AECOM
9 Jonathan Bourne Drive
Pocasset, MA 02559
www.aecom.com

508.833.6950 tel
508.833.6951 fax

Memorandum

To:	George Meservey, Director of Planning & Community Development
CC	Joseph Cerutti, MassDEP, UIC Program Coordinator Betsy Shreve, AICP, AECOM Project Director James Begley, LSP, MT Environmental AECOM PRB Team
Subject	**Town of Orleans, MA** **Water Quality and Wastewater Planning** **Eldredge Park Permeable Reactive Barrier Demonstration Project** **PRB Extension**
Project Number	60476644
From	Thomas Parece, P.E., AECOM Project Manager
Date	December 11, 2018

1. Introduction

The original Eldredge Parkway Demonstration Test Permeable Reactive Barrier (PRB) was installed in the parking lot area southwest of the Nauset Middle School in November 2016. Demonstration Test initial and ongoing activities are summarized in *Technical Memorandum for Eldredge Park Permeable Reactive Barriers Demonstration Overview of Baseline Sampling, Injection Activities and Post-Injection Groundwater Monitoring – Final* (AECOM, March 2017) and subsequent quarterly reports. Plans for the Demonstration Test were reviewed by the Massachusetts Department of Environmental Protection (MassDEP) and MassDEP issued Underground Injection Control (UIC) Registration ID#MAS41A224209-5B6 for the Demonstration Test in September 2016.

This memorandum has been prepared to provide details of a modification to the PRB completed in June 2018, extending the PRB groundwater treatment line approximately 100 feet to the north as shown in the attached site plan (Figure 1). A close-up detail is shown in Figure 2.

Baseline groundwater monitoring was completed before the initial PRB installation. Groundwater monitoring since initial installation has included full sampling events in 2017 (January, February, June and September) and 2018 (January and April). Groundwater flow at the location has proven to be complex with flow in more than one direction near the PRB. Flow through the PRB treatment line is critical to performance and it was determined through groundwater investigation that a portion of the flow through the field of downgradient monitoring wells was not coming through the PRB. The original section of PRB was designed for flow from the southwest through the PRB to the northeast. A localized variation in groundwater flow with flow from a westerly to northwesterly direction was identified north of the PRB. This area to the north also appears to be affected by a high concentration source of nitrate in groundwater. Additional monitoring wells were installed in April 2018 to refine the interpretation of groundwater flow. To optimize the Demonstration Test, a decision was made to extend the PRB to the north to intercept groundwater flow from the west moving toward the field of PRB monitoring wells. Notice was provided to the MassDEP and MassDEP approved the proposed PRB extension injections under the existing UIC registration #MAS41A224209-5B6 in April 2018.

Modification of the PRB is consistent with the Adaptive Management Approach to optimize treatment and obtain additional data to evaluate the effectiveness of PRB technology to reduce nitrogen loading to downgradient estuaries.

2. Groundwater Assessment to Evaluate PRB Extension and PRB Layout

A. Monitoring Well Installation

Additional monitoring wells were installed in April 2018 to refine the interpretation of groundwater flow and distribution of nitrate in groundwater and provide additional monitoring points for the new PRB line. The following new monitoring wells were installed as part of the investigation:

- MW-1R, - replacement well for the damaged MW-1;
- MW-BX2A, MW-BX2B, MW-BX2C – triplet upgradient monitoring location;
- MW-BN1A, MW-BN1B, MW-BN1C - triplet monitoring location to the north;
- MB-BN2C – monitoring well for groundwater elevation north of the parking lot;
- MW-BM050A, MW-BM050B, MW-BM050C - triplet downgradient monitoring location; and
- MW-BC4A, MW-BC4B, MW-BC4C - triplet downgradient monitoring location.

Monitoring well construction details are included in Table 1, groundwater elevations are included in Table 2, and baseline groundwater sample results for new monitoring wells collected in May 2018 are included in Table 3.

B. Investigation Conclusions

The investigation confirmed the prevalence of groundwater flow from the west carrying high concentrations of nitrate in the area north of the original PRB line and supported the orientation of a new PRB line aligned from approximately north to south. The grassy area adjacent to the parking lot was selected for PRB installation to minimize impacts to the property. Several previously existing monitoring wells and several of the new monitoring wells installed in April 2018 are downgradient of the new PRB extension line and testing will provide additional data for PRB evaluation.

3. Implementation of Demonstration Test PRB Extension

A. Implementation

The PRB extension injections were completed during the week of June 18, 2018.

B. Demonstration Test Extension Layout

The PRB Demonstration Test extension line was oriented to intercept flow coming from the west, north of the existing PRB, and then flowing through part of the existing field of groundwater monitoring wells. The PRB extension included injection of emulsified vegetable oil (EVO) along a line approximately 110 feet long with 20 injection points in the grass area adjacent to the Middle School parking lot as shown on Figure 1 and Figure 2. The south end of the injection line overlapped the previous PRB injection line, oriented northwest to southeast, installed in November 2016. The new injection points were oriented south to north in two parallel offset rows identified as N-21 through N-30 on the west and N-31 through N-40 to the east, with spacing of approximately 10 feet between points along each line and between rows. A vertical treatment injection interval was completed from the bottom up in 8-foot lifts, from 72 feet below ground surface to the approximate top of the groundwater table at 32 feet below ground surface. The injections were all completed in saturated soils below the water table. The completed PRB line including the extension intercepts groundwater flow along a line approximately 200 feet in length, formed in a wide-angle V pattern to intercept groundwater flow from both the southwest and west.

C. PRB Demonstration Test Substrate and System Details

As with the original injection, an EVO solution with a larger droplet size was selected so that the EVO droplets will adhere to sand grains in the formation to minimize the advection, or distribution, of EVO after injection. EVO adheres to the sandy aquifer material in the treatment zone and provides a slow release of soluble organic carbon compounds that are distributed by advection, dispersion, and diffusion in groundwater. A larger droplet size also maximizes the persistence of the carbon substrate within the PRB. Terra System's 60 percent Large Droplet Slow Release EVO for Nitrate Reduction (SRS-NR) was used. The SRS NR is a modified formulation developed so that the emulsion is "stickier" to further reduce migration after injection and increase persistence. Sodium lactate was also added to the injection solution for the extension to supply additional quick release carbon substrate to jumpstart treatment. Sodium bicarbonate was also again added as a pH buffer with the EVO in order to establish more favorable pH conditions for denitrifying bacteria. The 60 percent EVO solution was delivered to the site and additives were mixed with water making an approximately 14 percent EVO solution for injection. Representative PRB design parameters are summarized below:

Summary of Design Parameters for
Permeable Reactive Barrier Demonstration Test Extension

Parameter	Demonstration Test Site
Area Description	Eldredge Park edge of the soccer field by the track
Depth to Ground Water	Approximately 30 to 34 feet below grade
Demonstration Test Extension PRB Injection Length	110 feet
Injection Interval	32 to 70 feet below grade
Injection Point Spacing	10-foot 2-row grid (5-6 foot plus radius of influence)
Injection Points	20
Injection Pore Volume	12 percent (assumed effective porosity of 25 percent)
Total Injection Volume (gal)	14,800
Injection Volume Per Point (gal)	~750
Injection Flow Rate (GPM)	~4.62
60% EVO (gal)	3,696
Total Lactate (gal)	225
Total Diluted EVO (gal)	14,800
Final EVO Dilution	14.2 percent

D. Substrate Delivery Methodology and Field Injection Activities

ISOTEC, Inc. (ISOTEC) performed the injections with oversight by the AECOM PRB Team. ISOTEC also performed the November 2016 injections and used a similar methodology. Injection of carbon substrate was completed directly through driven rods with 8-foot steel screens at the end. The screen was constructed with thin laser cut injection holes for radial delivery.

The system for preparation, mixing, and injection of substrate solutions consisted of mixing tanks, mixers, pumps, piping, meters, valves, and fittings. Injection batches were prepared in 300-gallon plastic tanks by adding appropriate quantities of water to achieve the selected dilution concentration. Mobile above-ground pumps and hoses were used to convey mixed EVO directly to the injection points. Flow totalizers, pressure gauges, and shut-off valves were used to monitor injection pressure, flow rates, and total volume added to each injection interval at each injection point. A summary of information from field logs with a record the solution composition, volume of solution delivered to each injection interval at injection point, length of time required for injection, and the injection pressures was prepared by ISOTEC and is included in Appendix A. Pictures of field activities are included in Appendix B.

At each injection point, a direct-push drill rig advanced injection tooling to a targeted depth of 72 feet below grade. Approximately 150 gallons of the diluted EVO solution was injected per 8-foot interval. The injection rods were then lifted 8 feet to the subsequent injection target depth and the process repeated. This method of direct-push injection is referred to as bottom-up injection. Injections were completed at up to three injection points simultaneously. To minimize mounding and improve delivery, injections were not performed at adjacent points at the same time. Electricity to power remediation equipment was provided by a gasoline-powered generator. Potable water for batching and injection was stored onsite in a rental water tanker.

Injection monitoring included observations of groundwater elevations and the collection of water samples for visual observation at nearby monitoring wells during injection. Groundwater mounding and infiltration of EVO, visible as a milky solution, were noted within monitoring well MW-BX1B located within the injection area during injection to nearby points. Two soil borings were also completed for observation and collection of soil samples.

- Soil Boring SB-01 was completed through the west side of the parking lot to the south of MW-B1010C on June 20, 2018, prior to any new nearby injections, and within the area where EVO was injected during the November 2016 PRB injection.
- Soil Boring SB-02 was completed within the injection area approximately 6-feet from the nearest injection point near the northern end of the new section of PRB on June 22, 2018 after all new injections were completed.

Soil samples from both borings were collected from 40 to 45 feet below ground surface for visual observation and laboratory analyses of oil and grease, total organic carbon, moisture content, and grain size. The results of laboratory analyses are included in Appendix C. Visual observation and grain size analyses indicated the samples were composed of silty sand. No odor or visual staining were observed in the samples from SB-1 or SB-2. Laboratory analyses indicated a detectable concentration of total organic carbon (120 mg/kg) in the soil sample from SB-2 collected after the new PRB injection. Total organic carbon was not detected in the sample from the 2016 injection area (<106 mg/kg). These sample results can also be compared to two background soil samples collected from the soil boring for new monitoring well MW-1050A installed in April 2016. The total organic carbon analyses for the samples from the soil boring for monitoring well MW-1050A indicated concentrations <85 mg/kg and <73 mg/kg.

4. Permitting

The EPA Underground Injection Control (UIC) Program is responsible for regulating the construction, operation, permitting, and closure of injection wells that place fluids underground for storage and disposal. The UIC Program requirements were developed by EPA and designed to be adopted by states. The Massachusetts Department of Environmental Protection (MassDEP) UIC Program is defined in 310 CMR 27.00: Underground Injection Control Regulations and details the regulation of injection of fluids within Massachusetts.

To implement the Demonstration Test with the initial injection in November 2016, a UIC permit application (MassDEP form BRPWS 06) was filed with MassDEP under the category "Aquifer Remediation." Similar injections of carbon substrates to enhance biodegradation of chemicals in groundwater have been commonly implemented in Massachusetts. Many of these sites are exempt from the UIC registration process if the injections are conducted for waste site cleanup in accordance with the Massachusetts Contingency Plan (MCP, 310 CMR 40.0000) or similar federal statutes. In implementing the Demonstration Test all initial injections associated with the PRB complied with the requirements of the Massachusetts UIC regulations and the MCP requirements, including all required monitoring. MassDEP issued UIC Registration ID#MAS41A224209-5B6 for the Demonstration Test in September 2016. Plans for the extension were provided to the MassDEP and MassDEP approved the PRB extension injection event under the existing UIC registration #MAS41A224209-5B6 in April 2018.

5. Summary

A modification of the PRB line was necessary to adapt to existing conditions and improve the demonstration. This modification required the installation of additional monitoring wells to verify flow directions north of the original section of PRB and establish the additional PRB injection line. The monitoring wells were necessary to assess groundwater contours for orientation of the new section of PRB, perpendicular to the direction of groundwater flow in the target area to the extent possible. The PRB was successfully installed starting near the west end and overlapping the current PRB injection zone and extending to the north approximately 110 feet, along the edge of the field and parking lot areas. The modification of the PRB was coordinated with Nauset Public Schools Superintendent's office and implemented in June 2018. The next PRB full sampling round was scheduled and completed in September 2018. Results of the September 2018 analyses are included in Table 3 and interpretation of the September 2018 data will be included in the upcoming next quarterly report.

6. References

AECOM – Technical Memorandum Final for Preliminary Engineering Work Plan for Permeable Reactive Barriers. Submitted to Town of Orleans, MA. May 19, 2016.

AECOM - Technical Memorandum for Eldredge Park Permeable Reactive Barrier Demonstration Overview of Baseline Sampling, Injection Activities and Post-Injection Groundwater Monitoring – Final. March 1, 2017.

AECOM - Technical Memorandum for Eldredge Park Permeable Reactive Barrier Demonstration Project –Groundwater Monitoring Quarterly Report – Final. June 25, 2017.

AECOM - Technical Memorandum for Eldredge Park Permeable Reactive Barriers Demonstration Project – Groundwater Monitoring Quarterly Report – Final. February 2017.

Technical Memorandum for Eldredge Park Permeable Reactive Barrier Demonstration Project – Q-3 September 2017 Groundwater Monitoring Quarterly Report – Final. March 2018.

Cape Cod Commission - Cape Code Regional Wastewater Management Plan Technology Assessment – Conventional Infrastructure, March 2013.

Cape Cod Commission - Cape Cod Area Wide Water Quality Management Plan Update, June 2015.

Interstate Technology & Regulatory Council (ITRC) - Permeable Reactive Barrier: Technology Update (PRB-5), November 2011.

This Page Intentionally Left Blank.

Tables

This Page Intentionally Left Blank.

Table 1 Orleans Monitoring Well Construction Details

Well ID	Surface Elevation (ft)	TOC Elevation (ft)	Total Well Depth (ft bgs)	Screen Beginning Depth (ft bgs)	Screen End Depth (ft bgs)	Top Screen Elevation (ft)	Bottom Screen Elevation (ft)	Mid-Screen Elevation (ft)	Screen Length (ft)	Inst. Date	Location
MW-12A	45.6	45.57	80.0	70.0	80.0	-24.40	-34.40	-29.40	10.0	October 2016	Eldredge Park
MW-12B	45.6	45.58	65.0	55.0	65.0	-9.40	-19.40	-14.40	10.0	October 2016	Eldredge Park
MW-12C (Repaired)	45.6	45.36								April 2018	Eldredge Park
MW-BU1A	43.7	43.48	80.0	70.0	80.0	-26.30	-36.30	-31.30	10.0	September 2016	Eldredge Park
MW-BU1C	44.0	43.65	50.0	40.0	50.0	4.00	-6.00	-1.00	10.0	September 2016	Eldredge Park
MW-BU2A	45.1	44.56	80.0	70.0	80.0	-24.90	-34.90	-29.90	10.0	October 2016	Eldredge Park
MW-BU2B	45.1	44.70	65.0	55.0	65.0	-9.90	-19.90	-14.90	10.0	October 2016	Eldredge Park
MW-BU2C	45.1	44.68	50.0	40.0	50.0	5.10	-4.90	0.10	10.0	October 2016	Eldredge Park
MW-BC1C	42.5	42.50	50.0	40.0	50.0	2.50	-7.50	-2.50	10.0	September 2016	Eldredge Park
MW-BC2C	43.81	43.5	55.0	45.0	55.0	-1.48	-11.48	-6.48	10.0	October 2016	Eldredge Park
MW-B1010C	44.9	44.46	55.0	45.0	55.0	-0.10	-10.10	-5.10	10.0	October 2016	Eldredge Park
MW-B1020B	44.6	44.18	65.0	55.0	65.0	-10.40	-20.40	-15.40	10.0	October 2016	Eldredge Park
MW-B1020C	44.5	44.10	50.0	40.0	50.0	4.50	-5.50	-0.50	10.0	October 2016	Eldredge Park
MW-B1050A	43.9	43.42	80.0	70.0	80.0	-26.10	-36.10	-31.10	10.0	October 2016	Eldredge Park
MW-B1050B	43.9	43.54	65.0	55.0	65.0	-11.10	-21.10	-16.10	10.0	October 2016	Eldredge Park
MW-B1050C	44.9	43.55	50.0	40.0	50.0	4.90	-5.10	-0.10	10.0	October 2016	Eldredge Park
MW-B1075B	43.5	43.29	65.0	55.0	65.0	-11.50	-21.50	-16.50	10.0	October 2016	Eldredge Park
MW-B2010C	45.0	44.70	55.0	45.0	55.0	0.00	-10.00	-5.00	10.0	October 2016	Eldredge Park
MW-B2020B	44.9	44.50	65.0	55.0	65.0	-10.10	-20.10	-15.10	10.0	October 2016	Eldredge Park
MW-B2020C	44.8	44.45	50.0	40.0	50.0	4.80	-5.20	-0.20	10.0	October 2016	Eldredge Park
MW-B2050A	44.6	44.06	80.0	70.0	80.0	-25.40	-35.40	-30.40	10.0	October 2016	Eldredge Park
MW-B2050B	44.6	44.28	65.0	55.0	65.0	-10.40	-20.40	-15.40	10.0	October 2016	Eldredge Park
MW-B2050C	44.6	44.17	50.0	40.0	50.0	4.60	-5.40	-0.40	10.0	October 2016	Eldredge Park
MW-B2075A	44.6	44.23	75.0	65.0	75.0	-20.40	-30.40	-25.40	10.0	March 2017	Eldredge Park
MW-B2100	44.6	44.23	45.0	35.0	45.0	9.60	-0.40	4.60	10.0	September 2016	Eldredge Park
MW-BC3	44.2	43.86	65.0	55.0	65.0	-10.80	-20.80	-15.80	10.0	March 2017	Eldredge Park
MW-BX1B	45.6	45.38	65.0	55.0	65.0	-9.40	-19.40	-14.40	10.0	March 2017	Eldredge Park
MW-BX1C	45.37	45.7	50.0	40.0	50.0	5.37	-4.63	0.37	10.0	March 2017	Eldredge Park
MW-1R	44.40	47.2	45.0	35.0	45.0	9.40	-0.60	4.40	10.0	April 2018	Eldredge Park
MW-BX2A	46.40	46.1	80.0	70.0	80.0	-23.60	-33.60	-28.60	10.0	April 2018	Eldredge Park
MW-BX2B	46.40	46.1	65.0	55.0	65.0	-8.60	-18.60	-13.60	10.0	April 2018	Eldredge Park
MW-BX2C	46.47	46.0	50.0	40.0	50.0	6.47	-3.53	1.47	10.0	April 2018	Eldredge Park
MW-BN1A	44.50	44.0	80.0	70.0	80.0	-25.50	-35.50	-30.50	10.0	April 2018	Eldredge Park
MW-BN1B	44.40	43.9	65.0	55.0	65.0	-10.60	-20.60	-15.60	10.0	April 2018	Eldredge Park
MW-BN1C	44.38	44.2	50.0	40.0	50.0	4.38	-5.63	-0.63	10.0	April 2018	Eldredge Park
MB-BN2C	45.21	44.9	45.0	35.0	45.0	10.21	0.21	5.21	10.0	April 2018	Eldredge Park
MW-BM050A	44.68	44.3	80.0	70.0	80.0	-25.32	-35.32	-30.32	10.0	April 2018	Eldredge Park
MW-BM050B	44.80	44.4	65.0	55.0	65.0	-10.20	-20.20	-15.20	10.0	April 2018	Eldredge Park
MW-BM050C	44.80	44.4	50.0	40.0	50.0	4.80	-5.20	-0.20	10.0	April 2018	Eldredge Park
MW-BC4A	43.50	43.0	80.0	70.0	80.0	-26.50	-36.50	-31.50	10.0	April 2018	Eldredge Park

Table 1 Orleans Monitoring Well Construction Details

Well ID	Surface Elevation (ft)	TOC Elevation (ft)	Total Well Depth (ft bgs)	Screen Beginning Depth (ft bgs)	Screen End Depth (ft bgs)	Top Screen Elevation (ft)	Bottom Screen Elevation (ft)	Mid-Screen Elevation (ft)	Screen Length (ft)	Inst. Date	Location
MW-BC4B	43.50	43.1	65.0	55.0	65.0	-11.50	-21.50	-16.50	10.0	April 2018	Eldredge Park
MW-BC4C	43.50	43.2	50.0	40.0	50.0	3.50	-6.50	-1.50	10.0	April 2018	Eldredge Park

Notes:

N/A = Not Available

Table 2 Orleans Groundwater Elevations

Well ID	Location	Date	TOC Elevation (ft)	Depth to Water (ft)	GW Elevation (ft)
MW-1	Eldredge Park	11/3/2016	41.31	30.10	11.21
MW-1	Eldredge Park	11/14/2016	41.31	30.20	11.11
MW-1	Eldredge Park	1/18/2017	41.31	30.43	10.88
MW-1	Eldredge Park	1/27/2017	41.31	30.25	11.06
MW-1	Eldredge Park	2/24/2017	41.31	29.50	11.81
MW-1	Eldredge Park	4/25/2017	41.31	28.17	13.14
MW-1	Eldredge Park	6/29/2017	41.31	28.37	12.94
MW-1	Eldredge Park	9/13/2017	41.31	N/A	N/A
MW-1	Eldredge Park	1/10/2018	41.31	28.15	13.16
MW-1	Eldredge Park	4/18/2018	41.31	N/A	N/A
MW-1	Eldredge Park	9/20/2018	41.31	28.65	12.66
MW-11	Eldredge Park	11/3/2016	45.14	34.20	10.94
MW-11	Eldredge Park	11/14/2016	45.14	34.20	10.94
MW-11	Eldredge Park	1/18/2017	45.14	34.42	10.72
MW-11	Eldredge Park	1/27/2017	45.14	33.31	11.83
MW-11	Eldredge Park	2/24/2017	45.14	33.87	11.27
MW-11	Eldredge Park	4/25/2017	45.14	32.84	12.30
MW-11	Eldredge Park	6/29/2017	45.14	32.82	12.32
MW-11	Eldredge Park	9/13/2017	45.14	N/A	N/A
MW-11	Eldredge Park	1/10/2018	45.14	32.89	12.25
MW-11	Eldredge Park	4/19/2018	45.14	30.30	14.84
MW-11	Eldredge Park	9/20/2018	45.14	33.95	11.19
MW-11S	Eldredge Park	11/3/2016	45.25	34.15	11.10
MW-11S	Eldredge Park	11/14/2016	45.25	34.25	11.00
MW-11S	Eldredge Park	1/18/2017	45.25	34.51	10.74
MW-11S	Eldredge Park	1/27/2017	45.25	34.36	10.89
MW-11S	Eldredge Park	2/24/2017	45.25	33.93	11.32
MW-11S	Eldredge Park	4/25/2017	45.25	32.92	12.33
MW-11S	Eldredge Park	6/29/2017	45.25	32.90	12.35
MW-11S	Eldredge Park	9/13/2017	45.25	32.95	12.30
MW-11S	Eldredge Park	1/10/2018	45.25	32.97	12.28
MW-11S	Eldredge Park	4/19/2018	45.25	30.39	14.86
MW-11S	Eldredge Park	9/20/2018	45.25	33.00	12.25
MW-12A	Eldredge Park	11/3/2016	45.57	34.40	11.17
MW-12A	Eldredge Park	11/14/2016	45.57	35.01	10.56
MW-12A	Eldredge Park	1/18/2017	45.57	34.71	10.86
MW-12A	Eldredge Park	1/27/2017	45.57	34.57	11.00
MW-12A	Eldredge Park	2/23/2017	45.57	34.16	11.41
MW-12A	Eldredge Park	4/25/2017	45.57	33.85	11.72
MW-12A	Eldredge Park	6/29/2017	45.57	33.17	12.40
MW-12A	Eldredge Park	9/12/2017	45.57	33.17	12.40
MW-12A	Eldredge Park	1/8/2018	45.57	33.19	12.38
MW-12A	Eldredge Park	4/18/2018	45.57	30.77	14.80
MW-12A	Eldredge Park	9/19/2018	45.57	33.29	12.28

Table 2 Orleans Groundwater Elevations

Well ID	Location	Date	TOC Elevation (ft)	Depth to Water (ft)	GW Elevation (ft)
MW-12B	Eldredge Park	11/3/2016	45.58	34.50	11.08
MW-12B	Eldredge Park	11/14/2016	45.58	34.90	10.68
MW-12B	Eldredge Park	1/18/2017	45.58	34.79	10.79
MW-12B	Eldredge Park	1/27/2017	45.58	34.64	10.94
MW-12B	Eldredge Park	2/23/2017	45.58	34.24	11.34
MW-12B	Eldredge Park	4/25/2017	45.58	33.70	11.88
MW-12B	Eldredge Park	6/29/2017	45.58	33.21	12.37
MW-12B	Eldredge Park	9/12/2017	45.58	33.12	12.46
MW-12B	Eldredge Park	1/8/2018	45.58	33.30	12.28
MW-12B	Eldredge Park	4/18/2018	45.58	30.80	14.78
MW-12B	Eldredge Park	9/19/2018	45.58	33.35	12.23
MW-12C (Existing)	Eldredge Park	11/3/2016	46.61	36.27	10.34
MW-12C (Existing)	Eldredge Park	11/14/2016	46.61	35.99	10.62
MW-12C (Existing)	Eldredge Park	1/18/2017	46.61	36.21	10.40
MW-12C (Existing)	Eldredge Park	1/27/2017	46.61	36.06	10.55
MW-12C (Existing)[1]	Eldredge Park	2/23/2017	46.61	36.30	10.31
MW-12C (Existing)[1]	Eldredge Park	4/25/2017	46.61	34.95	11.66
MW-12C (Existing)[1]	Eldredge Park	6/29/2017	46.61	34.79	11.82
MW-12C (Existing)[1]	Eldredge Park	9/13/2017	46.61	13.00	33.61
MW-12C (Existing)[1]	Eldredge Park	1/8/2018	46.61	26.50	20.11
MW-12C (Existing)[1]	Eldredge Park	4/18/2018	46.61	N/A	N/A
MW-12C (Repaired)	Eldredge Park	9/19/2018	45.36	33.31	12.05
MW-2	Eldredge Park	11/3/2016	44.82	33.65	11.17
MW-2	Eldredge Park	11/14/2016	44.82	33.83	10.99
MW-2	Eldredge Park	1/18/2017	44.82	34.03	10.79
MW-2	Eldredge Park	1/27/2017	44.82	33.91	10.91
MW-2	Eldredge Park	2/24/2017	44.82	33.43	11.39
MW-2	Eldredge Park	4/25/2017	44.82	32.68	12.14
MW-2	Eldredge Park	6/29/2017	44.82	32.54	12.28
MW-2	Eldredge Park	9/13/2017	44.82	32.15	12.67
MW-2	Eldredge Park	1/10/2018	44.82	32.55	12.27
MW-2	Eldredge Park	4/19/2018	44.82	30.07	14.75
MW-2	Eldredge Park	9/20/2018	44.82	32.67	12.15
MW-4	Eldredge Park	11/3/2016	46.57	35.53	11.04
MW-4	Eldredge Park	11/14/2016	46.57	35.71	10.86
MW-4	Eldredge Park	1/18/2017	46.57	35.98	10.59
MW-4	Eldredge Park	1/27/2017	46.57	35.83	10.74
MW-4	Eldredge Park	2/24/2017	46.57	35.48	11.09
MW-4	Eldredge Park	4/25/2017	46.57	35.63	10.94
MW-4	Eldredge Park	6/29/2017	46.57	34.41	12.16
MW-4	Eldredge Park	9/13/2017	46.57	34.52	12.05
MW-4	Eldredge Park	1/10/2018	46.57	34.42	12.15
MW-4	Eldredge Park	4/19/2018	46.57	31.15	15.42
MW-4	Eldredge Park	9/19/2018	46.57	N/A	N/A

Table 2 Orleans Groundwater Elevations

Well ID	Location	Date	TOC Elevation (ft)	Depth to Water (ft)	GW Elevation (ft)
MW-8	Eldredge Park	October 2016	46.16	35.30	10.86
MW-8	Eldredge Park	11/14/2016	46.16	35.22	10.94
MW-8	Eldredge Park	1/18/2017	46.16	35.62	10.54
MW-8	Eldredge Park	1/27/2017	46.16	35.50	10.66
MW-8	Eldredge Park	2/24/2017	46.16	35.12	11.04
MW-8	Eldredge Park	4/25/2017	46.16	24.51	21.65
MW-8	Eldredge Park	6/29/2017	46.16	34.03	12.13
MW-8	Eldredge Park	9/13/2017	46.16	34.21	11.95
MW-8	Eldredge Park	1/10/2018	46.16	N/A	N/A
MW-8	Eldredge Park	4/19/2018	46.16	N/A	N/A
MW-8	Eldredge Park	9/19/2018	46.16	N/A	N/A
MW-B1010C	Eldredge Park	11/3/2016	44.46	33.60	10.86
MW-B1010C	Eldredge Park	11/14/2016	44.46	33.98	10.48
MW-B1010C	Eldredge Park	1/18/2017	44.46	33.97	10.49
MW-B1010C	Eldredge Park	1/27/2017	44.46	33.81	10.65
MW-B1010C	Eldredge Park	2/23/2017	44.46	33.25	11.21
MW-B1010C	Eldredge Park	4/25/2017	44.46	32.53	11.93
MW-B1010C	Eldredge Park	6/29/2017	44.46	32.15	12.31
MW-B1010C	Eldredge Park	9/12/2017	44.46	32.13	12.33
MW-B1010C	Eldredge Park	1/9/2018	44.46	32.18	12.28
MW-B1010C	Eldredge Park	4/18/2018	44.46	27.37	17.09
MW-B1010C	Eldredge Park	9/19/2018	44.46	32.32	12.14
MW-B1020B	Eldredge Park	11/3/2016	44.18	33.42	10.76
MW-B1020B	Eldredge Park	11/14/2016	44.18	33.68	10.50
MW-B1020B	Eldredge Park	1/18/2017	44.18	33.81	10.37
MW-B1020B	Eldredge Park	1/27/2017	44.18	33.66	10.52
MW-B1020B	Eldredge Park	2/23/2017	44.18	33.18	11.00
MW-B1020B	Eldredge Park	4/25/2017	44.18	32.60	11.58
MW-B1020B	Eldredge Park	6/29/2017	44.18	32.14	12.04
MW-B1020B	Eldredge Park	9/12/2017	44.18	32.01	12.17
MW-B1020B	Eldredge Park	1/9/2018	44.18	N/A	N/A
MW-B1020B	Eldredge Park	4/18/2018	44.18	29.63	14.55
MW-B1020B	Eldredge Park	9/19/2018	44.18	32.39	11.79
MW-B1020C	Eldredge Park	11/3/2016	44.10	33.16	10.94
MW-B1020C	Eldredge Park	11/14/2016	44.10	33.32	10.78
MW-B1020C	Eldredge Park	1/18/2017	44.10	33.53	10.57
MW-B1020C	Eldredge Park	1/27/2017	44.10	33.32	10.78
MW-B1020C	Eldredge Park	2/23/2017	44.10	32.80	11.30
MW-B1020C	Eldredge Park	4/25/2017	44.10	32.10	12.00
MW-B1020C	Eldredge Park	6/29/2017	44.10	31.71	12.39
MW-B1020C	Eldredge Park	9/12/2017	44.10	31.74	12.36
MW-B1020C	Eldredge Park	1/8/2018	44.10	31.74	12.36
MW-B1020C	Eldredge Park	4/18/2018	44.10	28.90	15.20
MW-B1020C	Eldredge Park	9/19/2018	44.10	31.93	12.17

Table 2 Orleans Groundwater Elevations

Well ID	Location	Date	TOC Elevation (ft)	Depth to Water (ft)	GW Elevation (ft)
MW-B1050A	Eldredge Park	11/3/2016	43.42	32.84	10.58
MW-B1050A	Eldredge Park	11/14/2016	43.42	32.92	10.50
MW-B1050A	Eldredge Park	1/18/2017	43.42	32.91	10.51
MW-B1050A	Eldredge Park	1/27/2017	43.42	32.88	10.54
MW-B1050A	Eldredge Park	2/23/2017	43.42	32.54	10.88
MW-B1050A	Eldredge Park	4/25/2017	43.42	31.28	12.14
MW-B1050A	Eldredge Park	6/29/2017	43.42	31.42	12.00
MW-B1050A	Eldredge Park	9/12/2017	43.42	31.45	11.97
MW-B1050A	Eldredge Park	1/9/2018	43.42	31.46	11.96
MW-B1050A	Eldredge Park	4/18/2018	43.42	28.74	14.68
MW-B1050A	Eldredge Park	9/20/2018	43.42	31.68	11.74
MW-B1050B	Eldredge Park	11/3/2016	43.54	32.65	10.89
MW-B1050B	Eldredge Park	11/14/2016	43.54	32.72	10.82
MW-B1050B	Eldredge Park	1/18/2017	43.54	32.98	10.56
MW-B1050B	Eldredge Park	1/27/2017	43.54	32.81	10.73
MW-B1050B	Eldredge Park	2/23/2017	43.54	32.28	11.26
MW-B1050B	Eldredge Park	4/25/2017	43.54	31.45	12.09
MW-B1050B	Eldredge Park	6/29/2017	43.54	31.21	12.33
MW-B1050B	Eldredge Park	9/12/2017	43.54	31.19	12.35
MW-B1050B	Eldredge Park	1/9/2018	43.54	31.18	12.36
MW-B1050B	Eldredge Park	4/18/2018	43.54	28.35	15.19
MW-B1050B	Eldredge Park	9/20/2018	43.54	31.41	12.13
MW-B1050C	Eldredge Park	11/3/2016	43.55	32.80	10.75
MW-B1050C	Eldredge Park	11/14/2016	43.55	32.80	10.75
MW-B1050C	Eldredge Park	1/18/2017	43.55	33.02	10.53
MW-B1050C	Eldredge Park	1/27/2017	43.55	32.96	10.59
MW-B1050C	Eldredge Park	2/23/2017	43.55	32.40	11.15
MW-B1050C	Eldredge Park	4/25/2017	43.55	31.52	12.03
MW-B1050C	Eldredge Park	6/29/2017	43.55	31.21	12.34
MW-B1050C	Eldredge Park	9/12/2017	43.55	31.22	12.33
MW-B1050C	Eldredge Park	1/9/2018	43.55	31.36	12.19
MW-B1050C	Eldredge Park	4/18/2018	43.55	28.52	15.03
MW-B1050C	Eldredge Park	9/20/2018	43.55	31.55	12.00
MW-B1075B	Eldredge Park	11/3/2016	43.29	32.55	10.74
MW-B1075B	Eldredge Park	11/14/2016	43.29	32.57	10.72
MW-B1075B	Eldredge Park	1/18/2017	43.29	32.78	10.51
MW-B1075B	Eldredge Park	1/27/2017	43.29	32.62	10.67
MW-B1075B	Eldredge Park	2/23/2017	43.29	32.10	11.19
MW-B1075B	Eldredge Park	4/25/2017	43.29	31.22	12.07
MW-B1075B	Eldredge Park	6/29/2017	43.29	30.98	12.31
MW-B1075B	Eldredge Park	9/13/2017	43.29	30.93	12.36
MW-B1075B	Eldredge Park	1/9/2018	43.29	31.15	12.14
MW-B1075B	Eldredge Park	4/18/2018	43.29	29.25	14.04
MW-B1075B	Eldredge Park	9/20/2018	43.29	31.26	12.03

Table 2 Orleans Groundwater Elevations

Well ID	Location	Date	TOC Elevation (ft)	Depth to Water (ft)	GW Elevation (ft)
MW-B2010C	Eldredge Park	11/3/2016	44.70	33.95	10.75
MW-B2010C	Eldredge Park	11/14/2016	44.70	34.10	10.60
MW-B2010C	Eldredge Park	1/18/2017	44.70	34.41	10.29
MW-B2010C	Eldredge Park	1/27/2017	44.70	34.21	10.49
MW-B2010C	Eldredge Park	2/24/2017	44.70	33.77	10.93
MW-B2010C	Eldredge Park	4/25/2017	44.70	33.00	11.70
MW-B2010C	Eldredge Park	6/29/2017	44.70	32.67	12.03
MW-B2010C	Eldredge Park	9/13/2017	44.70	32.52	12.18
MW-B2010C	Eldredge Park	1/10/2018	44.70	32.66	12.04
MW-B2010C	Eldredge Park	4/19/2018	44.70	30.28	14.42
MW-B2010C	Eldredge Park	9/19/2018	44.70	32.93	11.77
MW-B2020B	Eldredge Park	11/3/2016	44.50	33.90	10.60
MW-B2020B	Eldredge Park	11/14/2016	44.50	33.90	10.60
MW-B2020B	Eldredge Park	1/18/2017	44.50	34.15	10.35
MW-B2020B	Eldredge Park	1/27/2017	44.50	34.03	10.47
MW-B2020B	Eldredge Park	2/24/2017	44.50	33.50	11.00
MW-B2020B	Eldredge Park	4/25/2017	44.50	32.88	11.62
MW-B2020B	Eldredge Park	6/29/2017	44.50	32.45	12.05
MW-B2020B	Eldredge Park	9/13/2017	44.50	32.32	12.18
MW-B2020B	Eldredge Park	1/9/2018	44.50	32.58	11.92
MW-B2020B	Eldredge Park	4/19/2018	44.50	29.98	14.52
MW-B2020B	Eldredge Park	9/19/2018	44.50	32.64	11.86
MW-B2020C	Eldredge Park	11/3/2016	44.45	33.80	10.65
MW-B2020C	Eldredge Park	11/14/2016	44.45	33.98	10.47
MW-B2020C	Eldredge Park	1/18/2017	44.45	34.22	10.23
MW-B2020C	Eldredge Park	1/27/2017	44.45	34.07	10.38
MW-B2020C	Eldredge Park	2/24/2017	44.45	33.55	10.90
MW-B2020C	Eldredge Park	4/25/2017	44.45	32.90	11.55
MW-B2020C	Eldredge Park	6/29/2017	44.45	32.43	12.02
MW-B2020C	Eldredge Park	9/13/2017	44.45	32.23	12.22
MW-B2020C	Eldredge Park	1/9/2018	44.45	32.72	11.73
MW-B2020C	Eldredge Park	4/19/2018	44.45	30.01	14.44
MW-B2020C	Eldredge Park	9/19/2018	44.45	32.63	11.82
MW-B2050A	Eldredge Park	11/3/2016	44.06	33.41	10.65
MW-B2050A	Eldredge Park	11/14/2016	44.06	33.60	10.46
MW-B2050A	Eldredge Park	1/18/2017	44.06	33.88	10.18
MW-B2050A	Eldredge Park	1/27/2017	44.06	33.64	10.42
MW-B2050A	Eldredge Park	2/24/2017	44.06	33.04	11.02
MW-B2050A	Eldredge Park	4/25/2017	44.06	32.68	11.38
MW-B2050A	Eldredge Park	6/29/2017	44.06	32.12	11.94
MW-B2050A	Eldredge Park	9/13/2017	44.06	31.98	12.08
MW-B2050A	Eldredge Park	1/9/2018	44.06	32.23	11.83
MW-B2050A	Eldredge Park	4/19/2018	44.06	29.53	14.53
MW-B2050A	Eldredge Park	9/19/2018	44.06	32.35	11.71

Table 2 Orleans Groundwater Elevations

Well ID	Location	Date	TOC Elevation (ft)	Depth to Water (ft)	GW Elevation (ft)
MW-B2050B	Eldredge Park	11/3/2016	44.28	33.60	10.68
MW-B2050B	Eldredge Park	11/14/2016	44.28	33.73	10.55
MW-B2050B	Eldredge Park	1/18/2017	44.28	34.00	10.28
MW-B2050B	Eldredge Park	1/27/2017	44.28	33.84	10.44
MW-B2050B	Eldredge Park	2/24/2017	44.28	33.32	10.96
MW-B2050B	Eldredge Park	4/25/2017	44.28	32.63	11.65
MW-B2050B	Eldredge Park	6/29/2017	44.28	32.20	12.08
MW-B2050B	Eldredge Park	9/13/2017	44.28	32.01	12.27
MW-B2050B	Eldredge Park	1/9/2018	44.28	32.42	11.86
MW-B2050B	Eldredge Park	4/19/2018	44.28	29.70	14.58
MW-B2050B	Eldredge Park	9/19/2018	44.28	32.40	11.88
MW-B2050C	Eldredge Park	11/3/2016	44.17	33.35	10.82
MW-B2050C	Eldredge Park	11/14/2016	44.17	33.51	10.66
MW-B2050C	Eldredge Park	1/18/2017	44.17	33.90	10.27
MW-B2050C	Eldredge Park	1/27/2017	44.17	33.87	10.30
MW-B2050C	Eldredge Park	2/24/2017	44.17	33.07	11.10
MW-B2050C	Eldredge Park	4/25/2017	44.17	32.31	11.86
MW-B2050C	Eldredge Park	6/29/2017	44.17	31.93	12.24
MW-B2050C	Eldredge Park	9/13/2017	44.17	32.07	12.10
MW-B2050C	Eldredge Park	1/9/2018	44.17	32.11	12.06
MW-B2050C	Eldredge Park	4/19/2018	44.17	27.61	16.56
MW-B2050C	Eldredge Park	9/19/2018	44.17	32.17	12.00
MW-B2075A	Eldredge Park	4/25/2017	44.23	32.40	11.83
MW-B2075A	Eldredge Park	6/29/2017	44.23	31.97	12.26
MW-B2075A	Eldredge Park	9/12/2017	44.23	31.85	12.38
MW-B2075A	Eldredge Park	1/10/2018	44.23	32.30	11.93
MW-B2075A	Eldredge Park	4/19/2018	44.23	29.44	14.79
MW-B2075A	Eldredge Park	9/20/2018	44.23	32.40	11.83
MW-B2100	Eldredge Park	11/3/2016	44.23	33.50	10.73
MW-B2100	Eldredge Park	11/14/2016	44.23	33.65	10.58
MW-B2100	Eldredge Park	1/18/2017	44.23	33.87	10.36
MW-B2100	Eldredge Park	1/27/2017	44.23	33.66	10.57
MW-B2100	Eldredge Park	2/24/2017	44.23	33.10	11.13
MW-B2100	Eldredge Park	4/25/2017	44.23	32.38	11.85
MW-B2100	Eldredge Park	6/29/2017	44.23	32.01	12.22
MW-B2100	Eldredge Park	9/12/2017	44.23	31.89	12.34
MW-B2100	Eldredge Park	1/10/2018	44.23	32.29	11.94
MW-B2100	Eldredge Park	4/19/2018	44.23	30.34	13.89
MW-B2100	Eldredge Park	9/20/2018	44.23	32.36	11.87
MW-BC1C	Eldredge Park	11/3/2016	42.50	31.36	11.14
MW-BC1C	Eldredge Park	11/14/2016	42.50	31.87	10.63
MW-BC1C	Eldredge Park	1/18/2017	42.50	31.81	10.69
MW-BC1C	Eldredge Park	1/27/2017	42.50	31.65	10.85
MW-BC1C	Eldredge Park	2/24/2017	42.50	31.14	11.36
MW-BC1C	Eldredge Park	4/25/2017	42.50	30.43	12.07
MW-BC1C	Eldredge Park	6/29/2017	42.50	30.07	12.43
MW-BC1C	Eldredge Park	9/12/2017	42.50	N/A	N/A
MW-BC1C	Eldredge Park	1/10/2018	42.50	N/A	N/A
MW-BC1C	Eldredge Park	4/19/2018	42.50	27.61	14.89
MW-BC1C	Eldredge Park	9/20/2018	42.50	30.31	12.19

Table 2 Orleans Groundwater Elevations

Well ID	Location	Date	TOC Elevation (ft)	Depth to Water (ft)	GW Elevation (ft)
MW-BC2C	Eldredge Park	6/29/2017	43.52	31.61	11.91
MW-BC2C	Eldredge Park	11/3/2016	43.52	32.84	10.68
MW-BC2C	Eldredge Park	11/14/2016	43.52	N/A	N/A
MW-BC2C	Eldredge Park	1/18/2017	43.52	33.22	10.30
MW-BC2C	Eldredge Park	1/27/2017	43.52	33.08	10.44
MW-BC2C	Eldredge Park	2/24/2017	43.52	32.63	10.89
MW-BC2C	Eldredge Park	4/25/2017	43.52	31.93	11.59
MW-BC2C	Eldredge Park	9/13/2017	43.52	31.26	12.26
MW-BC2C	Eldredge Park	1/10/2018	43.52	31.70	11.82
MW-BC2C	Eldredge Park	4/19/2018	43.52	27.65	15.87
MW-BC2C	Eldredge Park	9/20/2018	43.52	32.45	11.07
MW-BC3B	Eldredge Park	4/25/2017	43.86	32.45	11.41
MW-BC3B	Eldredge Park	6/29/2017	43.86	31.90	11.96
MW-BC3B	Eldredge Park	9/12/2017	43.86	31.50	12.36
MW-BC3B	Eldredge Park	1/10/2018	43.86	32.36	11.50
MW-BC3B	Eldredge Park	4/19/2018	43.86	29.55	14.31
MW-BC3B	Eldredge Park	9/20/2018	43.86	32.47	11.39
MW-BU1A	Eldredge Park	11/3/2016	43.48	32.55	10.93
MW-BU1A	Eldredge Park	11/14/2016	43.48	32.44	11.04
MW-BU1A	Eldredge Park	1/18/2017	43.48	32.86	10.62
MW-BU1A	Eldredge Park	1/27/2017	43.48	32.74	10.74
MW-BU1A	Eldredge Park	2/24/2017	43.48	32.30	11.18
MW-BU1A	Eldredge Park	4/25/2017	43.48	31.75	11.73
MW-BU1A	Eldredge Park	6/29/2017	43.48	31.36	12.12
MW-BU1A	Eldredge Park	9/13/2017	43.48	31.21	12.27
MW-BU1A	Eldredge Park	1/10/2018	43.48	31.40	12.08
MW-BU1A	Eldredge Park	4/18/2018	43.48	28.83	14.65
MW-BU1A	Eldredge Park	9/20/2018	43.48	31.45	12.03
MW-BU1C	Eldredge Park	11/3/2016	43.65	32.50	11.15
MW-BU1C	Eldredge Park	11/14/2016	43.65	N/A	N/A
MW-BU1C	Eldredge Park	1/18/2017	43.65	32.84	10.81
MW-BU1C	Eldredge Park	1/27/2017	43.65	32.72	10.93
MW-BU1C	Eldredge Park	2/24/2017	43.65	32.25	11.40
MW-BU1C	Eldredge Park	4/25/2017	43.65	31.71	11.94
MW-BU1C	Eldredge Park	6/29/2017	43.65	31.31	12.34
MW-BU1C	Eldredge Park	9/13/2017	43.65	31.03	12.62
MW-BU1C	Eldredge Park	1/10/2018	43.65	31.30	12.35
MW-BU1C	Eldredge Park	4/18/2018	43.65	28.88	14.77
MW-BU1C	Eldredge Park	9/20/2018	43.65	31.39	12.26
MW-BU2A	Eldredge Park	11/3/2016	44.56	33.90	10.66
MW-BU2A	Eldredge Park	11/14/2016	44.56	34.03	10.53
MW-BU2A	Eldredge Park	1/18/2017	44.56	34.22	10.34
MW-BU2A	Eldredge Park	1/27/2017	44.56	34.05	10.51
MW-BU2A	Eldredge Park	2/23/2017	44.56	34.62	9.94
MW-BU2A	Eldredge Park	4/25/2017	44.56	33.25	11.31
MW-BU2A	Eldredge Park	6/29/2017	44.56	32.72	11.84
MW-BU2A	Eldredge Park	9/12/2017	44.56	32.56	12.00
MW-BU2A	Eldredge Park	1/10/2018	44.56	32.75	11.81
MW-BU2A	Eldredge Park	4/18/2018	44.56	30.26	14.30
MW-BU2A	Eldredge Park	9/20/2018	44.56	32.82	11.74

Table 2 Orleans Groundwater Elevations

Well ID	Location	Date	TOC Elevation (ft)	Depth to Water (ft)	GW Elevation (ft)
MW-BU2B	Eldredge Park	11/3/2016	44.70	33.93	10.77
MW-BU2B	Eldredge Park	11/14/2016	44.70	34.07	10.63
MW-BU2B	Eldredge Park	1/18/2017	44.70	34.31	10.39
MW-BU2B	Eldredge Park	1/27/2017	44.70	34.15	10.55
MW-BU2B	Eldredge Park	2/23/2017	44.70	33.75	10.95
MW-BU2B	Eldredge Park	4/25/2017	44.70	33.10	11.60
MW-BU2B	Eldredge Park	6/29/2017	44.70	32.72	11.98
MW-BU2B	Eldredge Park	9/12/2017	44.70	32.47	12.23
MW-BU2B	Eldredge Park	1/10/2018	44.70	32.76	11.94
MW-BU2B	Eldredge Park	4/18/2018	44.70	30.26	14.44
MW-BU2B	Eldredge Park	9/20/2018	44.70	32.82	11.88
MW-BU2C	Eldredge Park	11/3/2016	44.68	33.99	10.69
MW-BU2C	Eldredge Park	11/14/2016	44.68	34.08	10.60
MW-BU2C	Eldredge Park	1/18/2017	44.68	34.30	10.38
MW-BU2C	Eldredge Park	1/27/2017	44.68	34.15	10.53
MW-BU2C	Eldredge Park	2/23/2017	44.68	34.05	10.63
MW-BU2C	Eldredge Park	4/25/2017	44.68	33.08	11.60
MW-BU2C	Eldredge Park	6/29/2017	44.68	32.64	12.04
MW-BU2C	Eldredge Park	9/12/2017	44.68	32.60	12.08
MW-BU2C	Eldredge Park	1/10/2018	44.68	32.72	11.96
MW-BU2C	Eldredge Park	1/10/2018	44.68	30.40	14.28
MW-BU2C	Eldredge Park	4/18/2018	44.68	30.40	14.28
MW-BU2C	Eldredge Park	9/20/2018	44.68	32.85	11.83
MW-BX1B	Eldredge Park	4/25/2017	45.38	33.85	11.53
MW-BX1B	Eldredge Park	6/29/2017	45.38	33.46	11.92
MW-BX1B	Eldredge Park	9/12/2017	45.38	33.43	11.95
MW-BX1B	Eldredge Park	1/8/2018	45.38	33.46	11.92
MW-BX1B	Eldredge Park	4/18/2018	45.38	31.02	14.36
MW-BX1B	Eldredge Park	9/20/2018	45.38	33.61	11.77
MW-BX1C	Eldredge Park	4/25/2017	45.37	33.29	12.08
MW-BX1C	Eldredge Park	6/29/2017	45.37	32.98	12.39
MW-BX1C	Eldredge Park	9/12/2017	45.37	32.98	12.39
MW-BX1C	Eldredge Park	1/8/2018	45.37	32.95	12.42
MW-BX1C	Eldredge Park	4/18/2018	45.37	30.10	15.27
MW-BX1C	Eldredge Park	9/20/2018	45.37	33.16	12.21
MW-BX2A	Eldredge Park	5/9/2018	46.40	31.30	15.10
MW-BX2A	Eldredge Park	9/20/2018	46.40	34.31	12.09
MW-BX2B	Eldredge Park	5/9/2018	46.40	31.14	15.26
MW-BX2B	Eldredge Park	9/20/2018	46.40	34.37	12.03
MW-BX2C	Eldredge Park	5/9/2018	46.47	31.07	15.40
MW-BX2C	Eldredge Park	9/20/2018	46.47	33.66	12.81
MW-BN1A	Eldredge Park	5/9/2018	44.50	30.08	14.42
MW-BN1A	Eldredge Park	9/20/2018	44.50	32.36	12.14
MW-BN1B	Eldredge Park	5/9/2018	44.40	29.10	15.30
MW-BN1B	Eldredge Park	9/20/2018	44.40	31.71	12.69
MW-BN1C	Eldredge Park	5/9/2018	44.38	30.34	14.04
MW-BN1C	Eldredge Park	9/20/2018	44.38	31.87	12.51
MW-BN2C	Eldredge Park	5/9/2018	45.21	30.42	14.79
MW-BN2C	Eldredge Park	9/25/2018	45.21	32.64	12.57

Table 2 Orleans Groundwater Elevations

Well ID	Location	Date	TOC Elevation (ft)	Depth to Water (ft)	GW Elevation (ft)
MW-BM050A	Eldredge Park	5/9/2018	44.68	29.89	14.79
MW-BM050A	Eldredge Park	9/20/2018	44.68	32.29	12.39
MW-BM050B	Eldredge Park	5/9/2018	44.80	29.81	14.99
MW-BM050B	Eldredge Park	9/20/2018	44.80	32.41	12.39
MW-BM050C	Eldredge Park	5/9/2018	44.80	29.78	15.02
MW-BM050C	Eldredge Park	9/20/2018	44.80	32.38	12.42
MW-BC4A	Eldredge Park	5/9/2018	43.50	29.48	14.02
MW-BC4A	Eldredge Park	9/20/2018	43.50	31.55	11.95
MW-BC4B	Eldredge Park	5/9/2018	43.50	28.30	15.20
MW-BC4B	Eldredge Park	9/20/2018	43.50	29.45	14.05
MW-BC4C	Eldredge Park	5/9/2018	43.50	29.47	14.03
MW-BC4C	Eldredge Park	9/20/2018	43.50	31.57	11.93

Notes:

N/A = Not Available

1. MW-12C (Existing) was damaged during winter 2017. Water elevations taken prior to the repair in April 2018 may be affected.

Table 3 Orleans Monitoring Well Groundwater Data Summary

Sample ID	**MW-4**[3]		**MW-8**[3]	**MW-12A**							
Top of Screen Elevation (ft)	4.50		19.70	-24.4							
Bottom of Screen Elevation (ft)	-5.50		9.70	-34.4							
Sampling Date	10/4/2016	9/25/2018	10/4/2016	11/03/2016[1]	1/5/2017	2/23/2017	6/28/2017	9/12/2017	1/8/2018	4/18/2018	9/19/2018
Type of Sample	Sample	Q6 Sample	Sample	Sample	Sample	Q1 Sample	Q2 Sample	Q3 Sample	Q4 Sample	Q5 Sample	Q6 Sample
Field Measurements											
pH (SU)	5.52	6.30	5.23	6.94	5.46	5.53	5.58	5.59	4.89	5.60	5.44
Temperature (^{o}C)	15.54	12.65	15.87	14.38	11.78	13.81	13.91	14.02	13.62	13.7	15.3
Dissolved Oxygen (DO, mg/L)	7.89	7.99	9.58	1.13	3.69	7.03	14.81	6.92	7.65	7.99	7.33
Redox Potential (ORP; mV)	57.90	92.70	135.00	70.90	197.60	183.10	173.60	146.50	288.30	162.1	192.3
Specific Conductivity (µS/cm)[c]	171.00	170.00	190.00	667.00	572.00	550.00	537.00	518.00	563.00	483.9	445.0
Turbidity (NTU)	-	2.32	-	17.70	5.50	5.31	5.13	7.68	3.58	0.52	6.20
Laboratory Analyses											
Nitrogen											
Nitrate as N (mg/L)	**2.45**	**3.51**	**9.24**	**0.783**	**0.669**	**0.849**	**0.786**	**0.794**	**0.242**	**0.676**	**0.627**
Nitrite as N (mg/L)	-	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	**0.074**	<0.01	<0.01
Ammonia (mg/L)	**0.1**	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	**0.36**	<0.1
Total Kjeldahl Nitrogen (TKN)	**0.71**	-	**1.7**	-	<0.2	**0.4**	-	-	**0.22**	**0.57**	**0.4**
Total Nitrogen (mg/L)	**3.15**	-	**10.9**	**1**	**0.669**	**1.25**	**0.79**	**1.11**	**0.533**	**1.25**	-
Anions											
Chloride (mg/L)	**27.2**	-	**18.3**	**190**	**230**	**141**	**154**	**146**	**160**	**144**	**152**
Sulfate (mg/L)	**12.8**	-	**10.1**	**10**	**16.1**	**13.4**	**12.6**	**12.3**	**12.2**	**16.1**	**11.3**
Elements											
Dissolved Iron (mg/L)	-	-	-	**0.7**	-	<0.1	<0.1	**-**	<0.1	<0.1	<0.1
Dissolved Manganese (mg/L)	-	-	-	**0.325**	-	**0.033**	<0.02	**-**	<0.02	**0.023**	<0.02
Arsenic (mg/L)	-	<0.0025	-	-	-	-	-	-	-	-	-
Boron (mg/L)	-	-	-	<0.05	-	<0.05	-	-	-	-	-
Sodium (mg/L)	-	-	-	-	-	**98.3**	-	-	-	-	-
Other											
DOC (mg/L)	<0.5	-	<0.5	**0.55**	-	<0.5	**2.16**	**0.792**	**1.7**	**1.85**	**0.729**
Methane (µg/L)	-	-	-	-	-	-	**-**	-	-	-	-
Alkalinity as CaCO3 (mg/L)	-	-	-	-	**5**	**7**	-	-	-	-	-

Notes:

NS - Not Sampled

Bold - detected above the Minimum Detection Limit

D -Duplicate

1. DO was measured in the field as DO(%) and was converted using the online tool at: http://www.hbuehrer.ch/Rechner/O2satur.html

2. MW-12C references "MW-12" that was installed as part of the Nauset Regional Middle School monitoring well network.

3. Existing wells (MW-4, MW-8, MW-12C) screen elevations were determined based on field measurement of depth to bottom of well. Actual screen depths may vary if bottom was affected by silt build-up in well.

4. MW-12C (existing) was damaged during snow removal at the site in Winter 2017. A sample was unable to be taken during subsequent events. It was repaired in April 2018.

Table 3 Orleans Monitoring Well Groundwater Data Summary

Sample ID	**MW-12B**								**MW-12C[2,3]**							**MW-BU1A**	**MW-BU1C**
Top of Screen Elevation (ft)	-9.4								8.36							-26.3	4
Bottom of Screen Elevation (ft)	-19.4								-1.64							-36.3	-6
Sampling Date	11/03/2016[1]	1/5/2017	2/23/2017	6/28/2017	9/12/2017	1/8/2018	4/18/2018	9/19/2018	10/4/2016	11/03/2016[1]	11/17/2016	1/5/2017	2/23/2017	5/9/2018	9/19/2018	10/4/2016	10/4/2016
Type of Sample	Sample	Sample	Q1 Sample	Q2 Sample	Q3 Sample	Q4 Sample	Q5 Sample	Q6 Sample	Sample	Sample	Sample	Sample	Q1 Sample[4]	D2 Baseline	Q6 Sample	Sample	Sample
Field Measurements																	
pH (SU)	6.90	5.43	5.40	5.39	5.45	4.78	5.30	5.38	4.98	6.45	5.23	5.09	NS	5.23	5.65	5.44	5.27
Temperature (^{o}C)	14.50	11.82	14.18	14.37	14.56	13.80	14.1	19.2	17.50	14.08	14.42	12.60	NS	11.10	16.18	13.75	13.95
Dissolved Oxygen (DO, mg/L)	1.05	1.16	6.39	12.40	5.51	5.67	5.45	5.41	6.93	0.83	0.68	1.61	NS	8.12	2.70	7.60	8.75
Redox Potential (ORP; mV)	20.30	212.80	263.10	225.20	170.30	275.70	186.5	195.3	167.80	246.00	279.70	205.60	NS	221.80	93.80	70.90	130.90
Specific Conductivity (µS/cm)[c]	231.00	243.00	235.00	253.00	257.00	249.00	230.2	233.0	178.00	216.00	156.00	199.00	NS	189.60	151.00	1464.00	351.00
Turbidity (NTU)	8.73	1.89	0.91	2.62	1.52	1.48	0.50	140.00	-	0.60	2.58	0.84	NS	2.49	9.60	-	-
Laboratory Analyses																	
Nitrogen																	
Nitrate as N (mg/L)	**6.17**	**5.08**	**5.33**	**6.19**	**4.9**	**1.91**	**4.82**	**5.36**	**6.74**	**6.51**	-	**6.03**	NS	**5.47**	**3.78**	**0.443**	**1.97**
Nitrite as N (mg/L)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	-	<0.01	NS	<0.25	**0.047**	-	-
Ammonia (mg/L)	<0.1	**0.19**	<0.1	**0.12**	**0.26**	<0.1	<0.1	<0.1	<0.1	**0.11**	-	**0.12**	NS	**0.12**	**0.24**	**0.24**	<0.1
Total Kjeldahl Nitrogen (TKN)	-	**0.79**	**1.18**	-	-	<0.2	<0.2	<0.2	**1.34**	-	-	**1.24**	NS	<0.2	**0.9**	**0.38**	**0.4**
Total Nitrogen (mg/L)	**6.44**	**5.87**	**6.52**	**6.83**	**4.9**	**1.91**	**4.82**	-	**8.08**	**6.51**	-	**7.27**	NS	**5.47**	-	**0.827**	**2.37**
Anions																	
Chloride (mg/L)	**34.1**	**24.2**	**41.6**	**48.9**	**50.5**	**47.3**	**46.7**	**52.1**	**24.1**	-	-	**22.4**	NS	**12.4**	**13.7**	**458**	**96.1**
Sulfate (mg/L)	**9.8**	**13.6**	**9.7**	**9.2**	**12.1**	**11.2**	**13.2**	**10.7**	**8.7**	**9.3**	-	**8.6**	NS	**13.9**	**11.8**	**6.9**	**9.1**
Elements																	
Dissolved Iron (mg/L)	**0.36**	-	<0.05	<0.1	**-**	<0.1	<0.1	<0.1	-	<0.05	-	-	NS	<0.1	**3.67**	**0.799**	**0.099**
Dissolved Manganese (mg/L)	**0.228**	-	**0.046**	<0.02	**-**	<0.02	<0.02	<0.02	-	**0.02**	-	-	NS	<0.02	**0.674**	**0.185**	**0.047**
Arsenic (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Boron (mg/L)	<0.05	-	<0.05	-	**-**	**-**	**-**	-	-	<0.05	-	-	NS	-	-	<0.05	<0.05
Sodium (mg/L)	-	-	**18.7**	-	**-**	**-**	**-**	-	-	-	-	-	-	-	-	-	-
Other																	
DOC (mg/L)	**1.82**	-	<0.5	**1.02**	**1.1**	**2.29**	**3.66**	**1.11**	<0.5	**0.87**	**0.674**	-	NS	**3.96**	**2.75**	<0.5	<0.5
Methane (µg/L)	-	-	-	**-**	**-**	**-**	**-**	-	-	-	-	-	NS	-	-	<2	<2
Alkalinity as CaCO3 (mg/L)	-	**2**	**10**	-	**-**	**-**	**-**	-	-	-	**4**	**6**	NS	-	-	-	-

Notes:

NS - Not Sampled

Bold - detected above the Minimum Detection Limit

D -Duplicate

1. DO was measured in the field as DO(%) and was converted using the online tool at: http://www.hbuehrer.ch/Rechner/O2satur.html

2. MW-12C references "MW-12" that was installed as part of the Nauset Regional Middle School monitoring well network.

3. Existing wells (MW-4, MW-8, MW-12C) screen elevations were determined based on field measurement of depth to bottom of well. Actual screen depths may vary if bottom was affected by silt build-up in well.

4. MW-12C (existing) was damaged during snow removal at the site in Winter 2017. A sample was unable to be taken during subsequent events. It was repaired in April 2018.

Table 3 Orleans Monitoring Well Groundwater Data Summary

Sample ID	**MW-BU2A**								**MW-BU2B**							
Top of Screen Elevation (ft)	-24.9								-9.9							
Bottom of Screen Elevation (ft)	-34.9								-19.9							
Sampling Date	11/03/2016[1]	1/5/2017	2/23/2017	6/29/2017	9/12/2017	1/10/2018	4/18/2018	9/20/2018	11/03/2016[1]	1/5/2017	2/23/2017	6/29/2017	9/12/2017	1/10/2018	4/18/2018	9/20/2018
Type of Sample	Sample	Sample	Q1 Sample	Q2 Sample	Q3 Sample	Q4 Sample	Q5 Sample	Q6 Sample	Sample	Sample	Q1 Sample	Q2 Sample	Q3 Sample	Q4 Sample	Q5 Sample	Q6 Sample
Field Measurements																
pH (SU)	6.73	6.00	5.72	5.68	5.72	5.23	5.70	4.75	7.11	5.94	5.73	5.68	5.75	5.24	5.60	4.77
Temperature (^{o}C)	14.15	11.75	13.71	14.00	14.47	13.86	14.0	14.2	14.70	12.07	14.18	14.70	15.21	14.53	14.8	14.8
Dissolved Oxygen (DO, mg/L)	1.18	1.30	6.82	15.26	6.87	7.63	7.19	7.46	1.30	1.07	6.25	13.80	6.19	6.42	6.20	6.43
Redox Potential (ORP; mV)	37.50	127.00	149.50	225.20	172.00	211.40	111.5	101.6	20.20	136.30	177.60	221.40	156.50	213.20	143.6	88.0
Specific Conductivity (µS/cm)[c]	406.00	421.00	427.00	439.00	442.00	421.00	344.9	407.0	379.00	362.00	343.00	336.00	350.00	410.00	394.7	490.0
Turbidity (NTU)	44.50	257.00	378.00	2.55	4.02	20.90	32.00	8.48	102.00	146.00	32.60	4.16	8.58	26.40	12.70	9.11
Laboratory Analyses																
Nitrogen																
Nitrate as N (mg/L)	**0.357**	**0.426**	**0.452**	**0.408**	**0.61**	**0.467**	**0.374**	**0.617**	**1.06**	**0.826**	**1.01**	**0.768**	**1.07**	**2.78**	**2.44**	**4.46**
Nitrite as N (mg/L)	<0.01	<0.01	<0.01	<0.01	<0.01	**0.065**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ammonia (mg/L)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Kjeldahl Nitrogen (TKN)	-	<0.2	**0.3**	-	-	<0.2	**0.4**	**0.43**	-	<0.2	**0.43**	-	-	<0.2	**0.31**	**0.32**
Total Nitrogen (mg/L)	**0.357**	**0.426**	**0.76**	**0.408**	**0.834**	**0.532**	**0.78**		**1.06**	**0.826**	**1.44**	**0.768**	**1.07**	**2.78**	**2.75**	
Anions																
Chloride (mg/L)	**103**	**118**	**117**	**120**	**123**	**114**	**98.9**	**112**	**97.3**	**92.2**	**90.7**	**88.3**	**93.2**	**106**	**115**	**125**
Sulfate (mg/L)	**7.2**	**5.2**	**5.3**	<5	<5	**5.3**	**7.4**	**5.1**	<5	<5	<5	<5	<5	<5	<5	<5
Elements																
Dissolved Iron (mg/L)	**1.09**	-	**0.477**	<0.1	**-**	<0.1	<0.1	<0.1	**0.667**	-	**0.138**	<0.1	**-**	<0.1	<0.1	<0.1
Dissolved Manganese (mg/L)	**0.18**	-	**0.03**	<0.02	**-**	<0.02	<0.02	<0.02	**0.088**	-	<0.02	<0.02	**-**	<0.02	<0.02	<0.02
Arsenic (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Boron (mg/L)	<0.05	-	<0.05	-	**-**	**-**	**-**	**-**	<0.05	-	<0.05	-	**-**	**-**	**-**	**-**
Sodium (mg/L)	-	-	**63**	-	**-**	**-**	**-**	**-**	-	-	**37.2**	-	**-**	**-**	**-**	**-**
Other																
DOC (mg/L)	<0.5	-	**0.53**	<0.5	**0.707**	**1.14**	**1.58**	**0.258**	**0.612**	-	<0.5	**0.579**	**0.856**	**2.26**	**2.91**	**1.21**
Methane (µg/L)	-	-	-	-	**-**	**-**	**-**	**-**	<2	-	-	-	**-**	**-**	**-**	**-**
Alkalinity as CaCO3 (mg/L)	-	**11**	**10**	-	**-**	**-**	**-**	**-**	-	**18**	**16**	-	**-**	**-**	**-**	**-**

Notes:

NS - Not Sampled

Bold - detected above the Minimum Detection Limit

D -Duplicate

1. DO was measured in the field as DO(%) and was converted using the online tool at: http://www.hbuehrer.ch/Rechner/O2satur.html

2. MW-12C references "MW-12" that was installed as part of the Nauset Regional Middle School monitoring well network.

3. Existing wells (MW-4, MW-8, MW-12C) screen elevations were determined based on field measurement of depth to bottom of well. Actual screen depths may vary if bottom was affected by silt build-up in well.

4. MW-12C (existing) was damaged during snow removal at the site in Winter 2017. A sample was unable to be taken during subsequent events. It was repaired in April 2018.

Table 3 Orleans Monitoring Well Groundwater Data Summary

Sample ID	**MW-BU2C**									**MW-BC1C**	
Top of Screen Elevation (ft)	5.10									2.5	
Bottom of Screen Elevation (ft)	-4.90									-7.5	
Sampling Date	11/03/2016[1]	11/17/2016	1/10/2017	2/23/2017	6/29/2017	9/12/2017	1/10/2018	4/18/2018	9/20/2018	10/4/2016	4/19/2018
Type of Sample	Sample	Sample	Sample	Q1 Sample	Q2 Sample	Q3 Sample	Q4 Sample	Q5 Sample	Q6 Sample	Sample	Q5 Sample
Field Measurements											
pH (SU)	7.14	5.46	5.49	5.62	5.27	5.26	4.85	5.12	4.36	5.48	5.47
Temperature (^{o}C)	15.20	14.89	12.78	14.78	15.22	15.67	14.76	15.2	15.0	13.37	13.2
Dissolved Oxygen (DO, mg/L)	1.31	2.17	2.40	5.96	11.94	5.59	6.22	6.05	6.59	7.75	7.94
Redox Potential (ORP; mV)	203.00	51.20	194.10	227.50	249.50	208.60	243.90	162.7	101.3	70.10	211.1
Specific Conductivity (µS/cm)[c]	535.00	516.00	569.00	367.00	579.00	658.00	630.00	538.2	618.0	1029.00	1122.0
Turbidity (NTU)	11.40	14.20	5.55	7.33	2.08	11.35	3.86	5.72	5.19	-	1.13
Laboratory Analyses											
Nitrogen											
Nitrate as N (mg/L)	**5.39**	-	**7.42**	**1.78**	**5.39**	**6.35**	**8.03**	**5.78**	**7.35**	**0.481**	**0.75**
Nitrite as N (mg/L)	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01
Ammonia (mg/L)	<0.1	-	**0.1**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1
Total Kjeldahl Nitrogen (TKN)	-	-	<0.2	**0.55**	-		<0.2	**0.26**	**0.22**	-	-
Total Nitrogen (mg/L)	**5.39**	-	-	**2.32**	**5.39**	**6.35**	**8.03**	**6.04**		**0.481**	**1.19**
Anions											
Chloride (mg/L)	**134**	-	**143**	**96.8**	**146**	**174**	**165**	**162**	**169**	**438**	**279**
Sulfate (mg/L)	<5	-	<5	<5	<5	<5	<5	<5	<5	**11.5**	**9.2**
Elements											
Dissolved Iron (mg/L)	**0.817**	-	-	<0.1	<0.1	**-**	<0.1	<0.1	<0.1	-	<0.2
Dissolved Manganese (mg/L)	**0.26**	-	-	**0.077**	**0.081**	**-**	**0.076**	**0.078**	**0.078**	-	**0.066**
Arsenic (mg/L)	-	-	-	-	-	-	-	-	**-**	-	-
Boron (mg/L)	<0.05	-	-	<0.05	-	**-**	**-**	**-**	**-**	**-**	-
Sodium (mg/L)	-	-	-	**44.9**	-	**-**	**-**	**-**	**-**	**-**	-
Other											
DOC (mg/L)	**0.684**	**0.728**	<0.5	<0.5	**0.599**	**1.35**	**2.2**	**3.35**	**0.847**	<0.5	**1.99**
Methane (µg/L)	<2	-	-	-	-	**-**	**-**	**-**	**-**	-	**-**
Alkalinity as CaCO3 (mg/L)	-	**13**	**11**	**17**	-	**-**	**-**	**-**	**-**	-	**-**

Notes:

NS - Not Sampled

Bold - detected above the Minimum Detection Limit

D -Duplicate

1. DO was measured in the field as DO(%) and was converted using the online tool at: http://www.hbuehrer.ch/Rechner/O2satur.html

2. MW-12C references "MW-12" that was installed as part of the Nauset Regional Middle School monitoring well network.

3. Existing wells (MW-4, MW-8, MW-12C) screen elevations were determined based on field measurement of depth to bottom of well. Actual screen depths may vary if bottom was affected by silt build-up in well.

4. MW-12C (existing) was damaged during snow removal at the site in Winter 2017. A sample was unable to be taken during subsequent events. It was repaired in April 2018.

Table 3 Orleans Monitoring Well Groundwater Data Summary

Sample ID	**MW-BC2C**									**MW-BC3B**					
Top of Screen Elevation (ft)	-1.48									-10.80					
Bottom of Screen Elevation (ft)	-11.48									-20.80					
Sampling Date	11/04/2016	11/17/2016	1/10/2017	2/24/2017	6/29/2017	9/13/2017	1/10/2018	4/19/2018	9/20/2018	3/27/2017	6/29/2017	9/13/2017	1/10/2018	4/19/2018	9/20/2018
Type of Sample	Sample	Sample	Sample	Q1 Sample	Q2 Sample	Q3 Sample	Q4 Sample	Q5 Sample	Q6 Sample	Sample	Q2 Sample	Q3 Sample	Q4 Sample	Q5 Sample	Q6 Sample
Field Measurements															
pH (SU)	7.05	5.40	5.55	5.17	5.28	5.30	5.01	5.27	5.60	5.38	5.31	5.41	5.09	5.32	4.42
Temperature (^{o}C)	15.25	14.54	12.65	15.10	15.07	15.49	14.62	14.2	19.5	14.19	14.13	14.24	14.22	13.9	14.1
Dissolved Oxygen (DO, mg/L)	1.65	1.67	1.87	5.73	12.16	4.94	5.20	5.01	4.13	2.50	6.98	3.29	3.27	3.40	3.41
Redox Potential (ORP; mV)	74.80	100.70	169.00	259.10	239.90	256.70	184.90	215.0	165.2	113.80	251.90	238.30	137.40	191.4	104.5
Specific Conductivity (µS/cm)[c]	368.00	340.00	363.00	332.00	361.00	416.00	391.00	482.7	480.0	518.00	611.00	630.00	559.00	539.0	581.0
Turbidity (NTU)	6.00	19.20	16.60	20.40	3.76	2.62	2.40	0.37	478.00	5.69	16.40	5.82	4.65	2.82	3.62
Laboratory Analyses															
Nitrogen															
Nitrate as N (mg/L)	**4.16**	-	**5.91**	**3.32**	**3.42**	**3.13**	**4.25**	**3.26**	**0.407**	**2.2**	**4.59**	**3.45**	**4.26**	**3.45**	**4.96**
Nitrite as N (mg/L)	-	-	<0.01	<0.01	<0.01	<0.01	**0.08**	<0.01	<0.01	**0.032**	<0.01	<0.01	<0.01	<0.01	<0.01
Ammonia (mg/L)	<0.1	-	<0.1	<0.1	<0.1	**0.12**	<0.1	<0.1	<0.1	**0.91**	<0.1	<0.1	<0.1	<0.1	<0.1
Total Kjeldahl Nitrogen (TKN)	-	-	<0.2	**0.92**	-	**-**	<0.2	-	**0.56**	-	-	-	<0.2	-	**0.31**
Total Nitrogen (mg/L)	**4.43**	-		**4.24**	**3.42**	**3.13**	**4.33**	**3.61**		**2.59**	**4.59**	**3.45**	**4.26**	**3.69**	
Anions															
Chloride (mg/L)	**83.8**	-	**85.4**	**83.3**	**86.5**	**92.5**	**96**	**103**	**10**	**143**	**161**	**153**	**140**	**136**	**154**
Sulfate (mg/L)	**6.4**	-	<5	**6.3**	<5	<5	**5.3**	**7**	**12.2**	**8.3**	**6.8**	**9.1**	**13.6**	**12.6**	**10.4**
Elements															
Dissolved Iron (mg/L)	-	-	-	<0.1	<0.1	**-**	<0.1	<0.2	**0.131**	<0.1	<0.1	**-**	<0.1	<0.2	<0.1
Dissolved Manganese (mg/L)	-	-	-	**0.092**	**0.062**	**-**	**0.063**	**0.05**	<0.02	**0.298**	**0.077**	**-**	**0.078**	**0.048**	**0.046**
Arsenic (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Boron (mg/L)	-	-	-	<0.05	-	**-**	**-**	-	-	-	-	-	**-**	-	-
Sodium (mg/L)	-	-	-	41.8	-	**-**	**-**	-	-	-	-	-	**-**	-	-
Other															
DOC (mg/L)	**0.764**	**0.576**	<0.5	**1.54**	**1.68**	**3.32**	**1.67**	**3.31**	**2.68**	**1.86**	**1.02**	**3.79**	**2.36**	**4.95**	**1.65**
Methane (µg/L)	-	-	-	-	-	**-**	**-**	**-**	-	-	-	-	**-**	**-**	-
Alkalinity as CaCO3 (mg/L)	-	**8**	**9**	**9**	-	**-**	**-**	**-**	-	-	-	-	**-**	**-**	-

Notes:

NS - Not Sampled

Bold - detected above the Minimum Detection Limit

D -Duplicate

1. DO was measured in the field as DO(%) and was converted using the online tool at: http://www.hbuehrer.ch/Rechner/O2satur.html

2. MW-12C references "MW-12" that was installed as part of the Nauset Regional Middle School monitoring well network.

3. Existing wells (MW-4, MW-8, MW-12C) screen elevations were determined based on field measurement of depth to bottom of well. Actual screen depths may vary if bottom was affected by silt build-up in well.

4. MW-12C (existing) was damaged during snow removal at the site in Winter 2017. A sample was unable to be taken during subsequent events. It was repaired in April 2018.

Table 3 Orleans Monitoring Well Groundwater Data Summary

Sample ID	**MW-BX1B**						**MW-BX1C**					
Top of Screen Elevation (ft)	-9.40						5.37					
Bottom of Screen Elevation (ft)	-19.40						-4.63					
Sampling Date	3/27/2017	6/28/2017	9/12/2017	1/8/2018	4/18/2018	9/25/2018	3/27/2017	6/28/2017	9/12/2017	1/8/2018	4/18/2018	9/25/2018
Type of Sample	Sample	Q2 Sample	Q3 Sample	Q4 Sample	Q5 Sample	Q6 Sample	Sample	Q2 Sample	Q3 Sample	Q4 Sample	Q5 Sample	Q6 Sample
Field Measurements												
pH (SU)	4.67	5.05	5.03	4.04	4.77	6.56	4.44	4.70	4.80	3.89	4.59	4.82
Temperature (^{o}C)	13.76	14.28	14.50	13.33	14.1	14.2	13.87	14.32	14.44	13.44	14.1	13.5
Dissolved Oxygen (DO, mg/L)	1.73	1.87	0.07	0.09	0.60	0.37	0.63	2.30	0.79	1.56	1.30	1.10
Redox Potential (ORP; mV)	153.70	283.60	202.90	302.90	207.9	-111.6	199.90	315.80	232.40	328.60	230.9	-29.7
Specific Conductivity (µS/cm)[c]	367.00	446.00	470.00	468.00	456.2	574.0	521.00	473.00	447.00	499.00	450.0	499.0
Turbidity (NTU)	29.80	326.00	19.44	68.80	100.00	218.00	0.98	55.80	7.11	5.93	0.50	26.30
Laboratory Analyses												
Nitrogen												
Nitrate as N (mg/L)	**11.4**	**34.4**	**39**	**10**	**28.5**	<0.03	**0.25**	**38.7**	**37.8**	**11.1**	**27.7**	**5.77**
Nitrite as N (mg/L)	**0.018**	<0.01	<0.01	<0.01	<0.01	**0.049**	**0.012**	<0.01	<0.01	**0.074**	**0.016**	**0.118**
Ammonia (mg/L)	**0.4**	**0.7**	**0.39**	**0.51**	**0.44**	<0.1	**1.09**	**0.5**	**0.22**	**0.18**	**0.37**	**0.16**
Total Kjeldahl Nitrogen (TKN)	-	-		<0.2	<0.2	**2.14**	-	-		<0.2	<0.2	**2.9**
Total Nitrogen (mg/L)	**12.9**	**37**	**39**	**10**	**28.5**		**1.52**	**42**	**37.8**	**11.2**	**27.7**	
Anions												
Chloride (mg/L)	**43.1**	**41**	**37.9**	**33.4**	**47.1**	**38.5**	**49.6**	**40.8**	**37.3**	**34.5**	**52.6**	**45.9**
Sulfate (mg/L)	**7.6**	<5	<5	<5	**8.4**	**44**	<5	<5	<5	<5	**10**	**18.1**
Elements												
Dissolved Iron (mg/L)	<0.1	<0.1	**-**	<0.1	<0.1	**67.6**	<0.1	<0.1	**-**	<0.1	<0.1	**24.2**
Dissolved Manganese (mg/L)	**0.335**	**0.478**	**-**	**0.631**	**0.658**	**5.03**	**0.566**	**0.517**	**-**	**0.553**	**0.501**	**1.98**
Arsenic (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-
Boron (mg/L)	-	-	**-**	**0.052**	**0.056**	**-**	-	-	**-**	**0.052**	**0.057**	**-**
Sodium (mg/L)	-	-	**-**	**-**	**-**	**-**	-	-	**-**	**-**	**-**	**-**
Other												
DOC (mg/L)	**2.97**	**1.55**	**2.31**	**5.16**	**6.5**	**80.7**	**2.7**	**2.02**	**2.69**	**4.53**	**6.38**	**78.7**
Methane (µg/L)	-	-	-	-	-	-	-	-	-	-	-	-
Alkalinity as CaCO3 (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-

Notes:

NS - Not Sampled

Bold - detected above the Minimum Detection Limit

D -Duplicate

1. DO was measured in the field as DO(%) and was converted using the online tool at: http://www.hbuehrer.ch/Rechner/O2satur.html

2. MW-12C references "MW-12" that was installed as part of the Nauset Regional Middle School monitoring well network.

3. Existing wells (MW-4, MW-8, MW-12C) screen elevations were determined based on field measurement of depth to bottom of well. Actual screen depths may vary if bottom was affected by silt build-up in well.

4. MW-12C (existing) was damaged during snow removal at the site in Winter 2017. A sample was unable to be taken during subsequent events. It was repaired in April 2018.

Table 3 Orleans Monitoring Well Groundwater Data Summary

Sample ID	**MW-B1010C**									**MW-B1020B**							
Top of Screen Elevation (ft)	-0.10									-10.4							
Bottom of Screen Elevation (ft)	-10.10									-20.4							
Sampling Date	11/03/2016[1]	11/17/2016	1/5/2017	2/23/2017	6/28/2017	9/12/2017	1/9/2018	4/18/2018	9/19/2018	11/04/2016[1]	1/5/2017	2/23/2017	6/28/2017	9/12/2017	1/8/2018	4/18/2018	9/19/2018
Type of Sample	Sample	Sample	Sample	Q1 Sample	Q2 Sample	Q3 Sample	Q4 Sample	Q5 Sample	Q6 Sample	Sample	Sample	Q1 Sample	Q2 Sample	Q3 Sample	Q4 Sample	Q5 Sample	Q6 Sample
Field Measurements																	
pH (SU)	6.90	5.18	5.61	5.32	5.36	5.68	5.23	5.70	6.48	6.78	5.20	5.01	5.00	5.12	4.54	5.00	5.93
Temperature (^{o}C)	14.60	14.28	12.22	14.69	15.04	15.97	13.43	14.4	15.4	13.70	11.94	14.13	14.71	15.69	13.82	14.4	21.9
Dissolved Oxygen (DO, mg/L)	0.87	0.71	0.49	1.07	1.39	0.12	2.11	2.19	0.07	1.03	0.60	2.77	1.44	0.20	0.16	5.90	4.05
Redox Potential (ORP; mV)	110.70	231.60	190.80	252.20	204.80	2.70	86.20	-28.5	-121.7	45.00	190.70	251.30	276.30	160.30	166.20	132.0	-65.0
Specific Conductivity (µS/cm)[c]	262.00	230.00	289.00	258.00	269.00	238.00	249.00	240.0	920.0	465.00	355.00	353.00	352.00	332.00	288.00	302.8	1366.0
Turbidity (NTU)	16.00	5.97	10.60	5.62	2.73	2.99	5.15	0.50	9.60	67.90	321.00	11.00	14.60	2.50	2.84	0.50	207.00
Laboratory Analyses																	
Nitrogen																	
Nitrate as N (mg/L)	**13.6**	-	**6.74**	**9.94**	**13.8**	**2.49**	**2.76**	**6.66**	<0.03	**28.4**	**17.9**	**20.1**	**24.9**	**19.7**	**4.71**	**18.3**	<0.03
Nitrite as N (mg/L)	-	-	**0.509**	**0.474**	**0.171**	**0.185**	**0.052**	**0.026**	**0.049**	-	<0.01	<0.01	**0.158**	**0.076**	**0.091**	**0.028**	**0.02**
Ammonia (mg/L)	<0.1	-	<0.1	**0.18**	<0.1	<0.1	**0.13**	**0.16**	<0.1	**0.53**	**0.11**	<0.1	<0.1	<0.1	**0.14**	<0.1	**0.21**
Total Kjeldahl Nitrogen (TKN)	-	-	**1.36**	**1.95**	-		**0.88**	**1.03**	**1.9**	-	**1.79**	**2.92**	-	-	<0.2	<0.2	**5.48**
Total Nitrogen (mg/L)	**13.9**	-	**8.61**	**12.4**	**15.7**	**4.22**	**3.69**	**7.72**	-	**28.5**	**19.6**	**23**	**27.1**	**19.7**	**4.8**	**18.3**	-
Anions																	
Chloride (mg/L)	**27.5**	-	**24.3**	**25.2**	**24.2**	**23.6**	**22.6**	**21.5**	**27.5**	**49.8**	**33.6**	**34**	**32.3**	**30**	**25.1**	**25.2**	**35.1**
Sulfate (mg/L)	-	-	**23.7**	**16.5**	**11**	**22.6**	**10.8**	**14.3**	**19.9**	-	<5	<5	<5	<5	**6.8**	**6.1**	**33**
Elements																	
Dissolved Iron (mg/L)	-	-	-	<0.1	**0.143**	**3.88**	**9.69**	**9.62**	**87**	**2.52**	-	**0.153**	<0.1	<0.1	<0.1	<0.1	**10**
Dissolved Manganese (mg/L)	-	-	-	**0.234**	**0.324**	**0.996**	**0.531**	**0.6**	**5.78**	**0.948**	-	**0.293**	**0.333**	**0.32**	**0.307**	**0.326**	**0.896**
Arsenic (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Boron (mg/L)	-	-	-	<0.05	-	**-**	**-**	**-**	-	<0.05	-	**0.053**	-	**-**	**-**	**-**	-
Sodium (mg/L)	-	-	-	**22.8**	-	**-**	**-**	**-**	-	**27.5**	-	**24.6**	-	**-**	**-**	**-**	-
Other																	
DOC (mg/L)	-	**0.696**	-	**13.9**	**16.9**	**21.4**	**13.6**	**13**	**321**	-	-	**1.11**	**3.24**	**3.67**	**6.02**	**5.43**	**668**
Methane (µg/L)	-	-	-	-	<2	**-**	**-**	**-**	-	-	-	-	**-**	**-**	**-**	**-**	-
Alkalinity as CaCO3 (mg/L)	-	**11**	**31**	**15**	-	**-**	**-**	**-**	-	-	**9**	**6**	-	**-**	**-**	**-**	-

Notes:

NS - Not Sampled

Bold - detected above the Minimum Detection Limit

D -Duplicate

1. DO was measured in the field as DO(%) and was converted using the online tool at: http://www.hbuehrer.ch/Rechner/O2satur.html

2. MW-12C references "MW-12" that was installed as part of the Nauset Regional Middle School monitoring well network.

3. Existing wells (MW-4, MW-8, MW-12C) screen elevations were determined based on field measurement of depth to bottom of well. Actual screen depths may vary if bottom was affected by silt build-up in well.

4. MW-12C (existing) was damaged during snow removal at the site in Winter 2017. A sample was unable to be taken during subsequent events. It was repaired in April 2018.

Table 3 Orleans Monitoring Well Groundwater Data Summary

Sample ID	**MW-B1020C**									**MW-B1050A**							
Top of Screen Elevation (ft)	4.50									-26.1							
Bottom of Screen Elevation (ft)	-5.50									-36.1							
Sampling Date	11/04/2016[1]	11/17/2016	1/5/2017	2/23/2017	6/28/2017	9/12/2017	1/8/2018	4/18/2018	9/19/2018	11/04/2016[1]	1/5/2017	2/23/2017	6/28/2017	9/12/2017	1/9/2018	4/18/2018	9/25/2018
Type of Sample	Sample	Sample	Sample	Q1 Sample	Q2 Sample	Q3 Sample	Q4 Sample	Q5 Sample	Q6 Sample	Sample	Sample	Q1 Sample	Q2 Sample	Q3 Sample	Q4 Sample	Q5 Sample	Q6 Sample
Field Measurements																	
pH (SU)	6.88	5.27	5.38	5.17	5.16	5.22	4.54	5.09	5.74	7.15	5.60	5.50	5.00	5.27	5.06	5.35	6.19
Temperature (^{o}C)	14.24	14.66	12.73	15.06	15.26	15.97	13.97	14.9	21.4	13.77	11.87	14.05	14.27	15.87	14.11	14.3	14.8
Dissolved Oxygen (DO, mg/L)	1.44	0.56	0.31	2.69	3.72	1.81	3.78	4.05	0.74	1.34	0.26	4.24	1.75	0.06	0.75	1.90	0.18
Redox Potential (ORP; mV)	50.30	106.70	194.80	292.20	277.20	161.90	204.20	150.8	29.6	43.00	142.20	226.20	264.40	174.20	129.60	182.9	-52.1
Specific Conductivity (µS/cm)[c]	242.00	227.00	269.00	253.00	247.00	161.90	201.00	212.9	228.0	612.00	505.00	1648.00	508.00	422.00	1486.00	281.5	457.0
Turbidity (NTU)	321.00	15.60	6.31	18.00	8.87	243.00	14.60	1.17	30.00	962.00	297.00	76.60	4.10	3.10	9.57	5.70	8.10
Laboratory Analyses																	
Nitrogen																	
Nitrate as N (mg/L)	**10.6**	-	**11.1**	**12.6**	**13.9**	**12.4**	**2.97**	**9.7**	**1.92**	**37**	**26.6**	**11.8**	**26.8**	**26.7**	**4.89**	**13.1**	**11.7**
Nitrite as N (mg/L)	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	**0.033**	-	**0.105**	<0.01	**0.038**	**0.048**	**0.141**	**0.016**	**0.196**
Ammonia (mg/L)	<0.1	-	**0.19**	<0.1	<0.1	<0.1	**0.14**	<0.1	**0.14**	**1.93**	**1.72**	**0.54**	**0.57**	**1.24**	**0.38**	**0.28**	**0.28**
Total Kjeldahl Nitrogen (TKN)	-	-	**1.99**	**2.25**	-		<0.2	<0.2	**1.33**	-	**3.75**	**1.83**	-		<0.2	<0.2	**1.85**
Total Nitrogen (mg/L)	**10.6**	-	**13.1**	**14.9**	**15**	**12.4**	**2.97**	**9.7**	-	**37.2**	**30.5**	**13.7**	**26.8**	**26.7**	**5.03**	**13.1**	
Anions																	
Chloride (mg/L)	**25.5**	-	**25.6**	**25.6**	**24.8**	**24.1**	**18.7**	**18.7**	**16.7**	**54.8**	**48.9**	**399**	**48.9**	**41.4**	**429**	**44.8**	**63.7**
Sulfate (mg/L)	-	-	**5.6**	**6.1**	**5.8**	**5.8**	**6.7**	**8**	**20.4**	-	**6.1**	<5	<5	<5	<5	<5	**27.1**
Elements																	
Dissolved Iron (mg/L)	**2.23**	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	**5.58**	**4.29**	-	<0.1	<0.1	**-**	<0.1	<0.1	**41.4**
Dissolved Manganese (mg/L)	**0.249**	-	-	**0.076**	**0.057**	**0.042**	**0.054**	**0.06**	**0.249**	**0.655**	-	**0.18**	**0.654**	**-**	**0.236**	**0.214**	**1.95**
Arsenic (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Boron (mg/L)	**0.085**	-	-	**0.083**	-	**-**	**-**	**-**	-	<0.05	-	<0.05	-	**-**	**-**	**-**	**-**
Sodium (mg/L)	**13.4**	-	-	**18.4**	-	**-**	**-**	**-**	-	**33.7**	-	**345**	-	**-**	**-**	**-**	**-**
Other																	
DOC (mg/L)	-	**0.85**	-	**1.02**	**1.34**	**2.19**	**4.52**	**6.02**	**45.5**	-	-	**0.808**	**1.85**	**3.72**	**2.83**	**3.96**	**28**
Methane (µg/L)	-	-	-	-	**-**	**-**	**-**	**-**	-	-	-	-	-	**-**	**-**	**-**	**-**
Alkalinity as CaCO3 (mg/L)	-	**13**	**11**	**8**	-	**-**	**-**	**-**	-	-	**24**	**11**	-	**-**	**-**	**-**	**-**

Notes:

NS - Not Sampled

Bold - detected above the Minimum Detection Limit

D -Duplicate

1. DO was measured in the field as DO(%) and was converted using the online tool at: http://www.hbuehrer.ch/Rechner/O2satur.html

2. MW-12C references "MW-12" that was installed as part of the Nauset Regional Middle School monitoring well network.

3. Existing wells (MW-4, MW-8, MW-12C) screen elevations were determined based on field measurement of depth to bottom of well. Actual screen depths may vary if bottom was affected by silt build-up in well.

4. MW-12C (existing) was damaged during snow removal at the site in Winter 2017. A sample was unable to be taken during subsequent events. It was repaired in April 2018.

Table 3 Orleans Monitoring Well Groundwater Data Summary

Sample ID	**MW-B1050B**							**MW-B1050C**						
Top of Screen Elevation (ft)	-11.1							4.9						
Bottom of Screen Elevation (ft)	-21.1							-5.1						
Sampling Date	11/04/2016[1]	2/23/2017	6/28/2017	9/12/2017	1/9/2018	4/18/2018	9/25/2018	11/04/2016[1]	2/23/2017	6/28/2017	9/12/2017	1/9/2018	4/18/2018	9/25/2018
Type of Sample	Sample	Q1 Sample	Q2 Sample	Q3 Sample	Q4 Sample	Q5 Sample	Q6 Sample	Sample	Q1 Sample	Q2 Sample	Q3 Sample	Q4 Sample	Q5 Sample	Q6 Sample
Field Measurements														
pH (SU)	7.06	5.13	5.10	5.22	4.74	5.08	3.81	7.20	5.43	5.34	5.38	4.96	5.40	5.38
Temperature (^{o}C)	14.08	14.27	14.70	15.48	14.19	14.5	14.1	14.55	14.95	15.06	15.77	14.51	14.9	14.6
Dissolved Oxygen (DO, mg/L)	1.17	2.12	4.53	1.06	2.17	3.38	3.22	1.34	1.83	5.39	1.85	1.64	1.82	2.16
Redox Potential (ORP; mV)	80.30	304.40	260.10	203.80	160.40	306.5	151.8	48.60	205.90	230.20	176.50	167.20	171.8	157.7
Specific Conductivity (µS/cm)[c]	446.00	463.00	387.00	340.00	392.00	306.0	345.0	571.00	511.00	542.00	478.00	413.00	302.3	212.0
Turbidity (NTU)	3.97	7.20	0.72	2.75	5.06	5.03	3.87	8.21	2.27	0.98	3.23	1.90	0.80	1.51
Laboratory Analyses														
Nitrogen														
Nitrate as N (mg/L)	**25.7**	**28.7**	**18.2**	**18**	**10.8**	**20.1**	**24.3**	**3.83**	**3.96**	**3.26**	**4.18**	**2**	**5.76**	**8.43**
Nitrite as N (mg/L)	-	<0.01	<0.01	<0.01	<0.01	<0.01	**0.049**	-	<0.01	<0.01	<0.01	**0.088**	<0.01	<0.01
Ammonia (mg/L)	**0.19**	<0.1	<0.1	**0.14**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Kjeldahl Nitrogen (TKN)	-	**1.85**	-		<0.2	<0.2	<0.2	-	1.28	-		<0.2	<0.2	<0.2
Total Nitrogen (mg/L)	**26**	**30.5**	**18.2**	**18**	**10.8**	**20.1**		**4.05**	**5.24**	**3.26**	**4.4**	**2.08**	**5.76**	
Anions														
Chloride (mg/L)	**48.2**	**50.7**	**41.7**	**38.2**	**36.7**	**29.1**	**36.8**	**141**	**123**	**134**	**120**	**85.7**	**61.7**	**32.8**
Sulfate (mg/L)	-	<5	<5	<5	<5	<5	<5	-	**20.1**	**15.2**	**14.6**	**17.9**	**22.2**	**15.3**
Elements														
Dissolved Iron (mg/L)	**0.734**	<0.1	<0.1	**-**	<0.1	<0.1	<0.1	**0.493**	<0.1	<0.1	**-**	<0.1	<0.1	<0.1
Dissolved Manganese (mg/L)	**0.332**	**0.142**	**0.101**	**-**	**0.115**	**0.128**	**0.147**	**0.146**	**0.042**	**0.057**	**-**	**0.034**	**0.025**	**0.021**
Arsenic (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Boron (mg/L)	<0.05	<0.05	-	**-**	**-**	**-**	**-**	<0.05	<0.05	-	**-**	**-**	**-**	-
Sodium (mg/L)	**26.8**	**16.9**	-	**-**	**-**	**-**	**-**	**81.6**	**94.5**	-	**-**	**-**	**-**	-
Other														
DOC (mg/L)	-	**0.722**	**1.31**	**3.43**	**3.21**	**3.68**	**9.71**	-	**0.592**	**1.62**	**2.19**	**3.26**	**5.78**	**3.74**
Methane (µg/L)	-	-	-	**-**	**-**	**-**	**-**	-	-	-	**-**	**-**	**-**	-
Alkalinity as CaCO3 (mg/L)	-	**7**	-	**-**	**-**	**-**	**-**	-	**17**	-	**-**	**-**	**-**	-

Notes:

NS - Not Sampled

Bold - detected above the Minimum Detection Limit

D -Duplicate

1. DO was measured in the field as DO(%) and was converted using the online tool at: http://www.hbuehrer.ch/Rechner/O2satur.html

2. MW-12C references "MW-12" that was installed as part of the Nauset Regional Middle School monitoring well network.

3. Existing wells (MW-4, MW-8, MW-12C) screen elevations were determined based on field measurement of depth to bottom of well. Actual screen depths may vary if bottom was affected by silt build-up in well.

4. MW-12C (existing) was damaged during snow removal at the site in Winter 2017. A sample was unable to be taken during subsequent events. It was repaired in April 2018.

Table 3 Orleans Monitoring Well Groundwater Data Summary

Sample ID	**MW-B1075B**							**MW-B2010C**							
Top of Screen Elevation (ft)	-11.5							0							
Bottom of Screen Elevation (ft)	-21.5							-10							
Sampling Date	11/04/2016[1]	2/23/2017	6/28/2017	9/13/2017	1/9/2018	4/18/2018	9/25/2018	11/03/2016[1]	11/17/2016	2/24/2017	6/28/2017	9/13/2017	1/10/2018	4/19/2018	9/20/2018
Type of Sample	Sample	Q1 Sample	Q2 Sample	Q3 Sample	Q4 Sample	Q5 Sample	Q6 Sample	Sample	Sample	Q1 Sample	Q2 Sample	Q3 Sample	Q4 Sample	Q5 Sample	Q6 Sample
Field Measurements															
pH (SU)	7.19	5.59	5.66	5.83	5.53	5.74	4.49	7.04	5.32	5.70	6.11	6.29	6.20	6.51	6.53
Temperature (^{o}C)	15.20	14.20	14.74	14.93	14.13	14.6	14.2	15.12	14.58	14.81	15.39	15.69	14.71	14.6	16.9
Dissolved Oxygen (DO, mg/L)	0.71	1.50	1.95	0.12	0.11	0.43	0.59	0.67	0.61	3.38	1.78	0.10	0.10	0.30	0.14
Redox Potential (ORP; mV)	82.20	157.90	223.10	99.00	135.00	95.5	25.2	12.40	213.80	103.30	-41.60	-119.80	-102.10	-153.0	-133.0
Specific Conductivity (µS/cm)[c]	631.00	1755.00	736.00	719.00	2688.00	1048.0	717.0	333.00	304.00	302.00	431.00	689.00	862.00	860.0	764.0
Turbidity (NTU)	13.00	126.00	1.87	24.23	173.00	42.00	3.68	149.00	44.40	19.90	6.89	5.10	3.32	0.25	9.40
Laboratory Analyses															
Nitrogen															
Nitrate as N (mg/L)	**1.93**	**1**	**0.553**	**0.751**	**0.609**	**5.57**	**8.18**	**15.7**	-	**5.06**	**5.74**	**0.182**	<0.03	<0.03	<0.03
Nitrite as N (mg/L)	-	**0.048**	**0.05**	**0.064**	**0.201**	**0.098**	**0.062**	-	-	**0.499**	**0.128**	**0.081**	**0.027**	**0.09**	**0.058**
Ammonia (mg/L)	**3.73**	**5.26**	**11**	**12.2**	**14.3**	**17.8**	**9.56**	**0.14**	-	<0.1	**0.24**	<0.1	**0.17**	**0.49**	**0.86**
Total Kjeldahl Nitrogen (TKN)	-	**7.2**	-	**-**	**14.4**	**17.7**	**10.5**	-	-	**14.7**	-	-	**1.75**	-	**1.93**
Total Nitrogen (mg/L)	**6.36**	**8.25**	**13.6**	**15.1**	**15.3**	**23.4**		**16.1**	-	**20.3**	**7.69**	**2.26**	**1.75**	**2.34**	
Anions															
Chloride (mg/L)	**96.3**	**440**	**170**	**147**	**764**	**258**	**159**	**38.6**	-	**27.5**	**30**	**37.4**	**35.5**	**28.5**	**33.9**
Sulfate (mg/L)	-	**25.6**	**28.9**	**26.8**	**31.6**	**24.8**	**15.8**	**11**	-	**24.3**	**39.8**	**73.5**	**57**	**51.5**	**17.8**
Elements															
Dissolved Iron (mg/L)	-	**0.342**	<0.1	**-**	**0.886**	**0.253**	<0.1	-	-	**1.84**	**24.2**	**46.2**	**88.2**	**110**	**89.1**
Dissolved Manganese (mg/L)	-	**0.119**	**0.111**	**-**	**0.142**	**0.12**	**0.083**	-	-	**0.189**	**1.62**	**2.56**	**5.15**	**5.77**	**4.54**
Arsenic (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0.0599**
Boron (mg/L)	-	<0.05	-	**-**	**-**	**-**	**-**	-	-	<0.05	-	-	**-**	-	-
Sodium (mg/L)	-	**379**	-	**-**	**-**	**-**	**-**	-	-	**28.5**	-	-	**-**	-	-
Other															
DOC (mg/L)	-	**1.96**	**4.86**	**9.48**	**8.77**	**11.1**	**4.63**	**2.18**	**0.852**	**19.4**	**83.3**	**69.4**	**94.3**	**52.5**	**19.7**
Methane (µg/L)	-	-	-	**-**	**-**	**-**	**-**	-	-	-	**11.3**	-	**-**	**-**	-
Alkalinity as CaCO3 (mg/L)	-	**46**	-	**-**	**-**	**-**	**-**	-	**16**	**48**	-	-	**-**	**-**	-

Notes:

NS - Not Sampled

Bold - detected above the Minimum Detection Limit

D -Duplicate

1. DO was measured in the field as DO(%) and was converted using the online tool at: http://www.hbuehrer.ch/Rechner/O2satur.html

2. MW-12C references "MW-12" that was installed as part of the Nauset Regional Middle School monitoring well network.

3. Existing wells (MW-4, MW-8, MW-12C) screen elevations were determined based on field measurement of depth to bottom of well. Actual screen depths may vary if bottom was affected by silt build-up in well.

4. MW-12C (existing) was damaged during snow removal at the site in Winter 2017. A sample was unable to be taken during subsequent events. It was repaired in April 2018.

Table 3 Orleans Monitoring Well Groundwater Data Summary

Sample ID	**MW-B2020B**									**MW-B2020C**							
Top of Screen Elevation (ft)	-10.1									4.8							
Bottom of Screen Elevation (ft)	-20.1									-5.2							
Sampling Date	11/03/2016[1]	11/17/2016	1/10/2017	2/24/2017	6/28/2017	9/13/2017	1/9/2018	4/19/2018	9/25/2018	11/03/2016[1]	1/10/2017	2/24/2017	6/28/2017	9/13/2017	1/9/2018	4/19/2018	9/19/2018
Type of Sample	Sample	Sample	Sample	Q1 Sample	Q2 Sample	Q3 Sample	Q4 Sample	Q5 Sample	Q6 Sample	Sample	Sample	Q1 Sample	Q2 Sample	Q3 Sample	Q4 Sample	Q5 Sample	Q6 Sample
Field Measurements																	
pH (SU)	7.00	5.22	5.05	5.10	5.04	5.45	4.95	5.62	5.82	7.00	5.12	5.09	5.60	5.76	5.16	5.85	6.11
Temperature (^{o}C)	14.91	14.39	12.23	14.53	14.86	15.14	14.28	14.4	14.5	15.20	12.90	15.42	15.57	15.80	14.72	14.9	17.7
Dissolved Oxygen (DO, mg/L)	1.15	0.63	0.85	2.03	3.88	0.08	0.08	0.30	0.66	1.31	1.30	3.96	1.70	0.13	0.06	0.34	0.60
Redox Potential (ORP; mV)	90.80	182.60	170.50	308.10	285.90	120.70	173.60	149.3	16.7	29.80	201.50	316.20	73.80	-15.70	8.50	-36.0	15.2
Specific Conductivity (µS/cm)[c]	321.00	307.00	344.00	338.00	354.00	323.00	370.00	339.4	449.0	249.00	251.00	225.00	264.00	248.00	250.00	303.4	309.0
Turbidity (NTU)	14.30	17.40	6.95	6.11	8.12	5.91	10.00	4.01	4.40	28.00	5.81	5.17	6.23	1.30	6.09	0.50	6.45
Laboratory Analyses																	
Nitrogen																	
Nitrate as N (mg/L)	**16.9**	-	**25.6**	**14.8**	**22.4**	**5.96**	**3.26**	**2.4**	**3.06**	**8.71**	**12.6**	**6.95**	**0.457**	<0.03	<0.03	<0.03	<0.03
Nitrite as N (mg/L)	**0.022**	-	<0.01	<0.01	<0.01	**0.54**	**2.98**	**1.43**	**0.314**	**0.016**	<0.01	<0.01	**0.072**	**0.01**	**0.083**	<0.01	**0.012**
Ammonia (mg/L)	**0.1**	-	<0.1	<0.1	<0.1	<0.1	**0.23**	<0.1	**0.11**	**0.24**	<0.1	<0.1	<0.1	<0.1	**0.14**	**0.13**	<0.1
Total Kjeldahl Nitrogen (TKN)	-	-	<0.2	**3.86**	-	-	**4.32**	-	**0.91**	-	<0.2	**2.33**	-	-	**1.04**	-	**0.84**
Total Nitrogen (mg/L)	**17.2**	-	-	**18.7**	**24.2**	**7.84**	**10.6**	**4.58**		**9.02**	-	**9.28**	**0.85**	**0.424**	**1.1**	**1.19**	-
Anions																	
Chloride (mg/L)	**32.5**	-	**34.9**	**32.7**	**39.3**	**38**	**51.4**	**34.8**	**46.9**	**26.8**	**31**	**28.4**	**32.2**	**31.2**	**33**	**28.5**	**30.7**
Sulfate (mg/L)	**7.7**	-	**6**	**7.1**	**6.4**	**29.7**	**19.3**	**37**	**42.5**	**11.6**	**9.7**	**11.9**	**36.8**	**20.9**	**29**	**27.6**	**19.6**
Elements																	
Dissolved Iron (mg/L)	**1.2**	-	-	<0.1	<0.1	<0.1	<0.1	<0.2	**17.6**	**1.42**	-	<0.1	**7.97**	**13.1**	**1.83**	**4.56**	**14.5**
Dissolved Manganese (mg/L)	**0.126**	-	-	**0.028**	**0.029**	**0.187**	**0.374**	**0.76**	**3.54**	**1.14**	-	**0.067**	**0.964**	**2.08**	**5.09**	**8.28**	**11.1**
Arsenic (mg/L)	-	-	-	-	-	-	-	-	<0.0025	-	-	-	-	-	-	-	-
Boron (mg/L)	<0.05	-	-	**0.054**	-	-	**-**	-	**-**	<0.05	-	<0.05	-	-	**-**	-	-
Sodium (mg/L)	-	-	-	**21.6**	-	-	**-**	-	**-**	-	-	**15.2**	-	-	**-**	-	-
Other																	
DOC (mg/L)	**1.45**	**0.694**	<0.5	**1.02**	**3.47**	**29.8**	**16.5**	**17**	**17.3**	**1.17**	<0.5	**2.04**	**23.3**	**14.2**	**11.8**	**7.76**	**11.5**
Methane (µg/L)	<2	-	-	-	**-**	-	**-**	**-**	**-**	<2	-	-	**-**	-	**-**	**-**	-
Alkalinity as CaCO3 (mg/L)	-	**20**	**12**	**8**	-	-	**-**	**-**	**-**	-	**10**	**7**	-	-	**-**	**-**	-

Notes:

NS - Not Sampled

Bold - detected above the Minimum Detection Limit

D -Duplicate

1. DO was measured in the field as DO(%) and was converted using the online tool at: http://www.hbuehrer.ch/Rechner/O2satur.html

2. MW-12C references "MW-12" that was installed as part of the Nauset Regional Middle School monitoring well network.

3. Existing wells (MW-4, MW-8, MW-12C) screen elevations were determined based on field measurement of depth to bottom of well. Actual screen depths may vary if bottom was affected by silt build-up in well.

4. MW-12C (existing) was damaged during snow removal at the site in Winter 2017. A sample was unable to be taken during subsequent events. It was repaired in April 2018.

Table 3 Orleans Monitoring Well Groundwater Data Summary

Sample ID	**MW-B2050A**								**MW-B2050B**						
Top of Screen Elevation (ft)	-25.4								-10.4						
Bottom of Screen Elevation (ft)	-35.4								-20.4						
Sampling Date	11/03/2016[1]	1/10/2017	2/24/2017	6/28/2017	9/13/2017	1/9/2018	4/19/2018	9/19/2018	11/03/2016[1]	2/24/2017	6/28/2017	9/13/2017	1/9/2018	4/19/2018	9/19/2018
Type of Sample	Sample	Sample	Q1 Sample	Q2 Sample	Q3 Sample	Q4 Sample	Q5 Sample	Q6 Sample	Sample	Q1 Sample	Q2 Sample	Q3 Sample	Q4 Sample	Q5 Sample	Q6 Sample
Field Measurements															
pH (SU)	7.11	5.39	5.29	5.27	5.34	4.85	5.25	5.20	7.06	5.22	5.29	5.30	4.79	5.24	5.22
Temperature (^{o}C)	14.44	11.96	14.06	14.47	14.58	14.05	13.9	14.4	14.95	14.64	15.27	15.31	14.32	14.7	14.8
Dissolved Oxygen (DO, mg/L)	0.60	0.09	0.83	1.66	0.06	0.07	0.52	0.04	1.29	3.75	5.97	1.27	1.43	1.97	1.67
Redox Potential (ORP; mV)	0.80	182.80	251.80	217.00	98.90	147.00	197.8	156.5	80.50	304.60	242.20	169.70	156.90	203.3	168.4
Specific Conductivity (µS/cm)[c]	540.00	520.00	550.00	505.00	509.00	660.00	520.2	412.0	512.00	645.00	502.00	510.00	495.00	435.1	271.0
Turbidity (NTU)	50.70	8.10	14.10	26.70	5.04	4.16	10.40	5.25	123.00	4.67	5.78	0.61	1.54	0.50	1.02
Laboratory Analyses															
Nitrogen															
Nitrate as N (mg/L)	**35**	**39.3**	**27**	**32.8**	**25.5**	**11.6**	**24**	**22.9**	**4.75**	**3.64**	**5.27**	**3.94**	**1.72**	**4.04**	**4.94**
Nitrite as N (mg/L)	-	**0.025**	<0.010	<0.01	**0.166**	**0.04**	**0.179**	**0.215**	-	<0.010	<0.01	<0.01	**0.046**	<0.01	**0.011**
Ammonia (mg/L)	**1.05**	**0.87**	**0.89**	**1**	**0.63**	**0.78**	**0.83**	**0.68**	<0.1	<0.1	<0.1	<0.1	<0.1	**0.12**	<0.1
Total Kjeldahl Nitrogen (TKN)	-	**3.32**	**3.5**	-	**-**	<0.2	-	<0.2	-	**1.22**	-	-	<0.2	-	**0.35**
Total Nitrogen (mg/L)	**35.3**	-	**30.5**	**35.4**	**25.6**	**11.6**	**24.2**	-	**5.15**	**4.86**	**5.91**	**3.94**	**1.76**	**4.27**	-
Anions															
Chloride (mg/L)	**49.9**	**64.5**	**63.3**	**66.8**	**65.8**	**114**	**75.1**	**69.6**	**123**	**173**	**124**	**119**	**121**	**82.4**	**63.9**
Sulfate (mg/L)	**5.6**	**5.6**	**6.2**	**7.5**	**5.3**	**6.1**	**7.6**	**6.2**	**11.5**	**11.5**	**11**	**8.7**	**11.4**	**15.2**	**10.3**
Elements															
Dissolved Iron (mg/L)	**3.2**	-	<0.1	<0.1	**-**	<0.1	<0.2	<0.1	**0.551**	<0.1	<0.1	**-**	<0.1	<0.2	<0.1
Dissolved Manganese (mg/L)	**0.407**	-	**0.293**	**0.26**	**-**	**0.258**	**0.265**	**0.222**	**0.258**	**0.297**	**0.258**	**-**	**0.315**	**0.311**	**0.222**
Arsenic (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Boron (mg/L)	<0.05	-	<0.05	-	**-**	**-**	-	-	<0.05	<0.05	-	-	**-**	-	-
Sodium (mg/L)	-	-	**40**	-	**-**	**-**	-	-	-	**81.7**	-	-	**-**	-	-
Other															
DOC (mg/L)	**1.61**	-	**1.08**	**1.37**	**5.63**	**2.76**	**5.54**	**2.1**	**1.15**	**1.08**	**0.754**	**5.01**	**4.25**	**4.76**	**2.68**
Methane (µg/L)	-	-	-	**-**	**-**	**-**	**-**	-	-	-	**-**	-	**-**	**-**	-
Alkalinity as CaCO3 (mg/L)	-	**17**	**13**	-	**-**	**-**	**-**	-	-	**11**	-	-	**-**	**-**	-

Notes:

NS - Not Sampled

Bold - detected above the Minimum Detection Limit

D -Duplicate

1. DO was measured in the field as DO(%) and was converted using the online tool at: http://www.hbuehrer.ch/Rechner/O2satur.html

2. MW-12C references "MW-12" that was installed as part of the Nauset Regional Middle School monitoring well network.

3. Existing wells (MW-4, MW-8, MW-12C) screen elevations were determined based on field measurement of depth to bottom of well. Actual screen depths may vary if bottom was affected by silt build-up in well.

4. MW-12C (existing) was damaged during snow removal at the site in Winter 2017. A sample was unable to be taken during subsequent events. It was repaired in April 2018.

Table 3 Orleans Monitoring Well Groundwater Data Summary

Sample ID	**MW-B2050C**							**MW-B2075A**					
Top of Screen Elevation (ft)	4.6							-20.40					
Bottom of Screen Elevation (ft)	-5.4							-30.40					
Sampling Date	11/03/2016[1]	2/24/2017	6/28/2017	9/13/2017	1/9/2018	4/19/2018	9/19/2018	3/27/2017	6/28/2017	9/12/2017	1/10/2018	4/19/2018	9/25/2018
Type of Sample	Sample	Q1 Sample	Q2 Sample	Q3 Sample	Q4 Sample	Q5 Sample	Q6 Sample	Sample	Q2 Sample	Q3 Sample	Q4 Sample	Q5 Sample	Q6 Sample
Field Measurements													
pH (SU)	7.22	5.49	5.38	5.40	5.11	5.39	5.25	5.21	5.50	5.53	5.27	5.51	5.52
Temperature (^{o}C)	16.72	16.56	16.90	17.37	14.40	16.5	15.8	14.42	14.98	15.40	14.53	14.6	14.1
Dissolved Oxygen (DO, mg/L)	1.09	5.76	8.95	4.51	5.82	3.09	3.22	4.08	7.83	7.02	5.27	5.47	6.64
Redox Potential (ORP; mV)	82.50	179.50	236.30	177.90	171.50	207.7	179.7	130.70	234.90	205.30	173.40	152.7	193.6
Specific Conductivity (µS/cm)[c]	658.00	932.00	896.00	970.00	903.00	980.0	865.0	744.00	748.00	883.00	856.00	855.0	996.0
Turbidity (NTU)	212.00	36.10	9.68	20.03	16.10	86.50	120.00	159.00	3.85	43.20	333.00	414.00	24.90
Laboratory Analyses													
Nitrogen													
Nitrate as N (mg/L)	**3.01**	**1.68**	**3.05**	**2.19**	**1.41**	**2.9**	**3.47**	**0.348**	**0.539**	**0.676**	**0.762**	**0.642**	**0.81**
Nitrite as N (mg/L)	-	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ammonia (mg/L)	**0.11**	<0.1	**0.12**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	**0.12**	<0.1
Total Kjeldahl Nitrogen (TKN)	-	**0.66**	-	-	<0.2	-	<0.2	-	-		**0.31**	-	**0.45**
Total Nitrogen (mg/L)	**3.3**	**2.34**	**3.75**	**2.53**	**1.41**	**2.9**	-	**0.35**	**0.779**	**1.09**	**1.07**	**1.33**	
Anions													
Chloride (mg/L)	-	**251**	**253**	**278**	**257**	**270**	**315**	**246**	**214**	**261**	**257**	**268**	**308**
Sulfate (mg/L)	**11.9**	**11.1**	**10.1**	**8.9**	**9.6**	**13.5**	**9.3**	**5.7**	<5	**5.4**	**6.5**	**7.7**	**7.7**
Elements													
Dissolved Iron (mg/L)	-	**0.308**	<0.1	**-**	<0.1	<0.2	<0.1	**0.119**	<0.1	**-**	<0.1	<0.2	<0.1
Dissolved Manganese (mg/L)	-	**0.254**	**0.13**	**-**	**0.102**	**0.09**	**0.077**	**0.529**	**0.062**	**-**	**0.069**	**0.051**	**0.028**
Arsenic (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-
Boron (mg/L)	-	<0.05	-	-	**-**	-	-	**-**	**-**	**-**	**-**	-	**-**
Sodium (mg/L)	-	**120**	-	-	**-**	-	-	**-**	**-**	**-**	**-**	-	**-**
Other													
DOC (mg/L)	**1.13**	**0.87**	**0.639**	**3.73**	**2.75**	**2.93**	**1.33**	**1.08**	**0.668**	**0.722**	**2.26**	**0.882**	**1.31**
Methane (µg/L)	-	-	**-**	-	**-**	**-**	-	**-**	**-**	**-**	**-**	**-**	**-**
Alkalinity as CaCO3 (mg/L)	-	**9**	-	-	**-**	**-**	-	**-**	**-**	**-**	**-**	**-**	**-**

Notes:

NS - Not Sampled

Bold - detected above the Minimum Detection Limit

D -Duplicate

1. DO was measured in the field as DO(%) and was converted using the online tool at: http://www.hbuehrer.ch/Rechner/O2satur.html

2. MW-12C references "MW-12" that was installed as part of the Nauset Regional Middle School monitoring well network.

3. Existing wells (MW-4, MW-8, MW-12C) screen elevations were determined based on field measurement of depth to bottom of well. Actual screen depths may vary if bottom was affected by silt build-up in well.

4. MW-12C (existing) was damaged during snow removal at the site in Winter 2017. A sample was unable to be taken during subsequent events. It was repaired in April 2018.

Table 3 Orleans Monitoring Well Groundwater Data Summary

Sample ID	**MW-B2100C**								**MW-BC4A**		**MW-BC4B**		**MW-BC4C**		**MW-BM050A**	
Top of Screen Elevation (ft)	9.6								-26.50		-11.50		3.50		-25.32	
Bottom of Screen Elevation (ft)	-0.4								-36.50		-21.50		-6.50		-35.32	
Sampling Date	10/4/2016	11/03/2016[1]	2/24/2017	6/28/2017	9/12/2017	1/10/2018	4/19/2018	9/25/2018	5/8/2018	9/20/2018	5/8/2018	9/20/2018	5/8/2018	9/20/2018	5/8/2018	9/20/2018
Type of Sample	Sample	Sample	Q1 Sample	Q2 Sample	Q3 Sample	Q4 Sample	Q5 Sample	Q6 Sample	D2 Baseline	Q6 Sample	D2 Baseline	Q6 Sample	D2 Baseline	Q6 Sample	D2 Baseline	Q6 Sample
Field Measurements																
pH (SU)	5.26	6.98	5.46	5.27	5.41	4.93	5.32	6.09	5.34	4.32	5.34	5.40	5.37	5.21	5.90	4.83
Temperature (^{o}C)	14.42	14.95	16.84	14.44	14.43	14.55	14.4	14.0	11.2	13.6	12.1	17.6	12.0	15.2	12.0	14.0
Dissolved Oxygen (DO, mg/L)	5.90	1.50	7.37	10.84	5.09	4.99	4.35	4.71	0.13	0.95	0.06	1.68	0.09	0.30	0.77	1.03
Redox Potential (ORP; mV)	110.50	124.70	189.80	217.40	216.7	206	172.3	85.7	74.1	119.9	100.3	164.3	120.1	173.6	27.5	32.9
Specific Conductivity (µS/cm)[c]	272.00	297.00	346.00	364.00	377	378	322.8	458.0	601.8	326.0	567.0	274.0	380.5	287.0	811.2	570.0
Turbidity (NTU)	-	8.44	OVER	5.71	2.97	2.87	0.50	10.00	14.00	3.85	4.11	520.00	4.49	over	13.20	53.20
Laboratory Analyses																
Nitrogen																
Nitrate as N (mg/L)	**1.29**	**1.29**	**0.959**	**0.724**	**0.903**	**1.13**	**1.23**	**2.43**	**5.65**	**1.72**	**1.25**	**1.88**	**1.47**	**2.67**	**2.57**	**2.23**
Nitrite as N (mg/L)	-	-	<0.010	<0.01	<0.01	<0.01	<0.01	<0.01	<0.25	**0.164**	**0.25**	**0.324**	**0.27**	**0.521**	<0.25	<0.01
Ammonia (mg/L)	<0.1	<0.1	<0.1	<0.1	**0.1**	<0.1	<0.1	<0.1	**0.38**	<0.1	**0.36**	<0.1	**0.22**	<0.1	**0.24**	<0.1
Total Kjeldahl Nitrogen (TKN)	**0.72**	-	**0.54**	-		**0.21**	-	**0.39**	**0.97**	**0.46**	**0.64**	**0.52**	**0.54**	**0.39**	**0.57**	**0.45**
Total Nitrogen (mg/L)	**2.01**	**1.29**	**1.5**	**0.724**	**1.31**	**1.33**	**1.57**		**0.97**		**0.64**		**0.54**		**0.57**	
Anions																
Chloride (mg/L)	**65.4**	**67.8**	**83.2**	**96.4**	**97.3**	**97.8**	**72.5**	**116**	**77.2**	**60.2**	**70.7**	**72.6**	**33.2**	**72.1**	**150**	**153**
Sulfate (mg/L)	**14.1**	**16.2**	**12.1**	**10**	**8.3**	**10.8**	**13.9**	**9.4**	**14.8**	**27.5**	**26.3**	**33**	**25.6**	**17.8**	**7.7**	<5
Elements																
Dissolved Iron (mg/L)	**0.115**	-	**0.147**	<0.1	**-**	<0.1	<0.2	<0.1	**0.212**	<0.1	**0.491**	**0.217**	**0.486**	<0.1	**1.83**	**0.143**
Dissolved Manganese (mg/L)	**0.126**	-	**0.196**	**0.114**	**-**	**0.102**	**0.096**	**0.119**	**0.176**	**0.075**	**0.296**	**0.428**	**0.173**	**0.278**	**0.211**	**0.163**
Arsenic (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Boron (mg/L)	<0.05	-	<0.05	-	**-**	**-**	-	-	-	-	-	-	-	**-**	-	**-**
Sodium (mg/L)	-	-	**53.7**	-	**-**	**-**	-	-	-	-	-	-	-	**-**	-	**-**
Other																
DOC (mg/L)	<0.5	**0.866**	**0.862**	**0.959**	**0.78**	**2.28**	**2.25**	**1.17**	**6.67**	**11.4**	**13.5**	**14.1**	**9.39**	**7.49**	**1.2**	**1.33**
Methane (µg/L)	<2	-	-	-	**-**	**-**	**-**	-	**-**	-	**-**	-	**-**	**-**	**-**	**-**
Alkalinity as CaCO3 (mg/L)	-	-	**14**	-	**-**	**-**	**-**	-	**-**	-	**-**	-	**-**	**-**	**-**	**-**

Notes:

NS - Not Sampled

Bold - detected above the Minimum Detection Limit

D -Duplicate

1. DO was measured in the field as DO(%) and was converted using the online tool at: http://www.hbuehrer.ch/Rechner/O2satur.html

2. MW-12C references "MW-12" that was installed as part of the Nauset Regional Middle School monitoring well network.

3. Existing wells (MW-4, MW-8, MW-12C) screen elevations were determined based on field measurement of depth to bottom of well. Actual screen depths may vary if bottom was affected by silt build-up in well.

4. MW-12C (existing) was damaged during snow removal at the site in Winter 2017. A sample was unable to be taken during subsequent events. It was repaired in April 2018.

Table 3 Orleans Monitoring Well Groundwater Data Summary

Sample ID	MW-BM050B		MW-BM050C		MW-BN1A		MW-BN1B		MW-BN1C		MB-BN2C		MW-BX2A		MW-BX2B		MW-BX2C	
Top of Screen Elevation (ft)	-10.20		4.80		-25.50		-10.60		4.38		10.21		-23.60		-8.60		6.47	
Bottom of Screen Elevation (ft)	-20.20		-5.20		-35.50		-20.60		-5.63		0.21		-33.60		-18.60		-3.53	
Sampling Date	5/8/2018	9/20/2018	5/9/2018	9/20/2018	5/9/2018	9/20/2018	5/9/2018	9/20/2018	5/9/2018	9/20/2018	5/9/2018	9/25/2018	5/9/2018	9/20/2018	5/9/2018	9/25/2018	5/9/2018	9/20/2018
Type of Sample	D2 Baseline	Q6 Sample	D2 Baseline	Q6 Sample	D2 Baseline	Q6 Sample	D2 Baseline	Q6 Sample	D2 Baseline	Q6 Sample	D2 Baseline	Q6 Sample	D2 Baseline	Q6 Sample	D2 Baseline	Q6 Sample	D2 Baseline	Q6 Sample
Field Measurements																		
pH (SU)	5.38	4.48	5.47	4.37	5.39	4.39	5.50	4.52	NS	5.08	5.20	5.40	4.79	4.96	4.68	4,05	4.74	4.85
Temperature (^{o}C)	13.4	14.6	12.6	15.1	11.5	14.0	12.0	14.1	NS	14.4	14.6	15.4	10.9	13.8	11.1	13.4	11.6	17.7
Dissolved Oxygen (DO, mg/L)	0.01	0.30	4.05	5.31	0.00	0.21	0.08	0.26	NS	0.86	3.75	4.71	0.00	3.56	1.12	1.58	3.79	3.21
Redox Potential (ORP; mV)	132.2	35.5	186.9	78.7	178.3	38.8	169.2	46.3	NS	32.7	147.8	20.3	234.0	215.0	250.5	23.5	257.1	202.8
Specific Conductivity (µS/cm)[c]	1312.5	886.0	717.0	649.0	405.6	267.0	623.8	369.0	NS	628.0	9096.0	2223.0	713.1	184.0	690.0	290.0	769.4	395.0
Turbidity (NTU)	1.54	3.53	7.00	7.70	18.00	48.10	6.29	2.41	NS	19.10	186.00	165.00	1.04	200.00	4.18	2.97	7.37	over
Laboratory Analyses																		
Nitrogen																		
Nitrate as N (mg/L)	**4.9**	**6.39**	**1.06**	**1.05**	**10.1**	**11.1**	**8.85**	**10.6**	NS	**9.66**	**0.84**	**0.942**	**29**	**10.8**	**27.9**	**9.55**	**39.7**	**42.8**
Nitrite as N (mg/L)	<0.25	**0.016**	<0.25	<0.01	<0.25	**0.019**	<0.25	**0.046**	NS	**0.128**	<0.25	<0.01	<0.25	<0.01	<0.25	**0.198**	<0.25	<0.01
Ammonia (mg/L)	**0.55**	**1.52**	**0.12**	<0.1	**0.5**	**1.13**	**0.72**	**1.26**	NS	**9.97**	<0.1	<0.1	**0.57**	<0.1	**0.3**	**0.11**	**0.29**	<0.1
Total Kjeldahl Nitrogen (TKN)	**0.37**	**2.15**	**0.59**	**0.4**	<0.2	**1.32**	**0.45**	**1.16**	NS	**11.4**	**0.32**	**0.61**	**0.25**	**0.32**	<0.2	**0.42**	<0.2	<0.2
Total Nitrogen (mg/L)	**0.37**		**1.65**		**10.1**		**9.3**	**-**	NS		**1.16**		**29.2**		**27.9**		**39.7**	
Anions																		
Chloride (mg/L)	**258**	**238**	**115**	**193**	**28**	**28.2**	**70.6**	**52.3**	NS	**109**	**2620**	**1000**	**42.2**	**26.5**	**43**	**29.7**	**29.3**	**34**
Sulfate (mg/L)	**25.7**	**17.3**	<5	<5	**20.2**	**16.7**	**33.2**	**24.7**	NS	**28.1**	<5	**5.7**	**8.6**	**9.8**	**9.6**	**16.9**	**7.3**	**7.2**
Elements																		
Dissolved Iron (mg/L)	**0.537**	<0.1	**0.348**	<0.1	**0.225**	**0.248**	**0.33**	<0.1	NS	<0.1	**2.68**	<0.1	<0.1	**0.159**	<0.1	<0.1	<0.1	**0.164**
Dissolved Manganese (mg/L)	**0.319**	**0.06**	**0.072**	**0.041**	**0.342**	**0.232**	**0.089**	**0.042**	NS	**0.36**	**0.944**	**0.158**	**0.614**	**0.143**	**0.433**	**0.324**	**0.833**	**0.728**
Arsenic (mg/L)	-	-	-	-	-	-	-	-	NS	-	-	-	-	<0.0025	-	<0.0025		<0.0025
Boron (mg/L)	-	-	-	**-**	-	**-**	-	**-**	NS	-	-	-	-	-	-	-	-	-
Sodium (mg/L)	-	-	-	**-**	-	**-**	-	**-**	NS	-	-	-	-	-	-	-	-	-
Other																		
DOC (mg/L)	**2.42**	**2.26**	**2.43**	**1.38**	**3.69**	**2.83**	**6.18**	**3.66**	NS	**4.16**	**1.15**	**1.01**	**5.32**	**1.41**	**4.89**	**27.7**	**4.18**	**1.36**
Methane (µg/L)	**-**	-	**-**	**-**	**-**	**-**	**-**	**-**	NS	-	**-**	-	**-**	-	**-**	-	**-**	-
Alkalinity as CaCO3 (mg/L)	**-**	-	**-**	**-**	**-**	**-**	**-**	**-**	NS	-	**-**	-	**-**	-	**-**	-	**-**	-

Notes:

NS - Not Sampled

Bold - detected above the Minimum Detection Limit

D -Duplicate

1. DO was measured in the field as DO(%) and was converted using the online tool at: http://www.hbuehrer.ch/Rechner/O2satur.html

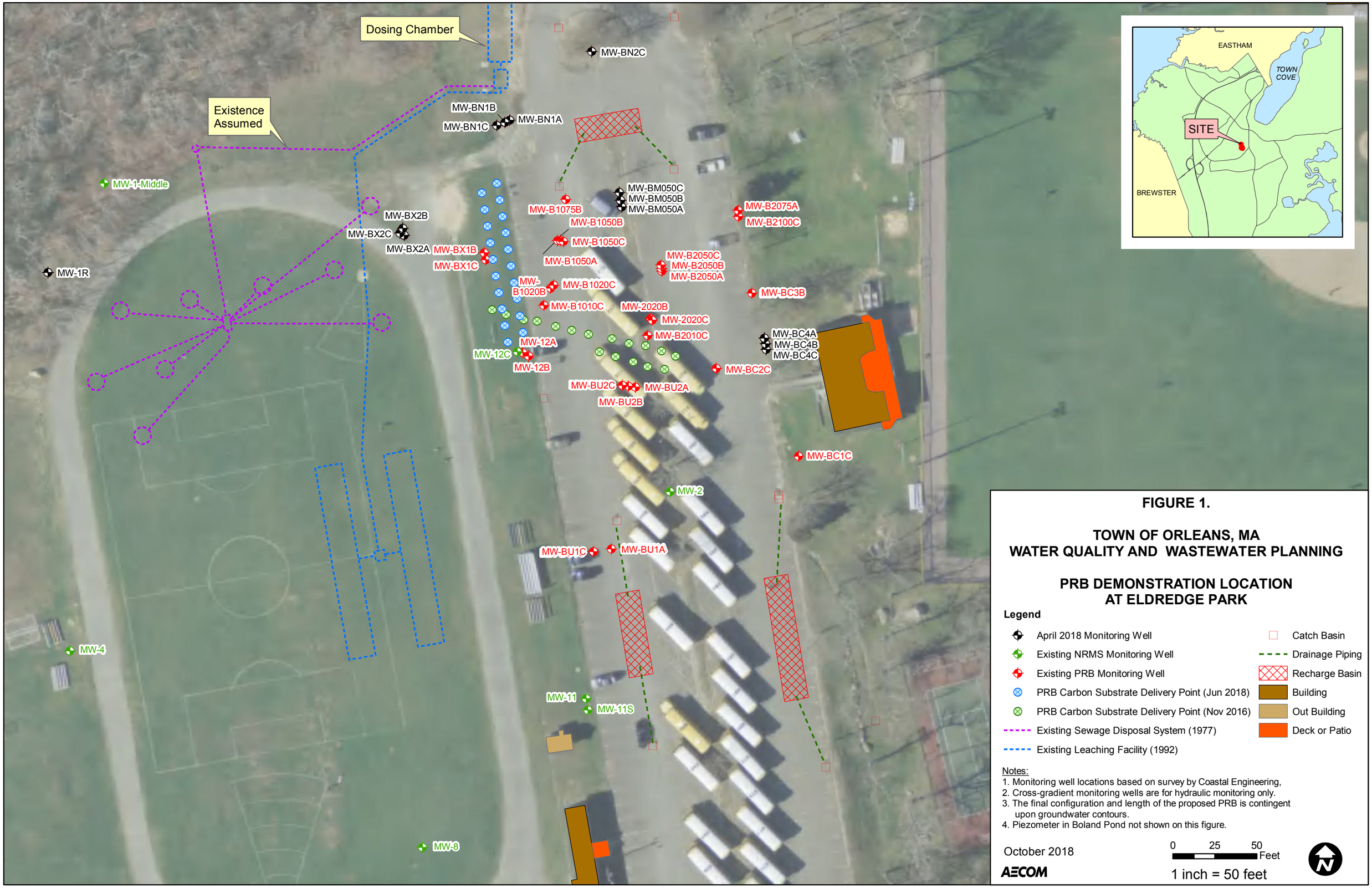
2. MW-12C references "MW-12" that was installed as part of the Nauset Regional Middle School monitoring well network.

3. Existing wells (MW-4, MW-8, MW-12C) screen elevations were determined based on field measurement of depth to bottom of well. Actual screen depths may vary if bottom was affected by silt build-up in well.

4. MW-12C (existing) was damaged during snow removal at the site in Winter 2017. A sample was unable to be taken during subsequent events. It was repaired in April 2018.

Figures

This Page Intentionally Left Blank.



G:\Projects\MUNI\60476644ORL\Maps\PRB_Figure1_EldredgePark.mxd

FIGURE 1.

TOWN OF ORLEANS, MA
WATER QUALITY AND WASTEWATER PLANNING

PRB DEMONSTRATION LOCATION AT ELDREDGE PARK

Legend

- April 2018 Monitoring Well
- Existing NRMS Monitoring Well
- Existing PRB Monitoring Well
- PRB Carbon Substrate Delivery Point (Jun 2018)
- PRB Carbon Substrate Delivery Point (Nov 2016)
- Existing Sewage Disposal System (1977)
- Existing Leaching Facility (1992)
- Catch Basin
- Drainage Piping
- Recharge Basin
- Building
- Out Building
- Deck or Patio

Notes:
1. Monitoring well locations based on survey by Coastal Engineering,
2. Cross-gradient monitoring wells are for hydraulic monitoring only.
3. The final configuration and length of the proposed PRB is contingent upon groundwater contours.
4. Piezometer in Boland Pond not shown on this figure.

October 2018

AECOM

0 25 50 Feet

1 inch = 50 feet

MW-BN2C
MW-BN1B
MW-BN1A
MW-BN1C
N40
N30
N39
N29
N38
MW-B1075B
MW-BM050C
MW-BM050B
MW-BM050A
MW-B2075A
MW-B2100C
MW-BX2B
MW-BX2C
MW-BX2A
N28
N37
MW-B1050A
MW-B1050B
MW-B1050C
N27
N36
MW-BX1B
MW-BX1C
N26
N35
MW-B2050C
MW-B2050B
MW-B2050A
N25
N34
MW-B1020C
MW-B1020B
N24
N33
MW-BC3B
N23
MW-B1010C
N32
MW-2020B
MW-2020C
N22
N31
MW-B2010C
MW-BC4A
MW-BC4B
MW-BC4C
N21
MW-12C
MW-12A
MW-12B
MW-BC2C
MW-BU2C
MW-BU2A
MW-BU2B

FIGURE 2.

TOWN OF ORLEANS, MA
WATER QUALITY AND WASTEWATER PLANNING

PRB DEMONSTRATION LOCATION AT ELDREDGE PARK

Legend

- April 2018 Monitoring Well
- Existing NRMS Monitoring Well
- Existing PRB Monitoring Well
- PRB Carbon Substrate Delivery Point (Jun 2018)
- PRB Carbon Substrate Delivery Point (Nov 2016)
- Catch Basin
- Drainage Piping
- Recharge Basin

October 2018

AECOM

0 10 20 Feet

1 inch = 20 feet

N

G:\Projects\MUN\60476644\ORL\Maps\PRB_Figure2_EldredgePark.mxd

Appendix A: ISOTEC Injection Summary

This Page Intentionally Left Blank.

PRB- Demonstration Test Injection Summary Event II
SRS-NR Injection Totals
AECOM/ Site B-Eldredge Park
Orleans, Massachusetts
ISOTEC #802166

ISOTEC

Date Completed	Injection Point ID	Screen Interval (ft bgs)	SRS-NR Concentration (%)	SRS-NR Injection Time (mins)	SRS-NR Volume (gal)	SRS-NR Flow Rate (gpm)	60% SRS-NR (gal)	Lactate (gal)	Max Well Head Pressure (psi)	Comments
21-Jun-18	N-21	72-64'	14%	28	150	5.36	37.50	2.25	30	
21-Jun-18	N-21	64-56'	14%	36	150	4.17	37.50	2.25	30	
21-Jun-18	N-21	56-48'	14%	28	150	5.36	37.50	2.25	0	
21-Jun-18	N-21	48-40'	14%	24	150	6.25	37.50	2.25	0	
21-Jun-18	N-21	40-32'	14%	32	140	4.38	35.00	2.10	10	
21-Jun-18	N-21	64-56'	14%	30	150	5.00	37.50	2.25	0	
21-Jun-18	N-21	48-40'	14%	38	150	3.95	37.50	2.25	10	
21-Jun-18	N-22	72-64'	14%	54	150	2.78	37.50	2.25	50	
21-Jun-18	N-22	56-48'	14%	26	150	5.77	37.50	2.25	0	
21-Jun-18	N-22	40-32'	14%	36	140	3.89	35.00	2.10	15	
21-Jun-18	N-23	72-64'	14%	38	150	3.95	37.50	2.25	70	
21-Jun-18	N-23	64-56'	14%	36	150	4.17	37.50	2.25	30	
21-Jun-18	N-23	56-48'	14%	45	150	3.33	37.50	2.25	30	
21-Jun-18	N-23	48-40'	14%	32	150	4.69	37.50	2.25	30	
21-Jun-18	N-23	40-32'	14%	36	140	3.89	35.00	2.10	40	
19-Jun-18	N-24	72-64'	14%	31	150	4.84	37.50	2.25	26	
19-Jun-18	N-24	64-56'	14%	29	150	5.17	37.50	2.25	14	
19-Jun-18	N-24	56-48'	14%	30	150	5.00	37.50	2.25	20	
19-Jun-18	N-24	48-40'	14%	30	150	5.00	37.50	2.25	10	
19-Jun-18	N-24	40-32'	14%	32	140	4.38	35.00	2.10	8	
20-Jun-18	N-25	72-64'	14%	30	150	5.00	37.50	2.25	30	
20-Jun-18	N-25	64-56'	14%	25	150	6.00	37.50	2.25	22	
20-Jun-18	N-25	56-48'	14%	30	150	5.00	37.50	2.25	10	
20-Jun-18	N-25	48-40'	14%	30	150	5.00	37.50	2.25	0	
20-Jun-18	N-25	40-32'	14%	28	140	5.00	35.00	2.10	0	
19-Jun-18	N-26	72-64'	14%	32	150	4.69	37.50	2.25	30	
19-Jun-18	N-26	64-56'	14%	27	150	5.56	37.50	2.25	0	
19-Jun-18	N-26	56-48'	14%	22	150	6.82	37.50	2.25	0	
19-Jun-18	N-26	48-40'	14%	26	150	5.77	37.50	2.25	0	
19-Jun-18	N-26	40-32'	14%	26	140	5.38	35.00	2.10	0	
18-Jun-18	N-27	72-64'	14%	30	150	5.00	37.50	2.25	20	Hit refusal @ 19', reinstalled 1' north.
18-Jun-18	N-27	64-56'	14%	30	150	5.00	37.50	2.25	20	
18-Jun-18	N-27	56-48'	14%	34	150	4.41	37.50	2.25	2	
18-Jun-18	N-27	48-40'	14%	34	150	4.41	37.50	2.25	4	
18-Jun-18	N-27	40-32'	14%	30	140	4.67	35.00	2.10	4	
20-Jun-18	N-28	72-64'	14%	36	150	4.17	37.50	2.25	30	
20-Jun-18	N-28	64-56'	14%	32	150	4.69	37.50	2.25	18	
20-Jun-18	N-28	56-48'	14%	30	150	5.00	37.50	2.25	15	
20-Jun-18	N-28	48-40'	14%	30	150	5.00	37.50	2.25	10	
20-Jun-18	N-28	40-32'	14%	28	140	5.00	35.00	2.10	10	
18-Jun-18	N-29	72-64'	14%	46	150	3.26	37.50	2.25	40	
18-Jun-18	N-29	64-56'	14%	30	150	5.00	37.50	2.25	5	
18-Jun-18	N-29	56-48'	14%	35	150	4.29	37.50	2.25	5	
18-Jun-18	N-29	48-40'	14%	40	150	3.75	37.50	2.25	10	
18-Jun-18	N-29	40-32'	14%	30	140	4.67	35.00	2.10	20	
19-Jun-18	N-30	72-64'	14%	37	150	4.05	37.50	2.25	4	
19-Jun-18	N-30	64-56'	14%	28	150	5.36	37.50	2.25	2	
19-Jun-18	N-30	56-48'	14%	27	150	5.56	37.50	2.25	4	
19-Jun-18	N-30	48-40'	14%	31	150	4.84	37.50	2.25	4	
19-Jun-18	N-30	40-32'	14%	32	140	4.38	35.00	2.10	2	
21-Jun-18	N-31	72-64'	14%	40	150	3.75	37.50	2.25	70	
21-Jun-18	N-31	64-56'	14%	46	150	3.26	37.50	2.25	30	Screen foulded, reinstalled 1' south.
21-Jun-18	N-31	56-48'	14%	24	150	6.25	37.50	2.25	0	
21-Jun-18	N-31	48-40'	14%	50	150	3.00	37.50	2.25	16	Surfacing from annulus.
21-Jun-18	N-31	40-32'	14%	48	140	2.92	35.00	2.10	10	Surfacing from annulus.
21-Jun-18	N-32	72-64'	14%	28	150	5.36	37.50	2.25	12	
21-Jun-18	N-32	64-56'	14%	28	150	5.36	37.50	2.25	8	
21-Jun-18	N-32	56-48'	14%	24	150	6.25	37.50	2.25	2	
21-Jun-18	N-32	48-40'	14%	26	150	5.77	37.50	2.25	12	
21-Jun-18	N-32	40-32'	14%	28	140	5.00	35.00	2.10	14	
21-Jun-18	N-33	72-64'	14%	34	150	4.41	37.50	2.25	55	
21-Jun-18	N-33	64-56'	14%	28	150	5.36	37.50	2.25	8	
21-Jun-18	N-33	56-48'	14%	28	150	5.36	37.50	2.25	14	
21-Jun-18	N-33	48-40'	14%	34	150	4.41	37.50	2.25	10	
21-Jun-18	N-33	40-32'	14%	26	140	5.38	35.00	2.10	0	
20-Jun-18	N-34	72-64'	14%	40	150	3.75	37.50	2.25	50	
20-Jun-18	N-34	64-56'	14%	36	150	4.17	37.50	2.25	40	
20-Jun-18	N-34	56-48'	14%	25	150	6.00	37.50	2.25	45	
20-Jun-18	N-34	48-40'	14%	31	150	4.84	37.50	2.25	40	
20-Jun-18	N-34	40-32'	14%	30	140	4.67	35.00	2.10	20	
18-Jun-18	N-35	72-64'	14%	54	150	2.78	37.50	2.25	10	
18-Jun-18	N-35	64-56'	14%	34	150	4.41	37.50	2.25	0	
18-Jun-18	N-35	56-48'	14%	30	150	5.00	37.50	2.25	16	
18-Jun-18	N-35	48-40'	14%	30	150	5.00	37.50	2.25	10	
19-Jun-18	N-35	40-32'	14%	35	140	4.00	35.00	2.10	10	
19-Jun-18	N-36	72-64'	14%	33	150	4.55	37.50	2.25	12	
19-Jun-18	N-36	64-56'	14%	30	150	5.00	37.50	2.25	6	
19-Jun-18	N-36	56-48'	14%	30	150	5.00	37.50	2.25	10	
19-Jun-18	N-36	48-40'	14%	28	150	5.36	37.50	2.25	2	
19-Jun-18	N-36	40-32'	14%	27	140	5.19	35.00	2.10	2	
19-Jun-18	N-37	72-64'	14%	26	150	5.77	37.50	2.25	4	Installed @ 72', screen would not expose hit obstruction @25'. Re-installed 1' north.
19-Jun-18	N-37	64-56'	14%	27	150	5.56	37.50	2.25	0	
19-Jun-18	N-37	56-48'	14%	28	150	5.36	37.50	2.25	0	
19-Jun-18	N-37	48-40'	14%	30	150	5.00	37.50	2.25	10	
19-Jun-18	N-37	40-32'	14%	30	140	4.67	35.00	2.10	10	
20-Jun-18	N-38	72-64'	14%	36	150	4.17	37.50	2.25	14	
20-Jun-18	N-38	64-56'	14%	36	150	4.17	37.50	2.25	8	
20-Jun-18	N-38	56-48'	14%	27	150	5.56	37.50	2.25	8	
20-Jun-18	N-38	48-40'	14%	31	150	4.84	37.50	2.25	8	
20-Jun-18	N-38	40-32'	14%	30	140	4.67	35.00	2.10	4	

PRB- Demonstration Test Injection Summary Event II
SRS-NR Injection Totals
AECOM/ Site B-Eldredge Park
Orleans, Massachusetts
ISOTEC #802166

Date Completed	Injection Point ID	Screen Interval (ft bgs)	SRS-NR Concentration (%)	SRS-NR Injection Time (mins)	SRS-NR Volume (gal)	SRS-NR Flow Rate (gpm)	60% SRS-NR (gal)	Lactate (gal)	Max Well Head Pressure (psi)	Comments
19-Jun-18	N-39	72-64'	14%	30	150	5.00	37.50	2.25	2	
19-Jun-18	N-39	64-56'	14%	30	150	5.00	37.50	2.25	8	
19-Jun-18	N-39	56-48'	14%	32	150	4.69	37.50	2.25	8	
19-Jun-18	N-39	48-40'	14%	30	150	5.00	37.50	2.25	12	
20-Jun-18	N-39	40-32'	14%	43	140	3.26	35.00	2.10	35	
20-Jun-18	N-40	72-64'	14%	31	150	4.84	37.50	2.25	15	
20-Jun-18	N-40	64-56'	14%	28	150	5.36	37.50	2.25	0	
20-Jun-18	N-40	56-48'	14%	30	150	5.00	37.50	2.25	0	
20-Jun-18	N-40	48-40'	14%	28	150	5.36	37.50	2.25	10	
20-Jun-18	N-40	40-32'	14%	38	140	3.68	35.00	2.10	10	
		Totals			14,800	4.62	3696	225.00		

NOTES:
SRS-NR = ~14.2% SRS-NR EVO
mins = minutes
ft bgs = feet below ground surface
gal = gallons
gpm = gallons per minute
psi = pounds per square inch

Appendix B: PRB Extension Injection Activities Photo Log

This Page Intentionally Left Blank.

PRB Demonstration Test – Extension – June 2018

Eldredge Park, Orleans, MA

Field Activities Photo Log

Injection area is blocked off by cones. The water tank is on the right and the drill rig in the center.

Close up of the water tank is on the right and the drill rig on the left.

EVO totes in white. Injections into one direct-push point is in progress.

Mixing tanks for EVO.

EVO totes and mixing tanks.

Staging area for EVO totes.

Cones to block off work area.

EVO totes staging area with secondary containment.

Cones on the left blocking off the water tanker and EVO mixing tanks area.

Mixing area which provides dilution for the EVO prior to injection.

Mixing area which provides dilution for the EVO prior to injection. Pumps are shown which pumped the EVO to the direct-push points.

Drill rig being used for direct-push points. Two in-progress points are shown on each side.

Drill rig used for direct-push points and some extra rods shown on the ground.


PENSKE
Truck Rental
TUNDRA

This Page Intentionally Left Blank.

Appendix C: PRB Extension Laboratory Reports

This Page Intentionally Left Blank.

CERTIFICATE OF ANALYSIS

Mark Owen
AECOM Environment - ENSR
9 Jonathon Bourne Dr.
Pocasset, MA 02559

RE: Orleans MA (60476644)
ESS Laboratory Work Order Number: 1804527

This signed Certificate of Analysis is our approved release of your analytical results. These results are only representative of sample aliquots received at the laboratory. ESS Laboratory expects its clients to follow all regulatory sampling guidelines. Beginning with this page, the entire report has been paginated. This report should not be copied except in full without the approval of the laboratory. Samples will be disposed of thirty days after the final report has been delivered. If you have any questions or concerns, please feel free to call our Customer Service Department.

Laurel Stoddard
Laboratory Director

REVIEWED
By ESS Laboratory at 3:37 pm, Apr 27, 2018

Analytical Summary
The project as described above has been analyzed in accordance with the ESS Quality Assurance Plan. This plan utilizes the following methodologies: US EPA SW-846, US EPA Methods for Chemical Analysis of Water and Wastes per 40 CFR Part 136, APHA Standard Methods for the Examination of Water and Wastewater, American Society for Testing and Materials (ASTM), and other recognized methodologies. The analyses with these noted observations are in conformance to the Quality Assurance Plan. In chromatographic analysis, manual integration is frequently used instead of automated integration because it produces more accurate results.

The test results present in this report are in compliance with TNI and relative state standards, and/or client Quality Assurance Project Plans (QAPP). The laboratory has reviewed the following: Sample Preservations, Hold Times, Initial Calibrations, Continuing Calibrations, Method Blanks, Blank Spikes, Blank Spike Duplicates, Duplicates, Matrix Spikes, Matrix Spike Duplicates, Surrogates and Internal Standards. Any results which were found to be outside of the recommended ranges stated in our SOPs will be noted in the Project Narrative.

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1804527

SAMPLE RECEIPT

The following samples were received on April 18, 2018 for the analyses specified on the enclosed Chain of Custody Record.

The samples and analyses listed below were analyzed in accordance with the Guidelines Establishing Test Procedures for the Analysis of Pollutants, 40 CFR Part 136, as amended.

Lab Number	Sample Name	Matrix	Analysis
1804527-01	MW-BM050A - Sand	Soil	9060
1804527-02	MW-BM050A - Silt	Soil	9060

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1804527

PROJECT NARRATIVE

No unusual observations noted.

End of Project Narrative.

DATA USABILITY LINKS

To ensure you are viewing the most current version of the documents below, please clear your internet cookies for www.ESSLaboratory.com. Consult your IT Support personnel for information on how to clear your internet cookies.

Definitions of Quality Control Parameters

Semivolatile Organics Internal Standard Information

Semivolatile Organics Surrogate Information

Volatile Organics Internal Standard Information

Volatile Organics Surrogate Information

EPH and VPH Alkane Lists

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1804527

CURRENT SW-846 METHODOLOGY VERSIONS

Analytical Methods

1010A - Flashpoint
6010C - ICP
6020A - ICP MS
7010 - Graphite Furnace
7196A - Hexavalent Chromium
7470A - Aqueous Mercury
7471B - Solid Mercury
8011 - EDB/DBCP/TCP
8015C - GRO/DRO
8081B - Pesticides
8082A - PCB
8100M - TPH
8151A - Herbicides
8260B - VOA
8270D - SVOA
8270D SIM - SVOA Low Level
9014 - Cyanide
9038 - Sulfate
9040C - Aqueous pH
9045D - Solid pH (Corrosivity)
9050A - Specific Conductance
9056A - Anions (IC)
9060A - TOC
9095B - Paint Filter
MADEP 04-1.1 - EPH / VPH

Prep Methods

3005A - Aqueous ICP Digestion
3020A - Aqueous Graphite Furnace / ICP MS Digestion
3050B - Solid ICP / Graphite Furnace / ICP MS Digestion
3060A - Solid Hexavalent Chromium Digestion
3510C - Separatory Funnel Extraction
3520C - Liquid / Liquid Extraction
3540C - Manual Soxhlet Extraction
3541 - Automated Soxhlet Extraction
3546 - Microwave Extraction
3580A - Waste Dilution
5030B - Aqueous Purge and Trap
5030C - Aqueous Purge and Trap
5035 - Solid Purge and Trap

SW846 Reactivity Methods 7.3.3.2 (Reactive Cyanide) and 7.3.4.1 (Reactive Sulfide) have been withdrawn by EPA. These methods are reported per client request and are not NELAP accredited.

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1804527

Classical Chemistry

Client Sample ID: MW-BM050A - Sand
Date Sampled: 04/17/18 16:00
Percent Solids: N/A

ESS Laboratory Sample ID: 1804527-01
Sample Matrix: Soil

All methods used are in accordance with 40 CFR 136.

Analyte	Results	Units	MRL	Method	DF	Analyst	Analyzed
Total Organic Carbon (Average)	ND	mg/kg dry wt	85.8	9060	1	CCP	04/21/18 16:43

Client Sample ID: MW-BM050A - Silt
Date Sampled: 04/17/18 16:05
Percent Solids: N/A

ESS Laboratory Sample ID: 1804527-02
Sample Matrix: Soil

All methods used are in accordance with 40 CFR 136.

Analyte	Results	Units	MRL	Method	DF	Analyst	Analyzed
Total Organic Carbon (Average)	ND	mg/kg dry wt	72.8	9060	1	CCP	04/21/18 15:10

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1804527

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Classical Chemistry										
Batch CD82101 - General Preparation										
Blank										
Total Organic Carbon (1)	ND	100	mg/kg							
Total Organic Carbon (2)	ND	100	mg/kg							
Total Organic Carbon (Average)	ND	100	mg/kg dry wt							
LCS										
Total Organic Carbon (1)	10500	100	mg/kg	10000		105	80-120			
Total Organic Carbon (2)	10600	100	mg/kg	10000		106	80-120			
Total Organic Carbon (Average)	10500	100	mg/kg dry wt							
LCS Dup										
Total Organic Carbon (1)	10200	100	mg/kg	10000		102	80-120	3	200	
Total Organic Carbon (2)	10100	100	mg/kg	10000		101	80-120	5	200	
Total Organic Carbon (Average)	10100	100	mg/kg dry wt							
Reference										
Total Organic Carbon (Average)	1.50		mg/kg dry wt							

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1804527

Notes and Definitions

U	Analyte included in the analysis, but not detected
ND	Analyte NOT DETECTED at or above the MRL (LOQ), LOD for DoD Reports, MDL for J-Flagged Analytes
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference
MDL	Method Detection Limit
MRL	Method Reporting Limit
LOD	Limit of Detection
LOQ	Limit of Quantitation
DL	Detection Limit
I/V	Initial Volume
F/V	Final Volume
§	Subcontracted analysis; see attached report
1	Range result excludes concentrations of surrogates and/or internal standards eluting in that range.
2	Range result excludes concentrations of target analytes eluting in that range.
3	Range result excludes the concentration of the C9-C10 aromatic range.
Avg	Results reported as a mathematical average.
NR	No Recovery
[CALC]	Calculated Analyte
SUB	Subcontracted analysis; see attached report
RL	Reporting Limit
EDL	Estimated Detection Limit

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1804527

ESS LABORATORY CERTIFICATIONS AND ACCREDITATIONS

ENVIRONMENTAL

Rhode Island Potable and Non Potable Water: LAI00179
http://www.health.ri.gov/find/labs/analytical/ESS.pdf

Connecticut Potable and Non Potable Water, Solid and Hazardous Waste: PH-0750
http://www.ct.gov/dph/lib/dph/environmental_health/environmental_laboratories/pdf/OutofStateCommercialLaboratories.pdf

Maine Potable and Non Potable Water, and Solid and Hazardous Waste: RI00002
http://www.maine.gov/dhhs/mecdc/environmental-health/dwp/partners/labCert.shtml

Massachusetts Potable and Non Potable Water: M-RI002
http://public.dep.state.ma.us/Labcert/Labcert.aspx

New Hampshire (NELAP accredited) Potable and Non Potable Water, Solid and Hazardous Waste: 2424
http://des.nh.gov/organization/divisions/water/dwgb/nhelap/index.htm

New York (NELAP accredited) Non Potable Water, Solid and Hazardous Waste: 11313
http://www.wadsworth.org/labcert/elap/comm.html

New Jersey (NELAP accredited) Non Potable Water, Solid and Hazardous Waste: RI006
http://datamine2.state.nj.us/DEP_OPRA/OpraMain/pi_main?mode=pi_by_site&sort_order=PI_NAMEA&Select+a+Site:=58715

United States Department of Agriculture Soil Permit: P330-12-00139

Pennsylvania: 68-01752
http://www.dep.pa.gov/Business/OtherPrograms/Labs/Pages/Laboratory-Accreditation-Program.aspx

ESS Laboratory

Division of Thielsch Engineering, Inc.
185 Frances Avenue, Cranston RI 02910
Tel. (401) 461-7181 Fax (401) 461-4486
www.esslaboratory.com

CHAIN OF CUSTODY

ESS Lab # R604527

Turn Time Standard Rush

Regulatory State

Reporting Limits

Is this project for any of the following?: ○CT RCP ○MA MCP ○RGP

Electonic Deliverables ☐Limit Checker ☐Standard Excel ☐Other (Please Specify →)

Company Name	Project #	Project Name
AECom	60476644	Orleans, MA

Contact Person	Address
Mark Owen	9 Jonathan Bourne Drive

City	State	Zip Code	PO #
Pocasset	MA	02559	

Telephone Number	FAX Number	Email Address
508-833-6950		Mark.owen@aecom.com

ESS Lab ID	Collection Date	Collection Time	Sample Type	Sample Matrix	Sample ID	Analysis: Total Organic Carbon
1	04/17/18	1600	Composite	Soil	MW-BM05ØA – Sand	X
2	04/17/18	1605	Composite	Soil	MW-BM05ØA – Silt	X

Container Type: AC-Air Cassette (AG-Amber Glass) B-BOD Bottle C-Cubitainer G - Glass O-Other P-Poly S-Sterile V-Vial

Container Volume: 1-100 mL 2-2.5 gal 3-250 mL 4-300 mL 5-500 mL 6-1L 7-VOA 8-2 oz 9-4 oz (10-8 oz) 11-Other*

Preservation Code: (1-Non Preserved) 2-HCl 3-H2SO4 4-HNO3 5-NaOH 6-Methanol 7-Na2S2O3 8-ZnAce, NaOH 9-NH4Cl 10-DI H2O 11-Other*

Number of Containers per Sample:

Laboratory Use Only

Cooler Present: Y

Seals Intact: N

Cooler Temperature: 5.1/5.4 °C 4/15/18 2010

Sampled by : Erika Amir-Lin

Comments: Please specify "Other" preservative and containers types in this space

Relinquished by: (Signature, Date & Time)	Received By: (Signature, Date & Time)	Relinquished By: (Signature, Date & Time)	Received By: (Signature, Date & Time)
04/18/18 1920	4/15/18 1920	4/15/18 2010	4/18/18 2100
Relinquished by: (Signature, Date & Time)	Received By: (Signature, Date & Time)	Relinquished By: (Signature, Date & Time)	Received By: (Signature, Date & Time)

CERTIFICATE OF ANALYSIS

Mark Owen
AECOM Environment - ENSR
9 Jonathon Bourne Dr.
Pocasset, MA 02559

RE: Orleans MA (60476644)
ESS Laboratory Work Order Number: 1806647

This signed Certificate of Analysis is our approved release of your analytical results. These results are only representative of sample aliquots received at the laboratory. ESS Laboratory expects its clients to follow all regulatory sampling guidelines. Beginning with this page, the entire report has been paginated. This report should not be copied except in full without the approval of the laboratory. Samples will be disposed of thirty days after the final report has been delivered. If you have any questions or concerns, please feel free to call our Customer Service Department.

Laurel Stoddard
Laboratory Director

REVIEWED
By ESS Laboratory at 1:43 pm, Jul 03, 2018

Analytical Summary
The project as described above has been analyzed in accordance with the ESS Quality Assurance Plan. This plan utilizes the following methodologies: US EPA SW-846, US EPA Methods for Chemical Analysis of Water and Wastes per 40 CFR Part 136, APHA Standard Methods for the Examination of Water and Wastewater, American Society for Testing and Materials (ASTM), and other recognized methodologies. The analyses with these noted observations are in conformance to the Quality Assurance Plan. In chromatographic analysis, manual integration is frequently used instead of automated integration because it produces more accurate results.

The test results present in this report are in compliance with TNI and relative state standards, and/or client Quality Assurance Project Plans (QAPP). The laboratory has reviewed the following: Sample Preservations, Hold Times, Initial Calibrations, Continuing Calibrations, Method Blanks, Blank Spikes, Blank Spike Duplicates, Duplicates, Matrix Spikes, Matrix Spike Duplicates, Surrogates and Internal Standards. Any results which were found to be outside of the recommended ranges stated in our SOPs will be noted in the Project Narrative.

Subcontracted Analyses

CTS - Cranston, RI	Grain Size Analysis

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1806647

SAMPLE RECEIPT

The following samples were received on June 25, 2018 for the analyses specified on the enclosed Chain of Custody Record.

The samples and analyses listed below were analyzed in accordance with the Guidelines Establishing Test Procedures for the Analysis of Pollutants, 40 CFR Part 136, as amended.

Lab Number	Sample Name	Matrix	Analysis
1806647-01	SB-01-062018	Soil	2540G, 9060, 9071M, SUB
1806647-02	SB-02-062218	Soil	2540G, 9060, 9071M, SUB

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1806647

PROJECT NARRATIVE

No unusual observations noted.

End of Project Narrative.

DATA USABILITY LINKS

To ensure you are viewing the most current version of the documents below, please clear your internet cookies for www.ESSLaboratory.com. Consult your IT Support personnel for information on how to clear your internet cookies.

Definitions of Quality Control Parameters

Semivolatile Organics Internal Standard Information

Semivolatile Organics Surrogate Information

Volatile Organics Internal Standard Information

Volatile Organics Surrogate Information

EPH and VPH Alkane Lists

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1806647

CURRENT SW-846 METHODOLOGY VERSIONS

Analytical Methods

1010A - Flashpoint
6010C - ICP
6020A - ICP MS
7010 - Graphite Furnace
7196A - Hexavalent Chromium
7470A - Aqueous Mercury
7471B - Solid Mercury
8011 - EDB/DBCP/TCP
8015C - GRO/DRO
8081B - Pesticides
8082A - PCB
8100M - TPH
8151A - Herbicides
8260B - VOA
8270D - SVOA
8270D SIM - SVOA Low Level
9014 - Cyanide
9038 - Sulfate
9040C - Aqueous pH
9045D - Solid pH (Corrosivity)
9050A - Specific Conductance
9056A - Anions (IC)
9060A - TOC
9095B - Paint Filter
MADEP 04-1.1 - EPH
MADEP 04-2.1 - VPH

Prep Methods

3005A - Aqueous ICP Digestion
3020A - Aqueous Graphite Furnace / ICP MS Digestion
3050B - Solid ICP / Graphite Furnace / ICP MS Digestion
3060A - Solid Hexavalent Chromium Digestion
3510C - Separatory Funnel Extraction
3520C - Liquid / Liquid Extraction
3540C - Manual Soxhlet Extraction
3541 - Automated Soxhlet Extraction
3546 - Microwave Extraction
3580A - Waste Dilution
5030B - Aqueous Purge and Trap
5030C - Aqueous Purge and Trap
5035 - Solid Purge and Trap

SW846 Reactivity Methods 7.3.3.2 (Reactive Cyanide) and 7.3.4.1 (Reactive Sulfide) have been withdrawn by EPA. These methods are reported per client request and are not NELAP accredited.

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: SB-01-062018
Date Sampled: 06/20/18 16:10
Percent Solids: 90

ESS Laboratory Work Order: 1806647
ESS Laboratory Sample ID: 1806647-01
Sample Matrix: Soil

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Oil & Grease	ND (110)		9071M		1	EEM	06/27/18 15:00	mg/kg dry	CF82716
Percent Moisture	**10** (1)		2540G		1	LAB	06/27/18 11:45	%	CF82705
Total Organic Carbon (Average)	ND (106)		9060		1	CCP	06/27/18 18:02	mg/kg dry wt	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: SB-01-062018
Date Sampled: 06/20/18 16:10

ESS Laboratory Work Order: 1806647
ESS Laboratory Sample ID: 1806647-01
Sample Matrix: Soil
Units: %

All methods used are in accordance with 40 CFR 136.

Subcontracted Analysis

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Sequence	Batch
Grain Size	**See Attached** (N/A)								

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: SB-02-062218
Date Sampled: 06/22/18 10:00
Percent Solids: 83

ESS Laboratory Work Order: 1806647
ESS Laboratory Sample ID: 1806647-02
Sample Matrix: Soil

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Oil & Grease	ND (120)		9071M		1	EEM	06/27/18 15:00	mg/kg dry	CF82716
Percent Moisture	**17** (1)		2540G		1	LAB	06/27/18 11:45	%	CF82705
Total Organic Carbon (Average)	**120** (99.5)		9060		1	CCP	06/27/18 19:52	mg/kg dry wt	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: SB-02-062218
Date Sampled: 06/22/18 10:00

ESS Laboratory Work Order: 1806647
ESS Laboratory Sample ID: 1806647-02
Sample Matrix: Soil
Units: %

All methods used are in accordance with 40 CFR 136.

Subcontracted Analysis

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Sequence	Batch
Grain Size	**See Attached** (N/A)								

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1806647

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Classical Chemistry										
Batch CF82716 - General Preparation										
Blank										
Oil & Grease	ND	100	mg/kg wet							
LCS										
Oil & Grease	3680	100	mg/kg wet	3938		93	79-114			
LCS Dup										
Oil & Grease	3670	100	mg/kg wet	3938		93	79-114	0.3	18	
Batch CF82727 - General Preparation										
Blank										
Total Organic Carbon (1)	ND	100	mg/kg							
Total Organic Carbon (2)	ND	100	mg/kg							
Total Organic Carbon (Average)	ND	100	mg/kg dry wt							
LCS										
Total Organic Carbon (1)	9480	100	mg/kg	10000		95	80-120			
Total Organic Carbon (2)	9490	100	mg/kg	10000		95	80-120			
Total Organic Carbon (Average)	9480	100	mg/kg dry wt							
LCS Dup										
Total Organic Carbon (1)	9450	100	mg/kg	10000		94	80-120	0.4	200	
Total Organic Carbon (2)	9390	100	mg/kg	10000		94	80-120	1	200	
Total Organic Carbon (Average)	9420	100	mg/kg dry wt							
Reference										
Total Organic Carbon (Average)	1.40		mg/kg dry wt							

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1806647

Notes and Definitions

Z-08	See Attached
U	Analyte included in the analysis, but not detected
ND	Analyte NOT DETECTED at or above the MRL (LOQ), LOD for DoD Reports, MDL for J-Flagged Analytes
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference
MDL	Method Detection Limit
MRL	Method Reporting Limit
LOD	Limit of Detection
LOQ	Limit of Quantitation
DL	Detection Limit
I/V	Initial Volume
F/V	Final Volume
§	Subcontracted analysis; see attached report
1	Range result excludes concentrations of surrogates and/or internal standards eluting in that range.
2	Range result excludes concentrations of target analytes eluting in that range.
3	Range result excludes the concentration of the C9-C10 aromatic range.
Avg	Results reported as a mathematical average.
NR	No Recovery
[CALC]	Calculated Analyte
SUB	Subcontracted analysis; see attached report
RL	Reporting Limit
EDL	Estimated Detection Limit

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1806647

ESS LABORATORY CERTIFICATIONS AND ACCREDITATIONS

ENVIRONMENTAL

Rhode Island Potable and Non Potable Water: LAI00179
http://www.health.ri.gov/find/labs/analytical/ESS.pdf

Connecticut Potable and Non Potable Water, Solid and Hazardous Waste: PH-0750
http://www.ct.gov/dph/lib/dph/environmental_health/environmental_laboratories/pdf/OutofStateCommercialLaboratories.pdf

Maine Potable and Non Potable Water, and Solid and Hazardous Waste: RI00002
http://www.maine.gov/dhhs/mecdc/environmental-health/dwp/partners/labCert.shtml

Massachusetts Potable and Non Potable Water: M-RI002
http://public.dep.state.ma.us/Labcert/Labcert.aspx

New Hampshire (NELAP accredited) Potable and Non Potable Water, Solid and Hazardous Waste: 2424
http://des.nh.gov/organization/divisions/water/dwgb/nhelap/index.htm

New York (NELAP accredited) Non Potable Water, Solid and Hazardous Waste: 11313
http://www.wadsworth.org/labcert/elap/comm.html

New Jersey (NELAP accredited) Non Potable Water, Solid and Hazardous Waste: RI006
http://datamine2.state.nj.us/DEP_OPRA/OpraMain/pi_main?mode=pi_by_site&sort_order=PI_NAMEA&Select+a+Site:=58715

United States Department of Agriculture Soil Permit: P330-12-00139

Pennsylvania: 68-01752
http://www.dep.pa.gov/Business/OtherPrograms/Labs/Pages/Laboratory-Accreditation-Program.aspx

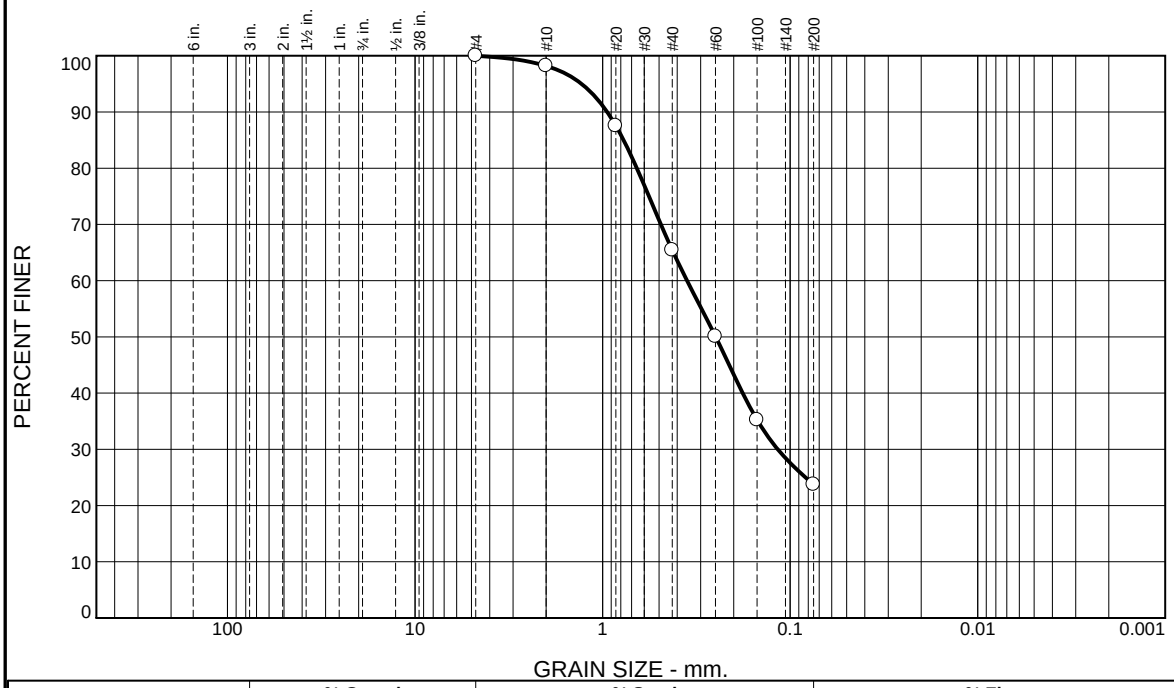
THIELSCH ENGINEERING	195 Frances Avenue Cranston RI, 02910 Phone: (401)-467-6454 Fax: (401)-467-2398 http://www.thielsch.com *Let's Build a Solid Foundation*	Client Information: AECOM Providence, RI PM: Heather Masse Assigned By: Heather Masse Collected By: Client	Project Information: **Orleans PRB** ESS Project Number: 1806647 Summary Page: 1 of 1 Report Date: 07.02.18

LABORATORY TESTING DATA SHEET

Sample Number	Depth (ft)	Laboratory No.	Identification Tests						Proctor / Consolidated Isotropically Drained										Laboratory Log and Soil Description
			Water Content %	LL %	PL %	Gravel %	Sand %	Fines %	Dry unit wt. pcf	Test Water Content %	γ_d MAX (pcf) W_{opt} (%)	γ_d MAX (pcf) W_{opt} (%) (Corr.)	Test Setup as % of Proctor	$\bar{\sigma}_c$ psf	Failure Criteria	σ_1 / σ_3 or τ psf	Strain %	EST. Internal Friction Angle	
1806647-01		18-S-859				0.0	76.3	23.7											Light Brown silty sand
1806647-02		18-S-860				0.3	74.6	25.1											Brown silty sand

Reviewed By _____ Date Reviewed 07.02.2018

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	1.8	32.8	41.7	23.7	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100.0		
#10	98.2		
#20	87.6		
#40	65.4		
#60	50.1		
#100	35.2		
#200	23.7		

* (no specification provided)

Material Description

Light Brown silty sand

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-2-4(0)

Coefficients

D_{90}= 0.9452 D_{85}= 0.7730 D_{60}= 0.3545
D_{50}= 0.2493 D_{30}= 0.1164 D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 06.26.18 **Date Tested:** 07.02.18

Tested By: MN / JS

Checked By: Rebecca Roth

Title: Laboratory Manager

Source of Sample: Borings **Date Sampled:**
Sample Number: 1806647-01

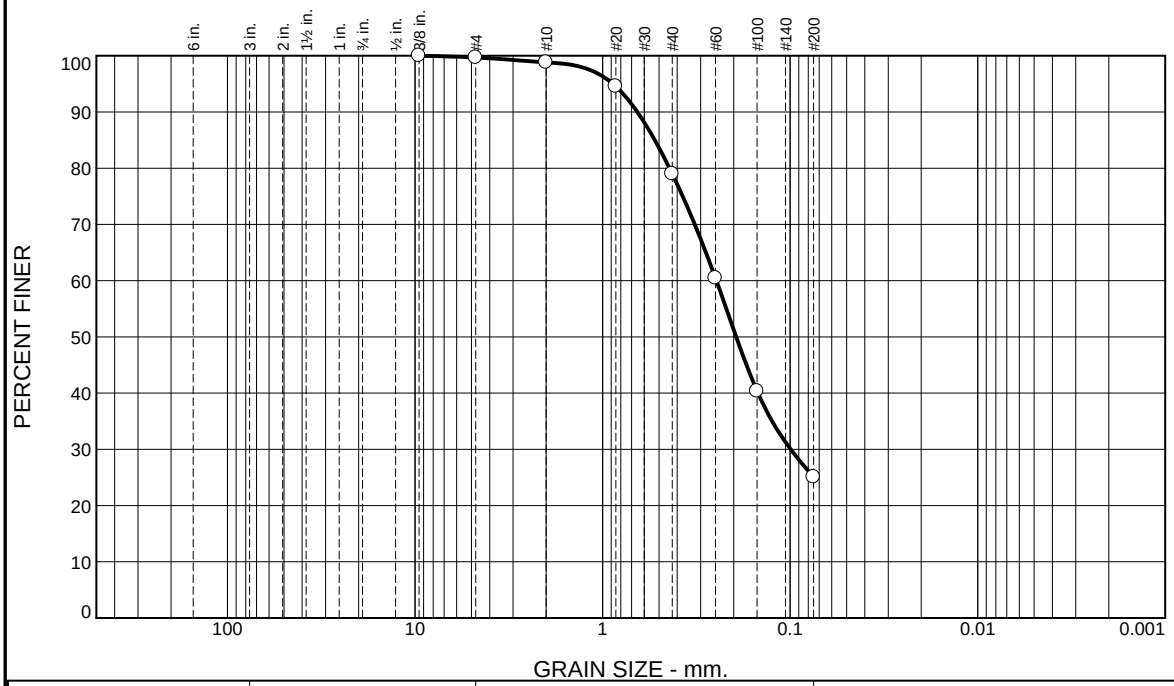
Thielsch Engineering Inc.

Cranston, RI

Client: ESS
Project: Orleans PRB

Project No: 1806647 **Figure** 1806647-01

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.3	0.9	19.8	53.9	25.1	

Test Results (D6913 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.375"	100.0		
#4	99.7		
#10	98.8		
#20	94.6		
#40	79.0		
#60	60.4		
#100	40.3		
#200	25.1		

* (no specification provided)

Material Description

Brown silty sand

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-2-4(0)

Coefficients

D_{90}= 0.6523 D_{85}= 0.5267 D_{60}= 0.2472
D_{50}= 0.1939 D_{30}= 0.0994 D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 06.26.18 **Date Tested:** 07.02.18

Tested By: MN / JS

Checked By: Rebecca Roth

Title: Laboratory Manager

Source of Sample: Borings **Date Sampled:**
Sample Number: 1806647-02

Thielsch Engineering Inc.

Cranston, RI

Client: ESS
Project: Orleans PRB

Project No: 1806647 **Figure** 1806647-02

ESS Laboratory

Division of Thielsch Engineering, Inc.
185 Frances Avenue, Cranston RI 02910
Tel. (401) 461-7181 Fax (401) 461-4486
www.esslaboratory.com

CHAIN OF CUSTODY

ESS Lab # 1806647

Turn Time Standard Rush

Regulatory State

Is this project for any of the following?: ○CT RCP ○MA MCP ○RGP

Reporting Limits

Electonic Deliverables ☐Limit Checker ☒Standard Excel ☐Other (Please Specify →)

Company Name	Project #	Project Name
AECOM	60476644	Orleans PRB

Contact Person	Address
Mark Owen; Erika Amir-Lin	9 Jonathan Bourne Drive

City	State	Zip Code	PO #
Pocasset	MA		

Telephone Number	FAX Number	Email Address
		mark.owen@aecom.com; erika.amir-lin@aecom.com

ESS Lab ID	Collection Date	Collection Time	Sample Type	Sample Matrix	Sample ID	Analysis: oil + grease	TOC	moisture content	grain size
1	06/20/18	1610	Comp.	Soil	SB-01-062018	X	X	X	X
2	06/22/18	1000	COMP	SOIL	SB-02-062218	X	X	X	X

Container Type: AC-Air Cassette AG-Amber Glass B-BOD Bottle C-Cubitainer G - Glass O-Other P-Poly S-Sterile V-Vial — AG AG AG AG

Container Volume: 1-100 mL 2-2.5 gal 3-250 mL 4-300 mL 5-500 mL 6-1L 7-VOA 8-2 oz 9-4 oz 10-8 oz 11-Other* — 10 10 10 10

Preservation Code: 1-Non Preserved 2-HCl 3-H2SO4 4-HNO3 5-NaOH 6-Methanol 7-Na2S2O3 8-ZnAce, NaOH 9-NH4Cl 10-DI H2O 11-Other* — 1 1 1 1

Number of Containers per Sample:

Laboratory Use Only

Cooler Present: ✓

Seals Intact:

Cooler Temperature: 3.4 °C ICE RC

Sampled by : Erika Amir-Lin, Briley Bana

Comments: Please specify "Other" preservative and containers types in this space

Relinquished by: (Signature, Date & Time)	Received By: (Signature, Date & Time)	Relinquished By: (Signature, Date & Time)	Received By: (Signature, Date & Time)
25 Jun 18 1415	6/25/18 1525	6/25/18 1650	6/25/18 1756
Relinquished by: (Signature, Date & Time)	Received By: (Signature, Date & Time)	Relinquished By: (Signature, Date & Time)	Received By: (Signature, Date & Time)