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January 3, 2018

Mr. Chris Swain
Maine Department of Environmental Protection
17 State House Station
Augusta, Maine 04333-0017

Subject: Third Quarter 2018 Short-Term Comprehensive Monitoring Plan Data Report
Orrington Remediation Site, Orrington, Maine

Dear Mr. Swain:

Results from monitoring conducted in the third quarter of 2018 at the Orrington Remediation Site (Site) are provided in this letter report. Samples of groundwater, surface water, and sediment were obtained according to the February 24, 2017 Short-Term Comprehensive Monitoring Plan (CMP). Sampling locations included in the Short-Term CMP are shown on Figure 1.

Sampling in the third quarter 2018 was conducted to satisfy the following monitoring programs:

- Interim Extraction System (IES) Monitoring;
- Landfill 5 Groundwater Monitoring Program;
- Short-Term Remediation Monitoring; and
- Site Perimeter Monitoring.

Sampling was conducted during the weeks of July 9, August 13, and September 10, 2018. Samples were sent via courier to Alpha Analytical Laboratory (Alpha) of Westborough, Massachusetts, for analysis of parameters according to the Short-Term CMP and described further in the sections below.

Analytical results were quantified to the laboratory's method detection limit (MDL). Concentrations detected between the MDL and the laboratory's reporting limit (RL) were qualified by Alpha as estimated (J) values. According to the MEDEP approved Data Validation Protocol dated January 29, 2018, final laboratory analytical reports and electronic data deliverables (EDDs) containing unvalidated data were submitted to Maine Department of Environmental Protection (MEDEP) on August 2, September 4, and October 10, 2018.

Similar to sampling conducted in June (as reported in the second quarter 2018 data transmittal report), joint sampling events with Geosyntec were conducted on August 13 and September 12 for monitoring points that overlap between the Short-Term CMP and the chloropicrin remediation performance monitoring program. Geosyntec representatives obtained samples for laboratory analysis of chloropicrin, from wells monitored as part of the IES and Remediation

(Landfill 1 and Plant Area) monitoring programs, and these data were submitted to MEDEP by Geosyntec on October 10, 2018.

SME conducted quality control review of the laboratory analytical data. Data review reports are provided in Attachment 1.

## IES MONITORING

### Operations and Maintenance

Operation of the IES had remained stable since initial operation was established in 2015 through the end of the second quarter 2018. In July 2018, with remediation construction as part of the Landfill 1 Corrective Measures Implementation (CMI), changes were initiated to the IES that extended beyond the third quarter. The piping to EW-1 was damaged during excavation on July 31, and the well remained off-line for approximately one week until repairs were made on August 8. As previously approved by MEDEP, EW-2 and EW-3 were taken off-line on August 8 as part of remediation construction, to allow construction of temporary piping from EW-3 and EW-5. The IES was shut down on August 14 to allow for final construction for the two-well temporary extraction system (EW-3 and EW-5), which operated for the duration of the Landfill 1 CMI and will continue to operate through construction of the final groundwater extraction system (Final GWES).

Pumps were installed on August 16, and the temporary GWES (EW-3 and EW-5) was brought on-line, with each well pumping at approximately 14 gallons per minute (gpm). MEDEP requested that the IES extraction rate be increased to 32 gpm, with flows from each extraction well nominally 16 gpm. The increase in pumping rates is in conformance with permit requirements, and was approved by Clarissa Trasko (MEDEP Wastewater Compliance Supervisor) by email on August 17. These flows remained steady through the end of the third quarter.

IES extraction wells EW-1, EW-2, EW-4, and MW-601 were decommissioned on August 23, 2018, with MEDEP approval and in accordance with MEDEP procedures. Well abandonment records were submitted to MEDEP on September 12.

Drilling and installation of Final GWES extraction wells EW-6 through EW-12 was conducted between September 18 and October 2, and wells were developed during the weeks of November 5 and November 12. Following construction of the Final GWES, the new extraction wells will be brought on-line in early 2019, and quarterly monitoring of the Final GWES will replace the IES monitoring program in the Short-Term CMP.

### Water Level Elevations

Water level elevations in the IES extraction wells and nearby monitoring points are recorded hourly by data logging pressure transducers. Pressure transducers were installed in EW-5 and piezometers PZ17-1, -2, and -3 on August 31. The transducer was removed from EW-3 due to limited space in the four-inch well, with the installation of the new, larger pump (capable of pumping at higher extraction rate) on August 16.

Pressure transducer graphs from individual monitoring points are provided in Attachment 2 and transducer data are provided in Attachment 3. Average groundwater elevations are shown on Figure 2. To remove the effects of tidal variations to groundwater levels, the average water levels recorded over a three-day period between September 1 and 3, 2018 were used. Based on average water level elevations, and observed drawdown at the extraction wells, the inferred hydraulic capture of groundwater extends beyond the pair of extraction wells.

Laboratory Analytical Data

Quarterly monitoring of IES extraction wells and the GWTP Influent was conducted according to the Short-Term CMP on September 12, 2018. As of September monitoring, extraction wells EW-3 and EW-5 were the operational wells comprising the IES as noted above, and therefore sampling according to the Short-Term CMP was conducted from these two extraction wells and the GWTP influent. Monitoring parameters are provided in Table 1.

**TABLE 1**

**INTERIM EXTRACTION SYSTEM MONITORING**

| Monitoring Locations | Monitoring Frequency | Sample Parameters | Sampling Date |
|---|---|---|---|
| Extraction Wells | Quarterly | Total mercury, chloropicrin, chloride | September 12, 2018 |
| GWTP Influent | Quarterly | Total mercury, chloropicrin, MPS VOCs, chloride, alkalinity, iron, manganese, and sodium | September 12, 2018 |

Samples for laboratory analysis of chloropicrin and total mercury were collected by Geosyntec representatives and submitted for laboratory analysis as part of both the chloropicrin remediation performance monitoring program and the Short-Term CMP IES and remediation monitoring programs. In addition to the quarterly IES monitoring, extraction wells were sampled monthly during the third quarter as part of the remediation monitoring for the Landfill 1 Area (discussed further below), which included analysis for IES monitoring parameters. Summary tables of field parameters and laboratory analytical data are provided in Attachment 4. Field sampling documentation is also provided in Attachment 4.

Analytical results from third quarter sampling indicate that mercury, chloropicrin, and chloride concentrations are within the range of historical detections with the exception of chloropicrin in EW-1 (detected concentration in July 2018 was above the previous maximum concentration, from August 2015) and EW-2 (detected concentration in July 2018 was below the previous minimum concentration, from September 2015). Concentrations of volatile organic compounds (VOCs) are below Media Protection Standards (MPS) and are within historical ranges. (Note the first VOC sample was obtained from EW-5 in the third quarter, as part of remediation monitoring). Detected concentrations of mercury and chloropicrin over time in the IES wells are shown on Figure 3.

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## LANDFILL 5 MONITORING

Landfill 5 Detection and Assessment monitoring was conducted according to the Short-Term CMP during the week of September 10, 2018. A summary of the Landfill 5 monitoring programs is provided in Table 2. Laboratory analytical results are generally consistent with recent monitoring results with detected concentrations below MPS and within or near the historical range of detections. Attachment 5 provides summary data tables of field parameters, laboratory analytical data, and field sampling documentation.

**TABLE 2**

**LANDFILL 5 MONITORING PROGRAMS**

| Program | Frequency | Monitoring Wells | Sample Parameters |
|---|---|---|---|
| Detection Monitoring | Semiannual (Quarters 1 and 3)[2] | B-304-B1/O1[1]<br>B-306-B3[1]<br>B-307-B1/B2<br>B-307-O1[1] | Total organic halogens, total organic carbon, pH, specific conductance, temperature, iron, manganese, sodium, mercury, chloride, sulfate, phenols |
| Assessment Monitoring | Quarterly | B-303-B1/B2/B3/O1(1)<br>B-306-B1/B2 | VOCs, mercury (unfiltered), pH, specific conductance |

Notes:
1. Monitoring wells B-304-O1, B-306-B3, B-307-O1, and B-303-O1 have historically either been dry or yielded an insufficient quantity of groundwater to obtain a groundwater sample.
2. Quarters 1 and 3 are for January through March and July through September, respectively.

## REMEDIATION MONITORING

Mallinckrodt began remediation monitoring, according to the Short-Term CMP, in February 2017. Remediation monitoring during the third quarter 2018 included monthly monitoring in the vicinity of the Plant Area and Landfill 1 and quarterly monitoring in the vicinity of the Landfill 2, Plant Area, and Landfill 1 remediation areas. A summary of these monitoring programs is provided in Table 3. Summary data tables and field sampling documentation for each remediation area are provided in Attachment 6.

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**TABLE 3**

**REMEDIATION MONITORING PROGRAMS**

| Area | Media | Locations | Parameters | Frequency | Final Sample Date |
|---|---|---|---|---|---|
| Landfill 2 and Southerly Stream (northern) | Groundwater | MW-409-O1/B1, MW-704-O1/O2, MW-705-O1, MW-706-O1/B1 | Total Mercury, Carbon Tetrachloride | Quarterly | September 2018 |
| | Water Level | B-301-O1/O2/B1, MW-409-O1/B1, MW-704-O1/O2, MW-705-O1, MW-706-O1/B1 | N/A | Quarterly | September 2018 |
| Plant Area | Groundwater | B-315-O1/O2/B1, B-316-O1/B1, B-327-O1, MW-403-O1/O2/B1, MW-509-B1, MW-701-O1/B1/B2 | Total Mercury, Chloropicrin, MPS VOCs, MPS SVOCs | Quarterly | TBD |
| | Groundwater | Chlorate Building MH | Total Mercury, MPS VOCs | Monthly | |
| | Surface Water | SW15-7, SW15-10R | | Monthly | |
| | Sediment | SD15-8, SD18-1 | Total Mercury, Chloropicrin | Monthly | |
| | Water Level | B-315-O1/O2/B1, B-316-O1/B1, B-327-O1, MW-403-O1/O2/B1, MW-503-O1/B1, MW-509-B1, MW-701-O1/O2/B1/B2, MW-702-O1/B1/B2 | N/A | Quarterly | |
| Landfill 1 | Groundwater | EW-1, EW-2, EW-3, EW-4, EW-5, MW-601 | Total Mercury, Chloropicrin, MPS VOCs, MPS SVOCs | Monthly | December 2018 (quarterly through December 2019) |
| | Groundwater | PZ14-12, PZ14-13, MW-602-O1 | | Quarterly | December 2019 |
| | Surface Water | SW18-1 | Total Mercury | Monthly | TBD |
| | Sediment | SD18-2 | | Monthly | TBD |
| | Water Level | MW-403-O1/O2/B1 | N/A | Quarterly | December 2019 |

Notes:
1. Red text indicates sampling that was completed (final samples obtained) according to the Short-Term CMP in the third quarter of 2018.

Landfill 2

Remediation monitoring in the vicinity of the Landfill 2 remediation area was conducted during the week of September, 2018, in accordance with the Short-Term CMP. Third quarter 2018 groundwater analytical results are below MPS and consistent with recent monitoring. Quarterly groundwater monitoring according to the Short-Term CMP is complete and no further samples will be obtained.

Plant Area

Remediation monitoring in the vicinity of the Plant Area was conducted during the weeks of July 9, August 13, and September 10, 2018, in general accordance with the Short-Term CMP and with previous monitoring rounds. Exceptions are:

- Sampling locations SW15-6 and SD15-7 are located in an area that was excavated in April. Mercury-containing sediments were removed from this area. These monitoring points were not accessible during third quarter monitoring. Following excavation and pending restoration of this vicinity, there was no surface water flow or sediment accumulation in this area during third quarter monitoring.
- Surface water sampling location SW15-10R was dry during August and September monitoring.

Where parameters were detected in groundwater above laboratory reporting limits, they were generally below MPS and within the historical range of detections, with the following exceptions:

- B-316-O1: Mercury and chloropicrin were detected at concentrations above MPS and within or near the range of previous detections. Mercury was detected in the parent sample above the previous maximum concentration, and in the duplicate sample within the range of previous detections. Groundwater from this area is captured by the groundwater extraction system in the Landfill 1 Area.
- B-316-B1: Acetone was detected at a concentration above MPS and within the range of historical detections. Groundwater from this area is captured by the groundwater extraction system in the Landfill 1 Area.

Surface water sampling results showed mercury below the MPS in all Plant Area surface water locations sampled this quarter; no MPS VOCs were detected above laboratory reporting limits in Plant Area surface water samples during third quarter monitoring.

Sediment sampling results from SD15-8 were below MPS and consistent with previous sampling results. Mercury concentrations exceeded MPS in all samples obtained from location SD18-1 in the third quarter. Due to the configuration of the surface water pond, sediment settles on the base of the paved sump rather than discharging with surface water; therefore, sediments remain relatively contained in the vicinity of SD18-1. Additionally, routine maintenance is conducted in the paved sump including removal of accumulated sediments. Consistent with previous monitoring, chloropicrin was not detected above laboratory reporting limits in any sediment samples obtained in the third quarter.

Landfill 1 Area

Remediation monitoring in the vicinity of the Landfill 1 Area was conducted during the weeks of July 9, August 13, and September 10, 2018, in general accordance with the Short-Term CMP.

Exceptions to the Short-Term CMP are:

- During third quarter monitoring, no surface water was observed at SW18-1 and no evidence was observed of sediment accumulation at location SD18-2; therefore, no samples of these media were obtained during third quarter monitoring. Continued observation will be made of this location, and in the event surface water is present and/or evidence of sediment accumulation is observed, samples will be obtained accordingly in future monitoring events.
- Extraction well sampling was adjusted according to the IES operation (described above). By the time of September monitoring, extraction wells EW-1, -2, -4, and MW-601 were abandoned and EW-5 was on-line. During each month of third quarter monitoring, samples were obtained from each well operating at the time of sampling.

Where parameters were detected in groundwater above laboratory reporting limits, they were below MPS with the following exceptions:

- Mercury was detected at concentrations above MPS in all extraction wells and monitoring points MW-602-O1 and PZ14-12.
- Chloropicrin was detected at concentrations above MPS in all extraction wells.
- Hexachloroethane was detected at concentrations above MPS in all extraction wells with the exception of EW-5.

Detections above the MPS are expected in extraction wells, and groundwater from this area is captured by the IES.

## SITE PERIMETER MONITORING

A summary of the Site Perimeter monitoring program is provided in Table 4. Site Perimeter monitoring was conducted during the week of September 10, 2018. Sampling was conducted according to the Short-Term CMP, with the exception of the permanent removal of the Haseltine and Safian monitoring points from the sampling program as approved by MEDEP and reported in the first and second quarter 2018 data transmittals.

**TABLE 4**

**SITE PERIMETER MONITORING PROGRAM**

| Monitoring Locations | Site Area | Sample Parameters |
|---|---|---|
| P-13-B1, P-13-B2 | Landfill 3 | Total mercury, chloropicrin, MPS VOCs, chloride |
| MW-704-O1/O2 | Landfill 2 | Total mercury, chloride |
| MW-511-B1/B2 | Ferry Road | Total mercury, chloride |
| B-321-B1/B2 | Ferry Road | Total mercury, chloride |
| B-320-O1/B1 | Landfill 1 | Total mercury, chloropicrin, chloride, MPS SVOCs |

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Third quarter laboratory analytical results for the Site Perimeter monitoring program are generally consistent with recent monitoring results. Detected concentrations were below MPS with the exception of P-13-B1, from which concentrations of chloropicrin, carbon tetrachloride, and 1,1-dichloroethene were above MPS. This area of the Site is the subject of additional pre-design testing, as described in the July 19, 2018 Pre-Design Work Plan for Landfills 3 through 5 Groundwater Conditions Assessment.

Summary data tables and field sheets are provided in Attachment 7. Please note that there is some overlap between the Site Perimeter and Remediation monitoring programs and therefore field documentation for some Site Perimeter monitoring points is provided in Attachment 6.

## CLOSING

The fourth quarter 2018 sampling and water level monitoring event was conducted during the week of December 10, 2018 and MEDEP was informed of that sampling schedule. If you have any questions concerning the monitoring programs conducted as part of the Short-Term CMP, please do not hesitate to contact Dave Kelley or me.

Very truly yours,

SEVEE & MAHER ENGINEERS, INC.

Lisa J. Jacob, C.G.
Senior Geologist

Attachments:

Figure 1 – Short-Term CMP Monitoring Locations
Figure 2 – Average Groundwater Elevations
Figure 3 – Mercury and Chloropicrin Concentration Plots
Attachment 1 – Data Review Reports
Attachment 2 – Transducer Graphs
Attachment 3 – Transducer Data (Excel Format)
Attachment 4 – Interim Extraction System Data Summary Tables and Field Sheets
Attachment 5 – Landfill 5 Data Summary Tables and Field Sheets
Attachment 6 – Remediation Monitoring Data Summary Tables and Field Sheets
Attachment 7 – Site Perimeter Data Summary Tables and Field Sheets

cc: Dave Kelley, Mallinckrodt US LLC (email only)
Chris Evans, Maine DEP (email only)
Chris Greene, Geosyntec (email only)
Orrington Public Library (hard copy only)

# FIGURES

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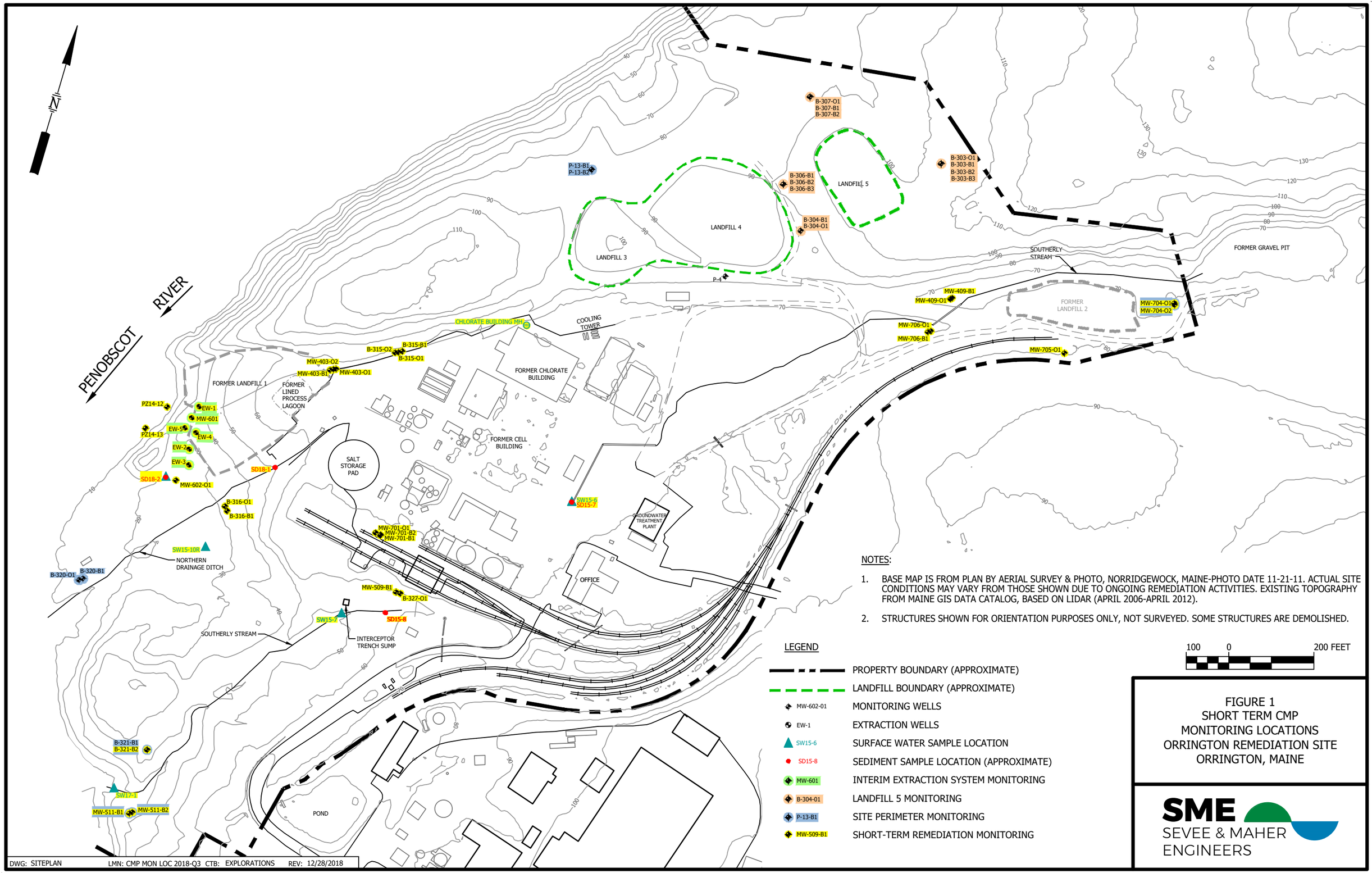


NOTES:

1. BASE MAP IS FROM PLAN BY AERIAL SURVEY & PHOTO, NORRIDGEWOCK, MAINE-PHOTO DATE 11-21-11. ACTUAL SITE CONDITIONS MAY VARY FROM THOSE SHOWN DUE TO ONGOING REMEDIATION ACTIVITIES. EXISTING TOPOGRAPHY FROM MAINE GIS DATA CATALOG, BASED ON LIDAR (APRIL 2006-APRIL 2012).
2. STRUCTURES SHOWN FOR ORIENTATION PURPOSES ONLY, NOT SURVEYED. SOME STRUCTURES ARE DEMOLISHED.

LEGEND

- PROPERTY BOUNDARY (APPROXIMATE)
- LANDFILL BOUNDARY (APPROXIMATE)
- MW-602-01 MONITORING WELLS
- EW-1 EXTRACTION WELLS
- SW15-6 SURFACE WATER SAMPLE LOCATION
- SD15-8 SEDIMENT SAMPLE LOCATION (APPROXIMATE)
- MW-601 INTERIM EXTRACTION SYSTEM MONITORING
- B-304-01 LANDFILL 5 MONITORING
- P-13-B1 SITE PERIMETER MONITORING
- MW-509-B1 SHORT-TERM REMEDIATION MONITORING

100 0 200 FEET

FIGURE 1
SHORT TERM CMP
MONITORING LOCATIONS
ORRINGTON REMEDIATION SITE
ORRINGTON, MAINE

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DWG: SITEPLAN LMN: CMP MON LOC 2018-Q3 CTB: EXPLORATIONS REV: 12/28/2018

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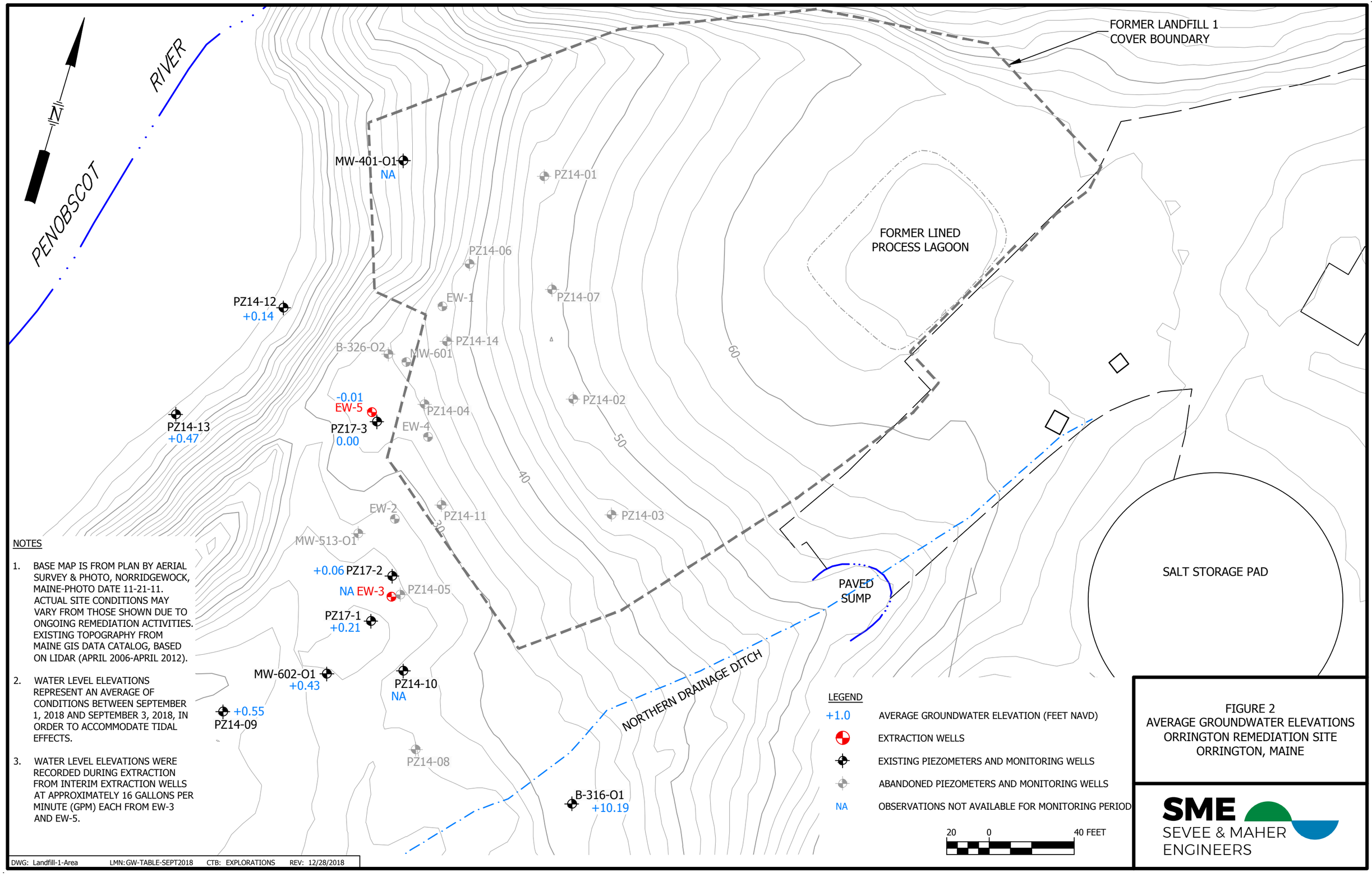


NOTES

1. BASE MAP IS FROM PLAN BY AERIAL SURVEY & PHOTO, NORRIDGEWOCK, MAINE-PHOTO DATE 11-21-11. ACTUAL SITE CONDITIONS MAY VARY FROM THOSE SHOWN DUE TO ONGOING REMEDIATION ACTIVITIES. EXISTING TOPOGRAPHY FROM MAINE GIS DATA CATALOG, BASED ON LIDAR (APRIL 2006-APRIL 2012).
2. WATER LEVEL ELEVATIONS REPRESENT AN AVERAGE OF CONDITIONS BETWEEN SEPTEMBER 1, 2018 AND SEPTEMBER 3, 2018, IN ORDER TO ACCOMMODATE TIDAL EFFECTS.
3. WATER LEVEL ELEVATIONS WERE RECORDED DURING EXTRACTION FROM INTERIM EXTRACTION WELLS AT APPROXIMATELY 16 GALLONS PER MINUTE (GPM) EACH FROM EW-3 AND EW-5.

LEGEND

+1.0 AVERAGE GROUNDWATER ELEVATION (FEET NAVD)

EXTRACTION WELLS

EXISTING PIEZOMETERS AND MONITORING WELLS

ABANDONED PIEZOMETERS AND MONITORING WELLS

NA OBSERVATIONS NOT AVAILABLE FOR MONITORING PERIOD

FIGURE 2
AVERAGE GROUNDWATER ELEVATIONS
ORRINGTON REMEDIATION SITE
ORRINGTON, MAINE

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DWG: Landfill-1-Area LMN: GW-TABLE-SEPT2018 CTB: EXPLORATIONS REV: 12/28/2018

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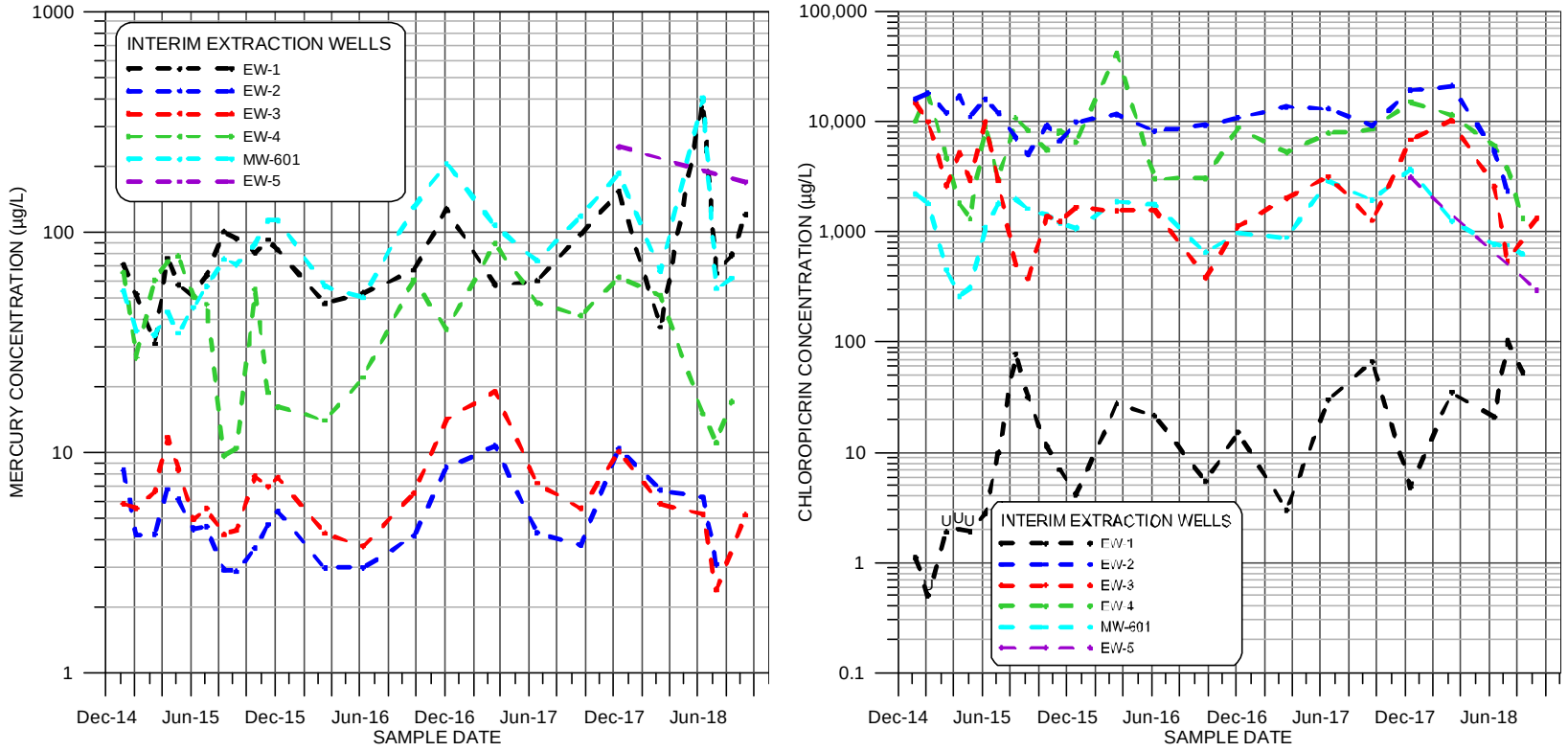
**FIGURE 3**

**MERCURY AND CHLOROPICRIN CONCENTRATION PLOTS**
**INTERIM EXTRACTION SYSTEM**
**ORRINGTON REMEDIATION SITE**
**ORRINGTON, MAINE**

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January 3, 2018