Stormwater Management Report

Twin River – Tiverton Proposed Casino & Hotel
William S. Canning Blvd & Stafford Road
Tiverton, Rhode Island

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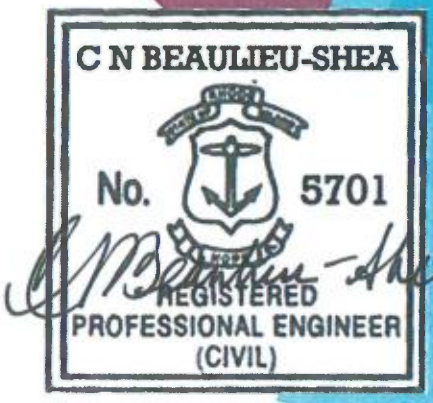

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1. INTRODUCTION

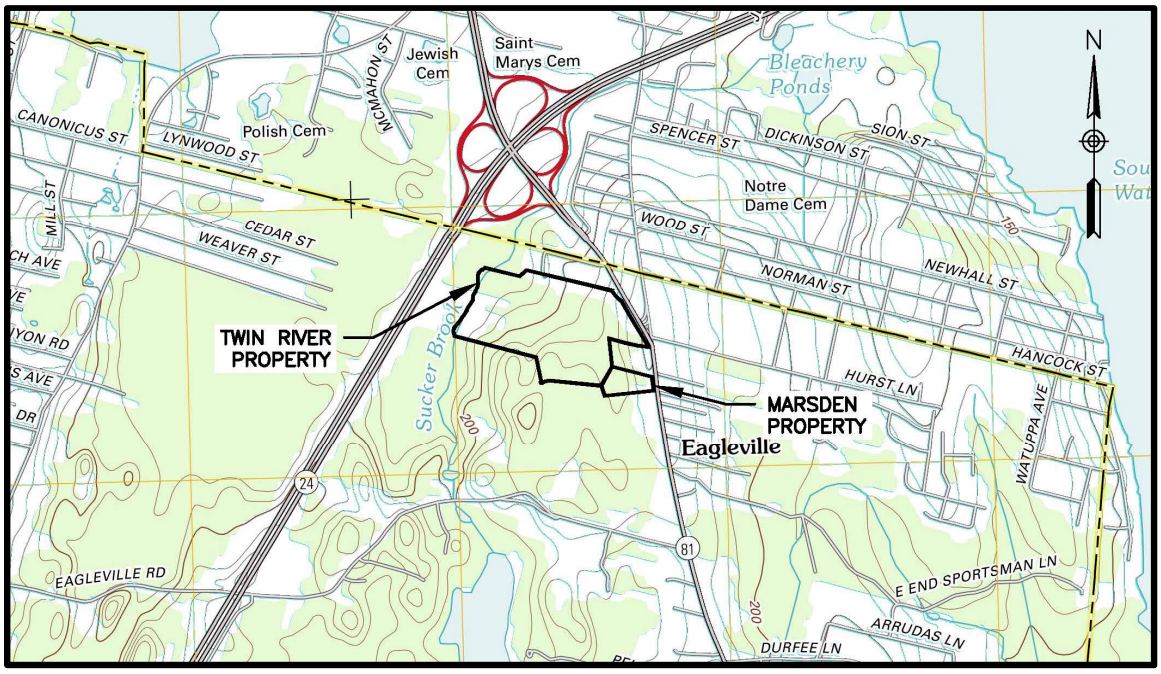
On behalf of Ferrucci Russo, PC (Ownerôs Representative) and Twin River ï Tiverton, LLC (Owner), Amec Foster Wheeler and Cherenzia & Associates, Ltd. have prepared this Stormwater Management Report in support of the Twin River ï Tiverton Proposed Casino and Hotel (ñProjectò or ñSiteò). The Project is located on Assessorôs Plat 203 Lot 111, a 46.6±-acre parcel of land at the intersection of William S. Canning Boulevard and Stafford Road in Tiverton Rhode Island. The Site is approximately 400 feet south of the Massachusetts state line and Route 24, Exit 1A. The casino, hotel, associated surface and structured parking, stormwater management areas, and other amenities will occupy approximately 20.2± acres within upland areas of the 46.6±-acre Site. In addition, the Owner has secured an easement on Assessorôs Plat 203 Lot 107 (3.6± acres) to provide emergency access to the local roadway network; therefore, for the purposes of this stormwater study, the Project includes all proposed development on both AP 203 Lot 111 and AP 203 Lot 207.

The Project includes the construction of a 77,500± square-foot footprint, partial two-story casino building, a 15,130± square-foot footprint, three-story, 84-guest-room hotel, a 140,000± square-foot footprint, two-story parking structure to accommodate 844± passenger vehicles. Additional surface parking for 275± passenger vehicles for employees, access drives, loading areas, stormwater management systems, retaining walls, and interior and perimeter landscaping surround the proposed structures. A permeable pavement (Gravelpave® or equivalent) emergency access drive will extend from the employee parking lot to Stafford Road and includes a 100-foot long bridge to cross the narrowest section of wetlands located on Lot 107. Utility services shall include municipal water from the North Tiverton Fire District (Tiverton Water Authority) and wastewater conveyed through the Tiverton Wastewater District (TWWD) and the City of Fall Riverôs municipal systems for treatment at the Fall River Regional Wastewater Treatment Facility. To the greatest extent practicable while supporting the programmatic needs of the development, existing wetlands and wooded areas surrounding the casino and hotel shall remain undisturbed.

The proposed development program preserves existing woods, wetlands, streams, and other natural resources to the greatest extent possible while meeting programmatic needs. The proposed bridge span, structured parking, and many retaining walls have been incorporated into the design to prevent impact to biological wetlands and to minimize disturbance into regulated wetlands while still meeting the programmatic needs of the casino and hotel. Additionally, the project will include pedestrian access to two wetland overlooks within upland areas of the Site adjacent to the wetlands and forested areas to remain. The Site Location is shown herein and is provided in a larger scale document as Appendix A.1.

Simultaneous with the construction of this project, the Rhode Island Department of Transportation (RIDOT) is proposing to construct a roundabout to improve traffic flow in the vicinity of the Site. The roundabout will encompass Hurst Lane, Stafford Road, William S. Canning Boulevard, and the Siteôs Primary Access Drive. Any drainage impacts associated with this ñoff-siteò work will be addressed independently by RIDOT and are not included in this drainage report.

Natural flow of surface water through the Site is generally southeast to northwest, with roughly an 80-acre watershed contributing to an intermittent stream, swamp and forested wetlands, and Sucker Brook. Sucker Brook represents the westernmost boundary of the Site, flowing northerly out of Stafford Pond (south of the Site in Tiverton, Rhode Island) and into an urbanized section of Fall River, Massachusetts north through a series of swales and culverts until it discharges into South Watuppa Pond. Information on water quality issues relating to the downstream section of Sucker Brook and South Watuppa Pond are provided in Appendix A.4.



The Project includes a number of stormwater best management practices (BMPs) to control stormwater quality and quantity for the development. BMPs proposed for the project include deep-sump catch basins, sediment forebays, sand filters, surface infiltration basins, subsurface Stormtech sand filters, a bioretention basin, and areas of permeable pavement (Gravel-pave® or equivalent). Low-impact development (LID) techniques were employed to the greatest extent practicable, given extensive areas of shallow and surficial ledge and a shallow seasonal high groundwater table. Despite these limitations, this Stormwater Management Report provides supporting evaluation, documentation, analysis, and calculations to confirm that all components of the stormwater management system have been designed to comply with the requirements set forth in the latest edition of the ñ*Rhode Island Stormwater Design and Installation Manual (RISDISM).*" Additionally, given the Site's proximity to the Massachusetts border, the Project has also been designed to meet the requirements of the ñ*Massachusetts Stormwater Handbook*".

2. EXISTING CONDITIONS

At present, the property is completely undeveloped, consisting of woods, boulders/ledge outcrops, and wetlands. There are numerous stonewalls defining current and former property lines. Within the Site, there are no known or mapped areas of agricultural uses, historic cemeteries, or unique archeological features.

WETLANDS

Nearly 22± acres of state-regulated wetlands exist within the 46.6± acre project Site. These wetland features were verified by the Rhode Island Department of Environmental Management (RIDEM) through a ñRequest to Verify Wetland Edges,ò on March 17, 2016.

Flag Series	Wetland Type	Associated Buffer
A-1 to A-11	Swamp	50ôPerimeter Wetland
A-100 to A-184	Swamp	50ôPerimeter Wetland
B-1 to B-20	Swamp	50ôPerimeter Wetland
B-100 to B-146	Swamp	50ôPerimeter Wetland
C-100 to C-134	Swamp	50ôPerimeter Wetland
E-1 to E-15	Forested Wetland	None
None	Intermittent Stream < 10ôWide	100ôRiverbank Wetland
Sucker Brook	River > 10ôWide	200ôRiverbank Wetland

These state-regulated wetlands are hydrologically and hydraulically connected to Sucker Brook, which is a stream > 10 feet wide that represents the westernmost property line of the Site. Sucker Brook flows from south to north, out of Stafford Pond, then along the subject propertyôs boundary, into the heavily developed areas adjacent to Route 24 in Fall River, MA, before ultimately discharging into South Watuppa Pond in Fall River, MA.

According to the RIDEM Water Quality Regulations (2010), Sucker Brook is a warm-water fishery.

IMPAIRMENTS/TMDLs

The wetlands and streams on-site are tributary to Sucker Brook. According to the report titled, ñState of Rhode Island 2014 303(d) List of Impaired Waters,ò published by the Rhode Island Department of Environmental Management Office of Water Resources, ñSucker Brook & Tributariesò (ID Number RI0007037R-01) was delisted for Enterococcus in 2012 and lists no impairments in the most recent edition (May 2015). See Appendix A.4 for Sucker Brook/South Watuppa Pond Hazard Analysis.

GROUNDWATER AND SOIL EVALUATION

Based on Natural Resources Conservation Service (NRCS) Web Soil Survey mapping, soils within the development areas of the Site are: (See Appendix A.2 for NRCS Web Soil Survey Map).

Soil Type	Abbreviation	Hydrologic Soil Group
Canton and Charlton fine sandy loam	CeC	B
Pittstown silt loam	PmA	C
Urban Land Complex (Udorthents)	Ur	A

Soil borings were conducted throughout the project site in January, February, and March of 2017 by Amec Foster Wheeler. Soil borings have determined similar soil characteristics across the development parcel, generally consisting of bedrock overlain by sand and glacial till material. Based on dense till material in the upper strata of the soil profile throughout the site, limited infiltration is assumed to occur under existing conditions. Although site runoff characteristics have been conservatively modeled to match hydrologic soil groups noted by NRCS (Hydrologic Soil Groups B, C, and A), runoff characteristics of the existing site may be more closely related to Hydrologic Soil Group D.

A shallow seasonal high groundwater table is present throughout the site. See Appendix B.1 for a Test Hole Location Plan, Appendix B.2 for the Soil boring logs, Appendix B.3 for seasonal high groundwater table adjustment calculations, and Appendix B.4 for the Falling Head Test Data.

FEMA

The Site is entirely located within Flood Zone X (Areas determined to be outside the 0.2% annual chance floodplain), based on FEMA Flood Insurance Map 44005C0041H, dated 4/5/2010, and FEMA Flood Insurance Map 44005C0042H, dated 10/19/2010, for Newport County, Rhode Island. Please note that according to FEMA Map 44005CIND0B, the two panels encompassing are not printed by FEMA due to no special flood hazard areas being present within those panel areas. See Appendix A.3 for FEMA Flood Maps.

FLOOD ANALYSIS

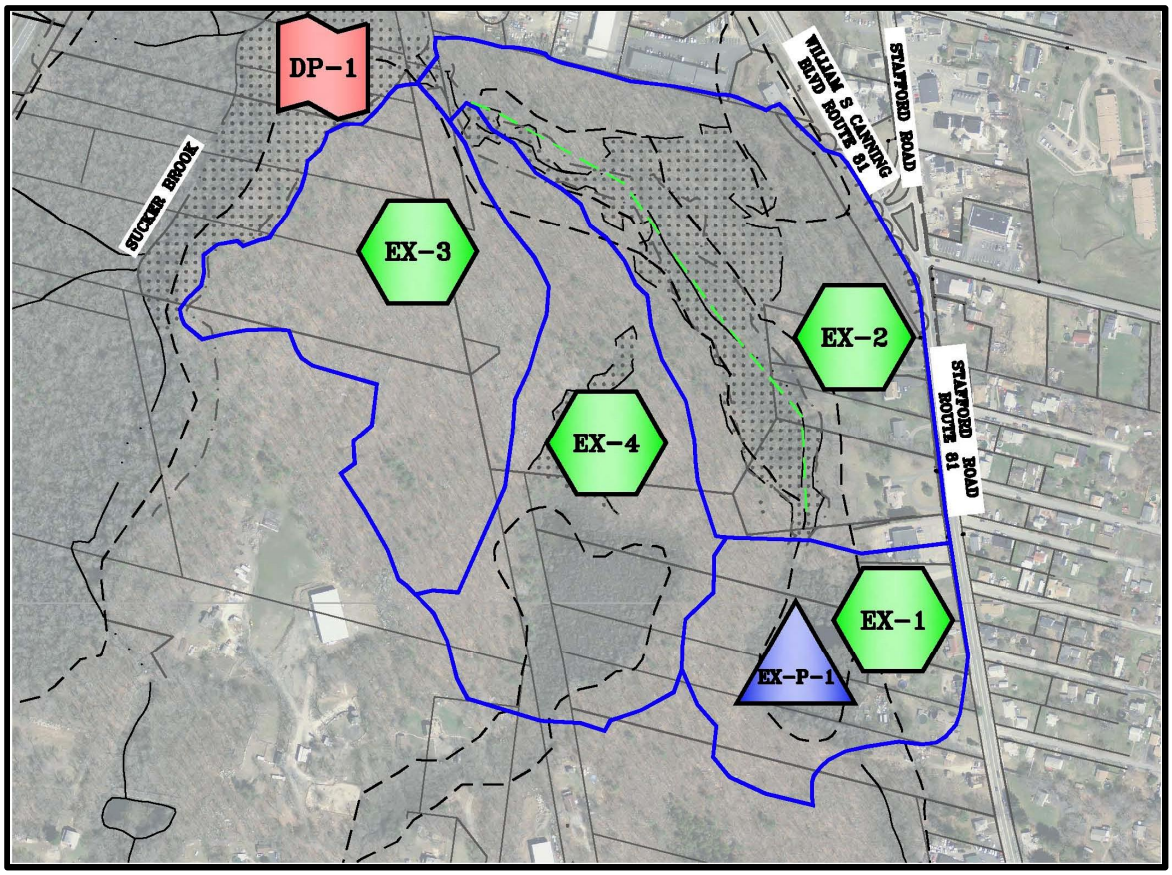
At the recommendation of RIDEM, a study to determine the Base Flood Elevations (BFE) for Sucker Brook and the Unnamed Intermittent Stream in the vicinity of the Site was performed. This report determined that the 100-year flood elevations for Sucker Brook range from elevation 179.2 (south of the Site) to elevation 177.2 (north of the Site). 100-year flood elevations for the intermittent stream range from elevation 236.4 (south of the Site) to elevation 182.4 (north of the Site). The study concludes that the flood elevations are either contained entirely within or minimally extends beyond the state-regulated wetlands. The proposed development was designed above and outside the limits of the calculated 100-year floodplain. The flood study is included under separate cover.

DESIGN POINT

Cherenzia and Amec Foster Wheeler conducted an evaluation of the existing site conditions and topography to determine the most-suitable Design Point (DP-1) for the purpose of analysis. This location has been set as the edge of wetlands associated with Sucker Brook, on the northwestern side of the Site. Peak flow rates for this Design Point were determined, as described in the following sections of this report.

PRE-DEVELOPMENT ANALYSIS

Under pre-development conditions, the Site was divided into four (4) sub-watersheds (total study area of 79.8± acres) contributing to the above described Design Point, where peak discharge rates were evaluated for the 2-year, 10-year, 25-year, and 100-year storm events. See Appendix C.1 for Existing HydroCAD Calculations and Appendix F for a 24òx 36òExisting Drainage Figure.



- Sub-watershed ñEX-1ò is 12.1± acres and is comprised of 8.2± acres of woods in good condition and 3.9± acres of rural residential properties along Stafford Road. Runoff from EX-1 flows overland to an existing wetland ponding area. This ponding area discharges stormwater to the south and north. The south discharge is not analyzed due to no change resulting from proposed conditions and the north discharge flows north into the wetlands, ASSFs and intermittent stream (R-1) to enter Sucker Brook (DP-1).

- Sub-watershed ñEX-2ò is 27.8± acres and is comprised of 22.7± acres of woods in good condition and 5.1± acres of rural residential properties along Stafford Road. Runoff from this watershed flows into wetlands between upland areas of the site and Stafford Road. Within these wetlands, runoff flows from east to west, through an ASSF and an intermittent stream, then into the wetlands associated with Sucker Brook (DP-1).

- Sub-watershed ñEX-3ò is comprised of 19.6± acres of woods in good condition. Runoff from this watershed flows over land to the northeast into wetlands along Sucker Brook (DP-1).

- Sub-watershed ñEX-4ò is comprised of 20.2± acres of woods in good condition. Runoff from this watershed flows overland to the north and enters an ASSF. Within this ASSF, runoff flows into the wetlands associated with Sucker Brook (DP-1).

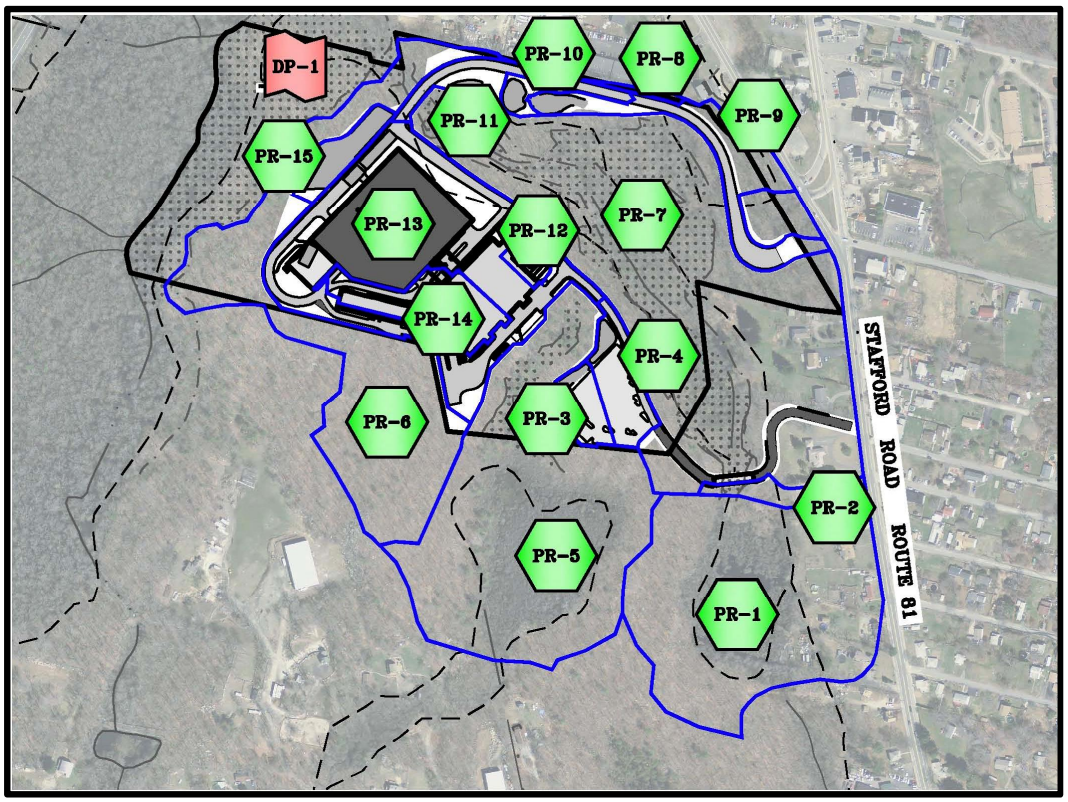
3. PROPOSED CONDITIONS

As stated in this reportôs introduction, the proposed development consists of the construction of a new casino, hotel, parking structure, and associated site amenities and features. Proposed development impacts have been minimized to the maximum extent practicable by incorporating retaining walls along site drives, designing the casino building as a ñwalk-outò two-level structure, including structured parking in the site design, and spanning existing wetlands with a new bridge. Low-impact design elements include sand filters, a bioretention basin, infiltration basins, subsurface infiltration systems, and permeable pavements.

In aggregate, the project has been designed to provide required water quality treatment, controls for post-development peak rates at or below pre-development rates for the 2-year, 10-year, 25-year, and 100-year storm events, and mechanisms to safely convey higher intensity storm events towards the wetlands and away from developed properties. (NOTE: This project is not a ñland use with higher potential pollutant loads (LUHPPL)ò as defined in the RISDISM.)

POST-DEVELOPMENT ANALYSIS

Under post-development conditions, the Site was divided into fifteen (15) sub-watersheds (total study area of 79.8± acres) contributing to the previously described Design Point, where peak discharge rates were evaluated for the 2-year, 10-year, 25-year, and 100-year storm events. See Appendix C.2 for Proposed HydroCAD calculations and Appendix F for a 24ò x 36ò Proposed Drainage Figure.



- Sub-watershed ñPR-1ò is 12.1± acres, representing the wooded and residential lot area that drains to an existing wetland ponding area (P-1). Stormwater drains from this ponding area to the south (which is not analyzed due to no affect from development conditions) and to the north under the

proposed bridge (C-1), along the intermittent stream (R-1 & R-2), and through the proposed culvert (C-3) into the wetlands and Sucker Brook at the western property boundary (Design Point 1). This sub-watershed is completely unchanged under proposed conditions, and is modeled exclusively to approximate flow contributing to the project site.

- Sub-watershed ñPR-2ò is 0.8± acres, representing the wooded and residential lot area that drains to the up-gradient side of the proposed bridge (C-1). Stormwater drains from this area to the north under the proposed bridge (C-1), along the intermittent stream (R-1 & R-2), and through the proposed culvert (C-3) into the wetlands and Sucker Brook at the western property boundary (Design Point 1).

- Sub-watershed ñPR-3ò is 0.9± acres, representing the western portion of the employee parking area that drains to the northern sediment forebay/sand filter along the employee parking area (P-1). Stormwater drains from this area into the lower sediment forebay/sand filter (P-2) which drains to the north through the proposed culvert (C-2), along the intermittent stream (R-2), and through the proposed culvert (C-3) into the wetlands and Sucker Brook at the western property boundary (Design Point 1).

- Sub-watershed ñPR-4ò is 1.4± acres, representing the eastern portion of the employee parking area that drains to the southern sediment forebay/sand filter along the employee parking area (P-2). Stormwater drains from this area to the north, through the proposed culvert (C-2), along the intermittent stream (R-2), and through the proposed culvert (C-3) into the wetlands and Sucker Brook at the western property boundary (Design Point 1).

- Sub-watershed ñPR-5ò is 14.3± acres, representing the undisturbed woodland area that drains to the proposed culvert (C-2). Stormwater drains from this area through the proposed culvert (C-2), along the intermittent stream (R-2), and through the proposed culvert (C-3) into the wetlands and Sucker Brook at the western property boundary (Design Point 1).

- Sub-watershed ñPR-6ò is 10.2± acres, representing the undetained and undisturbed woodland area up-gradient from the project that is either diverted through perforated pipe and stone along the toe of the retaining wall or flows directly into the wetlands and Sucker Brook at the western property boundary (Design Point 1).

- Sub-watershed ñPR-7ò is 22.5± acres, representing the undisturbed woodland area and residential lots that drain to the proposed culvert (C-3). This culvert drains northwest into the wetlands and Sucker Brook at the western property boundary (Design Point 1).

- Sub-watershed ñPR-8ò is 0.1± acres, representing a minor amount of existing developed area that drains off-site and eventually enter the wetlands and Sucker Brook at the western property boundary (Design Point 1).

- Sub-watershed ñPR-9ò is 2.6± acres, representing the portion of the roadway that drains into the sediment forebay/infiltration basin along the access road (P-3). Stormwater drains from this area to the west, through the middle sediment forebay/infiltration basin (P-4) to the proposed culvert (C-3) and into the wetlands and Sucker Brook at the western property boundary (Design Point 1).

- Sub-watershed ñPR-10ò is 0.6± acres, representing the portion of the roadway that will drain to the sediment forebay/infiltration basin along the access road (P-4). Stormwater drains from this treatment area to the proposed culvert (C-3) and into the wetlands and Sucker Brook at the western property boundary (Design Point 1).

- Sub-watershed ñPR-11ò is 1.0± acres, representing the portion of the roadway that will drain to the sediment forebay/sand filter along the access road (P-5). Stormwater drains from this treatment area to the proposed culvert (C-3) and into the wetlands and Sucker Brook at the western property boundary (Design Point 1).

- Sub-watershed ñPR-12ò is 0.5± acres, representing a small portion of casino roof and the surface parking lot located at the northeastern side of the casino. Stormwater from this area drains overland to a bioretention basin (P-6), to the proposed culvert (C-3) and into the wetlands and Sucker Brook at the western property boundary (Design Point 1).

- Sub-watershed ñPR-13ò is 9.9± acres, representing the majority of the site, including the parking garage, the northern portion of the casino roof, and areas surrounding the buildings. This area is collected by a closed drainage system that drains into the proposed MC-4500 and SC-740 Stormtech underground sand filter system located northwest of the garage (P-7 & P-8). This treatment system includes isolator rows for pre-treatment, and a layer of sand for water quality treatment. This area drains into the infiltration pond (P-10), and ultimately to the wetlands and Sucker Brook at the western property boundary (Design Point 1).

- Sub-watershed ñPR-14ò is 1.8± acres, representing the southern half of the casino roof, the hotel roof, and a small portion of the site drives. This area is collected by a closed drainage system that drains into the proposed MC-3500 Stormtech underground sand filter system located west of the garage (P-9). This treatment system includes isolator rows for pre-treatment, and a layer of sand for water quality treatment. This area drains into the infiltration pond (P-10), and ultimately to the wetlands and Sucker Brook at the western property boundary (Design Point 1).

- Sub-watershed ñPR-15ò is 0.9± acres, representing the area that directly drains into the infiltration pond (P-10). This area ultimately drains to the wetlands and Sucker Brook at the western property boundary (Design Point 1).

4. HYDROLOGIC ANALYSIS

The hydrologic analysis was performed using HydroCAD software for a 24-hour, Type III rainfall event for Newport County (2-year: 3.3 inches, 10-year: 4.9 inches, 25-year: 6.1 inches, 100-year: 8.6 inches) and one overall point of analysis, ñDesign Point 1 (DP-1)ò that conveys runoff off-site via Sucker Brook along the western property boundary. Sucker Brook flows from south to north, out of Stafford Pond, then through the subject property and into the heavily developed areas adjacent to Route 24 in Fall River, before ultimately discharging into South Watuppa Pond in Fall River, Massachusetts.

Table 1 provides a summary of this analysis, which shows that post-development peak discharge rates will be less than pre-development peak discharge rates for all calculated storms up to and including the 100-year event.

Table 1: Hydrologic Analysis Summary

Design Point	Description	Design Storm	Peak Flow (cfs)	
			EX	PR
1	**Wetlands at Sucker Brook**	2-YEAR	16.89	16.65
		10-YEAR	48.43	45.97
		25-YEAR	77.50	70.68
		100-YEAR	145.80	144.30

CULVERT ANALYSIS

Two culverts and a bridge crossings are proposed on the project site, and have been modeled in the HydroCAD analysis as ponds with insignificant storage.

- The bridge crossing (C-1) shows that the 100-year storm reaches elevation 234.3. Existing grades within the wetland area are intended to remain undisturbed so it is anticipated that proposed conveyance will closely match existing conditions.
- The crossing between the casino and employee parking area (C-2) is proposed to be two 48-inch HDPE pipe culverts with 12 inches of soil in the bottom of them to function as ñcritter crossings.ò This culvert is conservatively modeled as two (2) 36-inch pipes in the HydroCAD model. The model shows that for the 100-year storm, backwater conditions reach elevation 225.97. Existing grades at the up-gradient side of the culvert are approximately elevation 224.6 and the edge of wetlands is approximately elevation 226.7.
- The crossing north of the garage, along the primary access drive (C-3) is proposed to be 10ôx4ô tall box culvert with 12 inches of soil on the bottom; therefore, this culvert is modeled as a 10ôx3ô box culvert in the HydroCAD model. The model shows that the 100-year storm reaches elevation 189.16. Flood Study Cross-section 1.5 (under separate cover) was placed at the same location as the proposed crossing and depicts a 100-year flood elevation of 189.3. The proposed culvert 100-year elevation is below the 100-year flood elevation.

5. CONCLUSIONS (RHODE ISLAND STORMWATER STANDARDS)

This project has been designed in accordance with the latest edition of the *RISDISM,* Section 3.2 Minimum Stormwater Management Standards, as summarized below and provided in other submission documents.

MINIMUM STORMWATER MANAGEMENT STANDARDS

1. Minimum Standard 1: LID Site Planning and Design Strategies
   "LID Site planning and design strategies must be used to the maximum extent practicable in order to reduce the generation of the water runoff volume for both new and redevelopment projects."

   Standard Met
   LID site planning and design strategies have been employed on this project to the maximum extent practicable. The Stormwater Management Plan checklist from ñ*Appendix A"* of the (RISDISM) has been prepared and is provided under separate cover. This document provides data to show compliance with this standard.

2. Minimum Standard 2: Groundwater Recharge
   "Stormwater must be recharged within the same subwatershed to maintain base flow at pre-development recharge levels to the maximum extent practicable."

   Standard Met to the Maximum Extent Practicable
   Groundwater recharge is provided to the maximum extent practicable through the infiltration basins located along the primary access drive and the permeable pavement surface of the emergency access drive. (See Appendix E.1 for detailed groundwater recharge calculations).

   Groundwater recharge is not feasible in other areas of the site due to shallow bedrock and shallow seasonal high groundwater tables. In these areas, shallow groundwater flows along the restrictive ledge layer before finding daylight into the adjacent wetlands. To mimic this condition, underdrains below the sand filters, bioretention, and infiltration ponds were incorporated into the design to approximate groundwater recharge by filtering stormwater through soil media and conveying flow to the adjacent wetlands.

   Based on soil testing completed throughout the project site, groundwater recharge appears to be fairly limited under pre-development conditions. A dense till layer exists in the upper soil strata which is likely to limit infiltration potential. Although the site is mapped as Hydrologic Soil Groups A, B, and C by NRCS, the actual infiltrative capacity of the site when measured from existing grade is likely to be similar to that expected of Hydrologic Soil Group D.

3. Minimum Standard 3: Water Quality
   "Stormwater runoff must be treated before discharge."

   Standard Met
   Pre-treatment equal to 25% of the water quality volume is provided for all site parking lots, driveways, and sidewalks. Pre-treatment is achieved using sediment forebays and Stormtech® Isolator Rows before the stormwater treatment practice. Stormwater treatment is provided through the use of sand filters, a bioretention basin, permeable pavement, and infiltration practices. (See Appendix D.1 for detailed water quality calculations). Accordingly, the pre-treatment and treatment requirements of Minimum Standard 3 have been satisfied.

4. Minimum Standard 4: Conveyance and Natural Channel Protection
"Protection for natural channels downstream must be supplied by providing 24-hour extended detention of the one-year, 24-hour Type III design storm event runoff volume."

Standard Met
HydroCAD calculations are provided in Appendix C.2. These calculations show that the proposed bioretention basin, sand filters, and infiltration basins have been designed to completely infiltrate/filter the 1-year storm event without discharge through structural outlets as shown below. As noted in the RIDEM Water Quality Regulations (2010), the site discharges to a warm water fishery (Sucker Brook).

Pond Name	Exempt from Requirement?	1-Year Storm Management
P-1 Sand Filter Upper Employee Parking	Yes, post-development discharge to <2cfs & inflow area of <1 acre of impervious	Water volume fully filtered through sand media without overtopping outlet weir.
P-2 Sand Filter Lower Employee Parking	No	Water volume fully filtered through sand media without overtopping outlet weir.
P-3 Infiltration Basin Upper Access Road	Yes, inflow area of <1 acre of impervious.	Water volume fully infiltrated without overtopping outlet weir.
P-4 Infiltration Basin Middle Access Road	Yes, post-development discharge to <2cfs & inflow area of <1 acre of impervious.	Water volume fully infiltrated without overtopping outlet weir.
P-5 Sand Filter Lower Access Road	Yes, post-development discharge to <2cfs & inflow area of <1 acre of impervious	Water volume fully filtered through sand media without overtopping outlet weir.
P-6 Bioretention Basin	Yes, post-development discharge to <2cfs & inflow area of <1 acre of impervious	Water volume fully filtered through soil media without ponding to overflow catch basin.
P-7 & P-8 MC-3500 & SC-740	No	Excess runoff routed to Main Pond for management.
P-9 MC-3500	No	Excess runoff routed to Main Pond for management.
P-10 Main Pond	No	Water volume fully filtered through soil media without ponding outlet culvert or outlet weir.

5. Minimum Standard 5: Overbank Flood Protection
"Downstream overbank flood protection must be provided by attenuating the post-development peak discharge rate to the pre-development levels for the 10-year and 100-year, 24-hour Type III design storm events. In addition, designers must demonstrate that runoff from the Site for storms up to the 100-year, 24-hour Type III design storm events actually reach proposed structural practices designed to meet this criterion."

Standard Met
The stormwater management system has been designed to attenuate the post-development peak discharge rates to pre-development levels for the 10- and 100-year storm events. Additionally, an analysis of the system provides confirmation that the stormwater management system has been

adequately sized to convey the 100-year storm to the proposed structural practices. (See Section 4 Table 1 and Appendix C.2.); therefore, Minimum Standard 5 has been satisfied.

6. Minimum Standard 6: Redevelopment and Infill Projects
"The purpose of this minimum standard is to establish the alternative requirements for projects or portions of a project where existing impervious areas will be redeveloped or where the Site qualifies as infill."

Standard Not Applicable
This project is not considered a redevelopment or infill project; therefore, Minimum Standard 6 is not applicable to this project.

7. Minimum Standard 7: Pollution Prevention
"All development Sites require the use of source control and pollution prevention measures to minimize the impact that the land use may have on stormwater runoff quality."

Standard Met
Pollution prevention is addressed in the Soil Erosion and Sedimentation Control Plan provided under separate cover, which confirms that Minimum Standard 7 has been satisfied.

8. Minimum Standard 8: Land Uses with Higher Potential Pollutant Loads
"Stormwater discharges from land uses with higher potential pollutant loads (LUHPPLs) require the use of specific source control and pollution prevention measures and the specific stormwater BMPs approved for such use."

Standard Not Applicable
In accordance with the *RISDISM* definition, the project is not considered a ñland use with higher potential pollutant loads;ò therefore Minimum Standard 8 is not applicable to this project.

9. Minimum Standard 9: Illicit Discharges
"All illicit discharges to stormwater management systems are prohibited."

Standard Met
There are no existing or proposed illicit discharges to the stormwater management system; therefore, Minimum Standard 9 is not applicable to this project.

10. Minimum Standard 10: Construction Erosion and Sedimentation Control
"Erosion and sedimentation control (ESC) practices must be utilized during the construction phase as well as during any land disturbing activities. ESC practices must meet the following minimum design criteria: temporary sediment trapping practices must be sized to store 1 inch of runoff from the contributing area or per the sediment volume method (Rhode Island Soil Erosion and Sediment Control Handbook), whichever is greater; and temporary conveyance practices must be sized to handle the peak flow from the 10-year, 24-hour Type III design storm."

Standard Met
Site plans titled ñTwin River ï Tiverton, Proposed Hotel and Casinoò include plans titled ñSoil Erosion and Sediment Control Plan.ò (Sheets C-11 through C-14 & Sheet C-26). These plans have been developed in conformance with the checklist provided in RIPDES CGP Section 5. These plans illustrate the minimum construction erosion and sedimentation controls necessary to meet the requirements of Minimum Standard 10 at the start of construction. Details to control erosion and sediment transport throughout construction are also provided on these sheets. The RIPDES ñSoil

Erosion and Sediment Control Planòdocument is also provided with the submission under separate cover. These documents demonstrate that Minimum Standard 10 has been satisfied.

11. Minimum Standard 11: Stormwater Management Operation and Maintenance
"The stormwater management system, including all structural stormwater controls and conveyances, must have an operation and maintenance plan to ensure that it continues to function as designed."

Standard Met
An Operations and Maintenance Plan has been developed and is provided under separate cover. This document demonstrates compliance with Minimum Standard 11.

6. CONCLUSIONS (MASSACHUSETTS STORMWATER STANDARDS)

This project has been designed in accordance with the latest edition of the *RISDISM,* Section 3.2 Minimum Stormwater Management Standards, as summarized below and provided in other submission documents.

1. Standard 1: No New Untreated Discharges
   No new stormwater conveyances (e.g. outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.

   Standard Met
   No new untreated stormwater runoff from new impervious surfaces will be discharged off-site. LID practices of infiltration basins, sand filters, permeable pavement, a bioretention basin, and maintenance planning have been included in the Site stormwater management design. Proposed drainage patterns will emulate those of existing conditions, including reduction of pre-development peak runoff rates.

2. Standard 2: Post-Development Peak Discharge Rates
   Stormwater management systems shall be designed so that the post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for discharges to land subject to coastal storm flowage as defined in 310 CMR 10.04.

   Standard Met
   The stormwater management system has been designed to attenuate the post-development peak discharge rates to pre-development levels for the 2-, 10-, 25- and 100-year storm events. Additionally, an analysis of the system provides confirmation that the stormwater management system has been adequately sized to convey the 100-year storm to the proposed structural practices. (See Section 4 Table 1 and Appendix C.2.).

3. Standard 3: Groundwater Recharge
   Loss of annual recharge to groundwater shall be eliminated or minimized through the use of environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post- development site shall approximate the annual recharge from pre-development conditions based on soil type. This Standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.

   Standard Met to the Maximum Extent Possible
   Groundwater recharge is provided to the maximum extent practicable through the infiltration basins located along the primary access drive and the permeable pavement surface of the emergency access drive. (See Appendix E.1 for detailed groundwater recharge calculations).

   Groundwater recharge is not possible in other areas of the site due to shallow bedrock and shallow seasonal high groundwater tables. In these areas, shallow groundwater flows along the restrictive ledge layer before finding daylight into the adjacent wetlands. To mimic this condition, underdrains below the sand filters, bioretention, and infiltration ponds were incorporated into the design to approximate groundwater recharge by filtering stormwater through soil media and conveying flow to the adjacent wetlands.

Based on soil testing completed throughout the project site, groundwater recharge appears to be fairly limited under pre-development conditions. A dense till layer exists in the upper soil strata which is likely to limit infiltration potential. Although the site is mapped as Hydrologic Soil Groups A, B, and C by NRCS, the actual infiltrative capacity of the site when measured from existing grade is likely to be similar to that expected of Hydrologic Soil Group D.

4. Standard 4: Water Quality Volume
Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS).

Standard Met
Stormwater treatment is provided through the use of sand filters, a bioretention basin, permeable pavement, and infiltration practices. (See Appendix D.1 for detailed water quality calculations).

5. Standard 5: Land Uses with Higher Potential Pollutant Loads (LUHPPLs)
For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable.

Standard Not Applicable
The proposed land use is not considered a LUHPPL.

6. Standard 6: Critical Areas
Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply and stormwater discharges near or to any other critical area require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook. A discharge is near a critical area if there is a strong likelihood of a significant impact occurring to said area, taking into account site-specific factors. Stormwater discharges to Outstanding Resource Waters and Special Resource Waters shall be removed and set back from the receiving water or wetland and receive the highest and best practical method of treatment. A "storm water discharge" as defined in 314 CMR 3.04(2)(a)1 or (b) to an Outstanding Resource Water or Special Resource Water shall comply with 314 CMR 3.00 and 314 CMR 4.00. Stormwater discharges to a Zone I or Zone A are prohibited unless essential to the operation of a public water supply.

Standard Not Applicable
As indicated in the Massachusetts Stormwater Handbook, *"a discharge is near a critical area if there is a strong likelihood of a significant impact occurring to said area, taking into account site-specific factors."* The proposed development site lies within the watershed of Sucker Brook in Tiverton, RI. Sucker Brook flows northerly into an urban corridor along Route 24 and Fall River, MA. Thereafter, the direction of flow is into South Watuppa Pond, which flows to the Quequechan River, which flows to the Taunton River (total flow path of 4.5± miles). Given the flow distance between the site and the Taunton River, the restricted/prohibited status of shellfishing (see below), and proposed source control and pollution prevention measures employed on the project meeting or exceeding the requirements stipulated by the Massachusetts Stormwater Handbook, stormwater from the project does not discharge near or to any of the following Critical Areas, as denoted by the Massachusetts Stormwater Handbook

- Outstanding Resource Waters or Special Resource Waters as designated in 314 CMR 4.00
- Recharge areas for public water supplies as defined in 310 CMR 22.02 (Zone Is, Zone IIs, and Interim Wellhead Protection Areas for groundwater sources and Zone As for surface water sources, as shown in MassGISôs OLIVER Online Mapping Tool)
- Known bathing beaches as defined in 105 CMR 445.000
- Cold-water fisheries as defined in 314 CMR 9.02 and 310 CMR 10.04
- Shellfish growing areas, as defined by in 314 CMR 9.02 and 310 10.04 (the discharge point of the Quequechan River into the Taunton River is denoted as ñrestrictedò and ñprohibitedò for shellfishing on the *MHB2 Taunton River Shellfish Area Classification Map*, issued by the Massachusetts Division of Marine Fisheries on 6/25/2015.)

7. Standard 7: Redevelopments
   A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural stormwater best management practice requirements of Standards 4, 5, and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.

   Standard Not Applicable
   The proposed project is not considered a redevelopment.

8. Standard 8: Stormwater Pollution Prevention Plan (SWPPP)
   A plan to control construction-related impacts, including erosion, sedimentation, and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented.

   Standard Met
   A Soil Erosion & Sediment Control Plan (SESC Plan) has been produced for the proposed development. A SESC Plan is the Rhode Island equivalent to a Massachusetts SWPPP.

9. Standard 9: Long Term Operation and Maintenance (O&M) Plan
   A Long -Term Operation and Maintenance (O&M) Plan shall be developed and implemented to ensure that stormwater management systems function as designed.

   Standard Met
   A Long-Term Operation and Maintenance Plan has been developed for the proposed development and is available under separate cover.

10. Standard 10: Illicit Discharges
    All illicit discharges to the stormwater management system are prohibited.

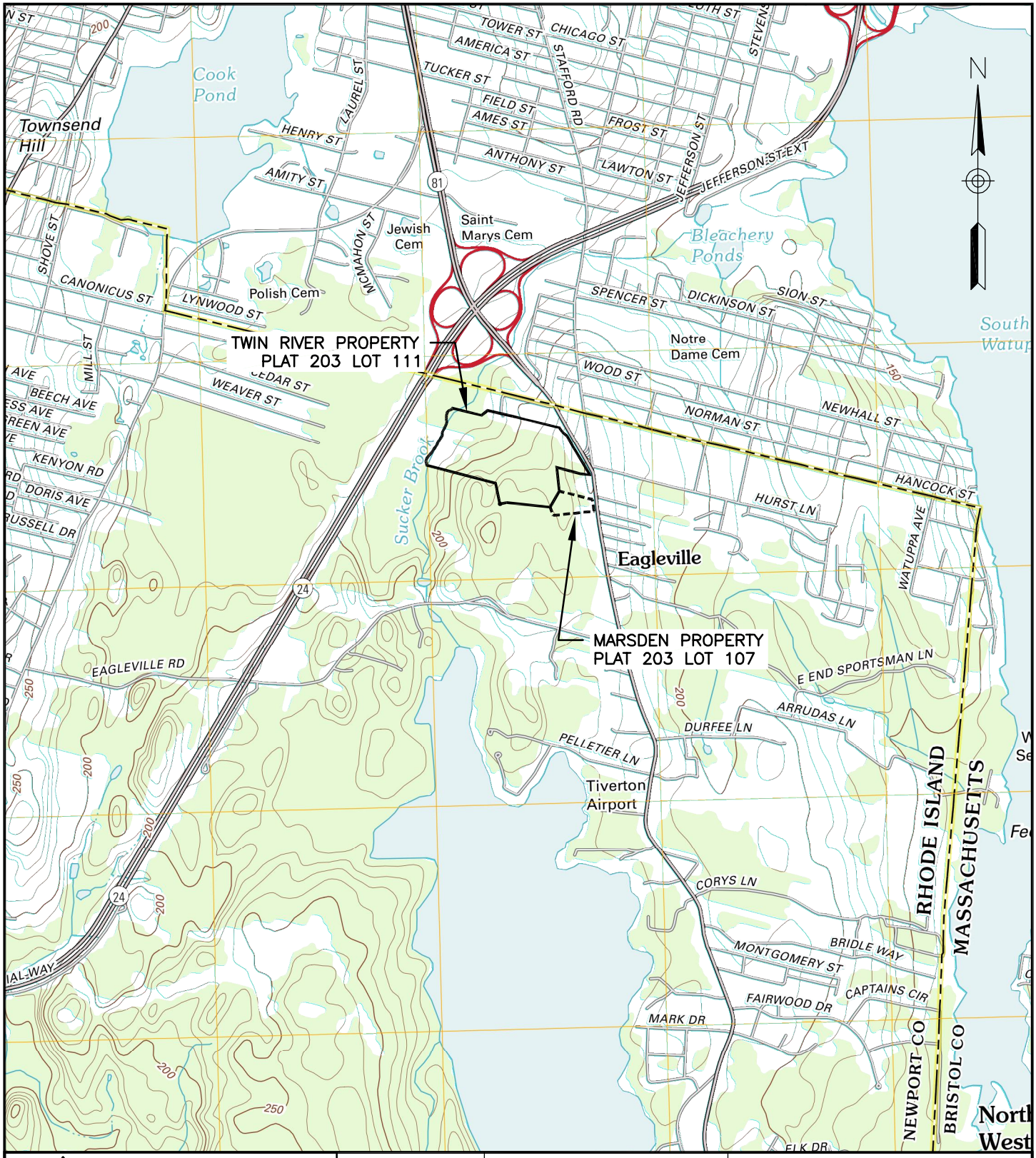
    Standard Met
    There are no known illicit discharges at the site and none are proposed as part of this project.

APPENDIX A:

Background Information

APPENDIX A.1:

Site Location Map



CHERENZIA & ASSOCIATES, LTD.

Civil Engineers
Land Surveyors
Land Use Planners
Environmental Engineers

99 Mechanic St.
Pawcatuck, CT 06379
Tel: 860.629.6500
Fax: 860.599.6090

P.O. Box 513
Westerly, RI 02891
Tel: 401.596.7747

www.cherenzia.com

CA JOB # 215010
MARCH 27, 2017

DRAWN BY: TMT
CHECK BY: CNB

TWIN RIVER – TIVERTON
WILLIAM S. CANNING BLVD &
STAFFORD ROAD
TIVERTON, RHODE ISLAND

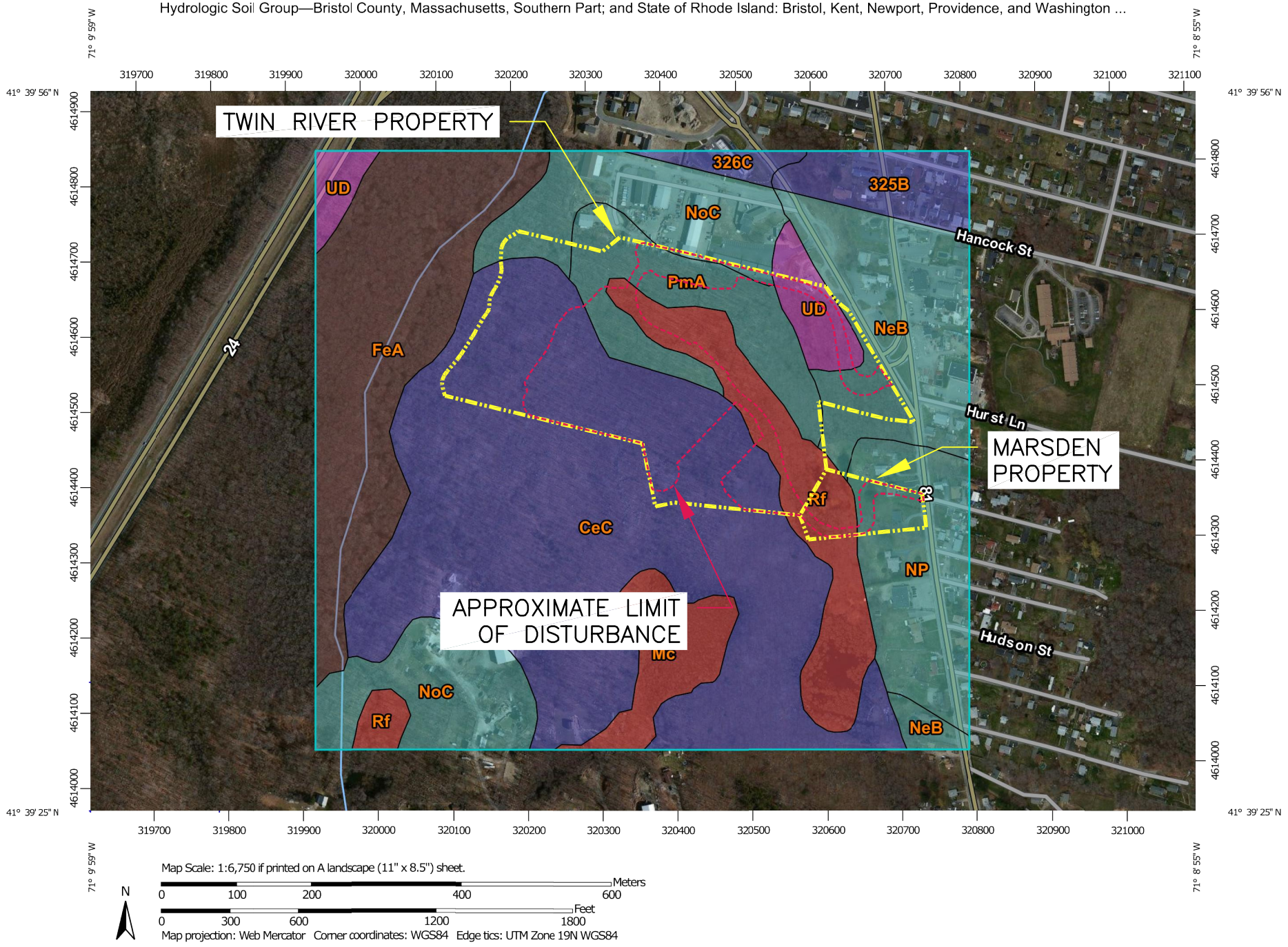
PREPARED FOR
FERRUCCI RUSSO PC

LOCATION MAP

0' 1,000' 2,000' 4,000'
SCALE: 1"=2,000'

APPENDIX A.2:

NRCS Soils Map



Map Scale: 1:6,750 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 300 600 1200 1800

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at scales ranging from 1:12,000 to 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Bristol County, Massachusetts, Southern Part
Survey Area Data: Version 9, Sep 28, 2015

Soil Survey Area: State of Rhode Island: Bristol, Kent, Newport, Providence, and Washington Counties
Survey Area Data: Version 14, Sep 22, 2015

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 8, 2011—Apr 9, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Bristol County, Massachusetts, Southern Part (MA603)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
325B	Newport loam, 3 to 8 percent slopes	B	5.1	3.0%
326C	Newport loam, 3 to 15 percent slopes, very stony	B	1.4	0.8%
Subtotals for Soil Survey Area			**6.5**	**3.8%**
Totals for Area of Interest			**172.6**	**100.0%**

Hydrologic Soil Group— Summary by Map Unit — State of Rhode Island: Bristol, Kent, Newport, Providence, and Washington Counties (RI600)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
CeC	Canton and Charlton fine sandy loams, very rocky, 3 to 15 percent slopes	B	62.7	36.3%
FeA	Freetown muck, 0 to 1 percent slopes	B/D	23.5	13.6%
Mc	Mansfield very stony mucky silt loam	D	5.6	3.3%
NeB	Newport silt loam, 3 to 8 percent slopes	C	16.2	9.4%
NoC	Newport extremely stony silt loam, 3 to 15 percent slopes	C	19.1	11.1%
NP	Newport-Urban land complex	C	12.3	7.1%
PmA	Pittstown silt loam, 0 to 3 percent slopes	C	9.8	5.7%
Rf	Ridgebury, Leicester, and Whitman soils, 0 to 8 percent slopes, extremely stony	D	12.2	7.1%
UD	Udorthents-Urban land complex	A	4.6	2.7%
Subtotals for Soil Survey Area			**166.1**	**96.2%**
Totals for Area of Interest			**172.6**	**100.0%**

Rating Options

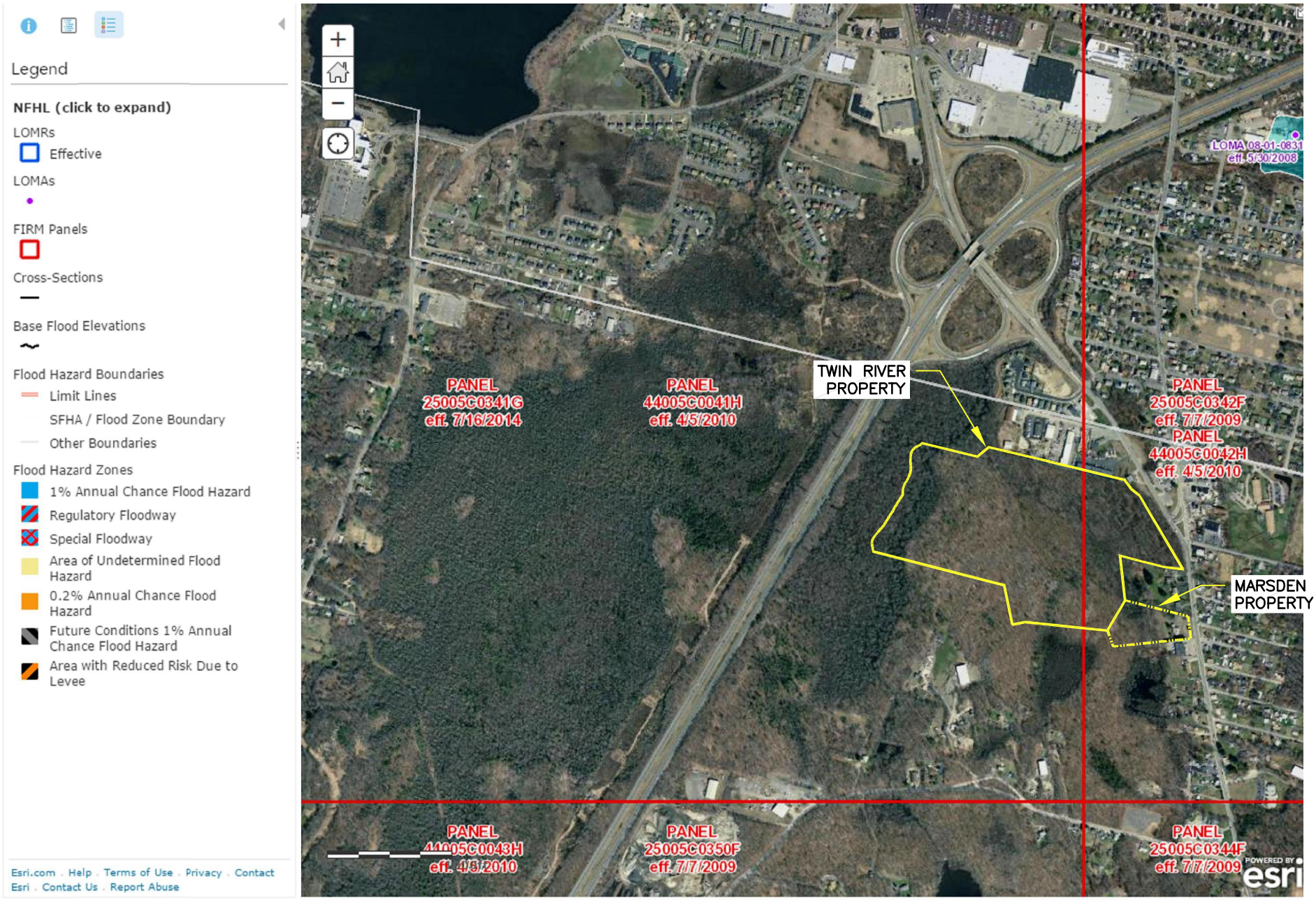
Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX A.3:

Flood Insurance Rate Maps (FIRM)


Legend
NFHL (click to expand)
LOMRs
Effective
LOMAs
FIRM Panels
Cross-Sections
Base Flood Elevations
Flood Hazard Boundaries
Limit Lines
SFHA / Flood Zone Boundary
Other Boundaries
Flood Hazard Zones
1% Annual Chance Flood Hazard
Regulatory Floodway
Special Floodway
Area of Undetermined Flood Hazard
0.2% Annual Chance Flood Hazard
Future Conditions 1% Annual Chance Flood Hazard
Area with Reduced Risk Due to Levee
Esri.com . Help . Terms of Use . Privacy . Contact Esri . Contact Us . Report Abuse
PANEL 25005C0341G eff. 7/16/2014
PANEL 44005C0041H eff. 4/5/2010
TWIN RIVER PROPERTY
PANEL 25005C0342F eff. 7/7/2009
PANEL 44005C0042H eff. 4/5/2010
LOMA 08-01-0831 eff. 5/30/2008
MARSDEN PROPERTY
PANEL 44005C0043H eff. 4/5/2010
PANEL 25005C0350F eff. 7/7/2009
PANEL 25005C0344F eff. 7/7/2009
POWERED BY esri

APPENDIX A.4:

Sucker Brook/South Watuppa Pond Hazard Analysis

Memo

To:	File
Date:	February 20, 2017
Re:	Sucker Brook / South Watuppa Pond Hazard Analysis Twin River – Tiverton Casino Project

This memorandum has been prepared to address potential hazards to water resources resulting from the development of the proposed Twin River – Tiverton Casino Project.

References:

- *Consumer Confidence Report for 2015*, City of Fall River, Department of Community Utilities, PWS ID 4095000
- *2015 Consumer Confidence Report,* Stone Bridge Fire District, Tiverton, RI PWS ID#1615619
- *The South Watuppa Pond and its Watershed Summary*, 1990, Whitman & Howard Engineers, prepared for the City of Fall River
- *FALL RIVER – Route 24 Off-Ramp Gasoline Tanker Accident Report, MassDEP Field Assessment and Support Team (FAST), January 27, 2014*
- *Rhode Island Statewide TMDL for Bacteria Impaired Waters, Sucker Brook Watershed Summary*, June 2011, Rhode Island Department of Environmental Management (expired)

Tiverton and Portsmouth Drinking Water

Stafford Pond

Stafford Pond is the water source for the Stone Bridge Fire District. The North Tiverton Fire District and the Tiverton Water Authority do not have dedicated water sources, and purchase all their water from the Stone Bridge Fire District (therefore, also source from Stafford Pond). The three water districts also purchase a portion of their water from the City of Fall River.

Based on USGS mapping, Stafford Pond is located up-gradient from the proposed casino development. Sucker Brook is the dam-controlled outlet of Stafford Pond, flows northerly past the project site, and toward South Watuppa Pond. There is no hazard to Stafford Pond from development of the proposed project.

Tiverton and Fall River Drinking Water

Sucker Brook

Sucker Brook is a dam-controlled stream that flows northerly from Stafford Pond toward South Watuppa Pond. The entire casino development is within the watershed of Sucker Brook. As noted in the RIDEM Sucker Brook Watershed Summary:

"Sucker Brook flows from Stafford Pond at the northern outlet in the Village of Eagleville, and flows north across Eagleville Road. The brook then flows parallel to Route 24 in a wooded area, flows into Massachusetts, and crosses Route 81 near the intersection with Route 24. In Massachusetts,

the brook is surrounded by high-density development and transportation land uses. Sucker Brook empties into South Watuppa Pond near the South Watuppa Boat Ramp."

Ownership of Sucker Brook waters has historically been attributed to the City of Fall River's Watuppa Water Board, which manages all of Fall River's water resources and drinking water.

Watuppa Water Board

As noted in the Fall River Water Division's 2015 Consumer Confidence Report, the Watuppa Water Board maintains water rights to the following water bodies:

Water Body	Water Source Designation
North Watuppa Pond	Primary Drinking Water Source
Copicut Reservoir	Primary Drinking Water Source (water is pumped to North Watuppa Pond as needed)
South Watuppa Pond	"Other Water Resource"
Terry Brook Pond	"Other Water Resource"
Sawdy Pond	"Other Water Resource"
Stafford Pond	"Other Water Resource"
Devol Pond	"Other Water Resource"
Lake Noquochoke	"Other Water Resource"

South Watuppa Pond

Sucker Brook ultimately flows to South Watuppa Pond, which is owned by the Watuppa Water Board. Recent newspaper articles indicate that South Watuppa Pond may be considered an emergency drinking water source for the City of Fall River, and the Fall River Water Division's most recent Consumer Confidence Report states that the water body is considered an "other water resource." To determine if South Watuppa Pond is a potential drinking water source for the City, Amec Foster Wheeler (AFW) has reviewed record information available through a desktop investigation.

<u>North Watuppa Pond Influence</u>

North Watuppa Pond (Fall River's main drinking water source) is connected to South Watuppa Pond by a narrow stream channel in an area known as the Narrows, which is located at the intersection of Interstate 195 and Route 24. Water flows southerly out of North Watuppa Pond into South Watuppa Pond.

Although North Watuppa Pond is located almost directly adjacent to Route 24, the Fall River Water Division's Consumer Confidence Report notes that *"an interceptor drain runs the length of Rt. 24 along the North Watuppa Pond's westerly boundary to reduce potential sources of contamination, potentially associated with highway and other runoff."* The interceptor drain extends the length of North Watuppa Pond, and ultimately discharges to South Watuppa Pond. A second interceptor, referred to as the North Pond Diverter, is located on the west side of North Watuppa Pond, and similarly diverts potentially contaminated waters directly to South Watuppa Pond. Documentation of the interceptors is found within both the MassDEP FAST Report for a Route 24 Off-Ramp Gasoline Tanker Accident in January 2014 and the Engineering Report prepared by Whitman & Howard Engineers in 1990.

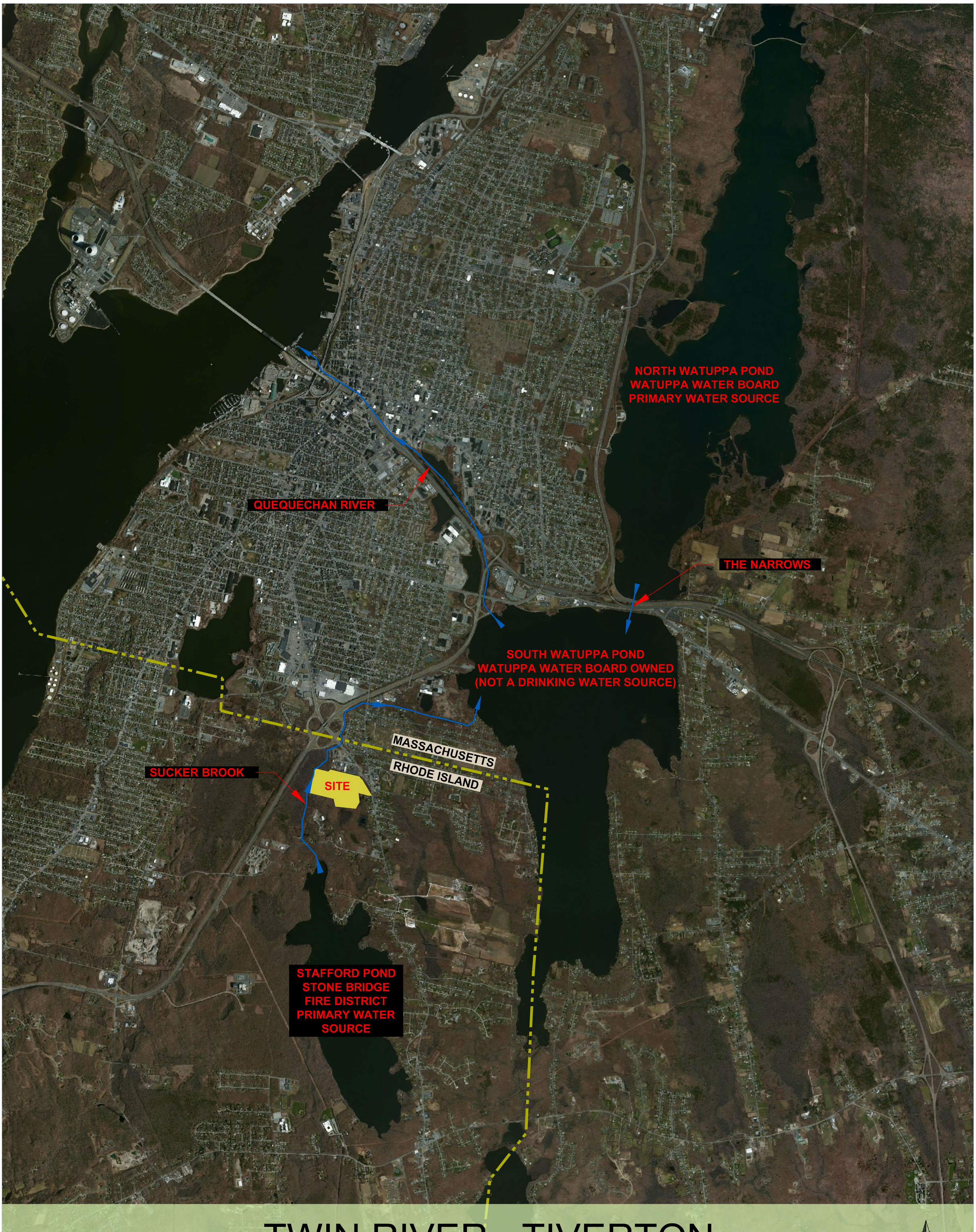
South Watuppa Pond Engineering Report

In 1990, Whitman & Howard Engineers prepared an engineering report for the City of Fall River. In the report, Whitman & Howard Engineers summarize characteristics of the South Watuppa Pond watershed, identify possible sources of contamination, and list remedial actions to reduce algae blooms and water quality issues within the Pond. Key excepts from the report are below:

- *"Due to the proximity of Sucker Brook to the Quequechan River outlet, it has been theorized that a certain amount of short-circuiting occurs. This theory is important to pond water quality because, if true, the impact of Sucker Brook on the pond is diminished."*
    - This theory speculates that because Sucker Brook and the Narrows drain into South Watuppa Pond very close to the outlet of South Watuppa Pond (the Quequechan River), flowage from Sucker Brook and the Narrows has very little impact on water quality within South Watuppa Pond. In short, water flowing into the Pond bypasses being store in the pond itself, and is quickly flushed out to the Quequechan River.
- *"Sucker Brook and the Bleachery Ponds…were the focus of a study conducted by Durfee High School's Environmental Control Committee (ECC) during 1981. The ECC monitored 61 sites along the (Sucker) Brook and Ponds and concluded that the main sources of pollution originate from the careless upkeep of these water resources. The ECC described the watercourse (Sucker Brook) and Ponds as fouled with rubbish, oil scums, algae, and decomposing organic matter. At one location, the concrete foundation of a demolished mill has been converted into a dumpsite containing, discarded vehicles and empty drums (some having contained cyanide). Leachings from these and other wastes enter the Brook and eventually South Pond."*
- *"Whereas the brook is considered a point source discharge of pollution, two industrial discharges along it must also be mentioned. They include;…the Fall River Tool and Dye Company (NPDES MA 003107) … the Fall River Plating Company (NPDES MA 0022471). These point source discharges, at a minimum, impact Sucker Brook's values of pH, hardness, nitrogen, phosphorus, and aluminum."*
- *"The ECC (1981) discovered that the used cyanide drums, previously mentioned, originated from the Fall River Tool and Dye Company. Cyanide is also a by-product of the metal cleaning and electroplating processes practiced by the Fall River Plating Company. The ECC measured cyanide levels during their study and found readings as high as* ***0.65 mg/L****. A proposed maximum contaminant level (MCL) for cyanide has not yet been proposed under the 1986 Amendments to the Safe Drinking Water Act. However, the 1962 U.S. Public Health Service Drinking Water Standards recommend a* ***limit of 0.10 mg/L****."*
- Additional sources of contamination have been identified the following point sources of contamination, including:
    - Industrial spills
    - The North Watuppa Pond diversion interceptors
    - Leaking fuel tanks
    - Insecticide use at a nearby farm
    - Identified septage releases
    - Spillage from lagoons at a nearby piggery

South Watuppa Pond Summary

Based on review of available sources, South Watuppa Pond is not an immediately viable drinking water source for the City of Fall River. The Pond recieves stormwater runoff from Route 24 and Interstate 195, which is bypassed to avoid contamination of North Watuppa Pond (the City's primary drinking water source). Several other point sources of contamination exist within South Watuppa Pond, including farm lagoons, industrial spills, and septage releases.



TWIN RIVER - TIVERTON
WATERSHED FIGURE

Tiverton, Rhode Island

amec foster wheeler

CHERENZIA & ASSOCIATES, LTD.

APPENDIX B: Soil Logs

APPENDIX B.1:

Test Hole Location Plan

DESIGNED BY:	AKG/TMT
DRAWN BY:	TMT
CHECKED BY:	AKG
SCALE:	1" = 80'
PROJECT NUMBER:	3653160007
DATE:	4/7/2017

CLIENT:
TWIN RIVER
TIVERTON, LLC
C/O MARK RUSSO ESQ
55 PINE STREET
4TH FLOOR
PROVIDENCE, RI 02903

PROJECT:
TWIN RIVER - TIVERTON
PROPOSED LAND CLEARING & GRADING
PLAT 203 LOTS 107 & 111
PLAT 204 LOTS 101, 102, 103, 106 & 108
WILLIAM S. CANNING BLVD AND STAFFORD ROAD
TIVERTON, RHODE ISLAND

TITLE:
TEST HOLE LOCATION & SEASONAL HIGH GROUND WATER PLAN

LEGEND
TEST HOLE #
SHGW ELEV.

AMEC FOSTER WHEELER
ENVIRONMENT & INFRASTRUCTURE, INC.
275 PROMENADE STREET, SUITE 120
PROVIDENCE RHODE ISLAND, 02908
WEB: WWW.AMECFW.COM

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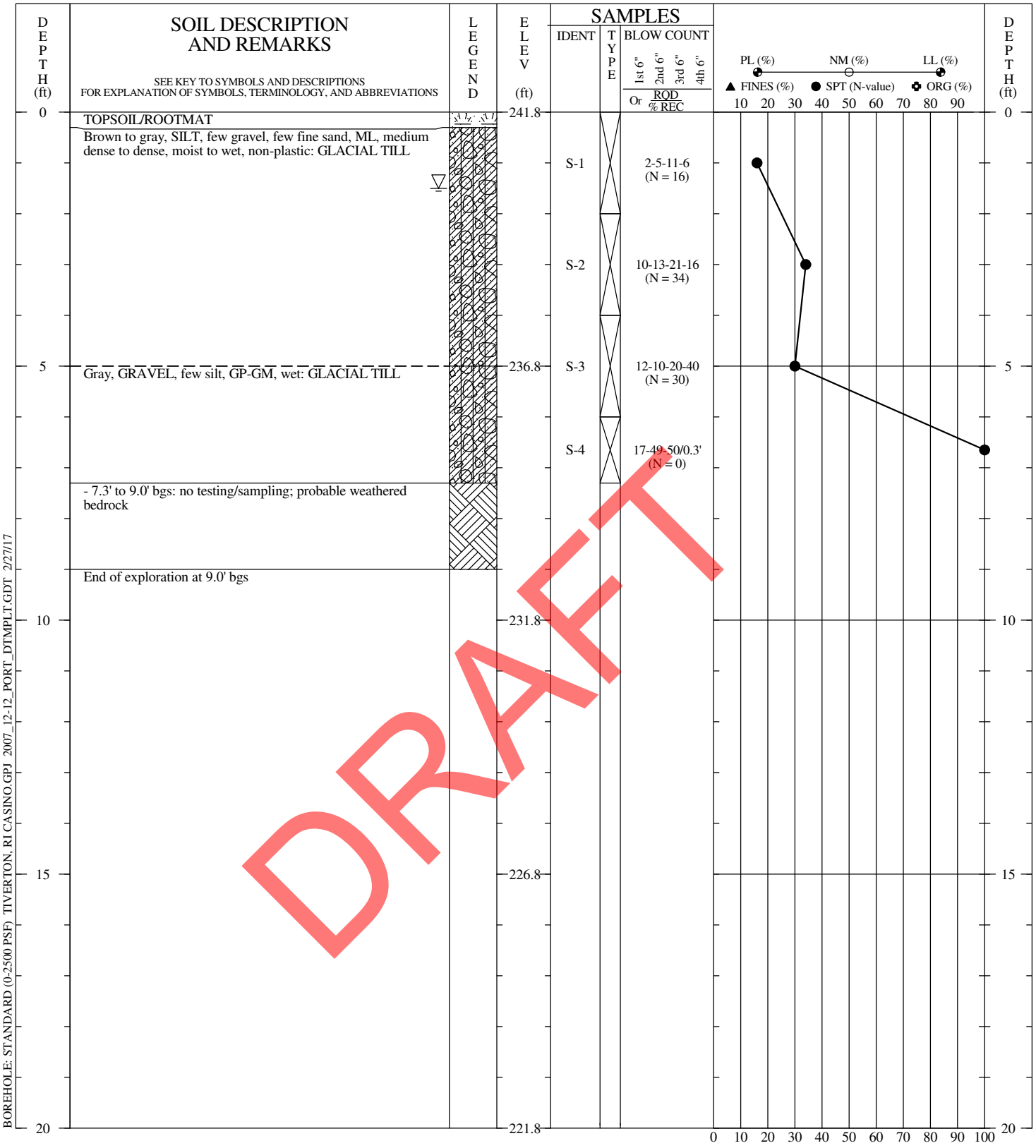
APPENDIX B.2:

Geotechnical Boring Records



BOREHOLE: STANDARD (0-2500 PSF) TIVERTON, RI CASINO.GPJ 2007_12-12_PORT_DTMPLT.GDT 2/27/17

DRILLER:	GeoLogic Earth Exploration
RIG TYPE:	CME-55
METHOD:	Rotary Wash with Water (Cased)
HOLE DIAM.:	3"
SPTs:	Rope & cathead.
REMARKS:	Water level measured in casing at completion of drilling. Boring backfilled with cuttings upon completion.
LOGGED BY:	JC CHECKED BY/DATE:

THIS BORING RECORD PRESENTS A REASONABLE INTERPRETATION OF THE SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. STRATA INTERFACES (AS SHOWN) ARE APPROXIMATE. ACTUAL TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

GEOTECHNICAL BORING RECORD

BORING NO.:	SB-01
DRILLED:	01/30/2017
PROJECT:	Twin River - Tiverton Casino & Hotel
LOCATION:	Tiverton, RI
PROJECT NO.:	3653160007

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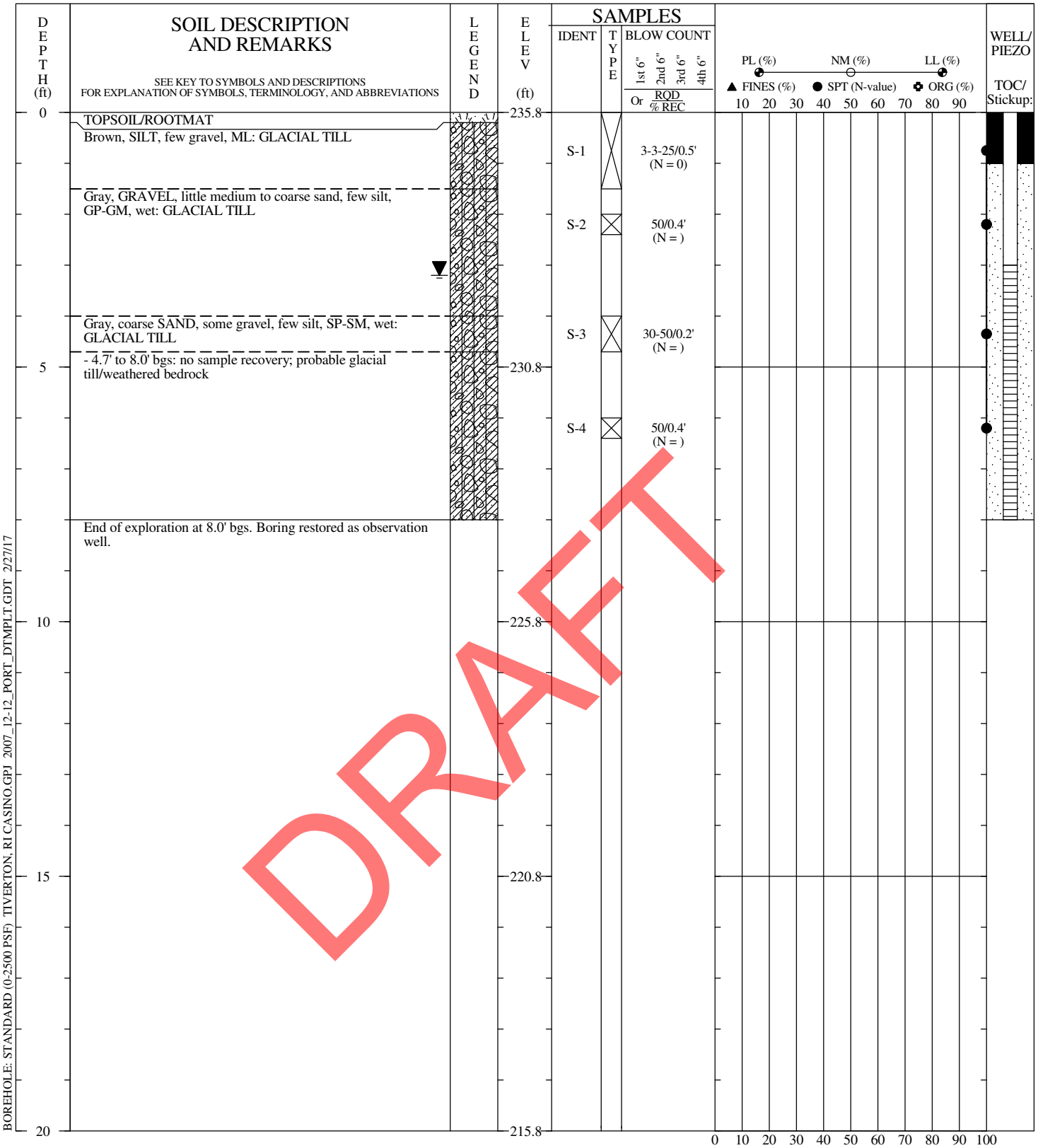

DRILLER:	GeoLogic Earth Exploration
RIG TYPE:	CME-55
METHOD:	Rotary Wash with Water (Cased)
HOLE DIAM.:	3"
SPTs:	Rope & cathead.
REMARKS:	Water level measured in observation well 1-day after completion. Boring restored as temporary observation well upon completion.
LOGGED BY:	JC CHECKED BY/DATE:

THIS BORING RECORD PRESENTS A REASONABLE INTERPRETATION OF THE SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. STRATA INTERFACES (AS SHOWN) ARE APPROXIMATE. ACTUAL TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

GEOTECHNICAL BORING RECORD

BORING NO.:	SB-02
DRILLED:	01/30/2017
PROJECT:	Twin River - Tiverton Casino & Hotel
LOCATION:	Tiverton, RI
PROJECT NO.:	3653160007

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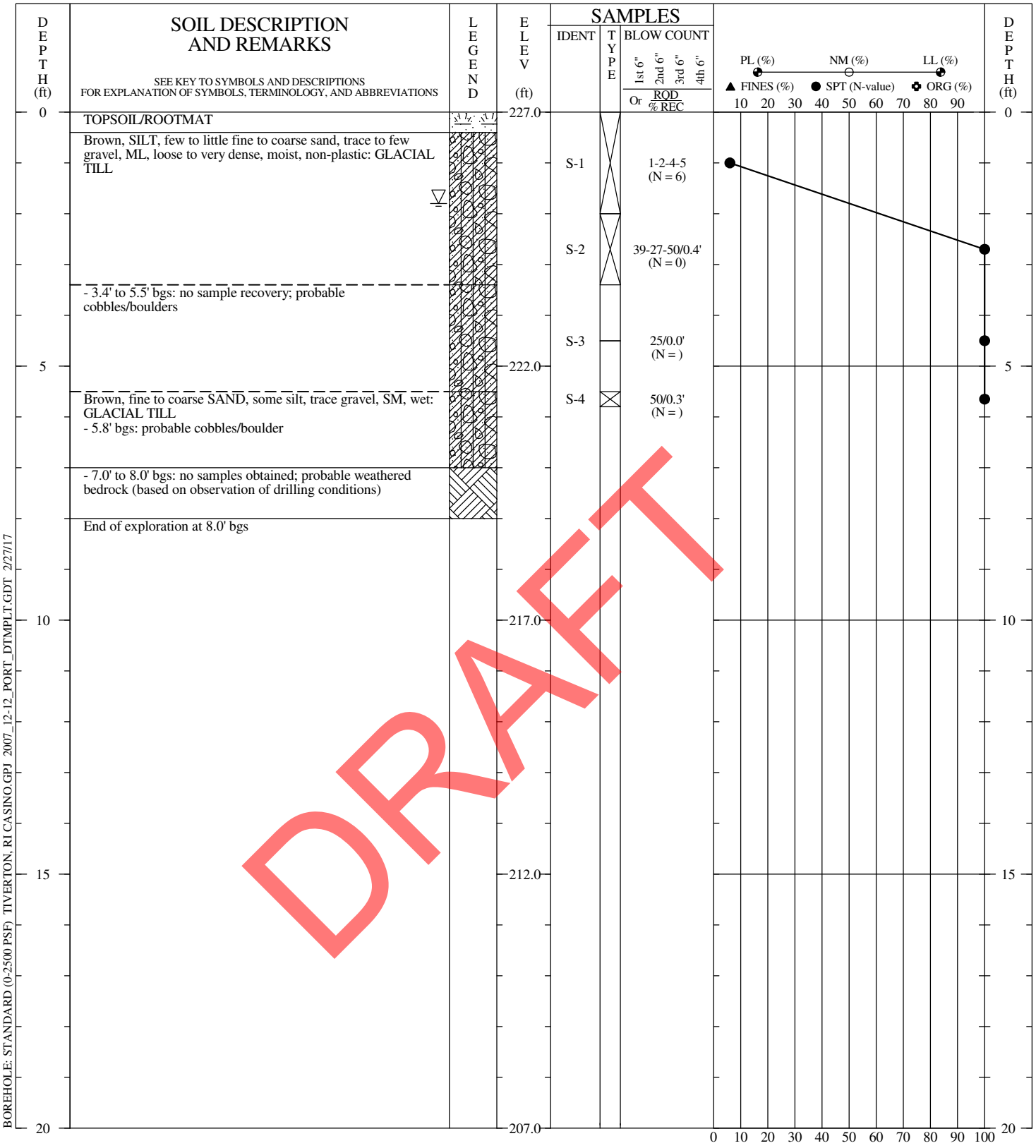


BOREHOLE: STANDARD (0-2500 PSF) TIVERTON, RI CASINO.GPJ 2007_12-12_PORT_DTMPLT.GDT 2/27/17

DRILLER:	GeoLogic Earth Exploration
RIG TYPE:	CME-55
METHOD:	Rotary Wash with Water (Cased)
HOLE DIAM.:	3"
SPTs:	Rope & cathead.
REMARKS:	Offset 18.5' SE of staked location. Approximate ground surface EL. Water level measured in casing at completion of drilling. Boring backfilled with cuttings upon completion.
LOGGED BY:	JC CHECKED BY/DATE:

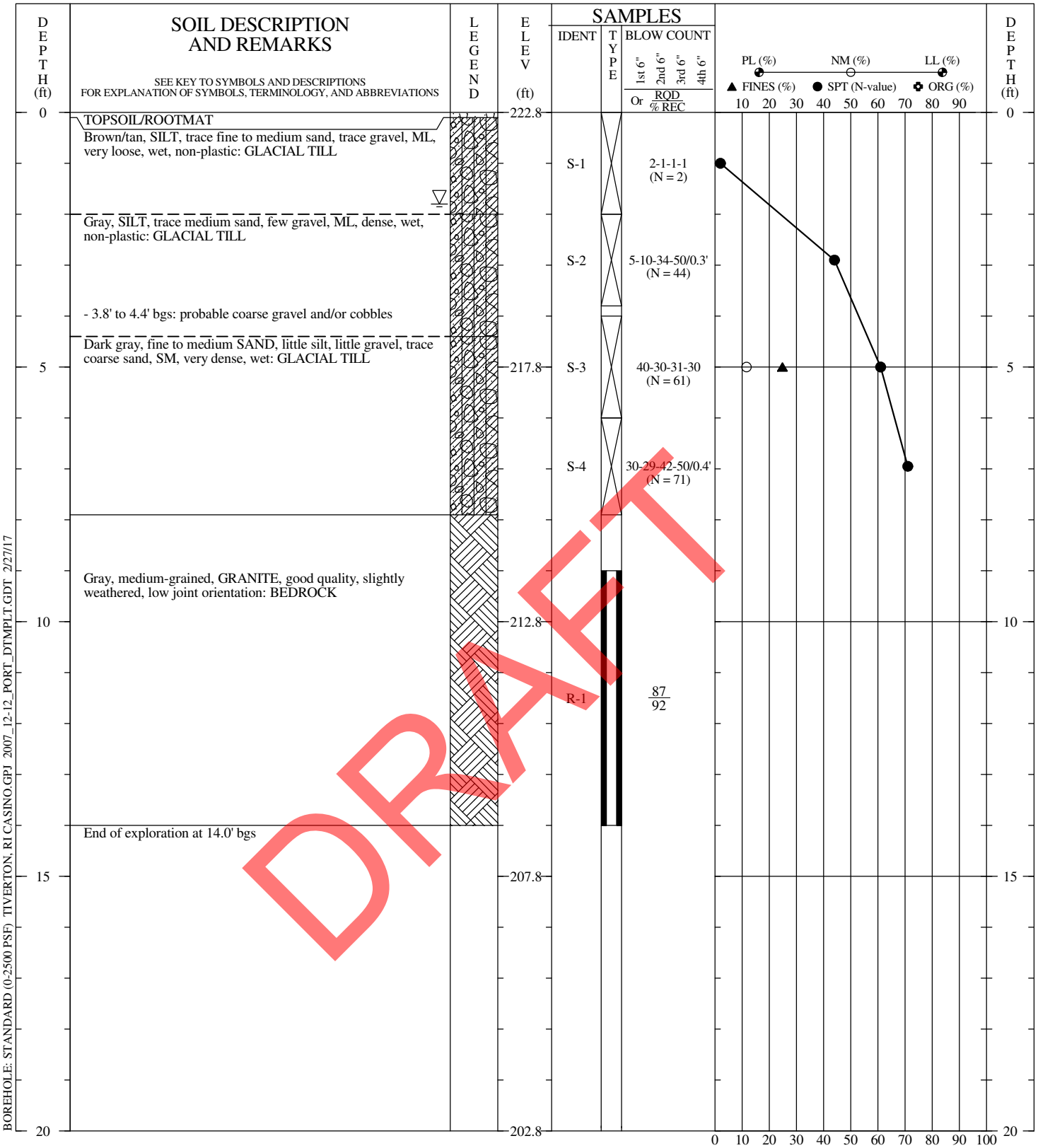
THIS BORING RECORD PRESENTS A REASONABLE INTERPRETATION OF THE SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. STRATA INTERFACES (AS SHOWN) ARE APPROXIMATE. ACTUAL TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

GEOTECHNICAL BORING RECORD

BORING NO.:	SB-03
DRILLED:	01/31/2017
PROJECT:	Twin River - Tiverton Casino & Hotel
LOCATION:	Tiverton, RI
PROJECT NO.:	3653160007

PAGE 1 **OF** 1

amec foster wheeler



DRILLER:	GeoLogic Earth Exploration
RIG TYPE:	CME-55
METHOD:	Rotary Wash with Water (Cased)
HOLE DIAM.:	3"
SPTs:	Rope & cathead.
REMARKS:	Groundwater depth based on observed sample moisture. Boring backfilled with cuttings upon completion.

LOGGED BY: JC CHECKED BY/DATE:

THIS BORING RECORD PRESENTS A REASONABLE INTERPRETATION OF THE SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. STRATA INTERFACES (AS SHOWN) ARE APPROXIMATE. ACTUAL TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

GEOTECHNICAL BORING RECORD

BORING NO.:	SB-04
DRILLED:	01/18/2017 - 01/19/2017
PROJECT:	Twin River - Tiverton Casino & Hotel
LOCATION:	Tiverton, RI
PROJECT NO.:	3653160007

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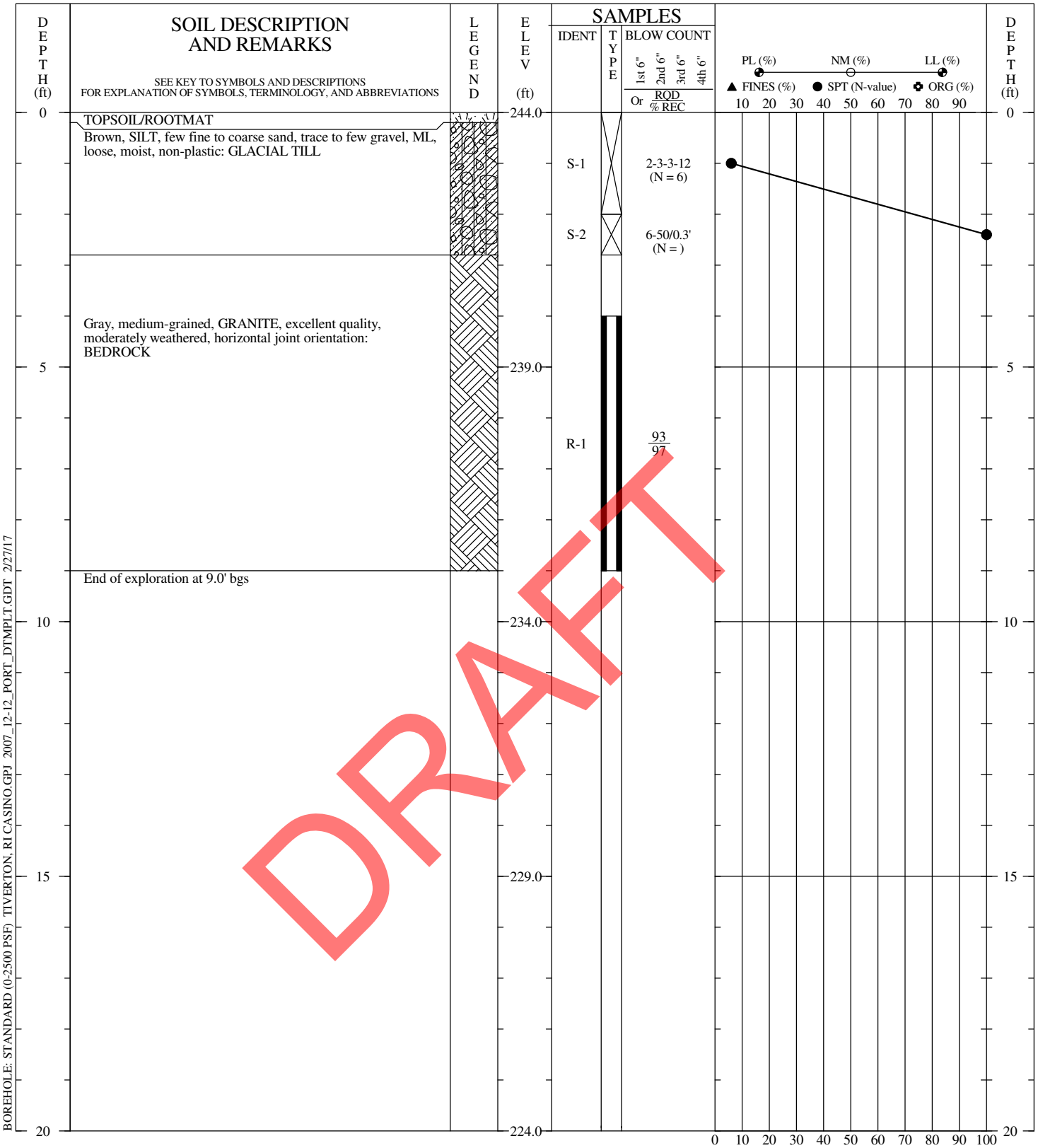

BOREHOLE: STANDARD (0-2500 PSF) TIVERTON, RI CASINO.GPJ 2007_12-12_PORT_DTMPLT.GDT 2/27/17

DRILLER:	GeoLogic Earth Exploration
RIG TYPE:	CME-55
METHOD:	Rotary Wash with Water (Cased)
HOLE DIAM.:	3"
SPTs:	Rope & cathead.
REMARKS:	Offset 21' NE of staked location. Approximate ground surface EL. Groundwater not encountered during drilling. Boring backfilled with cuttings upon completion.
LOGGED BY:	JC CHECKED BY/DATE:

THIS BORING RECORD PRESENTS A REASONABLE INTERPRETATION OF THE SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. STRATA INTERFACES (AS SHOWN) ARE APPROXIMATE. ACTUAL TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

GEOTECHNICAL BORING RECORD

BORING NO.:	SB-05
DRILLED:	01/20/2017
PROJECT:	Twin River - Tiverton Casino & Hotel
LOCATION:	Tiverton, RI
PROJECT NO.:	3653160007

PAGE 1 **OF** 1

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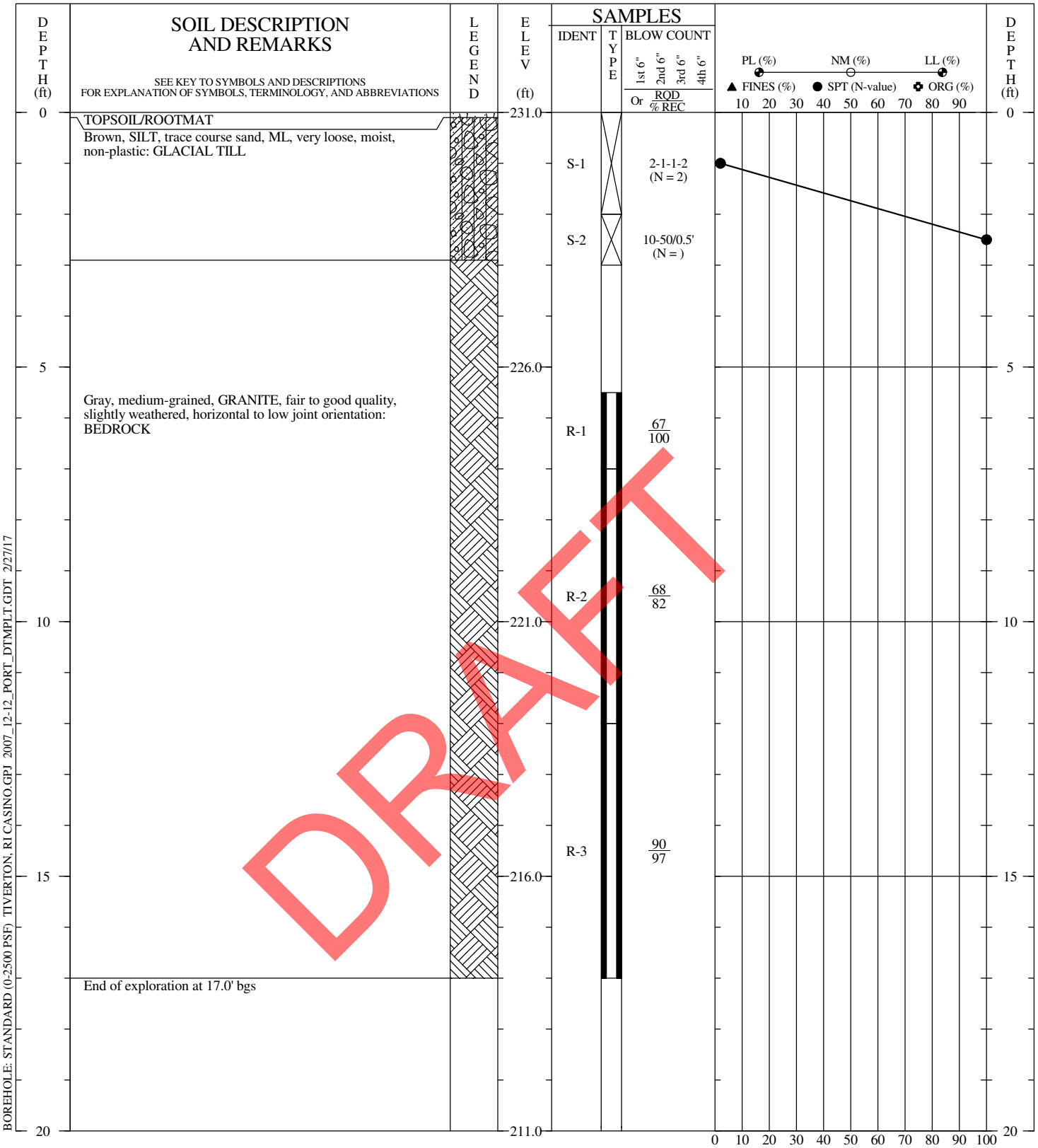

DRILLER:	GeoLogic Earth Exploration
RIG TYPE:	CME-55
METHOD:	Rotary Wash with Water (Cased)
HOLE DIAM.:	3"
SPTs:	Rope & cathead.
REMARKS:	Offset 20' North of staked location. Approximate ground surface EL. Groundwater not encountered during drilling. Boring backfilled with cuttings upon completion.
LOGGED BY:	JC CHECKED BY/DATE:

THIS BORING RECORD PRESENTS A REASONABLE INTERPRETATION OF THE SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. STRATA INTERFACES (AS SHOWN) ARE APPROXIMATE. ACTUAL TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

GEOTECHNICAL BORING RECORD

BORING NO.:	SB-06
DRILLED:	01/19/2017
PROJECT:	Twin River - Tiverton Casino & Hotel
LOCATION:	Tiverton, RI
PROJECT NO.:	3653160007

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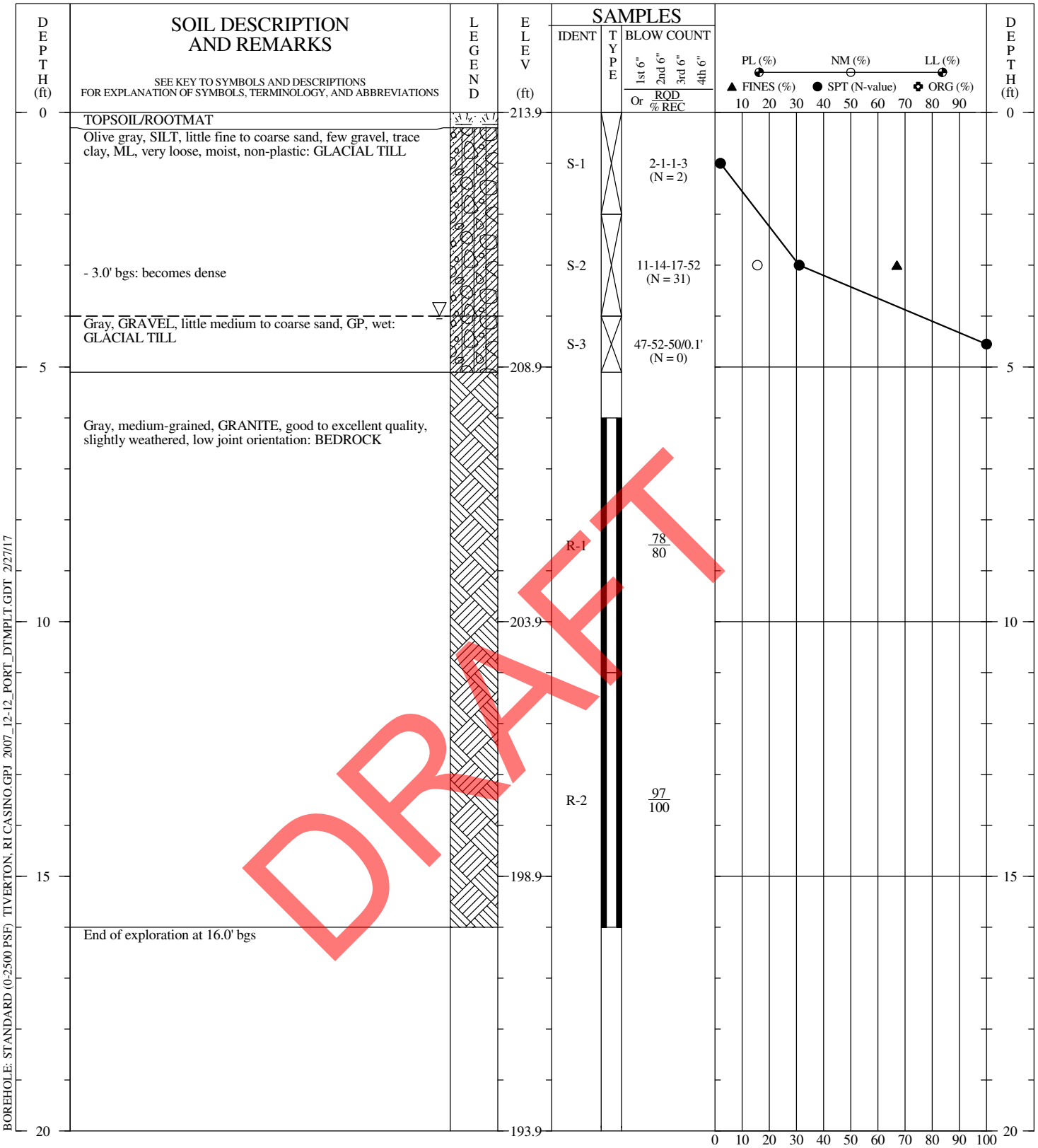

BOREHOLE: STANDARD (0-2500 PSF) TIVERTON, RI CASINO.GPJ 2007_12-12_PORT_DTMPLT.GDT 2/27/17

DRILLER:	GeoLogic Earth Exploration
RIG TYPE:	CME-55
METHOD:	Rotary Wash with Water (Cased)
HOLE DIAM.:	3"
SPTs:	Rope & cathead.
REMARKS:	Groundwater depth based on observed sample moisture. Boring backfilled with cuttings upon completion.

LOGGED BY: JC CHECKED BY/DATE:

THIS BORING RECORD PRESENTS A REASONABLE INTERPRETATION OF THE SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. STRATA INTERFACES (AS SHOWN) ARE APPROXIMATE. ACTUAL TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

GEOTECHNICAL BORING RECORD

BORING NO.:	SB-07
DRILLED:	01/17/2017 - 01/18/2017
PROJECT:	Twin River - Tiverton Casino & Hotel
LOCATION:	Tiverton, RI
PROJECT NO.:	3653160007

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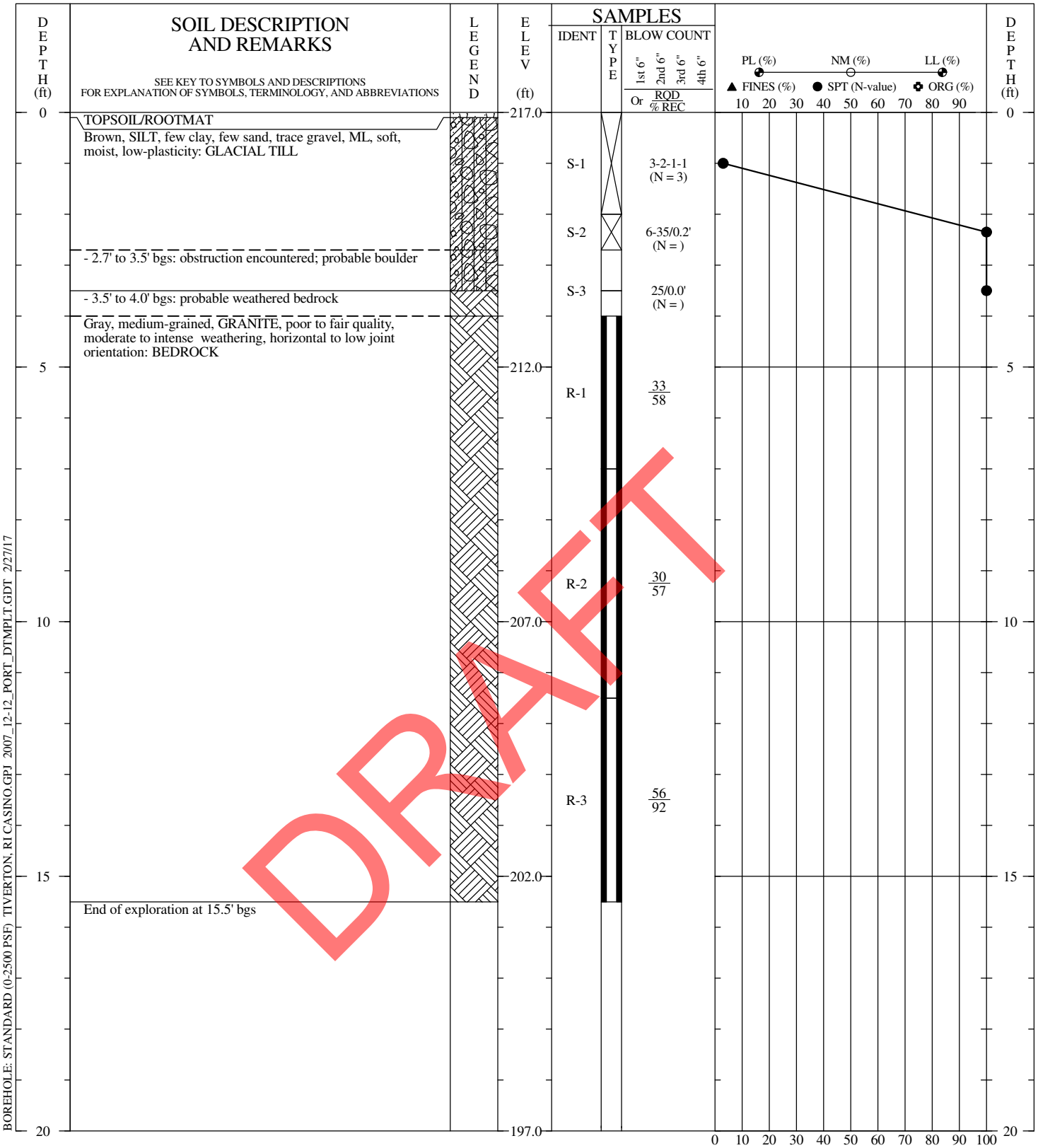

BOREHOLE: STANDARD (0-2500 PSF) TIVERTON, RI CASINO.GPJ 2007_12-12_PORT_DTMPLT.GDT 2/27/17

DRILLER:	GeoLogic Earth Exploration
RIG TYPE:	CME-55
METHOD:	Rotary Wash with Water (Cased)
HOLE DIAM.:	3"
SPTs:	Rope & cathead.
REMARKS:	Groundwater not encountered during drilling. Boring backfilled with cuttings upon completion.

LOGGED BY: JC CHECKED BY/DATE:

THIS BORING RECORD PRESENTS A REASONABLE INTERPRETATION OF THE SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. STRATA INTERFACES (AS SHOWN) ARE APPROXIMATE. ACTUAL TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

GEOTECHNICAL BORING RECORD

BORING NO.:	SB-08
DRILLED:	01/16/2017 - 01/17/2017
PROJECT:	Twin River - Tiverton Casino & Hotel
LOCATION:	Tiverton, RI
PROJECT NO.:	3653160007

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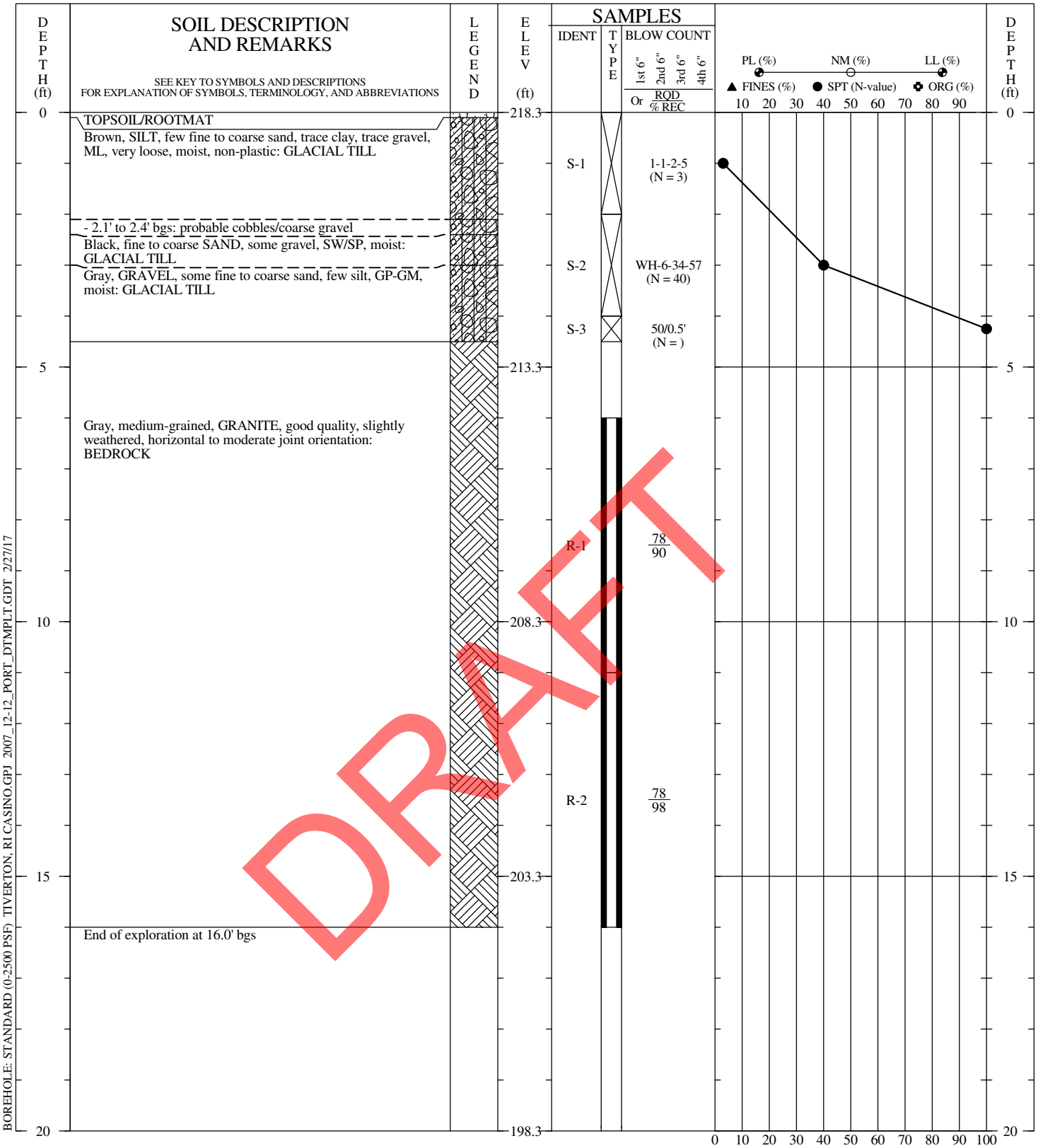


BOREHOLE: STANDARD (0-2500 PSF) TIVERTON, RI CASINO.GPJ 2007_12-12_PORT_DTMPLT.GDT 2/27/17

DRILLER:	GeoLogic Earth Exploration
RIG TYPE:	CME-55
METHOD:	Rotary Wash with Water (Cased)
HOLE DIAM.:	3"
SPTs:	Rope & cathead.
REMARKS:	Groundwater not encountered during drilling. Boring backfilled with cuttings upon completion.

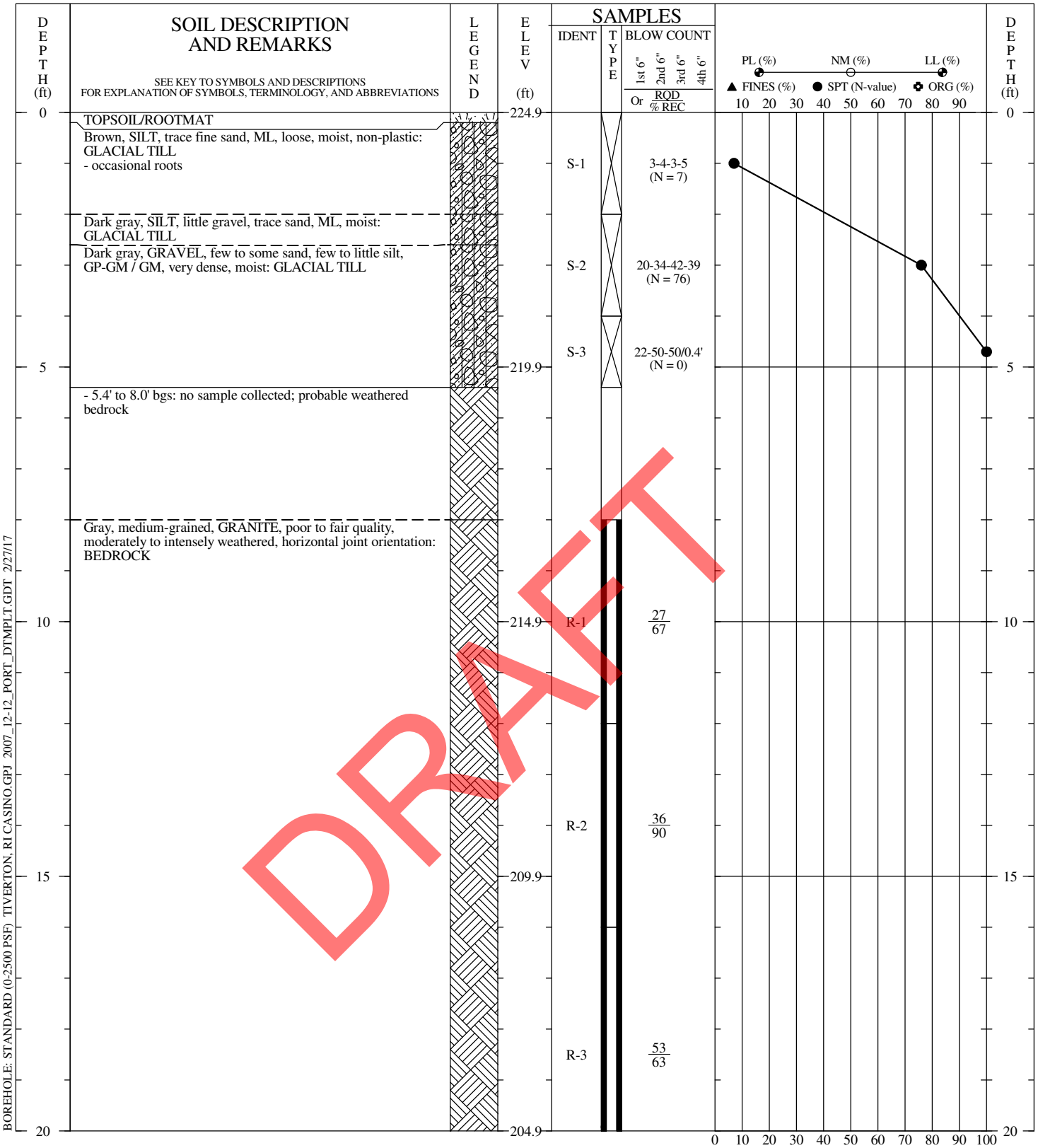
LOGGED BY: JC CHECKED BY/DATE:

THIS BORING RECORD PRESENTS A REASONABLE INTERPRETATION OF THE SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. STRATA INTERFACES (AS SHOWN) ARE APPROXIMATE. ACTUAL TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

GEOTECHNICAL BORING RECORD

BORING NO.:	SB-09
DRILLED:	01/20/2017
PROJECT:	Twin River - Tiverton Casino & Hotel
LOCATION:	Tiverton, RI
PROJECT NO.:	3653160007

amec foster wheeler



DRILLER:	GeoLogic Earth Exploration
RIG TYPE:	CME-55
METHOD:	Rotary Wash with Water (Cased)
HOLE DIAM.:	3"
SPTs:	Rope & cathead.
REMARKS:	Groundwater not encountered during drilling. Boring backfilled with cuttings upon completion.

LOGGED BY: JC CHECKED BY/DATE:

THIS BORING RECORD PRESENTS A REASONABLE INTERPRETATION OF THE SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. STRATA INTERFACES (AS SHOWN) ARE APPROXIMATE. ACTUAL TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

GEOTECHNICAL BORING RECORD

BORING NO.:	SB-10
DRILLED:	01/23/2017 - 01/24/2017
PROJECT:	Twin River - Tiverton Casino & Hotel
LOCATION:	Tiverton, RI
PROJECT NO.:	3653160007

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DEPTH (ft)	SOIL DESCRIPTION AND REMARKS SEE KEY TO SYMBOLS AND DESCRIPTIONS FOR EXPLANATION OF SYMBOLS, TERMINOLOGY, AND ABBREVIATIONS	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	SAMPLES BLOW COUNT 1st 6" / 2nd 6" / 3rd 6" / 4th 6" Or RQD / % REC	PL (%) NM (%) LL (%) ▲ FINES (%) ● SPT (N-value) ✪ ORG (%)	DEPTH (ft)
20	Gray, medium-grained, GRANITE, poor to fair quality, moderately to intensely weathered, horizontal joint orientation: BEDROCK		204.9				10 20 30 40 50 60 70 80 90	20
	End of exploration at 21.0' bgs							
25			199.9					25
30			194.9					30
35			189.9					35
40			184.9				0 10 20 30 40 50 60 70 80 90 100	40

BOREHOLE: STANDARD (0-2500 PSF) TIVERTON, RI CASINO.GPJ 2007_12-12_PORT_DTMPLT.GDT 2/27/17

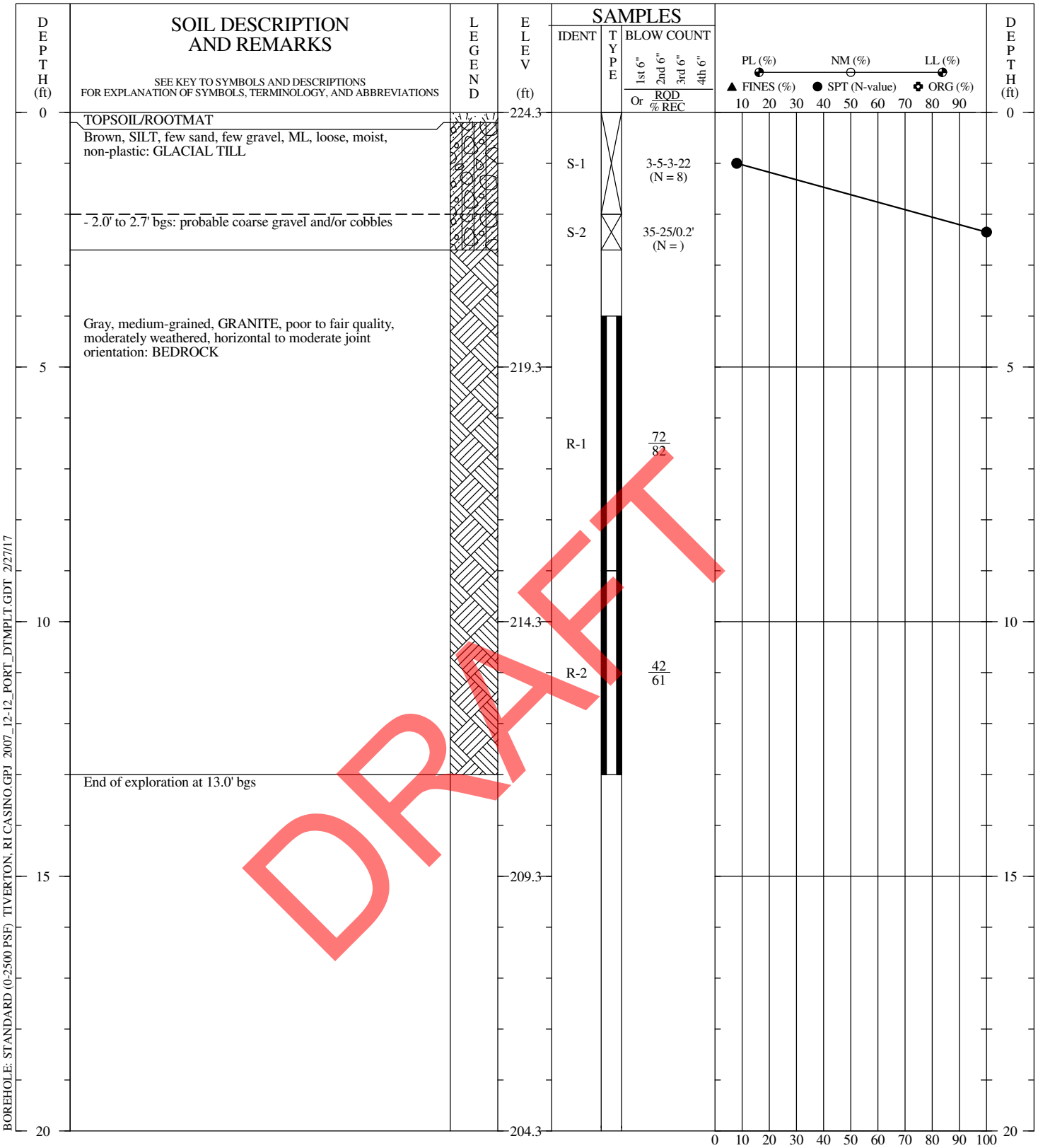
DRILLER:	GeoLogic Earth Exploration
RIG TYPE:	CME-55
METHOD:	Rotary Wash with Water (Cased)
HOLE DIAM.:	3"
SPTs:	Rope & cathead.
REMARKS:	Groundwater not encountered during drilling. Boring backfilled with cuttings upon completion.

THIS BORING RECORD PRESENTS A REASONABLE INTERPRETATION OF THE SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. STRATA INTERFACES (AS SHOWN) ARE APPROXIMATE. ACTUAL TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

GEOTECHNICAL BORING RECORD

BORING NO.:	SB-10
DRILLED:	01/23/2017 - 01/24/2017
PROJECT:	Twin River - Tiverton Casino & Hotel
LOCATION:	Tiverton, RI
PROJECT NO.:	3653160007

amec foster wheeler



BOREHOLE: STANDARD (0-2500 PSF) TIVERTON, RI CASINO.GPJ 2007_12-12_PORT_DTMPLT.GDT 2/27/17

DRILLER:	GeoLogic Earth Exploration
RIG TYPE:	CME-55
METHOD:	Rotary Wash with Water (Cased)
HOLE DIAM.:	3"
SPTs:	Rope & cathead.
REMARKS:	Groundwater not encountered during drilling. Boring backfilled with cuttings upon completion.

LOGGED BY: JC CHECKED BY/DATE:

THIS BORING RECORD PRESENTS A REASONABLE INTERPRETATION OF THE SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. STRATA INTERFACES (AS SHOWN) ARE APPROXIMATE. ACTUAL TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

GEOTECHNICAL BORING RECORD

BORING NO.:	SB-11
DRILLED:	01/23/2017
PROJECT:	Twin River - Tiverton Casino & Hotel
LOCATION:	Tiverton, RI
PROJECT NO.:	3653160007

PAGE 1 **OF** 1

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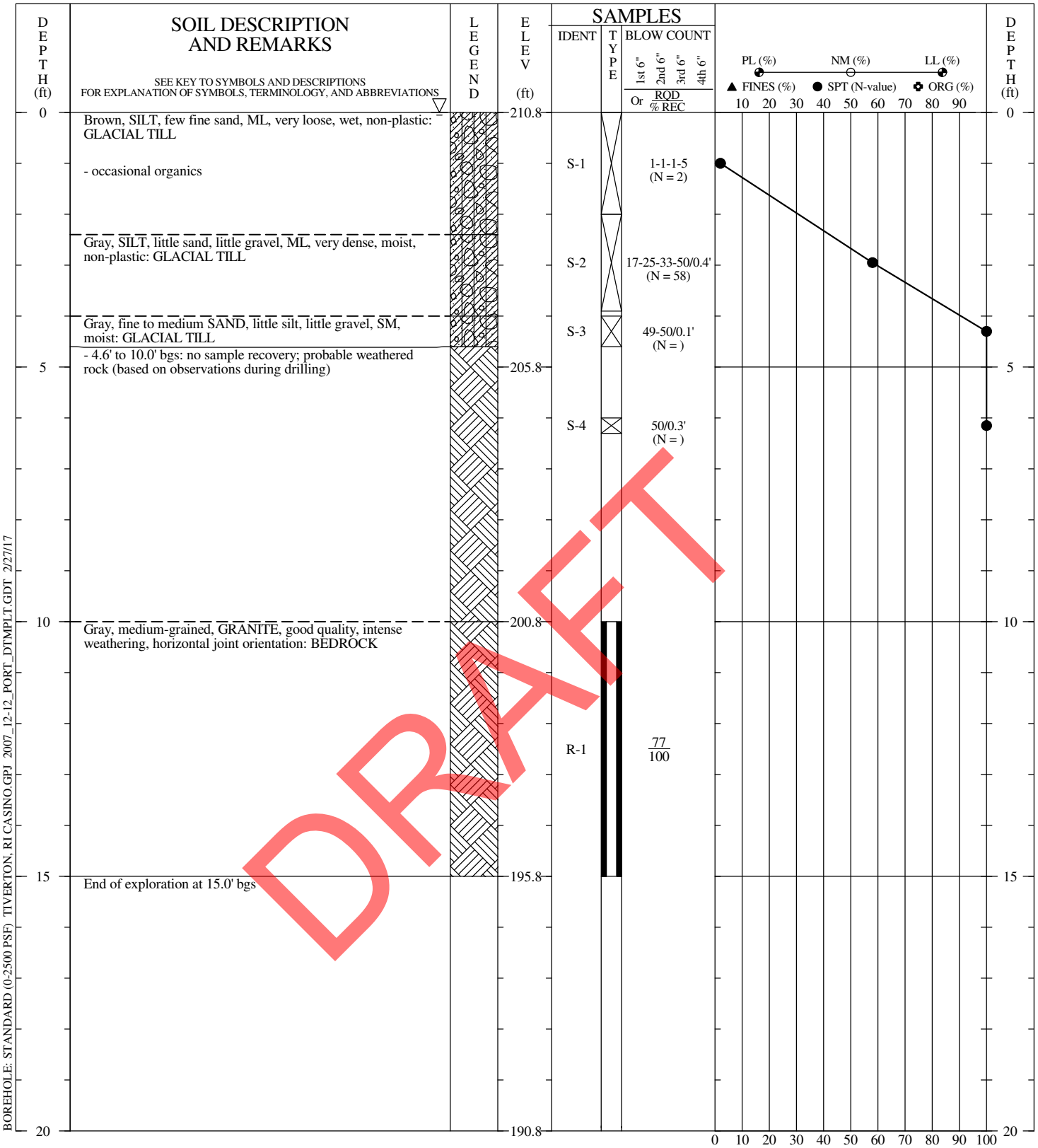


BOREHOLE: STANDARD (0-2500 PSF) TIVERTON, RI CASINO.GPJ 2007_12-12_PORT_DTMPLT.GDT 2/27/17

DRILLER:	GeoLogic Earth Exploration
RIG TYPE:	CME-55
METHOD:	Rotary Wash with Water (Cased)
HOLE DIAM.:	3"
SPTs:	Rope & cathead.
REMARKS:	Water encountered at ground surface. Boring backfilled with cuttings upon completion.

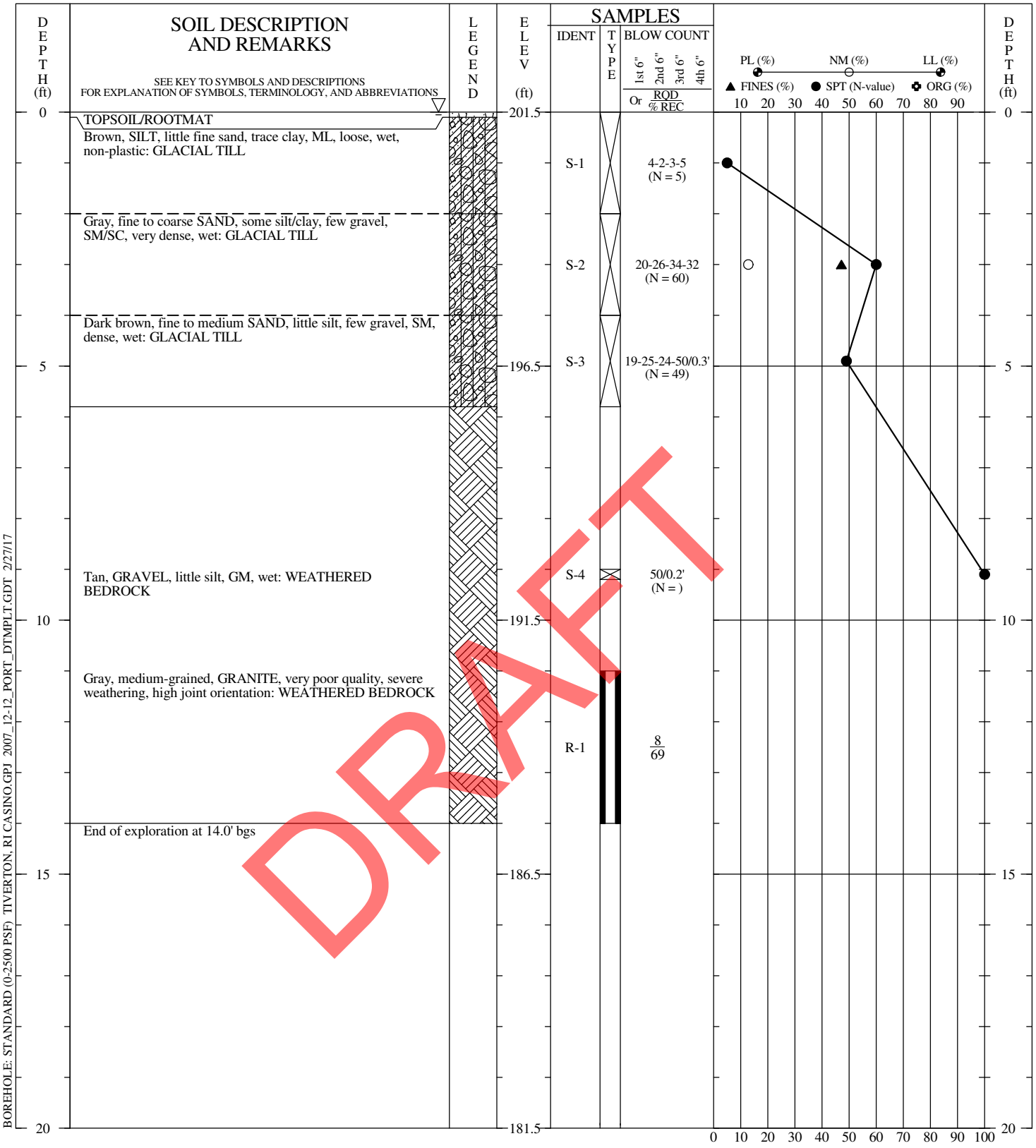
LOGGED BY: JC CHECKED BY/DATE:

THIS BORING RECORD PRESENTS A REASONABLE INTERPRETATION OF THE SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. STRATA INTERFACES (AS SHOWN) ARE APPROXIMATE. ACTUAL TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

GEOTECHNICAL BORING RECORD

BORING NO.:	SB-12
DRILLED:	01/31/2017 - 02/01/2017
PROJECT:	Twin River - Tiverton Casino & Hotel
LOCATION:	Tiverton, RI
PROJECT NO.:	3653160007

amec foster wheeler



BOREHOLE: STANDARD (0-2500 PSF) TIVERTON, RI CASINO.GPJ 2007_12-12_PORT_DTMPLT.GDT 2/27/17

DRILLER:	GeoLogic Earth Exploration
RIG TYPE:	CME-55
METHOD:	Rotary Wash with Water (Cased)
HOLE DIAM.:	3"
SPTs:	Rope & cathead.
REMARKS:	Water encountered at ground surface. Boring backfilled with cuttings upon completion.

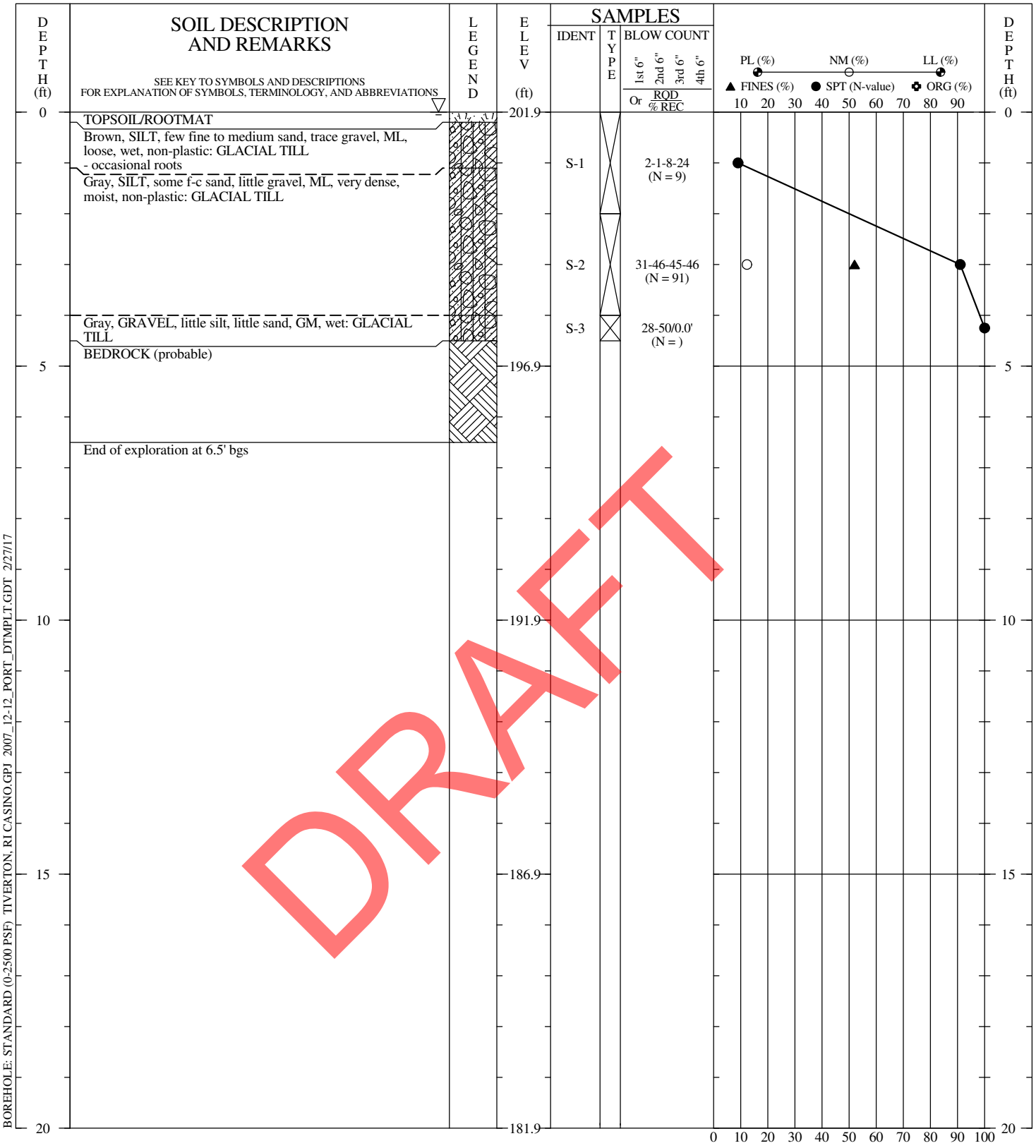
LOGGED BY: JC CHECKED BY/DATE:

THIS BORING RECORD PRESENTS A REASONABLE INTERPRETATION OF THE SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. STRATA INTERFACES (AS SHOWN) ARE APPROXIMATE. ACTUAL TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

GEOTECHNICAL BORING RECORD

BORING NO.:	SB-13
DRILLED:	01/25/2017
PROJECT:	Twin River - Tiverton Casino & Hotel
LOCATION:	Tiverton, RI
PROJECT NO.:	3653160007

amec foster wheeler



BOREHOLE: STANDARD (0-2500 PSF) TIVERTON, RI CASINO.GPJ 2007_12-12_PORT_DTMPLT.GDT 2/27/17

DRILLER:	GeoLogic Earth Exploration
RIG TYPE:	CME-55
METHOD:	Rotary Wash with Water (Cased)
HOLE DIAM.:	3"
SPTs:	Rope & cathead.
REMARKS:	Water encountered at ground surface. Boring backfilled with cuttings upon completion.

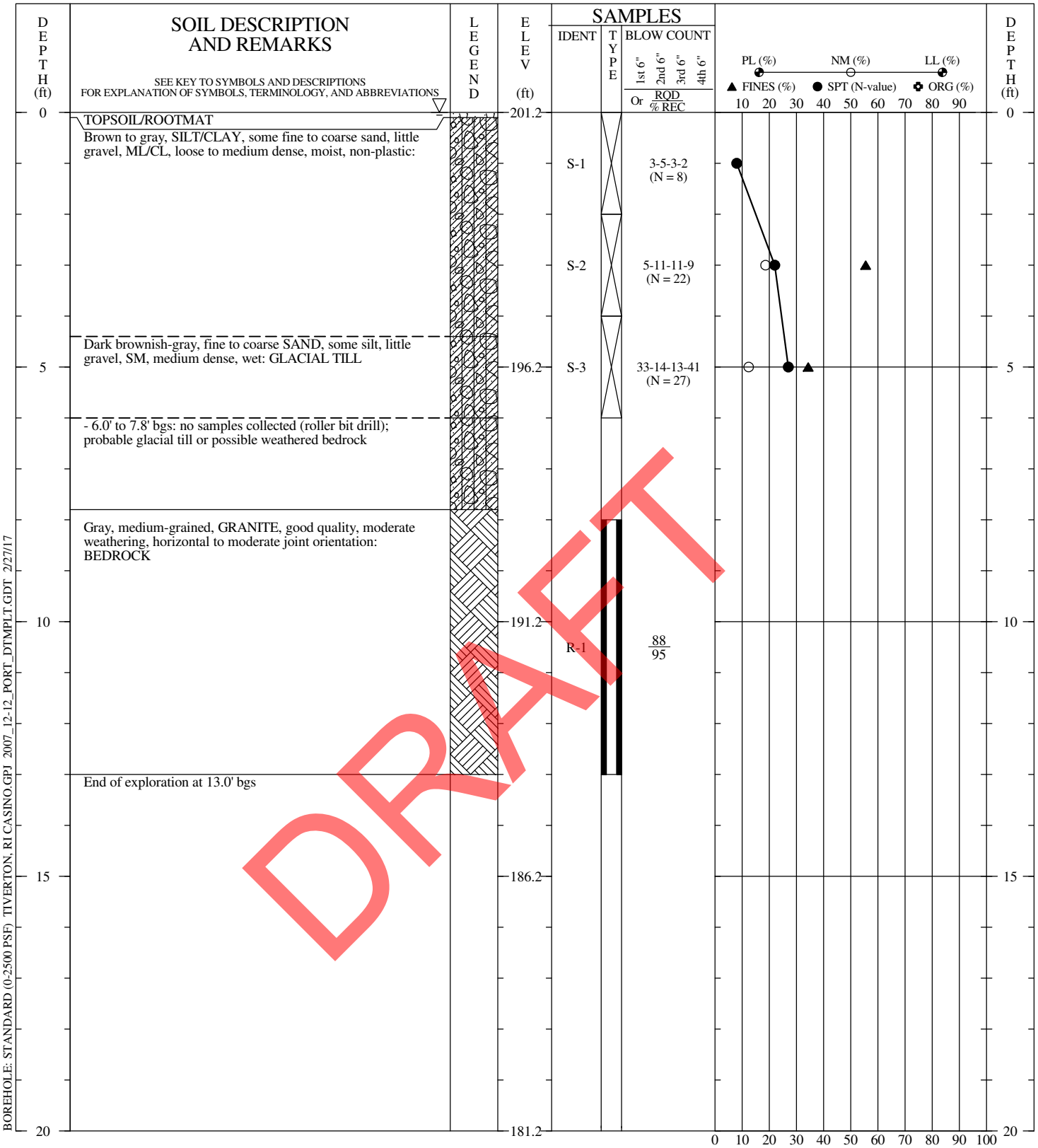
LOGGED BY: JC CHECKED BY/DATE:

THIS BORING RECORD PRESENTS A REASONABLE INTERPRETATION OF THE SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. STRATA INTERFACES (AS SHOWN) ARE APPROXIMATE. ACTUAL TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

GEOTECHNICAL BORING RECORD

BORING NO.:	SB-14
DRILLED:	01/24/2017
PROJECT:	Twin River - Tiverton Casino & Hotel
LOCATION:	Tiverton, RI
PROJECT NO.:	3653160007

amec foster wheeler



BOREHOLE: STANDARD (0-2500 PSF) TIVERTON, RI CASINO.GPJ 2007_12-12_PORT_DTMPLT.GDT 2/27/17

DRILLER:	GeoLogic Earth Exploration
RIG TYPE:	CME-55
METHOD:	Rotary Wash with Water (Cased)
HOLE DIAM.:	3"
SPTs:	Rope & cathead.
REMARKS:	Water encountered at ground surface. Boring backfilled with cuttings upon completion.

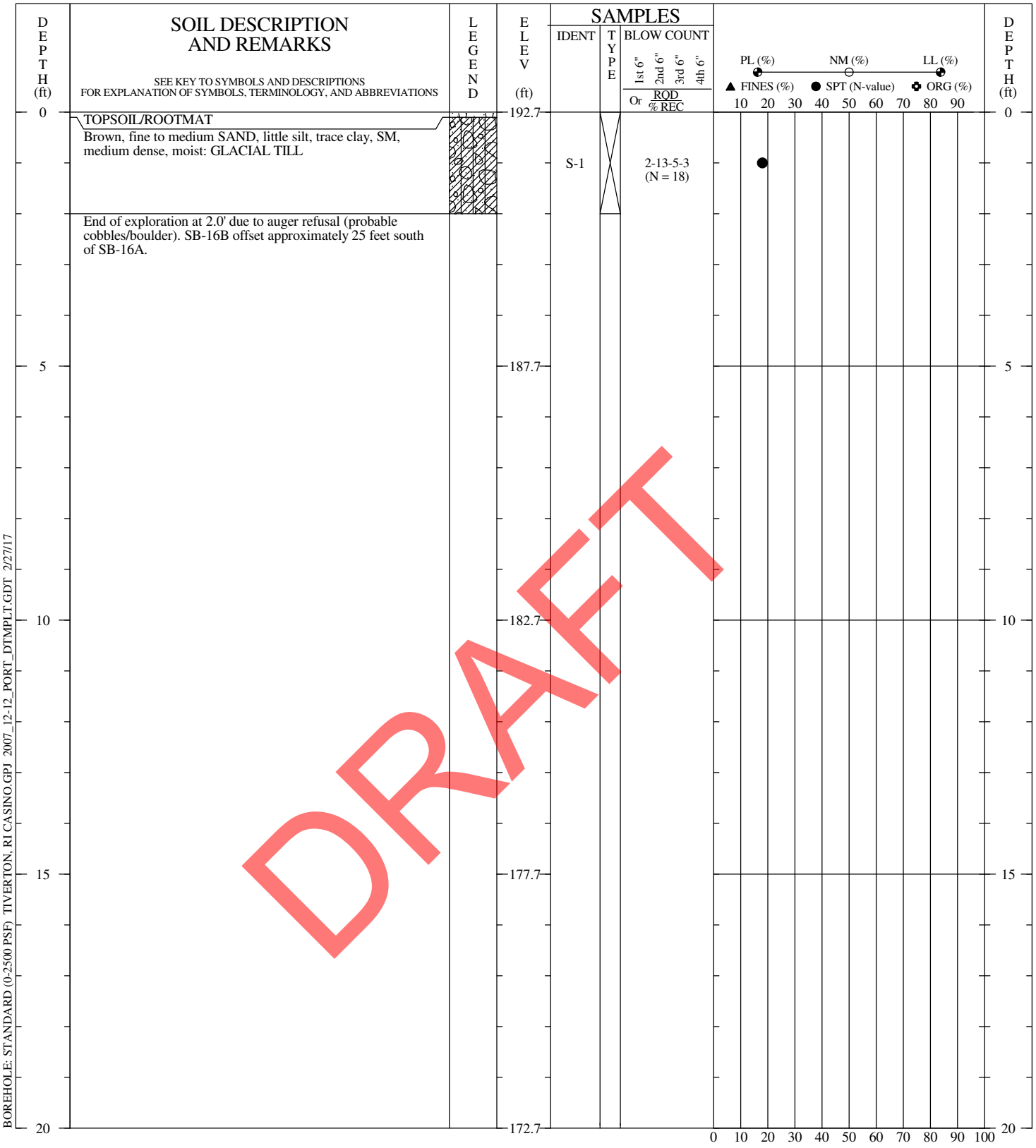
LOGGED BY: JC CHECKED BY/DATE:

THIS BORING RECORD PRESENTS A REASONABLE INTERPRETATION OF THE SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. STRATA INTERFACES (AS SHOWN) ARE APPROXIMATE. ACTUAL TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

GEOTECHNICAL BORING RECORD

BORING NO.:	SB-15
DRILLED:	01/24/2017
PROJECT:	Twin River - Tiverton Casino & Hotel
LOCATION:	Tiverton, RI
PROJECT NO.:	3653160007

amec foster wheeler



BOREHOLE: STANDARD (0-2500 PSF) TIVERTON, RI CASINO.GPJ 2007_12-12_PORT_DTMPLT.GDT 2/27/17

DRILLER:	GeoLogic Earth Exploration
RIG TYPE:	CME-55
METHOD:	Hollow-Stem Augers
HOLE DIAM.:	4.25" ID
SPTs:	Rope & cathead.
REMARKS:	Groundwater not encountered during drilling. Boring backfilled with cuttings upon completion. SB-16B offset 25 feet to south of SB-16A.
LOGGED BY:	JC CHECKED BY/DATE:

THIS BORING RECORD PRESENTS A REASONABLE INTERPRETATION OF THE SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. STRATA INTERFACES (AS SHOWN) ARE APPROXIMATE. ACTUAL TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

GEOTECHNICAL BORING RECORD

BORING NO.:	SB-16A
DRILLED:	01/13/2017
PROJECT:	Twin River - Tiverton Casino & Hotel
LOCATION:	Tiverton, RI
PROJECT NO.:	3653160007

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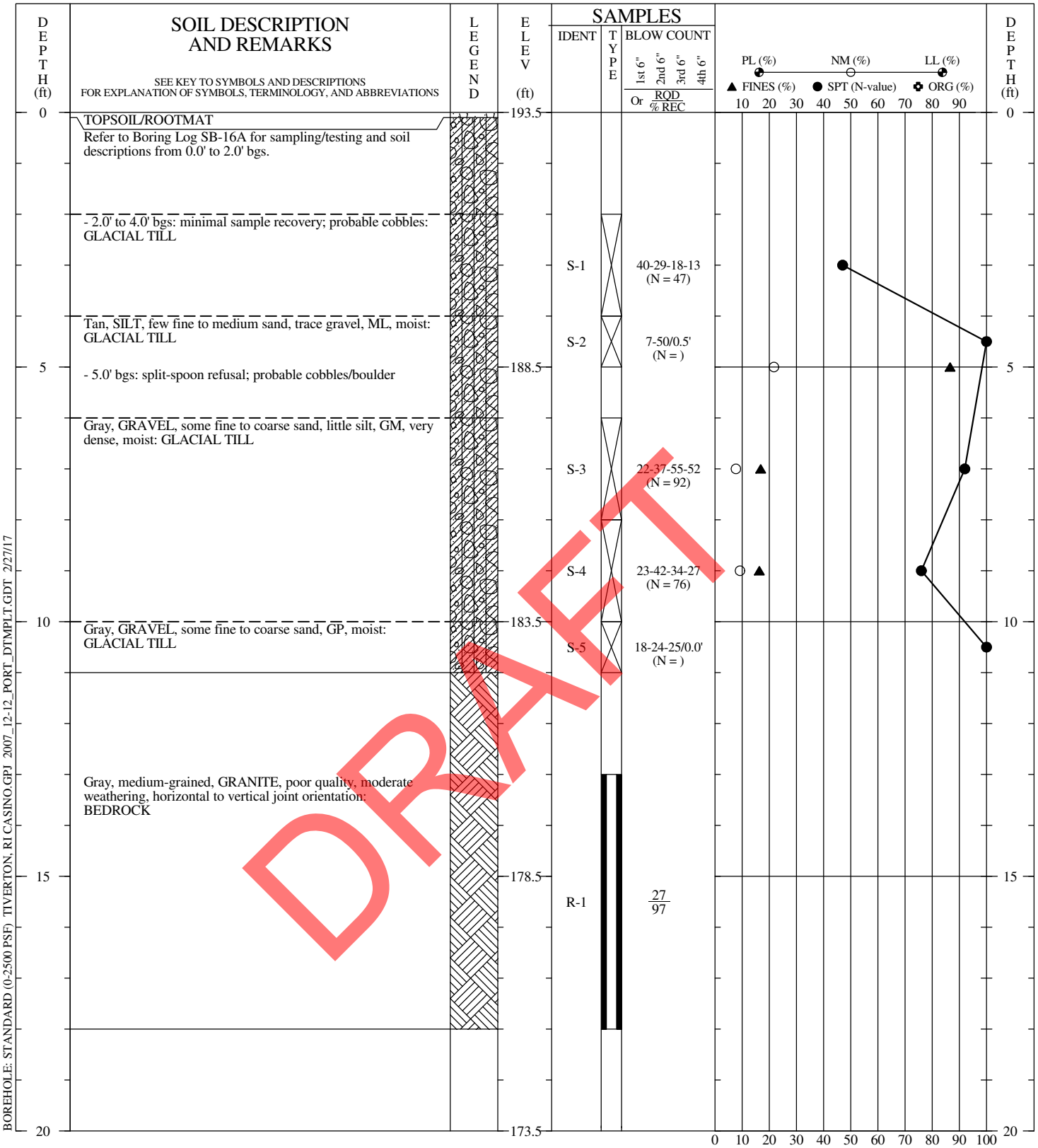


BOREHOLE: STANDARD (0-2500 PSF) TIVERTON, RI CASINO.GPJ 2007_12-12_PORT_DTMPLT.GDT 2/27/17

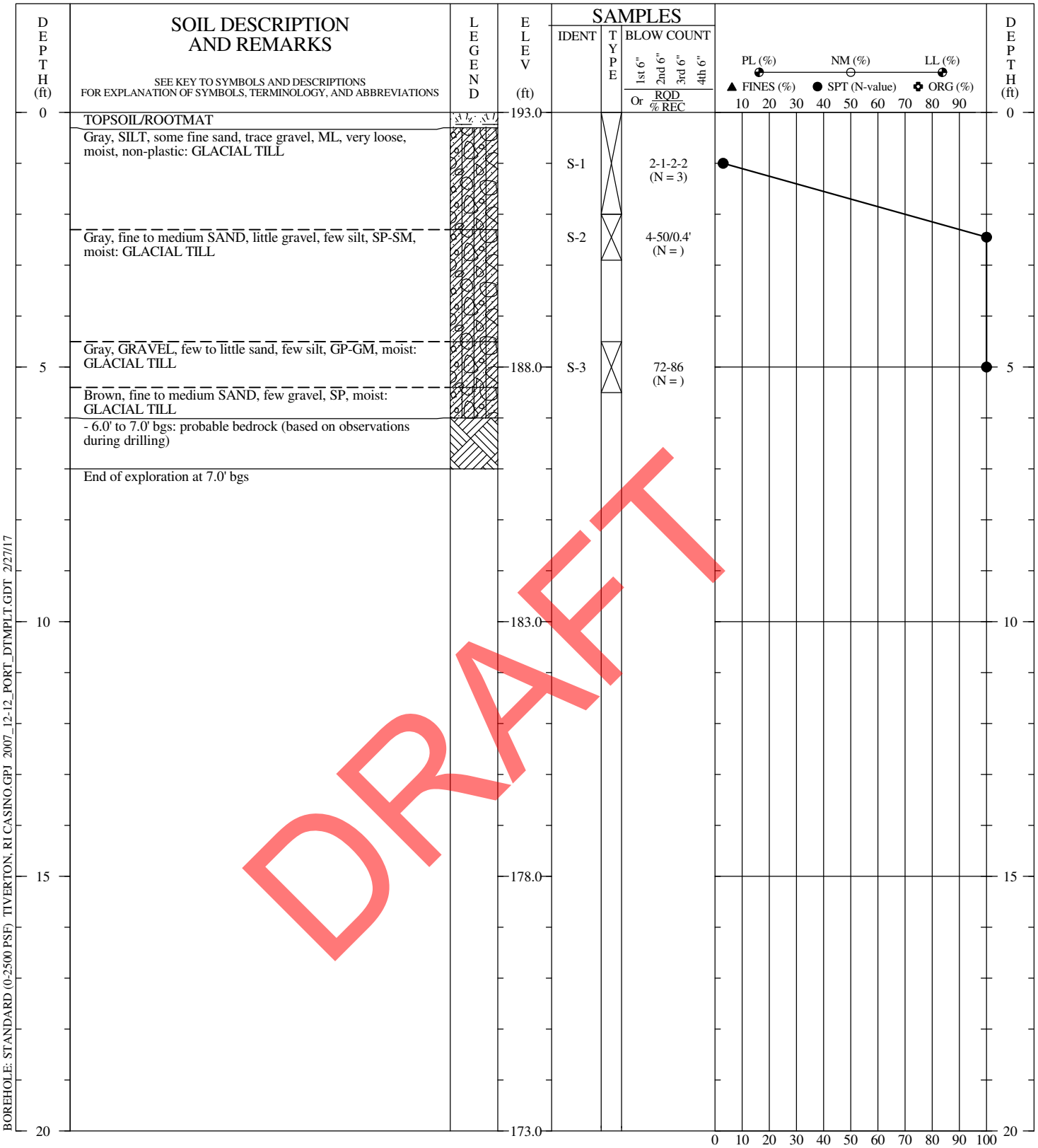
DRILLER:	GeoLogic Earth Exploration
RIG TYPE:	CME-55
METHOD:	Variable (HSA and Rotary Wash)
HOLE DIAM.:	Variable
SPTs:	Rope & cathead.
REMARKS:	Offset 25 feet South of SB-16A. Approximate ground surface EL. Groundwater not encountered during drilling. Hollow-stem augers (4.25" I.D.) to 5 feet bgs, 3" I.D. cased drive & wash thereafter. Boring backfilled with cuttings upon completion.
LOGGED BY: IG	CHECKED BY/DATE:

THIS BORING RECORD PRESENTS A REASONABLE INTERPRETATION OF THE SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. STRATA INTERFACES (AS SHOWN) ARE APPROXIMATE. ACTUAL TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

GEOTECHNICAL BORING RECORD

BORING NO.:	SB-16B
DRILLED:	01/13/2017 - 01/16/2017
PROJECT:	Twin River - Tiverton Casino & Hotel
LOCATION:	Tiverton, RI
PROJECT NO.:	3653160007

amec foster wheeler



BOREHOLE: STANDARD (0-2500 PSF) TIVERTON, RI CASINO.GPJ 2007_12-12_PORT_DTMPLT.GDT 2/27/17

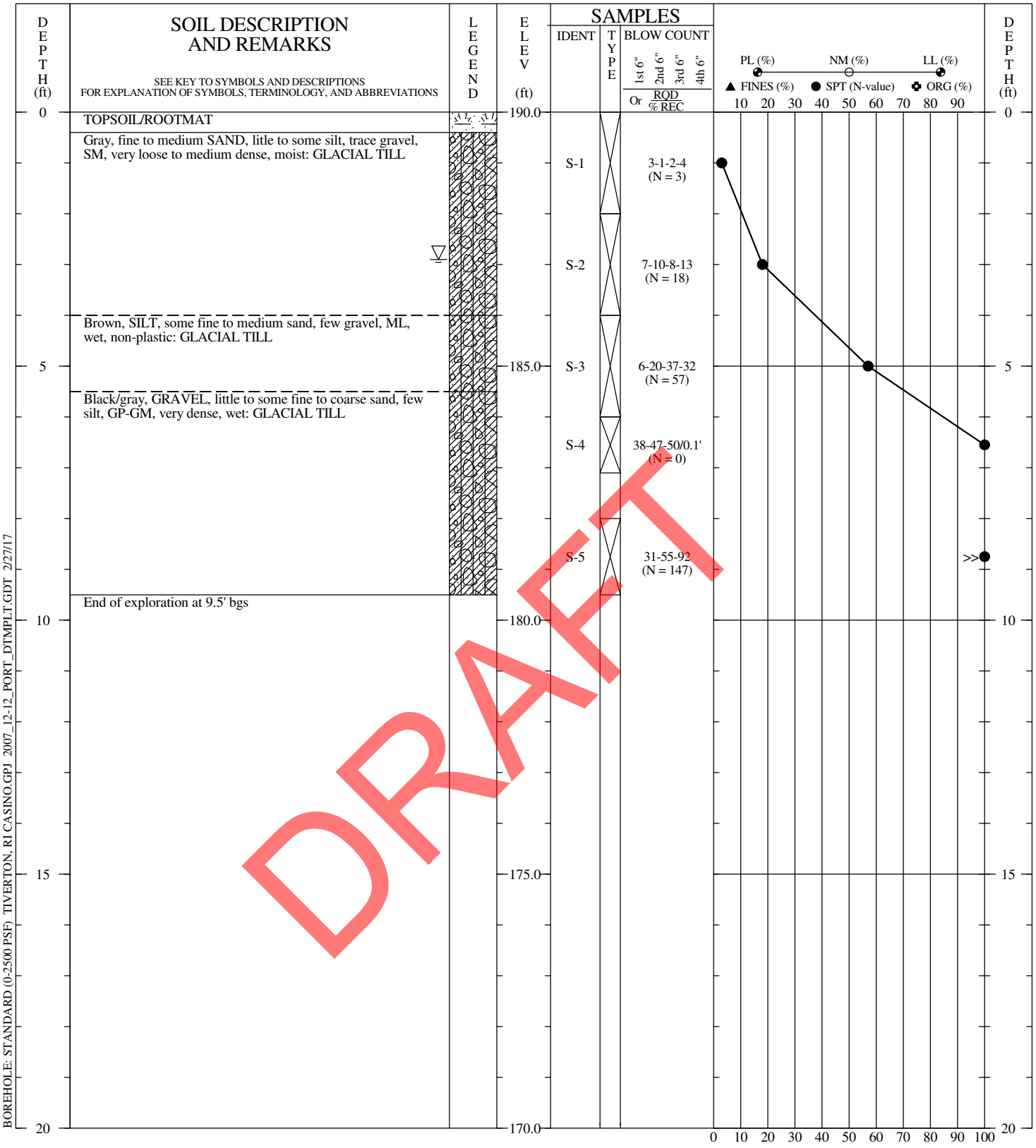
DRILLER:	GeoLogic Earth Exploration
RIG TYPE:	CME-55
METHOD:	Rotary Wash with Water (Cased)
HOLE DIAM.:	3"
SPTs:	Rope & cathead.
REMARKS:	Groundwater not encountered during drilling. Boring backfilled with cuttings upon completion. SB-16B offset 25 feet to south of SB-16A.
LOGGED BY:	JC CHECKED BY/DATE:

THIS BORING RECORD PRESENTS A REASONABLE INTERPRETATION OF THE SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. STRATA INTERFACES (AS SHOWN) ARE APPROXIMATE. ACTUAL TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

GEOTECHNICAL BORING RECORD

BORING NO.:	SB-17
DRILLED:	02/01/2017
PROJECT:	Twin River - Tiverton Casino & Hotel
LOCATION:	Tiverton, RI
PROJECT NO.:	3653160007

amec foster wheeler



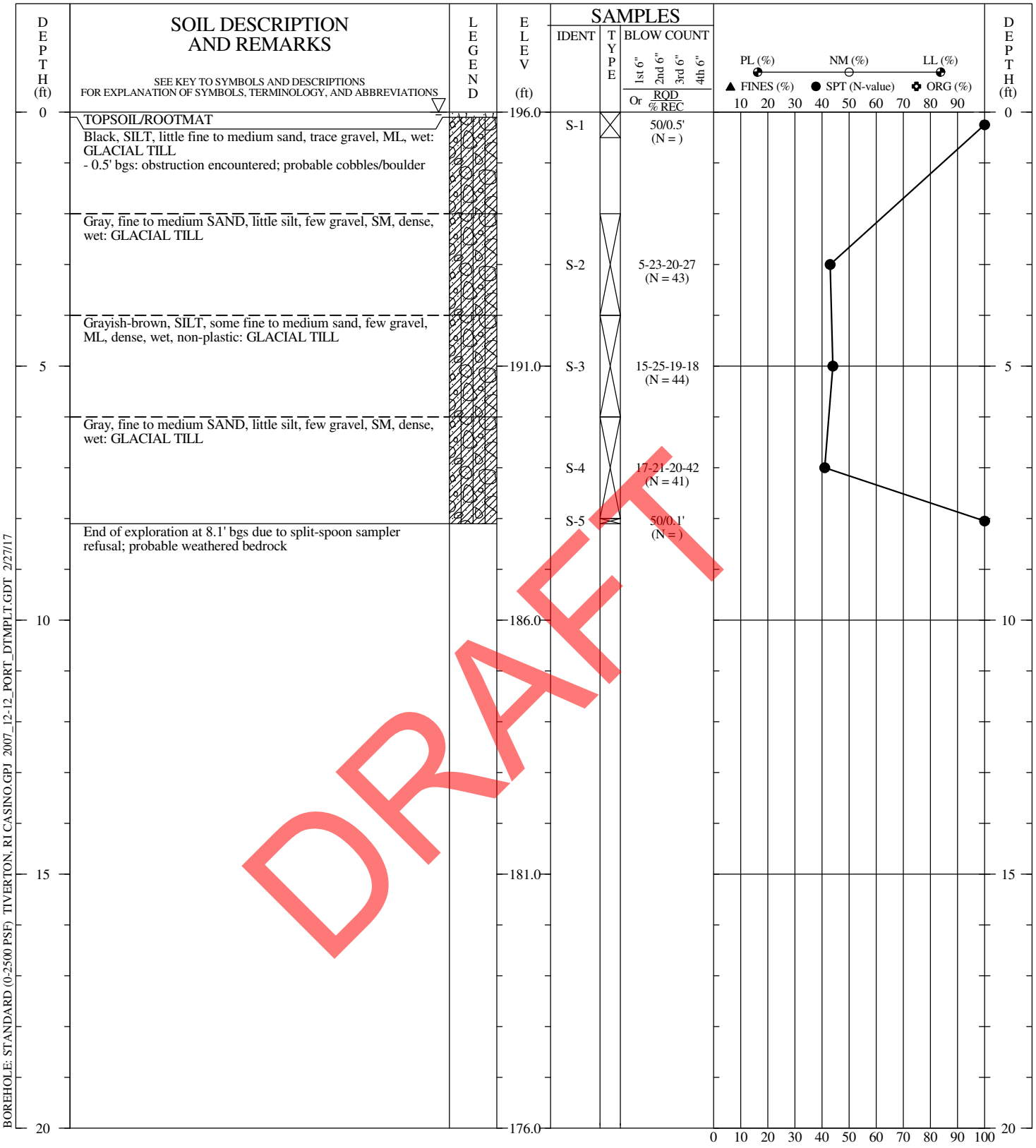
DRILLER:	GeoLogic Earth Exploration
RIG TYPE:	CME-55
METHOD:	Rotary Wash with Water (Cased)
HOLE DIAM.:	3"
SPTs:	Rope & cathead.
REMARKS:	Offset 24' E of staked location. Approximate ground surface EL. Water level measured in casing at completion of drilling. Boring backfilled with cuttings upon completion.
LOGGED BY:	JC CHECKED BY/DATE:

THIS BORING RECORD PRESENTS A REASONABLE INTERPRETATION OF THE SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. STRATA INTERFACES (AS SHOWN) ARE APPROXIMATE. ACTUAL TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

GEOTECHNICAL BORING RECORD

BORING NO.:	SB-18
DRILLED:	02/02/2017
PROJECT:	Twin River - Tiverton Casino & Hotel
LOCATION:	Tiverton, RI
PROJECT NO.:	3653160007

amec foster wheeler



BOREHOLE: STANDARD (0-2500 PSF) TIVERTON, RI CASINO.GPJ 2007_12-12_PORT_DTMPLT.GDT 2/27/17

DRILLER:	GeoLogic Earth Exploration
RIG TYPE:	CME-55
METHOD:	Rotary Wash with Water (Cased)
HOLE DIAM.:	3"
SPTs:	Rope & cathead.
REMARKS:	Water encountered at ground surface. Boring backfilled with cuttings upon completion.

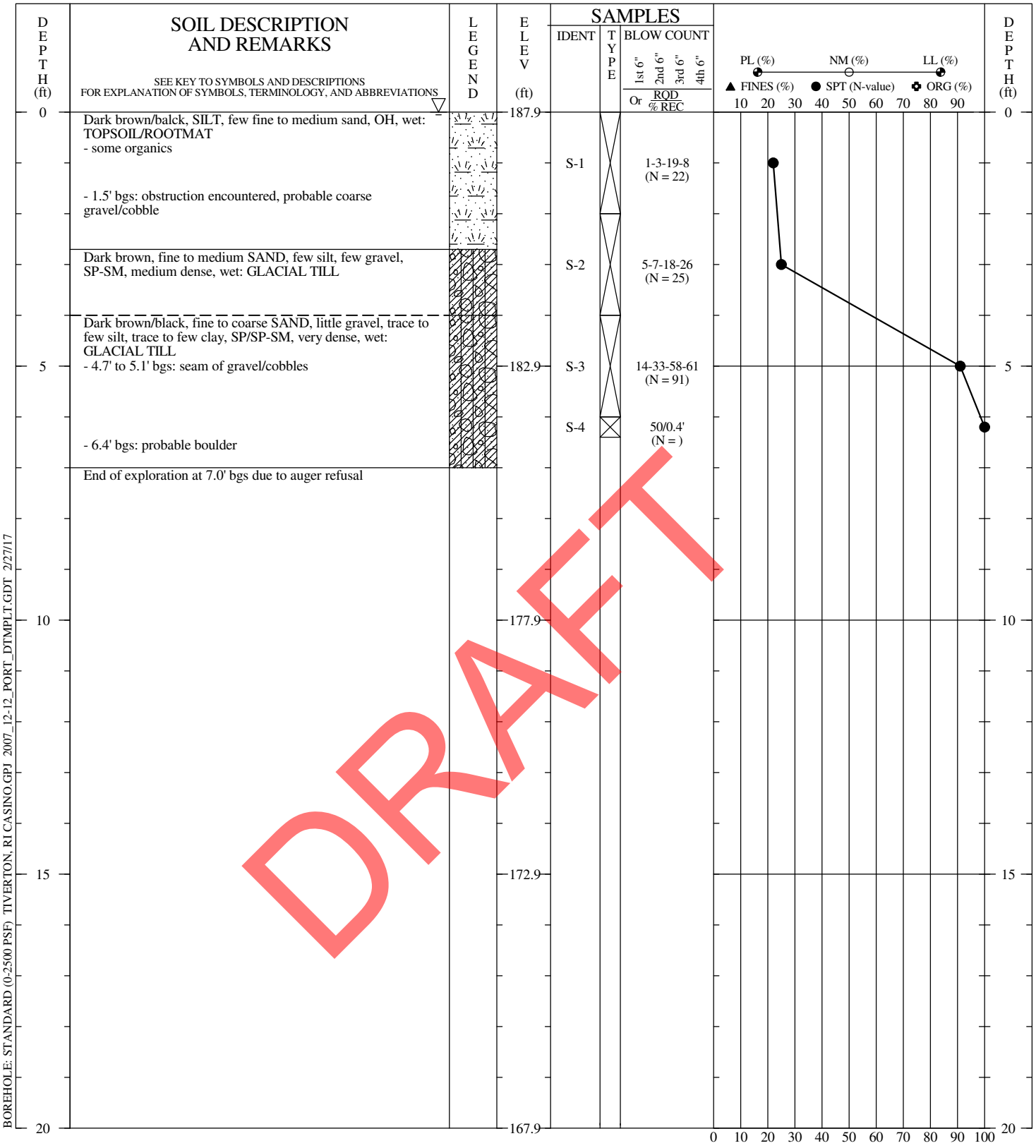
LOGGED BY: JC CHECKED BY/DATE:

THIS BORING RECORD PRESENTS A REASONABLE INTERPRETATION OF THE SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. STRATA INTERFACES (AS SHOWN) ARE APPROXIMATE. ACTUAL TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

GEOTECHNICAL BORING RECORD

BORING NO.:	SB-19
DRILLED:	01/25/2017
PROJECT:	Twin River - Tiverton Casino & Hotel
LOCATION:	Tiverton, RI
PROJECT NO.:	3653160007

amec foster wheeler



BOREHOLE: STANDARD (0-2500 PSF) TIVERTON, RI CASINO.GPJ 2007_12-12_PORT_DTMPLT.GDT 2/27/17

DRILLER:	GeoLogic Earth Exploration
RIG TYPE:	CME-55
METHOD:	Hollow-Stem Augers
HOLE DIAM.:	4.25" ID
SPTs:	Rope & cathead.
REMARKS:	Water encountered at ground surface. Boring backfilled with cuttings upon completion.

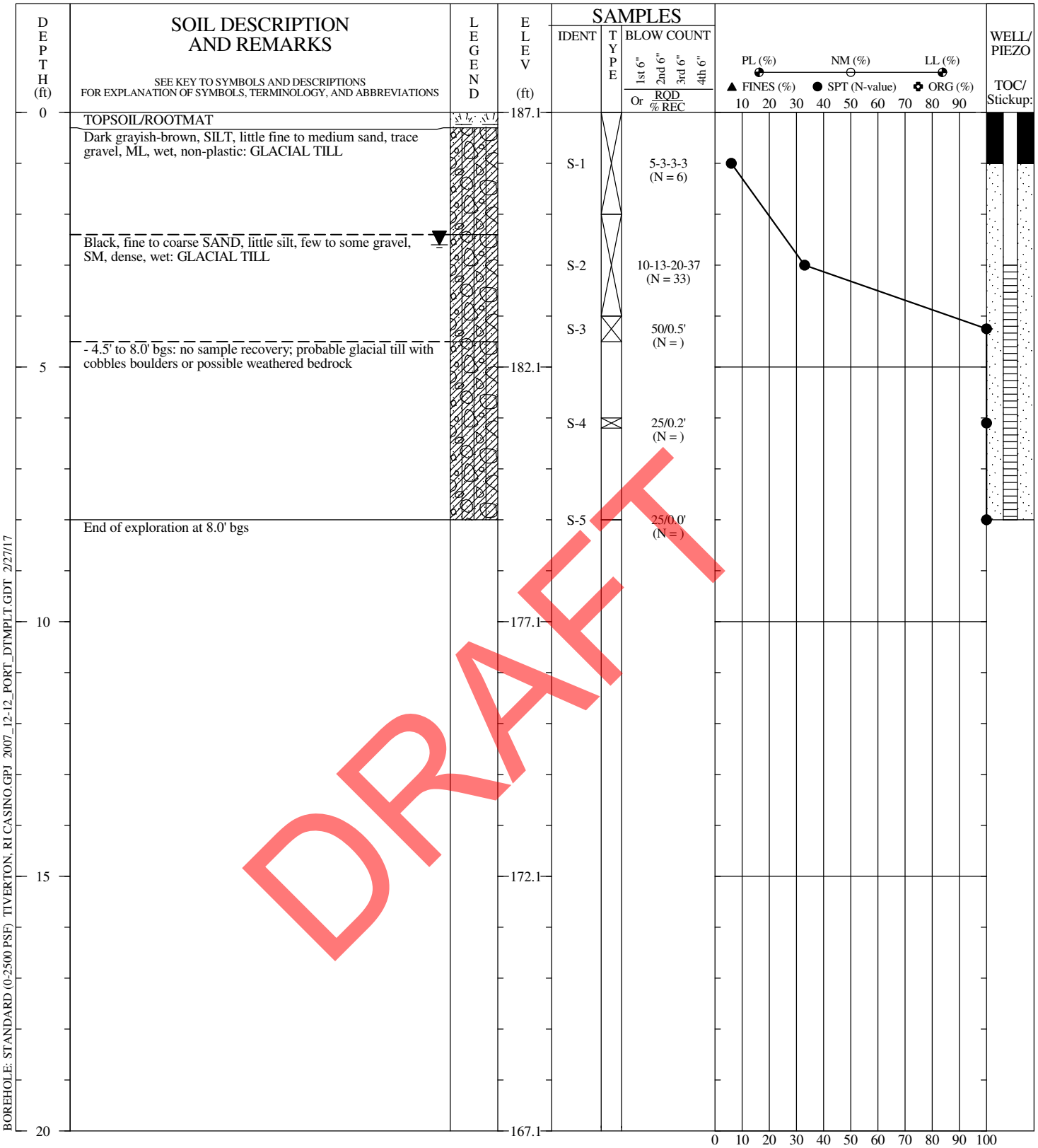
LOGGED BY: JC CHECKED BY/DATE:

THIS BORING RECORD PRESENTS A REASONABLE INTERPRETATION OF THE SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. STRATA INTERFACES (AS SHOWN) ARE APPROXIMATE. ACTUAL TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

GEOTECHNICAL BORING RECORD

BORING NO.:	SB-20
DRILLED:	01/13/2017
PROJECT:	Twin River - Tiverton Casino & Hotel
LOCATION:	Tiverton, RI
PROJECT NO.:	3653160007

amec foster wheeler



BOREHOLE: STANDARD (0-2500 PSF) TIVERTON, RI CASINO.GPJ 2007_12-12_PORT_DTMPLT.GDT 2/27/17

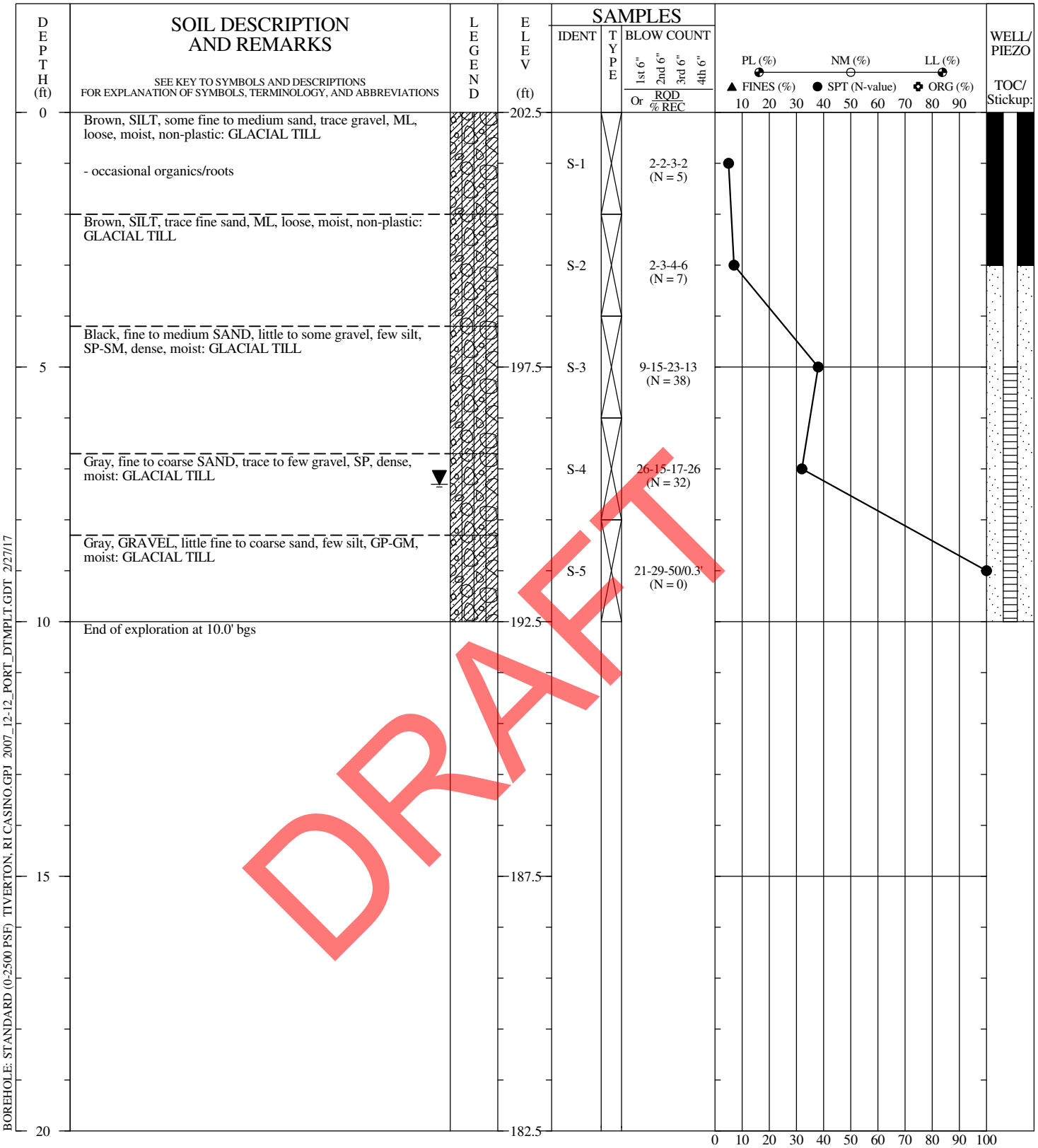
DRILLER:	GeoLogic Earth Exploration
RIG TYPE:	CME-55
METHOD:	Rotary Wash with Water (Cased)
HOLE DIAM.:	3"
SPTs:	Rope & cathead.
REMARKS:	Water level measured in observation well 1-day after completion. Boring restored as temporary observation well upon completion.
LOGGED BY:	JC CHECKED BY/DATE:

THIS BORING RECORD PRESENTS A REASONABLE INTERPRETATION OF THE SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. STRATA INTERFACES (AS SHOWN) ARE APPROXIMATE. ACTUAL TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

GEOTECHNICAL BORING RECORD

BORING NO.:	SB-21
DRILLED:	02/02/2017
PROJECT:	Twin River - Tiverton Casino & Hotel
LOCATION:	Tiverton, RI
PROJECT NO.:	3653160007

amec foster wheeler



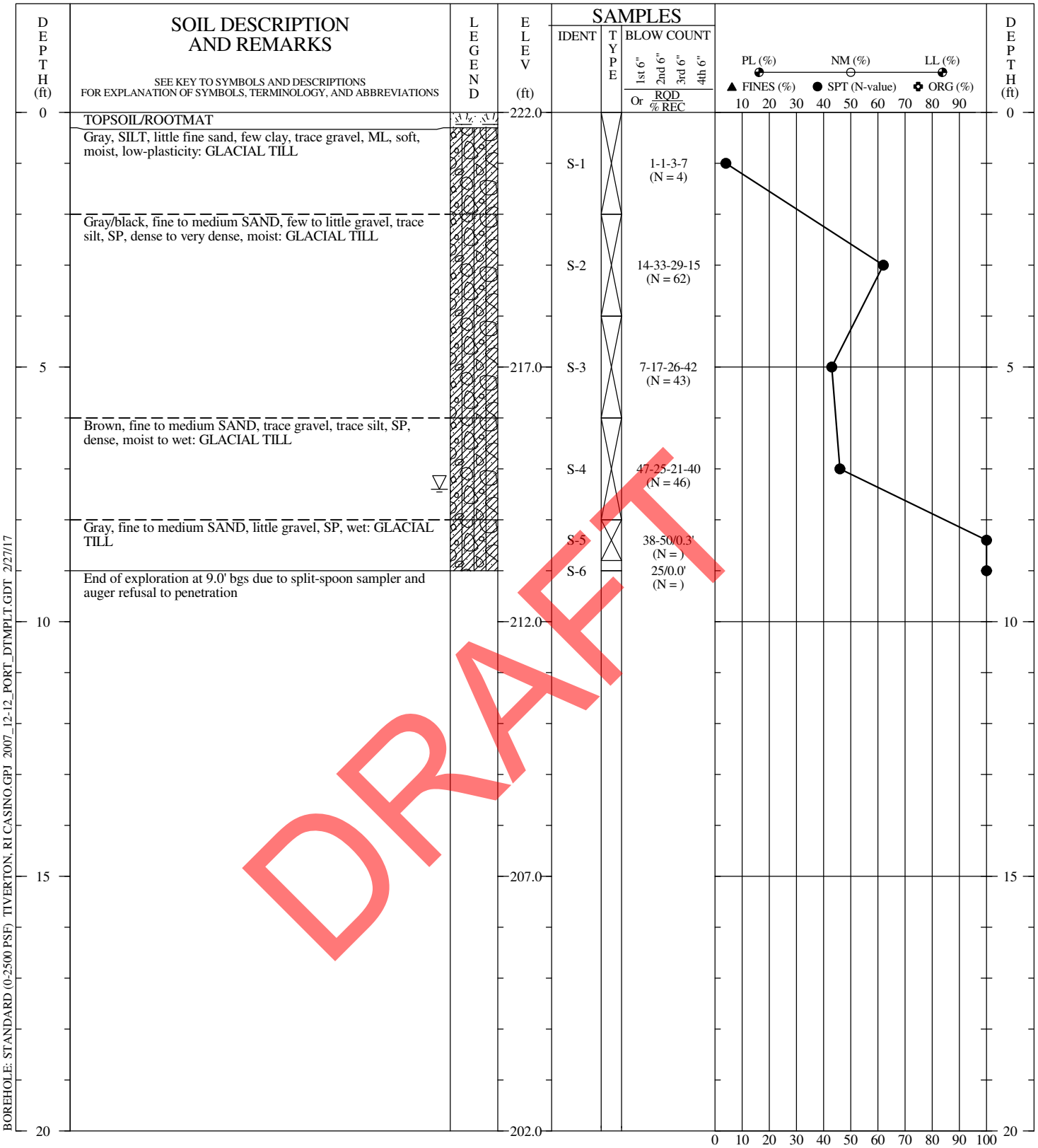
DRILLER:	GeoLogic Earth Exploration
RIG TYPE:	CME-55
METHOD:	Rotary Wash with Water (Cased)
HOLE DIAM.:	3"
SPTs:	Rope & cathead.
REMARKS:	Offset 15' N of staked location. Approximate ground surface EL. Water level measured in observation well after completion. Boring restored as temporary observation well upon completion.
LOGGED BY:	JC CHECKED BY/DATE:

THIS BORING RECORD PRESENTS A REASONABLE INTERPRETATION OF THE SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. STRATA INTERFACES (AS SHOWN) ARE APPROXIMATE. ACTUAL TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

GEOTECHNICAL BORING RECORD

BORING NO.:	SB-22
DRILLED:	02/03/2017
PROJECT:	Twin River - Tiverton Casino & Hotel
LOCATION:	Tiverton, RI
PROJECT NO.:	3653160007

amec foster wheeler



BOREHOLE: STANDARD (0-2500 PSF) TIVERTON, RI CASINO.GPJ 2007_12-12_PORT_DTMPLT.GDT 2/27/17

DRILLER:	GeoLogic Earth Exploration
RIG TYPE:	CME-55
METHOD:	Hollow-Stem Augers
HOLE DIAM.:	4.25" ID
SPTs:	Rope & cathead.
REMARKS:	Groundwater depth based on observed sample moisture. Boring backfilled with cuttings upon completion.

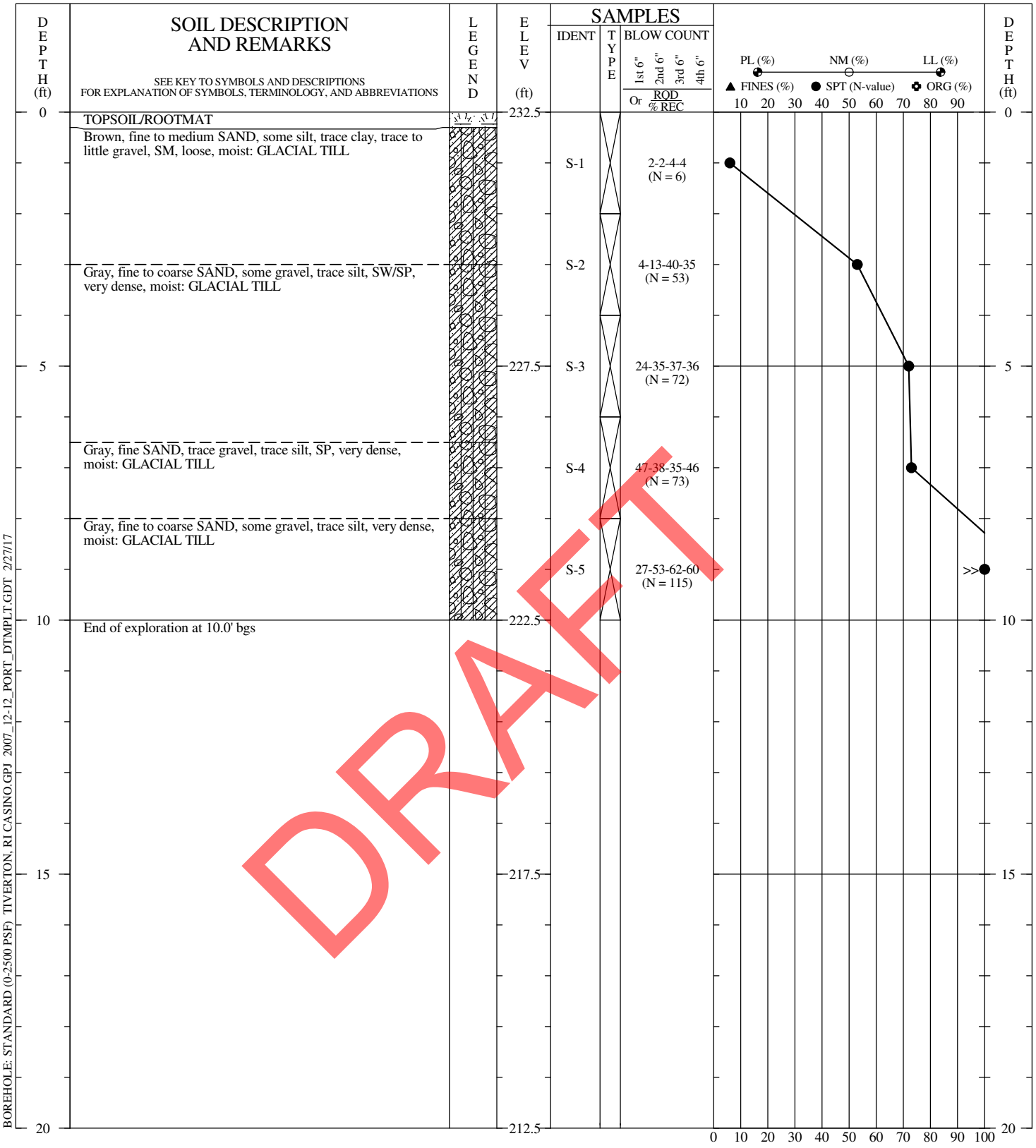
LOGGED BY: JC CHECKED BY/DATE:

THIS BORING RECORD PRESENTS A REASONABLE INTERPRETATION OF THE SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. STRATA INTERFACES (AS SHOWN) ARE APPROXIMATE. ACTUAL TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

GEOTECHNICAL BORING RECORD

BORING NO.:	SB-23
DRILLED:	01/12/2017
PROJECT:	Twin River - Tiverton Casino & Hotel
LOCATION:	Tiverton, RI
PROJECT NO.:	3653160007

amec foster wheeler



BOREHOLE: STANDARD (0-2500 PSF) TIVERTON, RI CASINO.GPJ 2007_12-12_PORT_DTMPLT.GDT 2/27/17

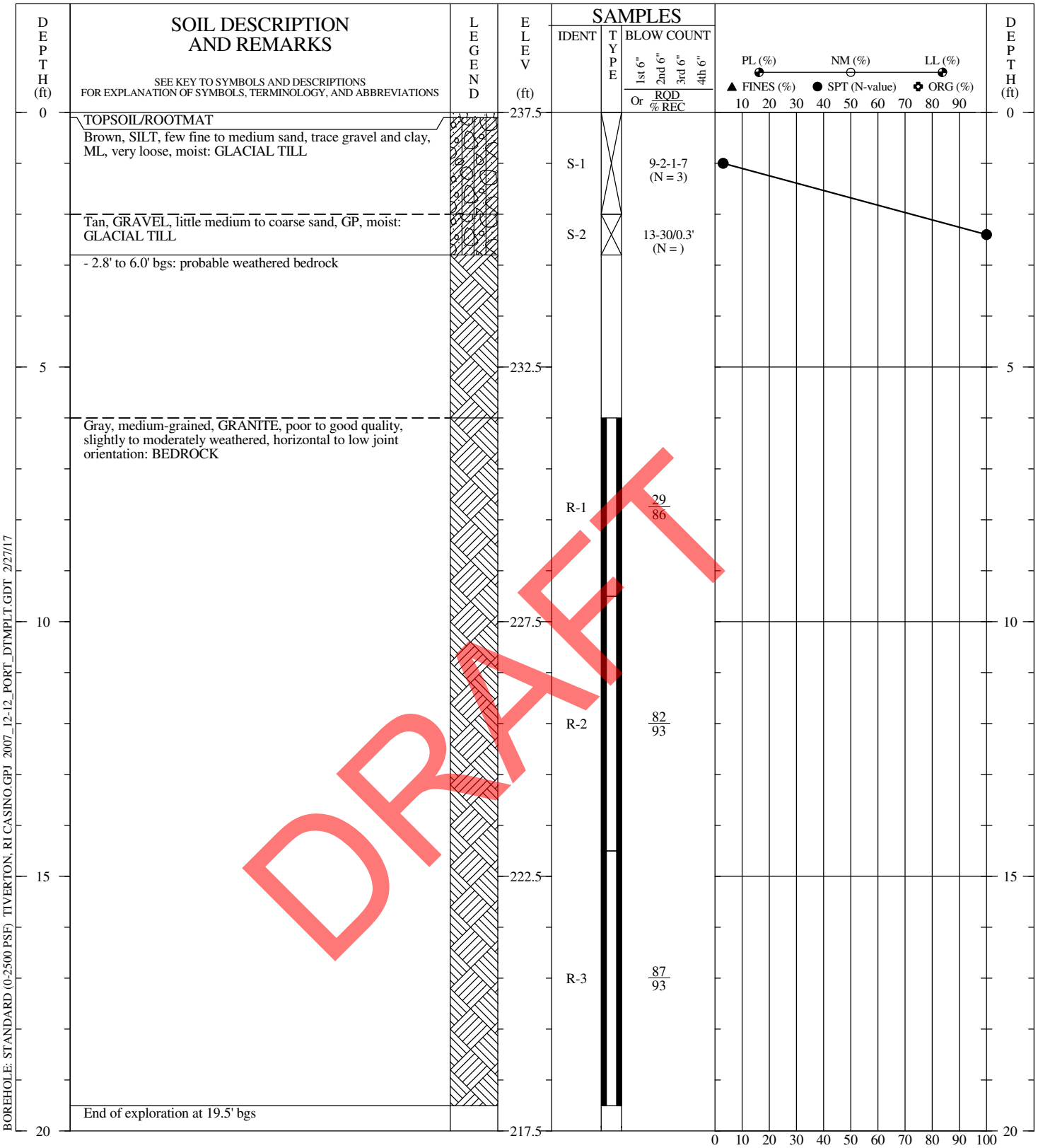
DRILLER:	GeoLogic Earth Exploration
RIG TYPE:	CME-55
METHOD:	Hollow-Stem Augers
HOLE DIAM.:	4.25" ID
SPTs:	Rope & cathead.
REMARKS:	Offset 11' NW of staked location. Approximate ground surface EL. Groundwater not encountered during drilling. Boring backfilled with cuttings upon completion.
LOGGED BY:	JC CHECKED BY/DATE:

THIS BORING RECORD PRESENTS A REASONABLE INTERPRETATION OF THE SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. STRATA INTERFACES (AS SHOWN) ARE APPROXIMATE. ACTUAL TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

GEOTECHNICAL BORING RECORD

BORING NO.:	SB-24
DRILLED:	01/12/2017
PROJECT:	Twin River - Tiverton Casino & Hotel
LOCATION:	Tiverton, RI
PROJECT NO.:	3653160007

amec foster wheeler



BOREHOLE: STANDARD (0-2500 PSF) TIVERTON, RI CASINO.GPJ 2007_12-12_PORT_DTMPLT.GDT 2/27/17

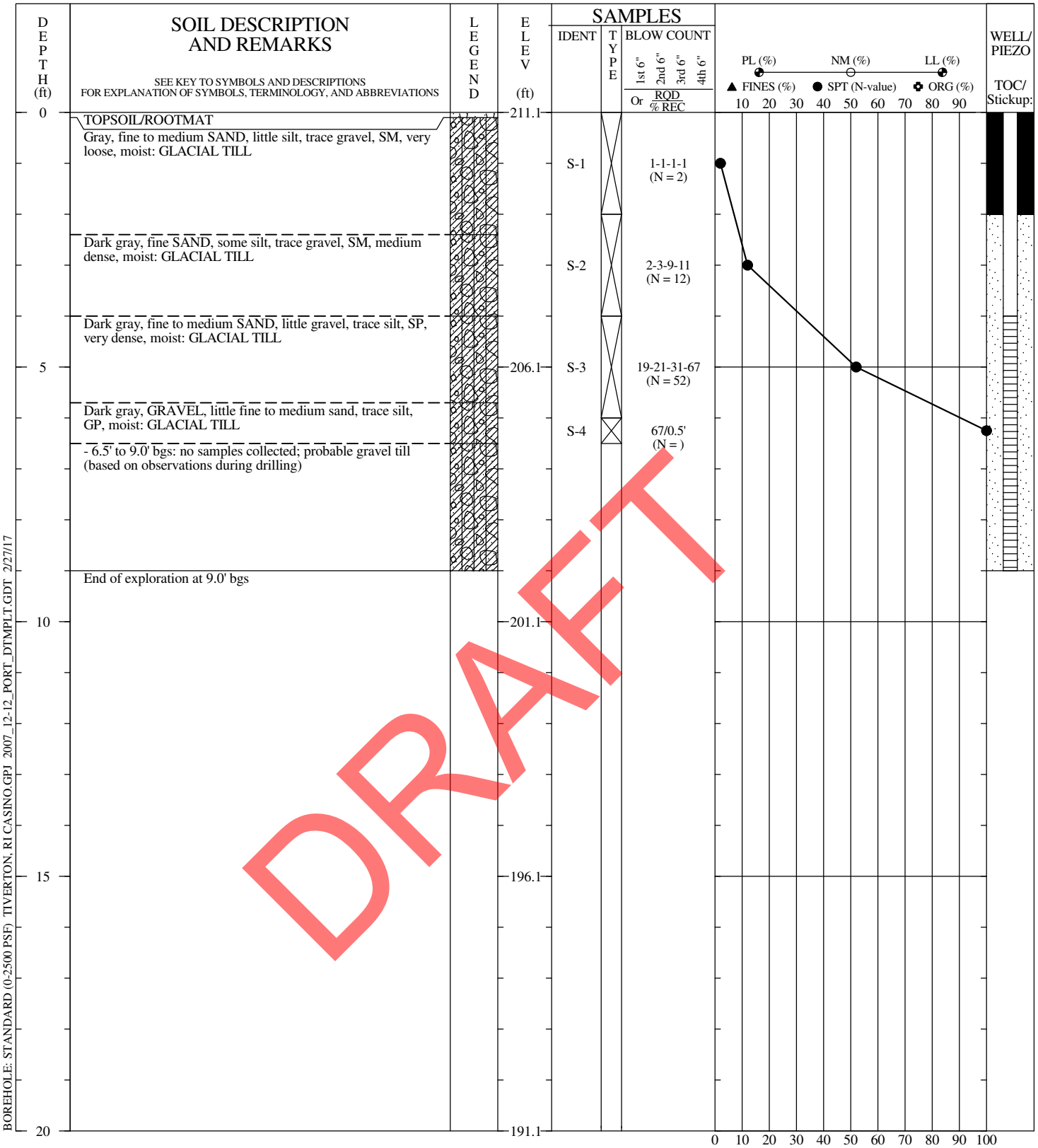
DRILLER:	GeoLogic Earth Exploration
RIG TYPE:	CME-55
METHOD:	Rotary Wash with Water (Cased)
HOLE DIAM.:	3"
SPTs:	Rope & cathead.
REMARKS:	Groundwater not encountered during drilling. Boring backfilled with cuttings upon completion. SB-16B offset 25 feet to south of SB-16A.
LOGGED BY:	JC CHECKED BY/DATE:

THIS BORING RECORD PRESENTS A REASONABLE INTERPRETATION OF THE SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. STRATA INTERFACES (AS SHOWN) ARE APPROXIMATE. ACTUAL TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

GEOTECHNICAL BORING RECORD

BORING NO.:	SB-25
DRILLED:	01/27/2017
PROJECT:	Twin River - Tiverton Casino & Hotel
LOCATION:	Tiverton, RI
PROJECT NO.:	3653160007

amec foster wheeler



DRILLER:	GeoLogic Earth Exploration
RIG TYPE:	CME-750
METHOD:	Rotary Wash with Water (Cased)
HOLE DIAM.:	3"
SPTs:	Auto-Hammer
REMARKS:	Groundwater not encountered during drilling. Boring restored as observation well upon completion.

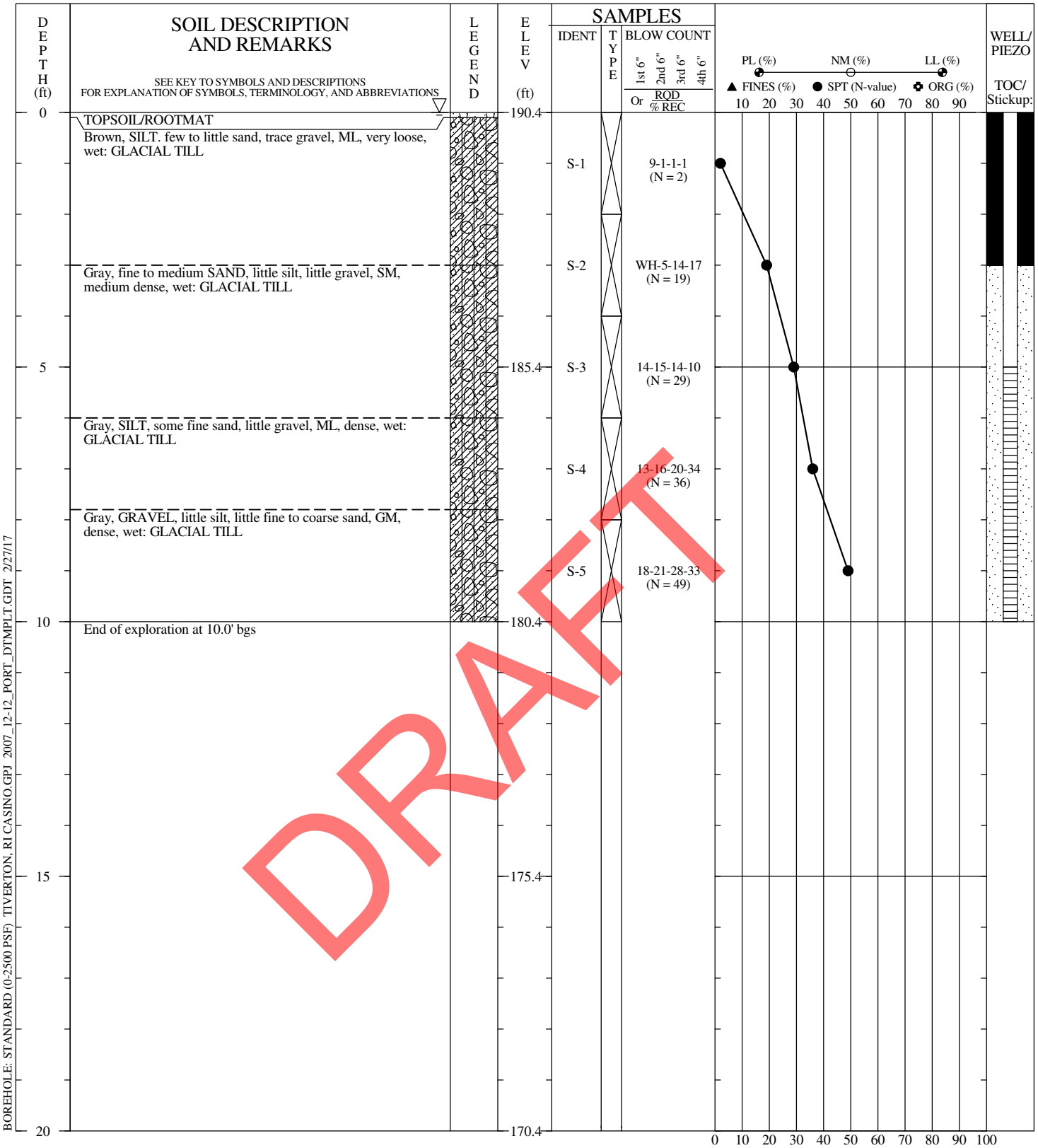
LOGGED BY: JC CHECKED BY/DATE:

THIS BORING RECORD PRESENTS A REASONABLE INTERPRETATION OF THE SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. STRATA INTERFACES (AS SHOWN) ARE APPROXIMATE. ACTUAL TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

GEOTECHNICAL BORING RECORD

BORING NO.:	SB-27
DRILLED:	02/23/2017
PROJECT:	Twin River - Tiverton Casino & Hotel
LOCATION:	Tiverton, RI
PROJECT NO.:	3653160007

amec foster wheeler



BOREHOLE: STANDARD (0-2500 PSF) TIVERTON, RI CASINO.GPJ 2007_12-12_PORT_DTMPLT.GDT 2/27/17

DRILLER:	GeoLogic Earth Exploration
RIG TYPE:	CME-750
METHOD:	Rotary Wash with Water (Cased)
HOLE DIAM.:	3"
SPTs:	Auto-Hammer
REMARKS:	Water encountered at ground surface. Boring restored as observation well upon completion.

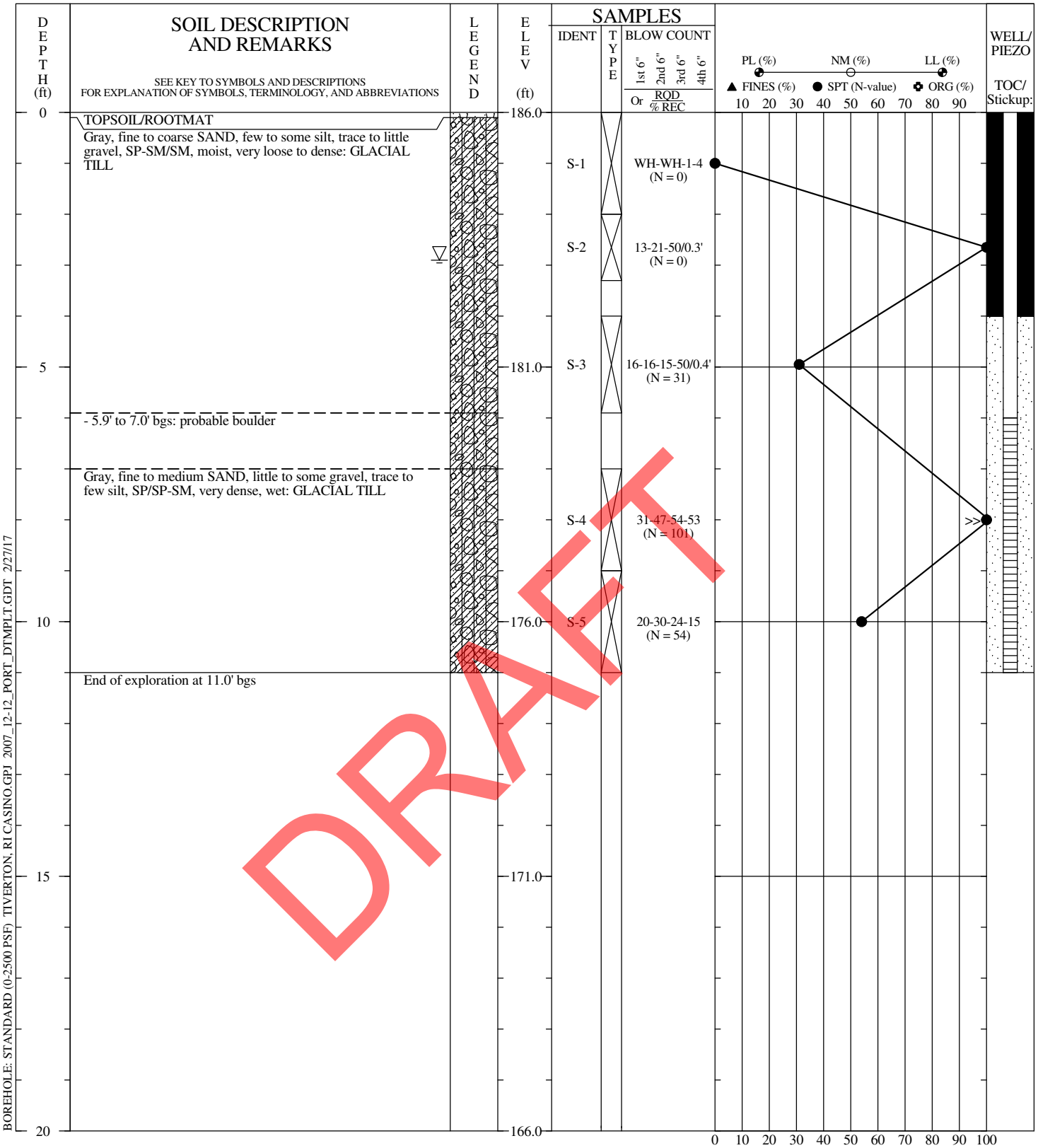
LOGGED BY: JC CHECKED BY/DATE:

THIS BORING RECORD PRESENTS A REASONABLE INTERPRETATION OF THE SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. STRATA INTERFACES (AS SHOWN) ARE APPROXIMATE. ACTUAL TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

GEOTECHNICAL BORING RECORD

BORING NO.:	SB-28
DRILLED:	02/23/2017
PROJECT:	Twin River - Tiverton Casino & Hotel
LOCATION:	Tiverton, RI
PROJECT NO.:	3653160007

amec foster wheeler



BOREHOLE: STANDARD (0-2500 PSF) TIVERTON, RI CASINO.GPJ 2007_12-12_PORT_DTMPLT.GDT 2/27/17

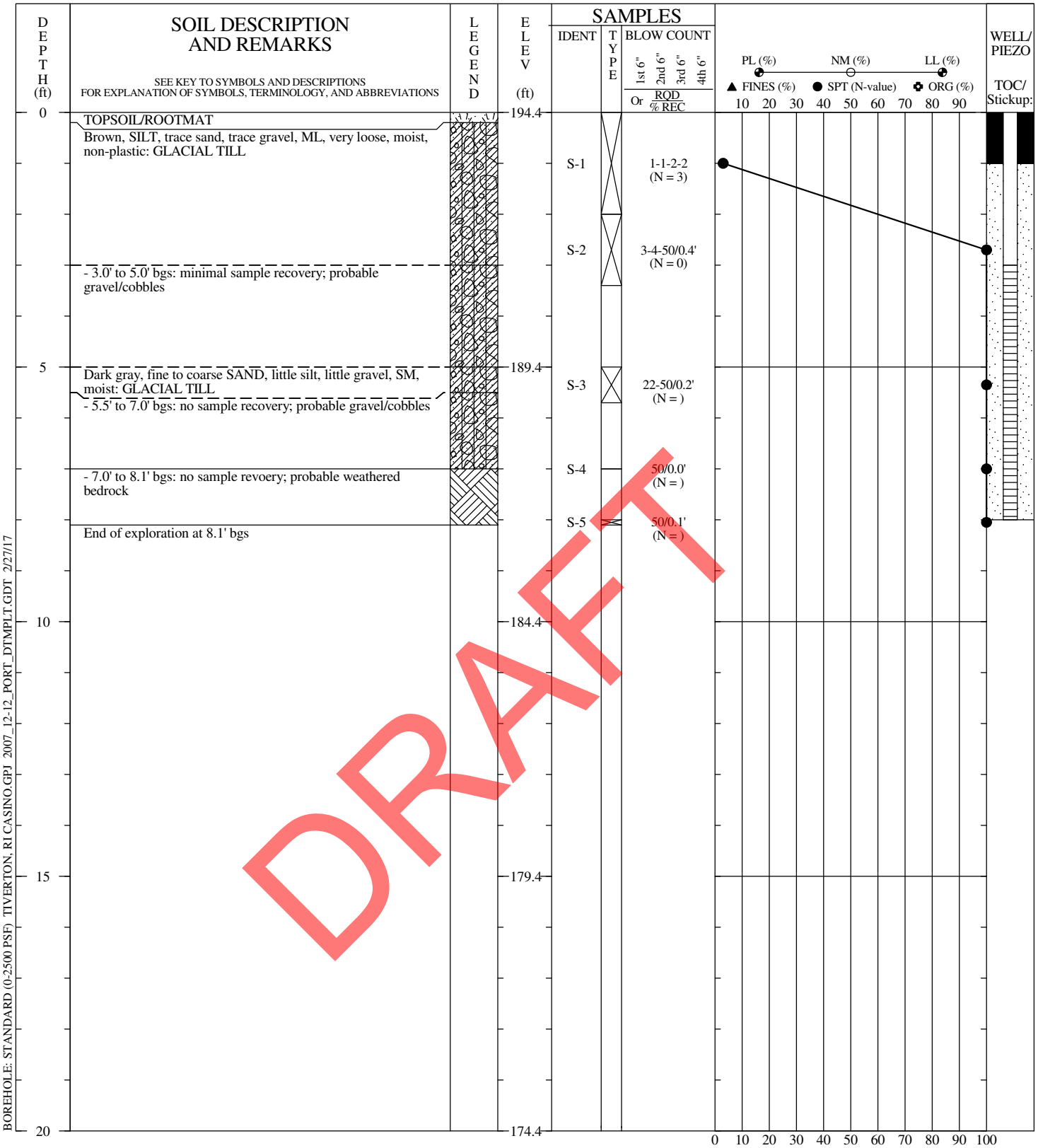
DRILLER:	GeoLogic Earth Exploration
RIG TYPE:	CME-750
METHOD:	Rotary Wash with Water (Cased)
HOLE DIAM.:	3"
SPTs:	Auto-Hammer
REMARKS:	Offset 15' SE of staked location. Approximate ground surface EL. Water level measured in observation well at completion of drilling. Boring restored as observation well upon completion.
LOGGED BY:	JC CHECKED BY/DATE:

THIS BORING RECORD PRESENTS A REASONABLE INTERPRETATION OF THE SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. STRATA INTERFACES (AS SHOWN) ARE APPROXIMATE. ACTUAL TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

GEOTECHNICAL BORING RECORD

BORING NO.:	SB-29
DRILLED:	02/22/2017
PROJECT:	Twin River - Tiverton Casino & Hotel
LOCATION:	Tiverton, RI
PROJECT NO.:	3653160007

amec foster wheeler



BOREHOLE: STANDARD (0-2500 PSF) TIVERTON, RI CASINO.GPJ 2007_12-12_PORT_DTMPLT.GDT 2/27/17

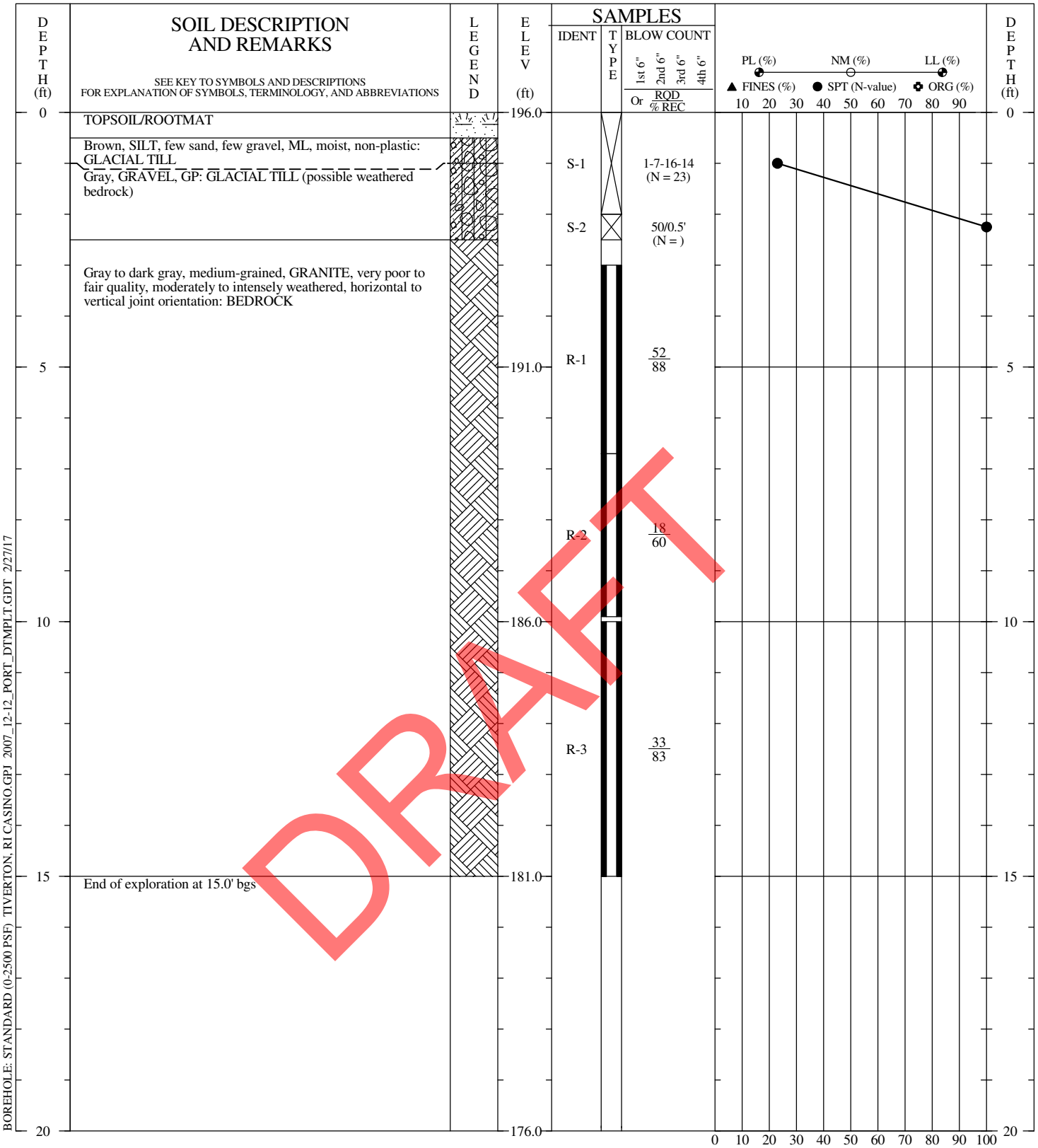
DRILLER:	GeoLogic Earth Exploration
RIG TYPE:	CME-750
METHOD:	Rotary Wash with Water (Cased)
HOLE DIAM.:	3"
SPTs:	Auto-Hammer
REMARKS:	Offset 5' N of staked location. Approximate ground surface EL. Groundwater not encountered. Boring restored as observation well upon completion.
LOGGED BY:	JC CHECKED BY/DATE:

THIS BORING RECORD PRESENTS A REASONABLE INTERPRETATION OF THE SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. STRATA INTERFACES (AS SHOWN) ARE APPROXIMATE. ACTUAL TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

GEOTECHNICAL BORING RECORD

BORING NO.:	SB-30
DRILLED:	02/17/2017 - 02/21/2017
PROJECT:	Twin River - Tiverton Casino & Hotel
LOCATION:	Tiverton, RI
PROJECT NO.:	3653160007

amec foster wheeler



BOREHOLE: STANDARD (0-2500 PSF) TIVERTON, RI CASINO.GPJ 2007_12-12_PORT_DTMPLT.GDT 2/27/17

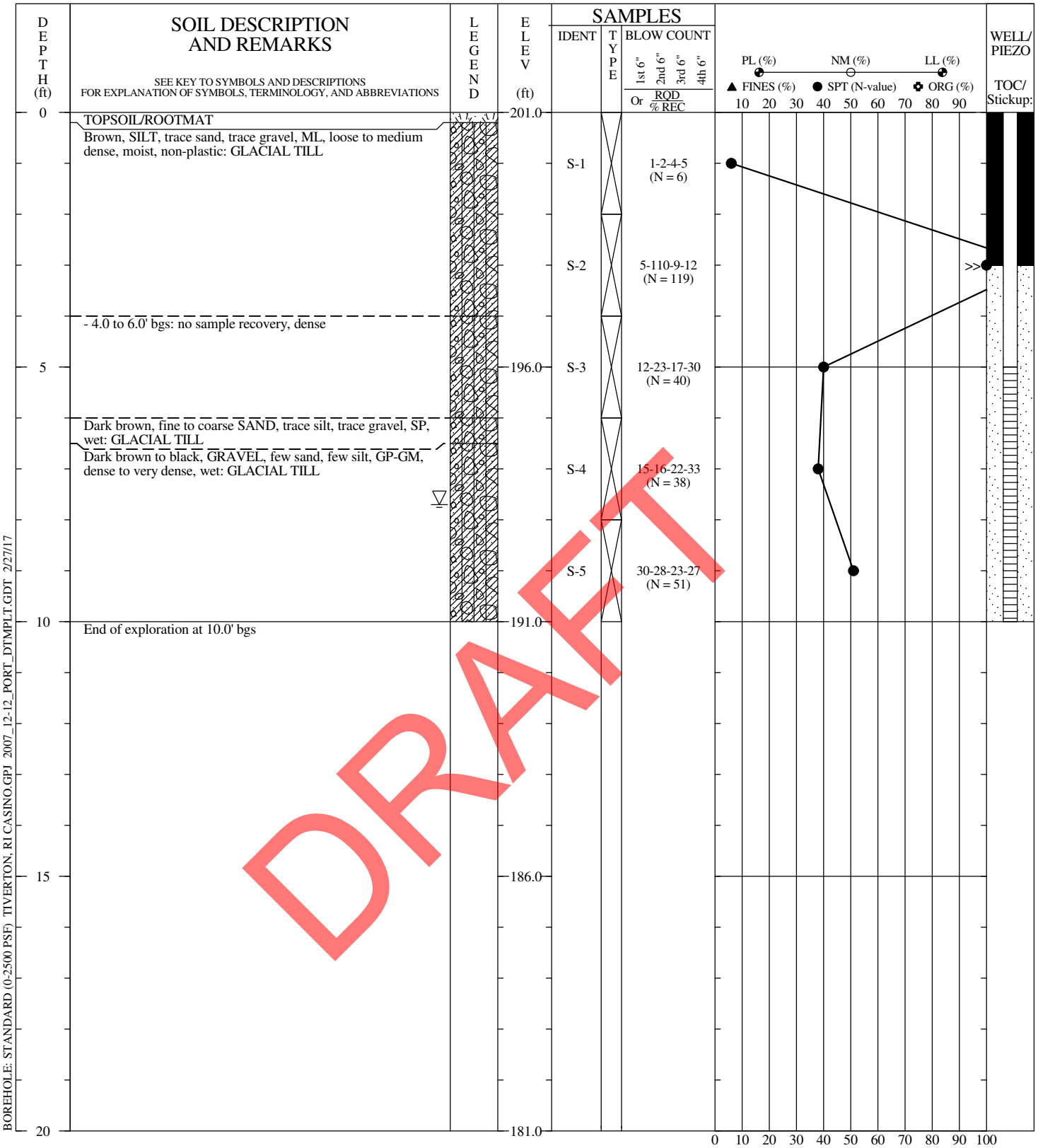
DRILLER:	GeoLogic Earth Exploration
RIG TYPE:	CME-750
METHOD:	Rotary Wash with Water (Cased)
HOLE DIAM.:	3"
SPTs:	Auto-Hammer
REMARKS:	Offset 47' E of staked location. Approximate ground surface EL. Groundwater not encountered. Boring backfilled with cuttings upon completion.
LOGGED BY:	JC CHECKED BY/DATE:

THIS BORING RECORD PRESENTS A REASONABLE INTERPRETATION OF THE SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. STRATA INTERFACES (AS SHOWN) ARE APPROXIMATE. ACTUAL TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

GEOTECHNICAL BORING RECORD

BORING NO.:	SB-31
DRILLED:	02/16/2017 - 02/17/2017
PROJECT:	Twin River - Tiverton Casino & Hotel
LOCATION:	Tiverton, RI
PROJECT NO.:	3653160007

amec foster wheeler



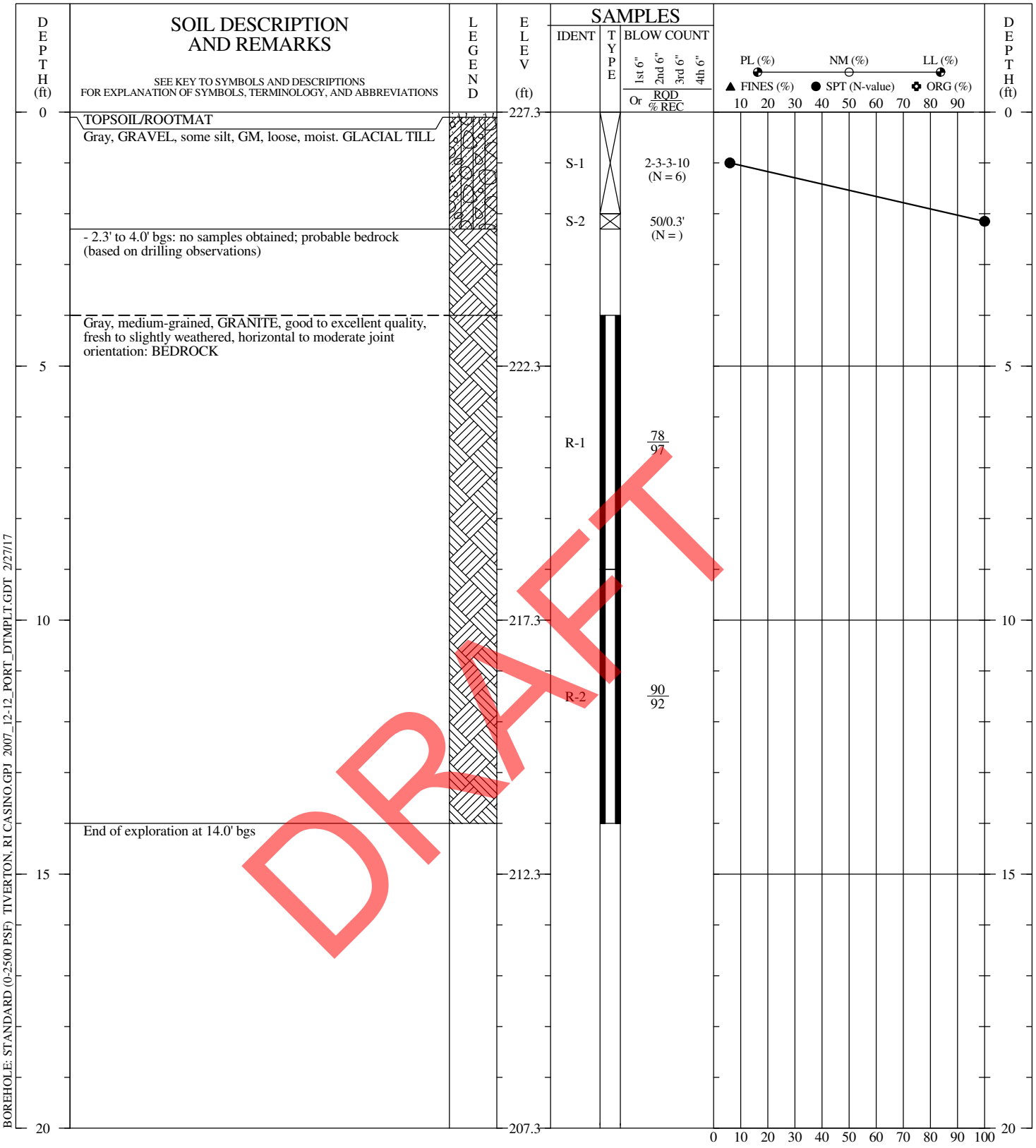
DRILLER:	GeoLogic Earth Exploration
RIG TYPE:	CME-750
METHOD:	Rotary Wash with Water (Cased)
HOLE DIAM.:	3"
SPTs:	Auto-Hammer
REMARKS:	Offset 12' SW of staked location. Approximate ground surface EL. Water level measured in observation well at completion of drilling. Boring restored as observation well upon completion.
LOGGED BY:	JC CHECKED BY/DATE:

THIS BORING RECORD PRESENTS A REASONABLE INTERPRETATION OF THE SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. STRATA INTERFACES (AS SHOWN) ARE APPROXIMATE. ACTUAL TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

GEOTECHNICAL BORING RECORD

BORING NO.:	SB-32
DRILLED:	02/16/2017
PROJECT:	Twin River - Tiverton Casino & Hotel
LOCATION:	Tiverton, RI
PROJECT NO.:	3653160007

amec foster wheeler



BOREHOLE: STANDARD (0-2500 PSF) TIVERTON, RI CASINO.GPJ 2007_12-12_PORT_DTMPLT.GDT 2/27/17

DRILLER:	GeoLogic Earth Exploration
RIG TYPE:	CME-55
METHOD:	Rotary Wash with Water (Cased)
HOLE DIAM.:	3"
SPTs:	Rope & cathead.
REMARKS:	Groundwater not encountered during drilling. Boring backfilled with cuttings upon completion.

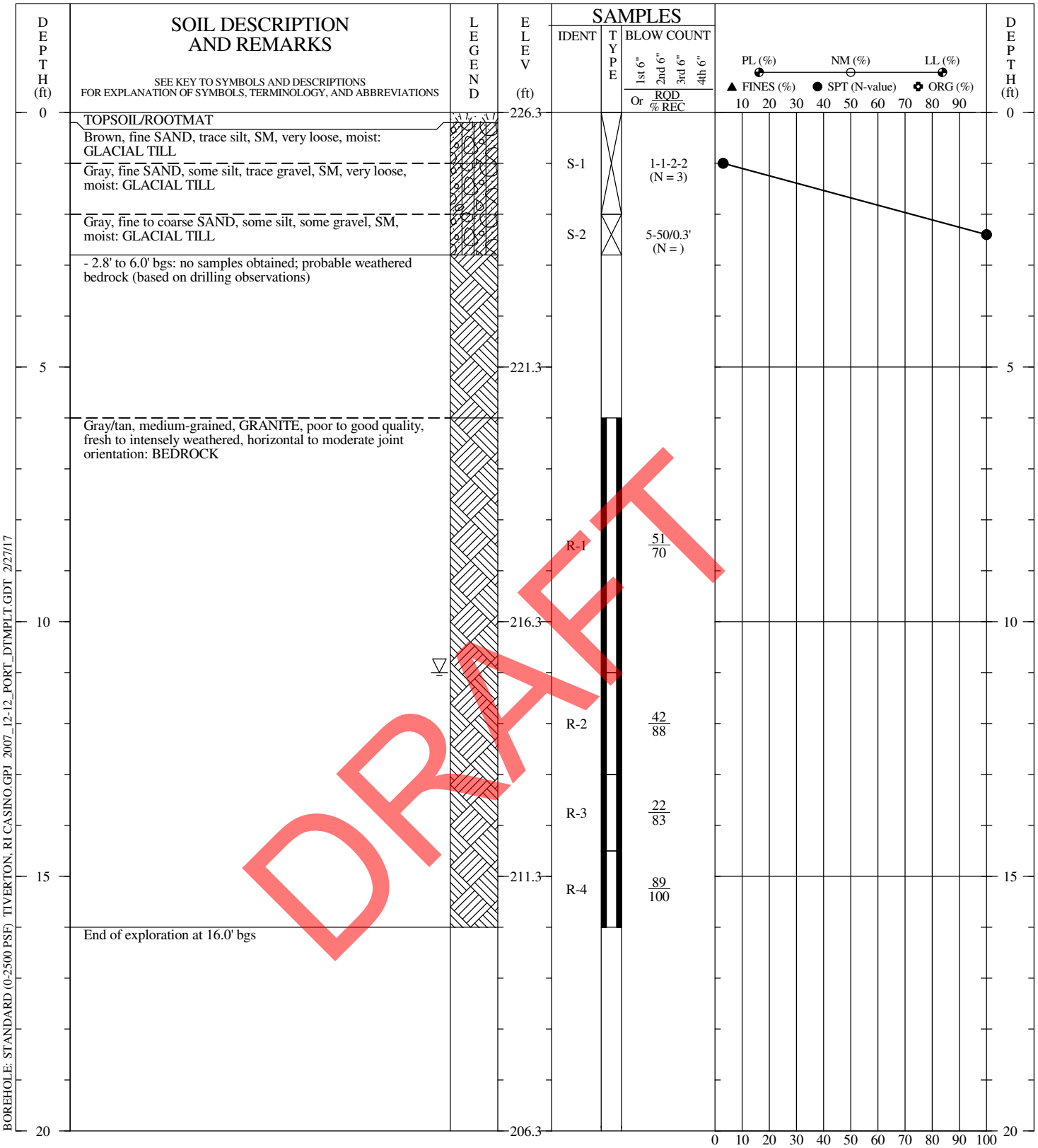
LOGGED BY: BH CHECKED BY/DATE:

THIS BORING RECORD PRESENTS A REASONABLE INTERPRETATION OF THE SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. STRATA INTERFACES (AS SHOWN) ARE APPROXIMATE. ACTUAL TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

GEOTECHNICAL BORING RECORD

BORING NO.:	SB-33
DRILLED:	02/10/2017
PROJECT:	Twin River - Tiverton Casino & Hotel
LOCATION:	Tiverton, RI
PROJECT NO.:	3653160007

amec foster wheeler



BOREHOLE: STANDARD (0-2500 PSF) TIVERTON, RI CASINO.GPJ 2007_12-12_PORT_DTMPLT.GDT 2/27/17

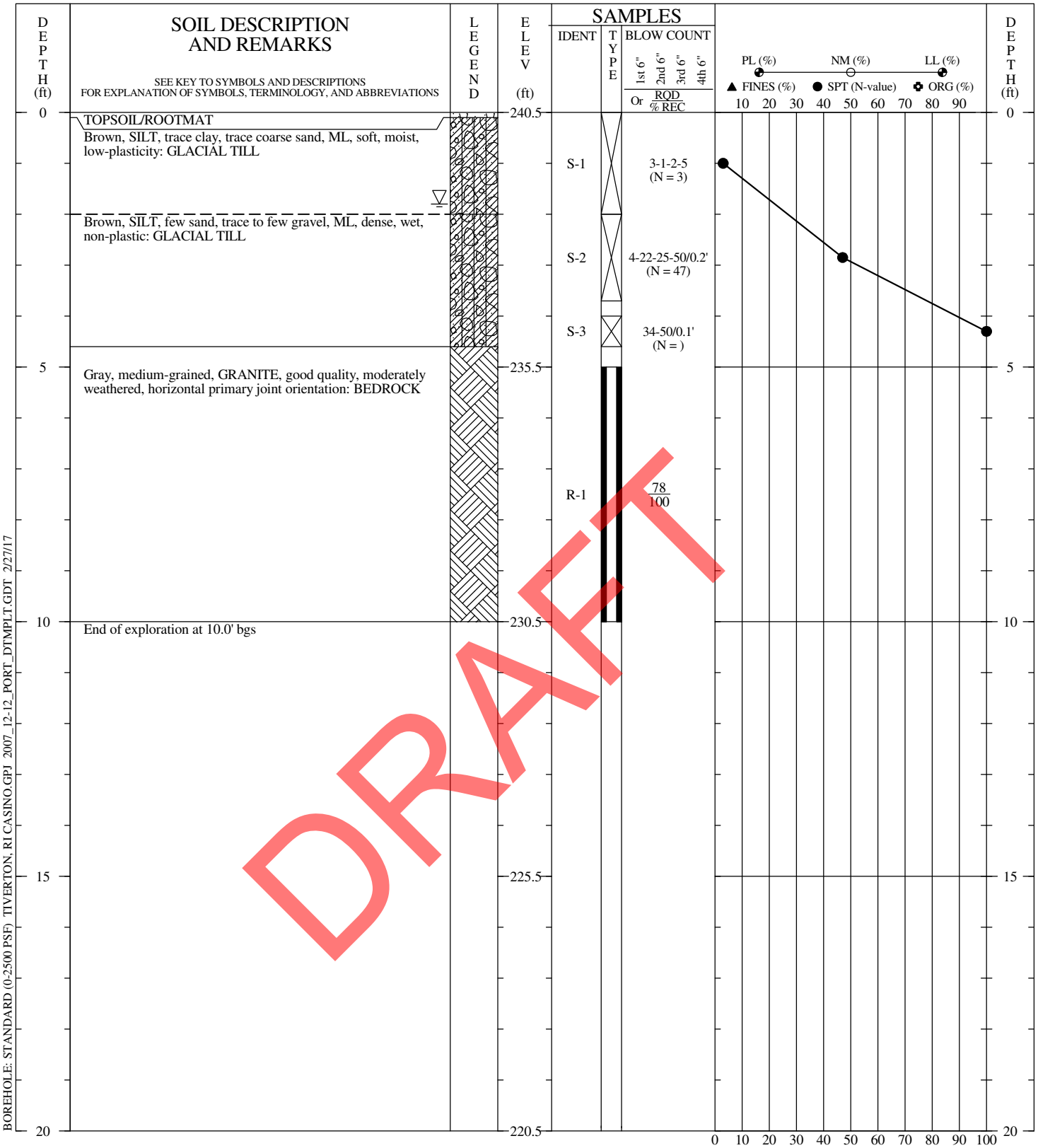
DRILLER:	GeoLogic Earth Exploration
RIG TYPE:	CME-55
METHOD:	Rotary Wash with Water (Cased)
HOLE DIAM.:	3"
SPTs:	Rope & cathead.
REMARKS:	Water level measured in casing at completion of drilling. Boring backfilled with cuttings upon completion.
LOGGED BY:	BH CHECKED BY/DATE:

THIS BORING RECORD PRESENTS A REASONABLE INTERPRETATION OF THE SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. STRATA INTERFACES (AS SHOWN) ARE APPROXIMATE. ACTUAL TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

GEOTECHNICAL BORING RECORD

BORING NO.:	SB-34
DRILLED:	02/08/2017 - 02/10/2017
PROJECT:	Twin River - Tiverton Casino & Hotel
LOCATION:	Tiverton, RI
PROJECT NO.:	3653160007

amec foster wheeler



BOREHOLE: STANDARD (0-2500 PSF) TIVERTON, RI CASINO.GPJ 2007_12-12_PORT_DTMPLT.GDT 2/27/17

DRILLER:	GeoLogic Earth Exploration
RIG TYPE:	CME-55
METHOD:	Rotary Wash with Water (Cased)
HOLE DIAM.:	3"
SPTs:	Rope & cathead.
REMARKS:	Offset 30' S of staked location. Approximate ground surface EL. Water level measured in casing at completion of drilling. Boring backfilled with cuttings upon completion.
LOGGED BY:	JC CHECKED BY/DATE:

THIS BORING RECORD PRESENTS A REASONABLE INTERPRETATION OF THE SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS MAY DIFFER. STRATA INTERFACES (AS SHOWN) ARE APPROXIMATE. ACTUAL TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

GEOTECHNICAL BORING RECORD

BORING NO.:	SB-37
DRILLED:	02/14/2017
PROJECT:	Twin River - Tiverton Casino & Hotel
LOCATION:	Tiverton, RI
PROJECT NO.:	3653160007

amec foster wheeler

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
Department of Environmental Management
Office of Water Resources
Onsite Wastewater Treatment System Program

Site Evaluation Form
Part A – Soil Profile Description Application Number NONE ASSIGNED

Property Owner: MARSDEN, BETTY
Property Location: TIVERTON 103 STAFFORD ROAD PLAT 203 LOT 107
Date of Test Hole: 19 MARCH, 2015
Soil Evaluator: N. LETENDRE License Number: D4019
Weather: SUNNY 3-8 mph 24° (at 0800) Shaded: Yes ☐ No ☐ Time: 12 NOON

TH 1 Horizon	Depth	Horizon Boundaries: Dist	Horizon Boundaries: Topo	Soil Colors: Matrix	Soil Colors: Re-Dox Features	Re-Dox: Ab. S. Contr.	Texture	Structure	Consistence	Soil Category
A	10	c	i	10YR 3/2			FSL	1fgr	fr	4
Bw	19	g	w	10YR 4/3			SL	1fsbk	fr	3
BC	30	c	w	2.5Y 4/2			SL	1fsbk	fr	3
C	96			2.5Y 3/1			vg SL	0mm	fr	6

TH 2 Horizon	Depth	Horizon Boundaries: Dist	Horizon Boundaries: Topo	Soil Colors: Matrix	Soil Colors: Re-Dox Features	Re-Dox: Ab. S. Contr.	Texture	Structure	Consistence	Soil Category
A	7	c	i	10YR 3/2			FSL	1fgr	fr	4
Bw	14	g	w	10YR 4/3			SL	1fsbk	fr	3
BC	20	c	w	2.5Y 4/2			SL	1fsbk	fr	3
C	80			2.5Y 3/1			vg SL	0mm	fr	6

TH 1 Soil Class B Total Depth 96" Impervious/Limiting Layer Depth N/A (cg) GW Seepage Depth 60" SHWT 36" (cg)
TH 2 Soil Class B Total Depth 80" Impervious/Limiting Layer Depth N/A (cg) GW Seepage Depth 40" SHWT 24" (cg)

Comments:

Revised 1/31/14

15-0101

Part B

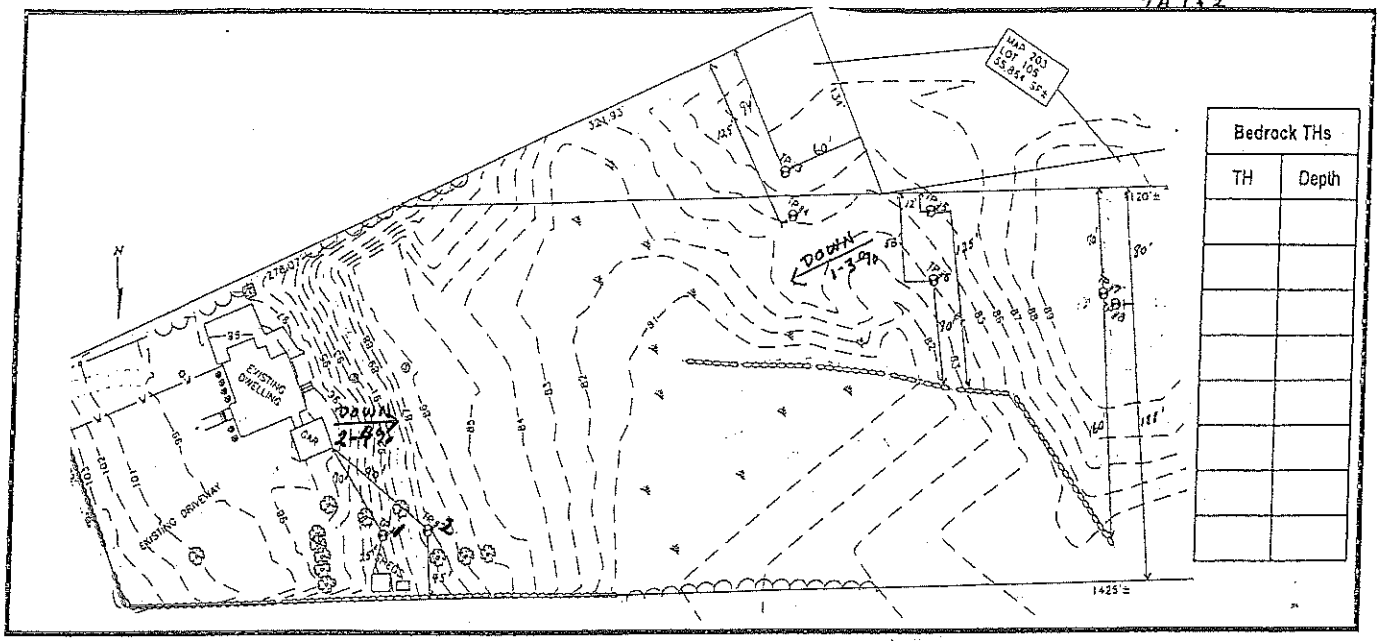
Site Evaluation -- to be completed by Soil Evaluator or Class II or III Designer

Please use the area below to locate:

1. Test holes and bedrock test holes,
2. Approximate direction of due north,
3. Offsets from all test holes to fixed points such as street, utility pole, or other permanent, marked object.*
   *OFFSETS MUST BE SHOWN

Key:
- Approximate location of test holes
- Approximate location of bedrock test holes
- x% — Estimated gradient and direction of slope
- N — Approximate direction of due north

TH 1 & 2



Bedrock THs	
TH	Depth

1-2

1. Relief and Slope: _____
2. Presence of any watercourse, wetlands or surface water bodies, within 200 feet of test holes? If yes, locate on above sketch. NO ☐ YES ☒
3. Restrictive Layer or Bedrock within 4' below original ground within 25 feet of test hole? Provide all test hole locations & depths above. NO ☒ YES ☐
4. Presence of existing or proposed private drinking water wells within 200 feet of test holes? If yes, locate on above sketch. NO ☒ YES ☐
5. Public drinking water wells within 500 feet of test holes? If yes, locate on above sketch. NO ☒ YES ☐
6. Is site within the watershed of a public drinking water reservoir or other critical area defined in Rule 38? NO ☒ YES ☐
7. Has soil been excavated from or fill deposited on site? If yes, locate on above sketch. NO ☒ YES ☐
8. Site's potential for flooding or ponding: NONE SLIGHT ☒ MODERATE ☐ SEVERE ☐
9. Landscape position: SIDESLOPE
10. Vegetation: LAWN GRASSES, SOFT & HARDWOODS
11. Indicate approximate location of property lines and roadways.
12. Additional comments, site constraints or additional information regarding site: _____

Certification

The undersigned hereby certifies that all information on this application and accompanying forms, submittals and sketches are true and accurate and that I have been authorized by the owner(s) to conduct these necessary field investigations and submit this request.

Part A prepared by: _____ D4019
Signature License #

Part B prepared by: _____ D4019
Signature License #

DO NOT WRITE IN THIS SPACE

Witnessed Soil Evaluation Decision: Concur ☐ Inconclusive ☐ Disclaim ☐

Unwitnessed Soil Evaluations Decision: Accept ☐ Inconclusive ☐ Disclaim ☐

Wet Season Determination required ☐ Additional Field Review Required ☐

Explanation: _____

_____ _____
Signature Authorized Agent Date

Revised 1/31/14

15-0101

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
Department of Environmental Management
Office of Water Resources
Onsite Wastewater Treatment System Program

Site Evaluation Form
Part A – Soil Profile Description Application Number NONE ASSIGNED

Property Owner: MARSDEN, BETTY
Property Location: TIVERTON 103 STAFFORD ROAD PLAT 203 LOT 107
Date of Test Hole: 19 MARCH, 2015
Soil Evaluator: N. LETENDRE License Number: D4019
Weather: SUNNY 3-8 mph 24° (at 0800) Shaded: Yes ☐ No ☐ Time: 12 NOON

TH 3 Horizon	Depth	Horizon Boundaries Dist	Horizon Boundaries Topo	Soil Colors Matrix	Soil Colors Re-Dox Features	Re-Dox Ab. S. Contr.	Texture	Structure	Consistence	Soil Category
A	4	c	i	10YR 4/2			FSL	1fgr	fr	4
Bw1	16	g	i	10YR 4/6			st SL	1fsbk	fr	3
Bw2	26	c	i	10YR 5/6			st SL	1fsbk	fr	3
C	60			2.5Y 3/1	@30 7.5YR 3/2	C 1 d	st cbg SL	0mm	fr	6

TH 4 Horizon	Depth	Horizon Boundaries Dist	Horizon Boundaries Topo	Soil Colors Matrix	Soil Colors Re-Dox Features	Re-Dox Ab. S. Contr.	Texture	Structure	Consistence	Soil Category
A	5	c	i	10YR 3/2			FSL	1fgr	fr	4
Bw1	12	g	i	10YR 4/6			st SL	1fsbk	fr	3
Bw2	24	c	i	10YR 5/6			st SL	1fsbk	fr	3
C	60			2.5Y 3/1			st cbg SL	0mm	fr	6

TH 3 Soil Class B Total Depth 60" Impervious/Limiting Layer Depth ? (og) GW ~~Seepage~~ STANDING Depth 40" SHWT 24" (og)
TH 4 Soil Class B Total Depth 60" Impervious/Limiting Layer Depth ? (og) GW ~~Seepage~~ STANDING Depth 48" SHWT 24" (og)

Comments:

evised 1/31/14

15-0101

Part B

Site Evaluation – to be completed by Soil Evaluator or Class II or III Designer

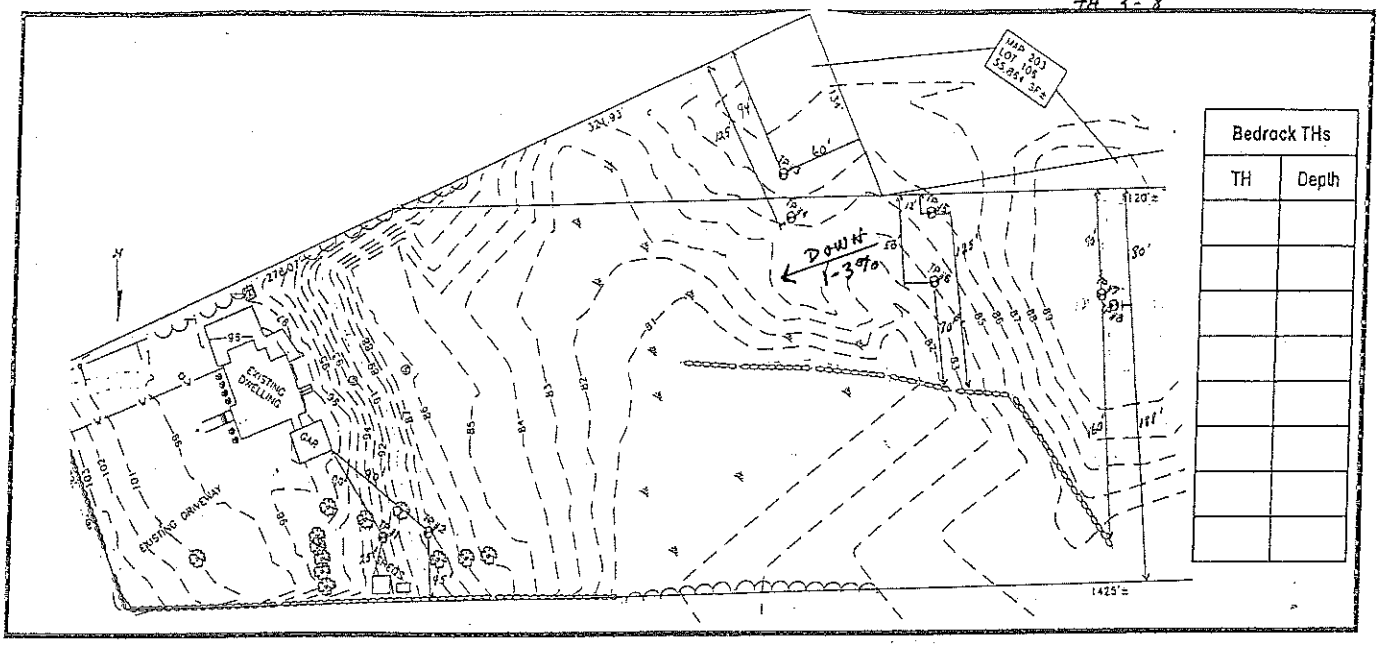
Please use the area below to locate:

1. Test holes and bedrock test holes,
2. Approximate direction of due north,
3. Offsets from all test holes to fixed points such as street, utility pole, or other permanent, marked object.*

*OFFSETS MUST BE SHOWN

Key:
- Approximate location of test holes
- Approximate location of bedrock test holes
- x% Estimated gradient and direction of slope
- N Approximate direction of due north

TH 3-8



Bedrock THs	
TH	Depth

3-8

1. Relief and Slope: _____
2. Presence of any watercourse, wetlands or surface water bodies, within 200 feet of test holes? If yes, locate on above sketch. NO ☐ YES ☒
3. Restrictive Layer or Bedrock within 4' below original ground within 25 feet of test hole? Provide all test hole locations & depths above. NO ☒ YES ☐
4. Presence of existing or proposed private drinking water wells within 200 feet of test holes? If yes, locate on above sketch. NO ☒ YES ☐
5. Public drinking water wells within 500 feet of test holes? If yes, locate on above sketch. NO ☒ YES ☐
6. Is site within the watershed of a public drinking water reservoir or other critical area defined in Rule 38? NO ☒ YES ☐
7. Has soil been excavated from or fill deposited on site? If yes, locate on above sketch. NO ☒ YES ☐
8. Site's potential for flooding or ponding: NONE ☐ SLIGHT ☐ MODERATE ☒ SEVERE ☐
9. Landscape position: SHOULDER SLOPE
10. Vegetation: MODERATELY WOODED
11. Indicate approximate location of property lines and roadways.
12. Additional comments, site constraints or additional information regarding site: _____

Certification

The undersigned hereby certifies that all information on this application and accompanying forms, submittals and sketches are true and accurate and that I have been authorized by the owner(s) to conduct these necessary field investigations and submit this request.

Part A prepared by: _____ D419 Part B prepared by: _____ D419

Signature License # Signature License #

DO NOT WRITE IN THIS SPACE

Witnessed Soil Evaluation Decision: Concur ☐ Inconclusive ☐ Disclaim ☐

Unwitnessed Soil Evaluations Decision: Accept ☐ Inconclusive ☐ Disclaim ☐

Wet Season Determination required ☐ Additional Field Review Required ☐

Explanation: _____

_____ _____

Signature Authorized Agent Date

Revised 1/31/14

15-0101

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
Department of Environmental Management
Office of Water Resources
Onsite Wastewater Treatment System Program

Site Evaluation Form
Part A – Soil Profile Description Application Number NONE ASSIGNED

Property Owner: MARSDEN, BETTY
Property Location: TIVERTON 103 STAFFORD ROAD PLAT 203 LOT 107
Date of Test Hole: 19 MARCH, 2015
Soil Evaluator: N. LETENDRE License Number: D4019
Weather: SUNNY 3-8 mph 24° (at 0800) Shaded: Yes ☐ No ☐ Time: 12 NOON

TH 5 Horizon	Depth	Horizon Boundaries		Soil Colors		Re-Dox		Texture	Structure	Consistence	Soil Category
		Dist	Topo	Matrix	Re-Dox Features	Ab. S. Contr.					
A	5	c	i	10YR 4/2				FSL	1fgr	fr	4
Bw1	12	g	i	10YR 4/6				ST SL	1fsbk	fr	3
Bw2	24	c	i	10YR 5/6				st SL	1fsbk	fr	3
C	84			2.5Y 3/1	@30 10YR 5/8	C	1 d	st cbgSL	omm	fr	6

TH 6 Horizon	Depth	Horizon Boundaries		Soil Colors		Re-Dox		Texture	Structure	Consistence	Soil Category
		Dist	Topo	Matrix	Re-Dox Features	Ab. S. Contr.					
A	6	c	i	10YR 4/2				FSL	1fgr	fr	4
Bw1	14	g	i	10YR 4/6				st SL	1fsbk	fr	3
Bw2	20	c	i	10YR 5/6				st SL	1fsbk	fr	3
C	84			2.5Y 3/1				st cbgSL	omm	fr	6

TH 5 Soil Class B Total Depth 84" Impervious/Limiting Layer Depth ? (og) GW Seepage Depth STANDING 52" SHWT 24" (og)
TH 6 Soil Class B Total Depth 84" Impervious/Limiting Layer Depth ? (og) GW Seepage Depth STANDING 30" SHWT ? (og)

Comments:

Revised 1/31/14

15-0101

Part B

Site Evaluation – to be completed by Soil Evaluator or Class II or III Designer

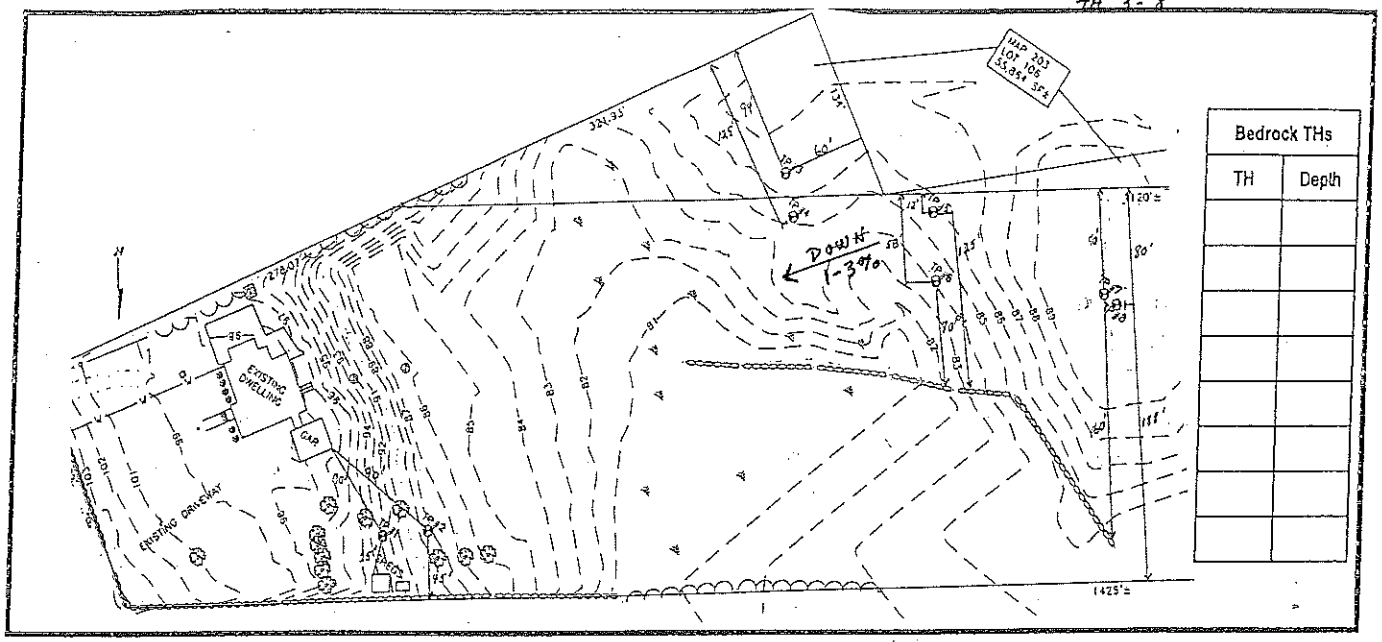
Please use the area below to locate:

1. Test holes and bedrock test holes,
2. Approximate direction of due north,
3. Offsets from all test holes to fixed points such as street, utility pole, or other permanent, marked object.*

*OFFSETS MUST BE SHOWN

Key:
- Approximate location of test holes
- Approximate location of bedrock test holes
- x% Estimated gradient and direction of slope
- N Approximate direction of due north

TH 3-8



Bedrock THs	
TH	Depth

3-8

1. Relief and Slope: _____
2. Presence of any watercourse, wetlands or surface water bodies, within 200 feet of test holes? If yes, locate on above sketch. NO ☐ YES ☒
3. Restrictive Layer or Bedrock within 4' below original ground within 25 feet of test hole? Provide all test hole locations & depths above. NO ☒ YES ☐
4. Presence of existing or proposed private drinking water wells within 200 feet of test holes? If yes, locate on above sketch. NO ☒ YES ☐
5. Public drinking water wells within 500 feet of test holes? If yes, locate on above sketch. NO ☒ YES ☐
6. Is site within the watershed of a public drinking water reservoir or other critical area defined in Rule 38? NO ☒ YES ☐
7. Has soil been excavated from or fill deposited on site? If yes, locate on above sketch. NO ☒ YES ☐
8. Site's potential for flooding or ponding: NONE ☐ SLIGHT ☐ MODERATE ☒ SEVERE ☐
9. Landscape position: SHOULDER SLOPE
10. Vegetation: MODERATELY WOODED
11. Indicate approximate location of property lines and roadways.
12. Additional comments, site constraints or additional information regarding site: _____

Certification

The undersigned hereby certifies that all information on this application and accompanying forms, submittals and sketches are true and accurate and that I have been authorized by the owner(s) to conduct these necessary field investigations and submit this request.

Part A prepared by: _____ D4019 (Signature / License #) Part B prepared by: _____ D4019 (Signature / License #)

DO NOT WRITE IN THIS SPACE

Witnessed Soil Evaluation Decision: Concur ☐ Inconclusive ☐ Disclaim ☐

Unwitnessed Soil Evaluations Decision: Accept ☐ Inconclusive ☐ Disclaim ☐

Wet Season Determination required ☐ Additional Field Review Required ☐

Explanation: _____

Signature Authorized Agent _____ Date _____

Revised 1/31/14

15-0101

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
Department of Environmental Management
Office of Water Resources
Onsite Wastewater Treatment System Program

Site Evaluation Form
Part A – Soil Profile Description Application Number NONE ASSIGNED

Property Owner: MARSDEN, BETTY
Property Location: TIVERTON 103 STAFFORD ROAD PLAT 203 LOT 107
Date of Test Hole: 19 MARCH, 2015
Soil Evaluator: N. LETENDRE License Number: D4019
Weather: SUNNY 3-8 mph 24° (at 0800) Shaded: Yes ☐ No ☐ Time: 12 NOON

TH 7 Horizon	Depth	Horizon Boundaries		Soil Colors		Re-Dox	Texture	Structure	Consistence	Soil Category
		Dist	Topo	Matrix	Re-Dox Features	Ab. S. Contr.				
A	9	c	w	10YR 4/2			FSL	1fgr	fr	4
Bw1	14	g	i	10YR 4/6			st SL	1fsbk	fr	3
Bw2	30	c	i	10YR 5/6			st SL	1fsbk	fr	3
C	84			2.5Y 3/1			st cbg SL	omm	fr	6

TH 8 Horizon	Depth	Horizon Boundaries		Soil Colors		Re-Dox	Texture	Structure	Consistence	Soil Category
		Dist	Topo	Matrix	Re-Dox Features	Ab. S. Contr.				
A	10	c	w	10YR 4/2			st FSL	1fgr	fr	4
Bw	30	c	i	10YR 4/6			st SL	1fsbk	fr	3
C	90			2.5Y 3/1			st cbg SL	omm	fr	6

TH 7 Soil Class B Total Depth 7' Impervious/Limiting Layer Depth ? (cg) GW ~~Seepage~~ STANDING Depth 58" SHWT 24" (cg)
TH 8 Soil Class B Total Depth 7.5' Impervious/Limiting Layer Depth ? (cg) GW ~~Seepage~~ STANDING Depth 60" SHWT 24" (cg)

Comments:

evised 1/31/14

15-0101

Part B

Site Evaluation – to be completed by Soil Evaluator or Class II or III Designer

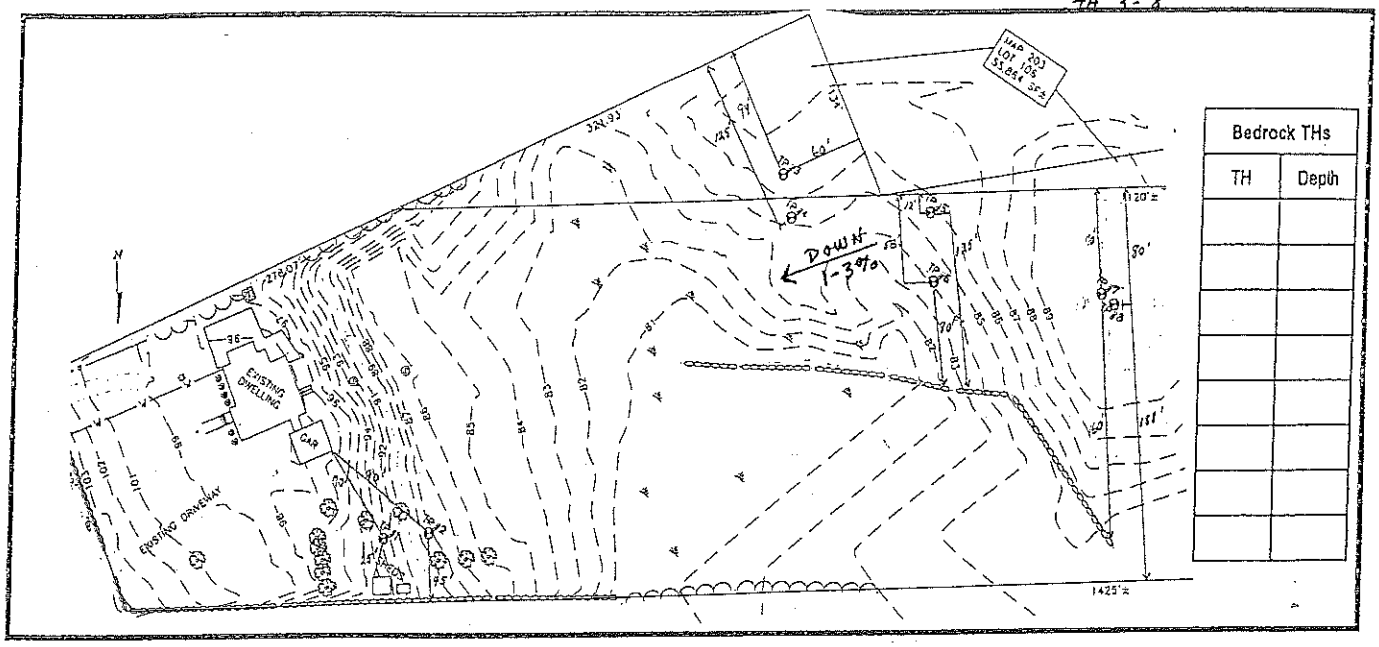
Please use the area below to locate:

1. Test holes and bedrock test holes,
2. Approximate direction of due north,
3. Offsets from all test holes to fixed points such as street, utility pole, or other permanent, marked object.*

*OFFSETS MUST BE SHOWN

Key:
- Approximate location of test holes
- Approximate location of bedrock test holes
- x% → Estimated gradient and direction of slope
- N → Approximate direction of due north

TH 3-8



Bedrock THs	
TH	Depth

3-8

1. Relief and Slope: _____
2. Presence of any watercourse, wetlands or surface water bodies, within 200 feet of test holes? If yes, locate on above sketch. NO ☐ YES ☒
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9. Landscape position: SHOULDER SLOPE
10. Vegetation: MODERATELY WOODED
11. Indicate approximate location of property lines and roadways.
12. Additional comments, site constraints or additional information regarding site: _____

Certification

The undersigned hereby certifies that all information on this application and accompanying forms, submittals and sketches are true and accurate and that I have been authorized by the owner(s) to conduct these necessary field investigations and submit this request.

Part A prepared by: _____ D419 Part B prepared by: _____ D419

Signature License # Signature License #

DO NOT WRITE IN THIS SPACE

Witnessed Soil Evaluation Decision: Concur ☐ Inconclusive ☐ Disclaim ☐

Unwitnessed Soil Evaluations Decision: Accept ☐ Inconclusive ☐ Disclaim ☐

Wet Season Determination required ☐ Additional Field Review Required ☐

Explanation: _____

_____ _____

Signature Authorized Agent Date

Revised 1/31/14

15-0101

Rhode Island Department of Environmental Management
Onsite Wastewater Treatment System Program
Phone: 401-222-6820
Fax: 401-222-6177

INSPECTION REPORT

APPLICATION NUMBER: MARSDEN SUBDIVISION

STREET: 103 STAFFORD

CITY/TOWN: TIVERTON

PLAT/LOT: POLE NO:

OWTS INSTALLER: LETOURNEAU

PHONE NO: INSPECTION NUMBER:

TYPE OF INSPECTION: SOIL EVALS

INSPECTOR:

INSPECTION DATE: 3-19-15

ARRIVAL TIME:

WEATHER CONDITIONS:

FINDINGS/COMMENTS

1 - OK ON 36" RESTRICT, H2O @ 84", 8' TD
2 OK ON 24" RESTRICT, H2O - 40", 6.5' TD
3 - OK ON 24" - H2O @ 40" 60" TD
4 OK ON 24" - H2O @ 45"
5 - OK ON 24', H2O @ 52"
6 - INCONCLUSIVE, H2O @ 30"
7 - OK ON 24" RESTRICT, H2O @ 53", 7' TD
8 - OK ON 24" RESTRICT, H2O @ 60" 7.5' TD

RESULTS OF INSPECTION/ACTION REQUIRED

☐ **CONSTRUCTION - DESIGNER MUST INSPECT/APPROVE PRIOR TO DEM INSPECTION**

- ☐ Bottom inspected
- ☐ Cover inspected
- ☐ Correct items listed
- ☐ (RFA) Address items listed and call for re-inspection.
- ☐ (ASB) Designer must submit As-Builts
- ☐ (RPREQ) Redesign required. Submit new application.
- ☐ (RFAD) Stop Construction. Contact OWTS office. DO NOT CONTINUE.
- ☐ (COC) Designer submit COC
- ☐ (O&M) O&M agreement and permit must be recorded in Land Evidence Records.
- ☐ (Fee) A $100.00 fee is required before re-inspection.
- ☐ Inspection waived

☑ **SITE TESTING**

- ☐ Soil Evaluation - Concur
- ☐ Soil Evaluation - Do not concur
- ☐ Soil Evaluation - Inconclusive
- ☐ Alteration Test Hole - Verified
- ☐ Alteration Test Hole - Unacceptable
- ☐ Ledge Test
- ☐ Fill Tests
- ☐ Repair Test Hole

Signature of Inspector _____

INSPECT FRM REV. 2/10

OWNER'S COPY

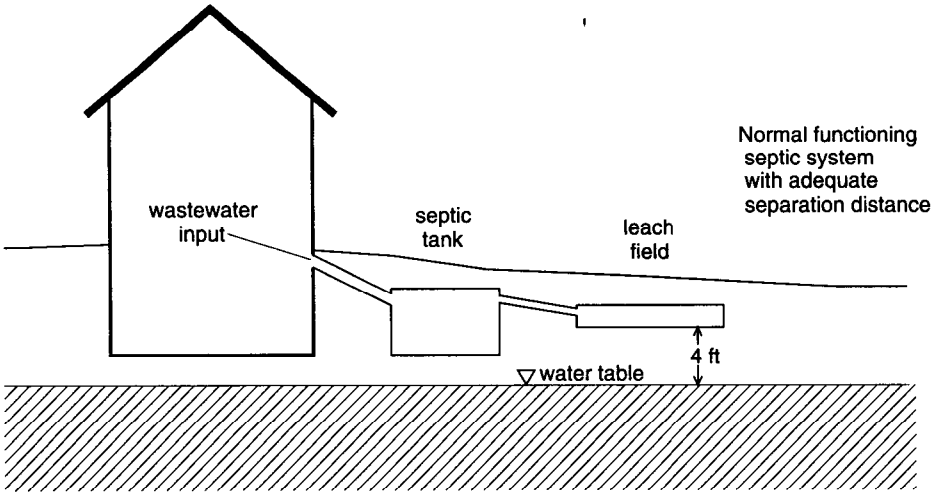
APPENDIX B.3:

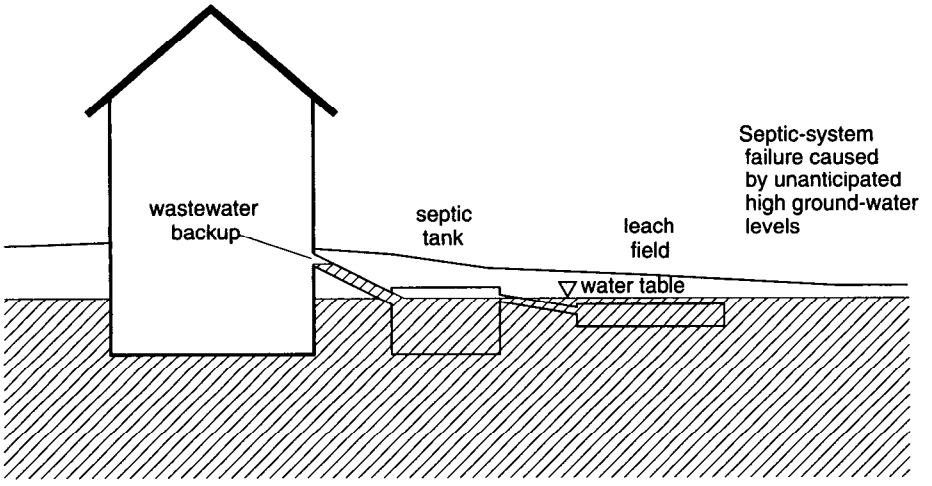
Estimated High Groundwater Levels (Frimpter Analysis)

	ID	Date	Sc	RI-POW 551		RI-LTW 142		Final Sh	Adjustment
				Wc	Sh	Wc	Sh		
	SB-1	1/30/2017	1.4	31.92	-0.94	8.4	-0.31	**0.00**	-1.4
	SB-2	1/30/2017	3.1	31.92	0.76	8.4	1.39	**0.76**	-2.3
	SB-3	1/31/2017	1.8	31.92	-0.54	8.4	0.09	**0.00**	-1.8
	SB-4	1/19/2017	1.9	31.92	-0.44	8.4	0.19	**0.00**	-1.9
*	SB-5	1/20/2017	9.0	31.92	6.66	8.4	7.29	**6.66**	-2.3
*	SB-6	1/19/2017	17.0	31.92	14.66	8.4	15.29	**14.66**	-2.3
	SB-7	1/18/2017	4.0	31.92	1.66	8.4	2.29	**1.66**	-2.3
*	SB-8	1/17/2017	15.5	31.92	13.16	8.4	13.79	**13.16**	-2.3
*	SB-9	1/20/2017	16.0	31.92	13.66	8.4	14.29	**13.66**	-2.3
*	SB-10	1/24/2017	21.0	31.92	18.66	8.4	19.29	**18.66**	-2.3
*	SB-11	1/23/2017	13.0	31.92	10.66	8.4	11.29	**10.66**	-2.3
	SB-12	2/1/2017	0.0	31.92	-2.34	8.4	-1.71	**0.00**	0.0
	SB-13	1/25/2017	0.0	31.92	-2.34	8.4	-1.71	**0.00**	0.0
	SB-14	1/24/2017	0.0	31.92	-2.34	8.4	-1.71	**0.00**	0.0
	SB-15	1/24/2017	0.0	31.92	-2.34	8.4	-1.71	**0.00**	0.0
*	SB-16B	1/16/2017	18.0	31.92	15.66	8.4	16.29	**15.66**	-2.3
*	SB-17	2/1/2017	7.0	31.92	4.66	8.4	5.29	**4.66**	-2.3
	SB-18	2/2/2017	2.9	31.92	0.56	8.4	1.19	**0.56**	-2.3
	SB-19	1/25/2017	0.0	31.92	-2.34	8.4	-1.71	**0.00**	0.0
	SB-20	1/13/2017	0.0	31.92	-2.34	8.4	-1.71	**0.00**	0.0
	SB-21	2/2/2017	2.6	31.92	0.26	8.4	0.89	**0.26**	-2.3
	SB-22	2/3/2017	7.2	31.92	4.86	8.4	5.49	**4.86**	-2.3
	SB-23	1/12/2017	7.4	31.92	5.06	8.4	5.69	**5.06**	-2.3
*	SB-24	1/12/2017	10.0	31.92	7.66	8.4	8.29	**7.66**	-2.3
*	SB-25	1/27/2017	6.0	31.92	3.66	8.4	4.29	**3.66**	-2.3
*	SB-27	2/23/2017	9.0	31.69	6.76	9.15	6.74	**6.74**	-2.3
	SB-28	2/23/2017	0.0	31.69	-2.24	9.15	-2.26	**0.00**	0.0
	SB-29	2/22/2017	2.9	31.69	0.66	9.15	0.64	**0.64**	-2.3
*	SB-30	2/21/2017	8.1	31.69	5.86	9.15	5.84	**5.84**	-2.3
	SB-31	2/17/2017	15.0	31.69	12.76	9.15	12.74	**12.74**	-2.3
	SB-32	2/16/2017	7.6	31.69	5.36	9.15	5.34	**5.34**	-2.3
*	SB-33	2/10/2017	14.0	31.69	11.76	9.15	11.74	**11.74**	-2.3
	SB-34	2/10/2017	11.0	31.69	8.76	9.15	8.74	**8.74**	-2.3
	SB-37	2/14/2017	1.8	31.69	-0.44	9.15	-0.46	**0.00**	-1.8
* Groundwater not encountered during testing									

A TECHNIQUE FOR ESTIMATING GROUND-WATER LEVELS AT SITES IN RHODE ISLAND FROM OBSERVATION-WELL DATA

U.S. GEOLOGICAL SURVEY
Water-Resources Investigations Report 94-4138





NOT TO SCALE

Prepared in cooperation with the
RHODE ISLAND DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

Table 5. Frequency distribution of ground-water levels computed from 5-day and monthly measurements for four wells in Rhode Island

Local well No. (fig. 3)	Period of comparison	Frequency of measurements	Number of measurements	Percentage of time depth to water level was equaled or exceeded								
				95	90	85	75	50	25	15	10	5
EXW-475	Mar 1981-	5-day	467	11.43	11.95	12.33	13.09	14.66	15.42	15.64	15.76	16.04
	Sept 1987	Monthly	80	11.40	12.10	12.34	13.09	14.47	15.47	15.66	15.84	16.43
RIW-417	Jan 1976-	5-day	788	5.55	5.75	5.92	6.17	6.92	7.40	7.58	7.67	7.79
	Sept 1987	Monthly	168	5.56	5.77	5.89	6.19	6.90	7.45	7.58	7.69	7.78
RIW-600	Sept 1977-	5-day	664	32.54	32.74	32.93	33.18	33.87	34.43	34.65	34.77	35.41
	Sept 1987	Monthly	148	32.43	32.74	32.94	33.19	33.89	34.44	34.69	34.89	35.39
SNW-6	Oct 1976-	5-day	721	9.72	10.12	10.51	11.07	12.17	13.34	13.63	13.92	14.54
	Sept 1987	Monthly	132	9.70	10.00	10.57	11.03	12.23	13.38	13.67	14.07	14.56

Estimation Equations

Results of correlation and regression analyses (discussed in the appendixes) indicate a relation between water-level fluctuations in an index well and water levels at a nearby site. (An index well is a long-term observation well that is unaffected by pumping, discharges, surface-water diversions, and other water management activities. An index well should have similar lithology and depth to water as the site for which the estimate is needed. Also, in the case of sand and gravel aquifers, the index well should have the same topographic setting as the site of interest.) This relation can be expressed as a proportion in which the ratio between potential water-level change and the annual water-level range at the site is equal to the ratio between potential water-level change and the maximum annual water-level range at the index well. The proportion to estimate high water level is expressed as

$$\frac{\text{Potential water-level change at site}}{\text{Annual water-level range at site}} = \frac{\text{Potential water-level change at index well}}{\text{Maximum annual water-level range at index well}} \quad (1)$$

which can be written as

$$\frac{Sc - Sh}{Sr} = \frac{Wc - Wh}{Wr}. \quad (2)$$

Through rearrangement of equation 2, the following equations were developed for estimating high, median, and low ground-water levels, where water levels are in depth below a reference plane:

$$Sh = Sc + [(Sr/Wr)\ (Wh - Wc)]. \quad (3)$$

Similar equations were developed for estimating median and low water levels:

$$Sm = Sc + [(Sr/Wr)\ (Wm - Wc)] \quad (4)$$

$$Sl = Sc + [(Sr/Wr)\ (Wl - Wc)], \quad (5)$$

where

- *Sh* is estimated depth to high water level at the site, in feet;
- *Sm* is estimated depth to median water level at the site, in feet;
- *Sl* is estimated depth to low water level at the site, in feet;
- *Sc* is measured depth to water level at the site, in feet;
- *Sr* is range of water level at the site, in feet (figs. 8 and 9);
- *Wr* is maximum annual water-level range recorded for the observation well being used as an index well, in feet (from table 2; wells affected by pumping should not be used as index wells);
- *Wc* is measured depth to water level at the observation well, in feet, measured within 15 days of measurement of *Sc* (*Wc* is available from "Current Water Resources Conditions in Central New England");

Wh is depth to high water level (95th percentile) in the observation well, in feet (from table 4);

Wm is depth to median water level (50th percentile) in the observation well, in feet (from table 4); and

Wl is depth to low water level (5th percentile) in the observation well, in feet (from table 4).

If the estimated levels are to be in altitude above some reference plane, such as sea level, the same equations should be used, except that all depths must be converted to altitudes.

Selection of Index Well

Use of the estimating technique requires a water-level measurement at the estimation site (herein referred to as site) and a concurrent water-level measurement (within about 15 days) at an index well. Selecting suitable index wells is essential for making accurate water-level estimates at sites. Some observation wells included in this study are of limited use as index wells. Those wells, and the reasons for their limitations, are described in the following paragraphs.

The index well must be unaffected by pumping, discharges, surface-water diversions, or other water-management activities. Most wells listed in table 2 can be used as index wells. Several wells (EXW-16, LIW-84, NKW-450, PRW-48, PRW-1051, RIW-231, and SNW-515) should not be used at all or should only be used selectively as index wells to represent local conditions. Wells EXW-16, PRW-48, and PRW-1051 are affected by nearby pumping and are not recommended for use as index wells to estimate water levels at distant sites.

Well NSW-21 was pumped for domestic supply from about 1947 through about 1980; however, information from the landowner and hydrographic analysis of water levels before and after pumping indicate that pumping did not adversely affect historical water-level data. Because the water-level record of well NSW-21 does not vary in response to pumping, the well can be use as an index well for estimating water levels.

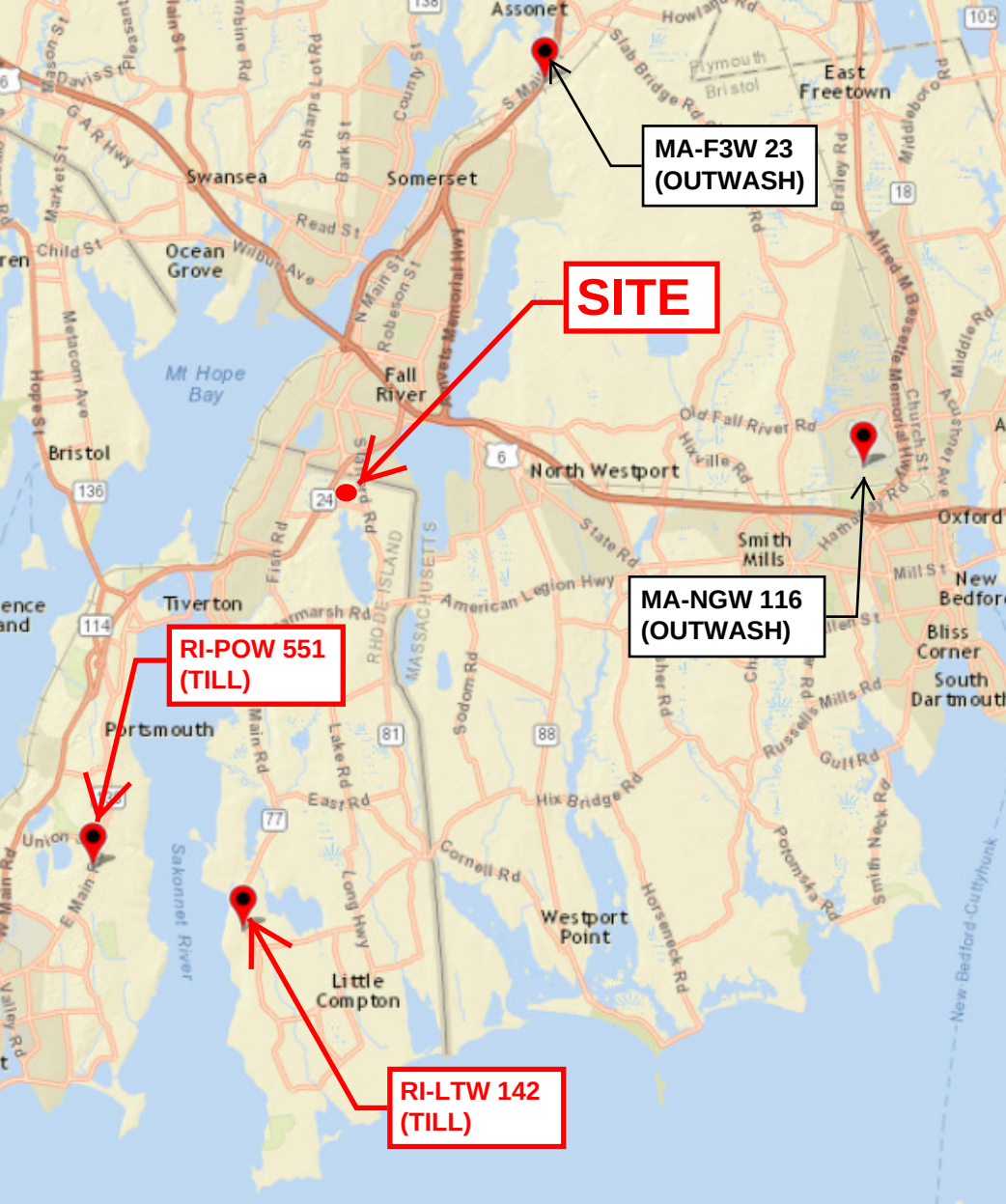
Well LIW-84 is affected by lower-bank flooding of the Blackstone River (highest water level is 0.97 ft above land surface). Although the well casing was extended, it should not be used for estimating high water levels when the Blackstone River is at extreme flood stage.

Water-level measurements in well RIW-231 were discontinued in 1991 at the request of the property owner. Water-level measurements in well NKW-450 were discontinued in 1992 when the well was destroyed. Water levels in wells RIW-231 and NKW-450 are used for demonstration purposes only and are no longer available.

Well SNW-515 has a median water level of 27.32 ft and is reported to be dry at times; the water levels have declined an unknown distance below the bottom of the well. Although well SNW-515 is not appropriate for estimating low water levels, it can be used for estimating high and median water levels at sites where depth to water is similar (median water level depth greater than approximately 20 ft).

The index well should have approximately the same measured depth to water (in "Current Water Resources Conditions in Central New England") as the site. For example, well RIW-600 has a median water level of 33.87 ft and can be used as an index well to estimate high, median, and low water levels at sites where depth to water is similar (median water level greater than approximately 30 ft).

The index well should be completed in the same or similar lithologic material as the site. For sites in sand and gravel, 15 potential index wells are currently (1994) available. Because of insufficient length of record (less than 5 years), and lack of recent and simultaneous record (data for wells completed in till span various time periods from 1946-61), no wells completed in till are currently (1994) available for use as index wells to estimate water levels at sites in till. As a result of this study, monthly measurements for seven wells used in this report and completed in till (EXW-158, EXW-238, EXW-278, FOW-40, HOW-67, WCW-59, and WGW-206) were resumed in October 1991. These wells will be available for use as index wells as of September 1996. Thirteen additional wells completed in till (BUW-395, BUW-396, BUW-397, BUW-398, CHW-586, CHW-587, COW-466, CRW-439, FOW-290, LTW-142, NHW-258, POW-551, and TIW-274) were added to the Rhode Island observation-well network in October 1992, and will be available for use as index wells as of September 1997. Use of


MA-F3W 23
(OUTWASH)
SITE
MA-NGW 116
(OUTWASH)
RI-POW 551
(TILL)
RI-LTW 142
(TILL)
Assonet
Swansea
Somerset
Ocean Grove
Fall River
Mt Hope Bay
Bristol
North Westport
Tiverton
Portsmouth
Westport Point
Little Compton
East Freetown
Smith Mills
Oxford
Bliss Corner
South Dartmouth
New Bedford
Sakonnet River
RHODE ISLAND
MASSACHUSETTS

RI-POW 551

Date	Measured Depth	Maximum Annual Range
9/28/1992	41.29	
11/25/1992	40.6	
12/22/1992	24.95	16.34
1/19/1993	31.6	
2/16/1993	36.2	
3/22/1993	25.25	
4/20/1993	32.19	
5/26/1993	38.5	
6/28/1993	44.55	
7/28/1993	48.05	
8/26/1993	49.92	
12/2/1993	47.66	
12/27/1993	32.02	24.67
2/24/1994	34.11	
3/28/1994	27.71	
4/25/1994	32.53	
5/24/1994	37.74	
6/27/1994	40.7	
7/27/1994	44.93	
8/31/1994	47.9	
9/29/1994	48.37	
10/28/1994	49.58	
11/29/1994	49.9	
12/28/1994	30.52	22.19
1/24/1995	30.71	
2/20/1995	34.66	
3/27/1995	31.28	
4/24/1995	35.88	
5/23/1995	38.14	
6/29/1995	39.15	
7/26/1995	44.06	
9/27/1995	50.32	
10/25/1995	48.83	
11/22/1995	33.54	
12/19/1995	33.98	19.61
1/22/1996	24.66	
2/19/1996	30.74	
3/25/1996	30.39	
4/25/1996	28.58	
5/20/1996	33.34	
6/24/1996	39.78	
7/24/1996	41.83	
8/20/1996	43.33	
9/24/1996	33.91	
10/23/1996	31.55	
11/22/1996	45.3	
12/23/1996	26.68	20.64
1/21/1997	34.19	

95th Percentile (Wh)	**26.43**	
Maximum Annual Range (Wr)	**25.78**	
Range of Water Level at Site (Sr)	**11**	(given)

2/24/1997	32.39	
3/24/1997	32.98	
4/22/1997	30.65	
5/22/1997	37.22	
6/24/1997	40.99	
7/22/1997	45.15	
8/25/1997	47.48	
9/24/1997	39.13	
10/22/1997	44.84	
11/24/1997	35.02	
12/22/1997	36.27	16.83
1/22/1998	27.52	
2/23/1998	24.86	
3/24/1998	27	
4/21/1998	32.85	
5/21/1998	29.68	
6/25/1998	28	
7/23/1998	36.63	
8/20/1998	44.28	
9/25/1998	47.61	
10/23/1998	44.78	
11/23/1998	44.96	
12/23/1998	43.31	22.75
1/20/1999	34.77	
2/23/1999	31.85	
3/23/1999	29.54	
4/22/1999	38.85	
5/24/1999	40.52	
6/25/1999	44.02	
7/23/1999	47.42	
8/26/1999	47.72	
9/29/1999	50.21	
10/25/1999	37.65	
11/23/1999	36.79	
12/22/1999	34.17	20.67
1/19/2000	34.92	
2/23/2000	37.64	
3/21/2000	24.42	
4/25/2000	25.98	
5/26/2000	35.07	
6/26/2000	35.99	
7/27/2000	42.88	
8/28/2000	37.41	
9/26/2000	36.19	
10/26/2000	41.73	
11/24/2000	43.64	
12/22/2000	32.58	19.22
1/22/2001	35.46	
2/26/2001	33.41	
3/19/2001	25.48	
4/25/2001	31.05	

5/30/2001	40.72	
6/26/2001	37.15	
7/25/2001	42.77	
8/30/2001	44.61	
9/25/2001	46.62	21.14
1/28/2002	42.73	
2/26/2002	38.41	
3/28/2002	35.1	
5/3/2002	34.49	
5/20/2002	27.65	
6/25/2002	35.57	
7/29/2002	43.36	
8/15/2002	46.04	
8/28/2002	48.21	
9/26/2002	49.9	
10/29/2002	44.41	
11/25/2002	29.23	
12/27/2002	25.46	24.44
1/28/2003	33.91	
2/26/2003	35.84	
3/25/2003	31.51	
4/28/2003	27.63	
6/10/2003	31.84	
6/27/2003	31.54	
6/30/2003	32.42	
7/28/2003	39.89	
7/29/2003	40.13	
8/28/2003	38.21	
9/25/2003	41.76	
10/30/2003	43.41	
11/26/2003	36.51	
12/30/2003	30.68	15.78
1/28/2004	37.08	
2/26/2004	40.25	
3/30/2004	37.14	
4/27/2004	29.98	
5/25/2004	37.14	
6/29/2004	41.54	
8/27/2004	43.54	
9/21/2004	41.92	
10/4/2004	34.53	
10/25/2004	34.61	
10/29/2004	34.46	
11/29/2004	35.12	
12/28/2004	31.62	13.56
1/31/2005	32.75	
2/25/2005	28.07	
3/31/2005	23.61	
4/26/2005	34.4	
5/27/2005	37.08	
6/29/2005	40.98	

8/3/2005	45.59	
9/1/2005	48.11	
9/30/2005	48.78	
10/26/2005	31.17	
11/29/2005	25.24	
12/27/2005	30.62	25.17
1/30/2006	27.93	
2/28/2006	33.25	
4/27/2006	40.52	
5/22/2006	26.39	
6/27/2006	28.58	
7/27/2006	30.67	
8/29/2006	44.08	
9/27/2006	44.18	
10/31/2006	33	
11/29/2006	26.66	
12/28/2006	29.54	17.79
1/29/2007	32.19	
2/28/2007	39.71	
3/28/2007	29.07	
4/26/2007	28.08	
7/9/2007	43.22	
7/31/2007	45.99	
8/28/2007	48.2	20.12
1/2/2008	43.66	
1/30/2008	36.34	
2/27/2008	31.88	
3/25/2008	29.8	
4/24/2008	33.14	
5/28/2008	36.03	
6/26/2008	41.04	
7/29/2008	44.99	
8/27/2008	44.67	
9/26/2008	46.13	
10/31/2008	40.14	
11/25/2008	38.9	
12/30/2008	25.14	20.99
1/21/2009	30.96	
2/26/2009	33.58	
3/23/2009	31.53	
4/27/2009	28.38	
5/28/2009	35.36	
6/25/2009	38.74	
7/30/2009	28.66	
8/24/2009	39.04	
9/28/2009	39.8	
10/26/2009	37.04	
11/23/2009	36.7	
12/21/2009	28.09	11.71
1/26/2010	32.6	
2/22/2010	37.78	

3/29/2010	24.37	
4/26/2010	34.24	
5/26/2010	41.15	
6/29/2010	42.38	
7/27/2010	45.88	
8/23/2010	47.59	
9/27/2010	49.82	
10/25/2010	48.83	
11/23/2010	41.96	
12/20/2010	39.31	25.45
1/24/2011	37.79	
2/22/2011	28.3	
3/28/2011	31.82	
4/25/2011	28.8	
5/23/2011	36.02	
6/27/2011	38.83	
7/26/2011	42.16	
9/27/2011	39.23	
10/25/2011	30.3	
11/28/2011	27.7	
12/28/2011	32.4	14.46
1/23/2012	35.63	
2/28/2012	37.68	
3/27/2012	37.67	
4/27/2012	42.17	
5/23/2012	32.84	
6/26/2012	38.18	
7/24/2012	44.48	
8/27/2012	42.84	
9/20/2012	44.72	
11/5/2012	47.2	
11/26/2012	43.88	
12/26/2012	36.84	14.36
1/31/2013	33.77	
2/25/2013	27.64	
3/27/2013	29.75	
4/26/2013	36.84	
5/29/2013	41.74	
6/25/2013	29.8	
7/19/2013	38.12	
8/27/2013	45.44	
9/25/2013	46.24	
10/31/2013	48.52	
11/26/2013	50.03	
12/23/2013	45.09	22.39
1/24/2014	28.85	
2/27/2014	24.82	
3/26/2014	33.98	
4/29/2014	31.47	
5/28/2014	36.61	
6/26/2014	42.48	

7/28/2014	43.84	
8/27/2014	46.38	
9/29/2014	49.46	
10/29/2014	50.6	
11/28/2014	48.33	
12/18/2014	32.74	25.78
1/21/2015	33.82	
2/25/2015	37.56	
3/24/2015	26	
4/21/2015	32	
5/28/2015	40.44	
6/25/2015	44.49	
7/28/2015	45.27	
8/27/2015	41.29	
9/29/2015	45.29	
10/21/2015	41.44	
11/24/2015	40.47	
12/22/2015	38.1	19.29
1/22/2016	30.24	
2/23/2016	27.79	
3/24/2016	32.54	
4/27/2016	33.88	
5/24/2016	38.95	
6/28/2016	44.21	
7/26/2016	47.25	
8/23/2016	49.56	
9/27/2016	50.66	
11/3/2016	50.69	
11/29/2016	48.83	
12/20/2016	44.92	22.9
1/25/2017	31.92	
2/23/2017	31.69	0.23

RI-LTW 142

Date	Measured Depth	Maximum Annual Range
10/14/1992	14.25	
11/25/1992	15.7	
12/22/1992	4.26	11.44
1/19/1993	10.25	
2/16/1993	12.9	
3/22/1993	5.34	
4/19/1993	9.64	
5/26/1993	14.7	
6/28/1993	17.39	
7/28/1993	18.6	
12/27/1993	9.69	13.26
1/28/1994	9.39	
2/24/1994	12.51	
3/28/1994	6.76	
4/25/1994	9.76	
5/24/1994	13.98	
6/27/1994	15.92	
7/27/1994	16.91	
8/31/1994	17.71	
9/29/1994	18.01	
10/27/1994	18.62	
11/29/1994	18.6	
12/28/1994	6.02	12.6
1/24/1995	9.38	
2/20/1995	11.94	
3/27/1995	10.63	
4/24/1995	13.27	
5/23/1995	14.25	
6/29/1995	16.1	
7/26/1995	16.82	
9/27/1995		
10/25/1995	17.96	
11/22/1995	8.62	
12/19/1995	11.24	9.34
1/22/1996	3.23	
2/19/1996	9.12	
3/25/1996	9.14	
4/25/1996	6.27	
5/20/1996	11.36	
6/25/1996	15.55	
7/24/1996	16.67	
8/20/1996	16.81	
9/24/1996	7.43	
10/23/1996	7.63	
11/22/1996	13.72	
12/24/1996	7.34	13.58
1/21/1997	12.4	
2/24/1997	11.52	

95th Percentile (Wh)	**6.07**	
Maximum Annual Range (Wr)	**15**	
Range of Water Level at Site (Sr)	**11**	(given)

3/24/1997	11.86	
4/22/1997	9.52	
5/22/1997	14.67	
6/24/1997	16.22	
7/22/1997	18.13	
8/22/1997	18.76	
9/24/1997	14.47	
10/22/1997	17.52	
11/24/1997	11.99	
12/22/1997	12.87	9.24
1/22/1998	7.15	
2/23/1998	5.52	
3/24/1998	6.84	
4/21/1998	10.46	
5/21/1998	8.64	
6/25/1998	7.72	
7/24/1998	14.52	
8/20/1998	17.69	
9/25/1998	18.35	
10/22/1998	17.24	
11/25/1998	17.52	
12/23/1998	17.3	12.83
1/21/1999	9.96	
2/23/1999	10.03	
3/24/1999	8.92	
4/22/1999	13.93	
5/25/1999	17.14	
6/25/1999	17.92	
9/29/1999	18.6	
10/25/1999	12.61	
11/24/1999	14.29	
12/21/1999	11.68	9.68
1/19/2000	12.26	
2/23/2000	12.46	
3/21/2000	4.86	
4/25/2000	6.01	
4/26/2000	9.32	
5/26/2000	12.82	
6/26/2000	13.61	
7/27/2000	16.92	
8/28/2000	14.76	
9/25/2000	14.62	
10/26/2000	16.52	
11/28/2000	17.23	
12/22/2000	10.14	12.37
1/22/2001	10.65	
2/28/2001	10.85	
3/19/2001	6.42	
4/26/2001	9.32	
5/30/2001	15.82	
6/28/2001	12.93	

7/26/2001	16.74	
8/28/2001	16.9	
9/26/2001	18.43	12.01
1/29/2002	13.42	
2/25/2002	13.53	
3/27/2002	11.25	
5/2/2002	11.75	
5/20/2002	6.81	
6/28/2002	13.68	
7/29/2002	17.46	
8/15/2002	18.43	
10/31/2002	16.03	
11/26/2002	7.77	
12/23/2002	6.16	12.27
1/27/2003	11.68	
2/24/2003	12.39	
3/24/2003	9.22	
4/28/2003	5.65	
6/9/2003	9.39	
6/27/2003	9.32	
6/30/2003	10.01	
7/24/2003	15.32	
7/29/2003	15.63	
8/26/2003	13.84	
9/26/2003	16.36	
10/28/2003	17.4	
11/26/2003	13.15	
12/29/2003	9.53	11.75
1/26/2004	14.04	
2/25/2004	15.43	
3/29/2004	13.83	
4/28/2004	9.94	
5/25/2004	2.98	
6/28/2004	16.42	
7/29/2004	17.98	
8/30/2004	16.12	
9/21/2004	15.96	
10/4/2004	10.67	
10/27/2004	11.09	
10/29/2004	11.23	
11/29/2004	12.66	
12/29/2004	10.41	15
1/26/2005	9.55	
2/25/2005	7.56	
3/30/2005	7.04	
4/25/2005	12.14	
5/27/2005	13.85	
6/29/2005	15.94	
8/2/2005	17.78	
9/26/2005	18.27	
10/26/2005	6.07	

11/30/2005	6.66	
12/27/2005	10.5	12.2
1/30/2006	7.52	
2/27/2006	12.06	
4/28/2006	16.14	
5/24/2006	7.68	
6/27/2006	10.08	
7/25/2006	12.32	
8/25/2006	16.84	
9/28/2006	16.96	
10/31/2006	14.76	
11/28/2006	7.81	
12/28/2006	13.18	9.44
1/26/2007	10.46	
2/27/2007	15.21	
3/27/2007	8.32	
4/26/2007	5.71	
7/9/2007	16.8	
7/30/2007	17.95	
8/28/2007	19.06	
9/25/2007	19.89	
10/25/2007	20.62	
11/27/2007	20.12	14.91
1/3/2008	14.44	
1/28/2008	10.87	
2/28/2008	9.72	
3/24/2008	8.65	
5/28/2008	13.21	
6/26/2008	16.08	
7/29/2008	17.12	
8/27/2008	14.71	
9/26/2008	15.92	
10/31/2008	13.69	
11/25/2008	13.29	
12/30/2008	5.68	11.44
1/21/2009	10.09	
2/27/2009	12.02	
3/23/2009	10.56	
4/27/2009	8.86	
5/28/2009	12.64	
6/25/2009	15.08	
7/30/2009	7.79	
8/24/2009	14.84	
9/28/2009	14.78	
10/26/2009	10.91	
11/23/2009	12.73	
12/21/2009	8.6	7.29
1/26/2010	11.4	
2/23/2010	14.53	
3/29/2010	4.92	
4/27/2010	12.62	

5/26/2010	16.16	
6/29/2010	16.48	
7/27/2010	18.04	
8/23/2010	18.94	
9/27/2010	19.74	
10/25/2010	18.4	
11/23/2010	12.99	
12/20/2010	13.92	14.82
1/24/2011	11.39	
2/22/2011	7.62	
3/28/2011	10.95	
4/25/2011	8.91	
5/23/2011	12.86	
6/27/2011	14.73	
7/26/2011	15.95	
9/27/2011	13.35	
10/25/2011	7.35	
11/28/2011	8.49	
12/28/2011	12.11	8.6
1/23/2012	13.17	
3/27/2012	14.24	
4/27/2012	16.58	
5/23/2012	9.76	
6/26/2012	15.05	
7/24/2012	17.76	
8/27/2012	17.36	
9/20/2012	18.46	
11/5/2012	17.79	
11/26/2012	16.98	
12/26/2012	10.8	8.7
1/31/2013	11.19	
2/25/2013	6.32	
3/27/2013	8.97	
4/26/2013	13.83	
5/29/2013	16.16	
6/25/2013	8.81	
7/19/2013	14.42	
8/27/2013	17.99	
9/25/2013	18.46	
10/31/2013	19.4	
11/26/2013	19.96	
12/23/2013	16.24	13.64
1/24/2014	6.26	
2/27/2014	4.54	
3/26/2014	12.08	
4/29/2014	10.04	
5/28/2014	13.95	
6/26/2014	16.74	
7/28/2014	14.46	
8/27/2014	17.25	
9/29/2014	19.09	

10/29/2014	19.25	
11/28/2014	17.39	
12/18/2014	7.12	14.71
1/21/2015	10.59	
2/25/2015	13.6	
3/24/2015	4.19	
4/21/2015	10.95	
5/28/2015	15.94	
6/25/2015	17.4	
7/28/2015	17.2	
8/27/2015	16.78	
9/29/2015	18.04	
10/21/2015	13.97	
11/24/2015	14.02	
12/22/2015	11.9	13.85
1/22/2016	9.16	
2/23/2016	8.24	
3/24/2016	10.94	
4/27/2016	12.57	
5/24/2016	15.1	
6/28/2016	16.83	
7/26/2016	18.43	
8/23/2016	19.5	
9/27/2016	20.43	
11/3/2016	17.93	
11/29/2016	17.92	
12/20/2016	15.63	12.19
1/25/2017	8.4	
2/23/2017	9.15	0.75

APPENDIX B.4:

Falling Head Test Data

Summary of In-Situ Falling Head Test Data

Test Location :	SB-17	Test 1
Ground Surface Elevation =	193	ft
Length of Casing	6.0	ft
Bottom Elevation of Casing =	189	ft (approx)
Diameter of Casing, D =	0.25	ft

5.5' of casing; bottom of casing 3.5' bgs; bottom of hole 4' bgs; 2' stickup

Date	Time (min)	Elapsed Time from Previous Reading ($t_2 - t_1$) (min)	Elapsed Time from Previous Reading ($t_2 - t_1$) (sec)	Cumulative Time (sec)	Depth to Water (from TOC) (ft)	Measured Head H_1 or H_2 (ft of water)	Measured Head H_1 or H_2 (cm of water)	Mean Permeability [1] k_m (cm/sec)	Mean Permeability [1] k_m (in/hr)
2/1/2017	0.00			-	3.70	2.30	70.1	-	-
	1.00	1.0	60	60	3.75	2.25	68.6	8.0E-04	1.13
	2.00	1.0	60	120	3.75	2.25	68.6	0.0E+00	0.00
	3.00	1.0	60	180	3.78	2.22	67.7	4.9E-04	0.69
	4.00	1.0	60	240	3.80	2.20	67.1	3.3E-04	0.47
	5.00	1.0	60	300	3.81	2.19	66.8	1.7E-04	0.23
	6.00	1.0	60	360	3.82	2.18	66.4	1.7E-04	0.24
	7.00	1.0	60	420	3.83	2.17	66.1	1.7E-04	0.24
	8.00	1.0	60	480	3.85	2.15	65.5	3.4E-04	0.48
	9.00	1.0	60	540	3.88	2.12	64.6	5.1E-04	0.72
	10.00	1.0	60	600	3.89	2.11	64.3	1.7E-04	0.24
	11.00	1.0	60	660	3.90	2.10	64.0	1.7E-04	0.24
	12.00	1.0	60	720	3.91	2.09	63.7	1.7E-04	0.25
	13.00	1.0	60	780	3.93	2.07	63.1	3.5E-04	0.49
	14.00	1.0	60	840	3.95	2.05	62.5	3.5E-04	0.50
	15.00	1.0	60	900	3.96	2.04	62.2	1.8E-04	0.25
							Average =	2.9E-04	0.41
							Geometric Mean =	2.7E-04	0.38

Notes:

1. $k_m = [(pi * D) / (11 * (t_2-t_1))] * \ln(H_1/H_2)$ equation C variable head
   From Foundation Engineering Handbook, 2005 (R. Day) p.4.59 - after Hvorslev, 1951

2. Seepage observed on outside of casing.

Prepared/Date:
Checked/Date:

Summary of In-Situ Falling Head Test Data

Test Location :	SB-17	Test 2
Ground Surface Elevation =	193	ft
Length of Casing	6.0	ft
Bottom Elevation of Casing =	189	ft (approx)
Diameter of Casing, D =	0.25	ft

5.5' of casing; bottom of casing 3.5' bgs; bottom of hole 4' bgs; 2' stickup

Date	Time (min)	Elapsed Time from Previous Reading ($t_2 - t_1$) (min)	Elapsed Time from Previous Reading ($t_2 - t_1$) (sec)	Cumulative Time (sec)	Depth to Water (from TOC) (ft)	Measured Head H_1 or H_2 (ft of water)	Measured Head H_1 or H_2 (cm of water)	Mean Permeability [1] k_m (cm/sec)	Mean Permeability [1] k_m (in/hr)
2/1/2017	0.00			-	3.68	2.32	70.7	-	-
	1.00	1.0	60	60	3.71	2.29	69.8	4.7E-04	0.67
	2.00	1.0	60	120	3.72	2.28	69.5	1.6E-04	0.22
	3.00	1.0	60	180	3.75	2.25	68.6	4.8E-04	0.68
	4.00	1.0	60	240	3.76	2.24	68.3	1.6E-04	0.23
	5.00	1.0	60	300	3.77	2.23	68.0	1.6E-04	0.23
	6.00	1.0	60	360	3.78	2.22	67.7	1.6E-04	0.23
	7.00	1.0	60	420	3.80	2.20	67.1	3.3E-04	0.47
	8.00	1.0	60	480	3.81	2.19	66.8	1.7E-04	0.23
	9.00	1.0	60	540	3.82	2.18	66.4	1.7E-04	0.24
	10.00	1.0	60	600	3.85	2.15	65.5	5.0E-04	0.71
	11.00	1.0	60	660	3.87	2.13	64.9	3.4E-04	0.48
	12.00	1.0	60	720	3.88	2.12	64.6	1.7E-04	0.24
	13.00	1.0	60	780	3.90	2.10	64.0	3.4E-04	0.49
	14.00	1.0	60	840	3.91	2.09	63.7	1.7E-04	0.25
	15.00	1.0	60	900	3.92	2.08	63.4	1.7E-04	0.25
							Average =	2.6E-04	0.37
							Geometric Mean =	2.4E-04	0.34

Notes:

1. $k_m = [(pi * D) / (11 * (t_2-t_1))] * \ln(H_1/H_2)$ equation C variable head
   From Foundation Engineering Handbook, 2005 (R. Day) p.4.59 - after Hvorslev, 1951

2. Seepage observed on outside of casing.

Prepared/Date:
Checked/Date:

Summary of In-Situ Falling Head Test Data

Test Location :	SB-18	Test 1
Ground Surface Elevation =	190	ft
Length of Casing	5.5	ft
Bottom Elevation of Casing =	186	ft (approx)
Diameter of Casing, D =	0.25	ft

Date	Time (min)	Elapsed Time from Previous Reading ($t_2 - t_1$) (min)	Elapsed Time from Previous Reading ($t_2 - t_1$) (sec)	Cumulative Time (sec)	Depth to Water (from TOC) (ft)	Measured Head H_1 or H_2 (ft of water)	Measured Head H_1 or H_2 (cm of water)	Mean Permeability [1] k_m (cm/sec)	Mean Permeability [1] k_m (in/hr)
2/2/2017	0.00			-	0.00	5.50	167.6	-	-
	0.17	0.17	10	10	1.20	4.30	131.1	5.3E-02	74.43
	0.75	0.58	35	45	1.30	4.20	128.0	1.5E-03	2.09
	1.00	0.25	15	60	1.40	4.10	125.0	3.5E-03	4.96
	1.25	0.25	15	75	1.60	3.90	118.9	7.3E-03	10.28
	1.50	0.25	15	90	1.60	3.90	118.9	0.0E+00	0.00
	1.75	0.25	15	105	1.70	3.80	115.8	3.8E-03	5.34
	2.00	0.25	15	120	1.75	3.75	114.3	1.9E-03	2.72
	2.25	0.25	15	135	1.87	3.63	110.6	4.7E-03	6.69
	2.50	0.25	15	150	1.90	3.60	109.7	1.2E-03	1.71
	2.75	0.25	15	165	2.00	3.50	106.7	4.1E-03	5.79
	3.00	0.25	15	180	2.05	3.45	105.2	2.1E-03	2.96
	3.25	0.25	15	195	2.07	3.43	104.5	8.4E-04	1.20
	3.50	0.25	15	210	2.10	3.40	103.6	1.3E-03	1.81
	3.75	0.25	15	225	2.15	3.35	102.1	2.1E-03	3.05
	4.00	0.25	15	240	2.21	3.29	100.3	2.6E-03	3.72
							Average =	6.0E-03	8.45
							Geometric Mean =	3.0E-03	4.21

Notes:

1. $k_m = [(pi * D) / (11 * (t_2-t_1))] * \ln(H_1/H_2)$ equation C variable head
   From Foundation Engineering Handbook, 2005 (R. Day) p.4.59 - after Hvorslev, 1951

Prepared/Date:
Checked/Date:

Summary of In-Situ Falling Head Test Data

Test Location :	SB-18	Test 2
Ground Surface Elevation =	190	ft
Length of Casing	5.5	ft
Bottom Elevation of Casing =	186	ft (approx)
Diameter of Casing, D =	0.25	ft

Date	Time (min)	Elapsed Time from Previous Reading ($t_2 - t_1$) (min)	Elapsed Time from Previous Reading ($t_2 - t_1$) (sec)	Cumulative Time (sec)	Depth to Water (from TOC) (ft)	Measured Head H_1 or H_2 (ft of water)	Measured Head H_1 or H_2 (cm of water)	Mean Permeability [1] k_m (cm/sec)	Mean Permeability [1] k_m (in/hr)
	0.00			-	0.00	5.50	167.6	-	-
	0.50	0.5	30	30	1.27	4.23	128.9	1.9E-02	26.99
	1.00	0.5	30	60	1.40	4.10	125.0	2.3E-03	3.21
	1.50	0.5	30	90	1.60	3.90	118.9	3.6E-03	5.14
	2.00	0.5	30	120	1.78	3.72	113.4	3.4E-03	4.86
	2.50	0.5	30	150	1.87	3.63	110.6	1.8E-03	2.52
	3.00	0.5	30	180	1.90	3.60	109.7	6.0E-04	0.85
	3.50	0.5	30	210	2.05	3.45	105.2	3.1E-03	4.38
2/2/2017	4.00	0.5	30	240	2.13	3.37	102.7	1.7E-03	2.41
	4.50	0.5	30	270	2.23	3.27	99.7	2.2E-03	3.10
	5.00	0.5	30	300	2.33	3.17	96.6	2.3E-03	3.19
	5.50	0.5	30	330	2.35	3.15	96.0	4.6E-04	0.65
	6.00	0.5	30	360	2.40	3.10	94.5	1.2E-03	1.65
	6.50	0.5	30	390	2.50	3.00	91.4	2.4E-03	3.37
	7.00	0.5	30	420	2.51	2.99	91.1	2.4E-04	0.34
	7.50	0.5	30	450	2.51	2.99	91.1	0.0E+00	0.00
	8.00	1.0	60	480	2.52	2.98	90.8	1.2E-04	0.17
							Average =	2.8E-03	3.93
							Geometric Mean =	1.5E-03	2.16

Notes:

1. $k_m = [(pi * D) / (11 * (t_2-t_1))] * \ln(H_1/H_2)$ equation C variable head
   From Foundation Engineering Handbook, 2005 (R. Day) p.4.59 - after Hvorslev, 1951

Prepared/Date:
Checked/Date:

Summary of In-Situ Falling Head Test Data

Test Location :	SB-21	Test 1
Ground Surface Elevation =	187.1	ft
Length of Casing	5.5	ft
Bottom Elevation of Casing =	183.1	ft (approx)
Diameter of Casing, D =	0.25	ft

Date	Time (min)	Elapsed Time from Previous Reading ($t_2 - t_1$) (min)	Elapsed Time from Previous Reading ($t_2 - t_1$) (sec)	Cumulative Time (sec)	Depth to Water (from TOC) (ft)	Measured Head H_1 or H_2 (ft of water)	Measured Head H_1 or H_2 (cm of water)	Mean Permeability [1] k_m (cm/sec)	Mean Permeability [1] k_m (in/hr)
2/2/2017	0.00			-	0.00	5.50	167.6	-	-
	0.50	0.5	30	30	0.33	5.17	157.6	4.5E-03	6.36
	1.00	0.5	30	60	0.60	4.90	149.4	3.9E-03	5.51
	1.50	0.5	30	90	0.85	4.65	141.7	3.8E-03	5.38
	2.00	0.5	30	120	1.07	4.43	135.0	3.5E-03	4.98
	2.50	0.5	30	150	1.42	4.08	124.4	6.0E-03	8.46
	3.00	0.5	30	180	1.51	3.99	121.6	1.6E-03	2.29
	3.50	0.5	30	210	1.74	3.76	114.6	4.3E-03	6.10
	4.00	0.5	30	240	1.86	3.64	110.9	2.4E-03	3.33
	4.50	0.5	30	270	2.10	3.40	103.6	4.9E-03	7.01
	5.00	0.5	30	300	2.25	3.25	99.1	3.3E-03	4.64
							Average =	3.8E-03	5.41
							Geometric Mean =	3.6E-03	5.11

Notes:

1. $k_m = [(pi * D) / (11 * (t_2-t_1))] * \ln(H_1/H_2)$ equation C variable head
   From Foundation Engineering Handbook, 2005 (R. Day) p.4.59 - after Hvorslev, 1951

Prepared/Date:
Checked/Date:

Summary of In-Situ Falling Head Test Data

Test Location :	SB-21	Test 2
Ground Surface Elevation =	187.1	ft
Length of Casing	5.5	ft
Bottom Elevation of Casing =	183.1	ft (approx)
Diameter of Casing, D =	0.25	ft

Date	Time (min)	Elapsed Time from Previous Reading ($t_2 - t_1$) (min)	Elapsed Time from Previous Reading ($t_2 - t_1$) (sec)	Cumulative Time (sec)	Depth to Water (from TOC) (ft)	Measured Head H_1 or H_2 (ft of water)	Measured Head H_1 or H_2 (cm of water)	Mean Permeability [1] k_m (cm/sec)	Mean Permeability [1] k_m (in/hr)
2/2/2017	0.00			-	0.00	5.50	167.6	-	-
	0.50	0.5	30	30	0.40	5.10	155.4	5.5E-03	7.76
	1.00	0.5	30	60	0.72	4.78	145.7	4.7E-03	6.66
	1.50	0.5	30	90	1.02	4.48	136.6	4.7E-03	6.66
	2.00	0.5	30	120	1.21	4.29	130.8	3.1E-03	4.46
	2.50	0.5	30	150	1.39	4.11	125.3	3.1E-03	4.41
	3.00	0.5	30	180	1.62	3.88	118.3	4.2E-03	5.92
	3.50	0.5	30	210	1.74	3.76	114.6	2.3E-03	3.23
	4.00	0.5	30	240	1.87	3.63	110.6	2.6E-03	3.62
	4.50	0.5	30	270	2.07	3.43	104.5	4.1E-03	5.83
	5.00	0.5	30	300	2.19	3.31	100.9	2.6E-03	3.66
							Average =	3.7E-03	5.22
							Geometric Mean =	3.5E-03	5.01

Notes:

1. $k_m = [(pi * D) / (11 * (t_2-t_1))] * \ln(H_1/H_2)$ equation C variable head
   From Foundation Engineering Handbook, 2005 (R. Day) p.4.59 - after Hvorslev, 1951

Prepared/Date:
Checked/Date:

Summary of In-Situ Falling Head Test Data

Test Location :	SB-22	
Ground Surface Elevation =	202.5	ft
Length of Casing	7.5	ft
Bottom Elevation of Casing =	196	ft (approx)
Diameter of Casing, D =	0.25	ft

Date	Time (min)	Elapsed Time from Previous Reading ($t_2 - t_1$) (min)	Elapsed Time from Previous Reading ($t_2 - t_1$) (sec)	Cumulative Time (sec)	Depth to Water (from TOC) (ft)	Measured Head H_1 or H_2 (ft of water)	Measured Head H_1 or H_2 (cm of water)	Mean Permeability [1] k_m (cm/sec)	Mean Permeability [1] k_m (in/hr)
2/3/2017	0.00			-	0.00	7.50	228.6	-	-
	1.00	1.0	60	60	1.71	5.79	176.5	9.4E-03	13.30
	1.50	0.5	30	90	1.74	5.76	175.6	3.8E-04	0.53
	2.00	0.5	30	120	1.76	5.74	175.0	2.5E-04	0.36
	2.50	0.5	30	150	1.80	5.70	173.7	5.1E-04	0.72
	3.00	0.5	30	180	1.81	5.69	173.4	1.3E-04	0.18
	3.50	0.5	30	210	1.85	5.65	172.2	5.1E-04	0.73
	4.00	0.5	30	240	1.87	5.63	171.6	2.6E-04	0.36
	4.50	0.5	30	270	1.92	5.58	170.1	6.5E-04	0.92
	5.00	0.5	30	300	1.96	5.54	168.9	5.2E-04	0.74
	5.50	0.5	30	330	2.00	5.50	167.6	5.3E-04	0.75
	6.00	0.5	30	360	2.03	5.47	166.7	4.0E-04	0.56
	6.50	0.5	30	390	2.07	5.43	165.5	5.3E-04	0.75
	7.00	0.5	30	420	2.10	5.40	164.6	4.0E-04	0.57
	7.50	0.5	30	450	2.12	5.38	164.0	2.7E-04	0.38
	8.00	0.5	30	480	2.17	5.33	162.5	6.8E-04	0.96
	8.50	0.5	30	510	2.22	5.28	160.9	6.8E-04	0.97
	9.00	0.5	30	540	2.24	5.26	160.3	2.8E-04	0.39
	9.50	0.5	30	570	2.28	5.22	159.1	5.5E-04	0.78
	10.00	0.5	30	600	2.30	5.20	158.5	2.8E-04	0.39
	10.50	0.5	30	630	2.34	5.16	157.3	5.6E-04	0.79
	11.00	0.5	30	660	2.37	5.13	156.4	4.2E-04	0.60
	11.50	0.5	30	690	2.40	5.10	155.4	4.3E-04	0.60
	12.00	0.5	30	720	2.43	5.07	154.5	4.3E-04	0.61
	12.50	0.5	30	750	2.45	5.05	153.9	2.9E-04	0.41
	13.00	0.5	30	780	2.51	4.99	152.1	8.7E-04	1.23
	13.50	0.5	30	810	2.53	4.97	151.5	2.9E-04	0.41
	14.00	0.5	30	840	2.56	4.94	150.6	4.4E-04	0.62
	14.50	0.5	30	870	2.58	4.92	150.0	2.9E-04	0.42
	15.00	0.5	30	900	2.60	4.90	149.4	3.0E-04	0.42
							Average =	7.4E-04	1.05
							Geometric Mean =	4.5E-04	0.63

Notes:

1. $k_m = [(pi * D) / (11 * (t_2-t_1))] * \ln(H_1/H_2)$ equation C variable head
   From Foundation Engineering Handbook, 2005 (R. Day) p.4.59 - after Hvorslev, 1951

Prepared/Date:
Checked/Date:

Summary of In-Situ Falling Head Test Data

Test Location :	SB-32	
Ground Surface Elevation =	201	ft
Length of Casing	10.5	ft
Bottom Elevation of Casing =	192	ft (approx)
Diameter of Casing, D =	0.25	ft

Date	Time (min)	Elapsed Time from Previous Reading ($t_2 - t_1$) (min)	Elapsed Time from Previous Reading ($t_2 - t_1$) (sec)	Cumulative Time (sec)	Depth to Water (from TOC) (ft)	Measured Head H_1 or H_2 (ft of water)	Measured Head H_1 or H_2 (cm of water)	Mean Permeability [1] k_m (cm/sec)	Mean Permeability [1] k_m (in/hr)
	0.00			-	0.00	10.50	320.0	-	-
	0.50	0.5	30	30	2.38	8.12	247.5	1.9E-02	26.43
	1.00	0.5	30	60	2.41	8.09	246.6	2.7E-04	0.38
	1.50	0.5	30	90	2.51	7.99	243.5	9.0E-04	1.28
	2.00	0.5	30	120	2.62	7.88	240.2	1.0E-03	1.43
	2.50	0.5	30	150	2.74	7.76	236.5	1.1E-03	1.58
	3.00	0.5	30	180	2.79	7.71	235.0	4.7E-04	0.66
	3.50	0.5	30	210	2.82	7.68	234.1	2.8E-04	0.40
	4.00	0.5	30	240	2.89	7.61	232.0	6.6E-04	0.94
	4.50	0.5	30	270	2.98	7.52	229.2	8.6E-04	1.22
	5.00	0.5	30	300	3.03	7.47	227.7	4.8E-04	0.69
	5.50	0.5	30	330	3.11	7.39	225.2	7.8E-04	1.11
	6.00	0.5	30	360	3.19	7.31	222.8	7.9E-04	1.12
	6.50	0.5	30	390	3.25	7.25	221.0	6.0E-04	0.85
	7.00	0.5	30	420	3.30	7.20	219.5	5.0E-04	0.71
2/16/2017	7.50	0.5	30	450	3.34	7.16	218.2	4.0E-04	0.57
	8.00	0.5	30	480	3.39	7.11	216.7	5.1E-04	0.72
	8.50	0.5	30	510	3.42	7.08	215.8	3.1E-04	0.43
	9.00	0.5	30	540	3.46	7.04	214.6	4.1E-04	0.58
	9.50	0.5	30	570	3.51	6.99	213.1	5.2E-04	0.73
	10.00	0.5	30	600	3.56	6.94	211.5	5.2E-04	0.74
	10.50	0.5	30	630	3.60	6.90	210.3	4.2E-04	0.59
	11.00	0.5	30	660	3.65	6.85	208.8	5.3E-04	0.75
	11.50	0.5	30	690	3.69	6.81	207.6	4.2E-04	0.60
	12.00	0.5	30	720	3.73	6.77	206.3	4.3E-04	0.61
	12.50	0.5	30	750	3.78	6.72	204.8	5.4E-04	0.76
	13.00	0.5	30	780	3.81	6.69	203.9	3.2E-04	0.46
	13.50	0.5	30	810	3.85	6.65	202.7	4.4E-04	0.62
	14.00	0.5	30	840	3.89	6.61	201.5	4.4E-04	0.62
	14.50	0.5	30	870	3.91	6.59	200.9	2.2E-04	0.31
	15.00	0.5	30	900	3.98	6.52	198.7	7.7E-04	1.10
							Average =	1.2E-03	1.63
							Geometric Mean =	5.7E-04	0.81

Notes:

1. $k_m = [(pi * D) / (11 * (t_2-t_1))] * \ln(H_1/H_2)$ equation C variable head
   From Foundation Engineering Handbook, 2005 (R. Day) p.4.59 - after Hvorslev, 1951

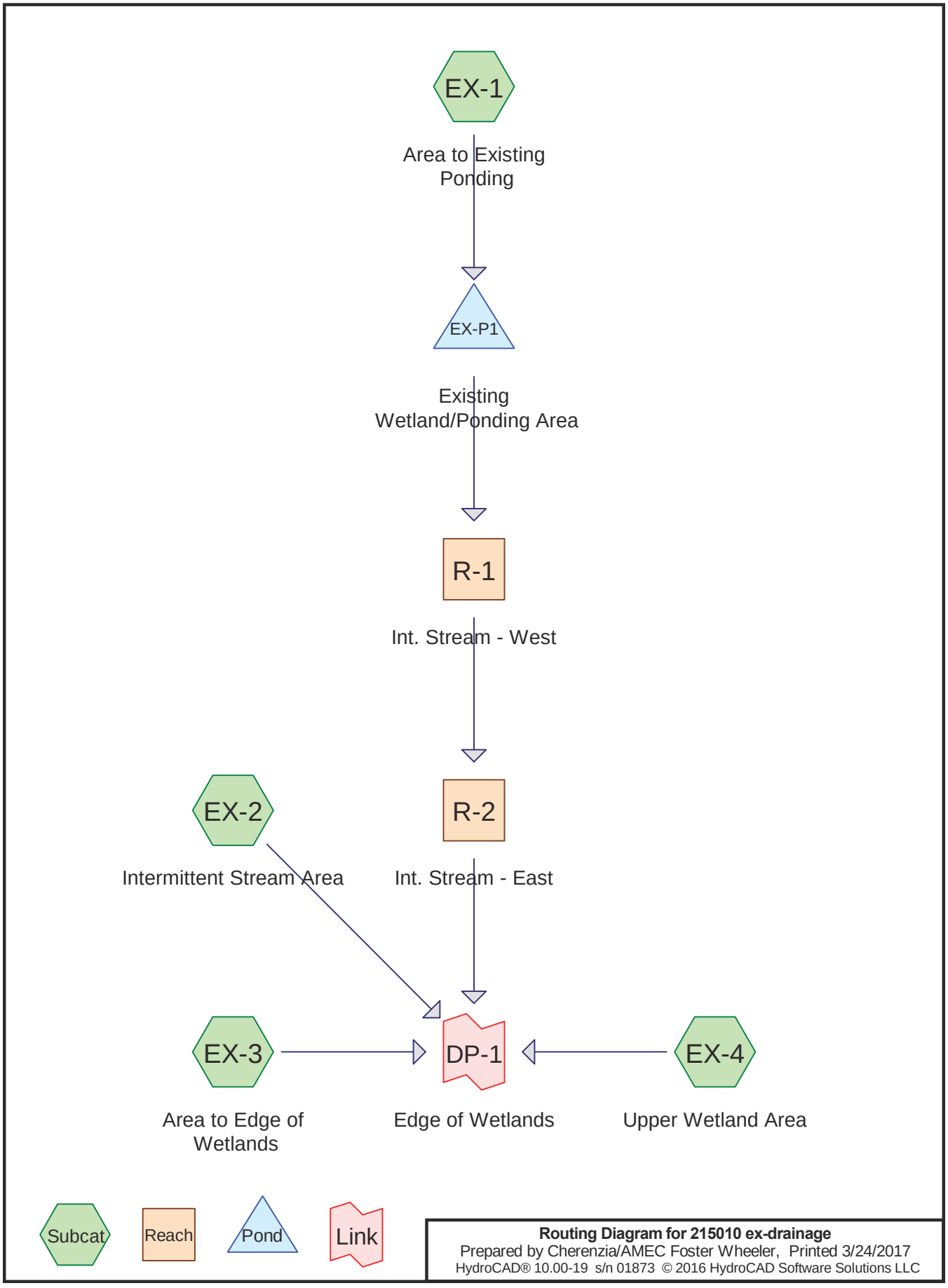
Prepared/Date:
Checked/Date:

APPENDIX C:

HydroCAD Analyses

APPENDIX C.1:

Existing HydroCAD Analysis


EX-1
Area to Existing Ponding
EX-P1
Existing Wetland/Ponding Area
R-1
Int. Stream - West
EX-2
Intermittent Stream Area
R-2
Int. Stream - East
EX-3
Area to Edge of Wetlands
DP-1
Edge of Wetlands
EX-4
Upper Wetland Area
Subcat
Reach
Pond
Link
Routing Diagram for 215010 ex-drainage
Prepared by Cherenzia/AMEC Foster Wheeler, Printed 3/24/2017
HydroCAD® 10.00-19 s/n 01873 © 2016 HydroCAD Software Solutions LLC

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX-1: Area to Existing Ponding Runoff Area=528,968 sf 6.38% Impervious Runoff Depth=0.79"
Flow Length=265' Tc=6.7 min CN=68 Runoff=9.51 cfs 0.797 af

Subcatchment EX-2: Intermittent Stream Area Runoff Area=1,211,380 sf 3.92% Impervious Runoff Depth=0.84"
Flow Length=1,634' Tc=44.0 min CN=69 Runoff=11.36 cfs 1.939 af

Subcatchment EX-3: Area to Edge of Wetlands Runoff Area=853,066 sf 0.00% Impervious Runoff Depth=0.28"
Flow Length=1,410' Tc=33.5 min CN=55 Runoff=1.69 cfs 0.459 af

Subcatchment EX-4: Upper Wetland Area Runoff Area=881,678 sf 0.00% Impervious Runoff Depth=0.49"
Flow Length=1,620' Tc=67.8 min CN=61 Runoff=2.96 cfs 0.819 af

Reach R-1: Int. Stream - West Avg. Flow Depth=0.48' Max Vel=1.92 fps Inflow=3.11 cfs 0.288 af
n=0.040 L=995.0' S=0.0130 '/' Capacity=49.86 cfs Outflow=2.38 cfs 0.288 af

Reach R-2: Int. Stream - East Avg. Flow Depth=0.35' Max Vel=2.88 fps Inflow=2.38 cfs 0.288 af
n=0.040 L=715.0' S=0.0427 '/' Capacity=90.44 cfs Outflow=2.29 cfs 0.288 af

Pond EX-P1: Existing Wetland/Ponding Area Peak Elev=236.07' Storage=1,652 cf Inflow=9.51 cfs 0.797 af
Discarded=5.48 cfs 0.509 af Primary=3.11 cfs 0.288 af Outflow=8.59 cfs 0.797 af

Link DP-1: Edge of Wetlands Inflow=16.89 cfs 3.505 af
Primary=16.89 cfs 3.505 af

Total Runoff Area = 79.777 ac Runoff Volume = 4.013 af Average Runoff Depth = 0.60"
97.66% Pervious = 77.913 ac 2.34% Impervious = 1.864 ac

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX-1: Area to Existing Ponding Runoff Area=528,968 sf 6.38% Impervious Runoff Depth=1.81"
Flow Length=265' Tc=6.7 min CN=68 Runoff=24.35 cfs 1.830 af

Subcatchment EX-2: Intermittent Stream Area Runoff Area=1,211,380 sf 3.92% Impervious Runoff Depth=1.89"
Flow Length=1,634' Tc=44.0 min CN=69 Runoff=27.97 cfs 4.368 af

Subcatchment EX-3: Area to Edge of Wetlands Runoff Area=853,066 sf 0.00% Impervious Runoff Depth=0.93"
Flow Length=1,410' Tc=33.5 min CN=55 Runoff=9.20 cfs 1.519 af

Subcatchment EX-4: Upper Wetland Area Runoff Area=881,678 sf 0.00% Impervious Runoff Depth=1.31"
Flow Length=1,620' Tc=67.8 min CN=61 Runoff=10.12 cfs 2.209 af

Reach R-1: Int. Stream - West Avg. Flow Depth=0.78' Max Vel=2.63 fps Inflow=8.16 cfs 0.662 af
n=0.040 L=995.0' S=0.0130 '/' Capacity=49.86 cfs Outflow=6.84 cfs 0.662 af

Reach R-2: Int. Stream - East Avg. Flow Depth=0.58' Max Vel=3.95 fps Inflow=6.84 cfs 0.662 af
n=0.040 L=715.0' S=0.0427 '/' Capacity=90.44 cfs Outflow=6.60 cfs 0.662 af

Pond EX-P1: Existing Wetland/Ponding Area Peak Elev=236.14' Storage=3,632 cf Inflow=24.35 cfs 1.830 af
Discarded=14.39 cfs 1.168 af Primary=8.16 cfs 0.662 af Outflow=22.55 cfs 1.830 af

Link DP-1: Edge of Wetlands Inflow=48.43 cfs 8.758 af
Primary=48.43 cfs 8.758 af

Total Runoff Area = 79.777 ac Runoff Volume = 9.926 af Average Runoff Depth = 1.49"
97.66% Pervious = 77.913 ac 2.34% Impervious = 1.864 ac

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX-1: Area to Existing Ponding Runoff Area=528,968 sf 6.38% Impervious Runoff Depth=2.70"
Flow Length=265' Tc=6.7 min CN=68 Runoff=37.12 cfs 2.730 af

Subcatchment EX-2: Intermittent Stream Area Runoff Area=1,211,380 sf 3.92% Impervious Runoff Depth=2.79"
Flow Length=1,634' Tc=44.0 min CN=69 Runoff=42.17 cfs 6.468 af

Subcatchment EX-3: Area to Edge of Wetlands Runoff Area=853,066 sf 0.00% Impervious Runoff Depth=1.58"
Flow Length=1,410' Tc=33.5 min CN=55 Runoff=17.41 cfs 2.571 af

Subcatchment EX-4: Upper Wetland Area Runoff Area=881,678 sf 0.00% Impervious Runoff Depth=2.07"
Flow Length=1,620' Tc=67.8 min CN=61 Runoff=16.95 cfs 3.496 af

Reach R-1: Int. Stream - West Avg. Flow Depth=0.97' Max Vel=3.01 fps Inflow=12.50 cfs 0.988 af
n=0.040 L=995.0' S=0.0130 '/' Capacity=49.86 cfs Outflow=10.81 cfs 0.988 af

Reach R-2: Int. Stream - East Avg. Flow Depth=0.72' Max Vel=4.54 fps Inflow=10.81 cfs 0.988 af
n=0.040 L=715.0' S=0.0427 '/' Capacity=90.44 cfs Outflow=10.48 cfs 0.988 af

Pond EX-P1: Existing Wetland/Ponding Area Peak Elev=236.18' Storage=5,249 cf Inflow=37.12 cfs 2.730 af
Discarded=22.02 cfs 1.742 af Primary=12.50 cfs 0.988 af Outflow=34.52 cfs 2.730 af

Link DP-1: Edge of Wetlands Inflow=77.50 cfs 13.523 af
Primary=77.50 cfs 13.523 af

Total Runoff Area = 79.777 ac Runoff Volume = 15.265 af Average Runoff Depth = 2.30"
97.66% Pervious = 77.913 ac 2.34% Impervious = 1.864 ac

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX-1: Area to Existing Ponding Runoff Area=528,968 sf 6.38% Impervious Runoff Depth=4.74"
Flow Length=265' Tc=6.7 min CN=68 Runoff=65.94 cfs 4.801 af

Subcatchment EX-2: Intermittent Stream Area Runoff Area=1,211,380 sf 3.92% Impervious Runoff Depth=4.86"
Flow Length=1,634' Tc=44.0 min CN=69 Runoff=74.27 cfs 11.272 af

Subcatchment EX-3: Area to Edge of Wetlands Runoff Area=853,066 sf 0.00% Impervious Runoff Depth=3.20"
Flow Length=1,410' Tc=33.5 min CN=55 Runoff=38.20 cfs 5.225 af

Subcatchment EX-4: Upper Wetland Area Runoff Area=881,678 sf 0.00% Impervious Runoff Depth=3.91"
Flow Length=1,620' Tc=67.8 min CN=61 Runoff=33.34 cfs 6.592 af

Reach R-1: Int. Stream - West Avg. Flow Depth=1.29' Max Vel=3.60 fps Inflow=22.28 cfs 1.737 af
n=0.040 L=995.0' S=0.0130 '/' Capacity=49.86 cfs Outflow=19.93 cfs 1.737 af

Reach R-2: Int. Stream - East Avg. Flow Depth=0.96' Max Vel=5.44 fps Inflow=19.93 cfs 1.737 af
n=0.040 L=715.0' S=0.0427 '/' Capacity=90.44 cfs Outflow=19.44 cfs 1.737 af

Pond EX-P1: Existing Wetland/Ponding Area Peak Elev=236.26' Storage=8,841 cf Inflow=65.94 cfs 4.801 af
Discarded=39.20 cfs 3.063 af Primary=22.28 cfs 1.737 af Outflow=61.48 cfs 4.801 af

Link DP-1: Edge of Wetlands Inflow=145.80 cfs 24.827 af
Primary=145.80 cfs 24.827 af

Total Runoff Area = 79.777 ac Runoff Volume = 27.890 af Average Runoff Depth = 4.20"
97.66% Pervious = 77.913 ac 2.34% Impervious = 1.864 ac

Summary for Subcatchment EX-1: Area to Existing Ponding

Runoff = 65.94 cfs @ 12.10 hrs, Volume= 4.801 af, Depth= 4.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr NEWP 100-YR Rainfall=8.60"

Area (sf)	CN	Description
218,538	55	Woods, Good, HSG B
141,671	77	Woods, Good, HSG D
18,095	68	1 acre lots, 20% imp, HSG B
150,664	79	1 acre lots, 20% imp, HSG C
528,968	68	Weighted Average
495,216		93.62% Pervious Area
33,752		6.38% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	50	0.0400	0.20		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.30"
0.7	91	0.1033	2.25		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.2	91	0.0330	1.27		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.6	33	0.0303	0.87		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.7	265	Total			

Summary for Subcatchment EX-2: Intermittent Stream Area

Runoff = 74.27 cfs @ 12.61 hrs, Volume= 11.272 af, Depth= 4.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr NEWP 100-YR Rainfall=8.60"

	Area (sf)	CN	Description
	82,157	30	Woods, Good, HSG A
	147,316	55	Woods, Good, HSG B
	418,623	70	Woods, Good, HSG C
	342,099	77	Woods, Good, HSG D
	205,945	79	1 acre lots, 20% imp, HSG C
	8,992	74	>75% Grass cover, Good, HSG C
*	6,248	98	Impervious surface
	1,211,380	69	Weighted Average
	1,163,943		96.08% Pervious Area
	47,437		3.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	50	0.0408	0.09		**Sheet Flow, TOC-1** Woods: Light underbrush n= 0.400 P2= 3.30"
8.1	50	0.0549	0.10		**Sheet Flow, TOC-2** Woods: Light underbrush n= 0.400 P2= 3.30"
1.2	126	0.1206	1.74		**Shallow Concentrated Flow, TOC-3** Woodland Kv= 5.0 fps
1.6	113	0.0531	1.15		**Shallow Concentrated Flow, TOC-4** Woodland Kv= 5.0 fps
15.6	733	0.0246	0.78		**Shallow Concentrated Flow, TOC-5** Woodland Kv= 5.0 fps
2.7	208	0.0673	1.30		**Shallow Concentrated Flow, TOC-6** Woodland Kv= 5.0 fps
3.6	203	0.0345	0.93		**Shallow Concentrated Flow, TOC-7** Woodland Kv= 5.0 fps
2.1	151	0.0583	1.21		**Shallow Concentrated Flow, TOC-8** Woodland Kv= 5.0 fps
44.0	1,634	Total			

Summary for Subcatchment EX-3: Area to Edge of Wetlands

Runoff = 38.20 cfs @ 12.50 hrs, Volume= 5.225 af, Depth= 3.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr NEWP 100-YR Rainfall=8.60"

Area (sf)	CN	Description
843,203	55	Woods, Good, HSG B
9,863	70	Woods, Good, HSG C
853,066	55	Weighted Average
853,066		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	50	0.0400	0.09		**Sheet Flow, TOC-1** Woods: Light underbrush n= 0.400 P2= 3.30"
5.0	177	0.0141	0.59		**Shallow Concentrated Flow, TOC-2** Woodland Kv= 5.0 fps
3.3	221	0.0498	1.12		**Shallow Concentrated Flow, TOC-3** Woodland Kv= 5.0 fps
5.3	352	0.0483	1.10		**Shallow Concentrated Flow, TOC-4** Woodland Kv= 5.0 fps
7.8	403	0.0298	0.86		**Shallow Concentrated Flow, TOC-5** Woodland Kv= 5.0 fps
2.9	207	0.0580	1.20		**Shallow Concentrated Flow, TOC-6** Woodland Kv= 5.0 fps
33.5	1,410	Total			

Summary for Subcatchment EX-4: Upper Wetland Area

Runoff = 33.34 cfs @ 12.95 hrs, Volume= 6.592 af, Depth= 3.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr NEWP 100-YR Rainfall=8.60"

Area (sf)	CN	Description
612,660	55	Woods, Good, HSG B
62,103	70	Woods, Good, HSG C
206,915	77	Woods, Good, HSG D
881,678	61	Weighted Average
881,678		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.9	50	0.0037	0.03		**Sheet Flow, TOC-1** Woods: Light underbrush n= 0.400 P2= 3.30"
24.1	440	0.0037	0.30		**Shallow Concentrated Flow, TOC-2** Woodland Kv= 5.0 fps
10.5	565	0.0319	0.89		**Shallow Concentrated Flow, TOC-3** Woodland Kv= 5.0 fps
3.5	288	0.0764	1.38		**Shallow Concentrated Flow, TOC-4** Woodland Kv= 5.0 fps
5.8	277	0.0253	0.80		**Shallow Concentrated Flow, TOC-5** Woodland Kv= 5.0 fps
67.8	1,620	Total			

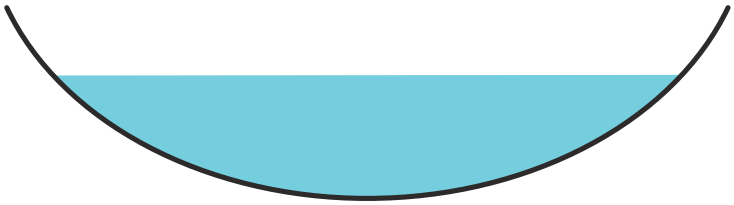
Summary for Reach R-1: Int. Stream - West

Inflow Area = 12.143 ac, 6.38% Impervious, Inflow Depth = 1.72" for NEWP 100-YR event
Inflow = 22.28 cfs @ 12.13 hrs, Volume= 1.737 af
Outflow = 19.93 cfs @ 12.26 hrs, Volume= 1.737 af, Atten= 11%, Lag= 7.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.60 fps, Min. Travel Time= 4.6 min
Avg. Velocity = 1.01 fps, Avg. Travel Time= 16.4 min

Peak Storage= 5,516 cf @ 12.18 hrs
Average Depth at Peak Storage= 1.29'
Bank-Full Depth= 2.00' Flow Area= 10.7 sf, Capacity= 49.86 cfs

8.00' x 2.00' deep Parabolic Channel, n= 0.040 Winding stream, pools & shoals
Length= 995.0' Slope= 0.0130 '/'
Inlet Invert= 232.90', Outlet Invert= 220.00'



Summary for Reach R-2: Int. Stream - East

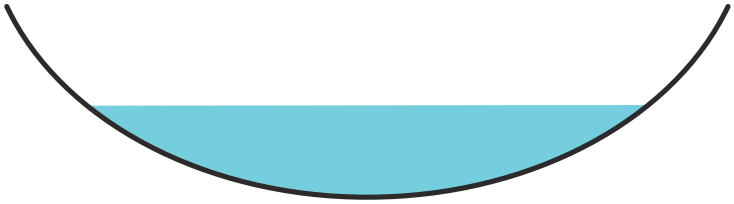
[61] Hint: Exceeded Reach R-1 outlet invert by 0.46' @ 12.29 hrs

Inflow Area = 12.143 ac, 6.38% Impervious, Inflow Depth = 1.72" for NEWP 100-YR event
Inflow = 19.93 cfs @ 12.26 hrs, Volume= 1.737 af
Outflow = 19.44 cfs @ 12.32 hrs, Volume= 1.737 af, Atten= 2%, Lag= 3.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.44 fps, Min. Travel Time= 2.2 min
Avg. Velocity = 1.56 fps, Avg. Travel Time= 7.6 min

Peak Storage= 2,554 cf @ 12.29 hrs
Average Depth at Peak Storage= 0.96'
Bank-Full Depth= 2.00' Flow Area= 10.7 sf, Capacity= 90.44 cfs

8.00' x 2.00' deep Parabolic Channel, n= 0.040 Mountain streams
Length= 715.0' Slope= 0.0427 '/'
Inlet Invert= 219.50', Outlet Invert= 189.00'



Summary for Pond EX-P1: Existing Wetland/Ponding Area

Inflow Area = 12.143 ac, 6.38% Impervious, Inflow Depth = 4.74" for NEWP 100-YR event
Inflow = 65.94 cfs @ 12.10 hrs, Volume= 4.801 af
Outflow = 61.48 cfs @ 12.13 hrs, Volume= 4.801 af, Atten= 7%, Lag= 2.0 min
Discarded = 39.20 cfs @ 12.13 hrs, Volume= 3.063 af
Primary = 22.28 cfs @ 12.13 hrs, Volume= 1.737 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 236.26' @ 12.13 hrs Surf.Area= 48,187 sf Storage= 8,841 cf

Plug-Flow detention time= 3.3 min calculated for 4.800 af (100% of inflow)
Center-of-Mass det. time= 3.3 min (829.7 - 826.4)

Volume	Invert	Avail.Storage	Storage Description
#1	236.00'	816,551 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
236.00	18,822	0	0
238.00	241,386	260,208	260,208
240.00	314,957	556,343	816,551

Device	Routing	Invert	Outlet Devices
#1	Primary	236.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 2.00 4.00 Width (feet) 47.00 105.00 248.00
#2	Discarded	236.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 2.00 4.00 Width (feet) 83.00 179.00 270.00

Discarded OutFlow Max=39.08 cfs @ 12.13 hrs HW=236.26' (Free Discharge)
↑—**2=Custom Weir/Orifice** (Weir Controls 39.08 cfs @ 1.66 fps)

Primary OutFlow Max=22.21 cfs @ 12.13 hrs HW=236.26' (Free Discharge)
↑—**1=Custom Weir/Orifice** (Weir Controls 22.21 cfs @ 1.66 fps)

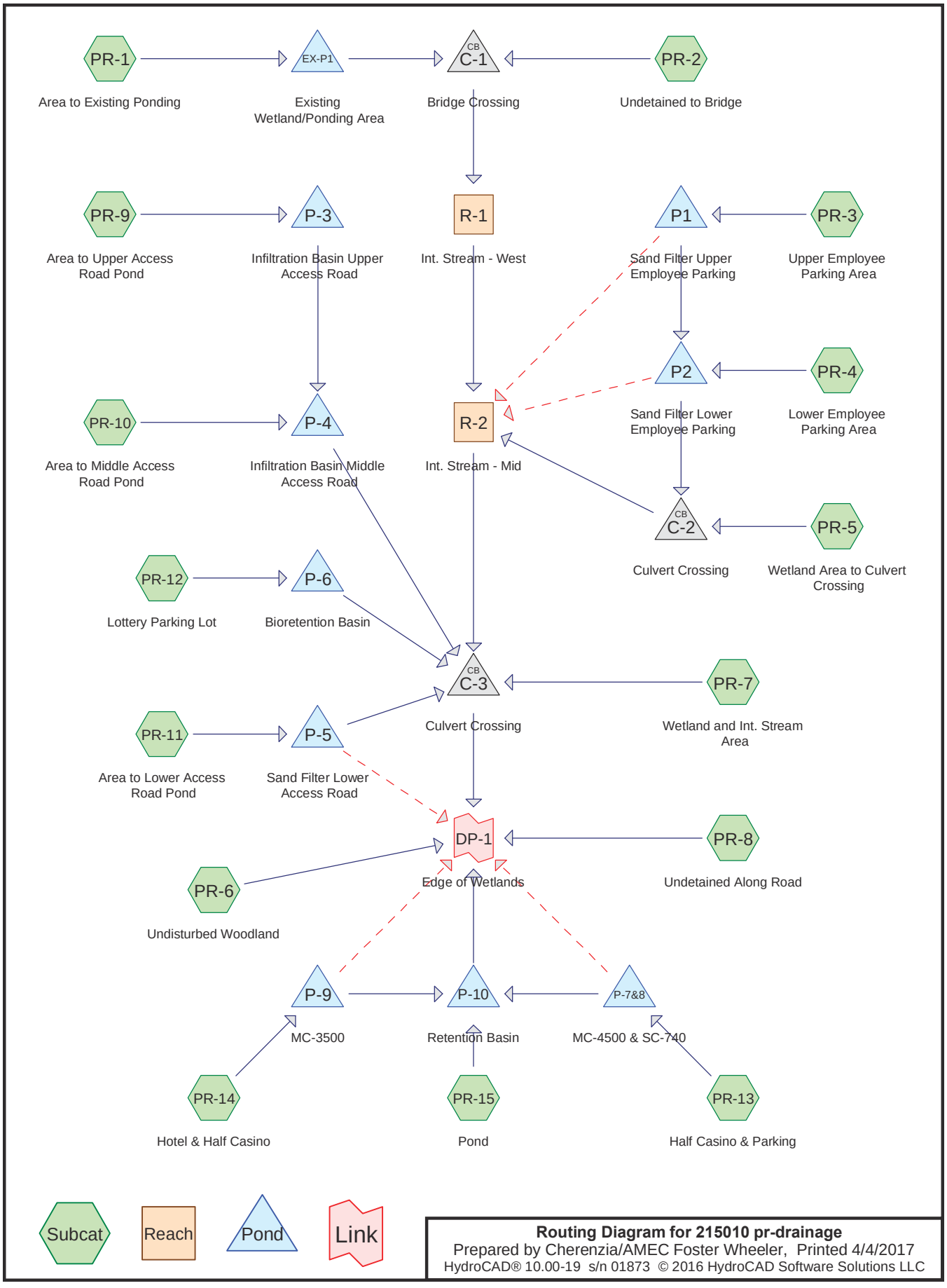
Summary for Link DP-1: Edge of Wetlands

Inflow Area = 79.777 ac, 2.34% Impervious, Inflow Depth = 3.73" for NEWP 100-YR event
Inflow = 145.80 cfs @ 12.57 hrs, Volume= 24.827 af
Primary = 145.80 cfs @ 12.57 hrs, Volume= 24.827 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

APPENDIX C.2:

Proposed HydroCAD Analysis



Routing Diagram for 215010 pr-drainage
Prepared by Cherenzia/AMEC Foster Wheeler, Printed 4/4/2017

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points x 2
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment PR-1: Area to Existing Runoff Area=528,968 sf 6.38% Impervious Runoff Depth=0.59"
Flow Length=265' Tc=6.7 min CN=66/98 Runoff=6.12 cfs 0.595 af

Subcatchment PR-10: Area to Middle Runoff Area=25,242 sf 25.60% Impervious Runoff Depth=1.24"
Tc=6.0 min CN=74/98 Runoff=0.76 cfs 0.060 af

Subcatchment PR-11: Area to Lower Runoff Area=44,094 sf 44.73% Impervious Runoff Depth=1.58"
Tc=6.0 min CN=74/98 Runoff=1.69 cfs 0.133 af

Subcatchment PR-12: Lottery Parking Lot Runoff Area=20,529 sf 48.72% Impervious Runoff Depth=1.40"
Tc=6.0 min CN=61/98 Runoff=0.65 cfs 0.055 af

Subcatchment PR-13: Half Casino & Runoff Area=432,344 sf 74.31% Impervious Runoff Depth=2.00"
Tc=6.0 min CN=63/98 Runoff=20.47 cfs 1.654 af

Subcatchment PR-14: Hotel & Half Casino Runoff Area=81,163 sf 86.97% Impervious Runoff Depth=2.27"
Tc=6.0 min CN=61/98 Runoff=4.41 cfs 0.353 af

Subcatchment PR-15: Pond Runoff Area=38,836 sf 0.00% Impervious Runoff Depth=0.29"
Tc=6.0 min CN=61/0 Runoff=0.14 cfs 0.022 af

Subcatchment PR-2: Undetained to Bridge Runoff Area=32,986 sf 11.54% Impervious Runoff Depth=0.95"
Tc=6.0 min CN=73/98 Runoff=0.75 cfs 0.060 af

Subcatchment PR-3: Upper Employee Runoff Area=40,272 sf 61.76% Impervious Runoff Depth=1.70"
Tc=6.0 min CN=61/98 Runoff=1.58 cfs 0.131 af

Subcatchment PR-4: Lower Employee Runoff Area=62,404 sf 75.87% Impervious Runoff Depth=2.03"
Tc=6.0 min CN=63/98 Runoff=3.01 cfs 0.243 af

Subcatchment PR-5: Wetland Area to Runoff Area=621,690 sf 0.00% Impervious Runoff Depth=0.32"
Flow Length=889' Tc=72.1 min CN=62/0 Runoff=1.17 cfs 0.383 af

Subcatchment PR-6: Undisturbed Runoff Area=444,734 sf 0.00% Impervious Runoff Depth=0.17"
Flow Length=1,373' Tc=27.4 min CN=56/0 Runoff=0.40 cfs 0.141 af

Subcatchment PR-7: Wetland and Int. Runoff Area=980,976 sf 3.75% Impervious Runoff Depth=0.68"
Flow Length=1,483' Tc=41.9 min CN=70/98 Runoff=7.30 cfs 1.275 af

Subcatchment PR-8: Undetained Along Runoff Area=6,285 sf 60.73% Impervious Runoff Depth=1.68"
Flow Length=945' Tc=14.6 min CN=61/98 Runoff=0.19 cfs 0.020 af

Subcatchment PR-9: Area to Upper Runoff Area=114,552 sf 33.43% Impervious Runoff Depth=0.94"
Tc=6.0 min CN=54/98 Runoff=2.38 cfs 0.206 af

Reach R-1: Int. Stream - West Avg. Flow Depth=0.44' Max Vel=1.83 fps Inflow=2.60 cfs 0.275 af
n=0.040 L=995.0' S=0.0130 '/' Capacity=49.86 cfs Outflow=2.01 cfs 0.275 af

Reach R-2: Int. Stream - Mid Avg. Flow Depth=0.35' Max Vel=2.86 fps Inflow=2.29 cfs 1.031 af
n=0.040 L=715.0' S=0.0427 '/' Capacity=90.49 cfs Outflow=2.24 cfs 1.031 af

Pond C-1: Bridge Crossing Peak Elev=233.73' Inflow=2.60 cfs 0.275 af
Outflow=2.60 cfs 0.275 af

Pond C-2: Culvert Crossing Peak Elev=224.03' Inflow=1.17 cfs 0.383 af
36.0" Round Culvert n=0.012 L=50.0' S=0.0060 '/' Outflow=1.17 cfs 0.383 af

Pond C-3: Culvert Crossing Peak Elev=187.53' Inflow=9.18 cfs 2.321 af
120.0" x 36.0" Box Culvert n=0.022 L=46.0' S=0.0413 '/' Outflow=9.18 cfs 2.321 af

Pond EX-P1: Existing Wetland/Ponding Area Peak Elev=236.05' Storage=1,188 cf Inflow=6.12 cfs 0.595 af
Discarded=3.49 cfs 0.380 af Primary=1.98 cfs 0.215 af Outflow=5.47 cfs 0.595 af

Pond P-10: Retention Basin Peak Elev=183.94' Storage=18,619 cf Inflow=10.89 cfs 0.627 af
Outflow=0.61 cfs 0.627 af

Pond P-3: Infiltration Basin Upper Access Peak Elev=208.07' Storage=489 cf Inflow=2.38 cfs 0.206 af
Discarded=1.30 cfs 0.207 af Primary=0.00 cfs 0.000 af Outflow=1.30 cfs 0.207 af

Pond P-4: Infiltration Basin Middle Access Road Peak Elev=202.00' Storage=0 cf Inflow=0.76 cfs 0.060 af
Discarded=0.76 cfs 0.060 af Primary=0.00 cfs 0.000 af Outflow=0.76 cfs 0.060 af

Pond P-5: Sand Filter Lower Access Road Peak Elev=188.07' Storage=2,219 cf Inflow=1.69 cfs 0.133 af
Primary=0.00 cfs 0.000 af Secondary=0.12 cfs 0.133 af Outflow=0.12 cfs 0.133 af

Pond P-6: Bioretention Basin Peak Elev=217.43' Storage=2,206 cf Inflow=0.65 cfs 0.055 af
Outflow=0.00 cfs 0.015 af

Pond P-7&8: MC-4500 & SC-740 Peak Elev=192.75' Storage=29,414 cf Inflow=20.47 cfs 1.654 af
Primary=10.76 cfs 0.529 af Secondary=0.33 cfs 1.125 af Outflow=11.10 cfs 1.654 af

Pond P-9: MC-3500 Peak Elev=205.98' Storage=6,433 cf Inflow=4.41 cfs 0.353 af
Primary=1.41 cfs 0.077 af Secondary=0.11 cfs 0.276 af Outflow=1.52 cfs 0.353 af

Pond P1: Sand Filter Upper Employee Peak Elev=230.56' Storage=1,904 cf Inflow=1.58 cfs 0.131 af
Primary=0.00 cfs 0.000 af Secondary=0.15 cfs 0.131 af Outflow=0.15 cfs 0.131 af

Pond P2: Sand Filter Lower Employee Peak Elev=229.48' Storage=6,087 cf Inflow=3.01 cfs 0.243 af
Primary=0.00 cfs 0.000 af Secondary=0.10 cfs 0.243 af Outflow=0.10 cfs 0.243 af

Link DP-1: Edge of Wetlands Inflow=10.57 cfs 4.644 af
Primary=10.57 cfs 4.644 af

Total Runoff Area = 79.777 ac Runoff Volume = 5.331 af Average Runoff Depth = 0.80"
82.25% Pervious = 65.619 ac 17.75% Impervious = 14.158 ac

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points x 2
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment PR-1: Area to Existing Runoff Area=528,968 sf 6.38% Impervious Runoff Depth=0.85"
Flow Length=265' Tc=6.7 min CN=66/98 Runoff=9.82 cfs 0.856 af

Subcatchment PR-10: Area to Middle Runoff Area=25,242 sf 25.60% Impervious Runoff Depth=1.61"
Tc=6.0 min CN=74/98 Runoff=1.01 cfs 0.078 af

Subcatchment PR-11: Area to Lower Runoff Area=44,094 sf 44.73% Impervious Runoff Depth=1.98"
Tc=6.0 min CN=74/98 Runoff=2.14 cfs 0.167 af

Subcatchment PR-12: Lottery Parking Lot Runoff Area=20,529 sf 48.72% Impervious Runoff Depth=1.74"
Tc=6.0 min CN=61/98 Runoff=0.82 cfs 0.068 af

Subcatchment PR-13: Half Casino & Runoff Area=432,344 sf 74.31% Impervious Runoff Depth=2.42"
Tc=6.0 min CN=63/98 Runoff=24.82 cfs 2.005 af

Subcatchment PR-14: Hotel & Half Casino Runoff Area=81,163 sf 86.97% Impervious Runoff Depth=2.73"
Tc=6.0 min CN=61/98 Runoff=5.28 cfs 0.424 af

Subcatchment PR-15: Pond Runoff Area=38,836 sf 0.00% Impervious Runoff Depth=0.49"
Tc=6.0 min CN=61/0 Runoff=0.33 cfs 0.036 af

Subcatchment PR-2: Undetained to Bridge Runoff Area=32,986 sf 11.54% Impervious Runoff Depth=1.28"
Tc=6.0 min CN=73/98 Runoff=1.05 cfs 0.081 af

Subcatchment PR-3: Upper Employee Runoff Area=40,272 sf 61.76% Impervious Runoff Depth=2.08"
Tc=6.0 min CN=61/98 Runoff=1.95 cfs 0.160 af

Subcatchment PR-4: Lower Employee Runoff Area=62,404 sf 75.87% Impervious Runoff Depth=2.46"
Tc=6.0 min CN=63/98 Runoff=3.64 cfs 0.294 af

Subcatchment PR-5: Wetland Area to Runoff Area=621,690 sf 0.00% Impervious Runoff Depth=0.52"
Flow Length=889' Tc=72.1 min CN=62/0 Runoff=2.26 cfs 0.624 af

Subcatchment PR-6: Undisturbed Runoff Area=444,734 sf 0.00% Impervious Runoff Depth=0.31"
Flow Length=1,373' Tc=27.4 min CN=56/0 Runoff=1.15 cfs 0.265 af

Subcatchment PR-7: Wetland and Int. Runoff Area=980,976 sf 3.75% Impervious Runoff Depth=0.97"
Flow Length=1,483' Tc=41.9 min CN=70/98 Runoff=11.09 cfs 1.818 af

Subcatchment PR-8: Undetained Along Runoff Area=6,285 sf 60.73% Impervious Runoff Depth=2.05"
Flow Length=945' Tc=14.6 min CN=61/98 Runoff=0.23 cfs 0.025 af

Subcatchment PR-9: Area to Upper Runoff Area=114,552 sf 33.43% Impervious Runoff Depth=1.19"
Tc=6.0 min CN=54/98 Runoff=2.85 cfs 0.261 af

Reach R-1: Int. Stream - West Avg. Flow Depth=0.55' Max Vel=2.12 fps Inflow=4.13 cfs 0.390 af
n=0.040 L=995.0' S=0.0130 '/' Capacity=49.86 cfs Outflow=3.29 cfs 0.390 af

Reach R-2: Int. Stream - Mid Avg. Flow Depth=0.43' Max Vel=3.28 fps Inflow=3.64 cfs 1.468 af
n=0.040 L=715.0' S=0.0427 '/' Capacity=90.49 cfs Outflow=3.54 cfs 1.468 af

Pond C-1: Bridge Crossing Peak Elev=233.78' Inflow=4.13 cfs 0.390 af
Outflow=4.13 cfs 0.390 af

Pond C-2: Culvert Crossing Peak Elev=224.21' Inflow=2.26 cfs 0.624 af
36.0" Round Culvert n=0.012 L=50.0' S=0.0060 '/' Outflow=2.26 cfs 0.624 af

Pond C-3: Culvert Crossing Peak Elev=187.68' Inflow=14.04 cfs 3.302 af
120.0" x 36.0" Box Culvert n=0.022 L=46.0' S=0.0413 '/' Outflow=14.04 cfs 3.302 af

Pond EX-P1: Existing Wetland/Ponding Area Peak Elev=236.08' Storage=1,729 cf Inflow=9.82 cfs 0.856 af
Discarded=5.70 cfs 0.546 af Primary=3.23 cfs 0.309 af Outflow=8.93 cfs 0.856 af

Pond P-10: Retention Basin Peak Elev=184.33' Storage=27,323 cf Inflow=23.38 cfs 1.016 af
Outflow=1.38 cfs 1.015 af

Pond P-3: Infiltration Basin Upper Access Peak Elev=208.12' Storage=867 cf Inflow=2.85 cfs 0.261 af
Discarded=1.32 cfs 0.262 af Primary=0.00 cfs 0.000 af Outflow=1.32 cfs 0.262 af

Pond P-4: Infiltration Basin Middle Access Road Peak Elev=202.00' Storage=0 cf Inflow=1.01 cfs 0.078 af
Discarded=1.00 cfs 0.078 af Primary=0.00 cfs 0.000 af Outflow=1.00 cfs 0.078 af

Pond P-5: Sand Filter Lower Access Road Peak Elev=188.33' Storage=3,067 cf Inflow=2.14 cfs 0.167 af
Primary=0.00 cfs 0.000 af Secondary=0.13 cfs 0.167 af Outflow=0.13 cfs 0.167 af

Pond P-6: Bioretention Basin Peak Elev=217.67' Storage=2,778 cf Inflow=0.82 cfs 0.068 af
Outflow=0.00 cfs 0.016 af

Pond P-7&8: MC-4500 & SC-740 Peak Elev=192.98' Storage=30,049 cf Inflow=24.82 cfs 2.005 af
Primary=22.42 cfs 0.845 af Secondary=0.33 cfs 1.160 af Outflow=22.76 cfs 2.005 af

Pond P-9: MC-3500 Peak Elev=206.09' Storage=6,638 cf Inflow=5.28 cfs 0.424 af
Primary=3.02 cfs 0.135 af Secondary=0.11 cfs 0.289 af Outflow=3.13 cfs 0.424 af

Pond P1: Sand Filter Upper Employee Peak Elev=231.02' Storage=2,538 cf Inflow=1.95 cfs 0.160 af
Primary=0.00 cfs 0.000 af Secondary=0.15 cfs 0.160 af Outflow=0.15 cfs 0.160 af

Pond P2: Sand Filter Lower Employee Peak Elev=229.87' Storage=7,733 cf Inflow=3.64 cfs 0.294 af
Primary=0.00 cfs 0.000 af Secondary=0.11 cfs 0.294 af Outflow=0.11 cfs 0.294 af

Link DP-1: Edge of Wetlands Inflow=16.65 cfs 6.224 af
Primary=16.65 cfs 6.224 af

Total Runoff Area = 79.777 ac Runoff Volume = 7.162 af Average Runoff Depth = 1.08"
82.25% Pervious = 65.619 ac 17.75% Impervious = 14.158 ac

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points x 2
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment PR-1: Area to Existing Runoff Area=528,968 sf 6.38% Impervious Runoff Depth=1.85"
Flow Length=265' Tc=6.7 min CN=66/98 Runoff=24.22 cfs 1.874 af

Subcatchment PR-10: Area to Middle Runoff Area=25,242 sf 25.60% Impervious Runoff Depth=2.89"
Tc=6.0 min CN=74/98 Runoff=1.86 cfs 0.140 af

Subcatchment PR-11: Area to Lower Runoff Area=44,094 sf 44.73% Impervious Runoff Depth=3.35"
Tc=6.0 min CN=74/98 Runoff=3.66 cfs 0.282 af

Subcatchment PR-12: Lottery Parking Lot Runoff Area=20,529 sf 48.72% Impervious Runoff Depth=2.94"
Tc=6.0 min CN=61/98 Runoff=1.43 cfs 0.116 af

Subcatchment PR-13: Half Casino & Runoff Area=432,344 sf 74.31% Impervious Runoff Depth=3.84"
Tc=6.0 min CN=63/98 Runoff=39.30 cfs 3.174 af

Subcatchment PR-14: Hotel & Half Casino Runoff Area=81,163 sf 86.97% Impervious Runoff Depth=4.23"
Tc=6.0 min CN=61/98 Runoff=8.10 cfs 0.656 af

Subcatchment PR-15: Pond Runoff Area=38,836 sf 0.00% Impervious Runoff Depth=1.31"
Tc=6.0 min CN=61/0 Runoff=1.24 cfs 0.097 af

Subcatchment PR-2: Undetained to Bridge Runoff Area=32,986 sf 11.54% Impervious Runoff Depth=2.49"
Tc=6.0 min CN=73/98 Runoff=2.13 cfs 0.157 af

Subcatchment PR-3: Upper Employee Runoff Area=40,272 sf 61.76% Impervious Runoff Depth=3.38"
Tc=6.0 min CN=61/98 Runoff=3.22 cfs 0.260 af

Subcatchment PR-4: Lower Employee Runoff Area=62,404 sf 75.87% Impervious Runoff Depth=3.89"
Tc=6.0 min CN=63/98 Runoff=5.75 cfs 0.464 af

Subcatchment PR-5: Wetland Area to Runoff Area=621,690 sf 0.00% Impervious Runoff Depth=1.38"
Flow Length=889' Tc=72.1 min CN=62/0 Runoff=7.32 cfs 1.638 af

Subcatchment PR-6: Undisturbed Runoff Area=444,734 sf 0.00% Impervious Runoff Depth=0.99"
Flow Length=1,373' Tc=27.4 min CN=56/0 Runoff=5.73 cfs 0.843 af

Subcatchment PR-7: Wetland and Int. Runoff Area=980,976 sf 3.75% Impervious Runoff Depth=2.06"
Flow Length=1,483' Tc=41.9 min CN=70/98 Runoff=25.39 cfs 3.873 af

Subcatchment PR-8: Undetained Along Runoff Area=6,285 sf 60.73% Impervious Runoff Depth=3.35"
Flow Length=945' Tc=14.6 min CN=61/98 Runoff=0.38 cfs 0.040 af

Subcatchment PR-9: Area to Upper Runoff Area=114,552 sf 33.43% Impervious Runoff Depth=2.14"
Tc=6.0 min CN=54/98 Runoff=5.51 cfs 0.469 af

Reach R-1: Int. Stream - West Avg. Flow Depth=0.87' Max Vel=2.81 fps Inflow=10.01 cfs 0.835 af
n=0.040 L=995.0' S=0.0130 '/' Capacity=49.86 cfs Outflow=8.55 cfs 0.835 af

Reach R-2: Int. Stream - Mid Avg. Flow Depth=0.69' Max Vel=4.39 fps Inflow=9.62 cfs 3.197 af
n=0.040 L=715.0' S=0.0427 '/' Capacity=90.49 cfs Outflow=9.40 cfs 3.197 af

Pond C-1: Bridge Crossing Peak Elev=233.91' Inflow=10.01 cfs 0.835 af
Outflow=10.01 cfs 0.835 af

Pond C-2: Culvert Crossing Peak Elev=224.76' Inflow=7.32 cfs 1.638 af
36.0" Round Culvert n=0.012 L=50.0' S=0.0060 '/' Outflow=7.32 cfs 1.638 af

Pond C-3: Culvert Crossing Peak Elev=188.13' Inflow=33.37 cfs 7.101 af
120.0" x 36.0" Box Culvert n=0.022 L=46.0' S=0.0413 '/' Outflow=33.37 cfs 7.101 af

Pond EX-P1: Existing Wetland/Ponding Peak Elev=236.14' Storage=3,642 cf Inflow=24.22 cfs 1.874 af
Discarded=14.31 cfs 1.196 af Primary=8.12 cfs 0.678 af Outflow=22.43 cfs 1.874 af

Pond P-10: Retention Basin Peak Elev=185.41' Storage=53,448 cf Inflow=47.68 cfs 2.398 af
Outflow=6.68 cfs 2.397 af

Pond P-3: Infiltration Basin Upper Access Peak Elev=208.50' Storage=3,609 cf Inflow=5.51 cfs 0.469 af
Discarded=1.46 cfs 0.469 af Primary=0.00 cfs 0.000 af Outflow=1.46 cfs 0.469 af

Pond P-4: Infiltration Basin Middle Access Peak Elev=202.05' Storage=268 cf Inflow=1.86 cfs 0.140 af
Discarded=1.16 cfs 0.140 af Primary=0.00 cfs 0.000 af Outflow=1.16 cfs 0.140 af

Pond P-5: Sand Filter Lower Access Road Peak Elev=189.21' Storage=6,317 cf Inflow=3.66 cfs 0.282 af
Primary=0.00 cfs 0.000 af Secondary=0.15 cfs 0.282 af Outflow=0.15 cfs 0.282 af

Pond P-6: Bioretention Basin Peak Elev=218.20' Storage=4,270 cf Inflow=1.43 cfs 0.116 af
Outflow=0.04 cfs 0.031 af

Pond P-7&8: MC-4500 & SC-740 Peak Elev=193.23' Storage=30,537 cf Inflow=39.30 cfs 3.174 af
Primary=38.81 cfs 1.963 af Secondary=0.33 cfs 1.211 af Outflow=39.15 cfs 3.174 af

Pond P-9: MC-3500 Peak Elev=206.34' Storage=7,072 cf Inflow=8.10 cfs 0.656 af
Primary=7.72 cfs 0.338 af Secondary=0.11 cfs 0.319 af Outflow=7.82 cfs 0.656 af

Pond P1: Sand Filter Upper Employee Peak Elev=231.57' Storage=5,006 cf Inflow=3.22 cfs 0.260 af
Primary=0.00 cfs 0.000 af Secondary=0.17 cfs 0.261 af Outflow=0.17 cfs 0.261 af

Pond P2: Sand Filter Lower Employee Peak Elev=231.00' Storage=13,463 cf Inflow=5.75 cfs 0.464 af
Primary=0.00 cfs 0.000 af Secondary=0.13 cfs 0.464 af Outflow=0.13 cfs 0.464 af

Link DP-1: Edge of Wetlands Inflow=45.97 cfs 12.193 af
Primary=45.97 cfs 12.193 af

Total Runoff Area = 79.777 ac Runoff Volume = 14.082 af Average Runoff Depth = 2.12"
82.25% Pervious = 65.619 ac 17.75% Impervious = 14.158 ac

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points x 2
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment PR-1: Area to Existing Runoff Area=528,968 sf 6.38% Impervious Runoff Depth=2.73"
Flow Length=265' Tc=6.7 min CN=66/98 Runoff=36.66 cfs 2.761 af

Subcatchment PR-10: Area to Middle Runoff Area=25,242 sf 25.60% Impervious Runoff Depth=3.93"
Tc=6.0 min CN=74/98 Runoff=2.54 cfs 0.190 af

Subcatchment PR-11: Area to Lower Runoff Area=44,094 sf 44.73% Impervious Runoff Depth=4.43"
Tc=6.0 min CN=74/98 Runoff=4.85 cfs 0.374 af

Subcatchment PR-12: Lottery Parking Lot Runoff Area=20,529 sf 48.72% Impervious Runoff Depth=3.92"
Tc=6.0 min CN=61/98 Runoff=1.93 cfs 0.154 af

Subcatchment PR-13: Half Casino & Runoff Area=432,344 sf 74.31% Impervious Runoff Depth=4.93"
Tc=6.0 min CN=63/98 Runoff=50.56 cfs 4.080 af

Subcatchment PR-14: Hotel & Half Casino Runoff Area=81,163 sf 86.97% Impervious Runoff Depth=5.37"
Tc=6.0 min CN=61/98 Runoff=10.25 cfs 0.834 af

Subcatchment PR-15: Pond Runoff Area=38,836 sf 0.00% Impervious Runoff Depth=2.07"
Tc=6.0 min CN=61/0 Runoff=2.07 cfs 0.154 af

Subcatchment PR-2: Undetained to Bridge Runoff Area=32,986 sf 11.54% Impervious Runoff Depth=3.48"
Tc=6.0 min CN=73/98 Runoff=3.01 cfs 0.220 af

Subcatchment PR-3: Upper Employee Runoff Area=40,272 sf 61.76% Impervious Runoff Depth=4.41"
Tc=6.0 min CN=61/98 Runoff=4.23 cfs 0.340 af

Subcatchment PR-4: Lower Employee Runoff Area=62,404 sf 75.87% Impervious Runoff Depth=4.99"
Tc=6.0 min CN=63/98 Runoff=7.37 cfs 0.596 af

Subcatchment PR-5: Wetland Area to Runoff Area=621,690 sf 0.00% Impervious Runoff Depth=2.16"
Flow Length=889' Tc=72.1 min CN=62/0 Runoff=12.07 cfs 2.568 af

Subcatchment PR-6: Undisturbed Runoff Area=444,734 sf 0.00% Impervious Runoff Depth=1.66"
Flow Length=1,373' Tc=27.4 min CN=56/0 Runoff=10.56 cfs 1.409 af

Subcatchment PR-7: Wetland and Int. Runoff Area=980,976 sf 3.75% Impervious Runoff Depth=3.00"
Flow Length=1,483' Tc=41.9 min CN=70/98 Runoff=37.42 cfs 5.623 af

Subcatchment PR-8: Undetained Along Runoff Area=6,285 sf 60.73% Impervious Runoff Depth=4.37"
Flow Length=945' Tc=14.6 min CN=61/98 Runoff=0.50 cfs 0.053 af

Subcatchment PR-9: Area to Upper Runoff Area=114,552 sf 33.43% Impervious Runoff Depth=2.96"
Tc=6.0 min CN=54/98 Runoff=7.91 cfs 0.648 af

Reach R-1: Int. Stream - West Avg. Flow Depth=1.06' Max Vel=3.19 fps Inflow=15.03 cfs 1.219 af
n=0.040 L=995.0' S=0.0130 '/' Capacity=49.86 cfs Outflow=13.17 cfs 1.219 af

Reach R-2: Int. Stream - Mid Avg. Flow Depth=0.86' Max Vel=5.05 fps Inflow=15.35 cfs 4.722 af
n=0.040 L=715.0' S=0.0427 '/' Capacity=90.49 cfs Outflow=15.08 cfs 4.722 af

Pond C-1: Bridge Crossing Peak Elev=234.04' Inflow=15.03 cfs 1.219 af
Outflow=15.03 cfs 1.219 af

Pond C-2: Culvert Crossing Peak Elev=225.18' Inflow=12.65 cfs 2.679 af
36.0" Round Culvert n=0.012 L=50.0' S=0.0060 '/' Outflow=12.65 cfs 2.679 af

Pond C-3: Culvert Crossing Peak Elev=188.46' Inflow=51.01 cfs 10.415 af
120.0" x 36.0" Box Culvert n=0.022 L=46.0' S=0.0413 '/' Outflow=51.01 cfs 10.415 af

Pond EX-P1: Existing Wetland/Ponding Peak Elev=236.18' Storage=5,217 cf Inflow=36.66 cfs 2.761 af
Discarded=21.75 cfs 1.762 af Primary=12.35 cfs 0.999 af Outflow=34.10 cfs 2.761 af

Pond P-10: Retention Basin Peak Elev=186.32' Storage=77,758 cf Inflow=61.89 cfs 3.507 af
Outflow=9.67 cfs 3.506 af

Pond P-3: Infiltration Basin Upper Access Peak Elev=208.91' Storage=6,579 cf Inflow=7.91 cfs 0.648 af
Discarded=1.62 cfs 0.648 af Primary=0.00 cfs 0.000 af Outflow=1.62 cfs 0.648 af

Pond P-4: Infiltration Basin Middle Access Peak Elev=202.12' Storage=713 cf Inflow=2.54 cfs 0.190 af
Discarded=1.18 cfs 0.190 af Primary=0.00 cfs 0.000 af Outflow=1.18 cfs 0.190 af

Pond P-5: Sand Filter Lower Access Road Peak Elev=189.87' Storage=9,123 cf Inflow=4.85 cfs 0.374 af
Primary=0.00 cfs 0.000 af Secondary=0.17 cfs 0.374 af Outflow=0.17 cfs 0.374 af

Pond P-6: Bioretention Basin Peak Elev=218.22' Storage=4,303 cf Inflow=1.93 cfs 0.154 af
Outflow=0.20 cfs 0.069 af

Pond P-7&8: MC-4500 & SC-740 Peak Elev=193.38' Storage=30,819 cf Inflow=50.56 cfs 4.080 af
Primary=50.06 cfs 2.849 af Secondary=0.33 cfs 1.231 af Outflow=50.39 cfs 4.080 af

Pond P-9: MC-3500 Peak Elev=206.44' Storage=7,231 cf Inflow=10.25 cfs 0.834 af
Primary=9.86 cfs 0.504 af Secondary=0.11 cfs 0.330 af Outflow=9.96 cfs 0.834 af

Pond P1: Sand Filter Upper Employee Peak Elev=232.01' Storage=7,221 cf Inflow=4.23 cfs 0.340 af
Primary=0.00 cfs 0.000 af Secondary=0.19 cfs 0.340 af Outflow=0.19 cfs 0.340 af

Pond P2: Sand Filter Lower Employee Peak Elev=231.11' Storage=14,066 cf Inflow=7.37 cfs 0.596 af
Primary=0.86 cfs 0.111 af Secondary=0.13 cfs 0.484 af Outflow=0.99 cfs 0.596 af

Link DP-1: Edge of Wetlands Inflow=70.68 cfs 17.316 af
Primary=70.68 cfs 17.316 af

Total Runoff Area = 79.777 ac Runoff Volume = 20.001 af Average Runoff Depth = 3.01"
82.25% Pervious = 65.619 ac 17.75% Impervious = 14.158 ac

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points x 2
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment PR-1: Area to Existing Runoff Area=528,968 sf 6.38% Impervious Runoff Depth=4.75"
Flow Length=265' Tc=6.7 min CN=66/98 Runoff=64.95 cfs 4.807 af

Subcatchment PR-10: Area to Middle Runoff Area=25,242 sf 25.60% Impervious Runoff Depth=6.21"
Tc=6.0 min CN=74/98 Runoff=4.00 cfs 0.300 af

Subcatchment PR-11: Area to Lower Runoff Area=44,094 sf 44.73% Impervious Runoff Depth=6.76"
Tc=6.0 min CN=74/98 Runoff=7.39 cfs 0.570 af

Subcatchment PR-12: Lottery Parking Lot Runoff Area=20,529 sf 48.72% Impervious Runoff Depth=6.08"
Tc=6.0 min CN=61/98 Runoff=3.04 cfs 0.239 af

Subcatchment PR-13: Half Casino & Runoff Area=432,344 sf 74.31% Impervious Runoff Depth=7.28"
Tc=6.0 min CN=63/98 Runoff=74.61 cfs 6.019 af

Subcatchment PR-14: Hotel & Half Casino Runoff Area=81,163 sf 86.97% Impervious Runoff Depth=7.78"
Tc=6.0 min CN=61/98 Runoff=14.79 cfs 1.208 af

Subcatchment PR-15: Pond Runoff Area=38,836 sf 0.00% Impervious Runoff Depth=3.91"
Tc=6.0 min CN=61/0 Runoff=4.06 cfs 0.290 af

Subcatchment PR-2: Undetained to Bridge Runoff Area=32,986 sf 11.54% Impervious Runoff Depth=5.69"
Tc=6.0 min CN=73/98 Runoff=4.92 cfs 0.359 af

Subcatchment PR-3: Upper Employee Runoff Area=40,272 sf 61.76% Impervious Runoff Depth=6.66"
Tc=6.0 min CN=61/98 Runoff=6.43 cfs 0.513 af

Subcatchment PR-4: Lower Employee Runoff Area=62,404 sf 75.87% Impervious Runoff Depth=7.34"
Tc=6.0 min CN=63/98 Runoff=10.85 cfs 0.877 af

Subcatchment PR-5: Wetland Area to Runoff Area=621,690 sf 0.00% Impervious Runoff Depth=4.03"
Flow Length=889' Tc=72.1 min CN=62/0 Runoff=23.35 cfs 4.790 af

Subcatchment PR-6: Undisturbed Runoff Area=444,734 sf 0.00% Impervious Runoff Depth=3.32"
Flow Length=1,373' Tc=27.4 min CN=56/0 Runoff=22.76 cfs 2.824 af

Subcatchment PR-7: Wetland and Int. Runoff Area=980,976 sf 3.75% Impervious Runoff Depth=5.11"
Flow Length=1,483' Tc=41.9 min CN=70/98 Runoff=64.34 cfs 9.591 af

Subcatchment PR-8: Undetained Along Runoff Area=6,285 sf 60.73% Impervious Runoff Depth=6.61"
Flow Length=945' Tc=14.6 min CN=61/98 Runoff=0.77 cfs 0.079 af

Subcatchment PR-9: Area to Upper Runoff Area=114,552 sf 33.43% Impervious Runoff Depth=4.85"
Tc=6.0 min CN=54/98 Runoff=13.51 cfs 1.063 af

Reach R-1: Int. Stream - West Avg. Flow Depth=1.41' Max Vel=3.79 fps Inflow=26.36 cfs 2.099 af
n=0.040 L=995.0' S=0.0130 '/' Capacity=49.86 cfs Outflow=23.80 cfs 2.099 af

Reach R-2: Int. Stream - Mid Avg. Flow Depth=1.26' Max Vel=6.44 fps Inflow=35.10 cfs 8.278 af
n=0.040 L=715.0' S=0.0427 '/' Capacity=90.49 cfs Outflow=34.56 cfs 8.278 af

Pond C-1: Bridge Crossing Peak Elev=234.35' Inflow=26.36 cfs 2.099 af
Outflow=26.36 cfs 2.099 af

Pond C-2: Culvert Crossing Peak Elev=225.97' Inflow=24.86 cfs 5.247 af
36.0" Round Culvert n=0.012 L=50.0' S=0.0060 '/' Outflow=24.86 cfs 5.247 af

Pond C-3: Culvert Crossing Peak Elev=189.16' Inflow=95.05 cfs 18.189 af
120.0" x 36.0" Box Culvert n=0.022 L=46.0' S=0.0413 '/' Outflow=95.05 cfs 18.189 af

Pond EX-P1: Existing Wetland/Ponding Peak Elev=236.26' Storage=8,740 cf Inflow=64.95 cfs 4.807 af
Discarded=38.61 cfs 3.067 af Primary=21.95 cfs 1.740 af Outflow=60.56 cfs 4.807 af

Pond P-10: Retention Basin Peak Elev=187.57' Storage=115,819 cf Inflow=92.43 cfs 5.920 af
Outflow=30.15 cfs 5.919 af

Pond P-3: Infiltration Basin Upper Access Peak Elev=209.26' Storage=9,793 cf Inflow=13.51 cfs 1.063 af
Discarded=1.74 cfs 0.908 af Primary=4.39 cfs 0.155 af Outflow=6.13 cfs 1.063 af

Pond P-4: Infiltration Basin Middle Access Peak Elev=203.13' Storage=6,988 cf Inflow=6.20 cfs 0.455 af
Discarded=1.36 cfs 0.430 af Primary=1.10 cfs 0.025 af Outflow=2.46 cfs 0.455 af

Pond P-5: Sand Filter Lower Access Road Peak Elev=190.19' Storage=10,670 cf Inflow=7.39 cfs 0.570 af
Primary=2.14 cfs 0.141 af Secondary=0.18 cfs 0.429 af Outflow=2.32 cfs 0.570 af

Pond P-6: Bioretention Basin Peak Elev=218.28' Storage=4,503 cf Inflow=3.04 cfs 0.239 af
Outflow=2.16 cfs 0.154 af

Pond P-7&8: MC-4500 & SC-740 Peak Elev=193.68' Storage=31,357 cf Inflow=74.61 cfs 6.019 af
Primary=74.08 cfs 4.761 af Secondary=0.33 cfs 1.258 af Outflow=74.42 cfs 6.019 af

Pond P-9: MC-3500 Peak Elev=206.62' Storage=7,521 cf Inflow=14.79 cfs 1.208 af
Primary=14.38 cfs 0.869 af Secondary=0.11 cfs 0.339 af Outflow=14.49 cfs 1.208 af

Pond P1: Sand Filter Upper Employee Peak Elev=232.40' Storage=9,359 cf Inflow=6.43 cfs 0.513 af
Primary=1.54 cfs 0.089 af Secondary=0.20 cfs 0.424 af Outflow=1.75 cfs 0.513 af

Pond P2: Sand Filter Lower Employee Peak Elev=231.39' Storage=15,749 cf Inflow=10.85 cfs 0.966 af
Primary=6.21 cfs 0.458 af Secondary=0.14 cfs 0.508 af Outflow=6.35 cfs 0.966 af

Link DP-1: Edge of Wetlands Inflow=144.30 cfs 29.038 af
Primary=144.30 cfs 29.038 af

Total Runoff Area = 79.777 ac Runoff Volume = 33.528 af Average Runoff Depth = 5.04"
82.25% Pervious = 65.619 ac 17.75% Impervious = 14.158 ac

Summary for Subcatchment PR-1: Area to Existing Ponding

Runoff = 64.95 cfs @ 12.10 hrs, Volume= 4.807 af, Depth= 4.75"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr NEWP 100-YR Rainfall=8.60"

Area (sf)	CN	Description
218,538	55	Woods, Good, HSG B
18,095	68	1 acre lots, 20% imp, HSG B
150,664	79	1 acre lots, 20% imp, HSG C
141,671	77	Woods, Good, HSG D
528,968	68	Weighted Average
495,216	66	93.62% Pervious Area
33,752	98	6.38% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	50	0.0400	0.20		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.30"
0.7	91	0.1033	2.25		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.2	91	0.0330	1.27		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.6	33	0.0303	0.87		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.7	265	Total			

Summary for Subcatchment PR-10: Area to Middle Access Road Pond

Runoff = 4.00 cfs @ 12.09 hrs, Volume= 0.300 af, Depth= 6.21"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr NEWP 100-YR Rainfall=8.60"

Area (sf)	CN	Description
6,462	98	Paved parking, HSG B
18,780	74	>75% Grass cover, Good, HSG C
25,242	80	Weighted Average
18,780	74	74.40% Pervious Area
6,462	98	25.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment PR-11: Area to Lower Access Road Pond

Runoff = 7.39 cfs @ 12.09 hrs, Volume= 0.570 af, Depth= 6.76"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr NEWP 100-YR Rainfall=8.60"

Area (sf)	CN	Description
19,724	98	Paved parking, HSG B
324	61	>75% Grass cover, Good, HSG B
21,699	74	>75% Grass cover, Good, HSG C
2,347	80	>75% Grass cover, Good, HSG D
44,094	85	Weighted Average
24,370	74	55.27% Pervious Area
19,724	98	44.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment PR-12: Lottery Parking Lot

Runoff = 3.04 cfs @ 12.09 hrs, Volume= 0.239 af, Depth= 6.08"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr NEWP 100-YR Rainfall=8.60"

	Area (sf)	CN	Description
	10,528	61	>75% Grass cover, Good, HSG B
*	10,001	98	Impervious
	20,529	79	Weighted Average
	10,528	61	51.28% Pervious Area
	10,001	98	48.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Min. Tc=6.0**

Summary for Subcatchment PR-13: Half Casino & Parking

Runoff = 74.61 cfs @ 12.08 hrs, Volume= 6.019 af, Depth= 7.28"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr NEWP 100-YR Rainfall=8.60"

	Area (sf)	CN	Description
	12,665	74	>75% Grass cover, Good, HSG C
	96,468	61	>75% Grass cover, Good, HSG B
*	321,291	98	Impervious
	1,920	85	Gravel roads, HSG B
	432,344	89	Weighted Average
	111,053	63	25.69% Pervious Area
	321,291	98	74.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment PR-14: Hotel & Half Casino

Runoff = 14.79 cfs @ 12.08 hrs, Volume= 1.208 af, Depth= 7.78"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr NEWP 100-YR Rainfall=8.60"

	Area (sf)	CN	Description
	10,575	61	>75% Grass cover, Good, HSG B
*	70,588	98	Impervious
	81,163	93	Weighted Average
	10,575	61	13.03% Pervious Area
	70,588	98	86.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Min. Tc=6.0**

Summary for Subcatchment PR-15: Pond

Runoff = 4.06 cfs @ 12.09 hrs, Volume= 0.290 af, Depth= 3.91"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr NEWP 100-YR Rainfall=8.60"

	Area (sf)	CN	Description
	38,836	61	>75% Grass cover, Good, HSG B
	38,836	61	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment PR-2: Undetained to Bridge

Runoff = 4.92 cfs @ 12.09 hrs, Volume= 0.359 af, Depth= 5.69"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr NEWP 100-YR Rainfall=8.60"

Area (sf)	CN	Description
2,996	55	Woods, Good, HSG B
910	61	>75% Grass cover, Good, HSG B
19,040	79	1 acre lots, 20% imp, HSG C
8,916	77	Woods, Good, HSG D
1,124	80	>75% Grass cover, Good, HSG D
32,986	76	Weighted Average
29,178	73	88.46% Pervious Area
3,808	98	11.54% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment PR-3: Upper Employee Parking Area

Runoff = 6.43 cfs @ 12.09 hrs, Volume= 0.513 af, Depth= 6.66"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr NEWP 100-YR Rainfall=8.60"

Area (sf)	CN	Description
15,398	61	>75% Grass cover, Good, HSG B
24,874	98	Paved parking, HSG B
40,272	84	Weighted Average
15,398	61	38.24% Pervious Area
24,874	98	61.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment PR-4: Lower Employee Parking Area

Runoff = 10.85 cfs @ 12.08 hrs, Volume= 0.877 af, Depth= 7.34"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr NEWP 100-YR Rainfall=8.60"

	Area (sf)	CN	Description
	47,349	98	Paved parking, HSG B
	14,100	61	>75% Grass cover, Good, HSG B
*	955	85	Stone Dust Path, HSG B
	62,404	89	Weighted Average
	15,055	63	24.13% Pervious Area
	47,349	98	75.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment PR-5: Wetland Area to Culvert Crossing

Runoff = 23.35 cfs @ 12.98 hrs, Volume= 4.790 af, Depth= 4.03"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr NEWP 100-YR Rainfall=8.60"

Area (sf)	CN	Description
412,775	55	Woods, Good, HSG B
2,000	61	>75% Grass cover, Good, HSG B
206,915	77	Woods, Good, HSG D
621,690	62	Weighted Average
621,690	62	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
41.5	100	0.0037	0.04		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.30"
24.1	440	0.0037	0.30		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.5	349	0.0319	0.89		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
72.1	889	Total			

Summary for Subcatchment PR-6: Undisturbed Woodland

Runoff = 22.76 cfs @ 12.39 hrs, Volume= 2.824 af, Depth= 3.32"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr NEWP 100-YR Rainfall=8.60"

Area (sf)	CN	Description
399,513	55	Woods, Good, HSG B
12,252	61	>75% Grass cover, Good, HSG B
5,938	74	>75% Grass cover, Good, HSG C
27,031	70	Woods, Good, HSG C
444,734	56	Weighted Average
444,734	56	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.0	100	0.0400	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.30"
5.0	177	0.0141	0.59		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.3	221	0.0498	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.4	700	0.0300	8.51	6.69	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
1.7	175	0.1180	1.72		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
27.4	1,373	Total			

Summary for Subcatchment PR-7: Wetland and Int. Stream Area

Runoff = 64.34 cfs @ 12.57 hrs, Volume= 9.591 af, Depth= 5.11"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr NEWP 100-YR Rainfall=8.60"

	Area (sf)	CN	Description
*	31,748	30	Woods, Good, HSG A
	325	39	>75% Grass cover, Good, HSG A
	107,779	55	Woods, Good, HSG B
	6,411	61	>75% Grass cover, Good, HSG B
*	316,340	70	Woods, Good, HSG C
	2,745	74	>75% Grass cover, Good, HSG C
	168,735	79	1 acre lots, 20% imp, HSG C
	322,219	77	Woods, Good, HSG D
	3,613	80	>75% Grass cover, Good, HSG D
*	3,000	98	Bridge
*	5,829	55	Porous Pavement, HSG B
*	12,232	70	Porous Pavement, HSG C
	980,976	71	Weighted Average
	944,229	70	96.25% Pervious Area
	36,747	98	3.75% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	50	0.0408	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.30"
8.1	50	0.0549	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.30"
1.2	126	0.1206	1.74		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.6	113	0.0531	1.15		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
15.6	733	0.0246	0.78		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
2.7	208	0.0673	1.30		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.6	203	0.0345	0.93		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
41.9	1,483	Total			

Summary for Subcatchment PR-8: Undetained Along Road

Runoff = 0.77 cfs @ 12.19 hrs, Volume= 0.079 af, Depth= 6.61"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr NEWP 100-YR Rainfall=8.60"

Area (sf)	CN	Description
3,817	98	Paved parking, HSG B
383	30	Woods, Good, HSG A
466	39	>75% Grass cover, Good, HSG A
1,619	74	>75% Grass cover, Good, HSG C
6,285	83	Weighted Average
2,468	61	39.27% Pervious Area
3,817	98	60.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	85	0.0700	0.19		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.30"
2.9	530	0.0230	3.08		**Shallow Concentrated Flow, Shallow** Paved Kv= 20.3 fps
4.2	330	0.0670	1.29		**Shallow Concentrated Flow, Shallow** Woodland Kv= 5.0 fps
14.6	945	Total			

Summary for Subcatchment PR-9: Area to Upper Access Road Pond

Runoff = 13.51 cfs @ 12.09 hrs, Volume= 1.063 af, Depth= 4.85"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr NEWP 100-YR Rainfall=8.60"

Area (sf)	CN	Description
38,300	98	Paved parking, HSG B
8,359	39	>75% Grass cover, Good, HSG A
21,195	74	>75% Grass cover, Good, HSG C
26,208	30	Woods, Good, HSG A
20,490	70	Woods, Good, HSG C
114,552	69	Weighted Average
76,252	54	66.57% Pervious Area
38,300	98	33.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

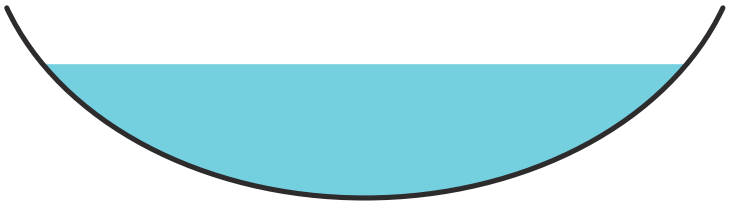
Summary for Reach R-1: Int. Stream - West

Inflow Area = 12.901 ac, 6.68% Impervious, Inflow Depth = 1.95" for NEWP 100-YR event
Inflow = 26.36 cfs @ 12.12 hrs, Volume= 2.099 af
Outflow = 23.80 cfs @ 12.17 hrs, Volume= 2.099 af, Atten= 10%, Lag= 2.9 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 3.79 fps, Min. Travel Time= 4.4 min
Avg. Velocity = 0.93 fps, Avg. Travel Time= 17.8 min

Peak Storage= 6,255 cf @ 12.17 hrs
Average Depth at Peak Storage= 1.41'
Bank-Full Depth= 2.00' Flow Area= 10.7 sf, Capacity= 49.86 cfs

8.00' x 2.00' deep Parabolic Channel, n= 0.040 Winding stream, pools & shoals
Length= 995.0' Slope= 0.0130 '/'
Inlet Invert= 232.90', Outlet Invert= 220.00'



Summary for Reach R-2: Int. Stream - Mid

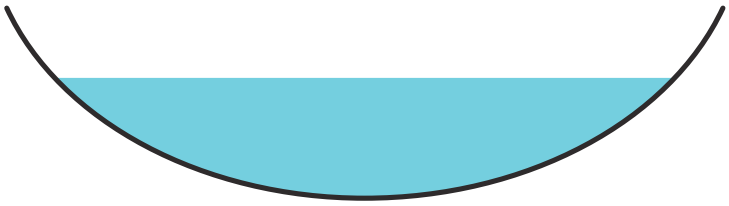
[62] Hint: Exceeded Reach R-1 OUTLET depth by 0.14' @ 13.10 hrs

Inflow Area = 29.530 ac, 8.53% Impervious, Inflow Depth = 3.36" for NEWP 100-YR event
Inflow = 35.10 cfs @ 12.18 hrs, Volume= 8.278 af
Outflow = 34.56 cfs @ 12.21 hrs, Volume= 8.278 af, Atten= 2%, Lag= 1.6 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 6.44 fps, Min. Travel Time= 1.9 min
Avg. Velocity = 1.72 fps, Avg. Travel Time= 6.9 min

Peak Storage= 3,836 cf @ 12.21 hrs
Average Depth at Peak Storage= 1.26'
Bank-Full Depth= 2.00' Flow Area= 10.7 sf, Capacity= 90.49 cfs

8.00' x 2.00' deep Parabolic Channel, n= 0.040 Mountain streams
Length= 715.0' Slope= 0.0427 '/'
Inlet Invert= 219.53', Outlet Invert= 189.00'



Summary for Pond C-1: Bridge Crossing

[57] Hint: Peaked at 234.35' (Flood elevation advised)

Inflow Area = 12.901 ac, 6.68% Impervious, Inflow Depth = 1.95" for NEWP 100-YR event
Inflow = 26.36 cfs @ 12.12 hrs, Volume= 2.099 af
Outflow = 26.36 cfs @ 12.12 hrs, Volume= 2.099 af, Atten= 0%, Lag= 0.0 min
Primary = 26.36 cfs @ 12.12 hrs, Volume= 2.099 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 234.35' @ 12.16 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	233.50'	**Grade Under Bridge, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 0.50 1.50 Width (feet) 0.00 38.00 77.00

Primary OutFlow Max=26.35 cfs @ 12.12 hrs HW=234.30' TW=234.24' (Dynamic Tailwater)
↑—**1=Grade Under Bridge** (Weir Controls 26.35 cfs @ 1.15 fps)

Summary for Pond C-2: Culvert Crossing

[57] Hint: Peaked at 225.97' (Flood elevation advised)

Inflow Area = 16.629 ac, 9.97% Impervious, Inflow Depth = 3.79" for NEWP 100-YR event
Inflow = 24.86 cfs @ 12.98 hrs, Volume= 5.247 af
Outflow = 24.86 cfs @ 12.98 hrs, Volume= 5.247 af, Atten= 0%, Lag= 0.0 min
Primary = 24.86 cfs @ 12.98 hrs, Volume= 5.247 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 225.97' @ 12.98 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	223.60'	**36.0" Round Culvert** L= 50.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 223.60' / 223.30' S= 0.0060 '/' Cc= 0.900 n= 0.012, Flow Area= 7.07 sf

Primary OutFlow Max=24.85 cfs @ 12.98 hrs HW=225.97' TW=220.69' (Dynamic Tailwater)
↑**1=Culvert** (Barrel Controls 24.85 cfs @ 5.70 fps)

Summary for Pond C-3: Culvert Crossing

[57] Hint: Peaked at 189.16' (Flood elevation advised)
[61] Hint: Exceeded Reach R-2 outlet invert by 0.16' @ 12.56 hrs

Inflow Area = 56.743 ac, 8.94% Impervious, Inflow Depth = 3.85" for NEWP 100-YR event
Inflow = 95.05 cfs @ 12.56 hrs, Volume= 18.189 af
Outflow = 95.05 cfs @ 12.56 hrs, Volume= 18.189 af, Atten= 0%, Lag= 0.0 min
Primary = 95.05 cfs @ 12.56 hrs, Volume= 18.189 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 189.16' @ 12.56 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	187.10'	**120.0" W x 36.0" H Box Culvert** L= 46.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 187.10' / 185.20' S= 0.0413 '/' Cc= 0.900 n= 0.022 Earth, clean & straight, Flow Area= 30.00 sf

Primary OutFlow Max=95.05 cfs @ 12.56 hrs HW=189.16' TW=0.00' (Dynamic Tailwater)
↑**1=Culvert** (Inlet Controls 95.05 cfs @ 4.61 fps)

Summary for Pond EX-P1: Existing Wetland/Ponding Area

Inflow Area = 12.143 ac, 6.38% Impervious, Inflow Depth = 4.75" for NEWP 100-YR event
Inflow = 64.95 cfs @ 12.10 hrs, Volume= 4.807 af
Outflow = 60.56 cfs @ 12.13 hrs, Volume= 4.807 af, Atten= 7%, Lag= 2.0 min
Discarded = 38.61 cfs @ 12.13 hrs, Volume= 3.067 af
Primary = 21.95 cfs @ 12.13 hrs, Volume= 1.740 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 236.26' @ 12.13 hrs Surf.Area= 47,953 sf Storage= 8,740 cf

Plug-Flow detention time= 3.9 min calculated for 4.807 af (100% of inflow)
Center-of-Mass det. time= 3.7 min (824.2 - 820.4)

Volume	Invert	Avail.Storage	Storage Description
#1	236.00'	816,551 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
236.00	18,822	0	0
238.00	241,386	260,208	260,208
240.00	314,957	556,343	816,551

Device	Routing	Invert	Outlet Devices
#1	Primary	236.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 2.00 4.00 Width (feet) 47.00 105.00 248.00
#2	Discarded	236.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 2.00 4.00 Width (feet) 83.00 179.00 270.00

Discarded OutFlow Max=38.59 cfs @ 12.13 hrs HW=236.26' (Free Discharge)
↑—**2=Custom Weir/Orifice** (Weir Controls 38.59 cfs @ 1.65 fps)

Primary OutFlow Max=21.94 cfs @ 12.13 hrs HW=236.26' TW=234.32' (Dynamic Tailwater)
↑—**1=Custom Weir/Orifice** (Weir Controls 21.94 cfs @ 1.65 fps)

Summary for Pond P-10: Retention Basin

Inflow Area = 12.680 ac, 70.95% Impervious, Inflow Depth = 5.60" for NEWP 100-YR event
Inflow = 92.43 cfs @ 12.09 hrs, Volume= 5.920 af
Outflow = 30.15 cfs @ 12.39 hrs, Volume= 5.919 af, Atten= 67%, Lag= 17.9 min
Primary = 30.15 cfs @ 12.39 hrs, Volume= 5.919 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 187.57' @ 12.39 hrs Surf.Area= 32,740 sf Storage= 115,819 cf

Plug-Flow detention time= 181.3 min calculated for 5.918 af (100% of inflow)
Center-of-Mass det. time= 181.5 min (976.0 - 794.4)

Volume	Invert	Avail.Storage	Storage Description
#1	183.00'	130,283 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
183.00	18,374	0	0
184.00	21,566	19,970	19,970
185.00	24,825	23,196	43,166
186.00	26,626	25,726	68,891
187.00	31,070	28,848	97,739
188.00	34,017	32,544	130,283

Device	Routing	Invert	Outlet Devices
#1	Primary	187.00'	**15.0' long x 8.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74
#2	Primary	183.00'	**8.750 in/hr Exfiltration over Horizontal area above 183.00'** Excluded Horizontal area = 18,374 sf
#3	Primary	184.00'	**15.0" Round Culvert** L= 39.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 184.00' / 183.00' S= 0.0256 '/' Cc= 0.900 n= 0.012, Flow Area= 1.23 sf

Primary OutFlow Max=30.15 cfs @ 12.39 hrs HW=187.57' TW=0.00' (Dynamic Tailwater)
- **1=Broad-Crested Rectangular Weir** (Weir Controls 17.11 cfs @ 2.01 fps)
- **2=Exfiltration** (Exfiltration Controls 2.91 cfs)
- **3=Culvert** (Inlet Controls 10.13 cfs @ 8.26 fps)

Summary for Pond P-3: Infiltration Basin Upper Access Road

[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=404)

Inflow Area = 2.630 ac, 33.43% Impervious, Inflow Depth = 4.85" for NEWP 100-YR event
Inflow = 13.51 cfs @ 12.09 hrs, Volume= 1.063 af
Outflow = 6.13 cfs @ 12.28 hrs, Volume= 1.063 af, Atten= 55%, Lag= 11.7 min
Discarded = 1.74 cfs @ 12.28 hrs, Volume= 0.908 af
Primary = 4.39 cfs @ 12.28 hrs, Volume= 0.155 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 209.26' @ 12.28 hrs Surf.Area= 8,592 sf Storage= 9,793 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 27.2 min (816.4 - 789.2)

Volume	Invert	Avail.Storage	Storage Description
#1	208.00'	16,206 cf	**Basin (Prismatic)** Listed below
#2	209.00'	1,169 cf	**Forebay (Prismatic)** Listed below (Recalc) -Impervious
		17,374 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
208.00	6,275	0	0
209.00	8,141	7,208	7,208
210.00	9,854	8,998	16,206

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
209.00	702	0	0
210.00	1,635	1,169	1,169

Device	Routing	Invert	Outlet Devices
#1	Discarded	208.00'	**8.750 in/hr Exfiltration over Surface area**
#2	Primary	209.00'	**10.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=1.74 cfs @ 12.28 hrs HW=209.26' (Free Discharge)
- **1=Exfiltration** (Exfiltration Controls 1.74 cfs)

Primary OutFlow Max=4.39 cfs @ 12.28 hrs HW=209.26' TW=202.65' (Dynamic Tailwater)
- **2=Sharp-Crested Rectangular Weir** (Weir Controls 4.39 cfs @ 1.68 fps)

Summary for Pond P-4: Infiltration Basin Middle Access Road

[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=468)

Inflow Area = 3.209 ac, 32.02% Impervious, Inflow Depth = 1.70" for NEWP 100-YR event
Inflow = 6.20 cfs @ 12.25 hrs, Volume= 0.455 af
Outflow = 2.46 cfs @ 12.59 hrs, Volume= 0.455 af, Atten= 60%, Lag= 20.3 min
Discarded = 1.36 cfs @ 12.59 hrs, Volume= 0.430 af
Primary = 1.10 cfs @ 12.59 hrs, Volume= 0.025 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 203.13' @ 12.59 hrs Surf.Area= 6,712 sf Storage= 6,988 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 31.1 min (804.5 - 773.4)

Volume	Invert	Avail.Storage	Storage Description
#1	202.00'	13,202 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
202.00	5,709	0	0
203.00	6,600	6,155	6,155
204.00	7,494	7,047	13,202

Device	Routing	Invert	Outlet Devices
#1	Discarded	202.00'	**8.750 in/hr Exfiltration over Surface area**
#2	Primary	203.00'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Discarded OutFlow Max=1.36 cfs @ 12.59 hrs HW=203.13' (Free Discharge)
1=Exfiltration (Exfiltration Controls 1.36 cfs)

Primary OutFlow Max=1.10 cfs @ 12.59 hrs HW=203.13' TW=189.16' (Dynamic Tailwater)
2=Broad-Crested Rectangular Weir (Weir Controls 1.10 cfs @ 0.88 fps)

Summary for Pond P-5: Sand Filter Lower Access Road

Inflow Area = 1.012 ac, 44.73% Impervious, Inflow Depth = 6.76" for NEWP 100-YR event
Inflow = 7.39 cfs @ 12.09 hrs, Volume= 0.570 af
Outflow = 2.32 cfs @ 12.40 hrs, Volume= 0.570 af, Atten= 69%, Lag= 18.6 min
Primary = 2.14 cfs @ 12.40 hrs, Volume= 0.141 af
Secondary = 0.18 cfs @ 12.40 hrs, Volume= 0.429 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 190.19' @ 12.40 hrs Surf.Area= 4,488 sf Storage= 10,670 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 438.0 min (1,210.9 - 773.0)

Volume	Invert	Avail.Storage	Storage Description
#1	188.00'	993 cf	**Forebay (Prismatic)**Listed below (Recalc) -Impervious
#2	186.00'	12,089 cf	**Sand Filter (Prismatic)**Listed below (Recalc) 18,111 cf Overall - 6,022 cf Embedded = 12,089 cf
#3	186.00'	1,987 cf	**Sand Media (Prismatic)**Listed below (Recalc) Inside #2 6,022 cf Overall x 33.0% Voids
		15,069 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
188.00	102	0	0
189.00	228	165	165
190.00	381	305	470
191.00	665	523	993

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
186.00	3,011	0	0
188.00	3,011	6,022	6,022
189.00	3,633	3,322	9,344
190.00	4,282	3,958	13,302
191.00	5,337	4,810	18,111

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
186.00	3,011	0	0
188.00	3,011	6,022	6,022

Device	Routing	Invert	Outlet Devices
#1	Secondary	186.00'	**1.750 in/hr Exfiltration over Surface area**
#2	Primary	190.00'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=2.14 cfs @ 12.40 hrs HW=190.19' TW=189.04' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 2.14 cfs @ 1.10 fps)

Secondary OutFlow Max=0.18 cfs @ 12.40 hrs HW=190.19' TW=0.00' (Dynamic Tailwater)
↑—**1=Exfiltration** (Exfiltration Controls 0.18 cfs)

Summary for Pond P-6: Bioretention Basin

Inflow Area = 0.471 ac, 48.72% Impervious, Inflow Depth = 6.08" for NEWP 100-YR event
Inflow = 3.04 cfs @ 12.09 hrs, Volume= 0.239 af
Outflow = 2.16 cfs @ 12.16 hrs, Volume= 0.154 af, Atten= 29%, Lag= 4.7 min
Primary = 2.16 cfs @ 12.16 hrs, Volume= 0.154 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 218.28' @ 12.16 hrs Surf.Area= 3,038 sf Storage= 4,503 cf

Plug-Flow detention time= 383.1 min calculated for 0.154 af (65% of inflow)

Center-of-Mass det. time= 274.7 min (1,048.0 - 773.3)

Volume	Invert	Avail.Storage	Storage Description
#1	215.00'	1,284 cf	**Soil Storage (Prismatic)**Listed below (Recalc) Inside #2 3,890 cf Overall x 33.0% Voids
#2	215.00'	5,585 cf	**Basin Storage (Prismatic)**Listed below (Recalc) 9,475 cf Overall - 3,890 cf Embedded = 5,585 cf
		6,868 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
215.00	1,945	0	0
217.00	1,945	3,890	3,890

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
215.00	1,945	0	0
217.00	1,945	3,890	3,890
218.00	2,836	2,391	6,281
219.00	3,552	3,194	9,475

Device	Routing	Invert	Outlet Devices
#1	Primary	215.00'	**0.050 in/hr Exfiltration over Surface area**
#2	Primary	218.20'	**2.5" x 2.5" Horiz. Orifice/Grate X 6.00 columns** X 6 rows C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=2.16 cfs @ 12.16 hrs HW=218.28' TW=188.63' (Dynamic Tailwater)
└─**1=Exfiltration** (Exfiltration Controls 0.00 cfs)
└─**2=Orifice/Grate** (Orifice Controls 2.15 cfs @ 1.38 fps)

Summary for Pond P-7&8: MC-4500 & SC-740

Inflow Area = 9.925 ac, 74.31% Impervious, Inflow Depth = 7.28" for NEWP 100-YR event
Inflow = 74.61 cfs @ 12.08 hrs, Volume= 6.019 af
Outflow = 74.42 cfs @ 12.09 hrs, Volume= 6.019 af, Atten= 0%, Lag= 0.4 min
Primary = 74.08 cfs @ 12.09 hrs, Volume= 4.761 af
Secondary = 0.33 cfs @ 4.80 hrs, Volume= 1.258 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 193.68' @ 12.09 hrs Surf.Area= 8,236 sf Storage= 31,357 cf

Plug-Flow detention time= 185.9 min calculated for 6.018 af (100% of inflow)
Center-of-Mass det. time= 186.1 min (940.4 - 754.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	185.75'	10,128 cf	**37.58'W x 147.99'L x 8.25'H Field A** 45,887 cf Overall - 15,194 cf Embedded = 30,692 cf x 33.0% Voids
#2A	188.00'	15,194 cf	**ADS_StormTech MC-4500 +Cap** x 140 Inside #1 Effective Size= 90.4"W x 60.0"H => 26.46 sf x 4.03'L = 106.5 cf Overall Size= 100.0"W x 60.0"H x 4.33'L with 0.31' Overlap 4 Rows of 35 Chambers Cap Storage= +35.7 cf x 2 x 4 rows = 285.6 cf
#3B	188.00'	3,321 cf	**39.50'W x 67.70'L x 5.00'H Field B** 13,370 cf Overall - 3,308 cf Embedded = 10,062 cf x 33.0% Voids
#4B	190.00'	3,308 cf	**ADS_StormTech SC-740 +Cap** x 72 Inside #3 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 8 Rows of 9 Chambers
		31,951 cf	Total Available Storage

Storage Group A created with Chamber Wizard
Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Secondary	185.75'	**1.750 in/hr Exfiltration over Surface area**
#2	Device 3	192.40'	**96.0" W x 24.0" H Vert. Orifice/Grate X 2.00** C= 0.600
#3	Primary	183.10'	**30.0" Round Culvert X 2.00** L= 15.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 183.10' / 183.00' S= 0.0067 '/' Cc= 0.900 n= 0.012, Flow Area= 4.91 sf

Primary OutFlow Max=74.06 cfs @ 12.09 hrs HW=193.68' TW=186.45' (Dynamic Tailwater)
└─**3=Culvert** (Passes 74.06 cfs of 127.07 cfs potential flow)
└─**2=Orifice/Grate** (Orifice Controls 74.06 cfs @ 3.63 fps)

Secondary OutFlow Max=0.33 cfs @ 4.80 hrs HW=188.00' TW=0.00' (Dynamic Tailwater)
└─**1=Exfiltration** (Exfiltration Controls 0.33 cfs)

Summary for Pond P-9: MC-3500

Inflow Area = 1.863 ac, 86.97% Impervious, Inflow Depth = 7.78" for NEWP 100-YR event
Inflow = 14.79 cfs @ 12.08 hrs, Volume= 1.208 af
Outflow = 14.49 cfs @ 12.10 hrs, Volume= 1.208 af, Atten= 2%, Lag= 1.0 min
Primary = 14.38 cfs @ 12.10 hrs, Volume= 0.869 af
Secondary = 0.11 cfs @ 3.52 hrs, Volume= 0.339 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 206.62' @ 12.10 hrs Surf.Area= 2,604 sf Storage= 7,521 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 167.6 min (914.5 - 746.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	201.50'	4,334 cf	**37.08'W x 70.23'L x 7.00'H Field A** 18,231 cf Overall - 5,097 cf Embedded = 13,134 cf x 33.0% Voids
#2A	203.75'	5,097 cf	**ADS_StormTech MC-3500 d +Cap** x 45 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 5 Rows of 9 Chambers Cap Storage= +14.9 cf x 2 x 5 rows = 149.0 cf
		9,431 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Secondary	201.50'	**1.750 in/hr Exfiltration over Surface area**
#2	Device 3	205.80'	**72.0" W x 24.0" H Vert. Orifice/Grate** C= 0.600
#3	Primary	200.70'	**18.0" Round Culvert** L= 119.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 200.70' / 194.70' S= 0.0504 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf

Primary OutFlow Max=14.38 cfs @ 12.10 hrs HW=206.62' TW=186.55' (Dynamic Tailwater)
↑—**3=Culvert** (Passes 14.38 cfs of 19.35 cfs potential flow)
↑—**2=Orifice/Grate** (Orifice Controls 14.38 cfs @ 2.91 fps)

Secondary OutFlow Max=0.11 cfs @ 3.52 hrs HW=201.57' TW=0.00' (Dynamic Tailwater)
↑—**1=Exfiltration** (Exfiltration Controls 0.11 cfs)

Summary for Pond P1: Sand Filter Upper Employee Parking

Inflow Area = 0.925 ac, 61.76% Impervious, Inflow Depth = 6.66" for NEWP 100-YR event
Inflow = 6.43 cfs @ 12.09 hrs, Volume= 0.513 af
Outflow = 1.75 cfs @ 12.44 hrs, Volume= 0.513 af, Atten= 73%, Lag= 21.5 min
Primary = 1.54 cfs @ 12.44 hrs, Volume= 0.089 af
Secondary = 0.20 cfs @ 12.44 hrs, Volume= 0.424 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 232.40' @ 12.44 hrs Surf.Area= 5,054 sf Storage= 9,359 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 358.0 min (1,120.7 - 762.8)

Volume	Invert	Avail.Storage	Storage Description
#1	231.00'	1,311 cf	**Forebay (Prismatic)**Listed below (Recalc) -Impervious
#2	229.00'	9,332 cf	**Sand Filter (Prismatic)**Listed below (Recalc) 16,716 cf Overall - 7,384 cf Embedded = 9,332 cf
#3	229.00'	2,437 cf	**Sand Media (Prismatic)**Listed below (Recalc) Inside #2 7,384 cf Overall x 33.0% Voids
		13,079 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
231.00	438	0	0
232.00	648	543	543
233.00	887	768	1,311

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
229.00	3,692	0	0
231.00	3,692	7,384	7,384
232.00	4,659	4,176	11,560
233.00	5,653	5,156	16,716

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
229.00	3,692	0	0
231.00	3,692	7,384	7,384

Device	Routing	Invert	Outlet Devices
#1	Secondary	229.00'	**1.750 in/hr Exfiltration over Surface area**
#2	Primary	232.30'	**21.0' long x 8.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74

Primary OutFlow Max=1.54 cfs @ 12.44 hrs HW=232.40' TW=231.32' (Dynamic Tailwater)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 1.54 cfs @ 0.76 fps)

Secondary OutFlow Max=0.20 cfs @ 12.44 hrs HW=232.40' TW=220.68' (Dynamic Tailwater)
└**1=Exfiltration** (Exfiltration Controls 0.20 cfs)

Summary for Pond P2: Sand Filter Lower Employee Parking

Inflow Area = 2.357 ac, 70.34% Impervious, Inflow Depth = 4.92" for NEWP 100-YR event
Inflow = 10.85 cfs @ 12.08 hrs, Volume= 0.966 af
Outflow = 6.35 cfs @ 12.19 hrs, Volume= 0.966 af, Atten= 41%, Lag= 6.5 min
Primary = 6.21 cfs @ 12.19 hrs, Volume= 0.458 af
Secondary = 0.14 cfs @ 12.19 hrs, Volume= 0.508 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 231.39' @ 12.19 hrs Surf.Area= 3,489 sf Storage= 15,749 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 580.8 min (1,337.6 - 756.8)

Volume	Invert	Avail.Storage	Storage Description
#1	226.00'	11,055 cf	**Sand Filter (Prismatic)**Listed below (Recalc) 14,657 cf Overall - 3,602 cf Embedded = 11,055 cf
#2	226.00'	1,189 cf	**Sand Media (Prismatic)**Listed below (Recalc) Inside #1 3,602 cf Overall x 33.0% Voids
#3	228.00'	7,442 cf	**Forebay (Prismatic)**Listed below (Recalc) -Impervious
		19,685 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
226.00	1,801	0	0
228.00	1,801	3,602	3,602
229.00	2,247	2,024	5,626
230.00	2,726	2,487	8,113
231.00	3,247	2,987	11,099
232.00	3,869	3,558	14,657

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
226.00	1,801	0	0
228.00	1,801	3,602	3,602

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
228.00	689	0	0
229.00	1,345	1,017	1,017
230.00	1,874	1,610	2,627
231.00	2,419	2,147	4,773
232.00	2,918	2,669	7,442

Device	Routing	Invert	Outlet Devices
#1	Secondary	226.00'	**1.750 in/hr Exfiltration over Surface area**
#2	Primary	231.00'	**10.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=6.20 cfs @ 12.19 hrs HW=231.39' TW=225.08' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 6.20 cfs @ 1.59 fps)

Secondary OutFlow Max=0.14 cfs @ 12.19 hrs HW=231.39' TW=220.79' (Dynamic Tailwater)
↑—**1=Exfiltration** (Exfiltration Controls 0.14 cfs)

Summary for Link DP-1: Edge of Wetlands

Inflow Area = 79.777 ac, 17.75% Impervious, Inflow Depth = 4.37" for NEWP 100-YR event
Inflow = 144.30 cfs @ 12.48 hrs, Volume= 29.038 af
Primary = 144.30 cfs @ 12.48 hrs, Volume= 29.038 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

APPENDIX C.3:

Water Quality Storm HydroCAD Analysis

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points x 2
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment PR-1: Area to Existing Runoff Area=528,968 sf 6.38% Impervious Runoff Depth=0.07"
Flow Length=265' Tc=6.7 min CN=66/98 Runoff=0.83 cfs 0.069 af

Subcatchment PR-10: Area to Middle Runoff Area=25,242 sf 25.60% Impervious Runoff Depth=0.30"
Tc=6.0 min CN=74/98 Runoff=0.16 cfs 0.014 af

Subcatchment PR-11: Area to Lower Runoff Area=44,094 sf 44.73% Impervious Runoff Depth=0.47"
Tc=6.0 min CN=74/98 Runoff=0.50 cfs 0.040 af

Subcatchment PR-12: Lottery Parking Lot Runoff Area=20,529 sf 48.72% Impervious Runoff Depth=0.48"
Tc=6.0 min CN=61/98 Runoff=0.25 cfs 0.019 af

Subcatchment PR-13: Half Casino & Runoff Area=432,344 sf 74.31% Impervious Runoff Depth=0.73"
Tc=6.0 min CN=63/98 Runoff=8.08 cfs 0.606 af

Subcatchment PR-14: Hotel & Half Casino Runoff Area=81,163 sf 86.97% Impervious Runoff Depth=0.86"
Tc=6.0 min CN=61/98 Runoff=1.77 cfs 0.133 af

Subcatchment PR-15: Pond Runoff Area=38,836 sf 0.00% Impervious Runoff Depth=0.00"
Tc=6.0 min CN=61/0 Runoff=0.00 cfs 0.000 af

Subcatchment PR-2: Undetained to Bridge Runoff Area=32,986 sf 11.54% Impervious Runoff Depth=0.16"
Tc=6.0 min CN=73/98 Runoff=0.10 cfs 0.010 af

Subcatchment PR-3: Upper Employee Runoff Area=40,272 sf 61.76% Impervious Runoff Depth=0.61"
Tc=6.0 min CN=61/98 Runoff=0.63 cfs 0.047 af

Subcatchment PR-4: Lower Employee Runoff Area=62,404 sf 75.87% Impervious Runoff Depth=0.75"
Tc=6.0 min CN=63/98 Runoff=1.19 cfs 0.089 af

Subcatchment PR-5: Wetland Area to Runoff Area=621,690 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=889' Tc=72.1 min CN=62/0 Runoff=0.00 cfs 0.000 af

Subcatchment PR-6: Undisturbed Runoff Area=444,734 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=1,373' Tc=27.4 min CN=56/0 Runoff=0.00 cfs 0.000 af

Subcatchment PR-7: Wetland and Int. Runoff Area=980,976 sf 3.75% Impervious Runoff Depth=0.06"
Flow Length=1,483' Tc=41.9 min CN=70/98 Runoff=0.45 cfs 0.115 af

Subcatchment PR-8: Undetained Along Runoff Area=6,285 sf 60.73% Impervious Runoff Depth=0.60"
Flow Length=945' Tc=14.6 min CN=61/98 Runoff=0.07 cfs 0.007 af

Subcatchment PR-9: Area to Upper Runoff Area=114,552 sf 33.43% Impervious Runoff Depth=0.33"
Tc=6.0 min CN=54/98 Runoff=0.96 cfs 0.072 af

Reach R-1: Int. Stream - West Avg. Flow Depth=0.16' Max Vel=0.93 fps Inflow=0.33 cfs 0.035 af
n=0.040 L=995.0' S=0.0130 '/' Capacity=49.86 cfs Outflow=0.22 cfs 0.035 af

Reach R-2: Int. Stream - Mid Avg. Flow Depth=0.16' Max Vel=1.74 fps Inflow=0.44 cfs 0.171 af
n=0.040 L=715.0' S=0.0427 '/' Capacity=90.49 cfs Outflow=0.43 cfs 0.171 af

Pond C-1: Bridge Crossing Peak Elev=233.60' Inflow=0.33 cfs 0.035 af
Outflow=0.33 cfs 0.035 af

Pond C-2: Culvert Crossing Peak Elev=223.60' Inflow=0.00 cfs 0.000 af
36.0" Round Culvert n=0.012 L=50.0' S=0.0060 '/' Outflow=0.00 cfs 0.000 af

Pond C-3: Culvert Crossing Peak Elev=187.19' Inflow=0.87 cfs 0.299 af
120.0" x 36.0" Box Culvert n=0.022 L=46.0' S=0.0413 '/' Outflow=0.87 cfs 0.299 af

Pond EX-P1: Existing Wetland/Ponding Area Peak Elev=236.01' Storage=269 cf Inflow=0.83 cfs 0.069 af
Discarded=0.44 cfs 0.044 af Primary=0.25 cfs 0.025 af Outflow=0.69 cfs 0.069 af

Pond P-10: Retention Basin Peak Elev=183.00' Storage=0 cf Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Pond P-3: Infiltration Basin Upper Access Road Peak Elev=208.00' Storage=0 cf Inflow=0.96 cfs 0.072 af
Discarded=0.96 cfs 0.072 af Primary=0.00 cfs 0.000 af Outflow=0.96 cfs 0.072 af

Pond P-4: Infiltration Basin Middle Access Road Peak Elev=202.00' Storage=0 cf Inflow=0.16 cfs 0.014 af
Discarded=0.16 cfs 0.014 af Primary=0.00 cfs 0.000 af Outflow=0.16 cfs 0.014 af

Pond P-5: Sand Filter Lower Access Road Peak Elev=186.33' Storage=332 cf Inflow=0.50 cfs 0.040 af
Primary=0.00 cfs 0.000 af Secondary=0.12 cfs 0.040 af Outflow=0.12 cfs 0.040 af

Pond P-6: Bioretention Basin Peak Elev=216.04' Storage=670 cf Inflow=0.25 cfs 0.019 af
Outflow=0.00 cfs 0.012 af

Pond P-7&8: MC-4500 & SC-740 Peak Elev=189.86' Storage=14,314 cf Inflow=8.08 cfs 0.606 af
Primary=0.00 cfs 0.000 af Secondary=0.33 cfs 0.606 af Outflow=0.33 cfs 0.606 af

Pond P-9: MC-3500 Peak Elev=204.02' Storage=2,517 cf Inflow=1.77 cfs 0.133 af
Primary=0.00 cfs 0.000 af Secondary=0.11 cfs 0.133 af Outflow=0.11 cfs 0.133 af

Pond P1: Sand Filter Upper Employee Parking Peak Elev=229.34' Storage=420 cf Inflow=0.63 cfs 0.047 af
Primary=0.00 cfs 0.000 af Secondary=0.15 cfs 0.047 af Outflow=0.15 cfs 0.047 af

Pond P2: Sand Filter Lower Employee Peak Elev=228.18' Storage=1,652 cf Inflow=1.19 cfs 0.089 af
Primary=0.00 cfs 0.000 af Secondary=0.08 cfs 0.089 af Outflow=0.08 cfs 0.089 af

Link DP-1: Edge of Wetlands Inflow=1.46 cfs 1.085 af
Primary=1.46 cfs 1.085 af

Total Runoff Area = 79.777 ac Runoff Volume = 1.222 af Average Runoff Depth = 0.18"
82.25% Pervious = 65.619 ac 17.75% Impervious = 14.158 ac

APPENDIX D:

Water Quality Analyses

APPENDIX D.1:

Water Quality Calculations

Proposed Stormwater Treatment

		PR-3 Upper Employee	PR-4 Lower Employee	PR-9 Upper Access Road Pond	PR-10 Middle Access Road Pond	PR-11 Lower Access Road Pond
	Pretreatment Treatment	Sediment Forebay Sand Filter	Sediment Forebay Sand Filter	Sediment Forebay Infiltration Basin	Sediment Forebay Infiltration Basin	Sediment Forebay Sand Filter
	Impervious Area, sq.ft. (non-roof)	24,874	47,349	36,010	6,462	19,724
	Impervious Area, sq.ft. (roof)	0	0	0	0	0
	Water Quality Volume, cu.ft. (RISDISM 3.3.3)	2,073	3,946	3,001	539	1,644
Sediment Forebay	Use	Pretreatment 25% WQV (non-roof)	Pretreatment 25% WQV (non-roof)	Pretreatment 25% WQV (non-roof)	Pretreatment 25% WQV (non-roof)	Pretreatment 25% WQV (non-roof)
	Required Storage Volume, cu.ft.	518	986	750	135	411
	Proposed Sediment Forebay Bottom Area, sq.ft.	438	689	702	0	102
	Proposed Sediment Forebay Top Area, sq.ft.	648	1,345	1,635	617	381
	Proposed Sediment Forebay Depth, ft	1	1	1	1	2
	Proposed Sediment Forebay Storage Volume, cu.ft.	**543**	**1,017**	**1,169**	**309**	**483**
Filter	Use	Treatment 100% WQV	Treatment 100% WQV			Treatment 100% WQV
	Required WQV, cu.ft.	2,073	3,946			1,644
	Filter Bed Depth, ft	1.50	1.50			1.50
	Permeability, ft/day	3.5	3.5			3.5
	Ponding Depth, ft	1	1			2
	Average height of water, ft	0.5	0.5			1
	Drain Time, day	2	2			2
	Min. Filter Area, sq.ft. (RISDISM 5.5.4)	222	423			141
	Proposed Filter Area, sq.ft.	**3,692**	**1,801**			**3,011**
	Proposed Filter Top of Ponding Area, sq.ft.	4,659	2,247			4,282
	Proposed Filter Storage Volume, cu.ft.	6,003	2,915			8,783
	75% Water Quality Volume, cu.ft.	1,555	2,959			1,233
	Total Storage Including Pretreatment, cu.ft.	**6,546**	**3,932**			**9,266**
Infiltration				Entire WQ-storm See HydroCAD	Entire WQ-storm See HydroCAD	

Proposed Stormwater Treatment

		PR-12 Bioretention Pond	PR-13 SC-740 + MC-4500 Sand Filter System	PR-14 MC-3500 Sand Filter System
	Pretreatment Treatment	Sediment Forebay Sand Filter	Isolator Row Sand Filter	Isolator Row Sand Filter
	Impervious Area, sq.ft. (non-roof)	4,167	289,919	18,090
	Impervious Area, sq.ft. (roof)	5,672	31,372	52,498
	Water Quality Volume, cu.ft. (RISDISM 3.3.3)	820	26,774	5,882
Sediment Forebay	Use	Pretreatment 25% WQV (non-roof)	Pretreatment 25% WQV (non-roof)	Pretreatment 25% WQV (non-roof)
	Required Storage Volume, cu.ft.	87	6,040	377
	Proposed Sediment Forebay Bottom Area, sq.ft.	0		
	Proposed Sediment Forebay Top Area, sq.ft.	221		
	Proposed Sediment Forebay Depth, ft	0.8		
	Proposed Sediment Forebay Storage Volume, cu.ft.	**88**	**6,134**	**1,230**
Filter	Use	Treatment 100% WQV	Treatment 100% WQV	Treatment 100% WQV
	Required WQV, cu.ft. Filter Bed Depth, ft Permeability, ft/day Ponding Depth, ft Average height of water, ft Drain Time, day	820 2.00 1.0 1 0.5 2	Entire WQ-storm infiltrations though system	Entire WQ-storm infiltrations though system
	Min. Filter Area, sq.ft. (RISDISM 5.5.4)	328		
	Proposed Filter Area, sq.ft.	**1,945**		
	Proposed Filter Top of Ponding Area, sq.ft.	2,615		
	Proposed Filter Storage Volume, cu.ft.	3,564		
	75% Water Quality Volume, cu.ft.	615		
	Total Storage Including Pretreatment, cu.ft.	**3,652**		
Infiltration				

APPENDIX D.2:

Pollutant Loading Analysis

Pollutant Loading Analysis

Existing TSS Pollutant Loading

		Area (acre)	Percent	Pollutant Loading*	Net Pollutant Loading	Removal Type	Removal Efficiency*	Discharge to Watershed
Existing	Commercial Undeveloped/Rural	0.000 47.700	0.0% 100.0%	75 mg/l 51 mg/l	51 mg/l	NA	0%	51 mg/l

Proposed TSS Pollutant Loading

		Area (acre)	Percent	Pollutant Loading*	Net Pollutant Loading	Removal Type	Removal Efficiency*	Discharge to Watershed	Percent Total	Overall Discharge to Watershed
Untreated	Commercial Undeveloped/Rural	0.500 26.700	1.8% 98.2%	75 mg/l 51 mg/l	51 mg/l	NA	0%	51 mg/l	56.9%	32 mg/l
Treated	Commercial Undeveloped/Rural	16.500 0.000	100.0% 0.0%	75 mg/l 51 mg/l	75 mg/l	Sediment Forebay & Sand Filter	25% 86%	8 mg/l	34.5%	
Treated	Commercial Undeveloped/Rural	2.600 0.500	83.9% 16.1%	75 mg/l 51 mg/l	71 mg/l	Sediment Forebay & Infiltration Basin	25% 90%	5 mg/l	6.5%	
Treated	Commercial Undeveloped/Rural	0.500 0.000	100.0% 0.0%	75 mg/l 51 mg/l	75 mg/l	Sediment Forebay & Bioretention	25% 90%	6 mg/l	1.0%	
Treated	Commercial Undeveloped/Rural	0.500 0.000	100.0% 0.0%	75 mg/l 51 mg/l	75 mg/l	Permeable Paving	90%	8 mg/l	1.0%	

Existing TP Pollutant Loading

		Area (acre)	Percent	Pollutant Loading*	Net Pollutant Loading	Removal Type	Removal Efficiency*	Discharge to Watershed
Existing	Commercial Undeveloped/Rural	0.000 47.700	0.0% 100.0%	0.20 mg/l 0.11 mg/l	0.11 mg/l	NA	0%	0.11 mg/l

Proposed TP Pollutant Loading

		Area (acre)	Percent	Pollutant Loading*	Net Pollutant Loading	Removal Type	Removal Efficiency*	Discharge to Watershed	Percent Total	Overall Discharge to Watershed
Untreated	Commercial Undeveloped/Rural	0.500 26.700	1.8% 98.2%	0.20 mg/l 0.11 mg/l	0.11 mg/l	NA	0%	0.11 mg/l	56.9%	0.09 mg/l
Treated	Commercial Undeveloped/Rural	16.500 0.000	100.0% 0.0%	0.20 mg/l 0.11 mg/l	0.20 mg/l	Sediment Forebay & Sand Filter	25% 59%	0.06 mg/l	34.5%	
Treated	Commercial Undeveloped/Rural	2.600 0.500	83.9% 16.1%	0.20 mg/l 0.11 mg/l	0.19 mg/l	Sediment Forebay & Infiltration Basin	25% 65%	0.05 mg/l	6.5%	
Treated	Commercial Undeveloped/Rural	0.500 0.000	100.0% 0.0%	0.20 mg/l 0.11 mg/l	0.20 mg/l	Sediment Forebay & Bioretention	25% 30%	0.11 mg/l	1.0%	
Treated	Commercial Undeveloped/Rural	0.500 0.000	100.0% 0.0%	0.20 mg/l 0.11 mg/l	0.20 mg/l	Permeable Paving	40%	0.12 mg/l	1.0%	

* Pollutant Loading from Table H-2 and Removal Efficiency from Tables H-3 & H-4 of the Rhode Island Stormwater Design and Installation Standards Manual

APPENDIX E:

Hydraulic Analyses

APPENDIX E.1:

Hydraulic Analysis

Groundwater Recharge (3.3.2)

A Soils Area	$Aa = 0.3\ ac.$
B Soils Area	$Ab = 10.8\ ac.$
C Soils Area	$Ac = 1.6\ ac.$
D Soils Area	$Ad = 0.1\ ac.$
Total Impervious Area	$I = 12.8\ ac.$

Recharge Factor (table 3-4) $F = \frac{Aa(0.60)+Ab(0.35)+Ac(0.25)+Ad(0.10)}{I} = 0.34$

Required Groundwater Recharge Volume $Re_v = \frac{1"}{12}(F)(I) = 0.36\ ac.ft.$

HydroCAD calculations are provided in Appendix C; these calculations show that for the 1-year storm, approximately 0.27 acre feet of stormwater is infiltrated. This does not include what will be infiltrated though the permeable pavement.

Based on soil investigations conducted throughout the development site, existing recharge appears to be limited. Subsurface soil conditions consist of dense glacial till, underlain by gravely sands. Due to the dense till in the upper soil strata, limited stormwater infiltration is expected to be possible.

Under proposed conditions, groundwater recharge is provided to the maximum extent practicable through the infiltration basins located along the primary access drive and the permeable pavement surface of the emergency access drive. Groundwater recharge is not possible in other areas of the site due to shallow bedrock and shallow seasonal high groundwater tables. In these areas, shallow groundwater flows along the restrictive ledge layer before finding daylight into the adjacent wetlands. To mimic this condition, underdrains are incorporated below proposed sand filters and bioretention. These systems approximate groundwater recharge by filtering stormwater through soil media and conveying flow to the adjacent wetland complexes, similar to that which occurs under existing conditions.

Outlet Protection

Rip Rap Stilling Basins shall be used as outlet protection for FES-2, FES-6, FES-10, HW-4, and HW-6. Stilling Basin rip rap has been sized according to the Rhode Island Soil Erosion and Sediment Control Hand Book (see example below). All Stilling Basins will use National Stone Association Modified NSA No. R-4 with a d_{50} of 7 per RIDOT Blue Book.

Sizing Example: FES #2 (25-yr storm)

$$d_{50} = \left(\frac{0.02}{TW}\right)\left(\frac{Q}{D_o}\right)^{4/3} = \left(\frac{0.02}{0.91}\right)\left(\frac{6.04}{1.25}\right)^{4/3} = 0.18\ ft = 2.15\ inches$$

Flared End Section Sizing Chart

	Inv.	HGL	TW	Q	Do	d50 (ft)	d50 (in)
FES-2	209.00	209.91	0.91	6.04	1.25	0.18	2.15
FES-6	235.00	235.85	0.85	4.46	1.25	0.13	1.54
FES-10	183.00	183.80	0.80	7.70	1.25	0.28	3.39
FES-11	194.00	194.87	0.87	4.33	1.00	0.16	1.95
HW-4	183.00	186.30	3.30	25.03	2.50	0.13	1.57
HW-6	183.00	186.30	3.30	25.03	2.50	0.13	1.57
HW-7	184.80	186.30	1.50	9.90	1.50	0.17	1.98

For all other flared end sections and head walls, the velocities are below maximum permissible velocity for grassed areas, therefore no additional erosion control measures are required.

APPENDIX E.2:

Gutter & Low Point Analysis

Catch Basin / Roof Areas and Low Point Analysis

Pro ect: Twin River - Tiverton
Town: Tiverton
Route:
Designed by: AKG **Date:** 4/4/2017

	10 Year	*25 Year*	*100 Year*
Intensity (in/hr):	6.1	7.4	10.0
Time of Concentration:		5 minutes	

CB-Type		*Perimeter (ft)*	*Area (sq.ft)*
Double Grate (RIDOT 6.3.0)	DCB	7.5	3.125
Single Grate (RIDOT 6.3.0)	CB	5	1.5625

Equations
Flow: $Q = CIA$
Depth above Grate:
Weir Equation for depths less than 0.4'
Orifice Equation for depths greater than 1.4'
Max depth from either equation when depth is between 0.4' and 1.4'
Weir Equation (C=3.0) $Q = CPd^{1.5} \rightarrow d = (Q/CP)^{2/3}$
Orifice Equation (C=0.67, g=32.2) $Q = CA\sqrt{2gd} \rightarrow d = \frac{(Q/CA)^2}{2g}$

Number	*C=0.9* Impervious Area (SF.)	*C=0.9* Impervious Area (acres)	*C=0.2* Grassed Area (SF.)	*C=0.2* Grassed Area (acres)	*C=0.1* Wooded Area (SF.)	*C=0.1* Wooded Area (acres)	Accepting Catch Basin/Pipe	Total Area (acres)	Weighted Runoff Coefficient, C	Total AC (see gutter flow)	Q_{25} (cfs)	Q_{100} (cfs)	CB Type	Water Depth Above Grate d_{25} (ft)	Water Depth Above Grate d_{100} (ft)
FES-5	19,047	0.437	45,093	1.035	0	0.000	FES-5	1.47	0.408	0.601	4.4	6.0		Piped	
HW-2	2,909	0.067	4,207	0.097	20,128	0.462	HW-2	0.63	0.201	0.126	0.9	1.3		Piped	
FES-1	0	0.000	5,394	0.124	15,576	0.358	FES-1	0.48	0.126	0.061	0.4	0.6		Piped	
FES-7	0	0.000	0	0.000	268,945	6.174	FES-7	6.17	0.100	0.617	4.6	6.2		Piped	
DMH-49	0	0.000	0	0.000	6,013	0.138	DMH-49	0.14	0.100	0.014	0.1	0.1		Piped	
CB-23	See HydroCAD										0.2	2.2		Piped	
DMH-39	See HydroCAD										9.9	14.4		Piped	
GARAGE	154,309	3.542	2,358	0.054	0	0.000	GARAGE	3.60	0.889	3.199	23.7	32.0		Piped	
BLDG-A	40,371	0.927	0	0.000	0	0.000	BLDG-A	0.93	0.900	0.834	6.2	8.3		Piped	
BLDG-B	52,879	1.214	0	0.000	0	0.000	BLDG-B	1.21	0.900	1.093	8.1	10.9		Piped	
CB-1A	6,664	0.153	1,860	0.043	0	0.000	CB-1A	0.20	0.747	0.146	1.1	1.5	CB	Gutter Flow	
CB-2A	3,029	0.070	1,097	0.025	0	0.000	CB-2A	0.09	0.714	0.120	0.9	1.2	CB	Gutter Flow	
CB-4A	3,173	0.073	1,110	0.025	0	0.000	CB-4A	0.10	0.719	0.111	0.8	1.1	CB	Gutter Flow	
CB-5A	3,021	0.069	1,109	0.025	0	0.000	CB-5A	0.09	0.712	0.106	0.8	1.1	CB	Gutter Flow	
CB-6A	3,241	0.074	1,196	0.027	0	0.000	CB-6A	0.10	0.711	0.111	0.8	1.1	CB	Gutter Flow	
CB-7A	3,615	0.083	0	0.000	0	0.000	CB-7A	0.08	0.900	0.116	0.9	1.2	CB	Gutter Flow	
CB-10A	7,315	0.168	1,383	0.032	0	0.000	CB-10A	0.20	0.789	0.268	2.0	2.7	DCB	0.20	0.24
CB-1B	8,904	0.204	1,183	0.027	0	0.000	CB-1B	0.23	0.818	0.189	1.4	1.9	CB	Gutter Flow	
CB-2B	4,786	0.110	2,519	0.058	7,317	0.168	CB-2B	0.34	0.379	0.204	1.5	2.0	CB	Gutter Flow	
CB-4B	5,381	0.124	3,062	0.070	14,980	0.344	CB-4B	0.54	0.297	0.249	1.8	2.5	CB	Gutter Flow	
CB-5B	3,340	0.077	1,368	0.031	691	0.016	CB-5B	0.12	0.620	0.200	1.5	2.0	CB	Gutter Flow	
CB-6B	3,221	0.074	1,199	0.028	0	0.000	CB-6B	0.10	0.710	0.166	1.2	1.7	CB	Gutter Flow	
CB-7B	3,639	0.084	1,993	0.046	0	0.000	CB-7B	0.13	0.652	0.157	1.2	1.6	CB	Gutter Flow	
CB-10B	6,417	0.147	2,630	0.060	0	0.000	CB-10B	0.21	0.697	0.213	1.6	2.1	DCB	0.17	0.21
CB-13A	6,365	0.146	1,413	0.032	0	0.000	CB-13A	0.18	0.773	0.150	1.1	1.5	DCB	Gutter Flow	
CB-14	2,087	0.048	749	0.017	0	0.000	CB-14	0.07	0.715	0.058	0.4	0.6	CB	Gutter Flow	
CB-15	2,050	0.047	764	0.018	0	0.000	CB-15	0.06	0.710	0.060	0.4	0.6	CB	Gutter Flow	
CB-20A	2,463	0.057	935	0.021	0	0.000	CB-20A	0.08	0.707	0.066	0.5	0.7	CB	Gutter Flow	
CB-21A	2,292	0.053	1,043	0.024	0	0.000	CB-21A	0.08	0.681	0.052	0.4	0.5	CB	Gutter Flow	
CB-13B	5,696	0.131	21,188	0.486	0	0.000	CB-13B	0.62	0.348	0.412	3.0	4.1	DCB	Gutter Flow	
CB-16	11,233	0.258	8,886	0.204	0	0.000	CB-16	0.46	0.591	0.384	2.8	3.8	CB	Gutter Flow	
CB-20B	2,416	0.055	834	0.019	0	0.000	CB-20B	0.07	0.720	0.207	1.5	2.1	CB	Gutter Flow	

Number	C=0.9		C=0.2		C=0.1		Accepting Catch Basin/Pipe	Total Area (acres)	Weighted Runoff Coefficient, C	Total AC (see gutter flow)	Q_{25} (cfs)	Q_{100} (cfs)	CB Type	Water Depth Above Grate d_{25} (ft)	Water Depth Above Grate d_{100} (ft)
	Impervious Area (SF.)	Impervious Area (acres)	Grassed Area (SF.)	Grassed Area (acres)	Wooded Area (SF.)	Wooded Area (acres)									
CB-21B	7,859	0.180	3,290	0.076	0	0.000	CB-21B	0.26	0.693	0.324	2.4	3.2	CB	Gutter Flow	
CB-22	12,316	0.283	2,443	0.056	0	0.000	CB-22	0.34	0.784	0.266	2.0	2.7	CB	Gutter Flow	
CB-18	3,590	0.082	0	0.000	0	0.000	CB-18	0.08	0.900	0.074	0.5	0.7	CB	Gutter Flow	
CB-19	3,973	0.091	1,083	0.025	0	0.000	CB-19	0.12	0.750	0.087	0.6	0.9	CB	0.12	0.15
CB-26	11,924	0.274	10,289	0.236	0	0.000	CB-26	0.51	0.576	0.554	4.1	5.5	DCB	0.32	0.39
CB-38	11,384	0.261	3,879	0.089	0	0.000	CB-38	0.35	0.722	0.253	1.9	2.5	DCB	0.19	0.23
CB-37	13,351	0.306	7,043	0.162	0	0.000	CB-37	0.47	0.658	0.308	2.3	3.1	CB	Gutter Flow	
CB-36	2,403	0.055	320	0.007	0	0.000	CB-36	0.06	0.818	0.051	0.4	0.5	CB	0.09	0.11
CB-35	1,694	0.039	850	0.020	0	0.000	CB-35	0.06	0.666	0.181	1.3	1.8	CB	Gutter Flow	
CB-34	1,866	0.043	2,873	0.066	0	0.000	CB-34	0.11	0.476	0.118	0.9	1.2	CB	Gutter Flow	
CB-33	8,316	0.191	8,858	0.203	0	0.000	CB-33	0.39	0.539	0.248	1.8	2.5	DCB	Gutter Flow	
CB-43	12,629	0.290	4,458	0.102	0	0.000	CB-43	0.39	0.717	0.281	2.1	2.8	CB	0.27	0.33
CB-41	4,628	0.106	2,566	0.059	0	0.000	CB-41	0.17	0.650	0.107	0.8	1.1	DCB	Gutter Flow	
CB-31	8,548	0.196	11,356	0.261	0	0.000	CB-31	0.46	0.501	0.377	2.8	3.8	CB	Gutter Flow	
CB-30	3,177	0.073	4,910	0.113	0	0.000	CB-30	0.19	0.475	0.300	2.2	3.0	CB	Gutter Flow	
CB-28	11,901	0.273	14,335	0.329	0	0.000	CB-28	0.60	0.518	0.467	3.5	4.7	DCB	0.29	0.35
CB-50	12,373	0.284	2,740	0.063	0	0.000	CB-50	0.35	0.773	0.268	2.0	2.7	CB	0.26	0.32

Tailwater				
Outlet	Pipe Number	Pond	25-yr Storm	100-yr Storm
FES-2	P-5A	P-3	208.9	209.3
FES-3	P-6A	P-4	202.2	203.1
FES-4	P-9	P-5	190.1	190.3
HW-7	P-47	P-10	186.3	187.6
DMH-39	P-41	P-9	206.5	206.7
DMH-24 DMH-11	P-26 P-13A	P-7+8	193.4	193.7

Gutter Flow Analysis

Pro ect: Twin River - Tiverton
Town: Tiverton
Designed by: AKG **Date:** 4/4/2017

GUTTER FLOW ANALYSIS (25 Year Storm)

Inlet Station and Offset	Area in Acres (A)	Runoff Coefficient (C)	Time to Inlet (Min)	Rainfall Intensity in/hr (I)	AC	AC From Bypassing Inlets	Total AC	Q_T To Inlet (cfs)	Grade of Gutter (ft/ft)	Cross Slope of Shoulder (ft/ft)	d Depth of Flow of Gutter (feet)	T Width of Flow (feet)	Q Bypassing Inlet (cfs)	AC Bypassing Inlet	AC Entering Catch Basin
CB-1A	0.20	0.747	5	7.4	0.146		0.146	1.082	0.055	0.020	0.100	4.99	0.389	0.053	0.094
CB-2A	0.09	0.714	5	7.4	0.068	0.053	0.120	0.889	0.050	0.020	0.094	4.72	0.295	0.040	0.080
CB-4A	0.10	0.719	5	7.4	0.071	0.040	0.111	0.818	0.036	0.020	0.097	4.86	0.284	0.038	0.072
CB-5A	0.09	0.712	5	7.4	0.068	0.038	0.106	0.783	0.028	0.020	0.100	5.02	0.283	0.038	0.068
CB-6A	0.10	0.711	5	7.4	0.072	0.038	0.111	0.819	0.027	0.020	0.103	5.13	0.305	0.041	0.070
CB-7A	0.08	0.900	5	7.4	0.075	0.041	0.116	0.858	0.029	0.020	0.103	5.15	0.321	0.043	0.072
CB-10A	0.20	0.789	5	7.4	0.157	0.110	0.268	1.983	Low Point						
CB-1B	0.23	0.818	5	7.4	0.189		0.189	1.402	0.053	0.020	0.111	5.53	0.571	0.077	0.112
CB-2B	0.34	0.379	5	7.4	0.127	0.077	0.204	1.512	0.045	0.020	0.118	5.88	0.658	0.089	0.115
CB-4B	0.54	0.297	5	7.4	0.160	0.089	0.249	1.839	0.032	0.020	0.135	6.73	0.908	0.123	0.126
CB-5B	0.12	0.620	5	7.4	0.077	0.123	0.200	1.477	0.028	0.020	0.127	6.37	0.695	0.094	0.106
CB-6B	0.10	0.710	5	7.4	0.072	0.094	0.166	1.228	0.028	0.020	0.119	5.94	0.540	0.073	0.093
CB-7B	0.13	0.652	5	7.4	0.084	0.073	0.157	1.164	0.027	0.020	0.117	5.86	0.505	0.068	0.089
CB-10B	0.21	0.697	5	7.4	0.145	0.068	0.213	1.576	Low Point						
CB-18	0.08	0.900	5	7.4	0.074		0.074	0.549	0.009	0.020	0.108	5.38	0.217	0.029	0.045
														to CB-16B	
CB-22	0.34	0.784	5	7.4	0.266		0.266	1.966	0.017	0.020	0.155	7.77	1.084	0.146	0.119
CB-21B	0.26	0.693	5	7.4	0.177	0.146	0.324	2.397	0.070	0.020	0.128	6.42	1.136	0.154	0.170
CB-20B	0.07	0.720	5	7.4	0.054	0.154	0.207	1.534	0.076	0.020	0.107	5.36	0.602	0.081	0.126
CB-16	0.46	0.591	5	7.4	0.273	0.111	0.384	2.838	0.060	0.020	0.141	7.05	1.456	0.197	0.187
CB-13B	0.62	0.348	5	7.4	0.215	0.197	0.412	3.047	0.012	0.020	0.195	9.75	1.925	0.260	0.152
CB-26	0.51	0.576	5	7.4	0.294	0.260	0.554	4.098	Low Point						
CB-21A	0.08	0.681	5	7.4	0.052		0.052	0.386	0.033	0.020	0.075	3.73	0.083	0.011	0.041
CB-20A	0.08	0.707	5	7.4	0.055	0.011	0.066	0.491	0.058	0.020	0.073	3.67	0.102	0.014	0.053
CB-15	0.06	0.710	5	7.4	0.046	0.014	0.060	0.441	0.060	0.020	0.070	3.51	0.081	0.011	0.049
CB-14	0.07	0.715	5	7.4	0.047	0.011	0.058	0.426	0.045	0.020	0.073	3.65	0.087	0.012	0.046
CB-13A	0.18	0.773	5	7.4	0.138	0.012	0.150	1.108	0.021	0.020	0.121	6.04	0.496	0.067	0.083
														to CB-10A	

Pro ect: Twin River - Tiverton
Town: Tiverton
Designed by: AKG **Date:** 4/4/2017

GUTTER FLOW ANALYSIS (25 Year Storm)

Inlet Station and Offset	Area in Acres (A)	Runoff Coefficient (C)	Time to Inlet (Min)	Rainfall Intensity in/hr (I)	AC	AC From Bypassing Inlets	Total AC	Q_T To Inlet (cfs)	Grade of Gutter (ft/ft)	Cross Slope of Shoulder (ft/ft)	d Depth of Flow of Gutter (feet)	T Width of Flow (feet)	Q Bypassing Inlet (cfs)	AC Bypassing Inlet	AC Entering Catch Basin
CB-37	0.47	0.658	5	7.4	0.308		0.308	2.281	0.075	0.020	0.124	6.22	1.050	0.142	0.166
CB-35	0.06	0.666	5	7.4	0.039	0.142	0.181	1.338	0.079	0.020	0.101	5.05	0.488	0.066	0.115
CB-34	0.11	0.476	5	7.4	0.052	0.066	0.118	0.871	0.068	0.020	0.088	4.42	0.261	0.035	0.082
CB-33	0.39	0.539	5	7.4	0.212	0.035	0.248	1.834	0.053	0.020	0.123	6.13	0.832	0.112	0.135
														to CB-31	
CB-41	0.17	0.650	5	7.4	0.107		0.107	0.795	0.038	0.020	0.095	4.76	0.267	0.036	0.071
CB-31	0.46	0.501	5	7.4	0.229	0.149	0.377	2.792	0.030	0.020	0.159	7.96	1.566	0.212	0.166
CB-30	0.19	0.475	5	7.4	0.088	0.212	0.300	2.218	0.034	0.020	0.143	7.16	1.152	0.156	0.144
CB-28	0.60	0.518	5	7.4	0.312	0.156	0.467	3.459	Low Point						

SUCKER BROOK

WILLIAM S. CANNING BLVD ROUTE 81

STAFFORD ROAD ROUTE 81

SCALE: 1"=80'

80' 0' 80' 160' 240'

N

CLIENT:
TWIN RIVER
TIVERTON, LLC
C/O MARK RUSSO ESQ
55 PINE STREET
4TH FLOOR
PROVIDENCE, RI 02903

PROJECT:
TWIN RIVER - TIVERTON
PROPOSED LAND CLEARING & GRADING
PLAT 203 LOTS 107 & 111
PLAT 204 LOTS 101, 102, 103, 106 & 108
WILLIAM S. CANNING BLVD AND STAFFORD ROAD
TIVERTON, RHODE ISLAND

TITLE:
GUTTER FLOW & LOW POINT FIGURE

LEGEND
EX-1 DRAINAGE AREA
DRAINAGE AREA DIVIDE

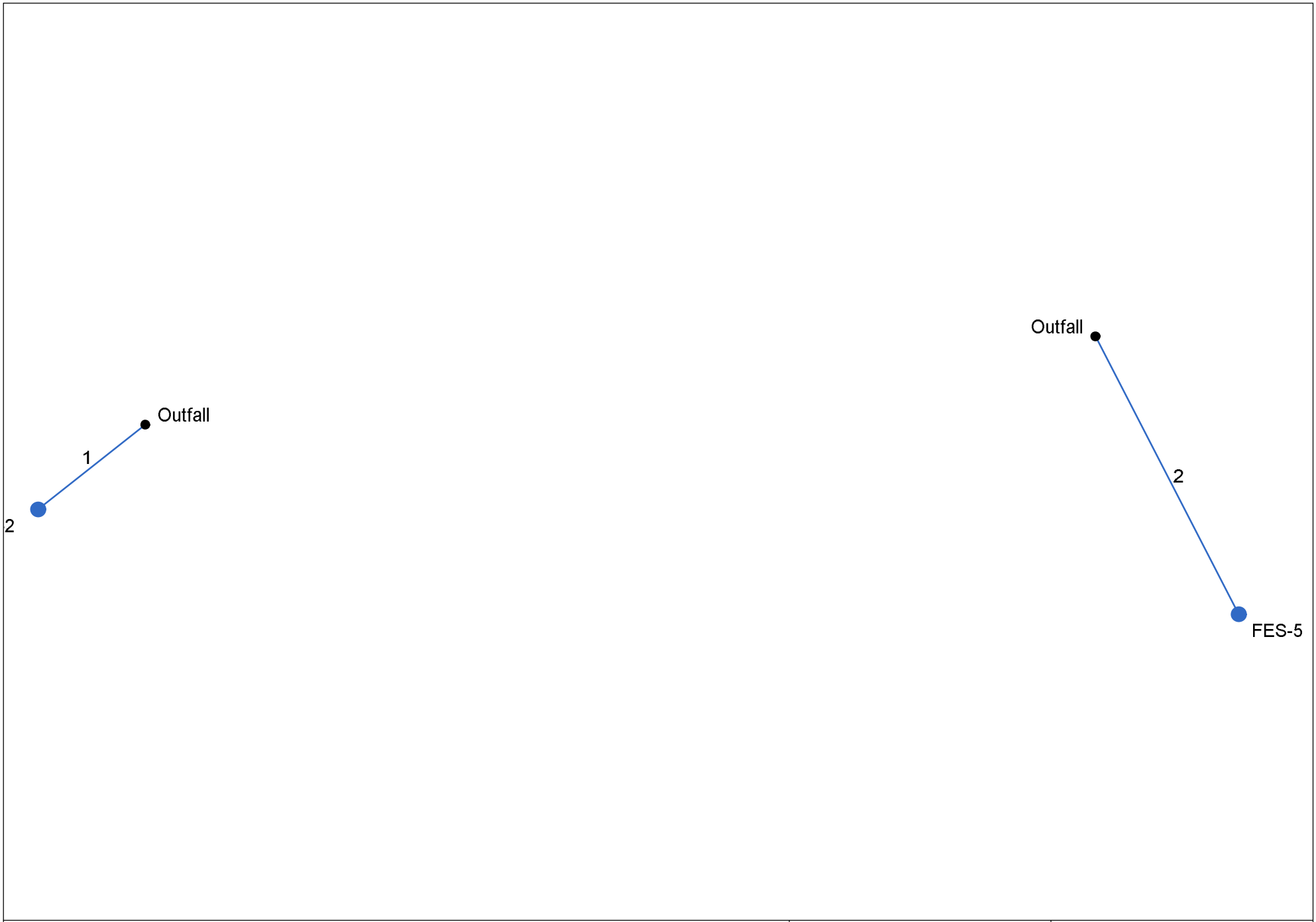
DESIGNED BY: AKG/TMT
DRAWN BY: AKG/TMT
CHECKED BY: CNB
SCALE: 1" = 80'
PROJECT NUMBER: 3653160007
DATE: 3/21/2017
DRAWING NUMBER:
SHEET NUMBER: 1 OF 1

amec foster wheeler
AMEC FOSTER WHEELER
ENVIRONMENT & INFRASTRUCTURE, INC.
275 PROMENADE STREET, SUITE 120
PROVIDENCE RHODE ISLAND, 02908
WEB: WWW.AMECFW.COM

APPENDIX E.3:

Pipe Flow Calculations

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: Culverts.stm	Number of lines: 2	Date: 3/16/2017

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	P-HW2	0.94	12	Cir	38.350	235.70	236.90	3.129	236.11	237.31	n/a	237.31	End	Manhole
2	P-FES5	4.46	15	Cir	88.093	235.00	235.70	0.795	235.85	236.55	0.39	236.55	End	Manhole

Project File: Culverts.stm | Number of lines: 2 | Run Date: 3/16/2017

NOTES: Return period = 25 Yrs.

Storm Sewer Tabulation

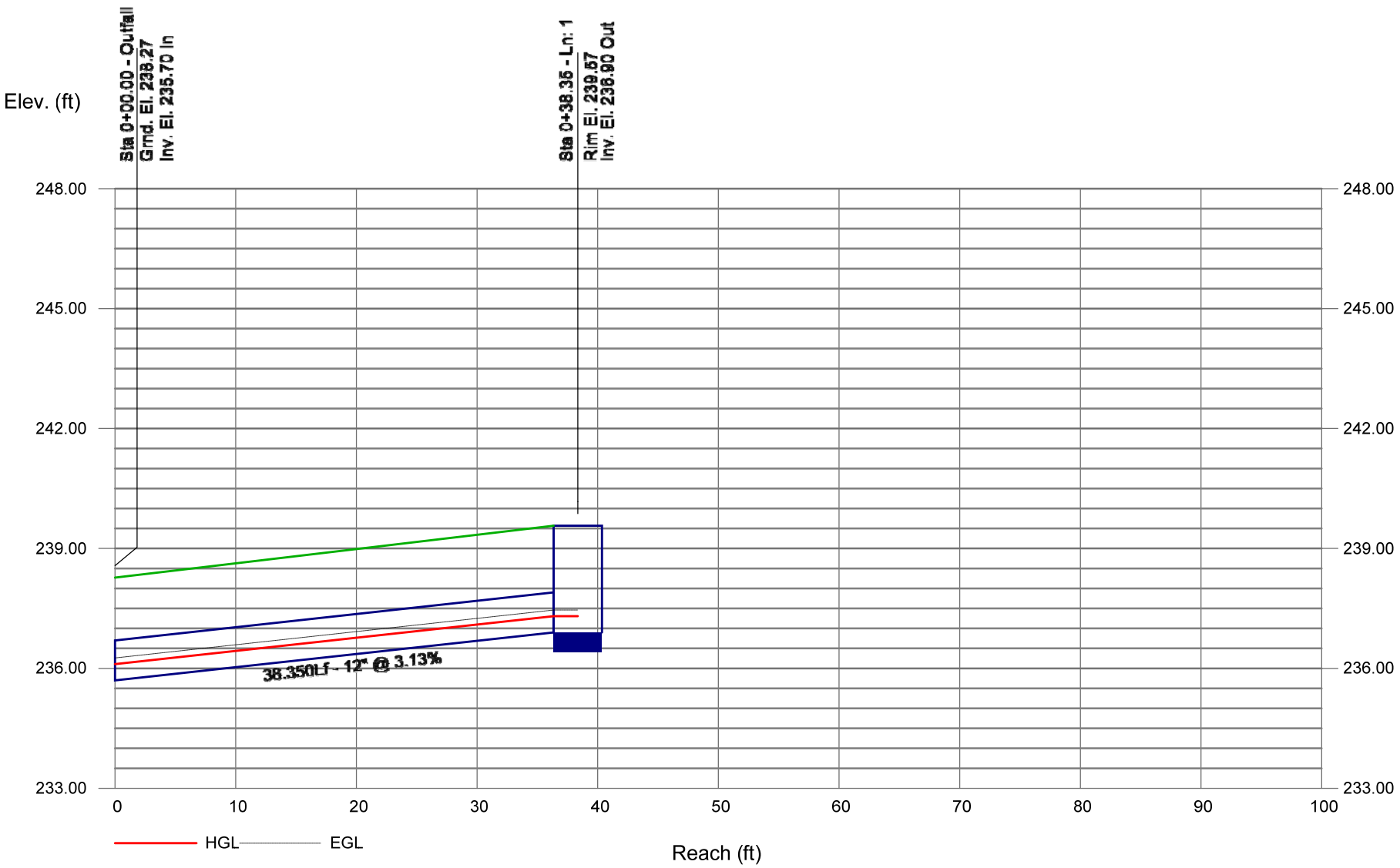
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	38.350	0.63	0.63	0.20	0.13	0.13	5.0	5.0	7.4	0.94	6.82	3.14	12	3.13	235.70	236.90	236.11	237.31	238.27	239.57	P-HW2
2	End	88.093	1.47	1.47	0.41	0.60	0.60	5.0	5.0	7.4	4.46	6.24	4.99	15	0.79	235.00	235.70	235.85	236.55	237.73	238.23	P-FES5

Project File: Culverts.stm | Number of lines: 2 | Run Date: 3/16/2017

NOTES:Intensity = 39.68 / (Inlet time + 6.30) ^ 0.69 ; Return period =Yrs. 25 ; c = cir e = ellip b = box

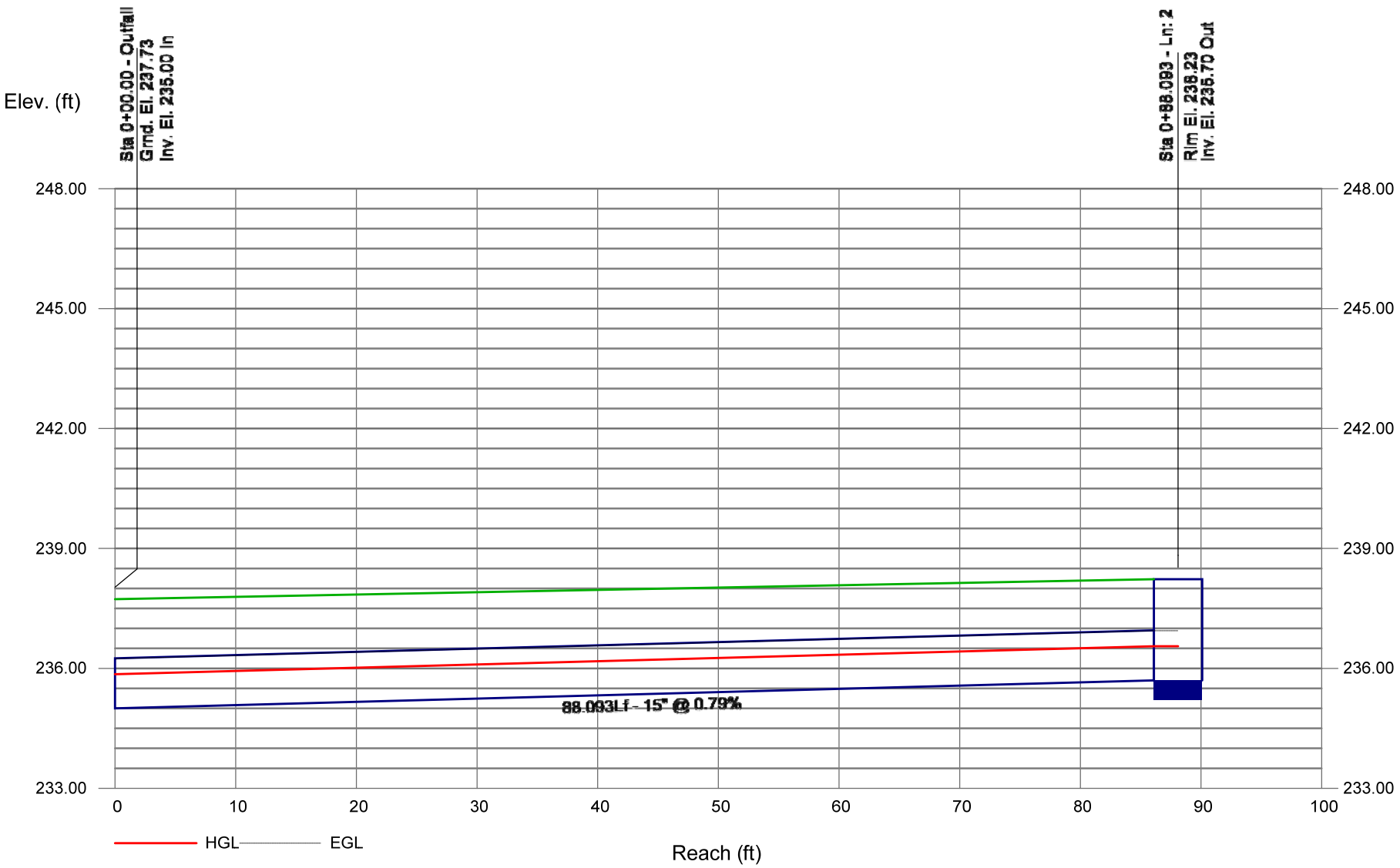
Storm Sewer Profile

Proj. file: Culverts.stm

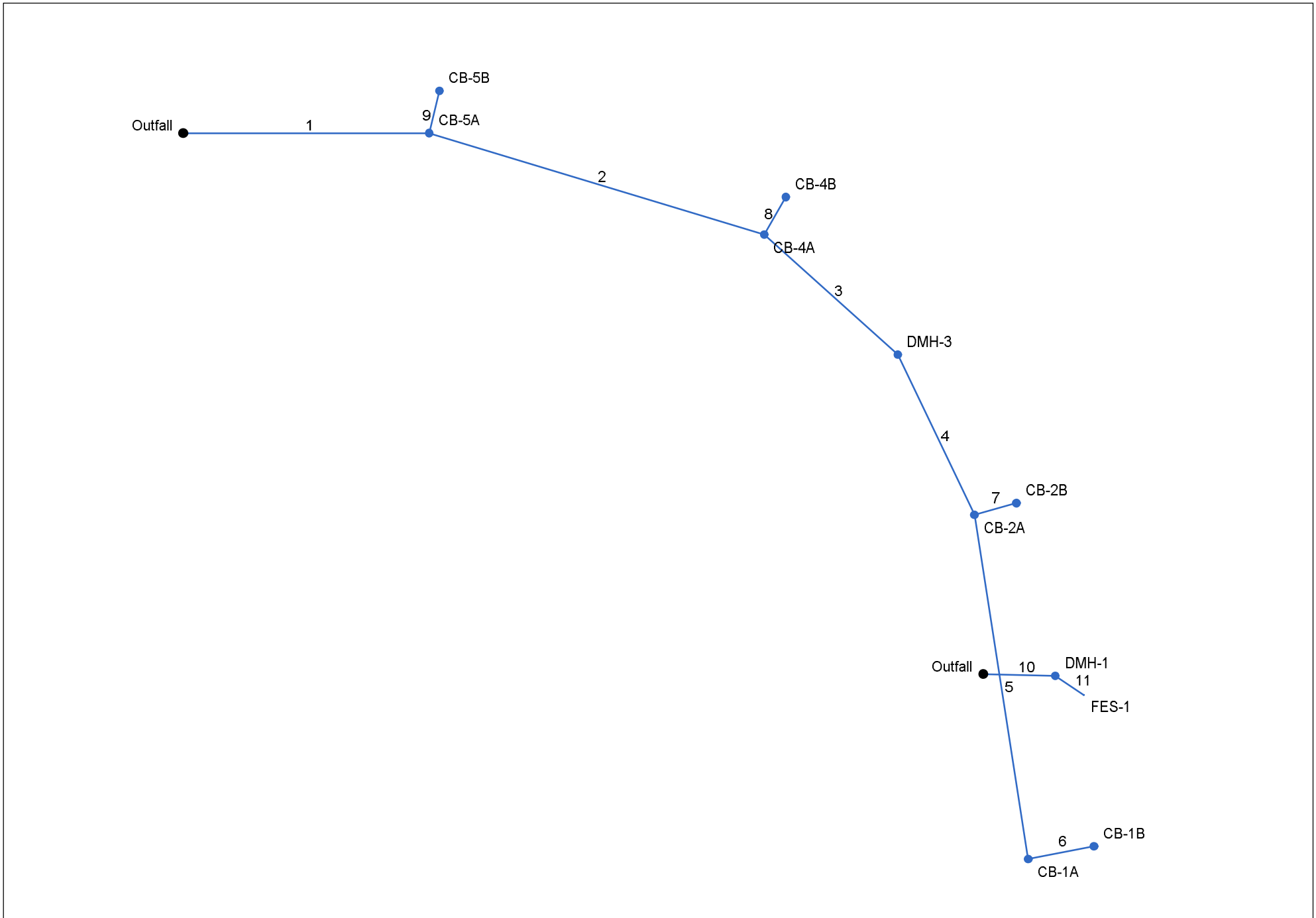


Storm Sewer Profile

Proj. file: Culverts.stm



Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: Pond 3.stm	Number of lines: 11	Date: 4/4/2017

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	P-5A	6.04	15	Cir	140.552	209.00	211.70	1.921	209.71	212.69	0.51	212.69	End	Manhole
2	P-4A	5.28	12	Cir	200.113	211.80	217.40	2.798	212.69	218.33	n/a	218.33	1	Manhole
3	P-3A	3.82	12	Cir	102.802	217.50	220.60	3.016	218.33	221.43	0.21	221.43	2	Manhole
4	P-2A	3.64	12	Cir	101.855	220.70	225.20	4.418	221.43	226.01	0.44	226.01	3	Manhole
5	P-1A	2.46	12	Cir	199.952	225.30	227.30	1.000	226.01	227.97	n/a	227.97 j	4	Manhole
6	P-1B	1.40	12	Cir	38.276	235.60	236.00	1.045	236.01	236.50	0.20	236.50	5	Manhole
7	P-2B	0.96	12	Cir	24.937	225.30	225.60	1.203	226.01	226.01	n/a	226.01 j	4	Manhole
8	P-4B	1.19	12	Cir	24.829	217.50	217.80	1.208	218.33	218.26	n/a	218.26	2	Manhole
9	P-5B	0.55	12	Cir	24.968	211.80	212.10	1.202	212.69	212.41	n/a	212.41	1	Manhole
10	P-DMH1	0.45	12	Cir	41.143	228.50	229.40	2.187	228.78	229.68	n/a	229.68	End	Manhole
11	P-FES1	0.46	12	Cir	19.572	231.50	233.80	11.752	231.63	234.08	n/a	234.08	10	Manhole

Project File: Pond 3.stm | Number of lines: 11 | Run Date: 4/4/2017

NOTES: Return period = 25 Yrs. ; j - Line contains hyd. jump.

Storm Sewer Tabulation

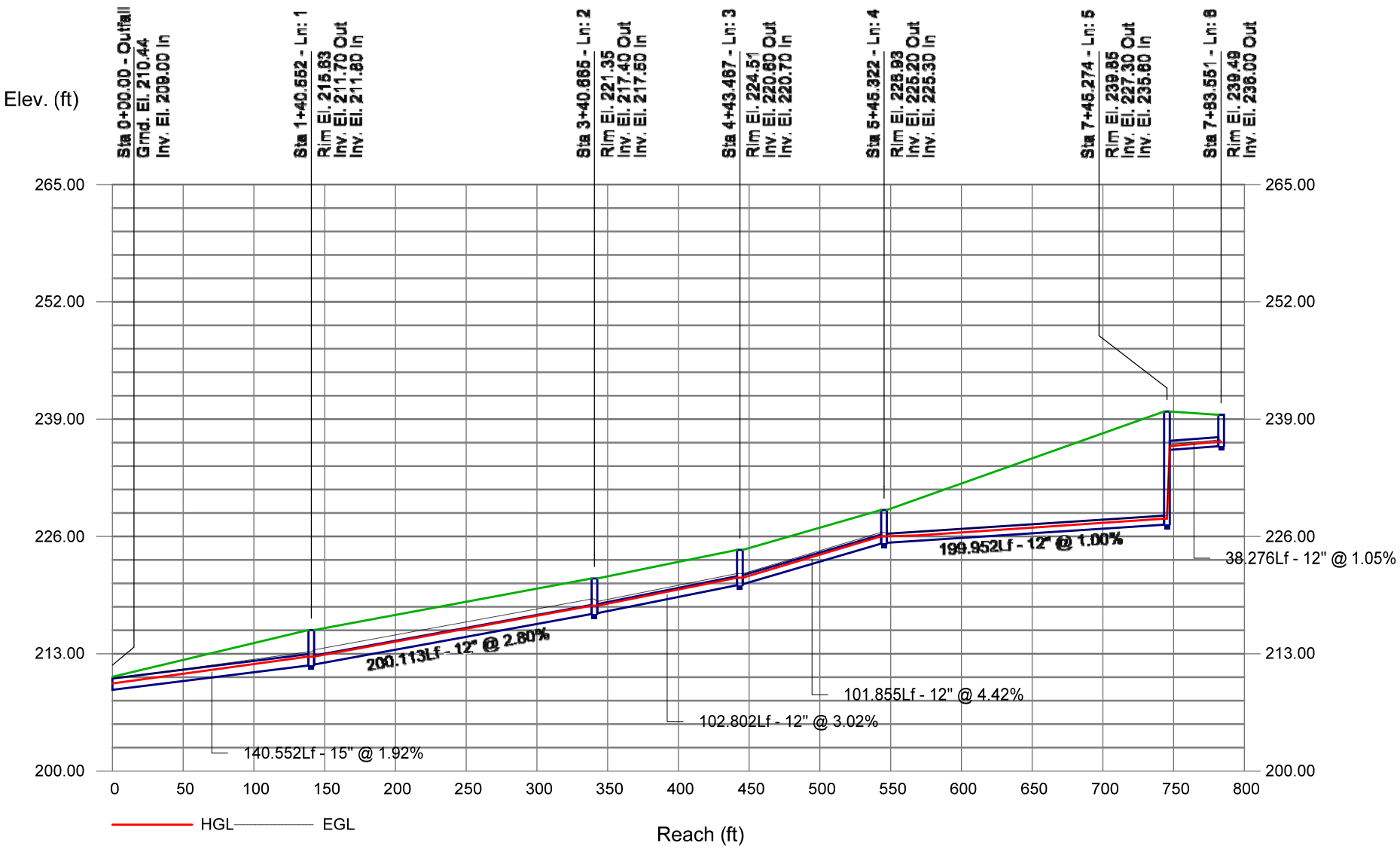
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	140.552	0.09	1.76	0.71	0.06	0.94	5.0	7.6	6.4	6.04	9.70	7.05	15	1.92	209.00	211.70	209.71	212.69	210.44	215.63	P-5A
2	1	200.113	0.10	1.55	0.72	0.07	0.80	5.0	7.1	6.6	5.28	6.45	7.04	12	2.80	211.80	217.40	212.69	218.33	215.63	221.35	P-4A
3	2	102.802	0.05	0.91	0.72	0.04	0.57	5.0	6.8	6.7	3.82	6.70	5.48	12	3.02	217.50	220.60	218.33	221.43	221.35	224.51	P-3A
4	3	101.855	0.09	0.86	0.71	0.06	0.53	5.0	6.4	6.9	3.64	8.11	5.63	12	4.42	220.70	225.20	221.43	226.01	224.51	228.93	P-2A
5	4	199.952	0.20	0.43	0.75	0.15	0.34	5.0	5.4	7.3	2.46	3.86	4.25	12	1.00	225.30	227.30	226.01	227.97	228.93	239.85	P-1A
6	5	38.276	0.23	0.23	0.82	0.19	0.19	5.0	5.0	7.4	1.40	3.94	4.08	12	1.05	235.60	236.00	236.01	236.50	239.85	239.49	P-1B
7	4	24.937	0.34	0.34	0.38	0.13	0.13	5.0	5.0	7.4	0.96	4.23	2.38	12	1.20	225.30	225.60	226.01	226.01	228.93	228.91	P-2B
8	2	24.829	0.54	0.54	0.30	0.16	0.16	5.0	5.0	7.4	1.19	4.24	2.55	12	1.21	217.50	217.80	218.33	218.26	221.35	221.34	P-4B
9	1	24.968	0.12	0.12	0.62	0.07	0.07	5.0	5.0	7.4	0.55	4.23	1.72	12	1.20	211.80	212.10	212.69	212.41	215.63	215.63	P-5B
10	End	41.143	0.00	0.48	0.00	0.00	0.06	5.0	5.6	7.2	0.45	5.71	2.53	12	2.19	228.50	229.40	228.78	229.68	229.69	234.13	P-DMH1
11	10	19.572	0.48	0.48	0.13	0.06	0.06	5.0	5.0	7.4	0.46	13.23	5.22	12	11.75	231.50	233.80	231.63	234.08	234.13	234.99	P-FES1

Project File: Pond 3.stm | Number of lines: 11 | Run Date: 4/4/2017

NOTES:Intensity = 39.68 / (Inlet time + 6.30) ^ 0.69 ; Return period =Yrs. 25 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: Pond 3.stm



Storm Sewer Profile

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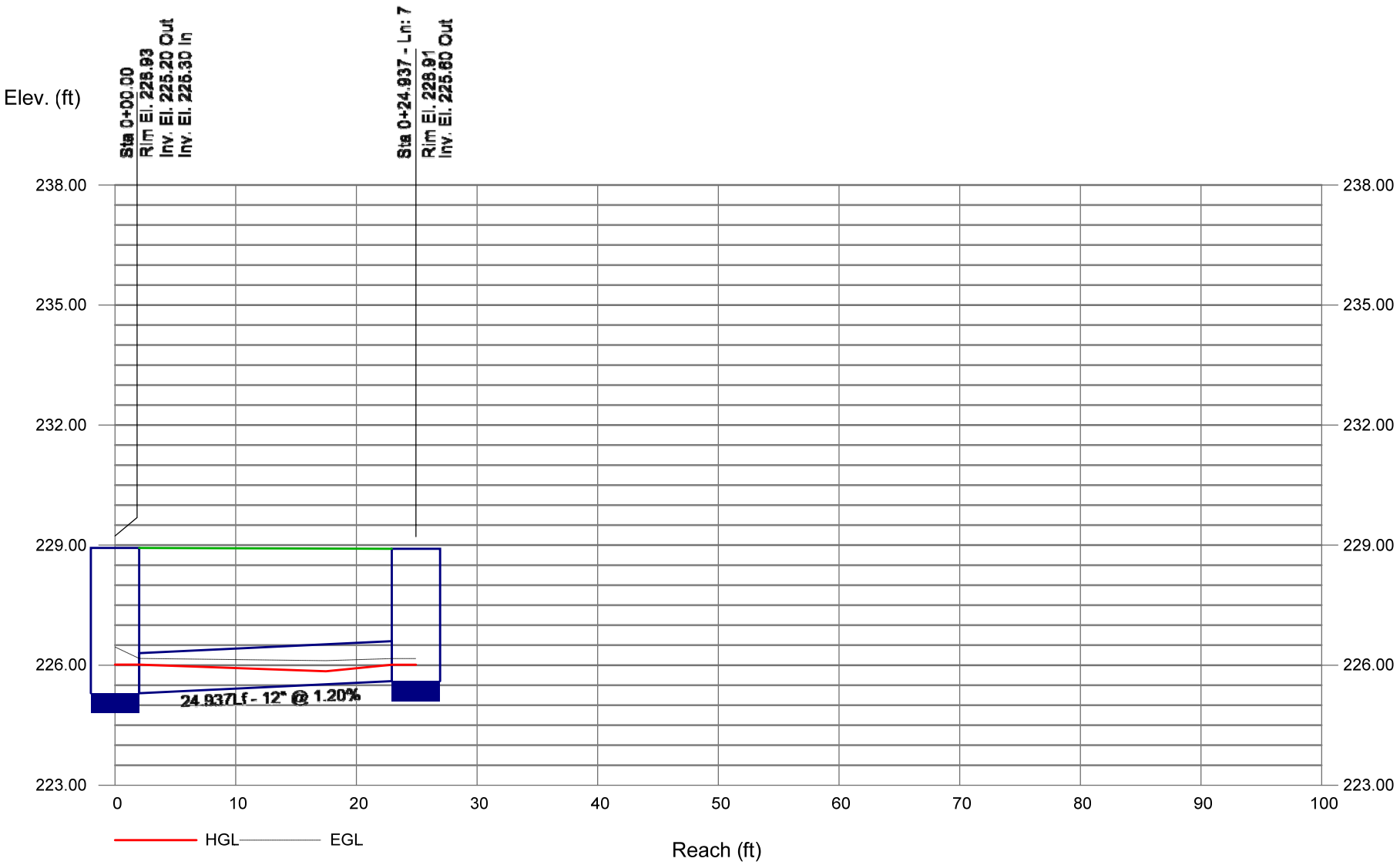

Storm Sewer Profile

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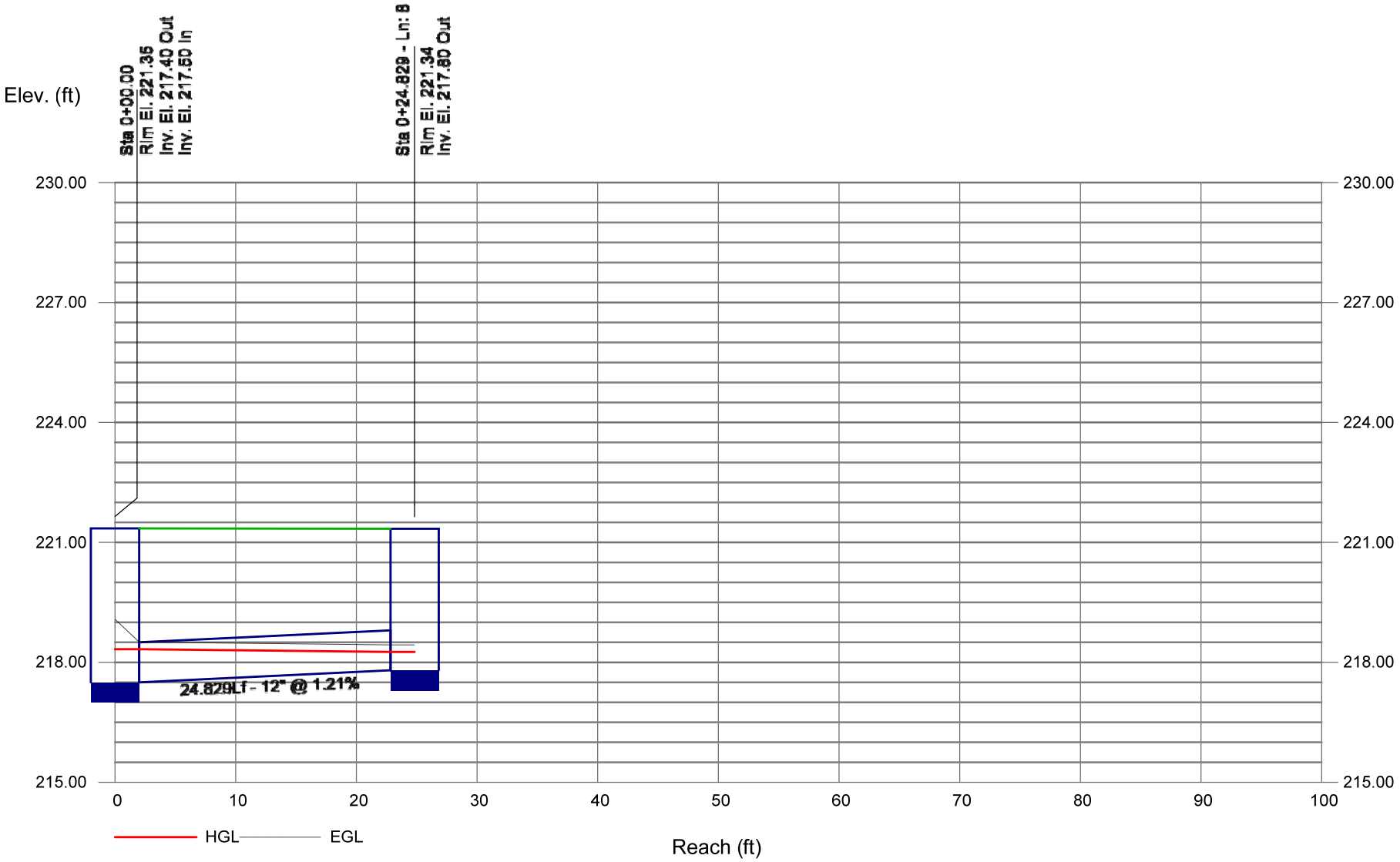

Storm Sewer Profile

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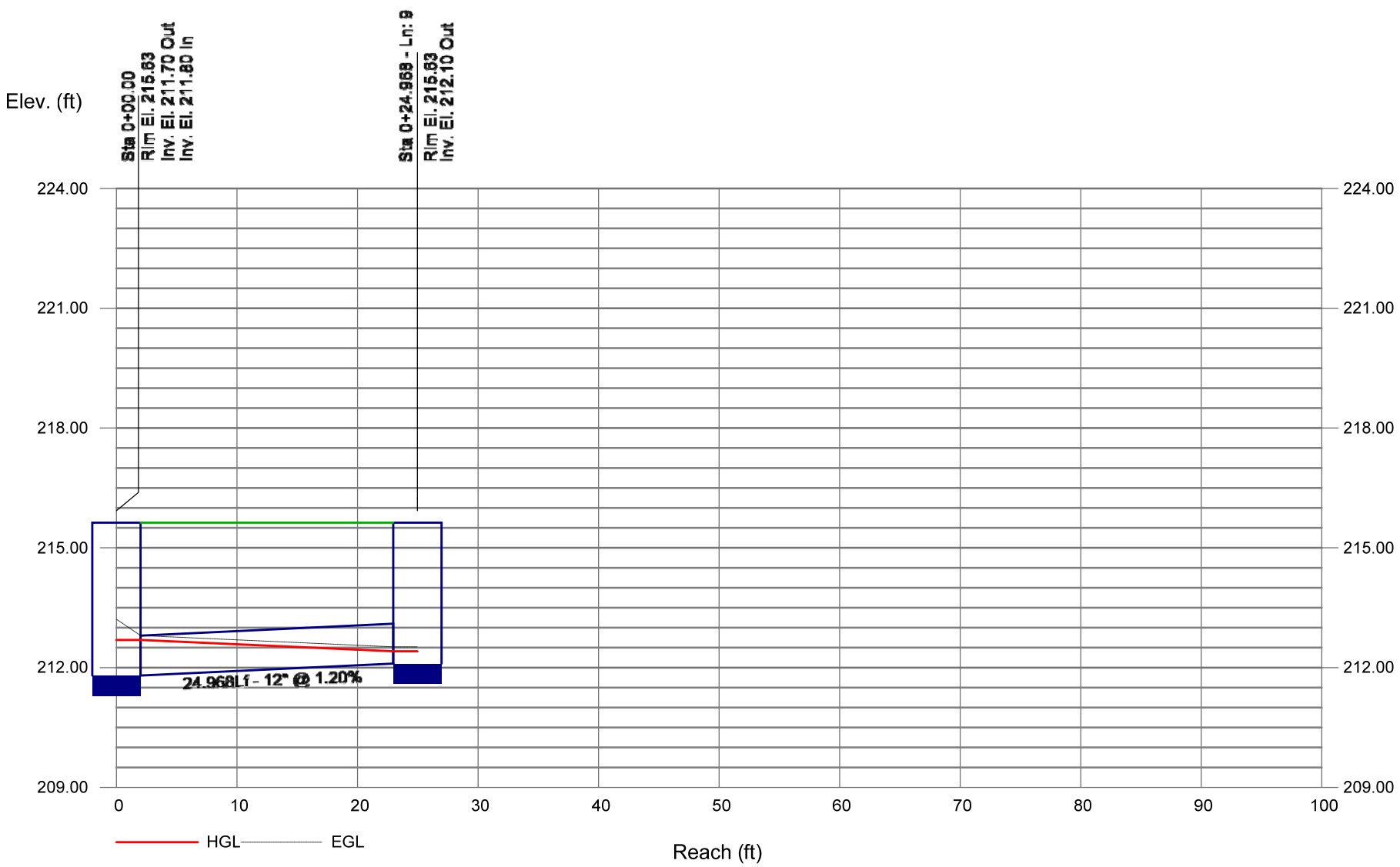
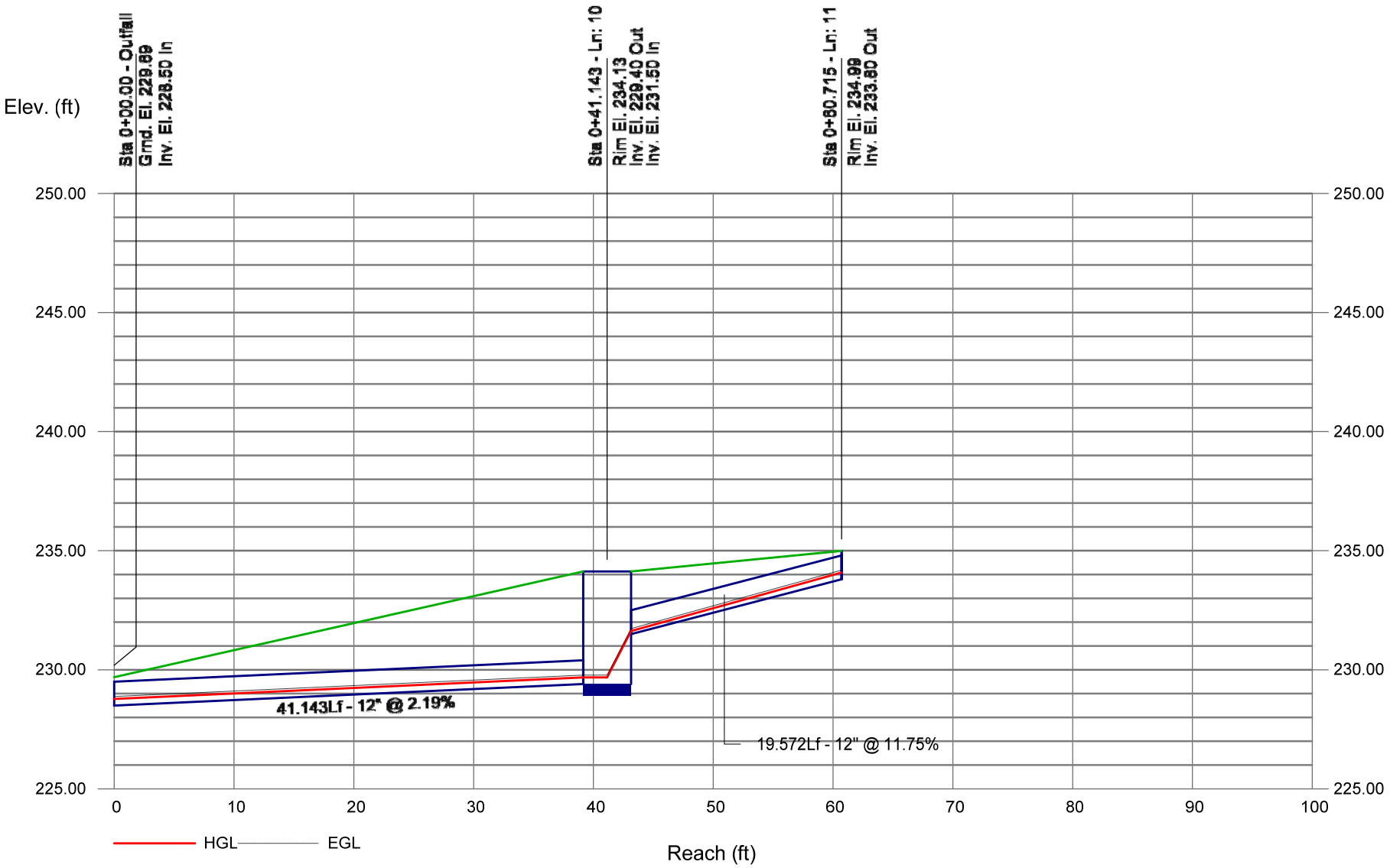
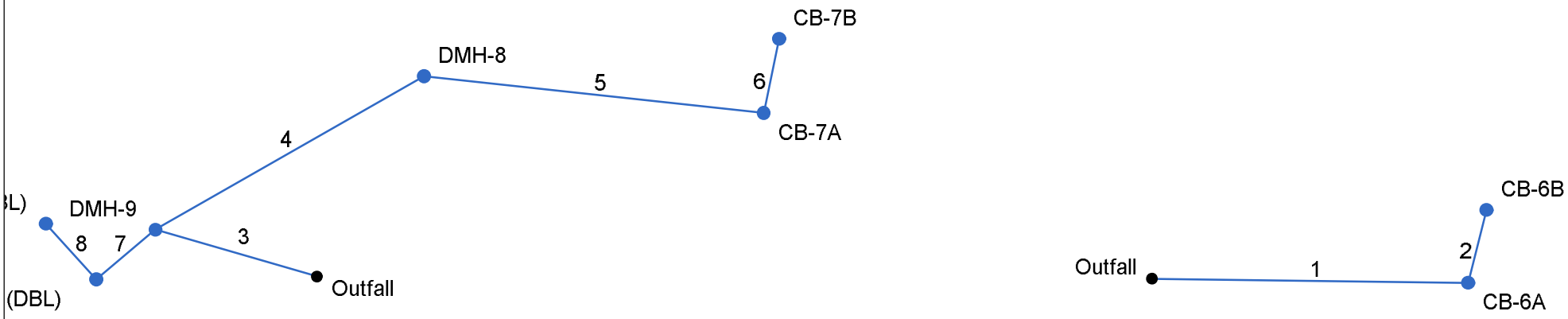


Storm Sewer Profile

Proj. file: Pond 3.stm



Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: Pond 5.stm	Number of lines: 8	Date: 4/4/2017

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	P-6A	1.02	12	Cir	105.028	204.70	205.70	0.952	205.06	206.12	0.16	206.12	End	Manhole
2	P-6B	0.53	12	Cir	25.023	205.80	206.10	1.199	206.12	206.40	n/a	206.40 j	1	Manhole
3	P-9	2.91	12	Cir	55.810	188.00	189.10	1.971	190.10*	190.42*	n/a	190.63	End	Manhole
4	P-8	1.05	12	Cir	102.844	193.90	196.30	2.334	194.19	196.73	n/a	196.73	3	Manhole
5	P-7A	1.13	12	Cir	113.514	196.40	199.00	2.290	196.73	199.45	n/a	199.45	4	Manhole
6	P-7B	0.63	12	Cir	25.240	199.10	199.40	1.189	199.45	199.73	n/a	199.73	5	Manhole
7	P-10A	2.23	12	Cir	25.662	193.90	194.20	1.169	194.42	194.84	n/a	194.84	3	Manhole
8	P-10B	1.09	12	Cir	24.924	194.30	194.60	1.204	194.84	195.04	n/a	195.04	7	Manhole

Project File: Pond 5.stm | Number of lines: 8 | Run Date: 4/4/2017

NOTES: Return period = 25 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Storm Sewer Tabulation

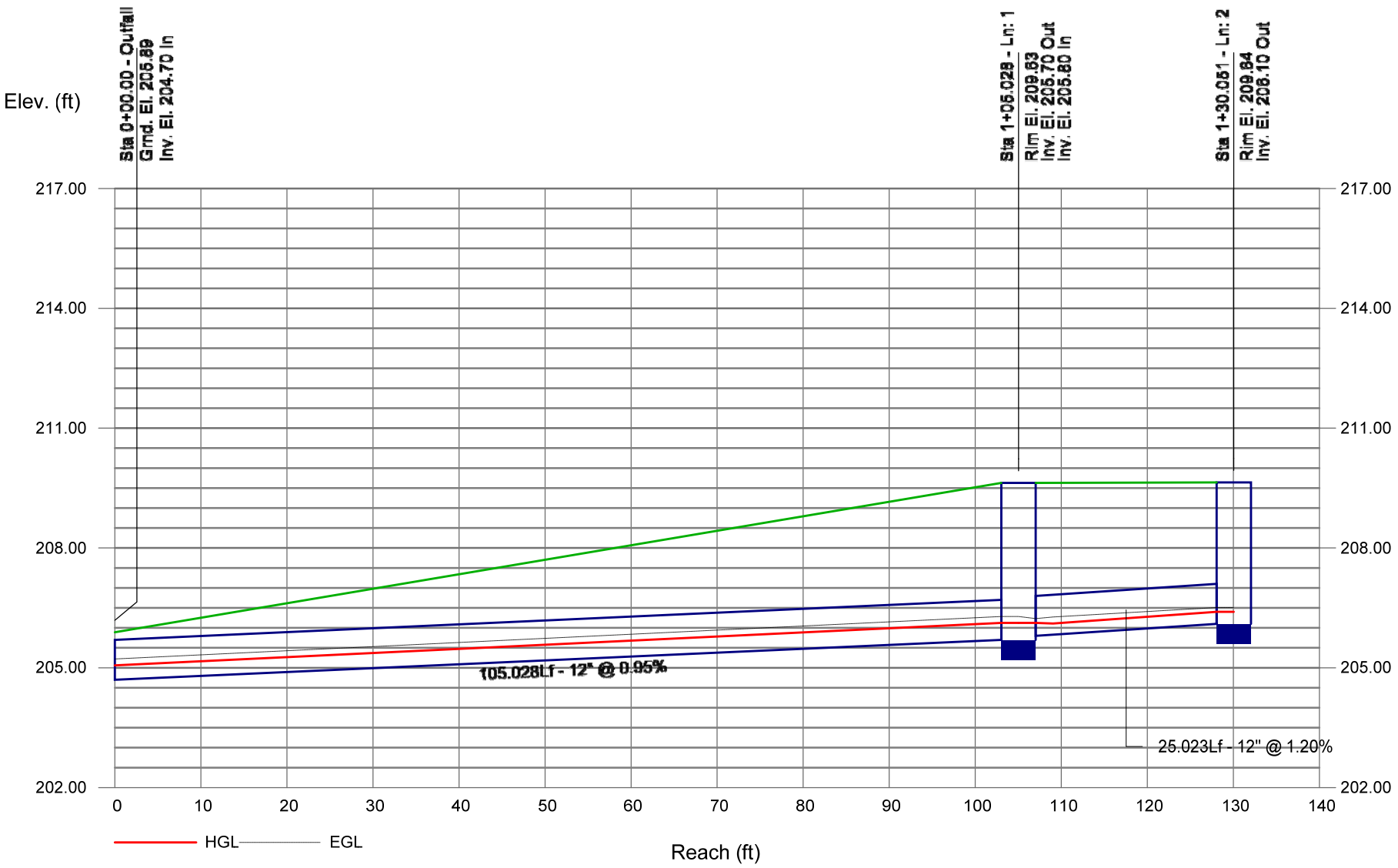
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	105.028	0.10	0.20	0.71	0.07	0.14	5.0	5.6	7.2	1.02	3.76	3.61	12	0.95	204.70	205.70	205.06	206.12	205.89	209.63	P-6A
2	1	25.023	0.10	0.10	0.71	0.07	0.07	5.0	5.0	7.4	0.53	4.22	2.52	12	1.20	205.80	206.10	206.12	206.40	209.63	209.64	P-6B
3	End	55.810	0.00	0.62	0.00	0.00	0.46	5.0	8.0	6.3	2.91	0.00	3.71	12	1.97	188.00	189.10	190.10	190.42	189.19	198.17	P-9
4	3	102.844	0.00	0.21	0.00	0.00	0.16	5.0	6.8	6.7	1.05	0.00	4.46	12	2.33	193.90	196.30	194.19	196.73	198.17	199.88	P-8
5	4	113.514	0.08	0.21	0.90	0.07	0.16	5.0	5.5	7.2	1.13	0.00	4.15	12	2.29	196.40	199.00	196.73	199.45	199.88	202.90	P-7A
6	5	25.240	0.13	0.13	0.65	0.08	0.08	5.0	5.0	7.4	0.63	0.00	2.69	12	1.19	199.10	199.40	199.45	199.73	202.90	202.88	P-7B
7	3	25.662	0.20	0.41	0.79	0.16	0.30	5.0	5.3	7.3	2.23	0.00	4.80	12	1.17	193.90	194.20	194.42	194.84	198.17	198.09	P-10A
8	7	24.924	0.21	0.21	0.70	0.15	0.15	5.0	5.0	7.4	1.09	0.00	2.91	12	1.20	194.30	194.60	194.84	195.04	198.09	198.09	P-10B

Project File: Pond 5.stm | Number of lines: 8 | Run Date: 4/4/2017

NOTES:Intensity = 39.68 / (Inlet time + 6.30) ^ 0.69 ; Return period =Yrs. 25 ; c = cir e = ellip b = box

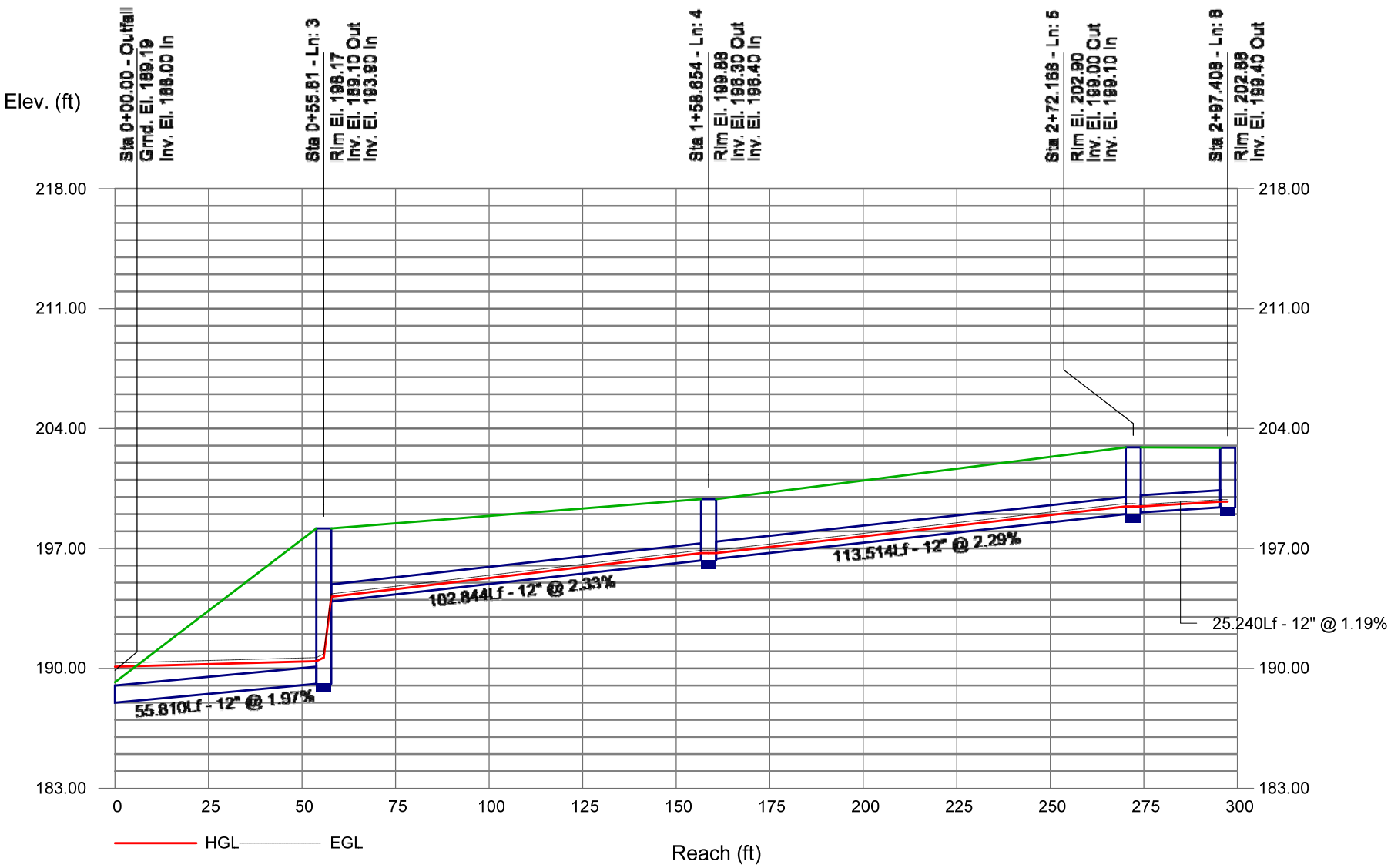
Storm Sewer Profile

Proj. file: Pond 5.stm



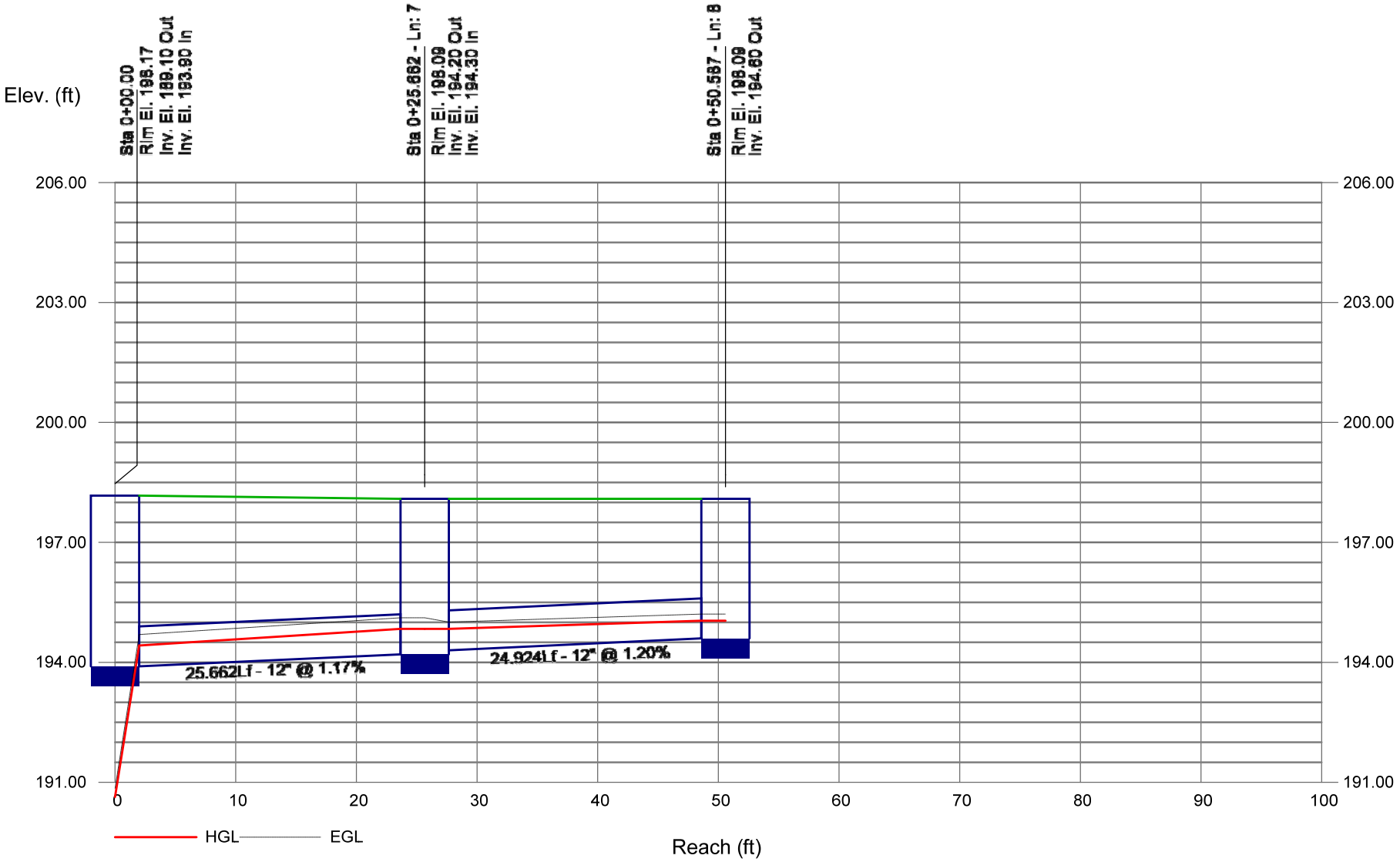
Storm Sewer Profile

Proj. file: Pond 5.stm

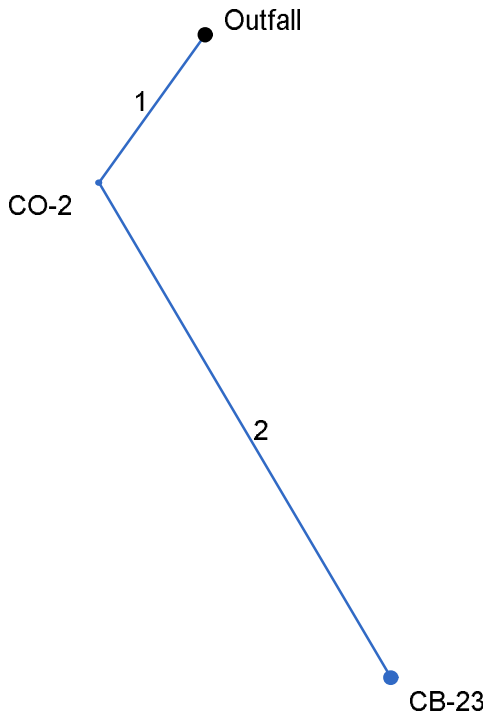


Storm Sewer Profile

Proj. file: Pond 5.stm



Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: Bio Basin.stm	Number of lines: 2	Date: 4/4/2017

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	Pipe - (89)	0.20	12	Cir	58.000	212.30	212.70	0.690	212.48	212.88	n/a	212.88	End	Manhole
2	Pipe - (88)	0.20	12	Cir	183.000	212.80	213.90	0.601	212.98	214.08	n/a	214.08	1	Manhole

Project File: Bio Basin.stm | Number of lines: 2 | Run Date: 4/4/2017

NOTES: Return period = 25 Yrs.

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	58.000	0.00	0.00	0.00	0.00	0.00	0.0	12.0	0.0	0.20	3.20	2.05	12	0.69	212.30	212.70	212.48	212.88	213.10	216.50	Pipe - (89)
2	1	183.000	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.20	2.99	2.09	12	0.60	212.80	213.90	212.98	214.08	216.50	218.20	Pipe - (88)

Project File: Bio Basin.stm

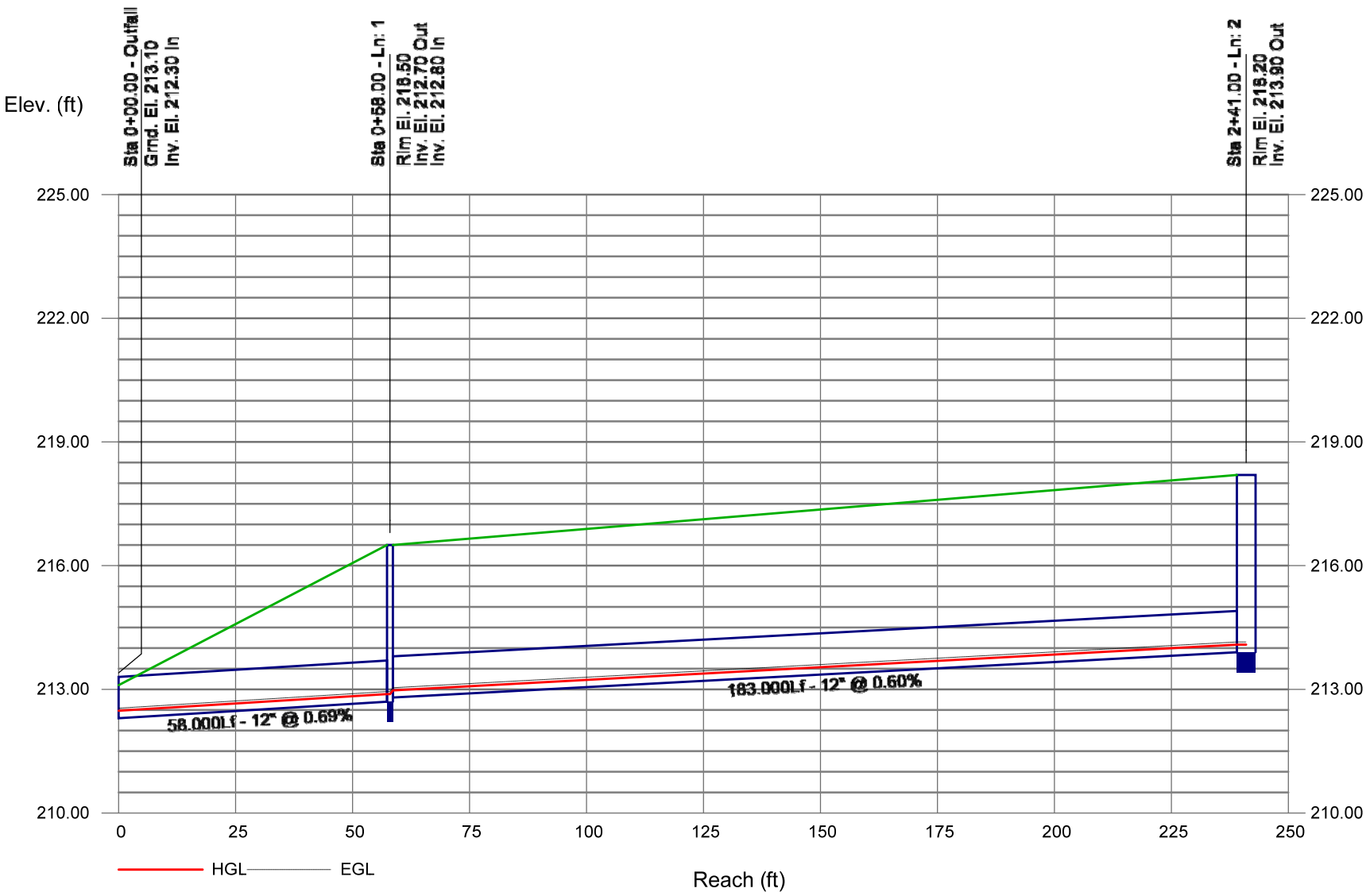
Number of lines: 2

Run Date: 4/4/2017

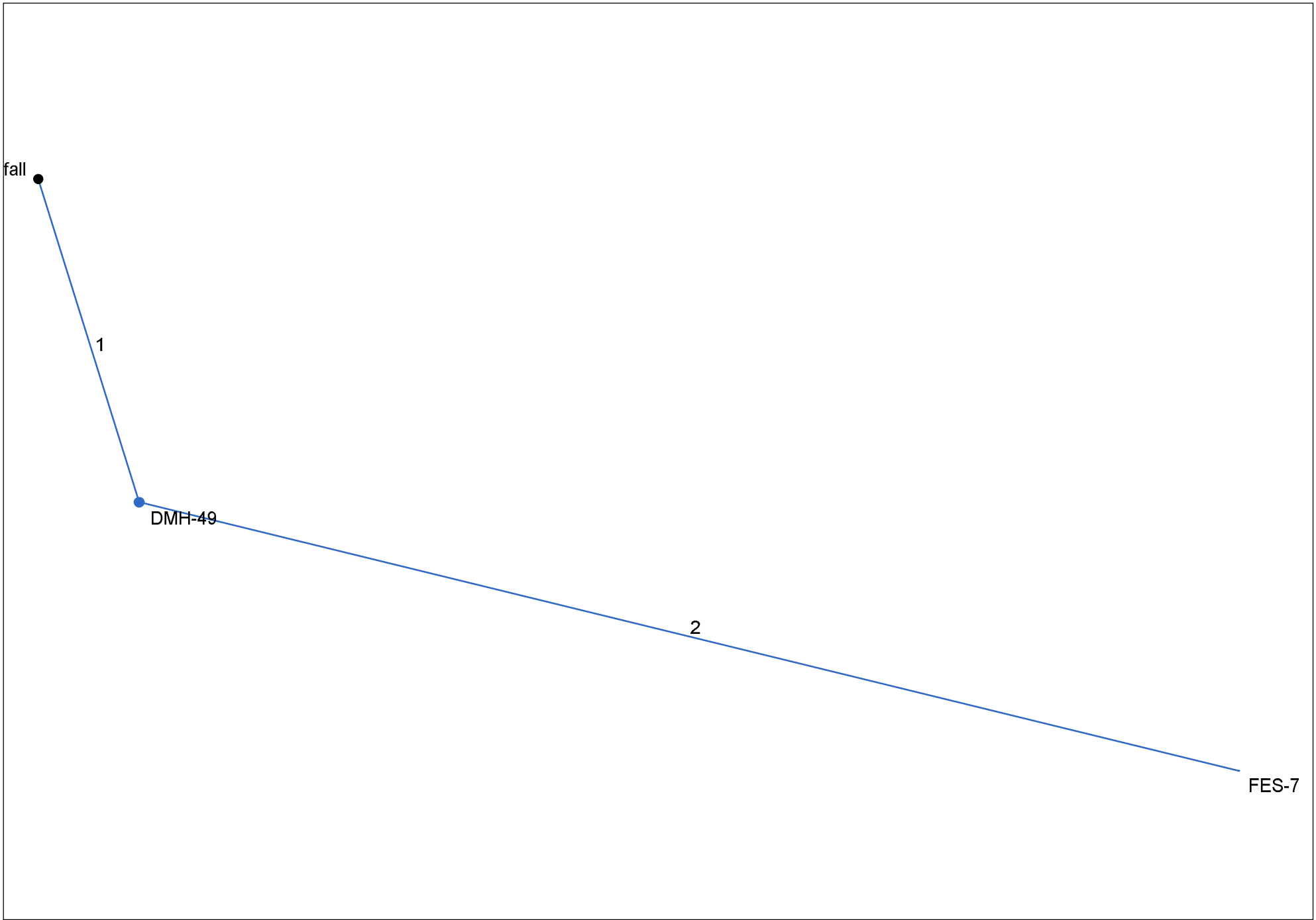
NOTES:Intensity = 39.68 / (Inlet time + 6.30) ^ 0.69 ; Return period =Yrs. 25 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: Bio Basin.stm



Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: Ledge Trench.stm	Number of lines: 2	Date: 3/24/2017

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	P-49	4.33	12	Cir	146.646	194.00	202.00	5.455	194.87	202.87	n/a	202.87	End	Manhole
2	P-7	4.59	12	Cir	488.398	201.90	218.00	3.296	202.87	218.89	n/a	218.89 j	1	Manhole

Project File: Ledge Trench.stm | Number of lines: 2 | Run Date: 3/24/2017

NOTES: Return period = 25 Yrs. ; j - Line contains hyd. jump.

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	146.646	0.14	6.31	0.10	0.01	0.63	5.0	6.4	6.9	4.33	9.01	5.96	12	5.46	194.00	202.00	194.87	202.87	195.19	206.00	P-49
2	1	488.398	6.17	6.17	0.10	0.62	0.62	5.0	5.0	7.4	4.59	7.00	6.04	12	3.30	201.90	218.00	202.87	218.89	206.00	221.00	P-7

Project File: Ledge Trench.stm

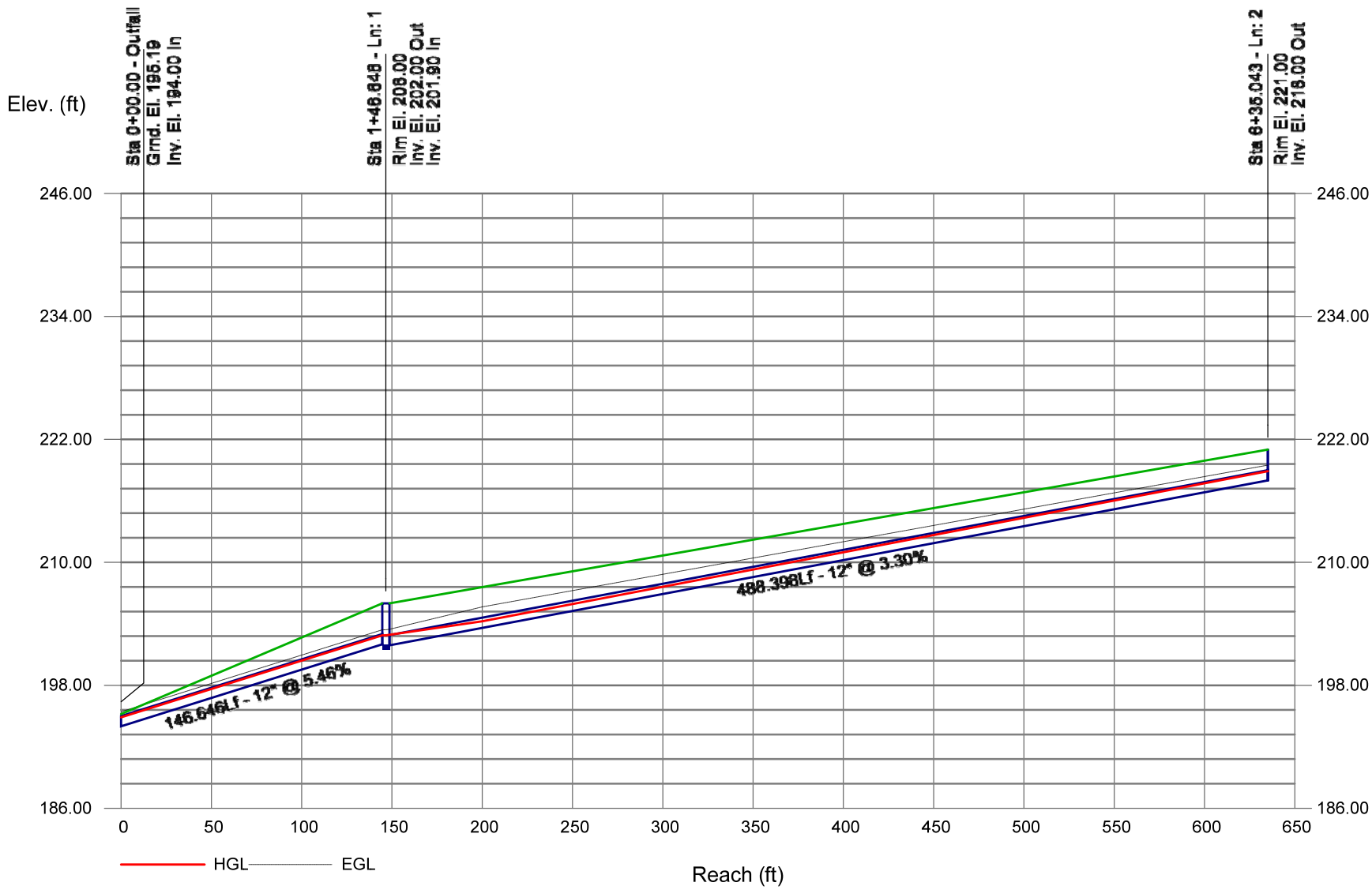
Number of lines: 2

Run Date: 3/24/2017

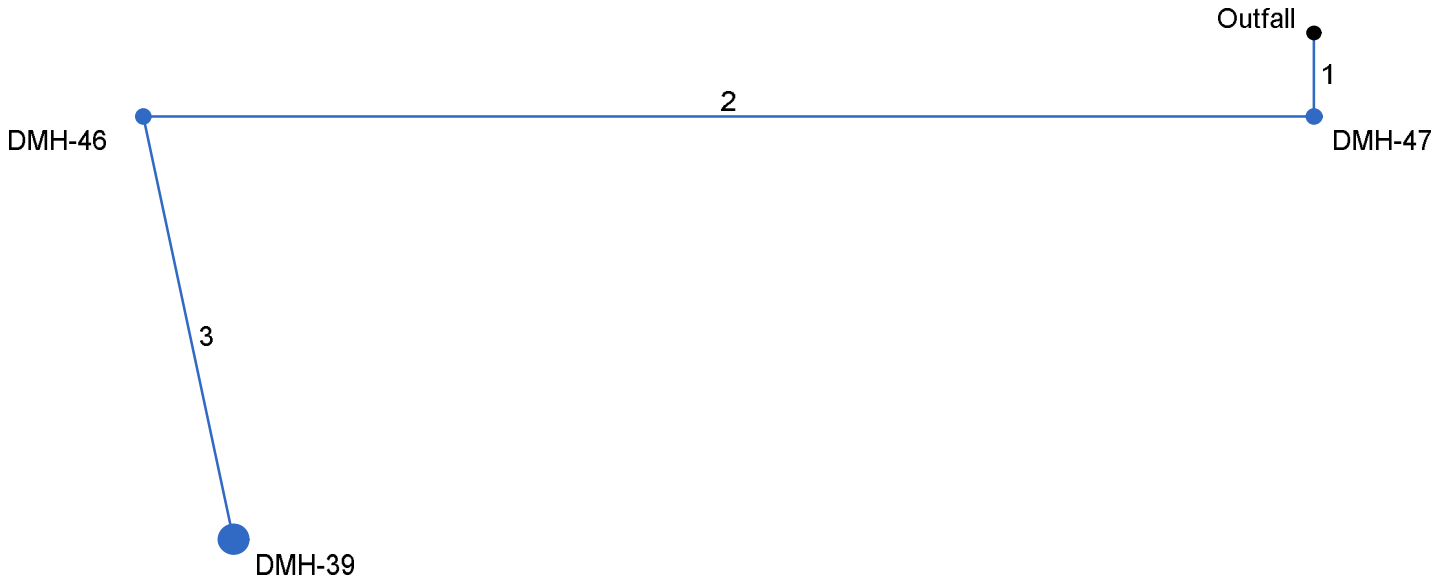
NOTES:Intensity = 39.68 / (Inlet time + 6.30) ^ 0.69 ; Return period =Yrs. 25 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: Ledge Trench.stm



Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: MC3500-OUTLET.stm	Number of lines: 3	Date: 4/4/2017

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	P-47	9.90	18	Cir	23.000	184.80	185.10	1.304	186.30	186.32	0.64	186.96	End	Manhole
2	P-46	9.90	18	Cir	321.000	185.20	188.90	1.153	186.96	190.11	n/a	190.11 j	1	Manhole
3	P-39	9.90	18	Cir	119.000	194.70	200.70	5.042	195.35	201.91	n/a	201.91	2	Manhole

Project File: MC3500-OUTLET.stm | Number of lines: 3 | Run Date: 4/4/2017

NOTES: Return period = 25 Yrs. ; j - Line contains hyd. jump.

Storm Sewer Tabulation

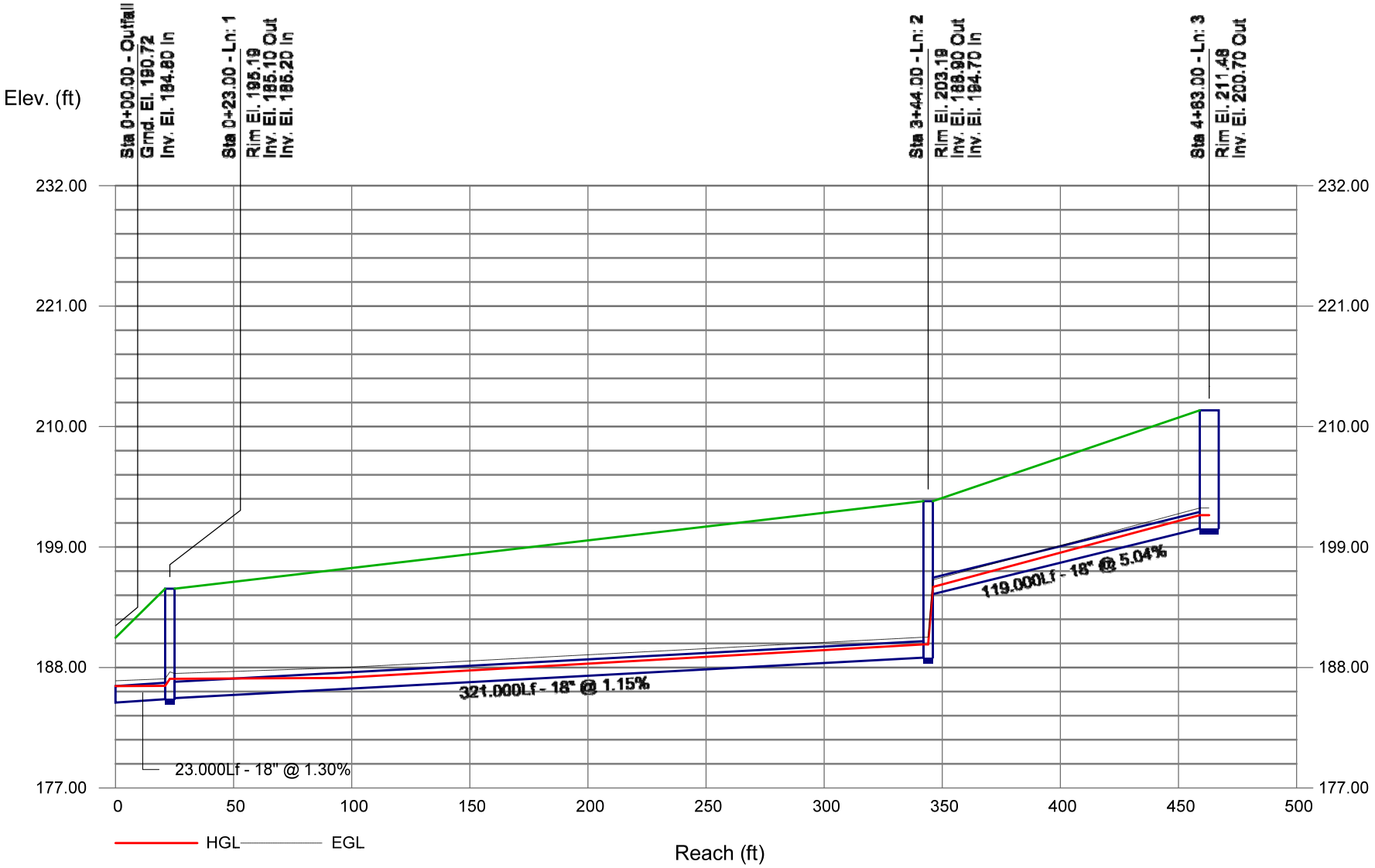
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	23.000	0.00	0.00	0.00	0.00	0.00	5.0	6.3	0.0	9.90	12.99	6.01	18	1.30	184.80	185.10	186.30	186.32	190.72	195.19	P-47
2	1	321.000	0.00	0.00	0.00	0.00	0.00	5.0	5.4	0.0	9.90	12.21	6.04	18	1.15	185.20	188.90	186.96	190.11	195.19	203.19	P-46
3	2	119.000	0.00	0.00	0.00	0.00	0.00	5.0	5.0	0.0	9.90	25.54	10.00	18	5.04	194.70	200.70	195.35	201.91	203.19	211.48	P-39

Project File: MC3500-OUTLET.stm | Number of lines: 3 | Run Date: 4/4/2017

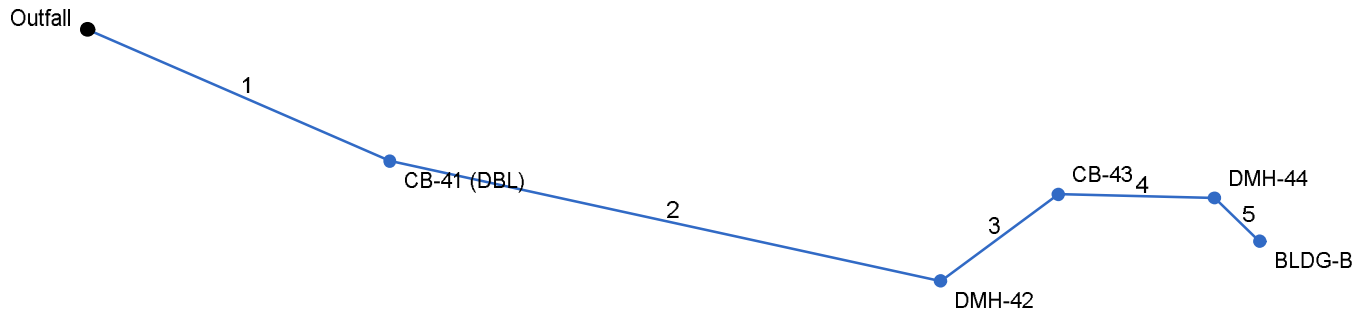
NOTES:Intensity = 39.68 / (Inlet time + 6.30) ^ 0.69 ; Return period =Yrs. 25 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: MC3500-OUTLET.stm



Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: MC3500.stm	Number of lines: 5	Date: 4/4/2017

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	P-41	10.34	18	Cir	125.475	204.40	205.70	1.036	206.50*	207.54*	0.13	207.66	End	Manhole
2	P-42	9.93	18	Cir	214.506	209.80	212.40	1.212	210.81	213.61	n/a	213.61	1	Manhole
3	P-43	10.03	18	Cir	55.641	212.50	213.20	1.258	213.61	214.42	n/a	214.42	2	Manhole
4	P-44	8.08	18	Cir	59.466	213.30	213.90	1.009	214.42	215.00	n/a	215.00 j	3	Manhole
5	P-BLDG-B	8.10	12	Cir	23.847	214.00	214.43	1.803	215.00*	216.05*	1.65	217.70	4	Manhole

Project File: MC3500.stm | Number of lines: 5 | Run Date: 4/4/2017

NOTES: Return period = 25 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	125.475	0.17	1.77	0.65	0.11	1.48	5.0	6.1	7.0	10.34	11.58	5.85	18	1.04	204.40	205.70	206.50	207.54	211.48	215.50	P-41
2	1	214.506	0.00	1.60	0.00	0.00	1.37	5.0	5.4	7.2	9.93	12.52	7.17	18	1.21	209.80	212.40	210.81	213.61	215.50	219.25	P-42
3	2	55.641	0.39	1.60	0.72	0.28	1.37	5.0	5.3	7.3	10.03	12.76	6.82	18	1.26	212.50	213.20	213.61	214.42	219.25	218.18	P-43
4	3	59.466	0.00	1.21	0.00	0.00	1.09	5.0	5.0	7.4	8.08	11.43	5.76	18	1.01	213.30	213.90	214.42	215.00	218.18	219.44	P-44
5	4	23.847	1.21	1.21	0.90	1.09	1.09	5.0	5.0	7.4	8.10	5.18	10.31	12	1.80	214.00	214.43	215.00	216.05	219.44	219.89	P-BLDG-B

Project File: MC3500.stm

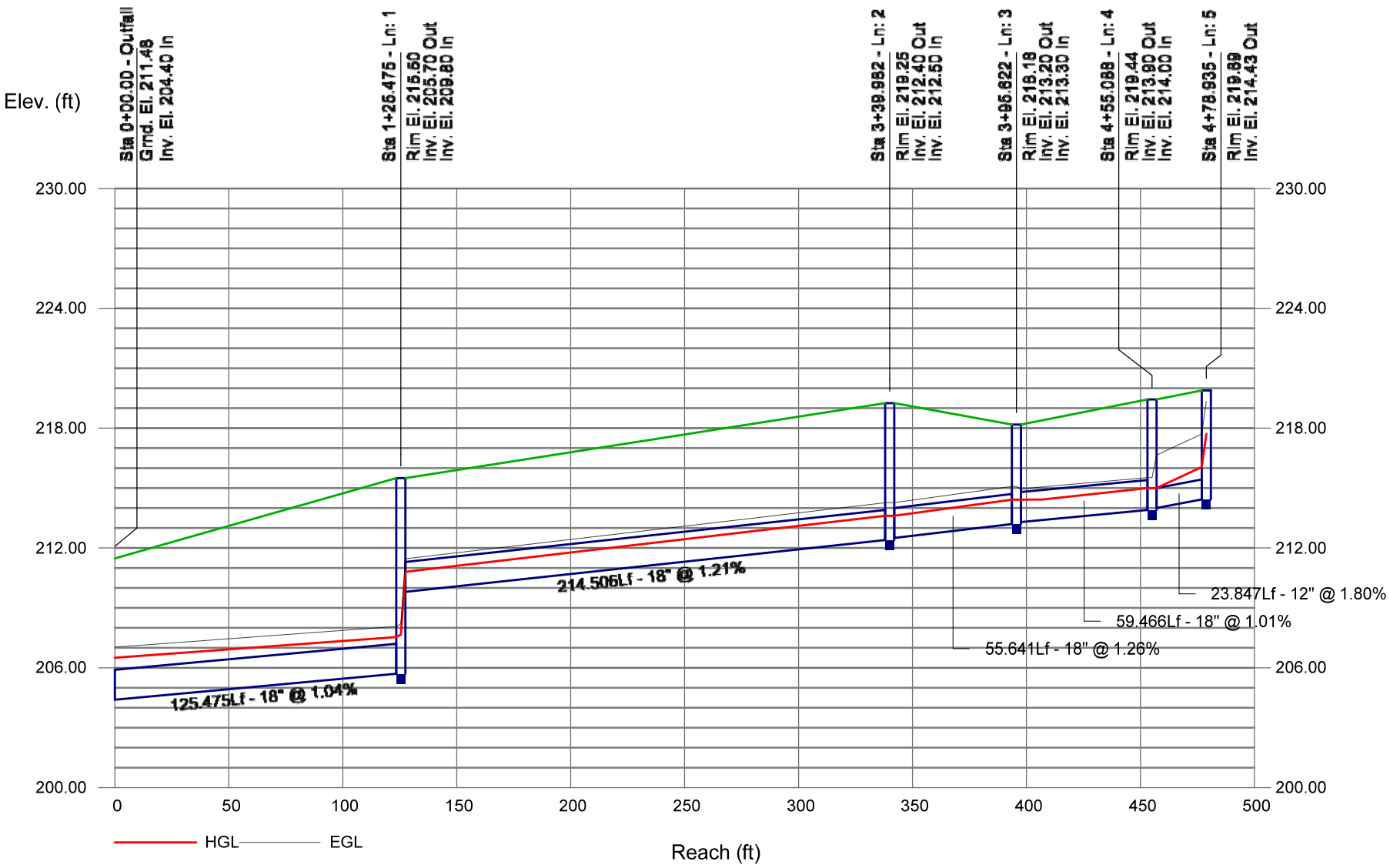
Number of lines: 5

Run Date: 4/4/2017

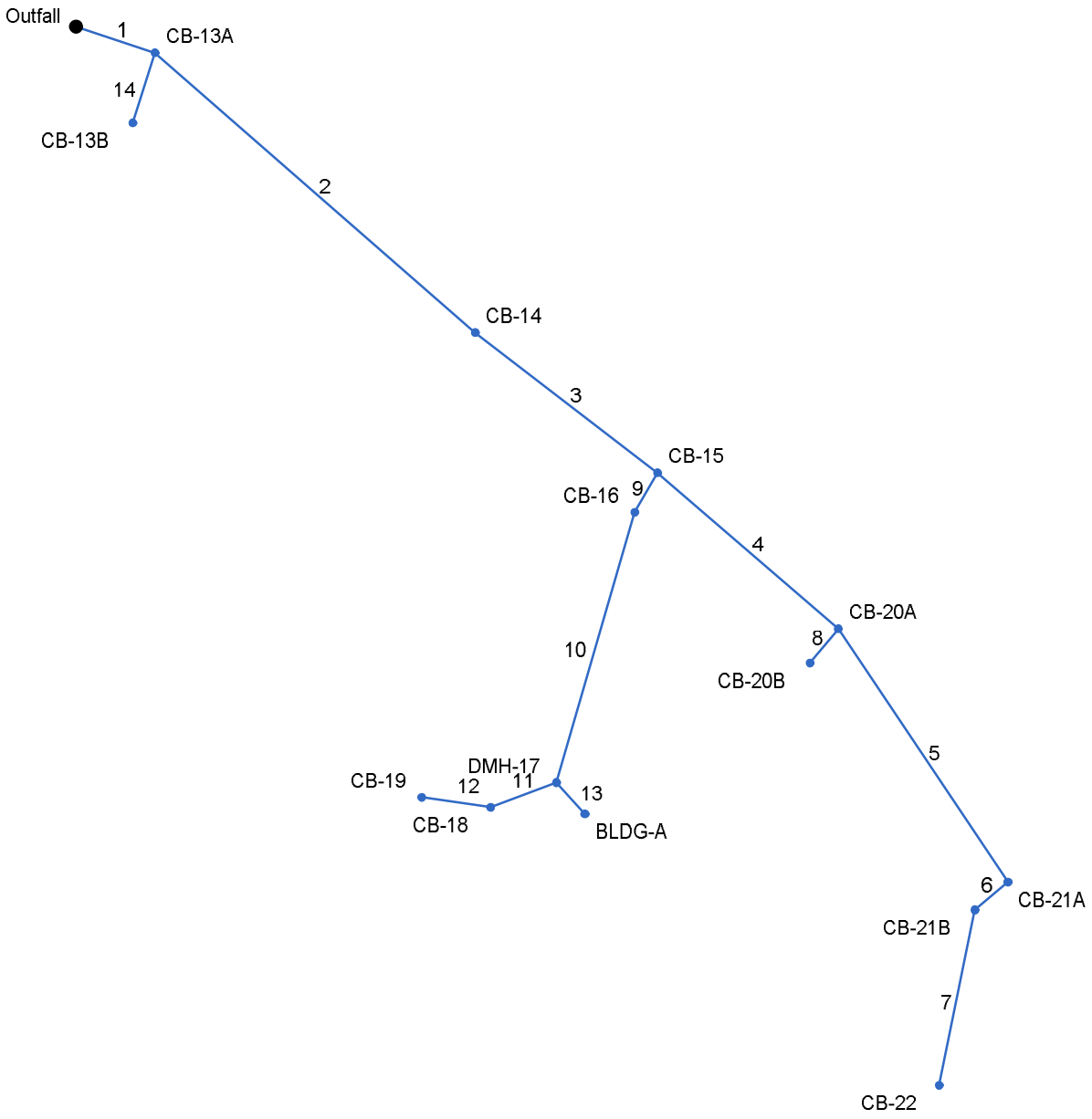
NOTES:Intensity = 39.68 / (Inlet time + 6.30) ^ 0.69 ; Return period =Yrs. 25 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: MC3500.stm



Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: MC4500-NORTH.stm	Number of lines: 14	Date: 4/4/2017

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	P-13A	14.93	18	Cir	50.178	193.80	195.80	3.986	194.69	197.20	n/a	197.20	End	Manhole
2	P-14	13.03	18	Cir	245.000	195.90	200.90	2.041	197.20	202.25	0.14	202.25	1	Manhole
3	P-15	12.91	18	Cir	133.646	201.00	207.00	4.489	202.25	208.35	0.93	208.35	2	Manhole
4	P-20A	4.18	12	Cir	137.634	207.10	213.60	4.723	208.35	214.46	n/a	214.46 j	3	Manhole
5	P-21A	3.56	12	Cir	168.857	217.00	224.70	4.560	217.46	225.51	n/a	225.51	4	Manhole
6	P-21B	3.19	12	Cir	24.936	224.80	225.10	1.203	225.51	225.86	n/a	225.86	5	Manhole
7	P-22A	1.98	12	Cir	94.824	225.20	231.80	6.960	225.86	232.40	n/a	232.40 j	6	Manhole
8	P-20B	0.37	12	Cir	24.895	217.00	217.30	1.205	217.20	217.55	n/a	217.55	4	Manhole
9	P-16	8.57	15	Cir	25.005	207.10	208.30	4.799	208.35	209.44	n/a	209.44 j	3	Manhole
10	P-17	6.89	15	Cir	150.000	208.40	212.60	2.800	209.44	213.65	0.56	213.65	9	Manhole
11	P-18	1.15	12	Cir	42.250	213.70	214.20	1.183	214.06	214.65	n/a	214.65	10	Manhole
12	P-19	0.67	12	Cir	42.498	214.30	214.80	1.177	214.65	215.14	n/a	215.14 j	11	Manhole
13	P-BLDG-A	6.22	12	Cir	24.037	212.70	212.75	0.208	213.70*	214.33*	0.98	215.30	10	Manhole
14	P-13B	1.60	12	Cir	39.309	195.90	197.30	3.562	197.20	197.84	n/a	197.84 j	1	Manhole

Project File: MC4500-NORTH.stm | Number of lines: 14 | Run Date: 4/4/2017

NOTES: Return period = 25 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	50.178	0.18	3.35	0.77	0.14	2.33	5.0	7.7	6.4	14.93	22.71	11.17	18	3.99	193.80	195.80	194.69	197.20	200.62	200.40	P-13A
2	1	245.000	0.07	2.55	0.72	0.05	1.97	5.0	7.1	6.6	13.03	16.25	7.88	18	2.04	195.90	200.90	197.20	202.25	200.40	205.05	P-14
3	2	133.646	0.06	2.48	0.71	0.04	1.92	5.0	6.8	6.7	12.91	24.10	7.95	18	4.49	201.00	207.00	202.25	208.35	205.05	212.65	P-15
4	3	137.634	0.08	0.83	0.71	0.06	0.61	5.0	6.3	6.9	4.18	8.38	5.56	12	4.72	207.10	213.60	208.35	214.46	212.65	220.77	P-20A
5	4	168.857	0.08	0.68	0.68	0.05	0.50	5.0	5.7	7.1	3.56	8.24	7.68	12	4.56	217.00	224.70	217.46	225.51	220.77	229.00	P-21A
6	5	24.936	0.26	0.60	0.69	0.18	0.45	5.0	5.6	7.2	3.19	4.23	5.18	12	1.20	224.80	225.10	225.51	225.86	229.00	229.15	P-21B
7	6	94.824	0.34	0.34	0.78	0.27	0.27	5.0	5.0	7.4	1.98	10.18	3.80	12	6.96	225.20	231.80	225.86	232.40	229.15	235.39	P-22A
8	4	24.895	0.07	0.07	0.72	0.05	0.05	5.0	5.0	7.4	0.37	4.24	2.87	12	1.21	217.00	217.30	217.20	217.55	220.77	220.77	P-20B
9	3	25.005	0.46	1.59	0.59	0.27	1.27	5.0	6.7	6.7	8.57	15.33	7.14	15	4.80	207.10	208.30	208.35	209.44	212.65	212.60	P-16
10	9	150.000	0.00	1.13	0.00	0.00	1.00	5.0	6.3	6.9	6.89	11.71	6.28	15	2.80	208.40	212.60	209.44	213.65	212.60	218.23	P-17
11	10	42.250	0.08	0.20	0.90	0.07	0.16	5.0	5.8	7.1	1.15	4.20	3.94	12	1.18	213.70	214.20	214.06	214.65	218.23	218.75	P-18
12	11	42.498	0.12	0.12	0.75	0.09	0.09	5.0	5.0	7.4	0.67	4.18	2.78	12	1.18	214.30	214.80	214.65	215.14	218.75	218.30	P-19
13	10	24.037	0.93	0.93	0.90	0.84	0.84	5.0	5.0	7.4	6.22	1.76	7.92	12	0.21	212.70	212.75	213.70	214.33	218.23	219.10	P-BLDG-A
14	1	39.309	0.62	0.62	0.35	0.22	0.22	5.0	5.0	7.4	1.60	7.28	2.89	12	3.56	195.90	197.30	197.20	197.84	200.40	200.77	P-13B

Project File: MC4500-NORTH.stm

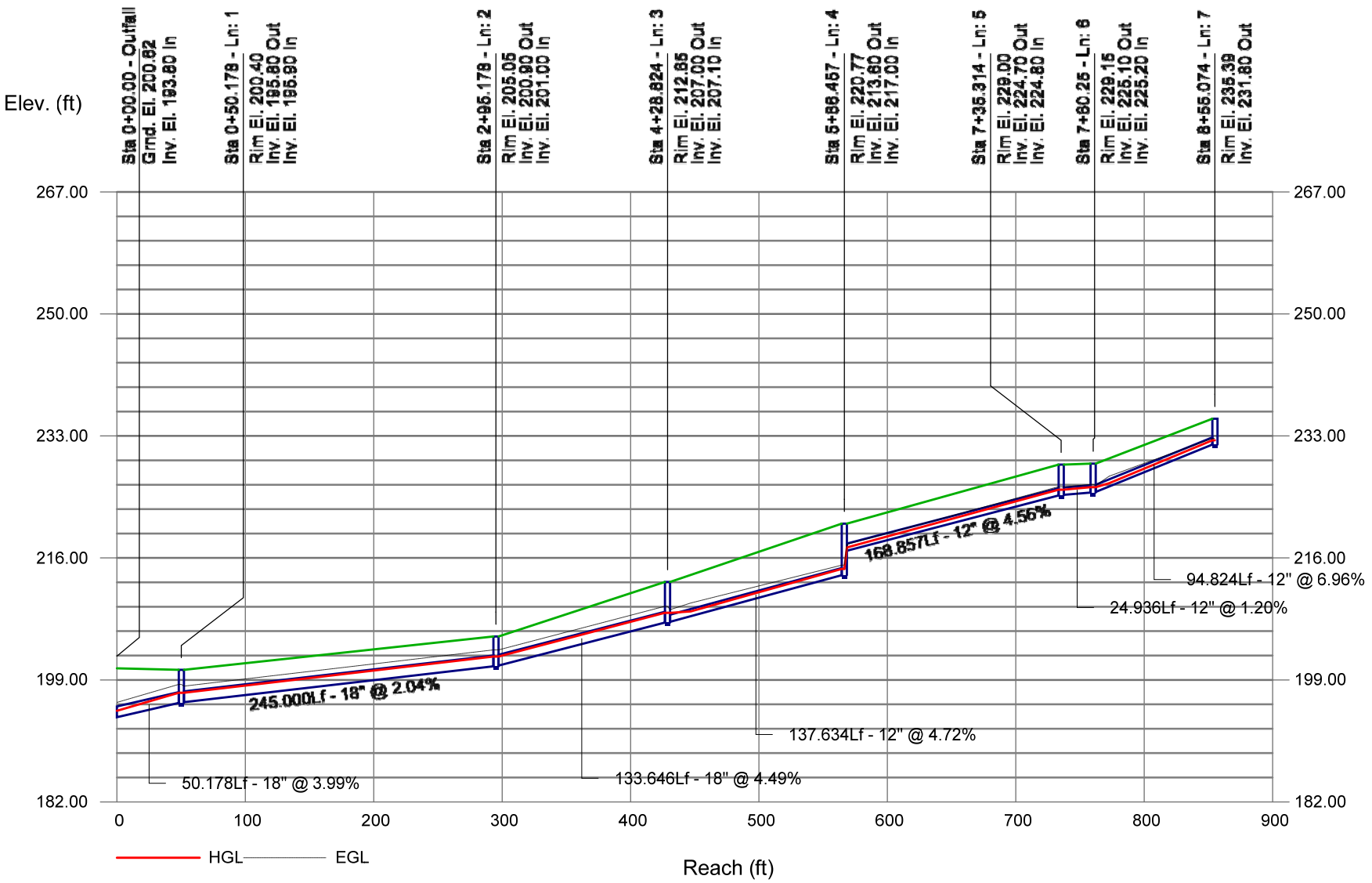
Number of lines: 14

Run Date: 4/4/2017

NOTES:Intensity = 39.68 / (Inlet time + 6.30) ^ 0.69 ; Return period =Yrs. 25 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: MC4500-NORTH.stm



Storm Sewer Profile

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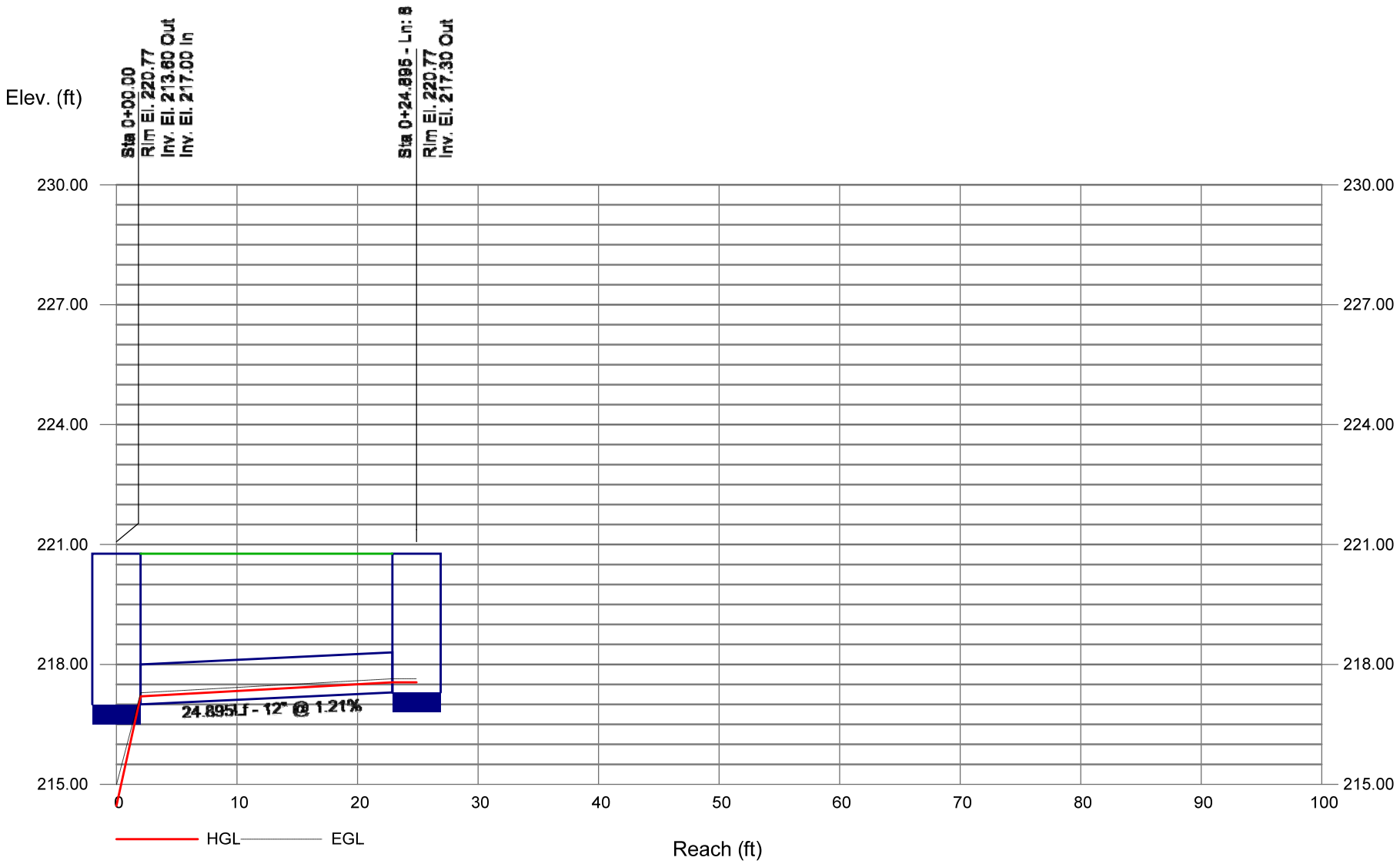

Storm Sewer Profile

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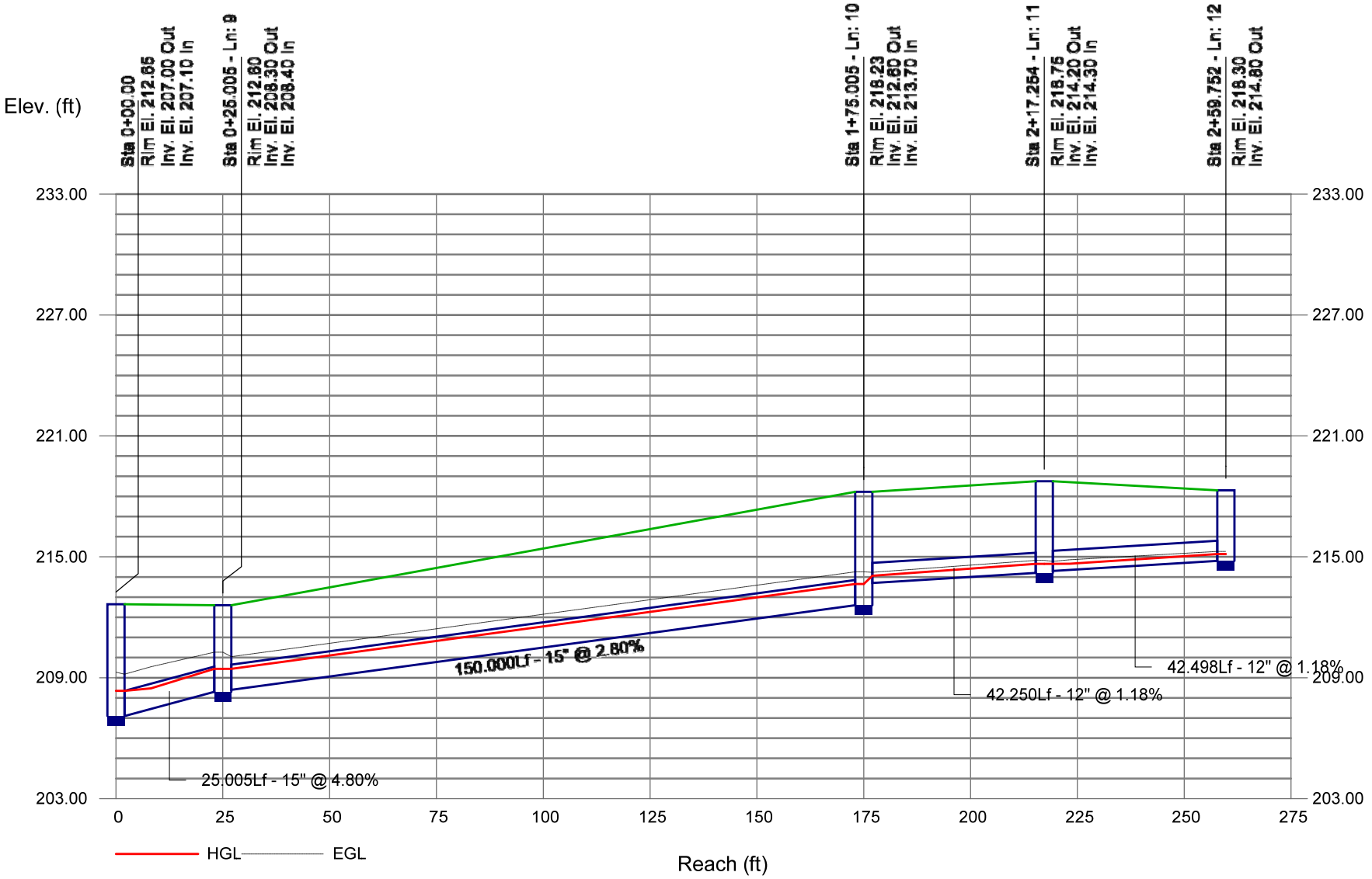

Storm Sewer Profile

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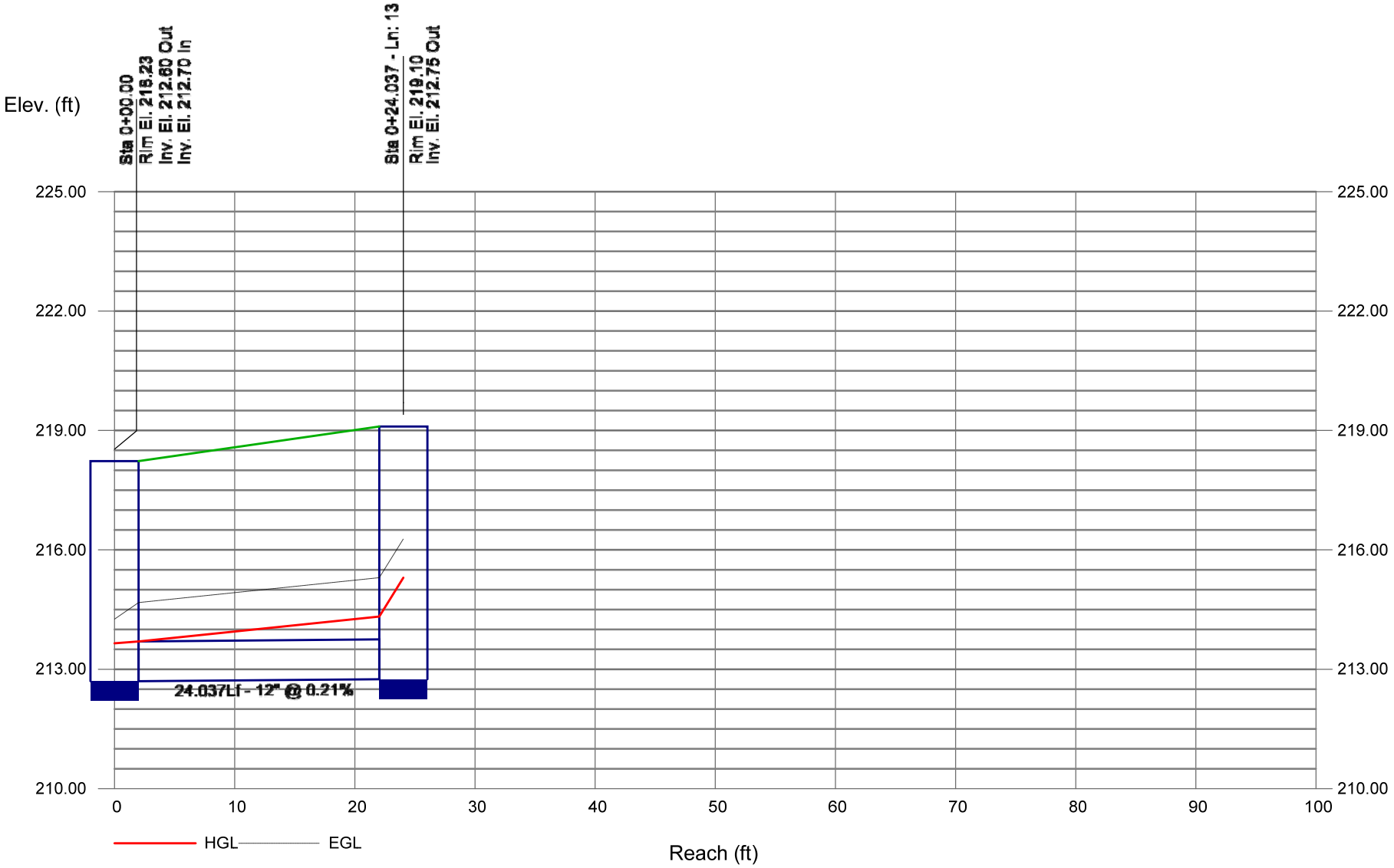

Storm Sewer Profile

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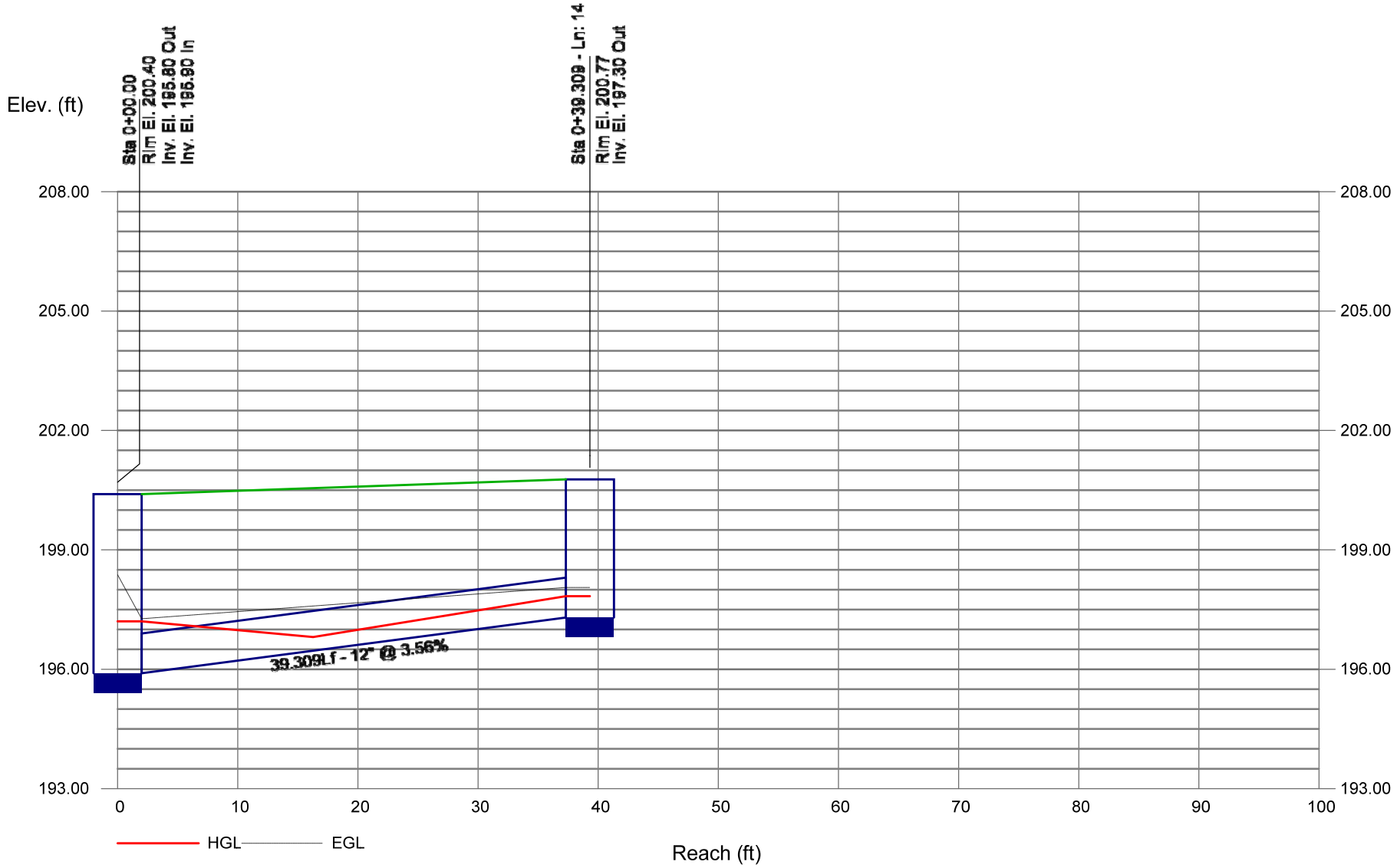
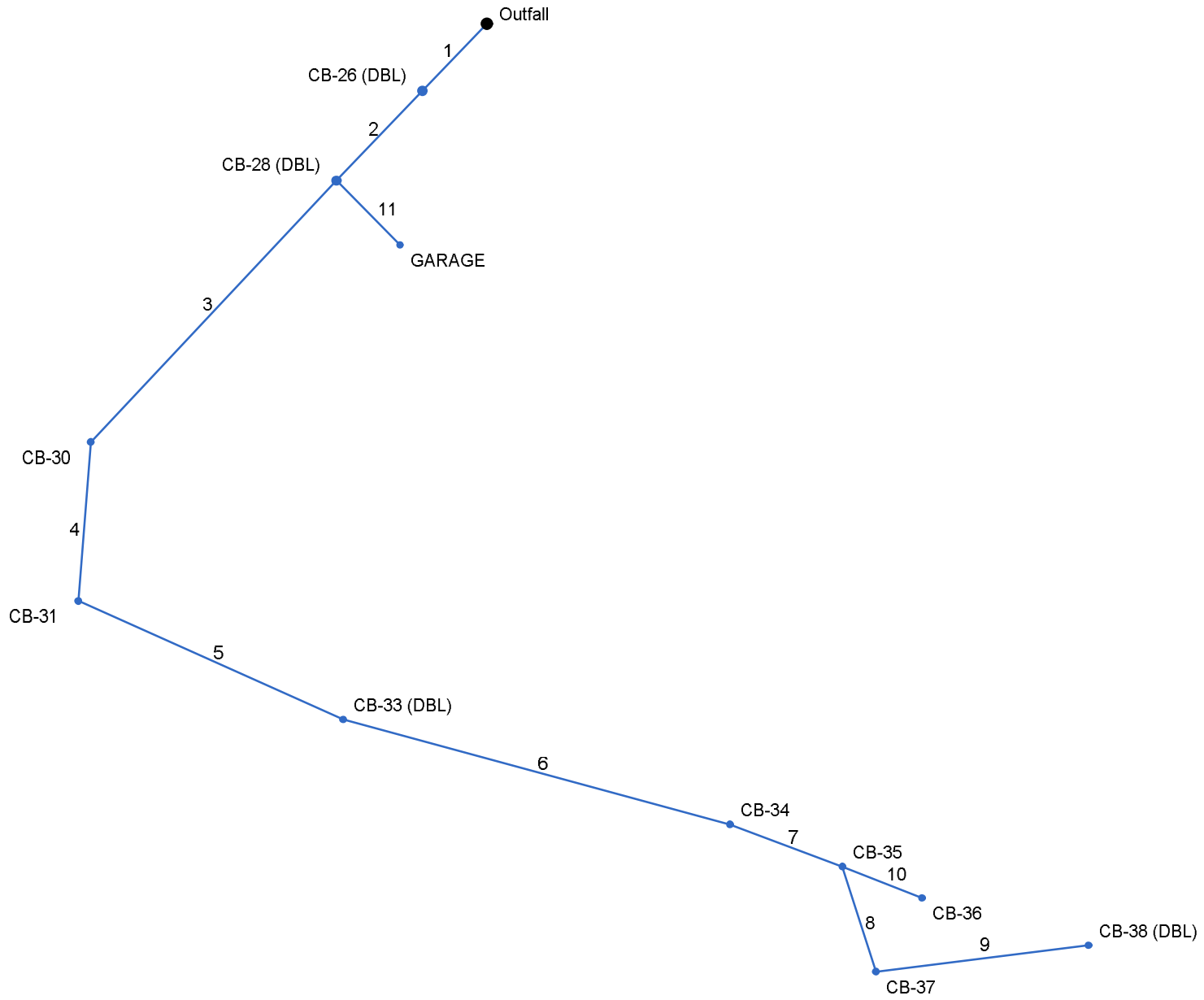


Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: MC4500-SOUTH.stm	Number of lines: 11	Date: 4/4/2017

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	P-26	28.80	36	Cir	67.342	188.00	188.40	0.594	193.40*	193.51*	0.04	193.55	End	Manhole
2	P-28	27.59	36	Cir	90.206	188.40	188.90	0.554	193.55*	193.68*	0.24	193.91	1	Manhole
3	P-30	7.42	15	Cir	260.000	190.30	198.30	3.077	193.91	199.38	n/a	199.38 j	2	Manhole
4	P-31	6.98	15	Cir	115.741	198.40	202.40	3.456	199.38	203.46	0.59	203.46	3	Manhole
5	P-33	5.70	12	Cir	210.000	202.50	210.70	3.905	203.46	211.65	n/a	211.65 j	4	Manhole
6	P-34	4.57	12	Cir	290.000	210.80	216.60	2.000	211.65	217.49	0.09	217.49	5	Manhole
7	P-35	4.28	12	Cir	86.853	216.70	223.60	7.944	217.49	224.47	n/a	224.47	6	Manhole
8	P-37	3.92	12	Cir	79.980	223.70	230.10	8.002	224.47	230.94	0.48	230.94	7	Manhole
9	P-38	1.87	12	Cir	155.019	230.20	232.90	1.742	230.94	233.48	n/a	233.48 j	8	Manhole
10	P-36	0.37	12	Cir	61.894	223.70	228.60	7.917	224.47	228.85	n/a	228.85 j	7	Manhole
11	P-GARAGE	23.82	24	Cir	65.521	189.00	190.00	1.526	193.91*	194.53*	0.89	195.43	2	Manhole

Project File: MC4500-SOUTH.stm | Number of lines: 11 | Run Date: 4/4/2017

NOTES: Return period = 25 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Storm Sewer Tabulation

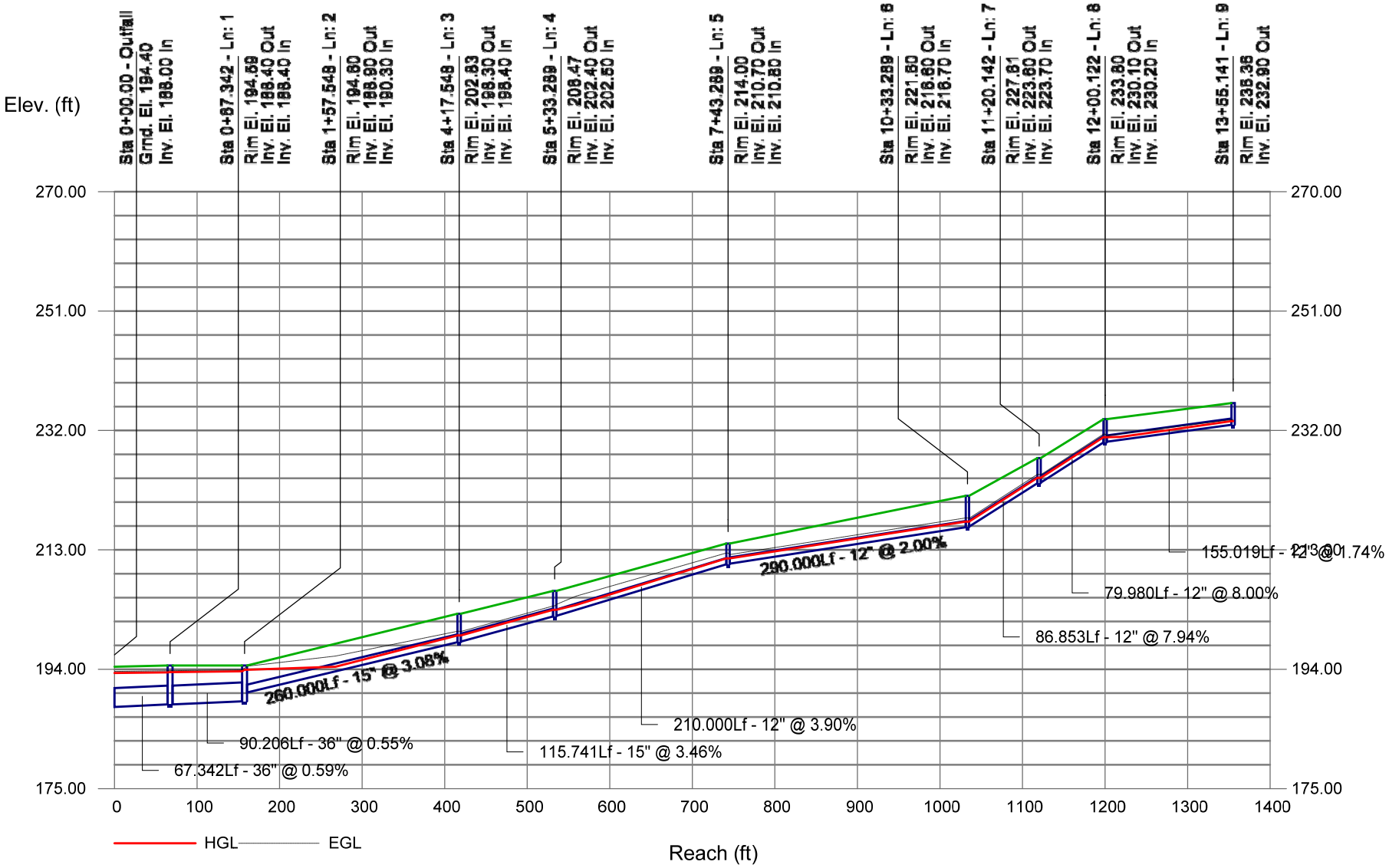
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	67.342	0.51	6.80	0.58	0.30	5.05	5.0	10.3	5.7	28.80	55.68	4.07	36	0.59	188.00	188.40	193.40	193.51	194.40	194.59	P-26
2	1	90.206	0.60	6.29	0.52	0.31	4.75	5.0	9.9	5.8	27.59	53.79	3.90	36	0.55	188.40	188.90	193.55	193.68	194.59	194.60	P-28
3	2	260.000	0.19	2.09	0.48	0.09	1.24	5.0	9.1	6.0	7.42	12.27	6.30	15	3.08	190.30	198.30	193.91	199.38	194.60	202.83	P-30
4	3	115.741	0.46	1.90	0.50	0.23	1.15	5.0	8.8	6.1	6.98	13.01	6.52	15	3.46	198.40	202.40	199.38	203.46	202.83	206.47	P-31
5	4	210.000	0.39	1.44	0.54	0.21	0.91	5.0	8.3	6.2	5.70	7.62	7.39	12	3.90	202.50	210.70	203.46	211.65	206.47	214.00	P-33
6	5	290.000	0.11	1.05	0.48	0.05	0.70	5.0	7.5	6.5	4.57	5.46	6.31	12	2.00	210.80	216.60	211.65	217.49	214.00	221.60	P-34
7	6	86.853	0.06	0.94	0.67	0.04	0.65	5.0	7.2	6.6	4.28	10.87	6.16	12	7.94	216.70	223.60	217.49	224.47	221.60	227.61	P-35
8	7	79.980	0.47	0.82	0.66	0.31	0.56	5.0	6.1	7.0	3.92	10.91	5.81	12	8.00	223.70	230.10	224.47	230.94	227.61	233.80	P-37
9	8	155.019	0.35	0.35	0.72	0.25	0.25	5.0	5.0	7.4	1.87	5.09	3.48	12	1.74	230.20	232.90	230.94	233.48	233.80	236.36	P-38
10	7	61.894	0.06	0.06	0.82	0.05	0.05	5.0	5.0	7.4	0.37	10.86	1.48	12	7.92	223.70	228.60	224.47	228.85	227.61	234.05	P-36
11	2	65.521	3.60	3.60	0.89	3.20	3.20	5.0	5.0	7.4	23.82	30.27	7.58	24	1.53	189.00	190.00	193.91	194.53	194.60	197.49	P-GARAGE

Project File: MC4500-SOUTH.stm | Number of lines: 11 | Run Date: 4/4/2017

NOTES:Intensity = 39.68 / (Inlet time + 6.30) ^ 0.69 ; Return period =Yrs. 25 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: MC4500-SOUTH.stm



Storm Sewer Profile

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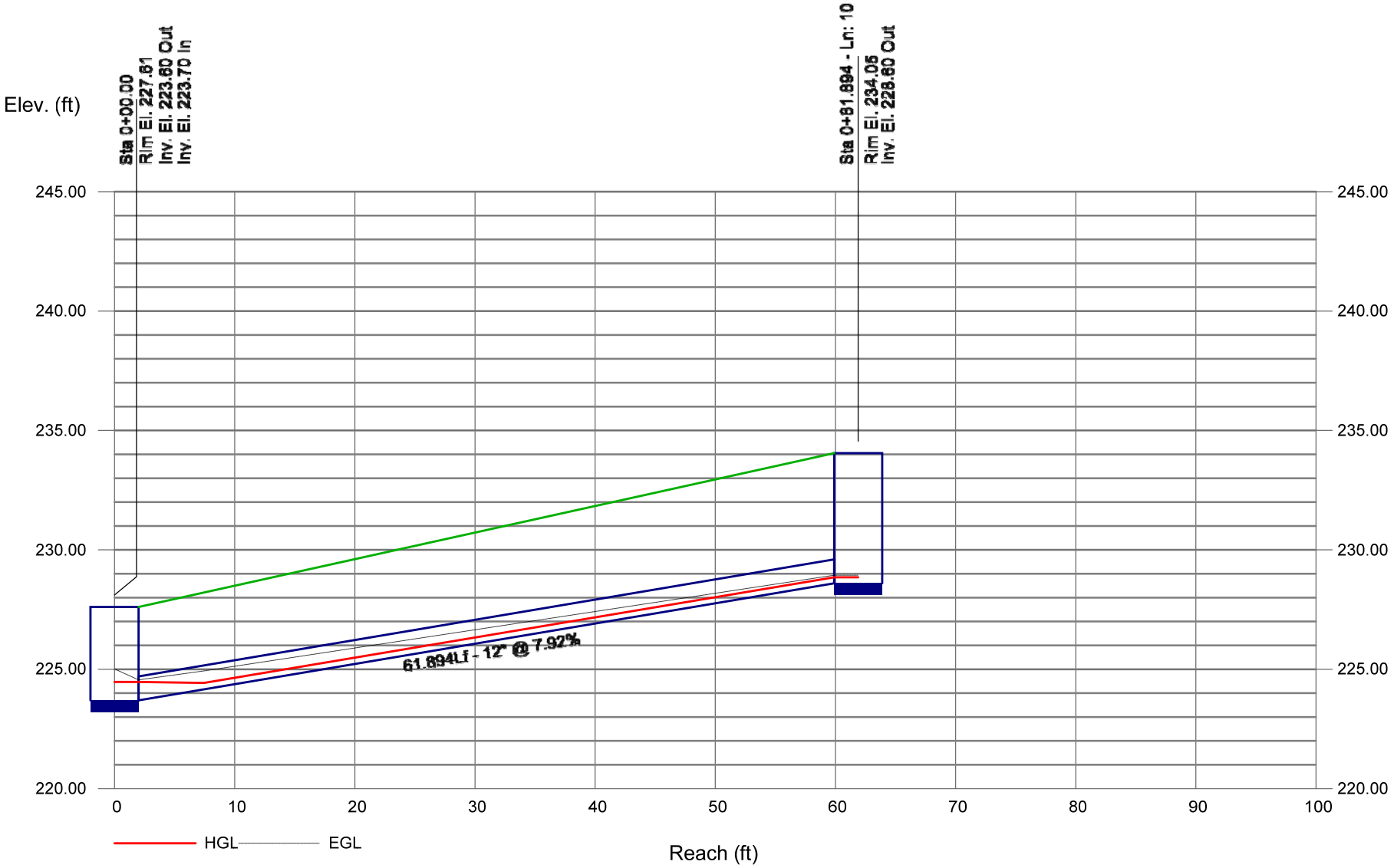

Storm Sewer Profile

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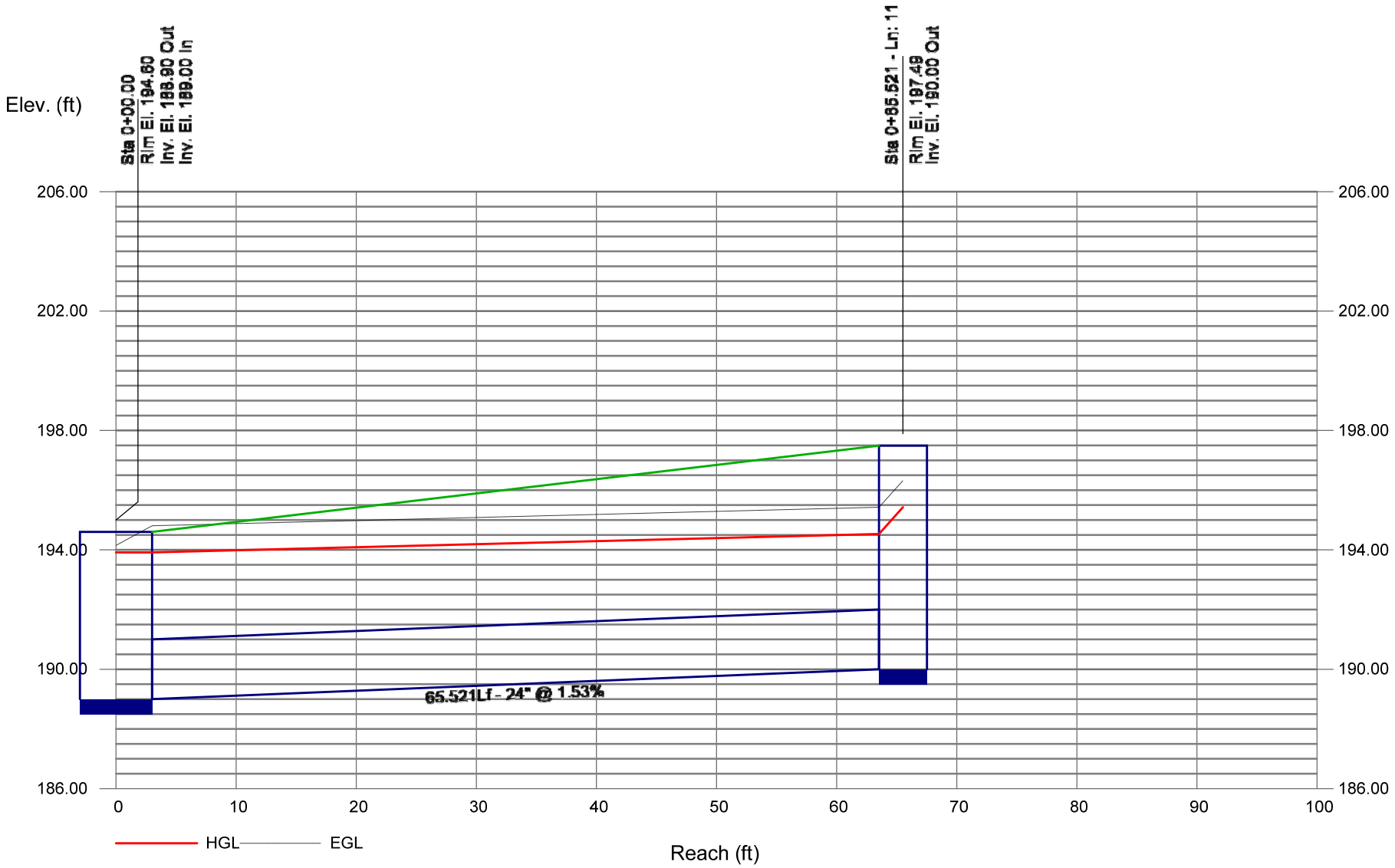
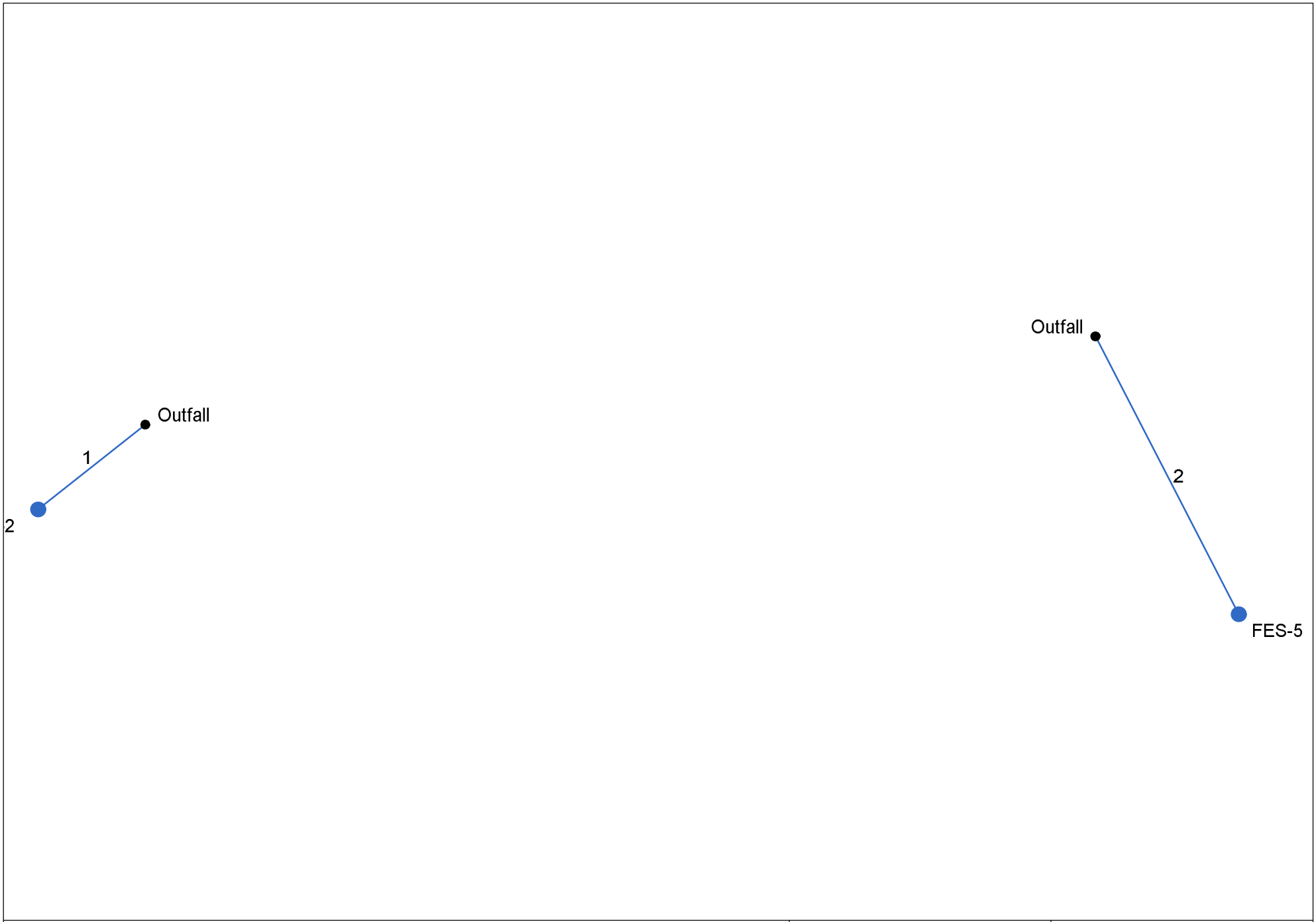


Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: Culverts.stm	Number of lines: 2	Date: 3/16/2017

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	P-HW2	1.26	12	Cir	38.350	235.70	236.90	3.129	236.17	237.37	n/a	237.37	End	Manhole
2	P-FES5	5.97	15	Cir	88.093	235.00	235.70	0.795	235.99	236.69	0.51	236.69	End	Manhole

Project File: Culverts.stm | Number of lines: 2 | Run Date: 3/16/2017

NOTES: Return period = 100 Yrs.

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	38.350	0.63	0.63	0.20	0.13	0.13	5.0	5.0	10.0	1.26	6.82	3.46	12	3.13	235.70	236.90	236.17	237.37	238.27	239.57	P-HW2
2	End	88.093	1.47	1.47	0.41	0.60	0.60	5.0	5.0	10.0	5.97	6.24	5.73	15	0.79	235.00	235.70	235.99	236.69	237.73	238.23	P-FES5

Project File: Culverts.stm

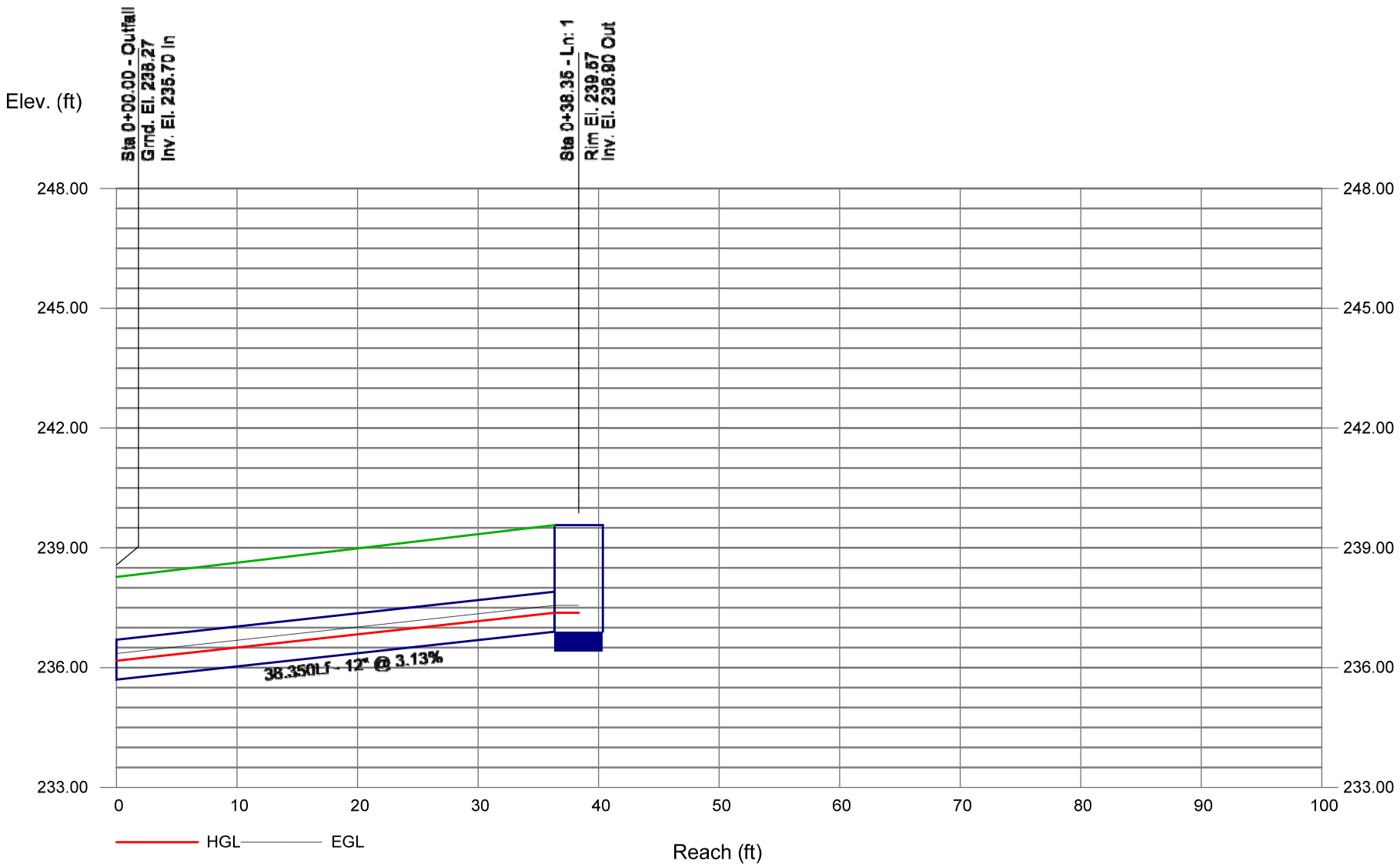
Number of lines: 2

Run Date: 3/16/2017

NOTES:Intensity = 36.98 / (Inlet time + 4.10) ^ 0.59 ; Return period =Yrs. 100 ; c = cir e = ellip b = box

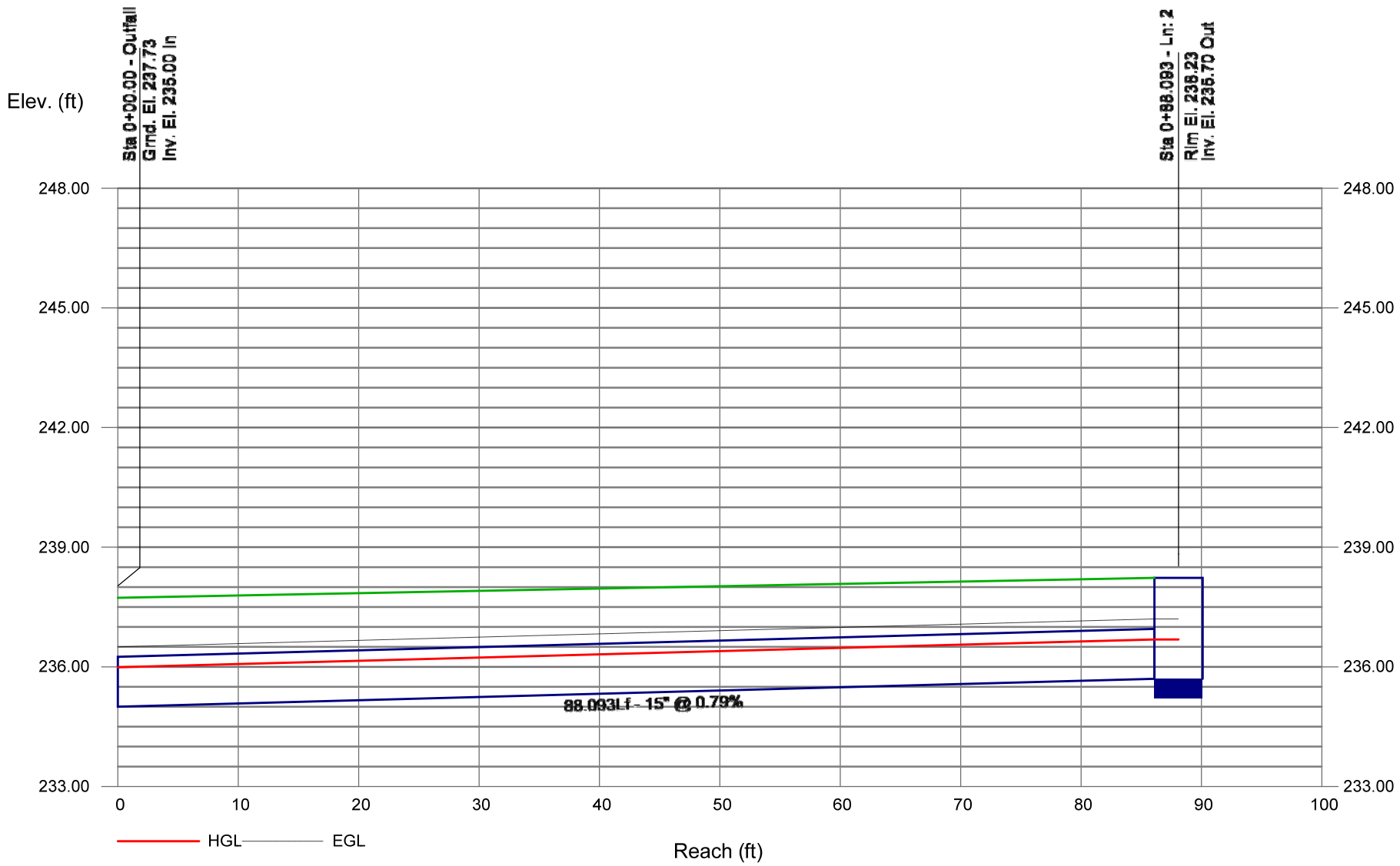
Storm Sewer Profile

Proj. file: Culverts.stm

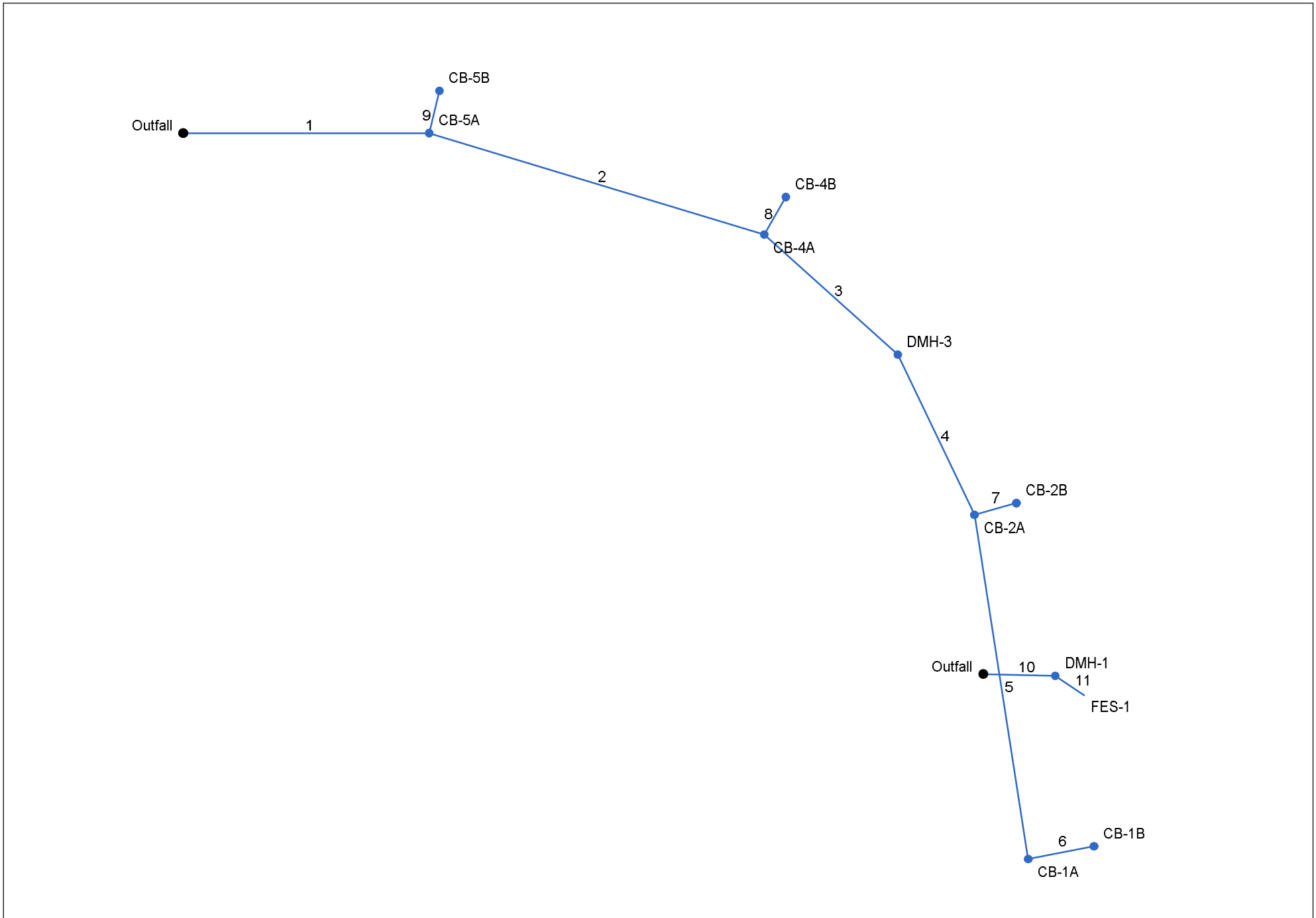


Storm Sewer Profile

Proj. file: Culverts.stm



Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: Pond 3.stm	Number of lines: 11	Date: 4/4/2017

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	P-5A	8.31	15	Cir	140.552	209.00	211.70	1.921	209.89	212.83	0.77	212.83	End	Manhole
2	P-4A	7.24	12	Cir	200.113	211.80	217.40	2.798	212.83*	219.87*	1.29	221.16	1	Manhole
3	P-3A	5.21	12	Cir	102.802	217.50	220.60	3.016	221.16*	223.04*	n/a	223.34	2	Manhole
4	P-2A	4.96	12	Cir	101.855	220.70	225.20	4.418	223.34	226.11	n/a	226.11 j	3	Manhole
5	P-1A	3.31	12	Cir	199.952	225.30	227.30	1.000	226.11	228.08	n/a	228.08 j	4	Manhole
6	P-1B	1.88	12	Cir	38.276	235.60	236.00	1.045	236.09	236.58	n/a	236.58	5	Manhole
7	P-2B	1.29	12	Cir	24.937	225.30	225.60	1.203	226.11	226.08	n/a	226.08 j	4	Manhole
8	P-4B	1.60	12	Cir	24.829	217.50	217.80	1.208	221.16*	221.21*	n/a	221.27	2	Manhole
9	P-5B	0.74	12	Cir	24.968	211.80	212.10	1.202	212.83	212.83	n/a	212.85	1	Manhole
10	P-DMH1	0.61	12	Cir	41.143	228.50	229.40	2.187	228.82	229.72	n/a	229.72	End	Manhole
11	P-FES1	0.62	12	Cir	19.572	231.50	233.80	11.752	231.65	234.13	n/a	234.13	10	Manhole

Project File: Pond 3.stm | Number of lines: 11 | Run Date: 4/4/2017

NOTES: Return period = 100 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Storm Sewer Tabulation

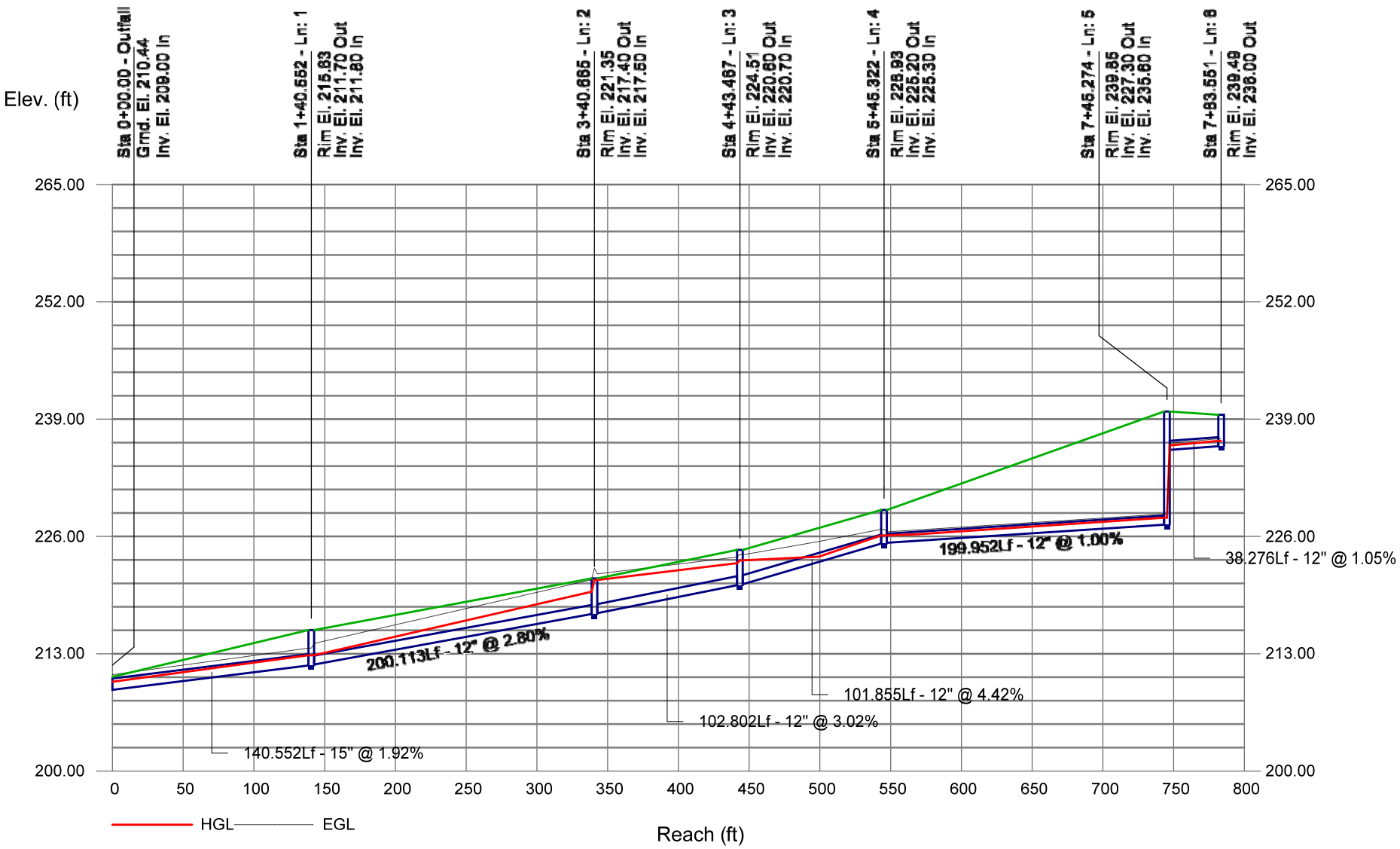
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	140.552	0.09	1.76	0.71	0.06	0.94	5.0	7.0	8.9	8.31	9.70	8.01	15	1.92	209.00	211.70	209.89	212.83	210.44	215.63	P-5A
2	1	200.113	0.10	1.55	0.72	0.07	0.80	5.0	6.6	9.0	7.24	6.45	9.21	12	2.80	211.80	217.40	212.83	219.87	215.63	221.35	P-4A
3	2	102.802	0.05	0.91	0.72	0.04	0.57	5.0	6.3	9.2	5.21	0.00	6.64	12	3.02	217.50	220.60	221.16	223.04	221.35	224.51	P-3A
4	3	101.855	0.09	0.86	0.71	0.06	0.53	5.0	6.1	9.3	4.96	0.00	6.45	12	4.42	220.70	225.20	223.34	226.11	224.51	228.93	P-2A
5	4	199.952	0.20	0.43	0.75	0.15	0.34	5.0	5.3	9.8	3.31	0.00	4.94	12	1.00	225.30	227.30	226.11	228.08	228.93	239.85	P-1A
6	5	38.276	0.23	0.23	0.82	0.19	0.19	5.0	5.0	10.0	1.88	0.00	4.45	12	1.05	235.60	236.00	236.09	236.58	239.85	239.49	P-1B
7	4	24.937	0.34	0.34	0.38	0.13	0.13	5.0	5.0	10.0	1.29	0.00	2.67	12	1.20	225.30	225.60	226.11	226.08	228.93	228.91	P-2B
8	2	24.829	0.54	0.54	0.30	0.16	0.16	5.0	5.0	10.0	1.60	0.00	2.03	12	1.21	217.50	217.80	221.16	221.21	221.35	221.34	P-4B
9	1	24.968	0.12	0.12	0.62	0.07	0.07	5.0	5.0	10.0	0.74	0.00	1.07	12	1.20	211.80	212.10	212.83	212.83	215.63	215.63	P-5B
10	End	41.143	0.00	0.48	0.00	0.00	0.06	5.0	5.4	9.7	0.61	0.00	2.75	12	2.19	228.50	229.40	228.82	229.72	229.69	234.13	P-DMH1
11	10	19.572	0.48	0.48	0.13	0.06	0.06	5.0	5.0	10.0	0.62	0.00	5.69	12	11.75	231.50	233.80	231.65	234.13	234.13	234.99	P-FES1

Project File: Pond 3.stm | Number of lines: 11 | Run Date: 4/4/2017

NOTES:Intensity = 36.98 / (Inlet time + 4.10) ^ 0.59 ; Return period =Yrs. 100 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: Pond 3.stm



Storm Sewer Profile

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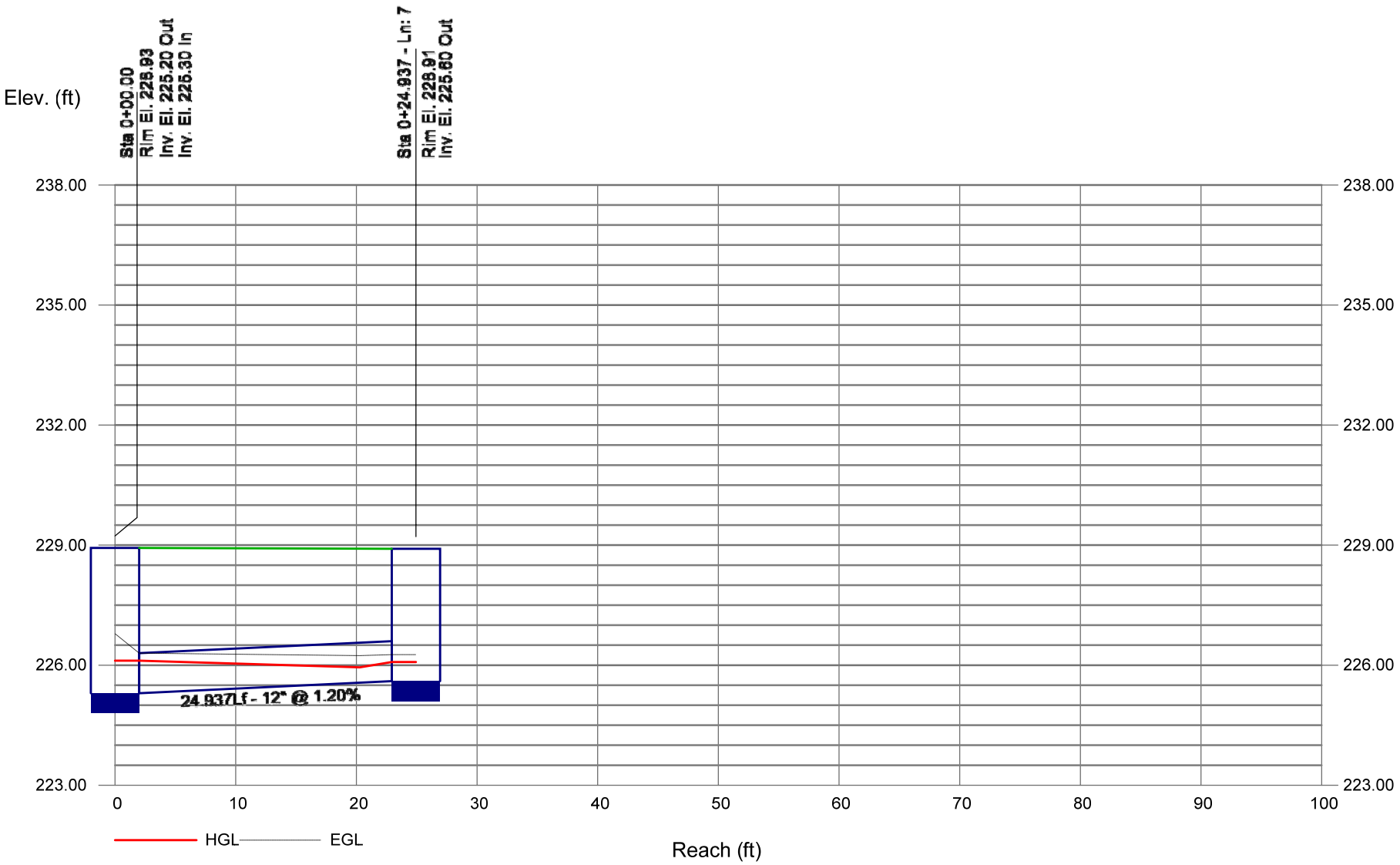

Storm Sewer Profile

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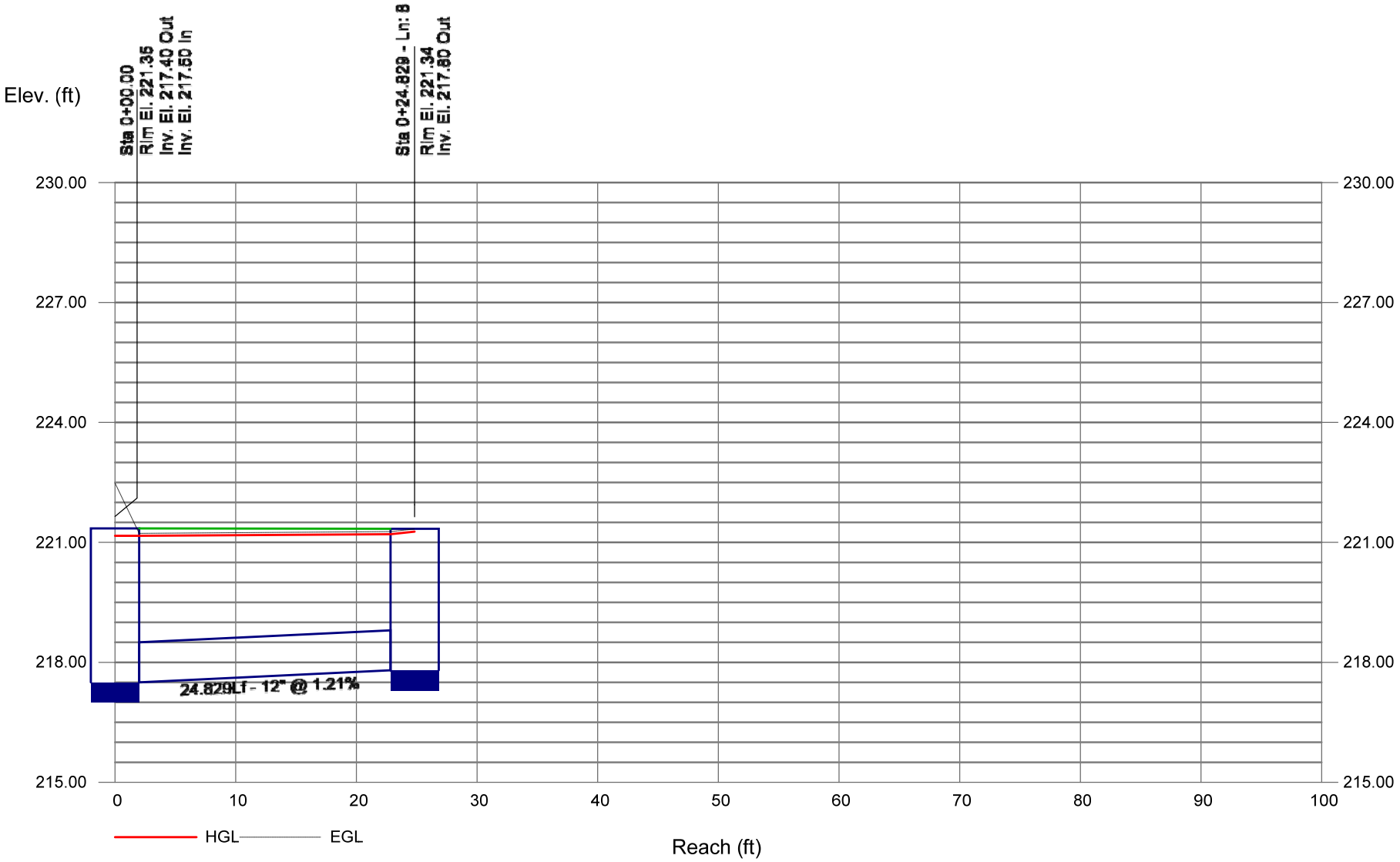

Storm Sewer Profile

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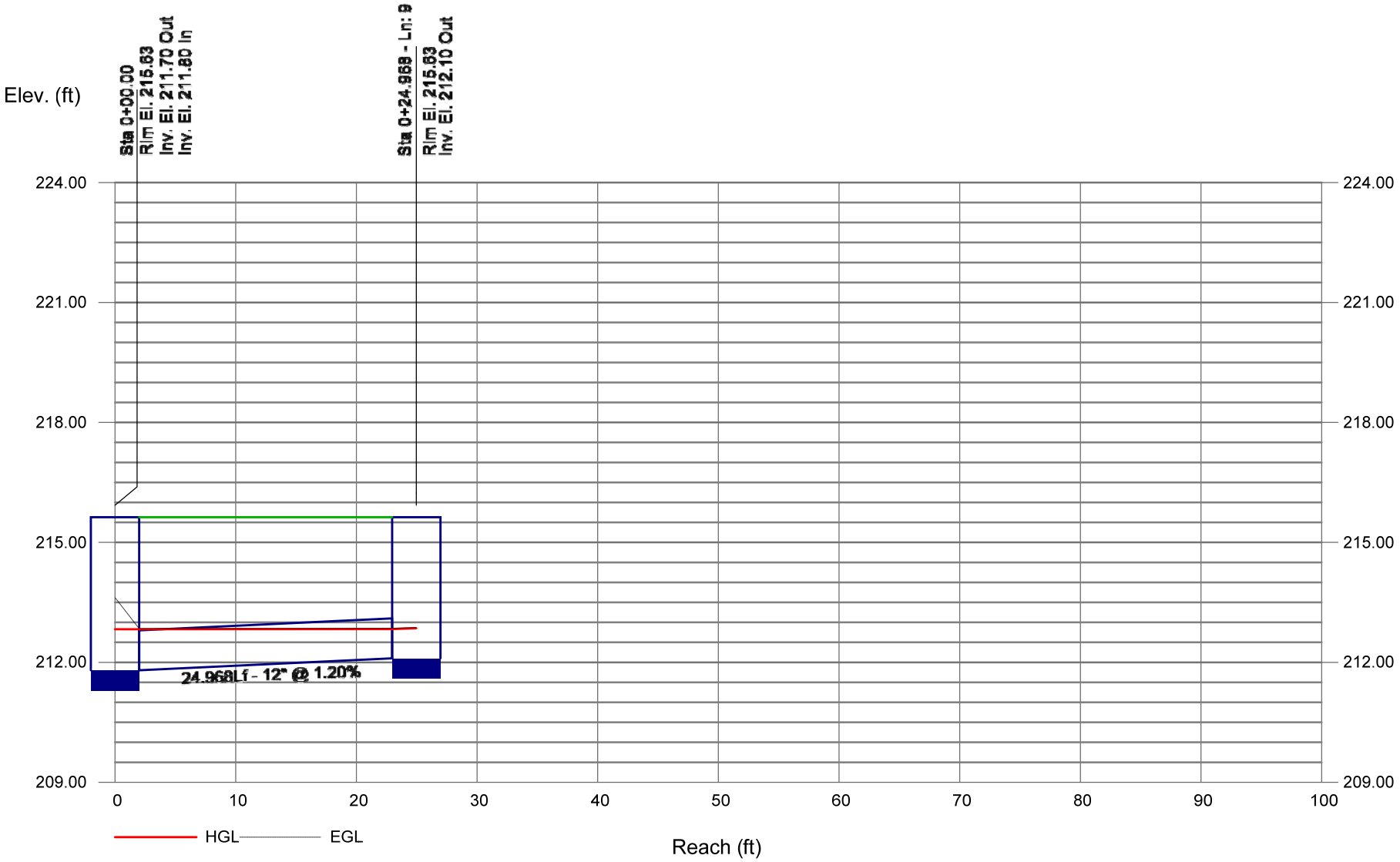

Storm Sewer Profile

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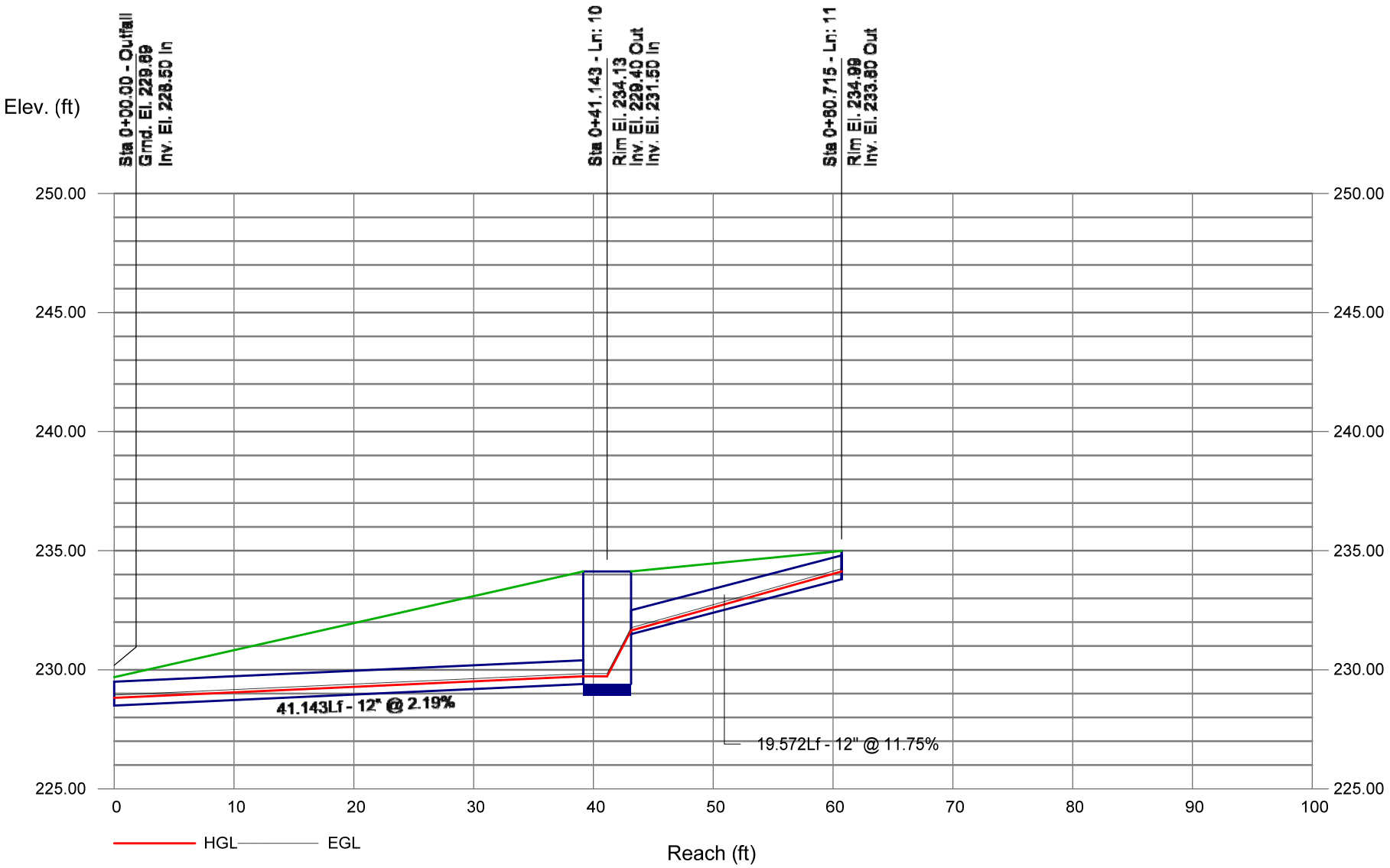
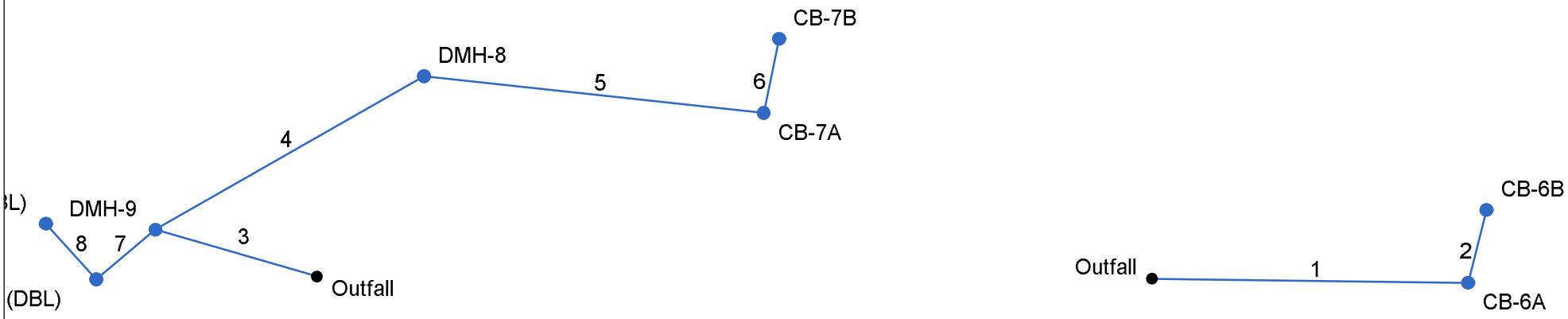


Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: Pond 5.stm	Number of lines: 8	Date: 4/4/2017

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	P-6A	1.37	12	Cir	105.028	204.70	205.70	0.952	205.12	206.20	n/a	206.20	End	Manhole
2	P-6B	0.71	12	Cir	25.023	205.80	206.10	1.199	206.20	206.45	n/a	206.45 j	1	Manhole
3	P-9	4.02	12	Cir	55.810	188.00	189.10	1.971	190.30*	190.91*	0.41	191.32	End	Manhole
4	P-8	1.43	12	Cir	102.844	193.90	196.30	2.334	194.24	196.81	n/a	196.81	3	Manhole
5	P-7A	1.52	12	Cir	113.514	196.40	199.00	2.290	196.81	199.52	n/a	199.52	4	Manhole
6	P-7B	0.84	12	Cir	25.240	199.10	199.40	1.189	199.52	199.78	n/a	199.78 j	5	Manhole
7	P-10A	2.99	12	Cir	25.662	193.90	194.20	1.169	194.53	194.94	n/a	194.94	3	Manhole
8	P-10B	1.46	12	Cir	24.924	194.30	194.60	1.204	194.94	195.11	n/a	195.11 j	7	Manhole

Project File: Pond 5.stm | Number of lines: 8 | Run Date: 4/4/2017

NOTES: Return period = 100 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Storm Sewer Tabulation

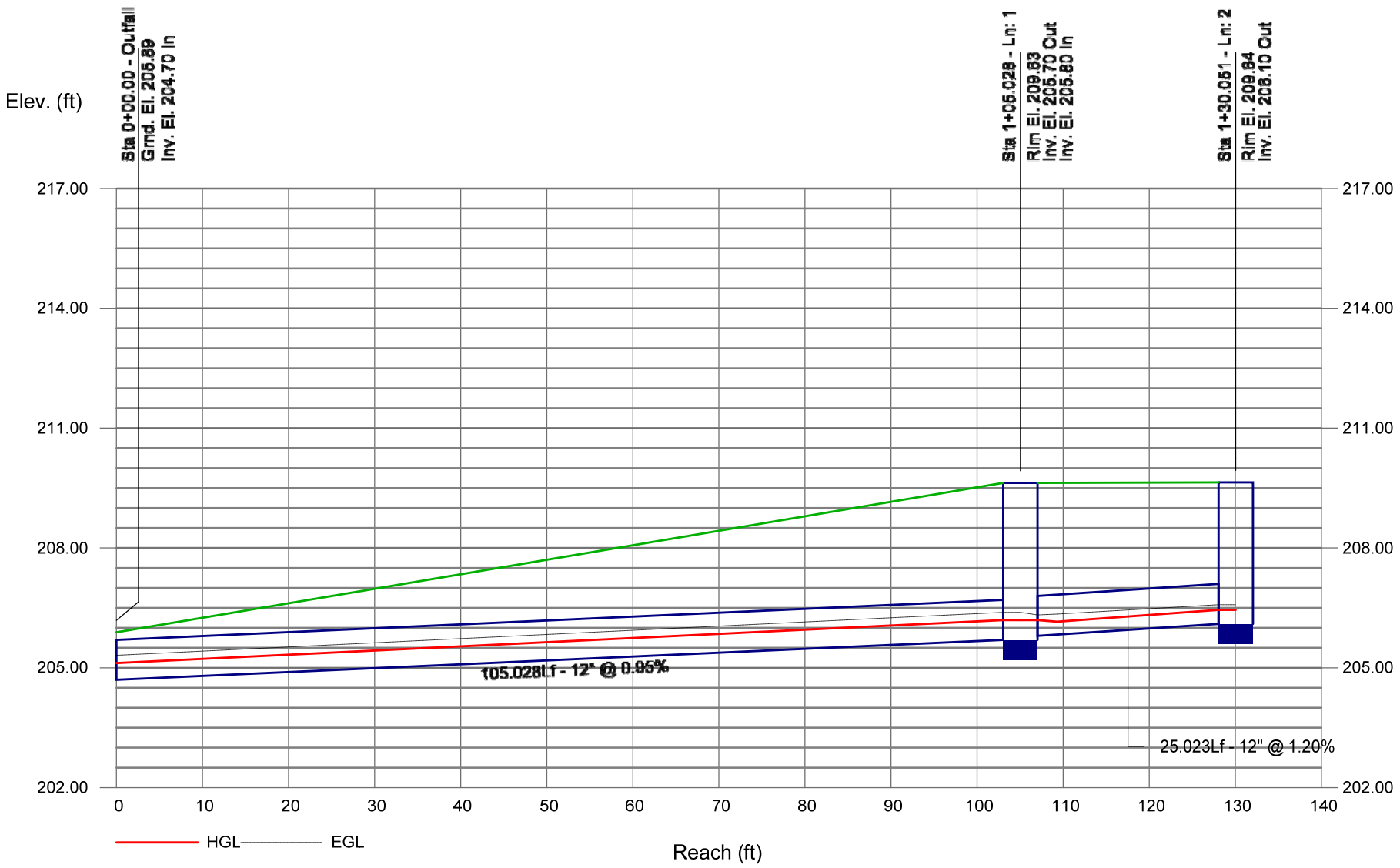
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	105.028	0.10	0.20	0.71	0.07	0.14	5.0	5.5	9.7	1.37	3.76	3.98	12	0.95	204.70	205.70	205.12	206.20	205.89	209.63	P-6A
2	1	25.023	0.10	0.10	0.71	0.07	0.07	5.0	5.0	10.0	0.71	4.22	2.66	12	1.20	205.80	206.10	206.20	206.45	209.63	209.64	P-6B
3	End	55.810	0.00	0.62	0.00	0.00	0.46	5.0	7.3	8.7	4.02	5.42	5.12	12	1.97	188.00	189.10	190.30	190.91	189.19	198.17	P-9
4	3	102.844	0.00	0.21	0.00	0.00	0.16	5.0	6.4	9.2	1.43	5.89	4.89	12	2.33	193.90	196.30	194.24	196.81	198.17	199.88	P-8
5	4	113.514	0.08	0.21	0.90	0.07	0.16	5.0	5.4	9.7	1.52	5.84	4.36	12	2.29	196.40	199.00	196.81	199.52	199.88	202.90	P-7A
6	5	25.240	0.13	0.13	0.65	0.08	0.08	5.0	5.0	10.0	0.84	4.21	2.85	12	1.19	199.10	199.40	199.52	199.78	202.90	202.88	P-7B
7	3	25.662	0.20	0.41	0.79	0.16	0.30	5.0	5.2	9.8	2.99	4.17	5.28	12	1.17	193.90	194.20	194.53	194.94	198.17	198.09	P-10A
8	7	24.924	0.21	0.21	0.70	0.15	0.15	5.0	5.0	10.0	1.46	4.23	3.18	12	1.20	194.30	194.60	194.94	195.11	198.09	198.09	P-10B

Project File: Pond 5.stm | Number of lines: 8 | Run Date: 4/4/2017

NOTES:Intensity = 36.98 / (Inlet time + 4.10) ^ 0.59 ; Return period =Yrs. 100 ; c = cir e = ellip b = box

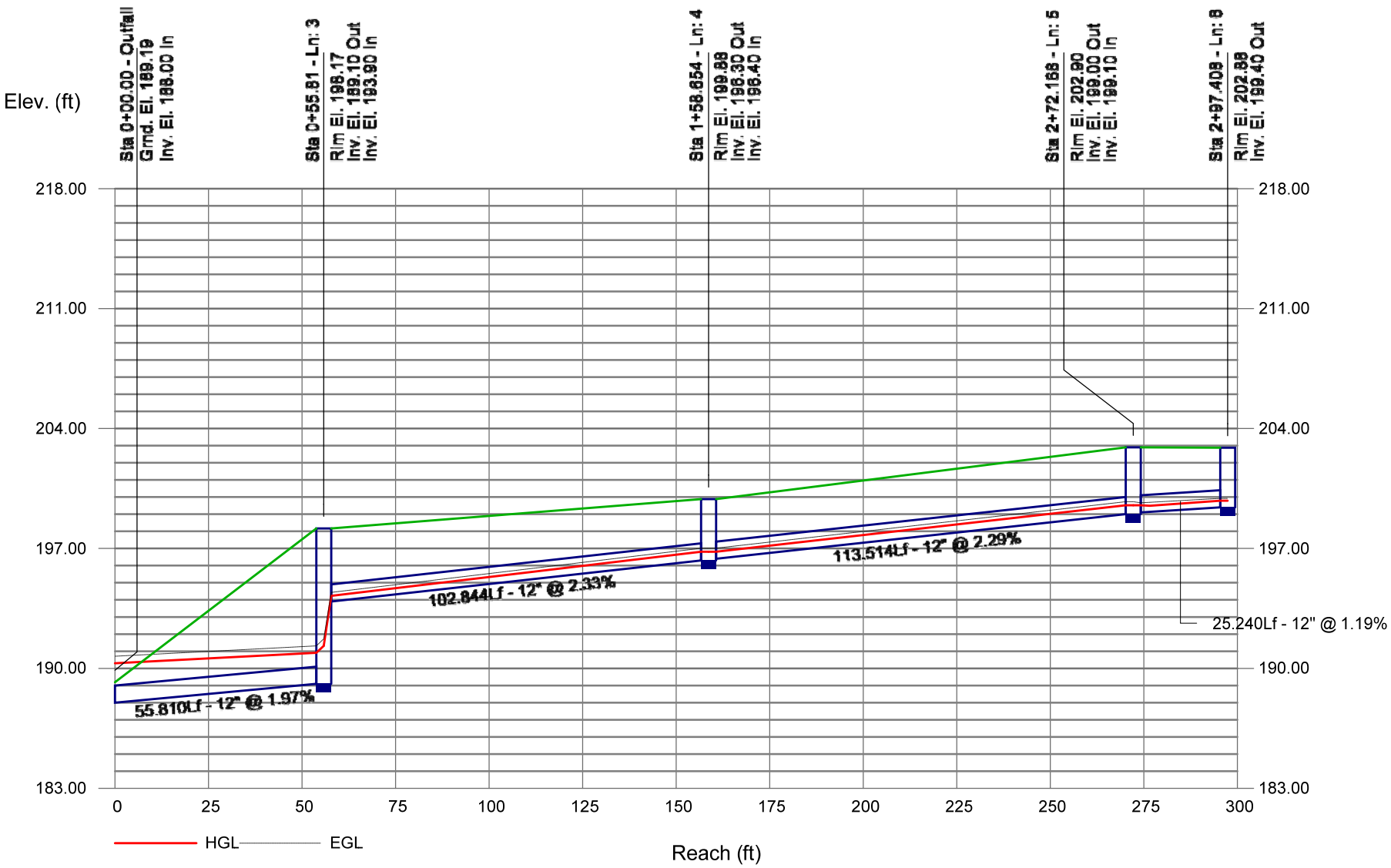
Storm Sewer Profile

Proj. file: Pond 5.stm



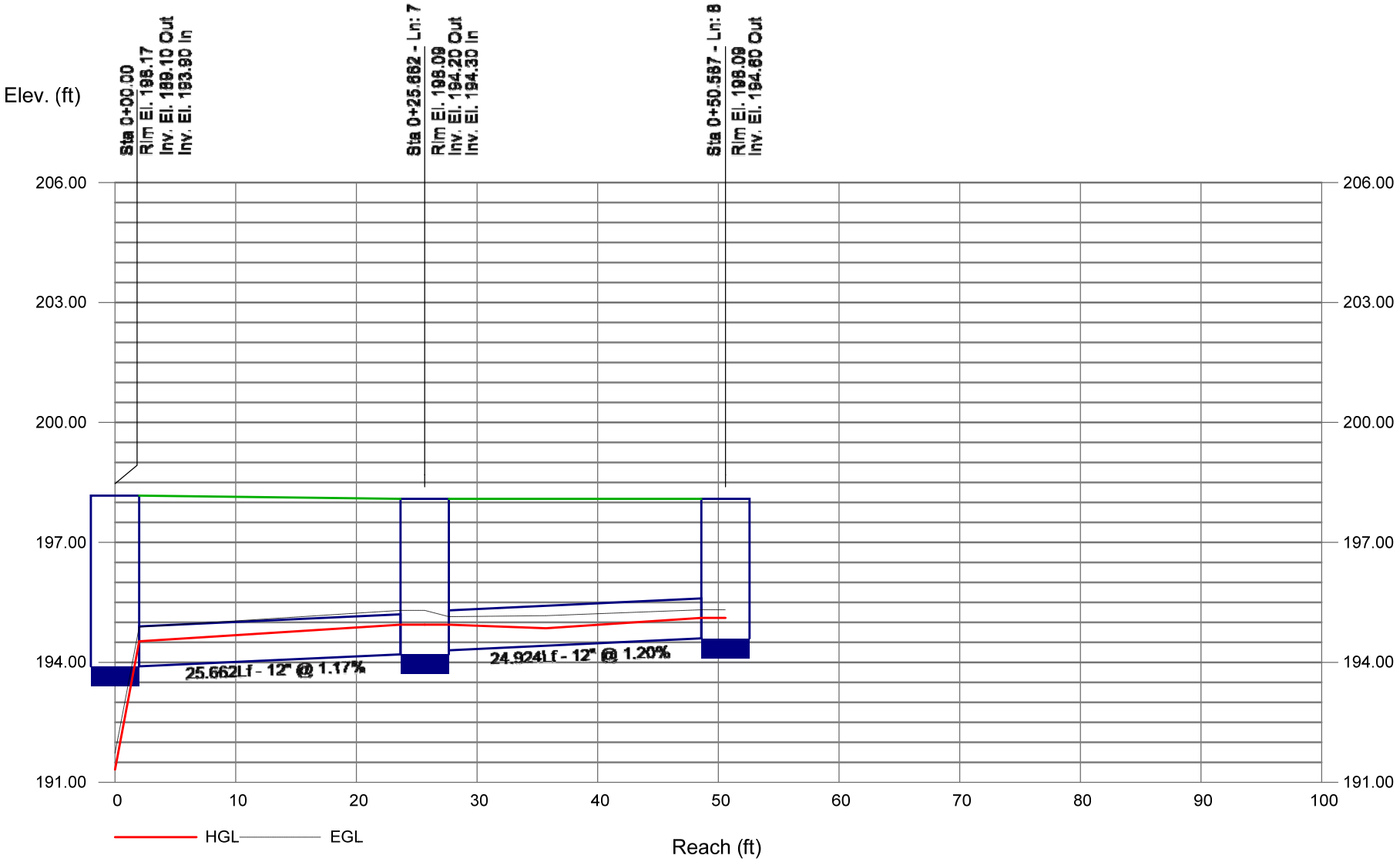
Storm Sewer Profile

Proj. file: Pond 5.stm

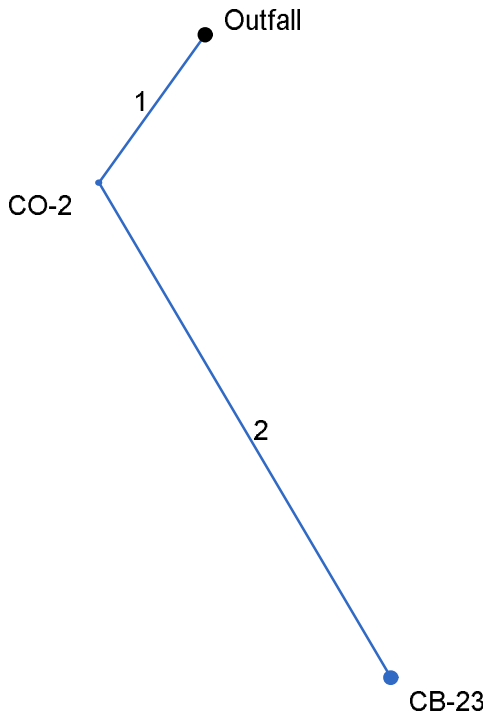


Storm Sewer Profile

Proj. file: Pond 5.stm



Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: Bio Basin.stm	Number of lines: 2	Date: 4/4/2017

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	Pipe - (89)	2.20	12	Cir	58.000	212.30	212.70	0.690	212.93	213.33	n/a	213.33	End	Manhole
2	Pipe - (88)	2.20	12	Cir	183.000	212.80	213.90	0.601	213.44	214.54	0.27	214.81	1	Manhole

Project File: Bio Basin.stm

Number of lines: 2

Run Date: 4/4/2017

NOTES: Return period = 100 Yrs.

Storm Sewer Tabulation

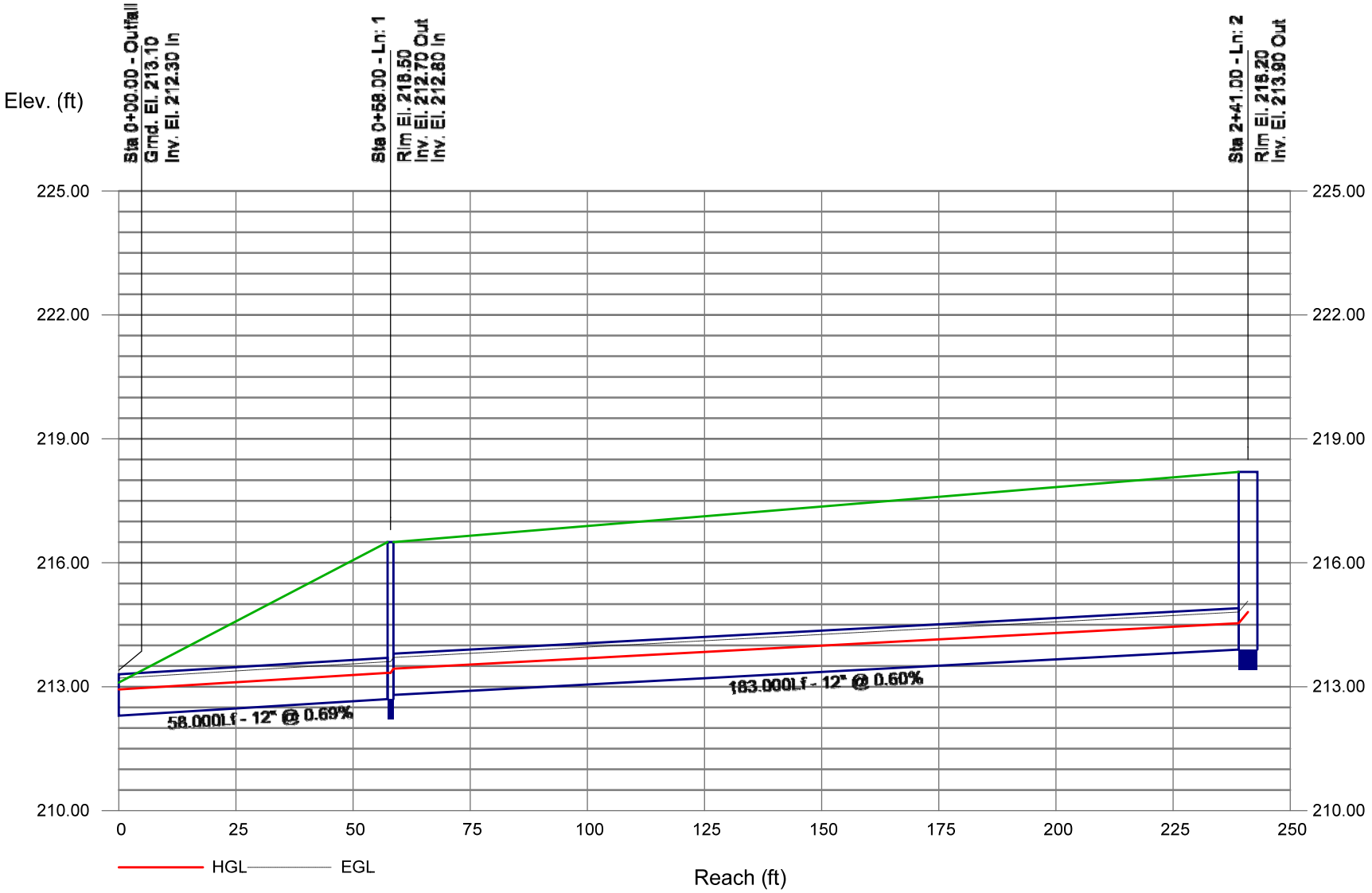
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	58.000	0.00	0.00	0.00	0.00	0.00	0.0	1.1	0.0	2.20	3.20	4.19	12	0.69	212.30	212.70	212.93	213.33	213.10	216.50	Pipe - (89)
2	1	183.000	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	2.20	2.99	4.16	12	0.60	212.80	213.90	213.44	214.54	216.50	218.20	Pipe - (88)

Project File: Bio Basin.stm | Number of lines: 2 | Run Date: 4/4/2017

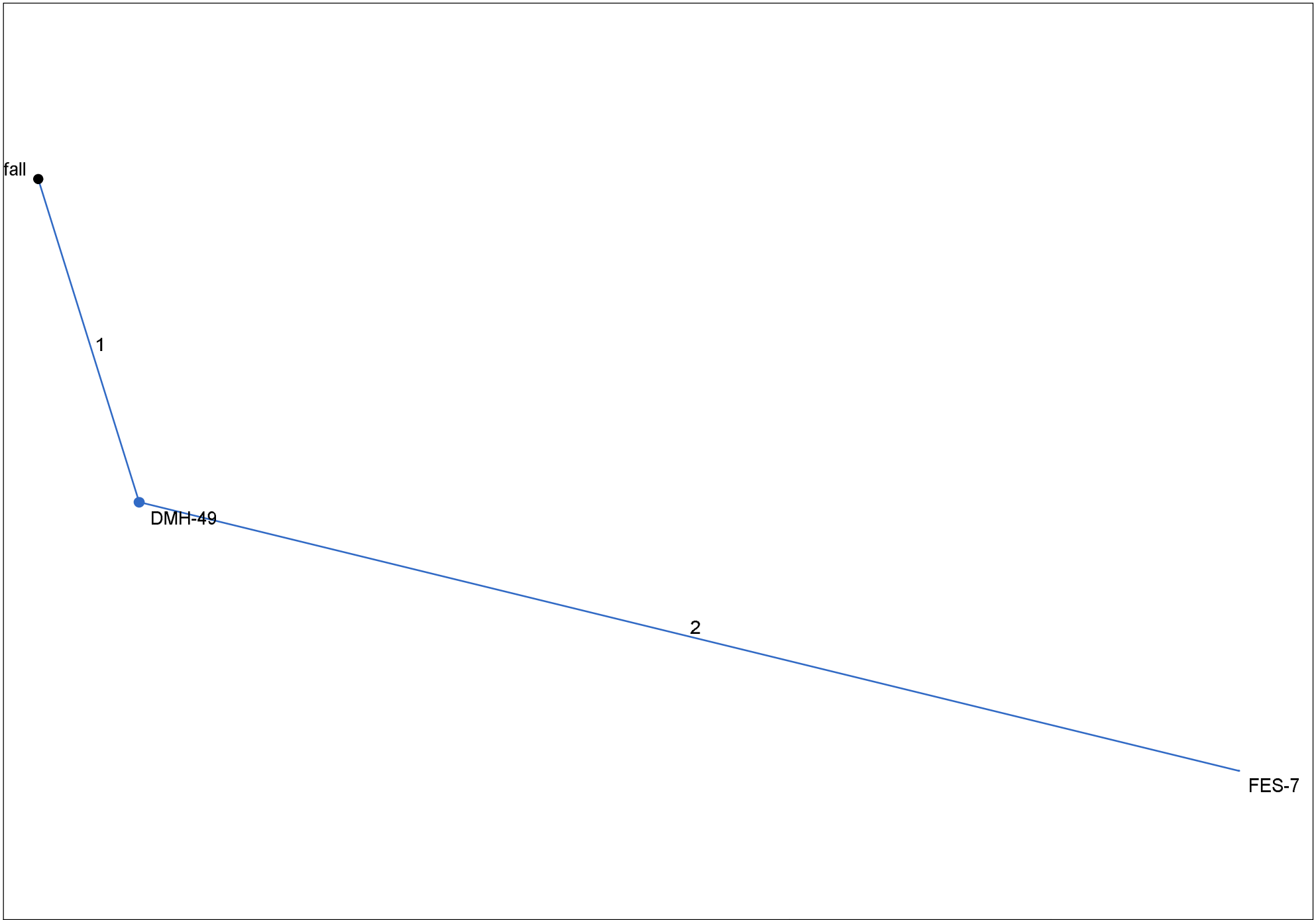
NOTES:Intensity = 36.98 / (Inlet time + 4.10) ^ 0.59 ; Return period =Yrs. 100 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: Bio Basin.stm



Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: Ledge Trench.stm	Number of lines: 2	Date: 3/24/2017

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	P-49	5.89	12	Cir	146.646	194.00	202.00	5.455	194.95	202.95	n/a	202.95	End	Manhole
2	P-7	6.14	12	Cir	488.398	201.90	218.00	3.296	202.95	218.96	n/a	218.96 j	1	Manhole

Project File: Ledge Trench.stm | Number of lines: 2 | Run Date: 3/24/2017

NOTES: Return period = 100 Yrs. ; j - Line contains hyd. jump.

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	146.646	0.14	6.31	0.10	0.01	0.63	5.0	6.0	9.3	5.89	9.01	7.63	12	5.46	194.00	202.00	194.95	202.95	195.19	206.00	P-49
2	1	488.398	6.17	6.17	0.10	0.62	0.62	5.0	5.0	10.0	6.14	7.00	7.88	12	3.30	201.90	218.00	202.95	218.96	206.00	221.00	P-7

Project File: Ledge Trench.stm

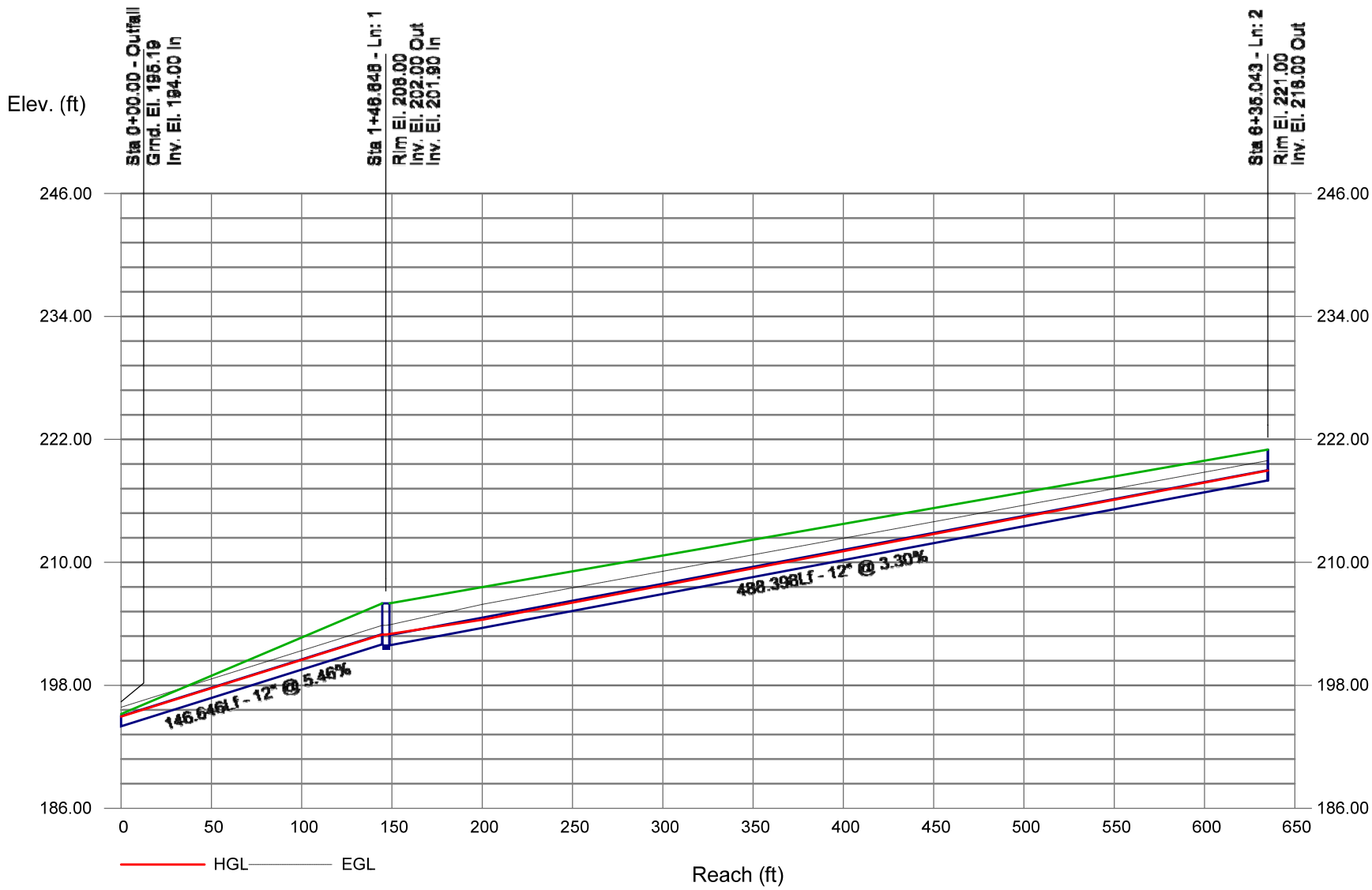
Number of lines: 2

Run Date: 3/24/2017

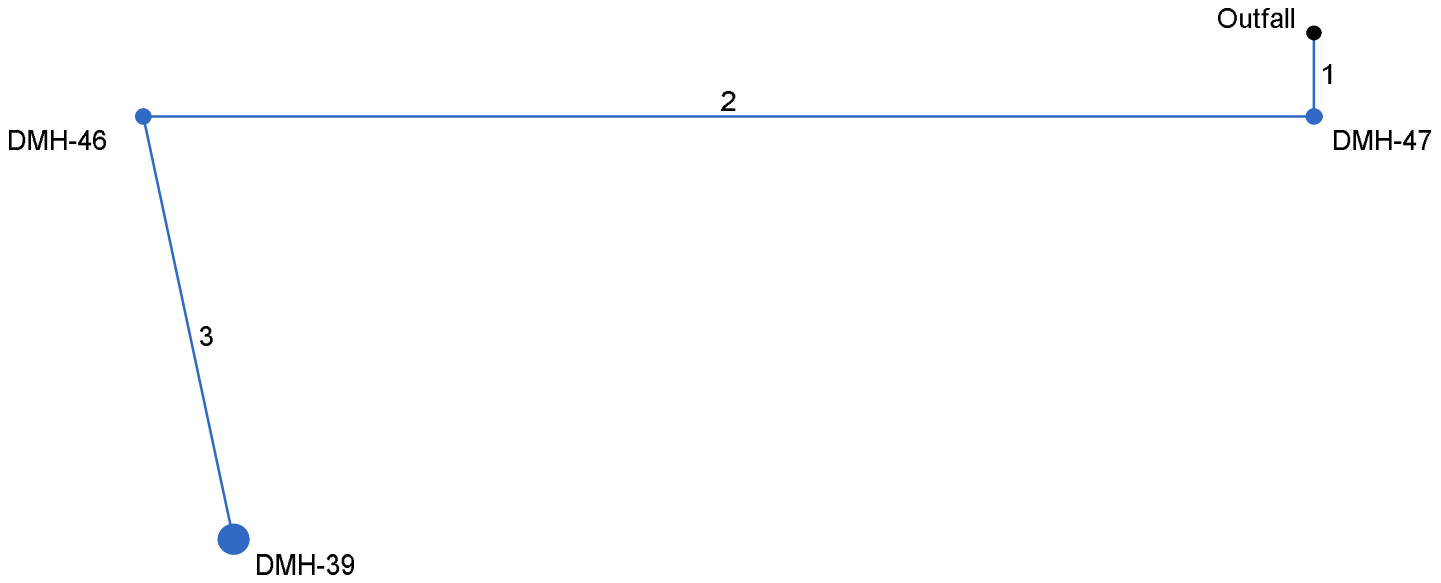
NOTES:Intensity = 36.98 / (Inlet time + 4.10) ^ 0.59 ; Return period =Yrs. 100 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: Ledge Trench.stm



Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: MC3500-OUTLET.stm	Number of lines: 3	Date: 4/4/2017

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	P-47	14.40	18	Cir	23.000	184.80	185.10	1.304	187.60*	187.97*	1.03	189.00	End	Manhole
2	P-46	14.40	18	Cir	321.000	185.20	188.90	1.153	189.00*	194.15*	1.03	195.18	1	Manhole
3	P-39	14.40	18	Cir	119.000	194.70	200.70	5.042	195.51	202.09	n/a	202.09	2	Manhole

Project File: MC3500-OUTLET.stm | Number of lines: 3 | Run Date: 4/4/2017

NOTES: Return period = 100 Yrs. ; *Surcharged (HGL above crown).

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	23.000	0.00	0.00	0.00	0.00	0.00	5.0	5.9	0.0	14.40	12.99	8.15	18	1.30	184.80	185.10	187.60	187.97	190.72	195.19	P-47
2	1	321.000	0.00	0.00	0.00	0.00	0.00	5.0	5.2	0.0	14.40	12.21	8.15	18	1.15	185.20	188.90	189.00	194.15	195.19	203.19	P-46
3	2	119.000	0.00	0.00	0.00	0.00	0.00	5.0	5.0	0.0	14.40	0.00	11.65	18	5.04	194.70	200.70	195.51	202.09	203.19	211.48	P-39

Project File: MC3500-OUTLET.stm

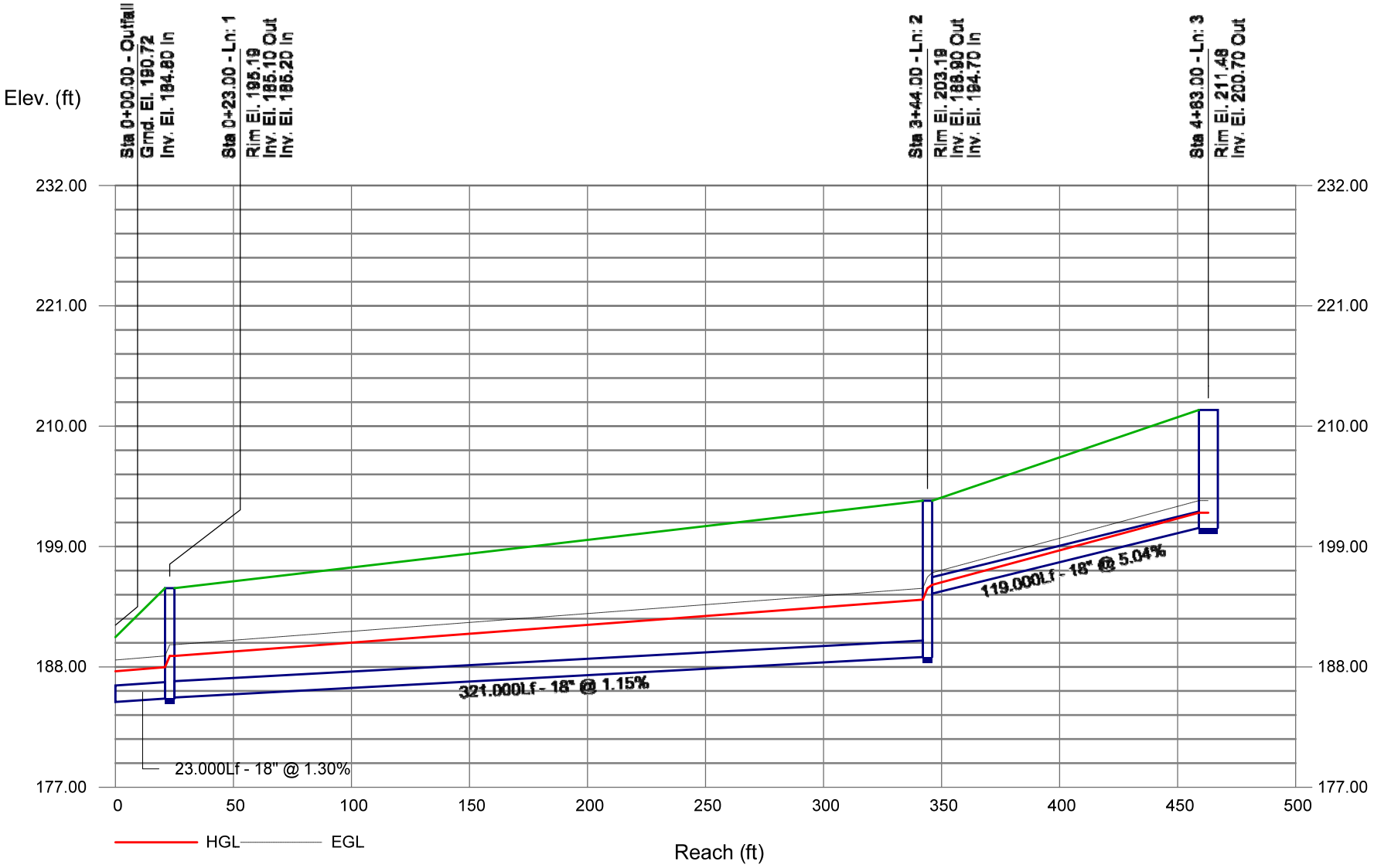
Number of lines: 3

Run Date: 4/4/2017

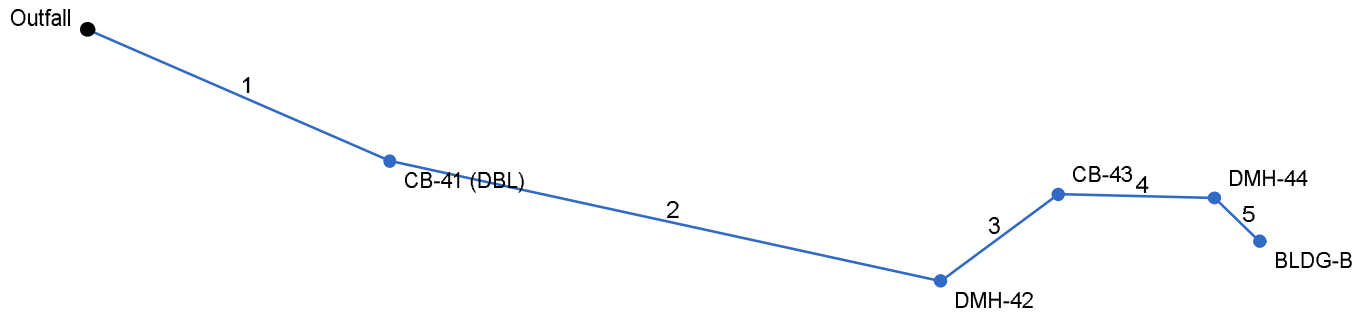
NOTES:Intensity = 36.98 / (Inlet time + 4.10) ^ 0.59 ; Return period =Yrs. 100 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: MC3500-OUTLET.stm



Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: MC3500.stm	Number of lines: 5	Date: 4/4/2017

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	P-41	14.01	18	Cir	125.475	204.40	205.70	1.036	206.70*	208.61*	0.23	208.84	End	Manhole
2	P-42	13.36	18	Cir	214.506	209.80	212.40	1.212	211.15	213.76	n/a	213.76	1	Manhole
3	P-43	13.47	18	Cir	55.641	212.50	213.20	1.258	213.82	214.57	n/a	214.57	2	Manhole
4	P-44	10.82	18	Cir	59.466	213.30	213.90	1.009	214.57	215.16	n/a	215.16 j	3	Manhole
5	P-BLDG-B	10.84	12	Cir	23.847	214.00	214.43	1.803	215.16*	217.04*	2.96	220.01	4	Manhole

Project File: MC3500.stm | Number of lines: 5 | Run Date: 4/4/2017

NOTES: Return period = 100 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	125.475	0.17	1.77	0.65	0.11	1.48	5.0	5.8	9.5	14.01	11.58	7.93	18	1.04	204.40	205.70	206.70	208.61	211.48	215.50	P-41
2	1	214.506	0.00	1.60	0.00	0.00	1.37	5.0	5.3	9.8	13.36	12.52	7.94	18	1.21	209.80	212.40	211.15	213.76	215.50	219.25	P-42
3	2	55.641	0.39	1.60	0.72	0.28	1.37	5.0	5.2	9.8	13.47	12.76	8.07	18	1.26	212.50	213.20	213.82	214.57	219.25	218.18	P-43
4	3	59.466	0.00	1.21	0.00	0.00	1.09	5.0	5.0	9.9	10.82	11.43	6.81	18	1.01	213.30	213.90	214.57	215.16	218.18	219.44	P-44
5	4	23.847	1.21	1.21	0.90	1.09	1.09	5.0	5.0	10.0	10.84	5.18	13.80	12	1.80	214.00	214.43	215.16	217.04	219.44	219.89	P-BLDG-B

Project File: MC3500.stm

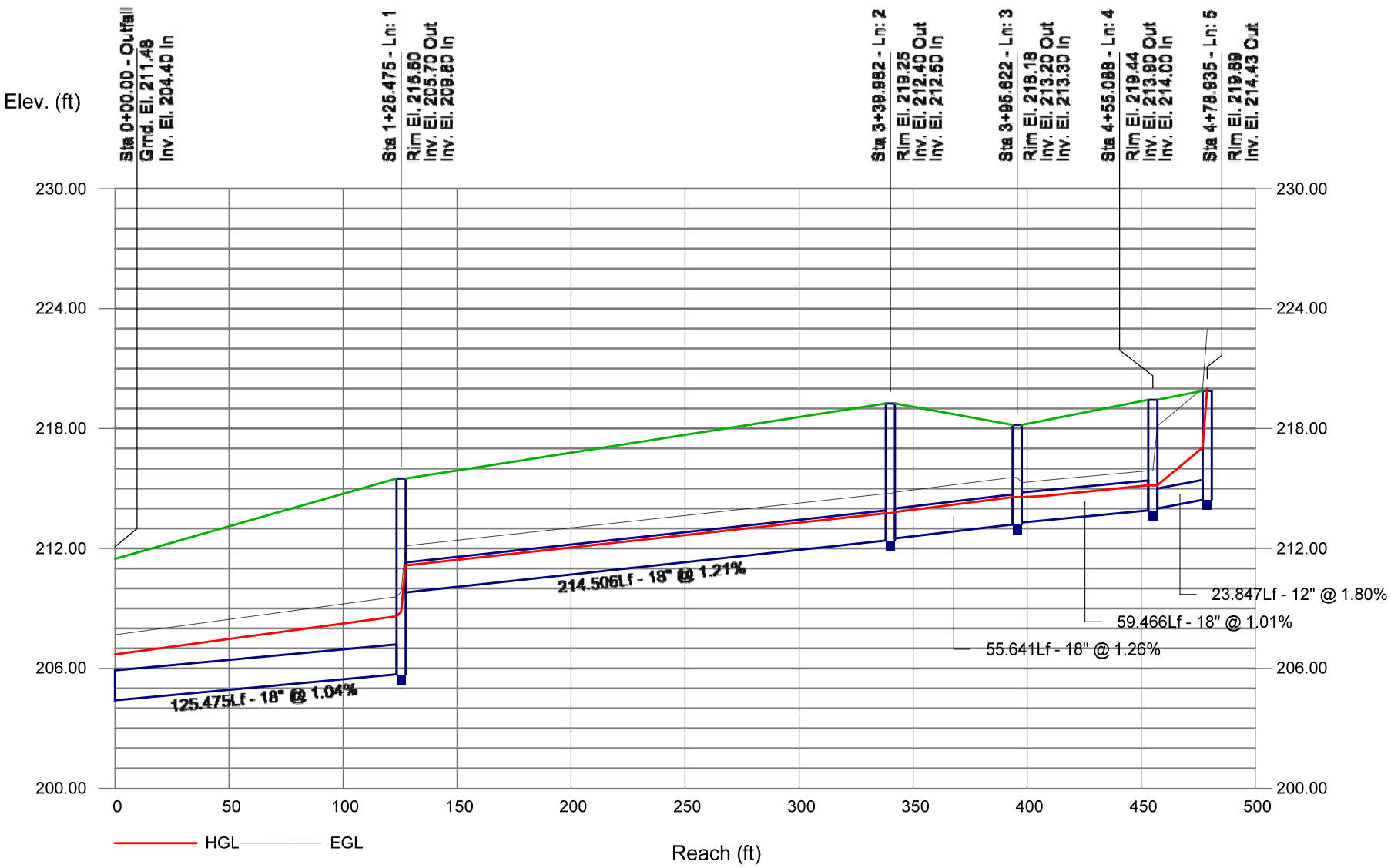
Number of lines: 5

Run Date: 4/4/2017

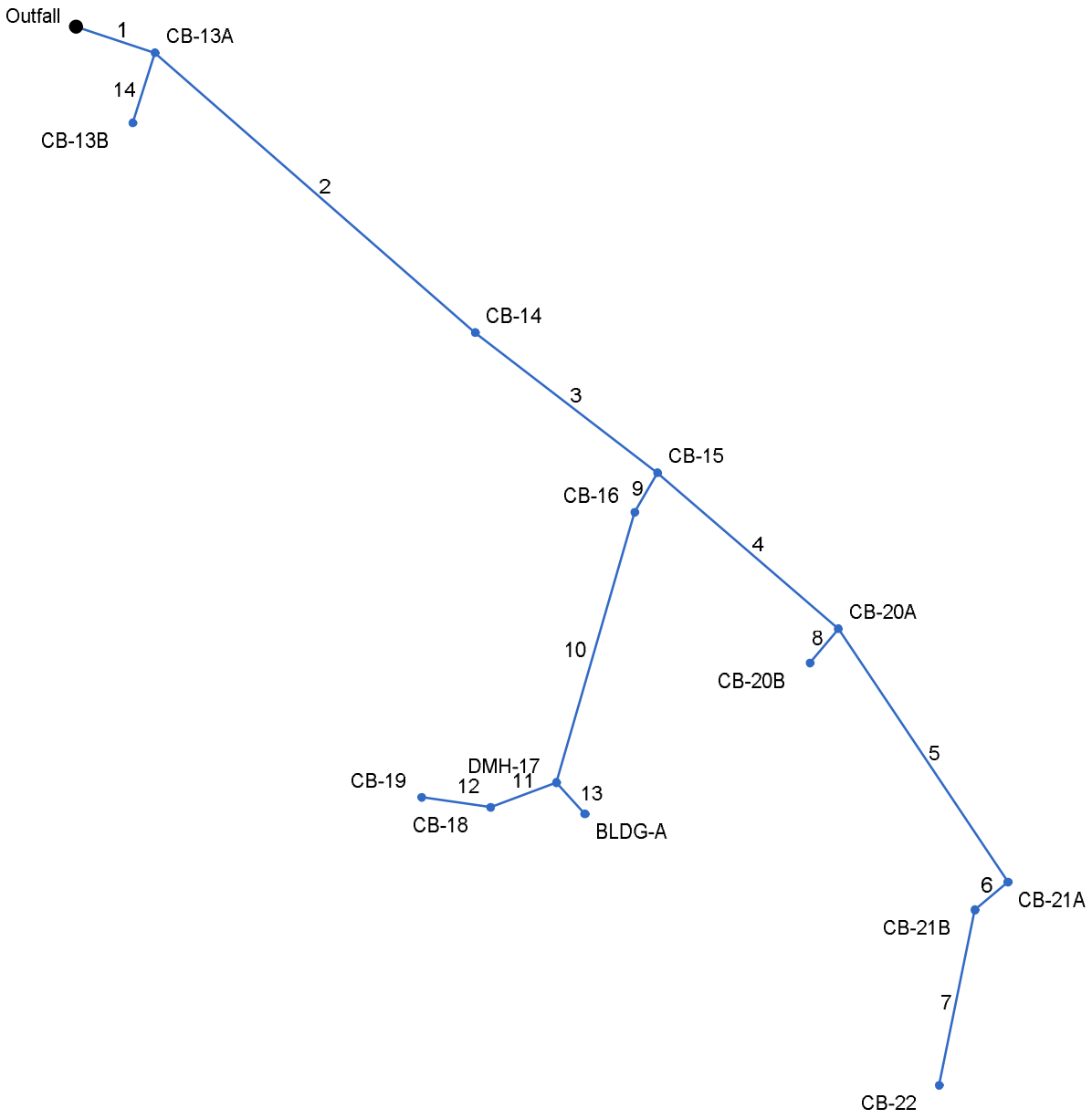
NOTES:Intensity = 36.98 / (Inlet time + 4.10) ^ 0.59 ; Return period =Yrs. 100 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: MC3500.stm



Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: MC4500-NORTH.stm	Number of lines: 14	Date: 4/4/2017

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	P-13A	20.56	18	Cir	50.178	193.80	195.80	3.986	194.92	197.27	n/a	197.27	End	Manhole
2	P-14	17.85	18	Cir	245.000	195.90	200.90	2.041	197.40*	203.44*	0.24	203.67	1	Manhole
3	P-15	17.63	18	Cir	133.646	201.00	207.00	4.489	203.67	208.45	n/a	208.45 j	2	Manhole
4	P-20A	5.68	12	Cir	137.634	207.10	213.60	4.723	208.45	214.55	n/a	214.55 j	3	Manhole
5	P-21A	4.81	12	Cir	168.857	217.00	224.70	4.560	217.55	225.61	0.64	225.61	4	Manhole
6	P-21B	4.31	12	Cir	24.936	224.80	225.10	1.203	225.64	225.97	n/a	225.97	5	Manhole
7	P-22A	2.65	12	Cir	94.824	225.20	231.80	6.960	225.97	232.50	n/a	232.50 j	6	Manhole
8	P-20B	0.50	12	Cir	24.895	217.00	217.30	1.205	217.23	217.59	0.11	217.59	4	Manhole
9	P-16	11.69	15	Cir	25.005	207.10	208.30	4.799	208.45	209.51	n/a	209.51 j	3	Manhole
10	P-17	9.36	15	Cir	150.000	208.40	212.60	2.800	209.51	213.77	0.88	213.77	9	Manhole
11	P-18	1.55	12	Cir	42.250	213.70	214.20	1.183	214.12	214.73	n/a	214.73	10	Manhole
12	P-19	0.90	12	Cir	42.498	214.30	214.80	1.177	214.73	215.20	n/a	215.20 j	11	Manhole
13	P-BLDG-A	8.33	12	Cir	24.037	212.70	212.75	0.208	213.77*	214.89*	1.75	216.64	10	Manhole
14	P-13B	2.15	12	Cir	39.309	195.90	197.30	3.562	197.27	197.93	n/a	197.93 j	1	Manhole

Project File: MC4500-NORTH.stm | Number of lines: 14 | Run Date: 4/4/2017

NOTES: Return period = 100 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	50.178	0.18	3.35	0.77	0.14	2.33	5.0	7.0	8.8	20.56	22.71	13.12	18	3.99	193.80	195.80	194.92	197.27	200.62	200.40	P-13A
2	1	245.000	0.07	2.55	0.72	0.05	1.97	5.0	6.6	9.1	17.85	16.25	10.10	18	2.04	195.90	200.90	197.40	203.44	200.40	205.05	P-14
3	2	133.646	0.06	2.48	0.71	0.04	1.92	5.0	6.3	9.2	17.63	24.10	10.03	18	4.49	201.00	207.00	203.67	208.45	205.05	212.65	P-15
4	3	137.634	0.08	0.83	0.71	0.06	0.61	5.0	6.0	9.4	5.68	8.38	7.31	12	4.72	207.10	213.60	208.45	214.55	212.65	220.77	P-20A
5	4	168.857	0.08	0.68	0.68	0.05	0.50	5.0	5.5	9.6	4.81	8.24	8.66	12	4.56	217.00	224.70	217.55	225.61	220.77	229.00	P-21A
6	5	24.936	0.26	0.60	0.69	0.18	0.45	5.0	5.5	9.7	4.31	4.23	6.03	12	1.20	224.80	225.10	225.64	225.97	229.00	229.15	P-21B
7	6	94.824	0.34	0.34	0.78	0.27	0.27	5.0	5.0	10.0	2.65	10.18	4.31	12	6.96	225.20	231.80	225.97	232.50	229.15	235.39	P-22A
8	4	24.895	0.07	0.07	0.72	0.05	0.05	5.0	5.0	10.0	0.50	4.24	3.11	12	1.21	217.00	217.30	217.23	217.59	220.77	220.77	P-20B
9	3	25.005	0.46	1.59	0.59	0.27	1.27	5.0	6.3	9.2	11.69	15.33	9.57	15	4.80	207.10	208.30	208.45	209.51	212.65	212.60	P-16
10	9	150.000	0.00	1.13	0.00	0.00	1.00	5.0	6.0	9.4	9.36	11.71	7.99	15	2.80	208.40	212.60	209.51	213.77	212.60	218.23	P-17
11	10	42.250	0.08	0.20	0.90	0.07	0.16	5.0	5.6	9.6	1.55	4.20	4.31	12	1.18	213.70	214.20	214.12	214.73	218.23	218.75	P-18
12	11	42.498	0.12	0.12	0.75	0.09	0.09	5.0	5.0	10.0	0.90	4.18	2.94	12	1.18	214.30	214.80	214.73	215.20	218.75	218.30	P-19
13	10	24.037	0.93	0.93	0.90	0.84	0.84	5.0	5.0	10.0	8.33	1.76	10.61	12	0.21	212.70	212.75	213.77	214.89	218.23	219.10	P-BLDG-A
14	1	39.309	0.62	0.62	0.35	0.22	0.22	5.0	5.0	10.0	2.15	7.28	3.44	12	3.56	195.90	197.30	197.27	197.93	200.40	200.77	P-13B

Project File: MC4500-NORTH.stm

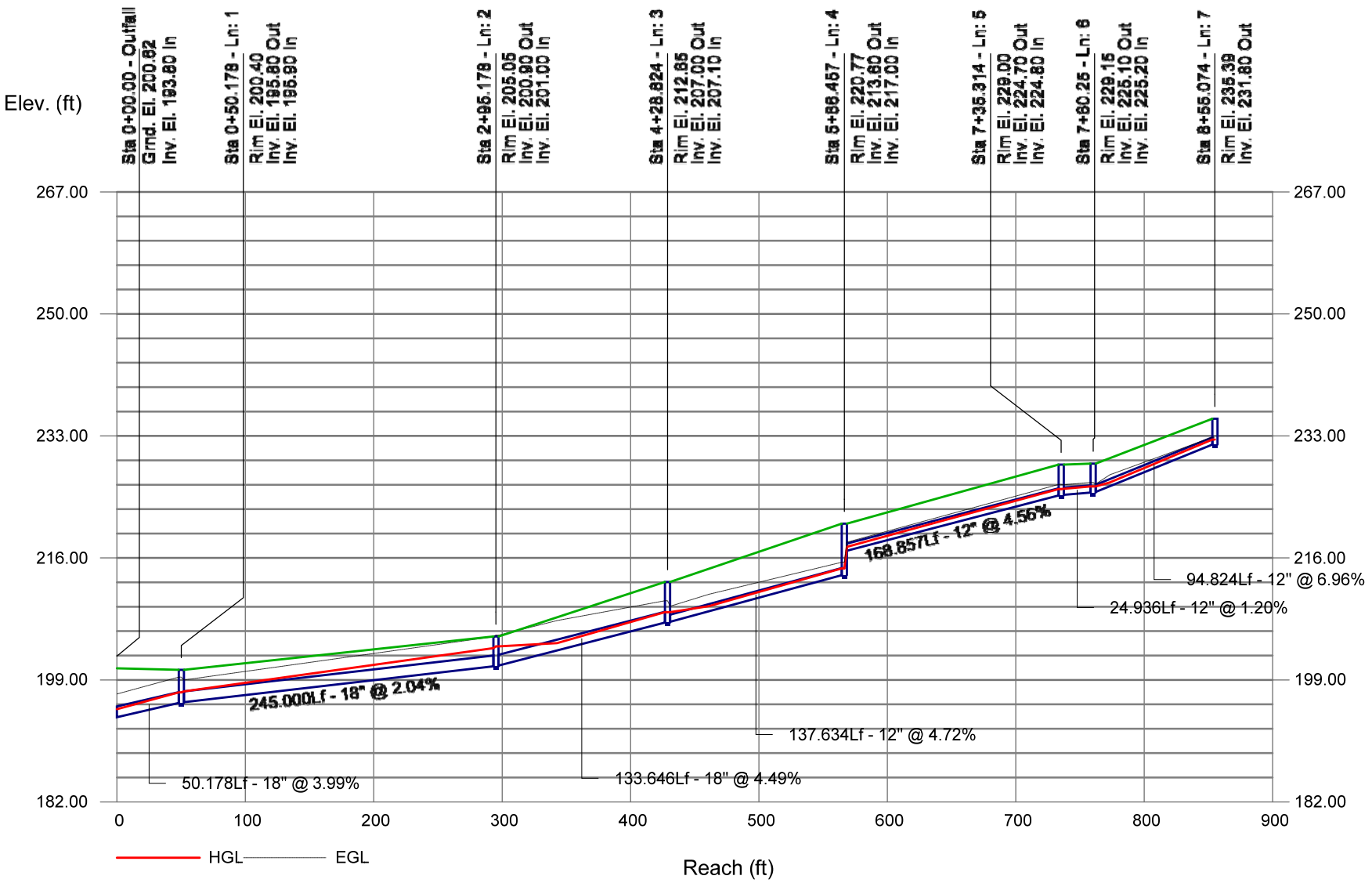
Number of lines: 14

Run Date: 4/4/2017

NOTES:Intensity = 36.98 / (Inlet time + 4.10) ^ 0.59 ; Return period =Yrs. 100 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: MC4500-NORTH.stm



Storm Sewer Profile

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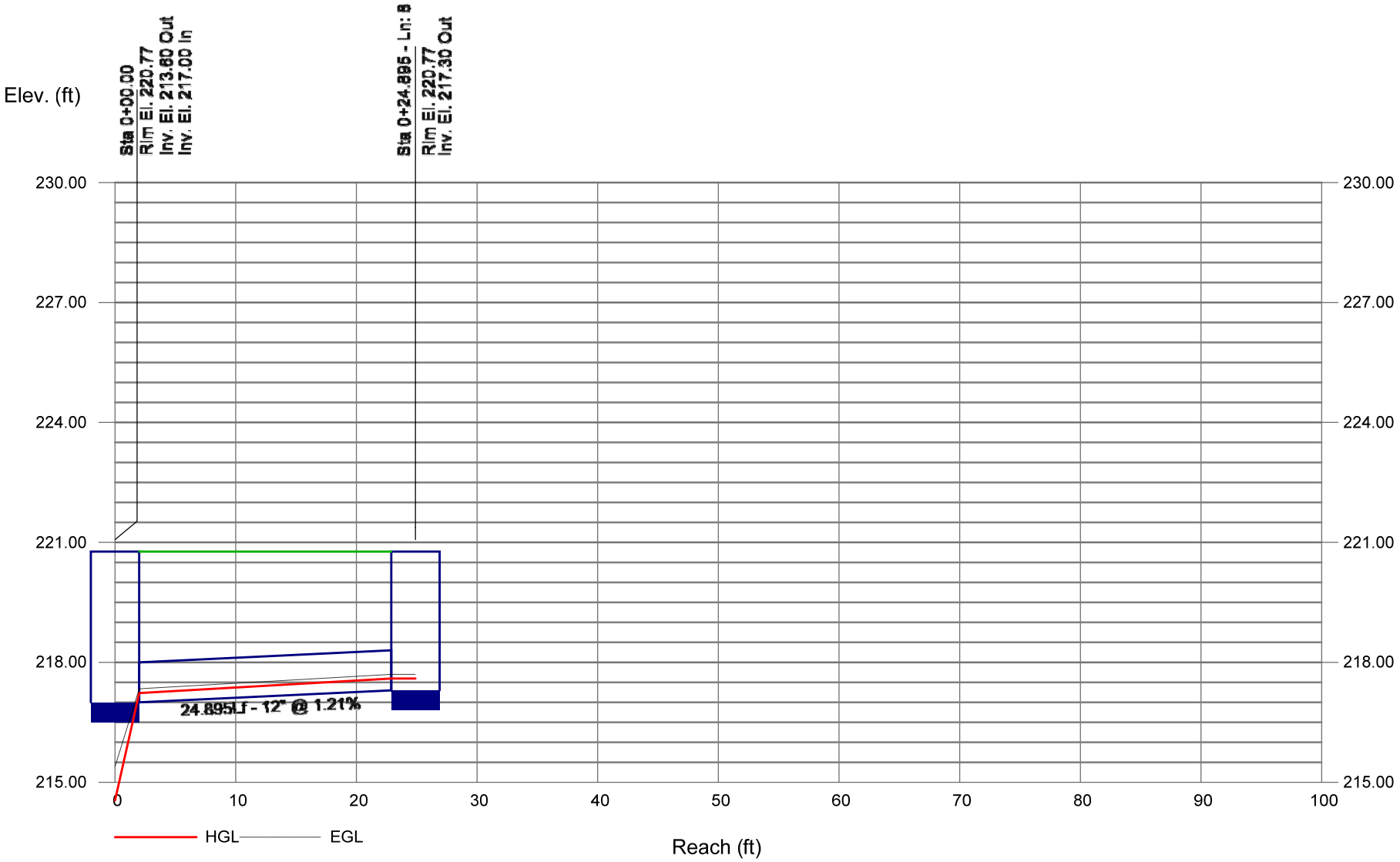
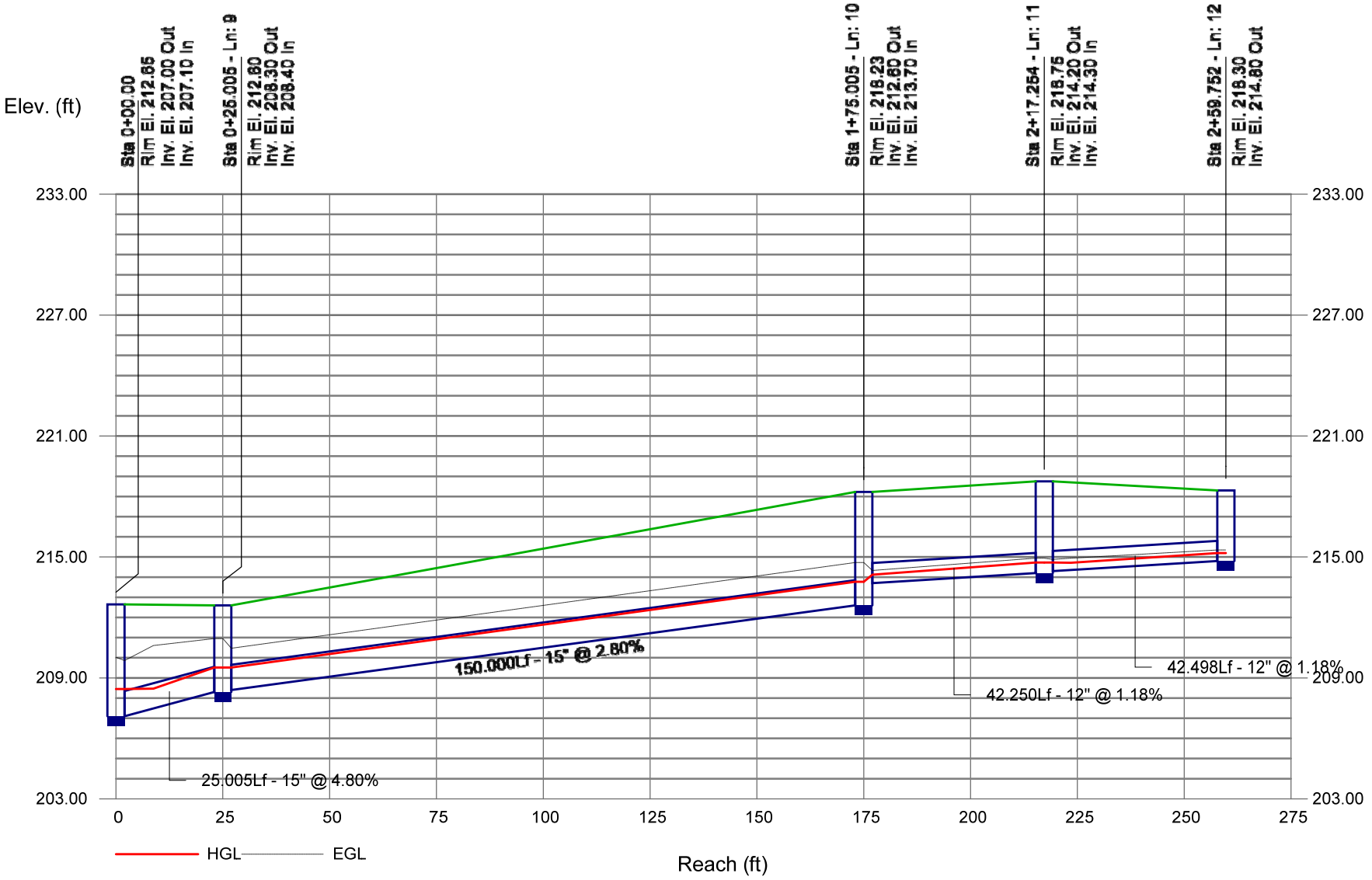


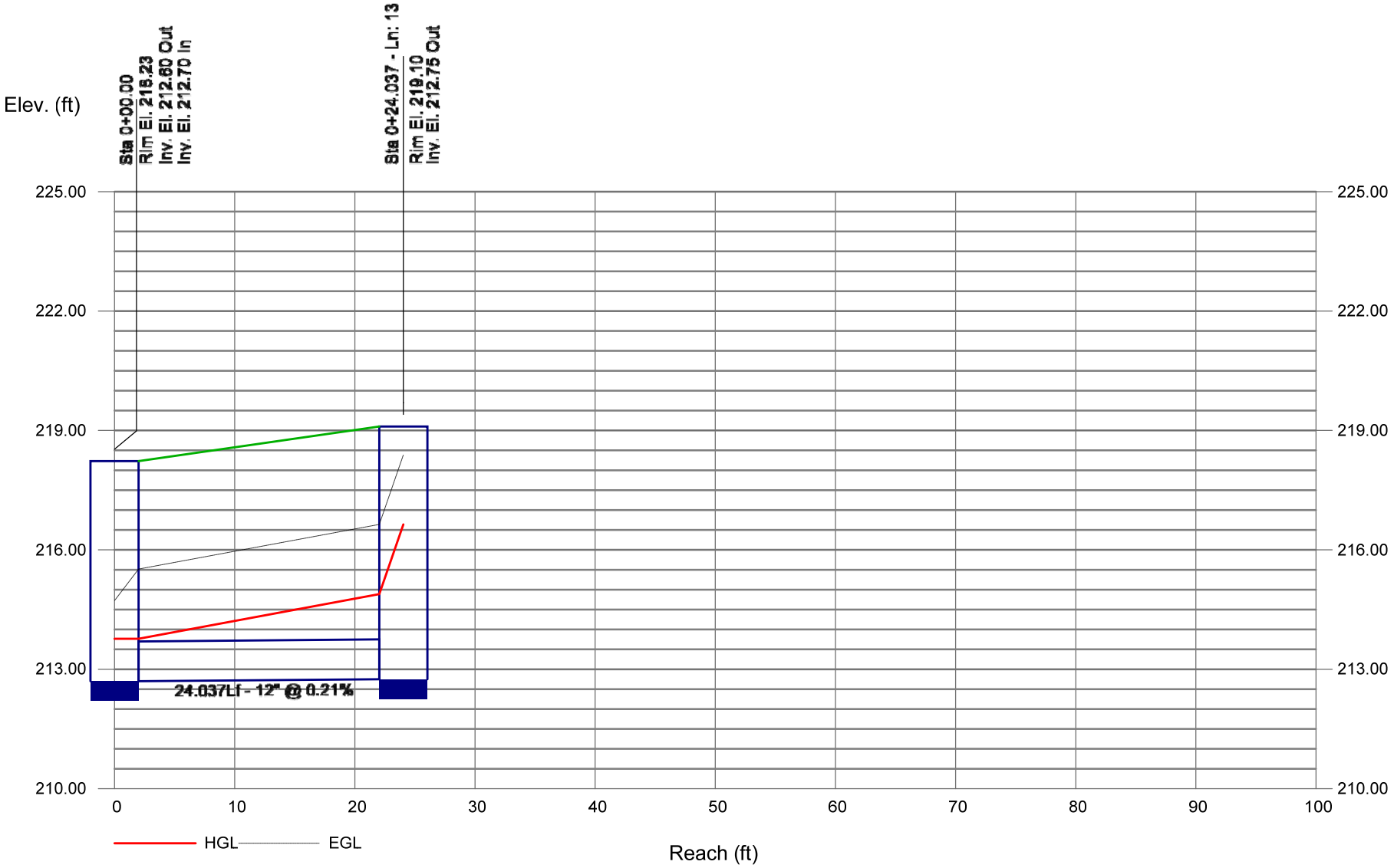
Storm Sewer Profile

Proj. file: MC4500-NORTH.stm



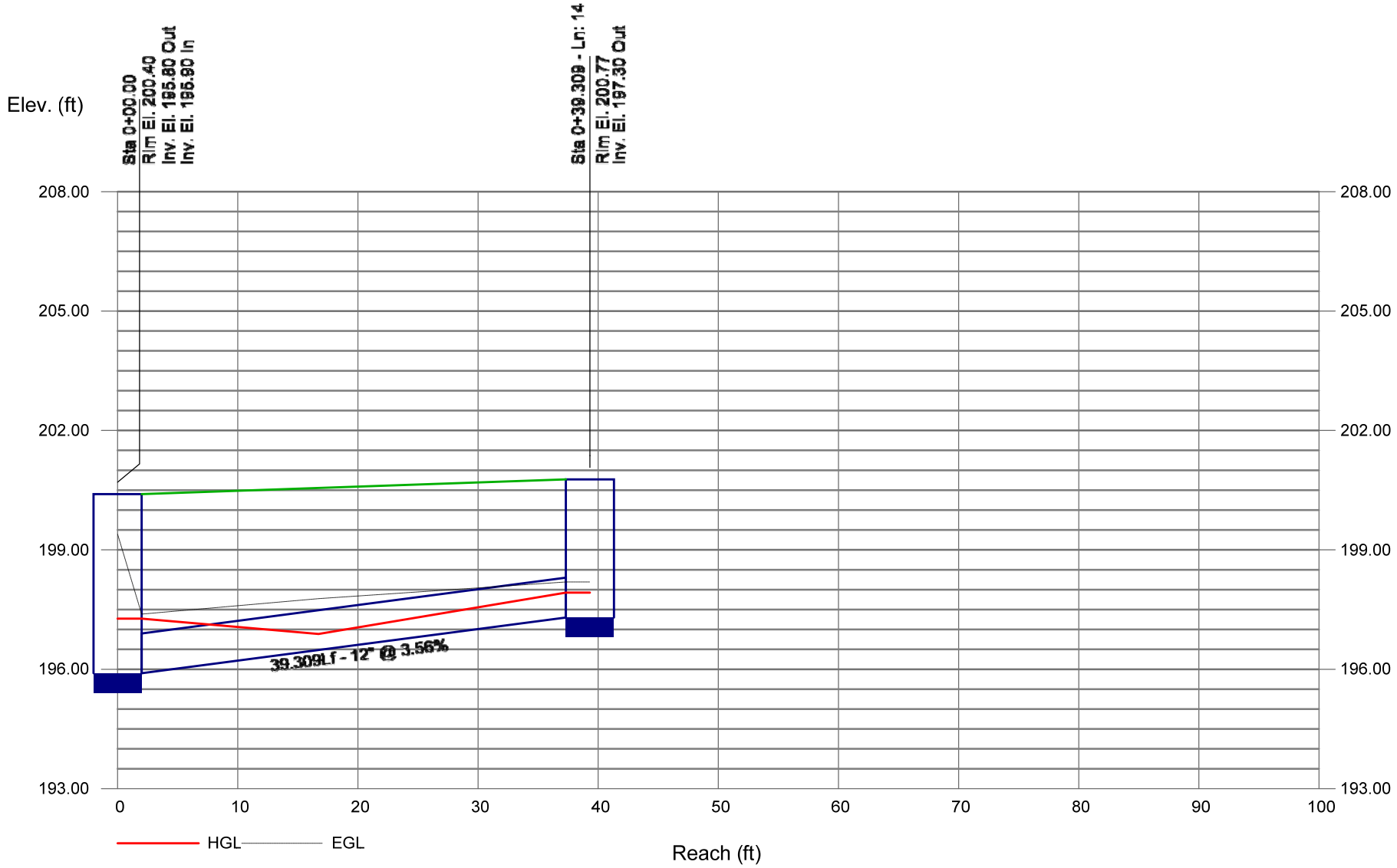
Storm Sewer Profile

Proj. file: MC4500-NORTH.stm

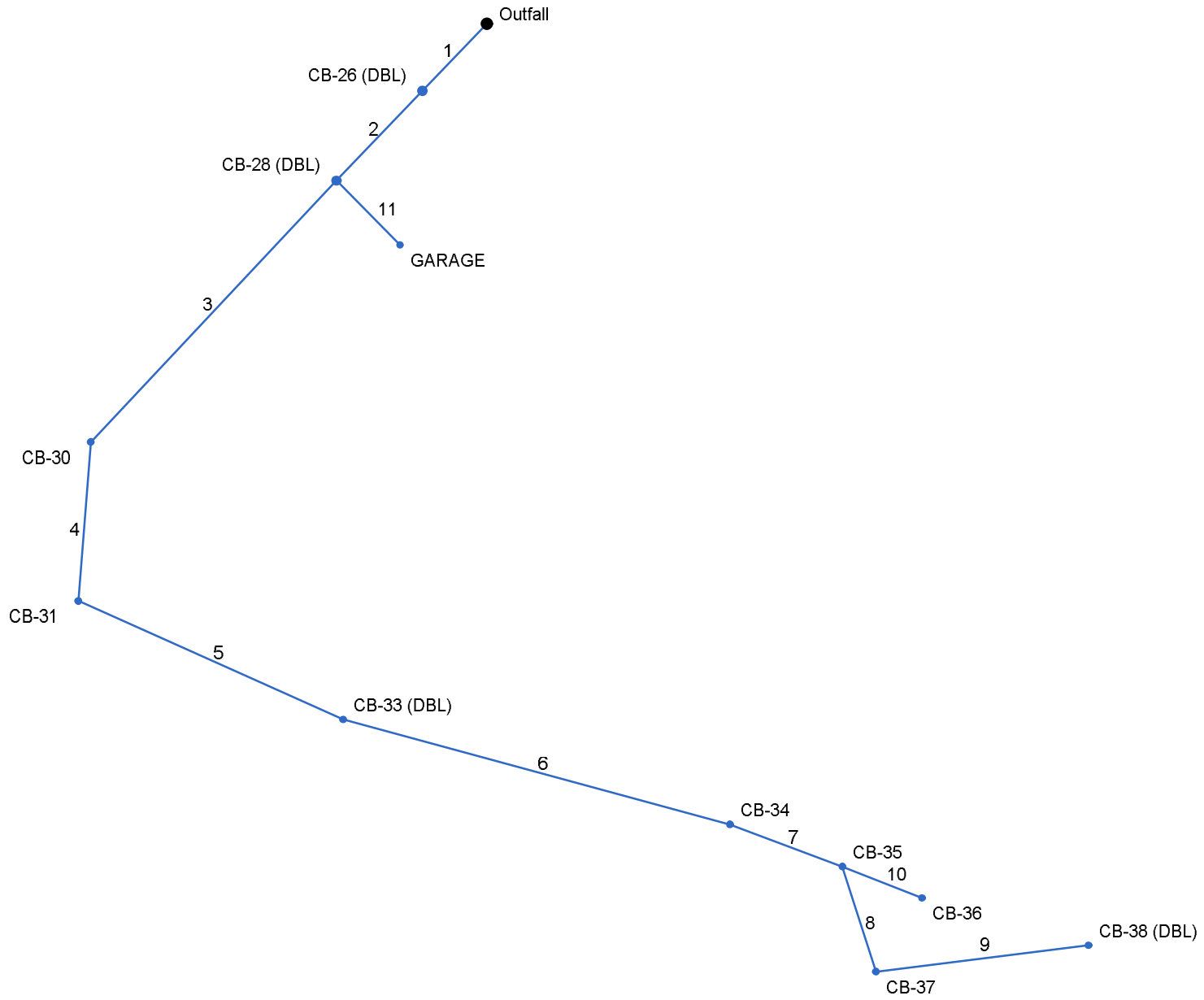


Storm Sewer Profile

Proj. file: MC4500-NORTH.stm



Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: MC4500-SOUTH.stm	Number of lines: 11	Date: 4/4/2017

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	P-26	40.55	36	Cir	67.342	188.00	188.40	0.594	193.70*	193.91*	0.08	193.99	End	Manhole
2	P-28	38.72	36	Cir	90.206	188.40	188.90	0.554	193.99*	194.25*	0.47	194.71	1	Manhole
3	P-30	10.35	15	Cir	260.000	190.30	198.30	3.077	194.71*	200.41*	0.75	201.16	2	Manhole
4	P-31	9.71	15	Cir	115.741	198.40	202.40	3.456	201.16	203.58	n/a	203.58 j	3	Manhole
5	P-33	7.90	12	Cir	210.000	202.50	210.70	3.905	203.58*	212.39*	0.30	212.69	4	Manhole
6	P-34	6.28	12	Cir	290.000	210.80	216.60	2.000	212.69*	220.39*	0.15	220.53	5	Manhole
7	P-35	5.87	12	Cir	86.853	216.70	223.60	7.944	220.53	224.55	n/a	224.55 j	6	Manhole
8	P-37	5.32	12	Cir	79.980	223.70	230.10	8.002	224.55	231.03	0.75	231.03	7	Manhole
9	P-38	2.51	12	Cir	155.019	230.20	232.90	1.742	231.03	233.58	n/a	233.58 j	8	Manhole
10	P-36	0.49	12	Cir	61.894	223.70	228.60	7.917	224.55	228.89	n/a	228.89 j	7	Manhole
11	P-GARAGE	31.89	24	Cir	65.521	189.00	190.00	1.526	194.71*	195.83*	1.60	197.43	2	Manhole

Project File: MC4500-SOUTH.stm | Number of lines: 11 | Run Date: 4/4/2017

NOTES: Return period = 100 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Storm Sewer Tabulation

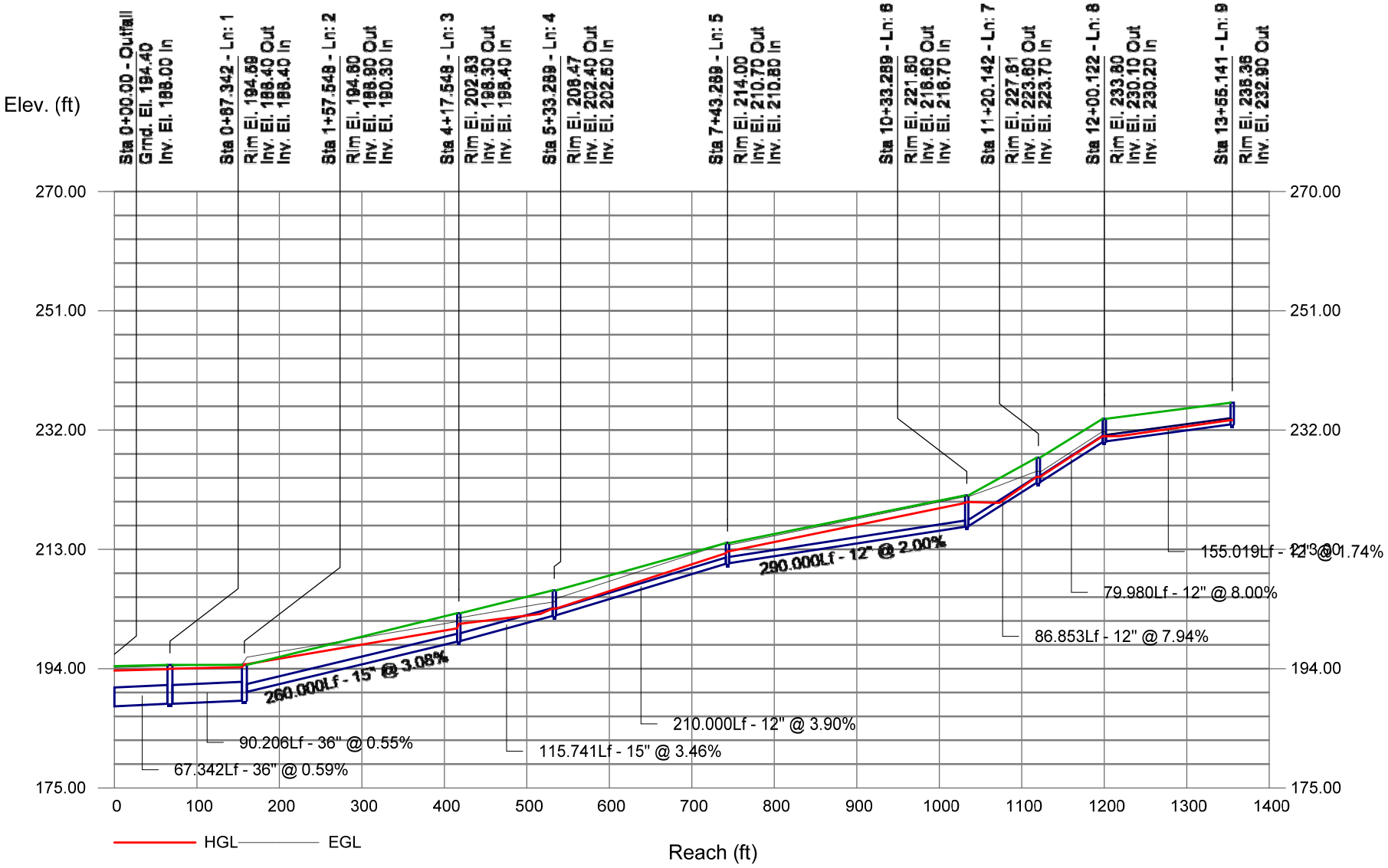
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	67.342	0.51	6.80	0.58	0.30	5.05	5.0	9.0	8.0	40.55	55.68	5.74	36	0.59	188.00	188.40	193.70	193.91	194.40	194.59	P-26
2	1	90.206	0.60	6.29	0.52	0.31	4.75	5.0	8.6	8.1	38.72	53.79	5.48	36	0.55	188.40	188.90	193.99	194.25	194.59	194.60	P-28
3	2	260.000	0.19	2.09	0.48	0.09	1.24	5.0	8.1	8.4	10.35	12.27	8.44	15	3.08	190.30	198.30	194.71	200.41	194.60	202.83	P-30
4	3	115.741	0.46	1.90	0.50	0.23	1.15	5.0	7.8	8.5	9.71	13.01	8.01	15	3.46	198.40	202.40	201.16	203.58	202.83	206.47	P-31
5	4	210.000	0.39	1.44	0.54	0.21	0.91	5.0	7.4	8.6	7.90	7.62	10.06	12	3.90	202.50	210.70	203.58	212.39	206.47	214.00	P-33
6	5	290.000	0.11	1.05	0.48	0.05	0.70	5.0	6.8	8.9	6.28	5.46	8.00	12	2.00	210.80	216.60	212.69	220.39	214.00	221.60	P-34
7	6	86.853	0.06	0.94	0.67	0.04	0.65	5.0	6.7	9.0	5.87	10.87	7.55	12	7.94	216.70	223.60	220.53	224.55	221.60	227.61	P-35
8	7	79.980	0.47	0.82	0.66	0.31	0.56	5.0	5.8	9.5	5.32	10.91	7.22	12	8.00	223.70	230.10	224.55	231.03	227.61	233.80	P-37
9	8	155.019	0.35	0.35	0.72	0.25	0.25	5.0	5.0	10.0	2.51	5.09	4.01	12	1.74	230.20	232.90	231.03	233.58	233.80	236.36	P-38
10	7	61.894	0.06	0.06	0.82	0.05	0.05	5.0	5.0	10.0	0.49	10.86	1.64	12	7.92	223.70	228.60	224.55	228.89	227.61	234.05	P-36
11	2	65.521	3.60	3.60	0.89	3.20	3.20	5.0	5.0	10.0	31.89	30.27	10.15	24	1.53	189.00	190.00	194.71	195.83	194.60	197.49	P-GARAGE

Project File: MC4500-SOUTH.stm | Number of lines: 11 | Run Date: 4/4/2017

NOTES:Intensity = 36.98 / (Inlet time + 4.10) ^ 0.59 ; Return period =Yrs. 100 ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: MC4500-SOUTH.stm



Storm Sewer Profile

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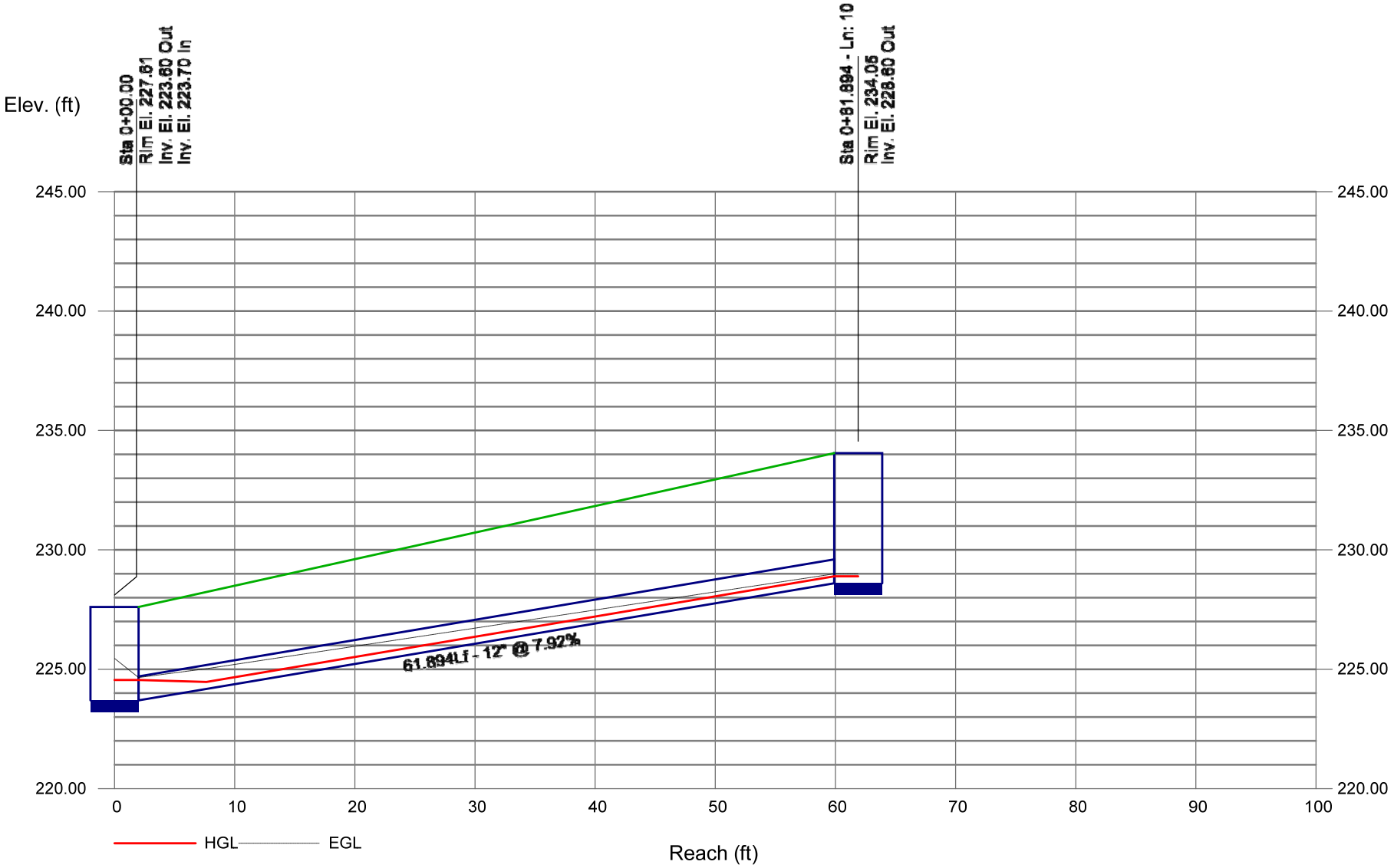

Storm Sewer Profile

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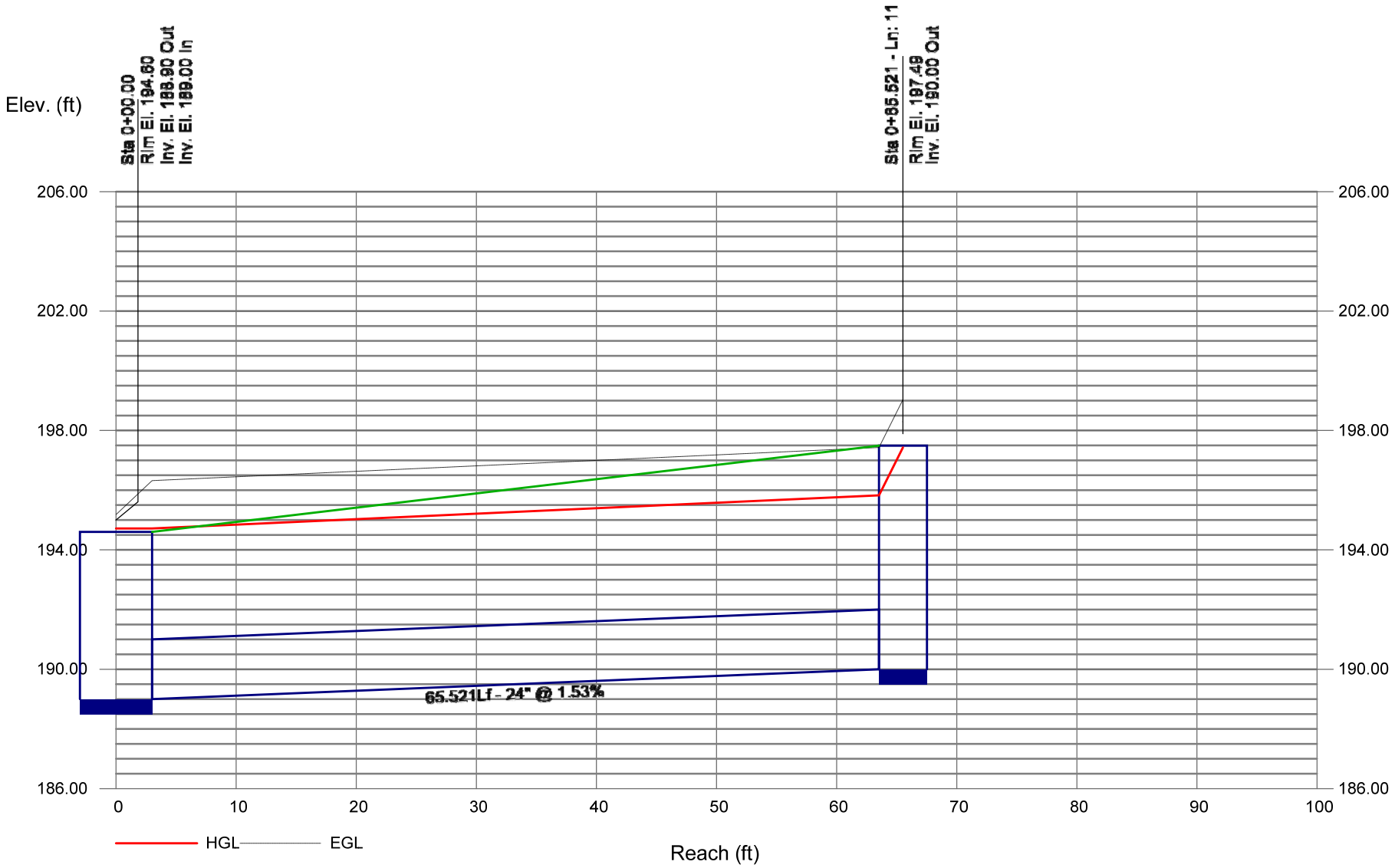
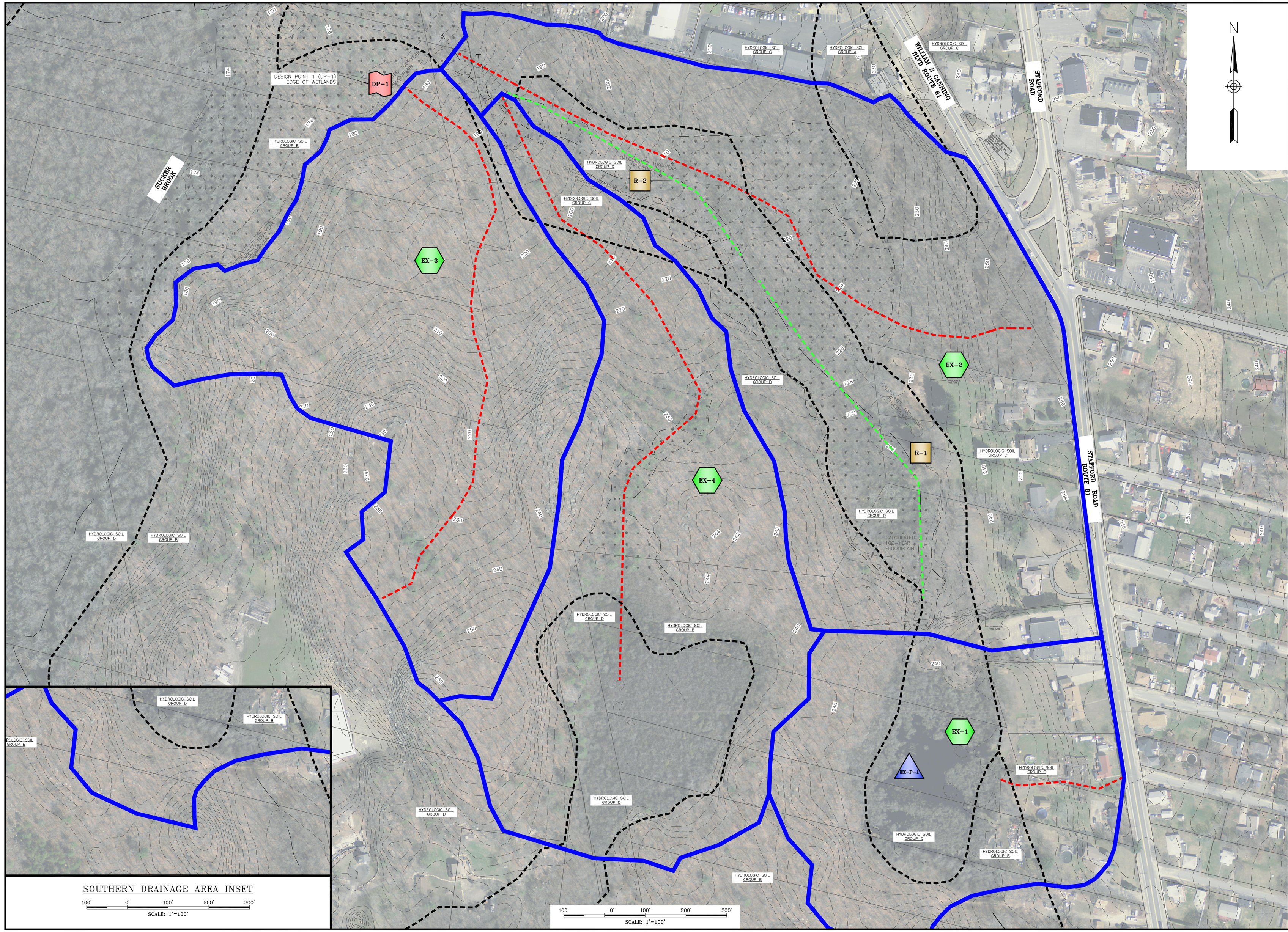


APPENDIX F:

Existing and Proposed Development Drainage Figures



SOUTHERN DRAINAGE AREA INSET

100' 0' 100' 200' 300'

SCALE: 1"=100'

100' 0' 100' 200' 300'

SCALE: 1"=100'

N

amec foster wheeler

AMEC FOSTER WHEELER
ENVIRONMENT & INFRASTRUCTURE, INC.
275 PROMENADE STREET, SUITE 120
PROVIDENCE RHODE ISLAND, 02908
WEB: WWW.AMECFW.COM

LEGEND

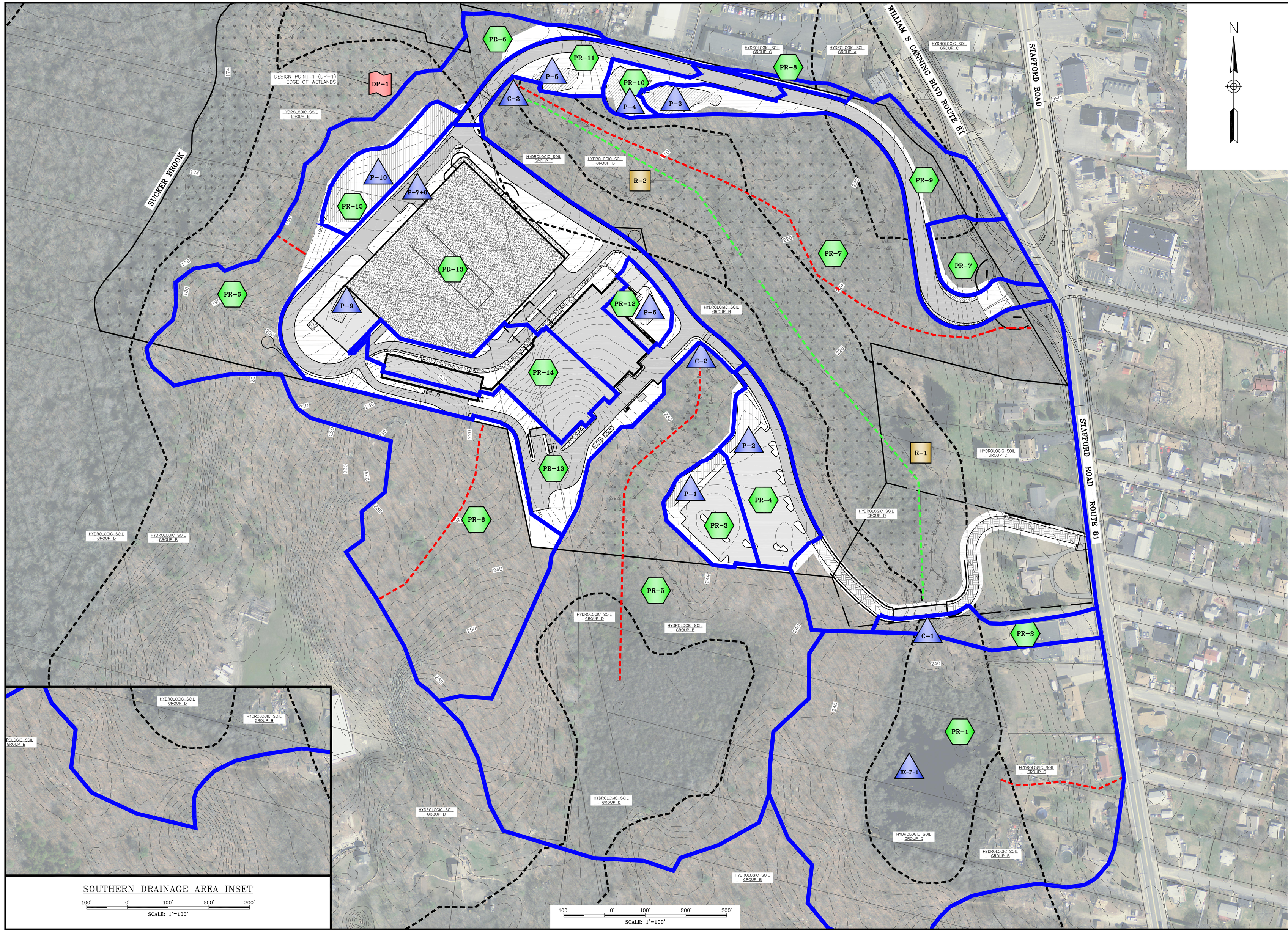
- PROPOSED PROPERTY LINE
- DRAINAGE AREA DIVIDE
- HYDROLOGIC SOIL GROUP DIVIDE
- TIME OF CONCENTRATION
- REACH TRAVEL PATH
- EX-1 DRAINAGE AREA
- P-1 STORMWATER POND
- R-1 STORMWATER REACH
- DP DESIGN POINT

PROJECT:
TWIN RIVER - TIVERTON
PROPOSED LAND CLEARING & GRADING
PLAT 203 LOTS 107 & 111
PLAT 204 LOTS 101, 102, 103, 106 & 108
WILLIAM S. CANNING BLVD AND STAFFORD ROAD
TIVERTON, RHODE ISLAND

TITLE:
EXISTING DRAINAGE FIGURE

CLIENT:
TWIN RIVER
TIVERTON, LLC
C/O MARK RUSSO ESQ
55 PINE STREET
4TH FLOOR
PROVIDENCE, RI 02903

DESIGNED BY: AKG/TMT	DRAWN BY: AKG/TMT
CHECKED BY: CNB	SCALE: 1" = 80'
PROJECT NUMBER 3653160007	DATE: 3/24/2017
DRAWING NUMBER:	
SHEET NUMBER: 1 OF 1	



LEGEND

- PROPOSED PROPERTY LINE
- DRAINAGE AREA DIVIDE
- HYDROLOGIC SOIL GROUP DIVIDE
- TIME OF CONCENTRATION
- REACH TRAVEL PATH
- EX-1 DRAINAGE AREA
- P-1 STORMWATER POND
- R-1 STORMWATER REACH
- DP DESIGN POINT

amec foster wheeler

AMEC FOSTER WHEELER
ENVIRONMENT & INFRASTRUCTURE, INC.
275 PROMENADE STREET, SUITE 120
PROVIDENCE RHODE ISLAND, 02908
WEB: WWW.AMECFW.COM

PROJECT:
TWIN RIVER - TIVERTON
PROPOSED LAND CLEARING & GRADING
PLAT 203 LOTS 107 & 111
PLAT 204 LOTS 101, 102, 103, 106 & 108
WILLIAM S. CANNING BLVD AND STAFFORD ROAD
TIVERTON, RHODE ISLAND

TITLE:
PROPOSED DRAINAGE FIGURE

CLIENT:
TWIN RIVER
TIVERTON, LLC
C/O MARK RUSSO ESQ
55 PINE STREET
4TH FLOOR
PROVIDENCE, RI 02903

DESIGNED BY: AKG/TMT	DRAWN BY: AKG/TMT
CHECKED BY: CNB	SCALE: 1" = 80'
PROJECT NUMBER 3653160007	DATE: 3/24/2017
DRAWING NUMBER:	
SHEET NUMBER: 1 OF 1	