Final

Matanuska-Susitna Borough Central Landfill Development Plan

Prepared for

Matanuska-Susitna Borough
Solid Waste Division

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CH2MHILL®

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Acronyms and Abbreviations

24/7	24 hours a day, seven days a week
AAC	Alaska Administrative Code
ADC	alternative daily cover
ADEC	Alaska Department of Environmental Conservation
ADOL	Alaska Department of Labor and Workforce Development, Research and Analysis Section
ATL	Air Toxics Ltd.
AWWU	Anchorage Water and Wastewater Utility
BOD	biochemical oxygen demand
BTU	British thermal units
cfm	cubic feet per minute
CFR	Code of Federal Regulations
CO_2e	carbon dioxide equivalent
COD	chemical oxygen demand
CY	cubic yard
EPA	U.S. Environmental Protection Agency
GHG	greenhouse gas
gpd	gallons per day
HELP	Hydrologic Evaluation Landfill Performance
IC	internal combustion
INORG	inorganic
ISER	Institute of Social and Economic Research
kW	kilowatt
lb	pound(s)
LandGEM	Landfill Gas Emissions Model (EPA)
LFGCCS	landfill gas collection control system
LFGTE	landfill gas to energy
m^3	cubic meters
m^3/mg	cubic meters per milligram(s)
Mg	megagram
mg/L	milligrams per liter
MBR	membrane bioreactor
MSB	Matanuska-Susitna Borough
MSW	municipal solid waste

MW	megawatt
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NMOC	non-methane organic compounds
NSPS	New Source Performance Standards
O&G	oil and grease
O&M	operations and maintenance
OOC	organochlorine compound
PEST	pesticide
PV	present value
RAD	radiation units
SBR	sequencing batch reactor
SVOC	semivolatile organic compound
SWD	Solid Waste Division
TDS	total dissolved solids
TOC	total organic carbon
TSS	total suspended solids
VOC	volatile organic compound
WQ	water quality
WQS	water quality standards

Executive Summary

The Matanuska-Susitna Borough (MSB) selected CH2M HILL to perform the following tasks:

- Evaluate future cell sequencing
- Evaluate total site soil balance
- Update budgetary cost estimates for onsite leachate treatment
- Evaluate the feasibility for onsite co-treatment of septage and leachate
- Evaluate the potential for methane capture and use
- Re-evaluate the existing formula for annual contribution to closure fund.

Using updated cell development criteria, site topographic data and civil design software, the CH2M HILL team created a future landfill development concept. The projected life of the landfill (151 years) with this revised development plan increased significantly from the previous 2006 plan for three main reasons: 1) the bottom of the landfill was dropped from 20-foot separation to groundwater to the regulatory required 10-foot separation, 2) increased waste placement density from improved field compaction, and 3) revised 3:1 side slopes confirmed stable via stability analysis. The proposed cell sequence stays east of the existing power line for the duration of development, and away from trailhead and Crevasse Moraine trails for as long as possible. With the updated side slopes and higher waste density, our analysis indicates that the current cell (Cell 3) may have up to 8 more years of capacity.

In addition to the longer landfill life, the updated development criteria yields a positive soil balance of approximately 9 million cubic yards (CY) over the life of the landfill. This additional gravel can be made available for other MSB projects.

The required annual contribution to closure for the final landfill cell has decreased dramatically because of the longer landfill life. However, this analysis assumes that interim cells are closed sequentially and federal regulations (40 Code of Federal Regulations [CFR] 258.71) require that MSB maintain sufficient funds to close the largest landfill cell open at any time during the active landfill life. Additional financial evaluation and planning is recommended to ensure that MSB has sufficient funds available for the interim cell closures.

It is CH2M HILL's recommendation that the MSB co-treat leachate and septage at the landfill. We understand that the MSB is planning to build a septage treatment facility somewhere within the MSB and is targeting MSB land. Sufficient land is available at the landfill and locating this facility at the centrally located landfill should minimize the average transport cost for haulers.

Co-treatment of leachate with pre-treated septage is feasible with commercially available biological package treatment systems. The recommended treatment process for this combined wastewater is a sequencing batch reactor (SBR). The permitted effluent discharge limits that will apply at the point of compliance will depend on Alaska Department of Environmental Conservation's (ADEC's) comfort level with the proposed treatment system. For planning purposes, the most stringent discharge criteria (drinking water standards) were used.

If the septage facility is not located at the landfill, then we recommend evaluating the costs of hauling leachate to the septage facility for co-treatment versus costs of construction and operation of an onsite leachate evaporator. Construction of both the septage treatment facility and the leachate evaporator at the landfill is not recommended because it would be redundant.

U.S. Environmental Protection Agency's (EPA's) screening model Landfill Gas Emissions Model (LandGEM) indicates that landfill gas generation at the Central Landfill may have reached a point where it can be beneficially used, either as fuel (for example, for leachate evaporation) or for generation of power. The Central Landfill is currently subject to the Greenhouse Gas (GHG) Reporting Rule (40 Code of Federal Regulations [CFR] 98, Subpart HH) and MSB needs to prepare a monitoring plan and submit an annual emission report to be compliant with this federal requirement. Our estimates indicate that the Central Landfill has not yet reached the New Source Performance Standards (NSPS) (40 CFR 60, Subpart WWW) limits requiring installation of landfill gas collection and control, but MSB should confirm this assumption by completing and submitting a design capacity report to ADEC. The Central Landfill is currently not subject to National Emissions Standards for Hazardous Air Pollutants (NESHAP) (40 CFR 63, Subpart AAAA) because the design capacity of the landfill is estimated to be below the NSPS regulatory thresholds. A landfill gas feasibility study involving installation of vertical gas collection wells is recommended when gas quality measurements from the passive gas vents to be installed on Cell 2A indicate good gas quality. Grant funding is available for alternative energy/GHG reduction projects of this type.

SECTION 1

Landfill Development Plan

The following landfill development plan provides a summary of the data, assumptions, and approaches that were used during the development of the conceptual layout for the Matanuska-Susitna Borough (MSB) Central Landfill. This includes a summary of baseline values used to determine future requirements, utilize existing site conditions, and assemble landfill elements to offer the MSB Solid Waste Division (SWD) a development plan that optimizes available horizontal and vertical space and gravel resources that can be used for other projects within the MSB. This development plan should be used by the MSB as the roadmap by which development of the cells proceed.

1.1 Air Space Requirements and Future Cell Sizing

In order to optimize site development, estimated yearly quantities of waste and associated daily/intermediate cover and final cover/bottom liner soils were projected to determine future airspace and related material needs. Concurrently, the future landfill boundary was established, followed by generating preliminary landfill liner and final cover system grades. This includes determining the baseline for incoming waste, the estimated daily cover soil to waste ratio, projected growth rates, available airspace, and finally establishing the criteria for future cell development.

1.1.1 Baseline Incoming Waste Volume

Incoming waste tonnages were provided by the MSB through Years 2007 to 2014. Additionally, historical in-place density information was provided and included data from Years 2009 to 2014. The information included a historical comparison of monthly incoming waste with associated monthly volumes which were developed by the MSB through comparing before and after waste placement land surveys. This information provided the basis for determining the average density of in-place waste.

While the 2009 through 2014 mass and volume comparisons were available for several months and years, only the September 2013 to May 2014 (end of record) information was used to estimate future in-place waste density. Following the contract change in September 2013, an average waste density of 1,400 pounds (lbs) of municipal solid waste (MSW) and daily cover soil per cubic yard (CY) of airspace was achieved. It is understood that similar compaction equipment and methods will be used in the future, so this density was used for future planning purposes. A summary of waste, volume, and density under the new service contract is shown in Table 1-1.

TABLE 1-1

Baseline Annual Incoming Waste Volume and Density

Matanuska-Susitna Borough Central Landfill Development Plan

Year	Month	Days Worked	MSW/ Residential Waste (lb)	Survey Data Volume (CY)	Density [a] (lb/CY)
2013	September	29	11519480	8321	1384
	October	31	11010840	8174	1347
	November	29	8491460	6907	1229
	December	30	8355880	7156	1167
2014	January	30	8780820	5690	1543
	February	28	7215340	4955	1456
	March	31	8158680	5600	1456

TABLE 1-1

Baseline Annual Incoming Waste Volume and Density

Matanuska-Susitna Borough Central Landfill Development Plan

Year	Month	Days Worked	MSW/ Residential Waste (lb)	Survey Data Volume (CY)	Density [a] (lb/CY)
	April	30	9620400	5583	1723
	May	30	11496340	8606	1335
				Average Density	1400

Notes

[a] Density reported is the weight of MSW per CY of airspace used, where the airspace includes daily and intermediate cover soils as well as MSW.

1.1.2 Daily Cover Soil-to-Waste Ratio

In order to estimate the daily and intermediate soil needs, a soil to waste ratio was developed that relates those materials to incoming waste quantities. The MSB does not currently track actual cover soil use, so estimates were developed based on typical daily fill operations. The MSB indicated that for each 10-foot-thick daily lift, an approximate 100-foot by 50-foot working face is covered with an alternative daily cover (ADC), and the remaining exposed surface is covered with soil. The working face was modeled as the two exposed sides of the daily lift. Calculations of exposed waste for each daily cell indicate that the ADC is generally large enough to cover the entire sloped face of the working landfill.

To estimate the daily cover soil usage, the working deck was assumed to be covered daily to allow subsequent travel over the previous day’s cell. Based on landfill operational experience, up to 1 foot of soil may be required on the top deck of the previous day’s lift in order to provide adequate support for vehicular travel over waste. In order to provide a conservative usage of daily cover soil, a minimum of 1 foot was assumed over the day’s lift. Additionally, a minimum of 6-inches of soil was assumed to be placed over the working face at least 10 percent of the time to account for periods of inclement weather or other conditions that could impact the deployment of ADC for the day. An average daily waste volume of approximately 278 CY and a fill depth of 10 feet results in a top deck area of approximately 750 square feet. An assumed 1-foot-thick daily cover on the top deck and a 6-inch layer over the working face 10 percent of the time results in an average of about 31 CY of cover soil needed daily, or 11,100 CY over a 359-day work year.

Using the estimated daily cover soil usage and the yearly waste records from 2007 through 2013, the average computed soil to waste ratio was 0.16, or a little more than 1:5 (soil:waste).

1.1.3 Solid Waste Growth Rates

The incoming volume of waste is expected to increase as the population in the Matanuska-Susitna Valley grows. Future solid waste growth rates were estimated using predictions for population growth rates from the Alaska Department of Labor and Workforce Development, Research and Analysis Section (ADOL). These ADOL rates were based on standard population growth and did not take into account the potential increases that could be realized should the Knik Arm Bridge be constructed. In order to account for the potential increase in growth because of the bridge, the additional percentage points related to bridge construction were determined starting from the present through year 2030, at which time the growth projections reverted to the standard ADOL growth rates.

The bridge-related population growth was developed from the *Environmental Impact Statement Memorandum on the Economic and Demographic Impacts of a Knik Arm Bridge* prepared by the Institute of Social and Economic Research (ISER) at the University of Alaska, Anchorage, dated 2005. Bridge-related population growth was obtained by isolating the growth attributed to the bridge. The resulting bridge-related growth rates were then added to the more recent ADOL population growth rates. The resulting yearly growth rates are presented in Table 1-2 below. Population estimates using these growth rates are provided in Appendix A.

TABLE 1-2
Matanuska-Susitna Growth Projections
Matanuska-Susitna Borough Central Landfill Development Plan

Year	Matanuska-Susitna Projection	5-Yearly Growth Rate [a]	Yearly Growth Rate	Yearly Growth Rate Attributable to Bridge [b]	Yearly Growth Rate with Bridge
July 1, 2012	93,801	--	--	--	--
July 1, 2017	105,617	12.60%	2.40%	0.08%	2.48%
July 1, 2022	117,845	11.58%	2.21%	0.17%	2.38%
July 1, 2027	130,254	10.53%	2.02%	0.32%	2.35%
July 1, 2032	142,615	9.49%	1.83%	0.28%	2.11%
July 1, 2037	154,692	8.47%	1.64%	--	1.64%
July 1, 2042	166,338	7.53%	1.46%	---	1.46%

Notes
[a] Source: ADOL, 2014
[b] Source: ISER, 2005

1.1.4 Airspace Requirements

Landfill airspace requirements were forecast using the MSW to airspace density, growth rates, and daily cover soil-to-waste ratio (with ADC) discussed in Section 1.1.3. Airspace requirements are shown by year in Appendix A. The calculation of average waste density is shown in Table 1-3.

TABLE 1-3
Average Weight of Municipal Solid Waste per Cubic Yard of Airspace
Matanuska-Susitna Borough Central Landfill Development Plan

Item	Value	Unit	Source/Notes
Average Weight of MSW	57,866	tons	MSB records from 2007 to 2013; MSW only
In-place volume of MSW	82,665	CY	MSB records from 2007 to 2013; includes MSW and daily cover soil
Density of MSW	1,400	lb/CY	Weight of MSW (not including cover soil) per CY of air space

1.1.5 Future Cell Sizing

For planning purposes, it was decided that each future landfill cell should have a life of approximately 5 to 7 years. The future capacity for each cell was computed using the forecast airspace requirements and estimated landfill and final cover liner systems. Future cell sizing is presented in Appendix C.

1.1.6 Cell Development Criteria

The following future cell development criteria were used for this project.

Property Boundaries. The Central Landfill property boundary was obtained from the MSB. The additional 190 acres on the east side of the property—parcels C2, C3, and C4—will not be used for landfilling waste. Per direction from the MSB, future development is limited to the area east of the existing Matanuska Electric Association 100-foot power line easement.

Buffer Zones Between New Cells and Residential Areas. Buffer zones are measured from the cell boundary to the facility boundary. The north boundary will have a 300-foot buffer from existing residential property. The buffer on the east, west, and south sides will be 100 feet, which exceeds the 50 feet required by permit for non-residential land.

Maximum Height Limit. The landfill height was assumed to be at a maximum elevation of 355 feet above mean sea level per North American Vertical Datum 1988, which is based on a recent waiver received by the MSB. This will require a permit modification, as the permitted elevation is 340 feet above mean sea level based on a locally established datum, and a waiver would be required for each cell, similar to the waiver for Cell 2A.

Stormwater Collection. The goal for stormwater control is to prevent ponding and erosion. It is assumed that stormwater will be routed to ditches for infiltration or discharge to the south of the site. Depending on changes in regulations, future stormwater may be re-circulated onto the waste in the lined cells.

Depth to Groundwater. The depth to groundwater was optimized to meet the minimum regulatory 10-foot separation from liner to high groundwater elevation. There are no hydrogeologic investigation or associated hydrographs available that identify the high groundwater elevation throughout the year; therefore, the high groundwater elevations are a compilation of the highest groundwater elevations between the available June 22, 2005, and March 11, 2014, groundwater maps (Shannon & Wilson, Inc. 2005; 2014).

Desired Soil Balance. The MSB can use an unlimited supply of soil (gravel) and would like to maximize positive soil balance in order to use gravel as a resource that can be used elsewhere within the MSB. The rate of use would equal the rate of excavation. Calculations used to determine soil balance currently assume that no stockpiling is required for such “resource” soils and that only soils needed for use at the landfill are to be stockpiled.

Leachate Collection System, Bottom Grades. Leachate will drain via gravity to a low spot within each landfill cell where it will then be collected in a sump and pumped into a leachate collection header. The header and subheaders will generally gravity flow to the east and south, providing a cost savings by not requiring a force main throughout the site. The slope for leachate collection system piping for future cells should be a minimum of 1.5 percent.

Location of Leachate Treatment System. The leachate treatment system is currently planned for the approximate 34-acre treatment area in the west of the site.

Bottom Liner Section. It was assumed that the bottom liner section would be the same as the one used for the first lined cell at the Central Landfill (Cell 2B). From the bottom up, the liner section will entail a prepared subgrade, 6-inch sand leveling course, geosynthetic clay liner, flexible membrane liner, and a 2-foot layer of granular drainage material.

Final Cover Section. The specific final cover section has not yet been designed but the following section is assumed using standard practice and regulatory guidance from Alaska Administrative Code (AAC) 18 AAC 60.395. From the bottom up, the final cover section will include a prepared subgrade, 6-inch leveling course, flexible membrane liner, 18-inch layer of granular drainage material, and 6 inches of earthen material capable of sustaining native plant growth, for a total soil thickness of 2.5 feet.

Cell Berm Slopes. Cell separation/stormwater control berms will have 2 horizontal (H):1 vertical (V) interior slopes, and 3H:1V exterior slopes. At a minimum, their height must be 5 feet above the granular drainage material in the cell.

Interior Landfill Slopes. Interior landfill slopes separating the three major landfill sections and around the landfill perimeter will be a maximum 3H:1V.

Final Cover Slopes. For the interior slopes between the cells and the exterior final slopes, a maximum of 3H:1V side slopes will be used. Benching will be assumed at one bench every 30 feet in elevation, with at least one 12-foot-wide bench placed mid-slope when height exceeds 60 feet. For design purposes, an effective slope of

3.2H:1V was used, which accounts for minimum intermediate benching requirements by taking the average slope from top to toe including the benches.

Access Roads. It was assumed that access roads will have a maximum grade of 7 percent on straight stretches and 5 percent on curves. Haul roads will be a minimum of 30 feet wide (not including ditches) to accommodate 2-way traffic. Service roads should be 20 feet wide and have a maximum grade of 12 percent.

1.2 MSW Landfill Development Basis

1.2.1 Methodology for Developing Landfill Bottom Grading and Final Grading Plans

The general methodology below was used to develop the landfill development grading plans for the Central Landfill:

- Develop a perimeter berm road set back from the property line as necessary to provide the appropriate buffer distance and to allow the cut and fill slopes to catch the existing ground within the site property boundary.
- Develop interior berm roads between each phase to provide for access, surface stormwater drainage, and leachate conveyance pipes.
- Develop overall bottom grades for the landfill that are a minimum of approximately 10 feet above the regional groundwater elevation and that provide adequate slope for leachate collection.
- Develop an overall final grading plan to a permitted maximum elevation of 355 feet.
- Calculate the amount of soil excavation and embankment fill between the existing ground topography and the bottom grading plan for total landfill development.
- Calculate the total landfill volume (air space) between the bottom grading plan and the final grading plan.
- Calculate the total soil required for the bottom liner, final cover, and daily cover.
- Estimate the amount of surplus soil available for offsite use by deducting the total soil required for bottom liner, final cover, and daily cover from the net amount of soil excavated for total landfill development (that is, surplus soil from excavation).
- Develop cell sequencing plan and determine the limits of individual landfill cells to provide approximately 5 to 7 years of life in each cell based on an assumed solid waste growth rate.

1.2.2 Perimeter and Interior Berm Roads

To define the horizontal limits of the MSW landfill, a perimeter berm road alignment was established to maximize the available property and establish the limits for the landfill. The horizontal alignment was set back from the property boundary to ensure sufficient buffer distance from the edge of waste to the property boundary (300-foot buffer in residential and 100-foot buffer for non-residential), maintain space for existing landfill facilities (construction and demolition waste disposal, asbestos disposal, and stockpiles) in the northwest of the site, and to allow space for an approximate 34-acre treatment area in the west of the site. The perimeter berm road alignment can be seen in Figure 2. The road embankment outside cut and fill slopes (3H:1V) catch the existing ground within the site property boundary. An approximate minimum 400-foot turning radius was used for the perimeter berm road alignment to allow for two-way haul truck traffic based on a selected AASHTO 74-foot-long semitrailer turning geometry. The vertical alignment of the perimeter berm road allows drainage to flow generally from north to south. The vertical alignment results in a high point at an elevation of approximately 295 feet at the northwest and a low point at an elevation of approximately 215 feet at the southeast, with the perimeter berm road draining from both sides of the northwest high point down along east and west sides of the landfill to the southeast low point. Perimeter berm road and ditches maintain a minimum 1 percent flow slope. Maximum perimeter berm road grades are 7 percent along straight portions and 5 percent on curves. The typical perimeter berm road section consists of a 30-foot-wide roadway (2x 12-foot lane and 3-foot shoulder with 1.5 percent centerline crown), a 10-foot-wide 3H:1V slope v-ditch on both sides of the roadway, and a 10-foot-wide area for liner anchor trench construction.

To provide corridors for access, surface stormwater drainage, and leachate conveyance pipes, an interior north berm (running west-east) and interior east berm (running north-south) was established within the perimeter berm road footprint, as shown in Figure 2. The location of the interior berm roads were selected to convey flows to the low point to the south, partition the landfill for future landfill sequencing to keep northeast trailheads open until final development, and in general maximize existing soil excavation. The interior berm road width provides adequate space for a section similar to the typical perimeter berm road section. Specific ditch and anchor trench sizing should be developed during final design. The interior berm roads, along with the perimeter berm road, define three main landfill sections, the existing landfill area, Phase 1 area to the south, and the Phase 2 area to the east. The interior north berm road drains from west to east and the interior east berm drains from north to south to convey surface stormwater and leachate to the southeast low point.

1.2.3 Stormwater

Stormwater runoff from future cells is directed to the perimeter and interior berm road ditches. In general, stormwater flows to the low point at the southeast. Stormwater will be routed under the perimeter road via culvert to the outside of the landfill for infiltration into existing natural basins. Stormwater may also discharge to the outside of the landfill footprint at intermediate locations along the perimeter berm. Specific infiltration areas may need to be developed during final design. Additional stormwater discharge locations may need to be identified if, during detail design, the stormwater volume exceeds the ditch capacity.

1.2.4 Bottom Grading Plan

The bottom grading plan (Figure 2) was developed so that bottom grades for the landfill are a minimum of approximately 10 feet above the assumed regional groundwater elevation and provide adequate slope for leachate collection. Based on highest groundwater elevations measured on June 22, 2005, and March 11, 2014 (Shannon & Wilson, Inc., 2005; 2014), groundwater generally slopes from north to south, with approximate elevations ranging from 230 feet at the north to 125 feet at the south, as shown on Figure 1. Minimum landfill bottom grades were developed by projecting the assumed regional groundwater surface up 10 feet to meet the minimum 10-foot separation requirement. As such, the landfill bottom also slopes to the south and allows leachate to be collected and removed at the south side of each landfill phase. Bottom grading plan side slopes from perimeter and interior berm roads are 3H:1V down to each landfill phase bottom. The depth of the landfill bottom ranges from approximately 20 to 100 feet below the elevation of the perimeter berm road, with the shallowest depth at the northeast of landfill Phase 2 and the deepest depth at the southwest of landfill Phase 1. The landfill floor of each phase was developed to optimize the separation between high groundwater and the bottom of the landfill and, therefore, does not have a uniform grade. However, when each 5-year cell is developed, the grades for each cell can be generated uniformly provided they do not exceed the minimum separation depth between the groundwater and bottom of landfill.

1.2.5 Leachate Collection

The bottom grading plan allows future leachate collection systems to drain at a minimum of 1.5 percent. Leachate would be collected at the south side of each landfill section and removed from the landfill using pumps in each cell or series of cells. The pumps would discharge leachate into a leachate transmission pipe located in the perimeter and interior berm roads then to the leachate equalization lagoon at the 34-acre treatment area on the west side of the site, where it would be pumped to the proposed leachate treatment system.

1.2.6 Final Grading Plan

The final grading plan was developed with ridges running east-west at the maximum elevation of 355 feet. The northern ridge is generally located in the middle of the existing landfill area and northern portion of landfill Phase 2, and the southern ridge is in the middle of Phase 2 and the southerly portion of Phase 2. Final cover top grades slope down from either side of the ridges at 4 percent. As shown in Figure 3, the intermediate final grading plan fills the existing landfill area and landfill Phases 1 and 2 to the maximum elevation and leaves interior berm roads open for access and surface stormwater conveyance. Figure 4 shows the ultimate final grading plan, which fills over the interior berm roads left open in the intermediate final grading plan. The ultimate final grading plan develops two swales that drain final cover stormwater flows collected from the middle of the landfill to the east and west perimeter berm road. As filling over the interior berm roads will bury the leachate transmission pipes with as much as 120 feet of waste, provisions for accessing and maintaining these lines should be developed if the ultimate final grading plan is implemented.

Steeper final cover slopes were evaluated in order to further optimize the quantity of airspace available within the landfill. A preliminary geotechnical analysis was performed using the revised bottom liner and final cover grades (Appendix B). The analysis demonstrated that 3H:1V slopes meet the minimum factors of safety of 1.5 and 1.0 for static and seismic conditions; therefore, intermediate and ultimate final grading plan side slopes were modeled using this criterion. As shown on Figures 3 and 4, the slopes were modeled at an approximate effective 3.2H: 1V slope. This effective slope accounts for an actual final side slope of 3H:1V, which includes minimum intermediate benching requirements. The final grading plan with a maximum permitted elevation of 355 feet, and bottom grading plan with a minimum 10-feet groundwater separation, represents a maximized landfill development.

1.3 MSW Conceptual Development Results

1.3.1 Excavation and Airspace Volumes

Computer-aided engineering/computer-aided drafting software was used to prepare a digital terrain model design surface for the existing ground surface from the most recent available aerial topography. Digital terrain model design surfaces were also created for the bottom grading plan, including the perimeter and interior berm roads, and the final grading plan, both with and without the valley fills. These surfaces were used to compute the excavation and embankment volume between the existing ground and the bottom grading plan, the airspace between the bottom grading plan and the final grading plan, and the airspace in the valley fills.

The excavation and embankment volumes between existing ground and the landfill bottom grading plan (bottom of bottom liner) including the perimeter and interior berm roads are presented below:

Total Excavation (cut)	21,830,000 CY
Total Embankment (fill)	2,680,000 CY
Net Excavation	**19,150,000 CY**

The net excavation represents the volume of gravel that would be available for landfill liner and cover construction and daily cover. Surplus gravel remaining after these needs are met would be available for other offsite uses.

1.3.2 Development Scenario 1: Standard Landfill Bury and Compact, Airspace Volume and Soil Balance

The total air space volume between the landfill bottom-grading plan (bottom of bottom flexible membrane liner) and the final grading plan (top of final cover) with the valley fill is presented below. The bottom liner leveling course was excluded from the computations because it lies immediately below the bottom of the bottom liner system. The final cover leveling course was also excluded from the computations assuming that the final daily/intermediate cover could be used as the leveling course. The following is a summary of volumes:

Landfill Air Space with Valley Fills	59,354,000 CY
Bottom Liner Volume (2.0 feet thick)	855,000 CY
Final Cover Volume (2.0 feet thick)	942,000 CY
Net Air Space with Valley Fills	**57,557,000 CY**

The population, MSW disposal, air space, and cover soil requirements forecast table indicates that this air space volume provides landfill capacity for approximately 40.9 million tons of waste and would last into year 2168. Cover soil, liner, and final cover soil requirements for this waste volume are presented below:

Cover Soil	7,974,000 CY
Bottom Liner Soil (2 feet)	855,000 CY
Bottom Liner Leveling Soil (0.5 feet)	214,000 CY
Final Cover Soil	942,000 CY
Total Soil Requirement	**9,985,000 CY**

The net soil balance for the final grading plan with the valley fills is shown below:

Net Excavation	19,150,000 CY
Total Soil Requirement	9,985,000CY
Net Soil Surplus	**9,165,000 CY**

The conceptual development plan with the valley fills results in a net soil surplus of about 9.2 million CY. This volume of soil could be removed for offsite uses over the course of the landfill life.

1.3.3 Development Scenario 2: Waste to Energy in Year 2040, Airspace Volume and Soil Balance

With the waste to energy option, the total airspace volume remains the same as noted above, for a net air space of 59,354,000.

The population, MSW disposal, air space, and cover soil requirements forecast table indicates that the air space volume provides landfill capacity to accept an equivalent of 399,500,000 tons of waste and would last into year 2317. Note, the quantity of waste would be reduced by about 90 percent when the waste to energy system begins operation. While the tonnage that can be processed is relatively high, the resulting airspace is substantially reduced. The following are the total soil requirements with the valley fills:

Cover Soil	21,500,000 CY
Bottom Liner Soil (2 feet)	855,000 CY
Final Cover Soil	942,000 CY
Total Soil Requirement	**23,297,000 CY**

For the final grading plan with the valley fills, the net soil balance would be as follows:

Net Excavation	19,150,000 CY
Total Soil Requirement	23,297,000 CY
Net Soil Deficiency	**(4,147,000) CY**

The additional daily cover soil needed to cover the ash results in a net soil deficiency of about 4.2 million CY. Note that projecting this far into the future (past year 2300) is generally inaccurate and the results should be considered general level of magnitude.

1.4 Municipal Solid Waste Landfill Cell Sequencing Plan

The cell sequencing plan was developed so that the next new cell would be located east of existing cells, which would then proceed immediately to the south, then to the west. Cells 4 through 7 will be developed east of Cell 3. Once these cells are filled, operations will move to the south into the Phase 1 development area starting with Cell 8, where subsequent cells will proceed south in rows from east to west. Each cell will be developed and closed in numerical order. Cells in the Phase 2 development area would be developed after those in Phase 1 are completed in order to preserve the trail system along the eastern portion of the property as long as possible. The Phase 2 development would start with Cell 25, then continue north, ending with Cell 29.

1.4.1 Methodology for Cell Sequencing

The perimeter and interior berm roads will form the boundary of the some of the future cells in the Phase 1 and Phase 2 areas. Other cell boundaries were established to provide enough air space capacity in each cell for approximately 5 to 7 years of landfill operation.

1.4.2 Cell Sequencing Plan

The sequencing plan is shown in Figure 5. The currently active cell is Cell 3. Cells 4 through 7 are east of the existing landfill. Landfill Phase 1 development comprises Cells 8 through 24; Landfill Phase 2 development comprises Cells 25 to 29.

1.4.3 Cell Capacity and Service Life

The capacity of each cell without the valley fills and the year in which each would be filled are presented in Table 1-4. The scenario with valley fills would provide approximately 4 additional years of airspace.

TABLE 1-4
Matanuska-Susitna Borough Central Landfill Development Plan without Valley Fills
Matanuska-Susitna Borough Central Landfill Development Plan

Cell Number	Waste and Cover Soil Volume (CY)	Average Annual Waste and Soil Volume (CY)	Start Date	End Date	Cell Life (Years)
LANDFILL SECTION 1					
3	848,000	95,400	May 2013	August 2022	9
4	495,000	116,700	August 2022	February 2027	5
5	580,000	126,339	February 2027	October 2031	5
6	567,000	136,500	October 2031	February 2036	5
7	1,114,000	149,800	February 2036	July 2043	7
LANDFILL SECTION 2					
8	924,000	167,800	July 2043	April 2049	6
9	865,000	181,300	April 2049	March 2054	5
10	863,000	188,700	March 2054	December 2058	5
11	1,300,000	209,200	December 2058	May 2065	6
12	1,109,000	224,700	May 2065	June 2070	5
13	1,245,000	241,000	June 2070	September 2075	5
14	1,235,000	259,800	September 2075	July 2080	5
15	2,074,000	285,700	July 2080	January 2088	7
16	1,423,000	310,600	January 2088	September 2092	5
17	1,519,000	330,800	September 2092	May 2097	5
18	1,778,000	355,400	May 2097	June 2102	5
19	2,001,000	387,700	June 2102	October 2107	5
20	2,057,000	412,900	October 2107	November 2112	5
21	2,206,000	445,000	November 2112	December 2117	5
22	2,333,000	486,500	December 2117	November 2122	5
23	3,073,000	521,000	November 2122	December 2128	6
24	3,277,000	577,400	December 2128	November 2134	6

TABLE 1-4
Matanuska-Susitna Borough Central Landfill Development Plan without Valley Fills
Matanuska-Susitna Borough Central Landfill Development Plan

Cell Number	Waste and Cover Soil Volume (CY)	Average Annual Waste and Soil Volume (CY)	Start Date	End Date	Cell Life (Years)
LANDFILL SECTION 3					
25	2,956,000	628,800	November 2134	October 2139	5
26	3,933,000	665,000	October 2139	October 2145	6
27	4,279,000	728,500	October 2145	November 2151	6
28	4,655,000	796,900	November 2151	November 2157	6
29	5,297,000	879,700	November 2164	November 2164	6
TOTAL	**47,946,389**		**2013**	**2164**	**151**

SECTION 2

Onsite Leachate Management

2.1 Leachate Volumes

A preliminary evaluation of leachate generation was performed using the Hydrologic Evaluation Landfill Performance (HELP) model. The HELP model was developed by the U.S. Army Engineer waterways Experimental Station for the U.S. Environmental Protection Agency (EPA) and has been in use since 1984.

The HELP model is a quasi-two-dimensional hydrogeologic water balance model developed specifically to perform municipal landfill evaluations. Weather, soil, and design data representative of the MSB Landfill were entered into the model. The HELP model uses solution techniques that account for the effect of surface storage, snow melt, surface runoff, infiltration, evapotranspiration, vegetative growth, soil moisture storage, lateral subsurface drainage, leachate recirculation (if any) unsaturated vertical drainage, and leakage through soil, geomembrane, or composite liners.

The HELP model was used to estimate leachate production at the end of the estimated 20-year design life for the treatment system. This corresponds to the estimated leachate flow from Cells 4-7 in 2035. A summary of the HELP model results is included in Appendix D. Table 2-1 summarizes the estimated annual historical leachate generation rates together with 2035 design volume.

TABLE 2-1
Actual and Estimated Leachate Generation (2035) at Central Landfill
Matanuska-Susitna Borough Central Landfill Development Plan

Year	Cells Open	Actual Annual Leachate Generation (gallons)
2005	2B	339,080
2006	2B	258,082
2007	2B	284,000
2008	2B	420,000
2009	2B, 3	600,250
2010	2B, 3	1,015,286
2011	2B, 3	1,106,395
2012	2B, 3	1,650,942
2013	2B, 3	1,645,772
		Estimated Annual Leachate Generation (gallons)
2035	6, 7	3,400,000

Adding a 20 percent factor of safety on the HELP estimate to account for peak periods yields a total annual leachate generation of approximately 4,000,000 gallons. The estimated average flow of leachate was estimated at 11,000 gallons per day (gpd) (but could be as high as 13,000 gallons if higher rainfall data from the last 2 years is taken into account), while the projected peak flow (based on 24-hour/25-year storm and newly opened cell) could reach 450,000 gpd (312 gallons per minute).

An average flow of 13,000 gpd was used to estimate the mass loading for onsite leachate treatment, while peak flow was used to determine the required equalization/storage volume.

2.2 Leachate Influent Characteristics and Effluent Limits

Leachate will collect a variety of dissolved organic and inorganic contaminants resulting from the dissolution and degradation of the MSW. The characteristics of leachate will vary over time and characteristics will change with the composition of the waste, age and degree of compaction. The concentrations of chemicals detected will vary dependent on the age of landfill, amount of annual precipitation, and landfill operation methods (leachate recirculation or bioreactor landfill).

MSB landfill leachate characterization data for 2012 and 2013 is summarized in Table 2-2 below. A detailed characterization report is included in Appendix E. The last 2 years of characterization data are evaluated because they are related to current waste placement operations in Cell 3, with the highest strength leachate concentrations. This table does not include all the regulated metals because only zinc exceeded the discharge permit limits from the Anchorage Water and Wastewater Utility (AWWU). Table 2-2 also shows the current AWWU permit discharge limits for the leachate generated at the site.

TABLE 2-2
Historical Leachate Characteristics and Current AWWU Discharge Limits
Matanuska-Susitna Borough Central Landfill Development Plan

Parameter	BOD mg/L	TSS mg/L	pH	O&G mg/L	Zinc mg/L
2012					
March	477	348	7.1	57.9	0.244
June	15,200	260	6.3	104	1.39
September	49	124	6.7	5.1	0.05
December	23,300	130	6.2	128	6.56
2013					
March	21,100	140	6.5	97	3.36
June	15,300	510	6.3	40.1	5.27
September	10,800	215	6,6	99.8	2.37
December	24,300	487	6,5	90.6	8.13
Permit Limits	**n/a**	**n/a**	**>5 & <12.5**	**250**	**5.62**

Notes:
BOD = biochemical oxygen demand
mg/L = milligrams per liter
n/a = not available
O&G = oil and grease
TSS = total suspended solids

Data in Table 2-2 is only for parameters currently monitored in MSB's groundwater monitoring program.

Other parameters of interest to onsite treatment are not measured routinely. Those parameters were extracted from typical values listed in the literature and summarized in Table 2-3. For example, the importance of hardness and other related compounds may be important in selecting the materials of construction for leachate storage and transmission, while ammonia, nitrogen, and phosphorus are critical for the biological type system. Additional importance is related to the fact that treated effluent (biological system) will be discharged to ground and therefore nitrate content becomes a critical parameter in the effluent.

It is recommended that a complete scan of characterization be conducted before detailed design of any treatment system.

TABLE 2-3
Typical Leachate Characteristics Reported in the Literature
Matanuska-Susitna Borough Central Landfill Development Plan

Parameter	New Landfill (less than 2 years) Range	New Landfill (less than 2 years) Typical	Mature Landfill (more than 10 years)
pH	4.5 – 7.5	6	6.6 -7.5
BOD	2,000 – 30,000	10,000	100 - 200
COD	3,000 – 60,000	18,000	100 - 500
TOC	1,500 – 20,000	6,000	80 - 160
TSS	200 -2,000	500	100 - 400
TDS	2,000 – 10,000	6,000	>10,000
Chloride	200 – 3,000	500	100 - 400
Sulfate	50 – 1,000	300	20 - 50
Organic Nitrogen	10 - 800	200	80 - 120
Nitrate	5 - 40	25	5 - 10
Total phosphorus	5 - 100	30	5 - 10
Orthophosphates	4 - 80	20	4 - 8
Alkalinity	1,000 – 10,000	3,000	200 – 1,000
Total hardness	300 – 10,000	3,500	200 - 500
Calcium	200 – 3,000	1,000	100 - 400
Magnesium	50 – 1,500	250	50 - 200
Potassium	200 – 1,000	300	50 - 400
Sodium	200 – 2,500	500	100 - 200
Total Iron	50 - 1,200	60	20 - 200

Notes:
COD = chemical oxygen demand
TOC = total organic carbon
TDS = total dissolved solids

Source: Handbook of Solid Waste Management, Tchobanoglous, Kreith, Second Edition, 2002

CH2M HILL conducted research on regulatory criteria and held a meeting on July 17, 2014, with MSB and the Alaska Department of Environmental Conservation (ADEC) wastewater division staff to confirm compliance criteria. A meeting summary is included in Appendix F. ADEC advised that for planning purposes, CH2M HILL and MSB should use the more stringent of the drinking water standards (18 AAC 80) and water quality standards (18 AAC 70) for both septage and leachate. CH2M HILL has assembled these standards in Table 2-4. It was generally agreed that the point of compliance could be set at groundwater monitoring wells at the downgradient property boundary.

TABLE 2-4
Onsite Treatment Compliance Criteria for Planning Purposes
Matanuska-Susitna Borough Central Landfill Development Plan

Pollutant	Type of Pollutant	mg/L	Notes	Limit Source	Hardness Dependent Resulting Most Stringent Criterion*
Alachlor	PEST	0.002		AK WQ	
Aldicarb	PEST	0.003		AK WQ	
Aldicarb Sulfone	PEST	0.002		AK WQ	
Aldicarb Sulfoxide	PEST	0.004		AK WQ	
Ammonia	INORG		pH and temperature dependent		
Antimony	INORG	0.006		AK WQ	
Arsenic*	INORG	0.010		ADEC WQS	Drinking water standard
Asbestos	INORG	0.007	million fibers/ liter (for fibers longer than 10 micrometers)	AK WQ	
Atrazine	PEST	0.003		AK WQ	
BOD		TBD		TBD	
Barium	INORG	2.000		AK WQ	
Benzene	VOC	0.005		AK WQ	
Benzo(a)Pyrene	SVOC	0.000		AK WQ	
Beryllium	INORG	0.004		AK WQ	
Bromate	DBP	0.010		AK WQ	
Cadmium*	INORG	0.000		AK WQ	Chronic Aquatic Life criteria
Carbofuran	PEST	0.040		AK WQ	
Carbon Tetrachloride	VOC	0.005		AK WQ	
Chlordane	PEST, SVOC	0.002		AK WQ	
Chlorides	INORG	<250mg/L		18 AAC 70	
Chromium (total)	INORG	0.100	total recoverable	AK WQ	
Chromium (III)*	INORG	0.067		ADEC WQS	Chronic Aquatic Life criteria
Chromium (VI)*	INORG	0.011		ADEC WQS	Chronic Aquatic Life criteria
Copper*	INORG	0.007		ADEC WQS	Chronic Aquatic Life criteria
Cyanide (as free cyanide, as CN/l)	INORG	0.200		AK WQ	
Dalapon	PEST	0.200		AK WQ	
Dibromo-chloropropane	PEST	0.000		AK WQ	
Dichlorobenzene 1,2-	VOC, SVOC	0.600		AK WQ	
Dichlorobenzene 1,4-	VOC, SVOC	0.075		AK WQ	
Dichloroethane 1,2-	VOC	0.005		AK WQ	
Dichloroethylene 1,1-	VOC	0.007		AK WQ	

TABLE 2-4
Onsite Treatment Compliance Criteria for Planning Purposes
Matanuska-Susitna Borough Central Landfill Development Plan

Pollutant	Type of Pollutant	mg/L	Notes	Limit Source	Hardness Dependent Resulting Most Stringent Criterion*
Dichloroethylene cis-1,2-	VOC	0.070		AK WQ	
Dichloroethylene trans-1,2-	VOC	0.100		AK WQ	
Dichlorophenoxy 2,4-Acetic Acid (2,4-D)	PEST	0.070		AK WQ	
Dichloropropane 1,2-	VOC	0.005		AK WQ	
Di(2-ethylhexyl) Adipate	OOC	0.400		AK WQ	
Di(2-ethylhexyl) Phthalate	SVOC, OOC	0.006		AK WQ	
Dioxin (2,3,7,8-TCDD)	OOC	0.000		AK WQ	
Diquat	PEST	0.020		AK WQ	
Endothall	PEST	0.100		AK WQ	
Endrin	PEST, SVOC	0.002		AK WQ	
Ethylbenzene	VOC	0.700		AK WQ	
Ethylene Dibromide	PEST	0.000		AK WQ	
Fecal Coliform	MICROORG	<3FC/100 mL	30 day mean, MPN Technique	18 AAC 70	
Fluoride	INORG	4.000		AK WQ	
Glyphosate	PEST	0.700		AK WQ	
Gross alpha	RAD	0.015	(pCi/l)	AK WQ	
Gross beta	RAD	0.004	millirems	AK WQ	
Heptachlor	PEST, SVOC	0.000		AK WQ	
Heptachlor Epoxide	PEST, SVOC	0.000		AK WQ	
Hexachloro-benzene	SVOC	0.001		AK WQ	
Hexachloro-cyclopentadiene	SVOC	0.050		AK WQ	
Lead*	INORG	0.002		ADEC WQS	Chronic Aquatic Life criteria
Lindane (gamma-BHC)	PEST, SVOC	0.000		AK WQ	
Mercury*	INORG	0.001		ADEC WQS	Chronic Aquatic Life criteria
Methoxychlor	PEST	0.040		AK WQ	
Methylene Chloride (Dichloromethane)	VOC	0.005		AK WQ	
Monochloro-benzene	VOC	0.100		AK WQ	
Nickel*	INORG	0.040		ADEC WQS	Chronic Aquatic Life criteria
Nitrate (as nitrogen)	INORG	10.000		AK WQ	
Nitrite (as nitrogen)	INORG	1.000		AK WQ	

TABLE 2-4
Onsite Treatment Compliance Criteria for Planning Purposes
Matanuska-Susitna Borough Central Landfill Development Plan

Pollutant	Type of Pollutant	mg/L	Notes	Limit Source	Hardness Dependent Resulting Most Stringent Criterion*
Total Nitrate and Nitrite (as nitrogen)	INORG	10.000		AK WQ	
Oil & Grease		No visible sheen		18 AAC 70	
Oxamyl (Vydate)	PEST	0.200		AK WQ	
pH		>6, <8.5			
Pentachloro-phenol	PEST	0.001		AK WQ	
Picloram	PEST	0.500		AK WQ	
Polychlorinated Biphenyls (PCBs)	SVOC	0.001		AK WQ	
Radium-226 and -228 (combined)	RAD	0.005	(pCi/l)	AK WQ	
Selenium	INORG	0.050	ADEC Toxics book says more information is needed to determine most stringent criteria	AK WQ	
Simazine	PEST	0.004		AK WQ	
Silver*	INORG	0.002		ADEC WQS	Acute Aquatic Life criteria
Strontium-90	RAD	0.008	(pCi/l)	AK WQ	
Styrene	OOC	0.100		AK WQ	
Sulfates	INORG	<250mg/L		18 AAC 70	
TDS		<500mg/L		18 AAC 70	
TSS		0.015		CH2M HILL, 2006	
Tetrachloro-ethylene	VOC	0.005		AK WQ	
Thallium	INORG	0.002		AK WQ	
Toluene	VOC	1.000		AK WQ	
Toxaphene	PEST	0.003		AK WQ	
Trichlorobenzene 1,2,4-	SVOC	0.070		AK WQ	
richloroethane 1,1,1-	VOC	0.200		AK WQ	
Trichloroethane 1,1,2-	VOC	0.005		AK WQ	
Trichloro-ethylene	VOC	0.005		AK WQ	
Trichloro-phenoxy 2,4,5-)-Propionic Acid (2,4,5-TP)	PEST	0.050		AK WQ	
Tritium	RAD	20.000	(pCi/l)	AK WQ	
Uranium	RAD	0.030		AK WQ	
Vinyl Chloride	VOC	0.002		AK WQ	

TABLE 2-4
Onsite Treatment Compliance Criteria for Planning Purposes
Matanuska-Susitna Borough Central Landfill Development Plan

Pollutant	Type of Pollutant	mg/L	Notes	Limit Source	Hardness Dependent Resulting Most Stringent Criterion*
Xylenes (total)	VOC	10.000		AK WQ	
Zinc*	INORG	0.093		ADEC WQS	Acute Aquatic Life criteria

Notes:

* Hardness dependent limits. Assumed average hardness of 74 mg/L for calculation of the limits. If this changes, recalculate limits in "ADEC WQS" and re-evaluate most stringent criterion.

Metal limits shown as "total recoverable": There are no direct effluent limits for BOD and TSS, but dissolved oxygen and turbidity would be measured at downgradient monitoring wells.

18 AAC 70 = Water Quality Standards, Fresh Water Uses, (A) Water Supply, (i) Drinking, Culinary, & Food Processing

ADEC WQS = Alaska Department of Environmental Conservation Water Quality Standards

AK WQ = Alaska Water Quality Criteria Manual for Toxic & Other Deleterious Organic and Inorganic Substances

INORG = inorganic
OOC = organochlorine compound
PEST = pesticide
RAD = radiation units
SVOC = semivolatile organic compound
VOC = volatile organic compound

These drinking water limits were generated using a guidance information provided by the ADEC and would apply at the point of compliance in groundwater monitoring wells at the property boundary. Because attenuation would occur between the point of discharge and the point of compliance, the end of pipe limits may be higher than the drinking water limits. CH2M HILL recommends modeling be conducted to estimate the required end of pipe limits.

It is recommended to execute a detailed characterization of the leachate once the final treatment option is selected.

2.3 Onsite Leachate Biological Treatment

CH2M HILL prescreened several leachate treatment options before selecting the most viable from technical and economical point of view. The onsite leachate treatment option that was recommended in 2006 (anaerobic bioreactor, aerobic lagoon, and wetland polishing) was analyzed for potential update for the current basis of design conditions, but was rejected because of high costs and inability to meet today's more stringent discharge requirements. Specifically, it was anticipated that the performance of standard surface flow treatment wetlands in winter would not meet the discharge criteria at the expected flow rates.

Additionally, advancements in the wastewater treatment technology have made other treatment options technically and economically feasible, as seen throughout many installations in US and abroad. CH2M HILL selected membrane bioreactor (MBR) for further evaluation, leachate treatment only, for the following reasons:

- Small footprint of the system
- System flexibility with changing influent conditions
- Need to ensure full nitrification/denitrification and produce effluent below 10 mg/L of nitrates and low turbidity levels

Today many manufacturers offer packaged MBR systems, capable to be housed in a small building, and providing healthy competition among vendors. The choice of packaged MBR system was based on the following advantages:

- Factory pre-assembled, which reduces on-site assembly time and costs
- Skid mounted for quick installation
- Factory tested for reliable system start-up and commissioning
- Space-saving compact design
- Pre-programmed control system for reliable operation and system troubleshooting
- User-friendly touch screen Human-Machine Interface for easy operation
- High-quality ancillary components for long lasting performance and minimal maintenance

The proposed two trains of MBR system will have the following components:

- Influent 2-millimeter rotary drum screen with re-screening system for improved membrane life
- Anoxic/Aerobic suspended growth-activated sludge biological treatment system for BOD removal, nitrification, and denitrification
- Hollow fiber, submerged membrane filtration for liquid solids separation
- Chemical-cleaning dosing skids
- Automation, control, and monitoring systems

Biological sludge produced by the system will be dewatered by natural system in the initial years (Geotubes® and sludge storage in dedicated area of the landfill until spring thaw), and in the final years (space provided in the building) by centrifuge. Further optimization of the dewatering approach could be explored during detailed design, if biological treatment is the selected leachate management approach.

2.4 Onsite Leachate Evaporation

Evaporation is very effective at reducing the volume of leachate. The most common type of leachate evaporation process is single stage flash evaporation. In this process the liquid mixture is heated and enters a flash chamber at a reduced pressure. The liquid partially vaporizes and the vapor comes to equilibrium with the residual liquid at the new lower temperature and pressure. The resulting liquid product is referred to as concentrate. The concentrate can be placed back into the waste mass of the landfill under the MSB's EPA Research, Development and Demonstration permit, which allows the placement of free liquids into the landfill.

An advantage of the evaporation process is the ability to reduce large volumes of leachate to more manageable quantities. Typically the footprint for an evaporation treatment system is small compared to other treatment systems.

In order to determine more precisely the size of the system, percentage of feasible leachate reduction, power requirements, and likelihood of scale formation, a sample of MSB leachate was tested. Boil testing indicated that volume reduction via evaporation could be as high as 96 percent (Appendix G). Testing also confirmed the need to address scaling and foaming. Consequently, the addition of an anti-foaming system is recommended. Additionally, higher-grade materials of construction are recommended to minimize impacts of scaling as the age of the landfill increases.

Table 2-5 summarizes the selected values for the design of the evaporation system evaluated in this study.

TABLE 2-5
Design Parameters for Leachate Evaporation
Matanuska-Susitna Borough Central Landfill Development Plan

Parameter	Flow gpd: 13,000	mg/L	lbs/day
BOD5 (2030)		13,000	1,407
TSS (2015)		500	36.8
TSS (2030)		500	54.1
NH4-N (2015)		288	21.2
NH4-N (2030)		260	28.1
TKN (2015)		474	34.9
TKN (2030)		304	32.9
TP (2015)		30	2.2
TP (2030)		30	3.2
PO4 (2015)		20	1.5
PO4 (2030)		20	2.2
Alkalinity (2015)		1,000	74
Alkalinity (2030)		1,000	108
Temperature (C)	15		

The selection of two identical evaporation systems, each one treating half of the leachate flows in 2035, was guided by several factors, including:

- Ability to service anyone of the two units while the second is operating
- Adaptability to lower initial leachate flows

The selected identical evaporators include the following components and accessories:

- Leachate Feed Holding Tank
- Air Diaphragm Feed Pump
- Holding Tank low level shutoff
- Two identical Evaporators (easy cleaning cycle of each one allows
- High temperature Exhaust Stack
- Digital Combustion Analysis Kit
- Auto-Dump/Auto-Restart
- Residue Holding Tank
- Residue Pumps (air diaphragm)
- Anti-Foam System
- Foam-Away Drums (startup)
- Ethernet Hub that allows for remote connection to PLC by Vendor Service Engineers

- On-board diagnostics that monitor level controls for correct operation and system shutdown
- Display scrolls showing Fluid Temperature, Air Temperature, and Mist Pad Pressure
- Normal operation and alarm conditions are displayed on interface panel as text messages
- Gas volume meter to monitor system throughput
- Mist Eliminator System to capture entrained water droplets
- Pressure Differential Sensor that is interfaced to the PLC to monitor the condition of the Mist Eliminator Pad, which will shut down the system when the pad requires cleaning
- Primary Low-Low Liquid Level shutdown of heat source with tuning fork level probe
- Redundant Low-Low liquid level shutdown with thermocouple and temperature controller
- High Auto Liquid Level to initiate and stop fill sequence
- High-High Liquid Level shutdown, which serves as redundancy for High AutoFill Level
- Insulation rated at up to 450F on all six sides
- Outer Skins constructed of 304 Stainless Steel (inner body Molybdenum alloys)
- Front panel Oil Weir and Decanting System
- Control Panel that meets NEMA 4 and UL standards; panel includes easy-to-read display with text messaging and digital display on temperature controllers
- Forced Draft Burner configuration to prevent flame impingement on the heat exchanger(s)

2.5 Evaluation of Leachate and Septage Co-treatment

Leachate and septage co-treatment was also evaluated. The basis of design of the co-treatment facility is a combination of the data on leachate characteristics from Table 2-1 and pretreated septage characteristics from the HDR Alaska study on regional septage treatment facility (Appendix H). The proposed co-treatment system was evaluated based on data from Table 2 of HDR report (2030 pretreated septage flows and loading). Septage and leachate co-treatment was evaluated based on data summarized in Table 2-6.

The proposed treatment system is a sequencing batch reactor (SBR). The SBR system has inherent simplicity (all unit process steps occur within the reactors), and the need for secondary clarifiers and a sludge recycle system are eliminated. The system offers high flexibility since the process steps are controlled by time (treatment step durations can be field adjusted to match plant operation with current hydraulic and organic loads). The flexible treatment steps allow the operator more process control than conventional systems that used fixed anoxic and aerobic volumes.

Combining both pre-treated septage and leachate has the beneficial effect of reducing the strength of the leachate, and thus providing better conditions for treatment. The SBR system would be enclosed in a building, eliminating the potential negative impact of the winter temperatures.

TABLE 2-6
Basis of Design Septage/Leachate Co-Treatment
Matanuska-Susitna Borough Central Landfill Development Plan

	Combined Septage & Leachate					
		Summer/Fall			Winter/Spring	
Parameter	**Flow gpd**	**mg/L**	**lbs/day**	**Flow gpd**	**mg/L**	**lbs/day**
2015	**161,836**			**49,436**		
2030	**250,994**			**85,053**		
BOD5 (2015)	613	1,182	1,594	187	2,043	841
BOD5 (2030)		1,147	2,398		1,819	1,288
TSS (2015)		500	674		500	206
TSS (2030)		500	1,045		500	354
NH4-N (2015)		41	84.9		67	27.4
NH4-N (2030)		61	127.2		62	44.3
TKN (2015)		88	119.0		94	38.8
TKN (2030)		68	141.9		80	56.8
TP (2015)		21	27.7		21	8.5
TP (2030)		21	42.9		12	8.5
PO4 (2015)		15	20.6		15	6.3
PO4 (2030)		15	31.9		15	10.8
Alkalinity (2015)		548	739		664	273.6
Alkalinity (2030)		547	1,143		550	389.9
Temperature (^{0}C)	15			8		

Slug feed control strategy to maximize aeration cycle time (65 percent) and reduce basin footprint as much as possible, considering this SBR will be housed indoors. The system will handle the maximum hydraulic requirements as well as the effluent requirements at the conditions specified in Table 2-6 for the combined septage and leachate.

The proposed SBR system will have the following components:

- Three tank SBR system with jet aeration (50 x 30 x 16 foot)
- Three jet recirculation pumps and one common spar
- Three waste activated sludge pumps and one common spare
- Four Blowers (one as a spare)
- One set of valves, which will allow for pump isolation and vac-flush
- Three Vari-Cant jet aeration headers with 12 Model 40 jet aerators per header
- Three decanters
- Three Influent distribution manifolds
- Three sludge collection manifolds

- In-basin air and liquid piping
- 304 stainless steel supports and mounting hardware
- Instrumentation & controls
- Centrifuge dewatering system (1,580 lbs/day solids) including all associated accessories and conditioning chemical system
- Sludge co-disposal with MSW at the Central Landfill

A proposed location for the septage treatment facility is shown on Figure 2. Septage would be truck hauled to the facility and received and pre-treated as described in Appendix H. Leachate would be pumped to the septage treatment facility and combined with pre-treated septage prior to the SBR biological treatment. Treated effluent would be discharged to ground via buried leach field, compliance would be monitored in groundwater monitoring wells at the property boundary.

In 2005, the annual leachate flow of 339,000 gallons (Table 2-1) was approximately 3 percent of the estimated 13,600,000 gallons of septage generated within MSB in that same year (Appendix H). The estimated annual leachate flow in 2035 of 4,000,000 gallons (Table 2-1) is approximately 10 percent of the estimated 38,000,000 gallons estimated within MSB in 2030 (Appendix H). At these low percentages, the higher strength leachate is not expected to cause problems for the biological treatment.

TABLE 2-7
Summary of Co-Treatment and Separate Leachate and Septage Treatment
Matanuska-Susitna Borough Central Landfill Development Plan

	Advantages	Disadvantages	Cost (millions) [a]	Required Land (acres)
Separate Leachate and Septage Treatment	Lower cost to MSB SWD Operational control	Higher overall cost and additional facility for MSB to maintain	$60.4 [b]	30
Leachate and Septage Co-treatment	Treats two waste streams together	Possible more stringent discharge criteria with the addition of leachate	$40.9	25

Note:

[a] Total present value of capital and 20 years of annual operations and maintenance (Section 2.6 and Appendix I).

[b] Sum of total present value for leachate evaporation and septage SBR. Septage SBR costs from HDR, 2013 (Appendix H). Annual O&M costs were increased to $1M based on CH2M HILL experience.

2.6 Cost Analysis for Onsite Leachate Management

Table 2-8 shows an analysis of present value (PV) of capital and operations and maintenance (O&M) costs for three onsite leachate management options: 1) evaporation (leachate only), 2) MBR biological treatment (leachate only), and 3) SBR co-treatment (septage and leachate). Costs for septage SBR treatment are included for comparison. It is assumed that this project would be eligible for Alaska Clean Water Loan with an interest rate of 1.5 percent. Cost estimate details are provided in Appendixes H and I.

TABLE 2-8
Summary of Leachate Treatment Cost Analysis
Matanuska-Susitna Borough Central Landfill Development Plan

Option	Capital Cost (Millions)	Annual O&M Cost (Millions)	PV of O&M Costs (20 years) (Millions)	Total PV (Millions)
Leachate Evaporation	$3	$1.4	$23.2	$26.2
Leachate MBR	$16	$1.0	$17.0	$33.0
Septage SBR [a]	$17	$1.0	$17.2	$34.2
Septage and Leachate SBR	$19	$1.3	$21.9	$40.9

[a] Septage SBR costs from HDR, 2013 (Appendix H). Annual O&M costs were increased to $1M based on CH2M HILL experience.

2.7 Conclusions and Recommendations for Onsite Leachate Management

CH2M HILL recommends that the MSB co-treat leachate and pre-treated septage using SBR biological treatment. We understand that the MSB is planning to build a septage treatment facility somewhere within the MSB and is targeting MSB land. Sufficient land is available at the landfill, and locating this facility at the centrally located landfill should minimize the transport cost for haulers. It is logical and feasible to co-treat these waste streams.

If the current leachate disposal at the AWWU becomes unavailable before the proposed MSB septage treatment facility is constructed, then we recommend evaluation of other interim offsite treatment options.

If the septage facility is not located at the landfill, then we recommend evaluating the costs of hauling leachate to the septage facility for co-treatment versus costs of construction and operation of an onsite leachate evaporator. Construction of both the septage treatment facility and the leachate evaporator at the landfill is not recommended because it would be redundant.

SECTION 3

Closure Fund Contribution

The CH2M HILL team calculated the required closure fund contribution to ensure that there are adequate funds available for closure and post-closure with a zero balance at the end of the period. The contribution is targeted so that the annual contribution is the same each year on a dollar per ton basis in real terms (that is, the contribution increases each year along with forecast inflation). An abbreviated summary of closure and post-closure costs (through 2024) is shown in Table 3-1. The assumed scope and cost estimate for closure is included in Appendix J. The complete table of closure contributions is included in Appendix K.

TABLE 3-1
Calculation of Closure Fund Contributions
Matanuska-Susitna Borough Central Landfill Development Plan

Year	Closure Cost	Post-Closure Cost	Closure Fund Contribution	End-Year Closure Fund Balance	Per-ton Contribution	Per-ton Contribution (2014$)
2014	$0	$0	$9,562	$3,934,996	$0.16	$0.16
2015	$0	$0	$10,034	$4,063,230	$0.16	$0.16
2016	$0	$0	$10,529	$4,195,814	$0.17	$0.16
2017	$0	$0	$11,049	$4,332,903	$0.17	$0.16
2018	$0	$0	$11,584	$4,474,647	$0.17	$0.16
2019	$0	$0	$12,144	$4,621,213	$0.18	$0.16
2020	$0	$0	$12,732	$4,772,772	$0.18	$0.16
2021	$0	$0	$13,348	$4,929,503	$0.19	$0.16
2022	$0	$0	$13,994	$5,091,591	$0.19	$0.16
2023	$0	$0	$14,666	$5,259,224	$0.20	$0.16
2024	$0	$0	$15,370	$5,432,601	$0.20	$0.16

Estimated costs, in 2014 dollars, are as follows. Closure costs, including contingency, administration, and technical and professional expenses, are approximately $17.3 million. Annual post-closure maintenance and monitoring costs are $175,000, and there is a $37,000 charge for post-closure certification anticipated in 2200, the last year of post-closure.

The following key assumptions formed the basis of the analysis:

- Annual inflation: 2.4 percent
- Annual interest on invested funds: 3.0 percent
- Current fund balance: $3,876,843 as of June 30, 2014
- Year of closure: 2170
- Post-closure period: 2071 to 2200

Given these assumptions, CH2M HILL determined that the required closure fund contribution in 2014 is $9,562, which corresponds to $0.16 per ton. Annual costs, contributions, fund balances, and per-ton contributions are shown in Appendix K.

SECTION 4

Evaluation of Methane Capture and Recovery

4.1 Site Background and Operations

The Central Landfill is a Class I landfill under ADEC Solid Waste Regulations (18 AAC 60), owned and operated by the MSB. Figure 1 shows the existing conditions and layout of the landfill.

Cells 1 and 2A are unlined disposal cells that were initially placed into operation in the 1980s. Cell 1 was closed in 1988, and Cell 2A was operated until late 2003. A partial final closure project will close Cell 2A in 2014. Cell 2B, a lined disposal cell, was operated from 2004 until late 2008, and currently has interim cover. The MSB operated lined Cell 3 Phase 1 from late 2008 until late 2010, and is now operating in lined Cell 3 Phase 2.

The Central Landfill does not have an existing gas management system installed. Cell 1 has a gas monitoring well for gas sampling (MSB, 2014a). When Cell 2A receives final cover, a passive gas venting system will be installed (HDR, 2012).

4.2 Historical Waste Disposal

The Central Landfill began waste disposal operations in 1980 in Cell 1. However, waste disposal records are not available until 2000, the year the MSB started using a Waste Works database to track incoming waste. Based on historical waste disposal data, approximately 207,601 short tons of waste were landfilled from 2000 to 2003 in the unlined landfill (Cells 1/2A). From 2004 until July 2014, an additional 744,275 short tons of waste were landfilled at the lined landfill (Cells 2B/3) (MSB, 2014b).

Table 1 of Appendix L shows the estimated waste disposal for operating years 1980 through 1999 based on the estimated population served by the landfill in each year, and the values for national average per capita waste disposal rates found in Table HH-2 to Subpart HH of Code of Federal Regulations (CFR) 40 CFR 98 and Equation HH-2 to Subpart HH of 40 CFR 98. Using this methodology, an estimated 603,627 short tons of waste were landfilled at the Central Landfill from 1980 to 1999.

Table 2 of Appendix L shows the estimated waste disposal for operating years 2000 to 2013, based on historical data records for the unlined and lined landfill disposal cells, and operating years 2000 and 2007 through June 2014. Waste disposal in operating years 2001 through 2006 and July 2014 were estimated based on calculated constant average waste disposal rates for missing years of data based on the historical data records. From 2000 to 2013, an estimated 887,111 short tons of waste were landfilled at the Central Landfill.

From 1980 to 2013, a total estimated 1,490,738 short tons (1,352,375 metric tons) of waste were landfilled at the Central Landfill.

4.3 Estimated Landfill Gas Generation

Using EPA's Landfill Gas Emissions Model (LandGEM) version 3.02, CH2M HILL estimated the landfill gas emissions at the Central Landfill based on historical waste disposal records and estimates, and future waste disposal projections (see Section 1.1, and Appendix A). LandGEM is based on a first-order decomposition rate equation for quantifying emission from the decomposition of landfilled waste in MSW landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills, and LandGEM is considered a screening tool that provides better estimates with better input data.

The first-order decomposition rate equation is:

$$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} k * L_0 \left(\frac{M_i}{10}\right) e^{-k*t_{ij}}$$

Where,

Q_{CH4} = annual methane generation in the year of calculation (m^3/year)
i = 1-year time increment
n = (year of the calculation) – (initial year of waste acceptance)
j = 0.1-year time increment
k = methane generation rate ($year^{-1}$)
L_o = potential methane generation capacity (m^3/mg)
M_i = mass of waste accepted in the i^{th} year (mg)
t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year

The following is a summary of LandGEM input data used and default selections based on 40 CFR 60.754 to model gas generation at the Central Landfill:

- *Initial Year of Waste Acceptance* = 1980
- *Mass of waste accepted, M_i* = waste acceptance rates for Years 1980 to 1999 are estimated per Eq. HH-2 to Subpart HH of 40 CFR 98. Waste acceptance rates for Years 2000 and 2007 to 2013 are based on MSB data records. Waste acceptance for Years 2001 to 2006 are estimated per Eq. HH-3 to Subpart HH of 40 CFR 98. Waste acceptance rates for 2014 to 2059 (maximum 80-year model run) are estimates based on population growth projects and waste data for 2013 (that is, input waste acceptance data is based on historical waste disposal records and future waste acceptance projections for the Central Landfill).
- *Methane generation rate constant, k* = 0.02 $year^{-1}$ for landfills located in geographical areas with 30 year annual average precipitation of less than 25 inches (40 CFR 60.754)
- *Potential methane generation capacity, L_o* = 170 m^3/mg (40 CFR 60.754)

LandGEM modeling results are included in Appendix M. In 2014, total landfill gas emissions are estimated at 482 cubic feet per minute (cfm). Peak generation is estimated to occur in 2060 with emissions of 1,481 cfm.

It is important to note that the predicted landfill gas emissions are only predictions. Better input data from site-specific studies will increase the accuracy of LandGEM predictions. In addition, the projected gas emissions overestimate what the MSB can expect to collect for an end-use option. A conservative assumption for gas capture from a landfill gas collection system is 50 to 75 percent of the projected gas generation rate (that is, collection efficiency of 50 to 70 percent), with the high-end value being at landfill closure with final cover because higher vacuums can be applied to the collection system. Lastly, gas quality (that is, percent methane by volume in landfill gas) will also play an important factor when evaluating end-use options.

4.4 Air Regulatory Status

The EPA has developed several regulatory documents that affect MSW disposal facilities. In particular, landfill gas is currently regulated by three separate regulations that set limits of emissions, operational standards, and other regulatory requirements that landfills must meet. These regulations include the mandatory Greenhouse Gas (GHG) Reporting Rule, the New Source Performance Standards (NSPS), and the National Emissions Standards for Hazardous Air Pollutants (NESHAP). Brief descriptions of these regulations, and the Central Landfill's current status under these regulations, are provided in the following sections.

4.4.1 Greenhouse Gas Reporting Rule (40 CFR 98, Subpart HH)

Owners and operators of landfills that accepted MSW on or after January 1, 1980, and that generate methane in amounts equal to or greater than 25,000 metric tons of carbon dioxide equivalent (CO_2e) must report GHG emissions annually using the EPA's electronic GHG Reporting Tool (e-GGRT), and have a GHG Monitoring Plan (and all revisions and addenda) on file at the facility. For additional information on the GHG Reporting Rule and its program, refer to http://www.epa.gov/ghgreporting/index.html.

Central Landfill Status:

Using the EPA's GHG Reporting Rule applicability tool, the Central Landfill is subject to the GHG Reporting Rule. A preliminary estimate of MSW landfill CO_2e emissions (intended for screening purposes only) is included in Appendix M. Emissions are estimated at 77,859 metric tons of CO_2e for Reporting Year 2014.

Per 40 CFR 98.3, the MSB will need to prepare a written GHG Monitoring Plan containing the required elements set forth in 40 CFR 98.3(g)(5)(i) and submit annual emission reports electronically to EPA, meeting the requirements of 40 CFR 98.3(c).

4.4.2 NSPS (40 CFR 60, Subpart WWW)

On March 12, 1996, the EPA promulgated the NSPS and Emissions Guidelines for new and existing landfills under Section III (b) of the Clean Air Act. The basis for this legislation was the EPA's determination that MSW landfills generate a significant quantity of air pollution that is potentially detrimental to public health. The NSPS are intended to control non-methane organic compounds (NMOC) and methane emissions from MSW landfills. NMOC include VOCs, hazardous air pollutants, and odorous compounds. The rules include provisions for "existing" and "new" landfills. The Emissions Guidelines applies to existing landfills that were permitted before May 30, 1991, and have not been modified or reconstructed since that date. The NSPS applies to new landfills that were permitted, modified, or reconstructed on or after May 30, 1991.

The ADEC chose not to implement the NSPS rules for existing landfills under Alaska regulations, so the requirements of that regulation are implemented under the Federal Implementation Plan, 40 CFR Part 62, Subpart GGG. The provisions for new landfills are implemented by the ADEC under 18 AAC 50.040(a)(2)(II).

Per 40 CFR 60.757(a), an initial design capacity report is required for landfills to determine if they surpass the thresholds of 2.5 million megagrams (Mg) and 2.5 million cubic meters (m^3) of MSW. If below regulatory thresholds, an amended design capacity report is to be submitted to ADEC providing notification of an increase in design capacity of the landfill, within 90 days of an increase in design capacity of the landfill to or above 2.5 million Mg and 2.5 million m^3. This design capacity increase could be attributed to an increase in the permitted volume of the landfill (for example, cell expansions) and/or an increase in density as documented in the annual recalculation required by 40 CFR 60.758(f) for landfills below the regulatory thresholds.

If the design capacity thresholds are exceeded by a facility, NSPS regulations require landfills to either calculate an NMOC emission rate for the landfill, or install a collection and control system that captures the gas generated within the facility (that is, landfill gas collection control system [LFGCCS]) per 40 CFR 60.752(b).

The NMOC emission rate report shall contain an annual or 5-year estimate of the NMOC emission rates at the landfill. If NMOC emissions are below 50 Mg/year*, the landfill is not required to install an LFGCCS. Per 40 CFR 60.754(a), the landfill is required to submit revised NMOC emission reports to the ADEC in accordance with 40 CFR 60.752(b)(1)(ii) until such time as the calculated NMOC emission rate is equal to or greater than 50 Mg/year, or the landfill is closed.

In addition, air regulations require that any landfill that exceeds the design capacity thresholds must apply for a Part 70 (also known as Title V) air quality operating permit. These landfills are deemed NSPS sites. In Alaska, Title V permitting is implemented under 18 AAC 50.326, and permits are issued by the ADEC Division of Air Quality.

Central Landfill Status:

Based on CH2M HILL's review of historical landfill documents and interviews with facility operators, a design capacity report for the Central Landfill has not been submitted to the ADEC.

Based on historical waste disposal and future waste projections for Cell 1, Cell 2A, Cell 2B, and Cell 3, CH2M HILL estimates that approximately 1,490,738 short tons (1,352,375 metric tons = 1,352,375 Mg) of waste were landfilled between 1980 and 2013, and approximately 598,255 short tons (542,728 metric tons = 542,728 Mg) of waste is anticipated to be landfilled at Cell 3 between 2014 and 2022. Therefore, CH2M HILL estimates that the current mass design capacity of the landfill is 1,895,103 Mg, which is below the regulatory threshold of 2.5 million Mg.

Assuming an average waste density of 1,400 pounds per CY, CH2M HILL estimates the current volume design capacity of the landfill is 2,281,646 m^3, which is below the regulatory threshold of 2.5 million m^3.

CH2M HILL recommends that the MSB complete a design capacity report and submit it to ADEC to demonstrate that the landfill, as currently permitted, has a design capacity less than regulatory thresholds of 2.5 million Mg and 2.5 million m^3. Updated design capacity reports should be submitted to ADEC as new cells are designed, constructed, and permitted.

When the 2.5 million Mg and 2.5 million m^3 regulatory thresholds are exceeded, the MSB is required to apply for a Title V permit [18 AAC 50.326(c)] and should complete a Tier 1 NMOC emissions report [40 CFR 60.754] to assess NMOC emissions at the landfill. If NMOC emissions exceed the regulatory threshold of 50 Mg/year*, the MSB is required to install a LFGCCS per 40 CFR 60.752(b)(2(ii) unless Tier 2 or Tier 3 NMOC testing [40 CFR 60.757(c)(1)/(2)] can demonstrate that a more site-specific calculation of the NMOC emission rate is less than the regulatory threshold.

*Note: new NSPS for landfills are being proposed by EPA to reduce the NMOC emissions threshold to 40 Mg/year. Refer to http://www.epa.gov/ttn/atw/landfill/landflpg.html for more information on the proposed rulemaking.

4.4.3 NESHAP (40 CFR 63, Subpart AAAA)

NSPS sites that are above the regulatory thresholds for design capacity and NMOC emissions are subject to the monitoring, recordkeeping, and reporting requirements for MSW landfills contained in 40 CFR 63, Subpart AAAA. These requirements include the submittal of a compliance report every 6 months, beginning 180 days after the startup of the LFGCCS, among other requirements such as the development of a written Startup, Shutdown and Malfunction Plan when air control devices (that is, the LFGCCS) are not operating.

Central Landfill Status:

The Central Landfill is currently not subject to NESHAP requirements because the design capacity of the landfill is below the NSPS regulatory thresholds.

4.5 Landfill Gas Capture and Destruction

4.5.1 Landfill Gas Collection Systems

There are two types of landfill gas collection systems: (1) passive collection systems that rely solely on positive pressure within the landfill to move the gas rather than using gas moving mechanical equipment (blowers or compressors) and (2) active collection systems that use gas moving equipment (blowers or compressors) to mechanically create a pressure gradient (vacuum) within the landfill to extract gas. Typically, well-designed active collection systems are more efficient than passive collection systems because of the ability to control pressure gradient within the landfill, and thus the gas flow from the system.

Passive collection systems are typically operated as venting systems, and consist of vertical vents installed within gravel trenches, as shown in Figure 7. They are primarily designed as a means of safely venting buildup of gas pressure from the landfill at final closure and can also help reduce the potential for offsite (subsurface) migration of gas. Gas vents can be designed to freely vent to the atmosphere, or use vent flares for odor and emissions control at the passive outlets with an igniter powered by solar panels or propane. These systems can be retrofitted for connection to an active collection system as well.

Active collection systems typically use horizontal collectors (perforated pipe installed within a gravel trench) for short-term, sacrificial use, and vertical gas extraction wells for long-term use. Typical details for horizontal and vertical gas extraction wells are shown in Figures 8 and 9, respectively. An example layout of an active collection system using vertical gas extraction wells is shown in Figure 10. Horizontal collectors should be designed with sufficient slope to allow drainage of gas condensate and leachate and to allow for differential settlement. Solid pipe sections should be installed at the end of the horizontal collectors to discourage air infiltration through the side slopes of the landfill. Landfill gas can typically be extracted after 25 feet of waste is placed over the horizontal collector pipe. Gas collected from horizontal collectors is typically of lower quality (that is, percent methane) and quantity than vertical wells because of the difficulty of maintaining uniform vacuum over the entire length of the collector, and lower gas flows to reduce the potential for air intrusion.

Vertical gas wells in an active collection system are typically drilled to around 75 percent of the landfill depth to avoid damaging the bottom liner system. The spacing of the wells depends on landfill characteristics such as waste density, landfill gas generation rates, proximity to side slopes, and the amount of applied vacuum on the well by the gas mover. Vertical gas wells are often only installed in areas of the landfill that have reached final grade because they are susceptible to damage by heavy equipment, and may impede filling operations.

The sizing of gas collection piping and gas mover equipment is very important in an active gas collection system. NSPS regulations require gas to be collected at an extraction rate sufficient to maintain negative pressure at all wellheads in the collection system without causing air infiltration. Typically, these systems are sized to handle the maximum expected flow rates over the expected lifespan of the collection equipment. Piping is often sized so that the total pressure head loss from the blower (gas mover) to the furthest wellhead is less than 10 percent of the applied vacuum (often 60 inches of water column), and gas velocity in piping traveling with and against the flow direction of condensate is maintained at or below 45 and 35 feet per second, respectively. The gas mover and control equipment (flare) are sized to handle the maximum expected gas flow rate over the area of the landfill that warrants control for the intended use period of the equipment, often 15 years or less.

Some advantages and disadvantages of passive and active gas collection systems are shown in Table 4-1.

TABLE 4-1
Advantages and Disadvantages of Passive and Active Gas Collection Systems
Matanuska-Susitna Borough Central landfill Development Plan

Passive Gas Collection System		Active Gas Collection System	
Advantages	**Disadvantages**	**Advantages**	**Disadvantages**
Low capital cost Low operating costs Simplicity of technology	Gas collection inefficiencies Condensate removal Relies on positive pressures for operation Minimum capacity Odors Limited gas migration control More difficult to be NSPS compliant	Maximum capacity Functions with various gas systems Maintains vacuum on landfill Good gas migration control Odor control through flare Easier to be NSPS compliant	Higher capital cost Higher operating costs More complex technology

4.5.2 Landfill Gas Control Devices

Landfill gas control devices and mechanical gas collection equipment are designed and sized to handle the maximum expected gas flow rate over the area of the landfill that warrants control for the intended use period of the equipment, typically 15 years or less.

A flare station is a common emission control device that destroys landfill gas with no energy recovery. Flares can be sized to handle gas flow rates of 30 to 6,000 cfm. Flares are primarily used at landfills for air emissions control but can also be used as a backup control device to a landfill gas end-use systems for when the system is offline or gas generation exceeds the capacity of the end-use system.

The two main types of flares that are used at landfills are: (1) open (candlestick) flares and (2) enclosed flares. Flare selection is usually based on the applicable regulatory requirements and end-use goals for landfill gas collection at the landfill. Under NSPS regulations (40 CFR 60, Subpart WWW), flare stations must be capable of combusting landfill gas at a wide range of flow rates and be designed to meet the requirements specified in 40 CFR 60.752(b)(2)(iii). For example, the flare must be designed and operated to reduce NMOC by 98 percent by weight (that is, 98 percent destruction efficiency). Typically both open and enclosed flares meet this requirement.

Open flares are often selected over enclosed flares because they are generally less expensive and easier to operate than enclosed flares. However, enclosed flares offer a more controlled combustion environment and are less susceptible to weather conditions because combustion occurs within the stack and the intake of air can be adjusted based on operating conditions. Additionally, enclosed flares can be sampled for emissions control validation.

4.6 Landfill Gas End-use Opportunities

Landfill gas is typically an underutilized byproduct of waste decomposition at landfills. Significant advancements in gas conversion techniques now allow landfill operators to use gas generated at landfills for beneficial end-uses that may be profitable for the landfill owner.

Landfill gas is comprised of methane, carbon dioxide, and several other constituents lumped together as balanced gas. Methane is typically the primary gas constituent accounting for an average percentage by volume of 50 percent. Landfill gas has a heating value of approximately 500 British thermal units (BTU) per cubic foot when the methane concentration is 50 percent. For comparison, natural gas has a heating value of roughly 1,000 BTU per cubic foot. The energy potential of landfill gas allows it to be used for beneficial end-uses.

Generally, there are three main end-use opportunities for landfill gas: (1) landfill gas to energy (LFGTE), (2) direct use as fuel, and (3) gas stream modifications.

The selection of a recovery technique (end-use opportunity) versus a control technique (gas flare) is highly dependent on such factors such as gas flow, gas quality, market conditions, and environmental impacts. If landfill characteristics are such that landfill gas generation and/or quality are low/poor, flaring is often best suited for a landfill. However, if a landfill has good gas generation rates and gas quality, and a demand by customers for LFGTE or gas supply (direct use or gas stream modification), an energy recovery system may be feasible.

4.6.1 Landfill Gas to Energy

Internal combustion (IC) engines are the most common type of technology used today to convert landfill gas into electricity. IC engines are modular, and come in a wide variety of sizes to meet the needs of LFGTE projects. For example, General Electric (GE) Jenbacher IC engines are available from 335 kilowatts (gas flow of 105 cfm at) to 2,700 kilowatts (gas flow of 785 cfm). Most models can operate with methane levels as low as 40 percent. IC engines can be ordered as containerized units, or installed inside of a building. Containerized units are attractive for landfill operators because generator sets can be added easily to match increased rates of landfill gas production as a LFGTE project grows. Otherwise, a building would need to be sized to accommodate the expected generator sets to manage the maximum landfill gas generation rate anticipated over the life of the project.

The IC engines will require routine maintenance such as oil changes and periodic engine overhauls every few years by a qualified maintenance technician. IC engines are also susceptible to damage from high concentrations of hydrogen sulfide and siloxanes – typical contaminants in landfill gas derived from mixed solid waste (that is, other waste than MSW such as construction and demolition waste). Testing can be conducted to screen the levels of these contaminants in landfill gas. If contaminant levels are elevated, an iron sponge for low concentrations, or scrubber for higher concentrations can be added to pre-treat the landfill gas before sending to the IC engines.

The use of IC engines is widespread because they have relatively low capital costs, high thermal efficiency, low emissions that can meet NSPS regulations for gas destruction and require minimal pre-treatment of landfill gas. Typical landfill gas pre-treatment consists of a coalescent filter to decrease moisture and particulate levels, and a blower to compress the gas to the fuel pressure required by the IC engine.

Since landfill gas is produces 24 hours a day, seven days a week (24/7), the electricity generated from IC engines should go to end-users who have a 24/7 demand. The end-user could be the landfill itself or an electric utility company.

4.6.2 Direct Use

Landfill gas may be used for a variety of direct use options if the conversion technology is available to make use of the gas. Some creative uses of landfill gas include heating greenhouses, producing electricity and heat in a cogeneration application (that is, combined heat and power project), fueling boiler systems, fueling boiler/steam turbine systems, fueling and/or providing heat to leachate evaporation systems, and fueling heaters or dryer systems (for example, building heaters, brick kilns, drying of biosolids at a waste water treatment plant).

Since landfill gas is produced 24/7, any direct use option should be continuous. The landfill itself or other local nearby industries/facilities can benefit from the use of landfill gas to help offset their fuel and/or heating costs. Unused landfill gas, as a result of load swings, excess gas generation, batch operations, or equipment/process downtime, will need to be combusted in a flare station.

For more information on example projects today, refer to EPA's listing of landfill gas energy project profiles assembled as part of their landfill methane outreach program: http://www.epa.gov/lmop/projects-candidates/profiles.html.

4.6.3 Gas Stream Modifications

The last potential end-use option for landfill gas is gas stream modifications. Gas stream modification consists of refining the landfill gas stream to a higher quality of gas such as natural gas. When the gas stream is refined, it may be conveyed to end-users through an existing or new gas transmission line. The end-user could be the landfill itself or the local gas utility company. However, CH2M HILL does not recommend this end-use alternative for the MSB because of the relatively high capital costs incurred to refine landfill gas to a higher quality product, and the current relatively inexpensive price of natural gas locally.

4.7 Landfill Gas Development Project Costs

In general, each landfill gas development project involves project evaluation, purchase and installation of equipment (capital costs), and the expense of operating and maintaining the project (O&M costs).

The first step in implementing a landfill gas development project is to complete a project evaluation, or feasibility study to assess the project potential. A typical desktop feasibility study is outlined in Section 4.8 below.

The next step in project evaluation is to assess the likely capital and O&M costs for a landfill development project. Table 4-2 below illustrates some typical capital and O&M costs of landfill gas development projects approximated by the EPA's Landfill Methane Outreach Program (EPA, 2009). Costs shown are adjusted for inflation from 2010 to 2014 dollars, rounded up to the nearest $10 amount.

TABLE 4-2
Capital and O&M Costs of Landfill Gas Development Projects
Matanuska-Susitna Borough Central landfill Development Plan

Item	Capital Costs	Annual O&M Costs
Landfill Gas Collection and Flare System	$26,160 per acre	$4,470 per acre
LFGTE System		
Microturbine (1 MW or less)	$6,000 per kW capacity	$420 per kW capacity
Small IC Engine (1 MW or less)	$2,510 per kW capacity	$230 per kW capacity
IC Engine (800 kW or greater)	$1,860 per kW capacity	$200 per kW capacity
Gas Turbine (3 MW or greater)	$1,530 per kW capacity	$150 per kW capacity
Direct-use Project Components		
Gas Compression and Treatment	$1,050 per standard cfm of landfill gas	$100 per standard cfm of landfill gas
Gas Pipeline and Condensate Management System	$359,700 per mile of pipeline	Negligible
End-of-pipeline Combustion Equipment Modifications (if needed)	Varies; usually borne by end-user	Negligible

* Costs in 2014 dollars
kW: kilowatt
MW: megawatt
Source: EPA, 2009

4.8 Landfill Gas Development Feasibility Study

Before pursuing a landfill gas development project, CH2M HILL recommends the MSB perform a feasibility study to assess its viability. At a minimum, a feasibility study should include the following:

- Assessment of the gas quantity and quality being generated at the landfill
- Identification and assessment of potential end-users and their needs
- Selection of appropriate equipment to match the gas generation characteristics of the landfill over the expected life of the project
- Identification of any regulatory issues or requirements that could impact the project
- Evaluation of the expected capital and O&M costs of project
- Development of procurement strategy for the project, including identifying potential private developers or parties to assist with financing, ownership, and/or operations
- Development of a financial plan and implementation schedule for the project
- Comparison of landfill gas development project versus other landfill gas development alternatives and a traditional LFGCCS, based on both monetary and non-monetary criteria

4.9 Landfill Gas Testing Program

CH2M HILL recommends the MSB conduct a landfill gas testing program before pursuing a landfill gas development project to evaluate the actual quantity and quality of gas that could be recovered from the landfill. Described below is a summary of a testing program for Cells 2A and 2B that is generally based on EPA's Method 2E, a test method for determination of landfill gas production flow rates. A copy of this test method is included in Appendix N.

4.9.1 Overview of Testing Program

This testing program is an EPA Method 2E-based testing program designed to assess the sustainable landfill gas generation rates and average radius of influence for vertical gas collection wells if installed at Cells 2A and 2B. Because the testing program will likely take place following partial final closure at Cell 2A, and Cell 2B is still anticipated to have interim cover, the results should indicate what the MSB can expect for sustainable gas flow rates from wells in closed and unclosed areas of the landfill.

This testing program assumes there are no gas extraction wells installed at the landfill before implementing this testing program. Any wells installed as part of the testing program should become permanent wells of a future active gas collection system at the landfill because gas extraction wells are a relatively high capital investment.

In addition to assessing the performance of an active gas collection system, a gas meter (for example, Landtec GEM2000 Plus) will be used to measure the concentrations of methane, carbon dioxide, oxygen, and hydrogen sulfide in the landfill gas. Gas samples will also be collected per Air Toxics Ltd. (ATL) Method @71 (see Appendix N), and tested in a laboratory for siloxanes concentrations in the landfill gas. As noted previously, hydrogen sulfide and siloxanes can be harmful to LFGTE equipment. Results from monitoring the methane, carbon dioxide, and oxygen levels in landfill gas should indicate what stage biodegradation of waste and gas generation the landfill is experiencing.

A study of MSW decomposition by Augenstein and Pacey in 2001 (see Appendix O) suggests there are five stages of biodegradation: (I) aerobic; (II) acidogenic; (III) exponential growth; (IV) stationary; and (V) endogenic decay. Gas development projects should occur during the stationary stage of biodegradation when methane levels are stable and at their highest levels.

There are five overall steps to this testing program:

1. Prepare design documents for construction of two sets of three cluster vertical gas extraction wells (one set per disposal area) with associated shallow and deep gas pressure probes, and an above ground temporary PVC collection network.
2. Construct the landfill gas vertical extraction wells, gas pressure probes, and above ground temporary collection network.
3. Prepare a sampling and testing plan for the EPA Method 2E-based testing program that includes gas meter measurements and gas sampling and testing for landfill gas constituents.
4. Conduct the landfill gas testing program in accordance with the sampling and testing plan. The testing program is likely to take approximately 12 weeks. Equipment necessary for testing includes the following:
    a. A portable blower system with a gas condensate knock-out drum, gas flow meter, and a gas sampling port that can be powered by a portable generator system. This blower system will be used to apply vacuum to the test wells and will vent gas to the atmosphere.
    b. A portable generator system for powering the blower system.
    c. A gas meter that is capable of measuring the concentrations of methane, carbon dioxide, oxygen, and hydrogen sulfide in landfill gas. Calibration gas will also be needed to calibrate the meter.
    d. For siloxanes sampling, a sample train per ATL Method @71, an explosion proof purge pump for evacuating wells before sampling, and a gas meter for extracting samples from the wells and through the sample train.
5. Prepare a test report that summarizes the results of the testing program, and recommendations for landfill gas development at the MSB's Central Landfill.

Before implementing this landfill gas testing program, CH2M HILL recommends the MSB evaluate the quality of landfill gas venting from the passive venting system to be installed in Cell 2A as part of the partial final closure project for that area.

4.9.2 Engineer's Order-of-Magnitude Cost Estimate for Cells 2A and 2B Landfill Gas Testing Program and Well Installations

CH2M HILL has prepared a conservative rough order of magnitude cost opinion to complete the landfill gas testing program described above for Cells 2A and 2B, including installing six permanent vertical gas extraction wells. This cost estimate is included in Appendix P. The project total, including a 30 percent contingency, is approximately $800,000.

SECTION 5
References

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Figures

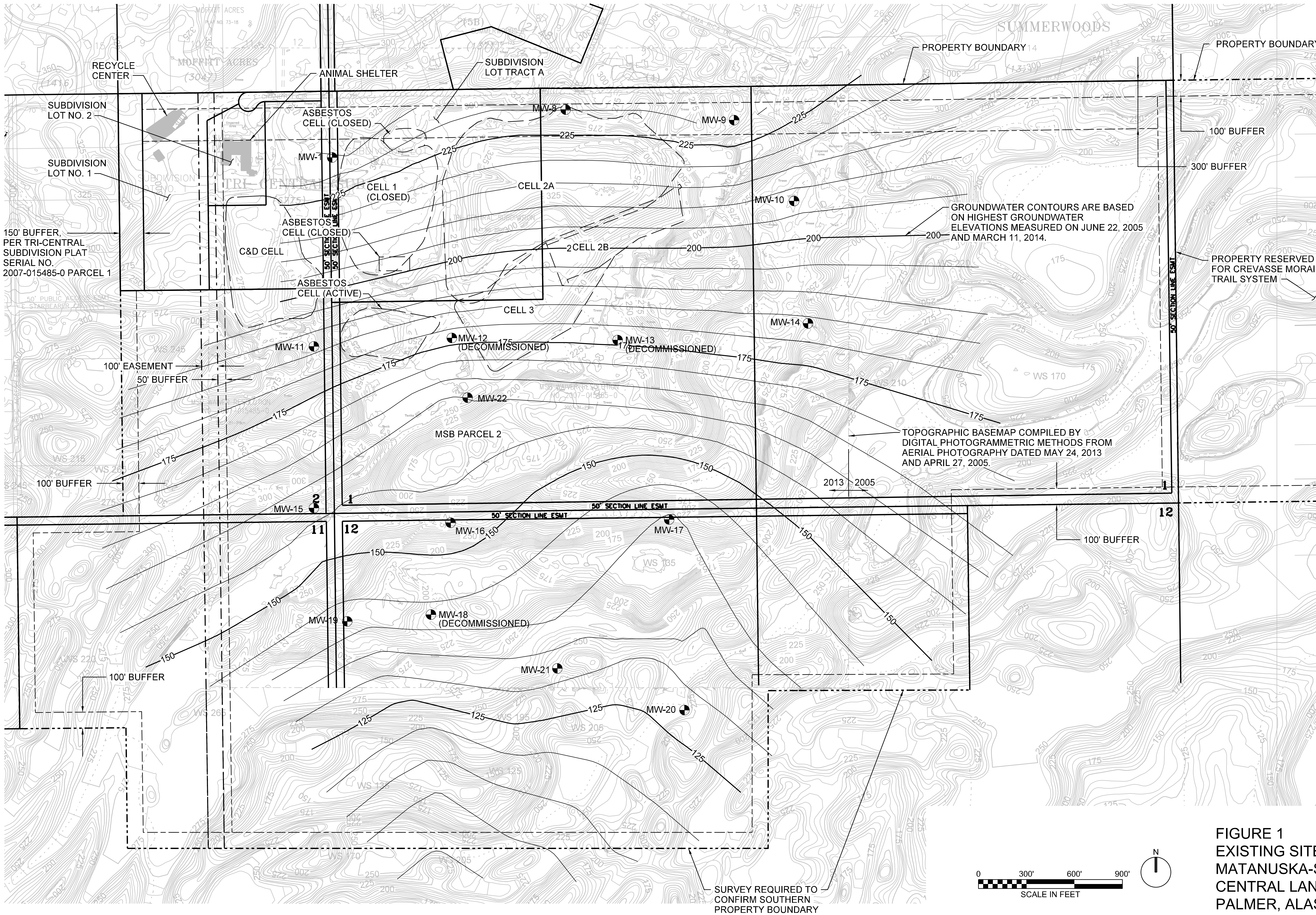


FIGURE 1
EXISTING SITE PLAN
MATANUSKA-SUSITNA BOROUGH
CENTRAL LANDFILL EXPANSION
PALMER, ALASKA

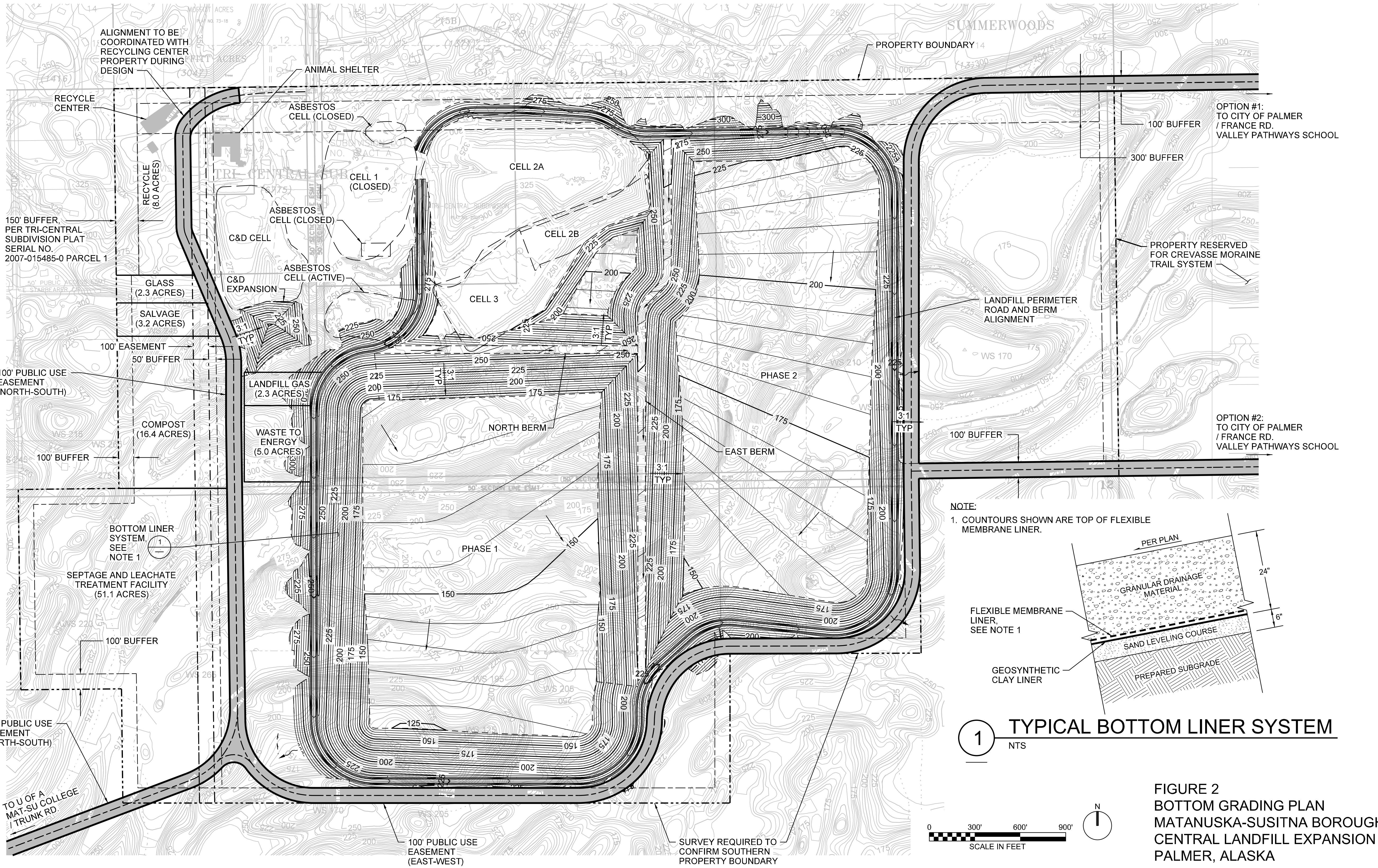


FIGURE 2
BOTTOM GRADING PLAN
MATANUSKA-SUSITNA BOROUGH
CENTRAL LANDFILL EXPANSION
PALMER, ALASKA

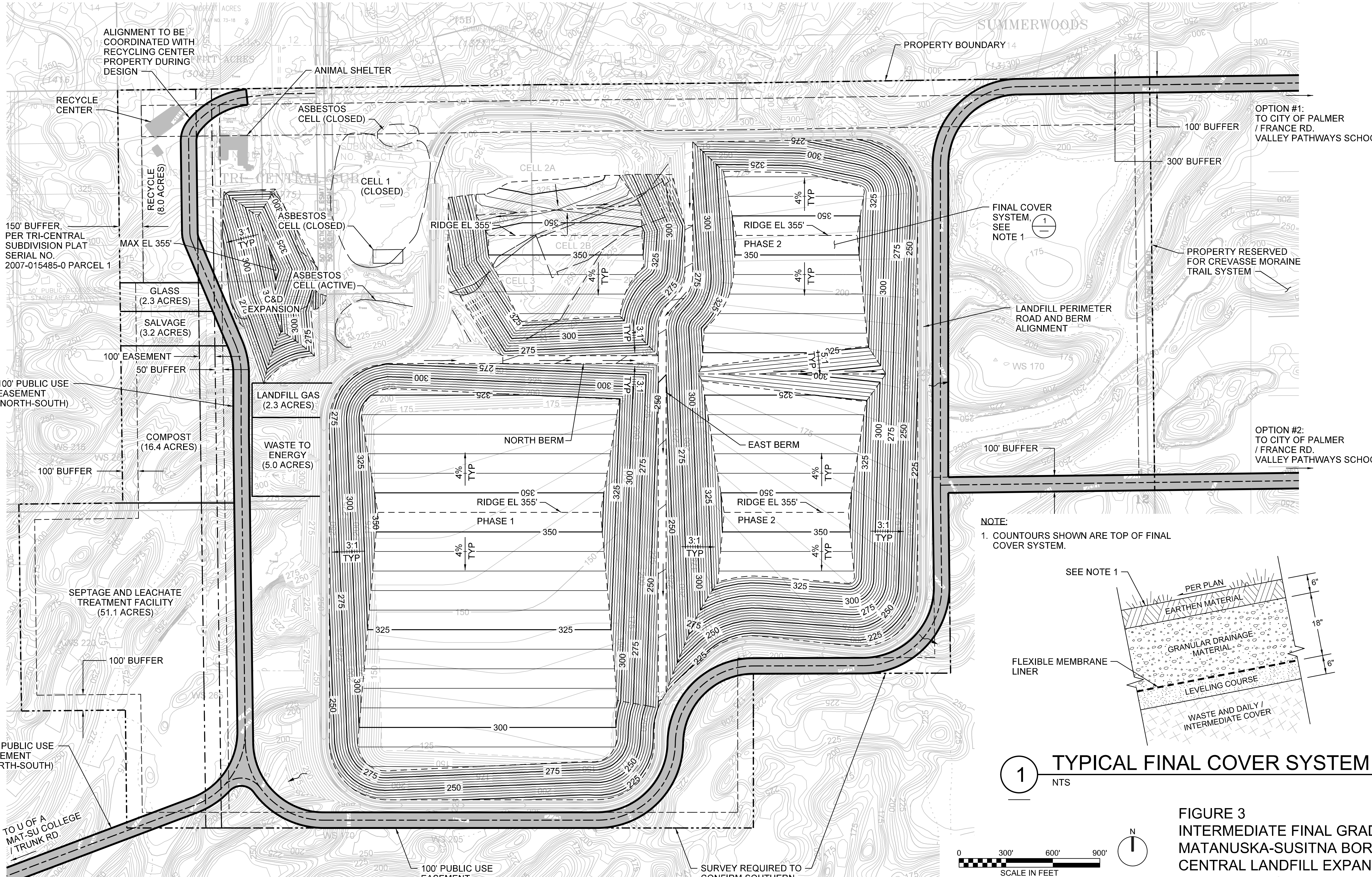


FIGURE 3
INTERMEDIATE FINAL GRADING PLAN
MATANUSKA-SUSITNA BOROUGH
CENTRAL LANDFILL EXPANSION
PALMER, ALASKA

CH2MHILL®

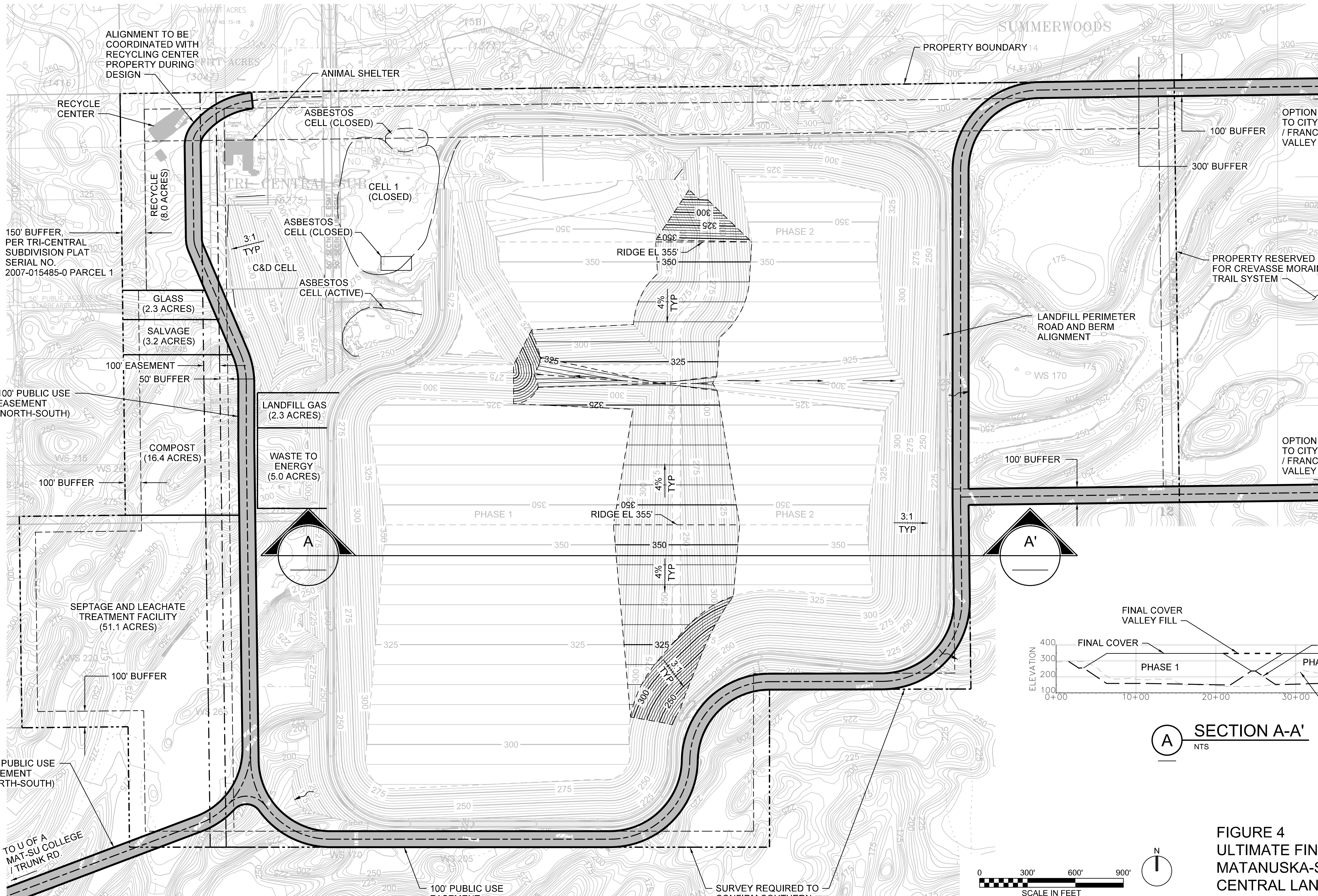


FIGURE 4
ULTIMATE FINAL GRADING PLAN
MATANUSKA-SUSITNA BOROUGH
CENTRAL LANDFILL EXPANSION
PALMER, ALASKA

CH2MHILL

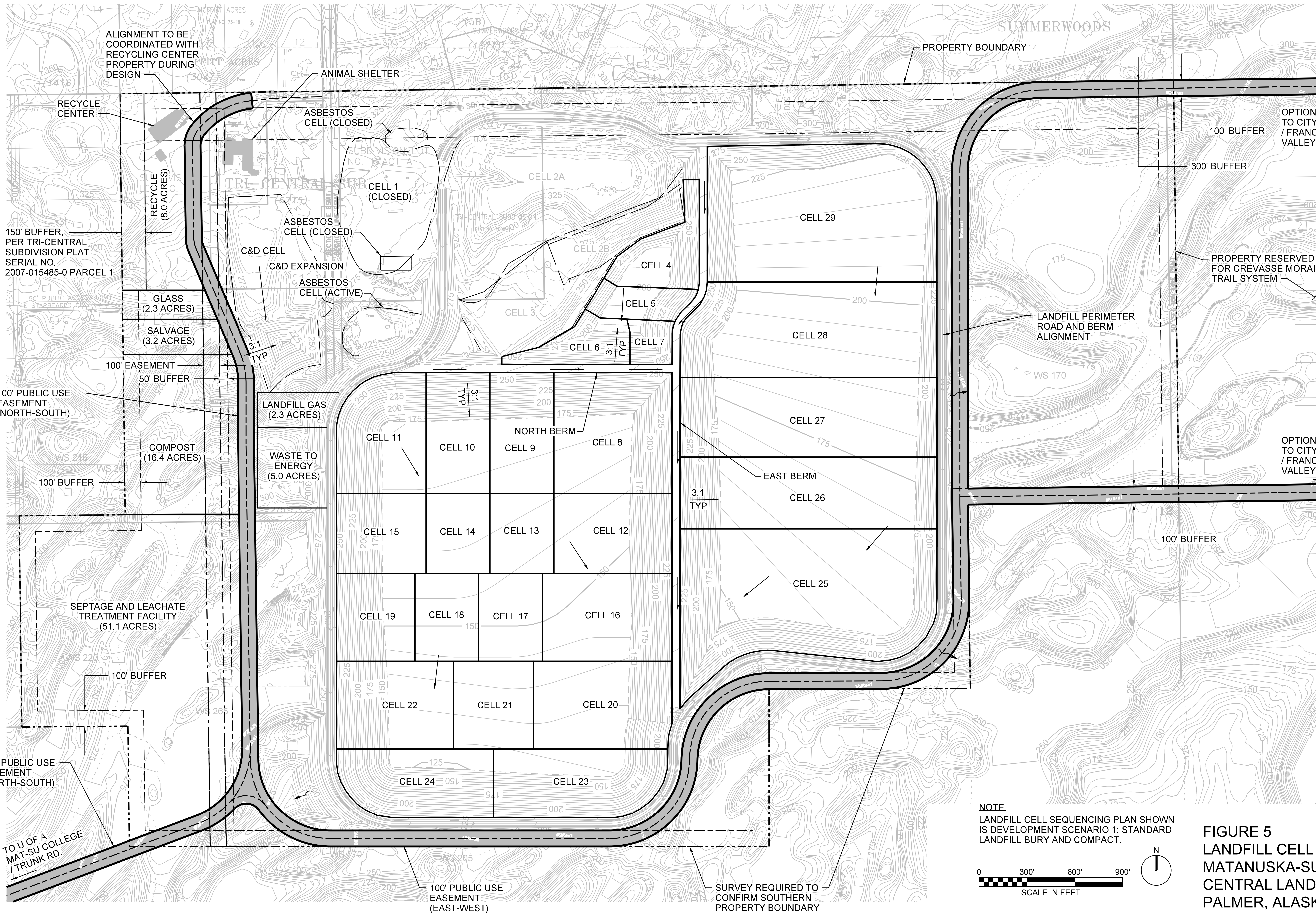
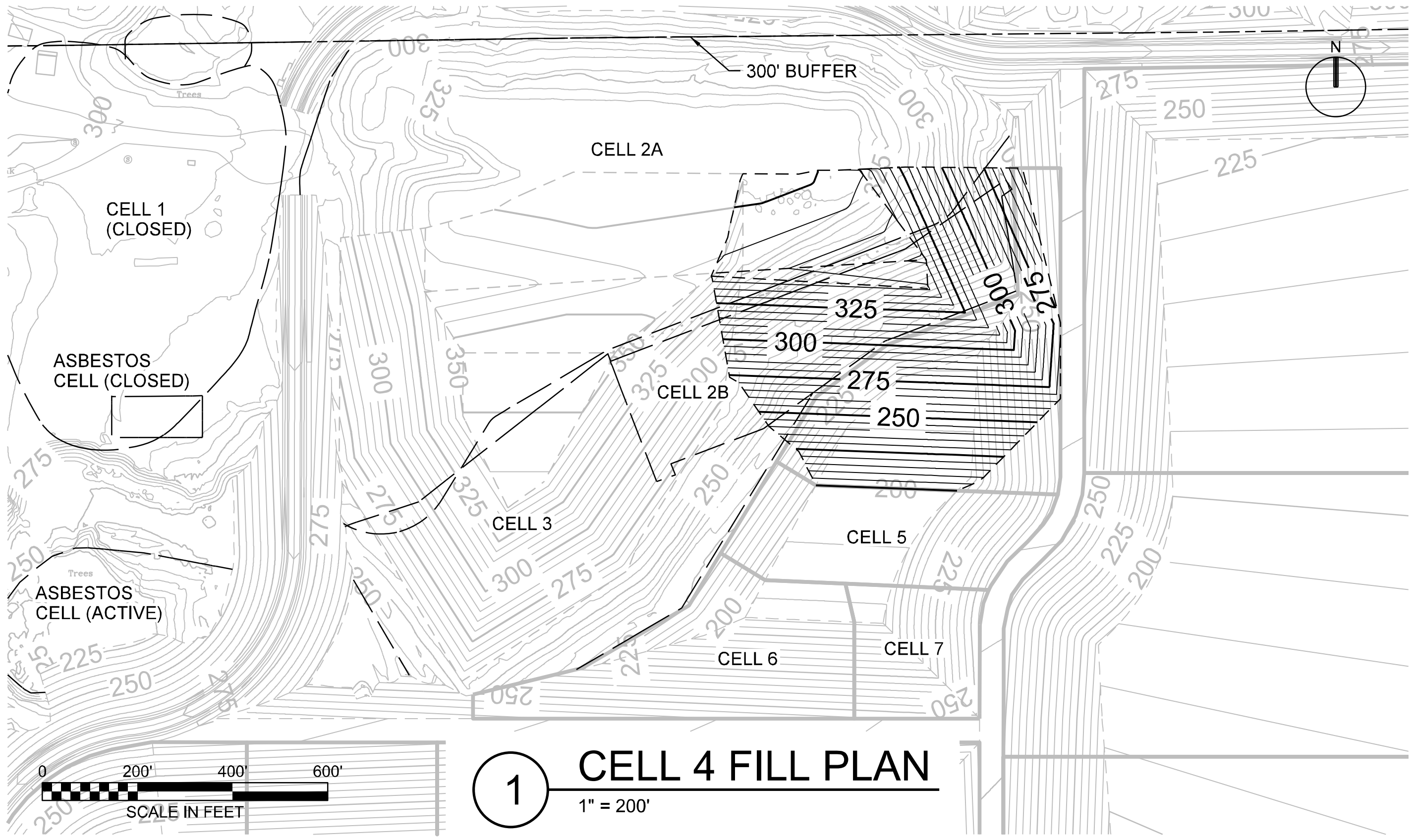
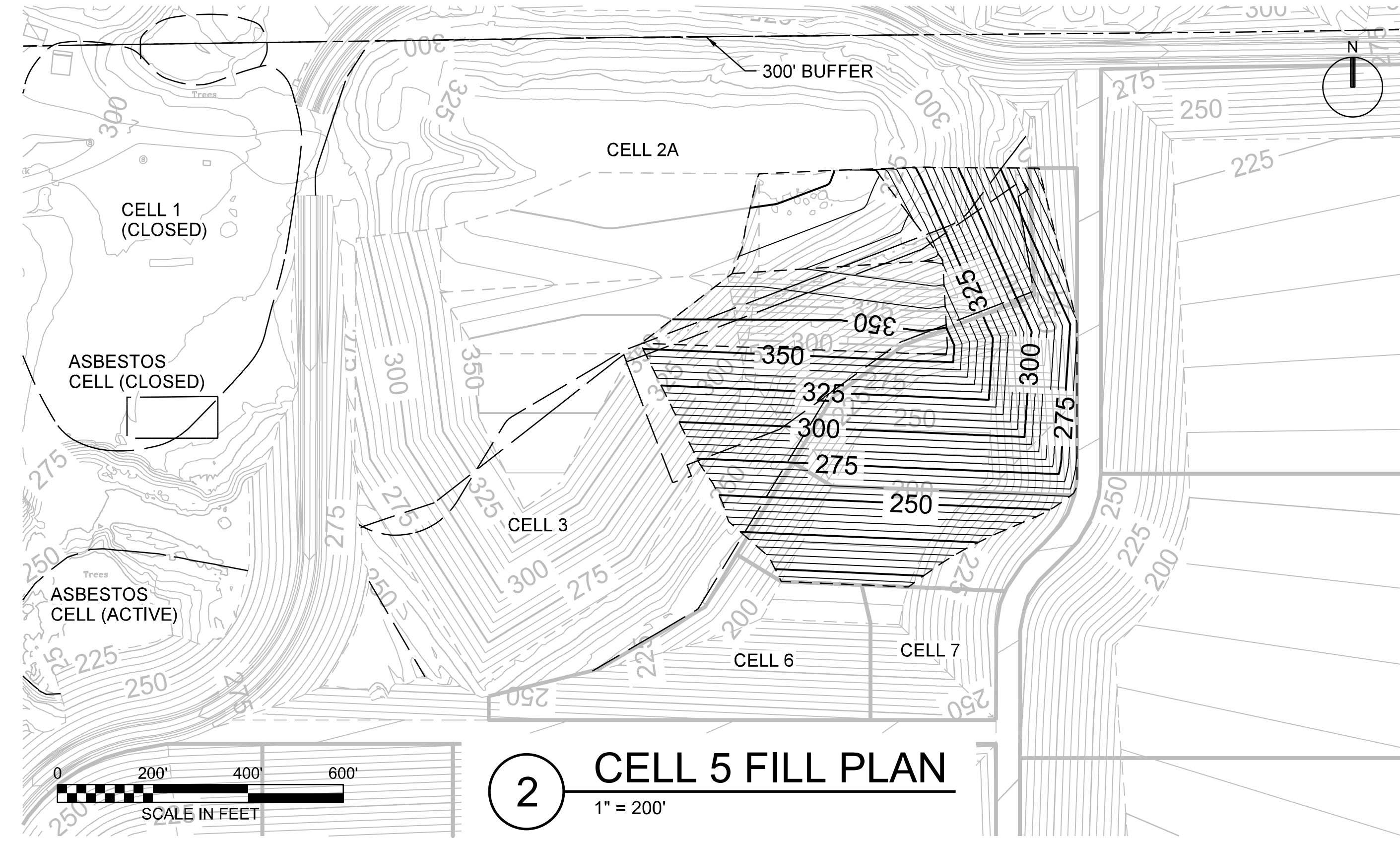


FIGURE 5
LANDFILL CELL SEQUENCING PLAN
MATANUSKA-SUSITNA BOROUGH
CENTRAL LANDFILL EXPANSION
PALMER, ALASKA

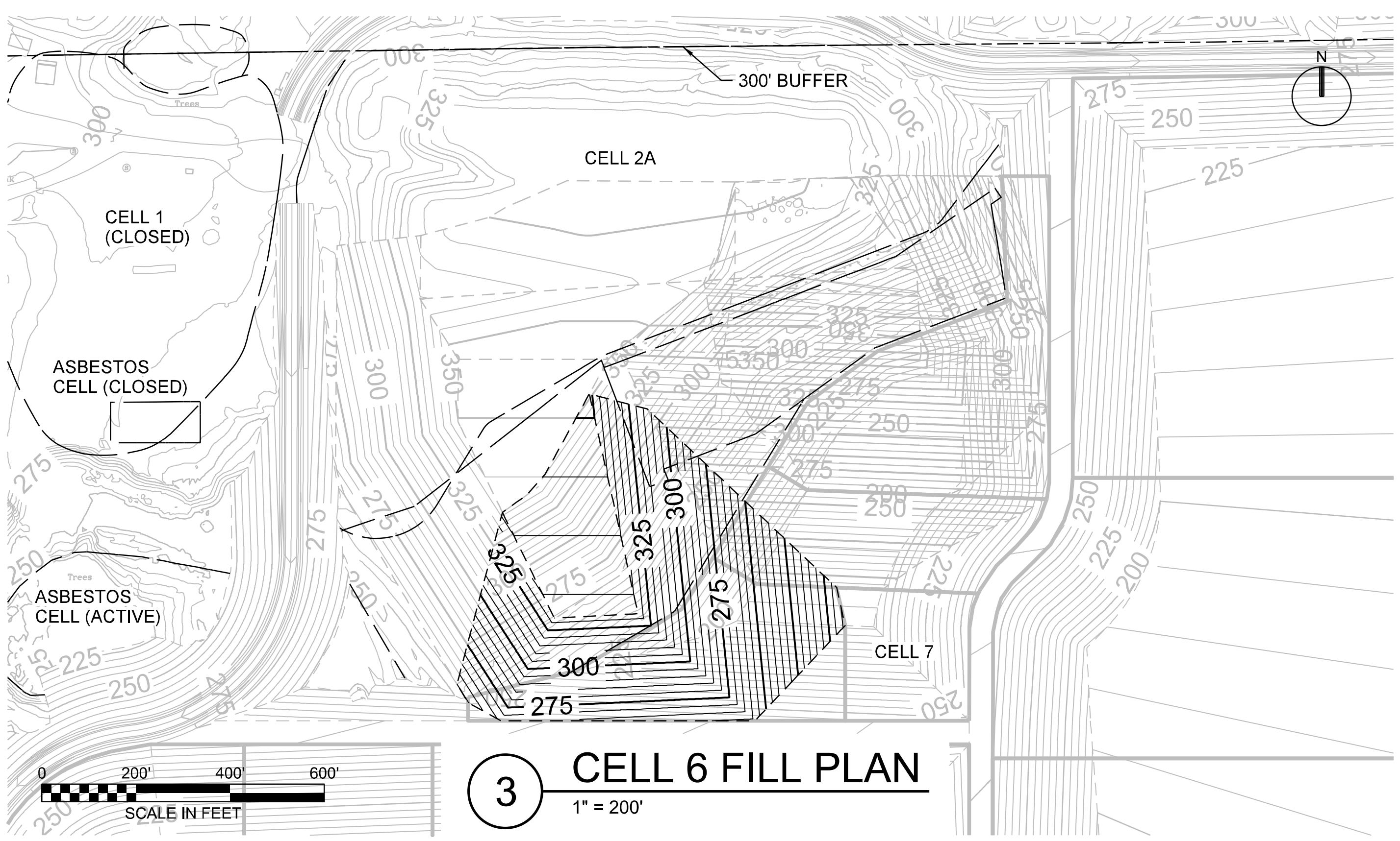
Figure 6.dgn 2014\09\23



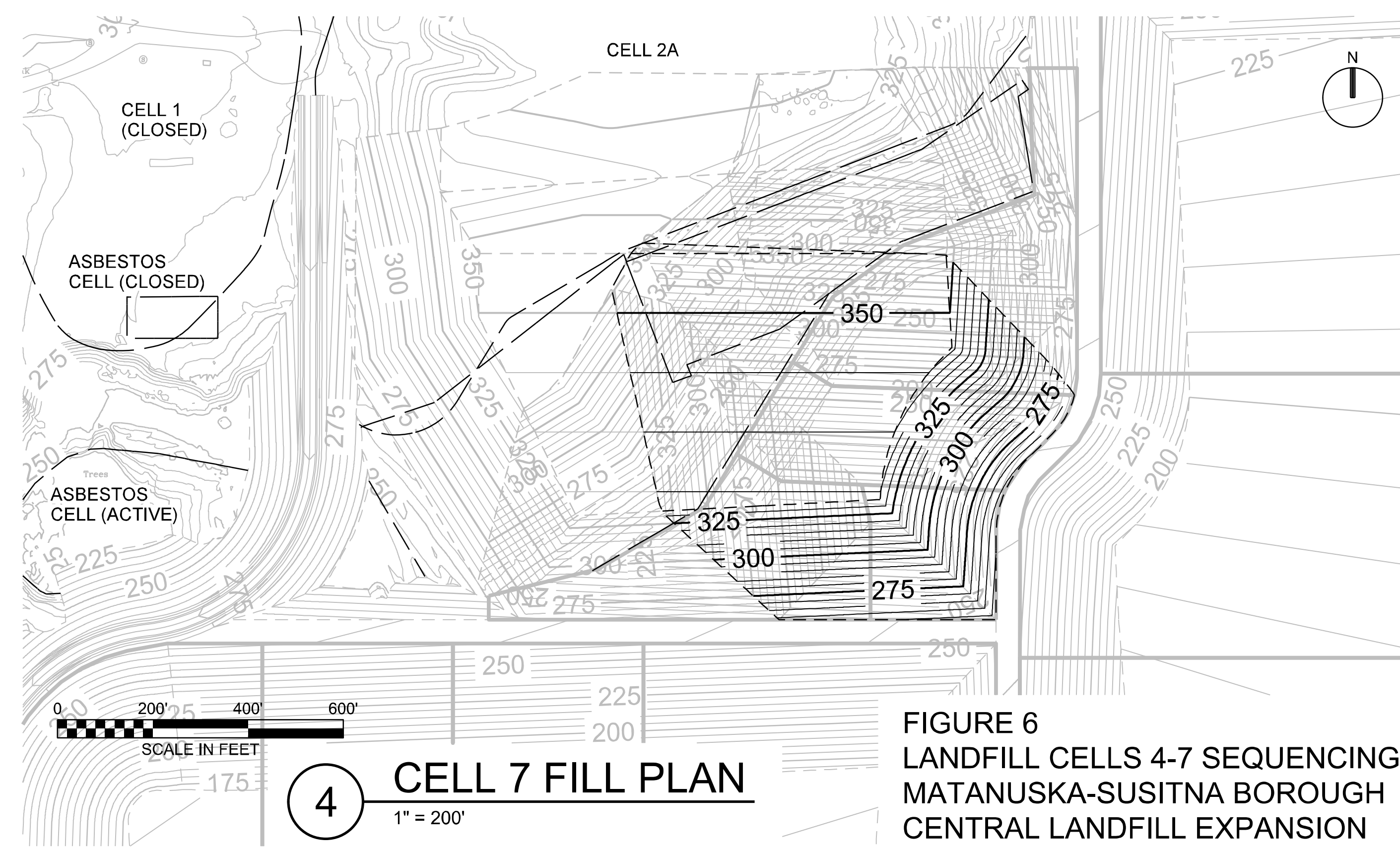
1 CELL 4 FILL PLAN
1" = 200'



2 CELL 5 FILL PLAN
1" = 200'



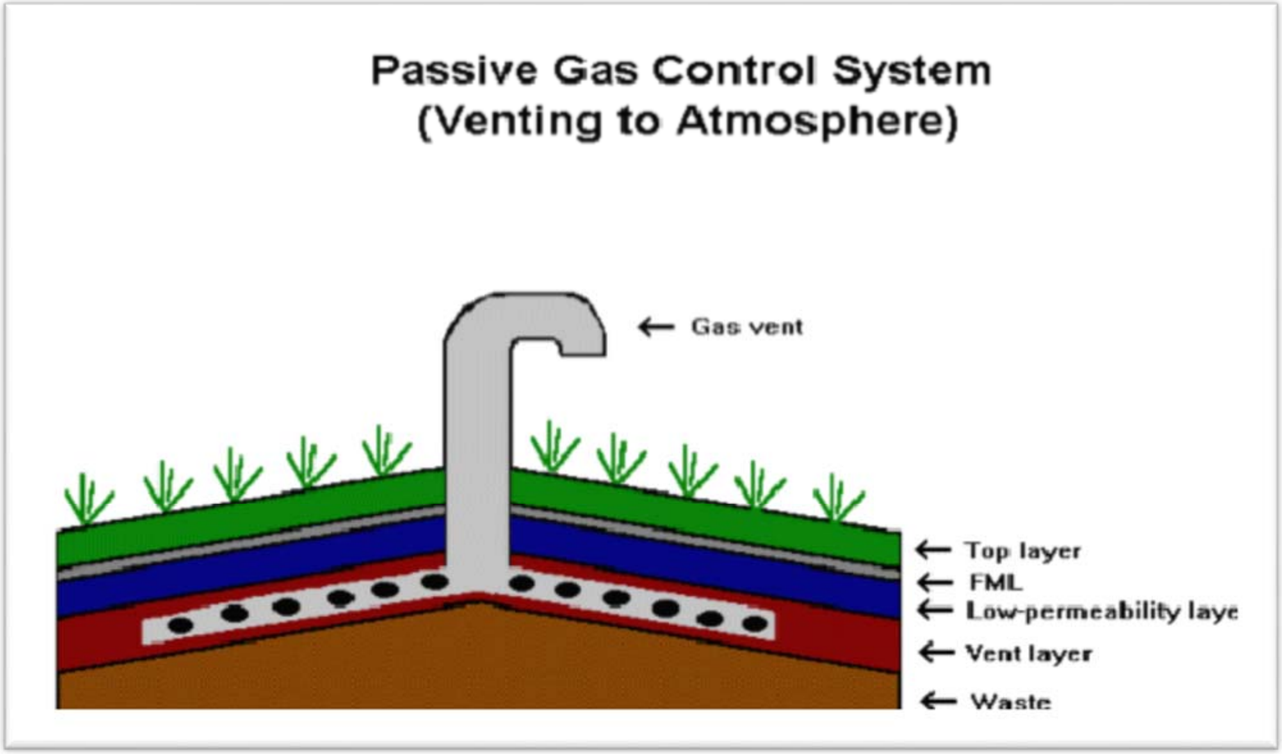
3 CELL 6 FILL PLAN
1" = 200'



4 CELL 7 FILL PLAN
1" = 200'

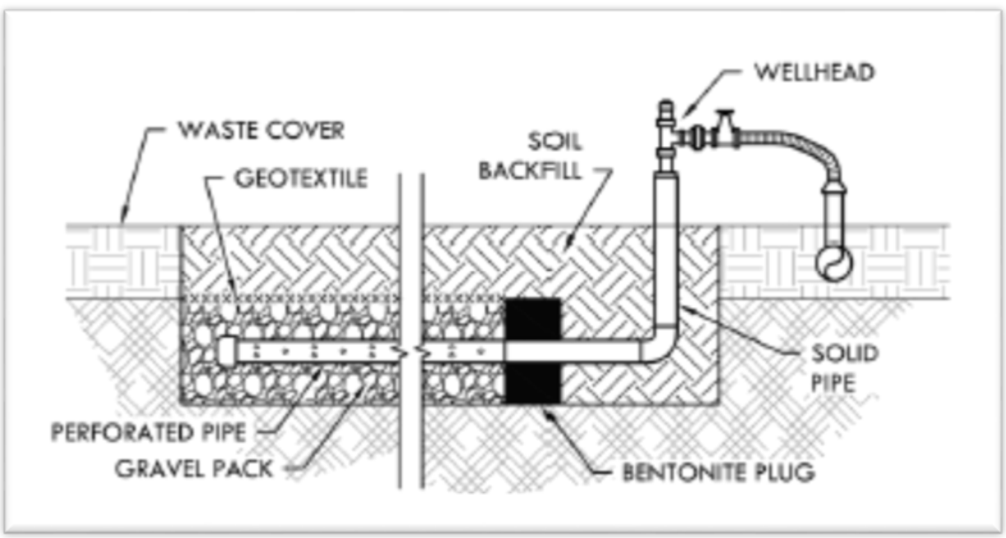
FIGURE 6
LANDFILL CELLS 4-7 SEQUENCING PLAN
MATANUSKA-SUSITNA BOROUGH
CENTRAL LANDFILL EXPANSION
PALMER, ALASKA

CH2MHILL®



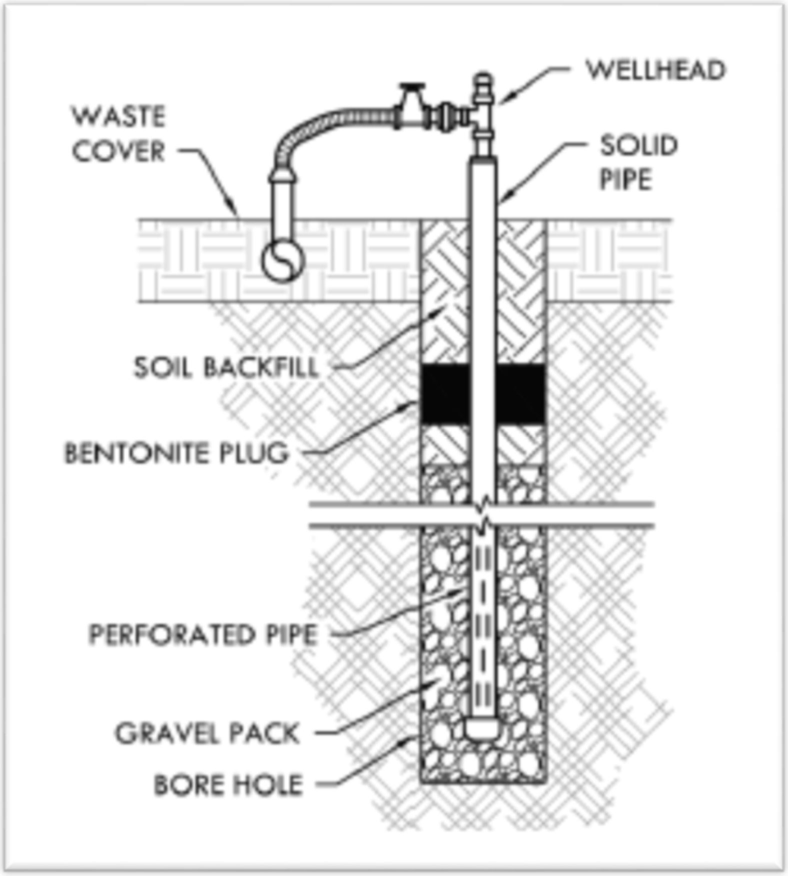
Source: http://www.epa.gov/region6/6pd/pd-u-sw/fig5.gif

FIGURE 7
Passive Gas Control System
Matanuska-Susitna Borough Central Landfill Development Plan



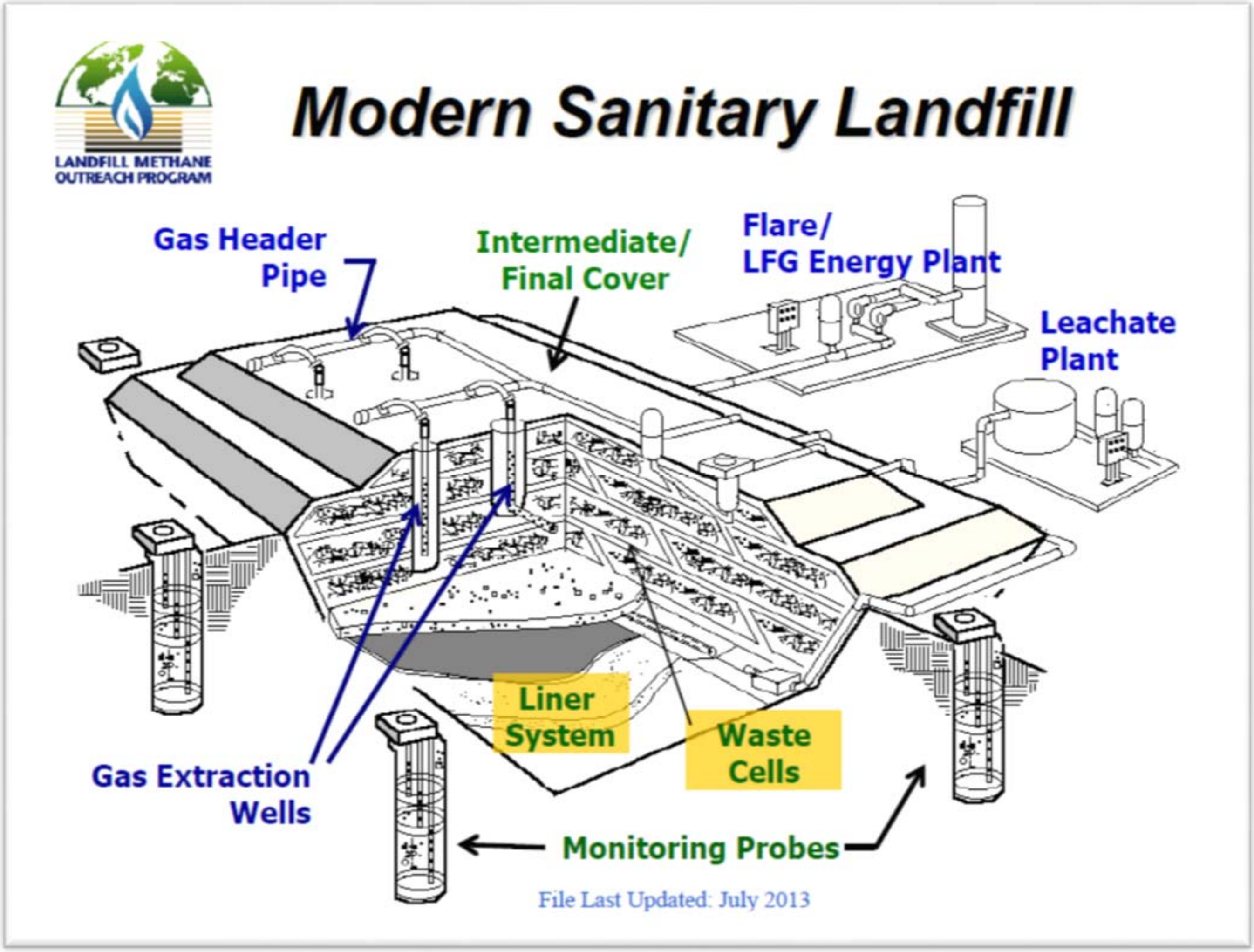
Source: https://www.globalmethane.org/documents/toolsres_lfg_ibpgch3.pdf

FIGURE 8
Horizontal Gas Collection Well
Matanuska-Susitna Borough Central Landfill Development Plan



Source: https://www.globalmethane.org/documents/toolsres_lfg_ibpgch3.pdf

FIGURE 9
Vertical Gas Collection Well
Matanuska-Susitna Borough Central Landfill Development Plan



Source: http://www.epa.gov/lmop/publications-tools/index.html

FIGURE 10
Active Gas Control System
Matanuska-Susitna Borough Central Landfill Development Plan

Appendix A
Population, MSW Disposal, Landfill Air Space Requirements, and Cover Soil Requirements Forecast

MATANUSKA-SUSITNA BOROUGH

Table A-1

Population, MSW Disposal, Landfill Air Space Requirements, and Cover Soil Requirements Forecast

				Landfilling Only					**Landfilling with WTE[7]**			
	Population[1,2]	**MSW Disposal**		**Landfill Air Space Required**			**Cover Soil Required**		**Landfill Air Space Required**		**Cover Soil Required**	
Year[6]		Yearly MSW (tons)	Cumulative MSW (tons)	Yearly Airspace [3] (CY)	Average Daily Airspace [9] (CY)	Cumulative Air Space (CY)	Yearly Cover Soil [4] (CY)	Cumulative Cover Soil (CY)	Yearly Airspace [3] (CY)	Cumulative Air Space (CY)	Yearly Cover Soil [4] (CY)	Cumulative Cover Soil (CY)
2013	96,125	58,796		83,995	234		11,466					
2014	98,507	60,253	60,253	86,076	240	86,076	11,750	11,750	86,076	86,076	11,750	11,750
2015	100,948	61,746	121,999	88,209	246	174,285	12,041	23,791	88,209	174,285	12,041	23,791
2016	103,450	63,276	185,275	90,395	252	264,679	12,340	36,131	90,395	264,679	12,340	36,131
2017	106,013	64,844	250,120	92,634	258	357,314	12,645	48,776	92,634	357,314	12,645	48,776
2018	108,538	66,388	316,508	94,841	264	452,154	12,947	61,723	94,841	452,154	12,947	61,723
2019	111,123	67,970	384,478	97,100	270	549,254	13,255	74,978	97,100	549,254	13,255	74,978
2020	113,770	69,588	454,066	99,412	277	648,666	13,571	88,548	99,412	648,666	13,571	88,548
2021	116,479	71,246	525,312	101,780	284	750,446	13,894	102,442	101,780	750,446	13,894	102,442
2022	119,253	72,943	598,255	104,204	290	854,650	14,225	116,666	104,204	854,650	14,225	116,666
2023	122,050	74,653	672,908	106,648	297	961,297	14,558	131,225	106,648	961,297	14,558	131,225
2024	124,912	76,404	749,312	109,149	304	1,070,446	14,900	146,124	109,149	1,070,446	14,900	146,124
2025	127,842	78,196	827,508	111,708	311	1,182,155	15,249	161,373	111,708	1,182,155	15,249	161,373
2026	130,840	80,030	907,538	114,328	318	1,296,483	15,607	176,980	114,328	1,296,483	15,607	176,980
2027	133,908	81,907	989,444	117,009	326	1,413,492	15,973	192,953	117,009	1,413,492	15,973	192,953
2028	136,733	83,634	1,073,079	119,478	333	1,532,970	16,310	209,263	119,478	1,532,970	16,310	209,263
2029	139,618	85,399	1,158,478	121,998	340	1,654,968	16,654	225,916	121,998	1,654,968	16,654	225,916
2030	142,563	87,200	1,245,678	124,572	347	1,779,540	17,005	242,921	124,572	1,779,540	17,005	242,921
2031	145,571	89,040	1,334,718	127,200	354	1,906,740	17,364	260,285	127,200	1,906,740	17,364	260,285
2032	148,642	90,918	1,425,637	129,883	362	2,036,624	17,730	278,015	129,883	2,036,624	17,730	278,015
2033	151,078	92,409	1,518,045	132,012	368	2,168,636	18,021	296,036	132,012	2,168,636	18,021	296,036
2034	153,554	93,923	1,611,968	134,176	374	2,302,812	18,316	314,352	134,176	2,302,812	18,316	314,352
2035	156,071	95,463	1,707,431	136,375	380	2,439,187	18,616	332,968	136,375	2,439,187	18,616	332,968
2036	158,629	97,027	1,804,458	138,610	386	2,577,797	18,921	351,890	138,610	2,577,797	18,921	351,890
2037	161,229	98,618	1,903,076	140,882	392	2,718,680	19,232	371,121	140,882	2,718,680	19,232	371,121
2038	163,587	100,060	2,003,135	142,942	398	2,861,622	19,513	390,634	142,942	2,861,622	19,513	390,634
2039	165,979	101,523	2,104,658	145,033	404	3,006,655	19,798	410,432	145,033	3,006,655	19,798	410,432
2040	168,406	103,007	2,207,666	147,153	410	3,153,808	20,088	430,520	14,715	3,021,370	5,468	415,900
2041	170,868	104,514	2,312,179	149,305	416	3,303,113	20,381	450,901	14,931	3,036,300	5,548	421,448
2042	173,367	106,042	2,418,221	151,489	422	3,454,602	20,679	471,581	15,149	3,051,449	5,629	427,077
2043	175,902	107,593	2,525,814	153,704	428	3,608,306	20,982	492,562	15,370	3,066,820	5,711	432,789
2044	178,474	109,166	2,634,980	155,951	434	3,764,257	21,289	513,851	15,595	3,082,415	5,795	438,583
2045	181,084	110,762	2,745,742	158,232	441	3,922,489	21,600	535,451	15,823	3,098,238	5,880	444,463
2046	183,732	112,382	2,858,124	160,546	447	4,083,035	21,916	557,367	16,055	3,114,293	5,966	450,429
2047	186,419	114,025	2,972,150	162,893	454	4,245,928	22,236	579,603	16,289	3,130,582	6,053	456,482
2048	189,145	115,693	3,087,842	165,275	460	4,411,203	22,561	602,164	16,528	3,147,109	6,141	462,623
2049	191,911	117,385	3,205,227	167,692	467	4,578,896	22,891	625,056	16,769	3,163,879	6,231	468,854
2050	194,717	119,101	3,324,328	170,144	474	4,749,040	23,226	648,282	17,014	3,180,893	6,322	475,176
2051	197,565	120,843	3,445,171	172,632	481	4,921,673	23,566	671,847	17,263	3,198,156	6,415	481,591
2052	200,454	122,610	3,567,781	175,157	488	5,096,829	23,910	695,758	17,516	3,215,672	6,509	488,100
2053	203,385	124,403	3,692,183	177,718	495	5,274,548	24,260	720,018	17,772	3,233,444	6,604	494,703
2054	206,359	126,222	3,818,405	180,317	502	5,454,865	24,615	744,632	18,032	3,251,476	6,700	501,404
2055	209,377	128,068	3,946,473	182,954	510	5,637,818	24,975	769,607	18,295	3,269,771	6,798	508,202
2056	212,438	129,940	4,076,413	185,629	517	5,823,447	25,340	794,947	18,563	3,288,334	6,898	515,100
2057	215,545	131,840	4,208,254	188,344	525	6,011,791	25,710	820,657	18,834	3,307,168	6,999	522,098
2058	218,697	133,768	4,342,022	191,098	532	6,202,889	26,086	846,743	19,110	3,326,278	7,101	529,199
2059	221,895	135,724	4,477,747	193,892	540	6,396,781	26,468	873,211	19,389	3,345,667	7,205	536,404
2060	225,139	137,709	4,615,456	196,727	548	6,593,508	26,855	900,066	19,673	3,365,340	7,310	543,714
2061	228,432	139,723	4,755,179	199,604	556	6,793,112	27,248	927,314	19,960	3,385,300	7,417	551,131

MATANUSKA-SUSITNA BOROUGH
Table A-1
Population, MSW Disposal, Landfill Air Space Requirements, and Cover Soil Requirements Forecast

				Landfilling Only					Landfilling with WTE[7]			
	Population[1,2]	MSW Disposal		Landfill Air Space Required			Cover Soil Required		Landfill Air Space Required		Cover Soil Required	
Year[6]		Yearly MSW (tons)	Cumulative MSW (tons)	Yearly Airspace [3] (CY)	Average Daily Airspace [9] (CY)	Cumulative Air Space (CY)	Yearly Cover Soil [4] (CY)	Cumulative Cover Soil (CY)	Yearly Airspace [3] (CY)	Cumulative Air Space (CY)	Yearly Cover Soil [4] (CY)	Cumulative Cover Soil (CY)
2062	231,772	141,766	4,896,945	202,523	564	6,995,635	27,646	954,960	20,252	3,405,553	7,525	558,656
2063	235,161	143,839	5,040,784	205,485	572	7,201,120	28,050	983,010	20,548	3,426,101	7,635	566,292
2064	238,600	145,943	5,186,726	208,489	581	7,409,609	28,460	1,011,470	20,849	3,446,950	7,747	574,039
2065	242,089	148,077	5,334,803	211,538	589	7,621,147	28,877	1,040,347	21,154	3,468,104	7,860	581,899
2066	245,629	150,242	5,485,045	214,631	598	7,835,779	29,299	1,069,646	21,463	3,489,567	7,975	589,875
2067	249,221	152,439	5,637,484	217,770	607	8,053,549	29,727	1,099,373	21,777	3,511,344	8,092	597,967
2068	252,865	154,668	5,792,152	220,954	615	8,274,503	30,162	1,129,535	22,095	3,533,439	8,210	606,177
2069	256,563	156,930	5,949,082	224,185	624	8,498,688	30,603	1,160,138	22,419	3,555,858	8,330	614,507
2070	260,315	159,225	6,108,307	227,464	634	8,726,152	31,051	1,191,189	22,746	3,578,604	8,452	622,959
2071	264,121	161,553	6,269,859	230,790	643	8,956,942	31,505	1,222,694	23,079	3,601,683	8,576	631,535
2072	267,984	163,915	6,433,775	234,165	652	9,191,107	31,965	1,254,659	23,416	3,625,100	8,701	640,236
2073	271,902	166,312	6,600,087	237,589	662	9,428,696	32,433	1,287,092	23,759	3,648,859	8,828	649,065
2074	275,878	168,744	6,768,831	241,063	671	9,669,759	32,907	1,319,999	24,106	3,672,965	8,958	658,022
2075	279,913	171,212	6,940,043	244,588	681	9,914,348	33,388	1,353,387	24,459	3,697,424	9,089	667,111
2076	284,006	173,715	7,113,759	248,165	691	10,162,513	33,876	1,387,264	24,816	3,722,240	9,221	676,332
2077	288,159	176,256	7,290,014	251,794	701	10,414,306	34,372	1,421,635	25,179	3,747,420	9,356	685,689
2078	292,373	178,833	7,468,848	255,476	712	10,669,782	34,874	1,456,510	25,548	3,772,967	9,493	695,182
2079	296,648	181,448	7,650,296	259,212	722	10,928,994	35,384	1,491,894	25,921	3,798,889	9,632	704,813
2080	300,986	184,102	7,834,397	263,002	733	11,191,996	35,902	1,527,796	26,300	3,825,189	9,773	714,586
2081	305,387	186,794	8,021,191	266,848	743	11,458,844	36,427	1,564,223	26,685	3,851,874	9,916	724,502
2082	309,853	189,525	8,210,716	270,750	754	11,729,595	36,960	1,601,183	27,075	3,878,949	10,061	734,562
2083	314,384	192,297	8,403,013	274,709	765	12,004,304	37,500	1,638,683	27,471	3,906,420	10,208	744,770
2084	318,981	195,109	8,598,121	278,727	776	12,283,031	38,048	1,676,731	27,873	3,934,292	10,357	755,127
2085	323,646	197,962	8,796,083	282,802	788	12,565,833	38,605	1,715,336	28,280	3,962,572	10,508	765,636
2086	328,378	200,856	8,996,939	286,938	799	12,852,771	39,169	1,754,505	28,694	3,991,266	10,662	776,298
2087	333,180	203,794	9,200,733	291,134	811	13,143,904	39,742	1,794,247	29,113	4,020,380	10,818	787,116
2088	338,052	206,774	9,407,507	295,391	823	13,439,295	40,323	1,834,570	29,539	4,049,919	10,976	798,092
2089	342,996	209,797	9,617,304	299,710	835	13,739,006	40,913	1,875,483	29,971	4,079,890	11,137	809,229
2090	348,011	212,865	9,830,169	304,093	847	14,043,099	41,511	1,916,994	30,409	4,110,299	11,300	820,529
2091	353,100	215,978	10,046,147	308,540	859	14,351,639	42,118	1,959,113	30,854	4,141,153	11,465	831,993
2092	358,264	219,136	10,265,283	313,052	872	14,664,691	42,734	2,001,847	31,305	4,172,458	11,632	843,626
2093	363,503	222,341	10,487,624	317,629	885	14,982,320	43,359	2,045,206	31,763	4,204,221	11,803	855,428
2094	368,818	225,592	10,713,216	322,274	898	15,304,594	43,993	2,089,199	32,227	4,236,449	11,975	867,404
2095	374,211	228,891	10,942,107	326,987	911	15,631,581	44,636	2,133,835	32,699	4,269,147	12,150	879,554
2096	379,684	232,238	11,174,345	331,768	924	15,963,349	45,289	2,179,124	33,177	4,302,324	12,328	891,882
2097	385,236	235,634	11,409,978	336,620	938	16,299,969	45,951	2,225,075	33,662	4,335,986	12,508	904,390
2098	390,869	239,080	11,649,058	341,542	951	16,641,511	46,623	2,271,698	34,154	4,370,140	12,691	917,081
2099	396,585	242,576	11,891,634	346,537	965	16,988,048	47,305	2,319,003	34,654	4,404,794	12,877	929,958
2100	402,384	246,123	12,137,757	351,604	979	17,339,652	47,997	2,367,000	35,160	4,439,954	13,065	943,023
2101	408,268	249,722	12,387,478	356,746	994	17,696,398	48,699	2,415,699	35,675	4,475,629	13,256	956,279
2102	414,238	253,374	12,640,852	361,962	1,008	18,058,360	49,411	2,465,109	36,196	4,511,825	13,450	969,729
2103	420,296	257,079	12,897,931	367,255	1,023	18,425,615	50,133	2,515,243	36,726	4,548,551	13,647	983,376
2104	426,442	260,838	13,158,769	372,626	1,038	18,798,241	50,866	2,566,109	37,263	4,585,813	13,846	997,222
2105	432,677	264,652	13,423,421	378,075	1,053	19,176,316	51,610	2,617,719	37,807	4,623,621	14,049	1,011,271
2106	439,005	268,522	13,691,943	383,603	1,069	19,559,919	52,365	2,670,084	38,360	4,661,981	14,254	1,025,525
2107	445,424	272,449	13,964,392	389,213	1,084	19,949,131	53,131	2,723,215	38,921	4,700,902	14,463	1,039,987
2108	451,938	276,433	14,240,825	394,904	1,100	20,344,036	53,908	2,777,122	39,490	4,740,393	14,674	1,054,661
2109	458,546	280,475	14,521,300	400,679	1,116	20,744,714	54,696	2,831,818	40,068	4,780,461	14,889	1,069,550
2110	465,252	284,577	14,805,877	406,538	1,132	21,151,252	55,496	2,887,314	40,654	4,821,114	15,106	1,084,656

MATANUSKA-SUSITNA BOROUGH
Table A-1
Population, MSW Disposal, Landfill Air Space Requirements, and Cover Soil Requirements Forecast

Year[6]	Population[1,2]	MSW Disposal		Landfilling Only					Landfilling with WTE[7]			
				Landfill Air Space Required			Cover Soil Required		Landfill Air Space Required		Cover Soil Required	
		Yearly MSW (tons)	Cumulative MSW (tons)	Yearly Airspace[3] (CY)	Average Daily Airspace[9] (CY)	Cumulative Air Space (CY)	Yearly Cover Soil[4] (CY)	Cumulative Cover Soil (CY)	Yearly Airspace[3] (CY)	Cumulative Air Space (CY)	Yearly Cover Soil[4] (CY)	Cumulative Cover Soil (CY)
2111	472,055	288,738	15,094,615	412,483	1,149	21,563,735	56,307	2,943,621	41,248	4,862,363	15,327	1,099,983
2112	478,958	292,960	15,387,575	418,515	1,166	21,982,250	57,131	3,000,751	41,851	4,904,214	15,551	1,115,535
2113	485,962	297,244	15,684,819	424,635	1,183	22,406,884	57,966	3,058,717	42,463	4,946,678	15,779	1,131,313
2114	493,068	301,591	15,986,410	430,844	1,200	22,837,728	58,814	3,117,531	43,084	4,989,762	16,009	1,147,323
2115	500,278	306,001	16,292,411	437,144	1,218	23,274,872	59,674	3,177,205	43,714	5,033,476	16,244	1,163,566
2116	507,594	310,476	16,602,886	443,537	1,235	23,718,409	60,546	3,237,751	44,354	5,077,830	16,481	1,180,047
2117	515,016	315,016	16,917,902	450,022	1,254	24,168,431	61,432	3,299,183	45,002	5,122,832	16,722	1,196,769
2118	522,547	319,622	17,237,524	456,603	1,272	24,625,035	62,330	3,361,513	45,660	5,168,493	16,967	1,213,736
2119	530,189	324,296	17,561,820	463,280	1,290	25,088,315	63,241	3,424,754	46,328	5,214,821	17,215	1,230,951
2120	537,942	329,038	17,890,859	470,055	1,309	25,558,369	64,166	3,488,920	47,005	5,261,826	17,466	1,248,417
2121	545,808	333,850	18,224,708	476,928	1,328	26,035,298	65,104	3,554,025	47,693	5,309,519	17,722	1,266,139
2122	553,789	338,732	18,563,440	483,902	1,348	26,519,200	66,057	3,620,081	48,390	5,357,909	17,981	1,284,120
2123	561,887	343,685	18,907,125	490,979	1,368	27,010,179	67,022	3,687,104	49,098	5,407,007	18,244	1,302,364
2124	570,104	348,711	19,255,836	498,158	1,388	27,508,337	68,003	3,755,106	49,816	5,456,823	18,511	1,320,875
2125	578,441	353,810	19,609,646	505,443	1,408	28,013,780	68,997	3,824,103	50,544	5,507,367	18,781	1,339,656
2126	586,899	358,984	19,968,629	512,834	1,429	28,526,613	70,006	3,894,109	51,283	5,558,650	19,056	1,358,712
2127	595,481	364,233	20,332,863	520,333	1,449	29,046,946	71,030	3,965,139	52,033	5,610,684	19,335	1,378,047
2128	604,189	369,559	20,702,422	527,942	1,471	29,574,888	72,068	4,037,207	52,794	5,663,478	19,617	1,397,665
2129	613,024	374,963	21,077,385	535,662	1,492	30,110,550	73,122	4,110,329	53,566	5,717,044	19,904	1,417,569
2130	621,989	380,447	21,457,832	543,495	1,514	30,654,046	74,191	4,184,520	54,350	5,771,394	20,195	1,437,764
2131	631,084	386,010	21,843,842	551,443	1,536	31,205,488	75,276	4,259,797	55,144	5,826,538	20,491	1,458,255
2132	640,312	391,654	22,235,496	559,506	1,559	31,764,995	76,377	4,336,174	55,951	5,882,489	20,790	1,479,045
2133	649,676	397,382	22,632,878	567,688	1,581	32,332,683	77,494	4,413,668	56,769	5,939,257	21,094	1,500,140
2134	659,176	403,193	23,036,070	575,989	1,604	32,908,672	78,627	4,492,295	57,599	5,996,856	21,403	1,521,543
2135	668,815	409,088	23,445,159	584,412	1,628	33,493,084	79,777	4,572,072	58,441	6,055,298	21,716	1,543,258
2136	678,595	415,071	23,860,230	592,958	1,652	34,086,042	80,943	4,653,015	59,296	6,114,593	22,033	1,565,292
2137	688,518	421,140	24,281,370	601,629	1,676	34,687,671	82,127	4,735,142	60,163	6,174,756	22,356	1,587,647
2138	698,586	427,299	24,708,668	610,427	1,700	35,298,098	83,328	4,818,470	61,043	6,235,799	22,682	1,610,330
2139	708,802	433,547	25,142,215	619,353	1,725	35,917,450	84,547	4,903,017	61,935	6,297,734	23,014	1,633,344
2140	719,167	439,887	25,582,102	628,410	1,750	36,545,860	85,783	4,988,800	62,841	6,360,575	23,351	1,656,695
2141	729,683	446,319	26,028,421	637,599	1,776	37,183,459	87,037	5,075,837	63,760	6,424,335	23,692	1,680,387
2142	740,353	452,846	26,481,267	646,923	1,802	37,830,381	88,310	5,164,147	64,692	6,489,027	24,039	1,704,425
2143	751,180	459,468	26,940,735	656,383	1,828	38,486,764	89,601	5,253,749	65,638	6,554,666	24,390	1,728,815
2144	762,164	466,187	27,406,921	665,981	1,855	39,152,745	90,912	5,344,660	66,598	6,621,264	24,747	1,753,562
2145	773,309	473,004	27,879,925	675,720	1,882	39,828,464	92,241	5,436,901	67,572	6,688,836	25,109	1,778,671
2146	784,617	479,920	28,359,845	685,601	1,910	40,514,065	93,590	5,530,491	68,560	6,757,396	25,476	1,804,147
2147	796,091	486,938	28,846,784	695,626	1,938	41,209,691	94,958	5,625,450	69,563	6,826,958	25,848	1,829,995
2148	807,732	494,059	29,340,843	705,798	1,966	41,915,489	96,347	5,721,797	70,580	6,897,538	26,226	1,856,221
2149	819,544	501,283	29,842,126	716,119	1,995	42,631,609	97,756	5,819,553	71,612	6,969,150	26,610	1,882,831
2150	831,528	508,614	30,350,740	726,591	2,024	43,358,200	99,185	5,918,738	72,659	7,041,809	26,999	1,909,830
2151	843,687	516,051	30,866,791	737,216	2,054	44,095,416	100,636	6,019,374	73,722	7,115,531	27,394	1,937,224
2152	856,025	523,598	31,390,389	747,996	2,084	44,843,412	102,107	6,121,481	74,800	7,190,330	27,794	1,965,018
2153	868,542	531,254	31,921,643	758,934	2,114	45,602,347	103,601	6,225,082	75,893	7,266,224	28,201	1,993,219
2154	881,243	539,023	32,460,665	770,032	2,145	46,372,379	105,116	6,330,198	77,003	7,343,227	28,613	2,021,832
2155	894,130	546,905	33,007,570	781,293	2,176	47,153,672	106,653	6,436,850	78,129	7,421,356	29,032	2,050,864
2156	907,204	554,902	33,562,472	792,717	2,208	47,946,389	108,212	6,545,062	79,272	7,500,628	29,456	2,080,320
2157	920,471	563,017	34,125,489	804,309	2,240	48,750,699	109,795	6,654,857	80,431	7,581,059	29,887	2,110,207
2158	933,931	571,250	34,696,739	816,071	2,273	49,566,770	111,400	6,766,257	81,607	7,662,666	30,324	2,140,530
2159	947,588	579,603	35,276,342	828,004	2,306	50,394,774	113,029	6,879,286	82,800	7,745,466	30,767	2,171,298

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Table A-1

Population, MSW Disposal, Landfill Air Space Requirements, and Cover Soil Requirements Forecast

				Landfilling Only					Landfilling with WTE[7]			
	Population[1,2]	MSW Disposal		Landfill Air Space Required			Cover Soil Required		Landfill Air Space Required		Cover Soil Required	
Year[6]		Yearly MSW (tons)	Cumulative MSW (tons)	Yearly Airspace [3] (CY)	Average Daily Airspace [9] (CY)	Cumulative Air Space (CY)	Yearly Cover Soil [4] (CY)	Cumulative Cover Soil (CY)	Yearly Airspace [3] (CY)	Cumulative Air Space (CY)	Yearly Cover Soil [4] (CY)	Cumulative Cover Soil (CY)
2160	961,444	588,079	35,864,420	840,112	2,340	51,234,886	114,682	6,993,968	84,011	7,829,478	31,217	2,202,515
2161	975,503	596,678	36,461,098	852,397	2,374	52,087,283	116,359	7,110,327	85,240	7,914,717	31,674	2,234,189
2162	989,768	605,403	37,066,502	864,862	2,409	52,952,145	118,061	7,228,388	86,486	8,001,204	32,137	2,266,326
2163	1,004,242	614,256	37,680,758	877,509	2,444	53,829,654	119,787	7,348,175	87,751	8,088,955	32,607	2,298,932
2164	1,018,927	623,238	38,303,996	890,341	2,480	54,719,995	121,539	7,469,713	89,034	8,177,989	33,084	2,332,016
2165	1,033,827	632,352	38,936,349	903,360	2,516	55,623,355	123,316	7,593,029	90,336	8,268,325	33,567	2,365,583
2166	1,048,944	641,599	39,577,948	916,570	2,553	56,539,925	125,119	7,718,148	91,657	8,359,982	34,058	2,399,642
2167	1,064,283	650,981	40,228,929	929,973	2,590	57,469,898	126,949	7,845,097	92,997	8,452,979	34,556	2,434,198
2168	1,079,846	660,501	40,889,429	943,572	2,628	58,413,470	128,805	7,973,902	94,357	8,547,336	35,062	2,469,260
2169	1,095,637	670,159	41,559,588						95,737	8,643,073	35,574	2,504,834
2170	1,111,658	679,959	42,239,547						97,137	8,740,210	36,095	2,540,928
2171	1,127,914	689,902	42,929,449						98,557	8,838,768	36,622	2,577,551
2172	1,144,408	699,990	43,629,439						99,999	8,938,766	37,158	2,614,709
2173	1,161,142	710,226	44,339,666						101,461	9,040,227	37,701	2,652,410
2174	1,178,122	720,612	45,060,278						102,945	9,143,172	38,253	2,690,662
2175	1,195,350	731,150	45,791,427						104,450	9,247,622	38,812	2,729,474
2176	1,212,829	741,841	46,533,268						105,977	9,353,599	39,379	2,768,854
2177	1,230,565	752,689	47,285,958						107,527	9,461,126	39,955	2,808,809
2178	1,248,559	763,696	48,049,653						109,099	9,570,225	40,540	2,849,349
2179	1,266,817	774,863	48,824,517						110,695	9,680,920	41,132	2,890,481
2180	1,285,342	786,194	49,610,711						112,313	9,793,234	41,734	2,932,215
2181	1,304,137	797,691	50,408,402						113,956	9,907,189	42,344	2,974,559
2182	1,323,208	809,355	51,217,757						115,622	10,022,812	42,963	3,017,522
2183	1,342,557	821,191	52,038,948						117,313	10,140,125	43,592	3,061,114
2184	1,362,189	833,199	52,872,147						119,028	10,259,153	44,229	3,105,343
2185	1,382,109	845,383	53,717,530						120,769	10,379,922	44,876	3,150,219
2186	1,402,319	857,745	54,575,275						122,535	10,502,457	45,532	3,195,751
2187	1,422,825	870,288	55,445,563						124,327	10,626,784	46,198	3,241,949
2188	1,443,632	883,014	56,328,577						126,145	10,752,929	46,873	3,288,822
2189	1,464,742	895,926	57,224,503						127,989	10,880,918	47,559	3,336,381
2190	1,486,161	909,028	58,133,531						129,861	11,010,779	48,254	3,384,635
2191	1,507,893	922,320	59,055,851						131,760	11,142,539	48,960	3,433,595
2192	1,529,943	935,808	59,991,659						133,687	11,276,226	49,676	3,483,271
2193	1,552,315	949,492	60,941,151						135,642	11,411,868	50,402	3,533,673
2194	1,575,015	963,376	61,904,527						137,625	11,549,493	51,139	3,584,812
2195	1,598,047	977,464	62,881,991						139,638	11,689,131	51,887	3,636,699
2196	1,621,415	991,757	63,873,748						141,680	11,830,810	52,646	3,689,345
2197	1,645,125	1,006,260	64,880,008						143,751	11,974,562	53,416	3,742,761
2198	1,669,182	1,020,974	65,900,983						145,853	12,120,415	54,197	3,796,958
2199	1,693,590	1,035,904	66,936,887						147,986	12,268,402	54,989	3,851,947
2200	1,718,356	1,051,052	67,987,939						150,150	12,418,552	55,793	3,907,740
2201	1,743,483	1,066,422	69,054,361						152,346	12,570,898	56,609	3,964,350
2202	1,768,978	1,082,016	70,136,377						154,574	12,725,472	57,437	4,021,787
2203	1,794,846	1,097,839	71,234,216						156,834	12,882,306	58,277	4,080,064
2204	1,821,092	1,113,892	72,348,108						159,127	13,041,433	59,129	4,139,193
2205	1,847,722	1,130,181	73,478,289						161,454	13,202,888	59,994	4,199,187
2206	1,874,742	1,146,708	74,624,997						163,815	13,366,703	60,871	4,260,058
2207	1,902,156	1,163,476	75,788,473						166,211	13,532,914	61,761	4,321,819
2208	1,929,971	1,180,489	76,968,962						168,641	13,701,555	62,664	4,384,484

MATANUSKA-SUSITNA BOROUGH
Table A-1
Population, MSW Disposal, Landfill Air Space Requirements, and Cover Soil Requirements Forecast

Year[6]	Population[1,2]	MSW Disposal		Landfilling Only: Landfill Air Space Required			Landfilling Only: Cover Soil Required		Landfilling with WTE[7]: Landfill Air Space Required		Landfilling with WTE[7]: Cover Soil Required	
		Yearly MSW (tons)	Cumulative MSW (tons)	Yearly Airspace [3] (CY)	Average Daily Airspace [9] (CY)	Cumulative Air Space (CY)	Yearly Cover Soil [4] (CY)	Cumulative Cover Soil (CY)	Yearly Airspace [3] (CY)	Cumulative Air Space (CY)	Yearly Cover Soil [4] (CY)	Cumulative Cover Soil (CY)
2209	1,958,193	1,197,752	78,166,714						171,107	13,872,663	63,581	4,448,064
2210	1,986,828	1,215,267	79,381,981						173,610	14,046,272	64,510	4,512,575
2211	2,015,882	1,233,038	80,615,018						176,148	14,222,420	65,454	4,578,029
2212	2,045,360	1,251,068	81,866,087						178,724	14,401,144	66,411	4,644,440
2213	2,075,269	1,269,363	83,135,449						181,338	14,582,482	67,382	4,711,822
2214	2,105,616	1,287,925	84,423,374						183,989	14,766,471	68,367	4,780,189
2215	2,136,407	1,306,758	85,730,132						186,680	14,953,151	69,367	4,849,556
2216	2,167,647	1,325,867	87,055,999						189,410	15,142,560	70,382	4,919,938
2217	2,199,345	1,345,255	88,401,254						192,179	15,334,740	71,411	4,991,348
2218	2,231,506	1,364,927	89,766,181						194,990	15,529,729	72,455	5,063,803
2219	2,264,138	1,384,886	91,151,067						197,841	15,727,570	73,514	5,137,318
2220	2,297,246	1,405,137	92,556,205						200,734	15,928,304	74,589	5,211,907
2221	2,330,839	1,425,685	93,981,889						203,669	16,131,973	75,680	5,287,588
2222	2,364,923	1,446,533	95,428,422						206,648	16,338,621	76,787	5,364,374
2223	2,399,505	1,467,685	96,896,108						209,669	16,548,290	77,910	5,442,284
2224	2,434,593	1,489,147	98,385,255						212,735	16,761,026	79,049	5,521,333
2225	2,470,195	1,510,923	99,896,179						215,846	16,976,872	80,205	5,601,538
2226	2,506,316	1,533,018	101,429,196						219,003	17,195,874	81,378	5,682,916
2227	2,542,966	1,555,435	102,984,631						222,205	17,418,079	82,568	5,765,484
2228	2,580,152	1,578,180	104,562,812						225,454	17,643,534	83,775	5,849,259
2229	2,617,882	1,601,258	106,164,070						228,751	17,872,285	85,000	5,934,259
2230	2,656,163	1,624,673	107,788,743						232,096	18,104,381	86,243	6,020,502
2231	2,695,005	1,648,431	109,437,174						235,490	18,339,871	87,504	6,108,007
2232	2,734,414	1,672,536	111,109,710						238,934	18,578,805	88,784	6,196,790
2233	2,774,399	1,696,994	112,806,704						242,428	18,821,233	90,082	6,286,873
2234	2,814,969	1,721,809	114,528,513						245,973	19,067,205	91,399	6,378,272
2235	2,856,133	1,746,987	116,275,500						249,570	19,316,775	92,736	6,471,008
2236	2,897,898	1,772,533	118,048,033						253,219	19,569,994	94,092	6,565,100
2237	2,940,274	1,798,453	119,846,486						256,922	19,826,916	95,468	6,660,568
2238	2,983,270	1,824,752	121,671,238						260,679	20,087,595	96,864	6,757,432
2239	3,026,895	1,851,435	123,522,674						264,491	20,352,085	98,280	6,855,713
2240	3,071,157	1,878,509	125,401,183						268,358	20,620,444	99,718	6,955,430
2241	3,116,067	1,905,979	127,307,161						272,283	20,892,726	101,176	7,056,606
2242	3,161,633	1,933,850	129,241,011						276,264	21,168,991	102,655	7,159,261
2243	3,207,866	1,962,129	131,203,140						280,304	21,449,295	104,156	7,263,418
2244	3,254,775	1,990,821	133,193,961						284,403	21,733,698	105,680	7,369,097
2245	3,302,369	2,019,933	135,213,894						288,562	22,022,260	107,225	7,476,322
2246	3,350,660	2,049,470	137,263,364						292,781	22,315,041	108,793	7,585,115
2247	3,399,657	2,079,440	139,342,804						297,063	22,612,104	110,384	7,695,499
2248	3,449,370	2,109,848	141,452,651						301,407	22,913,511	111,998	7,807,497
2249	3,499,811	2,140,700	143,593,351						305,814	23,219,325	113,636	7,921,132
2250	3,550,988	2,172,004	145,765,355						310,286	23,529,611	115,297	8,036,430
2251	3,602,915	2,203,765	147,969,120						314,824	23,844,435	116,983	8,153,413
2252	3,655,600	2,235,991	150,205,111						319,427	24,163,862	118,694	8,272,107
2253	3,709,056	2,268,688	152,473,798						324,098	24,487,960	120,430	8,392,537
2254	3,763,294	2,301,863	154,775,661						328,838	24,816,798	122,191	8,514,727
2255	3,818,325	2,335,523	157,111,184						333,646	25,150,444	123,977	8,638,705
2256	3,874,160	2,369,676	159,480,860						338,525	25,488,969	125,790	8,764,495
2257	3,930,813	2,404,327	161,885,187						343,475	25,832,444	127,630	8,892,125

MATANUSKA-SUSITNA BOROUGH

Table A-1

Population, MSW Disposal, Landfill Air Space Requirements, and Cover Soil Requirements Forecast

				Landfilling Only					Landfilling with WTE[7]			
	Population[1,2]	MSW Disposal		Landfill Air Space Required			Cover Soil Required		Landfill Air Space Required		Cover Soil Required	
Year[6]		Yearly MSW (tons)	Cumulative MSW (tons)	Yearly Airspace [3] (CY)	Average Daily Airspace [9] (CY)	Cumulative Air Space (CY)	Yearly Cover Soil [4] (CY)	Cumulative Cover Soil (CY)	Yearly Airspace [3] (CY)	Cumulative Air Space (CY)	Yearly Cover Soil [4] (CY)	Cumulative Cover Soil (CY)
2258	3,988,293	2,439,486	164,324,673						348,498	26,180,942	129,496	9,021,621
2259	4,046,614	2,475,159	166,799,832						353,594	26,534,537	131,390	9,153,011
2260	4,105,788	2,511,353	169,311,185						358,765	26,893,301	133,311	9,286,322
2261	4,165,827	2,548,077	171,859,262						364,011	27,257,312	135,261	9,421,583
2262	4,226,744	2,585,337	174,444,599						369,334	27,626,646	137,238	9,558,821
2263	4,288,552	2,623,143	177,067,742						374,735	28,001,381	139,245	9,698,067
2264	4,351,264	2,661,501	179,729,243						380,214	28,381,595	141,282	9,839,348
2265	4,414,892	2,700,421	182,429,664						385,774	28,767,370	143,347	9,982,696
2266	4,479,452	2,739,909	185,169,573						391,416	29,158,785	145,444	10,128,139
2267	4,544,955	2,779,975	187,949,548						397,139	29,555,924	147,570	10,275,710
2268	4,611,416	2,820,626	190,770,174						402,947	29,958,871	149,728	10,425,438
2269	4,678,849	2,861,873	193,632,047						408,839	30,367,710	151,918	10,577,356
2270	4,747,268	2,903,722	196,535,769						414,817	30,782,527	154,139	10,731,496
2271	4,816,687	2,946,183	199,481,952						420,883	31,203,411	156,393	10,887,889
2272	4,887,122	2,989,265	202,471,217						427,038	31,630,449	158,680	11,046,569
2273	4,958,587	3,032,978	205,504,195						433,283	32,063,731	161,001	11,207,570
2274	5,031,096	3,077,329	208,581,524						439,618	32,503,350	163,355	11,370,925
2275	5,104,666	3,122,329	211,703,853						446,047	32,949,397	165,744	11,536,669
2276	5,179,312	3,167,987	214,871,840						452,570	33,401,966	168,167	11,704,837
2277	5,255,050	3,214,312	218,086,152						459,187	33,861,154	170,627	11,875,463
2278	5,331,894	3,261,316	221,347,468						465,902	34,327,056	173,122	12,048,585
2279	5,409,863	3,309,006	224,656,473						472,715	34,799,771	175,653	12,224,238
2280	5,488,972	3,357,394	228,013,867						479,628	35,279,399	178,222	12,402,460
2281	5,569,237	3,406,489	231,420,356						486,641	35,766,040	180,828	12,583,288
2282	5,650,676	3,456,302	234,876,658						493,757	36,259,797	183,472	12,766,760
2283	5,733,306	3,506,844	238,383,502						500,978	36,760,775	186,155	12,952,915
2284	5,817,145	3,558,125	241,941,627						508,304	37,269,079	188,877	13,141,793
2285	5,902,209	3,610,155	245,551,782						515,736	37,784,815	191,639	13,333,432
2286	5,988,518	3,662,947	249,214,729						523,278	38,308,093	194,442	13,527,874
2287	6,076,088	3,716,510	252,931,239						530,930	38,839,023	197,285	13,725,159
2288	6,164,939	3,770,857	256,702,096						538,694	39,377,717	200,170	13,925,329
2289	6,255,089	3,825,998	260,528,095						546,571	39,924,288	203,097	14,128,426
2290	6,346,558	3,881,946	264,410,041						554,564	40,478,852	206,067	14,334,492
2291	6,439,364	3,938,712	268,348,753						562,673	41,041,525	209,080	14,543,573
2292	6,533,527	3,996,308	272,345,061						570,901	41,612,426	212,138	14,755,710
2293	6,629,067	4,054,746	276,399,807						579,249	42,191,676	215,240	14,970,950
2294	6,726,004	4,114,039	280,513,846						587,720	42,779,396	218,387	15,189,337
2295	6,824,359	4,174,199	284,688,045						596,314	43,375,710	221,581	15,410,918
2296	6,924,152	4,235,238	288,923,283						605,034	43,980,744	224,821	15,635,739
2297	7,025,404	4,297,170	293,220,454						613,881	44,594,625	228,108	15,863,847
2298	7,128,137	4,360,008	297,580,462						622,858	45,217,484	231,444	16,095,291
2299	7,232,372	4,423,765	302,004,227						631,966	45,849,450	234,828	16,330,119
2300	7,338,131	4,488,454	306,492,681						641,208	46,490,658	238,262	16,568,382
2301	7,445,437	4,554,089	311,046,769						650,584	47,141,242	241,746	16,810,128
2302	7,554,312	4,620,683	315,667,452						660,098	47,801,339	245,282	17,055,410
2303	7,664,779	4,688,252	320,355,704						669,750	48,471,090	248,868	17,304,278
2304	7,776,862	4,756,808	325,112,512						679,544	49,150,634	252,508	17,556,786
2305	7,890,583	4,826,367	329,938,880						689,481	49,840,115	256,200	17,812,986
2306	8,005,967	4,896,944	334,835,823						699,563	50,539,678	259,946	18,072,932

MATANUSKA-SUSITNA BOROUGH
Table A-1
Population, MSW Disposal, Landfill Air Space Requirements, and Cover Soil Requirements Forecast

Year[6]	Population[1,2]	MSW Disposal		Landfilling Only					Landfilling with WTE[7]			
				Landfill Air Space Required			Cover Soil Required		Landfill Air Space Required		Cover Soil Required	
		Yearly MSW (tons)	Cumulative MSW (tons)	Yearly Airspace [3] (CY)	Average Daily Airspace [9] (CY)	Cumulative Air Space (CY)	Yearly Cover Soil [4] (CY)	Cumulative Cover Soil (CY)	Yearly Airspace [3] (CY)	Cumulative Air Space (CY)	Yearly Cover Soil [4] (CY)	Cumulative Cover Soil (CY)
2307	8,123,039	4,968,552	339,804,375						709,793	51,249,471	263,748	18,336,680
2308	8,241,823	5,041,207	344,845,582						720,172	51,969,644	267,604	18,604,284
2309	8,362,343	5,114,925	349,960,507						730,704	52,700,347	271,518	18,875,802
2310	8,484,626	5,189,721	355,150,228						741,389	53,441,736	275,488	19,151,290
2311	8,608,697	5,265,610	360,415,838						752,230	54,193,966	279,516	19,430,806
2312	8,734,583	5,342,610	365,758,448						763,230	54,957,196	283,604	19,714,410
2313	8,862,309	5,420,735	371,179,183						774,391	55,731,587	287,751	20,002,161
2314	8,991,903	5,500,003	376,679,185						785,715	56,517,301	291,959	20,294,120
2315	9,123,392	5,580,429	382,259,615						797,204	57,314,505	296,228	20,590,348
2316	9,256,804	5,662,032	387,921,647						808,862	58,123,367	300,560	20,890,908
2317	9,392,166	5,744,828	393,666,475						820,690	58,944,057	304,955	21,195,863
2318	9,529,509	5,828,835	399,495,310						832,691	59,776,748	309,414	21,505,277

[1] 2005 to 2030 Population Source: *Memorandum on the Economic and Demographic Impacts of a Knik Arm Bridge* ; Scott Goldsmith, ISER University of Alaska Anchorage; September 2005; Table 22A. Matanuska-Susitna Borough Census Area 2005 Knik Arm Base Case With Bridge; Page 88.

[2] 2032 growth rate and beyond assumed to be same as Alaska Department of Labor and Workforce Development, Research and Analysis Section data 1.64%

[3] Pounds of MSW per CY of Air Space = 1400

[4] Cover Soil to Air Space Ratio = 14%

[5] Cover Soil to Air Space Ratio (Ash) = 37%

[6] Base year assumed 2013

[7] Landfilling with WTE begins 2040. Assume 90% reduction in waste volume.

[8] Total airspace (including liner system and cover system) available is 56,570,000 CY, which includes 1,860,000 CY of liner/cover system soils

[9] Based on 359 day year

CY = cubic yards

MATANUSKA-SUSITNA BOROUGH

Table A-2

Population, C&D Disposal, Landfill Air Space Requirements, and Cover Soil Requirements Forecast

				Landfilling Only			
	Population[1,2]	C&D Disposal		Landfill Air Space Required		Cover Soil Required	
Year[6]		Yearly C&D (tons)	Cumulative C&D (tons)	Yearly Airspace[3] (CY)	Cumulative Air Space (CY)	Yearly Cover Soil[4] (CY)	Cumulative Cover Soil (CY)
2013	96,125	11,631					
2014	98,507	11,919	11,919	14,324	14,324	3,282	3,282
2015	100,948	12,214	24,133	14,679	29,004	3,363	6,646
2016	103,450	12,517	36,650	15,043	44,047	3,447	10,092
2017	106,013	12,827	49,477	15,416	59,463	3,532	13,625
2018	108,538	13,133	62,610	15,783	75,246	3,616	17,241
2019	111,123	13,445	76,055	16,159	91,404	3,702	20,943
2020	113,770	13,766	89,821	16,544	107,948	3,791	24,734
2021	116,479	14,094	103,915	16,938	124,886	3,881	28,615
2022	119,253	14,429	118,344	17,341	142,227	3,973	32,588
2023	122,050	14,768	133,111	17,748	159,975	4,067	36,655
2024	124,912	15,114	148,225	18,164	178,139	4,162	40,817
2025	127,842	15,468	163,694	18,590	196,729	4,260	45,076
2026	130,840	15,831	179,525	19,026	215,755	4,359	49,436
2027	133,908	16,202	195,727	19,472	235,227	4,462	53,897
2028	136,733	16,544	212,271	19,883	255,110	4,556	58,453
2029	139,618	16,893	229,164	20,302	275,413	4,652	63,105
2030	142,563	17,250	246,414	20,731	296,143	4,750	67,855
2031	145,571	17,613	264,027	21,168	317,311	4,850	72,705
2032	148,642	17,985	282,012	21,615	338,926	4,953	77,658
2033	151,078	18,280	300,292	21,969	360,895	5,034	82,691
2034	153,554	18,579	318,872	22,329	383,224	5,116	87,808
2035	156,071	18,884	337,756	22,695	405,919	5,200	93,008
2036	158,629	19,193	356,949	23,067	428,986	5,285	98,293
2037	161,229	19,508	376,457	23,445	452,431	5,372	103,665
2038	163,587	19,793	396,250	23,788	476,219	5,450	109,115
2039	165,979	20,083	416,333	24,136	500,354	5,530	114,646
2040	168,406	20,376	436,710	24,489	524,843	5,611	120,257
2041	170,868	20,674	457,384	24,847	549,690	5,693	125,950
2042	173,367	20,977	478,361	25,210	574,900	5,776	131,726
2043	175,902	21,283	499,644	25,579	600,478	5,861	137,587
2044	178,474	21,595	521,239	25,953	626,431	5,947	143,533
2045	181,084	21,910	543,149	26,332	652,763	6,033	149,567
2046	183,732	22,231	565,380	26,717	679,481	6,122	155,689

MATANUSKA-SUSITNA BOROUGH
Table A-2
Population, C&D Disposal, Landfill Air Space Requirements, and Cover Soil Requirements Forecast

Year[6]	Population[1,2]	C&D Disposal		Landfilling Only			
				Landfill Air Space Required		Cover Soil Required	
		Yearly C&D (tons)	Cumulative C&D (tons)	Yearly Airspace[3] (CY)	Cumulative Air Space (CY)	Yearly Cover Soil[4] (CY)	Cumulative Cover Soil (CY)
2047	186,419	22,556	587,936	27,108	706,589	6,211	161,900
2048	189,145	22,886	610,822	27,504	734,093	6,302	168,202

[1] 2005 to 2030 Population Source: *Memorandum on the Economic and Demographic Impacts of a Knik Arm Bridge* ; Scott Goldsmith, ISER University of Alaska Anchorage; September 2005; Table 22A. Matanuska-Susitna Borough Census Area 2005 Knik Arm Base Case With Bridge; Page 88.

[2] 2032 growth rate and beyond assumed to be same as Alaska Department of Labor and Workforce Development, Research and Analysis Section data 1.64%

[3] Pounds of C&D per cy of Air Space = 1664

[4] Cover Soil to Air Space Ratio = 23%

[6] Base year assumed 2013

[6] Total airspace available is 690,000 cubic yards. Assume 1 foot of cover over C&D is adequate for final cover.

CY = cubic yards

Appendix B
Matanuska-Susitna Landfill:
Stability Evaluation Technical Memorandum

Matanuska-Susitna Landfill: Stability Evaluation

PREPARED FOR: Wright, Shannon/SAC

COPY TO: Harris, Dean/SAC

PREPARED BY: Mayer, Andrew/SAC

DATE: July 28, 2014

PROJECT NUMBER: 496410

This memorandum was prepared to summarize a stability analysis performed on three cross sections of the Matanuska-Susitna Borough Central Landfill. Material properties, geotechnical design criteria, and analyses are summarized below.

Material Properties

Material properties are based on properties used for previous studies. The landfill is comprised of waste overlying an impermeable barrier of a geosynthetic clay liner, granular drain material and an HDPE geomembrane, which overlies native soil.

TABLE 1
Material Properties for Analysis
Mat-Su Landfill

Material/Interface	Peak Friction Angle/ Cohesion Intercept	Residual Friction Angle/ Cohesion Intercept	Unit Weight (pcf)
GCL/HDPE	26˚, 500 psf	10˚, 500 psf	120
HDPE/ Granular Drain Material	28˚, 0 psf	28˚, 0 psf	120
Native Soil	35˚, 0 psf	35˚, 0 psf	130
Waste	20˚, 600 psf	20˚, 600 psf	75

Design Criteria

Shear strength and other stability considerations for geotechnical evaluation are based on previous studies (CH2M HILL, 2010). Mohr-Coulomb effective stress failure criterion was used for all analyses.

Three failure scenarios were considered for analysis of each landfill cross section. The slope stability software SLIDE was used to evaluate a circular slope failure, a block failure near or through the lining material, and failure through the lining. Static and seismic loading were evaluated for each failure mechanism. A minimum factor of safety of 1.5 and 1.0 are required for static and seismic conditions, respectively.

Stark (1994) recommended the use of residual shear strength along the side slopes to account for "down-drag" shearing or the displacements exerted on the lining system due to the settlement of landfill waste. The critical component of the lining system along the side slopes is the GCL at residual internal shear strength. Lining along the base will not be subject to downdrag and therefore the critical component to be considered is the interface strength of the HDPE geomembrane with the granular drain material.

Water level is conservatively assumed to be 6 feet above the lowest point of the landfill lining. This is not anticipated to occur in landfill operations but is intended to be a worst case scenario.

A horizontal pseudo static coefficient of 0.13, approximately half of the site peak ground acceleration, 0.25g, of the 50 year recurrence earthquake, is used for seismic analyses.

Results

SLIDE output results can be found in Attachment 1 of this memo and are summarized in tabular format below.

TABLE 2
SLIDE ANALYSIS RESULTS
Mat-Su Landfill – Cross Section A

Slip Surface	Case	Analysis Method	Required Factor of Safety	Computed Factor of Safety
Circular	Static	Spencer	1.5	2.0
	Seismic	Spencer	1.0	1.4
Block	Static	Spencer	1.5	2.1
	Seismic	Spencer	1.0	1.5
Lining System	Static	Spencer	1.5	2.1
	Seismic	Spencer	1.0	1.4

Note: Seismic analysis performed using horizontal pseudo-static coefficient of 0.13.

TABLE 3
SLIDE ANALYSIS RESULTS
Mat-Su Landfill – Cross Section B

Slip Surface	Case	Analysis Method	Required Factor of Safety	Computed Factor of Safety
Circular	Static	Spencer	1.5	2.0
	Seismic	Spencer	1.0	1.3
Block	Static	Spencer	1.5	2.2
	Seismic	Spencer	1.0	1.5
Lining System	Static	Spencer	1.5	2.2
	Seismic	Spencer	1.0	1.4

Note: Seismic analysis performed using horizontal pseudo-static coefficient of 0.13.

TABLE 4
SLIDE ANALYSIS RESULTS
Mat-Su Landfill – Cross Section D

Slip Surface	Case	Analysis Method	Required Factor of Safety	Computed Factor of Safety
Circular	Static	Spencer	1.5	2.1
	Seismic	Spencer	1.0	1.4
Block	Static	Spencer	1.5	2.1
	Seismic	Spencer	1.0	1.4
Lining System	Static	Spencer	1.5	2.1
	Seismic	Spencer	1.0	1.5

Note: Seismic analysis performed using horizontal pseudo-static coefficient of 0.13.

Conclusions

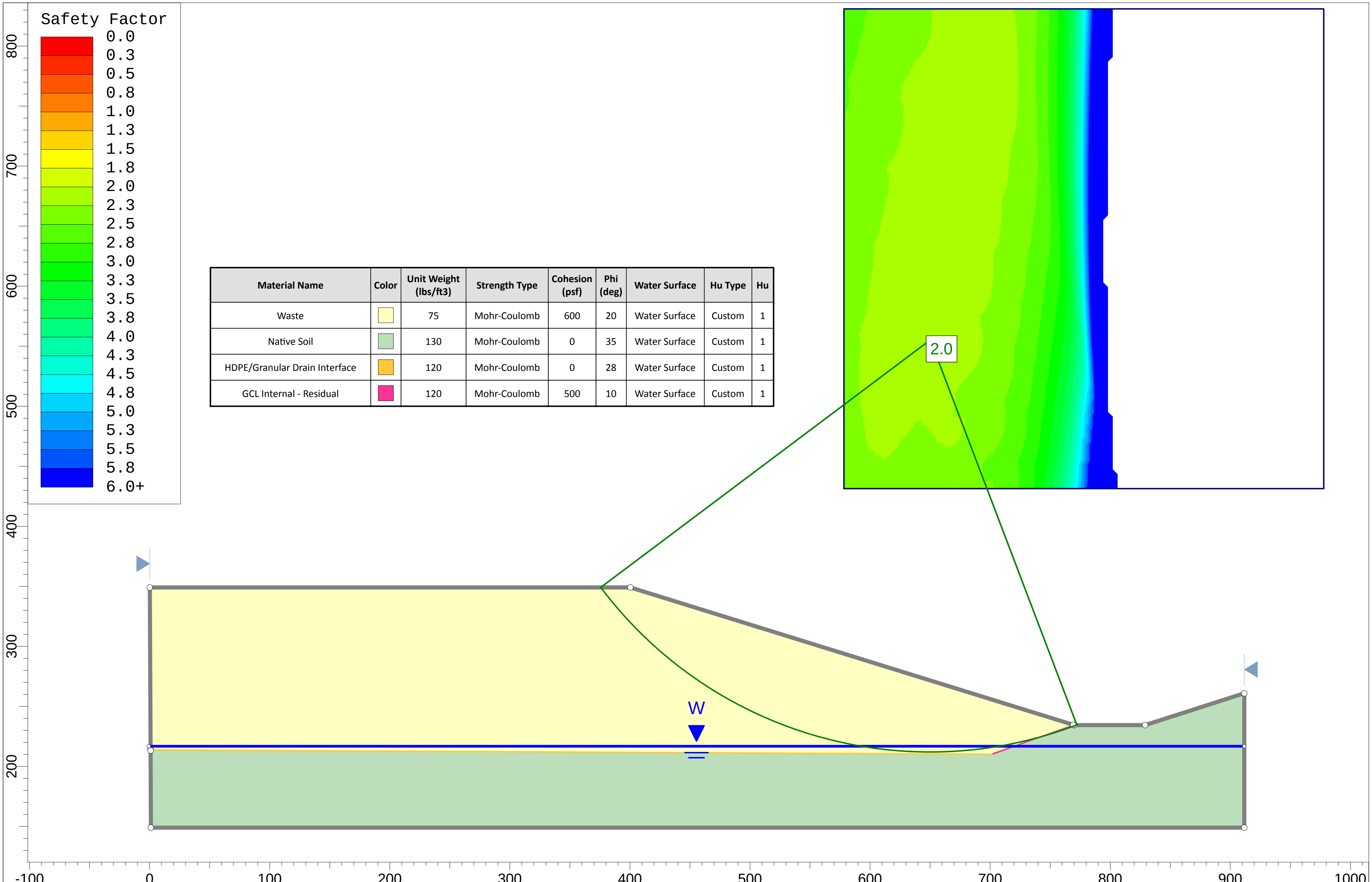
Acceptable factors of safety were calculated for cross sections A, B, and D for each of the considered potential failure modes. The computed factors of safety are similar in all each of the three cases and are well above required limits.

References

CH2M HILL (2010). Slope Stability Evaluation, Leachate Collection System Improvements Design Project, Prepared for Mat-Su Borough, Alaska. October 2010.

Rocscience, Inc. (2014). SLIDE Computer Software. Version 6.029, Build date: April 25, 2014.

Attachment 1
SLIDE OUTPUT



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Waste		75	Mohr-Coulomb	600	20	Water Surface	Custom	1
Native Soil		130	Mohr-Coulomb	0	35	Water Surface	Custom	1
HDPE/Granular Drain Interface		120	Mohr-Coulomb	0	28	Water Surface	Custom	1
GCL Internal - Residual		120	Mohr-Coulomb	500	10	Water Surface	Custom	1

CH2MHILL

SLIDEINTERPRET 6.029

Project	Matanuska-Susitna Borough Central Landfill				
Case	**Section A Circular Failure - Static**				
Description					
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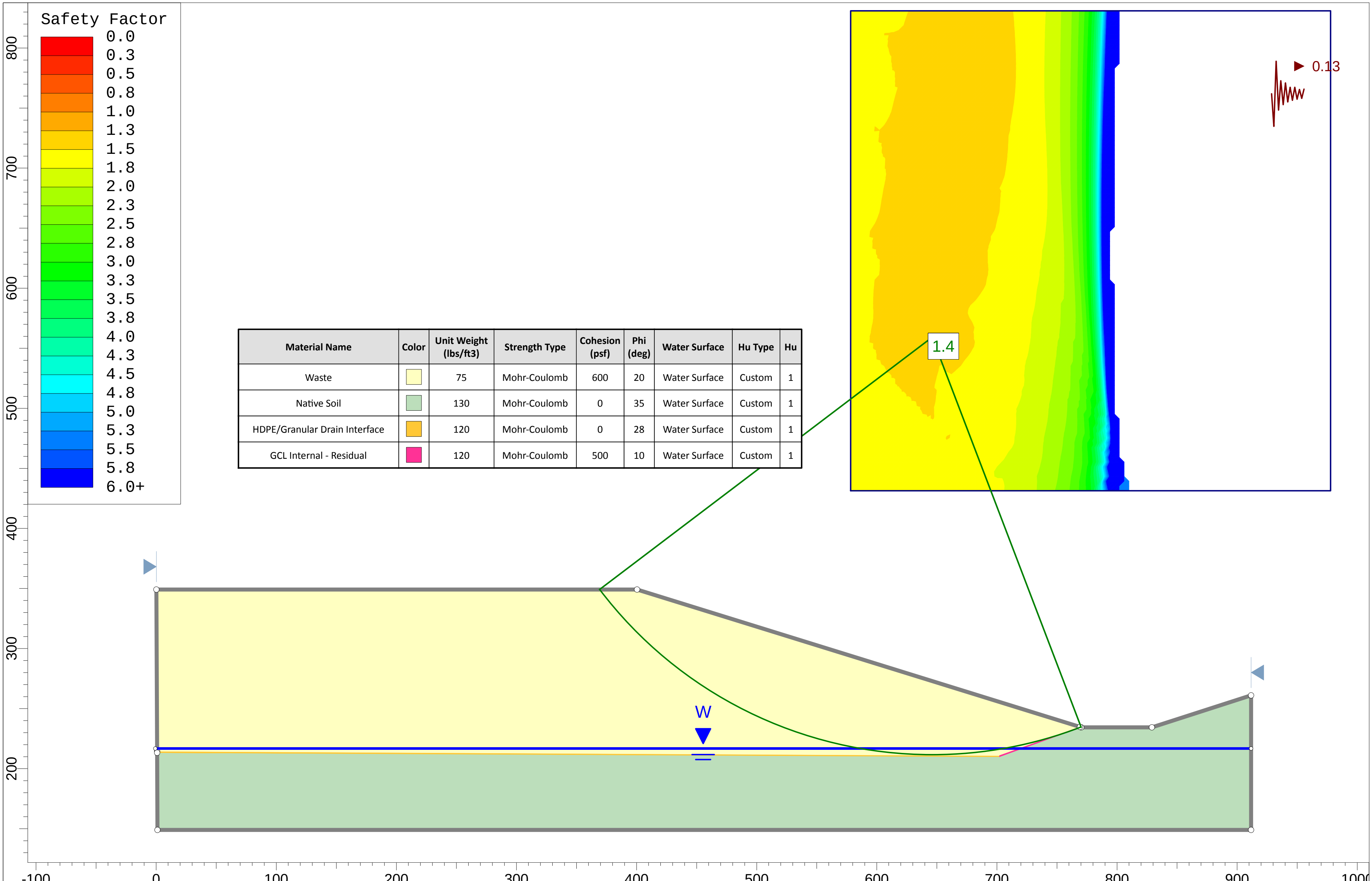


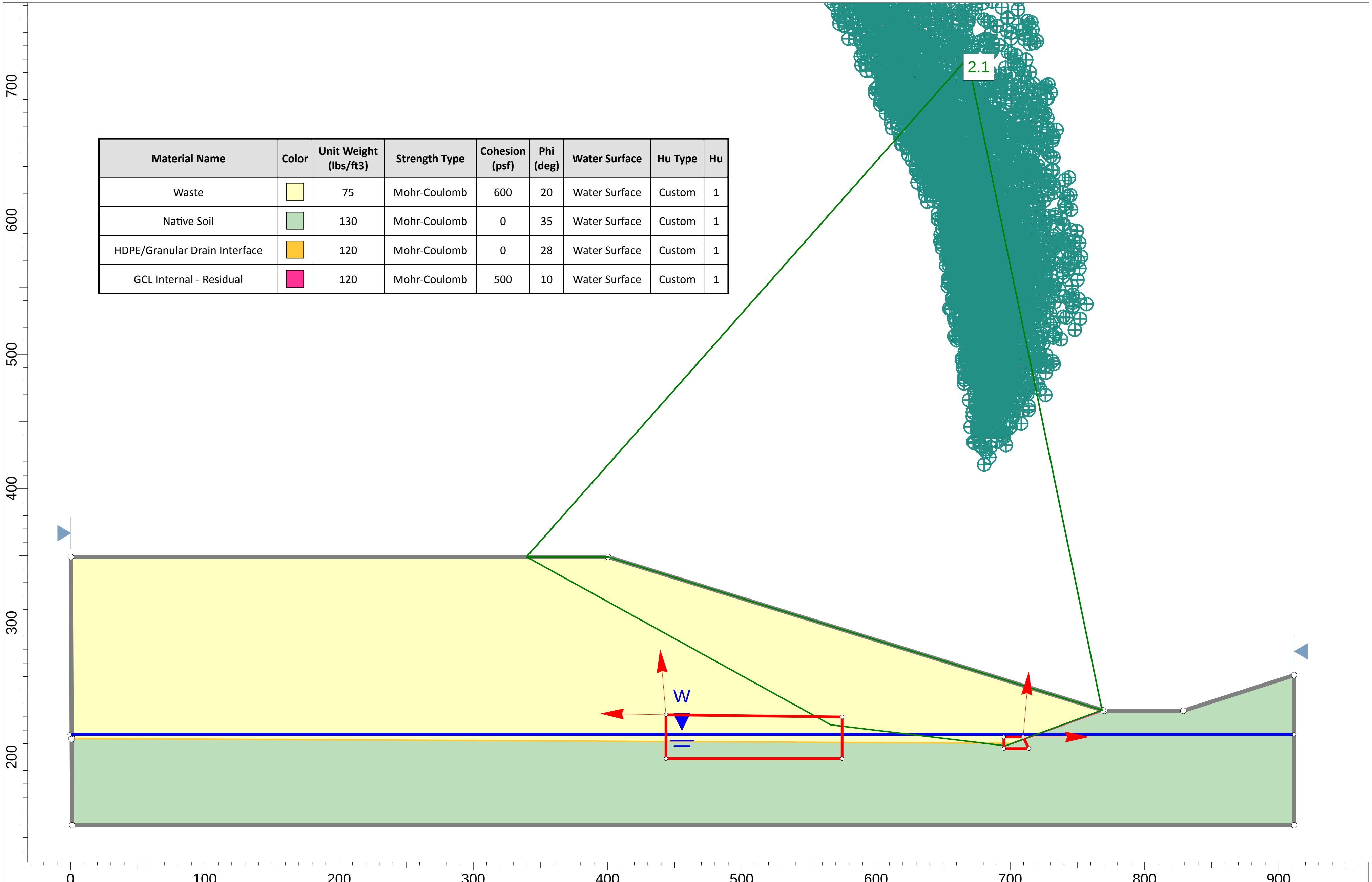
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Waste		75	Mohr-Coulomb	600	20	Water Surface	Custom	1
Native Soil		130	Mohr-Coulomb	0	35	Water Surface	Custom	1
HDPE/Granular Drain Interface		120	Mohr-Coulomb	0	28	Water Surface	Custom	1
GCL Internal - Residual		120	Mohr-Coulomb	500	10	Water Surface	Custom	1

CH2MHILL

SLIDEINTERPRET 6.029

Project	Matanuska-Susitna Borough Central Landfill
Case	**Section A Circular Failure - Seismic**
Description	
Date	7/28/2014 2:11:14 PM
Scale:	1:1300
File Name	Section A.slim

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Waste		75	Mohr-Coulomb	600	20	Water Surface	Custom	1
Native Soil		130	Mohr-Coulomb	0	35	Water Surface	Custom	1
HDPE/Granular Drain Interface		120	Mohr-Coulomb	0	28	Water Surface	Custom	1
GCL Internal - Residual		120	Mohr-Coulomb	500	10	Water Surface	Custom	1



CH2MHILL	*Project*	Matanuska-Susitna Borough Central Landfill			
	Case	**Section A Block Failure - Static**			
	Description				
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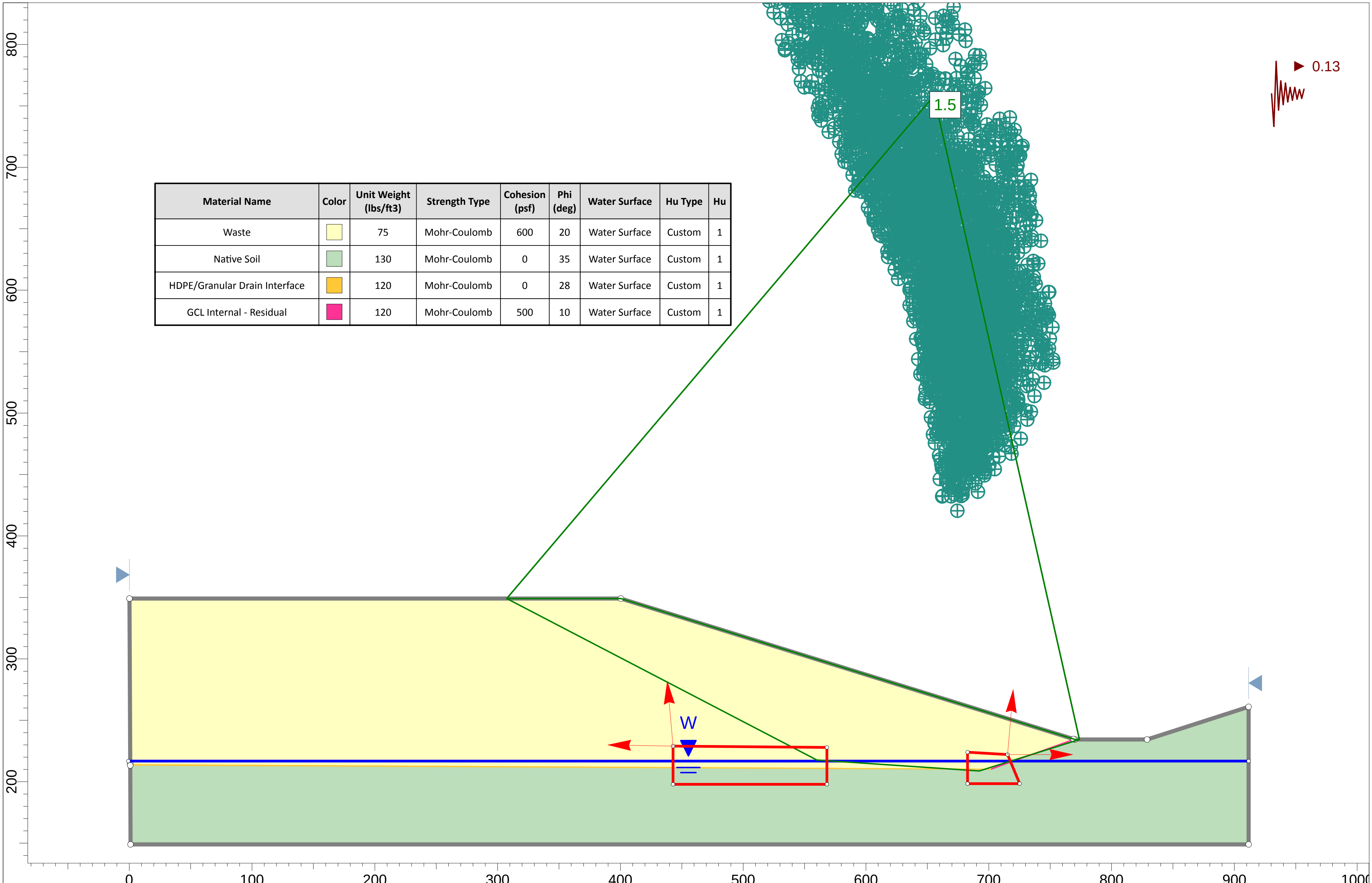
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Waste		75	Mohr-Coulomb	600	20	Water Surface	Custom	1
Native Soil		130	Mohr-Coulomb	0	35	Water Surface	Custom	1
HDPE/Granular Drain Interface		120	Mohr-Coulomb	0	28	Water Surface	Custom	1
GCL Internal - Residual		120	Mohr-Coulomb	500	10	Water Surface	Custom	1

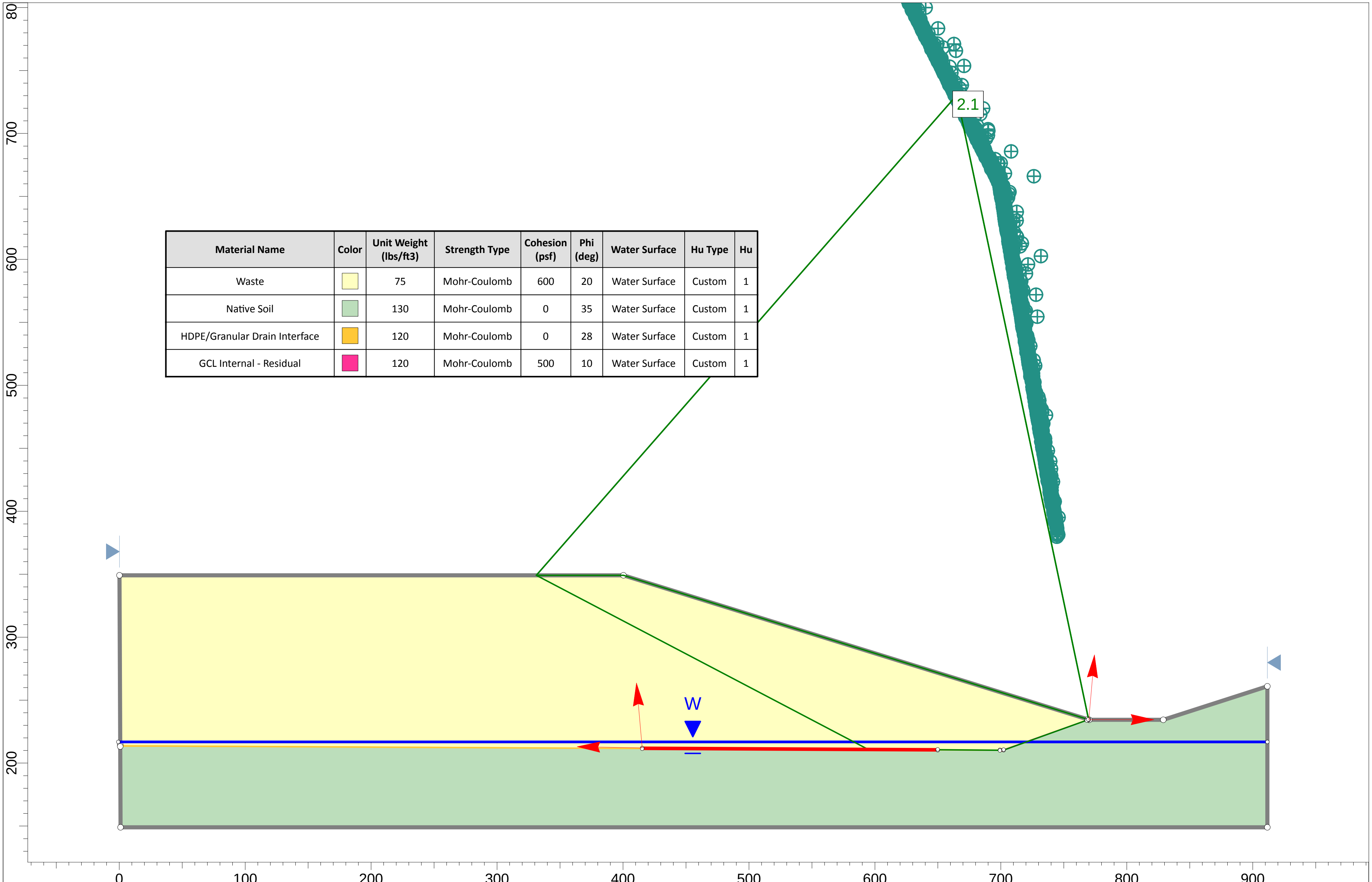


CH2MHILL

SLIDEINTERPRET 6.029

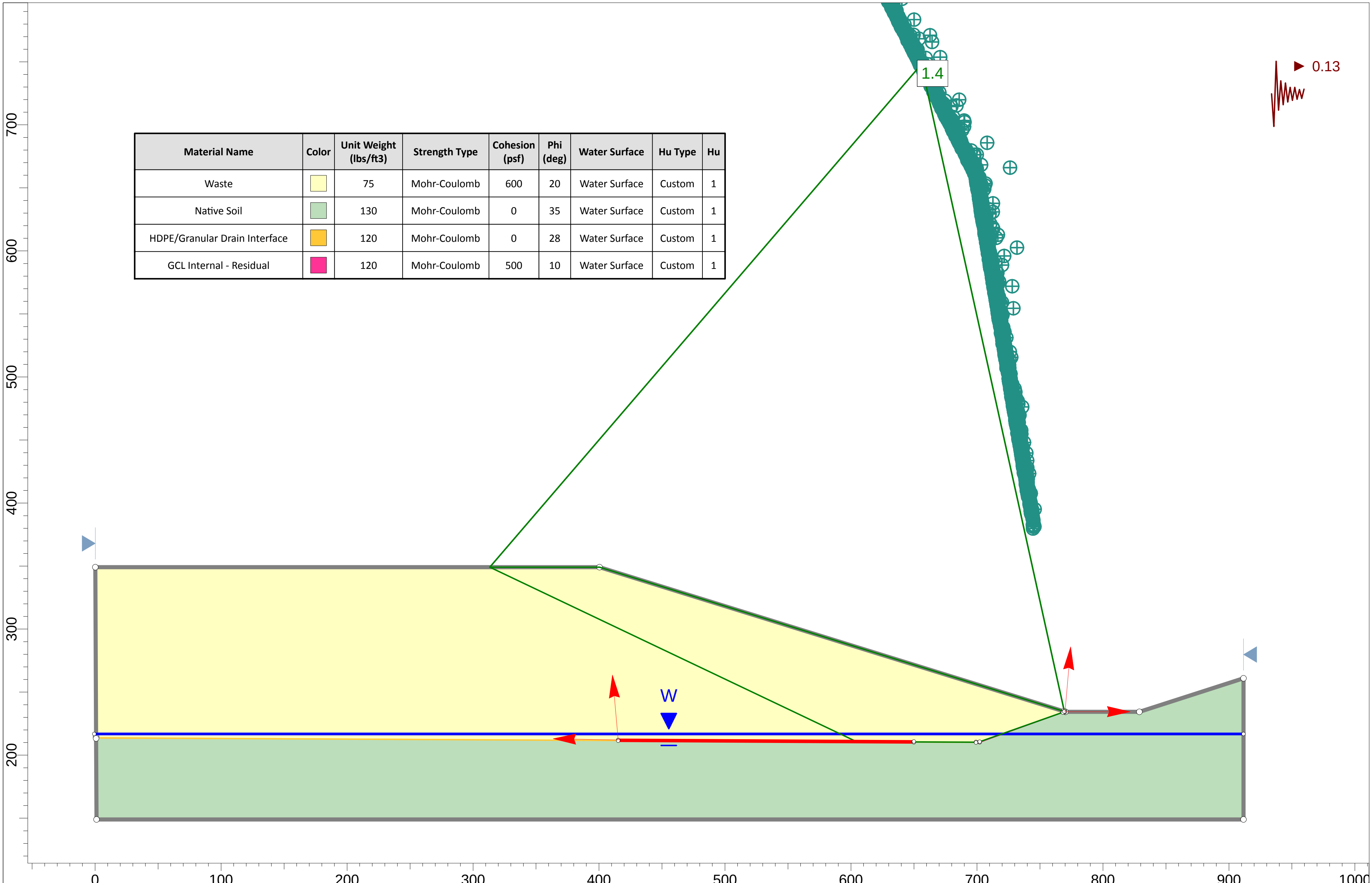
Project	Matanuska-Susitna Borough Central Landfill
Case	**Section A Block Failure - Seismic**
Description	

Date	7/25/2014 3:17:29 PM	*Scale:*	1:1272	*File Name*	Section A.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Waste		75	Mohr-Coulomb	600	20	Water Surface	Custom	1
Native Soil		130	Mohr-Coulomb	0	35	Water Surface	Custom	1
HDPE/Granular Drain Interface		120	Mohr-Coulomb	0	28	Water Surface	Custom	1
GCL Internal - Residual		120	Mohr-Coulomb	500	10	Water Surface	Custom	1

CH2MHILL	*Project*	Matanuska-Susitna Borough Central Landfill		
	Case	**Section A Lining Failure - Static**		
	Description			
SLIDEINTERPRET 6.029	*Date* 7/25/2014 2:17:58 PM	*Scale:* 1:1239	*File Name*	Section A.slim

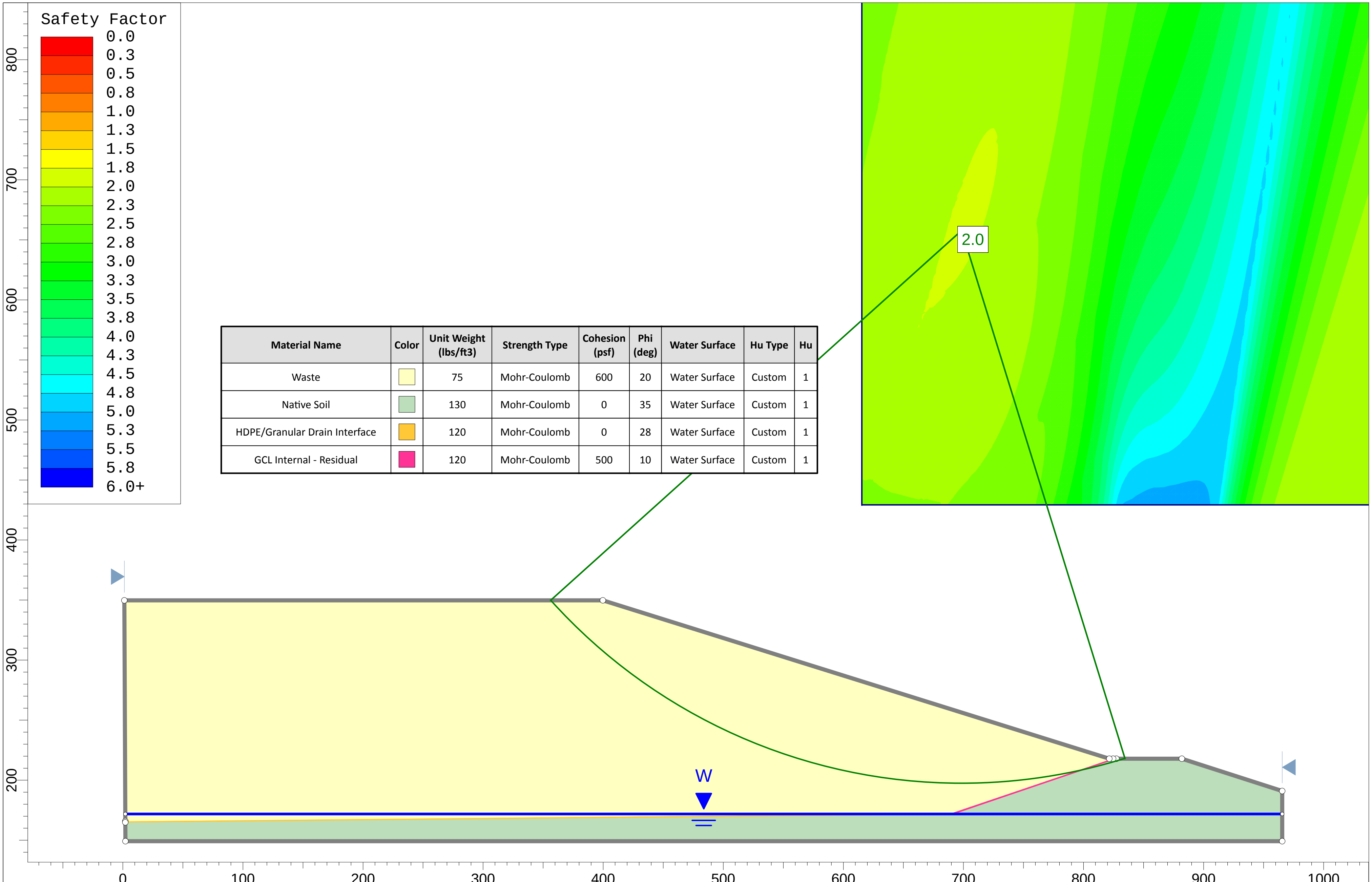


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Waste		75	Mohr-Coulomb	600	20	Water Surface	Custom	1
Native Soil		130	Mohr-Coulomb	0	35	Water Surface	Custom	1
HDPE/Granular Drain Interface		120	Mohr-Coulomb	0	28	Water Surface	Custom	1
GCL Internal - Residual		120	Mohr-Coulomb	500	10	Water Surface	Custom	1

CH2MHILL

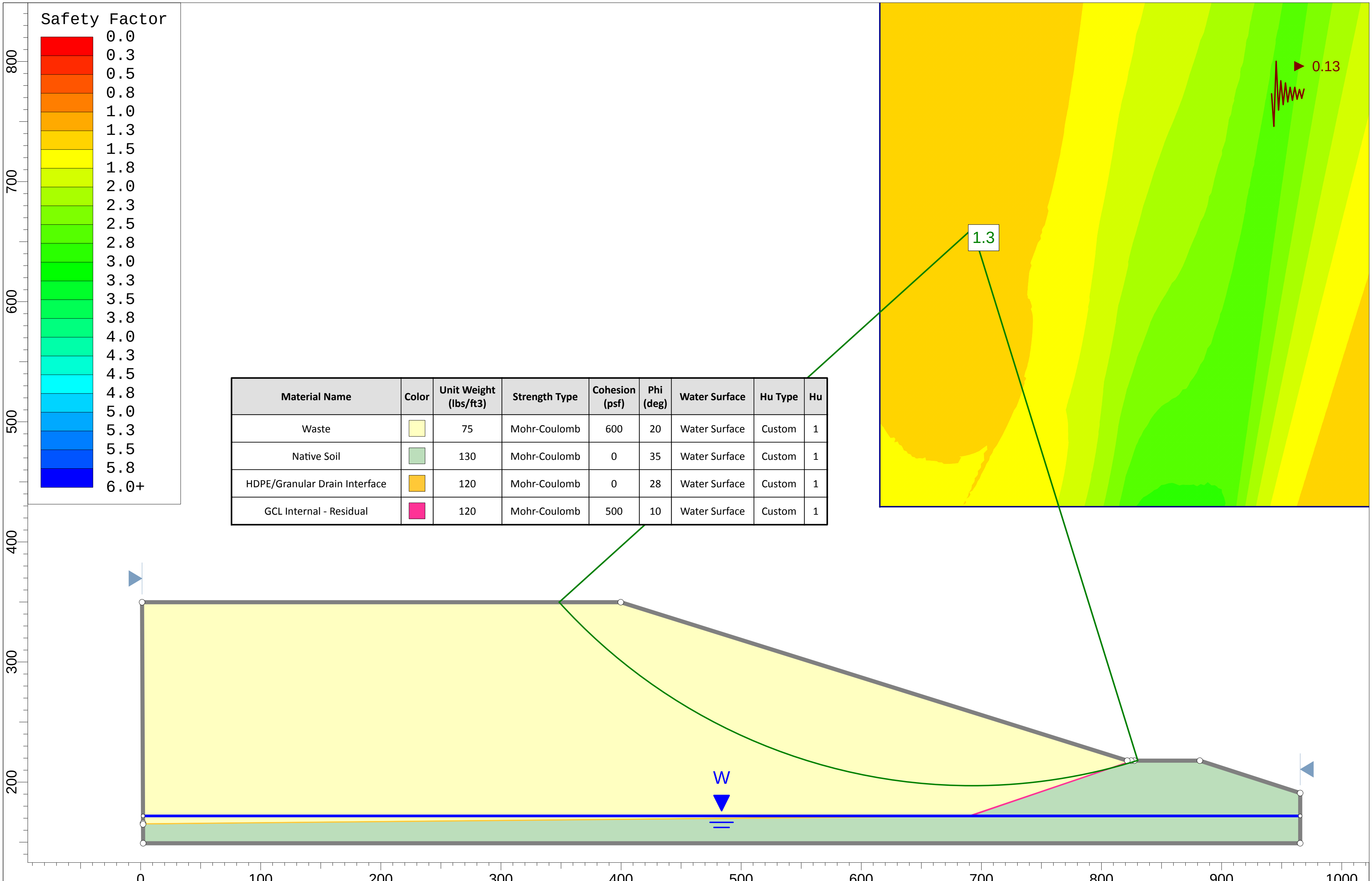
SLIDEINTERPRET 6.029

Project	Matanuska-Susitna Borough Central Landfill
Case	**Section A Lining Failure - Seismic**
Description	
Date	7/25/2014 2:19:26 PM
Scale:	1:1239
File Name	Section A.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Waste		75	Mohr-Coulomb	600	20	Water Surface	Custom	1
Native Soil		130	Mohr-Coulomb	0	35	Water Surface	Custom	1
HDPE/Granular Drain Interface		120	Mohr-Coulomb	0	28	Water Surface	Custom	1
GCL Internal - Residual		120	Mohr-Coulomb	500	10	Water Surface	Custom	1

CH2MHILL	*Project*	Matanuska-Susitna Borough Central Landfill			
	Case	**Section B Circular Failure - Static**			
	Description				
SLIDEINTERPRET 6.029	*Date* 7/28/2014 2:03:00 PM	*Scale:*	1:1300	*File Name*	Section B circular.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Waste		75	Mohr-Coulomb	600	20	Water Surface	Custom	1
Native Soil		130	Mohr-Coulomb	0	35	Water Surface	Custom	1
HDPE/Granular Drain Interface		120	Mohr-Coulomb	0	28	Water Surface	Custom	1
GCL Internal - Residual		120	Mohr-Coulomb	500	10	Water Surface	Custom	1

CH2MHILL	*Project*	Matanuska-Susitna Borough Central Landfill			
	Case	**Section B Circular Failure - Seismic**			
	Description				
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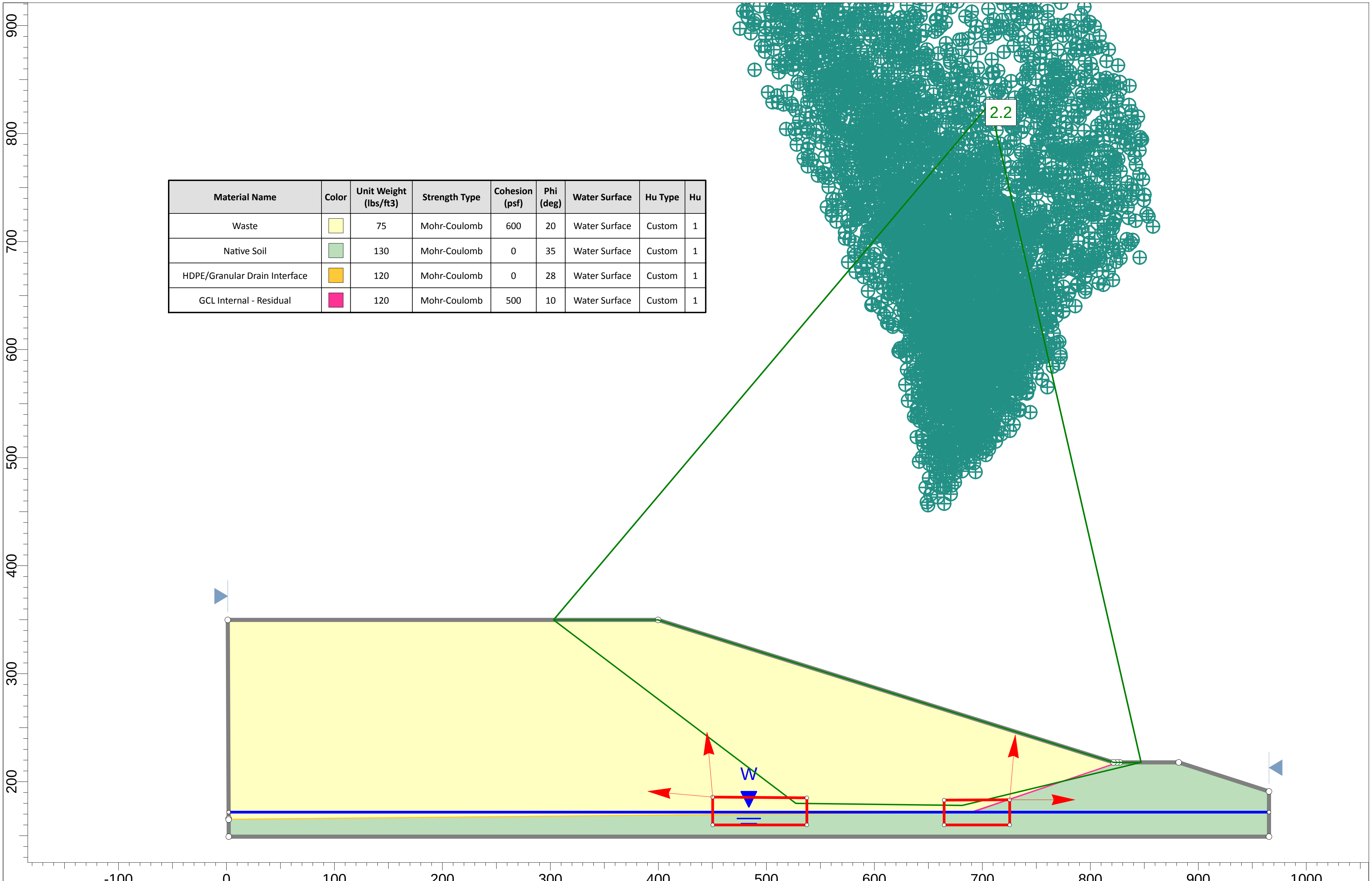

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Waste		75	Mohr-Coulomb	600	20	Water Surface	Custom	1
Native Soil		130	Mohr-Coulomb	0	35	Water Surface	Custom	1
HDPE/Granular Drain Interface		120	Mohr-Coulomb	0	28	Water Surface	Custom	1
GCL Internal - Residual		120	Mohr-Coulomb	500	10	Water Surface	Custom	1

CH2MHILL	*Project*	Matanuska-Susitna Borough Central Landfill			
	Case	**Section B Block Failure - Static**			
	Description				
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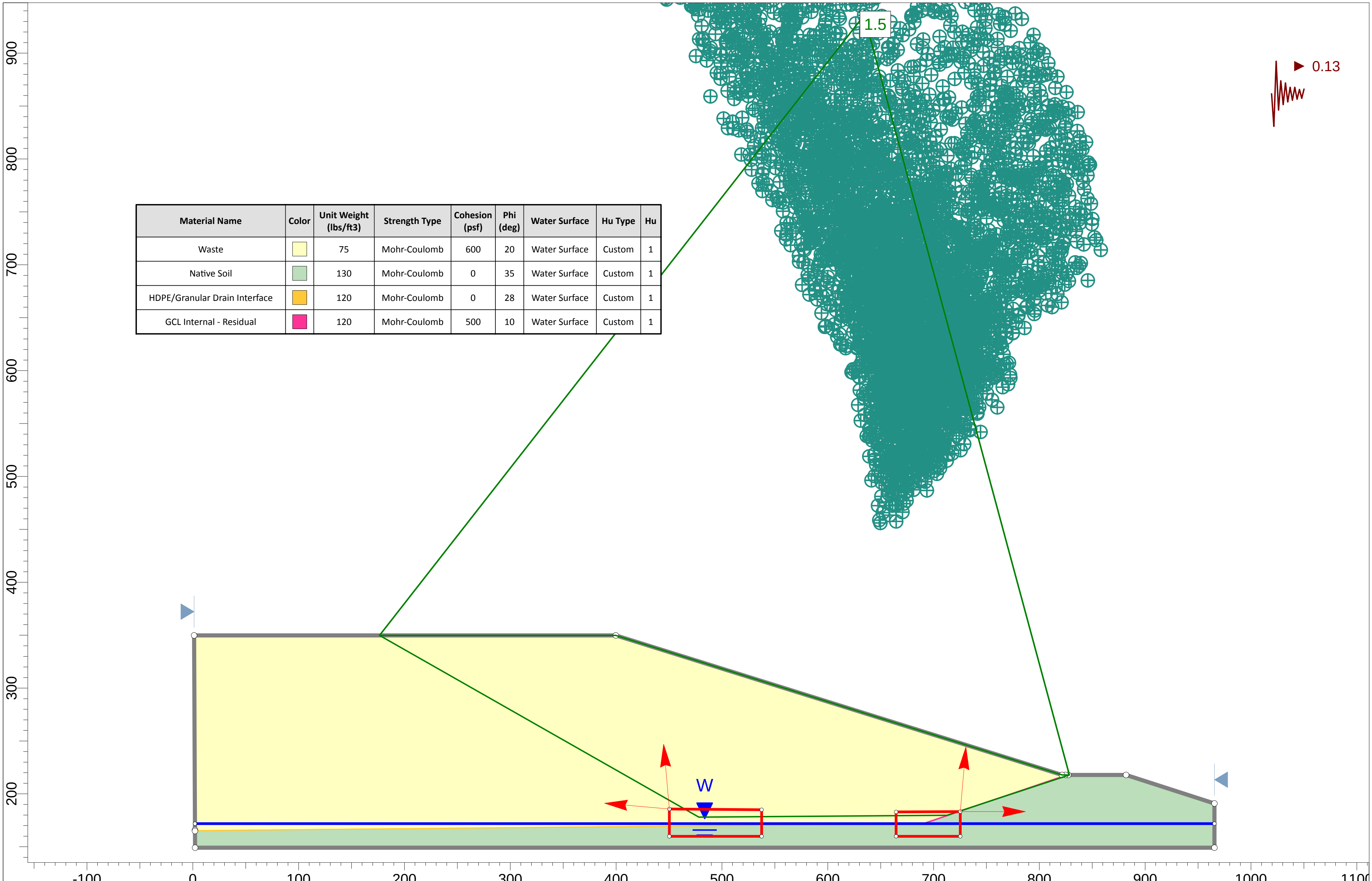

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Waste		75	Mohr-Coulomb	600	20	Water Surface	Custom	1
Native Soil		130	Mohr-Coulomb	0	35	Water Surface	Custom	1
HDPE/Granular Drain Interface		120	Mohr-Coulomb	0	28	Water Surface	Custom	1
GCL Internal - Residual		120	Mohr-Coulomb	500	10	Water Surface	Custom	1

CH2MHILL	*Project*	Matanuska-Susitna Borough Central Landfill
	Case	**Section B Block Failure - Seismic**
	Description	
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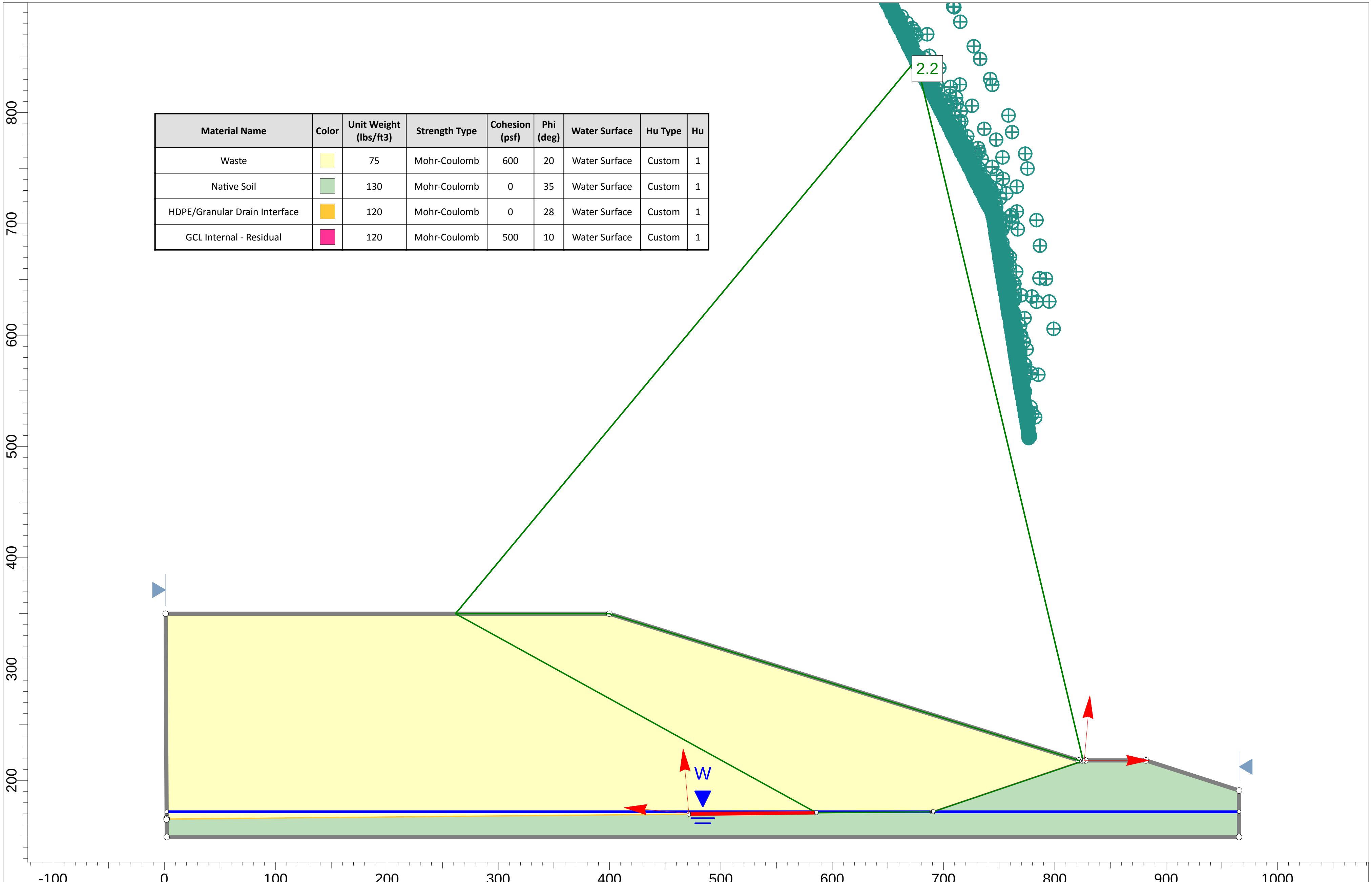

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Waste		75	Mohr-Coulomb	600	20	Water Surface	Custom	1
Native Soil		130	Mohr-Coulomb	0	35	Water Surface	Custom	1
HDPE/Granular Drain Interface		120	Mohr-Coulomb	0	28	Water Surface	Custom	1
GCL Internal - Residual		120	Mohr-Coulomb	500	10	Water Surface	Custom	1

CH2MHILL	*Project*	Matanuska-Susitna Borough Central Landfill
	Case	**Section B Lining Failure - Static**
	Description	
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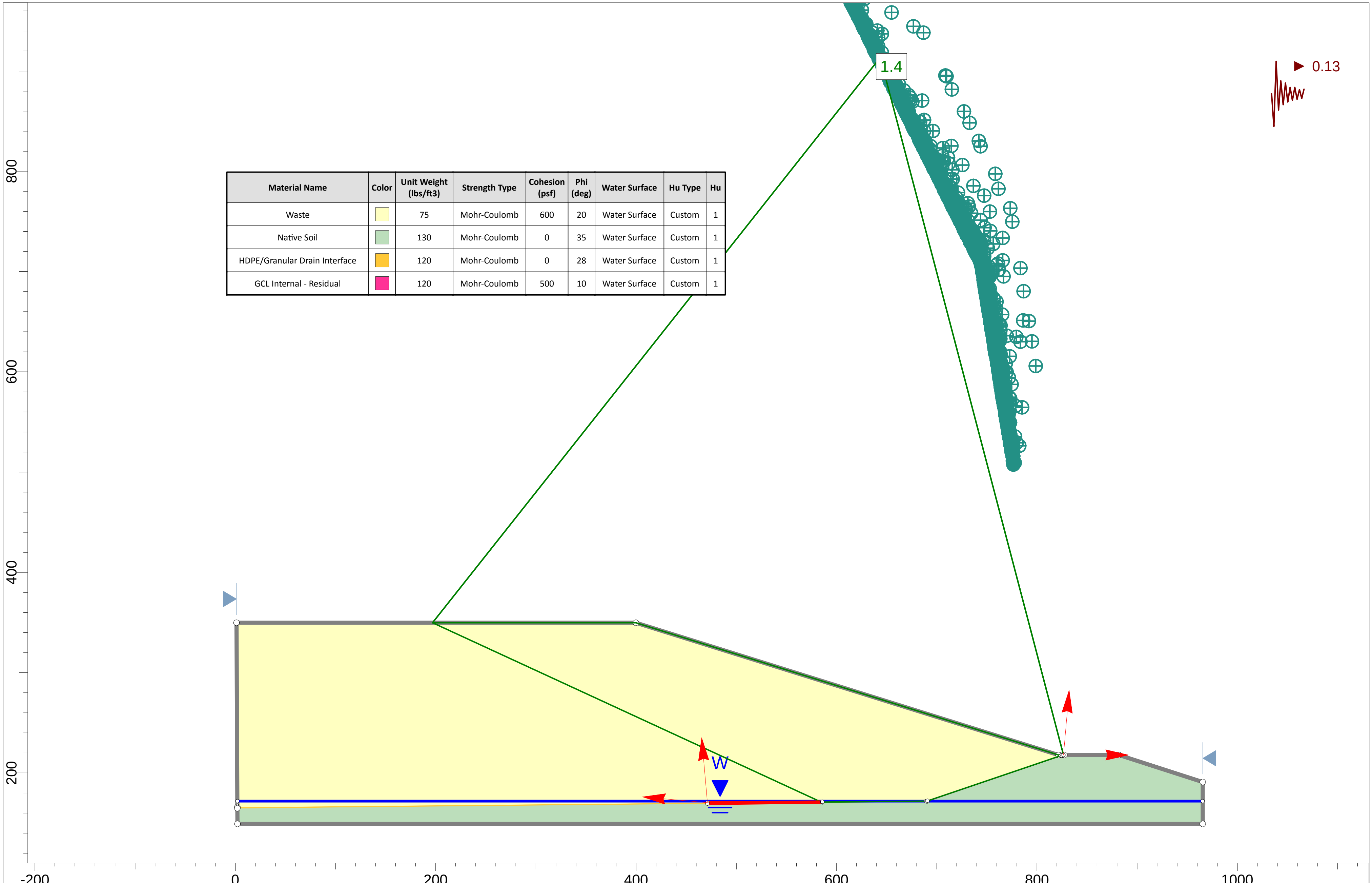

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Waste		75	Mohr-Coulomb	600	20	Water Surface	Custom	1
Native Soil		130	Mohr-Coulomb	0	35	Water Surface	Custom	1
HDPE/Granular Drain Interface		120	Mohr-Coulomb	0	28	Water Surface	Custom	1
GCL Internal - Residual		120	Mohr-Coulomb	500	10	Water Surface	Custom	1

CH2MHILL	*Project*	Matanuska-Susitna Borough Central Landfill			
	Case	**Section B Lining Failure - Seismic**			
	Description				
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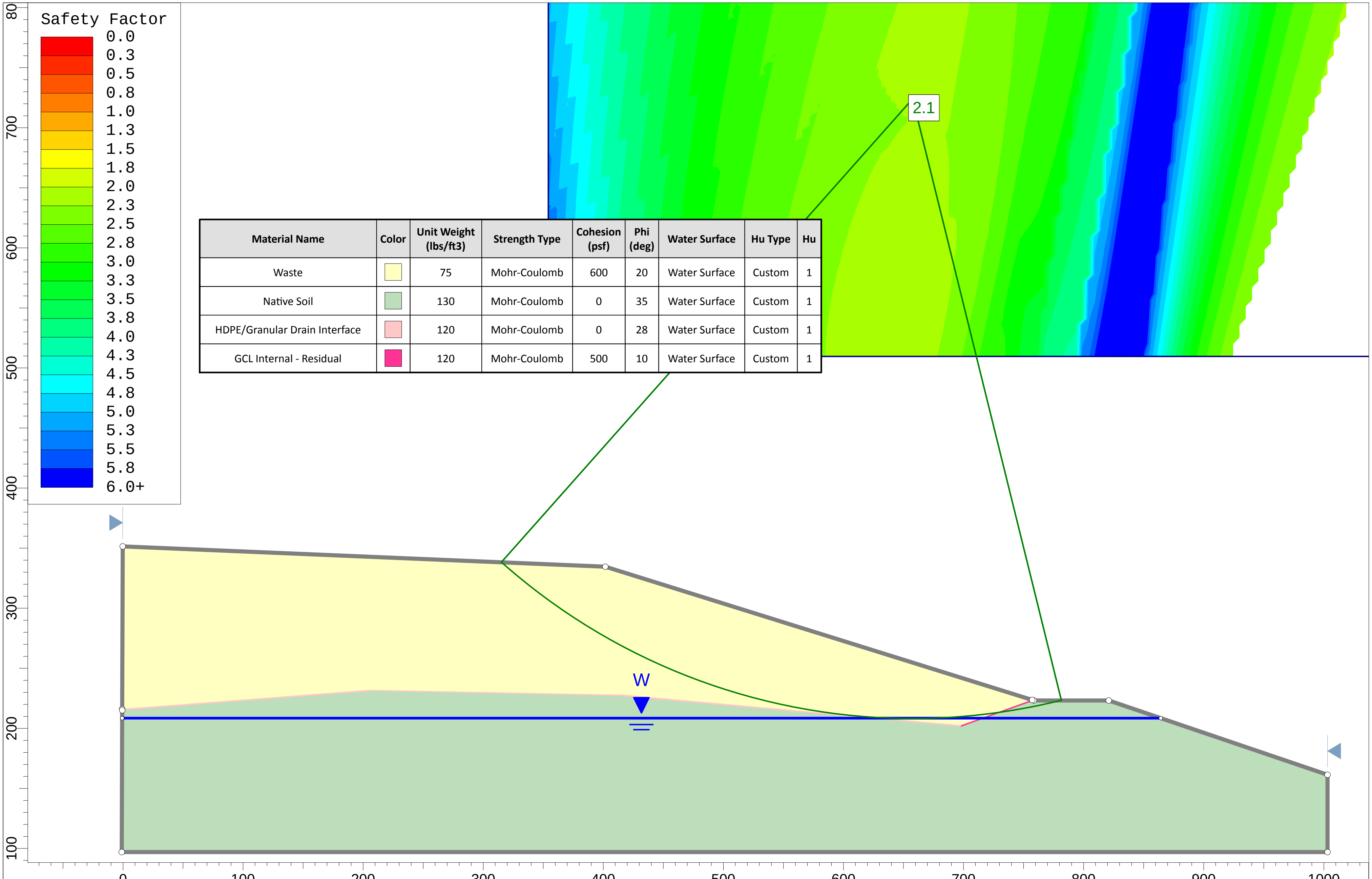
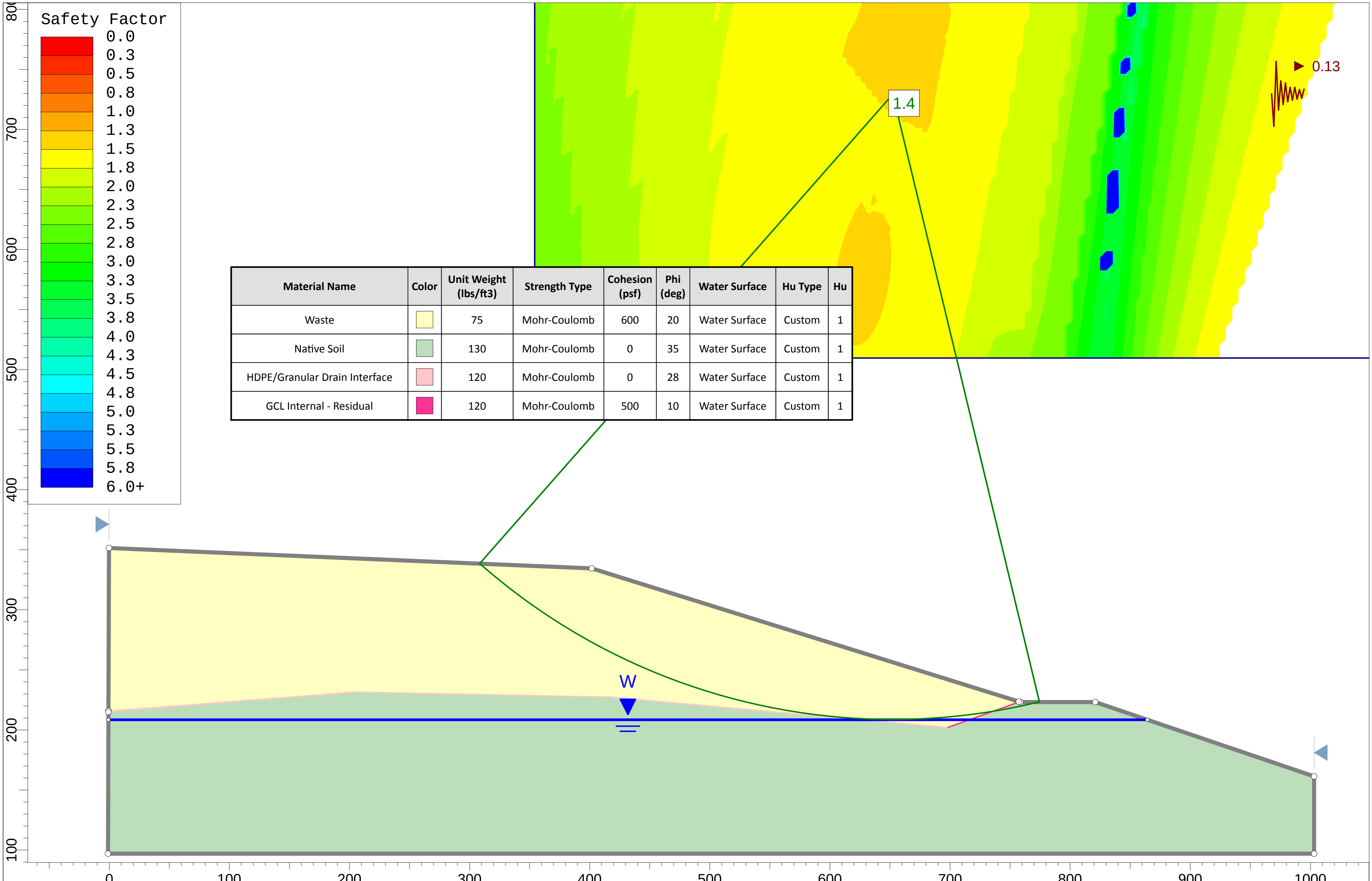


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Waste		75	Mohr-Coulomb	600	20	Water Surface	Custom	1
Native Soil		130	Mohr-Coulomb	0	35	Water Surface	Custom	1
HDPE/Granular Drain Interface		120	Mohr-Coulomb	0	28	Water Surface	Custom	1
GCL Internal - Residual		120	Mohr-Coulomb	500	10	Water Surface	Custom	1

CH2MHILL

SLIDEINTERPRET 6.029

Project	Matanuska-Sisitna Borough Central Landfill
Case	**Section D Circular Failure - Static**
Description	
Date	7/28/2014 12:51:48 PM
Scale:	1:1300
File Name	Section D.slim



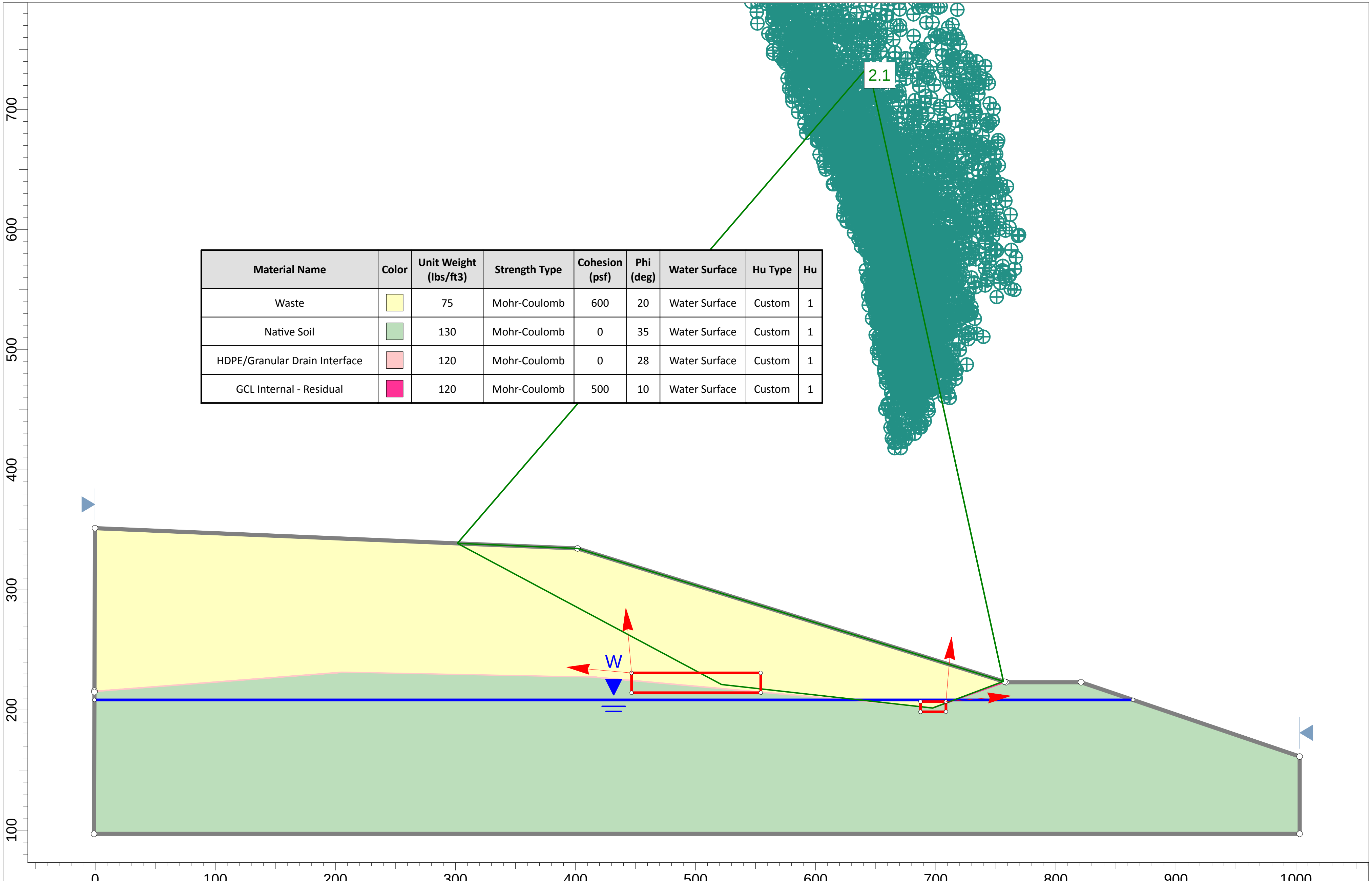
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Waste		75	Mohr-Coulomb	600	20	Water Surface	Custom	1
Native Soil		130	Mohr-Coulomb	0	35	Water Surface	Custom	1
HDPE/Granular Drain Interface		120	Mohr-Coulomb	0	28	Water Surface	Custom	1
GCL Internal - Residual		120	Mohr-Coulomb	500	10	Water Surface	Custom	1

CH2MHILL

SLIDEINTERPRET 6.029

Project	Matanuska-Sisitna Borough Central Landfill
Case	**Section D Circular Failure - Seismic**
Description	

Date	7/28/2014 12:49:40 PM	*Scale:*	1:1300	*File Name*	Section D.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Waste		75	Mohr-Coulomb	600	20	Water Surface	Custom	1
Native Soil		130	Mohr-Coulomb	0	35	Water Surface	Custom	1
HDPE/Granular Drain Interface		120	Mohr-Coulomb	0	28	Water Surface	Custom	1
GCL Internal - Residual		120	Mohr-Coulomb	500	10	Water Surface	Custom	1

CH2MHILL	*Project*	Matanuska-Sisitna Borough Central Landfill			
	Case	**Section D Block Failure - Static**			
	Description				
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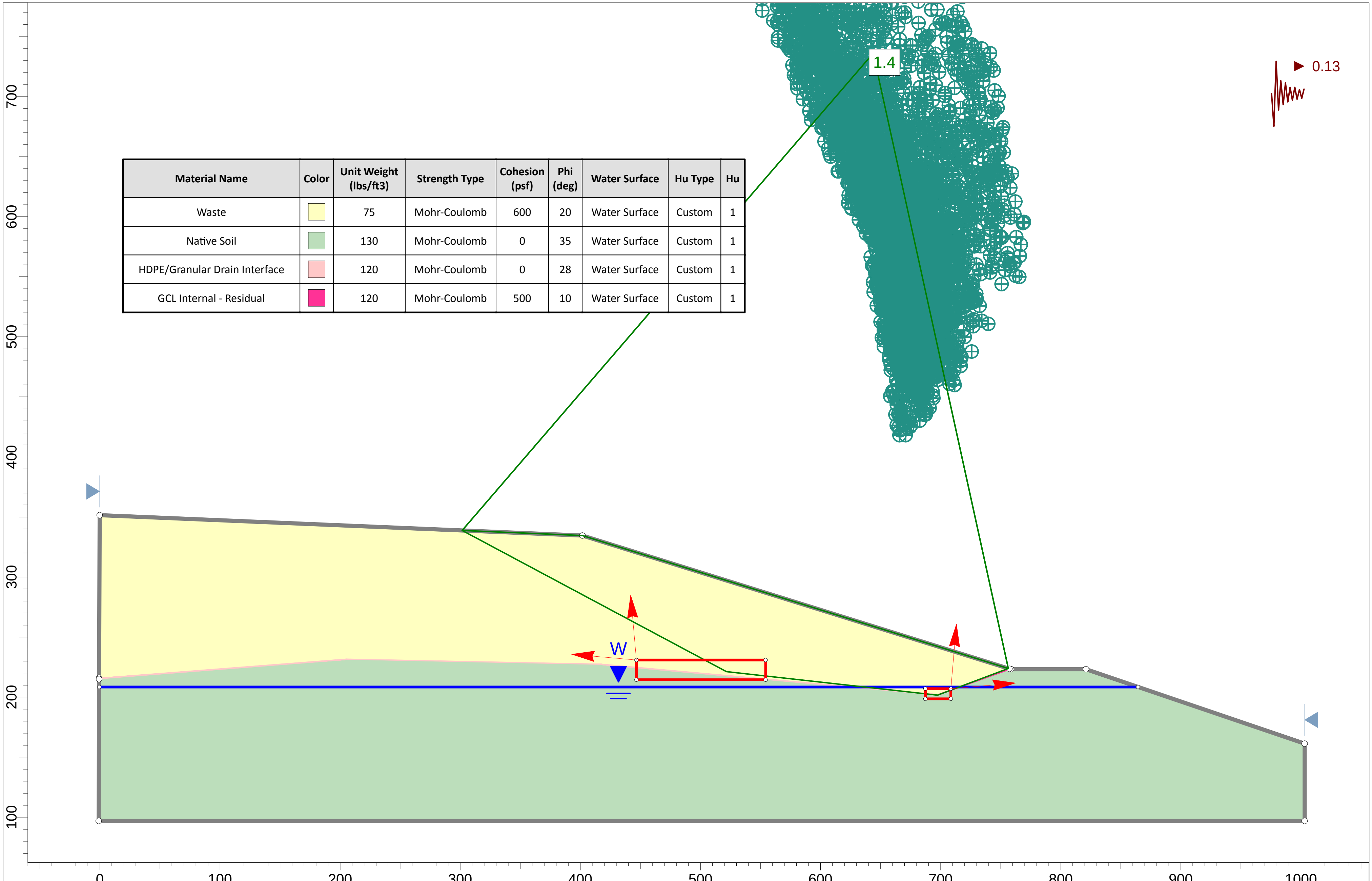


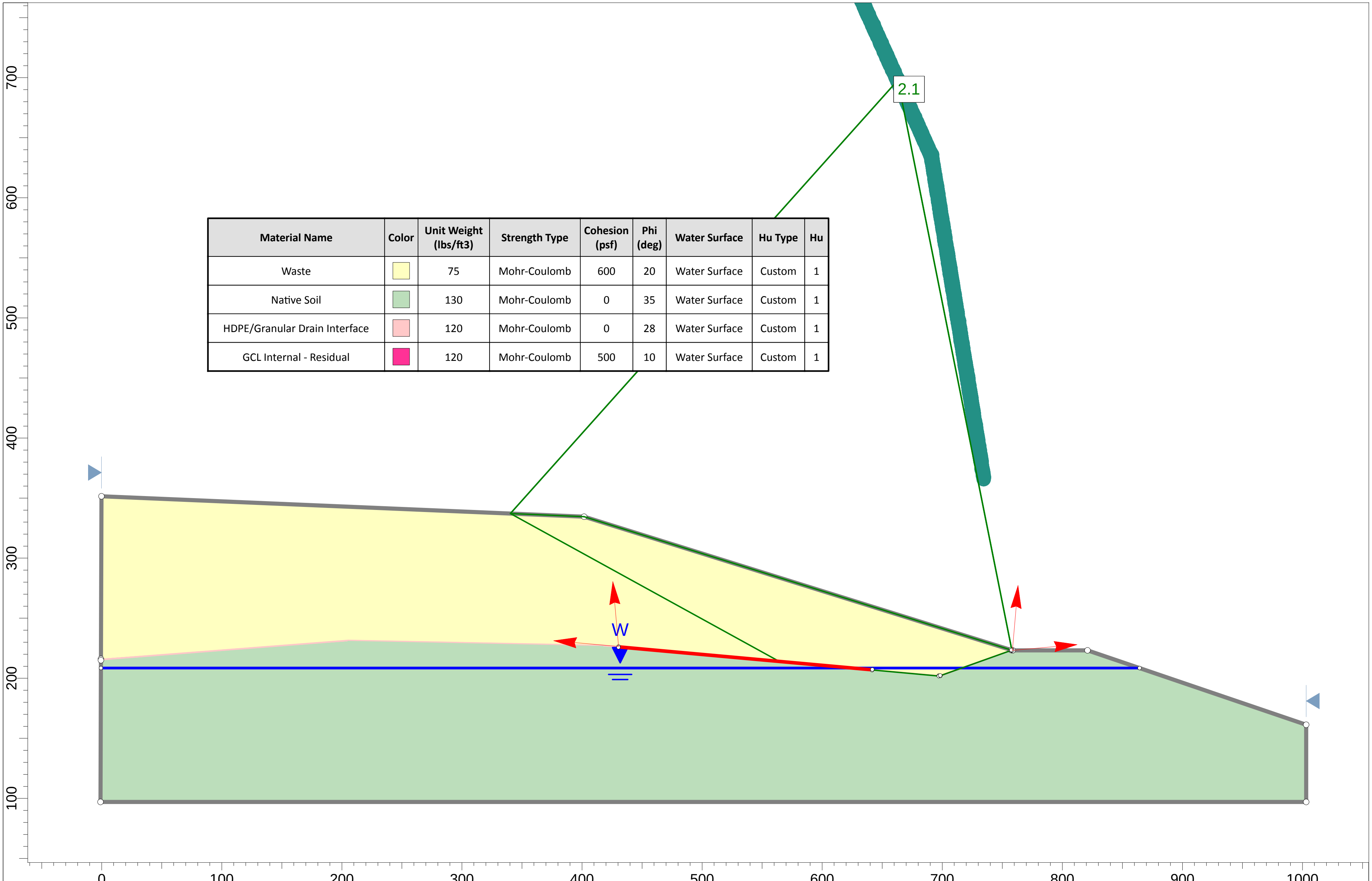
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Waste		75	Mohr-Coulomb	600	20	Water Surface	Custom	1
Native Soil		130	Mohr-Coulomb	0	35	Water Surface	Custom	1
HDPE/Granular Drain Interface		120	Mohr-Coulomb	0	28	Water Surface	Custom	1
GCL Internal - Residual		120	Mohr-Coulomb	500	10	Water Surface	Custom	1

CH2MHILL

SLIDEINTERPRET 6.029

Project	Matanuska-Sisitna Borough Central Landfill
Case	**Section D Block Failure - Seismic**
Description	

Date	7/28/2014 12:59:27 PM	*Scale:*	1:1300	*File Name*	Section D.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Waste		75	Mohr-Coulomb	600	20	Water Surface	Custom	1
Native Soil		130	Mohr-Coulomb	0	35	Water Surface	Custom	1
HDPE/Granular Drain Interface		120	Mohr-Coulomb	0	28	Water Surface	Custom	1
GCL Internal - Residual		120	Mohr-Coulomb	500	10	Water Surface	Custom	1

CH2MHILL	*Project*	Matanuska-Sisitna Borough Central Landfill	
	Case	**Section D Lining Failure - Static**	
	Description		
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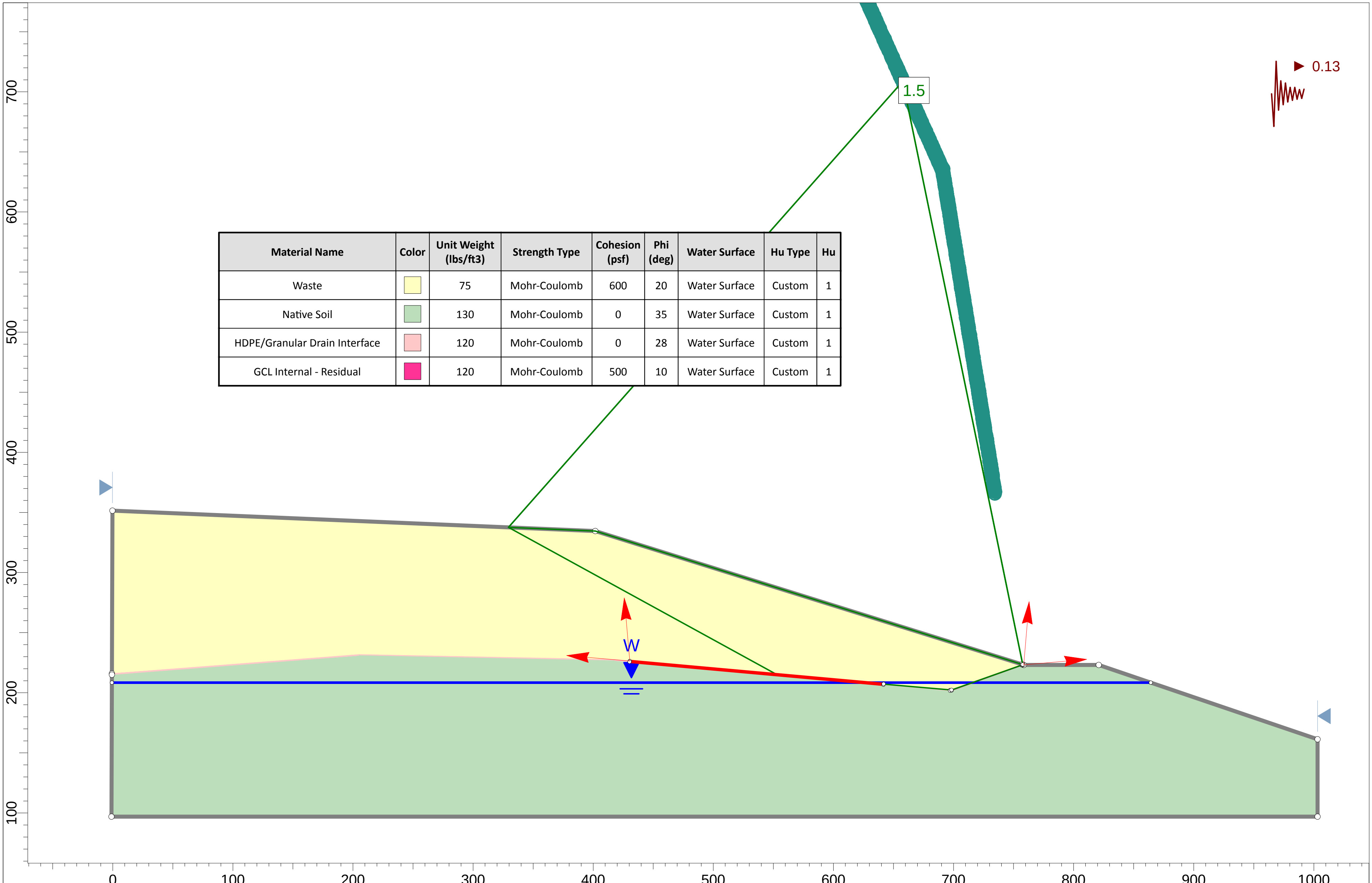

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Waste		75	Mohr-Coulomb	600	20	Water Surface	Custom	1
Native Soil		130	Mohr-Coulomb	0	35	Water Surface	Custom	1
HDPE/Granular Drain Interface		120	Mohr-Coulomb	0	28	Water Surface	Custom	1
GCL Internal - Residual		120	Mohr-Coulomb	500	10	Water Surface	Custom	1

CH2MHILL

SLIDEINTERPRET 6.029

Project	Matanuska-Sisitna Borough Central Landfill
Case	**Section D Lining Failure - Seismic**
Description	

Date	7/28/2014 1:02:56 PM	*Scale:*	1:1300	*File Name*	Section D.slim

Appendix C
Estimated Life of MSW Cells

Matanuska-Susitna Central Landfill
Table C-1
Estimated Life of MSW Cells w/o Valley Fills

Year	Cell	Total Volume Above Liner 1 (cy)	Cell Volume								Cumulative Net Volume Used (cy)	Start/Full Dates	Cell Life (Years)
			Area, Bottom Liner (sf)	Total Volume of Bottom Liner Soil (cy)	Area, Final Cover (sf)	Total Volume of Final Cover 2 (cy)	Total Airspace Required[3] (cy)	Total Daily / Intermediate Cover Soils (cy)	Net volume at beginning of year (cy)	Net volume at end of year (cy)			
EXISTING LANDFILL AREA													
2013	3[4]	880,567	-	-	442,842	32,803	33,138	4,524	847,764	814,626	33,138	May-13	
2014							86,076	11,750	814,626	728,550	119,213		
2015							88,209	12,041	728,550	640,342	207,422		
2016							90,395	12,340	640,342	549,947	297,817		
2017							92,634	12,645	549,947	457,313	390,451		
2018							94,841	12,947	457,313	362,472	485,292		
2019							97,100	13,255	362,472	265,372	582,391		
2020							99,412	13,571	265,372	165,960	681,804		
2021							101,780	13,894	165,960	64,181	783,583		
2022							64,181	8,761	64,181	0	847,764	Aug-22	9.2
	Total						**847,764**	**115,727**					
2022	4	522,859	212,465	15,738	170,263	12,612	40,023	5,463	494,509	454,486	40,023	Aug-22	
2023							106,648	14,558	454,486	347,838	146,671		
2024							109,149	14,900	347,838	238,689	255,819		
2025							111,708	15,249	238,689	126,981	367,528		
2026							114,328	15,607	126,981	12,653	481,856		
2027							12,652	1,727	12,653	0	494,508	Feb-27	4.5
	Total						**494,508**	**67,504**					
2027	5	595,005	128,514	9,520	79,020	5,853	104,357	14,246	579,632	475,275	104,357	Feb-27	
2028							119,478	16,310	475,275	355,797	223,835		
2029							121,998	16,654	355,797	233,799	345,833		
2030							124,572	17,005	233,799	109,227	470,405		
2031							109,227	14,910	109,227	0	579,632	Oct-31	4.7
	Total						**579,632**	**79,124**					
2031	6	588,977	166,611	12,342	125,731	9,313	17,973	2,453	567,322	549,349	17,973	Oct-31	
2032							129,883	17,730	549,349	419,466	147,856		
2033							132,012	18,021	419,466	287,454	279,868		
2034							134,176	18,316	287,454	153,278	414,044		
2035							136,375	18,616	153,278	16,902	550,420		
2036							16,902	2,307	16,902	0	567,322	Feb-36	4.3
	Total						**567,322**	**77,444**					
2036	7	1,114,301	78,134	5,788	324,776	24,057	121,708	16,614	1,084,456	962,748	121,708	Feb-36	
2037							140,882	19,232	962,748	821,866	262,590		
2038							142,942	19,513	821,866	678,923	405,533		
2039							145,033	19,798	678,923	533,891	550,565		
2040							147,153	20,088	533,891	386,737	697,719		
2041							149,305	20,381	386,737	237,432	847,024		
2042							151,489	20,679	237,432	85,943	998,512		
2043							85,944	11,732	85,943	0	1,084,456	Jul-43	7.4
	Total						**1,084,456**	**148,037**					
FUTURE LANDFILL PHASE 1													
2043	8	967,004	579,484	42,925	-	-	67,760	9,250	924,079	856,319	67,760	Jul-43	
2044							155,951	21,289	856,319	700,368	223,712		
2045							158,232	21,600	700,368	542,136	381,944		
2046							160,546	21,916	542,136	381,590	542,489		
2047							162,893	22,236	381,590	218,697	705,383		
2048							165,275	22,561	218,697	53,421	870,658		
2049							53,421	7,292	53,421	0	924,079	Apr-49	5.8

Matanuska-Susitna Central Landfill
Table C-1
Estimated Life of MSW Cells w/o Valley Fills

Year	Cell	Total Volume Above Liner 1 (cy)	Cell Volume									Cumulative Net Volume Used (cy)	Start/Full Dates	Cell Life (Years)
			Area, Bottom Liner (sf)	Total Volume of Bottom Liner Soil (cy)	Area, Final Cover (sf)	Total Volume of Final Cover 2 (cy)	Total Airspace Required[3] (cy)	Total Daily / Intermediate Cover Soils (cy)	Net volume at beginning of year (cy)	Net volume at end of year (cy)				
	Total						**924,079**	**126,144**						
2049	9	888,704	309,863	22,953	12,568	931	114,271	15,599	864,820	750,549		114,271	Apr-49	
2050							170,144	23,226	750,549	580,405		284,415		
2051							172,632	23,566	580,405	407,772		457,048		
2052							175,157	23,910	407,772	232,616		632,205		
2053							177,718	24,260	232,616	54,897		809,923		
2054							54,897	7,494	54,897	0		864,820	Mar-54	4.9
	Total						**864,820**	**118,055**						
2054	10	891,498	310,130	22,973	80,012	5,927	125,420	17,121	862,599	737,179		125,420	Mar-54	
2055							182,954	24,975	737,179	554,225		308,374		
2056							185,629	25,340	554,225	368,596		494,003		
2057							188,344	25,710	368,596	180,252		682,346		
2058							180,252	24,606	180,252	0		862,598	Dec-58	4.7
	Total						**862,598**	**117,752**						
2058	11	1,349,976	412,114	30,527	256,964	19,034	10,845	1,480	1,300,415	1,289,569		10,845	Dec-58	
2059							193,892	26,468	1,289,569	1,095,677		204,738		
2060							196,727	26,855	1,095,677	898,950		401,465		
2061							199,604	27,248	898,950	699,346		601,069		
2062							202,523	27,646	699,346	496,823		803,592		
2063							205,485	28,050	496,823	291,338		1,009,077		
2064							208,489	28,460	291,338	82,849		1,217,566		
2065							82,849	11,310	82,849	0		1,300,415	May-65	6.5
	Total						**1,300,415**	**177,517**						
2065	12	1,136,637	377,291	27,947	-	-	128,689	17,567	1,108,690	980,000		128,689	May-65	
2066							214,631	29,299	980,000	765,369		343,321		
2067							217,770	29,727	765,369	547,599		561,091		
2068							220,954	30,162	547,599	326,644		782,045		
2069							224,185	30,603	326,644	102,459		1,006,231		
2070							102,459	13,986	102,459	0		1,108,690	Jun-70	5.1
	Total						**1,108,690**	**151,345**						
2070	13	1,270,283	200,032	14,817	143,001	10,593	125,005	17,064	1,244,873	1,119,868		125,005	Jun-70	
2071							230,790	31,505	1,119,868	889,079		355,795		
2072							234,165	31,965	889,079	654,914		589,959		
2073							237,589	32,433	654,914	417,325		827,548		
2074							241,063	32,907	417,325	176,261		1,068,612		
2075							176,262	24,061	176,261	0		1,244,873	Sep-75	5.3
	Total						**1,244,873**	**169,935**						
2075	14	1,262,732	200,020	14,816	172,926	12,809	68,327	9,327	1,235,106	1,166,780		68,327	Sep-75	
2076							248,165	33,876	1,166,780	918,615		316,492		
2077							251,794	34,372	918,615	666,821		568,286		
2078							255,476	34,874	666,821	411,345		823,762		
2079							259,212	35,384	411,345	152,133		1,082,973		
2080							152,133	20,767	152,133	0		1,235,106	Jul-80	4.9
	Total						**1,235,106**	**168,602**						
2080	15	2,131,590	289,575	21,450	483,394	35,807	110,870	15,135	2,074,333	1,963,463		110,870	Jul-80	
2081							266,848	36,427	1,963,463	1,696,615		377,718		
2082							270,750	36,960	1,696,615	1,425,865		648,468		
2083							274,709	37,500	1,425,865	1,151,156		923,177		
2084							278,727	38,048	1,151,156	872,429		1,201,904		

Matanuska-Susitna Central Landfill
Table C-1
Estimated Life of MSW Cells w/o Valley Fills

			Cell Volume										
Year	**Cell**	**Total Volume Above Liner 1 (cy)**	**Area, Bottom Liner (sf)**	**Total Volume of Bottom Liner Soil (cy)**	**Area, Final Cover (sf)**	**Total Volume of Final Cover 2 (cy)**	**Total Airspace Required[3] (cy)**	**Total Daily / Intermediate Cover Soils (cy)**	**Net volume at beginning of year (cy)**	**Net volume at end of year (cy)**	**Cumulative Net Volume Used (cy)**	**Start/Full Dates**	**Cell Life (Years)**
2085							282,802	38,605	872,429	589,627	1,484,706		
2086							286,938	39,169	589,627	302,689	1,771,644		
2087							291,134	39,742	302,689	11,555	2,062,778		
2088							11,555	1,577	11,555	0	2,074,333	Jan-88	7.5
	Total						**2,074,333**	**283,163**					
2088	16	1,456,140	453,926	33,624	-	-	283,836	38,746	1,422,516	1,138,680	283,836	Jan-88	
2089							299,710	40,913	1,138,680	838,969	583,546		
2090							304,093	41,511	838,969	534,876	887,640		
2091							308,540	42,118	534,876	226,336	1,196,180		
2092							226,337	30,897	226,336	0	1,422,516	Sep-92	4.7
	Total						**1,422,516**	**194,185**					
2092	17	1,546,321	220,053	16,300	145,576	10,783	86,715	11,837	1,519,237	1,432,522	86,715	Sep-92	
2093							317,629	43,359	1,432,522	1,114,893	404,345		
2094							322,274	43,993	1,114,893	792,619	726,619		
2095							326,987	44,636	792,619	465,632	1,053,606		
2096							331,768	45,289	465,632	133,863	1,385,374		
2097							133,863	18,273	133,863	0	1,519,237	May-97	4.7
	Total						**1,519,237**	**207,388**					
2097	18	1,810,193	212,284	15,725	220,070	16,301	202,757	27,678	1,778,167	1,575,410	202,757	May-97	
2098							341,542	46,623	1,575,410	1,233,868	544,299		
2099							346,537	47,305	1,233,868	887,331	890,835		
2100							351,604	47,997	887,331	535,727	1,242,440		
2101							356,746	48,699	535,727	178,982	1,599,185		
2102							178,982	24,432	178,982	0	1,778,167	Jun-02	5.1
	Total						**1,778,167**	**242,734**					
2102	19	2,062,744	279,843	20,729	555,786	41,169	182,980	24,978	2,000,846	1,817,865	182,980	Jun-02	
2103							367,255	50,133	1,817,865	1,450,610	550,235		
2104							372,626	50,866	1,450,610	1,077,984	922,861		
2105							378,075	51,610	1,077,984	699,910	1,300,936		
2106							383,603	52,365	699,910	316,307	1,684,539		
2107							316,306	43,178	316,307	0	2,000,845	Oct-07	5.3
	Total						**2,000,845**	**273,131**					
2107	20	2,093,014	483,292	35,799	-	-	72,906	9,952	2,057,215	1,984,308	72,906	Oct-07	
2108							394,904	53,908	1,984,308	1,589,404	467,811		
2109							400,679	54,696	1,589,404	1,188,725	868,489		
2110							406,538	55,496	1,188,725	782,187	1,275,027		
2111							412,483	56,307	782,187	369,704	1,687,510		
2112							369,704	50,468	369,704	0	2,057,214	Nov-12	5.1
	Total						**2,057,214**	**280,826**					
2112	21	2,250,587	275,105	20,378	322,878	23,917	48,810	6,663	2,206,292	2,157,482	48,810	Nov-12	
2113							424,635	57,966	2,157,482	1,732,847	473,445		
2114							430,844	58,814	1,732,847	1,302,003	904,289		
2115							437,144	59,674	1,302,003	864,859	1,341,433		
2116							443,537	60,546	864,859	421,322	1,784,970		
2117							421,322	57,514	421,322	0	2,206,292	Dec-17	5.1
	Total						**2,206,292**	**301,176**					
2117	22	2,416,422	413,909	30,660	717,024	53,113	28,700	3,918	2,332,649	2,303,949	28,700	Dec-17	
2118							456,603	62,330	2,303,949	1,847,346	485,303		
2119							463,280	63,241	1,847,346	1,384,066	948,583		

Matanuska-Susitna Central Landfill
Table C-1
Estimated Life of MSW Cells w/o Valley Fills

			Cell Volume										
Year	Cell	Total Volume Above Liner 1 (cy)	Area, Bottom Liner (sf)	Total Volume of Bottom Liner Soil (cy)	Area, Final Cover (sf)	Total Volume of Final Cover 2 (cy)	Total Airspace Required[3] (cy)	Total Daily / Intermediate Cover Soils (cy)	Net volume at beginning of year (cy)	Net volume at end of year (cy)	Cumulative Net Volume Used (cy)	Start/Full Dates	Cell Life (Years)
2120							470,055	64,166	1,384,066	914,011	1,418,638		
2121							476,928	65,104	914,011	437,083	1,895,566		
2122							437,083	59,665	437,083	0	2,332,649	Nov-22	5.0
	Total						**2,332,649**	**318,425**					
2122	23	3,145,709	459,266	34,020	527,436	39,069	46,820	6,391	3,072,620	3,025,800	46,820	Nov-22	
2123							490,979	67,022	3,025,800	2,534,822	537,798		
2124							498,158	68,003	2,534,822	2,036,663	1,035,957		
2125							505,443	68,997	2,036,663	1,531,221	1,541,399		
2126							512,834	70,006	1,531,221	1,018,387	2,054,233		
2127							520,333	71,030	1,018,387	498,054	2,574,566		
2128							498,054	67,988	498,054	0	3,072,620	Dec-28	6.0
	Total						**3,072,620**	**419,437**					
2128	24	3,412,244	412,349	30,544	1,408,187	104,310	29,888	4,080	3,277,390	3,247,501	29,888	Dec-28	
2129							535,662	73,122	3,247,501	2,711,839	565,550		
2130							543,495	74,191	2,711,839	2,168,344	1,109,045		
2131							551,443	75,276	2,168,344	1,616,902	1,660,488		
2132							559,506	76,377	1,616,902	1,057,395	2,219,994		
2133							567,688	77,494	1,057,395	489,707	2,787,682		
2134							489,707	66,849	489,707	0	3,277,389	Nov-34	5.9
	Total						**3,277,389**	**447,390**					
FUTURE LANDFILL PHASE 2													
2134	25	3,097,417	1,347,630	99,824	558,783	41,391	86,282	11,778	2,956,201	2,869,919	86,282	Nov-34	
2135							584,412	79,777	2,869,919	2,285,507	670,695		
2136							592,958	80,943	2,285,507	1,692,549	1,263,653		
2137							601,629	82,127	1,692,549	1,090,920	1,865,282		
2138							610,427	83,328	1,090,920	480,493	2,475,708		
2139							480,493	65,591	480,493	0	2,956,201	Oct-39	4.9
	Total						**2,956,201**	**403,545**					
2139	26	4,026,232	733,822	54,357	522,853	38,730	138,860	18,955	3,933,145	3,794,285	138,860	Oct-39	
2140							628,410	85,783	3,794,285	3,165,876	767,269		
2141							637,599	87,037	3,165,876	2,528,277	1,404,868		
2142							646,923	88,310	2,528,277	1,881,354	2,051,791		
2143							656,383	89,601	1,881,354	1,224,972	2,708,173		
2144							665,981	90,912	1,224,972	558,991	3,374,154		
2145							558,990	76,307	558,991	0	3,933,145	Oct-45	6.1
	Total						**3,933,145**	**536,905**					
2145	27	4,392,656	814,495	60,333	721,736	53,462	116,729	15,934	4,278,861	4,162,132	116,729	Oct-45	
2146							685,601	93,590	4,162,132	3,476,532	802,330		
2147							695,626	94,958	3,476,532	2,780,905	1,497,956		
2148							705,798	96,347	2,780,905	2,075,107	2,203,754		
2149							716,119	97,756	2,075,107	1,358,988	2,919,873		
2150							726,591	99,185	1,358,988	632,397	3,646,465		
2151							632,396	86,327	632,397	0	4,278,861	Nov-51	6.0
	Total						**4,278,861**	**584,098**					
2151	28	4,792,427	941,318	69,727	917,896	67,992	104,820	14,309	4,654,707	4,549,888	104,820	Nov-51	
2152							747,996	102,107	4,549,888	3,801,891	852,816		
2153							758,934	103,601	3,801,891	3,042,957	1,611,751		
2154							770,032	105,116	3,042,957	2,272,924	2,381,783		
2155							781,293	106,653	2,272,924	1,491,632	3,163,076		

Matanuska-Susitna Central Landfill
Table C-1
Estimated Life of MSW Cells w/o Valley Fills

			Cell Volume										
Year	Cell	Total Volume Above Liner 1 (cy)	Area, Bottom Liner (sf)	Total Volume of Bottom Liner Soil (cy)	Area, Final Cover (sf)	Total Volume of Final Cover 2 (cy)	Total Airspace Required[3] (cy)	Total Daily / Intermediate Cover Soils (cy)	Net volume at beginning of year (cy)	Net volume at end of year (cy)	Cumulative Net Volume Used (cy)	Start/Full Dates	Cell Life (Years)
2156							792,717	108,212	1,491,632	698,914	3,955,793		
2157							698,914	95,407	698,914	0	4,654,707	Nov-57	6.0
	Total						**4,654,707**	**635,404**					
2157	29	5,505,059	1,228,350	90,989	1,587,132	117,565	105,396	14,387	5,296,505	5,191,109	105,396	Nov-57	
2158							816,071	111,400	5,191,109	4,375,038	921,466		
2159							828,004	113,029	4,375,038	3,547,034	1,749,471		
2160							840,112	114,682	3,547,034	2,706,922	2,589,583		
2161							852,397	116,359	2,706,922	1,854,524	3,441,980		
2162							864,862	118,061	1,854,524	989,663	4,306,842		
2163							877,509	119,787	989,663	112,154	5,184,351		
2164							112,153	15,310	112,154	0	5,296,505	Feb-64	6.3
	Total						**5,296,505**	**723,015**					
		55,607,298	**11,539,872**	**854,805**	**10,496,852**	**777,545**	**53,974,945**	**431,073**					**150.8**

[1] Total volume available, including soils above flexible membrane component of liner and to top of final cover.

[2] Total quantity of cover soils assumed 2.5 ft thick: 6" leveling layer, 18" low-permeability infiltration layer, and 6" erosion control layer; calculation only includes 2 ft of soil considering that the leveling layer is part of the daily cover previously placed.

[3] Includes daily/intermediate cover soils and MSW

[4] Bottom liner not included in Cells 1-3 since they have been constructed.

cy = cubic yards
sf = square feet

Matanuska-Susitna Central Landfill

Table C-2

Estimated Life of MSW Cells with Valley Fills

			Cell Volume										
Year	Cell	Total Volume Above Liner 1 (cy)	Area, Bottom Liner (sf)	Total Volume of Bottom Liner Soil (cy)	Area, Final Cover (sf)	Total Volume of Final Cover 2 (cy)	Total Airspace Required[3] (cy)	Total Daily / Intermediate Cover Soils (cy)	Net volume at beginning of year (cy)	Net volume at end of year (cy)	Cumulative Net Volume Used (cy)	Start/Full Dates	Cell Life (Years)
EXISTING LANDFILL AREA													
2013	3[4]	880,567	-	-	442,842	32,803	33,138	4,524	847,764	814,626	33,138	May-13	
2014							86,076	11,750	814,626	728,550	119,213		
2015							88,209	12,041	728,550	640,342	207,422		
2016							90,395	12,340	640,342	549,947	297,817		
2017							92,634	12,645	549,947	457,313	390,451		
2018							94,841	12,947	457,313	362,472	485,292		
2019							97,100	13,255	362,472	265,372	582,391		
2020							99,412	13,571	265,372	165,960	681,804		
2021							101,780	13,894	165,960	64,181	783,583		
2022							64,181	8,761	64,181	0	847,764	Aug-22	9.2
	Total						**847,764**	**115,727**					
2022	4	522,859	212,465	15,738	170,263	12,612	40,023	5,463	494,509	454,486	40,023	Aug-22	
2023							106,648	14,558	454,486	347,838	146,671		
2024							109,149	14,900	347,838	238,689	255,819		
2025							111,708	15,249	238,689	126,981	367,528		
2026							114,328	15,607	126,981	12,653	481,856		
2027							12,652	1,727	12,653	0	494,508	Feb-27	4.5
	Total						**494,508**	**67,504**					
2027	5	595,005	128,514	9,520	79,020	5,853	104,357	14,246	579,632	475,275	104,357	Feb-27	
2028							119,478	16,310	475,275	355,797	223,835		
2029							121,998	16,654	355,797	233,799	345,833		
2030							124,572	17,005	233,799	109,227	470,405		
2031							109,227	14,910	109,227	0	579,632	Oct-31	4.7
	Total						**579,632**	**79,124**					
2031	6	588,977	166,611	12,342	125,731	9,313	17,973	2,453	567,322	549,349	17,973	Oct-31	
2032							129,883	17,730	549,349	419,466	147,856		
2033							132,012	18,021	419,466	287,454	279,868		
2034							134,176	18,316	287,454	153,278	414,044		
2035							136,375	18,616	153,278	16,902	550,420		
2036							16,902	2,307	16,902	0	567,322	Feb-36	4.3
	Total						**567,322**	**77,444**					
2036	7	1,114,301	78,134	5,788	324,776	24,057	121,708	16,614	1,084,456	962,748	121,708	Feb-36	
2037							140,882	19,232	962,748	821,866	262,590		
2038							142,942	19,513	821,866	678,923	405,533		
2039							145,033	19,798	678,923	533,891	550,565		
2040							147,153	20,088	533,891	386,737	697,719		
2041							149,305	20,381	386,737	237,432	847,024		
2042							151,489	20,679	237,432	85,943	998,512		
2043							85,944	11,732	85,943	0	1,084,456	Jul-43	7.4
	Total						**1,084,456**	**148,037**					
FUTURE LANDFILL PHASE 1													
2043	8	967,004	579,484	42,925	-	-	67,760	9,250	924,079	856,319	67,760	Jul-43	
2044							155,951	21,289	856,319	700,368	223,712		
2045							158,232	21,600	700,368	542,136	381,944		
2046							160,546	21,916	542,136	381,590	542,489		
2047							162,893	22,236	381,590	218,697	705,383		
2048							165,275	22,561	218,697	53,421	870,658		

Matanuska-Susitna Central Landfill

Table C-2

Estimated Life of MSW Cells with Valley Fills

			Cell Volume										
Year	**Cell**	**Total Volume Above Liner 1 (cy)**	**Area, Bottom Liner (sf)**	**Total Volume of Bottom Liner Soil (cy)**	**Area, Final Cover (sf)**	**Total Volume of Final Cover 2 (cy)**	**Total Airspace Required[3] (cy)**	**Total Daily / Intermediate Cover Soils (cy)**	**Net volume at beginning of year (cy)**	**Net volume at end of year (cy)**	**Cumulative Net Volume Used (cy)**	**Start/Full Dates**	**Cell Life (Years)**
2049							53,421	7,292	53,421	0	924,079	Apr-49	5.8
	Total						**924,079**	**126,144**					
2049	9	888,704	309,863	22,953	12,568	931	114,271	15,599	864,820	750,549	114,271	Apr-49	
2050							170,144	23,226	750,549	580,405	284,415		
2051							172,632	23,566	580,405	407,772	457,048		
2052							175,157	23,910	407,772	232,616	632,205		
2053							177,718	24,260	232,616	54,897	809,923		
2054							54,897	7,494	54,897	0	864,820	Mar-54	4.9
	Total						**864,820**	**118,055**					
2054	10	891,498	310,130	22,973	80,012	5,927	125,420	17,121	862,599	737,179	125,420	Mar-54	
2055							182,954	24,975	737,179	554,225	308,374		
2056							185,629	25,340	554,225	368,596	494,003		
2057							188,344	25,710	368,596	180,252	682,346		
2058							180,252	24,606	180,252	0	862,598	Dec-58	4.7
	Total						**862,598**	**117,752**					
2058	11	1,349,976	412,114	30,527	256,964	19,034	10,845	1,480	1,300,415	1,289,569	10,845	Dec-58	
2059							193,892	26,468	1,289,569	1,095,677	204,738		
2060							196,727	26,855	1,095,677	898,950	401,465		
2061							199,604	27,248	898,950	699,346	601,069		
2062							202,523	27,646	699,346	496,823	803,592		
2063							205,485	28,050	496,823	291,338	1,009,077		
2064							208,489	28,460	291,338	82,849	1,217,566		
2065							82,849	11,310	82,849	0	1,300,415	May-65	6.5
	Total						**1,300,415**	**177,517**					
2065	12	1,136,637	377,291	27,947	-	-	128,689	17,567	1,108,690	980,000	128,689	May-65	
2066							214,631	29,299	980,000	765,369	343,321		
2067							217,770	29,727	765,369	547,599	561,091		
2068							220,954	30,162	547,599	326,644	782,045		
2069							224,185	30,603	326,644	102,459	1,006,231		
2070							102,459	13,986	102,459	0	1,108,690	Jun-70	5.1
	Total						**1,108,690**	**151,345**					
2070	13	1,270,283	200,032	14,817	143,001	10,593	125,005	17,064	1,244,873	1,119,868	125,005	Jun-70	
2071							230,790	31,505	1,119,868	889,079	355,795		
2072							234,165	31,965	889,079	654,914	589,959		
2073							237,589	32,433	654,914	417,325	827,548		
2074							241,063	32,907	417,325	176,261	1,068,612		
2075							176,262	24,061	176,261	0	1,244,873	Sep-75	5.3
	Total						**1,244,873**	**169,935**					
2075	14	1,262,732	200,020	14,816	172,926	12,809	68,327	9,327	1,235,106	1,166,780	68,327	Sep-75	
2076							248,165	33,876	1,166,780	918,615	316,492		
2077							251,794	34,372	918,615	666,821	568,286		
2078							255,476	34,874	666,821	411,345	823,762		
2079							259,212	35,384	411,345	152,133	1,082,973		
2080							152,133	20,767	152,133	0	1,235,106	Jul-80	4.9
	Total						**1,235,106**	**168,602**					
2080	15	2,131,590	289,575	21,450	483,394	35,807	110,870	15,135	2,074,333	1,963,463	110,870	Jul-80	
2081							266,848	36,427	1,963,463	1,696,615	377,718		
2082							270,750	36,960	1,696,615	1,425,865	648,468		

Matanuska-Susitna Central Landfill
Table C-2
Estimated Life of MSW Cells with Valley Fills

			Cell Volume										
Year	**Cell**	**Total Volume Above Liner 1 (cy)**	**Area, Bottom Liner (sf)**	**Total Volume of Bottom Liner Soil (cy)**	**Area, Final Cover (sf)**	**Total Volume of Final Cover 2 (cy)**	**Total Airspace Required[3] (cy)**	**Total Daily / Intermediate Cover Soils (cy)**	**Net volume at beginning of year (cy)**	**Net volume at end of year (cy)**	**Cumulative Net Volume Used (cy)**	**Start/Full Dates**	**Cell Life (Years)**
2083							274,709	37,500	1,425,865	1,151,156	923,177		
2084							278,727	38,048	1,151,156	872,429	1,201,904		
2085							282,802	38,605	872,429	589,627	1,484,706		
2086							286,938	39,169	589,627	302,689	1,771,644		
2087							291,134	39,742	302,689	11,555	2,062,778		
2088							11,555	1,577	11,555	0	2,074,333	Jan-88	7.5
	Total						**2,074,333**	**283,163**					
2088	16	1,456,140	453,926	33,624	-	-	283,836	38,746	1,422,516	1,138,680	283,836	Jan-88	
2089							299,710	40,913	1,138,680	838,969	583,546		
2090							304,093	41,511	838,969	534,876	887,640		
2091							308,540	42,118	534,876	226,336	1,196,180		
2092							226,337	30,897	226,336	0	1,422,516	Sep-92	4.7
	Total						**1,422,516**	**194,185**					
2092	17	1,546,321	220,053	16,300	145,576	10,783	86,715	11,837	1,519,237	1,432,522	86,715	Sep-92	
2093							317,629	43,359	1,432,522	1,114,893	404,345		
2094							322,274	43,993	1,114,893	792,619	726,619		
2095							326,987	44,636	792,619	465,632	1,053,606		
2096							331,768	45,289	465,632	133,863	1,385,374		
2097							133,863	18,273	133,863	0	1,519,237	May-97	4.7
	Total						**1,519,237**	**207,388**					
2097	18	1,810,193	212,284	15,725	220,070	16,301	202,757	27,678	1,778,167	1,575,410	202,757	May-97	
2098							341,542	46,623	1,575,410	1,233,868	544,299		
2099							346,537	47,305	1,233,868	887,331	890,835		
2100							351,604	47,997	887,331	535,727	1,242,440		
2101							356,746	48,699	535,727	178,982	1,599,185		
2102							178,982	24,432	178,982	0	1,778,167	Jun-02	5.1
	Total						**1,778,167**	**242,734**					
2102	19	2,062,744	279,843	20,729	555,786	41,169	182,980	24,978	2,000,846	1,817,865	182,980	Jun-02	
2103							367,255	50,133	1,817,865	1,450,610	550,235		
2104							372,626	50,866	1,450,610	1,077,984	922,861		
2105							378,075	51,610	1,077,984	699,910	1,300,936		
2106							383,603	52,365	699,910	316,307	1,684,539		
2107							316,306	43,178	316,307	0	2,000,845	Oct-07	5.3
	Total						**2,000,845**	**273,131**					
2107	20	2,093,014	483,292	35,799	-	-	72,906	9,952	2,057,215	1,984,308	72,906	Oct-07	
2108							394,904	53,908	1,984,308	1,589,404	467,811		
2109							400,679	54,696	1,589,404	1,188,725	868,489		
2110							406,538	55,496	1,188,725	782,187	1,275,027		
2111							412,483	56,307	782,187	369,704	1,687,510		
2112							369,704	50,468	369,704	0	2,057,214	Nov-12	5.1
	Total						**2,057,214**	**280,826**					
2112	21	2,250,587	275,105	20,378	322,878	23,917	48,810	6,663	2,206,292	2,157,482	48,810	Nov-12	
2113							424,635	57,966	2,157,482	1,732,847	473,445		
2114							430,844	58,814	1,732,847	1,302,003	904,289		
2115							437,144	59,674	1,302,003	864,859	1,341,433		
2116							443,537	60,546	864,859	421,322	1,784,970		
2117							421,322	57,514	421,322	0	2,206,292	Dec-17	5.1
	Total						**2,206,292**	**301,176**					

Matanuska-Susitna Central Landfill

Table C-2

Estimated Life of MSW Cells with Valley Fills

			Cell Volume										
Year	**Cell**	**Total Volume Above Liner 1 (cy)**	**Area, Bottom Liner (sf)**	**Total Volume of Bottom Liner Soil (cy)**	**Area, Final Cover (sf)**	**Total Volume of Final Cover 2 (cy)**	**Total Airspace Required[3] (cy)**	**Total Daily / Intermediate Cover Soils (cy)**	**Net volume at beginning of year (cy)**	**Net volume at end of year (cy)**	**Cumulative Net Volume Used (cy)**	**Start/Full Dates**	**Cell Life (Years)**
2117	22	2,416,422	413,909	30,660	717,024	53,113	28,700	3,918	2,332,649	2,303,949	28,700	Dec-17	
2118							456,603	62,330	2,303,949	1,847,346	485,303		
2119							463,280	63,241	1,847,346	1,384,066	948,583		
2120							470,055	64,166	1,384,066	914,011	1,418,638		
2121							476,928	65,104	914,011	437,083	1,895,566		
2122							437,083	59,665	437,083	0	2,332,649	Nov-22	5.0
	Total						**2,332,649**	**318,425**					
2122	23	3,145,709	459,266	34,020	527,436	39,069	46,820	6,391	3,072,620	3,025,800	46,820	Nov-22	
2123							490,979	67,022	3,025,800	2,534,822	537,798		
2124							498,158	68,003	2,534,822	2,036,663	1,035,957		
2125							505,443	68,997	2,036,663	1,531,221	1,541,399		
2126							512,834	70,006	1,531,221	1,018,387	2,054,233		
2127							520,333	71,030	1,018,387	498,054	2,574,566		
2128							498,054	67,988	498,054	0	3,072,620	Dec-28	6.0
	Total						**3,072,620**	**419,437**					
2128	24	3,412,244	412,349	30,544	1,408,187	104,310	29,888	4,080	3,277,390	3,247,501	29,888	Dec-28	
2129							535,662	73,122	3,247,501	2,711,839	565,550		
2130							543,495	74,191	2,711,839	2,168,344	1,109,045		
2131							551,443	75,276	2,168,344	1,616,902	1,660,488		
2132							559,506	76,377	1,616,902	1,057,395	2,219,994		
2133							567,688	77,494	1,057,395	489,707	2,787,682		
2134							489,707	66,849	489,707	0	3,277,389	Nov-34	5.9
	Total						**3,277,389**	**447,390**					
						FUTURE LANDFILL PHASE 2							
2134	25	3,097,417	1,347,630	99,824	558,783	41,391	86,282	11,778	2,956,201	2,869,919	86,282	Nov-34	
2135							584,412	79,777	2,869,919	2,285,507	670,695		
2136							592,958	80,943	2,285,507	1,692,549	1,263,653		
2137							601,629	82,127	1,692,549	1,090,920	1,865,282		
2138							610,427	83,328	1,090,920	480,493	2,475,708		
2139							480,493	65,591	480,493	0	2,956,201	Oct-39	4.9
	Total						**2,956,201**	**403,545**					
2139	26	4,026,232	733,822	54,357	522,853	38,730	138,860	18,955	3,933,145	3,794,285	138,860	Oct-39	
2140							628,410	85,783	3,794,285	3,165,876	767,269		
2141							637,599	87,037	3,165,876	2,528,277	1,404,868		
2142							646,923	88,310	2,528,277	1,881,354	2,051,791		
2143							656,383	89,601	1,881,354	1,224,972	2,708,173		
2144							665,981	90,912	1,224,972	558,991	3,374,154		
2145							558,990	76,307	558,991	0	3,933,145	Oct-45	6.1
	Total						**3,933,145**	**536,905**					
2145	27	4,392,656	814,495	60,333	721,736	53,462	116,729	15,934	4,278,861	4,162,132	116,729	Oct-45	
2146							685,601	93,590	4,162,132	3,476,532	802,330		
2147							695,626	94,958	3,476,532	2,780,905	1,497,956		
2148							705,798	96,347	2,780,905	2,075,107	2,203,754		
2149							716,119	97,756	2,075,107	1,358,988	2,919,873		
2150							726,591	99,185	1,358,988	632,397	3,646,465		
2151							632,396	86,327	632,397	0	4,278,861	Nov-51	6.0
	Total						**4,278,861**	**584,098**					
2151	28	4,792,427	941,318	69,727	917,896	67,992	104,820	14,309	4,654,707	4,549,888	104,820	Nov-51	

Matanuska-Susitna Central Landfill
Table C-2
Estimated Life of MSW Cells with Valley Fills

			Cell Volume										
Year	Cell	Total Volume Above Liner 1 (cy)	Area, Bottom Liner (sf)	Total Volume of Bottom Liner Soil (cy)	Area, Final Cover (sf)	Total Volume of Final Cover 2 (cy)	Total Airspace Required[3] (cy)	Total Daily / Intermediate Cover Soils (cy)	Net volume at beginning of year (cy)	Net volume at end of year (cy)	Cumulative Net Volume Used (cy)	Start/Full Dates	Cell Life (Years)
2152							747,996	102,107	4,549,888	3,801,891	852,816		
2153							758,934	103,601	3,801,891	3,042,957	1,611,751		
2154							770,032	105,116	3,042,957	2,272,924	2,381,783		
2155							781,293	106,653	2,272,924	1,491,632	3,163,076		
2156							792,717	108,212	1,491,632	698,914	3,955,793		
2157							698,914	95,407	698,914	0	4,654,707	Nov-57	6.0
	Total						**4,654,707**	**635,404**					
2157	29	5,505,059	1,228,350	90,989	1,587,132	117,565	105,396	14,387	5,296,505	5,191,109	105,396	Nov-57	
2158							816,071	111,400	5,191,109	4,375,038	921,466		
2159							828,004	113,029	4,375,038	3,547,034	1,749,471		
2160							840,112	114,682	3,547,034	2,706,922	2,589,583		
2161							852,397	116,359	2,706,922	1,854,524	3,441,980		
2162							864,862	118,061	1,854,524	989,663	4,306,842		
2163							877,509	119,787	989,663	112,154	5,184,351		
2164							112,153	15,310	112,154	0	5,296,505	Feb-64	6.3
	Total						**5,296,505**	**723,015**					
FUTURE LANDFILL VALLEY FILLS													
2164		3,747,000	-	-	2,215,818	164,135	778,187	106,229	3,582,865	2,804,678	778,187	Feb-64	
2165							903,360	123,316	2,804,678	1,901,318	1,681,547		
2166							916,570	125,119	1,901,318	984,748	2,598,117		
2167							929,973	126,949	984,748	54,775	3,528,091		
2168							54,774	7,477	54,775	0	3,582,865	Jan-68	3.9
	Total						**3,582,865**	**489,090**					
	Grand Total	**59,354,298**	**11,539,872**	**854,805**	**12,712,670**	**941,679**	**57,557,810**	**920,162**					

[1] Total volume available, including soils above flexible membrane component of liner and to top of final cover.
[2] Total quantity of cover soils assumed 2.5 ft thick: 6" leveling layer, 18" low-permeability infiltration layer, and 6" erosion control layer; calculation only includes 2 ft of soil considering that the leveling layer is part of the daily cover previously placed.
[3] Includes daily/intermediate cover soils and MSW
[4] Bottom liner not included in Cells 1-3 since they have been constructed.

cy = cubic yards
sf = square feet

Appendix D
HELP Modeling Results

(Select output files are included here. Full output is available upon request from CH2M HILL.)

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
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PRECIPITATION DATA FILE:    C:\matsu\P1.D4
TEMPERATURE DATA FILE:      C:\matsu\T1.D7
SOLAR RADIATION DATA FILE:  C:\matsu\s1.D13
EVAPOTRANSPIRATION DATA:    C:\matsu\e1.D11
SOIL AND DESIGN DATA FILE:  C:\matsu\futbotnw.D10
OUTPUT DATA FILE:           C:\matsu\futbotnw.OUT


TIME:  16:42     DATE:   8/20/2014


******************************************************************************

     TITLE:  Mat-Su Future Cells Bottom No Waste

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                   LAYER  1
                                   --------

                        TYPE 2 - LATERAL DRAINAGE LAYER
                          MATERIAL TEXTURE NUMBER   0
           THICKNESS                   =     24.00   INCHES
           POROSITY                    =      0.3970 VOL/VOL
           FIELD CAPACITY              =      0.0320 VOL/VOL
           WILTING POINT               =      0.0130 VOL/VOL
           INITIAL SOIL WATER CONTENT  =      0.0391 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.100000001000     CM/SEC
           SLOPE                       =      4.00   PERCENT
           DRAINAGE LENGTH             =    200.0    FEET
```

LAYER 2

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

```
THICKNESS                    =      0.08   INCHES
POROSITY                     =      0.0000 VOL/VOL
FIELD CAPACITY               =      0.0000 VOL/VOL
WILTING POINT                =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY          =      1.00   HOLES/ACRE
FML INSTALLATION DEFECTS     =      2.00   HOLES/ACRE
FML PLACEMENT QUALITY        =  3 - GOOD
```

LAYER 3

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 17

```
THICKNESS                    =      0.25   INCHES
POROSITY                     =      0.7500 VOL/VOL
FIELD CAPACITY               =      0.7470 VOL/VOL
WILTING POINT                =      0.4000 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.7500 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.300000003000E-08 CM/SEC
```

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

```
SCS RUNOFF CURVE NUMBER              =     80.40
FRACTION OF AREA ALLOWING RUNOFF     =      0.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE   =      1.000  ACRES
EVAPORATIVE ZONE DEPTH               =      8.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE    =      0.427  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE   =      3.176  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE   =      0.104  INCHES
INITIAL SNOW WATER                   =      1.478  INCHES
INITIAL WATER IN LAYER MATERIALS     =      1.127  INCHES
TOTAL INITIAL WATER                  =      2.604  INCHES
TOTAL SUBSURFACE INFLOW              =      0.00   INCHES/YEAR
```

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
BETHEL ALASKA

STATION LATITUDE = 60.78 DEGREES
MAXIMUM LEAF AREA INDEX = 0.00
START OF GROWING SEASON (JULIAN DATE) = 184
END OF GROWING SEASON (JULIAN DATE) = 225
EVAPORATIVE ZONE DEPTH = 8.0 INCHES
AVERAGE ANNUAL WIND SPEED = 12.90 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY = 75.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY = 78.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY = 83.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 80.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR MEDFORD OREGON

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
0.84	0.84	0.72	0.44	0.66	1.31
2.06	2.29	2.59	1.74	1.09	1.22

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR BETHEL ALASKA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
14.10	18.20	26.30	37.30	47.80	55.10
58.10	55.90	48.00	33.90	20.70	16.20

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR BETHEL ALASKA AND STATION LATITUDE = 60.78 DEGREES

****

ANNUAL TOTALS FOR YEAR 1

	INCHES	CU. FEET	PERCENT
PRECIPITATION	16.68	60548.406	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	6.777	24601.559	40.63
DRAINAGE COLLECTED FROM LAYER 1	9.9027	35946.801	59.37
PERC./LEAKAGE THROUGH LAYER 3	0.000026	0.095	0.00

DRAINAGE COLLECTED FROM LAYER 1	11.5010	41748.469	64.50
PERC./LEAKAGE THROUGH LAYER 3	0.000029	0.104	0.00
AVG. HEAD ON TOP OF LAYER 2	0.2750		
CHANGE IN WATER STORAGE	0.942	3420.119	5.28
SOIL WATER AT START OF YEAR	1.377	4997.279	
SOIL WATER AT END OF YEAR	2.233	8105.950	
SNOW WATER AT START OF YEAR	1.185	4302.502	6.65
SNOW WATER AT END OF YEAR	1.271	4613.951	7.13
ANNUAL WATER BUDGET BALANCE	0.0000	0.007	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.84	0.95	0.58	0.45	0.69	0.75
	1.70	2.12	2.90	1.99	1.11	1.15
STD. DEVIATIONS	0.32	0.43	0.27	0.18	0.44	0.70
	1.80	2.07	1.87	1.17	0.41	0.46
RUNOFF						
TOTALS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION						
TOTALS	0.440	0.479	0.485	0.151	0.407	0.486
	0.357	0.487	0.523	0.524	0.379	0.373
STD. DEVIATIONS	0.060	0.068	0.125	0.094	0.373	0.386
	0.315	0.420	0.283	0.257	0.093	0.074
LATERAL DRAINAGE COLLECTED FROM LAYER 1						
TOTALS	0.0000	0.0000	0.2364	0.5760	2.7031	0.4222

	1.3514	1.4517	2.1802	1.0614	0.1182	0.0001
STD. DEVIATIONS	0.0000	0.0000	0.5250	1.0349	0.9253	0.7726
	1.4738	1.6976	1.4406	1.2370	0.2131	0.0004

PERCOLATION/LEAKAGE THROUGH LAYER 3

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 2

AVERAGES	0.0000	0.0000	0.0674	0.1696	0.7703	0.1243
	0.3851	0.4137	0.6420	0.3024	0.0348	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.1496	0.3047	0.2637	0.2275
	0.4200	0.4837	0.4242	0.3525	0.0628	0.0001

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	INCHES	CU. FEET	PERCENT
PRECIPITATION	15.24 (3.800)	55313.9	100.00
RUNOFF	0.000 (0.0000)	0.00	0.000
EVAPOTRANSPIRATION	5.092 (1.0139)	18484.79	33.418
LATERAL DRAINAGE COLLECTED FROM LAYER 1	10.10076 (3.64993)	36665.750	66.28663
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.00003 (0.00001)	0.097	0.00018
AVERAGE HEAD ON TOP OF LAYER 2	0.242 (0.087)		
CHANGE IN WATER STORAGE	0.045 (1.2219)	163.30	0.295

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	3.00	10890.000
RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 1	0.93303	3386.90479
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.000003	0.01241
AVERAGE HEAD ON TOP OF LAYER 2	8.242	
MAXIMUM HEAD ON TOP OF LAYER 2	12.854	
LOCATION OF MAXIMUM HEAD IN LAYER 1 (DISTANCE FROM DRAIN)	43.8 FEET	
SNOW WATER	5.05	18347.8535
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3970	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0130	

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	2.0455	0.0852
2	0.0000	0.0000
3	0.1875	0.7500
SNOW WATER	1.271	

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
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```
PRECIPITATION DATA FILE:    C:\matsu\P1.D4
TEMPERATURE DATA FILE:      C:\matsu\T1.D7
SOLAR RADIATION DATA FILE:  C:\matsu\s1.D13
EVAPOTRANSPIRATION DATA:    C:\matsu\e1.D11
SOIL AND DESIGN DATA FILE:  C:\matsu\futssnw.D10
OUTPUT DATA FILE:           C:\matsu\futssnw.OUT


TIME:  14:52     DATE:   8/20/2014
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     TITLE:  Mat-Su Future Cells SS No Waste

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                   LAYER  1
                                   --------

                       TYPE 2 - LATERAL DRAINAGE LAYER
                         MATERIAL TEXTURE NUMBER   0
           THICKNESS                  =     24.00   INCHES
           POROSITY                   =      0.3970 VOL/VOL
           FIELD CAPACITY             =      0.0320 VOL/VOL
           WILTING POINT              =      0.0130 VOL/VOL
           INITIAL SOIL WATER CONTENT  =      0.0391 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.100000001000     CM/SEC
           SLOPE                      =     33.00   PERCENT
           DRAINAGE LENGTH            =    100.0    FEET
```

LAYER 2

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.08 INCHES
POROSITY	=	0.0000 VOL/VOL
FIELD CAPACITY	=	0.0000 VOL/VOL
WILTING POINT	=	0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY	=	1.00 HOLES/ACRE
FML INSTALLATION DEFECTS	=	2.00 HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD

LAYER 3

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 17

THICKNESS	=	0.25 INCHES
POROSITY	=	0.7500 VOL/VOL
FIELD CAPACITY	=	0.7470 VOL/VOL
WILTING POINT	=	0.4000 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.7500 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000003000E-08 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS USER-SPECIFIED.

SCS RUNOFF CURVE NUMBER	=	82.40	
FRACTION OF AREA ALLOWING RUNOFF	=	0.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	8.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	0.427	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	3.176	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.104	INCHES
INITIAL SNOW WATER	=	1.478	INCHES
INITIAL WATER IN LAYER MATERIALS	=	1.127	INCHES
TOTAL INITIAL WATER	=	2.604	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
BETHEL ALASKA

STATION LATITUDE	=	60.78 DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00
START OF GROWING SEASON (JULIAN DATE)	=	184
END OF GROWING SEASON (JULIAN DATE)	=	225
EVAPORATIVE ZONE DEPTH	=	8.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	12.90 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	75.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	78.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	83.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	80.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR MEDFORD OREGON

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
0.84	0.84	0.72	0.44	0.66	1.31
2.06	2.29	2.59	1.74	1.09	1.22

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BETHEL ALASKA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
14.10	18.20	26.30	37.30	47.80	55.10
58.10	55.90	48.00	33.90	20.70	16.20

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BETHEL ALASKA
AND STATION LATITUDE = 60.78 DEGREES

****

ANNUAL TOTALS FOR YEAR 1

	INCHES	CU. FEET	PERCENT
PRECIPITATION	16.68	60548.406	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	6.777	24601.559	40.63
DRAINAGE COLLECTED FROM LAYER 1	9.9027	35946.895	59.37
PERC./LEAKAGE THROUGH LAYER 3	0.000002	0.008	0.00

DRAINAGE COLLECTED FROM LAYER 1	11.5010	41748.566	64.50
PERC./LEAKAGE THROUGH LAYER 3	0.000002	0.008	0.00
AVG. HEAD ON TOP OF LAYER 2	0.0197		
CHANGE IN WATER STORAGE	0.942	3420.119	5.28
SOIL WATER AT START OF YEAR	1.377	4997.279	
SOIL WATER AT END OF YEAR	2.233	8105.950	
SNOW WATER AT START OF YEAR	1.185	4302.502	6.65
SNOW WATER AT END OF YEAR	1.271	4613.951	7.13
ANNUAL WATER BUDGET BALANCE	0.0000	0.006	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.84	0.95	0.58	0.45	0.69	0.75
	1.70	2.12	2.90	1.99	1.11	1.15
STD. DEVIATIONS	0.32	0.43	0.27	0.18	0.44	0.70
	1.80	2.07	1.87	1.17	0.41	0.46
RUNOFF						
TOTALS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION						
TOTALS	0.440	0.479	0.485	0.151	0.407	0.486
	0.357	0.487	0.523	0.524	0.379	0.373
STD. DEVIATIONS	0.060	0.068	0.125	0.094	0.373	0.386
	0.315	0.420	0.283	0.257	0.093	0.074
LATERAL DRAINAGE COLLECTED FROM LAYER 1						
TOTALS	0.0000	0.0000	0.2992	0.5357	2.7253	0.4107

	1.3964	1.5595	2.2038	0.9192	0.0510	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.6008	1.0000	0.9489	0.7758
	1.5495	1.8320	1.5862	1.1624	0.1013	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 3

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 2

AVERAGES	0.0000	0.0000	0.0058	0.0112	0.0588	0.0088
	0.0278	0.0314	0.0456	0.0180	0.0010	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0116	0.0214	0.0214	0.0173
	0.0310	0.0375	0.0330	0.0227	0.0020	0.0000

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	INCHES	CU. FEET	PERCENT
PRECIPITATION	15.24 (3.800)	55313.9	100.00
RUNOFF	0.000 (0.0000)	0.00	0.000
EVAPOTRANSPIRATION	5.092 (1.0139)	18484.79	33.418
LATERAL DRAINAGE COLLECTED FROM LAYER 1	10.10078 (3.64995)	36665.840	66.28680
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.00000 (0.00000)	0.008	0.00001
AVERAGE HEAD ON TOP OF LAYER 2	0.017 (0.006)		
CHANGE IN WATER STORAGE	0.045 (1.2219)	163.30	0.295

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	3.00	10890.000
RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 1	3.13158	11367.63180
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.000001	0.00284
AVERAGE HEAD ON TOP OF LAYER 2	2.144	
MAXIMUM HEAD ON TOP OF LAYER 2	3.586	
LOCATION OF MAXIMUM HEAD IN LAYER 1 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	5.05	18347.8535
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3970	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0130	

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	2.0455	0.0852
2	0.0000	0.0000
3	0.1875	0.7500
SNOW WATER	1.271	

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**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
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PRECIPITATION DATA FILE:    C:\matsu\P1.D4
TEMPERATURE DATA FILE:      C:\matsu\T1.D7
SOLAR RADIATION DATA FILE:  C:\matsu\s1.D13
EVAPOTRANSPIRATION DATA:    C:\matsu\e1.D11
SOIL AND DESIGN DATA FILE:  C:\matsu\scen1.D10
OUTPUT DATA FILE:           C:\matsu\scen1.OUT


TIME:  14:19     DATE:   8/20/2014


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     TITLE:  Mat-Su Future Cells SS 40' of Waste, Scenario 5B Final Cover

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                   LAYER  1
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   2
           THICKNESS                   =      6.00   INCHES
           POROSITY                    =      0.4370 VOL/VOL
           FIELD CAPACITY              =      0.0620 VOL/VOL
           WILTING POINT               =      0.0240 VOL/VOL
           INITIAL SOIL WATER CONTENT  =      0.0858 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.579999993000E-02 CM/SEC


                                   LAYER  2
                                   --------
```

```
            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER   1
THICKNESS                   =      6.00   INCHES
POROSITY                    =      0.4170 VOL/VOL
FIELD CAPACITY              =      0.0450 VOL/VOL
WILTING POINT               =      0.0180 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0363 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.999999978000E-02 CM/SEC
SLOPE                       =     33.00   PERCENT
DRAINAGE LENGTH             =    100.0    FEET


                        LAYER  3
                        --------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                   =      0.06   INCHES
POROSITY                    =      0.0000 VOL/VOL
FIELD CAPACITY              =      0.0000 VOL/VOL
WILTING POINT               =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY         =      1.00   HOLES/ACRE
FML INSTALLATION DEFECTS    =      2.00   HOLES/ACRE
FML PLACEMENT QUALITY       =  3 - GOOD


                        LAYER  4
                        --------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER  16
THICKNESS                   =      0.25   INCHES
POROSITY                    =      0.4270 VOL/VOL
FIELD CAPACITY              =      0.4180 VOL/VOL
WILTING POINT               =      0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.4270 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000001000E-06 CM/SEC


                        LAYER  5
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER   2
THICKNESS                   =     12.00   INCHES
POROSITY                    =      0.4370 VOL/VOL
FIELD CAPACITY              =      0.0620 VOL/VOL
WILTING POINT               =      0.0240 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0620 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.579999993000E-02 CM/SEC
```

LAYER 6

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 19

```
THICKNESS                   =    480.00   INCHES
POROSITY                    =      0.1680 VOL/VOL
FIELD CAPACITY              =      0.0730 VOL/VOL
WILTING POINT               =      0.0190 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0730 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000005000E-02 CM/SEC
```

LAYER 7

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

```
THICKNESS                   =     24.00   INCHES
POROSITY                    =      0.3970 VOL/VOL
FIELD CAPACITY              =      0.0320 VOL/VOL
WILTING POINT               =      0.0130 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0320 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.100000001000     CM/SEC
SLOPE                       =     33.00   PERCENT
DRAINAGE LENGTH             =    100.0    FEET
```

LAYER 8

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

```
THICKNESS                   =      0.08   INCHES
POROSITY                    =      0.0000 VOL/VOL
FIELD CAPACITY              =      0.0000 VOL/VOL
WILTING POINT               =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT  =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.   =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY         =      1.00   HOLES/ACRE
FML INSTALLATION DEFECTS    =      2.00   HOLES/ACRE
FML PLACEMENT QUALITY       =  3 - GOOD
```

LAYER 9

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 17

```
THICKNESS                   =      0.25   INCHES
POROSITY                    =      0.7500 VOL/VOL
```

```
FIELD CAPACITY               =      0.7470 VOL/VOL
WILTING POINT                =      0.4000 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.7500 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.300000003000E-08 CM/SEC
```

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

```
NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
         SOIL DATA BASE USING SOIL TEXTURE # 2 WITH A
         POOR STAND OF GRASS, A SURFACE SLOPE OF 33.%
         AND A SLOPE LENGTH OF  100. FEET.

SCS RUNOFF CURVE NUMBER             =     76.20
FRACTION OF AREA ALLOWING RUNOFF    =    100.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
EVAPORATIVE ZONE DEPTH              =      8.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE   =      0.553  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE  =      3.456  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE  =      0.180  INCHES
INITIAL SNOW WATER                  =      1.478  INCHES
INITIAL WATER IN LAYER MATERIALS    =     37.579  INCHES
TOTAL INITIAL WATER                 =     39.057  INCHES
TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR
```

EVAPOTRANSPIRATION AND WEATHER DATA

```
NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
         BETHEL                ALASKA

    STATION LATITUDE                        =  60.78 DEGREES
    MAXIMUM LEAF AREA INDEX                 =   0.00
    START OF GROWING SEASON (JULIAN DATE)   =    184
    END OF GROWING SEASON (JULIAN DATE)     =    225
    EVAPORATIVE ZONE DEPTH                  =   8.0  INCHES
    AVERAGE ANNUAL WIND SPEED               =  12.90 MPH
    AVERAGE 1ST QUARTER RELATIVE HUMIDITY   =  75.00 %
    AVERAGE 2ND QUARTER RELATIVE HUMIDITY   =  78.00 %
    AVERAGE 3RD QUARTER RELATIVE HUMIDITY   =  83.00 %
    AVERAGE 4TH QUARTER RELATIVE HUMIDITY   =  80.00 %

NOTE:  PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
         COEFFICIENTS FOR    MEDFORD             OREGON
```

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
0.84	0.84	0.72	0.44	0.66	1.31
2.06	2.29	2.59	1.74	1.09	1.22

```
******************************************************************************

        AVERAGE MONTHLY VALUES IN INCHES FOR YEARS    1 THROUGH   20
------------------------------------------------------------------------------

                         JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                         -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                 0.84     0.95     0.58     0.45     0.69     0.75
                           1.70     2.12     2.90     1.99     1.11     1.15

    STD. DEVIATIONS        0.32     0.43     0.27     0.18     0.44     0.70
                           1.80     2.07     1.87     1.17     0.41     0.46

  RUNOFF
  ------
    TOTALS                 0.000    0.013    0.744    0.392    0.085    0.000
                           0.076    0.065    0.067    0.092    0.126    0.010

    STD. DEVIATIONS        0.000    0.035    0.546    0.791    0.096    0.000
                           0.136    0.130    0.132    0.280    0.276    0.021

  EVAPOTRANSPIRATION
  ------------------
    TOTALS                 0.440    0.479    0.485    0.176    0.830    0.596
                           0.654    0.741    0.842    0.632    0.390    0.373

    STD. DEVIATIONS        0.060    0.068    0.125    0.130    0.403    0.498
                           0.534    0.602    0.467    0.326    0.113    0.074

  LATERAL DRAINAGE COLLECTED FROM LAYER  2
  ----------------------------------------
    TOTALS                 0.0000   0.0000   0.0000   0.0885   1.8106   0.2112
                           1.0302   1.0909   1.7125   0.8312   0.1010   0.0000

    STD. DEVIATIONS        0.0000   0.0000   0.0000   0.3959   0.6482   0.4678
                           1.1599   1.4391   1.2194   1.0488   0.1980   0.0000

  PERCOLATION/LEAKAGE THROUGH LAYER  4
  ------------------------------------
    TOTALS                 0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                           0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

    STD. DEVIATIONS        0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                           0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

  LATERAL DRAINAGE COLLECTED FROM LAYER  7
  ----------------------------------------
    TOTALS                 0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                           0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

    STD. DEVIATIONS        0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                           0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

  PERCOLATION/LEAKAGE THROUGH LAYER  9
```

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

AVERAGES	0.0000	0.0000	0.0000	0.0175	0.3466	0.0417
	0.1973	0.2086	0.3385	0.1596	0.0200	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0782	0.1243	0.0924
	0.2225	0.2752	0.2410	0.2025	0.0391	0.0000

DAILY AVERAGE HEAD ON TOP OF LAYER 8

AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

****

****

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	INCHES	CU. FEET	PERCENT
PRECIPITATION	15.24 (3.800)	55313.9	100.00
RUNOFF	1.670 (1.1436)	6062.46	10.960
EVAPOTRANSPIRATION	6.638 (1.4316)	24094.38	43.559
LATERAL DRAINAGE COLLECTED FROM LAYER 2	6.87616 (2.84239)	24960.457	45.12507
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00011 (0.00005)	0.400	0.00072
AVERAGE HEAD ON TOP OF LAYER 3	0.111 (0.046)		
LATERAL DRAINAGE COLLECTED FROM LAYER 7	0.00011 (0.00005)	0.395	0.00071
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.00000 (0.00000)	0.005	0.00001

```
 AVERAGE HEAD ON TOP               0.000 (    0.000)
   OF LAYER  8

 CHANGE IN WATER STORAGE           0.054   (  1.0642)        196.24      0.355

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	3.00	10890.000
RUNOFF	1.121	4067.7922
DRAINAGE COLLECTED FROM LAYER 2	1.08655	3944.18896
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000030	0.10774
AVERAGE HEAD ON TOP OF LAYER 3	6.841	
MAXIMUM HEAD ON TOP OF LAYER 3	12.441	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	0.0 FEET	
DRAINAGE COLLECTED FROM LAYER 7	0.00002	0.05665
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.000000	0.00002
AVERAGE HEAD ON TOP OF LAYER 8	0.000	
MAXIMUM HEAD ON TOP OF LAYER 8	0.038	
LOCATION OF MAXIMUM HEAD IN LAYER 7 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	5.05	18347.8535

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3932
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0225

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	1.6299	0.2716
2	0.3909	0.0651
3	0.0000	0.0000
4	0.1067	0.4270
5	0.7440	0.0620
6	35.0400	0.0730
7	0.7680	0.0320
8	0.0000	0.0000
9	0.1875	0.7500
SNOW WATER	1.271	

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
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PRECIPITATION DATA FILE:    C:\matsu\P1.D4
TEMPERATURE DATA FILE:      C:\matsu\T1.D7
SOLAR RADIATION DATA FILE:  C:\matsu\s1.D13
EVAPOTRANSPIRATION DATA:    C:\matsu\e1.D11
SOIL AND DESIGN DATA FILE:  C:\matsu\scen2.D10
OUTPUT DATA FILE:           C:\matsu\scen2.OUT


TIME:  14:29     DATE:   8/20/2014


******************************************************************************

     TITLE:  Mat-Su Future Cells Bottom 60 Feet Waste Final Cover

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                   LAYER  1
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   2
           THICKNESS                    =      6.00   INCHES
           POROSITY                     =      0.4370 VOL/VOL
           FIELD CAPACITY               =      0.0620 VOL/VOL
           WILTING POINT                =      0.0240 VOL/VOL
           INITIAL SOIL WATER CONTENT   =      0.0858 VOL/VOL
           EFFECTIVE SAT. HYD. COND.    =  0.579999993000E-02 CM/SEC


                                   LAYER  2
                                   --------
```

```
              TYPE 2 - LATERAL DRAINAGE LAYER
                MATERIAL TEXTURE NUMBER   1
THICKNESS                    =      6.00   INCHES
POROSITY                     =      0.4170 VOL/VOL
FIELD CAPACITY               =      0.0450 VOL/VOL
WILTING POINT                =      0.0180 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.0536 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.999999978000E-02 CM/SEC
SLOPE                        =      4.00   PERCENT
DRAINAGE LENGTH              =    200.0    FEET


                          LAYER  3
                          --------

              TYPE 4 - FLEXIBLE MEMBRANE LINER
                MATERIAL TEXTURE NUMBER  35
THICKNESS                    =      0.08   INCHES
POROSITY                     =      0.0000 VOL/VOL
FIELD CAPACITY               =      0.0000 VOL/VOL
WILTING POINT                =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY          =      0.00   HOLES/ACRE
FML INSTALLATION DEFECTS     =      0.00   HOLES/ACRE
FML PLACEMENT QUALITY        =  4 - POOR


                          LAYER  4
                          --------

                TYPE 3 - BARRIER SOIL LINER
                MATERIAL TEXTURE NUMBER  17
THICKNESS                    =      0.25   INCHES
POROSITY                     =      0.7500 VOL/VOL
FIELD CAPACITY               =      0.7470 VOL/VOL
WILTING POINT                =      0.4000 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.7500 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.300000003000E-08 CM/SEC


                          LAYER  5
                          --------

            TYPE 1 - VERTICAL PERCOLATION LAYER
                MATERIAL TEXTURE NUMBER   2
THICKNESS                    =     12.00   INCHES
POROSITY                     =      0.4370 VOL/VOL
FIELD CAPACITY               =      0.0620 VOL/VOL
WILTING POINT                =      0.0240 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.0620 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.579999993000E-02 CM/SEC
```

LAYER 6

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 19

```
THICKNESS                    =    480.00   INCHES
POROSITY                     =      0.1680 VOL/VOL
FIELD CAPACITY               =      0.0730 VOL/VOL
WILTING POINT                =      0.0190 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.0730 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC
```

LAYER 7

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

```
THICKNESS                    =     24.00   INCHES
POROSITY                     =      0.3970 VOL/VOL
FIELD CAPACITY               =      0.0320 VOL/VOL
WILTING POINT                =      0.0130 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.0320 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.100000001000     CM/SEC
SLOPE                        =      4.00   PERCENT
DRAINAGE LENGTH              =    200.0    FEET
```

LAYER 8

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

```
THICKNESS                    =      0.08   INCHES
POROSITY                     =      0.0000 VOL/VOL
FIELD CAPACITY               =      0.0000 VOL/VOL
WILTING POINT                =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY          =      1.00   HOLES/ACRE
FML INSTALLATION DEFECTS     =      2.00   HOLES/ACRE
FML PLACEMENT QUALITY        =  3 - GOOD
```

LAYER 9

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 17

```
THICKNESS                    =      0.25   INCHES
POROSITY                     =      0.7500 VOL/VOL
```

FIELD CAPACITY = 0.7470 VOL/VOL
WILTING POINT = 0.4000 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.7500 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.300000003000E-08 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 2 WITH A POOR STAND OF GRASS, A SURFACE SLOPE OF 4.% AND A SLOPE LENGTH OF 100. FEET.

SCS RUNOFF CURVE NUMBER	=	74.60	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	8.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	0.553	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	3.456	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.180	INCHES
INITIAL SNOW WATER	=	1.478	INCHES
INITIAL WATER IN LAYER MATERIALS	=	37.763	INCHES
TOTAL INITIAL WATER	=	39.241	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
BETHEL ALASKA

STATION LATITUDE	=	60.78	DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00	
START OF GROWING SEASON (JULIAN DATE)	=	184	
END OF GROWING SEASON (JULIAN DATE)	=	225	
EVAPORATIVE ZONE DEPTH	=	8.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	12.90	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	75.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	78.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	83.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	80.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR MEDFORD OREGON

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
0.84	0.84	0.72	0.44	0.66	1.31
2.06	2.29	2.59	1.74	1.09	1.22

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BETHEL ALASKA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
14.10	18.20	26.30	37.30	47.80	55.10
58.10	55.90	48.00	33.90	20.70	16.20

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BETHEL ALASKA
AND STATION LATITUDE = 60.78 DEGREES

****

ANNUAL TOTALS FOR YEAR 1

	INCHES	CU. FEET	PERCENT
PRECIPITATION	16.68	60548.406	100.00
RUNOFF	1.228	4456.134	7.36
EVAPOTRANSPIRATION	8.654	31414.291	51.88
DRAINAGE COLLECTED FROM LAYER 2	6.8010	24687.682	40.77
PERC./LEAKAGE THROUGH LAYER 4	0.000053	0.191	0.00
AVG. HEAD ON TOP OF LAYER 3	1.6811		
DRAINAGE COLLECTED FROM LAYER 7	0.0001	0.182	0.00
PERC./LEAKAGE THROUGH LAYER 9	0.000002	0.009	0.00
AVG. HEAD ON TOP OF LAYER 8	0.0000		
CHANGE IN WATER STORAGE	-0.003	-9.901	-0.02
SOIL WATER AT START OF YEAR	37.763	137080.687	
SOIL WATER AT END OF YEAR	37.761	137070.781	
SNOW WATER AT START OF YEAR	1.478	5364.229	8.86
SNOW WATER AT END OF YEAR	1.478	5364.229	8.86
ANNUAL WATER BUDGET BALANCE	0.0000	0.010	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.84	0.95	0.58	0.45	0.69	0.75
	1.70	2.12	2.90	1.99	1.11	1.15
STD. DEVIATIONS	0.32	0.43	0.27	0.18	0.44	0.70
	1.80	2.07	1.87	1.17	0.41	0.46
RUNOFF						
TOTALS	0.000	0.014	0.754	0.397	0.086	0.000
	0.059	0.137	0.180	0.150	0.126	0.010
STD. DEVIATIONS	0.000	0.035	0.552	0.790	0.093	0.000
	0.110	0.480	0.358	0.493	0.276	0.021
EVAPOTRANSPIRATION						
TOTALS	0.440	0.479	0.485	0.176	0.969	0.604
	0.726	0.790	0.913	0.660	0.389	0.373
STD. DEVIATIONS	0.060	0.068	0.125	0.130	0.387	0.503
	0.600	0.621	0.536	0.305	0.112	0.074
LATERAL DRAINAGE COLLECTED FROM LAYER 2						
TOTALS	0.0879	0.0322	0.0144	0.0261	0.7757	0.7065
	0.6469	0.8146	1.1774	1.1578	0.5840	0.2376
STD. DEVIATIONS	0.0588	0.0215	0.0097	0.0923	0.2556	0.1746
	0.3850	0.6333	0.7509	0.6898	0.3850	0.1548
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LATERAL DRAINAGE COLLECTED FROM LAYER 7						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 9

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

AVERAGES	0.2505	0.1007	0.0410	0.0770	2.2178	2.0803
	1.8803	2.4153	3.6641	3.4114	1.7235	0.6770
STD. DEVIATIONS	0.1677	0.0675	0.0275	0.2717	0.7303	0.5141
	1.1453	2.0023	2.4725	2.1636	1.1390	0.4411

DAILY AVERAGE HEAD ON TOP OF LAYER 8

AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	INCHES	CU. FEET	PERCENT
PRECIPITATION	15.24 (3.800)	55313.9	100.00
RUNOFF	1.912 (1.4313)	6939.82	12.546
EVAPOTRANSPIRATION	7.004 (1.5645)	25424.77	45.964
LATERAL DRAINAGE COLLECTED FROM LAYER 2	6.26107 (2.16301)	22727.668	41.08850
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00005 (0.00002)	0.177	0.00032
AVERAGE HEAD ON TOP OF LAYER 3	1.545 (0.560)		
LATERAL DRAINAGE COLLECTED FROM LAYER 7	0.00005 (0.00002)	0.168	0.00030
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.00000 (0.00000)	0.009	0.00002

```
 AVERAGE HEAD ON TOP               0.000 (    0.000)
   OF LAYER  8

 CHANGE IN WATER STORAGE           0.061   (  1.1305)        221.51      0.400

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	3.00	10890.000
RUNOFF	1.679	6095.8481
DRAINAGE COLLECTED FROM LAYER 2	0.10731	389.55002
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000001	0.00370
AVERAGE HEAD ON TOP OF LAYER 3	12.000	
MAXIMUM HEAD ON TOP OF LAYER 3	17.662	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	52.6 FEET	
DRAINAGE COLLECTED FROM LAYER 7	0.00000	0.00323
PERCOLATION/LEAKAGE THROUGH LAYER 9	0.000000	0.00002
AVERAGE HEAD ON TOP OF LAYER 8	0.000	
MAXIMUM HEAD ON TOP OF LAYER 8	0.000	
LOCATION OF MAXIMUM HEAD IN LAYER 7 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	5.05	18347.8535

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.4320

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.0225

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	1.6299	0.2716
2	0.6336	0.1056
3	0.0000	0.0000
4	0.1875	0.7500
5	0.7440	0.0620
6	35.0400	0.0730
7	0.7680	0.0320
8	0.0000	0.0000
9	0.1875	0.7500
SNOW WATER	1.271	

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**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
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PRECIPITATION DATA FILE:    C:\matsu\P1.D4
TEMPERATURE DATA FILE:      C:\matsu\T1.D7
SOLAR RADIATION DATA FILE:  C:\matsu\s1.D13
EVAPOTRANSPIRATION DATA:    C:\matsu\e1.D11
SOIL AND DESIGN DATA FILE:  C:\matsu\scen4.D10
OUTPUT DATA FILE:           C:\matsu\scen4.OUT


TIME:  14:35     DATE:   8/20/2014


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     TITLE:  Mat-Su Future Cells SS 40' of Waste, Scenario 4 Interim Covr

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                   LAYER  1
                                   --------

                        TYPE 1 - VERTICAL PERCOLATION LAYER
                            MATERIAL TEXTURE NUMBER   2
           THICKNESS                     =     12.00   INCHES
           POROSITY                      =      0.4370 VOL/VOL
           FIELD CAPACITY                =      0.0620 VOL/VOL
           WILTING POINT                 =      0.0240 VOL/VOL
           INITIAL SOIL WATER CONTENT    =      0.0775 VOL/VOL
           EFFECTIVE SAT. HYD. COND.     =  0.579999993000E-02 CM/SEC


                                   LAYER  2
                                   --------
```

```
          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER  19
THICKNESS                    =    480.00   INCHES
POROSITY                     =      0.1680 VOL/VOL
FIELD CAPACITY               =      0.0730 VOL/VOL
WILTING POINT                =      0.0190 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.0730 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.100000005000E-02 CM/SEC


                        LAYER  3
                        --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =     24.00   INCHES
POROSITY                     =      0.3970 VOL/VOL
FIELD CAPACITY               =      0.0320 VOL/VOL
WILTING POINT                =      0.0130 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.0443 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.100000001000     CM/SEC
SLOPE                        =      4.00   PERCENT
DRAINAGE LENGTH              =    100.0    FEET


                        LAYER  4
                        --------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                    =      0.08   INCHES
POROSITY                     =      0.0000 VOL/VOL
FIELD CAPACITY               =      0.0000 VOL/VOL
WILTING POINT                =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY          =      1.00   HOLES/ACRE
FML INSTALLATION DEFECTS     =      2.00   HOLES/ACRE
FML PLACEMENT QUALITY        =  3 - GOOD


                        LAYER  5
                        --------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER  17
THICKNESS                    =      0.25   INCHES
POROSITY                     =      0.7500 VOL/VOL
FIELD CAPACITY               =      0.7470 VOL/VOL
WILTING POINT                =      0.4000 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.7500 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.300000003000E-08 CM/SEC
```

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 2 WITH A POOR STAND OF GRASS, A SURFACE SLOPE OF 4.% AND A SLOPE LENGTH OF 100. FEET.

SCS RUNOFF CURVE NUMBER	=	74.60	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	8.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	0.565	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	3.496	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.192	INCHES
INITIAL SNOW WATER	=	1.478	INCHES
INITIAL WATER IN LAYER MATERIALS	=	37.220	INCHES
TOTAL INITIAL WATER	=	38.698	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM BETHEL ALASKA

STATION LATITUDE	=	60.78	DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00	
START OF GROWING SEASON (JULIAN DATE)	=	184	
END OF GROWING SEASON (JULIAN DATE)	=	225	
EVAPORATIVE ZONE DEPTH	=	8.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	12.90	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	75.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	78.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	83.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	80.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR MEDFORD OREGON

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
0.84	0.84	0.72	0.44	0.66	1.31
2.06	2.29	2.59	1.74	1.09	1.22

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR BETHEL ALASKA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
14.10	18.20	26.30	37.30	47.80	55.10
58.10	55.90	48.00	33.90	20.70	16.20

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BETHEL ALASKA
AND STATION LATITUDE = 60.78 DEGREES

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ANNUAL TOTALS FOR YEAR 1

	INCHES	CU. FEET	PERCENT
PRECIPITATION	16.68	60548.406	100.00
RUNOFF	1.226	4451.605	7.35
EVAPOTRANSPIRATION	8.616	31276.062	51.65
DRAINAGE COLLECTED FROM LAYER 3	6.8400	24829.275	41.01
PERC./LEAKAGE THROUGH LAYER 5	0.000009	0.032	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0830		
CHANGE IN WATER STORAGE	-0.002	-8.572	-0.01
SOIL WATER AT START OF YEAR	37.220	135110.312	
SOIL WATER AT END OF YEAR	37.218	135101.734	
SNOW WATER AT START OF YEAR	1.478	5364.229	8.86
SNOW WATER AT END OF YEAR	1.478	5364.229	8.86
ANNUAL WATER BUDGET BALANCE	0.0000	0.004	0.00

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ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	16.26	59023.809	100.00

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.84	0.95	0.58	0.45	0.69	0.75
	1.70	2.12	2.90	1.99	1.11	1.15
STD. DEVIATIONS	0.32	0.43	0.27	0.18	0.44	0.70
	1.80	2.07	1.87	1.17	0.41	0.46
RUNOFF						
TOTALS	0.000	0.013	0.746	0.394	0.084	0.000
	0.059	0.049	0.050	0.088	0.126	0.010
STD. DEVIATIONS	0.000	0.035	0.546	0.794	0.094	0.000
	0.109	0.101	0.111	0.267	0.276	0.021
EVAPOTRANSPIRATION						
TOTALS	0.440	0.479	0.485	0.177	0.852	0.597
	0.673	0.753	0.858	0.639	0.392	0.373
STD. DEVIATIONS	0.060	0.068	0.125	0.136	0.412	0.502
	0.549	0.621	0.482	0.327	0.117	0.074
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	0.0476	0.0306	0.0258	0.0512	1.3978	0.4114
	0.7014	0.9441	1.6097	1.2354	0.3027	0.0851
STD. DEVIATIONS	0.0113	0.0054	0.0037	0.1391	0.5185	0.4339
	0.7707	1.1062	1.3942	1.4173	0.3434	0.0324
PERCOLATION/LEAKAGE THROUGH LAYER 5						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
DAILY AVERAGE HEAD ON TOP OF LAYER 4						
AVERAGES	0.0068	0.0048	0.0037	0.0075	0.1992	0.0606
	0.0999	0.1345	0.2370	0.1760	0.0446	0.0121
STD. DEVIATIONS	0.0016	0.0008	0.0005	0.0205	0.0739	0.0639
	0.1098	0.1576	0.2053	0.2019	0.0506	0.0046

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	INCHES		CU. FEET	PERCENT
PRECIPITATION	15.24	(3.800)	55313.9	100.00
RUNOFF	1.618	(1.1346)	5872.58	10.617
EVAPOTRANSPIRATION	6.719	(1.4772)	24391.17	44.096
LATERAL DRAINAGE COLLECTED FROM LAYER 3	6.84279	(2.81500)	24839.342	44.90611
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00001	(0.00000)	0.032	0.00006
AVERAGE HEAD ON TOP OF LAYER 4	0.082	(0.034)		
CHANGE IN WATER STORAGE	0.058	(1.0426)	210.82	0.381

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	3.00	10890.000
RUNOFF	1.123	4075.1460
DRAINAGE COLLECTED FROM LAYER 3	0.29836	1083.05505
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000000	0.00118
AVERAGE HEAD ON TOP OF LAYER 4	1.318	
MAXIMUM HEAD ON TOP OF LAYER 4	2.329	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	11.5 FEET	
SNOW WATER	5.05	18347.8535
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3955	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0240	

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	2.2754	0.1896
2	35.0400	0.0730
3	1.0858	0.0452
4	0.0000	0.0000
5	0.1875	0.7500
SNOW WATER	1.271	

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**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
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PRECIPITATION DATA FILE:    C:\matsu\P1.D4
TEMPERATURE DATA FILE:      C:\matsu\T1.D7
SOLAR RADIATION DATA FILE:  C:\matsu\s1.D13
EVAPOTRANSPIRATION DATA:    C:\matsu\e1.D11
SOIL AND DESIGN DATA FILE:  C:\matsu\scen5a.D10
OUTPUT DATA FILE:           C:\matsu\scen5a.OUT


TIME:  14:39     DATE:   8/20/2014


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     TITLE:  Mat-Su Future Cells Bottom No Waste

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   2
           THICKNESS                   =    12.00   INCHES
           POROSITY                    =     0.4370 VOL/VOL
           FIELD CAPACITY              =     0.0620 VOL/VOL
           WILTING POINT               =     0.0240 VOL/VOL
           INITIAL SOIL WATER CONTENT  =     0.0775 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.579999993000E-02 CM/SEC


                                  LAYER  2
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TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 19

THICKNESS	=	480.00 INCHES
POROSITY	=	0.1680 VOL/VOL
FIELD CAPACITY	=	0.0730 VOL/VOL
WILTING POINT	=	0.0190 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0730 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000005000E-02 CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	24.00 INCHES
POROSITY	=	0.3970 VOL/VOL
FIELD CAPACITY	=	0.0320 VOL/VOL
WILTING POINT	=	0.0130 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0444 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000001000 CM/SEC
SLOPE	=	4.00 PERCENT
DRAINAGE LENGTH	=	200.0 FEET

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.08 INCHES
POROSITY	=	0.0000 VOL/VOL
FIELD CAPACITY	=	0.0000 VOL/VOL
WILTING POINT	=	0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY	=	1.00 HOLES/ACRE
FML INSTALLATION DEFECTS	=	2.00 HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD

LAYER 5

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 17

THICKNESS	=	0.25 INCHES
POROSITY	=	0.7500 VOL/VOL
FIELD CAPACITY	=	0.7470 VOL/VOL
WILTING POINT	=	0.4000 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.7500 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000003000E-08 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 2 WITH A POOR STAND OF GRASS, A SURFACE SLOPE OF 33.% AND A SLOPE LENGTH OF 100. FEET.

SCS RUNOFF CURVE NUMBER	=	76.20	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	8.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	0.565	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	3.496	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.192	INCHES
INITIAL SNOW WATER	=	1.478	INCHES
INITIAL WATER IN LAYER MATERIALS	=	37.224	INCHES
TOTAL INITIAL WATER	=	38.702	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM BETHEL ALASKA

STATION LATITUDE	=	60.78	DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00	
START OF GROWING SEASON (JULIAN DATE)	=	184	
END OF GROWING SEASON (JULIAN DATE)	=	225	
EVAPORATIVE ZONE DEPTH	=	8.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	12.90	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	75.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	78.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	83.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	80.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR MEDFORD OREGON

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
0.84	0.84	0.72	0.44	0.66	1.31
2.06	2.29	2.59	1.74	1.09	1.22

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR BETHEL ALASKA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
14.10	18.20	26.30	37.30	47.80	55.10
58.10	55.90	48.00	33.90	20.70	16.20

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BETHEL ALASKA
AND STATION LATITUDE = 60.78 DEGREES

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ANNUAL TOTALS FOR YEAR 1

	INCHES	CU. FEET	PERCENT
PRECIPITATION	16.68	60548.406	100.00
RUNOFF	1.285	4663.983	7.70
EVAPOTRANSPIRATION	8.616	31276.062	51.65
DRAINAGE COLLECTED FROM LAYER 3	6.7814	24616.627	40.66
PERC./LEAKAGE THROUGH LAYER 5	0.000016	0.057	0.00
AVG. HEAD ON TOP OF LAYER 4	0.1647		
CHANGE IN WATER STORAGE	-0.002	-8.322	-0.01
SOIL WATER AT START OF YEAR	37.224	135122.984	
SOIL WATER AT END OF YEAR	37.222	135114.656	
SNOW WATER AT START OF YEAR	1.478	5364.229	8.86
SNOW WATER AT END OF YEAR	1.478	5364.229	8.86
ANNUAL WATER BUDGET BALANCE	0.0000	0.000	0.00

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ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	16.26	59023.809	100.00

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.84	0.95	0.58	0.45	0.69	0.75
	1.70	2.12	2.90	1.99	1.11	1.15
STD. DEVIATIONS	0.32	0.43	0.27	0.18	0.44	0.70
	1.80	2.07	1.87	1.17	0.41	0.46
RUNOFF						
TOTALS	0.000	0.013	0.746	0.394	0.085	0.000
	0.077	0.065	0.067	0.093	0.126	0.010
STD. DEVIATIONS	0.000	0.035	0.546	0.794	0.096	0.000
	0.137	0.131	0.131	0.281	0.276	0.021
EVAPOTRANSPIRATION						
TOTALS	0.440	0.479	0.485	0.177	0.852	0.594
	0.672	0.756	0.860	0.638	0.393	0.373
STD. DEVIATIONS	0.060	0.068	0.125	0.134	0.411	0.504
	0.547	0.620	0.482	0.324	0.119	0.074
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	0.0482	0.0308	0.0259	0.0415	1.3229	0.4876
	0.6144	0.9378	1.5816	1.2736	0.3336	0.0880
STD. DEVIATIONS	0.0127	0.0062	0.0042	0.0954	0.4891	0.4228
	0.6774	1.0739	1.4071	1.3931	0.3651	0.0365
PERCOLATION/LEAKAGE THROUGH LAYER 5						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
DAILY AVERAGE HEAD ON TOP OF LAYER 4						
AVERAGES	0.0137	0.0096	0.0074	0.0122	0.3770	0.1436
	0.1751	0.2672	0.4657	0.3629	0.0982	0.0251
STD. DEVIATIONS	0.0036	0.0019	0.0012	0.0281	0.1394	0.1245
	0.1930	0.3060	0.4143	0.3970	0.1075	0.0104

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	INCHES		CU. FEET	PERCENT
PRECIPITATION	15.24	(3.800)	55313.9	100.00
RUNOFF	1.676	(1.1430)	6082.29	10.996
EVAPOTRANSPIRATION	6.718	(1.4723)	24387.83	44.090
LATERAL DRAINAGE COLLECTED FROM LAYER 3	6.78587	(2.76977)	24632.711	44.53255
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00002	(0.00001)	0.058	0.00011
AVERAGE HEAD ON TOP OF LAYER 4	0.163	(0.067)		
CHANGE IN WATER STORAGE	0.058	(1.0433)	211.06	0.382

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	3.00	10890.000
RUNOFF	1.123	4075.1477
DRAINAGE COLLECTED FROM LAYER 3	0.25918	940.83954
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000001	0.00225
AVERAGE HEAD ON TOP OF LAYER 4	2.290	
MAXIMUM HEAD ON TOP OF LAYER 4	4.092	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	21.0 FEET	
SNOW WATER	5.05	18347.8535
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3955	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0240	

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	2.2754	0.1896
2	35.0400	0.0730
3	1.0906	0.0454
4	0.0000	0.0000
5	0.1875	0.7500
SNOW WATER	1.271	

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**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
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PRECIPITATION DATA FILE:    C:\matsu\P1.D4
TEMPERATURE DATA FILE:      C:\matsu\T1.D7
SOLAR RADIATION DATA FILE:  C:\matsu\s1.D13
EVAPOTRANSPIRATION DATA:    C:\matsu\e1.D11
SOIL AND DESIGN DATA FILE:  C:\matsu\scen5b.D10
OUTPUT DATA FILE:           C:\matsu\scen5b.OUT


TIME:  14:47     DATE:   8/20/2014


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     TITLE:  Mat-Su Future Cells SS 40' of Waste, Scenario 5B

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                   LAYER  1
                                   --------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
                          MATERIAL TEXTURE NUMBER   2
          THICKNESS                   =    12.00   INCHES
          POROSITY                    =     0.4370 VOL/VOL
          FIELD CAPACITY              =     0.0620 VOL/VOL
          WILTING POINT               =     0.0240 VOL/VOL
          INITIAL SOIL WATER CONTENT  =     0.0775 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.579999993000E-02 CM/SEC


                                   LAYER  2
                                   --------
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          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER  19
THICKNESS                  =    480.00   INCHES
POROSITY                   =      0.1680 VOL/VOL
FIELD CAPACITY             =      0.0730 VOL/VOL
WILTING POINT              =      0.0190 VOL/VOL
INITIAL SOIL WATER CONTENT =      0.0730 VOL/VOL
EFFECTIVE SAT. HYD. COND.  =  0.100000005000E-02 CM/SEC


                        LAYER  3
                        --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                  =     24.00   INCHES
POROSITY                   =      0.3970 VOL/VOL
FIELD CAPACITY             =      0.0320 VOL/VOL
WILTING POINT              =      0.0130 VOL/VOL
INITIAL SOIL WATER CONTENT =      0.0442 VOL/VOL
EFFECTIVE SAT. HYD. COND.  =  0.100000001000     CM/SEC
SLOPE                      =     33.00   PERCENT
DRAINAGE LENGTH            =    100.0    FEET


                        LAYER  4
                        --------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                  =      0.08   INCHES
POROSITY                   =      0.0000 VOL/VOL
FIELD CAPACITY             =      0.0000 VOL/VOL
WILTING POINT              =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.  =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY        =      1.00   HOLES/ACRE
FML INSTALLATION DEFECTS   =      2.00   HOLES/ACRE
FML PLACEMENT QUALITY      =  3 - GOOD


                        LAYER  5
                        --------

              TYPE 3 - BARRIER SOIL LINER
              MATERIAL TEXTURE NUMBER  17
THICKNESS                  =      0.25   INCHES
POROSITY                   =      0.7500 VOL/VOL
FIELD CAPACITY             =      0.7470 VOL/VOL
WILTING POINT              =      0.4000 VOL/VOL
INITIAL SOIL WATER CONTENT =      0.7500 VOL/VOL
EFFECTIVE SAT. HYD. COND.  =  0.300000003000E-08 CM/SEC
```

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 2 WITH A POOR STAND OF GRASS, A SURFACE SLOPE OF 33.% AND A SLOPE LENGTH OF 100. FEET.

SCS RUNOFF CURVE NUMBER	=	76.20	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	8.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	0.565	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	3.496	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.192	INCHES
INITIAL SNOW WATER	=	1.478	INCHES
INITIAL WATER IN LAYER MATERIALS	=	37.218	INCHES
TOTAL INITIAL WATER	=	38.695	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM BETHEL ALASKA

STATION LATITUDE	=	60.78	DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00	
START OF GROWING SEASON (JULIAN DATE)	=	184	
END OF GROWING SEASON (JULIAN DATE)	=	225	
EVAPORATIVE ZONE DEPTH	=	8.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	12.90	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	75.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	78.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	83.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	80.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR MEDFORD OREGON

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
0.84	0.84	0.72	0.44	0.66	1.31
2.06	2.29	2.59	1.74	1.09	1.22

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR BETHEL ALASKA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
14.10	18.20	26.30	37.30	47.80	55.10
58.10	55.90	48.00	33.90	20.70	16.20

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR BETHEL ALASKA
AND STATION LATITUDE = 60.78 DEGREES

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ANNUAL TOTALS FOR YEAR 1

	INCHES	CU. FEET	PERCENT
PRECIPITATION	16.68	60548.406	100.00
RUNOFF	1.285	4663.983	7.70
EVAPOTRANSPIRATION	8.616	31276.062	51.65
DRAINAGE COLLECTED FROM LAYER 3	6.7816	24617.105	40.66
PERC./LEAKAGE THROUGH LAYER 5	0.000003	0.011	0.00
AVG. HEAD ON TOP OF LAYER 4	0.0110		
CHANGE IN WATER STORAGE	-0.002	-8.752	-0.01
SOIL WATER AT START OF YEAR	37.218	135099.859	
SOIL WATER AT END OF YEAR	37.215	135091.109	
SNOW WATER AT START OF YEAR	1.478	5364.229	8.86
SNOW WATER AT END OF YEAR	1.478	5364.229	8.86
ANNUAL WATER BUDGET BALANCE	0.0000	-0.004	0.00

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ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	16.26	59023.809	100.00

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.84	0.95	0.58	0.45	0.69	0.75
	1.70	2.12	2.90	1.99	1.11	1.15
STD. DEVIATIONS	0.32	0.43	0.27	0.18	0.44	0.70
	1.80	2.07	1.87	1.17	0.41	0.46
RUNOFF						
TOTALS	0.000	0.013	0.746	0.394	0.085	0.000
	0.077	0.065	0.067	0.093	0.126	0.010
STD. DEVIATIONS	0.000	0.035	0.546	0.794	0.096	0.000
	0.137	0.131	0.131	0.281	0.276	0.021
EVAPOTRANSPIRATION						
TOTALS	0.440	0.479	0.485	0.177	0.852	0.594
	0.672	0.756	0.860	0.638	0.393	0.373
STD. DEVIATIONS	0.060	0.068	0.125	0.134	0.411	0.504
	0.547	0.620	0.482	0.324	0.119	0.074
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	0.0462	0.0298	0.0253	0.0649	1.4254	0.3782
	0.7606	0.9434	1.5893	1.1575	0.2844	0.0811
STD. DEVIATIONS	0.0117	0.0058	0.0040	0.2017	0.5290	0.4277
	0.8083	1.1072	1.3409	1.3566	0.3305	0.0316
PERCOLATION/LEAKAGE THROUGH LAYER 5						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
DAILY AVERAGE HEAD ON TOP OF LAYER 4						
AVERAGES	0.0009	0.0006	0.0005	0.0013	0.0273	0.0075
	0.0145	0.0181	0.0314	0.0222	0.0056	0.0016
STD. DEVIATIONS	0.0002	0.0001	0.0001	0.0040	0.0101	0.0085
	0.0155	0.0212	0.0265	0.0260	0.0065	0.0006

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	INCHES		CU. FEET	PERCENT
PRECIPITATION	15.24	(3.800)	55313.9	100.00
RUNOFF	1.676	(1.1430)	6082.29	10.996
EVAPOTRANSPIRATION	6.718	(1.4723)	24387.83	44.090
LATERAL DRAINAGE COLLECTED FROM LAYER 3	6.78600	(2.77122)	24633.168	44.53338
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00000	(0.00000)	0.011	0.00002
AVERAGE HEAD ON TOP OF LAYER 4	0.011	(0.004)		
CHANGE IN WATER STORAGE	0.058	(1.0441)	210.64	0.381

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 20

	(INCHES)	(CU. FT.)
PRECIPITATION	3.00	10890.000
RUNOFF	1.123	4075.1477
DRAINAGE COLLECTED FROM LAYER 3	0.34132	1238.99670
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000000	0.00017
AVERAGE HEAD ON TOP OF LAYER 4	0.202	
MAXIMUM HEAD ON TOP OF LAYER 4	0.401	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	5.05	18347.8535
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3955	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0240	

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	2.2754	0.1896
2	35.0400	0.0730
3	1.0820	0.0451
4	0.0000	0.0000
5	0.1875	0.7500
SNOW WATER	1.271	

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Appendix E
December 2013 CLF Leachate Report

(Summary sheets only, full laboratory results on file at MSB SWD)

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

ALASKA
CALIFORNIA
COLORADO
FLORIDA
MISSOURI
OREGON
WASHINGTON
WISCONSIN

January 15, 2013

Matanuska-Susitna Borough
Department of Public Works
350 East Dahlia Avenue
Palmer, Alaska 99645-6488

Attn: Mr. Jason Garner

RE: SEPTEMBER 2013 CENTRAL LANDFILL LEACHATE MONITORING ANALYTICAL RESULTS, MATANUSKA-SUSITNA BOROUGH, ALASKA

Shannon & Wilson, Inc. is pleased to submit the analytical results for the December 19, 2013 leachate sampling event at Central Landfill. Samples were collected from the below-ground leachate tank. The Anchorage Water & Wastewater Utility Industrial Pretreatment Program report, a Volatile and Semivolatile Organic Compounds table, the chain-of-custody form, and the laboratory report including method and detection limits from SGS North America, Inc. are provided as attachments.

If you have any questions regarding this sampling event, please do not hesitate to contact Shayla Marshall or the undersigned at your convenience.

Sincerely,

SHANNON & WILSON, INC.

Dane Palmer

Dane Palmer
Environmental Engineer, E.I.T.

Enclosures:
AWWU Industrial Pretreatment Program Report
Volatile and Semivolatile Organic Compound Analytical Results Table
SGS laboratory report

5430 FAIRBANKS STREET•SUITE 3
ANCHORAGE, ALASKA 99518
907-561-2120 • FAX 907-561-4483

MATANUSKA-SUSITNA BOROUGH - DEPARTMENT OF PUBLIC WORKS
CENTRAL LANDFILL LEACHATE
ANCHORAGE WATER & WASTEWATER UTILITY INDUSTRIAL PRETREATMENT PROGRAM REPORT

Parameter	**Arsenic**	**Beryllium**	**BOD**	**Soluble BOD**	**Cadmium**	**Chromium**	**Copper**	**Cyanide**	**Lead**	**Mercury**	**Nickel**	**Oil & Grease**	**pH**	**Settleable matter**	**Silver**	**TAH***	**TSS**	**Zinc**
STORET (mg/L)	1002	1012	310	NA	1027	1034	1042	720	1051	71900	1067	3582	406	NA	1077	NA	530	1092
Permit Limit	3.7 mg/L	14.5 mg/L	NA	NA	0.69 mg/L	2.77 mg/L	3.38 mg/L	1.7 mg/L	0.69 mg/L	0.2 mg/L	3.88 mg/L	250 mg/L	>5.0, <12.5	NA	2.5 mg/L	5.0 mg/L	NA	5.62 mg/L
6/26/2009	0.0103	ND	1,130	-	ND	0.00786	0.00618	0.0019 J	0.00041	ND	0.0264	16.1	6.00	ND	ND	0.103	59.0	0.0114
9/16/2009	0.0182 J	ND	1,400	-	ND	0.00997 J	0.00704	0.0065	0.00105	ND	0.0634	19.1	6.20	ND	ND	0.200	55.0	0.0650
12/10/2009	0.0377	ND	19,100	-	0.00118 J	0.0455	0.0199	0.0085	0.00625	ND	0.199	171	6.70	ND	ND	0.114	172	0.583
3/24/2010	0.0109	ND	744	-	0.000189 J	0.0103	0.0200	ND	0.00252	ND	0.0379	17.7	7.10	ND	ND	0.00636	8.60	0.110
6/28/2010	0.0311	ND	6,750	6,870	0.00149 J	0.0329	0.0174	ND	0.00486	ND	0.154	33.6	7.12	ND	ND	0.435	170	0.634
9/20/2010	0.0260	ND	3,680	3,960	0.00102 J	0.0339	0.0247	0.0069 J	0.00630	ND	0.144	49.2	6.80	ND	ND	0.371	165	0.654
12/29/2010	0.0421	ND	2,580	2,420	0.00125 J	0.0613	0.0389	0.028	0.00886	ND	0.285	36.7	6.79	ND	ND	0.182	76	0.434
3/31/2011	0.00431 J	ND	149	123	0.000561	0.00703	0.0564	ND	0.00298	ND	0.0296	ND, B	7.50	ND	ND	0.00345 J	15.9	0.109
6/27/2011	0.0245 J	ND	2,090	3,370	0.000780 J	0.0560	0.0675	0.031	0.00643	ND	0.159	14.5	6.90	ND	ND	0.0601	135	0.473
9/29/2011	ND	ND	5,680	5,520	ND	0.0231	0.0128	0.051	0.00222	ND	0.0893	70.7	7.00	0.200	ND	1.14	205	0.201
12/6/2011	0.0539	ND	8,330	7,690	0.00108 J	0.0814	0.0281	0.031	0.00809	ND	0.422	86.3	6.60	ND	ND	2.04	176	0.409
3/29/2012	0.00819	0.000230 J	477	498	0.00106	0.0245	0.111	ND B	0.00846	ND	0.0422	57.9	7.10	0.200	ND	0.00727	348	0.244
6/4/2012	0.0376	ND	15,200	14,600	ND	0.160	0.0409	0.021	0.00322	ND	0.522	104	6.30	0.100	ND	0.780	260	1.39
9/12/2012	0.00342 J	ND	49.0	39.6	ND	0.00397	0.0136	ND	0.00234	ND	0.00841	5.10	6.70	0.500	ND	0.0294 J	124	0.0529
12/19/2012	0.0687 J	ND	23,100	24,500	ND	0.371	0.0719	0.19	0.0103	ND	1.18	128	6.20	ND	ND	0.763	130	**6.56**
3/28/2013	0.0445 J	ND	21,100	20,000	ND	0.254	0.0410	0.035	0.00459 J	ND	0.900	97.0	6.50	ND	ND	ND	140	3.36
6/17/2013	0.0410	ND	15,300	15,300	ND	0.287	0.0867	0.040	0.0128	ND,B	0.883	40.1	6.30	0.200	ND	0.586	510	5.27
9/25/2013	0.0318	ND	10,800	10,500	ND	0.176	0.0236	0.017	0.00517	0.000164 J	0.565	99.8	6.60	ND	ND	0.622	215	2.37
12/19/2013	0.0465	ND	24,300 †	21,700 †	0.000665 J	0.393	0.0276	0.017	0.00973	0.00115	1.18	90.6	6.50	ND	ND	0.878	487	**8.13**

Notes:

All concentrations reported in mg/L except pH

Shaded and bold values indicate concentration is greater than AWWU limit

<	= Less than
>	= Greater than
*	= Total Aromatic Hydrocarbon (TAH) result is sum of benzene (78124), toluene (78131), ethylbenzene (34371), & xylenes (81551) concentration results
-	= Sample not analyzed for this parameter
mg/L	= Milligrams per liter
NA	= Not Applicable
ND	= Not Detected
J	= Analyte detected, but at a concentration less than the detection limit
B	= Concentration reported in project sample was within five times the concentration reported in the method blank; project sample concentration is considered not detected.
†	= Sample was collected on December 21, 2013

MATANUSKA-SUSTINA BOROUGH - DEPARTMENT OF PUBLIC WORKS
CENTRAL LANDFILL LEACHATE
VOLATILE & SEMIVOLATILE ORGANIC COMPOUND ANALYTICAL RESULTS

Parameter	6/26/2009	9/16/2009	12/10/2009	3/24/2010	6/28/2010	9/20/2010	12/29/2010	3/31/2011	6/27/2011	9/29/2011	12/6/2011	3/29/2012	6/4/2012	9/12/2012	12/19/2012	3/28/2013	6/17/2013	9/25/2013	12/19/2013
Acetophenone* - µg/L	9.82 J	ND	ND	ND	ND	ND	169	ND	ND	145	ND	ND	ND	ND	ND	151 J	ND	ND	ND
Acetone - µg/L	635	2,160	21,400	2,100	27,100	ND	5,320	181	5,100	19,800	28,800	115	12,100	64.7	18,500	14,000	11,400	13,200	19200 J
Benzene - µg/L	8.68	14.8	13.2	0.580	16.2	48.0	8.9	0.250 J	5.10	23.5	26.0	0.170 J	23.5	1.13	18.6	17.3	38.9	16.7	27.1 J
Benzyl alcohol* - µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	360	451 J	ND	436 J-
Bis(2-ethylhexyl)phthalate* - µg/L	ND	ND	ND	ND	ND	ND	ND	ND	3.46 J	ND	ND	7.04 J	ND	ND	ND	ND	ND	11.9	ND
Benzoic acid* - µg/L	ND	ND	15,300	1,900	ND	3,910	318 J	ND	3,800	ND	ND	163	ND	21.9 J	ND	ND	7,510	934	657 J-
2-Butanone (MEK) - µg/L	321	2,620	39,700	2,580	23,200	13,000	9,560	153	6,340	24,200	43,700	117	18,600	92.6	ND	20,900	15,100	14,400	19,800
Carbon disulfide -µg/L	1.83 J	1.67 J	ND	18.2	ND	160 J	ND	ND	28.2	ND	1.61 J	ND B	ND	5.91	1.09 J	ND	18.7 J	ND	ND
Chloroethane - µg/L	5.18	30.9	ND	1.53	ND	ND	6.60 J	ND	ND	ND	8.79	ND	ND	ND	ND	ND	9.00 J	ND	ND
Chloroform - µg/L	1.63	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.850 J	ND	ND	ND	ND	ND	ND	ND	ND
Chloromethane - µg/L	ND	9.07	28.0	ND	43.2	ND	5.90 J	ND	10.4	ND	5.78	ND	18.0 J	ND	4.87	8.00 J	8.30 J	ND	ND
1,4-Dichlorobenzene - µg/L	0.270 J	0.690	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane - µg/L	ND	28.8	8.80 J	2.67	ND	ND	5.10 J	ND	ND	ND	5.73	ND	ND	0.540 J	6.11	6.40 J	9.70 J	ND	ND
1,2-Dichloroethane - µg/L	4.91	7.29	ND	1.12	ND	ND	4.90 J	ND	ND	ND	11.9	ND	11.5 J	1.20	17.4	25.9	22.6	ND	ND
1,1-Dichloroethene - µg/L	14.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
cis-1,2-Dichloroethene	0.730 J	1.73	8.40 J	0.450 J	16.2 J	ND	8.30 J	ND	ND	ND	ND	ND	ND	ND	4.01	4.80 J	7.40 J	9.10 J	ND
trans-1,2-Dichloroethene	0.920 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.84	ND	ND	ND	1.81	ND	ND	ND	ND
Dichlorodifluoromethane - µg/L	ND	4.98	ND	ND	ND	ND	ND	ND	ND	ND	2.00	ND	ND	ND	ND	ND	ND	ND	ND
Diethylphthalate* - µg/L	ND	4.04 J	ND	ND	ND	ND	ND	ND	12.1	49.8 J	47.3 J	3.47 J	ND	3.67 J	98.4 J	64.8 J	ND	52.5	76.2 J-
Dimethylphthalate* - µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	46.1 J	ND	30.0 J	9.29 J	25.1 J-
Ethylbenzene - µg/L	4.11	9.38	ND	ND	10.2 J	ND	4.40 J	ND	ND	19.5 J	16.0	ND	ND	0.680 J	18.0	13.1	24.1	13.8	20.8
2-Hexanone - µg/L	5.84 J	ND	1,280	105	529	ND	249	6.13 J	59.7 J	ND	495 J	ND	ND	ND	578 J	503	391	271	ND
Isophorone* - µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	141 J	ND	ND	ND
Methyl iodide - µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	20.6	ND	ND
2-Methylphenol (o-Cresol)* - µg/L	ND	ND	ND	ND	ND	ND	46.0 J	ND	ND	75.2 J	225	ND	ND	ND	ND	ND	ND	ND	ND
3&4-Methylphenol (p&m-Cresol)* - µg/L	75.9	ND	13,800	1,190	10,400	7,090	4,750	ND	2,400	11,600	12,600	65.6	11,400	ND	17,900	14,700	11,700	12,100	15,500 J-
4-Methyl-2-pentanone (MIBK) - µg/L	49.9	68.3	747	58.7	651	324 J	267	3.81 J	169	544	765	4.78 J	301 J	4.59 J	443 J	460 J	278	269	ND
Methyl-t-butyl ether - µg/L	19.1	10.3	ND	ND	ND	ND	ND	ND	ND	ND	9.45	ND	ND	ND	16.5	21.2 J	19.0 J	ND	ND
Methylene chloride - µg/L	105	130	241	34.0	136	226 J	93.4	2.60 J	259	668	221 J	ND B	147 J	6.55	251 J	182	214	85.8	170
N-Nitrosodimethylamine* - µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Napthalene* - µg/L	ND	ND	ND	ND	ND	ND	ND	ND	90,900	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
di-n-Octylphthalate* - µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phenol* - µg/L	398	429	259	139 J	697 J	725	804	ND	172 J	996	1,290	9.41 J	1,420	ND	2,570	1,720	1,600	1,310	1,370 J-
Styrene - µg/L	2.14	5.24	ND	ND	ND	ND	ND	ND	ND	ND	2.48	0.420 J	ND	ND	2.89	ND	ND	ND	ND
Tetrachloroethene - µg/L	11.7	13.8	ND	0.720 J	ND	ND	4.80 J	ND	ND	ND	14.3	ND	ND	0.870 J	9.75	7.10 J	5.00 J	6.50 J	ND
Toluene - µg/L	65.9	134	101	4.60	377	144	152	3.20	55.0	1,010	1,930	7.10	757	25.0	669	467	416	540	759
1,1,1-Trichloroethane - µg/L	13.9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.390 J	ND	ND	ND	ND	ND
Trichloroethene - µg/L	3.81	ND	18.4 J	0.760 J	17.2 J	ND	9.60 J	ND	ND	17.5 J	14.1	ND	ND	0.840 J	7.28	11.0	8.50 J	10.6	ND
Trichlorofluoromethane - µg/L	29.6	9.43	ND	ND	ND	ND	ND	ND	5.30 J	ND	7.05	ND	ND	0.700 J	3.84	ND	ND	ND	ND
2,4,5-Trichlorophenol* - µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vinyl chloride - µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.70 J	ND
Xylenes, total - µg/L	24.7	42.2	ND	1.18 J	32.0 J	179 J	16.9 J	ND	ND	84.0 J	71.0	ND	ND	2.55	57.2	46.1	107	51.0	71.0

Notes:

*	= Semivolatile Organic Compound
µg/L	= Micrograms per liter
ND	= Not Detected
J	= Analyte detected, but at a concentration less than the detection limit
J-	= Analyte may be biased low due to matrix interference
B	= Concentration reported in project sample was within five times the concentration reported in the trip blank; project sample concentration is considered not detected.

Appendix F
ADEC Meeting Summary – July 2014

MSB Central Landfill Planning Discharge Limits for Treated Leachate and Septage

ATTENDEES: Clint Adler/ADEC ES&PR
Gene McCabe/ADEC ES&PR
Mike Campfield/MSB Cap.Proj.
A. Kantardjieff/CH2MHILL
Katie Winter/CH2M HILL
Cory Hinds/CH2M HILL

COPY TO: Oran Woolley/ADEC ES&PR
Melinda Smodey/ADEC WW
Project file

PREPARED BY: Cory Hinds/CH2M HILL
DATE: July 17, 2014
PROJECT NUMBER: 496410

The following is a summary of discussion:

1. Introductions
   a. Clint is the chief technical engineer for ADEC Engineering Support & Plan Review (ES&PR) and supports Oran and others with technical reviews
   b. Gene is the manager of the ES&PR department which issues wastewater discharge authorizations
   c. Mike is the MSB project manager and a member of the MSB Wastewater & Septage Advisory Board
   d. Cory is the CH2M HILL project manager
   e. Katie is working for Cory determine numerical discharge limits
   f. Alexandra is a CH2M HILL wastewater treatment expert

2. Background (see also Attachment A, sent prior to the meeting)
   a. This is a planning study to evaluate long-term development of landfill cells and leachate treatment at the Central Landfill in Palmer.
   b. Both leachate and septage are currently hauled to Anchorage. There is pressure to keep and manage both of these waste streams in Mat-Su. MSB is considering treatment of leachate on site at the Central Landfill. MSB is also considering co-treatment of leachate and pre-treated septage at the Central Landfill. The decision on leachate treatment and co-treatment of leachate and septage has not yet been made. Depending on the outcome of this study, other possible studies, and funding, MSB may pursue design and construction of a leachate or leachate and septage treatment plant starting in the next couple years.
   c. CH2M HILL needs a reasonable understanding of expected discharge limits in order to price various treatment options.
3. Proposed Solution
   a. CH2M HILL is evaluating two possible treatments for leachate only:
      i. Biological treatment (MBR or SBR package treatment) with subsurface discharge
      ii. Leachate evaporation and recirculation of concentrate back to landfill
   b. CH2M HILL is also evaluating biological co-treatment of pre-treated septage and leachate by activated sludge, aeration and clarifier and subsurface discharge
   c. CH2M HILL presented proposed design discharge limits and point of compliance as described in Attachment A.

4. ADEC response and suggestions
    a. The CH2M HILL-proposed design discharge limits appear to be similar to the domestic wastewater limits in Article 2 of the Wastewater Disposal regulations (18 AAC 72). These are not appropriate because leachate is an industrial source. Similarly, because septage will be from all over the MSB, the septage will be considered coming from non-domestic sources.
    b. The appropriate regulations are Articles 5 and 6 for Nondomestic Wastewater (18 AAC 72) which include a more engineering-centric approach.
    c. CH2M HILL's proposed approach for point of compliance in downgradient monitoring wells on MSB property appears reasonable and has been approved by ADEC before. Upgradient monitoring wells can be used for comparison.
    d. For planning purposes, CH2M HILL/MSB can use the more stringent of the drinking water standards (18 AAC 80) and water quality standards (18 AAC 70) for both septage and leachate.

Appendix A

MSB Leachate and Septage Treatment: Background and Proposed Solution

Background:

CH2M HILL is under contract to the Mat-Su Borough (MSB) for long-term development planning at the Central LF in Palmer. The MSB will use the planning documents to make development decisions and obtain funding.

The MSB is currently trucking leachate to Anchorage where co-treatment of leachate, septage, and domestic sewage occurs at the Anchorage WWTP. Recently Anchorage has given MSB notice that the delivery of leachate to Anchorage will need to stop in the near future. Therefore, MSB is evaluating onsite leachate treatment options at the Central Landfill.

MSB also currently hauls septage to Anchorage and is receiving pressure from AWWU and local septage haulers to provide local treatment options. HDR Alaska has conducted several septage handling and disposal studies with economic analysis (2007, 2013) and recommends construction of a regional septage treatment facility with septage pretreatment followed by primary, secondary, and tertiary wastewater treatment to applicable discharge standards. MSB has added to CH2M HILL's scope the evaluation of co-location and treatment of septage and leachate treatment at the Central Landfill. Depending on the outcome of the CH2M HILL study and other considerations, MSB may or may not decide to pursue co-treatment of septage and leachate at the Central Landfill or another location.

CH2M HILL is contacting ADEC, on behalf of MSB, to discuss the proposed treatment processes, discharge limits, and compliance points summarized below to estimate order of magnitude treatment costs for comparative purposes.

Proposed Solution:

1. Treatment options for landfill leachate only
   a. Biological treatment using MBRor SBR Packaged Plant (primary, secondary, and tertiary) and subsurface discharge at the Central Landfill
   b. Evaporation (natural gas, landfill gas) and recirculation of concentrate back onto landfill
2. Treatment options for co-treatment of landfill leachate and septage
   a. Pre-treatment of septage to include screening/grit removal, equalization, and solids removal
   b. Co-treatment of pretreated septage and raw leachate with activated sludge (primary and secondary) with aeration and clarifier (tertiary) and subsurface discharge. Proposed treatment might be SBR, depending on costs.
3. Proposed design discharge limits protective of human health and environment (subsurface)

   BOD_5 – 30 mg/L (monthly average)

   TSS – 30 mg/L (monthly average)

   NO_3-N – 10 mg/L (monthly average)

   Metals < Maximum Contaminant Limits
4. Compliance
   a. Limits: as above
   b. Point of compliance: groundwater monitoring wells down gradient from subsurface discharge and within property boundary

Appendix G
Evaporation Boil Tests Results

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July 17, 2014

Alexandra Kantardjieff, P.E., M.Sc.A., BCEE
Senior Technologist
CH2M HILL
3120 Poplarwoods Boulevard, Suite 214
Raleigh, NC 27604

Dear Alexandra:

Please find attached results from the evaporation bench scale tests of the wastewater sample submitted from the Matanuska-Susitna Landfill.

As we discussed, the purpose of this test is to simulate the effects of boiling their wastewater in the **ENCON** Thermal Evaporator System to anticipate the effectiveness and expected reduction percentage. If issues with their application are identified in the bench scale test, we can establish simple procedures ahead of time to minimize operational problems once the system is installed.

The following is a summary of results based on an initial sample volume of 400 milliliters each:

Sample #	Sample Name	Suspended Solids % by Volume	Free Oil % by Volume	Temp.(F) Initial/Final	pH Initial/Final	Residue Volume/% Reduction
1	**Landfill Leachate** opaque, dark grey	throughout sample	<1% floating on top	213.2/222.6	6.5/7.0	25 mL 93.75%

Reduction %: Based on the sample provided and the results of the boil analysis, you will achieve a reduction percentage of approximately 96+% on the water portion of your waste stream.

Sample #	Sample Name	Beginning Chlorides	Ending Chlorides
1	**Landfill Leachate**	356 ppm	5,696 ppm

Corrosion: The initial concentration of inorganic chlorides in your wastewater sample was 356 ppm. Considering this, the pH, the anticipated reduction percentages and the expected increase in chloride concentrations in the future we recommend that the tank and heat exchanger be constructed of the optional 6% Moly Super Stainless Alloy. We also strongly recommend that they monitor the pH in your system during full-scale operation to verify that it is always in a neutral to alkaline condition (7-10).

Foaming: There was a foaming condition seen during the testing process. It did require the addition of anti-foam. We tested 2 different formulations and found the HT-50 controlled the foaming completely. We strongly recommend that they use the optional anti-foam addition system and an appropriate high temperature anti-foam.

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Solids Removal/Coating: There were visible suspended solids seen in their sample prior to evaporation and some coating at the end of the testing process. If there is a presence of settled solids in their full-scale operation, we recommend feeding the wastewater to the evaporator from above the settled solids. We also strongly recommend that any solids in their evaporator be evacuated before they encroach on the heat exchanger. To minimize solids precipitating out of solution inside the evaporator we recommend the use of the optional Auto-Dump/Auto-Restart feature and regular scheduled cleanings of the evaporator.

Oil Removal: There was a very small amount of free oil in their wastewater sample. If there is visible free-floating oil in their full-scale operation, we strongly recommend that the evaporator be fed from below the floating oil layer in order to minimize the frequency of decanting. In addition we recommend that they monitor the build-up of floating oil in the evaporator and limit the oil build-up to not more than 2 inches.

End Point: End point for their evaporation cycle will be based on reaching a high fluid temperature. Based on the results of our boil analyses, we would recommend establishing a high temperature endpoint of 222F and evacuating at the end of this cycle. This could potentially be modified upward/downward at some point in the future based on observation of full-scale operation.

Regulatory: Please note that in most cases the wastewater processed through our **ENCON** Evaporators is non-hazardous and also exempt from air quality requirements. If the subject wastewater requires permits and/or exemption certificates, it is the responsibility of the customer to secure appropriate exemptions or permits.

Note: Due to our knowledge that the residue will be recycled back into the landfill and that this will increase the level of incoming contaminants being fed to evaporator in the future, we strongly recommend that they consider including the optional elevated tank height and auto-wash of level probes as part of their evaporator package.

Based on tests performed the above referenced waste stream is qualified as a feasible application for the **ENCON** Thermal Evaporator System. Please inform us if chemistry changes are made to the tested applications or if additional waste streams are being considered for the evaporator.

We look forward to continuing to work with you and other key personnel at **CH2M Hill** on the implementation of an **ENCON** evaporator system.

Sincerely,
ENCON Evaporators

Mary Ann Rattay

Mary Ann Rattay

Appendix H
2013 MSB Septage Handling and Disposal Plan

M e m o r a n d u m

To: Michael J. Campfield, P.E.
Matanuska-Susitna Borough

From: Christopher Clark, P.E., HDR
J. Ryan Moyers, P.E., HDR

Date: February 19, 2013 (Revised March 19 & May 20, 2013)

Subject: Preliminary Engineering Technical Memorandum – Update to the 2007 Septage Handling and Disposal Plan

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Background and Introduction

In 2006, HDR was contracted by the Matanuska-Susitna Borough (MSB) Public Works Department to develop a Septage Handling and Disposal Plan (2007 Study) that would assess the current septage handling and treatment practices in the Borough, and develop MSB-based alternatives for the future. The resulting septage study evaluated four (4) alternatives including maintaining the existing hauling practices (Option 1), installing a septage consolidation facility and bulk haul to Anchorage (Option 2), constructing a co-treatment facility with the City of Palmer (Option 3), and constructing an independent regional septage facility (Option 4) to handle current and future septage loads in the MSB.

HDR's 2007 Study recommended that two of the four options be further explored; constructing a co-treatment facility with the City of Palmer (Option 3) and constructing an independent regional septage facility (Option 4). Both options would make the MSB independent of the Municipality of Anchorage (MOA) for septage disposal which may be advantageous in the future. The costs of these alternatives, as given in the 2007 Study, were found to be comparable to the 2007 cost of transporting and disposing of septage in Anchorage. The 2007 Study estimated that a regional septage treatment facility could be paid off in 20 years if septage haulers paid $166 for each load of septage that was disposed at the regional facility. This analysis did not take into account potential grants or funding that may be available to the MSB for the project, and represented the feasibility of a MSB-based septage treatment and disposal facility funded solely by the MSB.

In 2010, the MSB, in cooperation with the Cities of Palmer and Wasilla, completed a Regional Wastewater and Septage Treatment Study to address the short term regulatory compliance and capacity needs for the Palmer and Wasilla wastewater treatment plants (WWTP). Additionally, this study addressed the long-term regional needs for a wastewater and septage treatment system in the core area between Palmer and Wasilla. Long-term solutions presented in the 2010 study included either improvements to the City of Palmer WWTP to accommodate 4.0 million gallons per day (MGD) or constructing a new regional 4.0MGD WWTP at a central location. The total project cost of constructing a regional wastewater and septage facility including conveyance piping was estimated to be $119 to $132 million and was dependent upon the location and the treatment process selected. The 2010 Regional Wastewater and Septage Study did not evaluate separate septage treatment options but included septage receiving and pretreatment facilities at the larger regional WWTP alternatives. The septage receiving station considered in the 2010 study consisted of a dual bay septage receiving area with hot water wash stations and pretreatment facilities (including coarse screening, flow attenuation, fine screening and grit removal, and metering of the septage flows into the larger wastewater treatment process). The septage receiving /pretreatment station alone was estimated to cost approximately $7,133,000 (2010 dollars). The MSB Assembly formed a Wastewater and Septage Advisory Board to begin long-term wastewater and septage treatment planning.

The MSB has chosen to revisit the options available for an MSB-based regional septage facility. In 2012, the MSB Assembly adopted a resolution (2012-RS-083) that endorsed continued planning for a regional wastewater treatment facility. The resolution indicated that the MSB will be 'selecting a site for a future regional wastewater treatment facility that will be used at a minimum for future septage service'. As the MSB begins to seek funding for the site selection it has requested HDR complete an update to the 2007 Study cost estimates. Due to modifications to the fee structure at the septage receiving facilities in Anchorage, increases in fuel prices, and general operational changes, the updated cost estimates for the septage treatment facility have changed significantly from those calculated in 2007. Updating the cost information from 2007 to the present day ensures that current information is available for the planning process and provides more meaningful information to determine the feasibility of a septage treatment facility in the MSB.

This memorandum provides planning level costs for an independent regional septage facility including updated cost for the aerated lagoon system for secondary wastewater treatment as presented in the 2007 Study (Option 4), as well as a conceptual level analysis of an advanced treatment system (activated sludge process) capable of achieving more stringent tertiary treatment requirements if surface water discharge is required. This analysis has been completed using the same design criteria (projected flows, wastewater characteristics, etc.) provided in the 2007 Study.

Design Criteria

Septage is the concentrated sewage settled in the bottom of a septic tank and contains 70 percent of the suspended solids, oil, and grease of sewage. Septage is a highly variable organic waste that often contains large amounts of grease, grit, hair, and debris and is characterized by an objectionable odor and appearance, a resistance to settling and dewatering, and the potential to foam. These characteristics make septage difficult to handle and treat. The major reason for providing adequate treatment and disposal systems is to protect public health and the environment, as septage may harbor disease-causing viruses, bacteria, and parasites.

Factors that affect the physical characteristics of septage include septic tank size, design, and pumping frequency; user habits; water supply characteristics and piping materials; the presence of water conservation fixtures and garbage disposals; the use of household chemicals and water softeners; and climate. Septage must be pumped from a septic tank on a periodic basis depending on sewage production and the size of the septic tank. This memorandum uses the population growth and septage loading and strength as defined in the 2007 Study. The recommended rate of pump-out is every 12 to 24 months according to haulers operating within MSB. In 2005, approximately 13.6 million gallons of septage was pumped within the MSB annually. Based on HDR's 2007 Study it was estimated that septage production would increase to 38.1 million gallons per year by 2030. The design criteria from the 2007 Study are outlined in Tables 1 through 3 below.

Table 1 – 2030 Influent Raw Septage Flows and Loading

Flow	BOD		TSS	
GPD	mg/L	lbs/day	mg/L	lbs/day
238,000	2,255	4,482	7,138	14,178

Table 2 - 2030 Pretreated Septage Flows and Loading

Flow	BOD		TSS		Ammonia-N		Temperature (^oC)	
GPD	mg/L	lbs/day	mg/L	Min	mg/L	lbs/day	Min	Max
238,000	500	994	500	994	50	99	8	15

Table 3 - 2030 Design Effluent Criteria[1]

Parameter	Units	Secondary Limits (Average Monthly)	Tertiary Limits (Average Monthly)	
Biological Oxygen Demand (BOD_5)	mg/L	30	15	
Total Suspended Solids (TSS)	mg/L	30	15	
Ammonia as (N)	mg/L	-	Summer	Winter
			1.7	8.7
Fecal Coliform	FC/100 ml	20	20	
pH	S.U.	6.5-8.5	6.5-8.5	

[1] Effluent criteria based on City of Palmer's current Alaska Pollutant Discharge Elimination System (APDES) permit.

Septage Handling and Disposal Alternatives

This section provides updated evaluation and costs of two primary septage handling and disposal alternatives from the 2007 Study:

- Option 1 – Maintain Existing Hauling Practices
- Option 4 – Construct an Independent Regional Septage Facility

Option 1 – Maintain Existing Hauling Practices

The 2007 Study included a detailed analysis of the cost associated with the current septage hauling practices. In 2005, the estimated costs associated with hauling and disposal of septage were estimated at $825,000 and the current (2013) cost of transport and disposal of MSB septage is estimated at $1.4 million per year. This cost is a compilation of labor for the round trip from the MSB to the septage receiving facility in Anchorage, the cost of running and maintaining the septage trucks, and the current AWWU tipping fee. By 2030, the increase in septage production in the MSB will bring the total transport and disposal cost to an estimated $4.6 million per year. This cost is paid directly by septage haulers, and indirectly by MSB residents with septic tanks, who currently (2013) pay an average of $250 for each 1,000 gallon septic tank pumping.

In addition to direct costs to haulers and MSB residents, there are other important factors which affect the sustainability of the septage hauling practice and the triple bottom line to the MSB. The advantages of keeping existing haul practices include:

- *No capital and O&M costs to the MSB*

  Septage haulers and residents will continue to meet the cost of septage handling and disposal at no additional cost to the MSB.

- *No additional land use*

  No land will be occupied with treating and handling septage that could be used for other development.

- *No ADEC regulations*

  No additional permits are required for meeting EPA and ADEC regulations for storing, treating, or discharging septage.

The disadvantages of keeping existing haul practices include:

- *Reliance on MOA and being less able to adapt to changes in regulatory environment*

  The MSB is dependent on the MOA to continue to accept septage from outside of the MOA. If the MOA changes its policy the MSB would need to seek other disposal options. The timeframe for this might not be ideal for the MSB. The MSB could be forced into choosing a less efficient and economic solution at a time when funding is difficult to obtain.

- *Cost efficiency*

  The current cost of transporting septage comprises 72% of the total cost of transport and disposal costs. Designed around a competitive tipping fee in comparison to the existing disposal costs, a regional septage treatment facility could pay for itself.

- *Environmental Impact*

  Without a regional septage facility, MSB septage flows will continue to be treated only to the current primary treatment level of the Asplund WWTP. Furthermore septage hauled to Anchorage accounts for 1.1 million miles per year travelled on the Glenn Highway between Palmer and Anchorage. This contributes to wear and tear on the roadway network (and subsequently increased costs to maintain) as well as increased burning of fossil fuels.

Using the population predictions developed in the 2007 Study, HDR has updated current septage production and associated costs based on the 2013 MSB population, hauling costs (fuel) and current AWWU tipping fees (Table 4).

Table 4 - Turpin Street Disposal Estimated Cost (Option 1)

Transport and Disposal Cost - AWWU Turpin Street	Year 2005	Year 2013	Year 2030
Estimated Annual Septage Production (gallons/year)	13,596,389	17,761,301	38,102,185
No. of Average Hauler Loads (2,867 gallons per load)	4,742	6,195	13,290
Annual Mileage for Septage Delivery (miles)	379,390	495,607	1,063,193
Annual Fuel Consumption (gallons/year)	75,878	99,121	212,639
Cost per Trip	**$174**	**$229**	**$348**[3]
Annual Disposal Cost	**$825,200**	**$1,418,700**	**$4,624,900**

1. Septic haulers pay a monthly customer charge of $7.46, plus a usage charge of $21.66 per 1,000 gallons of estimated discharge per trip (these fee's includes AWWU's proposed 2013 rate hike). Estimated discharge is calculated at 87% of tank capacity for most of the year. During the times when seasonal weight restrictions are in effect, the estimated discharge is calculated at 50% of tank capacity.
2. Year 2013 cost of hauling is $172 per trip for fuel, and operations and maintenance and does not include the AWWU tipping fee.
3. Year 2030 disposal cost per trip has been estimated based on a 2.5% annual increase from current cost per trip.

Option 4 – Construct an Independent Regional Septage Facility

In an effort to gain independence from the MOA and avoid hauling septage to Anchorage, the 2007 Study evaluated the construction costs associated with an independent regional septage treatment facility (Option 4 in the 2007 Study). For consistency with the 2007 Study, this update memorandum continues to identify an independent regional septage facility as Option 4.

The following elements are required for Option 4:

- Site for the independent treatment facility
- Receiving and pretreatment facility
- Secondary/tertiary treatment facility
- Effluent discharge location – subsurface (percolation cell) or surface discharge
- Solids handling
- Discharge permit

Option 4 is further broken down in this memorandum as Option 4A, 4B, or 4C as shown in Figure 1 depending on the level of treatment and method of disposal.

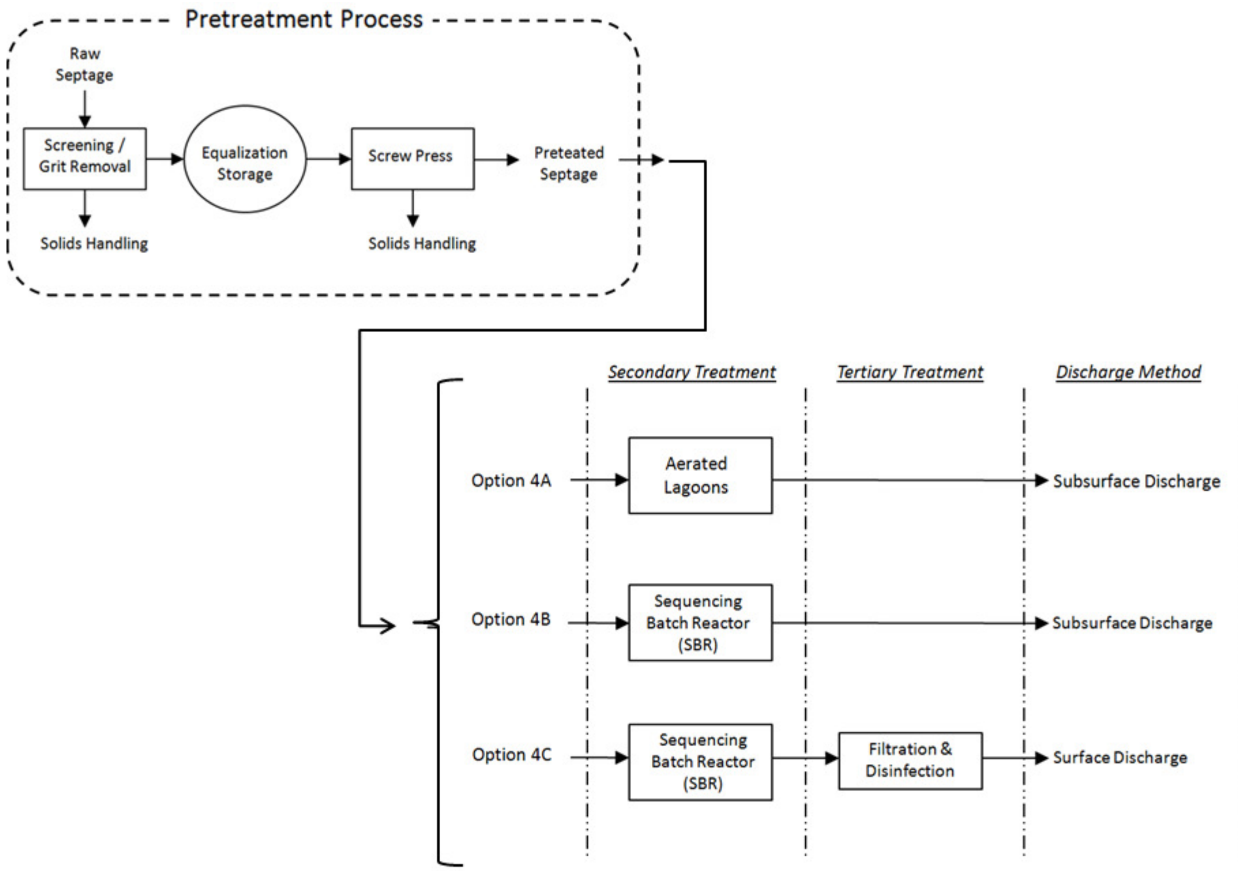

Figure 1 - Independent Regional Septage Treatment Facility Process Flow Options.

Option 4 Septage Receiving and Pretreatment

Regardless of the treatment process selected for secondary or tertiary treatment of the septage flows, septage receiving and pretreatment facilities will be required to remove a portion of the solids from the high-strength septage to create a more manageable/treatable wastewater flow. Removing septage solids through pretreatment and sending only the liquid portion to the wastewater treatment facility significantly reduces the waste load to the treatment facility and allows for design of downstream treatment processes more typical of domestic wastewater flows and strength.

Receiving station and odor control

A receiving station must be built at the septage pretreatment site to receive septage from the hauling trucks. The primary functions of a receiving station are the transfer of septage from hauler trucks, preliminary treatment of septage (i.e. screening and grit removal), and storage and equalization of septage flows. Receiving station design should encourage simple and reliable operation, and have the flexibility to accommodate varying flow and loading conditions. Odor control is essential for any waste handling operation, especially in the case of septage. Septage processing can result in the release of odors causing complaints from local residents. For septage receiving units, the best approach to control odors is to cover the sources of odor emissions and to exhaust this air to a suitable control system. Due to the concern of odor problems associated with septage receiving, only septage receiving units that provide a completely enclosed system should be investigated.

Equalization

An equalization tank is used at treatment plants to control influent flow rates and allows for a reduction in required downstream unit process capacity. The cost for a 150,000-gallon equalization tank is provided in the pretreatment cost estimate.

Septage conditioning

Septage has poor dewatering characteristics and needs conditioning prior to dewatering. The conditioning process must fundamentally alter the sludge structure so that the solid and liquid portions are more easily separated. This is typically accomplished through chemical means and the amount of chemical required is based on the load and its characteristics. A combination of lime and ferric chloride has been successfully used as well as certain polymers. The current trend in conditioning is to use polymers, and for this memorandum it will be assumed that polymers will be used for conditioning the septage prior to solid/liquid separation.

Solid/liquid separation

A number of mechanical septage dewatering systems are available. The degree of dewatering accomplished is a function of conditioning chemical, admixtures of other sludges, and the dewatering process used. Typically, dewatered septage (sludge cake) has a solids content of approximately 20 to 40 percent. Feasible options for the MSB include using screw or rotary presses. Standard equipment for septage dewatering includes a sludge feed pump, a polymer makeup system, a control panel, miscellaneous field instrumentation, a conveyor, and a truck/disposal bin. A screw press can produce Class A or Class B biosolids, depending on the process and the required product.

The requirements for Class A and Class B biosolids are outlined in EPA regulations 40 CFR Part 503. Class A biosolids contain no detectible levels of pathogens and have been treated to meet vector attraction reduction requirements. Class B biosolids have been treated but still may contain pathogens. There are buffer, public access, and crop harvesting restrictions for Class B biosolids. Either Class A or Class B biosolids from the screw press can be disposed of at the MSB landfill, but if the landfill is the ultimate disposal site it would not be worth the extra cost to produce the class A solids. Class A biosolids can be land applied as well as distributed to the public as fertilizer and offer more options for ultimate disposal than Class B biosolids. Producing Class A biosolids may provide cost savings and flexibility for biosolids management depending on the treatment process and the quality of the final product, and can generate revenue in some cases (distributed to the public as fertilizer, etc.). However, Class A solids treatment technologies generally require increased capital and operations and maintenance (O&M) costs for processing. Class B biosolids have historically been the predominant class of biosolids produced in the US. The cost estimate provided in Table 5 below for the septage pretreatment system assumes Class B biosolids as the basis of design but also includes an additional option for achieving Class A solids.

A conservative concentration of 500 mg/L for both BOD and TSS is assumed for the pretreated septage (the liquid filtrate from the screw press) based on estimated performance data received from the manufacturer of the FKC screw press and pretreatment equipment. This pretreated septage is further treated as described in following sections of this memorandum. Figure 2 below provides a general schematic of the pretreatment process described above and Figure 3 provides a typical screw press dewatering process flow diagram utilizing polymer for sludge conditioning (Class B solids option).

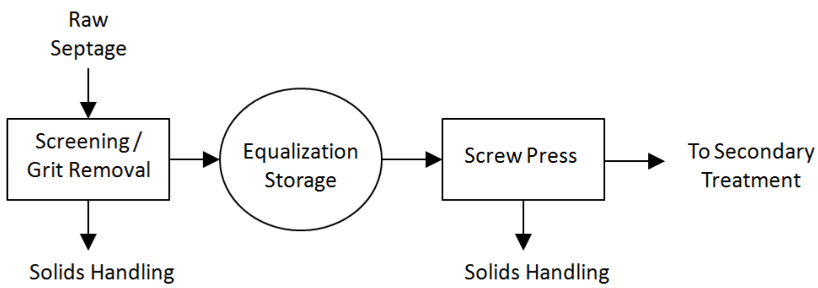

Figure 2 - Pretreatment Process

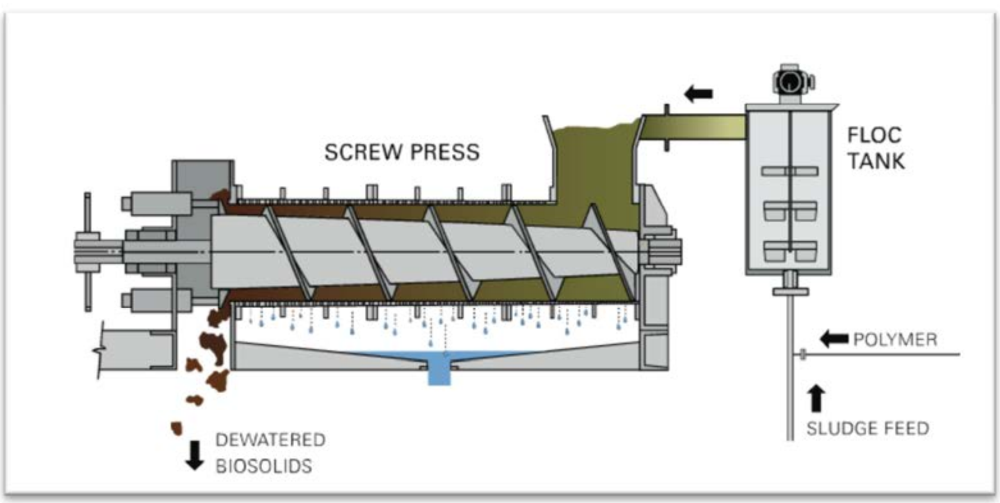

Figure 3 - Typical Screw Press Dewatering Process Flow Diagram

In general, a screw press is a contained unit where sludge that has been conditioned with a polymer is fed onto a screw-like drum that spins and transports sludge towards a discharge point. While the screw conveyor slowly turns, the screw pitch and drum diameter are decreased, which increases pressure on the sludge. The increased pressure forces water from the sludge, which is then filtered through small wire screening. A screw press can generally achieve high dewatered solids concentrations and offers very low maintenance and simple operation. A skid-mounted system is available that includes the screw press, flocculation tank, sludge pump, control panel, and polymer system (This skid-mounted system is the basis for the 'Screw Press' item in the Table 5 cost estimate.)

As discussed above, Class A biosolids can also be produced with the screw press equipment. In this process, lime is added to liquid biosolids to raise the pH to 12 to meet EPA vector attraction reduction requirements. The lime treated biosolids are then flocculated with polymer, pre-thickened in a rotary screen thickener, and then fed to a steam heated screw press. Inside the screw press the biosolids are dewatered and heated to meet EPA pathogen reduction requirements. Screw press outlet consistencies are usually 30 to 50% dry solids. Figure 4 below provides a typical screw press dewatering process flow diagram for Class A biosolids production. Equipment required for the Class A option includes the screw press mounted on a skid, flocculation tank, rotary screen thickener (RST), lime bag dump station with lime conveyor and inductor tank, boiler skid, Class A control panel, 15-foot screw conveyor, sludge pump, lime/sludge mixing tank, a recirculation pump, and polymer system.

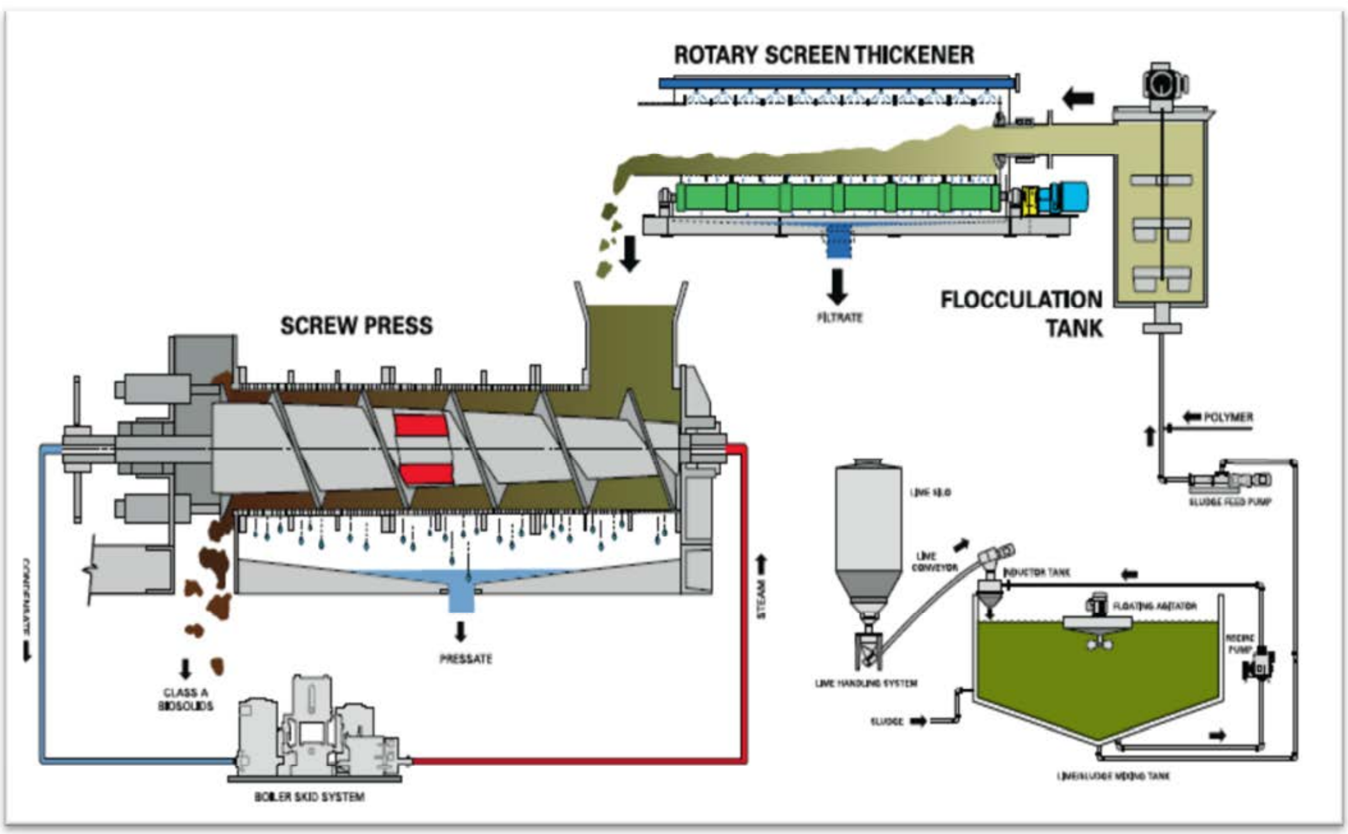

Figure 4 - Simultaneous Dewatering and Pasteurization –Class A Process

Costs for the receiving and pretreatment processes of a septage treatment facility are estimated in Table 5. The cost for pretreatment as presented in Table 5 is applied to each of the secondary and tertiary treatment process alternatives evaluated in the following sections.

Table 5 – Pretreatment Order of Magnitude Capital Cost Estimate

Item	Item Detail	Quantity	Unit	Unit Price	Total
Septage Pretreatment	Influent Screening	1	LS	$225,000	$225,000
	Grit Removal	1	LS	$200,000	$200,000
	Equalization Storage / Concrete Structure	430	CY	$900	$387,000
	Odor Control Towers and Fans	1	EA	$213,800	$213,800
	Screw Press	1	EA	$1,100,000	$1,100,000
	Screw Press - Class A Biosolids Option	1	LS	$400,000	$400,000
	Treatment Building	1,215	SF	$225	$273,400
	Misc. Site Work	1	15% of	$2,799,175	$419,900
	Misc. Equipment	1	20% of	$2,799,175	$559,800
				Subtotal [1,2]	**$3,778,900**

1. Per the Association of Advancement of Cost Estimating, Recommended Practice 17R-97 for Planning Level project this constitutes a Class 5 cost estimate with a Value of 5 with an implied Accuracy Range is +50% to -25%
2. This probable construction cost is an Order of Magnitude cost opinion in 2013 dollars, and does not include inflation, financing costs or operation and maintenance costs. This opinion assumes that a local general contractor will prime the project. It has been prepared for guidance in project evaluation and funding at the time of the estimate. Contractor bids and final construction costs will depend on actual labor and material costs, actual site conditions, productivity, fuel and expendable pricing, competitive market conditions, final project scope, final schedule and other variable factors. As a result, the final project costs will vary from this estimate.

Option 4A – Secondary Treatment by Aerated Lagoons

As previously presented in the 2007 Study, one option for secondary treatment of pretreated septage is an aerated lagoon system. This memorandum provides updated costs to the 2007 Study's aerated lagoon secondary treatment option. This design is based around peak BOD and TSS loading coming to the plant between the months of May through October (identified in the 2007 Study as the 'summer months' when septage hauling is approximately 3 times more than in the 'winter months' of November through April.) Aerated lagoons can be operated on a flow-through or solids recycle basis, with oxygen for wastewater conversion provided through surface aerators of diffused air units. Depending on the hydraulic detention time of the lagoon, effluent water quality can achieve up to 95 percent BOD removal with most of the solids settling out prior to discharge. Lagoon type systems are common for wastewater treatment in Alaska, however, limited operational flexibility and cold climate conditions make it more difficult, if not impossible, to meet higher tertiary treatment requirements outlined in the following section. Figure 5 below shows a general design schematic for a typical cold climate aerated lagoon system.

Options for discharge of treated effluent from an aerated lagoon include discharge to percolation cells or constructed wetlands. The treatment design evaluated in the 2007 Study assumed secondary treatment of wastewater would be required and the conceptual design was for BOD and TSS removal only; which is typical of cold climate lagoon systems. Based on recent regulatory changes, if the MSB seeks to discharge the treated effluent to a surface water (stream, river, etc.) this could result in more stringent permit limits. Depending on the receiving stream, more restrictive effluent limits could include the requirement to achieve some level of nutrient removal. Wastewater treatment facilities in Alaska that discharge to receiving waters that contain salmon are receiving more stringent seasonal limits for ammonia nitrogen when spawning may occur. Nitrogen is not typically removed in a secondary treatment process, especially a cold climate aerated lagoon system. The removal of nitrogen from the wastewater stream is achieved through biological processes called nitrification/denitrification. If nitrification/denitrification is necessary for the discharge permit (dependent upon ADEC requirements) then this design (2007 Option 4) may need to be modified into a lagoon activated sludge system (as discussed in the 2010 Regional Wastewater and Septage Treatment Study). In general, to achieve biological nitrogen removal in an aerated lagoon system several operating conditions must be maintained including temperature control (warmer temperatures are required to achieve nitrification), removal of settled solids from the lagoon bottom, and the recycling of beneficial microbes (activated sludge) back into the treatment process.

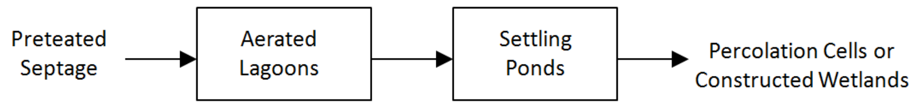

Figure 5 – Option 4A Septage Filtrate Aerated, Partially Mixed Lagoon Treatment Process

Table 6 shows the design criteria for the aerated lagoon system. Equipment typically required for aerated lagoons includes lining systems, inlet and outlet structures, hydraulic controls, floating dividers and baffles, and aeration equipment.

Table 6 – 2030 Design Criteria for Conventional Septage Treatment

Aeration Requirement:	993 lb X 2.25 = 2,235 lb/day
Volume Requirement:	3.84 million gallons (514,016 ft^3 with effective depth of 9 feet)
Aeration Area:	1.31 acres x 2 (approximately 3 acres total req'd)
Configurations:	Four aerated lagoon cells operated in series or parallel, followed by settling ponds.
Discharge	To percolation cell or constructed wetlands

Advantages and disadvantages of aerated, partial mix lagoons are listed below[1]:

[1] EPA Wastewater Technology Fact Sheet – Aerated, Partial Mix Lagoons

Aerated Lagoon Process Advantages

- An aerated lagoon can usually discharge throughout the winter
- Sludge disposal may be necessary but the quantity will be relatively small compared to other secondary treatment processes
- Aerated lagoons are relatively simple treatment processes compared to advanced treatment alternatives (more simple operation, less equipment typically, less maintenance, etc.)

Aerated Lagoon Process Disadvantages

- Aerated lagoons are not typically effective in removing ammonia nitrogen or phosphorous, unless designed for nitrification (challenging in cold climates)
- Effluent nitrate levels may cause ground water contamination – unless designed for nitrification/denitrification
- Reduced rates of biological activity occur during cold weather
- Mosquito and similar insect vectors can be a problem if vegetation on the dikes and berms is not properly maintained

- Sludge accumulation rates will be higher in cold climates because low temperature inhibits anaerobic reactions
- Would need to be converted/changed to a lagoon activated sludge (LAS) process to achieve reliable, significant biological nitrogen removal
- Many of the advantages typically cited for aerated lagoons (reduced capital costs, ease and cost of operation and maintenance, etc.) are not as prevalent if the system has to be converted to a more complex LAS process. The LAS system more closely resembles other, mechanical treatment processes in terms of equipment required, operational complexity, etc.

The primary disadvantage of aerated lagoon systems is the lack of ability to achieve enhanced (tertiary) treatment required to meet lower effluent limits if surface water discharge is required. As this will be a new facility and not a retro-fit to an existing lagoon system such as the City of Palmer WWTP, mechanical treatment options should be evaluated due to their ability to provide enhanced treatment and offer more operational flexibility compared to aerated lagoon systems. In order to provide a cost comparison between these more advanced treatment processes and the conventional aerated lagoon process, two alternatives (one secondary and one tertiary) are evaluated in following section of this memorandum.

Table 7 – Option 4A Aerated Lagoon Order of Magnitude Capital Cost Estimate

Item	Item Detail	Quantity	Unit	Unit Price	Total
Lagoon Treatment	Excavation	50,767	CY	$5.00	$253,800
	Load and Haul Excavated Material	25,384	CY	$10.2	$257,800
	Backfill with Selective Material	12,692	CY	$3.7	$47,500
	Structural Fill	6,346	CY	$25.7	$162,800
	Membrane Liner and Geotextile Fabric	198,632	SF	$5.6	$1,115,500
	Insulated Lagoon Covers (4-inch, installed)	165,527	SF	$5.6	$929,600
	Gravel Drain Bed	10,153	CY	$18.0	$183,100
	Aeration Equipment - Blowers	2	EA	$40,000	$80,000
	Aeration Equipment - Pipe	11,423	FT	$20	$228,500
Sludge Storage Facilities	Covered Sludge Storage Area	1,600	SF	$125	$200,000
Constructed Percolation Cells or Wetlands	Vegetation Planting	87	1,000 SF	$400	$34,800
	Excavation	25,384	CY	$5.00	$126,900
	Load and Haul Excavated Material	12,692	CY	$10.2	$128,900
	Backfill with Selective Material	6,346	CY	$3.7	$23,700
	Structural Fill	3,173	CY	$25.7	$81,400
	Membrane liner and Geotextile Fabric	43,560	SF	$5.6	$244,600
	Discharge Permit Plan Approval and Permit	80	HR	$150	$12,000
	Monitoring Wells	4	EA	$7,500	$30,000
Miscellaneous	Yard Piping	1	5% of	$4,140,982	$207,000
	Misc. Site Work	1	15% of	$4,140,982	$621,100
	Misc. Equipment	1	20% of	$4,140,982	$828,200
				Subtotal	**$5,797,400**

Table 8 – Order of Magnitude Cost Estimate for Pretreatment and Aerated Lagoon Treatment

Summary of Costs		
Aerated Lagoon Capital Cost (Secondary Treatment)		$5,797,400
Pretreatment Capital Costs		$3,778,900
Total Capital Cost		$9,576,300
Preliminary Engineering and Design (10%)	0.1	$957,700
Construction Management (10%)	0.1	$957,700
Direct Allocation & Allocated Funds During Construction Charges (17%)	0.17	$1,628,000
Administration (5%)	0.05	$478,800
Contingency (25%)	0.25	$2,394,100
Total Capital Construction Costs		**$15,992,200**
Payoff Period (yr)	20.00	
Interest Rate	1.5%	
Capital Cost to Payoff Each Year		$931,500
Estimated Annual O&M[3]		$440,000
Equivalent Annual Cost [1, 2]		**$1,371,500**

1. Per the Association of Advancement of Cost Estimating, Recommended Practice 17R-97 for Planning Level project this constitutes a Class 5 cost estimate with a Value of 5 with an implied Accuracy Range is +50% to -25%
2. This probable construction cost is an Order of Magnitude cost opinion in 2013 dollars, and does not include future inflation, financing costs or operation and maintenance costs. This opinion assumes that a local general contractor will prime the project. It has been prepared for guidance in project evaluation and funding at the time of the estimate. Contractor bids and final construction costs will depend on actual labor and material costs, actual site conditions, productivity, fuel and expendable pricing, competitive market conditions, final project scope, final schedule and other variable factors. As a result, the final project costs will vary from this estimate.
3. Estimated Annual O&M costs have been updated from the 2007 Study (as presented in Appendix 8 of the original study). Costs have been updated to include increases in chemical costs, power costs, etc.

Options 4B and 4C – Secondary Treatment by Sequencing Batch Reactor (SBR)

More advanced wastewater treatment processes such as an activated sludge process would be necessary to achieve better effluent water quality than what is possible from an aerated lagoon. There are a number of available activated sludge process alternatives including conventional activated sludge, lagoon activated sludge, sequencing batch reactor, and membrane bioreactor. The determination of the best available technology for a regional septage treatment facility would be impacted by the final site selected, discharge limits, etc. and should be evaluated in a more detailed engineering study. In order to provide a preliminary cost comparison between an advanced treatment process and the conventional aerated lagoon process presented in the 2007 study, a conceptual design cost estimate has been developed for a sequencing batch reactor.

A sequencing batch reactor (SBR) is an activated sludge batch-treatment process (fill-and-draw). The process involves fives steps including filling, aeration, settling, decanting and idling which all occur in the same tank in sequential order. SBRs can be designed and operated to enhance removal of nitrogen, phosphorus, and ammonia, in addition to removing TSS and BOD. The intermittent flow SBR accepts influent only at specified intervals and, in general, follows the five-step sequence. There are usually two units in parallel with one unit open for intake while the other runs through the remainder of the cycle.

Option 4B consists of the SBR directly followed by discharge to a percolation cell (or constructed wetland). The advantage of this method of secondary treatment is that it requires a much smaller site than a lagoon.

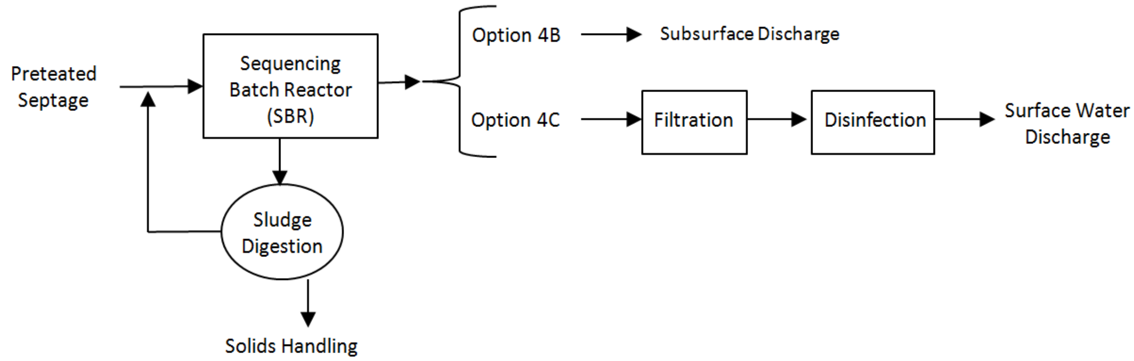

Figure 4 – Septage Filtrate Sequencing Batch Reactor Treatment Process

An SBR with filtration and disinfection (Option 4C) will typically produce an effluent of less than 15 mg/L BOD, 15 mg/L TSS, and 2 mg/L total nitrogen. These values will allow the proposed wastewater treatment plant to discharge to surface water discharge based on the assumed tertiary treatment requirements (15 mg/L BOD and TSS discharge limits). Solids produced by the system can be further treated for beneficial use (biosolids/composting) or delivered to the MSB landfill for disposal. See Attachment A to this report with design information from Aqua-Aerobic Systems, Inc., a manufacturer of one SBR system available.

Table 9 - 2030 Design Criteria for SBR Treatment [1]

Basin Geometry	38ft x 38ft x 21ft (W x L x D)
Number of Basins	2
Number of Cycles	2 per day
Treatment Cycle Duration	12.0 hrs
Food to Mass	0.198 lbs COD/lb MLSS-day
MLSS Concentration	4,500 mg/L
Hydraulic Retention Time	1.905 days
Solids Retention Time	8.4 days
Oxygen Required	2,940 lb/day
Air Flowrate/Basin	472 SCFM
Post-SBR Equalization	56,000 gallons
AquaDisk Total Filter Area	43.2 ft^2
AquaDisk Total Max Flow	165.4 gpm

[1] AquaSBR (2012)

Advantages and disadvantages of aerated, partial mix lagoons are listed below[1]:

SBR Process Advantages

- Equalization, primary clarification (in most cases), biological treatment, and secondary clarification can be achieved in a single reactor vessels
- With filtration and disinfection components the SBR process can produce effluent meeting tertiary limits
- No secondary clarifiers and return activated sludge lines

- Operating flexibility and control
- Reduced plant footprint
- Potential capital cost savings by eliminating clarifiers and other equipment

SBR Process Disadvantages

- Increased level of sophistication is required (compared to conventional lagoon systems) including supervisory control and data acquisition computer systems
- Higher level of maintenance associated with more sophisticated controls, automated switches, and automated valves
- Potential of discharging floating or settled sludge during the draw or decant phase with some SBR configurations
- Potential plugging of aeration devices during selected operating cycles, depending on the aeration system used by the manufacturer
- Potential requirement for equalization after the SBR, depending on the downstream processes

[1] EPA Wastewater Technology Fact Sheet – Sequencing Batch Reactors

Two cost estimates are presented in Tables 10 through 13. The first two tables represent the preliminary order of magnitude cost associated with Option 4B – a mechanical wastewater treatment process (SBR without filtration or disinfection) which can achieve secondary effluent limits similar to the aerated lagoon configuration. Tables 12 and 13 present the preliminary order of magnitude cost associated with Option 4C – a mechanical wastewater treatment process (SBR with filtration and disinfection) which can achieve tertiary effluent limits that would likely be required for any new wastewater treatment facility discharging to surface water.

Table 10 – Option 4B SBR (Secondary Treatment) Order of Magnitude Capital Cost Estimate

Item	Item Detail	Quantity	Unit	Unit Price	Total
SBR Treatment	Treatment Building	9,600	SF	$225	$2,160,000
	SBR Equipment (Diffusers, Blowers, Decanter, Transfer Pumps, etc.)	1	LS	$725,000	$725,000
	Digester Equipment (Diffusers, Blowers, Transfer Pumps, etc.)	1	LS	$350,000	$350,000
	Concrete Tanks (2 x SBR + 1 x Digester)	565	CY	$900.00	$508,500
Sludge Storage Facilities	Covered Sludge Storage Area	1,600	SF	$125	$200,000
Constructed Percolation Cells or Wetlands	Vegetation Planting	87	1,000 SF	$400	$34,800
	Excavation	25,384	CY	$5.00	$126,900
	Load and Haul Excavated Material	12,692	CY	$10.2	$128,900
	Backfill with Selective Material	6,346	CY	$3.7	$23,700
	Structural Fill	3,173	CY	$25.7	$81,400
	Membrane liner and Geotextile Fabric	43,560	SF	$5.6	$244,800
	Discharge Permit Plan Approval and Permit	80	HR	$150	$12,000
Miscellaneous	Yard Piping	1	5% of	$4,596,100	$229,800
	Misc. Site Work	1	15% of	$4,596,100	$689,400
	Misc. Equipment	1	20% of	$4,596,100	$919,200
				Subtotal	**$6,434,600**

Table 11 – Order of Magnitude Cost Estimate for Pretreatment and SBR Secondary Treatment

Summary of Costs		
SBR Only Capital Cost (Secondary Treatment)		$6,434,600
Pretreatment Capital Costs		$3,778,900
Total Capital Cost		$10,213,400
Preliminary Engineering and Design (10%)	0.1	$1,021,300
Construction Management (10%)	0.1	$1,021,300
Direct Allocation & Allocated Funds During Construction Charges (17%)	0.17	$1,736,300
Administration (5%)	0.05	$510,700
Contingency (25%)	0.25	$2,553,400
Total Capital Construction Costs		**$17,056,500**
Payoff Period (yr)	20.00	
Interest Rate	1.5%	
Capital Cost to Payoff Each Year		$993,500
Estimated Annual O&M[3]		$500,000
Equivalent Annual Cost [1, 2]		**$1,493,500**

1. Per the Association of Advancement of Cost Estimating, Recommended Practice 17R-97 for Planning Level project this constitutes a Class 5 cost estimate with a Value of 5 with an implied Accuracy Range is +50% to -25%
2. This probable construction cost is an Order of Magnitude cost opinion in 2013 dollars, and does not include future inflation, financing costs or operation and maintenance costs. This opinion assumes that a local general contractor will prime the project. It has been prepared for guidance in project evaluation and funding at the time of the estimate. Contractor bids and final construction costs will depend on actual labor and material costs, actual site conditions, productivity, fuel and expendable pricing, competitive market conditions, final project scope, final schedule and other variable factors. As a result, the final project costs will vary from this estimate.

3. Detailed Operation and Maintenance costs have not been developed for this conceptual design memorandum. An estimated annual value of $500,000 has been used for analysis based on chemical costs, power usage, sludge disposal, sampling and monitoring, and maintenance from similar sized SBR facilities. A detailed evaluation of site specific O&M costs should be included in the Preliminary Engineering for the facility.

Table 12 – Option 4C SBR (Tertiary Treatment) Order of Magnitude Capital Cost Estimate

Item	Item Detail	Quantity	Unit	Unit Price	Total
SBR Treatment	Treatment Building	16,000	SF	$225	$3,600,000
	SBR Equipment (Diffusers, Blowers, Decanter, Transfer Pumps, etc.)	1	LS	$725,000	$725,000
	Digester Equipment (Diffusers, Blowers, Transfer Pumps, etc.)	1	LS	$350,000	$350,000
	Equalization Basin Equipment and Tertiary Disk Filters	1	LS	$300,000	$300,000
	Concrete Tanks (2 x SBR + 1 x Digester)	565	CY	$900.00	$508,500
	Concrete Tanks (Post-Equalization Basin)	74	CY	$900.00	$66,600
	UV Disinfection	1	LS	$100,000	$100,000
	Outfall Pipe	1,000	LF	$150	$150,000
	Discharge Permit Plan Approval and Permit	80	HR	$150	$12,000
Sludge Storage Facilities	Covered Sludge Storage Area	1,600	SF	$125	$200,000
Miscellaneous	Yard Piping	1	5% of	$6,012,100	$300,605
	Misc. Site Work	1	15% of	$6,012,100	$901,815
	Misc. Equipment	1	20% of	$6,012,100	$1,202,420
				Subtotal	**$8,416,940**

Table 13 – Order of Magnitude Cost Estimate for Pretreatment and SBR Tertiary Treatment

Summary of Costs		
SBR, Filtration, and Disinfection Capital Cost (Tertiary Treatment)		$8,416,900
Pretreatment Capital Costs		$3,778,900
Total Capital Cost		$12,195,800
Preliminary Engineering and Design (10%)	0.1	$1,219,600
Construction Management (10%)	0.1	$1,219,600
Direct Allocation & Allocated Funds During Construction Charges (17%)	0.17	$2,073,300
Administration (5%)	0.05	$609,800
Contingency (25%)	0.25	$3,049,000
Total Capital Construction Costs		**$20,367,000**
Payoff Period (yr)	20.00	
Interest Rate	1.5%	
Capital Cost to Payoff Each Year		$1,186,300
Estimated Annual O&M[3]		$650,000
Equivalent Annual Cost [1, 2]		**$1,836,300**

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estimate. Contractor bids and final construction costs will depend on actual labor and material costs, actual site conditions, productivity, fuel and expendable pricing, competitive market conditions, final project scope, final schedule and other variable factors. As a result, the final project costs will vary from this estimate.

3. Detailed Operation and Maintenance costs have not been developed for this conceptual design memorandum. An estimated annual value of $650,000 has been used for analysis based on chemical costs, power usage, sludge disposal, sampling and monitoring, and maintenance from similar sized SBR facilities. A detailed evaluation of site specific O&M costs should be included in the Preliminary Engineering for the facility.

Recommendation

A regional septage treatment facility offers MSB independent septage disposal and treatment ownership and management. While this memorandum does not include funding opportunities as part of the cost analysis, the MSB will likely be eligible for Alaska Clean Water Fund loans (current interest rate of 1.5%) as well as possible grants through the Alaska Department of Environmental Conservation's (ADEC) Municipal Grants and Loans Program and other Federal programs. Loans can finance up to 100 percent of a project's eligible costs for planning, design and construction of publicly owned facilities. If the MSB were to acquire a $17.1 million loan from ADEC at 1.5% interest, the treatment facility could pay for itself with tipping fees shown in Table 14. This analysis includes $500,000 per year in operating costs and illustrates the economic feasibility of a MSB regional septage treatment facility. The tipping fee in Table 14 represents the fee required to payoff a 1.5% loan based on the constant tipping fee from 2013 through the year listed and includes a 2.5% inflation rate. For example, to pay off a $17.1 million dollar loan with $500,000 per year operating expenditures by 2020 would require a tipping fee of $354. These tipping fees can be related to the cost of existing hauling practices (MOA disposal) of $229 per trip as shown in Table 4.

Table 14 - Tipping Fee Required for 1.5% Loan Repayment

Year	Deliveries per Year	Tipping Fee Required for Payoff ($17.1 Million)
2013	6,589	$2,703
2014	6,983	$1,360
2015	7,378	$912
2016	7,772	$689
2017	8,166	$555
2018	8,560	$466
2019	8,954	$402
2020	9,348	$354
2021	9,743	$318
2022	10,137	$288
2023	10,531	$264
2024	10,925	$244
Current Tipping Cost Shown in Table 4		**$229**
2025	11,319	$227
2026	11,713	$213
2027	12,108	$201
2028	12,502	$190
2029	12,896	$180
2030	13,290	$172

Table 15 - Memorandum Cost Summary

Alternative	Order of Magnitude Capital Cost	Estimated Annual O&M Costs	Equivalent Annual Cost
Option 1 - Do Nothing - Maintaining Existing Haul Practices	$0	$0	$1,418,700
Option 4A - Aerated Lagoon (Secondary Treatment)	$15,992,200	$440,000	$1,371,500
Option 4B - SBR (Secondary Treatment)	$17,056,500	$500,000	$1,493,500
Option 4C - SBR/Filtration/Disinfection (Tertiary Treatment)	$20,367,000	$650,000	$1,836,300

The costs in this memorandum do not include the purchasing of land or potential funding opportunities (grants and/or loans). It is important to reiterate that this memorandum is based on the 2030 population projections used in the 2007 Study. These projections may be high as the recent growth trends in the Borough have slowed. However, the costs of each facility in this memorandum are based on the quantity of septage treated which is also based on the projected population. Any changes in projected population will result in a scalable construction cost difference within reason.

Dependent upon on the final location of the regional septage treatment facility, treatment plant effluent water quality requirements could range from secondary to tertiary treatment and will be designated in an Alaska Pollutant Discharge Elimination System (APDES) permit from ADEC. The determination of the best available technology for a regional septage treatment facility would be impacted by the final site selected, discharge limits, etc. and should be evaluated in a more detailed engineering study.

Attachment A

Sequencing Batch Reactor – Manufacturer's Information

PROCESS DESIGN REPORT

AQUA-AEROBIC SYSTEMS, INC.

MATSU BOROUGH AK

Design#: 132885

Option: AquaSBR Preliminary Design

Designed By: Eric Roundy on Friday, December 14, 2012

Design Notes

Pre-SBR

- Pre-SBR treatment includes a Dissolved Air Floatation System or other system to remove the influent COD and TSS to the design influent parameters shown on the design summary.

- Neutralization is recommended/required ahead of the SBR if the pH is expected to fall outside of 6.5-8.5 for significant durations.

- Coarse solids removal/reduction is recommended prior to the SBR.

SBR

- The flow pattern is assumed to occur 24 hours/day over 7 days/week.

- The Maximum flow, as shown on the design, has been assumed as a hydraulic maximum and does not represent an additional organic load.

- The decanter performance is based upon a free-air discharge following the valve and immediately adjacent to the basin. Actual decanter performance depends upon the complete installation including specific liquid and piping elevations and any associated field piping losses to the final point of discharge. Modification of the high water level, low water level, centerline of discharge, and / or cycle structure may be required to achieve discharge of full batch volume based on actual site installation specifics.

Aeration

- The aeration system has been designed to provide 1.0 lbs O2/lb COD applied and 4.6 lbs O2/lb NH3-N applied at the design average loading conditions.

Process/Site

- An elevation of 20 ft. has been assumed as displayed on the design.

- The anticipated effluent NH3-N requirement is predicated upon an influent waste temperature of 8°C or greater. While lower temperatures may be acceptable for a short-term duration, nitrification below 10°C can be unpredictable, requiring special operator attention.

- Based on the information provided, the waste may be nutrient deficient. Nutrient addition is recommended to achieve a ratio of 100:5:1 (BOD:N:P).

- Sufficient alkalinity is required for nitrification, as approximately 7.1 mg alkalinity (as CaCO3) is required for every mg of NH3-N nitrified. If the raw water alkalinity cannot support this consumption, while maintaining a residual concentration of 50 mg/l, supplemental alkalinity shall be provided (by others).

- It is assumed that there are no substances in the influent stream that would be inhibitory for a biological system.

Anticipated

- It is assumed the influent COD is either directly, or biologically oxidizeable to the required discharge limits.

- Treatability study recommended to assure required effluent quality is achievable.

- Maximum fats, oils, and grease to the AquaSBR is 100 mg/l. Depending upon the nature of the FOG, reduction in activated sludge treatment is unpredictable. If an effluent FOG requirement exists, FOG should be reduced to the effluent limit required prior to biological treatment. High FOG levels may also cause poor settling and excessive foaming which can damage equipment and lead to effluent quality degradation.

Equipment

- The basin dimensions reported on the design have been assumed based upon the required volumes and assumed basin geometry. Actual basin geometry may be circular, square, rectangular or sloped with construction materials including concrete, steel or earthen.

- Rectangular or sloped basin construction with length to width ratios greater than 1.5:1 may require alterations in the equipment recommendation.

- Tanks are not included in the pricing and shall be provided by others.

- Influent is assumed to enter the reactor above the waterline, located appropriately to avoid proximity to the decanter, splashing or direct discharge in the immediate vicinity of other equipment.

- If the influent is to be located submerged below the waterline, adequate hydraulic capacity shall be made in the headworks to prevent backflow from one reactor to the other during transition of influent.

- A minimum freeboard of 2.0 ft. is recommended for diffused aeration.

- Aqua-Aerobic Systems, Inc. (AASI) is familiar with the Buy American provision of the American Recovery and Reinvestment Act of 2009 as well as other Buy American provisions (i.e. FAR 52.225, EXIM Bank, USAid, etc.). AASI can provide a system that is in full compliance with Buy American provisions. As the project develops AASI can work with you to ensure full compliance with a Buy American provision, if required. Please contact the factory should compliance with a Buy American provision be required.

Pricing

- Scope of supply includes installation supervision and start-up services; however, freight is not included.

- If the equipment is installed indoors, please ensure that the minimum number of air exchanges are provided otherwise explosion proof materials of construction will be required.

AquaSBR - Sequencing Batch Reactor - Design Summary

DESIGN INFLUENT CONDITIONS

Avg. Design Flow = 0.238165 MGD = 900 m3/day
Max Design Flow = 0.238165 MGD = 900 m3/day

DESIGN PARAMETERS	Influent	mg/l	Effluent Required	<= mg/l	Effluent Anticipated	<= mg/l
Bio/Chem Oxygen Demand:	COD	1,250	BOD5	30	BOD5	30
Total Suspended Solids:	TSS	500	TSS	30	TSS	30
Inf. Ammonia Nitrogen:	NH3-N	50	--	--	--	--
Ammonia Nitrogen:	--	--	NH3-N	8.70	NH3-N	8.70

SITE CONDITIONS	Maximum		Minimum		Design		Elevation (MSL)
Ambient Air Temperatures:	70 F	21.1 C	20 F	-6.7 C	70 F	21.1 C	20 ft
Influent Waste Temperatures:	59 F	15.0 C	46 F	8.0 C	59 F	15.0 C	6.1 m

SBR BASIN DESIGN VALUES

			Water Depth			Basin Vol./Basin		
No./Basin Geometry:	= 2 Square Basin(s)		**Min**	= 15.5 ft	= (4.7 m)	**Min**	= 0.167 MG	= (633.3 m³)
Freeboard:	= 2.0 ft	= (0.6 m)	**Avg**	= 21.0 ft	= (6.4 m)	**Avg**	= 0.227 MG	= (858.7 m³)
Length of Basin:	= 38.0 ft	= (11.6 m)	**Max**	= 21.0 ft	= (6.4 m)	**Max**	= 0.227 MG	= (858.7 m³)
Width of Basin:	= 38.0 ft	= (11.6 m)						

Number of Cycles:	= 2 per Day/Basin (advances cycles beyond MDF)	
Cycle Duration:	= 12.0 Hours/Cycle	
Food/Mass (F/M) ratio:	= 0.198 lbs. COD/lb. MLSS-Day	
MLSS Concentration:	= 4500 mg/l @ Min. Water Depth	
Hydraulic Retention Time:	= 1.905 Days @ Avg. Water Depth	
Solids Retention Time:	= 8.4 Days	
Est. Net Sludge Yield:	= 0.581 lbs. WAS/lb. COD	
Est. Dry Solids Produced:	= 1443.7 lbs. WAS/Day	= (654.9 kg/Day)
Est. Solids Flow Rate:	= 300 GPM (17311 GAL/Day)	= (65.5 m³/Day)
Decant Flow Rate @ MDF:	= 992.0 GPM (as avg. from high to low water level)	= (62.6 l/sec)
LWL to CenterLine Discharge:	= 2.0 ft	= (0.6 m)
Lbs. O2/lb. COD	= 1.00	
Lbs. O2/lb. NH3-N	= 4.60	
Actual Oxygen Required:	= 2940 lbs./Day	= (1333.4 kg/Day)
Air Flowrate/Basin:	= 472 SCFM	= (13.4 Sm3/min)
Max. Discharge Pressure:	= 10.7 PSIG	= (74 KPA)
Avg. Power Required:	= 885.2 KW-Hrs/Day	

AquaSBR

Influent Valves

2 Influent Valve(s) will be provided as follows:

- 4 inch electrically operated plug valve(s).

Mixers

2 AquaDDM Direct Drive Mixer(s) will be provided as follows:

- 7.5 HP Aqua-Aerobic Systems Endura Series Model FSS DDM Mixer(s).

Mixer Mooring

2 Mixer pivotal mooring assembly(ies) consisting of:

- 304 stainless steel pivotal mooring arm(s).
- #12 AWG-four conductor electrical service cable(s).
- Electrical cable strain relief grip(s), 2 eye, wire mesh.

2 Mixer De-Watering Support(s) will be provided as follows:

- Galvanized steel dewatering support post(s).
- Galvanized steel support angle(s).
- 304 stainless steel anchors.

Decanters

2 Decanter assembly(ies) consisting of:

- 6x4 Aqua-Aerobics decanter(s) with fiberglass float, 304 stainless steel weir, galvanized restrained mooring frame, and painted steel power section with #14-10 conductor power cable wired into a NEMA 4X stainless steel junction box with terminal strips for the single phase, 60 hertz actuator and limit switches.
- 8 inch diameter decant hose assembly.
- 4" schedule 40 galvanized steel mooring post.
- 8 inch electrically operated butterfly valve(s) with actuator.

Transfer Pumps/Valves

2 Submersible Pump Assembly(ies) consisting of the following items:

- 3 HP Submersible Pump(s) with painted cast iron pump housing, discharge elbow, and multi-conductor electrical cable.
- Manual plug valve(s).
- 3 inch Nibco check valve(s).
- Galvanized steel slide rail assembly(ies).
- 304 stainless steel intermediate support(s).

Retrievable Fine Bubble Diffusers

4 Retrievable Fine Bubble Diffuser Assembly(ies) consisting of:

- 20 diffuser tubes consisting of two flexible EPDM porous membrane sheaths mounted on a rigid support pipe with 304 stainless steel band clamps.
- 304 stainless steel manifold weldment.
- 304 stainless steel leveling angles.
- 304 stainless steel leveling studs.
- Galvanized vertical support beam.
- Galvanized vertical air column assembly.
- Galvanized upper vertical beam and pulley assembly.
- Galvanized top support bracket.
- 3" EPDM flexible air line with ny-glass quick disconnect end fittings.
- Galvanized threaded flange.

- 3" manual isolation butterfly valve with cast iron body, EPDM seat, aluminum bronze disk and one-piece steel shaft.
- Ny-glass quick disconnect cam lock adapter.
- 304 stainless steel adhesive anchors.
- Brace angles.

1 Diffuser Electric Winch(es) will be provided as follows:

- Portable electric winch.

Positive Displacement Blowers

3 Positive Displacement Blower Package(s), with each package consisting of:

- Sutorbilt 6M Positive Displacement Blower Package with common base, V-belt drive, enclosed drive guard, pressure gauge, pressure relief valve, and vibration pads.
- 304 stainless steel anchors.
- 40 HP motor with slide base.
- Inlet filter and inlet silencer.
- Discharge silencer, check valve, manual butterfly isolation valve, and flexible discharge connector.

Level Sensor Assemblies

2 Pressure Transducer Assembly(ies) each consisting of:

- Submersible pressure transducer(s).
- Mounting bracket weldment(s).
- Transducer mounting weldment(s).
- 304 stainless steel anchors.

2 Level Sensor Assembly(ies) will be provided as follows:

- Float switch(es).
- Float switch mounting bracket(s).
- 304 stainless steel anchors.

Instrumentation

2 Dissolved Oxygen Assembly(ies) consisting of:

- Hach LDO dissolved oxygen probe with replaceable sensor cap and electric cable. Probe includes stainless steel stationary bracket and retrievable pole probe mounting assembly. One (1) probe per basin.
- Hach SC200 controller and display module(s).

Controls

Controls wo/Starters

1 Controls Package(s) will be provided as follows:

- NEMA 12 panel enclosure suitable for indoor installation and constructed of painted steel.
- Fuse(s) and fuse block(s).
- Allen Bradley SLC5/05 central processing unit with 32K memory and Ethernet connection.
- Operator interface(s).
- Remote Access Ethernet Modem.

PROCESS DESIGN REPORT

AQUA-AEROBIC SYSTEMS, INC.

MATSU BOROUGH AK

Design#: 132905

Option: AquaSBR and AquaDisk Preliminary Design

Designed By: Eric Roundy on Friday, December 14, 2012

The enclosed information is based on preliminary data which we have received from you. There may be factors unknown to us which would alter the enclosed recommendation. These recommendations are based on models and assumptions widely used in the industry. While we attempt to keep these current, Aqua-Aerobic Systems, Inc. assumes no responsibility for their validity or any risks associated with their use. Also, because of the various factors stated above, Aqua-Aerobic Systems, Inc. assumes no responsibility for any liability resulting from any use made by you of the enclosed recommendations.

Design Notes

Pre-SBR

- Pre-SBR treatment includes a Dissolved Air Floatation System or other system to remove the influent COD and TSS to the design influent parameters shown on the design summary.

- Neutralization is recommended/required ahead of the SBR if the pH is expected to fall outside of 6.5-8.5 for significant durations.

- Coarse solids removal/reduction is recommended prior to the SBR.

SBR

- The flow pattern is assumed to occur 24 hours/day over 7 days/week.

- The Maximum flow, as shown on the design, has been assumed as a hydraulic maximum and does not represent an additional organic load.

- The decanter performance is based upon a free-air discharge following the valve and immediately adjacent to the basin. Actual decanter performance depends upon the complete installation including specific liquid and piping elevations and any associated field piping losses to the final point of discharge. Modification of the high water level, low water level, centerline of discharge, and / or cycle structure may be required to achieve discharge of full batch volume based on actual site installation specifics.

Aeration

- The aeration system has been designed to provide 1.0 lbs O2/lb COD applied and 4.6 lbs O2/lb NH3-N applied at the design average loading conditions.

Process/Site

- An elevation of 20 ft. has been assumed as displayed on the design.

- The anticipated effluent NH3-N requirement is predicated upon an influent waste temperature of 8°C or greater. While lower temperatures may be acceptable for a short-term duration, nitrification below 10°C can be unpredictable, requiring special operator attention.

- Based on the information provided, the waste may be nutrient deficient. Nutrient addition is recommended to achieve a ratio of 100:5:1 (BOD:N:P).

- Sufficient alkalinity is required for nitrification, as approximately 7.1 mg alkalinity (as CaCO3) is required for every mg of NH3-N nitrified. If the raw water alkalinity cannot support this consumption, while maintaining a residual concentration of 50 mg/l, supplemental alkalinity shall be provided (by others).

- It is assumed that there are no substances in the influent stream that would be inhibitory for a biological system.

Anticipated

- It is assumed the influent COD is either directly, or biologically oxidizeable to the required discharge limits.

- Treatability study recommended to assure required effluent quality is achievable.

- Maximum fats, oils, and grease to the AquaSBR is 100 mg/l. Depending upon the nature of the FOG, reduction in activated sludge treatment is unpredictable. If an effluent FOG requirement exists, FOG should be reduced to the effluent limit required prior to biological treatment. High FOG levels may also cause poor settling and excessive foaming which can damage equipment and lead to effluent quality degradation.

Filtration

- Effluent flow equalization follows the AquaSBR process. The anticipated filtered effluent quality is based on the filter influent conditions as shown under "Design Parameters" of this Process Design Report. In addition, the filter influent should be free of algae and other colloidal solids that are not filterable through a nominal 10 micron pore size media. Provisions to treat algae and condition the solids to be filterable are the responsibility of others.

- The anticipated effluent quality is based upon filterable influent solids.

- For this application, pile filter cloth is recommended.

Equipment

- The basin dimensions reported on the design have been assumed based upon the required volumes and assumed basin geometry. Actual basin geometry may be circular, square, rectangular or sloped with construction materials including concrete, steel or earthen.

- Rectangular or sloped basin construction with length to width ratios greater than 1.5:1 may require alterations in the equipment recommendation.

- Tanks (except the package filter tank) are not included in the pricing and shall be provided by others.

- Influent is assumed to enter the reactor above the waterline, located appropriately to avoid proximity to the decanter, splashing or direct discharge in the immediate vicinity of other equipment.

- If the influent is to be located submerged below the waterline, adequate hydraulic capacity shall be made in the headworks to prevent backflow from one reactor to the other during transition of influent.

- A minimum freeboard of 2.0 ft. is recommended for diffused aeration.

- Aqua-Aerobic Systems, Inc. (AASI) is familiar with the Buy American provision of the American Recovery and Reinvestment Act of 2009 as well as other Buy American provisions (i.e. FAR 52.225, EXIM Bank, USAid, etc.). AASI can provide a system that is in full compliance with Buy American provisions. As the project develops AASI can work with you to ensure full compliance with a Buy American provision, if required. Please contact the factory should compliance with a Buy American provision be required.

Pricing

- Scope of supply includes installation supervision and start-up services; however, freight is not included.

- If the equipment is installed indoors, please ensure that the minimum number of air exchanges are provided otherwise explosion proof materials of construction will be required.

AquaSBR - Sequencing Batch Reactor - Design Summary

DESIGN INFLUENT CONDITIONS

Avg. Design Flow	= 0.238165 MGD	= 900 m3/day
Max Design Flow	= 0.238165 MGD	= 900 m3/day

DESIGN PARAMETERS	Influent	mg/l	Effluent (After Filtration) Required	<= mg/l	Anticipated	<= mg/l
Bio/Chem Oxygen Demand:	COD	1,250	BOD5	15	BOD5	15
Total Suspended Solids:	TSS	500	TSS	15	TSS	15
Inf. Ammonia Nitrogen:	NH3-N	50	--	--	--	--
Ammonia Nitrogen:	--	--	NH3-N	1.70	NH3-N	1.70

SITE CONDITIONS	Maximum		Minimum		Design		Elevation (MSL)
Ambient Air Temperatures:	70 F	21.1 C	20 F	-6.7 C	70 F	21.1 C	20 ft
Influent Waste Temperatures:	59 F	15.0 C	46 F	8.0 C	59 F	15.0 C	6.1 m

SBR BASIN DESIGN VALUES

No./Basin Geometry:	= 2 Square Basin(s)	
Freeboard:	= 2.0 ft	= (0.6 m)
Length of Basin:	= 38.0 ft	= (11.6 m)
Width of Basin:	= 38.0 ft	= (11.6 m)

Water Depth			Basin Vol./Basin		
Min	= 15.5 ft	= (4.7 m)	**Min**	= 0.167 MG	= (633.3 m³)
Avg	= 21.0 ft	= (6.4 m)	**Avg**	= 0.227 MG	= (858.7 m³)
Max	= 21.0 ft	= (6.4 m)	**Max**	= 0.227 MG	= (858.7 m³)

Number of Cycles:	= 2 per Day/Basin (advances cycles beyond MDF)	
Cycle Duration:	= 12.0 Hours/Cycle	
Food/Mass (F/M) ratio:	= 0.198 lbs. COD/lb. MLSS-Day	
MLSS Concentration:	= 4500 mg/l @ Min. Water Depth	
Hydraulic Retention Time:	= 1.905 Days @ Avg. Water Depth	
Solids Retention Time:	= 8.4 Days	
Est. Net Sludge Yield:	= 0.581 lbs. WAS/lb. COD	
Est. Dry Solids Produced:	= 1443.7 lbs. WAS/Day	= (654.9 kg/Day)
Est. Solids Flow Rate:	= 300 GPM (17311 GAL/Day)	= (65.5 m³/Day)
Decant Flow Rate @ MDF:	= 992.0 GPM (as avg. from high to low water level)	= (62.6 l/sec)
LWL to CenterLine Discharge:	= 2.0 ft	= (0.6 m)
Lbs. O2/lb. COD	= 1.00	
Lbs. O2/lb. NH3-N	= 4.60	
Actual Oxygen Required:	= 2940 lbs./Day	= (1333.4 kg/Day)
Air Flowrate/Basin:	= 472 SCFM	= (13.4 Sm3/min)
Max. Discharge Pressure:	= 10.7 PSIG	= (74 KPA)
Avg. Power Required:	= 885.2 KW-Hrs/Day	

POST-SBR EQUALIZATION DESIGN PARAMETERS

Avg. Daily Flow (ADF):	= 0.238165 MGD	= (900 m^3/day)
Max. Daily Flow (MDF):	= 0.238165 MGD	= (900 m^3/day)
Decant Flow Rate from (Qd):	= 992 gpm	= (3.8 m^3M)
Decant Duration (Td):	= 60 min	
Number Decants/Day:	= 4	
Time Between Start of Decants:	= 360 min	

POST-SBR EQUALIZATION VOLUME DETERMINATION

The volume required for equalization/storage shall be provided between the high and the low water levels of the basin(s). This Storage Volume (Vs) has been determined by the following:

Vs = [(Qd -(MDF x 694.4)] x Td = 49,597 gal = (6,630.5 ft^3) = (187.8 m^3)

The volumes determined in this summary reflect the minimum volumes necessary to achieve the desired results based upon the input provided to Aqua. If other hydraulic conditions exist that are not mentioned in this design summary or associated design notes, additional volume may be warranted.

Based upon liquid level inputs from each SBR reactor prior to decant, the rate of discharge from the Post-SBR Equalization basin shall be pre-determined to establish the proper number of pumps to be operated (or the correct valve position in the case of gravity flow). Level indication in the Post-SBR Equalization basin(s) shall override equipment operation.

POST-SBR EQUALIZATION BASIN DESIGN VALUES

No./Basin Geometry:	= 1 Rectangular Basin(s)				
Length of Basin:	= 38.0 ft	= (11.6 m)			
Width of Basin:	= 15.0 ft	= (4.6 m)			
Min. Water Depth:	= 1.5 ft	= (0.5 m)	**Min. Basin Vol. Basin:**	= 6,395.4 gal	= (24.2 m^3)
Max. Water Depth:	= 13.1 ft	= (4.0 m)	**Max. Basin Vol. Basin:**	= 55,991.9 gal	= (212.0 m^3)

POST-SBR EQUALIZATION EQUIPMENT CRITERIA

Mixing Energy with Diffusers:	= 15 SCFM/1000 ft^3	
SCFM Required to Mix:	= 112 SCFM/basin	= (191 Nm^3/hr/basin)
Max. Discharge Pressure:	= 6.3 PSIG	= (43.17 KPA)
Max. Flow Rate Required Basin:	= 165 gpm	= (0.626 m^3/min)
Avg. Power Required:	= 62.8 kW-hr/day	

AquaDISK Tertiary Filtration - Design Summary

DESIGN INFLUENT CONDITIONS

Pre-Filter Treatment: SBR

Avg. Design Flow	= 0.238165 MGD	= 165.4 gpm	= 900 m³/day
Max Design Flow	= 0.238165 MGD	= 165.4 gpm	= 900 m³/day

AquaDISK FILTER RECOMMENDATION

Qty Of Filter Units Recommended	= 1
Number Of Disks Per Unit	= 4
Total Number Of Disks Recommended	= 4
Total Filter Area Provided	= 43.2 ft² = (4.01 m²)
Filter Model Recommended	= AquaDisk Package: Model ADFSP-11-4E-PC
Filter Media Cloth Type	= OptiFiber PA2-13

AquaDISK FILTER CALCULATIONS

Filter Type:

Vertically Mounted Cloth Media Disks featuring automatically operated vacuum backwash . Tank shall include a rounded bottom and solids removal system.

Average Flow Conditions:

Average Hydraulic Loading = Avg. Design Flow (gpm) / Recommended Filter Area (ft²)
= 165.4 / 43.2 ft²
= 3.83 gpm/ft² (2.60 l/s/m²) at Avg. Flow

Maximum Flow Conditions:

Maximum Hydraulic Loading = Max. Design Flow (gpm) / Recommended Filter Area (ft²)
= 165.4 / 43.2 ft²
= 3.83 gpm/ft² (2.60 l/s/m²) at Max. Flow

AquaSBR

Influent Valves

2 Influent Valve(s) will be provided as follows:

- 4 inch electrically operated plug valve(s).

Mixers

2 AquaDDM Direct Drive Mixer(s) will be provided as follows:

- 7.5 HP Aqua-Aerobic Systems Endura Series Model FSS DDM Mixer(s).

Mixer Mooring

2 Mixer pivotal mooring assembly(ies) consisting of:

- 304 stainless steel pivotal mooring arm(s).
- #12 AWG-four conductor electrical service cable(s).
- Electrical cable strain relief grip(s), 2 eye, wire mesh.

2 Mixer De-Watering Support(s) will be provided as follows:

- Galvanized steel dewatering support post(s).
- Galvanized steel support angle(s).
- 304 stainless steel anchors.

Decanters

2 Decanter assembly(ies) consisting of:

- 6x4 Aqua-Aerobics decanter(s) with fiberglass float, 304 stainless steel weir, galvanized restrained mooring frame, and painted steel power section with #14-10 conductor power cable wired into a NEMA 4X stainless steel junction box with terminal strips for the single phase, 60 hertz actuator and limit switches.
- 8 inch diameter decant hose assembly.
- 4" schedule 40 galvanized steel mooring post.
- 8 inch electrically operated butterfly valve(s) with actuator.

Transfer Pumps/Valves

2 Submersible Pump Assembly(ies) consisting of the following items:

- 3 HP Submersible Pump(s) with painted cast iron pump housing, discharge elbow, and multi-conductor electrical cable.
- Manual plug valve(s).
- 3 inch Nibco check valve(s).
- Galvanized steel slide rail assembly(ies).
- 304 stainless steel intermediate support(s).

Retrievable Fine Bubble Diffusers

4 Retrievable Fine Bubble Diffuser Assembly(ies) consisting of:

- 20 diffuser tubes consisting of two flexible EPDM porous membrane sheaths mounted on a rigid support pipe with 304 stainless steel band clamps.
- 304 stainless steel manifold weldment.
- 304 stainless steel leveling angles.
- 304 stainless steel leveling studs.
- Galvanized vertical support beam.
- Galvanized vertical air column assembly.
- Galvanized upper vertical beam and pulley assembly.
- Galvanized top support bracket.
- 3" EPDM flexible air line with ny-glass quick disconnect end fittings.
- Galvanized threaded flange.

- 3" manual isolation butterfly valve with cast iron body, EPDM seat, aluminum bronze disk and one-piece steel shaft.
- Ny-glass quick disconnect cam lock adapter.
- 304 stainless steel adhesive anchors.
- Brace angles.

1 Diffuser Electric Winch(es) will be provided as follows:

- Portable electric winch.

Positive Displacement Blowers

3 Positive Displacement Blower Package(s), with each package consisting of:

- Sutorbilt 6M Positive Displacement Blower Package with common base, V-belt drive, enclosed drive guard, pressure gauge, pressure relief valve, and vibration pads.
- 304 stainless steel anchors.
- 40 HP motor with slide base.
- Inlet filter and inlet silencer.
- Discharge silencer, check valve, manual butterfly isolation valve, and flexible discharge connector.

Level Sensor Assemblies

2 Pressure Transducer Assembly(ies) each consisting of:

- Submersible pressure transducer(s).
- Mounting bracket weldment(s).
- Transducer mounting weldment(s).
- 304 stainless steel anchors.

2 Level Sensor Assembly(ies) will be provided as follows:

- Float switch(es).
- Float switch mounting bracket(s).
- 304 stainless steel anchors.

Instrumentation

2 Dissolved Oxygen Assembly(ies) consisting of:

- Hach LDO dissolved oxygen probe with replaceable sensor cap and electric cable. Probe includes stainless steel stationary bracket and retrievable pole probe mounting assembly. One (1) probe per basin.
- Hach SC200 controller and display module(s).

AquaSBR: Post-Equalization

Transfer Pumps/Valves

2 Submersible Pump Assembly(ies) consisting of the following items:

- 3 HP Submersible Pump(s) with painted cast iron pump housing, discharge elbow, and multi-conductor electrical cable.
- Manual plug valve(s).
- 3 inch Nibco check valve(s).
- Galvanized steel slide rail assembly(ies).

Fixed Coarse Bubble Diffusers

1 Aqua-Aerobic's Fixed Coarse Bubble Diffuser System(s) consisting of the following components:

- PVC diffuser(s).
- Schedule 40 galvanized steel riser pipe(s).
- Schedule 40 PVC manifold piping.
- 304 stainless steel anchors.

Positive Displacement Blowers

1 Positive Displacement Blower Package(s), with each package consisting of:

- Sutorbilt 3M Positive Displacement Blower Package with common base, V-belt drive, enclosed drive guard, pressure gauge, pressure relief valve, and vibration pads.

- 304 stainless steel anchors.
- 7.5 HP motor with slide base.
- Inlet filter and inlet silencer.
- Discharge silencer, check valve, manual butterfly isolation valve, and flexible discharge connector.

Level Sensor Assemblies

1 Pressure Transducer Assembly(ies) each consisting of:

- Submersible pressure transducer(s).
- Mounting bracket weldment(s).
- Transducer mounting weldment(s).
- 304 stainless steel anchors.

1 Level Sensor Assembly(ies) will be provided as follows:

- Float switch(es).
- Float switch mounting bracket(s).
- 304 stainless steel anchors.

Controls

Controls wo/Starters

1 Controls Package(s) will be provided as follows:

- NEMA 12 panel enclosure suitable for indoor installation and constructed of painted steel.
- Fuse(s) and fuse block(s).
- Allen Bradley SLC5/05 central processing unit with 32K memory and Ethernet connection.
- Operator interface(s).
- Remote Access Ethernet Modem.

Cloth Media Filters

AquaDisk Tanks/Basins

1 AquaDisk Model # ADFSP-11x4E-PC Package Filter Painted Steel Tank(s) consisting of:

- 4 disk tank(s) will be painted steel, estimated dry weight is 3,825 lbs., and estimated operating weight is 9,500 lbs. Each tank will include an integral solids waste collection manifold.
The tank finish will be:
Interior: near white sandblast (SSPC-SP10), painted with Tnemec N69 polyamide epoxy (color "safety blue") 2 coats 4-6 mils each for 8-12 mils DFT.
Exterior: commercial sandblast (SSPC-SP6), painted with Tnemec N69 polyamide epoxy (color "safety blue") 2 coats 3-4 mils each, 1 coat Tnemec 175 endurashield 2-3 mils for 8-11 mils DFT.
- 2" ball valve(s).

AquaDisk Centertube Assemblies

1 Centertube(s) consisting of:

- 304 stainless steel centertube weldment(s).
- Centertube driven sprocket(s).
- Dual wheel assembly(ies).
- Rider wheel bracket assembly(ies).
- Centertube bearing kit(s).
- Effluent centertube lip seal.
- Pile cloth media and non-corrosive support frame assemblies.
- 304 Stainless steel frame top plate(s),
- Media sealing gaskets.
- Disk segment 304 stainless steel support rods.

AquaDisk Drive Assemblies

1 Drive System(s) consisting of:

- Gearbox with motor.
- Drive sprocket(s).

- Drive chain(s) with pins.
- Stationary drive bracket weldment(s).
- Adjustable drive bracket weldment(s).
- Chain guard weldment(s).
- Warning label(s).

AquaDisk Backwash/Sludge Assemblies

1 Backwash System(s) consisting of:

- Backwash shoe assemblies.
- Backwash shoe support weldment(s).
- 1 1/2" flexible hose.
- Stainless steel backwash shoe springs.
- Hose clamps.

1 Backwash/Solids Waste Pump(s) consisting of:

- Backwash/waste pump(s).
- 0 to 15 psi pressure gauge(s).
- 0 to 30 inches mercury vacuum gauge(s).
- Throttling gate valve(s).
- 2" bronze 3 way ball valve(s).

AquaDisk Instrumentation

1 Pressure Transmitter(s) consisting of:

- Level transmitter(s).

1 Vacuum Transmitter(s) consisting of:

- Vacuum transmitter(s).

1 Float Switch(es) consisting of:

- Float switch(es).
- Float switch support bracket(s).

AquaDisk Valves

1 Solids Waste Valve(s) consisting of:

- 2" full port, three piece, stainless steel body ball valve(s), grooved end connections with single phase electric actuator(s). Valve / actuator combination shall be TCI / RCI (RCI, a division of Rotork), Nibco, or equal.
- 2" flexible hose.
- Victaulic coupler(s).

1 Set(s) of Backwash Valves consisting of:

- 2" full port, three piece, stainless steel body ball valve(s), grooved end connections with single phase electric actuator(s). Valve / actuator combination shall be TCI / RCI (RCI, a division of Rotork), Nibco, or equal.
- 2" flexible hose.
- Victaulic coupler(s).

AquaDisk Controls w/Starters

1 Control Panel(s) consisting of:

- NEMA 4X fiberglass enclosure(s).
- Circuit breaker with handle.
- Transformer(s).
- Fuses and fuse blocks.
- Line filter(s).
- GFI convenience outlet(s).
- Control relay(s).
- Selector switch(es).
- Indicating pilot light(s).
- MicroLogix 1400 PLC(s).
- Ethernet switch(es).

- Operator interface(s).
- Power supply(ies).
- Motor starter(s).
- Terminal blocks.
- UL label(s).

1 Conduit Installation(s) consisting of:

- PVC conduit and fittings.

Appendix I
Leachate Treatment Cost Estimates

07/31/2014 8:09
2014-071 PALMER LF LEACHATE EVAP-ENCON-ROM
***

BID TOTALS

Biditem	Description	Status - Rnd	Quantity	Units	Unit Price	Bid Total
10	MOBILIZATION		1.000	LS	200,000.00	200,000.00
20	BONDS & INSURANCE		1.000	LS	75,577.00	75,577.00
30	SUBMITTALS		1.000	LS	23,996.65	23,996.65
40	PERMITS		1.000	LS	47,500.00	47,500.00
50	SURVEY		1.000	LS	6,600.00	6,600.00
80	FENCING		1.000	LS	153,800.00	153,800.00
90	BUILDING FOUNDATION		1.000	LS	45,000.00	45,000.00
100	BUILDING STRUCTURE		1.000	LS	232,500.00	232,500.00
110	UTILITIES-OUTSIDE BUILDING		1.000	LS	30,000.00	30,000.00
120	UTILITIES - INSIDE BUILDING		1.000	LS	60,000.00	60,000.00
130	PURCHASE PLANT EQUIPMENT		1.000	LS	778,225.00	778,225.00
140	INSTALL PLANT EQUIPMENT		1.000	LS	155,645.00	155,645.00
150	INSIDE PIPING		1.000	LS	77,800.00	77,800.00
160	ELECTRICAL & NEW SUB STATION		1.000	LS	125,000.00	125,000.00
165	NATURAL GAS LINE		2,500.000	LF	30.00	75,000.00
170	INSTRUMENTS & CONTRLS		1.000	LS	10,000.00	10,000.00
180	LEACHATE EQUALIZATION LAGOON		750,000.000	GL	0.11	82,500.00
600	DEMOBILIZATION		1.000	LS	180,000.00	180,000.00
910	CONTRACTOR OVERHEAD(GENERAL CONDITIONS)		1.000	LS	105,374.00	105,374.00
920	CH OVERHEAD (GENERAL CONDITIONS)		1.000	LS	90,321.00	90,321.00
930	MANAGEMENT RESERVE (CONTINGENCY)		1.000	LS	225,802.00	225,802.00
970	TAXES		1.000	LS	88,052.00	88,052.00
980	MARK UP (PROFIT)		1.000	LS	228,350.00	228,350.00
			Bid Total	========>		$3,097,042.65

Activity / Resource	Desc	Quantity Pcs	Quantity Unit		Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 10 Land Item SCHEDULE: 1 100
Description = MOBILIZATION Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

19001005 MOBILIZATION Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4MOB	MOBILIZATION	1.00	1.00	LS	200,000.000					200,000	200,000

BID ITEM = 20 Land Item SCHEDULE: 1 100
Description = BONDS & INSURANCE Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11002005 BONDS Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

BONDS 1.7% X $3,023,109 = $

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3BOND	BOND COST	1.00	1.00	LS	51,393.000			51,393			51,393

11002010 INSURANCE Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

INSURANCE 0.8% X $3,023,109 = $24,184

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3INSURANC	INSURANCE COST	1.00	1.00	LS	24,184.000			24,184			24,184

=====> Item Totals: 20 - BONDS & INSURANCE

$75,577.00					[ ]			75,577			75,577
75,577.000		1 LS						75,577.00			75,577.00

BID ITEM = 30 Land Item SCHEDULE: 1 100
Description = SUBMITTALS Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11003005 WORK PLAN Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

**Unreviewed

11030 SUBMITTALS 16.00 CH Prod: 0.0625 UH Lab Pcs: 3.10 Eqp Pcs: 0.00

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3DOCMTRL	DOCUMENT MATE	1.00	1.00	LS	200.000			200			200
X414	Project Eng E6	1.00	16.00	MH	72.700	1,605					1,605
X430	Project Controls E 4	0.20	3.20	MH	52.900	234					234
X434	Cost/Schedule E3	0.20	3.20	MH	43.800	193					193
X442	Document Tech T2	0.10	1.60	MH	24.900	55					55
X450	Field Engineer T4	0.20	3.20	MH	39.800	176					176
X462	Quality Mngr E4	0.20	3.20	MH	52.900	234					234
X866	Admin Assist. T1	1.00	16.00	MH	22.900	506					506
X918	Safety Engineer E3	0.20	3.20	MH	43.900	194					194
$3,396.09	49.6000 MH/LS		49.60	MH	[2316]	3,196		200			3,396
0.0625 Units/Hr *	0.6250 Un/Shift		0.0202	Unit/M		3,196.09		200.00			3,396.09

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 30 Land Item SCHEDULE: 1 100
Description = SUBMITTALS Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11003010 PROJECT SCHEDULE Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

**Unreviewed

11030 SUBMITTALS 24.00 CH Prod: 0.0417 UH Lab Pcs: 1.85 Eqp Pcs: 0.00

Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3DOCMTRL	DOCUMENT MATE	1.00	1.00	LS	350.000			350			350
X414	Project Eng E6	0.15	3.60	MH	72.700	361					361
X430	Project Controls E 4	0.10	2.40	MH	52.900	175					175
X434	Cost/Schedule E3	1.00	24.00	MH	43.800	1,451					1,451
X442	Document Tech T2	0.10	2.40	MH	24.900	82					82
X866	Admin Assist. T1	0.50	12.00	MH	22.900	379					379
$2,798.72	44.4000 MH/LS		44.40	MH	[1774.44]	2,449		350			2,799
0.0417 Units/Hr *	0.4167 Un/Shift		0.0225	Unit/M		2,448.72		350.00			2,798.72

11003015 SWPPP Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

**Unreviewed

FOR ALL SUBMITTALS ASSUME A DRAFT A DRAFT FINAL AND A FINAL FOR MOST SUBMITTALS

11020 PLAN/DOC CREW 1.00 CH Prod: 1.0000 UH Lab Pcs: 68.00 Eqp Pcs: 0.00

Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3DOCMTRL	DOCUMENT MATE	1.00	1.00	LS	750.000			750			750
AAA	*********LABOR**		0.00	MH	0.000						
X274	Adminst Asst. T2	18.00	18.00	MH	24.900	619					619
X414	Project Eng E6	32.00	32.00	MH	72.700	3,210					3,210
X426	Jr Staff Eng E3	18.00	18.00	MH	43.800	1,088					1,088
$5,666.94	68.0000 MH/LS		68.00	MH	[3563]	4,917		750			5,667
1.0000 Units/Hr *	10.0000 Un/Shift		0.0147	Unit/M		4,916.94		750.00			5,666.94

11003020 HASP Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

**Unreviewed

11020 PLAN/DOC CREW 1.00 CH Prod: 1.0000 UH Lab Pcs: 58.00 Eqp Pcs: 0.00

Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3DOCMTRL	DOCUMENT MATE	1.00	1.00	LS	950.000			950			950
AAA	*********LABOR**		0.00	MH	0.000						
X274	Adminst Asst. T2	20.00	20.00	MH	24.900	687					687
X414	Project Eng E6	10.00	10.00	MH	72.700	1,003					1,003
X426	Jr Staff Eng E3	8.00	8.00	MH	43.800	484					484
X918	Safety Engineer E3	20.00	20.00	MH	43.900	1,212					1,212
$4,335.69	58.0000 MH/LS		58.00	MH	[2453.4]	3,386		950			4,336
1.0000 Units/Hr *	10.0000 Un/Shift		0.0172	Unit/M		3,385.69		950.00			4,335.69

11003025 QA/QC PLAN Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

**Unreviewed

11020 PLAN/DOC CREW 1.00 CH Prod: 1.0000 UH Lab Pcs: 56.00 Eqp Pcs: 0.00

Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3DOCMTRL	DOCUMENT MATE	1.00	1.00	LS	700.000			700			700
AAA	*********LABOR**		0.00	MH	0.000						
X274	Adminst Asst. T2	20.00	20.00	MH	24.900	687					687
X414	Project Eng E6	12.00	12.00	MH	72.700	1,204					1,204
X462	Quality Mngr E4	24.00	24.00	MH	52.900	1,752					1,752
$4,343.20	56.0000 MH/LS		56.00	MH	[2640]	3,643		700			4,343

Activity Resource	Desc	Pcs	Quantity Unit		Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 30 Land Item SCHEDULE: 1 100
Description = SUBMITTALS Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

1.0000 Units/Hr * 10.0000 Un/Shift 0.0179 Unit/M 3,643.20 700.00 4,343.20

11003030 TRAFFIC PLAN Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

**Unreviewed

11020	PLAN/DOC CREW		1.00	CH	Prod: 1.0000 UH		Lab Pcs: 52.00		Eqp Pcs: 0.00
3DOCMTRL	DOCUMENT MATE	1.00	1.00	LS	250.000		250		250
AAA	*********LABOR**		0.00	MH	0.000				
X274	Adminst Asst. T2	16.00	16.00	MH	24.900	550			550
X414	Project Eng E6	12.00	12.00	MH	72.700	1,204			1,204
X426	Jr Staff Eng E3	12.00	12.00	MH	43.800	725			725
X918	Safety Engineer E3	12.00	12.00	MH	43.900	727			727
$3,456.01	52.0000 MH/LS		52.00	MH	[2323.2]	3,206	250		3,456
1.0000 Units/Hr *	10.0000 Un/Shift		0.0192	Unit/M		3,206.01	250.00		3,456.01

=====> Item Totals: 30 - SUBMITTALS

$23,996.65	328.0000 MH/LS	328.00	MH	[15070.04]	20,797	3,200	23,997
23,996.650	1 LS				20,796.65	3,200.00	23,996.65

BID ITEM = 40 Land Item SCHEDULE: 1 100
Description = PERMITS Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11004005 404 PERMIT Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

**Unreviewed

3404PERM	404 PERMIT	1.00	1.00	LS	40,000.000	40,000	40,000

11004010 DUST PERMIT Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

**Unreviewed

3DUSTPRM	DUST PERMIT	1.00	1.00	LS	7,500.000	7,500	7,500

=====> Item Totals: 40 - PERMITS

$47,500.00		[ ]	47,500	47,500
47,500.000	1 LS		47,500.00	47,500.00

BID ITEM = 50 Land Item SCHEDULE: 1 100
Description = SURVEY Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11005005 SURVEY Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

THIS WOULD INCLUDE LAYOUT OF BUILDING , EQUALIZATION POND , ACCESS ROAD AND UTILITIES . ALSO EARTHWORK QUANTITIES AND FINAL AS BUILT DRAWAINGS

4SURVEY	SURVEY SUB	1.00	60.00	HR	110.000	6,600	6,600

Activity / Resource	Desc	Quantity Pcs	Unit		Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 80 Land Item SCHEDULE: 1 100
Description = FENCING Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

19008005	CL FENCE		Quan: 5,200.00 LF	Hrs/Shft: 10.00	Cal 10	WC NONE	
4FENCE	Fencing - Sub	1.00	5,200.00 LF	29.000		150,800	150,800
19008010	GATES - MAN		Quan: 4.00 EA	Hrs/Shft: 10.00	Cal 10	WC NONE	
4FENCE	Fencing - Sub	1.00	4.00 EA	300.000		1,200	1,200
19008015	GATES VEHICLE		Quan: 2.00 EA	Hrs/Shft: 10.00	Cal 10	WC NONE	
4FENCE	Fencing - Sub	1.00	2.00 EA	900.000		1,800	1,800

=====> Item Totals: 80 - FENCING
$153,800.00 [ ] 153,800 153,800
153,800.000 1 LS 153,800.00 153,800.00

BID ITEM = 90 Land Item SCHEDULE: 1 100
Description = BUILDING FOUNDATION Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

51009005	BUILDING FOUNDATION & SLAB		Quan: 1,500.00 SF	Hrs/Shft: 10.00	Cal 10	WC NONE	
4CONC	Concrete - Sub	1.00	1,500.00 SF	30.000		45,000	45,000

BID ITEM = 100 Land Item SCHEDULE: 1 100
Description = BUILDING STRUCTURE Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

60010005	BUILDING STRUCTURE		Quan: 1,500.00 SF	Hrs/Shft: 10.00	Cal 10	WC NONE	
4BLDG	Building - Sub	1.00	1,500.00 SF	155.000		232,500	232,500

BID ITEM = 110 Land Item SCHEDULE: 1 100
Description = UTILITIES-OUTSIDE BUILDING Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

60011005	UTILITIES-OUTSIDE BUILDING		Quan: 1.00 LS	Hrs/Shft: 10.00	Cal 10	WC NONE	
4UTIL	UTILLITY SUB	1.00	1.00 LS	30,000.000		30,000	30,000

Activity / Resource	Desc	Quantity Pcs	Quantity Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 120 Land Item SCHEDULE: 1 100
Description = UTILITIES - INSIDE BUILDING Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

60012005 UTILITIES - INSIDE BUILDING Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

4UTIL	UTILLITY SUB	1.00	1.00 LS	60,000.000					60,000	60,000

BID ITEM = 130 Land Item SCHEDULE: 1 100
Description = PURCHASE PLANT EQUIPMENT Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

30013005 PURCHASE PLANT EQUIPMENT Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

THIS IS VENDOR QUOTE FOR ENCON EVAPORATORS AND SUPPORT EQUIPMENT

2EVAPEQ	EVAPORATOR EQU	1.00	1.00 LS	778,225.000		778,225				778,225

=====> Item Totals: 130 - PURCHASE PLANT EQUIPMENT

$778,225.00				[ ]		778,225				778,225
778,225.000		1 LS				778,225.00				778,225.00

BID ITEM = 140 Land Item SCHEDULE: 1 100
Description = INSTALL PLANT EQUIPMENT Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

30014005 INSTALL EQUIPMENT Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

ASSUMES COST OF INSTALLATION 20% OF EQUIPMENT COST

4MECH	INSTALLATION SU	1.00	1.00 LS	155,645.000					155,645	155,645

BID ITEM = 150 Land Item SCHEDULE: 1 100
Description = INSIDE PIPING Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

30015005 INSIDE PIPING Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

ASSUME COST OF 1% OF EQUIPMENT COST

4MECH	INSTALLATION SU	1.00	1.00 LS	77,800.000					77,800	77,800

BID ITEM = 160 Land Item SCHEDULE: 1 100
Description = ELECTRICAL & NEW SUB STATION Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

Activity / Resource	Desc	Quantity Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 160 Land Item SCHEDULE: 1 100
Description = ELECTRICAL & NEW SUB STATION Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

30016005 SUB STATION Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

Activity / Resource	Desc	Quantity Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4ELECT	ELECTRICAL SUB	1.00	1.00	LS	50,000.000					50,000	50,000

30016010 OH POWER LINE Quan: 2,500.00 LF Hrs/Shft: 10.00 Cal 10 WC NONE

Activity / Resource	Desc	Quantity Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4ELEC	Electric - Sub	1.00	2,500.00	LF	30.000					75,000	75,000

=====> Item Totals: 160 - ELECTRICAL & NEW SUB STATION

$125,000.00					[ ]					125,000	125,000
125,000.000		1 LS								125,000.00	125,000.00

BID ITEM = 165 Land Item SCHEDULE: 1 100
Description = NATURAL GAS LINE Unit = LF Takeoff Quan: 2,500.000 Engr Quan: 2,500.000

30016505 NATURAL GAS LINE Quan: 2,500.00 LF Hrs/Shft: 10.00 Cal 10 WC NONE

Activity / Resource	Desc	Quantity Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4GAS	NATURAL GAS LIN	1.00	2,500.00	LF	30.000					75,000	75,000

BID ITEM = 170 Land Item SCHEDULE: 1 100
Description = INSTRUMENTS & CONTRLS Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

30017005 INSTRUMENTS & CONTRLS Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

Activity / Resource	Desc	Quantity Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4ELEC	Electric - Sub	1.00	1.00	LS	10,000.000					10,000	10,000

BID ITEM = 180 Land Item SCHEDULE: 1 100
Description = LEACHATE EQUALIZATION LAGOON Unit = GL Takeoff Quan: 750,000.000 Engr Quan: 750,000.000

19018005 EXCAVATE LAGOON Quan: 4,830.00 CY Hrs/Shft: 10.00 Cal 10 WC NONE

19015 SMALL EXCAV CREW 60.00 CH Prod: 80.5000 UH Lab Pcs: 6.00 Eqp Pcs: 4.00

Activity / Resource	Desc	Quantity Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3GRDST&S	GRADING ST&S	1.00	360.00	HM	2.000			720			720
3PPE	PPE	1.00	360.00	HM	2.500			900			900
8AAAA	*******EQUIPMEN		0.00	HR	0.000						
8EXC330	Excavator Cat 330D L	1.00	60.00	HR	188.085				11,285		11,285
8TRKHW10	Tandem Truck 12 CY	2.00	120.00	HR	73.856				8,863		8,863
8TRKPU15	Pickup 4x4 3/4 Ton G	1.00	60.00	HR	15.264				916		916

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 180 Land Item SCHEDULE: 1 100
Description = LEACHATE EQUALIZATION LAGOON Unit = GL Takeoff Quan: 750,000.000 Engr Quan: 750,000.000

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
AAA	*********LABOR**		0.00	MH	0.000						
LA30	Laborer General	1.00	60.00	MH	29.210	3,614					3,614
OP01F	Oper Foreman	1.00	60.00	MH	42.040	4,495					4,495
OPH14	Oper Hydr Backhoe 3	1.00	60.00	MH	39.280	4,280					4,280
OPSPT14	Oper Grade Checker	1.00	60.00	MH	37.790	4,164					4,164
TE22	Tmstr Dmp Trk 6-14c	2.00	120.00	MH	36.790	7,959					7,959
$47,195.84	0.0745 MH/CY		360.00	MH	[3.032]	24,512		1,620	21,064		47,196
80.5000 Units/Hr *	805.0000 Un/Shift		13.4167	Unit/M		5.07		0.34	4.36		9.77

19018010 INSTALL HDPE LINER Quan: 25,480.00 SF Hrs/Shft: 10.00 Cal 10 WC NONE

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4LINER	LINER SUB	1.00	25,480.00	SF	1.450					36,946	36,946

=====> Item Totals: 180 - LEACHATE EQUALIZATION LAGOON

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
$84,141.84	0.0004 MH/GL		360.00	MH	[0.02]	24,512		1,620	21,064	36,946	84,142
0.112	750000 GL					0.03			0.03	0.05	0.11

BID ITEM = 600 Land Item SCHEDULE: 1 100
Description = DEMOBILIZATION Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

19060005 DEMOBILIZATION Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4DEMOB	DEMOBILZATION	1.00	1.00	LS	180,000.000					180,000	180,000

BID ITEM = 910 Land Item SCHEDULE: 1 100
Description = CONTRACTOR OVERHEAD(GENERAL CO Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11091005 CONTRACTOR OVERHEAD(GENERAL Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

7% OF DIRECT COT EXCLUDING EQUIPMENT PURCHASE ,BONDS&INSURANCE,CH OVERSIGHT,MANAGEMENT RESERVE

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4CNTROH	CONTRACTOR OH	1.00	1.00	LS	105,374.000					105,374	105,374

BID ITEM = 920 Land Item SCHEDULE: 1 100
Description = CH OVERHEAD (GENERAL CONDITIONS) Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11092005 CH OVERHEAD (GENERAL CONDITIO Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

Activity / Resource	Desc	Quantity Pcs	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 920 Land Item SCHEDULE: 1 100
Description = CH OVERHEAD (GENERAL CONDITIONS) Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

CH OVERSIGHT 6% OF COSTS EXCLUDING,BONDS&INSURANCE,PERMITS,EQUIPMENT PURCHASE,CONTRACTOR OH,MANAGEMENT RESERVE AND MARK UP

Activity / Resource	Desc	Quantity Pcs	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4CH	CH OVERHEAD & P	1.00	1.00 LS	90,321.000					90,321	90,321

BID ITEM = 930 Land Item SCHEDULE: 1 100
Description = MANAGEMENT RESERVE (CONTINGENC Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11093005 MANAGEMENT RESERVE (CONTINGE Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

Activity / Resource	Desc	Quantity Pcs	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3MR15	MANAGEMNT RES	1.00	1.00 LS	225,802.000			225,802			225,802

=====> Item Totals: 930 - MANAGEMENT RESERVE (CONTINGENCY)

$225,802.00		[ ]			225,802		225,802
225,802.000	1 LS				225,802.00		225,802.00

BID ITEM = 970 Land Item SCHEDULE: 1 100
Description = TAXES Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11097005 TAXES (3% DIRECT COSTS) Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

Activity / Resource	Desc	Quantity Pcs	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3TAXES	TAXES PALMER A	1.00	1.00 LS	88,052.000			88,052			88,052

=====> Item Totals: 970 - TAXES

$88,052.00		[ ]			88,052		88,052
88,052.000	1 LS				88,052.00		88,052.00

BID ITEM = 980 Land Item SCHEDULE: 1 100
Description = MARK UP (PROFIT) Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11098005 MARK UP (PROFIT) Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

CONTRACTOR MARK UP OF 10% OF CONTRACTOR COSTS

Activity / Resource	Desc	Quantity Pcs	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3PROFIT	CONTRACTOR PRO	1.00	1.00 LS	228,350.000			228,350			228,350

=====> Item Totals: 980 - MARK UP (PROFIT)

$228,350.00		[ ]			228,350		228,350
228,350.000	1 LS				228,350.00		228,350.00

Activity Resource	Desc	Quantity Pcs	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 980 Land Item SCHEDULE: 1 100
Description = MARK UP (PROFIT) Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

$3,098,684.49	*** Report Totals ***	688.00	MH		45,309	778,225	670,101	21,064	1,583,986	3,098,684

>>> indicates Non Additive Activity
------Report Notes:------
The estimate was prepared with TAKEOFF Quantities.
This report shows TAKEOFF Quantities with the resources.

"Unreviewed" Activities are marked.

Bid Date: Owner: Engineering Firm:
Estimator-In-Charge:

JOB NOTES
Estimate created on: 07/23/2014 by User#: 0 -
Source estimate used: C:\HEAVYBID\EST\ESTMAST
Labor Setup copied from: C:\HEAVYBID\EST\2014-710
Equipment Setup copied from: C:\HEAVYBID\EST\2014-710
Crew Setup copied from: C:\HEAVYBID\EST\2014-710
Material/Other Resources Setup copied from: C:\HEAVYBID\EST\2013-107
Overtime Rules Setup copied from: C:\HEAVYBID\EST\2014-710
Burden Tables Setup copied from: C:\HEAVYBID\EST\2014-710

************Estimate created on: 07/30/2014 by User#: 0 -
Source estimate used: C:\HEAVYBID\EST\2014-070

* on units of MH indicate average labor unit cost was used rather than base rate.
[ ] in the Unit Cost Column = Labor Unit Cost Without Labor Burdens
In equipment resources, rent % and EOE % not = 100% are represented as XXX%YYY where XXX=Rent% and YYY=EOE%
------Calendar Codes------

10	10 HOUR SHIFT (Default Calendar)
8	8 HOUR SHIFT
9	9 HOUR SHIFT

07/31/2014 16:06
2014-072 PALMER LF OPTION#2 SEPTAGE LEACHATE-ROM
***

BID TOTALS

Biditem	Description	Status - Rnd	Quantity	Units	Unit Price	Bid Total
10	MOBILIZATION		1.000	LS	800,000.00	800,000.00
20	BONDS & INSURANCE		1.000	LS	2.00	2.00
25	ENGINEERING DESIGN		1.000	LS	157,262.80	157,262.80
30	SUBMITTALS		1.000	LS	23,996.65	23,996.65
40	PERMITS		1.000	LS	67,500.00	67,500.00
50	SURVEY		1.000	LS	9,900.00	9,900.00
80	FENCING		1.000	LS	153,800.00	153,800.00
85	LEACHATE EQUALIZATION LAGOON		1.000	LS	84,141.84	84,141.84
87	PUMP STA LAGOON TO PLANT		1.000	LS	35,000.00	35,000.00
90	SBR BUILDING FOUNDATION		1.000	LS	960,000.00	960,000.00
100	SBR BUILDING		1.000	LS	5,250,000.00	5,250,000.00
110	UTILITIES-OUTSIDE BUILDING		1.000	LS	60,000.00	60,000.00
120	UTILITIES - INSIDE BUILDING		1.000	LS	100,000.00	100,000.00
130	PURCHASE SBR PLANT EQUIPMENT		1.000	LS	825,000.00	825,000.00
135	INSTALL SBR EQUIPMENT		1.000	LS	165,000.00	165,000.00
137	PRETREATMENT BUILDING		1.000	LS	273,400.00	273,400.00
138	PURCHASE PRETREATMENT EQUIPMENT		1.000	LS	3,505,500.00	3,505,500.00
140	INSTALL PRETREATMENT PLANT EQUIPMENT		1.000	LS	701,100.00	701,100.00
142	CENTRIFUGES		2.000	EA	162,000.00	324,000.00
150	INSIDE PIPING		1.000	LS	155,000.00	155,000.00
160	ELECTRICAL & NEW SUB STATION		1.000	LS	237,500.00	237,500.00
165	NATURAL GAS LINE		2,500.000	LF	30.00	75,000.00
170	INSTRUMENTS & CONTRLS		1.000	LS	50,000.00	50,000.00
180	LEACHATE EQUALIZATION LAGOON		750,000.000	GL	0.11	82,500.00
190	LEACH FIELD		10,000.000	SF	6.08	60,800.00
195	2" GW MONITOR WELL		4.000	EA	2,500.00	10,000.00
600	DEMOBILIZATION		1.000	LS	700,000.00	700,000.00
910	CONTRACTOR OVERHEAD(GENERAL CONDITIONS)		1.000	LS	622,428.00	622,428.00
920	CH OVERHEAD (GENERAL CONDITIONS)		1.000	LS	518,690.00	518,690.00
930	MANAGEMENT RESERVE (CONTINGENCY)		1.000	LS	1,556,070.00	1,556,070.00
970	TAXES		1.000	LS	526,958.00	526,958.00
980	MARK UP (PROFIT)		1.000	LS	1,037,380.00	1,037,380.00
			Bid Total	========>		$19,127,929.29

Activity / Resource	Desc	Quantity Pcs	Quantity Unit		Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 10 Land Item SCHEDULE: 1 100
Description = MOBILIZATION Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

19001005 MOBILIZATION Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WCNONE

Activity / Resource	Desc	Pcs	Unit Qty	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4MOB	MOBILIZATION	1.00	1.00	LS	800,000.000					800,000	800,000

BID ITEM = 20 Land Item SCHEDULE: 1 100
Description = BONDS & INSURANCE Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11002005 BONDS Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WCNONE

BONDS 1.7% X $17,562,652 = $298,565

Activity / Resource	Desc	Pcs	Unit Qty	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3BOND	BOND COST	1.00	1.00	LS	1.000			1			1

11002010 INSURANCE Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WCNONE

INSURANCE 0.8% X $17,562,652 = $140,501

Activity / Resource	Desc	Pcs	Unit Qty	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3INSURANC	INSURANCE COST	1.00	1.00	LS	1.000			1			1

=====> Item Totals: 20 - BONDS & INSURANCE

$2.00					[ ]			2			2
2.000		1 LS						2.00			2.00

BID ITEM = 25 Land Item SCHEDULE: 1 100
Description = ENGINEERING DESIGN Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11002505 CH ENGINEERING DESIGN Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WCNONE

Activity / Resource	Desc	Pcs	Unit Qty	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3DOCCOSTS	DOCUMENT COST	1.00	1.00	LS	4,000.000			4,000			4,000
X414	==> Project Eng	1.00	800.00	MH	72.700	80,261					80,261
X418	==> Engineering Mgr	1.00	400.00	MH	52.900	29,201					29,201
X422	==> Staff Enginer	1.00	600.00	MH	52.900	43,801					43,801
$157,262.80	1,800.0000 MH/LS		1,800.00	MH	[111060]	153,263		4,000			157,263
			0.0006	Unit/M		153,262.80		4,000.00			157,262.80

=====> Item Totals: 25 - ENGINEERING DESIGN

$157,262.80	1,800.0000 MH/LS		1,800.00	MH	[111060]	153,263		4,000			157,263
157,262.800		1 LS				153,262.80		4,000.00			157,262.80

Activity / Resource	Desc		Quantity Pcs	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 30 Land Item SCHEDULE: 1 100
Description = SUBMITTALS Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11003005 WORK PLAN Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

Activity / Resource	Desc		Quantity Pcs	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
11030	SUBMITTALS		16.00	CH	Prod: 0.0625 UH	Lab Pcs: 3.10			Eqp Pcs: 0.00		
3DOCMTRL	DOCUMENT MATE	1.00	1.00	LS	200.000			200			200
X414	Project Eng E6	1.00	16.00	MH	72.700	1,605					1,605
X430	Project Controls E 4	0.20	3.20	MH	52.900	234					234
X434	Cost/Schedule E3	0.20	3.20	MH	43.800	193					193
X442	Document Tech T2	0.10	1.60	MH	24.900	55					55
X450	Field Engineer T4	0.20	3.20	MH	39.800	176					176
X462	Quality Mngr E4	0.20	3.20	MH	52.900	234					234
X866	Admin Assist. T1	1.00	16.00	MH	22.900	506					506
X918	Safety Engineer E3	0.20	3.20	MH	43.900	194					194
$3,396.09	49.6000 MH/LS		49.60	MH	[2316]	3,196		200			3,396
0.0625 Units/Hr *	0.6250 Un/Shift		0.0202	Unit/M		3,196.09		200.00			3,396.09

11003010 PROJECT SCHEDULE Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

Activity / Resource	Desc		Quantity Pcs	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
11030	SUBMITTALS		24.00	CH	Prod: 0.0417 UH	Lab Pcs: 1.85			Eqp Pcs: 0.00		
3DOCMTRL	DOCUMENT MATE	1.00	1.00	LS	350.000			350			350
X414	Project Eng E6	0.15	3.60	MH	72.700	361					361
X430	Project Controls E 4	0.10	2.40	MH	52.900	175					175
X434	Cost/Schedule E3	1.00	24.00	MH	43.800	1,451					1,451
X442	Document Tech T2	0.10	2.40	MH	24.900	82					82
X866	Admin Assist. T1	0.50	12.00	MH	22.900	379					379
$2,798.72	44.4000 MH/LS		44.40	MH	[1774.44]	2,449		350			2,799
0.0417 Units/Hr *	0.4167 Un/Shift		0.0225	Unit/M		2,448.72		350.00			2,798.72

11003015 SWPPP Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

FOR ALL SUBMITTALS ASSUME A DRAFT A DRAFT FINAL AND A FINAL FOR MOST SUBMITTALS

Activity / Resource	Desc		Quantity Pcs	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
11020	PLAN/DOC CREW		1.00	CH	Prod: 1.0000 UH	Lab Pcs: 68.00			Eqp Pcs: 0.00		
3DOCMTRL	DOCUMENT MATE	1.00	1.00	LS	750.000			750			750
AAA	*********LABOR**		0.00	MH	0.000						
X274	Adminst Asst. T2	18.00	18.00	MH	24.900	619					619
X414	Project Eng E6	32.00	32.00	MH	72.700	3,210					3,210
X426	Jr Staff Eng E3	18.00	18.00	MH	43.800	1,088					1,088
$5,666.94	68.0000 MH/LS		68.00	MH	[3563]	4,917		750			5,667
1.0000 Units/Hr *	10.0000 Un/Shift		0.0147	Unit/M		4,916.94		750.00			5,666.94

11003020 HASP Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

Activity / Resource	Desc		Quantity Pcs	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
11020	PLAN/DOC CREW		1.00	CH	Prod: 1.0000 UH	Lab Pcs: 58.00			Eqp Pcs: 0.00		
3DOCMTRL	DOCUMENT MATE	1.00	1.00	LS	950.000			950			950
AAA	*********LABOR**		0.00	MH	0.000						
X274	Adminst Asst. T2	20.00	20.00	MH	24.900	687					687

Activity / Resource	Desc		Quantity Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 30 Land Item SCHEDULE: 1 100
Description = SUBMITTALS Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

Activity / Resource	Desc		Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
X414	Project Eng	E6	10.00	10.00	MH	72.700	1,003					1,003
X426	Jr Staff Eng	E3	8.00	8.00	MH	43.800	484					484
X918	Safety Engineer	E3	20.00	20.00	MH	43.900	1,212					1,212
$4,335.69		58.0000 MH/LS		58.00	MH	[2453.4]	3,386		950			4,336
1.0000 Units/Hr *		10.0000 Un/Shift		0.0172	Unit/M		3,385.69		950.00			4,335.69

11003025 QA/QC PLAN Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

Activity / Resource	Desc		Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
11020	PLAN/DOC CREW			1.00	CH	Prod:	1.0000 UH	Lab Pcs: 56.00			Eqp Pcs: 0.00	
3DOCMTRL	DOCUMENT MATE		1.00	1.00	LS	700.000			700			700
AAA	*********LABOR**			0.00	MH	0.000						
X274	Adminst Asst.	T2	20.00	20.00	MH	24.900	687					687
X414	Project Eng	E6	12.00	12.00	MH	72.700	1,204					1,204
X462	Quality Mngr	E4	24.00	24.00	MH	52.900	1,752					1,752
$4,343.20		56.0000 MH/LS		56.00	MH	[2640]	3,643		700			4,343
1.0000 Units/Hr *		10.0000 Un/Shift		0.0179	Unit/M		3,643.20		700.00			4,343.20

11003030 TRAFFIC PLAN Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

Activity / Resource	Desc		Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
11020	PLAN/DOC CREW			1.00	CH	Prod:	1.0000 UH	Lab Pcs: 52.00			Eqp Pcs: 0.00	
3DOCMTRL	DOCUMENT MATE		1.00	1.00	LS	250.000			250			250
AAA	*********LABOR**			0.00	MH	0.000						
X274	Adminst Asst.	T2	16.00	16.00	MH	24.900	550					550
X414	Project Eng	E6	12.00	12.00	MH	72.700	1,204					1,204
X426	Jr Staff Eng	E3	12.00	12.00	MH	43.800	725					725
X918	Safety Engineer	E3	12.00	12.00	MH	43.900	727					727
$3,456.01		52.0000 MH/LS		52.00	MH	[2323.2]	3,206		250			3,456
1.0000 Units/Hr *		10.0000 Un/Shift		0.0192	Unit/M		3,206.01		250.00			3,456.01

=====> Item Totals: 30 - SUBMITTALS

$23,996.65	328.0000 MH/LS			328.00	MH	[15070.04]	20,797		3,200			23,997
23,996.650		1 LS					20,796.65		3,200.00			23,996.65

BID ITEM = 40 Land Item SCHEDULE: 1 100
Description = PERMITS Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11004005 MSB BUILDING PERMIT Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

**Unreviewed

Activity / Resource	Desc		Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3MSBBLDPR	MSB BUILDING PE		1.00	1.00	LS	60,000.000			60,000			60,000

11004010 DUST PERMIT Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

Activity / Resource	Desc		Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3DUSTPRM	DUST PERMIT		1.00	1.00	LS	7,500.000			7,500			7,500

Activity	Desc	Quantity		Unit		Perm	Constr	Equip	Sub-	
Resource		Pcs	Unit	Cost	Labor	Materi	Matl/Ex	Ment	Contrac	Total

BID ITEM = 40 Land Item SCHEDULE: 1 100
Description = PERMITS Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

=====> Item Totals: 40 - PERMITS
$67,500.00 [ ] 67,500 67,500
67,500.000 1 LS 67,500.00 67,500.00

BID ITEM = 50 Land Item SCHEDULE: 1 100
Description = SURVEY Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11005005 SURVEY Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

THIS WOULD INCLUDE LAYOUT OF BUILDING , EQUALIZATION POND , ACCESS ROAD AND
UTILITIES . ALSO EARTHWORK QUANTITIES AND FINAL AS BUILT DRAWAINGS

4SURVEY SURVEY SUB 1.00 90.00 HR 110.000 9,900 9,900

BID ITEM = 80 Land Item SCHEDULE: 1 100
Description = FENCING Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

19008005 CL FENCE Quan: 5,200.00 LF Hrs/Shft: 10.00 Cal 10 WC NONE

4FENCE Fencing - Sub 1.00 5,200.00 LF 29.000 150,800 150,800

19008010 GATES - MAN Quan: 4.00 EA Hrs/Shft: 10.00 Cal 10 WC NONE

4FENCE Fencing - Sub 1.00 4.00 EA 300.000 1,200 1,200

19008015 GATES VEHICLE Quan: 2.00 EA Hrs/Shft: 10.00 Cal 10 WC NONE

4FENCE Fencing - Sub 1.00 2.00 EA 900.000 1,800 1,800

=====> Item Totals: 80 - FENCING
$153,800.00 [ ] 153,800 153,800
153,800.000 1 LS 153,800.00 153,800.00

BID ITEM = 85 Land Item SCHEDULE: 1 100
Description = LEACHATE EQUALIZATION LAGOON Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

19085005 EXCAVATE LAGOON Quan: 4,830.00 CY Hrs/Shft: 10.00 Cal 10 WC NONE

**Unreviewed
19015 SMALL EXCAV CREW 60.00 CH Prod: 80.5000 UH Lab Pcs: 6.00 Eqp Pcs: 4.00
3GRDST&S GRADING ST&S 1.00 360.00 HM 2.000 720 720

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 85 Land Item SCHEDULE: 1 100
Description = LEACHATE EQUALIZATION LAGOON Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3PPE	PPE	1.00	360.00	HM	2.500			900			900
8AAAA	*******EQUIPMEN		0.00	HR	0.000						
8EXC330	Excavator Cat 330D L	1.00	60.00	HR	188.085				11,285		11,285
8TRKHW10	Tandem Truck 12 CY	2.00	120.00	HR	73.856				8,863		8,863
8TRKPU15	Pickup 4x4 3/4 Ton G	1.00	60.00	HR	15.264				916		916
AAA	*********LABOR**		0.00	MH	0.000						
LA30	Laborer General	1.00	60.00	MH	29.210	3,614					3,614
OP01F	Oper Foreman	1.00	60.00	MH	42.040	4,495					4,495
OPH14	Oper Hydr Backhoe 3	1.00	60.00	MH	39.280	4,280					4,280
OPSPT14	Oper Grade Checker	1.00	60.00	MH	37.790	4,164					4,164
TE22	Tmstr Dmp Trk 6-14c	2.00	120.00	MH	36.790	7,959					7,959
$47,195.84	0.0745 MH/CY		360.00	MH	[3.032]	24,512		1,620	21,064		47,196
80.5000 Units/Hr *	805.0000 Un/Shift		13.4167	Unit/M		5.07		0.34	4.36		9.77

19085010 INSTALL HDPE LINER Quan: 25,480.00 SF Hrs/Shft: 10.00 Cal 10 WC NONE

**Unreviewed

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4LINER	LINER SUB	1.00	25,480.00	SF	1.450					36,946	36,946

=====> Item Totals: 85 - LEACHATE EQUALIZATION LAGOON

$84,141.84	360.0000 MH/LS		360.00	MH	[14645.4]	24,512		1,620	21,064	36,946	84,142
84,141.840	1 LS					24,512.18		1,620.00	21,063.66	36,946.00	84,141.84

BID ITEM = 87 Land Item SCHEDULE: 1 100
Description = PUMP STA LAGOON TO PLANT Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

19008705 PUMP STA LAGOON TO PLANT Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

**Unreviewed

THIS INCLUDES PUMP,PAD,INTAKE PIPE POWER TO PUMP AND DISCHARGE LINE TO PLANT

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4MECH	INSTALLATION SU	1.00	1.00	LS	35,000.000					35,000	35,000

BID ITEM = 90 Land Item SCHEDULE: 1 100
Description = SBR BUILDING FOUNDATION Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

51009005 SBR BUILDING FOUNDATION & SLAB Quan: 30,000.00 SF Hrs/Shft: 10.00 Cal 10 WC NONE

BUILDING FOUNDATION WILL BE 200LF X 150LF = 30,000 SF

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4CONC	Concrete - Sub	1.00	30,000.00	SF	32.000					960,000	960,000

Activity / Resource	Desc	Quantity Pcs	Quantity Unit		Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 100 Land Item SCHEDULE: 1 100
Description = SBR BUILDING Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

60010005 SBR BUILDING STRUCTURE Quan: 30,000.00 SF Hrs/Shft: 10.00 Cal 10 WC NONE

4BLDG	Building - Sub	1.00	30,000.00	SF	175.000					5,250,000	5,250,000

BID ITEM = 110 Land Item SCHEDULE: 1 100
Description = UTILITIES-OUTSIDE BUILDING Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

60011005 UTILITIES-OUTSIDE BUILDING Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

4UTIL	UTILLITY SUB	1.00	1.00	LS	60,000.000					60,000	60,000

BID ITEM = 120 Land Item SCHEDULE: 1 100
Description = UTILITIES - INSIDE BUILDING Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

60012005 UTILITIES - INSIDE BUILDING Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

4UTIL	UTILLITY SUB	1.00	1.00	LS	100,000.000					100,000	100,000

BID ITEM = 130 Land Item SCHEDULE: 1 100
Description = PURCHASE SBR PLANT EQUIPMENT Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

30013005 PURCHASE SBR SYSTEM Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

THIS IS VENDOR QUOTE FOR SBR AND SUPPORT EQUIPMENT

2EVOQUASB	EVOQUA SBR SYS	1.00	1.00	LS	825,000.000		825,000				825,000

=====> Item Totals: 130 - PURCHASE SBR PLANT EQUIPMENT

$825,000.00					[ ]		825,000				825,000
825,000.000		1 LS					825,000.00				825,000.00

BID ITEM = 135 Land Item SCHEDULE: 1 100
Description = INSTALL SBR EQUIPMENT Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

13013505 INSTALL SBR EQUIPMENT Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

Activity Resource	Desc	Quantity Pcs	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 135 Land Item SCHEDULE: 1 100
Description = INSTALL SBR EQUIPMENT Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

ASSUME COST OF INSTALLATION AT 20% OF EQUIPMENT COST ($825,000) = $165,000

4MECH	INSTALLATION SU	1.00	1.00 LS	165,000.000					165,000	165,000

BID ITEM = 137 Land Item SCHEDULE: 1 100
Description = PRETREATMENT BUILDING Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

13013705 PRETREATMENT BUILDING CIP Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

4BLDG	Building - Sub	1.00	1.00 LS	273,400.000					273,400	273,400

BID ITEM = 138 Land Item SCHEDULE: 1 100
Description = PURCHASE PRETREATMENT EQUIPMENT Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

13013805 PURCHASE PRETREATMENT EQUIPM Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

2PRTEQP	PRETREATMENT E	1.00	1.00 LS	3,505,500.000		3,505,500				3,505,500

=====> Item Totals: 138 - PURCHASE PRETREATMENT EQUIPMENT

$3,505,500.00				[ ]		3,505,500				3,505,500
3,505,500.000		1 LS				3,505,500.00				3,505,500.00

BID ITEM = 140 Land Item SCHEDULE: 1 100
Description = INSTALL PRETREATMENT PLANT EQUIP Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

30014005 INSTALL EQUIPMENT Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

ASSUMES COST OF INSTALLATION 20% OF EQUIPMENT COST ($3,505500)=$701,100

4MECH	INSTALLATION SU	1.00	1.00 LS	701,100.000					701,100	701,100

BID ITEM = 142 Land Item SCHEDULE: 1 100
Description = CENTRIFUGES Unit = EA Takeoff Quan: 2.000 Engr Quan: 2.000

11014205 FURNISH & INSTALL CENTRIFUGES Quan: 2.00 EA Hrs/Shft: 10.00 Cal 10 WC NONE

2CNTRAFG	CENTRIFUGE	1.00	2.00 EA	162,000.000		324,000				324,000

Activity Resource	Desc	Quantity Pcs	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 142 Land Item SCHEDULE: 1 100
Description = CENTRIFUGES Unit = EA Takeoff Quan: 2.000 Engr Quan: 2.000

=====> Item Totals: 142 - CENTRIFUGES

$324,000.00		[ ]		324,000			324,000
162,000.000	2 EA			162,000.00			162,000.00

BID ITEM = 150 Land Item SCHEDULE: 1 100
Description = INSIDE PIPING Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

30015005 INSIDE PIPING Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

ASSUME COST OF 1% OF EQUIPMENT COST

Resource	Desc	Pcs	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4MECH	INSTALLATION SU	1.00	1.00 LS	155,000.000					155,000	155,000

BID ITEM = 160 Land Item SCHEDULE: 1 100
Description = ELECTRICAL & NEW SUB STATION Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

30016005 SUB STATION Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

Resource	Desc	Pcs	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4ELECT	ELECTRICAL SUB	1.00	1.00 LS	150,000.000					150,000	150,000

30016010 OH POWER LINE Quan: 2,500.00 LF Hrs/Shft: 10.00 Cal 10 WC NONE

Resource	Desc	Pcs	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4ELEC	Electric - Sub	1.00	2,500.00 LF	35.000					87,500	87,500

=====> Item Totals: 160 - ELECTRICAL & NEW SUB STATION

$237,500.00		[ ]				237,500	237,500
237,500.000	1 LS					237,500.00	237,500.00

BID ITEM = 165 Land Item SCHEDULE: 1 100
Description = NATURAL GAS LINE Unit = LF Takeoff Quan: 2,500.000 Engr Quan: 2,500.000

30016505 NATURAL GAS LINE Quan: 2,500.00 LF Hrs/Shft: 10.00 Cal 10 WC NONE

Resource	Desc	Pcs	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4GAS	NATURAL GAS LIN	1.00	2,500.00 LF	30.000					75,000	75,000

BID ITEM = 170 Land Item SCHEDULE: 1 100
Description = INSTRUMENTS & CONTRLS Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 170 Land Item SCHEDULE: 1 100
Description = INSTRUMENTS & CONTRLS Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

30017005 INSTRUMENTS & CONTRLS Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4ELEC	Electric - Sub	1.00	1.00	LS	50,000.000					50,000	50,000

BID ITEM = 180 Land Item SCHEDULE: 1 100
Description = LEACHATE EQUALIZATION LAGOON Unit = GL Takeoff Quan: 750,000.000 Engr Quan: 750,000.000

19018005 EXCAVATE LAGOON Quan: 4,830.00 CY Hrs/Shft: 10.00 Cal 10 WC NONE

19015 SMALL EXCAV CREW 60.00 CH Prod: 80.5000 UH Lab Pcs: 6.00 Eqp Pcs: 4.00

Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3GRDST&S	GRADING ST&S	1.00	360.00	HM	2.000			720			720
3PPE	PPE	1.00	360.00	HM	2.500			900			900
8AAAA	*******EQUIPMEN		0.00	HR	0.000						
8EXC330	Excavator Cat 330D L	1.00	60.00	HR	188.085				11,285		11,285
8TRKHW10	Tandem Truck 12 CY	2.00	120.00	HR	73.856				8,863		8,863
8TRKPU15	Pickup 4x4 3/4 Ton G	1.00	60.00	HR	15.264				916		916
AAA	*********LABOR**		0.00	MH	0.000						
LA30	Laborer General	1.00	60.00	MH	29.210	3,614					3,614
OP01F	Oper Foreman	1.00	60.00	MH	42.040	4,495					4,495
OPH14	Oper Hydr Backhoe 3	1.00	60.00	MH	39.280	4,280					4,280
OPSPT14	Oper Grade Checker	1.00	60.00	MH	37.790	4,164					4,164
TE22	Tmstr Dmp Trk 6-14c	2.00	120.00	MH	36.790	7,959					7,959
$47,195.84	0.0745 MH/CY		360.00	MH	[3.032]	24,512		1,620	21,064		47,196
80.5000 Units/Hr *	805.0000 Un/Shift		13.4167	Unit/M		5.07		0.34	4.36		9.77

19018010 INSTALL HDPE LINER Quan: 25,480.00 SF Hrs/Shft: 10.00 Cal 10 WC NONE

Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4LINER	LINER SUB	1.00	25,480.00	SF	1.450					36,946	36,946

=====> Item Totals: 180 - LEACHATE EQUALIZATION LAGOON

			Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
$84,141.84	0.0004 MH/GL		360.00	MH	[0.02]	24,512		1,620	21,064	36,946	84,142
0.112	750000 GL					0.03			0.03	0.05	0.11

BID ITEM = 190 Land Item SCHEDULE: 1 100
Description = LEACH FIELD Unit = SF Takeoff Quan: 10,000.000 Engr Quan: 10,000.000

19019005 EXCAVATE LEACH FIELD Quan: 750.00 CY Hrs/Shft: 10.00 Cal 10 WC NONE

19015 SMALL EXCAV CREW 12.00 CH Prod: 62.5000 UH Lab Pcs: 6.00 Eqp Pcs: 4.00

Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3GRDST&S	GRADING ST&S	1.00	72.00	HM	2.000			144			144

BID ITEM = 190 Land Item SCHEDULE: 1 100
Description = LEACH FIELD Unit = SF Takeoff Quan: 10,000.000 Engr Quan: 10,000.000

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3PPE	PPE	1.00	72.00	HM	2.500			180			180
8AAAA	*******EQUIPMEN		0.00	HR	0.000						
8EXC330	Excavator Cat 330D L	1.00	12.00	HR	188.085				2,257		2,257
8TRKHW10	Tandem Truck 12 CY	2.00	24.00	HR	73.856				1,773		1,773
8TRKPU15	Pickup 4x4 3/4 Ton G	1.00	12.00	HR	15.264				183		183
AAA	*********LABOR**		0.00	MH	0.000						
LA30	Laborer General	1.00	12.00	MH	29.210	723					723
OP01F	Oper Foreman	1.00	12.00	MH	42.040	899					899
OPH14	Oper Hydr Backhoe 3	1.00	12.00	MH	39.280	856					856
OPSPT14	Oper Grade Checker	1.00	12.00	MH	37.790	833					833
TE22	Tmstr Dmp Trk 6-14c	2.00	24.00	MH	36.790	1,592					1,592
$9,439.14	0.0960 MH/CY		72.00	MH	[3.905]	4,902		324	4,213		9,439
62.5000 Units/Hr *	625.0000 Un/Shift		10.4167	Unit/M		6.54		0.43	5.62		12.59

19019010 SET TANK AND LINES & GRAVEL & C Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WCNONE

13010 SMALL SWPP CREW 16.00 CH Prod: 0.0625 UH Lab Pcs: 5.00 Eqp Pcs: 3.00

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
2DRNGRVLD	GRAVEL DRAIN FO	1.00	555.00	TN	18.200		10,101				10,101
2PVCPP4	PVC PERF PIPE 4"	1.00	2,700.00	LF	8.200		22,140				22,140
2SEPBOX5M	TANK 5000 GAL	1.00	1.00	LS	12,400.000		12,400				12,400
3GRDST&S	GRADING ST&S	1.00	80.00	HM	2.000			160			160
3PPE	PPE	1.00	80.00	HM	2.500			200			200
8AAAA	*******EQUIPMEN		0.00	HR	0.000						
8BHLD416	BHL Cat 416E 1CY	1.00	16.00	HR	39.398				630		630
8TRKGS10	Flatbed Truck 15K 20	1.00	16.00	HR	25.297				405		405
8TRKPU10	Pickup 4x2 3/4 Ton G	1.00	16.00	HR	13.322				213		213
AAA	*********LABOR**		0.00	MH	0.000						
LA01F	Laborer Foreman	1.00	16.00	MH	36.260	1,110					1,110
LA30	Laborer General	3.00	48.00	MH	29.210	2,891					2,891
OPH14	Oper Hydr Backhoe 3	1.00	16.00	MH	39.280	1,141					1,141
$51,392.03	80.0000 MH/LS		80.00	MH	[2871.8]	5,143	44,641	360	1,248		51,392
0.0625 Units/Hr *	0.6250 Un/Shift		0.0125	Unit/M		5,142.80	44,641.00	360.00	1,248.23		51,392.03

=====> Item Totals: 190 - LEACH FIELD

$60,831.17	0.0152 MH/SF		152.00	MH	[0.58]	10,045	44,641	684	5,461		60,831
6.083	10000 SF					1.00	4.46	0.07	0.55		6.08

BID ITEM = 195 Land Item SCHEDULE: 1 100
Description = 2" GW MONITOR WELL Unit = EA Takeoff Quan: 4.000 Engr Quan: 4.000

20019505 2" GW MONITOR WELL Quan: 4.00 EA Hrs/Shft: 10.00 Cal 10 WCNONE

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4DRILL	WELL DRILLER	1.00	4.00	EA	2,500.000					10,000	10,000

Activity / Resource	Desc	Quantity Pcs	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 600 Land Item SCHEDULE: 1 100
Description = DEMOBILIZATION Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

19060005 DEMOBILIZATION Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

4DEMOB	DEMOBILZATION	1.00	1.00 LS	700,000.000					700,000	700,000

BID ITEM = 910 Land Item SCHEDULE: 1 100
Description = CONTRACTOR OVERHEAD(GENERAL CO Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11091005 CONTRACTOR OVERHEAD(GENERAL Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

6% OF DIRECT COT EXCLUDING EQUIPMENT PURCHASE ,BONDS&INSURANCE,CH OVERSIGHT,MANAGEMENT RESERVE

4CNTROH	CONTRACTOR OH	1.00	1.00 LS	622,428.000					622,428	622,428

BID ITEM = 920 Land Item SCHEDULE: 1 100
Description = CH OVERHEAD (GENERAL CONDITIONS) Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11092005 CH OVERHEAD (GENERAL CONDITIO Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

CH OVERSIGHT 5% OF COSTS EXCLUDING,BONDS&INSURANCE,PERMITS,EQUIPMENT PURCHASE,CONTRACTOR OH,MANAGEMENT RESERVE AND MARK UP

4CH	CH OVERHEAD & P	1.00	1.00 LS	518,690.000					518,690	518,690

BID ITEM = 930 Land Item SCHEDULE: 1 100
Description = MANAGEMENT RESERVE (CONTINGENC Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11093005 MANAGEMENT RESERVE (CONTINGE Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

MANAGEMENT RESERVE (CONTINGENCY) 15% OF DIRECT COSTS

4MR15	MANAGE MENT RE	1.00	1.00 LS	1,556,070.000					1,556,070	1,556,070

BID ITEM = 970 Land Item SCHEDULE: 1 100
Description = TAXES Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11097005 TAXES (3% DIRECT COSTS) Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

Activity Resource	Desc	Quantity Pcs	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 970 Land Item SCHEDULE: 1 100
Description = TAXES Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

3TAXES	TAXES PALMER A	1.00	1.00 LS	526,958.000			526,958			526,958

=====> Item Totals: 970 - TAXES
$526,958.00 [ ] 526,958 526,958
526,958.000 1 LS 526,958.00 526,958.00

BID ITEM = 980 Land Item SCHEDULE: 1 100
Description = MARK UP (PROFIT) Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11098005 MARK UP (PROFIT) Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

CONTRACTOR MARK UP OF 10% OF CONTRACTOR COSTS

4PROFIT	CONTRACTOR PRO	1.00	1.00 LS	1,037,380.000					1,037,380	1,037,380

$19,129,602.30 *** Report Totals *** 3,000.00 MH 233,129 4,699,141 605,584 47,588 13,544,160 19,129,602

>>> indicates Non Additive Activity
------Report Notes:------
The estimate was prepared with TAKEOFF Quantities.
This report shows TAKEOFF Quantities with the resources.

"Unreviewed" Activities are marked.

Bid Date: Owner: Engineering Firm:
Estimator-In-Charge:

JOB NOTES
Estimate created on: 07/23/2014 by User#: 0 -
Source estimate used: C:\HEAVYBID\EST\ESTMAST
Labor Setup copied from: C:\HEAVYBID\EST\2014-710
Equipment Setup copied from: C:\HEAVYBID\EST\2014-710
Crew Setup copied from: C:\HEAVYBID\EST\2014-710
Material/Other Resources Setup copied from: C:\HEAVYBID\EST\2013-107
Overtime Rules Setup copied from: C:\HEAVYBID\EST\2014-710
Burden Tables Setup copied from: C:\HEAVYBID\EST\2014-710

************Estimate created on: 07/30/2014 by User#: 0 -
Source estimate used: C:\HEAVYBID\EST\2014-070

Activity Resource	Desc	Quantity Pcs	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 980 Land Item SCHEDULE: 1 100
Description = MARK UP (PROFIT) Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

[ ] in the Unit Cost Column = Labor Unit Cost Without Labor Burdens
In equipment resources, rent % and EOE % not = 100% are represented as XXX%YYY where XXX=Rent% and YYY=EOE%

------Calendar Codes------

10	10 HOUR SHIFT (Default Calendar)
8	8 HOUR SHIFT
9	9 HOUR SHIFT

07/31/2014 14:39
2014-074 PALMER LF OPTN#3 EVOQUA MBR CL-5 ROM
***

BID TOTALS

Biditem	Description	Status - Rnd	Quantity	Units	Unit Price	Bid Total
10	MOBILIZATION		1.000	LS	800,000.00	800,000.00
20	BONDS & INSURANCE		1.000	LS	371,416.00	371,416.00
25	ENGINEERING DESIGN		1.000	LS	157,262.80	157,262.80
30	SUBMITTALS		1.000	LS	23,996.65	23,996.65
40	PERMITS		1.000	LS	67,500.00	67,500.00
50	SURVEY		1.000	LS	9,900.00	9,900.00
80	FENCING		1.000	LS	153,800.00	153,800.00
85	LEACHATE EQUALIZATION LAGOON		1.000	LS	84,141.84	84,141.84
87	PUMP STA LAGOON TO PLANT		1.000	LS	35,000.00	35,000.00
90	MBR BUILDING FOUNDATION		1.000	LS	960,000.00	960,000.00
100	MBR BUILDING STRUCTURE		1.000	LS	5,250,000.00	5,250,000.00
110	UTILITIES-OUTSIDE BUILDING		1.000	LS	60,000.00	60,000.00
120	UTILITIES - INSIDE BUILDING		1.000	LS	100,000.00	100,000.00
130	PURCHASE PLANT EQUIPMENT		1.000	LS	1,500,000.00	1,500,000.00
140	INSTALL EVOCA PLANT EQUIPMENT		1.000	LS	300,000.00	300,000.00
142	CENTRIFUGES		2.000	EA	194,400.00	388,800.00
150	INSIDE PIPING		1.000	LS	155,000.00	155,000.00
160	ELECTRICAL & NEW SUB STATION		1.000	LS	237,500.00	237,500.00
165	NATURAL GAS LINE		2,500.000	LF	30.00	75,000.00
170	INSTRUMENTS & CONTRLS		1.000	LS	50,000.00	50,000.00
190	LEACH FIELD		10,000.000	SF	6.08	60,800.00
195	2" GW MONITOR WELL		4.000	EA	2,500.00	10,000.00
600	DEMOBILIZATION		1.000	LS	700,000.00	700,000.00
910	CONTRACTOR OVERHEAD(GENERAL CONDITIONS)		1.000	LS	677,510.00	677,510.00
920	CH OVERHEAD (GENERAL CONDITIONS)		1.000	LS	580,722.00	580,722.00
930	MANAGEMENT RESERVE (CONTINGENCY)		1.000	LS	1,451,806.00	1,451,806.00
970	TAXES		1.000	LS	456,842.00	456,842.00
980	MARK UP (PROFIT)		1.000	LS	967,870.00	967,870.00
			Bid Total	========>		$15,684,867.29

Activity / Resource	Desc	Quantity Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 10 Land Item SCHEDULE: 1 100
Description = MOBILIZATION Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

19001005 MOBILIZATION Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

Activity / Resource	Desc	Quantity Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4MOB	MOBILIZATION	1.00	1.00	LS	800,000.000					800,000	800,000

BID ITEM = 20 Land Item SCHEDULE: 1 100
Description = BONDS & INSURANCE Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11002005 BONDS Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

BONDS 1.7% X $14,856,644 = $252,563

Activity / Resource	Desc	Quantity Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3BOND	BOND COST	1.00	1.00	LS	252,563.000			252,563			252,563

11002010 INSURANCE Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

INSURANCE 0.8% X $14,856,644 = $118,853

Activity / Resource	Desc	Quantity Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3INSURANC	INSURANCE COST	1.00	1.00	LS	118,853.000			118,853			118,853

=====> Item Totals: 20 - BONDS & INSURANCE

Activity / Resource	Desc	Quantity Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
$371,416.00					[ ]			371,416			371,416
371,416.000		1 LS						371,416.00			371,416.00

BID ITEM = 25 Land Item SCHEDULE: 1 100
Description = ENGINEERING DESIGN Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11002505 CH ENGINEERING DESIGN Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

Activity / Resource	Desc	Quantity Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3DOCCOSTS	DOCUMENT COST	1.00	1.00	LS	4,000.000			4,000			4,000
X414	==> Project Eng	1.00	800.00	MH	72.700	80,261					80,261
X418	==> Engineering Mgr	1.00	400.00	MH	52.900	29,201					29,201
X422	==> Staff Enginer	1.00	600.00	MH	52.900	43,801					43,801
$157,262.80	1,800.0000 MH/LS		1,800.00	MH	[111060]	153,263		4,000			157,263
			0.0006	Unit/M		153,262.80		4,000.00			157,262.80

=====> Item Totals: 25 - ENGINEERING DESIGN

Activity / Resource	Desc	Quantity Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
$157,262.80	1,800.0000 MH/LS		1,800.00	MH	[111060]	153,263		4,000			157,263
157,262.800		1 LS				153,262.80		4,000.00			157,262.80

Direct Cost Report

BID ITEM = 30 Land Item SCHEDULE: 1 100
Description = SUBMITTALS Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11003005 WORK PLAN Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

11030 SUBMITTALS 16.00 CH Prod: 0.0625 UH Lab Pcs: 3.10 Eqp Pcs: 0.00

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3DOCMTRL	DOCUMENT MATE	1.00	1.00	LS	200.000			200			200
X414	Project Eng E6	1.00	16.00	MH	72.700	1,605					1,605
X430	Project Controls E 4	0.20	3.20	MH	52.900	234					234
X434	Cost/Schedule E3	0.20	3.20	MH	43.800	193					193
X442	Document Tech T2	0.10	1.60	MH	24.900	55					55
X450	Field Engineer T4	0.20	3.20	MH	39.800	176					176
X462	Quality Mngr E4	0.20	3.20	MH	52.900	234					234
X866	Admin Assist. T1	1.00	16.00	MH	22.900	506					506
X918	Safety Engineer E3	0.20	3.20	MH	43.900	194					194
$3,396.09	49.6000 MH/LS		49.60	MH	[2316]	3,196		200			3,396
0.0625 Units/Hr *	0.6250 Un/Shift		0.0202	Unit/M		3,196.09		200.00			3,396.09

11003010 PROJECT SCHEDULE Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

11030 SUBMITTALS 24.00 CH Prod: 0.0417 UH Lab Pcs: 1.85 Eqp Pcs: 0.00

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3DOCMTRL	DOCUMENT MATE	1.00	1.00	LS	350.000			350			350
X414	Project Eng E6	0.15	3.60	MH	72.700	361					361
X430	Project Controls E 4	0.10	2.40	MH	52.900	175					175
X434	Cost/Schedule E3	1.00	24.00	MH	43.800	1,451					1,451
X442	Document Tech T2	0.10	2.40	MH	24.900	82					82
X866	Admin Assist. T1	0.50	12.00	MH	22.900	379					379
$2,798.72	44.4000 MH/LS		44.40	MH	[1774.44]	2,449		350			2,799
0.0417 Units/Hr *	0.4167 Un/Shift		0.0225	Unit/M		2,448.72		350.00			2,798.72

11003015 SWPPP Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

FOR ALL SUBMITTALS ASSUME A DRAFT A DRAFT FINAL AND A FINAL FOR MOST SUBMITTALS

11020 PLAN/DOC CREW 1.00 CH Prod: 1.0000 UH Lab Pcs: 68.00 Eqp Pcs: 0.00

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3DOCMTRL	DOCUMENT MATE	1.00	1.00	LS	750.000			750			750
AAA	*********LABOR**		0.00	MH	0.000						
X274	Adminst Asst. T2	18.00	18.00	MH	24.900	619					619
X414	Project Eng E6	32.00	32.00	MH	72.700	3,210					3,210
X426	Jr Staff Eng E3	18.00	18.00	MH	43.800	1,088					1,088
$5,666.94	68.0000 MH/LS		68.00	MH	[3563]	4,917		750			5,667
1.0000 Units/Hr *	10.0000 Un/Shift		0.0147	Unit/M		4,916.94		750.00			5,666.94

11003020 HASP Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

11020 PLAN/DOC CREW 1.00 CH Prod: 1.0000 UH Lab Pcs: 58.00 Eqp Pcs: 0.00

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3DOCMTRL	DOCUMENT MATE	1.00	1.00	LS	950.000			950			950
AAA	*********LABOR**		0.00	MH	0.000						
X274	Adminst Asst. T2	20.00	20.00	MH	24.900	687					687

BID ITEM = 30 Land Item SCHEDULE: 1 100
Description = SUBMITTALS Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
X414	Project Eng E6	10.00	10.00	MH	72.700	1,003					1,003
X426	Jr Staff Eng E3	8.00	8.00	MH	43.800	484					484
X918	Safety Engineer E3	20.00	20.00	MH	43.900	1,212					1,212
$4,335.69	58.0000 MH/LS		58.00	MH	[2453.4]	3,386		950			4,336
1.0000 Units/Hr *	10.0000 Un/Shift		0.0172	Unit/M		3,385.69		950.00			4,335.69

11003025 QA/QC PLAN Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
11020	PLAN/DOC CREW		1.00	CH	Prod: 1.0000 UH			Lab Pcs: 56.00			Eqp Pcs: 0.00
3DOCMTRL	DOCUMENT MATE	1.00	1.00	LS	700.000			700			700
AAA	*********LABOR**		0.00	MH	0.000						
X274	Adminst Asst. T2	20.00	20.00	MH	24.900	687					687
X414	Project Eng E6	12.00	12.00	MH	72.700	1,204					1,204
X462	Quality Mngr E4	24.00	24.00	MH	52.900	1,752					1,752
$4,343.20	56.0000 MH/LS		56.00	MH	[2640]	3,643		700			4,343
1.0000 Units/Hr *	10.0000 Un/Shift		0.0179	Unit/M		3,643.20		700.00			4,343.20

11003030 TRAFFIC PLAN Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
11020	PLAN/DOC CREW		1.00	CH	Prod: 1.0000 UH			Lab Pcs: 52.00			Eqp Pcs: 0.00
3DOCMTRL	DOCUMENT MATE	1.00	1.00	LS	250.000			250			250
AAA	*********LABOR**		0.00	MH	0.000						
X274	Adminst Asst. T2	16.00	16.00	MH	24.900	550					550
X414	Project Eng E6	12.00	12.00	MH	72.700	1,204					1,204
X426	Jr Staff Eng E3	12.00	12.00	MH	43.800	725					725
X918	Safety Engineer E3	12.00	12.00	MH	43.900	727					727
$3,456.01	52.0000 MH/LS		52.00	MH	[2323.2]	3,206		250			3,456
1.0000 Units/Hr *	10.0000 Un/Shift		0.0192	Unit/M		3,206.01		250.00			3,456.01

=====> Item Totals: 30 - SUBMITTALS

$23,996.65	328.0000 MH/LS		328.00	MH	[15070.04]	20,797		3,200			23,997
23,996.650	1 LS					20,796.65		3,200.00			23,996.65

BID ITEM = 40 Land Item SCHEDULE: 1 100
Description = PERMITS Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11004005 MSB BUILDING PERMIT Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3MSBBLDPR	MSB BUILDING PE	1.00	1.00	LS	60,000.000			60,000			60,000

11004010 DUST PERMIT Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3DUSTPRM	DUST PERMIT	1.00	1.00	LS	7,500.000			7,500			7,500

Activity	Desc	Quantity		Unit		Perm	Constr	Equip	Sub-	
Resource		Pcs	Unit	Cost	Labor	Materi	Matl/Ex	Ment	Contrac	Total

BID ITEM = 40 Land Item SCHEDULE: 1 100
Description = PERMITS Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

=====> Item Totals: 40 - PERMITS

$67,500.00				[ ]			67,500			67,500
67,500.000		1	LS				67,500.00			67,500.00

BID ITEM = 50 Land Item SCHEDULE: 1 100
Description = SURVEY Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11005005 SURVEY Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

THIS WOULD INCLUDE LAYOUT OF BUILDING , EQUALIZATION POND , ACCESS ROAD AND
UTILITIES . ALSO EARTHWORK QUANTITIES AND FINAL AS BUILT DRAWAINGS

4SURVEY	SURVEY SUB	1.00	90.00 HR	110.000					9,900	9,900

BID ITEM = 80 Land Item SCHEDULE: 1 100
Description = FENCING Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

19008005 CL FENCE Quan: 5,200.00 LF Hrs/Shft: 10.00 Cal 10 WC NONE

4FENCE	Fencing - Sub	1.00	5,200.00 LF	29.000					150,800	150,800

19008010 GATES - MAN Quan: 4.00 EA Hrs/Shft: 10.00 Cal 10 WC NONE

4FENCE	Fencing - Sub	1.00	4.00 EA	300.000					1,200	1,200

19008015 GATES VEHICLE Quan: 2.00 EA Hrs/Shft: 10.00 Cal 10 WC NONE

4FENCE	Fencing - Sub	1.00	2.00 EA	900.000					1,800	1,800

=====> Item Totals: 80 - FENCING

$153,800.00				[ ]					153,800	153,800
153,800.000		1	LS						153,800.00	153,800.00

BID ITEM = 85 Land Item SCHEDULE: 1 100
Description = LEACHATE EQUALIZATION LAGOON Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

19085005 EXCAVATE LAGOON Quan: 4,830.00 CY Hrs/Shft: 10.00 Cal 10 WC NONE

19015 SMALL EXCAV CREW 60.00 CH Prod: 80.5000 UH Lab Pcs: 6.00 Eqp Pcs: 4.00

3GRDST&S	GRADING ST&S	1.00	360.00 HM	2.000			720			720

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 85 Land Item SCHEDULE: 1 100
Description = LEACHATE EQUALIZATION LAGOON Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3PPE	PPE	1.00	360.00	HM	2.500			900			900
8AAAA	*******EQUIPMEN		0.00	HR	0.000						
8EXC330	Excavator Cat 330D L	1.00	60.00	HR	188.085				11,285		11,285
8TRKHW10	Tandem Truck 12 CY	2.00	120.00	HR	73.856				8,863		8,863
8TRKPU15	Pickup 4x4 3/4 Ton G	1.00	60.00	HR	15.264				916		916
AAA	*********LABOR**		0.00	MH	0.000						
LA30	Laborer General	1.00	60.00	MH	29.210	3,614					3,614
OP01F	Oper Foreman	1.00	60.00	MH	42.040	4,495					4,495
OPH14	Oper Hydr Backhoe 3	1.00	60.00	MH	39.280	4,280					4,280
OPSPT14	Oper Grade Checker	1.00	60.00	MH	37.790	4,164					4,164
TE22	Tmstr Dmp Trk 6-14c	2.00	120.00	MH	36.790	7,959					7,959
$47,195.84	0.0745 MH/CY		360.00	MH	[3.032]	24,512		1,620	21,064		47,196
80.5000 Units/Hr *	805.0000 Un/Shift		13.4167	Unit/M		5.07		0.34	4.36		9.77

19085010 INSTALL HDPE LINER Quan: 25,480.00 SF Hrs/Shft: 10.00 Cal 10 WC NONE

Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4LINER	LINER SUB	1.00	25,480.00	SF	1.450					36,946	36,946

=====> Item Totals: 85 - LEACHATE EQUALIZATION LAGOON

$84,141.84	360.0000 MH/LS		360.00	MH	[14645.4]	24,512		1,620	21,064	36,946	84,142
84,141.840	1 LS					24,512.18		1,620.00	21,063.66	36,946.00	84,141.84

BID ITEM = 87 Land Item SCHEDULE: 1 100
Description = PUMP STA LAGOON TO PLANT Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

19008705 PUMP STA LAGOON TO PLANT Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

THIS INCLUDES PUMP,PAD,INTAKE PIPE POWER TO PUMP AND DISCHARGE LINE TO PLANT

Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4MECH	INSTALLATION SU	1.00	1.00	LS	35,000.000					35,000	35,000

BID ITEM = 90 Land Item SCHEDULE: 1 100
Description = MBR BUILDING FOUNDATION Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

51009005 BUILDING FOUNDATION & SLAB Quan: 30,000.00 SF Hrs/Shft: 10.00 Cal 10 WC NONE

BUILDING FOUNDATION WILL BE 200LF X 150LF = 30,000 SF

Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4CONC	Concrete - Sub	1.00	30,000.00	SF	32.000					960,000	960,000

Activity / Resource	Desc	Quantity Pcs	Unit		Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 100 Land Item SCHEDULE: 1 100
Description = MBR BUILDING STRUCTURE Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

60010005 BUILDING STRUCTURE Quan: 30,000.00 SF Hrs/Shft: 10.00 Cal 10 WC NONE

Activity / Resource	Desc	Quantity Pcs	Unit		Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4BLDG	Building - Sub	1.00	30,000.00	SF	175.000					5,250,000	5,250,000

BID ITEM = 110 Land Item SCHEDULE: 1 100
Description = UTILITIES-OUTSIDE BUILDING Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

60011005 UTILITIES-OUTSIDE BUILDING Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

Activity / Resource	Desc	Quantity Pcs	Unit		Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4UTIL	UTILLITY SUB	1.00	1.00	LS	60,000.000					60,000	60,000

BID ITEM = 120 Land Item SCHEDULE: 1 100
Description = UTILITIES - INSIDE BUILDING Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

60012005 UTILITIES - INSIDE BUILDING Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

Activity / Resource	Desc	Quantity Pcs	Unit		Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4UTIL	UTILLITY SUB	1.00	1.00	LS	100,000.000					100,000	100,000

BID ITEM = 130 Land Item SCHEDULE: 1 100
Description = PURCHASE PLANT EQUIPMENT Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

30013005 PURCHASE EVOQUA MBR SYSTEM Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

THIS IS VENDOR QUOTE FOR SBR ACTIVATED SLUDGE AND SUPPORT EQUIPMENT

Activity / Resource	Desc	Quantity Pcs	Unit		Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
2EVOQUAM	EVOQUA MBR SYS	1.00	1.00	LS	1,500,000.000		1,500,000				1,500,000

=====> Item Totals: 130 - PURCHASE PLANT EQUIPMENT

					Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
$1,500,000.00					[ ]		1,500,000				1,500,000
1,500,000.000		1 LS					1,500,000.00				1,500,000.00

BID ITEM = 140 Land Item SCHEDULE: 1 100
Description = INSTALL EVOCA PLANT EQUIPMENT Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

30014005 INSTALL EQUIPMENT Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

Activity / Resource	Desc	Quantity Pcs	Quantity Unit		Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 140 Land Item SCHEDULE: 1 100
Description = INSTALL EVOCA PLANT EQUIPMENT Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

ASSUMES COST OF MBR EQUIPMENT
INSTALLATION 20% OF EQUIPMENT COST FOR EVOQUA ($1,500,000)=$300,000

4MECH	INSTALLATION SU	1.00	1.00	LS	300,000.000					300,000	300,000

BID ITEM = 142 Land Item SCHEDULE: 1 100
Description = CENTRIFUGES Unit = EA Takeoff Quan: 2.000 Engr Quan: 2.000

11014205 FURNISH & INSTALL CENTRIFUGES Quan: 2.00 EA Hrs/Shft: 10.00 Cal 10 WC NONE

INCLUDES INSTALLATION

2CNTRAFG	CENTRIFUGE	1.00	2.00	EA	194,400.000		388,800				388,800

=====> Item Totals: 142 - CENTRIFUGES

$388,800.00					[ ]		388,800				388,800
194,400.000		2		EA			194,400.00				194,400.00

BID ITEM = 150 Land Item SCHEDULE: 1 100
Description = INSIDE PIPING Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

30015005 INSIDE PIPING Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

ASSUME COST OF 1% OF EQUIPMENT COST

4MECH	INSTALLATION SU	1.00	1.00	LS	155,000.000					155,000	155,000

BID ITEM = 160 Land Item SCHEDULE: 1 100
Description = ELECTRICAL & NEW SUB STATION Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

30016005 SUB STATION Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

4ELECT	ELECTRICAL SUB	1.00	1.00	LS	150,000.000					150,000	150,000

30016010 OH POWER LINE Quan: 2,500.00 LF Hrs/Shft: 10.00 Cal 10 WC NONE

4ELEC	Electric - Sub	1.00	2,500.00	LF	35.000					87,500	87,500

=====> Item Totals: 160 - ELECTRICAL & NEW SUB STATION

$237,500.00					[ ]					237,500	237,500
237,500.000		1		LS						237,500.00	237,500.00

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 165 Land Item SCHEDULE: 1 100
Description = NATURAL GAS LINE Unit = LF Takeoff Quan: 2,500.000 Engr Quan: 2,500.000

30016505 NATURAL GAS LINE Quan: 2,500.00 LF Hrs/Shft: 10.00 Cal 10 WC NONE

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4GAS	NATURAL GAS LIN	1.00	2,500.00	LF	30.000					75,000	75,000

BID ITEM = 170 Land Item SCHEDULE: 1 100
Description = INSTRUMENTS & CONTRLS Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

30017005 INSTRUMENTS & CONTRLS Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4ELEC	Electric - Sub	1.00	1.00	LS	50,000.000					50,000	50,000

BID ITEM = 190 Land Item SCHEDULE: 1 100
Description = LEACH FIELD Unit = SF Takeoff Quan: 10,000.000 Engr Quan: 10,000.000

19019005 EXCAVATE LEACH FIELD Quan: 750.00 CY Hrs/Shft: 10.00 Cal 10 WC NONE

<u>19015</u> SMALL EXCAV CREW 12.00 CH Prod: 62.5000 UH Lab Pcs: 6.00 Eqp Pcs: 4.00

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3GRDST&S	GRADING ST&S	1.00	72.00	HM	2.000			144			144
3PPE	PPE	1.00	72.00	HM	2.500			180			180
8AAAA	*******EQUIPMEN		0.00	HR	0.000						
8EXC330	Excavator Cat 330D L	1.00	12.00	HR	188.085				2,257		2,257
8TRKHW10	Tandem Truck 12 CY	2.00	24.00	HR	73.856				1,773		1,773
8TRKPU15	Pickup 4x4 3/4 Ton G	1.00	12.00	HR	15.264				183		183
AAA	*********LABOR**		0.00	MH	0.000						
LA30	Laborer General	1.00	12.00	MH	29.210	723					723
OP01F	Oper Foreman	1.00	12.00	MH	42.040	899					899
OPH14	Oper Hydr Backhoe 3	1.00	12.00	MH	39.280	856					856
OPSPT14	Oper Grade Checker	1.00	12.00	MH	37.790	833					833
TE22	Tmstr Dmp Trk 6-14c	2.00	24.00	MH	36.790	1,592					1,592
$9,439.14	0.0960 MH/CY		72.00	MH	[3.905]	4,902		324	4,213		9,439
62.5000 Units/Hr *	625.0000 Un/Shift		10.4167	Unit/M		6.54		0.43	5.62		12.59

19019010 SET TANK AND LINES & GRAVEL & C Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

<u>13010</u> SMALL SWPP CREW 16.00 CH Prod: 0.0625 UH Lab Pcs: 5.00 Eqp Pcs: 3.00

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
2DRNGRVLD	GRAVEL DRAIN FO	1.00	555.00	TN	18.200		10,101				10,101
2PVCPP4	PVC PERF PIPE 4"	1.00	2,700.00	LF	8.200		22,140				22,140
2SEPBOX5M	TANK 5000 GAL	1.00	1.00	LS	12,400.000		12,400				12,400
3GRDST&S	GRADING ST&S	1.00	80.00	HM	2.000			160			160
3PPE	PPE	1.00	80.00	HM	2.500			200			200

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 190 Land Item SCHEDULE: 1 100
Description = LEACH FIELD Unit = SF Takeoff Quan: 10,000.000 Engr Quan: 10,000.000

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
8AAAA	*******EQUIPMEN		0.00	HR	0.000						
8BHLD416	BHL Cat 416E 1CY	1.00	16.00	HR	39.398				630		630
8TRKGS10	Flatbed Truck 15K 20	1.00	16.00	HR	25.297				405		405
8TRKPU10	Pickup 4x2 3/4 Ton G	1.00	16.00	HR	13.322				213		213
AAA	*********LABOR**		0.00	MH	0.000						
LA01F	Laborer Foreman	1.00	16.00	MH	36.260	1,110					1,110
LA30	Laborer General	3.00	48.00	MH	29.210	2,891					2,891
OPH14	Oper Hydr Backhoe 3	1.00	16.00	MH	39.280	1,141					1,141
$51,392.03	80.0000 MH/LS		80.00	MH	[2871.8]	5,143	44,641	360	1,248		51,392
0.0625 Units/Hr *	0.6250 Un/Shift		0.0125	Unit/M		5,142.80	44,641.00	360.00	1,248.23		51,392.03

=====> Item Totals: 190 - LEACH FIELD

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
$60,831.17	0.0152 MH/SF		152.00	MH	[0.58]	10,045	44,641	684	5,461		60,831
6.083	10000 SF					1.00	4.46	0.07	0.55		6.08

BID ITEM = 195 Land Item SCHEDULE: 1 100
Description = 2" GW MONITOR WELL Unit = EA Takeoff Quan: 4.000 Engr Quan: 4.000

20019505 2" GW MONITOR WELL Quan: 4.00 EA Hrs/Shft: 10.00 Cal 10 WC NONE

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4DRILL	WELL DRILLER	1.00	4.00	EA	2,500.000					10,000	10,000

BID ITEM = 600 Land Item SCHEDULE: 1 100
Description = DEMOBILIZATION Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

19060005 DEMOBILIZATION Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4DEMOB	DEMOBILZATION	1.00	1.00	LS	700,000.000					700,000	700,000

BID ITEM = 910 Land Item SCHEDULE: 1 100
Description = CONTRACTOR OVERHEAD(GENERAL CO Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11091005 CONTRACTOR OVERHEAD(GENERAL Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

7% OF DIRECT COT EXCLUDING EQUIPMENT PURCHASE ,BONDS&INSURANCE,CH
OVERSIGHT,MANAGEMENT RESERVE

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4CNTROH	CONTRACTOR OH	1.00	1.00	LS	677,510.000					677,510	677,510

Activity / Resource	Desc	Quantity Pcs	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 920 Land Item SCHEDULE: 1 100
Description = CH OVERHEAD (GENERAL CONDITIONS) Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11092005 CH OVERHEAD (GENERAL CONDITIO Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

CH OVERSIGHT 6% OF COSTS EXCLUDING,BONDS&INSURANCE,PERMITS,EQUIPMENT PURCHASE,CONTRACTOR OH,MANAGEMENT RESERVE AND MARK UP

Resource	Desc	Pcs	Quantity Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4CH	CH OVERHEAD & P	1.00	1.00 LS	580,722.000					580,722	580,722

BID ITEM = 930 Land Item SCHEDULE: 1 100
Description = MANAGEMENT RESERVE (CONTINGENC Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11093005 MANAGEMENT RESERVE (CONTINGE Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

MANAGEMENT RESERVE (CONTINGENCY) 15% DIRECT COST

Resource	Desc	Pcs	Quantity Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4MR15	MANAGE MENT RE	1.00	1.00 LS	1,451,806.000					1,451,806	1,451,806

BID ITEM = 970 Land Item SCHEDULE: 1 100
Description = TAXES Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11097005 TAXES (3% DIRECT COSTS) Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

Resource	Desc	Pcs	Quantity Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3TAXES	TAXES PALMER A	1.00	1.00 LS	456,842.000			456,842			456,842

=====> Item Totals: 970 - TAXES

$456,842.00		[ ]			456,842		456,842
456,842.000	1 LS				456,842.00		456,842.00

BID ITEM = 980 Land Item SCHEDULE: 1 100
Description = MARK UP (PROFIT) Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11098005 MARK UP (PROFIT) Quan: 1.00 LS Hrs/Shft: 10.00 Cal 10 WC NONE

CONTRACTOR MARK UP OF 10% OF CONTRACTOR COSTS

Resource	Desc	Pcs	Quantity Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4PROFIT	CONTRACTOR PRO	1.00	1.00 LS	967,870.000					967,870	967,870

	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
$15,684,898.46 *** Report Totals *** 2,640.00 MH	208,617	1,933,441	905,262	26,525	12,611,054	15,684,898

Activity Resource	Desc	Quantity Pcs	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 980 Land Item SCHEDULE: 1 100
Description = MARK UP (PROFIT) Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

>>> indicates Non Additive Activity
------Report Notes:------
The estimate was prepared with TAKEOFF Quantities.
This report shows TAKEOFF Quantities with the resources.

Bid Date: Owner: Engineering Firm:
Estimator-In-Charge:

JOB NOTES
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Estimate created on: 07/23/2014 by User#: 0 -
Source estimate used: C:\HEAVYBID\EST\ESTMAST
Labor Setup copied from: C:\HEAVYBID\EST\2014-710
Equipment Setup copied from: C:\HEAVYBID\EST\2014-710
Crew Setup copied from: C:\HEAVYBID\EST\2014-710
Material/Other Resources Setup copied from: C:\HEAVYBID\EST\2013-107
Overtime Rules Setup copied from: C:\HEAVYBID\EST\2014-710
Burden Tables Setup copied from: C:\HEAVYBID\EST\2014-710

************Estimate created on: 07/30/2014 by User#: 0 -
Source estimate used: C:\HEAVYBID\EST\2014-070

************Estimate created on: 07/31/2014 by User#: 0 -
Source estimate used: C:\HEAVYBID\EST\2014-072
```

* on units of MH indicate average labor unit cost was used rather than base rate.
[ ] in the Unit Cost Column = Labor Unit Cost Without Labor Burdens
In equipment resources, rent % and EOE % not = 100% are represented as XXX%YYY where XXX=Rent% and YYY=EOE%
------Calendar Codes------

10	10 HOUR SHIFT (Default Calendar)
8	8 HOUR SHIFT
9	9 HOUR SHIFT

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 10 Land Item SCHEDULE: 1 100
Description = SBR PLANT LABOR OPERATION Unit = YR Takeoff Quan: 1.000 Engr Quan: 1.000

11001005 EVAP PLANT LABOR OPERATION Quan: 1.00 YR Hrs/Shft: 8.00 WC NONE

11005 STANDARD CREW SBR 2,080.00 CH Prod: 0.0005 UH Lab Pcs: 3.25 Eqp Pcs: 1.20

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
8AAAA	*******EQUIPMEN		0.00	HR	0.000						
8FORK02	Forklift Cat TH220B	0.10	208.00	HR	34.270				7,128		7,128
8TRKGS10	Flatbed Truck 15K 20	0.10	208.00	HR	25.297				5,262		5,262
8TRKPU15	Pickup 4x4 3/4 Ton G	1.00	2,080.00	HR	15.264				31,749		31,749
AAA	*********LABOR**		0.00	MH	0.000						
PO01S	Supervisor	0.25	520.00	MH	55.000	44,590					44,590
PO0F	Foreman	1.00	2,080.00	MH	40.020	141,593					141,593
PO20	Plant Journyman	2.00	4,160.00	MH	38.000	273,270					273,270
$503,592.53	6,760.0000 MH/YR		6,760.00	MH	[269921.6]	459,453			44,139		503,593
0.0005 Units/Hr *	0.0038 Un/Shift		0.0001	Unit/M		459,453.49			44,139.04		503,592.53

=====> Item Totals: 10 - SBR PLANT LABOR OPERATION

$503,592.53	6,760.0000 MH/YR	6,760.00	MH	[269921.6]	459,453			44,139	503,593
503,592.530	1 YR				459,453.49			44,139.04	503,592.53

BID ITEM = 20 Land Item SCHEDULE: 1 100
Description = POWER FOR PLANT Unit = YR Takeoff Quan: 1.000 Engr Quan: 1.000

11002005 POWER FOR PLANT Quan: 1.00 YR Hrs/Shft: 8.00 WC NONE

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3KW/H	KW/HR	1.00	4,000,000.00	KW/H	0.190			760,000			760,000

=====> Item Totals: 20 - POWER FOR PLANT

$760,000.00		[ ]		760,000	760,000
760,000.000	1 YR			760,000.00	760,000.00

BID ITEM = 30 Land Item SCHEDULE: 1 100
Description = REPLACEMENT/REPAIR PARTS Unit = YR Takeoff Quan: 1.000 Engr Quan: 1.000

11003005 REPLACEMENT/REPAIR PARTS Quan: 1.00 YR Hrs/Shft: 8.00 WC NONE

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3RRP	REPAIR&REPLC PA	1.00	1.00	LS	8,000.000			8,000			8,000

=====> Item Totals: 30 - REPLACEMENT/REPAIR PARTS

$8,000.00		[ ]		8,000	8,000
8,000.000	1 YR			8,000.00	8,000.00

Activity Resource	Desc	Quantity Pcs	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 40 Land Item SCHEDULE: 1 100
Description = CHEMICALS Unit = YR Takeoff Quan: 1.000 Engr Quan: 1.000

11004005 CHEMICALS Quan: 1.00 YR Hrs/Shft: 8.00 WCNONE

Activity Resource	Desc	Quantity Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3MICCHEM	MISCELLANEOUS	1.00	4,000,000.00	GL	0.020			80,000			80,000

=====> Item Totals: 40 - CHEMICALS

$80,000.00		[ ]	80,000		80,000
80,000.000	1 YR		80,000.00		80,000.00

		Labor	Constr Matl/Ex	Equip Ment	Total
$1,351,592.53	*** Report Totals *** 6,760.00 MH	459,453	848,000	44,139	1,351,593

>>> indicates Non Additive Activity
------Report Notes:------
The estimate was prepared with TAKEOFF Quantities.
This report shows TAKEOFF Quantities with the resources.

Bid Date: Owner: Engineering Firm:
Estimator-In-Charge:

JOB NOTES
Estimate created on: 08/01/2014 by User#: 0 -
Source estimate used: C:\HEAVYBID\EST\ESTMAST
Labor Setup copied from: C:\HEAVYBID\EST\2014-072
Equipment Setup copied from: C:\HEAVYBID\EST\2014-072
Material/Other Resources Setup copied from: C:\HEAVYBID\EST\2014-072
Overtime Rules Setup copied from: C:\HEAVYBID\EST\2014-072
Burden Tables Setup copied from: C:\HEAVYBID\EST\2014-072

************Estimate created on: 08/01/2014 by User#: 0 -
Source estimate used: C:\HEAVYBID\EST\2014-073

* on units of MH indicate average labor unit cost was used rather than base rate.
[ ] in the Unit Cost Column = Labor Unit Cost Without Labor Burdens
In equipment resources, rent % and EOE % not = 100% are represented as XXX%YYY where XXX=Rent% and YYY=EOE%
------Calendar Codes------

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 10 Land Item SCHEDULE: 1 100
Description = MBR PLANT LABOR OPERATION Unit = YR Takeoff Quan: 1.000 Engr Quan: 1.000

11001005 SBR PLANT LABOR OPERATION Quan: 1.00 YR Hrs/Shft: 8.00 WC NONE

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
11005	STANDARD CREW SBR		2,080.00	CH	Prod: 0.0005 UH			Lab Pcs: 4.50		Eqp Pcs: 1.20	
8AAAA	*******EQUIPMEN		0.00	HR	0.000						
8FORK02	Forklift Cat TH220B	0.10	208.00	HR	34.270				7,128		7,128
8TRKGS10	Flatbed Truck 15K 20	0.10	208.00	HR	25.297				5,262		5,262
8TRKPU15	Pickup 4x4 3/4 Ton G	1.00	2,080.00	HR	15.264				31,749		31,749
AAA	*********LABOR**		0.00	MH	0.000						
PO01S	Supervisor	0.50	1,040.00	MH	55.000	89,180					89,180
PO0F	Foreman	1.00	2,080.00	MH	40.020	141,593					141,593
PO20	Plant Journyman	3.00	6,240.00	MH	38.000	409,906					409,906
$684,817.73	9,360.0000 MH/YR		9,360.00	MH	[377561.6]	640,679			44,139		684,818
0.0005 Units/Hr *	0.0038 Un/Shift		0.0001	Unit/M		640,678.69			44,139.04		684,817.73

=====> Item Totals: 10 - MBR PLANT LABOR OPERATION

$684,817.73	9,360.0000 MH/YR		9,360.00	MH	[377561.6]	640,679			44,139		684,818
684,817.730	1 YR					640,678.69			44,139.04		684,817.73

BID ITEM = 20 Land Item SCHEDULE: 1 100
Description = POWER FOR PLANT Unit = YR Takeoff Quan: 1.000 Engr Quan: 1.000

11002005 POWER FOR PLANT Quan: 1.00 YR Hrs/Shft: 8.00 WC NONE

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3KW/H	KW/HR	1.00	1,314,000.00	KW/H	0.190			249,660			249,660

=====> Item Totals: 20 - POWER FOR PLANT

$249,660.00					[ ]			249,660			249,660
249,660.000	1 YR							249,660.00			249,660.00

BID ITEM = 30 Land Item SCHEDULE: 1 100
Description = REPLACEMENT/REPAIR PARTS Unit = YR Takeoff Quan: 1.000 Engr Quan: 1.000

11003005 REPLACEMENT/REPAIR PARTS Quan: 1.00 YR Hrs/Shft: 8.00 WC NONE

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3RRP	REPAIR&REPLC PA	1.00	1.00	LS	15,000.000			15,000			15,000

=====> Item Totals: 30 - REPLACEMENT/REPAIR PARTS

$15,000.00					[ ]			15,000			15,000
15,000.000	1 YR							15,000.00			15,000.00

Activity / Resource	Desc	Quantity Pcs	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 40 Land Item SCHEDULE: 1 100
Description = CHEMICALS Unit = YR Takeoff Quan: 1.000 Engr Quan: 1.000

11004005 CHEMICALS Quan: 1.00 YR Hrs/Shft: 8.00 WCNONE

Activity / Resource	Desc	Quantity Pcs	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3MICCHEM	MISCELLANEOUS	1.00	1,314,000.00 GL	0.030			39,420			39,420

=====> Item Totals: 40 - CHEMICALS

$39,420.00		[ ]		39,420		39,420
39,420.000	1 YR			39,420.00		39,420.00

		Labor	Constr Matl/Ex	Equip Ment	Total
$988,897.73	*** Report Totals *** 9,360.00 MH	640,679	304,080	44,139	988,898

>>> indicates Non Additive Activity
------Report Notes:------
The estimate was prepared with TAKEOFF Quantities.
This report shows TAKEOFF Quantities with the resources.

Bid Date: Owner: Engineering Firm:
Estimator-In-Charge:

JOB NOTES
Estimate created on: 08/01/2014 by User#: 0 -
Source estimate used: C:\HEAVYBID\EST\ESTMAST
Labor Setup copied from: C:\HEAVYBID\EST\2014-072
Equipment Setup copied from: C:\HEAVYBID\EST\2014-072
Material/Other Resources Setup copied from: C:\HEAVYBID\EST\2014-072
Overtime Rules Setup copied from: C:\HEAVYBID\EST\2014-072
Burden Tables Setup copied from: C:\HEAVYBID\EST\2014-072

************Estimate created on: 08/01/2014 by User#: 0 -
Source estimate used: C:\HEAVYBID\EST\2014-073

* on units of MH indicate average labor unit cost was used rather than base rate.
[ ] in the Unit Cost Column = Labor Unit Cost Without Labor Burdens
In equipment resources, rent % and EOE % not = 100% are represented as XXX%YYY where XXX=Rent% and YYY=EOE%
------Calendar Codes------

Direct Cost Report

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 10 Land Item SCHEDULE: 1 100
Description = SBR PLANT LABOR OPERATION Unit = YR Takeoff Quan: 1.000 Engr Quan: 1.000

11001005 SBR PLANT LABOR OPERATION Quan: 1.00 YR Hrs/Shft: 8.00 WC NONE

11005 STANDARD CREW SBR 2,080.00 CH Prod: 0.0005 UH Lab Pcs: 6.50 Eqp Pcs: 1.20

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
8AAAA	*******EQUIPMEN		0.00	HR	0.000						
8FORK02	Forklift Cat TH220B	0.10	208.00	HR	34.270				7,128		7,128
8TRKGS10	Flatbed Truck 15K 20	0.10	208.00	HR	25.297				5,262		5,262
8TRKPU15	Pickup 4x4 3/4 Ton G	1.00	2,080.00	HR	15.264				31,749		31,749
AAA	*********LABOR**		0.00	MH	0.000						
PO01S	Supervisor	0.50	1,040.00	MH	55.000	89,180					89,180
PO0F	Foreman	1.00	2,080.00	MH	40.020	141,593					141,593
PO20	Plant Journyman	5.00	10,400.00	MH	38.000	683,176					683,176
$958,088.13	13,520.0000 MH/YR		13,520.00	MH	[535641.6]	913,949			44,139		958,088
0.0005 Units/Hr *	0.0038 Un/Shift		0.0001	Unit/M		913,949.09			44,139.04		958,088.13

=====> Item Totals: 10 - SBR PLANT LABOR OPERATION

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
$958,088.13	13,520.0000 MH/YR		13,520.00	MH	[535641.6]	913,949			44,139		958,088
958,088.130	1 YR					913,949.09			44,139.04		958,088.13

BID ITEM = 20 Land Item SCHEDULE: 1 100
Description = POWER FOR PLANT Unit = YR Takeoff Quan: 1.000 Engr Quan: 1.000

11002005 POWER FOR PLANT Quan: 1.00 YR Hrs/Shft: 8.00 WC NONE

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3KW/H	KW/HR	1.00	1,412,550.00	KW/H	0.190			268,385			268,385

=====> Item Totals: 20 - POWER FOR PLANT

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
$268,384.50					[ ]			268,385			268,385
268,384.500	1 YR							268,384.50			268,384.50

BID ITEM = 30 Land Item SCHEDULE: 1 100
Description = REPLACEMENT/REPAIR PARTS Unit = YR Takeoff Quan: 1.000 Engr Quan: 1.000

11003005 REPLACEMENT/REPAIR PARTS Quan: 1.00 YR Hrs/Shft: 8.00 WC NONE

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3RRP	REPAIR&REPLC PA	1.00	1.00	LS	7,500.000			7,500			7,500

=====> Item Totals: 30 - REPLACEMENT/REPAIR PARTS

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
$7,500.00					[ ]			7,500			7,500
7,500.000	1 YR							7,500.00			7,500.00

Direct Cost Report

Activity Resource	Desc	Quantity Pcs	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 40 Land Item SCHEDULE: 1 100
Description = CHEMICALS Unit = YR Takeoff Quan: 1.000 Engr Quan: 1.000

11004005 CHEMICALS Quan: 1.00 YR Hrs/Shft: 8.00 WCNONE

3MICCHEM	MISCELLANEOUS	1.00 1,412,500.00	GL	0.030			42,375			42,375
=====> Item Totals: 40	- CHEMICALS									
$42,375.00				[ ]			42,375			42,375
42,375.000		1	YR				42,375.00			42,375.00

$1,276,347.63	*** Report Totals ***	13,520.00	MH	913,949		318,260	44,139	1,276,348

>>> indicates Non Additive Activity
------Report Notes:------
The estimate was prepared with TAKEOFF Quantities.
This report shows TAKEOFF Quantities with the resources.

Bid Date: Owner: Engineering Firm:
Estimator-In-Charge:

JOB NOTES

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Estimate created on: 08/01/2014 by User#: 0 -
Source estimate used: C:\HEAVYBID\EST\ESTMAST
Labor Setup copied from: C:\HEAVYBID\EST\2014-072
Equipment Setup copied from: C:\HEAVYBID\EST\2014-072
Material/Other Resources Setup copied from: C:\HEAVYBID\EST\2014-072
Overtime Rules Setup copied from: C:\HEAVYBID\EST\2014-072
Burden Tables Setup copied from: C:\HEAVYBID\EST\2014-072
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* on units of MH indicate average labor unit cost was used rather than base rate.
[ ] in the Unit Cost Column = Labor Unit Cost Without Labor Burdens
In equipment resources, rent % and EOE % not = 100% are represented as XXX%YYY where XXX=Rent% and YYY=EOE%
------Calendar Codes------

Appendix J
Closure and Post-Closure Cost Estimate

APPENDIX J

Closure and Post-Closure Cost Estimate

TABLE J-1
Scope for Matanuska-Susitna Borough Central Landfill Post Closure Cost Estimate
Matanuska-Susitna Borough Central landfill Development Plan

No.	Item	Area (ft^2)	Depth (ft)	Quantity	Units	Comments
Location: Central Landfill in Palmer:						
Add contractor overhead, fee, bonding, and mob/demob						
Closure Construction: Apply Final Cover to the Final Cell, Cell 15, in Year 2071						
1	Final Cover Soil	1,904,000	1.0	70,519	yd^3	Supply (from onsite stockpile) and grade
2	Geosynthetic Clay Liner	1,904,000	—	1,904,000	ft^2	Use $0.42/ ft^2or your Alaska cost
3	Flexible Membrane Liner	1,904,000	—	1,904,000	ft^2	Use $0.35/ ft^2or your Alaska cost
4	Granular Drainage Material	1,904,000	1.5	105,778	yd^3	Assume screened from onsite materials to remove fines
5	Silt-Loam Topsoil	1,904,000	0.7	47,012	yd^3	Assume available onsite
6	Hydroseeding	1,904,000	—	1,904,000	ft^2	
7	Stormwater-Construct Terraces	—	—	1,000	LF	Use $8.00/LF (2006)
8	Landfill Gas Collection System	—	—	3,300,000	2006 dollars	EPA Guide for Methane Mitigation Projects, 1996
9	Flare System	—	—	300,000	2006 dollars	EPA Guide for Methane Mitigation Projects, 1996
Monitoring Equipment - Year 2071						
1	Abandon gas probes	—	150.0	2	300	
2	Install new gas probes	—	150.0	2	300	
3	Abandon monitoring wells	—	50.0	2	100	
4	Install new monitoring wells	—	50.0	2	100	
Annual Post-Closure Maintenance for 30 Years (2071 – 2101)						
1	Repair cover side slopes	13,425,000	—	24,861	yd^3	Assume 5% per year, 1-foot cover
2	Hydroseeding	13,425,000		671,250	ft^2	Assume 5% per year

TABLE J-1
Scope for Matanuska-Susitna Borough Central Landfill Post Closure Cost Estimate
Matanuska-Susitna Borough Central landfill Development Plan

No.	Item	Area (ft^2)	Depth (ft)	Quantity	Units	Comments
3	Maintain leachate collection equip.	—	5,000	dollars	—	
4	Collect, treat, dispose leachate	—	—	819,000	gal	Use $0.10 per gallon
5	Clean perimeter drainage ditches	—	—	3,000	LF	Use $5.00 per LF
Annual Post-Closure Monitoring for 30 Years (2071 - 2101)						
1	Groundwater sampling & analysis	—	—	—	$25,000	Estimated average over 30 years
2	Methane sampling & analysis	—	—	—	$15,000	Estimated average over 30 years
3	Surface water sampling & analysis	—	—	—	$10,000	Estimated average over 30 years
4	Leachate sampling & analysis	—	—	—	$10,000	Estimated average over 30 years
Post-Closure Certification - Year 2101						
1	Post-Closure Certification Report	—	—	—	$25,000	2006 costs, to be incurred in 2100
	Administrative Services	10% of subtotal				
	Technical and Professional Services	12% of subtotal				
	Closure Contingency	5% of subtotal				

Notes:

EPA = U.S. Environmental Protection Agency
ft^2 = square foot
LF = linear feet
yd^3 = cubic yard

09/12/2014 15:49
2014-080 MSB LANDFILL CLOSURE
***

BID TOTALS

Biditem	Description	Status - Rnd	Quantity	Units	Unit Price	Bid Total
10	MOBILIZATION		1.000	LS	496,000.00	496,000.00
20	BONDS & INSURANCE		1.000	LS	431,154.00	431,154.00
30	SUBMITTALS		1.000	LS	34,533.88	34,533.88
40	PERMITS		1.000	LS	7,500.00	7,500.00
50	SURVEY		1.000	LS	38,500.00	38,500.00
60	LEVELING COURSE (6")		32,569.000	CY	5.59	182,060.71
70	GEOSYNTHETIC CLAY LINER		195,412.000	SY	7.50	1,465,590.00
80	FLEXIBLE MEMBRANE LINER		195,412.000	SY	9.59	1,874,001.08
90	GRANULAR DRAINAGE MATERIAL(18")		97,706.000	CY	26.92	2,630,245.52
100	EARTHEN MATERIAL/TOPSOIL(6")		32,569.000	CY	14.92	485,929.48
110	HYDROSEEDING		1,759.000	MSF	150.00	263,850.00
120	MONITORING WELLS		4.000	EA	3,750.00	15,000.00
130	STORMWATER CONTROL TERRACES		1,000.000	LF	14.27	14,270.00
140	LANDFILL GAS COLLECTION SYSTEM		1.000	LS	3,750,000.00	3,750,000.00
150	GAS FLARE SYSTEM		1.000	LS	350,000.00	350,000.00
200	DEMOBILIZATION		1.000	LS	345,000.00	345,000.00
910	CONTRACTOR OVERHEAD		1.000	LS	1,235,440.00	1,235,440.00
920	CH OVERHEAD		1.000	LS	1,482,530.00	1,482,530.00
930	CONTINGENCY		1.000	LS	617,720.00	617,720.00
970	TAXES		1.000	LS	370,632.00	370,632.00
980	MARK UP(PROFIT)		1.000	LS	1,235,424.00	1,235,424.00
			Bid Total	========>		$17,325,380.67

Activity / Resource	Desc	Quantity Pcs	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 10 Land Item SCHEDULE: 1 100
Description = MOBILIZATION Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

19001005 MOBILIZATION Quan: 1.00 LS Hrs/Shft: 8.00 WCNONE

assume 4% of direct cost

Resource	Desc	Pcs	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4MOB	MOBILIZATION	1.00	1.00 LS	496,000.000					496,000	496,000

BID ITEM = 20 Land Item SCHEDULE: 1 100
Description = BONDS & INSURANCE Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11002005 BONDS Quan: 1.00 LS Hrs/Shft: 8.00 WCNONE

BONDS 1.7% X $17,246,165 = $293,185

Resource	Desc	Pcs	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3BOND	BOND COST	1.00	1.00 LS	293,185.000			293,185			293,185

11002010 INSURANCE Quan: 1.00 LS Hrs/Shft: 8.00 WCNONE

INSURANCE 0.8% X $17,246,165 = $137,969

Resource	Desc	Pcs	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3INSURANC	INSURANCE COST	1.00	1.00 LS	137,969.000			137,969			137,969

=====> Item Totals: 20 - BONDS & INSURANCE

$431,154.00				[ ]			431,154			431,154
431,154.000			1 LS				431,154.00			431,154.00

BID ITEM = 30 Land Item SCHEDULE: 1 100
Description = SUBMITTALS Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11003005 WORK PLAN Quan: 1.00 LS Hrs/Shft: 8.00 WCNONE

11030 SUBMITTALS 24.00 CH Prod: 0.0417 UH Lab Pcs: 3.10 Eqp Pcs: 0.00

Resource	Desc	Pcs	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3DOCMTRL	DOCUMENT MATE	1.00	1.00 LS	200.000			200			200
X414	Project Eng E6	1.00	24.00 MH	72.700	2,408					2,408
X430	Project Controls E 4	0.20	4.80 MH	52.900	350					350
X434	Cost/Schedule E3	0.20	4.80 MH	43.800	290					290
X442	Document Tech T2	0.10	2.40 MH	24.900	82					82
X450	Field Engineer T4	0.20	4.80 MH	39.800	264					264
X462	Quality Mngr E4	0.20	4.80 MH	52.900	350					350
X866	Admin Assist. T1	1.00	24.00 MH	22.900	758					758
X918	Safety Engineer E3	0.20	4.80 MH	43.900	291					291
$4,994.12	74.4000 MH/LS		74.40 MH	[3474]	4,794		200			4,994
0.0417 Units/Hr *	0.3333 Un/Shift		0.0134 Unit/M		4,794.12		200.00			4,994.12

BID ITEM = 30 | Land Item | SCHEDULE: 1 | 100
Description = SUBMITTALS | Unit = LS | Takeoff Quan: 1.000 | Engr Quan: 1.000

11003010 PROJECT SCHEDULE Quan: 1.00 LS Hrs/Shft: 8.00 WC NONE

Activity / Resource	Desc		Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
11030	SUBMITTALS			32.00	CH	Prod: 0.0313 UH	Lab Pcs: 1.85			Eqp Pcs: 0.00		
3DOCMTRL	DOCUMENT MATE		1.00	1.00	LS	350.000			350			350
X414	Project Eng	E6	0.15	4.80	MH	72.700	482					482
X430	Project Controls	E 4	0.10	3.20	MH	52.900	234					234
X434	Cost/Schedule	E3	1.00	32.00	MH	43.800	1,934					1,934
X442	Document Tech	T2	0.10	3.20	MH	24.900	110					110
X866	Admin Assist.	T1	0.50	16.00	MH	22.900	506					506
$3,614.97			59.2000 MH/LS	59.20	MH	[2365.92]	3,265		350			3,615
0.0313 Units/Hr *			0.2500 Un/Shift	0.0169	Unit/M		3,264.97		350.00			3,614.97

11003015 SWPPP Quan: 1.00 LS Hrs/Shft: 8.00 WC NONE

FOR ALL SUBMITTALS ASSUME A DRAFT A DRAFT FINAL AND A FINAL FOR MOST SUBMITTALS

Activity / Resource	Desc		Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
11020	PLAN/DOC CREW			2.00	CH	Prod: 0.5000 UH	Lab Pcs: 68.00			Eqp Pcs: 0.00		
3DOCMTRL	DOCUMENT MATE		1.00	1.00	LS	750.000			750			750
AAA	*********LABOR**			0.00	MH	0.000						
X274	Adminst Asst.	T2	18.00	36.00	MH	24.900	1,237					1,237
X414	Project Eng	E6	32.00	64.00	MH	72.700	6,421					6,421
X426	Jr Staff Eng	E3	18.00	36.00	MH	43.800	2,176					2,176
$10,583.87			136.0000 MH/LS	136.00	MH	[7126]	9,834		750			10,584
0.5000 Units/Hr *			4.0000 Un/Shift	0.0074	Unit/M		9,833.87		750.00			10,583.87

11003020 HASP Quan: 1.00 LS Hrs/Shft: 8.00 WC NONE

Activity / Resource	Desc		Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
11020	PLAN/DOC CREW			1.00	CH	Prod: 1.0000 UH	Lab Pcs: 58.00			Eqp Pcs: 0.00		
3DOCMTRL	DOCUMENT MATE		1.00	1.00	LS	950.000			950			950
AAA	*********LABOR**			0.00	MH	0.000						
X274	Adminst Asst.	T2	20.00	20.00	MH	24.900	687					687
X414	Project Eng	E6	10.00	10.00	MH	72.700	1,003					1,003
X426	Jr Staff Eng	E3	8.00	8.00	MH	43.800	484					484
X918	Safety Engineer	E3	20.00	20.00	MH	43.900	1,212					1,212
$4,335.69			58.0000 MH/LS	58.00	MH	[2453.4]	3,386		950			4,336
1.0000 Units/Hr *			8.0000 Un/Shift	0.0172	Unit/M		3,385.69		950.00			4,335.69

11003025 QA/QC PLAN Quan: 1.00 LS Hrs/Shft: 8.00 WC NONE

Activity / Resource	Desc		Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
11020	PLAN/DOC CREW			1.00	CH	Prod: 1.0000 UH	Lab Pcs: 56.00			Eqp Pcs: 0.00		
3DOCMTRL	DOCUMENT MATE		1.00	1.00	LS	700.000			700			700
AAA	*********LABOR**			0.00	MH	0.000						
X274	Adminst Asst.	T2	20.00	20.00	MH	24.900	687					687
X414	Project Eng	E6	12.00	12.00	MH	72.700	1,204					1,204
X462	Quality Mngr	E4	24.00	24.00	MH	52.900	1,752					1,752
$4,343.20			56.0000 MH/LS	56.00	MH	[2640]	3,643		700			4,343

Direct Cost Report

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 30 Land Item SCHEDULE: 1 100
Description = SUBMITTALS Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

1.0000 Units/Hr *	8.0000 Un/Shift		0.0179	Unit/M		3,643.20		700.00			4,343.20

11003030 TRAFFIC PLAN Quan: 1.00 LS Hrs/Shft: 8.00 WC NONE

11020 PLAN/DOC CREW 2.00 CH Prod: 0.5000 UH Lab Pcs: 52.00 Eqp Pcs: 0.00

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3DOCMTRL	DOCUMENT MATE	1.00	1.00	LS	250.000			250			250
AAA	*********LABOR**		0.00	MH	0.000						
X274	Adminst Asst. T2	16.00	32.00	MH	24.900	1,100					1,100
X414	Project Eng E6	12.00	24.00	MH	72.700	2,408					2,408
X426	Jr Staff Eng E3	12.00	24.00	MH	43.800	1,451					1,451
X918	Safety Engineer E3	12.00	24.00	MH	43.900	1,454					1,454
$6,662.03	104.0000 MH/LS		104.00	MH	[4646.4]	6,412		250			6,662
0.5000 Units/Hr *	4.0000 Un/Shift		0.0096	Unit/M		6,412.03		250.00			6,662.03

=====> Item Totals: 30 - SUBMITTALS

$34,533.88	487.6000 MH/LS		487.60	MH	[22705.72]	31,334		3,200			34,534
34,533.880	1 LS					31,333.88		3,200.00			34,533.88

BID ITEM = 40 Land Item SCHEDULE: 1 100
Description = PERMITS Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11004010 DUST PERMIT Quan: 1.00 LS Hrs/Shft: 8.00 WC NONE

NO INFORMATION ON ANY PERMITS ASSUME WE MAY NEED A DUST PERMIT AS A MINNIMUM

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3DUSTPRM	DUST PERMIT	1.00	1.00	LS	7,500.000			7,500			7,500

=====> Item Totals: 40 - PERMITS

$7,500.00					[ ]			7,500			7,500
7,500.000	1 LS							7,500.00			7,500.00

BID ITEM = 50 Land Item SCHEDULE: 1 100
Description = SURVEY Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11005005 SURVEY Quan: 1.00 LS Hrs/Shft: 8.00 WC NONE

THIS WOULD INCLUDE LAYOUT OF VARIOUS LIFTS . ALSO EARTHWORK QUANTITIES AND FINAL AS BUILT DRAWAINGS

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4SURVEY	SURVEY SUB	1.00	350.00	HR	110.000					38,500	38,500

Activity Resource	Desc	Pcs	Quantity Unit		Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 60 Land Item SCHEDULE: 1 100
Description = LEVELING COURSE (6") Unit = CY Takeoff Quan: 32,569.000 Engr Quan: 32,569.000

19006005 LEVELING COURSE (6") Quan: 32,569.00 CY Hrs/Shft: 8.00 WC NONE

THIS IS ON SITE MATERIAL THAT IS CLOSE THE QUANTITY OF MATERIAL SHOWN IS AVERAGE 6" OVER THE SITE

19200 SCRAPER EXCAV 70.00 CH Prod: 465.2714 UH Lab Pcs: 12.00 Eqp Pcs: 10.00

Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
8AAAA	*******EQUIPMEN		0.00	HR	0.000						
8BDZR09T	Bulldozer Cat D9T	1.00	70.00	HR	292.721				20,490		20,490
8COMPACB8	Compactor Cat 825H	1.00	70.00	HR	214.573				15,020		15,020
8GRDR16	Grader Cat 16M 297	1.00	70.00	HR	216.325				15,143		15,143
8SCRPRTE62	Scraper Cat 627G TE	4.00	280.00	HR	266.878				74,726		74,726
8TRKPU25	Pickup 4x4 3/4 Ton D	1.00	70.00	HR	14.854				1,040		1,040
8TRKWTR04	Water Truck 4,000 ga	1.00	70.00	HR	60.834				4,258		4,258
8WATERTK1	Klein Tank 12K Gallo	1.00	70.00	HR	18.585				1,301		1,301
AAA	*********LABOR**	1.00	70.00	MH	0.000						
LA30	Laborer General	1.00	70.00	MH	29.210	3,975					3,975
OP01F	Oper Foreman	1.00	70.00	MH	42.040	4,897					4,897
OPB14	Oper Blade (Rough)	1.00	70.00	MH	38.510	4,605					4,605
OPC10	Oper Compactor Larg	1.00	70.00	MH	37.790	4,546					4,546
OPD10	Oper Dozer Large	1.00	70.00	MH	39.280	4,669					4,669
OPSC10	Oper Scraper < 40 Cy	4.00	280.00	MH	38.510	18,422					18,422
OPSPT14	Oper Grade Checker	1.00	70.00	MH	37.790	4,546					4,546
TE22	Tmstr Dmp Trk 6-14c	1.00	70.00	MH	36.790	4,339					4,339
$181,977.24	0.0257 MH/CY		840.00	MH	[0.893]	49,999			131,978		181,977
465.2714 Units/Hr *	3,722.1714 Un/Shift		38.7726	Unit/M		1.54			4.05		5.59

=====> Item Totals: 60 - LEVELING COURSE (6")

$181,977.24	0.0257 MH/CY	840.00	MH	[0.893]	49,999			131,978	181,977
5.587	32569 CY				1.54			4.05	5.59

BID ITEM = 70 Land Item SCHEDULE: 1 100
Description = GEOSYNTHETIC CLAY LINER Unit = SY Takeoff Quan: 195,412.000 Engr Quan: 195,412.000

19007005 GEOSYNTHETIC CLAY LINER Quan: 195,412.00 SY Hrs/Shft: 8.00 WC NONE

13010 SMALL SWPP CREW 600.00 CH Prod: 325.6867 UH Lab Pcs: 11.00 Eqp Pcs: 4.00

Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
2GCL	GEOSYNTHETIC C	1.05	195,412.00	SY	4.900		957,519				957,519
3GRDST&S	GRADING ST&S	1.00	6,600.00	HM	2.000			13,200			13,200
3PPE	PPE	1.00	6,600.00	HM	2.500			16,500			16,500
8AAAA	*******EQUIPMEN		0.00	HR	0.000						
8LDRW950	Loader Cat 950H 4C	1.00	600.00	HR	84.857				50,914		50,914
8TRKGS10	Flatbed Truck 15K 20	2.00	1,200.00	HR	25.297				30,356		30,356
8TRKPU10	Pickup 4x2 3/4 Ton G	1.00	600.00	HR	13.322				7,993		7,993

BID ITEM = 70 Land Item SCHEDULE: 1 100
Description = GEOSYNTHETIC CLAY LINER Unit = SY Takeoff Quan: 195,412.000 Engr Quan: 195,412.000

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
AAA	*********LABOR**		0.00	MH	0.000						
LA01F	Laborer Foreman	1.00	600.00	MH	36.260	39,064					39,064
LA30	Laborer General	7.00	4,200.00	MH	29.210	238,509					238,509
OPL10	Oper Loader Wheel <	1.00	600.00	MH	37.790	38,965					38,965
TE18	Teamster Flatrack 1 A	2.00	1,200.00	MH	35.790	72,963					72,963
$1,465,983.40	0.0337 MH/SY		6,600.00	MH	[1.075]	389,501	957,519	29,700	89,264		1,465,983
325.6867 Units/Hr *	2,605.4933 Un/Shift		29.6079	Unit/M		1.99	4.90	0.15	0.46		7.50

=====> Item Totals: 70 - GEOSYNTHETIC CLAY LINER

$1,465,983.40	0.0337 MH/SY	6,600.00 MH	[1.075]	389,501	957,519	29,700	89,264		1,465,983
7.502	195412 SY			1.99	4.90	0.15	0.46		7.50

BID ITEM = 80 Land Item SCHEDULE: 1 100
Description = FLEXIBLE MEMBRANE LINER Unit = SY Takeoff Quan: 195,412.000 Engr Quan: 195,412.000

19008005 FLEXIBLE MEMBRANE LINER Quan: 195,412.00 SY Hrs/Shft: 8.00 WC NONE

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4LINER	LINER SUB	1.00	195,412.00	SY	9.500					1,856,414	1,856,414

19008010 LINER TESTING SUPPORT Quan: 195,412.00 SY Hrs/Shft: 8.00 WC NONE

13010 SMALL SWPP CREW 48.00 CH Prod: 4,071.0833 UH Lab Pcs: 4.00 Eqp Pcs: 4.00

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3GRDST&S	GRADING ST&S	1.00	192.00	HM	2.000			384			384
3PPE	PPE	1.00	192.00	HM	2.500			480			480
8AAAA	*******EQUIPMEN		0.00	HR	0.000						
8COMPR04	Compressor 185 CFM	1.00	48.00	HR	16.134				774		774
8TRKGS10	Flatbed Truck 15K 20	1.00	48.00	HR	25.297				1,214		1,214
8TRKPU10	Pickup 4x2 3/4 Ton G	1.00	48.00	HR	13.322				639		639
8TRKWTR04	Water Truck 4,000 ga	1.00	48.00	HR	60.834				2,920		2,920
AAA	*********LABOR**		0.00	MH	0.000						
LA01F	Laborer Foreman	1.00	48.00	MH	36.260	3,125					3,125
LA30	Laborer General	2.00	96.00	MH	29.210	5,452					5,452
TE22	Tmstr Dmp Trk 6-14c	1.00	48.00	MH	36.790	2,975					2,975
$17,964.04	0.0009 MH/SY		192.00	MH	[0.032]	11,552		864	5,548		17,964
4,071.0833 Units/Hr *	32,568.6667 Un/Shift		1,017.7806	Unit/M		0.06			0.03		0.09

=====> Item Totals: 80 - FLEXIBLE MEMBRANE LINER

$1,874,378.04	0.0009 MH/SY	192.00 MH	[0.032]	11,552		864	5,548	1,856,414	1,874,378
9.592	195412 SY			0.06			0.03	9.50	9.59

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 90 Land Item SCHEDULE: 1 100
Description = GRANULAR DRAINAGE MATERIAL(18") Unit = CY Takeoff Quan: 97,706.000 Engr Quan: 97,706.000

19009005 LOAD & HAUL (2 MI) TO SCREEN PLA Quan: 107,477.00 CY Hrs/Shft: 8.00 WC NONE

ASSUMES 10% WASTE WATER TRUCK AND BLADE FULL TIME ON HAUL ROAD ASSUMES THE HAUL ROAD (2 MILES) IS ROUGHED IN PLACE . D-7 DOZER PUSH TO 980 FEL AND D-7 DOZER AT PLANT STOCK PILE

19120 LOAD & HAUL 400.00 CH Prod: 268.6925 UH Lab Pcs: 12.00 Eqp Pcs: 11.00

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3GRDST&S	GRADING ST&S	1.00	4,800.00	HM	2.000			9,600			9,600
3PPE	PPE	1.00	4,800.00	HM	2.500			12,000			12,000
8AAAA	*******EQUIPMEN		0.00	HR	0.000						
8BDZR07R	Bulldozer Cat D7R X	2.00	800.00	HR	146.537				117,230		117,230
8GRDR12	Grader Cat 12H 145	1.00	400.00	HR	77.429				30,972		30,972
8LDRW980	Loader Cat 980H 7.5	1.00	400.00	HR	156.432				62,573		62,573
8TRKOR730	Off Road Cat 730 Arti	5.00	2,000.00	HR	131.807				263,614		263,614
8TRKPU15	Pickup 4x4 3/4 Ton G	1.00	400.00	HR	15.264				6,106		6,106
8TRKWTR04	Water Truck 4,000 ga	1.00	400.00	HR	60.834				24,334		24,334
AAA	*********LABOR**		0.00	MH	0.000						
LA30	Laborer General	1.00	400.00	MH	29.210	22,715					22,715
OP01F	Oper Foreman	1.00	400.00	MH	42.040	27,983					27,983
OPB14	Oper Blade (Rough)	1.00	400.00	MH	38.510	26,317					26,317
OPD10	Oper Dozer Large	2.00	800.00	MH	39.280	53,360					53,360
OPL14	Oper Loader Wheel >	1.00	400.00	MH	39.280	26,680					26,680
TE22	Tmstr Dmp Trk 6-14c	1.00	400.00	MH	36.790	24,793					24,793
TR26	Teamster Dump 29-3	5.00	2,000.00	MH	38.890	128,920					128,920
$837,195.68	0.0446 MH/CY		4,800.00	MH	[1.708]	310,768		21,600	504,827		837,196
268.6925 Units/Hr *	2,149.5400 Un/Shift		22.3910	Unit/M		2.89		0.20	4.70		7.79

19009010 MOB & SET UP SCREEN PLANT Quan: 1.00 LS Hrs/Shft: 8.00 WC NONE

19100 MOB & SET SCREEN 20.00 CH Prod: 0.0500 UH Lab Pcs: 11.00 Eqp Pcs: 14.00

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3GRDST&S	GRADING ST&S	1.00	220.00	HM	2.000			440			440
3MISCLMTR	MISCL MATERIAL	1.00	1.00	LS	750.000			750			750
3PPE	PPE	1.00	220.00	HM	2.500			550			550
8AAAA	*******EQUIPMEN		0.00	HR	0.000						
8AGGPL22	Conveyor 300 TPH, 2	1.00	20.00	HR	23.199				464		464
8AGGPL42	Vib Griz Feeder 42"x	1.00	20.00	HR	40.566				811		811
8AGGPL50	Screen Double Deck 5	1.00	20.00	HR	39.084				782		782
8BDZR08T	Bulldozer Cat D8T	1.00	20.00	HR	223.120				4,462		4,462
8CRANERT5	Crane Grove RT525E	1.00	20.00	HR	93.141				1,863		1,863
8GEN100	Generator 100 KW	1.00	20.00	HR	42.046				841		841
8LDRW980	Loader Cat 980H 7.5	1.00	20.00	HR	156.432				3,129		3,129
8TRKGS10	Flatbed Truck 15K 20	1.00	20.00	HR	25.297				506		506
8TRKGS60	Mechanics Truck 35K	1.00	20.00	HR	83.419				1,668		1,668
8TRKHW15	Tractor 400 HP 75K	2.00	40.00	HR	74.417				2,977		2,977
8TRKHW30	Lowbed Trailer 60 T	2.00	40.00	HR	29.470				1,179		1,179

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
BID ITEM = 90					Land Item	SCHEDULE: 1		100			
Description = GRANULAR DRAINAGE MATERIAL(18")				Unit = CY	Takeoff Quan: 97,706.000				Engr Quan: 97,706.000		
8TRKPU15	Pickup 4x4 3/4 Ton G	1.00	20.00	HR	15.264				305		305
AAA	*********LABOR**		0.00	MH	0.000						
LA30	Laborer General	2.00	40.00	MH	29.210	2,272					2,272
OP01F	Oper Foreman	1.00	20.00	MH	42.040	1,399					1,399
OPCR10	Opr Crane 15-50 Ton	1.00	20.00	MH	38.510	1,316					1,316
OPD10	Oper Dozer Large	1.00	20.00	MH	39.280	1,334					1,334
OPL14	Oper Loader Wheel >	1.00	20.00	MH	39.280	1,334					1,334
OPSPT22	Oper Mech (Heavy)	1.00	20.00	MH	41.040	1,376					1,376
OPSPT38	Oper Screen Belt Or	1.00	20.00	MH	37.790	1,299					1,299
TE18	Teamster Flatrack 1 A	1.00	20.00	MH	35.790	1,216					1,216
TE34	Teamster High-Low B	2.00	40.00	MH	38.890	2,578					2,578
$34,850.18	220.0000 MH/LS		220.00	MH	[8198.6]	14,123		1,740	18,987		34,850
0.0500 Units/Hr *	0.4000 Un/Shift		0.0045	Unit/M		14,123.34		1,740.00	18,986.84		34,850.18
19009015	**SCREEN MATERIAL**				Quan: 145,095.00 TN	Hrs/Shft: 8.00			WC NONE		
19100	MOB & SET SCREEN		820.00	CH	Prod: 176.9451 UH			Lab Pcs: 7.00		Eqp Pcs: 8.00	
3GRDST&S	GRADING ST&S	1.00	5,740.00	HM	2.000			11,480			11,480
3MSCLMTRL	MISCELLANEOUS	1.00	145,095.00	TN	0.100			14,510			14,510
3PPE	PPE	1.00	5,740.00	HM	2.500			14,350			14,350
8AAAA	*******EQUIPMEN		0.00	HR	0.000						
8AGGPL22	Conveyor 300 TPH, 2	1.00	820.00	HR	23.199				19,023		19,023
8AGGPL42	Vib Griz Feeder 42"x	1.00	820.00	HR	40.566				33,264		33,264
8AGGPL50	Screen Double Deck 5	1.00	820.00	HR	39.084				32,049		32,049
8BDZR08T	Bulldozer Cat D8T	1.00	820.00	HR	223.120				182,958		182,958
8GEN100	Generator 100 KW	1.00	820.00	HR	42.046				34,478		34,478
8LDRW980	Loader Cat 980H 7.5	1.00	820.00	HR	156.432				128,274		128,274
8TRKGS60	Mechanics Truck 35K	1.00	820.00	HR	83.419				68,404		68,404
8TRKPU15	Pickup 4x4 3/4 Ton G	1.00	820.00	HR	15.264				12,516		12,516
AAA	*********LABOR**		0.00	MH	0.000						
LA30	Laborer General	2.00	1,640.00	MH	29.210	93,132					93,132
OP01F	Oper Foreman	1.00	820.00	MH	42.040	57,365					57,365
OPD10	Oper Dozer Large	1.00	820.00	MH	39.280	54,694					54,694
OPL14	Oper Loader Wheel >	1.00	820.00	MH	39.280	54,694					54,694
OPSPT22	Oper Mech (Heavy)	1.00	820.00	MH	41.040	56,397					56,397
OPSPT38	Oper Screen Belt Or	1.00	820.00	MH	37.790	53,253					53,253
$920,841.55	0.0395 MH/TN		5,740.00	MH	[1.457]	369,535		40,340	510,967		920,842
176.9451 Units/Hr *	1,415.5610 Un/Shift		25.2779	Unit/M		2.55		0.28	3.52		6.35
19009020	**LOAD,HAUL&PLACE GRANULAR MA**				Quan: 97,706.00 CY	Hrs/Shft: 8.00			WC NONE		
19017	LOAD,HAUL,PLACE TS		500.00	CH	Prod: 195.4120 UH			Lab Pcs: 13.00		Eqp Pcs: 15.00	
3GRDST&S	GRADING ST&S	1.00	6,500.00	HM	2.000			13,000			13,000
3PPE	PPE	1.00	6,500.00	HM	2.500			16,250			16,250
8AAAA	*******EQUIPMEN		0.00	HR	0.000						

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 90 Land Item SCHEDULE: 1 100
Description = GRANULAR DRAINAGE MATERIAL(18") Unit = CY Takeoff Quan: 97,706.000 Engr Quan: 97,706.000

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
8BDZR04LGP	Bulldozer Cat D 4G L	1.00	500.00	HR	58.006				29,003		29,003
8GRDR12	Grader Cat 12H 145	1.00	500.00	HR	77.429				38,715		38,715
8LDRW980	Loader Cat 980H 7.5	1.00	500.00	HR	156.432				78,216		78,216
8TRKHW10	Tandem Truck 12 CY	5.00	2,500.00	HR	73.856				184,640		184,640
8TRKHW25	Bottom Dump Trailer	5.00	2,500.00	HR	12.270				30,675		30,675
8TRKPU25	Pickup 4x4 3/4 Ton D	1.00	500.00	HR	14.854				7,427		7,427
8TRKWTR04	Water Truck 4,000 ga	1.00	500.00	HR	60.834				30,417		30,417
AAA	*********LABOR**		0.00	MH	0.000						
LA30	Laborer General	2.00	1,000.00	MH	29.210	56,788					56,788
OP01F	Oper Foreman	1.00	500.00	MH	42.040	34,979					34,979
OPB10	Oper Blade Finish	1.00	500.00	MH	39.280	33,350					33,350
OPD10	Oper Dozer Large	1.00	500.00	MH	39.280	33,350					33,350
OPL10	Oper Loader Wheel <	1.00	500.00	MH	37.790	32,471					32,471
OPSPT14	Oper Grade Checker	1.00	500.00	MH	37.790	32,471					32,471
TE22	Tmstr Dmp Trk 6-14c	1.00	500.00	MH	36.790	30,991					30,991
TE26	Tmstr Dmp Trk 14-29	5.00	2,500.00	MH	36.790	154,956					154,956
$837,698.10	0.0665 MH/CY		6,500.00	MH	[2.433]	409,356		29,250	399,093		837,698
195.4120 Units/Hr *	1,563.2960 Un/Shift		15.0317	Unit/M		4.19		0.30	4.08		8.57

=====> Item Totals: 90 - GRANULAR DRAINAGE MATERIAL(18")

$2,630,585.51	0.1766 MH/CY		17,260.00	MH	[6.559]	1,103,783		92,930	1,433,873		2,630,586
26.923			97706	CY		11.30		0.95	14.68		26.92

BID ITEM = 100 Land Item SCHEDULE: 1 100
Description = EARTHEN MATERIAL/TOPSOIL(6") Unit = CY Takeoff Quan: 32,569.000 Engr Quan: 32,569.000

19010005 EARTHEN MATERIAL/TOPSOIL(6") Quan: 32,569.00 CY Hrs/Shft: 8.00 WC NONE

ASSUME CLOSE BY SOURCE WITH A $3.50 ROYALTY LOADED

19017 LOAD,HAUL,PLACE TS 232.00 CH Prod: 140.3836 UH Lab Pcs: 13.00 Eqp Pcs: 15.00

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
2TOPSOIL	TOP SOIL	1.00	32,569.00	CY	3.500		113,992				113,992
3GRDST&S	GRADING ST&S	1.00	3,016.00	HM	2.000			6,032			6,032
3PPE	PPE	1.00	3,016.00	HM	2.500			7,540			7,540
8AAAA	*******EQUIPMEN		0.00	HR	0.000						
8BDZR04LGP	Bulldozer Cat D 4G L	1.00	232.00	HR	58.006				13,457		13,457
8GRDR12	Grader Cat 12H 145	1.00	232.00	HR	77.429				17,964		17,964
8LDRW950	Loader Cat 950H 4C	1.00	232.00	HR	84.857				19,687		19,687
8TRKHW10	Tandem Truck 12 CY	5.00	1,160.00	HR	73.856				85,673		85,673
8TRKHW25	Bottom Dump Trailer	5.00	1,160.00	HR	12.270				14,233		14,233
8TRKPU25	Pickup 4x4 3/4 Ton D	1.00	232.00	HR	14.854				3,446		3,446
8TRKWTR04	Water Truck 4,000 ga	1.00	232.00	HR	60.834				14,113		14,113
AAA	*********LABOR**		0.00	MH	0.000						
LA30	Laborer General	2.00	464.00	MH	29.210	26,350					26,350

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 100 Land Item SCHEDULE: 1 100
Description = EARTHEN MATERIAL/TOPSOIL(6") Unit = CY Takeoff Quan: 32,569.000 Engr Quan: 32,569.000

Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
OP01F	Oper Foreman	1.00	232.00	MH	42.040	16,230					16,230
OPB10	Oper Blade Finish	1.00	232.00	MH	39.280	15,474					15,474
OPD10	Oper Dozer Large	1.00	232.00	MH	39.280	15,474					15,474
OPL10	Oper Loader Wheel <	1.00	232.00	MH	37.790	15,067					15,067
OPSPT14	Oper Grade Checker	1.00	232.00	MH	37.790	15,067					15,067
TE22	Tmstr Dmp Trk 6-14c	1.00	232.00	MH	36.790	14,380					14,380
TE26	Tmstr Dmp Trk 14-29	5.00	1,160.00	MH	36.790	71,899					71,899
$486,077.95	0.0926 MH/CY		3,016.00	MH	[3.386]	189,941	113,992	13,572	168,573		486,078
140.3836 Units/Hr *	1,123.0690 Un/Shift		10.7987	Unit/M		5.83	3.50	0.42	5.18		14.92

=====> Item Totals: 100 - EARTHEN MATERIAL/TOPSOIL(6")

$486,077.95	0.0926 MH/CY	3,016.00	MH	[3.386]	189,941	113,992	13,572	168,573		486,078
14.925	32569		CY		5.83	3.50	0.42	5.18		14.92

BID ITEM = 110 Land Item SCHEDULE: 1 100
Description = HYDROSEEDING Unit = MSF Takeoff Quan: 1,759.000 Engr Quan: 1,759.000

19011005 HYDROSEEDING Quan: 1,759.00 MS Hrs/Shft: 8.00 WC NONE

NO SEEDING SPECIFICATIONS USED ADJUSTED PRICE FROM 2006 ESTIMATE

Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4HYDRO	HYDRO SEEDER	1.00	1,759.00	MSF	150.000					263,850	263,850

BID ITEM = 120 Land Item SCHEDULE: 1 100
Description = MONITORING WELLS Unit = EA Takeoff Quan: 4.000 Engr Quan: 4.000

19012005 MONITORING WELLS (50VLF) Quan: 4.00 EA Hrs/Shft: 8.00 WC NONE

ASSUME $75/VLF @ 50 VLF = $3750 EA ASSUMED A 50' DEPTH

Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4DRILL	WELL DRILLER	1.00	4.00	EA	3,750.000					15,000	15,000

BID ITEM = 130 Land Item SCHEDULE: 1 100
Description = STORMWATER CONTROL TERRACES Unit = LF Takeoff Quan: 1,000.000 Engr Quan: 1,000.000

19013005 STORMWATER CONTROL TERRACES Quan: 1,000.00 LF Hrs/Shft: 8.00 WC NONE

THIS ITEM COPIED FROM 2006 ESTIMATE AS WE HAVE NO DRAWINGS OR SPECIFICATIONS FOR THESE DITCHES

19015 SMALL EXCAV CREW 20.00 CH Prod: 50.0000 UH Lab Pcs: 7.00 Eqp Pcs: 4.00

Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3GRDST&S	GRADING ST&S	1.00	140.00	HM	2.000			280			280

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 130 Land Item SCHEDULE: 1 100
Description = STORMWATER CONTROL TERRACES Unit = LF Takeoff Quan: 1,000.000 Engr Quan: 1,000.000

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3PPE	PPE	1.00	140.00	HM	2.500			350			350
8AAAA	*******EQUIPMEN		0.00	HR	0.000						
8EXC315	Excavator Cat 315D L	1.00	20.00	HR	79.812				1,596		1,596
8TRKHW10	Tandem Truck 12 CY	2.00	40.00	HR	73.856				2,954		2,954
8TRKPU15	Pickup 4x4 3/4 Ton G	1.00	20.00	HR	15.264				305		305
AAA	*********LABOR**		0.00	MH	0.000						
LA30	Laborer General	2.00	40.00	MH	29.210	2,272					2,272
OP01F	Oper Foreman	1.00	20.00	MH	42.040	1,399					1,399
OPH14	Oper Hydr Backhoe 3	1.00	20.00	MH	39.280	1,334					1,334
OPSPT14	Oper Grade Checker	1.00	20.00	MH	37.790	1,299					1,299
TE22	Tmstr Dmp Trk 6-14c	2.00	40.00	MH	36.790	2,479					2,479
$14,268.55	0.1400 MH/LF		140.00	MH	[5.022]	8,783		630	4,856		14,269
50.0000 Units/Hr *	400.0000 Un/Shift		7.1429	Unit/M		8.78		0.63	4.86		14.27

=====> Item Totals: 130 - STORMWATER CONTROL TERRACES

$14,268.55	0.1400 MH/LF		140.00	MH	[5.022]	8,783		630	4,856		14,269
14.269	1000 LF					8.78		0.63	4.86		14.27

BID ITEM = 140 Land Item SCHEDULE: 1 100
Description = LANDFILL GAS COLLECTION SYSTEM Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

19014005 LANDFILL GAS COLLECTION SYSTE Quan: 1.00 LS Hrs/Shft: 8.00 WC NONE

ADJUSTED COST FROM 2006 ESTIMATE AS WE HAVE NO DRAWINGS OR SPECIFICATIONS FOR THIS WORK

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4MECH	INSTALLATION SU	1.00	1.00	LS	3,750,000.000					3,750,000	3,750,000

BID ITEM = 150 Land Item SCHEDULE: 1 100
Description = GAS FLARE SYSTEM Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

19015005 GAS FLARE SYSTEM Quan: 1.00 LS Hrs/Shft: 8.00 WC NONE

ADJUSTED PRICE FROM 2006 ESTIMATE AS WE HAVE NO DRAWINGS OR SPECIFICATIONS

Activity / Resource	Desc	Pcs	Quantity	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4MECH	INSTALLATION SU	1.00	1.00	LS	350,000.000					350,000	350,000

BID ITEM = 200 Land Item SCHEDULE: 1 100
Description = DEMOBILIZATION Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

Activity Resource	Desc	Quantity Pcs	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 200 Land Item SCHEDULE: 1 100
Description = DEMOBILIZATION Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

19020005 DEMOBILIZATION Quan: 1.00 LS Hrs/Shft: 8.00 WC NONE

assume 3% of direct costs

4DEMOB	DEMOBILZATION	1.00	1.00 LS	345,000.000					345,000	345,000

BID ITEM = 910 Land Item SCHEDULE: 1 100
Description = CONTRACTOR OVERHEAD Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11091005 CONTRACTOR OVERHEAD(GENERAL Quan: 1.00 LS Hrs/Shft: 8.00 WC NONE

10% OF DIRECT COT EXCLUDING BONDS&INSURANCE,CH OVERSIGHT,MANAGEMENT RESERVE
AS PER 2006 ESTIMATE

4CNTROH	CONTRACTOR OH	1.00	1.00 LS	1,235,440.000					1,235,440	1,235,440

BID ITEM = 920 Land Item SCHEDULE: 1 100
Description = CH OVERHEAD Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11092005 CH OVERHEAD (TECHNICAL&PROFE Quan: 1.00 LS Hrs/Shft: 8.00 WC NONE

CH OVERSIGHT 12% OF COSTS EXCLUDING,BONDS&INSURANCE,PERMITS,EQUIPMENT
PURCHASE,CONTRACTOR OH,MANAGEMENT RESERVE AND MARK UP
AS PER 2006 ESTIMATE

4CH	CH OVERHEAD & P	1.00	1.00 LS	1,482,530.000					1,482,530	1,482,530

BID ITEM = 930 Land Item SCHEDULE: 1 100
Description = CONTINGENCY Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11093005 MANAGEMENT RESERVE (CONTINGE Quan: 1.00 LS Hrs/Shft: 8.00 WC NONE

ASSUME A MANAGEMENT RESERVE OF 5% OF DIRECT COSTS
AS PER 2006 ESTIMATE

4MR15	MANAGE MENT RE	1.00	1.00 LS	617,720.000					617,720	617,720

BID ITEM = 970 Land Item SCHEDULE: 1 100
Description = TAXES Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

Activity Resource	Desc	Quantity Pcs	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 970 Land Item SCHEDULE: 1 100
Description = TAXES Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11097005 TAXES (3% DIRECT COSTS) Quan: 1.00 LS Hrs/Shft: 8.00 WC NONE

TAXES 3% DIRECT COSTS
THIS TAX RATE HAS NOT BEEN CONFIRMED

Activity Resource	Desc	Quantity Pcs	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
3TAXES	TAXES PALMER A	1.00	1.00 LS	370,632.000			370,632			370,632

=====> Item Totals: 970 - TAXES

$370,632.00				[ ]			370,632			370,632
370,632.000			1 LS				370,632.00			370,632.00

BID ITEM = 980 Land Item SCHEDULE: 1 100
Description = MARK UP(PROFIT) Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

11098005 MARK UP (PROFIT) Quan: 1.00 LS Hrs/Shft: 8.00 WC NONE

CONTRACTOR MARK UP OF 10% OF CONTRACTOR COSTS
AS PER 2006 ESTIMATE

Activity Resource	Desc	Quantity Pcs	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total
4PROFIT	CONTRACTOR PRO	1.00	1.00 LS	1,235,424.000					1,235,424	1,235,424

$17,326,554.57	*** Report Totals ***	28,535.60 MH	1,784,892	1,071,510	950,182	1,834,093	11,685,878	17,326,555

>>> indicates Non Additive Activity
------Report Notes:------
The estimate was prepared with TAKEOFF Quantities.
This report shows TAKEOFF Quantities with the resources.

Bid Date: Owner: Engineering Firm:
Estimator-In-Charge:

JOB NOTES
Estimate created on: 07/30/2014 by User#: 0 -
Source estimate used: C:\HEAVYBID\EST\ESTMAST
Labor Setup copied from: C:\HEAVYBID\EST\2014-072
Equipment Setup copied from: C:\HEAVYBID\EST\2014-072
Crew Setup copied from: C:\HEAVYBID\EST\2014-072
Material/Other Resources Setup copied from: C:\HEAVYBID\EST\2014-072
Overtime Rules Setup copied from: C:\HEAVYBID\EST\2014-072
Burden Tables Setup copied from: C:\HEAVYBID\EST\2014-072

************Estimate created on: 09/10/2014 by User#: 0 -

Activity Resource	Desc	Quantity Pcs	Unit	Unit Cost	Labor	Perm Materi	Constr Matl/Ex	Equip Ment	Sub-Contrac	Total

BID ITEM = 980 Land Item SCHEDULE: 1 100
Description = MARK UP(PROFIT) Unit = LS Takeoff Quan: 1.000 Engr Quan: 1.000

Source estimate used: C:\HEAVYBID\EST\2014-068

* on units of MH indicate average labor unit cost was used rather than base rate.
[ ] in the Unit Cost Column = Labor Unit Cost Without Labor Burdens
In equipment resources, rent % and EOE % not = 100% are represented as XXX%YYY where XXX=Rent% and YYY=EOE%
------Calendar Codes------

Appendix K
Annual Contribution to Closure Fund Model

APPENDIX K

Annual Contribution to Closure Fund Model

TABLE K-1

Matanuska-Susitna Borough Central Landfill, Inputs to Closure Fund Contributions

Matanuska-Susitna Borough Central landfill Development Plan

Inflation	2.4%
Interest	3.0%
Model Start Year	2014
Year of Closure	2170
Post Closure Start	2171
Costs:	
Current Fund Balance	$3,876,843 [c]
Closure Costs ($2014)	$17,327,000
Closure Costs ($2170)	$700,675,000
Post Closure Costs (2014$) [a]	$175,000
Post Closure Costs (2014$) [b]	$37,000

[a] Post closure costs of annual maintenance and monitoring.

[b] Post closure cost of certification (2200 only)

[c] This is as of June 30, 2014

TABLE K-2

Matanuska-Susitna Borough Central Landfill, Closure and Post-Closure Costs (2014$)

Matanuska-Susitna Borough Central landfill Development Plan

Description	Quantity	Units	Unit Price	Total
Mobilization	1	LS	$496,000.00	$496,000.00
Bonds & insurance	1	LS	$431,154.00	$431,154.00
Submittals	1	LS	$34,533.88	$34,533.88
Permits	1	LS	$7,500.00	$7,500.00
Survey	1	LS	$38,500.00	$38,500.00
Leveling course (6")	32569	CY	$5.59	$181,977.24
Geosynthetic clay liner	195412	SY	$7.50	$1,465,983.40
Flexible membrane liner	195412	SY	$9.59	$1,874,378.09
Granular drainage material (18")	97706	CY	$26.92	$2,630,585.51
Earthen material/topsoil (6")	32569	CY	$14.92	$486,078.01
Hydroseeding	1759	MSF	$150.00	$263,850.00
Monitoring wells	4	EA	$3,750.00	$15,000.00
Stormwater control terraces	1000	LF	$14.27	$14,268.55
Landfill gas collection system	1	LS	$3,750,000.00	$3,750,000.00
Gas flare system	1	LS	$350,000.00	$350,000.00
Demobilization	1	LS	$345,000.00	$345,000.00
Contractor overhead	1	LS	$1,235,440.00	$1,235,440.00
CH overhead	1	LS	$1,482,530.00	$1,482,530.00
Contingency	1	LS	$617,720.00	$617,720.00
Taxes	1	LS	$370,632.00	$370,632.00
Mark-up (profit)	1	LS	$1,235,424.00	$1,235,424.00
				$17,326,554.68
Annual Post-Closure Maintenance 30Yrs				
Repair cover side slopes	3257	CY	$6.50	$21,170.00
Hydroseeding	87935	SF	$0.15	$13,190.00
Maintain leachate equipment	1	LS	$5,000.00	$5,000.00
Collect,treat,dispose leachate	75000	GL	$0.15	$11,250.00
Clean perimeter drainage ditches	3000	LF	$5.80	$17,400.00
				$68,010.00

TABLE K-2

Matanuska-Susitna Borough Central Landfill, Closure and Post-Closure Costs (2014$)

Matanuska-Susitna Borough Central landfill Development Plan

Description	Quantity	Units	Unit Price	Total
Annual Post-Closure Monitoring 30Yrs				
Groundwater sampling & analysis	1	LS	$29,000.00	$29,000.00
Methane sampling & analysis	1	LS	$17,400.00	$17,400.00
Surface water sampling & analysis	1	LS	$11,600.00	$11,600.00
Leachate sampling & analysis	1	LS	$11,600.00	$11,600.00
				$69,600.00
Post-Closure Certification				
Post-Closure Certification Report	1	LS	$29,000.00	$29,000.00
				$29,000.00
			SUBTOTAL	**$166,610.00**
			Administrative services (10%)	**$16,661.00**
			Technical and Professional Services (12%)	**$19,993.00**
			Closure Contingency (5%)	**$8,305.00**
			TOTAL	**$44,959.00**

Notes:

CY = cubic yard
GL = gallon
LF = linear foot
LS = lump sum
MSF = thousand square feet
SY = square yard

TABLE K-3
Matanuska-Susitna Borough Central Landfill, Calculation of Closure Fund Contributions
Matanuska-Susitna Borough Central landfill Development Plan

Year	Closure Cost	Post-Closure Cost	Closure Fund Contribution	End-Year Closure Fund Balance	Per-ton Contribution	Per-ton Contribution (2014$)
2014	$0	$0	$9,562	$3,934,996	$0.16	$0.16
2015	$0	$0	$10,034	$4,063,230	$0.16	$0.16
2016	$0	$0	$10,529	$4,195,814	$0.17	$0.16
2017	$0	$0	$11,049	$4,332,903	$0.17	$0.16
2018	$0	$0	$11,584	$4,474,647	$0.17	$0.16
2019	$0	$0	$12,144	$4,621,213	$0.18	$0.16
2020	$0	$0	$12,732	$4,772,772	$0.18	$0.16
2021	$0	$0	$13,348	$4,929,503	$0.19	$0.16
2022	$0	$0	$13,994	$5,091,591	$0.19	$0.16
2023	$0	$0	$14,666	$5,259,224	$0.20	$0.16
2024	$0	$0	$15,370	$5,432,601	$0.20	$0.16
2025	$0	$0	$16,108	$5,611,929	$0.21	$0.16
2026	$0	$0	$16,881	$5,797,421	$0.21	$0.16
2027	$0	$0	$17,692	$5,989,300	$0.22	$0.16
2028	$0	$0	$18,498	$6,187,755	$0.22	$0.16
2029	$0	$0	$19,342	$6,393,020	$0.23	$0.16
2030	$0	$0	$20,224	$6,605,338	$0.23	$0.16
2031	$0	$0	$21,146	$6,824,961	$0.24	$0.16
2032	$0	$0	$22,111	$7,052,152	$0.24	$0.16
2033	$0	$0	$23,012	$7,287,075	$0.25	$0.16
2034	$0	$0	$23,951	$7,529,997	$0.26	$0.16
2035	$0	$0	$24,928	$7,781,198	$0.26	$0.16
2036	$0	$0	$25,944	$8,040,968	$0.27	$0.16
2037	$0	$0	$27,002	$8,309,604	$0.27	$0.16
2038	$0	$0	$28,055	$8,587,368	$0.28	$0.16
2039	$0	$0	$29,148	$8,874,574	$0.29	$0.16
2040	$0	$0	$30,284	$9,171,550	$0.29	$0.16
2041	$0	$0	$31,464	$9,478,633	$0.30	$0.16
2042	$0	$0	$32,691	$9,796,173	$0.31	$0.16
2043	$0	$0	$33,965	$10,124,532	$0.32	$0.16
2044	$0	$0	$35,289	$10,464,086	$0.32	$0.16
2045	$0	$0	$36,664	$10,815,223	$0.33	$0.16
2046	$0	$0	$38,093	$11,178,344	$0.34	$0.16
2047	$0	$0	$39,578	$11,553,865	$0.35	$0.16
2048	$0	$0	$41,120	$11,942,218	$0.36	$0.16
2049	$0	$0	$42,723	$12,343,848	$0.36	$0.16
2050	$0	$0	$44,388	$12,759,217	$0.37	$0.16

TABLE K-3

Matanuska-Susitna Borough Central Landfill, Calculation of Closure Fund Contributions

Matanuska-Susitna Borough Central landfill Development Plan

Year	Closure Cost	Post-Closure Cost	Closure Fund Contribution	End-Year Closure Fund Balance	Per-ton Contribution	Per-ton Contribution (2014$)
2051	$0	$0	$46,118	$13,188,803	$0.38	$0.16
2052	$0	$0	$47,915	$13,633,101	$0.39	$0.16
2053	$0	$0	$49,782	$14,092,623	$0.40	$0.16
2054	$0	$0	$51,723	$14,567,900	$0.41	$0.16
2055	$0	$0	$53,739	$15,059,482	$0.42	$0.16
2056	$0	$0	$55,833	$15,567,937	$0.43	$0.16
2057	$0	$0	$58,009	$16,093,854	$0.44	$0.16
2058	$0	$0	$60,270	$16,637,843	$0.45	$0.16
2059	$0	$0	$62,619	$17,200,537	$0.46	$0.16
2060	$0	$0	$65,059	$17,782,588	$0.47	$0.16
2061	$0	$0	$67,595	$18,384,675	$0.48	$0.16
2062	$0	$0	$70,229	$19,007,498	$0.50	$0.16
2063	$0	$0	$72,966	$19,651,783	$0.51	$0.16
2064	$0	$0	$75,810	$20,318,284	$0.52	$0.16
2065	$0	$0	$78,765	$21,007,779	$0.53	$0.16
2066	$0	$0	$81,835	$21,721,075	$0.54	$0.16
2067	$0	$0	$85,024	$22,459,007	$0.56	$0.16
2068	$0	$0	$88,338	$23,222,440	$0.57	$0.16
2069	$0	$0	$91,781	$24,012,270	$0.58	$0.16
2070	$0	$0	$95,358	$24,829,427	$0.60	$0.16
2071	$0	$0	$99,074	$25,674,870	$0.61	$0.16
2072	$0	$0	$102,936	$26,549,595	$0.63	$0.16
2073	$0	$0	$106,947	$27,454,635	$0.64	$0.16
2074	$0	$0	$111,116	$28,391,056	$0.66	$0.16
2075	$0	$0	$115,446	$29,359,966	$0.67	$0.16
2076	$0	$0	$119,946	$30,362,509	$0.69	$0.16
2077	$0	$0	$124,620	$31,399,874	$0.71	$0.16
2078	$0	$0	$129,477	$32,473,290	$0.72	$0.16
2079	$0	$0	$134,524	$33,584,030	$0.74	$0.16
2080	$0	$0	$139,766	$34,733,414	$0.76	$0.16
2081	$0	$0	$145,214	$35,922,808	$0.78	$0.16
2082	$0	$0	$150,873	$37,153,629	$0.80	$0.16
2083	$0	$0	$156,753	$38,427,343	$0.82	$0.16
2084	$0	$0	$162,863	$39,745,468	$0.83	$0.16
2085	$0	$0	$169,210	$41,109,581	$0.85	$0.16
2086	$0	$0	$175,805	$42,521,310	$0.88	$0.16
2087	$0	$0	$182,657	$43,982,346	$0.90	$0.16

TABLE K-3

Matanuska-Susitna Borough Central Landfill, Calculation of Closure Fund Contributions

Matanuska-Susitna Borough Central landfill Development Plan

Year	Closure Cost	Post-Closure Cost	Closure Fund Contribution	End-Year Closure Fund Balance	Per-ton Contribution	Per-ton Contribution (2014$)
2088	$0	$0	$189,776	$45,494,439	$0.92	$0.16
2089	$0	$0	$197,172	$47,059,401	$0.94	$0.16
2090	$0	$0	$204,857	$48,679,113	$0.96	$0.16
2091	$0	$0	$212,841	$50,355,519	$0.99	$0.16
2092	$0	$0	$221,136	$52,090,638	$1.01	$0.16
2093	$0	$0	$229,754	$53,886,558	$1.03	$0.16
2094	$0	$0	$238,709	$55,745,444	$1.06	$0.16
2095	$0	$0	$248,012	$57,669,540	$1.08	$0.16
2096	$0	$0	$257,678	$59,661,169	$1.11	$0.16
2097	$0	$0	$267,721	$61,722,741	$1.14	$0.16
2098	$0	$0	$278,155	$63,856,751	$1.16	$0.16
2099	$0	$0	$288,996	$66,065,784	$1.19	$0.16
2100	$0	$0	$300,259	$68,352,521	$1.22	$0.16
2101	$0	$0	$311,962	$70,719,738	$1.25	$0.16
2102	$0	$0	$324,120	$73,170,312	$1.28	$0.16
2103	$0	$0	$336,752	$75,707,225	$1.31	$0.16
2104	$0	$0	$349,877	$78,333,567	$1.34	$0.16
2105	$0	$0	$363,513	$81,052,539	$1.37	$0.16
2106	$0	$0	$377,681	$83,867,461	$1.41	$0.16
2107	$0	$0	$392,400	$86,781,772	$1.44	$0.16
2108	$0	$0	$407,694	$89,799,034	$1.47	$0.16
2109	$0	$0	$423,583	$92,922,942	$1.51	$0.16
2110	$0	$0	$440,092	$96,157,323	$1.55	$0.16
2111	$0	$0	$457,244	$99,506,146	$1.58	$0.16
2112	$0	$0	$475,065	$102,973,521	$1.62	$0.16
2113	$0	$0	$493,580	$106,563,710	$1.66	$0.16
2114	$0	$0	$512,817	$110,281,130	$1.70	$0.16
2115	$0	$0	$532,803	$114,130,359	$1.74	$0.16
2116	$0	$0	$553,569	$118,116,142	$1.78	$0.16
2117	$0	$0	$575,143	$122,243,397	$1.83	$0.16
2118	$0	$0	$597,559	$126,517,221	$1.87	$0.16
2119	$0	$0	$620,848	$130,942,899	$1.91	$0.16
2120	$0	$0	$645,045	$135,525,907	$1.96	$0.16
2121	$0	$0	$670,185	$140,271,922	$2.01	$0.16
2122	$0	$0	$696,305	$145,186,829	$2.06	$0.16
2123	$0	$0	$723,443	$150,276,728	$2.10	$0.16
2124	$0	$0	$751,638	$155,547,943	$2.16	$0.16

TABLE K-3
Matanuska-Susitna Borough Central Landfill, Calculation of Closure Fund Contributions
Matanuska-Susitna Borough Central landfill Development Plan

Year	Closure Cost	Post-Closure Cost	Closure Fund Contribution	End-Year Closure Fund Balance	Per-ton Contribution	Per-ton Contribution (2014$)
2125	$0	$0	$780,933	$161,007,028	$2.21	$0.16
2126	$0	$0	$811,369	$166,660,778	$2.26	$0.16
2127	$0	$0	$842,991	$172,516,237	$2.31	$0.16
2128	$0	$0	$875,846	$178,580,708	$2.37	$0.16
2129	$0	$0	$909,981	$184,861,760	$2.43	$0.16
2130	$0	$0	$945,447	$191,367,241	$2.49	$0.16
2131	$0	$0	$982,294	$198,105,287	$2.54	$0.16
2132	$0	$0	$1,020,578	$205,084,333	$2.61	$0.16
2133	$0	$0	$1,060,354	$212,313,122	$2.67	$0.16
2134	$0	$0	$1,101,681	$219,800,722	$2.73	$0.16
2135	$0	$0	$1,144,618	$227,556,530	$2.80	$0.16
2136	$0	$0	$1,189,228	$235,590,292	$2.87	$0.16
2137	$0	$0	$1,235,577	$243,912,111	$2.93	$0.16
2138	$0	$0	$1,283,732	$252,532,463	$3.00	$0.16
2139	$0	$0	$1,333,764	$261,462,208	$3.08	$0.16
2140	$0	$0	$1,385,747	$270,712,607	$3.15	$0.16
2141	$0	$0	$1,439,755	$280,295,336	$3.23	$0.16
2142	$0	$0	$1,495,868	$290,222,501	$3.30	$0.16
2143	$0	$0	$1,554,168	$300,506,656	$3.38	$0.16
2144	$0	$0	$1,614,740	$311,160,817	$3.46	$0.16
2145	$0	$0	$1,677,673	$322,198,479	$3.55	$0.16
2146	$0	$0	$1,743,058	$333,633,637	$3.63	$0.16
2147	$0	$0	$1,810,992	$345,480,804	$3.72	$0.16
2148	$0	$0	$1,881,574	$357,755,025	$3.81	$0.16
2149	$0	$0	$1,954,906	$370,471,905	$3.90	$0.16
2150	$0	$0	$2,031,097	$383,647,626	$3.99	$0.16
2151	$0	$0	$2,110,257	$397,298,965	$4.09	$0.16
2152	$0	$0	$2,192,502	$411,443,323	$4.19	$0.16
2153	$0	$0	$2,277,952	$426,098,745	$4.29	$0.16
2154	$0	$0	$2,366,733	$441,283,941	$4.39	$0.16
2155	$0	$0	$2,458,974	$457,018,319	$4.50	$0.16
2156	$0	$0	$2,554,810	$473,322,001	$4.60	$0.16
2157	$0	$0	$2,654,382	$490,215,858	$4.71	$0.16
2158	$0	$0	$2,757,834	$507,721,535	$4.83	$0.16
2159	$0	$0	$2,865,317	$525,861,478	$4.94	$0.16
2160	$0	$0	$2,976,990	$544,658,967	$5.06	$0.16
2161	$0	$0	$3,093,015	$564,138,147	$5.18	$0.16

TABLE K-3

Matanuska-Susitna Borough Central Landfill, Calculation of Closure Fund Contributions

Matanuska-Susitna Borough Central landfill Development Plan

Year	Closure Cost	Post-Closure Cost	Closure Fund Contribution	End-Year Closure Fund Balance	Per-ton Contribution	Per-ton Contribution (2014$)
2162	$0	$0	$3,213,563	$584,324,058	$5.31	$0.16
2163	$0	$0	$3,338,808	$605,242,670	$5.44	$0.16
2164	$0	$0	$3,468,935	$626,920,918	$5.57	$0.16
2165	$0	$0	$3,604,133	$649,386,741	$5.70	$0.16
2166	$0	$0	$3,744,601	$672,669,113	$5.84	$0.16
2167	$0	$0	$3,890,543	$696,798,087	$5.98	$0.16
2168	$0	$0	$4,042,173	$721,804,835	$6.12	$0.16
2169	$0	$0	$4,199,712	$747,721,688	$6.27	$0.16
2170	$700,675,000	$0	$4,363,392	$73,907,181	$6.42	$0.16
2171	$0	$7,246,549	$4,468,113	$73,412,982	$6.57	$0.16
2172	$0	$7,420,466	$4,575,348	$72,838,883	$6.73	$0.16
2173	$0	$7,598,558	$4,685,156	$72,180,926	$6.89	$0.16
2174	$0	$7,780,923	$4,797,600	$71,434,995	$7.06	$0.16
2175	$0	$7,967,665	$4,912,742	$70,596,813	$7.23	$0.16
2176	$0	$8,158,889	$5,030,648	$69,661,937	$7.40	$0.16
2177	$0	$8,354,702	$5,151,384	$68,625,747	$7.58	$0.16
2178	$0	$8,555,215	$5,275,017	$67,483,447	$7.76	$0.16
2179	$0	$8,760,540	$5,401,617	$66,230,052	$7.94	$0.16
2180	$0	$8,970,793	$5,531,256	$64,860,385	$8.13	$0.16
2181	$0	$9,186,092	$5,664,006	$63,369,071	$8.33	$0.16
2182	$0	$9,406,559	$5,799,943	$61,750,526	$8.53	$0.16
2183	$0	$9,632,316	$5,939,141	$59,998,954	$8.73	$0.16
2184	$0	$9,863,492	$6,081,681	$58,108,337	$8.94	$0.16
2185	$0	$10,100,215	$6,227,641	$56,072,427	$9.16	$0.16
2186	$0	$10,342,621	$6,377,104	$53,884,740	$9.38	$0.16
2187	$0	$10,590,843	$6,530,155	$51,538,546	$9.60	$0.16
2188	$0	$10,845,024	$6,686,879	$49,026,861	$9.83	$0.16
2189	$0	$11,105,304	$6,847,364	$46,342,436	$10.07	$0.16
2190	$0	$11,371,832	$7,011,700	$43,477,754	$10.31	$0.16
2191	$0	$11,644,755	$7,179,981	$40,425,012	$10.56	$0.16
2192	$0	$11,924,230	$7,352,301	$37,176,118	$10.81	$0.16
2193	$0	$12,210,411	$7,528,756	$33,722,677	$11.07	$0.16
2194	$0	$12,503,461	$7,709,446	$30,055,985	$11.34	$0.16
2195	$0	$12,803,544	$7,894,473	$26,167,010	$11.61	$0.16
2196	$0	$13,110,829	$8,083,940	$22,046,390	$11.89	$0.16
2197	$0	$13,425,489	$8,277,955	$17,684,417	$12.17	$0.16
2198	$0	$13,747,701	$8,476,626	$13,071,024	$12.47	$0.16

TABLE K-3

Matanuska-Susitna Borough Central Landfill, Calculation of Closure Fund Contributions

Matanuska-Susitna Borough Central landfill Development Plan

Year	Closure Cost	Post-Closure Cost	Closure Fund Contribution	End-Year Closure Fund Balance	Per-ton Contribution	Per-ton Contribution (2014$)
2199	$0	$14,077,646	$8,680,065	$8,195,774	$12.77	$0.16
2200	$0	$17,463,360	$8,888,386	$0	$13.07	$0.16

Appendix L
Historical Waste Disposal

TABLE 1
ESTIMATED HISTORICAL WASTE DISPOSAL FOR YEARS 1980-1999

Year	MSB Population[1]	Waste Per Capita[2] (short ton/capita)	Estimated Waste Disposal[3] (short tons)	(metric tons)
1980	17,816	0.75	13,362	12,122
1981	19,574	0.76	14,876	13,495
1982	22,352	0.77	17,211	15,614
1983	26,856	0.77	20,679	18,760
1984	32,653	0.78	25,469	23,105
1985	38,078	0.79	30,082	27,290
1986	40,583	0.79	32,061	29,086
1987	40,189	0.80	32,151	29,167
1988	38,768	0.80	31,014	28,136
1989	38,002	0.83	31,542	28,615
1990	39,683	0.82	32,540	29,520
1991	41,819	0.76	31,782	28,832
1992	44,370	0.74	32,834	29,787
1993	46,659	0.76	35,461	32,170
1994	47,636	0.75	35,727	32,411
1995	48,906	0.70	34,234	31,057
1996	50,367	0.68	34,250	31,071
1997	52,125	0.69	35,966	32,628
1998	54,153	0.75	40,615	36,846
1999	55,694	0.75	41,771	37,894
		Total:	**603,627**	**547,606**

Notes:
1. Population and growth rate estimates are from the Alaska Department of Labor and Work Force Development's *Population by Alaska Economic Region, Borough and Census Area, 1980-1990* (Vintage 2013), and *Population by Alaska Economic Region, Borough and Census Area, 1990-2000 (Vintage 2012).*
http://labor.state.ak.us/research/pop/popest.htm
2. Waste per Capita waste disposal rates are from Table HH-2 to Subpart HH of 40 CFR 98 - U.S. Per Capita Waste Disposal Rates.
3. Estimated waste disposal quantity at the Central Landfill for Years 1980 to 1999 are based on the estimated population served by the landfill in each year, the values for national average per capita waste disposal rates found in Table HH-2 to Subpart HH of 40 CFR 98, and Equation HH-2 to Subpart HH of 40 CFR 98.

TABLE 2
ESTIMATED HISTORICAL WASTE DISPOSAL FOR YEARS 2000-2013

Historical Waste Disposal By Landfill Disposal Area[1]

Years	Active Disposal Area(s)	Total Waste Disposal	
		(short tons)	(metric tons)
2000 - 2003	Unlined Landfill (Cells 1/2A)	207,601	188,334
2004 - 2014/07	Lined Landfill (Cells 2B/3)	744,275	675,202
	Total:	**951,876**	**863,536**

Historical Waste Disposal by Year[1]

Year	Waste Disposal Records	
	(short tons)	(metric tons)
2000	45,758	41,511
Subtotal, 2000:	**45,758**	**41,511**
2007	59,099	53,614
2008	54,834	49,745
2009	57,067	51,771
2010	57,727	52,370
2011	58,934	53,465
2012	58,602	53,163
2013	58,796	53,339
up to 2014/06	57,141	51,838
Subtotal, 2007 - 2014/06:	**462,200**	**419,305**
Total:	**507,958**	**460,816**

Estimated Waste Disposal for Missing Years of Data

Years	Total Waste Disposal Remaining[2]	Constant Average Waste Disposal Rate[3]
	(short tons)	(short tons/year)
2001-2003	161,843	53,948
2004-2006, and 2014/07	282,075	91,484

Year	Estimated Waste Disposal[4]	
	(short tons)	(metric tons)
2001	53,948	48,941
2002	53,948	48,941
2003	53,948	48,941
2004	91,484	82,994
2005	91,484	82,994
2006	91,484	82,994
2014/07 only	7,624	6,916
Total:	**443,920**	**402,721**

Notes:
1. Historical waste disposal data by landfill disposal area, and operating years 2000, and 2007-2014/06 is from the MSB's Waste Works database. Summaries were emailed to C. Hinds/CH2M HILL by M. Shapiro/MSB in July 2014.
2. Total waste disposal remaining for years 2001- 2003, and years 2004 - 2006 and 2014/07, are based on the total disposal by landfill disposal area minus the subtotal of waste disposal by year, for the respective operating period.
3. Constant average waste disposal rates are calculated per Equation HH-3 to Subpart HH of 40 CFR 98.
4. Estimated waste disposal for missing years of data are based on the constant average waste disposal rates calucated using Eq. HH-3 for the respective time period.

Appendix M
Gas Generation Estimates

Summary Report

Landfill Name or Identifier: MSB Central Landfill

Date: Tuesday, July 29, 2014

Description/Comments:

Waste acceptance rates for Years 1980-1999 are estimated per Eq. HH-2 to Subpart HH of 40 CFR 98. Waste acceptance rates for Years 2000 and 2007-2013 are based on MSB data records. Waste acceptance rates for Years 2001-2006 are estimated per Eq. HH-3 to Subpart HH of 40 CFR 98. Waste acceptance rates for 2014-2059 are estimates based on population growth projections, and waste data for 2013.

About LandGEM:

First-Order Decomposition Rate Equation:

$$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} kL_o \left(\frac{M_i}{10} \right) e^{-kt_{ij}}$$

Where,

Q_{CH4} = annual methane generation in the year of the calculation *(m^3/year)*
i = 1-year time increment
n = (year of the calculation) - (initial year of waste acceptance)
j = 0.1-year time increment
k = methane generation rate *($year^{-1}$)*
L_o = potential methane generation capacity *(m^3/Mg)*

M_i = mass of waste accepted in the i^{th} year (*Mg*)
t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year (*decimal years*, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at http://www.epa.gov/ttnatw01/landfill/landflpg.html.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for convential landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

Input Review

LANDFILL CHARACTERISTICS

Landfill Open Year	**1980**	
Landfill Closure Year (with 80-year limit)	**2059**	
Actual Closure Year (without limit)	***2059***	
Have Model Calculate Closure Year?	**No**	
Waste Design Capacity		*short tons*

MODEL PARAMETERS

Methane Generation Rate, k	**0.020**	*$year^{-1}$*
Potential Methane Generation Capacity, L_o	**170**	*m^3/Mg*
NMOC Concentration	**4,000**	*ppmv as hexane*
Methane Content	**50**	*% by volume*

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1:	**Total landfill gas**
Gas / Pollutant #2:	**Methane**
Gas / Pollutant #3:	**Carbon dioxide**
Gas / Pollutant #4:	**NMOC**

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
1980	12,147	13,362	0	0
1981	13,524	14,876	12,147	13,362
1982	15,646	17,211	25,671	28,238
1983	18,799	20,679	41,317	45,449
1984	23,154	25,469	60,116	66,128
1985	27,347	30,082	83,270	91,597
1986	29,146	32,061	110,617	121,679
1987	29,228	32,151	139,764	153,740
1988	28,195	31,014	168,992	185,891
1989	28,675	31,542	197,186	216,905
1990	29,582	32,540	225,861	248,447
1991	28,893	31,782	255,443	280,987
1992	29,849	32,834	284,335	312,769
1993	32,237	35,461	314,185	345,603
1994	32,479	35,727	346,422	381,064
1995	31,122	34,234	378,901	416,791
1996	31,136	34,250	410,023	451,025
1997	32,696	35,966	441,159	485,275
1998	36,923	40,615	473,855	521,241
1999	37,974	41,771	510,778	561,856
2000	41,598	45,758	548,752	603,627
2001	49,044	53,948	590,350	649,385
2002	49,044	53,948	639,394	703,333
2003	49,044	53,948	688,437	757,281
2004	83,167	91,484	737,481	811,229
2005	83,167	91,484	820,648	902,713
2006	83,167	91,484	903,815	994,197
2007	53,726	59,099	986,983	1,085,681
2008	49,849	54,834	1,040,709	1,144,780
2009	51,879	57,067	1,090,558	1,199,614
2010	52,479	57,727	1,142,437	1,256,681
2011	53,576	58,934	1,194,916	1,314,408
2012	53,275	58,602	1,248,493	1,373,342
2013	53,451	58,796	1,301,767	1,431,944
2014	54,776	60,253	1,355,218	1,490,740
2015	56,133	61,746	1,409,994	1,550,993
2016	57,524	63,276	1,466,127	1,612,739
2017	58,949	64,844	1,523,650	1,676,015
2018	60,353	66,388	1,582,600	1,740,860
2019	61,791	67,970	1,642,953	1,807,248

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	(short tons/year)	(Mg)	(short tons)
2020	63,262	69,588	1,704,743	1,875,218
2021	64,769	71,246	1,768,006	1,944,806
2022	66,312	72,943	1,832,775	2,016,052
2023	67,867	74,653	1,899,086	2,088,995
2024	69,458	76,404	1,966,953	2,163,648
2025	71,087	78,196	2,036,411	2,240,052
2026	72,754	80,030	2,107,498	2,318,248
2027	74,461	81,907	2,180,253	2,398,278
2028	76,031	83,634	2,254,713	2,480,184
2029	77,635	85,399	2,330,745	2,563,819
2030	79,273	87,200	2,408,380	2,649,218
2031	80,945	89,040	2,487,653	2,736,418
2032	82,653	90,918	2,568,598	2,825,458
2033	84,008	92,409	2,651,251	2,916,377
2034	85,385	93,923	2,735,259	3,008,785
2035	86,784	95,463	2,820,644	3,102,708
2036	88,207	97,027	2,907,428	3,198,171
2037	89,652	98,618	2,995,635	3,295,198
2038	90,963	100,060	3,085,287	3,393,816
2039	92,293	101,523	3,176,250	3,493,875
2040	93,643	103,007	3,268,544	3,595,398
2041	95,012	104,514	3,362,187	3,698,406
2042	96,402	106,042	3,457,199	3,802,919
2043	97,812	107,593	3,553,601	3,908,961
2044	99,242	109,166	3,651,413	4,016,554
2045	100,693	110,762	3,750,654	4,125,720
2046	102,165	112,382	3,851,348	4,236,482
2047	103,659	114,025	3,953,513	4,348,864
2048	105,175	115,693	4,057,172	4,462,890
2049	106,713	117,385	4,162,348	4,578,582
2050	108,274	119,101	4,269,061	4,695,967
2051	109,857	120,843	4,377,335	4,815,068
2052	111,463	122,610	4,487,192	4,935,911
2053	113,093	124,403	4,598,655	5,058,521
2054	114,747	126,222	4,711,748	5,182,923
2055	116,425	128,068	4,826,496	5,309,145
2056	118,128	129,940	4,942,921	5,437,213
2057	119,855	131,840	5,061,048	5,567,153
2058	121,608	133,768	5,180,903	5,698,994
2059	123,386	135,724	5,302,511	5,832,762

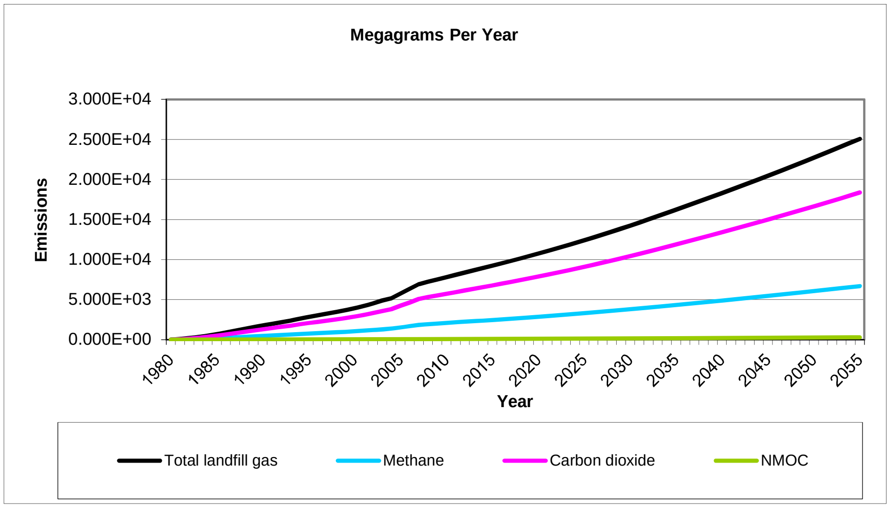
Pollutant Parameters

		Gas / Pollutant Default Parameters:		User-specified Pollutant Parameters:	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl chloroform) - HAP	0.48	133.41		
	1,1,2,2-Tetrachloroethane - HAP/VOC	1.1	167.85		
	1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC	2.4	98.97		
	1,1-Dichloroethene (vinylidene chloride) - HAP/VOC	0.20	96.94		
	1,2-Dichloroethane (ethylene dichloride) - HAP/VOC	0.41	98.96		
	1,2-Dichloropropane (propylene dichloride) - HAP/VOC	0.18	112.99		
	2-Propanol (isopropyl alcohol) - VOC	50	60.11		
	Acetone	7.0	58.08		
	Acrylonitrile - HAP/VOC	6.3	53.06		
	Benzene - No or Unknown Co-disposal - HAP/VOC	1.9	78.11		
	Benzene - Co-disposal - HAP/VOC	11	78.11		
	Bromodichloromethane - VOC	3.1	163.83		
	Butane - VOC	5.0	58.12		
	Carbon disulfide - HAP/VOC	0.58	76.13		
	Carbon monoxide	140	28.01		
	Carbon tetrachloride - HAP/VOC	4.0E-03	153.84		
	Carbonyl sulfide - HAP/VOC	0.49	60.07		
	Chlorobenzene - HAP/VOC	0.25	112.56		
	Chlorodifluoromethane	1.3	86.47		
	Chloroethane (ethyl chloride) - HAP/VOC	1.3	64.52		
	Chloroform - HAP/VOC	0.03	119.39		
	Chloromethane - VOC	1.2	50.49		
	Dichlorobenzene - (HAP for para isomer/VOC)	0.21	147		
	Dichlorodifluoromethane	16	120.91		
	Dichlorofluoromethane - VOC	2.6	102.92		
	Dichloromethane (methylene chloride) - HAP	14	84.94		
	Dimethyl sulfide (methyl sulfide) - VOC	7.8	62.13		
	Ethane	890	30.07		
	Ethanol - VOC	27	46.08		

Pollutant Parameters (Continued)

	Gas / Pollutant Default Parameters:			User-specified Pollutant Parameters:	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Pollutants	Ethyl mercaptan (ethanethiol) - VOC	2.3	62.13		
	Ethylbenzene - HAP/VOC	4.6	106.16		
	Ethylene dibromide - HAP/VOC	1.0E-03	187.88		
	Fluorotrichloromethane - VOC	0.76	137.38		
	Hexane - HAP/VOC	6.6	86.18		
	Hydrogen sulfide	36	34.08		
	Mercury (total) - HAP	2.9E-04	200.61		
	Methyl ethyl ketone - HAP/VOC	7.1	72.11		
	Methyl isobutyl ketone - HAP/VOC	1.9	100.16		
	Methyl mercaptan - VOC	2.5	48.11		
	Pentane - VOC	3.3	72.15		
	Perchloroethylene (tetrachloroethylene) - HAP	3.7	165.83		
	Propane - VOC	11	44.09		
	t-1,2-Dichloroethene - VOC	2.8	96.94		
	Toluene - No or Unknown Co-disposal - HAP/VOC	39	92.13		
	Toluene - Co-disposal - HAP/VOC	170	92.13		
	Trichloroethylene (trichloroethene) - HAP/VOC	2.8	131.40		
	Vinyl chloride - HAP/VOC	7.3	62.50		
	Xylenes - HAP/VOC	12	106.16		

Graphs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2.000E+04
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5.000E+03
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Emissions
1980
1985
1990
1995
2000
2005
2010
2015
2020
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2030
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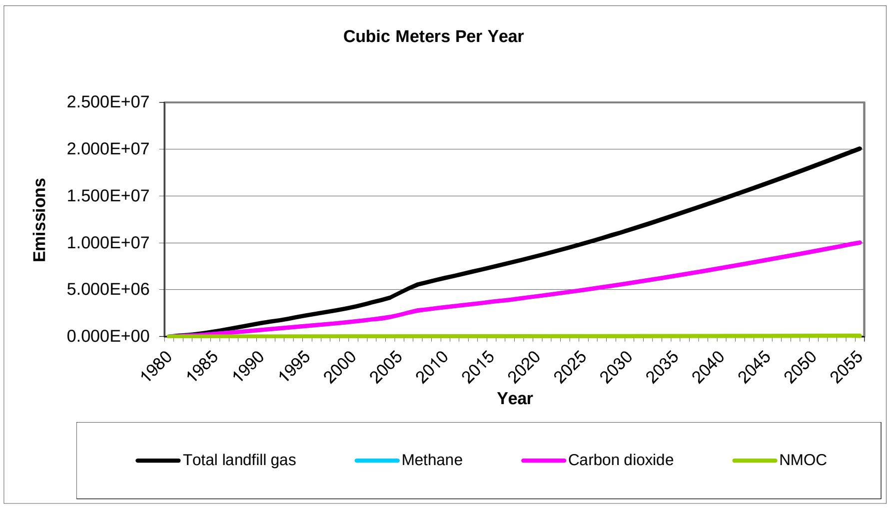
2045
2050
2055
Year
Total landfill gas
Methane
Carbon dioxide
NMOC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1.000E+07
5.000E+06
0.000E+00
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1980
1985
1990
1995
2000
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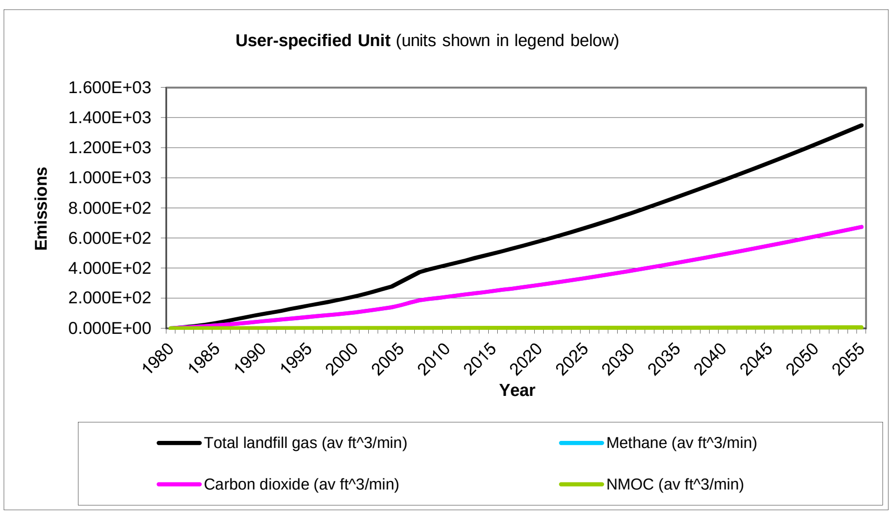
Year
Total landfill gas
Methane
Carbon dioxide
NMOC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8.000E+02
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4.000E+02
2.000E+02
0.000E+00
Emissions
1980
1985
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
2055
Year
Total landfill gas (av ft^3/min)
Methane (av ft^3/min)
Carbon dioxide (av ft^3/min)
NMOC (av ft^3/min)

Results

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
1980	0	0	0	0	0	0
1981	1.022E+02	8.186E+04	5.500E+00	2.731E+01	4.093E+04	2.750E+00
1982	2.140E+02	1.714E+05	1.152E+01	5.717E+01	8.569E+04	5.758E+00
1983	3.415E+02	2.734E+05	1.837E+01	9.121E+01	1.367E+05	9.186E+00
1984	4.929E+02	3.947E+05	2.652E+01	1.317E+02	1.974E+05	1.326E+01
1985	6.780E+02	5.429E+05	3.648E+01	1.811E+02	2.715E+05	1.824E+01
1986	8.948E+02	7.165E+05	4.814E+01	2.390E+02	3.582E+05	2.407E+01
1987	1.122E+03	8.987E+05	6.038E+01	2.998E+02	4.494E+05	3.019E+01
1988	1.346E+03	1.078E+06	7.242E+01	3.596E+02	5.389E+05	3.621E+01
1989	1.557E+03	1.247E+06	8.376E+01	4.158E+02	6.233E+05	4.188E+01
1990	1.767E+03	1.415E+06	9.508E+01	4.720E+02	7.076E+05	4.754E+01
1991	1.981E+03	1.586E+06	1.066E+02	5.292E+02	7.932E+05	5.330E+01
1992	2.185E+03	1.750E+06	1.176E+02	5.837E+02	8.749E+05	5.878E+01
1993	2.393E+03	1.916E+06	1.288E+02	6.392E+02	9.581E+05	6.438E+01
1994	2.617E+03	2.096E+06	1.408E+02	6.990E+02	1.048E+06	7.040E+01
1995	2.839E+03	2.273E+06	1.527E+02	7.582E+02	1.136E+06	7.636E+01
1996	3.044E+03	2.438E+06	1.638E+02	8.131E+02	1.219E+06	8.189E+01
1997	3.246E+03	2.599E+06	1.746E+02	8.670E+02	1.300E+06	8.732E+01
1998	3.457E+03	2.768E+06	1.860E+02	9.234E+02	1.384E+06	9.300E+01
1999	3.699E+03	2.962E+06	1.990E+02	9.881E+02	1.481E+06	9.951E+01
2000	3.946E+03	3.159E+06	2.123E+02	1.054E+03	1.580E+06	1.061E+02
2001	4.218E+03	3.377E+06	2.269E+02	1.127E+03	1.689E+06	1.135E+02
2002	4.547E+03	3.641E+06	2.446E+02	1.214E+03	1.820E+06	1.223E+02
2003	4.869E+03	3.899E+06	2.620E+02	1.301E+03	1.950E+06	1.310E+02
2004	5.186E+03	4.153E+06	2.790E+02	1.385E+03	2.076E+06	1.395E+02
2005	5.783E+03	4.631E+06	3.111E+02	1.545E+03	2.315E+06	1.556E+02
2006	6.368E+03	5.100E+06	3.426E+02	1.701E+03	2.550E+06	1.713E+02
2007	6.942E+03	5.559E+06	3.735E+02	1.854E+03	2.780E+06	1.868E+02
2008	7.257E+03	5.811E+06	3.904E+02	1.938E+03	2.906E+06	1.952E+02
2009	7.533E+03	6.032E+06	4.053E+02	2.012E+03	3.016E+06	2.026E+02
2010	7.820E+03	6.262E+06	4.208E+02	2.089E+03	3.131E+06	2.104E+02
2011	8.107E+03	6.492E+06	4.362E+02	2.165E+03	3.246E+06	2.181E+02
2012	8.397E+03	6.724E+06	4.518E+02	2.243E+03	3.362E+06	2.259E+02
2013	8.680E+03	6.950E+06	4.670E+02	2.318E+03	3.475E+06	2.335E+02
2014	8.958E+03	7.173E+06	4.819E+02	2.393E+03	3.586E+06	2.410E+02
2015	9.241E+03	7.400E+06	4.972E+02	2.468E+03	3.700E+06	2.486E+02
2016	9.531E+03	7.632E+06	5.128E+02	2.546E+03	3.816E+06	2.564E+02
2017	9.826E+03	7.868E+06	5.287E+02	2.625E+03	3.934E+06	2.643E+02
2018	1.013E+04	8.110E+06	5.449E+02	2.705E+03	4.055E+06	2.724E+02
2019	1.043E+04	8.356E+06	5.614E+02	2.787E+03	4.178E+06	2.807E+02
2020	1.075E+04	8.607E+06	5.783E+02	2.871E+03	4.303E+06	2.891E+02
2021	1.107E+04	8.863E+06	5.955E+02	2.956E+03	4.431E+06	2.977E+02
2022	1.139E+04	9.124E+06	6.130E+02	3.043E+03	4.562E+06	3.065E+02
2023	1.173E+04	9.390E+06	6.309E+02	3.132E+03	4.695E+06	3.155E+02
2024	1.207E+04	9.661E+06	6.491E+02	3.223E+03	4.831E+06	3.246E+02
2025	1.241E+04	9.938E+06	6.677E+02	3.315E+03	4.969E+06	3.339E+02
2026	1.276E+04	1.022E+07	6.867E+02	3.409E+03	5.110E+06	3.434E+02
2027	1.312E+04	1.051E+07	7.061E+02	3.505E+03	5.254E+06	3.530E+02
2028	1.349E+04	1.080E+07	7.258E+02	3.603E+03	5.401E+06	3.629E+02
2029	1.386E+04	1.110E+07	7.458E+02	3.703E+03	5.550E+06	3.729E+02

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2030	1.424E+04	1.140E+07	7.662E+02	3.804E+03	5.702E+06	3.831E+02
2031	1.463E+04	1.171E+07	7.870E+02	3.907E+03	5.856E+06	3.935E+02
2032	1.502E+04	1.203E+07	8.080E+02	4.012E+03	6.013E+06	4.040E+02
2033	1.542E+04	1.234E+07	8.294E+02	4.118E+03	6.172E+06	4.147E+02
2034	1.582E+04	1.267E+07	8.511E+02	4.225E+03	6.333E+06	4.255E+02
2035	1.622E+04	1.299E+07	8.729E+02	4.334E+03	6.496E+06	4.364E+02
2036	1.663E+04	1.332E+07	8.949E+02	4.443E+03	6.659E+06	4.474E+02
2037	1.705E+04	1.365E+07	9.171E+02	4.553E+03	6.825E+06	4.586E+02
2038	1.746E+04	1.398E+07	9.395E+02	4.664E+03	6.992E+06	4.698E+02
2039	1.788E+04	1.432E+07	9.621E+02	4.777E+03	7.160E+06	4.811E+02
2040	1.831E+04	1.466E+07	9.849E+02	4.890E+03	7.329E+06	4.924E+02
2041	1.873E+04	1.500E+07	1.008E+03	5.003E+03	7.499E+06	5.039E+02
2042	1.916E+04	1.534E+07	1.031E+03	5.118E+03	7.671E+06	5.154E+02
2043	1.959E+04	1.569E+07	1.054E+03	5.233E+03	7.844E+06	5.270E+02
2044	2.003E+04	1.604E+07	1.077E+03	5.349E+03	8.018E+06	5.387E+02
2045	2.047E+04	1.639E+07	1.101E+03	5.467E+03	8.194E+06	5.505E+02
2046	2.091E+04	1.674E+07	1.125E+03	5.585E+03	8.371E+06	5.624E+02
2047	2.135E+04	1.710E+07	1.149E+03	5.704E+03	8.549E+06	5.744E+02
2048	2.180E+04	1.746E+07	1.173E+03	5.824E+03	8.729E+06	5.865E+02
2049	2.226E+04	1.782E+07	1.197E+03	5.945E+03	8.911E+06	5.987E+02
2050	2.271E+04	1.819E+07	1.222E+03	6.067E+03	9.094E+06	6.110E+02
2051	2.318E+04	1.856E+07	1.247E+03	6.190E+03	9.279E+06	6.234E+02
2052	2.364E+04	1.893E+07	1.272E+03	6.315E+03	9.465E+06	6.360E+02
2053	2.411E+04	1.931E+07	1.297E+03	6.440E+03	9.653E+06	6.486E+02
2054	2.459E+04	1.969E+07	1.323E+03	6.567E+03	9.843E+06	6.614E+02
2055	2.506E+04	2.007E+07	1.349E+03	6.695E+03	1.004E+07	6.743E+02
2056	2.555E+04	2.046E+07	1.375E+03	6.824E+03	1.023E+07	6.873E+02
2057	2.604E+04	2.085E+07	1.401E+03	6.955E+03	1.042E+07	7.004E+02
2058	2.653E+04	2.124E+07	1.427E+03	7.086E+03	1.062E+07	7.137E+02
2059	2.703E+04	2.164E+07	1.454E+03	7.219E+03	1.082E+07	7.271E+02
2060	2.753E+04	2.205E+07	1.481E+03	7.354E+03	1.102E+07	7.406E+02
2061	2.699E+04	2.161E+07	1.452E+03	7.208E+03	1.080E+07	7.259E+02
2062	2.645E+04	2.118E+07	1.423E+03	7.065E+03	1.059E+07	7.116E+02
2063	2.593E+04	2.076E+07	1.395E+03	6.925E+03	1.038E+07	6.975E+02
2064	2.541E+04	2.035E+07	1.367E+03	6.788E+03	1.018E+07	6.837E+02
2065	2.491E+04	1.995E+07	1.340E+03	6.654E+03	9.974E+06	6.701E+02
2066	2.442E+04	1.955E+07	1.314E+03	6.522E+03	9.776E+06	6.569E+02
2067	2.393E+04	1.917E+07	1.288E+03	6.393E+03	9.583E+06	6.439E+02
2068	2.346E+04	1.879E+07	1.262E+03	6.266E+03	9.393E+06	6.311E+02
2069	2.300E+04	1.841E+07	1.237E+03	6.142E+03	9.207E+06	6.186E+02
2070	2.254E+04	1.805E+07	1.213E+03	6.021E+03	9.025E+06	6.064E+02
2071	2.209E+04	1.769E+07	1.189E+03	5.901E+03	8.846E+06	5.944E+02
2072	2.166E+04	1.734E+07	1.165E+03	5.785E+03	8.671E+06	5.826E+02
2073	2.123E+04	1.700E+07	1.142E+03	5.670E+03	8.499E+06	5.710E+02
2074	2.081E+04	1.666E+07	1.119E+03	5.558E+03	8.331E+06	5.597E+02
2075	2.040E+04	1.633E+07	1.097E+03	5.448E+03	8.166E+06	5.487E+02
2076	1.999E+04	1.601E+07	1.076E+03	5.340E+03	8.004E+06	5.378E+02
2077	1.960E+04	1.569E+07	1.054E+03	5.234E+03	7.846E+06	5.271E+02
2078	1.921E+04	1.538E+07	1.033E+03	5.131E+03	7.690E+06	5.167E+02
2079	1.883E+04	1.508E+07	1.013E+03	5.029E+03	7.538E+06	5.065E+02
2080	1.845E+04	1.478E+07	9.929E+02	4.929E+03	7.389E+06	4.964E+02

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2081	1.809E+04	1.448E+07	9.732E+02	4.832E+03	7.242E+06	4.866E+02
2082	1.773E+04	1.420E+07	9.540E+02	4.736E+03	7.099E+06	4.770E+02
2083	1.738E+04	1.392E+07	9.351E+02	4.642E+03	6.958E+06	4.675E+02
2084	1.704E+04	1.364E+07	9.166E+02	4.550E+03	6.821E+06	4.583E+02
2085	1.670E+04	1.337E+07	8.984E+02	4.460E+03	6.686E+06	4.492E+02
2086	1.637E+04	1.311E+07	8.806E+02	4.372E+03	6.553E+06	4.403E+02
2087	1.604E+04	1.285E+07	8.632E+02	4.285E+03	6.423E+06	4.316E+02
2088	1.573E+04	1.259E+07	8.461E+02	4.201E+03	6.296E+06	4.230E+02
2089	1.541E+04	1.234E+07	8.293E+02	4.117E+03	6.172E+06	4.147E+02
2090	1.511E+04	1.210E+07	8.129E+02	4.036E+03	6.049E+06	4.065E+02
2091	1.481E+04	1.186E+07	7.968E+02	3.956E+03	5.930E+06	3.984E+02
2092	1.452E+04	1.162E+07	7.810E+02	3.878E+03	5.812E+06	3.905E+02
2093	1.423E+04	1.139E+07	7.656E+02	3.801E+03	5.697E+06	3.828E+02
2094	1.395E+04	1.117E+07	7.504E+02	3.726E+03	5.584E+06	3.752E+02
2095	1.367E+04	1.095E+07	7.355E+02	3.652E+03	5.474E+06	3.678E+02
2096	1.340E+04	1.073E+07	7.210E+02	3.579E+03	5.365E+06	3.605E+02
2097	1.314E+04	1.052E+07	7.067E+02	3.509E+03	5.259E+06	3.534E+02
2098	1.288E+04	1.031E+07	6.927E+02	3.439E+03	5.155E+06	3.464E+02
2099	1.262E+04	1.011E+07	6.790E+02	3.371E+03	5.053E+06	3.395E+02
2100	1.237E+04	9.906E+06	6.656E+02	3.304E+03	4.953E+06	3.328E+02
2101	1.213E+04	9.709E+06	6.524E+02	3.239E+03	4.855E+06	3.262E+02
2102	1.189E+04	9.517E+06	6.395E+02	3.175E+03	4.759E+06	3.197E+02
2103	1.165E+04	9.329E+06	6.268E+02	3.112E+03	4.664E+06	3.134E+02
2104	1.142E+04	9.144E+06	6.144E+02	3.050E+03	4.572E+06	3.072E+02
2105	1.119E+04	8.963E+06	6.022E+02	2.990E+03	4.481E+06	3.011E+02
2106	1.097E+04	8.785E+06	5.903E+02	2.931E+03	4.393E+06	2.951E+02
2107	1.075E+04	8.611E+06	5.786E+02	2.873E+03	4.306E+06	2.893E+02
2108	1.054E+04	8.441E+06	5.671E+02	2.816E+03	4.220E+06	2.836E+02
2109	1.033E+04	8.274E+06	5.559E+02	2.760E+03	4.137E+06	2.780E+02
2110	1.013E+04	8.110E+06	5.449E+02	2.705E+03	4.055E+06	2.725E+02
2111	9.927E+03	7.949E+06	5.341E+02	2.652E+03	3.975E+06	2.671E+02
2112	9.731E+03	7.792E+06	5.235E+02	2.599E+03	3.896E+06	2.618E+02
2113	9.538E+03	7.638E+06	5.132E+02	2.548E+03	3.819E+06	2.566E+02
2114	9.349E+03	7.486E+06	5.030E+02	2.497E+03	3.743E+06	2.515E+02
2115	9.164E+03	7.338E+06	4.931E+02	2.448E+03	3.669E+06	2.465E+02
2116	8.983E+03	7.193E+06	4.833E+02	2.399E+03	3.596E+06	2.416E+02
2117	8.805E+03	7.050E+06	4.737E+02	2.352E+03	3.525E+06	2.369E+02
2118	8.630E+03	6.911E+06	4.643E+02	2.305E+03	3.455E+06	2.322E+02
2119	8.460E+03	6.774E+06	4.551E+02	2.260E+03	3.387E+06	2.276E+02
2120	8.292E+03	6.640E+06	4.461E+02	2.215E+03	3.320E+06	2.231E+02

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
1980	0	0	0	0	0	0
1981	7.492E+01	4.093E+04	2.750E+00	1.174E+00	3.275E+02	2.200E-02
1982	1.569E+02	8.569E+04	5.758E+00	2.457E+00	6.855E+02	4.606E-02
1983	2.503E+02	1.367E+05	9.186E+00	3.920E+00	1.094E+03	7.349E-02
1984	3.613E+02	1.974E+05	1.326E+01	5.659E+00	1.579E+03	1.061E-01
1985	4.969E+02	2.715E+05	1.824E+01	7.784E+00	2.172E+03	1.459E-01
1986	6.558E+02	3.582E+05	2.407E+01	1.027E+01	2.866E+03	1.926E-01
1987	8.225E+02	4.494E+05	3.019E+01	1.289E+01	3.595E+03	2.415E-01
1988	9.865E+02	5.389E+05	3.621E+01	1.545E+01	4.312E+03	2.897E-01
1989	1.141E+03	6.233E+05	4.188E+01	1.787E+01	4.986E+03	3.350E-01
1990	1.295E+03	7.076E+05	4.754E+01	2.029E+01	5.660E+03	3.803E-01
1991	1.452E+03	7.932E+05	5.330E+01	2.275E+01	6.346E+03	4.264E-01
1992	1.601E+03	8.749E+05	5.878E+01	2.509E+01	6.999E+03	4.703E-01
1993	1.754E+03	9.581E+05	6.438E+01	2.748E+01	7.665E+03	5.150E-01
1994	1.918E+03	1.048E+06	7.040E+01	3.005E+01	8.382E+03	5.632E-01
1995	2.080E+03	1.136E+06	7.636E+01	3.259E+01	9.092E+03	6.109E-01
1996	2.231E+03	1.219E+06	8.189E+01	3.495E+01	9.751E+03	6.552E-01
1997	2.379E+03	1.300E+06	8.732E+01	3.727E+01	1.040E+04	6.986E-01
1998	2.534E+03	1.384E+06	9.300E+01	3.969E+01	1.107E+04	7.440E-01
1999	2.711E+03	1.481E+06	9.951E+01	4.247E+01	1.185E+04	7.961E-01
2000	2.892E+03	1.580E+06	1.061E+02	4.530E+01	1.264E+04	8.491E-01
2001	3.091E+03	1.689E+06	1.135E+02	4.842E+01	1.351E+04	9.076E-01
2002	3.332E+03	1.820E+06	1.223E+02	5.220E+01	1.456E+04	9.785E-01
2003	3.569E+03	1.950E+06	1.310E+02	5.591E+01	1.560E+04	1.048E+00
2004	3.801E+03	2.076E+06	1.395E+02	5.954E+01	1.661E+04	1.116E+00
2005	4.238E+03	2.315E+06	1.556E+02	6.640E+01	1.852E+04	1.245E+00
2006	4.667E+03	2.550E+06	1.713E+02	7.312E+01	2.040E+04	1.371E+00
2007	5.088E+03	2.780E+06	1.868E+02	7.971E+01	2.224E+04	1.494E+00
2008	5.319E+03	2.906E+06	1.952E+02	8.332E+01	2.324E+04	1.562E+00
2009	5.521E+03	3.016E+06	2.026E+02	8.649E+01	2.413E+04	1.621E+00
2010	5.731E+03	3.131E+06	2.104E+02	8.979E+01	2.505E+04	1.683E+00
2011	5.942E+03	3.246E+06	2.181E+02	9.308E+01	2.597E+04	1.745E+00
2012	6.154E+03	3.362E+06	2.259E+02	9.641E+01	2.690E+04	1.807E+00
2013	6.361E+03	3.475E+06	2.335E+02	9.965E+01	2.780E+04	1.868E+00
2014	6.565E+03	3.586E+06	2.410E+02	1.028E+02	2.869E+04	1.928E+00
2015	6.773E+03	3.700E+06	2.486E+02	1.061E+02	2.960E+04	1.989E+00
2016	6.985E+03	3.816E+06	2.564E+02	1.094E+02	3.053E+04	2.051E+00
2017	7.201E+03	3.934E+06	2.643E+02	1.128E+02	3.147E+04	2.115E+00
2018	7.422E+03	4.055E+06	2.724E+02	1.163E+02	3.244E+04	2.180E+00
2019	7.648E+03	4.178E+06	2.807E+02	1.198E+02	3.342E+04	2.246E+00
2020	7.877E+03	4.303E+06	2.891E+02	1.234E+02	3.443E+04	2.313E+00
2021	8.112E+03	4.431E+06	2.977E+02	1.271E+02	3.545E+04	2.382E+00
2022	8.350E+03	4.562E+06	3.065E+02	1.308E+02	3.649E+04	2.452E+00
2023	8.594E+03	4.695E+06	3.155E+02	1.346E+02	3.756E+04	2.524E+00
2024	8.843E+03	4.831E+06	3.246E+02	1.385E+02	3.865E+04	2.597E+00
2025	9.096E+03	4.969E+06	3.339E+02	1.425E+02	3.975E+04	2.671E+00
2026	9.354E+03	5.110E+06	3.434E+02	1.465E+02	4.088E+04	2.747E+00
2027	9.618E+03	5.254E+06	3.530E+02	1.507E+02	4.203E+04	2.824E+00
2028	9.887E+03	5.401E+06	3.629E+02	1.549E+02	4.321E+04	2.903E+00
2029	1.016E+04	5.550E+06	3.729E+02	1.592E+02	4.440E+04	2.983E+00

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2030	1.044E+04	5.702E+06	3.831E+02	1.635E+02	4.562E+04	3.065E+00
2031	1.072E+04	5.856E+06	3.935E+02	1.679E+02	4.685E+04	3.148E+00
2032	1.101E+04	6.013E+06	4.040E+02	1.724E+02	4.810E+04	3.232E+00
2033	1.130E+04	6.172E+06	4.147E+02	1.770E+02	4.938E+04	3.318E+00
2034	1.159E+04	6.333E+06	4.255E+02	1.816E+02	5.067E+04	3.404E+00
2035	1.189E+04	6.496E+06	4.364E+02	1.863E+02	5.196E+04	3.491E+00
2036	1.219E+04	6.659E+06	4.474E+02	1.910E+02	5.328E+04	3.580E+00
2037	1.249E+04	6.825E+06	4.586E+02	1.957E+02	5.460E+04	3.668E+00
2038	1.280E+04	6.992E+06	4.698E+02	2.005E+02	5.593E+04	3.758E+00
2039	1.311E+04	7.160E+06	4.811E+02	2.053E+02	5.728E+04	3.849E+00
2040	1.342E+04	7.329E+06	4.924E+02	2.102E+02	5.863E+04	3.939E+00
2041	1.373E+04	7.499E+06	5.039E+02	2.151E+02	6.000E+04	4.031E+00
2042	1.404E+04	7.671E+06	5.154E+02	2.200E+02	6.137E+04	4.123E+00
2043	1.436E+04	7.844E+06	5.270E+02	2.249E+02	6.275E+04	4.216E+00
2044	1.468E+04	8.018E+06	5.387E+02	2.299E+02	6.415E+04	4.310E+00
2045	1.500E+04	8.194E+06	5.505E+02	2.350E+02	6.555E+04	4.404E+00
2046	1.532E+04	8.371E+06	5.624E+02	2.400E+02	6.697E+04	4.500E+00
2047	1.565E+04	8.549E+06	5.744E+02	2.452E+02	6.840E+04	4.595E+00
2048	1.598E+04	8.729E+06	5.865E+02	2.503E+02	6.984E+04	4.692E+00
2049	1.631E+04	8.911E+06	5.987E+02	2.555E+02	7.129E+04	4.790E+00
2050	1.665E+04	9.094E+06	6.110E+02	2.608E+02	7.275E+04	4.888E+00
2051	1.698E+04	9.279E+06	6.234E+02	2.661E+02	7.423E+04	4.988E+00
2052	1.733E+04	9.465E+06	6.360E+02	2.714E+02	7.572E+04	5.088E+00
2053	1.767E+04	9.653E+06	6.486E+02	2.768E+02	7.723E+04	5.189E+00
2054	1.802E+04	9.843E+06	6.614E+02	2.823E+02	7.875E+04	5.291E+00
2055	1.837E+04	1.004E+07	6.743E+02	2.878E+02	8.028E+04	5.394E+00
2056	1.872E+04	1.023E+07	6.873E+02	2.933E+02	8.183E+04	5.498E+00
2057	1.908E+04	1.042E+07	7.004E+02	2.989E+02	8.339E+04	5.603E+00
2058	1.944E+04	1.062E+07	7.137E+02	3.046E+02	8.497E+04	5.709E+00
2059	1.981E+04	1.082E+07	7.271E+02	3.103E+02	8.657E+04	5.817E+00
2060	2.018E+04	1.102E+07	7.406E+02	3.161E+02	8.818E+04	5.925E+00
2061	1.978E+04	1.080E+07	7.259E+02	3.098E+02	8.643E+04	5.808E+00
2062	1.939E+04	1.059E+07	7.116E+02	3.037E+02	8.472E+04	5.693E+00
2063	1.900E+04	1.038E+07	6.975E+02	2.977E+02	8.305E+04	5.580E+00
2064	1.863E+04	1.018E+07	6.837E+02	2.918E+02	8.140E+04	5.469E+00
2065	1.826E+04	9.974E+06	6.701E+02	2.860E+02	7.979E+04	5.361E+00
2066	1.790E+04	9.776E+06	6.569E+02	2.803E+02	7.821E+04	5.255E+00
2067	1.754E+04	9.583E+06	6.439E+02	2.748E+02	7.666E+04	5.151E+00
2068	1.719E+04	9.393E+06	6.311E+02	2.693E+02	7.514E+04	5.049E+00
2069	1.685E+04	9.207E+06	6.186E+02	2.640E+02	7.365E+04	4.949E+00
2070	1.652E+04	9.025E+06	6.064E+02	2.588E+02	7.220E+04	4.851E+00
2071	1.619E+04	8.846E+06	5.944E+02	2.537E+02	7.077E+04	4.755E+00
2072	1.587E+04	8.671E+06	5.826E+02	2.486E+02	6.937E+04	4.661E+00
2073	1.556E+04	8.499E+06	5.710E+02	2.437E+02	6.799E+04	4.568E+00
2074	1.525E+04	8.331E+06	5.597E+02	2.389E+02	6.665E+04	4.478E+00
2075	1.495E+04	8.166E+06	5.487E+02	2.342E+02	6.533E+04	4.389E+00
2076	1.465E+04	8.004E+06	5.378E+02	2.295E+02	6.403E+04	4.302E+00
2077	1.436E+04	7.846E+06	5.271E+02	2.250E+02	6.276E+04	4.217E+00
2078	1.408E+04	7.690E+06	5.167E+02	2.205E+02	6.152E+04	4.134E+00
2079	1.380E+04	7.538E+06	5.065E+02	2.162E+02	6.030E+04	4.052E+00
2080	1.352E+04	7.389E+06	4.964E+02	2.119E+02	5.911E+04	3.972E+00

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2081	1.326E+04	7.242E+06	4.866E+02	2.077E+02	5.794E+04	3.893E+00
2082	1.299E+04	7.099E+06	4.770E+02	2.036E+02	5.679E+04	3.816E+00
2083	1.274E+04	6.958E+06	4.675E+02	1.995E+02	5.567E+04	3.740E+00
2084	1.249E+04	6.821E+06	4.583E+02	1.956E+02	5.456E+04	3.666E+00
2085	1.224E+04	6.686E+06	4.492E+02	1.917E+02	5.348E+04	3.594E+00
2086	1.200E+04	6.553E+06	4.403E+02	1.879E+02	5.243E+04	3.522E+00
2087	1.176E+04	6.423E+06	4.316E+02	1.842E+02	5.139E+04	3.453E+00
2088	1.153E+04	6.296E+06	4.230E+02	1.805E+02	5.037E+04	3.384E+00
2089	1.130E+04	6.172E+06	4.147E+02	1.770E+02	4.937E+04	3.317E+00
2090	1.107E+04	6.049E+06	4.065E+02	1.735E+02	4.839E+04	3.252E+00
2091	1.085E+04	5.930E+06	3.984E+02	1.700E+02	4.744E+04	3.187E+00
2092	1.064E+04	5.812E+06	3.905E+02	1.667E+02	4.650E+04	3.124E+00
2093	1.043E+04	5.697E+06	3.828E+02	1.634E+02	4.558E+04	3.062E+00
2094	1.022E+04	5.584E+06	3.752E+02	1.601E+02	4.467E+04	3.002E+00
2095	1.002E+04	5.474E+06	3.678E+02	1.570E+02	4.379E+04	2.942E+00
2096	9.821E+03	5.365E+06	3.605E+02	1.539E+02	4.292E+04	2.884E+00
2097	9.627E+03	5.259E+06	3.534E+02	1.508E+02	4.207E+04	2.827E+00
2098	9.436E+03	5.155E+06	3.464E+02	1.478E+02	4.124E+04	2.771E+00
2099	9.249E+03	5.053E+06	3.395E+02	1.449E+02	4.042E+04	2.716E+00
2100	9.066E+03	4.953E+06	3.328E+02	1.420E+02	3.962E+04	2.662E+00
2101	8.887E+03	4.855E+06	3.262E+02	1.392E+02	3.884E+04	2.609E+00
2102	8.711E+03	4.759E+06	3.197E+02	1.365E+02	3.807E+04	2.558E+00
2103	8.538E+03	4.664E+06	3.134E+02	1.338E+02	3.731E+04	2.507E+00
2104	8.369E+03	4.572E+06	3.072E+02	1.311E+02	3.658E+04	2.458E+00
2105	8.203E+03	4.481E+06	3.011E+02	1.285E+02	3.585E+04	2.409E+00
2106	8.041E+03	4.393E+06	2.951E+02	1.260E+02	3.514E+04	2.361E+00
2107	7.882E+03	4.306E+06	2.893E+02	1.235E+02	3.445E+04	2.314E+00
2108	7.726E+03	4.220E+06	2.836E+02	1.210E+02	3.376E+04	2.269E+00
2109	7.573E+03	4.137E+06	2.780E+02	1.186E+02	3.310E+04	2.224E+00
2110	7.423E+03	4.055E+06	2.725E+02	1.163E+02	3.244E+04	2.180E+00
2111	7.276E+03	3.975E+06	2.671E+02	1.140E+02	3.180E+04	2.136E+00
2112	7.132E+03	3.896E+06	2.618E+02	1.117E+02	3.117E+04	2.094E+00
2113	6.990E+03	3.819E+06	2.566E+02	1.095E+02	3.055E+04	2.053E+00
2114	6.852E+03	3.743E+06	2.515E+02	1.073E+02	2.995E+04	2.012E+00
2115	6.716E+03	3.669E+06	2.465E+02	1.052E+02	2.935E+04	1.972E+00
2116	6.583E+03	3.596E+06	2.416E+02	1.031E+02	2.877E+04	1.933E+00
2117	6.453E+03	3.525E+06	2.369E+02	1.011E+02	2.820E+04	1.895E+00
2118	6.325E+03	3.455E+06	2.322E+02	9.909E+01	2.764E+04	1.857E+00
2119	6.200E+03	3.387E+06	2.276E+02	9.713E+01	2.710E+04	1.821E+00
2120	6.077E+03	3.320E+06	2.231E+02	9.520E+01	2.656E+04	1.785E+00

Results of GHG Reporting Rule Applicability

Yes, the facility is subject to the reporting rule, based on the information you have provided.

You will need Adobe Reader to view some of the files linked from this page. See EPA's PDF page to learn more.

Facility

Class 1 MSW Landfill
Not provided
Not provided

Date of This Assessment

Tuesday, July 29, 2014

Year of Emissions

2014

Preliminary Estimate of MSW Landfill's CO_2e Emissions

Calculation Variables	Value	Unit of Measure
Quantity of waste in place through 2013	1352388	Metric tons
Year landfill opened	1980	Calendar year
Adjusted CH_4 Generation for Reporting Year 2014	77859	**Metric tons CO_2e**

Calculation Variables	Value	Unit of Measure
Landfill Capacity	1352388	Metric Tons
Year landfill opened	1980	Calendar year
Year landfill closed	active	Calendar year
Adjusted CH_4 Generation for Reporting Year 2014	77859	**Metric tons CO_2e**

Note: This is a preliminary estimate of MSW landfill CO_2e emissions intended for screening purposes only.

Relevant Subparts

If subject to the rule, you must collect data; calculate GHGs; and follow the procedures for quality assurance, missing data, recordkeeping, and reporting that are specified in the 40 CFR part 98 subparts listed below based on your selections:

- Subpart A. - General Provisions
  - Section 98.1-98.8.
  - Information Sheet (PDF). (6 pp., 146 K)
  - Plain English Guide to the GHG Reporting Rule.
- Subpart HH. - Municipal Solid Waste Landfills
  - Section 98.340-98.348.
  - Information Sheet.
  - Monitoring Checklist (PDF). (1 p., 47 K)

Applicability Tool Disclaimer

The content provided in the applicability tool is intended solely as compliance assistance for potential reporters to aid in assessing whether they are required to report under the Greenhouse Gas Mandatory Reporting Rule. Any variation between the rule and the information provided in this tool is unintentional, and, in the case of such variations, the requirements of the rule govern.

http://www.epa.gov/ghgreporting/help/tool2014/must-report5.html

The applicability tool and its contents do not constitute rulemaking or a decision by EPA and may not be relied upon to create a substantive or procedural right or benefit enforceable by law, or in equity, by any person. While this tool is designed to help potential reporters comply with the rule, compliance with all Federal, State, and Local laws and regulations remains the sole responsibility of each facility owner or operator subject to those laws and regulations. Use of this tool does not constitute an assessment by EPA of the applicability of the rule to any particular facility. In any particular case, EPA will make its assessment by applying the law and regulations to the specific facts of the case.

No information entered by the user is maintained by EPA, and any results generated by the applicability tool, along with additional information entered by the user, do not constitute a submission for purposes of compliance with the rule.

Last updated on Thursday, January 09, 2014

Appendix N
Method Sampling Instructions

Method 2E - Determination of Landfill Gas Production Flow Rate

Note: This method does not include all of the specifications (*e.g*., equipment and supplies) and procedures (*e.g*., sampling and analytical) essential to its performance. Some material is incorporated by reference from other methods in this part. Therefore, to obtain reliable results, persons using this method should also have a thorough knowledge of at least the following additional test methods: Methods 2 and 3C.

1.0 Scope and Application

1.1 Applicability. This method applies to the measurement of landfill gas (LFG) production flow rate from municipal solid waste landfills and is used to calculate the flow rate of nonmethane organic compounds (NMOC) from landfills.

1.2 Data Quality Objectives. Adherence to the requirements of this method will enhance the quality of the data obtained from air pollutant sampling methods.

2.0 Summary of Method

2.1 Extraction wells are installed either in a cluster of three or at five dispersed locations in the landfill. A blower is used to extract LFG from the landfill. LFG composition, landfill pressures, and orifice pressure differentials from the wells are measured and the landfill gas production flow rate is calculated.

3.0 Definitions [Reserved]

4.0 Interferences [Reserved]

5.0 Safety

5.1 Since this method is complex, only experienced personnel should perform the test. Landfill gas contains methane, therefore explosive mixtures may exist at or near the landfill. It is advisable to take appropriate safety precautions when testing landfills, such as refraining from smoking and installing explosion-proof equipment.

6.0 Equipment and Supplies

6.1 Well Drilling Rig. Capable of boring a 0.61 m (24 in.) diameter hole into the landfill to a minimum of 75 percent of the landfill depth. The depth of the well shall not extend to the bottom of the landfill or the liquid level.

6.2 Gravel. No fines. Gravel diameter should be appreciably larger than perforations stated in Sections 6.10 and 8.2.

6.3 Bentonite.

6.4 Backfill Material. Clay, soil, and sandy loam have been found to be acceptable.

6.5 Extraction Well Pipe. Minimum diameter of 3 in., constructed of polyvinyl chloride (PVC), high density polyethylene (HDPE), fiberglass, stainless steel, or other suitable nonporous material capable of transporting landfill gas.

6.6 Above Ground Well Assembly. Valve capable of adjusting gas flow, such as a gate, ball, or butterfly valve; sampling ports at the well head and outlet; and a flow measuring device, such as an in-line orifice meter or pitot tube. A schematic of the aboveground well head assembly is shown in Figure 2E–1.

6.7 Cap. Constructed of PVC or HDPE.

6.8 Header Piping. Constructed of PVC or HDPE.

6.9 Auger. Capable of boring a 0.15-to 0.23-m (6-to 9-in.) diameter hole to a depth equal to the top of the perforated section of the extraction well, for pressure probe installation.

6.10 Pressure Probe. Constructed of PVC or stainless steel (316), 0.025-m (1-in.). Schedule 40 pipe. Perforate the bottom two-thirds. A minimum requirement for perforations is slots or holes with an open area equivalent to four 0.006-m (1/4-in.) diameter holes spaced 90° apart every 0.15 m (6 in.).

6.11 Blower and Flare Assembly. Explosion-proof blower, capable of extracting LFG at a flow rate of 8.5 m^3/min (300 ft^3/min), a water knockout, and flare or incinerator.

6.12 Standard Pitot Tube and Differential Pressure Gauge for Flow Rate Calibration with Standard Pitot. Same as Method 2, Sections 6.7 and 6.8.

6.13 Orifice Meter. Orifice plate, pressure tabs, and pressure measuring device to measure the LFG flow rate.

6.14 Barometer. Same as Method 4, Section 6.1.5.

6.15 Differential Pressure Gauge. Water-filled U-tube manometer or equivalent, capable of measuring within 0.02 mm Hg (0.01 in. H_2O), for measuring the pressure of the pressure probes.

7.0 Reagents and Standards. Not Applicable

8.0 Sample Collection, Preservation, Storage, and Transport

8.1 Placement of Extraction Wells. The landfill owner or operator may install a single cluster of three extraction wells in a test area or space five equal-volume wells over the landfill. The cluster wells are recommended but may be used only if the composition, age of the refuse, and the landfill depth of the test area can be determined.

8.1.1 Cluster Wells. Consult landfill site records for the age of the refuse, depth, and composition of various sections of the landfill. Select an area near the perimeter of the landfill with a depth equal to or greater than the average depth of the landfill and with the average age of the refuse between 2 and 10 years old. Avoid areas known to contain non-decomposable materials, such as concrete and asbestos. Locate the cluster wells as shown in Figure 2E–2.

8.1.1.1 The age of the refuse in a test area will not be uniform, so calculate a weighted average age of the refuse as shown in Section 12.2.

8.1.2 Equal Volume Wells. Divide the sections of the landfill that are at least 2 years old into five areas representing equal volumes. Locate an extraction well near the center of each area.

8.2 Installation of Extraction Wells. Use a well drilling rig to dig a 0.6 m (24 in.) diameter hole in the landfill to a minimum of 75 percent of the landfill depth, not to extend to the bottom of the landfill or the liquid level. Perforate the bottom two thirds of the extraction well pipe. A minimum requirement for perforations is holes or slots with an open area equivalent to 0.01-m (0.5-in.) diameter holes spaced 90° apart every 0.1 to 0.2 m (4 to 8 in.). Place the extraction well in the center of the hole and backfill with gravel to a level 0.30 m (1 ft) above the perforated section. Add a layer of backfill material 1.2 m (4 ft) thick. Add a layer of bentonite 0.9 m (3 ft) thick, and backfill the remainder of the hole with cover material or material equal in permeability to the existing cover material. The specifications for extraction well installation are shown in Figure 2E–3.

8.3 Pressure Probes. Shallow pressure probes are used in the check for infiltration of air into the landfill, and deep pressure probes are used to determine the radius of influence. Locate pressure probes along three radial arms approximately 120° apart at distances of 3, 15, 30, and 45 m (10, 50, 100, and 150 ft) from the extraction well. The tester has the option of locating additional pressure probes at distances every 15 m (50 feet) beyond 45 m (150 ft). Example placements of probes are shown in Figure 2E–4. The 15-, 30-, and 45-m, (50-, 100-, and 150-ft) probes from each well, and any additional probes located along the three radial arms (deep probes), shall extend to a depth equal to the top of the perforated section of the extraction wells. All other probes (shallow probes) shall extend to a depth equal to half the depth of the deep probes.

8.3.1 Use an auger to dig a hole, 0.15- to 0.23-m (6-to 9-in.) in diameter, for each pressure probe. Perforate the bottom two thirds of the pressure probe. A minimum requirement for perforations is holes or slots with an open area equivalent to four 0.006-m (0.25-in.) diameter holes spaced 90° apart every 0.15 m (6 in.). Place the pressure probe in the center of the hole and backfill with gravel to a level 0.30 m (1 ft) above the perforated section. Add a layer of backfill material at least 1.2 m (4 ft) thick. Add a layer of bentonite at least 0.3 m (1 ft) thick, and backfill the remainder of the hole with cover material or material equal in permeability to the existing cover material. The specifications for pressure probe installation are shown in Figure 2E–5.

8.4 LFG Flow Rate Measurement. Place the flow measurement device, such as an orifice meter, as shown in Figure 2E–1. Attach the wells to the blower and flare assembly. The individual wells may be ducted to a common header so that a single blower, flare assembly, and flow meter may be used. Use the procedures in Section 10.1 to calibrate the flow meter.

8.5 Leak-Check. A leak-check of the above ground system is required for accurate flow rate measurements and for safety. Sample LFG at the well head sample port and at the outlet sample port. Use Method 3C to determine nitrogen (N_2) concentrations. Determine the difference between the well head and outlet N_2 concentrations using the formula in Section 12.3. The system passes the leak-check if the difference is less than 10,000 ppmv.

8.6 Static Testing. Close the control valves on the well heads during static testing. Measure the gauge pressure (P_g) at each deep pressure probe and the barometric pressure (P_{bar}) every 8 hours (hr) for 3 days. Convert the gauge pressure of each deep pressure probe to absolute pressure using the equation in Section 12.4. Record as P_i (initial absolute pressure).

8.6.1 For each probe, average all of the 8-hr deep pressure probe readings (P_i) and record as P_{ia} (average absolute pressure). P_{ia} is used in Section 8.7.5 to determine the maximum radius of influence.

8.6.2 Measure the static flow rate of each well once during static testing.

8.7 Short-Term Testing. The purpose of short-term testing is to determine the maximum vacuum that can be applied to the wells without infiltration of ambient air into the landfill. The short-term testing is performed on one well at a time. Burn all LFG with a flare or incinerator.

8.7.1 Use the blower to extract LFG from a single well at a rate at least twice the static flow rate of the respective well measured in Section 8.6.2. If using a single blower and flare assembly and a common header system, close the control valve on the wells not being measured. Allow 24 hr for the system to stabilize at this flow rate.

8.7.2 Test for infiltration of air into the landfill by measuring the gauge pressures of the shallow pressure probes and using Method 3C to determine the LFG N_2 concentration. If the LFG N_2 concentration is less than 5 percent and all of the shallow probes have a positive gauge pressure, increase the blower vacuum by 3.7 mm Hg (2 in. H_2O), wait 24 hr, and repeat the tests for infiltration. Continue the above steps of increasing blower vacuum by 3.7 mm Hg (2 in. H_2O), waiting 24 hr, and testing for infiltration until the concentration of N_2 exceeds 5 percent or any of the shallow probes have a negative gauge pressure. When this occurs, reduce the blower vacuum to the maximum setting at which the N_2 concentration was less than 5 percent and the gauge pressures of the shallow probes are positive.

8.7.3 At this blower vacuum, measure atmospheric pressure (P_{bar}) every 8 hr for 24 hr, and record the LFG flow rate (Q_s) and the probe gauge pressures (P_f) for all of the probes. Convert the gauge pressures of the deep probes to absolute pressures for each 8-hr reading at Q_s as shown in Section 12.4.

8.7.4 For each probe, average the 8-hr deep pressure probe absolute pressure readings and record as P_{fa} (the final average absolute pressure).

8.7.5 For each probe, compare the initial average pressure (P_{ia}) from Section 8.6.1 to the final average pressure (P_{fa}). Determine the furthermost point from the well head along each radial arm where $P_{fa} \leq P_{ia}$. This distance is the maximum radius of influence (R_m), which is the distance from the well affected by the vacuum. Average these values to determine the average maximum radius of influence (R_{ma}).

8.7.6 Calculate the depth (D_{st}) affected by the extraction well during the short term test as shown in Section 12.6. If the computed value of D_{st} exceeds the depth of the landfill, set D_{st} equal to the landfill depth.

8.7.7 Calculate the void volume (V) for the extraction well as shown in Section 12.7.

8.7.8 Repeat the procedures in Section 8.7 for each well.

8.8 Calculate the total void volume of the test wells (V_v) by summing the void volumes (V) of each well.

8.9 Long-Term Testing. The purpose of long-term testing is to extract two void volumes of LFG from the extraction wells. Use the blower to extract LFG from the wells. If a single Blower and flare assembly and common header system are used, open all control valves and set the blower vacuum equal to the highest stabilized blower vacuum demonstrated by any individual well in Section 8.7. Every 8 hr, sample the LFG from the well head sample port, measure the gauge pressures of the shallow pressure probes, the blower vacuum, the LFG flow rate, and use the criteria for infiltration in Section 8.7.2 and Method 3C to test for infiltration. If infiltration is detected, do not reduce the blower vacuum, instead reduce the LFG flow rate from the well by adjusting the control valve on the well head. Adjust each affected well individually. Continue until the equivalent of two total void volumes (V_v) have been extracted, or until $V_t = 2V_v$.

8.9.1 Calculate V_t, the total volume of LFG extracted from the wells, as shown in Section 12.8.

8.9.2 Record the final stabilized flow rate as Q_f and the gauge pressure for each deep probe. If, during the long term testing, the flow rate does not stabilize, calculate Q_f by averaging the last 10 recorded flow rates.

8.9.3 For each deep probe, convert each gauge pressure to absolute pressure as in Section 12.4. Average these values and record as P_{sa}. For each probe, compare P_{ia} to P_{sa}. Determine the furthermost point from the well head along each radial arm where $P_{sa} \leq P_{ia}$. This distance is the stabilized radius of influence. Average these values to determine the average stabilized radius of influence (R_{sa}).

8.10 Determine the NMOC mass emission rate using the procedures in Section 12.9 through 12.15.

9.0 Quality Control

9.1 Miscellaneous Quality Control Measures.

Section	Quality control measure	Effect
10.1	LFG flow rate meter calibration	Ensures accurate measurement of LFG flow rate and sample volume

10.0 Calibration and Standardization

10.1 LFG Flow Rate Meter (Orifice) Calibration Procedure. Locate a standard pitot tube in line with an orifice meter. Use the procedures in Section 8, 12.5, 12.6, and 12.7 of Method 2 to determine the average dry gas volumetric flow rate for at least five flow rates that bracket the expected LFG flow rates, except in Section 8.1, use a standard pitot tube rather than a Type S pitot tube. Method 3C may be used to determine the dry molecular weight. It may be necessary to calibrate more than one orifice meter in order to bracket the LFG flow rates. Construct a calibration curve by plotting the pressure drops across the orifice meter for each flow rate versus the average dry gas volumetric flow rate in m^3/min of the gas.

11.0 Procedures [Reserved]

12.0 Data Analysis and Calculations

12.1 Nomenclature.

A=Age of landfill, yr.

A_{avg} = Average age of the refuse tested, yr.

A_i = Age of refuse in the ^{ith} fraction, yr.

A_r = Acceptance rate, Mg/yr.

C_{NMOC} = NMOC concentration, ppmv as hexane (C_{NMOC}=C_t/6).

C_o = Concentration of N_2 at the outlet, ppmv.

C_t = NMOC concentration, ppmv (carbon equivalent) from Method 25C.

C_w = Concentration of N_2 at the wellhead, ppmv.

D = Depth affected by the test wells, m.

D_{st} = Depth affected by the test wells in the short-term test, m.

e = Base number for natural logarithms (2.718).

f = Fraction of decomposable refuse in the landfill.

f_i = Fraction of the refuse in the ^{ith} section.

k = Landfill gas generation constant, yr^{-1}.

L_o = Methane generation potential, m^3/Mg.

L_o' = Revised methane generation potential to account for the amount of non-decomposable material in the landfill, m^3/Mg.

M_i = Mass of refuse in the ^{ith} section, Mg.

M_r = Mass of decomposable refuse affected by the test well, Mg.

P_{bar} = Atmospheric pressure, mm Hg.

P_f = Final absolute pressure of the deep pressure probes during short-term testing, mm Hg.

P_{fa} = Average final absolute pressure of the deep pressure probes during short-term testing, mm Hg.

P_{gf} = final gauge pressure of the deep pressure probes, mm Hg.

P_{gi} = Initial gauge pressure of the deep pressure probes, mm Hg.

P_i = Initial absolute pressure of the deep pressure probes during static testing, mm Hg.

P_{ia} = Average initial absolute pressure of the deep pressure probes during static testing, mm Hg.

P_s = Final absolute pressure of the deep pressure probes during long-term testing, mm Hg.

P_{sa} = Average final absolute pressure of the deep pressure probes during long-term testing, mm Hg.

Q_f = Final stabilized flow rate, m^3/min.

Q_i = LFG flow rate measured at orifice meter during the ith interval, m^3/min.

Q_s = Maximum LFG flow rate at each well determined by short-term test, m^3/min.

Q_t = NMOC mass emission rate, m^3/min.

R_m = Maximum radius of influence, m.

R_{ma} = Average maximum radius of influence, m.

R_s = Stabilized radius of influence for an individual well, m.

R_{sa} = Average stabilized radius of influence, m.

t_i = Age of section i, yr.

t_t = Total time of long-term testing, yr.

t_{vi} = Time of the ^{ith} interval (usually 8), hr.

V=Void volume of test well, m^3.

V_r = Volume of refuse affected by the test well, m^3.

V_t = Total volume of refuse affected by the long-term testing, m^3.

V_v = Total void volume affected by test wells, m^3.

WD = Well depth, m.

ρ = Refuse density, Mg/m^3 (Assume 0.64 Mg/m^3 if data are unavailable).

12.2 Use the following equation to calculate a weighted average age of landfill refuse.

$$A_{avg} = \sum_{i=1}^{n} f_i A_i \qquad Eq.\ 2E\text{-}1$$

12.3 Use the following equation to determine the difference in N_2 concentrations (ppmv) at the well head and outlet location.

$$Difference = C_o - C_w \qquad Eq.\ 2E\text{-}2$$

12.4 Use the following equation to convert the gauge pressure (P_g) of each initial deep pressure probe to absolute pressure (P_i).

$$P_i = P_{bar} + P_{gi} \qquad Eq.\ 2E\text{-}3$$

12.5 Use the following equation to convert the gauge pressures of the deep probes to absolute pressures for each 8-hr reading at Q_s.

$$P_f = P_{bar} + P_{gf} \qquad Eq.\ 2E\text{-}4$$

12.6 Use the following equation to calculate the depth (D_{st}) affected by the extraction well during the short-term test.

$$D_{st} = WD + R_{ma} \qquad Eq.\ 2E\text{-}5$$

12.7 Use the following equation to calculate the void volume for the extraction well (V).

$$V = 0.40\ \Pi\ R_{ma}^{2}\ D_{st} \qquad Eq.\ 2E\text{-}6$$

12.8 Use the following equation to calculate V_t, the total volume of LFG extracted from the wells.

$$V_t = \sum_{i=1}^{n} 60\, Q_i t_{vi} \qquad Eq.\ 2E\text{-}7$$

12.9 Use the following equation to calculate the depth affected by the test well. If using cluster wells, use the average depth of the wells for WD. If the value of D is greater than the depth of the landfill, set D equal to the landfill depth.

$$D = WD + R_{sa} \qquad Eq.\ 2E\text{-}8$$

12.10 Use the following equation to calculate the volume of refuse affected by the test well.

$$V_r = R_{sa}^{2}\ \Pi\ D \qquad Eq.\ 2E\text{-}9$$

12.11 Use the following equation to calculate the mass affected by the test well.

$$M_r = V_r\, \rho \qquad Eq.\ 2E\text{-}10$$

12.12 Modify L_o to account for the non-decomposable refuse in the landfill.

$$L_o' = f\ L_o \qquad Eq.\ 2E\text{-}11$$

12.13 In the following equation, solve for k (landfill gas generation constant) by iteration. A suggested procedure is to select a value for k, calculate the left side of the equation, and if not equal to zero, select another value for k. Continue this process until the left hand side of the equation equals zero, ±0.001.

$$k_e^{-k} A_{avg} - \frac{Q_f}{2\ L_o' M_r} = 0 \qquad Eq.\ 2E\text{-}12$$

12.14 Use the following equation to determine landfill NMOC mass emission rate if the yearly acceptance rate of refuse has been consistent (10 percent) over the life of the landfill.

$$Q_t = 2L_o^{'} A_T \left(1 - e^{-kA}\right) C_{NMOC} \left(3.595 \times 10^{-9}\right) \qquad Eq.\ 2E\text{-}13$$

12.15 Use the following equation to determine landfill NMOC mass emission rate if the acceptance rate has not been consistent over the life of the landfill.

$$Q_t = 2kL_o^{'} C_{NMOC} \left(3.595 \times 10^{-9}\right) \sum_{i=1}^{n} M_i e^{-kt_i} \qquad Eq.\ 2E\text{-}14$$

13.0 Method Performance [Reserved]

14.0 Pollution Prevention [Reserved]

15.0 Waste Management [Reserved]

16.0 References

1. Same as Method 2, Appendix A, 40 CFR Part 60.

2. Emcon Associates, Methane Generation and Recovery from Landfills. Ann Arbor Science, 1982.

3. The Johns Hopkins University, Brown Station Road Landfill Gas Resource Assessment, Volume 1: Field Testing and Gas Recovery Projections. Laurel, Maryland: October 1982.

4. Mandeville and Associates, Procedure Manual for Landfill Gases Emission Testing.

5. Letter and attachments from Briggum, S., Waste Management of North America, to Thorneloe, S., EPA. Response to July 28, 1988 request for additional information. August 18, 1988.

6. Letter and attachments from Briggum, S., Waste Management of North America, to Wyatt, S., EPA. Response to December 7, 1988 request for additional information. January 16, 1989.

17.0 Tables, Diagrams, Flowcharts, and Validation Data

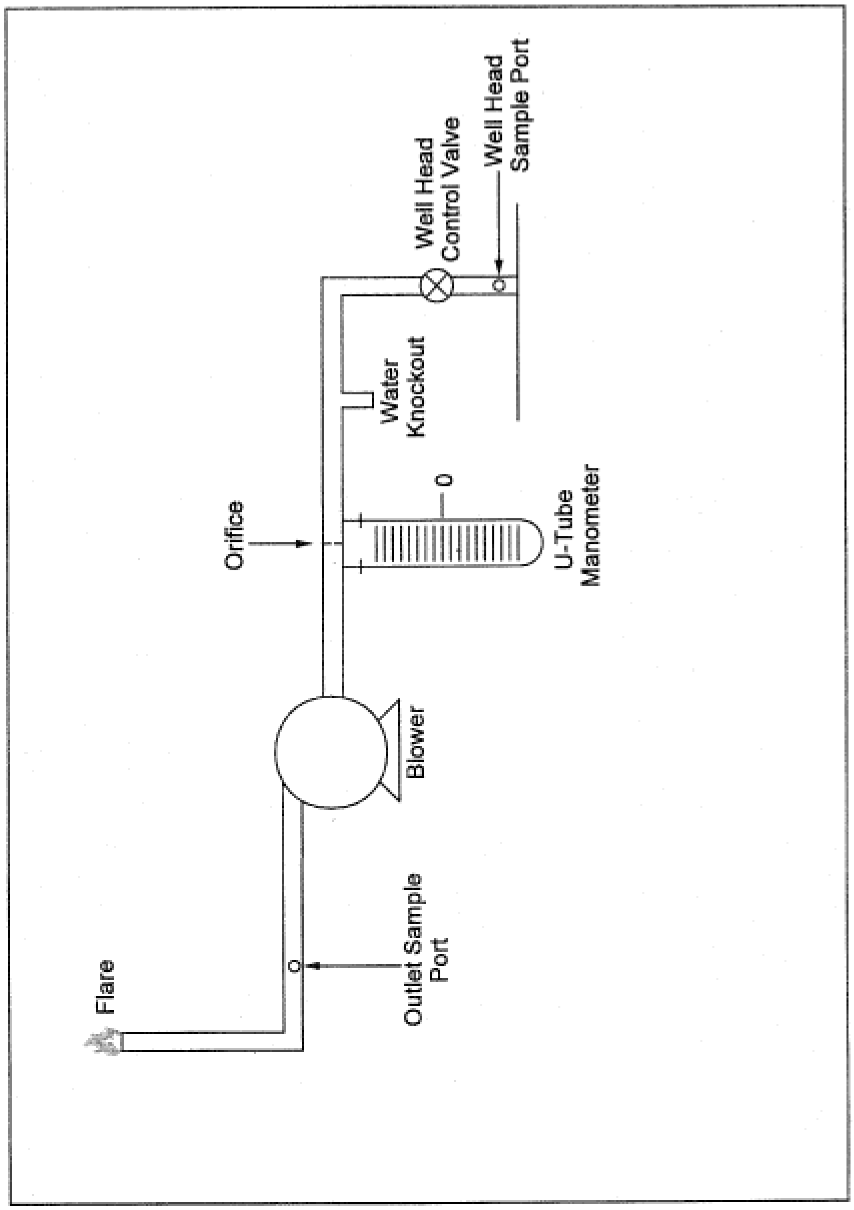


Figure 2E-1. Schematic of Aboveground Well Head Assembly.

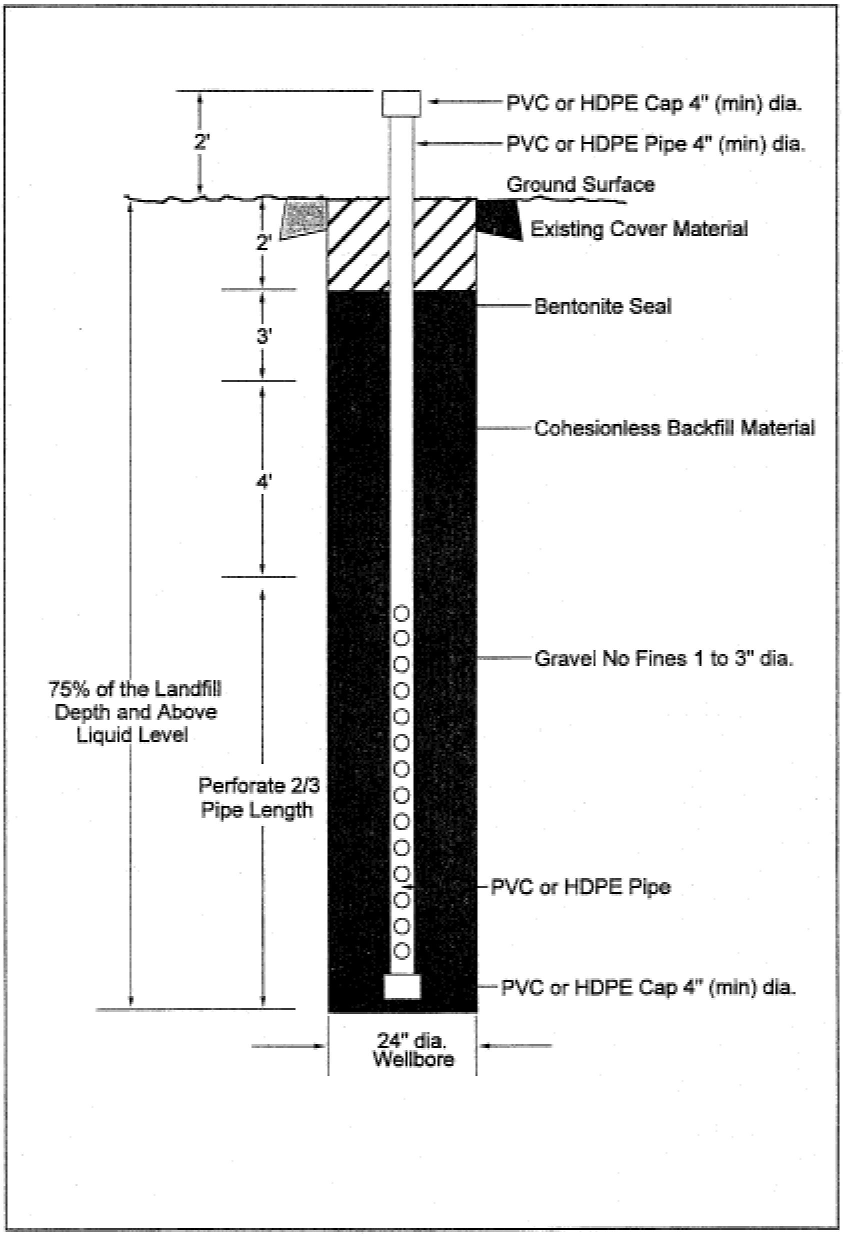


Figure 2E-3. Gas Extraction Well.

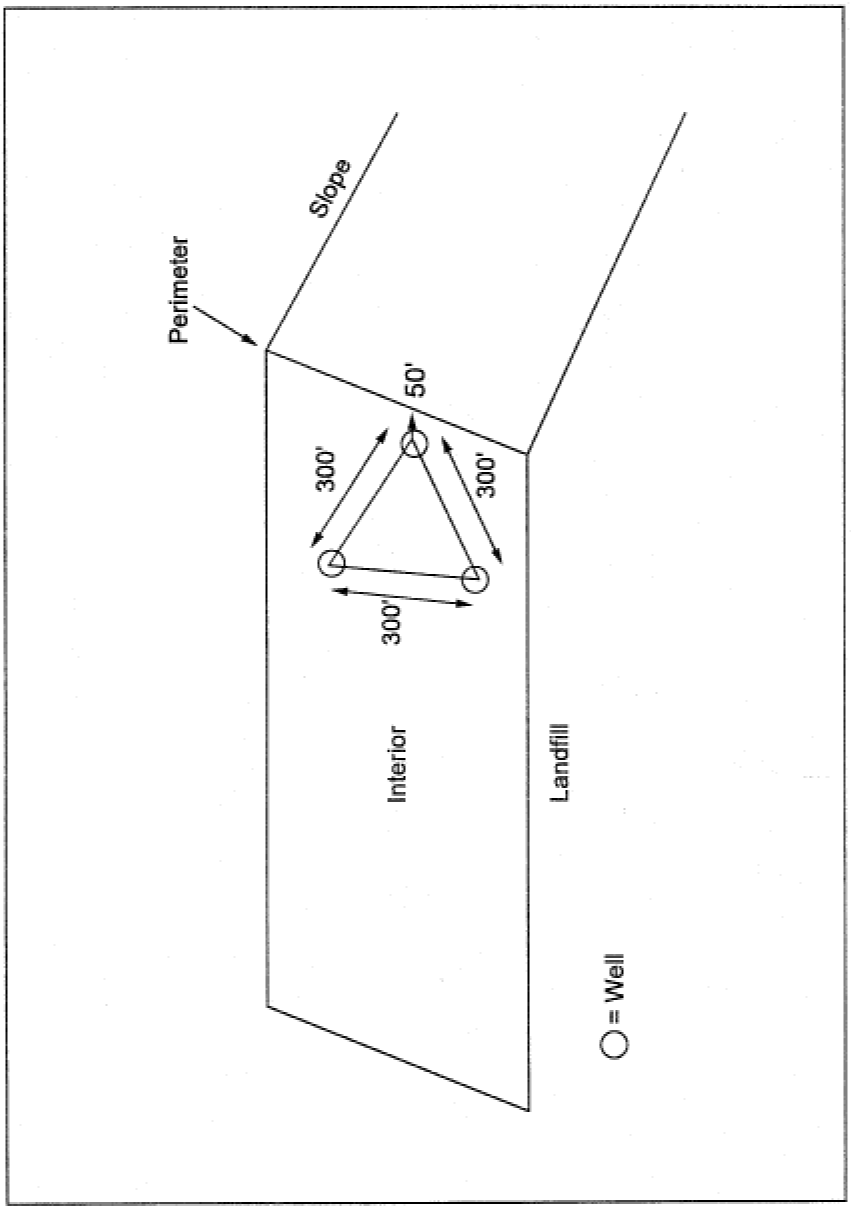


Figure 2E-2. Cluster Well Placement.

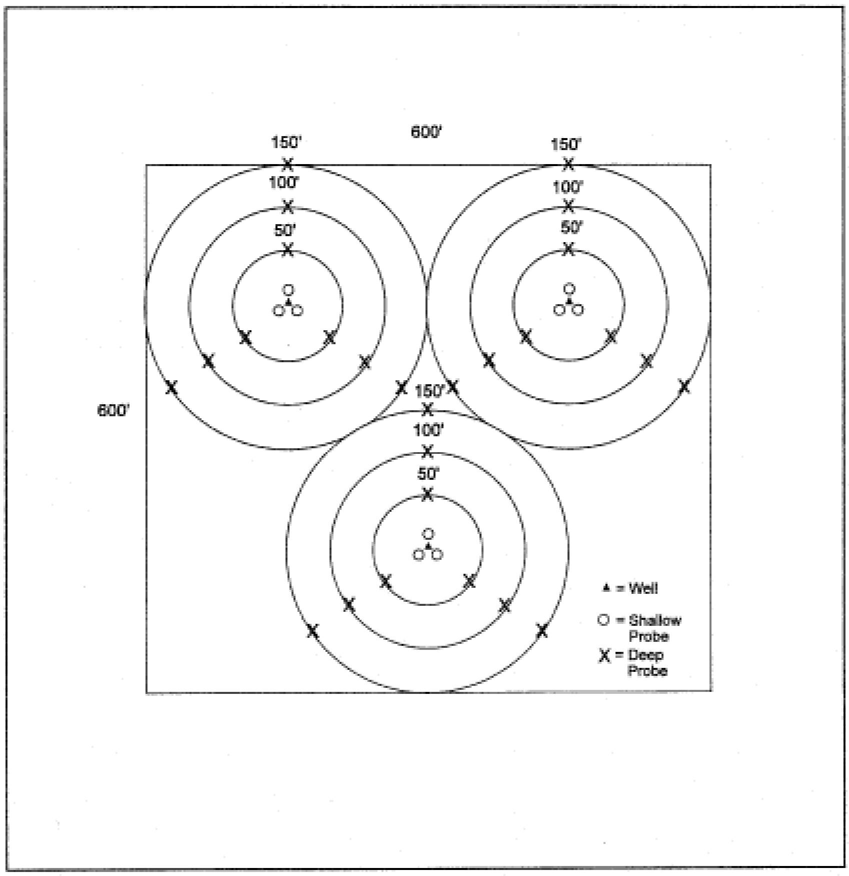


Figure 2E-4. Cluster Well Configuration.

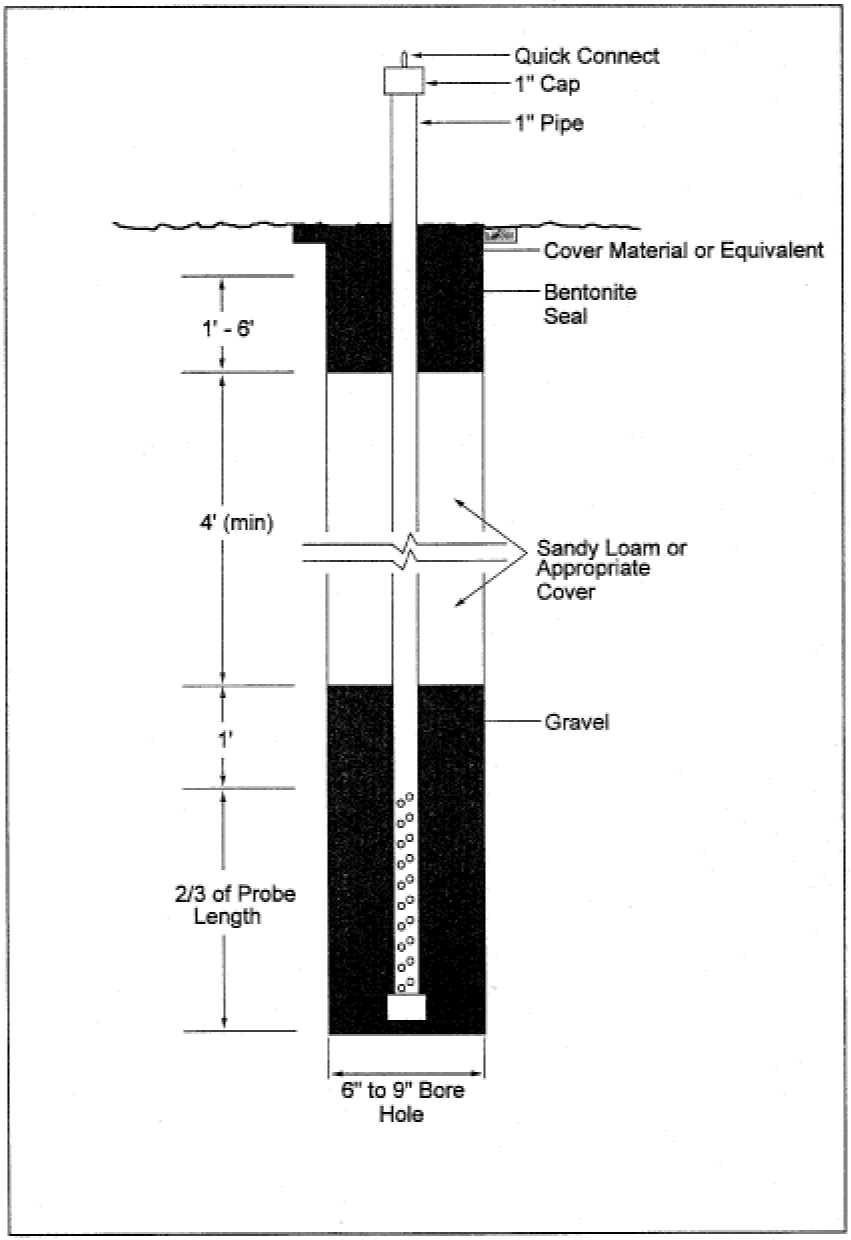


Figure 2E-5. Pressure Probe.

3.1 Method Specific Sampling Instructions

Air Toxics Method @ 71 Siloxanes

Siloxanes are a family of organic compounds containing chains of silicon, oxygen, and methyl groups. These organosilicon compounds, commonly called silicones, differ from naturally occurring inorganic forms of silicon (i.e., silicates). Siloxanes are manufactured in a wide variety of forms including low to high viscosity fluids, gums, elastomers, and resins.

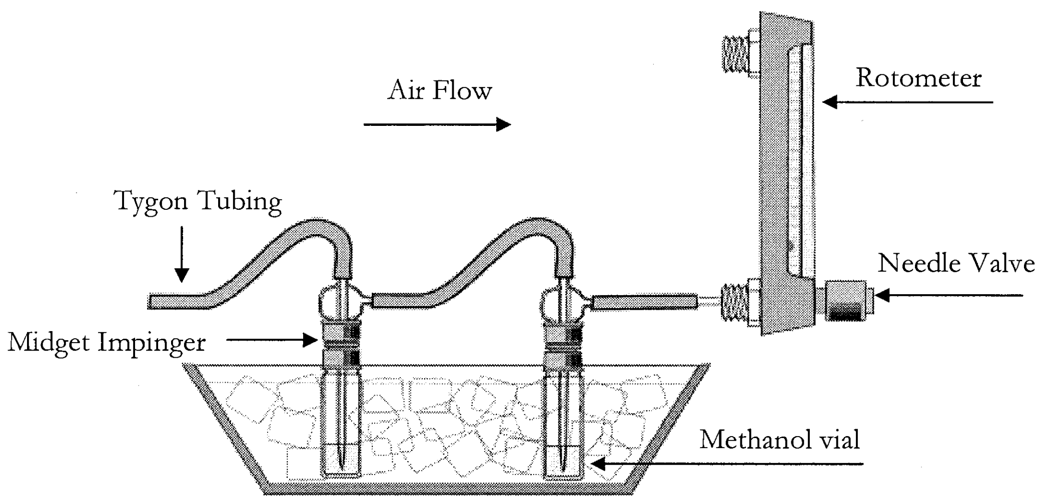
Building on results of the 1997 Dow Corning landfill consortium investigation, the ATL method is based on drawing air-phase samples through a series of two midget impingers containing methanol (see Table 1). Siloxanes present in the air-phase dissolve in the chilled methanol solution and are subsequently capped and kept chilled until analysis. The suggested media hold time is 30 days and the suggested sample hold time until analysis is 21 days.

Air Toxics @ 71 Siloxanes

Media	One pair of 24 mL borosilicate glass vials with Teflon screw caps and midget impingers in ice bath
Impinger Solution	Up to 15 mL methanol (6 mL suggested)
Sampling Volume	Determined by user (20 L suggested)
Sampling Rate	Determined by user (112 mL/min for 3 hours suggested)
Sample Handling	Cap vials and keep chilled at 4 ± 2°C
Media Hold Time	30 days from date of certification
Sample Hold Time	21 days from collection

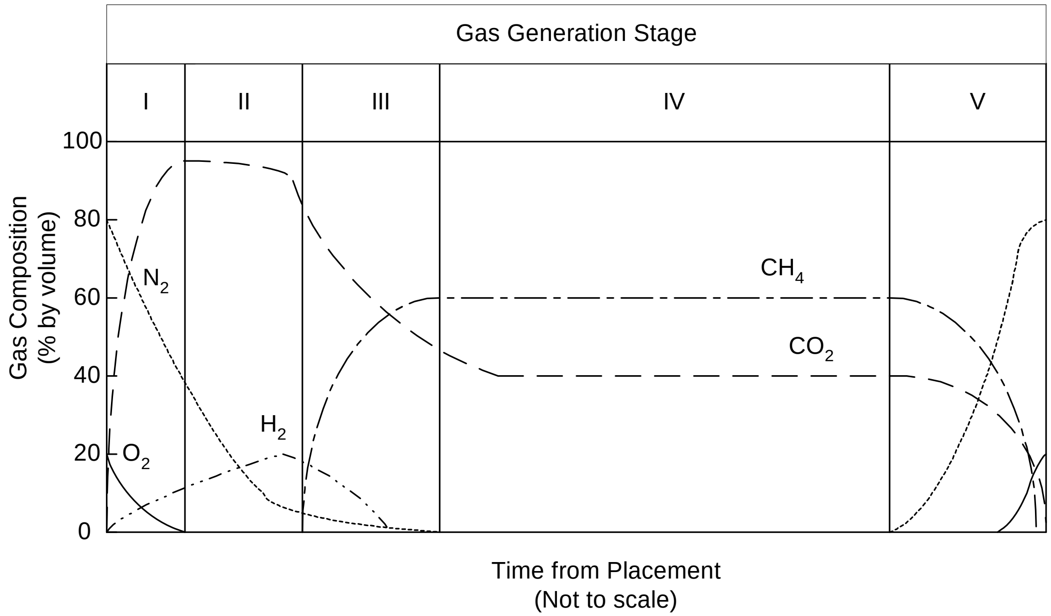
3.1 Method Specific Sampling Instructions

Collect the sample by attaching inert, flexible tubing from the source air stream to the inlet of the first impinger (see Figure 4). Additional tubing connects the outlet of the first impinger to the inlet of the second impinger and both impingers are chilled in an ice bath. If the source is not under pressure, a low-volume pump can supply the vacuum required to draw the sample though the impingers.



A needle valve and rotameter can be used to adjust and measure the flow rate of sample through the impingers. The user must determine optimum sampling rate and volume to achieve the data quality objectives of the sampling program. Sampling rates from 100 to 1,000 mL/min are appropriate as long as there is not significant loss of impinger solution. The amount of sample air drawn through the impingers and the amount of methanol in the impinger determine the final reporting limit concentration. The more sample air drawn through the impingers equates to more target constituent concentrated in the solution and thus lower reporting limits. Be careful not to over sample and saturate the solution. Less impinger solution equates to lower reporting limits, but has less capacity to dissolve the target constituents. For applications involving siloxanes removal from methane gas sources, Applied Filter Technology suggests filling each impinger with 6 mL of methanol and sampling at a flow rate of 112 mL/min for 180 minutes [4]. This arrangement results in a sampling volume of approximately 20 L.

Appendix O
Stages of Biodegradation



Stage I - Aerobic phase
Stage II - Acidogenic phase
Stage III - Exponential growth phase
Stage IV - Stationary phase
Stage V - Endogenic decay phase

Fig. 2-1 Stages of biodegradation of solid waste (Augenstein and Pacey, 1991)

Appendix P
Gas Testing Cost Estimates

CH2M HILL

MSB Central Landfill
Costs for a Landfill Gas Testing Program and Well Installations at Cells 2A and 2B

Engineer's Order-of-Magnitude Cost Estimate[a]

Item No.	Description	Estimated Quantity	Unit	Unit Price	Extended Unit Price
Step 1 - Prepare Design Documents for Active Landfill Gas Collection System (LFGCS)					
1	Design Drawings and Specifications	1	LS	$ 20,000.00	$ 20,000
	Step 1 Subtotal				**$ 20,000**
Step 2 - Construct Active LFGCS					
2	Cell 2A Vertical Gas Extraction Wells, 45' Depth	3	EA	$ 40,000.00	$ 120,000
3	Cell 2B Vertical Gas Extraction Wells, 75' Depth	3	EA	$ 62,500.00	$ 187,500
4	Cell 2A Shallow Probes, 15' Depth	9	EA	$ 250.00	$ 2,250
5	Cell 2A Deep Probes, 30' Depth	27	EA	$ 500.00	$ 13,500
6	Cell 2B Shallow Probes, 25' Depth	9	EA	$ 400.00	$ 3,600
7	Cell 2B Deep Probes, 50' Depth	27	EA	$ 800.00	$ 21,600
8	Above Ground Temporary Gas Collection Network	1	LS	$ 15,000.00	$ 15,000
	Construction Subtotal				$ 363,450
9	Bonds, Insurance Premiums, Mob/Demob, and Contract Closeout	6%			$ 21,807
10	Construction Facilities, Temporary Controls, and HSE	4%			$ 14,538
11	Engineering Construction Management	6%			$ 21,807
	Step 2 Subtotal				**$ 421,602**
Step 3 - Prepare Sampling and Testing Plan					
12	Prepare Sampling and Testing Plan	1	LS	$ 14,000.00	$ 14,000
	Step 3 Subtotal				**$ 14,000**
Step 4 - Conduct Landfill Gas Testing Program					
13	Blower System Rental	1	LS	$ 15,000.00	$ 15,000
14	Light Tower Rental, Fuel, and O&M	1	LS	$ 15,000.00	$ 15,000
15	Gas Meter Rental, and Calibration Gases	1	LS	$ 4,500.00	$ 4,500
16	Siloxanes Sampling Equipment and Blower Rental	1	LS	$ 1,000.00	$ 1,000
17	Siloxanes Laboratory Testing, including S/H	1	LS	$ 2,000.00	$ 2,000
18	Engineering for Landfill Gas Testing Program Implementation	1	LS	$ 100,000.00	$ 100,000
19	Miscellaneous Field Expenses and Per Diem	1	LS	$ 10,000.00	$ 10,000
	Step 4 Subtotal				**$ 147,500**
Step 5 - Prepare Test Report					
20	Prepare Test report	1	LS	$ 14,000.00	$ 14,000
	Step 5 Subtotal				**$ 14,000**
	Project Subtotal				**$ 617,102**
	Contingency[b]	30%			$ 185,131
	PROJECT TOTAL (rounded)				**$ 802,000**

Notes:

(a) This cost opinion is a rough order of magnitude (ROM) estimate in 2014$ and has been prepared for project guidance based on the landfill gas testing program for Cells 2A and 2B described in the 2014 MSB Central Landfill Development Plan. The actual cost of the project will depend on competitive market conditions, actual labor and material costs, actual site conditions, productivity, project scope, final design and schedule, and other factors. As a result, the actual project costs will vary from those presented above. Because of these factors, funding needs must be carefully reviewed prior to making specific financial decisions or establishing final budgets.

(b) Contingency is for scope changes that are presently unforeseen

LS = lump sum