



July 23, 2018

U.S. EPA Region 5
Remediation and Reuse Branch
Land and Chemicals Division, LU-9J
77 West Jackson Blvd.
Chicago, IL 60604-3590
Attn: Mirtha Cápiro

RE: Phase 1 Dynamic Groundwater Recirculation Interim Measure Design Report
and Work Plan
Revision No. 1
RACER Trust Moraine Facilities
Moraine, Ohio

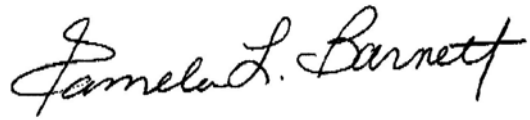
Dear Ms. Cápiro:

The Revitalizing Auto Communities Environmental Response Trust (RACER Trust) is providing this Phase 1 Dynamic Groundwater Recirculation Interim Measure Design Report and Work Plan (Report) for the RACER Trust Moraine Facilities in Moraine, Ohio (Site). This Report was prepared in accordance with the Phase 1 Dynamic Groundwater Recirculation (DGRTM) Interim Measure Pilot Test Work Plan which was submitted to the United States Environmental Protection Agency (U.S. EPA) on May 18, 2017 and approved on June 6, 2017.

The Report presents the pilot testing results, summary of the updated groundwater model, well installation activities, groundwater treatment system installation, investigation derived waste management activities, planned reporting, and project schedule. Per the U.S. EPA's request, the revised Report includes memorandums summarizing Montgomery County sewer improvement projects near the Site.

If you have any questions, please contact me at (937) 751-8635.

Sincerely,

A handwritten signature in black ink that reads "Pamela L. Barnett". The signature is written in a cursive style with a large initial "P".

Pamela L. Barnett, PG
Cleanup Manager (DE, LA, MA, OH, PA, VA)
RACER Trust

cc: Brian Gitzinger – Ohio EPA
Valerie Orr – Ohio EPA
Renee Miller - Montgomery County
Beth Moore - Montgomery County

DRAFT

Revitalizing Auto Communities Environmental
Response Trust (RACER Trust)

**PHASE 1 DYNAMIC GROUNDWATER
RECIRCULATION (DGR™) INTERIM
MEASURE (IM) DESIGN REPORT AND
WORK PLAN**

July 2018

Revision No. 1

PHASE 1 DYNAMIC GROUNDWATER RECIRCULATION (DGR™) INTERIM MEASURE (IM) DESIGN REPORT AND WORK PLAN

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1 INTRODUCTION AND OBJECTIVES

This Phase 1 Dynamic Groundwater Recirculation (DGR™) Interim Measure (IM) Design Report and Work Plan (Report) was developed to detail the results of the Phase 1 DGR™ IM Pilot Test (Pilot Test) and the corresponding design basis for full-scale implementation of the DGR™ IM at the Revitalizing Auto Communities Environmental Response Trust (RACER Trust) Moraine Facilities (formerly General Motors Corporation [former GM Corporation]) located in Moraine, Ohio (Site). The Site includes the former Delphi Harrison Thermal Systems Moraine Plant (former Delphi Thermal Moraine), former General Motors Powertrain Group, Moraine Engine Plant (former Moraine Engine), and former General Motors Truck Group, Moraine Assembly Plant (former Moraine Assembly) (**Figure 1**).

The work completed and documented in this Report was based on the Phase 1 Dynamic Groundwater Recirculation Interim Measure Pilot Test Work Plan (Work Plan; Arcadis, Inc. 2017) that was approved by the United States Environmental Protection Agency (U.S. EPA) on June 6, 2017 (U.S. EPA 2017a). As stated in the Work Plan, this IM is in response to a request by the U.S. EPA (U.S. EPA 2017b). The overall objective of the Phase 1 DGR™ IM is to reduce site-specific volatile organic compounds (VOCs) in groundwater within the Riverview Plat neighborhood (neighborhood) to concentrations below the U.S. EPA Maximum Contaminant Levels (MCLs) within 5 years of initiating full-scale operation.

1.1 DGR™ Overview

Hydraulic containment (i.e., pump-and-treat) is a conventional remedial technology to protect receptors and provide hydraulic control of dissolved-phase contaminants. The DGR™ remedy is a modification to traditional hydraulic containment methods and employs groundwater recirculation to enhance advective flushing by creating the dynamic gradients required to reverse the processes of plume development, with routine optimization to achieve optimal performance.

Using the DGR™ approach, extracted groundwater would be treated with an aboveground treatment system. Treated groundwater would then be reinjected into injection wells to promote enhanced groundwater flushing within the neighborhood area upper aquifer (UA). The extraction volumes, reinjection flow rates, and targeted reinjection well locations can be modified to adapt to changing site conditions and observed treatment performance.

In 2017, a Pilot Test was completed to supplement existing data to support the full-scale Phase I DGR™ IM design. The Pilot Test objectives were:

- Install two UA extraction wells and two monitoring well pairs (shallow and deep) that would be part of the full-scale Phase 1 DGR™ IM design
- Complete testing to determine hydraulic influence, evaluate extraction and injection capacity, and refine the understanding of hydraulic characteristics in the UA
- Evaluate the hydraulic testing data, revise the existing numerical groundwater flow model (model) through validation of hydraulic testing results, and complete model simulations to support the full-scale Phase 1 DGR™ IM design

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- Complete simulations to evaluate the Phase 1 DGR™ IM program in comparison to groundwater extraction alone
- Collect groundwater samples for target analytes to refine the understanding of potential well fouling and management protocols and total site-specific VOC concentrations before and during testing

The results of the Pilot Test and the corresponding Phase 1 DGR™ IM design are provided in the following sections.

1.2 Site Description and History

The Site has been used for industrial purposes since the property was acquired in the mid-1920s by former GM Corporation. The historical site operations have included appliance manufacturing, machining and assembly of automotive air conditioning equipment, automotive machining and painting, and the assembly of diesel engines. The former Moraine Engine and Moraine Assembly facilities occupy approximately 282 acres, while the adjacent former Delphi Thermal Moraine facility occupies approximately 143 acres. Most of the historical structures have been demolished; however, some structures remain on-site (**Figure 1**). The ground cover is largely comprised of concrete building foundation floors, intact and deteriorated concrete and asphalt pavement, and gravel or open soil surfaces with vegetation.

On June 30, 2011, RACER Trust sold the properties, former Delphi Thermal Moraine, former Moraine Engine Plant, and former Moraine Assembly Plant to Industrial Realty Group Moraine, LLC (IRG). As part of the property transfer, RACER Trust retained environmental liability for these properties. The closed South Settling Lagoon was not included in this property transaction and is retained by RACER Properties LLC. IRG currently leases several portions of the Site for industrial purposes. IRG sold several portions of the property to Copart of Connecticut, Inc., Fuyao Asset Management A, LLC, Inland Property Management, Inc., Wright Warehouse, Inc., and the State of Ohio. Current Site operations include multi-tenant use for industrial and commercial purposes.

Additional details regarding former Site operations and remedial actions are provided in the Corrective Measures Proposal (2012 CMP; Arcadis, Inc. 2012a) and the 2017 Groundwater Monitoring Report (Arcadis, Inc. 2018).

2 PHASE 1 DGR™ PILOT TEST SUMMARY AND RESULTS

The following subsections detail the Pilot Test activities and results, including permitting and planning, utility clearance, well installation and development, groundwater monitoring, and hydraulic testing.

2.1 Permitting and Planning

Arcadis acquired an Authorization to Discharge permit from Montgomery County Environmental Services to discharge treated, extracted groundwater produced during the Pilot Test activities to the sanitary sewer system. The discharge permit required treating the groundwater for site-specific VOCs to concentrations below the MCLs. To evaluate the effectiveness of the treatment system, two samples were collected from the effluent of the mobile treatment system and analyzed for site-specific VOCs (1,1,1-trichloroethane, 1,1-dichloroethane, 1,1-dichloroethene, benzene, cis-1,2-dichloroethene, ethylbenzene, tetrachloroethene [PCE], toluene, trans-1,2-dichloroethene, trichloroethene [TCE], vinyl chloride, and xylene [total]) (**Table 1**). The first sample was collected on the first day of system discharge and the second sample was collected on the last day of discharge. Both samples confirmed that the concentrations of site-specific VOCs were less than the applicable MCL.

In accordance with Ohio Administrative Code (OAC) 3745-27-13 (Rule 13), a request was submitted to the Ohio Environmental Protection Agency (Ohio EPA) for approval to install the proposed wells as the drilling locations were within 300 feet of solid waste in the closed South Settling Lagoon (for additional detail, reference the Work Plan). The Rule 13 request was approved on July 5, 2017 (Ohio EPA 2017c). A Certification Report (RACER Trust 2017) that included information required by Rule 13 after drilling activities were complete was submitted to the Ohio EPA.

An underground injection control (UIC) permit was not required based on OAC 3745-24-11(H). The referenced OAC indicates: “the injection of fluids into a class V well for purposes of remediating ground water or soil contamination is authorized without a permit”. It should also be noted that an air permit associated with the air stripper treatment system was not required due to the emission of less than 10 pounds per day of total site-specific VOCs.

2.2 Utility Clearance

Prior to the installation of the soil borings, the locations were cleared for underground utilities and surveyed for overhead utilities. Utilities were cleared following the Arcadis Utility Location Policy and Procedures. Arcadis contacted the Ohio Utility Protection Service (OUPS), reviewed available facility utility drawings, and conducted a detailed visual site inspection. Each boring was physically cleared to 6 feet below ground surface (bgs) using an “air-knife” and vacuum truck. In addition, a private utility locating company surveyed the drilling area using ground penetrating radar and electromagnetic induction techniques.

2.3 Monitoring Well Installation and Development

Soil borings were advanced with 8.5-inch diameter, hollow stem augers at each of the two monitoring well pair locations to the regional clay till (approximately 60 feet bgs). Soil samples were continuously

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collected, field screened for VOCs using a photoionization device (PID), and classified based on the Udden-Wentworth grain size scale. The soil descriptions, including Unified Soil Classification System (USCS) descriptions, grain size distribution, sorting, moisture content, consistency/density, color (based on the Munsel color system), and PID readings were recorded on field boring logs (**Appendix A**). In addition, 13 soil samples from boring RMW-93 were collected and sent to a geotechnical laboratory for grain size analysis for use in the design of the extraction well screens and filter packs.

Of the wells pairs, the deeper monitoring wells (RMW-91 and RMW-93) were installed in the initial boring, and the shallow monitoring wells (RMW-92 and RMW-94) were installed in offset borings that were advanced with hollow stem augers. Monitoring wells were constructed of 2-inch diameter Schedule-40 polyvinyl chloride (PVC) with 10-slot PVC screens. Screen length and depth were determined based on lithologic and saturation relationships to cover shallow and deeper portions of the UA (i.e. near the groundwater table and just above the regional clay till).

After the well screen and sand pack were in place, each well was pre-developed to ensure proper placement of the filter pack around the well screen. Wells were completed with a lockable outer protective casing set within a concrete pad. Once installed, monitoring wells were developed by method of surge and volumetric purge. The horizontal coordinates, ground elevation, and the top-of-casing measuring point elevation of each monitoring well were then surveyed by a licensed professional.

Well construction information is detailed in **Table 2**. Well locations are shown on **Figure 2**. Well construction logs and boring logs are included as **Appendix A**.

2.4 Extraction Well Installation and Development

Extraction wells EW-1 and EW-2 were installed using a 14-inch diameter, hollow stem auger. The borehole was completed with an 8-inch steel drive casing advanced within the hollow stem auger to a depth of approximately 63 feet bgs to accommodate a well sump. The well screens were installed with an 8-inch diameter, 20-foot, stainless steel wire-wrapped screen and a 3-foot sump. Based on grain size analysis results, it was determined that a 60-slot screen with Perry #4 sand filter pack was appropriate. To complete the installation, the annular seal was installed between the 8-inch Schedule-80 PVC well casing and annulus using neat cement to 6 feet bgs. From 6 feet bgs to ground surface, sand pack material was added to allow for easy retrofitting for a permanent surface completion and plumbing to be during the DGR™ Phase I implementation.

During installation of EW-1, the shallow segment of the filter pack was displaced by formation heaving sands. This resulted in an area at the top of the screen that likely has a natural pack overlain by a thicker filter pack. The displaced filter pack did not impact well performance.

Before the well seal was installed and after screen installation, pre-development was performed to allow for the sand pack to settle and to avoid any bridging. Well development began after the wells were installed and the wells had sufficient time to cure. The well development process incorporated multiple development techniques to allow for an increased removal of fines and to increase hydraulic communication with the UA. To monitor the development process and well-aquifer connectivity, a specific capacity test was performed. Water quality parameters were collected before and after well development.

The stages of development consisted several rounds of the following:

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- Initial pumping to remove fines
- Surging the entire screen utilizing a double surge block in 2-foot screen increments
- Using a pump to remove fines periodically from the bottom of the well between rounds of surging

Following the completion of the surging well development approach, it was determined that the specific capacity for each of the extraction wells was below design targets. A more aggressive well development approach was then employed. The wells were backwashed using a surge tank and chemical dispersant. The water was then re-circulated into the well to flush out fine particles within the filter pack. The more aggressive development approach successfully increased the specific capacity to within design targets.

It should be noted that the enhanced well development necessary to improve the specific capacity of the extraction wells was required because of fine soil particles retained in the filter pack during installation. Based on the understanding that increased well performance can be obtained using wells where natural formation collapse is used for construction (e.g., historical extraction wells TW-1 and TW-2) and the results of the pilot boring grain size analysis, it is recommended that a natural formation pack design be used for future installation of system wells, where feasible. While these construction methods are recommended for future well installation, the baseline and post-development data were assessed to confirm that an adequate specific capacity and targeted well yield was achieved for wells installed during the pilot test (see **Section 2.6**).

Well construction information is detailed in **Table 2**. Well locations are shown on **Figure 2**. Well construction logs and boring logs are included as **Appendix A**.

2.5 Groundwater Monitoring

Monitoring wells were used to measure UA groundwater level response during the Pilot Test to assess the operational hydraulic influence. Pressure transducers were installed in 12 wells (EW-1, EW-2, W-3-S, W-4-S, RZ-4I, GM-16, GM-63, GM-64, RMW-91, RMW-92, RMW-93, and RMW-94), and periodic manual groundwater level measurements were taken at 10 wells (RZ-4A, RZ-4L, RZ-4O, GM-47, GM-50, W-2-S, WSU-23, GM-19S, HR-16, and HR-17) as detailed on **Figure 2**. The monitoring well network outlined for each hydraulic test included background groundwater water level monitoring (GM-16) located downgradient and outside the testing influence area and barometric pressure observations (using current monitoring equipment at lower aquifer (LA) extraction well DN-13). Rainfall data was collected via download of observations from the Dayton Wright Brothers Airport station operated by the National Oceanic and Atmosphere Administration (NOAA, 2017).

Pre-test groundwater level monitoring was completed for a period of 5 days to establish baseline groundwater level conditions. Groundwater elevation measurements were taken at the start and finish of the pre-test monitoring period and at the start and finish of each hydraulic testing phase. The data were used to evaluate the presence of any background trends during the testing, evaluate barometric effects, and provide data for necessary post-test data corrections. It should be noted that precipitation and barometric pressure were not found to have a material influence during the Pilot Test. However, an overall declining groundwater elevation background trend was observed in GM-16 during the EW-2 extraction constant rate test, and drawdown during the testing was corrected for this trend.

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Groundwater samples were collected from the extraction wells and select monitoring wells before the extraction constant rate test, in the middle of the constant rate test, and at the end of the hydraulic testing. The samples were collected utilizing the low-flow groundwater sampling methodology except for the sample collected from extraction well EW-2 during the constant rate test which was sampled from the sample influent port. Samples were submitted to TestAmerica Laboratories of North Canton, Ohio for analysis of site-specific VOCs by U.S. EPA Method 8260B. Laboratory methodology and quality assurance / quality control (QA/QC) information presented in the amended *Quality Assurance Project Plan* (QAPP) (Arcadis, Inc. 2011) were followed.

2.5.1 Baseline Groundwater Sampling

On September 13, 2017, baseline groundwater samples were collected from EW-1, EW-2, W-3-S, W-4-S, GM-63, GM-64, RMW-91, RMW-92, RMW-93, and RMW-94. The results indicate that site-specific VOC concentrations were relatively consistent with previously collected data for this area (**Table 1**).

2.5.2 Mid-Testing Groundwater Sampling

During the middle portion of the constant rate extraction test on September 26, 2017, a groundwater sample was collected from EW-2 to evaluate influent concentrations to the treatment system. The results indicate that site-specific VOC concentrations were relatively consistent with previously collected data for this area. These results are included with other influent and effluent samples in **Table 1**.

2.5.3 Post-Testing Groundwater Sampling

On September 29, 2017, post-hydraulic testing groundwater samples were collected from EW-1, EW-2, W-3-S, W-4-S, GM-63, GM-64, RMW-91, RMW-92, RMW-93, and RMW-94. The results indicate that site-specific VOC concentrations were relatively consistent with previous data for this area (**Table 1**). Comparison of the baseline and post-testing groundwater sampling results generally indicate that site-specific VOC concentrations remained similar. A slight increase in VOC concentrations was observed at seven out of the 10 wells sampled which may suggest that the constant rate extraction test resulted in an increase in overall mass flux towards the extraction well EW-2. For a more robust understanding, additional groundwater sampling during extended operation would be necessary to evaluate long-term trends.

2.5.4 Bench-Scale Testing

Bench-scale testing was performed on three groundwater samples to evaluate the potential for physical, biological, or chemical fouling of the well screens and infrastructure during full-scale DGR™ operation and to identify potential mitigation agents during full-scale operations, if needed. Specifically, two groundwater samples were collected on September 25, 2017 during the constant rate extraction test, from an influent sampling port at EW-2, after approximately 1,000 gallons and 10,000 gallons of groundwater was extracted. A third sample was collected from EW-2 on September 29, 2017 after the hydraulic testing was completed. Samples were submitted to Water Systems Engineering (WSE), Inc. located in Ottawa, Kansas.

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Evaluation of the samples included a series of inorganic chemical and microbiological tests as well as visual observations (**Table 3**). The test results are consistent with previous geochemical evaluations (Arcadis, Inc., 2016) and indicate that the background geochemical and biological conditions of the groundwater are not expected to lead to excessive amounts of physical, biological, or chemical fouling of the extraction wells, injection wells, or the treatment system. At this time, best management practices will be sufficient to maintain operation of the system; consequently, no chemical amendment is recommended during the initiation of the final design. The need for well redevelopment or system maintenance will be evaluated regularly during operation and monitoring of the treatment system. If conditions indicate that additional mitigation measures would improve operation, they will be evaluated using the operational data available at that time and proposed in a subsequent Quarterly Progress Report.

2.6 Hydraulic Testing

This section provides the methods and results for the hydraulic testing completed during the Pilot Test. The resulting data and evaluation were used to refine the hydraulic properties of the UA to support the full-scale Phase 1 DGR™ IM design. The following hydraulic tests were performed:

- Extraction step testing – used to evaluate well performance (optimal flow rates) and establish baseline well specific capacity
- Extraction constant rate testing – used to evaluate hydraulic influence and refine UA hydraulic parameters
- Injection (large and small volume) step testing – used to evaluate optimal injection flow rates

2.6.1 Extraction Step Testing

Short-term step tests were completed on extraction wells EW-1 and EW-2 to evaluate specific capacity and baseline performance (yield). This information was used for optimal flow rate determination for additional hydraulic tests, to support full-scale Phase 1 DGR™ IM system design, and to assist with future operation and maintenance decisions. During the step drawdown test, the well was pumped at several successively higher flow rates, and the drawdown for each rate (or step) was recorded. The response of groundwater levels to pumping was recorded with pressure transducers and manual measurements for confirmation. The extraction well drawdown was monitored from the pressure transducer in real-time to assure a sufficient water column was available and to assess additional step flow rates.

The first step was initiated with a flow rate of about half of the target design flow. After the first test step response, additional steps were added by increasing the flow rate and continued groundwater level response was monitored for the next step. The duration of the step was based on real-time evaluation with an approximate duration of 10 to 40 minutes. The process was repeated to estimate a maximum flow rate for each well. Following the final step, the pumps were turned off and recovery was monitored.

As illustrated in **Figure 3**, four steps were completed at EW-1 at the following flow rates: 100 gallons per minute (gpm), 109 gpm, 116 gpm, and 130 gpm. The results indicate a specific capacity of 27.3 gpm/foot based on the first two steps that reached near sustainable drawdown. The step 4 flow rate of 130 gpm was not sustainable. A maximum sustainable extraction flow rate of approximately 120 gpm was determined for EW-1.

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As illustrated on **Figure 4**, five steps were completed at EW-2 at the following flow rates: 79 gpm, 104 gpm, 122 gpm, 125 gpm, and 139 gpm. The results indicate a specific capacity of 18.4 gpm/foot and an approximate maximum extraction flow rate of 140 gpm.

2.6.2 Constant Rate Extraction Test

A 49.5-hour constant rate extraction test was performed at EW-2 to evaluate UA hydraulic influence and refine hydraulic parameters. The optimal flow rate was determined from the step testing and was estimated to be within a target flow rate of 120 to 130 gpm. The response of groundwater levels to pumping were recorded with pressure transducers in the extraction well EW-2, within local monitoring (observation) wells, and manually measured periodically for confirmation in wells equipped with pressure transducers and during critical testing times with an extended monitoring (observation) well network (**Figure 2**). The drawdown was monitored from the pressure transducer in EW-2 real-time to evaluate the drawdown response. Responses included initial drawdown followed by expected gravity drainage. The test was stopped after the gravity drainage response was observed, based on the equilibration of the water levels.

Additionally, the extraction well flow rate was closely monitored for the first 2 hours (readings approximately every 10 minutes). After the flow rate and temporary treatment system was confirmed to be stabilized, the readings were reduced to 30 minutes for the remainder of the testing period. The final measurements were recorded, and the recovery monitoring stopped after the full drawdown response was observed and after the delayed gravity response was recognized through stabilized groundwater levels.

The constant rate test responses (time-drawdown) are summarized on (**Figure 5**). The flow rate average during the entire test was 126.2 gpm with a drawdown reaching equilibrium at approximately 9 to 10 feet in EW-2. It should be noted that the approximate saturated thickness of the UA is approximately 40 feet in the area of the Pilot Test, and the extraction wells are screened across the bottom half of the UA. The observations indicate that a shallow cone of depression developed with the gravity drainage (unconfined response) occurring relatively early in the test (after approximately 50 minutes). The post-drainage response (stabilization of the cone of depression) occurred after approximately 1,100 minutes (within 19 hours). The closest response was at 51 feet (W-4-S) and demonstrated a drawdown response of approximately 0.15 of a foot. Additional monitoring points further away from EW-2 had lower drawdown responses. The furthest measurable response was recorded at W-3-S (approximately 249 feet from EW-2) at 0.03 of a foot. This indicates that hydraulic influence can be achieved at these approximate flow rates. The hydraulic influence will continue to be monitored during the full-scale Phase 1 DGR™ IM system implementation. Specifically, horizontal hydraulic gradient directional changes from ambient conditions to full pumping conditions will be monitored to evaluate hydraulic capture. Recovery observations indicate rapid recovery of the wells.

Vertical influence in the UA was also observed. Vertical hydraulic gradients were calculated for deep/shallow well pairs in the vicinity of the Pilot Test area (cross-gradient [RMW-94/RMW-93 and GM-64/GM-63], upgradient [RMW-92/RMW-91], and downgradient] GM-47/GM-50)). Baseline monitoring results indicate that a downward vertical gradient was observed at well pairs in cross-gradient and downgradient directions, and an upward vertical gradient was observed at upgradient well pair RMW-92/RMW-91. The upward vertical gradient is likely due to the presence of the upper clay till in the area of

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RMW-92/RMW-91. Vertical gradients remained consistent in direction (up or down) from baseline to pumping conditions; however, the magnitude of the vertical gradients increased in the vicinity of EW-2 pumping that supports shallow UA hydraulic influence (full hydraulic influence across the UA saturated thickness). The vertical gradients are summarized on **Table 4**.

Time-drawdown data for the monitoring (observation) wells were analyzed using AQTESOLV® for Windows® Pro 4.5 (Duffield, 2007), and aquifer parameters (transmissivity, hydraulic conductivity, and storage) were estimated using applicable analytical solutions. Diagnostic plots (i.e., radial flow plots and derivative analysis) were used to evaluate flow conditions and to help determine the appropriate analytical solution(s) to be used. The Moench (1997) analytical solution that incorporates partial-penetration effects and wellbore storage within an unconfined aquifer with delayed gravity response was used to analyze the drawdown portion of the test. Results of the analyses are summarized in **Table 5** and solution reports with individual solution matches are provided in **Appendix B**.

Transmissivity results were used to calculate hydraulic conductivities using the average saturated thickness of the UA equal to approximately 40 feet. As a result, hydraulic conductivity values from the constant rate extraction test ranged from approximately 2,625 to 3,250 feet per day (ft/day). Historical results from constant rate extraction test at TW-2 were compared to the results and are consistent. Taken together, the results indicate a range of hydraulic conductivity from 1,562 to 3,250 ft/day with a geometric mean of 2,477 ft/day.

Additional hydraulic parameters were also measured. The specific yield results ranged from 0.10 to 0.20. These results are reasonable and within an expected range for an unconfined aquifer system. The anisotropy ratio (geometric mean of vertical to horizontal conductivity) was determined to be 0.02.

Overall, the constant rate extraction test results refined the understanding of hydraulic parameters, refined the understanding of hydraulic influence based on design flow rate, and support the feasibility of hydraulic containment for the UA.

2.6.3 Large Volume Injection Step Testing

A short-term injection step test was performed on extraction well EW-1 to evaluate injection flow rate ranges under gravity fed conditions (no applied pressure) to support the full-scale Phase 1 DGR™ IM design. The methods included starting the initial injection step flow rate at the lowest flow rate, followed by a series of higher flow rates based on field judgement to understand the potential range of injection flow rates. The EW-1 testing results (time-mounding) are presented on **Figure 6**. As shown on **Figure 6**, the flow rate during the second step was too high (approximately 80 gpm) and did not stabilize. The following steps were completed at declining flow rates to determine a sustainable mounding condition. The maximum flow rate was determined during step 5 with an approximate flow rate of 73.4 gpm and 4.1 feet of mounding over 1 hour of testing.

Observation wells were monitored during the testing with limited or no indication of mounding. Based on the observations, the nearest monitoring well (W-3-S) demonstrated slight mounding with an increase in water levels of approximately 0.04 of a foot but were stable during the last step. Monitoring well pair RMW-94/RMW-93 indicated similar responses in the shallow and deep portions of the UA that indicated full UA influence. The recovery of groundwater levels following the injection step testing were observed almost immediately (within seconds at the test well and within minutes in the observations wells).

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Overall, the results indicate that approximately 70 gpm can be injected into the UA under gravity feed (zero pressure) conditions. In addition, there was full aquifer influence with only minor mounding observed near the injection well.

2.6.4 Small Volume Injection Step Testing

Additional step testing was completed at injection well RZ-4I, which is a smaller diameter well (2-inches) with a longer well screen (30-feet) compared to EW-1 (8-inches in diameter with 20-feet of screen). The testing results (time-mounding) are presented on **Figure 7** and followed the methods of starting at a low flow rate and gradually increasing by step to determine the maximum sustainable injection flow rate. The data collected had significant variability due to the small diameter of the well causing turbulence during the injection process. Due to this variability, the moving average for RZ-4I response was used. The results indicated that at flow rates between 6 and 20 gpm (steps 1 through 3) minimal mounding response was observed (2 feet or less), and no response was observed in the nearest monitoring (observation) well W-4-S, located 67 feet side gradient. The background well GM-16 had similar response over time during the lower flow rates of steps 1 through 3. Step 4 was used to determine the approximate maximum injection flow rate at approximately 25 gpm with 6 to 8 feet of mounding at RZ-4I. Minor mounding response was observed at W-4-S at less than 0.02 of a foot over 1 hour of injection testing.

Overall, the results suggest that utilizing small diameter wells may be feasible; however, larger diameter wells provide higher injection capacity with less system infrastructure (e.g. piping/controls) compared to several smaller diameter wells to meet the same design criteria. Therefore, the use of these wells is not recommended during initiation of the full-scale Phase 1 DGR™ IM design.

2.7 Investigation Derived Waste

The following waste management activities were completed as part of the Pilot Test:

- The water generated during extraction well development, groundwater sampling, and hydraulic testing was pumped into frac tanks and treated on-site with an air stripper treatment system and discharged into the sanitary sewer in accordance with a discharge permit with Montgomery County Environmental Services. Approximately 396,284 gallons of treated water was discharged to the sanitary sewer between 9/25/18 and 9/28/18.
- One roll-off container with 2.42 tons non-hazardous chlorinated VOC-impacted soil was transported off-site on December 4, 2017. The soil was generated during extraction well installation activities. The waste was transported by LDR Services and Brennen Disposal and disposed of at the Waste Management, Inc., Stony Hollow RDF Landfill in Dayton, Ohio.
- A total of 11 55-gallon drums of non-hazardous chlorinated VOC-impacted soil was transported off-site on December 4, 2017. The soil was generated during utility locating and monitoring well installation activities. Waste transportation and disposal services were completed by Chemtron Corporation (Chemtron) of Avon, Ohio.
- A total of 13 55-gallon drums of non-hazardous chlorinated VOC-impacted groundwater were transported off-site on December 4, 2017. The water was generated during monitoring well

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development and frac tank cleaning activities. Waste transportation and disposal services were completed by Chemtron.

Waste disposal documentation is included in **Appendix C**.

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3 AREA-SPECIFIC CONCEPTUAL SITE MODEL

This area-specific conceptual site model (CSM) is focused on information as it relates to the UA in the neighborhood area located southwest of the Site and just south of the closed South Settling Lagoon. CSM information was presented in the 2012 CMP (Arcadis, Inc. 2012a) and has been updated using data collected during recent groundwater sampling (Arcadis, Inc. 2018) and obtained during the extraction and injection pilot tests.

3.1 Area-Specific Geology / Hydrogeology

The neighborhood area is underlain by glacial outwash sand and gravel deposits with a relatively continuous glacial till unit. There are three main hydrostratigraphic units (i.e., UA, regional clay till, and LA), including two principle aquifers (i.e., UA and LA). The regional clay till unit extends laterally across the area with a uniform thickness of approximately 11 feet and acts as an aquitard between the UA and LA. Boring log data indicates that the UA in this area is mostly comprised of poorly sorted coarse-grained soil (e.g., sand and sand/gravel with some borings containing intervals with minor amounts of fine sand), before terminating at the top of regional clay till aquitard at a depth of approximately 55 to 62 feet bgs. There is limited occurrence of the upper clay till zone from approximately 36 to 43 feet bgs at the RMW-91/RMW-92 UA well pair.

The UA saturated thickness is approximately 40 feet. Sieve samples were collected from boring RMW-93 at 2.5 ft intervals from 27.5 ft bgs to 60 ft bgs. The results confirm visual observations with a dominant presence of coarse-grained material; specifically, gravel and sand (95-99%) within the UA saturated thickness. Fine to coarse sands with some small to large sub round to sub angular pebbles compose the 27.5 to 40 feet bgs interval with a slight increase (1-4%) in finer grained sand-sized particles between 40 and 60 feet below grade. Boring logs and well construction logs for the area are provided in **Appendix A**.

3.2 Upper Aquifer Hydraulic Characteristics

Regionally, the UA consists of two distinguishable facies, a higher permeable (i.e., sand and gravel) facie and a lower permeable (i.e., interbedded fine sand, silt, clay, and till) facie. Based on historical and recent information/testing, the neighborhood area is dominated by the high permeability zones (i.e., sand and gravel) that are indicative of rapid advective groundwater transport. Groundwater generally flows from the northeast to the southwest across the neighborhood area and flows toward the Great Miami River. The horizontal hydraulic gradient within the UA in 2017 between monitoring well HR-1 (located just northeast of the closed South Setting Lagoon) and monitoring well GM-16 (in the southern area of the neighborhood) was 5.4×10^{-4} feet per foot (ft/ft). Horizontal hydraulic gradient values within the UA in 2017, ranged from 3.4×10^{-4} ft/ft to 5.4×10^{-4} ft/ft. The average horizontal hydraulic gradient, based on the well pairs presented in the 2017 Groundwater Monitoring Report (Arcadis, Inc. 2018) was 4.5×10^{-4} ft/ft for the UA.

Hydraulic testing results from the Pre-Design Investigation (Arcadis, Inc. 2012b) discreet point testing from vertical aquifer profiling intervals indicates an average hydraulic conductivity of 975 ft/day just to the east of the neighborhood at the former Building 21 area. However, historical testing from large scale pumping tests at nearby extraction well TW-2 (located southeast of the neighborhood) recorded an

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average hydraulic conductivity value of 1,785 ft/day (Arcadis, Inc. 2018). Current results from the Pilot Test confirm these values with an overall understanding of hydraulic conductivity of the UA in the neighborhood area ranging from the lower average of 1,785 ft/day to the upper averages collected from the Pilot Test at 2,938 ft/day.

3.3 Area-Specific Plume Concentrations and Distribution

The plume below the neighborhood is primarily composed of PCE and TCE. Concentrations of total site-specific VOCs exceeding 100 ug/L just upgradient of the neighborhood are distributed across the eastern half of the closed South Settling Lagoon, emanate from the UA primary source area (approximately 3,500 feet upgradient at the former Process Sump Area), and extend downgradient into the north central portion of the neighborhood. Plume concentrations decrease cross gradient and downgradient of the neighborhood. The estimated total plume width is approximately 1,000 feet perpendicular to groundwater flow at the upgradient-northern edge of the neighborhood. The plume width is based on concentrations that exceed 5 ug/L total site-specific VOCs. Based on a comparison of the well pairs sampled during the Pilot Test, concentrations of site-specific VOCs increased with depth at well pairs GM-63/GM-64 and RMW-93/RMW-94. Concentrations of site-specific VOCs were relatively consistent with depth at well pair RMW-91/RMW-92. **Table 2** summarizes the site-specific VOC concentration data, **Figure 2** shows the well locations, and **Figure 8** shows total site-specific VOC concentration distribution within the UA within the area of the neighborhood.

4 GROUNDWATER FLOW MODEL

The data collected during the Pilot Test, along with historical site and regional data, were used to update the revised three-dimensional groundwater flow model (Model) for the Site, as summarized in the technical memorandum provided in **Appendix D**. It should be noted that the technical memorandum includes site-wide (Phase 2) DGR™ modeling results combined with Phase 1 DGR™ IM modeling results. The information below captures the results pertinent to the full-scale Phase 1 DGR™ IM design.

Since the previous Model update in 2008, there have been several investigations and evaluations that resulted in updates to the CSM (Arcadis Inc., 2012a and 2015; RACER Trust 2016). These data directly relate to the main objective of modeling: to support remedial design simulations of DGR™ for treatment of site-specific VOCs in the UA. The activities for the Model update included the following: (1) review of existing CSM and recently collected hydrogeologic data; (2) refine the CSM; (3) update and refine the previous Model; (4) calibrate the refined Model to recent flow conditions; and (5) verification by simulating Pilot Test results. The CSM-related items (#1 and #2 above) are provided in **Section 3** with additional details applicable to the Model revisions are provided in **Appendix D**. The following sections provide a summary of the Model calibration, Model verification, and the remediation design analysis.

4.1 Model Calibration and Verification

Calibration of a groundwater flow model refers to the iterative process of systematically adjusting the model boundary conditions and input parameters within a justifiable and generally-accepted range of values to obtain as close a match between observed and simulated water levels. The generally-accepted process for comparison of simulated and observed water levels is summarized in ASTM Standard D-5490-93 (ASTM, 1994) and utilizes the concept of residuals (the differences between simulated and observed water levels).

The calibration statistics for the groundwater flow model indicate a good match between simulated and measured groundwater elevations. These statistics and observations indicate that the calibrated model can be used as a critical tool for the evaluation of Site remedial design. In order to verify the effectiveness and calibration of the groundwater flow, baseline and constant rate extraction test water level responses were simulated and are shown on **Figures 9** and **10**. A transient response was also produced and plotted with observed responses for the constant rate extraction test. The transient simulated response is shown on **Figure 11** with drawdown response at 63 feet from EW-2 (equating to observation well RMW-93) and hypothetical distance of 100 feet. The actual and the simulated responses are consistent with similar full response to the cone of depression. Note that the early time data will be inconsistent due to the grid resolution of the model at 25 by 25 feet.

4.2 Remediation Design Analysis

The Model was used to support the remedial design of the full-scale Phase 1 DGR™ IM system to address the UA dissolved phase plume. The primary basis for the design of a DGR™ system is the volume of water contained within the plume and the number of clean water pore volume flushes required to achieve the water quality goals set forth by the site-specific performance objectives. Based on the distribution and magnitude of VOC concentrations, the water quality goals, and the hydrogeologic

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characteristics of the Site, the necessary number of groundwater pore flushes can be calculated. With the calculated required pore flushes and the sustainable yields and hydraulic influence of the extraction and injection wells determined during the Pilot Test, the number of necessary extraction and injection wells can be computed to achieve water quality goals in a desired timeframe. Strategic placement of the injection and extraction wells can then be determined and further assessed with Model simulations to ensure hydraulic containment of the plume and to confirm the pore flush distribution for the designed DGR™ systems.

The Phase 1 DGR™ IM extraction and injection well locations were located immediately upgradient and downgradient of the neighborhood. Phase 1 utilizes the Pilot Test wells and minimizes the installation of infrastructure within the neighborhood. The Phase 1 design consists of four extraction well locations and five injection well locations with total flow balanced at a rate of 400 gpm. The three upgradient extraction well locations (EW-1, EW-2, and EW-3) were designed to capture the mass flux migrating towards the neighborhood. The four upgradient injection well locations (IW-1, IW-2, IW-3, and IW-4) were designed to enhance the advancement of clean, treated water through the neighborhood. Wells EW-1 and EW-2, used as extraction wells during the Pilot Test, are being converted to IW-1 and IW-2, respectively. The downgradient extraction well (EW-4) is positioned to hydraulically control the distal toe of the plume currently present within the neighborhood. The downgradient injection well (IW-5) is located on the eastern edge of the plume to provide additional flushing without compromising hydraulic control.

The hydraulic capture zone for the cumulative DGR™ design was delineated using the MODular flow ALlocation (MODALL) program (Potter et al. 2008). MODALL uses the MODFLOW-calculated cell-by-cell flow terms to delineate the zone of capture of selected boundary conditions. The capture zones delineated by MODALL provide a conservative estimate of capture limits similar to a MODPATH pathline analysis. The MODALL fraction of hydraulic capture is shown in **Appendix D**. This fraction of hydraulic capture indicates the targeted area of capture is hydraulically controlled (hydraulic capture fraction greater than 0.5). The limited portions of the composite PCE/TCE plume that are not captured are downgradient or side-gradient of the low concentration dissolved-phase plume.

In addition to the capture delineation, MODALL was utilized to estimate the spatial remedial time distribution throughout the composite plume as shown in **Appendix D**. This spatial remedial time distribution was estimated by multiplying the spatial distribution of the required number of pore flushes by the simulated average pore flush duration per cell by the average grid cell length in the direction of flow (25 feet). This estimated cleanup distribution indicates the bulk of the plume targeted by the DGR™ system will reach remedial goals. Several portions of this cleanup time distribution within the plume footprint indicate longer cleanup times, but this is a function of running a steady-state groundwater flow model where stagnation points may form. These areas do not indicate that additional infrastructure is necessary, but rather where the proposed DGR™ system pumping rates will be varied to shift these hydraulic stagnation points over time. This is a key aspect of the need for dynamic operation of the DGR™ system through optimization.

A qualitative evaluation of groundwater extraction without re-injection (i.e., pump and treat) was completed. As detailed above, DGR™ systems are designed to ensure hydraulic containment of the plume and to enhance pore flushing. The results from the evaluation indicate that the remedial impact of a conventional pump and treat system would be limited due to static hydraulic conditions that develop (e.g. hydraulic stagnation points). To meet the same remedial objectives, a conventional pump and treat

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system would need to capture a greater volume of groundwater, which would require additional extraction wells (in addition to those proposed herein) within the neighborhood that would need to be connected to the treatment system. Additionally, the extracted groundwater would need to be treated and discharged under an applicable permit. Overall, DGR™ is a more sustainable and cost-effective means of managing extracted groundwater with less community impact. As a result, the conventional pump and treat option will not be carried forward at the Site.

4.3 Summary and Conclusions

The Model was revised with updates from the CSM and Pilot Test data to support the evaluation of the DGR™ IM for the neighborhood and as an on-site dissolved phase plume remedy. The Model was calibrated under steady-state conditions using average groundwater level measurements from 2012 through 2015 at 144 locations and verified with Pilot Test observed results. The Model indicated that the targeted area of capture within the UA is hydraulically controlled and that the composite PCE/TCE plume will achieve the applicable corrective measures objectives in the Phase 1 DGR™ IM design area.

5 PHASE 1 DGR™ DESIGN

Based on the data collected, processed, and evaluated as explained in the preceding sections, a Phase 1 DGR™ IM design and implementation plan was developed. The following sections provide information relating to permitting and access; well design, installation, and development; piping plans; and treatment system details. Additional information relating to the standard operating procedures (SOPs) and field forms associated with these tasks can be found in the Work Plan.

5.1 Access and Permitting

The Phase 1 DGR™ IM system includes installation of three extraction wells, four injection wells, a treatment system, and associated piping on the closed South Settling Lagoon property that is owned by RACER Trust. Therefore, an access agreement will not be required for the portion of the system installed on the closed South Settling Lagoon property. One extraction well and one injection well are proposed to the south of the neighborhood, on property owned by Montgomery County. With approval of the Report, RACER Trust will submit an access agreement to Montgomery County for installation of the two wells and associated system components on the property to the south of the neighborhood. Montgomery County indicated that several sewer improvement projects are planned near the Site. Memorandums documenting the planned activities and how the activities may affect site conditions are included as **Appendices E and F**.

In accordance with Rule 13, a request will be submitted to the Ohio EPA for approval to install the proposed wells and piping on the closed South Settling Lagoon property as the subsurface work will be within 300 feet of solid waste in the closed South Settling Lagoon. It is to be noted that the proposed well locations and piping were selected so as not to disturb the existing solid waste. The anticipated trenching depths will not impact the existing solid waste. The request will include an overview of the closed South Settling Lagoon history and information required by Rule 13 (e.g., name/type of facility, address, contact information, identification of the type and amount of waste present, a description of the proposed activities, institutional controls that apply to the Site, controls planned during the proposed activities). Installation of the system will not be completed until Ohio EPA approval is received.

An UIC permit is not required based on OAC 3745-24-11(H). The referenced Code indicates that “the injection of fluids into a class V well for purposes of remediating ground water or soil contamination is authorized without a permit.” This Report will be submitted to the Ohio EPA to review and confirm any potential UIC requirements.

Use of granular activated carbon (GAC) is the planned treatment method for extracted groundwater. One of the benefits of this technology is that there are no air emissions associated with groundwater treatment. Therefore, a permit for air emissions is not required.

A permit from the City of Moraine may be required for a new power drop/easement to the Site. With approval of the Report, power requirements will be reviewed, and appropriate state and local permits will be obtained.

5.2 Utility Clearance

Prior to intrusive subsurface activities (i.e., drilling or trenching), underground utilities will be cleared, and locations will be surveyed for overhead utilities. Utilities will be cleared following the Arcadis Utility Location Policy and Procedures. A copy of the Arcadis Utility Location Policy and Procedures can be found in the site-specific health and safety plan. At a minimum, Arcadis will contact the Ohio Utility Protection Service (OUPS), review available facility utility drawings, and conduct a detailed visual site inspection. Invasive utility clearance procedures will be completed, which may include clearing each boring using an “air-knife” or similar device to approximately 6 feet bgs. Other lines of evidence which may be utilized include, but are not limited to, a private utility locating service, hand augering or digging, and utility provided utility location maps.

5.3 Well Network

The proposed design layout detailed below meets the remedial objectives while limiting intrusive activities within the neighborhood (i.e., limited drilling for monitoring wells and no trenching).

There are two primary areas associated with the Phase 1 DGR™ IM, with each area presented on **Figure 12**. One group of extraction and injection wells is proposed in the former South Settling Lagoon area, immediately upgradient of the neighborhood. Specifically, three new extraction wells (EW-1 through EW-3) will be installed in the closed South Settling Lagoon. There are four corresponding injection wells (IW-1 through IW-4) also proposed for installation on the closed South Settling Lagoon. Two of the injection wells (IW-1 and IW-2) were installed during the pilot test activities as extraction wells (EW-1 and EW-2); therefore, only two new injection wells (IW-3 and IW-4) are proposed for the full-scale implementation in this area.

A second group of system wells that consist of extraction well EW-4 and injection well IW-5 is proposed immediately downgradient of the neighborhood just south of Main Street on Montgomery County property with the intent to limit current groundwater concentrations from migrating downgradient of the neighborhood (**Figure 12**).

To assist in the monitoring of total site-specific VOC concentration distribution and to assess hydraulic response in the UA, seven monitoring wells will be installed in the shallow and deep portions of the UA. These will include two monitoring well pairs on the western (RMW-98 and RMW-99) and eastern (RMW-100 and RMW-101) sides of the neighborhood. One monitoring well (RMW-102) will be installed within the shallow (water table) portion of the UA at the southern end of the neighborhood to pair with the existing deep UA monitoring well GM-16. One additional well pair is south of Main Street adjacent to EW-4 (RMW-103 and RMW-104).

5.4 Monitoring Well Installation, Sampling, and Development

Initial borings will be advanced utilizing sonic or hollow stem auger drilling methods at each of the extraction and injection well locations to the regional clay till (approximately 60 feet bgs). Up to seven initial soil borings will be installed to confirm lithology and collect samples for grain size analysis within screen target intervals for each of the Phase I DGR™ injection (IW-3, IW-4, and IW-5) and extraction wells (EW-1, EW-2, EW-3, and EW-4). The initial boring installed in the area of EW-4 will be converted

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into a new 2-inch diameter PVC monitoring well pair (RMW-103 and RMW-104). The deeper UA monitoring well will be installed in the initial boring, and the shallow UA monitoring well will be installed in an offset boring. The remaining proposed monitoring wells will be installed as detailed below and will not include laboratory grain size evaluation.

Soil samples will be continuously collected, field screened for VOCs using a PID and classified based on the Udden-Wentworth grain-size scale. The soil descriptions, including Unified Soil Classification System (USCS) descriptions, grain size distribution, sorting, moisture content, consistency/density, color (based on the Munsel color system), and PID readings will be recorded on field boring logs. Soil grain size analysis samples will be collected throughout the saturated zone for each injection well and throughout the proposed well screen interval of each extraction well. The grain size samples will be submitted to a local geotechnical laboratory to assist in well screen design.

Monitoring wells will be constructed of 2-inch diameter Schedule-40 PVC with 10-slot PVC. Screen length and depth will be determined based on lithologic and saturation relationships to cover shallow and deep portions of the UA (i.e. near the groundwater table and just above the regional clay till). During installation, after the well screen and sand pack are in place, each well will be pre-developed to ensure proper placement of the filter pack around the well screen. Wells will be completed with either a flush mount well vault or lockable stickup with a concrete pad. Once installed, monitoring wells will be developed by the surge and volumetric purge method. In addition, the ground elevation and the top-of-casing measuring point of each monitoring well will be surveyed by a licensed professional once all the wells are installed.

5.5 Extraction and Injection Well Installation

Based on the CSM, known lithology, and data collected during the Pilot Test, the full-scale Phase 1 DGR™ extraction and injection well design will consist of 8-inch diameter stainless steel wire-wrapped screens with natural formation pack and 8-inch diameter PVC risers. Based on the Pilot Test, the screen length for the proposed extraction wells is estimated to be 20 to 30 feet. Conversely, the screen length for the proposed injection wells is estimated to be the full UA saturated thickness of 40 feet. Note that two injection wells (IW-1 and IW-2) were installed during the Pilot Test with 20-foot screen lengths at the base of the UA. The Model accounted for the shorter injection well screens at these two locations. The information compiled from the initial borings (i.e., soil grain size results) will be used to confirm appropriate screen lengths with custom slot sizes for a natural formation pack well. The proposed design parameters, including screen manufacturer specifics, will be used in calculations (Driscoll, 1986) to verify screen transmitting capacity.

Extraction and injection wells will be installed using hollow stem auger methodologies. The target depth of 62-64 feet bgs is approximately 2 to 3 feet into the regional clay till, which has a known thickness of 11 or more feet in the area, to accommodate a well sump. Once the borehole is complete, the well screens will be installed with a 2 to 3 feet stainless steel basal sump.

After the well screen is installed to the design depth, the formation will be allowed to collapse along the screen and casing to surface. To complete the installation, the surface completions will consist of pitless adapters that will be connected to a treatment system through underground piping, as detailed in **Section 5.7**. Typical injection and extraction well details are shown on **Figure 13**.

5.6 Extraction and Injection Well Development and Hydraulic Testing

Pre-development will be performed after screen installation to allow for the natural formation pack to settle and to avoid bridging. Final well development will begin once the wells have been completed. The process will combine multiple development techniques to allow for an increased removal of fines and to increase hydraulic communication for groundwater to move both in and out of the well screen. To gauge the development process and well-aquifer connectivity, a specific capacity test will be performed, and water quality parameters will be collected prior to engaging in well development procedures. The data collected will be used as a baseline comparison throughout well development efforts.

The stages of development are expected to consist of the following:

- Initial pumping or air-lift to remove fines
- Surge entire screen utilizing a double surge block in 2-foot screen increments
- Using pumps and backwash techniques to aggressively remove fines from well between rounds of surging

Once the stages of development are complete, a second round of water quality parameters will be collected along with an additional specific capacity test. A comparison between the baseline values will be assessed to identify if additional rounds of surging, backwashing, or jetting need to be performed. This process will be repeated until specific capacity shows an improvement of less than approximately 10% and measured parameters have stabilized against predetermined criteria. After development is determined to be complete, a step test will be completed to document well-specific capacity and performance. These data will be the baseline dataset for future comparison purposes to determine the need for well re-development.

5.7 System Process and Flow

Extracted groundwater will be conveyed by way of 3-inch diameter, high-density polyethylene (HDPE), underground piping to centralized above ground treatment systems. Approximate well, piping, and treatment system locations are shown on **Figure 12**. Flow rate and in-well drawdown will be managed at each extraction well using well-specific pressure transducers, flow meters/totalizers, and flow controllers to optimize the extraction well capture zone. Flows from extraction wells will be combined in an equalization tank. A transfer pump will be used to pump the extracted water through parallel bag filters (bag filters will be in parallel to decrease change out frequency) and two GAC vessels in series to remove particulates and contaminants respectively, before being redistributed to the injection well network through underground piping.

Granular activated carbon was selected as the primary contaminant removal mechanism because it is thoroughly demonstrated to be effective for the target contaminants (PCE and TCE) and because it was the most cost-effective option for the concentrations and flow rates anticipated for this treatment system. It should be noted that the existing on-site air stripper (TW-2) was considered as part of this evaluation. The maximum flow capacity of the existing air stripper was insufficient to treat the anticipated flow rate of

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extracted groundwater. Furthermore, procurement and operation of a supplemental air stripper was not cost-effective as compared to a GAC unit.

System operational parameters (e.g., flow rates, system pressures, alarm conditions) will be routed through a Programmable Logic Control (PLC) system for remote monitoring and the operator is notified if any of the operational parameters exceed their specified ranges. The system will be equipped with safe guards, and the PLC will be programmed with shut down interlocks to prevent damage to injection or extraction wells, treatment system components, and to monitor for spills or leaks from the system.

5.8 Performance Monitoring Program

An integral component to successful groundwater recirculation remedies is maintaining an overall degree of adaptability over the course of operation to respond to field observations and to maintain the pace of overall remedial performance. The key end points of the performance monitoring program include groundwater capture and site-specific VOC concentration reduction. These indicators will be assessed as part of the monitoring program and used to adapt overall extraction and injection operations throughout the lifecycle of the system.

The layout for the well network is provided on **Figure 12**. Performance data will be used to guide system operation and associated operational flows to meet the overall Phase 1 DGR™ objectives over the course of operation. Data that will be evaluated continuously to optimize the DGR™ system performance include, but are not limited to, the following:

- Monitoring well water quality data, including laboratory data (e.g., site-specific VOCs) and field parameters (e.g., dissolved oxygen and oxidation reduction potential)
- Extraction well water quality data (e.g., site-specific VOCs)
- Water-level measurements including both manual depth-to-water measurements during pumping and high frequency water-level data from the pressure transducers. The water-level monitoring locations are presented in **Figure 12**.
- Individual extraction and injection well flow rates and totalizer readings

Prior to the installation and start-up of the system, a baseline groundwater sampling event for site-specific VOCs will be completed. The groundwater monitoring well network is illustrated on **Figure 12**. Following the installation and start-up of the system, quarterly groundwater sampling of site-specific VOCs using the same well network is proposed to monitor the overall DGR™ system efficacy.

5.9 Waste Disposal

Soil cuttings generated from well installation activities and excess soil generated from trenching activities will be properly containerized and disposed of at an appropriate off-site disposal facility. Purge-water from well development and groundwater sampling activities will be temporarily stored in tanks and transferred to the treatment system following sufficient time for solids to settle. The settled solids will be disposed of at an appropriate off-site disposal facility. Groundwater will be treated before being re-injected. Sludge or filter cake generated from groundwater treatment will be disposed of at an appropriate off-site disposal facility.

5.10 Operation and Maintenance

Regular operation and maintenance (O&M) will be completed on the groundwater treatment system to maximize the efficiency of the overall DGR™ system. The following items will be considered as part of the routine O&M program for the groundwater treatment system:

- Inspect the system and correct any leaks or other unusual conditions
- Record pressure gauge readings, record unusually high readings, and compare to normal pressure readings as detailed in an O&M manual
- Collect analytical samples of site-specific VOCs at the system influent, mid-point between the two carbon vessels, and the system effluent; if site-specific VOCs exceeding MCLs are identified in the mid-point sample, a carbon change out will be scheduled
- Replace exhausted GAC, as needed
- Replace bag filters, as needed

It should be noted that based on the current site-specific VOC concentrations and approximate flow rates, vendor-provided carbon usage rates were estimated at 63 pounds/day. As with any groundwater remediation system, operational downtime is anticipated. It is expected that the system will be operational for approximately 50% to 70% of the time during the first one to three months as system operation is initiated and is fine-tuned. After the first three months, it is expected that the system will be operational approximately 90% of the time. A designated system operator(s) will be notified by the PLC of alarm conditions or system shutdowns and, if possible, will respond within approximately 24 hours to initiate system troubleshooting, maintenance, or repairs, as needed, or system restart. Should the system be inoperable for a sustained period of time exceeding this assumed efficiency, remedial actions will be taken.

5.10.1 Injection and Extraction Well Flow Rates and Operating Sequencing

Operation of the individual injection and extraction wells will be modified based on routine performance data reviews reliant on both operational and treatment monitoring. Data collected over the course of operation will be used to adapt the overall program based on observed response, with a focus on overcoming aquifer heterogeneities and optimizing groundwater capture.

Injection well operational modification may include the following:

- Injection rates in individual injection wells may be reduced or temporarily stopped to alter the hydraulic gradients and stresses applied to the UA. As previously discussed, injection rates may also be reduced to focus available recirculation water on other well locations.
- Injection wells may temporarily or permanently be converted to extraction wells to enhance hydraulic control, mass removal, and/or overcome aquifer heterogeneities.

Similarly, individual extraction well operational modifications may include the following:

- Adjustment of extraction rates may be completed to optimize mass recovery, hydraulic control, overcome aquifer heterogeneities, and optimize groundwater capture.

5.10.2 Potential Corrective Actions

Based on the results of the performance monitoring, various actions may be undertaken to enhance the performance of the DGR™ system, including:

- Flow meter check/calibration
- Pump inspection/cleaning
- Pump motor refurbishment
- Wellhead pressure gauge check/calibration
- Discharge line inspection/cleaning
- Well casing/screen video log
- Well casing/screen redevelopment or rehabilitation
- Well testing (e.g., step drawdown test)
- Replacing destroyed or severely fouled wells

It is noted that the life-cycle of the injection and extraction well pair to the south of the neighborhood is expected to be less than the duration of the network of injection and extraction wells located in the former South Settling Lagoon. The site-specific VOC concentrations in the full network will be monitored, and a request for approval to shut down this system will be submitted when the data indicate this is appropriate.

5.11 Reporting

A quarterly evaluation of the performance monitoring data will be completed to recognize indications of deteriorating equipment and/or well fouling/scaling of the well screen through evaluation of specific performance criteria. The results of this data evaluation will be provided quarterly in a Quarterly Progress Report (QPR) and annually in the Annual Groundwater Monitoring Report.

Quarterly summaries presented in the QPR will include:

- A quarterly data summary and evaluation,
- Corresponding figures and tables, and
- An evaluation and recommendations regarding system modifications, future data collection, and/or corrective actions.

The annual summary presented in the Annual Site-Wide Groundwater Monitoring Report will include:

- An annual data summary and evaluation,
- Corresponding figures and tables,
- An evaluation and recommendations regarding future data collection and/or corrective actions,
- Documentation of O&M activities/actions performed during the reporting year.

PHASE 1 DYNAMIC GROUNDWATER RECIRCULATION (DGR™) INTERIM MEASURE (IM) DESIGN REPORT AND WORK PLAN

These reports will include analytical data, average flow rates, system downtime, notable O&M activities, system modifications and/or recommended corrective actions.

DRAFT

6 SCHEDULE

Implementation of the full-scale DGR™ system, including planning and subcontractor procurement are expected to occur after agency approval of this Report. Field work is expected to be initiated within 2 months of U.S. EPA approval. System start-up and shake down are expected to be completed within 3 months of initiating field work, and the system is expected to be operational approximately 2 weeks after start-up and shake down, approximately 5.5 months from U.S. EPA approval of this Report. To the extent possible, the installation schedule will be expedited. However, this schedule is contingent on weather, contractor availability, and other factors beyond our control. It is expected that the Phase 1 DGR™ IM will take approximately five years to meet the clean-up criteria within the neighborhood.

DRAFT

PHASE 1 DYNAMIC GROUNDWATER RECIRCULATION (DGR™) INTERIM MEASURE (IM) DESIGN REPORT AND WORK PLAN

7 REFERENCES

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- U.S. EPA, 2017c. Ohio Administrative Code (OAC) Rule 27-13 Request. July 5, 2017.

TABLES



Table 1
Groundwater VOC Analytical Results
DGR™ Pilot Test Monitoring Well Network
RACER Trust Moraine Facilities
Moraine, Ohio

	Units	MCL ¹	DGR™ Pilot Test Monitoring Well Network-Baseline Sampling Event									
			RMW-91 9/13/2017 Upper Aquifer	RMW-92 9/13/2017 Upper Aquifer	RMW-93 9/13/2017 Upper Aquifer	RMW-94 9/13/2017 Upper Aquifer	W-3-S 9/13/2017 Upper Aquifer	W-4-S 9/13/2017 Upper Aquifer	GM-63 9/13/2017 Upper Aquifer	GM-64 9/13/2017 Upper Aquifer	EW-1 9/13/2017 Upper Aquifer	EW-2 9/13/2017 Upper Aquifer
Site-Specific Volatile Organic Compounds												
1,1,1-Trichloroethane	ug/L	200	1.8	3.6	2.7	4.9	0.6 J	2.2	1.9	1.7	2.2	1.0
1,1-Dichloroethane	ug/L		2.4	1.1	1.4	1.2	0.72 J	1.8	2.2	3.7	1.2	2.0
1,1-Dichloroethene	ug/L	7	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Benzene	ug/L	5	0.29 J	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
cis-1,2-Dichloroethene	ug/L	70	10	0.38 J	2.1	< 1.0 U	< 1.0 U	2.5	7.8	3.6	1.8	9.1
Ethylbenzene	ug/L	700	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Tetrachloroethene	ug/L	5	82	85	56	92	84	73	39	36	26	27
Toluene	ug/L	1,000	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U
trans-1,2-Dichloroethene	ug/L	100	0.75 J	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	0.82 J	1.1 U	1.6	0.39 J	0.93 J
Trichloroethene	ug/L	5	52	0.56 J	31	0.84 J	1.9	29	8.1	37	44	22
Vinyl chloride	ug/L	2	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	1.8	< 1.0 U	< 1.0 U
Xylene (total)	ug/L	10,000	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U

NOTES:

< - Constituent not detected above laboratory reporting limit shown.

Influent samples were collected prior to system treatment from EW-2 and effluent samples were collected from sample ports post-system treatment.

¹ - A MCL is not listed for 1,1-dichloroethane.

BOLD - Result above MCL.

ug/L - Micrograms per Liter.

F1- MS/MSD outside acceptance limits

J - Value is estimated.

MCL - Maximum Contaminant Level.

U - Constituent not detected above laboratory reporting limit shown.

Table 1
Groundwater VOC Analytical Results
DGR™ Pilot Test Monitoring Well Network
RACER Trust Moraine Facilities
Moraine, Ohio

	Units	MCL ¹	DGR™ Pilot Test Monitoring Well Network-Post Testing Sampling Event									
			RMW-91 9/29/2017 Upper Aquifer	RMW-92 9/29/2017 Upper Aquifer	RMW-93 9/29/2017 Upper Aquifer	RMW-94 9/29/2017 Upper Aquifer	W-3-S 9/29/2017 Upper Aquifer	W-4-S 9/29/2017 Upper Aquifer	GM-63 9/29/2017 Upper Aquifer	GM-64 9/29/2017 Upper Aquifer	EW-1 9/29/2017 Upper Aquifer	EW-2 9/29/2017 Upper Aquifer
Site-Specific Volatile Organic Compounds												
1,1,1-Trichloroethane	ug/L	200	2.8	3.4	3.4	5.0	0.59 J	2.6	1.7 J	1.2	1.9	3.2
1,1-Dichloroethane	ug/L		2.3	0.83 J	1.5	1.2	0.53 J	2.1	1.9 J	3.8	0.84 J	1.6
1,1-Dichloroethene	ug/L	7	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 2.0 U	0.28 J	< 1.0 U	< 1.0 U
Benzene	ug/L	5	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 2.0 U	< 1.0 U	< 1.0 U	< 1.0 U
cis-1,2-Dichloroethene	ug/L	70	13	0.44 J	3.2	< 1.0 U	1.5	12	3.4	37	1.5	3.6
Ethylbenzene	ug/L	700	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 2.0 U	< 1.0 U	< 1.0 U	< 1.0 U
Tetrachloroethene	ug/L	5	110	71	79	120	83	89	46	33	35	86
Toluene	ug/L	1,000	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 2.0 U	< 1.0 U	2.8	< 1.0 U
trans-1,2-Dichloroethene	ug/L	100	1.0	< 1.0 U	0.43 J	< 1.0 U	< 1.0 U	1.3	1.1 J	2.1	0.30 J	0.42 J
Trichloroethene	ug/L	5	72	2.3	36	1.8	5.6	31	9.7	42	48 F1	28
Vinyl chloride	ug/L	2	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 1.0 U	< 2.0 U	3.3	< 1.0 U	< 1.0 U
Xylene (total)	ug/L	10,000	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 2.0 U	< 4.0 U	< 2.0 U	< 2.0 U	< 2.0 U

NOTES:

< - Constituent not detected above laboratory reporting limit shown.

¹ - A MCL is not listed for 1,1-dichloroethane.

BOLD - Result above MCL.

ug/L - Micrograms per Liter.

F1- MS/MSD outside acceptance limits

J - Value is estimated.

MCL - Maximum Contaminant Level.

U - Constituent not detected above laboratory reporting limit shown.

Table 1
 Groundwater VOC Analytical Results
 DGR™ Pilot Test Monitoring Well Network
 RACER Trust Moraine Facilities
 Moraine, Ohio

	Units	MCL ¹	Influent and Effluent Data				
			INFLUENT-1 (EW-2) 9/6/2017 Pre-Treatment	EFFLUENT-1 9/6/2017 Post-Treatment	INFLUENT-2 (EW-2) 9/26/2017 Pre-Treatment	EFFLUENT-2 9/25/2017 Post-Treatment	EFFLUENT-FINAL 9/28/2017 Post-Treatment
Site-Specific Volatile Organic Compounds							
1,1,1-Trichloroethane	ug/L	200	<1.0 U	<1.0 U	1.7	<1.0 U	<1.0 U
1,1-Dichloroethane	ug/L		<1.0 U	<1.0 U	0.66 J	<1.0 U	<1.0 U
1,1-Dichloroethene	ug/L	7	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U
Benzene	ug/L	5	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U
cis-1,2-Dichloroethene	ug/L	70	<1.0 U	<1.0 U	1.5	<1.0 U	<1.0 U
Ethylbenzene	ug/L	700	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U
Tetrachloroethene	ug/L	5	2.6	<1.0 U	57	2.0	2.4
Toluene	ug/L	1,000	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U
trans-1,2-Dichloroethene	ug/L	100	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U
Trichloroethene	ug/L	5	2.9	<1.0 U	7.1	0.48 J	0.75 J
Vinyl chloride	ug/L	2	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U
Xylene (total)	ug/L	10,000	<2.0 U	<2.0 U	<2.0 U	<2.0 U	<2.0 U

NOTES:

< - Constituent not detected above laboratory reporting limit shown.

¹ - A MCL is not listed for 1,1-dichloroethane.

BOLD - Result above MCL.

ug/L - Micrograms per Liter.

F1- MS/MSD outside acceptance limits

J - Value is estimated.

MCL - Maximum Contaminant Level.

U - Constituent not detected above laboratory reporting limit shown.

Table 2
Groundwater Well Construction Details
RACER Trust Moraine Facilities
Moraine, Ohio



Well	Surface Elevation	TOC Elevation	Well Diameter	Screened Interval				Borehole Depth	State Plane Coordinates		Geologic
	ft amsl	ft amsl	inches	ft bls	ft bls	ft amsl	ft amsl	ft bls	Northing, y	Easting, x	Modifiers
Upper Aquifer Wells											
W-1-N	737.61	739.02	4	35	70	702.61	667.61	70	625116.2043	1483946.9943	UA:TT
W-2-N	729.68	731.68	4	35	60	694.68	669.68	60	623865.9104	1483351.6742	UA
W-3-N	731.98	733.66	4	32	57	699.98	674.98	57	623695.8796	1483607.3111	UA
W-4-N	729.88	731.63	4	40	65	689.88	664.88	65	623651.9134	1483795.0108	UA:TT
HR-1	730.10	732.71	2	47	57	683.10	673.10	57	621967.7490	1483378.1275	UA:TT
HR-2	732.62	734.75	2	47	57	685.62	675.62	58	623649.3090	1484030.9226	UA:TT
HR-3	734.31	736.75	2	50	60	684.31	674.31	61	623612.1403	1484238.0984	UA:TT
HR-4	740.61	742.60	2	55	65	685.61	675.61	67	624582.0074	1484003.5860	UA:TT
HR-5	730.95	734.27	2	44	54	686.95	676.95	59	623354.8172	1483478.6541	UA:TT
HR-6	730.18	732.66	2	43	53	687.18	677.18	59	622588.6622	1483298.8965	UA:TT
HR-7	731.00	731.73	2	47	57	684.00	674.00	58	623373.8266	1483168.5266	UA:TT
HR-11	740.90	743.33	2	60	70	680.90	670.90	75	625682.4858	1485262.9762	UA
HR-16	724.60	727.01	4	42	62	682.60	662.60	70	621167.6648	1482171.8435	UA:TT
HR-17	725.40	726.43	4	27	47	698.40	678.40	56	621128.4488	1482780.5158	UA:TT
W-1-S	728.23	729.29	4	25	60	703.23	668.23	60	621396.0291	1482990.4046	UA:TT
W-2-S	725.01	726.64	4	30	65	695.01	660.01	65	620618.7813	1482078.7622	UA:TT
W-3-S ⁽¹⁾	727.17	729.17	4	36	76	691.17	651.17	76	620466.6686	1482207.4451	UA
W-4-S	726.66	727.92	4	30	70	696.66	656.66	70	620394.9579	1482564.2035	UA
GM-2 ⁽²⁾	NM	735.81	2	45	55	688.00	678.00	55	619586.2208	1483427.9998	UA
4S ⁽²⁾	NM	731.36	4	30	65	699.00	664.00	65	619578.3226	1483129.6378	UA
GM-6 ⁽²⁾	727.87	729.46	2	35	45	692.87	682.87	45	619627.6172	1482930.9571	UA:TT
GM-8	732.67	734.40	2	40	50	692.67	682.67	50	619866.4552	1482965.5535	UA:TT
GM-10 ⁽²⁾	NM	723.90	2	40	50	681.00	671.00	50	618762.6410	1482667.7306	UA:TT
GM-16 ⁽²⁾	NM	725.30	2	48	58	678.00	668.00	58	619420.5576	1482149.1466	UA
GM-17 ⁽²⁾	NM	723.84	2	40	50	684.00	674.00	50	619311.8761	1482697.0210	UA
GM-18 ⁽²⁾	NM	723.80	2	45	55	679.00	669.00	55	619229.5883	1482505.4542	UA:TT
GM-19S ⁽²⁾	NM	730.92	2	47	57	691.00	681.00	57	620339.5683	1483017.2551	UA:TT
GM-21	725.36	725.00	2	45	55	680.36	670.36	55	619920.5937	1483764.5951	UA:TT
GM-22	731.84	731.63	2	44	54	687.84	677.84	54	620840.4209	1484226.5683	UA:TT
GM-23 ⁽²⁾	NM	731.07	2	24	34	674.00	664.00	34	623699.2336	1484619.9213	UA:TUT
GM-24	747.61	747.29	2	58	68	689.61	679.61	70	625945.0802	1486991.6971	UA
GM-25	747.05	746.17	2	48	58	699.05	689.05	58	622786.2705	1486599.6865	UA:TT

Table 2
Groundwater Well Construction Details
RACER Trust Moraine Facilities
Moraine, Ohio



Well	Surface Elevation	TOC Elevation	Well Diameter	Screened Interval				Borehole Depth	State Plane Coordinates		Geologic Modifiers
	ft amsl	ft amsl		ft bls	ft bls	ft amsl	ft amsl		ft bls	Northing, y	
Upper Aquifer Wells											
GM-26	722.29	722.29	2	50	60	672.29	662.29	60	617729.9788	1482129.0695	UA
GM-27	731.03	730.57	2	40	50	691.03	681.03	58	623696.6136	1484630.7659	UA:TT
GM-28 ⁽²⁾⁽³⁾	NM	736.46	2	22	32	715.00	705.00	32	623392.3799	1484436.8617	UA:TUT
GM-28R ⁽⁴⁾	731.87	731.28	2	20	30	711.87	701.87	30.5	623340.7680	1484507.2070	UA
GM-29	731.31	731.37	2	28	38	703.31	693.31	38	623534.4471	1484535.0727	UA:TUT
GM-30 ⁽²⁾⁽⁵⁾	NM	734.79	2	28	38	707.00	697.00	38	623876.3465	1484609.5933	UA:TUT
GM-31 ⁽⁵⁾	732.05	732.13	2	51	61	681.05	671.05	62	621336.9337	1483965.1322	UA:TT
GM-32	732.47	732.08	2	51	61	681.47	671.47	51	620114.2493	1483379.9656	UA:TT
GM-33	730.30	729.77	2	48	58	682.30	672.30	58	620761.9955	1483714.2282	UA:TT
GM-34	731.06	730.56	2	26	36	705.06	695.06	36	620753.8480	1483727.5719	UA:WT
GM-35	731.56	731.27	2	57	67	674.56	664.56	70	620389.3810	1483279.5201	UA:TT
GM-36	731.44	731.11	2	25	35	706.44	696.44	35	620383.2312	1483300.8386	UA:WT
GM-37	730.36	730.05	2	46	56	684.36	674.36	56	620407.3595	1483456.0282	UA:TT
GM-38	730.31	729.88	2	24	34	706.31	696.31	34	620403.1387	1483471.6479	UA:WT
GM-43	729.41	729.00	2	40	50	689.41	679.41	54	622192.2046	1483441.3723	UA:TT
GM-44	729.30	728.77	2	51	61	678.30	668.30	62	621686.3425	1483331.5124	UA:TT
GM-45	730.03	729.75	2	50	60	680.03	670.03	60	621409.1769	1483266.9285	UA:TT
GM-46	728.13	727.79	2	19.8	29.8	708.33	698.33	29.8	623393.7601	1484777.0271	UA:TUT
GM-47	727.03	726.75	2	49.4	59.4	677.63	667.63	59.4	620060.6143	1482479.3608	UA:TT
GM-48	728.98	728.67	2	63.2	73.2	665.78	655.78	73.2	619488.4287	1481740.8154	UA:TT
GM-49	728.28	727.88	2	66.9	76.9	661.38	651.38	76.9	618643.7266	1481742.8231	UA:TT
GM-50	727.03	726.56	2	29.7	39.7	697.33	687.33	39.7	620065.0482	1482445.8840	UA:WT
GM-51	728.82	728.30	2	34.3	44.3	694.52	684.52	44.3	619465.2399	1481753.1472	UA:WT
GM-52	728.16	727.62	2	34	44	694.16	684.16	44	618604.5296	1481740.7235	UA:WT
GM-53	730.53	730.35	2	23	33	707.53	697.53	33	621184.8324	1484855.6876	UA:TT
GM-55	719.90	719.86	2	25	35	694.90	684.90	35	618008.2839	1482441.5719	UA:WT
GM-57 ⁽⁶⁾	719.41	721.40	2	25	35	694.41	684.41	35	617724.0851	1482132.1351	UA:WT
GM-59	732.46	732.25	2	25	35	707.46	697.46	35	622761.5281	1484712.7729	UA:WT
GM-60	732.46	732.24	2	42	52	690.46	680.46	52	622761.3002	1484712.7809	UA:TT
GM-62R ⁽⁴⁾	723.15	723.51	2	50	60	673.15	663.15	60	618423.9410	1482812.6470	UA
GM-63	726.21	725.79	2	30	40	696.21	686.21	40	620283.7218	1482686.3290	UA:WT
GM-64	726.38	725.95	2	50	60	676.38	666.38	60	620284.6106	1482681.2885	UA:TT
GM-65S	723.94	723.58	2	42	52	681.94	671.94	52	617392.2259	1481382.4271	UA
GM-66	733.50	733.22	2	45	55	688.50	678.50	57	622780.3860	1484091.5572	UA:TT
GM-67S	732.54	732.06	2	44	54	688.54	678.54	54	623050.0533	1484547.2174	UA:TT
GM-68S	732.48	732.18	2	39.5	49.5	692.98	682.98	49.5	622326.2125	1484652.8528	UA:TT
GM-71	737.19	736.82	2	21	31	716.19	706.19	37	622633.7567	1485222.9070	UA:TUT

Table 2
Groundwater Well Construction Details
RACER Trust Moraine Facilities
Moraine, Ohio



Well	Surface Elevation	TOC Elevation	Well Diameter	Screened Interval				Borehole Depth	State Plane Coordinates		Geologic
	ft amsl	ft amsl	inches	ft bls	ft bls	ft amsl	ft amsl	ft bls	Northing, y	Easting, x	Modifiers
Upper Aquifer Wells											
GM-72	737.05	736.78	2	52	62	685.05	675.05	67	622633.7567	1485233.9320	UA:TT
GM-74S	732.52	732.17	2	40	50	692.52	682.52	50	622444.5430	1484733.8601	UA:TT
GM-75S	738.26	737.69	2	42	52	696.26	686.26	52	622790.6745	1485039.3503	UA:TT
GM-76S	739.49	739.00	2	27	37	712.49	702.49	37	623538.7809	1485313.4176	UA:TT
GM-77S	741.49	741.14	2	33	43	708.49	698.49	43	621576.9342	1485892.0315	UA:TT
GM-78	721.58	721.18	2	40	50	681.58	671.58	70	618257.5787	1483035.5947	UA
GM-79	718.54	717.91	2	45	55	673.54	663.54	60	618970.9862	1481045.8893	UA:TT
GM-80	716.23	715.82	2	15	25	701.23	691.23	25	617951.2997	1480939.3277	UA:WT
GM-81	715.80	715.31	2	50	60	665.80	655.80	90	617934.8895	1480934.7439	UA
GM-83S	726.44	725.84	2	44	54	682.44	672.44	54	622568.7465	1482112.9569	UA:TT
RMW-89 ⁽⁴⁾	738.84	738.50	2	40.7	50.7	698.14	688.14	65	623394.9330	1484777.0130	UA
RMW-90 ⁽⁴⁾	727.44	727.05	2	43.5	53.5	683.94	673.94	100	623067.3300	1485313.5590	UA:TT
RMW-91 ⁽⁴⁾	723.16	725.50	2	48	53	675.16	670.16	57	620642.1340	1482814.1830	UA:WT
RMW-92 ⁽⁴⁾	723.37	725.92	2	26	36	697.37	687.37	38	620642.2440	1482803.2450	UA
RMW-93 ⁽⁴⁾	724.66	727.56	2	50	60	674.66	664.66	60	620378.8040	1482440.7050	UA:TT
RMW-94 ⁽⁴⁾	724.83	727.53	2	30	40	694.83	684.83	40	620379.9670	1482432.7020	UA
RMW-95 ⁽⁴⁾	716.01	715.33	2	6.3	21.3	709.71	694.71	22	619596.1990	1480976.9770	UA
RMW-96 ⁽⁴⁾	717.12	716.73	2	7.5	22.5	709.62	694.62	24	618973.8400	1481026.2050	UA
RMW-97 ⁽⁴⁾	714.84	714.21	2	9	24	705.84	690.84	24	618501.5300	1480934.2350	UA
PW-1S ⁽⁴⁾	736.18	735.76	2	36	51	700.18	685.18	54	622968.4670	1484992.4760	UA
PW-1D ⁽⁴⁾	736.18	735.81	2	51.5	56.5	684.68	679.68	60	622975.6010	1484993.9630	UA:TT
PW-2S/D ⁽⁴⁾	736.05	735.30	2	41	61	695.05	675.05	62.5	622929.6530	1484983.1820	UA:TT
PW-3S ⁽⁴⁾	736.13	735.75	2	36	41	700.13	695.13	70	622949.6170	1484987.7260	UA
PW-3D ⁽⁴⁾	736.13	735.79	2	47	57	689.13	679.13	70	622949.3510	1484987.8520	UA:TT
PW-4S ⁽⁴⁾	736.17	735.73	2	37	47	699.17	689.17	50	622964.5560	1484989.6620	UA
PW-4D ⁽⁴⁾	736.18	735.67	2	50	55	686.18	681.18	55	622971.9500	1484991.3960	UA:TT
PW-5S ⁽⁴⁾	735.99	735.52	2	39	49	696.99	686.99	63	622919.2550	1484979.0620	UA
PW-5D ⁽⁴⁾	735.99	735.62	2	56	61	679.99	674.99	63	622919.0190	1484979.3390	UA:TT
PW-6S ⁽⁴⁾	731.35	731.08	2	25	35	706.35	696.35	35	622831.4210	1484839.3060	UA
PW-6D ⁽⁴⁾	731.35	731.04	2	40	50	691.35	681.35	63.5	622837.3590	1484840.7790	UA:TT
EW-1 ⁽⁴⁾	724.95	726.97	8	40	60	684.95	664.95	63	620405.0250	1482238.8630	UA:TT
EW-2 ⁽⁴⁾	725.26	726.74	8	39.5	59.5	685.76	665.76	63	620369.7470	1482502.1140	UA:TT
EAST	NM	730.98	2	NA	NA	NA	NA	71	620545.6947	1483674.2190	UA:TT
WEST	NM	731.08	2	NA	NA	NA	NA	52	620509.6228	1483299.0985	UA:TT
WSU-17	726.93	726.18	2	11.69	66.9	715.24	659.28	67	619558.2279	1482898.5384	UA:TT
WSU-18	734.18	733.52	2	29.2	69.2	704.98	664.32	69	619554.9290	1483096.6469	UA:TT
WSU-19	727.28	726.62	2	33.4	63.4	693.88	663.22	63	619736.8872	1482880.3995	UA:TT

Table 2
Groundwater Well Construction Details
RACER Trust Moraine Facilities
Moraine, Ohio



Well	Surface Elevation	TOC Elevation	Well Diameter	Screened Interval				Borehole Depth	State Plane Coordinates		Geologic
	ft amsl	ft amsl	inches	ft bls	ft bls	ft amsl	ft amsl	ft bls	Northing, y	Easting, x	Modifiers
Upper Aquifer Wells											
WSU-22	726.21	726.49	2	NA	NA	NA	NA	52	620311.4363	1482687.2293	UA:TT
WSU-23	724.65	724.90	2	NA	NA	NA	NA	58	620381.0854	1481978.6336	UA:TT
WSU-24	725.10	724.82	2	NA	NA	NA	NA	66	619124.1425	1483169.1107	UA:TT
TW-2 ⁽²⁾	NM	733.38	10	35	45	696.00	686.00	45	619568.4036	1482942.6663	UA:TT
ME-2 ⁽⁵⁾	731.60	731.28	2	27	37	704.60	694.60	37	621327.2669	1484014.6258	UA:WT
ME-3 ⁽⁵⁾	732.23	731.73	2	29	39	703.23	693.23	39	621288.3532	1483969.5620	UA:WT
ME-4 ⁽⁵⁾	732.05	732.24	2	26	36	706.05	696.05	36	621321.4422	1483952.3693	UA:WT
ME-6 ⁽⁵⁾	733.09	732.68	2	29	39	704.09	694.09	39	621706.9517	1484057.0461	UA:WT
MW-1 ⁽⁷⁾	713.60	715.53	2	61.2	71.2	652.40	642.40	71.7	621420.6144	1480209.1127	UA:TT
MW-4 ⁽⁷⁾	707.45	707.19	2	19.6	39.6	687.85	667.85	40	619035.3250	1478050.0733	UA
MW-5 ⁽⁷⁾	709.59	709.34	2	22.5	42.5	687.09	667.09	43	618787.9839	1478971.6197	UA
MW-9 ⁽⁷⁾	713.16	712.85	2	63	73	650.16	640.16	73.5	617169.4849	1478747.1452	UA
GM-1	NM	735.74	2	90	100	NA	NA	100	619570.7118	1483421.8130	LA
GM-3	NM	730.44	2	90	100	NA	NA	100	619621.9727	1482926.3542	LA
GM-4	NM	731.46	2	140	150	NA	NA	150	619602.7099	1482922.7333	LA
GM-5	NM	731.29	2	90	100	NA	NA	100	619588.6213	1483126.6107	LA
GM-7R	NM	735.61	2	80	90	NA	NA	91	619863.8298	1482962.1340	LA
GM-9	NM	724.07	2	90	100	NA	NA	100	618771.8670	1482674.1902	LA
GM-11	NM	723.71	2	90	100	NA	NA	100	619318.6270	1482694.0524	LA

Table 2
Groundwater Well Construction Details
RACER Trust Moraine Facilities
Moraine, Ohio



Well	Surface Elevation	TOC Elevation	Well Diameter	Screened Interval				Borehole Depth	State Plane Coordinates		Geologic Modifiers
	ft amsl	ft amsl		ft bls	ft bls	ft amsl	ft amsl		ft bls	Northing, y	
Lower Aquifer Wells											
GM-13	NM	723.82	2	90	100	NA	NA	100	619239.1943	1482501.6168	LA
GM-14	NM	723.50	2	140	150	NA	NA	150	619244.0886	1482515.5184	LA
GM-15	NM	725.23	2	90	100	NA	NA	100	619427.7004	1482156.5128	LA
GM-19D	727.90	729.40	4	145	150	NA	NA	150	620339.8625	1483063.5273	LA
GM-20D	NM	727.26	4	87	92	NA	NA	92	619177.7271	1483236.8889	LA
GM-39	731.15	730.95	2	106	116	625.15	615.15	116	623705.5364	1484609.0626	LA
GM-40	727.28	727.04	2	140	150	587.28	577.28	150	621693.8055	1483084.8121	LA
GM-41	731.22	733.65	2	104	114	627.22	617.22	114	621635.7801	1484818.4021	LA
GM-42	729.48	729.16	2	140	150	589.48	579.48	150	620810.1968	1483562.5296	LA
GM-54	730.51	730.29	2	70	80	660.51	650.51	80	621182.1891	1484848.6752	LA
GM-56	719.75	719.52	2	75	85	644.75	634.75	85	618006.1752	1482448.5647	LA:NTP
GM-58	735.59	735.46	2	72	82	663.59	653.59	82	621541.9882	1485308.7468	LA:BT
GM-61	732.48	732.23	2	70	80	662.48	652.48	80	622762.6947	1484707.4691	LA:BT
GM-65D	723.83	723.54	2	85	95	638.83	628.83	108	617389.5183	1481380.4746	LA:NTP
GM-67D	731.93	731.45	2	70	80	661.93	651.93	121	623053.5624	1484533.4779	LA:BT
GM-68D	732.46	732.27	2	64	74	668.46	658.46	150	622327.5383	1484645.8862	LA:BT
GM-69	732.42	732.08	2	90	100	642.42	632.42	140	621314.8199	1484401.6371	LA
GM-70	737.47	737.19	2	72	82	665.47	655.47	120	621944.0370	1485505.8829	LA
GM-73	737.34	736.97	2	85	95	652.34	642.34	120	622635.9765	1485216.5022	LA
GM-74D	732.49	732.04	2	69	79	663.49	653.49	120	622450.0123	1484735.6502	LA:BT
GM-75D	738.13	737.68	2	85	95	653.13	643.13	120	622793.2406	1485027.5873	LA
GM-76D	739.48	738.94	2	70	80	669.48	659.48	120	623535.2043	1485312.4245	LA:BT
GM-77D	741.52	740.93	2	75	85	666.52	656.52	100	621574.4283	1485889.3662	LA:BT
GM-82	732.55	732.14	2	85	95	647.55	637.55	119.5	621972.7146	1484304.7894	LA
GM-83D	726.41	725.77	2	110	120	616.41	606.41	120	622568.1953	1482120.4685	LA
GM-84	740.44	739.92	2	96.5	106.5	643.94	633.94	120	620619.4561	1485522.1487	LA:BT
RMW-85 ⁽⁸⁾	736.28	736.65	2	85	95	651.28	641.28	105	622914.0083	1484978.1674	LA
RMW-86 ⁽⁸⁾	728.85	729.22	2	70	80	658.85	648.85	105	620409.7071	1483253.2715	LA:BT
RMW-87 ⁽⁸⁾	727.69	728.01	2	67	77	660.69	650.69	100	621671.6198	1483277.4116	LA:BT
RMW-88 ⁽⁴⁾	738.42	738.25	2	90	100	648.42	638.42	100	625051.9881	1484580.6683	LA

Table 2
Groundwater Well Construction Details
RACER Trust Moraine Facilities
Moraine, Ohio

Well	Surface Elevation	TOC Elevation	Well Diameter	Screened Interval				Borehole Depth	State Plane Coordinates		Geologic
	ft amsl	ft amsl	inches	ft bls	ft bls	ft amsl	ft amsl	ft bls	Northing, y	Easting, x	Modifiers
Lower Aquifer Wells											
HR-12	741.00	742.64	4	120	130	621.00	611.00	130	625702.3993	1485250.0490	LA
HR-13	733.20	735.03	4	75	85	658.20	648.20	85	623616.8315	1484215.3411	LA:BT
HR-14	729.90	731.63	4	78	88	651.90	641.90	88	623675.4267	1483782.2839	LA
HR-15	732.10	733.74	4	88	98	644.10	634.10	98	623712.7941	1483595.9072	LA
M73C	NM	716.55	NA	NA	NA	NA	NA	NA	618973.2537	1482114.3309	LA
MT69 ⁽⁹⁾	719.84	722.71	8	NA	NA	NA	NA	158	617749.1907	1482121.3945	LA
MT576M	750.00	751.46	5	NA	NA	NA	NA	114	622940.2909	1487799.4686	LA
MT596M ⁽¹⁰⁾	759.18	757.73	5	NA	NA	NA	NA	89	624057.1091	1488849.1418	LA
DN-13	724.09	727.54	20	110	170	614.09	554.09	170	619196.1959	1482267.5426	LA
11B	744.50	742.56	NA	NA	NA	NA	NA	158	622501.4801	1485799.6814	LA
A	NM	739.00	20	155	205	NA	NA	205	624325.4108	1484805.7949	LA
31	NM	734.05	20	90	122	NA	NA	122	623727.4107	1485049.2752	LA
34	NM	733.46	20	107	140	NA	NA	140	622178.4664	1485017.7925	LA
39	NM	732.07	20	117	142	NA	NA	145	623442.4628	1484987.5777	LA
44	733.91	734.62	24	128	166	605.91	567.91	NA	624519.7322	1483988.8824	LA
FW-1A	NM	739.89	24	105	166	NA	NA	169	625357.5160	1486090.3366	LA
FW-2	NM	737.48	20	NA	150	NA	NA	160	622516.4369	1485616.6642	LA
FW-3	NM	739.26	20	NA	141	NA	NA	200	622675.0394	1484968.9430	LA
FW-4	NM	731.62	14	NA	136	NA	NA	160	620605.0473	1484338.1137	LA

NOTES:

Survey of all well coordinates were originally to a site-specific coordinate system in feet with the vertical datum as the National Geodetic Vertical Datum of 1929 (NGVD 29) using an on-site benchmark. Base map and well coordinates were converted in 2011 to the Ohio South State Plane Coordinate system North American Datum of 1983 (NAD 83) and NGVD 29 was retained as the vertical datum.

TOC - Top of Casing.

ft amsl - feet above mean sea level.

ft bls - feet below land surface.

(1) - Ground surface elevation estimated based on a 2-foot height of outer casing stick-up.

(2) - Elevations estimated.

(3) - Well flush mount damaged and obstructed at depth.

(4) - Wells installed after 2011 are surveyed to the Ohio South State Plan coordinate system and the North American Vertical Datum of 1988 (NAVD 88).

(5) - Depth of screened interval and total well depth have been modified from the well log due to site construction.

(6) - Well above grade construction damaged in 2011.

(7) - City of Moraine Monitoring Wells.

(8) - TOC elevation is calculated based on adjacent well elevations and field measurements on November 26, 2012.

(9) - Well unusable - collapsed screen.

(10) - Measuring point is top of cement housing.

BT - Below Till (regional clay till).

LA - Lower Aquifer.

NA - Not Available.

NM - Not Measured.

NTP - No Till Present.

TT - Top of Till (regional clay till).

TUT - Top of Upper Till (upper clay till).

UA - Upper Aquifer.

WT - Water Table (screened across the water table interface).

Table 3
Bench Scale Analytical Results
RACER Trust Moraine Facilities
Moraine, Ohio



	Units	Well Location Purge Volume Detection Limits	EW-2 1,000 gallons 9/25/2017	EW-2 10,000 gallons 9/25/2017	EW-1 Post-Constant Rate Test 9/29/2017
pH Value		NA	7.41	7.43	7.63
Phenolphthalein Alkalinity*	mg/L	4.0	ND	ND	ND
Total Alkalinity*	mg/L	4.0	408	392	392
Hydroxide Alkalinity	mg/L	4.0	ND	ND	ND
Carbonate Alkalinity	mg/L	4.0	ND	ND	ND
Bicarbonate Alkalinity	mg/L	4.0	408	392	392
Total Dissolved Solids	mg/L	1.0	846	840	836
Conductivity	um or uS/cm	NA	1,175	1,167	1,161
ORP	mV	NA	184.1	183.0	170.7
Langelier Saturation Index ⁽¹⁾ (at 16°C)		NA	0.34	0.33	0.50
Total Hardness*	mg/L	4.0	452	428	408
Carbonate Hardness	mg/L	4.0	408	392	392
Non Carbonate Hardness	mg/L	4.0	44	36	16
Calcium*	mg/L	4.0	300	288	272
Magnesium*	mg/L	4.0	152	140	136
Sodium (as Na)	mg/L	0.02	104	103	95.8
Potassium (as K)	mg/L	0.1	3.1	3.1	2.3
Phosphate (as PO4)	mg/L	0.06	ND	0.06	0.09
Chlorides (as Cl)	mg/L	2.0	155.6	149.6	140.8
Nitrate (Nitrogen)	mg/L	0.3	4.1	4	4.1
Chlorine (as Cl)	mg/L	0.02	ND	ND	ND
Dissolved Iron (as Fe2+)	mg/L	0.02	ND	ND	ND
Suspended Iron (as Fe3+)	mg/L	0.02	ND	ND	0.02
Iron Total (as Fe)	mg/L	0.0	ND	ND	0.02
Iron (resuspended)	mg/L	0.02	0.23	0.14	1.81
Copper (as Cu)	mg/L	0.04	ND	ND	ND
Manganese (as Mn)	mg/L	0.1	ND	ND	ND
Sulfate (as SO4)	mg/L	2.0	70	69	67
Silica (as SiO2)	mg/L	1.0	14.8	15.4	15.8
Tannin/Lignin	mg/L	0.1	0.1	0.1	0.1
Total Organic Carbon (C)	mg/L	0.0	0	0.4	1
Plate Count	colonies/mL	NA	>1,500	>1,500	>1,500
Anaerobic Growth	%	NA	50	10	50
Sulfate Reducing Bacteria	NA	NA	Positive	Negative	Positive
SRB Occurrence	NA	NA	Excessive	NA	Excessive
Fe/Mn Oxidizing Bacteria	NA	NA	Negative	Negative	Negative
ATP Initial	cells/mL	NA	364,000	208,000	1.5 Million
ATP 24 Hour	cells/mL	NA	392,000	297,000	1.6 Million
Bacterial Identification		NA	Aeromonas jandaei	Bacillus subtilis	Aeromonas baumannii
Bacterial Identification		NA	Pseudomonas stutzeri	Pseudomonas aeruginosa	ND
Bacterial Identification		NA	Bacillus specie	ND	ND

NOTES:

* as CaCO₃

(1) Langelier Saturation Index = measure of the corrosivity of water (nonaggressive >0.0, moderately aggressive -2.0 to 0.0, highly aggressive <-2.0)

% = percent

°C = degrees celsius

> = greater than

Field Parameters = pH, conductivity and temperature

ATP = adenosine triphosphate

mg/L = milligrams per liter

mL = milliliters

mmol/L = millimoles per liter

uS/cm = microsiemens per centimeter

NA = not applicable

ND = not detected

ORP = oxidation-reduction potential

SRB = sulfate reducing bacteria

Table 4
Vertical Hydraulic Gradients for Shallow/Deep Upper Aquifer Well Pairs
RACER Trust Moraine Facilities
Moraine, Ohio

Vertical Gradients			
DGR™ Pilot Test Wells	Direction	Gradient (ft./ft.)	Distance and Direction from EW-2
<u>Baseline</u>			
RMW-92/RMW-91	U	3.1E-03	465 ft. upgradient
RMW-94/RMW-93	D	-1.5E-03	67 ft. side gradient
GM-63/GM-64	D	-1.0E-03	220 ft. downgradient
GM-50/GM-47	D	-7.3E-03	350 ft. downgradient
<u>EW-2 Constant Rate Test</u>			
RMW-92/RMW-91	U	3.6E-03	465 ft. upgradient
RMW-94/RMW-93	D	-2.5E-03	67 ft. side gradient
GM-63/GM-64	D	-2.0E-03	220 ft. downgradient
GM-50/GM-47	D	-9.8E-03	350 ft. downgradient

NOTES:

Well pairs listed as: shallow monitoring well / deep monitoring well within the upper aquifer.

D - Downward gradient (-).

ft. - feet.

U - Upward gradient (+).

Table 5
Hydraulic Parameter Results
RACER Trust Moraine Facilities
Moraine, Ohio

Observation Well	Distance from Pumping Well	Boring Diameter (inches)	Casing Diameter (inches)	Top of Screen (ft-bgs)	Top of Screen (ft-amsl)	Bottom of Screen (ft-bgs)	Bottom of Screen (ft-amsl)	Screen Length (ft)	Slot Size (slot)	T (ft ² /day)	K (ft/day)	S	Sy	β	Kz/Kr ¹	Solution
2017 Phase I DGR™ Pilot Test Results																
RMW-93	62.9	8.25	2	50	674.66	60	664.66	10	10	130,000	3,250	4.0E-03	0.20	0.06	0.02	Moench
RMW-94	71.2	8.25	2	30	694.83	40	684.83	10	10	105,000	2,625	2.0E-03	0.10	0.02	0.01	Moench
W-4-S ⁴	51.0	8.25	4	30	696.66	70	656.66	40	10	115,000	2,875	4.0E-03	0.15	0.02	0.01	Moench
Combined Analysis										120,000	3,000	5.0E-03	0.20		0.01	Moench
1989 TW-2 Pumping Test Results²																
WSU-17	93.0		2	12		67		55		38,880	2,008	1.0E-02	0.065	0.50	0.02	Neuman
GM-6	52.0		4	35	696 ³	45	686 ³	10		30,240	1,562	1.2E-02	0.075	0.37	0.05	Neuman
Minimum										30,240	1,562	2.0E-03	0.065	0.02	0.01	
Maximum										130,000	3,250	1.2E-02	0.20	0.50	0.05	
Geometric Mean										77,783	2,477	5.2E-03	0.12	0.08	0.02	

NOTES:

¹ Kz/Kr values calculated from equation: $\beta = (r^2 K_z) / (b^2 K_r)$

² Results from A Technical Memorandum, Data Analysis and Evaluation of Aquifer Tests, Harrison Radiator Facility, Moraine, OH (Geraghty and Miller, 1990)

³ Elevations estimated

⁴ The effective bottom depth of the well screen is 60' bgs.

ft = feet

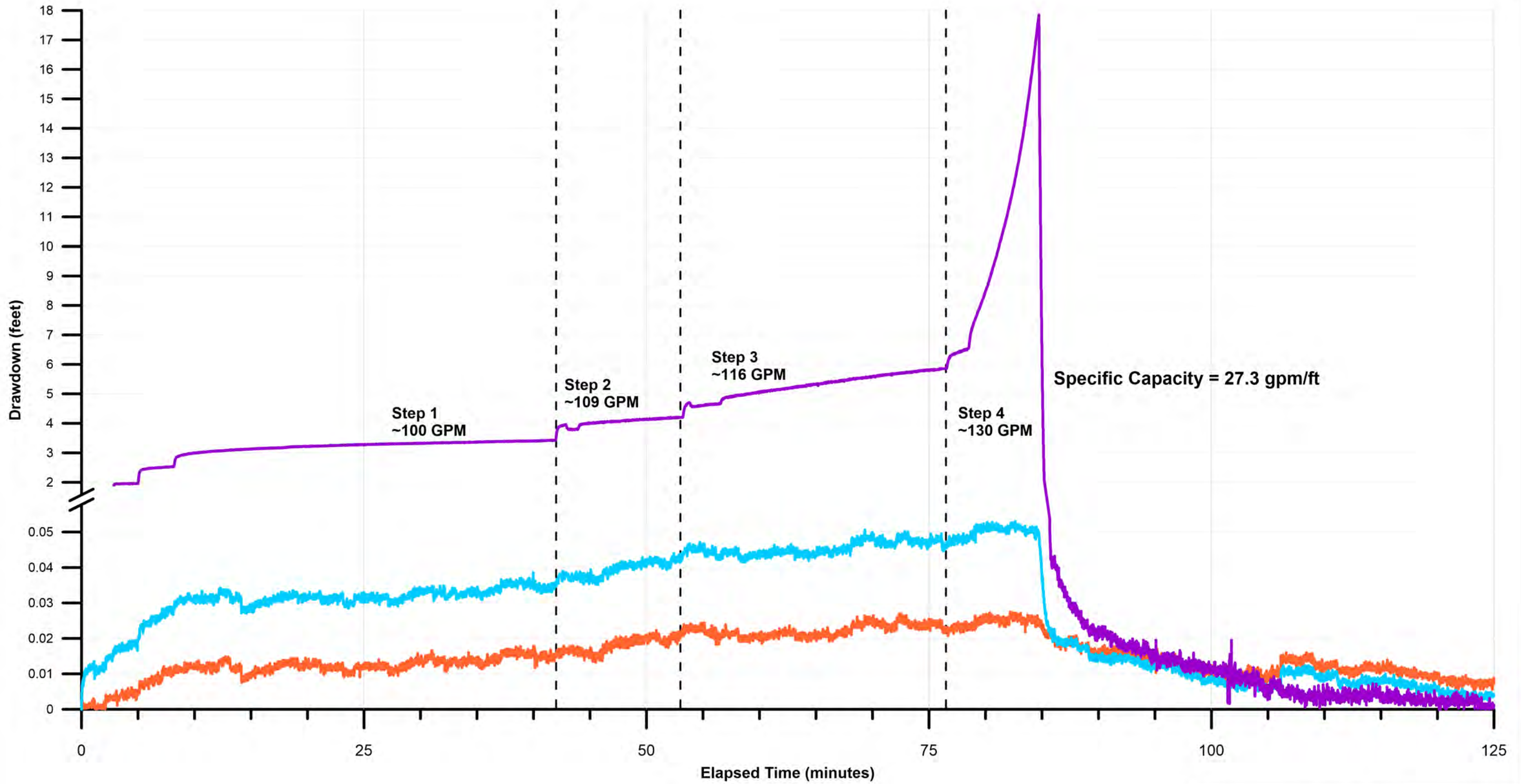
bgs = below ground surface

amsl = above mean sea level

grey cell = not applicable or not available

FIGURES



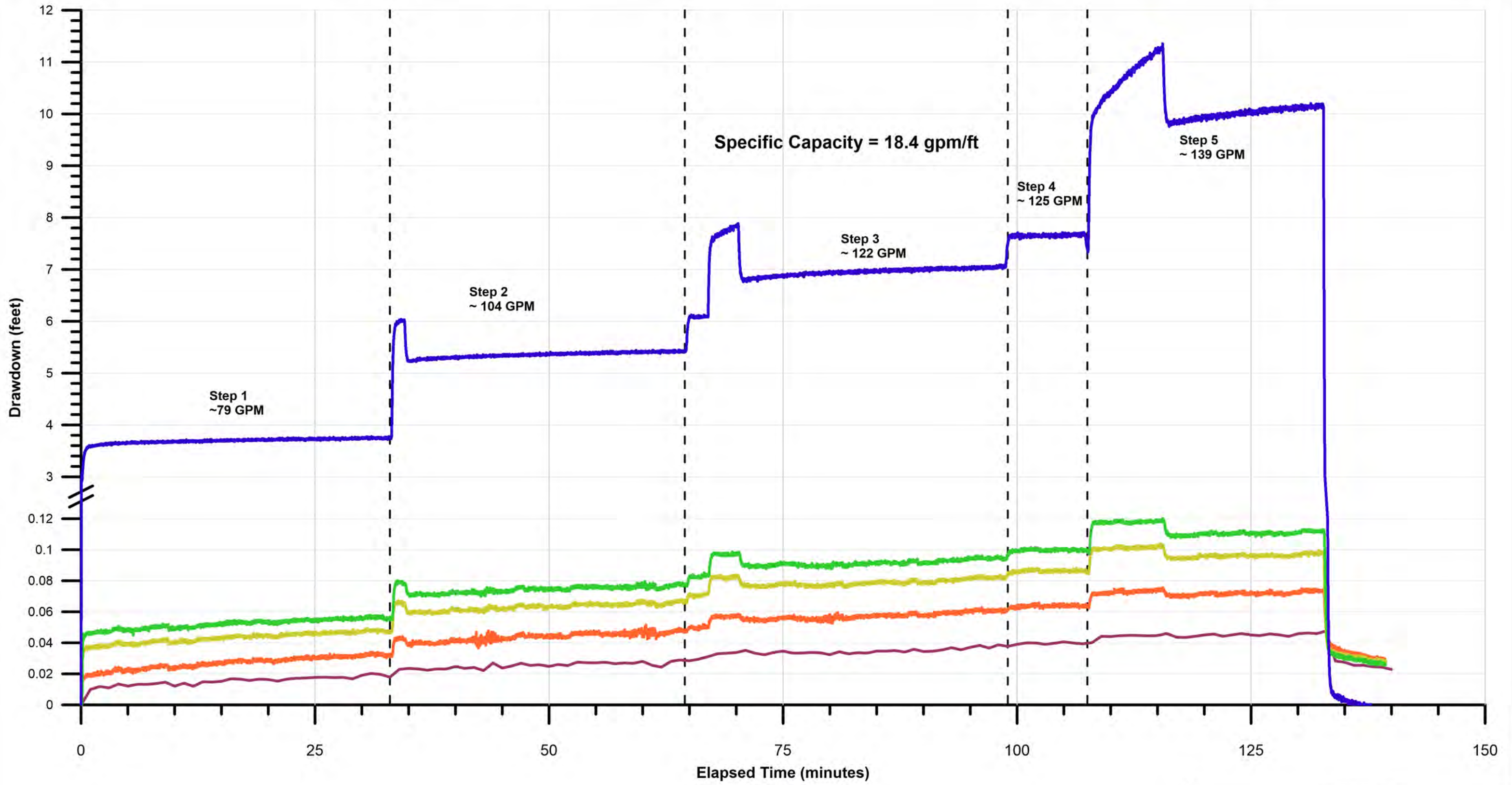


Notes:

1. Average flow rates determined from totalizer readings during each step
2. Specific capacity calculated from average flow rate and final drawdown value from each step
3. Step 3 and 4 not used in specific capacity calculation

- EW-1 Drawdown: Pumping Well
- W-3-S Drawdown: 53 feet from EW-1
- RMW-94 Drawdown: 193 feet from EW-1

RACER TRUST MORaine, OHIO OH000294.2018	
EW-1 Step Test	
 ARCADIS <small>Design & Consultancy for natural and built assets</small>	<small>FIGURE</small> 3

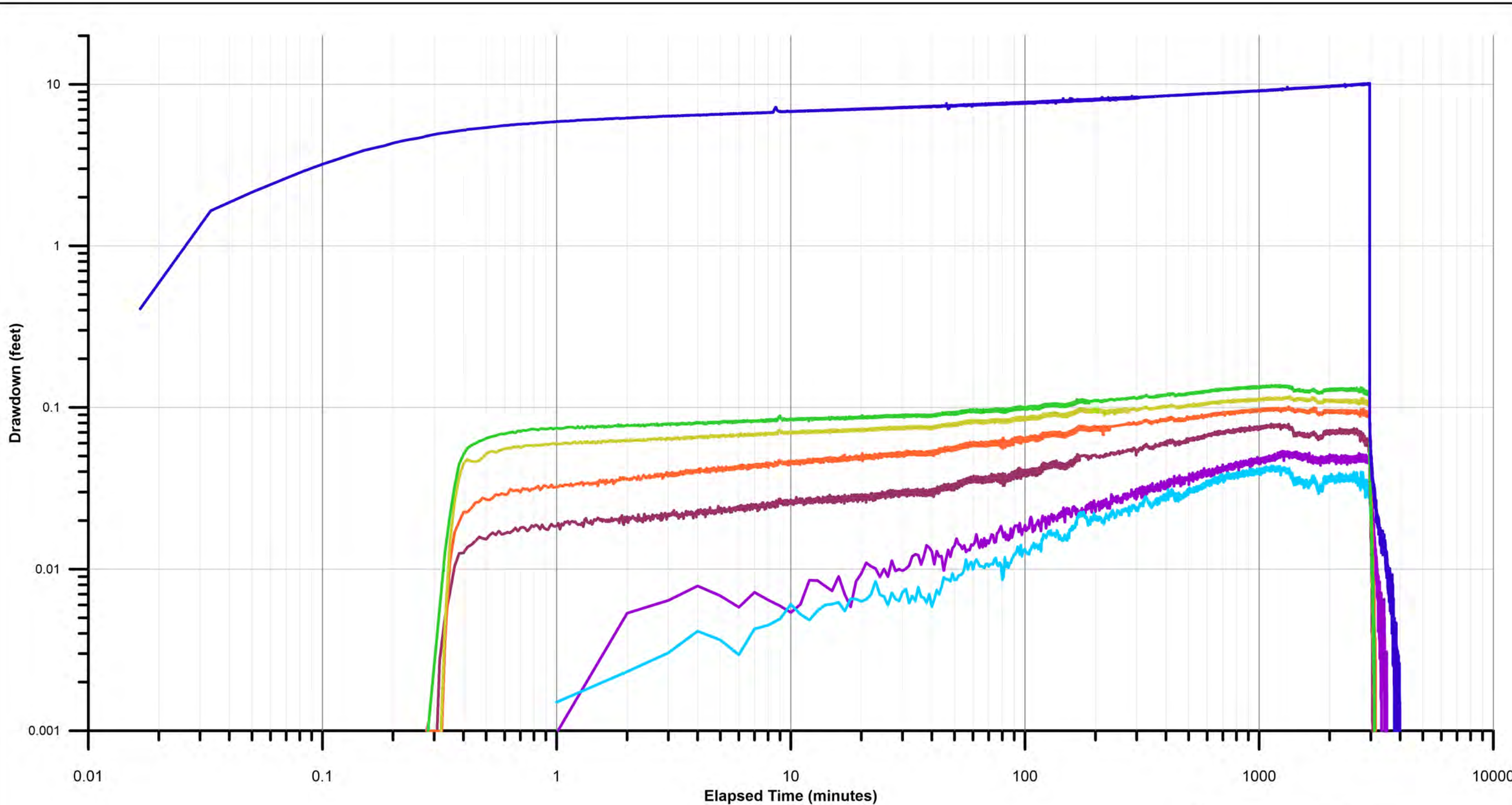


Notes:

1. Average flow rates determined from totalizer readings during each step
2. Specific capacity calculated from average flow rate and final drawdown value from each step
3. Step 5 not used in specific capacity calculation

- EW-2 Drawdown: Pumping Well
- W-4-S Drawdown: 51 feet from EW-2
- RMW-93 Drawdown: 63 feet from EW-2
- RMW-94 Drawdown: 71 feet from EW-2
- RZ-4I Drawdown: 132 feet from EW-2

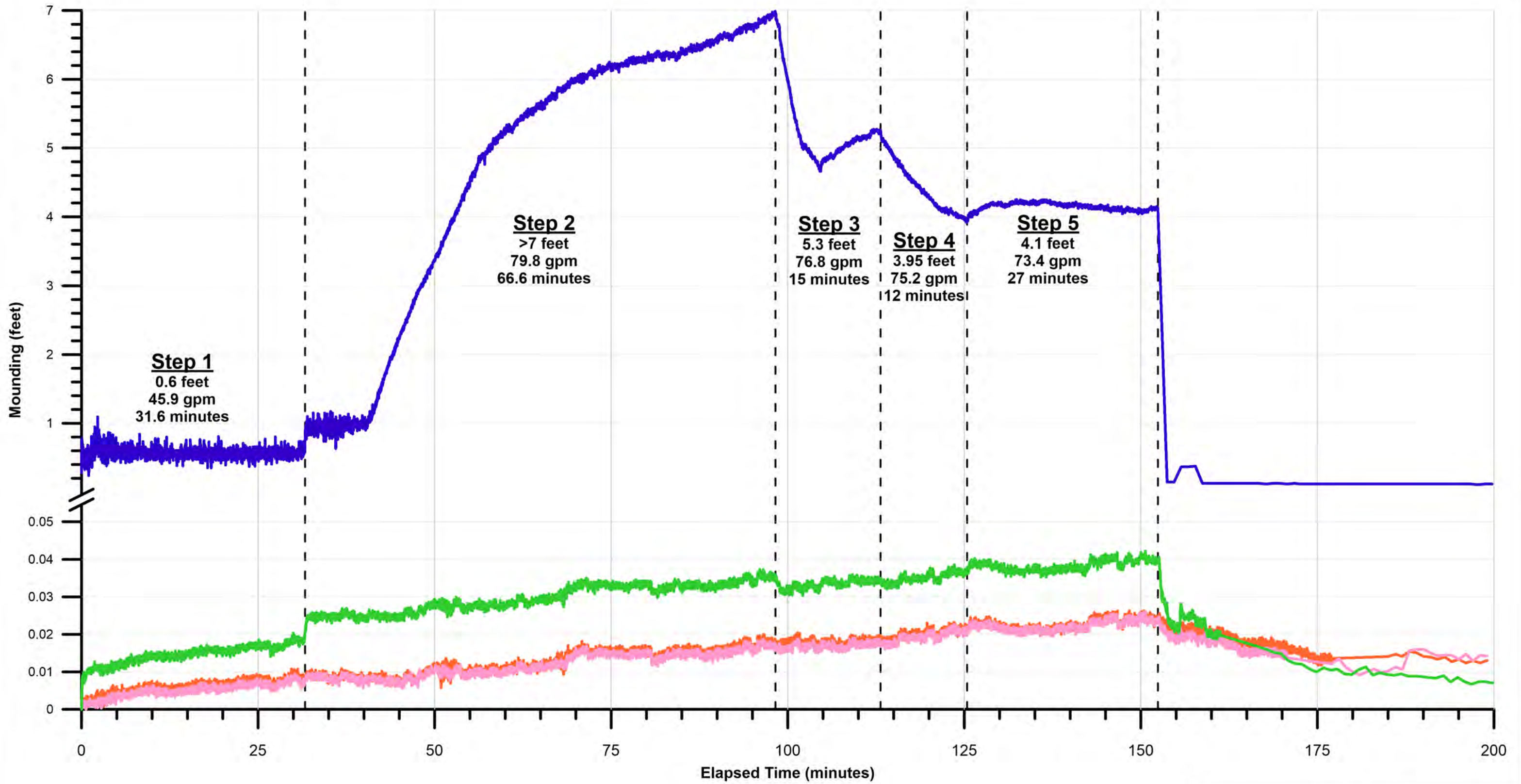
RACER TRUST MORAINE, OHIO OH000294.2018	
EW-2 Step Test	
ARCADIS <small>Design & Consultancy for natural and built assets</small>	FIGURE 4



Notes:
 1. Average flow rate of 126 gpm.
 2. A declining background trend was present during the testing period.
 The trend was removed prior to analysis.

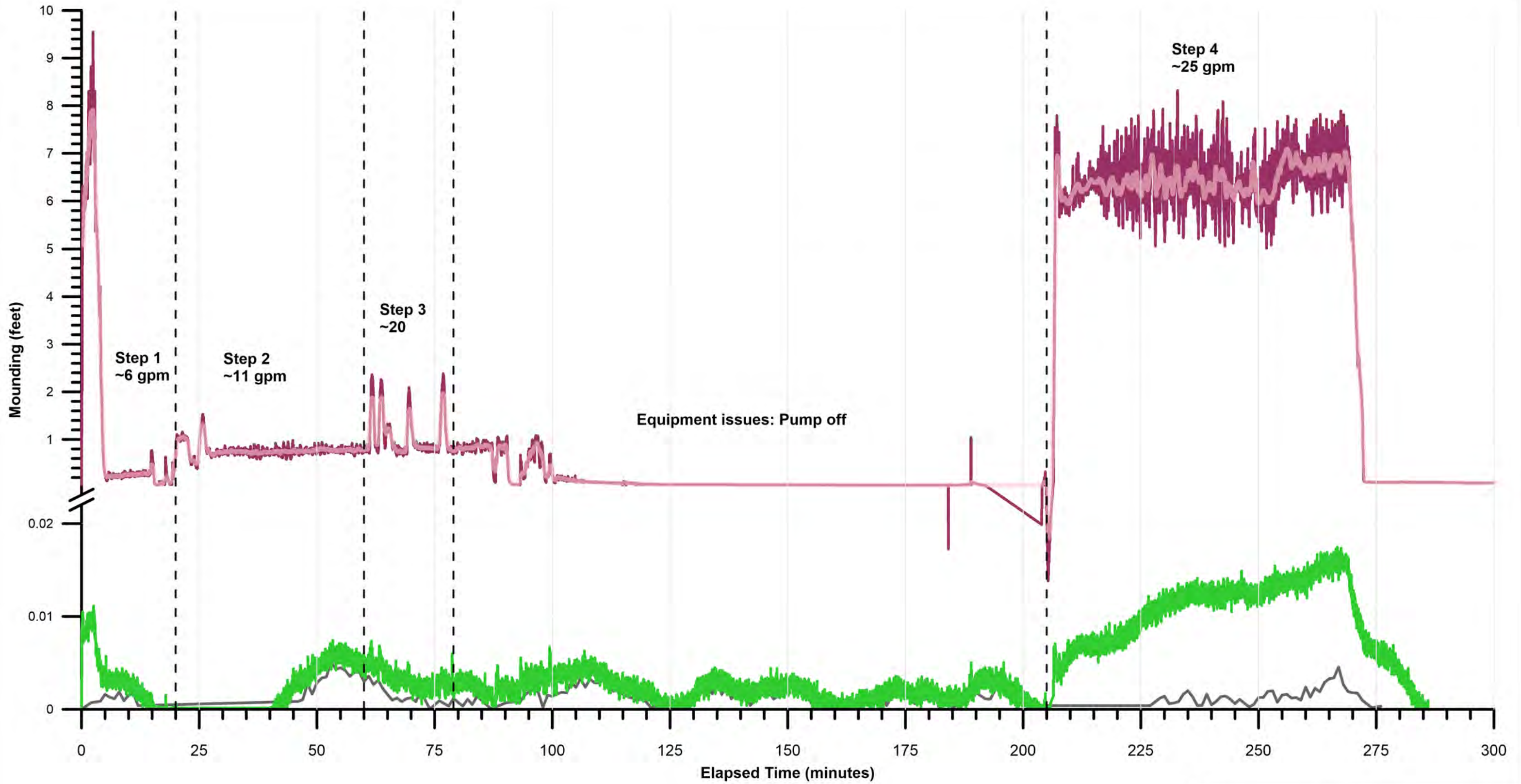
- EW-2 Drawdown: Pumping Well
- W-4-S Drawdown: 51 feet from EW-2
- RMW-93 Drawdown: 63 feet from EW-2
- RMW-94 Drawdown: 71 feet from EW-2
- RZ-4I Drawdown: 132 feet from EW-2
- W-3-S Drawdown: 249 feet from EW-2
- EW-1 Drawdown: 250 feet from EW-2

RACER TRUST MORAINÉ, OHIO OH000294.2018
EW-2 Constant Rate Test
<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="text-align: center;"> ARCADIS <small>Design & Consultancy for natural and built assets</small> </div> <div style="text-align: right;"> <small>FIGURE</small> 5 </div> </div>



- EW-1: Injection Well
- W-3-S Mounding: 53 feet from EW-1
- RMW-94 Mounding: 193 feet from EW-1
- RMW-93 Mounding: 199 feet from EW-1

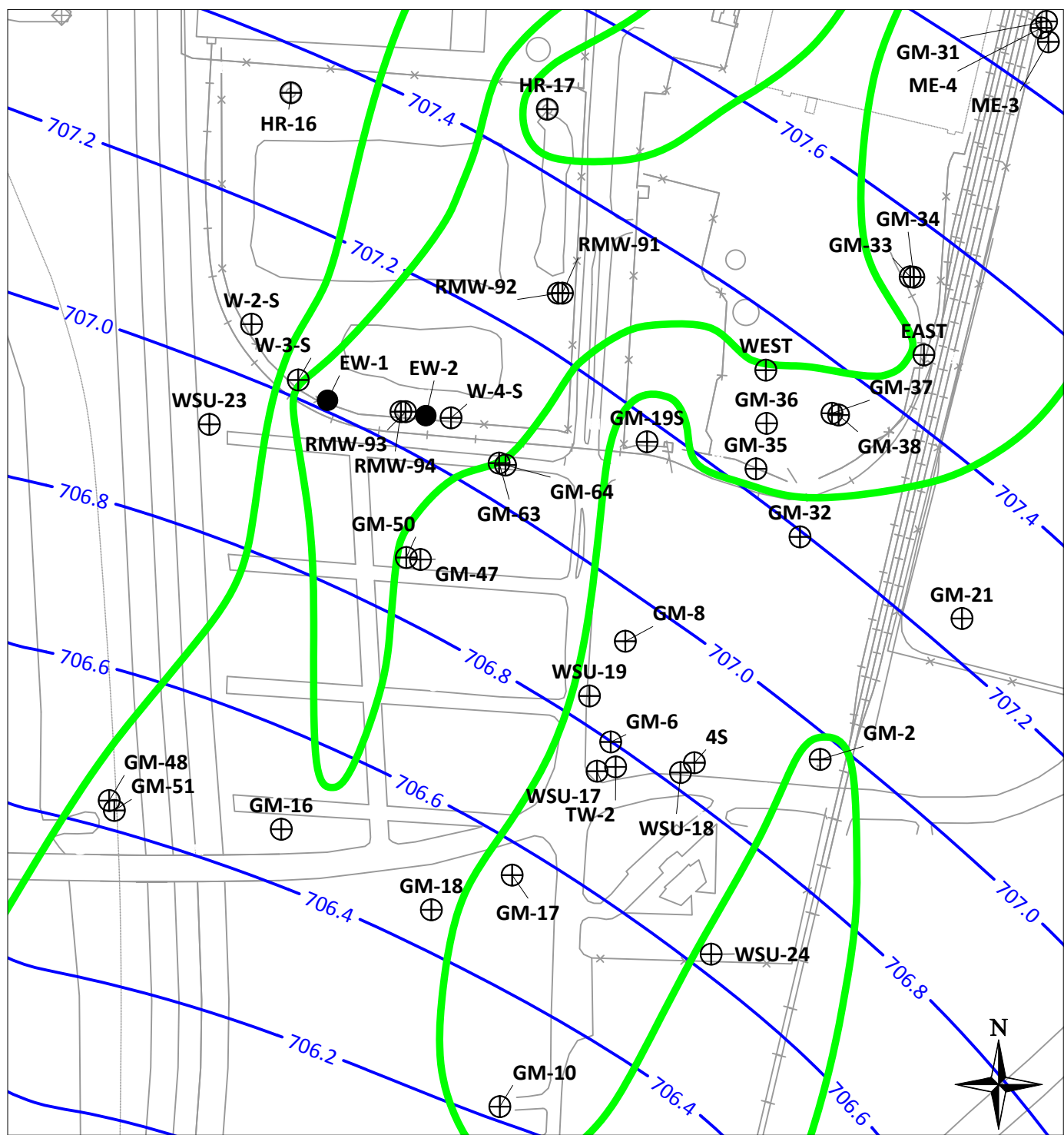
RACER TRUST MORaine, OHIO OH000294.2018
<h3>EW-1 Injection Test</h3>
<div style="display: flex; align-items: center;"> Design & Consultancy for natural and built assets </div> <div style="text-align: right; font-weight: bold; font-size: 12px;">FIGURE 6</div>



Notes:
 1. Plotted RZ-4I moving average to show overall trend and minimize inherent noise.

- RZ-4I: Injection Well
- W-4-S Mounding: 67 feet from RZ-4I
- GM-16 Background Well: 1020 feet from RZ-4I
- RZ-4I Moving Average

RACER TRUST MORaine, OHIO OH000294.2018	
RZ-4I Injection Test	
ARCADIS <small>Design & Consultancy for natural and built assets</small>	FIGURE 7



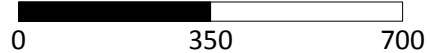
LEGEND

- ⊕ Monitoring Well (Upper Aquifer)
- Extraction Well (Upper Aquifer)
- 2016 PCE Plume
- 700 — Simulated Water Level (ft NGVD88)

Well Rates (gpm)

EW-1	0
EW-2	0

SCALE (FT)



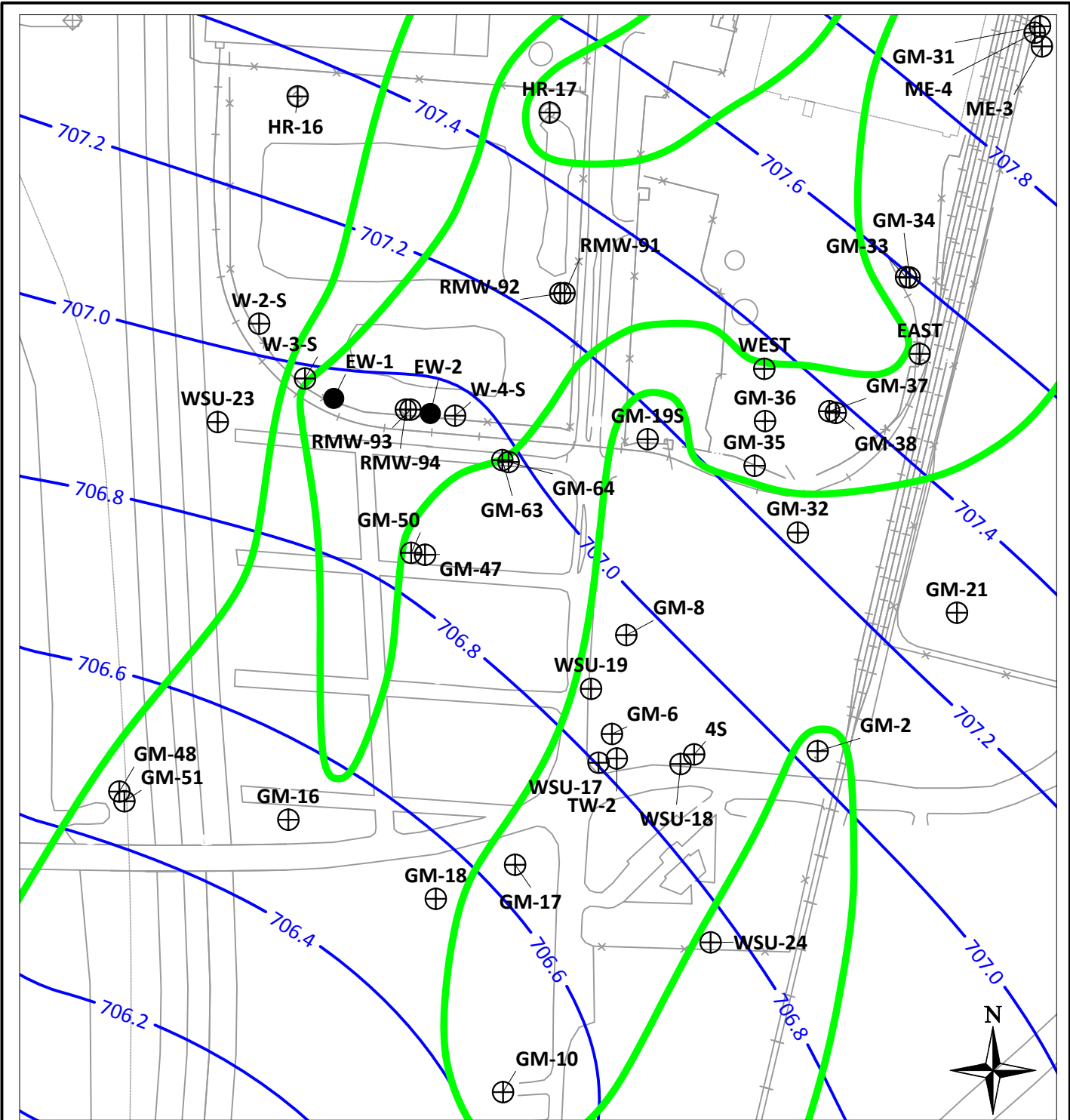
RACER TRUST
MORaine, OH
OH000294.2018.0003E

**UPPER AQUIFER GROUNDWATER
CONTOUR MAP - BASELINE CONDITIONS -
SIMULATED**



FIGURE

9



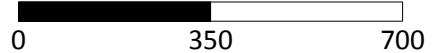
LEGEND

- ⊕ Monitoring Well (Upper Aquifer)
- Extraction Well (Upper Aquifer)
- 2016 PCE Plume
- 700 — Simulated Water Level (ft NGVD88)

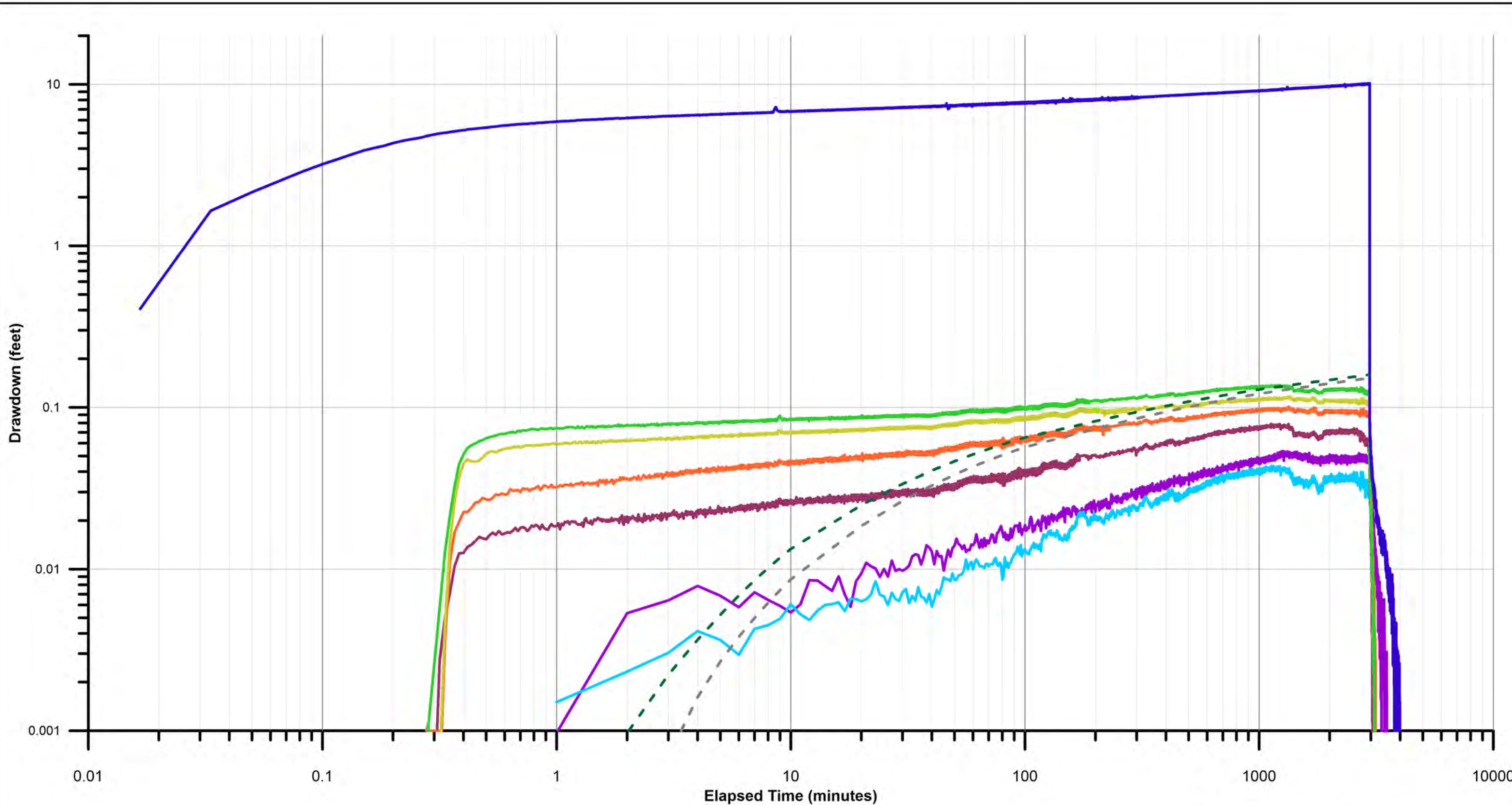
Well Rates (gpm)

EW-1 0
 EW-2 -126

SCALE (FT)



RACER TRUST MORaine, OH OH000294.2018.0003E	
UPPER AQUIFER GROUNDWATER CONTOUR MAP - CONSTANT RATE TEST CONDITIONS - SIMULATED	
	Design & Consultancy for natural and built assets
FIGURE 10	

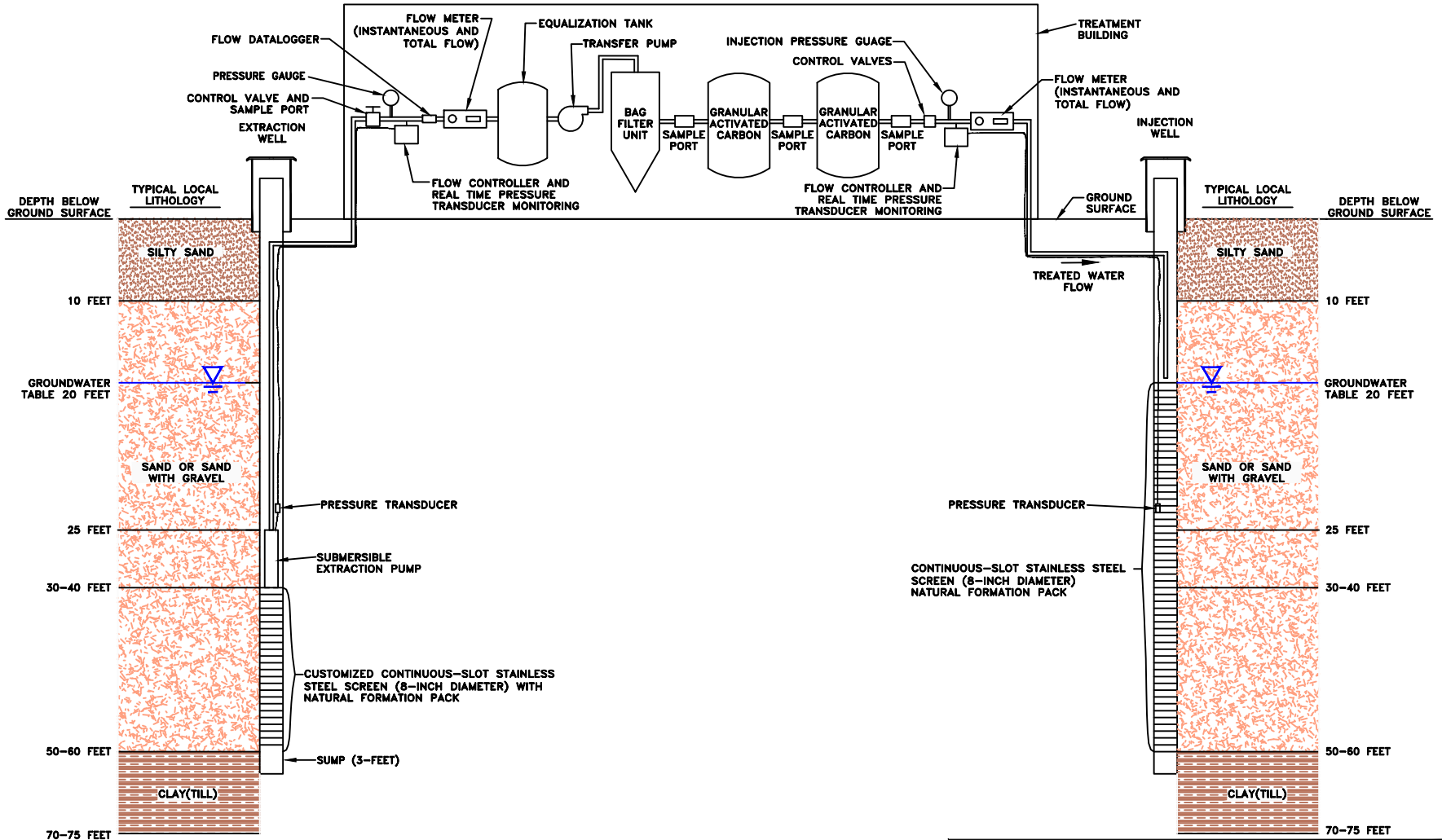


Notes:
 1. Average flow rate of 126 gpm.
 2. A declining background trend was present during the testing period. The trend was removed prior to analysis.


- EW-2 Drawdown: Pumping Well
- W-4-S Drawdown: 51 feet from EW-2
- RMW-93 Drawdown: 63 feet from EW-2
- RMW-94 Drawdown: 71 feet from EW-2
- RZ-4I Drawdown: 132 feet from EW-2
- W-3-S Drawdown: 249 feet from EW-2
- EW-1 Drawdown: 250 feet from EW-2
- - Model Output: RMW-93 Drawdown: 63 ft from EW-2
- - Model Output: Test Well Drawdown: 100 ft from EW-2

RACER TRUST MORAINE, OHIO OH000294.2018	
EW-2 Constant Rate Test Model Verification	
ARCADIS <small>Design & Consultancy for natural and built assets</small>	FIGURE 11

XREFS: IMAGES: PROJECTNAME: ---



NOT TO SCALE

RACER TRUST MORaine, OHIO OH000294.2018.0003E	
WELL AND TREATMENT SYSTEM DESIGN (Typ.)	
 Design & Consultancy for industrial and built assets	FIGURE 13

Notes:

The well construction and treatment system design details are typical. Modifications may be made based on field observations.

APPENDIX A

Boring Logs and Well Construction Logs



BORING/WELL CONSTRUCTION LOG



WELL NO.: **EW-1**

TOTAL DEPTH: **63** feet bls

PROJECT INFORMATION

CLIENT: **RACER Trust**
SITE LOCATION: **Moraine**
CITY, STATE: **Moraine, Ohio**
PROJECT NUMBER: **OH000294.2017**
LOGGED BY: **Kari Eldridge**
DATE STARTED: **08/24/2017**
DATE COMPLETED: **08/24/2017**

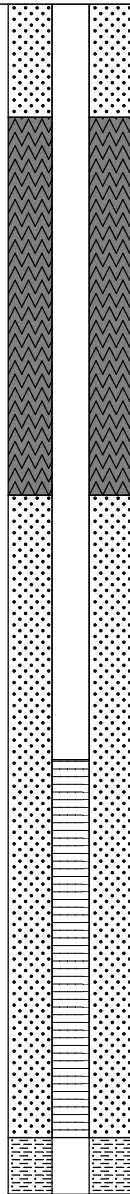
DRILLING INFORMATION

DRILLING CO.: **Layne**
DRILLER: **Tim Woods**
DRILLING METHOD: **Hollow Stem Auger - CME 95**
GROUND ELEVATION: **724.9 feet AMSL**
NORTHING: **620405.0**
EASTING: **1482238.9**

DEPTH
(feet)

WELL CONSTRUCTION DETAILS

0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
60
62
64



Sand
(0 to 6 ft)

8" PVC Sch 80 Casing
(0 to 40 ft)

Portland Cement
(6 to 26 ft)

Parry No. 4
(26 to 63 ft)

8" Stainless Steel Screen slot size 0.06
(40 to 60 ft)

Well Sump
(60 to 63 ft)
Clay Till
(60 to 63 ft)

Notes:

bls: below land surface
in.: inch
s.u.: Standard Unit

AMSL: Above Mean Sea Level
TOC: Top of Casing
USCS: Unified Soil Classification System
NM: Not Measured

ppm: parts per million
PID: Photo-ionization Detector
ft: feet

Date: 4/18/2018
Page: 1 of 1

BORING/WELL CONSTRUCTION LOG



WELL NO.: **EW-2**

TOTAL DEPTH: **62.5** feet bls

PROJECT INFORMATION

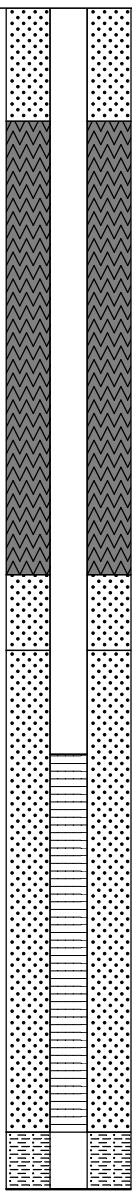
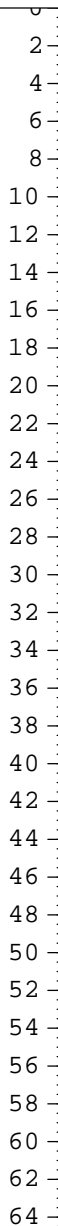
CLIENT: **RACER Trust**
SITE LOCATION: **Moraine**
CITY, STATE: **Moraine, Ohio**
PROJECT NUMBER: **OH000294.2017**
LOGGED BY: **Kari Eldridge**
DATE STARTED: **08/22/2017**
DATE COMPLETED: **08/22/2017**

DRILLING INFORMATION

DRILLING CO.: **Layne**
DRILLER: **Tim Woods**
DRILLING METHOD: **Hollow Stem Auger - CME 95**
GROUND ELEVATION: **725.3 feet AMSL**
NORTHING: **620369.7**
EASTING: **1482502.1**

DEPTH
(feet)

WELL CONSTRUCTION DETAILS



Sand
(0 to 6 ft)

8" PVC Sch 80 Casing
(0 to 39.5 ft)

Portland Cement
(6 to 30 ft)

Parry No. 5
(30 to 34 ft)

Parry No. 4
(30 to 62.5 ft)

8" Stainless Steel Screen slot size 0.06
(39.5 to 59.5 ft)

Well Sump
(59.5 to 62.5 ft)

Clay Till
(59.5 to 62.5 ft)

Notes:

bls: below land surface
in.: inch
s.u.: Standard Unit

AMSL: Above Mean Sea Level
TOC: Top of Casing
USCS: Unified Soil Classification System
NM: Not Measured

ppm: parts per million
PID: Photo-ionization Detector
ft: feet

Date: 4/18/2018
Page: 1 of 1

BORING/WELL CONSTRUCTION LOG

WELL NO.: **RMW-91**

TOTAL DEPTH: **57** feet bls



PROJECT INFORMATION

CLIENT: **RACER Trust**
 SITE LOCATION: **South Setting Logan**
 CITY, STATE: **Moraine, Ohio**
 PROJECT NUMBER: **OH000294.2017**
 LOGGED BY: **Kevin Swiadek**
 DATE STARTED: **7/25/2017**
 DATE COMPLETED: **7/27/2017**

DRILLING INFORMATION

DRILLING CO.: **Layne Christensen Co.**
 DRILLER: **Tim Woods**
 DRILLING METHOD: **Hollow Stem Auger**
 GROUND ELEVATION: **723.2 feet AMSL**
 NORTHING: **620642.1**
 EASTING: **1482814.2**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Blow Counts	Soil Symbols	USCS Classification	SOIL DESCRIPTION	WELL CONSTRUCTION DETAILS
--------------	-------------------	-----------	-------------	--------------	---------------------	------------------	---------------------------

0					SW	(0.0 - 8.0) SAND, fine to medium, some small to large pebbles, poorly sorted, dry, medium dense, 5YR 5/3.	Grout (0 to 42 ft)
2	Air Knife	0.0	NM				
4		0.0	NM				
6		0.0	NM				2" PVC Casing (0 to 48 ft)
8	N/A	0.0	5,26,30,27			Note: crushed rock at 7.3 feet.	
10		1.0	21,12,11,18		SW	(8.0 - 12.0) SAND, medium to coarse, some granules, little small pebbles, angular to subround, poorly sorted, loose, dry, 7.5YR 5/1.	Grout (0 to 42 ft)
12		0.8	10,13,10,12			Note: dry, 10YR 6/2 from 10 to 12 feet.	
14		0.4	8,9,11,13		SW	(12.0 - 14.0) SAND, fine to medium, trace silt, subround to angular, well sorted, medium dense, moist, grain size and moisture increasing with depth, 10YR 5/4.	
16		1.4	11,13,13,8		SW	(14.0 - 16.0) SAND, medium to coarse and granules, some small to large pebbles, subangular to angular, poorly sorted, medium dense, wet, 2.5YR 4/2.	

Notes:
 bls: below land surface
 in.: inch
 s.u.: Standard Unit
 AMSL: Above Mean Sea Level
 TOC: Top of Casing
 USCS: Unified Soil Classification System
 NM: Not Measured
 ppm: parts per million
 PID: Photo-ionization Detector
 ft: feet
 Stickup Surface Completion
 Date: 2/8/2018
 Page: 1 of 4

BORING/WELL CONSTRUCTION LOG

WELL NO.: **RMW-91**

TOTAL DEPTH: **57** feet bls



PROJECT INFORMATION

CLIENT: **RACER Trust**
 SITE LOCATION: **South Setting Logan**
 CITY, STATE: **Moraine, Ohio**
 PROJECT NUMBER: **OH000294.2017**
 LOGGED BY: **Kevin Swiadek**
 DATE STARTED: **7/25/2017**
 DATE COMPLETED: **7/27/2017**

DRILLING INFORMATION

DRILLING CO.: **Layne Christensen Co.**
 DRILLER: **Tim Woods**
 DRILLING METHOD: **Hollow Stem Auger**
 GROUND ELEVATION: **723.2 feet AMSL**
 NORTHING: **620642.1**
 EASTING: **1482814.2**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Blow Counts	Soil Symbols	USCS Classification	SOIL DESCRIPTION	WELL CONSTRUCTION DETAILS
16					SW	(16.0 - 16.5) SAND, fine to medium, well sorted, loose to medium dense, wet, 2.5Y 4/1.	
15	1.5		8,19,21,16		SW	(16.5 - 18.0) SAND, medium to coarse and granules, some small to large pebbles, subangular to angular, poorly sorted, medium dense, wet, 2.5Y 7/6.	
18					SW	(18.0 - 18.5) SAND, fine to medium, well sorted, loose to medium dense, wet, 2.5Y 6/4.	
18	1.1		4,8,8,12		SW	(18.5 - 20.0) SAND, medium to coarse and granules, some small to large pebbles, subangular to angular, poorly sorted, medium dense, wet, 2.5Y 6/4.	
20		0.0	NM		SW	(20.0 - 36.0) SAND, medium to coarse and granules, some small to very large pebbles, subrounded to angular, poorly sorted, loose, wet, 10YR 5/3. Note: begin sampling with suction bailer. Note: wet, 10YR 5/3 from 22.5 to 25 feet.	Grout (0 to 42 ft)
22		0.0	NM			Note: wet, 7.5YR 5/2 from 25 to 27.5 feet.	
24		0.0	NM				
26		0.0	NM				
28		0.1	NM			Note: increase in granules to small pebbles, wet, 7.5YR 5/2 from 27.5 to 30 feet.	
30		0.2	NM			Note: increase in large pebbles, wet, 7.5YR 5/2 from 30 to 32.5 feet.	Grout (0 to 42 ft)
32							

Notes:
 bls: below land surface
 in.: inch
 s.u.: Standard Unit
 AMSL: Above Mean Sea Level
 TOC: Top of Casing
 USCS: Unified Soil Classification System
 NM: Not Measured
 ppm: parts per million
 PID: Photo-ionization Detector
 ft: feet
 Stickup Surface Completion
 Date: 2/8/2018
 Page: 2 of 4

BORING/WELL CONSTRUCTION LOG

WELL NO.: **RMW-91**

TOTAL DEPTH: **57** feet bls



PROJECT INFORMATION

CLIENT: **RACER Trust**
 SITE LOCATION: **South Setting Logan**
 CITY, STATE: **Moraine, Ohio**
 PROJECT NUMBER: **OH000294.2017**
 LOGGED BY: **Kevin Swiadek**
 DATE STARTED: **7/25/2017**
 DATE COMPLETED: **7/27/2017**

DRILLING INFORMATION

DRILLING CO.: **Layne Christensen Co.**
 DRILLER: **Tim Woods**
 DRILLING METHOD: **Hollow Stem Auger**
 GROUND ELEVATION: **723.2 feet AMSL**
 NORTHING: **620642.1**
 EASTING: **1482814.2**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Blow Counts	Soil Symbols	USCS Classification	SOIL DESCRIPTION	WELL CONSTRUCTION DETAILS
32	NM	0.0	NM	[Symbol]	SW	SAND, medium to coarse and granules, some small to very large pebbles, subrounded to angular, poorly sorted, loose, wet, 10YR 5/3. Note: begin sampling with suction bailer.	
34	NM	0.0	NM	[Symbol]	SW		
36	NM	0.0	NM	[Symbol]	CL	(36.0 - 38.0) CLAY, some silt, trace pebbles, medium plasticity, very dense, dark gray.	Grout (0 to 42 ft) Bentonite Pellets (42 to 45 ft) Sand Pack (45 to 53 ft)
38	24	1.1	13,30,28,18	[Symbol]	SW	(38.0 - 39.8) SAND, medium to coarse and small to large pebbles, subangular to angular, poorly sorted, wet, 10YR 5/1.	
40	16	0.0	20,12,21,27	[Symbol]	CL	(39.8 - 40.0) CLAY, some silt, medium dilatancy, high plasticity, very hard, dry, 7.5YR 5/1.	
42	12	0.4	13,17,21,26	[Symbol]	CL	(40.0 - 42.0) CLAY, some silt, trace granules and small to medium pebbles, high plasticity, low dilatancy, medium soft, dry, 7.5YR 6/1.	
44	16	1.2	3,17,25,29	[Symbol]	SW	(42.0 - 42.5) SAND, medium to coarse, angular, well sorted, loose, 5Y 4/3, moist.	
46	14	1.8	18,22,33,39	[Symbol]	CL	(42.5 - 42.9) CLAY, some silt, trace granules and small to medium pebbles, high plasticity, low dilatancy, medium soft, dry, 7.5YR 6/1.	
48				[Symbol]	ML	(42.9 - 46.0) SILT, fine sand, well sorted, very loose, wet, 2.5Y 8/3.	
				[Symbol]	SW	(46.0 - 47.0) SAND, medium to coarse, angular, well sorted, loose, 5Y 4/3, moist.	
				[Symbol]	ML	(47.0 - 48.0) SILT, fine sand, well sorted, very loose, wet, 2.5Y 8/3.	

Notes:
 bls: below land surface
 in.: inch
 s.u.: Standard Unit
 AMSL: Above Mean Sea Level
 TOC: Top of Casing
 USCS: Unified Soil Classification System
 NM: Not Measured
 ppm: parts per million
 PID: Photo-ionization Detector
 ft: feet
 Stickup Surface Completion
 Date: 2/8/2018
 Page: 3 of 4

BORING/WELL CONSTRUCTION LOG



WELL NO.: **RMW-91**

TOTAL DEPTH: **57** feet bls

PROJECT INFORMATION

CLIENT: **RACER Trust**
 SITE LOCATION: **South Setting Logan**
 CITY, STATE: **Moraine, Ohio**
 PROJECT NUMBER: **OH000294.2017**
 LOGGED BY: **Kevin Swiadek**
 DATE STARTED: **7/25/2017**
 DATE COMPLETED: **7/27/2017**

DRILLING INFORMATION

DRILLING CO.: **Layne Christensen Co.**
 DRILLER: **Tim Woods**
 DRILLING METHOD: **Hollow Stem Auger**
 GROUND ELEVATION: **723.2 feet AMSL**
 NORTHING: **620642.1**
 EASTING: **1482814.2**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Blow Counts	Soil Symbols	USCS Classification	SOIL DESCRIPTION	WELL CONSTRUCTION DETAILS
48	11	3.6	13,12,15,11		SW	(48.0 - 53.0) SAND, medium to coarse and granules, some small pebbles, subangular to angular, poorly sorted, loose, wet, 2.5Y 5/3.	
50	8	N/A	0.8				
52	NR						
54	24	0.8	13,26,35,29		SC	(53.0 - 55.0) SILT and fine SAND, well sorted, loose, wet, 2.5Y 5/1.	
56	12	N/A	15,54,45,17		CL	(55.0 - 57.0) CLAY, some silt, trace granules to medium pebble, very hard, no plasticity, no dilatancy, dry, 10YR 3/4.	
58						End of boring at 57 feet.	
60							

Notes:
 bls: below land surface
 in.: inch
 s.u.: Standard Unit

AMSL: Above Mean Sea Level
 TOC: Top of Casing
 USCS: Unified Soil Classification System
 NM: Not Measured

ppm: parts per million
 PID: Photo-ionization Detector
 ft: feet
 Stickup Surface Completion

Date: 2/8/2018
 Page: 4 of 4

BORING/WELL CONSTRUCTION LOG

WELL NO.: **RMW-92**

TOTAL DEPTH: **36** feet bls



PROJECT INFORMATION

CLIENT: **RACER Trust**
 SITE LOCATION: **South Setting Logan**
 CITY, STATE: **Moraine, Ohio**
 PROJECT NUMBER: **OH000294.2017**
 LOGGED BY: **Kevin Swiadek**
 DATE STARTED: **7/25/2017**
 DATE COMPLETED: **7/27/2017**

DRILLING INFORMATION

DRILLING CO.: **Layne Christensen Co.**
 DRILLER: **Tim Woods**
 DRILLING METHOD: **Hollow Stem Auger**
 GROUND ELEVATION: **723.4 feet AMSL**
 NORTHING: **620642.2**
 EASTING: **1482803.2**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Blow Counts	Soil Symbols	USCS Classification	SOIL DESCRIPTION	WELL CONSTRUCTION DETAILS
--------------	-------------------	-----------	-------------	--------------	---------------------	------------------	---------------------------

0					SW	(0.0 - 8.0) SAND, fine to medium, some small to large pebbles, poorly sorted, dry, medium dense, 5YR 5/3.	Grout (0 to 20 ft)
2	Air Knife	0.0	NM				
4		0.0	NM				
6		0.0	NM				2" PVC Casing (0 to 26 ft)
8	N/A	0.0	5,26,30,27			Note: crushed rock at 7.3 feet.	
10	13	1.0	21,12,11,18		SW	(8.0 - 12.0) SAND, medium to coarse, some granules, little small pebbles, angular to subround, poorly sorted, loose, dry, 7.5YR 5/1. Note: dry, 10YR 6/2 from 10 to 12 feet.	
12	16	0.8	10,13,10,12				
14	17	0.4	8,9,11,13		SW	(12.0 - 14.0) SAND, fine to medium, trace silt, subround to angular, well sorted, medium dense, moist, fine and moisture grading with depth, 10YR 5/4.	

Notes:
 bls: below land surface
 in.: inch
 s.u.: Standard Unit
 AMSL: Above Mean Sea Level
 TOC: Top of Casing
 USCS: Unified Soil Classification System
 NM: Not Measured
 ppm: parts per million
 PID: Photo-ionization Detector
 ft: feet
 Stickup Surface Completion
 Date: 2/8/2018
 Page: 1 of 3

BORING/WELL CONSTRUCTION LOG

WELL NO.: **RMW-92**

TOTAL DEPTH: **36** feet bls



PROJECT INFORMATION

CLIENT: **RACER Trust**
 SITE LOCATION: **South Setting Logan**
 CITY, STATE: **Moraine, Ohio**
 PROJECT NUMBER: **OH000294.2017**
 LOGGED BY: **Kevin Swiadek**
 DATE STARTED: **7/25/2017**
 DATE COMPLETED: **7/27/2017**

DRILLING INFORMATION

DRILLING CO.: **Layne Christensen Co.**
 DRILLER: **Tim Woods**
 DRILLING METHOD: **Hollow Stem Auger**
 GROUND ELEVATION: **723.4 feet AMSL**
 NORTHING: **620642.2**
 EASTING: **1482803.2**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Blow Counts	Soil Symbols	USCS Classification	SOIL DESCRIPTION	WELL CONSTRUCTION DETAILS
14	15	1.4	11,13,13,8		SW	(14.0 - 16.0) SAND, medium to coarse and granules, some small to large pebbles, subangular to angular, poorly sorted, medium dense, wet, 2.5YR 4/2.	
16	15	1.5	8,19,21,16		SW	(16.0 - 16.5) SAND, fine to medium, well sorted, loose to medium dense, wet, 2.5Y 4/1.	
18	18	1.1	4,8,8,12		SW	(16.5 - 18.0) SAND, medium to coarse and granules, some small to large pebbles, subangular to angular, poorly sorted, medium dense, wet, 2.5Y 7/6.	
20	NM	0.0	NM		SW	(18.0 - 18.5) SAND, fine to medium, well sorted, loose to medium dense, wet, 2.5Y 6/4.	
22	NM	0.0	NM		SW	(18.5 - 20.0) SAND, medium to coarse and granules, some small to large pebbles, subangular to angular, poorly sorted, medium dense, wet, 2.5Y 6/4.	
24	NM	0.0	NM		SW	(20.0 - 36.0) SAND, medium to coarse and granules, some small to very large pebbles, subrounded to angular, poorly sorted, loose, wet, 10YR 5/3. Note: begin sampling with suction bailer. Note: wet, 10YR 5/3 from 22.5 to 25 feet.	Bentonite Pellets (20 to 23 ft)
26	NM	0.0	NM		SW	Note: wet, 7.5YR 5/2 from 25 to 27.5 feet.	Sand Pack (23 to 36 ft)
28	NM	0.0	NM		SW	Note: increase in granules to small pebbles, wet,	2" PVC Screen (26 to 36 ft)

Notes:
 bls: below land surface
 in.: inch
 s.u.: Standard Unit
 AMSL: Above Mean Sea Level
 TOC: Top of Casing
 USCS: Unified Soil Classification System
 NM: Not Measured
 ppm: parts per million
 PID: Photo-ionization Detector
 ft: feet
 Stickup Surface Completion
 Date: 2/8/2018
 Page: 2 of 3

BORING/WELL CONSTRUCTION LOG



WELL NO.: **RMW-92**

TOTAL DEPTH: **36** feet bls

PROJECT INFORMATION

DRILLING INFORMATION

CLIENT: **RACER Trust**
 SITE LOCATION: **South Setting Logan**
 CITY, STATE: **Moraine, Ohio**
 PROJECT NUMBER: **OH000294.2017**
 LOGGED BY: **Kevin Swiadek**
 DATE STARTED: **7/25/2017**
 DATE COMPLETED: **7/27/2017**

DRILLING CO.: **Layne Christensen Co.**
 DRILLER: **Tim Woods**
 DRILLING METHOD: **Hollow Stem Auger**
 GROUND ELEVATION: **723.4 feet AMSL**
 NORTHING: **620642.2**
 EASTING: **1482803.2**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Blow Counts	Soil Symbols	USCS Classification	SOIL DESCRIPTION	WELL CONSTRUCTION DETAILS
28	NM	0.1	NM			7.5YR 5/2 from 27.5 to 30 feet.	
30	NM	0.2	NM			Note: increase in large pebbles, wet, 7.5YR 5/2 from 30 to 32.5 feet.	
32	NM	0.0	NM				
34	NM	0.0	NM			Note: increase in pebbles, wet, 2.5YR 5/1 from 35 to 36 feet.	
36						End of boring at 36 feet.	
38							

Notes:
 bls: below land surface
 in.: inch
 s.u.: Standard Unit

AMSL: Above Mean Sea Level
 TOC: Top of Casing
 USCS: Unified Soil Classification System
 NM: Not Measured

ppm: parts per million
 PID: Photo-ionization Detector
 ft: feet
 Stickup Surface Completion

Date: 2/8/2018
 Page: 3 of 3

BORING/WELL CONSTRUCTION LOG

WELL NO.: **RMW-93**

TOTAL DEPTH: **63.5** feet bls



PROJECT INFORMATION

CLIENT: **RACER Trust**
 SITE LOCATION: **South Setting Logan**
 CITY, STATE: **Moraine, Ohio**
 PROJECT NUMBER: **OH000294.2017**
 LOGGED BY: **Kevin Swiadek**
 DATE STARTED: **7/24/2017**
 DATE COMPLETED: **7/27/2017**

DRILLING INFORMATION

DRILLING CO.: **Layne Christensen Co.**
 DRILLER: **Tim Woods**
 DRILLING METHOD: **Hollow Stem Auger**
 GROUND ELEVATION: **724.7 feet AMSL**
 NORTHING: **620378.8**
 EASTING: **1482440.7**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Blow Counts	Soil Symbols	USCS Classification	SOIL DESCRIPTION	WELL CONSTRUCTION DETAILS
--------------	-------------------	-----------	-------------	--------------	---------------------	------------------	---------------------------

0					SW	(0.0 - 10.0) SAND, fine to medium, some small to large pebbles, poorly sorted, angular to subangular, loose, dry, 7.5YR 6/1.	Grout (0 to 43 ft)
2	Air Knife	0.0	NM				
4		0.0	NM				
6		0.0	NM				
8		0.9	12,14,16,26			Note: large pebble at 9.4 feet, dry, 7.5YR 5.1.	2" PVC Casing (0 to 50 ft)
10		2.0	22,38,45,38				
12		0.3	18,25,25,21		SW	(10.0 - 14.0) SAND, medium to coarse, some small to large pebbles, angular to subangular, poorly sorted, loose, dry, 5YR 5/1.	Grout (0 to 43 ft)
17		0.6	5,12,16,18			Note: mostly coarse, dry to moist, 5YR 4.1.	

Notes:
 bls: below land surface
 in.: inch
 s.u.: Standard Unit
 AMSL: Above Mean Sea Level
 TOC: Top of Casing
 USCS: Unified Soil Classification System
 NM: Not Measured
 ppm: parts per million
 PID: Photo-ionization Detector
 ft: feet
 Stickup Surface Completion
 Date: 2/8/2018
 Page: 1 of 5

BORING/WELL CONSTRUCTION LOG

WELL NO.: **RMW-93**

TOTAL DEPTH: **63.5** feet bls



PROJECT INFORMATION

CLIENT: **RACER Trust**
 SITE LOCATION: **South Setting Logan**
 CITY, STATE: **Moraine, Ohio**
 PROJECT NUMBER: **OH000294.2017**
 LOGGED BY: **Kevin Swiadek**
 DATE STARTED: **7/24/2017**
 DATE COMPLETED: **7/27/2017**

DRILLING INFORMATION

DRILLING CO.: **Layne Christensen Co.**
 DRILLER: **Tim Woods**
 DRILLING METHOD: **Hollow Stem Auger**
 GROUND ELEVATION: **724.7 feet AMSL**
 NORTHING: **620378.8**
 EASTING: **1482440.7**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Blow Counts	Soil Symbols	USCS Classification	SOIL DESCRIPTION	WELL CONSTRUCTION DETAILS
14						(14.0 - 14.3) SAND and GRANULES, some small pebbles, poorly sorted, moist, 10YR 5/4.	
16	16	1.4	7,7,9,14		SW	(14.3 - 16.0) SAND, medium to coarse, some small to large pebbles, poorly sorted, loose, dry to moist.	
18					GW	(16.0 - 20.0) GRANULES, some coarse sand, some small to large pebbles, subrounded to angular, poorly sorted, loose, wet, 10YR 5/8.	
20						Note: wet, 2.5Y 6/4 from 18 to 20 feet.	
22					SW	(20.0 - 42.5) SAND, fine to coarse and granules, some small to large pebbles, subround to angular, loose, wet, poorly sorted, 5Y 5/4.	Grout (0 to 43 ft)
24						Note: begin sampling with suction bailer.	
26						Note: 5Y 5/2 from 25 to 32.5 feet.	

Notes:
 bls: below land surface
 in.: inch
 s.u.: Standard Unit
 AMSL: Above Mean Sea Level
 TOC: Top of Casing
 USCS: Unified Soil Classification System
 NM: Not Measured
 ppm: parts per million
 PID: Photo-ionization Detector
 ft: feet
 Stickup Surface Completion
 Date: 2/8/2018
 Page: 2 of 5

BORING/WELL CONSTRUCTION LOG



WELL NO.: **RMW-93**

TOTAL DEPTH: **63.5** feet bls

PROJECT INFORMATION

DRILLING INFORMATION

CLIENT: **RACER Trust**
 SITE LOCATION: **South Setting Logan**
 CITY, STATE: **Moraine, Ohio**
 PROJECT NUMBER: **OH000294.2017**
 LOGGED BY: **Kevin Swiadek**
 DATE STARTED: **7/24/2017**
 DATE COMPLETED: **7/27/2017**

DRILLING CO.: **Layne Christensen Co.**
 DRILLER: **Tim Woods**
 DRILLING METHOD: **Hollow Stem Auger**
 GROUND ELEVATION: **724.7 feet AMSL**
 NORTHING: **620378.8**
 EASTING: **1482440.7**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Blow Counts	Soil Symbols	USCS Classification	SOIL DESCRIPTION	WELL CONSTRUCTION DETAILS
--------------	-------------------	-----------	-------------	--------------	---------------------	------------------	---------------------------

26	NM		NM				
28	NM	0.2	NM				
30	NM	0.3	NM				
32	NM	0.4	NM				
34	NM	0.9	NM				
36	NM	0.4	NM				
38	NM	0.4	NM				
	NM	0.4	NM				

SW

SAND, fine to coarse and granules, some small to large pebbles, subround to angular, loose, wet, poorly sorted, 5Y 5/4.
 Note: begin sampling with suction bailer.

Note: 5Y 6/1 from 32.5 to 37.5 feet.

Note: decrease in large pebbles, 5Y 5/4 from 37.5 to 40 feet.

Grout (0 to 43 ft)

Notes:
 bls: below land surface
 in.: inch
 s.u.: Standard Unit
 AMSL: Above Mean Sea Level
 TOC: Top of Casing
 USCS: Unified Soil Classification System
 NM: Not Measured
 ppm: parts per million
 PID: Photo-ionization Detector
 ft: feet
 Stickup Surface Completion
 Date: 2/8/2018
 Page: 3 of 5

BORING/WELL CONSTRUCTION LOG



WELL NO.: **RMW-93**

TOTAL DEPTH: **63.5** feet bls

PROJECT INFORMATION

DRILLING INFORMATION

CLIENT: **RACER Trust**
 SITE LOCATION: **South Setting Logan**
 CITY, STATE: **Moraine, Ohio**
 PROJECT NUMBER: **OH000294.2017**
 LOGGED BY: **Kevin Swiadek**
 DATE STARTED: **7/24/2017**
 DATE COMPLETED: **7/27/2017**

DRILLING CO.: **Layne Christensen Co.**
 DRILLER: **Tim Woods**
 DRILLING METHOD: **Hollow Stem Auger**
 GROUND ELEVATION: **724.7 feet AMSL**
 NORTHING: **620378.8**
 EASTING: **1482440.7**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Blow Counts	Soil Symbols	USCS Classification	SOIL DESCRIPTION	WELL CONSTRUCTION DETAILS
40	NM	0.4	NM	[Symbol]	SW	Note: 5Y 6/4 from 40 to 42.5 feet.	Grout (0 to 43 ft)
42	NM	0.4	NM	[Symbol]	SW	SAND, fine to coarse and granules, some small to large pebbles, subround to angular, loose, wet, poorly sorted, 5Y 5/4. Note: begin sampling with suction bailer.	
44	NM	0.4	NM	[Symbol]	SW	(42.5 - 45.0) SAND, fine to coarse and granules, some small to very large pebbles, subrounded to angular, poorly sorted, loose, wet, 5Y 6/4.	
46	NM	0.6	NM	[Symbol]	SW	(45.0 - 55.0) SAND, fine to medium, trace to little granules, trace small to large pebbles, angular, poorly sorted, loose, wet, 5Y 6/4.	Bentonite Pellets (43 to 47 ft)
48	NM	0.3	NM	[Symbol]	SW	Note: increase in pebbles, small to large and granules, wet, 2.5Y 6/6 from 47.5 to 50 feet.	
50	NM	0.0	NM	[Symbol]	SW		Sand Pack (47 to 60 ft)
52	NM	0.0	NM	[Symbol]	SW		

Notes:
 bls: below land surface
 in.: inch
 s.u.: Standard Unit
 AMSL: Above Mean Sea Level
 TOC: Top of Casing
 USCS: Unified Soil Classification System
 NM: Not Measured
 ppm: parts per million
 PID: Photo-ionization Detector
 ft: feet
 Stickup Surface Completion
 Date: 2/8/2018
 Page: 4 of 5

BORING/WELL CONSTRUCTION LOG



WELL NO.: **RMW-93**

TOTAL DEPTH: **63.5** feet bls

PROJECT INFORMATION

DRILLING INFORMATION

CLIENT: **RACER Trust**
 SITE LOCATION: **South Setting Logan**
 CITY, STATE: **Moraine, Ohio**
 PROJECT NUMBER: **OH000294.2017**
 LOGGED BY: **Kevin Swiadek**
 DATE STARTED: **7/24/2017**
 DATE COMPLETED: **7/27/2017**

DRILLING CO.: **Layne Christensen Co.**
 DRILLER: **Tim Woods**
 DRILLING METHOD: **Hollow Stem Auger**
 GROUND ELEVATION: **724.7 feet AMSL**
 NORTHING: **620378.8**
 EASTING: **1482440.7**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Blow Counts	Soil Symbols	USCS Classification	SOIL DESCRIPTION	WELL CONSTRUCTION DETAILS
52							
54	0.2				SW	SAND, fine to medium, trace to little granules, trace small to large pebbles, angular, poorly sorted, loose, wet, 5Y 6/4.	
56	0.7				SW	(55.0 - 60.0) SAND, medium to coarse and granules, trace small pebbles, poorly sorted, loose, wet, 2.5Y 5/2.	
58							
60						(60.0 - 61.5) NO RECOVERY.	
62	0.5				SW	(61.5 - 62.0) SAND, medium to coarse, poorly sorted, soft, wet.	
					CL	(62.0 - 63.5) CLAY, some silt, trace pebbles, no plasticity, no dilatancy, dry, hard, dark gray.	
64						End of boring at 63.5 feet.	

BORING/WELL CONSTRUCTION LOG

WELL NO.: **RMW-94**

TOTAL DEPTH: **40** feet bls



PROJECT INFORMATION

CLIENT: **RACER Trust**
 SITE LOCATION: **South Setting Logan**
 CITY, STATE: **Moraine, Ohio**
 PROJECT NUMBER: **OH000294.2017**
 LOGGED BY: **Kevin Swiadek**
 DATE STARTED: **7/24/2017**
 DATE COMPLETED: **7/27/2017**

DRILLING INFORMATION

DRILLING CO.: **Layne Christensen Co.**
 DRILLER: **Tim Woods**
 DRILLING METHOD: **Hollow Stem Auger**
 GROUND ELEVATION: **724.8 feet AMSL**
 NORTHING: **620380.0**
 EASTING: **1482432.7**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Blow Counts	Soil Symbols	USCS Classification	SOIL DESCRIPTION	WELL CONSTRUCTION DETAILS
0							
0 - 6	Air Knife	0.0	NM		SW	(0.0 - 10.0) SAND, fine to medium, some small to large pebbles, poorly sorted, angular to subangular, loose, dry, 7.5YR 6/1.	Grout (0 to 24 ft)
2		0.0	NM				
4		0.0	NM				
6							
6 - 8		0.9	12,14,16,26				2" PVC Casing (0 to 30 ft)
8		2.0	22,38,45,38			Note: large pebble at 9.4 feet, dry, 7.5YR 5.1.	
10							
10 - 12		0.3	18,25,25,21		SW	(10.0 - 14.0) SAND, medium to coarse, some small to large pebbles, angular to subangular, poorly sorted, loose, dry, 5.YR 5/1.	Grout (0 to 24 ft)
12		0.6	5,12,16,18			Note: mostly coarse, dry to moist, 5YR 4.1.	
14						(14.0 - 14.3) SAND and GRANULES, some small pebbles, poorly sorted, moist, 10YR 5/4.	
14 - 16		1.4	7,7,9,14		SW	(14.3 - 16.0) SAND, medium to coarse, some small to large pebbles, poorly sorted, loose, dry to moist.	
16					SW		
16 - 18		2.2	8,14,17,9		GW	(16.0 - 20.0) GRANULES, some sand, coarse, some small to large pebbles, subrounded to angular, poorly sorted, loose, wet, 10YR 5/8.	
18						Note: wet, 2.5Y 6/4 from 18 to 20 feet.	
18 - 20		1.6	11,12,15,12				
20							
20 - 22		1.6	NM		SW	(20.0 - 40.0) SAND, fine to coarse and granules, some small to large pebbles, subround to angular, loose, poorly sorted, 5Y 5/4.	
22							

Notes:
 bls: below land surface
 in.: inch
 s.u.: Standard Unit
 AMSL: Above Mean Sea Level
 TOC: Top of Casing
 USCS: Unified Soil Classification System
 NM: Not Measured
 ppm: parts per million
 PID: Photo-ionization Detector
 ft: feet
 Stickup Surface Completion
 Date: 2/8/2018
 Page: 1 of 2

BORING/WELL CONSTRUCTION LOG



WELL NO.: **RMW-94**

TOTAL DEPTH: **40** feet bls

PROJECT INFORMATION

DRILLING INFORMATION

CLIENT: **RACER Trust**
 SITE LOCATION: **South Setting Logan**
 CITY, STATE: **Moraine, Ohio**
 PROJECT NUMBER: **OH000294.2017**
 LOGGED BY: **Kevin Swiadek**
 DATE STARTED: **7/24/2017**
 DATE COMPLETED: **7/27/2017**

DRILLING CO.: **Layne Christensen Co.**
 DRILLER: **Tim Woods**
 DRILLING METHOD: **Hollow Stem Auger**
 GROUND ELEVATION: **724.8 feet AMSL**
 NORTHING: **620380.0**
 EASTING: **1482432.7**

DEPTH (feet)	Recovery (inches)	PID (ppm)	Blow Counts	Soil Symbols	USCS Classification	SOIL DESCRIPTION	WELL CONSTRUCTION DETAILS	
22	NM					SAND, fine to coarse and granules, some small to large pebbles, subround to angular, loose, poorly sorted, 5Y 5/4. Note: 5Y 5/2 from 25 to 32.5 feet.		
24		0.3			SW Note: 5Y 6/1 from 32.5 to 37.5 feet.			Grout (0 to 24 ft) Bentonite Pellets (24 to 27 ft) Sand Pack (27 to 40 ft) 2" PVC Screen (30 to 40 ft)
26	NM							
28	NM							
30	NM							
32	NM							
34	NM							
36	NM							
38	NM							
40	NM							
42					End of boring at 40 feet.			

Notes:
 bls: below land surface
 in.: inch
 s.u.: Standard Unit
 AMSL: Above Mean Sea Level
 TOC: Top of Casing
 USCS: Unified Soil Classification System
 NM: Not Measured
 ppm: parts per million
 PID: Photo-ionization Detector
 ft: feet
 Stickup Surface Completion
 Date: 2/8/2018
 Page: 2 of 2

APPENDIX B

AQTESOLV Solution Reports



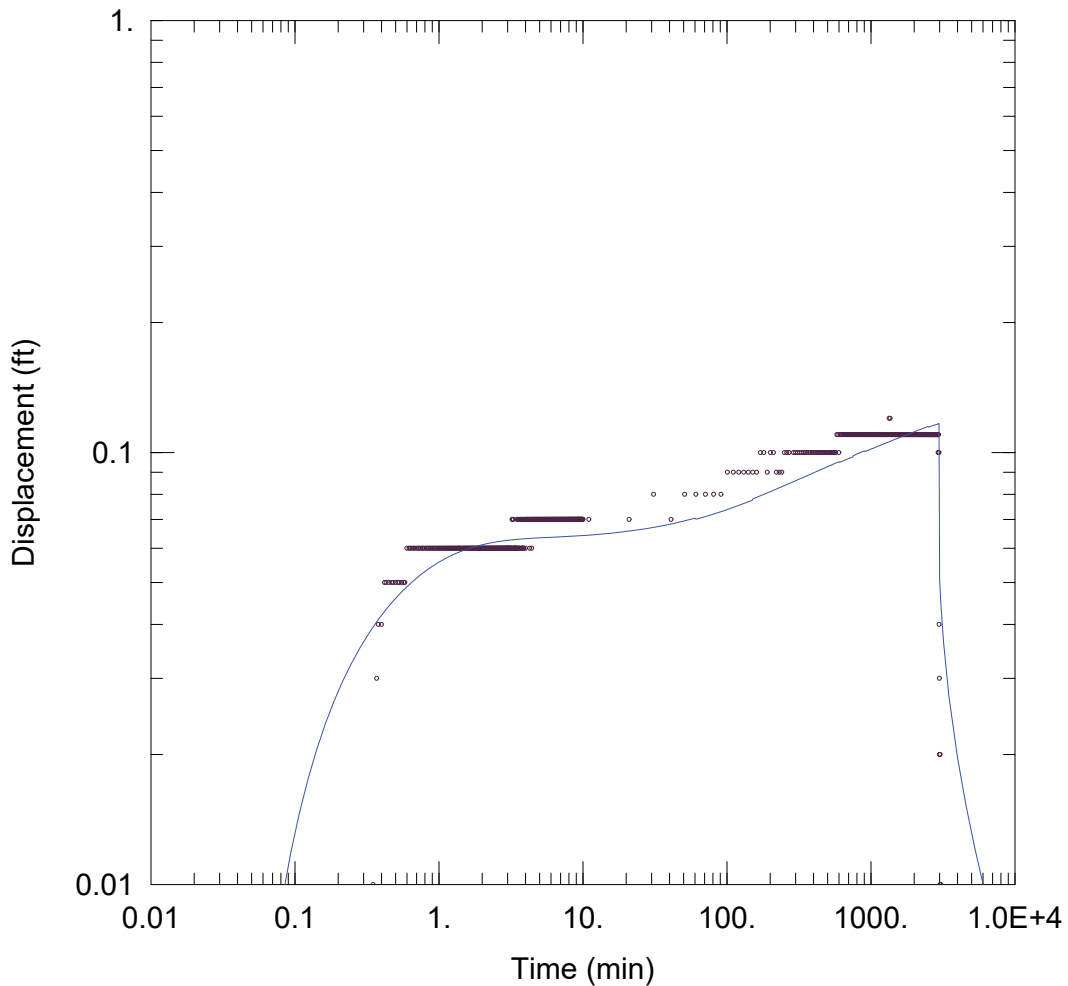
EW-2 Constant Rate Test - RMW-93

Prepared By:
Arcadis

Prepared For:
RACER Trust

Project:
OH000294.2018

Location:
Moraine, OH



SOLUTION

Aquifer Model: Unconfined
 Solution Method: Moench

T = <u>1.3E+5</u> ft ² /day	S = <u>0.004</u>
Sy = <u>0.2</u>	β = <u>0.06</u>
Sw = <u>0.</u>	r(w) = <u>0.583</u> ft
r(c) = <u>0.333</u> ft	alpha = <u>1.0E+30</u> min ⁻¹

AQUIFER DATA

Saturated Thickness: 40. ft
 Anisotropy Ratio (Kz/Kr): 0.02

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
EW-2	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
◦ RMW-93	62.9	0

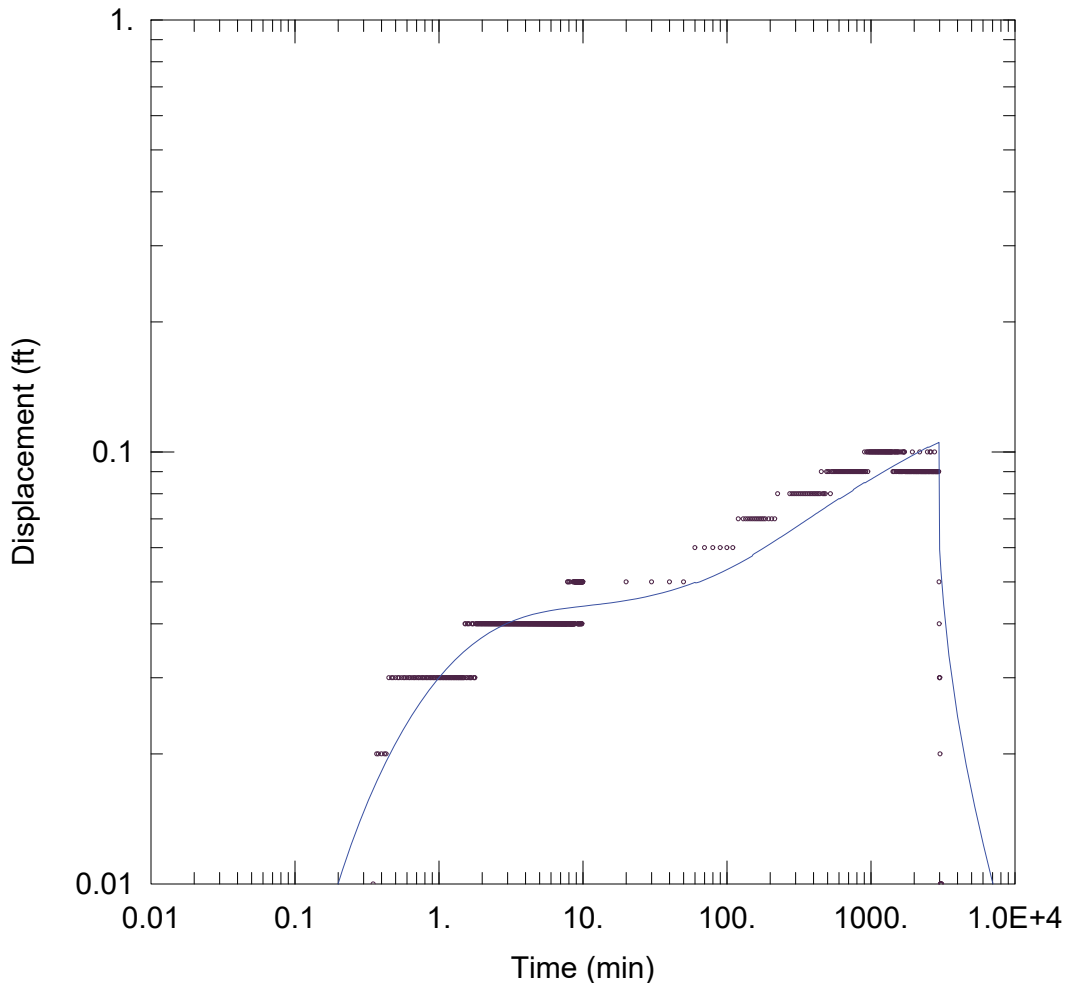
EW-2 Constant Rate Test - RWM-94

Prepared By:
Arcadis

Prepared For:
RACER Trust

Project:
OH000294.2018

Location:
Moraine, OH



SOLUTION

Aquifer Model: Unconfined
Solution Method: Moench

$T = 1.05E+5 \text{ ft}^2/\text{day}$ $S = 0.002$
 $S_y = 0.1$ $\beta = 0.02$
 $S_w = 0.$ $r(w) = 0.583 \text{ ft}$
 $r(c) = 0.333 \text{ ft}$ $\alpha = 1.0E+30 \text{ min}^{-1}$

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 0.01

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
EW-2	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
◦ RMW-94	71.2	0

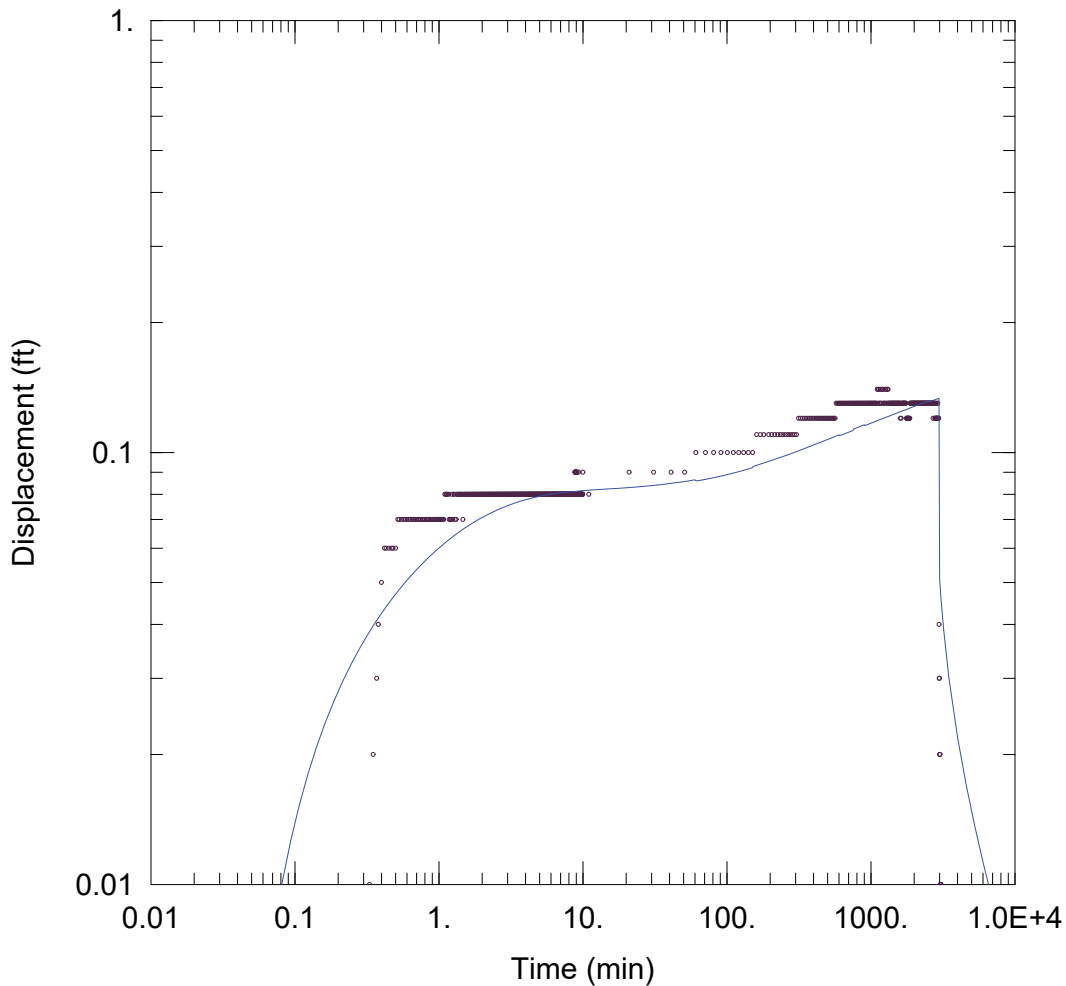
EW-2 Constant Rate Test - W-4-S

Prepared By:
Arcadis

Prepared For:
RACER Trust

Project:
OH000294.2018

Location:
Moraine, OH



SOLUTION

Aquifer Model: Unconfined
 Solution Method: Moench

T = <u>1.15E+5</u> ft ² /day	S = <u>0.004</u>
Sy = <u>0.15</u>	β = <u>0.02</u>
Sw = <u>0.</u>	r(w) = <u>0.583</u> ft
r(c) = <u>0.333</u> ft	alpha = <u>1.0E+30</u> min ⁻¹

AQUIFER DATA

Saturated Thickness: 40. ft
 Anisotropy Ratio (Kz/Kr): 0.01

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
EW-2	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
◦ W-4-S	51	0

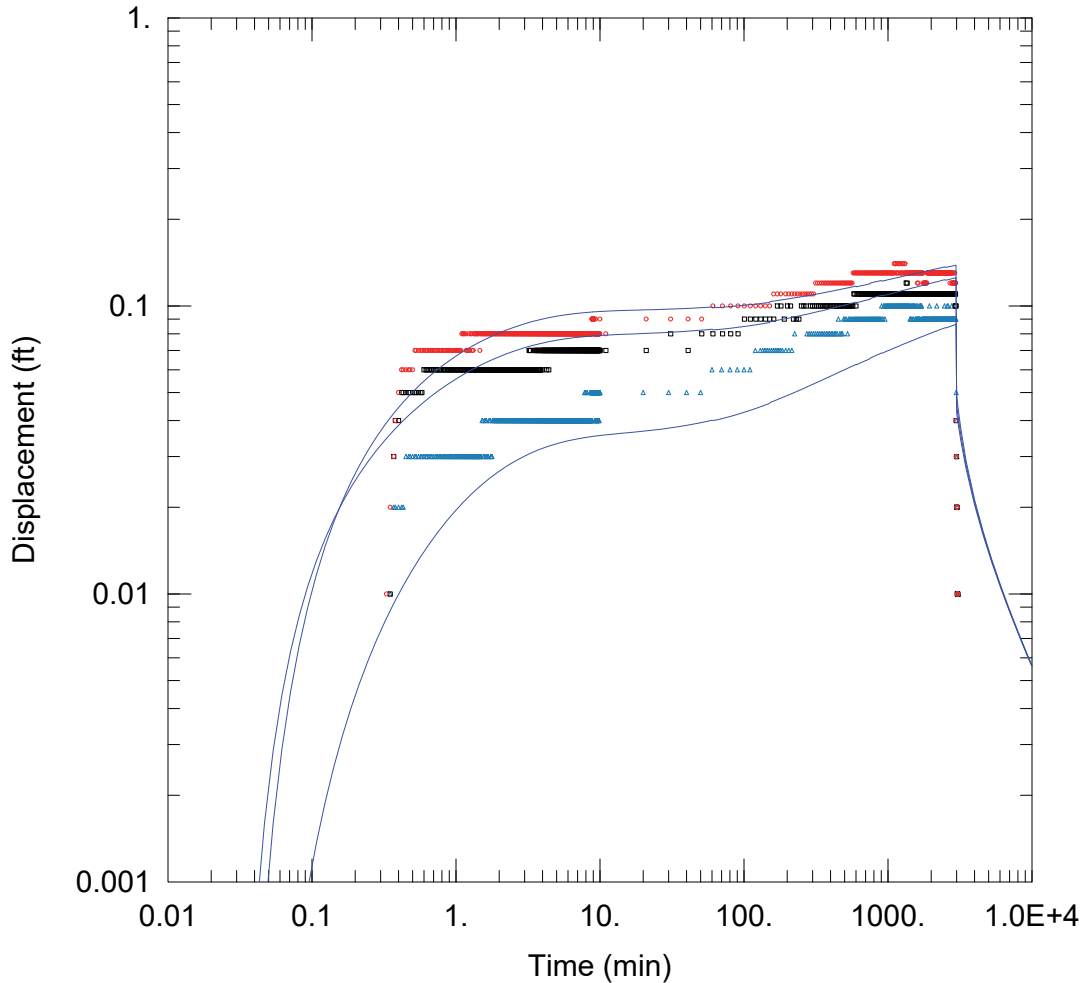
EW-2 Constant Rate - Combined

Prepared By:
Arcadis

Prepared For:
RACER Trust

Project:
OH000294.2018

Location:
Moraine, OH



SOLUTION

Aquifer Model: Unconfined
 Solution Method: Moench

T = <u>1.2E+5</u> ft ² /day	S = <u>0.005</u>
Sy = <u>0.2</u>	Kz/Kr = <u>0.01</u>
Sw = <u>0.</u>	r(w) = <u>0.583</u> ft
r(c) = <u>0.333</u> ft	alpha = <u>1.0E+30</u> min ⁻¹

AQUIFER DATA

Saturated Thickness: 40. ft
 Anisotropy Ratio (Kz/Kr): 0.01

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
EW-2	1482502.114	620369.747

Observation Wells

Well Name	X (ft)	Y (ft)
▲ RMW-94	1482432.702	620379.967
◻ RMW-93	1482440.705	620378.804
○ W-4-S	1482551.361	620363.763

APPENDIX C

Waste Documents





Stony Hollow RDF
 2460 S Gettysburg Ave
 Dayton, OH, 45417
 Ph: 937-268-1133

14349356
 Original
 Ticket# 520226

Customer: ARCADIS 5022110H
 630 PLAZA DR STE 100
 HIGHLANDS RANCH, CO, 80129

Ticket Date 12/04/2017

Account #: 0004768
 Payment Type: Credit Account
 Check #:
 Manual Tckt#:
 PO: OH000294.2017.0003E

Carrier:
 Dest.:
 Vehicle#: 01
 Container:
 Driver:
 Haul Tic#:
 Contract:
 Volume

Manifest: 120417
 Profile: 5022110H (CHLORINATED IMPACTED SOIL)
 Generator: 119-RACERTRUSTMORAIN RACER TRUST - MORAIN FACILITIES

Time	Scale	Operator
In 12/04/2017 11:07:09	Scale1	Rose
Out 12/04/2017 11:31:17	Scale1	Rose

Comments: RACER TRUST

Inbound	Gross	Tare	Net	Tons
	26980 lb	22140 lb	4840 lb	2.42

Product	LDX	Qty	Rate	Fee	Amount	Origin
Cont Soil Sp. W.-Tons-Unspec	100	2.42 Tons	21.27	24.21	\$63.81	OH-MONTGOM
RCR-P-Regulatory Cost Recove	100	%	3.60		\$3.09	OH-MONTGOM
FUEL-Fuel Surcharge - Landfi	100	%	5.94		\$5.10	OH-MONTGOM
EVF-L-Standard Environmental	100	1 Load	22.00		\$22.00	OH-MONTGOM

Total Fees \$24.21
 Total Ticket \$118.21

[Handwritten Signature]
 Driver's Signature



NON-HAZARDOUS WASTE MANIFEST		1. Generator ID Number N/A	2. Page 1 of 1	3. Emergency Response Phone 614-271-6586	4. Waste Tracking Number N/A
5. Generator's Name and Mailing Address Racer Trust 500 Woodward Avenue, Suite 2650 Detroit, MI 48226			Generator's Site Address (if different than mailing address) 3600 Dryden Road Moraine, OH 45439		
6. Transporter 1 Company Name LDR Services			U.S. EPA ID Number N/A		
7. Transporter 2 Company Name DRENNEN Disposal 01			U.S. EPA ID Number		
8. Designated Facility Name and Site Address Stony Hollow RDF 24600 South Gattysburg Ave. Dayton, OH 45417			U.S. EPA ID Number N/A		
9. Waste Shipping Name and Description			10. Containers		12. Unit Wt./Vol.
			No.	Type	11. Total Quantity
1. Non-DOT, Non-RCRA Chlorinated VOC-impacted Soil			1	CM	15 tons
2.					
3.					
4.					
13. Special Handling Instructions and Additional Information WMI Approval No. 5022110H RACER Trust Project Manager: Pam Barnett Project No. 0H000294. 2017. 0003E Please return final manifest to Carolyn.Grogan@arcadis.com					
14. GENERATOR'S/OFFEROR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations.					
Generator's/Offor's Printed/Typed Name Carolyn Grogan on behalf of RACER			Signature <i>Carolyn Grogan</i>		Month Day Year 12 4 17
15. International Shipments <input type="checkbox"/> Import to U.S. <input type="checkbox"/> Export from U.S. Port of entry/exit: _____ Date leaving U.S.: _____					
16. Transporter Acknowledgment of Receipt of Materials					
Transporter 1 Printed/Typed Name Richard W ROBB			Signature <i>Richard W Robb</i>		Month Day Year 12 4 17
Transporter 2 Printed/Typed Name			Signature		Month Day Year
17. Discrepancy					
17a. Discrepancy Indication Space <input type="checkbox"/> Quantity <input type="checkbox"/> Type <input type="checkbox"/> Residue <input type="checkbox"/> Partial Rejection <input type="checkbox"/> Full Rejection					
Manifest Reference Number: _____					
17b. Alternate Facility (or Generator)			U.S. EPA ID Number		
Facility's Phone: _____					
17c. Signature of Alternate Facility (or Generator)			Signature		Month Day Year
18. Designated Facility Owner or Operator: Certification of receipt of materials covered by the manifest except as noted in Item 17a					
Printed/Typed Name JAC			Signature <i>JAC</i>		Month Day Year 12 4 17

GENERATOR

INTL

TRANSPORTER

DESIGNATED FACILITY



153

NON-HAZARDOUS WASTE MANIFEST

1. Generator ID Number
OH-D000817577

2. Page 1 of 1

3. Emergency Response Phone
614-271-6586

4. Waste Tracking Number
120401

5. Generator's Name and Mailing Address
PACER TRUST

Generator's Site Address (if different than mailing address)

500 WOODWARD AVE . SUITE 2650
DETROIT . MI 48226

3600 DYDEN ROAD
MORAINE , OHIO 45439

Generator's Phone: 937-751-8635

6. Transporter 1 Company Name
CHEMTRON-CORP.

U.S. EPA ID Number
OH-D066060609

7. Transporter 2 Company Name

U.S. EPA ID Number

8. Designated Facility Name and Site Address

CHEMTRON CORPORATION
35850 SCHNEIDER CT. AVON OHIO 44011

U.S. EPA ID Number

Facility's Phone: 440-933-6348

OH-D066060609

9. Waste Shipping Name and Description

10. Containers

11. Total Quantity

12. Unit Wt./Vol.

1. NON HAZARDOUS NON REGULATED MATERIAL
(UNUSED DYED WATER AND EOS PRO) D137598-1

003 DM 165 G

2. NON HAZARDOUS NON REGULATED MATERIAL
(NON-HAZARDOUS WATER)

2 013 DM 715 G

3. NON HAZARDOUS NON REGULATED MATERIAL
(SOIL CUTTINGS)

3 040 DM 20000 P

13. Special Handling Instructions and Additional Information

1) 20171122-011
2) 2017112-009

3) 20171122-007

D137598

14. GENERATOR'S/OFFEROR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations.

Generator's/Offoror's Printed/Typed Name

on behalf of
Carolyn Grogan PACER TRUST

Signature

on behalf
Carolyn Grogan OF PACER

Month Day Year
12 04 17

15. International Shipments

Import to U.S.

Export from U.S.

Port of entry/exit:

Date leaving U.S.:

16. Transporter Acknowledgment of Receipt of Materials

Transporter 1 Printed/Typed Name

Jeremy M Bracic

Signature

Jey M Bracic

Month Day Year
12 04 17

Transporter 2 Printed/Typed Name

Signature

Month Day Year

17. Discrepancy

17a. Discrepancy Indication Space

Quantity

Type

Residue

Partial Rejection

Full Rejection

Manifest Reference Number:

U.S. EPA ID Number

17b. Alternate Facility (or Generator)

Facility's Phone:

17c. Signature of Alternate Facility (or Generator)

Month Day Year

18. Designated Facility Owner or Operator: Certification of receipt of materials covered by the manifest except as noted in Item 17a

Printed/Typed Name

JOSEPH T. KISKA

Signature

Month Day Year
12 11 17

APPENDIX D

Groundwater Modeling Technical Memo



To:

Mirtha Capiro
U.S. EPA

Copies:

Pamela L. Barnett
RACER Trust

Arcadis U.S., Inc.

100 E Campus View Boulevard

Suite 200

Columbus

Ohio 43235-1447

Tel 614 985 9100

Fax 614 985 9170

From:

Arcadis U.S., Inc.

Date:

March 22, 2018

Arcadis Project No.:

OH000294.2018.0003E

Subject:

Updates to Groundwater Flow Model for RACER Trust Moraine Facilities in
Moraine, Ohio

INTRODUCTION AND OBJECTIVES

Arcadis U.S., Inc. (Arcadis) prepared this technical memorandum (memo) on behalf of the Revitalizing Auto Communities Environmental Response Trust (RACER Trust) to present an update of the revised three-dimensional groundwater flow model (Model; Arcadis Inc., 2008) for the RACER Trust (formerly General Motors Corporation [former GM Corporation]) Moraine Facilities in Moraine, Ohio (Site; **Figure 1**). The facilities included:

- former Delphi Harrison Thermal Systems Moraine Plant (former Delphi Thermal Moraine)
- former General Motors Powertrain Group, Moraine Engine Plant (former Moraine Engine)
- former General Motors Truck Group, Moraine Assembly Plant (former Moraine Assembly)

Since the last Model update in 2008, there have been several investigations and evaluations that resulted in updates to the conceptual site model (CSM; Arcadis Inc., 2012, 2015, and 2016). Recently, the Phase 1 Dynamic Groundwater Recirculation (DGR™) Interim Measure Pilot Test Work Plan (Work Plan; Arcadis Inc., 2017a) included additional Site characterization, well installation, and hydraulic testing. This recent work directly relates to the main objective of the groundwater flow Model: to support remedial design simulations of DGR™ for treatment of site-specific volatile organic compounds (VOCs) in the upper

aquifer. Phase 1 is an interim measure (IM) for UA groundwater within the Riverview Plat neighborhood (neighborhood), and Phase 2 is anticipated to be a portion of the final remedy for on-site dissolved-phase UA groundwater. The remedial goal for the Phase 1 IM is to reduce site-specific VOCs in groundwater within the neighborhood to concentrations below the Maximum Contaminant Levels (MCLs) within 5 years of initiating full-scale operation. The remedial goal for Phase 2 on-site is to reduce site-specific VOCs in groundwater to concentrations below MCLs at the property boundary.

The remedial activities are intended to expedite treatment within an abbreviated timeframe. The neighborhood IM (capture portion) would require operation north of the neighborhood until treatment of the on-site plume (upgradient) is complete. Therefore, the Phase 1 IM DGR™ design and Phase 2 on-site DGR™ simulations presented in this memo will be coupled with the final site-wide remedial approach selected during the Statement of Basis development that includes in-situ treatment to address relatively high concentrations of site-specific VOCs in the former Process Sump Area (PSA).

The activities for the Model update included the following: (1) review of existing CSM and recently collected hydrogeologic data; (2) refine the CSM; (3) update and refine the previous groundwater flow Model; and (4) calibrate the refined groundwater flow Model to recent flow conditions.

RECENT SITE INFORMATION AND CSM REFINEMENT

The comprehensive CSM was presented in the 2012 Corrective Measures Proposal (CMP; Arcadis Inc., 2012) that includes specifics on (1) site characteristics; (2) regional to local geology, hydrogeology, and groundwater use/flow; (3) site-specific assessment (three-dimensional data analysis and detailed hydrostratigraphy); (4) hydrogeologic characteristics and parameters; (5) source area and site-wide dissolved-phase plume understanding; and (6) risk assessment. Additional area specific CSMs for the former PSA were presented in 2015 and 2016, facilitating the improved understanding of the Site geology, hydrogeology, and distribution of site-specific VOCs (Arcadis Inc., 2015 and 2016). Current information on the site-wide dissolved-phase plume was available as part of the 2016 Site-Wide Annual Groundwater Report (Arcadis Inc., 2017b). In addition, current information was compiled for precipitation (National Oceanic and Atmospheric Administration [NOAA], 2018) and groundwater use (pumping) from the Ohio Department of Natural Resources (ODNR).

As mentioned above, a recent DGR™ pilot test for the neighborhood was completed in 2017 based on the Work Plan (Arcadis Inc., 2017a). The pilot test objectives were to determine extraction and injection UA influence, capacity from the newly designed system wells, and refinement of area-specific hydraulic parameters. The results from the pilot test (influence, capacity, and hydraulic parameters) were used along with other CSM data mentioned above in the Model update.

MODEL UPDATE

This section summarizes the updates made to the existing site groundwater flow Model. These updates were based on a review of the existing Model in conjunction with new and relevant data/information from the CSM. Review of the existing model developed by Arcadis (2008) relative to recent water-level data collected from the Site indicated that some boundary conditions, the distribution of upper and regional clay till, the hydraulic conductivity, applied recharge, and the Model grid required adjustment to better represent conditions at the Site.

As outlined in the CSM, the groundwater flow system resides within the glacial buried valley complex of the Great Miami River valley. Locally the hydrogeology can be divided into three main hydrostratigraphic units (i.e., upper aquifer [UA], regional clay till [RCT], and lower aquifer [LA]), including two principle aquifers (i.e., UA and LA). The UA and LA consist of glacial outwash sand and gravel deposits (sand and gravel facies) and an area of the UA near the former Moraine Assembly (northeastern portion of the Site) that consists of interbedded finer grained units with the sand and gravel (interbedded facies). The UA has an average saturated thickness of 30 feet. The upper clay till (UCT) and RCT units act as aquitards that transmit water at relatively low rates. The UCT and RCT were fully to partially eroded during the deposition of the UA. This resulted in the UCT distribution being discontinuous and primarily located east of the railroad. The RCT is distributed across the Site with some thinner areas near the former Moraine Assembly. Southwest and northeast of the Site, portions of the RCT have been eroded allowing direct communication between aquifers (Spieker, 1968). The LA underlies the RCT and ranges in thickness from a few feet along the valley walls to greater than 200 feet in the central part of the valley. The base of the valley and valley walls are comprised of low permeability Ordovician shales and limestones of the Richmond Group (Slucher et al. 2006).

The previous Model finite-difference grid was oriented due north, approximately parallel to the primary direction of groundwater flow, the Great Miami River, and the buried valley. The model structure is composed of five layers. Model layers 1 and 2 represent the UA and the RCT, respectively. The LA was divided into 3 separate model layers due to the thickness. The updated Model maintains the same north-south grid orientation; however, the number of rows and columns of the grid were increased to accurately incorporate the geologic data (elevations and thicknesses of hydrostratigraphic units) collected during investigations since 2008, represent the details of the evaluated remediation systems, and to incorporate the current site-wide dissolved-phase plume distribution. The refined grid is presented on **Figure 2**. The updated finite-difference grid consists of 623 columns, 653 rows, and 5 layers for a total of 2,034,095 model cells. The updated model is significantly more detailed than the 2008 model which was composed of 282 columns, 301 rows, and 5 layers for a total of 424,410 model cells.

Boundary conditions in the existing model included constant head boundaries (representing inflow/outflow), river boundaries (representing the Great Miami River, retention basins, ponds, and tributaries), no flow boundaries, and regional pumping wells. The boundary conditions are presented on **Figure 3**. These boundary conditions were retained from the existing model with updates from the current CSM and regional information. The no-flow boundary condition used to represent the limits of the bedrock valley was updated based on bedrock depth data from the Ohio Division of Geological Survey (2003), adjusted with Site data points for bedrock depth. The river and constant head boundaries were updated using surface elevations obtained from the United States Geological Survey (USGS). Changes to the river and no-flow boundaries were also made to accommodate the refined finite-difference grid. River cell conductance was refined to accommodate the refined finite-difference grid, with conductance values for the Great Miami River ranging from 31.25 to 5,000 square feet per day (ft²/day). The 2008 model used conductance values ranging from 20 to 500 ft²/day. Regional pumping rates obtained from the ODNR for regional groundwater pumping wells were updated to align with current Site conditions (**Table 1**).

The hydraulic conductivity zones in the model were refined based on recently collected data that included the DGR™ pilot test results for the neighborhood and depths of the RCT. The UCT distribution was also updated, and in areas where the depth extends into the UA, the model was refined to reflect a local reduction of the UA transmissivity (**Figure 4**). These effects were incorporated in the Model by spatially varying the hydraulic conductivity. The updated hydraulic conductivity values in the model are presented on **Figure 5**. The recharge distribution was simplified from two zones in the original Model, to a single

recharge zone of 7.7 inches per year which represents 18.3% of the average annual precipitation of 42 inches per year recorded between 2013 and 2017 (NOAA, 2018).

The updated Model was calibrated to recently collected groundwater data at 144 Site and regional locations representing average 2012 through 2015 conditions. The updated model was calibrated assuming steady-state conditions.

MODEL CALIBRATION

Calibration of a groundwater flow model refers to the iterative process of systematically adjusting the model boundary conditions and input parameters within a justifiable and generally-accepted range of values to obtain as close a match between observed and simulated water levels. The generally-accepted process for comparison of simulated and observed water levels is summarized in ASTM Standard D-5490-93 (ASTM, 1994), utilizing the concept of residuals (the differences between simulated and observed water levels).

The residuals are evaluated using standard statistical measures; residual sum-of-squares (RSS), variance, and mean. The standard deviation (the square root of the variance) is the median error and needs to be relatively small compared to the range in observed data. A well calibrated model will reproduce observed water levels with a maximum median error of less than 10% of the difference between the largest and smallest observed water level (Anderson and Woessner, 1992).

The average water levels from 2012 to 2015 used for model calibration are summarized in **Table 2**. The regional simulated UA groundwater elevation contour map is shown on **Figure 6**. A plot of observed versus simulated groundwater elevations for the 144 calibration targets is presented on **Figure 7**.

The calibration statistics for the groundwater flow model indicate a good match between simulated and measured groundwater elevations. The residual mean, residual standard deviation, and RSS were calculated to be -0.13 feet, 0.44 feet, and 30.07 square feet (ft²), respectively. The residual mean is close to zero and the residual standard deviation is less than 5% of the range in observed water levels. Simulated water level contours and residuals for each target are plotted by layer on **Figure 8** for layers 1 (UA), 3 and 4 (both LA). There are no targets in the RCT (layer 2) or at the bottom of the LA (layer 5). **Figure 8** indicates that the residuals are unbiased with positive and negative residuals relatively balanced throughout the Site. These statistics and observations indicate that the calibrated model can be used as a critical tool for the evaluation of Site remedial design.

REMEDIATION DESIGN ANALYSIS

The Model was used as a primary support for the remedial design of the Phase 1 DGR™ IM (off-site) and the conceptual design of the Phase 2 DGR™ (on-site) system to address the UA dissolved phase plume. The general approach to DGR™ includes hydraulic containment and contaminant removal via groundwater extraction combined with strategic reinjection of treated groundwater to enhance advective flushing of the contaminant mass from the aquifer matrix. The dynamic nature of this remedial approach allows for variations in pumping rates and locations to target specific areas of the plume and reduce the potential for hydraulic stagnation points and accelerate remedial timeframes.

For the design simulations, the DGR™ technology is proposed to be implemented across the Site, at the property boundary just north of the neighborhood, and at the distal toe of the plume south of the neighborhood. This approach was presented in the Proposed Final Remedy Components Amendment (RACER Trust, 2016).

Utilizing the updated CSM, pilot test data results, and Model, the specific design aspects of the DGR™ remedial approach was assessed. The primary basis for the design of a DGR™ system is the volume of water contained within the plume and the number of clean water pore volume flushes required to achieve the water quality goals set forth by the site-specific performance objectives. Based on the distribution and magnitude of VOC concentrations, the water quality goals, and the hydrogeologic characteristics of the Site, the necessary number of groundwater pore flushes can be calculated. With the calculated required pore flushes and the sustainable yields and hydraulic influence of the extraction and injection wells determined during the pilot test, the number of necessary extraction and injection wells can be computed to achieve water quality goals in a desired timeframe. Strategic placement of the injection and extraction wells can then be determined and further assessed with Model simulations to ensure hydraulic containment of the plume and to confirm the pore flush distribution for the designed DGR™ systems.

The UA dissolved phase plume concentrations consist primarily of tetrachloroethene (PCE) and trichloroethene (TCE). The data and the resulting distribution in the UA were utilized to develop the DGR™ design. A single composite PCE and TCE plume distribution was developed to represent the maximum observed concentration as of 2016 (Arcadis Inc., 2017b). This plume distribution is shown in **Figure 9**. The composite PCE/TCE plume distribution was then directly utilized to compute the spatial distribution of the number of clean water pore flushes (NF) required to achieve the water quality goals using the batch flush equation:

$$NF = LN \left(\frac{C_o}{C} \right) * R_f$$

Where:

C_o = the initial contaminant concentration

C = the target clean-up goal concentration

R_f = Retardation factor (site-specific average value of 1.71)

The resultant number of required clean water pore flushes for the composite PCE/TCE plume is shown in **Figure 10**.

The DGR™ design for the dissolved-phase plume was developed in two phases: Phase 1 is to restore groundwater quality within the neighborhood to below MCLs within 5 years of initiating full-scale operation. The remedial goals for Phase 2 on-site is to reduce VOCs in groundwater to below MCLs at the property boundary. The extraction wells were located to maintain hydraulic control and maximize the removal of mass, while the injection wells were located to focus hydraulic gradients, maximize clean water pore flushes, and to prevent hydraulic stagnation points developing within the aquifer during operation. The cumulative proposed DGR™ design (Phase 1 and 2) layout that was used for calculations and simulations is shown in **Figure 11**. The specifics for the proposed extraction/injection well locations, rates, and estimated UCT thickness at each well are further summarized in **Table 3**.

The Phase 1 DGR™ extraction and injection well locations were located immediately upgradient and downgradient of the neighborhood. Phase 1 utilizes the pilot test wells and minimizes the installation of infrastructure within the neighborhood. The Phase 1 design consists of four extraction well locations and five injection well locations with total flow balanced at a rate of 400 gallons per minute (gpm). The three upgradient extraction well locations (EW-1, EW-2, and EW-3) were designed to capture the mass flux migrating towards the neighborhood. The four upgradient injection well locations (IW-1, IW-2, IW-3, and IW-4) were designed to enhance the clean water flush through the neighborhood. Wells IW-1 and IW-2 are located at existing well locations EW-1 and EW-2 that were used for the pilot test. The downgradient

extraction well (EW-4) is positioned to hydraulically control the distal toe of the plume currently within the neighborhood. The downgradient injection well (IW-5) is located on the eastern edge of the plume to provide additional flushing without compromising hydraulic control.

The Phase 2 DGR™ extraction and injection well locations were spatially located throughout the footprint of the dissolved-phase plume. The Phase 2 design consists of nine extraction well locations and 17 injection well locations that has a total flow balanced at a rate of 900 gpm. The northeastern injection well locations (IW-6, IW-7, IW-8, IW-10, IW-11, and IW-13) were simulated along the perimeter of the proposed in-situ treatment area to help hydraulically isolate the in-situ treatment area and minimize the potential migration of in-situ treatment byproducts from the former PSA. The Phase 2 extraction well locations were located along the core of the plume and at the southeastern edge of the plume to maximize mass removal. The remainder of the injection well locations were placed along the edge of the plume and between proposed extraction locations to maintain hydraulic control and alleviate potential hydraulic stagnation points.

As shown in **Table 3**, the collective DGR™ design consists of 13 extraction well locations and 22 injection well locations, with a total extraction flow rate of 1,300 gpm and total injection flow rate of 1,300 gpm. The individual extraction wells operated at a flow rate of 100 gpm each, while the individual injection well location flow rates varied from 25 gpm in the north to 100 gpm in the south. A total of 13 of the 22 injection well locations are within the estimated extents of the UCT (IW-7 through IW-15, IW-17 through IW-19, and IW-22), and it is assumed that well pairs will be installed in these locations to effectively inject above and below the localized UCT.

The hydraulic capture zone for the cumulative DGR™ design was delineated using the MODular flow ALlocation (MODALL) program (Potter et al. 2008). MODALL uses the MODFLOW-calculated cell-by-cell flow terms to delineate the zone of capture of selected boundary conditions. The capture zones delineated by MODALL provide a conservative estimate of capture limits similar to a pathline analysis using MODPATH. The MODALL fraction of hydraulic capture is shown in **Figure 12**. This fraction of hydraulic capture indicates the targeted area of capture is hydraulically controlled (hydraulic capture fraction greater than 0.5). The limited portions of the composite PCE/TCE plume that are not captured are downgradient or side-gradient of the low concentration dissolved-phase plume or are the upgradient former PSA source area designed to be addressed by in-situ treatment.

In addition to the capture delineation, MODALL was utilized to estimate the spatial remedial time distribution throughout the composite plume as shown in **Figure 12**. This spatial remedial time distribution was estimated by multiplying the spatial distribution of the required number of pore flushes by the simulated average pore flush duration per cell by the average grid cell length in the direction of flow (25 feet). This estimated cleanup distribution indicates the bulk of the plume targeted by the DGR cumulative DGR™ system (Phase 1 and 2) will reach remedial goals. Several portions of this cleanup time distribution within the plume footprint indicate longer cleanup times, but this is a function of running a steady-state groundwater flow model where stagnation points may form. These areas do not indicate that additional infrastructure is necessary, but rather where the proposed DGR™ system pumping rates will be varied to shift these hydraulic stagnation points over time. This is a key aspect of the need for dynamic operation of the DGR™ system through optimization.

SUMMARY AND CONCLUSIONS

The numerical groundwater flow model was revised with updates from the CSM and pilot test data to support the evaluation of a DGR™ as an IM in the neighborhood and as an on-site dissolved phase plume

remedy. The model was calibrated under steady-state conditions using average groundwater level measurements from 2012 through 2015 at 144 locations. The model was used to evaluate two phases of DGR™ system design. Each area (neighborhood Phase 1 and on-site Phase 2) showed that the targeted area of capture is hydraulically controlled and that the composite PCE/TCE plume will reach water quality goals.

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TABLES



Table 1
Regional Pumping Wells
RACER Trust Moraine Facilities
Moraine, Ohio
Groundwater Flow Model Update

Well ID	Easting (STPL NAD 83 ft Ohio South)	Northing (STPL NAD 83 ft Ohio South)	Layer	2012-2015 Average Pumping Rate (gpm)
BarrettPaving-WestCarPlant	1,470,492	615,452	3, 4, 5	370.2
AppletonPapers	1,479,453	613,760	3, 4, 5	640.7
WestCarrolltonCityPWS	1,476,552	613,412	3, 4, 5	685.7
MoCo- GreaterMoraineSystem1	1,480,466	617,285	3, 4, 5	2,180.2
MoraineCoClub	1,490,483	618,105	3, 4, 5	47.5
PointWest	1,489,072	626,227	3, 4, 5	0.4
Miller-ValentineGr	1,483,270	629,373	3, 4, 5	1,032.8
MoCo-WestRegWWPlant	1,485,252	630,853	3, 4, 5	20.8
DPL-TaitElecGenStn	1,487,892	634,042	3, 4, 5	1.9
DN-13	1,482,252	619,198	3	620.9

Notes and Abbreviations

STPL NAD 83 = State Plane North American Datum of 1983

ft = feet

gpm = gallons per minute

DN-13 - Montgomery County Well (used by RACER Trust as lower aquifer recovery well)

Layers 3, 4, and 5 are Lower Aquifer.

Pumping rates obtained from the Ohio Department of Natural Resources (ODNR)

Table 2
Groundwater Targets and Residuals
RACER Trust Moraine Facilities
Moraine, Ohio
Groundwater Flow Model Update

Well ID	Easting (STPL NAD 83 ft Ohio South)	Northing (STPL NAD 83 ft Ohio South)	Layer	2012-2015 Average Observed Water Level (ft amsl)	Simulated Water Level (ft amsl)	Residual (ft)
W-1-N	1,483,947	625,116	1	709.27	709.68	-0.41
W-2-N	1,483,352	623,866	1	708.61	708.99	-0.38
W-3-N	1,483,607	623,696	1	708.62	708.98	-0.36
W-4-N	1,483,795	623,652	1	708.20	709.01	-0.81
HR-1	1,483,378	621,968	1	707.78	708.03	-0.25
HR-2	1,484,031	623,649	1	708.76	709.08	-0.32
HR-3	1,484,238	623,612	1	708.78	709.11	-0.33
HR-4	1,484,004	624,582	1	709.08	709.47	-0.40
HR-5	1,483,479	623,355	1	708.50	708.77	-0.27
HR-6	1,483,299	622,589	1	707.90	708.33	-0.43
HR-7	1,483,169	623,374	1	708.30	708.70	-0.40
HR-11	1,485,263	625,682	1	709.68	710.17	-0.49
HR-16	1,482,172	621,168	1	707.07	707.34	-0.28
HR-17	1,482,781	621,128	1	707.37	707.47	-0.10
W-1-S	1,482,990	621,396	1	707.60	707.64	-0.04
W-2-S	1,482,079	620,619	1	706.58	707.06	-0.49
W-3-S	1,482,167	620,461	1	706.66	707.00	-0.34
W-4-S	1,482,551	620,364	1	706.96	707.05	-0.09
GM-2	1,483,428	619,586	1	707.08	706.97	0.12
4S	1,483,130	619,578	1	706.78	706.85	-0.07
GM-6	1,482,931	619,628	1	706.32	706.80	-0.48
GM-8	1,482,966	619,866	1	706.52	706.94	-0.42
GM-10	1,482,668	618,763	1	706.27	706.22	0.05
GM-16	1,482,149	619,421	1	706.20	706.47	-0.27
GM-17	1,482,697	619,312	1	706.43	706.56	-0.13
GM-18	1,482,505	619,230	1	706.28	706.46	-0.18
GM-19S	1,483,017	620,340	1	707.18	707.18	0.01
GM-21	1,483,765	619,921	1	707.57	707.24	0.33
GM-22	1,484,227	620,840	1	708.05	707.76	0.28
GM-23	1,484,620	623,699	1	708.96	709.25	-0.29
GM-24	1,486,992	625,945	1	710.30	710.53	-0.23
GM-25	1,486,600	622,786	1	708.72	709.31	-0.59
GM-26	1,482,129	617,730	1	705.89	705.48	0.41
GM-27	1,484,631	623,697	1	708.99	709.25	-0.27
GM-28	1,484,437	623,392	1	708.79	709.06	-0.27
GM-29	1,484,535	623,534	1	709.74	709.15	0.59
GM-30	1,484,610	623,876	1	708.94	709.33	-0.39
GM-31	1,483,965	621,337	1	707.73	707.88	-0.15
GM-32	1,483,380	620,114	1	707.17	707.19	-0.03
GM-33	1,483,641	620,731	1	707.67	707.54	0.13
GM-34	1,483,650	620,730	1	707.11	707.54	-0.43
GM-35	1,483,276	620,275	1	707.11	707.23	-0.12
GM-36	1,483,301	620,383	1	707.24	707.28	-0.04
GM-37	1,483,456	620,407	1	707.49	707.34	0.14
GM-38	1,483,472	620,403	1	707.24	707.35	-0.11
GM-43	1,483,441	622,192	1	707.84	708.16	-0.32
GM-44	1,483,332	621,686	1	707.58	707.86	-0.28
GM-45	1,483,267	621,409	1	708.18	707.72	0.46
GM-46	1,484,777	623,394	1	709.47	709.15	0.32
GM-47	1,482,479	620,061	1	706.45	706.88	-0.44
GM-48	1,481,741	619,488	1	705.94	706.44	-0.50
GM-49	1,481,743	618,644	1	705.68	705.93	-0.26
GM-50	1,482,446	620,065	1	706.41	706.88	-0.46
GM-51	1,481,753	619,465	1	705.99	706.42	-0.43
GM-52	1,481,741	618,605	1	705.57	705.91	-0.34
GM-53	1,484,856	621,185	1	708.09	708.16	-0.06
GM-55	1,482,442	618,008	1	705.90	705.75	0.15
GM-57	1,482,132	617,724	1	705.72	705.48	0.24
GM-59	1,484,696	622,767	1	708.58	708.77	-0.19
GM-60	1,484,696	622,767	1	708.54	708.77	-0.24
GM-62	1,482,818	618,397	1	706.44	706.06	0.38
GM-63	1,482,671	620,288	1	706.71	707.05	-0.34
GM-64	1,482,666	620,289	1	706.67	707.05	-0.38
GM-65S	1,481,382	617,392	1	705.10	704.85	0.25
GM-66	1,484,092	622,780	1	708.33	708.62	-0.29
GM-67S	1,484,547	623,050	1	707.88	708.89	-1.01
GM-68S	1,484,653	622,326	1	708.22	708.57	-0.35
GM-71	1,485,206	622,640	1	708.72	708.85	-0.13

Table 2
Groundwater Targets and Residuals
RACER Trust Moraine Facilities
Moraine, Ohio
Groundwater Flow Model Update

Well ID	Easting (STPL NAD 83 ft Ohio South)	Northing (STPL NAD 83 ft Ohio South)	Layer	2012-2015 Average Observed Water Level (ft amsl)	Simulated Water Level (ft amsl)	Residual (ft)
GM-72	1,485,218	622,639	1	708.71	708.85	-0.14
GM-74S	1,484,734	622,445	1	708.56	708.65	-0.09
GM-75S	1,485,022	622,797	1	708.66	708.87	-0.21
GM-76S	1,485,297	623,545	1	709.18	709.36	-0.18
GM-77S	1,485,876	621,583	1	708.73	708.65	0.08
GM-78	1,483,036	618,258	1	706.47	706.12	0.35
GM-79	1,481,032	618,974	1	705.29	705.79	-0.50
GM-80	1,480,926	617,956	1	705.01	704.77	0.23
GM-81	1,480,921	617,939	1	704.96	704.76	0.21
EAST	1,483,674	620,546	1	707.58	707.47	0.10
WEST	1,483,299	620,510	1	707.41	707.34	0.07
WSU-17	1,482,899	619,558	1	706.18	706.75	-0.58
WSU-18	1,483,097	619,555	1	706.73	706.82	-0.09
WSU-19	1,482,880	619,737	1	704.91	706.84	-1.93
WSU-23	1,481,979	620,381	1	706.22	706.93	-0.71
WSU-24	1,483,169	619,124	1	706.78	706.63	0.15
TW-2	1,482,943	619,568	1	707.54	706.77	0.77
ME-2	1,484,015	621,327	1	707.18	707.89	-0.71
ME-3	1,483,970	621,288	1	707.63	707.86	-0.23
ME-4	1,483,952	621,321	1	707.69	707.87	-0.19
ME-6	1,484,057	621,707	1	707.64	708.09	-0.45
MW-4	1,478,050	619,035	1	701.21	703.15	-1.94
MW-5	1,478,958	618,790	1	702.94	703.93	-1.00
GM-1	1,483,422	619,571	3	706.82	706.57	0.25
GM-3	1,482,926	619,622	3	706.37	706.25	0.11
GM-5	1,483,127	619,589	3	706.51	706.38	0.12
GM-7R	1,482,962	619,864	3	706.84	706.40	0.44
GM-9	1,482,674	618,772	3	706.02	705.86	0.15
GM-11	1,482,694	619,319	3	706.01	705.90	0.11
GM-13	1,482,502	619,239	3	705.61	705.57	0.04
GM-15	1,482,157	619,428	3	705.37	705.47	-0.10
GM-20D	1,483,237	619,178	3	706.97	706.34	0.63
GM-39	1,484,609	623,706	3	708.95	709.16	-0.21
GM-41	1,484,818	621,636	3	708.21	708.26	-0.05
GM-54	1,484,849	621,182	3	708.21	708.05	0.16
GM-56	1,482,449	618,006	3	705.89	705.72	0.17
GM-58	1,485,309	621,542	3	708.53	708.43	0.09
GM-61	1,484,707	622,763	3	708.62	708.75	-0.13
GM-65D	1,481,380	617,390	3	705.08	704.77	0.31
GM-67D	1,484,533	623,054	3	708.67	708.83	-0.16
GM-68D	1,484,646	622,328	3	708.46	708.52	-0.06
GM-69	1,484,402	621,315	3	707.84	707.91	-0.07
GM-70	1,485,506	621,944	3	708.72	708.68	0.04
GM-73	1,485,217	622,636	3	709.11	708.87	0.24
GM-74D	1,484,736	622,450	3	708.51	708.62	-0.11
GM-75D	1,485,028	622,793	3	708.82	708.88	-0.06
GM-76D	1,485,312	623,535	3	709.44	709.29	0.15
GM-77D	1,485,889	621,574	3	708.78	708.66	0.12
RMW-85	1,484,978	622,914	3	708.86	708.92	-0.06
RMW-86	1,483,253	620,410	3	706.91	706.87	0.05
RMW-87	1,483,277	621,672	3	707.43	707.57	-0.14
RMW-88	1,484,581	625,052	3	709.62	709.78	-0.16
HR-12	1,485,250	625,702	3	709.67	710.18	-0.51
HR-13	1,484,215	623,617	3	708.85	708.99	-0.14
HR-14	1,483,782	623,675	3	708.65	708.88	-0.23
HR-15	1,483,596	623,713	3	708.50	708.84	-0.34
M73C	1,482,114	618,973	3	705.58	705.32	0.26
MT576M	1,487,799	622,940	3	710.58	709.62	0.96
MT596M	1,488,849	624,057	3	711.00	710.12	0.87
31	1,485,049	623,727	3	709.96	709.30	0.66
A	1,484,806	624,325	3	710.69	709.51	1.18
FW-1A	1,486,090	625,358	3	708.49	710.19	-1.71
FW-2	1,485,617	622,516	3	708.94	708.95	-0.01
FW-3	1,484,969	622,675	3	708.92	708.81	0.11
FW-4	1,484,338	620,605	3	707.54	707.53	0.01
MW-1	1,480,209	621,421	3	705.84	705.84	0.01
MW-9	1,478,734	617,171	3	702.16	703.40	-1.25
GM-4	1,482,923	619,603	4	706.35	706.24	0.11

Table 2
Groundwater Targets and Residuals
RACER Trust Moraine Facilities
Moraine, Ohio
Groundwater Flow Model Update

Well ID	Easting (STPL NAD 83 ft Ohio South)	Northing (STPL NAD 83 ft Ohio South)	Layer	2012-2015 Average Observed Water Level (ft amsl)	Simulated Water Level (ft amsl)	Residual (ft)
GM-14	1,482,516	619,244	4	705.59	705.65	-0.05
GM-19D	1,483,064	620,340	4	707.21	706.72	0.49
GM-40	1,483,085	621,694	4	707.20	707.49	-0.29
GM-42	1,483,563	620,810	4	707.06	707.24	-0.18
12A	1,485,913	622,838	4	708.60	709.17	-0.57
11B	1,485,800	622,501	4	709.10	709.00	0.10
34	1,485,018	622,178	4	708.56	708.60	-0.04
39	1,484,988	623,442	4	709.17	709.15	0.01
Residual Statistics						
Residual Mean (ft)						-0.128
Residual Std. Deviation (ft)						0.44
Sum of Squares (ft ²)						30.07
Number of Observations						144
Range in Observations (ft)						9.79
Scaled Residual Std. Deviation						4.48%

Notes and Abbreviations

STPL NAD 83 = State Plane North American Datum of 1983

ft = feet

gpm = gallons per minute

ft amsl = feet above mean sea level

Table 3
Proposed DGR Wells
RACER Trust Moraine Facilities
Moraine, Ohio
Groundwater Flow Model Update

Well ID	Easting (STPL NAD 83 ft Ohio South)	Northing (STPL NAD 83 ft Ohio South)	Layer	Proposed Extraction or Injection Rates ² (gpm)	Estimated Upper Aquifer Saturated Thickness (ft)	Estimated Upper Clay Till Thickness (ft)
EW-1	1,482,346	620,653	1	-100	41.8	1.0
EW-2	1,482,558	620,653	1	-100	39.4	2.7
EW-3	1,482,788	620,653	1	-100	37.3	6.2
EW-4	1,482,031	619,284	1	-100	43.2	0.0
EW-5	1,483,844	623,156	1	-100	29.9	5.7
EW-6	1,483,669	622,542	1	-100	29.4	3.1
EW-7	1,484,350	622,210	1	-100	31.3	9.1
EW-8	1,483,553	622,002	1	-100	32.5	6.0
EW-9	1,483,221	621,446	1	-100	36.6	2.5
EW-10	1,483,703	621,346	1	-100	38.0	5.5
EW-11	1,483,047	620,649	1	-100	35.7	2.1
EW-12	1,483,337	620,616	1	-100	35.4	2.2
EW-13	1,483,603	620,583	1	-100	34.5	0.0
IW-1 ¹	1,482,248	620,399	1	75	42.8	0.0
IW-2 ¹	1,482,501	620,368	1	75	39.8	0.1
IW-3	1,482,692	620,368	1	75	37.9	0.0
IW-4	1,482,840	620,356	1	75	37.1	0.1
IW-5	1,482,737	619,393	1	100	35.8	0.1
IW-6	1,484,300	623,671	1	25	27.2	0.2
IW-7	1,484,267	623,372	1	25	26.5	2.8
IW-8	1,484,184	623,073	1	25	27.0	7.5
IW-9	1,483,595	623,447	1	25	32.9	5.5
IW-10	1,484,458	622,550	1	33	27.4	4.8
IW-11	1,484,748	622,500	1	33	27.9	5.2
IW-12	1,484,707	622,160	1	33	31.4	10.3
IW-13	1,484,076	622,724	1	50	27.9	6.7
IW-14	1,483,346	622,857	1	50	31.3	2.2
IW-15	1,483,893	622,218	1	50	31.1	6.5
IW-16	1,483,155	622,276	1	50	30.4	0.8
IW-17	1,483,014	621,836	1	67	32.4	2.8
IW-18	1,483,487	621,695	1	67	38.6	7.4
IW-19	1,483,918	621,836	1	67	35.5	9.6
IW-20	1,483,047	621,114	1	100	36.5	1.3
IW-21	1,483,470	621,031	1	100	36.7	1.8
IW-22	1,483,769	621,048	1	100	36.4	2.8

Notes and Abbreviations

STPL NAD 83 = State Plane North American Datum of 1983

ft = feet

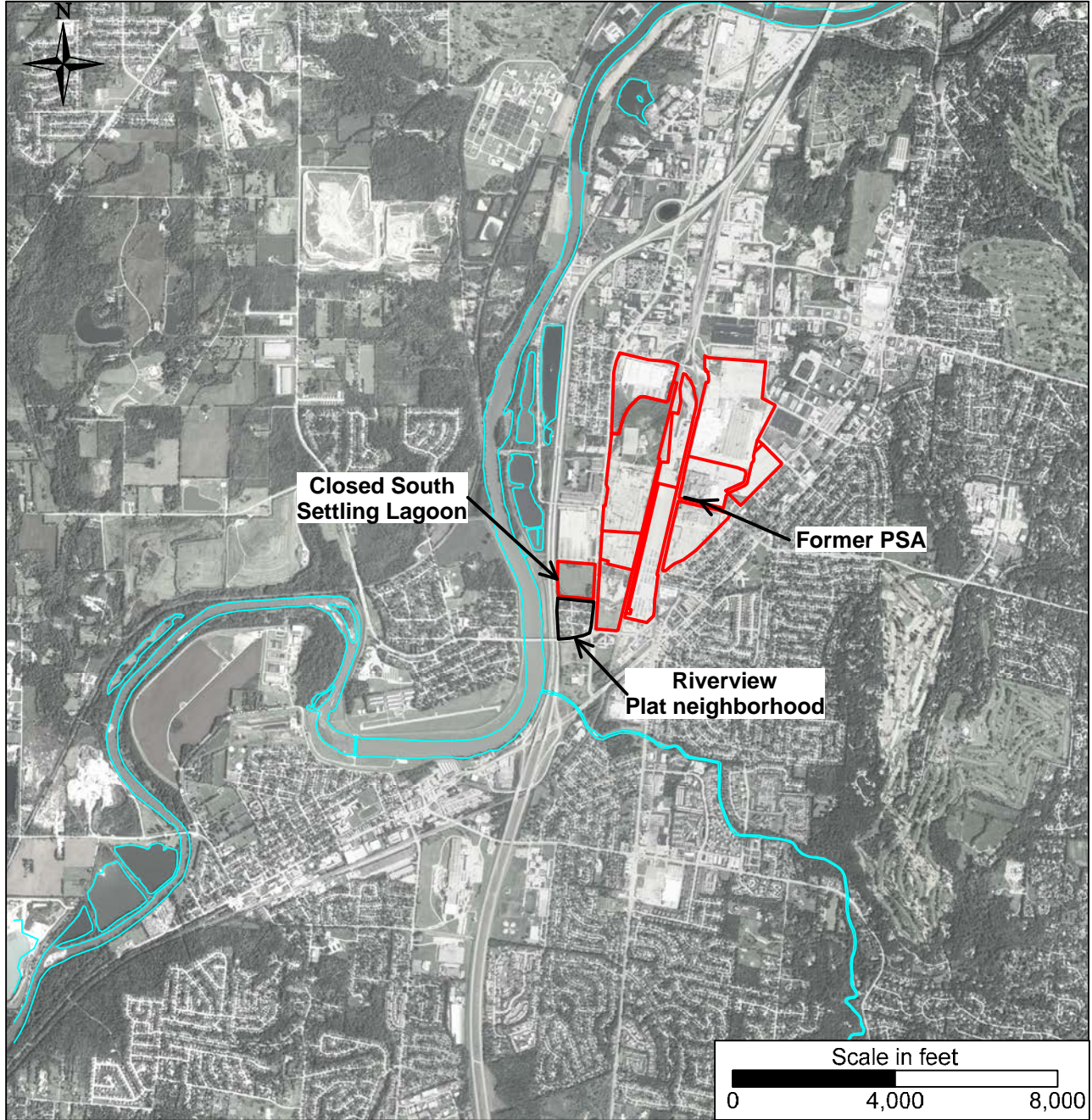
gpm = gallons per minute

¹ Existing well

² Negative rates represent extraction; positive rates represent injection

FIGURES

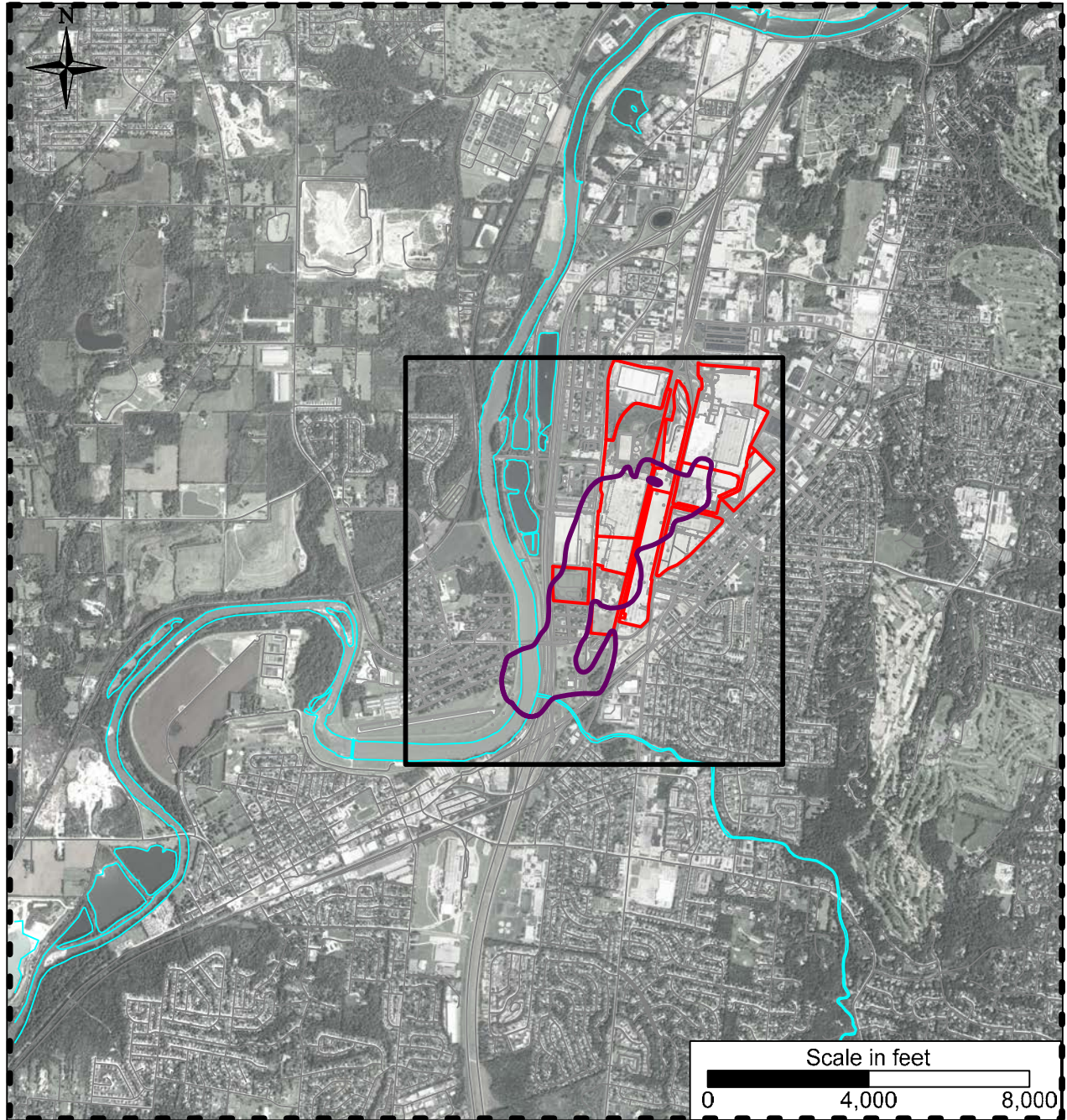




Legend

- Site Property Line
- Great Miami River, tributaries, and surface water features in the model.

RACER TRUST MORaine FACILITIES MORaine, OHIO GROUNDWATER FLOW MODEL UPDATE	
SITE LOCATION	
Design & Consultancy for natural and built assets	FIGURE 1



Legend

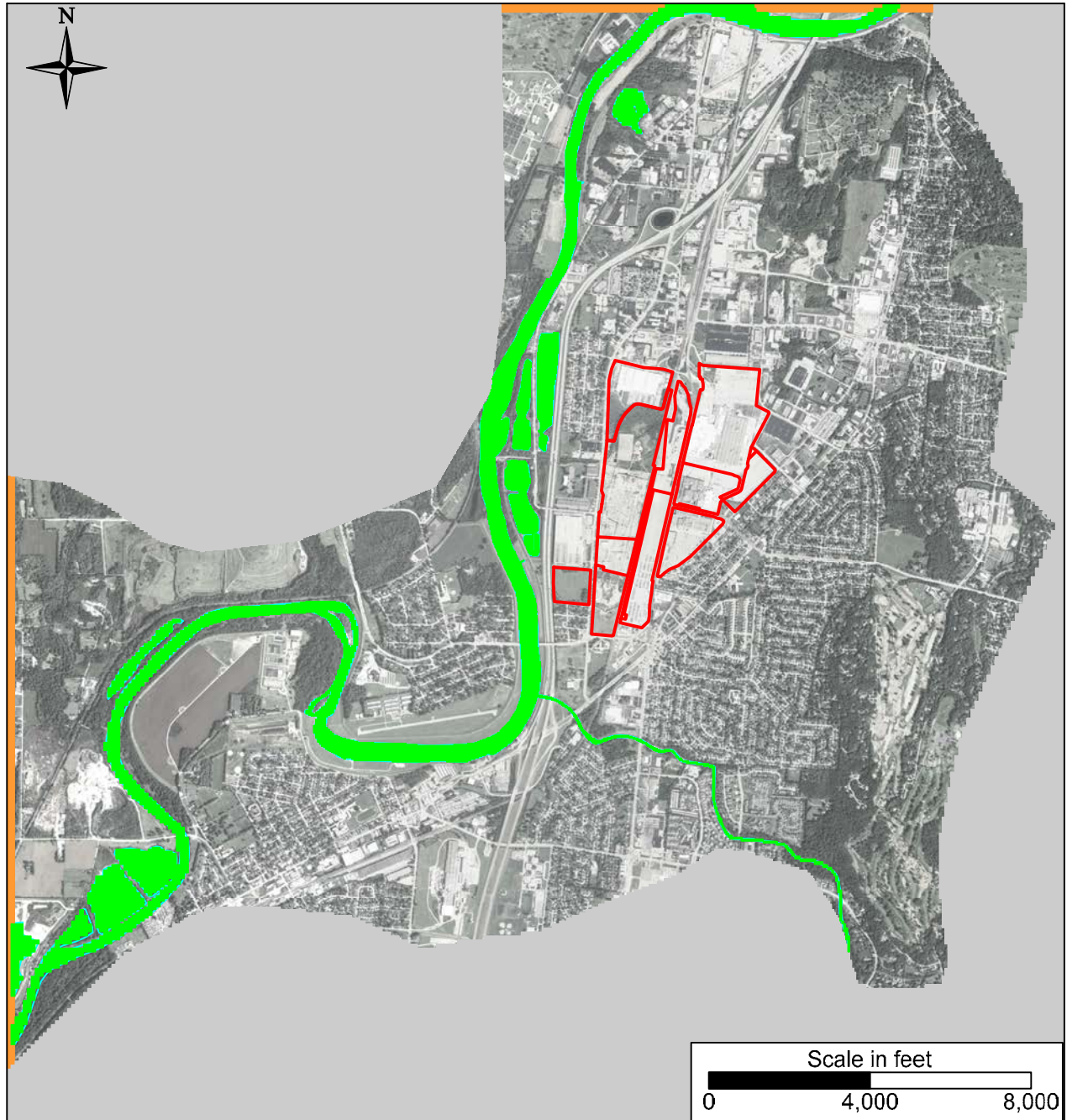
- Area of uniform 25 ft x 25 ft grid cells
- - Model Extent
- Site Property Line
- Great Miami River, tributaries, and surface water features in the model
- Composite PCE/TCE Upper Aquifer Plume greater than 5 µg/L

Notes:

1. The grid cells expand to 100 ft x 100 ft at the model extents.
2. PCE - Tetrachloroethene
3. TCE - Trichloroethene
4. µg/L - micrograms per liter

RACER TRUST MORaine FACILITIES
MORaine, OHIO
GROUNDWATER FLOW MODEL UPDATE

MODEL GRID EXTENTS



Legend

- Constant Head Boundary
- River Boundary
- No Flow Boundary
- Site Property Line

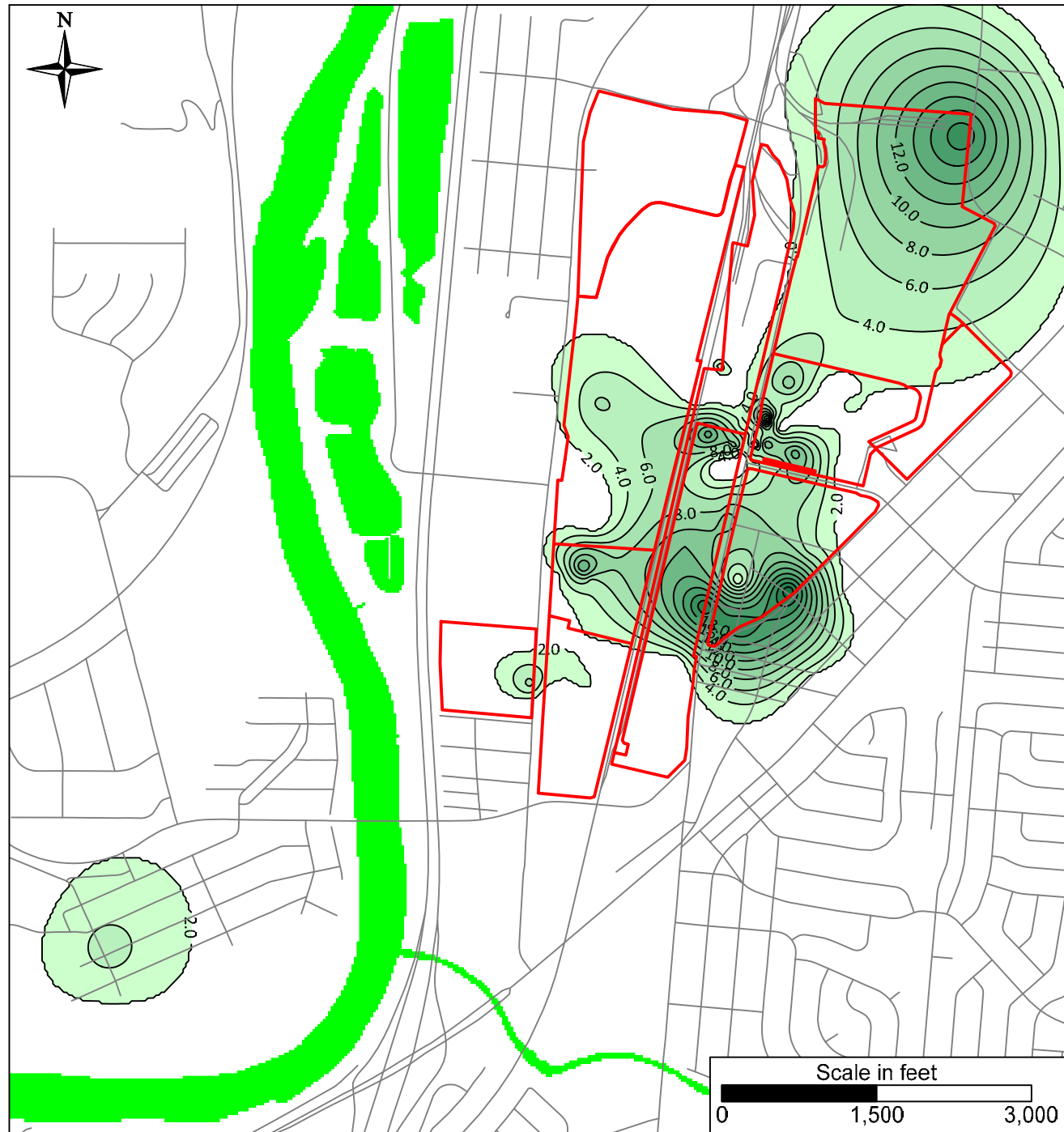
Notes:

1. River boundaries are located in layer 1 only.
2. Regional Pumping Wells are summarized on Table 1.

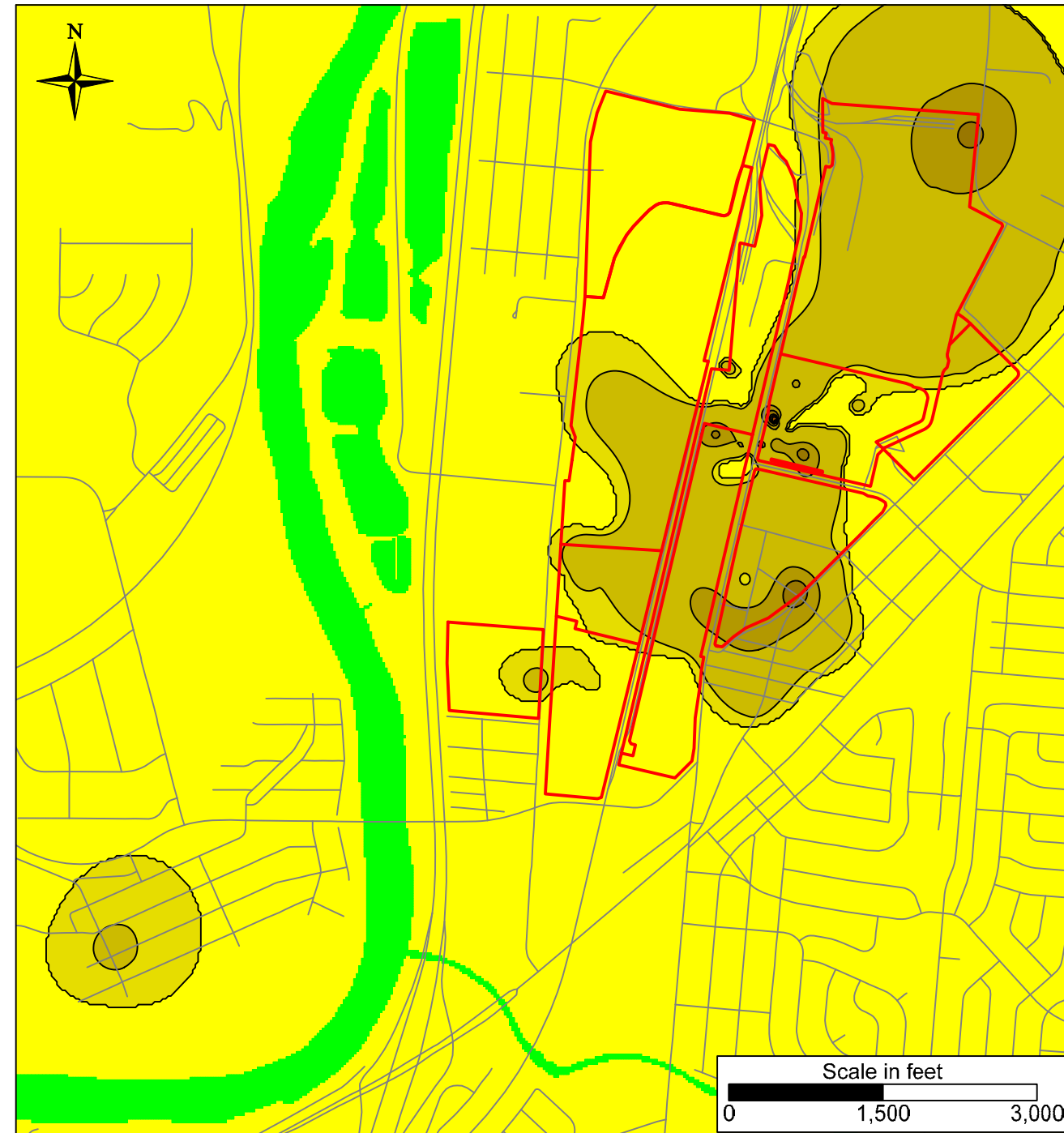
RACER TRUST MORaine FACILITIES
 MORaine, OHIO
 GROUNDWATER FLOW MODEL UPDATE

BOUNDARY CONDITIONS

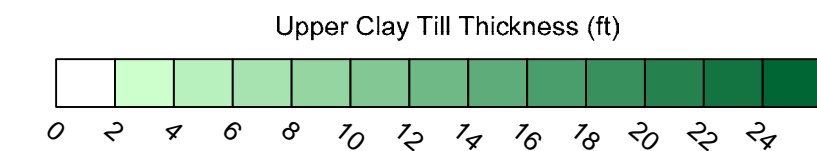
Upper Clay Till Thickness (ft)



Layer 1 (Upper Aquifer) Hydraulic Conductivity Distribution

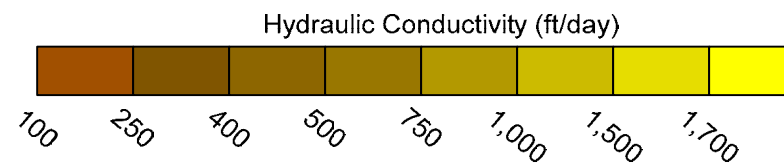


Legend



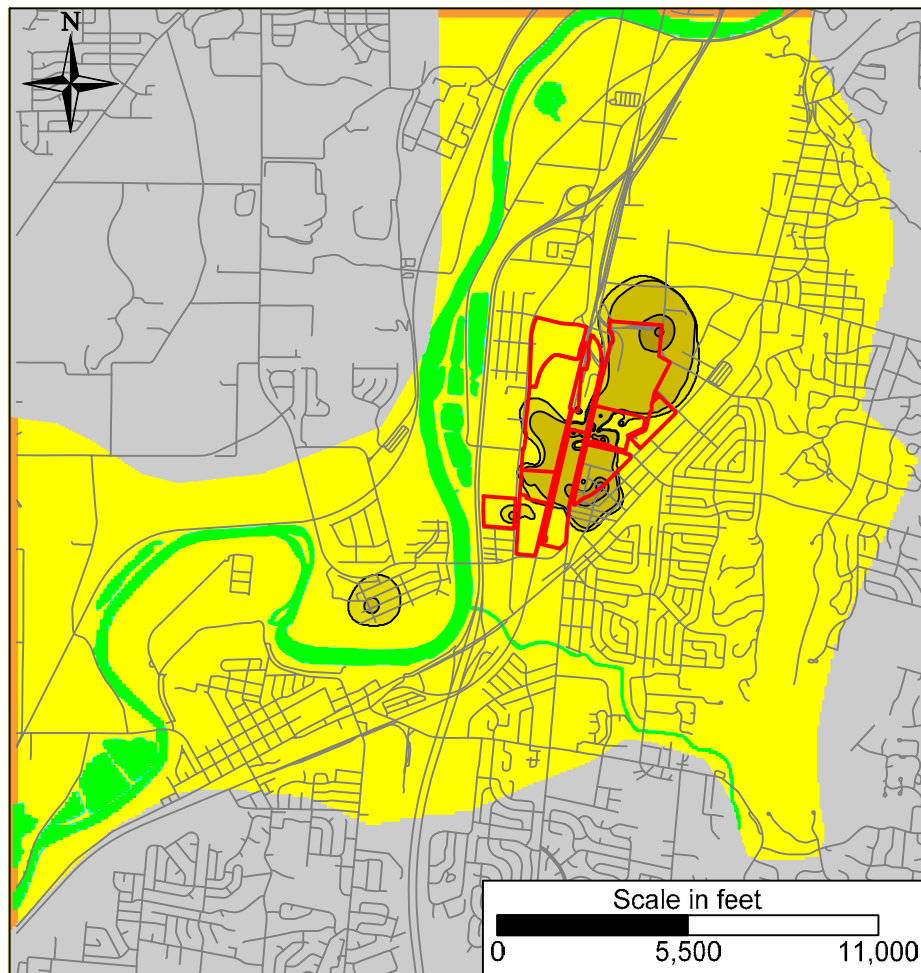
- River Boundary
- Site Property Line

Notes:
 1. Hydraulic conductivity in the area of upper clay till reflects a reduction in upper aquifer saturated thickness.

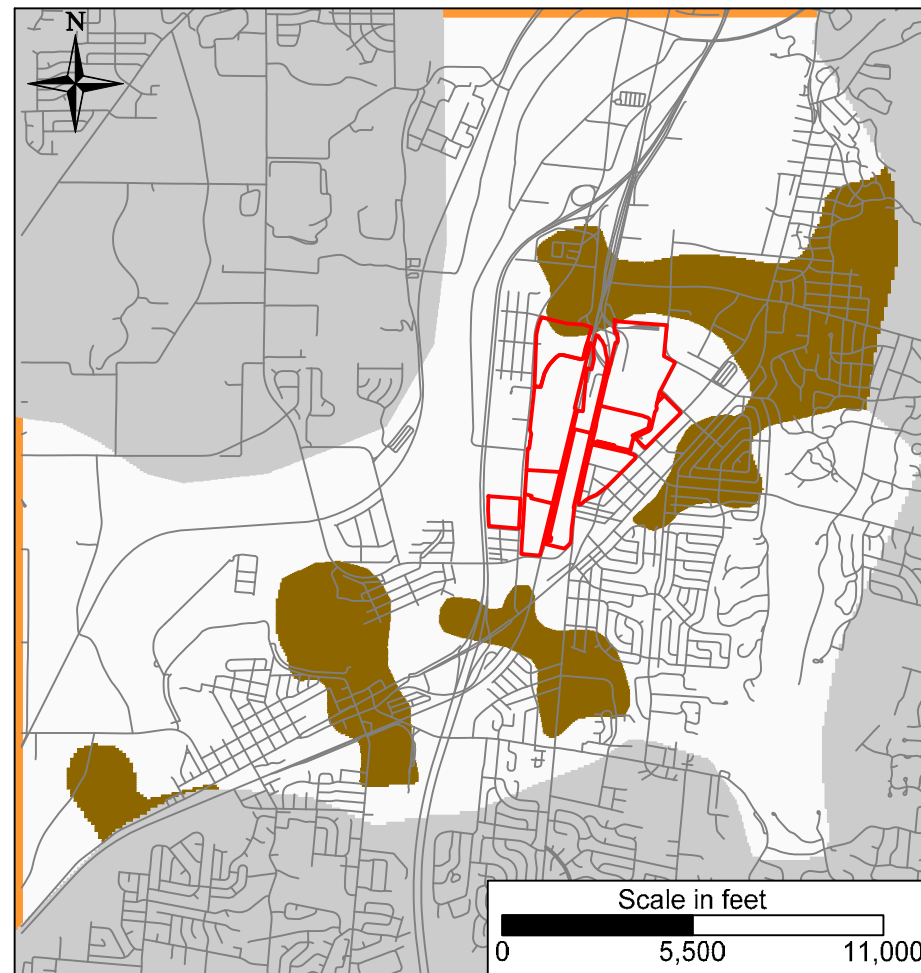


RACER TRUST MORaine FACILITIES MORaine, OHIO GROUNDWATER FLOW MODEL UPDATE	
UPPER CLAY TILL THICKNESS AND LAYER 1 HYDRAULIC CONDUCTIVITY	
ARCADIS <small>Design & Consultancy for natural and built assets</small>	FIGURE 4

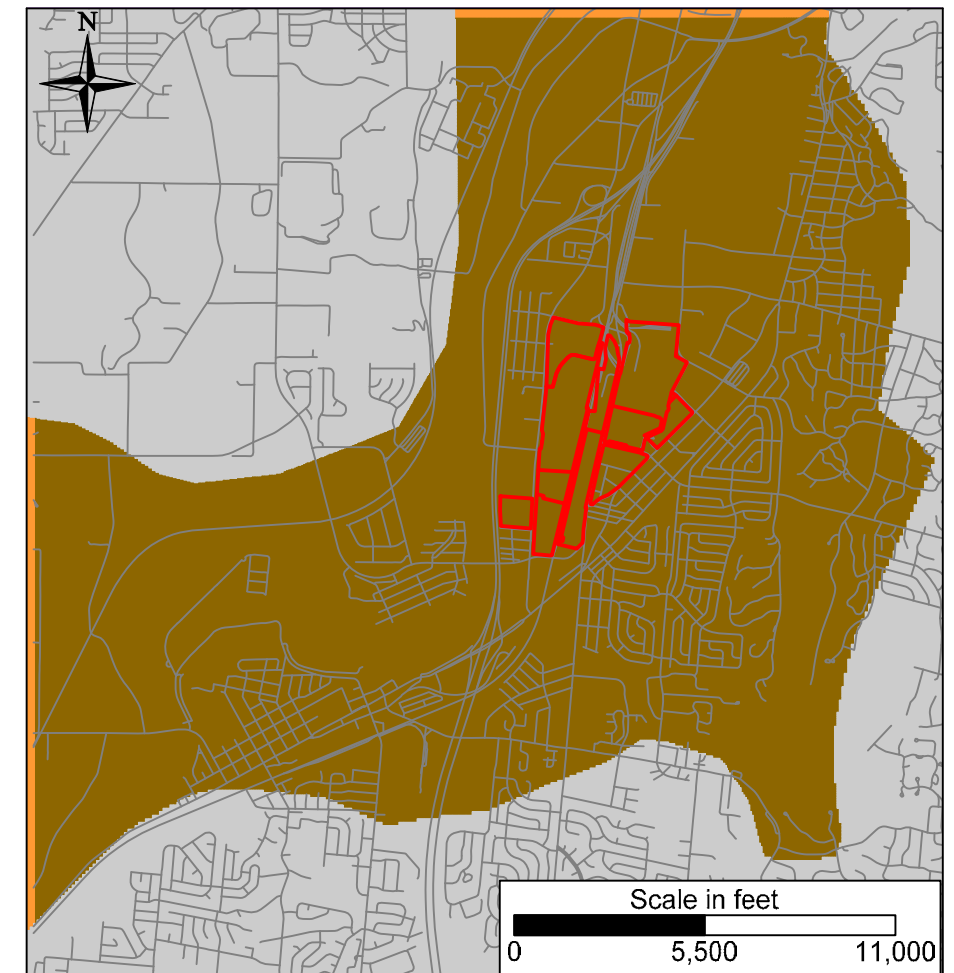
Layer 1 (Upper Aquifer)



Layer 2 (Regional Clay Till)



Layers 3-5 (Lower Aquifer)



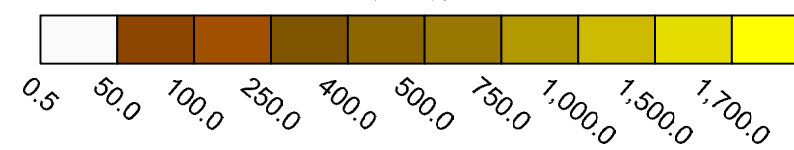
Legend

- Constant Head Boundary
- River Boundary
- No Flow Boundary
- Site Property Line

Note:

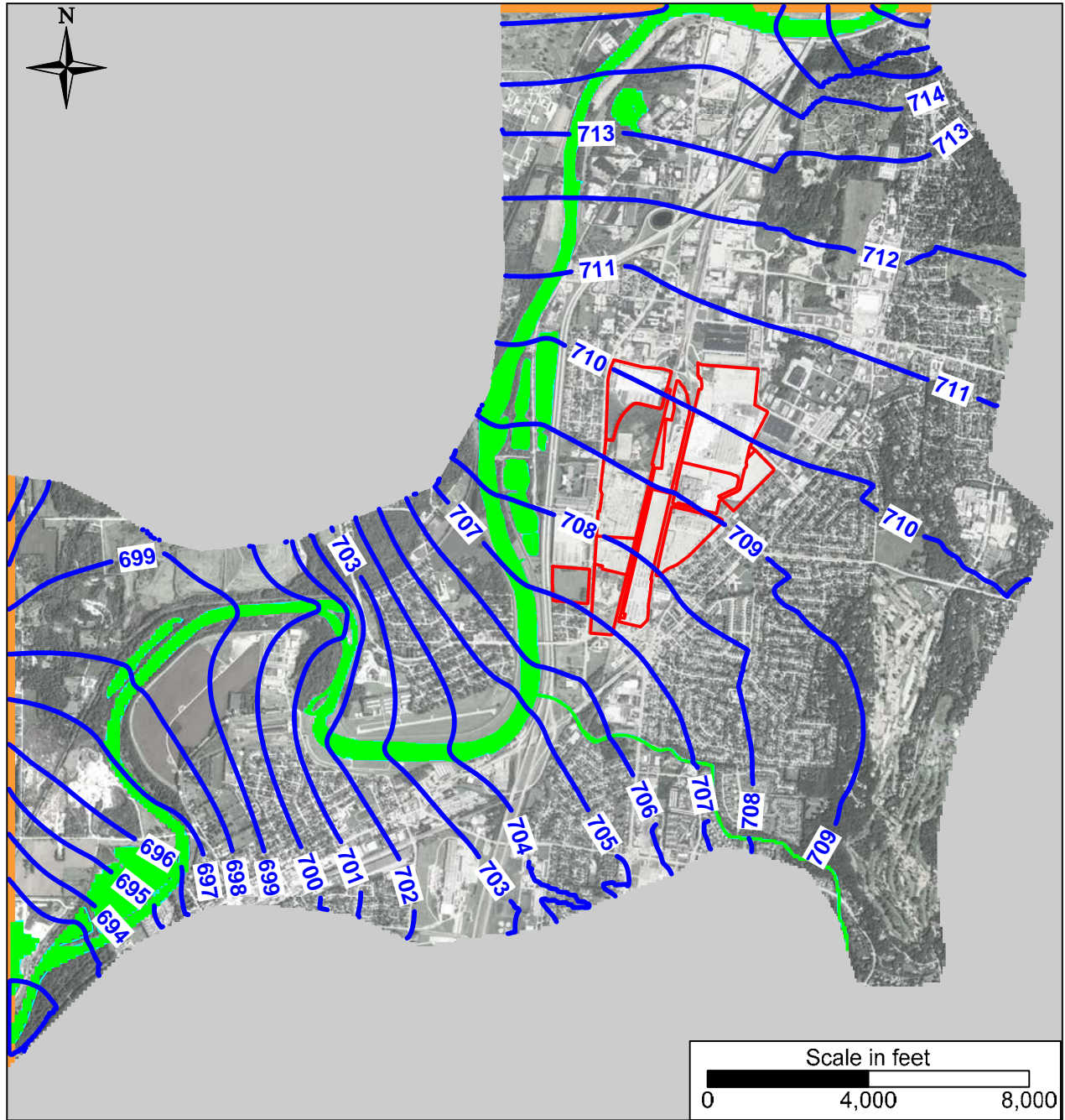
1. Vertical hydraulic conductivity is ten times lower than horizontal hydraulic conductivity.

Horizontal Hydraulic Conductivity (ft/day)



RACER TRUST MORaine FACILITIES
MORaine, OHIO
GROUNDWATER FLOW MODEL UPDATE

SIMULATED HYDRAULIC CONDUCTIVITY



Legend

Constant Head Boundary

River Boundary

No Flow Boundary

Site Property Line

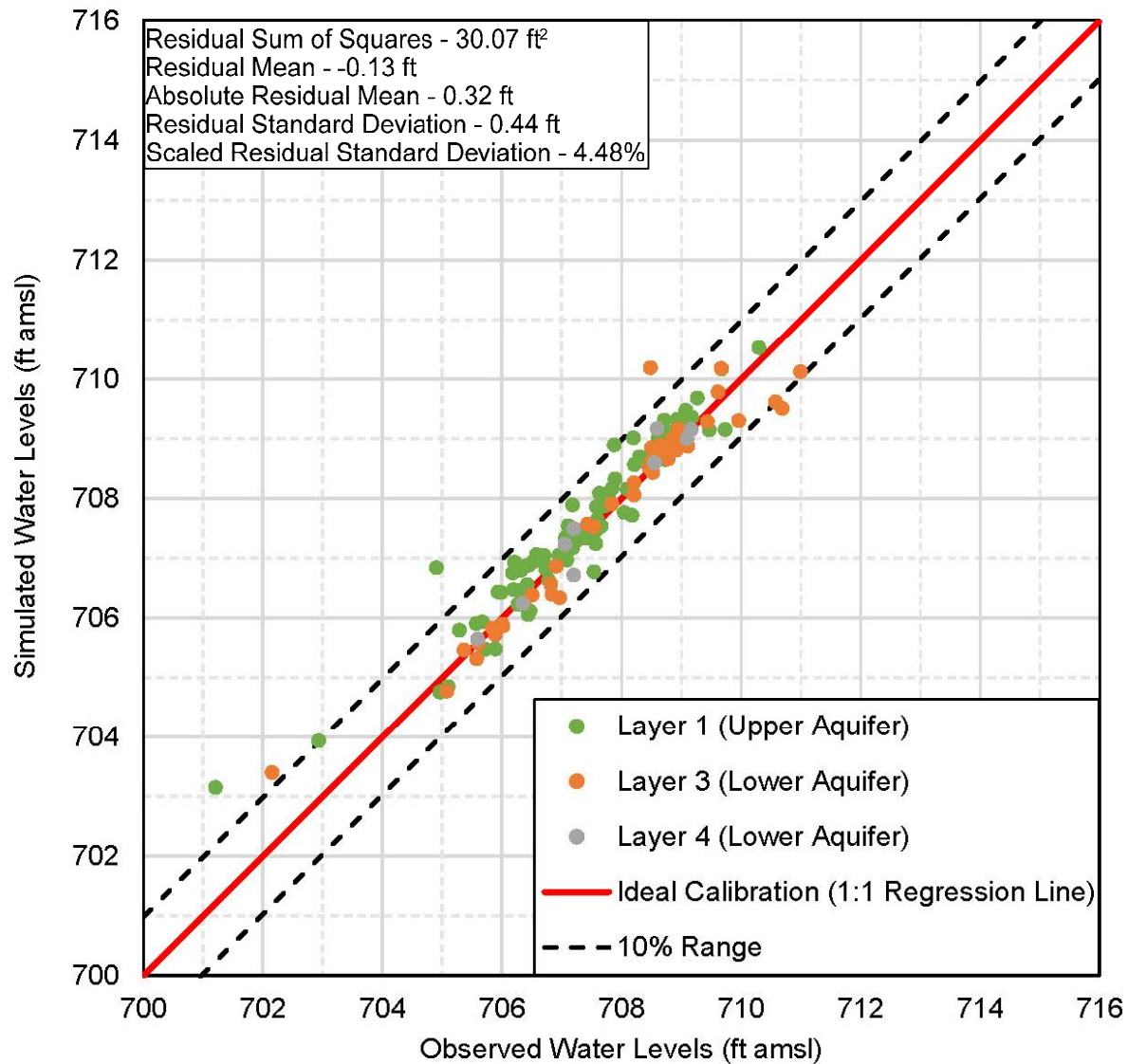
—700— Simulated Groundwater Contours (ft amsl)

Notes:

1. River boundaries are located in layer 1 only.
2. Regional Pumping Wells are summarized on Table 1.

RACER TRUST MORaine FACILITIES
MORaine, OHIO
GROUNDWATER FLOW MODEL UPDATE

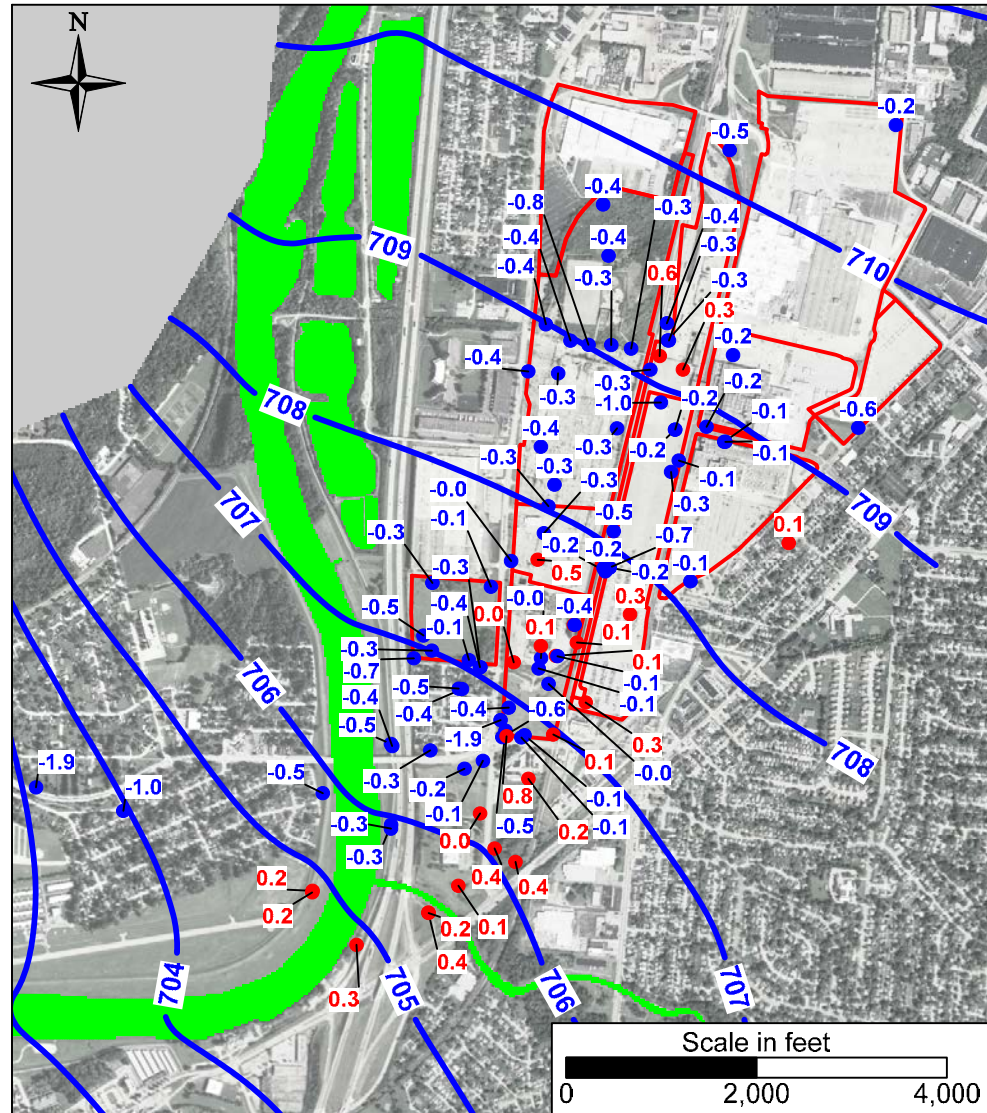
REGIONAL SIMULATED
WATER TABLE



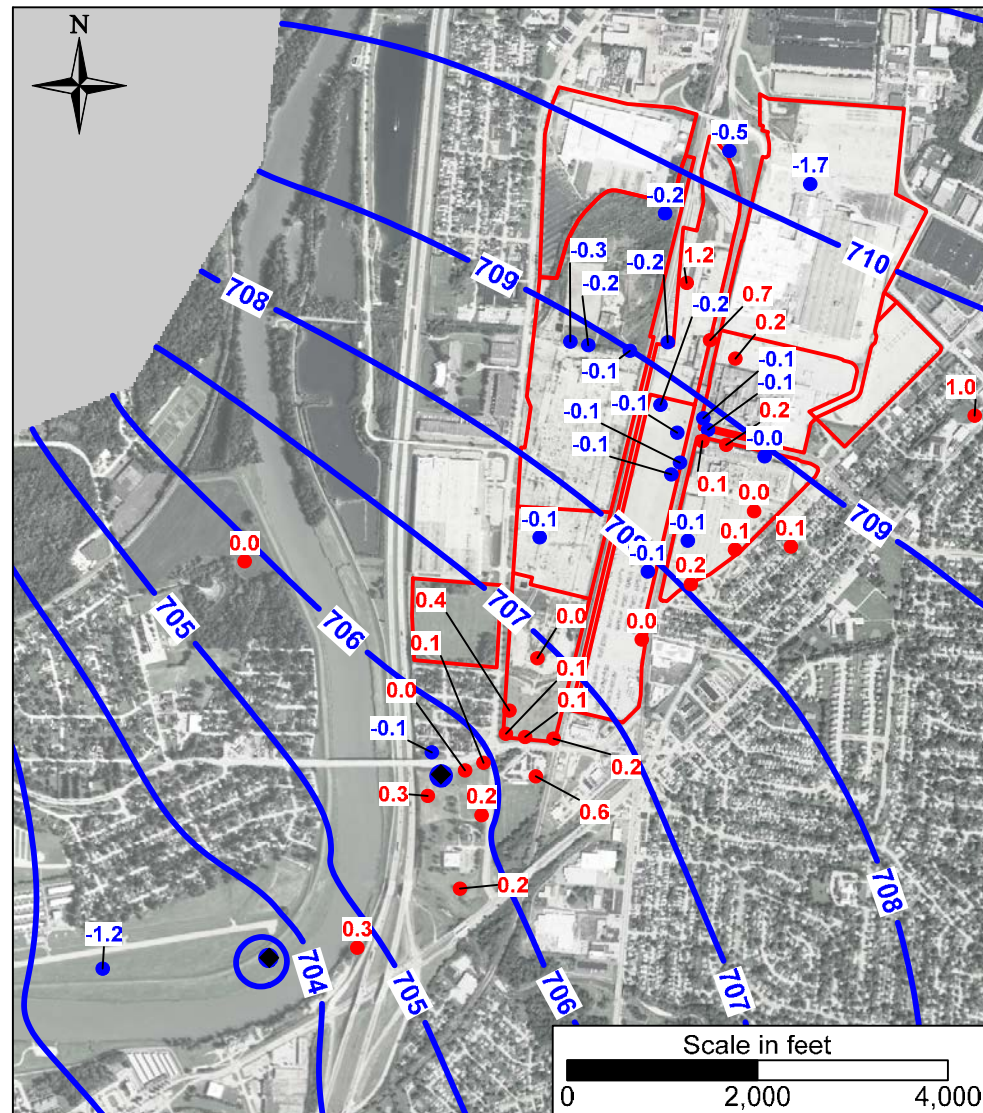
RACER TRUST MORaine FACILITIES
 MORaine, OHIO
 GROUNDWATER FLOW MODEL UPDATE

MODEL CALIBRATION TARGETS:
 OBSERVED VS SIMULATED
 GROUNDWATER ELEVATIONS

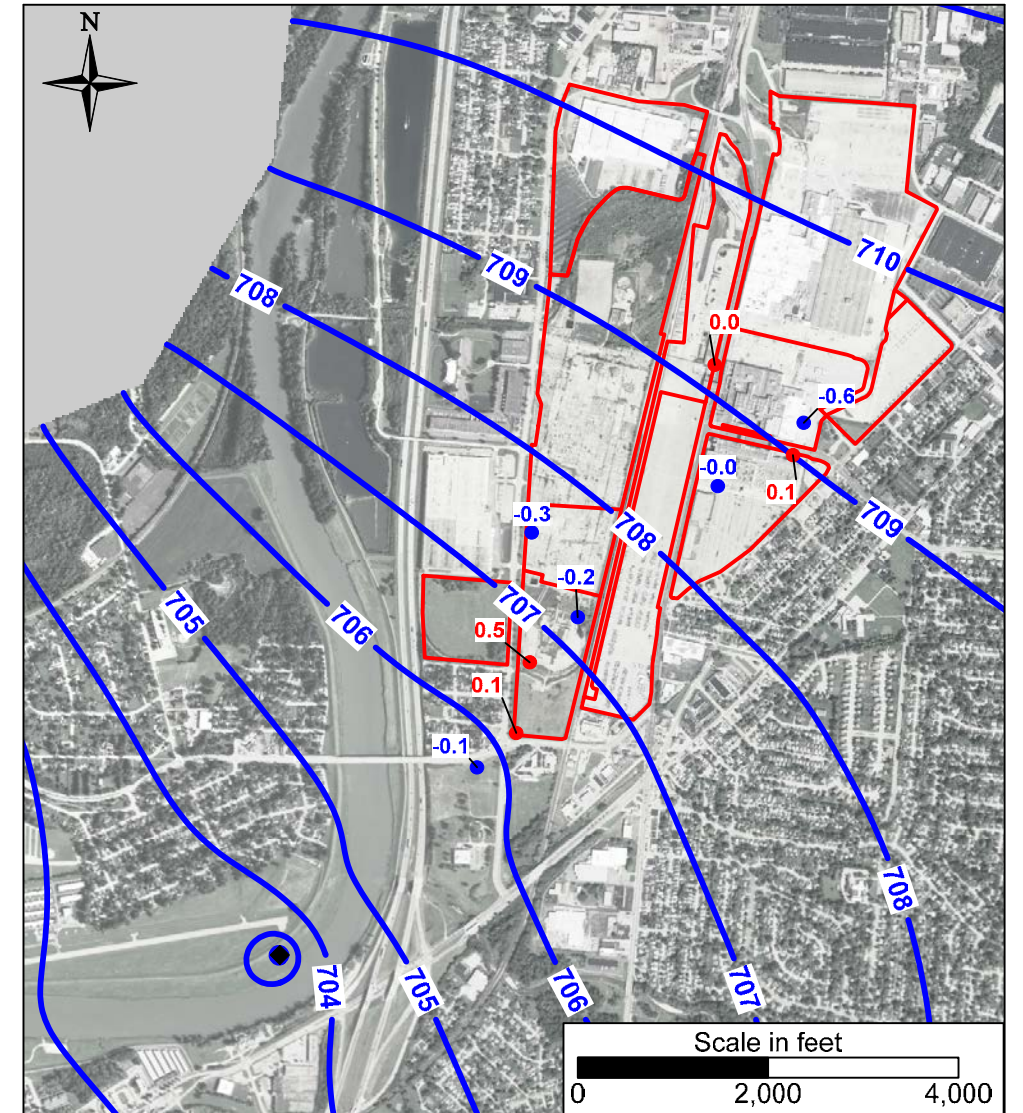
Layer 1 (Upper Aquifer)



Layer 3 (Lower Aquifer)



Layer 4 (Lower Aquifer)



Legend

- ◆ Regional Pumping Well (Lower Aquifer)
- River Boundary
- No Flow Boundary
- Site Property Line
- 700— Simulated Groundwater Elevation (ft amsl)
- 0.1 -0.1 Residual (ft)
(Residual = Observed Water Level - Simulated Water Level)

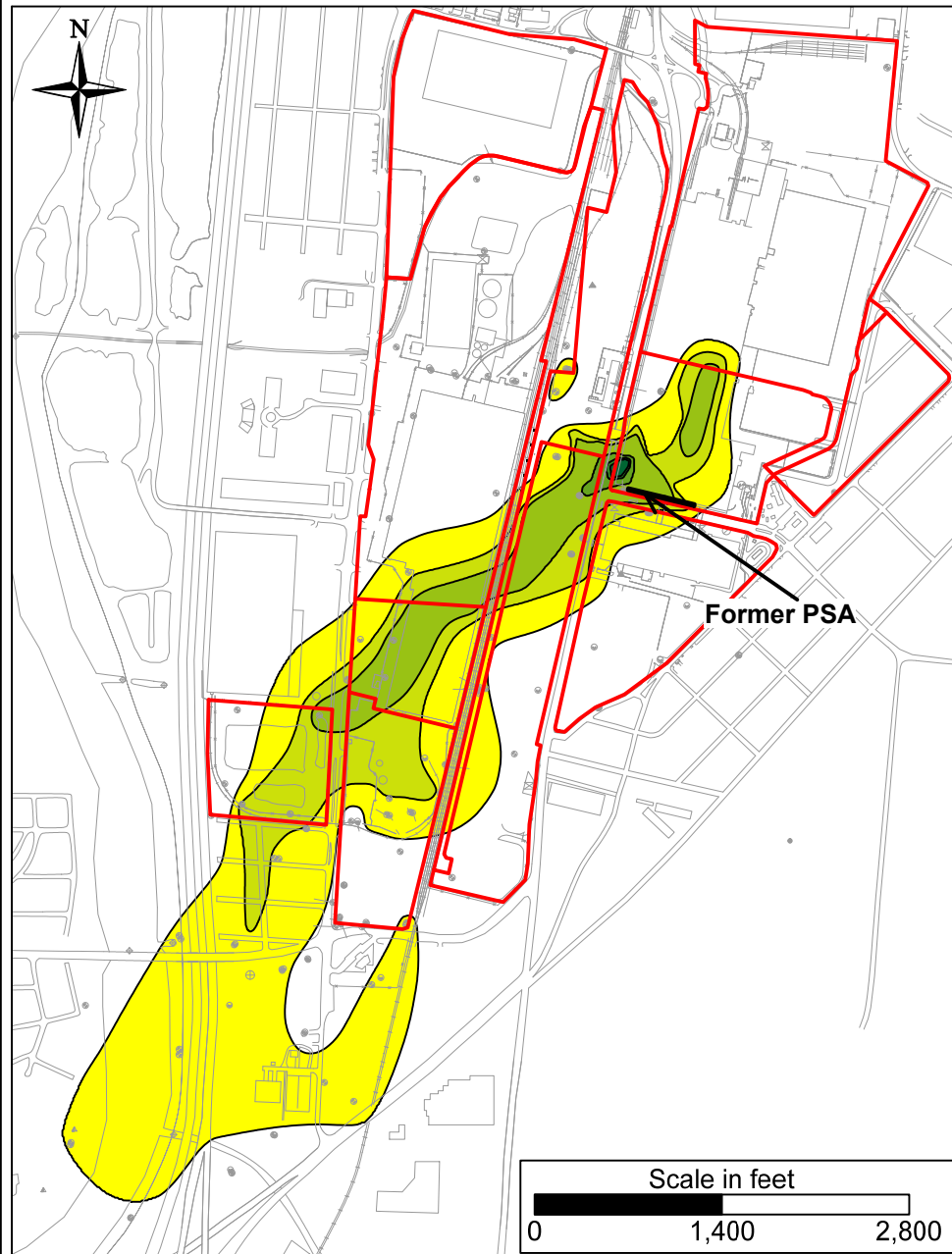
Notes:

1. Blue circles represent over simulation (simulated water levels are greater than observed water levels).
Red circles represent under simulation (simulated water levels are less than observed water levels).

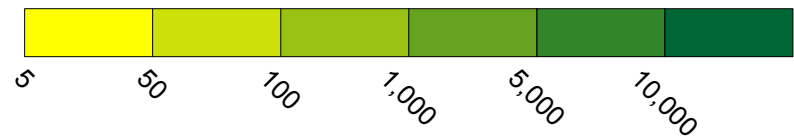
RACER TRUST MORaine FACILITIES
MORaine, OHIO
GROUNDWATER FLOW MODEL UPDATE

SIMULATED GROUNDWATER
ELEVATIONS AND RESIDUALS

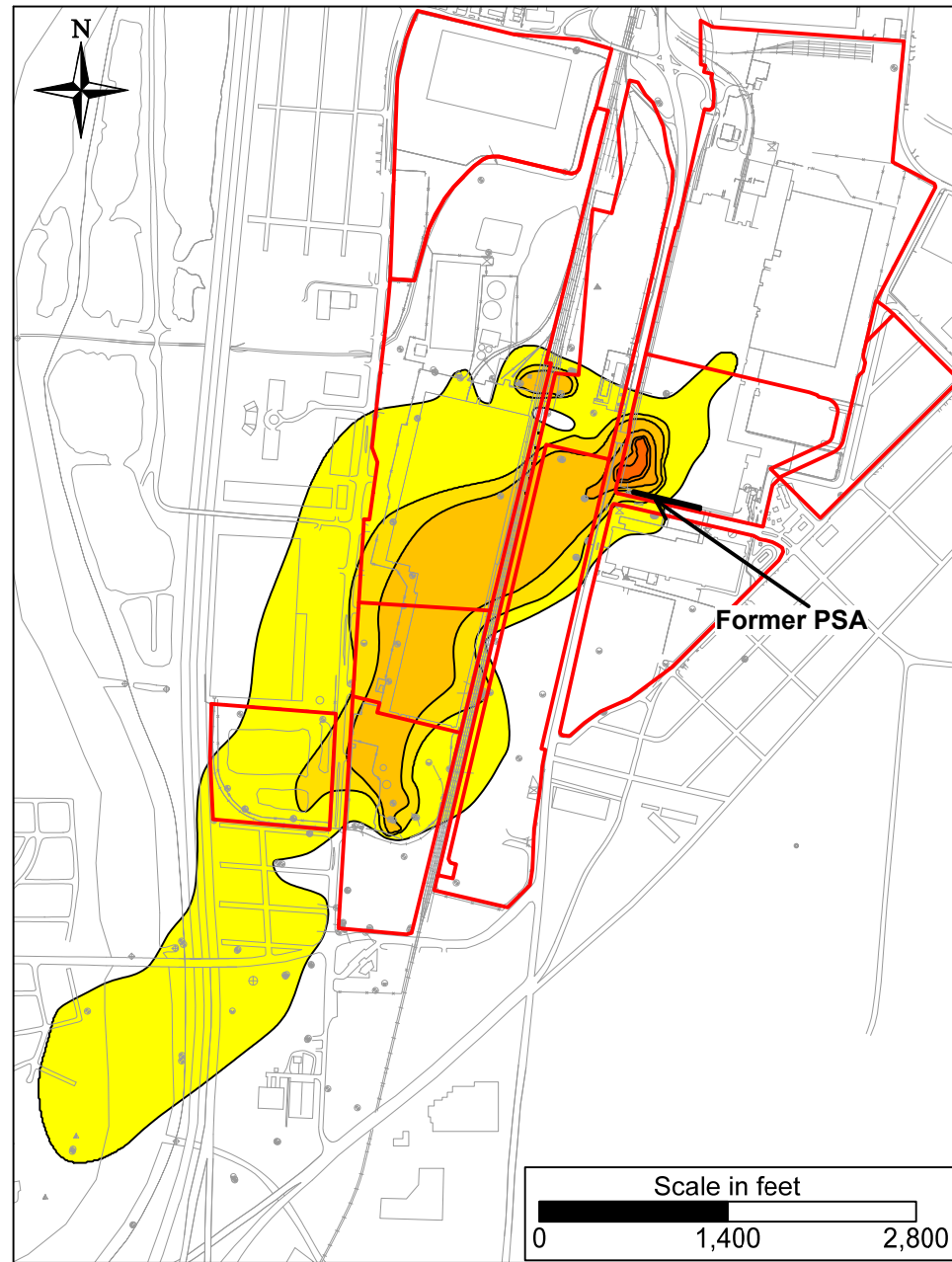
2016 UPPER AQUIFER PCE PLUME



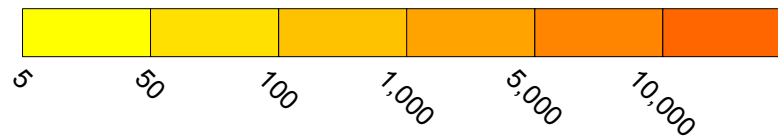
PCE Concentration ($\mu\text{g/L}$)



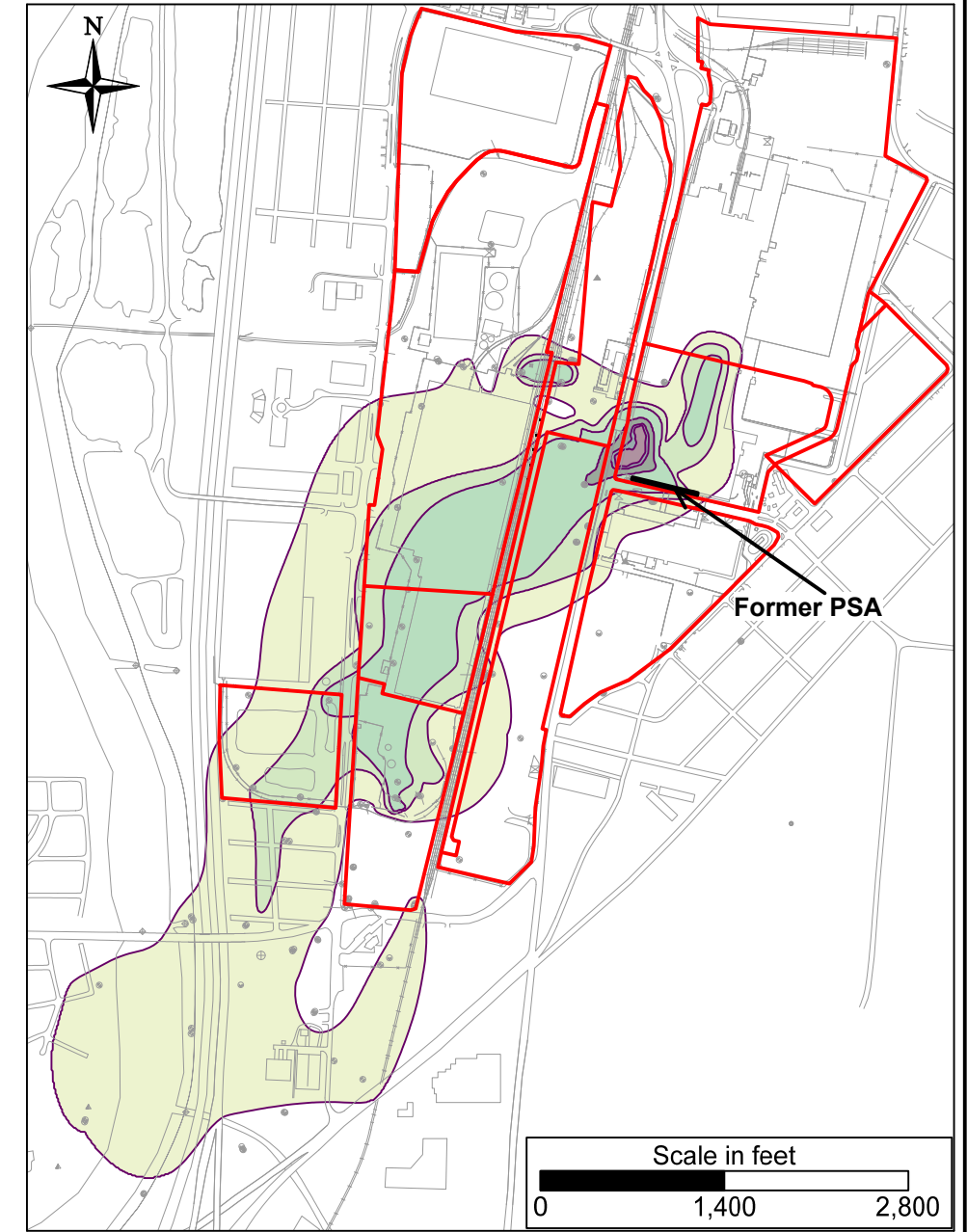
2016 UPPER AQUIFER TCE PLUME



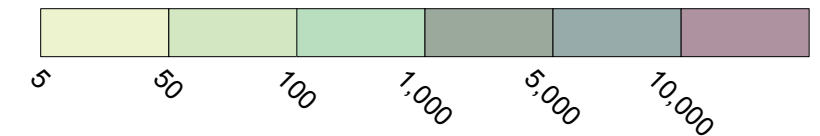
TCE Concentration ($\mu\text{g/L}$)



2016 COMPOSITE UPPER AQUIFER PCE AND TCE PLUME



Maximum PCE and TCE Composite Concentration ($\mu\text{g/L}$)



Legend

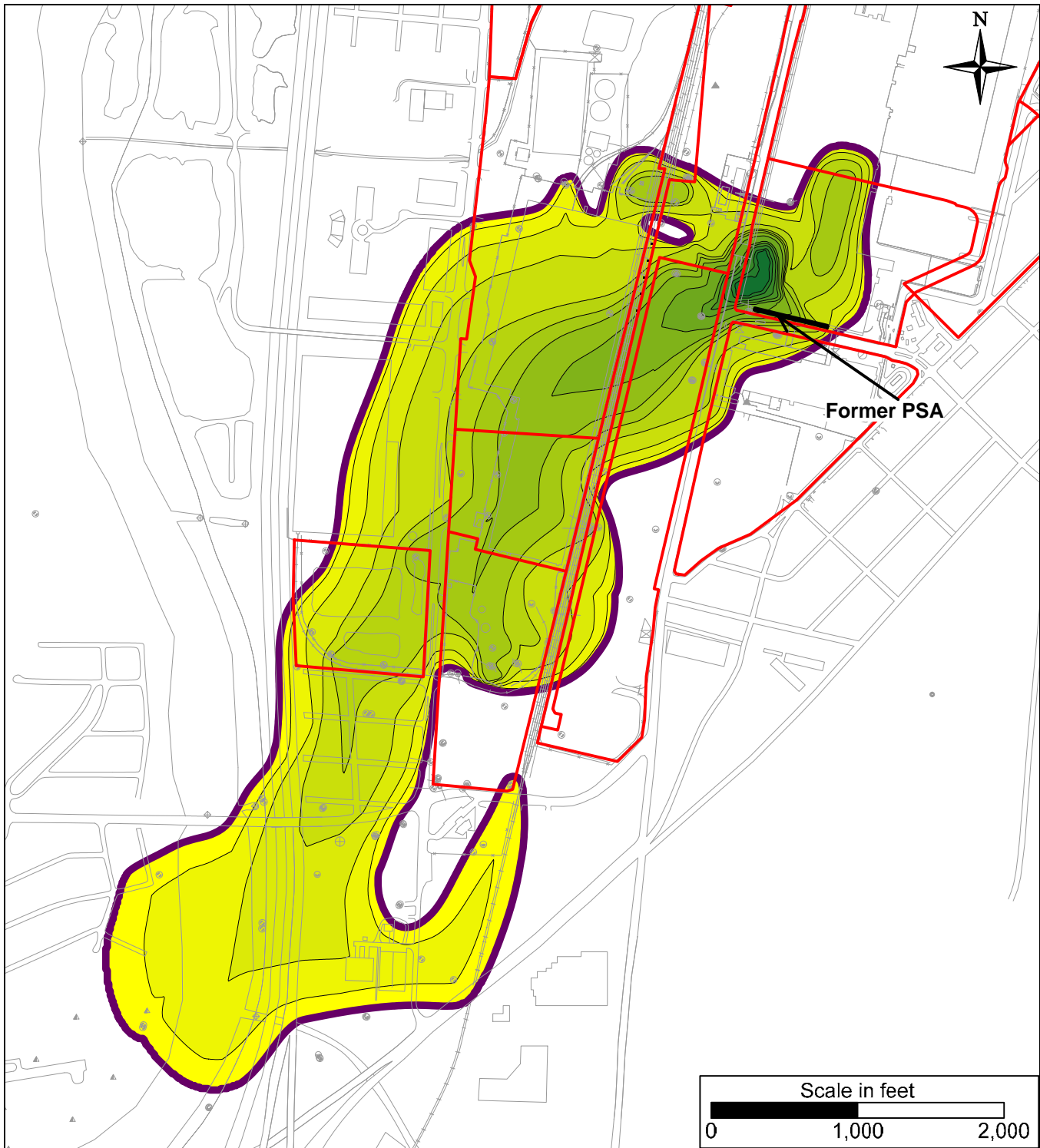
□ Site Property Line

Notes:

1. PCE - Tetrachloroethene
2. TCE - Trichloroethene
3. $\mu\text{g/L}$ - micrograms per liter

RACER TRUST MORaine FACILITIES
MORaine, OHIO
GROUNDWATER FLOW MODEL UPDATE

2016 UPPER AQUIFER PCE, TCE, AND
MAXIMUM COMPOSITE
PLUME DISTRIBUTION



Legend

□ Site Location

— Composite Upper Aquifer Maximum PCE and TCE Plume Outline

Number of Required Pore Flushes

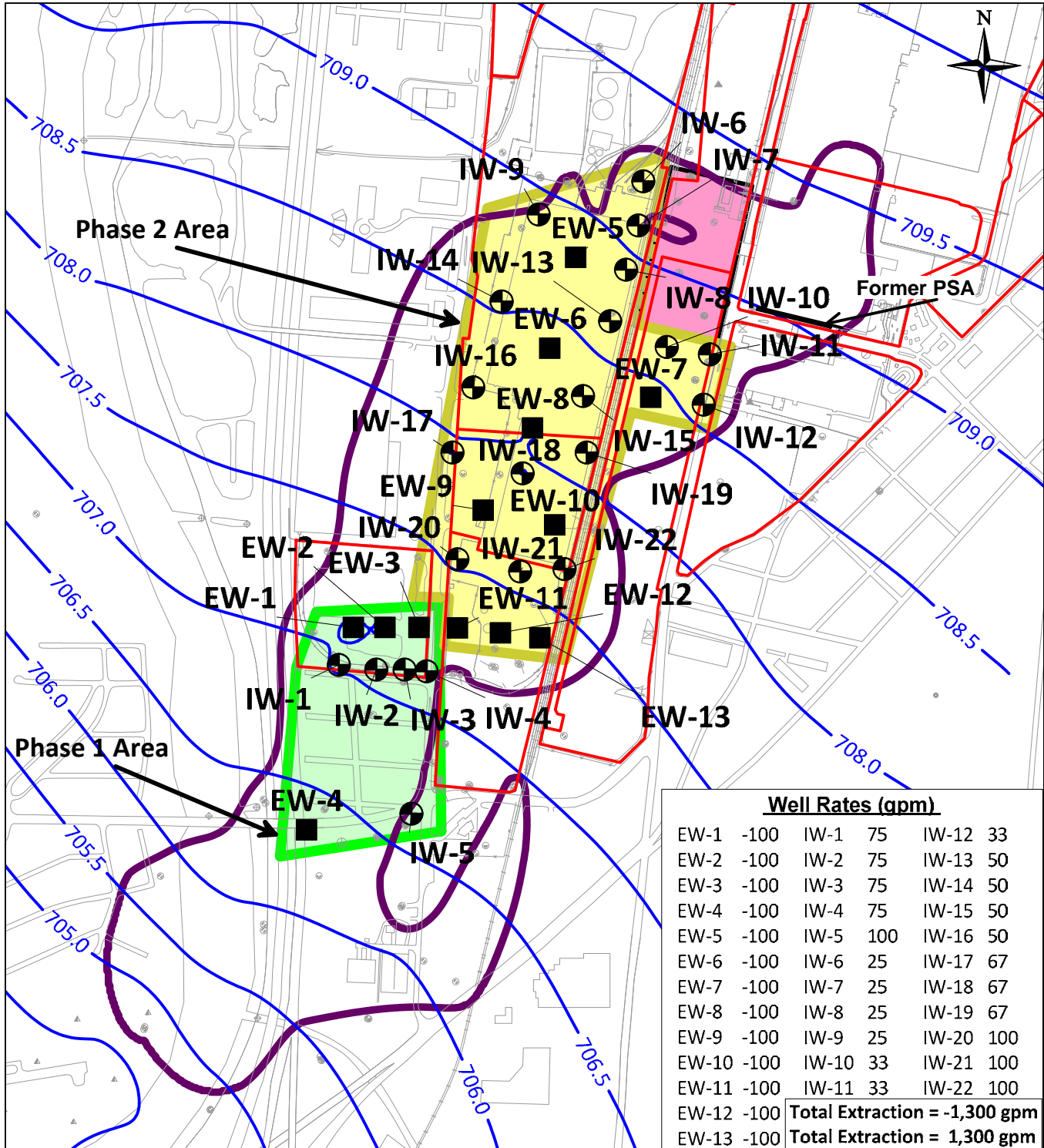


Notes:

1. PCE - Tetrachloroethene
2. TCE - Trichloroethene

RACER TRUST MORaine FACILITIES
MORaine, OHIO
GROUNDWATER FLOW MODEL UPDATE

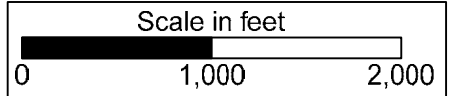
NUMBER OF REQUIRED PORE
VOLUME FLUSHES



Well Rates (gpm)					
EW-1	-100	IW-1	75	IW-12	33
EW-2	-100	IW-2	75	IW-13	50
EW-3	-100	IW-3	75	IW-14	50
EW-4	-100	IW-4	75	IW-15	50
EW-5	-100	IW-5	100	IW-16	50
EW-6	-100	IW-6	25	IW-17	67
EW-7	-100	IW-7	25	IW-18	67
EW-8	-100	IW-8	25	IW-19	67
EW-9	-100	IW-9	25	IW-20	100
EW-10	-100	IW-10	33	IW-21	100
EW-11	-100	IW-11	33	IW-22	100
EW-12	-100	Total Extraction = -1,300 gpm			
EW-13	-100	Total Extraction = 1,300 gpm			

Legend

- Site Property Line
- Composite Upper Aquifer Maximum PCE and TCE Plume Outline
- ⊕ Injection Well
- Extraction Well
- 700 Simulated Layer 1 (Upper Aquifer) Groundwater Contour (ft amsl)
- In-Situ Treatment Area (Former PSA)
- Phase 1 Area
- Phase 2 Area



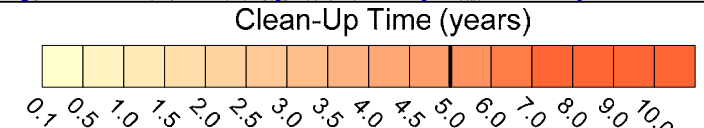
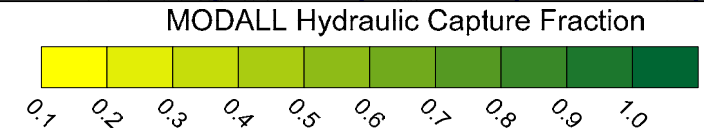
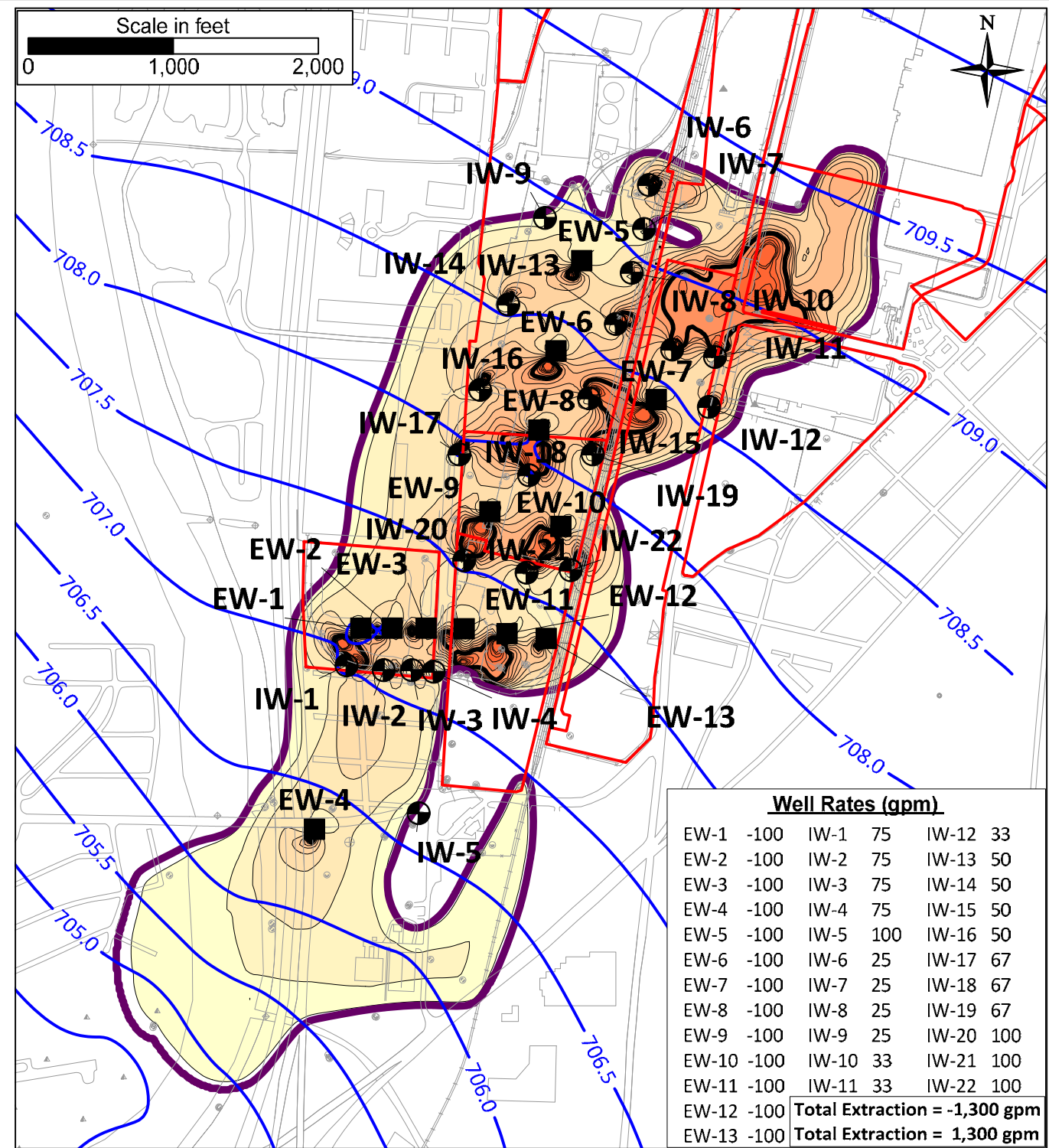
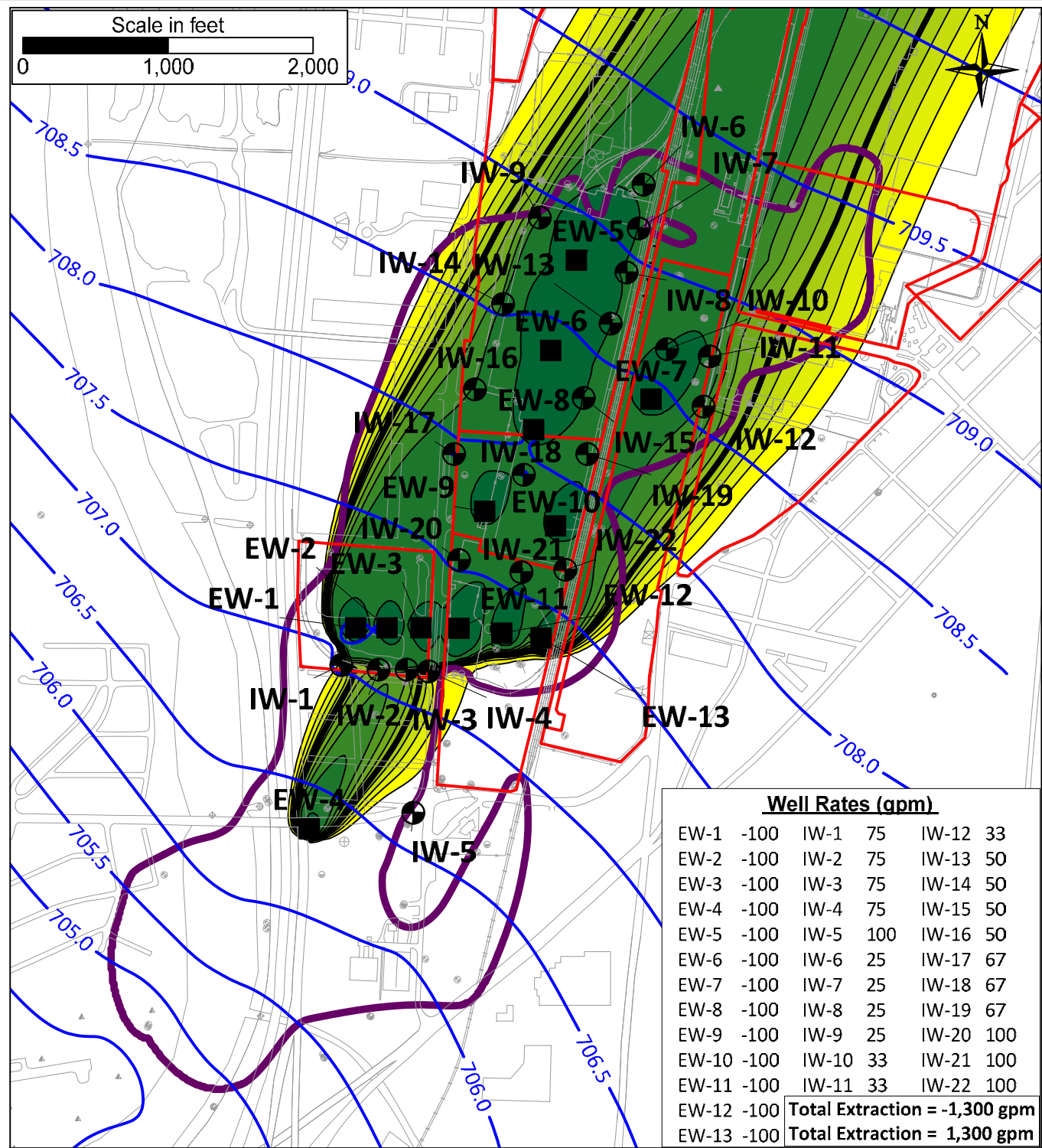
RACER TRUST MORaine FACILITIES
MORaine, OHIO

GROUNDWATER FLOW MODEL UPDATE

PROPOSED DGR™ SYSTEM LAYOUT

Design & Consultancy
for natural and built assets

FIGURE
11



- Legend**
- Site Property Line
 - Composite Maximum Upper Aquifer PCE and TCE Plume Outline
 - ⊕ Injection Well
 - Extraction Well
 - 700 — Simulated Layer 1 (Upper Aquifer) Groundwater Contours (ft amsl)

- Notes:
- Clean-up time is computed by multiplying the number of required pore flushes by the simulated cell pore flush duration by the 25 ft grid cell dimension.
 - MODALL - MODular flow ALlocation program (Potter et al. 2008)
 - PCE - Tetrachloroethene
 - TCE - Trichloroethene

RACER TRUST MORaine FACILITIES
MORaine, OHIO
GROUNDWATER FLOW MODEL UPDATE

MODALL FRACTION OF UPPER AQUIFER
HYDRAULIC CAPTURE
AND ESTIMATED CLEANUP TIMES

ARCADIS Design & Consultancy
for natural and built assets

FIGURE
12

APPENDIX E

RACER Trust Moraine Facilities – Miami Shores Sanitary Sewer
Improvements (Project No. 130006-15) – Revision 1 Memorandum



MEMO

To:

Renee Miller, Montgomery County
Kenneth Stewart, Montgomery
County

Copies:

Ms. Mirtha Capiro, U.S. EPA
Ms. Bhooma Sundar, U.S. EPA
Mr. Conor Neal, U.S. EPA
Ms. Pam Barnett, RACER Trust

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From:

Mr. Everett H. Fortner III (Trey)
Ms. Carolyn Grogan
Mr. Jason Manzo

Date:

July 19, 2018

Arcadis Project No.:

OH000294.2018.00001

Subject:

RACER Trust Moraine Facilities – Miami Shores Sanitary Sewer
Improvements (Project No. 130006-15) – Revision 1

On behalf of Revitalizing Auto Communities Environmental Response Trust (RACER Trust), Arcadis U.S., Inc. (Arcadis) is providing this memorandum that summarizes details on potential effects that the dewatering scenarios related to the Miami Shores Sanitary Sewer Improvements (Project No. 130006-15) could have on the volatile organic compound (VOC) upper aquifer groundwater plume associated with the RACER Trust Moraine Facilities site (Site) in Moraine, Ohio (**Figure 1**). This information was requested by Montgomery County during a conference call with RACER Trust and Arcadis on July 3, 2018.

Introduction

It is possible that influence from the dewatering activities associated with the Miami Shores Sanitary Sewer Improvements would result in accelerated migration of the upper aquifer VOC plume towards the Miami Shores neighborhood (neighborhood), causing a potential vapor intrusion pathway. In 2017, RACER Trust completed a focused groundwater investigation for the upper aquifer west of the Great Miami River (Arcadis 2018a). Data from the groundwater investigation were screened against site-specific United States Environmental Protection Agency (U.S. EPA) Vapor Intrusion Screening Levels for

groundwater. While concentrations of site-specific VOCs were present in the groundwater samples from the focused groundwater investigation, the results indicated that concentrations of these site-specific VOCs in water table groundwater did not present an unacceptable vapor intrusion risk in the neighborhood.

RACER Trust has designed and proposed an upgradient, upper aquifer remedy (Phase 1 Dynamic Groundwater Recirculation [DGR™] Interim Measure) that would capture and inhibit further migration of impacted, upper aquifer groundwater downgradient of the Site. The remedial objective is to mitigate the vapor intrusion pathway in the Riverview Plat neighborhood and prevent a downgradient, vapor intrusion risk for the Miami Shores neighborhood. It is estimated that the vapor intrusion risk below the Riverview Plat neighborhood will be addressed approximately 5 years from remedy implementation. Additional fate and transport groundwater modeling would be required to understand when, during remedy implementation, concentrations of site-specific VOCs will be reduced so that dewatering activities in the neighborhood are not likely pose a vapor intrusion risk for the Miami Shores neighborhood. U.S. EPA approval of the remedy is pending.

Information Review

Historical information and more recent analyses, including groundwater flow modeling, was reviewed for consistency with the current conceptual site model (CSM) understanding. It should be noted that RACER Trust has prepared and refined a CSM for the Site over the course of more than 30 years of investigation and evaluation. The CSM can be found in the Corrective Measures Proposal (Arcadis 2012) with additional area focused CSMs documented in separate reports (RACER Trust 2016, Arcadis 2018b).

Below is a bulleted summary of each document reviewed related to the Miami Shores neighborhood:

- CBC Engineers & Associates, Ltd - Design of Dewatering System for Splash Moraine and Miami Shores Area (2006):
 - This report summarized a subsurface and groundwater investigation within the Miami Shores area to support the design for a potential dewatering system to maintain groundwater levels below required levels within the Splash Moraine water park and Miami Shores residential basements due to flooding issues.
 - The investigation included subsurface descriptions, geotechnical (soil properties) testing, and installation of monitoring wells and piezometers.
 - An evaluation for a well dewatering system within the upper aquifer was completed.
 - Installation of test wells for further evaluation and to finalize the design was recommended.
- CBC Engineers & Associates, Ltd – Report of Groundwater Pump Test and Pumping System Design for Splash Moraine and Miami Shores Area (2007):
 - This report provided an evaluation of the groundwater aquifer (upper aquifer), recommendations for dewatering, and the dewatering system design criteria.
 - The investigation included installation of additional monitoring wells and a test well for a large-scale pumping test. The test well was installed to a depth of 60 feet below ground surface (bgs), using cable tool drilling methods (24-inch drive casing), and constructed with 16-inch diameter casing and screen. The steel screen was 20 feet in length and 100 slot-size (0.1 of an inch). The filter pack installed consisted of Parry No. 2.

- A pumping test was completed at a constant rate of 1,570 gallons per minute (gpm) over a duration of 4,110 minutes (2.85 days). The resulting permeability estimate (hydraulic conductivity) from the pumping test was 1,210 feet per day (ft/day).
- The tentative design elements for the dewatering consisted of 24-inch diameter dewatering wells installed to the regional clay till (varies in depth from 65 feet to 80 feet bgs). Tentative design based on the evaluation was a total of six dewatering wells with flow rates at 5,000 gpm each across the Miami Shores area.
- An additional high capacity pumping test at 5,000 gpm for a longer period was recommended for the final design.
- Black & Veatch – Groundwater Modeling Summary Memorandum Well Field Feasibility Modeling (2018):
 - This report provided an evaluation for potential operation of the Miami Shores Wellfield and examination for a possible new wellfield to the southwest.
 - The report included the compilation of available hydrogeologic investigations to evaluate current groundwater conditions, Miami Shores Wellfield yield, and groundwater conditions during Miami Shores Wellfield operation.
 - A calibrated three-dimensional groundwater flow model was developed and used as the primary tool for the evaluation.
 - The total capacity of the Miami Shores Wellfield was estimated from 22 to 23 million gallons per day (MGD) from the existing nine wells. An additional five wells were used in simulations (approximately 1,800 gpm over 14 total wells) to reach the peak target maximum day rate of 36 MGD.
 - Modeling results indicated that an annual yield of 21 MGD was sustainable by the aquifer from 14 total wells, and the maximum day rate of 36 MGD was achievable.
 - An additional evaluation was provided with relation to the Miami Shores Wellfield under operation conditions to the current upper and lower aquifer plumes from the Site. Well DN-13 was included in the evaluation. Particle tracking was performed based on varying pumping timeframes from the 14 total wells at a continuous 21 MGD. The results indicated:
 - The upper aquifer influence occurred at approximately 1 month of operation due to the local areas where the regional clay till is absent.
 - A vertical flow component from the upper to the lower aquifers begins at 6 months of operation near Wells 15 and 16 near openings in the regional clay till.
 - Pathlines reach east of the river in the lower aquifer to the extent mapped with greater than 5 micrograms per liter (ug/L) VOCs at 5 years.
 - Pathlines extend from Wells 19 and 20 to the area of maximum contamination within the lower aquifer at 10 to 15 years.
 - Pathlines extend into the area of maximum contamination within the upper aquifer, and a hydraulic barrier forms for the eastern Miami Shores Wellfield wells capturing most of the contaminated plume at 20 years.

- Additional simulations were completed for adding new capture wells (10 total at 9.5 MGD) to DN-13 to contain the plume during the operation of the 14 wells at 21 MGD. The results indicated that new capture wells east of the river would be effective in capturing the plume during the operation scenario and that treatment and long-term maintenance would need to be considered for the additional capture wells.
- Other simulations consisted of a new well field to the southwest of the Western Regional Wastewater Reclamation Facility. The simulation assumed 14 new wells with similar capacities to the Miami Shores Wellfield and similar target yields.
- Particle tracking was performed for the new well field based on varying pumping timeframes from the 14 new wells at a continuous 21 MGD. The results indicated:
 - Pathlines extend to the upper aquifer on the east side of the Miami Shores neighborhood to the extent map with greater than 5 ug/L VOCs at 5 years.
 - Pathlines reach the west side of the RACER Trust Moraine Facilities but remain in the lower aquifer at 15 years.
 - Pathlines reach the upper aquifer to the east of the river with the capture zone extending mostly west of the contaminant plume at 20 to 25 years.
 - The capture zone for the new well field remains primarily to the west of the contaminant plume with no pathlines that extend into the maximum area of contamination at 50 years.
 - The capture zone for the new well field would not extend as far east beneath the contaminant plume as the Miami Shores Wellfield capture zone.
- Overall, after confirmation testing, the aquifer yield is adequate for both wellfield scenarios. The primary concern is groundwater contamination from the Site.
- Eagon & Associates, Inc. – Groundwater Flow Modeling for Miami Shores Sanitary Sewer Improvements Montgomery County, Ohio (2018a):
 - This report evaluated construction dewatering pumping rates necessary for planned installation of a drop manhole and a section of sanitary sewer line and a determination on the effect from dewatering on the movement of the VOC plume from the Site.
 - The groundwater flow modeling simulations for the dewatering scenarios were performed using the calibrated groundwater flow model from Black & Veatch (2018).
 - The report conclusions were as follows:
 - “Water-quality data from the 2017 RACER Trust Groundwater Monitoring report show that VOCs are present in the upper aquifer to the southwest of the lift station location. In order to have an estimate of groundwater flow from August 2017 (RACER groundwater sampling event) to August 2018 (proposed construction dewatering start date) a non-pumping particle tracking simulation was performed. Particle tracking using the groundwater flow model developed by Black & Veatch for MCES shows that groundwater flow over the next year could cause additional west-southwest migration of VOCs in groundwater of up to about 2,000 feet without construction dewatering. This is likely an overestimate of the particle movement since the model only accounts for advective groundwater flow and does not account for other contaminant fate and

transport factors such as dilution, dispersion, sorption and degradation that can retard contaminant migration.”

- “Based on the groundwater flow model simulation of dewatering for construction of the drop manhole, a maximum pumping rate of 5,000 gpm can be achieved by a single well in the upper aquifer. The maximum model pumping rate for construction of the sanitary sewer from the drop manhole to Vance Road is 7,500 gpm (1,500 gpm from each of five wells). These pumping rates are strictly a model limitation on pumping rates in the upper aquifer and may not reflect the pumping rates that may actually be required for construction dewatering.”
 - “According to engineering estimates, construction of the drop manhole will take approximately 14 days, and construction of the sewer section between the drop manhole and Vance Road will take approximately 30 days. Particle tracking for these two dewatering scenarios indicates that pumping near the lift station at these rates will have limited effect on contaminant migration east of the Great Miami River.”
 - “The capture zones for the dewatering scenarios encompass areas where VOCs are present west of the Great Miami River, based on the 2017 RACER Trust data. Sewer dewatering operations described herein should be expected to cause a shift from naturally occurring southwestward groundwater flow in the upper aquifer west of the river to more northwestward flow. This shift has the potential to draw contamination detected in monitoring wells, and contamination that should be assumed to exist further down- and side-gradient of the monitoring wells, toward residential areas. It is noted that the extent of the contaminant plume west of the river has not been delineated and we are not aware of any available information regarding the presence or absence of contamination beneath residential areas of the Miami Shores subdivision. The existing VOC impact west of the Great Miami River has not been fully evaluated. It is not possible to model the extent of VOC migration based on the limited data available. Furthermore, it is not appropriate to base residential risk assumptions on estimates from groundwater flow modeling. VOCs beneath inhabited structures should be evaluated with Ohio EPA oversight and in accordance with relative state and federal vapor intrusion and drinking water guidance. Chlorinated solvents such as TCE, which has relatively low regulatory action levels and is a significant component of the former GM facility plume, have the potential to cause unacceptable exposure risks if present beneath buildings and left unmitigated.”
- Montgomery County – Addendum #3, Project Number: 130006-15, Miami Shores Sanitary Sewer Improvements (2018):
 - This addendum indicates that during the construction of the drop manhole and during other excavation/construction activities that are below an elevation of 700 feet above mean sea level (AMSL), engineering controls (e.g., solid sheeting, soil mixing, injectable barrier wall grouting, jet grouting) should be used to limit the infiltration of groundwater to the excavation, thereby reducing the degree of dewatering. Monitoring of water levels at 50 to 100 east or southeast of the work area is required to verify groundwater elevations are not lower than 700 feet AMSL. The addendum indicates the intent of utilizing additional engineering controls is to reduce dewatering and reduce the risk for potential VOC plume migration.

- Eagon & Associates, Inc. – Addendum to Groundwater Flow Modeling Report, Miami Shores Sanitary Sewer Improvements (2018b):
 - This addendum summarizes the results of groundwater flow modeling and particle tracking for dewatering below 700 feet AMSL for the point dewatering (i.e., drop manhole) and line dewatering for the sanitary sewer line northwest of the manhole. The model was not altered from what was used in the Groundwater Flow Modeling for Miami Shores Sanitary Sewer Improvements (2018a), and the basis for limiting the dewatering to 700 feet AMSL appears to be an estimate on the amount of dewatering necessary with the additional methods (engineering controls) to limit the groundwater infiltration. The following is a summary of the simulation results:
 - Drop Manhole Simulation (point dewatering for 14 days at 1,000 gpm): Over 1.5 feet of drawdown near the excavation is predicted. Particle tracks west of the river have a movement of less than 100 feet.
 - Line Dewatering Simulation (5 wells along the sewer line for 30 days at 2,000 gpm): Over 2.5 feet of drawdown near the excavation is predicted with a 700 feet AMSL cone of depression that extends approximately 100 feet to the east/southeast of the excavation. Particle tracks west of the river have a movement of 200 to 250 feet.

Conclusions

Based on the review of the groundwater flow model by Black & Veatch (2018), the model characteristics are mostly consistent with the current CSM understanding. It is agreed that the simulated dewatering activities, based on particle tracking scenarios by Eagon & Associates (2018a and 2018b), have the potential to shift groundwater flow directions in a more northwesterly direction at the current edge of the total VOC, upper aquifer plume west of the Great Miami River and potentially divert the natural groundwater flow horizontal hydraulic gradient so that the plume migrates toward residential areas. Although the hydraulic conductivity used for the model was estimated at 1,210 feet per day from testing in the Miami Shores area, this sensitive factor may vary spatially by a factor of 2 with testing estimates from the upper aquifer east of the Great Miami River. This highly sensitive factor has a major role in the dewatering design estimates and hydraulic gradient influence.

The current total VOC upper aquifer plume (**Figure 1**) was overlain on Figure 6 of the Eagon & Associates modeling memo and is shown on **Figure 2**. Based on the provided simulated pathlines representing the 30-day advective flow path under 2,000 gpm dewatering pumping, the induced hydraulic gradient, and average hydraulic conductivity of 1,210 ft/day, the projected leading edge of the plume was drawn after this 30-day dewatering period. This estimated projection is considered conservative as it is more consistent with only groundwater advection and it does not account for solute transport parameters that may reduce concentrations along the leading edge (dilution) or slow the advancement of the total VOC plume due to sorption. While the projected total VOC plume is not hydraulically captured in the simulated dewatering timeframe, there is a potential to divert the natural groundwater flow horizontal hydraulic gradient so that the plume migrates toward the neighborhood and could result in groundwater concentrations that pose an unacceptable risk for vapor intrusion (**Figure 2**).

Additionally, it is agreed that the simulated dewatering activities will have a nominal effect on groundwater flow directions and velocities on the eastern side of the Great Miami River. This muted hydraulic response is due to the duration of the dewatering, the distance from the dewatering center, and the hydraulic buffering capacity of the river in the upper aquifer despite the relatively low simulated riverbed conductance. The simulated nominal hydraulic influence east of the river further indicates that the

simulated dewatering activities will have little to no impact on the proposed remedy design for the upper aquifer.

Recommendations

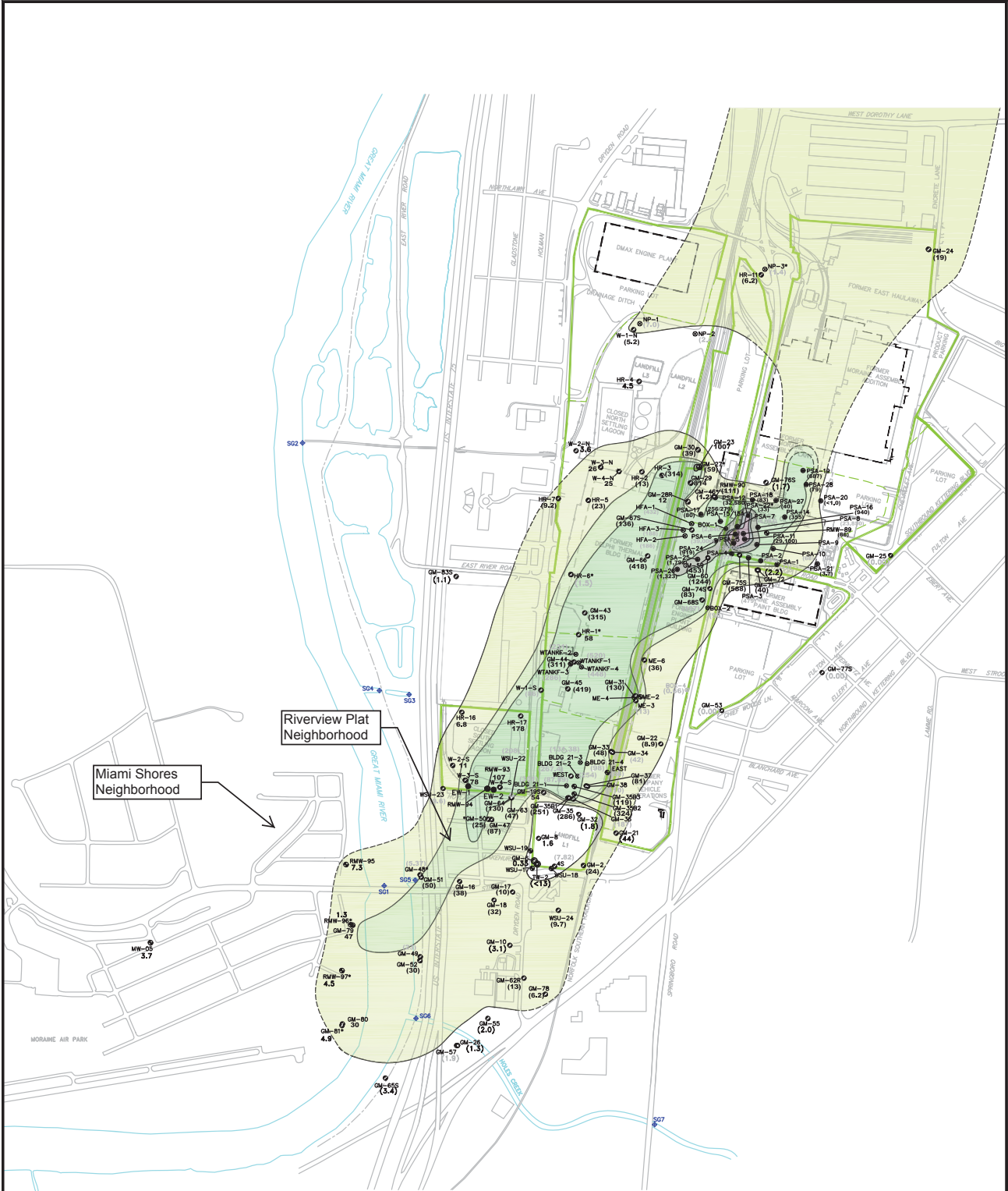
Based on the review of the currently available information and out of an abundance of caution, any dewatering activities should be completed after the Phase I DGR™ Interim Measure in the upper aquifer is operational on the east side of the Great Miami River. Baseline groundwater data will be collected to monitor the effect of the dewatering activities to assess potential vapor intrusion risk for the Miami Shores residential neighborhood. Once available, this data will be shared with all stakeholders.

References

- Arcadis, Inc., 2012. Corrective Measures Proposal, RACER Trust, Moraine, Ohio. December 31.
- Arcadis, Inc., 2018a. Groundwater Monitoring Report, RACER Trust, Moraine, Ohio. February 27.
- Arcadis, Inc., 2018b. Phase 1 Dynamic Groundwater Recirculation Interim Measure Design Report and Work Plan, RACER Trust, Moraine, Ohio. May 1.
- Black and Veatch, 2018. Groundwater Modeling Summary Memorandum: Well Field Feasibility Modeling, Montgomery County Environmental Services, Moraine, Ohio. January 25.
- CBC Engineers & Associates, 2006. Design of Dewatering System for Splash Moraine and Miami Shores Area, City of Moraine, Ohio. June 30.
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- Eagon & Associates, Inc., 2018a. Groundwater Flow Modeling for Miami Shores Sanitary Sewer Improvements, Hazen and Sawyer, Montgomery County, Ohio. June 5.
- Eagon & Associates, Inc., 2018b. Addendum to Groundwater Flow Modeling Report, Miami Shores Sanitary Sewer Improvements, Hazen and Sawyer, Montgomery County, Ohio. July 5.
- Montgomery County, 2018. Addendum #3, Project Number: 130006-15, Miami Shores Sanitary Sewer Improvements, Due Date: July 11, 2018 @ 1:30 PM, Montgomery County, Ohio. July 5.
- RACER Trust, 2016. Updated Former Process Sump Area Draft Data Package, RACER Trust, Moraine, Ohio. February 16.

FIGURES





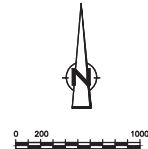
LEGEND

- ⊕ MONITORING WELL (UPPER AQUIFER)
- INACTIVE RECOVERY WELL (TW-2)
- ⊕ STREAM GAUGE
- ⊕ BORING LOCATION
- RIVER LEVEE
- FORMER BUILDING FOOTPRINT
- SURFACE WATER FEATURE
- PROPERTY BOUNDARY
- PARCEL BOUNDARY
- ug/L MICROGRAMS PER LITER
- <1.0 CONSTITUENT NOT DETECTED ABOVE LABORATORY LIMIT SHOWN
- MCL MAXIMUM CONTAMINANT LEVEL
- <1.0 2017 CONCENTRATIONS
- <1.0 2016-2013 CONCENTRATIONS
- <1.0 PRE-2013 CONCENTRATIONS
- THE SAMPLE INTERVAL IS LOCATED VERTICALLY ABOVE OR BELOW THE INTERPRETED REPRESENTATIVE CONCENTRATION USED FOR CONTOURING

- >10000 ug/L
- 5000-10000 ug/L
- 1000-5000 ug/L
- 100-1000 ug/L
- 50-100 ug/L
- 5-50 ug/L

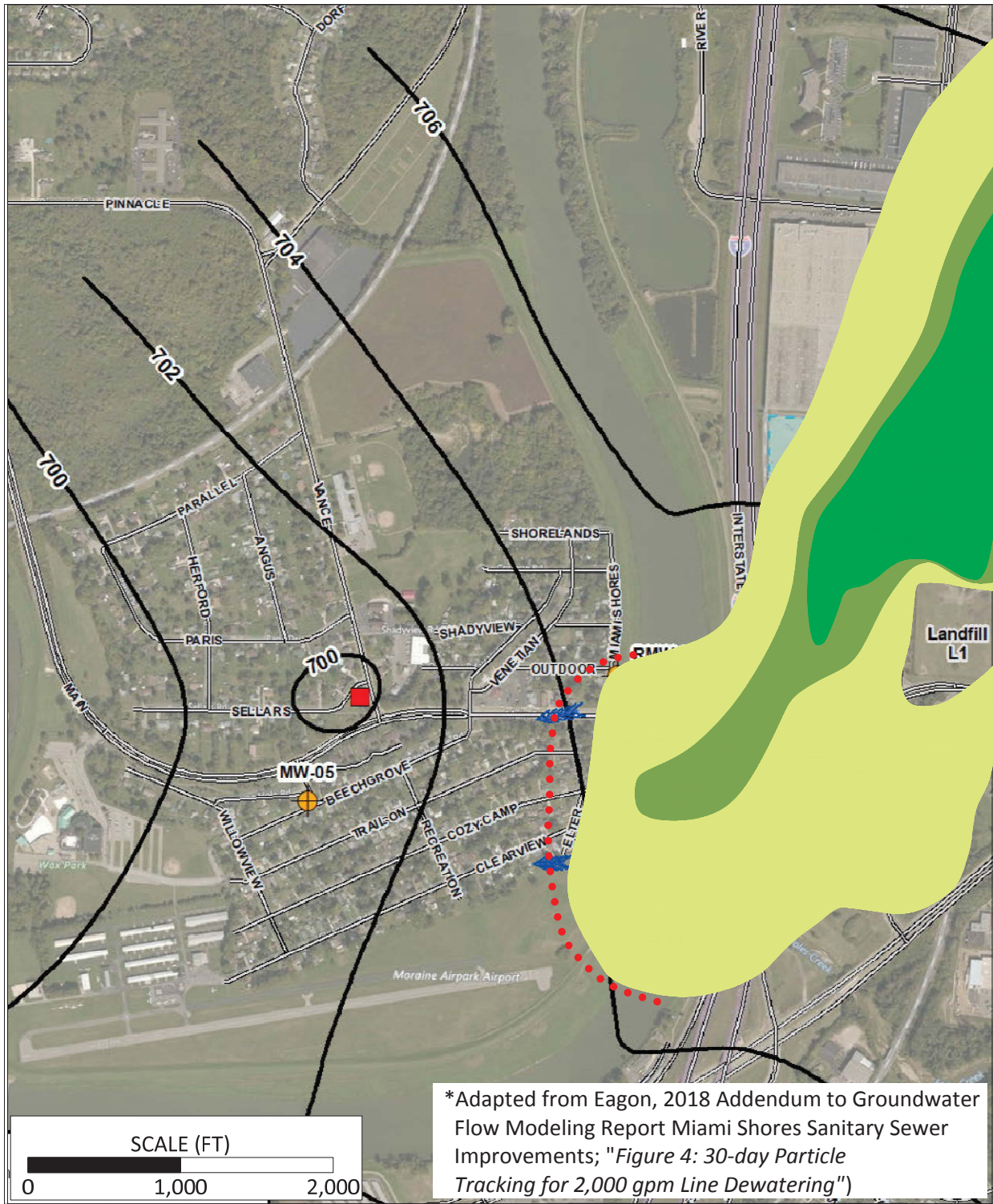
NOTE:

- CONCENTRATIONS POSTED REFLECT 2017 MONITORING WELL RESULTS, 2016 THROUGH 2013 MONITORING WELL RESULTS, PRE-2013 MONITORING WELL RESULTS, AND MAXIMUM CONCENTRATION FROM VERTICAL AQUIFER PROFILING FROM 2011 THROUGH 2015. THE INTERPRETATION OF THE ISOCONCENTRATION INCLUDES THE CONCEPTUAL SITE MODEL UNDERSTANDING (I.E. GROUNDWATER FLOW AND INTERIM MEASURES OPERATION).
- WHEN SAMPLE RESULT IS NON-DETECT, HALF THE REPORTING LIMIT IS HONORED WITH THE CONTOURING.
- RELATIVE UNDERSTANDING OF PRE-2013 CONCENTRATIONS (GRAY) WAS USED TO DEVELOP THE OVERALL PLUME GEOMETRY IN THE VICINITY OF THESE WELLS.



RACER TRUST
 MORaine, OHIO
 OH000294.2018

**ISOCONCENTRATION MAP
 (UPPER AQUIFER)
 TOTAL CHLORINATED VOCs - 2017**



LEGEND

- Extraction Well
- 700 - Simulated Water Level (ft NGVD88)
- ← Simulated Pathline (5-day arrows)

TVOC Plume (2017)

- 5 - 50 ppb
- 50 - 100 ppb
- >100 ppb

Projected Leading Edge of TVOC Plume Footprint After 30 days Based on Eagon Pathlines

RACER MORaine, OH	
ESTIMATED PLUME INFLUENCE DUE TO DEWATERING	
ARCADIS	Design & Consultancy for natural and built assets
FIGURE 2	

APPENDIX F

RACER Trust Moraine Facilities – Montgomery County Sewer Improvement Projects Memorandum



MEMO

To:
Ms. Mirtha Capiro, U.S. EPA

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Mr. Conor Neal, U.S. EPA
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From:
Mr. Josh Ferry
Ms. Carolyn Grogan

Date:
July 23, 2018
Subject:

Arcadis Project No.:
OH000294.2018.00001

RACER Trust Moraine Facilities – Montgomery County Sewer Improvement
Projects

On behalf of Revitalizing Auto Communities Environmental Response Trust (RACER Trust), Arcadis U.S., Inc. (Arcadis) is providing this memorandum to summarize the planned Montgomery County (County) sewer improvement projects as per the United States Environmental Protection Agency's (U.S. EPA's) request during a June 25, 2018 conference call with the U.S. EPA, RACER Trust, and Arcadis. The following information was provided by the County during phone calls. It should be noted that the sewer improvement projects are in the design and/or planning phases and are subject to change. A tentative schedule for the projects summarized below is included as **Attachment 1**.

Miami Shores Sanitary Sewer Improvements (Project No. 130006-15)

Mr. Kenneth Stewart of Montgomery County Environmental Services provided the following information regarding the Miami Shores Sanitary Sewer Improvements project during a June 26, 2018 phone call with Arcadis:

- Montgomery County is currently in the bidding phase for a sanitary sewer improvement project in the Miami Shores neighborhood, along Pinnacle Road and Vance Road. The project involves replacing an existing 10-inch sanitary sewer with a 16-inch sanitary sewer and installing a drop manhole. The plans that the County provided for the project are included as **Attachment 2**. It should be noted that the County issued an addendum to the Plans on July 5, 2018 (**Attachment 3**).

- The approximately 90-day project is planned to begin on or around September 1, 2018. The project is currently out to bid.
- Sanitary sewer systems are typically constructed from the point with the lowest elevation to the point with the highest elevation. Some work can occur simultaneously.
- The portion of the project that is expected to require dewatering is approximately 1,000 feet long, and spans from San Drop Doghouse MH#1 (estimated 16 feet of dewatering at this location) to San MH#6. These areas are shown on sheets C-01 and C-02 in the plans (**Attachment 2**). However, during a July 11, 2018 meeting with Montgomery County and RACER Trust, the County indicated that the dewatering operations have changed, and less dewatering may occur.
- It will take several weeks to install the dewatering wells, and the wells will need to pump for several weeks to achieve a dry trench and install the sewer.
- Sewer installation between MH#1 and MH#6 is expected to take three weeks with a 24/7 operation and continuous dewatering.
- Sewer installation activities outside of the MH#1 to MH#6 stretch may require dewatering with a trash pump (i.e., minor dewatering activities).
- The Ohio Environmental Protection Agency (Ohio EPA) is sending Montgomery County the Permit to Install. The dewatering water will be discharged to the Great Miami River through Montgomery Conservancy District Gate 80. Mr. Stewart indicated that a National Pollutant Discharge Elimination System (NPDES) permit is not required since the disturbance is less than 1 acre and the water is similar in character to the water discharged from well DN-13.
- The project schedule will be refined once the bid is awarded in mid-August.

Sanitary Conveyance and Treatment Western Regional Project

Mr. Tony Jasinski provided the following information regarding the Dryden Road Sewer Project during a June 27, 2018 phone call with Arcadis:

- The project generally involves installation of a 6-foot diameter tunnel from Dryden Road to the pre-treatment facility located to the west of the Great Miami River. The tunnel is generally oriented east-west and will span from a location south of the Montgomery County Environmental Services building, under the river, and westward.
- The County is planning to issue the Request for Qualifications and Request for Proposals this year. Work may begin mid to late next year. The project is planned for completion in 2022.
- The methods for tunnel installation have not been finalized. Micro-tunneling is an option.
- The project will be a design build and the dewatering approach is up to the builder. Minimal dewatering is expected.
- Montgomery County contracted Black and Veatch for the engineering services associated with this project.
- Mr. Jasinski is new to the project and suggested a meeting if we would like additional details.

- Based on the information available to date (i.e., minimal dewatering), the proposed remedial design for the upper aquifer (i.e., Phase 1 Dynamic Groundwater Recirculation [DGR™] Interim Measure) is appropriate and is not expected to be adversely affected by the Sanitary Conveyance and Treatment Western Regional Project.

Potential Additional Miami Shores Sewer Project

During the June 26, 2018 phone conversation, Mr. Stewart indicated that there is an additional sewer project that may occur several years from now in the Miami Shores neighborhood. This project is conceptual, and planning has not been initiated. The project would connect the sewer installed during the Miami Shores Sewer Improvement project planned this year with the sewer installed during the Dryden Road Sewer project. Directional drilling is an option should this project move forward. Plans for dewatering are unknown, and additional details are not available.

Recommendation

Given the significance of the upcoming County projects and associated potential dewatering activities, the vapor intrusion risks for the Riverview Plat neighborhood, and the potential vapor intrusion risks associated with plume expansion, it is recommended that the Phase 1 DGR™ Interim Measure be implemented as soon as possible.

Enclosures:

Attachments

- 1 Miami Shores Sanitary Sewer Improvements Schedule
- 2 Miami Shores Sanitary Sewer Improvements Bid Drawings
- 3 Addendum to Bid Drawings

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ATTACHMENT 1

Miami Shores Sanitary Sewer Improvements Schedule



Attachment 1 - Miami Shores Sanitary Sewer Improvements Schedule

Project Task	Date Ending													2018	2019	2022	
	9/1/18	9/8/18	9/15/18	9/22/18	9/29/18	10/6/18	10/13/18	10/20/18	10/27/18	11/3/18	11/10/18	11/17/18	11/24/18				12/1/18
Miami Shores Sanitary Sewer Improvements (Project No. 130006-15 ¹⁾																	
Sanitary Conveyance and Treatment Western Regional Project ²																	
Potential Additional Miami Shores Sewer Project ³																	

Notes:

- 1) Projected to take 90-days, 9/1/2018 through 12/1/18. This timeline assumes simultaneous operations will occur (i.e., well installation, development, dewatering, and sewer line installation). The timeline also assumes that dewatering will commence several weeks prior to sewer line installation and during the three week sewer line installation period.
- 2) Request for quotes and requests for pricing will be issued in 2018. Construction start is expected in mid to late 2019. Construction completion is planned for 2022.
- 3) Project feasibility and timeline are to be determined.

ATTACHMENT 2

Miami Shores Sanitary Sewer Improvements Bid Drawings



MONTGOMERY COUNTY ENVIRONMENTAL SERVICES

MIAMI SHORES SANITARY SEWER IMPROVEMENTS CONTRACT NO. 1 PROJECT NO. 13000-1

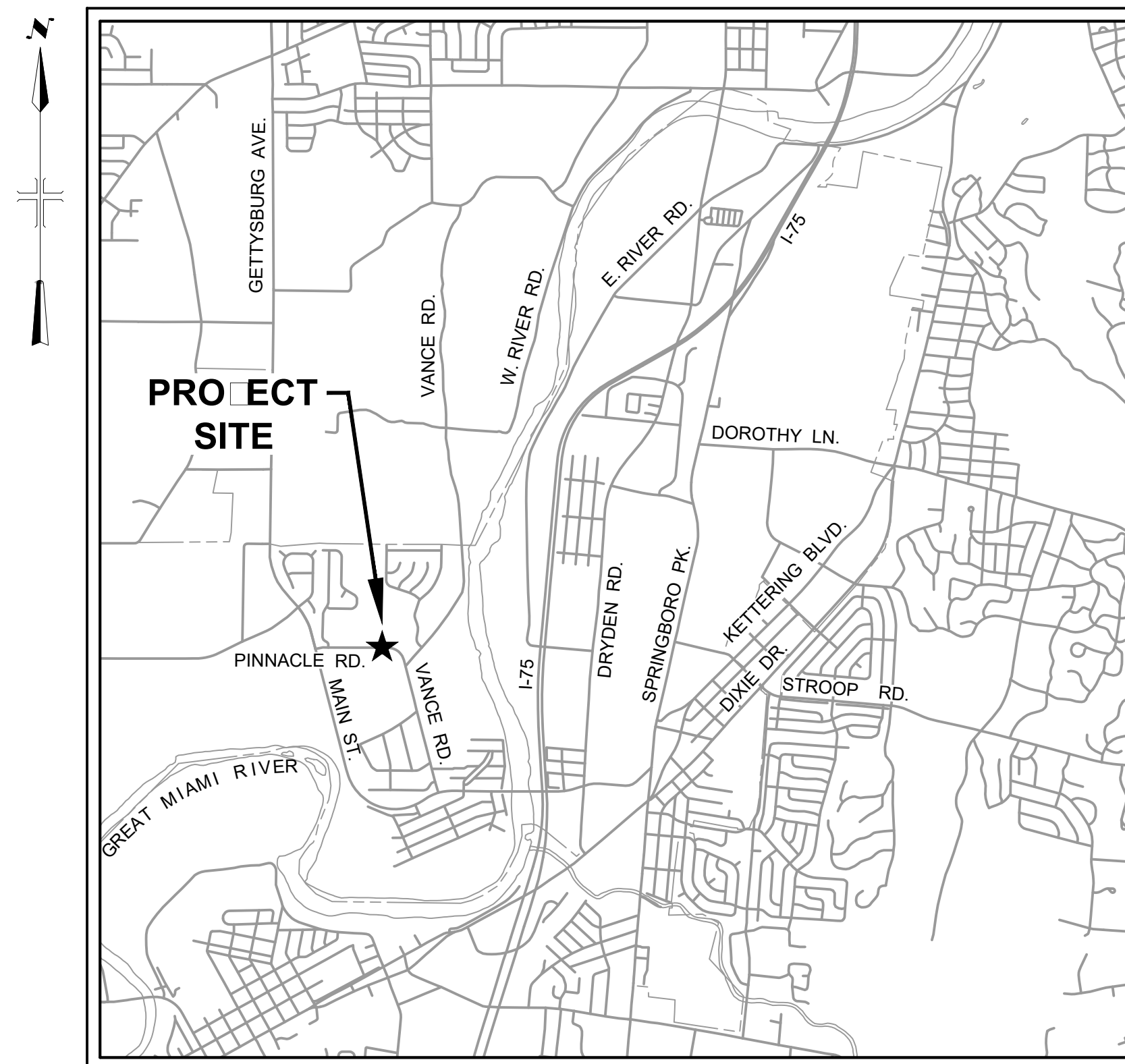
SECTION 1 TOWN 1 RANGE E
CITY OF MORAINES OHIO
MIAMI TOWNSHIP - MONTGOMERY COUNTY

APPROVALS :

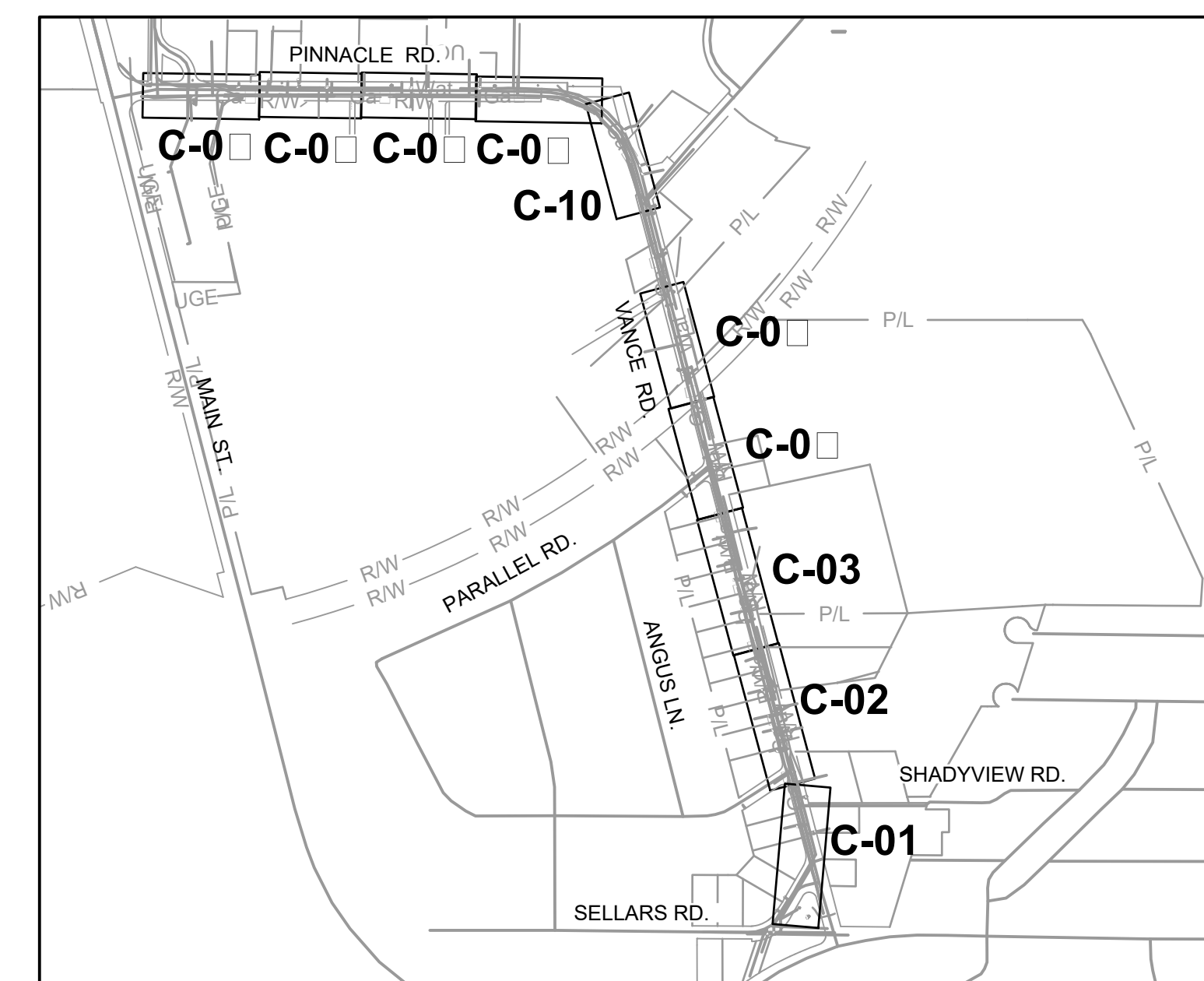
PATRICK TURNBULL, P.E.
MONTGOMERY COUNTY ENVIRONMENTAL SERVICES DIRECTOR

DATE

SHEET INDEX	
SHEET G-01	TITLE SHEET
SHEET G-02	GENERAL NOTES
SHEET G-03	ABBREVIATIONS & LEGEND
SHEET C-01	VANCE RD. SEWER PLAN AND PROFILE STA. 10+00 TO STA. 15+50
SHEET C-02	VANCE RD. SEWER PLAN AND PROFILE STA. 15+50 TO STA. 21+00
SHEET C-03	VANCE RD. SEWER PLAN AND PROFILE STA. 21+00 TO STA. 26+50
SHEET C-04	VANCE RD. SEWER PLAN AND PROFILE STA. 26+50 TO STA. 31+00
SHEET C-05	VANCE RD. SEWER PLAN AND PROFILE STA. 31+00 TO STA. 36+00
SHEET C-06	PINNACLE RD. SEWER PLAN AND PROFILE STA. 10+00 TO STA. 14+00
SHEET C-07	PINNACLE RD. SEWER PLAN AND PROFILE STA. 14+00 TO STA. 18+50
SHEET C-08	PINNACLE RD. SEWER PLAN AND PROFILE STA. 18+50 TO STA. 23+00
SHEET C-09	PINNACLE RD. SEWER PLAN AND PROFILE STA. 23+00 TO STA. 26+50
SHEET C-10	PINNACLE RD. SEWER PLAN AND PROFILE STA. 26+50 TO STA. 31+60
SHEET SD-01	MCES STANDARD DETAILS
SHEET SD-02	MCES STANDARD DETAILS
SHEET D-01	STANDARD DETAILS
SHEET D-02	STANDARD DETAILS
SHEET D-03	STANDARD DETAILS



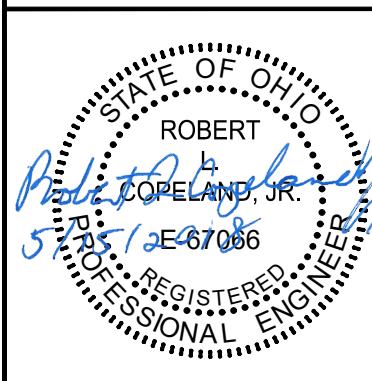
VICINITY MAP
NO SCALE



KEY MAP
NO SCALE



BID DRAWING



REV. NO.	REVISIONS

DESIGNED BY:	JMC
DRAWN BY:	PJO
SHEET CHKD BY:	JMC
CROSS CHKD BY:	JM
APPROVED BY:	BC
DATE:	MAY 2018



1850 Spaulding Road
Kettering, Ohio 45432
Tel: (937) 781-2550

Hazen

HAZEN AND SAWYER
7870 EAST KEMPER ROAD, SUITE 300
CINCINNATI, OHIO 45249

MIAMI SHORES
SANITARY SEWER IMPROVEMENTS
CONTRACT NO. 1

TITLE SHEET

PROJECT NO. 130006-15
FILE NAME: G-1.DWG

SHEET NO.

-01

File: HAZENANDSAWYER\COM\HSPROJECTS\130006-15\G-1.DWG Design\DRAWINGS\GEN\G-1.dwg, Saved by: POCOINOR, Save date: 5/15/2018 11:53 AM, Plot date: 5/15/2018 1:58 PM, BY: POCOINOR

1. GENERAL NOTES FOR ALL WORK

- "MONTGOMERY COUNTY WATER SERVICES", "MONTGOMERY COUNTY ENVIRONMENTAL SERVICES" AND / OR "MONTGOMERY COUNTY ENGINEERING DEPARTMENT" AS REFERRED, ALL OR IN PART, ALL REFER TO AND ARE THE SAME AS MONTGOMERY COUNTY ENVIRONMENTAL SERVICES.
- SAFETY - CONTRACTOR SHALL BE RESPONSIBLE FOR INITIATING, MAINTAINING AND SUPERVISING ALL SAFETY PRECAUTIONS AND PROGRAMS IN CONNECTIONS WITH THE WORK IN ACCORDANCE WITH PROJECT SPECIFICATIONS GENERAL CONDITIONS ARTICLE 6-"CONTRACTOR'S RESPONSIBILITIES".
- REFERENCE STANDARDS/SPECIFICATIONS - CONTRACTOR SHALL PERFORM ALL WORK IN ACCORDANCE WITH PROJECT SPECIFICATIONS AND REFERENCE DOCUMENTS AND SPECIFICATIONS CITED BUT NOT INCLUDED IN THE PROJECT SPECIFICATIONS. THESE MAY INCLUDE THE FOLLOWING:
 - WATER SERVICES DEPARTMENT RULES AND REGULATIONS, LATEST REVISION.
 - OHIO DEPARTMENT OF TRANSPORTATION (ODOT) CONSTRUCTION AND MATERIAL SPECIFICATIONS, LATEST REVISION.
 - ODOT "OHIO MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES", LATEST REVISION.
 - OHIO ENVIRONMENTAL PROTECTION AGENCY (OEPA) PERMIT NUMBER OHC000004 - "AUTHORIZATION FOR STORM WATER DISCHARGES ASSOCIATED WITH CONSTRUCTION ACTIVITY UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM" EFFECTIVE APRIL 21, 2013.
 - FEDERAL, STATE, COUNTY, CITY, TOWNSHIP, PARK DISTRICT OR OTHER RELEVANT AGENCY RULES, REGULATIONS AND SPECIFICATIONS FOR WORK ON ASSETS UNDER THEIR JURISDICTION.
 - OTHER DOCUMENTS AND SPECIFICATIONS REFERENCED IN THE PLANS AND/OR PROJECT SPECIFICATIONS.
- CONNECTIONS - ROOF DRAINS, FOUNDATION DRAINS, OR OTHER CLEAN WATER CONNECTIONS TO THE SANITARY SEWER SYSTEM ARE PROHIBITED.
- DITCHES AND EROSION CONTROL - CONTRACTOR SHALL MAINTAIN AND RESTORE ALL EXISTING DITCHES THROUGHOUT THE PERIOD OF CONSTRUCTION ACTIVITY AND THE MAINTENANCE PERIOD. CONTRACTOR SHALL PROVIDE SEDIMENT AND EROSION CONTROL FOR ALL DISTURBED AREAS.
- PERMITS - CONTRACTOR SHALL OBTAIN PERMITS REQUIRED TO WORK WITHIN THE PUBLIC RIGHT-OF-WAY, AS REQUIRED BY THE APPROPRIATE JURISDICTIONS. WATER SERVICES PERMITS WILL NOT BE ISSUED UNTIL ALL PERMITS REQUIRED BY OTHER JURISDICTIONS HAVE BEEN ISSUED. CONTRACTOR SHALL NOT COMMENCE CONSTRUCTION UNTIL WATER SERVICES PERMITS HAVE BEEN ISSUED. CONTRACTOR SHALL PROCURE AND PAY ALL PERMITS, LICENSES, INSPECTIONS AND APPROVALS NECESSARY FOR CONSTRUCTION OF THE WORK. CONTRACTOR SHALL INCLUDE THE COST OF THE PERMITS IN THE BID UNLESS OTHERWISE SPECIFIED.
- CHANGES - CONTRACTOR SHALL NOT INSTALL ADDITIONS, DELETIONS, OR REVISIONS TO THE SANITARY SEWERS, STORM WATER SEWERS, WATER MAINS AND APPURTENANCES WITHOUT PRIOR WRITTEN APPROVAL BY THE ENVIRONMENTAL SERVICES PROJECT ENGINEER.
- TREE AND SHRUB PROTECTION AND TRIMMING - CONTRACTOR SHALL TAKE SPECIAL CARE TO AVOID DAMAGE TO TREES, SHRUBS AND THEIR ROOT SYSTEMS. CONTRACTOR SHALL MEET ALL REQUIREMENTS OF SPECIFICATION SECTION 0298.
- BURNING AND BURYING - CONTRACTOR SHALL NOT BURN OR BURY TREES, STUMPS OR OTHER CONSTRUCTION DEBRIS ON THE PROJECT SITE.
- TRAFFIC CONTROL - CONTRACTOR SHALL PLAN AND EXECUTE TRAFFIC CONTROL IN ACCORDANCE WITH THE TRAFFIC CONTROL NOTES.
- OPERATION OF WATER SERVICES UTILITIES - ONLY MONTGOMERY COUNTY WATER SERVICES PERSONNEL SHALL OPERATE MAIN LINE WATER VALVES, SEWER FORCE MAIN VALVES, AND ALL OTHER WATER AND SEWAGE FACILITIES AND APPURTENANCES.
- NOTIFICATION TO OTHER AGENCIES - CONTRACTOR SHALL NOTIFY AGENCIES RESPONSIBLE FOR PUBLIC RIGHT-OF-WAY AND EASEMENTS PRIOR TO PERFORMING WORK IN THEM. NOTIFICATION SHALL BE ON THE FORM AND THE LEAD TIME REQUIRED BY EACH AGENCY.
- REPORT OF SPILLS AND SAMPLING - CONTRACTOR SHALL IMMEDIATELY REPORT TO THE ON-SITE WATER SERVICES INSPECTOR AND THE PROJECT ENGINEER ANY SPILL OF SANITARY SEWAGE. CONTRACTOR SHALL DOCUMENT THE TIME THE DISCHARGE BEGAN, THE TIME IT ENDED, ESTIMATED AMOUNT IN GALLONS THAT REACHED THE WATER OF THE STATE (ANY STREAM) AND THE REASON THE DISCHARGE OCCURRED, SUCH AS FAILED PIPE GASKET, BROKEN PUMP HOSE, OR OTHERS REASONS. CONTRACTOR SHALL REMOVE SEWAGE THAT DOES NOT DRAIN TO THE WATERS OF OHIO AND DELIVER IT TO THE MONTGOMERY COUNTY SEPTAGE RECEIVING STATION AT 4257 DRYDEN ROAD FOR TREATMENT.
- HISTORICAL OR ARCHEOLOGICAL EVIDENCE - CONTRACTOR SHALL IMMEDIATELY CEASE OPERATIONS WHEN EVIDENCE OF DEPOSITS OF HISTORICAL OR ARCHEOLOGICAL INTEREST IS FOUND. CONTRACTOR SHALL IMMEDIATELY NOTIFY THE WATER SERVICES PROJECT ENGINEER. WATER SERVICES WILL NOTIFY THE OHIO HISTORIC PRESERVATION OFFICE. CONTRACTOR SHALL NOT PERMIT FURTHER DISTURBANCE OF THE EVIDENCE UNTIL CONTRACTOR HAS BEEN NOTIFIED IN WRITING BY THE PROJECT ENGINEER THAT HE/SHE MAY PROCEED. THAT NOTICE WILL BE ISSUED ONLY AFTER THE OHIO HISTORIC PRESERVATION OFFICE HAS SURVEYED THE FIND AND MADE A DETERMINATION OF VALUE AND EFFORT AND SUBMITTED SUCH DETERMINATION TO THE OWNER.
- PLANNING - CONTRACTOR SHALL PLAN HIS OPERATION IN ORDER TO MINIMIZE DISRUPTION OF EXISTING FACILITIES. THE CONTRACTOR SHALL PREPARE AND SUBMIT A CONSTRUCTION SCHEDULE IN ACCORDANCE WITH SPECIFICATION SECTION 01310.

WATER MAINS

- SEVERED CONNECTION - CONTRACTOR SHALL REPLACE ALL SERVICE CONNECTIONS THAT ARE SEVERED OR DAMAGED DURING CONSTRUCTION.
- MINIMUM COVER - WATER MAINS SHALL HAVE FOUR FEET SIX INCHES (4'6") MINIMUM COVER.
- SEPARATION - WATER MAINS SHALL HAVE A MINIMUM HORIZONTAL SEPARATION OF TEN FEET (10') FROM ANY SANITARY OR STORM SEWER. THE SEPARATION DISTANCE SHALL BE MEASURED LEVEL BETWEEN THE OUTSIDE SURFACE OF THE WATER MAIN PIPE AND THE OUTSIDE SURFACE OF ANY SANITARY OR STORM SEWER PIPE. WATER MAINS SHALL HAVE A MINIMUM VERTICAL SEPARATION OF EIGHTEEN INCHES (18") MEASURED VERTICALLY BETWEEN THE OUTSIDE SURFACE OF THE WATER MAIN PIPE AND THE OUTSIDE SURFACE OF ANY SANITARY OR STORM SEWER PIPE. WHERE A WATER MAIN CROSSES A SANITARY OR STORM SEWER, ONE FULL LENGTH OF WATER MAIN PIPE SHALL BE CENTERED AT THE POINT OF CROSSING SUCH THAT BOTH JOINTS WILL BE EQUIDISTANT, AND AS FAR AS POSSIBLE, FROM THE SEWER PIPE.
- INSPECTIONS - WATER MAIN INSTALLATIONS WILL BE INSPECTED BY WATER SERVICES PERSONNEL AND MAY BE INSPECTED BY OTHER JURISDICTIONS HAVING AUTHORITY OVER WATER MAINS.
- VALVE LOCATIONS - ALL GATE VALVES AT TEES OR CROSSES SHALL BE LOCATED WITHIN THREE FEET (3') FROM THE NIPPLE ON THE TEE OR CROSS. WHERE PLUGS ARE INSTALLED ON A BRANCH, THEY SHALL BE CONNECTED TO VALVES EXCEPT WHERE OTHERWISE SHOWN ON THE PLANS.
- CONNECTIONS TO PRE-STRESSED - CONTRACTOR SHALL MEET WITH WATER SERVICES REPRESENTATIVES BEFORE ORDERING ANY WATER PIPE WHEN A CONNECTION TO PRE-STRESSED WATER MAINS IS INCLUDED IN THE WORK.
- NOTICE TO SHUT DOWN WATER MAIN - CONTRACTOR SHALL PROVIDE A MINIMUM OF SEVENTY-TWO (72)

BID DRAWING

HOURS NOTICE TO THE PROJECT ENGINEER (EXCLUSIVE OF WEEKENDS AND HOLIDAYS) FOR ANY PLANNED WATER MAIN SHUTDOWN NOTIFICATIONS WHEN NECESSARY.

- DEFLECTIONS - PIPE DEFLECTIONS AT A JOINT SHALL NOT EXCEED ONE HALF (1/2) OF THE MAXIMUM DEFLECTION RECOMMENDED BY THE PIPE MANUFACTURER.

SANITARY SEWERS

- RELEASES AND CONNECTIONS - CONTRACTOR SHALL NOT PLACE NEW SEWER SEGMENTS IN SERVICE UNTIL AUTHORIZED BY MCES AFTER DOWNSTREAM SEWERS AND MANHOLE HAVE BEEN INSPECTED, TESTED, AND RELEASED. AS WORK PROGRESSES FROM DOWNSTREAM TO UPSTREAM, SEWER LATERALS MAY BE CONNECTED TO THE NEW SEWER SEGMENT AS THEY ARE ENCOUNTERED. OTHER FLOWS, INCLUDING FLOW FROM EXISTING SEWERS TO BE ABANDONED, MAY BE CONNECTED INTO NEW SEWERS ONLY AFTER THEY HAVE BEEN INSPECTED, TESTED AND RELEASED..
- BYPASS PUMPING - CONTRACTOR SHALL ENSURE THAT NO SEWAGE IS RELEASED FROM THE MONTGOMERY COUNTY SANITARY SEWER SYSTEM. SEE PROJECT SPECIFICATION SECTION 01046. SANITARY SEWAGE SPILLS SHALL BE REPORTED AND REMOVED IN ACCORDANCE WITH THE "GENERAL NOTES FOR ALL WORK", ABOVE. CONTRACTOR SHALL BE REQUIRED TO SUBMIT A BYPASS PUMPING PLAN.
- MANHOLES - CONTRACTOR SHALL FURNISH AND INSTALL PRECAST CONCRETE MANHOLES CONFORMING TO ASTM C-478. JOINTS BETWEEN MANHOLE SECTIONS SHALL CONFORM TO ASTM C-443. MANHOLES SHALL BE VACUUM TESTED ALL IN ACCORDANCE WITH THE PROJECT SPECIFICATION SECTION 02722.
- CHIMNEY SEALS - CONTRACTOR SHALL INSTALL AN APPROVED CHIMNEY SEAL BETWEEN THE CASTING AND CONE SECTION OF EACH MANHOLE.
- MANHOLE BASE - BASE SECTIONS OF EACH MANHOLE SHALL BE CHANNIELED TO ACCOMMODATE FLOW AND PROVIDE A STEP FOR MAINTENANCE PERSONNEL. EACH BASE SHALL BE PRECAST CONCRETE UNLESS THE PLANS DIRECT OTHERWISE. PRECAST CONCRETE BASES SHALL HAVE TWO (2) CAGES OF REINFORCING STEEL IN THE WALL. EACH CAGE HAVING AN AREA OF STEEL EQUAL TO THAT REQUIRED IN THE RISER SECTIONS IN ACCORDANCE WITH PROJECT SPECIFICATION SECTION 02722.
- MANHOLE STEPS - STEPS SHALL NOT BE INSTALLED IN MANHOLES.
- ALL ACTIVE SANITARY SEWER LATERALS SHALL BE REPLACED UP TO THE RIGHT OF WAY, PER THE DETAILS SHOWN IN THESE DRAWINGS.
- ANTI-SEEP COLLAR SHALL BE INSTALLED AT MID-SPAN OF EACH SEWER SEGMENT THAT IS INSTALLED USING OPEN CUT METHODS.

CONSTRUCTION INSPECTION

- NOTIFICATION - CONTRACTOR SHALL NOTIFY MONTGOMERY COUNTY WATER SERVICES TEN (10) CALENDAR DAYS PRIOR TO COMMENCEMENT OF PROJECT ACTIVITIES. THIS TIME IS NECESSARY TO LOCATE VALVES AND MANHOLES, CREATE WORK ORDERS AND PERFORM REPAIRS WHEN NECESSARY IN A NON-EMERGENCY MODE.
- REPLACEMENT PARTS - PRIOR TO START OF CONSTRUCTION, CONTRACTOR SHALL SCHEDULE A "PROJECT WALK THROUGH" WITH WATER SERVICES INSPECTION PERSONNEL AND RELEVANT SUBCONTRACTORS. CONTRACTOR SHALL IDENTIFY EXISTING WATER SERVICES UTILITIES THAT REQUIRE REPAIR OR REPLACEMENT. PARTS MAY INCLUDE BROKEN OR MISSING VALVE CAPS, VALVE BOXES, MANHOLE LIDS, MANHOLE CASTINGS, INOPERABLE FIRE HYDRANTS, AND OTHER SIMILAR ITEMS. WATER SERVICES WILL PROVIDE REPLACEMENT PARTS TO CONTRACTOR FOR INSTALLATION BY CONTRACTOR AT THE APPROPRIATE TIME.
- NOTICE TO TEST OR TAP MAINS - CONTRACTOR SHALL NOTIFY PROJECT ENGINEER FORTY- EIGHT (48) HOURS PRIOR TO ANY PLANNED TESTING OR TAPPING OF MAIN LINE UTILITIES OR THEIR APPURTENANCES. CONTRACTOR SHALL OBTAIN ALL REQUIRED PERMITS PRIOR TO BEGINNING WORK.
- INSPECTOR DUTIES - INSPECTORS ARE AVAILABLE TO DISCUSS WITH CONTRACTOR THE CONSTRUCTION EVENTS ASSOCIATED WITH PROJECT PLANS, SPECIFICATIONS OR OTHER REQUIREMENTS OR REGULATIONS NECESSARY FOR COMPLETION OF THE PROJECT. WATER SERVICES INSPECTORS DO NOT HAVE AUTHORITY TO CHANGE ANY PORTIONS OF A PROJECT THAT WILL INCREASE OR DECREASE PROJECT COSTS. ALL CHANGES IN WORK (WHICH COULD CAUSE AN INCREASE IN PROJECT COSTS) SHALL BE REVIEWED BY THE WATER SERVICES PROJECT ENGINEER. CONTRACTOR SHALL DISCUSS WITH THE PROJECT ENGINEER ANY ADDITIONS OR DELETIONS FOR THE PURPOSE OF SEEKING APPROVAL OF THE PROPOSED CHANGES.
- MARKING AND ACCESSIBILITY - CONTRACTOR SHALL AT ALL TIMES PROTECT AND ENSURE THAT VALVES, HYDRANTS, AND MANHOLES OR OTHER APPURTENANCES ARE ACCESSIBLE AND VISIBLY MARKED DURING CONSTRUCTION. FAILURE TO MAINTAIN ACCESSIBILITY AND MARKS FOR THESE ITEMS MAY REQUIRE WATER SERVICES TO PERFORM THESE TASKS AT CONTRACTOR'S EXPENSE.
- ALL WORK REQUIRING INSPECTION, ATTENTION OR PRESENCE FOR ANY REASON OF OWNER'S PERSONNEL SHALL BE PERFORMED DURING MONTGOMERY COUNTY ENVIRONMENTAL SERVICES REGULAR WORKING HOURS. REGULAR WORKING HOURS ARE 7:30AM TO 4:00PM, MONDAY THROUGH FRIDAY. IF CONTRACTOR WISHES TO PERFORM REGULAR WORK AT TIMES OTHER THAN REGULAR WORKING HOURS, CONTRACTOR SHALL BE REQUIRED TO PAY THE OWNER FOR THE SERVICES OF THE RESIDENT PROJECT REPRESENTATIVE AND THE ENGINEER AT ESTABLISHED RATES ON RECORD IN THE OFFICE OF MONTGOMERY COUNTY ENVIRONMENTAL SERVICES. IN THE EVENT OF AN EMERGENCY OR OTHER UNPLANNED EVENT DUE TO THE CONTRACTOR'S WORK, NEGLIGENCE OR OTHERWISE ATTRIBUTABLE TO THE CONTRACTOR, CONTRACTOR SHALL SUBMIT PAYMENT FOR EXACT HOURS OF OVERTIME WORKED BY OWNER'S PERSONNEL. THE CONTRACTOR SHALL GIVE A MINIMUM OF TWO (2) WEEKS' NOTICE OF INTENT TO WORK AT TIMES OTHER THAN REGULAR WORKING HOURS TO THE RESIDENT PROJECT REPRESENTATIVE AND ENGINEER. ENGINEER HAS THE RIGHT TO DENY PERMISSION, WITH DUE CAUSE, FOR THE CONTRACTOR TO WORK AT TIMES OTHER THAN REGULAR WORKING HOURS. WHEN WORKING WITHIN THE EXISTING PUBLIC RIGHT-OF-WAY, THE CONTRACTOR SHALL ERECT CONSTRUCTION SIGNAGE AT LIMITS OF WORK AT LEAST TEN DAYS IN ADVANCE OF COMMENCEMENT OF ANY WORK ADVISING OF THE START DATE AND LENGTH OF CONSTRUCTION.
- CONTRACTOR ASSISTANCE - CONTRACTOR SHALL PROVIDE ASSISTANCE TO WATER SERVICES PERSONNEL, IN CASE OF EMERGENCY, TO SHUT DOWN VALVES OR OTHER OPERATIONS REQUESTED BY WATER SERVICES PERSONNEL IN ORDER TO LIMIT DAMAGE OR LOSS.

SUPPLEMENTAL NOTES

- UNDERGROUND UTILITIES LOCATIONS - CONTRACTOR SHALL NOTIFY WATER SERVICES AND OTHER UTILITY OWNERS MORE THAN TWO FULL WORKING DAYS PRIOR TO BEGINNING CONSTRUCTION AND REQUEST ACCURATE FIELD LOCATIONS OF EXISTING UNDERGROUND UTILITIES.
- UNDERGROUND UTILITY LOCATIONS - ALL EXISTING UNDERGROUND UTILITIES ARE SHOWN ON THE PLANS IN THE APPROXIMATE LOCATIONS ACCORDING TO THE BEST AVAILABLE INFORMATION. THE LOCATIONS SHOWN ARE INTENDED ONLY AS A GUIDE AND THE WATER SERVICES DEPARTMENT CANNOT GUARANTEE ACCURACY OF THEIR LOCATIONS. THE CONTRACTOR SHALL BE RESPONSIBLE TO PERFORM THE FOLLOWING WORK AND INCLUDE THE COSTS FOR THE WORK IN THE RELEVANT BID ITEMS.
 - NOTIFY OHIO UTILITY PROTECTION SERVICE (OUPS) AT PHONE NUMBER 811 OR 1-800-362-2764 MORE THAN FORTY-EIGHT (48) HOURS PRIOR TO BEGINNING CONSTRUCTION AND REQUEST ACCURATE FIELD LOCATIONS OF EXISTING UNDERGROUND UTILITIES.
 - CONFIRM THAT ALL UTILITIES OF OUPS MEMBER UTILITIES, LIMITED BASED PARTNER UTILITIES AND NON-MEMBER UTILITIES ARE MARKED PRIOR TO BEGINNING CONSTRUCTION ACTIVITY.
 - CONFORM TO THE CONSTRUCTION ACTIVITY TIME LIMITATIONS FOR MARKINGS ESTABLISHED BY OUPS AND APPLY THE SAME LIMITATIONS TO NON-MEMBER UTILITIES.
 - VERIFY BY VACUUM EXCAVATION OR OTHER RELIABLE MEANS THE HORIZONTAL AND VERTICAL LOCATION OF EACH UTILITY PRIOR TO BEGINNING EXCAVATION.

POTENTIAL UTILITIES AND IMPORTANT CONTACTS:

- | | |
|---|--|
| A. OHIO UTILITY PROTECTION SERVICE (OUPS) PHONE: 811 OR 1-800-362-2764 | H. AT&T 3233 WOODMAN DRIVE DAYTON, OHIO 45420 (937) 333-3725 |
| B. CITY OF MORAIN, OHIO 4200 DRYDEN ROAD MORAIN, OHIO 45439 (937) 535-1000 | I. MCI WORLD COM/VERIZON 120 RAVINE STREET AKRON, OHIO 44303 (330) 253-8267 |
| C. MONTGOMERY COUNTY ENGINEER 451 W THIRD STREET, 8TH FLOOR PO BOX 972 DAYTON, OHIO 45422-1260 (937) 225-4904 | J. DTE ENERGY 4220 PINNACLE ROAD MORAIN, OHIO 45439 (937) 268-5479 |
| D. MONTGOMERY COUNTY ENVIRONMENTAL SERVICES 1850 SPAULDING ROAD DAYTON, OHIO 45432-1260 (937) 781-2500 | K. CSX TRANSPORTATION 500 WATER STREET JACKSONVILLE, FLORIDA 32202 (904) 359-3100 |
| E. VECTREN GAS TRANSMISSION 6500 CLOY ROAD DAYTON, OHIO 45459 (937) 909-7668 | L. PINNACLE RIDGE DEVELOPMENT ENGINEER DAN MUTZNER - NORFLEET BROWN AND PETCEWICZ DMUTZNER@NBP-ENG.COM |
| F. SPECTRUM CABLE 275 LEO STREET DAYTON, OHIO 45404 (866) 874-2389 | M. MIAMI CONSERVANCY DISTRICT ROXANNE FARRIER, PROPERTY ADMINISTRATOR (937) 223-1278 EXT. 3230 RFARRIER@MCDWATER.ORG |
| G. DAYTON POWER AND LIGHT 1900 DRYDEN ROAD, PO BOX 1807 DAYTON, OHIO 45439 (937) 331-4834 | |
- CONTRACTOR SHALL FIELD VERIFY ALL WORK SHOWN AS "BY OTHERS" AND COORDINATE WITH OTHERS AS NECESSARY.
 - RESTORATION - CONTRACTOR SHALL RESTORE DISTURBED AREAS TO THEIR ORIGINAL CONTOURS AND ELEVATIONS, AS NEAR AS POSSIBLE. RESTORE PAVING, CURB AND SIDEWALK WITH THE SAME TYPE OF MATERIAL. RESTORE UNDERGROUND UTILITIES, WIRES AND SPRINKLER SYSTEMS TO THEIR ORIGINAL CONDITION, AND INSTALL GRASS TURF BY INSTALLING GRASS SEED AND MULCH, ALL IN ACCORDANCE WITH SPECIFICATION SECTION 0285. MINIMUM STANDARDS FOR RESTORATION ARE DEFINED IN SPECIFICATION SECTION 02512. CONTRACTOR SHALL REPLACE CURB AND GUTTER IN KIND ON LINE AND GRADE OR AS OTHERWISE REQUIRED BY THE CITY OF MORAIN.
 - PAVEMENT FAILURES - CONTRACTOR SHALL REPAIR OR REPLACE PAVEMENT DAMAGED BY CONSTRUCTION ACTIVITY AT ANY ON-SITE OR OFF-SITE FACILITY IN ACCORDANCE WITH THE REQUIREMENTS OF THE RELEVANT AGENCY OR OWNER, AT NO COST TO MONTGOMERY COUNTY.
 - DAMAGE DURING CONSTRUCTION - CONTRACTORS SHALL REMOVE AND REPLACE ALL PAVEMENT, CURBS, SIDEWALKS AND DRIVEWAYS DAMAGED DURING CONSTRUCTION AT NO COST TO MONTGOMERY COUNTY. DAMAGED ITEMS SHALL BE REPLACED IN KIND TO THE NEAREST EXISTING EXPANSION/CONSTRUCTION JOINT OF THE ADJACENT UNDAAMAGED PANEL.
 - STORM SEWER RESTORATION - CONTRACTOR SHALL REPAIR OR REPLACE ANY STORMWATER INFRASTRUCTURE DISTURBED BY CONSTRUCTION ACTIVITIES IN ACCORDANCE WITH THE REQUIREMENTS OF THE RELEVANT AGENCY AND AS DIRECTED BY THE CONTRACT DOCUMENTS.
 - MAILBOXES - CONTRACTOR SHALL REPLACE TO THE ORIGINAL LOCATION, WHERE POSSIBLE, ANY MAILBOX MOVED DURING CONSTRUCTION OPERATIONS. REPLACEMENT, EITHER PERMANENT OR TEMPORARY, SHALL OCCUR ON THE SAME DAY CONSTRUCTION OCCURS. CONTRACTOR SHALL REPLACE DAMAGED MAILBOXES WITH A BOX OF THE SAME SIZE, SHAPE AND STYLE. PERMANENT REPLACEMENT OF MAILBOXES SHALL CONFORM TO THE REQUIREMENTS OF THE UNITED STATES POSTAL SERVICE AS TO THE MAILBOX AND ITS LOCATION.
 - WORK AREA - CONTRACTOR SHALL CONFINE HIS OPERATIONS TO DESIGNATED WORK AREA IN PUBLIC RIGHT-OF-WAYS, PERMANENT EASEMENTS AND TEMPORARY EASEMENTS AS SHOWN ON THE DRAWINGS. CONTRACTOR SHALL IMMEDIATELY REPAIR OR COMPENSATE PROPERTY OWNERS FOR ANY DAMAGE OUTSIDE DESIGNATED WORK AREAS CAUSED BY HIS OPERATIONS, AT NO COST TO MONTGOMERY COUNTY.
 - PEDESTRIAN SAFETY - CONTRACTOR SHALL GIVE CONSIDERATION TO PEDESTRIAN TRAFFIC IN THE PROJECT AREA.
 - PERMITS - CONTRACTOR SHALL NOT COMMENCE CONSTRUCTION UNTIL APPLICABLE PERMITS HAVE BEEN ISSUED.
 - BLASTING - CONTRACTOR SHALL NOT USE EXPLOSIVES OR PERFORM BLASTING ON THIS PROJECT.
 - OCCUPATION SAFETY AND HEALTH ADMINISTRATION:
 - CONTRACTOR AND ALL SUBCONTRACTORS SHALL NOT REQUIRE ANY LABORER OR MECHANIC EMPLOYED IN PERFORMANCE ON THE CONTRACT TO WORK IN SURROUNDINGS OR UNDER WORKING CONDITIONS WHICH ARE UNSANITARY, HAZARDOUS OR DANGEROUS TO HIS/HER HEALTH OR SAFETY, AS DETERMINED UNDER FEDERAL AND/OR STATE CONSTRUCTION SAFETY AND HEALTH STANDARDS AND REGULATIONS (SEE TITLE 29, CODE OF FEDERAL REGULATIONS, LATEST REV.)
 - CONTRACTOR SHALL CONSTRUCT OR ERECT ALL SAFETY DEVICES OR APPURTENANCES, REQUIRED BY FEDERAL AND/OR STATE LAWS FOR EMPLOYEE SAFETY. CONTRACTOR SHALL PERFORM THIS WORK PRIOR TO PERSONNEL FROM WATER SERVICES, CONTRACTORS, SUBCONTRACTORS, CONSULTANTS OR OTHERS PERFORMING REQUIRED SURVEY WORK, INSPECTION, TESTING OR OTHER TASKS IN THE AFFECTED AREA.
 - STREAM CROSSING MITIGATION
 - CONTRACTOR SHALL ALLOW TREE ROOTS AND STUMPS TO REMAIN IN PLACE, WHERE POSSIBLE, WHERE TREE REMOVAL ALONG A STREAM IS NECESSARY, IN ORDER TO ANCHOR THE STREAM BANK.
 - CONTRACTOR SHALL CONTINUE CONSTRUCTION ACTIVITY DURING REGULAR WORKING HOURS IN A STREAM UNTIL THE WORK IS COMPLETED.
 - CONTRACTOR SHALL COMPLETE STREAM RESTORATION IMMEDIATELY AFTER COMPLETION OR WORK IN A STREAM. RESTORATION SHALL INCLUDE THE RE-ESTABLISHMENT OF CHANNEL CONTOURS AND BANK STABILIZATION. CONTRACTOR SHALL COMPLETE STREAM RESTORATION WITHIN FORTY-EIGHT (48) HOURS WHERE OPEN CUT METHODS ARE EMPLOYED TO INSTALL PIPE ACROSS AN INTERMITTENT OR VERY SMALL STREAM. CONTRACTOR SHALL COMPLETE STREAM CROSSING AND ASSOCIATED RESTORATION WITHIN SEVEN (7) CALENDAR DAYS WHERE TO CROSSING INCLUDES TEMPORARY DIVERSION OF A SMALL TO MODERATE SIZE STREAM.
 - CONTRACTOR SHALL MAINTAIN A BUFFER ZONE OR UNDISTURBED VEGETATION BETWEEN THE WORK AREA AND A WATERWAY WHEN WORKING ADJACENT TO A WATERWAY. CONTRACTOR SHALL INSTALL SILT BARRIERS TO PREVENT SEDIMENT LADEN RUNOFF FROM ENTERING THE WATERWAY WHERE A BUFFER ZONE OF VEGETATION DOES NOT PREVENT SEDIMENT FROM ENTERING THE WATER.
 - TWO LANDFILL LEACHATE COLLECTION SYSTEMS DISCHARGE INTO THE SANITARY SEWER SYSTEM ALONG, OR TRIBUTARY TO, PINNACLE ROAD. AT LEAST ONE OF THESE LANDFILLS WAS USED FOR INDUSTRIAL WASTE.

AT LEAST ONE OF THESE FORCE MAINS DISCHARGES DIRECTLY INTO MH 500056 (PROPOSED MH #19), BUT THE DISCHARGE LOCATION OF THE OTHER SYSTEM HAS NOT BEEN CONFIRMED. FLOW DISCHARGED FROM THESE SYSTEMS IS LIKELY TO CONTAIN CHLORIDES, AMMONIA, AND HAZARDOUS CHEMICALS NOT TYPICALLY FOUND IN SANITARY SEWER COLLECTION SYSTEMS. CONTRACTOR SHALL TAKE ALL APPROPRIATE SAFETY PRECAUTIONS TO PROTECT EMPLOYEES, THE PUBLIC AND THE ENVIRONMENT FROM ANY POTENTIAL HAZARDS ASSOCIATED WITH THE FLOW DISCHARGED FROM THESE SYSTEMS. IT IS THE FULL RESPONSIBILITY OF THE CONTRACTOR TO MONITOR THE WORK AREA, INCLUDING ANY CONFINED SPACES, IN COMPLETE ACCORDANCE WITH OSHA 29 CFR PART 1926 AND PROVIDE APPROPRIATE PROTECTION FOR WORKERS.

ENVIRONMENTAL PROTECTION MEASURES

- CONTRACTOR SHALL LIMIT ALL LAND DISTURBANCE AND CONSTRUCTION-RELATED ACTIVITIES THAT COULD LEAD TO THE GENERATION OF POLLUTANTS TO LESS THAN 1.00 ACRE FOR THIS PROJECT. IF THE TOTAL PROJECT AREA TO BE DISTURBED WILL BE 1 ACRE OR MORE, CONTRACTOR SHALL OBTAIN PERMIT COVERAGE FROM THE OHIO ENVIRONMENTAL PROTECTION AGENCY (OEPA) UNDER PERMIT OHC000004 AUTHORIZATION FOR STORM WATER DISCHARGES ASSOCIATED WITH CONSTRUCTION ACTIVITY AND SHALL NOT MAKE ANY CLAIMS FOR DELAY OR ADDITIONAL COMPENSATION THEREFOR.
- POLLUTION PREVENTION PLAN - CONTRACTOR SHALL PREPARE A STORM WATER POLLUTION PREVENTION PLAN IN ACCORDANCE WITH THE REQUIREMENTS OF OEPA PERMIT OHC000004, BUT NOT OBTAIN PERMIT COVERAGE WHEN COVERAGE IS NOT REQUIRED.
- SOIL STOCKPILES - CONTRACTOR SHALL STOCKPILE TOPSOIL TO BE REPLACED AFTER FINAL GRADING. EXCESS SOIL SHALL BE REMOVED FROM THE SITE OR PERMANENTLY STABILIZED IN ACCORDANCE WITH THE REQUIREMENTS OF OEPA PERMIT OHC000004. CONTRACTOR SHALL IMPLEMENT EROSION AND SEDIMENT CONTROL MEASURES FOR DISTURBED AREAS AND STOCKPILED SOIL BY INSTALLING SILT BARRIERS, TEMPORARY SEED, MULCH, WOOD CHIP WINDROWS OR OTHER METHODS APPROVED BY PERMIT OHC000004.
- DEBRIS AND SILT CONTROL - CONTRACTOR SHALL REMOVE EACH DAY, ALL MUD, SOIL, AND DEBRIS THAT MAY BE TRACKED ONTO EXISTING STREETS, DRIVES OR WALKS BY CONTRACTOR EQUIPMENT OR EQUIPMENT OPERATED BY SUBCONTRACTORS OR SUPPLIERS.
- DISPOSAL - CONTRACTOR SHALL DISPOSE OF MATERIAL TO BE REMOVED FROM THE SITE IN AN ENVIRONMENTALLY SOUND MANNER IN ACCORDANCE WITH LOCAL, STATE, AND FEDERAL REGULATIONS. CONTRACTOR SHALL NOT DISPOSE OF EXCESS MATERIALS IN WET LANDS, FLOOD PLAINS OR OTHER ENVIRONMENTALLY SENSITIVE AREAS. EROSION CONTROL MEASURE AT THE DISPOSAL SITE SHALL BE INSTALLED AND MAINTAINED UNTIL THE DISPOSAL SITE IS PERMANENTLY STABILIZED.
- REFER TO SPECIFICATION SECTION 01560.

LIGHT AND NOISE CONTROL

- LIGHTING - CONTRACTOR SHALL PROVIDE LIGHTING AT CONSTRUCTION SITES DURING HOURS OF DARKNESS IN ACCORDANCE WITH LOCAL CITY REQUIREMENTS. LIGHTS SHALL BE MOUNTED AND ALIGNED TO ILLUMINATE ONLY THE SITE WHERE CONSTRUCTION ACTIVITY IS ON-GOING AND OTHER SITES AS NECESSARY TO ENSURE SAFETY OF THE PUBLIC AND CONSTRUCTION PERSONNEL.
- NOISE - CONTRACTOR SHALL CONTROL NOISE AT CONSTRUCTION SITES IN ACCORDANCE WITH THE LOCAL REQUIREMENTS. CONSTRUCTION EQUIPMENT SHALL BE PROVIDED WITH INTAKE SILENCERS AND MUFFLERS.

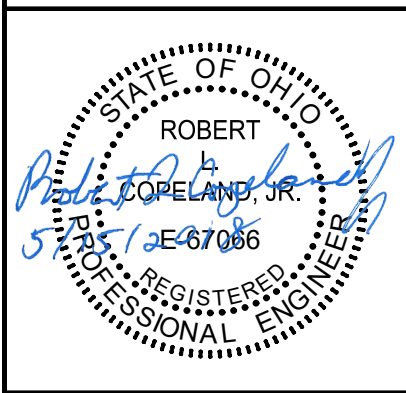
DEWATERING OPERATIONS

- DEWATERING - DEWATERING WILL BE REQUIRED FOR CONSTRUCTION OF THIS PROJECT. GROUNDWATER IN THE PROJECT AREA ALONG SELLARS ROAD AND VANCE ROAD IS ELEVATED DUE TO THE LOW-HEAD DAM IN THE GREAT MIAMI RIVER SOUTH OF THE PROJECT AREA. GROUNDWATER LEVELS ARE EXPECTED TO BE ABOVE THE PROPOSED SEWER INVERT ALONG SELLARS ROAD AND MAY BE ABOVE THE PROPOSED SEWER INVERT ALONG VANCE ROAD DURING PART OF THE YEAR. DURING HIGH-RIVER EVENTS, AND FOR SEVERAL DAYS OR WEEKS FOLLOWING, HIGH GROUNDWATER LEVELS UP TO ELEVATION 711 ARE POSSIBLE. REFER TO APPENDIX B OF THE BIDDING DOCUMENTS FOR MORE INFORMATION.
- WATER FLOWS - CONTRACTOR SHALL CONVEY ALL WATER FROM DEWATERING OPERATIONS IN A CLOSED CONDUIT. CONTRACTOR SHALL NOT USE TRENCH EXCAVATIONS AS A TEMPORARY DRAINAGE DITCH. WATER FLOWS SHALL BE SETTLED IN SILTATION BASINS OR DIRECTED THROUGH FILTERING DEVICES BEFORE BEING DISCHARGED TO STABILIZED SITES, STREAMS, STORM SEWERS OR DRYWELLS. WATER FLOWS SHALL NOT BE DIRECTED TO EXPOSED SOILS, STREAM BANKS, OR ANY OTHER SITE WHERE THE FLOW COULD CAUSE EROSION.
- SILT IN STORM SEWERS - CONTRACTOR SHALL NOT PERMIT SILT FROM CONSTRUCTION SITES TO ENTER STORM SEWERS OR DRYWELLS. CONTRACTOR SHALL INSTALL EROSION CONTROL MEASURES, SUCH AS INLET FILTERS, TO PREVENT SILT FROM ENTERING STORM SEWERS.

TRAFFIC CONTROL

- STANDARDS - CONTRACTOR SHALL PLAN AND EXECUTE TRAFFIC CONTROL IN ACCORDANCE WITH THE "OHIO DEPARTMENT OF TRANSPORTATION MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES" AND THE PERMIT REQUIREMENTS OF FEDERAL, STATE AND/OR LOCAL AGENCIES HAVING JURISDICTION OVER TRAFFIC CONTROL.
- PLAN - CONTRACTOR SHALL SUBMIT A TRAFFIC CONTROL PLAN FOR REVIEW BY AGENCIES HAVING JURISDICTION AND WATER SERVICES.
- APPROVALS - CONTRACTOR SHALL NOT PERFORM ANY CONSTRUCTION WORK, OR CLOSE ANY LANE OR STREET, UNTIL TRAFFIC CONTROL PLAN HAS BEEN APPROVED BY ALL AGENCIES.
- AGENCY NOTIFICATION - CONTRACTOR SHALL PROVIDE NOTICE TO JURISDICTION AND WATER SERVICES, IN ACCORDANCE WITH AGENCY REQUIREMENTS, PRIOR TO BEGINNING CONSTRUCTION, CLOSING STREET LANES OR CLOSING AN ENTIRE STREET.
- JOB-SITE NOTIFICATIONS - CONTRACTOR SHALL NOTIFY RESIDENTS AND BUSINESSES SEVEN (7) CALENDAR DAYS PRIOR TO BEGINNING CONSTRUCTION ACTIVITY THAT WILL IMPACT ACCESS TO THEIR PROPERTY. CONTRACTOR SHALL ARRANGE ALTERNATE ROUTES OF ACCESS WITH SPECIAL ATTENTION TO ELDERLY PEOPLE AND PEOPLE WITH DISABILITIES.
- SECTIONS OF VANCE ROAD MAY BE CLOSED TO TRAFFIC WITHIN THE IMMEDIATE ACTIVE CONSTRUCTION AREA FOR PERIODS AS APPROVED BY THE CITY OF MORAIN. AT LEAST ONE LANE OF TRAFFIC SHALL BE MAINTAINED ON ALL OTHER ROADS ALONG THE PROPOSED SEWER ALIGNMENT UNLESS OTHERWISE APPROVED BY THE CITY OF MORAIN.
- STREET ACCESS - CONTRACTOR SHALL OPEN ALL LANES OF INTERSECTING STREETS TO TRAFFIC DURING NON-WORKING HOURS. CONTRACTOR MAY INSTALL A TEMPORARY GRAVEL BYPASS, WHEN NECESSARY, TO MAINTAIN TRAFFIC ACCESS TO INTERSECTING STREETS.
- DRIVEWAY ACCESS - CONTRACTOR SHALL NOTIFY ALL AFFECTED RESIDENTIAL AND BUSINESS PROPERTY OWNERS 24 HOURS IN ADVANCE OF CONSTRUCTION THAT WILL TEMPORARILY RESTRICT ACCESS TO THEIR DRIVEWAY. DRIVEWAYS SHALL BE OPEN TO VEHICLE ACCESS DURING NON-WORKING HOURS
- SERVICE VEHICLE ACCESS - CONTRACTOR SHALL AT ALL TIMES ENABLE ACCESS BY SERVICE VEHICLES TO RESIDENCES AND BUSINESSES. SERVICE VEHICLES INCLUDE FIRE TRUCKS, AMBULANCES, POLICE VEHICLES, SCHOOL BUSES, SNOW PLOWS, SOLID WASTE TRUCKS, MAIL DELIVERY AND SIMILAR PUBLIC SERVICE VEHICLES.
- REFER TO SPECIFICATION SECTION 01570.

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DESIGNED BY:	JMC
DRAWN BY:	PJO
SHEET CKD BY:	JMC
CROSS CKD BY:	JM
APPROVED BY:	BC
DATE:	MAY 2018
REV. NO.	REVISIONS

DESIGNED BY:	JMC
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DATE:	MAY 2018

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MIAMI SHORES
SANITARY SEWER IMPROVEMENTS
CONTRACT NO. 1

GENERAL NOTES

PROJECT NO.	130006-15
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SHEET NO.	-02

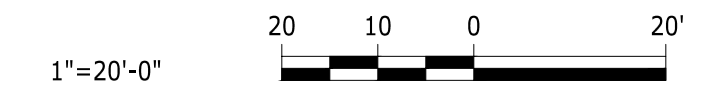
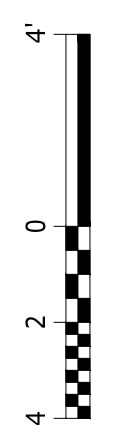
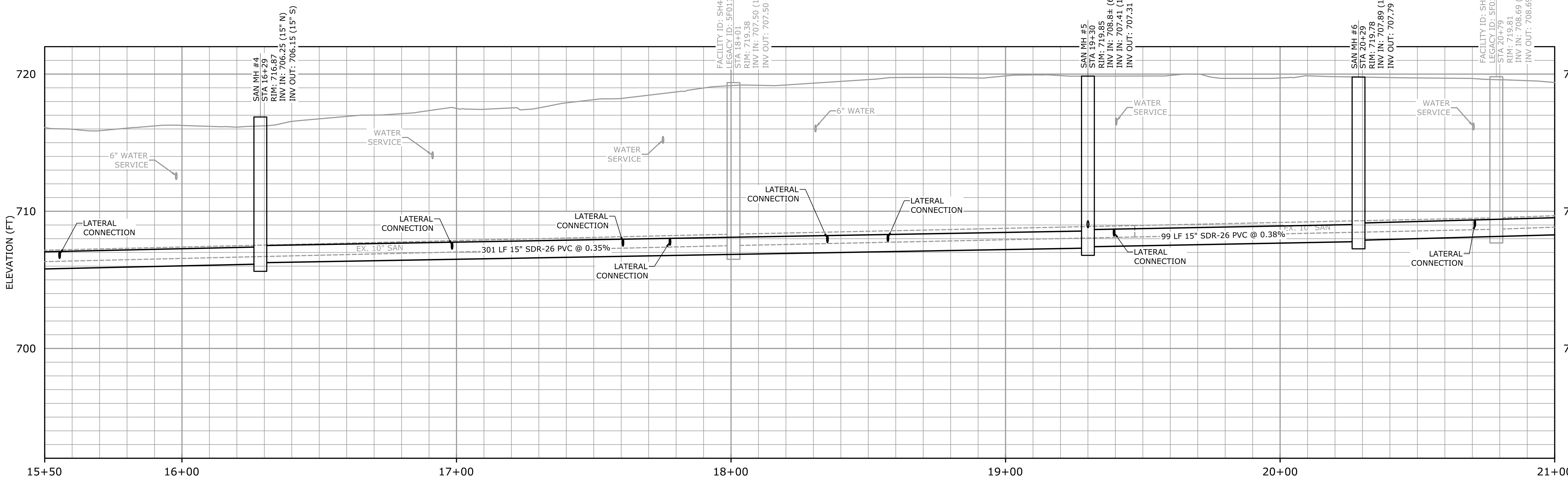
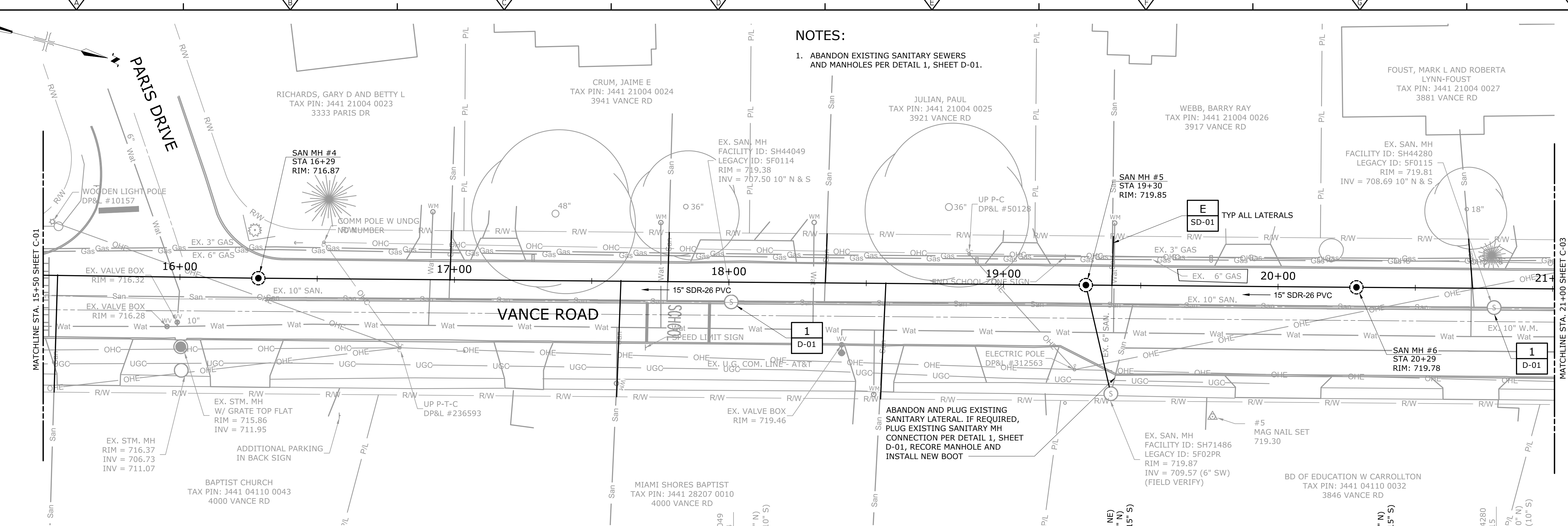
NOTES:

1. ABANDON EXISTING SANITARY SEWERS AND MANHOLES PER DETAIL 1, SHEET D-01.

ABANDON AND PLUG EXISTING SANITARY LATERAL. IF REQUIRED, PLUG EXISTING SANITARY MH CONNECTION PER DETAIL 1, SHEET D-01, RECORE MANHOLE AND INSTALL NEW BOOT

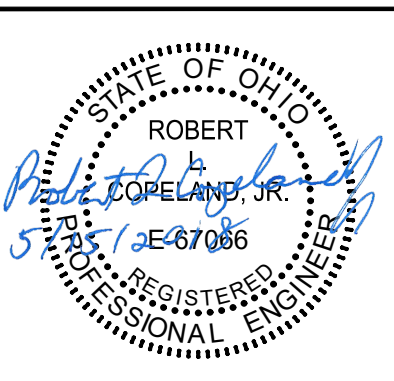
E SD-01 TYP ALL LATERALS

1 D-01



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BID DRAWING



DESIGNED BY:	JMC
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**MIAMI SHORES
 SANITARY SEWER IMPROVEMENTS
 CONTRACT NO. 1**

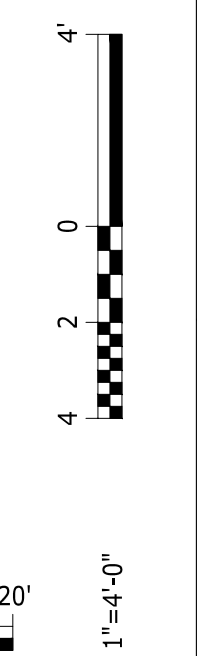
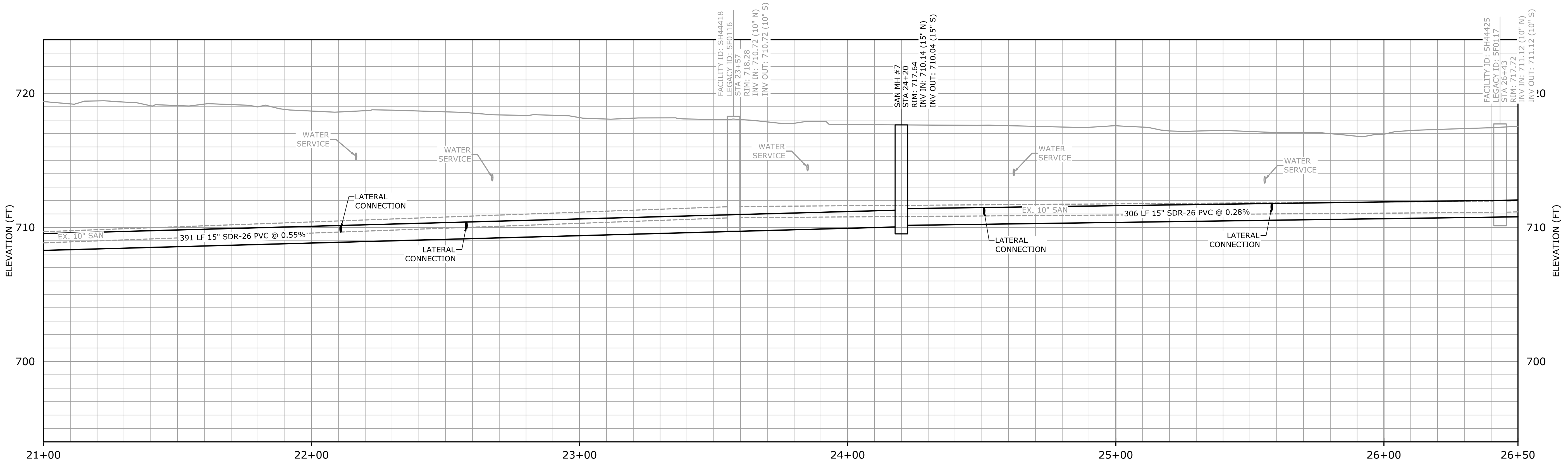
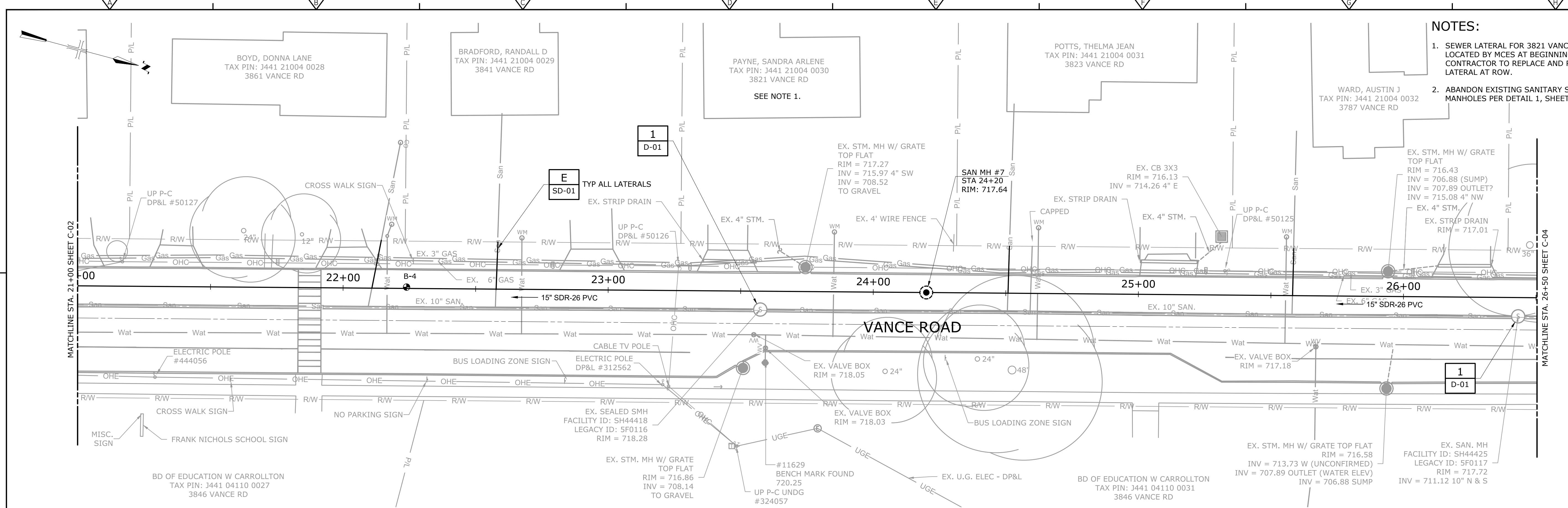
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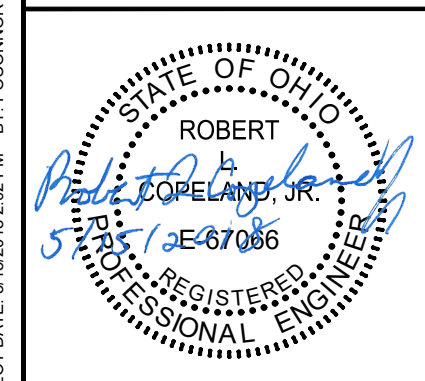
SHEET NO.

C-02

- NOTES:**
- SEWER LATERAL FOR 3821 VANCE TO BE FIELD LOCATED BY MCES AT BEGINNING OF CONSTRUCTION. CONTRACTOR TO REPLACE AND RECONNECT SEWER LATERAL AT ROW.
 - ABANDON EXISTING SANITARY SEWERS AND MANHOLES PER DETAIL 1, SHEET D-01.



BID DRAWING



REV. NO.	REVISIONS

DESIGNED BY: JMC
 DRAWN BY: PJO
 SHEET CHK'D BY: JMC
 CROSS CHK'D BY: JM
 APPROVED BY: BC
 DATE: MAY 2018

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MIAMI SHORES
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CONTRACT NO. 1

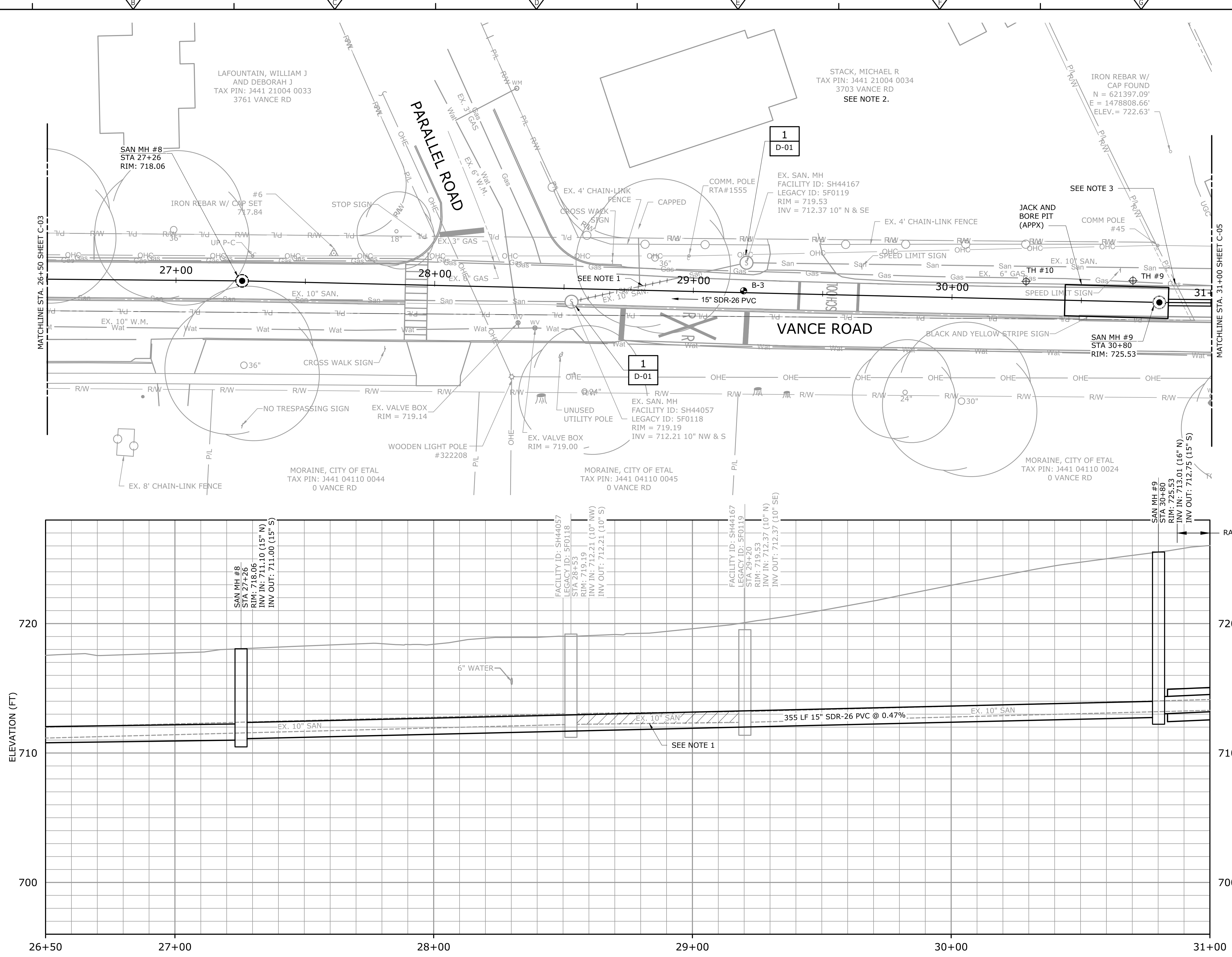
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PLAN AND PROFILE
STA. 21+00 TO STA. 26+50

PROJECT NO. 130006-15
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C-03

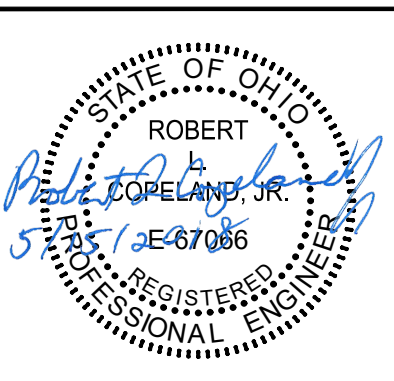
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NOTES:

1. DEMOLISH EXISTING SANITARY SEWER AS NECESSARY TO INSTALL NEW PIPING. BYPASS PUMP AS REQUIRED. ABANDON OTHER EXISTING SANITARY SEWERS AND MANHOLES PER DETAIL 1, SHEET D-01.
2. SEWER LATERAL FOR 3703 VANCE TO BE FIELD LOCATED BY MCES AT BEGINNING OF CONSTRUCTION. CONTRACTOR TO REPLACE AND RECONNECT SEWER LATERAL AT ROW PER DETAIL E ON SHEET SD-01.
3. PROTECT EXISTING GAS MAIN. SEE APPENDIX C.



BID DRAWING



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DRAWN BY:	PJO
SHEET CHKD BY:	JMC
CROSS CHKD BY:	JM
APPROVED BY:	BC
DATE:	MAY 2018
REV. NO.	REVISIONS

DESIGNED BY:	JMC
DRAWN BY:	PJO
SHEET CHKD BY:	JMC
CROSS CHKD BY:	JM
APPROVED BY:	BC
DATE:	MAY 2018

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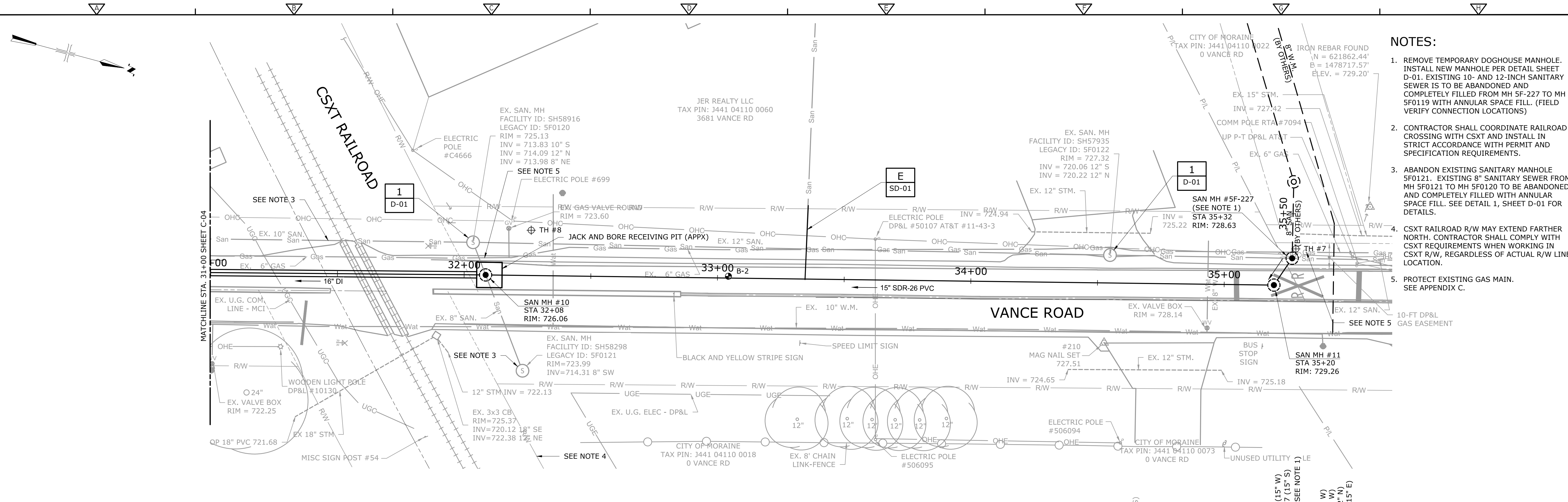
MIAMI SHORES
SANITARY SEWER IMPROVEMENTS
CONTRACT NO. 1

VANCE RD. SEWER
PLAN AND PROFILE
STA. 26+50 TO STA. 31+00

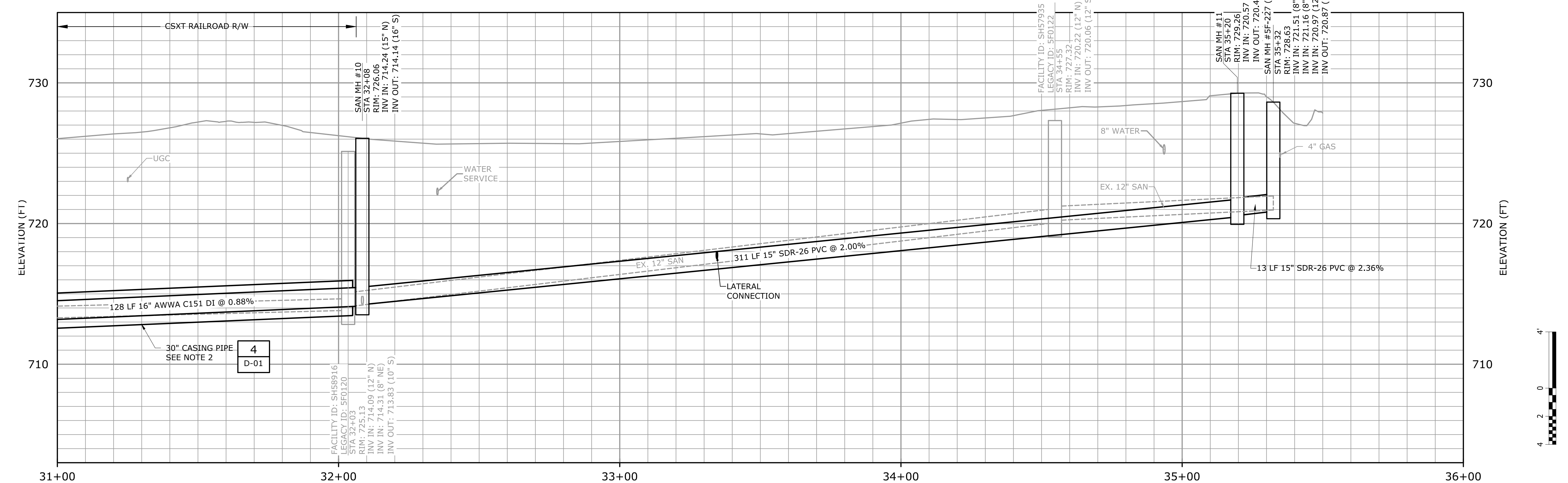
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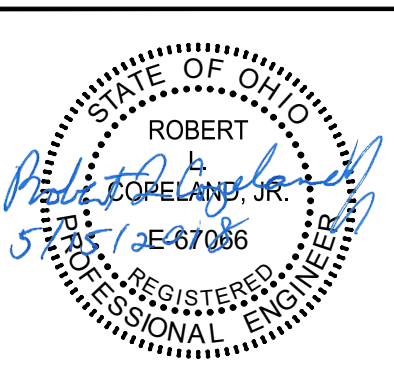
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- NOTES:**
1. REMOVE TEMPORARY DOGHOUSE MANHOLE. INSTALL NEW MANHOLE PER DETAIL SHEET D-01. EXISTING 10- AND 12-INCH SANITARY SEWER IS TO BE ABANDONED AND COMPLETELY FILLED FROM MH 5F-227 TO MH 5F0119 WITH ANNULAR SPACE FILL. (FIELD VERIFY CONNECTION LOCATIONS)
 2. CONTRACTOR SHALL COORDINATE RAILROAD CROSSING WITH CSXT AND INSTALL IN STRICT ACCORDANCE WITH PERMIT AND SPECIFICATION REQUIREMENTS.
 3. ABANDON EXISTING SANITARY MANHOLE 5F0121. EXISTING 8" SANITARY SEWER FROM MH 5F0121 TO MH 5F0120 TO BE ABANDONED AND COMPLETELY FILLED WITH ANNULAR SPACE FILL. SEE DETAIL 1, SHEET D-01 FOR DETAILS.
 4. CSXT RAILROAD R/W MAY EXTEND FARTHER NORTH. CONTRACTOR SHALL COMPLY WITH CSXT REQUIREMENTS WHEN WORKING IN CSXT R/W, REGARDLESS OF ACTUAL R/W LINE LOCATION.
 5. PROTECT EXISTING GAS MAIN. SEE APPENDIX C.



BID DRAWING



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CROSS CHKD BY:	JM
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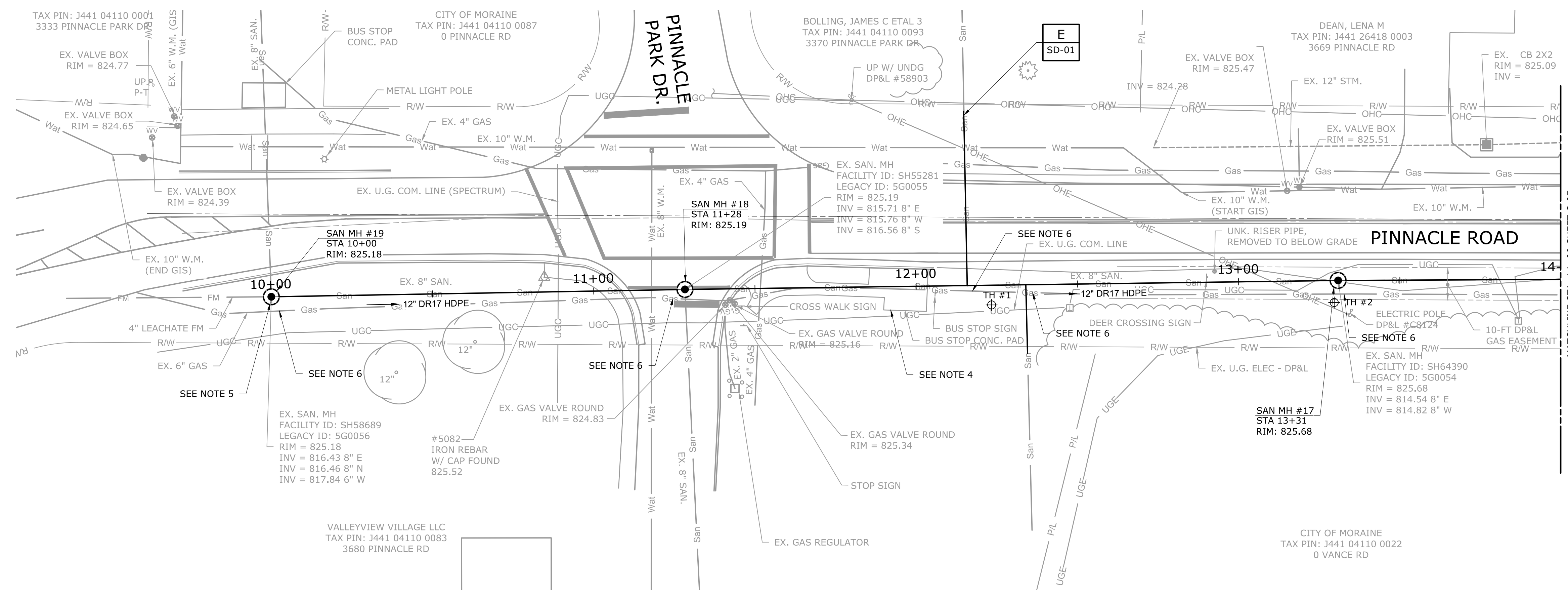
**MIAMI SHORES
SANITARY SEWER IMPROVEMENTS
CONTRACT NO. 1**

**VANCE RD. SEWER
PLAN AND PROFILE
STA. 31+00 TO STA. 36+00**

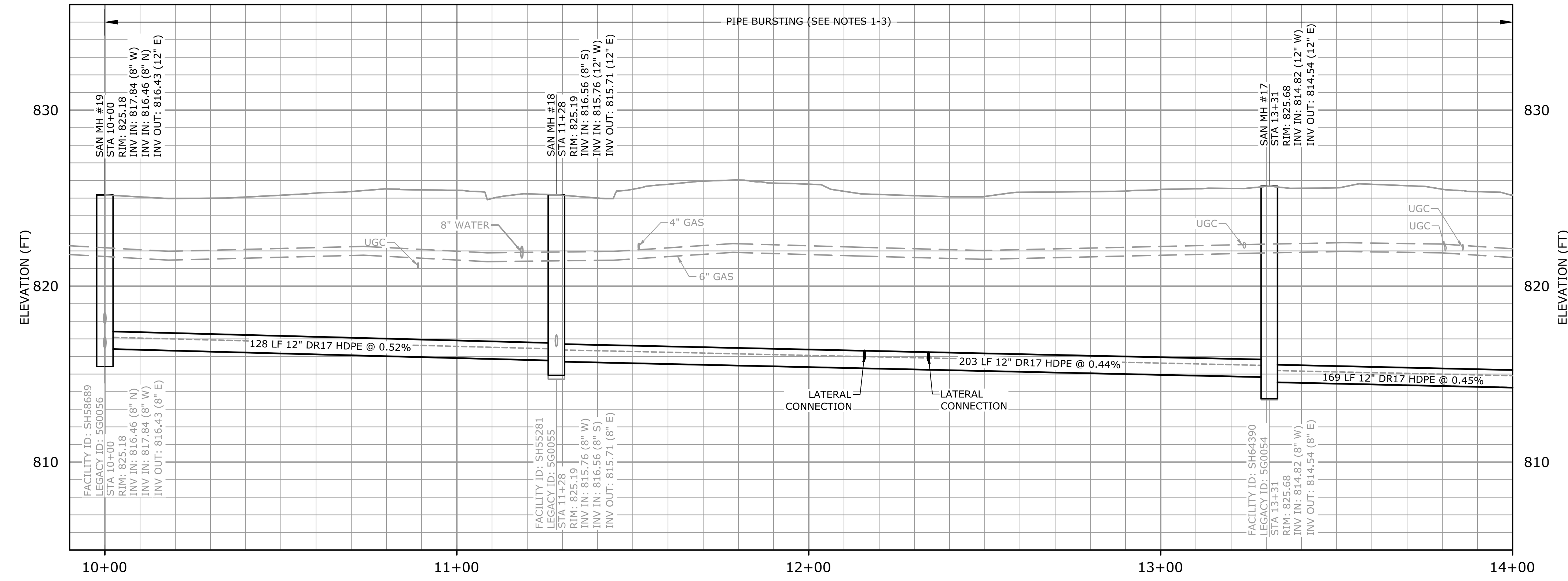
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- NOTES:**
1. REPLACE EXISTING 8" VCP SANITARY SEWER BY PIPE BURSTING FROM EXISTING SANITARY MANHOLE SG0056 TO EXISTING SANITARY MANHOLE SG0055. REMOVE AND REPLACE EXISTING MANHOLES. INSTALL NEW MANHOLES PER DETAIL A, SHEET SD-01.
 2. PROPOSED SANITARY SEWER IS SHOWN WITH EXISTING INVERT ELEVATIONS FOR REFERENCE ONLY. ACTUAL INSTALLED INVERT ELEVATIONS MAY VARY FOR PIPE INSTALLED BY PIPE BURSTING. CONTRACTOR SHALL ADJUST DEPTHS OF MANHOLES AS NEEDED TO MATCH FINAL SEWER DEPTHS. PROVIDE DROP ACROSS MANHOLE WHERE POSSIBLE.
 3. REPLACE ALL EXISTING SANITARY LATERALS USING AN INSERTA TEE AND IN ACCORDANCE WITH DETAIL E, SHEET SD-01.
 4. PROTECT EXISTING BUS STOP AND ASSOCIATED SIDEWALK AND CONCRETE PAD. REPAIR AS DIRECTED BY OWNER IF DAMAGED BY CONSTRUCTION ACTIVITIES.
 5. TWO LANDFILL LEACHATE COLLECTION SYSTEMS DISCHARGE INTO THE SANITARY SEWER SYSTEM ALONG, OR TRIBUTARY TO, PINNACLE ROAD. AT LEAST ONE OF THESE LANDFILLS WAS USED FOR INDUSTRIAL WASTE. AT LEAST ONE OF THESE FORCE MAINS DISCHARGES DIRECTLY INTO MH 5G0056 (PROPOSED MH #19), BUT THE DISCHARGE LOCATION OF THE OTHER SYSTEM HAS NOT BEEN CONFIRMED. FLOW DISCHARGED FROM THESE SYSTEMS IS LIKELY TO CONTAIN HIGH-TEMPERATURE WASTEWATER, HIGH AMMONIA CONCENTRATION, CHLORIDES, AND HAZARDOUS CHEMICALS NOT TYPICALLY FOUND IN SANITARY SEWER COLLECTION SYSTEMS. CONTRACTOR SHALL TAKE ALL APPROPRIATE SAFETY PRECAUTIONS TO PROTECT EMPLOYEES, THE PUBLIC, AND THE ENVIRONMENT FROM ANY POTENTIAL HAZARDS ASSOCIATED WITH THE FLOW DISCHARGED FROM THESE SYSTEMS.
 6. PROTECT EXISTING GAS MAIN. RELOCATE GAS MAIN IF NECESSARY. SEE APPENDIX C.



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BID DRAWING



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CROSS CHKD BY:	JM
APPROVED BY:	BC
DATE:	MAY 2018

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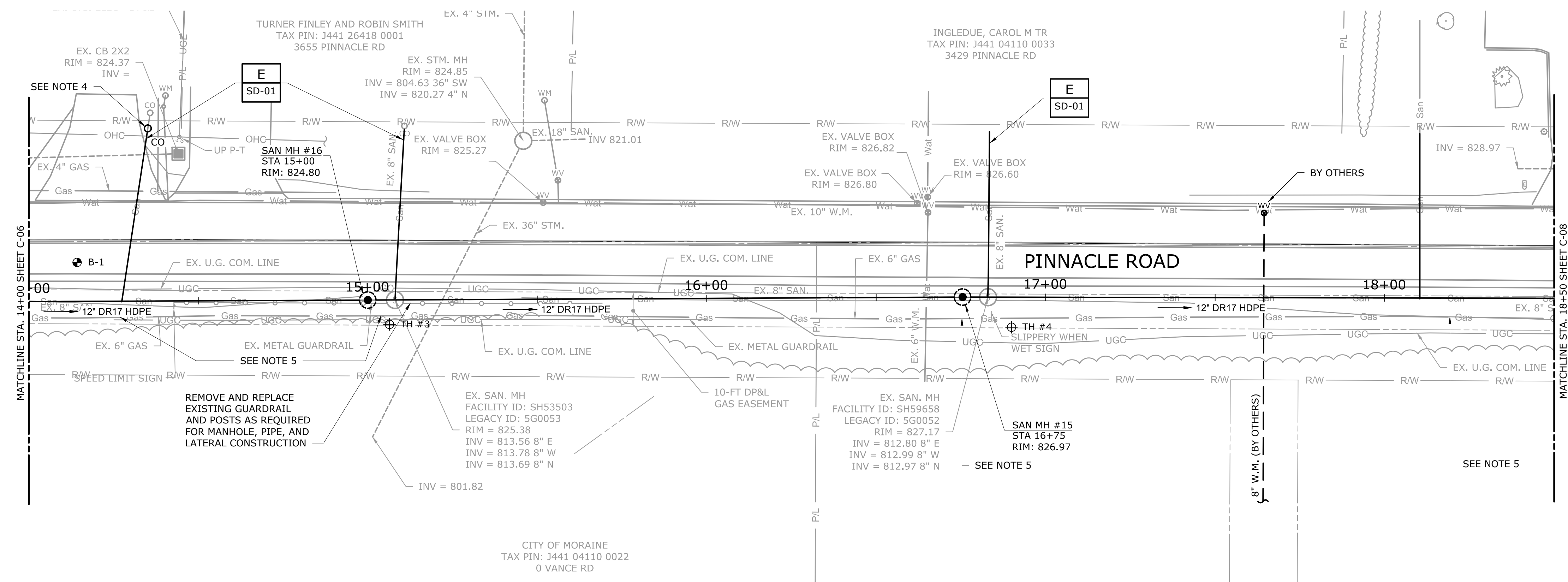
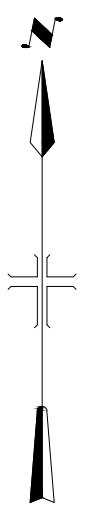
**MIAMI SHORES
 SANITARY SEWER IMPROVEMENTS
 CONTRACT NO. 1**

**PINNACLE RD. SEWER
 PLAN AND PROFILE
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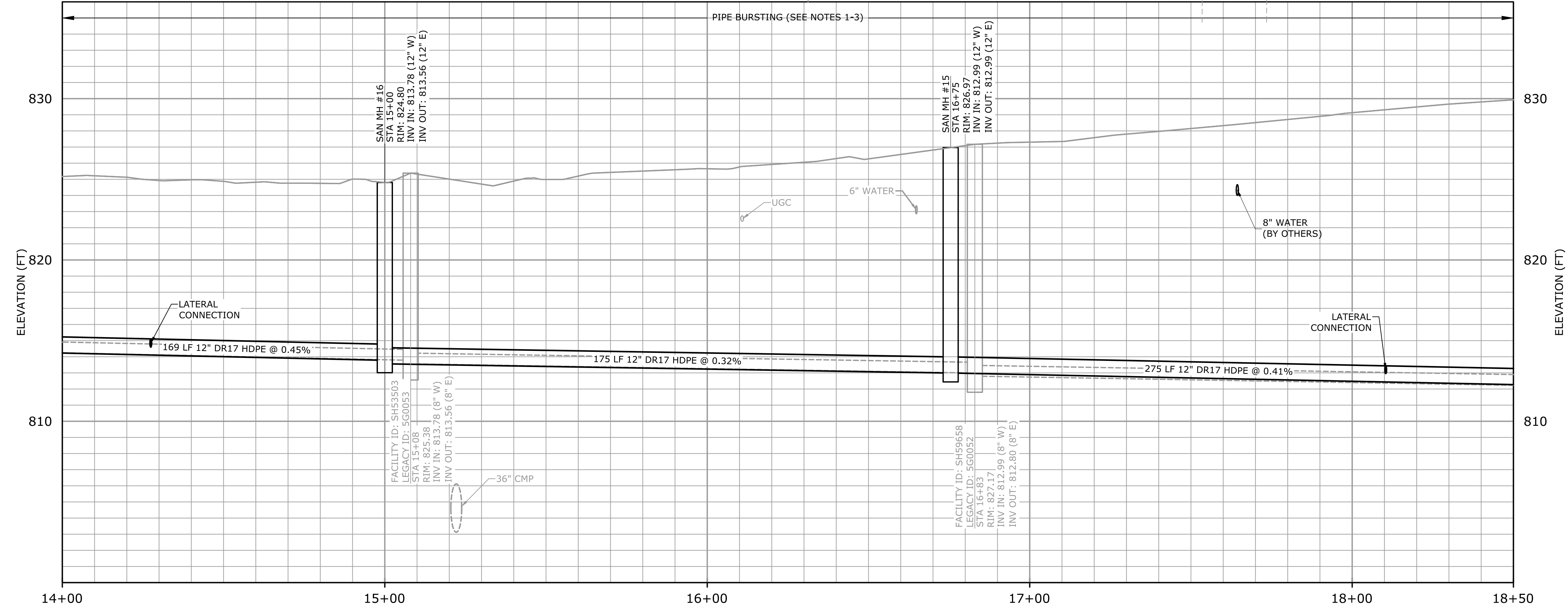
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C-0



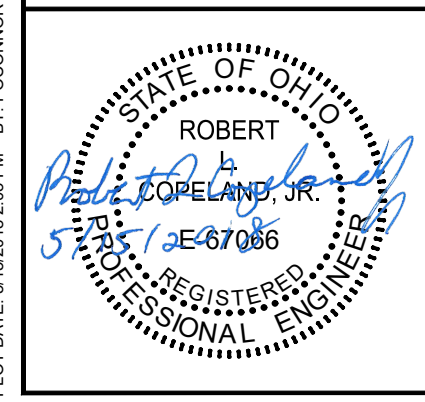


- NOTES:**
1. REPLACE EXISTING 8" VCP SANITARY SEWER BY PIPE BURSTING FROM EXISTING SANITARY MANHOLE 5G0056 TO EXISTING SANITARY MANHOLE 5G0050. REMOVE AND REPLACE EXISTING MANHOLES. INSTALL NEW MANHOLES PER DETAIL A, SHEET SD-01.
 2. PROPOSED SANITARY SEWER IS SHOWN WITH EXISTING INVERT ELEVATIONS FOR REFERENCE ONLY. ACTUAL INSTALLED INVERT ELEVATIONS MAY VARY FOR PIPE INSTALLED BY PIPE BURSTING. CONTRACTOR SHALL ADJUST DEPTHS OF MANHOLES AS NEEDED TO MATCH FINAL SEWER DEPTHS. PROVIDE DROP ACROSS MANHOLE WHERE POSSIBLE.
 3. REPLACE ALL EXISTING SANITARY LATERALS USING AN INSERTA TEE AND IN ACCORDANCE WITH DETAIL E, SHEET SD-01.
 4. INSTALL NEW CLEANOUT WITHIN ROW.
 5. PROTECT EXISTING GAS MAIN. RELOCATE GAS MAIN IF NECESSARY. SEE APPENDIX C.



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DATE:	MAY 2018

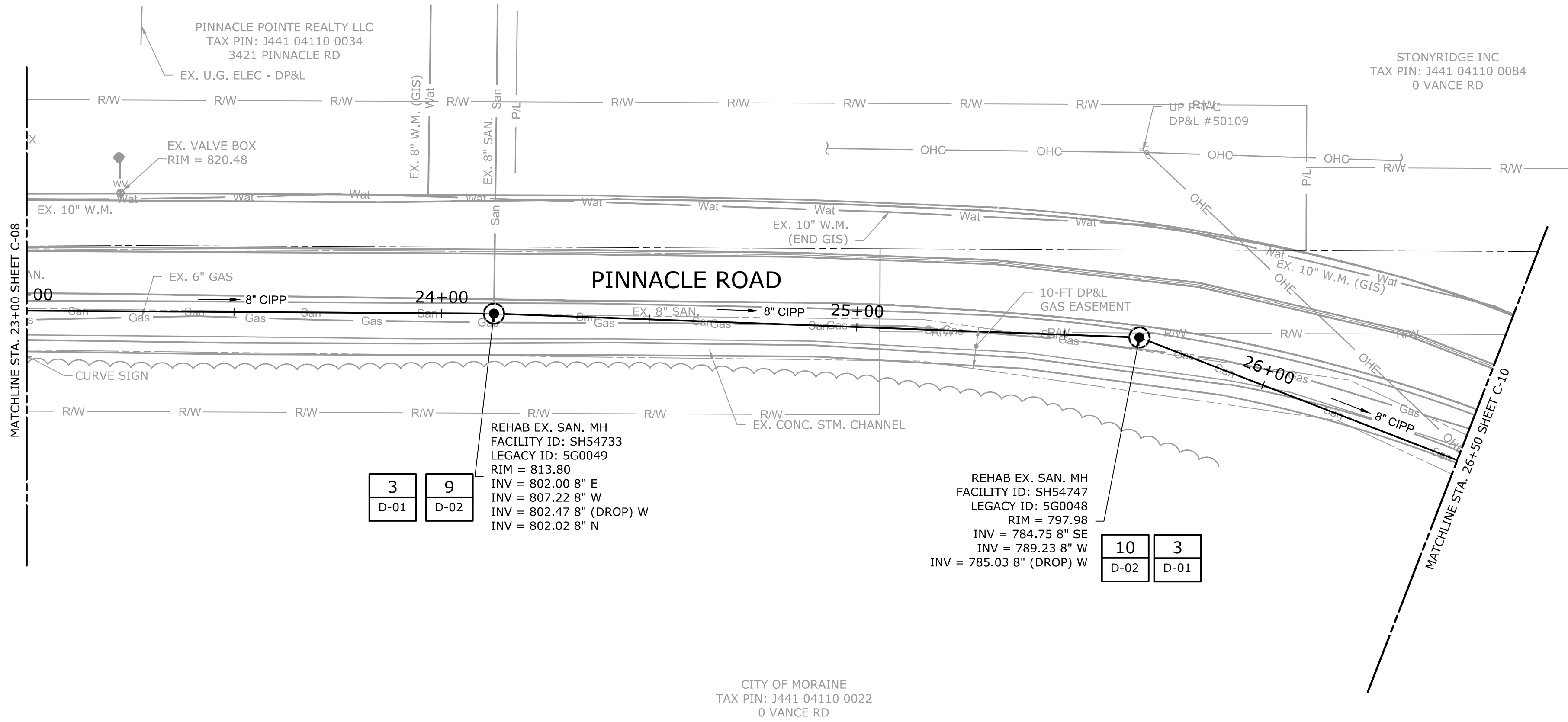
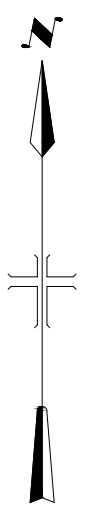
1850 Spaulding Road
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 Tel: (937) 781-2550

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 CINCINNATI, OHIO 45249

**MIAMI SHORES
 SANITARY SEWER IMPROVEMENTS
 CONTRACT NO. 1**

**PINNACLE RD. SEWER
 PLAN AND PROFILE
 STA. 14+00 TO STA. 18+50**

PROJECT NO. 130006-15
 FILE NAME: 50021-004_C07.DWG
 SHEET NO.
C-0



- NOTES:**
- CIPP LINE EXISTING 8" SANITARY FROM EXISTING SANITARY MANHOLE 5G0050 TO EXISTING SANITARY MANHOLE 5G0001. WHERE NOTED, REHAB ALL MANHOLES PER DETAIL 3, SHEET D-01.

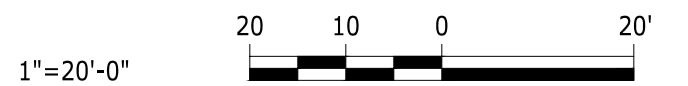
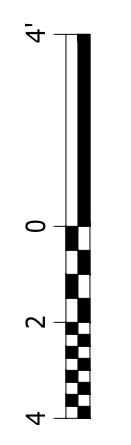
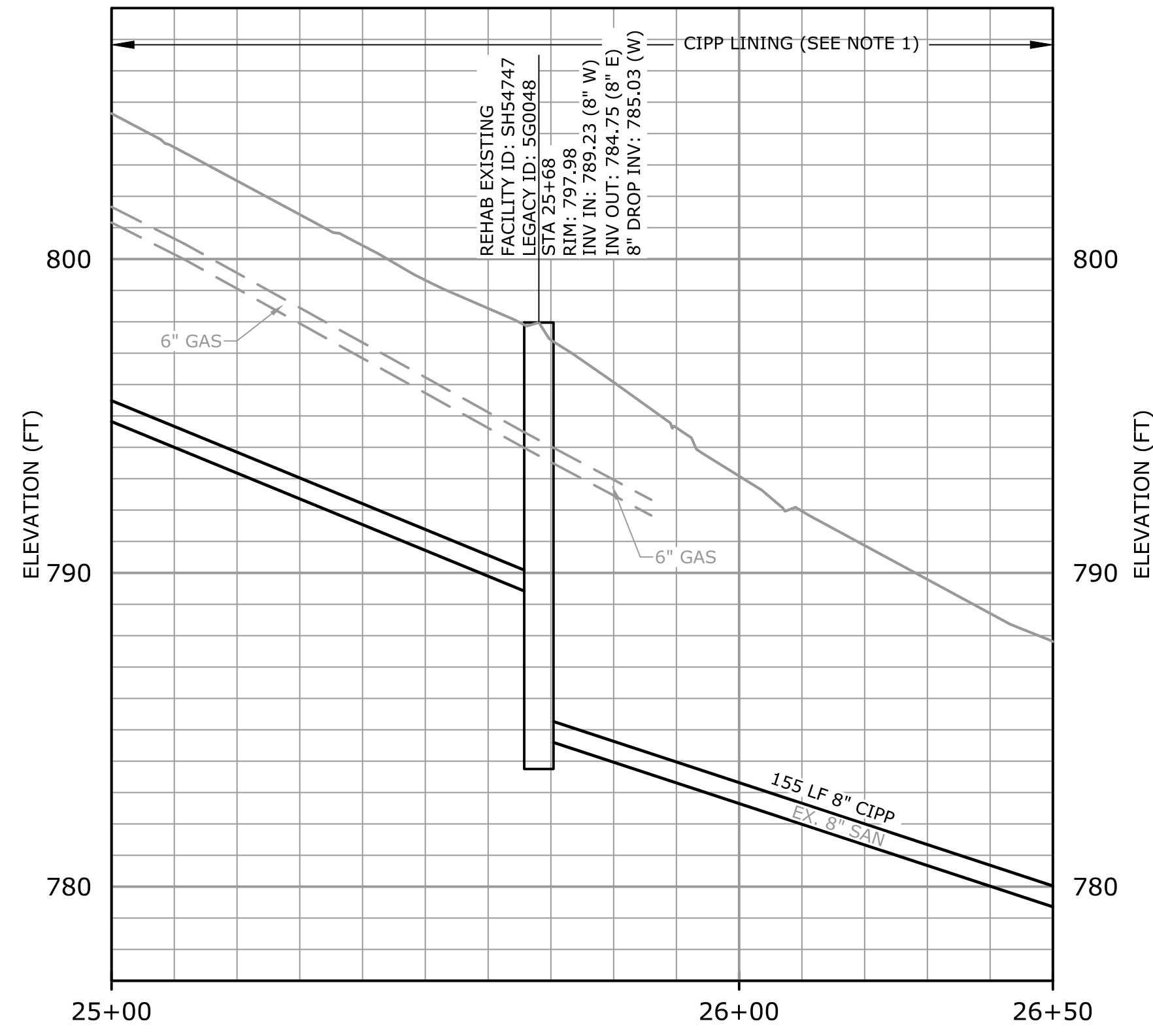
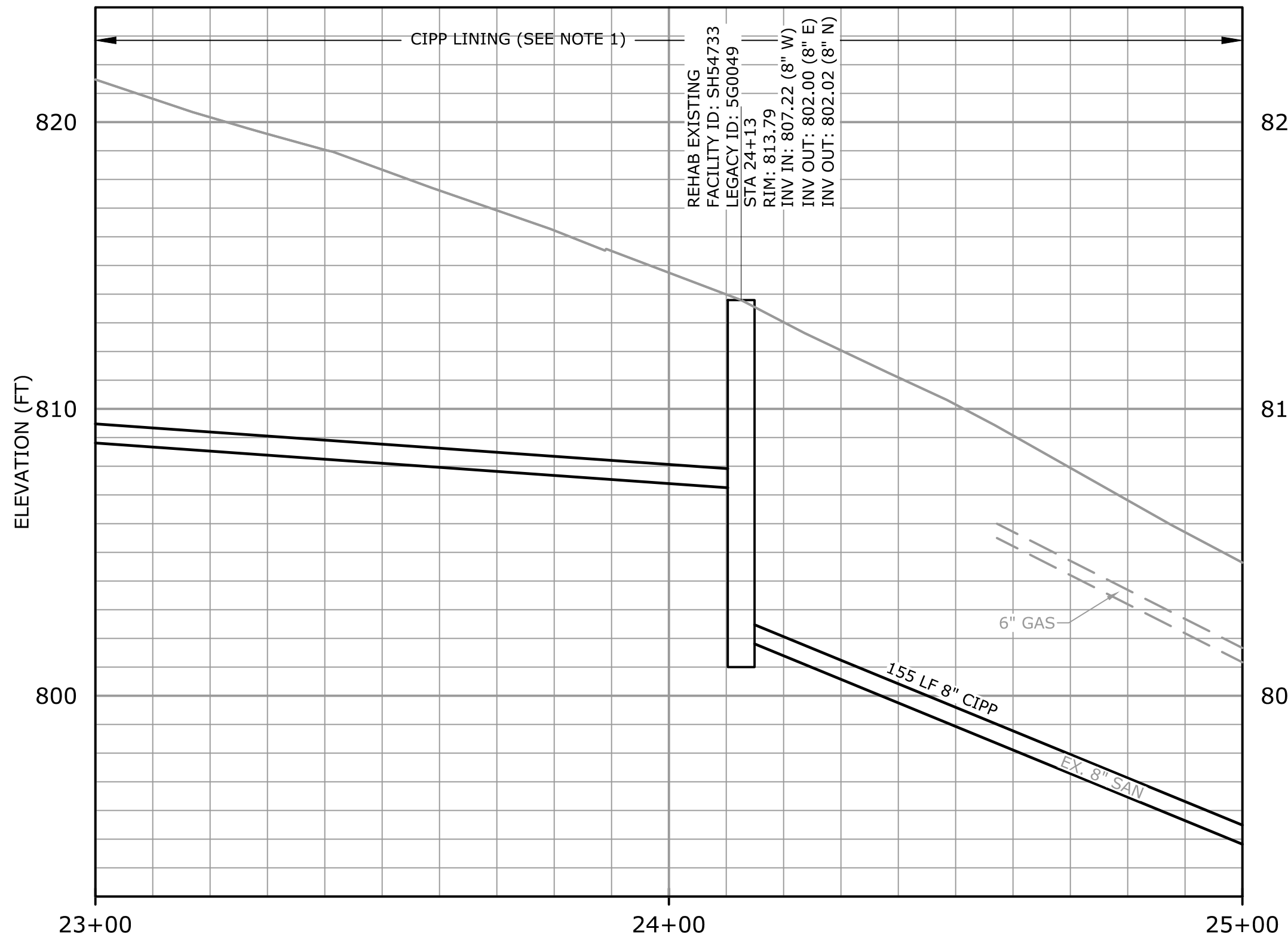
3	9
D-01	D-02

REHAB EX. SAN. MH
 FACILITY ID: SH54733
 LEGACY ID: 5G0049
 RIM = 813.80
 INV = 802.00 8" E
 INV = 807.22 8" W
 INV = 802.47 8" (DROP) W
 INV = 802.02 8" N

10	3
D-02	D-01

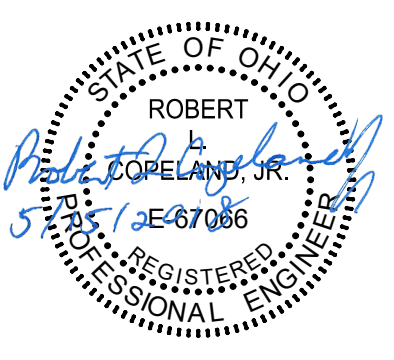
REHAB EX. SAN. MH
 FACILITY ID: SH54747
 LEGACY ID: 5G0048
 RIM = 797.98
 INV = 784.75 8" SE
 INV = 789.23 8" W
 INV = 785.03 8" (DROP) W

CITY OF MORAINE
 TAX PIN: J441 04110 0022
 0 VANCE RD



File: \HAZENANDSAWYER\COM\PROJECTS\00021-CIN\0201-004\DESIGN\DRAWINGS\CIVIL\0201-004_C09_Sewer.dwg, Saved by: POCOINOR, Save date: 5/10/2018 11:56 AM
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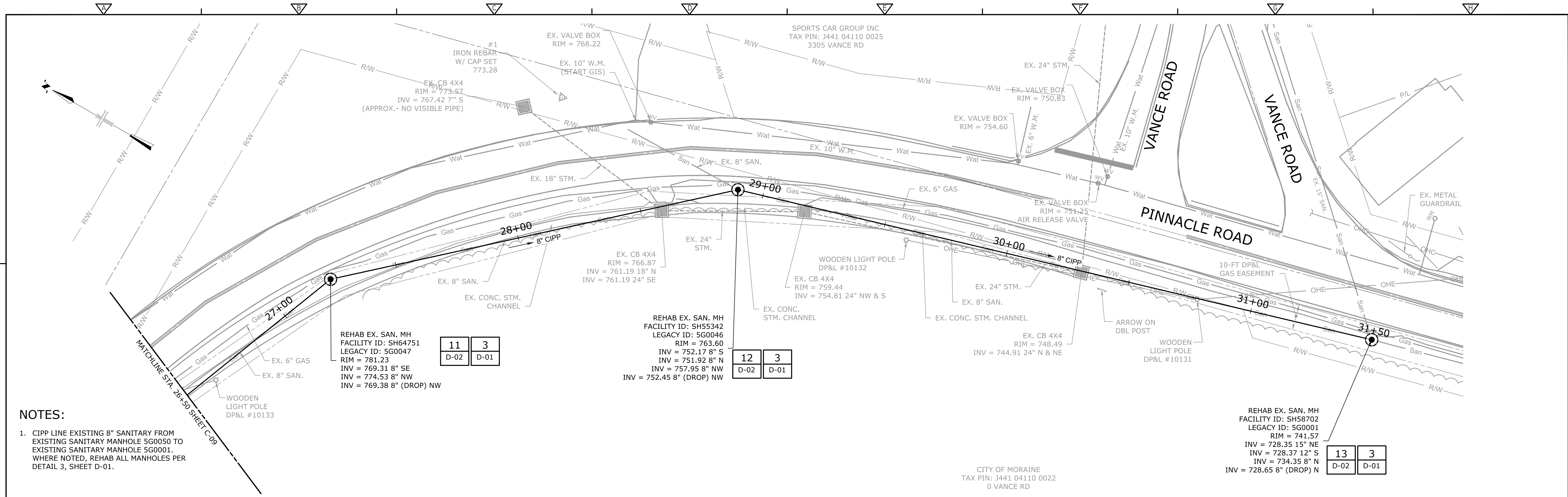
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**MIAMI SHORES
 SANITARY SEWER IMPROVEMENTS
 CONTRACT NO. 1**

**PINNACLE RD. SEWER
 PLAN AND PROFILE
 STA. 23+00 TO STA. 26+50**

PROJECT NO. 130006-15
 FILE NAME: 50021-004_C09.DWG

SHEET NO.
C-0



NOTES:

1. CIPP LINE EXISTING 8" SANITARY FROM EXISTING SANITARY MANHOLE 5G0050 TO EXISTING SANITARY MANHOLE 5G0001. WHERE NOTED, REHAB ALL MANHOLES PER DETAIL 3, SHEET D-01.

REHAB EX. SAN. MH
 FACILITY ID: SH64751
 LEGACY ID: 5G0047
 RIM = 781.23
 INV = 769.31 8" SE
 INV = 774.53 8" NW
 INV = 769.38 8" (DROP) NW

11	3
D-02	D-01

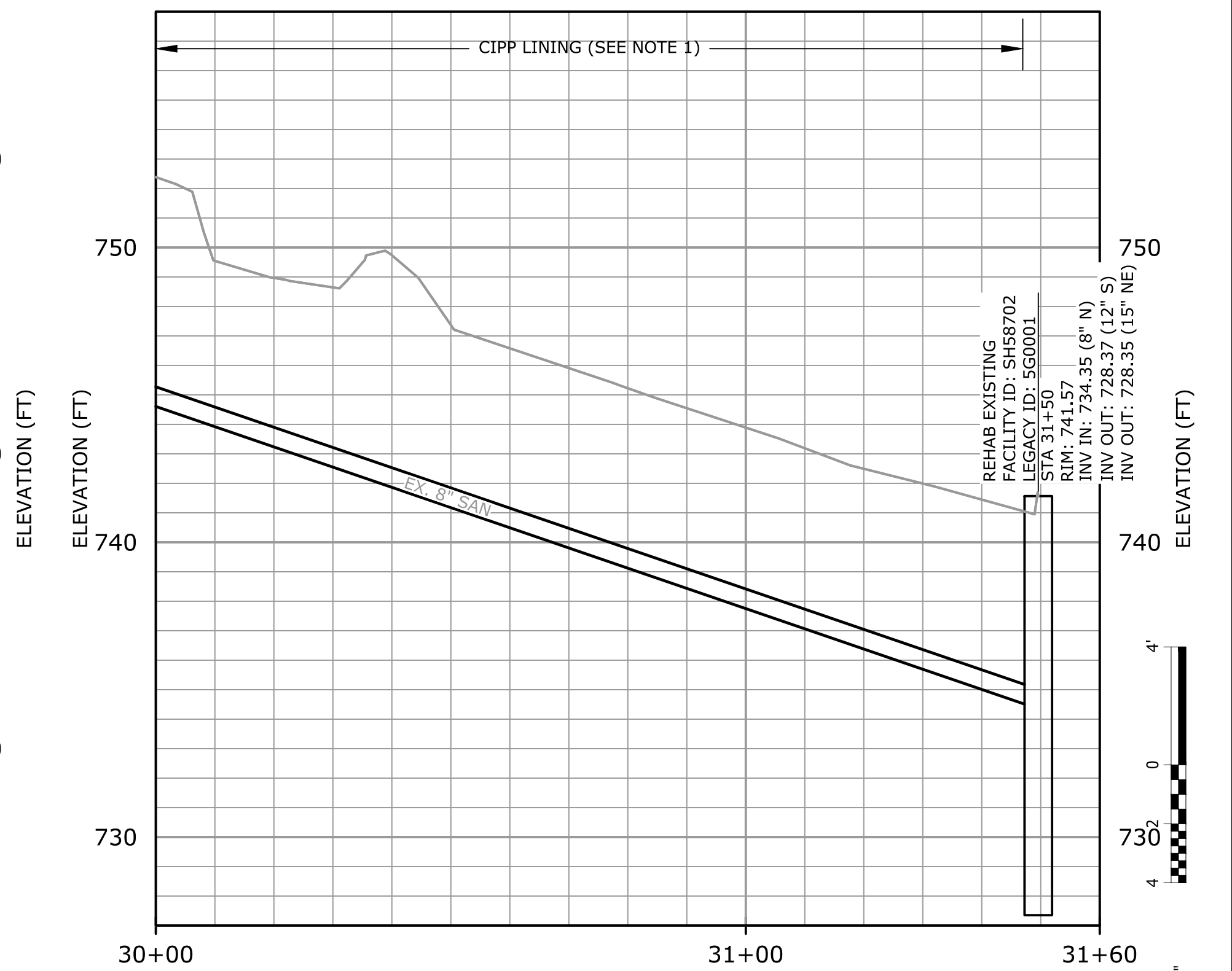
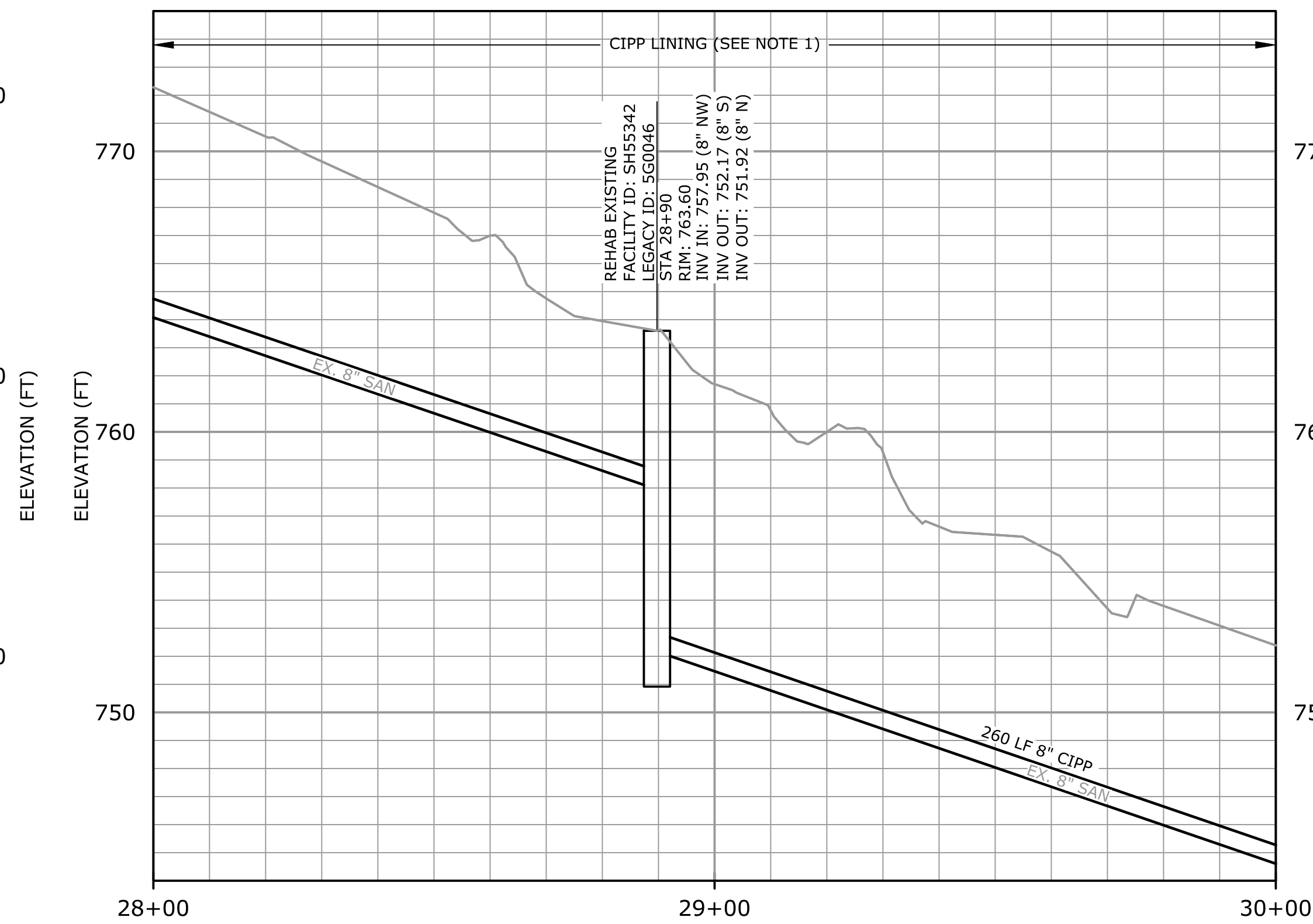
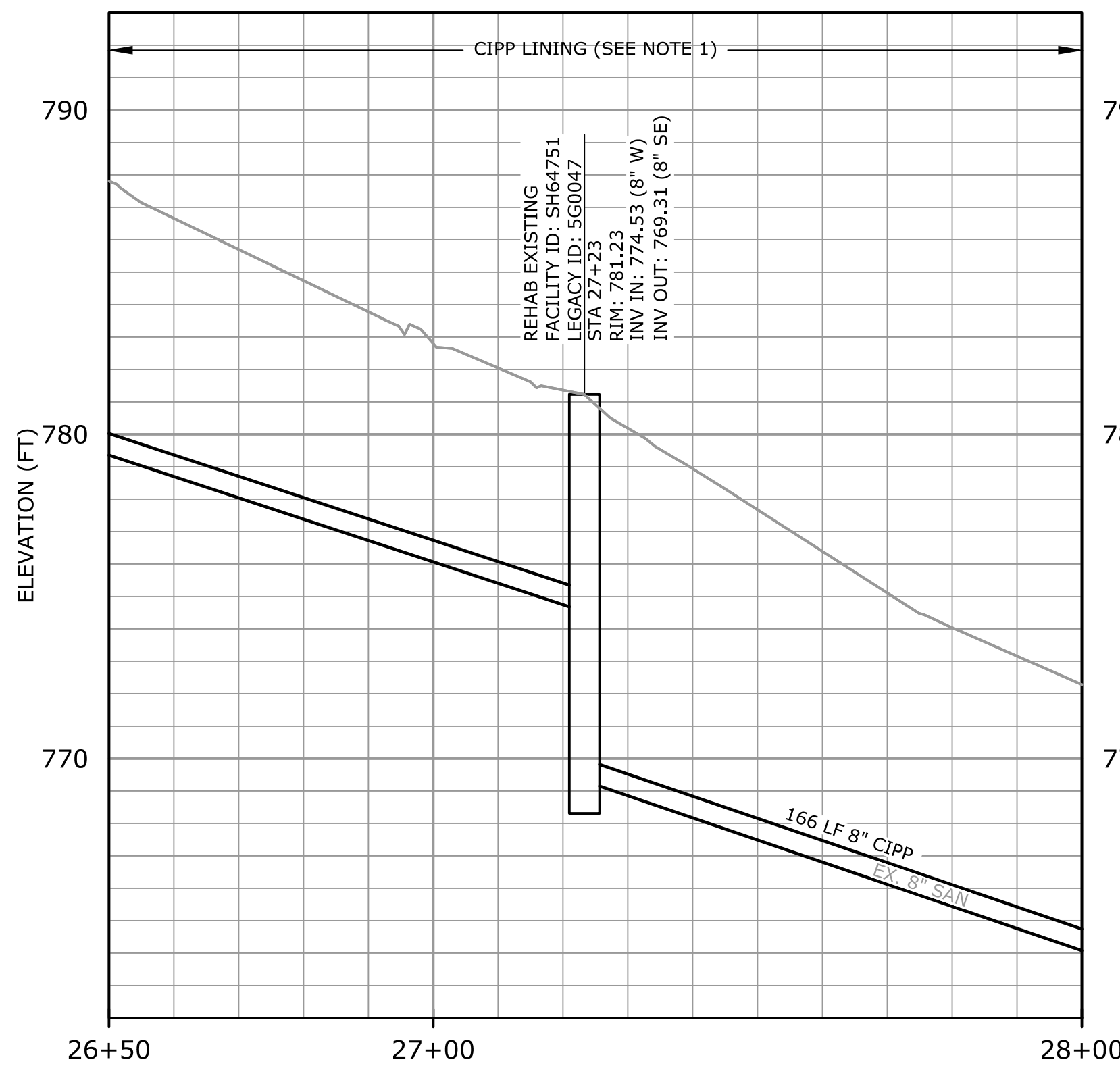
REHAB EX. SAN. MH
 FACILITY ID: SH55342
 LEGACY ID: 5G0046
 RIM = 763.60
 INV = 752.17 8" S
 INV = 751.92 8" N
 INV = 757.95 8" NW
 INV = 752.45 8" (DROP) NW

12	3
D-02	D-01

REHAB EX. SAN. MH
 FACILITY ID: SH58702
 LEGACY ID: 5G0001
 RIM = 741.57
 INV = 728.35 15" NE
 INV = 728.37 12" S
 INV = 734.35 8" N
 INV = 728.65 8" (DROP) N

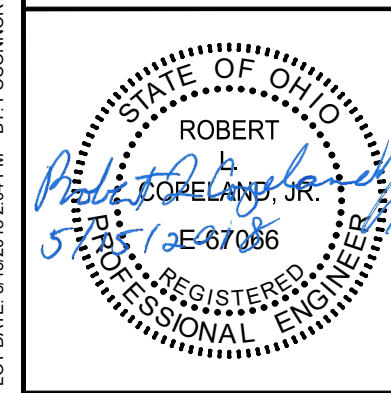
13	3
D-02	D-01

CITY OF MORAINÉ
 TAX PIN: J441 04110 0022
 0 VANCE RD



BID DRAWING

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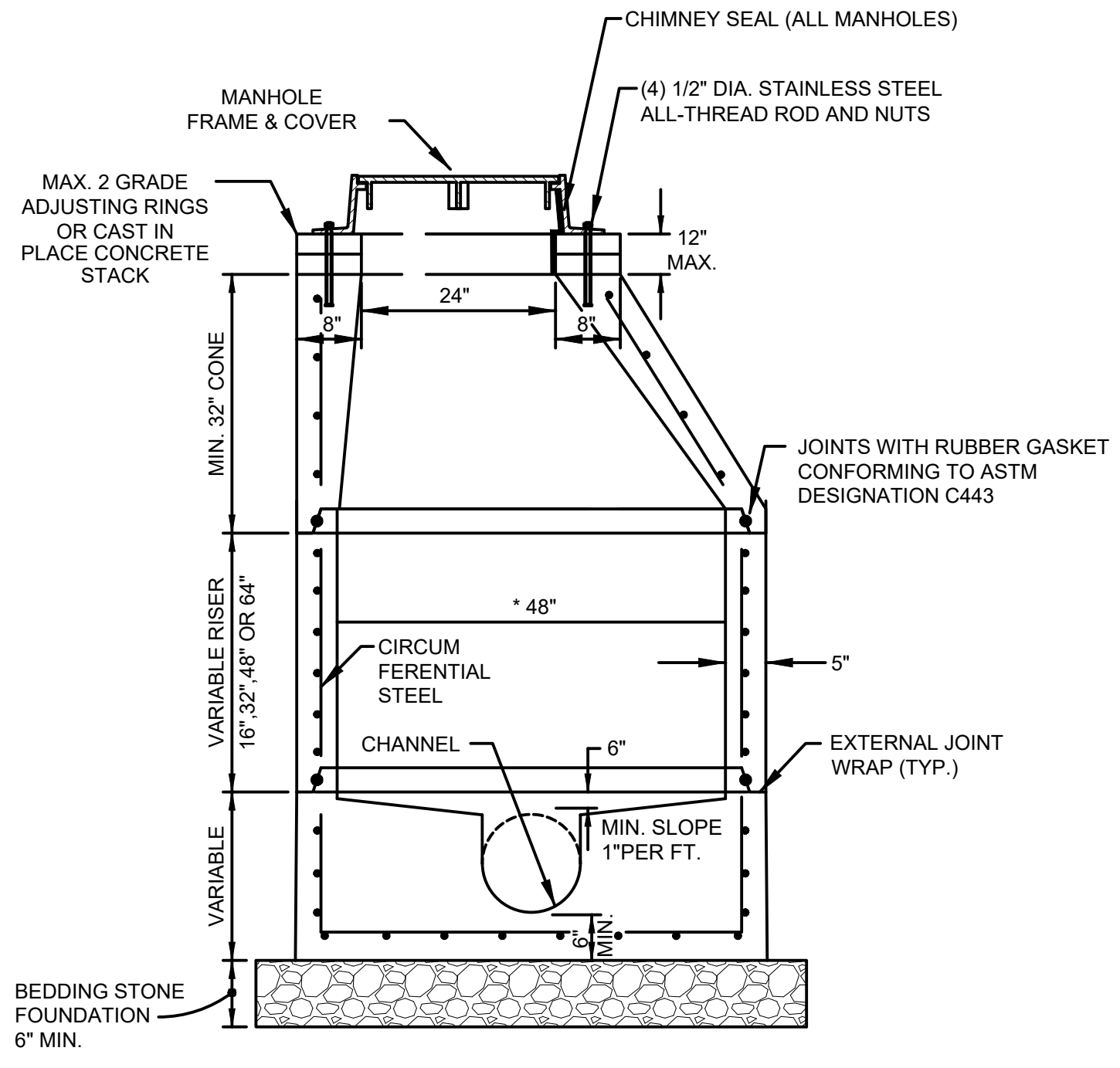
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**MIAMI SHORES
 SANITARY SEWER IMPROVEMENTS
 CONTRACT NO. 1**

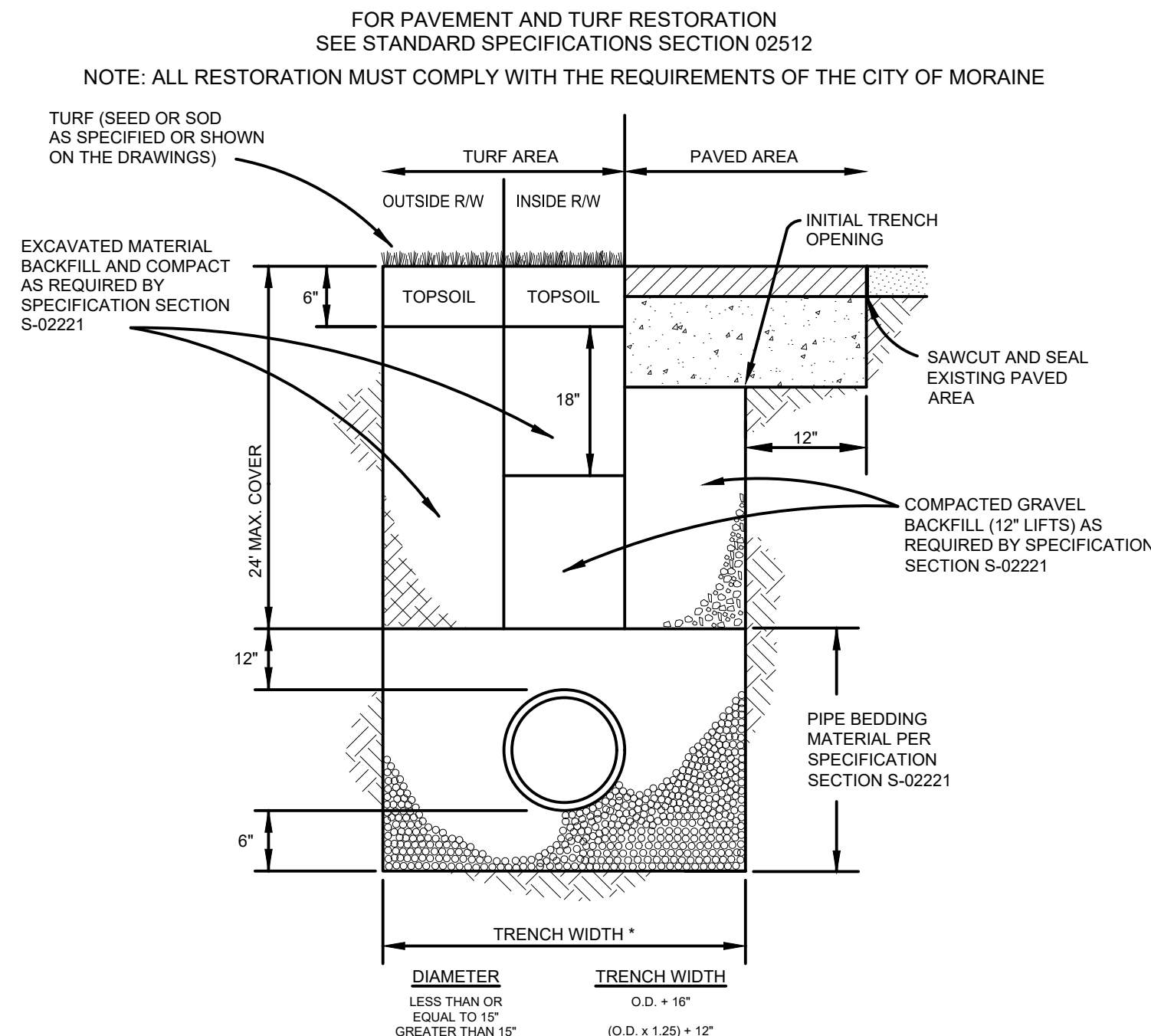
**PINNACLE RD. SEWER
 PLAN AND PROFILE
 STA. 26+50 TO STA. 31+60**

PROJECT NO. 130006-15
 FILE NAME: 50021-004\C10.DWG
 SHEET NO.
C-10



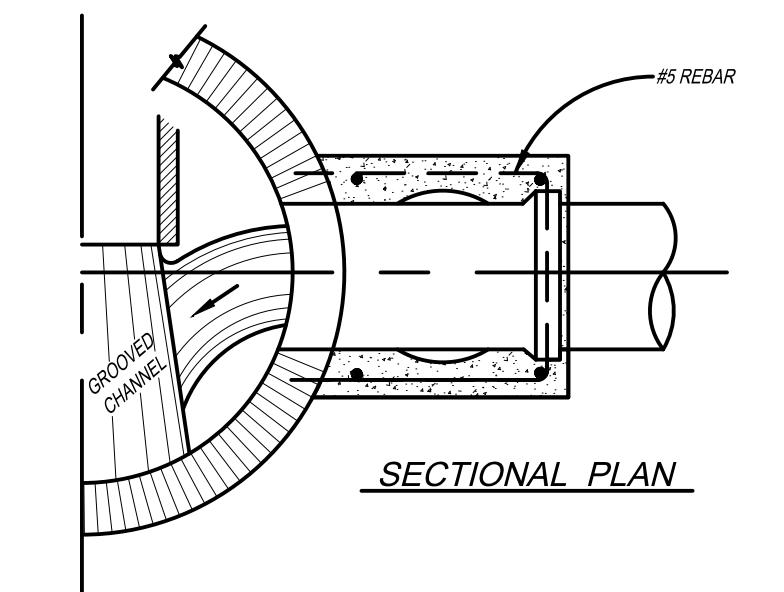
TYPICAL PRECAST SANITARY MANHOLE

DETAIL A
NOT TO SCALE



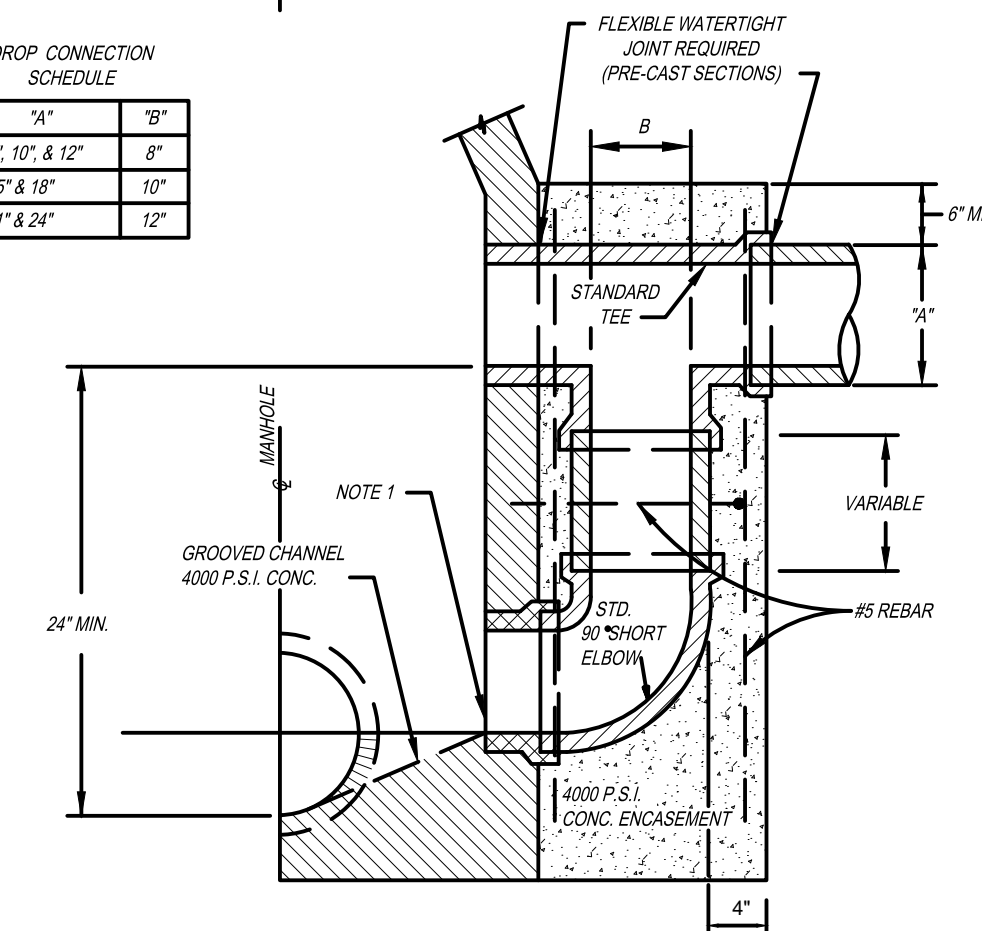
PIPE BEDDING AND TRENCH DETAIL

DETAIL B
NOT TO SCALE



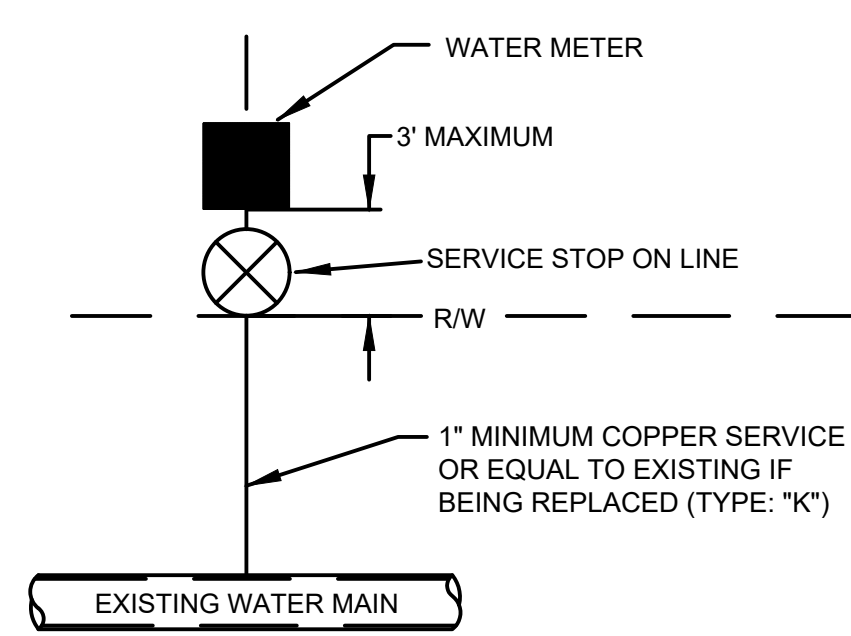
DROP CONNECTION SCHEDULE

24"	18"
8", 10", & 12"	8"
15" & 18"	10"
21" & 24"	12"



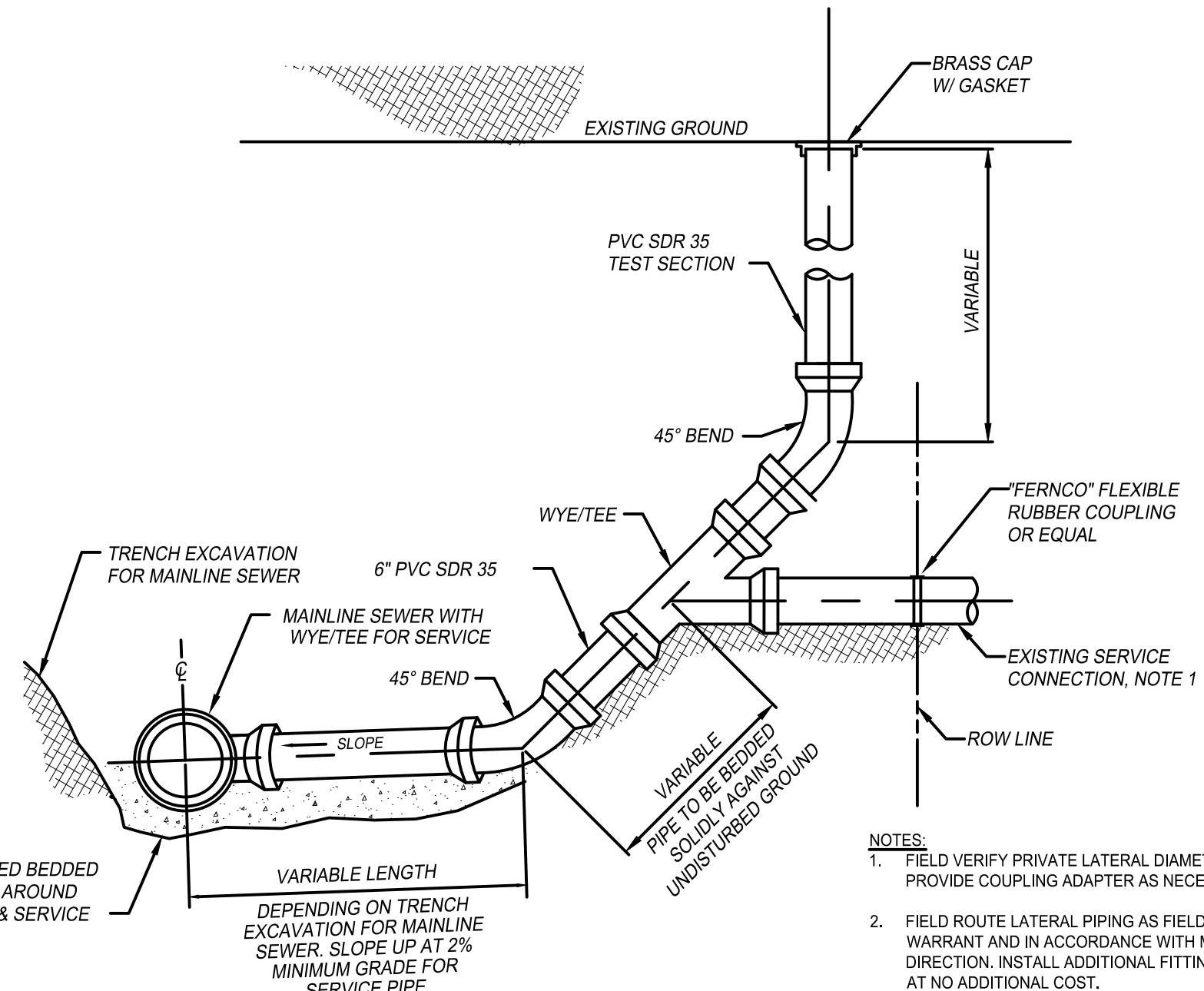
STANDARD MANHOLE DROP CONNECTION

DETAIL C
NOT TO SCALE



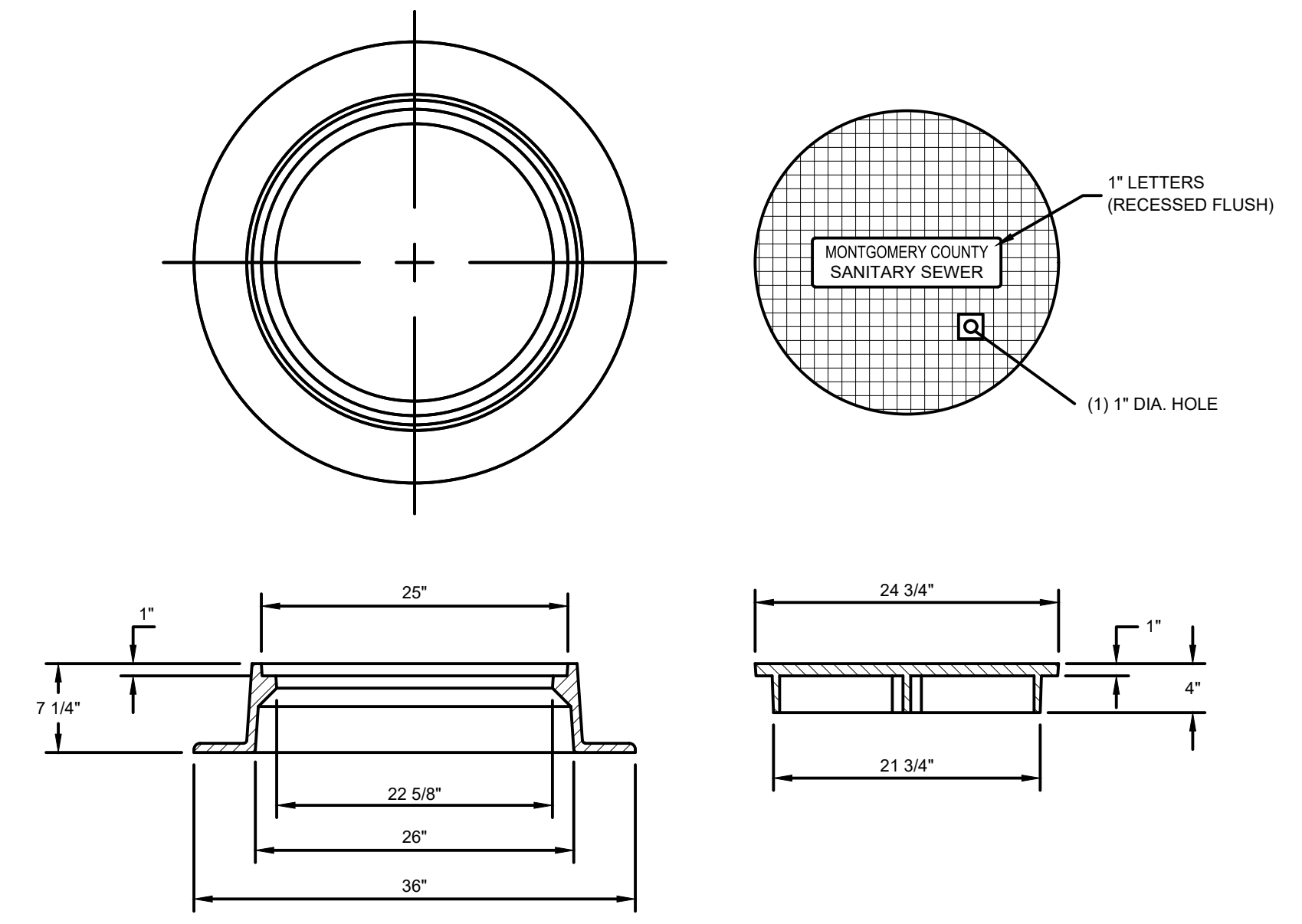
WATER SERVICE DETAIL

DETAIL D
NOT TO SCALE



LATERAL RECONNECTION/TESTING

DETAIL E
NOT TO SCALE

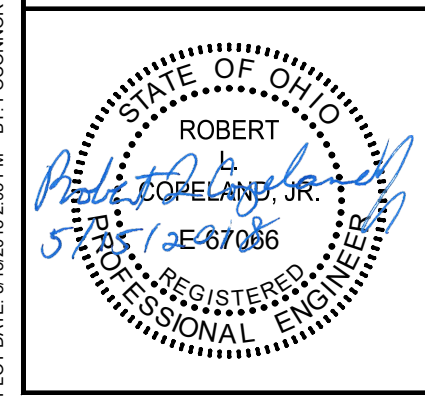


STANDARD MANHOLE FRAME AND COVER

DETAIL F
NOT TO SCALE

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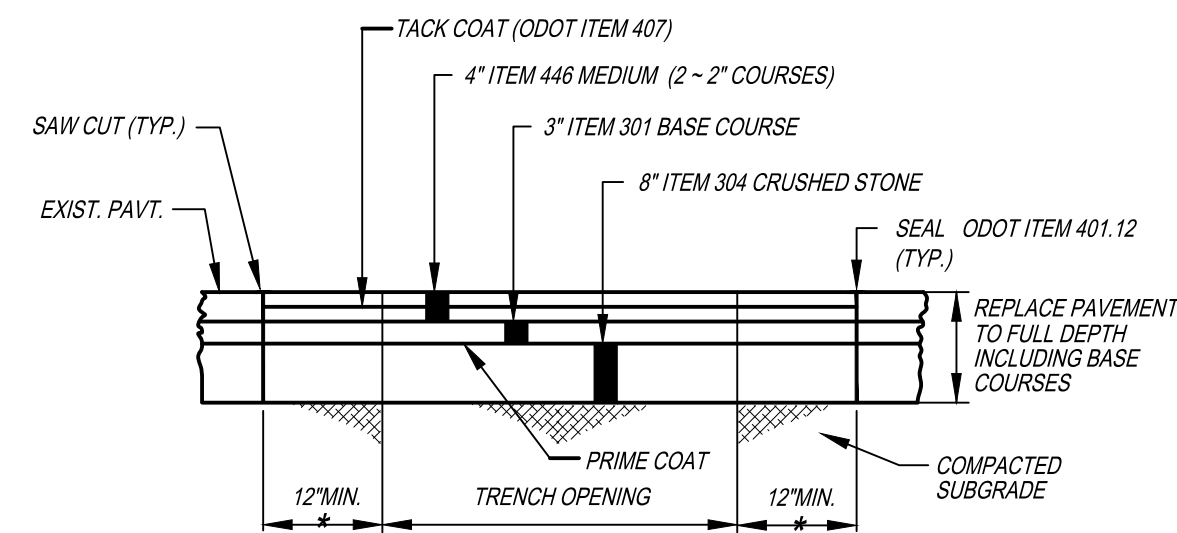
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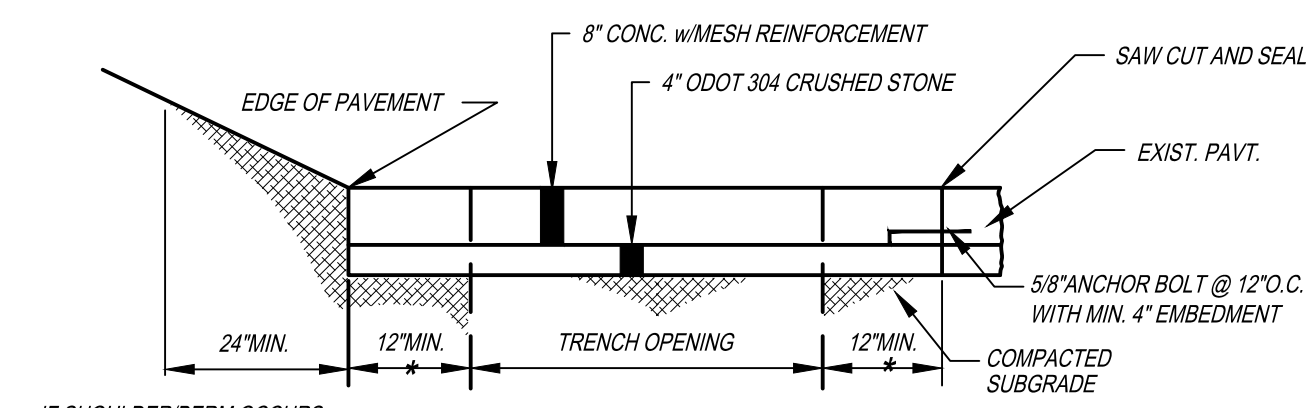
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**MIAMI SHORES
 SANITARY SEWER IMPROVEMENTS
 CONTRACT NO. 1**

**MCES
 STANDARD DETAILS**
 PROJECT NO. 130006-15
 FILE NAME: SD-01.DWG
 SHEET NO.
SD-01



ASPHALTIC CONCRETE PAVEMENT



CONC. PAVEMENT

PAVEMENT RESTORATION DETAIL

DETAIL G
NOT TO SCALE

NOTES:

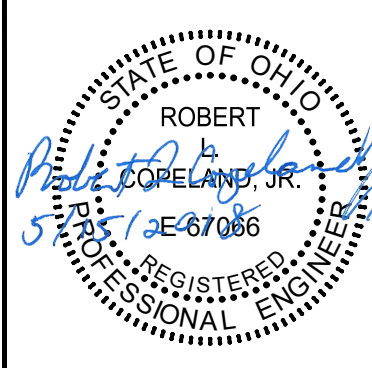
1. MINIMUM STANDARD DETAILS OF CONSTRUCTION ARE SHOWN. HOWEVER ALL CONSTRUCTION SHALL COMPLY WITH REQUIREMENTS OF LOCAL AGENCIES WITH JURISDICTION OVER PAVEMENT AT NO ADDITIONAL COMPENSATION TO CONTRACTOR.

* NOTE:

(FOR PAVEMENT CUTS APPROXIMATELY PARALLEL TO ROADWAY CENTERLINE) IF CONCRETE CURB OR EDGE OF PAVEMENT IS LESS THAN THREE (3) FEET FROM EDGE OF TRENCH OPENING CONTRACTOR SHALL REMOVE ALL SUCH PAVEMENT TO CURB OR EDGE OF PAVEMENT AND REPLACE AS SPECIFIED.

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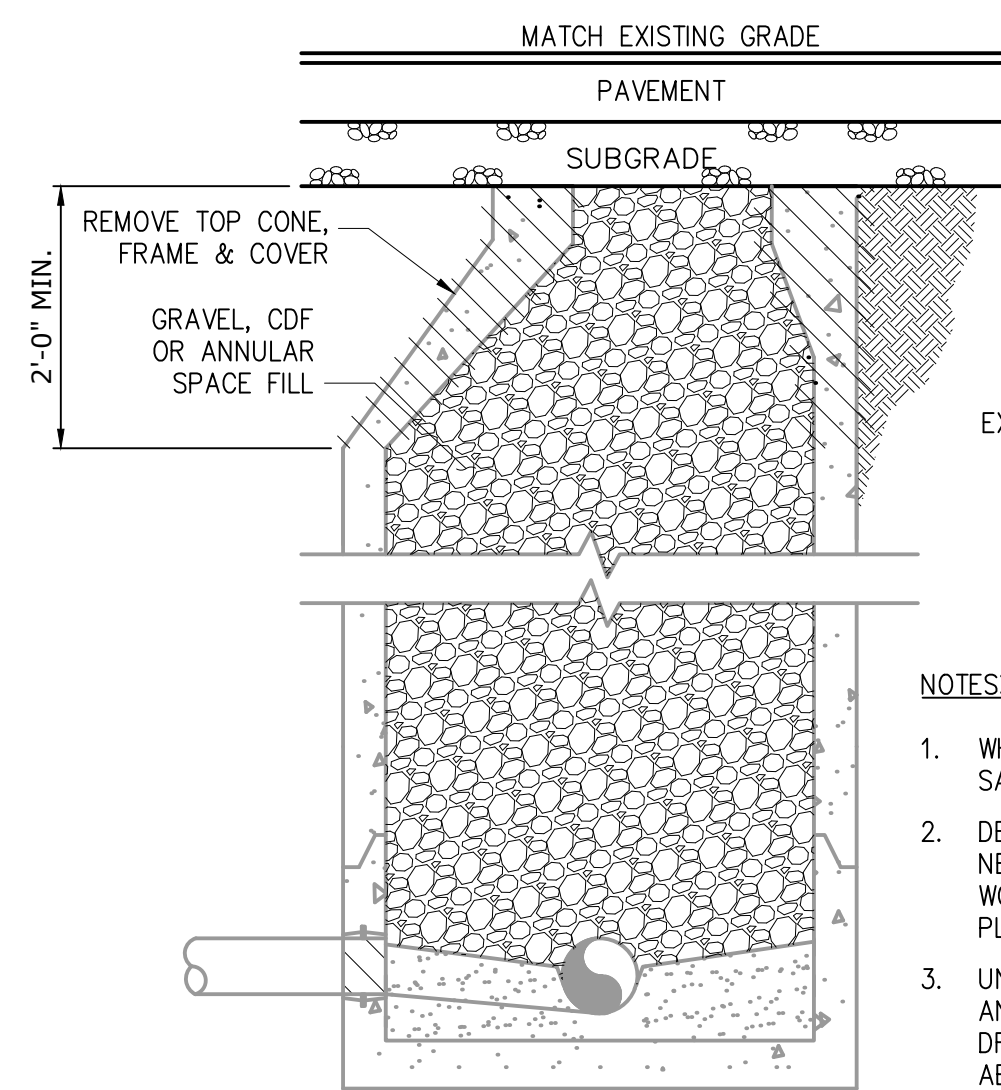
HAZEN AND SAWYER
7870 EAST KEMPER ROAD, SUITE 300
CINCINNATI, OHIO 45249

MIAMI SHORES
SANITARY SEWER IMPROVEMENTS
CONTRACT NO. 1

MCES
STANDARD DETAILS

PROJECT NO. 130006-15
FILE NAME: SD-02.DWG

SHEET NO.
SD-02

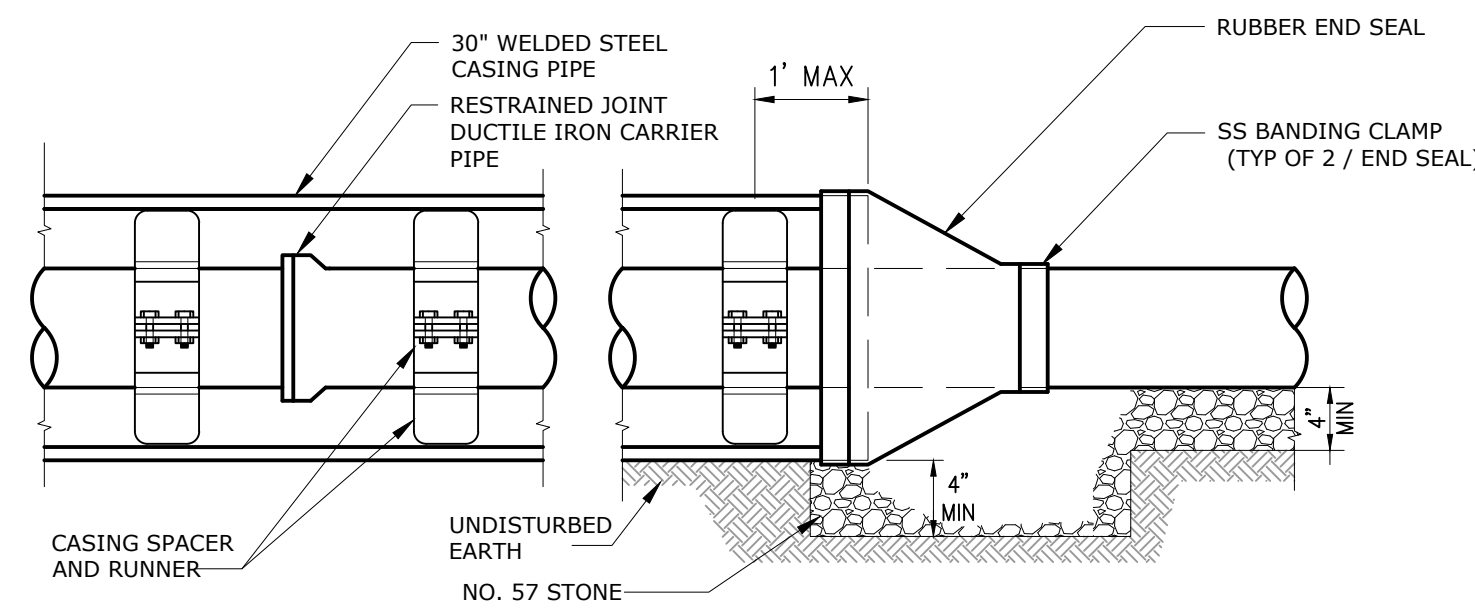


NOTES:

- WHERE DRAWINGS SHOW NEW SANITARY SEWER INSTALLATION, EXISTING SANITARY SEWER SHALL BE ABANDONED PER THIS DETAIL, AS APPLICABLE.
- DEMOLISH EXISTING SANITARY SEWER, LATERALS, AND/OR MANHOLES AS NECESSARY TO INSTALL NEW PIPING AT NO ADDITIONAL COST. WHERE NEW WORK WILL NOT DISTURB EXISTING SANITARY SEWER OR MANHOLES, ABANDON IN PLACE AS DIRECTED HEREIN.
- UNLESS OTHERWISE SPECIFIED ON THE DRAWINGS, ABANDONED SEWER PIPES 10" AND SMALLER SHALL BE ABANDONED IN PLACE. WHERE NOTED ON THE DRAWINGS, FILL PIPES 10" AND SMALLER WITH ANNULAR SPACE FILL. ABANDONED SEWER PIPES LARGER THAN 10" SHALL BE FILLED WITH ANNULAR SPACE FILL.
- PLUG ALL PIPES ENTERING AND EXITING EXISTING MANHOLES WITH CONCRETE.
- FOR ABANDONED MANHOLES IN ROAD, SAW CUT EXISTING PAVEMENT IN DIAMOND SHAPE IN DIRECTION OF TRAFFIC FLOW.
- DRILL A MINIMUM OF FOUR 3" DRAIN HOLES IN BOTTOM OF MANHOLE AROUND THE PERIMETER IF GRAVEL FILL IS USED.
- RESTORE OPENING WITH SUBGRADE AND PAVEMENT AS SHOWN IN TRENCH DETAIL AND PAVEMENT RESTORATION DETAIL.
- ANNULAR SPACE FILL SHALL BE A PORTLAND CEMENT BASED MIX SPECIFICALLY DESIGNED FOR HIGH FLOWABILITY. MIX SHALL USE FINE AGGREGATE, AIR ENTRAINMENT, HAVE A 28-DAY COMPRESSIVE STRENGTH OF 50 PSI, AND SHALL MAINTAIN CONSISTENCY WITH SEGREGATION. MIX SHALL BE HIGH FLOW PIPE BACKFILL PRODUCED BY ERNST CONCRETE, OR EQUAL.

ABANDONMENT DETAIL

DETAIL	1
NOT TO SCALE	

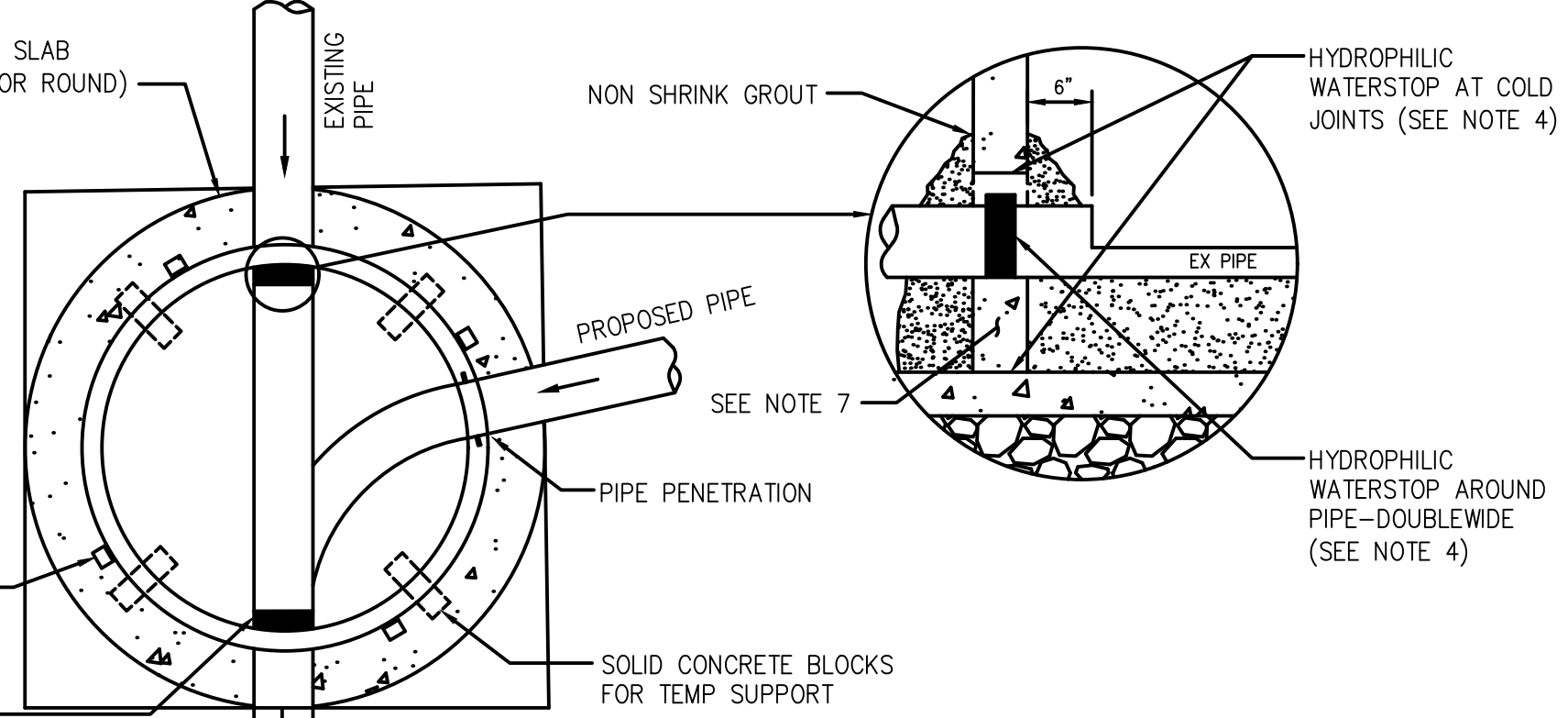
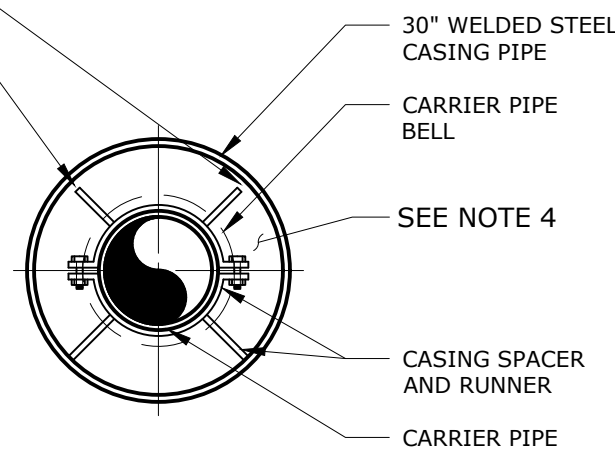


CASING NOTES

- CARRIER PIPE SHALL ESSENTIALLY BE CENTERED IN CASING PIPE.
- SEE SPECIFICATION S-02600 FOR END SEAL AND CASING SPACER REQUIREMENTS.
- MINIMUM NUMBER OF RUNNERS PER SPACER IS FOUR, BASED ON MANUFACTURER'S RECOMMENDATION. ADDITIONAL RUNNERS WILL BE SUPPLIED TO PROVIDE ACCEPTABLE SUPPORT TO CARRIER PIPE.
- FILL VOID WITH ANNULAR SPACE FILL. SEE NOTE 8, DETAIL 1, THIS SHEET.
- COMPLY WITH CSX PERMIT.

JACK AND BORE CASING DETAIL

DETAIL	4
NOT TO SCALE	

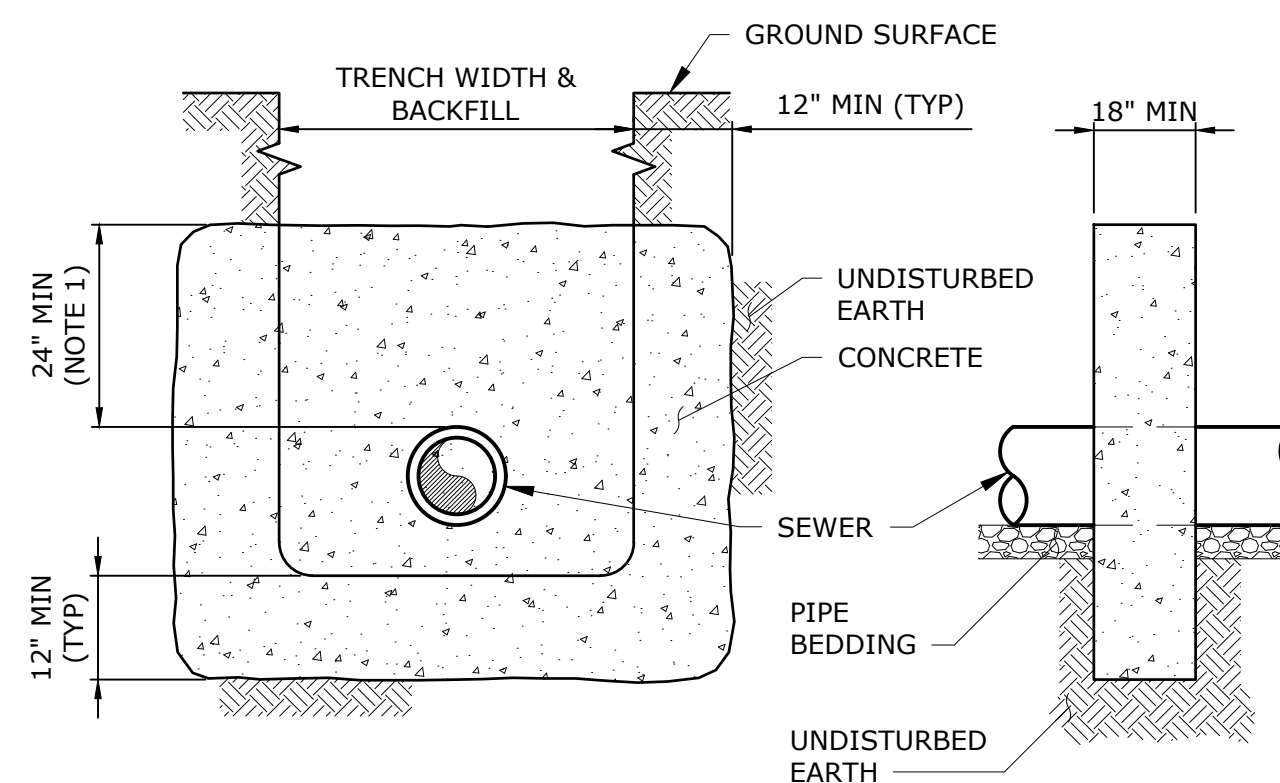


NOTES:

- ALL NOTES ON TYPICAL PRECAST SANITARY MANHOLE DETAIL "A" SHALL APPLY TO DOGHOUSE MANHOLES.
- DROP MANHOLE TO BE SIZED TO ENSURE 12" OF CONCRETE BETWEEN ANY OPENING OR JOINT IN PRECAST SECTION.
- BEFORE POURING CONCRETE SLAB, DOGHOUSE MANHOLE SECTION SHALL BE STABLE, RESTING ON CONCRETE BLOCKING, AND PLUMB.
- HYDROPHILIC WATERSTOP SHALL BE SIKA HYDROTITE, P-201 BY ADEKA, OR APPROVED EQUAL.
- SUPPORT EXISTING PIPE WITH SOLID CONCRETE BLOCKS AS REQUIRED.
- CONTRACTOR SHALL BE RESPONSIBLE FOR DESIGN OF THE BOTTOM SLAB.
- FILL ANNULAR SPACE WITH 4,000 PSI CONCRETE AFTER PLACING HYDROPHILIC WATERSTOP.

MANHOLE OVER EXISTING SEWER (DOGHOUSE)

DETAIL	2
NOT TO SCALE	

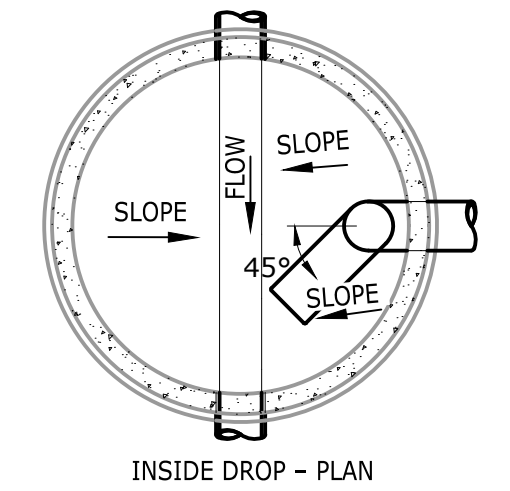
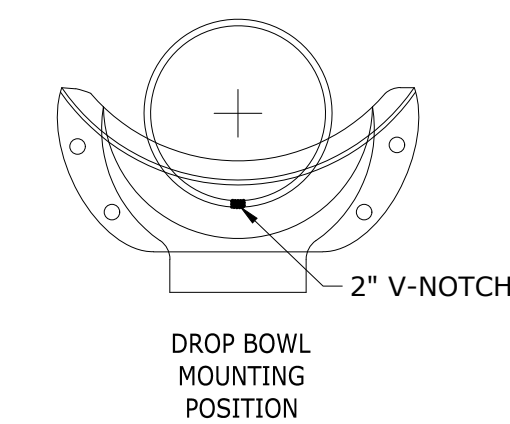


NOTES:

- TOP OF COLLAR TO EXTEND INTO TRENCH ZONE BACKFILL 12" MINIMUM.
- ANTI-SEEP COLLAR SHALL BE PLACED AT MID-SPAN OF EACH SEWER SEGMENT (MH TO MH) INSTALLED USING OPEN CUT METHODS.
- ANTI-SEEP COLLARS ARE NOT REQUIRED FOR PIPE INSTALLED BY PIPE-BURSTING, JACK AND BOR, OR CIPP.

ANTI-SEEP COLLAR

DETAIL	5
NOT TO SCALE	

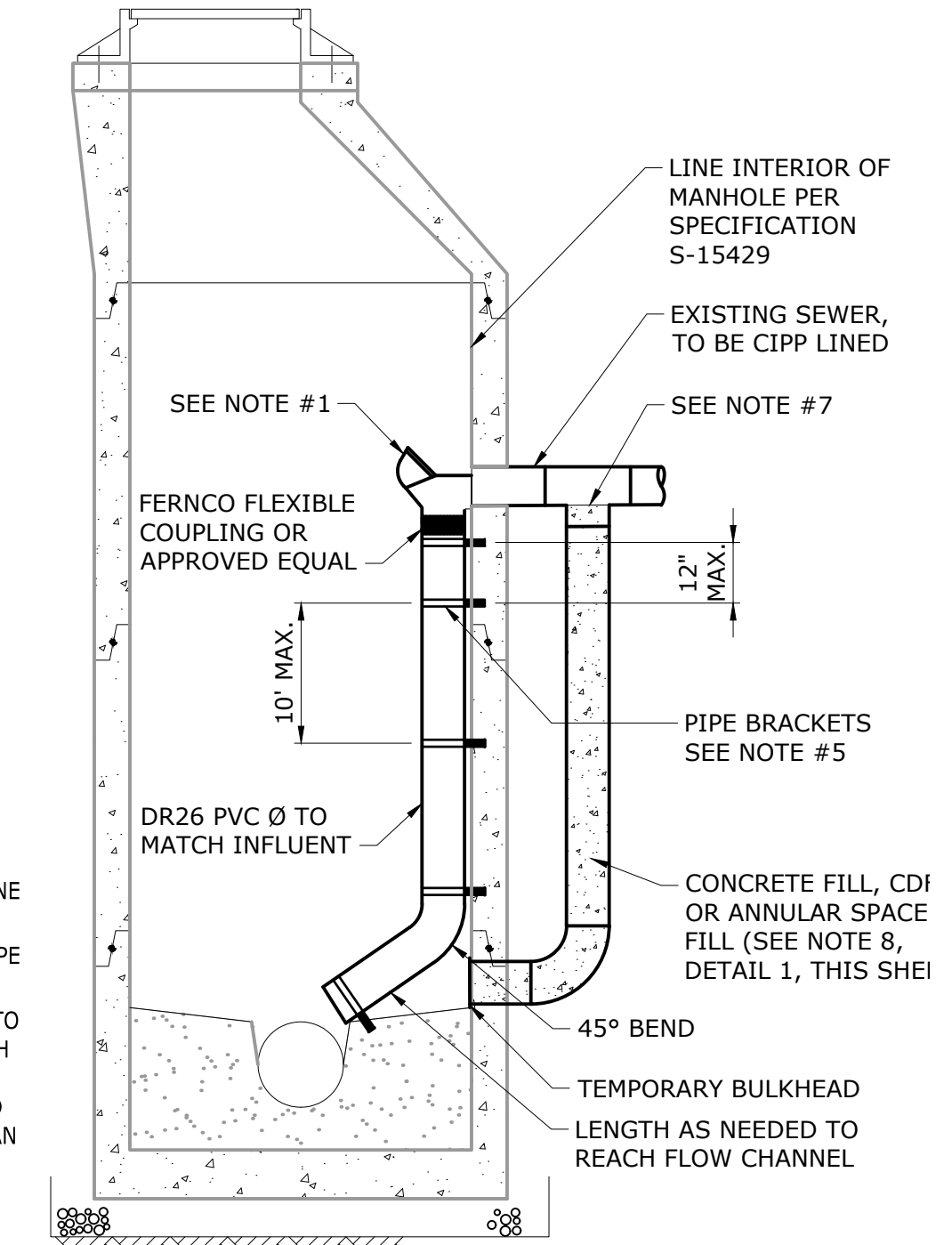


NOTES:

- DROP BOWL AND HOOD AS MANUFACTURED BY RELINER-DURAN INC. OR APPROVED EQUAL.
- DROP BOWL TO BE SIZED PER MANUFACTURER'S RECOMMENDATIONS OR AS SPECIFIED IN CONTRACT DOCUMENTS.
- PIPE AND FITTINGS FOR DROP ASSEMBLY SHALL BE PVC SDR 26.
- DROP ASSEMBLY SHALL DISCHARGE INTO CHANNEL, DIRECTED IN THE DIRECTION OF PIPE FLOW.
- TYPE 316 STAINLESS STEEL ADJUSTABLE PIPE BRACKETS AS MANUFACTURED BY RELINER-DURAN INC. OR APPROVED EQUAL. MINIMUM 3 REQUIRED, INCLUDING ONE ON 45° BEND.
- 2" V-NOTCH TO BE CUT BOTTOM EDGE OF DISCHARGE PIPE JUST BEFORE ITS ENTRY INTO THE DROP BOWL.
- OUTSIDE DROP SHALL BE FILLED WITH CONCRETE PRIOR TO CIPP LINING. CONCRETE FILL SHALL BE FLOATED SMOOTH AND FLUSH TO BOTTOM OF PIPE TO AVOID DIMPLES IN CIPP LINING. TEMPORARY BULKHEAD SHALL BE REMOVED AFTER CONCRETE HAS CURED. CONTRACTOR SHALL CLEAN DROP PIPES PRIOR TO FILLING, IF REQUIRED.
- PRIOR TO LINING, REMOVE EXISTING MANHOLE STEPS UNLESS OTHERWISE INSTRUCTED BY MCES.

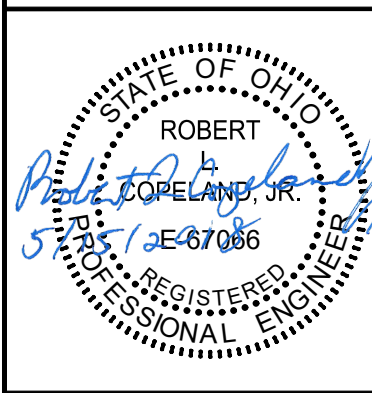
INSIDE DROP MANHOLE AND REHABILITATION

DETAIL	3
NOT TO SCALE	



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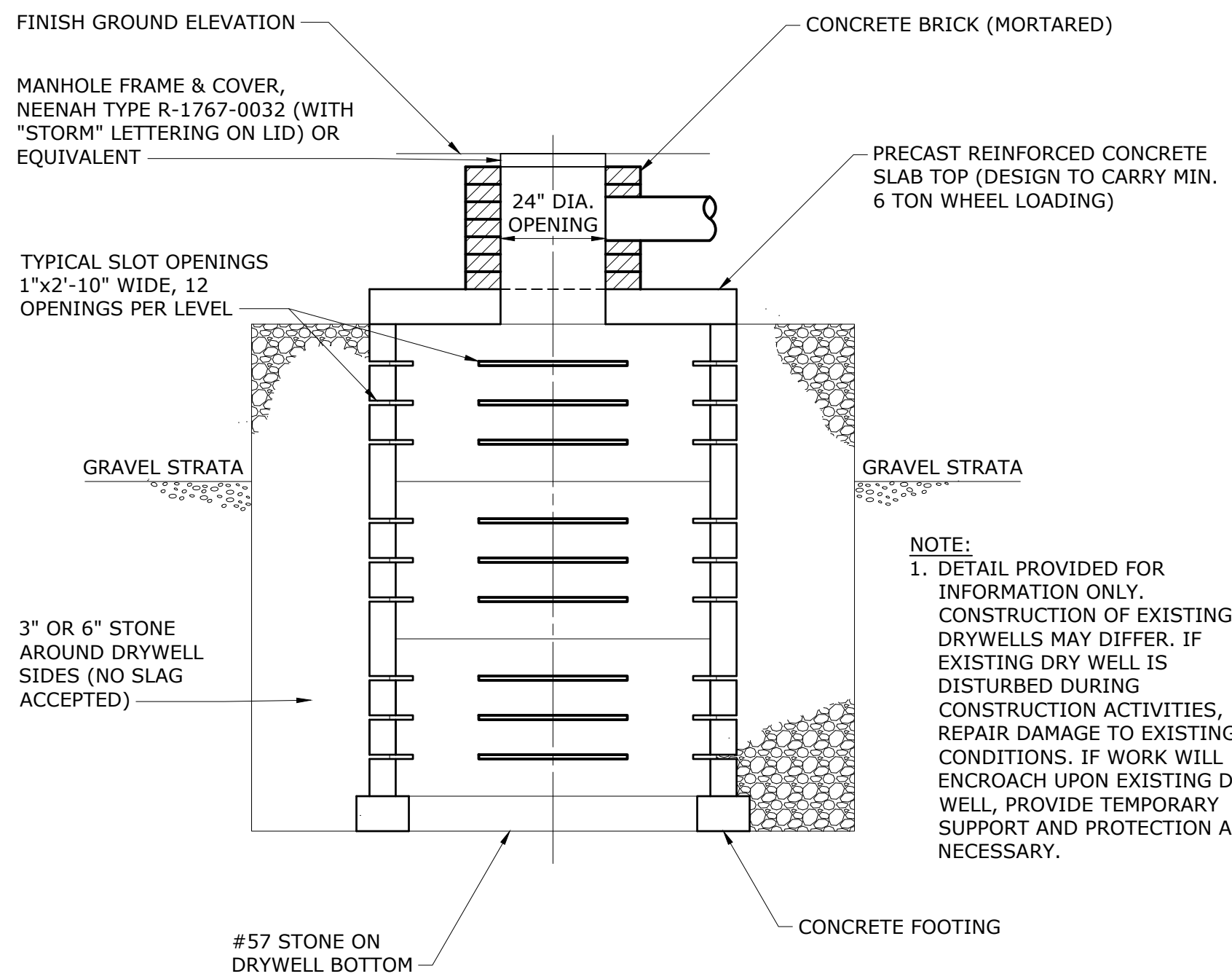
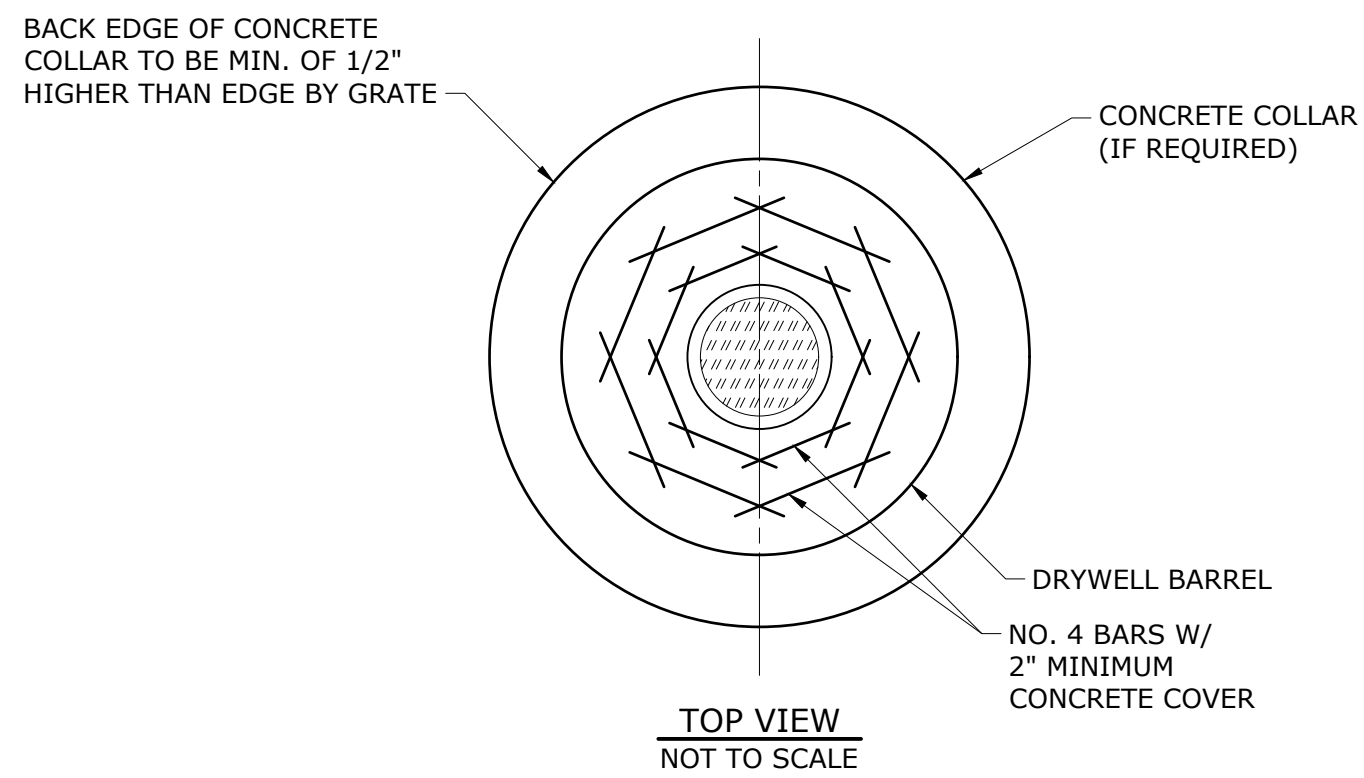
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**MIAMI SHORES
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 CONTRACT NO. 1**

STANDARD DETAILS
 PROJECT NO. 130006-15
 FILE NAME: D-01.DWG
 SHEET NO.
D-01



EXAMPLE STORMWATER DRYWELL

DETAIL 7
NOT TO SCALE



IMAGE OF INSIDE MANHOLE 5F0226

DETAIL 8
NOT TO SCALE



IMAGE OF INSIDE MANHOLE 5G0049

DETAIL 9
NOT TO SCALE

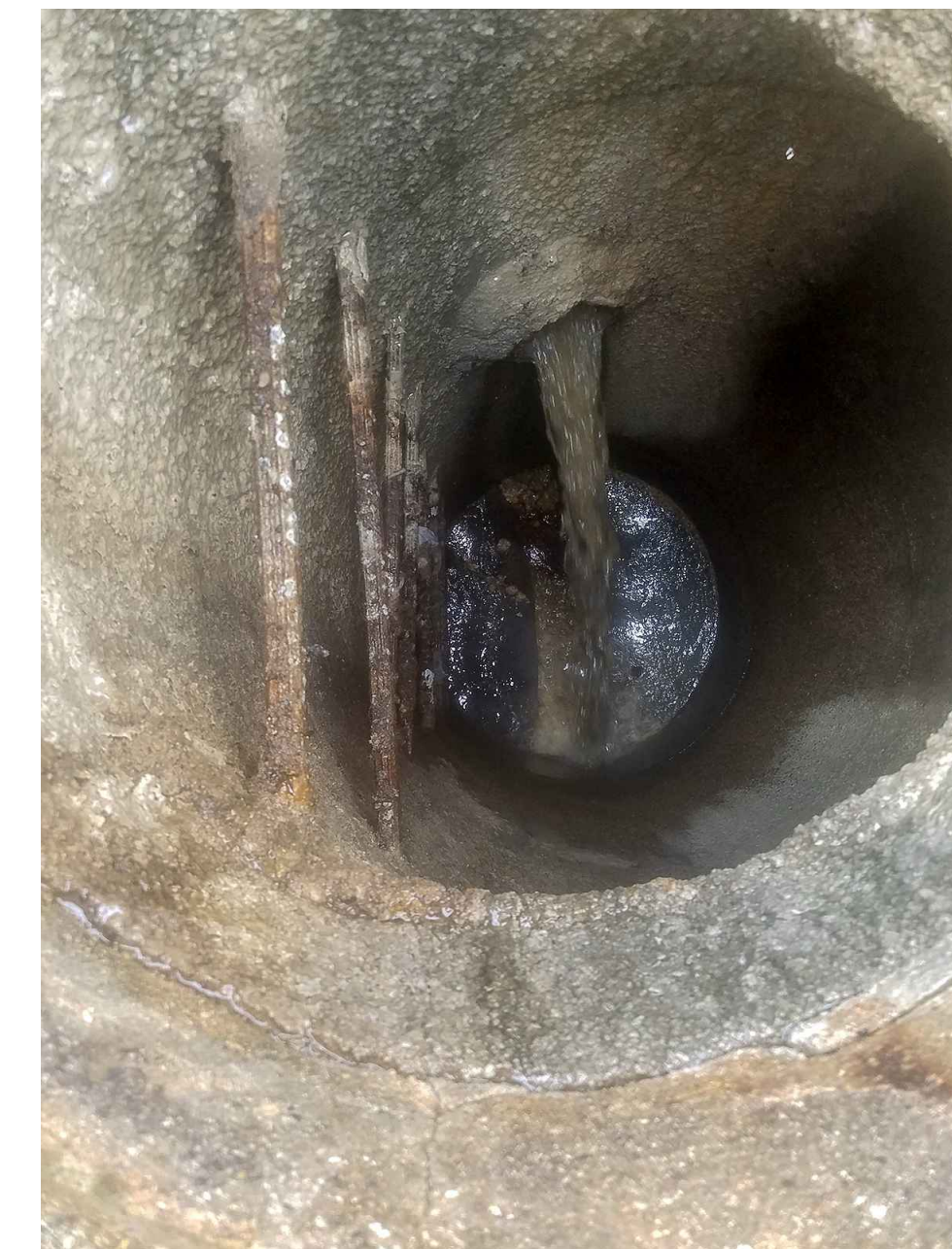


IMAGE OF INSIDE MANHOLE 5G0048

DETAIL 10
NOT TO SCALE



IMAGE OF INSIDE MANHOLE 5G0047

DETAIL 11
NOT TO SCALE

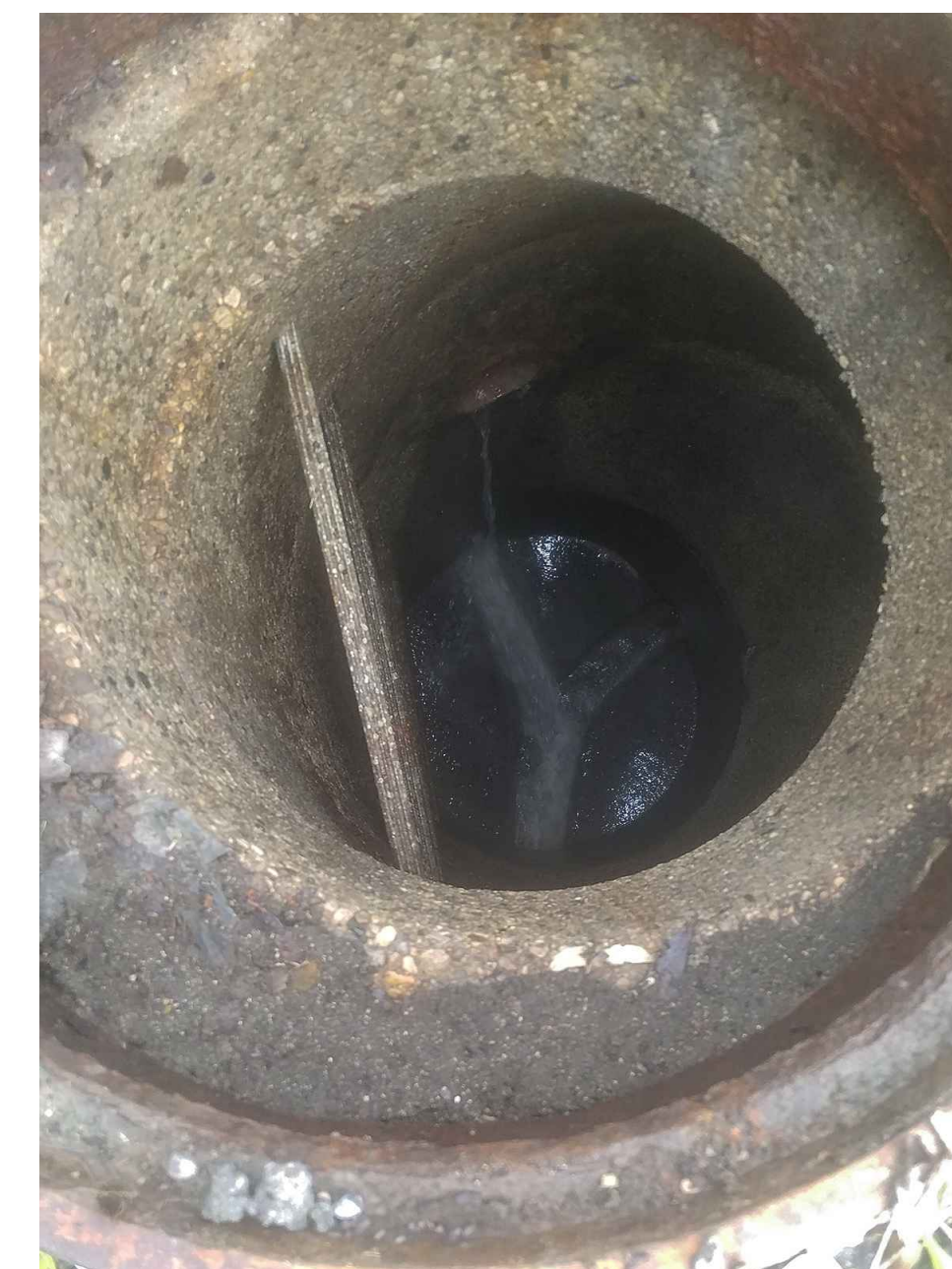


IMAGE OF INSIDE MANHOLE 5G0046

DETAIL 12
NOT TO SCALE

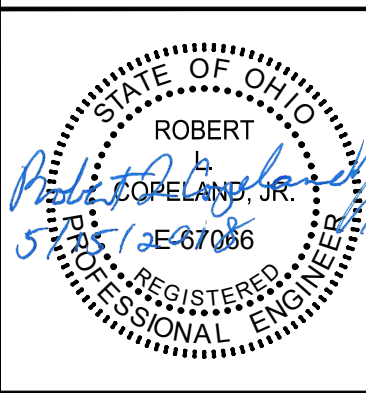


IMAGE OF INSIDE MANHOLE 5G0001

DETAIL 13
NOT TO SCALE

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CROSS CHKD BY:	JM
APPROVED BY:	BO
DATE:	MAY 2018
REV. NO.	REVISIONS

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DRAWN BY:	PJO
SHEET CHKD BY:	JMC
CROSS CHKD BY:	JM
APPROVED BY:	BO
DATE:	MAY 2018

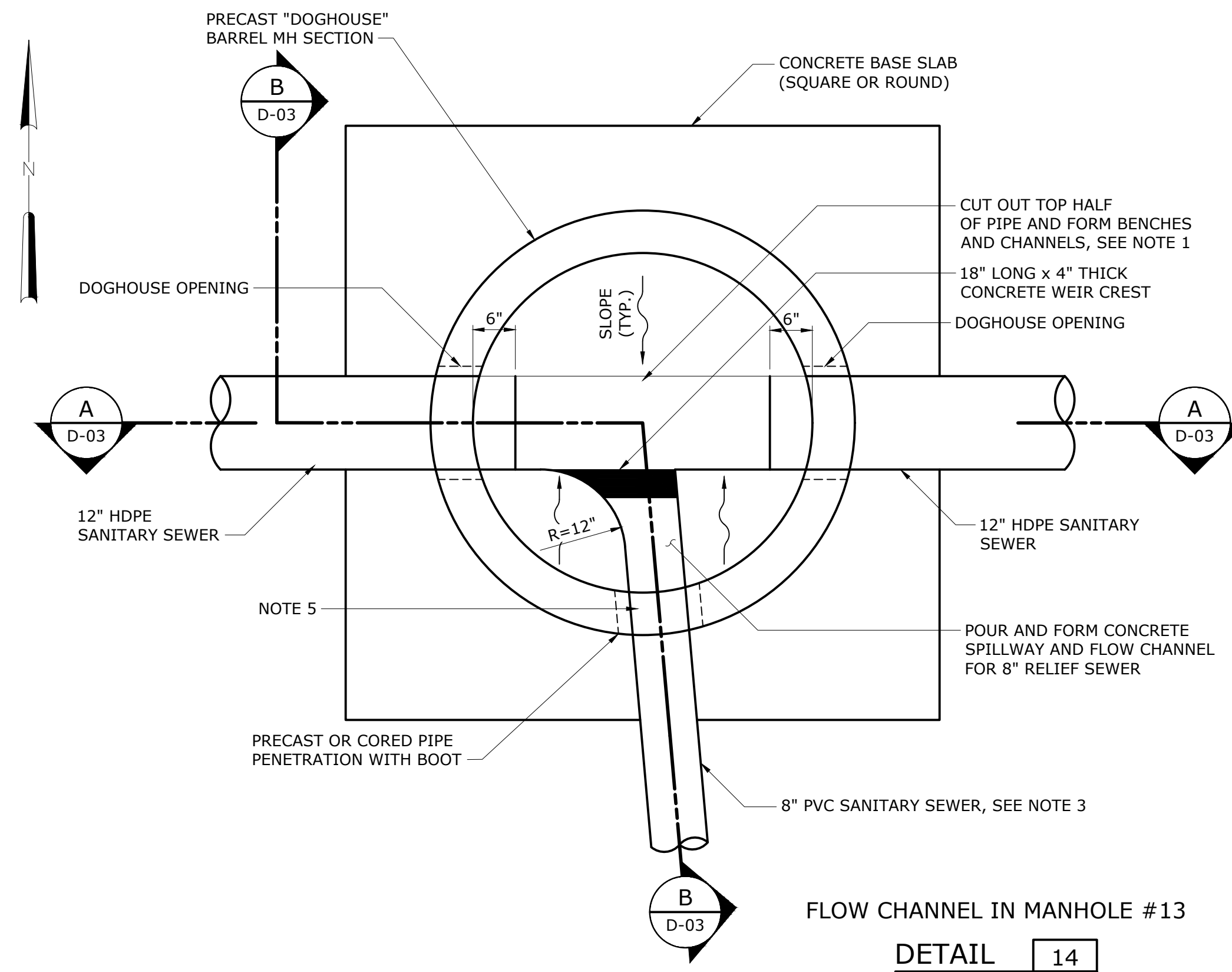
1850 Spaulding Road
 Kettering, Ohio 45432
 Tel: (937) 781-2550

Hazen
 HAZEN AND SAWYER
 7870 EAST KEMPER ROAD, SUITE 300
 CINCINNATI, OHIO 45249

**MIAMI SHORES
 SANITARY SEWER IMPROVEMENTS
 CONTRACT NO. 1**

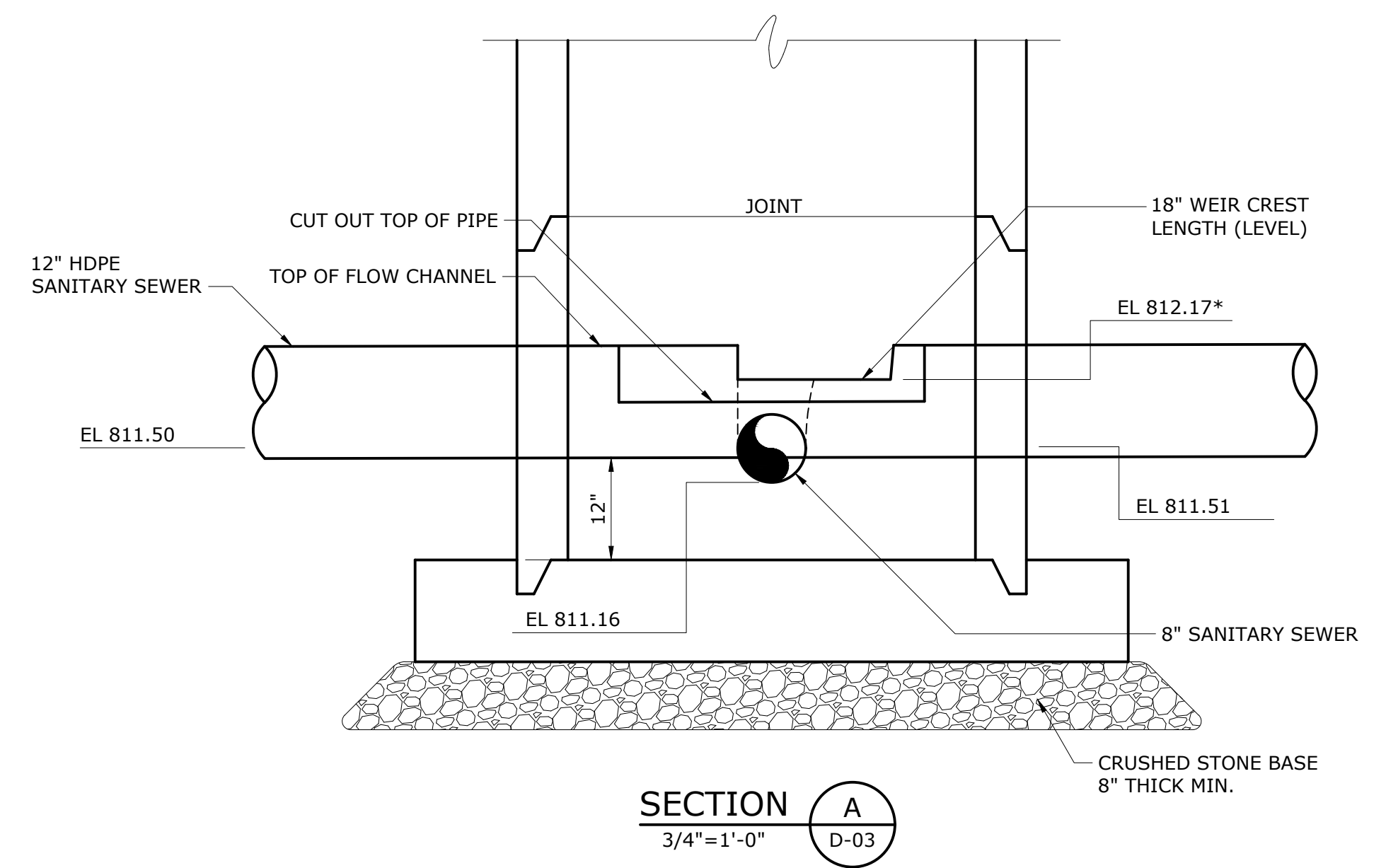
STANDARD DETAILS

PROJECT NO. 130006-15
 FILE NAME: D-02.DWG
 SHEET NO.
D-02

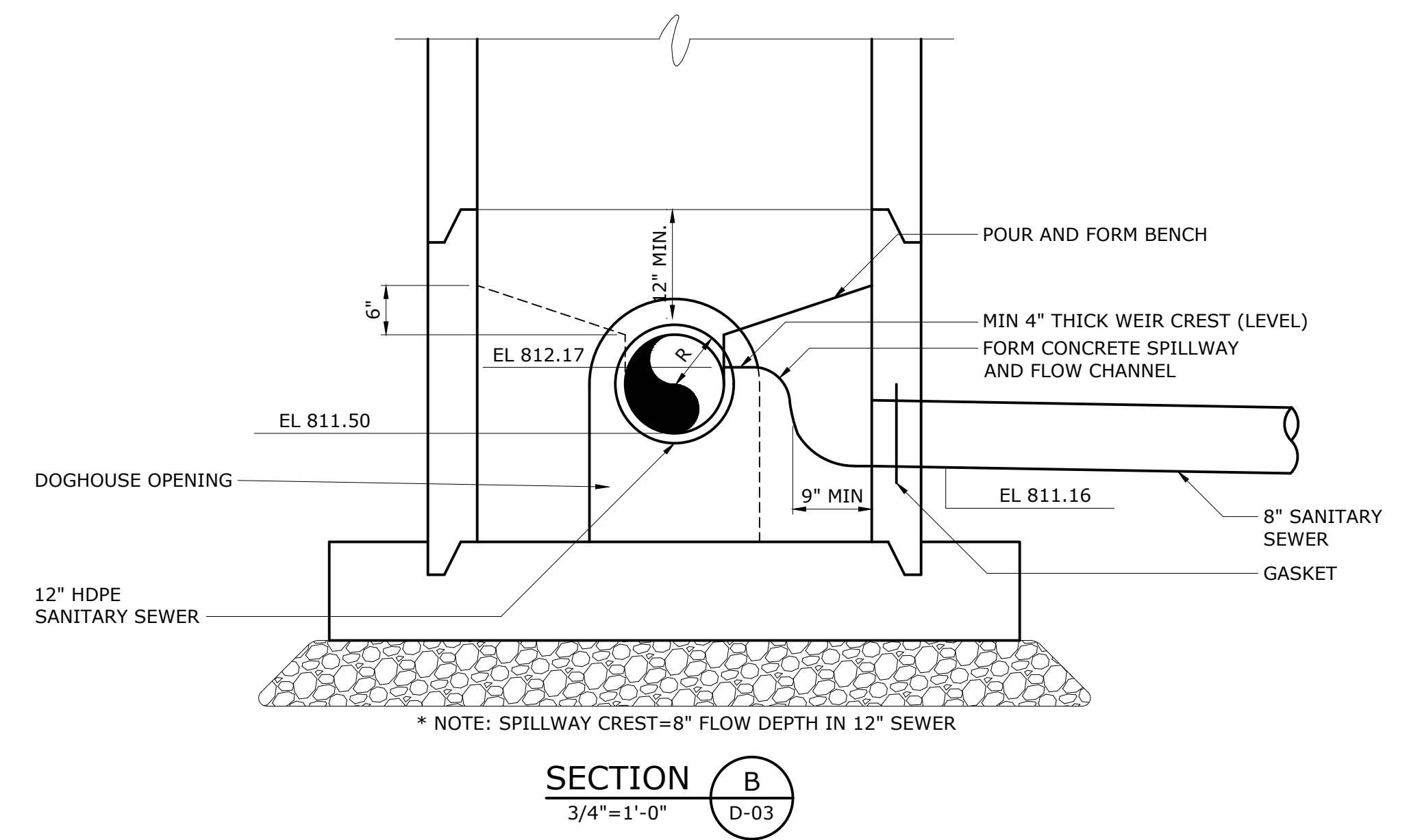


- NOTES:**
- DO NOT POUR BENCHES, WEIR, OR SPILLWAY UNTIL AFTER ALL DOWNSTREAM CIPP LINING, MH MODIFICATIONS AND REHABILITATION ARE COMPLETE AND ACCEPTED.
 - FOR DURATION OF CONSTRUCTION ONLY, DURING DRY WEATHER, ALL SANITARY FLOWS FROM PINNACLE ROAD MAY BE ROUTED THROUGH 8" SANITARY SEWER. 12" SEWER SHALL BE AVAILABLE DURING WET WEATHER.
 - UPON COMPLETION OF PROJECT, 8" SANITARY SEWER WILL SERVE ONLY TO RELIEVE EXCESS FLOWS IN 12" SEWER.
 - REQUIREMENTS OF DETAIL A ON SHEET SD-01 AND DOGHOUSE MANHOLE DETAIL 2 SHALL APPLY TO THIS MANHOLE, EXCEPT AS OTHERWISE INDICATED.
 - PROVIDE TEMPORARY PLUG OR BULKHEAD AS DIRECTED BY MCEs UNTIL DOWNSTREAM 8" SEWER BY OTHERS IS ACCEPTED AND RELEASED BY MCEs.

FLOW CHANNEL IN MANHOLE #13
DETAIL 14
 3/4"=1'-0"

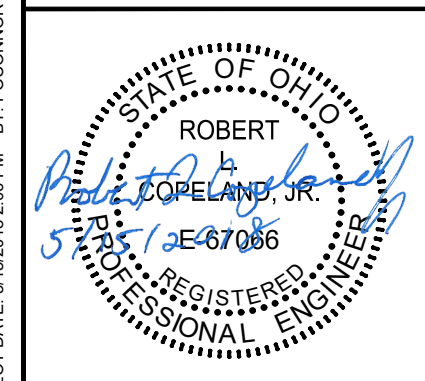


SECTION A
 3/4"=1'-0" D-03



SECTION B
 3/4"=1'-0" D-03

BID DRAWING



REV. NO.	REVISIONS

DESIGNED BY:	VALUE
DRAWN BY:	VALUE
SHEET CHKD BY:	VALUE
CROSS CHKD BY:	VALUE
APPROVED BY:	VALUE
DATE:	MAY 2018

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**MIAMI SHORES
 SANITARY SEWER IMPROVEMENTS
 CONTRACT NO. 1**

STANDARD DETAILS

PROJECT NO. 130006-15
 FILE NAME: D-03.DWG
 SHEET NO.
D-03

File: HAZENANDSAWYER\COM\HSPROJECTS\130006-15\DESIGN\DRAWINGS\DETAILS\D-03.DWG Saved by POCANNOR Save date: 5/10/2018 12:11 PM
 PLOT DATE: 5/10/2018 2:06 PM BY: POCANNOR

ATTACHMENT 3

Addendum to Bid Drawings





Purchasing Department

MONTGOMERY COUNTY ADMINISTRATION
BUILDING
451 WEST THIRD STREET
P.O. BOX 972
DAYTON, OHIO 45422-1110

July 5, 2018

***** ADDENDUM #3 *****

PROJECT NUMBER: 130006-15
MIAMI SHORES SANITARY SEWER IMPROVEMENTS
DUE DATE: JULY 11, 2018 @ 1:30 PM

Dear Prospective Bidders:

The following additions, deletions and/or changes to Project Number 130006-15, Miami Shores Sanitary Sewer Improvements, are to be considered part of the original Bid Documents and are equally binding.

Questions/Answers from Submitted Questions
Changes to Bid Documents – Specifications and Contract Documents
Bidding Information and Clarifications
Addendum Attachments
Attachment 01 (6 pages – addition to Appendix E)

Please download Addendum #3 from the online bid website located at www.mcoho.org/onlinebids.

If you should have any questions concerning these changes, please contact Barbara Asberry at (937) 225-6391.

Sincerely,

MONTGOMERY COUNTY PURCHASING
Tyler Small, CPSM
Purchasing Director

STATEMENT BY BIDDER

Please sign the following acknowledgement and return it with the bid documents for Project No. 130006-15, Miami Shores Sanitary Sewer Improvements, due on July 11, 2018.

We acknowledge receipt of Addendum #3.

Signed: _____ Date: _____

Company: _____

**MIAMI SHORES SANITARY SEWER IMPROVEMENTS
PROJECT NO. 130006-15**

QUESTIONS/ANSWERS FROM SUBMITTED QUESTIONS

1. The notes say “flow discharged from these systems is likely to contain high-temperature wastewater, high ammonia concentration, chlorides, and hazardous chemicals not typically found in sanitary sewer collection systems.” Can you please clarify the requirements with handling or disposing of this material?

The intent of these notes is to make the Bidders/Contractor aware that the flows in these sewers are not limited to domestic wastewater typically found in residential sanitary sewer systems. The Contractor is responsible for developing and implementing the project safety program; and the Contractor shall determine and provide the appropriate level of protection to workers in accordance with OSHA standards, including, but not limited to, while working in confined spaces. The Contractor is expected to limit workers' exposure to wastewater flow during pipe bursting, CIPP lining, manhole rehabilitation, and other activities as necessary, through appropriate use of bypass pumping of the existing sanitary sewers in conformance with the Contract Documents.

2. Does the contractor or subcontractor have to have HAZWOPER training to deal with the type of sewer cleaning and disposal detailed in Question 1?

Refer to the answer to Question 1 above.

3. Does the disposal of the material detailed in Question 1 need to be treated as contaminated debris?

As required in Supplemental Specification Section S-01046, “All bypasses involving sewage must return sewage to the Montgomery County sanitary sewer system without allowing the sewage to enter the environment.” The contractor shall be responsible for classifying all material to be removed and providing proper disposal when necessary. Any debris or other material removed from the sanitary sewer system during sewer cleaning operations shall be disposed of as directed by MCES at the Eastern Regional Water Reclamation Facility, located at 1802 Spaulding Road, Dayton, Ohio, 45432, or other MCES facility located closer to the project site. Disposal location will be determined by MCES based on the nature of the material. No dumping fees will be charged by MCES to the Contractor for receiving materials removed from the sanitary sewers involved in this project.

4. Will the sewer treatment plant take the materials detailed in Question 1?

Refer to the answer to Question 3 above.

5. Can black HDPE be used instead of light reflective green, as the green is very difficult to obtain.

If the specified reflective green pipe is not available or cannot be obtained in time to meet the Contractor's approved schedule, the Owner will approve a substitution request to use standard black HDPE pipe that otherwise complies with the project specifications, provided such

substitution request is submitted by the Contractor in accordance with S-01630. Use of black HDPE pipe shall not in any way reduce the inspection requirements or acceptance criteria for the required CCTV inspection; the CCTV inspection video shall be clearly visible before the HDPE pipe will be accepted.

**MIAMI SHORES SANITARY SEWER IMPROVEMENTS
PROJECT NO. 130006-15**

**CHANGES TO BID DOCUMENTS – SPECIFICATIONS AND CONTRACT
DOCUMENTS**

1. VOLUME 1, APPENDIX E – GROUNDWATER FLOW MODELING BY EAGON & ASSOCIATES FOR MIAMI SHORES SANITARY SEWER IMPROVEMENTS
 - a. Add the following wording to the cover page of Appendix E: The groundwater flow modeling report prepared by Eagon & Associates, Inc., is included as an appendix but is not part of these Contract Documents. All information relative to subsurface conditions and groundwater flow is offered in good faith to assist the Bidder in evaluation of the work, but with no specific guaranty as to the completeness or accuracy on the part of the Owner or Engineer. This report is included for the Bidders' information and shall be used by Bidders at their own risk. Neither Montgomery County nor Hazen and Sawyer shall be responsible for the conclusions, opinions, or recommendations made by the Bidder based on the data included herein.

2. VOLUME 1, APPENDIX E – GROUNDWATER FLOW MODELING BY EAGON & ASSOCIATES FOR MIAMI SHORES SANITARY SEWER IMPROVEMENTS
 - a. Add Attachment 01 to Appendix E.

3. VOLUME 3, SECTION S-02221 – TRENCH EXCAVATION AND BACKFILL
 - a. PAGE S-02221-8: Add Paragraph 3.5.A.8.: Pumping of groundwater in the project area shall be kept to the minimum required to complete the work. During construction for Manhole No. 1 and any other excavation below elevation 700 ft., the Contractor shall use methods such as solid sheeting, soil mixing, injectable barrier wall grouting, jet grouting, and/or other approved methods to exclude groundwater from the excavation during installation of the proposed sanitary sewer system improvements. Throughout dewatering operations for this project, Contractor shall monitor groundwater level at least every 4 hours in all wells actively being used for dewatering purposes and at least one other sufficiently-deep well located to the east or southeast within 50 – 100 feet of active dewatering operations. Groundwater level at the well located 50 – 100 feet from dewatering operations shall not be allowed to fall below 700 ft. Monitored water levels shall be reported to MCES and the Engineer at least daily.
 - b. PAGE S-02221-8: Add Paragraph 3.5.A.9.: Within eight (8) hours of when groundwater level in the work area has been sufficiently lowered by dewatering to permit excavation work to proceed, and at any time thereafter during which dewatering pumping of groundwater is ongoing, Contractor shall have a full construction crew and all other personnel as needed to support the work (e.g., traffic control, truck drivers, etc.) on-site actively working on installation of the proposed sanitary sewer system improvements for which the dewatering pumping is necessary. Such dewatering and construction work shall continue uninterrupted (excepting meals, brief shift changes, other necessary breaks, weather or other situations that would present unsafe conditions, or if otherwise approved or

directed by MCES) on a 24-hours-per-day, 7-days-per-week schedule, until site conditions no longer require dewatering pumping to lower or maintain the groundwater table for construction to proceed—at which time, Contractor may resume a normal construction schedule with regular working hours. Furthermore, if dewatering is suspended due to high river conditions per the requirements of Paragraph 3.5.C of this section, Contractor may temporarily resume a normal construction schedule with regular working hours (or suspend work) until such time as dewatering resumes.

4. VOLUME 3, SECTION S-02221 – TRENCH EXCAVATION AND BACKFILL

- a. PAGE S-02221-8: Add Paragraph 3.5.B.5.: Ohio EPA Permit No. OHC000004 may only cover existing and new discharges composed entirely of storm water discharges associated with construction activity that enter surface waters of the State or a storm drain leading to surface waters of the State. All discharges covered by this permit must be composed entirely of storm water, or uncontaminated ground water from trench or well point dewatering. Discharges of material from trench or well point dewatering other than storm water or uncontaminated ground water must comply with an individual NPDES permit or an alternative NPDES general permit issued for the discharge.
- b. PAGE S-02221-8: Add Paragraph 3.5.B.6.: There shall be no turbid discharges to surface waters of the State resulting from dewatering activities. If trench or ground water contains sediment, it must pass through a sediment settling pond or other equally effective sediment control device, prior to being discharged from the construction site. Alternatively, sediment may be removed by settling in place or by dewatering into a sump pit, filter bag or comparable practice. Ground water dewatering which does not contain sediment or other pollutants is not required to be treated prior to discharge. However, care must be taken when discharging ground water to ensure that it does not become pollutant laden by traversing over disturbed soils or other pollutant sources.
- c. PAGE S-02221-8: Add Paragraph 3.5.B.7.: Where construction activities are to occur on sites with contamination from previous activities, operators must be aware that concentrations of materials that meet other criteria (e.g., is not considered a Hazardous Waste, meeting VAP standards, etc.) may still result in storm water discharges in excess of Ohio Water Quality Standards. Such discharges are not authorized by Ohio EPA Permit No. OHC000004. Appropriate BMPs include, but are not limited to:
 - The use of berms, trenches, and pits to collect contaminated runoff and prevent discharges;
 - Pumping runoff into a sanitary sewer (where and when available capacity exists and with prior approval of MCES; available capacity in the existing Miami Shores Lift Station is never more than approximately 800 – 1,000 gpm, and no available capacity exists during wet weather and/or high groundwater levels) or into a container for transport to an appropriate treatment/disposal facility; and
 - Covering areas of contamination with tarps or other methods that prevent storm water from coming into contact with the material. Contractor shall consult with Ohio EPA Division of Surface Water prior to seeking permit coverage.

**MIAMI SHORES SANITARY SEWER IMPROVEMENTS
PROJECT NO. 130006-15**

BIDDING INFORMATION AND CLARIFICATIONS

1. Due to the anticipated groundwater levels and to manage the risk of potentially impacting the natural migration of existing groundwater contamination, pumping of groundwater in the project area shall be kept to the minimum required to complete the work. Contractor's excavation plan (as required by Specification Section S-02221.1.3.A) and dewatering plan (as required by Section S-02221.3.5.B.4) shall be developed to minimize dewatering and in accordance with Section S-02221.3.5. During the period(s) when uninterrupted, 24-hours-per-day, 7-days-per-week construction activity is ongoing as specified in Section S-02221.3.5.A.8, the requirements regarding performance of work during Montgomery County Environmental Services regular working hours, as specified in Section 01000.1.02 (and further defined in Construction Inspection Note 6, on Sheet G-02 of the Drawings), will be waived—i.e., no charges for services of the Resident Project Representative, the Engineer, or other overtime inspection services, will be assessed to the Contractor. At all other times, the specified requirements regarding performance of work during Montgomery County Environmental Services regular working hours will be strictly enforced—subject to clarification of inspection requirements discussed under Item 5 on page 7 of the Pre-Bid Meeting Minutes.