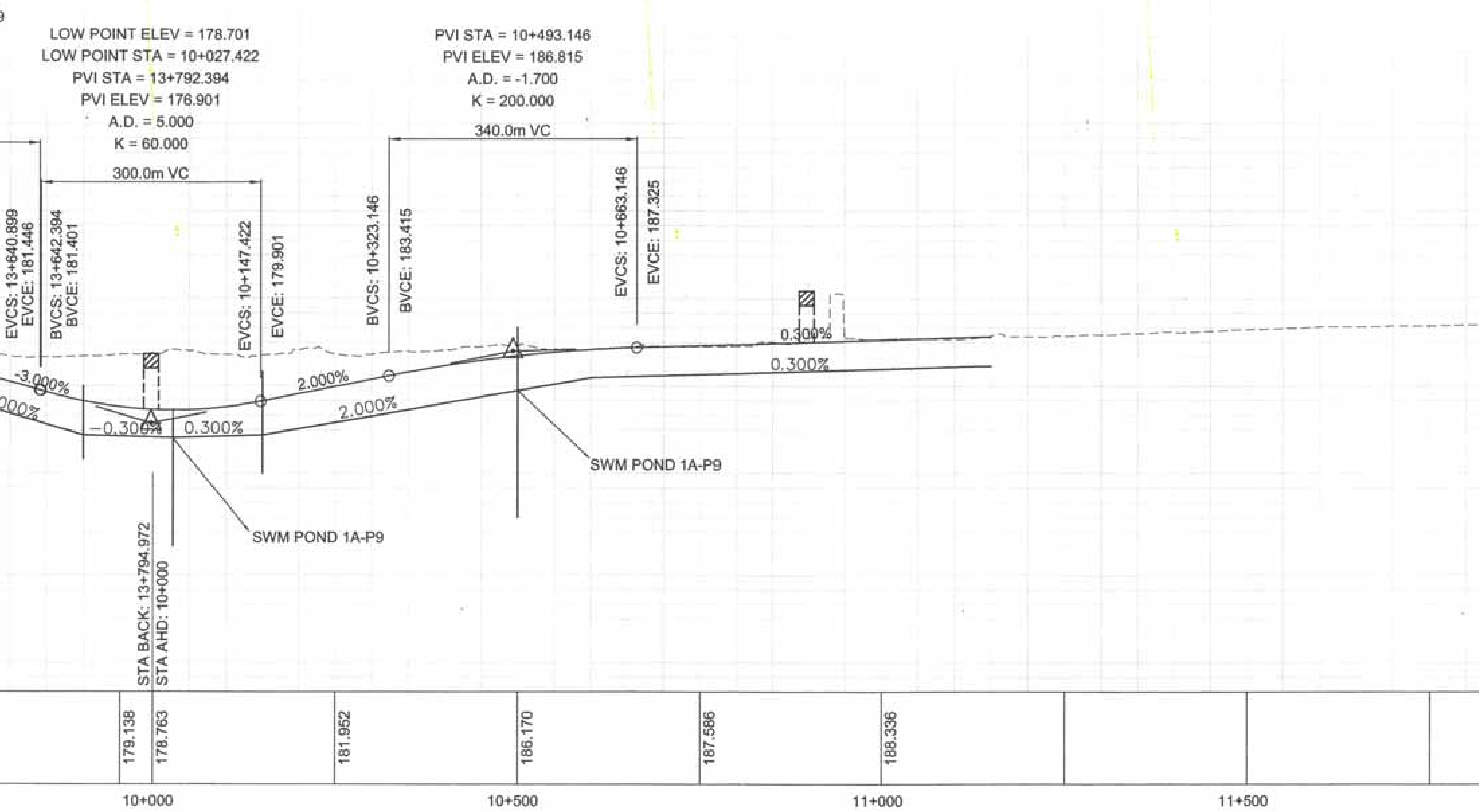
183.802
11+000
11+500
12+000
12+500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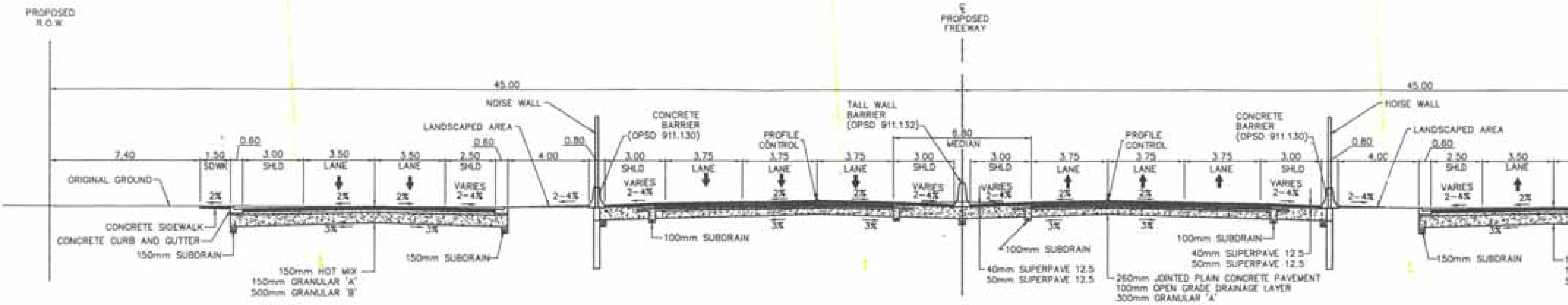
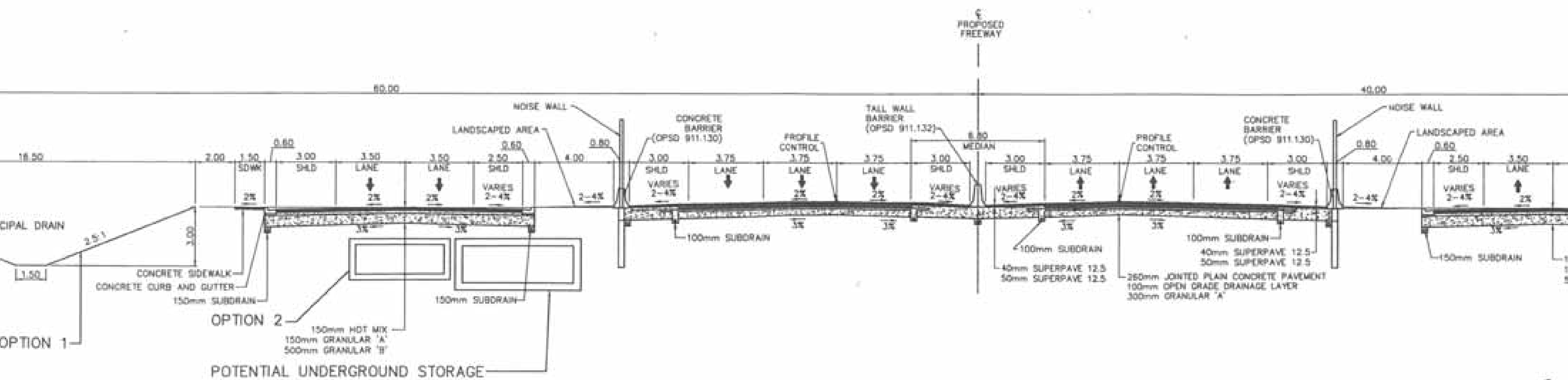
300.0m VC
PVI STA = 10+493.146
PVI ELEV = 186.815
A.D. = -1.700
K = 200.000
340.0m VC
EVCS: 13+640.899
EVCE: 181.446
BVCS: 13+642.394
BVCE: 181.401
EVCS: 10+147.422
EVCE: 179.901
BVCS: 10+323.146
BVCE: 183.415
EVCS: 10+663.146
EVCE: 187.325
-3.000%
-0.300%
0.300%
2.000%
2.000%
0.300%
0.300%
SWM POND 1A-P9
SWM POND 1A-P9
STA BACK: 13+794.972
STA AHD: 10+000
179.138
178.763
181.952
186.170
187.586
188.336
10+000
10+500
11+000
11+500

HIGHWAY 3/TALBOT ROAD/HURON CHURCH ROAD CORRIDOR

TYPICAL 6-LANE URBAN FREEWAY SECTION WITH 2-LANE SERVICE ROADS ON BOTH SIDES



TYPICAL 6-LANE URBAN FREEWAY SECTION WITH 2-LANE SERVICE ROADS ON BOTH SIDES WITH MUNICIPAL DRAIN

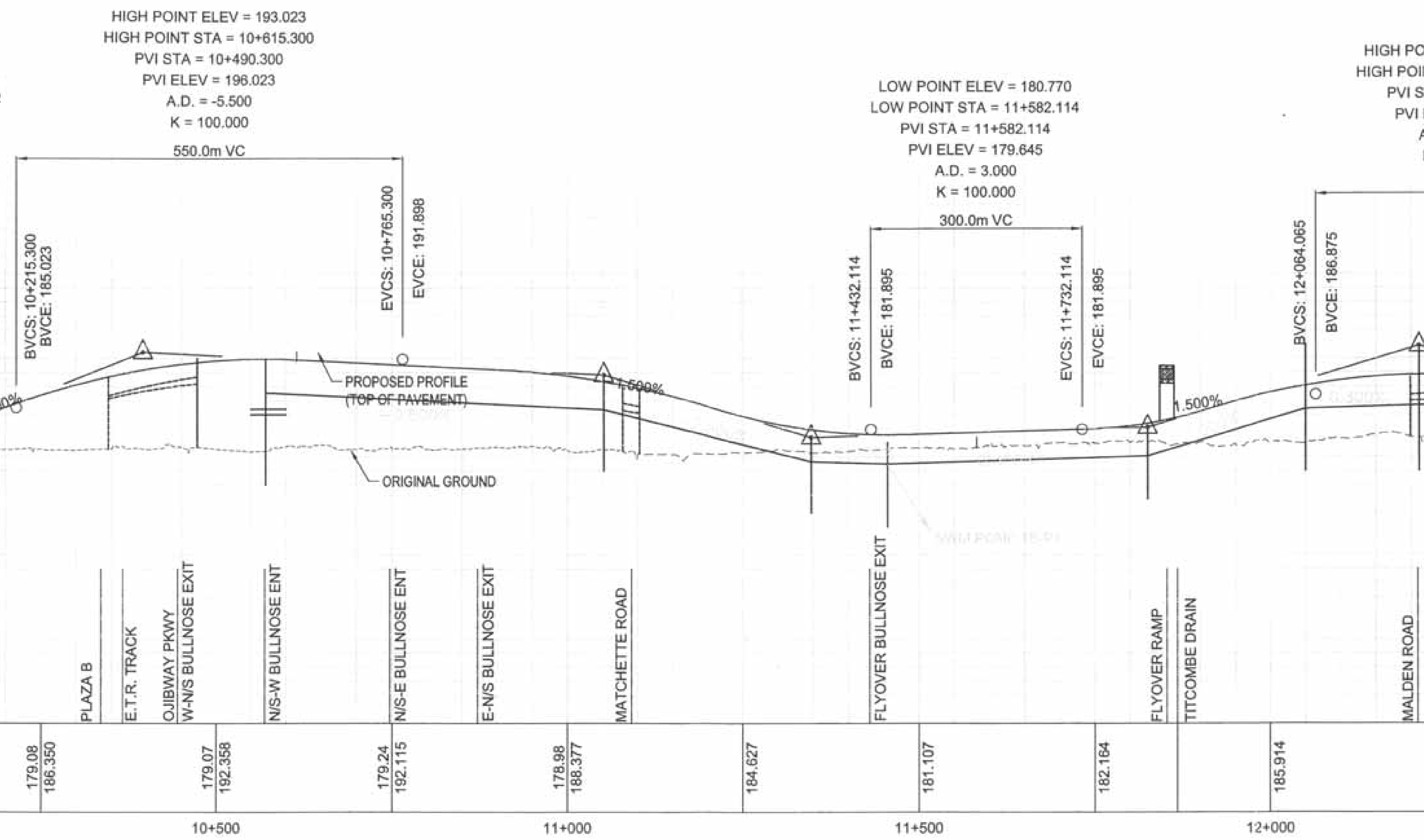


CON

PROPOSED HIGHWAY 401 ALONG THE TALBOT ROAD/ HURON CHURCH ROAD CORRIDOR WIT
SERVICE ROADS ON BOTH SIDES

PROPOSED HIGHWAY 401 ALONG THE TALBOT ROAD/ HURON CHURCH ROAD CORRIDOR WIT
SERVICE ROADS ON BOTH SIDES

PROPOSED HIGHWAY 401 ALONG THE TALBOT ROAD/ HURON CHURCH ROAD CORRIDOR WITH
SERVICE ROADS ON BOTH SIDES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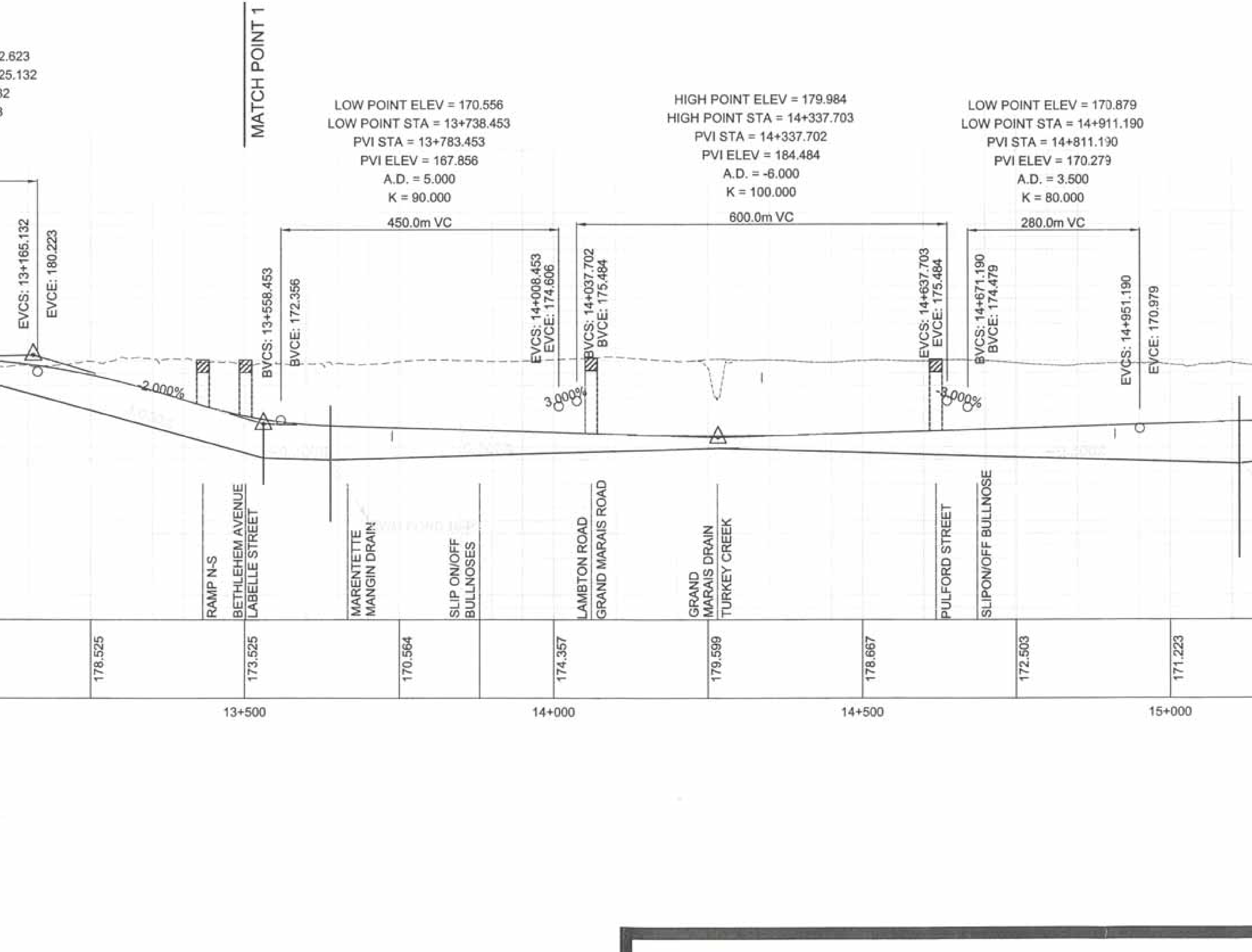
K = 100.000
550.0m VC
BVCS: 10+215.300
BVCE: 185.023
EVCS: 10+765.300
EVCE: 191.898
PROPOSED PROFILE
(TOP OF PAVEMENT)
ORIGINAL GROUND
1.500%
LOW POINT ELEV = 180.770
LOW POINT STA = 11+582.114
PVI STA = 11+582.114
PVI ELEV = 179.645
A.D. = 3.000
K = 100.000
300.0m VC
BVCS: 11+432.114
BVCE: 181.895
EVCS: 11+732.114
EVCE: 181.895
1.500%
BVCS: 12+064.065
BVCE: 186.875
PLAZA B
E.T.R. TRACK
OJIBWAY PKWY
W-N/S BULLNOSE EXIT
N/S-W BULLNOSE ENT
N/S-E BULLNOSE ENT
E-N/S BULLNOSE EXIT
MATCHETTE ROAD
FLYOVER BULLNOSE EXIT
FLYOVER RAMP
TITCOMBE DRAIN
MALDEN ROAD
179.08
186.350
179.07
192.358
179.24
192.115
178.98
188.377
184.627
181.107
182.164
185.914
10+500
11+000
11+500
12+000



2.623
25.132
32
3
MATCH POINT 1
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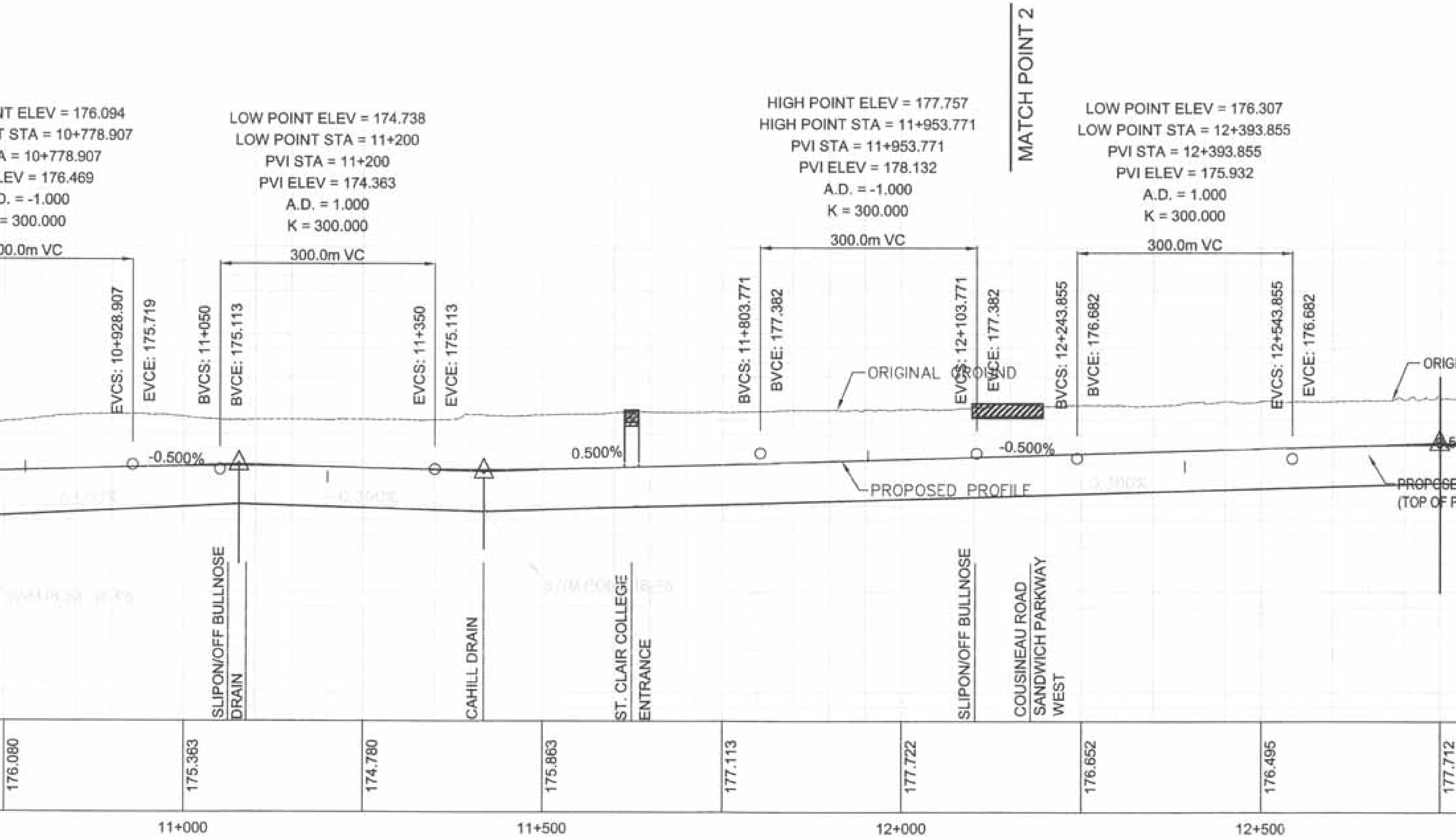
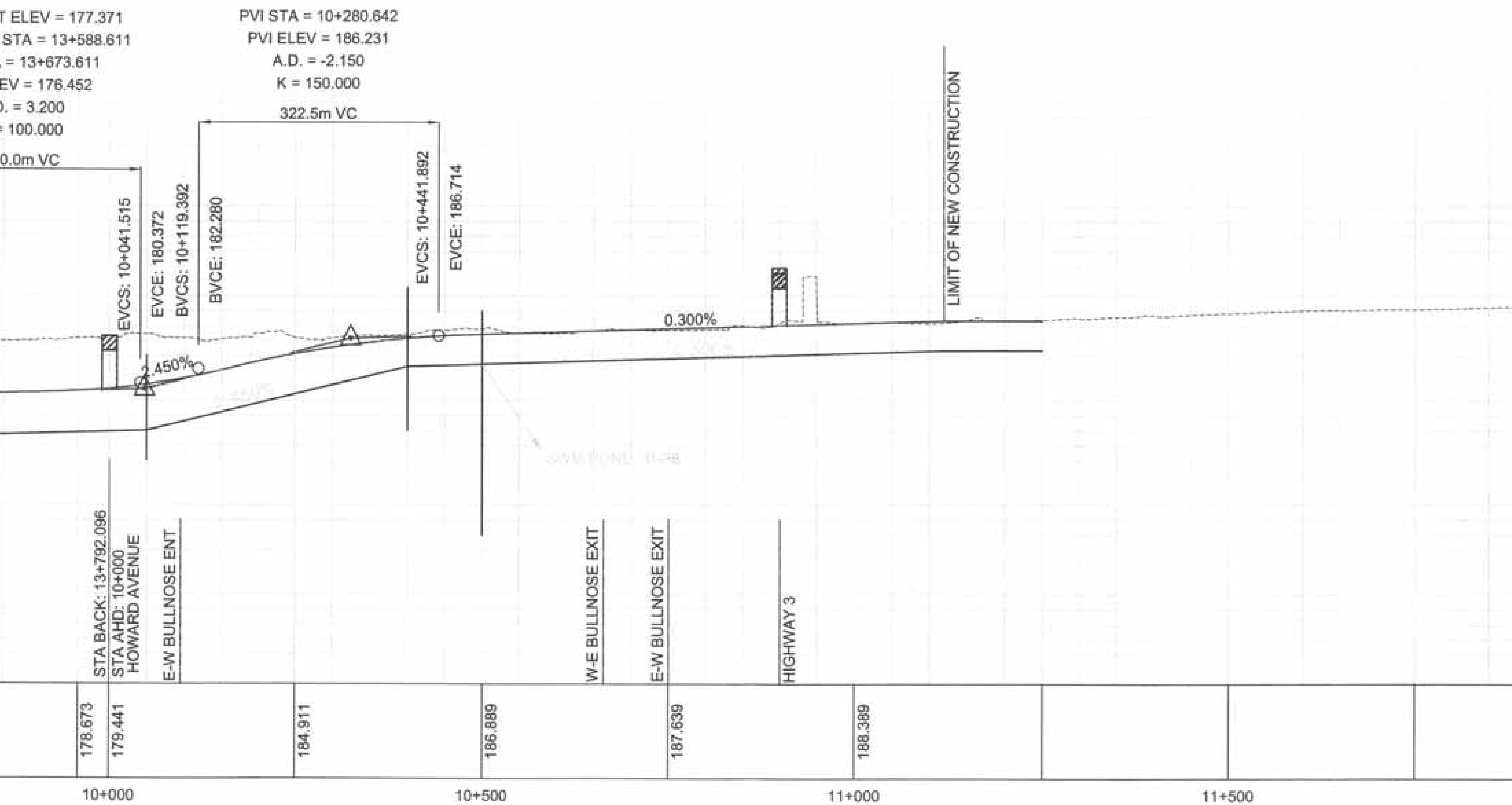
PVI STA = 13+783.453
PVI ELEV = 167.856
A.D. = 5.000
K = 90.000
450.0m VC
HIGH POINT ELEV = 179.984
HIGH POINT STA = 14+337.703
PVI STA = 14+337.702
PVI ELEV = 184.484
A.D. = -6.000
K = 100.000
600.0m VC
LOW POINT ELEV = 170.879
LOW POINT STA = 14+911.190
PVI STA = 14+811.190
PVI ELEV = 170.279
A.D. = 3.500
K = 80.000
280.0m VC
EVCS: 13+165.132
EVCE: 180.223
BVCS: 13+558.453
BVCE: 172.356
EVCS: 14+008.453
EVCE: 174.606
BVCS: 14+037.702
BVCE: 175.484
EVCS: 14+637.703
EVCE: 175.484
BVCS: 14+671.190
BVCE: 174.479
EVCS: 14+951.190
EVCE: 170.979
-2.000%
3.000%
-3.000%
RAMP N-S
BETHLEHEM AVENUE
LABELLE STREET
MARENTETTE
MANGIN DRAIN
SLIP ON/OFF
BULLNOSES
LAMBTON ROAD
GRAND MARAIS ROAD
GRAND
MARAIS DRAIN
TURKEY CREEK
PULFORD STREET
SLIPON/OFF BULLNOSE
178.525
173.525
170.564
174.357
179.599
178.667
172.503
171.223
13+500
14+000
14+500
15+000

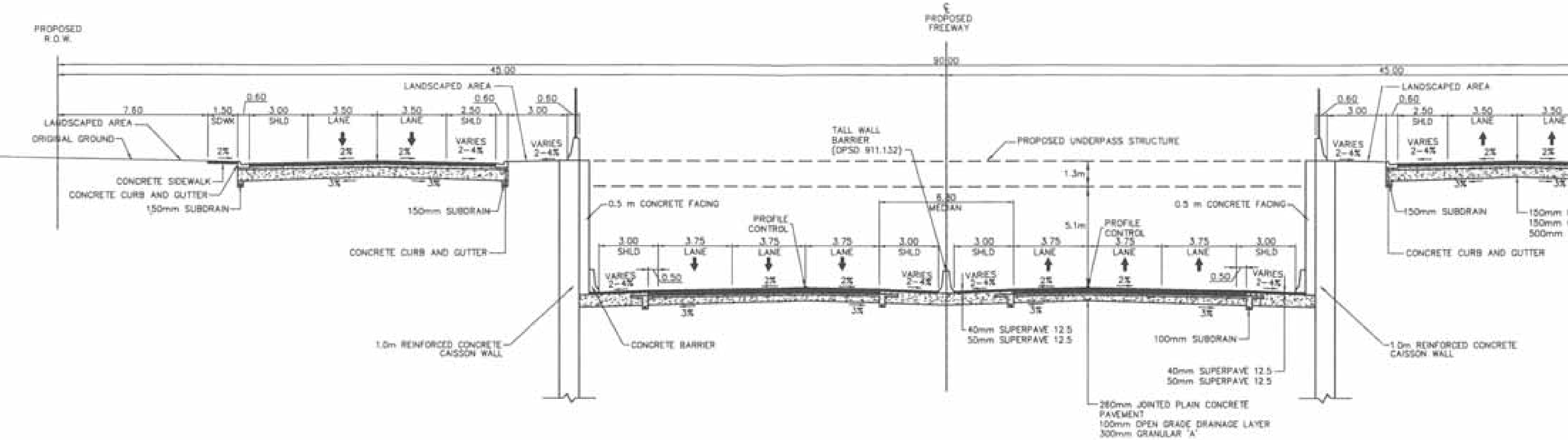


MATCH POINT 2
NT ELEV = 176.094
T STA = 10+778.907
A = 10+778.907
LEV = 176.469
D. = -1.000
= 300.000
00.0m VC
LOW POINT ELEV = 174.738
LOW POINT STA = 11+200
PVI STA = 11+200
PVI ELEV = 174.363
A.D. = 1.000
K = 300.000
300.0m VC
HIGH POINT ELEV = 177.757
HIGH POINT STA = 11+953.771
PVI STA = 11+953.771
PVI ELEV = 178.132
A.D. = -1.000
K = 300.000
300.0m VC
LOW POINT ELEV = 176.307
LOW POINT STA = 12+393.855
PVI STA = 12+393.855
PVI ELEV = 175.932
A.D. = 1.000
K = 300.000
300.0m VC
EVCS: 10+928.907
EVCE: 175.719
BVCS: 11+050
BVCE: 175.113
EVCS: 11+350
EVCE: 175.113
BVCS: 11+803.771
BVCE: 177.382
EVCS: 12+103.771
EVCE: 177.382
BVCS: 12+243.855
BVCE: 176.682
EVCS: 12+543.855
EVCE: 176.682
ORIGINAL GROUND
PROPOSED PROFILE
-0.500%
0.500%
-0.500%
SLIPON/OFF BULLNOSE
DRAIN
CAHILL DRAIN
ST. CLAIR COLLEGE
ENTRANCE
SLIPON/OFF BULLNOSE
COUSINEAU ROAD
SANDWICH PARKWAY
WEST
176.080
175.363
174.780
175.863
177.113
177.722
176.652
176.495
177.712
11+000
11+500
12+000
12+500

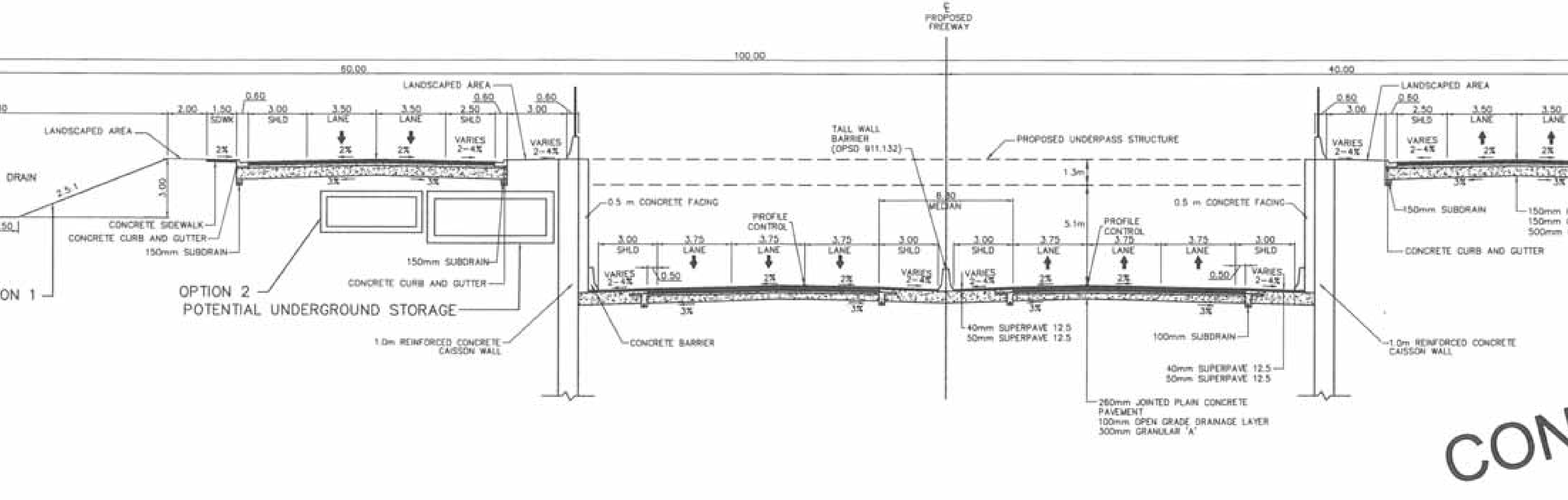


T ELEV = 177.371
STA = 13+588.611
. = 13+673.611
EV = 176.452
). = 3.200
= 100.000
0.0m VC
PVI STA = 10+280.642
PVI ELEV = 186.231
A.D. = -2.150
K = 150.000
322.5m VC
EVCS: 10+041.515
EVCE: 180.372
BVCS: 10+119.392
BVCE: 182.280
EVCS: 10+441.892
EVCE: 186.714
LIMIT OF NEW CONSTRUCTION
2.450%
0.300%
STA BACK: 13+792.096
STA AHD: 10+000
HOWARD AVENUE
E-W BULLNOSE ENT
W-E BULLNOSE EXIT
E-W BULLNOSE EXIT
HIGHWAY 3
178.673
179.441
184.911
186.889
187.639
188.389
10+000
10+500
11+000
11+500

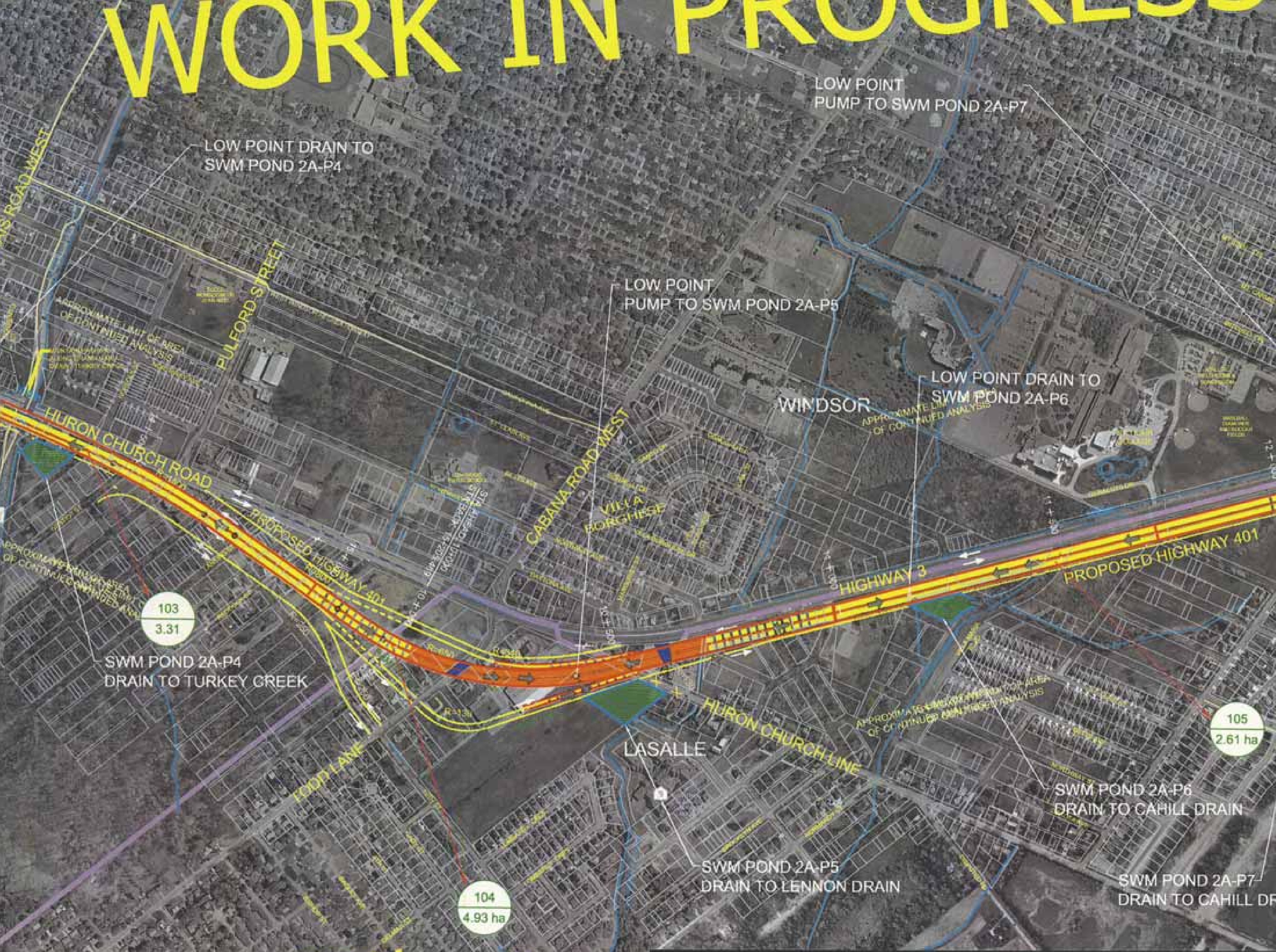
TYPICAL BELOW-GRADE 6-LANE URBAN FREEWAY SECTION WITH ONE-WAY SERVICE ROADS



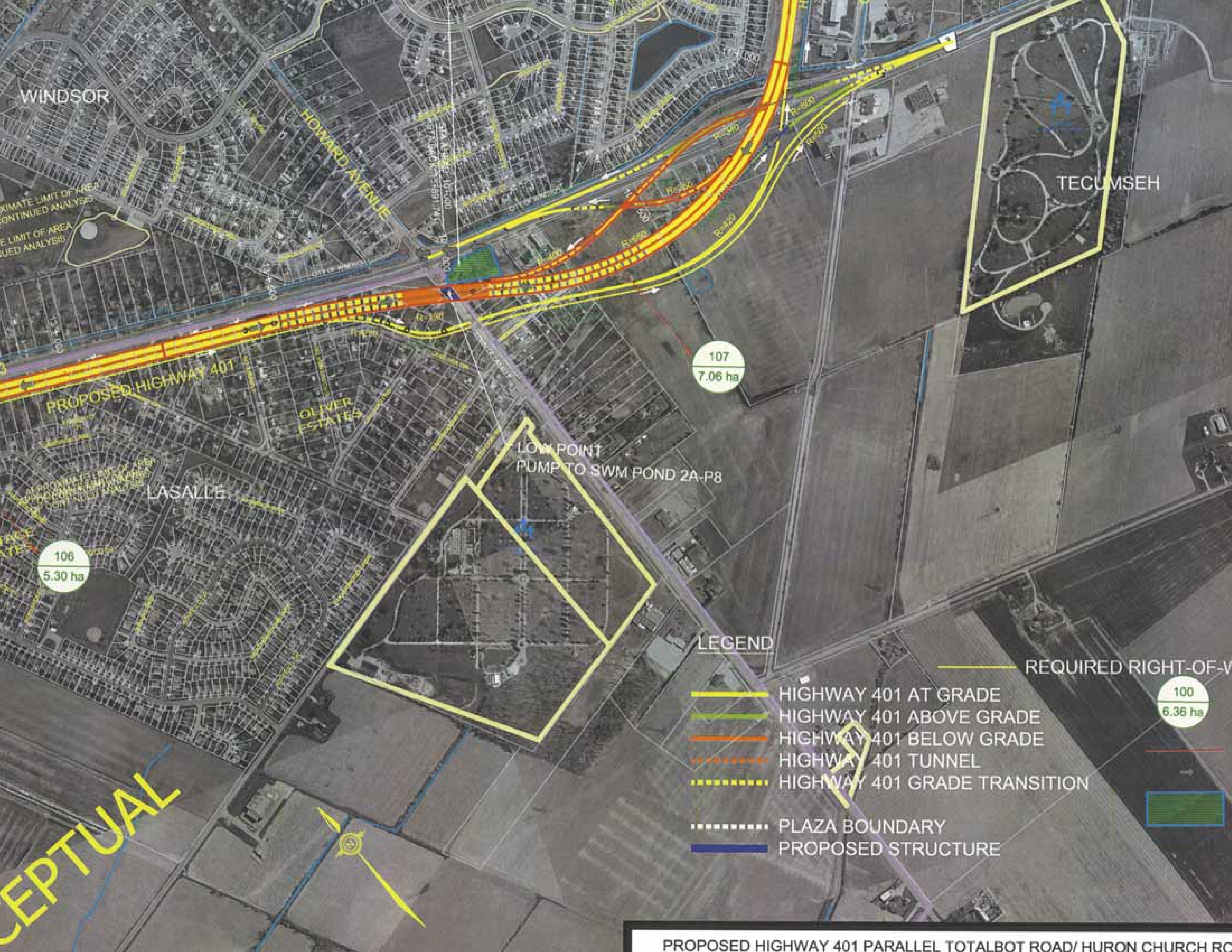
TYPICAL BELOW-GRADE 6-LANE URBAN FREEWAY SECTION WITH ONE-WAY SERVICE ROADS AND MUNICIPAL DRAIN



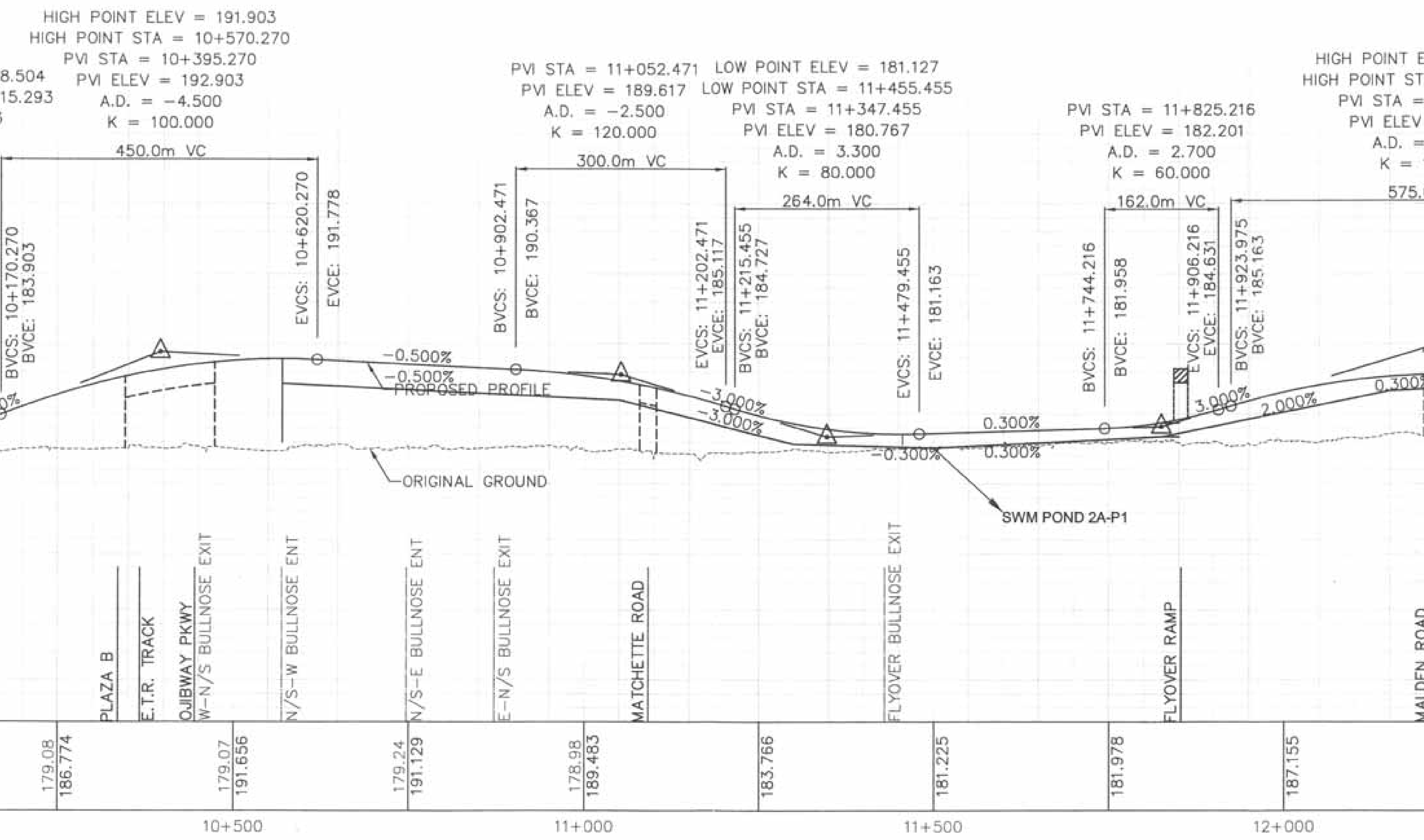

LOW POINT DRAIN TO
SWM POND 2A-P2
HURON CHURCH ROAD
LOW POINT DRAIN
TO SWM POND 2A-P1
E.C.ROW EXPRESSWAY
PROPOSED
HIGHWAY 401
MALDEN ROAD
MATCHETTE ROAD
SPRING
GARDEN
101
1.69 ha
100
6.36 ha
WINDSOR
SWM POND 2A-P2
DRAIN TO BASIN DRAIN
SWM POND 2A-P3
DRAIN TO MARENTETTE
MANGIN DRAIN
LAMBTON
SWM POND 2A-P1
DRAIN TO TITCOMBE DRAIN
PROPOSED HIGHWAY 401 PARALLEL TOTALBOT ROAD/ HURON CHURCH RO



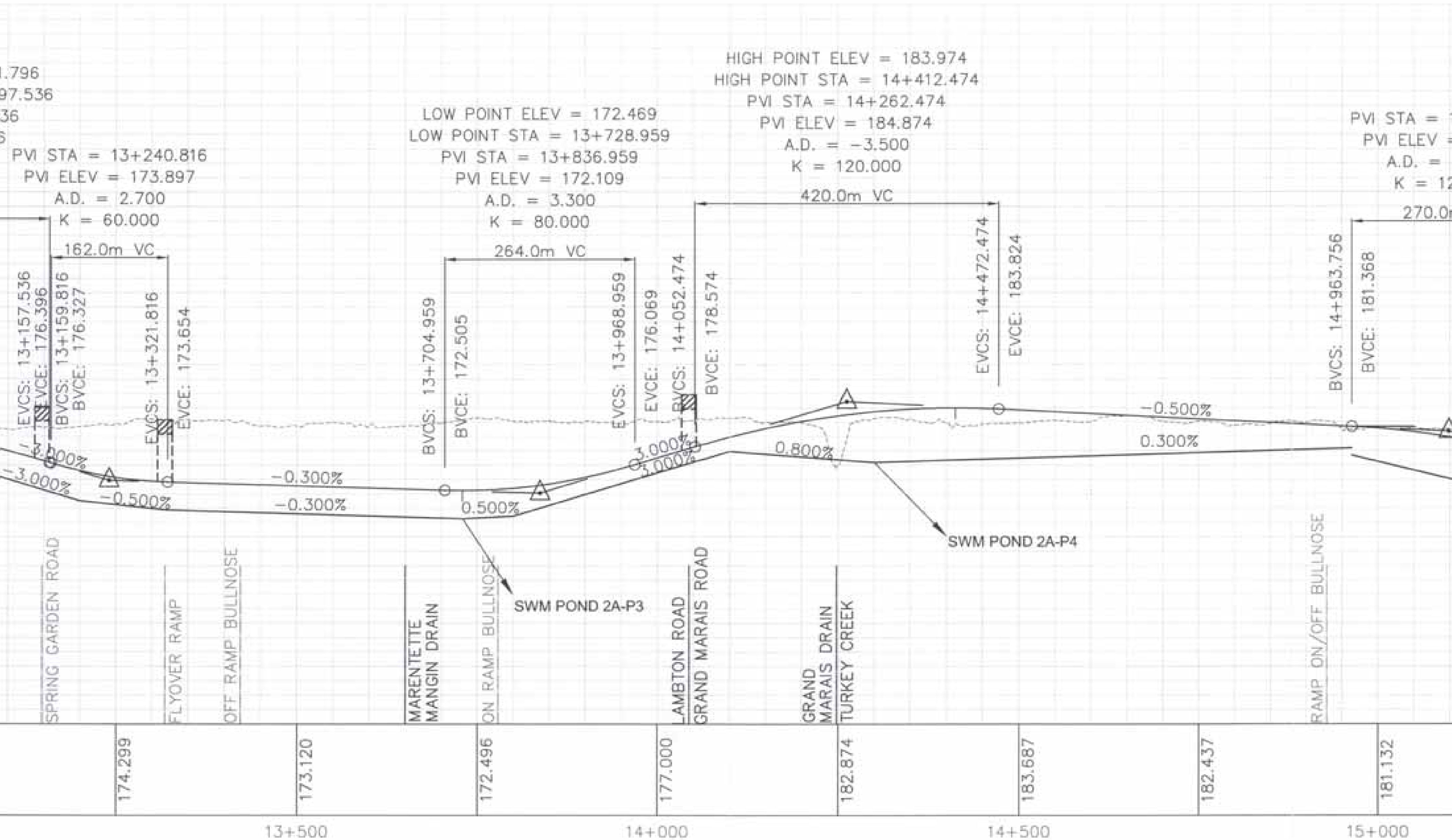
PROPOSED HIGHWAY 401 PARALLEL TOTALBOT ROAD/ HURON CHURCH RO



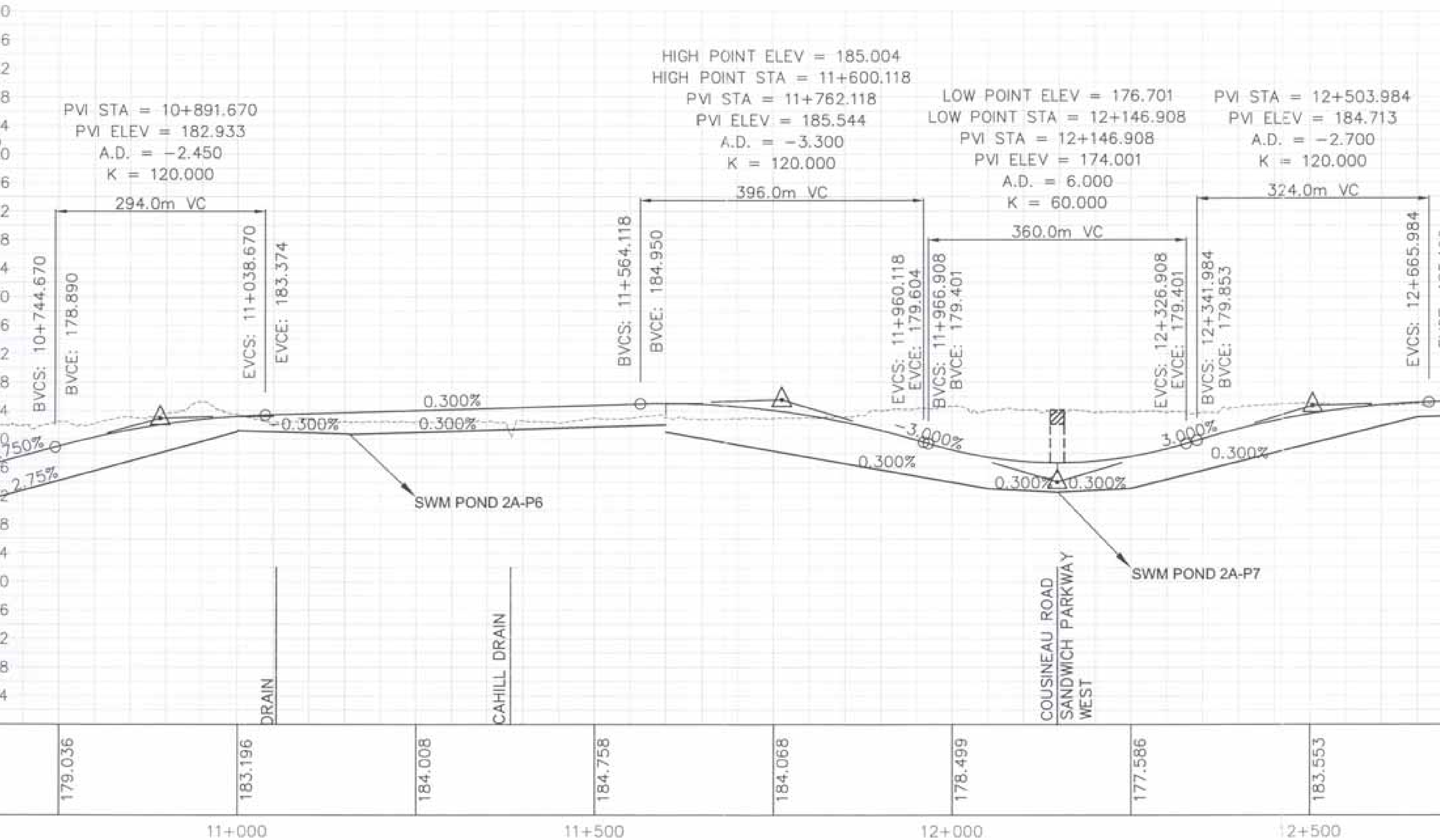
WINDSOR
HOWARD AVENUE
TECUMSEH
PROPOSED HIGHWAY 401
OLIVER ESTATES
LOW POINT
PUMP TO SWM POND 2A-P8
LASALLE
107
7.06 ha
106
5.30 ha
100
6.36 ha
CEPTUAL
LEGEND
REQUIRED RIGHT-OF-W
HIGHWAY 401 AT GRADE
HIGHWAY 401 ABOVE GRADE
HIGHWAY 401 BELOW GRADE
HIGHWAY 401 TUNNEL
HIGHWAY 401 GRADE TRANSITION
PLAZA BOUNDARY
PROPOSED STRUCTURE
PROPOSED HIGHWAY 401 PARALLEL TOTALBOT ROAD/ HURON CHURCH RO

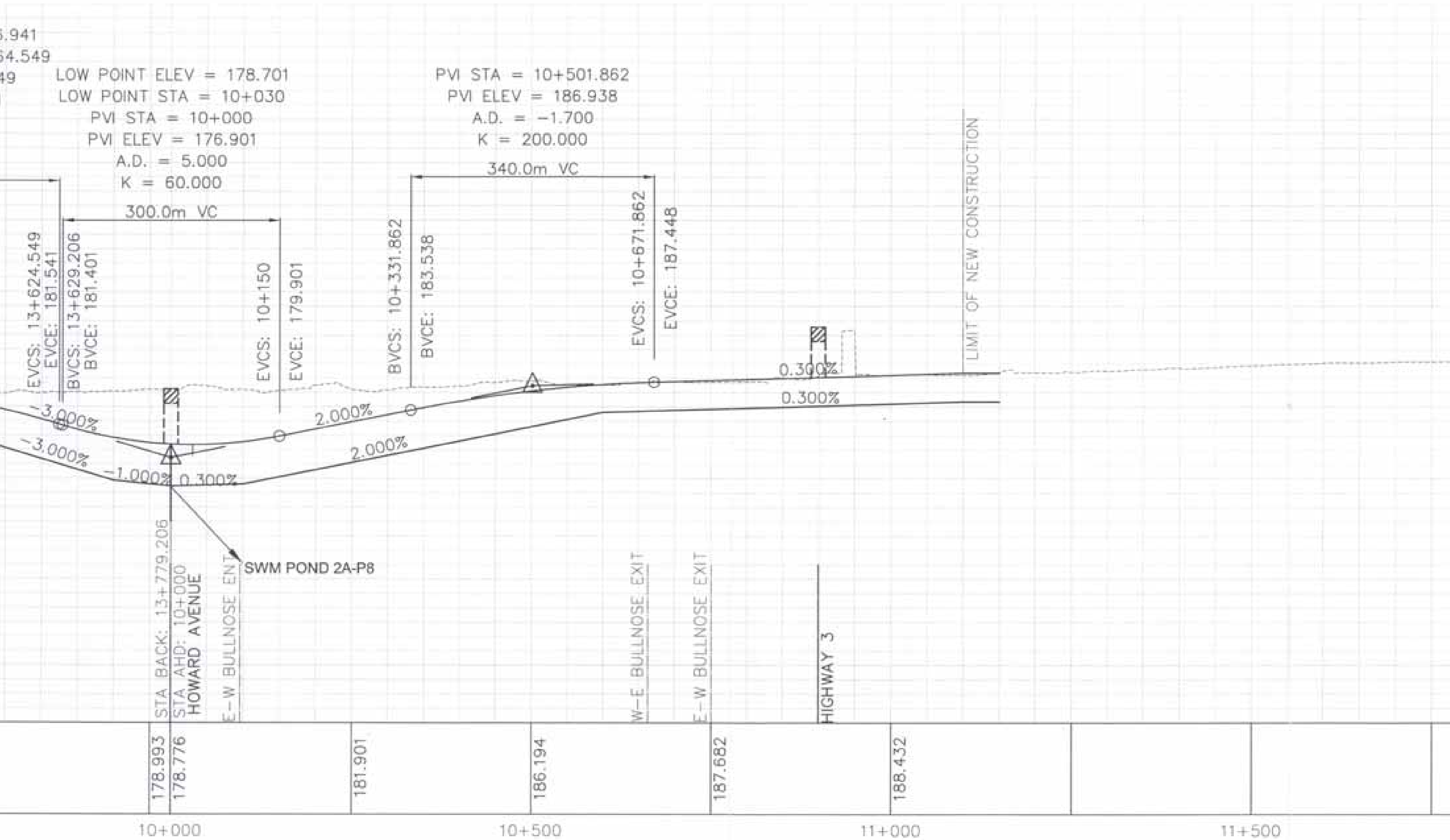


HIGH POINT ELEV = 191.903
HIGH POINT STA = 10+570.270
PVI STA = 10+395.270
PVI ELEV = 192.903
A.D. = -4.500
K = 100.000
450.0m VC
BVCS: 10+170.270
BVCE: 183.903
EVCS: 10+620.270
EVCE: 191.778
PVI STA = 11+052.471
PVI ELEV = 189.617
A.D. = -2.500
K = 120.000
300.0m VC
BVCS: 10+902.471
BVCE: 190.367
EVCS: 11+202.471
EVCE: 185.117
LOW POINT ELEV = 181.127
LOW POINT STA = 11+455.455
PVI STA = 11+347.455
PVI ELEV = 180.767
A.D. = 3.300
K = 80.000
264.0m VC
BVCS: 11+215.455
BVCE: 184.727
EVCS: 11+479.455
EVCE: 181.163
PVI STA = 11+825.216
PVI ELEV = 182.201
A.D. = 2.700
K = 60.000
162.0m VC
BVCS: 11+744.216
BVCE: 181.958
EVCS: 11+906.216
EVCE: 184.631
BVCS: 11+923.975
BVCE: 185.163
-0.500%
-0.500%
PROPOSED PROFILE
-3.000%
-3.000%
0.300%
-0.300%
0.300%
3.000%
2.000%
0.300%
ORIGINAL GROUND
SWM POND 2A-P1
PLAZA B
E.T.R. TRACK
OJIBWAY PKWY
W-N/S BULLNOSE EXIT
N/S-W BULLNOSE ENT
N/S-E BULLNOSE ENT
E-N/S BULLNOSE EXIT
MATCHETTE ROAD
FLYOVER BULLNOSE EXIT
FLYOVER RAMP
MALDEN ROAD
179.08
186.774
179.07
191.656
179.24
191.129
178.98
189.483
183.766
181.225
181.978
187.155
10+500
11+000
11+500
12+000



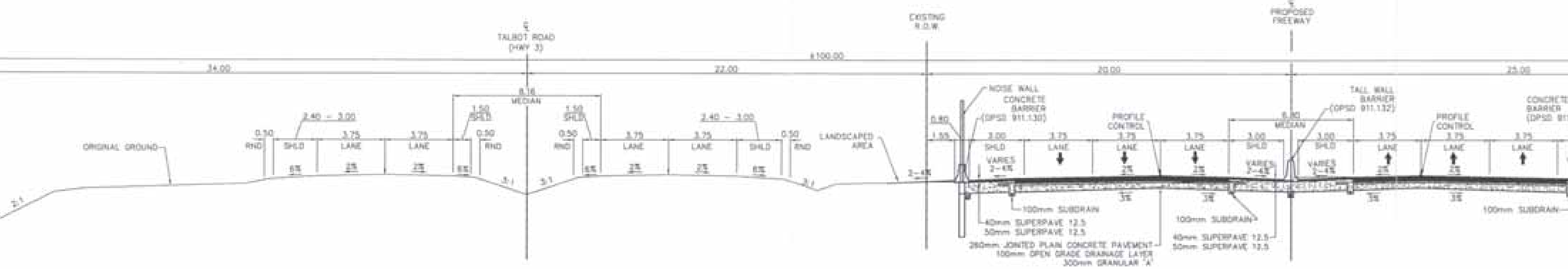
HIGH POINT ELEV = 183.974
HIGH POINT STA = 14+412.474
PVI STA = 14+262.474
PVI ELEV = 184.874
A.D. = -3.500
K = 120.000
420.0m VC
LOW POINT ELEV = 172.469
LOW POINT STA = 13+728.959
PVI STA = 13+836.959
PVI ELEV = 172.109
A.D. = 3.300
K = 80.000
264.0m VC
PVI STA = 13+240.816
PVI ELEV = 173.897
A.D. = 2.700
K = 60.000
162.0m VC
EVCS: 13+157.536
EVCE: 176.396
BVCS: 13+159.816
BVCE: 176.327
EVCS: 13+321.816
EVCE: 173.654
BVCS: 13+704.959
BVCE: 172.505
EVCS: 13+968.959
EVCE: 176.069
BVCS: 14+052.474
BVCE: 178.574
EVCS: 14+472.474
EVCE: 183.824
BVCS: 14+963.756
BVCE: 181.368
270.0m
-3.000%
-0.500%
-0.300%
-0.300%
0.500%
3.000%
3.000%
0.800%
-0.500%
0.300%
SWM POND 2A-P3
SWM POND 2A-P4
SPRING GARDEN ROAD
FLYOVER RAMP
OFF RAMP BULLNOSE
MARENTETTE MANGIN DRAIN
ON RAMP BULLNOSE
LAMBTON ROAD
GRAND MARAIS ROAD
GRAND MARAIS DRAIN
TURKEY CREEK
RAMP ON/OFF BULLNOSE
174.299
173.120
172.496
177.000
182.874
183.687
182.437
181.132
13+500
14+000
14+500
15+000


PVI STA = 10+891.670
PVI ELEV = 182.933
A.D. = -2.450
K = 120.000
294.0m VC
BVCS: 10+744.670
BVCE: 178.890
EVCS: 11+038.670
EVCE: 183.374
HIGH POINT ELEV = 185.004
HIGH POINT STA = 11+600.118
PVI STA = 11+762.118
PVI ELEV = 185.544
A.D. = -3.300
K = 120.000
396.0m VC
BVCS: 11+564.118
BVCE: 184.950
EVCS: 11+960.118
EVCE: 179.604
LOW POINT ELEV = 176.701
LOW POINT STA = 12+146.908
PVI STA = 12+146.908
PVI ELEV = 174.001
A.D. = 6.000
K = 60.000
360.0m VC
BVCS: 11+966.908
BVCE: 179.401
EVCS: 12+326.908
EVCE: 179.401
PVI STA = 12+503.984
PVI ELEV = 184.713
A.D. = -2.700
K = 120.000
324.0m VC
BVCS: 12+341.984
BVCE: 179.853
EVCS: 12+665.984
2.75%
0.300%
-0.300%
-3.000%
3.000%
SWM POND 2A-P6
SWM POND 2A-P7
DRAIN
CAHILL DRAIN
COUSINEAU ROAD
SANDWICH PARKWAY WEST
179.036
183.196
184.008
184.758
184.068
178.499
177.586
183.553
11+000
11+500
12+000
12+500



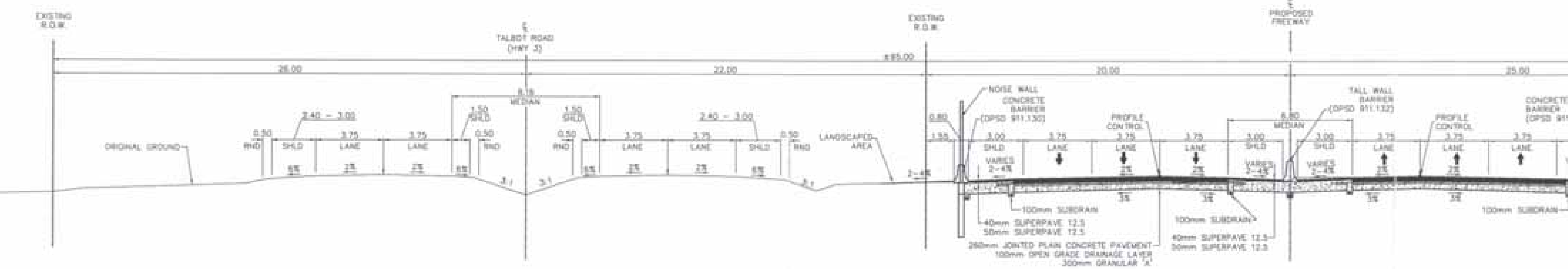
LOW POINT ELEV = 178.701
LOW POINT STA = 10+030
PVI STA = 10+000
PVI ELEV = 176.901
A.D. = 5.000
K = 60.000
300.0m VC
PVI STA = 10+501.862
PVI ELEV = 186.938
A.D. = -1.700
K = 200.000
340.0m VC
EVCS: 13+624.549
EVCE: 181.541
BVCS: 13+629.206
BVCE: 181.401
EVCS: 10+150
EVCE: 179.901
BVCS: 10+331.862
BVCE: 183.538
EVCS: 10+671.862
EVCE: 187.448
LIMIT OF NEW CONSTRUCTION
-3.000%
-3.000%
-1.000%
0.300%
2.000%
2.000%
0.300%
0.300%
SWM POND 2A-P8
STA BACK: 13+779.206
STA AHD: 10+000
HOWARD AVENUE
E-W BULLNOSE ENT
W-E BULLNOSE EXIT
E-W BULLNOSE EXIT
HIGHWAY 3
178.993
178.776
181.901
186.194
187.682
188.432
10+000
10+500
11+000
11+500

NOISE BARRIER ON NORTH SIDE WITH NO SERVICE ROAD ON SOUTH SIDE OF URBAN FREEWAY



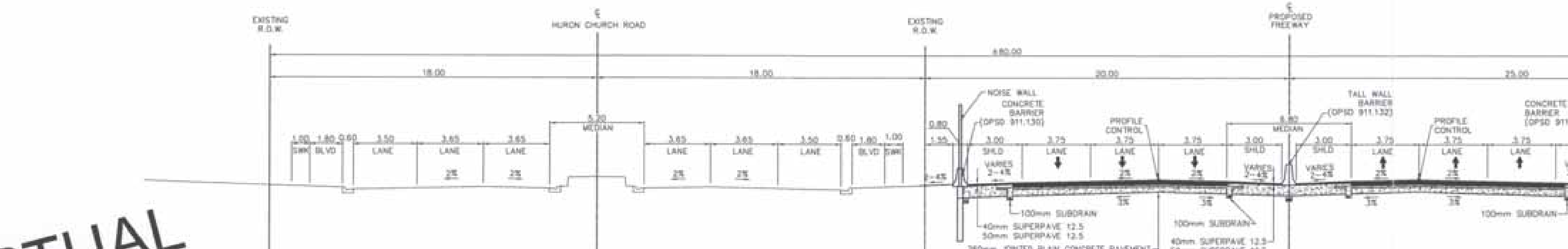
TYPICAL 6-LANE URBAN FREEWAY SECTION ADJACENT TO TALBOT ROAD

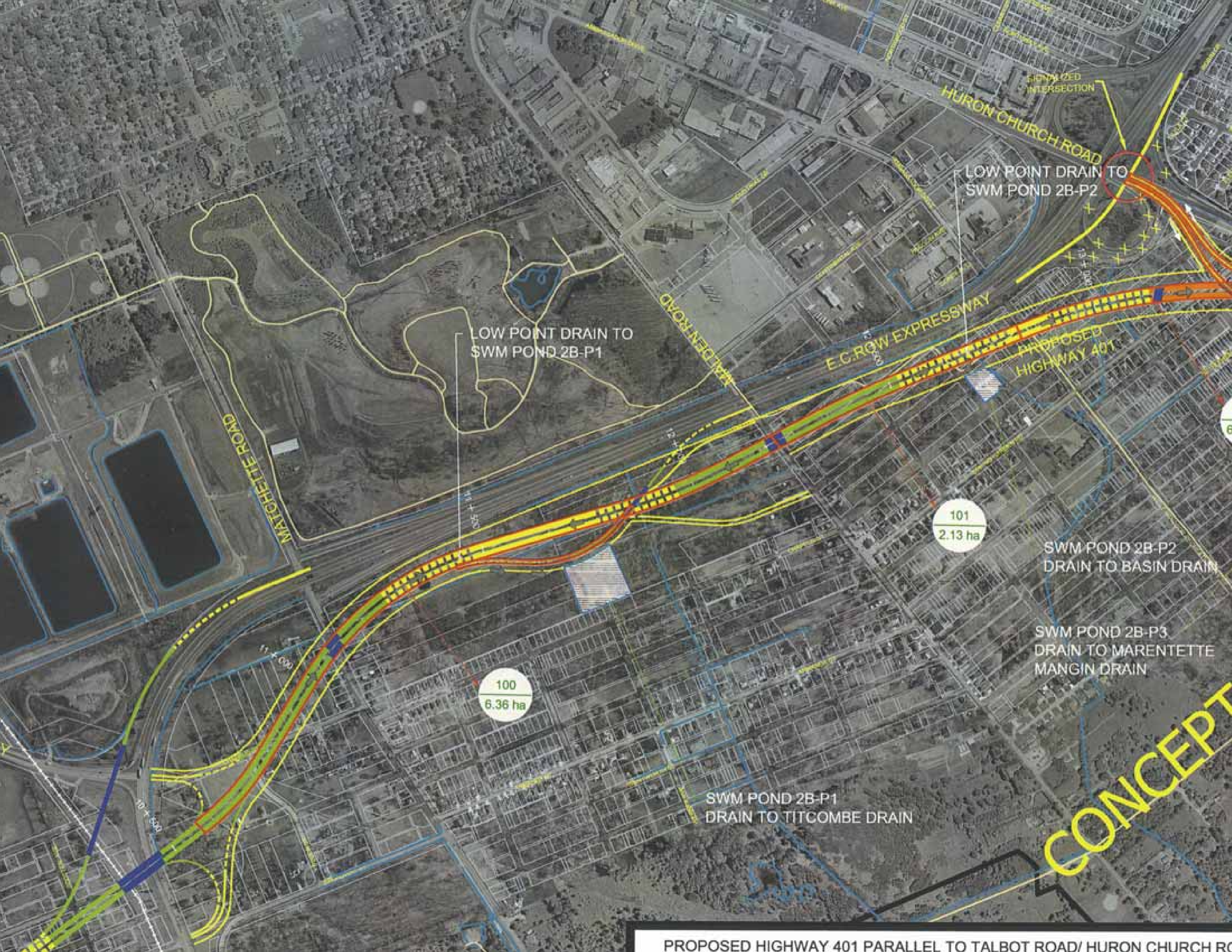
NOISE BARRIER ON NORTH SIDE WITH NO SERVICE ROAD ON SOUTH SIDE OF URBAN FREEWAY



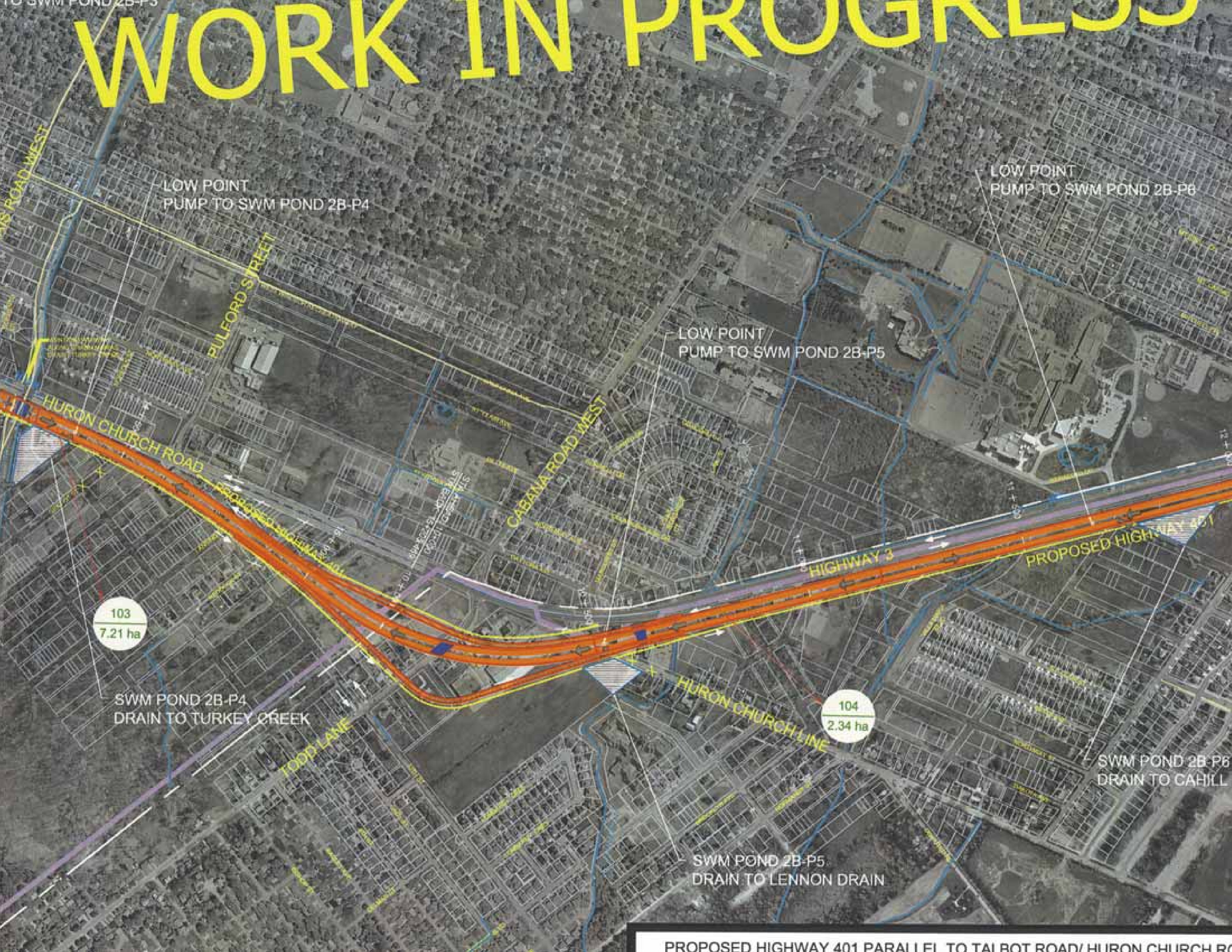
TYPICAL 6-LANE URBAN FREEWAY SECTION ADJACENT TO HURON CHURCH ROAD

NOISE BARRIER ON NORTH SIDE WITH NO SERVICE ROAD ON SOUTH SIDE OF URBAN FREEWAY

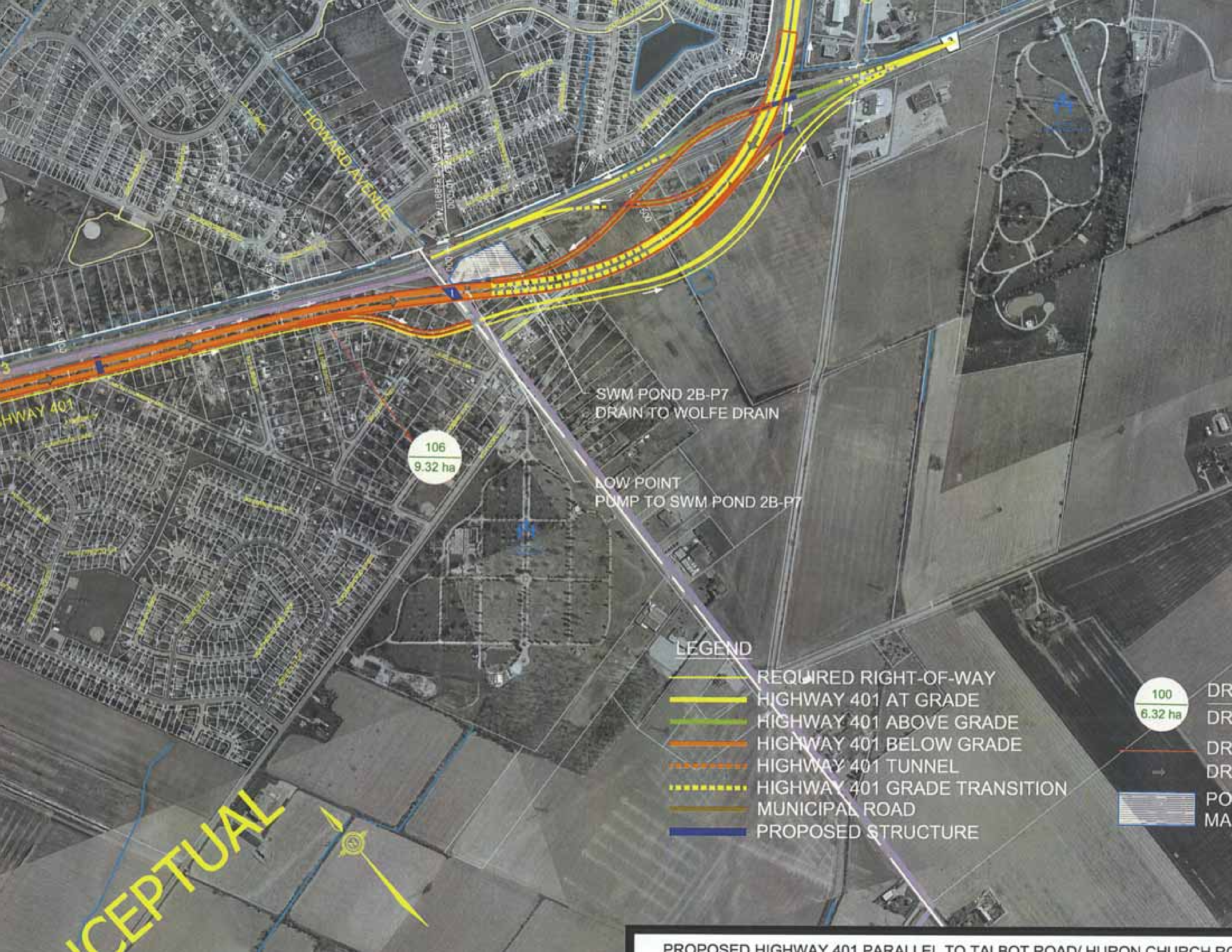


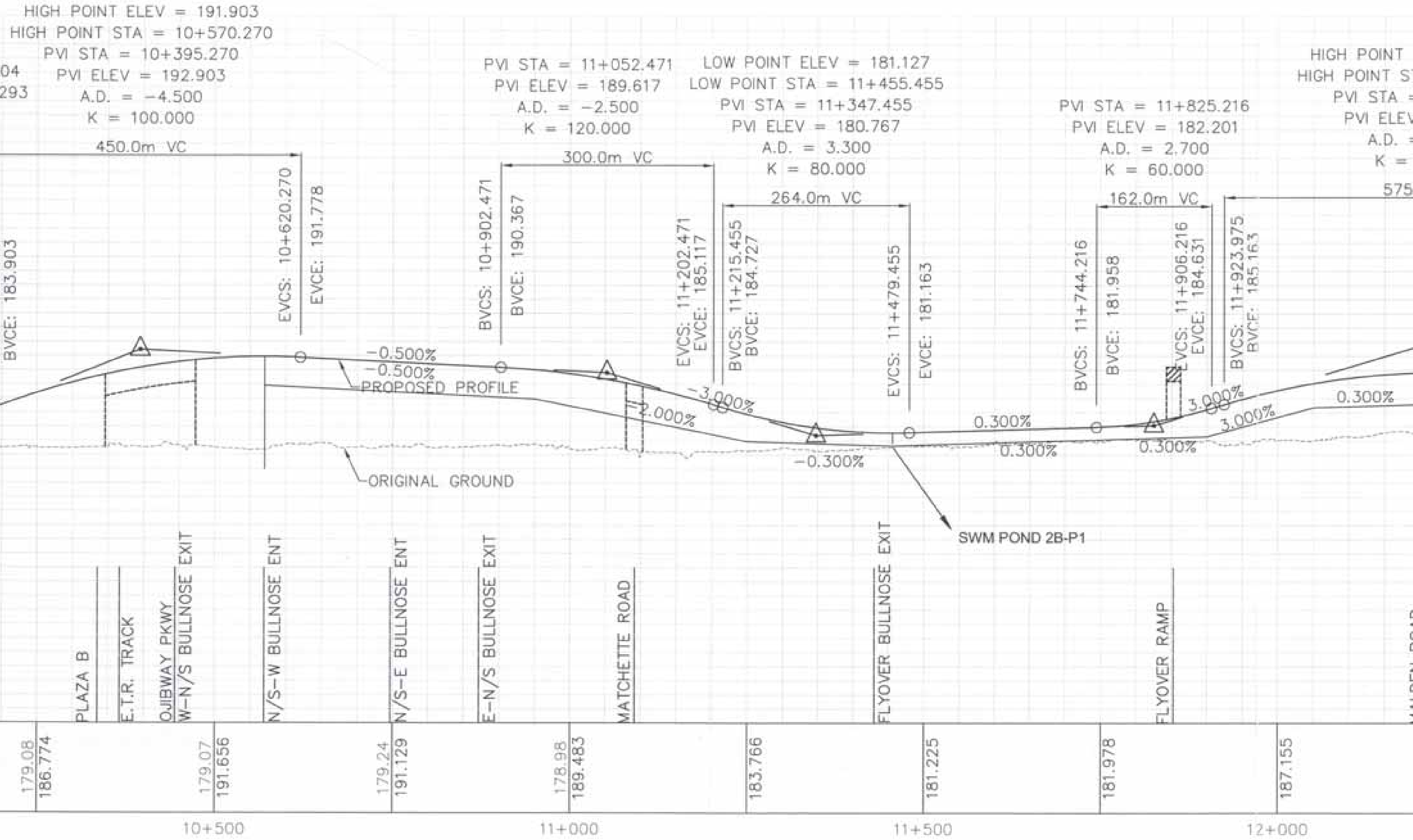


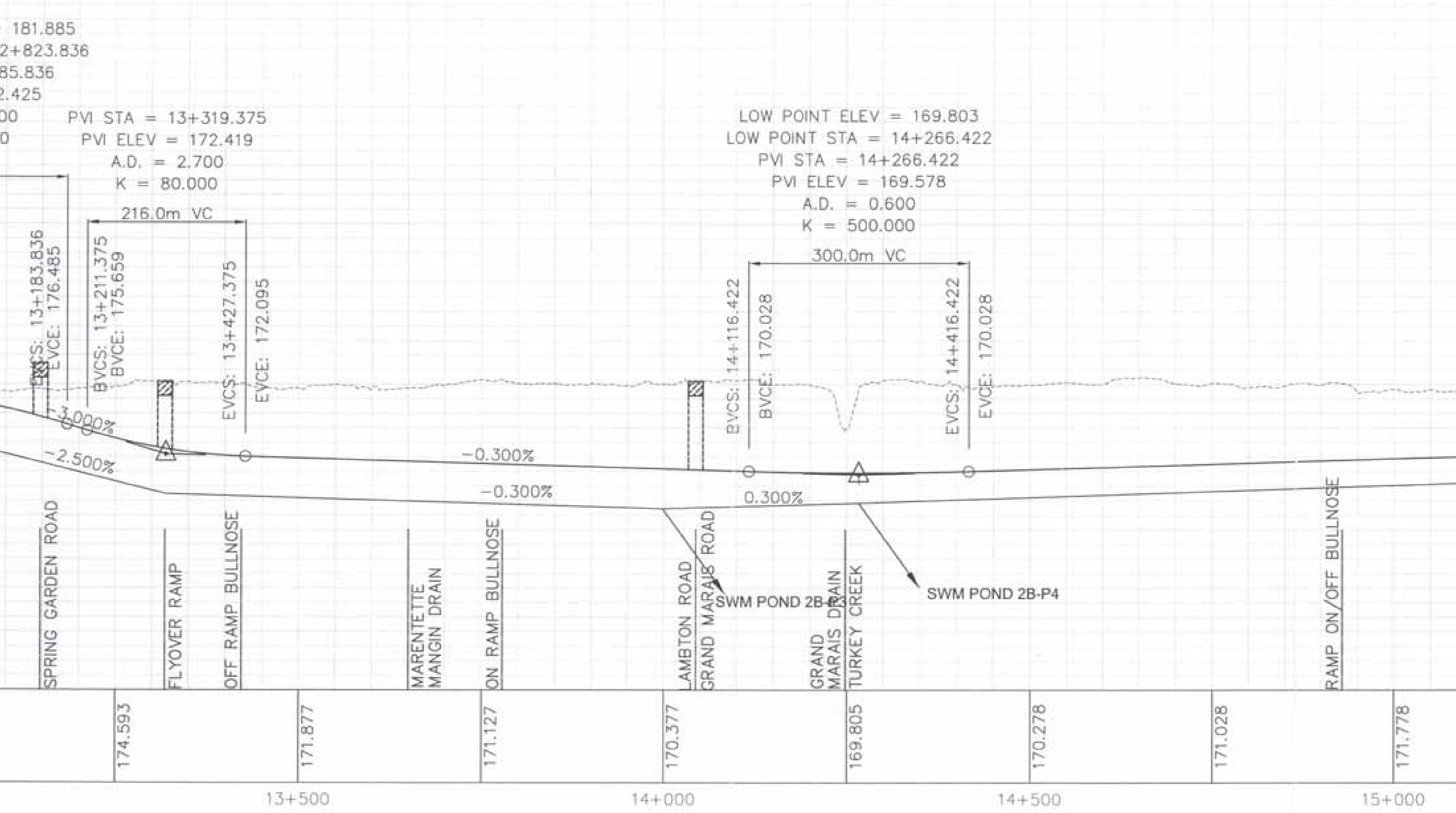
HURON CHURCH ROAD
SIGNALIZED INTERSECTION
LOW POINT DRAIN TO SWM POND 2B-P2
LOW POINT DRAIN TO SWM POND 2B-P1
E.C.ROW EXPRESSWAY
PROPOSED HIGHWAY 401
MALDEN ROAD
MATCHETTE ROAD
101
2.13 ha
100
6.36 ha
SWM POND 2B-P2
DRAIN TO BASIN DRAIN
SWM POND 2B-P3
DRAIN TO MARENTETTE
MANGIN DRAIN
SWM POND 2B-P1
DRAIN TO TITCOMBE DRAIN
CONCEPT
PROPOSED HIGHWAY 401 PARALLEL TO TALBOT ROAD/ HURON CHURCH RO



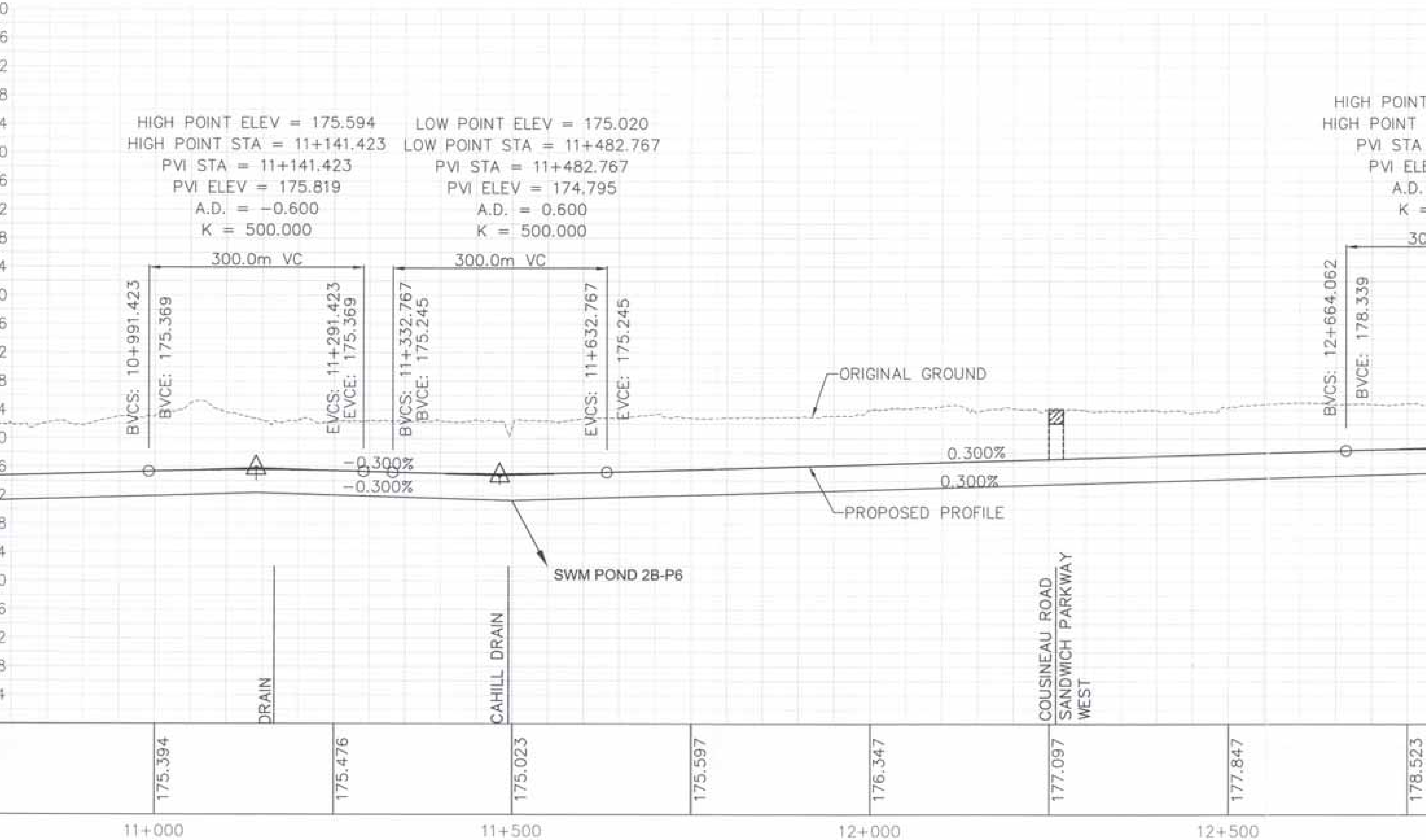
PROPOSED HIGHWAY 401 PARALLEL TO TALBOT ROAD/ HURON CHURCH RO


HOWARD AVENUE
HWAY 401
SWM POND 2B-P7
DRAIN TO WOLFE DRAIN
LOW POINT
PUMP TO SWM POND 2B-P7
106
9.32 ha
LEGEND
REQUIRED RIGHT-OF-WAY
HIGHWAY 401 AT GRADE
HIGHWAY 401 ABOVE GRADE
HIGHWAY 401 BELOW GRADE
HIGHWAY 401 TUNNEL
HIGHWAY 401 GRADE TRANSITION
MUNICIPAL ROAD
PROPOSED STRUCTURE
100
6.32 ha
CEPTUAL
PROPOSED HIGHWAY 401 PARALLEL TO TALBOT ROAD/ HURON CHURCH RO

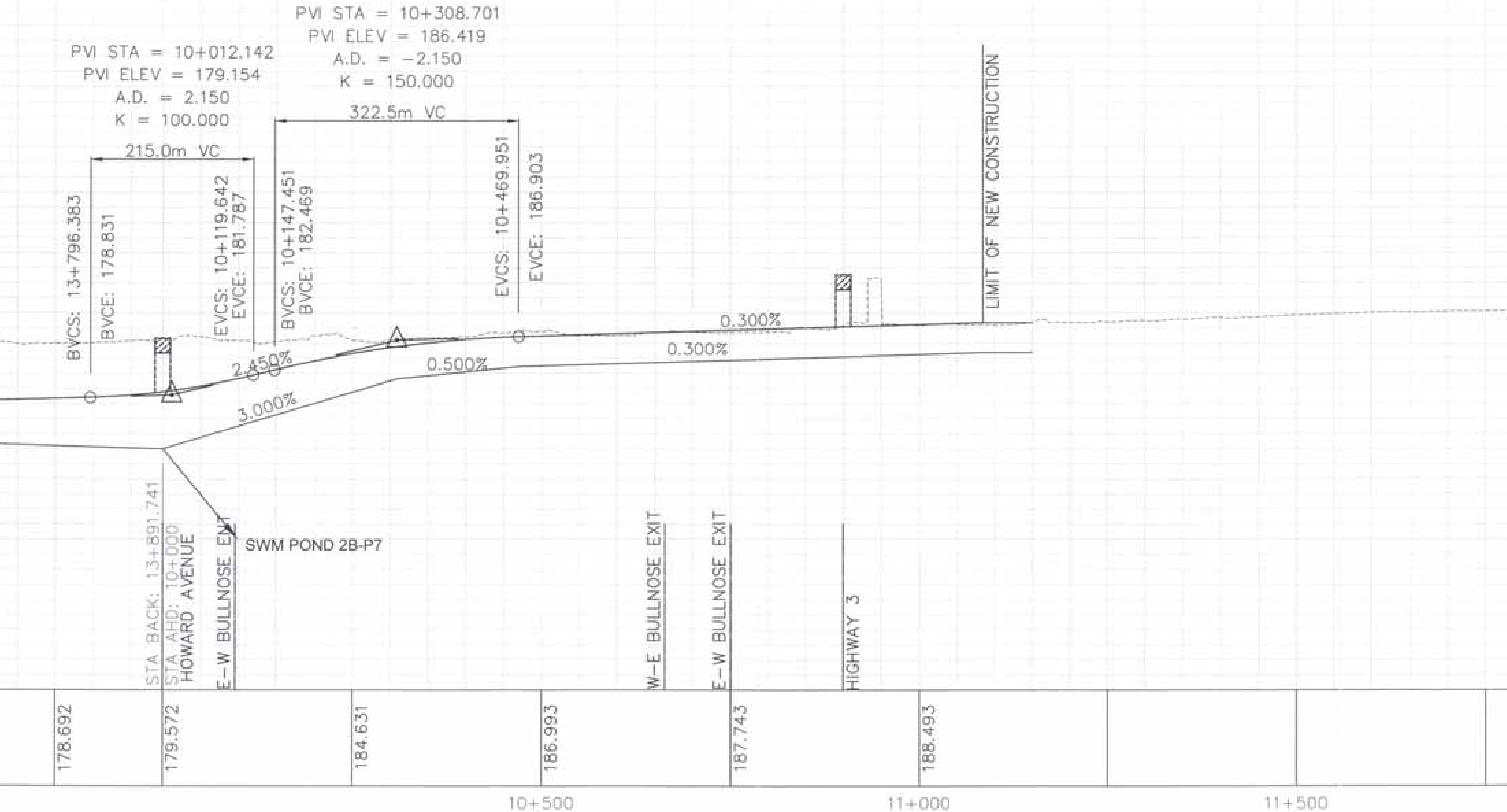

HIGH POINT ELEV = 191.903
HIGH POINT STA = 10+570.270
PVI STA = 10+395.270
PVI ELEV = 192.903
A.D. = -4.500
K = 100.000
450.0m VC
BVCE: 183.903
EVCS: 10+620.270
EVCE: 191.778
PVI STA = 11+052.471
PVI ELEV = 189.617
A.D. = -2.500
K = 120.000
300.0m VC
BVCS: 10+902.471
BVCE: 190.367
EVCS: 11+202.471
EVCE: 185.117
LOW POINT ELEV = 181.127
LOW POINT STA = 11+455.455
PVI STA = 11+347.455
PVI ELEV = 180.767
A.D. = 3.300
K = 80.000
264.0m VC
BVCS: 11+215.455
BVCE: 184.727
EVCS: 11+479.455
EVCE: 181.163
PVI STA = 11+825.216
PVI ELEV = 182.201
A.D. = 2.700
K = 60.000
162.0m VC
BVCS: 11+744.216
BVCE: 181.958
EVCS: 11+906.216
EVCE: 184.631
BVCS: 11+923.975
BVCE: 185.163
-0.500%
-0.500%
PROPOSED PROFILE
-2.000%
-3.000%
-0.300%
0.300%
0.300%
0.300%
3.000%
3.000%
0.300%
ORIGINAL GROUND
SWM POND 2B-P1
PLAZA B
E.T.R. TRACK
OJIBWAY PKWY
W-N/S BULLNOSE EXIT
N/S-W BULLNOSE ENT
N/S-E BULLNOSE ENT
E-N/S BULLNOSE EXIT
MATCHETTE ROAD
FLYOVER BULLNOSE EXIT
FLYOVER RAMP
179.08
186.774
179.07
191.656
179.24
191.129
178.98
189.483
183.766
181.225
181.978
187.155
10+500
11+000
11+500
12+000



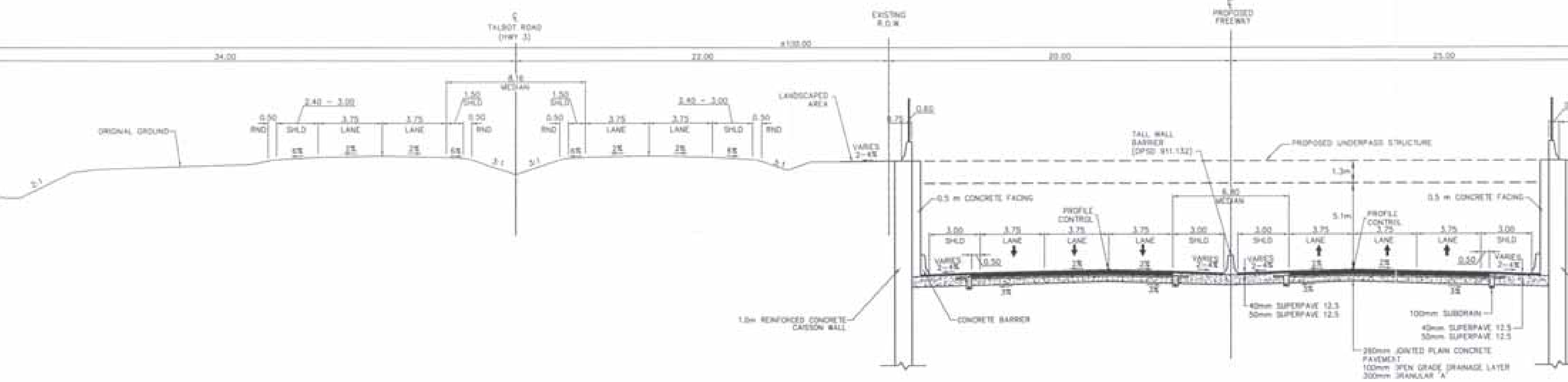
181.885
2+823.836
85.836
2.425
PVI STA = 13+319.375
PVI ELEV = 172.419
A.D. = 2.700
K = 80.000
216.0m VC
LOW POINT ELEV = 169.803
LOW POINT STA = 14+266.422
PVI STA = 14+266.422
PVI ELEV = 169.578
A.D. = 0.600
K = 500.000
300.0m VC
EVCS: 13+183.836
EVCE: 176.485
BVCS: 13+211.375
BVCE: 175.659
EVCS: 13+427.375
EVCE: 172.095
BVCS: 14+116.422
BVCE: 170.028
EVCS: 14+416.422
EVCE: 170.028
-3.000%
-2.500%
-0.300%
-0.300%
0.300%
SPRING GARDEN ROAD
FLYOVER RAMP
OFF RAMP BULLNOSE
MARENTETTE MANGIN DRAIN
ON RAMP BULLNOSE
LAMBTON ROAD
GRAND MARAIS ROAD
SWM POND 2B-P3
GRAND MARAIS DRAIN
TURKEY CREEK
SWM POND 2B-P4
RAMP ON/OFF BULLNOSE
174.593
171.877
171.127
170.377
169.805
170.278
171.028
171.778
13+500
14+000
14+500
15+000



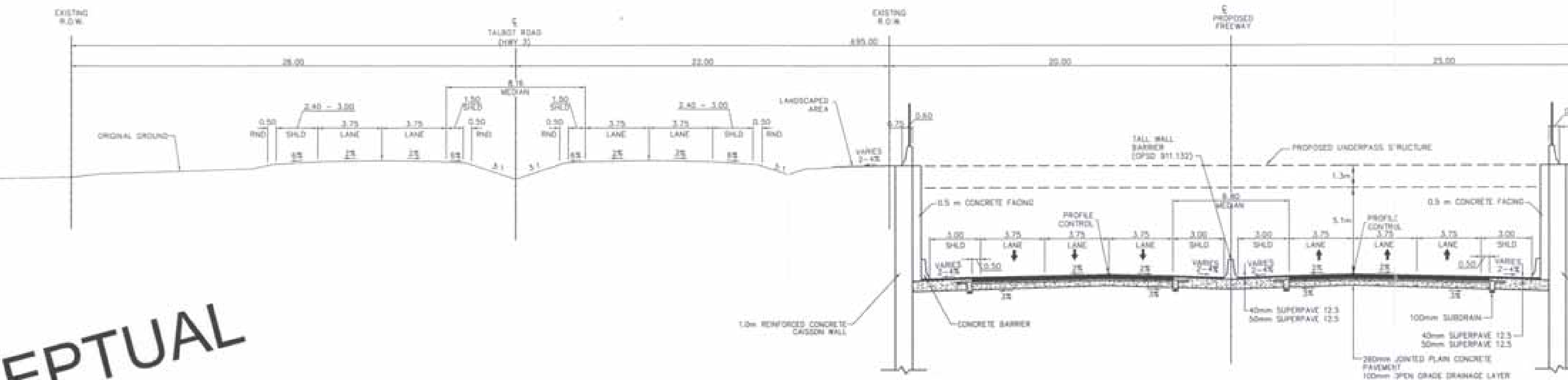
HIGH POINT ELEV = 175.594
HIGH POINT STA = 11+141.423
PVI STA = 11+141.423
PVI ELEV = 175.819
A.D. = −0.600
K = 500.000
300.0m VC
LOW POINT ELEV = 175.020
LOW POINT STA = 11+482.767
PVI STA = 11+482.767
PVI ELEV = 174.795
A.D. = 0.600
K = 500.000
300.0m VC
BVCS: 10+991.423
BVCE: 175.369
EVCS: 11+291.423
EVCE: 175.369
BVCS: 11+332.767
BVCE: 175.245
EVCS: 11+632.767
EVCE: 175.245
BVCS: 12+664.062
BVCE: 178.339
ORIGINAL GROUND
PROPOSED PROFILE
−0.300%
−0.300%
0.300%
0.300%
SWM POND 2B-P6
DRAIN
CAHILL DRAIN
COUSINEAU ROAD
SANDWICH PARKWAY
WEST
175.394
175.476
175.023
175.597
176.347
177.097
177.847
178.523
11+000
11+500
12+000
12+500


PVI STA = 10+012.142
PVI ELEV = 179.154
A.D. = 2.150
K = 100.000
215.0m VC
PVI STA = 10+308.701
PVI ELEV = 186.419
A.D. = −2.150
K = 150.000
322.5m VC
BVCS: 13+796.383
BVCE: 178.831
EVCS: 10+119.642
EVCE: 181.787
BVCS: 10+147.451
BVCE: 182.469
EVCS: 10+469.951
EVCE: 186.903
LIMIT OF NEW CONSTRUCTION
0.300%
0.300%
2.450%
0.500%
3.000%
STA BACK: 13+891.741
STA AHD: 10+000
HOWARD AVENUE
E−W BULLNOSE ENT
SWM POND 2B-P7
W−E BULLNOSE EXIT
E−W BULLNOSE EXIT
HIGHWAY 3
178.692
179.572
184.631
186.993
187.743
188.493
10+500
11+000
11+500

NOISE BARRIER ON NORTH SIDE WITH NO SERVICE ROAD ON SOUTH SIDE OF URBAN FREEWAY



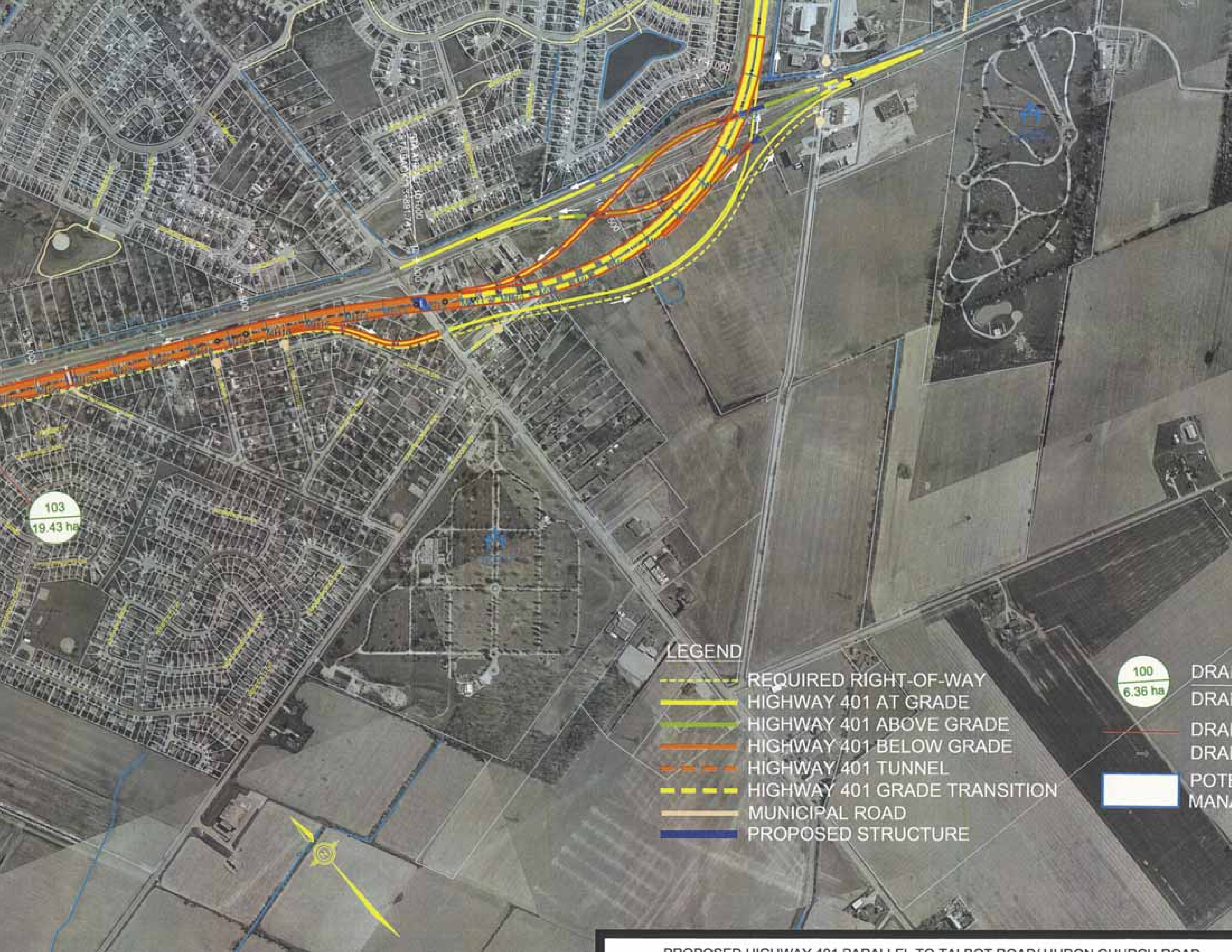
TYPICAL BELOW GRADE 6-LANE URBAN FREEWAY SECTION ADJACENT TO TALBOT ROAD
NOISE BARRIER ON NORTH SIDE WITH NO SERVICE ROAD ON SOUTH SIDE OF URBAN FREEWAY

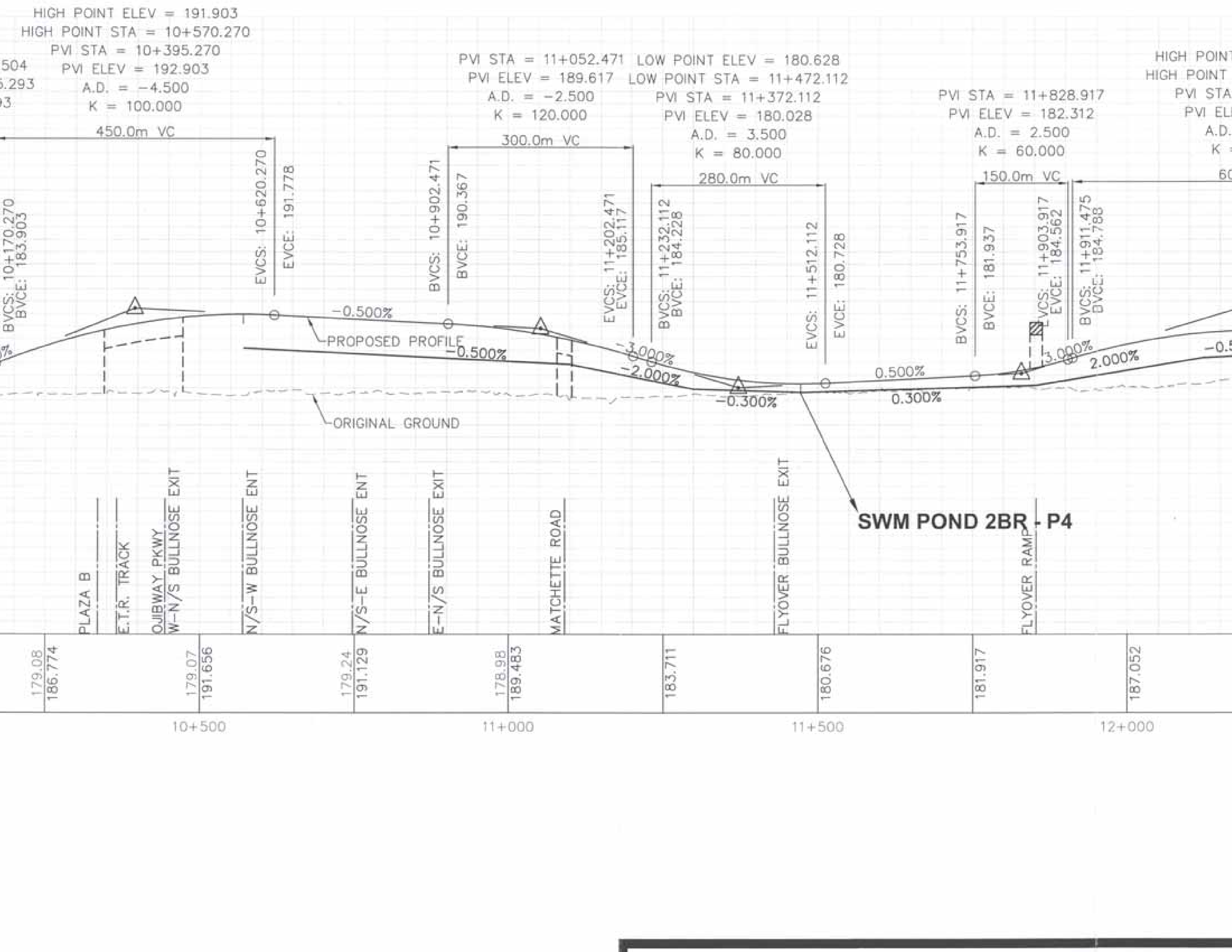


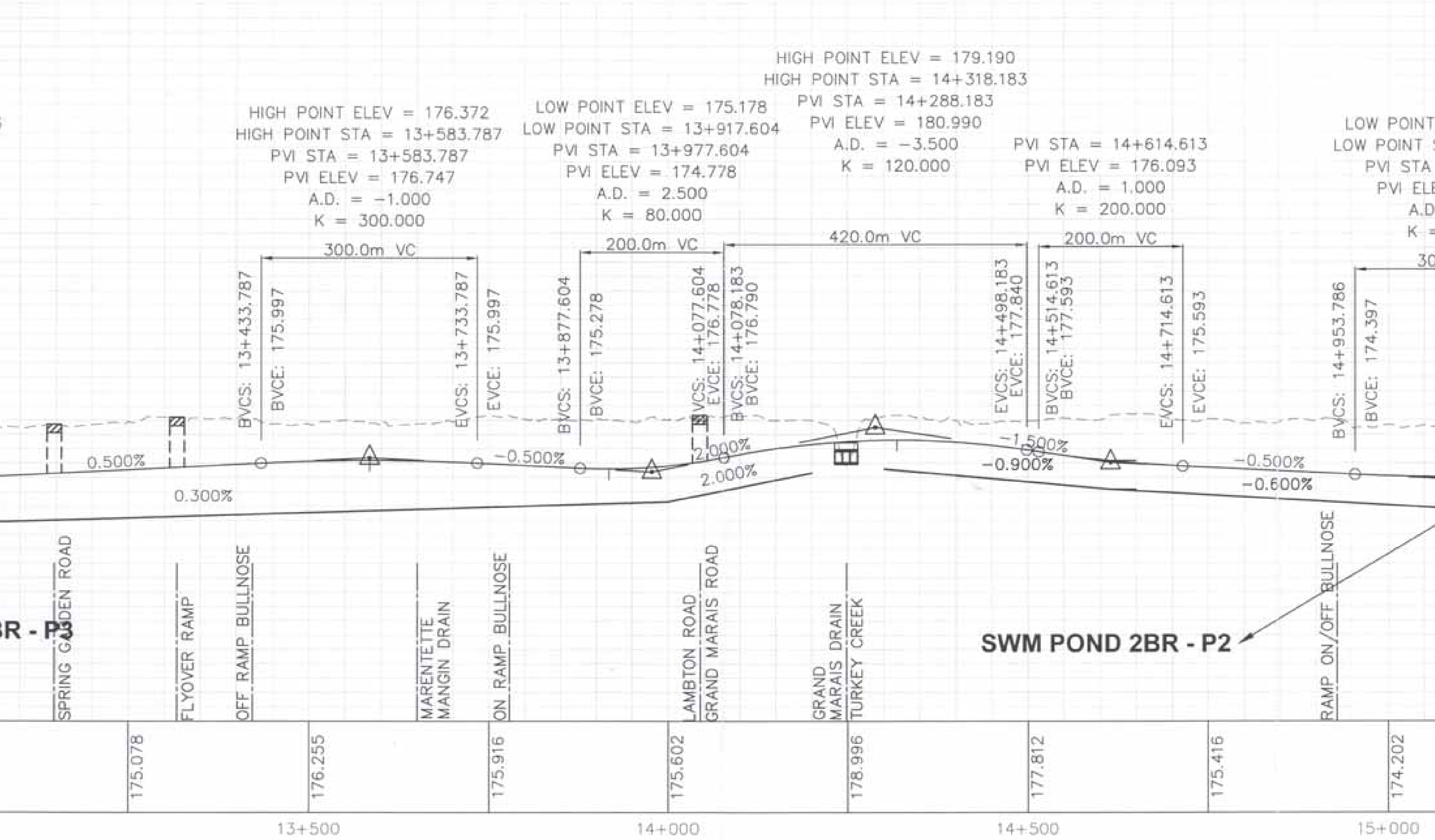
TYPICAL BELOW GRADE 6-LANE URBAN FREEWAY SECTION ADJACENT TO TALBOT ROAD
NOISE BARRIER ON NORTH SIDE WITH NO SERVICE ROAD ON SOUTH SIDE OF URBAN FREEWAY


LOW POINT
PUMP TO SWM POND 2BR - P3
LOW POINT
DRAIN TO SWM POND 2BR - P4
SWM POND 2BR - P3
DRAIN TO BASIN DRAIN
100
6.36 ha
SWM POND 2BR - P4
DRAIN TO TITCOMBER DRAIN

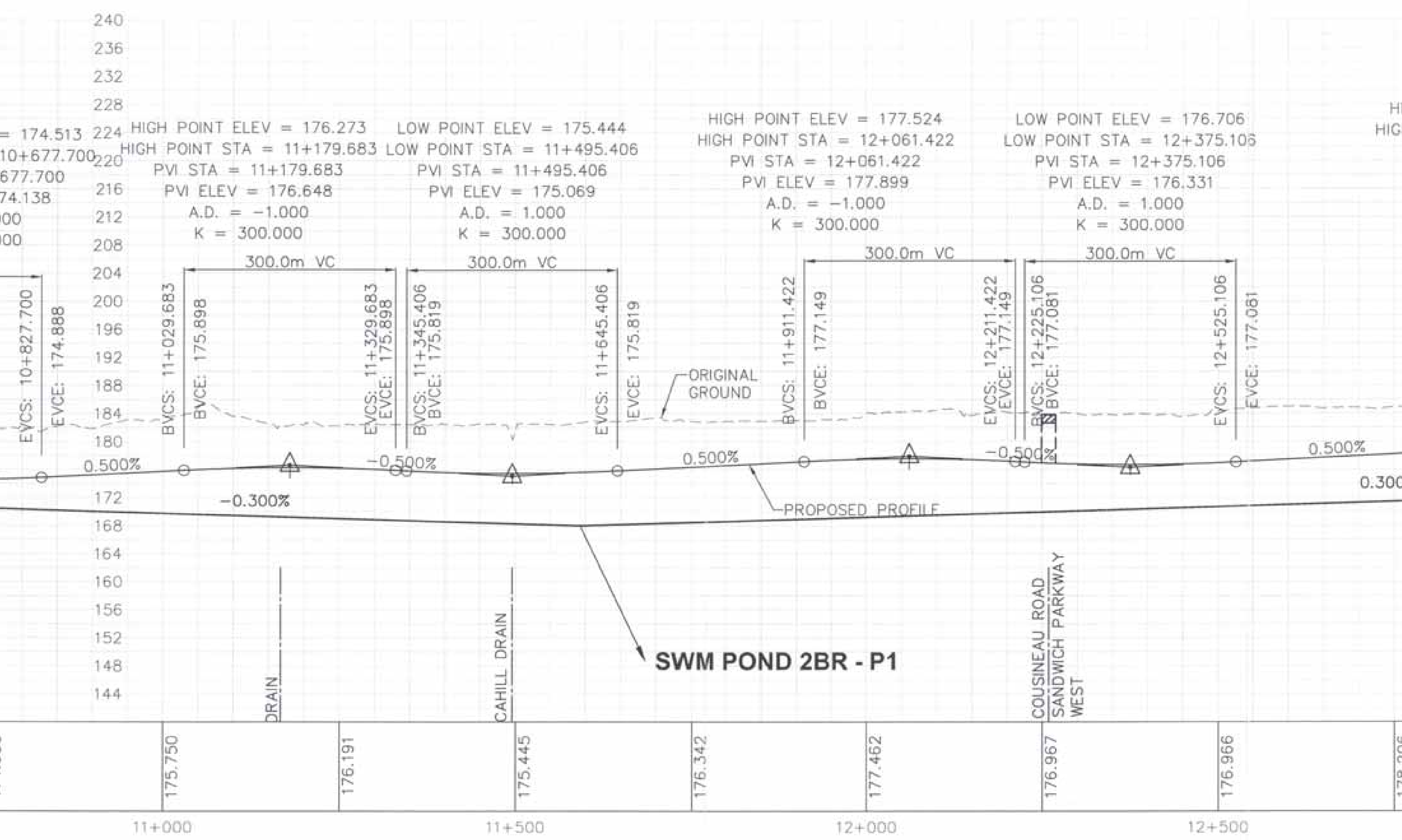

LOW POINT
PUMP TO SWM POND 2BR - P2
LOW POINT
PUMP TO SWM POND 2BR - P1
SWM POND 2BR - P1
DRAIN TO CAHILL DRA
SWM POND 2BR - P2
DRAIN TO LENNON DRAIN
102
6.22 ha


LEGEND
REQUIRED RIGHT-OF-WAY
HIGHWAY 401 AT GRADE
HIGHWAY 401 ABOVE GRADE
HIGHWAY 401 BELOW GRADE
HIGHWAY 401 TUNNEL
HIGHWAY 401 GRADE TRANSITION
MUNICIPAL ROAD
PROPOSED STRUCTURE
103
19.43 ha
100
6.36 ha

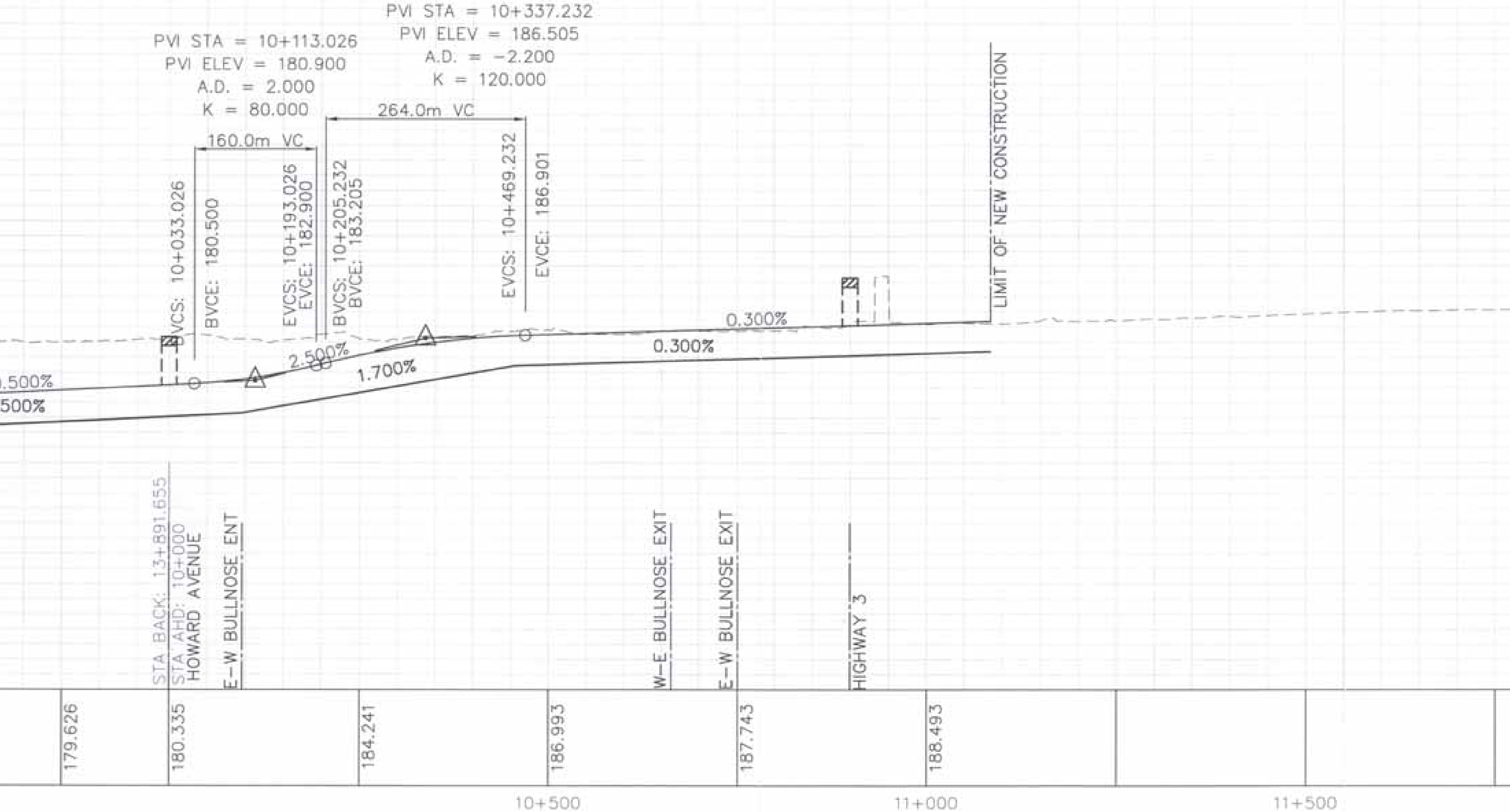

HIGH POINT ELEV = 191.903
HIGH POINT STA = 10+570.270
PVI STA = 10+395.270
PVI ELEV = 192.903
A.D. = -4.500
K = 100.000
450.0m VC
BVCS: 10+170.270
BVCE: 183.903
EVCS: 10+620.270
EVCE: 191.778
PVI STA = 11+052.471
PVI ELEV = 189.617
A.D. = -2.500
K = 120.000
300.0m VC
BVCS: 10+902.471
BVCE: 190.367
EVCS: 11+202.471
EVCE: 185.117
LOW POINT ELEV = 180.628
LOW POINT STA = 11+472.112
PVI STA = 11+372.112
PVI ELEV = 180.028
A.D. = 3.500
K = 80.000
280.0m VC
BVCS: 11+232.112
BVCE: 184.228
EVCS: 11+512.112
EVCE: 180.728
PVI STA = 11+828.917
PVI ELEV = 182.312
A.D. = 2.500
K = 60.000
150.0m VC
BVCS: 11+753.917
BVCE: 181.937
EVCS: 11+903.917
EVCE: 184.562
BVCS: 11+911.475
BVCE: 184.788
HIGH POINT
HIGH POINT
PVI STA
PVI EL
A.D.
-0.500%
-0.500%
-3.000%
-2.000%
-0.300%
0.500%
0.300%
3.000%
2.000%
PROPOSED PROFILE
ORIGINAL GROUND
SWM POND 2BR - P4
PLAZA B
E.T.R. TRACK
OJIBWAY PKWY
W-N/S BULLNOSE EXIT
N/S-W BULLNOSE ENT
N/S-E BULLNOSE ENT
E-N/S BULLNOSE EXIT
MATCHETTE ROAD
FLYOVER BULLNOSE EXIT
FLYOVER RAMP
179.08
186.774
179.07
191.656
179.24
191.129
178.98
189.483
183.711
180.676
181.917
187.052
10+500
11+000
11+500
12+000



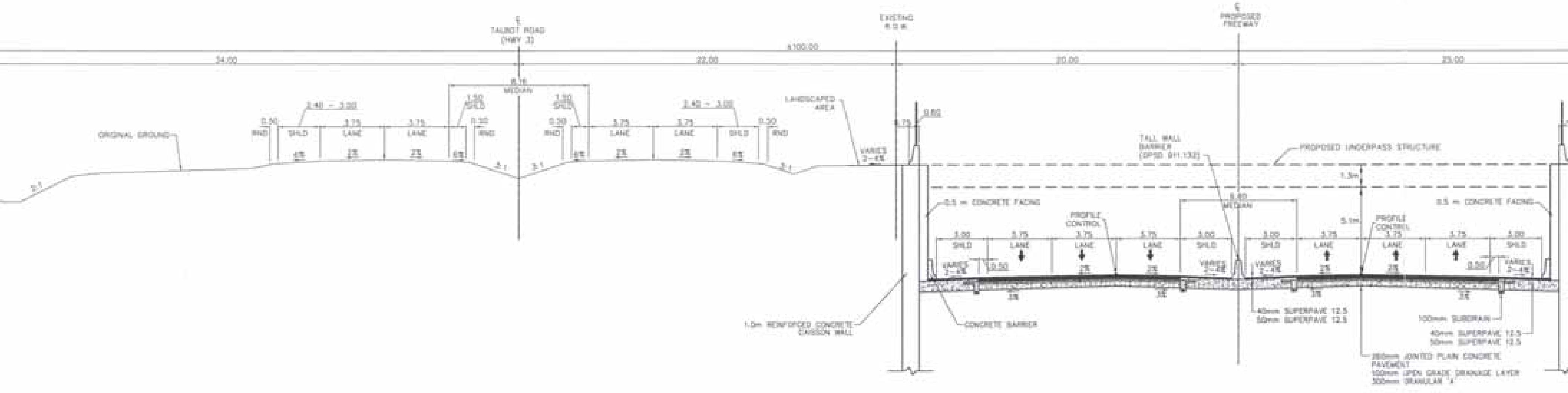
HIGH POINT ELEV = 176.372
HIGH POINT STA = 13+583.787
PVI STA = 13+583.787
PVI ELEV = 176.747
A.D. = -1.000
K = 300.000
300.0m VC
LOW POINT ELEV = 175.178
LOW POINT STA = 13+917.604
PVI STA = 13+977.604
PVI ELEV = 174.778
A.D. = 2.500
K = 80.000
200.0m VC
HIGH POINT ELEV = 179.190
HIGH POINT STA = 14+318.183
PVI STA = 14+288.183
PVI ELEV = 180.990
A.D. = -3.500
K = 120.000
420.0m VC
PVI STA = 14+614.613
PVI ELEV = 176.093
A.D. = 1.000
K = 200.000
200.0m VC
BVCS: 13+433.787
BVCE: 175.997
EVCS: 13+733.787
EVCE: 175.997
BVCS: 13+877.604
BVCE: 175.278
EVCS: 14+077.604
EVCE: 176.778
BVCS: 14+078.183
BVCE: 176.790
EVCS: 14+498.183
EVCE: 177.840
BVCS: 14+514.613
BVCE: 177.593
EVCS: 14+714.613
EVCE: 175.593
BVCS: 14+953.786
BVCE: 174.397
0.500%
0.300%
-0.500%
2.000%
2.000%
-1.500%
-0.900%
-0.500%
-0.600%
SPRING GARDEN ROAD
FLYOVER RAMP
OFF RAMP BULLNOSE
MARENTETTE MANGIN DRAIN
ON RAMP BULLNOSE
LAMBTON ROAD
GRAND MARAIS ROAD
GRAND MARAIS DRAIN
TURKEY CREEK
RAMP ON/OFF BULLNOSE
SWM POND 2BR - P2
175.078
176.255
175.916
175.602
178.996
177.812
175.416
174.202
13+500
14+000
14+500
15+000



= 174.513
10+677.700
677.700
74.138
HIGH POINT ELEV = 176.273
HIGH POINT STA = 11+179.683
PVI STA = 11+179.683
PVI ELEV = 176.648
A.D. = -1.000
K = 300.000
LOW POINT ELEV = 175.444
LOW POINT STA = 11+495.406
PVI STA = 11+495.406
PVI ELEV = 175.069
A.D. = 1.000
K = 300.000
HIGH POINT ELEV = 177.524
HIGH POINT STA = 12+061.422
PVI STA = 12+061.422
PVI ELEV = 177.899
A.D. = -1.000
K = 300.000
LOW POINT ELEV = 176.706
LOW POINT STA = 12+375.106
PVI STA = 12+375.106
PVI ELEV = 176.331
A.D. = 1.000
K = 300.000
300.0m VC
EVCS: 10+827.700
EVCE: 174.888
BVCS: 11+029.683
BVCE: 175.898
EVCS: 11+329.683
EVCE: 175.898
BVCS: 11+345.406
BVCE: 175.819
EVCS: 11+645.406
EVCE: 175.819
BVCS: 11+911.422
BVCE: 177.149
EVCS: 12+211.422
EVCE: 177.149
BVCS: 12+225.106
BVCE: 177.081
EVCS: 12+525.106
EVCE: 177.081
ORIGINAL GROUND
PROPOSED PROFILE
0.500%
-0.500%
-0.300%
SWM POND 2BR - P1
DRAIN
CAHILL DRAIN
COUSINEAU ROAD
SANDWICH PARKWAY WEST
240
236
232
228
224
220
216
212
208
204
200
196
192
188
184
180
172
168
164
160
156
152
148
144
175.750
176.191
175.445
176.342
177.462
176.967
176.966
11+000
11+500
12+000
12+500

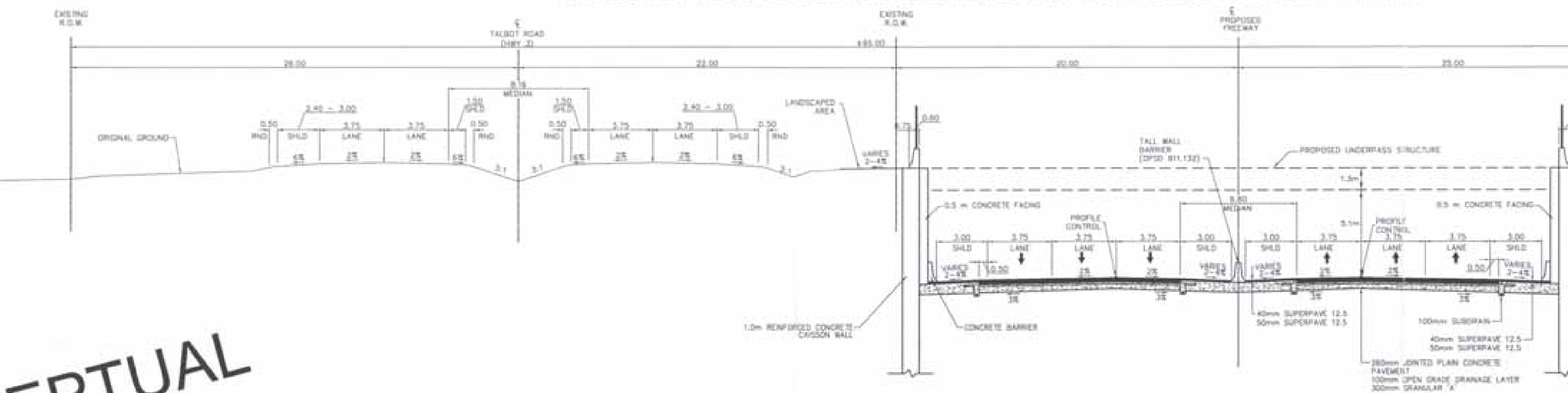

PVI STA = 10+113.026
PVI ELEV = 180.900
A.D. = 2.000
K = 80.000
PVI STA = 10+337.232
PVI ELEV = 186.505
A.D. = -2.200
K = 120.000
160.0m VC
264.0m VC
BVCS: 10+033.026
BVCE: 180.500
EVCS: 10+193.026
EVCE: 182.900
BVCS: 10+205.232
BVCE: 183.205
EVCS: 10+469.232
EVCE: 186.901
LIMIT OF NEW CONSTRUCTION
0.500%
0.500%
2.500%
1.700%
0.300%
0.300%
STA BACK: 13+891.655
STA AHD: 10+000
HOWARD AVENUE
E-W BULLNOSE ENT
W-E BULLNOSE EXIT
E-W BULLNOSE EXIT
HIGHWAY 3
179.626
180.335
184.241
186.993
187.743
188.493
10+500
11+000
11+500

NOISE BARRIER ON NORTH SIDE WITH NO SERVICE ROAD ON SOUTH SIDE OF URBAN FREEWAY



TYPICAL BELOW GRADE 6-LANE URBAN FREEWAY SECTION ADJACENT TO TALBOT ROAD

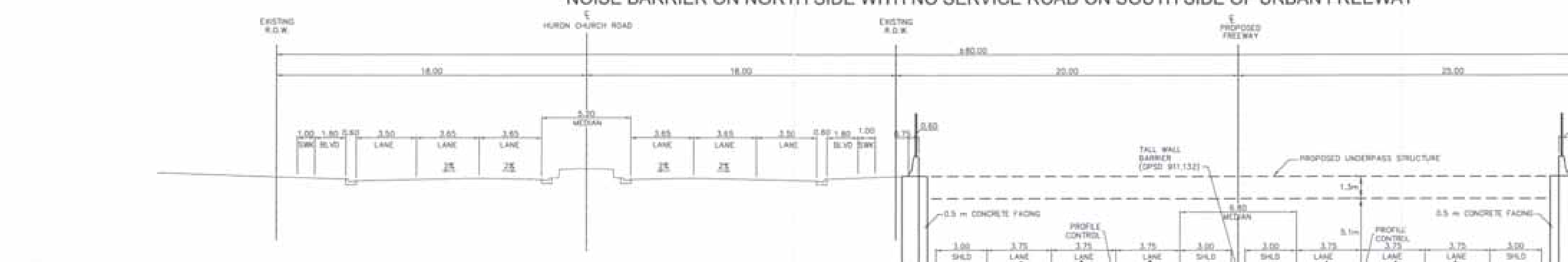
NOISE BARRIER ON NORTH SIDE WITH NO SERVICE ROAD ON SOUTH SIDE OF URBAN FREEWAY



CEPTUAL

TYPICAL BELOW GRADE 6-LANE URBAN FREEWAY SECTION ADJACENT TO TALBOT ROAD

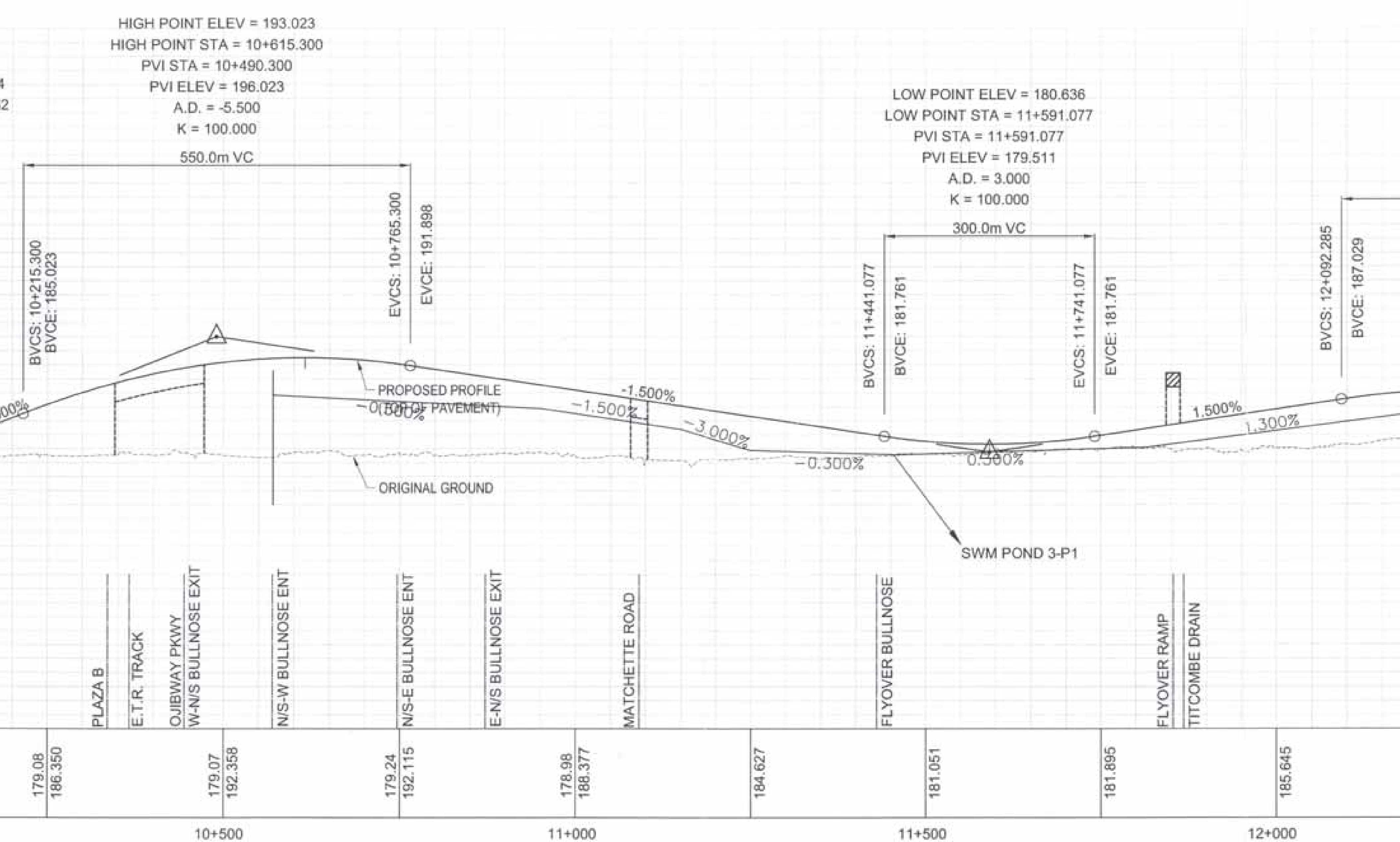
NOISE BARRIER ON NORTH SIDE WITH NO SERVICE ROAD ON SOUTH SIDE OF URBAN FREEWAY



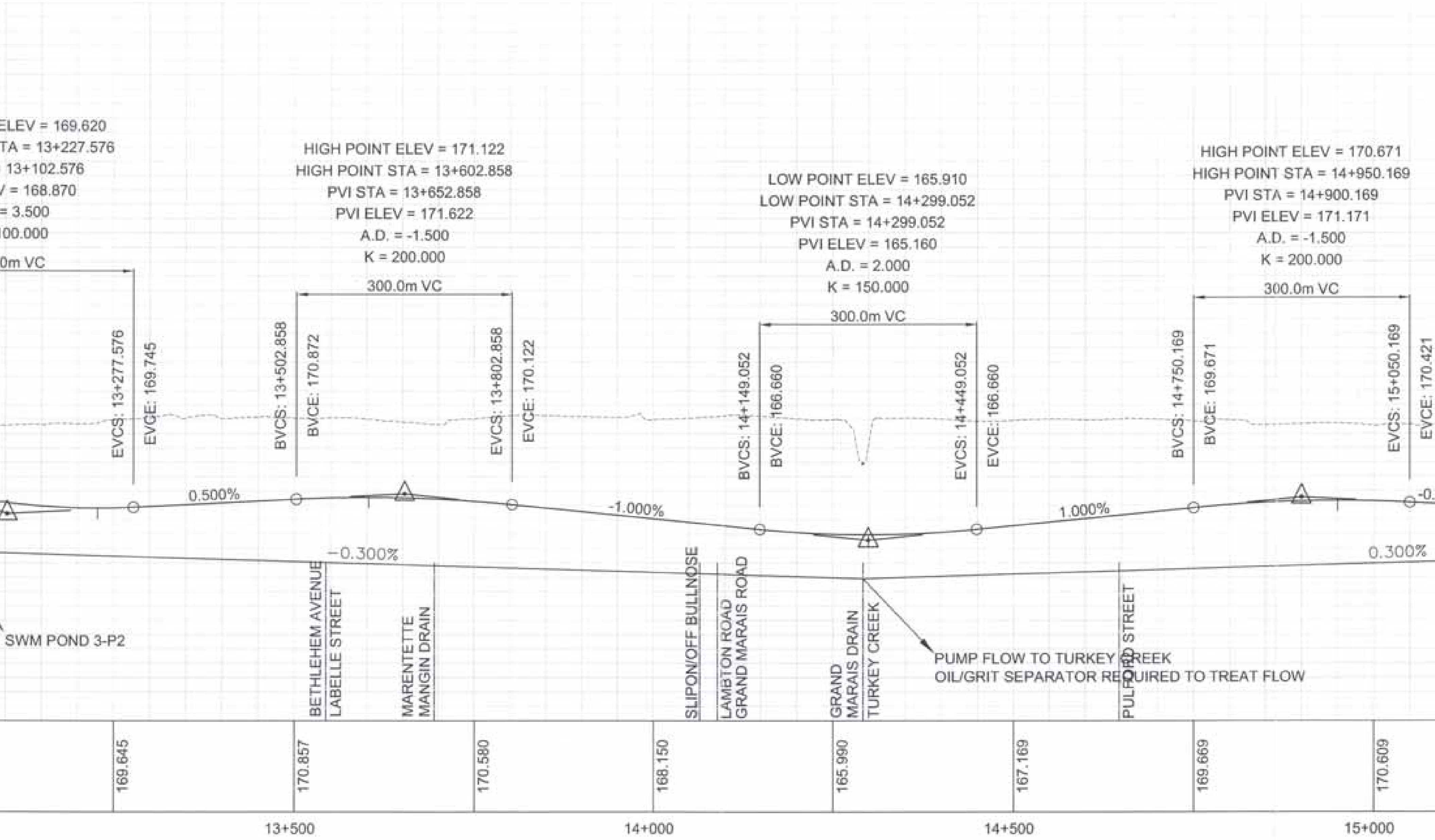
PROPOSED HIGHWAY 401 ALONG THE TALBOT ROAD/ HURON CHURCH ROAD CORRIDOR
WITH SERVICE ROADS

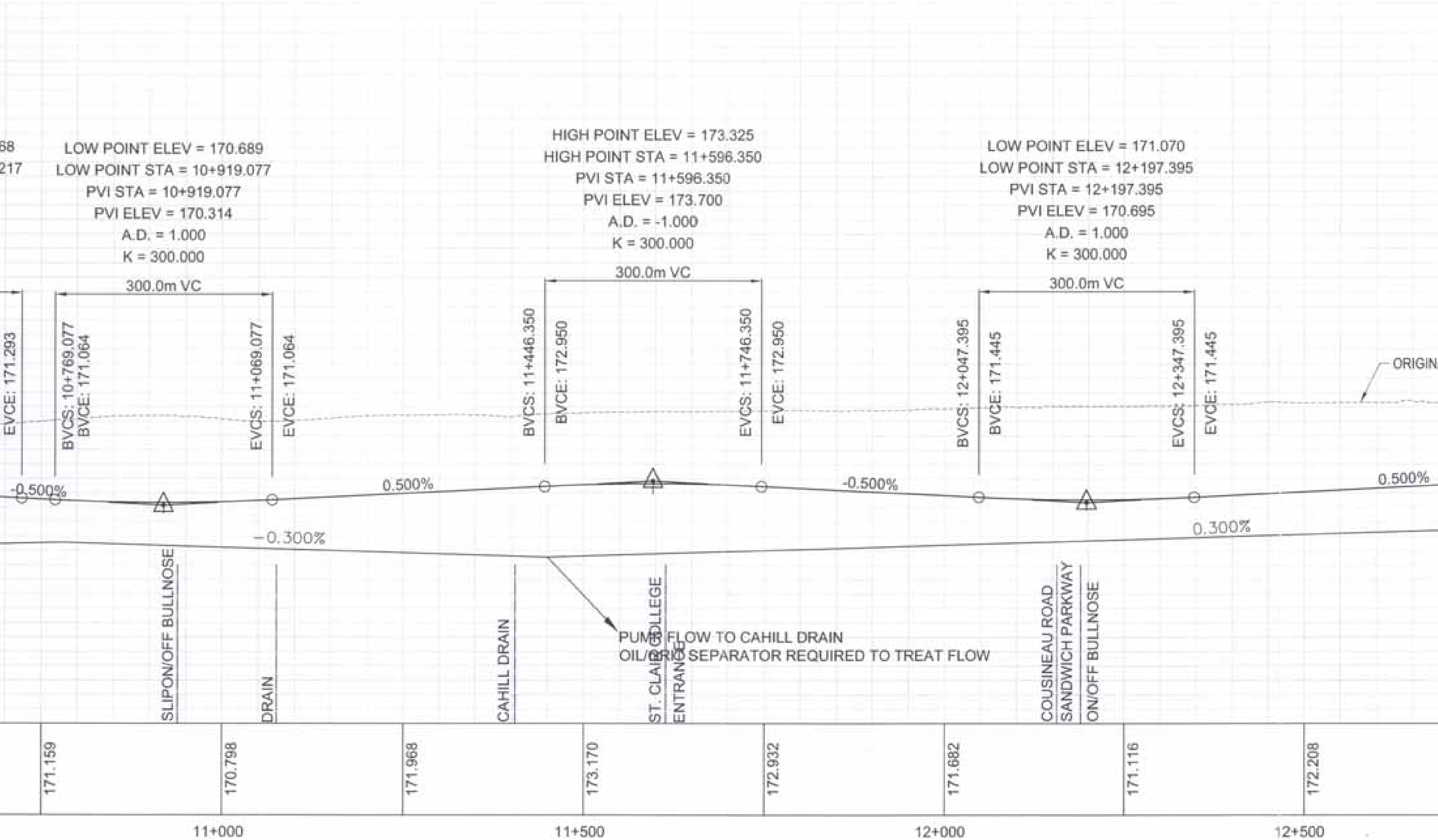

WORK IN PROGRESS
GRAND MARAIS ROAD WEST
PULFORD STREET
APPROXIMATE LIMIT OF AREA OF CONTINUED ANALYSIS
CABANA ROAD WEST
VILLA BORGHESE
104
0.14 ha
105
0.19 ha
HURON CHURCH LINE
TODD LANE
TUNNEL STORM SEWER FLOW
PUMP TO OIL/GRIT SEPARATOR
DRAIN TO TURKEY CREEK
TUNNEL STORM SEWER FLOW
PUMP TO OIL/GRIT SEPARATOR
DRAIN TO CAHILL DRAIN
PROPOSED HIGHWAY 401 ALONG THE TALBOT ROAD/ HURON CHURCH ROAD CORRIDOR

PROPOSED HIGHWAY 401 ALONG THE TALBOT ROAD/ HURON CHURCH ROAD CORRIDOR

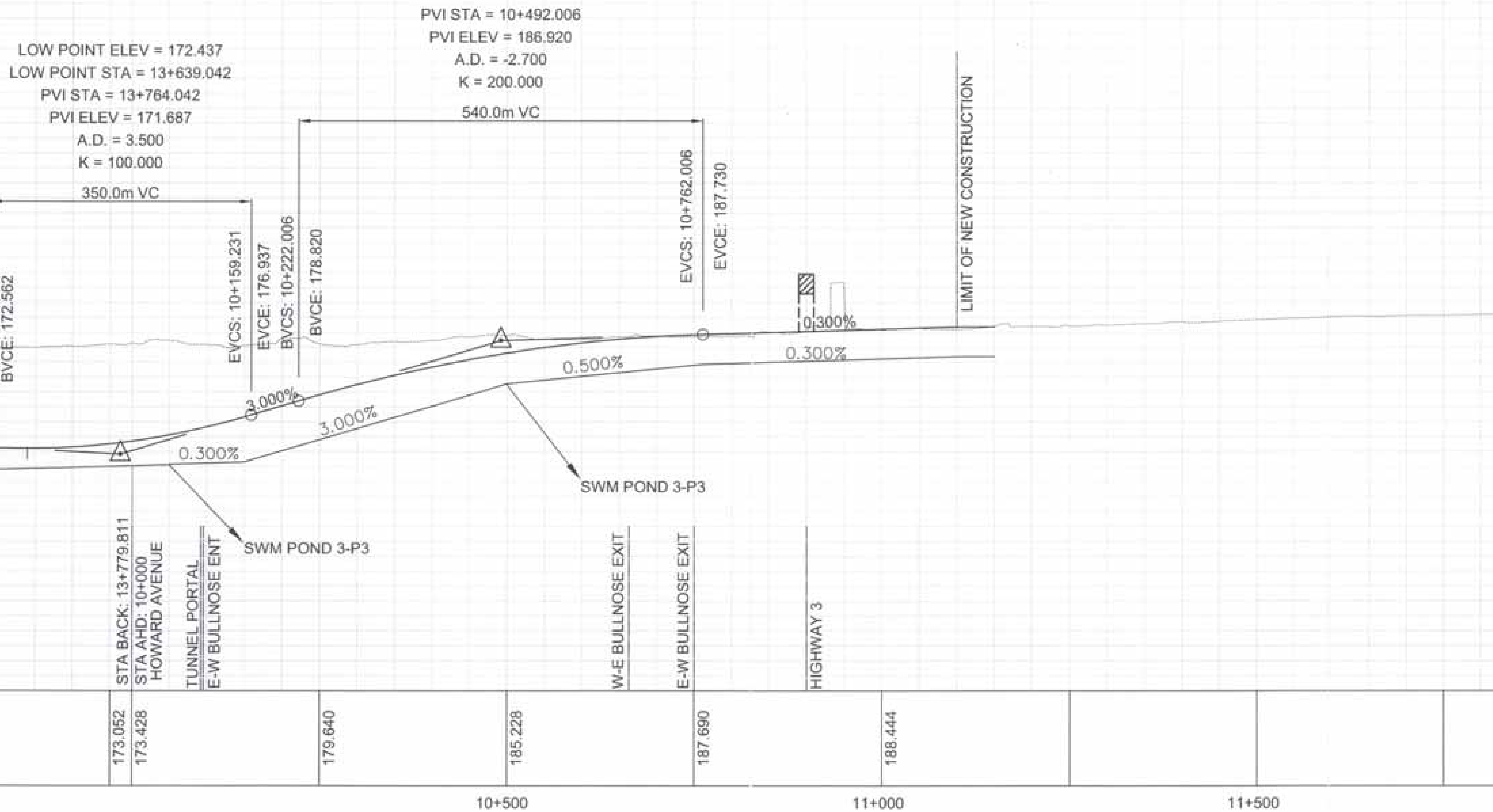


HIGH POINT ELEV = 193.023
HIGH POINT STA = 10+615.300
PVI STA = 10+490.300
PVI ELEV = 196.023
A.D. = -5.500
K = 100.000
550.0m VC
BVCS: 10+215.300
BVCE: 185.023
EVCS: 10+765.300
EVCE: 191.898
PROPOSED PROFILE
(TOP OF PAVEMENT)
ORIGINAL GROUND
-1.500%
-1.500%
-3.000%
-0.300%
LOW POINT ELEV = 180.636
LOW POINT STA = 11+591.077
PVI STA = 11+591.077
PVI ELEV = 179.511
A.D. = 3.000
K = 100.000
300.0m VC
BVCS: 11+441.077
BVCE: 181.761
EVCS: 11+741.077
EVCE: 181.761
SWM POND 3-P1
0.300%
1.500%
1.300%
BVCS: 12+092.285
BVCE: 187.029
PLAZA B
E.T.R. TRACK
OJIBWAY PKWY
W-N/S BULLNOSE EXIT
N/S-W BULLNOSE ENT
N/S-E BULLNOSE ENT
E-N/S BULLNOSE EXIT
MATCHETTE ROAD
FLYOVER BULLNOSE
FLYOVER RAMP
TITCOMBE DRAIN
179.08
186.350
179.07
192.358
179.24
192.115
178.98
188.377
184.627
181.051
181.895
185.645
10+500
11+000
11+500
12+000

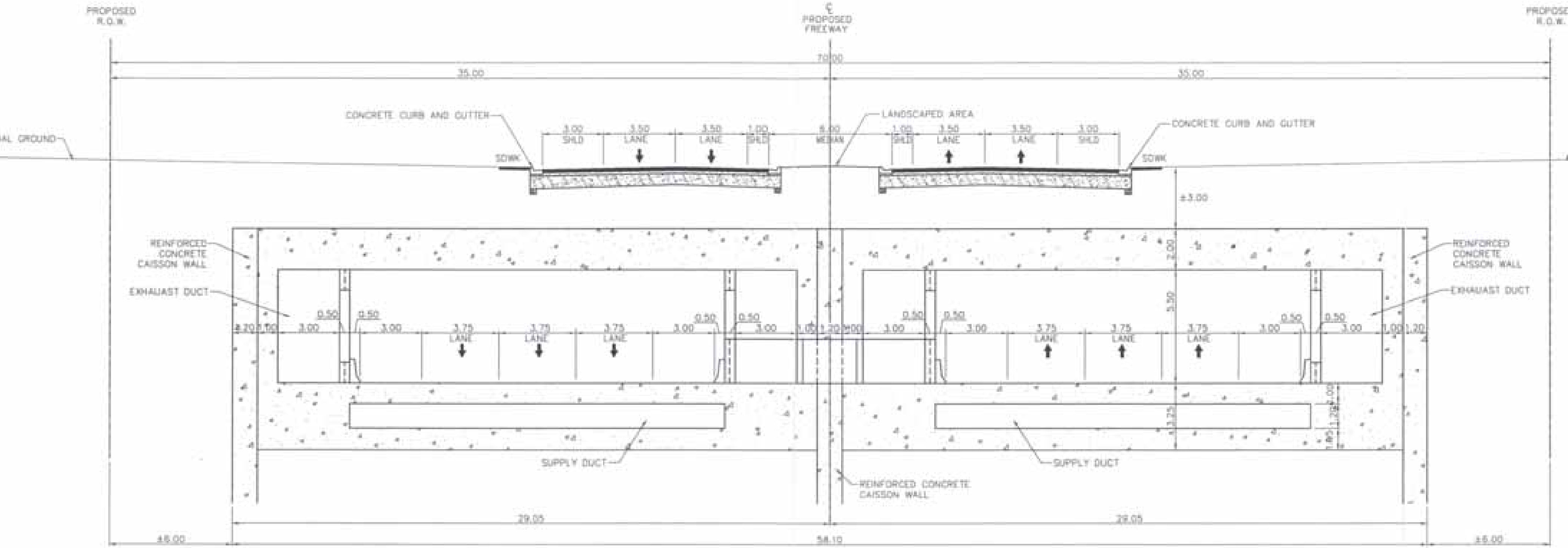

ELEV = 169.620
TA = 13+227.576
13+102.576
/ = 168.870
= 3.500
00.000
0m VC
HIGH POINT ELEV = 171.122
HIGH POINT STA = 13+602.858
PVI STA = 13+652.858
PVI ELEV = 171.622
A.D. = -1.500
K = 200.000
300.0m VC
LOW POINT ELEV = 165.910
LOW POINT STA = 14+299.052
PVI STA = 14+299.052
PVI ELEV = 165.160
A.D. = 2.000
K = 150.000
300.0m VC
HIGH POINT ELEV = 170.671
HIGH POINT STA = 14+950.169
PVI STA = 14+900.169
PVI ELEV = 171.171
A.D. = -1.500
K = 200.000
300.0m VC
EVCS: 13+277.576
EVCE: 169.745
BVCS: 13+502.858
BVCE: 170.872
EVCS: 13+802.858
EVCE: 170.122
BVCS: 14+149.052
BVCE: 166.660
EVCS: 14+449.052
EVCE: 166.660
BVCS: 14+750.169
BVCE: 169.671
EVCS: 15+050.169
EVCE: 170.421
0.500%
-1.000%
1.000%
-0.300%
0.300%
SWM POND 3-P2
BETHLEHEM AVENUE
LABELLE STREET
MARENTETTE
MANGIN DRAIN
SLIPON/OFF BULLNOSE
LAMBTON ROAD
GRAND MARAIS ROAD
GRAND
MARAIS DRAIN
TURKEY CREEK
PUMP FLOW TO TURKEY CREEK
OIL/GRIT SEPARATOR REQUIRED TO TREAT FLOW
PULFORD STREET
169.645
170.857
170.580
168.150
165.990
167.169
169.669
170.609
13+500
14+000
14+500
15+000



LOW POINT ELEV = 170.689
LOW POINT STA = 10+919.077
PVI STA = 10+919.077
PVI ELEV = 170.314
A.D. = 1.000
K = 300.000
300.0m VC
HIGH POINT ELEV = 173.325
HIGH POINT STA = 11+596.350
PVI STA = 11+596.350
PVI ELEV = 173.700
A.D. = -1.000
K = 300.000
300.0m VC
LOW POINT ELEV = 171.070
LOW POINT STA = 12+197.395
PVI STA = 12+197.395
PVI ELEV = 170.695
A.D. = 1.000
K = 300.000
300.0m VC
EVCE: 171.293
BVCS: 10+769.077
BVCE: 171.064
EVCS: 11+069.077
EVCE: 171.064
BVCS: 11+446.350
BVCE: 172.950
EVCS: 11+746.350
EVCE: 172.950
BVCS: 12+047.395
BVCE: 171.445
EVCS: 12+347.395
EVCE: 171.445
ORIGIN
-0.500%
0.500%
-0.500%
0.500%
-0.300%
0.300%
SLIPON/OFF BULLNOSE
DRAIN
CAHILL DRAIN
ST. CLAIR COLLEGE
ENTRANCE
PUMP FLOW TO CAHILL DRAIN
OIL/GRIT SEPARATOR REQUIRED TO TREAT FLOW
COUSINEAU ROAD
SANDWICH PARKWAY
ON/OFF BULLNOSE
171.159
170.798
171.968
173.170
172.932
171.682
171.116
172.208
11+000
11+500
12+000
12+500

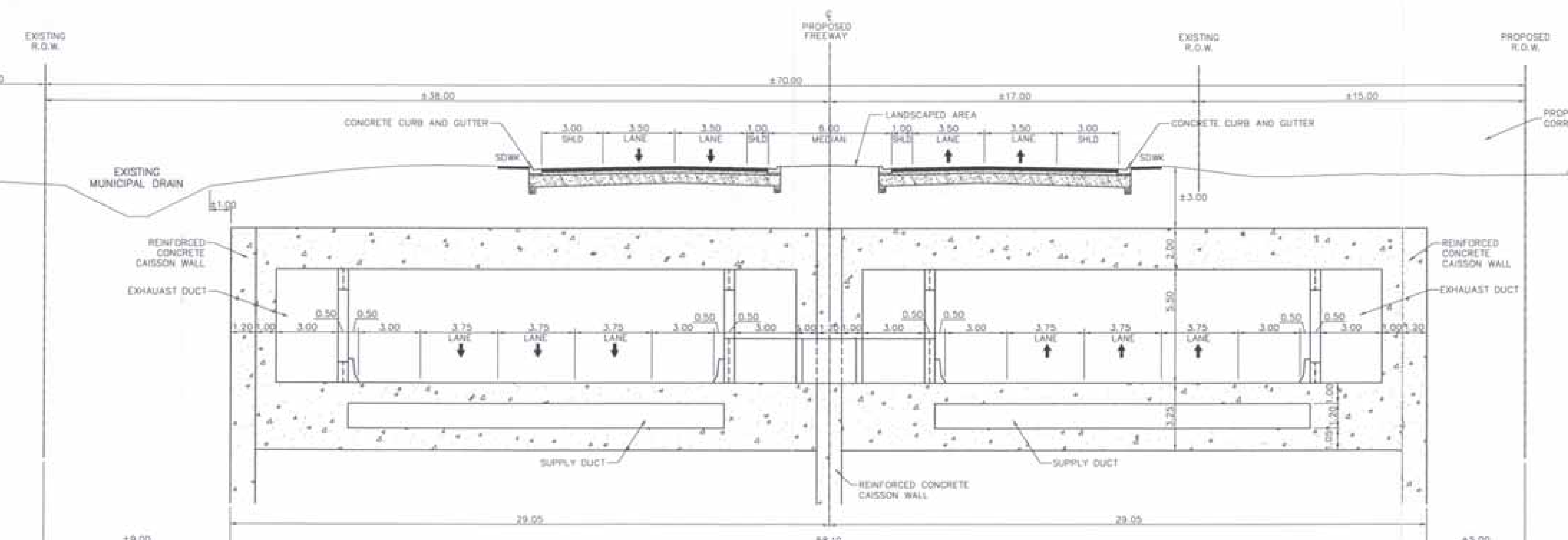


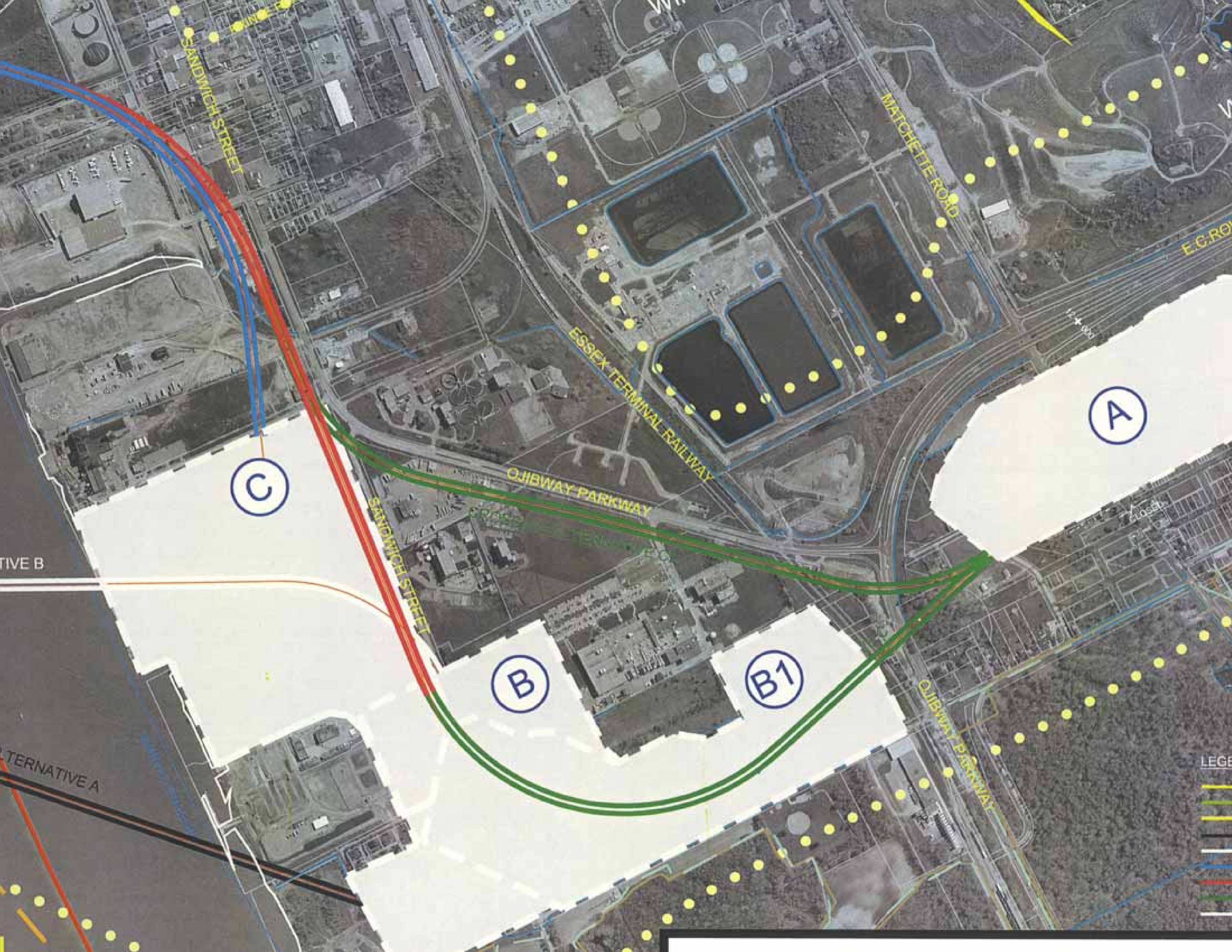
LOW POINT ELEV = 172.437
LOW POINT STA = 13+639.042
PVI STA = 13+764.042
PVI ELEV = 171.687
A.D. = 3.500
K = 100.000
350.0m VC
PVI STA = 10+492.006
PVI ELEV = 186.920
A.D. = -2.700
K = 200.000
540.0m VC
BVCE: 172.562
EVCS: 10+159.231
EVCE: 176.937
BVCS: 10+222.006
BVCE: 178.820
EVCS: 10+762.006
EVCE: 187.730
LIMIT OF NEW CONSTRUCTION
0.300%
3.000%
0.500%
0.300%
3.000%
0.300%
SWM POND 3-P3
SWM POND 3-P3
STA BACK: 13+779.811
STA AHD: 10+000
HOWARD AVENUE
TUNNEL PORTAL
E-W BULLNOSE ENT
W-E BULLNOSE EXIT
E-W BULLNOSE EXIT
HIGHWAY 3
173.052
173.428
179.640
185.228
187.690
188.444
10+500
11+000
11+500



TUAL

CUT AND COVER TUNNEL SECTION WITH MUNICIPAL DRAIN



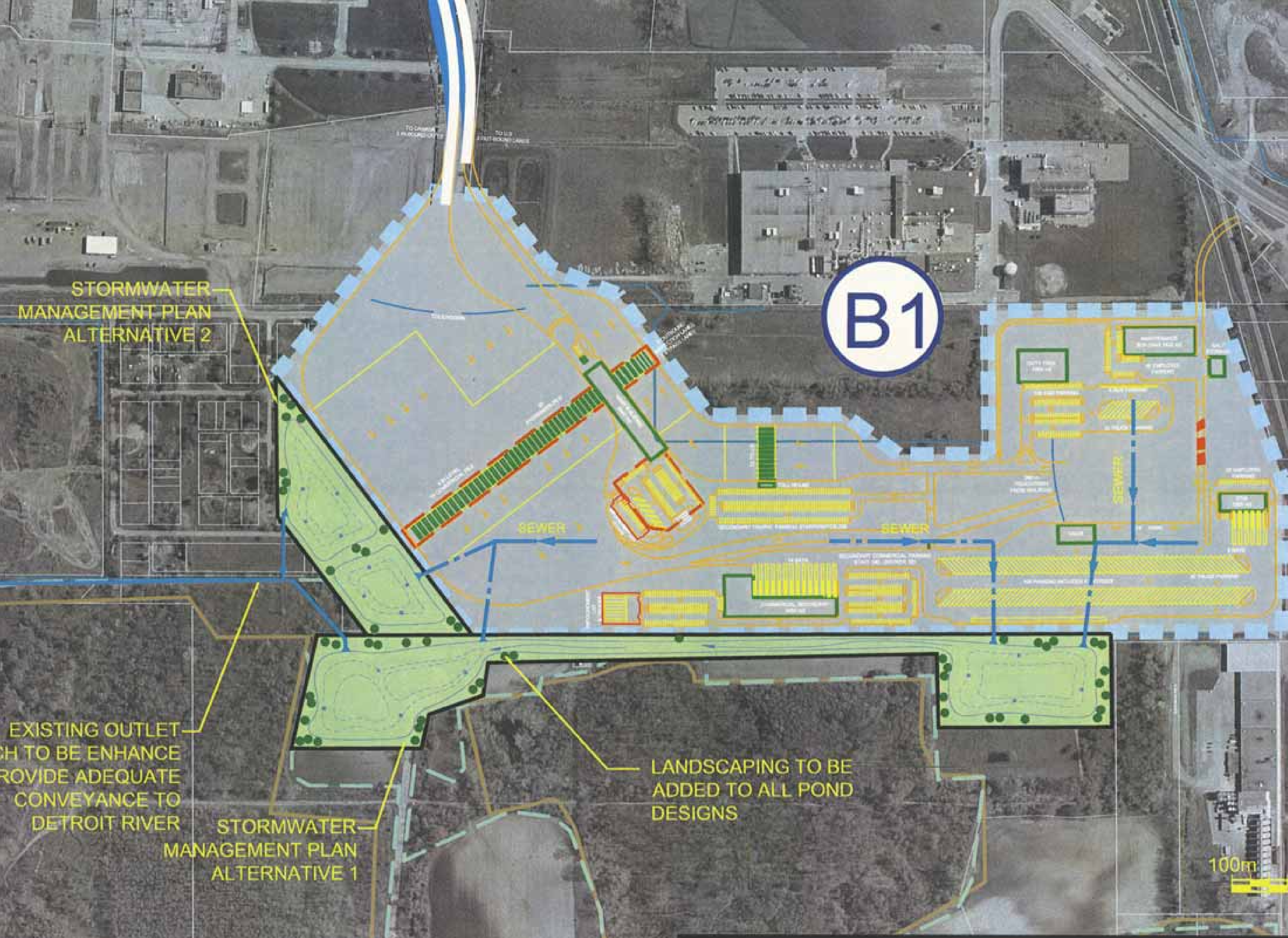


A
B1
B
C
MATCHETTE ROAD
ESSEX TERMINAL RAILWAY
OJIBWAY PARKWAY
OJIBWAY PARKWAY
SANDWICH STREET
SANDWICH STREET

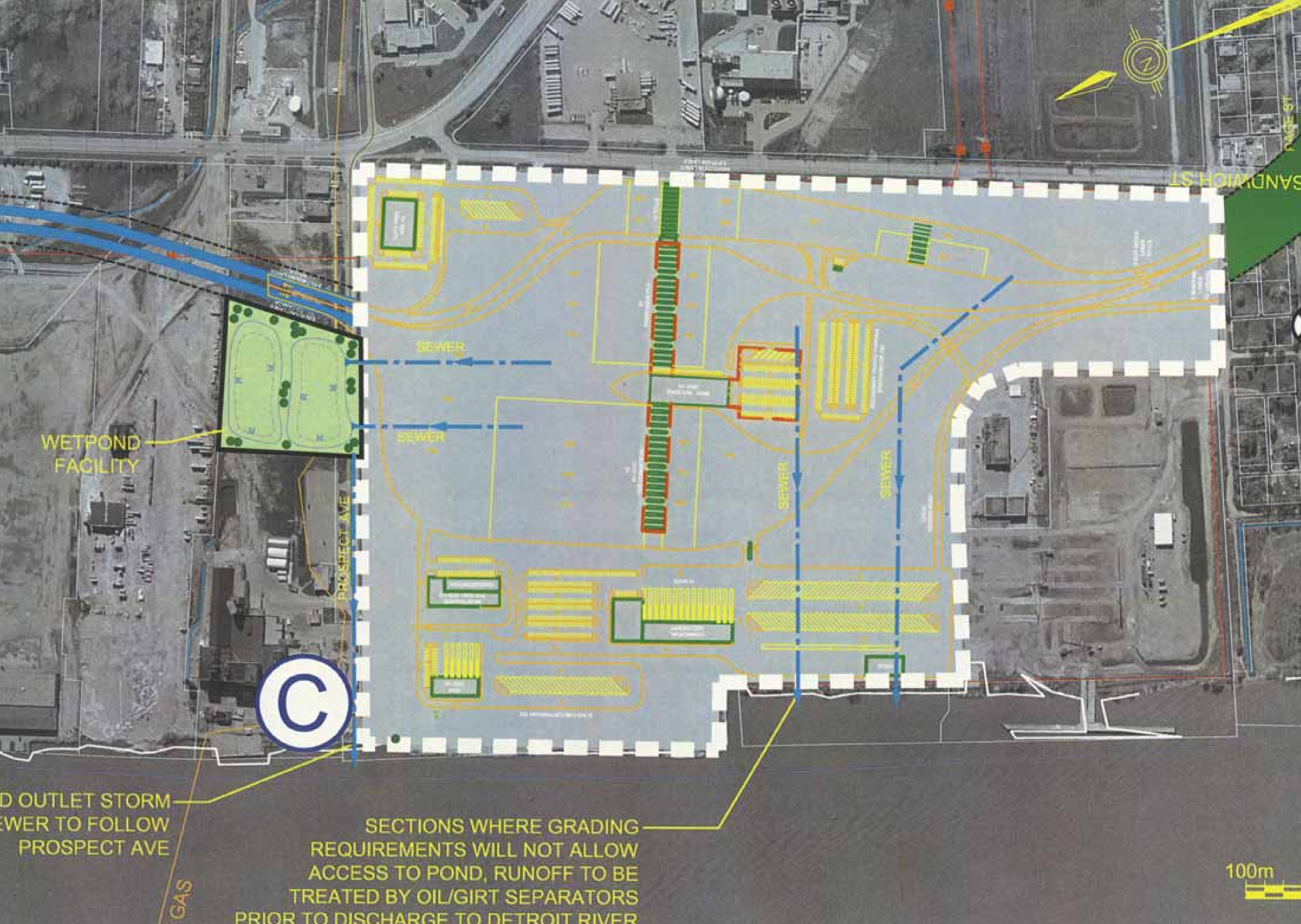
PLAZA OPTION "A"


A
ESSEX TERMINAL RAILWAY
OJIBWAY PARKWAY
SANDWICH ST
APPROXIMATE LIMIT OF AREA
OF CONTINUED ANALYSIS
OJIBWAY PARKWAY
BROADWAY STREET
OUTLET OPTION 1
EXISTING RECIPIENT
DRAINAGE SYSTEM
OUTLET OPTION 2
NEW STORM SEWER
LEGEND

PLAZA OPTION "B"



PLAZA OPTION "B1"



PLAZA OPTION "C"

Canada | U.S. Department of Transportation Federal Highway Administration | Ontario | MDOT Michigan Department of Transportation

Canada-United States-Ontario-Michigan
Border Transportation Partnership

Practical Alternatives Evaluation Assessment Report

Stormwater Management Plan

Appendices

URS

July 2007
Revised December 2007

Appendices

Appendix A

Hydraulic Analysis
Post Development Condition

Appendix A.1

Alternative 1A

Titcombe Drain Crossing
Basin Drain Crossing
Cahill Drain Crossing
Cahill / Wolfe Drainage Along Talbot Road

Titcombe Drain
Worksheet for Circular Channel

Project Description	
Worksheet	Titcome_prelimin
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Full Flow Diamet(

Input Data		
Mannings Coeffici	0.013	
Channel Slope	005000	m/m
Discharge	3.2000	m³/s

Results		
Depth	1.27	m
Diameter	1,269.0	mm
Flow Area	1.3	m²
Wetted Perimet	4.30	m
Top Width	0.00	m
Critical Depth	0.97	m
Percent Full	100.0	%
Critical Slope	005735	m/m
Velocity	2.53	m/s
Velocity Head	0.33	m
Specific Energy	1.60	m
Froude Numbei	0.00	
Maximum Disct	3.4423	m³/s
Discharge Full	3.2000	m³/s
Slope Full	005000	m/m
Flow Type	N/A	

Notes: Discharge of 3.2 m3/s was taken from taking 50% of the 100 year flow of subcatchment 140 of turkey creek watershed.
Drainage area D/S of Titcombe is approximately 274 ha, 55% of the entire subcatch #140. Drainage area therefore U/S Titcombe crossing is app. 50% of the entire subcatch.
From 1989 Maclaren report:
Catch # 140
DA = 496 Ha.
100 yr existing = 6.4 m3/s
100 yr efuture = 16.7 m3/s

Culvert Calculator Report
Basin Drain -All Alternatives - Reg Check

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	181.40 m	Headwater Depth/Height	1.20
Computed Headwater Elevat	180.32 m	Discharge	8.1000 m^3/s
Inlet Control HW Elev.	180.32 m	Tailwater Elevation	179.70 m
Outlet Control HW Elev.	180.32 m	Control Type	Inlet Control

Grades

Upstream Invert	178.50 m	Downstream Invert	178.20 m
Length	58.00 m	Constructed Slope	0.005172 m/m

Hydraulic Profile

Profile	CompositeS1S2	Depth, Downstream	1.05 m
Slope Type	Steep	Normal Depth	1.05 m
Flow Regime	N/A	Critical Depth	1.14 m
Velocity Downstream	3.62 m/s	Critical Slope	0.004178 m/m

Section

Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	2.13 m
Section Size	2130 x 1520 mm	Rise	1.52 m
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	180.32 m	Upstream Velocity Head	0.57 m
Ke	0.20	Entrance Loss	0.11 m

Inlet Control Properties

Inlet Control HW Elev.	180.32 m	Flow Control	Transition
Inlet Type	90° headwall w 45° bevels	Area Full	3.3 m^2
K	0.49500	HDS 5 Chart	10
M	0.66700	HDS 5 Scale	2
C	0.03140	Equation Form	2
Y	0.82000		

Culvert Calculator Report
Lennon Drain - Alt1A-100yr-Existing

Solve For: Headwater Elevation

Culvert Summary			
Allowable HW Elevation	182.00 m	Headwater Depth/Height	1.40
Computed Headwater Elev:	181.91 m	Discharge	8.3000 m³/s
Inlet Control HW Elev.	181.91 m	Tailwater Elevation	180.85 m
Outlet Control HW Elev.	181.82 m	Control Type	Inlet Control

Grades			
Upstream Invert	180.20 m	Downstream Invert	179.30 m
Length	138.00 m	Constructed Slope	0.006522 m/m

Hydraulic Profile			
Profile	CompositePressureProfileS1S2	Depth, Downstream	0.82 m
Slope Type	N/A	Normal Depth	0.82 m
Flow Regime	N/A	Critical Depth	1.02 m
Velocity Downstream	3.92 m/s	Critical Slope	0.003567 m/m

Section			
Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	2.59 m
Section Size	1219 mm x 2591 mm	Rise	1.22 m
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	181.82 m	Upstream Velocity Head	0.51 m
Ke	0.20	Entrance Loss	0.10 m

Inlet Control Properties			
Inlet Control HW Elev.	181.91 m	Flow Control	N/A
Inlet Type	90° headwall w 45° bevels	Area Full	3.2 m²
K	0.49500	HDS 5 Chart	10
M	0.66700	HDS 5 Scale	2
C	0.03140	Equation Form	2
Y	0.82000		

Culvert Calculator Report
Cahill Alt 1A-Future

Comments: Unknown Flow

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	183.50 m	Headwater Depth/Height	1.97
Computed Headwater Elevat	183.26 m	Discharge	27.6000 m^3/s
Inlet Control HW Elev.	183.26 m	Tailwater Elevation	180.23 m
Outlet Control HW Elev.	183.02 m	Control Type	Inlet Control

Grades

Upstream Invert	180.31 m	Downstream Invert	179.33 m
Length	192.00 m	Constructed Slope	0.005104 m/m

Hydraulic Profile

Profile	PressureProfile	Depth, Downstream	1.50 m
Slope Type	N/A	Normal Depth	N/A m
Flow Regime	N/A	Critical Depth	1.50 m
Velocity Downstream	4.09 m/s	Critical Slope	0.006085 m/m

Section

Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	4.50 m
Section Size	4500 x 1500 mm	Rise	1.50 m
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	183.02 m	Upstream Velocity Head	0.85 m
Ke	0.20	Entrance Loss	0.17 m

Inlet Control Properties

Inlet Control HW Elev.	183.26 m	Flow Control	Submerged
Inlet Type	90° headwall w 45° bevels	Area Full	6.8 m^2
K	0.49500	HDS 5 Chart	10
M	0.66700	HDS 5 Scale	2
C	0.03140	Equation Form	2
Y	0.82000		

Cahill/Wolfe Drain Along Talbot Roac
Worksheet for Rectangular Channel

Project Description	
Worksheet	Rectangular Channel - Cahill Drain (4.5 ›
Flow Element	Rectangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffici	0.013	
Channel Slope	002400	m/m
Bottom Width	4.50	m
Discharge	12.1000	m³/s

Results		
Depth	0.94	m
Flow Area	4.2	m²
Wetted Perime	6.38	m
Top Width	4.50	m
Critical Depth	0.90	m
Critical Slope	0.002689	m/rr
Velocity	2.86	m/s
Velocity Head	0.42	m
Specific Energ	1.36	m
Froude Numbe	0.94	
Flow Type	Subcritical	

Cahill/Wolfe Drain Along Talbot Roac
Worksheet for Rectangular Channel

Project Description	
Worksheet	Rectangular Channel - Cahill Drain (4.5 ›
Flow Element	Rectangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffici	0.013	
Channel Slope	002400	m/m
Bottom Width	4.50	m
Discharge	12.1000	m³/s

Results		
Depth	0.94	m
Flow Area	4.2	m²
Wetted Perime	6.38	m
Top Width	4.50	m
Critical Depth	0.90	m
Critical Slope	0.002689	m/n
Velocity	2.86	m/s
Velocity Head	0.42	m
Specific Energ	1.36	m
Froude Numbe	0.94	
Flow Type	Subcritical	

Appendix A.2

Alternative 1B

Appendix A.2.1

Titcombe Drain Crossing

Titcombe Drain
Worksheet for Circular Channel

Project Description	
Worksheet	Titcome_prelimin
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Full Flow Diamet(

Input Data		
Mannings Coeffici	0.013	
Channel Slope	005000	m/m
Discharge	3.2000	m³/s

Results		
Depth	1.27	m
Diameter	1,269.0	mm
Flow Area	1.3	m²
Wetted Perimet	4.30	m
Top Width	0.00	m
Critical Depth	0.97	m
Percent Full	100.0	%
Critical Slope	005735	m/m
Velocity	2.53	m/s
Velocity Head	0.33	m
Specific Energy	1.60	m
Froude Numbe	0.00	
Maximum Disch	3.4423	m³/s
Discharge Full	3.2000	m³/s
Slope Full	005000	m/m
Flow Type	N/A	

Notes: Discharge of 3.2 m3/s was taken from taking 50% of the 100 year flow of subcatchment 140 of turkey creek watershed.
Drainage area D/S of Titcombe is approximately 274 ha, 55% of the entire subcatch #140. Drainage area therefore U/S Titcombe crossing is app. 50% of the entire subcatch.
From 1989 Maclaren report:
Catch # 140
DA = 496 Ha.
100 yr existing = 6.4 m3/s
100 yr efuture = 16.7 m3/s

Appendix A.2.2

Basin Drain Crossing

Culvert Calculator Report
Basin Drain -All Alternatives - Reg Check

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	181.40	m	Headwater Depth/Height	1.20	
Computed Headwater Elevat	180.32	m	Discharge	8.1000	m^3/s
Inlet Control HW Elev.	180.32	m	Tailwater Elevation	179.70	m
Outlet Control HW Elev.	180.32	m	Control Type	Inlet Control	

Grades

Upstream Invert	178.50	m	Downstream Invert	178.20	m
Length	58.00	m	Constructed Slope	0.005172	m/m

Hydraulic Profile

Profile	CompositeS1S2		Depth, Downstream	1.05	m
Slope Type	Steep		Normal Depth	1.05	m
Flow Regime	N/A		Critical Depth	1.14	m
Velocity Downstream	3.62	m/s	Critical Slope	0.004178	m/m

Section

Section Shape	Box		Mannings Coefficient	0.013	
Section Material	Concrete		Span	2.13	m
Section Size	2130 x 1520 mm		Rise	1.52	m
Number Sections	1				

Outlet Control Properties

Outlet Control HW Elev.	180.32	m	Upstream Velocity Head	0.57	m
Ke	0.20		Entrance Loss	0.11	m

Inlet Control Properties

Inlet Control HW Elev.	180.32	m	Flow Control	Transition	
Inlet Type	90° headwall w 45° bevels		Area Full	3.3	m^2
K	0.49500		HDS 5 Chart	10	
M	0.66700		HDS 5 Scale	2	
C	0.03140		Equation Form	2	
Y	0.82000				

Appendix A.2.3

Cahill / Wolfe Drainage Along Talbot Road

Cahill/Wolfe Drain Along Talbot Roac
Worksheet for Rectangular Channel

Project Description	
Worksheet	Rectangular Channel - Cahill Drain (4.5 ›
Flow Element	Rectangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffici	0.013	
Channel Slope	002400	m/m
Bottom Width	4.50	m
Discharge	12.1000	m^3/s

Results		
Depth	0.94	m
Flow Area	4.2	m^2
Wetted Perime	6.38	m
Top Width	4.50	m
Critical Depth	0.90	m
Critical Slope	0.002689	m/n
Velocity	2.86	m/s
Velocity Head	0.42	m
Specific Energ	1.36	m
Froude Numbe	0.94	
Flow Type	Subcritical	

Appendix A.2.4

Syphon Analysis

Appendix A.2.4.1

Turkey Creek

```
1         ************************************************
          *    U.S. Environmental Protection Agency      *
          *    Storm Water Management Model  (SWMM)      *
          *              Version 4.4GU                   *
          *                                              *
          *               CDM/OSU Beta                   *
          *      Release Date - November 23, 1999        *
          * Camp Dresser & McKee and Oregon State Univ.  *
          *         Chuck Moore and Wayne Huber          *
          *  Compiled using Digital Visual Fortran 6.0   *
          ************************************************

                        Developed by

          ************************************************
          *            Metcalf & Eddy, Inc.              *
          *           University of Florida              *
          *       Water Resources Engineers, Inc.        *
          *     (Now Camp, Dresser and McKee, Inc.)      *
          *              September 1970                  *
          ************************************************

                  Distributed and Maintained by

          ************************************************
          *      U.S. Environmental Protection Agency    *
          * Center for Exposure Assessment Modeling (CEAM)*
          *    Athens Environmental Research Laboratory  *
          *            960 College Station Road          *
          *            Athens, GA    30605-2720          *
          ************************************************

          ************************************************
          *     This is a new release of SWMM.  If any   *
          *     problems occur executing this model      *
          *     system, contact Mr. Frank Stancil,       *
          *     U.S. Environmental Protection Agency.    *
          *     706/355-8328 (voice)                     *
          *     e-mail: stancil@athens.ath.epa.gov       *
          *     Or contact Wayne C. Huber at Oregon St. U.*
          *     541/737-6150 or wayne.huber@orst.edu     *
          *     Or Michael F. Schmidt at Camp Dresser &  *
          *     McKee (904) 281-0170 SCHMIDTMF@CDM.COM   *
          ************************************************
```

```
         ************************************************
         *  This is an implementation of EPA SWMM 4.4GU  *
         *  "Nature is full of infinite causes which     *
         *   have never occurred in experience" da Vinci *
         ************************************************


 ###########################################
 #        File names by SWMM Block         #
 #         JIN  -> Input to a Block        #
 #        JOUT  -> Output from a Block     #
 ###########################################

    JIN for Block #      1 File #     0  JIN.UF
   JOUT for Block #      1 File #     9  PCTmp1.int

 ###########################################
 # Scratch file names for this simulation. #
 ###########################################

 NSCRAT #      1 File #    21  SCRT1.UF
 NSCRAT #      2 File #    22  SCRT2.UF
 NSCRAT #      3 File #    23  SCRT3.UF
 NSCRAT #      4 File #    24  SCRT4.UF
 NSCRAT #      5 File #    25  SCRT5.UF
 NSCRAT #      6 File #    26  SCRT6.UF
 NSCRAT #      7 File #    27  SCRT7.UF
 NSCRAT #      8 File #    28  SCRT8.UF

 ***************************************************
 *    Parameter Values on the Tapes Common Block   *
 ***************************************************

  Number of Subcatchments in the Runoff Block (NW)...... 1000
  Number of Channel/Pipes in the Runoff Block (NG)...... 1000
  Number of Connections to Runoff Channels/Inlets (NCP).    6
  Number of Water Quality Constituents (MQUAL).........   20
  Number of Runoff Land Uses per Subcatchment (NLU).....   20
  Number of Groundwater Subcatchments in Runoff (NGW)...  100
  Number of Interface Locations for all Blocks (NIE).... 1000
  Number of Elements in the Transport Block (NET).......  500
  Number of Storage Junctions in Transport (NTSE).......  100
  Number of Transport interface input locations (NTHI)..  500
  Number of Transport interface output locations (NTHO).  500
  Number of Transport input locations on R lines (NTHR).   80
```

```
 Number of Transport printed output locations (NTOA)...   80
 Number of Tabular Flow Splitters in Transport (NTSP)..   50
 Number of Elements in the Extran Block (NEE).......... 4000
 Number of Pumps in Extran (NEP).......................   75
 Number of Orifices in Extran (NEO)....................  200
 Number of Tide Gates/Free Outfalls in Extran (NTG)....  200
 Number of Extran Weirs (NEW)..........................  400
 Number of Extran Printout Locations (NPO).............  150
 Number of Tide Elements in Extran (NTE)...............   50
 Number of Natural Channels (NNC)...................... 1200
 Number of Storage Junctions in Extran (NVSE).......... 1000
 Number of Time History Data Points in Extran (NTVAL)..  500
 Number of Data Points for Variable Storage Elements
   in the Extran Block (NVST)..........................   25
 Number of Input Hydrographs in Extran (NEH)...........  500
 Number of Allowable Channel Connections to
   Junctions in the Extran Block (NCHN)................   15
 Number Rain Gages in Rain and Runoff (MAXRG)..........  200
 Number PRATE/VRATE Points for Extran Pump
   Input (MAXPRA)......................................   10
 Number of Variable Orifices in Extran (NVORF).........   50
 Number of Variable Orifice Data Points (NVOTIM).......   50
 Number of Allowable Precip. Values/yr in Rain (LIMRN). 5000
 Number of Storm Events for Rain Analysis (LSTORM).....20000
 Number of Plugs for Plug-flow in S/T (NPLUG).......... 3000
 Number Conduits for Extran Results to ASCII
   File (MXFLOW).......................................  400


 ******************************************************
 * Entry made to the EXTENDED TRANSPORT MODEL (EXTRAN)  *
 * developed 1973 by Camp, Dresser and McKee (CDM) with *
 * modifications 1977-1991 by the University of Florida. *
 *                                                      *
 * Most recent update: March 1999 by CDM, Oregon        *
 * State University, and XP Software, Inc.              *
 *                                                      *
 * "Smooth runs the water where the brook is deep."     *
 *                  Shakespeare, Henry VI, II, III, 1   *
 ******************************************************


1-------------------------------------------------------------------------------
 ENVIRONMENTAL PROTECTION AGENCY          ****   EXTENDED TRANSPORT PROGRAM   ****        WATER RESOURCES DIVISION
```

```
WASHINGTON, D.C.                    ****                        ****      CAMP DRESSER & MCKEE INC.
                                    ****    ANALYSIS MODULE     ****      ANNANDALE, VIRGINIA

   Detroit River International Crossing
   Turkey Creek Existing Condition - 100-Year Flow


Control information for simulation
----------------------------------


Integration cycles.................   1440

Length of integration step is......   5.00 seconds
Simulation length..................   2.00 hours

Do not create equiv. pipes(NEQUAL).      0

Use metric units for I/O...........      1

Printing starts in cycle...........      1

Intermediate printout intervals of.      1 cycles
Intermediate printout intervals of.   0.08 minutes

Summary printout intervals of......      1 cycles
Summary printout time interval of..   0.08 minutes

Hot start file parameter (JREDO)...      0

Initial time (TZERO)...............   0.00 hours
This is time displacement from JIN interface file starting date/time when
interface file is used.
This also describes starting hour in K3 line hydrograph input when K3
lines are used.
Initial date (IDATZ)............ 19060714 (yr/mo/day)
NOTE: Initial date from JIN interface file will be used, if accessed,
unless IDATZ is negative.

Iteration variables: ITMAX.........     30
                     SURTOL........ 0.0500

Default surface area of junctions.. 1.22 square meters.

EXTRAN VERSION 3.3 SOLUTION. (ISOL = 0).
Sum of junction flow is zero during surcharge.
```

```
NORMAL FLOW OPTION WHEN THE WATER
SURFACE SLOPE IS LESS THAN THE
GROUND SURFACE SLOPE (KSUPER=0)....

NJSW INPUT HYDROGRAPH JUNCTIONS....     0

    INTERMEDIATE HEADER LINES ARE PRINTED AS IN ORIGINAL PROGRAM

    IDS ARE WRITTEN AS IN ORIGINAL PROGRAM

    CONDUIT LENGTHS ON C1 LINE MUST EQUAL IRREGULAR SECTION LENGTH ENTERED ON THE C3 OR X1 LINES (IWLEN = 0)

    JELEV = 0 (DEFAULT). STANDARD INPUTS ARE DEPTHS NOT ELEVATIONS

    JDOWN = 0 - Minimum of normal or critical depth will be used at free outfalls (I1).

    Characteristic depth for M2 and S2 water surface profiles will be computed as in previous versions of EXTRAN (IM2 = 0).

    SEDIMENT DEPTHS WILL NOT BE READ FROM C1 LINES

    Intermediate continuity output will not be created

1--------------------------------------------------------------------------------
ENVIRONMENTAL PROTECTION AGENCY           ****   EXTENDED TRANSPORT PROGRAM   ****        WATER RESOURCES DIVISION
WASHINGTON, D.C.                          ****                                ****        CAMP DRESSER & MCKEE INC.
                                          ****         ANALYSIS MODULE        ****        ANNANDALE, VIRGINIA

    Detroit River International Crossing
    Turkey Creek Existing Condition - 100-Year Flow


1
**************************************************
*                    Conduit Data                *
**************************************************
```

INP NUM	CONDUIT NUMBER	LENGTH (M)	CONDUIT CLASS	AREA (SQ M)	MANNING COEF.	MAX WIDTH (M)	DEPTH (M)	JUNCTIONS AT THE ENDS		INVERT HEIGHT ABOVE JUNCTIONS	TRAPEZOID SIDE SLOPES	
1	1	100.	TRAPEZOID	96.91	0.01500	9.75	4.64	1	2		2.40	2.40
2	2	100.	TRAPEZOID	96.91	0.01500	9.75	4.64	2	3		2.40	2.40
3	3	100.	TRAPEZOID	96.91	0.01500	9.75	4.64	3	4		2.40	2.40
4	4	60.	TRAPEZOID	96.91	0.01500	9.75	4.64	4	5		2.40	2.40
5	5	40.	TRAPEZOID	96.91	0.01500	9.75	4.64	5	6		2.40	2.40

```
  6        6      100. TRAPEZOID     96.91   0.01500       9.75      4.64        6         7                     2.40    2.40
  7        7      100. TRAPEZOID     96.91   0.01500       9.75      4.64        7         8                     2.40    2.40
  8        8      100. TRAPEZOID     96.91   0.01500       9.75      4.64        8         9                     2.40    2.40
  9        9      100. TRAPEZOID     96.91   0.01500       9.75      4.64        9        10                     2.40    2.40
 10       10      100. TRAPEZOID     96.91   0.01500       9.75      4.64       10        11                     2.40    2.40


 ********************
 *  Conduit Volume  *
 ********************

 Input full depth volume...........    8.7220E+04 cubic meters

1-------------------------------------------------------------------------------
 ENVIRONMENTAL PROTECTION AGENCY             ****   EXTENDED TRANSPORT PROGRAM   ****        WATER RESOURCES DIVISION
 WASHINGTON, D.C.                            ****                                ****        CAMP DRESSER & MCKEE INC.
                                             ****         ANALYSIS MODULE        ****        ANNANDALE, VIRGINIA

     Detroit River International Crossing
     Turkey Creek Existing Condition - 100-Year Flow


1
 *****************************************************
 *                  Junction Data                    *
 *****************************************************

 INP  JUNCTION    GROUND    CROWN    INVERT     QINST   INITIAL     CONNECTING CONDUITS
 NUM   NUMBER      ELEV.     ELEV.    ELEV.       CMS  DEPTH(M)
 ---   ------    -------   -------   ------   ------- ---------   -------------------
   1        1    182.00    180.68    176.04     62.60      0.00         1
   2        2    182.00    180.64    176.00      0.00      0.00         1        2
   3        3    182.00    180.60    175.96      0.00      0.00         2        3
   4        4    182.00    180.56    175.92      0.00      0.00         3        4
   5        5    182.00    180.54    175.90      0.00      0.00         4        5
   6        6    182.00    180.52    175.88      0.00      0.00         5        6
   7        7    182.00    180.48    175.84      0.00      0.00         6        7
   8        8    182.00    180.44    175.80      0.00      0.00         7        8
   9        9    182.00    180.40    175.76      0.00      0.00         8        9
  10       10    182.00    180.36    175.72      0.00      0.00         9       10
  11       11    182.00    180.32    175.68      0.00      0.00        10


 **************************************************
```

```
*          FREE OUTFALL DATA (DATA GROUP I1)      *
*         BOUNDARY CONDITION ON DATA GROUP J1     *
***************************************************

OUTFALL AT JUNCTION....        11 HAS BOUNDARY CONDITION NUMBER...         1

1--------------------------------------------------------------------------------
ENVIRONMENTAL PROTECTION AGENCY             ****  EXTENDED TRANSPORT PROGRAM  ****       WATER RESOURCES DIVISION
WASHINGTON, D.C.                            ****                              ****       CAMP DRESSER & MCKEE INC.
                                            ****        ANALYSIS MODULE       ****       ANNANDALE, VIRGINIA

    Detroit River International Crossing
    Turkey Creek Existing Condition - 100-Year Flow



***************************************************
*        INTERNAL CONNECTIVITY INFORMATION        *
***************************************************

         CONDUIT     JUNCTION     JUNCTION
         -------     --------     --------
         90011          11            0
1
******************************************************
*        BOUNDARY CONDITON INFORMATION               *
*                 DATA GROUPS J1-J4                  *
******************************************************



BC NUMBER..         1 CONTROL WATER SURFACE ELEVATION IS..    178.80 METERS.
 TZERO =       1906195  0.0000000E+00

***********************************
*    INITIAL MODEL CONDITION      *
* INITIAL TIME =       0.00 HOURS *
***********************************

JUNCTION / DEPTH  / ELEVATION    ===>  "*" JUNCTION IS SURCHARGED.
        1/   0.00 /   176.04         2/   0.00 /   176.00         3/   0.00 /   175.96
        4/   0.00 /   175.92         5/   0.00 /   175.90         6/   0.00 /   175.88
        7/   0.00 /   175.84         8/   0.00 /   175.80         9/   0.00 /   175.76
       10/   0.00 /   175.72        11/   0.00 /   175.68
```

```
  CONDUIT/       FLOW   ===> "*" CONDUIT USES THE NORMAL FLOW OPTION.
        1/       0.00          2/       0.00         3/       0.00          4/       0.00
        5/       0.00          6/       0.00         7/       0.00          8/       0.00
        9/       0.00         10/       0.00     90011/       0.00

  CONDUIT/   VELOCITY
        1/       0.00          2/       0.00         3/       0.00          4/       0.00
        5/       0.00          6/       0.00         7/       0.00          8/       0.00
        9/       0.00         10/       0.00

  CONDUIT/ CROSS SECTIONAL AREA
        1/       0.00          2/       0.00         3/       0.00          4/       0.00
        5/       0.00          6/       0.00         7/       0.00          8/       0.00
        9/       0.00         10/       0.00

  CONDUIT/ HYDRAULIC RADIUS
        1/       0.00          2/       0.00         3/       0.00          4/       0.00
        5/       0.00          6/       0.00         7/       0.00          8/       0.00
        9/       0.00         10/       0.00

  CONDUIT/ UPSTREAM/ DOWNSTREAM ELEVATION
        1/   176.04/   176.00         2/   176.00/   175.96         3/   175.96/   175.92
        4/   175.92/   175.90         5/   175.90/   175.88         6/   175.88/   175.84
        7/   175.84/   175.80         8/   175.80/   175.76         9/   175.76/   175.72
       10/   175.72/   175.68


 ********************************
 *     FINAL MODEL CONDITION    *
 *  FINAL TIME =      2.00 HOURS *
 ********************************

 >>> ENDING DATE AND TIME OF EXTRAN RUN ARE:
 JULIAN DATE: 1906195
 YR/MO/DA:   1906/ 7/14
 TIME OF DAY:  2.000 HRS

 JUNCTION / DEPTH  / ELEVATION    ===>  "*" JUNCTION IS SURCHARGED.
        1/   2.86 /   178.90        2/   2.89 /   178.89        3/   2.92 /   178.88
        4/   2.95 /   178.87        5/   2.96 /   178.86        6/   2.97 /   178.85
        7/   3.00 /   178.84        8/   3.03 /   178.83        9/   3.06 /   178.82
       10/   3.09 /   178.81       11/   3.12 /   178.80

  CONDUIT/       FLOW   ===> "*" CONDUIT USES THE NORMAL FLOW OPTION.
        1/      62.60          2/      62.59         3/      62.61          4/      62.60
```

```
      5/     62.59          6/     62.60         7/     62.60          8/     62.59
      9/     62.60         10/     62.59     90011/     62.59

 CONDUIT/   VELOCITY
      1/      1.31          2/      1.29         3/      1.27          4/      1.26
      5/      1.25          6/      1.24         7/      1.22          8/      1.20
      9/      1.19         10/      1.17

 CONDUIT/ CROSS SECTIONAL AREA
      1/     47.94          2/     48.57         3/     49.22          4/     49.69
      5/     50.02          6/     50.55         7/     51.24          8/     51.95
      9/     52.67         10/     53.41

 CONDUIT/  FINAL VOLUME
      1/   4793.90          2/   4856.83         3/   4921.51          4/   2981.39
      5/   2000.85          6/   5055.19         7/   5124.48          8/   5195.12
      9/   5267.39         10/   5340.97

 CONDUIT/ HYDRAULIC RADIUS
      1/      1.94          2/      1.95         3/      1.97          4/      1.98
      5/      1.99          6/      2.00         7/      2.01          8/      2.03
      9/      2.05         10/      2.06

 CONDUIT/ UPSTREAM/ DOWNSTREAM ELEVATION
      1/  178.90/  178.89        2/  178.89/  178.88        3/  178.88/  178.87
      4/  178.87/  178.86        5/  178.86/  178.85        6/  178.85/  178.84
      7/  178.84/  178.83        8/  178.83/  178.82        9/  178.82/  178.81
     10/  178.81/  178.80


##################################################
#          Surcharge Iteration Summary           #
##################################################

Maximum number of iterations in a time step.....       22
Total number of iterations in the simulation..       3151
Average number of iterations per time step......      2.19
Surcharge iterations during the simulation......       271
Maximum surcharge flow error during simulation.. 4.73E+00 cms
Total number of time steps during simulation..       1440


1
 ++++++++++++++++++++++++++++++++++++++++++++++++++
```

```
 *         CONDUIT COURANT CONDITION SUMMARY        *
 * TIME IN MINUTES DELT > COURANT TIME STEP         *
 ****************************************************
 * SEE BELOW FOR EXPLANATION OF COURANT TIME STEP.  *
 ****************************************************

  CONDUIT #  TIME(MN)  CONDUIT #  TIME(MN)  CONDUIT #  TIME(MN)CONDUIT #  TIME(MN)
  ---------  --------  ---------  --------  ---------  -----------------  --------
          1      0.00          2      0.00          3      0.00          4      0.00
          5      0.33          6      0.00          7      0.00          8      0.00
          9      0.00         10      0.00

1
 ************************************************
 *         CONDUIT COURANT CONDITION SUMMARY    *
 ************************************************
 * COURANT   =            CONDUIT LENGTH        *
 * TIME STEP = ------------------------------   *
 *              VELOCITY + SQRT(GRVT*AREA/WIDTH) *
 ************************************************
 * AVERAGE COURANT CONDITION TIME STEP(SECONDS) *
 ************************************************

  CONDUIT # TIME(SEC)  CONDUIT # TIME(SEC)  CONDUIT # TIME(SEC)CONDUIT # TIME(SEC)
  ---------  --------  ---------  --------  ---------  -----------------  --------
          1     17.23          2     17.25          3     17.91          4     12.67
          5      8.85          6     22.33          7     17.08          8     17.08
          9     17.08         10     16.96

1
 ****************************************************
 * EXTRAN CONTINUITY BALANCE AT THE LAST TIME STEP *
 ****************************************************

 ************************************************
 * JUNCTION INFLOW, OUTFLOW OR STREET FLOODING *
 ************************************************

   JUNCTION   INFLOW, CU M
   --------  -------------
          1    4.5072E+05

   JUNCTION  OUTFLOW, CU M
   --------  -------------
          1    2.6693E+03
```

```
           2     5.6062E+02
           3     2.0810E+02
           4     1.8592E+03
           5     5.6534E+03
           6     1.3183E+03
           7     9.4449E+02
           8     2.9801E+03
           9     1.3814E+03
          10     1.5085E+03
          11     3.9284E+05

  ***************************************************
  * INITIAL SYSTEM VOLUME       =     9.0000E-03 CU M  *
  * TOTAL SYSTEM INFLOW VOLUME  =     4.5072E+05 CU M  *
  * INFLOW + INITIAL VOLUME     =     4.5072E+05 CU M  *
  ***************************************************
  * TOTAL SYSTEM OUTFLOW        =     4.1192E+05 CU M  *
  * VOLUME LEFT IN SYSTEM       =     4.5538E+04 CU M  *
  * OUTFLOW + FINAL VOLUME      =     4.5746E+05 CU M  *
  ***************************************************
  * ERROR IN CONTINUITY, PERCENT =         -1.50       *
  ***************************************************


  TEST WRITE OF ALTERNATIVE CONTINUITY ERROR CALCULATION
  VOLUME LEFT IN SYSTEM       =     6.7482E+04 CU. FT.
  ERROR IN CONTINUITY PERCENT =         -63.64


- - - - - - - - - - - - - - - -  SUMMARY OF FULL FLOW CHANNEL WARNINGS - - - - - - - - - - - - - - - - - - - - -
```

OPEN CHANNEL NUMBER	TIME STEP OF FIRST OCCURRENCE	TIME OF FIRST OCCURRENCE (HOURS)	TIME STEP OF LAST OCCURRENCE	TIME OF LAST OCCURRENCE (HOURS)
1	1	0.00	84	0.12
2	38	0.05	82	0.11
3	31	0.04	81	0.11
4	27	0.04	81	0.11
5	26	0.04	74	0.10
6	24	0.03	70	0.10
7	20	0.03	70	0.10
8	17	0.02	59	0.08
9	15	0.02	61	0.08
10	15	0.02	61	0.08

THE PROGRAM USES FULL DEPTH CHANNEL CHARACTERISTICS TO COMPUTE FLOW THROUGH THE TRAPEZOIDAL, IRREGULAR, OR PARABOLIC/POWER FUNCTION CONDUIT WHEN THE COMPUTED DEPTHS EXCEED MAXIMUM DEPTH. THIS WILL AFFECT THE MAXIMUM COMPUTED HEAD AND FLOWS IN THE MODEL. IT IS HIGHLY RECOMMENDED THAT THE MODELED CROSS SECTIONS BE EXTENDED TO ELIMINATE THESE FULL FLOW CHANNEL WARNINGS

1

```
**************************************************************
*  J U N C T I O N   S U M M A R Y   S T A T I S T I C S  *
**************************************************************
```

Detroit River International Crossing
Turkey Creek Existing Condition - 100-Year Flow

JUNCTION NUMBER	GROUND ELEVATION (M)	UPPERMOST PIPE CROWN ELEVATION (M)	MEAN JUNCTION ELEVATION (M)	JUNCTION AVERAGE % CHANGE	MAXIMUM JUNCTION ELEV. (M)	TIME OF OCCURENCE HR.	MIN.	METERS OF SURCHARGE AT MAX ELEVATION	METERS MAX. DEPTH IS BELOW GROUND ELEVATION	LENGTH OF SURCHARGE (MIN)	LENGTH OF FLOODING (MIN)	MAXIMUM JUNCTION AREA (SQ.MET)
1	182.00	180.68	178.96	0.3566	182.00	0	3	1.32	0.00	0.8	0.3	3.522E+04
2	182.00	180.64	178.94	0.3323	182.00	0	3	1.36	0.00	0.5	0.1	6.990E+04
3	182.00	180.60	178.91	0.2984	182.00	0	5	1.40	0.00	0.4	0.1	5.033E+04
4	182.00	180.56	178.89	0.3581	182.00	0	2	1.44	0.00	0.9	0.2	4.026E+04
5	182.00	180.54	178.88	0.3984	182.00	0	2	1.46	0.00	0.7	0.3	3.403E+04
6	182.00	180.52	178.87	0.3937	182.00	0	2	1.48	0.00	0.3	0.3	4.789E+04
7	182.00	180.48	178.85	0.3333	182.00	0	2	1.52	0.00	0.3	0.2	3.544E+04
8	182.00	180.44	178.84	0.3701	182.00	0	1	1.56	0.00	0.7	0.3	2.120E+04
9	182.00	180.40	178.83	0.3194	182.00	0	1	1.60	0.00	0.3	0.2	4.340E+04
10	182.00	180.36	178.82	0.3523	182.00	0	1	1.64	0.00	0.3	0.3	3.099E+04
11	182.00	180.32	178.81	0.0960	180.32	0	1	0.00	1.68	0.4	0.0	1.458E+04

1

```
**************************************************************
*  C O N D U I T   S U M M A R Y   S T A T I S T I C S  *
**************************************************************
```

Detroit River International Crossing
Turkey Creek Existing Condition - 100-Year Flow

CONDUIT	DESIGN FLOW	DESIGN VELOCITY	CONDUIT VERTICAL DEPTH	MAXIMUM COMPUTED FLOW	TIME OF OCCURRENCE	MAXIMUM COMPUTED VELOCITY	TIME OF OCCURRENCE	RATIO OF MAX. TO DESIGN	MAXIMUM DEPTH ABOVE INV. AT CONDUIT ENDS UPSTREAM	DOWNSTREAM	LENGTH OF NORM FLOW	CONDUIT SLOPE

NUMBER	(CMS)	(M/S)	(M)	(CMS)	HR.	MIN.	(MPS)	HR.	MIN.	FLOW	(M)	(M)	(MIN)	(M/M)
1	2.60E+02	2.69	4.640	-1.95E+02	0	3	4.06	0	0	-0.75	5.96	5.53	0.5	0.00040
2	2.60E+02	2.69	4.640	-2.28E+02	0	3	4.15	0	1	-0.88	5.53	6.04	0.3	0.00040
3	2.60E+02	2.69	4.640	-2.47E+02	0	3	4.14	0	1	-0.95	6.04	6.08	0.3	0.00040
4	2.38E+02	2.45	4.640	-4.24E+02	0	2	-4.77	0	2	-1.78	6.08	6.10	0.3	0.00033
5	2.91E+02	3.00	4.640	-7.58E+02	0	2	-8.07	0	2	-2.60	6.10	6.12	0.1	0.00050
6	2.60E+02	2.69	4.640	-5.79E+02	0	2	-6.64	0	2	-2.22	6.12	6.08	0.2	0.00040
7	2.60E+02	2.69	4.640	-7.19E+02	0	1	-8.32	0	2	-2.76	6.08	6.20	0.3	0.00040
8	2.60E+02	2.69	4.640	-7.36E+02	0	1	-8.37	0	1	-2.83	6.20	6.24	0.2	0.00040
9	2.60E+02	2.69	4.640	-7.29E+02	0	1	-7.76	0	1	-2.80	6.24	6.28	0.3	0.00040
10	2.60E+02	2.69	4.640	-7.66E+02	0	1	-7.96	0	1	-2.94	6.28	4.64	0.2	0.00040
90011	UNDEF	UNDEF	UNDEF	-7.66E+02	0	1								

1

```
**************************************************
* SUBCRITICAL AND CRITICAL FLOW ASSUMPTIONS FROM *
* SUBROUTINE HEAD.  SEE FIGURE 5-4 IN THE EXTRAN *
*       MANUAL FOR FURTHER INFORMATION.          *
**************************************************
```

CONDUIT NUMBER	LENGTH OF DRY FLOW(MIN)	LENGTH OF SUBCRITICAL FLOW(MIN)	LENGTH OF UPSTR. CRITICAL FLOW(MIN)	LENGTH OF DOWNSTR. CRITICAL FLOW(MIN)	MEAN FLOW (CMS)	AVERAGE % CHANGE	TOTAL FLOW CUBIC MET	MAXIMUM HYDRAULIC RADIUS(MET)	MAXIMUM CROSS SECT AREA(SQ.M)
1	0.00	120.00	0.00	0.00	62.38	0.4018	4.4914E+05	2.8606	96.9110
2	0.08	119.92	0.00	0.00	61.55	0.4045	4.4315E+05	2.8317	95.0900
3	0.08	119.92	0.00	0.00	60.79	0.5007	4.3772E+05	2.8606	96.9110
4	0.25	119.75	0.00	0.00	60.30	0.7906	4.3419E+05	2.8499	96.2355
5	0.58	119.42	0.00	0.00	59.26	0.7936	4.2664E+05	2.8606	96.9110
6	0.92	119.08	0.00	0.00	58.48	0.6124	4.2108E+05	2.7665	91.0556
7	1.00	119.00	0.00	0.00	57.33	0.7272	4.1280E+05	2.8039	93.3605
8	0.58	119.42	0.00	0.00	56.72	0.7770	4.0839E+05	2.7152	87.9453
9	0.17	119.83	0.00	0.00	55.68	0.6837	4.0092E+05	2.8136	93.9603
10	0.00	120.00	0.00	0.00	54.56	0.6524	3.9284E+05	2.8606	96.9110
90011	UNDEFINED	UNDEFINED	UNDEFINED	UNDEFINED	54.56		3.9284E+05		

```
************************************************************
* AVERAGE % CHANGE IN JUNCTION OR CONDUIT IS DEFINED AS:   *
* CONDUIT  % CHANGE ==> 100.0 ( Q(n+1) - Q(n) ) / Qfull    *
* JUNCTION % CHANGE ==> 100.0 ( Y(n+1) - Y(n) ) / Yfull    *
************************************************************
```

The Conduit with the largest average change...   5 had   0.794 percent

```
The Junction with the largest average change...          5 had     0.398 percent


===> Extended Transport model simulation ended normally.

===> SWMM 4.4GU  simulation ended normally.
     Always check output file for possible warning messages.

===> Your input file was named : PCTmp1.dat
===> Your output file was named: PCTmp1.out

*******************************************************
*       SWMM 4.4GU  Simulation Date and Time Summary  *
*******************************************************
* Starting Date... November   16, 2006                *
*          Time...         16:24:48.900               *
*   Ending Date... November   16, 2006                *
*          Time...         16:24:53.510               *
*  Elapsed Time...               0.077 minutes.       *
*  Elapsed Time...               4.611 seconds.       *
*******************************************************
```

```
1        ************************************************
         *    U.S. Environmental Protection Agency      *
         *    Storm Water Management Model  (SWMM)      *
         *                Version 4.4GU                 *
         *                                              *
         *                 CDM/OSU Beta                 *
         *      Release Date - November 23, 1999        *
         * Camp Dresser & McKee and Oregon State Univ.  *
         *          Chuck Moore and Wayne Huber         *
         *  Compiled using Digital Visual Fortran 6.0   *
         ************************************************

                          Developed by

         ************************************************
         *             Metcalf & Eddy, Inc.             *
         *            University of Florida             *
         *        Water Resources Engineers, Inc.       *
         *      (Now Camp, Dresser and McKee, Inc.)     *
         *               September 1970                 *
         ************************************************

                  Distributed and Maintained by

         ************************************************
         *      U.S. Environmental Protection Agency    *
         * Center for Exposure Assessment Modeling (CEAM)*
         *    Athens Environmental Research Laboratory  *
         *            960 College Station Road          *
         *            Athens, GA    30605-2720          *
         ************************************************

         ************************************************
         *     This is a new release of SWMM.  If any   *
         *     problems occur executing this model      *
         *     system, contact Mr. Frank Stancil,       *
         *     U.S. Environmental Protection Agency.    *
         *     706/355-8328 (voice)                     *
         *     e-mail: stancil@athens.ath.epa.gov       *
         *     Or contact Wayne C. Huber at Oregon St. U.*
         *     541/737-6150 or wayne.huber@orst.edu     *
         *     Or Michael F. Schmidt at Camp Dresser &  *
         *     McKee (904) 281-0170 SCHMIDTMF@CDM.COM   *
         ************************************************
```

```
            *************************************************
            *  This is an implementation of EPA SWMM 4.4GU  *
            *  "Nature is full of infinite causes which     *
            *   have never occurred in experience" da Vinci *
            *************************************************


 ##########################################
 #         File names by SWMM Block       #
 #          JIN  -> Input to a Block      #
 #         JOUT  -> Output from a Block   #
 ##########################################

   JIN for Block #      1 File #    0  JIN.UF
  JOUT for Block #      1 File #    9  PCTmp1.int

 ##########################################
 # Scratch file names for this simulation. #
 ##########################################

 NSCRAT #     1 File #   21  SCRT1.UF
 NSCRAT #     2 File #   22  SCRT2.UF
 NSCRAT #     3 File #   23  SCRT3.UF
 NSCRAT #     4 File #   24  SCRT4.UF
 NSCRAT #     5 File #   25  SCRT5.UF
 NSCRAT #     6 File #   26  SCRT6.UF
 NSCRAT #     7 File #   27  SCRT7.UF
 NSCRAT #     8 File #   28  SCRT8.UF

 ***************************************************
 *    Parameter Values on the Tapes Common Block   *
 ***************************************************

  Number of Subcatchments in the Runoff Block (NW)...... 1000
  Number of Channel/Pipes in the Runoff Block (NG)...... 1000
  Number of Connections to Runoff Channels/Inlets (NCP).    6
  Number of Water Quality Constituents (MQUAL)..........   20
  Number of Runoff Land Uses per Subcatchment (NLU).....   20
  Number of Groundwater Subcatchments in Runoff (NGW)...  100
  Number of Interface Locations for all Blocks (NIE).... 1000
  Number of Elements in the Transport Block (NET).......  500
  Number of Storage Junctions in Transport (NTSE).......  100
  Number of Transport interface input locations (NTHI)..  500
  Number of Transport interface output locations (NTHO).  500
  Number of Transport input locations on R lines (NTHR).   80
```

```
 Number of Transport printed output locations (NTOA)...    80
 Number of Tabular Flow Splitters in Transport (NTSP)..    50
 Number of Elements in the Extran Block (NEE).......... 4000
 Number of Pumps in Extran (NEP).......................    75
 Number of Orifices in Extran (NEO)....................   200
 Number of Tide Gates/Free Outfalls in Extran (NTG)....   200
 Number of Extran Weirs (NEW)..........................   400
 Number of Extran Printout Locations (NPO).............   150
 Number of Tide Elements in Extran (NTE)...............    50
 Number of Natural Channels (NNC)...................... 1200
 Number of Storage Junctions in Extran (NVSE).......... 1000
 Number of Time History Data Points in Extran (NTVAL)..   500
 Number of Data Points for Variable Storage Elements
   in the Extran Block (NVST)..........................    25
 Number of Input Hydrographs in Extran (NEH)...........   500
 Number of Allowable Channel Connections to
   Junctions in the Extran Block (NCHN)................    15
 Number Rain Gages in Rain and Runoff (MAXRG)..........   200
 Number PRATE/VRATE Points for Extran Pump
   Input (MAXPRA)......................................    10
 Number of Variable Orifices in Extran (NVORF).........    50
 Number of Variable Orifice Data Points (NVOTIM).......    50
 Number of Allowable Precip. Values/yr in Rain (LIMRN). 5000
 Number of Storm Events for Rain Analysis (LSTORM).....20000
 Number of Plugs for Plug-flow in S/T (NPLUG).......... 3000
 Number Conduits for Extran Results to ASCII
   File (MXFLOW).......................................   400


 *******************************************************
 * Entry made to the EXTENDED TRANSPORT MODEL (EXTRAN)   *
 * developed 1973 by Camp, Dresser and McKee (CDM) with  *
 * modifications 1977-1991 by the University of Florida. *
 *                                                       *
 * Most recent update: March 1999 by CDM, Oregon         *
 * State University, and XP Software, Inc.               *
 *                                                       *
 * "Smooth runs the water where the brook is deep."      *
 *                  Shakespeare, Henry VI, II, III, 1    *
 *******************************************************


1-------------------------------------------------------------------------------
 ENVIRONMENTAL PROTECTION AGENCY         ****   EXTENDED TRANSPORT PROGRAM   ****        WATER RESOURCES DIVISION
```

```
WASHINGTON, D.C.                   ****                        ****      CAMP DRESSER & MCKEE INC.
                                   ****    ANALYSIS MODULE     ****      ANNANDALE, VIRGINIA

   Detroit River International Crossing
   Turkey Creek Alternative 1B,2B Syphon - 100-Year Flow


Control information for simulation
----------------------------------

Integration cycles................   1440

Length of integration step is......   5.00 seconds
Simulation length.................   2.00 hours

Do not create equiv. pipes(NEQUAL).      0

Use metric units for I/O..........      1

Printing starts in cycle..........      1

Intermediate printout intervals of.      1 cycles
Intermediate printout intervals of.   0.08 minutes

Summary printout intervals of......      1 cycles
Summary printout time interval of..   0.08 minutes

Hot start file parameter (JREDO)...      0

Initial time (TZERO)..............   0.00 hours
This is time displacement from JIN interface file starting date/time when
interface file is used.
This also describes starting hour in K3 line hydrograph input when K3
lines are used.
Initial date (IDATZ)............ 19060714 (yr/mo/day)
NOTE: Initial date from JIN interface file will be used, if accessed,
unless IDATZ is negative.

Iteration variables: ITMAX.........     30
                     SURTOL........  0.0500

Default surface area of junctions..  1.22 square meters.

EXTRAN VERSION 3.3 SOLUTION. (ISOL = 0).
Sum of junction flow is zero during surcharge.
```

```
NORMAL FLOW OPTION WHEN THE WATER
SURFACE SLOPE IS LESS THAN THE
GROUND SURFACE SLOPE (KSUPER=0)....

NJSW INPUT HYDROGRAPH JUNCTIONS....     0

    INTERMEDIATE HEADER LINES ARE PRINTED AS IN ORIGINAL PROGRAM

    IDS ARE WRITTEN AS IN ORIGINAL PROGRAM

    CONDUIT LENGTHS ON C1 LINE MUST EQUAL IRREGULAR SECTION LENGTH ENTERED ON THE C3 OR X1 LINES (IWLEN = 0)

    JELEV = 0 (DEFAULT). STANDARD INPUTS ARE DEPTHS NOT ELEVATIONS

    JDOWN = 0 - Minimum of normal or critical depth will be used at free outfalls (I1).

    Characteristic depth for M2 and S2 water surface profiles will be computed as in previous versions of EXTRAN (IM2 = 0).

    SEDIMENT DEPTHS WILL NOT BE READ FROM C1 LINES

    Intermediate continuity output will not be created

1--------------------------------------------------------------------------------
ENVIRONMENTAL PROTECTION AGENCY           ****   EXTENDED TRANSPORT PROGRAM   ****       WATER RESOURCES DIVISION
WASHINGTON, D.C.                          ****                                ****       CAMP DRESSER & MCKEE INC.
                                          ****         ANALYSIS MODULE        ****       ANNANDALE, VIRGINIA

    Detroit River International Crossing
    Turkey Creek Alternative 1B,2B Syphon - 100-Year Flow


1
****************************************************
*                    Conduit Data                  *
****************************************************
```

INP NUM	CONDUIT NUMBER	LENGTH (M)	CONDUIT CLASS	AREA (SQ M)	MANNING COEF.	MAX WIDTH (M)	DEPTH (M)	JUNCTIONS AT THE ENDS		INVERT HEIGHT ABOVE JUNCTIONS		TRAPEZOID SIDE SLOPES	
1	1	100.	TRAPEZOID	96.91	0.01500	9.75	4.64	1	2			2.40	2.40
2	2	100.	TRAPEZOID	96.91	0.01500	9.75	4.64	2	3			2.40	2.40
3	3	100.	TRAPEZOID	96.91	0.01500	9.75	4.64	3	4			2.40	2.40
4	4	100.	TRAPEZOID	96.91	0.01500	9.75	4.64	4	5			2.40	2.40
5	5	15.	RECTANGLE	60.00	0.01300	15.00	4.00	5	50				

```
   6        50       23. RECTANGLE     50.00    0.01300      25.00       2.00         50         51
   7        51       40. RECTANGLE     50.00    0.01300      25.00       2.00         51         55
   8        55       23. RECTANGLE     50.00    0.01300      25.00       2.00         55         56
   9        56       15. RECTANGLE     80.00    0.01300      20.00       4.00         56          6
  10         6      100. TRAPEZOID     96.91    0.01500       9.75       4.64          6          7                    2.40     2.40
  11         7      100. TRAPEZOID     96.91    0.01500       9.75       4.64          7          8                    2.40     2.40
  12         8      100. TRAPEZOID     96.91    0.01500       9.75       4.64          8          9                    2.40     2.40
  13         9      100. TRAPEZOID     96.91    0.01500       9.75       4.64          9         10                    2.40     2.40
  14        10      100. TRAPEZOID     96.91    0.01500       9.75       4.64         10         11                    2.40     2.40


===> WARNING !!! (C*DELT/LEN) IN CONDUIT         5 IS  2.1 AT FULL DEPTH.
===> WARNING !!! (C*DELT/LEN) IN CONDUIT        56 IS  2.1 AT FULL DEPTH.

 ********************
 *  Conduit Volume  *
 ********************

 Input full depth volume...........    9.3620E+04 cubic meters
             Conduit #...        51 has zero slope.  0.001 feet added to upstream invert.

===> Warning !! The upstream and downstream junctions for the following conduits
                have been reversed to correspond to the positive flow and decreasing
                slope EXTRAN convention.  A negative flow in the output thus means
                the flow was from your original upstream junction to your original
                downstream junction.  Any initial flow has been multiplied by -1.

                1.  Conduit #...        55  has been changed.

1-------------------------------------------------------------------------------
 ENVIRONMENTAL PROTECTION AGENCY             ****   EXTENDED TRANSPORT PROGRAM   ****       WATER RESOURCES DIVISION
 WASHINGTON, D.C.                            ****                                ****       CAMP DRESSER & MCKEE INC.
                                             ****         ANALYSIS MODULE        ****       ANNANDALE, VIRGINIA


     Detroit River International Crossing
     Turkey Creek Alternative 1B,2B Syphon - 100-Year Flow


1
 *****************************************************
 *                  Junction Data                    *
 *****************************************************


 INP  JUNCTION     GROUND     CROWN     INVERT     QINST   INITIAL    CONNECTING CONDUITS
 NUM    NUMBER      ELEV.      ELEV.     ELEV.       CMS  DEPTH(M)
```

1	1	182.00	180.71	176.07	62.60	0.00	1	
2	2	182.00	180.67	176.03	0.00	0.00	1	2
3	3	182.00	180.63	175.99	0.00	0.00	2	3
4	4	182.00	180.59	175.95	0.00	0.00	3	4
5	5	182.00	180.55	175.91	0.00	0.00	4	5
6	50	182.00	179.90	175.90	0.00	0.00	5	50
7	51	182.00	166.31	164.30	0.00	0.00	50	51
8	55	182.00	166.30	164.30	0.00	0.00	51	55
9	56	182.00	179.87	175.87	0.00	0.00	55	56
10	6	182.00	180.50	175.86	0.00	0.00	56	6
11	7	182.00	180.46	175.82	0.00	0.00	6	7
12	8	182.00	180.42	175.78	0.00	0.00	7	8
13	9	182.00	180.38	175.74	0.00	0.00	8	9
14	10	182.00	180.34	175.70	0.00	0.00	9	10
15	11	182.00	180.30	175.66	0.00	0.00	10	

```
*************************************************
*         FREE OUTFALL DATA (DATA GROUP I1)     *
*        BOUNDARY CONDITION ON DATA GROUP J1    *
*************************************************

OUTFALL AT JUNCTION....        11 HAS BOUNDARY CONDITION NUMBER...        1

1----------------------------------------------------------------------------
ENVIRONMENTAL PROTECTION AGENCY          ****  EXTENDED TRANSPORT PROGRAM  ****      WATER RESOURCES DIVISION
WASHINGTON, D.C.                         ****                              ****      CAMP DRESSER & MCKEE INC.
                                         ****        ANALYSIS MODULE       ****      ANNANDALE, VIRGINIA

    Detroit River International Crossing
    Turkey Creek Alternative 1B,2B Syphon - 100-Year Flow


*************************************************
*       INTERNAL CONNECTIVITY INFORMATION       *
*************************************************

        CONDUIT     JUNCTION     JUNCTION
        -------     --------     --------
        90015          11            0
1
****************************************************
*       BOUNDARY CONDITON INFORMATION              *
```

```
*                  DATA GROUPS J1-J4                  *
*****************************************************



BC NUMBER..          1 CONTROL WATER SURFACE ELEVATION IS..    178.80 METERS.
 TZERO =       1906195  0.0000000E+00

***********************************
*    INITIAL MODEL CONDITION      *
* INITIAL TIME =       0.00 HOURS  *
***********************************

JUNCTION / DEPTH  / ELEVATION    ===>  "*" JUNCTION IS SURCHARGED.
        1/   0.00 /   176.07          2/   0.00 /   176.03          3/   0.00 /   175.99
        4/   0.00 /   175.95          5/   0.00 /   175.91         50/   0.00 /   175.90
       51/   0.00 /   164.30         55/   0.00 /   164.30         56/   0.00 /   175.87
        6/   0.00 /   175.86          7/   0.00 /   175.82          8/   0.00 /   175.78
        9/   0.00 /   175.74         10/   0.00 /   175.70         11/   0.00 /   175.66

  CONDUIT/       FLOW   ===> "*" CONDUIT USES THE NORMAL FLOW OPTION.
        1/       0.00          2/        0.00          3/        0.00          4/        0.00
        5/       0.00         50/        0.00         51/        0.00         55/        0.00
       56/       0.00          6/        0.00          7/        0.00          8/        0.00
        9/       0.00         10/        0.00      90015/        0.00

  CONDUIT/   VELOCITY
        1/       0.00          2/        0.00          3/        0.00          4/        0.00
        5/       0.00         50/        0.00         51/        0.00         55/        0.00
       56/       0.00          6/        0.00          7/        0.00          8/        0.00
        9/       0.00         10/        0.00

  CONDUIT/ CROSS SECTIONAL AREA
        1/       0.00          2/        0.00          3/        0.00          4/        0.00
        5/       0.00         50/        0.00         51/        0.00         55/        0.00
       56/       0.00          6/        0.00          7/        0.00          8/        0.00
        9/       0.00         10/        0.00

  CONDUIT/ HYDRAULIC RADIUS
        1/       0.00          2/        0.00          3/        0.00          4/        0.00
        5/       0.00         50/        0.00         51/        0.00         55/        0.00
       56/       0.00          6/        0.00          7/        0.00          8/        0.00
        9/       0.00         10/        0.00

  CONDUIT/ UPSTREAM/ DOWNSTREAM ELEVATION
```

```
       1/   176.07/   176.03          2/   176.03/   175.99          3/   175.99/   175.95
       4/   175.95/   175.91          5/   175.91/   175.90         50/   175.90/   164.30
      51/   164.31/   164.30         55/   175.87/   164.30         56/   175.87/   175.86
       6/   175.86/   175.82          7/   175.82/   175.78          8/   175.78/   175.74
       9/   175.74/   175.70         10/   175.70/   175.66


********************************
*     FINAL MODEL CONDITION     *
*  FINAL TIME =      2.00 HOURS *
********************************

>>> ENDING DATE AND TIME OF EXTRAN RUN ARE:
JULIAN DATE: 1906195
YR/MO/DA:   1906/ 7/14
TIME OF DAY:  2.000 HRS

JUNCTION / DEPTH  / ELEVATION    ===>  "*" JUNCTION IS SURCHARGED.
       1/   2.86 /   178.93         2/   2.89 /   178.92         3/   2.91 /   178.90
       4/   2.94 /   178.89         5/   2.97 /   178.88        50/   2.98 /   178.88
      51/  14.56*/   178.87        55/  14.56*/   178.86        56/   2.98 /   178.85
       6/   3.00 /   178.86         7/   3.02 /   178.84         8/   3.05 /   178.83
       9/   3.08 /   178.82        10/   3.11 /   178.81        11/   3.14 /   178.80

 CONDUIT/       FLOW   ===> "*" CONDUIT USES THE NORMAL FLOW OPTION.
       1/      62.57          2/      62.61          3/      62.59          4/      62.59
       5/      62.18         50/      62.89         51/      63.09         55/     -60.48
      56/      66.50          6/      62.31          7/      62.58          8/      62.68
       9/      62.48         10/      62.60      90015/      62.60

 CONDUIT/   VELOCITY
       1/       1.31          2/       1.29          3/       1.27          4/       1.26
       5/       1.39         50/       1.26         51/       1.26         55/      -1.21
      56/       1.11          6/       1.22          7/       1.21          8/       1.20
       9/       1.18         10/       1.16

 CONDUIT/ CROSS SECTIONAL AREA
       1/      47.85          2/      48.47          3/      49.12          4/      49.77
       5/      44.61         50/      50.00         51/      50.00         55/      50.00
      56/      59.73          6/      51.03          7/      51.69          8/      52.43
       9/      53.15         10/      53.90

 CONDUIT/  FINAL VOLUME
       1/    4785.28          2/    4847.46          3/    4912.26          4/    4977.36
       5/     669.11         50/    1150.00         51/    2000.00         55/    1150.00
```

```
      56/    895.95          6/    5102.61          7/    5169.46          8/    5243.20
       9/   5314.87         10/    5389.59

  CONDUIT/ HYDRAULIC RADIUS
       1/      1.94          2/       1.95          3/       1.97          4/       1.98
       5/      2.13         50/       0.93         51/       0.93         55/       0.93
      56/      2.30          6/       2.01          7/       2.02          8/       2.04
       9/      2.06         10/       2.07

  CONDUIT/ UPSTREAM/ DOWNSTREAM ELEVATION
       1/  178.93/  178.92          2/  178.92/  178.90          3/  178.90/  178.89
       4/  178.89/  178.88          5/  178.88/  178.88         50/  178.88/  178.87
      51/  178.87/  178.86         55/  178.85/  178.86         56/  178.85/  178.86
       6/  178.86/  178.84          7/  178.84/  178.83          8/  178.83/  178.82
       9/  178.82/  178.81         10/  178.81/  178.80



 ##################################################
 #           Surcharge Iteration Summary           #
 ##################################################

 Maximum number of iterations in a time step.....      31
 Total number of iterations in the simulation..      4109
 Average number of iterations per time step......    2.85
 Surcharge iterations during the simulation......    1229
 Maximum surcharge flow error during simulation.. 6.92E+01 cms
 Total number of time steps during simulation..      1440


1
 **************************************************
 *         CONDUIT COURANT CONDITION SUMMARY       *
 * TIME IN MINUTES DELT > COURANT TIME STEP        *
 **************************************************
 * SEE BELOW FOR EXPLANATION OF COURANT TIME STEP. *
 **************************************************

  CONDUIT #  TIME(MN)  CONDUIT #  TIME(MN)  CONDUIT #  TIME(MN)CONDUIT #  TIME(MN)
  ---------  --------  ---------  --------  ---------  -----------------  --------
          1      0.00          2      0.00          3      0.00        4      0.00
          5    118.58         50    118.25         51    117.75       55    117.92
         56    118.08          6      0.00          7      0.00        8      0.00
          9      0.00         10      0.00
```

```
1
 ************************************************
 *         CONDUIT COURANT CONDITION SUMMARY    *
 ************************************************
 * COURANT    =              CONDUIT LENGTH      *
 * TIME STEP = -------------------------------- *
 *                VELOCITY + SQRT(GRVT*AREA/WIDTH) *
 ************************************************
 * AVERAGE COURANT CONDITION TIME STEP(SECONDS) *
 ************************************************

  CONDUIT # TIME(SEC)  CONDUIT # TIME(SEC)  CONDUIT # TIME(SEC)CONDUIT # TIME(SEC)
  ---------  --------  ---------  --------  ---------  ----------------  --------
          1     17.24          2     17.25          3     17.95         4     21.36
          5      2.74         50      2.16         51      3.16        55      1.82
         56      2.35          6     17.12          7     17.09         8     17.09
          9     17.11         10     17.02

1
 ***************************************************
 * EXTRAN CONTINUITY BALANCE AT THE LAST TIME STEP *
 ***************************************************

 ************************************************
 * JUNCTION INFLOW, OUTFLOW OR STREET FLOODING *
 ************************************************

    JUNCTION   INFLOW, CU M
    --------  -------------
           1    4.5072E+05

    JUNCTION  OUTFLOW, CU M
    --------  -------------
           1    9.2710E+02
           3    2.9048E+02
           4    5.0193E+01
           5    4.3016E+02
          50    7.5294E+02
          56    7.3184E+01
           6    7.2493E+03
           7    4.5054E+02
           8    1.6235E+03
           9    1.2573E+03
          10    3.8129E+02
          11    3.8971E+05
```

```
*****************************************************
* INITIAL SYSTEM VOLUME         =    1.0160E-02 CU M  *
* TOTAL SYSTEM INFLOW VOLUME    =    4.5072E+05 CU M  *
* INFLOW + INITIAL VOLUME       =    4.5072E+05 CU M  *
*****************************************************
* TOTAL SYSTEM OUTFLOW          =    4.0319E+05 CU M  *
* VOLUME LEFT IN SYSTEM         =    5.1608E+04 CU M  *
* OUTFLOW + FINAL VOLUME        =    4.5480E+05 CU M  *
*****************************************************
* ERROR IN CONTINUITY, PERCENT =          -0.91       *
*****************************************************


TEST WRITE OF ALTERNATIVE CONTINUITY ERROR CALCULATION
VOLUME LEFT IN SYSTEM       =     9.8749E+04 CU. FT.
ERROR IN CONTINUITY PERCENT =         -113.64
```

- - - - - - - - - - - - - - - - - SUMMARY OF FULL FLOW CHANNEL WARNINGS -

OPEN CHANNEL NUMBER	TIME STEP OF FIRST OCCURRENCE	TIME OF FIRST OCCURRENCE (HOURS)	TIME STEP OF LAST OCCURRENCE	TIME OF LAST OCCURRENCE (HOURS)
1	1	0.00	91	0.13
2	74	0.10	91	0.13
3	74	0.10	92	0.13
4	74	0.10	92	0.13
6	24	0.03	82	0.11
7	20	0.03	25	0.03
8	17	0.02	57	0.08
9	15	0.02	63	0.09
10	15	0.02	63	0.09

THE PROGRAM USES FULL DEPTH CHANNEL CHARACTERISTICS TO COMPUTE FLOW THROUGH THE TRAPEZOIDAL, IRREGULAR, OR PARABOLIC/POWER FUNCTION CONDUIT WHEN THE COMPUTED DEPTHS EXCEED MAXIMUM DEPTH. THIS WILL AFFECT THE MAXIMUM COMPUTED HEAD AND FLOWS IN THE MODEL. IT IS HIGHLY RECOMMENDED THAT THE MODELED CROSS SECTIONS BE EXTENDED TO ELIMINATE THESE FULL FLOW CHANNEL WARNINGS

```
1
**********************************************************
*  J U N C T I O N   S U M M A R Y   S T A T I S T I C S *
**********************************************************
```

Detroit River International Crossing
Turkey Creek Alternative 1B,2B Syphon - 100-Year Flow

JUNCTION NUMBER	GROUND ELEVATION (M)	UPPERMOST PIPE CROWN ELEVATION (M)	MEAN JUNCTION ELEVATION (M)	JUNCTION AVERAGE % CHANGE	MAXIMUM JUNCTION ELEV. (M)	TIME OF OCCURENCE HR.	MIN.	METERS OF SURCHARGE AT MAX ELEVATION	METERS MAX. DEPTH IS BELOW GROUND ELEVATION	LENGTH OF SURCHARGE (MIN)	LENGTH OF FLOODING (MIN)	MAXIMUM JUNCTION AREA (SQ.MET)
1	182.00	180.71	178.98	0.3684	182.00	0	5	1.29	0.00	0.8	0.3	4.880E+04
2	182.00	180.67	178.95	0.2199	181.93	0	7	1.26	0.07	0.3	0.0	9.721E+04
3	182.00	180.63	178.92	0.2144	182.00	0	7	1.37	0.00	0.3	0.1	9.732E+04
4	182.00	180.59	178.90	0.2467	182.00	0	6	1.41	0.00	0.2	0.1	9.882E+04
5	182.00	180.55	178.88	0.3865	182.00	0	6	1.45	0.00	0.3	0.1	5.312E+04
50	182.00	179.90	178.87	0.6565	182.00	0	2	2.10	0.00	2.8	0.1	1.240E+04
51	182.00	166.31	178.66	1.6342	181.41	0	2	15.11	0.59	117.9	0.0	2.441E+04
55	182.00	166.30	178.65	2.0175	180.96	0	6	14.65	1.04	117.9	0.0	2.441E+04
56	182.00	179.87	178.85	0.6963	182.00	0	2	2.13	0.00	2.4	0.1	1.356E+04
6	182.00	180.50	178.86	0.4825	182.00	0	2	1.50	0.00	0.6	0.3	5.323E+04
7	182.00	180.46	178.84	0.3419	182.00	0	2	1.54	0.00	0.2	0.1	4.803E+04
8	182.00	180.42	178.83	0.3371	182.00	0	1	1.58	0.00	0.2	0.2	1.597E+04
9	182.00	180.38	178.82	0.3148	182.00	0	1	1.62	0.00	0.5	0.1	4.363E+04
10	182.00	180.34	178.81	0.3738	182.00	0	1	1.66	0.00	0.2	0.2	9.404E+04
11	182.00	180.30	178.81	0.0957	180.30	0	1	0.00	1.70	0.3	0.0	4.259E+04

1

****
* C O N D U I T   S U M M A R Y   S T A T I S T I C S *
****

Detroit River International Crossing
Turkey Creek Alternative 1B,2B Syphon - 100-Year Flow

CONDUIT NUMBER	DESIGN FLOW (CMS)	DESIGN VELOCITY (M/S)	CONDUIT VERTICAL DEPTH (M)	MAXIMUM COMPUTED FLOW (CMS)	TIME OF OCCURRENCE HR.	MIN.	MAXIMUM COMPUTED VELOCITY (MPS)	TIME OF OCCURRENCE HR.	MIN.	RATIO OF MAX. TO DESIGN FLOW	MAXIMUM DEPTH ABOVE INV. AT CONDUIT ENDS UPSTREAM (M)	DOWNSTREAM (M)	LENGTH OF NORM FLOW (MIN)	CONDUIT SLOPE (M/M)
1	2.60E+02	2.69	4.640	1.67E+02	0	0	4.06	0	0	0.64	5.93	5.88	0.8	0.00040
2	2.60E+02	2.69	4.640	1.42E+02	0	5	4.15	0	1	0.55	5.88	6.01	0.5	0.00040
3	2.60E+02	2.69	4.640	1.46E+02	0	9	3.94	0	1	0.56	6.01	6.05	0.4	0.00040
4	2.60E+02	2.69	4.640	1.56E+02	0	8	3.72	0	1	0.60	6.05	6.09	0.3	0.00040
5	1.62E+02	2.69	4.000	2.00E+02	0	7	6.76	0	2	1.24	6.09	6.10	0.1	0.00067

50	2.59E+03	51.89	2.000	7.04E+02	0	2	8.03	0	1	0.27	6.10	17.09	0.6	0.50413
51	1.83E+01	0.37	2.000	-2.30E+02	0	2	-4.60	0	2	-12.55	17.09	16.65	0.1	0.00003
55	2.59E+03	51.82	2.000	6.77E+02	0	2	6.23	0	2	0.26	6.12	16.65	0.5	0.50283
56	2.23E+02	2.79	4.000	-6.89E+02	0	2	-8.61	0	2	-3.09	6.12	6.14	0.1	0.00067
6	2.60E+02	2.69	4.640	-6.33E+02	0	2	-7.33	0	2	-2.43	6.14	6.10	0.0	0.00040
7	2.60E+02	2.69	4.640	-7.32E+02	0	1	-8.48	0	2	-2.81	6.10	6.22	0.1	0.00040
8	2.60E+02	2.69	4.640	-7.07E+02	0	1	-7.30	0	1	-2.72	6.22	5.85	0.2	0.00040
9	2.60E+02	2.69	4.640	-7.86E+02	0	1	-8.37	0	1	-3.02	5.85	6.30	0.2	0.00040
10	2.60E+02	2.69	4.640	-7.57E+02	0	1	-7.86	0	1	-2.91	6.30	4.64	0.3	0.00040
90015	UNDEF	UNDEF	UNDEF	-7.57E+02	0	1								

1

```
*************************************************
* SUBCRITICAL AND CRITICAL FLOW ASSUMPTIONS FROM *
* SUBROUTINE HEAD.  SEE FIGURE 5-4 IN THE EXTRAN *
*       MANUAL FOR FURTHER INFORMATION.          *
*************************************************
```

CONDUIT NUMBER	LENGTH OF DRY FLOW(MIN)	LENGTH OF SUBCRITICAL FLOW(MIN)	LENGTH OF UPSTR. CRITICAL FLOW(MIN)	LENGTH OF DOWNSTR. CRITICAL FLOW(MIN)	MEAN FLOW (CMS)	AVERAGE % CHANGE	TOTAL FLOW CUBIC MET	MAXIMUM HYDRAULIC RADIUS(MET)	MAXIMUM CROSS SECT AREA(SQ.M)
1	0.00	120.00	0.00	0.00	62.60	0.3486	4.5074E+05	2.8606	96.9110
2	0.08	119.92	0.00	0.00	61.93	0.3652	4.4592E+05	2.8606	96.9110
3	0.08	119.92	0.00	0.00	61.20	0.3023	4.4067E+05	2.8205	94.3929
4	0.25	119.75	0.00	0.00	60.47	0.4788	4.3537E+05	2.8606	96.9110
5	0.58	119.42	0.00	0.00	59.97	1.8271	4.3180E+05	2.4111	60.0000
50	1.08	118.92	0.00	0.00	60.08	0.1324	4.3261E+05	1.0787	50.0000
51	1.25	118.75	0.00	0.00	59.40	10.9593	4.2765E+05	0.9660	50.0000
55	1.67	118.33	0.00	0.00	-58.79	0.1639	-4.2326E+05	1.4793	50.0000
56	1.58	118.42	0.00	0.00	58.78	3.8133	4.2321E+05	2.6418	80.0000
6	1.33	118.67	0.00	0.00	57.56	0.9117	4.1440E+05	2.7102	87.6460
7	1.00	119.00	0.00	0.00	56.62	0.7945	4.0769E+05	2.6881	86.3271
8	0.58	119.42	0.00	0.00	55.67	0.7054	4.0084E+05	2.8606	96.9110
9	0.17	119.83	0.00	0.00	55.10	0.7921	3.9673E+05	2.8136	93.9603
10	0.00	120.00	0.00	0.00	54.13	0.6719	3.8971E+05	2.8606	96.9110
90015	UNDEFINED	UNDEFINED	UNDEFINED	UNDEFINED	54.13		3.8971E+05		

```
************************************************************
* AVERAGE % CHANGE IN JUNCTION OR CONDUIT IS DEFINED AS:   *
* CONDUIT  % CHANGE ==> 100.0 ( Q(n+1) - Q(n) ) / Qfull    *
* JUNCTION % CHANGE ==> 100.0 ( Y(n+1) - Y(n) ) / Yfull    *
************************************************************
```

```
 The Conduit with the largest average change...         51 had    10.959 percent
The Junction with the largest average change...         55 had     2.018 percent


===> Extended Transport model simulation ended normally.

===> SWMM 4.4GU  simulation ended normally.
     Always check output file for possible warning messages.

===> Your input file was named : PCTmpl.dat
===> Your output file was named: PCTmpl.out

*******************************************************
*       SWMM 4.4GU  Simulation Date and Time Summary  *
*******************************************************
* Starting Date... November   17, 2006                *
*         Time...           9:34: 9.480               *
*   Ending Date... November   17, 2006                *
*         Time...           9:34:15.420               *
*  Elapsed Time...               0.099 minutes.       *
*  Elapsed Time...               5.941 seconds.       *
*******************************************************
```

Appendix A.2.4.2

Lennon Drain

```
1          ************************************************
           *    U.S. Environmental Protection Agency      *
           *    Storm Water Management Model  (SWMM)      *
           *                Version 4.4GU                 *
           *                                              *
           *                 CDM/OSU Beta                 *
           *       Release Date - November 23, 1999       *
           * Camp Dresser & McKee and Oregon State Univ.  *
           *          Chuck Moore and Wayne Huber         *
           *  Compiled using Digital Visual Fortran 6.0   *
           ************************************************

                          Developed by

           ************************************************
           *             Metcalf & Eddy, Inc.             *
           *            University of Florida             *
           *       Water Resources Engineers, Inc.        *
           *     (Now Camp, Dresser and McKee, Inc.)      *
           *               September 1970                 *
           ************************************************

                  Distributed and Maintained by

           ************************************************
           *      U.S. Environmental Protection Agency    *
           * Center for Exposure Assessment Modeling (CEAM)*
           *    Athens Environmental Research Laboratory  *
           *            960 College Station Road          *
           *            Athens, GA    30605-2720          *
           ************************************************

           ************************************************
           *     This is a new release of SWMM.  If any   *
           *     problems occur executing this model      *
           *     system, contact Mr. Frank Stancil,       *
           *     U.S. Environmental Protection Agency.    *
           *     706/355-8328 (voice)                     *
           *     e-mail: stancil@athens.ath.epa.gov       *
           *     Or contact Wayne C. Huber at Oregon St. U.*
           *     541/737-6150 or wayne.huber@orst.edu     *
           *     Or Michael F. Schmidt at Camp Dresser &  *
           *     McKee (904) 281-0170 SCHMIDTMF@CDM.COM   *
           ************************************************
```

```
        *************************************************
        *  This is an implementation of EPA SWMM 4.4GU  *
        *  "Nature is full of infinite causes which     *
        *   have never occurred in experience" da Vinci *
        *************************************************


 ###########################################
 #        File names by SWMM Block         #
 #         JIN  -> Input to a Block        #
 #        JOUT  -> Output from a Block     #
 ###########################################

    JIN for Block #     1 File #     0  JIN.UF
   JOUT for Block #     1 File #     9  PCTmp1.int

 ###########################################
 # Scratch file names for this simulation. #
 ###########################################

 NSCRAT #      1 File #    21  SCRT1.UF
 NSCRAT #      2 File #    22  SCRT2.UF
 NSCRAT #      3 File #    23  SCRT3.UF
 NSCRAT #      4 File #    24  SCRT4.UF
 NSCRAT #      5 File #    25  SCRT5.UF
 NSCRAT #      6 File #    26  SCRT6.UF
 NSCRAT #      7 File #    27  SCRT7.UF
 NSCRAT #      8 File #    28  SCRT8.UF

 ***************************************************
 *    Parameter Values on the Tapes Common Block    *
 ***************************************************

  Number of Subcatchments in the Runoff Block (NW)...... 1000
  Number of Channel/Pipes in the Runoff Block (NG)...... 1000
  Number of Connections to Runoff Channels/Inlets (NCP).    6
  Number of Water Quality Constituents (MQUAL).........   20
  Number of Runoff Land Uses per Subcatchment (NLU).....   20
  Number of Groundwater Subcatchments in Runoff (NGW)...  100
  Number of Interface Locations for all Blocks (NIE).... 1000
  Number of Elements in the Transport Block (NET).......  500
  Number of Storage Junctions in Transport (NTSE).......  100
  Number of Transport interface input locations (NTHI)..  500
  Number of Transport interface output locations (NTHO).  500
  Number of Transport input locations on R lines (NTHR).   80
```

```
 Number of Transport printed output locations (NTOA)...    80
 Number of Tabular Flow Splitters in Transport (NTSP)..    50
 Number of Elements in the Extran Block (NEE)......... 4000
 Number of Pumps in Extran (NEP).......................    75
 Number of Orifices in Extran (NEO)...................   200
 Number of Tide Gates/Free Outfalls in Extran (NTG)....   200
 Number of Extran Weirs (NEW).........................   400
 Number of Extran Printout Locations (NPO)............   150
 Number of Tide Elements in Extran (NTE)..............    50
 Number of Natural Channels (NNC)..................... 1200
 Number of Storage Junctions in Extran (NVSE)......... 1000
 Number of Time History Data Points in Extran (NTVAL)..   500
 Number of Data Points for Variable Storage Elements
   in the Extran Block (NVST).........................    25
 Number of Input Hydrographs in Extran (NEH)..........   500
 Number of Allowable Channel Connections to
   Junctions in the Extran Block (NCHN)...............    15
 Number Rain Gages in Rain and Runoff (MAXRG).........   200
 Number PRATE/VRATE Points for Extran Pump
   Input (MAXPRA).....................................    10
 Number of Variable Orifices in Extran (NVORF)........    50
 Number of Variable Orifice Data Points (NVOTIM).......    50
 Number of Allowable Precip. Values/yr in Rain (LIMRN). 5000
 Number of Storm Events for Rain Analysis (LSTORM).....20000
 Number of Plugs for Plug-flow in S/T (NPLUG)......... 3000
 Number Conduits for Extran Results to ASCII
   File (MXFLOW)......................................   400


*********************************************************
* Entry made to the EXTENDED TRANSPORT MODEL (EXTRAN)   *
* developed 1973 by Camp, Dresser and McKee (CDM) with  *
* modifications 1977-1991 by the University of Florida. *
*                                                       *
* Most recent update: March 1999 by CDM, Oregon         *
* State University, and XP Software, Inc.               *
*                                                       *
* "Smooth runs the water where the brook is deep."      *
*                    Shakespeare, Henry VI, II, III, 1  *
*********************************************************


1--------------------------------------------------------------------------------
 ENVIRONMENTAL PROTECTION AGENCY         ****   EXTENDED TRANSPORT PROGRAM   ****        WATER RESOURCES DIVISION
```

```
WASHINGTON, D.C.                    ****                       ****     CAMP DRESSER & MCKEE INC.
                                    ****   ANALYSIS MODULE     ****     ANNANDALE, VIRGINIA

   Detroit River International Crossing
   Lennon Drain Existing Condition - 100-Year Flow


Control information for simulation
----------------------------------

Integration cycles................   4000

Length of integration step is......  15.00 seconds
Simulation length.................  16.67 hours

Do not create equiv. pipes(NEQUAL).      0

Use metric units for I/O..........      1

Printing starts in cycle..........      1

Intermediate printout intervals of.      1 cycles
Intermediate printout intervals of.   0.25 minutes

Summary printout intervals of......      1 cycles
Summary printout time interval of..   0.25 minutes

Hot start file parameter (JREDO)...      0

Initial time (TZERO)..............   0.00 hours
This is time displacement from JIN interface file starting date/time when
interface file is used.
This also describes starting hour in K3 line hydrograph input when K3
lines are used.
Initial date (IDATZ)............  19060714 (yr/mo/day)
NOTE: Initial date from JIN interface file will be used, if accessed,
unless IDATZ is negative.

Iteration variables: ITMAX.........     30
                     SURTOL........  0.0500

Default surface area of junctions..  1.22 square meters.

EXTRAN VERSION 3.3 SOLUTION. (ISOL = 0).
Sum of junction flow is zero during surcharge.
```

```
NORMAL FLOW OPTION WHEN THE WATER
SURFACE SLOPE IS LESS THAN THE
GROUND SURFACE SLOPE (KSUPER=0)....

NJSW INPUT HYDROGRAPH JUNCTIONS....     0

    INTERMEDIATE HEADER LINES ARE PRINTED AS IN ORIGINAL PROGRAM

    IDS ARE WRITTEN AS IN ORIGINAL PROGRAM

    CONDUIT LENGTHS ON C1 LINE MUST EQUAL IRREGULAR SECTION LENGTH ENTERED ON THE C3 OR X1 LINES (IWLEN = 0)

    JELEV = 0 (DEFAULT). STANDARD INPUTS ARE DEPTHS NOT ELEVATIONS

    JDOWN = 0 - Minimum of normal or critical depth will be used at free outfalls (I1).

    Characteristic depth for M2 and S2 water surface profiles will be computed as in previous versions of EXTRAN (IM2 = 0).

    SEDIMENT DEPTHS WILL NOT BE READ FROM C1 LINES

    Intermediate continuity output will not be created

1-------------------------------------------------------------------------------
ENVIRONMENTAL PROTECTION AGENCY          ****   EXTENDED TRANSPORT PROGRAM   ****       WATER RESOURCES DIVISION
WASHINGTON, D.C.                         ****                                ****       CAMP DRESSER & MCKEE INC.
                                         ****         ANALYSIS MODULE        ****       ANNANDALE, VIRGINIA

    Detroit River International Crossing
    Lennon Drain Existing Condition - 100-Year Flow


1
*****************************************************
*                     Conduit Data                  *
*****************************************************
```

INP NUM	CONDUIT NUMBER	LENGTH (M)	CONDUIT CLASS	AREA (SQ M)	MANNING COEF.	MAX WIDTH (M)	DEPTH (M)	JUNCTIONS AT THE ENDS		INVERT HEIGHT ABOVE JUNCTIONS		TRAPEZOID SIDE SLOPES	
1	1	70.	TRAPEZOID	803.64	0.03500	350.00	2.20	1	2			5.20	8.70
2	2	70.	TRAPEZOID	803.64	0.03500	350.00	2.20	2	3			5.20	8.70
3	3	100.	TRAPEZOID	803.64	0.03500	350.00	2.20	3	4			5.20	8.70
4	4	100.	TRAPEZOID	803.64	0.03500	350.00	2.20	4	5			5.20	8.70
5	5	60.	TRAPEZOID	46.22	0.03500	2.50	2.30	5	6			6.60	8.70

```
  6        6       75. RECTANGLE     3.17   0.01500      2.60      1.22       6        7
  7        7       40. TRAPEZOID    21.80   0.03500      2.30      2.00       7        8                     2.90    5.70
  8        8       75. TRAPEZOID    18.18   0.03500      2.00      1.80       8        9                     4.30    4.70
  9        9       75. TRAPEZOID    18.18   0.03500      2.00      1.80       9       10                     4.30    4.70
 10       10       75. TRAPEZOID    18.18   0.03500      2.00      1.80      10       11                     4.30    4.70


 ===> WARNING !!! (C*DELT/LEN) IN CONDUIT        7 IS  1.2 AT FULL DEPTH.

 *******************
 *  Conduit Volume  *
 *******************

 Input full depth volume...........    2.8121E+05 cubic meters

1--------------------------------------------------------------------------------
 ENVIRONMENTAL PROTECTION AGENCY            ****   EXTENDED TRANSPORT PROGRAM   ****        WATER RESOURCES DIVISION
 WASHINGTON, D.C.                           ****                                ****        CAMP DRESSER & MCKEE INC.
                                            ****         ANALYSIS MODULE        ****        ANNANDALE, VIRGINIA

     Detroit River International Crossing
     Lennon Drain Existing Condition - 100-Year Flow


1
 *****************************************************
 *                  Junction Data                    *
 *****************************************************

 INP  JUNCTION    GROUND    CROWN    INVERT     QINST   INITIAL    CONNECTING CONDUITS
 NUM    NUMBER     ELEV.     ELEV.    ELEV.       CMS  DEPTH(M)
 ---  -------  --------  --------  -------  -------- ---------  -------------------
   1        1    183.00    182.61   180.41     11.80      0.00        1
   2        2    183.00    182.47   180.27      0.00      0.00        1       2
   3        3    183.00    182.33   180.13      0.00      0.00        2       3
   4        4    183.00    182.13   179.93      0.00      0.00        3       4
   5        5    183.00    182.03   179.73      0.00      0.00        4       5
   6        6    183.00    181.91   179.61      0.00      0.00        5       6
   7        7    183.00    181.46   179.46      0.00      0.00        6       7
   8        8    183.00    181.38   179.38      0.00      0.00        7       8
   9        9    183.00    181.03   179.23      0.00      0.00        8       9
  10       10    183.00    180.88   179.08      0.00      0.00        9      10
  11       11    183.00    180.73   178.93      0.00      0.00       10
```

```
 **************************************************
 *         FREE OUTFALL DATA (DATA GROUP I1)      *
 *        BOUNDARY CONDITION ON DATA GROUP J1     *
 **************************************************

 OUTFALL AT JUNCTION....       11 HAS BOUNDARY CONDITION NUMBER...        1

1--------------------------------------------------------------------------------
 ENVIRONMENTAL PROTECTION AGENCY             ****   EXTENDED TRANSPORT PROGRAM   ****        WATER RESOURCES DIVISION
 WASHINGTON, D.C.                            ****                                ****        CAMP DRESSER & MCKEE INC.
                                             ****         ANALYSIS MODULE        ****        ANNANDALE, VIRGINIA

     Detroit River International Crossing
     Lennon Drain Existing Condition - 100-Year Flow



 **************************************************
 *       INTERNAL CONNECTIVITY INFORMATION        *
 **************************************************

          CONDUIT     JUNCTION     JUNCTION
          -------     --------     --------
          90011          11            0
1
 *****************************************************
 *       BOUNDARY CONDITON INFORMATION               *
 *                DATA GROUPS J1-J4                  *
 *****************************************************



 BC NUMBER..         1 HAS NO CONTROL WATER SURFACE.
  TZERO =       1906195  0.0000000E+00

 **********************************
 *    INITIAL MODEL CONDITION     *
 * INITIAL TIME =      0.00 HOURS *
 **********************************

 JUNCTION / DEPTH  / ELEVATION    ===>  "*" JUNCTION IS SURCHARGED.
         1/   0.00 /   180.41         2/   0.00 /   180.27         3/   0.00 /   180.13
         4/   0.00 /   179.93         5/   0.00 /   179.73         6/   0.00 /   179.61
         7/   0.00 /   179.46         8/   0.00 /   179.38         9/   0.00 /   179.23
        10/   0.00 /   179.08        11/   0.00 /   178.93
```

```
  CONDUIT/       FLOW   ===> "*" CONDUIT USES THE NORMAL FLOW OPTION.
       1/        0.00          2/        0.00          3/        0.00          4/        0.00
       5/        0.00          6/        0.00          7/        0.00          8/        0.00
       9/        0.00         10/        0.00      90011/        0.00

  CONDUIT/   VELOCITY
       1/        0.00          2/        0.00          3/        0.00          4/        0.00
       5/        0.00          6/        0.00          7/        0.00          8/        0.00
       9/        0.00         10/        0.00

  CONDUIT/ CROSS SECTIONAL AREA
       1/        0.00          2/        0.00          3/        0.00          4/        0.00
       5/        0.00          6/        0.00          7/        0.00          8/        0.00
       9/        0.00         10/        0.00

  CONDUIT/ HYDRAULIC RADIUS
       1/        0.00          2/        0.00          3/        0.00          4/        0.00
       5/        0.00          6/        0.00          7/        0.00          8/        0.00
       9/        0.00         10/        0.00

  CONDUIT/ UPSTREAM/ DOWNSTREAM ELEVATION
       1/   180.41/   180.27         2/   180.27/   180.13         3/   180.13/   179.93
       4/   179.93/   179.73         5/   179.73/   179.61         6/   179.61/   179.46
       7/   179.46/   179.38         8/   179.38/   179.23         9/   179.23/   179.08
      10/   179.08/   178.93


*******************************
*     FINAL MODEL CONDITION     *
*  FINAL TIME =     16.67 HOURS *
*******************************

>>> ENDING DATE AND TIME OF EXTRAN RUN ARE:
JULIAN DATE: 1906195
YR/MO/DA:    1906/ 7/14
TIME OF DAY: 16.667 HRS

JUNCTION / DEPTH  / ELEVATION    ===>  "*" JUNCTION IS SURCHARGED.
       1/   1.11 /   181.52        2/   1.25 /   181.52        3/   1.39 /   181.52
       4/   1.59 /   181.52        5/   1.79 /   181.52        6/   1.90 /   181.51
       7/   1.34 /   180.80        8/   1.33 /   180.71        9/   1.32 /   180.55
      10/   1.30 /   180.38       11/   0.86 /   179.79

  CONDUIT/       FLOW   ===> "*" CONDUIT USES THE NORMAL FLOW OPTION.
```

```
        1/     11.77          2/      11.69         3/      11.61          4/      11.54
        5/     11.48          6/      11.48         7/      11.48          8/      11.48
        9/     11.48         10/      11.48     90011/      11.48

  CONDUIT/   VELOCITY
        1/      0.03          2/       0.02         3/       0.02          4/       0.02
        5/      0.37          6/       3.62         7/       1.07          8/       1.08
        9/      1.11         10/       1.55

  CONDUIT/ CROSS SECTIONAL AREA
        1/    422.16          2/     473.58         3/     536.38          4/     610.78
        5/     30.62          6/       3.17         7/      10.73          8/      10.60
        9/     10.35         10/       7.42

  CONDUIT/  FINAL VOLUME
        1/  29551.41          2/   33150.29         3/   53638.02          4/   61078.38
        5/   1837.36          6/     237.90         7/     429.35          8/     795.01
        9/    775.93         10/     556.28

  CONDUIT/ HYDRAULIC RADIUS
        1/      1.15          2/       1.29         3/       1.45          4/       1.63
        5/      0.99          6/       0.42         7/       0.76          8/       0.74
        9/      0.73         10/       0.62

  CONDUIT/ UPSTREAM/ DOWNSTREAM ELEVATION
        1/  181.52/   181.52          2/  181.52/   181.52          3/  181.52/   181.52
        4/  181.52/   181.52          5/  181.52/   181.51          6/  181.51/   180.80
        7/  180.80/   180.71          8/  180.71/   180.55          9/  180.55/   180.38
       10/  180.38/   179.79


##################################################
#          Surcharge Iteration Summary           #
##################################################

Maximum number of iterations in a time step.....        2
Total number of iterations in the simulation..       8001
Average number of iterations per time step......     2.00
Surcharge iterations during the simulation......        1
Maximum surcharge flow error during simulation.. 0.00E+00 cms
Total number of time steps during simulation..       4000
```

1

```
 ***************************************************
 *         CONDUIT COURANT CONDITION SUMMARY        *
 * TIME IN MINUTES DELT > COURANT TIME STEP         *
 ***************************************************
 * SEE BELOW FOR EXPLANATION OF COURANT TIME STEP. *
 ***************************************************

  CONDUIT #  TIME(MN)  CONDUIT #  TIME(MN)  CONDUIT #  TIME(MN)CONDUIT #  TIME(MN)
  ---------  --------  ---------  --------  ---------  ----------------  --------
          1      0.25          2      0.50          3      0.00          4      0.00
          5      0.00          6    991.25          7    996.00          8      0.00
          9      0.00         10      0.00

1
 ************************************************
 *         CONDUIT COURANT CONDITION SUMMARY    *
 ************************************************
 * COURANT   =              CONDUIT LENGTH      *
 * TIME STEP = -------------------------------- *
 *              VELOCITY + SQRT(GRVT*AREA/WIDTH) *
 ************************************************
 * AVERAGE COURANT CONDITION TIME STEP(SECONDS) *
 ************************************************

  CONDUIT # TIME(SEC)  CONDUIT # TIME(SEC)  CONDUIT # TIME(SEC)CONDUIT # TIME(SEC)
  ---------  --------  ---------  --------  ---------  ----------------  --------
          1     23.95          2     22.19          3     29.36          4     27.23
          5     18.18          6     11.29          7     11.02          8     22.31
          9     20.58         10     20.94

1
 ***************************************************
 * EXTRAN CONTINUITY BALANCE AT THE LAST TIME STEP *
 ***************************************************

 ************************************************
 * JUNCTION INFLOW, OUTFLOW OR STREET FLOODING *
 ************************************************

   JUNCTION   INFLOW, CU M
   --------  -------------
          1    7.0800E+05

   JUNCTION  OUTFLOW, CU M
   --------  -------------
```

```
        11    5.8673E+05

 ****************************************************
 * INITIAL SYSTEM VOLUME        =     7.4000E-03 CU M  *
 * TOTAL SYSTEM INFLOW VOLUME   =     7.0800E+05 CU M  *
 * INFLOW + INITIAL VOLUME      =     7.0800E+05 CU M  *
 ****************************************************
 * TOTAL SYSTEM OUTFLOW         =     5.8673E+05 CU M  *
 * VOLUME LEFT IN SYSTEM        =     1.8209E+05 CU M  *
 * OUTFLOW + FINAL VOLUME       =     7.6882E+05 CU M  *
 ****************************************************
 * ERROR IN CONTINUITY, PERCENT =          -8.59       *
 ****************************************************


 TEST WRITE OF ALTERNATIVE CONTINUITY ERROR CALCULATION
 VOLUME LEFT IN SYSTEM       =     1.1790E+05 CU. FT.
 ERROR IN CONTINUITY PERCENT =           4.76


- - - - - - - - - - - - - - - - SUMMARY OF FULL FLOW CHANNEL WARNINGS - - - - - - - - - - - - - - - - - - - - -

   OPEN CHANNEL   TIME STEP OF FIRST   TIME OF FIRST   TIME STEP OF LAST   TIME OF LAST
     NUMBER          OCCURRENCE         OCCURRENCE        OCCURRENCE        OCCURRENCE
                                          (HOURS)                             (HOURS)
   ------------   ------------------   -------------   -----------------   ------------
        1                 1                0.00                1               0.00

   THE PROGRAM USES FULL DEPTH CHANNEL CHARACTERISTICS TO COMPUTE FLOW THROUGH THE TRAPEZOIDAL, IRREGULAR, OR
   PARABOLIC/POWER FUNCTION CONDUIT WHEN THE COMPUTED DEPTHS EXCEED MAXIMUM DEPTH.  THIS WILL AFFECT THE MAXIMUM
   COMPUTED HEAD AND FLOWS IN THE MODEL.  IT IS HIGHLY RECOMMENDED THAT THE MODELED CROSS SECTIONS BE EXTENDED
   TO ELIMINATE THESE FULL FLOW CHANNEL WARNINGS

1
 ************************************************************
 *  J U N C T I O N   S U M M A R Y   S T A T I S T I C S *
 ************************************************************


        Detroit River International Crossing
        Lennon Drain Existing Condition - 100-Year Flow

                          UPPERMOST    MEAN             MAXIMUM     TIME   METERS OF   METERS MAX.     LENGTH    LENGTH     MAXIMUM
                  GROUND  PIPE CROWN  JUNCTION  JUNCTION JUNCTION    OF    SURCHARGE    DEPTH IS        OF        OF      JUNCTION
   JUNCTION ELEVATION  ELEVATION ELEVATION   AVERAGE   ELEV.   OCCURENCE   AT MAX    BELOW GROUND  SURCHARGE  FLOODING      AREA
```

NUMBER	(M)	(M)	(M)	% CHANGE	(M)	HR.	MIN.	ELEVATION	ELEVATION	(MIN)	(MIN)	(SQ.MET)
1	183.00	182.61	181.27	0.0685	182.52	0	0	0.00	0.48	0.0	0.0	2.607E+04
2	183.00	182.47	181.27	0.0591	181.71	0	0	0.00	1.29	0.0	0.0	2.607E+04
3	183.00	182.33	181.27	0.0487	181.62	0	1	0.00	1.38	0.0	0.0	3.141E+04
4	183.00	182.13	181.26	0.0315	181.52	16	40	0.00	1.48	0.0	0.0	3.721E+04
5	183.00	182.03	181.26	0.0361	181.52	16	40	0.00	1.48	0.0	0.0	1.962E+04
6	183.00	181.91	181.25	0.0486	181.51	16	39	0.00	1.49	0.0	0.0	1.033E+03
7	183.00	181.46	180.70	0.0307	180.80	16	40	0.00	2.20	0.0	0.0	3.744E+02
8	183.00	181.38	180.62	0.0245	180.71	16	40	0.00	2.29	0.0	0.0	8.012E+02
9	183.00	181.03	180.46	0.0227	180.55	16	40	0.00	2.45	0.0	0.0	1.043E+03
10	183.00	180.88	180.29	0.0193	180.38	16	40	0.00	2.62	0.0	0.0	9.927E+02
11	183.00	180.73	179.72	0.0133	179.79	16	40	0.00	3.21	0.0	0.0	8.074E+02

1

```
********************************************************
*  C O N D U I T   S U M M A R Y   S T A T I S T I C S *
********************************************************
```

Detroit River International Crossing
Lennon Drain Existing Condition - 100-Year Flow

CONDUIT NUMBER	DESIGN FLOW (CMS)	DESIGN VELOCITY (M/S)	CONDUIT VERTICAL DEPTH (M)	MAXIMUM COMPUTED FLOW (CMS)	TIME OF OCCURRENCE HR.	MIN.	MAXIMUM COMPUTED VELOCITY (MPS)	TIME OF OCCURRENCE HR.	MIN.	RATIO OF MAX. TO DESIGN FLOW	MAXIMUM DEPTH ABOVE INV. AT CONDUIT ENDS UPSTREAM (M)	DOWNSTREAM (M)	LENGTH OF NORM FLOW (MIN)	CONDUIT SLOPE (M/M)
1	1.69E+03	2.10	2.200	1.79E+03	0	0	2.85	0	0	1.06	2.11	2.02	0.3	0.00200
2	1.69E+03	2.10	2.200	1.75E+03	0	0	5.45	0	1	1.04	2.02	1.39	0.3	0.00200
3	1.69E+03	2.10	2.200	5.39E+02	0	1	1.79	0	1	0.32	1.39	1.59	0.3	0.00200
4	1.69E+03	2.10	2.200	2.21E+02	0	2	1.16	0	2	0.13	1.59	1.79	0.5	0.00200
5	6.73E+01	1.46	2.300	1.17E+01	0	3	1.41	0	3	0.17	1.79	1.90	1.0	0.00200
6	5.26E+00	1.66	1.220	1.15E+01	16	39	3.62	16	40	2.18	1.90	1.34	1.8	0.00200
7	2.95E+01	1.35	2.000	1.15E+01	16	40	1.91	0	4	0.39	1.34	1.33	7.5	0.00200
8	2.29E+01	1.26	1.800	1.15E+01	16	40	1.21	0	5	0.50	1.33	1.32	2.5	0.00200
9	2.29E+01	1.26	1.800	1.15E+01	16	38	1.26	0	7	0.50	1.32	1.30	1.5	0.00200
10	2.29E+01	1.26	1.800	1.15E+01	16	40	1.55	16	38	0.50	1.30	0.86	0.0	0.00200
90011	UNDEF	UNDEF	UNDEF	1.15E+01	16	40								

1

```
***************************************************
* SUBCRITICAL AND CRITICAL FLOW ASSUMPTIONS FROM *
* SUBROUTINE HEAD.  SEE FIGURE 5-4 IN THE EXTRAN *
```

```
*       MANUAL FOR FURTHER INFORMATION.         *
*************************************************
```

CONDUIT NUMBER	LENGTH OF DRY FLOW(MIN)	LENGTH OF SUBCRITICAL FLOW(MIN)	LENGTH OF UPSTR. CRITICAL FLOW(MIN)	LENGTH OF DOWNSTR. CRITICAL FLOW(MIN)	MEAN FLOW (CMS)	AVERAGE % CHANGE	TOTAL FLOW CUBIC MET	MAXIMUM HYDRAULIC RADIUS(MET)	MAXIMUM CROSS SECT AREA(SQ.M)
1	0.00	1000.00	0.00	0.00	12.23	0.0669	7.3409E+05	1.6751	627.0582
2	0.25	999.75	0.00	0.00	12.06	0.0679	7.2343E+05	1.2850	473.5616
3	0.25	999.75	0.00	0.00	11.35	0.0253	6.8101E+05	1.4461	536.3661
4	0.50	999.50	0.00	0.00	10.39	0.0271	6.2365E+05	1.6343	610.7724
5	0.50	999.50	0.00	0.00	9.84	0.0374	5.9042E+05	0.9892	30.6229
6	1.00	999.00	0.00	0.00	9.82	0.1841	5.8922E+05	0.5952	3.1720
7	1.75	998.25	0.00	0.00	9.81	0.0357	5.8889E+05	0.7601	10.7336
8	2.25	997.75	0.00	0.00	9.80	0.0259	5.8828E+05	0.7439	10.5999
9	3.25	996.75	0.00	0.00	9.79	0.0190	5.8749E+05	0.7348	10.3456
10	3.75	996.25	0.00	0.00	9.78	0.0136	5.8673E+05	0.6199	7.4170
90011	UNDEFINED	UNDEFINED	UNDEFINED	UNDEFINED	9.78		5.8673E+05		

```
***********************************************************
* AVERAGE % CHANGE IN JUNCTION OR CONDUIT IS DEFINED AS:  *
* CONDUIT  % CHANGE ==> 100.0 ( Q(n+1) - Q(n) ) / Qfull   *
* JUNCTION % CHANGE ==> 100.0 ( Y(n+1) - Y(n) ) / Yfull   *
***********************************************************
```

The Conduit with the largest average change... 6 had 0.184 percent
The Junction with the largest average change... 1 had 0.068 percent

===> Extended Transport model simulation ended normally.

===> SWMM 4.4GU simulation ended normally.
Always check output file for possible warning messages.

===> Your input file was named : PCTmpl.dat
===> Your output file was named: PCTmpl.out

```
*************************************************
*      SWMM 4.4GU  Simulation Date and Time Summary  *
*************************************************
* Starting Date... November   17, 2006          *
*          Time...           9:15:35.600        *
*   Ending Date... November   17, 2006          *
*          Time...           9:15:49. 50        *
```

```
*  Elapsed Time...              0.224 minutes.      *
*  Elapsed Time...             13.450 seconds.      *
*****************************************************
```

```
1         ************************************************
          *     U.S. Environmental Protection Agency     *
          *     Storm Water Management Model  (SWMM)     *
          *                Version 4.4GU                 *
          *                                              *
          *                CDM/OSU Beta                  *
          *       Release Date - November 23, 1999       *
          * Camp Dresser & McKee and Oregon State Univ.  *
          *         Chuck Moore and Wayne Huber          *
          *  Compiled using Digital Visual Fortran 6.0   *
          ************************************************

                          Developed by

          ************************************************
          *             Metcalf & Eddy, Inc.             *
          *            University of Florida             *
          *       Water Resources Engineers, Inc.        *
          *     (Now Camp, Dresser and McKee, Inc.)      *
          *               September 1970                 *
          ************************************************

                  Distributed and Maintained by

          ************************************************
          *      U.S. Environmental Protection Agency    *
          * Center for Exposure Assessment Modeling (CEAM)*
          *    Athens Environmental Research Laboratory  *
          *           960 College Station Road           *
          *           Athens, GA    30605-2720           *
          ************************************************

          ************************************************
          *     This is a new release of SWMM.  If any   *
          *     problems occur executing this model      *
          *     system, contact Mr. Frank Stancil,       *
          *     U.S. Environmental Protection Agency.    *
          *     706/355-8328 (voice)                     *
          *     e-mail: stancil@athens.ath.epa.gov       *
          *     Or contact Wayne C. Huber at Oregon St. U.*
          *     541/737-6150 or wayne.huber@orst.edu     *
          *     Or Michael F. Schmidt at Camp Dresser &  *
          *     McKee (904) 281-0170 SCHMIDTMF@CDM.COM   *
          ************************************************
```

```
         ************************************************
         *  This is an implementation of EPA SWMM 4.4GU  *
         *  "Nature is full of infinite causes which     *
         *   have never occurred in experience" da Vinci *
         ************************************************


###########################################
#        File names by SWMM Block         #
#         JIN  -> Input to a Block        #
#        JOUT  -> Output from a Block     #
###########################################

   JIN for Block #     1 File #    0  JIN.UF
  JOUT for Block #     1 File #    9  PCTmp1.int

###########################################
# Scratch file names for this simulation. #
###########################################

NSCRAT #     1 File #   21  SCRT1.UF
NSCRAT #     2 File #   22  SCRT2.UF
NSCRAT #     3 File #   23  SCRT3.UF
NSCRAT #     4 File #   24  SCRT4.UF
NSCRAT #     5 File #   25  SCRT5.UF
NSCRAT #     6 File #   26  SCRT6.UF
NSCRAT #     7 File #   27  SCRT7.UF
NSCRAT #     8 File #   28  SCRT8.UF

***************************************************
*    Parameter Values on the Tapes Common Block   *
***************************************************

 Number of Subcatchments in the Runoff Block (NW)...... 1000
 Number of Channel/Pipes in the Runoff Block (NG)...... 1000
 Number of Connections to Runoff Channels/Inlets (NCP).    6
 Number of Water Quality Constituents (MQUAL).........   20
 Number of Runoff Land Uses per Subcatchment (NLU).....   20
 Number of Groundwater Subcatchments in Runoff (NGW)...  100
 Number of Interface Locations for all Blocks (NIE).... 1000
 Number of Elements in the Transport Block (NET).......  500
 Number of Storage Junctions in Transport (NTSE).......  100
 Number of Transport interface input locations (NTHI)..  500
 Number of Transport interface output locations (NTHO).  500
 Number of Transport input locations on R lines (NTHR).   80
```

```
Number of Transport printed output locations (NTOA)...   80
Number of Tabular Flow Splitters in Transport (NTSP)..   50
Number of Elements in the Extran Block (NEE).......... 4000
Number of Pumps in Extran (NEP).......................   75
Number of Orifices in Extran (NEO)....................  200
Number of Tide Gates/Free Outfalls in Extran (NTG)....  200
Number of Extran Weirs (NEW)..........................  400
Number of Extran Printout Locations (NPO).............  150
Number of Tide Elements in Extran (NTE)...............   50
Number of Natural Channels (NNC)...................... 1200
Number of Storage Junctions in Extran (NVSE).......... 1000
Number of Time History Data Points in Extran (NTVAL)..  500
Number of Data Points for Variable Storage Elements
  in the Extran Block (NVST)..........................   25
Number of Input Hydrographs in Extran (NEH)...........  500
Number of Allowable Channel Connections to
  Junctions in the Extran Block (NCHN)................   15
Number Rain Gages in Rain and Runoff (MAXRG)..........  200
Number PRATE/VRATE Points for Extran Pump
  Input (MAXPRA)......................................   10
Number of Variable Orifices in Extran (NVORF).........   50
Number of Variable Orifice Data Points (NVOTIM).......   50
Number of Allowable Precip. Values/yr in Rain (LIMRN). 5000
Number of Storm Events for Rain Analysis (LSTORM).....20000
Number of Plugs for Plug-flow in S/T (NPLUG).......... 3000
Number Conduits for Extran Results to ASCII
  File (MXFLOW).......................................  400


*******************************************************
* Entry made to the EXTENDED TRANSPORT MODEL (EXTRAN)  *
* developed 1973 by Camp, Dresser and McKee (CDM) with *
* modifications 1977-1991 by the University of Florida. *
*                                                      *
* Most recent update: March 1999 by CDM, Oregon        *
* State University, and XP Software, Inc.              *
*                                                      *
* "Smooth runs the water where the brook is deep."     *
*                   Shakespeare, Henry VI, II, III, 1  *
*******************************************************


1--------------------------------------------------------------------------------
ENVIRONMENTAL PROTECTION AGENCY          ****   EXTENDED TRANSPORT PROGRAM   ****       WATER RESOURCES DIVISION
```

```
WASHINGTON, D.C.                   ****                        ****      CAMP DRESSER & MCKEE INC.
                                   ****     ANALYSIS MODULE    ****      ANNANDALE, VIRGINIA

   Detroit River International Crossing
   Lennon Drain Alternative 1B,2B Syphon  - 100-Year Flow


Control information for simulation
----------------------------------

Integration cycles................   12000

Length of integration step is......    5.00 seconds
Simulation length.................   16.67 hours

Do not create equiv. pipes(NEQUAL).       0

Use metric units for I/O..........       1

Printing starts in cycle..........       1

Intermediate printout intervals of.       1 cycles
Intermediate printout intervals of.    0.08 minutes

Summary printout intervals of......       1 cycles
Summary printout time interval of..    0.08 minutes

Hot start file parameter (JREDO)...       0

Initial time (TZERO)..............    0.00 hours
This is time displacement from JIN interface file starting date/time when
interface file is used.
This also describes starting hour in K3 line hydrograph input when K3
lines are used.
Initial date (IDATZ)............  19060714 (yr/mo/day)
NOTE: Initial date from JIN interface file will be used, if accessed,
unless IDATZ is negative.

Iteration variables: ITMAX........      30
                     SURTOL.......  0.0500

Default surface area of junctions..  1.22 square meters.

EXTRAN VERSION 3.3 SOLUTION. (ISOL = 0).
Sum of junction flow is zero during surcharge.
```

```
NORMAL FLOW OPTION WHEN THE WATER
SURFACE SLOPE IS LESS THAN THE
GROUND SURFACE SLOPE (KSUPER=0)....

NJSW INPUT HYDROGRAPH JUNCTIONS....     0

    INTERMEDIATE HEADER LINES ARE PRINTED AS IN ORIGINAL PROGRAM

    IDS ARE WRITTEN AS IN ORIGINAL PROGRAM

    CONDUIT LENGTHS ON C1 LINE MUST EQUAL IRREGULAR SECTION LENGTH ENTERED ON THE C3 OR X1 LINES (IWLEN = 0)

    JELEV = 0 (DEFAULT). STANDARD INPUTS ARE DEPTHS NOT ELEVATIONS

    JDOWN = 0 - Minimum of normal or critical depth will be used at free outfalls (I1).

    Characteristic depth for M2 and S2 water surface profiles will be computed as in previous versions of EXTRAN (IM2 = 0).

    SEDIMENT DEPTHS WILL NOT BE READ FROM C1 LINES

    Intermediate continuity output will not be created

1-------------------------------------------------------------------------------
ENVIRONMENTAL PROTECTION AGENCY          ****   EXTENDED TRANSPORT PROGRAM   ****       WATER RESOURCES DIVISION
WASHINGTON, D.C.                         ****                                ****       CAMP DRESSER & MCKEE INC.
                                         ****        ANALYSIS MODULE         ****       ANNANDALE, VIRGINIA

    Detroit River International Crossing
    Lennon Drain Alternative 1B,2B Syphon  - 100-Year Flow


1
 ****************************************************
 *                   Conduit Data                   *
 ****************************************************
```

INP NUM	CONDUIT NUMBER	LENGTH (M)	CONDUIT CLASS	AREA (SQ M)	MANNING COEF.	MAX WIDTH (M)	DEPTH (M)	JUNCTIONS AT THE ENDS		INVERT HEIGHT ABOVE JUNCTIONS		TRAPEZOID SIDE SLOPES	
1	1	70.	TRAPEZOID	803.64	0.03500	350.00	2.20	1	2			5.20	8.70
2	2	70.	TRAPEZOID	803.64	0.03500	350.00	2.20	2	3			5.20	8.70
3	3	100.	TRAPEZOID	803.64	0.03500	350.00	2.20	3	4			5.20	8.70
4	4	100.	TRAPEZOID	803.64	0.03500	350.00	2.20	4	5			5.20	8.70
5	5	30.	RECTANGLE	3.12	0.01500	2.60	1.20	5	55				

```
   6        55       35. RECTANGLE      4.50   0.01500      3.00      1.50       55        6     0.00     0.30
   7         6       50. RECTANGLE      4.50   0.01500      3.00      1.50        6       66
   8        66       35. RECTANGLE      4.50   0.01500      3.00      1.50       66        7
   9         7       10. RECTANGLE      4.50   0.01500      3.00      1.50        7        8
  10         8       75. TRAPEZOID     18.18   0.03500      2.00      1.80        8        9                        4.30   4.70
  11         9       75. TRAPEZOID     18.18   0.03500      2.00      1.80        9       10                        4.30   4.70
  12        10       75. TRAPEZOID     18.18   0.03500      2.00      1.80       10       11                        4.30   4.70


 ===> WARNING !!! (C*DELT/LEN) IN CONDUIT         7 IS  1.9 AT FULL DEPTH.

 ********************
 *  Conduit Volume  *
 ********************

 Input full depth volume............    2.7801E+05 cubic meters
            Conduit #...         6 has zero slope.  0.001 feet added to upstream invert.

 ===> Warning !! The upstream and downstream junctions for the following conduits
                 have been reversed to correspond to the positive flow and decreasing
                 slope EXTRAN convention.  A negative flow in the output thus means
                 the flow was from your original upstream junction to your original
                 downstream junction.  Any initial flow has been multiplied by -1.

                 1.  Conduit #...        66  has been changed.

1--------------------------------------------------------------------------------
 ENVIRONMENTAL PROTECTION AGENCY            ****   EXTENDED TRANSPORT PROGRAM   ****       WATER RESOURCES DIVISION
 WASHINGTON, D.C.                           ****                                ****       CAMP DRESSER & MCKEE INC.
                                            ****         ANALYSIS MODULE        ****       ANNANDALE, VIRGINIA

     Detroit River International Crossing
     Lennon Drain Alternative 1B,2B Syphon  - 100-Year Flow


1
 ****************************************************
 *                  Junction Data                   *
 ****************************************************

 INP  JUNCTION    GROUND     CROWN     INVERT     QINST   INITIAL     CONNECTING CONDUITS
 NUM   NUMBER      ELEV.     ELEV.      ELEV.       CMS  DEPTH(M)
 ---   ------    -------   -------    ------    ------- ---------   -------------------
   1         1    183.00    182.61    180.41     11.80      0.00        1
   2         2    183.00    182.47    180.27      0.00      0.00        1       2
```

```
   3       3   183.00   182.33   180.13     0.00     0.00        2       3
   4       4   183.00   182.13   179.93     0.00     0.00        3       4
   5       5   183.00   181.93   179.73     0.00     0.00        4       5
   6      55   183.00   181.17   179.67     0.00     0.00        5      55
   7       6   183.00   170.90   169.10     0.00     0.00       55       6
 ===> Warning all conduits connecting to Junction         6 lie above the Junction invert.
   8      66   183.00   170.60   169.10     0.00     0.00        6      66
   9       7   183.00   180.96   179.46     0.00     0.00       66       7
  10       8   183.00   181.18   179.38     0.00     0.00        7       8
  11       9   183.00   181.03   179.23     0.00     0.00        8       9
  12      10   183.00   180.88   179.08     0.00     0.00        9      10
  13      11   183.00   180.73   178.93     0.00     0.00       10


 **************************************************
 *          FREE OUTFALL DATA (DATA GROUP I1)     *
 *         BOUNDARY CONDITION ON DATA GROUP J1    *
 **************************************************

 OUTFALL AT JUNCTION....        11 HAS BOUNDARY CONDITION NUMBER...         1

1-------------------------------------------------------------------------------
 ENVIRONMENTAL PROTECTION AGENCY           ****   EXTENDED TRANSPORT PROGRAM   ****        WATER RESOURCES DIVISION
 WASHINGTON, D.C.                          ****                                ****        CAMP DRESSER & MCKEE INC.
                                           ****         ANALYSIS MODULE        ****        ANNANDALE, VIRGINIA

     Detroit River International Crossing
     Lennon Drain Alternative 1B,2B Syphon  - 100-Year Flow



 **************************************************
 *        INTERNAL CONNECTIVITY INFORMATION       *
 **************************************************

          CONDUIT     JUNCTION     JUNCTION
          -------     --------     --------
          90013          11            0
1
 *****************************************************
 *        BOUNDARY CONDITON INFORMATION              *
 *                 DATA GROUPS J1-J4                 *
 *****************************************************
```

```
BC NUMBER..         1 HAS NO CONTROL WATER SURFACE.
 TZERO =       1906195  0.0000000E+00

***********************************
*    INITIAL MODEL CONDITION      *
* INITIAL TIME =       0.00 HOURS  *
***********************************

JUNCTION / DEPTH  / ELEVATION    ===>  "*" JUNCTION IS SURCHARGED.
       1/   0.00 /   180.41         2/   0.00 /   180.27         3/   0.00 /   180.13
       4/   0.00 /   179.93         5/   0.00 /   179.73        55/   0.00 /   179.67
       6/   0.00 /   169.10        66/   0.00 /   169.10         7/   0.00 /   179.46
       8/   0.00 /   179.38         9/   0.00 /   179.23        10/   0.00 /   179.08
      11/   0.00 /   178.93

  CONDUIT/       FLOW   ===> "*" CONDUIT USES THE NORMAL FLOW OPTION.
       1/        0.00          2/        0.00          3/        0.00          4/        0.00
       5/        0.00         55/        0.00          6/        0.00         66/        0.00
       7/        0.00          8/        0.00          9/        0.00         10/        0.00
   90013/        0.00

  CONDUIT/   VELOCITY
       1/        0.00          2/        0.00          3/        0.00          4/        0.00
       5/        0.00         55/        0.00          6/        0.00         66/        0.00
       7/        0.00          8/        0.00          9/        0.00         10/        0.00

  CONDUIT/ CROSS SECTIONAL AREA
       1/        0.00          2/        0.00          3/        0.00          4/        0.00
       5/        0.00         55/        0.00          6/        0.00         66/        0.00
       7/        0.00          8/        0.00          9/        0.00         10/        0.00

  CONDUIT/ HYDRAULIC RADIUS
       1/        0.00          2/        0.00          3/        0.00          4/        0.00
       5/        0.00         55/        0.00          6/        0.00         66/        0.00
       7/        0.00          8/        0.00          9/        0.00         10/        0.00

  CONDUIT/ UPSTREAM/ DOWNSTREAM ELEVATION
       1/   180.41/   180.27         2/   180.27/   180.13         3/   180.13/   179.93
       4/   179.93/   179.73         5/   179.73/   179.67        55/   179.67/   169.40
       6/   169.10/   169.10        66/   179.46/   169.10         7/   179.46/   179.38
       8/   179.38/   179.23         9/   179.23/   179.08        10/   179.08/   178.93


*********************************
```

```
 *      FINAL MODEL CONDITION     *
 *   FINAL TIME =     16.67 HOURS *
 **********************************

 >>> ENDING DATE AND TIME OF EXTRAN RUN ARE:
 JULIAN DATE: 1906195
 YR/MO/DA:   1906/ 7/14
 TIME OF DAY: 16.667 HRS

 JUNCTION / DEPTH  / ELEVATION    ===>  "*" JUNCTION IS SURCHARGED.
         1/   1.14 /   181.55          2/   1.28 /   181.55          3/   1.42 /   181.55
         4/   1.62 /   181.55          5/   1.82 /   181.55         55/   1.60*/   181.27
         6/  12.05*/   181.15         66/  11.87*/   180.97          7/   0.91 /   180.37
         8/   1.32 /   180.70          9/   1.31 /   180.54         10/   1.28 /   180.36
        11/   0.85 /   179.78

  CONDUIT/       FLOW   ===> "*" CONDUIT USES THE NORMAL FLOW OPTION.
        1/      11.72          2/      11.55          3/      11.45          4/      11.23
        5/      11.16         55/      11.16          6/      11.16         66/     -11.16
        7/      11.16*         8/      11.16          9/      11.16         10/      11.16
    90013/      11.16

  CONDUIT/   VELOCITY
        1/       0.03          2/       0.02          3/       0.02          4/       0.02
        5/       3.58         55/       2.48          6/       2.48         66/      -3.09
        7/       3.34          8/       1.07          9/       1.10         10/       1.54

  CONDUIT/ CROSS SECTIONAL AREA
        1/     435.22          2/     486.71          3/     549.59          4/     624.10
        5/       3.12         55/       4.50          6/       4.50         66/       3.62
        7/       3.35          8/      10.39          9/      10.15         10/       7.26

  CONDUIT/  FINAL VOLUME
        1/   30465.41          2/   34069.54          3/   54958.80          4/   62409.62
        5/      93.60         55/     157.50          6/     225.00         66/     126.59
        7/      33.45          8/     779.13          9/     761.00         10/     544.85

  CONDUIT/ HYDRAULIC RADIUS
        1/       1.19          2/       1.32          3/       1.48          4/       1.67
        5/       0.41         55/       0.50          6/       0.50         66/       0.67
        7/       0.64          8/       0.74          9/       0.73         10/       0.61

  CONDUIT/ UPSTREAM/ DOWNSTREAM ELEVATION
        1/   181.55/   181.55          2/   181.55/   181.55          3/   181.55/   181.55
        4/   181.55/   181.55          5/   181.55/   181.27         55/   181.27/   181.15
```

```
      6/   181.15/   180.97         66/   180.37/   180.97          7/   180.37/   180.70
      8/   180.70/   180.54          9/   180.54/   180.36         10/   180.36/   179.78



 ##################################################
 #           Surcharge Iteration Summary          #
 ##################################################

 Maximum number of iterations in a time step.....       31
 Total number of iterations in the simulation..      26677
 Average number of iterations per time step......     2.22
 Surcharge iterations during the simulation......     2677
 Maximum surcharge flow error during simulation.. 1.52E+00 cms
 Total number of time steps during simulation..      12000


1
 **************************************************
 *         CONDUIT COURANT CONDITION SUMMARY      *
 * TIME IN MINUTES DELT > COURANT TIME STEP       *
 **************************************************
 * SEE BELOW FOR EXPLANATION OF COURANT TIME STEP. *
 **************************************************

  CONDUIT #  TIME(MN)  CONDUIT #  TIME(MN)  CONDUIT #  TIME(MN)CONDUIT #  TIME(MN)
  ---------  --------  ---------  --------  ---------  ----------------  --------
          1     0.00           2     0.00           3     0.00         4     0.00
          5   832.67          55   990.67           6   990.00        66   989.92
          7   989.58           8     0.00           9     0.00        10     0.00

1
 ***********************************************
 *         CONDUIT COURANT CONDITION SUMMARY   *
 ***********************************************
 * COURANT   =            CONDUIT LENGTH       *
 * TIME STEP = ------------------------------- *
 *               VELOCITY + SQRT(GRVT*AREA/WIDTH) *
 ***********************************************
 * AVERAGE COURANT CONDITION TIME STEP(SECONDS) *
 ***********************************************

  CONDUIT # TIME(SEC)  CONDUIT # TIME(SEC)  CONDUIT # TIME(SEC)CONDUIT # TIME(SEC)
  ---------  --------  ---------  --------  ---------  ----------------  --------
          1    24.99           2    23.01           3    30.32         4    28.57
```

```
        5      4.82           55     2.82            6      4.72           66      2.69
        7      1.69            8    20.78            9     21.25           10     20.95

1
 ***************************************************
 * EXTRAN CONTINUITY BALANCE AT THE LAST TIME STEP *
 ***************************************************

 ************************************************
 * JUNCTION INFLOW, OUTFLOW OR STREET FLOODING *
 ************************************************

   JUNCTION   INFLOW, CU M
   --------  -------------
          1    7.0800E+05

   JUNCTION  OUTFLOW, CU M
   --------  -------------
         11    5.5374E+05

 *******************************************************
 * INITIAL SYSTEM VOLUME         =     7.2500E-03 CU M  *
 * TOTAL SYSTEM INFLOW VOLUME    =     7.0800E+05 CU M  *
 * INFLOW + INITIAL VOLUME       =     7.0800E+05 CU M  *
 *******************************************************
 * TOTAL SYSTEM OUTFLOW          =     5.5374E+05 CU M  *
 * VOLUME LEFT IN SYSTEM         =     1.8466E+05 CU M  *
 * OUTFLOW + FINAL VOLUME        =     7.3840E+05 CU M  *
 *******************************************************
 * ERROR IN CONTINUITY, PERCENT =          -4.29        *
 *******************************************************


 TEST WRITE OF ALTERNATIVE CONTINUITY ERROR CALCULATION
 VOLUME LEFT IN SYSTEM        =     1.5432E+05 CU. FT.
 ERROR IN CONTINUITY PERCENT =          -0.08


- - - - - - - - - - - - - - - -  SUMMARY OF FULL FLOW CHANNEL WARNINGS - - - - - - - - - - - - - - - - - - - - - -

  OPEN CHANNEL  TIME STEP OF FIRST  TIME OF FIRST  TIME STEP OF LAST  TIME OF LAST
     NUMBER         OCCURRENCE        OCCURRENCE       OCCURRENCE       OCCURRENCE
                                       (HOURS)                           (HOURS)
  ------------  ------------------  -------------  -----------------  ------------
          1               1              0.00               1              0.00
```

THE PROGRAM USES FULL DEPTH CHANNEL CHARACTERISTICS TO COMPUTE FLOW THROUGH THE TRAPEZOIDAL, IRREGULAR, OR PARABOLIC/POWER FUNCTION CONDUIT WHEN THE COMPUTED DEPTHS EXCEED MAXIMUM DEPTH. THIS WILL AFFECT THE MAXIMUM COMPUTED HEAD AND FLOWS IN THE MODEL. IT IS HIGHLY RECOMMENDED THAT THE MODELED CROSS SECTIONS BE EXTENDED TO ELIMINATE THESE FULL FLOW CHANNEL WARNINGS

1

```
***********************************************************
*  J U N C T I O N   S U M M A R Y   S T A T I S T I C S *
***********************************************************
```

Detroit River International Crossing
Lennon Drain Alternative 1B,2B Syphon - 100-Year Flow

JUNCTION NUMBER	GROUND ELEVATION (M)	UPPERMOST PIPE CROWN ELEVATION (M)	MEAN JUNCTION ELEVATION (M)	JUNCTION AVERAGE % CHANGE	MAXIMUM JUNCTION ELEV. (M)	TIME OF OCCURENCE HR.	MIN.	METERS OF SURCHARGE AT MAX ELEVATION	METERS MAX. DEPTH IS BELOW GROUND ELEVATION	LENGTH OF SURCHARGE (MIN)	LENGTH OF FLOODING (MIN)	MAXIMUM JUNCTION AREA (SQ.MET)
1	183.00	182.61	181.24	0.0231	182.52	0	0	0.00	0.48	0.0	0.0	2.607E+04
2	183.00	182.47	181.24	0.0114	181.55	16	40	0.00	1.45	0.0	0.0	2.575E+04
3	183.00	182.33	181.24	0.0093	181.55	16	40	0.00	1.45	0.0	0.0	3.145E+04
4	183.00	182.13	181.23	0.0122	181.55	16	40	0.00	1.45	0.0	0.0	3.726E+04
5	183.00	181.93	181.23	0.0176	181.55	16	40	0.00	1.45	0.0	0.0	1.877E+04
55	183.00	181.17	180.94	1.4442	181.28	15	1	0.11	1.72	341.2	0.0	1.668E+03
6	183.00	170.90	180.81	1.1602	181.17	15	1	10.27	1.83	990.3	0.0	3.954E+03
66	183.00	170.60	180.68	0.9829	181.02	15	0	10.42	1.98	990.7	0.0	5.581E+03
7	183.00	180.96	180.47	0.6701	180.61	4	40	0.00	2.39	0.0	0.0	3.256E+03
8	183.00	181.18	180.58	0.2041	180.71	15	0	0.00	2.29	0.0	0.0	5.390E+02
9	183.00	181.03	180.42	0.0629	180.54	15	1	0.00	2.46	0.0	0.0	1.037E+03
10	183.00	180.88	180.25	0.0223	180.37	15	1	0.00	2.63	0.0	0.0	9.870E+02
11	183.00	180.73	179.69	0.0197	179.79	15	1	0.00	3.21	0.0	0.0	8.023E+02

1

```
*******************************************************
*  C O N D U I T   S U M M A R Y   S T A T I S T I C S  *
*******************************************************
```

Detroit River International Crossing
Lennon Drain Alternative 1B,2B Syphon - 100-Year Flow

CONDUIT MAXIMUM TIME MAXIMUM TIME RATIO OF MAXIMUM DEPTH ABOVE LENGTH CONDUIT

CONDUIT NUMBER	DESIGN FLOW (CMS)	DESIGN VELOCITY (M/S)	VERTICAL DEPTH (M)	COMPUTED FLOW (CMS)	OF OCCURRENCE HR.	OF OCCURRENCE MIN.	COMPUTED VELOCITY (MPS)	OF OCCURRENCE HR.	OF OCCURRENCE MIN.	MAX. TO DESIGN FLOW	INV. AT CONDUIT ENDS UPSTREAM (M)	INV. AT CONDUIT ENDS DOWNSTREAM (M)	OF NORM FLOW (MIN)	SLOPE (M/M)
1	1.69E+03	2.10	2.200	7.32E+02	0	0	2.04	0	0	0.43	2.11	1.28	28.7	0.00200
2	1.69E+03	2.10	2.200	2.50E+02	0	0	1.47	0	0	0.15	1.28	1.42	4.4	0.00200
3	1.69E+03	2.10	2.200	9.72E+01	0	2	0.88	0	2	0.06	1.42	1.62	2.8	0.00200
4	1.69E+03	2.10	2.200	7.55E+01	0	4	0.68	0	4	0.04	1.62	1.82	0.7	0.00200
5	5.14E+00	1.65	1.200	1.23E+01	4	28	3.94	4	28	2.39	1.82	1.61	17.0	0.00200
55	1.02E+02	22.75	1.500	1.13E+01	14	56	7.84	0	2	0.11	1.61	11.77	9.4	0.29343
6	8.48E-01	0.19	1.500	1.13E+01	14	56	2.50	14	56	13.28	12.07	11.93	0.6	0.00002
66	1.03E+02	22.85	1.500	-1.13E+01	14	56	-3.09	15	1	-0.11	1.15	11.93	0.0	0.29600
7	1.69E+01	3.76	1.500	1.17E+01	15	0	3.43	15	0	0.69	1.15	1.33	108.4	0.00800
8	2.29E+01	1.26	1.800	1.14E+01	15	0	1.09	0	12	0.50	1.33	1.31	17.2	0.00200
9	2.29E+01	1.26	1.800	1.13E+01	15	1	1.11	15	1	0.49	1.31	1.29	8.5	0.00200
10	2.29E+01	1.26	1.800	1.13E+01	15	1	1.54	15	1	0.49	1.29	0.86	0.0	0.00200
90013	UNDEF	UNDEF	UNDEF	1.13E+01	15	1								

1

```
**************************************************
* SUBCRITICAL AND CRITICAL FLOW ASSUMPTIONS FROM *
* SUBROUTINE HEAD.  SEE FIGURE 5-4 IN THE EXTRAN *
*       MANUAL FOR FURTHER INFORMATION.          *
**************************************************
```

CONDUIT NUMBER	LENGTH OF DRY FLOW(MIN)	LENGTH OF SUBCRITICAL FLOW(MIN)	LENGTH OF UPSTR. CRITICAL FLOW(MIN)	LENGTH OF DOWNSTR. CRITICAL FLOW(MIN)	MEAN FLOW (CMS)	AVERAGE % CHANGE	TOTAL FLOW CUBIC MET	MAXIMUM HYDRAULIC RADIUS(MET)	MAXIMUM CROSS SECT AREA(SQ.M)
1	0.00	1000.00	0.00	0.00	12.03	0.0125	7.2191E+05	1.1857	435.2089
2	0.08	999.92	0.00	0.00	11.53	0.0059	6.9179E+05	1.3189	486.6992
3	0.08	999.92	0.00	0.00	10.80	0.0084	6.4818E+05	1.4797	549.5795
4	0.25	999.75	0.00	0.00	9.82	0.0168	5.8950E+05	1.6677	624.0876
5	0.83	999.17	0.00	0.00	9.27	3.2861	5.5639E+05	0.5899	3.1200
55	1.67	993.92	0.00	4.42	9.27	0.0759	5.5624E+05	0.7104	4.5000
6	1.83	998.17	0.00	0.00	9.26	9.0791	5.5584E+05	0.7045	4.5000
66	9.92	990.08	0.00	0.00	-9.26	0.0750	-5.5581E+05	0.7033	3.9726
7	10.00	990.00	0.00	0.00	9.26	0.8226	5.5565E+05	0.6718	3.6499
8	10.08	989.92	0.00	0.00	9.26	0.2413	5.5531E+05	0.7406	10.5079
9	10.17	989.83	0.00	0.00	9.24	0.0746	5.5448E+05	0.7306	10.2297
10	10.75	989.25	0.00	0.00	9.23	0.0247	5.5373E+05	0.6160	7.3254
90013	UNDEFINED	UNDEFINED	UNDEFINED	UNDEFINED	9.23		5.5373E+05		

```
*************************************************************
```

```
* AVERAGE % CHANGE IN JUNCTION OR CONDUIT IS DEFINED AS:   *
* CONDUIT  % CHANGE ==> 100.0 ( Q(n+1) - Q(n) ) / Qfull    *
* JUNCTION % CHANGE ==> 100.0 ( Y(n+1) - Y(n) ) / Yfull    *
************************************************************

 The Conduit with the largest average change...         6 had     9.079 percent
The Junction with the largest average change...        55 had     1.444 percent


===> Extended Transport model simulation ended normally.

===> SWMM 4.4GU  simulation ended normally.
     Always check output file for possible warning messages.

===> Your input file was named : PCTmpl.dat
===> Your output file was named: PCTmpl.out

*******************************************************
*       SWMM 4.4GU  Simulation Date and Time Summary  *
*******************************************************
* Starting Date... November   17, 2006                *
*         Time...          9:35:20.890                *
*   Ending Date... November   17, 2006                *
*         Time...          9:36: 1.700                *
*  Elapsed Time...              0.680 minutes.        *
*  Elapsed Time...             40.809 seconds.        *
*******************************************************
```

Appendix A.2.4.3

Cahill Drain

```
1          ************************************************
           *    U.S. Environmental Protection Agency      *
           *    Storm Water Management Model  (SWMM)      *
           *                Version 4.4GU                 *
           *                                              *
           *                CDM/OSU Beta                  *
           *       Release Date - November 23, 1999       *
           * Camp Dresser & McKee and Oregon State Univ.  *
           *          Chuck Moore and Wayne Huber         *
           *  Compiled using Digital Visual Fortran 6.0   *
           ************************************************

                           Developed by

           ************************************************
           *             Metcalf & Eddy, Inc.             *
           *            University of Florida             *
           *       Water Resources Engineers, Inc.        *
           *     (Now Camp, Dresser and McKee, Inc.)      *
           *               September 1970                 *
           ************************************************

                   Distributed and Maintained by

           ************************************************
           *      U.S. Environmental Protection Agency    *
           * Center for Exposure Assessment Modeling (CEAM)*
           *    Athens Environmental Research Laboratory  *
           *            960 College Station Road          *
           *            Athens, GA    30605-2720          *
           ************************************************

           ************************************************
           *     This is a new release of SWMM.  If any   *
           *     problems occur executing this model      *
           *     system, contact Mr. Frank Stancil,       *
           *     U.S. Environmental Protection Agency.    *
           *     706/355-8328 (voice)                     *
           *     e-mail: stancil@athens.ath.epa.gov       *
           *     Or contact Wayne C. Huber at Oregon St. U.*
           *     541/737-6150 or wayne.huber@orst.edu     *
           *     Or Michael F. Schmidt at Camp Dresser &  *
           *     McKee (904) 281-0170 SCHMIDTMF@CDM.COM   *
           ************************************************
```

```
         ************************************************
         *  This is an implementation of EPA SWMM 4.4GU  *
         *  "Nature is full of infinite causes which     *
         *   have never occurred in experience" da Vinci *
         ************************************************


 ###########################################
 #        File names by SWMM Block         #
 #         JIN  -> Input to a Block        #
 #        JOUT  -> Output from a Block     #
 ###########################################

   JIN for Block #     1 File #    0  JIN.UF
  JOUT for Block #     1 File #    9  PCTmp1.int

 ###########################################
 # Scratch file names for this simulation. #
 ###########################################

 NSCRAT #     1 File #   21  SCRT1.UF
 NSCRAT #     2 File #   22  SCRT2.UF
 NSCRAT #     3 File #   23  SCRT3.UF
 NSCRAT #     4 File #   24  SCRT4.UF
 NSCRAT #     5 File #   25  SCRT5.UF
 NSCRAT #     6 File #   26  SCRT6.UF
 NSCRAT #     7 File #   27  SCRT7.UF
 NSCRAT #     8 File #   28  SCRT8.UF

 ***************************************************
 *    Parameter Values on the Tapes Common Block   *
 ***************************************************

  Number of Subcatchments in the Runoff Block (NW)...... 1000
  Number of Channel/Pipes in the Runoff Block (NG)...... 1000
  Number of Connections to Runoff Channels/Inlets (NCP).    6
  Number of Water Quality Constituents (MQUAL)..........   20
  Number of Runoff Land Uses per Subcatchment (NLU).....   20
  Number of Groundwater Subcatchments in Runoff (NGW)...  100
  Number of Interface Locations for all Blocks (NIE).... 1000
  Number of Elements in the Transport Block (NET).......  500
  Number of Storage Junctions in Transport (NTSE).......  100
  Number of Transport interface input locations (NTHI)..  500
  Number of Transport interface output locations (NTHO).  500
  Number of Transport input locations on R lines (NTHR).   80
```

```
 Number of Transport printed output locations (NTOA)...   80
 Number of Tabular Flow Splitters in Transport (NTSP)..   50
 Number of Elements in the Extran Block (NEE).......... 4000
 Number of Pumps in Extran (NEP)......................   75
 Number of Orifices in Extran (NEO)...................  200
 Number of Tide Gates/Free Outfalls in Extran (NTG)....  200
 Number of Extran Weirs (NEW).........................  400
 Number of Extran Printout Locations (NPO)............  150
 Number of Tide Elements in Extran (NTE)..............   50
 Number of Natural Channels (NNC)..................... 1200
 Number of Storage Junctions in Extran (NVSE)......... 1000
 Number of Time History Data Points in Extran (NTVAL)..  500
 Number of Data Points for Variable Storage Elements
   in the Extran Block (NVST).........................   25
 Number of Input Hydrographs in Extran (NEH)..........  500
 Number of Allowable Channel Connections to
   Junctions in the Extran Block (NCHN)...............   15
 Number Rain Gages in Rain and Runoff (MAXRG).........  200
 Number PRATE/VRATE Points for Extran Pump
   Input (MAXPRA).....................................   10
 Number of Variable Orifices in Extran (NVORF)........   50
 Number of Variable Orifice Data Points (NVOTIM).......   50
 Number of Allowable Precip. Values/yr in Rain (LIMRN). 5000
 Number of Storm Events for Rain Analysis (LSTORM).....20000
 Number of Plugs for Plug-flow in S/T (NPLUG)......... 3000
 Number Conduits for Extran Results to ASCII
   File (MXFLOW)......................................  400


 ********************************************************
 * Entry made to the EXTENDED TRANSPORT MODEL (EXTRAN)   *
 * developed 1973 by Camp, Dresser and McKee (CDM) with  *
 * modifications 1977-1991 by the University of Florida. *
 *                                                       *
 * Most recent update: March 1999 by CDM, Oregon         *
 * State University, and XP Software, Inc.               *
 *                                                       *
 * "Smooth runs the water where the brook is deep."      *
 *                  Shakespeare, Henry VI, II, III, 1    *
 ********************************************************
```

```
WASHINGTON, D.C.                           ****                          ****      CAMP DRESSER & MCKEE INC.
                                           ****      ANALYSIS MODULE     ****      ANNANDALE, VIRGINIA

    Detroit River International Crossing
    Wolfe/Cahill Drain Existing Condition - 100-Year Flow


Control information for simulation
----------------------------------

Integration cycles.................   1440

Length of integration step is......   5.00 seconds
Simulation length..................   2.00 hours

Do not create equiv. pipes(NEQUAL).      0

Use metric units for I/O...........      1

Printing starts in cycle...........      1

Intermediate printout intervals of.      1 cycles
Intermediate printout intervals of.   0.08 minutes

Summary printout intervals of......      1 cycles
Summary printout time interval of..   0.08 minutes

Hot start file parameter (JREDO)...      0

Initial time (TZERO)...............   0.00 hours
This is time displacement from JIN interface file starting date/time when
interface file is used.
This also describes starting hour in K3 line hydrograph input when K3
lines are used.
Initial date (IDATZ).............  19060714 (yr/mo/day)
NOTE: Initial date from JIN interface file will be used, if accessed,
unless IDATZ is negative.

Iteration variables: ITMAX.........     30
                     SURTOL........ 0.0500

Default surface area of junctions..  1.22 square meters.

EXTRAN VERSION 3.3 SOLUTION. (ISOL = 0).
Sum of junction flow is zero during surcharge.
```

```
NORMAL FLOW OPTION WHEN THE WATER
SURFACE SLOPE IS LESS THAN THE
GROUND SURFACE SLOPE (KSUPER=0)....

NJSW INPUT HYDROGRAPH JUNCTIONS....     0

    INTERMEDIATE HEADER LINES ARE PRINTED AS IN ORIGINAL PROGRAM

    IDS ARE WRITTEN AS IN ORIGINAL PROGRAM

    CONDUIT LENGTHS ON C1 LINE MUST EQUAL IRREGULAR SECTION LENGTH ENTERED ON THE C3 OR X1 LINES (IWLEN = 0)

    JELEV = 0 (DEFAULT). STANDARD INPUTS ARE DEPTHS NOT ELEVATIONS

    JDOWN = 0 - Minimum of normal or critical depth will be used at free outfalls (I1).

    Characteristic depth for M2 and S2 water surface profiles will be computed as in previous versions of EXTRAN (IM2 = 0).

    SEDIMENT DEPTHS WILL NOT BE READ FROM C1 LINES

    Intermediate continuity output will not be created

1--------------------------------------------------------------------------------
ENVIRONMENTAL PROTECTION AGENCY           ****  EXTENDED TRANSPORT PROGRAM  ****        WATER RESOURCES DIVISION
WASHINGTON, D.C.                          ****                              ****        CAMP DRESSER & MCKEE INC.
                                          ****        ANALYSIS MODULE       ****        ANNANDALE, VIRGINIA

    Detroit River International Crossing
    Wolfe/Cahill Drain Existing Condition - 100-Year Flow


1
*****************************************************
*                    Conduit Data                   *
*****************************************************
```

INP NUM	CONDUIT NUMBER	LENGTH (M)	CONDUIT CLASS	AREA (SQ M)	MANNING COEF.	MAX WIDTH (M)	DEPTH (M)	JUNCTIONS AT THE ENDS		INVERT HEIGHT ABOVE JUNCTIONS	TRAPEZOID SIDE SLOPES	
1	1	100.	TRAPEZOID	12.27	0.03500	0.91	2.26	1	2		2.00	2.00
2	2	100.	TRAPEZOID	12.27	0.03500	0.91	2.26	2	3		2.00	2.00
3	3	100.	TRAPEZOID	12.27	0.03500	0.91	2.26	3	4		2.00	2.00
4	4	100.	TRAPEZOID	12.27	0.03500	0.91	2.26	4	5		2.00	2.00
5	5	40.	RECTANGLE	6.75	0.01500	4.50	1.50	5	6			

```
  6        6      100. TRAPEZOID    12.27   0.03500      0.91      2.26        6        7                    2.00    2.00
  7        7      100. TRAPEZOID    12.27   0.03500      0.91      2.26        7        8                    2.00    2.00
  8        8      100. TRAPEZOID    12.27   0.03500      0.91      2.26        8        9                    2.00    2.00
  9        9      100. TRAPEZOID    12.27   0.03500      0.91      2.26        9       10                    2.00    2.00
 10       10      100. TRAPEZOID    12.27   0.03500      0.91      2.26       10       11                    2.00    2.00


 *******************
 *  Conduit Volume  *
 *******************

 Input full depth volume...........    1.1315E+04 cubic meters

1-------------------------------------------------------------------------------
 ENVIRONMENTAL PROTECTION AGENCY          ****   EXTENDED TRANSPORT PROGRAM   ****       WATER RESOURCES DIVISION
 WASHINGTON, D.C.                         ****                                ****       CAMP DRESSER & MCKEE INC.
                                          ****         ANALYSIS MODULE        ****       ANNANDALE, VIRGINIA

    Detroit River International Crossing
    Wolfe/Cahill Drain Existing Condition - 100-Year Flow


1
 **********************************************
 *                Junction Data               *
 **********************************************

 INP  JUNCTION    GROUND    CROWN     INVERT     QINST   INITIAL    CONNECTING CONDUITS
 NUM    NUMBER     ELEV.     ELEV.     ELEV.       CMS  DEPTH(M)
 ---    ------   -------   -------    ------   ------- ---------   ------------------
   1         1    183.00    181.74    179.48     12.10      0.00         1
   2         2    183.00    181.50    179.24      0.00      0.00         1       2
   3         3    183.00    181.26    179.00      0.00      0.00         2       3
   4         4    183.00    181.02    178.76      0.00      0.00         3       4
   5         5    183.00    180.78    178.52      0.00      0.00         4       5
   6         6    183.00    180.68    178.42      0.00      0.00         5       6
   7         7    183.00    180.44    178.18      0.00      0.00         6       7
   8         8    183.00    180.20    177.94      0.00      0.00         7       8
   9         9    183.00    179.96    177.70      0.00      0.00         8       9
  10        10    183.00    179.72    177.46      0.00      0.00         9      10
  11        11    183.00    179.48    177.22      0.00      0.00        10


 *********************************************
```

```
 *          FREE OUTFALL DATA (DATA GROUP I1)     *
 *         BOUNDARY CONDITION ON DATA GROUP J1    *
 **************************************************

 OUTFALL AT JUNCTION....        11 HAS BOUNDARY CONDITION NUMBER...         1

1--------------------------------------------------------------------------------
 ENVIRONMENTAL PROTECTION AGENCY             ****   EXTENDED TRANSPORT PROGRAM   ****        WATER RESOURCES DIVISION
 WASHINGTON, D.C.                            ****                                ****        CAMP DRESSER & MCKEE INC.
                                             ****         ANALYSIS MODULE        ****        ANNANDALE, VIRGINIA

     Detroit River International Crossing
     Wolfe/Cahill Drain Existing Condition - 100-Year Flow



 **************************************************
 *        INTERNAL CONNECTIVITY INFORMATION       *
 **************************************************

          CONDUIT     JUNCTION     JUNCTION
          -------     --------     --------
          90011          11            0
1
 *****************************************************
 *        BOUNDARY CONDITON INFORMATION              *
 *                 DATA GROUPS J1-J4                 *
 *****************************************************



 BC NUMBER..         1 HAS NO CONTROL WATER SURFACE.
  TZERO =       1906195  0.0000000E+00

 **********************************
 *    INITIAL MODEL CONDITION     *
 * INITIAL TIME =      0.00 HOURS *
 **********************************

 JUNCTION / DEPTH  / ELEVATION    ===>  "*" JUNCTION IS SURCHARGED.
         1/   0.00 /   179.48        2/   0.00 /   179.24        3/   0.00 /   179.00
         4/   0.00 /   178.76        5/   0.00 /   178.52        6/   0.00 /   178.42
         7/   0.00 /   178.18        8/   0.00 /   177.94        9/   0.00 /   177.70
        10/   0.00 /   177.46       11/   0.00 /   177.22
```

```
 CONDUIT/       FLOW   ===> "*" CONDUIT USES THE NORMAL FLOW OPTION.
       1/        0.00          2/         0.00         3/         0.00          4/         0.00
       5/        0.00          6/         0.00         7/         0.00          8/         0.00
       9/        0.00         10/         0.00     90011/         0.00

 CONDUIT/   VELOCITY
       1/        0.00          2/         0.00         3/         0.00          4/         0.00
       5/        0.00          6/         0.00         7/         0.00          8/         0.00
       9/        0.00         10/         0.00

 CONDUIT/ CROSS SECTIONAL AREA
       1/        0.00          2/         0.00         3/         0.00          4/         0.00
       5/        0.00          6/         0.00         7/         0.00          8/         0.00
       9/        0.00         10/         0.00

 CONDUIT/ HYDRAULIC RADIUS
       1/        0.00          2/         0.00         3/         0.00          4/         0.00
       5/        0.00          6/         0.00         7/         0.00          8/         0.00
       9/        0.00         10/         0.00

 CONDUIT/ UPSTREAM/ DOWNSTREAM ELEVATION
       1/   179.48/   179.24          2/   179.24/   179.00          3/   179.00/   178.76
       4/   178.76/   178.52          5/   178.52/   178.42          6/   178.42/   178.18
       7/   178.18/   177.94          8/   177.94/   177.70          9/   177.70/   177.46
      10/   177.46/   177.22


********************************
*     FINAL MODEL CONDITION    *
*  FINAL TIME =      2.00 HOURS *
********************************

>>> ENDING DATE AND TIME OF EXTRAN RUN ARE:
JULIAN DATE: 1906195
YR/MO/DA:    1906/ 7/14
TIME OF DAY:  2.000 HRS

JUNCTION / DEPTH  / ELEVATION    ===>  "*" JUNCTION IS SURCHARGED.
       1/   1.90 /   181.38        2/   1.90 /   181.14        3/   1.89 /   180.89
       4/   1.88 /   180.64        5/   1.86 /   180.38        6/   1.90 /   180.32
       7/   1.90 /   180.08        8/   1.89 /   179.83        9/   1.88 /   179.58
      10/   1.87 /   179.33       11/   1.29 /   178.51

 CONDUIT/       FLOW   ===> "*" CONDUIT USES THE NORMAL FLOW OPTION.
       1/       12.10          2/        12.10         3/        12.10          4/        12.10
```

```
      5/      12.10          6/      12.10          7/      12.10          8/      12.10
      9/      12.10         10/      12.10      90011/      12.10

  CONDUIT/   VELOCITY
      1/       1.36          2/       1.36          3/       1.37          4/       1.39
      5/       1.79          6/       1.36          7/       1.36          8/       1.37
      9/       1.38         10/       1.89

  CONDUIT/ CROSS SECTIONAL AREA
      1/       8.92          2/       8.89          3/       8.84          4/       8.70
      5/       6.75          6/       8.92          7/       8.90          8/       8.85
      9/       8.75         10/       6.41

  CONDUIT/  FINAL VOLUME
      1/     891.86          2/     889.28          3/     883.55          4/     870.33
      5/     270.00          6/     892.25          7/     890.12          8/     885.41
      9/     874.71         10/     641.08

  CONDUIT/ HYDRAULIC RADIUS
      1/       0.95          2/       0.95          3/       0.95          4/       0.94
      5/       0.56          6/       0.95          7/       0.95          8/       0.95
      9/       0.94         10/       0.80

  CONDUIT/ UPSTREAM/ DOWNSTREAM ELEVATION
      1/   181.38/   181.14          2/   181.14/   180.89          3/   180.89/   180.64
      4/   180.64/   180.38          5/   180.38/   180.32          6/   180.32/   180.08
      7/   180.08/   179.83          8/   179.83/   179.58          9/   179.58/   179.33
     10/   179.33/   178.51


 ###################################################
 #          Surcharge Iteration Summary            #
 ###################################################

 Maximum number of iterations in a time step.....        6
 Total number of iterations in the simulation..       2890
 Average number of iterations per time step......     2.01
 Surcharge iterations during the simulation......       10
 Maximum surcharge flow error during simulation.. 3.97E-02 cms
 Total number of time steps during simulation..       1440


1
 +++++++++++++++++++++++++++++++++++++++++++++++++++
```

```
 *         CONDUIT COURANT CONDITION SUMMARY       *
 * TIME IN MINUTES DELT > COURANT TIME STEP        *
 ***************************************************
 * SEE BELOW FOR EXPLANATION OF COURANT TIME STEP. *
 ***************************************************

  CONDUIT #  TIME(MN)  CONDUIT #  TIME(MN)  CONDUIT #  TIME(MN)CONDUIT #  TIME(MN)
  ---------  --------  ---------  --------  ---------  ----------------  --------
          1      0.00          2      0.00          3      0.00          4      0.00
          5      0.00          6      0.00          7      0.00          8      0.00
          9      0.00         10      0.00

1
 ************************************************
 *         CONDUIT COURANT CONDITION SUMMARY    *
 ************************************************
 * COURANT   =              CONDUIT LENGTH      *
 * TIME STEP = -------------------------------- *
 *             VELOCITY + SQRT(GRVT*AREA/WIDTH) *
 ************************************************
 * AVERAGE COURANT CONDITION TIME STEP(SECONDS) *
 ************************************************

  CONDUIT # TIME(SEC)  CONDUIT # TIME(SEC)  CONDUIT # TIME(SEC)CONDUIT # TIME(SEC)
  ---------  --------  ---------  --------  ---------  ----------------  --------
          1     21.85          2     21.96          3     23.41          4     30.44
          5     12.05          6     29.42          7     42.38          8     37.77
          9     33.44         10     56.77

1
 ***************************************************
 * EXTRAN CONTINUITY BALANCE AT THE LAST TIME STEP *
 ***************************************************

 ************************************************
 * JUNCTION INFLOW, OUTFLOW OR STREET FLOODING *
 ************************************************

   JUNCTION   INFLOW, CU M
   --------  -------------
          1    8.7120E+04

   JUNCTION  OUTFLOW, CU M
   --------  -------------
          1    3.6105E+01
```

```
        11    7.9703E+04

 ****************************************************
 * INITIAL SYSTEM VOLUME        =     9.4000E-03 CU M  *
 * TOTAL SYSTEM INFLOW VOLUME   =     8.7120E+04 CU M  *
 * INFLOW + INITIAL VOLUME      =     8.7120E+04 CU M  *
 ****************************************************
 * TOTAL SYSTEM OUTFLOW         =     7.9739E+04 CU M  *
 * VOLUME LEFT IN SYSTEM        =     8.0054E+03 CU M  *
 * OUTFLOW + FINAL VOLUME       =     8.7744E+04 CU M  *
 ****************************************************
 * ERROR IN CONTINUITY, PERCENT =          -0.72       *
 ****************************************************


 TEST WRITE OF ALTERNATIVE CONTINUITY ERROR CALCULATION
 VOLUME LEFT IN SYSTEM       =     7.3918E+03 CU. FT.
 ERROR IN CONTINUITY PERCENT =          -0.12
```

- - - - - - - - - - - - - - - - SUMMARY OF FULL FLOW CHANNEL WARNINGS -

OPEN CHANNEL NUMBER	TIME STEP OF FIRST OCCURRENCE	TIME OF FIRST OCCURRENCE (HOURS)	TIME STEP OF LAST OCCURRENCE	TIME OF LAST OCCURRENCE (HOURS)
1	1	0.00	4	0.01

THE PROGRAM USES FULL DEPTH CHANNEL CHARACTERISTICS TO COMPUTE FLOW THROUGH THE TRAPEZOIDAL, IRREGULAR, OR PARABOLIC/POWER FUNCTION CONDUIT WHEN THE COMPUTED DEPTHS EXCEED MAXIMUM DEPTH. THIS WILL AFFECT THE MAXIMUM COMPUTED HEAD AND FLOWS IN THE MODEL. IT IS HIGHLY RECOMMENDED THAT THE MODELED CROSS SECTIONS BE EXTENDED TO ELIMINATE THESE FULL FLOW CHANNEL WARNINGS

```
1
 **********************************************************
 *   J U N C T I O N   S U M M A R Y   S T A T I S T I C S *
 **********************************************************
```

Detroit River International Crossing
Wolfe/Cahill Drain Existing Condition - 100-Year Flow

JUNCTION	GROUND ELEVATION	UPPERMOST PIPE CROWN ELEVATION	MEAN JUNCTION ELEVATION	JUNCTION AVERAGE	MAXIMUM JUNCTION ELEV.	TIME OF OCCURENCE	METERS OF SURCHARGE AT MAX	METERS MAX. DEPTH IS BELOW GROUND	LENGTH OF SURCHARGE	LENGTH OF FLOODING	MAXIMUM JUNCTION AREA

NUMBER	(M)	(M)	(M)	% CHANGE	(M)	HR.	MIN.	ELEVATION	ELEVATION	(MIN)	(MIN)	(SQ.MET)
1	183.00	181.74	181.38	0.1772	183.00	0	0	1.26	0.00	0.3	0.2	2.438E+03
2	183.00	181.50	181.12	0.0655	181.14	0	54	0.00	1.86	0.0	0.0	1.701E+03
3	183.00	181.26	180.86	0.0638	180.89	1	22	0.00	2.11	0.0	0.0	8.485E+02
4	183.00	181.02	180.60	0.0664	180.64	1	55	0.00	2.36	0.0	0.0	8.444E+02
5	183.00	180.78	180.31	0.0705	180.38	1	4	0.00	2.62	0.0	0.0	5.098E+02
6	183.00	180.68	180.25	0.0716	180.32	1	4	0.00	2.68	0.0	0.0	5.162E+02
7	183.00	180.44	179.99	0.0614	180.08	1	4	0.00	2.92	0.0	0.0	8.506E+02
8	183.00	180.20	179.73	0.0610	179.83	1	5	0.00	3.17	0.0	0.0	8.491E+02
9	183.00	179.96	179.46	0.0604	179.59	1	23	0.00	3.41	0.0	0.0	8.457E+02
10	183.00	179.72	179.19	0.0598	179.33	1	9	0.00	3.67	0.0	0.0	8.110E+02
11	183.00	179.48	178.41	0.0414	178.51	1	40	0.00	4.49	0.0	0.0	6.651E+02

1

```
*******************************************************
*  C O N D U I T   S U M M A R Y   S T A T I S T I C S  *
*******************************************************
```

Detroit River International Crossing
Wolfe/Cahill Drain Existing Condition - 100-Year Flow

CONDUIT NUMBER	DESIGN FLOW (CMS)	DESIGN VELOCITY (M/S)	CONDUIT VERTICAL DEPTH (M)	MAXIMUM COMPUTED FLOW (CMS)	TIME OF OCCURRENCE HR.	MIN.	MAXIMUM COMPUTED VELOCITY (MPS)	TIME OF OCCURRENCE HR.	MIN.	RATIO OF MAX. TO DESIGN FLOW	MAXIMUM DEPTH ABOVE INV. AT CONDUIT ENDS UPSTREAM (M)	DOWNSTREAM (M)	LENGTH OF NORM FLOW (MIN)	CONDUIT SLOPE (M/M)
1	1.85E+01	1.50	2.260	1.64E+01	0	0	2.47	0	0	0.89	3.52	1.90	0.2	0.00240
2	1.85E+01	1.50	2.260	1.29E+01	0	2	2.11	0	1	0.70	1.90	1.89	0.1	0.00240
3	1.85E+01	1.50	2.260	1.22E+01	0	3	2.02	0	2	0.66	1.89	1.88	0.8	0.00240
4	1.85E+01	1.50	2.260	1.31E+01	0	4	2.08	0	4	0.71	1.88	1.86	0.0	0.00240
5	1.53E+01	2.27	1.500	1.33E+01	0	4	2.30	0	3	0.87	1.86	1.90	0.4	0.00250
6	1.85E+01	1.50	2.260	1.21E+01	1	28	1.96	0	5	0.66	1.90	1.90	0.0	0.00240
7	1.85E+01	1.50	2.260	1.21E+01	1	47	1.85	0	6	0.66	1.90	1.89	0.0	0.00240
8	1.85E+01	1.50	2.260	1.21E+01	1	28	1.86	0	7	0.66	1.89	1.89	0.0	0.00240
9	1.85E+01	1.50	2.260	1.21E+01	1	23	1.83	0	8	0.66	1.89	1.87	0.0	0.00240
10	1.85E+01	1.50	2.260	1.21E+01	1	40	1.89	1	41	0.66	1.87	1.29	0.0	0.00240
90011	UNDEF	UNDEF	UNDEF	1.21E+01	1	40								

1

```
***************************************************
* SUBCRITICAL AND CRITICAL FLOW ASSUMPTIONS FROM *
* SUBROUTINE HEAD.  SEE FIGURE 5-4 IN THE EXTRAN *
```

```
*      MANUAL FOR FURTHER INFORMATION.          *
*************************************************
```

CONDUIT NUMBER	LENGTH OF DRY FLOW(MIN)	LENGTH OF SUBCRITICAL FLOW(MIN)	LENGTH OF UPSTR. CRITICAL FLOW(MIN)	LENGTH OF DOWNSTR. CRITICAL FLOW(MIN)	MEAN FLOW (CMS)	AVERAGE % CHANGE	TOTAL FLOW CUBIC MET	MAXIMUM HYDRAULIC RADIUS(MET)	MAXIMUM CROSS SECT AREA(SQ.M)
1	0.00	120.00	0.00	0.00	12.11	0.1154	8.7187E+04	0.9497	8.9187
2	0.08	119.92	0.00	0.00	11.98	0.0708	8.6267E+04	0.9483	8.8929
3	0.08	119.92	0.00	0.00	11.86	0.0753	8.5367E+04	0.9453	8.8356
4	0.33	119.67	0.00	0.00	11.74	0.0842	8.4494E+04	0.9382	8.7034
5	0.92	119.08	0.00	0.00	11.64	0.1979	8.3829E+04	0.8361	6.7500
6	1.58	118.42	0.00	0.00	11.56	0.0648	8.3255E+04	0.9499	8.9225
7	2.33	117.67	0.00	0.00	11.44	0.0546	8.2361E+04	0.9488	8.9013
8	3.17	116.83	0.00	0.00	11.32	0.0502	8.1470E+04	0.9463	8.8543
9	3.92	116.08	0.00	0.00	11.19	0.0459	8.0586E+04	0.9405	8.7473
10	4.92	115.08	0.00	0.00	11.07	0.0459	7.9702E+04	0.8050	6.4109
90011	UNDEFINED	UNDEFINED	UNDEFINED	UNDEFINED	11.07		7.9702E+04		

```
************************************************************
* AVERAGE % CHANGE IN JUNCTION OR CONDUIT IS DEFINED AS:   *
* CONDUIT  % CHANGE ==> 100.0 ( Q(n+1) - Q(n) ) / Qfull    *
* JUNCTION % CHANGE ==> 100.0 ( Y(n+1) - Y(n) ) / Yfull    *
************************************************************

 The Conduit with the largest average change...        5 had     0.198 percent
The Junction with the largest average change...        1 had     0.177 percent


===> Extended Transport model simulation ended normally.

===> SWMM 4.4GU  simulation ended normally.
     Always check output file for possible warning messages.

===> Your input file was named : PCTmp1.dat
===> Your output file was named: PCTmp1.out

*******************************************************
*       SWMM 4.4GU  Simulation Date and Time Summary  *
*******************************************************
* Starting Date... November   16, 2006                *
*          Time...          16:31:49.300              *
*   Ending Date... November   16, 2006                *
*          Time...          16:31:53.630              *
```

```
*  Elapsed Time...              0.072 minutes.       *
*  Elapsed Time...              4.332 seconds.       *
******************************************************
```

```
1        *****************************************************
         *    U.S. Environmental Protection Agen y           *
         *    Storm Water Management Model   (SWM I)         *
         *              Version 4.4GU                        *
         *                                                   *
         *               CDM/OSU Beta                        *
         *      Release Date - November 23, 199              *
         * Camp Dresser & McKee and Oregon State Univ.       *
         *         Chuck Moore and Wayne Huber               *
         *  Compiled using Digital Visual Fortra  6.0        *
         *****************************************************

                       Developed by

         *****************************************************
         *            Metcalf & Eddy, Inc.                   *
         *           University of Florida                   *
         *      Water Resources Engineers, Inc.              *
         *     (Now Camp, Dresser and McKee, Inc )           *
         *              September 1970                       *
         *****************************************************

                Distributed and Maintained by

         *****************************************************
         *     U.S. Environmental Protection Ag ncy          *
         * Center for Exposure Assessment Modeli g (CEAM)    *
         *   Athens Environmental Research Labo atory        *
         *           960 College Station Road                *
         *           Athens, GA    30605-2720                *
         *****************************************************

         *****************************************************
         *    This is a new release of SWMM.  I  any         *
         *    problems occur executing this mod l            *
         *    system, contact Mr. Frank Stancil              *
         *    U.S. Environmental Protection Age cy.          *
         *    706/355-8328 (voice)                           *
         *    e-mail: stancil@athens.ath.epa.go              *
         *    Or contact Wayne C. Huber at Oreg     . U.     *
         *    541/737-6150 or wayne.huber@orst.              *
         *    Or Michael F. Schmidt at Camp Dre              *
         *    McKee (904) 281-0170 SCHMIDTMF@C               *
         *****************************************************
```

```
*************************************************
*  This is an implementation of EPA SWMM 4.4GU   *
*  "Nature is full of infinite causes which      *
*   have never occurred in experience" da Vinci  *
*************************************************


###########################################
#        File names by SWMM Block         #
#         JIN  -> Input to a Block        #
#        JOUT  -> Output from a Block     #
###########################################

   JIN for Block #      1 File #     0  JIN.UF
  JOUT for Block #      1 File #     9  PCTmp1.int

###########################################
# Scratch file names for this simulation. #
###########################################

NSCRAT #      1 File #    21   SCRT1.UF
NSCRAT #      2 File #    22   SCRT2.UF
NSCRAT #      3 File #    23   SCRT3.UF
NSCRAT #      4 File #    24   SCRT4.UF
NSCRAT #      5 File #    25   SCRT5.UF
NSCRAT #      6 File #    26   SCRT6.UF
NSCRAT #      7 File #    27   SCRT7.UF
NSCRAT #      8 File #    28   SCRT8.UF

**************************************************
*    Parameter Values on the Tapes Common Block  *
**************************************************

 Number of Subcatchments in the Runoff Block (NW)...... 1000
 Number of Channel/Pipes in the Runoff Block (NG)...... 1000
 Number of Connections to Runoff Channels/Inlets (NCP).    6
 Number of Water Quality Constituents (NQUAL).........   20
 Number of Runoff Land Uses per Subcatchment (NLU).....   20
 Number of Groundwater Subcatchments in Runoff (NGW)...  100
 Number of Interface Locations for all Blocks (NIE).... 1000
 Number of Elements in the Transport Block (NET).......  500
 Number of Storage Junctions in Transport (NTSE).......  100
 Number of Transport interface input locations (NTHI)..  500
 Number of Transport interface output locations (NTHO).  500
 Number of Transport input locations on R lines (NTHR).   80
```

```
Number of Transport printed output locations (NTOA)...    80
Number of Tabular Flow Splitters in Transport (NTSP)..    50
Number of Elements in the Extran Block (NEE).......... 4000
Number of Pumps in Extran (NEP).......................    75
Number of Orifices in Extran (NEO)....................   200
Number of Tide Gates/Free Outfalls in Extran (NTG)....   200
Number of Extran Weirs (NEW)..........................   400
Number of Extran Printout Locations (NPO).............   150
Number of Tide Elements in Extran (NTE)...............    50
Number of Natural Channels (NNC)...................... 1200
Number of Storage Junctions in Extran (NVSE).......... 1000
Number of Time History Data Points in Extran (NTVAL)..   500
Number of Data Points for Variable Storage Elements
  in the Extran Block (NVST)..........................    25
Number of Input Hydrographs in Extran (NEH)...........   500
Number of Allowable Channel Connections to
  Junctions in the Extran Block (NCHN)................    15
Number Rain Gages in Rain and Runoff (MAXRG)..........   200
Number PRATE/VRATE Points for Extran Pump
  Input (MAXPRA)......................................    10
Number of Variable Orifices in Extran (NVORF).........    50
Number of Variable Orifice Data Points (NVOTIM).......    50
Number of Allowable Precip. Values/yr in Rain (LIMRN). 5000
Number of Storm Events for Rain Analysis (LSTORM).....20000
Number of Plugs for Plug-flow in S/T (NPLUG).......... 3000
Number Conduits for Extran Results to ASCII
  File (MXFLOW).......................................   400


*************************************************************
* Entry made to the EXTENDED TRANSPORT MODEL (EXTRAN)        *
* developed 1973 by Camp, Dresser and McKee (CDM) with       *
* modifications 1977-1991 by the University of Florida.      *
*                                                            *
* Most recent update: March 1999 by CDM, Oregon              *
* State University, and XP Software, Inc.                    *
*                                                            *
* "Smooth runs the water where the brook is deep."           *
*                     Shakespeare, Henry VI, II, III, 1      *
*************************************************************
```

```
WASHINGTON, D.C.                    ****                      ****    CAMP DRESSER & MCKEE INC.
                                    ****   ANALYSIS MODULE    ****    ANNANDALE, VIRGINIA

   Detroit River International Crossing
   Wolfe/Cahill Drain Alternative 1B,2B Syphon - 100-Year Flow


Control information for simulation
----------------------------------

Integration cycles.................    1440

Length of integration step is......    5.00 seconds
Simulation length..................    2.00 hours

Do not create equiv. pipes(NEQUAL).       0

Use metric units for I/O...........       1

Printing starts in cycle...........       1

Intermediate printout intervals of.       1 cycles
Intermediate printout intervals of.    0.08 minutes

Summary printout intervals of......       1 cycles
Summary printout time interval of..    0.08 minutes

Hot start file parameter (JREDO)...       0

Initial time (TZERO)...............    0.00 hours
This is time displacement from JIN interface file starting date/time when
interface file is used.
This also describes starting hour in K3 line hydrograph input when K3
lines are used.
Initial date (IDATZ)............  19060714 (yr/mo/day)
NOTE: Initial date from JIN interface file will be used, if accessed,
unless IDATZ is negative.

Iteration variables: ITMAX.........      30
                     SURTOL........  0.0500

Default surface area of junctions..  1.22 square meters.

EXTRAN VERSION 3.3 SOLUTION. (ISOL = 0).
Sum of junction flow is zero during surcharge.
```

NORMAL FLOW OPTION WHEN THE WATER
SURFACE SLOPE IS LESS THAN THE
GROUND SURFACE SLOPE (KSUPER=0)....

NJSW INPUT HYDROGRAPH JUNCTIONS.... 0

INTERMEDIATE HEADER LINES ARE PRINTED AS IN ORIGINAL PROGRAM

IDS ARE WRITTEN AS IN ORIGINAL PROGRAM

CONDUIT LENGTHS ON C1 LINE MUST EQUAL IRREGULAR SECTION LENGTH ENTERED ON THE C3 OR X1 LINES (IWLEN = 0)

JELEV = 0 (DEFAULT). STANDARD INPUTS ARE DEPTHS NOT ELEVATIONS

JDOWN = 0 - Minimum of normal or critical depth will be used at free outfalls (I1).

Characteristic depth for M2 and S2 water surface profiles will be computed as in previous versions of EXTRAN (IM2 = 0).

SEDIMENT DEPTHS WILL NOT BE READ FROM C1 LINES

Intermediate continuity output will not be created

1---

ENVIRONMENTAL PROTECTION AGENCY	****	EXTENDED TRANSPORT PROGRAM	****	WATER RESOURCES DIVISION
WASHINGTON, D.C.	****		****	CAMP DRESSER & MCKEE INC.
	****	ANALYSIS MODULE	****	ANNANDALE, VIRGINIA

Detroit River International Crossing
Wolfe/Cahill Drain Alternative 1B,2B Syphon · 100-Year Flow

1
****
* Conduit Data *
****

INP NUM	CONDUIT NUMBER	LENGTH (M)	CONDUIT CLASS	AREA (SQ M)	MANNING COEF.	MAX WIDTH (M)	DEPTH (M)	JUNCTIONS AT THE ENDS		INVERT HEIGHT ABOVE JUNCTIONS	TRAPEZOID SIDE SLOPES	
1	1	100.	TRAPEZOID	12.27	0.03500	0.91	2.26	1	2		2.00	2.00
2	2	100.	TRAPEZOID	12.27	0.03500	0.91	2.26	2	3		2.00	2.00
3	3	100.	TRAPEZOID	12.27	0.03500	0.91	2.26	3	4		2.00	2.00
4	4	70.	TRAPEZOID	12.27	0.03500	0.91	2.26	4	5		2.00	2.00
5	5	30.	TRAPEZOID	11.25	0.01500	4.50	1.50	5	55		2.00	2.00

6	55	15.	RECTANGLE	6.75	0.01500	4.50	1.50	55	66			
7	66	50.	RECTANGLE	6.75	0.01500	4.50	1.50	66	6			
8	6	15.	RECTANGLE	6.75	0.01500	4.50	1.50	6	77			
9	77	30.	TRAPEZOID	11.25	0.01500	4.50	1.50	77	7		2.00	2.00
10	7	70.	TRAPEZOID	12.27	0.01500	0.91	2.26	7	8		2.00	2.00
11	8	100.	TRAPEZOID	12.27	0.03500	0.91	2.26	8	9		2.00	2.00
12	9	100.	TRAPEZOID	12.27	0.03500	0.91	2.26	9	10		2.00	2.00
13	10	100.	TRAPEZOID	12.27	0.03500	0.91	2.26	10	11		2.00	2.00

```
===> WARNING !!! (C*DELT/LEN) IN CONDUIT        55 IS  1.3 AT FULL DEPTH.
===> WARNING !!! (C*DELT/LEN) IN CONDUIT         6 IS  1.3 AT FULL DEPTH.

*******************
*  Conduit Volume  *
*******************

Input full depth volume............     1.0296E+01 cubic meters
            Conduit #...       66 has zero slope.  0.001 feet added to upstream invert.

===> Warning !! The upstream and downstream junctions for the following conduits
                have been reversed to correspond to the positive flow and decreasing
                slope EXTRAN convention.  A negative flow in the output thus means
                the flow was from your original upstream junction to your original
                downstream junction.  Any initial flow has been multiplied by -1.

                1.  Conduit #...         6  has been changed.

1-------------------------------------------------------------------------------
ENVIRONMENTAL PROTECTION AGENCY          ****   EXTENDED TRANSPORT PROGRAM   ****      WATER RESOURCES DIVISION
WASHINGTON, D.C.                         ****                                ****      CAMP DRESSER & MCKEE INC.
                                         ****          ANALYSIS MODULE       ****      ANNANDALE, VIRGINIA

    Detroit River International Crossing
    Wolfe/Cahill Drain Alternative 1B,2B Syphon - 100-Year Flow


1
**************************************************
*                  Junction Data                 *
**************************************************

INP  JUNCTION   GROUND    CROWN     INVERT    QINST   INITIAL    CONNECTING CONDUITS
NUM   NUMBER     ELEV.     ELEV.     ELEV.     CMS   DEPTH(M)
---   ------   -------   -------    ------   ------ ---------  -------------------
```

1	1	183.00	181.70	179.44	2.10	0.00	1	
2	2	183.00	181.46	179.20	0.00	0.00	1	2
3	3	183.00	181.22	178.96	0.00	0.00	2	3
4	4	183.00	180.98	178.72	0.00	0.00	3	4
5	5	183.00	180.82	178.56	0.00	0.00	4	5
6	55	183.00	179.98	178.48	0.00	0.00	5	55
7	66	183.00	173.94	172.44	0.00	0.00	55	66
8	6	183.00	173.94	172.44	0.00	0.00	66	6
9	77	183.00	179.96	178.46	0.00	0.00	6	77
10	7	183.00	180.64	178.38	0.00	0.00	77	7
11	8	183.00	180.48	178.22	0.00	0.00	7	8
12	9	183.00	180.24	177.98	0.00	0.00	8	9
13	10	183.00	180.00	177.74	0.00	0.00	9	10
14	11	183.00	179.76	177.50	0.00	0.00	10	

```
**************************************************
*          FREE OUTFALL DATA (DATA GROUP I1)     *
*        BOUNDARY CONDITION ON DATA GROUP J1     *
**************************************************

OUTFALL AT JUNCTION....        11 HAS BOUNDARY CONDITION NUMBER...        1

1-------------------------------------------------------------------------------
ENVIRONMENTAL PROTECTION AGENCY          ****  EXTENDED TRANSPORT PROGRAM  ****      WATER RESOURCES DIVISION
WASHINGTON, D.C.                         ****                              ****      CAMP DRESSER & MCKEE INC.
                                         ****        ANALYSIS MODULE       ****      ANNANDALE, VIRGINIA

    Detroit River International Crossing
    Wolfe/Cahill Drain Alternative 1B,2B Syphon - 100-Year Flow

**************************************************
*        INTERNAL CONNECTIVITY INFORMATION       *
**************************************************

         CONDUIT     JUNCTION     JUNCTION
         -------     --------     --------
         90014          11            0
1
**************************************************
*        BOUNDARY CONDITON INFORMATION           *
*                 DATA GROUPS J1-J4              *
**************************************************
```

```
BC NUMBER..         1 HAS NO CONTROL WATER SURFACE.
 TZERO =       1906195  0.0000000E+00

**********************************
*    INITIAL MODEL CONDITION      *
* INITIAL TIME =      0.00 HOURS  *
**********************************

JUNCTION / DEPTH  / ELEVATION    ===>  "*" JUNCTION IS SURCHARGED.
       1/   0.00 /   179.44         2/   0.00 /   179.20         3/   0.00 /   178.96
       4/   0.00 /   178.72         5/   0.00 /   178.56        55/   0.00 /   178.48
      66/   0.00 /   172.44         6/   0.00 /   172.44        77/   0.00 /   178.46
       7/   0.00 /   178.38         8/   0.00 /   178.22         9/   0.00 /   177.98
      10/   0.00 /   177.74        11/   0.00 /   177.50

  CONDUIT/       FLOW   ===> "*" CONDUIT USES TH  NORMAL FLOW OPTION.
       1/        0.00          2/        0.00          3/        0.00          4/        0.00
       5/        0.00         55/        0.00         66/        0.00          6/        0.00
      77/        0.00          7/        0.00          8/        0.00          9/        0.00
      10/        0.00      90014/        0.00

  CONDUIT/   VELOCITY
       1/        0.00          2/        0.00          3/        0.00          4/        0.00
       5/        0.00         55/        0.00         66/        0.00          6/        0.00
      77/        0.00          7/        0.00          8/        0.00          9/        0.00
      10/        0.00

  CONDUIT/ CROSS SECTIONAL AREA
       1/        0.00          2/        0.00          3/        0.00          4/        0.00
       5/        0.00         55/        0.00         66/        0.00          6/        0.00
      77/        0.00          7/        0.00          8/        0.00          9/        0.00
      10/        0.00

  CONDUIT/ HYDRAULIC RADIUS
       1/        0.00          2/        0.00          3/        0.00          4/        0.00
       5/        0.00         55/        0.00         66/        0.00          6/        0.00
      77/        0.00          7/        0.00          8/        0.00          9/        0.00
      10/        0.00

  CONDUIT/ UPSTREAM/ DOWNSTREAM ELEVATION
       1/   179.44/   179.20         2/   179.2  /   178.96         3/   178.96/   178.72
       4/   178.72/   178.56         5/   178.5  /   178.48        55/   178.48/   172.44
```

```
      66/   172.44/   172.44          6/   178.4?/   172.44         77/   178.46/   178.38
       7/   178.38/   178.22          8/   178.2?/   177.98          9/   177.98/   177.74
      10/   177.74/   177.50


********************************
*     FINAL MODEL CONDITION    *
*  FINAL TIME =      2.00 HOURS *
********************************

>>> ENDING DATE AND TIME OF EXTRAN RUN ARE:
JULIAN DATE: 1906195
YR/MO/DA:    1906/ 7/14
TIME OF DAY:  2.000 HRS

JUNCTION / DEPTH  / ELEVATION    ===>  "*" JUNCT ON IS SURCHARGED.
       1/   1.89 /   181.33         2/   1.88 /   181.08          3/   1.86 /   180.82
       4/   1.81 /   180.53         5/   1.70 /   180.26         55/   1.77*/   180.25
      66/   7.79*/   180.23         6/   7.71*/   180.15         77/   1.66*/   180.12
       7/   1.74 /   180.12         8/   1.89 /   180.11          9/   1.89 /   179.87
      10/   1.87 /   179.61        11/   1.29 /   178.79

  CONDUIT/        FLOW   ===> "*" CONDUIT USES TH : NORMAL FLOW OPTION.
       1/      12.10          2/      12.10          3/      12.10          4/      12.10
       5/      12.10         55/      12.10         66/      12.10          6/     -12.10
      77/      12.10          7/      12.10          8/      12.10          9/      12.10
      10/      12.10      90014/      12.10

  CONDUIT/   VELOCITY
       1/       1.37          2/       1.39          3/       1.44          4/       1.56
       5/       1.08         55/       1.79         66/       1.79          6/      -1.79
      77/       1.08          7/       1.47          8/       1.37          9/       1.38
      10/       1.89

  CONDUIT/ CROSS SECTIONAL AREA
       1/       8.84          2/       8.72          3/       8.43          4/       7.75
       5/      11.25         55/       6.75         66/       6.75          6/       6.75
      77/      11.25          7/       8.24          8/       8.85          9/       8.75
      10/       6.41

  CONDUIT/  FINAL VOLUME
       1/     884.47          2/     872.49          3/     842.70          4/     542.76
       5/     337.50         55/     101.25         66/     337.50          6/     101.25
      77/     337.50          7/     576.73          8/     885.41          9/     874.71
      10/     641.08
```

```
 CONDUIT/ HYDRAULIC RADIUS
       1/        0.95          2/        0.94          3/        0.92          4/        0.89
       5/        1.00         55/        0.56         66/        0.56          6/        0.56
      77/        1.00          7/        0.91          8/        0.95          9/        0.94
      10/        0.80

 CONDUIT/ UPSTREAM/ DOWNSTREAM ELEVATION
       1/    181.33/    181.08         2/    181.08/    180.82         3/    180.82/    180.53
       4/    180.53/    180.26         5/    180.26/    180.25        55/    180.25/    180.23
      66/    180.23/    180.15         6/    180.15/    180.15        77/    180.12/    180.12
       7/    180.12/    180.11         8/    180.11/    179.87         9/    179.87/    179.61
      10/    179.61/    178.79


##################################################
#           Surcharge Iteration Summary          #
##################################################

Maximum number of iterations in a time step.....        16
Total number of iterations in the simulation..        3063
Average number of iterations per time step......      2.13
Surcharge iterations during the simulation......       183
Maximum surcharge flow error during simulation.. 5.47E-01 cms
Total number of time steps during simulation..        1440


1
**************************************************
*         CONDUIT COURANT CONDITION SUMMARY      *
* TIME IN MINUTES DELT > COURANT TIME STEP       *
**************************************************
* SEE BELOW FOR EXPLANATION OF COURANT TIME STEP. *
**************************************************

 CONDUIT #  TIME(MN)  CONDUIT #  TIME(MN)  CONDUIT #  TIME(MN)CONDUIT #  TIME(MN)
 ---------  --------  ---------  --------  ---------  -----------------  --------
         1      0.00          2      0.00          3      0.00         4      0.00
         5      0.25         55    117.42         66    114.08         6    115.50
        77      0.08          7      0.00          8      0.00         9      0.00
        10      0.00

1
************************************************
```

```
*         CONDUIT COURANT CONDITION SUMMARY        *
****************************************************
* COURANT    =             CONDUIT LENGTH          *
* TIME STEP = -------------------------------      *
*               VELOCITY + SQRT(GRVT*AREA/WIDTH)   *
****************************************************
* AVERAGE COURANT CONDITION TIME STEP(SECONDS)     *
****************************************************
```

CONDUIT #	TIME(SEC)	CONDUIT #	TIME(SEC)	CONDUIT #	TIME(SEC)	CONDUIT #	TIME(SEC)
1	21.83	2	21.91	3	23.28	4	20.53
5	9.42	55	1.90	66	5.51	6	1.57
77	6.90	7	14.89	8	22.23	9	24.30
10	34.41						

1

```
****************************************************
* EXTRAN CONTINUITY BALANCE AT THE LAST TIME STEP  *
****************************************************

****************************************************
* JUNCTION INFLOW, OUTFLOW OR STREET FLOODING      *
****************************************************
```

JUNCTION	INFLOW, CU M
1	8.7120E+04

JUNCTION	OUTFLOW, CU M
1	3.5265E+01
11	7.9960E+04

```
************************************************************
* INITIAL SYSTEM VOLUME       =    8.8000E-03 CU M  *
* TOTAL SYSTEM INFLOW VOLUME  =    8.7120E+04 CU M  *
* INFLOW + INITIAL VOLUME     =    8.7120E+04 CU M  *
************************************************************
* TOTAL SYSTEM OUTFLOW        =    7.9995E+04 CU M  *
* VOLUME LEFT IN SYSTEM       =    7.3537E+03 CU M  *
* OUTFLOW + FINAL VOLUME      =    8.7348E+04 CU M  *
************************************************************
* ERROR IN CONTINUITY, PERCENT =          -0.26     *
************************************************************
```

TEST WRITE OF ALTERNATIVE CONTINUITY ERROR CALCULATION
VOLUME LEFT IN SYSTEM = 7.7720E+03 CU. FT.
ERROR IN CONTINUITY PERCENT = -7.42

- - - - - - - - - - - - - - - - SUMMARY OF FULL FLOW CHANNEL WARNINGS -

OPEN CHANNEL NUMBER	TIME STEP OF FIRST OCCURRENCE	TIME OF FIRST OCCURRENCE (HOURS)	TIME STEP OF LAST OCCURRENCE	TIME OF LAST OCCURRENCE (HOURS)
1	1	0.00	4	0.01
5	68	0.09	1440	2.00
77	97	0.13	1440	2.00

THE PROGRAM USES FULL DEPTH CHANNEL CHARACTERISTICS TO COMPUTE FLOW THROUGH THE TRAPEZOIDAL, IRREGULAR, OR PARABOLIC/POWER FUNCTION CONDUIT WHEN THE COMPUTED DEPTHS EXCEED MAXIMUM DEPTH. THIS WILL AFFECT THE MAXIMUM COMPUTED HEAD AND FLOWS IN THE MODEL. IT IS HIGHLY RECOMMENDED THAT THE MODELED CROSS SECTIONS BE EXTENDED TO ELIMINATE THESE FULL FLOW CHANNEL WARNINGS

1

```
*************************************************
* J U N C T I O N   S U M M A R Y   S T A T I S T I C S *
*************************************************
```

Detroit River International Crossing
Wolfe/Cahill Drain Alternative 1B,2B Syphon - 100-Year Flow

JUNCTION NUMBER	GROUND ELEVATION (M)	UPPERMOST PIPE CROWN ELEVATION (M)	MEAN JUNCTION ELEVATION (M)	JUNCTION AVERAGE % CHANGE	MAXIMUM JUNCTION ELEV. (M)	TIME OF OCCURENCE HR.	MIN.	METERS OF SURCHARGE AT MAX ELEVATION	METERS MAX. DEPTH IS BELOW GROUND ELEVATION	LENGTH OF SURCHARGE (MIN)	LENGTH OF FLOODING (MIN)	MAXIMUM JUNCTION AREA (SQ.MET)
1	183.00	181.70	181.33	0.1793	183.00	0	0	1.30	0.00	0.3	0.2	2.438E+03
2	183.00	181.46	181.07	0.0655	181.08	0	53	0.00	1.92	0.0	0.0	1.704E+03
3	183.00	181.22	180.80	0.065	180.82	1	42	0.00	2.18	0.0	0.0	8.361E+02
4	183.00	180.98	180.49	0.073	180.56	0	5	0.00	2.44	0.0	0.0	6.932E+02
5	183.00	180.82	180.18	0.156	180.26	0	57	0.00	2.74	0.0	0.0	1.821E+03
55	183.00	179.98	180.16	0.390	180.57	0	5	0.59	2.43	111.8	0.0	1.913E+03
66	183.00	173.94	179.94	1.466	180.82	0	4	6.87	2.18	115.8	0.0	2.341E+03
6	183.00	173.94	179.86	0.808	180.15	1	56	6.21	2.85	115.9	0.0	2.881E+03
77	183.00	179.96	180.04	0.320	180.12	0	56	0.16	2.88	110.6	0.0	1.591E+03

7	183.00	180.64	180.03	0.130	180.12	1	56	0.00	2.88	0.0	0.0	1.192E+03
8	183.00	180.48	180.01	0.067	180.11	1	36	0.00	2.89	0.0	0.0	7.163E+02
9	183.00	180.24	179.75	0.063	179.87	1	50	0.00	3.13	0.0	0.0	8.457E+02
10	183.00	180.00	179.47	0.059	179.61	1	49	0.00	3.39	0.0	0.0	8.110E+02
11	183.00	179.76	178.69	0.041	178.79	1	21	0.00	4.21	0.0	0.0	6.651E+02

1

```
***************************************************
*  C O N D U I T   S U M M A R Y   S T A T I S T I C S  *
***************************************************
```

Detroit River International Crossing
Wolfe/Cahill Drain Alternative 1B,2B Syphon - 100-Year Flow

CONDUIT NUMBER	DESIGN FLOW (CMS)	DESIGN VELOCITY (M/S)	CONDUIT VERTICAL DEPTH (M)	MAXIMUM COMPUTED FLOW (CMS)	TIME OF OCCURRENCE HR.	MIN.	MAXIMUM COMPUTED VELOCITY (MPS)	TIME OF OCCURRENCE HR.	MIN.	RATIO OF MAX. TO DESIGN FLOW	MAXIMUM DEPTH ABOVE INV. AT CONDUIT ENDS UPSTREAM (M)	DOWNSTREAM (M)	LENGTH OF NORM FLOW (MIN)	CONDUIT SLOPE (M/M)
1	1.85E+01	1.50	2.260	1.64E+01	0	0	2.46	0	0	0.89	3.56	1.88	0.2	0.00240
2	1.85E+01	1.50	2.260	1.28E+01	0	2	2.11	0	1	0.69	1.88	1.86	0.3	0.00240
3	1.85E+01	1.50	2.260	1.25E+01	0	6	2.00	0	2	0.68	1.86	1.84	0.3	0.00240
4	1.80E+01	1.47	2.260	1.63E+01	0	5	2.48	0	4	0.90	1.84	1.70	0.0	0.00229
5	3.88E+01	3.45	1.500	2.80E+01	0	4	7.54	0	4	0.72	1.70	2.09	0.3	0.00267
55	1.95E+02	28.83	1.500	2.65E+01	0	4	6.61	0	4	0.14	2.09	8.37	1.8	0.40267
66	1.38E+00	0.20	1.500	2.65E+01	0	4	3.92	0	4	19.23	8.37	7.71	0.1	0.00002
6	1.94E+02	28.78	1.500	-2.63E+01	0	4	-4.23	0	4	-0.14	1.66	7.71	0.0	0.40133
77	3.88E+01	3.45	1.500	2.87E+01	0	4	3.49	0	4	0.74	1.66	1.74	0.2	0.00267
7	4.20E+01	3.42	2.260	1.45E+01	0	6	2.88	0	6	0.34	1.74	1.89	0.8	0.00229
8	1.85E+01	1.50	2.260	1.21E+01	1	16	1.99	0	7	0.66	1.89	1.89	0.1	0.00240
9	1.85E+01	1.50	2.260	1.21E+01	1	12	1.91	0	7	0.66	1.89	1.87	0.0	0.00240
10	1.85E+01	1.50	2.260	1.21E+01	1	21	1.89	1	21	0.66	1.87	1.29	0.0	0.00240
90014	UNDEF	UNDEF	UNDEF	1.21E+01	1	21								

1

```
*********************************************
* SUBCRITICAL AND CRITICAL FLOW ASSUMPTIONS FROM *
* SUBROUTINE HEAD.  SEE FIGURE 5-4 IN THE EXTRAN *
*        MANUAL FOR FURTHER INFORMATION          *
*********************************************
```

LENGTH OF	LENGTH OF	LENGTH OF UPSTR.	LENGTH OF DOWNSTR.	MEAN	TOTAL	MAXIMUM	MAXIMUM

CONDUIT NUMBER	DRY FLOW(MIN)	SUBCRITICAL FLOW(MIN)	CRITICAL FLOW(MIN)	CRITICAL FLOW(MIN)	FLOW (CMS)	AVERAGE % CHANGE	FLOW CUBIC MET	HYDRAULIC RADIUS(MET)	CROSS SECT AREA(SQ.M)
1	0.00	120.00	0.00	0.00	12.11	0.1153	8.7190E+04	0.9458	8.8448
2	0.08	119.92	0.00	0.00	11.98	0.0695	8.6280E+04	0.9393	8.7250
3	0.08	119.92	0.00	0.00	11.86	0.0956	8.5401E+04	0.9231	8.4271
4	0.33	119.67	0.00	0.00	11.76	0.1699	8.4692E+04	0.8855	7.7539
5	0.83	119.17	0.00	0.00	11.69	0.3079	8.4199E+04	1.0037	11.2500
55	1.58	118.42	0.00	0.00	11.63	0.0295	8.3708E+04	0.8363	6.7500
66	2.08	117.92	0.00	0.00	11.61	7.0886	8.3579E+04	0.8108	6.7500
6	4.33	115.67	0.00	0.00	-11.55	0.0321	-8.3148E+04	0.8421	6.7500
77	4.33	115.67	0.00	0.00	11.52	0.2510	8.2934E+04	1.0037	11.2500
7	4.42	115.58	0.00	0.00	11.45	0.0637	8.2458E+04	0.9128	8.2392
8	4.50	115.50	0.00	0.00	11.35	0.0761	8.1731E+04	0.9463	8.8543
9	4.67	115.33	0.00	0.00	11.23	0.0474	8.0845E+04	0.9405	8.7473
10	5.00	115.00	0.00	0.00	11.11	0.0459	7.9959E+04	0.8050	6.4109
90014	UNDEFINED	UNDEFINED	UNDEFINED	UNDEFINED	11.11		7.9959E+04		

```
*************************************************************
* AVERAGE % CHANGE IN JUNCTION OR CONDUIT IS DEF NED AS:    *
* CONDUIT  % CHANGE ==> 100.0 ( Q(n+1) - Q(n) ) ' Qfull     *
* JUNCTION % CHANGE ==> 100.0 ( Y(n+1) - Y(n) ) ' Yfull     *
*************************************************************

 The Conduit with the largest average change...      66 had    7.089 percent
The Junction with the largest average change...      66 had    1.466 percent


===> Extended Transport model simulation ended n rmally.

===> SWMM 4.4GU  simulation ended normally.
     Always check output file for possible warni g messages.

===> Your input file was named : PCTmpl.dat
===> Your output file was named: PCTmpl.out

*******************************************************
*       SWMM 4.4GU  Simulation Date and Time Sum ary  *
*******************************************************
* Starting Date... November   17, 2006                *
*          Time...           9:34:42.  0              *
*   Ending Date... November   17, 2006                *
*          Time...           9:34:46.830              *
*  Elapsed Time...                0.081 minutes.      *
*  Elapsed Time...                4.831 seconds.      *
```

++

Appendix A.3

Alternative 2A

Cahill Drain Crossing
Lennon Drain Crossing
Basin Drain Crossing
Titcombe Drain Crossing

Culvert Calculator Report
Basin Drain -All Alternatives - Reg Check

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	181.40 m	Headwater Depth/Height	1.20
Computed Headwater Elevat	180.32 m	Discharge	8.1000 m^3/s
Inlet Control HW Elev.	180.32 m	Tailwater Elevation	179.70 m
Outlet Control HW Elev.	180.32 m	Control Type	Inlet Control

Grades

Upstream Invert	178.50 m	Downstream Invert	178.20 m
Length	58.00 m	Constructed Slope	0.005172 m/m

Hydraulic Profile

Profile	CompositeS1S2	Depth, Downstream	1.05 m
Slope Type	Steep	Normal Depth	1.05 m
Flow Regime	N/A	Critical Depth	1.14 m
Velocity Downstream	3.62 m/s	Critical Slope	0.004178 m/m

Section

Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	2.13 m
Section Size	2130 x 1520 mm	Rise	1.52 m
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	180.32 m	Upstream Velocity Head	0.57 m
Ke	0.20	Entrance Loss	0.11 m

Inlet Control Properties

Inlet Control HW Elev.	180.32 m	Flow Control	Transition
Inlet Type	90° headwall w 45° bevels	Area Full	3.3 m^2
K	0.49500	HDS 5 Chart	10
M	0.66700	HDS 5 Scale	2
C	0.03140	Equation Form	2
Y	0.82000		

Culvert Calculator Report
Lennon Drain - Alt2A-100yr-Existing

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	182.00 m	Headwater Depth/Height	1.54
Computed Headwater Elevat	181.38 m	Discharge	8.3000 m^3/s
Inlet Control HW Elev.	181.21 m	Tailwater Elevation	180.70 m
Outlet Control HW Elev.	181.38 m	Control Type	Outlet Control

Grades

Upstream Invert	179.50 m	Downstream Invert	179.20 m
Length	67.00 m	Constructed Slope	0.004478 m/m

Hydraulic Profile

Profile	PressureProfile	Depth, Downstream	1.50 m
Slope Type	N/A	Normal Depth	0.93 m
Flow Regime	N/A	Critical Depth	1.02 m
Velocity Downstream	2.63 m/s	Critical Slope	0.003567 m/m

Section

Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	2.59 m
Section Size	1219 mm x 2591 mm	Rise	1.22 m
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	181.38 m	Upstream Velocity Head	0.35 m
Ke	0.20	Entrance Loss	0.07 m

Inlet Control Properties

Inlet Control HW Elev.	181.21 m	Flow Control	Submerged
Inlet Type	90° headwall w 45° bevels	Area Full	3.2 m^2
K	0.49500	HDS 5 Chart	10
M	0.66700	HDS 5 Scale	2
C	0.03140	Equation Form	2
Y	0.82000		

Culvert Calculator Report
Cahill Alt 2A-Future

Comments: Unknown Flow

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	184.40	m	Headwater Depth/Height	1.97	
Computed Headwater Elevat	182.77	m	Discharge	27.6000	m^3/s
Inlet Control HW Elev.	182.77	m	Tailwater Elevation	181.14	m
Outlet Control HW Elev.	182.61	m	Control Type	Inlet Control	

Grades

Upstream Invert	179.82	m	Downstream Invert	179.64	m
Length	74.00	m	Constructed Slope	0.002432	m/m

Hydraulic Profile

Profile	PressureProfile		Depth, Downstream	1.50	m
Slope Type	N/A		Normal Depth	N/A	m
Flow Regime	N/A		Critical Depth	1.50	m
Velocity Downstream	4.09	m/s	Critical Slope	0.006085	m/m

Section

Section Shape	Box		Mannings Coefficient	0.013	
Section Material	Concrete		Span	4.50	m
Section Size	4500 x 1500 mm		Rise	1.50	m
Number Sections	1				

Outlet Control Properties

Outlet Control HW Elev.	182.61	m	Upstream Velocity Head	0.85	m
Ke	0.20		Entrance Loss	0.17	m

Inlet Control Properties

Inlet Control HW Elev.	182.77	m	Flow Control	N/A	
Inlet Type	90° headwall w 45° bevels		Area Full	6.8	m^2
K	0.49500		HDS 5 Chart	10	
M	0.66700		HDS 5 Scale	2	
C	0.03140		Equation Form	2	
Y	0.82000				

Appendix A.4

Alternative 2B

Appendix A.4.1

Titcombe Drain Crossing

Titcombe Drain
Worksheet for Circular Channel

Project Description	
Worksheet	Titcome_prelimin
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Full Flow Diamete

Input Data		
Mannings Coeffici	0.013	
Channel Slope	005000	m/m
Discharge	3.2000	m³/s

Results		
Depth	1.27	m
Diameter	1,269.0	mm
Flow Area	1.3	m²
Wetted Perimet	4.30	m
Top Width	0.00	m
Critical Depth	0.97	m
Percent Full	100.0	%
Critical Slope	005735	m/m
Velocity	2.53	m/s
Velocity Head	0.33	m
Specific Energy	1.60	m
Froude Number	0.00	
Maximum Disch	3.4423	m³/s
Discharge Full	3.2000	m³/s
Slope Full	005000	m/m
Flow Type	N/A	

Notes: Discharge of 3.2 m3/s was taken from taking 50% of the 100 year flow of subcatchment 140 of turkey creek watershed.
Drainage area D/S of Titcombe is approximately 274 ha, 55% of the entire subcatch #140. Drainage area therefore U/S Titcombe crossing is app. 50% of the entire subcatch.
From 1989 Maclaren report:
Catch # 140
DA = 496 Ha.
100 yr existing = 6.4 m3/s
100 yr efuture = 16.7 m3/s

Appendix A.4.2

Basin Drain Crossing

Culvert Calculator Report
Basin Drain -All Alternatives - Reg Check

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	181.40 m	Headwater Depth/Height	1.20
Computed Headwater Elevat	180.32 m	Discharge	8.1000 m^3/s
Inlet Control HW Elev.	180.32 m	Tailwater Elevation	179.70 m
Outlet Control HW Elev.	180.32 m	Control Type	Inlet Control

Grades

Upstream Invert	178.50 m	Downstream Invert	178.20 m
Length	58.00 m	Constructed Slope	0.005172 m/m

Hydraulic Profile

Profile	CompositeS1S2	Depth, Downstream	1.05 m
Slope Type	Steep	Normal Depth	1.05 m
Flow Regime	N/A	Critical Depth	1.14 m
Velocity Downstream	3.62 m/s	Critical Slope	0.004178 m/m

Section

Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	2.13 m
Section Size	2130 x 1520 mm	Rise	1.52 m
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	180.32 m	Upstream Velocity Head	0.57 m
Ke	0.20	Entrance Loss	0.11 m

Inlet Control Properties

Inlet Control HW Elev.	180.32 m	Flow Control	Transition
Inlet Type	90° headwall w 45° bevels	Area Full	3.3 m^2
K	0.49500	HDS 5 Chart	10
M	0.66700	HDS 5 Scale	2
C	0.03140	Equation Form	2
Y	0.82000		

Appendix A.5

Alternative 2B – Revised

Appendix A.5.1

Titcombe Drain Crossing

Titcombe Drain
Worksheet for Circular Channel

Project Description	
Worksheet	Titcome_prelimin
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Full Flow Diamet‹

Input Data		
Mannings Coeffici	0.013	
Channel Slope	005000	m/m
Discharge	3.2000	m³/s

Results		
Depth	1.27	m
Diameter	1,269.0	mm
Flow Area	1.3	m²
Wetted Perimet	4.30	m
Top Width	0.00	m
Critical Depth	0.97	m
Percent Full	100.0	%
Critical Slope	005735	m/m
Velocity	2.53	m/s
Velocity Head	0.33	m
Specific Energy	1.60	m
Froude Number	0.00	
Maximum Disch	3.4423	m³/s
Discharge Full	3.2000	m³/s
Slope Full	005000	m/m
Flow Type	N/A	

Notes: Discharge of 3.2 m3/s was taken from taking 50% of the 100 year flow of subcatchment 140 of turkey creek watershed.
Drainage area D/S of Titcombe is approximately 274 ha, 55% of the entire subcatch #140. Drainage area therefore U/S Titcombe crossing is app. 50% of the entire subcatch.
From 1989 Maclaren report:
Catch # 140
DA = 496 Ha.
100 yr existing = 6.4 m3/s
100 yr efuture = 16.7 m3/s

Appendix A.5.2

Basin Drain Crossing

Culvert Calculator Report
Basin Drain -All Alternatives - Reg Check

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	181.40 m	Headwater Depth/Height	1.20
Computed Headwater Elevat	180.32 m	Discharge	8.1000 m^3/s
Inlet Control HW Elev.	180.32 m	Tailwater Elevation	179.70 m
Outlet Control HW Elev.	180.32 m	Control Type	Inlet Control

Grades

Upstream Invert	178.50 m	Downstream Invert	178.20 m
Length	58.00 m	Constructed Slope	0.005172 m/m

Hydraulic Profile

Profile	CompositeS1S2	Depth, Downstream	1.05 m
Slope Type	Steep	Normal Depth	1.05 m
Flow Regime	N/A	Critical Depth	1.14 m
Velocity Downstream	3.62 m/s	Critical Slope	0.004178 m/m

Section

Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	2.13 m
Section Size	2130 x 1520 mm	Rise	1.52 m
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	180.32 m	Upstream Velocity Head	0.57 m
Ke	0.20	Entrance Loss	0.11 m

Inlet Control Properties

Inlet Control HW Elev.	180.32 m	Flow Control	Transition
Inlet Type	90° headwall w 45° bevels	Area Full	3.3 m^2
K	0.49500	HDS 5 Chart	10
M	0.66700	HDS 5 Scale	2
C	0.03140	Equation Form	2
Y	0.82000		

Appendix A.5.3

Turkey Creek Hydraulic Analysis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9.7
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Appendix A.5.3.1

Existing Condition

HEC-RAS Version 3.1.3 May 2005
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX   XXXX       XXXX     XX    XXXX
X     X  X       X    X      X   X   X  X  X
X     X  X       X           X   X  X    X X
XXXXXXX  XXXX    X     XXX   XXXX   XXXXXX  XXXX
X     X  X       X           X X    X    X      X
X     X  X       X    X      X  X   X    X      X
X     X  XXXXXX   XXXX       X   X  X    X  XXXXX
```

****

PROJECT DATA
Project Title: Turkey River
Project File : dric.prj
Run Date and Time: 15/11/2006 2:56:15 PM

Project in SI units

****

PLAN DATA

Plan Title: Plan 37
Plan File : o:\DRIC\19_WaterResources\hec\dric.p37

Geometry Title: existing
Geometry File : o:\DRIC\19_WaterResources\hec\dric.g01

Flow Title   : Flow 01
Flow File   : o:\DRIC\19_WaterResources\hec\dric.f01

Plan Summary Information:

Number of:					
Cross Sections	=	10	Multiple Openings	=	0
Culverts	=	0	Inline Structures	=	0
Bridges	=	1	Lateral Structures	=	0

Computational Information
Water surface calculation tolerance = 0.003
Critical depth calculation tolerance = 0.003
Maximum number of iterations = 20
Maximum difference tolerance = 0.1
Flow tolerance factor = 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Subcritical Flow

****

FLOW DATA

Flow Title: Flow 01
Flow File : o:\DRIC\19_WaterResources\hec\dric.f01

Flow Data (m3/s)

River	Reach	RS	100 yr	Regional
Turkey Creek	Main	10	39.5	62.6

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Turkey Creek	Main	100 yr		Normal S = 0.000375

```
* Turkey Creek    Main             Regional          *                          Normal S = 0.000375
*
*******************************************************************************************************
*

*******************************************************************************

GEOMETRY DATA

Geometry Title: existing
Geometry File : o:\DRIC\19_WaterResources\hec\dric.g01

CROSS SECTION


RIVER: Turkey Creek
REACH: Main                RS: 10

INPUT
Description:
Station Elevation Data     num=      30
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
*******************************************************************************
       0      183   76.736      183   99.766    182.5  101.278      182  102.644    181.5
  104.01      181  105.363    180.5  106.485      180  107.607    179.5  108.729      179
 109.851    178.5  110.973      178  112.095    177.5  113.217      177  116.947   176.56
 117.547   176.36  119.547   176.36  120.147   176.56  123.877      177  124.941    177.5
 126.005      178  127.069    178.5  128.133      179  129.197    179.5  130.261      180
 131.624    180.5  132.798      181  134.684    181.5  136.554      182   264.86    182.5

Manning's n Values         num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
************************************************
       0      .03  116.947     .017  120.147      .03

Bank Sta: Left   Right     Lengths: Left Channel   Right      Coeff Contr.    Expan.
       116.947 120.147            207.817 210.778 216.406                .1        .3

CROSS SECTION OUTPUT  Profile #100 yr
*******************************************************************************************
* E.G. Elev (m)         *   178.68  * Element                *  Left OB *  Channel * Right OB *
* Vel Head (m)          *     0.27  * Wt. n-Val.             *   0.030  *   0.017  *   0.030  *
* W.S. Elev (m)         *   178.40  * Reach Len. (m)         *  207.82  *  210.78  *  216.41  *
* Crit W.S. (m)         *           * Flow Area (m2)         *    8.25  *    6.41  *    8.13  *
* E.G. Slope (m/m)      * 0.001101  * Area (m2)              *    8.25  *    6.41  *    8.13  *
* Q Total (m3/s)        *    39.50  * Flow (m3/s)            *    9.99  *   19.62  *    9.89  *
* Top Width (m)         *    16.78  * Top Width (m)          *    6.87  *    3.20  *    6.71  *
* Vel Total (m/s)       *     1.73  * Avg. Vel. (m/s)        *    1.21  *    3.06  *    1.22  *
* Max Chl Dpth (m)      *     2.04  * Hydr. Depth (m)        *    1.20  *    2.00  *    1.21  *
* Conv. Total (m3/s)    *   1190.6  * Conv. (m3/s)           *   301.0  *   591.3  *   298.2  *
* Length Wtd. (m)       *   211.47  * Wetted Per. (m)        *    7.20  *    3.26  *    7.05  *
* Min Ch El (m)         *   176.36  * Shear (N/m2)           *   12.37  *   21.19  *   12.45  *
* Alpha                 *     1.80  * Stream Power (N/m s)   *   14.98  *   64.86  *   15.15  *
* Frctn Loss (m)        *     0.16  * Cum Volume (1000 m3)   *    3.89  *    5.02  *    4.35  *
* C & E Loss (m)        *     0.03  * Cum SA (1000 m2)       *    3.03  *    2.34  *    3.46  *
*******************************************************************************************

CROSS SECTION OUTPUT  Profile #Regional
*******************************************************************************************
* E.G. Elev (m)         *   179.26  * Element                *  Left OB *  Channel * Right OB *
* Vel Head (m)          *     0.36  * Wt. n-Val.             *   0.030  *   0.017  *   0.030  *
* W.S. Elev (m)         *   178.90  * Reach Len. (m)         *  207.82  *  210.78  *  216.41  *
* Crit W.S. (m)         *           * Flow Area (m2)         *   11.93  *    8.00  *   11.72  *
* E.G. Slope (m/m)      * 0.001143  * Area (m2)              *   11.93  *    8.00  *   11.72  *
* Q Total (m3/s)        *    62.60  * Flow (m3/s)            *   16.96  *   28.90  *   16.74  *
* Top Width (m)         *    18.95  * Top Width (m)          *    7.99  *    3.20  *    7.77  *
* Vel Total (m/s)       *     1.98  * Avg. Vel. (m/s)        *    1.42  *    3.61  *    1.43  *
* Max Chl Dpth (m)      *     2.54  * Hydr. Depth (m)        *    1.49  *    2.50  *    1.51  *
* Conv. Total (m3/s)    *   1851.8  * Conv. (m3/s)           *   501.8  *   854.8  *   495.2  *
* Length Wtd. (m)       *   211.51  * Wetted Per. (m)        *    8.42  *    3.26  *    8.22  *
* Min Ch El (m)         *   176.36  * Shear (N/m2)           *   15.89  *   27.45  *   15.99  *
* Alpha                 *     1.82  * Stream Power (N/m s)   *   22.59  *   99.18  *   22.83  *
* Frctn Loss (m)        *     0.19  * Cum Volume (1000 m3)   *    5.48  *    6.16  *    6.15  *
* C & E Loss (m)        *     0.03  * Cum SA (1000 m2)       *    3.54  *    2.34  *    3.96  *
*******************************************************************************************

CROSS SECTION


RIVER: Turkey Creek
```

```
REACH: Main                RS: 9.9

INPUT
Description:
Station Elevation Data     num=       32
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
*******************************************************************************************
       0    182.5  120.028    182.5  136.616      182  137.952    181.5  139.286      181
  140.62    180.5  141.772      180  142.859    179.5  143.941      179  145.023    178.5
 146.105      178  147.187    177.5  148.269      177  149.351    176.5  152.673   176.06
 153.273   175.86  155.273   175.86  155.873   176.06  159.195    176.5  160.399      177
 161.603    177.5  162.805      178  164.002    178.5  165.197      179   166.39    179.5
 167.992      180  169.998    180.5  172.048      181  174.284    181.5  180.916      182
 191.253    182.5  277.679      183

Manning's n Values         num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
*****************************************************
       0      .03  152.673     .017  155.873      .03

Bank Sta: Left   Right     Lengths: Left Channel   Right      Coeff Contr.    Expan.
       152.673 155.873            104.462 100.685  96.329                .1        .3

CROSS SECTION OUTPUT  Profile #100 yr
*******************************************************************************************************
* E.G. Elev (m)          *   178.48  * Element                 *  Left OB *  Channel * Right OB *
* Vel Head (m)           *     0.18  * Wt. n-Val.              *   0.030  *   0.017  *   0.030  *
* W.S. Elev (m)          *   178.30  * Reach Len. (m)          *  104.46  *  100.68  *   96.33  *
* Crit W.S. (m)          *           * Flow Area (m2)          *   10.23  *    7.69  *   10.63  *
* E.G. Slope (m/m)       *0.000579   * Area (m2)               *   10.23  *    7.69  *   10.63  *
* Q Total (m3/s)         *    39.50  * Flow (m3/s)             *    9.96  *   19.28  *   10.26  *
* Top Width (m)          *    18.08  * Top Width (m)           *    7.22  *    3.20  *    7.66  *
* Vel Total (m/s)        *     1.38  * Avg. Vel. (m/s)         *    0.97  *    2.51  *    0.97  *
* Max Chl Dpth (m)       *     2.44  * Hydr. Depth (m)         *    1.42  *    2.40  *    1.39  *
* Conv. Total (m3/s)     *   1642.2  * Conv. (m3/s)            *   414.2  *   801.6  *   426.5  *
* Length Wtd. (m)        *   100.42  * Wetted Per. (m)         *    7.65  *    3.26  *    8.04  *
* Min Ch El (m)          *   175.86  * Shear (N/m2)            *    7.59  *   13.37  *    7.50  *
* Alpha                  *     1.85  * Stream Power (N/m s)    *    7.39  *   33.51  *    7.24  *
* Frctn Loss (m)         *     0.06  * Cum Volume (1000 m3)    *    1.97  *    3.53  *    2.32  *
* C & E Loss (m)         *     0.00  * Cum SA (1000 m2)        *    1.57  *    1.67  *    1.91  *
*******************************************************************************************************

CROSS SECTION OUTPUT  Profile #Regional
*******************************************************************************************************
* E.G. Elev (m)          *   179.04  * Element                 *  Left OB *  Channel * Right OB *
* Vel Head (m)           *     0.26  * Wt. n-Val.              *   0.030  *   0.017  *   0.030  *
* W.S. Elev (m)          *   178.78  * Reach Len. (m)          *  104.46  *  100.68  *   96.33  *
* Crit W.S. (m)          *           * Flow Area (m2)          *   13.93  *    9.22  *   14.55  *
* E.G. Slope (m/m)       *0.000698   * Area (m2)               *   13.93  *    9.22  *   14.55  *
* Q Total (m3/s)         *    62.60  * Flow (m3/s)             *   16.67  *   28.63  *   17.30  *
* Top Width (m)          *    20.25  * Top Width (m)           *    8.26  *    3.20  *    8.80  *
* Vel Total (m/s)        *     1.66  * Avg. Vel. (m/s)         *    1.20  *    3.11  *    1.19  *
* Max Chl Dpth (m)       *     2.92  * Hydr. Depth (m)         *    1.69  *    2.88  *    1.65  *
* Conv. Total (m3/s)     *   2369.7  * Conv. (m3/s)            *   631.1  *  1083.9  *   654.7  *
* Length Wtd. (m)        *   100.36  * Wetted Per. (m)         *    8.79  *    3.26  *    9.28  *
* Min Ch El (m)          *   175.86  * Shear (N/m2)            *   10.85  *   19.33  *   10.73  *
* Alpha                  *     1.88  * Stream Power (N/m s)    *   12.99  *   60.02  *   12.75  *
* Frctn Loss (m)         *     0.08  * Cum Volume (1000 m3)    *    2.80  *    4.34  *    3.31  *
* C & E Loss (m)         *     0.00  * Cum SA (1000 m2)        *    1.85  *    1.67  *    2.17  *
*******************************************************************************************************

CROSS SECTION


RIVER: Turkey Creek
REACH: Main                RS: 9.8

INPUT
Description: US of Huron Church Road
Station Elevation Data     num=       30
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
*******************************************************************************************
       0    182.5   37.489      182   45.643    181.5   47.136      181   48.636    180.5
  50.024      180     51.1    179.5   52.174      179   53.246    178.5   54.316      178
  55.384    177.5   56.451      177   57.519    176.5   60.347   176.06   60.947   175.86
  62.947   175.86   63.547   176.06   66.375    176.5   67.488      177    71.05    177.5
   72.19      178    73.33    178.5   74.472      179   75.609    179.5   76.733      180
  77.849    180.5   94.858      181  118.672    181.5  142.126      182  143.791    182.5

Manning's n Values         num=        3
```

```
     Sta   n Val     Sta   n Val     Sta   n Val
************************************************
       0     .03  60.347    .017  63.547     .03

Bank Sta: Left   Right    Lengths: Left Channel  Right      Coeff Contr.   Expan.
        60.347  63.547            24.356  24.248  24.356              .1       .3

CROSS SECTION OUTPUT  Profile #100 yr
*******************************************************************************************
* E.G. Elev (m)             *   178.42  * Element                  *  Left OB *  Channel * Right OB *
* Vel Head (m)              *     0.21  * Wt. n-Val.               *   0.030  *   0.017  *   0.030  *
* W.S. Elev (m)             *   178.20  * Reach Len. (m)           *   24.36  *   24.25  *   24.36  *
* Crit W.S. (m)             *           * Flow Area (m2)           *    8.54  *    7.38  *   11.02  *
* E.G. Slope (m/m)          *0.000709   * Area (m2)                *    8.54  *    7.38  *   11.02  *
* Q Total (m3/s)            *    39.50  * Flow (m3/s)              *    8.75  *   19.90  *   10.85  *
* Top Width (m)             *    18.77  * Top Width (m)            *    6.47  *    3.20  *    9.11  *
* Vel Total (m/s)           *     1.47  * Avg. Vel. (m/s)          *    1.03  *    2.70  *    0.98  *
* Max Chl Dpth (m)          *     2.34  * Hydr. Depth (m)          *    1.32  *    2.31  *    1.21  *
* Conv. Total (m3/s)        *   1483.3  * Conv. (m3/s)             *   328.6  *   747.4  *   407.3  *
* Length Wtd. (m)           *    24.28  * Wetted Per. (m)          *    6.88  *    3.26  *    9.43  *
* Min Ch El (m)             *   175.86  * Shear (N/m2)             *    8.63  *   15.71  *    8.12  *
* Alpha                     *     1.94  * Stream Power (N/m s)     *    8.85  *   42.39  *    8.00  *
* Frctn Loss (m)            *     0.01  * Cum Volume (1000 m3)     *    0.99  *    2.77  *    1.28  *
* C & E Loss (m)            *     0.02  * Cum SA (1000 m2)         *    0.85  *    1.35  *    1.10  *
*******************************************************************************************

CROSS SECTION OUTPUT  Profile #Regional
*******************************************************************************************
* E.G. Elev (m)             *   178.97  * Element                  *  Left OB *  Channel * Right OB *
* Vel Head (m)              *     0.29  * Wt. n-Val.               *   0.030  *   0.017  *   0.030  *
* W.S. Elev (m)             *   178.67  * Reach Len. (m)           *   24.36  *   24.25  *   24.36  *
* Crit W.S. (m)             *           * Flow Area (m2)           *   11.80  *    8.88  *   15.53  *
* E.G. Slope (m/m)          *0.000813   * Area (m2)                *   11.80  *    8.88  *   15.53  *
* Q Total (m3/s)            *    62.60  * Flow (m3/s)              *   14.55  *   29.00  *   19.05  *
* Top Width (m)             *    20.84  * Top Width (m)            *    7.47  *    3.20  *   10.18  *
* Vel Total (m/s)           *     1.73  * Avg. Vel. (m/s)          *    1.23  *    3.27  *    1.23  *
* Max Chl Dpth (m)          *     2.81  * Hydr. Depth (m)          *    1.58  *    2.77  *    1.53  *
* Conv. Total (m3/s)        *   2195.7  * Conv. (m3/s)             *   510.3  *  1017.3  *   668.0  *
* Length Wtd. (m)           *    24.29  * Wetted Per. (m)          *    7.99  *    3.26  *   10.60  *
* Min Ch El (m)             *   175.86  * Shear (N/m2)             *   11.78  *   21.67  *   11.68  *
* Alpha                     *     1.93  * Stream Power (N/m s)     *   14.52  *   70.81  *   14.33  *
* Frctn Loss (m)            *     0.01  * Cum Volume (1000 m3)     *    1.45  *    3.43  *    1.86  *
* C & E Loss (m)            *     0.03  * Cum SA (1000 m2)         *    1.03  *    1.35  *    1.25  *
*******************************************************************************************

CROSS SECTION


RIVER: Turkey Creek
REACH: Main                  RS: 9.7

INPUT
Description: DS of Huron Church Road
Station Elevation Data     num=      22
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
****************************************************************************
       0     182 135.597     182 140.617   181.5 141.147     181 141.663   180.5
 142.193     180 142.948   179.5 144.066     179 145.159   178.5 146.135     178
 147.372   177.5 148.469     177 149.758   176.5 151.708  176.06 152.308  175.86
 154.308  175.86 154.908  176.06 156.858   176.5 157.961     177 161.475   177.1
 167.781   181.5 235.174     182

Manning's n Values         num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
************************************************
       0     .02 148.469    .017 157.961     .02

Bank Sta: Left   Right    Lengths: Left Channel  Right      Coeff Contr.   Expan.
       148.469 157.961            35.414  35.414  35.414              .3       .5

CROSS SECTION OUTPUT  Profile #100 yr
*******************************************************************************************
* E.G. Elev (m)             *   178.38  * Element                  *  Left OB *  Channel * Right OB *
* Vel Head (m)              *     0.15  * Wt. n-Val.               *   0.020  *   0.017  *   0.020  *
* W.S. Elev (m)             *   178.24  * Reach Len. (m)           *    0.62  *    0.62  *    0.62  *
* Crit W.S. (m)             *   177.50  * Flow Area (m2)           *    1.74  *   18.68  *    5.10  *
* E.G. Slope (m/m)          *0.000396   * Area (m2)                *    1.74  *   18.68  *    5.10  *
* Q Total (m3/s)            *    39.50  * Flow (m3/s)              *    1.19  *   33.49  *    4.82  *
* Top Width (m)             *    17.43  * Top Width (m)            *    2.80  *    9.49  *    5.14  *
* Vel Total (m/s)           *     1.55  * Avg. Vel. (m/s)          *    0.68  *    1.79  *    0.95  *
```

```
* Max Chl Dpth (m)       *    2.38  * Hydr. Depth (m)       *   0.62  *   1.97  *   0.99  *
* Conv. Total (m3/s)     *  1985.3  * Conv. (m3/s)          *   59.8  * 1683.1  *  242.4  *
* Length Wtd. (m)        *    0.62  * Wetted Per. (m)       *   3.06  *   9.86  *   5.50  *
* Min Ch El (m)          *  175.86  * Shear (N/m2)          *   2.21  *   7.36  *   3.60  *
* Alpha                  *    1.19  * Stream Power (N/m s)  *   1.51  *  13.19  *   3.40  *
* Frctn Loss (m)         *    0.00  * Cum Volume (1000 m3)  *   0.86  *   2.45  *   1.08  *
* C & E Loss (m)         *    0.00  * Cum SA (1000 m2)      *   0.74  *   1.19  *   0.93  *
*******************************************************************************************

CROSS SECTION OUTPUT  Profile #Regional
*******************************************************************************************
* E.G. Elev (m)          *  178.92  * Element               * Left OB * Channel * Right OB *
* Vel Head (m)           *    0.21  * Wt. n-Val.            *  0.020  *  0.017  *  0.020  *
* W.S. Elev (m)          *  178.72  * Reach Len. (m)        *   0.62  *   0.62  *   0.62  *
* Crit W.S. (m)          *  177.87  * Flow Area (m2)        *   3.32  *  23.25  *   7.74  *
* E.G. Slope (m/m)       *0.000433  * Area (m2)             *   3.32  *  23.25  *   7.74  *
* Q Total (m3/s)         *   62.60  * Flow (m3/s)           *   2.97  *  50.43  *   9.20  *
* Top Width (m)          *   19.12  * Top Width (m)         *   3.79  *   9.49  *   5.83  *
* Vel Total (m/s)        *    1.82  * Avg. Vel. (m/s)       *   0.89  *   2.17  *   1.19  *
* Max Chl Dpth (m)       *    2.86  * Hydr. Depth (m)       *   0.88  *   2.45  *   1.33  *
* Conv. Total (m3/s)     *  3008.5  * Conv. (m3/s)          *  142.8  * 2423.6  *  442.1  *
* Length Wtd. (m)        *    0.62  * Wetted Per. (m)       *   4.16  *   9.86  *   6.34  *
* Min Ch El (m)          *  175.86  * Shear (N/m2)          *   3.39  *  10.02  *   5.18  *
* Alpha                  *    1.21  * Stream Power (N/m s)  *   3.03  *  21.72  *   6.16  *
* Frctn Loss (m)         *    0.00  * Cum Volume (1000 m3)  *   1.27  *   3.04  *   1.58  *
* C & E Loss (m)         *    0.00  * Cum SA (1000 m2)      *   0.89  *   1.19  *   1.06  *
*******************************************************************************************

BRIDGE


RIVER: Turkey Creek
REACH: Main                RS: 9.65

INPUT
Description:
Distance from Upstream XS =    .621
Deck/Roadway Width        =   34.79
Weir Coefficient          =    1.44
Upstream  Deck/Roadway Coordinates
    num=       9
     Sta Hi Cord Lo Cord      Sta Hi Cord Lo Cord      Sta Hi Cord Lo Cord
*******************************************************************************

       0  181.74            90.83 182.081          118.067 182.057
  140.62 182.199   181.5   152.78 182.207   181.5   167.78 182.179   181.5
 168.067 182.156          190.032 181.964          218.067 181.884

Upstream Bridge Cross Section Data
Station Elevation Data    num=       22
     Sta     Elev     Sta     Elev     Sta     Elev     Sta     Elev     Sta     Elev
***************************************************************************************

       0      182 135.597      182 140.617    181.5 141.147      181 141.663    180.5
 142.193      180 142.948    179.5 144.066      179 145.159    178.5 146.135      178
 147.372    177.5 148.469      177 149.758    176.5 151.708   176.06 152.308   175.86
 154.308   175.86 154.908   176.06 156.858    176.5 157.961      177 161.475    177.1
 167.781    181.5 235.174      182

Manning's n Values        num=       3
     Sta    n Val     Sta    n Val     Sta    n Val
*****************************************************

       0      .02 148.469     .017 157.961      .02

Bank Sta: Left   Right    Coeff Contr.   Expan.
       148.469 157.961             .3        .5

Downstream  Deck/Roadway Coordinates
    num=      11
     Sta Hi Cord Lo Cord      Sta Hi Cord Lo Cord      Sta Hi Cord Lo Cord
*******************************************************************************

       0  181.74            90.83 182.081          118.067 182.057
  133.85 182.157   181.5   137.28 182.199   181.5   152.78 182.207   181.5
  165.46 182.179   181.5  168.067 182.156   181.5   175.93  182.11   181.5
 190.032 181.964          218.067 181.884

Downstream Bridge Cross Section Data
Station Elevation Data    num=       18
     Sta     Elev     Sta     Elev     Sta     Elev     Sta     Elev     Sta     Elev
***************************************************************************************

       0      182  125.33      182  133.85    181.5 139.252    179.5 140.572      177
  141.87    176.5  145.27   176.06  145.87   175.86  147.87   175.86  148.47   176.06
```

```
  151.87    176.5 152.973     177 156.487   177.1 159.275   179.5 161.948    180.5
  166.14      181 170.386   181.5 199.519     182

Manning's n Values          num=       3
     Sta    n Val     Sta    n Val     Sta    n Val
************************************************
       0      .02 140.572    .017 152.973     .02

Bank Sta: Left   Right     Coeff Contr.   Expan.
       140.572 152.973              .3        .5

Upstream Embankment side slope              =        0 horiz. to 1.0 vertical
Downstream Embankment side slope            =        0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =      .95
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Bridge Coefficient Sets =  1

Low Flow Methods and Data
       Energy
Selected Low Flow Methods = Highest Energy Answer

High Flow Method
       Pressure and Weir flow
           Submerged Inlet Cd            =
           Submerged Inlet + Outlet Cd =      .8
           Max Low Cord                  =

Additional Bridge Parameters
       Add Friction component to Momentum
       Do not add Weight component to Momentum
       Class B flow critical depth computations use critical depth
           inside the bridge at the upstream end
       Criteria to check for pressure flow = Upstream energy grade line

BRIDGE OUTPUT  Profile #100 yr
****************************************************************************************
* E.G. US. (m)            *       178.38  * Element               *Inside BR US *Inside BR DS *
* W.S. US. (m)            *       178.24  * E.G. Elev (m)         *      178.38  *      178.35  *
* Q Total (m3/s)          *        39.50  * W.S. Elev (m)         *      178.24  *      178.25  *
* Q Bridge (m3/s)         *        39.50  * Crit W.S. (m)         *      177.50  *      177.31  *
* Q Weir (m3/s)           *               * Max Chl Dpth (m)      *        2.38  *        2.39  *
* Weir Sta Lft (m)        *               * Vel Total (m/s)       *        1.55  *        1.32  *
* Weir Sta Rgt (m)        *               * Flow Area (m2)        *       25.52  *       29.91  *
* Weir Submerg            *               * Froude # Chl          *        0.41  *        0.33  *
* Weir Max Depth (m)      *               * Specif Force (m3)     *       29.14  *       33.37  *
* Min El Weir Flow (m)    *       181.95  * Hydr Depth (m)        *        1.46  *        1.67  *
* Min El Prs (m)          *       181.50  * W.P. Total (m)        *       18.42  *       19.41  *
* Delta EG (m)            *         0.03  * Conv. Total (m3/s)    *      1984.8  *      2482.2  *
* Delta WS (m)            *        -0.01  * Top Width (m)         *       17.43  *       17.91  *
* BR Open Area (m2)       *        99.65  * Frctn Loss (m)        *        0.01  *        0.00  *
* BR Open Vel (m/s)       *         1.55  * C & E Loss (m)        *        0.02  *        0.00  *
* Coef of Q               *               * Shear Total (N/m2)    *        5.38  *        3.83  *
* Br Sel Method           *Energy only    * Power Total (N/m s)   *        8.33  *        5.05  *
****************************************************************************************

BRIDGE OUTPUT  Profile #Regional
****************************************************************************************
* E.G. US. (m)            *       178.92  * Element               *Inside BR US *Inside BR DS *
* W.S. US. (m)            *       178.72  * E.G. Elev (m)         *      178.92  *      178.88  *
* Q Total (m3/s)          *        62.60  * W.S. Elev (m)         *      178.72  *      178.73  *
* Q Bridge (m3/s)         *        62.60  * Crit W.S. (m)         *      177.87  *      177.64  *
* Q Weir (m3/s)           *               * Max Chl Dpth (m)      *        2.86  *        2.87  *
* Weir Sta Lft (m)        *               * Vel Total (m/s)       *        1.82  *        1.61  *
* Weir Sta Rgt (m)        *               * Flow Area (m2)        *       34.31  *       38.79  *
* Weir Submerg            *               * Froude # Chl          *        0.44  *        0.37  *
* Weir Max Depth (m)      *               * Specif Force (m3)     *       49.38  *       55.26  *
* Min El Weir Flow (m)    *       181.95  * Hydr Depth (m)        *        1.79  *        2.07  *
* Min El Prs (m)          *       181.50  * W.P. Total (m)        *       20.36  *       20.71  *
* Delta EG (m)            *         0.04  * Conv. Total (m3/s)    *      3007.8  *      3671.7  *
* Delta WS (m)            *        -0.02  * Top Width (m)         *       19.11  *       18.73  *
* BR Open Area (m2)       *        99.65  * Frctn Loss (m)        *        0.01  *        0.00  *
* BR Open Vel (m/s)       *         1.82  * C & E Loss (m)        *        0.03  *        0.00  *
* Coef of Q               *               * Shear Total (N/m2)    *        7.16  *        5.34  *
* Br Sel Method           *Energy only    * Power Total (N/m s)   *       13.06  *        8.62  *
****************************************************************************************
```

```
CROSS SECTION


RIVER: Turkey Creek
REACH: Main                RS: 9.6

INPUT
Description:
Station Elevation Data     num=      18
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
********************************************************************************
       0      182   125.33      182   133.85    181.5  139.252    179.5  140.572      177
  141.87    176.5   145.27   176.06   145.87   175.86   147.87   175.86   148.47   176.06
  151.87    176.5  152.973      177  156.487    177.1  159.275    179.5  161.948    180.5
  166.14      181  170.386    181.5  199.519      182

Manning's n Values         num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
************************************************
       0      .02  140.572     .017  152.973      .02

Bank Sta: Left   Right     Lengths: Left Channel    Right     Coeff Contr.    Expan.
       140.572 152.973              3.943        3    4.798              .3        .5

CROSS SECTION OUTPUT  Profile #100 yr
******************************************************************************************
* E.G. Elev (m)            *   178.35  * Element                  *  Left OB  *  Channel  * Right OB  *
* Vel Head (m)             *     0.10  * Wt. n-Val.               *   0.020   *   0.017   *   0.020   *
* W.S. Elev (m)            *   178.25  * Reach Len. (m)           *    3.94   *    3.00   *    4.80   *
* Crit W.S. (m)            *           * Flow Area (m2)           *    0.41   *   24.52   *    4.98   *
* E.G. Slope (m/m)         *0.000253   * Area (m2)                *    0.41   *   24.52   *    4.98   *
* Q Total (m3/s)           *    39.50  * Flow (m3/s)              *    0.14   *   35.54   *    3.81   *
* Top Width (m)            *    17.91  * Top Width (m)            *    0.66   *   12.40   *    4.85   *
* Vel Total (m/s)          *     1.32  * Avg. Vel. (m/s)          *    0.35   *    1.45   *    0.77   *
* Max Chl Dpth (m)         *     2.39  * Hydr. Depth (m)          *    0.62   *    1.98   *    1.03   *
* Conv. Total (m3/s)       *   2482.2  * Conv. (m3/s)             *     9.1   *  2233.4   *   239.7   *
* Length Wtd. (m)          *     3.18  * Wetted Per. (m)          *    1.41   *   12.72   *    5.28   *
* Min Ch El (m)            *   175.86  * Shear (N/m2)             *    0.72   *    4.79   *    2.34   *
* Alpha                    *     1.12  * Stream Power (N/m s)     *    0.25   *    6.94   *    1.80   *
* Frctn Loss (m)           *     0.00  * Cum Volume (1000 m3)     *    0.83   *    1.69   *    0.91   *
* C & E Loss (m)           *     0.01  * Cum SA (1000 m2)         *    0.68   *    0.81   *    0.75   *
******************************************************************************************

CROSS SECTION OUTPUT  Profile #Regional
******************************************************************************************
* E.G. Elev (m)            *   178.88  * Element                  *  Left OB  *  Channel  * Right OB  *
* Vel Head (m)             *     0.15  * Wt. n-Val.               *   0.020   *   0.017   *   0.020   *
* W.S. Elev (m)            *   178.73  * Reach Len. (m)           *    3.94   *    3.00   *    4.80   *
* Crit W.S. (m)            *           * Flow Area (m2)           *    0.79   *   30.53   *    7.47   *
* E.G. Slope (m/m)         *0.000291   * Area (m2)                *    0.79   *   30.53   *    7.47   *
* Q Total (m3/s)           *    62.60  * Flow (m3/s)              *    0.37   *   54.88   *    7.35   *
* Top Width (m)            *    18.73  * Top Width (m)            *    0.92   *   12.40   *    5.41   *
* Vel Total (m/s)          *     1.61  * Avg. Vel. (m/s)          *    0.47   *    1.80   *    0.98   *
* Max Chl Dpth (m)         *     2.87  * Hydr. Depth (m)          *    0.87   *    2.46   *    1.38   *
* Conv. Total (m3/s)       *   3671.7  * Conv. (m3/s)             *    21.7   *  3218.8   *   431.2   *
* Length Wtd. (m)          *     3.22  * Wetted Per. (m)          *    1.96   *   12.72   *    6.02   *
* Min Ch El (m)            *   175.86  * Shear (N/m2)             *    1.15   *    6.84   *    3.54   *
* Alpha                    *     1.13  * Stream Power (N/m s)     *    0.54   *   12.29   *    3.48   *
* Frctn Loss (m)           *     0.00  * Cum Volume (1000 m3)     *    1.20   *    2.09   *    1.31   *
* C & E Loss (m)           *     0.01  * Cum SA (1000 m2)         *    0.81   *    0.81   *    0.86   *
******************************************************************************************

CROSS SECTION


RIVER: Turkey Creek
REACH: Main                RS: 9.5

INPUT
Description:
Station Elevation Data     num=      14
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
********************************************************************************
       0    182.5   58.964      182   67.647    181.5   80.298    176.5   83.844   176.06
  84.444   175.86   86.444   175.86   87.044   176.06    90.59    176.5   92.841    177.5
    98.2      180   99.757    180.5  106.622    181.5  138.493      182

Manning's n Values         num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
************************************************
```

```
      0      .02  80.298     .017    90.59      .02

Bank Sta: Left    Right    Lengths: Left Channel    Right      Coeff Contr.    Expan.
         80.298   90.59              39.545  39.545  39.545               .1         .3

CROSS SECTION OUTPUT  Profile #100 yr
*******************************************************************************************
* E.G. Elev (m)          *   178.34  * Element                *  Left OB *  Channel * Right OB *
* Vel Head (m)           *     0.12  * Wt. n-Val.             *   0.020  *    0.017 *   0.020  *
* W.S. Elev (m)          *   178.22  * Reach Len. (m)         *   39.55  *    39.55 *   39.55  *
* Crit W.S. (m)          *           * Flow Area (m2)         *    3.75  *    21.22 *    3.31  *
* E.G. Slope (m/m)       *0.000292   * Area (m2)              *    3.75  *    21.22 *    3.31  *
* Q Total (m3/s)         *    39.50  * Flow (m3/s)            *    2.77  *    34.30 *    2.43  *
* Top Width (m)          *    18.45  * Top Width (m)          *    4.36  *    10.29 *    3.80  *
* Vel Total (m/s)        *     1.40  * Avg. Vel. (m/s)        *    0.74  *     1.62 *    0.73  *
* Max Chl Dpth (m)       *     2.36  * Hydr. Depth (m)        *    0.86  *     2.06 *    0.87  *
* Conv. Total (m3/s)     *   2309.8  * Conv. (m3/s)           *   161.9  *   2005.9 *   141.9  *
* Length Wtd. (m)        *    39.55  * Wetted Per. (m)        *    4.69  *    10.41 *    4.17  *
* Min Ch El (m)          *   175.86  * Shear (N/m2)           *    2.30  *     5.84 *    2.28  *
* Alpha                  *     1.20  * Stream Power (N/m s)   *    1.69  *     9.45 *    1.67  *
* Frctn Loss (m)         *     0.01  * Cum Volume (1000 m3)   *    0.82  *     1.62 *    0.89  *
* C & E Loss (m)         *     0.02  * Cum SA (1000 m2)       *    0.67  *     0.77 *    0.73  *
*******************************************************************************************

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than
         0.7 or greater than 1.4.  This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT  Profile #Regional
*******************************************************************************************
* E.G. Elev (m)          *   178.88  * Element                *  Left OB *  Channel * Right OB *
* Vel Head (m)           *     0.17  * Wt. n-Val.             *   0.020  *    0.017 *   0.020  *
* W.S. Elev (m)          *   178.70  * Reach Len. (m)         *   39.55  *    39.55 *   39.55  *
* Crit W.S. (m)          *           * Flow Area (m2)         *    6.13  *    26.15 *    5.38  *
* E.G. Slope (m/m)       *0.000334   * Area (m2)              *    6.13  *    26.15 *    5.38  *
* Q Total (m3/s)         *    62.60  * Flow (m3/s)            *    5.69  *    51.94 *    4.96  *
* Top Width (m)          *    20.69  * Top Width (m)          *    5.57  *    10.29 *    4.83  *
* Vel Total (m/s)        *     1.66  * Avg. Vel. (m/s)        *    0.93  *     1.99 *    0.92  *
* Max Chl Dpth (m)       *     2.84  * Hydr. Depth (m)        *    1.10  *     2.54 *    1.11  *
* Conv. Total (m3/s)     *   3425.3  * Conv. (m3/s)           *   311.6  *   2842.2 *   271.4  *
* Length Wtd. (m)        *    39.55  * Wetted Per. (m)        *    5.99  *    10.41 *    5.31  *
* Min Ch El (m)          *   175.86  * Shear (N/m2)           *    3.35  *     8.23 *    3.32  *
* Alpha                  *     1.24  * Stream Power (N/m s)   *    3.11  *    16.34 *    3.06  *
* Frctn Loss (m)         *     0.01  * Cum Volume (1000 m3)   *    1.18  *     2.01 *    1.28  *
* C & E Loss (m)         *     0.03  * Cum SA (1000 m2)       *    0.80  *     0.77 *    0.83  *
*******************************************************************************************

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than
         0.7 or greater than 1.4.  This may indicate the need for additional cross sections.

CROSS SECTION


RIVER: Turkey Creek
REACH: Main                RS: 9.4

INPUT
Description:
Station Elevation Data     num=       15
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
*************************************************************************************
       0    182.5   22.451      182   30.035    181.5   50.694    176.5   57.847   176.06
  58.447   175.86   60.447   175.86   61.047   176.06     68.2    176.5   77.642      180
  80.038    180.5   84.157      181   86.382    181.5   87.423      182  124.022    182.5

Manning's n Values         num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
************************************************
       0      .02   50.694     .017     68.2      .02

Bank Sta: Left    Right    Lengths: Left Channel    Right      Coeff Contr.    Expan.
         50.694   68.2                3.308   3.678   4.068               .1         .3

CROSS SECTION OUTPUT  Profile #100 yr
*******************************************************************************************
* E.G. Elev (m)          *   178.31  * Element                *  Left OB *  Channel * Right OB *
* Vel Head (m)           *     0.04  * Wt. n-Val.             *   0.020  *    0.017 *   0.020  *
* W.S. Elev (m)          *   178.27  * Reach Len. (m)         *    3.31  *     3.68 *    4.07  *
* Crit W.S. (m)          *           * Flow Area (m2)         *    6.47  *    36.06 *    4.23  *
* E.G. Slope (m/m)       *0.000103   * Area (m2)              *    6.47  *    36.06 *    4.23  *
* Q Total (m3/s)         *    39.50  * Flow (m3/s)            *    2.96  *    34.65 *    1.89  *
```

```
* Top Width (m)          *   29.59  * Top Width (m)          *    7.31  *   17.51  *    4.77  *
* Vel Total (m/s)        *    0.84  * Avg. Vel. (m/s)        *    0.46  *    0.96  *    0.45  *
* Max Chl Dpth (m)       *    2.41  * Hydr. Depth (m)        *    0.88  *    2.06  *    0.88  *
* Conv. Total (m3/s)     *  3900.9  * Conv. (m3/s)           *   292.7  *  3421.6  *   186.6  *
* Length Wtd. (m)        *    3.67  * Wetted Per. (m)        *    7.52  *   17.60  *    5.09  *
* Min Ch El (m)          *  175.86  * Shear (N/m2)           *    0.86  *    2.06  *    0.83  *
* Alpha                  *    1.17  * Stream Power (N/m s)   *    0.40  *    1.98  *    0.37  *
* Frctn Loss (m)         *    0.00  * Cum Volume (1000 m3)   *    0.62  *    0.49  *    0.74  *
* C & E Loss (m)         *    0.00  * Cum SA (1000 m2)       *    0.44  *    0.22  *    0.56  *
*********************************************************************************************

CROSS SECTION OUTPUT  Profile #Regional
*********************************************************************************************
* E.G. Elev (m)          *  178.84  * Element                *  Left OB *  Channel * Right OB *
* Vel Head (m)           *    0.06  * Wt. n-Val.             *   0.020  *   0.017  *   0.020  *
* W.S. Elev (m)          *  178.77  * Reach Len. (m)         *    3.31  *    3.68  *    4.07  *
* Crit W.S. (m)          *          * Flow Area (m2)         *   10.68  *   44.88  *    6.97  *
* E.G. Slope (m/m)       *0.000114  * Area (m2)              *   10.68  *   44.88  *    6.97  *
* Q Total (m3/s)         *   62.60  * Flow (m3/s)            *    6.10  *   52.62  *    3.89  *
* Top Width (m)          *   33.03  * Top Width (m)          *    9.39  *   17.51  *    6.13  *
* Vel Total (m/s)        *    1.00  * Avg. Vel. (m/s)        *    0.57  *    1.17  *    0.56  *
* Max Chl Dpth (m)       *    2.91  * Hydr. Depth (m)        *    1.14  *    2.56  *    1.14  *
* Conv. Total (m3/s)     *  5862.1  * Conv. (m3/s)           *   570.8  *  4927.4  *   363.8  *
* Length Wtd. (m)        *    3.67  * Wetted Per. (m)        *    9.67  *   17.60  *    6.54  *
* Min Ch El (m)          *  175.86  * Shear (N/m2)           *    1.24  *    2.85  *    1.19  *
* Alpha                  *    1.20  * Stream Power (N/m s)   *    0.71  *    3.34  *    0.66  *
* Frctn Loss (m)         *    0.00  * Cum Volume (1000 m3)   *    0.85  *    0.60  *    1.03  *
* C & E Loss (m)         *    0.00  * Cum SA (1000 m2)       *    0.50  *    0.22  *    0.62  *
*********************************************************************************************

CROSS SECTION


RIVER: Turkey Creek
REACH: Main                RS: 9.3

INPUT
Description:
Station Elevation Data     num=       14
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
*************************************************************************************
       0    182.5   22.465      182   35.015    181.5   36.837      181   51.171    176.5
  58.923   176.06   59.523   175.86   61.523   175.86   62.123   176.06   69.875    176.5
  81.981    180.5   86.631      181   89.072      182   225.65    182.5

Manning's n Values         num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
*****************************************************
       0      .02   51.171     .017   69.875      .02

Bank Sta: Left   Right     Lengths: Left Channel    Right      Coeff Contr.    Expan.
        51.171  69.875              3.308       5   4.166                .1        .3

CROSS SECTION OUTPUT  Profile #100 yr
*********************************************************************************************
* E.G. Elev (m)          *  178.31  * Element                *  Left OB *  Channel * Right OB *
* Vel Head (m)           *    0.04  * Wt. n-Val.             *   0.020  *   0.017  *   0.020  *
* W.S. Elev (m)          *  178.27  * Reach Len. (m)         *    3.31  *    5.00  *    4.17  *
* Crit W.S. (m)          *          * Flow Area (m2)         *    5.00  *   38.48  *    4.75  *
* E.G. Slope (m/m)       *0.000094  * Area (m2)              *    5.00  *   38.48  *    4.75  *
* Q Total (m3/s)         *   39.50  * Flow (m3/s)            *    2.16  *   35.29  *    2.05  *
* Top Width (m)          *   29.71  * Top Width (m)          *    5.64  *   18.70  *    5.36  *
* Vel Total (m/s)        *    0.82  * Avg. Vel. (m/s)        *    0.43  *    0.92  *    0.43  *
* Max Chl Dpth (m)       *    2.41  * Hydr. Depth (m)        *    0.89  *    2.06  *    0.89  *
* Conv. Total (m3/s)     *  4084.4  * Conv. (m3/s)           *   223.5  *  3649.2  *   211.6  *
* Length Wtd. (m)        *    4.49  * Wetted Per. (m)        *    5.92  *   18.79  *    5.65  *
* Min Ch El (m)          *  175.86  * Shear (N/m2)           *    0.78  *    1.88  *    0.77  *
* Alpha                  *    1.15  * Stream Power (N/m s)   *    0.34  *    1.72  *    0.33  *
* Frctn Loss (m)         *    0.00  * Cum Volume (1000 m3)   *    0.60  *    0.35  *    0.72  *
* C & E Loss (m)         *    0.00  * Cum SA (1000 m2)       *    0.42  *    0.16  *    0.54  *
*********************************************************************************************

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than
         0.7 or greater than 1.4.  This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT  Profile #Regional
*********************************************************************************************
* E.G. Elev (m)          *  178.83  * Element                *  Left OB *  Channel * Right OB *
* Vel Head (m)           *    0.06  * Wt. n-Val.             *   0.020  *   0.017  *   0.020  *
* W.S. Elev (m)          *  178.78  * Reach Len. (m)         *    3.31  *    5.00  *    4.17  *
```

```
* Crit W.S. (m)         *            * Flow Area (m2)        *    8.25  *   47.91  *    7.84  *
* E.G. Slope (m/m)      *0.000105    * Area (m2)             *    8.25  *   47.91  *    7.84  *
* Q Total (m3/s)        *    62.60   * Flow (m3/s)           *    4.47  *   53.90  *    4.23  *
* Top Width (m)         *    32.84   * Top Width (m)         *    7.25  *   18.70  *    6.89  *
* Vel Total (m/s)       *     0.98   * Avg. Vel. (m/s)       *    0.54  *    1.13  *    0.54  *
* Max Chl Dpth (m)      *     2.92   * Hydr. Depth (m)       *    1.14  *    2.56  *    1.14  *
* Conv. Total (m3/s)    *   6107.2   * Conv. (m3/s)          *   435.8  *  5258.7  *   412.7  *
* Length Wtd. (m)       *     4.45   * Wetted Per. (m)       *    7.60  *   18.79  *    7.25  *
* Min Ch El (m)         *   175.86   * Shear (N/m2)          *    1.12  *    2.63  *    1.11  *
* Alpha                 *     1.18   * Stream Power (N/m s)  *    0.61  *    2.96  *    0.60  *
* Frctn Loss (m)        *     0.00   * Cum Volume (1000 m3)  *    0.82  *    0.43  *    1.00  *
* C & E Loss (m)        *     0.00   * Cum SA (1000 m2)      *    0.47  *    0.16  *    0.59  *
*********************************************************************************************

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than
         0.7 or greater than 1.4.  This may indicate the need for additional cross sections.

CROSS SECTION


RIVER: Turkey Creek
REACH: Main                RS: 9.2

INPUT
Description:
Station Elevation Data     num=       28
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
********************************************************************************
       0      182   12.725    181.5    14.44      181   16.148    180.5   17.868      180
  19.579    179.5   21.223      179   22.754    178.5   24.249      178   25.742    177.5
  27.224      177   28.735    176.5   36.975   176.06   37.575   175.86   39.575   175.86
  40.175   176.06   48.415    176.5   49.851      177   51.275    177.5   52.723      178
  54.188    178.5   55.665      179    57.16    179.5    58.63      180   60.657    180.5
  65.963      181   67.032    181.5    68.12      182

Manning's n Values         num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
********************************************************
       0      .03   36.975     .017   40.175      .03

Bank Sta: Left   Right      Lengths: Left Channel   Right      Coeff Contr.    Expan.
        36.975  40.175                30.4   31.81  33.814                .1        .3

CROSS SECTION OUTPUT  Profile #100 yr
*********************************************************************************************
* E.G. Elev (m)         *   178.31   * Element               *  Left OB *  Channel * Right OB *
* Vel Head (m)          *     0.05   * Wt. n-Val.            *   0.030  *   0.017  *   0.030  *
* W.S. Elev (m)         *   178.26   * Reach Len. (m)        *   30.40  *   31.81  *   33.81  *
* Crit W.S. (m)         *            * Flow Area (m2)        *   20.91  *    7.55  *   20.71  *
* E.G. Slope (m/m)      *0.000229    * Area (m2)             *   20.91  *    7.55  *   20.71  *
* Q Total (m3/s)        *    39.50   * Flow (m3/s)           *   13.92  *   11.75  *   13.83  *
* Top Width (m)         *    29.99   * Top Width (m)         *   13.49  *    3.20  *   13.30  *
* Vel Total (m/s)       *     0.80   * Avg. Vel. (m/s)       *    0.67  *    1.56  *    0.67  *
* Max Chl Dpth (m)      *     2.40   * Hydr. Depth (m)       *    1.55  *    2.36  *    1.56  *
* Conv. Total (m3/s)    *   2609.6   * Conv. (m3/s)          *   919.8  *   776.3  *   913.5  *
* Length Wtd. (m)       *    32.03   * Wetted Per. (m)       *   13.79  *    3.26  *   13.61  *
* Min Ch El (m)         *   175.86   * Shear (N/m2)          *    3.41  *    5.19  *    3.42  *
* Alpha                 *     1.60   * Stream Power (N/m s)  *    2.27  *    8.09  *    2.28  *
* Frctn Loss (m)        *     0.01   * Cum Volume (1000 m3)  *    0.55  *    0.24  *    0.67  *
* C & E Loss (m)        *     0.00   * Cum SA (1000 m2)      *    0.38  *    0.10  *    0.50  *
*********************************************************************************************

CROSS SECTION OUTPUT  Profile #Regional
*********************************************************************************************
* E.G. Elev (m)         *   178.83   * Element               *  Left OB *  Channel * Right OB *
* Vel Head (m)          *     0.08   * Wt. n-Val.            *   0.030  *   0.017  *   0.030  *
* W.S. Elev (m)         *   178.76   * Reach Len. (m)        *   30.40  *   31.81  *   33.81  *
* Crit W.S. (m)         *            * Flow Area (m2)        *   28.02  *    9.15  *   27.71  *
* E.G. Slope (m/m)      *0.000265    * Area (m2)             *   28.02  *    9.15  *   27.71  *
* Q Total (m3/s)        *    62.60   * Flow (m3/s)           *   22.69  *   17.41  *   22.50  *
* Top Width (m)         *    32.97   * Top Width (m)         *   15.00  *    3.20  *   14.77  *
* Vel Total (m/s)       *     0.96   * Avg. Vel. (m/s)       *    0.81  *    1.90  *    0.81  *
* Max Chl Dpth (m)      *     2.90   * Hydr. Depth (m)       *    1.87  *    2.86  *    1.88  *
* Conv. Total (m3/s)    *   3843.1   * Conv. (m3/s)          *  1392.8  *  1069.0  *  1381.3  *
* Length Wtd. (m)       *    32.07   * Wetted Per. (m)       *   15.38  *    3.26  *   15.16  *
* Min Ch El (m)         *   175.86   * Shear (N/m2)          *    4.74  *    7.29  *    4.76  *
* Alpha                 *     1.59   * Stream Power (N/m s)  *    3.84  *   13.88  *    3.86  *
* Frctn Loss (m)        *     0.01   * Cum Volume (1000 m3)  *    0.76  *    0.29  *    0.93  *
* C & E Loss (m)        *     0.00   * Cum SA (1000 m2)      *    0.44  *    0.10  *    0.55  *
*********************************************************************************************
```

```
CROSS SECTION


RIVER: Turkey Creek
REACH: Main              RS: 9.1

INPUT
Description:
Station Elevation Data     num=      29
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
******************************************************************************************
       0    181.5   84.335    181.5    89.24      181    91.04    180.5   92.826      180
  94.617    179.5   96.484      179   98.345    178.5  100.173      178   101.97    177.5
 103.725      177  106.858    176.5  111.217   176.06  111.817   175.86  113.817   175.86
 114.417   176.06  118.776    176.5  122.227      177  125.249    177.5  130.295      178
 131.458    178.5  132.634      179  133.814    179.5  134.997      180  136.182    180.5
 142.388      181  143.457    181.5  144.535      182  251.616      182

Manning's n Values         num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
******************************************************
       0      .03  111.217     .017  114.417      .03

Bank Sta: Left   Right     Lengths: Left Channel    Right      Coeff Contr.    Expan.
       111.217 114.417                  0       0       0               .1        .3

CROSS SECTION OUTPUT  Profile #100 yr
*********************************************************************************************
* E.G. Elev (m)           *   178.30  * Element                 *  Left OB  *  Channel  * Right OB  *
* Vel Head (m)            *     0.09  * Wt. n-Val.              *   0.030   *   0.017   *   0.030   *
* W.S. Elev (m)           *   178.21  * Reach Len. (m)          *           *           *           *
* Crit W.S. (m)           *   177.38  * Flow Area (m2)          *    15.54  *     7.39  *    18.67  *
* E.G. Slope (m/m)        *0.000375   * Area (m2)               *    15.54  *     7.39  *    18.67  *
* Q Total (m3/s)          *    39.50  * Flow (m3/s)             *    11.90  *    14.52  *    13.08  *
* Top Width (m)           *    31.36  * Top Width (m)           *    11.80  *     3.20  *    16.36  *
* Vel Total (m/s)         *     0.95  * Avg. Vel. (m/s)         *     0.77  *     1.96  *     0.70  *
* Max Chl Dpth (m)        *     2.35  * Hydr. Depth (m)         *     1.32  *     2.31  *     1.14  *
* Conv. Total (m3/s)      *   2038.5  * Conv. (m3/s)            *    614.4  *    749.2  *    675.0  *
* Length Wtd. (m)         *           * Wetted Per. (m)         *    12.03  *     3.26  *    16.52  *
* Min Ch El (m)           *   175.86  * Shear (N/m2)            *     4.76  *     8.33  *     4.16  *
* Alpha                   *     1.95  * Stream Power (N/m s)    *     3.64  *    16.37  *     2.91  *
* Frctn Loss (m)          *           * Cum Volume (1000 m3)    *           *           *           *
* C & E Loss (m)          *           * Cum SA (1000 m2)        *           *           *           *
*********************************************************************************************

CROSS SECTION OUTPUT  Profile #Regional
*********************************************************************************************
* E.G. Elev (m)           *   178.82  * Element                 *  Left OB  *  Channel  * Right OB  *
* Vel Head (m)            *     0.11  * Wt. n-Val.              *   0.030   *   0.017   *   0.030   *
* W.S. Elev (m)           *   178.71  * Reach Len. (m)          *           *           *           *
* Crit W.S. (m)           *   177.71  * Flow Area (m2)          *    21.94  *     9.00  *    27.19  *
* E.G. Slope (m/m)        *0.000375   * Area (m2)               *    21.94  *     9.00  *    27.19  *
* Q Total (m3/s)          *    62.60  * Flow (m3/s)             *    19.16  *    20.16  *    23.29  *
* Top Width (m)           *    34.39  * Top Width (m)           *    13.65  *     3.20  *    17.53  *
* Vel Total (m/s)         *     1.08  * Avg. Vel. (m/s)         *     0.87  *     2.24  *     0.86  *
* Max Chl Dpth (m)        *     2.85  * Hydr. Depth (m)         *     1.61  *     2.81  *     1.55  *
* Conv. Total (m3/s)      *   3231.8  * Conv. (m3/s)            *    989.1  *   1040.6  *   1202.2  *
* Length Wtd. (m)         *           * Wetted Per. (m)         *    13.95  *     3.26  *    17.80  *
* Min Ch El (m)           *   175.86  * Shear (N/m2)            *     5.79  *    10.14  *     5.62  *
* Alpha                   *     1.83  * Stream Power (N/m s)    *     5.05  *    22.71  *     4.81  *
* Frctn Loss (m)          *           * Cum Volume (1000 m3)    *           *           *           *
* C & E Loss (m)          *           * Cum SA (1000 m2)        *           *           *           *
*********************************************************************************************


******************************************************************************************

SUMMARY OF MANNING'S N VALUES

River:Turkey Creek
*****************************************************************
*     Reach      *   River Sta.   *    n1     *    n2     *    n3     *
*****************************************************************
*Main            *   10           *       .03*      .017*       .03*
*Main            *   9.9          *       .03*      .017*       .03*
*Main            *   9.8          *       .03*      .017*       .03*
*Main            *   9.7          *       .02*      .017*       .02*
*Main            *   9.65         *Bridge     *          *          *
*Main            *   9.6          *       .02*      .017*       .02*
*Main            *   9.5          *       .02*      .017*       .02*
```

*Main	9.4	.02*	.017*	.02*
*Main	9.3	.02*	.017*	.02*
*Main	9.2	.03*	.017*	.03*
*Main	9.1	.03*	.017*	.03*

SUMMARY OF REACH LENGTHS

River: Turkey Creek

Reach	River Sta.	Left	Channel	Right
*Main	10	207.817*	210.778*	216.406*
*Main	9.9	104.462*	100.685*	96.329*
*Main	9.8	24.356*	24.248*	24.356*
*Main	9.7	35.414*	35.414*	35.414*
*Main	9.65	*Bridge *	*	*
*Main	9.6	3.943*	3*	4.798*
*Main	9.5	39.545*	39.545*	39.545*
*Main	9.4	3.308*	3.678*	4.068*
*Main	9.3	3.308*	5*	4.166*
*Main	9.2	30.4*	31.81*	33.814*
*Main	9.1	0*	0*	0*

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS

River: Turkey Creek

Reach	River Sta.	Contr.	Expan.
*Main	10	.1*	.3*
*Main	9.9	.1*	.3*
*Main	9.8	.1*	.3*
*Main	9.7	.3*	.5*
*Main	9.65	*Bridge *	*
*Main	9.6	.3*	.5*
*Main	9.5	.1*	.3*
*Main	9.4	.1*	.3*
*Main	9.3	.1*	.3*
*Main	9.2	.1*	.3*
*Main	9.1	.1*	.3*

Appendix A.5.3.2

Proposed Condition

```
                 HEC-RAS Version 3.1.3 May 2005
                  U.S. Army Corp of Engineers
                 Hydrologic Engineering Center
                       609 Second Street
                       Davis, California

         X     X  XXXXXX   XXXX        XXXX      XX     XXXX
         X     X  X       X    X       X   X    X  X   X
         X     X  X       X            X   X   X    X  X
         XXXXXXX  XXXX    X       XXX  XXXX    XXXXXX   XXXX
         X     X  X       X            X  X    X    X       X
         X     X  X       X    X       X   X   X    X       X
         X     X  XXXXXX   XXXX        X    X  X    X  XXXXX

********************************************************************************

PROJECT DATA
Project Title: Turkey River
Project File : dric.prj
Run Date and Time: 15/11/2006 2:55:20 PM

Project in SI units

********************************************************************************

PLAN DATA

Plan Title: Plan 36
Plan File : o:\DRIC\19_WaterResources\hec\dric.p36

           Geometry Title: proposed
           Geometry File : o:\DRIC\19_WaterResources\hec\dric.g02

           Flow Title    : Flow 01
           Flow File     : o:\DRIC\19_WaterResources\hec\dric.f01

Plan Summary Information:
Number of:  Cross Sections =   10    Multiple Openings  =    0
            Culverts       =    0    Inline Structures  =    0
            Bridges        =    2    Lateral Structures =    0

Computational Information
    Water surface calculation tolerance  =  0.003
    Critical depth calculation tolerance =  0.003
    Maximum number of iterations         =  20
    Maximum difference tolerance         =  0.1
    Flow tolerance factor                =  0.001

Computation Options
    Critical depth computed only where necessary
    Conveyance Calculation Method: At breaks in n values only
    Friction Slope Method:         Average Conveyance
    Computational Flow Regime:     Subcritical Flow

********************************************************************************

FLOW DATA

Flow Title: Flow 01
Flow File : o:\DRIC\19_WaterResources\hec\dric.f01

Flow Data (m3/s)
******************************************************************************
* River           Reach           RS       *         100 yr        Regional *
* Turkey Creek    Main            10       *           39.5            62.6 *
******************************************************************************

Boundary Conditions
**********************************************************************************************************
*
* River           Reach           Profile         *            Upstream                   Downstream
*
**********************************************************************************************************
*
* Turkey Creek    Main            100 yr          *                                 Normal S = 0.000375
*
```

```
* Turkey Creek    Main            Regional           *                      Normal S = 0.000375
*
****************************************************************************************************
*

********************************************************************************

GEOMETRY DATA

Geometry Title: proposed
Geometry File : o:\DRIC\19_WaterResources\hec\dric.g02

CROSS SECTION


RIVER: Turkey Creek
REACH: Main                RS: 10

INPUT
Description:
Station Elevation Data    num=       30
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
********************************************************************************
       0      183   76.736      183   99.766    182.5  101.278      182  102.644    181.5
  104.01      181  105.363    180.5  106.485      180  107.607    179.5  108.729      179
 109.851    178.5  110.973      178  112.095    177.5  113.217      177  116.947   176.56
 117.547   176.36  119.547   176.36  120.147   176.56  123.877      177  124.941    177.5
 126.005      178  127.069    178.5  128.133      179  129.197    179.5  130.261      180
 131.624    180.5  132.798      181  134.684    181.5  136.554      182   264.86    182.5

Manning's n Values        num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
************************************************
       0      .03  116.947     .017  120.147      .03

Bank Sta: Left   Right    Lengths: Left Channel   Right      Coeff Contr.    Expan.
       116.947 120.147          207.817 210.778 216.406                .1        .3

CROSS SECTION OUTPUT  Profile #100 yr
******************************************************************************************
* E.G. Elev (m)          *   178.60  * Element                 *  Left OB *  Channel * Right OB *
* Vel Head (m)           *     0.34  * Wt. n-Val.              *   0.030  *   0.017  *   0.030  *
* W.S. Elev (m)          *   178.26  * Reach Len. (m)          *  207.82  *  210.78  *  216.41  *
* Crit W.S. (m)          *           * Flow Area (m2)          *    7.29  *    5.95  *    7.20  *
* E.G. Slope (m/m)       * 0.001477  * Area (m2)               *    7.29  *    5.95  *    7.20  *
* Q Total (m3/s)         *    39.50  * Flow (m3/s)             *    9.74  *   20.10  *    9.66  *
* Top Width (m)          *    16.16  * Top Width (m)           *    6.55  *    3.20  *    6.41  *
* Vel Total (m/s)        *     1.93  * Avg. Vel. (m/s)         *    1.34  *    3.38  *    1.34  *
* Max Chl Dpth (m)       *     1.90  * Hydr. Depth (m)         *    1.11  *    1.86  *    1.12  *
* Conv. Total (m3/s)     *   1027.7  * Conv. (m3/s)            *   253.4  *   522.9  *   251.4  *
* Length Wtd. (m)        *   211.45  * Wetted Per. (m)         *    6.85  *    3.26  *    6.71  *
* Min Ch El (m)          *   176.36  * Shear (N/m2)            *   15.43  *   26.42  *   15.53  *
* Alpha                  *     1.79  * Stream Power (N/m s)    *   20.61  *   89.18  *   20.85  *
* Frctn Loss (m)         *     0.23  * Cum Volume (1000 m3)    *    2.69  *    6.60  *    2.87  *
* C & E Loss (m)         *     0.03  * Cum SA (1000 m2)        *    2.28  *    2.51  *    2.58  *
******************************************************************************************

CROSS SECTION OUTPUT  Profile #Regional
******************************************************************************************
* E.G. Elev (m)          *   179.19  * Element                 *  Left OB *  Channel * Right OB *
* Vel Head (m)           *     0.43  * Wt. n-Val.              *   0.030  *   0.017  *   0.030  *
* W.S. Elev (m)          *   178.76  * Reach Len. (m)          *  207.82  *  210.78  *  216.41  *
* Crit W.S. (m)          *           * Flow Area (m2)          *   10.85  *    7.56  *   10.67  *
* E.G. Slope (m/m)       * 0.001435  * Area (m2)               *   10.85  *    7.56  *   10.67  *
* Q Total (m3/s)         *    62.60  * Flow (m3/s)             *   16.68  *   29.45  *   16.47  *
* Top Width (m)          *    18.35  * Top Width (m)           *    7.68  *    3.20  *    7.47  *
* Vel Total (m/s)        *     2.15  * Avg. Vel. (m/s)         *    1.54  *    3.90  *    1.54  *
* Max Chl Dpth (m)       *     2.40  * Hydr. Depth (m)         *    1.41  *    2.36  *    1.43  *
* Conv. Total (m3/s)     *   1652.8  * Conv. (m3/s)            *   440.3  *   777.6  *   434.9  *
* Length Wtd. (m)        *   211.50  * Wetted Per. (m)         *    8.08  *    3.26  *    7.89  *
* Min Ch El (m)          *   176.36  * Shear (N/m2)            *   18.90  *   32.56  *   19.02  *
* Alpha                  *     1.81  * Stream Power (N/m s)    *   29.05  *  126.90  *   29.37  *
* Frctn Loss (m)         *     0.24  * Cum Volume (1000 m3)    *    3.92  *    7.83  *    4.25  *
* C & E Loss (m)         *     0.03  * Cum SA (1000 m2)        *    2.69  *    2.51  *    3.01  *
******************************************************************************************

CROSS SECTION


RIVER: Turkey Creek
```

```
REACH: Main                RS: 9.9

INPUT
Description:
Station Elevation Data     num=       32
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
*******************************************************************************************
       0    182.5  120.028    182.5  136.616      182  137.952    181.5  139.286      181
  140.62    180.5  141.772      180  142.859    179.5  143.941      179  145.023    178.5
 146.105      178  147.187    177.5  148.269      177  149.351    176.5  152.673   176.06
 153.273   175.86  155.273   175.86  155.873   176.06  159.195    176.5  160.399      177
 161.603    177.5  162.805      178  164.002    178.5  165.197      179   166.39    179.5
 167.992      180  169.998    180.5  172.048      181  174.284    181.5  180.916      182
 191.253    182.5  277.679      183

Manning's n Values         num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
*******************************************************
       0      .03  152.673     .017  155.873      .03

Bank Sta: Left   Right     Lengths: Left Channel   Right       Coeff Contr.    Expan.
       152.673 155.873             104.462 100.685  96.329                .1        .3

CROSS SECTION OUTPUT  Profile #100 yr
*******************************************************************************************************
* E.G. Elev (m)           *   178.34  * Element                 *   Left OB  *  Channel  * Right OB  *
* Vel Head (m)            *     0.23  * Wt. n-Val.              *    0.030   *   0.017   *   0.030   *
* W.S. Elev (m)           *   178.11  * Reach Len. (m)          *   104.46   *  100.68   *   96.33   *
* Crit W.S. (m)           *           * Flow Area (m2)          *     8.86   *    7.07   *    9.18   *
* E.G. Slope (m/m)        *0.000814   * Area (m2)               *     8.86   *    7.07   *    9.18   *
* Q Total (m3/s)          *    39.50  * Flow (m3/s)             *     9.70   *   19.85   *    9.95   *
* Top Width (m)           *    17.19  * Top Width (m)           *     6.80   *    3.20   *    7.19   *
* Vel Total (m/s)         *     1.57  * Avg. Vel. (m/s)         *     1.09   *    2.81   *    1.08   *
* Max Chl Dpth (m)        *     2.25  * Hydr. Depth (m)         *     1.30   *    2.21   *    1.28   *
* Conv. Total (m3/s)      *   1384.8  * Conv. (m3/s)            *    339.9   *   696.1   *   348.8   *
* Length Wtd. (m)         *   100.47  * Wetted Per. (m)         *     7.18   *    3.26   *    7.54   *
* Min Ch El (m)           *   175.86  * Shear (N/m2)            *     9.85   *   17.28   *    9.71   *
* Alpha                   *     1.84  * Stream Power (N/m s)    *    10.77   *   48.52   *   10.53   *
* Frctn Loss (m)          *     0.11  * Cum Volume (1000 m3)    *     1.01   *    5.23   *    1.10   *
* C & E Loss (m)          *     0.01  * Cum SA (1000 m2)        *     0.90   *    1.84   *    1.11   *
*******************************************************************************************************

CROSS SECTION OUTPUT  Profile #Regional
*******************************************************************************************************
* E.G. Elev (m)           *   178.92  * Element                 *   Left OB  *  Channel  * Right OB  *
* Vel Head (m)            *     0.32  * Wt. n-Val.              *    0.030   *   0.017   *   0.030   *
* W.S. Elev (m)           *   178.59  * Reach Len. (m)          *   104.46   *  100.68   *   96.33   *
* Crit W.S. (m)           *           * Flow Area (m2)          *    12.43   *    8.63   *   12.96   *
* E.G. Slope (m/m)        *0.000916   * Area (m2)               *    12.43   *    8.63   *   12.96   *
* Q Total (m3/s)          *    62.60  * Flow (m3/s)             *    16.35   *   29.34   *   16.91   *
* Top Width (m)           *    19.40  * Top Width (m)           *     7.85   *    3.20   *    8.35   *
* Vel Total (m/s)         *     1.84  * Avg. Vel. (m/s)         *     1.32   *    3.40   *    1.31   *
* Max Chl Dpth (m)        *     2.73  * Hydr. Depth (m)         *     1.58   *    2.70   *    1.55   *
* Conv. Total (m3/s)      *   2068.9  * Conv. (m3/s)            *    540.2   *   969.7   *   558.9   *
* Length Wtd. (m)         *   100.39  * Wetted Per. (m)         *     8.34   *    3.26   *    8.80   *
* Min Ch El (m)           *   175.86  * Shear (N/m2)            *    13.37   *   23.72   *   13.22   *
* Alpha                   *     1.87  * Stream Power (N/m s)    *    17.60   *   80.69   *   17.26   *
* Frctn Loss (m)          *     0.11  * Cum Volume (1000 m3)    *     1.50   *    6.12   *    1.69   *
* C & E Loss (m)          *     0.01  * Cum SA (1000 m2)        *     1.08   *    1.84   *    1.30   *
*******************************************************************************************************

CROSS SECTION


RIVER: Turkey Creek
REACH: Main                RS: 9.8

INPUT
Description: US of Huron Church Road
Station Elevation Data     num=       30
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
*******************************************************************************************
       0    182.5   37.489      182   45.643    181.5   47.136      181   48.636    180.5
  50.024      180     51.1    179.5   52.174      179   53.246    178.5   54.316      178
  55.384    177.5   56.451      177   57.519    176.5   60.347   176.06   60.947   175.86
  62.947   175.86   63.547   176.06   66.375    176.5   67.488      177    71.05    177.5
   72.19      178    73.33    178.5   74.472      179   75.609    179.5   76.733      180
  77.849    180.5   94.858      181  118.672    181.5  142.126      182  143.791    182.5

Manning's n Values         num=        3
```

```
    Sta   n Val     Sta   n Val     Sta   n Val
************************************************
       0     .03  60.347    .017  63.547     .03

Bank Sta: Left   Right    Lengths: Left Channel   Right       Coeff Contr.    Expan.
        60.347  63.547           24.356  24.248  24.356                .1         .3

CROSS SECTION OUTPUT  Profile #100 yr
*******************************************************************************************
* E.G. Elev (m)           *   178.22  * Element                * Left OB * Channel * Right OB *
* Vel Head (m)            *     0.36  * Wt. n-Val.             *  0.030  *  0.017  *  0.030   *
* W.S. Elev (m)           *   177.86  * Reach Len. (m)         *  24.36  *  24.25  *  24.36   *
* Crit W.S. (m)           *           * Flow Area (m2)         *   6.45  *   6.28  *   8.03   *
* E.G. Slope (m/m)        * 0.001411  * Area (m2)              *   6.45  *   6.28  *   8.03   *
* Q Total (m3/s)          *    39.50  * Flow (m3/s)            *   8.40  *  21.47  *   9.62   *
* Top Width (m)           *    17.26  * Top Width (m)          *   5.73  *   3.20  *   8.33   *
* Vel Total (m/s)         *     1.90  * Avg. Vel. (m/s)        *   1.30  *   3.42  *   1.20   *
* Max Chl Dpth (m)        *     2.00  * Hydr. Depth (m)        *   1.12  *   1.96  *   0.96   *
* Conv. Total (m3/s)      *   1051.7  * Conv. (m3/s)           *  223.7  *  571.7  *  256.2   *
* Length Wtd. (m)         *    24.27  * Wetted Per. (m)        *   6.07  *   3.26  *   8.58   *
* Min Ch El (m)           *   175.86  * Shear (N/m2)           *  14.69  *  26.62  *  12.95   *
* Alpha                   *     1.95  * Stream Power (N/m s)   *  19.15  *  90.98  *  15.52   *
* Frctn Loss (m)          *     0.02  * Cum Volume (1000 m3)   *   0.21  *   4.55  *   0.27   *
* C & E Loss (m)          *     0.07  * Cum SA (1000 m2)       *   0.24  *   1.52  *   0.36   *
*******************************************************************************************

Warning: The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for
         additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than
         0.7 or greater than 1.4.  This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT  Profile #Regional
*******************************************************************************************
* E.G. Elev (m)           *   178.80  * Element                * Left OB * Channel * Right OB *
* Vel Head (m)            *     0.42  * Wt. n-Val.             *  0.030  *  0.017  *  0.030   *
* W.S. Elev (m)           *   178.37  * Reach Len. (m)         *  24.36  *  24.25  *  24.36   *
* Crit W.S. (m)           *           * Flow Area (m2)         *   9.67  *   7.92  *  12.60   *
* E.G. Slope (m/m)        * 0.001315  * Area (m2)              *   9.67  *   7.92  *  12.60   *
* Q Total (m3/s)          *    62.60  * Flow (m3/s)            *  14.12  *  30.53  *  17.95   *
* Top Width (m)           *    19.53  * Top Width (m)          *   6.83  *   3.20  *   9.50   *
* Vel Total (m/s)         *     2.07  * Avg. Vel. (m/s)        *   1.46  *   3.85  *   1.42   *
* Max Chl Dpth (m)        *     2.51  * Hydr. Depth (m)        *   1.42  *   2.48  *   1.33   *
* Conv. Total (m3/s)      *   1726.3  * Conv. (m3/s)           *  389.5  *  841.9  *  494.9   *
* Length Wtd. (m)         *    24.28  * Wetted Per. (m)        *   7.28  *   3.26  *   9.85   *
* Min Ch El (m)           *   175.86  * Shear (N/m2)           *  17.13  *  31.30  *  16.49   *
* Alpha                   *     1.93  * Stream Power (N/m s)   *  25.01  * 120.57  *  23.49   *
* Frctn Loss (m)          *     0.02  * Cum Volume (1000 m3)   *   0.34  *   5.29  *   0.46   *
* C & E Loss (m)          *     0.06  * Cum SA (1000 m2)       *   0.31  *   1.52  *   0.44   *
*******************************************************************************************

Warning: The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for
         additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than
         0.7 or greater than 1.4.  This may indicate the need for additional cross sections.

CROSS SECTION


RIVER: Turkey Creek
REACH: Main               RS: 9.7

INPUT
Description: DS of Huron Church Road
Station Elevation Data    num=       13
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
****************************************************************************************
       0      182  135.597      182  140.617    181.5  146.159    178.5  146.159    176.5
 151.177   176.06  151.777   175.86  153.777   175.86  154.377   176.06  159.395    176.5
 159.395    178.5  165.459    181.5  235.174      182

Manning's n Values        num=        3
    Sta   n Val     Sta   n Val     Sta   n Val
************************************************
       0     .02 146.159    .017 159.395     .02

Bank Sta: Left   Right    Lengths: Left Channel   Right       Coeff Contr.    Expan.
       146.159 159.395           35.414  35.414  35.414                .3         .5

CROSS SECTION OUTPUT  Profile #100 yr
*******************************************************************************************
```

```
* E.G. Elev (m)          *  178.14  * Element             *  Left OB *  Channel * Right OB *
* Vel Head (m)           *    0.14  * Wt. n-Val.          *          *   0.017  *          *
* W.S. Elev (m)          *  178.00  * Reach Len. (m)      *    0.62  *    0.62  *    0.62  *
* Crit W.S. (m)          *  177.15  * Flow Area (m2)      *          *   23.95  *          *
* E.G. Slope (m/m)       *0.000472  * Area (m2)           *          *   23.95  *          *
* Q Total (m3/s)         *   39.50  * Flow (m3/s)         *          *   39.50  *          *
* Top Width (m)          *   13.24  * Top Width (m)       *          *   13.24  *          *
* Vel Total (m/s)        *    1.65  * Avg. Vel. (m/s)     *          *    1.65  *          *
* Max Chl Dpth (m)       *    2.14  * Hydr. Depth (m)     *          *    1.81  *          *
* Conv. Total (m3/s)     *  1818.7  * Conv. (m3/s)        *          *  1818.7  *          *
* Length Wtd. (m)        *    0.62  * Wetted Per. (m)     *          *   16.33  *          *
* Min Ch El (m)          *  175.86  * Shear (N/m2)        *          *    6.78  *          *
* Alpha                  *    1.00  * Stream Power (N/m s) *         *   11.19  *          *
* Frctn Loss (m)         *    0.00  * Cum Volume (1000 m3) *   0.13  *    4.19  *    0.17  *
* C & E Loss (m)         *    0.00  * Cum SA (1000 m2)    *    0.17  *    1.32  *    0.26  *
*******************************************************************************************

CROSS SECTION OUTPUT  Profile #Regional
*******************************************************************************************
* E.G. Elev (m)          *  178.71  * Element             *  Left OB *  Channel * Right OB *
* Vel Head (m)           *    0.21  * Wt. n-Val.          *          *   0.017  *          *
* W.S. Elev (m)          *  178.50  * Reach Len. (m)      *    0.62  *    0.62  *    0.62  *
* Crit W.S. (m)          *  177.50  * Flow Area (m2)      *          *   30.60  *          *
* E.G. Slope (m/m)       *0.000567  * Area (m2)           *          *   30.60  *          *
* Q Total (m3/s)         *   62.60  * Flow (m3/s)         *          *   62.60  *          *
* Top Width (m)          *   13.24  * Top Width (m)       *          *   13.24  *          *
* Vel Total (m/s)        *    2.05  * Avg. Vel. (m/s)     *          *    2.05  *          *
* Max Chl Dpth (m)       *    2.64  * Hydr. Depth (m)     *          *    2.31  *          *
* Conv. Total (m3/s)     *  2629.0  * Conv. (m3/s)        *          *  2629.0  *          *
* Length Wtd. (m)        *    0.62  * Wetted Per. (m)     *          *   17.34  *          *
* Min Ch El (m)          *  175.86  * Shear (N/m2)        *          *    9.81  *          *
* Alpha                  *    1.00  * Stream Power (N/m s) *         *   20.07  *          *
* Frctn Loss (m)         *    0.00  * Cum Volume (1000 m3) *   0.23  *    4.82  *    0.31  *
* C & E Loss (m)         *    0.00  * Cum SA (1000 m2)    *    0.23  *    1.32  *    0.32  *
*******************************************************************************************

BRIDGE


RIVER: Turkey Creek
REACH: Main                RS: 9.65

INPUT
Description:
Distance from Upstream XS =     .621
Deck/Roadway Width        =    34.79
Weir Coefficient          =     1.44
Upstream  Deck/Roadway Coordinates
    num=        9
     Sta Hi Cord Lo Cord      Sta Hi Cord Lo Cord      Sta Hi Cord Lo Cord
***************************************************************************
       0  181.74             90.83 182.081            118.067 182.057
  140.62 182.199   181.5  152.78 182.207   181.5  166.46 182.179   181.5
 168.067 182.156           190.032 181.964            218.067 181.884

Upstream Bridge Cross Section Data
Station Elevation Data     num=       13
     Sta     Elev     Sta     Elev     Sta     Elev     Sta     Elev     Sta     Elev
****************************************************************************************
       0      182 135.597      182 140.617    181.5 146.159    178.5 146.159    176.5
 151.177   176.06 151.777   175.86 153.777   175.86 154.377   176.06 159.395    176.5
 159.395    178.5 165.459    181.5 235.174      182

Manning's n Values         num=        3
     Sta    n Val     Sta    n Val     Sta    n Val
************************************************
       0      .02 146.159     .017 159.395      .02

Bank Sta: Left   Right     Coeff Contr.   Expan.
       146.159 159.395             .3       .5

Downstream  Deck/Roadway Coordinates
    num=       11
     Sta Hi Cord Lo Cord      Sta Hi Cord Lo Cord      Sta Hi Cord Lo Cord
***************************************************************************
       0  181.74             90.83 182.081            118.067 182.057
  133.85 182.157   181.5  137.28 182.199   181.5  152.78 182.207   181.5
  165.46 182.179   181.5 168.067 182.156   181.5  175.93  182.11   181.5
 190.032 181.964           218.067 181.884
```

Downstream Bridge Cross Section Data
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	182	125.33	182	133.85	181.5	140.248	179.5	140.248	176.5
145.27	176.06	145.87	175.86	147.87	175.86	148.47	176.06	153.492	176.5
153.492	179.5	161.948	180.5	166.14	181	170.386	181.5	199.519	182

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.02	140.248	.017	153.492	.02

Bank Sta: Left Right Coeff Contr. Expan.
140.248 153.492 .3 .5

Upstream Embankment side slope = 0 horiz. to 1.0 vertical
Downstream Embankment side slope = 0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow = .95
Elevation at which weir flow begins =
Energy head used in spillway design =
Spillway height used in design =
Weir crest shape = Broad Crested

Number of Bridge Coefficient Sets = 1

Low Flow Methods and Data
Energy
Selected Low Flow Methods = Highest Energy Answer

High Flow Method
Pressure and Weir flow
Submerged Inlet Cd =
Submerged Inlet + Outlet Cd = .8
Max Low Cord =

Additional Bridge Parameters
Add Friction component to Momentum
Do not add Weight component to Momentum
Class B flow critical depth computations use critical depth
inside the bridge at the upstream end
Criteria to check for pressure flow = Upstream energy grade line

BRIDGE OUTPUT Profile #100 yr

		Element	Inside BR US	Inside BR DS
E.G. US. (m)	178.14	Element	Inside BR US	Inside BR DS
W.S. US. (m)	178.00	E.G. Elev (m)	178.14	178.12
Q Total (m3/s)	39.50	W.S. Elev (m)	178.00	177.98
Q Bridge (m3/s)	39.50	Crit W.S. (m)	177.16	177.16
Q Weir (m3/s)		Max Chl Dpth (m)	2.14	2.12
Weir Sta Lft (m)		Vel Total (m/s)	1.65	1.67
Weir Sta Rgt (m)		Flow Area (m2)	23.95	23.69
Weir Submerg		Froude # Chl	0.39	0.40
Weir Max Depth (m)		Specif Force (m3)	28.57	28.17
Min El Weir Flow (m)	181.95	Hydr Depth (m)	1.81	1.79
Min El Prs (m)	181.50	W.P. Total (m)	16.33	16.30
Delta EG (m)	0.02	Conv. Total (m3/s)	1818.1	1788.3
Delta WS (m)	0.02	Top Width (m)	13.24	13.24
BR Open Area (m2)	87.72	Frctn Loss (m)	0.02	0.00
BR Open Vel (m/s)	1.67	C & E Loss (m)	0.00	0.00
Coef of Q		Shear Total (N/m2)	6.79	6.95
Br Sel Method	Energy only	Power Total (N/m s)	11.19	11.59

BRIDGE OUTPUT Profile #Regional

E.G. US. (m)	178.71	Element	Inside BR US	Inside BR DS
W.S. US. (m)	178.50	E.G. Elev (m)	178.71	178.69
Q Total (m3/s)	62.60	W.S. Elev (m)	178.50	178.47
Q Bridge (m3/s)	62.60	Crit W.S. (m)	177.50	177.50
Q Weir (m3/s)		Max Chl Dpth (m)	2.64	2.61
Weir Sta Lft (m)		Vel Total (m/s)	2.05	2.07
Weir Sta Rgt (m)		Flow Area (m2)	30.60	30.28
Weir Submerg		Froude # Chl	0.43	0.44
Weir Max Depth (m)		Specif Force (m3)	48.68	48.06
Min El Weir Flow (m)	181.95	Hydr Depth (m)	2.31	2.29
Min El Prs (m)	181.50	W.P. Total (m)	17.34	17.30
Delta EG (m)	0.02	Conv. Total (m3/s)	2628.3	2587.0
Delta WS (m)	0.03	Top Width (m)	13.24	13.24
BR Open Area (m2)	87.72	Frctn Loss (m)	0.02	0.00

```
* BR Open Vel (m/s)     *        2.07  * C & E Loss (m)         *       0.00  *       0.00  *
* Coef of Q             *              * Shear Total (N/m2)     *       9.82  *      10.05  *
* Br Sel Method         *Energy only   * Power Total (N/m s)    *      20.09  *      20.78  *
*********************************************************************************************

CROSS SECTION


RIVER: Turkey Creek
REACH: Main              RS: 9.6

INPUT
Description:
Station Elevation Data    num=      15
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
****************************************************************************************
       0      182   125.33      182   133.85    181.5  140.248    179.5  140.248    176.5
  145.27   176.06   145.87   175.86   147.87   175.86   148.47   176.06  153.492    176.5
 153.492    179.5  161.948    180.5   166.14      181  170.386    181.5  199.519      182

Manning's n Values        num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
******************************************************
       0      .02  140.248     .017  153.492      .02

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       140.248 153.492            8.508       3   8.362              .3        .5

CROSS SECTION OUTPUT  Profile #100 yr
*********************************************************************************************
* E.G. Elev (m)         *   178.12  * Element                *   Left OB *  Channel * Right OB *
* Vel Head (m)          *     0.14  * Wt. n-Val.             *           *   0.017  *          *
* W.S. Elev (m)         *   177.98  * Reach Len. (m)         *      8.51 *    3.00  *    8.36  *
* Crit W.S. (m)         *           * Flow Area (m2)         *           *   23.69  *          *
* E.G. Slope (m/m)      *0.000488   * Area (m2)              *           *   23.69  *          *
* Q Total (m3/s)        *    39.50  * Flow (m3/s)            *           *   39.50  *          *
* Top Width (m)         *    13.24  * Top Width (m)          *           *   13.24  *          *
* Vel Total (m/s)       *     1.67  * Avg. Vel. (m/s)        *           *    1.67  *          *
* Max Chl Dpth (m)      *     2.12  * Hydr. Depth (m)        *           *    1.79  *          *
* Conv. Total (m3/s)    *   1788.3  * Conv. (m3/s)           *           *  1788.3  *          *
* Length Wtd. (m)       *     3.00  * Wetted Per. (m)        *           *   16.30  *          *
* Min Ch El (m)         *   175.86  * Shear (N/m2)           *           *    6.95  *          *
* Alpha                 *     1.00  * Stream Power (N/m s)   *           *   11.59  *          *
* Frctn Loss (m)        *     0.00  * Cum Volume (1000 m3)   *      0.13 *    3.34  *    0.17  *
* C & E Loss (m)        *     0.06  * Cum SA (1000 m2)       *      0.17 *    0.85  *    0.26  *
*********************************************************************************************

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than
         0.7 or greater than 1.4.  This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT  Profile #Regional
*********************************************************************************************
* E.G. Elev (m)         *   178.69  * Element                *   Left OB *  Channel * Right OB *
* Vel Head (m)          *     0.22  * Wt. n-Val.             *           *   0.017  *          *
* W.S. Elev (m)         *   178.47  * Reach Len. (m)         *      8.51 *    3.00  *    8.36  *
* Crit W.S. (m)         *           * Flow Area (m2)         *           *   30.28  *          *
* E.G. Slope (m/m)      *0.000586   * Area (m2)              *           *   30.28  *          *
* Q Total (m3/s)        *    62.60  * Flow (m3/s)            *           *   62.60  *          *
* Top Width (m)         *    13.24  * Top Width (m)          *           *   13.24  *          *
* Vel Total (m/s)       *     2.07  * Avg. Vel. (m/s)        *           *    2.07  *          *
* Max Chl Dpth (m)      *     2.61  * Hydr. Depth (m)        *           *    2.29  *          *
* Conv. Total (m3/s)    *   2587.0  * Conv. (m3/s)           *           *  2587.0  *          *
* Length Wtd. (m)       *     3.00  * Wetted Per. (m)        *           *   17.30  *          *
* Min Ch El (m)         *   175.86  * Shear (N/m2)           *           *   10.05  *          *
* Alpha                 *     1.00  * Stream Power (N/m s)   *           *   20.78  *          *
* Frctn Loss (m)        *     0.00  * Cum Volume (1000 m3)   *      0.23 *    3.74  *    0.31  *
* C & E Loss (m)        *     0.09  * Cum SA (1000 m2)       *      0.23 *    0.85  *    0.32  *
*********************************************************************************************

Warning: The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for
         additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than
         0.7 or greater than 1.4.  This may indicate the need for additional cross sections.

CROSS SECTION


RIVER: Turkey Creek
REACH: Main              RS: 9.5
```

```
INPUT
Description:
Station Elevation Data   num=      14
    Sta     Elev     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
************************************************************************************
      0    182.5  58.964      182   66.492      180   66.492    176.5   80.892  176.06
 81.492   175.86  83.492   175.86   84.092   176.06   98.492    176.5   98.492     180
 99.757    180.5 103.154      181  106.622    181.5  138.493      182

Manning's n Values       num=       3
    Sta    n Val     Sta    n Val      Sta    n Val
**************************************************
      0      .02  66.492     .017   98.492      .02

Bank Sta: Left   Right    Lengths: Left Channel   Right      Coeff Contr.   Expan.
        66.492  98.492            39.545  39.545  39.545               .3       .5

CROSS SECTION OUTPUT  Profile #100 yr
*******************************************************************************************
* E.G. Elev (m)         *  178.06  * Element                * Left OB *  Channel * Right OB *
* Vel Head (m)          *    0.02  * Wt. n-Val.             *         *   0.017  *          *
* W.S. Elev (m)         *  178.03  * Reach Len. (m)         *   0.14  *    0.14  *    0.14  *
* Crit W.S. (m)         *  176.78  * Flow Area (m2)         *         *   57.38  *          *
* E.G. Slope (m/m)      *0.000071  * Area (m2)              *         *   57.38  *          *
* Q Total (m3/s)        *   39.50  * Flow (m3/s)            *         *   39.50  *          *
* Top Width (m)         *   32.00  * Top Width (m)          *         *   32.00  *          *
* Vel Total (m/s)       *    0.69  * Avg. Vel. (m/s)        *         *    0.69  *          *
* Max Chl Dpth (m)      *    2.17  * Hydr. Depth (m)        *         *    1.79  *          *
* Conv. Total (m3/s)    *  4679.2  * Conv. (m3/s)           *         *  4679.2  *          *
* Length Wtd. (m)       *    0.14  * Wetted Per. (m)        *         *   35.15  *          *
* Min Ch El (m)         *  175.86  * Shear (N/m2)           *         *    1.14  *          *
* Alpha                 *    1.00  * Stream Power (N/m s)   *         *    0.79  *          *
* Frctn Loss (m)        *    0.00  * Cum Volume (1000 m3)   *   0.13  *    3.22  *    0.17  *
* C & E Loss (m)        *    0.00  * Cum SA (1000 m2)       *   0.17  *    0.78  *    0.26  *
*******************************************************************************************

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than
         0.7 or greater than 1.4.  This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT  Profile #Regional
*******************************************************************************************
* E.G. Elev (m)         *  178.60  * Element                * Left OB *  Channel * Right OB *
* Vel Head (m)          *    0.04  * Wt. n-Val.             *         *   0.017  *          *
* W.S. Elev (m)         *  178.56  * Reach Len. (m)         *   0.14  *    0.14  *    0.14  *
* Crit W.S. (m)         *  176.97  * Flow Area (m2)         *         *   74.31  *          *
* E.G. Slope (m/m)      *0.000079  * Area (m2)              *         *   74.31  *          *
* Q Total (m3/s)        *   62.60  * Flow (m3/s)            *         *   62.60  *          *
* Top Width (m)         *   32.00  * Top Width (m)          *         *   32.00  *          *
* Vel Total (m/s)       *    0.84  * Avg. Vel. (m/s)        *         *    0.84  *          *
* Max Chl Dpth (m)      *    2.70  * Hydr. Depth (m)        *         *    2.32  *          *
* Conv. Total (m3/s)    *  7059.7  * Conv. (m3/s)           *         *  7059.7  *          *
* Length Wtd. (m)       *    0.14  * Wetted Per. (m)        *         *   36.21  *          *
* Min Ch El (m)         *  175.86  * Shear (N/m2)           *         *    1.58  *          *
* Alpha                 *    1.00  * Stream Power (N/m s)   *         *    1.33  *          *
* Frctn Loss (m)        *    0.00  * Cum Volume (1000 m3)   *   0.23  *    3.59  *    0.31  *
* C & E Loss (m)        *    0.01  * Cum SA (1000 m2)       *   0.23  *    0.78  *    0.32  *
*******************************************************************************************

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than
         0.7 or greater than 1.4.  This may indicate the need for additional cross sections.

BRIDGE


RIVER: Turkey Creek
REACH: Main               RS: 9.45

INPUT
Description:
Distance from Upstream XS =    .143
Deck/Roadway Width        =  36.402
Weir Coefficient          =    1.44
Upstream  Deck/Roadway Coordinates
    num=      17
     Sta Hi Cord Lo Cord      Sta Hi Cord Lo Cord      Sta Hi Cord Lo Cord
********************************************************************************
       0   180.1            32.49     180            66.99  179.06  176.06
   66.99  179.06  177.86    76.99  179.03  177.86    76.99  179.03  176.06
   77.49  179.03  176.06    77.49  179.03  177.86    82.49  179.03  177.86
   87.49  179.03  177.86    87.49  179.03  176.06    87.99  179.03  176.06
```

```
   87.99  179.03  177.86   97.99  179.03  177.86   97.99  179.03  176.06
  132.49   178.3          182.49     178

Upstream Bridge Cross Section Data
Station Elevation Data    num=      14
     Sta     Elev     Sta     Elev     Sta     Elev     Sta     Elev     Sta     Elev
********************************************************************************
       0    182.5  58.964      182  66.492      180  66.492    176.5  80.892  176.06
  81.492   175.86  83.492   175.86  84.092   176.06  98.492    176.5  98.492     180
  99.757    180.5 103.154      181 106.622    181.5 138.493      182

Manning's n Values        num=       3
     Sta    n Val     Sta    n Val     Sta    n Val
************************************************
       0      .02  66.492     .017  98.492      .02

Bank Sta: Left    Right    Coeff Contr.   Expan.
        66.492   98.492            .3       .5

Downstream  Deck/Roadway Coordinates
    num=      17
     Sta Hi Cord Lo Cord      Sta Hi Cord Lo Cord      Sta Hi Cord Lo Cord
************************************************************************
       0     180             9.55     180             44.05  179.06  176.06
   44.05  179.06  177.86    54.05  179.03  177.86    54.05  179.03  176.06
   54.55  179.03  176.06    54.55  179.03  177.86    59.55  179.03  177.86
   64.55  179.03  177.86    64.55  179.03  176.06    65.05  179.03  176.06
   65.05  179.03  177.86    75.05  179.03  177.86    75.05  179.03  176.06
  109.55   178.3           159.55     178

Downstream Bridge Cross Section Data
Station Elevation Data    num=      15
     Sta     Elev     Sta     Elev     Sta     Elev     Sta     Elev     Sta     Elev
********************************************************************************
       0    182.5  22.451      182  30.035    181.5  43.553    179.5  43.553   176.5
  57.953   176.06  58.553   175.86  60.553   175.86  61.153   176.06  75.553   176.5
  75.553    179.5  84.157      181  86.382    181.5  87.423      182 124.022   182.5

Manning's n Values        num=       3
     Sta    n Val     Sta    n Val     Sta    n Val
************************************************
       0      .02  43.553     .017  75.553      .02

Bank Sta: Left    Right    Coeff Contr.   Expan.
        43.553   75.553            .3       .5

Upstream Embankment side slope            =       0 horiz. to 1.0 vertical
Downstream Embankment side slope          =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =    .95
Elevation at which weir flow begins       =
Energy head used in spillway design       =
Spillway height used in design            =
Weir crest shape                          = Broad Crested

Number of Bridge Coefficient Sets =  1

Low Flow Methods and Data
       Energy
Selected Low Flow Methods = Highest Energy Answer

High Flow Method
       Energy Only

Additional Bridge Parameters
       Add Friction component to Momentum
       Do not add Weight component to Momentum
       Class B flow critical depth computations use critical depth
           inside the bridge at the upstream end
       Criteria to check for pressure flow = Upstream energy grade line

BRIDGE OUTPUT  Profile #100 yr
*****************************************************************************************
* E.G. US. (m)          *     178.06  * Element              *Inside BR US *Inside BR DS *
* W.S. US. (m)          *     178.03  * E.G. Elev (m)        *      178.06 *      178.05 *
* Q Total (m3/s)        *      39.50  * W.S. Elev (m)        *      178.02 *      178.01 *
* Q Bridge (m3/s)       *      39.50  * Crit W.S. (m)        *      176.80 *      176.80 *
* Q Weir (m3/s)         *             * Max Chl Dpth (m)     *        2.16 *        2.15 *
* Weir Sta Lft (m)      *             * Vel Total (m/s)      *        0.81 *        0.81 *
* Weir Sta Rgt (m)      *             * Flow Area (m2)       *       48.73 *       48.73 *
* Weir Submerg          *             * Froude # Chl         *        0.19 *        0.19 *
```

```
* Weir Max Depth (m)    *              * Specif Force (m3)    *      51.18  *      50.63  *
* Min El Weir Flow (m)  *      179.02  * Hydr Depth (m)       *             *             *
* Min El Prs (m)        *      177.86  * W.P. Total (m)       *      69.58  *      69.58  *
* Delta EG (m)          *        0.02  * Conv. Total (m3/s)   *     2260.3  *     2260.2  *
* Delta WS (m)          *        0.02  * Top Width (m)        *             *             *
* BR Open Area (m2)     *       48.73  * Frctn Loss (m)       *       0.01  *       0.00  *
* BR Open Vel (m/s)     *        0.81  * C & E Loss (m)       *       0.00  *       0.00  *
* Coef of Q             *              * Shear Total (N/m2)   *       2.10  *       2.10  *
* Br Sel Method         *Energy only   * Power Total (N/m s)  *       1.70  *       1.70  *
*******************************************************************************************
```

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than
0.7 or greater than 1.4. This may indicate the need for additional cross sections.

```
BRIDGE OUTPUT   Profile #Regional
*******************************************************************************************
* E.G. US. (m)          *      178.60  * Element              *Inside BR US *Inside BR DS *
* W.S. US. (m)          *      178.56  * E.G. Elev (m)        *     178.59  *     178.56  *
* Q Total (m3/s)        *       62.60  * W.S. Elev (m)        *     178.50  *     178.47  *
* Q Bridge (m3/s)       *       62.60  * Crit W.S. (m)        *     177.00  *     177.00  *
* Q Weir (m3/s)         *              * Max Chl Dpth (m)     *       2.64  *       2.61  *
* Weir Sta Lft (m)      *              * Vel Total (m/s)      *       1.28  *       1.28  *
* Weir Sta Rgt (m)      *              * Flow Area (m2)       *      48.73  *      48.73  *
* Weir Submerg          *              * Froude # Chl         *       0.27  *       0.27  *
* Weir Max Depth (m)    *              * Specif Force (m3)    *      79.45  *      78.09  *
* Min El Weir Flow (m)  *      179.02  * Hydr Depth (m)       *             *             *
* Min El Prs (m)        *      177.86  * W.P. Total (m)       *      69.58  *      69.58  *
* Delta EG (m)          *        0.07  * Conv. Total (m3/s)   *     2260.3  *     2260.2  *
* Delta WS (m)          *        0.07  * Top Width (m)        *             *             *
* BR Open Area (m2)     *       48.73  * Frctn Loss (m)       *       0.03  *       0.00  *
* BR Open Vel (m/s)     *        1.28  * C & E Loss (m)       *       0.00  *       0.02  *
* Coef of Q             *              * Shear Total (N/m2)   *       5.27  *       5.27  *
* Br Sel Method         *Energy only   * Power Total (N/m s)  *       6.77  *       6.77  *
*******************************************************************************************
```

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than
0.7 or greater than 1.4. This may indicate the need for additional cross sections.

```
CROSS SECTION


RIVER: Turkey Creek
REACH: Main                RS: 9.4

INPUT
Description:
Station Elevation Data      num=       15
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
*******************************************************************************************
       0    182.5   22.451      182   30.035    181.5   43.553    179.5   43.553    176.5
  57.953   176.06   58.553   175.86   60.553   175.86   61.153   176.06   75.553    176.5
  75.553    179.5   84.157      181   86.382    181.5   87.423      182  124.022    182.5

Manning's n Values          num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
*******************************************************
       0      .02   43.553     .017   75.553      .02

Bank Sta: Left   Right      Lengths: Left Channel    Right      Coeff Contr.    Expan.
        43.553  75.553               5.639       5   6.353               .3        .5

CROSS SECTION OUTPUT  Profile #100 yr
*******************************************************************************************
* E.G. Elev (m)         *   178.04  * Element                *  Left OB  *  Channel  * Right OB  *
* Vel Head (m)          *     0.02  * Wt. n-Val.             *           *    0.017  *           *
* W.S. Elev (m)         *   178.02  * Reach Len. (m)         *     5.64  *     5.00  *     6.35  *
* Crit W.S. (m)         *           * Flow Area (m2)         *           *    56.76  *           *
* E.G. Slope (m/m)      *0.000074   * Area (m2)              *           *    56.76  *           *
* Q Total (m3/s)        *    39.50  * Flow (m3/s)            *           *    39.50  *           *
* Top Width (m)         *    32.00  * Top Width (m)          *           *    32.00  *           *
* Vel Total (m/s)       *     0.70  * Avg. Vel. (m/s)        *           *     0.70  *           *
* Max Chl Dpth (m)      *     2.16  * Hydr. Depth (m)        *           *     1.77  *           *
* Conv. Total (m3/s)    *   4599.1  * Conv. (m3/s)           *           *   4599.1  *           *
* Length Wtd. (m)       *     5.00  * Wetted Per. (m)        *           *    35.11  *           *
* Min Ch El (m)         *   175.86  * Shear (N/m2)           *           *     1.17  *           *
* Alpha                 *     1.00  * Stream Power (N/m s)   *           *     0.81  *           *
* Frctn Loss (m)        *     0.00  * Cum Volume (1000 m3)   *     0.13  *     1.28  *     0.17  *
* C & E Loss (m)        *     0.00  * Cum SA (1000 m2)       *     0.17  *     0.73  *     0.26  *
*******************************************************************************************
```

```
CROSS SECTION OUTPUT  Profile #Regional
******************************************************************************************
* E.G. Elev (m)          *   178.53  * Element              *  Left OB *  Channel * Right OB *
* Vel Head (m)           *     0.04  * Wt. n-Val.           *          *   0.017  *          *
* W.S. Elev (m)          *   178.50  * Reach Len. (m)       *    5.64  *    5.00  *    6.35  *
* Crit W.S. (m)          *           * Flow Area (m2)       *          *   72.14  *          *
* E.G. Slope (m/m)       *0.000086   * Area (m2)            *          *   72.14  *          *
* Q Total (m3/s)         *    62.60  * Flow (m3/s)          *          *   62.60  *          *
* Top Width (m)          *    32.00  * Top Width (m)        *          *   32.00  *          *
* Vel Total (m/s)        *     0.87  * Avg. Vel. (m/s)      *          *    0.87  *          *
* Max Chl Dpth (m)       *     2.64  * Hydr. Depth (m)      *          *    2.25  *          *
* Conv. Total (m3/s)     *   6735.6  * Conv. (m3/s)         *          *  6735.6  *          *
* Length Wtd. (m)        *     5.00  * Wetted Per. (m)      *          *   36.07  *          *
* Min Ch El (m)          *   175.86  * Shear (N/m2)         *          *    1.69  *          *
* Alpha                  *     1.00  * Stream Power (N/m s) *          *    1.47  *          *
* Frctn Loss (m)         *     0.00  * Cum Volume (1000 m3) *    0.23  *    1.62  *    0.31  *
* C & E Loss (m)         *     0.01  * Cum SA (1000 m2)     *    0.23  *    0.73  *    0.32  *
******************************************************************************************

CROSS SECTION


RIVER: Turkey Creek
REACH: Main                 RS: 9.3

INPUT
Description:
Station Elevation Data     num=       16
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
*****************************************************************************************
       0    182.5   22.465      182   35.015    181.5   36.837      181   47.673      178
  47.673    176.5   58.823   176.06   59.423   175.86   61.423   175.86   62.023   176.06
  73.173    176.5   73.173      178   81.981    180.5   86.631      181   89.072      182
  225.65    182.5

Manning's n Values         num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
***********************************************
       0      .02   47.673     .017   73.173      .02

Bank Sta: Left    Right    Lengths: Left Channel    Right        Coeff Contr.     Expan.
        47.673   73.173              4.02   3.772    4.02                  .1         .3

CROSS SECTION OUTPUT  Profile #100 yr
******************************************************************************************
* E.G. Elev (m)          *   178.04  * Element              *  Left OB *  Channel * Right OB *
* Vel Head (m)           *     0.04  * Wt. n-Val.           *          *   0.017  *          *
* W.S. Elev (m)          *   178.00  * Reach Len. (m)       *    4.02  *    3.77  *    4.02  *
* Crit W.S. (m)          *           * Flow Area (m2)       *          *   44.98  *          *
* E.G. Slope (m/m)       *0.000122   * Area (m2)            *          *   44.98  *          *
* Q Total (m3/s)         *    39.50  * Flow (m3/s)          *          *   39.50  *          *
* Top Width (m)          *    25.50  * Top Width (m)        *          *   25.50  *          *
* Vel Total (m/s)        *     0.88  * Avg. Vel. (m/s)      *          *    0.88  *          *
* Max Chl Dpth (m)       *     2.14  * Hydr. Depth (m)      *          *    1.76  *          *
* Conv. Total (m3/s)     *   3580.8  * Conv. (m3/s)         *          *  3580.8  *          *
* Length Wtd. (m)        *     3.78  * Wetted Per. (m)      *          *   28.57  *          *
* Min Ch El (m)          *   175.86  * Shear (N/m2)         *          *    1.88  *          *
* Alpha                  *     1.00  * Stream Power (N/m s) *          *    1.65  *          *
* Frctn Loss (m)         *     0.00  * Cum Volume (1000 m3) *    0.13  *    1.03  *    0.17  *
* C & E Loss (m)         *     0.00  * Cum SA (1000 m2)     *    0.17  *    0.59  *    0.26  *
******************************************************************************************

CROSS SECTION OUTPUT  Profile #Regional
******************************************************************************************
* E.G. Elev (m)          *   178.53  * Element              *  Left OB *  Channel * Right OB *
* Vel Head (m)           *     0.06  * Wt. n-Val.           *   0.020  *   0.017  *   0.020  *
* W.S. Elev (m)          *   178.47  * Reach Len. (m)       *    4.02  *    3.77  *    4.02  *
* Crit W.S. (m)          *           * Flow Area (m2)       *    0.39  *   56.97  *    0.38  *
* E.G. Slope (m/m)       *0.000138   * Area (m2)            *    0.39  *   56.97  *    0.38  *
* Q Total (m3/s)         *    62.60  * Flow (m3/s)          *    0.09  *   62.43  *    0.08  *
* Top Width (m)          *    28.82  * Top Width (m)        *    1.68  *   25.50  *    1.64  *
* Vel Total (m/s)        *     1.08  * Avg. Vel. (m/s)      *    0.22  *    1.10  *    0.22  *
* Max Chl Dpth (m)       *     2.61  * Hydr. Depth (m)      *    0.23  *    2.23  *    0.23  *
* Conv. Total (m3/s)     *   5321.4  * Conv. (m3/s)         *     7.2  *  5307.2  *     7.1  *
* Length Wtd. (m)        *     3.78  * Wetted Per. (m)      *    1.75  *   28.58  *    1.71  *
* Min Ch El (m)          *   175.86  * Shear (N/m2)         *    0.30  *    2.70  *    0.30  *
* Alpha                  *     1.02  * Stream Power (N/m s) *    0.07  *    2.96  *    0.07  *
* Frctn Loss (m)         *     0.00  * Cum Volume (1000 m3) *    0.22  *    1.30  *    0.31  *
* C & E Loss (m)         *     0.00  * Cum SA (1000 m2)     *    0.22  *    0.59  *    0.32  *
******************************************************************************************
```

```
CROSS SECTION


RIVER: Turkey Creek
REACH: Main                RS: 9.2

INPUT
Description:
Station Elevation Data     num=       28
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
*******************************************************************************
       0      182   12.725    181.5    14.44      181   16.148    180.5   17.868      180
  19.579    179.5   21.223      179   22.754    178.5   24.249      178   25.742    177.5
  27.224      177   28.735    176.5   36.975   176.06   37.575   175.86   39.575   175.86
  40.175   176.06   48.415    176.5   49.851      177   51.275    177.5   52.723      178
  54.188    178.5   55.665      179    57.16    179.5    58.63      180   60.657    180.5
  65.963      181   67.032    181.5    68.12      182

Manning's n Values         num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
*************************************************
       0      .03   28.735     .017   48.415      .03

Bank Sta: Left    Right     Lengths: Left Channel   Right      Coeff Contr.    Expan.
        28.735   48.415              30.4   31.81  33.814                .1        .3

CROSS SECTION OUTPUT  Profile #100 yr
***********************************************************************************************
* E.G. Elev (m)           *   178.03  * Element                  *  Left OB  *  Channel  * Right OB  *
* Vel Head (m)            *     0.06  * Wt. n-Val.               *   0.030   *   0.017   *   0.030   *
* W.S. Elev (m)           *   177.98  * Reach Len. (m)           *   30.40   *   31.81   *   33.81   *
* Crit W.S. (m)           *           * Flow Area (m2)           *    3.27   *   34.61   *    3.12   *
* E.G. Slope (m/m)        *0.000160   * Area (m2)                *    3.27   *   34.61   *    3.12   *
* Q Total (m3/s)          *    39.50  * Flow (m3/s)              *    1.09   *   37.38   *    1.03   *
* Top Width (m)           *    28.34  * Top Width (m)            *    4.42   *   19.68   *    4.24   *
* Vel Total (m/s)         *     0.96  * Avg. Vel. (m/s)          *    0.33   *    1.08   *    0.33   *
* Max Chl Dpth (m)        *     2.12  * Hydr. Depth (m)          *    0.74   *    1.76   *    0.74   *
* Conv. Total (m3/s)      *   3125.6  * Conv. (m3/s)             *    86.1   *  2957.7   *    81.8   *
* Length Wtd. (m)         *    31.85  * Wetted Per. (m)          *    4.66   *   19.77   *    4.49   *
* Min Ch El (m)           *   175.86  * Shear (N/m2)             *    1.10   *    2.74   *    1.09   *
* Alpha                   *     1.20  * Stream Power (N/m s)     *    0.37   *    2.96   *    0.36   *
* Frctn Loss (m)          *     0.01  * Cum Volume (1000 m3)     *    0.13   *    0.88   *    0.17   *
* C & E Loss (m)          *     0.01  * Cum SA (1000 m2)         *    0.16   *    0.50   *    0.25   *
***********************************************************************************************

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than
         0.7 or greater than 1.4.  This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT  Profile #Regional
***********************************************************************************************
* E.G. Elev (m)           *   178.52  * Element                  *  Left OB  *  Channel  * Right OB  *
* Vel Head (m)            *     0.08  * Wt. n-Val.               *   0.030   *   0.017   *   0.030   *
* W.S. Elev (m)           *   178.44  * Reach Len. (m)           *   30.40   *   31.81   *   33.81   *
* Crit W.S. (m)           *           * Flow Area (m2)           *    5.64   *   43.74   *    5.41   *
* E.G. Slope (m/m)        *0.000176   * Area (m2)                *    5.64   *   43.74   *    5.41   *
* Q Total (m3/s)          *    62.60  * Flow (m3/s)              *    2.36   *   57.99   *    2.25   *
* Top Width (m)           *    31.08  * Top Width (m)            *    5.80   *   19.68   *    5.60   *
* Vel Total (m/s)         *     1.14  * Avg. Vel. (m/s)          *    0.42   *    1.33   *    0.42   *
* Max Chl Dpth (m)        *     2.58  * Hydr. Depth (m)          *    0.97   *    2.22   *    0.97   *
* Conv. Total (m3/s)      *   4717.3  * Conv. (m3/s)             *   178.1   *  4369.7   *   169.6   *
* Length Wtd. (m)         *    31.88  * Wetted Per. (m)          *    6.12   *   19.77   *    5.93   *
* Min Ch El (m)           *   175.86  * Shear (N/m2)             *    1.59   *    3.82   *    1.58   *
* Alpha                   *     1.26  * Stream Power (N/m s)     *    0.67   *    5.07   *    0.66   *
* Frctn Loss (m)          *     0.01  * Cum Volume (1000 m3)     *    0.21   *    1.11   *    0.30   *
* C & E Loss (m)          *     0.01  * Cum SA (1000 m2)         *    0.21   *    0.50   *    0.30   *
***********************************************************************************************

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than
         0.7 or greater than 1.4.  This may indicate the need for additional cross sections.

CROSS SECTION


RIVER: Turkey Creek
REACH: Main                RS: 9.1

INPUT
Description:
Station Elevation Data     num=       29
```

```
     Sta      Elev      Sta      Elev      Sta      Elev      Sta      Elev      Sta      Elev
*******************************************************************************************
       0     181.5   84.335    181.5    89.24      181    91.04     180.5   92.826      180
  94.617     179.5   96.484      179   98.345    178.5  100.173      178   101.97     177.5
 103.725       177  106.858    176.5  111.217   176.06  111.817   175.86  113.817   175.86
 114.417    176.06  118.776    176.5  122.227      177  125.249    177.5  130.295      178
 131.458     178.5  132.634      179  133.814    179.5  134.997      180  136.182    180.5
 142.388       181  143.457    181.5  144.535      182  251.616      182

Manning's n Values          num=        3
     Sta    n Val     Sta    n Val      Sta    n Val
****************************************************
       0      .03  106.858     .017  118.776      .03

Bank Sta: Left    Right    Lengths: Left Channel    Right      Coeff Contr.    Expan.
       106.858  118.776                0       0        0                .1         .3

CROSS SECTION OUTPUT  Profile #100 yr
**********************************************************************************************
* E.G. Elev (m)        *  178.02  * Element                 *  Left OB *  Channel * Right OB *
* Vel Head (m)         *    0.12  * Wt. n-Val.              *   0.030  *   0.017  *  0.030   *
* W.S. Elev (m)        *  177.90  * Reach Len. (m)          *          *          *          *
* Crit W.S. (m)        *  177.20  * Flow Area (m2)          *    5.05  *   20.56  *    6.77  *
* E.G. Slope (m/m)     *0.000375  * Area (m2)               *    5.05  *   20.56  *    6.77  *
* Q Total (m3/s)       *   39.50  * Flow (m3/s)             *    2.76  *   33.51  *    3.24  *
* Top Width (m)        *   28.79  * Top Width (m)           *    6.34  *   11.92  *   10.54  *
* Vel Total (m/s)      *    1.22  * Avg. Vel. (m/s)         *    0.55  *    1.63  *    0.48  *
* Max Chl Dpth (m)     *    2.04  * Hydr. Depth (m)         *    0.80  *    1.73  *    0.64  *
* Conv. Total (m3/s)   *  2038.9  * Conv. (m3/s)            *   142.2  *  1729.7  *   167.0  *
* Length Wtd. (m)      *          * Wetted Per. (m)         *    6.50  *   12.03  *   10.63  *
* Min Ch El (m)        *  175.86  * Shear (N/m2)            *    2.86  *    6.29  *    2.34  *
* Alpha                *    1.54  * Stream Power (N/m s)    *    1.56  *   10.25  *    1.12  *
* Frctn Loss (m)       *          * Cum Volume (1000 m3)    *          *          *          *
* C & E Loss (m)       *          * Cum SA (1000 m2)        *          *          *          *
**********************************************************************************************

CROSS SECTION OUTPUT  Profile #Regional
**********************************************************************************************
* E.G. Elev (m)        *  178.51  * Element                 *  Left OB *  Channel * Right OB *
* Vel Head (m)         *    0.15  * Wt. n-Val.              *   0.030  *   0.017  *  0.030   *
* W.S. Elev (m)        *  178.36  * Reach Len. (m)          *          *          *          *
* Crit W.S. (m)        *  177.53  * Flow Area (m2)          *    8.32  *   26.00  *   12.13  *
* E.G. Slope (m/m)     *0.000375  * Area (m2)               *    8.32  *   26.00  *   12.13  *
* Q Total (m3/s)       *   62.60  * Flow (m3/s)             *    5.41  *   49.53  *    7.66  *
* Top Width (m)        *   32.27  * Top Width (m)           *    8.00  *   11.92  *   12.35  *
* Vel Total (m/s)      *    1.35  * Avg. Vel. (m/s)         *    0.65  *    1.90  *    0.63  *
* Max Chl Dpth (m)     *    2.50  * Hydr. Depth (m)         *    1.04  *    2.18  *    0.98  *
* Conv. Total (m3/s)   *  3232.0  * Conv. (m3/s)            *   279.3  *  2557.1  *   395.5  *
* Length Wtd. (m)      *          * Wetted Per. (m)         *    8.22  *   12.03  *   12.53  *
* Min Ch El (m)        *  175.86  * Shear (N/m2)            *    3.72  *    7.95  *    3.56  *
* Alpha                *    1.63  * Stream Power (N/m s)    *    2.42  *   15.15  *    2.25  *
* Frctn Loss (m)       *          * Cum Volume (1000 m3)    *          *          *          *
* C & E Loss (m)       *          * Cum SA (1000 m2)        *          *          *          *
**********************************************************************************************

*******************************************************************************************

SUMMARY OF MANNING'S N VALUES

River:Turkey Creek
*************************************************************************
*     Reach        *   River Sta.   *   n1     *    n2     *    n3     *
*************************************************************************
*Main              *   10           *      .03*    .017*        .03*
*Main              *   9.9          *      .03*    .017*        .03*
*Main              *   9.8          *      .03*    .017*        .03*
*Main              *   9.7          *      .02*    .017*        .02*
*Main              *   9.65         *Bridge    *         *           *
*Main              *   9.6          *      .02*    .017*        .02*
*Main              *   9.5          *      .02*    .017*        .02*
*Main              *   9.45         *Bridge    *         *           *
*Main              *   9.4          *      .02*    .017*        .02*
*Main              *   9.3          *      .02*    .017*        .02*
*Main              *   9.2          *      .03*    .017*        .03*
*Main              *   9.1          *      .03*    .017*        .03*
*************************************************************************

*******************************************************************************************

SUMMARY OF REACH LENGTHS
```

River: Turkey Creek

Reach	River Sta.	Left	Channel	Right
Main	10	207.817	210.778	216.406
Main	9.9	104.462	100.685	96.329
Main	9.8	24.356	24.248	24.356
Main	9.7	35.414	35.414	35.414
Main	9.65	Bridge		
Main	9.6	8.508	3	8.362
Main	9.5	39.545	39.545	39.545
Main	9.45	Bridge		
Main	9.4	5.639	5	6.353
Main	9.3	4.02	3.772	4.02
Main	9.2	30.4	31.81	33.814
Main	9.1	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Turkey Creek

Reach	River Sta.	Contr.	Expan.
Main	10	.1	.3
Main	9.9	.1	.3
Main	9.8	.1	.3
Main	9.7	.3	.5
Main	9.65	Bridge	
Main	9.6	.3	.5
Main	9.5	.3	.5
Main	9.45	Bridge	
Main	9.4	.3	.5
Main	9.3	.1	.3
Main	9.2	.1	.3
Main	9.1	.1	.3

Appendix A.6

Alternative 3

Culvert Calculator Report
Basin Drain -All Alternatives - Reg Check

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	181.40 m	Headwater Depth/Height	1.20
Computed Headwater Elevat	180.32 m	Discharge	8.1000 m^3/s
Inlet Control HW Elev.	180.32 m	Tailwater Elevation	179.70 m
Outlet Control HW Elev.	180.32 m	Control Type	Inlet Control

Grades

Upstream Invert	178.50 m	Downstream Invert	178.20 m
Length	58.00 m	Constructed Slope	0.005172 m/m

Hydraulic Profile

Profile	CompositeS1S2	Depth, Downstream	1.05 m
Slope Type	Steep	Normal Depth	1.05 m
Flow Regime	N/A	Critical Depth	1.14 m
Velocity Downstream	3.62 m/s	Critical Slope	0.004178 m/m

Section

Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	2.13 m
Section Size	2130 x 1520 mm	Rise	1.52 m
Number Sections	1		

Outlet Control Properties

Outlet Control HW Elev.	180.32 m	Upstream Velocity Head	0.57 m
Ke	0.20	Entrance Loss	0.11 m

Inlet Control Properties

Inlet Control HW Elev.	180.32 m	Flow Control	Transition
Inlet Type	90° headwall w 45° bevels	Area Full	3.3 m^2
K	0.49500	HDS 5 Chart	10
M	0.66700	HDS 5 Scale	2
C	0.03140	Equation Form	2
Y	0.82000		

Titcombe Drain
Worksheet for Circular Channel

Project Description	
Worksheet	Titcome_prelimin
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Full Flow Diamet(

Input Data		
Mannings Coeffici	0.013	
Channel Slope	005000	m/m
Discharge	3.2000	m^3/s

Results		
Depth	1.27	m
Diameter	1,269.0	mm
Flow Area	1.3	m^2
Wetted Perimet	4.30	m
Top Width	0.00	m
Critical Depth	0.97	m
Percent Full	100.0	%
Critical Slope	005735	m/m
Velocity	2.53	m/s
Velocity Head	0.33	m
Specific Energy	1.60	m
Froude Numbei	0.00	
Maximum Disct	3.4423	m^3/s
Discharge Full	3.2000	m^3/s
Slope Full	005000	m/m
Flow Type	N/A	

Notes: Discharge of 3.2 m3/s was taken from taking 50% of the 100 year flow of subcatchment 140 of turkey creek watershed.
Drainage area D/S of Titcombe is approximately 274 ha, 55% of the entire subcatch #140. Drainage area therefore U/S Titcombe crossing is app. 50% of the entire subcatch.
From 1989 Maclaren report:
Catch # 140
DA = 496 Ha.
100 yr existing = 6.4 m3/s
100 yr efuture = 16.7 m3/s

Appendix B

Hydrologic Analysis
Pre & Post Development Conditions

Appendix B.1

Pre-Development Condition

Project: **Detroit River International Crossing Study**
Design Storm: **100-year**
Rainfall Data: **MTO District I Chatham**
Rainfall Intensity Coefficients:
A: **2824.505**
B: **13.74**
C: **0.88**

Rational Method Calculation
Existing Conidtion
Alternative 1A

Drainage ID	Drainage Area (ha)	Run-off Coefficient C	Travelled Distance d (m)	Time of Concentration Tc (hr)	Rainfall Intensity I (mm/h)	100-year Peak Flow (m3/s)	Remarks
100	6.36	0.30	850	0.91	68.7	0.37	To TTcombe Drain
101	2.53	0.30	733	0.82	73.9	0.16	To Basin Drain
102	5.60	0.30	833	0.26	143.5	0.68	Pump to Mangin Drain
103	2.60	0.30	747	0.83	73.2	0.16	To Turkey Creek
104	2.50	0.30	353	0.52	99.0	0.21	Pump to Lenon Drain
105	2.50	0.30	533	0.67	84.6	0.18	To Lenon Drain
106	5.60	0.30	767	0.85	72.0	0.34	Pump to Cahill Drain
107	3.10	0.30	881	0.92	67.9	0.18	To Wolfe Drain
108	3.96	0.30	834	0.89	69.6	0.23	Pump to Wolfe Drain
109	6.60	0.30	1737	1.45	48.8	0.27	To Wolfe Drain

Project: **Detroit River International Crossing Study**
Design Storm: **100-year**
Rainfall Data: **MTO District I Chatham**
Rainfall Intensity Coefficients:
A: **2824.505**
B: **13.74**
C: **0.88**

Rational Method Calculation
Existing Conidtion
Alternative 1B

Drainage ID	Drainage Area (ha)	Run-off Coefficient C	Travelled Distance d (m)	Time of Concentration Tc (hr)	Rainfall Intensity I (mm/h)	100-year Peak Flow (m3/s)	Remarks
100	6.36	0.30	885	0.93	67.5	0.36	To TTcombe Drain
101	2.70	0.30	468	0.62	89.0	0.20	To Basin Drain
102	5.38	0.30	670	0.78	76.3	0.34	Pump to Mangin Drain
103	4.50	0.30	847	0.90	69.0	0.26	Pump to Turkey Creek
104	2.74	0.30	451	0.61	90.2	0.21	Pump to Lenon Drain
105	7.21	0.30	1,016	1.02	63.3	0.38	Pump to Cahill Drain
106	6.17	0.30	1,498	1.31	52.6	0.27	Pump to Wolfe Drain
107	6.56	0.30	1737	1.45	48.8	0.27	To Wolfe Drain

Project: **Detroit River International Crossing Study**
Design Storm: **100-year**
Rainfall Data: **MTO District I Chatham**
Rainfall Intensity Coefficients:
A: **2824.505**
B: **13.74**
C: **0.88**

Rational Method Calculation
Existing Conidtion
Alternative 2A

Drainage ID	Drainage Area (ha)	Run-off Coefficient C	Travelled Distance d (m)	Time of Concentration Tc (hr)	Rainfall Intensity I (mm/h)	100 - year Peak Flow (m^3/s)	Remarks
100	6.36	0.30	880	0.928	67.7	0.36	Drain to TTcombe Drain
101	1.69	0.30	483	0.626	88.3	0.13	Basin Drain
102	5.19	0.30	847	0.904	68.9	0.30	Pump to Mangin Drain
103	3.31	0.30	732	0.820	73.8	0.21	To Turkey Creek
104	4.93	0.30	556	0.696	82.4	0.34	Pump to Lennon Drain
105	2.61	0.30	529	0.667	84.8	0.19	To Cahill Drain
106	5.30	0.30	969	0.985	64.9	0.29	Pump to Cahill Drain
107	7.06	0.30	998	1.007	63.9	0.38	Pump to Wolfe Drain

Project: **Detroit River International Crossing Study**
Design Storm: **100-year**
Rainfall Data: **MTO District I Chatham**
Rainfall Intensity Coefficients:
A: **2824.505**
B: **13.74**
C: **0.88**

Rational Method Calculation
Existing Conidtion
Alternative 2B

Drainage ID	Drainage Area (ha)	Run-off Coefficient C	Travelled Distance d (m)	Time of Concentration Tc (hr)	Rainfall Intensity I (mm/h)	100-year Peak Flow (m^3/s)	Remarks
100	6.36	0.30	880	0.93	67.7	0.36	Drain to TTcombe Drain
101	2.13	0.30	482	0.63	88.2	0.16	Basin Drain
102	6.54	0.30	884	0.93	67.5	0.37	Pump to Mangin Drain
103	7.21	0.30	1453	1.29	53.4	0.32	Pump to Turkey Creek
104	2.34	0.30	421	0.58	92.8	0.18	Pump to Lennon Drain
105	5.77	0.30	1377	1.24	54.8	0.27	Pump to Cahill Drain
106	9.32	0.30	1023	1.03	63.0	0.49	Pump to Wolfe Drain

Project: **Detroit River International Crossing Study**
Design Storm: **100-year**
Rainfall Data: **MTO District I Chatham**
Rainfall Intensity Coefficients:
A: **2824.505**
B: **13.74**
C: **0.88**

Rational Method Calculation
Existing Conidtion
Alternative 2B - Revised Proposed

Drainage ID	Drainage Area (ha)	Run-off Coefficient C	Travelled Distance d (m)	Time of Concentration Tc (hr)	Rainfall Intensity I (mm/h)	100-year Peak Flow (m3/s)	Remarks
100	6.36	0.30	810	0.88	70.2	0.37	To TTcombe Drain
101	8.67	0.30	1260	1.17	57.2	0.42	Pump To Basin Drain
102	6.22	0.30	1080	1.06	61.6	0.32	Pump to Lenon Drain
103	19.43	0.30	3240	2.22	35.0	0.57	Pump to Cahill Drain

Project: **Detroit River International Crossing Study**
Design Storm: **100-year**
Rainfall Data: **MTO District I Chatham**
Rainfall Intensity Coefficients: Inlet Time (t_i)= 5 min
A: **2824.505** Average Velocity = 1.5 m/s
B: **13.74**
C: **0.88**

Rational Method Calculation
Existing Conidtion
Alternative 3

Drainage ID	Drainage Area (ha)	Run-off Coefficient C	Travelled Distance d (m)	Time of Concentration Tc (hr)	Rainfall Intensity I (mm/h)	100-year Peak Flow (m3/s)	Remarks
100	6.36	0.30	850	0.91	68.7	0.37	To TTcombe Drain
101	2.80	0.30	798	0.87	71.1	0.17	Pump to Basin Drain
102	0.34	0.30	342	0.50	101.7	0.03	Pump to Turkey Creek
103	0.34	0.30	342	0.50	101.7	0.03	Pump to Turkey Creek
104	0.14	0.30	140	0.29	138.1	0.02	Pump to Cahill Drain
105	0.19	0.30	194	0.35	124.6	0.02	Pump to Cahill Drain
106	0.17	0.30	174	0.33	129.1	0.02	Pump to Cahill Drain
107	0.19	0.30	191	0.35	125.3	0.02	Pump to Cahill Drain
108	2.16	0.30	774	0.85	72.1	0.13	Pump to Wolfe Drain
109	6.56	0.30	1737	1.45	48.8	0.27	To Wolfe Drain

Appendix B.2

Post Development Condition

Project: **Detroit River International Crossing Study**
Design Storm: **100-year**
Rainfall Data: **MTO District I Chatham**
Rainfall Intensity Coefficients: Inlet Time (t_i)= 5 min
A: **2824.505** Average Velocity = 1.5 m/s
B: **13.74**
C: **0.88**

Rational Method Calculation
Proposed Conidtion
Alternative 1A

Drainage ID	Drainage Area (ha)	Run-off Coefficient C	Travelled Distance d (m)	Time of Concentration $Tc = t_i + t_d$ (hr)	Rainfall Intensity I (mm/h)	100-year Peak Flow (m3/s)	Remarks
100	6.36	0.90	850	0.24	149.6	2.40	To TTcombe Drain
101	2.53	0.90	733	0.22	155.9	0.99	To Basin Drain
102	5.60	0.90	833	0.24	150.5	2.12	Pump to Mangin Drain
103	2.60	0.90	747	0.22	155.2	1.02	To Turkey Creek
104	2.50	0.90	353	0.15	181.2	1.14	Pump to Lenon Drain
105	2.50	0.90	533	0.18	168.2	1.06	To Lenon Drain
106	5.60	0.90	767	0.23	154.0	2.17	Pump to Cahill Drain
107	3.10	0.90	881	0.25	148.0	1.16	To Wolfe Drain
108	3.96	0.90	834	0.24	150.4	1.50	Pump to Wolfe Drain
109	6.60	0.90	1737	0.41	114.9	1.91	To Wolfe Drain

Project:	**Detroit River International Crossing Study**				
Design Storm:	**100-year**				
Rainfall Data:	**MTO District I Chatham**				
Rainfall Intensity Coefficients:		Inlet Time (t_i) =	5	min
A:	**2824.505**	Average Velocity (v) =	1.5	m/s
B:	**13.74**				
C:	**0.88**				

Rational Method Calculation
Proposed Conidtion
Alternative 1B

Drainage ID	Drainage Area (ha)	Run-off Coefficient C	Travelled Distance d (m)	Time of Concentration $Tc = t_i + t_d$ (hr)	Rainfall Intensity I (mm/h)	100-year Peak Flow (m3/s)	Remarks
100	6.36	0.90	885	0.25	147.8	2.37	To TTcombe Drain
101	2.70	0.90	468	0.17	172.7	1.18	To Basin Drain
102	5.38	0.90	670	0.21	159.6	2.16	Pump to Mangin Drain
103	4.50	0.90	847	0.24	149.8	1.70	Pump to Turkey Creek
104	2.74	0.90	451	0.17	173.9	1.20	Pump to Lenon Drain
105	7.21	0.90	1,016	0.27	141.5	2.57	Pump to Cahill Drain
106	6.17	0.90	1,498	0.36	122.5	1.90	Pump to Wolfe Drain
107	6.56	0.90	1737	0.41	114.9	1.90	To Wolfe Drain

Project: **Detroit River International Crossing Study**
Design Storm: **100-year**
Rainfall Data: **MTO District I Chatham**
Rainfall Intensity Coefficients: Inlet Time (t_i)= 5 min
A: **2824.505** Average Velocity = 1.5 m/s
B: **13.74**
C: **0.88**

Rational Method Calculation
Proposed Conidtion
Alternative 2A

Drainage ID	Drainage Area (ha)	Run-off Coefficient C	Travelled Distance d (m)	Time of Concentration $Tc = t_i + t_d$ (hr)	Rainfall Intensity I (mm/h)	100-year Peak Flow (m^3/s)	Remarks
100	6.36	0.90	880	0.25	148.1	2.37	Drain to TTcombe Drain
101	1.69	0.90	483	0.17	171.7	0.73	Basin Drain
102	5.19	0.90	847	0.24	149.8	1.96	Pump to Mangin Drain
103	3.31	0.90	732	0.22	156.0	1.30	To Turkey Creek
104	4.93	0.90	556	0.19	166.7	2.07	Pump to Lennon Drain
105	2.61	0.90	529	0.18	168.5	1.11	To Cahill Drain
106	5.30	0.90	969	0.26	143.7	1.92	Pump to Cahill Drain
107	7.06	0.90	998	0.27	142.3	2.53	Pump to Wolfe Drain

Project: **Detroit River International Crossing Study**
Design Storm: **100-year**
Rainfall Data: **MTO District I Chatham**
Rainfall Intensity Coefficients: Inlet Time (t_i)= 5 min
A: **2824.505** Average Velocity = 1.5 m/s
B: **13.74**
C: **0.88**

Rational Method Calculation
Proposed Conidtion
Alternative 2B

Drainage ID	Drainage Area (ha)	Run-off Coefficient C	Travelled Distance d (m)	Time of Concentration $Tc = t_i + t_d$ (hr)	Rainfall Intensity I (mm/h)	100-year Peak Flow (m^3/s)	Remarks
100	6.36	0.90	880	0.25	148.1	2.37	Drain to TTcombe Drain
101	2.13	0.90	482	0.17	171.7	0.92	Basin Drain
102	6.54	0.90	884	0.25	147.9	2.44	Pump to Mangin Drain
103	7.21	0.90	1453	0.35	124.0	2.25	Pump to Turkey Creek
104	2.34	0.90	421	0.16	176.1	1.04	Pump to Lennon Drain
105	5.77	0.90	1377	0.34	126.7	1.84	Pump to Cahill Drain
106	9.32	0.90	1023	0.27	141.2	3.32	Pump to Wolfe Drain

STORM SEWER CALCULATIONS
FOR
Detroit River International Crossing Study
Alternative 2B - Revised Profiles

Designed by Kevin Chen

Date: 11/16/06
File : 33015384

LOCATION	FROM MH	TO MH	CATCHMENT AREA NUMBERS	CATCHMENT CHARACTERISTICS A (ha)	C	"AC"	ACCUM. "AC"	CONCENTRATION TIME (min) INLET	IN PIPE	TOTAL	CATCHMENT RUNOFF "I" (mm/hr)	"Q" (m3/s)	PIPE CHARACTERISTICS LENGTH (m)	DIAMETER (mm)	SLOPE (%)	CAPACITY (m3/s)	VELOCITY (m/s)
To 2BR - P1	1	2	1	0.310	0.90	0.28	0.28	5.00	1.26	6.26	214.24	0.166	90.00	600	0.30	0.336	1.19
	2	3	2	0.320	0.90	0.29	0.57	6.26	1.26	7.52	202.31	0.318	90.00	600	0.30	0.336	1.19
	3	4	3	0.320	0.90	0.29	0.86	7.52	1.04	8.56	191.71	0.454	90.00	800	0.30	0.724	1.44
	4	5	4	0.580	0.90	0.52	1.38	8.56	1.04	9.60	183.81	0.701	90.00	800	0.30	0.724	1.44
	5	6	5	0.610	0.90	0.55	1.93	9.60	0.90	10.50	176.58	0.942	90.00	1000	0.30	1.313	1.67
	6	7	6	0.320	0.90	0.29	2.21	10.50	0.90	11.40	170.82	1.048	90.00	1000	0.30	1.313	1.67
	7	8	7	0.320	0.90	0.29	2.50	11.40	0.90	12.30	165.44	1.147	90.00	1000	0.30	1.313	1.67
	8	9	8	0.320	0.90	0.29	2.79	12.30	0.38	12.67	160.41	1.240	90.00	1000	1.70	3.126	3.98
	9	10	9	0.310	0.90	0.28	3.07	12.67	0.38	13.05	158.40	1.347	90.00	1000	1.70	3.126	3.98
	10	11	10	0.310	0.90	0.28	3.35	13.05	0.38	13.43	156.44	1.451	90.00	1000	1.70	3.126	3.98
	11	12	11	1.080	0.90	0.97	4.32	13.43	0.38	13.80	154.52	1.849	90.00	1000	1.70	3.126	3.98
	12	13	12	0.320	0.90	0.29	4.61	13.80	0.62	14.42	152.66	1.949	90.00	1200	0.50	2.757	2.44
	13	14	13	0.320	0.90	0.29	4.90	14.42	0.62	15.03	149.72	2.031	90.00	1200	0.50	2.757	2.44
	14	15	14	0.320	0.90	0.29	5.18	15.03	0.62	15.65	146.90	2.109	90.00	1200	0.50	2.757	2.44
	15	16	15	0.720	0.90	0.65	5.83	15.65	0.62	16.26	144.19	2.329	90.00	1200	0.50	2.757	2.44
	16	17	16	0.320	0.90	0.29	6.12	16.26	0.62	16.88	141.59	2.400	90.00	1200	0.50	2.757	2.44
	17	18	17	0.320	0.90	0.29	6.41	16.88	0.62	17.50	139.08	2.469	90.00	1200	0.50	2.757	2.44
	18	19	18	0.320	0.90	0.29	6.70	17.50	0.62	18.11	136.66	2.535	90.00	1200	0.50	2.757	2.44
	19	20	19	0.310	0.90	0.28	6.98	18.11	0.62	18.73	134.34	2.596	90.00	1200	0.50	2.757	2.44
	20	21	20	0.320	0.90	0.29	7.26	18.73	0.68	19.41	132.09	2.658	90.00	1500	0.30	3.872	2.19
	21	22	21	0.320	0.90	0.29	7.55	19.41	0.68	20.10	129.69	2.713	90.00	1500	0.30	3.872	2.19
	22	23	22	0.320	0.90	0.29	7.84	20.10	0.68	20.78	127.38	2.766	90.00	1500	0.30	3.872	2.19
	23	24	23	0.320	0.90	0.29	8.13	20.78	0.68	21.46	125.15	2.817	90.00	1500	0.30	3.872	2.19
	24	25	24	0.320	0.90	0.29	8.42	21.46	0.68	22.15	123.01	2.867	90.00	1500	0.30	3.872	2.19
	25	26	25	0.320	0.90	0.29	8.70	22.15	0.68	22.83	120.94	2.916	90.00	1500	0.30	3.872	2.19
	26	27	26	0.320	0.90	0.29	8.99	22.83	0.68	23.52	118.95	2.962	90.00	1500	0.30	3.872	2.19
	27	28	27	0.320	0.90	0.29	9.28	23.52	0.68	24.20	117.02	3.008	90.00	1500	0.30	3.872	2.19
	28	29	28	0.320	0.90	0.29	9.57	24.20	0.68	24.89	115.16	3.052	90.00	1500	0.30	3.872	2.19
	29	30	29	0.320	0.90	0.29	9.86	24.89	0.68	25.57	113.36	3.095	90.00	1500	0.30	3.872	2.19
	30	31	30	0.320	0.90	0.29	10.14	25.57	0.68	26.26	111.62	3.136	90.00	1500	0.30	3.872	2.19
	31	32	31	0.310	0.90	0.28	10.42	26.26	0.68	26.94	109.94	3.174	90.00	1500	0.30	3.872	2.19
	32	33	32	0.310	0.90	0.28	10.70	26.94	0.68	27.63	108.31	3.211	90.00	1500	0.30	3.872	2.19
	33	34	33	0.320	0.90	0.29	10.99	27.63	0.68	28.31	106.73	3.249	90.00	1500	0.30	3.872	2.19
	34	35	34	0.320	0.90	0.29	11.28	28.31	0.68	29.00	105.20	3.286	90.00	1500	0.30	3.872	2.19
	35	36	35	0.320	0.90	0.29	11.57	29.00	0.68	29.68	103.72	3.323	90.00	1500	0.30	3.872	2.19
	36	37	36	0.320	0.90	0.29	11.85	29.68	0.68	30.36	102.28	3.358	90.00	1500	0.30	3.872	2.19
			Sub Total	13.170									3240.00				
	50	49	50	0.490	0.90	[illegible]	0.44	5.00	1.26	6.26	214.24	0.262	90.00	600	0.30	0.336	1.19
	49	48	49	0.320	0.90	[illegible]	0.73	6.26	1.04	7.30	202.31	0.409	90.00	800	0.30	0.724	1.44
	48	47	48	0.320	0.90	[illegible]	1.02	7.30	1.04	8.34	193.47	0.545	90.00	800	0.30	0.724	1.44
	47	46	47	0.320	0.90	[illegible]	2.76	8.34	0.79	9.14	185.43	1.419	90.00	1200	0.30	2.135	1.89
	46	45	46	0.320	0.90	[illegible]	3.05	9.14	0.79	9.93	179.75	1.519	90.00	1200	0.30	2.135	1.89
	45	44	45	0.320	0.90	[illegible]	3.34	9.93	0.79	10.73	174.43	1.613	90.00	1200	0.30	2.135	1.89
	44	43	44	0.320	0.90	[illegible]	3.63	10.73	0.79	11.52	169.43	1.702	90.00	1200	0.30	2.135	1.89

Designed by Kevin Chen

S ORM SEWER CALCULATIONS
FOR
Detroit F iver International Crossing Stud
lternative 2B - Revised Profiles

Date: 11/16/06
File : 33015384

LOCATION	FROM MH	TO MH	CATCHMENT AREA NUMBERS	CATCHMENT CHARACTERISTICS A (ha)	C	"AC"	ACCUM. "AC"	CONCENTRATION TIME (min) INLET	IN PIPE	TOTAL	CATCHMENT RUNOFF "I" (mm/hr)	"Q" (m3/s)	PIPE CHARACTERISTICS LENGTH (m)	DIAMETER (mm)	SLOPE (%)	CAPACITY (m3/s)	VELOCITY (m/s)
	43	42	43	0.320	0.90	0.29	3.92	11.52	0.79	12.32	164.74	1.786	90.00	1200	0.30	2.135	1.89
	42	41	42	0.320	0.90	0.29	4.20	12.32	0.79	13.11	160.31	1.866	90.00	1200	0.30	2.135	1.89
	41	40	41	0.320	0.90	0.29	4.49	13.11	0.79	13.90	156.13	1.942	90.00	1200	0.30	2.135	1.89
	40	39	40	0.320	0.90	0.29	4.78	13.90	0.79	14.70	152.17	2.014	90.00	1200	0.30	2.135	1.89
	39	38	39	0.310	0.90	0.28	5.06	14.70	0.79	15.49	148.42	2.080	90.00	1200	0.30	2.135	1.89
	38	37	38	0.320	0.90	0.29	5.35	15.49	0.68	16.18	144.87	2.145	90.00	1500	0.30	3.872	2.19
			Sub Total	4.320													
	11a	12a	11a	0.140	0.90	0.13	0.13	5.00	0.84	5.84	214.24	0.075	90.00	450	1.00	0.285	1.79
	12a	13a	12a	0.180	0.90	0.16	0.29	5.84	0.84	6.67	206.16	0.164	90.00	450	1.00	0.285	1.79
	13a	47	13a	0.360	0.90	0.32	0.61	6.67	0.69	7.36	198.71	0.337	90.00	600	1.00	0.614	2.17
				0.680													
	14a	15a	14a	0.180	0.90	0.16	0.16	5.00	0.84	5.84	214.24	0.096	90.00	450	1.00	0.285	1.79
	15a	16a	15a	0.180	0.90	0.16	0.32	5.84	0.84	6.67	206.16	0.185	90.00	450	1.00	0.285	1.79
	16a	17a	16a	0.180	0.90	0.16	0.49	6.67	0.84	7.51	198.71	0.268	90.00	450	1.00	0.285	1.79
	17a	47	17a	0.400	0.90	0.36	0.85	7.51	0.69	8.20	191.81	0.449	90.00	600	1.00	0.614	2.17
				0.940													
	37	MH POND		0.320	0.90	0.29	17.49	30.36	0.53	30.89	100.89	4.887	90.00	1500	0.50	4.998	2.83
			Drainage Area	19.43							Peak Flow	4.887					
To 2BR - P2	51	52	51	0.320	0.90	0.29	0.29	5.00	1.18	6.18	214.24	0.171	90.00	450	0.50	0.202	1.27
	52	53	52	0.320	0.90	0.29	0.58	6.18	0.98	7.16	203.00	0.324	90.00	600	0.50	0.434	1.54
	53	54	53	0.310	0.90	0.28	0.86	7.16	0.81	7.97	194.63	0.461	90.00	800	0.50	0.935	1.86
	63	62	63	0.340	0.90	0.31	0.31	5.00	0.88	5.88	214.24	0.182	90.00	450	0.90	0.270	1.70
	62	61	62	0.320	0.90	0.29	0.59	5.88	0.73	6.61	205.74	0.339	90.00	600	0.90	0.583	2.06
	61	60	61	0.320	0.90	0.29	0.88	6.61	0.60	7.21	199.25	0.487	90.00	800	0.90	1.254	2.50
	60	59	60	0.320	0.90	0.29	1.17	7.21	0.74	7.95	194.21	0.629	90.00	800	0.60	1.024	2.04
	59	58	59	0.310	0.90	0.28	1.45	11.00	0.74	11.74	167.78	0.673	90.00	800	0.60	1.024	2.04
	58	57	58	0.320	0.90	0.29	1.74	11.74	0.74	12.47	163.51	0.787	90.00	800	0.60	1.024	2.04
	57	56	57	0.320	0.90	0.29	2.03	12.47	0.74	13.21	159.46	0.894	90.00	800	0.60	1.024	2.04
	56	55	56	0.320	0.90	0.29	2.31	13.21	0.74	13.94	155.62	0.997	90.00	800	0.60	1.024	2.04
	55	54	55	0.310	0.90	0.28	2.59	13.94	0.63	14.58	151.98	1.091	90.00	1000	0.60	1.857	2.36
													1080.00				
	1a	2a	1a	0.180	0.90	0.16	0.16	5.00	0.84	5.84	214.24	0.096	90.00	450	1.00	0.285	1.79
	2a	3a	2a	0.180	0.90	0.16	0.32	5.84	0.84	6.67	206.16	0.185	90.00	450	1.00	0.285	1.79
	3a	4a	3a	0.180	0.90	0.16	0.49	6.67	0.84	7.51	198.71	0.268	90.00	450	1.00	0.285	1.79
	4a	5a	4a	0.180	0.90	0.16	0.65	5.00	0.69	5.69	214.24	0.385	90.00	600	1.00	0.614	2.17
	5a	6a	5a	0.180	0.90	0.16	0.81	5.69	0.69	6.38	207.53	0.466	90.00	600	1.00	0.614	2.17
	6a	58	6a	0.200	0.90	0.18	0.99	6.38	0.69	7.07	201.24	0.552	90.00	600	1.00	0.614	2.17
	7a	8a	7a	0.180	0.90	0.16	0.16	5.00	0.84	5.84	214.24	0.096	90.00	450	1.00	0.285	1.79
	8a	9a	8a	0.180	0.90	0.16	0.32	5.84	0.84	6.67	206.16	0.185	90.00	450	1.00	0.285	1.79
	9a	10a	9a	0.180	0.90	0.16	0.49	6.67	0.84	7.51	198.71	0.268	90.00	450	1.00	0.285	1.79
	10a	58	10a	0.190	0.90	0.17	0.66	5.00	0.69	5.69	214.24	0.390	90.00	600	1.00	0.614	2.17

Designed by Kevin Chen

S' ORM SEWER CALCULATIONS
FOR
Detroit F iver International Crossing Stud)
\lternative 2B - Revised Profiles

Date: 11/16/06
File : 33015384

LOCATION	FROM MH	TO MH	CATCHMENT AREA NUMBERS	CATC IMENT CHARAC ERISTICS A (ha)	C	"AC"	ACCUM. "AC"	CONCENTRATION TIME (min) INLET	IN PIPE	TOTAL	CATCHMENT RUNOFF "I" (mm/hr)	"Q" (m3/s)	PIPE CHARACTERISTICS LENGTH (m)	DIAMETER (mm)	SLOPE (%)	CAPACITY (m3/s)	VELOCITY (m/s)
	54	MH POND	54	0.560	0.90	0.50	5.60	14.68	0.49	15.17	148.51	2.303	90.00	1000	1.00	2.398	3.05
			Drainage Area	6.220							Peak Flow	2.303					
To 2BR - P3	64	65	64	0.320	0.90	0.29	0.29	5.00	0.59	5.59	214.24	0.171	90.00	450	2.00	0.403	2.54
	65	66	65	0.320	0.90	0.29	0.58	5.59	0.49	6.08	208.46	0.333	90.00	600	2.00	0.868	3.07
	66	67	66	0.320	0.90	0.29	0.86	6.08	0.40	6.48	203.93	0.488	90.00	800	2.00	1.870	3.72
	67	68	67	0.350	0.90	0.32	1.18	6.48	1.04	7.52	200.35	0.654	90.00	800	0.30	0.724	1.44
	68	69	68	0.280	0.90	0.25	1.43	7.52	0.90	8.42	191.69	0.760	90.00	1000	0.30	1.313	1.67
	69	70	69	1.090	0.90	0.98	2.41	8.42	0.90	9.32	184.85	1.235	90.00	1000	0.30	1.313	1.67
	70	71	70	0.310	0.90	0.28	2.69	9.32	0.79	10.11	178.51	1.331	90.00	1200	0.30	2.135	1.89
	71	72	71	0.890	0.90	0.80	3.49	10.11	0.79	10.91	173.26	1.676	90.00	1200	0.30	2.135	1.89
	73	74	73	0.330	0.90	0.30	3.79	10.91	0.79	11.70	168.34	1.767	90.00	1200	0.30	2.135	1.89
	74	75	74	0.310	0.90	0.28	4.07	11.70	0.79	12.50	163.70	1.845	90.00	1200	0.30	2.135	1.89
	75	76	75	0.320	0.90	0.29	4.36	12.50	0.79	13.29	159.33	1.923	90.00	1200	0.30	2.135	1.89
	76	77	76	0.310	0.90	0.28	4.64	13.29	0.79	14.09	155.21	1.993	90.00	1200	0.30	2.135	1.89
	77	78	77	0.310	0.90	0.28	4.91	14.09	0.79	14.88	151.30	2.059	90.00	1200	0.30	2.135	1.89
	78	79	78	0.310	0.90	0.28	5.19	14.88	0.79	15.67	147.60	2.123	90.00	1200	0.30	2.135	1.89
													1260.00				
	87	86	87	0.240	0.90	0.22	0.22	5.00	1.18	6.18	214.24	0.128	90.00	450	0.50	0.202	1.27
	86	85	86	0.310	0.90	0.28	0.50	6.18	0.40	6.58	203.00	0.278	90.00	600	3.00	1.063	3.76
	85	84	85	0.320	0.90	0.29	0.78	6.58	0.33	6.91	199.49	0.433	90.00	800	3.00	2.290	4.56
	84	83	84	0.310	0.90	0.28	1.06	6.91	0.33	7.24	196.69	0.579	90.00	800	3.00	2.290	4.56
	83	82	83	0.320	0.90	0.29	1.35	7.24	0.33	7.57	193.97	0.725	90.00	800	3.00	2.290	4.56
	82	81	82	0.320	0.90	0.29	1.64	7.57	0.28	7.85	191.33	0.868	90.00	1000	3.00	4.153	5.29
	81	80	81	0.310	0.90	0.28	1.92	7.85	0.40	8.25	189.12	1.004	90.00	1000	1.50	2.936	3.74
	80	79	80	0.310	0.90	0.28	2.20	8.25	0.40	8.66	186.08	1.132	90.00	1000	1.50	2.936	3.74
	79	MH POND	79	0.460	0.90	0.41	7.80	15.67	0.49	16.16	144.10	3.115	90.00	1200	0.80	3.487	3.08
			Drainage Area	8.670							Peak Flow	3.115					
To 2BR - P4	88	89	88	0.310	0.90	0.28	0.28	5.00	1.18	6.18	214.24	0.166	90.00	450	0.50	0.202	1.27
	89	90	89	0.320	0.90	0.29	0.57	6.18	0.59	6.78	203.00	0.319	90.00	450	2.00	0.403	2.54
	90	91	90	0.310	0.90	0.28	0.85	6.78	0.49	7.26	197.84	0.464	90.00	600	2.00	0.868	3.07
	91	92	91	0.330	0.90	0.30	1.14	7.26	0.49	7.75	193.79	0.614	90.00	600	2.00	0.868	3.07
	92	93	92	0.320	0.90	0.29	1.43	7.75	0.90	8.65	189.91	0.753	90.00	1000	0.30	1.313	1.67
	93	94	93	0.320	0.90	0.29	1.72	8.65	0.90	9.55	183.19	0.872	90.00	1000	0.30	1.313	1.67
	94	95	94	0.320	0.90	0.29	2.01	9.55	0.90	10.44	176.97	0.984	90.00	1000	0.30	1.313	1.67
	95	96	95	0.330	0.90	0.30	2.30	10.44	0.90	11.34	171.18	1.092	90.00	1000	0.30	1.313	1.67
													720.00				
	105	104	105	0.170	0.90	0.15	0.15	5.00	1.18	6.18	214.24	0.091	90.00	450	0.50	0.202	1.27
	104	103	104	0.320	0.90	0.29	0.44	6.18	0.98	7.16	203.00	0.248	90.00	600	0.50	0.434	1.54
	103	102	103	0.320	0.90	0.29	0.73	7.16	0.98	8.14	194.63	0.393	90.00	600	0.50	0.434	1.54
	102	101	102	0.320	0.90	0.29	1.02	8.14	0.81	8.94	186.96	0.527	90.00	800	0.50	0.935	1.86
	101	100	101	0.320	0.90	0.29	1.31	8.94	0.81	9.75	181.10	0.655	90.00	800	0.50	0.935	1.86
	100	99	100	0.320	0.90	0.29	1.59	9.75	0.81	10.56	175.62	0.775	90.00	800	0.50	0.935	1.86

S' ORM SEWER CALCULATIONS

FOR

Detroit F iver International Crossing Stud

\lternative 2B - Revised Profiles

Designed by Kevin Chen

Date: 11/16/06
File : 33015384

LOCATION	FROM	TO	CATCHMENT	CATC IMENT CHARAC ERISTICS				CONCENTRATION TIME (min)			CATCHMENT RUNOFF		PIPE CHARACTERISTICS				
	MH	MH	AREA NUMBERS	A (ha)	C	"AC"	ACCUM. "AC"	INLET	IN PIPE	TOTAL	"I" (mm/hr)	"Q" (m3/s)	LENGTH (m)	DIAMETER (mm)	SLOPE (%)	CAPACITY (m3/s)	VELOCITY (m/s)
	99	98	99	0.320	0.90	0.29	1.88	10.56	0.40	10.96	170.48	0.888	90.00	800	2.00	1.870	3.72
	98	97	98	0.320	0.90	0.29	2.17	11.00	0.40	11.40	167.78	1.008	90.00	800	2.00	1.870	3.72
	97	96	97	0.310	0.90	0.28	2.45	11.40	0.90	12.30	165.41	1.122	90.00	1000	0.30	1.313	1.67
													810.00				
	96	MH POND	96	1.080	0.90	0.97	5.72	12.30	0.62	12.92	160.39	2.543	90.00	1200	0.50	2.757	2.44
			Drainage Area	6.360							Peak Flow	2.543					

DESIGN PARAMETERS:

I = a/(t+b)^c

100 Year Storm Parameters

a = 2824.51

b = 13.7400

c= 0.8800

manning's 0.0130

Min. veloc 0.8000 m/s

Max. velo 6.0000 m/s

Project: **Detroit River International Crossing Study**
Design Storm: **100-year**
Rainfall Data: **MTO District I Chatham**
Rainfall Intensity Coefficients: Inlet Time (t_i)= 5 min
A: **2824.505** Average Velocity = 1.5 m/s
B: **13.74**
C: **0.88**

Rational Method Calculation
Proposed Conidtion
Alternative 3

Drainage ID	Drainage Area (ha)	Run-off Coefficient C	Travelled Distance d (m)	Time of Concentration $Tc = t_i + t_d$ (hr)	Rainfall Intensity I (mm/h)	100-year Peak Flow (m3/s)	Remarks
100	6.36	0.90	850	0.24	149.6	2.40	To TTcombe Drain
101	2.80	0.90	798	0.23	152.4	1.08	Pump to Basin Drain
102	0.34	0.90	342	0.15	182.1	0.16	Pump to Turkey Creek
103	0.34	0.90	342	0.15	182.1	0.16	Pump to Turkey Creek
104	0.14	0.90	140	0.11	199.7	0.07	Pump to Cahill Drain
105	0.19	0.90	194	0.12	194.7	0.10	Pump to Cahill Drain
106	0.17	0.90	174	0.12	196.5	0.09	Pump to Cahill Drain
107	0.19	0.90	191	0.12	194.9	0.09	Pump to Cahill Drain
108	2.16	0.90	774	0.23	153.7	0.84	Pump to Wolfe Drain
109	6.56	0.90	1737	0.41	114.9	1.90	To Wolfe Drain

Appendix C

Stormwater Management Computations

Appendix C.1

Alternative 1A

Modified Rational Method

Project Name : **Detroit River International Crossing** November 14, 2006 9:58 AM

Stormwater Management Study

Alternative 1A

	100	
Area =	6.36	ha
"C" =	0.9	
AC=	5.724	
Tc =	14.4	min
Time Increment =	10.0	min
Release Rate =	367.1	l/s
Max.Storage =	2376	m^3

Controlled Condition

100 Year - Post Dev't.	
a=	2825
b=	13.74
c=	0.880

Constant Inflows

	l/s

100						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
14.4	149.6	2380.56	2063.1	318.1	1745.0	
24.4	114.5	1822.33	2672.7	538.4	2134.3	
34.4	93.3	1485.01	3069.0	758.7	2310.4	
44.4	79.1	1257.93	3354.5	978.9	2375.6	<<<<
54.4	68.8	1094.07	3574.0	1199.2	2374.8	
64.4	61.0	969.93	3750.4	1419.4	2331.0	
74.4	54.8	872.45	3897.0	1639.7	2257.3	
84.4	49.9	793.76	4021.7	1859.9	2161.8	
94.4	45.8	728.82	4130.0	2080.2	2049.8	
104.4	42.4	674.27	4225.4	2300.5	1925.0	
114.4	39.5	627.76	4310.6	2520.7	1789.9	
124.4	36.9	587.60	4387.4	2741.0	1646.5	
134.4	34.7	552.56	4457.3	2961.2	1496.1	
144.4	32.8	521.70	4521.4	3181.5	1339.9	
154.4	31.1	494.31	4580.6	3401.7	1178.8	
164.4	29.5	469.81	4635.4	3622.0	1013.5	
174.4	28.1	447.77	4686.6	3842.2	844.4	
184.4	26.9	427.82	4734.6	4062.5	672.1	
194.4	25.7	409.69	4779.7	4282.8	496.9	
204.4	24.7	393.12	4822.2	4503.0	319.2	
214.4	23.7	377.92	4862.5	4723.3	139.3	
224.4	22.9	363.92	4900.8	4943.5	-42.8	
234.4	22.1	350.98	4937.2	5163.8	-226.6	
244.4	21.3	338.99	4971.9	5384.0	-412.2	

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Modified Rational Method

Project Name : **Detroit River International Crossing** November 14, 2006 9:58 AM

Stormwater Management Study

Alternative 1A

	101	
Area =	2.53	ha
"C" =	0.9	
AC=	2.277	
Tc =	13.1	min
Time Increment =	10.0	min
Release Rate =	156.9	l/s
Max.Storage =	915	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.	
a=	2825
b=	13.74
c=	0.880

101						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
13.1	155.9	987.16	778.5	123.8	654.8	
23.1	118.1	747.36	1037.8	217.9	819.9	
33.1	95.6	605.12	1203.4	312.1	891.3	
43.1	80.6	510.45	1321.4	406.3	915.1	<<<<
53.1	69.9	442.65	1411.5	500.4	911.0	
63.1	61.9	391.57	1483.5	594.6	888.9	
73.1	55.5	351.63	1543.2	688.8	854.4	
83.1	50.5	319.48	1593.8	783.0	810.8	
93.1	46.3	293.03	1637.6	877.1	760.5	
103.1	42.8	270.85	1676.2	971.3	704.9	
113.1	39.8	251.97	1710.5	1065.5	645.1	
123.1	37.2	235.70	1741.5	1159.6	581.9	
133.1	35.0	221.52	1769.6	1253.8	515.9	
143.1	33.0	209.05	1795.4	1348.0	447.5	
153.1	31.3	197.98	1819.2	1442.1	377.1	
163.1	29.7	188.10	1841.2	1536.3	304.9	
173.1	28.3	179.21	1861.8	1630.5	231.3	
183.1	27.0	171.18	1881.0	1724.6	156.4	
193.1	25.9	163.87	1899.1	1818.8	80.3	
203.1	24.8	157.21	1916.1	1913.0	3.2	
213.1	23.9	151.09	1932.3	2007.1	-74.9	
223.1	23.0	145.46	1947.6	2101.3	-153.7	
233.1	22.2	140.27	1962.1	2195.5	-233.3	
243.1	21.4	135.45	1976.0	2289.6	-313.6	

Modified Rational Method

Project Name : **Detroit River International Crossing** November 14, 2006 9:58 AM

Stormwater Management Study

Alternative 1A

	102	
Area =	5.60	ha
"C" =	0.9	
AC=	5.04	
Tc =	14.3	min
Time Increment =	10.0	min
Release Rate =	675.0	l/s
Max.Storage =	1363	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.	
a=	2825
b=	13.74
c=	0.880

102						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
14.3	150.5	2108.53	1803.5	577.4	1226.1	
24.3	115.0	1611.58	2345.4	982.4	1363.0	<<<<
34.3	93.6	1312.08	2696.8	1387.4	1309.3	
44.3	79.3	1110.79	2949.5	1792.4	1157.1	
54.3	68.9	965.68	3143.6	2197.5	946.2	
64.3	61.1	855.85	3299.6	2602.5	697.1	
74.3	54.9	769.65	3429.0	3007.5	421.5	
84.3	50.0	700.09	3539.2	3412.5	126.7	
94.3	45.9	642.72	3634.8	3817.6	-182.8	
104.3	42.4	594.53	3719.0	4222.6	-503.6	
114.3	39.5	553.46	3794.2	4627.6	-833.4	
124.3	37.0	518.01	3861.9	5032.6	-1170.7	
134.3	34.8	487.08	3923.6	5437.6	-1514.1	
144.3	32.8	459.84	3980.1	5842.7	-1862.6	
154.3	31.1	435.67	4032.3	6247.7	-2215.4	
164.3	29.6	414.05	4080.6	6652.7	-2572.1	
174.3	28.2	394.61	4125.8	7057.7	-2931.9	
184.3	26.9	377.02	4168.0	7462.7	-3294.7	
194.3	25.8	361.02	4207.8	7867.8	-3660.0	
204.3	24.7	346.40	4245.3	8272.8	-4027.5	
214.3	23.8	333.00	4280.8	8677.8	-4397.0	
224.3	22.9	320.65	4314.5	9082.8	-4768.3	
234.3	22.1	309.25	4346.6	9487.9	-5141.3	
244.3	21.3	298.68	4377.2	9892.9	-5515.7	

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Modified Rational Method

Project Name : **Detroit River International Crossing** November 14, 2006 9:58 AM

Stormwater Management Study

Alternative 1A

	103	
Area =	**2.60**	ha
"C" =	**0.9**	
AC=	**2.34**	
Tc =	**13.3**	min
Time Increment =	**10.0**	min
Release Rate =	**159.9**	l/s
Max.Storage =	**944**	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.

a=	**2825**
b=	**13.74**
c=	**0.880**

103						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
13.3	155.2	1009.34	805.5	127.6	677.8	
23.3	117.6	765.20	1069.7	223.6	846.2	
33.3	95.3	620.06	1238.9	319.5	919.3	
43.3	80.4	523.32	1359.6	415.5	944.1	<<<<
53.3	69.8	453.97	1451.8	511.4	940.4	
63.3	61.7	401.69	1525.6	607.4	918.2	
73.3	55.5	360.79	1586.7	703.3	883.4	
83.3	50.4	327.86	1638.6	799.3	839.3	
93.3	46.2	300.75	1683.6	895.3	788.3	
103.3	42.7	278.02	1723.1	991.2	731.9	
113.3	39.8	258.66	1758.4	1087.2	671.2	
123.3	37.2	241.98	1790.2	1183.1	607.0	
133.3	35.0	227.44	1819.0	1279.1	540.0	
143.3	33.0	214.64	1845.5	1375.0	470.5	
153.3	31.3	203.29	1869.9	1471.0	398.9	
163.3	29.7	193.15	1892.5	1566.9	325.6	
173.3	28.3	184.04	1913.6	1662.9	250.7	
183.3	27.0	175.79	1933.3	1758.9	174.5	
193.3	25.9	168.30	1951.9	1854.8	97.1	
203.3	24.8	161.45	1969.4	1950.8	18.7	
213.3	23.9	155.18	1986.0	2046.7	-60.7	
223.3	23.0	149.40	2001.7	2142.7	-141.0	
233.3	22.1	144.07	2016.7	2238.6	-222.0	
243.3	21.4	139.12	2030.9	2334.6	-303.6	

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Modified Rational Method

Project Name : **Detroit River International Crossing** November 14, 2006 9:58 AM

Stormwater Management Study

Alternative 1A

	104	
Area =	**2.50**	ha
"C" =	**0.9**	
AC=	**2.25**	
Tc =	**8.9**	min
Time Increment =	**10.0**	min
Release Rate =	**207.9**	l/s
Max.Storage =	**775**	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.	
a=	**2825**
b=	**13.74**
c=	**0.880**

104						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
8.9	181.2	1133.71	606.9	111.3	495.6	
18.9	131.4	821.88	933.1	236.1	697.0	
28.9	103.9	649.73	1127.5	360.8	766.7	
38.9	86.3	539.82	1260.7	485.6	775.1	<<<<
48.9	74.1	463.24	1359.8	610.3	749.4	
58.9	65.0	406.65	1437.6	735.1	702.6	
68.9	58.0	363.03	1501.2	859.8	641.4	
78.9	52.5	328.32	1554.7	984.6	570.1	
88.9	48.0	300.00	1600.6	1109.3	491.3	
98.9	44.2	276.44	1640.8	1234.1	406.7	
108.9	41.0	256.51	1676.4	1358.9	317.5	
118.9	38.3	239.42	1708.3	1483.6	224.7	
128.9	35.9	224.58	1737.2	1608.4	128.9	
138.9	33.8	211.59	1763.6	1733.1	30.5	
148.9	32.0	200.10	1787.9	1857.9	-69.9	
158.9	30.4	189.86	1810.4	1982.6	-172.2	
168.9	28.9	180.68	1831.3	2107.4	-276.1	
178.9	27.6	172.40	1850.8	2232.1	-381.3	
188.9	26.4	164.90	1869.1	2356.9	-487.7	
198.9	25.3	158.05	1886.4	2481.6	-595.2	
208.9	24.3	151.79	1902.7	2606.4	-703.7	
218.9	23.3	146.03	1918.2	2731.1	-813.0	
228.9	22.5	140.72	1932.9	2855.9	-923.0	
238.9	21.7	135.81	1946.9	2980.7	-1033.8	

Modified Rational Method

Project Name : **Detroit River International Crossing** November 14, 2006 9:58 AM

Stormwater Management Study

Alternative 1A

	105	
Area =	**2.50**	ha
"C" =	**0.9**	
AC=	**2.25**	
Tc =	**10.9**	min
Time Increment =	**10.0**	min
Release Rate =	**177.6**	l/s
Max.Storage =	**847**	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.

a=	**2825**
b=	**13.74**
c=	**0.880**

105						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
10.9	168.2	1052.40	689.7	116.4	573.3	
20.9	124.7	780.00	979.2	222.9	756.3	
30.9	99.8	624.05	1157.8	329.4	828.4	
40.9	83.5	522.40	1282.7	436.0	846.7	<<<<
50.9	72.0	450.61	1376.8	542.5	834.3	
60.9	63.5	397.05	1451.3	649.0	802.3	
70.9	56.8	355.47	1512.6	755.6	757.1	
80.9	51.5	322.21	1564.4	862.1	702.3	
90.9	47.2	294.95	1609.1	968.6	640.4	
100.9	43.5	272.19	1648.2	1075.2	573.1	
110.9	40.4	252.88	1683.0	1181.7	501.3	
120.9	37.8	236.28	1714.3	1288.2	426.1	
130.9	35.5	221.85	1742.7	1394.8	347.9	
140.9	33.4	209.18	1768.7	1501.3	267.3	
150.9	31.6	197.96	1792.6	1607.8	184.7	
160.9	30.0	187.95	1814.7	1714.4	100.3	
170.9	28.6	178.96	1835.3	1820.9	14.4	
180.9	27.3	170.84	1854.6	1927.4	-72.9	
190.9	26.1	163.48	1872.7	2034.0	-161.3	
200.9	25.1	156.76	1889.7	2140.5	-250.8	
210.9	24.1	150.60	1905.9	2247.0	-341.2	
220.9	23.2	144.94	1921.2	2353.6	-432.4	
230.9	22.3	139.71	1935.7	2460.1	-524.4	
240.9	21.6	134.87	1949.6	2566.6	-617.0	

Modified Rational Method

Project Name : **Detroit River International Crossing** November 14, 2006 9:58 AM

Stormwater Management Study

Alternative 1A

	106	
Area =	**5.60**	ha
"C" =	**0.9**	
AC=	**5.04**	
Tc =	**13.5**	min
Time Increment =	**10.0**	min
Release Rate =	**338.5**	l/s
Max.Storage =	**2049**	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.	
a=	**2825**
b=	**13.74**
c=	**0.880**

106						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
13.5	154.0	2158.36	1751.1	274.6	1476.5	
23.5	117.0	1639.46	2313.8	477.7	1836.1	
33.5	94.9	1329.98	2675.0	680.8	1994.2	
43.5	80.2	1123.29	2933.3	883.9	2049.4	<<<<
53.5	69.6	974.94	3130.9	1087.0	2043.8	
63.5	61.6	862.99	3289.1	1290.1	1999.0	
73.5	55.3	775.34	3420.3	1493.2	1927.0	
83.5	50.3	704.74	3531.7	1696.3	1835.3	
93.5	46.1	646.58	3628.2	1899.4	1728.8	
103.5	42.7	597.80	3713.2	2102.5	1610.6	
113.5	39.7	556.27	3788.9	2305.6	1483.3	
123.5	37.1	520.44	3857.2	2508.7	1348.4	
133.5	34.9	489.21	3919.2	2711.8	1207.4	
143.5	33.0	461.73	3976.1	2914.9	1061.2	
153.5	31.2	437.35	4028.6	3118.0	910.5	
163.5	29.7	415.56	4077.2	3321.1	756.1	
173.5	28.3	395.97	4122.6	3524.2	598.3	
183.5	27.0	378.25	4165.0	3727.3	437.7	
193.5	25.8	362.14	4205.0	3930.4	274.5	
203.5	24.8	347.43	4242.6	4133.5	109.1	
213.5	23.8	333.94	4278.3	4336.6	-58.4	
223.5	22.9	321.53	4312.1	4539.7	-227.6	
233.5	22.1	310.06	4344.3	4742.8	-398.6	
243.5	21.4	299.42	4375.0	4945.9	-571.0	

Modified Rational Method

Project Name : **Detroit River International Crossing** November 14, 2006 9:58 AM
Stormwater Management Study
Alternative 1A

	107	
Area =	3.10	ha
"C" =	0.9	
AC=	2.79	
Tc =	14.8	min
Time Increment =	10.0	min
Release Rate =	176.9	l/s
Max.Storage =	1164	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.	
a=	2825
b=	13.74
c=	0.880

107						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
14.8	148.0	1148.00	1018.7	157.0	861.7	
24.8	113.6	881.25	1310.7	263.1	1047.6	
34.8	92.7	719.30	1501.4	369.2	1132.2	
44.8	78.6	609.97	1639.2	475.3	1163.8	<<<<
54.8	68.5	530.91	1745.3	581.5	1163.8	
64.8	60.7	470.94	1830.7	687.6	1143.1	
74.8	54.6	423.80	1901.7	793.7	1108.0	
84.8	49.7	385.71	1962.2	899.9	1062.3	
94.8	45.7	354.25	2014.7	1006.0	1008.7	
104.8	42.3	327.81	2061.1	1112.1	948.9	
114.8	39.4	305.26	2102.4	1218.3	884.2	
124.8	36.8	285.78	2139.7	1324.4	815.4	
134.8	34.7	268.78	2173.7	1430.5	743.2	
144.8	32.7	253.80	2204.9	1536.7	668.2	
154.8	31.0	240.50	2233.6	1642.8	590.8	
164.8	29.5	228.61	2260.3	1748.9	511.4	
174.8	28.1	217.90	2285.2	1855.1	430.1	
184.8	26.8	208.21	2308.5	1961.2	347.3	
194.8	25.7	199.40	2330.5	2067.3	263.1	
204.8	24.7	191.35	2351.2	2173.4	177.7	
214.8	23.7	183.96	2370.8	2279.6	91.2	
224.8	22.8	177.16	2389.4	2385.7	3.6	
234.8	22.0	170.87	2407.1	2491.8	-84.8	
244.8	21.3	165.04	2424.0	2598.0	-174.0	

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Modified Rational Method

Project Name : **Detroit River International Crossing** November 14, 2006 9:58 AM

Stormwater Management Study

Alternative 1A

	108	
Area =	**3.96**	ha
"C" =	**0.9**	
AC=	**3.564**	
Tc =	**14.3**	min
Time Increment =	**10.0**	min
Release Rate =	**231.4**	l/s
Max.Storage =	**1471**	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.

a=	**2825**
b=	**13.74**
c=	**0.880**

108						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
14.3	150.4	1490.51	1275.9	198.1	1077.8	
24.3	115.0	1139.33	1658.9	336.9	1321.9	
34.3	93.6	927.64	1907.2	475.8	1431.5	
44.3	79.3	785.35	2085.9	614.6	1471.3	<<<<
54.3	68.9	682.78	2223.1	753.4	1469.7	
64.3	61.1	605.13	2333.4	892.3	1441.1	
74.3	54.9	544.19	2424.9	1031.1	1393.8	
84.3	50.0	495.02	2502.8	1169.9	1332.9	
94.3	45.9	454.45	2570.4	1308.8	1261.6	
104.3	42.4	420.38	2629.9	1447.6	1182.3	
114.3	39.5	391.35	2683.1	1586.5	1096.6	
124.3	37.0	366.28	2731.0	1725.3	1005.7	
134.3	34.8	344.41	2774.6	1864.1	910.4	
144.3	32.8	325.16	2814.5	2003.0	811.6	
154.3	31.1	308.06	2851.4	2141.8	709.6	
164.3	29.6	292.78	2885.6	2280.7	605.0	
174.3	28.2	279.03	2917.5	2419.5	498.1	
184.3	26.9	266.59	2947.4	2558.3	389.1	
194.3	25.8	255.28	2975.5	2697.2	278.4	
204.3	24.7	244.95	3002.1	2836.0	166.1	
214.3	23.8	235.47	3027.2	2974.8	52.3	
224.3	22.9	226.74	3051.0	3113.7	-62.7	
234.3	22.1	218.67	3073.7	3252.5	-178.8	
244.3	21.3	211.20	3095.3	3391.4	-296.0	

Modified Rational Method

Project Name : **Detroit River International Crossing** November 14, 2006 9:58 AM

Stormwater Management Study

Alternative 1A

	109	
Area =	**6.60**	ha
"C" =	**0.9**	
AC=	**5.94**	
Tc =	**24.3**	min
Time Increment =	**10.0**	min
Release Rate =	**270.3**	l/s
Max.Storage =	**2847**	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.	
a=	**2825**
b=	**13.74**
c=	**0.880**

109						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
24.3	114.9	1897.41	2766.4	394.1	2372.3	
34.3	93.6	1545.12	3179.9	556.3	2623.6	
44.3	79.2	1308.26	3477.4	718.5	2758.9	
54.3	68.9	1137.47	3705.9	880.6	2825.3	
64.3	61.1	1008.17	3889.5	1042.8	2846.7	<<<<
74.3	54.9	906.68	4042.0	1205.0	2837.0	
84.3	49.9	824.78	4171.7	1367.2	2804.6	
94.3	45.9	757.21	4284.3	1529.3	2755.0	
104.3	42.4	700.47	4383.5	1691.5	2692.0	
114.3	39.5	652.09	4472.1	1853.7	2618.3	
124.3	37.0	610.34	4551.9	2015.9	2536.0	
134.3	34.8	573.90	4624.5	2178.1	2446.5	
144.3	32.8	541.82	4691.1	2340.2	2350.9	
154.3	31.1	513.35	4752.6	2502.4	2250.1	
164.3	29.5	487.89	4809.6	2664.6	2145.0	
174.3	28.2	464.98	4862.8	2826.8	2036.0	
184.3	26.9	444.25	4912.6	2989.0	1923.6	
194.3	25.8	425.41	4959.4	3151.1	1808.3	
204.3	24.7	408.19	5003.6	3313.3	1690.3	
214.3	23.8	392.40	5045.4	3475.5	1569.9	
224.3	22.9	377.85	5085.1	3637.7	1447.5	
234.3	22.1	364.41	5122.9	3799.9	1323.1	
244.3	21.3	351.96	5159.0	3962.0	1196.9	
254.3	20.6	340.38	5193.4	4124.2	1069.2	

Stormwater Management Pond Area Requirement Calculation Sheet
Alternative 1A

Stormerwater Management Facility No.	**1A-P1**	**1A-P2**	**1A-P3**	**1A-P4**	**1A-P5**	**1A-P6**	**1A-P7**	**1A-P8**	**1A-P9**	**1A-P9**
Drainage ID	**100**	**101**	**102**	**103**	**104**	**105**	**106**	**107**	**108**	**109**
Drainage Area (ha)	6.4	2.5	5.6	2.6	2.5	2.5	5.6	3.1	4.0	6.6
Imperviousness of Drainage Area	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Runoff Volume[1] (25mm Storm) (mm)	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Permanent Pool Volume Required[2] (m^3)	1,336	531	1,176	546	525	525	1,176	651	832	1,386
Extended Detention Volume[3] (m^3)	254	101	224	104	100	100	224	124	158	264
Erosion Control Volume[4], 25mm Storm (m^3)	1,590	633	1,400	650	625	625	1,400	775	990	1,650
Total Extended Detention Vol. Req't[5] (m^3)	**1,590**	**633**	**1,400**	**650**	**625**	**625**	**1,400**	**775**	**990**	**1,650**
Assumed Permanent Pool Depth	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Assumed Quantity Storage Depth	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Designed Slope V :1 H :	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Trial and Error Method Assuming square lot										
Assumed Bottom width	25.00	15.25	22.25	12.00	11.50	11.50	22.25	14.00	17.25	25.00
Volume	1668.75	860.72	1411.97	654.75	625.88	625.88	1411.97	777.75	1003.22	1668.75
Pond Bottom Area Requirement (m^2)	625	233	495	144	132	132	495	196	298	625
Pond Bottom width requirement assuming a square lot	25.00	15.25	22.25	12.00	11.50	11.50	22.25	14.00	17.25	25.00
Pond Area at Normal Water Level	1,600	915	1,388	729	702	702	1,388	841	1,040	1,600
Pond Area Requirement (m^2)	**3,364**	**2,328**	**3,053**	**2,025**	**1,980**	**1,980**	**3,053**	**2,209**	**2,525**	**3,364**
Pond Area Requirement with 10 m buffer (m^2)	**6,084**	**4,658**	**5,663**	**4,225**	**4,160**	**4,160**	**5,663**	**4,489**	**4,935**	**6,084**
Total Quantity Control Volume @ 1.80m depth from NWL =	4,468	2,919	3,996	2,479	2,414	2,414	3,996	2,745	3,209	4,468
Total Quality and Quantity Control Volume =	6,136	3,780	5,408	3,133	3,040	3,040	5,408	3,523	4,212	6,136
Approximate Volume of Excavation =	17,779	12,960	16,318	11,578	11,375	11,375	16,318	12,415	13,866	17,779

Notes:

[1] Based on Imperviousness for the site (25mm * Imperviousness)
[2] Calculated using Table 3.2 Of the MOE 2003 SWM Planning and Design Manual, 85% Imperviousness (250m ^{3}/ha - 40m^3/ha)
[3] Based on 40m^3/ha
[4] Area x Runoff Volume
[5] Greater of Extended Detention or Erosion Control
[6] Average release over 24 hours.

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11/17/2006

Appendix C.2

Alternative 1B

Modified Rational Method

Project Name : **Detroit River International Crossing** November 14, 2006 10:30 AM

Stormwater Management Study

Alternative 1B

	100	
Area =	**6.36**	ha
"C" =	**0.9**	
AC=	**5.724**	
Tc =	**14.8**	min
Time Increment =	**10.0**	min
Release Rate =	**360.5**	l/s
Max.Storage =	**2395**	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.	
a=	**2825**
b=	**13.74**
c=	**0.880**

100						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
14.8	147.8	2352.02	2093.3	320.9	1772.4	
24.8	113.5	1806.15	2691.2	537.2	2154.0	
34.8	92.7	1474.54	3081.8	753.5	2328.3	
44.8	78.6	1250.58	3364.1	969.8	2394.2	
54.8	68.4	1088.60	3581.5	1186.2	2395.4	<<<<
64.8	60.7	965.71	3756.6	1402.5	2354.1	
74.8	54.6	869.08	3902.2	1618.8	2283.4	
84.8	49.7	791.00	4026.2	1835.1	2191.1	
94.8	45.7	726.52	4133.9	2051.4	2082.5	
104.8	42.3	672.32	4228.9	2267.7	1961.2	
114.8	39.3	626.09	4313.7	2484.1	1829.7	
124.8	36.8	586.15	4390.3	2700.4	1689.9	
134.8	34.6	551.29	4459.9	2916.7	1543.2	
144.8	32.7	520.58	4523.8	3133.0	1390.8	
154.8	31.0	493.30	4582.8	3349.3	1233.4	
164.8	29.5	468.91	4637.5	3565.7	1071.8	
174.8	28.1	446.96	4688.6	3782.0	906.6	
184.8	26.8	427.09	4736.4	3998.3	738.1	
194.8	25.7	409.01	4781.4	4214.6	566.8	
204.8	24.7	392.50	4823.8	4430.9	392.9	
214.8	23.7	377.35	4864.0	4647.3	216.8	
224.8	22.8	363.40	4902.2	4863.6	38.6	
234.8	22.0	350.50	4938.5	5079.9	-141.4	
244.8	21.3	338.54	4973.2	5296.2	-323.0	

Modified Rational Method

Project Name : **Detroit River International Crossing** November 14, 2006 10:30 AM

Stormwater Management Study

Alternative 1B

	101	
Area =	2.70	ha
"C" =	0.9	
AC=	2.43	
Tc =	10.2	min
Time Increment =	10.0	min
Release Rate =	201.9	l/s
Max.Storage =	890	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.	
a=	2825
b=	13.74
c=	0.880

101						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
10.2	172.7	1166.71	714.0	123.6	590.5	
20.2	127.0	858.16	1040.1	244.7	795.4	
30.2	101.2	683.72	1238.9	365.8	873.1	
40.2	84.5	570.84	1376.9	486.9	889.9	<<<<
50.2	72.8	491.49	1480.4	608.1	872.3	
60.2	64.0	432.49	1562.2	729.2	833.0	
70.2	57.3	386.81	1629.3	850.3	778.9	
80.2	51.9	350.34	1685.8	971.5	714.4	
90.2	47.4	320.50	1734.5	1092.6	641.9	
100.2	43.8	295.61	1777.2	1213.7	563.5	
110.2	40.6	274.52	1815.1	1334.9	480.2	
120.2	38.0	256.40	1849.1	1456.0	393.1	
130.2	35.6	240.65	1880.0	1577.1	302.9	
140.2	33.6	226.84	1908.2	1698.2	209.9	
150.2	31.8	214.62	1934.2	1819.4	114.8	
160.2	30.2	203.72	1958.2	1940.5	17.7	
170.2	28.7	193.94	1980.6	2061.6	-81.1	
180.2	27.4	185.12	2001.5	2182.8	-181.3	
190.2	26.2	177.11	2021.1	2303.9	-282.8	
200.2	25.1	169.80	2039.6	2425.0	-385.4	
210.2	24.1	163.11	2057.1	2546.2	-489.0	
220.2	23.2	156.96	2073.7	2667.3	-593.6	
230.2	22.4	151.28	2089.5	2788.4	-698.9	
240.2	21.6	146.03	2104.5	2909.6	-805.0	

Modified Rational Method

Project Name : **Detroit River International Crossing** November 14, 2006 10:30 AM

Stormwater Management Study

Alternative 1B

	102	
Area =	5.38	ha
"C" =	0.9	
AC=	4.842	
Tc =	12.4	min
Time Increment =	10.0	min
Release Rate =	344.6	l/s
Max.Storage =	1917	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.	
a=	2825
b=	13.74
c=	0.880

102						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
12.4	159.6	2148.49	1604.2	257.3	1346.9	
22.4	120.1	1616.27	2176.6	464.1	1712.5	
32.4	96.9	1303.93	2538.3	670.9	1867.5	
42.4	81.5	1097.36	2794.6	877.6	1917.0	<<<<
52.4	70.6	950.05	2989.5	1084.4	1905.1	
62.4	62.4	839.40	3145.0	1291.2	1853.8	
72.4	55.9	753.07	3273.3	1498.0	1775.4	
82.4	50.8	683.72	3382.1	1704.7	1677.4	
92.4	46.6	626.73	3476.2	1911.5	1564.7	
102.4	43.0	579.00	3558.9	2118.3	1440.7	
112.4	40.0	538.43	3632.6	2325.1	1307.5	
122.4	37.4	503.48	3698.9	2531.8	1167.1	
132.4	35.1	473.04	3759.1	2738.6	1020.5	
142.4	33.2	446.28	3814.2	2945.4	868.9	
152.4	31.4	422.56	3865.1	3152.1	712.9	
162.4	29.8	401.38	3912.2	3358.9	553.2	
172.4	28.4	382.35	3956.1	3565.7	390.4	
182.4	27.1	365.15	3997.1	3772.5	224.7	
192.4	26.0	349.52	4035.7	3979.2	56.5	
202.4	24.9	335.25	4072.1	4186.0	-113.9	
212.4	23.9	322.17	4106.6	4392.8	-286.2	
222.4	23.0	310.14	4139.3	4599.6	-460.3	
232.4	22.2	299.02	4170.4	4806.3	-636.0	
242.4	21.4	288.73	4200.0	5013.1	-813.1	

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Modified Rational Method

Project Name : **Detroit River International Crossing** November 14, 2006 10:30 AM

Stormwater Management Study

Alternative 1B

	103	
Area =	**4.50**	ha
"C" =	**0.9**	
AC=	**4.05**	
Tc =	**14.4**	min
Time Increment =	**10.0**	min
Release Rate =	**260.9**	l/s
Max.Storage =	**1678**	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.	
a=	**2825**
b=	**13.74**
c=	**0.880**

103						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
14.4	149.8	1686.11	1457.9	225.6	1232.3	
24.4	114.6	1290.37	1890.0	382.2	1507.8	
34.4	93.4	1051.35	2170.7	538.7	1632.0	
44.4	79.1	890.49	2372.9	695.2	1677.6	<<<<
54.4	68.8	774.44	2528.3	851.8	1676.5	
64.4	61.0	686.53	2653.2	1008.3	1644.9	
74.4	54.8	617.51	2757.0	1164.9	1592.1	
84.4	49.9	561.79	2845.3	1321.4	1523.8	
94.4	45.8	515.82	2921.9	1478.0	1443.9	
104.4	42.4	477.20	2989.5	1634.5	1354.9	
114.4	39.5	444.27	3049.8	1791.1	1258.7	
124.4	36.9	415.84	3104.1	1947.6	1156.5	
134.4	34.7	391.04	3153.6	2104.2	1049.4	
144.4	32.8	369.20	3199.0	2260.7	938.2	
154.4	31.1	349.81	3240.8	2417.3	823.5	
164.4	29.5	332.47	3279.7	2573.8	705.8	
174.4	28.1	316.87	3315.9	2730.4	585.5	
184.4	26.9	302.75	3349.8	2886.9	462.9	
194.4	25.7	289.91	3381.7	3043.5	338.3	
204.4	24.7	278.19	3411.9	3200.0	211.8	
214.4	23.8	267.43	3440.4	3356.6	83.8	
224.4	22.9	257.52	3467.4	3513.1	-45.7	
234.4	22.1	248.37	3493.2	3669.7	-176.5	
244.4	21.3	239.88	3517.8	3826.2	-308.5	

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Modified Rational Method

Project Name : **Detroit River International Crossing** November 14, 2006 10:30 AM

Stormwater Management Study

Alternative 1B

	104	
Area =	**2.74**	ha
"C" =	**0.9**	
AC=	**2.466**	
Tc =	**10.0**	min
Time Increment =	**10.0**	min
Release Rate =	**207.7**	l/s
Max.Storage =	**896**	m^3

Controlled Condition

100 Year - Post Dev't.

a=	**2825**
b=	**13.74**
c=	**0.880**

Constant Inflows

	l/s

104						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
10.0	173.9	1192.28	716.2	124.8	591.4	
20.0	127.7	875.16	1050.8	249.4	801.4	
30.0	101.6	696.48	1254.1	374.0	880.1	
40.0	84.8	581.08	1395.0	498.6	896.4	<<<<
50.0	72.9	500.07	1500.5	623.2	877.3	
60.0	64.2	439.89	1583.9	747.9	836.0	
70.0	57.4	393.32	1652.2	872.5	779.7	
80.0	52.0	356.16	1709.8	997.1	712.7	
90.0	47.5	325.77	1759.4	1121.7	637.6	
100.0	43.8	300.43	1802.8	1246.3	556.4	
110.0	40.7	278.96	1841.3	1371.0	470.3	
120.0	38.0	260.52	1875.9	1495.6	380.3	
130.0	35.7	244.50	1907.3	1620.2	287.1	
140.0	33.6	230.45	1935.9	1744.8	191.1	
150.0	31.8	218.02	1962.3	1869.4	92.9	
160.0	30.2	206.94	1986.8	1994.1	-7.3	
170.0	28.7	197.00	2009.5	2118.7	-109.2	
180.0	27.4	188.02	2030.7	2243.3	-212.6	
190.0	26.2	179.88	2050.7	2367.9	-317.2	
200.0	25.2	172.45	2069.5	2492.5	-423.0	
210.0	24.2	165.65	2087.3	2617.2	-529.9	
220.0	23.3	159.40	2104.1	2741.8	-637.7	
230.0	22.4	153.63	2120.2	2866.4	-746.2	
240.0	21.6	148.29	2135.4	2991.0	-855.6	

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Modified Rational Method

Project Name : **Detroit River International Crossing** November 14, 2006 10:30 AM

Stormwater Management Study

Alternative 1B

	105	
Area =	**7.21**	ha
"C" =	**0.9**	
AC=	**6.489**	
Tc =	**16.3**	min
Time Increment =	**10.0**	min
Release Rate =	**383.5**	l/s
Max.Storage =	**2796**	m^3

Controlled Condition

100 Year - Post Dev't.	
a=	**2825**
b=	**13.74**
c=	**0.880**

Constant Inflows

	l/s

105						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
16.3	141.5	2552.29	2494.4	374.8	2119.6	
26.3	109.9	1981.87	3126.1	605.0	2521.1	
36.3	90.3	1628.74	3546.3	835.1	2711.2	
46.3	76.9	1387.42	3853.3	1065.2	2788.1	
56.3	67.2	1211.49	4091.6	1295.3	2796.3	<<<<
66.3	59.7	1077.23	4284.5	1525.5	2759.0	
76.3	53.8	971.20	4445.5	1755.6	2689.9	
86.3	49.1	885.23	4583.1	1985.7	2597.4	
96.3	45.1	814.03	4702.9	2215.8	2487.1	
106.3	41.8	754.04	4808.8	2446.0	2362.8	
116.3	39.0	702.76	4903.4	2676.1	2227.3	
126.3	36.5	658.41	4989.0	2906.2	2082.8	
136.3	34.3	619.63	5066.9	3136.3	1930.6	
146.3	32.5	585.42	5138.5	3366.4	1772.0	
156.3	30.8	555.02	5204.6	3596.6	1608.0	
166.3	29.3	527.79	5266.0	3826.7	1439.3	
176.3	27.9	503.27	5323.3	4056.8	1266.5	
186.3	26.7	481.06	5377.0	4286.9	1090.1	
196.3	25.5	460.85	5427.6	4517.1	910.5	
206.3	24.5	442.37	5475.3	4747.2	728.1	
216.3	23.6	425.40	5520.5	4977.3	543.2	
226.3	22.7	409.76	5563.5	5207.4	356.1	
236.3	21.9	395.31	5604.4	5437.6	166.8	
246.3	21.2	381.90	5643.4	5667.7	-24.3	

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Modified Rational Method

Project Name : **Detroit River International Crossing** November 14, 2006 10:30 AM

Stormwater Management Study

Alternative 1B

	106	
Area =	6.17	ha
"C" =	0.9	
AC=	5.553	
Tc =	21.6	min
Time Increment =	10.0	min
Release Rate =	272.5	l/s
Max.Storage =	2586	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.

a=	2825
b=	13.74
c=	0.880

106						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
21.6	122.5	1890.43	2455.0	353.8	2101.2	
31.6	98.4	1518.58	2883.3	517.3	2365.9	
41.6	82.6	1274.48	3184.5	680.8	2503.7	
51.6	71.3	1101.28	3412.5	844.3	2568.2	
61.6	62.9	971.64	3593.8	1007.8	2586.0	<<<<
71.6	56.4	870.77	3743.1	1171.3	2571.9	
81.6	51.2	789.90	3869.5	1334.7	2534.7	
91.6	46.9	723.55	3978.6	1498.2	2480.4	
101.6	43.3	668.08	4074.4	1661.7	2412.7	
111.6	40.2	620.96	4159.6	1825.2	2334.4	
121.6	37.6	580.41	4236.2	1988.7	2247.5	
131.6	35.3	545.13	4305.8	2152.2	2153.6	
141.6	33.3	514.13	4369.5	2315.6	2053.8	
151.6	31.5	486.68	4428.1	2479.1	1949.0	
161.6	29.9	462.17	4482.4	2642.6	1839.8	
171.6	28.5	440.16	4533.1	2806.1	1727.0	
181.6	27.2	420.27	4580.4	2969.6	1610.8	
191.6	26.1	402.21	4624.9	3133.1	1491.8	
201.6	25.0	385.73	4666.8	3296.5	1370.3	
211.6	24.0	370.63	4706.5	3460.0	1246.5	
221.6	23.1	356.74	4744.2	3623.5	1120.6	
231.6	22.3	343.91	4779.9	3787.0	993.0	
241.6	21.5	332.03	4814.1	3950.5	863.6	
251.6	20.8	321.00	4846.7	4114.0	732.7	

Modified Rational Method

Project Name : **Detroit River International Crossing** November 14, 2006 10:30 AM

Stormwater Management Study

Alternative 1B

	107	
Area =	**6.56**	ha
"C" =	**0.9**	
AC=	**5.904**	
Tc =	**24.3**	min
Time Increment =	**10.0**	min
Release Rate =	**268.7**	l/s
Max.Storage =	**2829**	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.	
a=	**2825**
b=	**13.74**
c=	**0.880**

107						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
24.3	114.9	1885.91	2749.7	391.7	2358.0	
34.3	93.6	1535.76	3160.6	552.9	2607.7	
44.3	79.2	1300.33	3456.3	714.1	2742.2	
54.3	68.9	1130.58	3683.4	875.3	2808.1	
64.3	61.1	1002.06	3866.0	1036.5	2829.5	<<<<
74.3	54.9	901.19	4017.5	1197.7	2819.8	
84.3	49.9	819.78	4146.5	1358.9	2787.6	
94.3	45.9	752.63	4258.4	1520.1	2738.3	
104.3	42.4	696.22	4357.0	1681.2	2675.7	
114.3	39.5	648.14	4444.9	1842.4	2602.5	
124.3	37.0	606.64	4524.3	2003.6	2520.7	
134.3	34.8	570.43	4596.5	2164.8	2431.7	
144.3	32.8	538.54	4662.7	2326.0	2336.7	
154.3	31.1	510.24	4723.8	2487.2	2236.5	
164.3	29.5	484.93	4780.4	2648.4	2132.0	
174.3	28.2	462.16	4833.3	2809.6	2023.7	
184.3	26.9	441.56	4882.8	2970.8	1912.0	
194.3	25.8	422.83	4929.3	3132.0	1797.3	
204.3	24.7	405.72	4973.3	3293.2	1680.1	
214.3	23.8	390.02	5014.8	3454.4	1560.5	
224.3	22.9	375.56	5054.3	3615.6	1438.7	
234.3	22.1	362.20	5091.9	3776.8	1315.1	
244.3	21.3	349.82	5127.7	3938.0	1189.8	
254.3	20.6	338.31	5162.0	4099.1	1062.8	

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Stormwater Management Pond Area Requirement Calculation Sheet
Alternative 1B

Stormerwater Management Facility No.	1B-P1	1B-P2	1B-P3	1B-P4	1B-P5	1B-P6	1B-P7	1B-P8
Drainage ID	**100**	**101**	**102**	**103**	**104**	**105**	**106**	**107**
Drainage Area (ha)	6.4	2.7	5.4	4.5	2.7	7.2	6.2	6.6
Imperviousness of Drainage Area	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Runoff Volume[1] (25mm Storm) (mm)	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Permanent Pool Volume Required[2] (m^3)	1,336	567	1,130	945	575	1,514	1,296	1,378
Extended Detention Volume[3] (m^3)	254	108	215	180	110	288	247	262
Erosion Control Volume[4], 25mm Storm (m^3)	1,590	675	1,345	1,125	685	1,803	1,543	1,640
Total Extended Detention Vol. Req't[5] (m^3)	**1,590**	**675**	**1,345**	**1,125**	**685**	**1,803**	**1,543**	**1,640**
Assumed Permanent Pool Depth	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Assumed Quantity Storage Depth	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Designed Slope V :1 H :	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Trial and Error Method Assuming square lot								
Assumed Bottom width	25.00	12.75	21.50	19.00	12.75	26.50	23.75	25.00
Volume	1668.75	699.47	1345.88	1137.75	699.47	1818.38	1549.22	1668.75
Pond Bottom Area Requirement (m^2)	625	163	462	361	163	702	564	625
Pond Bottom width requirement assuming a square lot	25.00	12.75	21.50	19.00	12.75	26.50	23.75	25.00
Pond Area at Normal Water Level	1,600	770	1,332	1,156	770	1,722	1,502	1,600
Pond Area Requirement (m^2)	**3,364**	**2,093**	**2,970**	**2,704**	**2,093**	**3,540**	**3,221**	**3,364**
Pond Area Requirement with 10 m buffer (m^2)	**6,084**	**4,323**	**5,550**	**5,184**	**4,323**	**6,320**	**5,891**	**6,084**
Total Quantity Control Volume @ 1.80m depth from NWL =	4,468	2,577	3,872	3,474	2,577	4,736	4,250	4,468
Total Quality and Quantity Control Volume =	6,136	3,276	5,218	4,612	3,276	6,555	5,799	6,136
Approximate Volume of Excavation =	17,779	11,887	15,933	14,694	11,887	18,610	17,105	17,779

Notes:

1 Based on Imperviousness for the site (25mm * Imperviousness)
2 Calculated using Table 3.2 Of the MOE 2003 SWM Planning and Design Manual, 85% Imperviousness (250m ^{3}/ha - 40m^3/ha)
3 Based on 40m^3/ha
4 Area x Runoff Volume
5 Greater of Extended Detention or Erosion Control
6 Average release over 24 hours.

Appendix C.3

Alternative 2A

Modified Rational Method

Project Name : Detroit River International Crossing November 16, 2006 9:41 AM
Stormwater Management Study Alternative 2A
Project No. : 33015384

	100	
Area =	6.36	ha
"C" =	0.9	
AC=	5.724	
Tc =	14.8	min
Time Increment =	2.0	min
Release Rate =	0.4	l/s
Max.Storage =	3688	m3

One Hundred Year

a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
14.8	148.1	2356.05	2089.0	0.3	2088.7	
16.8	139.5	2219.63	2234.4	0.4	2234.1	
18.8	131.9	2099.04	2364.9	0.4	2364.5	
20.8	125.2	1991.63	2482.9	0.4	2482.5	
22.8	119.1	1895.32	2590.3	0.5	2589.8	
24.8	113.6	1808.44	2688.6	0.5	2688.0	
26.8	108.7	1729.65	2779.0	0.6	2778.4	
28.8	104.2	1657.85	2862.6	0.6	2861.9	
30.8	100.1	1592.13	2940.1	0.7	2939.5	
32.8	96.3	1531.73	3012.4	0.7	3011.7	
34.8	92.8	1476.03	3080.0	0.8	3079.2	
36.8	89.5	1424.48	3143.3	0.8	3142.6	
38.8	86.5	1376.63	3203.0	0.8	3202.1	
40.8	83.7	1332.09	3259.2	0.9	3258.3	
42.8	81.1	1290.52	3312.3	0.9	3311.4	
44.8	78.7	1251.62	3362.7	1.0	3361.7	
46.8	76.4	1215.15	3410.5	1.0	3409.5	
48.8	74.2	1180.87	3456.0	1.1	3455.0	
50.8	72.2	1148.60	3499.4	1.1	3498.3	
52.8	70.3	1118.15	3540.8	1.1	3539.7	
54.8	68.5	1089.38	3580.4	1.2	3579.2	
56.8	66.7	1062.15	3618.4	1.2	3617.1	
58.8	65.1	1036.32	3654.8	1.3	3653.5	
60.8	63.6	1011.81	3689.7	1.3	3688.4	<<<<

Modified Rational Method

Project Name : Detroit River International Crossing — November 16, 2006 — 9:42 AM
Stormwater Management Study Alternative 2A
Project No. : 33015384

	101	
Area =	1.69	ha
"C" =	0.9	
AC=	1.521	
Tc =	10.4	min
Time Increment =	2.0	min
Release Rate =	0.1	l/s
Max.Storage =	959	m3

One Hundred Year

a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
10.4	171.7	725.83	451.5	0.1	451.4	
12.4	160.0	676.67	502.1	0.1	502.0	
14.4	150.0	634.11	546.6	0.1	546.5	
16.4	141.2	596.89	586.1	0.1	586.0	
18.4	133.4	564.04	621.6	0.1	621.4	
20.4	126.5	534.83	653.6	0.2	653.4	
22.4	120.3	508.67	682.6	0.2	682.5	
24.4	114.7	485.10	709.2	0.2	709.0	
26.4	109.7	463.75	733.7	0.2	733.4	
28.4	105.1	444.31	756.2	0.2	756.0	
30.4	100.9	426.53	777.1	0.2	776.9	
32.4	97.0	410.21	796.6	0.3	796.4	
34.4	93.5	395.16	814.8	0.3	814.6	
36.4	90.2	381.25	831.9	0.3	831.6	
38.4	87.1	368.34	847.9	0.3	847.6	
40.4	84.3	356.33	863.0	0.3	862.7	
42.4	81.6	345.13	877.3	0.3	877.0	
44.4	79.1	334.66	890.9	0.3	890.5	
46.4	76.8	324.84	903.7	0.4	903.3	
48.4	74.6	315.61	915.9	0.4	915.5	
50.4	72.6	306.93	927.5	0.4	927.2	
52.4	70.7	298.74	938.7	0.4	938.2	
54.4	68.8	291.01	949.3	0.4	948.9	
56.4	67.1	283.69	959.4	0.4	959.0	<<<<

Modified Rational Method

Project Name : Detroit River International Crossing November 16, 2006 9:43 AM
Stormwater Management Study Alternative 2A
Project No. : 33015384

	102	
Area =	5.19	ha
"C" =	0.9	
AC=	4.671	
Tc =	14.4	min
Time Increment =	2.0	min
Release Rate =	0.3	l/s
Max.Storage =	3005	m3

One Hundred Year

a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
14.4	149.8	1944.65	1681.5	0.3	1681.2	
16.4	141.0	1830.67	1802.6	0.3	1802.3	
18.4	133.2	1730.07	1911.2	0.3	1910.8	
20.4	126.3	1640.59	2009.2	0.4	2008.8	
22.4	120.2	1560.45	2098.3	0.4	2097.9	
24.4	114.6	1488.23	2179.8	0.4	2179.3	
26.4	109.6	1422.80	2254.7	0.5	2254.2	
28.4	105.0	1363.22	2323.8	0.5	2323.3	
30.4	100.8	1308.72	2388.0	0.5	2387.4	
32.4	96.9	1258.68	2447.7	0.6	2447.1	
34.4	93.4	1212.56	2503.5	0.6	2502.9	
36.4	90.1	1169.90	2555.8	0.7	2555.2	
38.4	87.0	1130.33	2605.0	0.7	2604.3	
40.4	84.2	1093.51	2651.4	0.7	2650.7	
42.4	81.6	1059.16	2695.2	0.8	2694.4	
44.4	79.1	1027.04	2736.7	0.8	2735.9	
46.4	76.8	996.93	2776.1	0.8	2775.3	
48.4	74.6	968.64	2813.6	0.9	2812.7	
50.4	72.5	942.01	2849.3	0.9	2848.4	
52.4	70.6	916.90	2883.4	0.9	2882.4	
54.4	68.8	893.18	2915.9	1.0	2915.0	
56.4	67.1	870.74	2947.2	1.0	2946.1	
58.4	65.4	849.46	2977.1	1.1	2976.0	
60.4	63.9	829.27	3005.8	1.1	3004.7	<<<<

Modified Rational Method

Project Name : Detroit River International Crossing November 16, 2006 9:43 AM
Stormwater Management Study Alternative 2A
Project No. : 33015384

	103	
Area =	3.31	ha
"C" =	0.9	
AC=	2.979	
Tc =	13.1	min
Time Increment =	2.0	min
Release Rate =	0.2	l/s
Max.Storage =	1905	m3

One Hundred Year	
a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
13.1	156.0	1291.98	1018.1	0.2	1017.9	
15.1	146.5	1212.89	1101.3	0.2	1101.1	
17.1	138.1	1143.47	1175.5	0.2	1175.3	
19.1	130.7	1082.02	1242.2	0.2	1241.9	
21.1	124.0	1027.22	1302.5	0.3	1302.2	
23.1	118.1	978.03	1357.5	0.3	1357.2	
25.1	112.7	933.61	1407.9	0.3	1407.6	
27.1	107.9	893.29	1454.3	0.3	1453.9	
29.1	103.4	856.51	1497.2	0.4	1496.8	
31.1	99.4	822.83	1537.0	0.4	1536.6	
33.1	95.6	791.85	1574.2	0.4	1573.8	
35.1	92.2	763.26	1609.0	0.4	1608.5	
37.1	89.0	736.79	1641.6	0.5	1641.1	
39.1	86.0	712.21	1672.3	0.5	1671.8	
41.1	83.2	689.32	1701.2	0.5	1700.7	
43.1	80.7	667.94	1728.6	0.5	1728.1	
45.1	78.2	647.93	1754.6	0.6	1754.0	
47.1	76.0	629.16	1779.3	0.6	1778.7	
49.1	73.8	611.52	1802.7	0.6	1802.1	
51.1	71.8	594.89	1825.1	0.6	1824.5	
53.1	69.9	579.21	1846.5	0.7	1845.8	
55.1	68.1	564.38	1867.0	0.7	1866.3	
57.1	66.5	550.34	1886.6	0.7	1885.9	
59.1	64.8	537.03	1905.4	0.7	1904.6	<<<<

Modified Rational Method

Project Name : Detroit River International Crossing November 16, 2006 9:43 AM
Stormwater Management Study Alternative 2A
Project No. : 33015384

	104	
Area =	4.93	ha
"C" =	0.9	
AC=	4.437	
Tc =	11.2	min
Time Increment =	2.0	min
Release Rate =	0.3	l/s
Max.Storage =	2809	m3

One Hundred Year

a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
11.2	166.7	2056.59	1379.3	0.2	1379.1	
13.2	155.8	1921.51	1519.3	0.3	1519.0	
15.2	146.3	1804.06	1642.9	0.3	1642.6	
17.2	137.9	1700.96	1753.1	0.4	1752.8	
19.2	130.5	1609.67	1852.2	0.4	1851.8	
21.2	123.9	1528.25	1941.9	0.4	1941.5	
23.2	118.0	1455.16	2023.6	0.5	2023.2	
25.2	112.6	1389.14	2098.5	0.5	2098.0	
27.2	107.8	1329.21	2167.5	0.6	2166.9	
29.2	103.3	1274.55	2231.3	0.6	2230.7	
31.2	99.3	1224.47	2290.6	0.6	2289.9	
33.2	95.5	1178.42	2345.8	0.7	2345.2	
35.2	92.1	1135.92	2397.5	0.7	2396.8	
37.2	88.9	1096.56	2446.1	0.8	2445.3	
39.2	85.9	1060.00	2491.7	0.8	2490.9	
41.2	83.2	1025.96	2534.8	0.8	2534.0	
43.2	80.6	994.16	2575.5	0.9	2574.7	
45.2	78.2	964.41	2614.2	0.9	2613.3	
47.2	75.9	936.49	2650.9	1.0	2649.9	
49.2	73.8	910.24	2685.8	1.0	2684.8	
51.2	71.8	885.52	2719.1	1.0	2718.1	
53.2	69.9	862.18	2750.9	1.1	2749.9	
55.2	68.1	840.13	2781.4	1.1	2780.3	
57.2	66.4	819.24	2810.5	1.2	2809.4	<<<<

Modified Rational Method

Project Name : Detroit River International Crossing — November 16, 2006 — 9:44 AM
Stormwater Management Study Alternative 2A
Project No. : 33015384

	105	
Area =	2.61	ha
"C" =	0.9	
AC=	2.349	
Tc =	10.9	min
Time Increment =	2.0	min
Release Rate =	0.2	l/s
Max.Storage =	1485	m3

One Hundred Year	
a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
10.9	168.5	1100.45	718.2	0.1	718.1	
12.9	157.3	1027.35	793.8	0.1	793.7	
14.9	147.6	963.90	860.4	0.2	860.3	
16.9	139.1	908.27	919.8	0.2	919.6	
18.9	131.6	859.07	973.0	0.2	972.8	
20.9	124.8	815.24	1021.2	0.2	1021.0	
22.9	118.8	775.93	1065.1	0.3	1064.8	
24.9	113.4	740.45	1105.2	0.3	1105.0	
26.9	108.5	708.27	1142.2	0.3	1141.9	
28.9	104.0	678.94	1176.4	0.3	1176.0	
30.9	99.9	652.08	1208.1	0.4	1207.7	
32.9	96.1	627.40	1237.7	0.4	1237.3	
34.9	92.6	604.63	1265.3	0.4	1264.9	
36.9	89.4	583.56	1291.2	0.4	1290.8	
38.9	86.4	563.99	1315.6	0.4	1315.2	
40.9	83.6	545.78	1338.6	0.5	1338.1	
42.9	81.0	528.78	1360.4	0.5	1359.9	
44.9	78.5	512.87	1381.0	0.5	1380.5	
46.9	76.3	497.95	1400.6	0.5	1400.0	
48.9	74.1	483.92	1419.2	0.6	1418.6	
50.9	72.1	470.72	1436.9	0.6	1436.4	
52.9	70.2	458.26	1453.9	0.6	1453.3	
54.9	68.4	446.48	1470.1	0.6	1469.5	
56.9	66.7	435.34	1485.7	0.6	1485.0	<<<<

Modified Rational Method

Project Name : Detroit River International Crossing November 16, 2006 9:44 AM
Stormwater Management Study Alternative 2A
Project No. : 33015384

	106	
Area =	5.3	ha
"C" =	0.9	
AC=	4.77	
Tc =	15.8	min
Time Increment =	2.0	min
Release Rate =	0.3	l/s
Max.Storage =	3088	m3

One Hundred Year

a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
15.8	143.7	1905.35	1802.5	0.3	1802.2	
17.8	135.6	1798.50	1917.2	0.3	1916.9	
19.8	128.5	1703.69	2020.6	0.3	2020.2	
21.8	122.1	1618.95	2114.3	0.4	2114.0	
23.8	116.3	1542.73	2199.9	0.4	2199.5	
25.8	111.1	1473.79	2278.5	0.4	2278.0	
27.8	106.4	1411.11	2350.9	0.5	2350.4	
29.8	102.1	1353.87	2418.0	0.5	2417.5	
31.8	98.1	1301.37	2480.4	0.6	2479.9	
33.8	94.5	1253.03	2538.6	0.6	2538.1	
35.8	91.1	1208.37	2593.2	0.6	2592.5	
37.8	88.0	1166.99	2644.4	0.7	2643.7	
39.8	85.1	1128.51	2692.6	0.7	2691.9	
41.8	82.4	1092.65	2738.2	0.7	2737.5	
43.8	79.9	1059.14	2781.3	0.8	2780.5	
45.8	77.5	1027.75	2822.2	0.8	2821.4	
47.8	75.3	998.28	2861.1	0.8	2860.3	
49.8	73.2	970.56	2898.1	0.9	2897.2	
51.8	71.2	944.44	2933.4	0.9	2932.5	
53.8	69.4	919.77	2967.2	0.9	2966.3	
55.8	67.6	896.44	2999.5	1.0	2998.5	
57.8	65.9	874.34	3030.5	1.0	3029.5	
59.8	64.4	853.37	3060.2	1.0	3059.1	
61.8	62.9	833.45	3088.8	1.1	3087.7	<<<<

Modified Rational Method

Project Name : Detroit River International Crossing — November 16, 2006 — 9:44 AM
Stormwater Management Study Alternative 2A
Project No. : 33015384

	107	
Area =	7.06	ha
"C" =	0.9	
AC=	6.354	
Tc =	16.1	min
Time Increment =	2.0	min
Release Rate =	0.4	l/s
Max.Storage =	4119	m3

One Hundred Year	
a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
16.1	142.3	2513.93	2426.8	0.4	2426.4	
18.1	134.4	2374.39	2577.0	0.4	2576.6	
20.1	127.4	2250.41	2712.5	0.5	2712.0	
22.1	121.1	2139.48	2835.5	0.5	2835.0	
24.1	115.5	2039.62	2947.9	0.5	2947.4	
26.1	110.3	1949.22	3051.2	0.6	3050.6	
28.1	105.7	1866.96	3146.5	0.6	3145.8	
30.1	101.4	1791.78	3234.8	0.7	3234.1	
32.1	97.5	1722.79	3316.9	0.7	3316.2	
34.1	93.9	1659.23	3393.7	0.8	3392.9	
36.1	90.6	1600.48	3465.6	0.8	3464.8	
38.1	87.5	1546.01	3533.1	0.9	3532.3	
40.1	84.7	1495.34	3596.8	0.9	3595.9	
42.1	82.0	1448.10	3656.9	1.0	3656.0	
44.1	79.5	1403.93	3713.9	1.0	3712.9	
46.1	77.1	1362.55	3767.9	1.1	3766.9	
48.1	74.9	1323.69	3819.3	1.1	3818.2	
50.1	72.9	1287.12	3868.2	1.1	3867.1	
52.1	70.9	1252.64	3914.9	1.2	3913.7	
54.1	69.1	1220.08	3959.6	1.2	3958.3	
56.1	67.3	1189.28	4002.3	1.3	4001.0	
58.1	65.7	1160.09	4043.3	1.3	4042.0	
60.1	64.1	1132.39	4082.6	1.4	4081.3	
62.1	62.6	1106.06	4120.5	1.4	4119.0	<<<<

Stormwater Management Pond Area Requirement Calculation Sheet
Alternative 2A

Stormwater Management Facility No.	**2A-P1**	**2A-P2**	**2A-P3**	**2A-P4**	**2A-P5**	**2A-P6**	**2A-P7**	**2A-P8**
Drainage ID	**100**	**101**	**102**	**103**	**104**	**105**	**106**	**107**
Drainage Area (ha)	6.4	1.7	5.2	3.3	4.9	2.6	5.3	7.1
Imperviousness of Drainage Area	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Runoff Volume[1] (25mm Storm) (mm)	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Permanent Pool Volume Required[2] (m^3)	1,336	357	1,092	693	1,035	548	1,113	1,483
Extended Detention Volume[3] (m^3)	254	68	208	132	197	104	212	282
Erosion Control Volume[4], 25mm Storm (m^3)	1,590	425	1,300	825	1,233	653	1,325	1,765
Total Extended Detention Vol. Req't[5] (m^3)	**1,590**	**425**	**1,300**	**825**	**1,233**	**653**	**1,325**	**1,765**
Assumed Permanent Pool Depth	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Assumed Quantity Storage Depth	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Designed Slope V :1 H :	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Trial and Error Method Assuming square lot								
Assumed Bottom width	25.00	10.00	22.00	15.00	18.00	8.00	24.00	26.00
Volume	1668.75	543.75	1389.75	843.75	1059.75	444.75	1572.75	1767.75
Pond Bottom Area Requirement (m^2)	625	100	484	225	324	64	576	676
Pond Bottom width requirement assuming a square lot	25.00	10.00	22.00	15.00	18.00	8.00	24.00	26.00
Pond Area at Normal Water Level	1,600	625	1,369	900	1,089	529	1,521	1,681
Pond Area Requirement (m^2)	**3,364**	**1,849**	**3,025**	**2,304**	**2,601**	**1,681**	**3,249**	**3,481**
Pond Area Requirement with 10 m buffer (m^2)	**6,084**	**3,969**	**5,625**	**4,624**	**5,041**	**3,721**	**5,929**	**6,241**
Total Quantity Control Volume @ 1.80m depth from NWL =	4,468	2,227	3,955	2,884	3,321	1,989	4,293	4,646
Total Quality and Quantity Control Volume =	6,136	2,770	5,344	3,727	4,381	2,434	5,866	6,414
Approximate Volume of Excavation =	17,779	10,783	16,189	12,850	14,217	10,030	17,238	18,330

Notes:

1. Based on Imperviousness for the site (25mm * Imperviousness)
2. Calculated using Table 3.2 Of the MOE 2003 SWM Planning and Design Manual, 85% Imperviousness (250m ^{3}/ha - 40m^3/ha)
3. Based on 40m^3/ha
4. Area x Runoff Volume
5. Greater of Extended Detention or Erosion Control
6. Average release over 24 hours.

O:\DRIC\19_WaterResources\Hydrology\[Pond Area Reqt Calc_Option 2A.xls]Option 2A
9:39 AM 16/11/2006

Appendix C.4

Alternative 2B

Modified Rational Method

Project Name : Detroit River International Crossing — November 16, 2006 — 9:46 AM
Stormwater Management Study Alternative 2B
Project No. : 33015384

	100	
Area =	6.36	ha
"C" =	0.9	
AC=	5.724	
Tc =	14.8	min
Time Increment =	2.0	min
Release Rate =	0.4	l/s
Max.Storage =	3688	m3

One Hundred Year

a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
14.8	148.1	2356.05	2089.0	0.3	2088.7	
16.8	139.5	2219.63	2234.4	0.4	2234.1	
18.8	131.9	2099.04	2364.9	0.4	2364.5	
20.8	125.2	1991.63	2482.9	0.4	2482.5	
22.8	119.1	1895.32	2590.3	0.5	2589.8	
24.8	113.6	1808.44	2688.6	0.5	2688.0	
26.8	108.7	1729.65	2779.0	0.6	2778.4	
28.8	104.2	1657.85	2862.6	0.6	2861.9	
30.8	100.1	1592.13	2940.1	0.7	2939.5	
32.8	96.3	1531.73	3012.4	0.7	3011.7	
34.8	92.8	1476.03	3080.0	0.8	3079.2	
36.8	89.5	1424.48	3143.3	0.8	3142.6	
38.8	86.5	1376.63	3203.0	0.8	3202.1	
40.8	83.7	1332.09	3259.2	0.9	3258.3	
42.8	81.1	1290.52	3312.3	0.9	3311.4	
44.8	78.7	1251.62	3362.7	1.0	3361.7	
46.8	76.4	1215.15	3410.5	1.0	3409.5	
48.8	74.2	1180.87	3456.0	1.1	3455.0	
50.8	72.2	1148.60	3499.4	1.1	3498.3	
52.8	70.3	1118.15	3540.8	1.1	3539.7	
54.8	68.5	1089.38	3580.4	1.2	3579.2	
56.8	66.7	1062.15	3618.4	1.2	3617.1	
58.8	65.1	1036.32	3654.8	1.3	3653.5	
60.8	63.6	1011.81	3689.7	1.3	3688.4	<<<<

Modified Rational Method

Project Name : Detroit River International Crossing November 16, 2006 9:47 AM
Stormwater Management Study Alternative 2B
Project No. : 33015384

	101	
Area =	2.13	ha
"C" =	0.9	
AC=	1.917	
Tc =	10.4	min
Time Increment =	2.0	min
Release Rate =	0.2	l/s
Max.Storage =	1209	m3

One Hundred Year	
a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
10.4	171.7	915.18	568.6	0.1	568.5	
12.4	160.1	853.16	632.5	0.1	632.4	
14.4	150.0	799.48	688.6	0.1	688.5	
16.4	141.2	752.54	738.5	0.2	738.3	
18.4	133.4	711.11	783.2	0.2	783.0	
20.4	126.5	674.27	823.5	0.2	823.3	
22.4	120.3	641.28	860.2	0.2	860.0	
24.4	114.8	611.56	893.7	0.2	893.5	
26.4	109.7	584.63	924.5	0.3	924.2	
28.4	105.1	560.12	953.0	0.3	952.7	
30.4	100.9	537.70	979.3	0.3	979.0	
32.4	97.0	517.12	1003.9	0.3	1003.6	
34.4	93.5	498.15	1026.8	0.3	1026.5	
36.4	90.2	480.60	1048.4	0.3	1048.0	
38.4	87.1	464.33	1068.6	0.4	1068.2	
40.4	84.3	449.19	1087.6	0.4	1087.2	
42.4	81.6	435.06	1105.6	0.4	1105.2	
44.4	79.2	421.86	1122.7	0.4	1122.3	
46.4	76.8	409.48	1138.9	0.4	1138.4	
48.4	74.7	397.85	1154.3	0.5	1153.8	
50.4	72.6	386.90	1169.0	0.5	1168.5	
52.4	70.7	376.58	1183.0	0.5	1182.5	
54.4	68.8	366.83	1196.4	0.5	1195.8	
56.4	67.1	357.60	1209.2	0.5	1208.6	<<<<

Modified Rational Method

Project Name : Detroit River International Crossing November 16, 2006 9:47 AM
Stormwater Management Study Alternative 2B
Project No. : 33015384

	102	
Area =	6.54	ha
"C" =	0.9	
AC=	5.886	
Tc =	14.8	min
Time Increment =	2.0	min
Release Rate =	0.4	l/s
Max.Storage =	3794	m3

One Hundred Year	
a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
14.8	147.9	2419.42	2151.7	0.3	2151.3	
16.8	139.3	2279.53	2300.8	0.4	2300.4	
18.8	131.8	2155.85	2434.7	0.4	2434.3	
20.8	125.0	2045.68	2555.7	0.5	2555.3	
22.8	119.0	1946.88	2665.9	0.5	2665.4	
24.8	113.5	1857.74	2766.8	0.6	2766.2	
26.8	108.6	1776.89	2859.6	0.6	2859.0	
28.8	104.1	1703.20	2945.4	0.6	2944.8	
30.8	100.0	1635.75	3025.0	0.7	3024.4	
32.8	96.2	1573.76	3099.3	0.7	3098.5	
34.8	92.7	1516.58	3168.6	0.8	3167.9	
36.8	89.4	1463.66	3233.7	0.8	3232.9	
38.8	86.4	1414.54	3294.9	0.9	3294.1	
40.8	83.7	1368.81	3352.7	0.9	3351.8	
42.8	81.0	1326.12	3407.3	1.0	3406.3	
44.8	78.6	1286.19	3459.0	1.0	3458.0	
46.8	76.3	1248.73	3508.1	1.0	3507.1	
48.8	74.2	1213.54	3554.9	1.1	3553.8	
50.8	72.1	1180.39	3599.4	1.1	3598.3	
52.8	70.2	1149.12	3642.0	1.2	3640.8	
54.8	68.4	1119.57	3682.7	1.2	3681.4	
56.8	66.7	1091.60	3721.6	1.3	3720.4	
58.8	65.1	1065.08	3759.0	1.3	3757.7	
60.8	63.6	1039.90	3794.9	1.4	3793.6	<<<<

Modified Rational Method

Project Name : Detroit River International Crossing — November 16, 2006 — 9:47 AM
Stormwater Management Study Alternative 2B
Project No. : 33015384

	103	
Area =	7.21	ha
"C" =	0.9	
AC=	6.489	
Tc =	21.1	min
Time Increment =	2.0	min
Release Rate =	0.3	l/s
Max.Storage =	4298	m3

One Hundred Year	
a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
21.1	124.0	2236.91	2837.9	0.4	2837.5	
23.1	118.1	2129.82	2957.6	0.4	2957.2	
25.1	112.7	2033.12	3067.3	0.5	3066.8	
27.1	107.8	1945.33	3168.3	0.5	3167.8	
29.1	103.4	1865.27	3261.7	0.6	3261.2	
31.1	99.3	1791.93	3348.5	0.6	3347.9	
33.1	95.6	1724.49	3429.4	0.6	3428.8	
35.1	92.1	1662.24	3505.1	0.7	3504.4	
37.1	89.0	1604.61	3576.1	0.7	3575.4	
39.1	86.0	1551.09	3643.0	0.8	3642.2	
41.1	83.2	1501.24	3706.1	0.8	3705.3	
43.1	80.6	1454.69	3765.7	0.8	3764.9	
45.1	78.2	1411.12	3822.3	0.9	3821.4	
47.1	76.0	1370.25	3876.0	0.9	3875.1	
49.1	73.8	1331.82	3927.1	0.9	3926.2	
51.1	71.8	1295.63	3975.9	1.0	3974.9	
53.1	69.9	1261.48	4022.4	1.0	4021.4	
55.1	68.1	1229.19	4067.0	1.1	4065.9	
57.1	66.4	1198.62	4109.7	1.1	4108.6	
59.1	64.8	1169.62	4150.6	1.1	4149.5	
61.1	63.3	1142.09	4189.9	1.2	4188.8	
63.1	61.9	1115.90	4227.8	1.2	4226.6	
65.1	60.5	1090.97	4264.2	1.3	4263.0	
67.1	59.2	1067.19	4299.4	1.3	4298.1	<<<<

Modified Rational Method

Project Name : Detroit River International Crossing November 16, 2006 9:47 AM
Stormwater Management Study Alternative 2B
Project No. : 33015384

	104	
Area =	2.34	ha
"C" =	0.9	
AC=	2.106	
Tc =	9.7	min
Time Increment =	2.0	min
Release Rate =	0.2	l/s
Max.Storage =	1323	m3

One Hundred Year	
a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
9.7	176.1	1030.97	598.6	0.1	598.5	
11.7	163.8	959.23	672.1	0.1	672.0	
13.7	153.3	897.38	736.5	0.1	736.3	
15.7	144.1	843.47	793.4	0.2	793.3	
17.7	136.0	796.03	844.3	0.2	844.1	
19.7	128.8	753.95	890.2	0.2	890.0	
21.7	122.4	716.36	931.7	0.2	931.5	
23.7	116.6	682.55	969.7	0.3	969.4	
25.7	111.4	651.98	1004.5	0.3	1004.2	
27.7	106.6	624.20	1036.6	0.3	1036.3	
29.7	102.3	598.82	1066.3	0.3	1066.0	
31.7	98.3	575.55	1093.9	0.3	1093.6	
33.7	94.6	554.14	1119.7	0.4	1119.4	
35.7	91.3	534.35	1143.9	0.4	1143.5	
37.7	88.1	516.02	1166.5	0.4	1166.1	
39.7	85.2	498.98	1187.9	0.4	1187.5	
41.7	82.5	483.10	1208.1	0.5	1207.6	
43.7	80.0	468.26	1227.1	0.5	1226.7	
45.7	77.6	454.36	1245.2	0.5	1244.8	
47.7	75.4	441.31	1262.4	0.5	1261.9	
49.7	73.3	429.04	1278.8	0.5	1278.3	
51.7	71.3	417.48	1294.5	0.6	1293.9	
53.7	69.4	406.56	1309.4	0.6	1308.8	
55.7	67.7	396.23	1323.7	0.6	1323.1	<<<<

Modified Rational Method

Project Name : Detroit River International Crossing November 16, 2006 9:47 AM
Stormwater Management Study Alternative 2B
Project No. : 33015384

	105	
Area =	5.77	ha
"C" =	0.9	
AC=	5.193	
Tc =	20.3	min
Time Increment =	2.0	min
Release Rate =	0.3	l/s
Max.Storage =	3428	m3

One Hundred Year	
a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
20.3	126.7	1829.17	2227.9	0.3	2227.6	
22.3	120.5	1739.54	2327.5	0.4	2327.1	
24.3	114.9	1658.80	2418.5	0.4	2418.1	
26.3	109.8	1585.66	2502.2	0.4	2501.7	
28.3	105.2	1519.09	2579.4	0.5	2578.9	
30.3	101.0	1458.21	2651.0	0.5	2650.5	
32.3	97.1	1402.32	2717.7	0.5	2717.2	
34.3	93.6	1350.81	2780.0	0.6	2779.4	
36.3	90.3	1303.19	2838.3	0.6	2837.7	
38.3	87.2	1259.01	2893.2	0.6	2892.6	
40.3	84.4	1217.91	2944.9	0.7	2944.3	
42.3	81.7	1179.58	2993.8	0.7	2993.1	
44.3	79.2	1143.73	3040.0	0.7	3039.3	
46.3	76.9	1110.14	3084.0	0.8	3083.2	
48.3	74.7	1078.58	3125.7	0.8	3125.0	
50.3	72.7	1048.89	3165.5	0.8	3164.7	
52.3	70.7	1020.88	3203.5	0.8	3202.7	
54.3	68.9	994.43	3239.8	0.9	3239.0	
56.3	67.1	969.40	3274.6	0.9	3273.7	
58.3	65.5	945.67	3308.0	0.9	3307.0	
60.3	63.9	923.16	3340.0	1.0	3339.0	
62.3	62.5	901.75	3370.8	1.0	3369.7	
64.3	61.1	881.39	3400.4	1.0	3399.3	
66.3	59.7	861.98	3428.9	1.1	3427.9	<<<<

Modified Rational Method

Project Name : Detroit River International Crossing November 16, 2006 9:48 AM
Stormwater Management Study Alternative 2B
Project No. : 33015384

	106	
Area =	9.32	ha
"C" =	0.9	
AC=	8.388	
Tc =	16.4	min
Time Increment =	2.0	min
Release Rate =	0.5	l/s
Max.Storage =	5444	m3

One Hundred Year	
a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
16.4	141.2	3291.72	3232.5	0.5	3232.0	
18.4	133.4	3110.58	3427.9	0.5	3427.3	
20.4	126.5	2949.49	3604.3	0.6	3603.7	
22.4	120.3	2805.23	3764.6	0.7	3764.0	
24.4	114.7	2675.25	3911.2	0.7	3910.5	
26.4	109.7	2557.50	4046.0	0.8	4045.2	
28.4	105.1	2450.29	4170.4	0.8	4169.6	
30.4	100.9	2352.24	4285.8	0.9	4284.9	
32.4	97.0	2262.21	4393.2	1.0	4392.3	
34.4	93.5	2179.24	4493.6	1.0	4492.6	
36.4	90.2	2102.51	4587.7	1.1	4586.6	
38.4	87.1	2031.33	4676.1	1.1	4675.0	
40.4	84.3	1965.10	4759.5	1.2	4758.3	
42.4	81.6	1903.32	4838.3	1.2	4837.0	
44.4	79.1	1845.55	4912.9	1.3	4911.6	
46.4	76.8	1791.40	4983.7	1.4	4982.3	
48.4	74.6	1740.54	5051.0	1.4	5049.6	
50.4	72.6	1692.66	5115.2	1.5	5113.7	
52.4	70.7	1647.52	5176.5	1.5	5175.0	
54.4	68.8	1604.87	5235.1	1.6	5233.5	
56.4	67.1	1564.51	5291.2	1.7	5289.5	
58.4	65.5	1526.26	5344.9	1.7	5343.2	
60.4	63.9	1489.95	5396.6	1.8	5394.8	
62.4	62.4	1455.44	5446.2	1.8	5444.4	<<<<

Stormwater Management Pond Area Requirement Calculation Sheet
Alternative 2B

Stormwater Management Facility No.	**2B-P1**	**2B-P2**	**2B-P3**	**2B-P4**	**2B-P5**	**2B-P6**	**2B-P7**
Drainage ID	**100**	**101**	**102**	**103**	**104**	**105**	**106**
Drainage Area (ha)	6.4	2.1	6.5	7.2	2.3	5.8	9.3
Imperviousness of Drainage Area	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Runoff Volume[1] (25mm Storm) (mm)	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Permanent Pool Volume Required[2] (m^3)	1,336	447	1,373	1,514	491	1,212	1,957
Extended Detention Volume[3] (m^3)	254	85	262	288	94	231	373
Erosion Control Volume[4], 25mm Storm (m^3)	1,590	533	1,635	1,803	585	1,443	2,330
Total Extended Detention Vol. Req't[5] (m^3)	**1,590**	**533**	**1,635**	**1,803**	**585**	**1,443**	**2,330**
Assumed Permanent Pool Depth	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Assumed Quantity Storage Depth	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Designed Slope V :1 H :	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Trial and Error Method Assuming square lot							
Assumed Bottom width	25.00	10.00	25.00	29.00	12.00	23.00	32.00
Volume	1668.75	543.75	1668.75	2082.75	654.75	1479.75	2424.75
Pond Bottom Area Requirement (m^2)	625	100	625	841	144	529	1,024
Pond Bottom width requirement assuming a square lot	25.00	10.00	25.00	29.00	12.00	23.00	32.00
Pond Area at Normal Water Level	1,600	625	1,600	1,936	729	1,444	2,209
Pond Area Requirement (m^2)	**3,364**	**1,849**	**3,364**	**3,844**	**2,025**	**3,136**	**4,225**
Pond Area Requirement with 10 m buffer (m^2)	**6,084**	**3,969**	**6,084**	**6,724**	**4,225**	**5,776**	**7,225**
Total Quantity Control Volume @ 1.80m depth from NWL =	4,468	2,227	4,468	5,202	2,479	4,122	5,791
Total Quality and Quantity Control Volume =	6,136	2,770	6,136	7,285	3,133	5,602	8,215
Approximate Volume of Excavation =	17,779	10,783	17,779	20,047	11,578	16,708	21,860

Notes:

1 Based on Imperviousness for the site (25mm * Imperviousness)
2 Calculated using Table 3.2 Of the MOE 2003 SWM Planning and Design Manual, 85% Imperviousness (250m^3/ha - 40m^3/ha)
3 Based on 40m^3/ha
4 Area x Runoff Volume
5 Greater of Extended Detention or Erosion Control
6 Average release over 24 hours.

O:\DRIC\19_WaterResources\Hydrology\[Pond Area Reqt Calc_Option 2B.xls]Option 2B
9:39 AM 16/11/2006

Appendix C.5

Alternative 2B – Revised

Modified Rational Method

Project Name : Detroit River International Crossing — November 17, 2006 — 3:49 PM
Stormwater Management Study Alternative 2B Revised Profile

Project No. : 33015384

	2BR - P1	
Area =	19.43	ha
"C" =	0.9	
AC=	17.487	
Tc =	30.9	min
Time Increment =	2.0	min
Release Rate =	0.6	l/s
Max.Storage =	12001	m3

One Hundred Year	
a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
30.9	99.8	4853.23	8995.0	1.1	8993.9	
32.9	96.1	4669.57	9214.9	1.1	9213.8	
34.9	92.6	4500.15	9420.6	1.2	9419.4	
36.9	89.3	4343.34	9613.5	1.3	9612.3	
38.9	86.3	4197.76	9795.0	1.3	9793.7	
40.9	83.6	4062.22	9966.2	1.4	9964.8	
42.9	81.0	3935.70	10128.1	1.5	10126.7	
44.9	78.5	3817.31	10281.5	1.5	10280.0	
46.9	76.2	3706.27	10427.2	1.6	10425.6	
48.9	74.1	3601.92	10565.9	1.7	10564.2	
50.9	72.1	3503.65	10698.0	1.7	10696.3	
52.9	70.2	3410.93	10824.3	1.8	10822.4	
54.9	68.4	3323.30	10945.0	1.9	10943.1	
56.9	66.7	3240.35	11060.6	1.9	11058.7	
58.9	65.0	3161.70	11171.5	2.0	11169.5	
60.9	63.5	3087.01	11278.1	2.1	11276.0	
62.9	62.0	3016.00	11380.6	2.2	11378.4	
64.9	60.6	2948.39	11479.3	2.2	11477.0	
66.9	59.3	2883.93	11574.4	2.3	11572.1	
68.9	58.1	2822.42	11666.2	2.4	11663.8	
70.9	56.8	2763.64	11754.9	2.4	11752.4	
72.9	55.7	2707.41	11840.6	2.5	11838.1	
74.9	54.6	2653.58	11923.6	2.6	11921.0	
76.9	53.5	2601.97	12004.0	2.6	12001.3	<<<<

Modified Rational Method

Project Name : Detroit River International Crossing   November 17, 2006   3:46 PM
Stormwater Management Study Alternative 2B Revised Profile

Project No. : 33015384

	2BR - P2	
Area =	6.22	ha
"C" =	0.9	
AC=	5.598	
Tc =	15.2	min
Time Increment =	2.0	min
Release Rate =	0.3	l/s
Max.Storage =	3614	m3

One Hundred Year

a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
15.2	146.3	2276.66	2072.2	0.3	2071.9	
17.2	137.9	2146.51	2211.3	0.3	2211.0	
19.2	130.5	2031.29	2336.4	0.4	2336.0	
21.2	123.9	1928.52	2449.6	0.4	2449.2	
23.2	118.0	1836.26	2552.8	0.4	2552.3	
25.2	112.6	1752.94	2647.3	0.5	2646.8	
27.2	107.8	1677.30	2734.3	0.5	2733.8	
29.2	103.3	1608.31	2814.9	0.6	2814.3	
31.2	99.3	1545.11	2889.7	0.6	2889.1	
33.2	95.5	1486.98	2959.4	0.6	2958.8	
35.2	92.1	1433.34	3024.6	0.7	3024.0	
37.2	88.9	1383.67	3085.9	0.7	3085.2	
39.2	85.9	1337.54	3143.5	0.8	3142.7	
41.2	83.2	1294.57	3197.9	0.8	3197.1	
43.2	80.6	1254.45	3249.3	0.8	3248.5	
45.2	78.2	1216.90	3298.0	0.9	3297.2	
47.2	75.9	1181.66	3344.3	0.9	3343.4	
49.2	73.8	1148.54	3388.4	0.9	3387.5	
51.2	71.8	1117.34	3430.5	1.0	3429.5	
53.2	69.9	1087.90	3470.6	1.0	3469.6	
55.2	68.1	1060.06	3509.0	1.1	3508.0	
57.2	66.4	1033.71	3545.8	1.1	3544.7	
59.2	64.8	1008.71	3581.1	1.1	3580.0	
61.2	63.3	984.97	3615.1	1.2	3613.9	<<<<

Modified Rational Method

Project Name : Detroit River International Crossing — November 17, 2006 3:47 PM
Stormwater Management Study Alternative 2B Revised Profile

Project No. : 33015384

	2BR - P3	
Area =	8.67	ha
"C" =	0.9	
AC=	7.803	
Tc =	16.2	min
Time Increment =	2.0	min
Release Rate =	0.4	l/s
Max.Storage =	5060	m3

One Hundred Year

a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
16.2	142.0	3080.76	2987.1	0.4	2986.7	
18.2	134.2	2910.13	3170.9	0.5	3170.4	
20.2	127.2	2758.50	3336.7	0.5	3336.2	
22.2	120.9	2622.80	3487.3	0.6	3486.7	
24.2	115.3	2500.61	3624.9	0.6	3624.3	
26.2	110.2	2389.97	3751.3	0.7	3750.6	
28.2	105.5	2289.29	3868.0	0.7	3867.3	
30.2	101.3	2197.25	3976.1	0.8	3975.4	
32.2	97.4	2112.78	4076.8	0.8	4076.0	
34.2	93.8	2034.95	4170.8	0.9	4170.0	
36.2	90.5	1963.00	4258.9	0.9	4258.0	
38.2	87.4	1896.28	4341.7	1.0	4340.8	
40.2	84.6	1834.22	4419.7	1.0	4418.7	
42.2	81.9	1776.34	4493.4	1.1	4492.4	
44.2	79.4	1722.23	4563.2	1.1	4562.1	
46.2	77.1	1671.53	4629.5	1.2	4628.3	
48.2	74.9	1623.91	4692.4	1.2	4691.2	
50.2	72.8	1579.09	4752.4	1.3	4751.2	
52.2	70.8	1536.84	4809.7	1.3	4808.4	
54.2	69.0	1496.94	4864.4	1.4	4863.1	
56.2	67.3	1459.18	4916.9	1.4	4915.4	
58.2	65.6	1423.40	4967.1	1.5	4965.6	
60.2	64.1	1389.45	5015.3	1.5	5013.8	
62.2	62.6	1357.18	5061.7	1.6	5060.2	<<<<

Modified Rational Method

Project Name : Detroit River International Crossing November 17, 2006 4:09 PM
Stormwater Management Study Alternative 2B Revised Profile

Project No. : 33015384

	2BR - P4	
Area =	6.36	ha
"C" =	0.9	
AC=	5.724	
Tc =	12.9	min
Time Increment =	2.0	min
Release Rate =	0.4	l/s
Max.Storage =	3656	m3

One Hundred Year	
a=	2824.505
b=	13.74
c=	0.880

Constant Inflows

Rooftop 1	0.0	l/s
Rooftop 2	0.0	l/s
External Area	0.0	l/s
		l/s

Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m3)	Storage Volume (m3)	
12.9	157.1	2499.94	1938.0	0.3	1937.7	
14.9	147.4	2345.76	2099.9	0.3	2099.6	
16.9	138.9	2210.56	2244.2	0.4	2243.8	
18.9	131.4	2090.99	2373.7	0.4	2373.3	
20.9	124.7	1984.44	2490.9	0.5	2490.4	
22.9	118.7	1888.85	2597.5	0.5	2597.0	
24.9	113.3	1802.59	2695.2	0.6	2694.7	
26.9	108.4	1724.33	2785.1	0.6	2784.5	
28.9	103.9	1652.98	2868.3	0.6	2867.6	
30.9	99.8	1587.66	2945.4	0.7	2944.7	
32.9	96.0	1527.62	3017.4	0.7	3016.6	
34.9	92.5	1472.23	3084.6	0.8	3083.8	
36.9	89.3	1420.96	3147.7	0.8	3146.9	
38.9	86.3	1373.36	3207.1	0.9	3206.2	
40.9	83.5	1329.04	3263.1	0.9	3262.1	
42.9	80.9	1287.67	3316.0	1.0	3315.0	
44.9	78.5	1248.95	3366.2	1.0	3365.2	
46.9	76.2	1212.64	3413.8	1.0	3412.8	
48.9	74.1	1178.52	3459.2	1.1	3458.1	
50.9	72.0	1146.38	3502.4	1.1	3501.3	
52.9	70.1	1116.05	3543.7	1.2	3542.5	
54.9	68.3	1087.40	3583.2	1.2	3582.0	
56.9	66.6	1060.26	3621.0	1.3	3619.7	
58.9	65.0	1034.54	3657.3	1.3	3656.0	<<<<

Stormwater Management Pond Area Requirement Calculation Sheet
Alternative 2B-Revised Profile

Stormwater Management Facility No.	2BR - P1	2BR - P2	2BR - P3	2BR - P4
Drainage Area ID	103	102	101	100
Drainage Area (ha)	19.4	6.2	8.7	6.4
Imperviousness of Drainage Area	1.00	1.00	1.00	1.00
Runoff Volume[1] (25mm Storm) (mm)	25.00	25.00	25.00	25.00
Permanent Pool Volume Required[2] (m^3)	4,080	1,306	1,821	1,336
Extended Detention Volume[3] (m^3)	777	249	347	254
Erosion Control Volume[4], 25mm Storm (m^3)	4,858	1,555	2,168	1,590
Total Extended Detention Vol. Req't[5] (m^3)	**4,858**	**1,555**	**2,168**	**1,590**
Assumed Permanent Pool Depth	1.50	1.50	1.50	1.50
Assumed Quantity Storage Depth	1.80	1.80	1.80	1.80
Designed Slope V :1 H :	5.00	5.00	5.00	5.00
Trial and Error Method Assuming square lot				
Assumed Bottom width	49.00	24.00	30.00	29.00
Volume	4872.75	1572.75	2193.75	2082.75
Pond Bottom Area Requirement (m^2)	2,401	576	900	841
Pond Bottom width requirement assuming a square lot	49.00	24.00	30.00	29.00
Pond Area at Normal Water Level	4,096	1,521	2,025	1,936
Pond Area Requirement (m^2)	**6,724**	**3,249**	**3,969**	**3,844**
Pond Area Requirement with 10 m buffer (m^2)	**10,404**	**5,929**	**6,889**	**6,724**
Total Quantity Control Volume @ 1.80m depth from NWL =	9,738	4,293	5,395	5,202
Total Quality and Quantity Control Volume =	14,611	5,866	7,588	7,285
Approximate Volume of Excavation =	33,933	17,238	20,641	20,047

Notes:

[1] Based on Imperviousness for the site (25mm * Imperviousness)

[2] Calculated using Table 3.2 Of the MOE 2003 SWM Planning and Design Manual, 85% Imperviousness (25C

[3] Based on $40m^3$/ha

[4] Area x Runoff Volume

[5] Greater of Extended Detention or Erosion Control

[6] Average release over 24 hours.

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3:25 PM 17/11/2006

Appendix C.6

Alternative 3 – Tunnel

Modified Rational Method

Project Name : **Detroit River International Crossing** November 14, 2006 11:19 AM
Stormwater Management Study
Alternative 3

	100	
Area =	6.36	ha
"C" =	0.9	
AC=	5.724	
Tc =	14.4	min
Time Increment =	10.0	min
Release Rate =	367.0	l/s
Max.Storage =	2376	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.

a=	2825
b=	13.74
c=	0.880

100						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
14.4	149.6	2380.56	2063.1	318.1	1745.0	
24.4	114.5	1822.33	2672.7	538.3	2134.4	
34.4	93.3	1485.01	3069.0	758.6	2310.5	
44.4	79.1	1257.93	3354.5	978.8	2375.7	<<<<
54.4	68.8	1094.07	3574.0	1199.0	2374.9	
64.4	61.0	969.93	3750.4	1419.2	2331.2	
74.4	54.8	872.45	3897.0	1639.5	2257.5	
84.4	49.9	793.76	4021.7	1859.7	2162.0	
94.4	45.8	728.82	4130.0	2079.9	2050.1	
104.4	42.4	674.27	4225.4	2300.1	1925.3	
114.4	39.5	627.76	4310.6	2520.4	1790.2	
124.4	36.9	587.60	4387.4	2740.6	1646.8	
134.4	34.7	552.56	4457.3	2960.8	1496.5	
144.4	32.8	521.70	4521.4	3181.0	1340.4	
154.4	31.1	494.31	4580.6	3401.3	1179.3	
164.4	29.5	469.81	4635.4	3621.5	1014.0	
174.4	28.1	447.77	4686.6	3841.7	844.9	
184.4	26.9	427.82	4734.6	4061.9	672.6	
194.4	25.7	409.69	4779.7	4282.2	497.5	
204.4	24.7	393.12	4822.2	4502.4	319.8	
214.4	23.7	377.92	4862.5	4722.6	139.9	
224.4	22.9	363.92	4900.8	4942.8	-42.1	
234.4	22.1	350.98	4937.2	5163.1	-225.9	
244.4	21.3	338.99	4971.9	5383.3	-411.4	

Modified Rational Method

Project Name : **Detroit River International Crossing** November 14, 2006 11:19 AM
Stormwater Management Study
Alternative 3

	101	
Area =	2.80	ha
"C" =	0.9	
AC=	2.52	
Tc =	13.9	min
Time Increment =	10.0	min
Release Rate =	167.3	l/s
Max.Storage =	1030	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.	
a=	2825
b=	13.74
c=	0.880

101						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
13.9	152.4	1067.32	888.0	139.2	748.8	
23.9	116.1	813.12	1164.4	239.6	924.8	
33.9	94.3	660.75	1342.7	340.0	1002.7	
43.9	79.7	558.69	1470.5	440.3	1030.1	<<<<
53.9	69.3	485.29	1568.4	540.7	1027.7	
63.9	61.4	429.81	1647.0	641.1	1005.9	
73.9	55.1	386.33	1712.2	741.5	970.7	
83.9	50.1	351.27	1767.6	841.9	925.8	
93.9	46.0	322.38	1815.6	942.2	873.4	
103.9	42.6	298.13	1858.0	1042.6	815.3	
113.9	39.6	277.47	1895.7	1143.0	752.7	
123.9	37.1	259.65	1929.7	1243.4	686.3	
133.9	34.8	244.10	1960.6	1343.8	616.9	
143.9	32.9	230.42	1989.0	1444.1	544.9	
153.9	31.2	218.28	2015.1	1544.5	470.6	
163.9	29.6	207.43	2039.4	1644.9	394.5	
173.9	28.2	197.66	2062.0	1745.3	316.8	
183.9	27.0	188.83	2083.2	1845.7	237.6	
193.9	25.8	180.81	2103.1	1946.0	157.1	
203.9	24.8	173.47	2121.9	2046.4	75.5	
213.9	23.8	166.75	2139.7	2146.8	-7.1	
223.9	22.9	160.56	2156.6	2247.2	-90.6	
233.9	22.1	154.84	2172.7	2347.6	-174.9	
243.9	21.3	149.54	2188.0	2447.9	-259.9	

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Modified Rational Method

Project Name : **Detroit River International Crossin[** November 14, 2006 11:19 AM
Stormwater Management Study
Alternative 3

	108	
Area =	2.16	ha
"C" =	0.9	
AC=	1.944	
Tc =	13.6	min
Time Increment =	10.0	min
Release Rate =	130.6	l/s
Max.Storage =	790	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.

a=	2825
b=	13.74
c=	0.880

108						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
13.6	153.7	830.43	677.6	106.6	571.0	
23.6	116.8	631.20	893.8	185.0	708.8	
33.6	94.8	512.25	1032.7	263.4	769.3	
43.6	80.1	432.75	1132.1	341.7	790.3	<<<<
53.6	69.5	375.67	1208.1	420.1	788.0	
63.6	61.5	332.57	1269.1	498.5	770.6	
73.6	55.3	298.82	1319.6	576.9	742.7	
83.6	50.3	271.64	1362.5	655.3	707.3	
93.6	46.1	249.24	1399.7	733.6	666.1	
103.6	42.6	230.45	1432.5	812.0	620.4	
113.6	39.7	214.44	1461.7	890.4	571.3	
123.6	37.1	200.64	1488.0	968.8	519.2	
133.6	34.9	188.61	1511.9	1047.1	464.7	
143.6	32.9	178.02	1533.8	1125.5	408.3	
153.6	31.2	168.62	1554.0	1203.9	350.1	
163.6	29.6	160.23	1572.8	1282.3	290.5	
173.6	28.3	152.68	1590.3	1360.7	229.6	
183.6	27.0	145.85	1606.6	1439.0	167.6	
193.6	25.8	139.64	1622.0	1517.4	104.6	
203.6	24.8	133.97	1636.6	1595.8	40.7	
213.6	23.8	128.77	1650.3	1674.2	-23.9	
223.6	22.9	123.98	1663.3	1752.6	-89.2	
233.6	22.1	119.56	1675.7	1830.9	-155.2	
243.6	21.4	115.46	1687.6	1909.3	-221.7	

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Modified Rational Method

Project Name : **Detroit River International Crossing** November 14, 2006 11:19 AM
Stormwater Management Study
Alternative 3

	109	
Area =	**6.56**	ha
"C" =	**0.9**	
AC=	**5.904**	
Tc =	**24.3**	min
Time Increment =	**10.0**	min
Release Rate =	**268.7**	l/s
Max.Storage =	**2829**	m^3

Constant Inflows

	l/s

Controlled Condition

100 Year - Post Dev't.	
a=	**2825**
b=	**13.74**
c=	**0.880**

109						
Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Runoff Volume (m3)	Released Volume (m^3)	Storage Volume (m^3)	
24.3	114.9	1885.91	2749.7	391.8	2357.9	
34.3	93.6	1535.76	3160.6	553.0	2607.6	
44.3	79.2	1300.33	3456.3	714.3	2742.0	
54.3	68.9	1130.58	3683.4	875.5	2807.9	
64.3	61.1	1002.06	3866.0	1036.7	2829.2	<<<<
74.3	54.9	901.19	4017.5	1197.9	2819.6	
84.3	49.9	819.78	4146.5	1359.2	2787.3	
94.3	45.9	752.63	4258.4	1520.4	2738.0	
104.3	42.4	696.22	4357.0	1681.6	2675.3	
114.3	39.5	648.14	4444.9	1842.9	2602.1	
124.3	37.0	606.64	4524.3	2004.1	2520.2	
134.3	34.8	570.43	4596.5	2165.3	2431.2	
144.3	32.8	538.54	4662.7	2326.6	2336.1	
154.3	31.1	510.24	4723.8	2487.8	2236.0	
164.3	29.5	484.93	4780.4	2649.0	2131.4	
174.3	28.2	462.16	4833.3	2810.2	2023.0	
184.3	26.9	441.56	4882.8	2971.5	1911.3	
194.3	25.8	422.83	4929.3	3132.7	1796.6	
204.3	24.7	405.72	4973.3	3293.9	1679.3	
214.3	23.8	390.02	5014.8	3455.2	1559.7	
224.3	22.9	375.56	5054.3	3616.4	1437.9	
234.3	22.1	362.20	5091.9	3777.6	1314.3	
244.3	21.3	349.82	5127.7	3938.9	1188.9	
254.3	20.6	338.31	5162.0	4100.1	1061.9	

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Stormwater Management Pond Area Requirement Calculation Sheet
OPTION 3

Stormwater Management Facility No.	3-P1	3-P2	N/A	N/A	N/A	N/A	N/A	N/A	3-P3	3-P3
Drainage ID	**100**	**101**	**102**	**103**	**104**	**105**	**106**	**107**	**108**	**109**
Drainage Area (ha)	6.4	2.8	0.3	0.3	0.1	0.2	0.2	0.2	2.2	6.6
Imperviousness of Drainage Area	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Runoff Volume[1] (25mm Storm) (mm)	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Permanent Pool Volume Required[2] (m^3)	1,336	588	71	71	29	40	36	40	454	1,378
Extended Detention Volume[3] (m^3)	254	112	14	14	6	8	7	8	86	262
Erosion Control Volume[4], 25mm Storm (m^3)	1,590	700	85	85	35	48	43	48	540	1,640
Total Extended Detention Vol. Req't[5] (m^3)	**1,590**	**700**	**85**	**85**	**35**	**48**	**43**	**48**	**540**	**1,640**
Assumed Permanent Pool Depth	1.50	1.50	N/A	N/A	N/A	N/A	N/A	N/A	1.50	1.50
Assumed Quantity Storage Depth	1.80	1.80	N/A	N/A	N/A	N/A	N/A	N/A	1.80	1.80
Designed Slope V :1 H :	5.00	5.00	N/A	N/A	N/A	N/A	N/A	N/A	5.00	5.00
Trial and Error Method Assuming square lot										
Assumed Bottom width	25.00	14.00	N/A	N/A	N/A	N/A	N/A	N/A	11.00	25.00
Volume	1668.75	777.75	N/A	N/A	N/A	N/A	N/A	N/A	597.75	1668.75
Pond Bottom Area Requirement (m^2)	625	196	N/A	N/A	N/A	N/A	N/A	N/A	121	625
Pond Bottom width requirement assuming a square lot	25.00	14.00	N/A	N/A	N/A	N/A	N/A	N/A	11.00	25.00
Pond Area at Normal Water Level	1,600	841	N/A	N/A	N/A	N/A	N/A	N/A	676	1,600
Pond Area Requirement (m^2)	**3,364**	**2,209**	N/A	N/A	N/A	N/A	N/A	N/A	**1,936**	**3,364**
Pond Area Requirement with 10 m buffer (m^2)	**6,084**	**4,489**	N/A	N/A	N/A	N/A	N/A	N/A	**4,096**	**6,084**
Total Quantity Control Volume @ 1.80m depth from NWL =	4,468	2,745	N/A	N/A	N/A	N/A	N/A	N/A	2,351	4,468
Total Quality and Quantity Control Volume =	6,136	3,523	N/A	N/A	N/A	N/A	N/A	N/A	2,949	6,136
Approximante Volume of Excavation =	17,779	12,415	N/A	N/A	N/A	N/A	N/A	N/A	11,175	17,779

Notes:
1 Based on Imperviousness for the site (25mm * Imperviousness)
2 Calculated using Table 3.2 Of the MOE 2003 SWM Planning and Design Manual, 85% Imperviousness ($250m^3$/ha - $40m^3$/ha)
3 Based on $40m^3$/ha
4 Area x Runoff Volume
5 Greater of Extended Detention or Erosion Control
6 Average release over 24 hours.
* Drainage Area 108 and 109 Drain to same pond 3-P3

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