CES INC

Engineers ◆ Environmental Scientists ◆ Surveyors

August 14, 2018

Peter Britz
Coakley Project Coordinator
1 Junkins Avenue
Portsmouth, New Hampshire 03801

**RE: Results of Storm Water Sampling at the Coakley Landfill - North Hampton, New Hampshire**

Dear Mr. Britz:

As requested by the Coakley Landfill Group (CLG), CES, Inc. (CES) has prepared this letter to describe actions completed to date regarding the interaction between Site stormwater management components (i.e. stormwater retention ponds, pond outfall pipes, perimeter drainage ditches, and sand drainage layer discharge (underdrain discharge)) relative to seepage discharging on an embankment adjacent to seep sampling location L-1. A Site Plan is included as **Figure 1**.

## BACKGROUND

As part of Site remedy design and construction activities implemented in the mid to late 1990s, stormwater runoff from the landfill surface is conveyed to two unlined stormwater retention ponds (northwest and northeast ponds) via a series of perimeter drainage ditches and rip rap let-down structures on the landfill. Stormwater retained in the ponds is subsequently discharged to adjacent wetland areas via an outlet structure in the ponds and associated corrugated metal piping (outfall pipe).

In addition to direct surface stormwater runoff, precipitation falling on the landfill surface infiltrates through the upper part of the landfill's cover system above the liner (discussed below). The cover system is composed of a vegetative layer, cover soil, and sand drainage layer placed immediately above an impermeable, polyethylene geomembrane liner. Water that infiltrates through the vegetative layer and cover soil enters the sand drainage layer above the liner and is then collected and conveyed via perforated piping (underdrain) to three discharge locations; one at each retention pond and a third at a rip rap outlet near the northwestern toe of the landfill slope.

Following remedy construction, a seepage area was noted on an embankment adjacent to the northwest pond outfall pipe discharge. This seepage was previously interpreted to be shallow groundwater discharging to the ground surface at or near the head of a wetland complex west of the landfill. The seepage location became a sampling point in the Site monitoring network in 2001 and is designated as location L-1 on site plans and in annual monitoring reports. Analytical results for samples collected at L-1 have been reported in monitoring reports since 2001. Some historic reports have referred to L-1 and a "leachate" sampling location but more recent review by CES,



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including developing the cross sections discussed below, indicates it is most accurately referred to simply as a “seep”.

During a review of 2017 analytical data for the L-1 location, it was noted that concentrations of per and polyfluoro alkyl substances (PFAS) in the L-1 sample were significantly higher in the Spring event when discharge was observed from the adjacent pond outfall pipe, as compared to the Fall event when little or no discharge was observed in the pond outfall pipe. These results seemed contrary to an assumption that a potentially larger stormwater component would result in a lower PFAS concentration in the L-1 sample since stormwater runoff has no direct contact with landfill waste.

Following discussions with CLG, CES was proactively authorized to prepare a workplan and further investigate the relationship between stormwater and seepage observed at the L-1 sampling location. The initial workplan was submitted to the agencies on December 22, 2017 and sampling was performed in conjunction with the 2018 Spring semiannual sampling event.

## INVESTIGATION

As a first step, CES conducted a site visit on December 7, 2017 to observe conditions at the L-1 location and adjacent pond outfall pipe. During the Site visit, iron stained soil on the embankment adjacent to the corrugated steel outfall pipe from the landfill stormwater retention pond was noted. Soil staining appeared to extend to (or above) the bottom elevation (invert) of the stormwater outfall pipe, although the inside of the stormwater outfall pipe did not show evidence of iron staining or iron precipitates. The heaviest staining and actual water seepage was observed to be in a ponded area (head of wetland) approximately 10-20 feet downslope and slightly lower in elevation than the bottom of the outfall pipe. The extent of staining is interpreted to represent an approximation of shallow (or seasonal high) groundwater levels adjacent to the wetland complex.

Based on the results of this Site visit and a review of available site information (i.e. well logs, cover system design, topography), a cross section was created depicting the relationships between the structures and features discussed above. The location of the cross section can be found on **Figure 1** with the cross section illustrated as **Figure 2**.

As shown on the cross section, elevations of shallow groundwater and the bottom of the retention pond do not indicate a direct hydraulic connection between shallow groundwater and the northwest retention pond. However, during high recharge/groundwater level periods, seepage along the embankment may be close to the pond outfall pipe invert elevation.

To better understand local conditions, water samples were collected from the stormwater management system during the Spring 2018 sampling event to further investigate stormwater quality for comparison to L-1 sample results. Note that the Spring 2018 sampling event occurred from April 24 through May 2, 2018 with stormwater samples collected within 24-hours following a large rain event on April 25, 2018.

CES collected samples of stormwater runoff from a landfill perimeter ditch, a sand drainage layer underdrain outlet that discharges to a rip-rap lined drainage sump west of the landfill, and the outfall pipe from the northwest pond on April 26, 2018. Samples were sent to Eastern Analytical Inc. (EAI) in Concord, New Hampshire with PFAS analysis performed by Vista Analytical (Vista) (via subcontract to EAI). Samples were analyzed for 1,4-dioxane and six PFAS compounds in accordance with the EPA approved Sampling and Analytical Plan (SAP).

Laboratory results are enclosed as **Attachment 1** with a summary of analytical results from samples collected as part of this stormwater investigation presented in **Table 1**. Results for the seep (L-1) sample collected during the Spring 2018 sampling event in addition to the two sampling events performed in 2017 were added to the table for comparison.

As shown on Table 1, 1,4-dioxane was not detected in any of the stormwater samples collected. 1,4-dioxane was reported in the L-1 seep sample at concentrations of 4.9 and 4.1 ug/L (2018 original and duplicate samples, respectively).

Concentrations of PFOA ranged from 532 (B) nanograms per liter (ng/L) (northwest pond Outfall piping) to 1,480 (B) ng/L (underdrain discharge at rip rap sump). The B qualifier indicates that PFOA was also detected in the method blank at a very low concentration. PFOA was reported in the L-1 seep at concentrations of 532 and 492 ng/L.

Concentrations of PFOS ranged from 1,230 (northwest pond Outfall piping duplicate sample) to 3,060 (D) ng/L (underdrain discharge at rip rap sump). The D qualifier indicated that the sample was diluted at the lab before analysis due to high concentration. PFOS was reported in the L-1 seep sample at concentrations of 567 and 571 ng/L.

The combined concentrations of PFOA and PFOS ranged from 1,831 (Perimeter ditch) to 4,540 ng/L (underdrain discharge at rip rap sump). The combined concentrations of PFOA and PFOS were reported in the L-1 seep and L-1 seep duplicate at concentrations of 1,099 and 1,063 ng/L, respectively.

The higher PFAS concentration in the underdrain sample is likely due to a longer residence (contact) time for water infiltrating and traveling through cover materials and conveyance piping, as compared to the perimeter ditch sample which reflects the more short-term runoff from the rain event.

## CONCLUSIONS

Concentrations of 1,4-dioxane were not reported in any of the stormwater samples collected. 1,4-dioxane has been detected in many of the groundwater monitoring wells, as well as in the L-1 sample and is a Contaminant of Concern (CoC) at the Coakley Site. The absence of 1,4-dioxane suggests that the stormwater samples are not interacting with shallow groundwater, landfill waste, or leachate.

All three stormwater samples reported concentrations of PFOA/PFOS at higher concentrations than those reported in the L-1 seep sample. These data suggest that stormwater is coming into contact with PFAS-containing materials and subsequently being conveyed to the wetland complex west of the landfill.

## RECOMMENDATIONS

The sampling results represent one limited data set focused on stormwater runoff samples. Data suggest that stormwater is coming into contact with PFAS-containing materials, but the currently available information is insufficient to identify variability of results or a direct source of PFAS. Stormwater comes in contact with one or more of the following:

- Vegetative (topsoil) layer
- Cover soil (frost protection barrier for the liner)
- Sand drainage layer
- The linear low-density polyethylene (LDPE) liner, and
- High density polyethylene (HDPE) underdrain piping

In order to address these data gaps, we recommend the following actions:

1) Collect a second set of stormwater samples from the same locations as the original samples and analyze for the six PFAS compounds in the original samples (**Table 1**). Samples will need to be collected following a rain event when surface runoff is present and be representative of the conditions under which the original samples were obtained.

2) Expand the sampling to include the northeast pond outfall and underdrain discharge to both retention ponds and complete the same analysis as noted above.

3) Collect representative samples (minimum of three) from each of the earthen materials used in the cover system – vegetative layer, cover soil and sand drainage layer and analyze for the six PFAS compounds listed above.

4) Investigate the use of PFAS in polyethylene liner and piping manufacturing in the 1990s.

If you have any questions concerning this letter, please contact either of the undersigned at (207) 795-6009.

Sincerely,
CES, Inc.

Suzanne Yerina, P.G.
Project Geologist

Michael A. Deyling, P.G.
Senior Project Geologist

SLY/MAD/jna

Enclosures

TABLE

TABLE

Summary of Stormwater Analytical Data for Spring 2018

Coakley Landfill Superfund Site - North Hampton Greenland, New Hampshire

| **SAMPLE IDENTIFICATION** | **Perimeter Ditch** | **Northwest Outfall Pipe** | **Northwest Outfall Pipe Dup** | **Subsurface Underdrain Piping** | **L-1** | **L-1 Dup** | **L-1** | **L-1 Dup** | **L-1** | **L-1 Dup** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **DATE SAMPLED** | **4/26/2018** | **4/26/2018** | **4/26/2018** | **4/26/2018** | **4/28/17** | **4/28/17** | **9/21/17** | **9/21/17** | **4/30/2018** | **4/30/2018** | **EPA Screening Levels** | | **EPA Screening Levels** | |
| **1,4-Dioxane by 8260B SIM ug/L** | | | | | | | | | | | **Adult Recreator** | **Child Recreator** | **Adult Recreator** | **Child Recreator** |
| 1,4-Dioxane | 0.25U | 0.25U | 0.25U | 0.25U | 1.5 | 1.3 | 17 | 18 | 4.9 | 4.1 | | | | |
| **PERFLUORINATED CHEMICALS BY MODIFIED 537 - (ng/L)** | | | | | | | | | | | **EF = 45 Days** | | **EF = 120 Days** | |
| Perfluorobutanesulfonic acid (PFBS) | 2.58U | 2.29U | 2.19U | 3.62J | 2.09U | 2.13U | 4.85J | 5.50J | 2.72J | 2.99J | 18,300,000 | 2,030,000 | 6,850,000 | 760,000 |
| Perfluoroheptanoic acid (PFHpA) | 217 | 223 | 223 | 531 | 175 | 170 | 111 | 109 | 208 | 196 | --- | --- | --- | --- |
| Perfluorohexanesulfonic acid (PFHxS) | 6.68U | 7.77J | 8.22J | 19.6J | 9.12J | 9.39J | 19.0J | 19.4J | 12.0J | 11.6J | --- | --- | --- | --- |
| Perfluorooctanoic acid (PFOA) | 591B | 532B | 631B | 1480B | 656 | 736 | 319 | 310 | 532 | 492 | 18,300 | 2,030 | 6,850 | 760 |
| Perfluorononanoic acid (PFNA) | 268 | 307 | 299 | 770 | 308 | 310 | 70.3 | 75.6 | 207 | 193 | --- | --- | --- | --- |
| Perfluorooctanesulfonic (PFOS) | 1240 | 1440 | 1230 | 3060D | 1930D | 1560J | 164J | 150 | 567 | 571 | 18,300 | 2,030 | 6,850 | 760 |
| Combination of PFOA and PFOS | 1831 | 1972 | 1861 | 4540 | 2586 | 2296 | 483 | 460 | 1099 | 1063 | --- | --- | --- | --- |

**NOTES:**

1. J = Amount detected is below the reporting limit/Limits of Quantitation
2. B = Compound detected in the method blank
3. D = Dilution
4. U = Not detected above the detection limit
5. Shaded values denote EPA Screening Level Child Recreator Exceedances, EF = 120 days
6. Shaded values denote EPA Screening Level Child Recreator Exceedances, EF = 45 days

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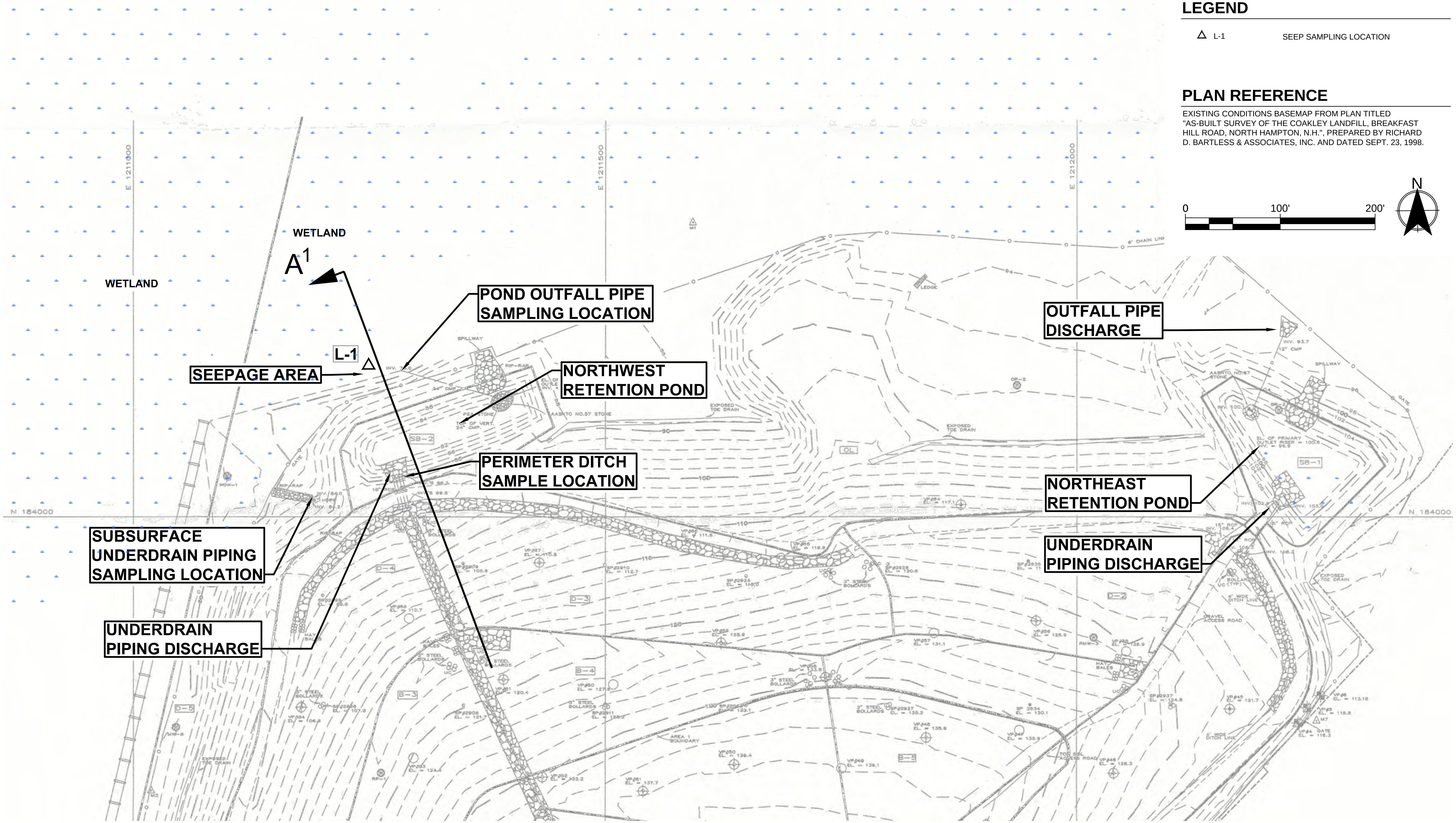
# FIGURES




## LEGEND

△ L-1 SEEP SAMPLING LOCATION

## PLAN REFERENCE

EXISTING CONDITIONS BASEMAP FROM PLAN TITLED "AS-BUILT SURVEY OF THE COAKLEY LANDFILL, BREAKFAST HILL ROAD, NORTH HAMPTON, N.H.", PREPARED BY RICHARD D. BARTLESS & ASSOCIATES, INC. AND DATED SEPT. 23, 1998.

0 100' 200'

N

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| PROJECT TITLE: COAKLEY LANDFILL SUPERFUND SITE NORTH HAMPTON & GREENLAND, NEW HAMPSHIRE | DWG: FIGURE 1 | BY: | BLQ | REV: | DESCRIPTION: | | CES INC Engineers • Environmental Scientists • Surveyors |
| | | DATE: | 2018-08-08 | REV DATE: | | | |
| SHEET TITLE: STORM WATER SAMPLING PLAN | JN: 10424.019 | APPROVED BY: | MD | ISSUE: | DESCRIPTION: | | |
| | SCALE: 1"=100' | CHECKED BY: | SY | ISSUE DATE: | | | |

LEGEND

FILL MATERIAL

LANDFILL REFUSE

MARINE DEPOSITS:
Medium dense, gray clay and silt to soft gray silt and clay, locally stratified with fine sand.

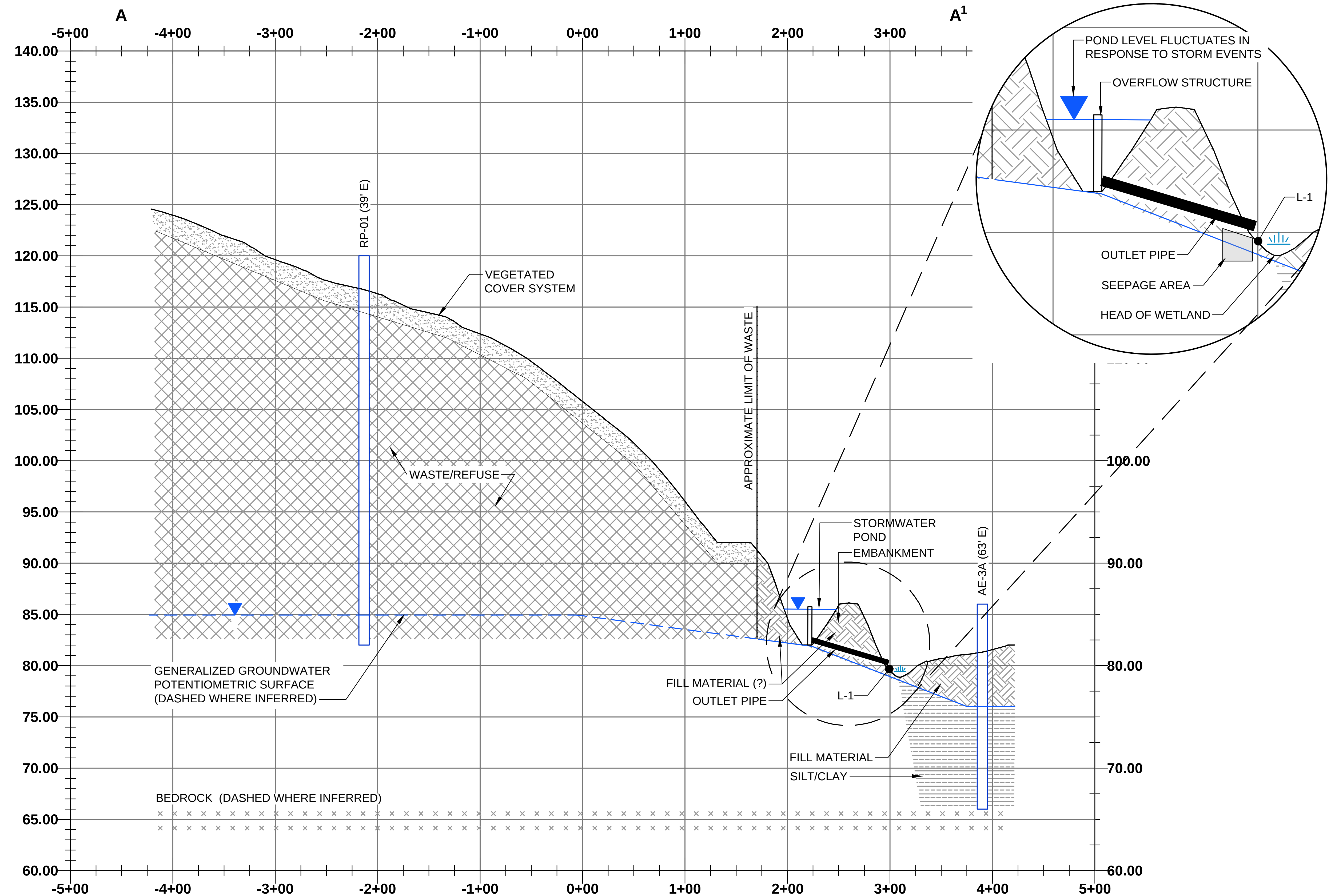
BEDROCK
(DASHED WHERE INFERRED)

WETLAND

WATER ELEVATION
(DASHED WHERE INFERRED)

NOTE:

CROSS SECTIONS BASED ON ORIGINAL SOIL BORING LOGS AND WELL INSTALLATION INFORMATION PROVIDED IN THE SEPTEMBER 2017 SAMPLING AND ANALYSIS PLAN (SAP). EXISTING GRADE AND LOCATION OF L-1 BASED UPON 2011 COASTAL NEW HAMPSHIRE LIDAR, WITH A VERTICAL ACCURACY OF 15 CM.




20'
10'
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VERTICAL SCALE: 1"=10'

0 100' 200'
HORIZONTAL SCALE: 1"=100'

| | | | | | |
|---|---|---|---|---|---|
| PROJECT TITLE: COAKLEY LANDFILL SUPERFUND SITE NORTH HAMPTON & GREENLAND, NEW HAMPSHIRE | DWG: FIGURE 2 | BY: BLQ | REV: | DESCRIPTION: | CES INC Engineers • Environmental Scientists • Surveyors |
| | | DATE: 2018-08-08 | REV DATE: | | |
| SHEET TITLE: CROSS SECTION A-A1 | JN: 10424.002 | APPROVED BY: MD | ISSUE: | DESCRIPTION: | |
| | SCALE: AS SHOWN | CHECKED BY: DC | ISSUE DATE: | | |

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