Memorandum

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Date: January 20, 2016
Subject: Juniper Ridge Landfill - Expansion Application
MEDEP Project Number S-020700-WD-BI-N

Sevee & Maher Engineers, Inc. (SME), on behalf of the Maine Bureau of General Services and NEWSME Landfill Operations, LLC (NEWSME), has prepared an Application (Volumes I through V), dated July 2015, for a 54-acre expansion of the Juniper Ridge Landfill (JRL) in Old Town. The proposed expansion will provide an additional disposal capacity of approximately 9.35 million cubic yards. A proposed double composite liner system consists of the following from top to bottom: 12 inches of leachate collection sand with perforated pipe, a drainage geocomposite, an 80-mil textured high-density polyethylene (HDPE) geomembrane, a geosynthetic clay liner (GCL), 12 inches of barrier soil, 12 inches of leak detection sand with perforated pipe, a drainage geocomposite, and a 60-mil textured HDPE geomembrane. A GCL and 12 inches of barrier soil will supplement the liner system within 11 acres of the expansion area where the in-situ soil depth is within five feet of the bedrock surface. Additionally, a groundwater underdrain system is proposed within 12.7 acres of the expansion area where the proposed landfill base grades are below the phreatic surface.

The proposed expansion consists of six landfill cells (Cells 11 through 16) that will be constructed and operated in a sequential manner. Each cell will have approximately two years of capacity at an estimated waste acceptance rate of 700,000 tons per year. Landfill leachate will be conveyed to an existing 921,000 gallon above-ground glass-lined storage tank and subsequently transported via tanker truck to an off-site wastewater treatment facility. Landfill gas (LFG) will be managed through the installation of vertical extraction wells, horizontal extraction trenches, and a header pipe conveyance and transport system. LFG will be conveyed through an existing Thiopac® sulfur removal system prior to being combusted at a flare or sent to a future landfill gas to energy facility.

We have the following recommendations and comments that need to be addressed before we can recommend your approval of the engineering portions of the proposed expansion project.

I. VOLUME I - MAINE SOLID WASTE MANAGEMENT RULES[1]

A. Section 9.0, MEDEP Reg. Chapter 400.11 - Financial Assurance

For completeness, the closure and post-closure care cost estimates should be included in the Application. This section specifies that the cost estimates are included with the facility Annual Report. Additionally, due to the degree of uncertainty involved in both closure and post-closure care cost estimating, we recommend that a general cost contingency be included. This is typically 10 or 15 percent of the total costs.

B. Section 11.0, MEDEP Reg. Chapter 400.13 - Variances

An alternative design assessment needs to be completed in general conformance with *Landfill Siting, Design and Operation,* 06-096 CMR 401(2)(E) (last amended April 12, 2015) in order to demonstrate that the barrier soil can be placed in a compacted lift thickness of 12 inches in lieu of the required maximum allowable 9-inch lift thickness. A variance request is not necessary as long as the technical equivalency of the proposed thickness can be successfully demonstrated. The completion of a test pad is proposed during each cell's construction in order to demonstrate that a homogeneous barrier layer meeting the design standards can be produced using the specified compaction techniques.

C. APPENDIX J - STORMWATER MANAGEMENT PLAN

1. The time of concentration table on Sheet D-101 has many flow lengths that do not match the HydroCAD calculation lengths. This needs to be clarified.

2. On Sheet C-306, Outlet Control Structure table, the orifice Inv. El. "E" for DP-10 shows 178.3 feet while the HydroCAD calculations show this as 178.0 feet. This should be clarified.

D. APPENDIX L - LEACHATE DISPOSAL CONTRACTS

Section 1 of the Industrial Wastewater Discharge Permit between NEWSME and the City of Brewer Water Pollution Control Authority (Brewer) specifies that Brewer is the secondary discharge location and that authorization is required prior to discharge. It is our understanding that Brewer will now be the primary discharge location. The Discharge Permit and Sections 2.4.5 and 3.3 of the Design Report (Volume III) will need to be updated accordingly.

[1] *Juniper Ridge Landfill Expansion Application - Volume I - Maine Solid Waste Management Rules,* Sevee & Maher Engineers, Inc., July 2015.

II. VOLUME III - DESIGN REPORT[2]

A. Section 2.1.1 Liner System. This Section specifies that the secondary liner will be augmented "in areas where the soil depth between the bedrock and landfill base grades is less than 10 feet…." We assume that this is a typographical error and the sentence should read 5 feet in lieu of 10 feet. This section and Section 2.2 should be updated as necessary.

B. Section 2.3 Base Preparation Below Liner Systems. The acceptability of placing the barrier soil in a 12-inch lift will need to be determined based on the results of each cell's test pad construction.

C. Section 3.1 Geotechnical Evaluation. This section notes that calculated tensile strains are "less that the maximum allowable strains recommended by geosynthetic manufacturers". Potential adverse impacts of calculated maximum tensile strains on the soil components of liner and cover systems should also be addressed.

D. Table 3-4, Leachate Transport System. The Design Selection column lists the existing leachate pond as available leachate storage capacity. The pond is a former leachate pond that is now part of the stormwater management system and is not available for leachate storage.

E. Table 3-5, Gas Management Systems. For clarity, the proposed gas header piping should be noted as 24-inch not 30-inch HDPE.

F. Table 3-6, Cover Systems. The Table lists 20-mil geomembrane as an option for intermediate cover. Section 5.2 of the Operations Manual[3] specifies a 40-mil material while Section 7.8.2 notes a minimum 30-mil material when geomembrane is used as intermediate cover. A clarification should be made.

G. Table 3-7, Potential Failure Modes and Significance of Failures in Engineered Systems. The Table generally does an adequate job identifying Potential Modes of Failure but not Failure Significance. The Failure Significance column mostly addresses how the significance of failure is limited/ minimized through the design instead of what the significance of failure would be if it were to occur. The Table should be revised accordingly.

[2] *Juniper Ridge Landfill Expansion Application - Volume III - Design Report,* Sevee & Maher Engineers, Inc., July 2015.
[3] *Juniper Ridge Landfill - Operations Manual,* August 2005, last updated April 2015.

H. Section 3.5.1 Cell Development. This Section notes that final closure "will likely occur over a several-year period" following filling in Cell 16. The closure sequencing should be scheduled such that final cover installation will be completed within one year of final waste acceptance.

I. Figure 3-7 in Section 3.5.1 depicts stormwater flowing from intermediate cover onto final cover. A detail of how this transition will be accomplished should be developed and included with the Typical Operational Development Details in Appendix E of the Operations Manual.

J. APPENDIX A - CONSTRUCTION SPECIFICATIONS[4]

1. **Section 02200 - Earthwork**

a. Page 02200-7

Part 2.01 D. 1. b) The clay layer should achieve an in-place, not remolded, hydraulic conductivity less than or equal to 1×10^{-7} cm/sec. This paragraph and Part 3.11 B. 1. b) of this section should be revised accordingly.

b. Page 02200-13

i. Part 3.09 C. Clay test pads for liner systems should encompass the transition from base liner to perimeter berm. Also, the clay test pads for the secondary liner systems should encompass the transition from standard liner (one foot of clay) to augmented liner (two feet of clay) where applicable.

ii. Part 3.09 C. Clay test pads for cover systems should encompass the transition from topslope to sideslope.

iii. Part 3.09 C. Hydraulic conductivity samples for clay test pads should also be taken across the interface between the two lifts of the augmented secondary liner and the two lifts of the final cover systems.

c. Page 02200-17

Part 3.14 B. The common borrow moisture content should be tested in general accordance with ASTM D 6938. This standard replaced ASTM D 3017.

[4] *Bid Documents and Technical Specifications - Landfill Expansion - Juniper Ridge Landfill - Old Town, Maine,* Sevee & Maher Engineers, Inc., July 2015.

2. **Section 02272 - Geotextiles and Drainage Geocomposite**

   a. Page 02272-5

      i. Part 2.01 A. 5. This section should reference the Mirafi® 600X woven geotextile that is proposed to be used within the plunge pool associated with the perimeter berm downspout. This detail is illustrated on Sheet C-306 of the Cell 11 Drawings.

      ii. Part 2.01 B. Minimum property values with corresponding test methods should be established for the 10 oz/yd² non-woven geotextile that is proposed to be utilized within the gas header pipe trenches.

      iii. Part 2.01 B. 5. a) Reference to ASTM D 3786, "Standard Test Method for Hydraulic Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method" should be removed from this section. ASTM Committee D35 on Geosynthetics does not currently recognize D 3786 as being applicable to geotextiles. This section and Parts 1.05 C. 10. d. and 1.06 1. should be updated accordingly.

   b. Page 02272-6

      Part 2.01 C. 6. ASTM D 7179, "Standard Test Method for Determining Geonet Breaking Force" should be specified in lieu of D 5034. The former method is the most appropriate method for geonet testing.

3. **Section 02275 - Geosynthetic Clay Liner**

   a. Page 02275-5

      Parts 3.02 B. 1. & 6. Installation provisions for the GCL in contact with the 60-mil geomembrane within the proposed secondary liner systems will need to be established. This section only references the GCL in contact with the 80-mil geomembrane within the proposed primary liner system.

4. **Section 02771 - Geomembrane Liner High Density Polyethylene (HDPE)**

   a. Page 02771-2

      Part 1.05 C. Geomembrane asperity testing should be conducted in general conformance with ASTM D 7466 in lieu of the specified GM 12. GM 12 has been discontinued by the Geosynthetic Institute. Part 1.06 of this Section does note the correct test method.

5. **Section 02772 - Leak Location Survey**

   a. This section should note that the leak location survey will be conducted in general conformance with ASTM D 7007, "Standard Practices for Electrical Methods for Locating Leaks in Geomembranes Covered with Water or Earth Materials". This test method is referenced in Technical Specification Section 02771 and Section 3.1 of the Quality Assurance/Quality Control Plan.

   b. We assume that one leak location survey will be conducted upon completion of the installation of both the secondary and primary liner systems including the primary leachate collection system. A clarification should be made as necessary.

6. **Section 02780 - Interfacial Friction Angle Conformance Testing**

   a. This section will need to be clarified to state that an interface shear strength test will be conducted on the drainage geocomposite to 80-mil geomembrane and 80-mil geomembrane to GCL interfaces within the proposed primary liner system and the drainage geocomposite to 60-mil geomembrane and 60-mil geomembrane to GCL interfaces within the proposed secondary liner systems. Also, the 60-mil geomembrane to compacted clay will need to be tested for the non-augmented secondary liner.

   b. It should be specified that the geomembranes will be tested against the non-woven side of the GCL and that the compacted clay will be tested against the woven side of the GCL.

   c. Part 3.03 allows re-testing of failed interface tests. It should require the successful completion of a minimum of two re-tests for each failure.

7. **Section 15100 - HDPE Pipe and Fittings**

   a. This section should specify pipe size and corresponding SDR rating in accordance with the pipe strength design calculations presented in Appendix D-1. Alternately, the SDR rating for all piping could be specified within pertinent details of the drawings.

   b. Part 2.11 A. inadvertently specifies that pressure transducers will be installed within Cell 6 in lieu of Cells 11 through 16. A clarification should be made.

K. APPENDIX B - CONSTRUCTION QUALITY ASSURANCE MANUAL

1. Section 5.5.1 Seam Layout. This section should be consistent with Technical Specification Section 02771-9 Part 3.05 A. which notes that "no horizontal seams shall be allowed on the sideslopes of the cell."

2. Section 5.10.1 Preparation. This section specifies the installation of electrodes "if required" under the GCL prior to deployment. We assume that electrode installation under the GCL is necessary in order to appropriately perform the leak location survey. A clarification should be made.

L. APPENDIX D-3, GEOCOMPOSITE DRAINAGE NET DESIGN

1. Supporting justification should be provided for the selected reduction factors (RFs) used to determine the drainage geocomposite allowable flow rate. As an example, for the intermediate condition, SME selected a RF_{IN} of 1.0 for intrusion, a RF_{CR} of 1.2 for creep, a RF_{BC} of 1.6 for biological clogging and a RF_{CC} of 1.6 for chemical clogging. Dr. Robert Koerner[5] recommends reduction factors ranging from 1.5 to 2.0 for intrusion, biological clogging and chemical clogging and 1.4 to 2.0 for creep for both primary and secondary leachate collection systems. The selected reduction factors used within the leak detection system design in Appendix D-5 of the Design Report should also be justified. Technical Specification Section 02272-6 may need to be updated if the reduction factors are modified.

2. The calculations associated with the Cell 11 Leachate Collection Design Intermediate Condition should note that the specified drainage geocomposite transmissivity is 3.17×10^{-4} m^2/sec rather than 3.17×10^{-3} m^2/sec.

[5]Designing with Geosynthetics, 6th Edition, Vol. 2, Robert M. Koerner, 2012, page 873.

M. APPENDIX D-5, LEAK DETECTION SYSTEM

A RF_{CC} of 1.3 and RF_{BC} of 1.5 were utilized within the leak detection system design calculations while a RF_{CC} of 1.5 and RF_{BC} of 1.3 were used for the same design calculations presented in Appendix D-3. We assume that this was a typographical error. A clarification should be made.

N. APPENDIX E - DESIGN DRAWINGS

1. Sheet C-102, Site Base Grading Plan

   Installation details should be provided for the groundwater level monitoring transducers that are proposed to be installed under Cells 12 and 13.

2. Sheet C-104, Leak Detection Piping Plan

   a. The location of the Cell 11 leak detection sample sump should be shown.

   b. The locations and dimensions of the temporary cell division berms separating Cells 12 and 13, Cells 14 and 15, and Cells 15 and 16 should be shown.

3. Sheet C-105, Leachate Collection Piping Plan

   Installation details and specifications for the leachate level transducers should be included.

4. Sheet C-106, Gas Collection System Plan

   A note specifies connection of a new 12-inch header pipe along the west side of the landfill to an existing 12-inch conveyance pipe. The existing conveyance pipe is 24-inches.

5. Sheet C-107, Final Site Drainage Plan

   Details of drainage relief at the toe of the final cover system should be included. This includes both the riprap downspouts and the drainage sand layer.

6. Sheet C-108, Final Development Plan

   a. The following additional typical details should be developed and included:

      i. Final cover system to liner system connections;

ii. Final cover penetration boots for the active landfill gas extraction system wells and wellheads and the leachate collection and leak detection cleanouts; and

iii. Final cover system to pump station connections.

7. Sheet C-201, Transverse Cross Sections Sta 14+00 to Sta 24+00

   The cross section for station 16+00 should be provided. It appears that it was inadvertently omitted from the drawings.

8. Sheet C-300, Sections and Details

   a. The transition between the native till and imported soil (12-inch compacted clay) should be depicted on the Liner System with Augmented Secondary Liner Detail. It is unclear if the intent is to "box" cut into the till.

   b. The dimensions of the drainage stone envelope around the leak detection pipe as depicted on the Piping at Perimeter Berm Detail should be specified.

   c. The north/south extent of the 6-inch deep by 6-foot wide base grade undercut leak detection sump, as indicated on the Leachate Collection & Leak Detection Cleanouts Detail, should be specified.

   d. Liner Termination. We assume that the impervious borrow specified within the anchor trench will achieve the specification for "clay borrow". If so, the terminology should be consistent. If not, a specification for impervious borrow should be established.

9. Sheet C-302, Sections and Details

   A description and details to describe how the temporary leachate collection sumps will be abandoned or removed and how connections to subsequent cells will be made should be provided.

10. Sheet C-306, Sections and Details

    a. Culvert Schedule. Based on the information provided in Table 7-1 of the Stormwater Management Plan (Appendix J, Volume III), the inlet invert elevation for C-2BA should be 203.2 feet not 202.9 feet and the slope should be 0.008 % instead of 0.02 %.

    b. Catch Basins 4K & 4L. For clarity, the depth below the pipe stub invert should be specified as 2 feet.

11. Sheet C-307, Sections and Details

    a. The Final Cover System Detail indicates that the 24-inch soil barrier layer is to be constructed over a surface prepared with "select waste". The term select waste should be defined. It should capable of acting as a gas transmission layer with a minimum hydraulic conductivity of $1x10^{-3}$ cm/sec.

    b. Rodent guards should be specified on the drainage pipe discharges to the riprap down spouts depicted on the Riprap Down Spout Detail.

    c. The Terrace Drainage Swale Detail notes a swale depth of 1.5 feet while the sizing information provided in Appendix K, Erosion and Sedimentation Control Plan of Volume III specifies a 2-foot depth. A clarification should be made.

    d. Depending on the results of the analysis recommended in Comment O. 1. of Appendix F below, it may be appropriate to add a drainage geocomposite between the geomembrane and topsoil at the Terrace Drainage Swale.

12. Sheet C-308, Sections and Details

    a. Anti-Seep Collar. This detail specifies a pipe length of 70 feet and saturated pipe length of 32 feet for DP-10 while the Detention Pond OCS Table (Table) in Appendix C-2 of Appendix J of Volume III notes a pipe length of 52 feet and saturated pipe length of 42 feet. Additionally, the detail specifies a saturated pipe length of 30 feet for DP-11 while the Table notes a saturated pipe length of 37 feet. Clarifications should be made as necessary.

    b. Level Spreader. The type of geotextile proposed to be placed underneath the stone within the level spreader should be clearly specified.

O. APPENDIX F - GEOTECHNICAL DATA

1. The geotechnical report should evaluate veneer stability of the final cover system. The evaluation should include sand saturation conditions due to failure of a 4-inch perforated Hancor drainage pipe at a terrace drainage swale.

2. Figures E-2 and E-3 in the Operations Manual indicate a slope of 1:1 over a length of about 4.5 feet at the waste toe. The geotechnical report should evaluate stability through these segments.

3. Peak and large displacement liner strength envelopes have been taken from a 2005 geotechnical stability analysis. Substantial additional interface strength data from subsequent construction projects at the JRL facility is available and comparison of that data with the 2005 values should be made.

4. The Sensitivity Assessment in Appendix F-7 should include an evaluation of the impact of leachate head build-up on the primary liner system if it were to occur.

5. The Settlement Evaluation Points on Figure 1 of Appendix F-8, Settlement Coefficients, should be labeled.

P. APPENDIX I - LANDFILL GAS DESIGN REPORT[6]

1. Section 3.0 - Facility Description. This section discusses the capacity of the site flares and a future landfill gas-to-energy facility in terms of a landfill gas (LFG) methane (CH_4) concentration of 50 percent by volume. Historic data suggests that the CH_4 concentration at JRL is on the order of 35 to 40 percent by volume. System capacities should also be compared to the likely lower concentrations of CH_4.

2. Section 4.0 - Landfill Gas Generation Estimates. This section discusses LFG generation estimates as predicted by the LandGEM[7] Model. The Model projection has been initiated from the first year of operation at JRL. A comparison of the projected generation rates with actual data from JRL to date should be made to calibrate the LandGEM Model input.

[6] *LFG System Expansion Design Report - Juniper Ridge Landfill - Old Town, Maine,* Sanborn, Head & Associates, Inc., June 2015.
[7] *Landfill Gas Emissions Model,* United States Environmental Protection Agency, Version 3.02, May 2005.

3. Section 5.2 - Gas Collection Trenches. It is noted that intermediate cover will be placed over the extraction trenches. Intermediate cover over the trenches would interfere with LFG extraction above the trenches and the reasons including it should be discussed.

4. Section 5.3 - Conveyance Pipe. Reference is made to "industry experience" when sizing smaller diameter pipe. A citation or citation(s) for "industry experience" should be included.

5. APPENDIX A - CALCULATIONS

    a. The LandGEM Model includes estimates for the methane generation rate of k = 0.1 $year^{-1}$ and potential methane generation capacity of L_o = 110 m^3/Mg. As noted above, actual data from JRL should be used to calibrate the Model input.

    b. The calculated LFG flow velocity in the new 24 inch header on the east side of the landfill is checked against criteria for concurrent LFG and condensate flow. Flow in the northern half of the header is countercurrent and that condition should be checked as well.

    c. The calculated LFG flow velocity in two of the internal header pipes (5 and 6) exceeded identified criteria. The calculated exceedances are under a worst case scenario where LFG is being pulled from one side of the header only. Both headers are designed to be pulled from two directions, therefore velocity "is not expected" to exceed criteria under normal operations. Calculations under normal operations should be included to verify the expectation.

6. APPENDIX B - ENGINEERING DRAWINGS[8]

    a. <u>Sheet 2 of 14 - Landfill Gas Extraction System Plan</u>

        i. An existing conditions plan should be prepared to depict the LFG infrastructure expected to exist at the time of the development of the first cell of the expansion. For clarity the horizontal collectors can be left off the plan.

[8] *Landfill Gas System Expansion Drawings - Juniper Ridge Landfill - Old Town, Maine*, Sanborn, Head & Associates, Inc., June 2015.

ii. Consideration should be given to providing a redundant header connection for extraction laterals that collect LFG from several, as an example more than three, extraction wells. Under this example, six relatively short sections of header pipe would be required and the need for future repairs may be mitigated.

b. Sheet 3 of 14 - Perimeter LFG Header Pipe Profile

i. A note should be added to field verify the leachate force main locations prior to installing the LFG header pipe.

ii. Procedures for completing the LFG header pipe crossings under culverts should be developed.

c. Sheet 4 of 14 - Cell 11 LFG Infrastructure Development Plan

i. This plan depicts extraction wells labeled GW-24, 25, and 16 while the Cell 11 construction drawings[9] label the same wells GW-24R, 25R, and 16R. We assume that the R indicates that these are replacement wells and that the construction drawings depict the intended designations, however, a clarification should be provided. Abandonment procedures for the old wells should be developed if wells are to be replaced.

ii. LFG collection headers and laterals for extraction wells on the north sideslope at this stage of development should be depicted on the plan.

d. Sheet 7 of 14 - Cell 14 LFG Infrastructure Development Plan

In general, it is not clear whether many of the extraction wells within the existing landfill footprint are to be extended or abandoned and replaced as the expansion cells fill over them. As an example GW-12, which currently exists within the Cell 3A footprint, will be 64 feet beneath the waste surface at the stage of development depicted on this plan. GW-12 is, however, shown as an existing well connected to a new collection lateral located near the waste surface.

[9] *Cell 11 Landfill Gas System Expansion Drawings - Juniper Ridge Landfill - Old Town, Maine*, Sanborn, Head & Associates, Inc., June 2015.

e. Sheet 10 of 14 - Landfill Gas Extraction System Details

i. A polyvinyl chloride (PVC) well bore seal with a collapsible boot is proposed around the final cover system LFG pipe penetrations. While not indicated on the details, the well bore seal skirt should be sealed to the cover system geomembrane.

ii. Detail 2, Typical Gas Extraction System Wellhead Detail, depicts the collapsible portion of the well bore seal partially below final cover system grade. The well bore seal should be installed such that the collapsible portion is located fully above grade.

iii. Detail 2 depicts the 90° elbow connection to the LFG header a minimum of 4 feet below the bottom of the final cover. This conflicts with the Cell 11 construction plans (Detail 3, Sheet 8 of 11) which specifies the elbow 2 feet below the final waste grade.

iv. Detail 4, Typical Cover System, depicts the final cover system barrier soil placed directly on refuse. The barrier soil should be placed on a LFG transmission sand layer or equivalent.

v. Gas extraction system boots associated with the geomembrane intermediate cover should also be detailed.

f. Sheet 12 of 14 - Landfill Gas Extraction System Details

i. The condensate knockout (KO-4) appears to be inappropriately designed for its location. There is no LFG flow from the downstream side of the structure so it will function only as a low point collector.

ii. Note 9 states “Pump in condensate knockout shall be able to pump more than 1 gpm.” An actual pump should be selected and specified.

g. Sheet 13 of 14 - Landfill Gas Extraction System Details

i. Detail 2, Typical Gas Collection Trench Section, specifies “12-inch intermediate cover” placed directly over the trench. As noted earlier, intermediate cover over the trenches would interfere with LFG collection above them.

ii. Perforation size and pattern should be specified for the horizontal LFG collection pipe.

h. Sheet 14 of 14 - Landfill Gas Extraction System Details

Note 4 indicates that the intent is for LFG extraction wells and wellheads to stick up three feet above the final waste fill grade. Details and procedures to extend them at the time of final closure should be established.

7. APPENDIX C - TECHNICAL SPECIFICATIONS

Section 02560 - Landfill Gas Extraction Wells

Part 1.3 B. requires removal of any soil placed to level drilling locations following well completion. Proper disposal requirements for any soil mixed with waste should be specified.

8. APPENDIX D - CONSTRUCTION QUALITY ASSURANCE PLAN[10]

Section 3.1 - Pre-Construction Meeting

The Department should be notified of the time and location of pre-construction meetings.

9. APPENDIX E - OPERATION AND MAINTENANCE MANUAL (Manual)[11]

a. General

The Manual is very generic and should be reviewed and updated to reflect the actual conditions at JRL, which are well known at this point. Some examples include, but are not limited to, the following:

i. Section 2.1 notes that LFG is comprised of methane "(typically about 55 percent)" and carbon dioxide "(typically about 45 percent)". Methane concentrations at JRL are typically 30 to 40 percent and carbon dioxide concentrations are typically 20 to 35 percent.

[10]*Construction Quality Assurance Plan - Landfill Gas Extraction System Expansion - Juniper Ridge Landfill - Old Town, Maine,* Sanborn, Head & Associates, Inc., June 2015.
[11]*Operation and Maintenance Manual - Landfill Gas Management System - Juniper Ridge Landfill - Old Town, Maine,* Sanborn, Head & Associates, Inc., June 2015.

ii. Section 2.1 describes the concentration of nitrogen as "lesser amounts". The concentration of nitrogen (balance gas) at JRL is quite high, typically 20 to 50 percent.

iii. Section 2.2.1 states that "Potentially lethal concentrations of hydrogen sulfide (H_2S) may be present at landfills". H_2S is highly elevated at JRL and the levels should be noted. Additional emphasis on the dangers associated with H_2S should be addressed in the Manual.

iv. Section 5.3 states that "conveyance pipe is generally installed at a minimum slope of 5 percent within the landfill". Conveyance pipe within the JRL is required to be installed at a minimum slope of 7 percent.

v. Section 5.4.1 discusses what pipe and fittings "commonly consist of" or have "been successfully used in landfill gas applications". The section should be specific to the pipe and fittings actually used at JRL. Section 5.4.2 treats valves in the same manner.

vi. Section 7.1 covers data assessment and focuses on assessment during the initial start-up and operation of the landfill gas management system. It introduces such terms as "baseline data", "normal conditions", "established parameters for normal operating ranges", "acceptable ranges and conditions", and "target criteria". Since initial start-up and operation of the landfill gas management system happened about ten years ago the aforementioned terms can be, and should be, defined and included in the Manual.

vii. Section 7.3 refers to migration monitoring probes surrounding the landfill. Currently, there are no migration monitoring probes surrounding the landfill.

b. Section 2.1 - Landfill Gas Characteristics. LFG is described as flammable and explosive in the range of 5 to 15 percent in air. It should state that LFG is flammable and explosive when *methane* is present in the range of 5 to 15 percent in air.

c. Section 2.1 states that gas levels should be monitored "at any location where there is potential for landfill gas to be present and where personnel could be exposed". There are known locations at JRL that meet this description and they should be listed in the Manual. The same paragraph states that the <u>percent</u> hydrogen sulfide should be monitored. Hydrogen sulfide should be monitored in the unit of <u>parts per million</u>.

d. 3.0 - System Components and Monitoring Program

   i. Section 3.1 - Introduction. It is stated that LFG is conveyed to a blower/flare station for treatment. The LFG is first conveyed to a sulfur treatment unit.

   ii. Condensate structures and management systems located outside the landfill footprint should be addressed in this section.

   iii. The Thiopac® and SulfaTreat® sulfur scrubbing units should be addressed in this section or reference made to where they are addressed.

   iv. Section 3.4 - Wellhead Assemblies. It is stated (also in Section 3.7) that wellheads are monitored on a weekly basis. The wellheads are currently monitored less frequently.

   v. Section 3.4 should also address inspection and adjustment of the well bore seals that will be installed during phased final closure of the landfill.

   vi. Extension of the temporary collection trench risers should be addressed in this section.

e. 4.0 - Operation and Adjustment

   i. Section 4.3 - Indicator Parameters. This section should identify levels of oxygen and nitrogen that are excessive in LFG and actions to take if they are present.

   ii. Section 4.5 - Pressures. Reference is made to “normal ranges” of LFG constituent concentrations. Normal ranges of LFG constituents at JRL should be identified.

   iii. Section 4.6 - Temperature. This section should address excessively high temperatures, identify what they are, and discuss actions to take if excessive temperatures are present.

f. 5.0 - Maintenance and Troubleshooting

i. Section 5.3 - Conveyance Pipe. This section discusses excavation into the landfill to address problems with blocked header pipe. Process and procedures to be followed if excavation into a section of the landfill with final cover in place is necessary, including cover system restoration, should be discussed.

ii. Section 5.4.10 - Condensate Handling Systems. This section should address operation and maintenance requirements for the condensate handling system recently installed to collect and recirculate condensate from the sulfur treatment system building and Condensate Knockout KO-3.

g. TABLE 1 - Typical Landfill Gas Constituents. The table should be revised to reflect the concentration ranges of landfill gas constituents typically measured at JRL.

11. APPENDIX K - CELL 11 DESIGN DRAWINGS

a. Sheet C-101, Existing Site Conditions Plan

This sheet should be updated prior to construction to reflect existing conditions at that time. The current schedule calls for 2017 construction to allow use of Cell 11 in 2018.

b. Sheet C-102, Base Grading Plan

i. The reference to the section for the intermediate cell berm is to Detail 2 on Sheet C-300. The correct reference is Detail 1 on Sheet C-300. This reference carries through to other sheets.

ii. The reference for Grass Ditch DP-10 is to DWG C-304. The correct reference is to DWG C-307.

iii. The reference for exterior layout grade points is to the 200 Series Table. The correct reference is to the 500 Series Table.

c. Sheet C-104, Leachate Collection Piping Plan

The proposed leachate level transducer along with any pertinent installation details should be illustrated on this drawing. Sheet C-105 of the Design Drawings found in Appendix E of the Design Report illustrates the transducer location within Cells 11.

d. Sheet C-200, Force Main and Landfill Gas Header Plan and Profile

The Landfill Gas Header Plan and Profile should be updated prior to Cell 11 construction. A Thiopaq® sulfur treatment system is now in use and a landfill gas-to-energy plant is planned to be constructed during 2016.

e. Sheet C-300, Sections and Details

i. The transition between the native till and imported soil (12-inch compacted clay) should be depicted on the Liner System with Augmented Secondary Liner Detail. It is unclear if the intent is to "box" cut into the till.

ii. The dimensions of the drainage stone envelope around the leak detection pipe as depicted on the Piping at Perimeter Berm Detail should be specified.

iii. The north/south extent of the 6-inch deep by 6-foot wide base grade undercut leak detection sump, as indicated on the Leachate Collection & Leak Detection Cleanouts Detail, should be specified.

iv. Liner Termination. We assume that the impervious borrow specified within the anchor trench will achieve the specification for "clay borrow". If so, the terminology should be consistent. If not, a specification for impervious borrow should be established.

f. Sheet C-305, Sections and Details

Catch Basins 4K & 4L. For clarity, the depth below the pipe stub invert should be specified as 2 feet in accordance with the design presented in Appendix J, Stormwater Management Plan and Appendix K, Erosion and Sedimentation Control Plan of Volume I.

g. Sheet C-306, Sections and Details

We could not locate stormwater sizing calculations for the perimeter berm down spout and associated riprap plunge pool that is illustrated on this drawing. The calculations should be provided for our review at this time.

CELL 11 GAS SYSTEM

h. Sheet 6 of 11 - LFG Infrastructure Development Plan - Stage 5

i. The Cell 11 Infrastructure Development Plan provided with the LFG plans for the Application[6] (Sheet 4 of 14) indicate the installation of five additional LFG extraction wells not shown here (GW-22R, 32R, 41, 50, and 59) during Cell 11 development. The same plan also indicates that the main 12-inch header in Cell 11 is to connect to a stub at an existing 12-inch header in Cell 4.

ii. The same Cell 11 Infrastructure Development Plan indicates that extraction wells GW-72, 71, and 61 are to be developed with Cell 11, while this sheet indicates that they are existing, and that existing headers in Cells 8 and 10 are to be extended and connected within Cell 11, while this sheet does not.

i. Sheet 8 of 11 - Details

i. A detail of penetration boot connections to the geomembrane intermediate cover should be prepared and included.

ii. A Well Schedule is included on this sheet. It appears that that the Bottom of Waste elevations listed for extraction wells GW-98 through GW-106 will all be four feet higher than what is listed. These wells are all located within the Cell 11 footprint and it is likely that the specified elevations were taken from base grades before liner construction instead of the top of the leachate collection system sand. The Total Well Depth and Bottom of Well Screen elevations for these wells will also need to be raised by four feet.

III. VOLUME IV - OPERATIONS MANUAL[12]

A. Section 5.1, Cell Construction, notes that information regarding the design and construction of the leachate collection and storage systems can be found in Construction Documentation Reports for the individual cells. We recommend the development of an overall site plan depicting the location of all leachate collection, transport, and storage systems at the facility for inclusion in the Operations Manual (Manual). The plan can subsequently be updated as new construction projects are completed.

B. Section 5.2, Landfill Cell Intermediate Cover, specifies that intermediate cover may consist of a 40-mil geomembrane while Section 7.8.2 specifies a 30-mil geomembrane. A clarification should be made.

C. Section 6.1, Permitted Landfill Cell Development, references waste material approved for use as soft layer material. The Manual should list materials approved as soft layer material. Other materials can be considered and added to the list on a case by case basis as appropriate.

D. Section 7.2, Facility Access/Hours of Operation, refers to the application of calcium chloride to internal gravel access roads. We recommend alternatives to calcium chloride where practical.

E. Section 7.7, Compaction (Waste Placement), sixth operational detail, states that "Waste setbacks, a minimum of 2 feet, shall be maintained at the outer edge of the waste to contain surface water runoff, to allow it to infiltrate into the waste". It is unclear what this statement is specifying and a clarification should be provided.

F. Section 7.8.2, Intermediate Cover, specifies either geomembrane or soil based intermediate cover. The Manual should include provisions for removal and stockpiling or disposal as appropriate of soil intermediate cover, if it is used, prior to waste placement above it.

G. Section 9.3, Annual Report, includes a summary of items to be included in the annual operations report. The summary of leak detection system monitoring should include a comparison with previous years' monitoring data. Site changes that did not require Department approval and a summary of operator training during the year should also be included.

H. Appendix B, Compliance Self Audit Checklist, should include a check to assure that leak detection monitoring is being conducted as specified in the Manual.

[12] *Juniper Ridge Landfill Expansion - Volume IV - Operations Manual*, Sevee & Maher Engineers, Inc., July 2015.

I. The following apply to Appendix D, Cell Development Plans:

1. Section 2.0, Cell 11 Development, states that chimney drains will be constructed of "tire shreds and piping". The chimney drain detail on Figure E-3 does not indicate that piping will be included. A clarification should be provided.

2. The Cell Development Figures should specify where the perimeter downspouts, as detailed on Figure E-3, are to be located.

3. A cross-section of landfill access road construction, as discussed in Section 2.0, should be developed and included along with details needed to construct the access roads in areas of intermediate cover.

4. Details adequate to construct the stormwater discharge internal to the perimeter access road in the northeast corner of Cell 11 should be developed and included.

5. It is not clear how stormwater and leachate will be kept separate in the northwest and southeast corners of the Cell 11 stages as they are built out. Additional detail should be developed and included.

6. Figure 5 depicts a triangular wedge of intermediate cover discharging directly into the active area of Stage 4 at about elevation 360 feet. The stormwater should be diverted from the operating area.

J. The following apply to the details in Appendix E, Typical Operational Development details:

1. It is unclear what the function of the drainage geocomposite, fully embedded in clay above the anchor trench, as depicted on the Final Cover Termination at Top of Slopes is. A clarification should be provided.

2. A pipe boot detail should accompany the Leachate Collection Inlet detail depicted on Figure E-2.

3. The Temporary Up-Slope Stormwater Diversion Berm detail on Figure E-2 indicates that the berm is to be constructed with "select waste". The term select waste should be defined.

4. The Downspout Section depicted on Figure E-3 specifies stripping of topsoil. It is unclear why topsoil would be present in this location.

K. The Gas Monitoring Operation and Maintenance Manual is included in Appendix J. We have discussed that Manual previously in this memorandum.

L. The Geotechnical Monitoring Plan[13] included in Appendix N discusses an annual review of measurements obtained from site transducers "installed below the landfill liner". We assume that the intent is to reference the transducers above the landfill liner within the leachate collection system. The Manual itself should address the procedures and frequency for monitoring of the transducers and response actions to take if elevated leachate levels are measured. We note that transducers installed within leachate collection systems at other landfills have been problematic and spare transducers should be maintained on-site in the event of failure.

M. The following apply to the Liner Action Plan[14] included in Appendix P:

1. In general we do not recommend implementing the leak detection program proposed. It is based on a formula to derive a Leak Detection System Action Level (LDSAL) considering action leakage rates (ALRs), base flow rates, baseline specific conductance, leachate specific conductance, and base flow rate to the underdrain. The formula was developed for a different landfill in Maine with a different liner and leak detection configuration (the base flow rate to the underdrain is not a consideration at JRL).

   We recommend a simpler approach that establishes a two tiered action leakage rate program, based on gallons per acre per day (gpad), similar to what is done at most landfills with double liner systems. If our recommended approach is followed, the proposed ALRs of 4.6 and 92 gpad should be rounded for ease of monitoring and reporting. SME could consider rounding the ALR-I to 10 gpad and the ALR-II to 100 gpad.

2. Section 2.2, Leak Detection Flow Rates, correctly notes that there will be liquids other than leakage water present in the leak detection system. These flows include construction water, consolidation water, impingement water, and condensation. There are calculation methods available to predict these flows and we recommend doing so prior to placing each cell in service in the event of, and to the extent they are, encountered during active monitoring of the leak detection system.

[13] *Juniper Ridge Landfill Expansion Application - Geotechnical Monitoring Plan,* Sevee & Maher Engineers, Inc., July 2015.
[14] *Juniper Ridge Landfill Expansion Application - Liner Action Plan,* Sevee & Maher Engineers, Inc., July 2015.

3. Leak detection system flow rates, along with leachate collection system flow rates, should be provided to the Department on a monthly basis in electronic data deliverable (EDD) format.

We would be happy to discuss these recommendations and comments with SME and NEWSME as needed. Please see us if have any questions.

Pc: Kathy Tarbuck, P.E.