

**Taylor, Dianna**

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**From:** McWilliams, Clark  
**Sent:** Tuesday, January 12, 2016 1:41 PM  
**To:** Taylor, Dianna  
**Subject:** NABORS: 100% Design Review

DT-  
AFIN: 03-00051  
Permits: 0249-S1-R2 and 0249-S4

<G:\Shared Folders\SolidWaste\NABORS Design Review Letter Report.pdf>

Thanks,  
Clark McWilliams P.E. 501-682-0510  
ADEQ – Solid Waste Management Division  
1/12/16

Rec'd Digitally

**AFIN:** 03-00051

**PMT#:** 0249-S4

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*By Dianna Taylor at 2:14 pm, Jan 12, 2016*

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January 11, 2016

Mr. Bryan Leamons, P.E.  
Arkansas Department of Environmental Quality  
Solid Waste Management Division  
5301 Northshore Drive  
North Little Rock, Arkansas 72118

Re: Closure Design Review  
Construction Documents for NABORS Landfill Closure  
Three Brothers, Arkansas  
AFIN: #03-00051 Permits: 0249-S1-R2, 0249-S4  
Design Professional Services Contract 4600021812  
EnSafe Project Code: 0888818233

Dear Mr. Leamons:

EnSafe is pleased to submit this letter report on our design review of construction documents for the NABORS landfill closure. It presents our findings and recommendations, which were communicated verbally to Mr. Clark McWilliams and you during an informal debrief meeting on January 7, 2016.

The purpose of the closure design review is to ensure fiscally responsible, proper closure of the inactive landfill units at the NABORS landfill site. As specified in the scope of work provided by ADEQ, our scope of work consisted of:

- Evaluating the design to ensure compliance with Arkansas Regulation 22 closure requirements (including groundwater evaluation of corrective measures).
- Evaluating the design documents to assess correction of landfill deficiencies in preparation for closure under existing permit options (waste overfill, inoperative leachate collection system components, inadequate access roads, etc.).
- Reviewing the design documents to ensure construction costs are minimized while achieving adequate closure and minimizing post closure care costs (i.e., closure is designed and can be constructed to function reliably and with minimum day-to-day care).

On January 5 through 7, 2016, Tom Green of EnSafe reviewed closure design documents compiled by ADEQ in your offices in North Little Rock. The files provided by ADEQ included correspondence, news clippings, design criteria reports, and progressive versions (50%, 75%, 100%) of design plans. In addition, on January 6, Mr. McWilliams and you arranged and

participated with Mr. Green in a conference call with Mr. Floyd Cotter and Mr. Dillon Baird of SCS Aquaterra, the firm retained by ADEQ to prepare the design, to assist our understanding of elements of the project.

EnSafe focused its review on the most pertinent documents, in particular, the following prepared by SCS Aquaterra:

- *Design Criteria Report, Design Professional Services, Closure of Inactive NABORS Landfill* ("Design Criteria Report"), April 2015
- *Project Manual – Specifications, Closure of Inactive N.A.B.O.R.S. Landfills* ("Project Manual"), November 17, 2015
- Engineering Drawings, titled *Closure of Inactive NABORS Landfills*, November 20, 2015
- Engineer's Estimate, November 2015

### Findings and Recommendations

In EnSafe's opinion, the design as formulated in the Design Criteria Report and presented in the Project Manual and 100% Engineering Drawings complies with Arkansas Regulation 22 closure requirements, namely:

- The capping of Class 1 wastes with a final cover meeting Reg.22.428. Use of a geosynthetic clay liner in lieu of 18 inches of low permeability clay ( $1 \times 10^{-7}$  cm/sec) is a proven alternative that is cost effective when suitable clay soil is unavailable at or near the landfill. Its equivalency was documented by SCS Aquaterra in the Design Criteria Report. The cover system with its integral 40-mil LLDPE geomembrane helps minimize leachate generation and gas migration.
- The capping of Class 4 wastes with a final cover meeting Reg.22.624.

The design addresses correction of identified deficiencies:

- Waste overfill – wastes in Class 1 areas 1-2 and 1-3 and in the Class 4 area will be relocated within the respective permitted footprints and airspaces.
- Inoperative leachate collection system components – leachate collection sumps are being upgraded with new pumps and sumps with pumps are being added, where needed. New force mains will convey leachate from the sumps to a new central leachate tank farm. From the tank farm, leachate can be pumped to a proposed gas-fired evaporator, re-injected into the landfill, or hauled to an offsite facility for treatment and disposal.
- Inadequate access roads – the main access road will be improved and the central leachate tank farm will eliminate the need for tanker trucks to access leachate sumps at the perimeter of the fill areas. Perimeter access roads will be upgraded to accommodate maintenance vehicles.

- Control of gas migration – capping with a system that includes a geomembrane layer and the installation of an active gas collection system will minimize the migration of landfill gases beyond the waste footprints and reduce the concentration of water soluble volatile substances (volatile organic compounds, etc.) in leachate. The proposed flare will reduce the emissions of methane and non-methane organic compounds to the atmosphere.

The proposed design offers a reasonable approach to minimizing long-term project costs (construction costs plus post-closure operating and maintenance costs) while achieving regulatory requirements and site-specific closure objectives. The selected final cover systems are designed in accordance with generally accepted practice for side slopes (3 horizontal: 1 vertical or flatter) and surface water management (benches or terraces at suitable intervals leading to down chutes) to minimize erosion. Installation of the final caps should lead to a decrease in leachate generation and its associated disposal costs, although the actual quantity is difficult to predict accurately.

On the subject of construction costs, our review revealed several inconsistencies and ambiguities in the plans and project manual that could create uncertainty among bidding contractors and consequently increase construction bid prices. These are noted in detail in the attached red-lined copy of these documents. Specific findings are described as follows.

The names used to describe the various soil layers are not consistent. For example:

- Structural fill is defined in Section 310513 to be free of stones having any dimension greater than 2 inches, but is included in Section 329113 as one of the soils that is to be screened to remove particles larger than 1 inch.
- The Section 310513 specifications for Barrier Soil materials state at paragraph 2.3.A that they are for the construction of the “compacted soil layer,” which seems to be intended to define the “low permeability soil layer” of the Class 4 cap shown in the Engineering Drawings.
- The terms “protective layer” and “grading layer” are used, but their soil characteristics are not defined other than that protective cover soil is included in Section 329113 as a soil to be screened.

Temporary Leachate Disposal – The bid form asks for a lump sum price to “provide leachate disposal from the existing leachate collection system until the new leachate collection system is operational”. The volume of leachate generated during construction will be a function of many factors, several of which - especially the weather, are beyond the control of the contractor. Therefore, it would appear more appropriate for this item to be bid, measured and paid on a volumetric basis (by the gallon or tanker truck load).

We note that the cost and basis included in the Engineer’s Estimate (\$233,080 for 29,000 gallons per week for 1 year) equate to a unit cost of \$0.15 per gallon, while a cost of \$0.26 per gallon was presented in the Design Criteria Report. We understand ADEQ is currently paying approximately \$0.19 per gallon plus a handling fee.

Leachate Evaporator — On the subject of long-term leachate disposal we recognize there are many variables, including the availability and cost of offsite disposal, that make evaluation of alternatives a somewhat subjective process. We further recognize that the Design Criteria Report was completed in April 2015 and the latest Engineer's Estimate in November 2015, but we suggest that the comparison between offsite disposal and onsite evaporation presented in the Design Criteria Report be re-visited if it is now believed that the cost of offsite disposal will vary much from \$0.26 per gallon. Preliminary calculations (see attached spreadsheet) indicate the comparison is sensitive to this unit cost and the long-term cost savings of an evaporator may not be realized if offsite disposal is and remains available for \$0.20 or less per gallon and the installed cost of an evaporator with its foundation equals or exceeds its estimated value of \$1,050,000.

Soil Screening – The estimated quantity of 193,600 cubic yards approximates the volume of in-place soil needed for intermediate cover and the various soil layers of final cover, adjusted for the re-use of 36,000 cubic yards of topsoil in area 1-2, but this may be merely a coincidence. Measurement and Payment defines this item as soil prior to screening, but does not specify if it is to be measured as excavated from the borrow area or as loosely placed into the screen. The estimated quantity, definition and basis of measurement of this item should be reviewed and revised, as appropriate.

Waste relocation – This work is identified in the Unit Price Bid Form as three discrete lump sums, one each for areas 1-2, 1-3, and 4. The specifications (Section 312324) state this work is to be done in accordance with applicable sections of Arkansas Regulation 22 and that a daily cover layer 12 inches thick is to be applied over exposed surfaces from which waste has been removed and waste surfaces newly created by the placement of relocated waste. The specifications further state that relocated waste is to be compacted by two to three passes with a sheepfoot roller.

We note that Regulation 22 calls for daily cover to be a minimum thickness of 6 inches rather than 12 inches. Regulation 22 is silent as to the thickness at which waste can be placed prior to compaction; we suggest the designer consider specifying 3 feet or less. We also question whether two or three passes of a sheepfoot roller will provide adequate compaction to return the waste to its pre-excavation volume or to provide sufficient stability when construction of intermediate and final covers are to commence in days or weeks rather than in months or years. We suggest the designer review this matter and revise the specifications as deemed appropriate.

EnSafe did not independently verify the estimated quantities given in the Engineer's Estimate or the airspace available for waste in each landfill area. We deduce that the quantities to be relocated are of the existing waste/soil mixture (assumed to be re-compacted to the same or lesser volume) and do NOT include the daily cover required by Section 312324. We suggest the designer verify that available airspace will accommodate the relocated wastes plus appropriate volumes of daily cover.

Interim (or Intermediate) Cover – The plans define this layer as being 12 inches thick. The Bid Form items 41 and 49 listed as "Prepare Subgrade" are shown to be priced by the acre and the Engineer's Estimate is approximately \$2,100 per acre. In Section 012010 Measurement and

Payment of the Project Manual, however, these items are defined as "materials, equipment, and labor required to place and compact intermediate cover." The costs estimated for placing and compacting other soil layers make it likely that the cost for this layer will be much greater than \$2,100 per acre.

Contract Time – The Bid Form and the Agreement Form both state the work is to be completed in 120 calendar days. We suspect this is a placeholder number that will be changed prior to formal issuance of the bidding documents.

Insurance Requirements – The required aggregate amount of Pollution Liability insurance is listed as \$50,000,000. This is much greater than we customarily see in projects of this magnitude.

Construction Quality Assurance Plan (CQA Plan) – There are numerous references to this plan throughout the documents, but it is unclear which entity is to prepare such a plan. Reg.22.428 requires final covers to be constructed in accordance with written quality assurance plans. Under the circumstances of this closure, the technical specifications of the Project Manual could be considered to function as the CQA Plan. If so, references to a separate CQA Plan should be removed from the documents.

We sincerely appreciate the hospitality and cooperation extended to us by the ADEQ staff during our time in your office. If you have questions or wish to discuss our report, please contact Claire Barnett or me at (901) 372-7962, cbarnett@ensafe.com, or tgreen@ensafe.com.

Sincerely,  
EnSafe Inc.



By: Thomas B. Green, Jr., PE (Tennessee)  
Associate Principal



Claire Barnett, PE  
Project Manager

cc: Mr. Clark McWilliams, PE, ADEQ  
Paul Stoddard, EnSafe

Enclosures: Red-lined Copy of Project Manual  
Red-lined Copy of Engineer's Estimate  
Cost Analysis of Leachate Evaporator vs Hauling



1-11-2016

# Red-lined Pages from "Project Manual"

## BID FORM Section 00 41 13 / Rev: August 2015

Bid Date: TBD  
Bid Time: 3:30 p.m.  
Bid Opening Location: Division of Building Authority,  
Ground Floor Room G-05, 501  
Woodlane Avenue, Little Rock,  
Arkansas 72201  
Bid To: Arkansas Department of Environmental Quality  
Bid From: \_\_\_\_\_

DBA Project Number: 9301601

Project Name: Closure of Inactive N.A.B.O.R.S. Landfills

- 1) Having carefully examined the Contract Documents for this project, as well as the premises and all conditions affecting the proposed construction, the undersigned proposes to provide all labor, materials, services, and equipment necessary for, or incidental to, the construction of the project in accordance with the Contract Documents within the time set forth, for the lump sum base bid of:

\$ \_\_\_\_\_

Dollar Amount Is To Be Shown Numerically

- 2) Allowances:  
Not Required
- 3) Unit Prices: If the required quantities of the items listed are increased or decreased by change order, the unit prices set forth shall apply to such quantities. Dollar amount is to be shown numerically. See Attachment A for Unit Prices.  
Required
- 4) Trench Safety:  
Not Required

\$ \_\_\_\_\_

Not Required

Dollar Amount Is To Be Shown Numerically

- 5) Completion Date: The Bidder agrees that the work will be complete in accordance with the contract documents and ready for Substantial Completion:

Number of Calendar Days: 120  
On or Before Date: N/A

Revise

**Please Note: Do not strike through or add language to the bid form. See Instruction to Bidders #6.1**

# Section 00 43 22 / Bid Form Attachment A Unit Prices

| Item/Spec    | Description   | Quantity | Unit | Cost/Unit | Total for Item |
|--------------|---|----------|------|-----------|----------------|
| 1/Div 01     | Mobilization / Demobilization                                       | 1        | LS   |           |                |
| 2/015713     | Provide and Maintain Stormwater/Erosion Control Structures          | 1        | LS   |           |                |
| 3/014000     | Construction Quality Assurance                                      | 1        | LS   |           |                |
| 4/012010     | Provide Temporary Leachate Disposal                                 | 1        | LS   |           |                |
| 5/311000     | Clear Existing Vegetation in Pond Basin                             | 3        | AC   |           |                |
| 6/312316     | Excavate Soil to Sedimentation Pond Base Elevations                 | 7,260    | CY   |           |                |
| 7/310513     | Place Structural Fill for Dam                                       | 7,000    | CY   |           |                |
| 8/312513     | Install Outlet Structure, Discharge Pipe, Overflow Weir, and Riprap | 1        | LS   |           |                |
| 9/310513     | Strip grub and stockpile organic containing soil from Area 1-2      | 36,000   | CY   |           |                |
| 10/312324    | Excavate and Relocate Waste/Soil Mix from Area 1-2                  | 1        | LS   |           |                |
| 11/312324    | Excavate and Relocate/Regrade Waste/Soil Mix in Area 1-3            | 1        | LS   |           |                |
| 12/312324    | Excavate and Relocate/Regrade Waste/Soil Mix in Class 4             | 1        | LS   |           |                |
| 13/332300    | Driller Mobilization  | 1        | LS   |           |                |
| 14/332300    | Vertical Gas Extraction Well Drilling and Installation              | 1,208    | LF   |           |                |
| 15/332300    | Provide and Install LFG Wellheads                                   | 37       | EA   |           |                |
| 16/332300    | 10'x10' Wellbore Seal   | 21       | EA   |           |                |
| 17/400533    | Provide and Install 4" HDPE LFG Piping                              | 1,625    | LF   |           |                |
| 18/400533    | Provide and Install 8" HDPE LFG Piping                              | 10,050   | LF   |           |                |
| 19/400533    | Provide and Install 12" HDPE LFG Piping                             | 770      | LF   |           |                |
| 20/400533.16 | Provide and Install 12" Butterfly Valve                             | 4        | EA   |           |                |
| 21/400533.16 | Provide and Install 8" Butterfly Valve                              | 19       | EA   |           |                |
| 22/400533    | Provide and Install HDPE Access Riser with Fiberglass Lid           | 10       | EA   |           |                |
| 23/400533    | Provide and Install HDPE Condensate Knockout                        | 3        | EA   |           |                |
| 24/400533    | Provide and Install Dual Containment Condensate Sump with Pump      | 4        | EA   |           |                |
| 25/400533    | Provide and Install 4" HDPE Condensate and 2" Air Lines             | 4,025    | LF   |           |                |

Appropriate unit?  
Any control over where it is hauled?

Would LS be more appropriate for this

# Section 00 43 22 / Bid Form Attachment A Unit Prices

| Item/Spec    | Description  | Quantity  | Unit | Cost/Unit | Total for Item |
|--------------|--|-----------|------|-----------|----------------|
| 26/221519    | Air Compressor, Concrete Pad, and 10'x10' Shed                                       | 1         | LS   |           |                |
| 27/334213    | Provide and Install 24" CMP Road Crossing  | 5         | EA   |           |                |
| 28/431343.13 | Provide and Install Candlestick Flare, Skid, Electrical, and Pad                     | 1         | LS   |           |                |
| 29/432236.13 | Provide and Install Leachate Evaporator  | 1         | EA   |           |                |
| 30/333613.16 | Fiberglass Tanks and Valve Connections   | 8         | EA   |           |                |
| 31/033000    | Provide and Install Concrete Secondary Containment and Evaporator Pad                | 210       | CY   |           |                |
| 32/400533    | Provide and Install 2"x4" Dual Contained HDPE Forcemain                              | 7,500     | LF   |           |                |
| 33/400533.16 | Provide and Install Air Release Valves and Protective Concrete Vaults                | 11        | EA   |           |                |
| 34/221429    | Pumps (Includes control panels, lines, and 5 spare pumps)                            | 14        | EA   |           |                |
| 35/221429    | Manholes with Pumps (Includes Panels and Lines)                                      | 2         | EA   |           |                |
| 36/400533.16 | Valves (Includes Forcemain and Condensate Knockout)                                  | 20        | EA   |           |                |
| 37/431343    | Heat Tracing and Insulation for Exposed Forcemain                                    | 220       | LF   |           |                |
| 38/334213    | Provide Protective CMP at Flare Pad and Road Crossings                               | 300       | LF   |           |                |
| 39/024119    | Demolition   | 1         | LS   |           |                |
| 40/310513    | Soil Screening (Includes material for Class 1 and Class 4)                           | 193,600   | CY   |           |                |
| 41/310513    | Prepare Subgrade   | 41        | AC   |           |                |
| 42/329113    | Install 6-inch Grading Layer   | 33,074    | CY   |           |                |
| 43/310519.23 | Provide and Install Geosynthetic Clay Liner  | 1,785,960 | SF   |           |                |
| 44/310519.16 | Provide and Install LLDPE 40 mil Textured Geomembrane                                | 1,785,960 | SF   |           |                |
| 45/310519.16 | Provide and Install Geocomposite Drainage Layer                                      | 1,785,960 | SF   |           |                |
| 46/310519.16 | Excavate and Backfill Geosynthetics Anchor Trench                                    | 8,310     | LF   |           |                |
| 47/310513    | Install 12-inch Protective Cover Layer   | 66,148    | CY   |           |                |
| 48/310513    | Install 6-inch Vegetative Layer  | 33,074    | CY   |           |                |
| 49/312323    | Prepare Subgrade   | 7         | AC   |           |                |
| 50/310513    | Install 18-inch Compacted Soil Layer (Max. Permeability 1 x 10 <sup>-5</sup> cm/sec) | 16,940    | CY   |           |                |

for this?

separate item

low if input

City probably too measured by C.I. to screen.

- M&P defines this to include Interim Cover

Interim Cover

**Section 00 43 22 / Bid Form Attachment A Unit Prices**

| Item/Spec    | Description   | Quantity | Unit | Cost/Unit | Total for Item |
|--------------|---|----------|------|-----------|----------------|
| 51/310513    | Install 6-inch Vegetative Layer   | 5,646    | CY   |           |                |
| 52/310513    | Install Tack-on Terraces  | 16,000   | LF   |           |                |
| 53/312513    | Provide and Install HDPE Down Chutes  | 2,700    | LF   |           |                |
| 54/313700    | Provide and Install Energy Dissipaters<br>(Includes Geotextile and Rip-Rap) | 10       | EA   |           |                |
| 55/329219    | Seeding, Fertilizing, Mulching  | 80       | AC   |           |                |
| 56/323113    | Provide and Install Perimeter Fencing                                       | 7,800    | LF   |           |                |
| 57/012010    | Install Three Phase Power   | 1        | LS   |           |                |
| 58/320516    | Access Road Construction/Rehabilitation                                     | 1        | LS   |           |                |
| 59/312213    | Ditch Construction  | 1        | LS   |           |                |
| 60/312213    | Soil Borrow Area Grading  | 30       | AC   |           |                |
| 61/400533    | 4" HDPE Forcemain Piping  | 2,000    | LF   |           |                |
| 62/431343.13 | Leachate Injection Port   | 162      | LF   |           |                |
| 63/221429    | Leachate Recirculation Pump   | 1        | EA   |           |                |

**AGREEMENT FORM**  
**Section 00 52 13 / Rev: August 2015**

THIS AGREEMENT entered into this \_\_\_\_\_ by and between  
\_\_\_\_\_ hereinafter referred to as the Contractor,  
and Arkansas Department of Environmental Quality hereinafter referred to as the Owner,  
and the Department of Finance and Administration, Division of Building Authority (DBA),

WITNESSETH:

1) That for and in consideration of the payment by the owner in the amount of \$ \_\_\_\_\_  
to be made as set forth in the Contract Documents, the Contractor hereby agrees to furnish  
all tools, labor, equipment, and materials, and to build and construct that certain project in  
Baxter County, designated as

Project # : 9301601

Project Name: Closure of Inactive N.A.B.O.R.S. Landfills

consisting of construction, more specifically described in the Contract Documents attached hereto  
and incorporated herein by reference. Contract Documents include the following: the Agreement  
Form (this instrument); the Invitation to Bid; Instruction to Bidders; Bid Form; all Addenda;  
Performance and Payment Bond; General and Supplementary Conditions; Drawings and  
Specifications, Drawings listed in the Specifications; Notice to Proceed; Negotiated Changes  
Documents; and Change Orders. All capital improvements shall be in exact accord with the Contract  
Documents filed with the Construction Section Office, Division of Building Authority,  
located in Little Rock, on: TBD

The Division of Building Authority (DBA) Construction Section shall have direct contract supervision.  
Said capital improvements shall be to the satisfaction of the DBA Construction Section, and in  
accordance with the laws of the State of Arkansas, and the work shall be subject to inspection and  
approval at all times by the appropriate state and federal agencies.

2) Owner may at any time during the progress of the work alter, change, subtract from, or add to  
said Contract Documents without violating this Agreement or the terms thereof. Said changes,  
alterations, subtractions, or additions shall be set forth in writing in a document referred to as a  
"Change Order." Said document shall not be effective unless approved by the DBA. Once effective,  
the Change Order shall be attached hereto and incorporated herein by reference and shall be made a  
condition or term of the Contract Documents. Nothing contained in the Change Order shall be  
construed to waive the sovereign immunity of the State or entities thereof.

3) The Contractor agrees, for the consideration set forth in the Bid Form, to begin work within the  
time frame stated in 6 (b) of Section 00 41 13 Bid Form after a Notice to Proceed is issued and to  
complete the work:

In: 120 Calendar Days

On or Before: N/A

If the Contractor fails to complete the work within the time limit herein specified, he shall pay to the  
Owner, as liquidated damages and not in the nature of a penalty, the sum specified in the Bid Form of  
for each calendar day delayed, it being understood and agreed between the parties hereto that the  
said sum fixed as liquidated damages is a reasonable sum, considering the damages that the  
Owner will sustain in the event of any such delay, and said amount is herein agreed upon

**Insurance Requirements**  
**Section 00 73 16 / Rev: August 2015**

**Article 11 - Insurance and Bonds**

(see General Conditions Article 11 for additional information)

- 1) Subparagraph 11.1.1, add the following sentence:

The amount of such insurance shall be not less than the following or any limits required by law.

- 2) Subparagraph 11.1.2, add the following clause:

11.1.2.1 Workers' Compensation

|                         |                  |
|-------------------------|------------------|
| a. State                | <u>Statutory</u> |
| b. Applicable Federal   | <u>Statutory</u> |
| c. Employers' Liability |                  |
| Per Accident:           | <u>\$100,000</u> |
| Disease, Policy Limit:  | <u>\$500,000</u> |
| Disease, Each Employee: | <u>\$100,000</u> |

- 3) Subparagraph 11.1.3, add the following clause:

11.1.3.1 Commercial General Liability

|  |                        |                    |
|--|------------------------|--------------------|
| General Aggregate:   | Per Project Aggregate: | <u>\$2,000,000</u> |
| Completed Operations:<br>(to be maintained for one year after final payment) | Aggregate:             | <u>\$1,000,000</u> |
| Personal Injury:   | Each Occurrence:       | <u>\$1,000,000</u> |
| Each Occurrence Limit:   | Each Occurrence:       | <u>\$1,000,000</u> |

- 4) Subparagraph 11.1.4, add the following clause:

|   |                        |                    |
|---|------------------------|--------------------|
| 11.1.4.1 Automobile Liability:<br>(including, non-owned and hired vehicles) | Combined Single Limit: | <u>\$1,000,000</u> |
|---|------------------------|--------------------|

- 5) Subparagraph 11.1.5, add the following clause:

|                              |                  |            |
|------------------------------|------------------|------------|
| 11.1.5.1 Umbrella Liability: | Each Occurrence: | <u>\$0</u> |
|------------------------------|------------------|------------|

- 6) Subparagraph 11.1.6, add the following clause:

|                               |            |                     |
|-------------------------------|------------|---------------------|
| 11.1.6.1 Pollution Liability: | Per Loss:  | <u>\$2,000,000</u>  |
|                               | Aggregate: | <u>\$50,000,000</u> |

- 7) Subparagraph 11.1.7, add the following clause:

|   |                             |
|---|-----------------------------|
| 11.1.7.1 Builder's Risk or Installation Floater Policy: | <u>\$ = Contract Amount</u> |
|---|-----------------------------|

- 8) Contractor shall deliver to the Owner a copy of each Insurance certificate and any other requested supporting document for the Owners review and approval prior to the issuance of the Notice to Proceed and any work being performed.

Please Note: Policy Certificates of Insurance shall state "The insurance covered by this certificate will not be cancelled, or materially altered except after proper written notice pursuant Ark. Code Ann. § 23-66-206 has been received by the Owner."

End of Document

*higher than I usually see.*

## SECTION 011000

### SUMMARY

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. This Section includes the following:
1. Work covered by the Contract Documents.
  2. Use of premises.
  3. Specification formats and conventions.

##### 1.2 WORK COVERED BY CONTRACT DOCUMENTS

- A. Project Identification: Closure of Inactive NABORS Landfills
1. Project Location: 1320 Landfill Road  
Mountain Home, Arkansas 72701
- B. OWNER: Arkansas Department of Environmental Quality (ADEQ)

OWNER's  
Representative: Clark McWilliams, P.E.  
Solid Waste Management Division  
Arkansas Department of Environmental Quality  
5301 Northshore Drive  
North Little Rock, Arkansas 72118-5317  
(501) 682-0510

- C. Design Professional: SCS Aquaterra  
7311 West 130<sup>th</sup> Street, Ste. 100  
Overland Park, Kansas 66213  
(913) 681-0030

- D. The Work consists of the following:

The work to be performed for this Contract includes, but is not necessarily limited to, relocation of approximately 231,600 cubic yards of waste overfill, the construction of approximately 41 acres of composite Class 1 landfill cover, approximately 7 acres of Class 4 landfill cover, an active landfill gas collection system, leachate forcemain and storage system, leachate evaporator, road construction, storm water structures, erosion control structures, silt fence, fencing and outer grading at the Site.

Section 011000  
Summary  
NABORS Landfill

Work items may include:

- Mobilizing and demobilizing to and from site.
- Providing and maintaining stormwater/erosion control structures.
- Providing Construction Quality Assurance (CQA) in accordance with the CQA Plans. The Contractor will provide documentation in the form of a typical CQA report that meets ADEQ requirements and will document the quality of construction for all components of the projects.
- Providing temporary leachate collection, hauling, and disposal services until the designed leachate disposal system is operational.
- Clearing existing vegetation in the pond basin.
- Excavating soil to sedimentation pond base elevations.
- Placing structural fill for the dam.
- Providing and installing sedimentation pond outlet structure as indicated on the Construction Drawings.
- Stripping and stockpiling of organic containing soil from Area 1-2.
- Performing soil screening to obtain the type and volume of soil specified for each construction component.
- Strip, grub and stockpile organic containing soil from Area 1-2.
- Waste relocation from Area 1-2 (Class 1) to Area 1-3 (Class 1) to achieve top of intermediate cover elevations.
- Waste relocation/regarding within Area 1-3 (Class 1) to achieve top of intermediate cover elevations.
- Waste relocation within Class 4 to achieve top of intermediate cover elevations.
- Vertical gas extraction well driller mobilization.
- Providing and installing HDPE vertical gas extraction wells, wellheads, and wellbore seals.
- Providing and installing HDPE piping, fittings, valves, sumps, condensate sump pumps, header access risers, and appurtenances as indicated on the Construction Drawings for the gas collection and control system in Area 1-2 and Area 1-3.
- Providing and installing a rotary screw air compressor, concrete pad, and shed for connection to the landfill gas air line.
- Providing and installing leachate and LFG gas system encasements as indicated on the Construction Drawings.
- Installing a pad for the LFG flare, leachate evaporator, and leachate tank farm.
- Providing and installing landfill gas flare and skid.
- Providing and installing a leachate evaporator.
- Providing and installing a centralized leachate tank farm with concrete reinforced secondary containment.

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- Providing and installing a dual-contained HDPE leachate forcemain piping, fittings, valves, and appurtenances as indicated on the Construction Drawings. New leachate forcemain piping to be connected to the existing leachate collection systems Area 1-1, Area 1-2, Area 1-3, and Class 4.
- Providing and installing air release valves and protective concrete vaults.
- Providing and replacing existing electric leachate collection pumps.
- Providing 5 spare electric leachate collection pumps.
- Providing and installing vertical leachate extraction manholes and pumps as indicated on the Construction Drawings.
- Demolishing existing leachate storage tanks and secondary containments as shown on the Construction Drawings.
- Screening of borrow soil for use in the final cover systems.
- Class 4 final cover installation including the following:
  - ~~Installing a 6-inch grading layer~~
  - Constructing an 18-inch low permeability soil layer (max. permeability  $1 \times 10^{-5}$  cm/sec)
  - Installing a 6-inch vegetative layer
- Area 1-2 and Area 1-3 (Class 1) final cover installation including the following:
  - Installing a 6-inch grading layer
  - Providing and installing a geosynthetic clay liner
  - Providing and installing a 40 mil LLDPE textured geomembrane
  - Providing and installing a drainage geocomposite
  - Installing a 12-inch protective cover layer
  - Installing a 6-inch vegetative layer
  - Excavating and backfilling a geosynthetic anchor trench around the perimeter of Area 1-2 and Area 1-3
- Installing tack-on terraces on Class 4, Area 1-2, and Area 1-3 final cover systems.
- Performing earthwork cut and fill to construct perimeter stormwater channels.
- Providing and installing HDPE pipe down chutes and energy dissipaters on Class 4, Area 1-2, and Area 1-3 final cover systems.
- Performing earthwork cut and fill and provide and installing aggregate for access road improvements indicated on the Construction Drawings.
- Providing and installing perimeter access control fencing and appurtenances.
- Providing and installing seeding and revegetation.
- Performing site grading of disturbed areas and borrow area.
- Providing three phase power to operate the leachate evaporator and landfill gas flare.
- Providing and installing leachate injection ports on Area 1-3 as shown on the Construction Drawings.

duplicate?

X

or here?

Preparation of subgrade including interim cover.

- Providing a leachate pump and HDPE piping for use as temporary leachate recirculation.
- E. Project will be constructed under a single prime contract.

### **1.3 USE OF PREMISES**

- A. General: Contractor shall have full use of premises for construction operations during construction period. Contractor's use of premises is limited only by Owner's right to perform work or to retain other Contractors on portions of Project.

### **1.4 SPECIFICATION FORMATS AND CONVENTIONS**

- A. Specification Format: The Specifications are organized into Divisions and Sections using the 49-division format and the Construction Specifications Institute's "Master Format" numbering system.
  - 1. Division 01: Sections in Division 01 govern the execution of the Work of all Sections in the Specifications.
- B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
  - 1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
  - 2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.
    - a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

**SECTION 012010  
MEASUREMENT AND PAYMENT**

**PART 1 – GENERAL**

**1.1 SUMMARY**

- A. This Section includes requirements for measurement and payment for items listed on the bid form included in Section 004322, "Bid Form Attachment A Unit Prices." The bid form includes line items for unit prices and lump sum prices.

**1.2 DEFINITIONS**

- A. Unit price is an amount stated on the Bid Form, as a price per unit of measurement for materials or services added to or deducted from the Contract Sum by appropriate modification, if estimated quantities of Work required by the Contract Documents are increased or decreased.
- B. Lump sum is an amount stated on the Bid Form, as the total price for the materials or services described in the measurement and payment item description, specified in the project manual, and indicated on the Construction Drawings.

**1.3 MEASUREMENT AND PAYMENT ITEM DESCRIPTIONS**

**A. General**

- 1. Mobilization/Demobilization includes: materials, equipment, and labor required for equipment mobilization/demobilization, project management, submittals (including Waste Relocation Plan), construction reports, field office, sanitary facilities, waste services, utilities (e.g., water, electricity, phone), temporary roads and paved areas, site enclosure fence, barricades and warning signs, protection of vegetation, dust and pollution control, final cleaning, project closeout, and record documents.

Payment for Mobilization/Demobilization will be lump sum, with 25% of the fee after mobilization, 50% after earning 10% of the original contract amount and 100% after earning 25% of the original contract amount.

- 2. Stormwater/Erosion Controls includes: materials, equipment, and labor required to obtain an Arkansas Construction General Permit for Stormwater Discharges Associated with Construction (including Storm Water Pollution Prevention Plan) and to provide controls (silt fence, mulch, socks) as determined necessary to comply with the General Permit and SWPPP. Additionally, includes inspections and maintenance of controls.

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Payment for Stormwater/Erosion Controls will be lump sum on a percent complete basis.

3. Provide Construction Quality Assurance includes: materials, equipment, and labor required to provide an independent CQA manager, conduct testing, and submit reports specified in the CQA Plan.

Payment for Construction Quality Assurance will be lump sum.

4. Provide Temporary Leachate Disposal includes: materials, equipment, and labor required to provide leachate disposal from the existing leachate collection system until the new leachate collection system is operational.

Payment for ~~Construction Quality Assurance~~ <sup>Temporary Leachate Disposal</sup> will be lump sum ?

**B. Sedimentation Pond/Dam**

5. Clear Existing Vegetation in Pond Basin includes materials, equipment, and labor required to materials, equipment, and labor required to remove vegetation including roots, apply herbicide, segregate and stockpile topsoil, dispose of vegetation, and excavate and fill to rough grade pond basin.

Payment for Clear Existing Vegetation in Pond Basin will be unit price for each acre.

6. Excavate Soil to Sedimentation Pond Base Elevations includes: materials, equipment, and labor required for excavation of soil to elevations shown on the construction drawings and stockpiling excavated soil on site.

Payment for Excavate Soil to Sedimentation Pond Base Elevations will be a unit price for each cubic yard.

7. Place Structural Fill for Dam includes: materials, equipment, and labor required to prepare, haul, place, compact, and test structural fill to construct the dam to the elevations shown on the construction drawings.

Payment for Place Structural Fill for Dam will be a unit price for each cubic yard.

8. Install Outlet Structure, Discharge Pipe, Overflow Weir, and Riprap includes: materials, equipment, and labor required to install outlet pipe, anti-seep collars, riser pipe, riprap for culvert discharge, and concrete overflow weir.

Payment for Install Outlet Structure, Discharge Pipe, Overflow Weir, and Riprap will be lump sum.

### C. Waste Relocation

9. Strip, Grub, and Stockpile includes: materials, equipment, and labor required to segregate and stockpile existing organic containing cover soil in Area 1-2 for use in the final cover system(s).

Payment for Strip, Grub, and Stockpile will be unit price for each cubic yard removed.

10. Excavate and Relocate Waste/Soil Mix from Area 1-2 includes: materials, equipment, and labor required to remove landfill material to the elevations shown on the construction drawings, and transport, place, and compact waste material in Area 1-3 to the elevations shown on the construction drawings.

Payment for Excavate and Relocate Waste/Soil Mix from Area 1-2 will be lump sum.

11. Excavate and Relocate/Regrade Waste/Soil Mix in Area 1-3 includes: materials, equipment, and labor required to remove landfill material to the elevations shown on the construction drawings, and transport, fill, and compact waste material within Area 1-3 to the elevations shown on the construction drawings.

Payment for Excavate and Relocate Waste/Soil Mix within Area 1-3 will be lump sum.

12. Excavate and Relocate Waste/Soil Mix in Class 4 includes: materials, equipment, and labor required to remove landfill material to the elevations shown on the construction drawings, and transport, fill, and compact waste material within Class 4 to the elevations shown on the construction drawings.

Payment for Excavate and Relocate Waste/Soil Mix within Class 4 will be lump sum.

### D. Gas Collection and Control System

13. Driller Mobilization/Demobilization includes: materials, equipment, and labor required to mobilize/demobilize driller equipment, submittals, and equipment decontamination.

Payment for Driller Mobilization/Demobilization will be lump sum after mobilization.

14. Vertical Gas Extraction Well Drilling and Installation includes: materials, equipment, and labor required to drill the well boreholes, install 6-inch HDPE perforated and solid pipe and pipe caps, and place crushed stone, clay,

*Per spec, these include  
Daily Cover.  
Interim cover under Items 41 & 49*

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bentonite, and soil backfill.

Payment for Vertical Gas Extraction Well Drilling and Installation will be a unit price for each vertical foot of drilling (below ground surface).

15. Provide and Install LFG Wellheads includes: materials, equipment, and labor required to install wellhead assembly, including coupling, union with orifice plate, well riser, flexible hose, powerlock clamp, and HDPE reducer.

Payment for Provide and Install LFG Wellheads will be a unit price for each wellhead.

16. Install 10'x10' Wellbore Seal includes: materials, equipment, and labor required to install wellbore seal to seal well pipe to landfill cover liner.

Payment for 10'x10' Wellbore Seal will be a unit price for each wellbore seal.

17. Provide and Install 4" HDPE LFG Piping includes: materials, equipment, and labor required to excavate trenches, place bedding material, install 4" HDPE piping, backfill trench, place warning tape, and repair landfill cover.

Payment for Provide and Install 4" HDPE LFG Piping will be a unit price per linear foot of piping.

18. Provide and Install 8" HDPE LFG Piping includes: materials, equipment, and labor required to excavate trenches, place bedding material, install 8" HDPE piping, backfill trench, place warning tape, and repair landfill cover.

Payment for Provide and Install 8" HDPE LFG Piping will be a unit price per linear foot of piping.

19. Provide and Install 12" HDPE LFG Piping includes: materials, equipment, and labor required to excavate trenches, place bedding material, install 12" HDPE piping, backfill trench, place warning tape, and repair landfill cover.

Payment for Provide and Install 12" HDPE LFG Piping will be a unit price per linear foot of piping.

20. Provide and Install 12" Butterfly Valve and Vault includes: materials, equipment, and labor required to install header isolation valves including butterfly valve, valve support timbers, stainless steel flexible metal hose, valve casing, stem casing, compacted backfill, granular material, HDPE outer vault casing, valve actuator, and outer casing pipe cover.

Payment for Provide and Install 12" Butterfly Valve will be a unit price per valve.

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21. Provide and Install 8" Butterfly Valve and Vault includes: materials, equipment, and labor required to install header isolation valves including butterfly valve, valve support timbers, stainless steel flexible metal hose, valve casing, stem casing, compacted backfill, granular material, HDPE outer vault casing, valve actuator, outer casing pipe cover, warning tape, and repair of landfill cover to match existing conditions.

Payment for Provide and Install 8" Butterfly Valve will be a unit price per valve.

22. Provide and Install HDPE Access Riser includes: materials, equipment, and labor required to install HDPE Access Riser including monitoring port, tubing, reducer Tee (if required), HDPE blind flange neoprene gasket, HDPE pipe, warning tape, and repair of landfill cover to match existing conditions.

Payment for Provide and Install HDPE Access Riser with Fiberglass Lid will be unit price per Access Riser.

23. Provide and Install HDPE Condensate Knockout includes: materials, equipment, and labor required to excavate; install access risers with HDPE blind flanges with neoprene gaskets, HDPE pipe and elbows, pancake reducer, and HDPE gravity line and Tee; backfill excavation with washed gravel; and repair cover to match existing conditions.

Payment for Provide and Install HDPE Condensate Knockout will be unit price for each knockout.

24. Provide and Install Dual Containment Condensate Sump with Pump includes: materials, equipment, and labor required to install outer HDPE pipe, inner 6" perforated HDPE pipe, inner 6" vacuum break HDPE pipe riser, 2" air supply elbow and pipe, HDPE condensate discharge pipe and elbow, monitoring port, equalizer line and ball valve, HDPE flange, and pneumatic pump.

Payment for Provide and Install Dual Containment Condensate Sump with Pump will be unit price per sump and pump.

25. Provide and Install 4" HDPE Condensate and 2" Airlines includes: materials, equipment, and labor required to excavate trench, place bedding material, install HDPE piping and airline, backfill trench, and place warning tape.

Payment for Provide and Install 4" HDPE Condensate and 2" Airlines will be a unit price per linear foot of piping.

26. Provide and Install 10 HP Rotary Screw Air Compressor and Shed includes: materials, equipment, and labor required to compact subgrade and install gravel pad beneath shed, construct shed, provide and install air compressor, and connect air lines.

Payment for 10 HP Rotary Screw Air Compressor and Shed will be lump sum.

27. Provide and Install CMP Road Crossing includes: materials, equipment, and labor required to excavate, place and compact pipe bedding, place filter fabric, lay pipe, backfill, and install culvert end gratings.

Payment for Provide and Install CMP Road Crossing will be unit price for each road crossing.

28. Provide and Install Candlestick Flare Skid, Electrical, Fencing and Pad includes: materials, equipment, and labor required to compact subgrade and install gravel pad beneath flare skid, provide and install fully assembled candlestick flare and blowers with knockout pot on structural skid, connect piping, supply and connect fully assembled electrical control panel, and provide Operation and Maintenance (O&M) manual and testing plan.

Payment for Provide and Install Candlestick Flare Skid, Electrical, Fencing and Pad will be lump sum.

#### E. Leachate Disposal System

29. Provide and Install Leachate Evaporator includes: materials, equipment, and labor required to provide and install fully assembled blowers with knockout pot on structural skid, provide and install leachate evaporator, connect piping, supply and connect fully assembled electrical control panel, and provide O&M manual and testing plan.

Payment for Provide and Install Leachate Evaporator will be lump sum.

30. Provide and Install 10,500 Gallon Fiberglass Tanks includes: materials, equipment, and labor required to provide, deliver, and install fiberglass tanks on concrete containment pad and connect piping.

Payment for Provide and Install 10,500 Gallon Fiberglass Tanks will be unit price for each tank.

31. Provide and Install Concrete Secondary Containment and Evaporator Pad includes: regrading, compact subgrade, place and compact granular fill, and construct concrete containment pad.

Payment for Provide and Install Concrete Secondary Containment and Evaporator Pad will be unit price for each cubic yard of concrete.

*Consider separate item?*

32. Provide and Install 2"x4" Dual Contained HDPE Forcemain includes: materials, equipment, and labor required to excavate trench, place bedding material,

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install dual contained HDPE piping, backfill trench, and place warning tape.

Payment for Provide and Install 2"x4" HDPE Forcemain will be a unit price for each linear foot of piping.

33. Provide and Install Air Release Valves includes: materials, equipment, and labor required to provide and install air release valves.

Payment for Provide and Install Air Release Valves will be unit price for each valve.

34. Provide and install 1.0 HP Leachate Pumps includes: materials, equipment, and labor required to provide and install sump pumps in existing leachate sumps, new condensate sumps, and new leachate storage tanks complete with piping, fittings, and valves including float switches and high level alarms; and to connect pumps to piping and switches to contacts for remote alarm and disabling pump operation. Additionally, a total of five spare leachate pumps will be provided.

Payment for Provide and install 1.0 HP Leachate Pumps will be unit price for each pump.

35. Provide and Install Vertical Leachate Manholes: materials equipment and labor required to install proposed vertical leachate manholes, pumps, control panels, float switches, and high level alarms; and to connect pumps to piping switches to contacts for remote alarm and disabling pump operation.

Payment for Provide and Install Vertical Leachate Manholes will be unit price for each manhole setup.

36. Provide 2"x4" Dual Contained Check Valve: materials equipment and labor required to provide 2"x4" Dual Contained Check Valves.

Payment for Provide 2"x4" Check Valves will be unit price per valve.

37. Provide Heat tracing and insulation for Exposed Forcemain: materials, equipment, and labor required to provide heat tape for any exposed forcemain during the cold season as needed.

Payment for providing Heat Tape for Exposed Forcemain During Cold Season will be unit price per each linear foot of exposed forcemain covered.

38. Provide Protective CMP at Flare Pad and Road Crossings: materials, equipment, and labor required to provide and construct protective CMP around forcemain 3' beneath grade at flare pad and road crossings where vehicular traffic is possible.

Which soils/layers require screening?

Daily cover  
Interim cover  
grading layer  
low permeability layer  
protective layer  
vegetative layer

Payment for providing Protective CMP at Flare Pad will be unit price per each linear foot of CMP pipe.

39. Demolition includes: materials, equipment, and labor required to demolish leachate tanks and reinforced concrete containment as listed on the Demolition Schedule including delivery of Owner-identified items to be salvaged.

Payment for Demolition will be lump sum.

**F. Class 1 Final Cover System**

40. Soil Screening Class 1 and Class 4 includes: materials, equipment, and labor required to Screen soil to remove particles larger than 1 inch.

Payment for Soil Screening Class 1 and 4 will be unit price for each cubic yard of soil prior to screening.

41. Prepare Subgrade includes: materials, equipment, and labor required to place and compact intermediate cover.

Payment for Prepare Subgrade will be unit price for each acre.

42. Install 6-inch Grading Layer includes: materials, equipment, and labor required to place 6-inch screened soil grading layer.

Payment for Install 6-inch Grading Layer will be unit price for each cubic yard of screened soil.

43. Provide and Install Geosynthetic Clay Liner includes: materials, equipment, and labor required to provide and install geosynthetic clay liner including placement, overlapping of seams, and repairs.

Payment for Provide and Install Geosynthetic Clay Liner will be unit price for each square foot of installed geosynthetic clay liner.

44. Provide and Install 40 mil LLDPE Textured Geomembrane includes: materials, equipment, and labor required to provide and install the geomembrane including placement, seaming, repairs, and plywood protection.

Payment for Provide and Install 40 mil LLDPE Textured Geomembrane will be unit price for each square foot of installed geomembrane.

45. Provide and Install Geocomposite Drainage Layer includes: materials, equipment, and labor required to provide and install Geocomposite Drainage layer including placement, roll joining, and repairs.

May need to adjust estimated quantity to allow for input vs. output and for which layers require screening

\$2100/acre not enough for this.

Payment for Provide and Install Geo-composite Drainage Layer will be unit price for each square foot of installed geocomposite.

46. Excavate and Backfill Geosynthetics Anchor includes: materials, equipment, and labor required to excavate and backfill the trench with compacted low permeability soil layer.

Payment for Excavate and Backfill Geosynthetics Anchor will be unit price for each linear foot.

47. Install 12" Protective Cover Layer includes: materials, equipment, and labor required to place the protective soil cover layer using screened soil and low ground pressure equipment.

Payment for Install 12" Protective Cover Layer will be unit price for each cubic yard of screened soil.

48. Install 6" Vegetative Layer includes: materials, equipment, and labor required to place topsoil using low ground pressure equipment.

Payment for Install 6" Vegetative Layer will be unit price for each cubic yard of topsoil.

#### G. Class 4 Final Cover System

49. Prepare Subgrade includes: materials, equipment, and labor required to place and compact intermediate cover.

Payment for Prepare Subgrade will be unit price for each acre.

50. Install 18" Compacted Soil Layer Class 4 includes: materials, equipment, and labor required to screen, place, and compact the low permeability soil layer.

Payment for Install 18" Compacted Soil Layer Class 4 will be unit price for each cubic yard of screened soil.

51. Install 6" Vegetative Layer Class 4 includes: materials, equipment, and labor required to place topsoil using low ground pressure equipment.

Payment for Install 6" Protective Cover Layer will be unit price for each cubic yard of vegetative soil.

#### H. Stormwater Controls/Site Cleanup

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*not screened?*

52. Install Tack-on Terraces includes: materials, equipment, and labor required to place and compact structural fill for tack-on terraces.

Payment for Install Tack-on Terraces will be unit price for each linear foot of terrace.

53. Provide and Install HDPE Down Chutes includes: materials, equipment, and labor required to provide and install HDPE corrugated pipe for down chutes, including flared end, protective cover layer of screened soil, and energy dissipater.

Payment for Provide and Install HDPE Down Chutes will be unit price for each linear foot of HDPE down chutes.

54. Provide and Install Energy Dissipaters includes: materials, equipment, and labor required to provide and install the geotextile and rip-rap required for energy dissipation.

Payment for Provide and install energy dissipaters will be unit price for each energy dissipater.

55. Seeding, Fertilizing, Mulching includes: materials, equipment, and labor required to seed, mulch, fertilize, place erosion fabric, and protect with stakes and string vegetated areas.

Payment for Seeding, Fertilizing, Mulching will be unit price for each acre.

56. Provide and Install Perimeter Fencing includes materials, equipment, and labor required to provide and install fence panels, truss rods, brace rails, top rails or tension wires, tie wires or clips, fence posts, barbed wire, and concrete bases.

Payment for Provide and Install Perimeter Fencing will be unit price for each linear foot of fencing.

57. Install Three Phase Power includes: materials, equipment, and labor required to provide Three Phase Power to the site.

Payment for Install Three Phase Power will be lump sum.

58. Access Road Construction/Rehabilitation includes: materials, equipment, and labor required construct/repair, grade, and surface perimeter roads.

Payment for Access Road Construction/Rehabilitation will be lump sum.

59. Ditch Construction includes: materials, equipment, and labor required to construct the ditches outside of Area 1-2, Area 1-3, and Class 4.

Payment for Ditch Construction will be lump sum.

60. Soil Borrow Area Grading includes: materials, equipment, and labor required to grade the borrow area to drain toward the sedimentation pond.

Payment for Soil Borrow Area Grading will be unit price for each acre of borrow area.

**A. Leachate Recirculation System**

61. Provide and Install 4" HDPE Recirculation Forcemain includes: materials, equipment, and labor required to install HDPE piping.

Payment for Provide and Install 4" HDPE Recirculation Forcemain will be a unit price for each linear foot of piping.

62. Leachate Injection Port includes: pressure testing, materials, equipment, and labor required to provide and install 36" perforated and solid HDPE pipe and blind flange.

Payment for Leachate Injection Port will be unit price per linear foot of injection port pipe.

63. Leachate Recirculation Pump includes: materials, equipment, pad, electrical work, appurtenances needed for connection to leachate storage tank, and labor required for providing the pump for recirculation.

Payment for Leachate Recirculation Pump will be lump sum.

**PART 2 - PRODUCTS**

Not Used

**PART 3 - EXECUTION**

Not Used

**END OF SECTION**

*CQA Plan used  
through manual.  
Does it exist?*

13. Recommendations on retesting and reinspecting.

- C. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

## 1.5 QUALIFICATIONS

- A. General: Contractor shall provide an independent CQA Manager and specific QA/QC and CQC inspectors in accordance with the CQA Plans and individual Specifications Sections.
- B. General: Qualifications paragraphs in this section establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- C. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- D. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- E. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- F. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required

## SECTION 017300 EXECUTION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
  - 1. Construction layout.
  - 2. Field engineering and surveying.
  - 3. Progress cleaning.
  - 4. Protection of installed construction.
  - 5. Correction of the Work.
- B. Related Sections:
  - 1. Section 017700 - Closeout Procedures.

#### 1.2 SUBMITTALS

- A. Certificates: Submit certificate signed by an Arkansas-licensed land surveyor certifying that location and elevation of improvements comply with requirements.
- B. Certified Surveys: Submit three hard copies and one electronic copy (on CD) signed and stamped by an Arkansas-licensed land surveyor for the following:
  - 1. Class 4: Top of intermediate cover, top of low permeability layer, top of final cover.
  - 2. Area 1-2 and Area 1-3 (Class 1): Top of intermediate cover, top of grading layer, top of final cover.
  - 3. All other installed or constructed work items (leachate collection system components, gas management components, etc).
- C. Final Property Survey: Submit three hard copies and one electronic copy (on CD) showing the Work performed and record survey data, including elevations of the final, completed landfill cap.

*Does bottom of interim cover need to be surveyed to verify 12" thickness?*

*need consistent naming system*

## SECTION 310513 SOILS FOR EARTHWORK

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Structural Fill
  2. Barrier Soil
  3. Topsoil materials.
- B. Related Sections:
1. Section 014000 - Quality Requirements
  2. Section 015000 - Temporary Facilities and Controls
  3. Section 015713 - Temporary Erosion and Sediment Controls
  4. Section 310516 - Aggregates for Earthwork
  5. Section 312213 - Rough Grading
  6. Section 312317 - Trenching
  7. Section 313700 - Riprap

*elsewhere we have  
daily cover  
interim cover  
grading layer  
low permeability layer  
protective layer  
vegetative layer*

#### 1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. ASTM International:
1. ASTM D422 – Standard Test Methods for Particle-Size Analysis of Soils.
  2. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
  3. ASTM D1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>)).
  4. ASTM D2216 – Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
  5. ASTM D2487 – Standard Test Method for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
  6. ASTM D4318 – Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

7. ASTM D5084 – Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible-Wall Permeameter.
8. ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

### 1.3 QUALITY ASSURANCE

- A. ~~Quality Assurance/Quality Control shall be provided as specified in Construction Quality Assurance Plan and the Technical Specifications.~~
- B. ~~The Contractor shall be responsible for reworking or removing and replacing nonconforming soil and other construction materials that do not meet the requirements of the Technical Specifications and the Construction Drawings as directed by the Design Professional.~~
- C. The Contractor shall be responsible for all survey work required to complete construction in accordance with the required lines and elevations as described in the Technical Specifications and as shown on the Construction Drawings.

### 1.4 SUBMITTALS

- A. The Contractor shall submit proposed material sources to the Design Professional for approval before construction.
- B. The Contractor shall submit soil test results for structural fill, barrier soil, and topsoil before construction. *submitted only, no approval?*
- C. The Contractor shall submit Test Fill results for the barrier soil layer for approval prior to construction. *OK*
- D. Laboratory and field tests during construction shall be submitted to the Design Professional within 24 hours of receipt of laboratory data or field test performance.

## PART 2 PRODUCTS

### 2.1 GENERAL

- A. All fill and topsoil material must be approved by the Design Professional.
- B. Excavated materials from the project construction areas may be used as fill material as directed by the Design Professional.

- C. The final surface of all excavated areas and all areas designated to receive fill will be prepared and accepted in accordance with the Technical Specifications and Construction Quality Assurance Plan. The final surface will also be free of loose material, clods and any other debris including grade stakes and hubs.
- D. Natural subgrade soils or compacted fill softened by frost, flooding, weather or any other natural or man-made events will be removed and replaced or re-compacted in accordance with the requirements specified herein.
- E. Fill will not be placed on snow, ice, or frozen ground surfaces.

## 2.2 STRUCTURAL FILL

- A. Structural fill materials will refer to materials used for subgrade construction, the construction of berms, and backfilling trenches.
- B. Structural fill shall be tested for laboratory compaction by ASTM D698 prior to construction in locations where compaction specifications are applicable.
- C. Structural fill materials shall be removed from the borrow area as directed by the Design Professional.
- D. Structural fill materials will be free of debris, roots, organic matter, frozen matter, roots, wood, peat, cinders, rubbish, stones having any dimension greater than two (2) inches or any other deleterious materials.

## 2.3 BARRIER SOIL MATERIALS

- A. Barrier soil materials will refer to materials used for the construction of the compacted soil liner. *low permeability soil layer*
- B. Barrier soil materials will be moisture conditioned and installed by the Contractor and tested by the CQA Manager to verify compliance with the Technical Specifications and the Construction Drawings.
- C. Provide borrow soil materials when sufficient satisfactory soil materials are not available from onsite. Due to project location and availability of acceptable barrier soil material, it is anticipated that soil screening will be required to meet the specifications for the barrier soil. *lack of?*
- D. Barrier Soil Fill: Soil Classification — Groups SC, CL, or CH according to ASTM D 2487, or a combination of these groups. Rock/gravel fragments larger than 1 inch in diameter may not be used as barrier soil

fill. Barrier soil fill shall have fines content of soil (material passing a #200 sieve) greater than 30 percent. Soils shall have a Plasticity Index (PI) greater than 10, and material greater than the #4 sieve must compose less than 20 percent of soil by weight. Soil clods must be less than 4 inches.

## 2.4 TOPSOIL MATERIALS

- A. Topsoil shall consist of friable sandy loam with soil particles within the following percentages: clay; 0-25; silt; 25-50; sand; 50-70; decomposed organic matter; 5-10 and reasonably free of grass, roots, weeds sticks, stones and other foreign materials.

## 2.5 SOURCE QUALITY CONTROL

- A. Testing and Analysis of Structural Fill: Perform in accordance with ASTM D698.
- B. Testing and Analysis of Barrier Soil
  - 1. Barrier soil fill taken at the borrow source during pre-construction testing shall be tested at the rate of one test per every 20,000 cubic yards of material, or more frequently if visual observations indicate a change in material characteristics, or deemed so by the geotechnical technician. Soil from the borrow source shall be tested before transportation to the landfill site.
  - 2. Bulk sample testing shall include:
    - a. Moisture Content (ASTM D854)
    - b. Particle Size (ASTM D1140, D442)
    - c. Atterburg Limits (ASTM D4318)
    - d. Laboratory Compaction (ASTM D698)
    - e. Laboratory Hydraulic Conductivity at a specified compaction (ASTM D5084)
- C. Testing and Analysis of Topsoil Material: Perform in accordance with ASTM D422 and testing by an agricultural testing laboratory for nitrogen, phosphorus, potash, soluble salt content, organic matter content, and pH.

*5,000 on next page*

## PART 3 EXECUTION

### 3.1 PLACEMENT AND COMPACTION

- A. The Design Professional will be notified at least forty eight (48) hours prior to Contractor placing any fill material.

- B. The Contractor shall place and compact fill in accordance with industry standard construction practices and procedures.
- C. Hauling and spreading equipment will not be considered compaction equipment.
- D. Exposed areas to receive fill, backfill, or embankment shall be proof-rolled to detect localized zones of excessively wet, unstable, organic, or low bearing capacity materials to the extent as follows:
  - 1. Proof roll as a single-pass operation with conventional compaction equipment during subgrade preparation and prior to placement of fill, and as a spot check process without the need for complete coverage per unit area of tire. Soft spots shall be over excavated, backfilled, and compacted with suitable material.
- E. The Contractor shall perform a Test Fill of the Barrier Soil Layer in accordance with the Construction Quality Assurance Plan. The Test Fill results must be accepted by the Design Professional before beginning construction of the Barrier Soil layer.
- F. The Contractor shall be responsible for maintaining proper lift thickness. The maximum loose lift thickness shall not exceed eight (8) inches.
- G. Soil utilized for structural components shall be compacted to a minimum of 95 percent of the maximum dry density as determined by field testing performed in accordance with ASTM D6938 by the CQA Manager.
- H. Barrier soil fill taken at the borrow source during construction testing shall be tested at the rate of one test per every 5,000 cubic yards of material, or more frequently if visual observations indicate a change in material characteristics, or deemed so by the geotechnical technician. Soil from the borrow source shall be tested before transportation to the landfill site.
  - 1. Bulk sample testing shall include:
    - a. Moisture Content (ASTM D854)
    - b. Particle Size (ASTM D1140, D442)
    - c. Atterburg Limits (ASTM D4318)
    - d. Laboratory Compaction (ASTM D698)
    - e. Laboratory Hydraulic Conductivity at a specified compaction (ASTM D5084)
- I. The barrier soil compacted soil layer shall be compacted to at least 90 percent of the maximum dry density at a moisture content at or exceeding

the optimum moisture content or as directed by the Design Professional. Compaction shall be field tested at a rate of one test per 10,000 square feet in accordance with ASTM D6938 by the CQA Manager.

- J. The barrier soil compacted soil layer must achieve a hydraulic conductivity of  $1 \times 10^{-5}$  cm/sec or less as determined on an undisturbed soil sample by ASTM D5084. Tests shall be conducted every 40,000 square feet.
- K. Temperature probes, if warranted, should be installed at 3" increments in the top foot of the barrier layer to monitor soil temperature and confirm the barrier soil is not damaged due to freeze/thaw cycles. If the temperature reading in any probe drops below 32 degrees F, the vegetative layer shall be removed, clay material exposed, and the clay damaged by the freeze thaw cycle shall be re-compacted within the "acceptable zone" and the entire liner system shall be recertified.
- L. If the compacted barrier soil layer is not protected or instrumented while the ambient air temperature drops below 27 degrees F at the nearest national weather station observation point, the top lift of the compacted clay material shall be repaired by removing the vegetative layer, exposing the barrier soil layer, re-compacting the clay damaged by the freeze thaw cycle within the "acceptable zone", and recertifying the construction of the barrier soil system in accordance with this plan.
- M. Each accepted lift will be left rough or scarified at least two (2) inches before placing the next overlying lift.
- N. Final surfaces will be graded to the lines and elevations shown on the Construction Drawings.
- O. Final surfaces will be smooth drum rolled free of loose material, clods, and other debris including grade stakes and hubs.
- P. Compact each lift so that the in-place dry unit weight and moisture content are within the acceptable placement zone as indicated by the CQA Manager.
- Q. The structural fill material for the anchor trench backfill material will be nominally compacted to the satisfaction of the Design Professional.
- R. The Contractor shall place the protective cover layer and vegetative layer so as not to damage the underlying geosynthetics. Low ground pressure equipment shall be used to spread the overlying soil. Any damage to the geosynthetics will be repaired at the Contractor's expense.

*what is spec for this?*

Design Professional for possible rejection. Rejected materials will be removed from the site and replaced at no additional cost to the Owner.

- D. Deliver, store and handle in accordance with the manufacturer's recommendations.
- E. Geotextile shall be lifted off the ground when moving.
- F. Contractor shall use a front end loader fitted with a tapered pole for loading and unloading geotextile.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Contractor shall demonstrate that the properties (excluding seam strength) of the materials specified in the tables under Parts 2.2, 2.3 and 2.4 of this Section do not deviate more than the specified percentage from values of average test results obtained from the manufacturer testing program and NOT compared to the values listed in these tables. Acceptable evidence may consist of comparing average values of at least five tests before and after exposure or any other method proposed by the Contractor that is acceptable to the Design Professional. In any case, values shall not fall below the values listed in the tables in Parts 2.2, 2.3 and 2.4 of this Section.

### 2.2 6-OZ NON-WOVEN GEOTEXTILE

*something missing here*

- A. Non-woven geotextile for the shall have the following minimum properties:

| Properties                                    | Value <sup>(1)</sup>     | Test Method <sup>(4)</sup> |
|---|--------------------------|----------------------------|
| Mass Per Unit Area                            | 6.0 oz/sy                | ASTM D 5261                |
| Permeability                                  | 0.1 cm/sec               | ASTM D 4491                |
| Grab Strength @ 50% Elongation <sup>(2)</sup> | 170 lb                   | ASTM D 4632                |
| Tear Strength <sup>(3)</sup>                  | 65 lb                    | ASTM D 4533                |
| CBR Puncture Strength                         | 90 lb                    | ASTM D 4833                |
| UV Resistance @ 500 hours                     | 70 percent, minimum      | ASTM D 7238                |
| Apparent Opening Size                         | No. 70 US Standard Sieve | ASTM D 4751                |

### 2.3 4-OZ WOVEN GEOTEXTILE

- A. Woven geotextile used for service roadways shall have the following minimum properties:

| Properties         | Value <sup>(1)</sup> | Test Method <sup>(4)</sup> |
|--------------------|----------------------|----------------------------|
| Mass Per Unit Area | 4.0 oz/sy            | ASTM D 5261                |

installation, the geotextile shall not be exposed to sunlight for more than 30 days. Geotextile exposed to sunlight for more than 30 days will be removed from the site and replaced at no additional cost to the Owner.

- B. Where applicable, the areas to be blanketed with geotextile shall be prepared in accordance with NYSDOT Specifications, Section 203-3.01.G, Subgrade Area.
- C. The geotextile shall be unrolled in overlapping strips as recommended by the manufacturer and directed by the Design Professional.
- D. The geotextile shall not be placed on top of fill material until the geotextile has been inspected and approved by the Design Professional.
- E. Care shall be taken in installing geotextile to avoid excessive stretching and tearing of the material.
- F. All non-woven geotextile seams for energy dissipaters shall be overlapped a minimum of 6 inches and sewn according to manufacturer's recommendations and procedures, and as approved by the Design Professional. The woven geotextiles for roadways shall be overlapped a minimum of 1 foot. Seams on side-slopes shall be oriented perpendicular to the slope contours. End-of-roll seams shall be offset a minimum of 5 feet between adjacent rolls ends. Cross-slope seams shall be avoided as much as possible. All geotextile seams shall be sewn, not layered.
- G. Any fabric damaged during its installation or during placement of cover materials shall be replaced by the Contractor at no additional cost to the Owner, as specified in Part 3.4 of this Section.
- H. Upon complete installation of geotextile fabrics, and prior placement of overlying materials, the QC Manager shall inspect the installed geotextile fabrics for physical damage, satisfactory sewing of seams and/ or proper seam overlap in accordance with the installation instructions.
- I. The Contractor shall mark any damaged area requiring repair.
- J. The Contractor shall inspect all repairs prior to overlying material placement.

### 3.2 PRODUCT QUALIFICATION TESTING

- A. Quality Control Testing:
  - 1. The Contractor shall perform the initial QC Testing specified herein for each manufacturer and model of geotextile material prior to approval of material for use.

### 3.3 TOPSOIL EXCAVATION

- A. Excavate topsoil from areas to be further excavated or regraded without mixing with foreign materials for use in finish grading.
- B. Do not excavate wet topsoil.
- C. Stockpile in area designated on site to depth not exceeding 8 feet and protect from erosion.
- D. Do not remove topsoil from site.

### 3.4 SUBSOIL EXCAVATION

- A. Excavate subsoil from areas to be further excavated or regraded.
- B. When excavating through roots, perform Work by hand and cut roots with sharp axe.
- C. Stockpile subsoil in area designated on site to depth not exceeding 8 feet and protect from erosion.
- D. Benching Slopes: Horizontally bench existing slopes greater than 1:4 to key placed fill material to slope to provide firm bearing.
- E. Stability: Replace damaged or displaced subsoil as specified for fill.

### 3.5 FILLING

- A. Fill areas to contours and elevations with unfrozen materials.
- B. Place material in continuous layers as follows:
  - 1. Structural Fill: Maximum 8 inches compacted depth.
  - 2. Low Permeability Soil: Maximum 6 inches compacted depth.
- C. Maintain optimum moisture content of fill materials to attain required compaction density.
- D. Make grade changes gradual. Blend slope into level areas.
- E. Repair or replace items indicated to remain damaged by excavation or filling.

*depths for 2  
other layers*

### 3.6 TOLERANCES

- A. Section 014000 - Quality Requirements: Tolerances.

*is this precision  
needed and reasonably  
attainable?*

- B. Top Surface of Subgrade: Plus or minus 1/10 foot from required elevation.

### 3.7 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

END OF SECTION

**Section 312324  
Waste Relocation  
NABORS Landfill**

2. Reg. 22.414 – Disease Vector Control
3. Reg. 22.415 – Explosive Gases Control
4. Reg. 22.416 – Air Criteria
5. Reg. 22.418 – Run-on/Run-off Control Systems

And for Class 4 landfills:

6. Reg. 22.609 – Cover Material Requirements
7. Reg. 22.610 – Disease Vector Control
8. Reg. 22.611 – Explosive Gases Control
9. Reg. 22.612 – Air Criteria
10. Reg. 22.614 – Run-on/Run-off Control Systems

**1.5 QUALIFICATIONS**

- A. Contractor shall have a Class 1 Level C licensed Operator on site during waste relocation. Operator shall be licensed in accordance with License as required by Arkansas Pollution Control and Ecology Commission Regulation No. 27.

**PART 2 PRODUCTS**

Not Used

**PART 3 EXECUTION**

**3.1 WASTE REMOVAL**

- A. Waste shall be removed from the locations and to the elevations indicated on the Construction Drawings.
- B. Existing soil cover shall be removed and stockpiled for reuse, if feasible.
- C. Waste removal shall be scheduled to minimize exposed waste.
- D. Water shall be used to minimize dust and blowing debris.
- E. Erosion control measures shall be used to minimize run-on and run-off from exposed waste.
- F. Spillage and airborne waste shall be minimized during transport. Waste blown or spilled from transport vehicles shall be recovered promptly and added to relocated waste.

*All areas, or  
only in 1-2"*

Section 312324  
Waste Relocation  
NABORS Landfill

Regs require  
only 6

- G. Stockpiled cover soil or imported fill shall be used to provide 12 inches of daily cover for exposed waste.
- H. Benchmarks, survey control points, and existing structures shall be protected from excavating equipment and vehicular traffic.

### 3.2 REMOVED WASTE RELOCATION

- A. Removed waste shall be placed in the locations and to the elevations indicated on the Construction Drawings.
- B. Waste placement shall be scheduled to minimize exposed waste.
- C. Water shall be used to minimize dust and blowing debris.
- D. Erosion control measures shall be used to minimize run-on and run-off from exposed waste in accordance with Sections 015000 and 015713.
- E. Erosion control measures shall be used to minimize run-on and run-off from exposed waste.
- F. Waste blown or spilled from transport vehicles shall be recovered promptly and added to relocated waste.
- G. Waste shall be mechanically compacted using two to three passes of a sheepsfoot roller.
- H. Stockpiled soil or imported fill shall be used to provide 12 inches of daily cover for exposed waste.
- I. Benchmarks, survey control points, and existing structures shall be protected from excavating equipment and vehicular traffic.

### 3.3 FIELD QUALITY CONTROL

- A. Survey final elevations to verify grades.

END OF SECTION

will this be adequate?

- C. Geotextile Fabric: Furnish in accordance with Arkansas Department of Transportation standards.

## 2.2 PIPE MATERIALS

- A. Pipe: Corrugated plastic, as specified in Section 334213.

*this section  
has CMP  
only*

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Section 013100 – Project Management and Coordination: Verification of existing conditions before starting work.
- B. Verify gradients and elevations of base or foundation for other work are correct.

### 3.2 DIVERSION CHANNELS

- A. Windrow excavated material on low side of channel.
- B. Compact to 95 percent maximum density.
- C. On entire channel area, apply soil supplements and sow seed as specified in Section 329219.
- D. Mulch seeded areas with hay as specified in Section 329219.

### 3.3 ROCK ENERGY DISSIPATOR

- A. Excavate to indicated depth of rock lining or nominal placement thickness as follows. Remove loose, unsuitable material below bottom of rock lining, then replace with suitable material. Thoroughly compact and finish entire foundation area to firm, even surface.

| NCSA Class | Nominal Placement Thickness<br>(inches) |
|------------|---|
| R8         | 48                                      |
| R7         | 36                                      |
| R6         | 30                                      |
| R5         | 24                                      |
| R4         | 18                                      |
| R3         | 12                                      |

## SECTION 329113 SOIL PREPARATION

what about?  
other layers?

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Preparation of structural fill, low permeability soil, and protective cover soil.
  - 2. Soil testing.
- B. Related Sections:
  - 1. Section 312213 - Rough Grading: Rough grading of site.
  - 2. Section 312317 - Trenching: Rough grading over cut.
  - 3. Section 329219 - Seeding

#### 1.2 QUALITY ASSURANCE

- A. Perform Work in accordance with applicable federal, state, and municipal standards.

#### 1.3 COORDINATION

- A. Section 013100 – Project Management and Coordination: Requirements for coordination.

### PART 2 PRODUCTS

#### 2.1 SOIL MATERIALS

- A. Soil Types: As specified in Section 310513.

#### 2.2 ACCESSORIES

- A. Edging: Galvanized steel.

where?

#### 2.3 SOURCE QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Testing, inspection and analysis requirements.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Section 013100 – Project Management and Coordination: Verification of existing conditions before starting work.
- B. Verify prepared soil base is ready to receive the Work of this section.

### 3.2 PREPARATION OF SOIL

- A. Screen soil to remove particles larger than 1 inch.
- B. Mechanical methods for removing large particles may be used for the grading layer.

END OF SECTION

Size?

## SECTION 334213 PIPE CULVERTS

*Plastic pipe  
not included  
in this  
section.*

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Corrugated steel pipe culvert.
  - 2. Concrete pipe culvert.
  - 3. Joints and accessories.
  - 4. Bedding.
  - 5. Slope protection at pipe end.
- B. Related Sections:
  - 1. Section 310516 - Aggregates for Earthwork
  - 2. Section 310519.13 – Geotextiles for Earthwork
  - 3. Section 313700 - Riprap
  - 4. Section 033000 – Cast-in-Place Concrete

#### 1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
  - 1. AASHTO M294 - Specification for Corrugated Polyethylene Pipe, 305- to 915-mm (12- to 36-in.) Diameter.
  - 2. AASHTO T99 - Standard Specification for the Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb) Rammer and a 305 mm (12 in.) Drop.
  - 3. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. ASTM International:
  - 1. ASTM A929/A929M - Standard Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe.
  - 2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
  - 3. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>)).

4. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
5. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

### **1.3 SUBMITTALS**

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data on pipe, fittings and accessories.
- C. Manufacturer's Installation Instructions: Submit special procedures required to install Products specified.

### **1.4 CLOSEOUT SUBMITTALS**

- A. Sections 017300 - Execution and 017700 - Closeout Procedures: Requirements for submittals.
- B. Project Record Documents:
  1. Accurately record actual locations of pipe runs, connections, and invert elevations.
  2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.
- C. Operation and Maintenance Data: Procedures for submittals.

## **PART 2 PRODUCTS**

### **2.1 STEEL CULVERT PIPE**

- A. Manufacturers:
  1. Hall Pacific Corrugated Pipe.
- B. Corrugated Steel Pipe: ASTM A929/A929M, galvanized.
- C. Tapered Ends: Same material as pipe, machine cut, for joining to pipe end.
- D. Coupling Bands: Galvanized steel, 0.052 inches thick x 10 inches wide; connected with two neoprene "O" ring gaskets and two galvanized steel bolts.

## **2.2 ACCESSORIES**

- A. Geotextile Fabric: Non-biodegradable, non-woven in accordance with Section 310519.13.
- B. Fill at Pipe Ends: Riprap as specified in Section 313700.
- C. Pipe bedding as specified for fine aggregate in Section 310516.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Section 013100 – Project Management and Coordination: Verification of existing conditions before starting work.
- B. Verify trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.

### **3.2 PREPARATION**

- A. Remove large stones or other hard matter which could damage piping or impede consistent backfilling or compaction.

### **3.3 EXCAVATION AND BEDDING**

- A. Excavate culvert trench to 12 inches below pipe invert. Hand trim excavation for accurate placement of pipe to elevations indicated.
- B. Place bedding material at trench bottom, level fill materials in one continuous layer not exceeding 6 inches compacted depth, compact to 95 percent.
- C. Maintain optimum moisture content of bedding material to attain required compaction density.
- D. Place filter fabric over compacted bedding.

### **3.4 INSTALLATION - PIPE**

- A. Lift or roll pipe into position. Do not drop or drag pipe over prepared bedding.
- B. Shore pipe to required position; retain in place until after compaction of adjacent fills. Ensure pipe remains in correct position and to required slope.

~~HDPE~~ **SECTION 400533.16**  
**VALVES AND APPURTENANCES** FOR HDPE PIPE

**PART 1 GENERAL**

(some valves specified as PVC)

**1.1 SUMMARY**

- A. Section includes the valves and sample ports for High Density Polyethylene Pipe (HDPE):
  - 1. Valves shall include all valve bodies, stems, seats, rotating or lifting elements, bearings, operators, actuators and appurtenances required for a completely functional valve installation.
  - 2. Valve extensions shall be furnished and installed for smooth operation of the valves.
  - 3. Valve boxes shall include all construction, materials, box bodies and covers required for operation of buried valves and incidentals.
- B. Related Sections:
  - 1. Section 310513 – Soils for Earthwork
  - 2. Section 310516 – Aggregates for Earthwork
  - 3. Section 312316 – Excavation
  - 4. Section 400533 – High-Density Polyethylene Process Pipe
  - 5. Section 40533.23 – HDPE Pipe Testing

**1.2 REFERENCES**

- A. Occupational Health and Safety Act Regulations (Standards – 29 Code of Federal Regulations).
- B. ASME B16.40 Manually Operated Thermoplastic Gas Shutoffs and Valves in Gas Distribution Systems.
- C. ASTM D-2513 Standard Specification for Polyethylene Gas Pressure Pipe, Tubing, and Fittings.

**1.3 QUALITY ASSURANCE**

- A. Parts Interchangeability
  - 1. All valves of like size and type shall be the product of a single manufacturer.

Section 431343  
Waste Gas Burner System  
NABORS Landfill

- Tulsa, Oklahoma 74116  
800-421-9242
2. Perennial Energy LLC  
1375 CR 8690  
West Plains, Missouri 65775  
(417) 256-2002
3. LFG Specialties LLC  
16406 U.S. Route 224 East  
Findlay, Ohio 45840-9761  
419-424-4999
4. Parnel Biogas, Inc.  
5868 129<sup>th</sup> East Avenue  
Tulsa, Oklahoma 74134  
918-294-3868
5. AXD Service Industries Corp.  
PO Box 39  
Trenton, New Jersey 07763  
732-946-9462)

#### 1.4 DESIGN CRITERIA

##### A. Landfill Gas

1. Equipment specified herein is intended to be standard equipment for use in a landfill gas handling system.
- Site elevation 1,390 feet above MSL
- Gas composition:
- |  |               |
|--|---------------|
| Methane                                    | 30 percent    |
| Carbon Dioxide                             | 30 percent    |
| Oxygen                                     | 10 percent    |
| Nitrogen                                   | 30 percent    |
| Trace gases (e.g., VOCs, H <sub>2</sub> S) | 0 - 1 percent |
- LFG inlet temperature:
- |                    |    |
|--------------------|----|
| Maximum, degrees F | 80 |
| Minimum, degrees F | 40 |
- LFG moisture content 100% saturated
2. The flare shall be capable of achieving a minimum weighted average destruction efficiency of greater than 98 percent of total non-methane organic compounds and meet the requirements of 40 CFR 60.18.

1060

different  
in  
Section  
432236

### 1.3 DESIGN CRITERIA

A. The evaporator shall be designed to operate continuously with landfill gas as the primary fuel source.

B. The landfill gas stream is characterized by the following parameters.

|                   |  |
|-------------------|--|
| Type:             | landfill   |
| Composition:      | 50% CH <sub>4</sub><br>50% CO <sub>2</sub> , air, inerts |
| Gas Temperature:  | 100° F   |
| System Flow Rate: | 270-700 (estimated)                                      |
| Heat Release:     | 7.5 MM BTU/hr  |

C. The leachate stream is characterized by the following parameters.

|              |                        |
|--------------|------------------------|
| Composition: | varies                 |
| Flow Rate:   | 15,000 gallons per day |

D. The evaporator system shall satisfy the following site conditions.

|                                 |                              |
|---------------------------------|------------------------------|
| Site Elevation:                 | 1060 ft above sea level      |
| Ambient Temperature:            | 32 °F to 120 °F              |
| Electrical Area Classification: | non-hazardous (unclassified) |

E. The following utilities are required to support operation of the evaporator system.

|                           |   |
|---------------------------|---|
| Pilot Gas (intermittent): | 22 SCFH of propane at 7-10 psig<br>50 SCFH of natural gas at 10-15 psig |
| Electricity:              | 480 V, 3 phase, 60 Hz   |

### 1.4 REFERENCES

A. All equipment shall be manufactured in accordance with codes and guidelines as specifically detailed herein and in accordance with applicable portions of the following (latest edition):

1. Local laws and ordinances.
2. State and Federal laws.
3. National Electrical Code (NEC).
4. National Electrical Manufacturers Association (NEMA)
5. Underwriters Laboratories (UL).
6. State Building Code.
7. American National Standards Institute (ANSI).
8. American Society of Engineers (ASME).
9. Institute of Electrical and Electronic Engineers (IEEE).
10. Instrument Society of America (ISA).
11. Industrial Risk Insurance (IRI).
12. Factory Mutual (FM).
13. Environmental Protection Agency (EPA).

OK  
Is contractor to provide or make arrangements for LP tank supply?

CALCULATION SHEET

PAGE

1 of 2

Text and cells in RED indicate review comments by EnSafe, January 2016

|         |                                      |
|---------|--------------------------------------|
| CLIENT  | ADEQ                                 |
| PROJECT | Closure of Inactive NABORS Landfills |
| SUBJECT | Engineer's Estimate Range            |

|             |             |      |            |
|-------------|-------------|------|------------|
| PROJECT NO. | 27214218.01 | DATE | 11/12/2015 |
| PREPARED BY | DRS         | DATE | 11/13/2015 |
| REVIEWED BY | DMB         | DATE |            |
| APPROVED BY |             | DATE |            |

Note: Item 4 pricing equates to approximately \$0.15 per gallon.

| Item No.                          | Description  | Estimated Quantity | Units | Unit Price      | Estimated Price | Unit Price Source   | Basis of Quantity  |
|-----------------------------------|--|--------------------|-------|-----------------|-----------------|---|--|
| 1                                 | Mobilization / Demobilization  | 1                  | LS    | \$ 757,900.00   | \$ 757,900.00   | 5% of Total Project Cost.   | One time event   |
| 2                                 | Provide and Maintain Stormwater/Erosion Control Structures                           | 1                  | LS    | \$ 84,000.00    | \$ 84,000.00    | Estimated to be \$1,200/acre over approximately 70 acres (LFs and borrow area). | One time event   |
| 3                                 | Construction Quality Assurance   | 1                  | LS    | \$ 912,500.00   | \$ 912,500.00   | SCS estimate of \$2500 per day.   | Assume to require CQA for 12 months (365 days)                 |
| 4                                 | Provide Temporary Leachate Disposal  | 1                  | LS    | \$ 223,080.00   | \$ 223,080.00   | SCS estimate of \$4000 per week for hauling, \$0.01/gal disposal for 52 weeks.  | Estimated 29,000 gallons per week for 1 year.                  |
| Sedimentation Pond /Dam           |  |                    |       |                 |                 |   |  |
| 5                                 | Clear Existing Vegetation in Pond Basin  | 3                  | AC    | \$ 7,668.00     | \$ 23,004.00    | RSMeans Line Number 311110100350.   | Area from AutoCAD Delineating Cleared Area for Basin and Dam.  |
| 6                                 | Excavate Soil to Sedimentation Pond Base Elevations                                  | 7,260              | CY    | \$ 6.53         | \$ 47,407.80    | RSMeans Line Number 312316465420.   | Volume Estimated by Excavating 1-2 feet from the Basin Area.   |
| 7                                 | Place Structural Fill for Dam  | 7,000              | CY    | \$ 3.69         | \$ 25,830.00    | RSMeans Line Number 312323145440 (place fill) + 312323240300 (compaction)       | Volume Calculation from AutoCAD.                               |
| 8                                 | Install Outlet Structure, Discharge Pipe, Overflow Weir, and Riprap                  | 1                  | LS    | \$ 35,000.00    | \$ 35,000.00    | SCS Estimate.   | Items depicted on Construction Drawings.                       |
| Waste Relocation                  |  |                    |       |                 |                 |   |  |
| 9                                 | Strip grub and stockpile organic containing soil from Area 1-2                       | 36,000             | CY    | \$ 2.69         | \$ 96,840.00    | RSMeans Line Number 311413230700.   | Area 1-2.  |
| 10                                | Excavate and Relocate Waste/Soil Mix from Area 1-2                                   | 1                  | LS    | \$ 1,470,000.00 | \$ 1,470,000.00 | 2015 Waste Relocation Bid. (\$10/CY)  | Volume Calculation using AutoCAD, 147,000 CY.                  |
| 11                                | Excavate and Relocate/Regrade Waste/Soil Mix in Area 1-3                             | 1                  | LS    | \$ 458,400.00   | \$ 458,400.00   | 2015 Waste Relocation Bid. (\$8/CY)   | Volume Calculation using AutoCAD, 57,300 CY.                   |
| 12                                | Excavate and Relocate/Regrade Waste/Soil Mix in Class 4                              | 1                  | LS    | \$ 273,000.00   | \$ 273,000.00   | 2015 Waste Relocation Bid. (\$10/CY)  | Volume Calculation using AutoCAD, 27,300 cubic yard.           |
| Gas Collection and Control System |  |                    |       |                 |                 |   |  |
| 13                                | Driller Mobilization   | 1                  | LS    | \$ 7,500.00     | \$ 7,500.00     | SCS Engineers LFG Price Calculator  | One time event   |
| 14                                | Vertical Gas Extraction Well Drilling and Installation                               | 1,208              | LF    | \$ 158.00       | \$ 190,864.00   | SCS Engineers LFG Price Calculator  | Total depth for all the gas wells                              |
| 15                                | Provide and Install LFG Wellheads  | 37                 | EA    | \$ 600.00       | \$ 22,200.00    | SCS Engineers LFG Price Calculator  | Total number of gas wells                                      |
| 16                                | 10'x10' Wellbore Seal  | 21                 | EA    | \$ 630.00       | \$ 13,230.00    | SCS Engineers LFG Price Calculator  | Gas wells with less than 16' of solid pipe                     |
| 17                                | Provide and Install 4" HDPE LFG Piping   | 1,625              | LF    | \$ 24.00        | \$ 39,000.00    | SCS Engineers LFG Price Calculator  | Calculated total length of all 4" gas pipe plus 10%            |
| 18                                | Provide and Install 8" HDPE LFG Piping   | 10,050             | LF    | \$ 33.00        | \$ 331,650.00   | SCS Engineers LFG Price Calculator  | Calculated total length of all 8" gas pipe plus 10%            |
| 19                                | Provide and Install 12" HDPE LFG Piping  | 770                | LF    | \$ 48.00        | \$ 36,960.00    | SCS Engineers LFG Price Calculator  | Calculated total length of all 12" gas pipe plus 10%           |
| 20                                | Provide and Install 12" Butterfly Valve  | 4                  | EA    | \$ 3,300.00     | \$ 13,200.00    | SCS Engineers LFG Price Calculator  | Total number of 12" Butterfly Valves                           |
| 21                                | Provide and Install 8" Butterfly Valve   | 19                 | EA    | \$ 2,200.00     | \$ 41,800.00    | SCS Engineers LFG Price Calculator  | Total number of 8" Butterfly Valves                            |
| 22                                | Provide and Install HDPE Access Riser with Fiberglass Lid                            | 10                 | EA    | \$ 1,300.00     | \$ 13,000.00    | SCS Engineers LFG Price Calculator  | Total number of Access Risers                                  |
| 23                                | Provide and Install HDPE Condensate Knockout   | 3                  | EA    | \$ 8,500.00     | \$ 25,500.00    | SCS Engineers LFG Price Calculator  | Total number of Condensate Knockouts                           |
| 24                                | Provide and Install Dual Containment Condensate Sump with Pump                       | 4                  | EA    | \$ 25,000.00    | \$ 100,000.00   | SCS Engineers LFG Price Calculator  | Total number of Condensate Sumps                               |
| 25                                | Provide and Install 4" HDPE Condensate and 2" Air Lines                              | 4,025              | LF    | \$ 12.00        | \$ 48,300.00    | SCS Engineers LFG Price Calculator  | Calculated total length of Forcemain and Air Lines plus 10%    |
| 26                                | Provide and Install 10HP Rotary Screw Air Compressor, Concrete Pad, and 10'x10' Shed | 1                  | LS    | \$ 30,000.00    | \$ 30,000.00    | SCS Engineers LFG Price Calculator  | Only one compressor needed                                     |
| 27                                | Provide and Install 24" CMP Road Crossing  | 5                  | EA    | \$ 60.00        | \$ 300.00       | SCS Engineers LFG Price Calculator  | Total number of road crossing by gas lines                     |
| 28                                | Provide and Install Candlestick Flare, Skid, Electrical, and Pad                     | 1                  | LS    | \$ 400,000.00   | \$ 400,000.00   | SCS Engineers LFG Price Calculator  | Only one flare needed  |
| Leachate Disposal System          |  |                    |       |                 |                 |   |  |
| 29                                | Provide and Install Leachate Evaporator  | 1                  | EA    | \$ 1,000,000.00 | \$ 1,000,000.00 | Quote from John Zink  | Only one evaporator needed                                     |
| 30                                | Provide and Install 10,500 gallon Fiberglass Tanks and Valve Connections             | 8                  | EA    | \$ 10,500.00    | \$ 84,000.00    | Quote from KBH Corp.  | Calculated to handle 110% of predicted leachate and condensate |
| 31                                | Provide and Install Concrete Secondary Containment and Evaporator Pad                | 210                | CY    | \$ 800.00       | \$ 168,000.00   | SCS Engineers LFG Price Calculator  | Designed to hold 110% of available tank storage                |
| 32                                | Provide and Install 2"x4" Dual Contained HDPE Forcemain                              | 7,500              | LF    | \$ 56.00        | \$ 420,000.00   | SCS Engineers LFG Price Calculator  | Calculated total length of Forcemain                           |



Table 5 - Cost Analysis of Leachate Evaporator vs Hauling  
(as presented in Design Criteria Report)

| Year | Estimated LFG Flow (scfm) | Estimated Leachate Volume (gallons) | Cumulative Estimated Leachate Evaporator Cost | Cumulative Estimated Hauling Disposal Cost | Cumulative Cost Savings |
|------|---------------------------|-------------------------------------|---|--|-------------------------|
| 2017 | 401                       | 1,500,000                           | \$ 918,500                                    | \$ 390,000                                 | \$ (528,500)            |
| 2018 | 366                       | 1,368,158                           | \$ 972,500                                    | \$ 745,721                                 | \$ (226,779)            |
| 2019 | 333                       | 1,247,904                           | \$ 1,026,500                                  | \$ 1,070,176                               | \$ 43,676               |
| 2020 | 304                       | 1,138,219                           | \$ 1,080,500                                  | \$ 1,366,113                               | \$ 285,613              |
| 2021 | 277                       | 1,038,176                           | \$ 1,134,500                                  | \$ 1,636,039                               | \$ 501,539              |
| 2022 | 253                       | 946,925                             | \$ 1,188,500                                  | \$ 1,882,239                               | \$ 693,739              |
| 2023 | 231                       | 863,696                             | \$ 1,242,500                                  | \$ 2,106,800                               | \$ 864,300              |
| 2024 | 211                       | 787,781                             | \$ 1,296,500                                  | \$ 2,311,623                               | \$ 1,015,123            |
| 2025 | 192                       | 718,539                             | \$ 1,350,500                                  | \$ 2,498,443                               | \$ 1,147,943            |
| 2026 | 175                       | 655,383                             | \$ 1,404,500                                  | \$ 2,668,843                               | \$ 1,264,343            |

Hauling & Disposal Unit Cost, \$/gallon: 0.26  
Annual Evaporator O&M Cost \$ 54,000

Table 5A - Cost Analysis of Leachate Evaporator vs Hauling  
(with hauling & disposal cost of \$0.20/gallon))

| Year | Estimated LFG Flow (scfm) | Estimated Leachate Volume (gallons) | Cumulative Estimated Leachate Evaporator Cost | Cumulative Estimated Hauling Disposal Cost | Cumulative Cost Savings of Evaporator |
|------|---------------------------|-------------------------------------|---|--|---------------------------------------|
| 2017 | 401                       | 1,500,000                           | \$ 918,500                                    | \$ 300,000                                 | \$ (618,500)                          |
| 2018 | 366                       | 1,368,158                           | \$ 972,500                                    | \$ 573,632                                 | \$ (398,868)                          |
| 2019 | 333                       | 1,247,904                           | \$ 1,026,500                                  | \$ 823,212                                 | \$ (203,288)                          |
| 2020 | 304                       | 1,138,219                           | \$ 1,080,500                                  | \$ 1,050,856                               | \$ (29,644)                           |
| 2021 | 277                       | 1,038,176                           | \$ 1,134,500                                  | \$ 1,258,491                               | \$ 123,991                            |
| 2022 | 253                       | 946,925                             | \$ 1,188,500                                  | \$ 1,447,876                               | \$ 259,376                            |
| 2023 | 231                       | 863,696                             | \$ 1,242,500                                  | \$ 1,620,616                               | \$ 378,116                            |
| 2024 | 211                       | 787,781                             | \$ 1,296,500                                  | \$ 1,778,172                               | \$ 481,672                            |
| 2025 | 192                       | 718,539                             | \$ 1,350,500                                  | \$ 1,921,880                               | \$ 571,380                            |
| 2026 | 175                       | 655,383                             | \$ 1,404,500                                  | \$ 2,052,956                               | \$ 648,456                            |

Hauling & Disposal Unit Cost, \$/gallon: \$ 0.20  
Annual Evaporator O&M Cost \$ 54,000

Table 5B - Cost Analysis of Leachate Evaporator vs Hauling  
(with evaporator cost of \$1.05 million and hauling & disposal cost of \$0.20/gallon))

| Year | Estimated LFG Flow (scfm) | Estimated Leachate Volume (gallons) | Cumulative Estimated Leachate Evaporator Cost | Cumulative Estimated Hauling Disposal Cost | Cumulative Cost Savings of Evaporator |
|------|---------------------------|-------------------------------------|---|--|---------------------------------------|
| 2017 | 401                       | 1,500,000                           | \$ 1,050,000                                  | \$ 300,000                                 | \$ (750,000)                          |
| 2018 | 366                       | 1,368,158                           | \$ 1,104,000                                  | \$ 573,632                                 | \$ (530,368)                          |
| 2019 | 333                       | 1,247,904                           | \$ 1,158,000                                  | \$ 823,212                                 | \$ (334,788)                          |
| 2020 | 304                       | 1,138,219                           | \$ 1,212,000                                  | \$ 1,050,856                               | \$ (161,144)                          |
| 2021 | 277                       | 1,038,176                           | \$ 1,266,000                                  | \$ 1,258,491                               | \$ (7,509)                            |
| 2022 | 253                       | 946,925                             | \$ 1,320,000                                  | \$ 1,447,876                               | \$ 127,876                            |
| 2023 | 231                       | 863,696                             | \$ 1,374,000                                  | \$ 1,620,616                               | \$ 246,616                            |
| 2024 | 211                       | 787,781                             | \$ 1,428,000                                  | \$ 1,778,172                               | \$ 350,172                            |
| 2025 | 192                       | 718,539                             | \$ 1,482,000                                  | \$ 1,921,880                               | \$ 439,880                            |
| 2026 | 175                       | 655,383                             | \$ 1,536,000                                  | \$ 2,052,956                               | \$ 516,956                            |

Hauling & Disposal Unit Cost, \$/gallon: \$ 0.20  
Annual Evaporator O&M Cost \$ 54,000  
Evaporator Cost per Engineer's Estimate of \$1,000,000 plus \$50,000 for foundation pad.

Table 5C - Cost Analysis of Leachate Evaporator vs Hauling  
(with evaporator cost of \$1.05 million and hauling & disposal cost of \$0.15/gallon))

| Year | Estimated LFG Flow (scfm) | Estimated Leachate Volume (gallons) | Cumulative Estimated Leachate Evaporator Cost | Cumulative Estimated Hauling Disposal Cost | Cumulative Cost Savings of Evaporator |
|------|---------------------------|-------------------------------------|---|--|---------------------------------------|
| 2017 | 401                       | 1,500,000                           | \$ 1,050,000                                  | \$ 225,000                                 | \$ (825,000)                          |
| 2018 | 366                       | 1,368,158                           | \$ 1,104,000                                  | \$ 430,224                                 | \$ (673,776)                          |
| 2019 | 333                       | 1,247,904                           | \$ 1,158,000                                  | \$ 617,409                                 | \$ (540,591)                          |
| 2020 | 304                       | 1,138,219                           | \$ 1,212,000                                  | \$ 788,142                                 | \$ (423,858)                          |
| 2021 | 277                       | 1,038,176                           | \$ 1,266,000                                  | \$ 943,869                                 | \$ (322,131)                          |
| 2022 | 253                       | 946,925                             | \$ 1,320,000                                  | \$ 1,085,907                               | \$ (234,093)                          |
| 2023 | 231                       | 863,696                             | \$ 1,374,000                                  | \$ 1,215,462                               | \$ (158,538)                          |
| 2024 | 211                       | 787,781                             | \$ 1,428,000                                  | \$ 1,333,629                               | \$ (94,371)                           |
| 2025 | 192                       | 718,539                             | \$ 1,482,000                                  | \$ 1,441,410                               | \$ (40,590)                           |
| 2026 | 175                       | 655,383                             | \$ 1,536,000                                  | \$ 1,539,717                               | \$ 3,717                              |

Hauling & Disposal Unit Cost, \$/gallon: \$ 0.15  
Annual Evaporator O&M Cost \$ 54,000  
Evaporator Cost per Engineer's Estimate of \$1,000,000 plus \$50,000 for foundation pad.