TS LANDFILL, INC.

BROAD CANYON LANDFILL

ENGINEERING DESIGN

AND

OPERATIONS REPORT

JUNE 2016

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1.8 FINANCIAL ASSURANCE CRITERIA

1.8.1 Written Documentation

The closure and post closure care cost estimates are presented in Appendix 4. The estimates are based on hiring a third party to close the facility and conduct post closure care. The closure estimate is based on the estimate of a third party's cost to close the largest area of the site and facility that may require closing during the active life of the facility.

1.8.2 The Operator will maintain:

1) A detailed written estimate of the cost of hiring a third party to close the Broad Canyon Landfill..

2) A detailed written estimate of the cost of hiring a third party to conduct post-closure care at the Broad Canyon Landfill.

1.8.3 Cost Estimates

The required cost estimates for closure and post closure care and financial assurance information are submitted under separate cover to the Division's staff. The Financial Assurance information provided will be reviewed and approved by the Division under separate cover outside of the EDOP.

Original closure and post closure cost estimates expressed in current dollars will look ahead 5 years and predict the maximum area expected to require closure and will be submitted to the Division for review and approval. Original cost estimates and cost estimates adjusted for inflation will be submitted to the Department by April 30th of each year.

The cost estimates will be adjusted annually to account for inflation by using the implicit price deflator for the gross domestic product or its successor as published by the U.S. Department of Commerce. Original cost estimates will be replaced with new cost estimates every five (5) years unless otherwise required by the Department.

Cost estimates for closure and post closure may be increased or decreased. Justification for changing the cost estimates must be presented to the Division and local governing body having jurisdiction. Such justification will be made a permanent part of the operating record.

Financial assurance coverage must be provided continuously until release is granted by the Department.

1.8.4 Financial Assurance

In 1997 the Operator established financial assurance in the form of a trust agreement with Colorado National Bank, now US Bank and a Letter or Credit with Western Colorado Bank. By letter dated August 13, 1997, the Department approved the Trust Agreement and Letter or Credit. In 2000 the Operator increased the value of its trust and the Department released the letter of credit. The Operator typically contributes quarterly to the trust account.

2.2 Groundwater Monitoring

A detailed site wide monitoring plan is included in Appendix 6.

2.3 EXPLOSIVE GASES

According to an EPA Handbook titled Remedial Action at Waste Disposal Sites dated June 1982, landfill facilities that have never received organic wastes will more than likely not produce gas. Methane gas production requires an anaerobic environment. Therefore, sites that are very young will not have had the time necessary to produce gas. Coal and peat processing waste, incinerator composting, resource recovery residues and septic tank pumpings are considered organic wastes.

Initially, the frequency of explosive gas monitoring will be quarterly. Well head explosive gas monitoring will be performed at the monitoring wells shown on drawing LF-02. This well head monitoring will be considered monitoring at the boundary of the facility. A detailed site wide monitoring plan is included in Appendix 6.

Additionally, explosive gas monitoring will be performed in all structures and any crawl spaces under the structures. Structure design will consider the potential presence of explosive gases. Trailer skirting will not be installed in an air tight fashion if at all. Permanent structures may be constructed with on grade slabs without crawl spaces.

The Operator will notify the Department and County within 7 days:

1) if the concentration of explosive gases generated by the facility exceed 25% of the lower explosive limit (1% by volume in air for methane) in structures; or

2) if the concentration of explosive gases in monitoring wells is over 5% by volume in air for methane; and

3) immediately take all necessary steps to ensure protection of human health; and

4) within seven days of detection, place in the operating record documentation of the explosive gas levels detected and a description of the actions taken; and

5) the Operator will develop a plan that describes the nature and extent of the problem and a proposed remedy. The proposed mitigation plan will be submitted to the Division and the County within 60 days for review and approval and landfill will implement the plan after Division approval.

3.1 LOCATION RESTRICTIONS AND SITE STANDARDS

3.1.1 Airports

The Site Location Map (LF-001) shows the location of two airports that are nearest the landfill site. Hopkins Field, located between Naturita and Nucla is approximately six air miles from the landfill site. The landing strip near Basin is also located approximately six air miles from the landfill site. Other regional airports include Dove Creek, Telluride and Montrose. The Dove Creek airport, the nearest of the three, is about 34 air miles from the landfill site. Since all airports are over 5 miles from the landfill site, no notifications are required.

3.1.2 Wetlands

The landfill site is not located in a swamp, marsh, bog or similar area that could be defined as a wetland. The area is not saturated or inundated by surface or ground water. There is no vegetation on site that would typically be adapted for life in saturated soil conditions. Some of the area springs could be considered wetlands based upon a liberal definition of the term. The most likely spring to be categorized as a wetland would be spring SP-6 which has been noted as a pond in the past. Spring SP-6 is located over three miles from the landfill site. Hamilton and Naturita Creeks both potentially contain wetlands. These creeks are also approximately three miles from the landfill site. The location of spring SP-6 and the two creeks mentioned above are shown on the Hydrologic Area Map (LF-03).

3.1.3 Faults

No faulting has been identified in the immediate landfill area. However, structural roses (rolls) and terraces of relatively low relief appear to be typical. These features are most probably the result of differential compaction around "channel type" sands located below the landfill. The publication Earthquake Potential in Colorado, by Robert M. Kirkham and William P Rogers, published by the Colorado Geological Survey, was used as a reference to determine if the landfill site is within 200 feet of a fault that has had a displacement in the Holocene time. This publication contains a map which presents the location of potentially active faults in Colorado. One potentially active faults lies within the boundary of the Site Location Map. Its location is presented on the Site Location Map, LF-001. This fault is one of twelve faults that flank the Paradox Valley. Based on the information presented above, the landfill site is over four miles from the nearest potentially active fault.

3.1.4 Seismic Impact Zones

According to a United States earthquake hazard map (from Algermissen and Perkins 1976) the landfill site can be expected to have a 0.04 g earthquake every 50 years. The earthquake hazard map is based upon a 90% probability level, therefore there is a 10% chance the magnitude of the earthquake would be greater than 0.04 g.

3.1.5 Unstable Areas

There is no indication that on-site or local soil conditions may result in significant differential settling. The Drill Hole and Soil Logs Map (LF-05) presents a geologic column of the soil and subsoil at the landfill site. This site has up to 10 feet of topsoil sub-soil and caliche that overlies bedrock that is comprised of shale, sandstone and coal. This geologic column would be considered stable and not subject to differential settling.

There are no on-site or local geologic or geomorphologic features that would cause the landfill site to be unstable. As explained above, the geologic column existing at the site is considered stable.

There are no on-site or local human-made features or events that would cause the landfill site to be unstable. There are no human-made underground excavations in the vicinity of the site. There are no human-made features or events on the surface that would cause the site to be unstable. The local landfill site does not have any significant geologic hazards. Since the

landfill is basically situated on the top of a mesa, there are no rockfall hazards. The landfill is not on or near any steep slopes so slope stability and landslides are not a concern.

3.1.6 Prevailing Winds, Precipitation Catchment Area

The landfill site has a relatively small precipitation catchment area (112.4 acres) upgradient of the site so erosion potential is not significant. Most of the area above the site drains to the west and east into Long Draw and Wickson Draw respectively.

There is a ridge immediately west of the landfill and a small hill immediately north of the landfill that will help block wind. According to the Climatic Atlas of the United States by Stephen S. Visher, the prevailing wind in the area of the landfill is from the northwest to southeast. Both of the features mentioned above will help block the prevailing winds.

3.1.7 Flood Plain

See the discussion in Section 3.2.2(E).

3.1.8 Waste Isolation, Public and Environment

The landfill site is located on a remote mesa southeast of Naturita. Naturita is 10.4 miles by road from the landfill site and is the closest community to the landfill. Because of its remote location, the landfill site is isolated from the public.

The geologic conditions at the landfill site are considered ideal. There is a potential water bearing zone 60 to 80 feet below the ground surface that is mostly dry. There is a natural barrier layer of shale immediately below the surface with a hydraulic conductivity of less that 1×10^{-7} cm/sec. See the following information for further details on the landfill design.

3.1.9 Waste in Surface or Ground Water

Waste will not be placed in surface or ground water. As explained above, the nearest potential ground water is 60 to 80 feet below the surface. There is no surface water at the landfill site. Run-off from areas upgradient of the landfill will be diverted away from the active portion of the landfill by diversion ditches.

3.2.1 Geologic Data

General Description

The proposed landfill area lies within the Colorado Plateau physiographic province, within the Paradox Basin. The basin is bordered by the Uncompahgre uplift to the northeast, a remnant of an ancient mountain range, by the Manti-La Sal uplift to the west and by the Four Corners uplift, including the San Miguel mountains to the south and southeast. It is characterized as a highly dissected area of mesas and canyons which are formed primarily from crestal collapse features of salt anticlines. This basin is drained by the Dolores and San Miguel Rivers, which originate in the mountains to the south and east and drain generally north and west into the Colorado River.

The proposed landfill site is situated atop a flat, north sloping mesa that drains into Naturita Creek and the San Miguel River. The mesa is part of an extensive flat-land area, which extends to the San Miguel Mountains to the southeast. The area was formed from the resistant, Cretaceous-age Dakota Sandstone and Burrow Canyon Formation. The Dakota is the bedrock of the landfill area.

The landfill area is located about two miles southeast of the town of Naturita, Colorado. The prospect is located on northward sloping (dip slopes) mesas which are incised by northward flowing drainages. The general area of interest is located along the southwest flank of the Nucla syncline which is located between the Uncompahgre Uplift to the north and the Paradox Anticline to the south. Rocks exposed in the general area of the landfill include strata of the Morrison and Brushy Basin Formations of Jurrasic age and of the Dakota and Mancos Formations of Cretaceous age.

Stratigraphy

In the general landfill area, the Dakota Formation has been subdivided by others into three parts. The upper unit consisting primarily of sandstones is thought to be of marine and\or shoreline origin deposited as the Cretaceous sea transgressed over the area, (Eakins, 1986). The contact with the overlying Mancos Formation is conformable and transitional. The middle unit is comprised of lacustrine/paludal sandstone, siltstones, shales, mudstones, and coal. Siltstones are typically laminated with carbonaceous material as are some fine grained sandstones. Shales and mudstones vary from light gray to black depending on the amount of carbonaceous material. The basal unit is primarily coarser sandstone and conglomerates with some carbonaceous siltstones, shale and thin coal. This lower Dakota unit disconformably overlies Brushy Basin Member of the Morrison Formation.

The sedimentary units exposed in the report area are of Jurassic to Quaternary age. They are described below in ascending order.

Morrison Formation (Jurassic)

Brushy Basin Member (Upper Jurassic)

The Brushy Basin Member (approx. 400 feet thick) is the oldest stratigraphic unit exposed adjacent to the landfill area. It is a slope-forming unit that consists dominantly of flood-plain mudstones and bentonitic shales with minor lacustrine limestones beds and rusty-red interlayed lenses of sandstone and conglomerate. The shale and mudstone vary from white to pastel tints of red, blue and green. Random throughout are thin beds of hard finegrained sandstone. The beds of chert pebble conglomerate range from a few inches to about 25 feet thick. This member is well known for a great abundance of petrified wood and bone.

Burro Canyon Formation (Lower Cretaceous)

The Burro Canyon Formation (approx. 150 feet thick) of early Cretaceous age overlies the Morrison, and forms either mesa-capping resistant units or ledgy outcrops above the less resistant Morrison shales. The formation generally consists of two conglomeratic sandstone beds 10-40 feet thick separated by light green mudstone and shale. Irregular, dense, pink to gray limestone nodules are locally present in the mudstone. The sandstone is poorly sorted and consists mostly of quarts with some chert grains. The conglomerate consists of pebbles of chert, quarts, limestone, quartzite and sandstone.

The Burro Canyon Formation is interpreted as an alluvial system deposited across a broad, relatively even surface on top of the Morrison Formation. In many respects, the formation appears to represent a continuation of Morrison deposition. The sandstone and conglomeratic sandstone were deposited from a relatively high energy transport medium and is a distinctly fluvial deposit formed by meandering or sinous streams.

Dakota Sandstone (Upper Cretaceous)

The Dakota Sandstone (approx. 100 feet thick) of late Cretaceous age is a coastal-plain deposit laid down in front of the advancing Mancos sea. The Dakota consists of conglomeratic channel sandstone, dark-grey carbonaceous shale, coal, and, in places, a marine sandstone at the top. Some of the sandstone is fine grained and thin bedded and some is course grained and cross bedded. Occurring scattered through the sandstones are irregular, discontinuous beds and lenses of

conglomerate containing chert, quartz and limestone pebbles. Interfingered with the sandstone beds are thin-bedded gray and black carbonaceous shales with coal seams as much as 6 feet thick. The Dakota is preserved on the mesas in the landfill area but the top has been removed by erosion.

Quaternary age deposits

The Quaternary age depositions consist of aeolian material, alluvium and talus. This material is predominantly eolian but some is alluvial having been reworked by water and intermixed by sheet wash. The greatest observed thickness in some of the dry washes in the area is about 20 feet. The surface deposits range up to about 6 feet in thickness. Talus slopes along the canyon sides are comprised of colluvium and dry stream beds are composed of alluvium with some gravel deposits. The alluvium is principally light brown to light gray sand, silt and clay with discontinuous stratified layers of gravel. The gravel consists primarily of pebbles of sandstone, limestone, chert, quartz and some shale. The colluvium and block rubble are comprised of sandstone, conglomerate and shale derived from the overlying younger sedimentary beds cut by the canyons. The deposited material in these canyons varies in depths up to about 30 feet.

Structure

The landfill is located along the southwest flank of the Nucla syncline. The regional strike is generally N 30 W with a dip to the northeast varying from about 2 1/2 degrees to less than 1 degree with an average of about 1 1/4 degree. The local strike is N 60 W with a dip of about 5% to the northwest.

3.2.2 Hydrologic data

General

Because of the limited amount of precipitation in the area and the coarse texture of the surface soils, little or no run-off from the area occurs. Most snowmelt evaporates or percolates directly into the soils and only a limited number of severe summer storms are intense and severe enough to generate any surface run-off.

A collection pond has been constructed to contain the run-off from the active landfill site. Surface run-off from the vicinity of the landfill flows through ephemeral drainages into Naturita Creek which in turn flows into the San Miguel River. There are no surface water bodies within or adjacent to the landfill area. The town of Naturita has water supply reservoirs north of the San Miguel River which are about four miles from the landfill area.

Wickson Draw is the drainage feature east of the landfill area. It dissects the east side of the NW/4 of Section 15 in a north to northeast direction. Long Draw is the drainage feature to the west of the landfill. Flow from Wickson Draw and Long Draw would discharge into Broad Canyon. Flow from Broad Canyon would discharge directly into Naturita Creek.

The flow from Broad Canyon was monitored monthly near its confluence with Naturita Creek by a nearby coal mining operation. In the years 1988 and 1991 the canyon had flow during spring run-off. The maximum reported flow was 2.5 gpm and 20 gpm for 1988 and 1991 respectively. For the years 1992 and 1993 the canyon was reported as dry all year.

3.2.2 (A) Lakes, rivers, streams, springs, or bogs, on site or within a two miles or the site boundary;

There are no lakes, rivers, streams or bogs on-site or within two miles of the site boundary.

The nearby coal mining operation has monitored six springs. The location of the springs designated SP-1 through SP-6 are presented on the Hydrologic Area Map (LF-03). The results of the monitoring is presented in Appendix 2, Ground Water Monitoring. Springs SP-1, SP-3, SP-4 and SP-5 are located a little over two miles from the landfill boundary. Springs SP-2 and SP-6 are well beyond the two mile limit.

SP-1, located in Long Draw has had flow recorded 4 times from 1988 to 1991. The spring was dry or damp from 1992 through 1988 and dry or damp in 2012. The maximum flow was 1.5 gpm recorded March 3, 1988.

SP-2 located in Section 33 Creek has had flow recorded three times from 1988 to 1991. The spring was dry or damp from 1992 through 1988 and dry in 2012. The maximum flow was 1 gpm recorded March 13, 1991.

SP-3 located in Bramiers Draw has not had any recorded flow from 1989 to 1998 or 2012. The spring was noted as a seep during the first quarter of 1989 and damp the second quarter of 1992.

SP-4 located in Bramiers Draw has not had any recorded flow from 1989 to 1998 or 2012. The spring was noted as a seep during the first and fourth quarters of 1989 and dry during all subsequent monitoring.

SP-5 also located in Bramiers Draw has not had any recorded flow from 1989 to 1998 or 2012. The spring was noted as a seep during the first quarter of 1989 and dry during all subsequent monitoring.

SP-6 also located in Bramiers Draw has been monitored from 1991 to 1998 and 2012. During two of the quarters in 1991, flow was measured with the maximum flow being 1.8 gpm. During 1992, SP-6 was a pool during the first quarter, damp during the second and third quarters and noted as frozen during the fourth quarter. During 1993, SP-6 was noted as a stagnant pool during the first and third quarters and dry the second and fourth quarters. From 1994 through 1998 and 2012 the spring was either dry or had a pool of water.

In addition to the six springs monitored by the near by coal mining operation, three additional springs were identified. One is located in Long Draw immediately below county road HH31. Two are located in Wickson Draw. They are shown on the Hydrologic Area Map, (LF-03). The springs in Long Draw and Wickson Draw are labeled SP-A, SP-B & SP-C.

Springs SP-A, SP-B and SP-C are identified as a springs because of the vegetation they support. Moisture from SP-A and SP-C support Cottonwood trees. Moisture from SP-B supports a large Tamarisk tree.

3.2.2 (B) Depth to and thickness or perched zones and uppermost aquifer;

The uppermost aquifer is located in the lower sandstone sequence of the Burro Canyon Formation. This aquifer is identified during drilling operations as damp sandstone. Three water monitoring wells were drilled in mid 1993 along the north boundary (downdip) of the landfill site. The damp sandstone sequence was noted in monitoring well M-1 from 75.5 feet to 81 feet. Although the aquifer has been penetrated by all three monitoring wells, none of the wells have standing water. All three of the monitoring wells are dry.

Eight monitoring wells were installed in 2015. One of the wells (WD-2B) had depth below ground surface of about 57. All of the other monitoring wells were dry.

The Drill Hole and Soil Logs Map, (LF-05), presents the location and elevation of the uppermost water bearing zone based on the elevation of adjacent springs and groundwater wells.

Construction activity at the landfill can change local run off patterns. There is potential for shallow perched zones of groundwater due to surface water infiltration in areas where run off collects. Shallow perched zones of groundwater may have been the source of water in alluvial wells AW-2 and AW-3 that were drilled in August of 2011. Alluvial wells AW-1, AW-2 and AW-3 were sealed in July 2012 so a disposal cell could be excavated.

3.2.2(C) Ground water wells within one mile of the site boundary, including well depth, depth to water, screened intervals, yields and aquifers tapped.

Three bedrock wells are located adjacent to the landfill area. They were developed and monitored by the nearby coal mining operation. BW-1 a well owned by David and Terri Andrews, is located about two miles north or the landfill boundary. The period of record is from the fourth quarter of 1990 through 1998 and 2012. It has contained consistent measurable quantities from 1990 through 1998 and 2012. This is the only well in the area that has contained consistent quantities of water. According to the landowner, it will produce about two gallons per minute on a consistent basis. It is approximately 120 feet deep and taps the uppermost aquifer.

BW-2 located about three miles northwest of the landfill boundary. The period of record is from the fourth quarter of 1990 through 1998 and 2012. This well contained measurable quantities of water during 1990 and 2012. It is approximately 135 feet deep and taps the uppermost aquifer. BW-2 was sealed in 2012.

BW-3 a well owned by David and Terri Andrews is located about one half mile northeast of the landfill area. The period of record is from the fourth quarter of 1990 through 1998 and 2012. The well contained measurable quantities of water during 1990, 1992 and 2012. It is 180 feet deep and taps the uppermost aquifer at about 120 feet. It was drilled extra deep to provide water storage.

3.2.2(D) Hydrologic properties of the perched zones and uppermost aquifer, including flow directions, flow rates, porosity, coefficient of storage, permeability, and potentiometric surface;

Eight monitoring wells were installed in 2015. One of the wells (WD-2B) had depth below ground surface of about 57. All of the other monitoring wells were dry.

Based upon the lack of water in all but one of the monitoring wells, the uppermost water bearing zone under the landfill site is heterogeneous. However, the information from the adjacent wells does provide some limited information about the water bearing zone. Bedrock well BW-1 has been able to produce 2 gallons per minute on a consistent basis. Based upon a 6-foot thick water bearing zone and a 6-inch diameter well, this yields a permeability of about 10^{-2} cm/sec. This figure is quite high. A more typical permeability for a tight sandstone aquifer would be in the order of 10^{-5} cm/sec. The flow direction in the water bearing zone would be downdip, generally to the north. The potentiometric surface of the water bearing zone is presented on the Hydrologic Area Map, LF-03.

3.2.2(E) Site location in relation to the base floodplain of nearby drainages;

The mesa where the landfill site is located is bordered by Wickson Draw on the east and Long Draw on the west. These ephemeral drainages have formed channels by down cutting into the alluvium. The channels are well defined in the vicinity of the landfill site. The base floodplain of these two ephemeral drainages is assumed to be the elevation of the top of the alluvial deposit in the drainage. The landfill site is protected from these ephemeral drainages by ridges on each side that are at least 40 feet in elevation above the alluvial deposits which makes them 50 to 60 feet above the dry creek beds of the ephemeral drainages. Based on the above facts, it is almost certain the landfill site is in no danger of being impacted by the base flood of nearby drainages.

3.2.2(F) An evaluation of the potential for impacts to existing surface water and ground water quality from the proposed facility for solid waste disposal;

The potential for impacts to the surface water in the area is very slight. All of the run-off from the landfill is contained in a pond. The nearby drainages are all ephemeral. The only way the surface water system would be impacted is by contamination from windblown debris.

The potential for impact to the ground water is also considered slight because there is limited groundwater in the uppermost water bearing zone. The nearest potential water bearing zone is about 60 feet below the surface. The ground water in the area is not used domestically. The only known use of the ground water is for stock watering.

3.2.2(G) The existing quality of ground water beneath the proposed facility;

As stated above, the water monitoring wells drilled on the northern boundary of the landfill site are dry. The adjacent mining operation has collected ground water quality data from bedrock wells BW-1 and BW-3. Water from BW-1 has been collected and analyzed nine times from the fourth

quarter of 1990 through 1993. Water from BW-3 has been collected and analyzed two times form the fourth quarter of 1990 through 1993. The water from both wells consists of bicarbonate-type water with both sodium and calcium. The water from well BW-1 is better quality than BW-3. The total dissolved solids in the wells has averaged 1527 and 2320 mg/l from BW-1 and BW-3 respectively. See Appendix 2 for water quality data.

Eight monitoring wells were installed in 2015. One of the wells (WD-2B) had depth below ground surface of about 57. All of the other monitoring wells were dry. The point of compliance wells are WD-1A, WD-1B, WD-2A and WD-2B. All wells except WD-2B were dry. The water in WD-2B is classified as a calcium bicarbonate type of water. This is typical of shallow groundwater aquifers.

The most likely aquifer recharge area is along Naturita Ridge which is approximately 3 miles southwest of the landfill site.

3.2.5 Liner/design components

3.2.5(A) Demonstration shall be made, to the Department and the local governing body having jurisdiction, that the design developed for the facility will comply with Section 2.1.15 at the relevant point of compliance. The owner/operator shall consider at least the following factors:

(1) Barrier layer permeability;

As explained below, a field test and laboratory a test were performed to determine the permeability of a natural barrier layer. The field tests indicate the natural barrier layer has a permeability of 6.6 X 10^{-8} cm/sec. The laboratory testing referenced below indicates the natural barrier layer has a permeability of 1.lE-06 cm/sec.

There are random coal beds within the barrier layer. The effect the coal beds could have on the barrier layer is of some concern. The permeability of this particular coal seam was not determined. In general, coal is considered to have a low permeability. In a study performed by Kaman Tempo for a coal mine near Cedaredge, Colorado, the permeability of the E-Seam was determined through field tests to be 0.19 ft/day. This equates to 6 X 10^{-6} cm/sec. Based on the above figures, the random coal seams within the barrier layer will not significantly affect the characteristics of the barrier layer.

Recent site characterization included the drilling of eleven borings, and completion of eight borings as wet/dry wells. The locations of these borings and wells are illustrated on drawing LF-02. The drilling program was completed during the periods of August 12 through September 17, 2015. The site characterization confirmed the data explained above. See Appendix 11 for site characterization details. The following table shows the characteristics of the barrier layer:

Exploration Hole Designation	Amount of Material <E10-7
BL-8	32.0
BL-9	38.3
WD-1B	37.5
WD-2B	24.8
WD-3B	44.3
WD-4B	23.5

(2) Barrier layer thickness;

The thickness of the natural barrier layer is defined by the five exploratory holes within and nearby the landfill area as shown on Drawing LF-05 (M-1, M-2, M-3, ES-7-88 and ES-8-88). Hole M-1 depicts the 18 foot minimum barrier layer thickness. Experience drilling blast holes at the site has confirmed the isolated nature of the sandstone lenses in the barrier layer. There are two sandstone lenses in the barrier layer in hole M-3, yet the sandstones lenses are not present in hole ES-8-88 that is located only 250 from M-3. Experience has show the sandstone layer is discontinuous.

Shale, mudstone, sandstone and coal interbeds underlie the landfill. The thickness of shale interbeds between the base of the landfill and the Burrow Canyon sandstone aquifer, based on the five exploratory holes, averages 29.5 feet and ranges from 20.5 to 41.4 feet. The drill logs on Drawing LF-05 indicates the depth to massive sandstone potentially representing the top of the Burro Canyon Formation is about 60 feet below original ground surface.

The 2015 site characterization explained above shows the landfill is underlain by a barrier layer (of $< 1 \times 10^{-7}$cm/sec material) that varies between 23.5 feet (WD-4B) and 44.3 feet (WD-3B) thick. This characteristic far exceeds the requirements specified in the *(C) Barrier Layer, (1) Natural Lithology with Recompaction* standard.

The Operator blasts and removes about 20 feet of overburden so it can place waste on the top portion of the barrier layer.

Monitoring wells M-1, M-2 and M-3 were drilled to investigate the presence of ground water beneath the landfill site. They are completed as a typical bedrock well as shown of the Hydrologic Area Map, LF-03.

Drill holes BL-1 through BL-5 were drilled specifically to investigate the depth to and thickness of the barrier layer. These holes were cemented shortly after they were drilled.

Two ES holes (ES-7 & 8-88) were used to correlate the potential water bearing zone and barrier layer thickness. These holes were drilled and completed by the nearby coal mining operation. There was no notation on the logs for these holes that groundwater was present. The location of drill hole ES-8-88 is show on Map LF-02. Drill hole ES-7-88 is located immediately north of the landfill site in the southwest quarter of section 10, T 45 N, R 15 W.

(3) Barrier layer porosity;

Porosity is a relationship between the volumes in a soil material occupied by solids and non-solids. Porosity *n*, is expressed as a percentage of the volume of voids divided by the total volume of soil. The barrier layer is to be natural lithology (shale) with re-compaction of a twelve inch thick low permeability layer or natural lithology (shale) covered with a Geosynthetic Clay Liner.

(4) Slope of the barrier layer;

Based on available information, the barrier layer slopes about 3.5% to the northeast.

(5) Hydraulic head on the barrier layer;

The hydraulic head on the barrier layer should be minimal. Perforated drains and or porous rock drains will be strategically placed on the top of the barrier layer to provide a flow path for potential seepage water or leachate. Since the landfill area and the barrier layer both slope about 3.5% to the northeast the maximum worst case head on the barrier layer will be less than one foot.

(6) Distance to the relevant point of compliance;

The relevant point of compliance is the property boundary to the north. The landfill is within 250 feet of the relevant point of compliance in the northeast corner of the property.

(7) Distance and characteristics, including quality, of the uppermost aquifer or monitored unit;

There is a potential water bearing zone approximately 60 feet below the ground surface. The Hydrologic Area Map, LF-03, presents the contours of the potential water bearing zone. Water is evident is Springs A and B which are near the landfill area. However, monitoring wells M-1, M-2 and M-3 have been reported as dry during all monitoring events through 2015. These monitoring wells were drilled during the second quarter of 1993.

A typical bedrock well completion is shown on drawing LF-03. All three wells, M-1, M-2 and M-3 have 20 feet of slotted casing below the clay seal. The following table provides completion details.

	M-1	M-2	M-3
Ground Elevation	6194	6198	6213
Casing Elevation	6197.4	6201.4	6216
Depth From Top of Casing	101.2	90.1	97.7
Slotted Casing	20	20	20
Slotted Casing Elevation	6076.2 - 6096.2	6091.3 - 6111.3	6098.2 - 6118.3

Eight groundwater monitoring wells were installed during 2015. All but one well (WD-2B) were dry. The water level in WD-2B is about 57 below ground surface. Quality information for WD-2B is included in Appendix 2. There were no volatile organic compounds detected in the ground water sample from WD-2B. This groundwater is classified as a calcium bicarbonate type of water which is typical of shallow groundwater aquifers.

A nearby coal mine operation accumulated water quality information on the uppermost aquifer. The quality information is presented in Appendix 2.

(8) Climatic factors;

No climatic data is available for the landfill or adjacent area. A National Weather Service Station does exist in the town of Uravan, Colorado approximately 16 miles northwest of the permit area. The period of record for temperature and precipitation is 29 years through and including 1990.

The following table presents the average monthly temperature and precipitation data for the period of record. All temperatures are in degrees F.

NCDC 1961-1990 Monthly Normals

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean Max. Temperature (F)	39.7	47.9	56.0	65.2	76.5	87.9	94.0	90.9	82.2	70.6	53.7	41.6	67.2
Mean Min. Temperature (F)	13.0	20.3	28.1	34.7	44.1	51.9	58.9	57.7	47.7	36.5	25.9	17.1	36.3
Mean Precipitation (in.)	0.88	0.62	1.00	1.01	1.00	0.45	1.32	1.42	1.30	1.53	1.09	0.98	12.60

Western Regional Climate Center, wrcc@dri.edu

Wind speed and direction are not recorded at the landfill nor is it available from the Uravan Station.

Climatic factors should not hinder the ability of the landfill to comply with Section 2.1.15. The relatively small amount of rainfall in the area will reduce the potential for impacts to the surface water system. The small amount of rainfall will also minimize the potential for the generation of leachate.

Most precipitation is lost to evaporation from the soil or is transpired by vegetation before it can percolate to the water table and recharge the aquifer. Most precipitation recharge likely occurs during periods of snowmelt or prolonged rainfall when water is available for percolation and evapotranspiration rates are small. In clayey soils, percolation is slow, and most soil water is held at shallow depth, where it can be lost to evapotranspiration. Intense precipitation produces surface runoff and low percolation.

(9) The estimated volume, physical characteristics and chemical characteristics of the leachate;

Leachate is defined as liquid that has passed through or had contact with solid wastes and may contain soluble, miscible, or suspended constituents removed from the wastes. Construction of the landfill cells can change local run off patterns. There is potential for shallow perched zones of groundwater due to surface water infiltration in areas where run off collects. Shallow perched zones of groundwater may have been the source of water in alluvial wells AW-2 and AW-3 that were drilled in August of 2011.

There is as minor volume of leachate being generated from the landfill. The first leachate production recorded at the landfill was on July 27, 2011. Since July 27th approximately 63.5 gallons have been produced through December 10, 2015. The average leachate production from July 27, 2011 through December 10, 2015 has been 0.04 gallons per day which equals less than 15 gallons per year.

Leachate samples were collected on April 3, 2013 and March 27, 2014. The April 3, 2013 sample had a pH of 4.94, conductivity of 120 mmhos/cm and a temperature of 10.3 degrees Celsius. Twenty-five organic compounds were detected in the April 3, 2013 sample. Eighteen of the twenty-five were at such a low concentration they met the Colorado Basic Standards for Groundwater. The March 27, 2014 sample had a pH of 5.2, conductivity of 60 mmhos/cm and a temperature of 7.4 degrees Celsius. Twenty-three organic compounds were detected in the March 27, 2014 sample. Eighteen of the twenty-three were at such a low concentration they met the Colorado Basic Standards for Groundwater.

Organic Compounds				
				Basic Standards
Compound	Unit	Concentration	Note	**Regulation 41**
		4-3-13 / 3-27-14		
Acetone	ug/l	1540 / 691	Meets Standard	6300
Benzene	ug/l	2.9 / 2.1	Meets Standard	5
Chloroethane	ug/l	5.7 / 6.7	Exceeds Standard	5(1)
Chloroform	ug/l	0.52 / 0.31	Meets Standard	3.5
1,1-Dichloroethane	ug/l	4.2 / 6.1	Exceeds Standard	1(1)
1,2-Dichloroethane	ug/l	4.7 / 6.1	Meets Standard	7
1,2-Dichloropropane	ug/l	0.47 / 0.52	Meets Standard	0.52 to 5
cis-1,2-Dichloroethylene	ug/l	3.6 / 3.9	Meets Standard	14 to 70
p-Dichlorobenzene	ug/l	1.9 / 2.1	Meets Standard	75
trans-1,2-Dichloroethylene	ug/l	14.3 / 18.3	Meets Standard	140 or 100
Ethylbenzene	ug/l	4.2 / 2.3	Meets Standard	700
2-Hexanone	ug/l	2.1 / ND	Meets Standard	35

4-Methyl-2-pentanone	ug/l	9.9 / 2.6	Exceeds / Meets Standard	5[1]
Methyl chloride; Chloromethane	ug/l	1.6 / 0.90	Exceeds/Meets Standard	1.0
Methyl iodide	ug/l	0.25 / ND	Meets Standard	40[1]
Methylene chloride	ug/l	79.7 / 154	Exceeds Standard	5.6 or 5
Methyl ethyl ketone	ug/l	629 / 172	Exceeds Standard	10[1]
Styrene	ug/l	1.4 / 0.31	Meets Standard	100
1,1,1-Trichloroethane	ug/l	1.1 / 0.80	Meets Standard	14,000 or 200
Tetrachloroethylene	ug/l	9.5 / 12.6	Exceeds Standard	17 or 5
Toluene	ug/l	47.8 / 29.2	Meets Standard	560 to 1000
Trichloroethylene	ug/l	3.4 / 3.9	Meets Standard	5
Trichlorofluoromethane	ug/l	3.8 / 3.9	Meets Standard	10[1]
Vinyl chloride	ug/l	0.28 / 0.31	Meets Standard	0.23 to 2
Xylene (total)	ug/l	17.3 / 13.3	Meets Standard	1,400 to 10,000
Total Metals				
Antimony	ug/l	2.5 / 4.5	Meets Standard	6
Arsenic	ug/l	4.4 / 4.6	Meets Standard	10
Barium	ug/l	34.0 / 21.7	Meets Standard	2000
Beryllium	ug/l	<1.0 / <1.0	Meets Standard	4
Cadmium	ug/l	0.64 / <0.50	Meets Standard	5
Chromium	ug/l	<10 / <10	Meets Standard	100
Cobalt	ug/l	<1.0/ <1.0	Meets Standard	50
Copper	ug/l	620 / 2650	Meets / Exceeds Standard	1000
Lead	ug/l	87 / 192	Exceeds Standard	50
Nickel	ug/l	16 / 25.1	Meets Standard	100
Selenium	ug/l	<2.0 / <2.0	Meets Standard	50
Silver	ug/l	<0.5 / <0.5	Meets Standard	50
Thallium	ug/l	<1.0 / <1.0	Meets Standard	2
Vanadium	ug/l	<5.0 / <5.0	Meets Standard	100
Zinc	ug/l	1500 / 2220	Meets Standard	5000

[1] Standard from CDPHE regulations pertaining to solid waste sites and facilities.
ND = Not Detected

(10) The chemical compatibility of the barrier layer to estimated leachate chemical characteristics;

The barrier layer is comprised of shale. Shale is a fine-grained rock formation formed by the hardening of clay. It is very unlikely the chemical characteristics of the leachate would have any deleterious effect on the shale barrier layer.

(11) The distance ground water beneath the site would flow during the facility's operating life and post-closure care period. Distance to domestic wells or springs shown to tap the uppermost aquifer down gradient of the site shall be presented. The potential water bearing zone beneath the landfill is

comprised of moderately to well cemented sandstone. The permeability of this formation, obtained from Appendix 11, is 1.1 x 10^{-4} cm/sec or 0.312 ft/day. Therefore, if there were water in the water bearing zone, it would travel roughly 113.9 feet per year. The landfill has an estimated life of over 100 years (6.3 million cubic yards at 55,000 cubic yards per year) and the post-closure care period is another 30 years. The distance ground water beneath the site would flow during the two periods is 2.8 miles, 14,800 feet (130 X 113.9). This calculation is considered meaningless since the Dakota sandstone throughout the footprint of the landfill is vertically very heterogeneous. The layers (beds) were typically measured in tenths of a inch. Homogeneous layers thicker than 24 inches were rare. The formation is also laterally very heterogenous. Although consistent layers (horizontally) were visible in the core, lithologic correlation between borings (even as close as 20 feet) was rare.

There are no known domestic wells that tap the uppermost aquifer down gradient of the site. The potential water bearing zone outcrops in Naturita Creek which is approximately four miles north and down gradient of the landfill site. There are a number of springs down gradient of the site as shown on the Hydrologic Area Map (LF-03). The closest spring is SP-A which is a damp area in the water bearing zone that exhibits riparian vegetation. It is located approximately 3,000 feet north and down gradient from the landfill site.

As explained below the permeability of the barrier layer has been determined by field tests to be 6.6 X 10^{-8} cm/sec or 2.0 X 10^{-4} ft/day. Therefore, the leachate from the landfill would only flow approximately 9.5 feet in 130 years.

3.2.5(C)(4) The alternative design of the barrier layer is to be natural lithology with re-compaction of a twelve inch thick low permeability layer or a geosynthetic clay liner.

As noted above, the barrier layer is to be natural lithology (shale) with re-compaction of a twelve inch thick low permeability layer. Shale is defined as a fine-grained rock formation formed by the hardening of clay.

The clay liner will consist of twelve inches of weathered shale from on site or off site sources. The shale will be processed and compacted in six inch lifts to achieve a hydraulic conductivity of less than or equal to $1x10^{-7}$cm/sec. The twelve inch layer will seal any natural or blasting induced bedrock fractures at the base of cell. See Appendix 13 for the QA/QC plan for the compacted clay liner.

A Geosynthetic Clay Liner (GCL) may also be used as a barrier layer and also may be used as a barrier layer for the 3H:1V slopes at the end of each line of pits. The GCL to be installed is

BENTOMAT® ST 200R, a reinforced GCL consisting of a layer of sodium bentonite between a woven and a nonwoven geotextile, which are needlepunched together. See drawing LF-07 for details. See Appendix 12 for the QA/QC plan for the GCL.

The permeability of the natural barrier layer was determined by performing a field test. A 4" diameter casing was cemented 24 inches deep in the barrier layer and filled with water. The permeability was calculated using the formula k=(0.024*Q)/(R*H) where:

k = ft/min
Q = gallons/minute
R = diameter of pipe in feet
H = head on the barrier layer in feet

(Ref: Essentials of Soil Mechanics and Foundations, David F. McCarthy, Third Edition, Table 5-2 Methods for Performing Field Permeability Tests)

The field test began on October 15, 1993. Initial tests indicated the permeability of the barrier layer was between 6×10^{-6} and 6.9×10^{-7} cm/sec. However, after about 15 days duration, the barrier layer evidently became saturated and therefore less permeable. The final eight tests (tests 12 -19) performed from November 1, 1993 to March 24, 1994 yielded an average permeability of 6.6×10^{-8} cm/sec. See Appendix 3 for the results of the field tests.

In addition to the field test, IGES recently (2011) performed an analysis on the site soils to get a baseline understanding of saturated permeability. Two backpressure permeability tests were performed on site soils, one with a consolidation stress of 1.4 psi and one with a consolidation stress of 13.9 psi. The lower consolidation stress best represents the saturated permeability of the site soils utilized in a cover application while the higher consolidation stress representing the saturated permeability of the site soils utilized as a liner. The permeability value for the cover application was 1.9E-05 cm/sec with a lower permeability of 1.lE-06 cm/sec for the liner application. The IGES reports a located in Appendix 8.

The 2015 site characterization explained above shows the landfill is underlain by a barrier layer (of $< 1 \times 10^{-7}$cm/sec material) that varies between 23.5 feet (WD-4B) and 44.3 feet (WD-3B) thick. This characteristic far exceeds the requirements specified in the *(C) Barrier Layer, (1) Natural Lithology with Recompaction* standard. See Appendix 11.

3.2.5(D) Leachate collection and leachate removal system

This initial leachate collection system installed up through 2015 is a single perforated pipe surrounded by gravel. The disposal cells were all sloped (east and west) towards the perforated pipe. As of August 2015 the leachate collection pipe extends into the last pit to the north. There are about twenty lineal feet of solid formation to the south of the last northwest pit. The leachate collection pipe was placed into a 35 feet wide excavated trench extending through this solid formation so any leachate from the southern pits will drain down gradient to the north. The up gradient cells all slope towards the leachate pipe (low point).

A typical line of cells is shown on drawing LF-07. Each line of cells extending in a southwest to northeast direction will be constructed to promote and direct leachate to the northwest. A rock drain with no pipe will be installed along the northwest edge of each line of cells. The rock burrito drains will be extended the full length of each cell and they will intersect the main leachate line. The low permeability layer explained above will extend under the entire length of the burrrito drain. The base elevations of the cells will provide a smooth and continuous surface with the adjacent line of cells. A main leachate collection system will be at the north end of the last cells. A four inch diameter perforated pipe will be placed in the north end of the last cell. The main leachate pipe will be continuous from cell to cell. The pipe will be surrounded with gravel. The main leachate pipe with projected elevations are shown on drawing LF-04.

The landfill plans to make each row of cells continuous so there will be no discontinuous connecting points between cells. The method of making the row of cells continuous is to drill and shoot the first two cells in a row of cells. The cells are then excavated from southwest to northeast. The northeast end of the second cell will not be totally excavated. At least 50 feet of rubble (shot rock) will be left in northeast end of the cell. The leachate line and low permeability layer are placed in the first cell and the first cell begins to fill with refuse. As the first cell fills with refuse a third cell is drilled and shot and the second cell is prepared to accept refuse. There will not be any discontinuous connecting points between the cells using this method of development.

The main leachate piping will exit the landfill footprint via solid piping in two separate locations (see LF-04). A Titan double wall 1,000 gallon tank, or equal, will be placed at the end of each line. The Titan Tank is a structurally superior steel tank bonded with the Space Age developed Molecular Weight Polymer. Titan Tanks are equipped with an internal 2” monitoring port near one end of the tank. The tank will be lined for water storage. Appendix 16 contains leachate tank details.

Leachate will re-circulated from the tank(s) and spread on the landfill. Leachate shall be analyzed annually consistent with Appendix 1A and 1B parameters. The leachate tanks shall be monitored monthly unless more frequent monitoring is warranted. The leachate pipes along with the leachate tank(s) shall be monitored monthly preferably on the same day. Leachate flows shall be recorded along with the date, time, weather conditions, and amount of leachate present in the tank(s). Flow will be determined by the change in leachate volume in the tank each month.

The leachate line(s) outside the landfill footprint will be protected from freezing by having a soil cover. Dirt may have to be mounded over the line(s) to provide at least 36" of cover. The leachate tank will be buried so freezing should not be a problem.

The leachate burrito drain (no pipe) will have at least 3 square feet of screened 3/4" to 1.5" rock. Darcy's Law can be used to calculate the flow though the drain. The drain will have 3 square feet of screened rock and a slope of 2% to 5%.

Darcy's Law is $Q = kA\ dh/dl$
where:
Q = rate of water flow calculated by formula (0.12 to 30.0 cubic feet per minute)
k = hydraulic conductivity of clean gravel (2.0 to 200 ft/minute)[1]
A = column cross sectional area (3 SF)
dh/dl = hydraulic gradient, the change in head over the length of interest (0.02 to 0.05).

The flow rate through the burrito rock drain is 0.9 to 224 gallons per minute. The velocity through the drain is Q/A equals 0.04 to 10 feet per minute which equals 21,000 to 5.2×10^6 feet per year. The maximum time it will take leachate to flow the length of the longest row of cells (~2,700 feet) is approximately 1.5 months.

In order to determine if the leachate collection system is functioning correctly, sets of wet dry wells are constructed down gradient of the landfill. One well in each set is completed in the formation above the barrier layer. The second well in each set was completed in the barrier layer. If it is determined the collection system is not collecting all of the leachate, then appropriate action will be taken. The design of the wet dry wells is shown on Map LF-02. Monitoring of the wet/dry wells is detailed in Appendix 6. Two sets of wet/dry wells are installed north of the fist 3 lines of cells.

1 Principles of Geotechnical Engineering, Braja M. DAS, 1985, page 84.

3.2.6 Surface Water Control Systems

The operational water control system is shown on Map LF-06 and design details are presented in Appendix 1. The operational surface water control system was designed to restrict the flow onto the active portion of the landfill during the peak discharge from a 25-year storm and contain the water volume resulting from a 24-hour 25-year storm from the active portion of the landfill. Two diversion ditches are utilized to divert the run-off from the active portion of the landfill. Two collection ditches and a containment pond are utilized to contain the run-off from the active portion of the landfill. The collection ditches will be relocated as the landfill expands to assure all run-off is contained in the containment pond.

Containment pond design location and details are shown on Map LF-06. The pond has a capacity of 4.45 acre feet. Allowing for sediment storage, the pond has a water capacity of 4.02 acre feet. The 25 year storm event generates 2.84 acre feet of run-off from the landfill and the upland areas. See Appendix 1 for details.

The final water control system is shown on Map LF-04 and design details are presented in Appendix 1. Sixty-four ditches were designed to covey run-off from the landfill in a controlled manner. The ditches are designed to handle the 100 year 24 hour storm event.

The surface water control system including diversion ditches, collection ditches and the run-off containment pond will be inspected quarterly. The inspections will note if clean out is required to maintain the design capacity of the ditches and storage capacity of the pond. The inspection will determine if structural weakness, erosion or other potential hazards exist.

3.2.7 Construction Certification

Prior to the acceptance of waste, a report was sent to the Department of Health and the local governing body documenting that the designed construction has been completed in accordance with the approved plan. The report was signed by a Colorado registered professional engineer, approved by the Department of Health and placed in the operating record.

The original construction certification was sent to the Department of Health and Montrose County by letter dated January 12, 1996.

Construction certification reports will be submitted to the Division for review and approval following construction of each cell and prior to accepting waste into that cell beginning in 2016.

3.3 OPERATING CRITERIA

3.3.1 General Data

(A) Mailing Address, county and legal description of the landfill for solid wastes and disposal, township, section, quarter section and range;

Mailing Address:

TS Landfill, Inc.
2352 North 7th Street, Unit B
Grand Junction, CO 81501

Physical Address:

T S Landfill Inc.
30120 HH31 Road
Naturita, CO 81422

County: Montrose, Colorado

Legal Description:

Township 45 North, Range 15 West, N.M.P.M.
Section 15: NW/4 east of Wickson Draw
Section 10: SW/4SW/4
containing 210 more or less

Emergency Contacts: David Andrews (970)-729-1542
Leroy Archer (970) 901-1517
Billing Contact: James Stover (970) 245-4101

A sign will be erected at the landfill gate that has emergency contact information, hours of operation and acceptable or non acceptable wastes.

(B) Area site, in acres:

TS Landfill, Inc. owns the land described above which encompasses 210 acres more or less.

(C) Type of landfill for solid waste disposal proposed for the site;

The proposed landfill will be a municipal solid waste landfill (MSWLF).

(D) Discussion of landfills service area, including transportation corridors and surrounding access;

The service area for the landfill includes the towns of Nucla, Naturita, Redvale, Norwood, Telluride, Montrose, Ridgway, Ouray, Silverton and the surrounding rural areas. Transportation routes to the landfill would be as follows:

Nucla: South 5 miles on State Highway 97 to Naturita; east 4 miles on State Highway 145 to the intersection with State Highway 141; south 3.4 miles on State Highway 141 to the intersection with County Road HH31; west 2.5 miles to the private road to the landfill; south 0.5 miles on the private road to the landfill area; a total of 15.4 miles.

Naturita: East 4 miles on State Highway 145 to the intersection with State Highway 141; south 3.4 miles on State Highway 141 to the intersection with County Road HH31; west 2.5 miles to the private road to the landfill; south 0.5 miles on the private road to the landfill area; a total of 10.4 miles.

Redvale: Northwest 7 miles on State Highway 145 to the intersection with State Highway 141; south 3.4 miles on State Highway 141 to the intersection with County Road HH31; west 2.5 miles to the private road to the landfill; south 0.5 miles on the private road to the landfill area; a total of 13.4 miles.

Norwood: Northwest 16 miles on State Highway 145 to the intersection with State Highway 141; south 3.4 miles on State Highway 141 to the intersection with County Road HH31; west 2.5 miles to the private road to the landfill; south 0.5 miles on the private road to the landfill area; a total of 22.4 miles.

Telluride: Northwest 46 miles on State Highway 145 to the intersection with State Highway 141; south 3.4 miles on State Highway 141 to the intersection with County Road HH31; west 2.5 miles to the private road to the landfill; south 0.5 miles on the private road to the landfill area; a total of 52.4 miles.

The landfill is located in a remote area. The only vehicular access will be as described above. Wickson Draw obstructs unauthorized vehicular traffic from the south and southeast. The surrounding terrain restricts unauthorized vehicular access to the landfill area from the west and southwest. The only access corridor to the landfill area is from the north. Vehicular traffic will be restricted to the private road intersection off of County Road HH31.

3.3.2 Operational Data

(A) The qualifications, names, and addresses of the persons operating the landfill and having the authority to take corrective action in the event of noncompliance;

Landfill Manager - Leroy Archer backed up by Ted Swain - MOLO Certified - Responsible for the operation of the landfill in compliance with the operations plan. Responsible for record keeping, reporting and supervising other personnel.

Equipment Operators - Mike Rich and/or Leroy Archer - Operate the landfill equipment so the landfill is operated in an efficient, safe and in compliance with the operations plan.

Gate Attendant - Ascertain the size of the load for each incoming vehicle. Collect the published disposal fee. Control incoming refuse and take care of daily records. Trained to detect the type of waste that can be accepted by the landfill and have authority to refuse admission to the landfill in the case of unsuitable refuse.

During the initial operation of the landfill, the Landfill Manager and or equipment operator will be the gate attendant.

(B) The hours of the day and the days of the week that the land will be operating;

The landfill will be operated Monday through Friday 8:00 A.M. to 3:30 P.M. The landfill will be closed on the day the following holidays are observed: Memorial Day, the Fourth of July, Labor Day, Thanksgiving Day, one-half day Christmas Eve, Christmas Day and New Years Day.

(C) A listing of the waste stream types approved for routine receipt and the types and daily volume of wastes to be received.

The Broad Canyon Landfill is intended to serve the needs of Montrose, San Miguel Counties. It also serves Mesa County in the Gateway area. The current yearly volume of waste is about 50,000 to 60,000 compacted cubic yards (190 to 230 compacted cubic yards per day). These figures are derived by dividing the loose volume hauled to the landfill by two and then adding the compacted yardage.

The main waste stream to be accepted at the landfill is municipal waste. It will consist of residential and commercial waste and waste from manufacturing type industries.

Acceptable wastes approved for routine receipt are all waste streams except the non acceptable and hazardous wastes streams detailed below. Acceptable wastes include but are not limited to:

- Paper and paper products
- Cardboard
- Plastic
- Glass
- Metal (ferrous and non-ferrous)
- Rubber
- Leather
- Textiles
- Wood
- Food wastes
- Containers and packaging
- Yard wastes
- Inorganic materials
- Dead animals
- Commercial solid wastes
- Construction and demolition debris
- Institutional solid wastes
- Tires were and can be accepted from individuals if they sign a document that states no reasonable recycling option is available. The individual must have inquired into local tire recycling options by querying the local telephone directory and contacting the county or municipality of their residence regarding the availability of local recycling facilities, collection centers, or collection events.
- Tires are placed in a roll-off container. The roll-off container is periodically hauled by Bruin Waste Management (Certificate of Registration ID# 2242) to 3XM Grinding and Compost, LLC, located in Olathe, CO, Facility #1805.
- All refrigerant or Freon containing appliances, such as refrigerators, freezers, and some air conditioners are accepted and set aside for Freon removal.

Wastes that Require Special Handling or Testing (See Appendix 10 for Details)

- Non friable asbestos
- Friable Asbestos (See Appendix 15)
- Biosolids

- Contaminated soil
- Medical Waste including Sharps (non-infectious)
- Special wastes approved for disposal

Non acceptable wastes:

- Used tires other than from individuals as explained above
- Lead acid batteries
- All electronic waste (computers, phones, televisions, etc.)
- PCB Waste
- Waste oil
- Biomedical infectious waste
- Waste containing free liquid (paint filter test)
- Septage
- Radioactive wastes
- Transformers
- Mercury containing devices
- Fluorescent light tubes
- Liquids
- Sludge
- Special waste not approved for disposal

Electronic waste is set aside to be sent to a recycler.

Lead acid batteries are set aside in a location near the landfill office and periodically delivered to a recycle facility. The lead acid batteries are managed as follows:

- Any used lead-acid battery that shows evidence of leakage, spillage, or damage that could cause leakage, will be placed in a container. The container will be closed, labeled as to its contents, structurally sound, compatible with the contents of the battery, and must lack evidence of leakage, spillage, or damage that could cause leakage;
- Batteries that are not leaking and are in good condition will be stored on pallets or in a comparable manner that keeps all batteries off the ground;
- Batteries stored outside shall be protected from the weather;
- Used lead-acid batteries must be stored in a designated accumulation area indicated by signs, markings, or other identifiers; and
- Any release associated with the storage or recycling of lead-acid batteries will be immediately contained and remediated.

Used oil is not accepted at the landfill. Residentially generated used oil is diverted if possible or returned to the person attempting to dispose of the waste oil. Diverted used oil is stored in a 55 gallon drum. Used oil from this facility is given to a company that uses an oil-fired space heater. Used oil totaling 55 gallons or less is transported by the company that owns the used oil-fired space heater.

White goods are stored in a cleared area located east of the landfill. The landfill has two methods of handling Freon containing devices. On method is to have a qualified person come to the landfill remove the Freon and tag the devices. The second method is to ship the Freon containing devices to a recycle company which removes the Freon.

Hazardous waste will not knowingly be accepted for disposal at the landfill. The following program will be implemented to detect and prevent the disposal of polychlorinated biphenyl (PCB) wastes and hazardous wastes:

Incoming loads will be continually inspected to ensure that the loads do not contain hazardous wastes. Once a week a random load is thoroughly inspected for hazardous waste.

Hazardous waste identifiers include hazardous waste placards, liquids, powders or dusts, sludges, bright or unusual colors, transformers, drums or commercial sized containers and chemical type odors.

If hazard wastes are identified at the facility they will be moved to an isolated area of the facility for proper disposal at an offsite location. The facility personnel will be trained to recognize these wastes; and the Department will be notified if these wastes are discovered at the site and facility.

(D) The number, classification, and job descriptions of personnel projected to be employed at the landfill when operating at full capacity;

The small size of the landfill dictates that two people, a Landfill manager and an equipment operator, will be employed at the landfill. The job descriptions are presented above

The public will be allowed to haul refuse to the landfill.

(E) Number, description, and uses of all equipment projected to be employed at the landfill when operating at full capacity;

Landfill equipment includes a Cat 825G landfill compactor, Cat 966F front end loader, Cat 950E front end loader, Cat 140 G motor grader, John Deere 250 haul truck, Mack 3,000 gallon water truck and a service truck and welder.

In the case of equipment breakdown, rental equipment will be obtained to facilitate continued operation of the landfill. Rental equipment may also be utilized during a particular stage of the landfill operation such as when the final cover is being placed on the landfill.

(F) The size and types of disposal cells or processing areas to be constructed;

Disposal cells will be developed about twenty feet deep and about 150-feet wide and 150 to 300-feet long. Most cells will have a southwest to northeast direction orientation. Material excavated from the disposal cells is either stockpiled or hauled back to the active area for daily cover.

The disposal cells are excavated through sandstone and into the shale barrier layer. It is necessary to drill and blast each disposal cell. Drilling of the shot holes is performed by an independent company at the direction of the Operator. Explosives are not stored on site. The loading of explosives and detonation of the blast is performed by an outside independent company such as Western Explosives Systems Company or Dyno Noble Inc. The blasting company assures that personnel and equipment are located at a safe location prior to the detonation of the explosives.

(G) The frequency of the application of adequate cover;

Disposed solid waste will be covered with six inches of earthen material at the end of every day unless conditions warrant more frequent application. Intermediate cover of a minimum depth of 1 foot will be placed on the waste if the area will not be worked for 30 days or longer. Tire shreds may also be used and daily cover. The minimum tire shred thickness shall be 8 inches.

(H) The types and heights of fencing to be placed on-site;

The entrance to the landfill is secured by a cattle guard and locked gate. Topographic features east of the gate would not prohibit some vehicles from gaining access to the landfill. Therefore, a barbed wire fence was constructed from the entrance gate to the east to where topographic features would prohibit off road vehicle travel. Large boulders were placed

along the south side of the fence to prohibit vehicle entrance. Topographic features prohibit vehicle travel on the west side of the entrance gate.

Fencing is used to control windblown debris. A wire mesh (elk) fence is located north and east of the landfill. The north fence is 8-feet high and approximately one thousand feet long. The east fence is also 8-feet high and about 500 feet long.

(I) Provisions to minimize nuisance conditions on-site;

1. Disease and nuisance vectors will flourish at the landfill only if they have a source of food and shelter. The source of food and shelter are controlled at the landfill by compacting the refuse and applying daily cover material. Odors at landfills primarily originate from the incoming solid waste. As in the control of disease and nuisance vectors, odors are controlled by compacting the refuse and applying daily cover material. If nuisance conditions occur at the site for any reason, appropriate action will be taken.

   Nuisance conditions will be mitigated within 7 days and documentation of the mitigation will be noted in the site log book.

(J) Provisions for fire protection to eliminate open burning on-site;

The burning of refuse is not permitted at the landfill. If a fire accidently occurred, one of the three following methods would be used to extinguish it; 1) the equipment on site would isolate the burning material and cover it with soil; 2) the water truck on site would be positioned so it could dump or spay water on the fire; or 3) a fire extinguisher obtained from the site equipment would be used to put out the fire. Records of fires will be maintained in the facility log book.

(K) Provisions for the retrieval of windblown solid wastes, on or off-site;

If solid wastes are blown from the working face and escape the fencing, the solid waste will be picked up by the site personnel and, if required temporary labor.

(L) Conceptual plans to be implemented if the contamination of surface waters or ground waters occur, or if nuisance conditions are confirmed beyond the site;

The stormwater collection and diversion ditches and the sediment pond comprise the surface water on site. The drainages surrounding landfill are ephemeral. About the only way that

these drainages could be contaminated would be by wind blow debris. If this occurred, the wind blow debris would be accumulated and returned to the landfill site.

Some areas of a landfill that may produce contaminated stormwater include the open face of the landfill with exposed waste and no cover added. A berm will be maintained around the open face to prevent contaminated stormwater from exiting the open face area.

There is limited deep ground water under the site so the contamination of ground water should not be an issue. Construction of the landfill cells changes local run off patterns. There is potential for shallow perched zones of groundwater due to surface water infiltration in areas where run off collects. Shallow perched zones of groundwater may have been the source of water in alluvial wells AW-2 and AW-3 that were drilled in August of 2011. In the event the water monitoring wells do at some point in time contain contaminated water the following steps could be taken.

If nuisance conditions are confirmed beyond the site boundary it would probably be related to wind blow debris or unauthorized dumping. In any case, adequate personnel would be mobilized to accumulate the refuse and return it to the landfill site.

The Department will be notified within 24 hours of a petroleum spill greater than 25 gallons. The Department will be notified within 24 hours after the discovery of an unknown or suspicious waste. The Department will be notified of any groundwater impacts within 14 days after receipt of laboratory reports.

(M) The amounts and sources of water to be used on site for the control of nuisance conditions, fire protection, construction purposes and personnel use;

Potable water will be hauled to site for personnel use. Sanitary services are provided by a holding tank.

A 3,000 to 4,000 gallon water truck will be available for use at the landfill as needed to control nuisance conditions and for fire protection. Water will be purchased from the town of Naturita. Water will be hauled via highway style water truck from this point to the operation as necessary to control nuisance conditions and for fire protection.

3.3.3 Quality Assurance and Quality Control Reports

Quality assurance and quality control reports shall be developed and implemented for all engineered structures at the landfill. Engineered structures and the respective quality control reports are explained below. See Appendices 12 and 13 for the quality assurance quality control plans.

IGES, 4153 South , 300 West, Salt Lake City, Utah prepared a technical report which addresses site soils, the feasibility of use of an ET cover and slope stability analysis. Their report is attached as Appendix 8.

IGES analyzed the site soils to get a baseline understanding of saturated permeability. Two backpressure permeability tests were performed on site soils, one with a consolidation stress of 1.4 psi and one with a consolidation stress of 13.9 psi. The lower consolidation stress best represents the saturated permeability of the site soils utilized in a cover application while the higher consolidation stress representing the saturated permeability of the site soils utilized as a liner. The permeability value for the cover application was 1.9E-05 cm/sec with a lower permeability of 1.lE-06 cm/sec for the liner application.

Disposal cells will be lined with a geosynthetic clay liner GCL or 12-inches of compacted clay. See drawing LF-07 for details. See the Construction Quality Assurance (QA) and Construction Quality Control (QC) plan presented in Appendix 12 for the GCL liner and Appendix 13 for the clay liner.

Each time a disposal cell is built and leachate system is extended, a Construction Certification Report must be submitted to the Division for review/approval.

3.3.4 Cover Material Requirements

A. The disposed solid waste will be covered with six (6) inches of earthen material at the end of each operating day, or at more frequent intervals if necessary, to control disease vectors, fires, odors, blowing litter and scavenging.

B. Tire shreds will be used as alternate daily cover (ADC). During a field trial during October and November 2014, the Operator demonstrated to the Division the tire shreds control nuisance conditions and scavenging without presenting a threat to human health and the environment. By e-mail dated November 11, 2014 the Division approved the use of tire shreds as ADC. The minimum tire shred thickness shall be 8 inches. The tire shreds are from a standard tub grinder which should yield 10% greater than 6 inches and 90% less than 6 inches.

Petroleum contaminated soil (PCS), if accepted into the landfill will not be used as ADC.

C. A temporary waiver, based on extreme seasonal climatic conditions, from the requirement of daily and intermediate cover requirements is not being requested.

3.3.5 Sufficient Amounts of Adequate Cover

The entire landfill has a capacity of approximately 6.3 million cubic yards. The excavation of the disposal cells generates about 1.9 million cubic yards (60 acres 20 feet deep). Therefore, the ratio between refuse and soil material is about 3.3:1. The 60 acre figure is less than the 71 acre landfill foot print because the pits need to have stable slopes around the perimeter of the landfill.

The landfill owns the SW/4SW/4 (Government Lot 13) of Section 10 which encompasses approximately 40 acres. This area will provide a alternative borrow area to assure there are sufficient amounts of adequate cover material and adequate water balance cover material.

3.3.6 Adequate Amounts of Water

The source of water for construction purposes and to minimize nuisance conditions will be purchased from the town of Naturita. Water will be hauled to the landfill in a highway legal water truck.

3.3.7 Leachate and Landfill Gas Condensate

If necessary, the landfill plans to re-circulate leachate over the active landfill. The leachate recirculation will be managed so no run-off occurs.

3.4 RECORDKEEPING

3.4(A) Incoming waste volumes;

The operator will keep a record of the volume of waste received by the facility. The volumes will be based upon load counts, sizes of loads and estimated load factors.

3.4(B) Water quality monitoring results;

The Operator will keep a record of all of the results of water quality monitoring. This includes but may not be limited to groundwater and leachate analysis.

3.4(C) Explosive gas monitoring;

The operator will keep a record of all explosive gas monitoring results. Such records will note the monitoring location, the type of monitoring instrument, the individual who performed the monitoring, the date and result of the monitoring. Monitoring will be performed at least quarterly.

3.4(D) Construction as-built details;

The operator will keep a record of all construction as-built details. The information will include but not be limited to as built details of the surface run-on and run-off control system, monitoring wells, geosynthetic clay liner (GCL), 12" thick low permeability layer (barrier layer liner), leachate collection system and final cover.

3.4(E) Variations from approved operations procedures;

The operator will keep a record of any variation from the approved operations procedures. Such record will include the authority for the variation or an explanation as to why the variation from the approved operations procedures was necessary.

3.4(F) Any demonstration and waiver documentation;

The operator will keep a record of any demonstration and waiver documentation required by the regulations.

3.4 (G) Engineering Design and Operations Plan;

The operator will keep a record of the approved Engineering Design and Operations Plan at the landfill site for reference and inspection.

3.4 (H) Employee Training;

- The landfill manager will have current manager of landfill operations (MOLO) training
- The operator will keep a record of all employee training. Such training will include but not be limited to instruction on how to detect incoming hazardous wastes, instruction about special wastes, instruction on the requirements of the landfill operations plan and appropriate safety training.

3.4 (I) Reporting;

- Records of water monitoring, gas monitoring and leachate monitoring will be submitted to the Department by April 30th of each year.
- The Operator submits the solid waste user fee to the Division quarterly
- Annual financial assurance, original cost estimates and cost estimates adjusted for inflation will be submitted to the Department by April 30th of each year.

3.4 (J) Records;

The following records will be kept on site:

- Inspection records
- Certificate of Designation
- Financial assurance information
- All facility records

3.4.1 <u>Deed Notation</u>

Following closure of the landfill, the operator will record a notation on the deed to the facility property, or some other instrument that is normally examined during title search. The operator will notify the Department and the local governing body that the notation has been recorded and a copy of the notation has been placed in the operating record.

3.5 Closure

3.5.1(A) The closure plan is included in the Design and Operations plan. The Department and Montrose County and other local agencies will be notified in writing at least sixty (60) days in advance of the proposed closure date. The Operator will notify the general public at least sixty (60) days in advance of the proposed closure date by placing signs of suitable size at the entrance to the site and facility.

After closure, the gate to the facility will remain locked to prevent further use of the facility. Fences and boulders along the northern boundary of the facility will help prevent further use of the facility.

(1) Final Cover Description;

The final cover will be a water balance cover. The landfill cover will be comprised of a 12-inches intermediate cover layer and a 30 inch thick water balance layer.

(2) An estimate of the largest area of the landfill ever requiring final cover;

The landfill outline encompasses 71 acres. It is estimated one-third of the landfill ~25 acres could require final cover.

(3) A schedule for completing all activities necessary to satisfy closure criteria of this section;

Closure Schedule

	Work Days
Notify Department of Pending Closure	5
Commence Closure Activities:	
Plan Closure - Receive Proposals	30
Place 30-Inches of ET Cover	60
Seed Area - In Fall of Year	1
Submit Closure Report to Department	10
Total Time To Close Each Discrete Area	106

3.5.1(B) Discrete units of a landfill will be closed independently of closure of the entire facility.

3.5.2 Final grades:

The final grades of the landfill are presented on Map LF-07. The slide slopes of the landfill are designed at 2.5H:1V with 45 foot wide benches on 30 foot vertical centers. The effective slope of the landfill is 4.0H:1V.

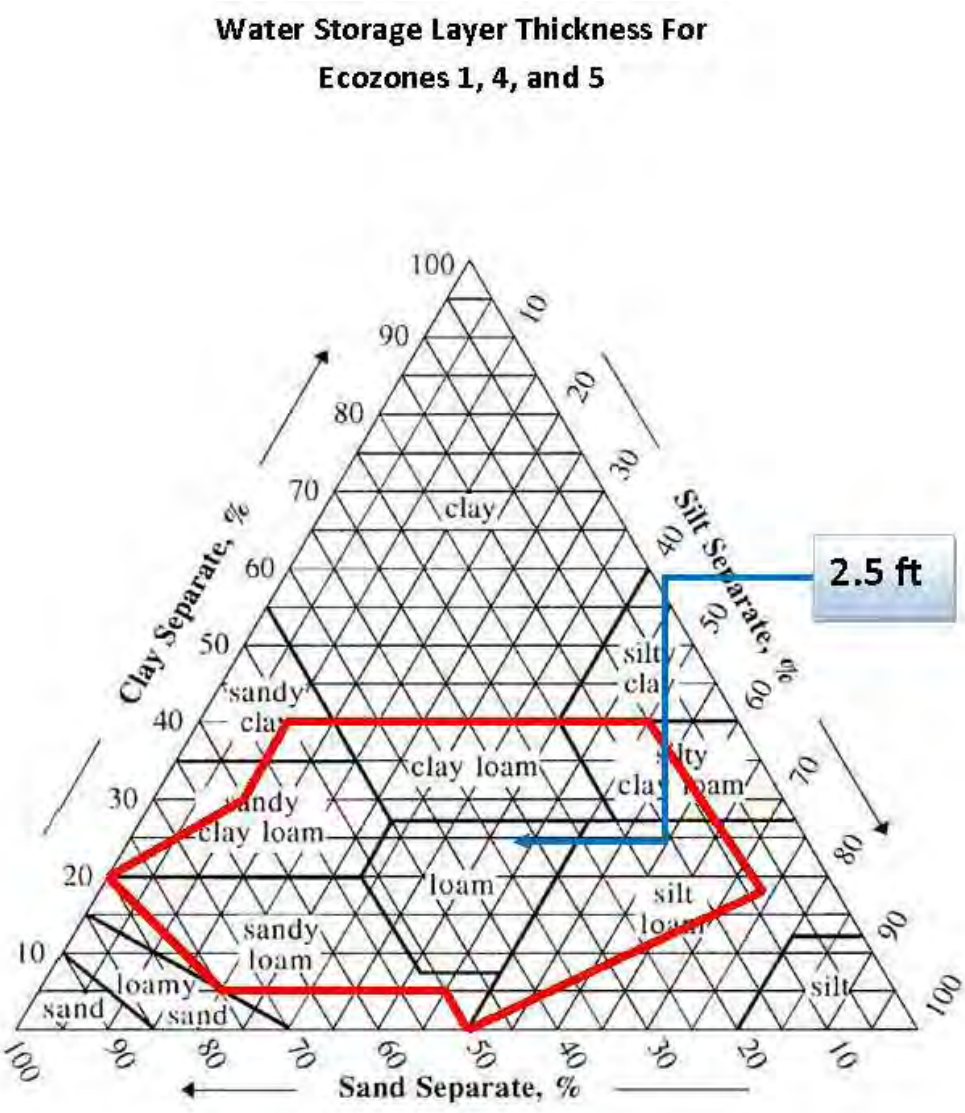
IGES addressed the stability of the landfill. Their report states in part:

"Based on conservative values for unit weight and strength parameters the static analysis model indicates a minimum factor of safety of 2.01 for the intermediate 2.5H: IV proposed slopes and 1.78 for the veneer. The Pseudo-static analysis indicates a factor of safety of 1.40. Global stability analyses of the overall benched 2-slope configuration resulted in minimum factors of safety of 2.32 and 1.51 for the static and pseudo-statics cases respectively. An additional analysis was performed to evaluate the impacts of using the 2.5H:1V intermediate slope and bench configuration for further vertical expansion of the landfill up to a maximum height of 180 fee or six-30 ft. lifts. The resulting minimum global stability of the expanded configuration had a calculated factor of safety of 2.32 under static conditions."

Western Colorado has infrequent but intense rain storms. Fifteen years experience at the landfill have shown that concentrated rain showers will inflict sever erosion on long side slopes with 20% to 25% grades. Experience has shown the relatively steep outslopes of the landfill minimize erosion. The horizontal projection of a 30 foot high 4H:1V slope is 120 feet compared to 75 feet for a 2.5H:1V slope. This makes a big difference when it comes to slope erosion. The landfill is designed to contain the run-off on intermediate benches and direct the flow from the benches into stabilized channels. The benches are generally sloped at a 2.5% grade. This grade has proven to work well at the landfill with very little erosion on the benches.

3.5.3 Final cover

The final cover will be a water balance cover. A QAQC plan for the water balance layer is included in Appendix 12 Section 4. Figure 2.2.1-1 of the March 2013 water balance guidance document (WBG) places the landfill in ecozone 1. Figure 2.2.1-3 from the WBG shows that a 2.5 foot water storage layer is required for ecozone 1. The same figure also outlines the acceptable soil types for the ET cover. The acceptable soil types are clay loam, sandy clay loam, sandy loam, loam, and silt loam as shown below.



There are not many burrowing animals in the landfill area. Therefore a biota barrier is not considered necessary.

3.5.4 Landfill gases should not have a deleterious effect on the proposed water balance cover (ET Cover).

3.5.5 Upon approval, and prior to beginning closure of each landfill phase, the Operator will notify the Division and place notice of the intent to close the phase in the operating record.

3.5.6 The Operator will commence closure activities of each landfill phase no later than 30 days after final refuse grades are reached. Extensions beyond the 30-day deadline for beginning closure may be granted by the Division if the owner or operator demonstrates that all steps necessary to prevent threats to human health and the environment from the active landfill phase will be taken.

3.5.7 The Operator will complete closure activities of each landfill phase, in accordance with the closure plan, within one hundred eighty (180) days following the beginning of closure. Extensions of the closure period may be granted by the Division if the Operator demonstrates that closure will of necessity, take longer than one hundred eighty (180) days and the Operator has taken and will continue to take all steps to prevent threats to human health and the environment.

3.5.8 Following closure of each landfill phase, the Operator will submit a report to the Division documenting that closure has been completed in accordance with the approved closure plan. The report, which will be signed by a Colorado registered professional engineer, shall be approved by the Department and placed in the operating record.

3.6 Post Closure Care

3.6.1(A) Following closure of each landfill or landfill phase, the owner or operator must conduct post-closure care which shall consist of at least the following:

(1) Provisions to minimize nuisance conditions;

Disease and nuisance vectors will flourish at the landfill only if they have a source of food and shelter. The integrity of the landfill will be inspected periodically. Should there be any indication that nuisance conditions exist, or that there is an environment that would promote nuisance conditions, appropriate action will be taken.

(2) Maintaining the integrity of the final cover;

The integrity of the final cover will be inspected quarterly. The inspection will note the condition of the vegetation and if any rills or gullies have formed. If necessary, the vegetation will be replanted. Rills and gullies will be repaired. The inspection will also note if any areas have subsided. Areas where subsidence would cause the impounding of water will be filled to establish positive drainage. The condition of the drainage control system will also be noted. Diversion and collection ditches will be maintained to the appropriate design depth and grade.

(3) Monitoring of ground water;

The approved monitoring plan shall be followed during the post closure care period. The monitoring plan includes landfill gas (LFG), ground water and leachate.

(4) Operating the leachate collection system;

> The leachate line(s) outside the landfill footprint will be protected from freezing by having a soil cover. Dirt may have to be mounded over the line(s) to provide 24" to 36" of cover. Insulation may need to be placed around the pipe where it enters the leachate tank. Leachate may need to be hauled to a sewage treatment plan for disposal.

(5) Maintaining and operating the gas monitoring system;

LFG monitoring will be conducted quarterly throughout the 30 year post-closure period in accordance with the monitoring plan presented in Appendix 6.

(6) Name address and telephone number of person to contact about the facility during the post closure care period;

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(7) The land use of landfill property is currently rangeland and wildlife habitat. During the post-closure care period, the use of the land will revert back to rangeland and wildlife habitat. Livestock grazing will be restricted on revegetated areas as appropriate to assure the success of the newly established vegetation. A land use of rangeland and wildlife habitat should not disturb the integrity of the final cover, drainage control system or any of the monitoring systems.

3.6.2 Following completion of the post-closure care period, the Operator will notify the Department and the local governing body that a certification signed by an independent Colorado registered professional engineer verifying that post-closure care has been completed in accordance with the post-closure plan has been placed in the operating record.

3.6.3 Post-closure care must be conducted for a minimum of thirty (30) years. The length of the post-closure care period may be:

(A) Decreased by the Department after consultation with the local governing body having jurisdiction if the owner or operator demonstrates that the reduced period is sufficient to protect human health and the environment; or

(B) Increased by the Department after consultation with the local governing body having jurisdiction if it is determined that the lengthened period is necessary to protect human health and the environment.

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APPENDIX 1

SURFACE WATER CONTROL SYSTEM

BROAD CANYON LANDFILL

MAY 2016

APPENDIX 1

Broad Canyon Landfill
Drainage Plans

The operational water control system is shown on Map LF-06 and design details are presented in this appendix. The operational surface water control system is designed as follows: (a) A run-on control system to prevent flow onto the active facility during the peak discharge from a 25-year, 24-hour storm, and (b) A run-off control system to: (1) collect the water volume resulting from a 25-year, 24-hour storm event and (2) control the water volume resulting from a 100-year, 24-hour storm event.

Two diversion ditches are utilized to divert the run-off from the active portion of the landfill. Two collection ditches and a containment pond are utilized to contain the run-off from the active portion of the landfill. The collection ditches will be relocated as the landfill expands to assure all run-off is contained in the sediment pond. The east and west collection ditches are each sized to handle the entire flow from the 24-hour 25-year storm event. The upper diversion ditches are sized to handle the 24-hour 100-year storm event. These two ditches are ditches 63 and 64 in the final closure drainage design.

Sediment pond design location and details are shown on Map LF-06. The pond has a capacity of 4.45 acre feet. Allowing for sediment storage, the pond has a water capacity of 4.02 acre feet. As can be seen on the following pages, the 25 year storm event generates 2.84 acre feet of run-off from the landfill and the upland areas.

Designs are provided for the final closure grading and drainage plan. Drawing LF-04 shows the location of sixty four (64) ditches that make up the final drainage plan. The ditches are designed based on the 100 year storm event of 2.9 inches.

The flow to each of the ditches was calculated with SedCad[4] using a curve number of 71.5 for all of the runoff originating within the landfill footprint. The following discussion provides the basis of selecting a curve number of 71.5.

The soil type in Section 15 is Pinon-Bowdish-Rock outcrop complex 3 to 30 percent slopes. The soils in Section 10 are the Pinon-Bowdish-Rock complex and Barx-Progresso complex, 3 to 12 percent slopes. All of the soil types have a hydraulic soil

group of C except the Pinon which has a hydraulic soil group of D. A hydraulic soil group of C was used to determine the curve numbers.

The vegetative ground cover at the landfill during final closure will be poor to fair. Poor ground cover is defined as having less than 30% cover. Fair ground cover is defined as having 30 to 70% cover.

The Soils Conservation Service has tables that provide runoff curve number for various hydrologic conditions. Table 2-2d - Runoff curve numbers for arid and semiarid rangelands was utilized to determine the runoff curve number for the landfill. A sagebrush community with grass understory was used as the vegetation type. Soil hydrologic group C with fair cover yields a curve number of 63. Soil hydrologic group C with poor cover yields a curve number of 80. The average of the two curve numbers (71.5) was used for the runoff calculations for all of the runoff originating within the landfill footprint.

The upland drainage area and diversion ditches derive runoff from Pinyon juniper and Sagebrush cover types. Soil hydrologic group C with good cover in the Pinyon juniper cover type yields a curve number of 61. Soil hydrologic group C with good cover in the Sagebrush cover type yields a curve number of 47.

APPENDIX 1

BROAD CANYON LANDFILL

OPERATIONAL DRAINAGE CONTROL PLAN

CONTAIN 25 YEAR EVENT & CONTROL 100 YEAR EVENT

STORM EVENTS

25 YEAR 24 HOUR EVENT	2.2	INCHES
100 YEAR 24 HOUR EVENT	2.9	INCHES

The information presented for peak flow calculations is developed with the use of SEDCAD. The output from SEDCAD follows and is summarized on the ditch design sheets.

The run-off areas are shown on LF-06. The run-off curve numbers are developed based upon vegetation and soil

The soil type in Section 15 is Pinon-Bowdish-Rock outcrop complex 3 to 30 percent slopes. The soils in Section 10 are the Pinon-Bowdish-Rock complex and Barx-Progresso complex, 3 to 12 percent slopes. All of the soil types have a hydraulic soil group of C except the Pinion which has a hydraulic soil group of D. A hydraulic soil group of C was used to determine the curve numbers.

The Soils Conservation Service has tables that provide runoff curve number for various hydrologic conditions. Table 2-2d - Runoff curve numbers for arid and semiarid rangelands was utilized to determine the runoff curve number for the landfill. A sagebrush community with grass understory was used as the vegetation type. Soil hydrologic group C with fair cover yields a curve number of 63. Soil hydrologic group C with poor cover yields a curve number of 80. The average of the two curve numbers (71.5) was used for the runoff calculations for all of the runoff originating within the landfill footprint.

The upland drainage area and diversion ditches derive runoff from a Pinyon juniper and Sagebrush cover types. Soil hydrologic group C with good cover in the Pinyon juniper cover type yields a curve number of 61. Soil hydrologic group C with good cover in the Sagebrush cover type yields a curve number of 47.

RUN-OFF VOLUME - - Containment Pond

Area	Acres	Curve #	25-Year Precip Amount	Direct Run-off	Run-off Vol A-F
Upland PJ	71.4	61	2.2	0.12	0.690
Upland Sagebrush	37.7	47	2.2	0.00	0.001
Landfill	70.7	71.5	2.2	0.37	2.151
TOTAL	179.80				2.843

SEDIMENT VOLUME

Determine sediment storage using the universal soil loss equation

A = R K L S C P	
R = rainfall factor	30.00
K = soil erodibility factor - sandy loam	0.37
LS = combined length slope factor	0.57
Use 1000 @ 3%	
C = cropping management factor - Figure 7	1.00
P = erosion control practice factor	1.00
A = sediment, tons/acre/year	6.33

ONE YEAR SEDIMENT VOLUME - CUBIC FEET 0.45

179.80 ACRES - 115 #/CF

TOTAL REQUIRED POND CAPACITY -- Acre Feet 3.30

The following peak flow calculations were compiled with SEDCAD. Details of the run-off calculations are shown on the following pages.

100-YR 24 HR Event	25-YR 24 HR Event
85.1	34.9

Flow calculations for the site ditches both operational and after final grading are presented in following sections of this exhibit.

Emergency Spillway Design Pond
Manning's Equation
Flow In a Trapezoidal Channel
Size Emergency Spillway for the 100-Year Event

DEPTH	D	1.45	FEET
WIDTH	W	8.0	FEET
Slope	S	0.02	EXPRESS AS DECIMAL
Manning's "N"	N	0.04	EXPRESS AS DECIMAL
SIDE SLOPE	X	2	SLOPE = X:1

AREA=(W*D)+(X*D^2)=	15.81	Feet^2
WETTED PERIMETER=(W)+2*[((X*D)^2+D^2)$^{1/2}$]	14.48	Feet
R=AREA/WETTED PERIMETER	1.09	
V=(1.49/N)*(R$^{2/3}$)*(S$^{1/2}$)=	5.58	Ft/Sec
Q = A X V =	88.25	CFS
Q REQUIRED - Peak Discharge	85.10	CFS

A new sediment pond has been constructed. Design location and details are shown on Map LF-06. The new pond has a capacity of 4.45 acre feet. Allowing for sediment storage, the pond has a water capacity of 4.02 acre feet. As can be seen on the following pages, the 25 year storm event generates 2.84 acre feet of run-off from the landfill and upland areas. The new pond has adequate capacity to contain the 25 year storm event.

ELEVATION-CAPACITY-TABLE

Sediment Pond

Calculations for volume based on average end area method

New Sediment Pond

Elev	End Area	ΔH	Vol. CF	Vol. Ac-Ft	
6180	**425**				
6182	**18327.0**	**2**	**18752.0**	0.43	Elev.of valved 6" Dewatering Pipe
6184	**47717.0**	**2**	**66044.0**	1.52	
6186	**61409.0**	**2**	**109126.0**	2.51	Elev. of Emergency Spillway
6187.45					Elev. of Emergency Spillway flowing full
Total				4.45	
				0.43	Sediment Capacity
				4.02	Water Capacity
				4.45	Total Capacity

Required storage volumes based on the 25-year event shown above.

SEDIMENT POND REQUIRED STORAGE SUMMARY

0.45	Ac-Ft	Required Sediment Storage
2.8	Ac-Ft	Required Water Storage
3.3	Ac-Ft	Required Pond Storage

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Broad Canyon Landfill

Contain the 25 year event.

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Phone: 970-245-4101
Email: jestover@bresnan.net

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	25 yr - 24 hr
Rainfall Depth:	2.200 inches

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	71.400	0.100	0.000	0.000	61.000	TR55	5.03	0.689
	2	37.700	0.100	0.000	0.000	47.000	TR55	0.00	0.000
	3	70.700	0.100	0.000	0.000	71.500	TR55	29.89	2.148
	Σ	**179.800**						**34.93**	**2.837**

Flow used for east and west collection ditches

Run-off volume must be contained in pond.

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T S Landfill, Inc.

Broad Canyon Landfill

Control of the 100-Year Event

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General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 24 hr
Rainfall Depth:	2.900 inches

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	71.400	0.100	0.000	0.000	61.000	TR55	25.62	1.948
	2	37.700	0.100	0.000	0.000	47.000	TR55	0.15	0.109
	3	70.700	0.100	0.000	0.000	71.500	TR55	59.44	4.273
	Σ	**179.800**						**85.06**	**6.329**

Used to design pond emergency spillway

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East & West Collection Ditches

Material: Riprap

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
1.5:1	1.5:1	3.0	0.30		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	34.93 cfs	
Depth:	1.92 ft	2.22 ft
Top Width:	5.75 ft	6.65 ft
Velocity:	6.34 fps	
X-Section Area:	5.51 sq ft	
Hydraulic Radius:	0.797 ft	
Froude Number:	1.14	
Manning's n:	0.0350	
Dmin:	2.00 in	
D50:	3.00 in	
Dmax:	4.50 in	

APPENDIX 1

FINAL CLOSURE DRAINAGE PLAN

Reference Map LF-04 for Ditch Locations

MAY 2016

Broad Canyon Landfill																
Closure Grading Plan - Ditch Sizing																
Ditch	Channel	Elevation	Percent	Drainage	Contributing				Sedcad	Contributing Flow				Total	Ditch	Ditch Type
Number	Length	Drop	Slope	Area	Ditch Numbers				Flow	Fom Ditches				Flow	Number	
1	2420	70	2.9%	41.10	20	28	37	64	10.44	0.96	1.01	2.05	9.44	23.90	1	Triangular
2	215	10	4.7%	0.56	7				0.47	8.99				9.46	2	Terrace
3	290	16	5.5%	0.30					0.25					0.25	3	Triangular
4	133	2	1.5%	0.20	6				0.17	0.65				0.82	4	Triangular
5	590	10	1.7%	1.00	12				0.84	19.09				19.93	5	Triangular
6	66	28	42.4%	0.00	8	9			0.00	0.27	0.38			0.65	6	Trapezoidal
7	56	24	42.9%	0.00	14	15	21.00		0.00	2.72	0.50	5.77		8.99	7	Trapezoidal
8	133	2	1.5%	0.32					0.27					0.27	8	Terrace
9	162	3	1.9%	0.45					0.38					0.38	9	Terrace
10	120	3	2.5%	0.32					0.27					0.27	10	Terrace
11	540	12	2.2%	1.50					1.26					1.26	11	Terrace
12	75	30	40.0%	0.00	10	11	13		0.00	0.27	1.26	17.56		19.09	12	Trapezoidal
13	60	24	40.0%	0.00	16	17			0.00	0.46	17.10			17.56	13	Trapezoidal
14	1128	26	2.3%	3.24					2.72					2.72	14	Terrace
15	236	12	5.1%	0.59					0.50					0.50	15	Terrace
16	200	4	2.0%	0.55					0.46					0.46	16	Terrace
17	625	14	2.2%	1.66	22				1.40	15.70				17.10	17	Terrace
18	110	2	1.8%	0.31					0.26					0.26	18	Terrace
19	365	8	2.2%	0.83					0.70					0.70	19	Terrace
20	82	6	7.3%	0.00	18	19			0.00	0.26	0.70			0.96	20	Triangular
21	80	32	40.0%	0.00	23	24	29		0.00	1.99	0.87	2.91		5.77	21	Trapezoidal
22	45	18	40.0%	0.00	25	26			0.00	0.75	14.95			15.70	22	Trapezoidal
23	937	24	2.6%	2.37					1.99					1.99	23	Terrace
24	400	10	2.5%	1.04					0.87					0.87	24	Terrace
25	320	8	2.5%	0.89					0.75					0.75	25	Terrace
26	438	8	1.8%	0.93	30				0.78	14.17				14.95	26	Terrace
27	550	12	2.2%	1.20					1.01					1.01	27	Terrace
28	32	8	25.0%	0.00	27				0.00	1.01				1.01	28	Trapezoidal
29	76	30	39.5%	0.00	31	32	38		0.00	1.14	0.59	1.18		2.91	29	Trapezoidal
30	45	18	40.0%	0.00	33	34			0.00	11.21	2.96			14.17	30	Trapezoidal
31	567	16	2.8%	1.36					1.14					1.14	31	Terrace
32	292	7	2.4%	0.70					0.59					0.59	32	Terrace
33	560	14	2.5%	1.48	39				1.24	9.97				11.21	33	Terrace
34	1325	32	2.4%	3.52					2.96					2.96	34	Terrace
35	678	18	2.7%	1.65					1.39					1.39	35	Terrace
36	366	10	2.7%	0.79					0.66					0.66	36	Terrace
37	74	26	35.1%	0.00	35	36			0.00	1.39	0.66			2.05	37	Trapezoidal
38	84	26	31.0%	0.00	40	41			0.00	0.79	0.39			1.18	38	Trapezoidal
39	70	27	38.6%	0.00	42	43			0.00	6.54	3.43			9.97	39	Trapezoidal
40	375	10	2.7%	0.94					0.79					0.79	40	Terrace
41	196	5	2.6%	0.46					0.39					0.39	41	Terrace

Broad Canyon Landfill																
Closure Grading Plan - Ditch Sizing																
Ditch	Channel	Elevation	Percent	Drainage	Contributing				Sedcad	Contributing Flow				Total	Ditch	Ditch Type
Number	Length	Drop	Slope	Area	Ditch Numbers				Flow	Fom Ditches				Flow	Number	
42	400	10	2.5%	1.21	49				1.02	5.52				6.54	42	Terrace
43	1640	39	2.4%	4.08					3.43					3.43	43	Terrace
44	53	21	39.6%	0.00	45	46			0.00	1.61	0.41			2.02	44	Trapezoidal
45	696	16	2.3%	1.92					1.61					1.61	45	Terrace
46	190	4	2.1%	0.49					0.41					0.41	46	Terrace
47	125	28	22.4%	0.00	48				0.00	0.45				0.45	47	Trapezoidal
48	411	10	2.4%	0.53					0.45					0.45	48	Terrace
49	100	30	30.0%	6.56					5.52					5.52	49	Trapezoidal
50	1075	22	2.0%	1.71					1.44					1.44	50	Triangular
51	800	12	1.5%	5.28	50	56			4.44	1.44	8.31			14.19	51	Triangular
52	990	30	3.0%	1.20					1.01					1.01	52	Triangular
53	400	26	10.0%	0.00	52				0.00	1.01				1.01	53	Triangular
54	1820	64	3.5%	4.57					3.84					3.84	54	Triangular
55	150	4	2.7%	0.00	57				0.00	4.41				4.41	55	Triangular
56	75	30	40.0%	0.00	58	59			0.00	4.20	4.11			8.31	56	Trapezoidal
57	57	23	40.4%	0.00	60	61			0.00	1.12	3.29			4.41	57	Trapezoidal
58	960	24	2.5%	5.00					4.20					4.20	58	Terrace
59	1215	38	3.1%	4.89					4.11					4.11	59	Terrace
60	935	22	2.4%	1.33					1.12					1.12	60	Terrace
61	66	26	39.4%	0.00	62				0.00					3.29	61	Trapezoidal
62	1550	38	2.5%	3.91					3.29					3.29	62	Terrace
63	1200	30	2.5%	22.90	Curve # 61				8.22					8.22	63	Triangular
64	800	20	1.5%	26.30	Curve # 61				9.44					9.44	64	Triangular

Ditch 1

Material: Riprap

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
2.5:1	2.5:1	2.9	1.00		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	23.90 cfs	
Depth:	1.36 ft	2.36 ft
Top Width:	6.79 ft	11.79 ft
Velocity:	5.18 fps	
X-Section Area:	4.61 sq ft	
Hydraulic Radius:	0.631 ft	
Froude Number:	1.11	
Manning's n:	0.0360	
Dmin:	2.00 in	
D50:	3.00 in	
Dmax:	4.50 in	

Ditch 2

Material: Alluvial silts colloidal

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
0.00	1.5:1	20.0:1	4.7	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	9.46 cfs	
Depth:	0.43 ft	0.73 ft
Top Width:	9.35 ft	15.80 ft
Velocity:	4.66 fps	
X-Section Area:	2.03 sq ft	
Hydraulic Radius:	0.216 ft	
Froude Number:	1.76	

Ditch 3

Material: Alluvial silts colloidal

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
0.00	1.5:1	1.5:1	4.7	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	0.25 cfs	
Depth:	0.24 ft	0.54 ft
Top Width:	0.73 ft	1.63 ft
Velocity:	2.81 fps	
X-Section Area:	0.09 sq ft	
Hydraulic Radius:	0.102 ft	
Froude Number:	1.42	

Ditch 4

Material: Alluvial silts colloidal

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
0.00	1.5:1	1.5:1	4.7	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	0.82 cfs	
Depth:	0.38 ft	0.68 ft
Top Width:	1.14 ft	2.04 ft
Velocity:	3.78 fps	
X-Section Area:	0.22 sq ft	
Hydraulic Radius:	0.158 ft	
Froude Number:	1.53	

Ditch 5

Material: Riprap

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
2.5:1	2.5:1	1.7	0.30		

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	19.93 cfs	
Depth:	0.60 ft	0.90 ft
Top Width:	3.02 ft	4.52 ft
Velocity*:		
X-Section Area:	0.91 sq ft	
Hydraulic Radius:	0.280 ft	
Froude Number*:		
Manning's n*:		
Dmin:	6.00 in	
D50:	18.00 in	
Dmax:	22.50 in	

Velocity and Manning's n calculations may not apply for this method.

Ditch 6

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
3.00	2.5:1	2.5:1	42.4	1.00		

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	0.65 cfs	
Depth:	0.03 ft	1.03 ft
Top Width:	3.15 ft	8.15 ft
Velocity*:		
X-Section Area:	0.09 sq ft	
Hydraulic Radius:	0.030 ft	
Froude Number*:		
Manning's n*:		
Dmin:	3.00 in	
D50:	9.00 in	
Dmax:	11.25 in	

Velocity and Manning's n calculations may not apply for this method.

Ditch 7

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
3.00	2.5:1	2.5:1	42.9	1.00		

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	8.99 cfs	
Depth:	0.10 ft	1.10 ft
Top Width:	3.48 ft	8.48 ft
Velocity*:		
X-Section Area:	0.31 sq ft	
Hydraulic Radius:	0.089 ft	
Froude Number*:		
Manning's n*:		
Dmin:	6.00 in	
D50:	18.00 in	
Dmax:	22.50 in	

Velocity and Manning's n calculations may not apply for this method.

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Ditch 8

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.5:1	20.0:1	1.5	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	0.27 cfs	
Depth:	0.14 ft	0.44 ft
Top Width:	3.11 ft	9.86 ft
Velocity:	1.23 fps	
X-Section Area:	0.22 sq ft	
Hydraulic Radius:	0.069 ft	
Froude Number:	0.82	

Ditch 9

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.5:1	20.0:1	1.9	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	0.38 cfs	
Depth:	0.15 ft	0.45 ft
Top Width:	3.42 ft	10.17 ft
Velocity:	1.47 fps	
X-Section Area:	0.26 sq ft	
Hydraulic Radius:	0.076 ft	
Froude Number:	0.94	

Ditch 10

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.5:1	20.0:1	2.5	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	0.27 cfs	
Depth:	0.13 ft	0.43 ft
Top Width:	2.84 ft	9.59 ft
Velocity:	1.49 fps	
X-Section Area:	0.18 sq ft	
Hydraulic Radius:	0.063 ft	
Froude Number:	1.05	

Ditch 11

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.5:1	20.0:1	2.2	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	1.26 cfs	
Depth:	0.23 ft	0.53 ft
Top Width:	5.20 ft	11.95 ft
Velocity:	2.09 fps	
X-Section Area:	0.60 sq ft	
Hydraulic Radius:	0.115 ft	
Froude Number:	1.08	

Ditch 12

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
3.00	2.5:1	2.5:1	40.0	1.00		

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	19.09 cfs	
Depth:	0.16 ft	1.16 ft
Top Width:	3.79 ft	8.79 ft
Velocity*:		
X-Section Area:	0.53 sq ft	
Hydraulic Radius:	0.139 ft	
Froude Number*:		
Manning's n*:		
Dmin:	8.00 in	
D50:	24.00 in	
Dmax:	30.00 in	

Velocity and Manning's n calculations may not apply for this method.

Ditch 13

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
3.00	2.5:1	2.5:1	40.0	1.00		

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	17.56 cfs	
Depth:	0.15 ft	1.15 ft
Top Width:	3.75 ft	8.75 ft
Velocity*:		
X-Section Area:	0.50 sq ft	
Hydraulic Radius:	0.132 ft	
Froude Number*:		
Manning's n*:		
Dmin:	8.00 in	
D50:	24.00 in	
Dmax:	30.00 in	

Velocity and Manning's n calculations may not apply for this method.

Ditch 14

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.5:1	20.0:1	2.3	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	2.72 cfs	
Depth:	0.31 ft	0.61 ft
Top Width:	6.89 ft	13.64 ft
Velocity:	2.58 fps	
X-Section Area:	1.05 sq ft	
Hydraulic Radius:	0.152 ft	
Froude Number:	1.16	

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Ditch 15

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.5:1	20.0:1	5.1	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	0.50 cfs	
Depth:	0.14 ft	0.44 ft
Top Width:	3.12 ft	9.87 ft
Velocity:	2.26 fps	
X-Section Area:	0.22 sq ft	
Hydraulic Radius:	0.069 ft	
Froude Number:	1.52	

Ditch 16

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.5:1	20.0:1	2.0	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	0.46 cfs	
Depth:	0.16 ft	0.46 ft
Top Width:	3.63 ft	10.38 ft
Velocity:	1.57 fps	
X-Section Area:	0.29 sq ft	
Hydraulic Radius:	0.080 ft	
Froude Number:	0.97	

Ditch 17

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.5:1	20.0:1	2.2	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	17.10 cfs	
Depth:	0.62 ft	0.92 ft
Top Width:	13.84 ft	20.59 ft
Velocity:	4.02 fps	
X-Section Area:	4.26 sq ft	
Hydraulic Radius:	0.306 ft	
Froude Number:	1.28	

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Ditch 18

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.5:1	20.0:1	1.8	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	0.26 cfs	
Depth:	0.13 ft	0.43 ft
Top Width:	2.99 ft	9.74 ft
Velocity:	1.31 fps	
X-Section Area:	0.20 sq ft	
Hydraulic Radius:	0.066 ft	
Froude Number:	0.89	

Ditch 19

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.5:1	20.0:1	2.2	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	0.70 cfs	
Depth:	0.19 ft	0.49 ft
Top Width:	4.17 ft	10.92 ft
Velocity:	1.80 fps	
X-Section Area:	0.39 sq ft	
Hydraulic Radius:	0.092 ft	
Froude Number:	1.05	

Ditch 20

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
1.5:1	1.5:1	7.3	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	0.96 cfs	
Depth:	0.37 ft	0.67 ft
Top Width:	1.11 ft	2.01 ft
Velocity:	4.62 fps	
X-Section Area:	0.20 sq ft	
Hydraulic Radius:	0.154 ft	
Froude Number:	1.89	

Ditch 21

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
3.00	2.5:1	2.5:1	40.0	1.00		

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	5.77 cfs	
Depth:	0.07 ft	1.07 ft
Top Width:	3.37 ft	8.37 ft
Velocity*:		
X-Section Area:	0.23 sq ft	
Hydraulic Radius:	0.069 ft	
Froude Number*:		
Manning's n*:		
Dmin:	5.00 in	
D50:	15.00 in	
Dmax:	18.75 in	

Velocity and Manning's n calculations may not apply for this method.

Ditch 22

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
3.00	2.5:1	2.5:1	40.0	1.00		

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	15.70 cfs	
Depth:	0.14 ft	1.14 ft
Top Width:	3.70 ft	8.70 ft
Velocity*:		
X-Section Area:	0.47 sq ft	
Hydraulic Radius:	0.124 ft	
Froude Number*:		
Manning's n*:		
Dmin:	7.00 in	
D50:	21.00 in	
Dmax:	26.25 in	

Velocity and Manning's n calculations may not apply for this method.

Ditch 23

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.5:1	20.0:1	2.6	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	1.99 cfs	
Depth:	0.27 ft	0.57 ft
Top Width:	5.99 ft	12.74 ft
Velocity:	2.50 fps	
X-Section Area:	0.80 sq ft	
Hydraulic Radius:	0.133 ft	
Froude Number:	1.21	

Ditch 24

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.5:1	20.0:1	2.5	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	0.87 cfs	
Depth:	0.20 ft	0.50 ft
Top Width:	4.42 ft	11.17 ft
Velocity:	2.00 fps	
X-Section Area:	0.43 sq ft	
Hydraulic Radius:	0.098 ft	
Froude Number:	1.13	

Ditch 25

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.5:1	20.0:1	2.5	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	0.75 cfs	
Depth:	0.19 ft	0.49 ft
Top Width:	4.17 ft	10.92 ft
Velocity:	1.93 fps	
X-Section Area:	0.39 sq ft	
Hydraulic Radius:	0.092 ft	
Froude Number:	1.11	

Ditch 26

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.5:1	20.0:1	1.8	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	14.95 cfs	
Depth:	0.61 ft	0.91 ft
Top Width:	13.66 ft	20.41 ft
Velocity:	3.60 fps	
X-Section Area:	4.15 sq ft	
Hydraulic Radius:	0.302 ft	
Froude Number:	1.15	

Ditch 27

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.5:1	20.0:1	2.2	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	1.01 cfs	
Depth:	0.21 ft	0.51 ft
Top Width:	4.78 ft	11.53 ft
Velocity:	1.98 fps	
X-Section Area:	0.51 sq ft	
Hydraulic Radius:	0.106 ft	
Froude Number:	1.07	

Ditch 28

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
3.00	2.5:1	2.5:1	25.0	1.00		

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	1.01 cfs	
Depth:	0.03 ft	1.03 ft
Top Width:	3.17 ft	8.17 ft
Velocity*:		
X-Section Area:	0.10 sq ft	
Hydraulic Radius:	0.033 ft	
Froude Number*:		
Manning's n*:		
Dmin:	3.00 in	
D50:	9.00 in	
Dmax:	11.25 in	

Velocity and Manning's n calculations may not apply for this method.

Ditch 29

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
3.00	2.5:1	2.5:1	39.5	1.00		

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	2.91 cfs	
Depth:	0.05 ft	1.05 ft
Top Width:	3.25 ft	8.25 ft
Velocity*:		
X-Section Area:	0.16 sq ft	
Hydraulic Radius:	0.048 ft	
Froude Number*:		
Manning's n*:		
Dmin:	4.00 in	
D50:	12.00 in	
Dmax:	15.00 in	

Velocity and Manning's n calculations may not apply for this method.

Ditch 30

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
3.00	2.5:1	2.5:1	40.0	1.00		

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	14.17 cfs	
Depth:	0.13 ft	1.13 ft
Top Width:	3.65 ft	8.65 ft
Velocity*:		
X-Section Area:	0.43 sq ft	
Hydraulic Radius:	0.117 ft	
Froude Number*:		
Manning's n*:		
Dmin:	7.00 in	
D50:	21.00 in	
Dmax:	26.25 in	

Velocity and Manning's n calculations may not apply for this method.

Ditch 31

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.5:1	20.0:1	2.8	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	1.14 cfs	
Depth:	0.21 ft	0.51 ft
Top Width:	4.78 ft	11.53 ft
Velocity:	2.23 fps	
X-Section Area:	0.51 sq ft	
Hydraulic Radius:	0.106 ft	
Froude Number:	1.21	

Ditch 32

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.5:1	20.0:1	2.4	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	0.59 cfs	
Depth:	0.17 ft	0.47 ft
Top Width:	3.85 ft	10.60 ft
Velocity:	1.79 fps	
X-Section Area:	0.33 sq ft	
Hydraulic Radius:	0.085 ft	
Froude Number:	1.08	

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Ditch 33

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.5:1	20.0:1	2.5	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	11.21 cfs	
Depth:	0.51 ft	0.81 ft
Top Width:	11.53 ft	18.28 ft
Velocity:	3.79 fps	
X-Section Area:	2.96 sq ft	
Hydraulic Radius:	0.255 ft	
Froude Number:	1.32	

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Ditch 34

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.5:1	20.0:1	2.4	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	2.96 cfs	
Depth:	0.31 ft	0.61 ft
Top Width:	7.05 ft	13.80 ft
Velocity:	2.68 fps	
X-Section Area:	1.10 sq ft	
Hydraulic Radius:	0.156 ft	
Froude Number:	1.19	

Ditch 35

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.5:1	20.0:1	2.7	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	1.39 cfs	
Depth:	0.23 ft	0.53 ft
Top Width:	5.20 ft	11.95 ft
Velocity:	2.32 fps	
X-Section Area:	0.60 sq ft	
Hydraulic Radius:	0.115 ft	
Froude Number:	1.20	

Ditch 36

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.5:1	20.0:1	2.7	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	0.66 cfs	
Depth:	0.17 ft	0.47 ft
Top Width:	3.93 ft	10.68 ft
Velocity:	1.92 fps	
X-Section Area:	0.34 sq ft	
Hydraulic Radius:	0.087 ft	
Froude Number:	1.15	

Ditch 37

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
3.00	2.5:1	2.5:1	35.1	1.00		

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	2.05 cfs	
Depth:	0.04 ft	1.04 ft
Top Width:	3.21 ft	8.21 ft
Velocity*:		
X-Section Area:	0.13 sq ft	
Hydraulic Radius:	0.041 ft	
Froude Number*:		
Manning's n*:		
Dmin:	4.00 in	
D50:	12.00 in	
Dmax:	15.00 in	

Velocity and Manning's n calculations may not apply for this method.

Ditch 38

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
3.00	2.5:1	2.5:1	31.0	1.00		

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	1.18 cfs	
Depth:	0.04 ft	1.04 ft
Top Width:	3.18 ft	8.18 ft
Velocity*:		
X-Section Area:	0.11 sq ft	
Hydraulic Radius:	0.034 ft	
Froude Number*:		
Manning's n*:		
Dmin:	3.00 in	
D50:	9.00 in	
Dmax:	11.25 in	

Velocity and Manning's n calculations may not apply for this method.

Ditch 39

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
3.00	2.5:1	2.5:1	38.6	1.00		

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	9.97 cfs	
Depth:	0.10 ft	1.10 ft
Top Width:	3.52 ft	8.52 ft
Velocity*:		
X-Section Area:	0.34 sq ft	
Hydraulic Radius:	0.095 ft	
Froude Number*:		
Manning's n*:		
Dmin:	6.00 in	
D50:	18.00 in	
Dmax:	22.50 in	

Velocity and Manning's n calculations may not apply for this method.

Ditch 40

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.5:1	20.0:1	2.7	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	0.79 cfs	
Depth:	0.19 ft	0.49 ft
Top Width:	4.20 ft	10.95 ft
Velocity:	2.01 fps	
X-Section Area:	0.39 sq ft	
Hydraulic Radius:	0.093 ft	
Froude Number:	1.16	

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Ditch 41

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.5:1	20.0:1	2.6	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	0.39 cfs	
Depth:	0.14 ft	0.44 ft
Top Width:	3.25 ft	10.00 ft
Velocity:	1.66 fps	
X-Section Area:	0.23 sq ft	
Hydraulic Radius:	0.072 ft	
Froude Number:	1.09	

Ditch 42

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.5:1	20.0:1	2.5	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	6.54 cfs	
Depth:	0.42 ft	0.72 ft
Top Width:	9.42 ft	16.17 ft
Velocity:	3.31 fps	
X-Section Area:	1.97 sq ft	
Hydraulic Radius:	0.209 ft	
Froude Number:	1.28	

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Ditch 43

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.5:1	20.0:1	2.4	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	3.43 cfs	
Depth:	0.33 ft	0.63 ft
Top Width:	7.45 ft	14.20 ft
Velocity:	2.78 fps	
X-Section Area:	1.23 sq ft	
Hydraulic Radius:	0.165 ft	
Froude Number:	1.20	

Ditch 44

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
3.00	2.5:1	2.5:1	39.6	1.00		

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	2.02 cfs	
Depth:	0.04 ft	1.04 ft
Top Width:	3.21 ft	8.21 ft
Velocity*:		
X-Section Area:	0.13 sq ft	
Hydraulic Radius:	0.041 ft	
Froude Number*:		
Manning's n*:		
Dmin:	4.00 in	
D50:	12.00 in	
Dmax:	15.00 in	

Velocity and Manning's n calculations may not apply for this method.

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Ditch 45

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.5:1	20.0:1	2.3	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	1.61 cfs	
Depth:	0.25 ft	0.55 ft
Top Width:	5.66 ft	12.41 ft
Velocity:	2.26 fps	
X-Section Area:	0.71 sq ft	
Hydraulic Radius:	0.125 ft	
Froude Number:	1.12	

Ditch 46

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.5:1	20.0:1	2.1	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	0.41 cfs	
Depth:	0.15 ft	0.45 ft
Top Width:	3.46 ft	10.21 ft
Velocity:	1.56 fps	
X-Section Area:	0.27 sq ft	
Hydraulic Radius:	0.077 ft	
Froude Number:	0.99	

Ditch 47

Material: Alluvial silts colloidal

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.00	2.5:1	20.0:1	22.4	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	0.45 cfs	
Depth:	0.04 ft	0.34 ft
Top Width:	3.97 ft	10.72 ft
Velocity:	3.17 fps	
X-Section Area:	0.15 sq ft	
Hydraulic Radius:	0.038 ft	
Froude Number:	2.88	

Ditch 48

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.5:1	20.0:1	2.4	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	0.45 cfs	
Depth:	0.15 ft	0.45 ft
Top Width:	3.48 ft	10.23 ft
Velocity:	1.67 fps	
X-Section Area:	0.27 sq ft	
Hydraulic Radius:	0.077 ft	
Froude Number:	1.06	

Ditch 49

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
3.00	2.5:1	2.5:1	30.0	1.00		

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	5.52 cfs	
Depth:	0.07 ft	1.07 ft
Top Width:	3.36 ft	8.36 ft
Velocity*:		
X-Section Area:	0.23 sq ft	
Hydraulic Radius:	0.067 ft	
Froude Number*:		
Manning's n*:		
Dmin:	5.00 in	
D50:	15.00 in	
Dmax:	18.75 in	

Velocity and Manning's n calculations may not apply for this method.

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Ditch 50

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
1.5:1	1.5:1	2.0	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	1.44 cfs	
Depth:	0.55 ft	0.85 ft
Top Width:	1.65 ft	2.55 ft
Velocity:	3.16 fps	
X-Section Area:	0.46 sq ft	
Hydraulic Radius:	0.229 ft	
Froude Number:	1.06	

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Ditch 51

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
1.5:1	1.5:1	1.5	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	14.19 cfs	
Depth:	1.37 ft	1.67 ft
Top Width:	4.12 ft	5.02 ft
Velocity:	5.02 fps	
X-Section Area:	2.82 sq ft	
Hydraulic Radius:	0.571 ft	
Froude Number:	1.07	

Ditch 52

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
1.5:1	1.5:1	3.0	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	1.01 cfs	
Depth:	0.45 ft	0.75 ft
Top Width:	1.34 ft	2.24 ft
Velocity:	3.36 fps	
X-Section Area:	0.30 sq ft	
Hydraulic Radius:	0.186 ft	
Froude Number:	1.25	

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Ditch 53

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
1.5:1	1.5:1	10.0	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	1.01 cfs	
Depth:	0.36 ft	0.66 ft
Top Width:	1.07 ft	1.97 ft
Velocity:	5.27 fps	
X-Section Area:	0.19 sq ft	
Hydraulic Radius:	0.148 ft	
Froude Number:	2.20	

Ditch 54

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
1.5:1	1.5:1	3.5	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	3.84 cfs	
Depth:	0.72 ft	1.02 ft
Top Width:	2.15 ft	3.05 ft
Velocity:	4.98 fps	
X-Section Area:	0.77 sq ft	
Hydraulic Radius:	0.298 ft	
Froude Number:	1.47	

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Ditch 55

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
1.5:1	1.5:1	2.7	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	4.41 cfs	
Depth:	0.79 ft	1.09 ft
Top Width:	2.38 ft	3.28 ft
Velocity:	4.68 fps	
X-Section Area:	0.94 sq ft	
Hydraulic Radius:	0.330 ft	
Froude Number:	1.31	

Ditch 56

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
3.00	2.5:1	2.5:1	40.0	1.00		

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	8.31 cfs	
Depth:	0.09 ft	1.09 ft
Top Width:	3.46 ft	8.46 ft
Velocity*:		
X-Section Area:	0.30 sq ft	
Hydraulic Radius:	0.085 ft	
Froude Number*:		
Manning's n*:		
Dmin:	6.00 in	
D50:	18.00 in	
Dmax:	22.50 in	

Velocity and Manning's n calculations may not apply for this method.

Ditch 57

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
3.00	2.5:1	2.5:1	40.4	1.00		

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	4.41 cfs	
Depth:	0.06 ft	1.06 ft
Top Width:	3.31 ft	8.31 ft
Velocity*:		
X-Section Area:	0.20 sq ft	
Hydraulic Radius:	0.059 ft	
Froude Number*:		
Manning's n*:		
Dmin:	5.00 in	
D50:	15.00 in	
Dmax:	18.75 in	

Velocity and Manning's n calculations may not apply for this method.

Ditch 58

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.5:1	20.0:1	2.5	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	4.20 cfs	
Depth:	0.35 ft	0.65 ft
Top Width:	7.98 ft	14.73 ft
Velocity:	2.97 fps	
X-Section Area:	1.42 sq ft	
Hydraulic Radius:	0.177 ft	
Froude Number:	1.24	

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Ditch 59

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.5:1	20.0:1	3.1	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	4.11 cfs	
Depth:	0.34 ft	0.64 ft
Top Width:	7.60 ft	14.35 ft
Velocity:	3.20 fps	
X-Section Area:	1.28 sq ft	
Hydraulic Radius:	0.168 ft	
Froude Number:	1.37	

Ditch 60

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.5:1	20.0:1	2.4	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	1.12 cfs	
Depth:	0.22 ft	0.52 ft
Top Width:	4.90 ft	11.65 ft
Velocity:	2.10 fps	
X-Section Area:	0.53 sq ft	
Hydraulic Radius:	0.109 ft	
Froude Number:	1.12	

Ditch 61

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
3.00	2.5:1	2.5:1	39.4	1.00		

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	3.29 cfs	
Depth:	0.05 ft	1.05 ft
Top Width:	3.27 ft	8.27 ft
Velocity*:		
X-Section Area:	0.17 sq ft	
Hydraulic Radius:	0.051 ft	
Froude Number*:		
Manning's n*:		
Dmin:	4.00 in	
D50:	12.00 in	
Dmax:	15.00 in	

Velocity and Manning's n calculations may not apply for this method.

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Ditch 62

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.5:1	20.0:1	2.5	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	3.29 cfs	
Depth:	0.32 ft	0.62 ft
Top Width:	7.28 ft	14.03 ft
Velocity:	2.79 fps	
X-Section Area:	1.18 sq ft	
Hydraulic Radius:	0.161 ft	
Froude Number:	1.22	

Ditch 63

Material: Riprap

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
2.5:1	2.5:1	2.5	1.00		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	8.22 cfs	
Depth:	0.88 ft	1.88 ft
Top Width:	4.42 ft	9.42 ft
Velocity:	4.20 fps	
X-Section Area:	1.96 sq ft	
Hydraulic Radius:	0.411 ft	
Froude Number:	1.11	
Manning's n:	0.0310	
Dmin:	1.00 in	
D50:	1.50 in	
Dmax:	3.00 in	

Ditch 64

Material: Alluvial silts colloidal

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
1.5:1	1.5:1	1.5	0.0250	0.30			5.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	9.44 cfs	
Depth:	1.18 ft	1.48 ft
Top Width:	3.53 ft	4.43 ft
Velocity:	4.54 fps	
X-Section Area:	2.08 sq ft	
Hydraulic Radius:	0.490 ft	
Froude Number:	1.04	

APPENDIX 2

WATER QUALITY DATA

BROAD CANYON LANDFILL

HONEYWOOD COAL COMPANY

WATER MONITORING DATA

LOCATION: SP-1

SP-1 Long Draw Spring
Quarterly Field - Semi Full Suite
TR-06 - 4th 95 - Survey April or May - Full Suite if > 5 gpm - Field if > 5 gpm in the fall.

QUARTER:		1st 88	2nd 88	3rd 88	4th 88	1st 91	2nd 91	3rd 91	4th 91	1st 92	2nd 92	3rd 92	4th 92	1st 93	2nd 93	3rd 93	4th 93	1st 94	2nd 94	3rd 94	4th 94
DATE:	Units	3/3/88	6/2/88	10/3/88	1/5/89	3/13/91	5/9/91	8/28/91	12/28/91	3/21/92	6/30/92	9/30/92	12/22/92	3/25/93	6/27/93	9/29/93	12/22/93	3/28/94	4/24/94	7/08/94	11/20/94
Flow (gpm)	gpm	1.5	0.3	0	0	1	0.5	0	0	Damp	Damp	Damp	Frozen	Dry	Dry	Damp	Dry	Dry		Dry	Dry
pH	pH units	8.2	6.5			7.8	8.4														
Conductivity @ 25 C	umhos/cm	1100	1650			2750	1850														
Tot Diss Solids	mg/l	816	1510			2000															
Bicarbonate (HCO3)	mg/l	333	304			449															
Carbonate (CO3)	mg/l	31	0			0															
Calcium (Ca)	mg/l	106	154			129															
Chloride (Cl)	mg/l	7	28			76															
Magnesium (Mg)	mg/l	57	121			193															
Ammonia (N)	mg/l	1.38	0.00			2.07															
Nitrate (N)	mg/l	3.910	4.240			3.100															
Nitrite (N)	mg/l	0.00	0.00			0.79															
Phosphate (P)	mg/l	0.06	0.07			0.08															
Sodium (Na)	mg/l	66.5	106.0			197.0															
Sulfate (SO4)	mg/l	250	875			999															
Arsenic (As)	mg/l	0.000	0.000			0.004															
Cadmium (Cd)	mg/l	0.0000	0.0000			0.0000															
Iron (Fe)	mg/l	0.00	0.34			0.00															
Manganese (Mn)	mg/l	0.005	0.042			0.169															
Mercury (Hg)	mg/l	0.0000	0.0000			0.0000															
Selenium (Se)	mg/l	0.003	0.000			0.009															
Zinc (Zn)	mg/l	0.183	0.084			0.041															

HONEYWOOD COAL COMPANY

WATER MONITORING DATA

LOCATION: SP-1

SP-1 Long Draw Spring
Quarterly Field - Semi Full Suite
TR-06 - 4th 95 - Survey April or May - Fu

QUARTER:		1st 95	2nd 95	3rd 95	4th 95	2nd 96	4th 96	2nd 97	4th 97	2nd 98	3rd 98	1st 12	3rd 12			
DATE:	Units	3/17/95	7/01/95	10/1/95	12/28/95	5/20/1996	12/16/1996	5/6/1997	1/15/1998	4/18/1998	7/30/1998	4/6/12	9/13/12	MIN	MAX	AVG
Flow (gpm)	gpm	Dry	Damp	Dry	Dry	Dry	Damp	Dry	Pool Stagnent	Dry	Dry	Damp	Dry	0.0	1.5	0.4
pH	pH units													6.5	8.4	7.7
Conductivity @ 25 C	umhos/cm													1100	2750	1838
Tot Diss Solids	mg/l													816	2000	1442
Bicarbonate (HCO3)	mg/l													304	449	362
Carbonate (CO3)	mg/l													0	31	10
Calcium (Ca)	mg/l													106	154	130
Chloride (Cl)	mg/l													7	76	37
Magnesium (Mg)	mg/l													57	193	124
Ammonia (N)	mg/l													0.00	2.07	1.15
Nitrate (N)	mg/l													3.100	4.240	3.750
Nitrite (N)	mg/l													0.00	0.79	0.26
Phosphate (P)	mg/l													0.06	0.08	0.07
Sodium (Na)	mg/l													66.5	197.0	123.2
Sulfate (SO4)	mg/l													250	999	708
Arsenic (As)	mg/l													0.000	0.004	0.001
Cadmium (Cd)	mg/l													0.0000	0.0000	0.0000
Iron (Fe)	mg/l													0.00	0.34	0.11
Manganese (Mn)	mg/l													0.005	0.169	0.072
Mercury (Hg)	mg/l													0.0000	0.0000	0.0000
Selenium (Se)	mg/l													0.000	0.009	0.004
Zinc (Zn)	mg/l													0.041	0.183	0.103

HONEYWOOD COAL COMPANY

WATER MONITORING DATA

LOCATION: SP-2

Section 33 Spring
Quarterly Field - Semi Full Suite
TR-06 - 4th 95 - Survey April or May - Full Suite if >5 gpm - Field if > 5 gpm in fall

QUARTER:		1st 88	2nd 88	3rd 88	4th 88	1st 91	2nd 91	3rd 91	4th 91	1st 92	2nd 92	3rd 92	4th 92	1st 93	2nd 93	3rd 93	4th 93	1st 94	2nd 94	3rd 94	4th 94
DATE:	Units	3/3/88	6/2/88	10/3/88	1/5/89	3/13/91	5/09/91	7/12/91	12/28/91	3/21/92	6/30/92	9/30/92	12/22/92	3/25/93	6/27/93	9/29/93	12/22/93	3/28/94	4/24/94	7/8/94	11/20/94
Flow (gpm)	gpm	0.5	0.0	0	0	1	Pool	Dry	Dry	Damp	Damp	Dry	Dry	Damp	Dry	Damp	Dry	Stagnent Pool		Dry	Dry
pH	pH units	8.3				7.2	8.3														
Conductivity @ 25 C	umhos/cm	1660				2450	3150														
Tot Diss Solids	mg/l	1410																			
Bicarbonate (HCO3)	mg/l	390																			
Carbonate (CO3)	mg/l	19																			
Calcium (Ca)	mg/l	110																			
Chloride (Cl)	mg/l	42																			
Magnesium (Mg)	mg/l	170																			
Ammonia (N)	mg/l	0.94																			
Nitrate (N)	mg/l	0.100																			
Nitrite (N)	mg/l	0.00																			
Phosphate (P)	mg/l	0.00																			
Sodium (Na)	mg/l	84.5																			
Sulfate (SO4)	mg/l	625																			
Arsenic (As)	mg/l	0.008																			
Cadmium (Cd)	mg/l	0.0000																			
Iron (Fe)	mg/l	0.00																			
Manganese (Mn)	mg/l	0.003																			
Mercury (Hg)	mg/l	0.0000																			
Selenium (Se)	mg/l	0.003																			
Zinc (Zn)	mg/l	0.004																			

HONEYWOOD COAL COMP

WATER MONITORING DAT

LOCATION: SP-2

Section 33 Spring
Quarterly Field - Semi Full Suite
TR-06 - 4th 95 - Survey April or

QUARTER:		1st 95	2nd 95	3rd 95	4th 95	2nd 96	4th 96	2nd 97	4th 97	2nd 98	3rd 98	1st 2012	3rd 2012			
DATE:	Units	3/17/95	7/1/95	10/1/95	12/28/94	#######	########	5/6/1997	1/15/1998	4/18/1998	7/30/1998	4/6/2012	9/13/2012	MIN	MAX	AVG
Flow (gpm)	gpm	Dry	Damp	Dry	Dry	Dry	Full of Silt	Full of Silt	Full of Silt	Dry	Dry	Dry	Dry	0.0	0.8	0.3
pH	pH units													7.2	8.3	7.9
Conductivity @ 25 C	umhos/cm													1660	3150	2420
Tot Diss Solids	mg/l													1410	1410	1410
Bicarbonate (HCO3)	mg/l													390	390	390
Carbonate (CO3)	mg/l													19	19	19
Calcium (Ca)	mg/l													110	110	110
Chloride (Cl)	mg/l													42	42	42
Magnesium (Mg)	mg/l													170	170	170
Ammonia (N)	mg/l													0.94	0.94	0.94
Nitrate (N)	mg/l													0.100	0.100	0.100
Nitrite (N)	mg/l													0.00	0.00	0.00
Phosphate (P)	mg/l													0.00	0.00	0.00
Sodium (Na)	mg/l													84.5	84.5	84.5
Sulfate (SO4)	mg/l													625	625	625
Arsenic (As)	mg/l													0.008	0.008	0.008
Cadmium (Cd)	mg/l													0.0000	0.0000	0.0000
Iron (Fe)	mg/l													0.00	0.00	0.00
Manganese (Mn)	mg/l													0.003	0.003	0.003
Mercury (Hg)	mg/l													0.0000	0.0000	0.0000
Selenium (Se)	mg/l													0.003	0.003	0.003
Zinc (Zn)	mg/l													0.004	0.004	0.004

HONEYWOOD COAL COMPANY

WATER MONITORING DATA

SPRINGS

LOCATION:	SP-3 Homestead Spring			
YEAR: 1989	1st QTR	2nd QTR	3rd QTR	4th QTR
Date:	4/28/89			12/16/89
Flow (gpm)	Seep	Dry	Dry	Dry
pH	8.3			
Conductivity @ 25 C	1200			
Temperature C	14			

LOCATION:	SP-4 Bramier Draw Spring			
YEAR: 1989	1st QTR	2nd QTR	3rd QTR	4th QTR
Date:	4/28/89			12/16/89
Flow (gpm)	Seep	Dry	Dry	Seep
pH	6.8			7.2
Conductivity @ 25 C	1680			1480
Temperature C	18			3

LOCATION:	SP-5 East Homestead Spring			
YEAR: 1989	1st QTR	2nd QTR	3rd QTR	4th QTR
Date:	4/28/89			12/16/89
Flow (gpm)	Seep	Dry	Dry	Dry
pH	8.1			
Conductivity @ 25 C	1220			
Temperature C	15			

LOCATION:	SP-3 Homestead Spring			
YEAR: 1989	1st QTR	2nd QTR	3rd QTR	4th QTR
DATE:	4/28/89			12/16/89
Flow (gpm)	Seep	Dry	Dry	Dry
pH	8.3			
Conductivity @ 25 C	1200			
Temperature C	14			

LOCATION:	SP-4 Bramier Draw Spring			
YEAR: 1990	1st QTR	2nd QTR	3rd QTR	4th QTR
Flow (gpm)	Dry	Dry	Dry	Dry
pH				
Conductivity @ 25 C				
Temperature C				

LOCATION:	SP-5 East Homestead Spring			
YEAR: 1990	1st QTR	2nd QTR	3rd QTR	4th QTR
Flow (gpm)	Dry	Dry	Dry	Dry
pH				
Conductivity @ 25 C				
Temperature C				

UNITS

Flow = gallons per minute

pH = pH units

Conductivity = umhos/cm

Temperature = degrees Celsius

HONEYWOOD COAL COMPANY

WATER MONITORING DATA

SPRINGS

LOCATION:	SP-3 Homestead Spring			
YEAR: 1991	1st QTR	2nd QTR	3rd QTR	4th QTR
Date:	3/13/91	5/09/91	8/28/91	12/28/91
Flow (gpm)	Dry	Dry	Dry	Dry
pH				
Conductivity @ 25 C				
Temperature C				

LOCATION:	SP-4 Bramier Draw Spring			
YEAR: 1991	1st QTR	2nd QTR	3rd QTR	4th QTR
Date:	3/13/91	5/09/91	8/28/91	12/28/91
Flow (gpm)	Dry	Dry	Dry	Dry
pH				
Conductivity @ 25 C				
Temperature C				

LOCATION:	SP-5 East Homestead Spring			
YEAR: 1991	1st QTR	2nd QTR	3rd QTR	4th QTR
Date:	3/13/91	5/09/91	8/28/91	12/28/91
Flow (gpm)	Dry	Dry	Dry	Dry
pH				
Conductivity @ 25 C				
Temperature C				

LOCATION:	SP-3 Homestead Spring			
YEAR: 1992	1st QTR	2nd QTR	3rd QTR	4th QTR
Date:	3/21/92	6/30/92	9/30/92	12/22/92
Flow (gpm)	Dry	Damp	Dry	Dry
pH				
Conductivity @ 25 C				
Temperature C				

LOCATION:	SP-4 Bramier Draw Spring			
YEAR: 1992	1st QTR	2nd QTR	3rd QTR	4th QTR
Date:	3/21/92	6/30/92	9/30/92	12/22/92
Flow (gpm)	Dry	Dry	Dry	Dry
pH				
Conductivity @ 25 C				
Temperature C				

LOCATION:	SP-5 East Homestead Spring			
YEAR: 1992	1st QTR	2nd QTR	3rd QTR	4th QTR
Date:	3/21/92	6/30/92	9/30/92	12/22/92
Flow (gpm)	Dry	Dry	Dry	Dry
pH				
Conductivity @ 25 C				
Temperature C				

UNITS

Flow = gallons per minute

pH = pH units

Conductivity = umhos/cm

Temperature = degrees Celsius

HONEYWOOD COAL COMPANY

WATER MONITORING DATA

SPRINGS

LOCATION:	SP-3 Homestead Spring			
YEAR: 1993	1st QTR	2nd QTR	3rd QTR	4th QTR
Date:	3/25/93	6/27/93	9/29/93	12/22/93
Flow (gpm)	Dry	Dry	Dry	Dry
pH				
Conductivity @ 25 C				
Temperature C				

LOCATION:	SP-4 Bramier Draw Spring			
YEAR: 1993	1st QTR	2nd QTR	3rd QTR	4th QTR
Date:	3/25/93	6/27/93	9/29/93	12/22/93
Flow (gpm)	Dry	Dry	Dry	Dry
pH				
Conductivity @ 25 C				
Temperature C				

LOCATION:	SP-5 East Homestead Spring			
YEAR: 1993	1st QTR	2nd QTR	3rd QTR	4th QTR
Date:	3/25/93	6/27/93	9/29/93	12/22/93
Flow (gpm)	Dry	Dry	Dry	Dry
pH				
Conductivity @ 25 C				
Temperature C				

LOCATION:	SP-3 Homestead Spring			
YEAR: 1994	1st QTR	2nd QTR	3rd QTR	4th QTR
Date:	3/28/94	4/24/94	7/08/94	11/24/94
Flow (gpm)	Dry	Dry	Dry	Dry
pH				
Conductivity @ 25 C				
Temperature C				

LOCATION:	SP-4 Bramier Draw Spring			
YEAR: 1994	1st QTR	2nd QTR	3rd QTR	4th QTR
Date:	3/28/94	4/24/94	7/08/94	11/24/94
Flow (gpm)	Dry	Dry	Dry	Dry
pH				
Conductivity @ 25 C				
Temperature C				

LOCATION:	SP-5 East Homestead Spring			
YEAR: 1994	1st QTR	2nd QTR	3rd QTR	4th QTR
Date:	3/28/94	4/24/94	7/08/94	11/24/94
Flow (gpm)	Dry	Dry	Dry	Dry
pH				
Conductivity @ 25 C				
Temperature C				

UNITS

Flow = gallons per minute
pH = pH units
Conductivity = umhos/cm
Temperature = degrees Celsius

HONEYWOOD COAL COMPANY

WATER MONITORING DATA

SPRINGS

LOCATION:	SP-3 Homestead Spring			
YEAR: 1995	1st QTR - 95	2nd QTR - 95	3rd QTR - 95	4th QTR - 95
Date:	3/17/95	7/01/95	10/01/95	12/28/95
Flow (gpm)	Dry	Dry	Dry	Dry
pH				
Conductivity @ 25 C				
Temperature C				

LOCATION:	SP-4 Bramier Draw Spring			
YEAR: 1995	1st QTR - 95	2nd QTR - 95	3rd QTR - 95	4th QTR - 95
Date:	3/17/95	7/01/95	10/01/95	12/28/95
Flow (gpm)	Dry	Dry	Dry	Dry
pH				
Conductivity @ 25 C				
Temperature C				

LOCATION:	SP-5 East Homestead Spring			
YEAR: 1995	1st QTR - 95	2nd QTR - 95	3rd QTR - 95	4th QTR - 95
Date:	3/17/95	7/01/95	10/01/95	12/28/95
Flow (gpm)	Dry	Dry	Dry	Dry
pH				
Conductivity @ 25 C				
Temperature C				

LOCATION:	SP-3 Homestead Spring			
Quarter	2nd QTR - 96	4th QTR - 96	2nd QTR - 97	4th QTR - 97
Date:	5/20/1996	12/16/1996	5/6/1997	1/15/1998
Flow (gpm)	Dry	Dry	Dry	Dry
pH				
Conductivity @ 25 C				
Temperature C				

LOCATION:	SP-4 Bramier Draw Spring			
Quarter	2nd QTR - 96	4th QTR - 96	2nd QTR - 97	4th QTR - 97
Date:	5/20/1996	12/16/1996	5/6/1997	1/15/1998
Flow (gpm)	Dry	Dry	Dry	Dry
pH				
Conductivity @ 25 C				
Temperature C				

LOCATION:	SP-5 East Homestead Spring			
Quarter	2nd QTR - 96	4th QTR - 96	2nd QTR - 97	4th QTR - 97
Date:	5/20/1996	12/16/1996	5/6/1997	1/15/1998
Flow (gpm)	Dry	Dry	Dry	Dry
pH				
Conductivity @ 25 C				
Temperature C				

UNITS

Flow = gallons per minute
pH = pH units
Conductivity = umhos/cm
Temperature = degrees Celsius

HONEYWOOD COAL COMPANY

WATER MONITORING DATA

SPRINGS

LOCATION:	SP-3 Homestead Spring			
Quarter	2nd QTR - 98	3rd QTR - 98	1st QTR - 2012	1st QTR - 2012
Date:	4/18/1998	7/30/1998	4/6/2012	9/13/2012
Flow (gpm)	Dry	Dry	Damp Rocks	Dry
pH				
Conductivity @ 25 C				
Temperature C				

LOCATION:	SP-4 Bramier Draw Spring			
Quarter	2nd QTR - 98	3rd QTR - 98	1st QTR - 2012	1st QTR - 2012
Date:	4/18/1998	7/30/1998	4/6/2012	9/13/2012
Flow (gpm)	Dry	Dry	Trickle	Dry
pH			7.2	
Conductivity @ 25 C			3300	
Temperature C			6.1	

LOCATION:	SP-5 East Homestead Spring			
Quarter	2nd QTR - 98	3rd QTR - 98	1st QTR - 2012	1st QTR - 2012
Date:	4/18/1998	7/30/1998	4/6/2012	9/13/2012
Flow (gpm)	Dry	Dry	Dry	Dry
pH				
Conductivity @ 25 C				
Temperature C				

LOCATION:	SP-3 Homestead Spring			
Quarter				
Date:				
Flow (gpm)				
pH				
Conductivity @ 25 C				
Temperature C				

LOCATION:	SP-4 Bramier Draw Spring			
Quarter				
Date:				
Flow (gpm)				
pH				
Conductivity @ 25 C				
Temperature C				

LOCATION:	SP-5 East Homestead Spring			
Quarter				
Date:				
Flow (gpm)				
pH				
Conductivity @ 25 C				
Temperature C				

UNITS

Flow = gallons per minute
pH = pH units
Conductivity = umhos/cm
Temperature = degrees Celsius

HONEYWOOD COAL COMPANY

WATER MONITORING DATA

LOCATION: SP-6

B & W Spring No. 1
Quarterly Field - Semi Full Suite
TR-06 - 4th 95 - Survey April or May - Full Suite if > 5 gpm - Field if > 5 gpm in the fall.

QUARTER:		1st 91	2nd 91	3rd 91	4th 91	1st 92	2nd 92	3rd 92	4th 92	1st 93	2nd 93	3rd 93	4th 93	1st 94	2nd 94	3rd 94	4th 94	1st 95	2nd 95	3rd 95	4th 95	2nd 96
DATE:	Units	3/13/91	5/09/91	8/28/91	12/28/91	3/21/92	6/30/92	9/30/92	12/22/92	3/25/93	6/27/93	9/29/93	12/22/93	3/28/94	4/24/94	7/08/94	11/20/94	3/17/95	7/01/95	10/1/95	12/28/95	5/20/1996
Flow (gpm)	gpm	1.8	1.5	Pool	Dry	Pool	Damp	Damp	Frozen	Damp*	Dry	Damp*	Dry	Dry	Damp*	Dry	Dry	Dry	Damp*	Dry	Dry	Dry
pH	pH units	7.8	7.6	8.2	7.8	8.0																
Conductivity @ 25 C	umhos/cm	2900	4050	2375	1700	2500																
Temp	Celsius																					
Total Dissolved Solid	mg/l		2990			1940																
Bicarbonate (HCO3)	mg/l		520			339																
Carbonate (CO3)	mg/l		0			0																
Calcium (Ca)	mg/l		234			142																
Chloride (Cl)	mg/l		156			106																
Magnesium (Mg)	mg/l		249			156																
Ammonia (N)	mg/l		0.45			0.00																
Nitrate (N)	mg/l		0.878			0.666																
Nitrite (N)	mg/l		0.06			0.00																
Phosphate (P)	mg/l		0.03			0.02																
Sodium (Na)	mg/l		372.0			240.0																
Sulfate (SO4)	mg/l		1570			1040																
Arsenic (As)	mg/l		0.000			0.000																
Cadmium (Cd)	mg/l		0.0000			0.0001																
Iron (Fe)	mg/l		0.02			0.00																
Manganese (Mn)	mg/l		0.072			0.189																
Mercury (Hg)	mg/l		0.00000			0.00011																
Selenium (Se)	mg/l		0.000			0.000																
Zinc (Zn)	mg/l		0.005			0.067																

Damp* = Damp with stagnent pool

HONEYWOOD COAL COM

WATER MONITORING DA'

LOCATION: SP-6

B & W Spring No. 1
Quarterly Field - Semi Full Suite
TR-06 - 4th 95 - Survey April or

QUARTER:		4th 96	2nd 97	4th 97	2nd 98	3rd 98	1st 2012	3rd 2012			
DATE:	Units	12/16/1996	5/5/1997	1/15/1998	4/18/1998	7/30/1998	4/6/2012	9/13/2012	MIN	MAX	AVG
Flow (gpm)	gpm	Damp*	Dry	Damp	Damp	Dry	Pool	Dry	1.5	1.8	1.6
pH	pH units						7.1		7.6	8.2	7.9
Conductivity @ 25 C	umhos/cm						4300		1700	4050	2705
Temp	Celsius						11.0				
Total Dissolved Solid	mg/l								1940	2990	2465
Bicarbonate (HCO3)	mg/l								339	520	430
Carbonate (CO3)	mg/l								0	0	0
Calcium (Ca)	mg/l								142	234	188
Chloride (Cl)	mg/l								106	156	131
Magnesium (Mg)	mg/l								156	249	203
Ammonia (N)	mg/l								0.00	0.45	0.23
Nitrate (N)	mg/l								0.666	0.878	0.772
Nitrite (N)	mg/l								0.00	0.06	0.03
Phosphate (P)	mg/l								0.02	0.03	0.03
Sodium (Na)	mg/l								240.0	372.0	306.0
Sulfate (SO4)	mg/l								1040	1570	1305
Arsenic (As)	mg/l								0.000	0.000	0.000
Cadmium (Cd)	mg/l								0.0000	0.0001	0.0001
Iron (Fe)	mg/l								0.00	0.02	0.01
Manganese (Mn)	mg/l								0.072	0.189	0.131
Mercury (Hg)	mg/l								0.00000	0.00011	0.00006
Selenium (Se)	mg/l								0.000	0.000	0.000
Zinc (Zn)	mg/l								0.005	0.067	0.036

Damp* = 1

HONEYWOOD COAL COMPANY

WATER MONITORING DATA

LOCATION: BW-1

Bedrock Well - Section 3
Quarterly Field - Semi Full Suite
TR-06 - 4th 95 - Depth to water semi-annually.

QUARTER:		4th 90	1st 91	2nd 91	3rd 91	4th 91	1st 92	2nd 92	3rd 92	4th 92	1st 93	2nd 93	3rd 93	4th 93	1st 94	2nd 94	3rd 94	4th 94
DATE:	Units	12/6/90	3/13/91	5/09/91	8/28/91	12/30/91	3/21/92	6/30/92	9/30/92	12/22/92	3/25/93	6/27/93	9/29/93	12/22/93	3/28/94	4/24/94	7/08/94	11/20/94
Depth to Water	feet	120	119	119	119	119	119	119	119	No Sample	120	120	No Sample	120	No Sample	120	120	120
pH	pH units	7.2	6.9	6.8	7.1	8.0	7.1	7.1	7.0		7.1	7.6		6.8		6.8	7.6	7.0
Conductivity @ 25 C	umhos/cm	1600	1325	1600	1350	1900	1900	2200	1950		2000	2300		1960		1720	1690	1980
Temp																		
Total Dissolved Solids	mg/l	1290		1400		1440	1550	1530	1650		1460	1860		1560		1430	1520	1550
Bicarbonate (HCO3)	mg/l	300		622		334	571	523	618		512	595		543		278	543	556
Carbonate (CO3)	mg/l	0		0		0	0	0	0		0	0		0		0	0	0
Calcium (Ca)	mg/l	48		159		143	147	171	149		176	186		158		183	168	121
Chloride (Cl)	mg/l	24		31		24	20	18	11		14	14		8		10	9	18
Magnesium (Mg)	mg/l	41		63		67	69	63	77		76	87		81		70	72	55
Ammonia (N)	mg/l	0.00		0.56		0.00	0.00	0.54	1.40		0.17	0.25		1.32		0.30	0.32	0.25
Nitrate (N)	mg/l	0.751		0.243		0.444	0.250	0.235	0.216		0.840	0.312		0.440		0.109	0.250	0.110
Nitrite (N)	mg/l	0.01		0.00		0.00	0.00	0.03	0.00		0.00	0.00		0.00		0.00	0.00	0.00
Phosphate (P)	mg/l	0.01		0.03		0.00	0.01	0.00	0.00		0.01	0.00		0.02		0.00	0.00	0.00
Sodium (Na)	mg/l	263.0		186.0		200.0	193.0	173.0	180.0		193.0	215.0		125.0		118.0	170.0	200.0
Sulfate (SO4)	mg/l	503		538		697	660	557	605		706	743		616		755	543	585
Arsenic (As) Dis	mg/l	0.000		0.000		0.000	0.000	0.000	0.000		0.000	0.000		0.000		0.000	0.000	0.000
Cadmium (Cd) Dis	mg/l	0.0002		0.0000		0.0044	0.0000	0.0004	0.0000		0.0002	0.0003		0.0000		0.0000	0.0002	0.0004
Iron (Fe) Dis	mg/l	0.00		0.06		0.00	0.00	0.22	0.10		0.05	0.43		3.58		0.16	0.00	0.12
Manganese (Mn) Dis	mg/l	1.640		1.180		0.410	0.000	0.782	0.429		0.795	0.618		0.650		0.644	0.232	0.470
Mercury (Hg) Dis	mg/l	0.00011		0.00000		0.00000	0.00000	0.00000	0.00000		0.00000	0.00000		0.00000		0.00000	0.00000	0.00000
Selenium (Se) Dis	mg/l	0.004		0.000		0.003	0.001	0.000	0.004		0.000	0.000		0.000		0.000	0.000	0.000
Zinc (Zn) Dis	mg/l	0.148		0.097		3.680	0.081	0.115	0.276		0.061	0.136		0.051		0.082	0.041	0.128

Dis = Dissolved

HONEYWOOD COAL COMPANY

WATER MONITORING DATA

LOCATION: BW-1

Bedrock Well - Section 3
Quarterly Field - Semi Full Suite
TR-06 - 4th 95 - Depth to water semi-annu

QUARTER:		1st 95	2nd 95	3rd 95	2nd 96	4th 96	2nd 97	4th 97	2nd 98	3rd 98	1st 12	3rd 12			
DATE:	Units	3/17/95	7/1/95	10/1/95	05/20/96	12/16/96	05/06/97	08/21/97	04/18/98	07/30/98	4/6/12	9/13/12	MIN	MAX	AVG
Depth to Water	feet	Dry	120	120	119	119	119	119	119	119	naccessibl	120	119	120	119
pH	pH units		7.8	7.2		6.9			2 gpm	2 gpm		7.1	6.8	8.0	7.2
Conductivity @ 25 C	umhos/cm		1680	1750		2060						1800	1325	2300	1820
Temp												13.9	13.9	13.9	13.9
Total Dissolved Solids	mg/l		1300	1820		1310						1320	1290	1860	1499
Bicarbonate (HCO3)	mg/l		550	520		551						515.0	278	622	508
Carbonate (CO3)	mg/l		0	0		0						<MDL	0	0	0
Calcium (Ca)	mg/l		141	154		159						158	48	186	151
Chloride (Cl)	mg/l		12	18		20						21.1	8	31	17
Magnesium (Mg)	mg/l		27	56		59						641	27	641	100
Ammonia (N)	mg/l		0.97	0.65		0.45						0.2	0.00	1.40	0.46
Nitrate (N)	mg/l		0.12	0.17		0.69						<MDL	0.109	0.840	0.345
Nitrite (N)	mg/l		0.00	0.00		0.00						<MDL	0.00	0.03	0.00
Phosphate (P)	mg/l		0.10	0.02		0.01						0.057	0.00	0.10	0.02
Sodium (Na)	mg/l		180	300		186.0						187.0	118.0	300.0	191.8
Sulfate (SO4)	mg/l		450	750		625						558	450	755	618
Arsenic (As) Dis	mg/l		0.000	0.000		0.001						<MDL	0.000	0.001	0.000
Cadmium (Cd) Dis	mg/l		0.0000	0.0000		0.0002						<MDL	0.0000	0.0044	0.0004
Iron (Fe) Dis	mg/l		0.00	3.12		0.01						1.44	0.00	3.58	0.58
Manganese (Mn) Dis	mg/l		0.356	0.054		0.472						0.234	0.000	1.640	0.560
Mercury (Hg) Dis	mg/l		0.00000	0.00000		0.00005						<MDL	0.00000	0.00011	0.00001
Selenium (Se) Dis	mg/l		0.000	0.002		0.002						<MDL	0.000	0.004	0.001
Zinc (Zn) Dis	mg/l		0.146	0.061		0.050						0.0332	0.033	3.680	0.324

Dis = Dissolved

HONEYWOOD COAL COMPANY

WATER MONITORING DATA

LOCATION: BW-2

Bedrock Well - Section 33
Quarterly Field - Semi Full Suite
TR-06 - 4th 95 - Depth to water semi-annually.

QUARTER:		4th 90	1st 91	2nd 91	3rd 91	4th 91	1st 92	2nd 92	3rd 92	4th 92	1st 93	2nd 93	3rd 93	4th 93	1st 94	2nd 94	3rd 94	4th 94	1st 95	2nd 95	3rd 95	2nd 96
DATE:	Units	12/6/90	3/13/91	5/09/91	8/28/91	12/30/91	3/21/92	6/30/92	9/30/92	12/22/92	3/25/93	6/27/93	9/29/93	12/22/93	3/28/94	4/24/94	7/08/94	11/20/94	3/17/95	7/1/95	10/1/95	05/20/96
Depth to Water	feet	118	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
pH	pH units	Note 1																				
Conductivity @ 25 C	umhos/cm																					
Total Dissolved Solids	mg/l																					
Temp	Celsius																					
Bicarbonate (HCO3)	mg/l																					
Carbonate (CO3)	mg/l																					
Calcium (Ca)	mg/l																					
Chloride (Cl)	mg/l																					
Magnesium (Mg)	mg/l																					
Amonia (N)	mg/l																					
Nitrate (N)	mg/l																					
Nitrite (N)	mg/l																					
Phosphate (P)	mg/l																					
Sodium (Na)	mg/l																					
Sulfate (SO4)	mg/l																					
Arsenic (As)	mg/l																					
Cadmium (Cd)	mg/l																					
Iron (Fe)	mg/l																					
Manganese (Mn)	mg/l																					
Mercury (Hg)	mg/l																					
Selenium (Se)	mg/l																					
Zinc (Zn)	mg/l																					

Note 1 - Not enough water to obtain a sample.

HONEYWOOD COAL COMPANY

WATER MONITORING DATA

LOCATION: BW-2

Bedrock Well - Section 33
Quarterly Field - Semi Full Suite
TR-06 - 4th 95 - Depth to water semi-annu

QUARTER:		4th 96	2nd 97	4th 97	2nd 98	3rd 98	1st 12	3rd 12
DATE:	Units	12/16/96	05/06/97	08/21/97	04/18/98	07/30/98	4/6/12	9/13/12
Depth to Water	feet	Dry	Dry	Dry	Dry	Dry	120.3	120.7
pH	pH units						7.1	6.8
Conductivity @ 25 C	umhos/cm						2300	2400
Total Dissolved Solids	mg/l							1860
Temp	Celsius						13.0	12.3
Bicarbonate (HCO3)	mg/l							747.0
Carbonate (CO3)	mg/l							<MDL
Calcium (Ca)	mg/l							242
Chloride (Cl)	mg/l							51.8
Magnesium (Mg)	mg/l							143
Amonia (N)	mg/l							<MDL
Nitrate (N)	mg/l							0.51
Nitrite (N)	mg/l							<MDL
Phosphate (P)	mg/l							0.081
Sodium (Na)	mg/l							124
Sulfate (SO4)	mg/l							730
Arsenic (As)	mg/l							<MDL
Cadmium (Cd)	mg/l							<MDL
Iron (Fe)	mg/l							0.195
Manganese (Mn)	mg/l							0.245
Mercury (Hg)	mg/l							<MDL
Selenium (Se)	mg/l							<MDL
Zinc (Zn)	mg/l							0.0989

Note 1 - Not enough water to obtain a samp

HONEYWOOD COAL COMPANY

WATER MONITORING DATA

LOCATION: BW-3

Bedrock Well - Section 11
Quarterly Field - Semi Full Suite
TR-06 - 4th 95 - Depth to water seim-annually.

QUARTER:		4th 90	1st 91	2nd 91	3rd 91	4th 91	1st 92	2nd 92	3rd 92	4th 92	1st 93	2nd 93	3rd 93	4th 93	1st 94	2nd 94	3rd 94	4th 94	1st 95	2nd 95
DATE:	Units	12/6/90	3/13/91	5/09/91	8/28/91	12/30/91	3/21/92	6/30/92	9/30/92	12/22/92	3/25/93	6/27/93	9/29/93	12/22/93	3/28/94	4/24/94	7/8/94	11/20/94	3/17/95	7/1/95
Depth to Water	feet	120	Dry	Dry	Dry	Dry	120	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
pH	pH units	7.5					7.0													
Conductivity @ 25 C	umhos/cm	2550					3100													
Total Dissolved Solids	mg/l	2120					2520													
Temp	Celsius																			
Bicarbonate (HCO3)	mg/l	294					488													
Carbonate (CO3)	mg/l	0					0													
Calcium (Ca)	mg/l	284					290													
Chloride (Cl)	mg/l	119					120													
Magnesium (Mg)	mg/l	102					143													
Ammonia (N)	mg/l	1.65					4.38													
Nitrate (N)	mg/l	0.732					0.544													
Nitrite (N)	mg/l	0.01					0.00													
Phosphate (P)	mg/l	0.02					0.01													
Sodium (Na)	mg/l	266.0					278.0													
Sulfate (SO4)	mg/l	1220					1480													
Arsenic (As)	mg/l	0.000					0.000													
Cadmium (Cd)	mg/l	0.0004					0.0000													
Iron (Fe)	mg/l	0.00					0.00													
Manganese (Mn)	mg/l	7.890					0.000													
Mercury (Hg)	mg/l	0.00000					0.00000													
Selenium (Se)	mg/l	0.000					0.001													
Zinc (Zn)	mg/l	0.018					0.152													

HONEYWOOD COAL COMPANY

WATER MONITORING DATA

LOCATION: BW-3

Bedrock Well - Section 11
Quarterly Field - Semi Full Suite
TR-06 - 4th 95 - Depth to water seim-an

QUARTER:		3rd 95	2nd 96	4th 96	2nd 97	4th 97	2nd 98	3rd 98	1st 12	3rd 12	MIN	MAX	AVG
DATE:	Units	10/1/95	05/20/96	12/16/96	05/06/97	08/21/97	04/18/98	07/30/98	4/6/12	9/13/12			
Depth to Water	feet	Dry	Dry	Dry	Dry	Dry	Dry	Dry	115	111	111	120	116.5
pH	pH units								6.8	6.8	6.8	7.5	7.0
Conductivity @ 25 C	umhos/cm								3600	3500	2550	3600	3187.5
Total Dissolved Solids	mg/l									2700	2120	2700	2446.7
Temp	Celsius								11.0	12.5	11.0	12.5	11.8
Bicarbonate (HCO3)	mg/l									1090	294	1090	624
Carbonate (CO3)	mg/l									<MDL	0	0	0
Calcium (Ca)	mg/l									313	284	313	296
Chloride (Cl)	mg/l									148	119	148	129
Magnesium (Mg)	mg/l									166	102	166	137
Ammonia (N)	mg/l									5.00	1.65	5	3.68
Nitrate (N)	mg/l									0.56	0.544	0.732	0.612
Nitrite (N)	mg/l									<MDL	0.00	0.01	0.01
Phosphate (P)	mg/l									2.5	0.01	2.5	0.84
Sodium (Na)	mg/l									280	266	280	274.7
Sulfate (SO4)	mg/l									994	994	1480	1231.3
Arsenic (As)	mg/l									<MDL	0.000	0.000	0.000
Cadmium (Cd)	mg/l									<MDL	0.0000	0.0004	0.000
Iron (Fe)	mg/l									0.0812	0.000	0.081	0.027
Manganese (Mn)	mg/l									3.12	0.000	7.890	3.670
Mercury (Hg)	mg/l									<MDL	0.00000	0.00000	0.00000
Selenium (Se)	mg/l									<MDL	0.000	0.001	0.001
Zinc (Zn)	mg/l									<MDL	0.018	0.152	0.085

Sample Results

Report of Analysis

WD-2B Monitoring Well

Report of Analysis

Client Sample ID:	WD-2B		
Lab Sample ID:	D81037-1	**Date Sampled:**	03/22/16
Matrix:	AQ - Ground Water	**Date Received:**	03/24/16
Method:	SW846 8260B	**Percent Solids:**	n/a
Project:	Broad Canyon Landfill		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	7V32450.D	1	03/25/16	TL	n/a	n/a	V7V1762
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

VOA Appendix I 40 CFR Part 258

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	ND	20	10	ug/l	
107-13-1	Acrylonitrile	ND	5.0	4.0	ug/l	
71-43-2	Benzene	ND	1.0	0.50	ug/l	
74-97-5	Bromochloromethane	ND	4.0	3.0	ug/l	
75-27-4	Bromodichloromethane	ND	2.0	1.0	ug/l	
75-25-2	Bromoform	ND	2.0	1.0	ug/l	
75-15-0	Carbon disulfide	ND	4.0	3.0	ug/l	
56-23-5	Carbon tetrachloride	ND	2.0	0.70	ug/l	
108-90-7	Chlorobenzene	ND	1.0	0.50	ug/l	
75-00-3	Chloroethane	ND	4.0	3.0	ug/l	
67-66-3	Chloroform	ND	2.0	1.0	ug/l	
96-12-8	1,2-Dibromo-3-chloropropane	ND	2.0	1.0	ug/l	
124-48-1	Dibromochloromethane	ND	2.0	0.51	ug/l	
106-93-4	1,2-Dibromoethane	ND	1.0	0.50	ug/l	
95-50-1	o-Dichlorobenzene	ND	1.0	0.50	ug/l	
106-46-7	p-Dichlorobenzene	ND	2.0	1.5	ug/l	
110-57-6	Trans-1,4-Dichloro-2-Butene	ND	2.0	1.0	ug/l	
75-34-3	1,1-Dichloroethane	ND	2.0	1.5	ug/l	
107-06-2	1,2-Dichloroethane	ND	1.0	0.60	ug/l	
75-35-4	1,1-Dichloroethylene	ND	2.0	1.5	ug/l	
156-59-2	cis-1,2-Dichloroethylene	ND	4.0	2.5	ug/l	
156-60-5	trans-1,2-Dichloroethylene	ND	2.0	1.7	ug/l	
78-87-5	1,2-Dichloropropane	ND	1.0	0.60	ug/l	
10061-01-5	cis-1,3-Dichloropropene	ND	1.0	0.60	ug/l	
10061-02-6	trans-1,3-Dichloropropene	ND	1.0	0.50	ug/l	
100-41-4	Ethylbenzene	ND	1.0	0.52	ug/l	
591-78-6	2-Hexanone	ND	10	2.8	ug/l	
74-83-9	Methyl bromide	ND	2.0	1.0	ug/l	
74-87-3	Methyl chloride	ND	2.0	1.0	ug/l	
74-88-4	Methyl iodide	ND	5.0	2.5	ug/l	
74-95-3	Methylene bromide	ND	2.0	1.0	ug/l	
75-09-2	Methylene chloride	ND	4.0	3.0	ug/l	

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	WD-2B		
Lab Sample ID:	D81037-1	**Date Sampled:**	03/22/16
Matrix:	AQ - Ground Water	**Date Received:**	03/24/16
Method:	SW846 8260B	**Percent Solids:**	n/a
Project:	Broad Canyon Landfill		

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CAS No.	Compound	Result	RL	MDL	Units	Q
108-10-1	4-Methyl-2-pentanone	ND	5.0	2.5	ug/l	
78-93-3	Methyl ethyl ketone	ND	5.0	3.2	ug/l	
100-42-5	Styrene	ND	1.0	0.50	ug/l	
630-20-6	1,1,1,2-Tetrachloroethane	ND	1.0	0.50	ug/l	
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.0	0.50	ug/l	
127-18-4	Tetrachloroethylene	ND	1.0	0.80	ug/l	
108-88-3	Toluene	ND	1.0	0.71	ug/l	
71-55-6	1,1,1-Trichloroethane	ND	4.0	3.0	ug/l	
79-00-5	1,1,2-Trichloroethane	ND	2.0	1.0	ug/l	
79-01-6	Trichloroethylene	ND	1.0	0.70	ug/l	
75-69-4	Trichlorofluoromethane	ND	2.0	1.8	ug/l	
96-18-4	1,2,3-Trichloropropane	ND	2.0	1.0	ug/l	
108-05-4	Vinyl Acetate	ND	10	5.0	ug/l	
75-01-4	Vinyl chloride	ND	2.0	1.0	ug/l	
1330-20-7	Xylene (total)	ND	1.0	1.0	ug/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	105%		70-130%
17060-07-0	1,2-Dichloroethane-D4	105%		62-130%
2037-26-5	Toluene-D8	116%		70-130%
460-00-4	4-Bromofluorobenzene	105%		69-130%

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	WD-2B		
Lab Sample ID:	D81037-1	**Date Sampled:**	03/22/16
Matrix:	AQ - Ground Water	**Date Received:**	03/24/16
		Percent Solids:	n/a
Project:	Broad Canyon Landfill		

Total Metals Analysis

Analyte	Result	RL	Units	DF	Prep	Analyzed	By	Method	Prep Method
Antimony	< 30	30	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Arsenic	< 25	25	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Barium	41.1	10	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Beryllium	< 10	10	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Cadmium	< 10	10	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Calcium	204000	400	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Chromium	< 10	10	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Cobalt	10.0	5.0	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Copper	< 10	10	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Lead	< 50	50	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Magnesium	157000	200	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Nickel	< 30	30	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Potassium	31400	1000	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Selenium	< 50	50	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Silver	< 30	30	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Sodium	104000	400	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Thallium	< 10	10	ug/l	1	03/25/16	03/28/16	AS	SW846 6010C [2]	SW846 3010A [3]
Vanadium	< 10	10	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Zinc	< 30	30	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]

(1) Instrument QC Batch: MA7151
(2) Instrument QC Batch: MA7154
(3) Prep QC Batch: MP18309

RL = Reporting Limit

Report of Analysis

Client Sample ID:	WD-2B		
Lab Sample ID:	D81037-1	**Date Sampled:**	03/22/16
Matrix:	AQ - Ground Water	**Date Received:**	03/24/16
		Percent Solids:	n/a
Project:	Broad Canyon Landfill		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Bicarbonate as HCO3	1080	5.0	mg/l	1	03/28/16	JD	SM20 2320B
Carbonate as CO3	< 5.0	5.0	mg/l	1	03/28/16	JD	SM20 2320B
Chloride	61.2	2.5	mg/l	5	03/24/16 13:34	JB	EPA 300.0/SW846 9056
Nitrogen, Nitrate [a]	< 0.050	0.050	mg/l	5	03/24/16 13:34	JB	EPA 300.0/SW846 9056
Nitrogen, Nitrite [b]	0.90	0.020	mg/l	5	03/25/16 17:21	JB	EPA 300.0/SW846 9056
Specific Conductivity	2130	1.0	umhos/cm	1	03/29/16	JD	SM 2510B-2011
Sulfate	501	25	mg/l	50	03/24/16 13:47	JB	EPA 300.0/SW846 9056
Total Organic Carbon [a]	< 10	10	mg/l	10	03/29/16 11:27	JB	SM 5310B-2011
pH	7.10		su	1	03/25/16 14:00	JF	SM4500HB+ -2011/9040C

(a) Elevated detection limit due to matrix interference.
(b) The sample was originally analyzed within the method hold time. However, the sample required re-run due to sample matrix carryover which was then analyzed outside the recommended hold time.

RL = Reporting Limit

Report of Analysis

Client Sample ID:	WD-2B		
Lab Sample ID:	D81037-1F	**Date Sampled:**	03/22/16
Matrix:	AQ - Groundwater Filtered	**Date Received:**	03/24/16
		Percent Solids:	n/a
Project:	Broad Canyon Landfill		

Dissolved Metals Analysis

Analyte	Result	RL	Units	DF	Prep	Analyzed	By	Method	Prep Method
Antimony	< 30	30	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Arsenic	< 25	25	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Barium	30.5	10	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Beryllium	< 10	10	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Cadmium	< 10	10	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Calcium	198000	400	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Chromium	< 10	10	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Cobalt	9.7	5.0	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Copper	< 10	10	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Lead	< 50	50	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Magnesium	152000	200	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Nickel	< 30	30	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Potassium	30100	1000	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Selenium	< 50	50	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Silver	< 30	30	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Sodium	107000	400	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Thallium	< 10	10	ug/l	1	03/25/16	03/28/16	AS	SW846 6010C [2]	SW846 3010A [3]
Vanadium	< 10	10	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Zinc	< 30	30	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]

(1) Instrument QC Batch: MA7151
(2) Instrument QC Batch: MA7154
(3) Prep QC Batch: MP18309

RL = Reporting Limit

Report of Analysis

Client Sample ID:	LEACHATE		
Lab Sample ID:	D81037-2	**Date Sampled:**	03/22/16
Matrix:	AQ - Ground Water	**Date Received:**	03/24/16
Method:	SW846 8260B	**Percent Solids:**	n/a
Project:	Broad Canyon Landfill		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	7V32449.D	1	03/25/16	TL	n/a	n/a	V7V1762
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

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CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	39.1	20	10	ug/l	
107-13-1	Acrylonitrile	ND	5.0	4.0	ug/l	
71-43-2	Benzene	ND	1.0	0.50	ug/l	
74-97-5	Bromochloromethane	ND	4.0	3.0	ug/l	
75-27-4	Bromodichloromethane	ND	2.0	1.0	ug/l	
75-25-2	Bromoform	ND	2.0	1.0	ug/l	
75-15-0	Carbon disulfide	ND	4.0	3.0	ug/l	
56-23-5	Carbon tetrachloride	ND	2.0	0.70	ug/l	
108-90-7	Chlorobenzene	ND	1.0	0.50	ug/l	
75-00-3	Chloroethane	ND	4.0	3.0	ug/l	
67-66-3	Chloroform	ND	2.0	1.0	ug/l	
96-12-8	1,2-Dibromo-3-chloropropane	ND	2.0	1.0	ug/l	
124-48-1	Dibromochloromethane	ND	2.0	0.51	ug/l	
106-93-4	1,2-Dibromoethane	ND	1.0	0.50	ug/l	
95-50-1	o-Dichlorobenzene	ND	1.0	0.50	ug/l	
106-46-7	p-Dichlorobenzene	ND	2.0	1.5	ug/l	
110-57-6	Trans-1,4-Dichloro-2-Butene	ND	2.0	1.0	ug/l	
75-34-3	1,1-Dichloroethane	2.1	2.0	1.5	ug/l	
107-06-2	1,2-Dichloroethane	1.6	1.0	0.60	ug/l	
75-35-4	1,1-Dichloroethylene	1.6	2.0	1.5	ug/l	J
156-59-2	cis-1,2-Dichloroethylene	ND	4.0	2.5	ug/l	
156-60-5	trans-1,2-Dichloroethylene	5.6	2.0	1.7	ug/l	
78-87-5	1,2-Dichloropropane	ND	1.0	0.60	ug/l	
10061-01-5	cis-1,3-Dichloropropene	ND	1.0	0.60	ug/l	
10061-02-6	trans-1,3-Dichloropropene	ND	1.0	0.50	ug/l	
100-41-4	Ethylbenzene	0.56	1.0	0.52	ug/l	J
591-78-6	2-Hexanone	ND	10	2.8	ug/l	
74-83-9	Methyl bromide	ND	2.0	1.0	ug/l	
74-87-3	Methyl chloride	ND	2.0	1.0	ug/l	
74-88-4	Methyl iodide	ND	5.0	2.5	ug/l	
74-95-3	Methylene bromide	ND	2.0	1.0	ug/l	
75-09-2	Methylene chloride	29.6	4.0	3.0	ug/l	

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	LEACHATE		
Lab Sample ID:	D81037-2	**Date Sampled:**	03/22/16
Matrix:	AQ - Ground Water	**Date Received:**	03/24/16
Method:	SW846 8260B	**Percent Solids:**	n/a
Project:	Broad Canyon Landfill		

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CAS No.	Compound	Result	RL	MDL	Units	Q
108-10-1	4-Methyl-2-pentanone	ND	5.0	2.5	ug/l	
78-93-3	Methyl ethyl ketone	ND	5.0	3.2	ug/l	
100-42-5	Styrene	ND	1.0	0.50	ug/l	
630-20-6	1,1,1,2-Tetrachloroethane	ND	1.0	0.50	ug/l	
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.0	0.50	ug/l	
127-18-4	Tetrachloroethylene	8.6	1.0	0.80	ug/l	
108-88-3	Toluene	5.1	1.0	0.71	ug/l	
71-55-6	1,1,1-Trichloroethane	ND	4.0	3.0	ug/l	
79-00-5	1,1,2-Trichloroethane	ND	2.0	1.0	ug/l	
79-01-6	Trichloroethylene	1.4	1.0	0.70	ug/l	
75-69-4	Trichlorofluoromethane	ND	2.0	1.8	ug/l	
96-18-4	1,2,3-Trichloropropane	ND	2.0	1.0	ug/l	
108-05-4	Vinyl Acetate	ND	10	5.0	ug/l	
75-01-4	Vinyl chloride	23.3	2.0	1.0	ug/l	
1330-20-7	Xylene (total)	2.8	1.0	1.0	ug/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	109%		70-130%
17060-07-0	1,2-Dichloroethane-D4	108%		62-130%
2037-26-5	Toluene-D8	116%		70-130%
460-00-4	4-Bromofluorobenzene	103%		69-130%

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	LEACHATE		
Lab Sample ID:	D81037-2	**Date Sampled:**	03/22/16
Matrix:	AQ - Ground Water	**Date Received:**	03/24/16
		Percent Solids:	n/a
Project:	Broad Canyon Landfill		

Total Metals Analysis

Analyte	Result	RL	Units	DF	Prep	Analyzed	By	Method	Prep Method
Antimony	< 30	30	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Arsenic	< 25	25	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Barium	60.3	10	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Beryllium	< 10	10	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Cadmium	< 10	10	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Calcium	9350	400	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Chromium	< 10	10	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Cobalt	< 5.0	5.0	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Copper	12100	10	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Lead	424	50	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Magnesium	7750	200	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Nickel	102	30	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Potassium	< 1000	1000	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Selenium	< 50	50	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Silver	< 30	30	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Sodium	4080	400	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Thallium	< 10	10	ug/l	1	03/25/16	03/28/16	AS	SW846 6010C [2]	SW846 3010A [3]
Vanadium	< 10	10	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Zinc	10100	30	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]

(1) Instrument QC Batch: MA7151
(2) Instrument QC Batch: MA7154
(3) Prep QC Batch: MP18309

RL = Reporting Limit

Report of Analysis

Client Sample ID:	LEACHATE		
Lab Sample ID:	D81037-2	**Date Sampled:**	03/22/16
Matrix:	AQ - Ground Water	**Date Received:**	03/24/16
		Percent Solids:	n/a
Project:	Broad Canyon Landfill		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Bicarbonate as HCO3	53.0	5.0	mg/l	1	03/28/16	JD	SM20 2320B
Carbonate as CO3	< 5.0	5.0	mg/l	1	03/28/16	JD	SM20 2320B
Chloride	14.5	2.5	mg/l	5	03/24/16 14:40	JB	EPA 300.0/SW846 9056
Nitrogen, Nitrate [a]	< 0.050	0.050	mg/l	5	03/24/16 14:40	JB	EPA 300.0/SW846 9056
Nitrogen, Nitrite [b]	< 0.020	0.020	mg/l	5	03/25/16 17:35	JB	EPA 300.0/SW846 9056
Specific Conductivity	186	1.0	umhos/cm	1	03/29/16	JD	SM 2510B-2011
Sulfate	30.4	2.5	mg/l	5	03/24/16 14:40	JB	EPA 300.0/SW846 9056
Total Organic Carbon	10.0	1.0	mg/l	1	03/29/16 11:38	JB	SM 5310B-2011
pH	5.35		su	1	03/25/16 14:00	JF	SM4500HB+ -2011/9040C

(a) Elevated detection limit due to matrix interference.
(b) The sample was originally analyzed within the method hold time. However, the sample required re-run due to sample matrix carryover which was then analyzed outside the recommended hold time. Elevated reporting limit due to matrix.

RL = Reporting Limit

Report of Analysis

Client Sample ID:	LEACHATE		
Lab Sample ID:	D81037-2F	**Date Sampled:**	03/22/16
Matrix:	AQ - Groundwater Filtered	**Date Received:**	03/24/16
		Percent Solids:	n/a
Project:	Broad Canyon Landfill		

Dissolved Metals Analysis

Analyte	Result	RL	Units	DF	Prep	Analyzed	By	Method	Prep Method
Antimony	< 30	30	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Arsenic	< 25	25	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Barium	54.7	10	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Beryllium	< 10	10	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Cadmium	< 10	10	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Calcium	8680	400	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Chromium	< 10	10	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Cobalt	< 5.0	5.0	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Copper	6270	10	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Lead	187	50	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Magnesium	7500	200	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Nickel	87.6	30	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Potassium	< 1000	1000	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Selenium	< 50	50	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Silver	< 30	30	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Sodium	3910	400	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Thallium	< 10	10	ug/l	1	03/25/16	03/28/16	AS	SW846 6010C [2]	SW846 3010A [3]
Vanadium	< 10	10	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]
Zinc	8550	30	ug/l	1	03/25/16	03/25/16	AS	SW846 6010C [1]	SW846 3010A [3]

(1) Instrument QC Batch: MA7151
(2) Instrument QC Batch: MA7154
(3) Prep QC Batch: MP18309

RL = Reporting Limit

Report of Analysis

Client Sample ID:	TRIP BLANK		
Lab Sample ID:	D81037-3	**Date Sampled:**	03/22/16
Matrix:	AQ - Trip Blank Water	**Date Received:**	03/24/16
Method:	SW846 8260B	**Percent Solids:**	n/a
Project:	Broad Canyon Landfill		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	7V32446.D	1	03/25/16	TL	n/a	n/a	V7V1762
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

VOA Appendix I 40 CFR Part 258

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	ND	20	10	ug/l	
107-13-1	Acrylonitrile	ND	5.0	4.0	ug/l	
71-43-2	Benzene	ND	1.0	0.50	ug/l	
74-97-5	Bromochloromethane	ND	4.0	3.0	ug/l	
75-27-4	Bromodichloromethane	ND	2.0	1.0	ug/l	
75-25-2	Bromoform	ND	2.0	1.0	ug/l	
75-15-0	Carbon disulfide	ND	4.0	3.0	ug/l	
56-23-5	Carbon tetrachloride	ND	2.0	0.70	ug/l	
108-90-7	Chlorobenzene	ND	1.0	0.50	ug/l	
75-00-3	Chloroethane	ND	4.0	3.0	ug/l	
67-66-3	Chloroform	ND	2.0	1.0	ug/l	
96-12-8	1,2-Dibromo-3-chloropropane	ND	2.0	1.0	ug/l	
124-48-1	Dibromochloromethane	ND	2.0	0.51	ug/l	
106-93-4	1,2-Dibromoethane	ND	1.0	0.50	ug/l	
95-50-1	o-Dichlorobenzene	ND	1.0	0.50	ug/l	
106-46-7	p-Dichlorobenzene	ND	2.0	1.5	ug/l	
110-57-6	Trans-1,4-Dichloro-2-Butene	ND	2.0	1.0	ug/l	
75-34-3	1,1-Dichloroethane	ND	2.0	1.5	ug/l	
107-06-2	1,2-Dichloroethane	ND	1.0	0.60	ug/l	
75-35-4	1,1-Dichloroethylene	ND	2.0	1.5	ug/l	
156-59-2	cis-1,2-Dichloroethylene	ND	4.0	2.5	ug/l	
156-60-5	trans-1,2-Dichloroethylene	ND	2.0	1.7	ug/l	
78-87-5	1,2-Dichloropropane	ND	1.0	0.60	ug/l	
10061-01-5	cis-1,3-Dichloropropene	ND	1.0	0.60	ug/l	
10061-02-6	trans-1,3-Dichloropropene	ND	1.0	0.50	ug/l	
100-41-4	Ethylbenzene	ND	1.0	0.52	ug/l	
591-78-6	2-Hexanone	ND	10	2.8	ug/l	
74-83-9	Methyl bromide	ND	2.0	1.0	ug/l	
74-87-3	Methyl chloride	ND	2.0	1.0	ug/l	
74-88-4	Methyl iodide	ND	5.0	2.5	ug/l	
74-95-3	Methylene bromide	ND	2.0	1.0	ug/l	
75-09-2	Methylene chloride	ND	4.0	3.0	ug/l	

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	TRIP BLANK		
Lab Sample ID:	D81037-3	**Date Sampled:**	03/22/16
Matrix:	AQ - Trip Blank Water	**Date Received:**	03/24/16
Method:	SW846 8260B	**Percent Solids:**	n/a
Project:	Broad Canyon Landfill		

VOA Appendix I 40 CFR Part 258

CAS No.	Compound	Result	RL	MDL	Units	Q
108-10-1	4-Methyl-2-pentanone	ND	5.0	2.5	ug/l	
78-93-3	Methyl ethyl ketone	ND	5.0	3.2	ug/l	
100-42-5	Styrene	ND	1.0	0.50	ug/l	
630-20-6	1,1,1,2-Tetrachloroethane	ND	1.0	0.50	ug/l	
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.0	0.50	ug/l	
127-18-4	Tetrachloroethylene	ND	1.0	0.80	ug/l	
108-88-3	Toluene	ND	1.0	0.71	ug/l	
71-55-6	1,1,1-Trichloroethane	ND	4.0	3.0	ug/l	
79-00-5	1,1,2-Trichloroethane	ND	2.0	1.0	ug/l	
79-01-6	Trichloroethylene	ND	1.0	0.70	ug/l	
75-69-4	Trichlorofluoromethane	ND	2.0	1.8	ug/l	
96-18-4	1,2,3-Trichloropropane	ND	2.0	1.0	ug/l	
108-05-4	Vinyl Acetate	ND	10	5.0	ug/l	
75-01-4	Vinyl chloride	ND	2.0	1.0	ug/l	
1330-20-7	Xylene (total)	ND	1.0	1.0	ug/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	107%		70-130%
17060-07-0	1,2-Dichloroethane-D4	109%		62-130%
2037-26-5	Toluene-D8	115%		70-130%
460-00-4	4-Bromofluorobenzene	104%		69-130%

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

APPENDIX 3

Field Permeability Tests

BROAD CANYON LANDFILL

FIELD PERMEABILITY TESTS

DATE	TEST	TEST DAYS	TIME-BEG HRS	TIME-BEG MIN	TIME-END HRS	TIME-END MIN	DEPTH TO WATER BEG	DEPTH TO WATER END	TIME (MIN)	LOSS Q-GPM	K (FT/MIN)	PERM (CM/SEC)	AVE H (FEET)
15-Oct-93	1	0	8	6	10	45	0	4.88	159	1.67E-03	1.2E-05	6.0E-06	20.2967
15-Oct-93	2	0	10	48	15	0	0	2.50	252	5.40E-04	3.8E-06	1.9E-06	20.3958
16-Oct-93	3	1	15	0	13	0	0	8.00	1320	3.30E-04	2.4E-06	1.2E-06	20.1667
19-Oct-93	4	3	13	0	10	0	0	24.00	4140	3.15E-04	2.3E-06	1.2E-06	19.5000
20-Oct-93	5	1	10	0	9	0	0	13.25	1380	5.22E-04	3.8E-06	1.9E-06	19.9479
21-Oct-93	6	1	9	0	8	30	0	26.25	1410	1.01E-03	7.5E-06	3.8E-06	19.4063
22-Oct-93	7	1	8	30	8	30	0	18.75	1440	7.08E-04	5.2E-06	2.6E-06	19.7188
25-Oct-93	8	3	8	30	10	30	0	30.50	4440	3.74E-04	2.8E-06	1.4E-06	19.2292
26-Oct-93	9	1	10	30	10	30	30.5	50	1440	7.37E-04	6.2E-06	3.1E-06	17.1458
27-Oct-93	10	1	10	30	9	0	50	54	1350	1.61E-04	1.4E-06	7.3E-07	16.1667
28-Oct-93	11	1	9	0	9	15	54	58	1455	1.50E-04	1.4E-06	6.9E-07	15.8333
01-Nov-93	12	4	9	15	8	30	58	67	5715	8.57E-05	8.1E-07	4.1E-07	15.2917
14-Nov-93	13	13	8	30	10	0	67	73.5	18810	1.88E-05	1.8E-07	9.4E-08	14.6458
21-Nov-93	14	7	10	0	15	30	73.5	75	10410	7.84E-06	7.9E-08	4.0E-08	14.3125
28-Nov-93	15	7	15	30	17	30	75	75.25	10200	1.33E-06	1.3E-08	6.8E-09	14.2396
06-Jan-94	16	39	15	30	10	30	75.25	78.25	55860	2.92E-06	3.0E-08	1.5E-08	14.1042
22-Jan-94	17	16	10	30	10	15	78.25	95.00	23025	3.96E-05	4.3E-07	2.2E-07	13.2813
13-Feb-94	18	22	10	15	9	30	95	101	31635	1.03E-05	1.2E-07	6.1E-08	12.3333
24-Mar-94	19	39	9	30	16	30	95	105	56580	9.61E-06	1.1E-07	5.8E-08	12.1667
Test	12-19	143	9	15	16	30	58	105	206355	1.24E-05	1.3E-07	6.6E-08	13.7083

APPENDIX 4

CLOSURE

&

POST CLOSURE CARE ESTIMATES

CLOSURE ESTIMATE - BROAD CANYON LANDFILL

Item		Unit	Unit Cost	Quantity	Total
1	Final Cover				
	6-inch Foundation Layer	CY	$ 2.00	12100	$ 24,200
	30-Inch ET Cover	CY	$ 2.00	60500	$ 121,000
	Rehandle Glass	HR	$ 100.00	8	$ 800
2	Construction Supervision	Day	$ 400	60	$ 24,000
3	Revegetation	Acre	$ 750	15	$ 11,250
	Revegetation Glass Recycle	Acre	$ 750	1	$ 750
Total Estimated Cost					$ 182,000

Post Closure Care Estimate - Broad Canyon Landfill

Item		Frequency	Cost/Event		Annual Cost
1	Liner				
	a. Inspection	Quarterly	125		500
	b. Maintenance	Annually	400		400
2	Drainage System				
	a. Inspection	Quarterly	125		500
	b. Maintenance	Annually	400		400
3	Vegetation				
	a. Inspection	Quarterly	125		500
	b. Maintenance	Annually	100		100
4	Ground Water Monitoring				
	a. Check for Water	Quarterly	125		500
Annual Cost					2900
Cost for 30 Years					87000

Total Cost Closure and Post Closure Care	$ 269,000

5/17/2016

Notes on Closure Estimate

1. The 6-inch foundation layer and 24 inches of cover will be hauled from alluvial material in Wickson Draw. Attached is an estimate from Tri-Park Corp. to furnish the material from Wickson Draw for $1.75 per cubic yard. The $1.75 cost per cubic yard was increased to $2.00 for inflation.

2. Supervision is assumed to cost $50.00 per hour or $400 per day. The time estimate of 60 days is presented in Section 3.5(A)(3) Closure Schedule.

3. Revegetation is an allowance of $750.00 per acre.

4. The acreage to cover was increased to fifteen acres.

5. The one acre glass recycle area will be cleaned up in an estimated eight hours with a $100 per hour loader.

6. One acre of revegetation will be added for the glass recycle area.

Notes on Post Closure Estimate

1. The quarterly inspections are performed by one person at a cost of $500.00 per quarter or $125 per item.

2. ET Liner maintenance may cost $750 per year for the first 5 to 10 years but should diminish in years 10 through 30. Assume $750 per year for the first 10 years, $300 per year for the next ten years and $100 per year for the final 10 years which is an average cost of $383.33. Use $400.00 per year.

3. The drainage maintenance allows for a motor grader for a total of eight hours per year. (8hrs X $75 = $600). The drainage system maintenance will reduce dramatically after vegetation is established. Assume $600 per year for the first 10 years, $400 per year for the next 10 years and the $200 per year for the final 10 years for an average cost of $400 per year.

4. Vegetation maintenance should taper off after 5 years. Assume $250 per year for five years to control noxious weeds and re-seed as necessary. Then allow $50.00 per year thereafter for miscellaneous expense. Average cost per year equals $83.33. Use $100.00 per year.

APPENDIX 5

TS Certification of Incorporation
&
Land Rights

OFFICE OF THE SECRETARY OF STATE
OF THE STATE OF COLORADO

CERTIFICATE OF FACT OF GOOD STANDING

I, Wayne W. Williams, as the Secretary of State of the State of Colorado, hereby certify that, according to the records of this office,

TS LANDFILL, INC.

is a

Corporation

formed or registered on 09/07/1993 under the law of Colorado, has complied with all applicable requirements of this office, and is in good standing with this office. This entity has been assigned entity identification number 19931092854 .

This certificate reflects facts established or disclosed by documents delivered to this office on paper through 05/16/2016 that have been posted, and by documents delivered to this office electronically through 05/17/2016 @ 08:38:57 .

I have affixed hereto the Great Seal of the State of Colorado and duly generated, executed, and issued this official certificate at Denver, Colorado on 05/17/2016 @ 08:38:57 in accordance with applicable law. This certificate is assigned Confirmation Number 9652901 .

Secretary of State of the State of Colorado

**********End of Certificate**********

Notice: A certificate issued electronically from the Colorado Secretary of State's Web site is fully and immediately valid and effective. However, as an option, the issuance and validity of a certificate obtained electronically may be established by visiting the Validate a Certificate page of the Secretary of State's Web site, http://www.sos.state.co.us/biz/CertificateSearchCriteria.do entering the certificate's confirmation number displayed on the certificate, and following the instructions displayed. Confirming the issuance of a certificate is merely optional and is not necessary to the valid and effective issuance of a certificate. For more information, visit our Web site, http://www.sos.state.co.us/ click "Businesses, trademarks, trade names" and select "Frequently Asked Questions."

RECEPTION#: 858943, 09/17/2014 at
11:56:31 AM, 1 OF 4, QCD R $26.00
FRANCINE TIPTON-LONG, MONTROSE
COUNTY, CO CLERK AND RECORDER

QUITCLAIM DEED

This Deed is made and entered into by and between the following parties:

GRANTOR: **TS Landfill, Inc.**, a Colorado corporation
c/o J. E. Stover & Assoc., Inc.
2352 N. 7th St., Unit B
Grand Junction, CO 81501

GRANTEE: **TS Landfill, Inc.**, a Colorado corporation
c/o J. E. Stover & Assoc., Inc.
2352 N. 7th St., Unit B
Grand Junction, CO 81501

WITNESSETH, that in order to combine the below-described parcels into a single parcel, the Grantor hereby assigns, transfers, conveys, grants, bargains, and sells to itself as Grantee, its successors and assigns forever, any and all right, title and interest which Grantor owns or claims in or to the following described real property situated in Montrose County, Colorado:

Parcel 1: the SW1/4SW1/4 of Section 10, Township 45 N, Range 15 W, NMPM, also known as Government Lot 13 of said Section 10, together with an access easement sixty feet in width across Government Lot 12 of the aforesaid Section 10, said easement being more particularly described on the attached Exhibit A which consists of two pages including a written legal description and map of the easement. Prior deed reference: Rec. No. 848367, 7/18/2013

Parcel 2: the NW1/4, Section 15, Township 45 North, Range 15 West, N.M.P.M. Prior deed reference: Rec. No. 597396, 4/25/94.

together with all and singular the hereditaments and appurtenances thereunto belonging or in any way appertaining thereto, including but not limited to any and all mineral, water, timber, grazing, access, and development rights, and any and all rights of reversion or remainder, and all rents, issues, profits thereof; and all estate, right, title, interest, claim and demand whatsoever of the Grantor, either in law or in equity, of, in and to the above bargained premises, with the hereditaments and appurtenances;

TO HAVE AND TO HOLD the said premises above bargained and described, with the appurtenances, unto the Grantee, and its successors and assigns forever.

IN WITNESS WHEREOF, Grantor has executed this deed as of the date set forth below.

TS Landfill, Inc.

By: James E. Stover
President

STATE OF COLORADO:
COUNTY OF Mesa:

The foregoing instrument was acknowledged before me this 15th day of September, 2014 by James E. Stover who attested that he is the President of TS Landfill, Inc. duly authorized to sign this instrument. Witness my hand and official seal. My commission expires: 12-09-2014.

Tonya Hammond
Notary Public

TONYA HAMMOND
NOTARY
PUBLIC
STATE OF COLORADO

Notice: This deed is being given to combine two parcels and is therefore exempt from state documentary fees.

When recorded, please return to TS Landfill, Inc., a Colorado corporation, c/o J. E. Stover & Assoc., Inc., 2352 N. 7th St., Unit B, Grand Junction, CO 81501

EXHIBIT A

Ingress & Egress Easement

Legal Description

A strip of land 60 feet in width, 30 feet each side of centerline, measured at right angles, for a nonexclusive perpetual ingress and egress easement across and over that part of Government Lot 12, Section 10, Township 45 North, Range 15 West, New Mexico Principal Meridian, County of Montrose, State of Colorado, centerline of said easement being more particularly described as follows:

Commencing at the Northwest corner of Government Lot 12 (W 1/4) of said Section 10, an accepted stone monument, whence the Southwest corner of Government Lot 12 of said Section 10, a 2 1/2 inch Aluminum cap scribed PLS 38005 on a No. 6 rebar, bears South 01°50'08" East, a distance of 1324.41 feet, with all bearings herein being relative thereto;
thence South 62°47'32" East, a distance of 872.87 feet to a point on the South right-of-way line of Montrose County Road HH31, the POINT OF BEGINNING, whence the Southwest corner of Government Lot 12 of said Section 10, bears South 38°26'19" West, a distance of 1180.47 feet;
thence along said centerline the following two courses:
1) thence South 01°34'08" East, a distance of 183.26 feet;
2) thence South 06°47'57" East, a distance of 746.62 feet, to the South line of Government Lot 12 of said Section 10, and its TERMINUS, whence the Southwest corner of Government Lot 12 of said Section 10, bears South 89°59'40" West, a distance of 827.28 feet.

Containing 1.28 acres by these measures.

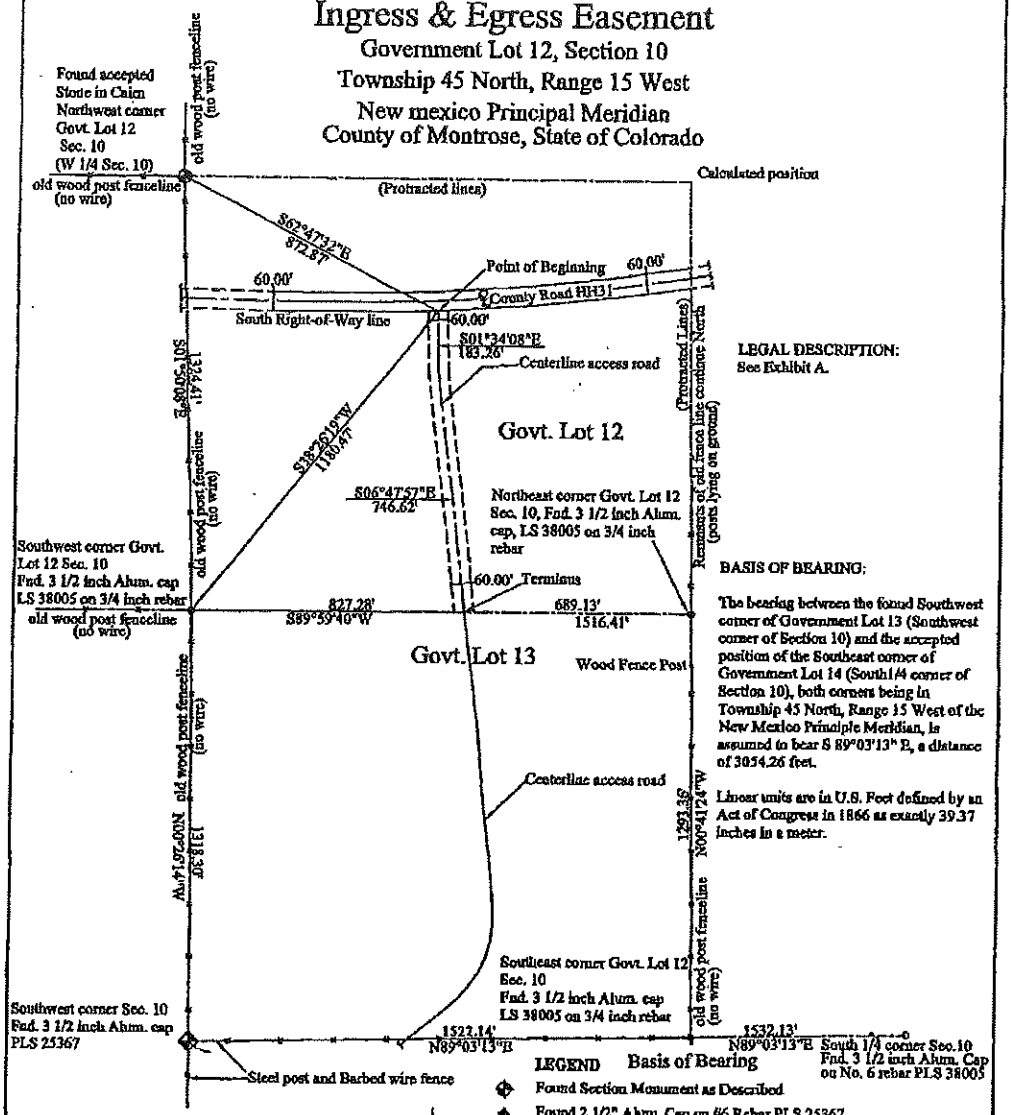
Legal description prepared by:
Merritt LS, L. L. C.
743 Horizon Ct., Suite 100B
Grand Junction, CO. 81506

Thomas W. Sylvester,
P. E. 14249 & P. L. S. 38005
May 22, 2013

COLORADO LICENSED
THOMAS W. SYLVESTER
5/29/13
PE 14249
PLS 38005
P.E. AND P.L.S.

Ingress & Egress Easement

Government Lot 12, Section 10
Township 45 North, Range 15 West
New mexico Principal Meridian
County of Montrose, State of Colorado



LEGEND Basis of Bearing

- Found Section Monument as Described
- Found 2 1/2" Alum. Cap on #6 Rebar PLS 25367
- Found Survey Monument as Described
- Set 2 1/2" Alum. Cap on #6 Rebar PLS 38005
- Monuments found within 0.25' of record are considered as being in record position.
- Fence line or remnant of fence line

N

400 0 400 800

SCALE 1" = 400'

EASEMENT EXHIBIT B

Surveyor's Statement:

I, Thomas W. Sylvester, a Registered Professional Engineer and Professional Land Surveyor in the State of Colorado, do hereby certify that this Exhibit B, of the Ingress & Egress easement, on Government Lot 12 and the survey upon which it was based was completed by me or under my direct supervision, is based upon my knowledge, information, and belief, is in accordance with applicable standards of practice, and is not a guaranty or warranty, either expressed or implied.

Thomas W. Sylvester, PE 14249 & PLS 38005

COLORADO LICENSED THOMAS W. SYLVESTER 5/24/15 PE 14249 PLS 38005 P.E. AND P.L.S.

Merritt LS L.L.C.
743 Horizon Ct., Suite 100H
Grand Junction, Co. 81506
(970) 255-7386

Ingress & Egress Easement
Government Lot 12, Section 10
Township 45 North, Range 15 West
New Mexico Principal Meridian
County of Montrose, State of Colorado

RECEPTION#: 848367, 07/18/2013 at
11:03:30 AM, 1 OF 4, DEED R $26.00 N
$5.00
FRANCINE TIPTON-LONG, MONTROSE
COUNTY, CO CLERK AND RECORDER

DEED

This Deed is made and entered into as of July 17, 2013 by and between the following parties:

GRANTORS: **David Andrews and Terri Andrews**, husband and wife, as joint tenants
with right of survivorship,
P. O. Box 523
Norwood, CO 81423

GRANTEE: **TS Landfill, Inc.**, a Colorado corporation
c/o J. E. Stover & Associates, Inc.
2352 N 7th St Unit B
Grand Junction, CO 81501

WITNESSETH, that the Grantors for and in consideration of the sum of Ten Dollars ($10.00) and other good and valuable consideration, the receipt and sufficiency of which is hereby irrevocably acknowledged, do hereby grant, bargain, sell and convey to Grantee, its successors and assigns forever, the following described vacant real property situated in Montrose County, Colorado, to wit: the SW1/4SW1/4 of Section 10, Township 45 N, Range 15 W, NMPM, also known as Government Lot 13 of said Section 10, being property acquired by Grantors from Davis and Andrews, LLLP by deed dated December 31, 2009 recorded February 17, 2010 at Reception No. 811369 in the land records of Montrose County, together with an access easement sixty feet in width across Government Lot 12 of the aforesaid Section 10, said easement being more particularly described on the attached Exhibit A which consists of two pages including a written legal description and map of the easement.

Together with all and singular the hereditaments and appurtenances thereunto belonging or in any way appertaining thereto, including but not limited to any and all mineral, water, timber, grazing, access, and development rights, and any and all rights of reversion or remainder, and all rents, issues, profits thereof; and all estate, right, title, interest, claim and demand whatsoever of the Grantor, either in law or in equity, of, in and to the above bargained premises, with the hereditaments and appurtenances;

TO HAVE AND TO HOLD the said premises above bargained and described, with the appurtenances, unto the Grantee, and its successors and assigns forever. Grantors, for themselves, their heirs, successors and assigns, hereby covenant and agree that they have good, clear title to the same, in fee simple absolute, without limitation, and has good right, full power and authority to grant, bargain, sell and convey the same in the manner and form as aforesaid, and that the same are free and clear of and from all former and other grants, bargains, sales, liens, taxes, assessments, encumbrances and restrictions of any kind or nature whatsoever except: taxes for 2013 which are a lien but are not yet due and payable; and any applicable zoning, land use, subdivision or other regulations of Montrose County, Colorado.

IN WITNESS WHEREOF, Grantors has hereunto set his hand executed as of the date set forth above.

David Andrews

Terri Andrews

STATE OF COLORADO:
COUNTY OF MONTROSE:

The foregoing instrument was acknowledged before me this 18th day of July, 2013 by David Andrews and by Terri Andrews. Witness my hand and official seal. ~~My commission expires:~~
/////////////////////

COUNTY CLERK
SEAL
MONTROSE COUNTY, COLORADO

~~Notary Public~~ Deputy County Clerk

EXHIBIT A

Ingress & Egress Easement

Legal Description

A strip of land 60 feet in width, 30 feet each side of centerline, measured at right angles, for a nonexclusive perpetual ingress and egress easement across and over that part of Government Lot 12, Section 10, Township 45 North, Range 15 West, New Mexico Principal Meridian, County of Montrose, State of Colorado, centerline of said easement being more particularly described as follows:

Commencing at the Northwest corner of Government Lot 12 (W 1/4) of said Section 10, an accepted stone monument, whence the Southwest corner of Government Lot 12 of said Section 10, a 2 1/2 inch Aluminum cap scribed PLS 38005 on a No. 6 rebar, bears South 01°50'08" East, a distance of 1324.41 feet, with all bearings herein being relative thereto;
thence South 62°47'32" East, a distance of 872.87 feet to a point on the South right-of-way line of Montrose County Road HH31, the POINT OF BEGINNING, whence the Southwest corner of Government Lot 12 of said Section 10, bears South 38°26'19" West, a distance of 1180.47 feet;
thence along said centerline the following two courses:
1) thence South 01°34'08" East, a distance of 183.26 feet;
2) thence South 06°47'57" East, a distance of 746.62 feet, to the South line of Government Lot 12 of said Section 10, and its TERMINUS, whence the Southwest corner of Government Lot 12 of said Section 10, bears South 89°59'40" West, a distance of 827.28 feet.

Containing 1.28 acres by these measures.

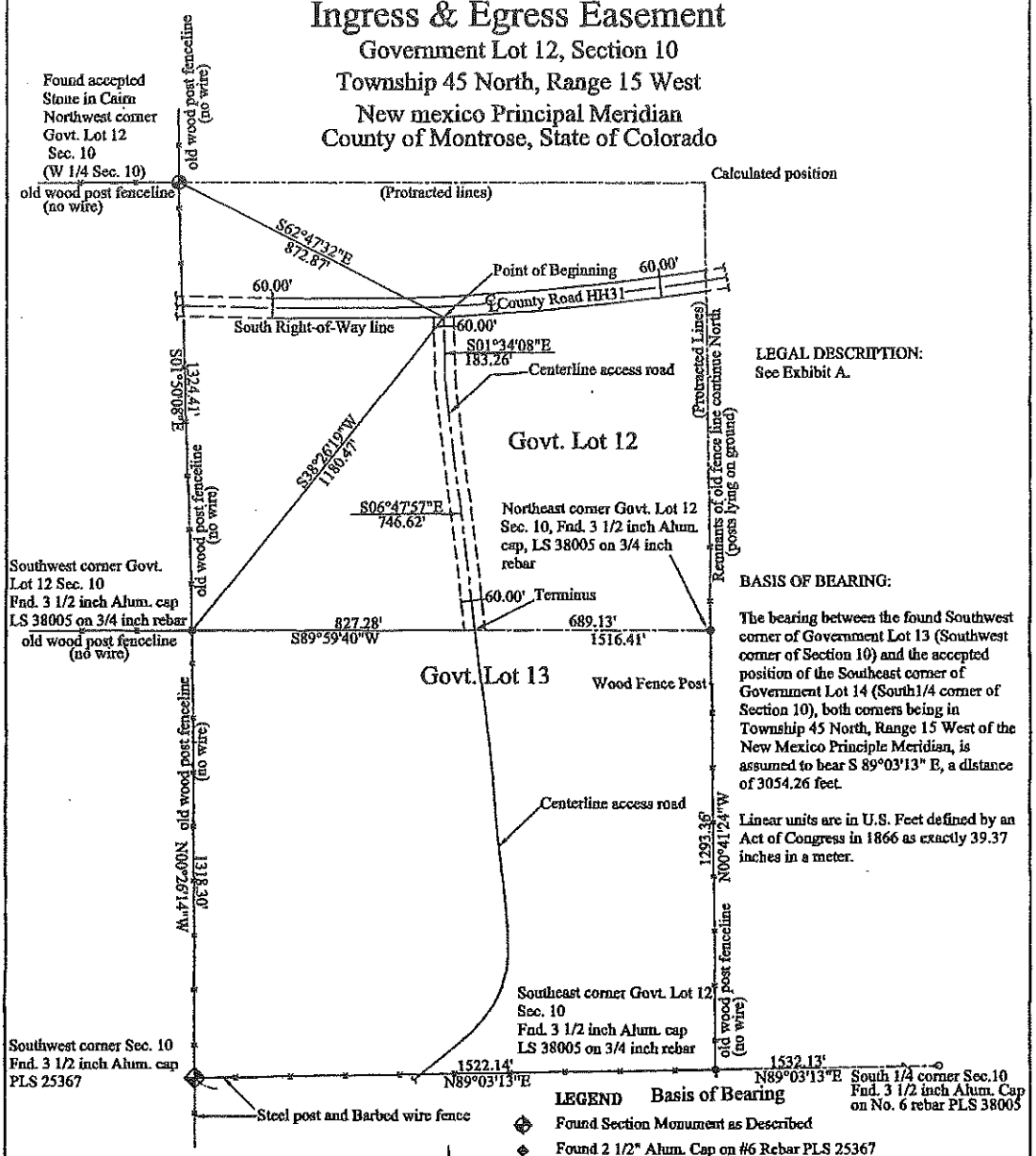
Legal description prepared by:
Merritt LS, L. L. C.
743 Horizon Ct., Suite 100B
Grand Junction, CO. 81506

Thomas W. Sylvester,
P. E. 14249 & P. L. S. 38005
May 22, 2013

COLORADO LICENSED
THOMAS W. SYLVESTER
5/29/13
PE 14249
PLS 38005
P.E. AND P.L.S.

Ingress & Egress Easement

Government Lot 12, Section 10
Township 45 North, Range 15 West
New mexico Principal Meridian
County of Montrose, State of Colorado



LEGAL DESCRIPTION:
See Exhibit A.

BASIS OF BEARING:

The bearing between the found Southwest corner of Government Lot 13 (Southwest corner of Section 10) and the accepted position of the Southeast corner of Government Lot 14 (South1/4 corner of Section 10), both corners being in Township 45 North, Range 15 West of the New Mexico Principle Meridian, is assumed to bear S 89°03'13" E, a distance of 3054.26 feet.

Linear units are in U.S. Feet defined by an Act of Congress in 1866 as exactly 39.37 inches in a meter.

Surveyor's Statement:

I, Thomas W. Sylvester, a Registered Professional Engineer and Professional Land Surveyor in the State of Colorado, do hereby certify that this Exhibit B, of the Ingress & Egress easement, on Government Lot 12 and the survey upon which it was based was completed by me or under my direct supervision, is based upon my knowledge, information, and belief, is in accordance with applicable standards of practice, and is not a guaranty or warranty, either expressed or implied.
Thomas W. Sylvester, PE 14249 & PLS 38005

COLORADO LICENSED
THOMAS W. SYLVESTER
5/20/13
PE 14249
PLS 38005
P.E. AND P.L.S.

EASEMENT EXHIBIT B

Merritt LS L.L.C.
743 Horizon Ct., Suite 100B
Grand Junction, Co. 81506
(970) 255-7386

Ingress & Egress Easement
Government Lot 12, Section 10
Township 45 North, Range 15 West
New Mexico Principal Meridian
County of Montrose, State of Colorado

RECEPTION#: 848368, 07/18/2013 at
11:03:31 AM, 1 OF 2, DEED R $16.00
FRANCINE TIPTON-LONG, MONTROSE
COUNTY, CO CLERK AND RECORDER

Copy

DEED

This Deed is made and entered into as of July 17, 2013 by and between the following parties:

GRANTOR: **TS Landfill, Inc.**, a Colorado corporation
c/o J. E. Stover & Associates, Inc.
2352 N 7th St Unit B
Grand Junction, CO 81501

GRANTEES: **David Andrews and Terri Andrews**, husband and wife, as joint tenants
with right of survivorship,
P. O. Box 523
Norwood, CO 81423

WITNESSETH, that the Grantor for and in consideration of the sum of Ten Dollars ($10.00) and other good and valuable consideration, the receipt and sufficiency of which is hereby irrevocably acknowledged, does hereby grant, bargain, sell and convey to Grantees, their heirs, successors and assigns forever, the following described vacant real property situated in Montrose County, Colorado, to wit: that portion of the NW/4 of Section 15 lying east of the centerline of Wickson Draw, being a portion of the property acquired by Grantor from Roy M. Davis and Betsy Davis by deed dated April 15, 1994 recorded at Book 876, Page 218, Reception No. 597396 of the land records of Montrose County, Colorado.

Together with all and singular the hereditaments and appurtenances thereunto belonging or in any way appertaining thereto, including but not limited to any and all mineral, water, timber, grazing, access, and development rights, and any and all rights of reversion or remainder, and all rents, issues, profits thereof; and all estate, right, title, interest, claim and demand whatsoever of the Grantor, either in law or in equity, of, in and to the above bargained premises, with the hereditaments and appurtenances;

TO HAVE AND TO HOLD the said premises above bargained and described, with the appurtenances, unto the Grantee, and its successors and assigns forever. Grantor, for itself and its successors and assigns, hereby covenants and agrees that it has good, clear title to the same, in fee simple absolute, without limitation, and has good right, full power and authority to grant, bargain, sell and convey the same in the manner and form as aforesaid, and that the same are free and clear of and from all former and other grants, bargains, sales, liens, taxes, assessments, encumbrances and restrictions of any kind or nature whatsoever except: taxes for 2013 which are a lien but are not yet due and payable; and any applicable zoning, land use, subdivision or other regulations of Montrose County, Colorado.

IN WITNESS WHEREOF, Grantor has hereunto set his hand executed as of the date set forth above.

TS Landfill, Inc.

By: _____

STATE OF COLORADO:
COUNTY OF Mesa:

The foregoing instrument was acknowledged before me this 17th day of July 2013 by James E. Stover who attested that he is the President of TS Landfill, Inc. and that he has been duly authorized to sign this instrument on behalf of TS Landfill, Inc. Witness my hand and official seal. My commission expires: 1/22/2015.

TAMMERIN K BISHOP
NOTARY
PUBLIC
STATE OF COLORADO

Tammerin K Bishop
Notary Public

STATE OF COLORADO, COUNTY OF MONTROSE
RECORDED AT 8:38 O'CLOCK A. M. 4-25-94
RECEPTION NO. 597396 DIANE L. HEATH, RECORDER

STATE DOCUMENTARY FEE
DATE APR 25 1994
$ .24

BARGAIN AND SALE DEED

ROY M. DAVIS and BETSY DAVIS, Grantors, whose address is P.O. Box 387, Norwood, Colorado 81423, for the consideration of TEN dollars and other good and valuable consideration, in hand paid, hereby sell and convey to TS Landfill, Inc., Grantee, whose address is 2768 Compass Drive, Suite 101, Grand Junction, Colorado 81506, the following real property to wit:

TOWNSHIP 45 NORTH, RANGE 15 WEST, N.M.P.M.
Section 15: NW/4

with all its appurtenances, subject to the reservation of the possibility of reverter to take effect at such time as the Grantee no longer exists or owns the described lands, such possibility of reverter to apply soley to the following portion of the described lands:

Beginning at the Northeast corner of said Northwest quarter of said Section 15; thence West 660 feet; thence South Southwesterly to the Southwest corner of the Southeast quarter of said Northwest quarter; thence East 1320 feet to Southeast corner of the Northwest quarter; thence North to the point of beginning,

County of Montrose,
State of Colorado.

Signed this 15th day of April, 1994.

Roy M. Davis

Roy M. Davis

Betsy Davis

Betsy Davis

STATE OF COLORADO)
) ss.
COUNTY OF San Miguel)

The foregoing was acknowledged before me on April 15, 1994, by Roy M. Davis and Betsy Davis.

My commission expires 6-9-97.
Witness my hand and official seal.

Notary Public

RECEPTION#: 846060, 05/07/2013 at
03:21:47 PM, 1 OF 2, QCD R $16.00
FRANCINE TIPTON-LONG, MONTROSE
COUNTY, CO CLERK AND RECORDER

QUITCLAIM DEED
and
RELEASE OF POSSIBILITY OF REVERTER

Know all men by these presents that:

WHEREAS, Roy M. Davis and Betsy Davis, retained a possibility of reverter in certain property transferred to TS Landfill, Inc. by deed dated April 15, 1994, which deed was recorded in the land records of Montrose County on April 25, 1994 at Reception No. 597396, Book 876, Page 218; and

WHEREAS, Roy M. Davis died testate in 1997; and

WHEREAS, Betsy Davis was Roy M. Davis' sole heir and is the recipient of any rights retained by Roy M. Davis under the possibility of reverter described above; and

WHEREAS, Betsy Davis is now the sole beneficiary of the possibility of reverter retained in the aforesaid deed; and

WHEREAS, the original purposes for which the possibility of reverter was written no longer exist and Betsy Davis has determined that there no longer is any reason for her to retain any rights under the possibility of reverter;

NOW THEREFORE, for and in consideration of the sum of One Dollar and other good and valuable consideration, the receipt and adequacy of which is hereby irrevocably acknowledged, Betsy Davis, P. O. Box 387, for herself and as sole heir of Roy M. Davis, deceased, Grantor, hereby grants, conveys, and quitclaims to TS Landfill, Inc, 2352 N 7th Street, Unit B, Grand Junction, CO 81501, Grantee, all right, title and interest which she may have under the possibility of reverter set forth in the above-referenced deed in and to a parcel of land which was previously owned by Grantor and located in

MONTROSE COUNTY, CO - TOWNSHIP 45 NORTH, RANGE 15 WEST, N.M.P.M.
Section 15: NW/4

Further, Grantor hereby releases said property from any and all limitations, restrictions or obligations whatsoever under the aforesaid possibility of reverter.

Witness my hand signed below this 1st day of May, 2013.

Grantor:

Betsy Davis

Betsy Davis

State of Colorado:
County of San Miguel:

The foregoing instrument was acknowledged before me this 1st day of May, 2013 by Betsy Davis, Grantor, as her free and voluntary act and deed. Witness my hand and official seal. My commission expires 11-23-15.

DONA M. LONG
NOTARY PUBLIC
STATE OF COLORADO
NOTARY ID 20114068562
MY COMMISSION EXPIRES 11-23-2015

Dona M. Long
Notary Public

APPENDIX 6

MONITORING

June 2016

APPENDIX 6

MONITORING

Monitoring Well Sampling Protocol

Disposable Gloves

New and clean disposal gloves are worn during all monitoring activities. The gloves should be changed after each monitoring step.

Decontamination

All monitoring/measuring equipment will be decontaminated before each use and decontaminated between wells. The equipment will be decontaminated with a laboratory detergent like Liquinoz or Alconox. New clean disposal gloves will be worn. The monitoring/measuring equipment will be rubbed clean with a paper towel saturated with the detergent. If necessary a soft brush can be used. The equipment will then be rinsed with a water detergent mix followed by a final rinse with distilled water.

Static Water Level

Static water level will be obtained at each well with a decontaminated m-scope before the well is bailed. Water level measurements will be determined from the top of the well casing. The elevation of the top of each well casing will be surveyed to an accuracy of 0.01 feet. The static water level will be measured to an accuracy of 0.01 feet.

Sample Bottles

The field personnel will obtain the required sample bottles from the laboratory that is performing the analyses. The laboratory will add acid to any of the bottles requiring such treatment. Sample bottles are to be labeled with the label affixed to each sample bottle. The label will contain the well identifier, date and time of sample collection, initials of sampler and analysis to be performed. A chain of custody form will be provided by the testing laboratory.

Groundwater Sample Collection

Prior to initiating groundwater sampling activities, the monitoring personnel will decontaminate and calibrate all field test equipment. New and clean disposable gloves shall be worn. Disposable bailers and associated disposable rope will be used to obtain water samples.

Purging of each well will be accomplished with a disposable bailer. After approximately three casing volumes have been evacuated, a ground-water sample will be collected. It is unlikely the monitoring wells at the Broad Canyon Landfill will yield three casing volumes because the wells will be very low yielding. If the wells are very low yielding, purging the wells will not be necessary. The water bailed from the wells will be placed directly into the sample bottles. Airspace at the top of the bottles shall be minimized. Some of the water bailed from each well can be placed in a separate container to determine field parameters. Field parameters consist of measurements of pH, conductivity, temperature.

Records

A log book will be maintained to record the following:

- Name(s) of field personnel
- Monitoring Well Identifier
- Weather conditions
- Date and time of sample collection
- Field parameters with depth to water measured to the nearest 0.01 foot

Monitoring is required for surface water, ground water and explosive gasses. The following narrative summarizes the monitoring plan for the landfill:

Surface Water

Surface run-off from up gradient of the landfill will be diverted away from the active portion of the landfill by two diversion ditches. Most of the surface run-off from the active portion of the landfill will be collected into a containment (sediment) pond. Surface water will be monitored at the outlet of the containment pond and in accordance with the Operators stormwater management plan. Details of the sediment pond are presented on drawings LF-06 and LF-07.

Ground Water

The following wells shown on drawing LF-02 are monitored:

Well Nomenclature	Elevation Ground	Elevation Casing	Monitored Interval Elevation		Methane Monitored
M-1	6194	6197.4	6096.2	6076.2	No
M-2	6198	6201.4	6111.3	6091.3	No
M-3	6213	6216	6118.3	6098.2	No
WD-1A	6215.23	6218.56	6211.1	6193.5	Yes
WD-1B	6204.32	6217.01	6183.3	6124.5	No
WD-2A	6204.32	6206.78	6200.3	6183.5	Yes
WD-2B	6204.82	6206.94	6182.4	6139.8	No
WD-3A	6305.67	6308.18	6301.7	6285.5	Yes
WD-3B	6307.17	6310.45	6285.2	6233.8	No
WD-4A	6273.38	6275.72	6267.9	6240.6	Yes
WD-4B	6272.01	6274.47	6238.5	6198.3	No
LGF Probe-1	6264.83	6267.36	6260.8	6237.0	Yes

Monitoring wells M-1, M-2 and M-3 are completed as a typical bedrock well as shown of the Hydrologic Area Map, LF-03. The completion details for the remaining wells are shown of Map LF-04.

The well(s) will be monitoring quarterly for 8 events testing for Appendix IA and IB parameters to establish background levels. After 8 monitoring events, the wells will be monitored on a semi-annual basis. Monitoring results will be submitted to the Department with the annual report.

If the Operator observes, or is made aware of a condition or event which is likely to cause a release or has caused a release of a substance containing a parameter identified in the facility detection monitoring program and that such condition or event is likely to cause a statistically significant increase over background, the owner or operator shall notify the department and the local governing body having jurisdiction in writing within ten (10) days. The notification(s) will be made part of the facility operating record.

Leachate

Leachate production will be monitored monthly. Flow will be determined by one of the methods described below. A sample of leachate will be tested for field parameters (pH, conductivity and temperature quarterly. Leachate will be analyzed annually for the BSGW Regulation 41 constituents.

Reporting

By April 30th of each year the Division will be provided an annual monitoring report, to include all monitoring information collected during the prior calendar year.

Explosive Gases

Quarterly well head monitoring will be performed on the wells shown above. This monitoring is considered monitoring at the boundary of the facility.

Quarterly monitoring in the office and any other enclosed structures.

Methods

The following narrative explains the methods used to perform water monitoring:

Flow - Flow is determined by the following methods:

- Timing flow into a bucket of known volume
- Using a portable flume
- Determining the change in water level in a tank of known volume

pH - A pocket size tester (pH. Range -1.0 to 15.0 pH). Resolution 0.1 pH. Accuracy +/- 0.1 pH. Operating temperature 0 to 50 ^{o}C. Temperature compensation: automatic 0 to 50 ^{o}C.

Conductivity - Pocket size EC Testr(s). Accuracy: +/- 1% FS. Temperature compensation: automatic 0 to 50 ^{o}C. Operating temperature: 0 to 50 ^{o}C. Ranges: 0 to 0 to 1,990 umhos/cm and 2.0 to 19.90 mmhos/cm.

Temperature - Conductivity meter has a temperature reading.

Other parameters - Water samples are placed in a cooler with ice and sent to a laboratory for analysis. SGS Accutest Laboratories is currently used for full suite analysis.

APPENDIX 7

MONTROSE COUNTY
CERTIFICATE OF DESIGNATION

BROAD CANYON LANDFILL

No. 12 - 95

RESOLUTION
of
THE BOARD OF MONTROSE COUNTY COMMISSIONERS

CONCERNING: Certificate of Designation
for
TS Landfill, Inc.

WHEREAS, TS Landfill, Inc. has requested approval to site a landfill in Montrose County, Colorado; and

WHEREAS, J.E. Stover and Associates has completed the necessary engineering for such site to be located on NW1/4 Section 15, Township 45N, Range 15W, NMPM.

WHEREAS, the Hazardous Materials and Waste Management Division of the Colorado Department of Health has completed its technical review of the application; and

WHEREAS, hearings were held on April 12, 1995, in Naturita, Colorado, and April 25, 1995, in Montrose, Colorado; and

WHEREAS, the Board of Montrose County Commissioners considered CRS 30-20-104 "Factors to be considered" in deliberation of this decision.

NOW, THEREFORE BE IT RESOLVED that the undersigned County Commissioners of Montrose County, Colorado, do hereby issue a **Certificate of Designation** to TS Landfill, Inc. to site the Broad Canyon Landfill with the following stipulations:

1. Pursuant of section 1.8 of the Regulations, TS Landfill, Inc. shall establish financial assurance sufficient to hire a third party to close such site and facility and to conduct post closure care of such site and facility. (From the letter by Donna Stoner, of the Colorado Department of Health, to the Commissioners, dated December 14, 1994)
2. The Broad Canyon Landfill shall be sited by April 25, 1997.

Is hereby granted this 23 day of May, 1995.

BOARD OF MONTROSE COUNTY COMMISSIONERS

Cindy K. Bowen
CINDY K. BOWEN

Melvin W. Staats
MELVIN W. STAATS

David L. Gann
DAVID L. GANN

ATTEST:

Connie J. Hunt
DEPUTY CLERK

APPENDIX 8

IGES TECHNICAL REPORTS

DATED

SEPTEMBER 8, 2011

&

FEBRUARY 27, 2012

IGES®
Intermountain GeoEnvironmental Services Inc.
4153 South 300 West Salt Lake City, Utah 84107 ~ T: (801) 270-9400 ~ F: (801) 270-9401

February 27, 2012

Jim Stover
J. E. Stover & Associates, Inc.
2352 N 7th St Unit B
Grand Junction, CO 81501

RE: Colorado Department of Public Health and Environment
Technical Comments – January 9, 2012

Dear Mr. Stover,

This document is a partial response to the January 9, 2012 Colorado Department of Public Health and Environment (CDPHE) document sent to your office regarding Broad Canyon Landfill. This document contains supplemental analysis and clarifications to the September 8, 2011 IGES, Inc. Broad Canyon Landfill Cover Assessment report. This document should not be read without first reading the September 8th IGES report.

WATER BALANCE

Several sophisticated Evapotranspiration Cover (ET cover) software applications (EPIC, UNSAT-H, HYDRUS, etc.) are available for use in the modeling of alternate landfill covers, but those applications rely on very precise measurements of site parameters. In order to utilize features of the sophisticated models, it would be necessary to install equipment at the landfill site including lysimeters and a class-A rain gauge station. Not only will the data collection equipment need to be installed at the site, the equipment may need to be operated for several years to collect statistically meaningful data.

The excel spreadsheet that IGES Inc. has utilized is a screening level water balance model that incorporates regional evaporation and precipitation data while testing the site-specific soil parameters. In rural areas (usually small landfills) the availability of daily meteorological data is limited so the use of the more sophisticated ET cover models is not practical.

The ET cover analysis that IGES has performed in association with the Broad Canyon Landfill utilize precipitation data from the closest Western Regional Climate Centers weather stations (Uravan and Norwood Colorado) and regional monthly pan evaporation data from Montrose. The pan evaporation and precipitation data was monthly data that was inserted into a monthly water balance as fixed values. Pan evaporation values were reduced by 40% to provide a more realistic field performance as determined by Penman-Wilson.

Other fixed values input into the model were the wilting point of soil and the field capacity of soil for the site soils. The soil moisture relationship was derived by the development of the Soil Water Characteristic Curve utilizing ASTM D6836. The three other variables accounted for in the IGES model are runoff, initial moisture of cover soil and the thickness of cover soil. IGES set runoff to 0% while putting initial moisture content of the soil at the midpoint of the wilting point and field capacity of the site soils. Soil cover thickness was set to 12 inches for the analysis.

The results of the ET cover analysis showed that even after reducing the pan evaporation measurements, using the climatological site with the highest precipitation, utilizing the worst soil data (lowest difference between Wilting Point and Field Capacity), setting site runoff to 0% and limiting the cover thickness to a minimum of 12 inches that a successful ET cover could be constructed at Broad Canyon Landfill. Actual final design will obviously include a landfill with positive slopes that will shed more water than the 0% design analysis and a final cover thickness well over 12 inches in thickness further enhancing the ET covers performance.

STABILITY ANALYSIS

Additional slope stability analysis was performed for Broad Canyon Landfill utilizing a new final slope configuration. The static and pseudo-static slope stability analyses were completed using the computer program SLIDE v.6.0 by RocScience. In addition to reconfiguring the final cover geometry, modified strength and seismic values were utilized to reflect comments in the CDPHE letter.

The stability analysis was again performed on the north slope of the reconfigured landfill which is comprised of a series of slopes and benches. The proposed geometry has a composite slope of 4H to 1V or 25% as prescribed by State regulations.

The unit weight of the MSW in the landfill was calculated to be 67.5 pcf assuming 25% of the landfill is composed of Sandy CLAY from daily cover. The strength value of the MSW was decreased to 25 degrees for the angle of internal friction for all analysis to reflect CDPHE comments. The 121 psf cohesion previously used for the waste was not modified.

Seismic loading was considered based on 2% probability of exceedance in 50 years of the Maximum Credible Earthquake for a firm rock site. The value generated for Peak Ground Acceleration (PGA) by the USGS Earthquake Ground Motion Tool was 0.12g. In addition, the cohesion intercept was reduced by 20% for the waste mass in the pseudo static case.

Static and pseudo-static analyses of the slope sections were performed using the revised landfill geometry, changes in strength noted above and the soil and waste parameters utilized in the previous IGES report.

Based on conservative values for unit weight and strength parameters the static analysis the model indicates a minimum factor of safety of 2.01 for the intermediate 2.5H:1V proposed slopes and 1.78 for the veneer. The Pseudo-static analysis indicates a factor of safety of 1.40. Results from the analysis are attached. Global stability analyses of the overall benched 2-slope configuration resulted in minimum factors of safety of 2.32 and 1.51 for the static and pseudo-statics cases respectively. An additional analysis was performed to evaluate the impacts of using the 2.5H:1V intermediate slope and bench configuration for further vertical expansion of the landfill up to a maximum height of 180 feet or six-30 ft. lifts. The resulting minimum global stability of the expanded configuration had a calculated factor of safety of 2.23 under static conditions. The results of the revised analyses presented herein showed that utilizing the flatter 2.5H:1V slope geometry, lower strength values, and higher seismic loads produced adequate factors of safety for the proposed landfill final cover.

CLOSURE

LIMITATIONS

The recommendations contained in this report are based on a limited field observations, laboratory testing, and our present understanding of the proposed landfill expansion. The subsurface data used in the preparation of this report were obtained from the explorations made for this investigation, values obtained from the literature, professional judgment and reduced strength values for MSW as suggested by the State of Colorado in their review comments.

This report was prepared in accordance with the generally accepted standard of practice at the time the report was written. No warranty, expressed or implied, is otherwise made.

ooOoo

It has been a pleasure assisting you on this project. We look forward to providing additional assistance as the project should it be required. If you have any questions, please feel free to call at your earliest opportunity.

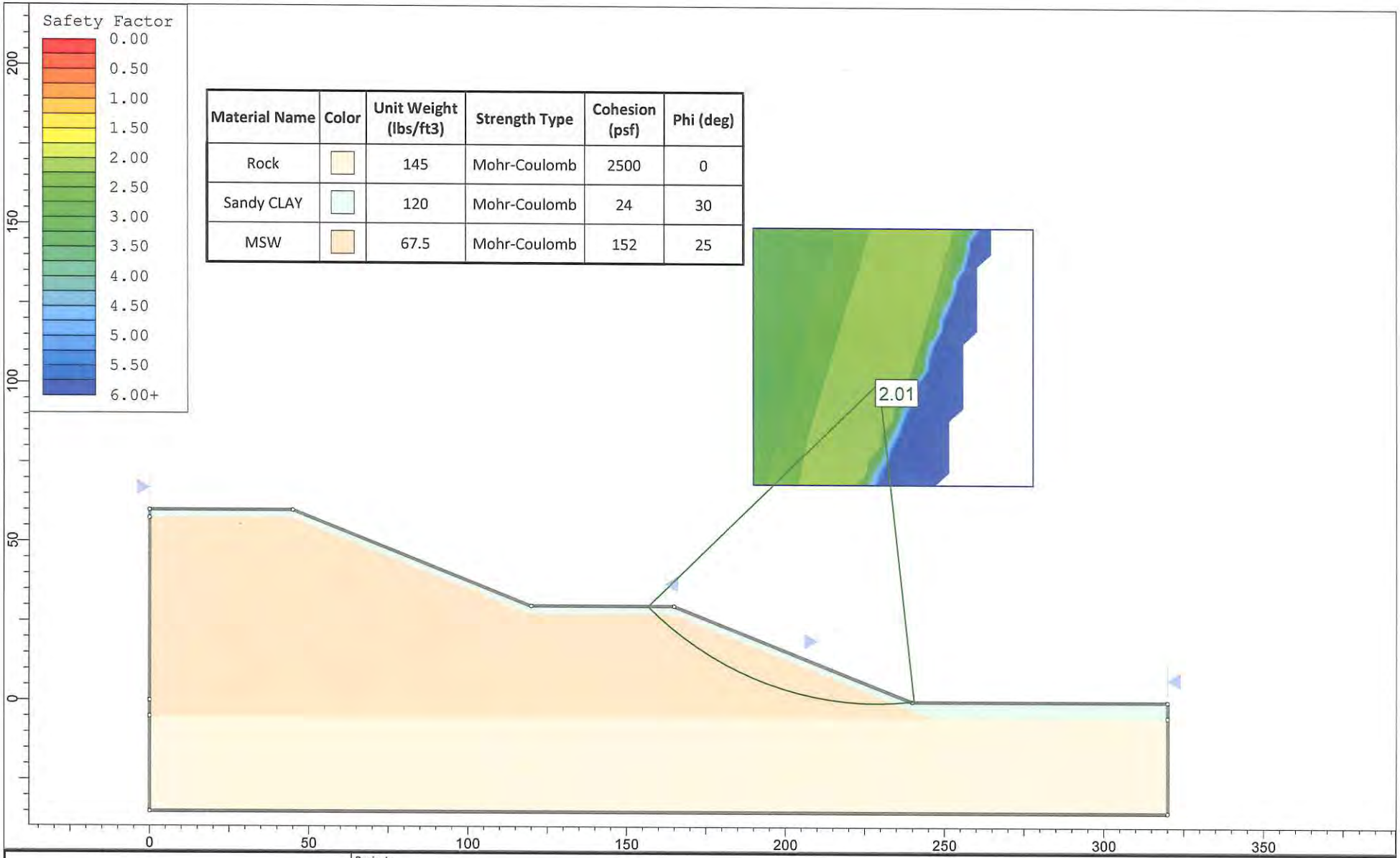
Very truly yours,
IGES, INC.

COLORADO REGISTERED JOHN F. WALLACE 28165 PROFESSIONAL ENGINEER

2-27-12

John F. Wallace, P.E.
Principal
Professional Engineer No. 28165
State of Colorado

Attachments/

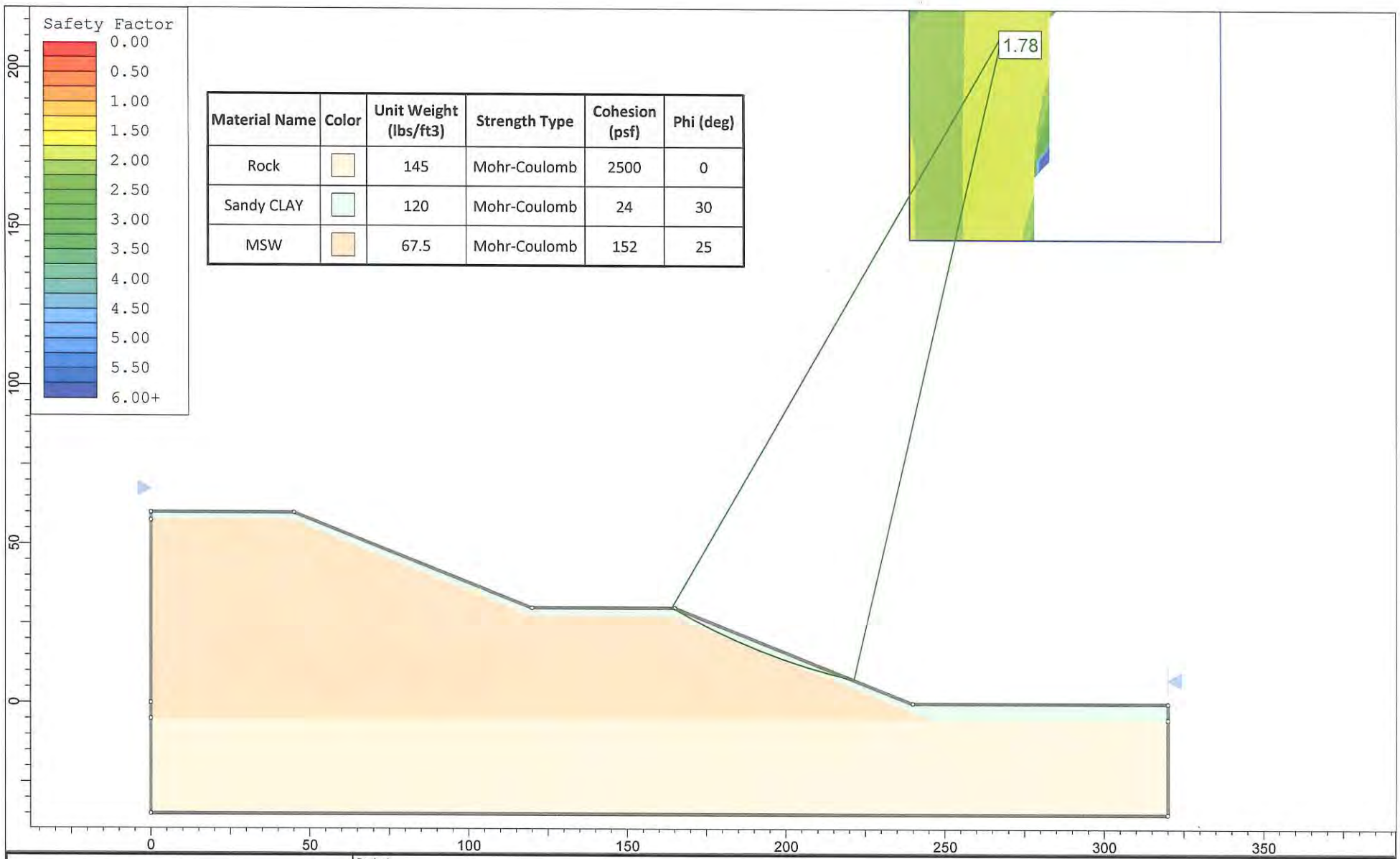


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Rock		145	Mohr-Coulomb	2500	0
Sandy CLAY		120	Mohr-Coulomb	24	30
MSW		67.5	Mohr-Coulomb	152	25

IGES®

SLIDEINTERPRET 6.015

Project	Broad Canyon Landfill		
Analysis Description	North Slope, soil and MSW - 2.5 to 1 with 45 foot benches - lower slope - Static analysis		
Drawn By	JMB	Scale 1:500	Company IGES, Inc
Date	1/27/2012, 11:52:58 PM		File Name North Slope, soil and MSW 2.5 to 1 with benches - lower slope.slim

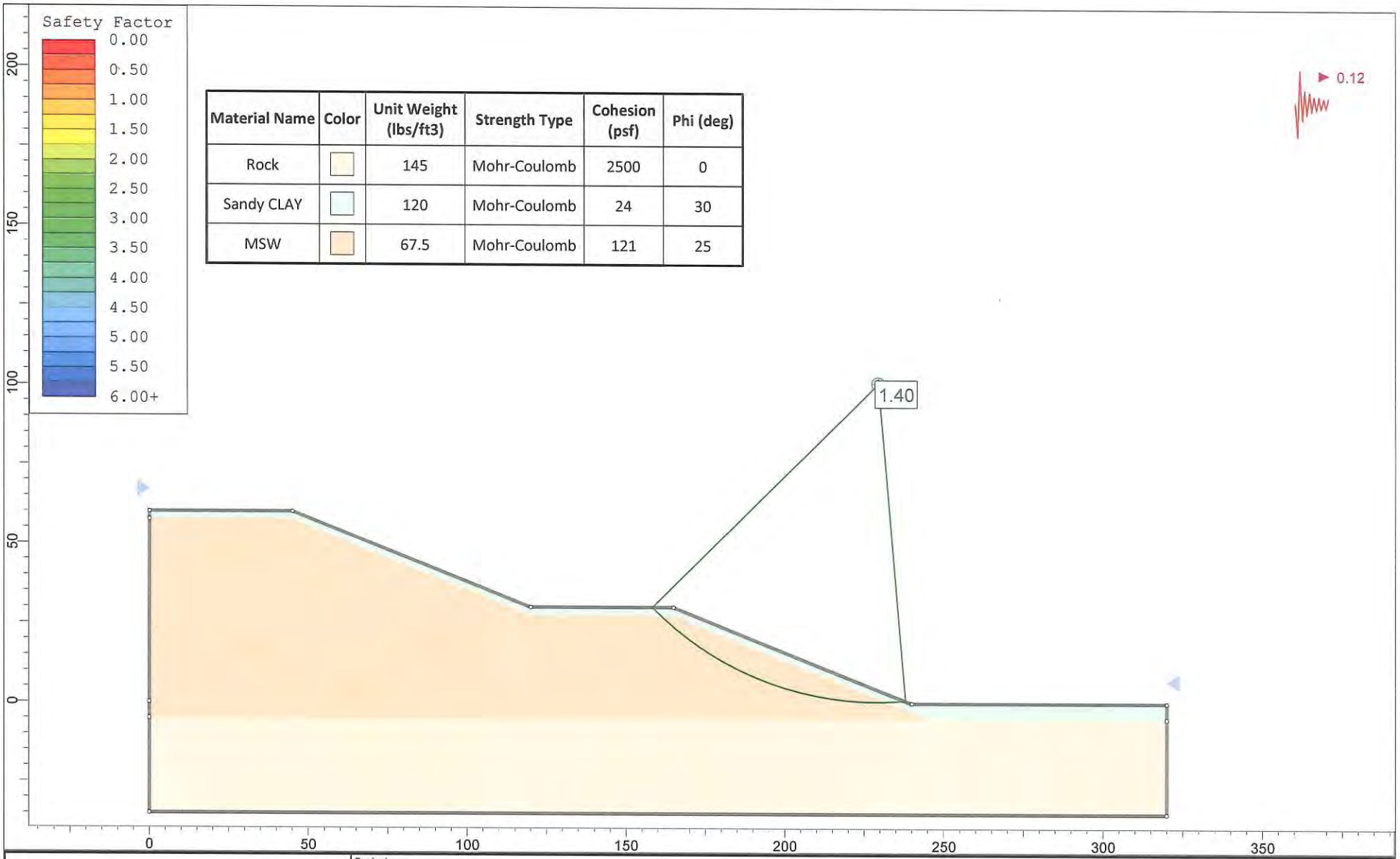


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Rock		145	Mohr-Coulomb	2500	0
Sandy CLAY		120	Mohr-Coulomb	24	30
MSW		67.5	Mohr-Coulomb	152	25

IGES®

SLIDEINTERPRET 6.015

Project	Broad Canyon Landfill		
Analysis Description	North Slope, soil and MSW - 2.5 to 1 with 45 foot benches - lower slope cap - Static analysis		
Drawn By JMB	*Scale* 1:500	*Company* IGES, Inc	
Date 1/27/2012, 11:52:58 PM		*File Name* North Slope, soil and MSW 2.5 to 1 with benches - lower slope cap.slim	

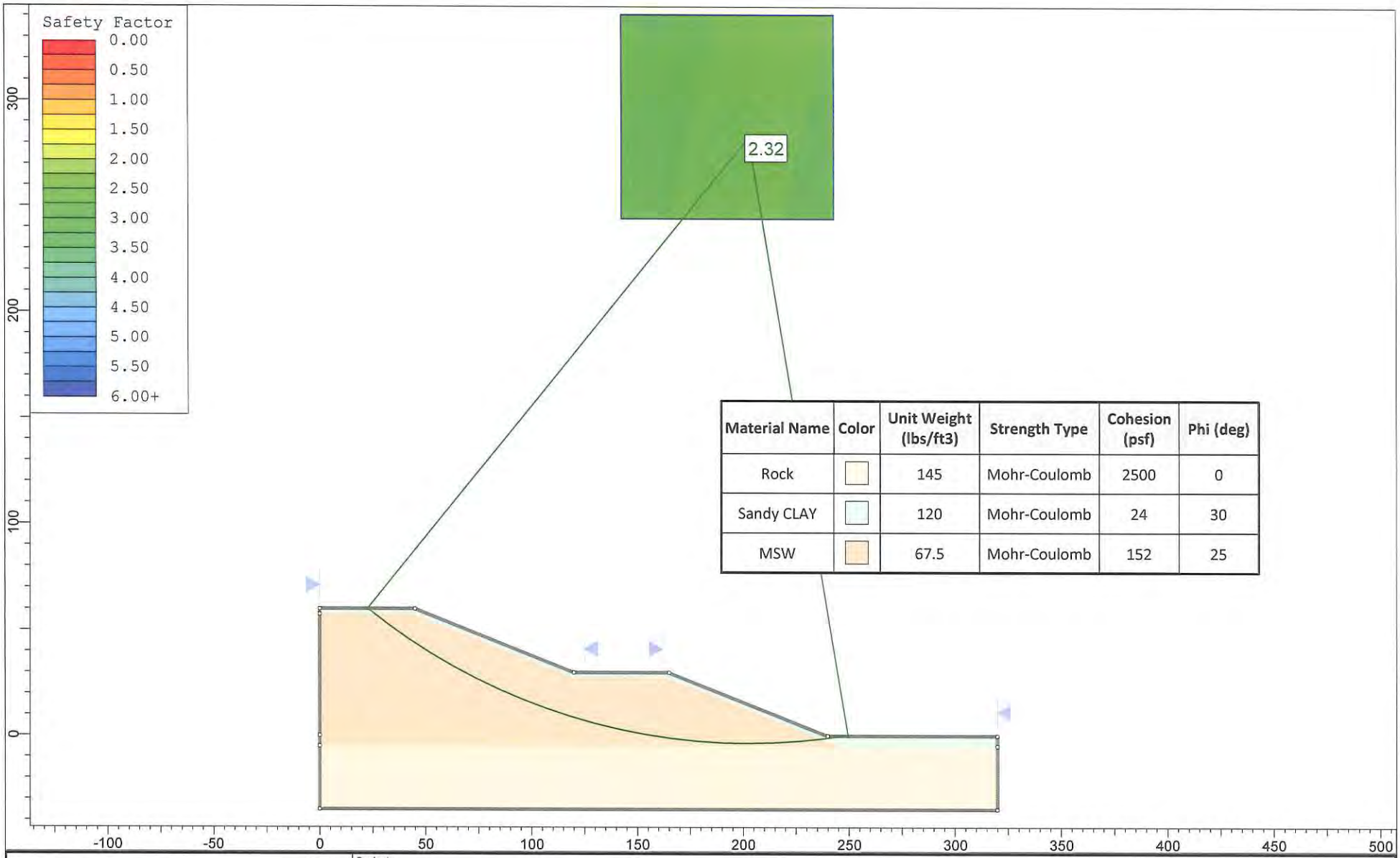


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Rock		145	Mohr-Coulomb	2500	0
Sandy CLAY		120	Mohr-Coulomb	24	30
MSW		67.5	Mohr-Coulomb	121	25

IGES®

SLIDEINTERPRET 6.015

Project	Broad Canyon Landfill		
Analysis Description	North Slope, soil and MSW - 2.5 to 1 with 45 foot benches - lower slope - Pseudostatic analysis		
Drawn By	JMB	Scale 1:500	Company IGES, Inc
Date	1/27/2012, 11:52:58 PM		File Name North Slope, soil and MSW 2.5 to 1 with benches - lower slope - pseudostatic.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Rock		145	Mohr-Coulomb	2500	0
Sandy CLAY		120	Mohr-Coulomb	24	30
MSW		67.5	Mohr-Coulomb	152	25

IGES®

SLIDEINTERPRET 6.015

Project	Broad Canyon Landfill
Analysis Description	North Slope, soil and MSW - 2.5 to 1 with 45 foot benches - whole slope - Static analysis
Drawn By	JMB
Scale	1:750
Company	IGES, Inc
Date	1/27/2012, 11:52:58 PM
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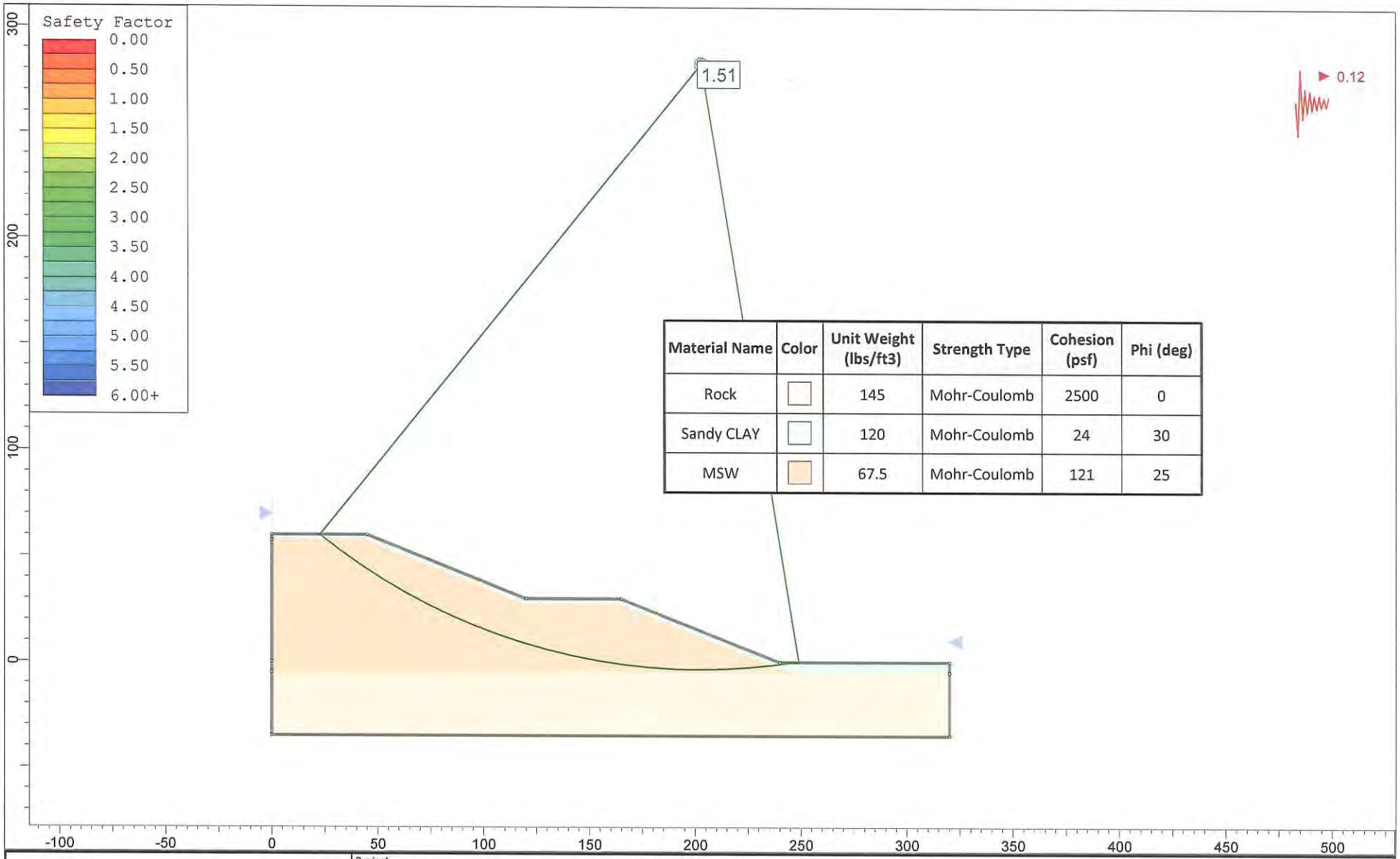
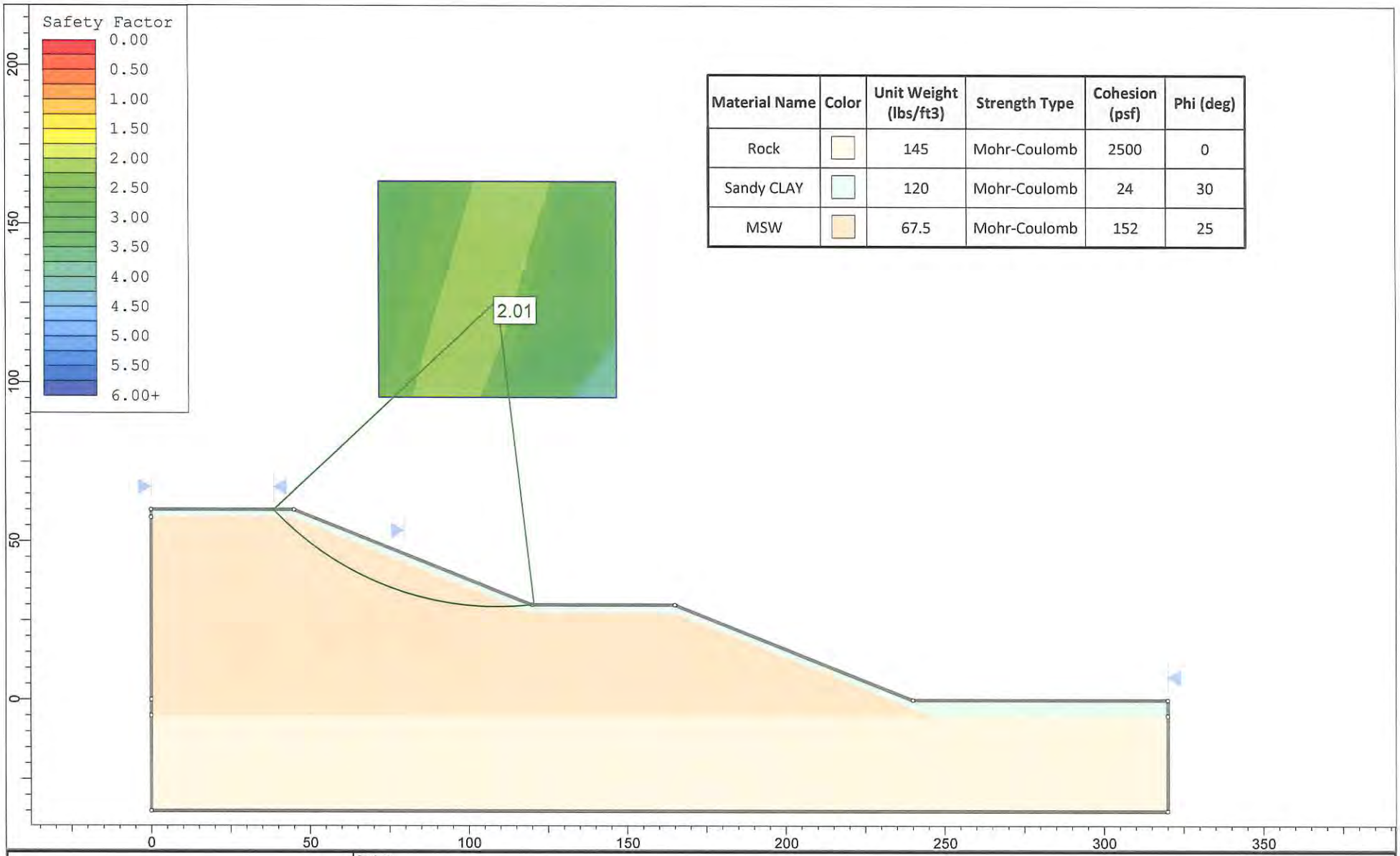


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Rock		145	Mohr-Coulomb	2500	0
Sandy CLAY		120	Mohr-Coulomb	24	30
MSW		67.5	Mohr-Coulomb	121	25

IGES®

SLIDEINTERPRET 6.015

Project	Broad Canyon Landfill		
Analysis Description	North Slope, soil and MSW - 2.5 to 1 with 45 foot benches - whole slope - Pseudostatic analysis		
Drawn By	JMB	Scale 1:750	Company IGES, Inc
Date	1/27/2012, 11:52:58 PM		File Name North Slope, soil and MSW 2.5 to 1 with benches - whole slope - pseudostatic.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Rock		145	Mohr-Coulomb	2500	0
Sandy CLAY		120	Mohr-Coulomb	24	30
MSW		67.5	Mohr-Coulomb	152	25

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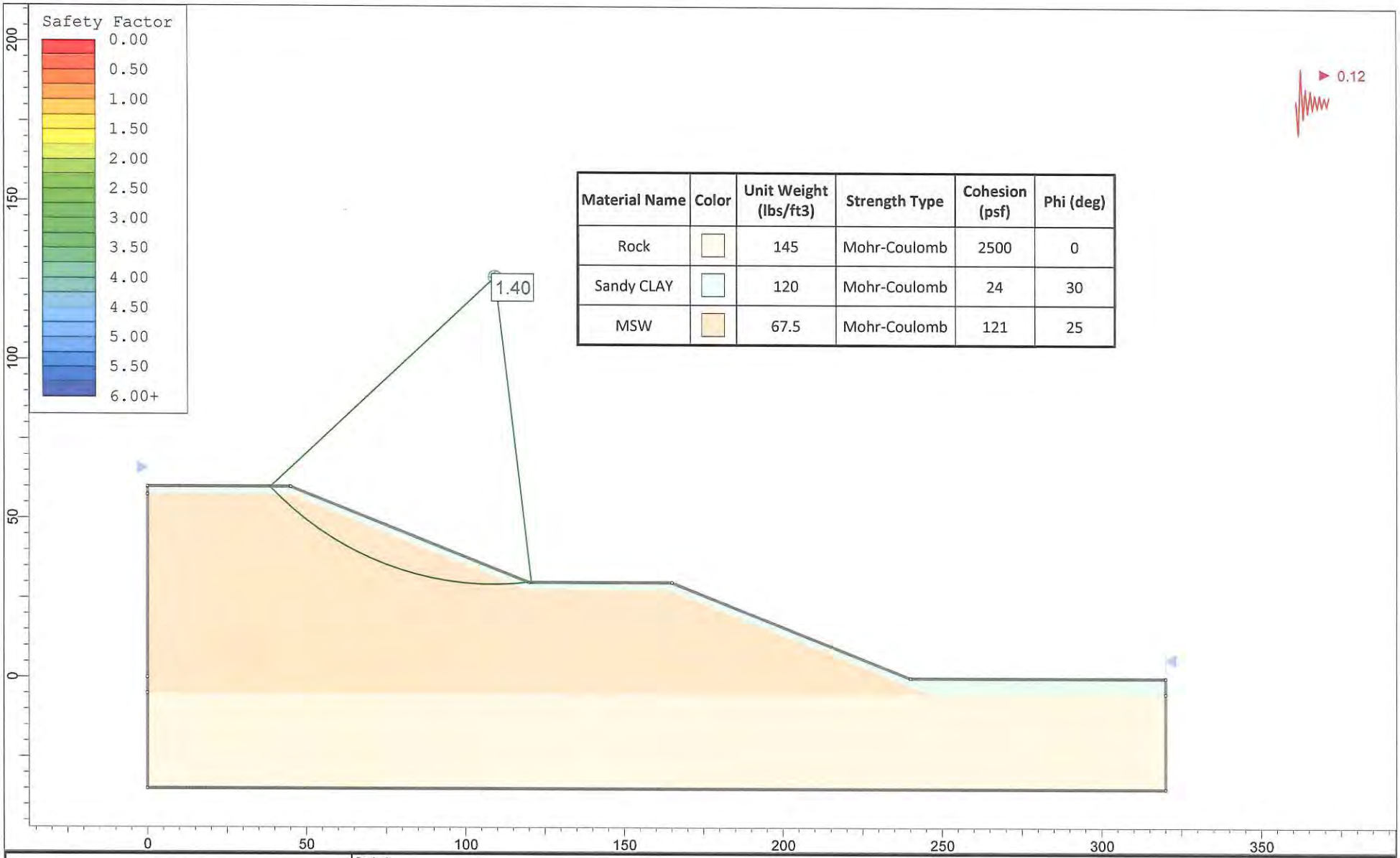
SLIDEINTERPRET 6.015

Project	Broad Canyon Landfill		
Analysis Description	North Slope, soil and MSW - 2.5 to 1 with 45 foot benches - upper slope - Static analysis		
Drawn By JMB	*Scale* 1:500	*Company* IGES, Inc	
Date 1/27/2012, 11:52:58 PM		*File Name* North Slope, soil and MSW 2.5 to 1 with benches - upper slope.slim	

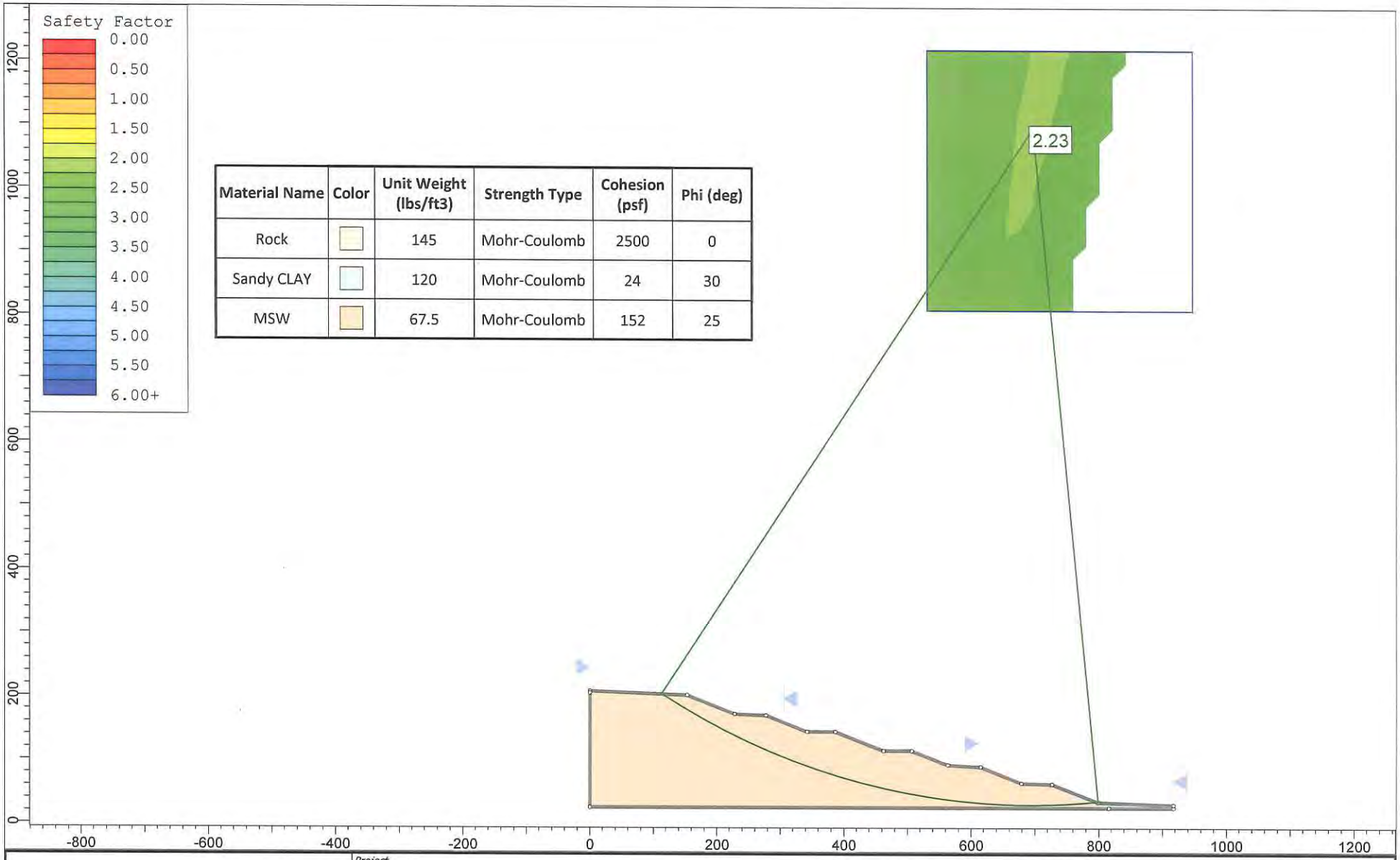


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Rock		145	Mohr-Coulomb	2500	0
Sandy CLAY		120	Mohr-Coulomb	24	30
MSW		67.5	Mohr-Coulomb	121	25

IGES®

SLIDEINTERPRET 6.015

Project	Broad Canyon Landfill		
Analysis Description	North Slope, soil and MSW - 2.5 to 1 with 45 foot benches - upper slope - Pseudostatic analysis		
Drawn By	JMB	Scale 1:500	Company IGES, Inc
Date	1/27/2012, 11:52:58 PM		File Name North Slope, soil and MSW 2.5 to 1 with benches - upper slope - pseudostatic.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Rock		145	Mohr-Coulomb	2500	0
Sandy CLAY		120	Mohr-Coulomb	24	30
MSW		67.5	Mohr-Coulomb	152	25

IGES®

SLIDEINTERPRET 6.015

Project	Broad Canyon Landfill		
Analysis Description	North Slope, soil and MSW - 2.5 to 1 with 45 foot benches - entire slope - Static analysis		
Drawn By	JMB	Scale 1:2500	Company IGES, Inc
Date	2/27/2012, 11:52:58 PM		File Name North Slope, soil and MSW 2.5 to 1 with benches - entire north slope.slim

Intermountain GeoEnvironmental Services, Inc.
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BROAD CANYON LANDFILL COVER ASSESSMENT NATURITA, COLORADO

IGES Project No. 01508-001

September 8, 2011

Prepared for:

J.E. Stover & Associates, Inc.

PURPOSE AND SCOPE OF WORK

IGES Inc. has been retained by J. E. Stover and Associates Inc. to assist in the evaluation of an alternate cover system for the Broad Canyon Landfill located near Naturita Colorado. The scope of work associated with the alternative cover assessment included geotechnical laboratory testing, collection of rainfall and evaporation data, slope stability analysis and computer modeling of an evapotranspiration (ET) soil cover. IGES personnel visited the Broad Canyon Landfill on April 30, 2011 to become familiar with the landfill and to collect soil samples for laboratory analysis.

LABORATORY TESTING

Bulk samples were collected from various locations around the landfill for potential geotechnical laboratory testing. A suite of testing was conducted on two bulk samples that represented site soils likely to be utilized in future cover construction. Testing included the following:

- Specific Gravity
- Soil Water Characteristic Curve (Capillary moisture)
- Atterberg Limits
- Particle Size Analysis (Hydrometer)
- Laboratory Compaction (Standard Proctor)
- Direct Shear

Additional analysis was performed on the site soils to get a baseline understanding of saturated permeability. Two backpressure permeability tests were performed on site soils, one with a consolidation stress of 1.4 psi and one with a consolidation stress of 13.9 psi. The lower consolidation stress best represents the saturated permeability of the site soils utilized in a cover application while the higher consolidation stress representing the saturated permeability of the site soils utilized as a liner. The permeability value for the cover application was 1.9E-05 cm/sec with a lower permeability of 1.1E-06 cm/sec for the liner application.

Appendix A contains the laboratory testing results.

ALTERNATE COVER ANALYSIS

Precipitation and pan evaporation data was collected for sites near the Broad Canyon Landfill. The two sites closest to the landfill that had precipitation data were the Uravan and Norwood Colorado climate stations, pan evaporation data from the Montrose 1 evaporation station was

utilized for the analysis. Appendix B contains the precipitation and Pan Evaporation data. ET analysis was conducted as follows:

Norwood – Analysis (Soil Sample 1):

- Average monthly (84 years of data) precipitation data from the Norwood Colorado climate station = 15.41 inches.
- Average monthly (34 years of data) pan evaporation data from Montrose Colorado data = 57.45 inches. Pan evaporation reduced by 40% (Penman-Wilson) = 34.47 inches.
- Soil data from bulk sample 1
  - Wilting Point = 28%
  - Field Capacity = 16%
- Initial soil moisture set to mid-point between Wilting Point and Field Capacity.
- Runoff set to zero.
- Landfill cover thickness set to a minimum of 12".

Norwood – Analysis (Soil Sample 2):

- Average monthly (84 years of data) precipitation data from the Norwood Colorado climate station = 15.41 inches.
- Average monthly (34 years of data) pan evaporation data from Montrose Colorado data = 57.45 inches. Pan evaporation reduced by 40% (Penman-Wilson) = 34.47 inches.
- Soil data from bulk sample 2
  - Wilting Point = 20%
  - Field Capacity = 10%
- Initial soil moisture set to mid-point between Wilting Point and Field Capacity.
- Runoff set to zero.
- Landfill cover thickness set to a minimum of 12".

Uravan – Analysis (Soil Sample 1):

- Average monthly (50 years of data) precipitation data from the Uravan Colorado climate station = 12.6 inches.
- Average monthly (34 years of data) pan evaporation data from Montrose Colorado data = 57.45 inches. Pan evaporation reduced by 40% (Penman-Wilson) = 34.47 inches.
- Soil data from bulk sample 1
  - Wilting Point = 28%
  - Field Capacity = 16%

- Initial soil moisture set to mid-point between Wilting Point and Field Capacity.
- Runoff set to zero.
- Landfill cover thickness set to a minimum of 12".

Uravan – Analysis (Soil Sample 2):

- Average monthly (50 years of data) precipitation data from the Norwood Colorado climate station = 12.6 inches.
- Average monthly (34 years of data) pan evaporation data from Montrose Colorado data = 57.45 inches. Pan evaporation reduced by 40% (Penman-Wilson) = 34.47 inches.
- Soil data from bulk sample 2
  - Wilting Point = 20%
  - Field Capacity = 10%
- Initial soil moisture set to mid-point between Wilting Point and Field Capacity.
- Runoff set to zero.
- Landfill cover thickness set to a minimum of 12".

Appendix C contains the results of each of the ET cover analysis.

SLOPE STABILITY ANALYSIS

Stability analysis was performed on the existing slope configuration on the North side of the landfill. As built drawings were reviewed and it was determined the North Slope of the Broad Canyon Landfill has the steepest slopes at approximately 1.5H to 1V with some areas slightly steeper. On-site physical observations indicate the slope is stable. The unit weight of the MSW in the landfill was calculated to be 67.5 pcf assuming 25% of the landfill is composed of Sandy CLAY from daily cover and 75% MSW with a unit weight of 51 pcf. Higher unit weight is conservative and represents a higher instability driving force for both the static and pseudo-static cases. Seismic loading was considered based on 2% probability of exceedance in 50 years of the Maximum Credible Earthquake for a firm rock site. Due to extrapolation of attenuation curves, the horizontal acceleration of 0.088g is very conservative for the pseudo-static case. The static and pseudo-static slope stability analyses were completed using the computer program SLIDE v.6.0 by RocScience.

Based on conservative values for unit weight and strength parameters the static analysis the model indicates a factor of safety of 1.5. The pseudo-static analysis indicates a factor of safety of 1.01 for the existing slope.

Additional slope stability analysis was performed on the Broad Canyon Landfill that represents future construction of the landfill utilizing 1.5:1 side slopes and a 30′ setback from the existing slope. The model indicates a factor of safety of 1.75 for static conditions and a factor of safety of 1.11 for Pseudo-static conditions for the overall slope. Slope stability analysis for the upper slope only indicates a static factor of safety of 1.55 with a Pseudo-static factor of safety of 1.02.

Appendix D contains the results for the slope stability analysis.

RESULTS

ET Cover - The combination of site soil characteristics combined with precipitation and Pan Evaporation data show that the Broad Canyon Landfill is suitable for an ET Cover. ET cover analysis of the site soils showed no water percolating through the 12" soil cover thickness.

The Norwood precipitation data showed that there were 3 months that the precipitation exceeded the projected evaporation rate but did not exceed the soils moisture storage capacity. The Uravan precipitation data showed that there were 2 months that the precipitation exceeded the projected evaporation but did not exceed the cover soils moisture storage capacity.

Slope Stability Analysis – The existing landfill northern slopes are the longest and steepest slopes at the Broad Canyon Landfill. Based upon the stability analysis the existing slopes are stable with a static factor of safety of 1.5 and a pseudo-static factor of safety of 1.01. Stability of the planned future slopes (slightly less steep and a setback of 30′) will have higher factors of safety that the existing slopes.

CLOSURE

This report was prepared in accordance with the generally accepted standard of practice at the time the report was written. No warranty, expressed or implied, is made.

We appreciate the opportunity to be of service on this project. Should you have any questions regarding the report or wish to discuss additional services, please do not hesitate to contact us at your convenience at (801) 270-9400.

Respectfully Submitted,
IGES, Inc.

Brett Mickelson

Brett Mickelson, P.E.
Principal

APPENDIX A

Specific Gravity of Soils

(ASTM D854)

IGES

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Project: J.E. Stover & Associates
No: 01508-001
Location: Naturita Colorado
Date: 6/29/2011
By: JDF

Drill hole / Sample:						
Sample No:	Bulk 1	Bulk 2				
Depth (ft)						
Engineering Classification						
Method	A	A				
Material passing No. 4 seive, P (%)						
Pycnometer No.	7	8				
Mass of pycnometer (g)	184.33	188.91				
Mass of pycnometer, soil, and water, $M_{pws,t}$ (g)	707.5	715.77				
Temperature, T_t (°C)	21.9	21.9				
Mass of pycnometer and water at test temperature, $M_{pw,t}$ (g)	682.70	687.29				
Mass of tare + dry soil (g)	356.57	357.93				
Mass of tare (g)	316.64	310.71				
Mass of soil, M_s (g)	39.93	47.22				
Specific gravity of soil solids at test temperature, G_t	2.639	2.520				
Temperature coefficient, K	0.99959	0.99959				
Specific gravity of soil solids at 20°C, $G_{20°C}$	**2.638**	**2.519**				
Apparent specific gravity of solids retained on No. 4, $G_{1@20°C}$						
Average specific gravity at 20°C, $G_{avg\ @20°C}$						

Tested by: JDF
Reviewed by: NB

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Determination of the Soil Water Characteristic Curve for Desorption

Using Pressure Extractor

(In general accordance with ASTM D6836)

IGES

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Project: J.E. Stover & Associates
No: 01508-001
Location: Naturita Colorado
Date: 7/26/2011
By: NB

Specific gravity, Gs: 2.638

Boring No.:
Sample: Bulk 1
Depth:
Description: Brown sandy clay
Sample type: Laboratory compacted
Dry unit weight 97.7 pcf
at 13.9 (%) w
Compaction specifications: 85% of ASTM D698B

		Test No.	1	2	3	4	5	
		Tension (psi)	1.5	70.0	14.7	4.8	217.6	
Sample A	Initial Condition	Sample height, H (in)	0.501	0.501	0.501	0.501	0.501	
		Sample diameter, D (in)	1.880	1.880	1.880	1.880	1.880	
		Sample Volume (ft^3)	0.001	0.001	0.001	0.001	0.001	
		Wt. rings + wet soil (g)	61.25	61.19	61.22	61.24	61.24	
		Wt. rings/tare (g)	20.69	20.70	20.69	20.69	20.69	
		Wet soil + tare (g)	45.66	45.66	45.66	45.66	45.66	
		Dry soil + tare (g)	43.15	43.15	43.15	43.15	43.15	
		Tare (g)	25.19	25.19	25.19	25.19	25.19	
		Moisture Content, w (%)	14.0	14.0	14.0	14.0	14.0	
		Dry Unit Wt., γ_d (pcf)	97.48	97.31	97.41	97.46	97.46	
	Final Condition	Wet soil + tare (g)	64.69	61.99	61.97	62.78	59.71	
		Dry soil + tare (g)	57.15	57.68	56.47	56.52	56.14	
		Moisture loss (g)	7.54	4.31	5.50	6.26	3.57	
		Tare (g)	22.49	22.22	21.13	21.13	21.12	
		Dry soil (g)	34.66	35.46	35.34	35.39	35.02	
		Moisture Content, w (%)	21.75	12.15	15.56	17.69	10.19	
		Volumetric Water Content, θ	0.34	0.19	0.24	0.28	0.16	
		Zero Matric Suction WC, θ_{sat}:	0.41	0.41	0.41	0.41	0.41	
Sample B	Initial Condition	Sample height, H (in)	0.500	0.500	0.500	0.500	0.500	
		Sample diameter, D (in)	1.887	1.887	1.887	1.887	1.887	
		Sample Volume (ft^3)	0.001	0.001	0.001	0.001	0.001	
		Wt. rings + wet soil (g)	61.25	61.31	61.25	61.25	61.25	
		Wt. rings/tare (g)	20.48	20.48	20.48	20.48	20.48	
		Wet soil + tare (g)	45.66	45.66	45.66	45.66	45.66	
		Dry soil + tare (g)	43.15	43.15	43.15	43.15	43.15	
		Tare (g)	25.19	25.19	25.19	25.19	25.19	
		Moisture Content, w (%)	14.0	14.0	14.0	14.0	14.0	
		Dry Unit Wt., γ_d (pcf)	97.45	97.60	97.45	97.45	97.45	
	Final Condition	Wet soil + tare (g)	63.44	60.98	63.36	64.45	61.32	
		Dry soil + tare (g)	56.02	56.70	57.80	58.04	57.62	
		Moisture loss (g)	7.42	4.28	5.56	6.41	3.70	
		Tare (g)	21.07	20.91	22.23	22.23	22.22	
		Dry soil (g)	34.95	35.79	35.57	35.81	35.40	
		Moisture Content, w (%)	21.23	11.96	15.63	17.90	10.45	
		Volumetric Water Content, θ	0.33	0.19	0.24	0.28	0.16	
		Zero Matric Suction, θ_{sat}:	0.41	0.41	0.41	0.41	0.41	
		Average Volumetric Moisture:	**0.34**	**0.19**	**0.24**	**0.28**	**0.16**	
		Pressure (ft. H_2O):	**3.5**	**161.6**	**33.9**	**11.1**	**502.4**	
		Zero tension line, moisture content:		**0.41**				

Entered by: NB
Reviewed: NB

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Determination of the Soil Water Characteristic Curve for Desorption

Using Pressure Extractor

(In general accordance with ASTM D6836)

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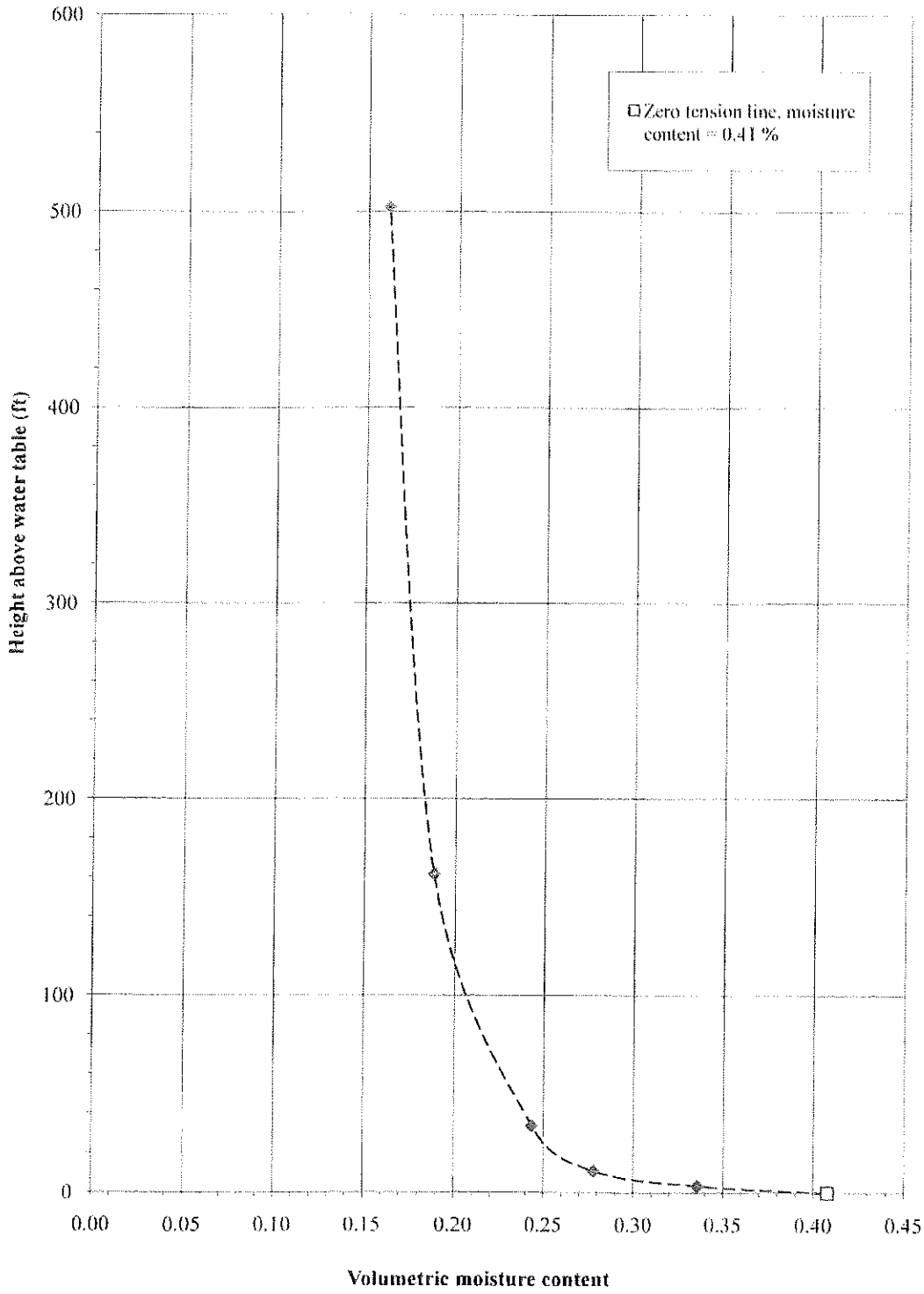
Project: J.E. Stover & Associates
No: 01508-001
Location: Naturita Colorado
Date: 7/26/2011
By: NB

Boring No.:
Sample: Bulk 1
Depth:
Description: Brown sandy clay
Sample type: Laboratory compacted



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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

IGES

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Project: J.E. Stover & Associates
No: 01508-001
Location: Naturita Colorado
Date: 6/28/2011
By: JA

Boring No.:
Sample: Bulk 1
Depth:
Description: Brown clay

Preparation method: Air Dry
Liquid limit test method: Multipoint

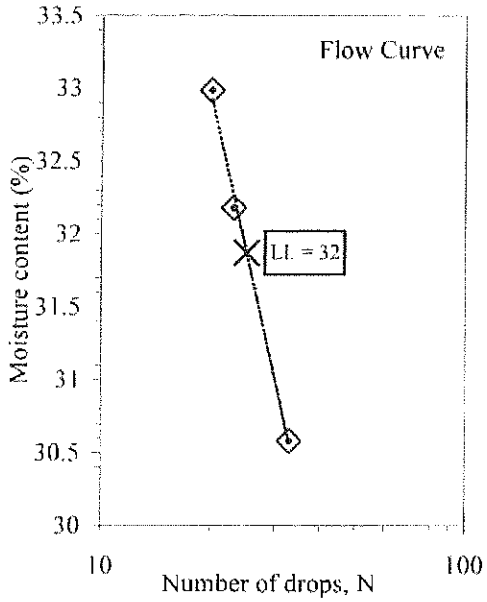
Plastic Limit

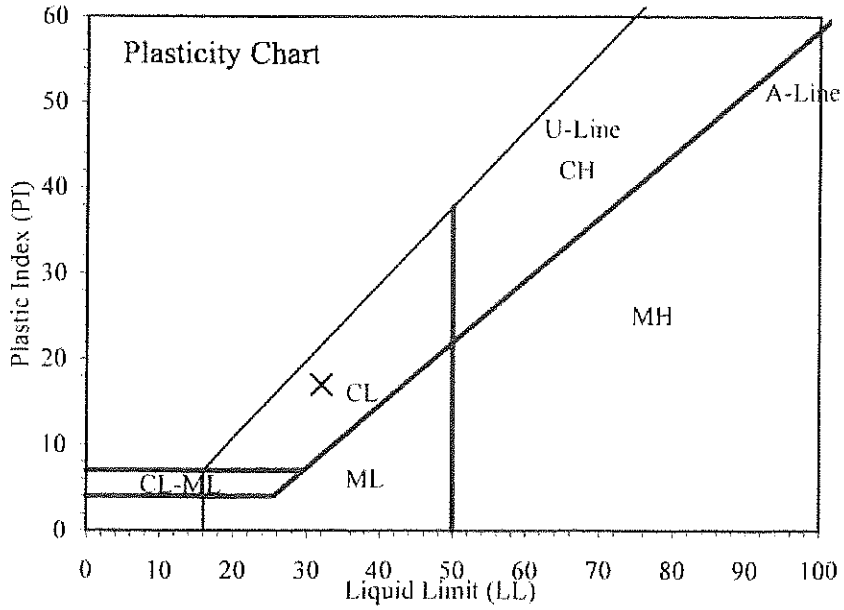
Determination No	1	2				
Wet Soil + Tare (g)	8.32	8.12				
Dry Soil + Tare (g)	7.42	7.25				
Moisture Loss (g)	0.90	0.87				
Tare (g)	1.39	1.39				
Dry Soil (g)	6.03	5.86				
Moisture Content, w (%)	14.93	14.85				

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	33	23	20			
Wet Soil + Tare (g)	12.56	11.65	12.88			
Dry Soil + Tare (g)	9.93	9.14	10.03			
Moisture Loss (g)	2.63	2.51	2.85			
Tare (g)	1.33	1.34	1.39			
Dry Soil (g)	8.60	7.80	8.64			
Moisture Content, w (%)	30.58	32.18	32.99			
One-Point LL (%)		32	32			

Liquid Limit, LL (%)	**32**
Plastic Limit, PL (%)	**15**
Plasticity Index, PI (%)	**17**





Entered by: NB
Reviewed: NB

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Particle-Size Analysis of Soils *with hydrometer*

(ASTM D422)

IGES

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Project: J.E. Stover & Associates
No: 01508-001
Location: Naturita Colorado
Date: 6/29/2011
By: BRR

Boring No.:
Sample: Bulk 1
Depth:
Description: Brown sandy clay

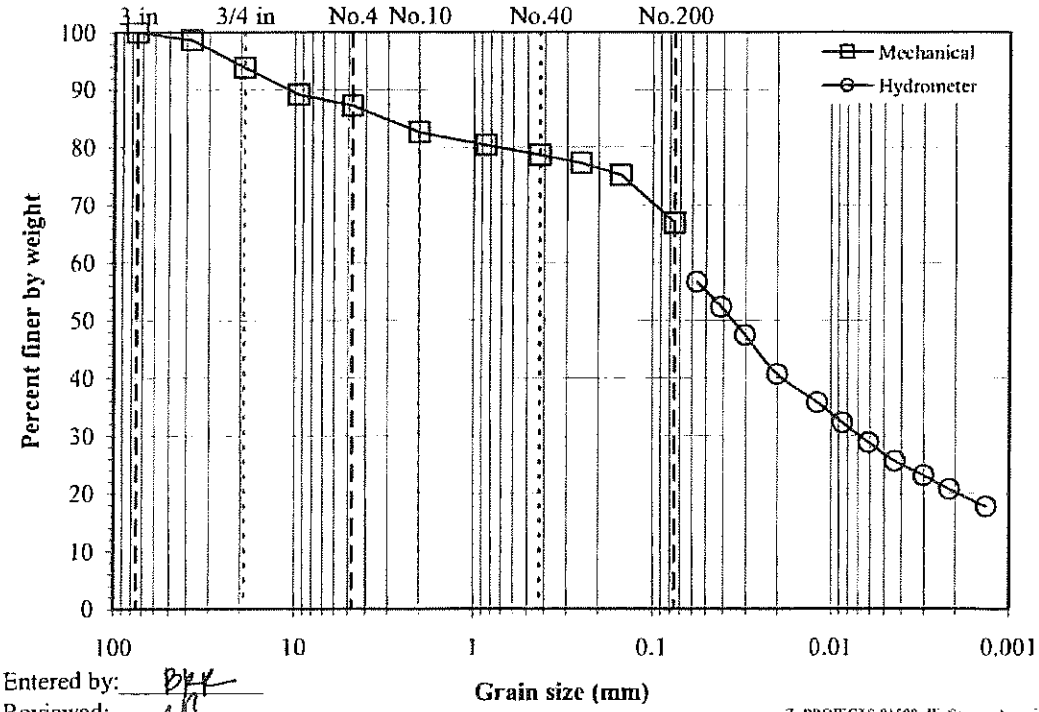
Split sieve:	Yes	
Split sieve:	3/8"	
	Moist	Dry
Total sample wt. (g):	18584.4	16607.63
+3/8" Coarse fraction (g):	1880.65	1803.10
-3/8" Split fraction (g):	776.62	688.32
Hydrometer fraction (g):	68.76	67.27
Split fraction:	0.891	

Moisture data	C.F.(+3/8")	S.F.(-3/8")	Hyd.(-No.10)
Moist soil + tare (g):	2329.20	550.62	106.16
Dry soil + tare (g):	2249.98	513.49	104.51
Tare (g):	407.98	224.06	29.79
Moisture content (%):	4.30	12.83	2.21

Hydrometer data				
Hyd. split:	No.10		Slope:	-0.164
Gs:	2.638	Determined	Intercept:	16.3
Bulb No.	1		α:	1.00
Dispersion period (min):	15		Hyd. fraction:	82.61
			Dispersion device:	Air-jet

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
12"	-	300	-
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	100.0
1.5"	218.50	37.5	98.7
3/4"	1017.20	19	93.9
3/8"	1803.10	9.5	89.1
No.4	14.81	4.75	87.2
No.10	50.46	2	82.6
No.20	1.84	0.85	80.3
No.40	3.23	0.425	78.6
No.60	4.35	0.25	77.3
No.100	6.06	0.15	75.2
No.200	12.81	0.075	66.9

	Elapsed time (min)	Temp. (°C)	Hydrometer Reading	Grain Size (mm)	% Soil in Suspension
	0.5	16.7	52	0.05627	56.65
	1	16.7	48.5	0.04123	52.34
	2	16.7	44.5	0.03028	47.42
	5	16.7	39	0.02009	40.65
	15	17	35	0.01193	35.82
	30	17.6	32	0.00857	32.31
	60	18.5	29	0.00612	28.89
<=Split	120	19.8	26	0.00435	25.61
	250	21.5	23.5	0.00300	23.06
<=Split hyd.	468	23.9	21	0.00217	20.73
	1346	20.2	19.5	0.00135	17.73



Gravel (%): 12.8
Sand (%): 20.3
Fines (%): 66.9

Entered by: BRR
Reviewed: NS

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Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

IGES

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Project: J.E. Stover & Associates
No: 01508-001
Location: Naturita Colorado
Date: 6/24/2011
By: BRR

Boring No.:
Sample: Bulk 1
Depth:
Sample Description: Brown sandy clay
Engineering Classification: Not requested
As-received moisture content (%): Not requested

Method: ASTM D698 B
Mold volume (ft^3): 0.0333

Preparation method: Moist
Rammer: Mechanical-circular face
Rock Correction: Yes * See results below

Optimum moisture content (%): 13.9
Maximum dry unit weight (pcf): 114.6

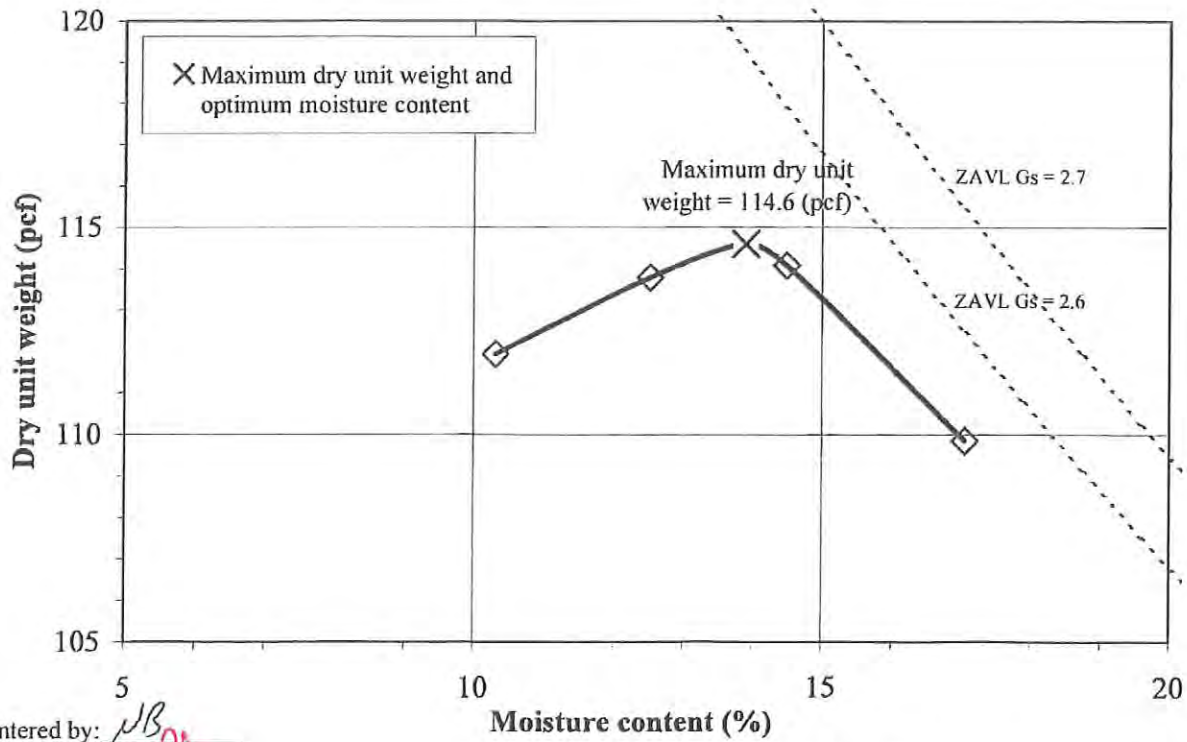
Point Number	+2	As is	+4	-2				
Wt. Sample + Mold (g)	6140.9	6101.8	6110.2	6032.9				
Wt. of Mold (g)	4165.9	4165.9	4165.9	4165.9				
Wet Unit Wt., γ_m (pcf)	130.6	128.0	128.6	123.5				
Wet Soil + Tare (g)	721.22	652.41	647.47	682.03				
Dry Soil + Tare (g)	647.58	596.7	575.03	631.44				
Tare (g)	139.66	151.73	150.25	140.87				
Moisture Content, w (%)	**14.5**	**12.5**	**17.1**	**10.3**				
Dry Unit Wt., γ_d (pcf)	**114.1**	**113.8**	**109.9**	**111.9**				

*Correction of Unit Weight and Water Content for Soils Containing Oversize Particles

(ASTM D4718)

Corrected moisture content (%): 12.9
Corrected dry unit weight (pcf): 118.6

Oversized fraction, +3/8-in. (%): 10.9
Moisture content, +3/8-in. (%): 4.3
Sieve for oversized fraction: 3/8-in.
Bulk specific gravity, Gs: 2.65 Assumed



Entered by: JB
Reviewed:

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Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter, Method C (ASTM D5084)

IGES

© IGES 2010

Project: J.E. Stover & Associates
No: 01508-001
Location: Naturita Colorado
Date: 6/30/2011
By: JDF/NB

Boring No.:
Sample: Bulk 1
Depth:
Sample Description: Brown clay with sand and gravel
Sample Type: Laboratory Compacted
Compaction Specifications: 85 (%) Dry unit weight
at 13.9 (%) w

	Initial (o)	Final (f)
Sample Height, H (in)	3.008	2.999
Sample Diameter, D (in)	2.396	2.38
Sample Length, L (cm)	7.640	7.618
Sample Area, A (cm^2)	29.089	28.655
Sample Volume, V (cm^3)	222.25	218.28
Wt. Rings + Wet Soil (g)	395.84	428.43
Wt. Rings (g)	0	0
Wet Unit Wt., γ_m (pcf)	111.2	122.5
Wet Soil + Tare (g)	320.68	575.79
Dry Soil + Tare (g)	299.03	494.35
Tare (g)	139.97	139.72
Weight of solids, Ws (g)	348.42	348.42
Moisture Content, w (%)	13.61	22.96
Dry Unit Wt, γ_d (pcf)	97.9	99.6
Void ratio, e	0.68	0.61
Saturation (%)	52.6	100 [a]
Average k[b] (cm/sec)	**1.9E-05**	

[a] Saturation set to 100% for phase calculations
[b] k corrected to 20°C

Optimum moisture content (%)	13.9
Maximum dry unit weight (pcf)	114.6
Gs	2.638 Determined
Cell No.	T1
Station No.	1
Permeant liquid used	De-aired water
Total backpressure (psi)	30
Effective horiz. consolidation stress (psi)	1.4
Effective vert. consolidation stress (psi)	1.4

	Initial (o)	Final (f)
B value	0.80	1.00
Volume reading (cm^3)	3.60	4.40
Cell Pressure (psi)	0.0	31.4

System volume coefficient (cm^3/psi)	0.119
System volume change (cm^3)	3.74
Net sample volume change (cm^3)	-3.97
M_1	0.0302
M_2	1.0410
S	0.2658

☐ Pipet
☐ Annulus
☒ Pipet and Annulus

Start Date and Time: 6/29/11 8:52 Equilibrium reading, R_{eq} (cm) 1.9

Elapsed time (sec)	z_1 (cm)	z_2 (cm)	Temp (°C)	δ	Gradient i	C	T	k (cm/sec)	k[b] (cm/sec)
20.0	22.35	3.52	24.3	12.55	18.92	6.4E-04	0.0466	2.0E-05	1.8E-05
20.7	20.60	3.21	24.3	12.55	17.16	6.4E-04	0.0505	1.9E-05	1.8E-05
19.1	18.41	3.00	24.3	12.55	15.10	6.4E-04	0.0565	2.1E-05	1.9E-05
18.7	19.15	2.84	24.3	12.55	15.60	6.4E-04	0.0544	2.2E-05	2.0E-05

Entered by: NB
Reviewed:

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter, Method C (ASTM D5084)

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Project: J.E. Stover & Associates
No: 01508-001
Location: Naturita Colorado
Date: 6/30/2011
By: JDF/NB

Boring No.:
Sample: Bulk 1
Depth:
Sample Description: Brown clay with sand
Sample Type: Laboratory Compacted
Compaction Specifications: 95 (%) Dry unit weight
at 13.9 (%) w

	Initial (o)	Final (f)
Sample Height, H (in)	3.010	2.990
Sample Diameter, D (in)	2.41	2.37
Sample Length, L (cm)	7.645	7.595
Sample Area, A (cm^2)	29.430	28.445
Sample Volume, V (cm^3)	225.00	216.03
Wt. Rings + Wet Soil (g)	447.67	467.04
Wt. Rings (g)	0	0
Wet Unit Wt., γ_m (pcf)	124.2	135.0
Wet Soil + Tare (g)	320.68	609.06
Dry Soil + Tare (g)	299.03	535.76
Tare (g)	139.97	140.14
Weight of solids, Ws (g)	394.04	394.04
Moisture Content, w (%)	13.61	18.53
Dry Unit Wt, γ_d (pcf)	109.3	113.9
Void ratio, e	0.51	0.49
Saturation (%)	70.9	100 [a]
Average k[b] (cm/sec)	**1.1E-06**	

[a] Saturation set to 100% for phase calculations
[b] k corrected to 20°C

Optimum moisture content (%)	13.9	
Maximum dry unit weight (pcf)	114.6	
Gs	2.638	Determined
Cell No.	T2	
Station No.	2	
Permeant liquid used	De-aired water	
Total backpressure (psi)	30	
Effective horiz. consolidation stress (psi)	13.9	
Effective vert. consolidation stress (psi)	13.9	

	Initial (o)	Final (f)
B value	0.88	1.00
Volume reading (cm^3)	3.80	5.60
Cell Pressure (psi)	0.0	43.9

System volume coefficient (cm^3/psi)	0.108
System volume change (cm^3)	4.75
Net sample volume change (cm^3)	-8.97
M_1	0.0302
M_2	1.0410
S	0.2670

○ Pipet
○ Annulus
◉ Pipet and Annulus

Start Date and Time: 6/28/11 7:15 Equilibrium reading, R_{eq} (cm) 1.9

Elapsed time (sec)	z_1 (cm)	z_2 (cm)	Temp (°C)	δ	Gradient i	C	T	k (cm/sec)	k[b] (cm/sec)
300.0	25.50	7.80	24.0	12.55	25.37	6.4E-04	0.0408	1.2E-06	1.1E-06
300.0	24.90	7.20	24.0	12.55	24.34	6.4E-04	0.0418	1.2E-06	1.1E-06
315.0	21.10	5.54	24.0	12.55	19.64	6.4E-04	0.0493	1.2E-06	1.1E-06
300.0	22.20	5.71	24.0	12.55	20.73	6.4E-04	0.0469	1.2E-06	1.1E-06
300.0	20.71	5.26	24.0	12.55	19.07	6.4E-04	0.0503	1.2E-06	1.1E-06

Entered by: NB
Reviewed: DJF

Direct Shear Test for Soils Under Drained Conditions

(ASTM D3080)

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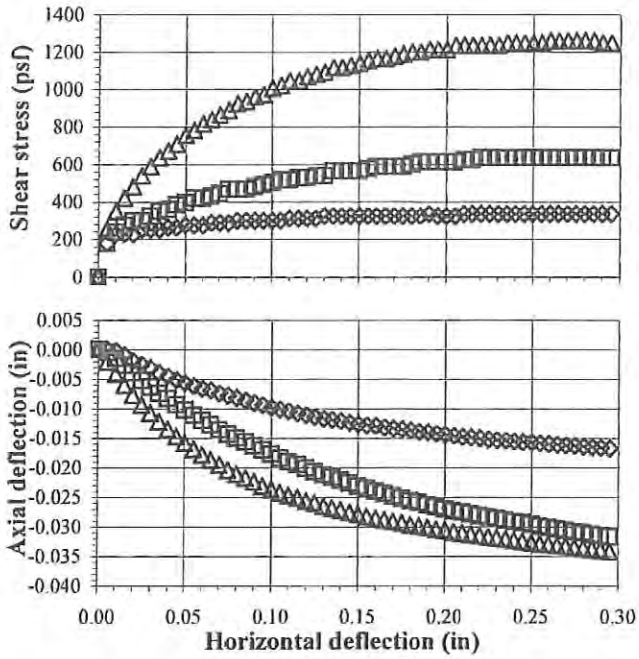
Project: J.E. Stover & Associates
No: 01508-001
Location: Naturita Colorado
Date: 6/28/2011
By: JDF

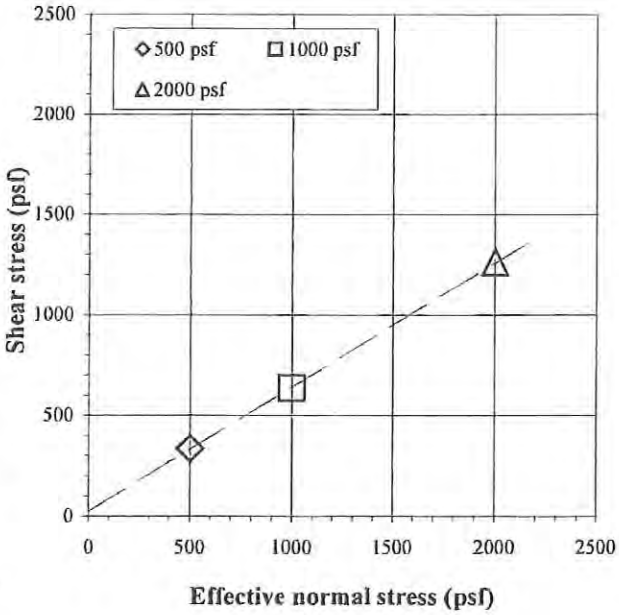
Boring No.:
Sample: Bulk 1
Depth:
Sample Description: Brown silty sand
Sample type: Laboratory compacted
Dry unit weight 97.7 pcf
at 13.9 (%) w
Compaction specifications: 85% of ASTM D698B

Test type: Inundated
Horizontal deformation (in.): 0.3
Shear rate (in./min): 0.0042

	Sample 1		Sample 2		Sample 3	
Effective normal stress (psf)	500		1000		2000	
Peak shear stress (psf)	336		636		1260	
Horizontal deformation at peak(in)	0.190		0.220		0.260	
	Initial	Final	Initial	Final	Initial	Final
Sample height (in)	1.0000	0.9765	1.0000	0.9476	1.0000	0.9208
Sample diameter (in)	2.416	2.416	2.416	2.416	2.416	2.416
Wt. rings + wet soil (g)	176.96	186.95	178.77	186.75	178.06	184.59
Wt. rings (g)	43.36	43.36	45.17	45.17	44.46	44.46
Wet soil + tare (g)	433.89	164.24	433.89	163.32	433.89	159.79
Dry soil + tare (g)	400.26	138.27	400.26	139.35	400.26	137.39
Tare (g)	154.32	21.14	154.32	22.23	154.32	20.92
Water content (%)	13.7	22.2	13.7	20.5	13.7	19.2
Dry unit weight (pcf)	97.7	100.0	97.7	103.1	97.7	106.1

ϕ' (deg)	32	Average of 3 samples	Initial	Final
c' (psf)	24	Water content (%)	13.7	20.6
		Dry unit weight (pcf)	97.7	103.0





Entered by: MB
Reviewed:

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Effective normal stress = 500 psf			Effective normal stress = 1000 psf			Effective normal stress = 2000 psf		
Horizontal Deflection (in)	Shear Stress (psf)	Axial deflection (in)	Horizontal Deflection (in)	Shear Stress (psf)	Axial deflection (in)	Horizontal Deflection (in)	Shear Stress (psf)	Axial deflection (in)
0.000	0	0.000	0.000	0	0.000	0.000	0	0.000
0.005	180	0.000	0.005	180	0.000	0.005	252	-0.002
0.010	228	0.000	0.010	240	-0.002	0.010	348	-0.004
0.015	228	-0.001	0.015	276	-0.003	0.015	420	-0.006
0.020	228	-0.002	0.020	300	-0.004	0.020	480	-0.008
0.025	252	-0.003	0.025	300	-0.005	0.025	540	-0.009
0.030	252	-0.003	0.030	324	-0.006	0.030	588	-0.011
0.035	252	-0.004	0.035	348	-0.007	0.035	636	-0.012
0.040	264	-0.005	0.040	360	-0.008	0.040	672	-0.014
0.045	264	-0.005	0.045	384	-0.009	0.045	708	-0.015
0.050	276	-0.006	0.050	396	-0.010	0.050	756	-0.016
0.055	276	-0.006	0.055	420	-0.011	0.055	780	-0.017
0.060	276	-0.007	0.060	420	-0.012	0.060	816	-0.018
0.065	288	-0.007	0.065	432	-0.013	0.065	840	-0.019
0.070	288	-0.007	0.070	444	-0.014	0.070	864	-0.020
0.075	288	-0.008	0.075	468	-0.014	0.075	888	-0.020
0.080	300	-0.008	0.080	468	-0.015	0.080	924	-0.021
0.085	300	-0.009	0.085	468	-0.016	0.085	936	-0.022
0.090	300	-0.009	0.090	480	-0.016	0.090	960	-0.022
0.095	300	-0.009	0.095	492	-0.017	0.095	972	-0.023
0.100	300	-0.010	0.100	504	-0.018	0.100	1008	-0.024
0.105	300	-0.010	0.105	516	-0.018	0.105	1020	-0.024
0.110	312	-0.010	0.110	516	-0.019	0.110	1044	-0.025
0.115	312	-0.011	0.115	528	-0.020	0.115	1044	-0.025
0.120	312	-0.011	0.120	528	-0.020	0.120	1068	-0.026
0.125	312	-0.011	0.125	540	-0.021	0.125	1080	-0.026
0.130	324	-0.012	0.130	540	-0.021	0.130	1092	-0.027
0.135	324	-0.012	0.135	564	-0.022	0.135	1116	-0.027
0.140	324	-0.012	0.140	564	-0.022	0.140	1116	-0.027
0.145	324	-0.012	0.145	564	-0.023	0.145	1128	-0.028
0.150	324	-0.013	0.150	564	-0.023	0.150	1140	-0.028
0.155	324	-0.013	0.155	576	-0.024	0.155	1152	-0.028
0.160	324	-0.013	0.160	588	-0.024	0.160	1164	-0.029
0.165	324	-0.013	0.165	588	-0.024	0.165	1164	-0.029
0.170	324	-0.013	0.170	588	-0.025	0.170	1176	-0.029
0.175	324	-0.014	0.175	588	-0.025	0.175	1188	-0.029
0.180	324	-0.014	0.180	600	-0.026	0.180	1200	-0.030
0.185	324	-0.014	0.185	612	-0.026	0.185	1200	-0.030
0.190	336	-0.014	0.190	612	-0.026	0.190	1212	-0.030
0.195	324	-0.014	0.195	612	-0.027	0.195	1212	-0.030
0.200	324	-0.014	0.200	612	-0.027	0.200	1212	-0.031
0.205	324	-0.015	0.205	612	-0.027	0.205	1236	-0.031
0.210	336	-0.015	0.210	624	-0.028	0.210	1236	-0.031
0.215	336	-0.015	0.215	624	-0.028	0.215	1236	-0.031
0.220	336	-0.015	0.220	636	-0.028	0.220	1236	-0.032
0.225	336	-0.015	0.225	636	-0.028	0.225	1236	-0.032
0.230	336	-0.015	0.230	636	-0.029	0.230	1236	-0.032
0.235	336	-0.015	0.235	636	-0.029	0.235	1248	-0.032
0.240	336	-0.016	0.240	636	-0.029	0.240	1248	-0.032
0.245	336	-0.016	0.245	636	-0.029	0.245	1248	-0.033
0.250	336	-0.016	0.250	636	-0.030	0.250	1248	-0.033
0.255	336	-0.016	0.255	636	-0.030	0.255	1248	-0.033
0.260	336	-0.016	0.260	636	-0.030	0.260	1260	-0.033
0.265	336	-0.016	0.265	636	-0.030	0.265	1260	-0.033
0.270	336	-0.016	0.270	636	-0.031	0.270	1260	-0.033
0.275	336	-0.016	0.275	636	-0.031	0.275	1260	-0.034
0.280	336	-0.016	0.280	636	-0.031	0.280	1260	-0.034
0.285	336	-0.017	0.285	636	-0.031	0.285	1260	-0.034
0.290	336	-0.017	0.290	636	-0.032	0.290	1248	-0.034
0.295	336	-0.017	0.295	636	-0.032	0.295	1248	-0.034
0.300	336	-0.017	0.300	636	-0.032	0.300	1248	-0.034

Determination of the Soil Water Characteristic Curve for Desorption Using Pressure Extractor

(In general accordance with ASTM D6836)

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Project: J.E. Stover & Associates
No: 01508-001
Location: Naturita Colorado
Date: 7/26/2011
By: NB

Specific gravity, Gs: 2.519

Boring No.:
Sample: Bulk 2
Depth:
Description: Black clay with sand
Sample type: Laboratory compacted
Dry unit weight 98.4 pcf
at 11.8 (%) w
Compaction specifications 85% of ASTM D698B

		Test No.	1	2	3	4	5	
		Tension (psi)	1.5	70.0	14.7	4.8	217.6	
Sample A	Initial Condition	Sample height, H (in)	0.501	0.501	0.501	0.501	0.501	
		Sample diameter, D (in)	1.882	1.882	1.882	1.882	1.882	
		Sample Volume (ft^3)	0.001	0.001	0.001	0.001	0.001	
		Wt. rings + wet soil (g)	60.83	60.85	60.85	60.84	60.84	
		Wt. rings/tare (g)	20.57	20.57	20.57	20.57	20.57	
		Wet soil + tare (g)	58.37	58.37	58.37	58.37	58.37	
		Dry soil + tare (g)	54.48	54.48	54.48	54.48	54.48	
		Tare (g)	22.39	22.39	22.39	22.39	22.39	
		Moisture Content, w (%)	12.1	12.1	12.1	12.1	12.1	
		Dry Unit Wt., γ_d (pcf)	98.15	98.20	98.20	98.18	98.18	
	Final Condition	Wet soil + tare (g)	61.70	68.67	60.86	61.61	60.21	
		Dry soil + tare (g)	56.47	65.69	56.66	56.96	57.74	
		Moisture loss (g)	5.23	2.98	4.20	4.65	2.47	
		Tare (g)	20.68	29.76	20.92	21.06	22.49	
		Dry soil (g)	35.79	35.93	35.74	35.90	35.25	
		Moisture Content, w (%)	14.61	8.29	11.75	12.95	7.01	
		Volumetric Water Content, θ	0.23	0.13	0.18	0.20	0.11	
		Zero Matric Suction WC, θ_{sat}	0.38	0.38	0.38	0.38	0.38	
Sample B	Initial Condition	Sample height, H (in)	0.498	0.498	0.498	0.498	0.498	
		Sample diameter, D (in)	1.881	1.881	1.881	1.881	1.881	
		Sample Volume (ft^3)	0.001	0.001	0.001	0.001	0.001	
		Wt. rings + wet soil (g)	60.51	60.52	60.50	60.52	60.52	
		Wt. rings/tare (g)	20.53	20.54	20.54	20.54	20.54	
		Wet soil + tare (g)	58.37	58.37	58.37	58.37	58.37	
		Dry soil + tare (g)	54.48	54.48	54.48	54.48	54.48	
		Tare (g)	22.39	22.39	22.39	22.39	22.39	
		Moisture Content, w (%)	12.1	12.1	12.1	12.1	12.1	
		Dry Unit Wt., γ_d (pcf)	98.16	98.16	98.11	98.16	98.16	
	Final Condition	Wet soil + tare (g)	62.23	68.77	62.35	61.23	58.96	
		Dry soil + tare (g)	57.07	65.77	58.18	56.54	56.78	
		Moisture loss (g)	5.16	3.00	4.17	4.69	2.18	
		Tare (g)	21.78	29.95	22.50	20.67	21.05	
		Dry soil (g)	35.29	35.82	35.68	35.87	35.73	
		Moisture Content, w (%)	14.62	8.38	11.69	13.07	6.10	
		Volumetric Water Content, θ	0.23	0.13	0.18	0.21	0.10	
		Zero Matric Suction, θ_{sat}	0.38	0.38	0.38	0.38	0.38	
		Average Volumetric Moisture:	**0.23**	**0.13**	**0.18**	**0.20**	**0.10**	
		Pressure (ft. H_2O):	**3.5**	**161.6**	**33.9**	**11.1**	**502.4**	
		Zero tension line, moisture content:		**0.38**				

Entered by: NB
Reviewed: MB

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Determination of the Soil Water Characteristic Curve for Desorption

Using Pressure Extractor

(In general accordance with ASTM D6836)

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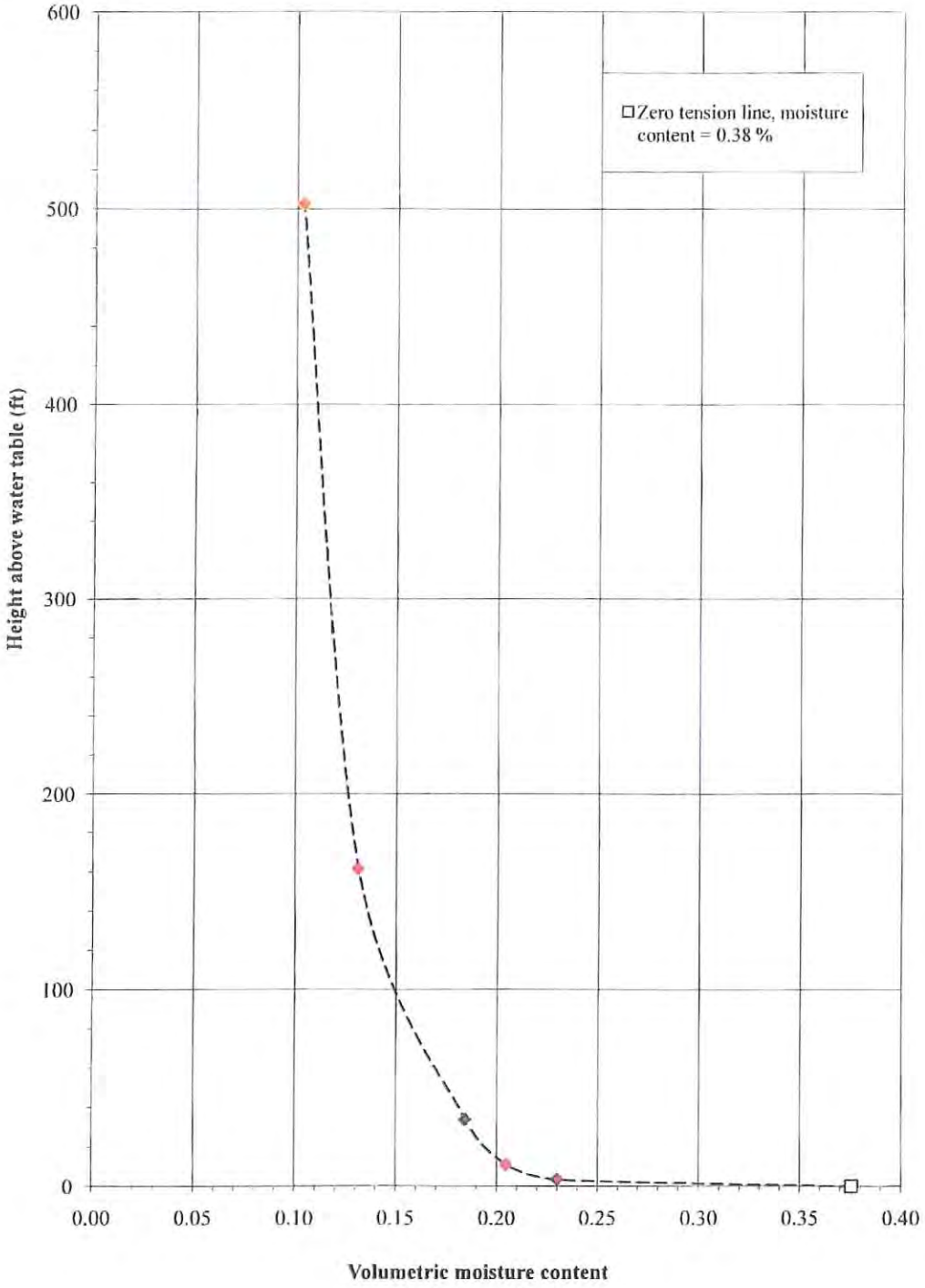
Project: J.E. Stover & Associates
No: 01508-001
Location: Naturita Colorado
Date: 7/26/2011
By: NB

Boring No.:
Sample: Bulk 2
Depth:
Description: Black clay with sand
Sample type: Laboratory compacted



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Liquid Limit, Plastic Limit, and Plasticity Index of Soils

(ASTM D4318)

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Project: J.E. Stover & Associates
No: 01508-001
Location: Naturita Colorado
Date: 6/28/2011
By: JA

Boring No.:
Sample: Bulk 2
Depth:
Description: Grey clay

Preparation method: Air Dry
Liquid limit test method: Multipoint

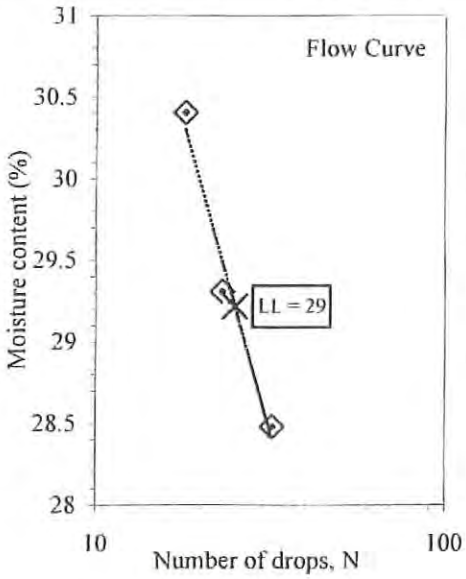
Plastic Limit

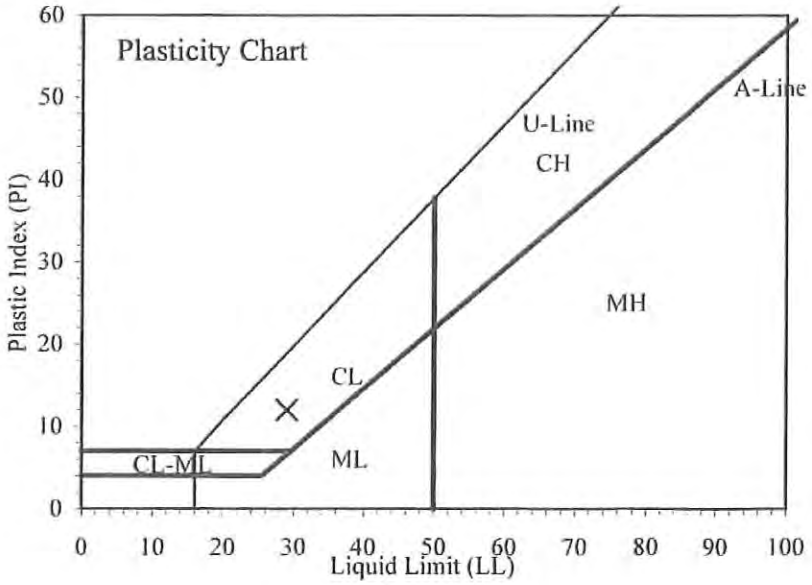
Determination No	1	2				
Wet Soil + Tare (g)	7.70	7.91				
Dry Soil + Tare (g)	6.78	6.96				
Moisture Loss (g)	0.92	0.95				
Tare (g)	1.39	1.35				
Dry Soil (g)	5.39	5.61				
Moisture Content, w (%)	17.07	16.93				

Liquid Limit

Determination No	1	2	3			
Number of Drops, N	32	23	18			
Wet Soil + Tare (g)	11.36	10.92	12.65			
Dry Soil + Tare (g)	9.15	8.76	10.02			
Moisture Loss (g)	2.21	2.16	2.63			
Tare (g)	1.39	1.39	1.37			
Dry Soil (g)	7.76	7.37	8.65			
Moisture Content, w (%)	28.48	29.31	30.40			
One-Point LL (%)		29				

Liquid Limit, LL (%)	**29**
Plastic Limit, PL (%)	**17**
Plasticity Index, PI (%)	**12**





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Reviewed: [illegible]

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Particle-Size Analysis of Soils *with hydrometer*

(ASTM D422)

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Project: J.E. Stover & Associates
No: 01508-001
Location: Naturita Colorado
Date: 6/29/2011
By: BRR

Boring No.:
Sample: Bulk 2
Depth:
Description: Black clay with sand

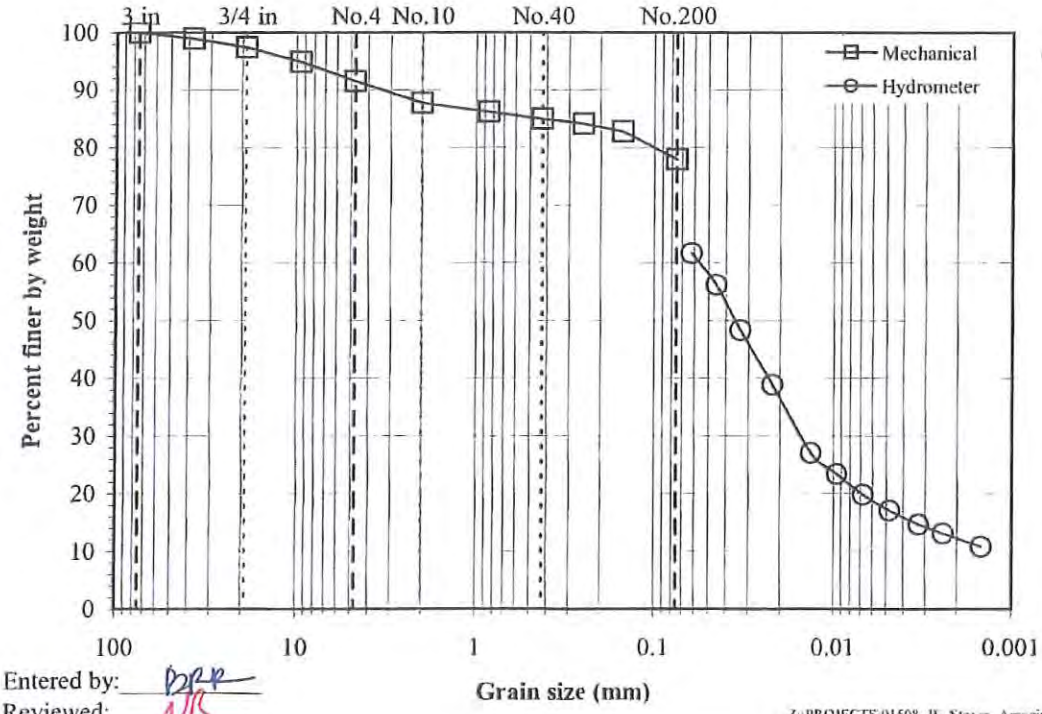
Split sieve:	Yes	
Split sieve:	3/8"	
	Moist	Dry
Total sample wt. (g):	15646.3	14732.66
+3/8" Coarse fraction (g):	785.16	756.60
-3/8" Split fraction (g):	689.88	648.79
Hydrometer fraction (g):	58.63	57.59
Split fraction:	0.949	

Moisture data	C.F.(+3/8")	S.F.(-3/8")	Hyd.(-No.10)
Moist soil + tare (g):	1196.90	860.02	65.97
Dry soil + tare (g):	1168.24	826.34	65.34
Tare (g):	409.00	294.51	30.36
Moisture content (%):	3.77	6.33	1.80

Hydrometer data				
Hyd. split:	No.10		Slope:	-0.164
Gs:	2.519	Determined	Intercept:	16.3
Bulb No.	1		α:	1.03
			Hyd. fraction:	87.74
Dispersion period (min):	15		Dispersion device:	Air-jet

Sieve	Accum. Wt. Ret. (g)	Grain Size (mm)	Percent Finer
12"	-	300	-
8"	-	200	-
6"	-	150	-
4"	-	100	-
3"	-	75	100.0
1.5"	157.20	37.5	98.9
3/4"	381.00	19	97.4
3/8"	756.60	9.5	94.9
No.4	22.98	4.75	91.5
No.10	48.75	2	87.7
No.20	1.03	0.85	86.2
No.40	1.84	0.425	84.9
No.60	2.38	0.25	84.1
No.100	3.28	0.15	82.7
No.200	6.44	0.075	77.9

	Elapsed time (min)	Temp. (°C)	Hydrometer Reading	Grain Size (mm)	% Soil in Suspension
	0.5	17.4	45	0.06205	61.64
	1	17.4	41.5	0.04527	56.14
	2	17.4	36.5	0.03336	48.27
	5	17.4	30.5	0.02208	38.83
	15	17.5	23	0.01341	27.08
	30	18.1	20.5	0.00957	23.38
	60	19	18	0.00680	19.81
<=Split	120	20	16	0.00480	17.06
	250	21.9	14	0.00329	14.67
<=Split hyd.	460	24	12.5	0.00239	13.15
	1338	20.1	12	0.00147	10.81



Gravel (%): 8.5
Sand (%): 13.6
Fines (%): 77.9

Entered by: BRR
Reviewed: NJS

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Laboratory Compaction Characteristics of Soil

(ASTM D698 / D1557)

IGES

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Project: J.E. Stover & Associates
No: 01508-001
Location: Naturita Colorado
Date: 6/24/2011
By: BRR

Boring No.:
Sample: Bulk 2
Depth:
Sample Description: Black clay with sand
Engineering Classification: Not requested
As-received moisture content (%): Not requested

Method: ASTM D698 B
Mold volume (ft^3): 0.0333

Preparation method: Moist
Rammer: Mechanical-circular face
Rock Correction: Yes * See results below

Optimum moisture content (%): 11.8
Maximum dry unit weight (pcf): 115.7

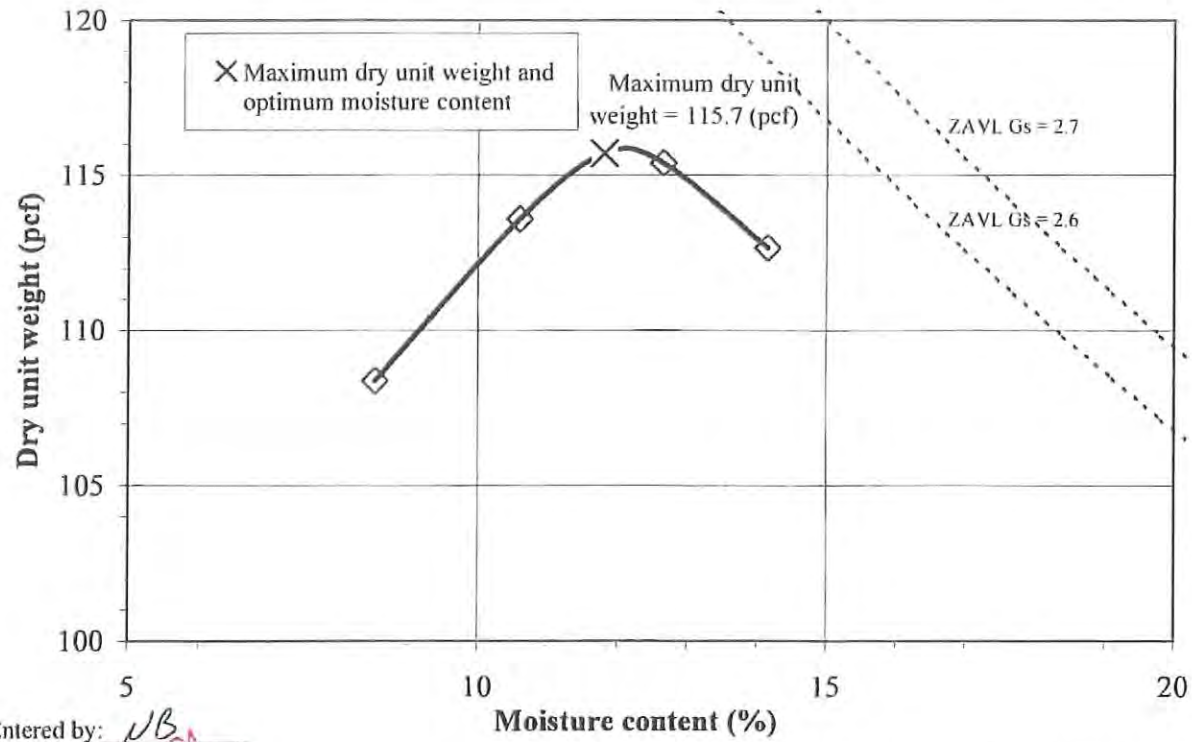
Point Number	+4	+6	+8	+2				
Wt. Sample + Mold (g)	6065.2	6131.3	6110.1	5944.2				
Wt. of Mold (g)	4165.9	4165.9	4165.9	4165.9				
Wet Unit Wt., γ_m (pcf)	125.6	130.0	128.6	117.6				
Wet Soil + Tare (g)	615.84	676.88	785.05	698.26				
Dry Soil + Tare (g)	571.27	621.03	713.57	657.91				
Tare (g)	150.63	179.7	208.41	185.02				
Moisture Content, w (%)	**10.6**	**12.7**	**14.1**	**8.5**				
Dry Unit Wt., γ_d (pcf)	**113.6**	**115.4**	**112.6**	**108.4**				

*Correction of Unit Weight and Water Content for Soils Containing Oversize Particles

(ASTM D4718)

Corrected moisture content (%): 11.4
Corrected dry unit weight (pcf): 117.5

Oversized fraction, +3/8-in. (%): 5.1
Moisture content, +3/8-in. (%): 3.8
Sieve for oversized fraction: 3/8-in.
Bulk specific gravity, Gs: 2.65 Assumed



Entered by: JB
Reviewed: [illegible]

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APPENDIX B

AVERAGE PRECIPITATION

URAVAN, COLORADO (058560)

Period of Record Monthly Climate Summary

Period of Record : 11/17/1960 to 12/31/2010

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	42.7	49.8	58.7	67.5	78.5	89.4	95.6	92.3	83.8	71.4	55.1	43.3	69
Average Min. Temperature (F)	15.5	22.4	29.2	35.6	44.6	52.4	59.5	58.2	48.4	37	26.6	17.9	37.3
Average Total Precipitation (in.)	0.88	0.78	1.03	1	0.94	0.49	1.16	1.37	1.48	1.47	1.01	0.99	12.61
Average Total SnowFall (in.)	3.8	1.3	0.5	0.2	0	0	0	0	0	0.2	0.8	4.2	11.1
Average Snow Depth (in.)	1	0	0	0	0	0	0	0	0	0	0	0	0

Percent of possible observations for period of record.
Max. Temp.: 97.7% Min. Temp.: 98.2% Precipitation: 99.5% Snowfall: 86.4% Snow Depth: 82.3%
Check Station Metadata or Metadata graphics for more detail about data completeness.

Western Regional Climate Center, wrcc@dri.edu

NORWOOD, COLORADO (056012)

Period of Record Monthly Climate Summary

Period of Record : 4/ 1/1924 to 8/31/2008

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	37.4	41.5	48.6	58	68.1	78.7	83.9	80.7	73.4	62.1	48	38.7	59.9
Average Min. Temperature (F)	9.6	14.6	21.8	28.3	35.9	43.7	50	48.9	41.8	31.9	20.5	11.9	29.9
Average Total Precipitation (in.)	0.95	0.93	1.14	1.22	1.12	0.78	1.86	1.96	1.77	1.59	1.11	0.97	15.41
Average Total SnowFall (in.)	12.7	10.5	9.8	5.3	0.8	0	0	0	0.1	2.3	7.7	10.9	60.2
Average Snow Depth (in.)	4	3	1	0	0	0	0	0	0	0	1	2	1

Percent of possible observations for period of record.
Max. Temp.: 98.4% Min. Temp.: 98.4% Precipitation: 99.3% Snowfall: 95.7% Snow Depth: 74.9%
Check Station Metadata or Metadata graphics for more detail about data completeness.

Western Regional Climate Center, wrcc@dri.edu

COLORADO

MONTHLY AVERAGE PAN EVAPORATION (INCHES)

	PERIOD OF RECORD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
AKRON 4 E	1918-2005	0.00	0.00	0.00	7.30	9.29	11.43	13.26	11.16	9.09	6.16	0.00	0.00	67.69
ALAMOSA WSO AP	1948-2005	0.00	0.00	0.00	7.06	9.01	10.08	9.16	7.81	6.40	4.39	0.00	0.00	53.91
ARBOLES	1957-1963	0.00	0.00	0.00	5.41	7.95	9.56	9.78	8.61	6.52	0.00	0.00	0.00	47.83
BONNY LAKE	1949-2005	0.00	0.00	0.00	7.26	8.69	10.86	11.78	10.61	8.12	6.12	4.57	0.00	68.01
CLIMAX	1949-2005	0.00	0.00	0.00	0.00	0.00	5.36	5.32	4.44	3.41	0.00	0.00	0.00	18.53
CONEJOS 3 NNW	1948-1960	0.00	0.00	0.00	6.30	7.14	7.67	7.41	6.87	7.19	5.74	0.00	0.00	48.32
ESTES PARK	1948-1994	0.00	0.00	0.00	5.78	5.26	7.09	7.13	6.15	5.04	4.04	0.00	0.00	40.49
FORT COLLINS	1900-2005	0.00	0.00	2.50	4.52	5.42	6.32	6.92	6.07	4.74	3.07	1.48	0.00	41.04
GRAND JUNCTION WALKER	1900-2005	0.00	0.00	4.67	8.53	12.18	15.96	16.53	14.02	10.98	7.05	2.42	0.00	92.34
GRAND JUNCTION 6 ESE	1962-2005	0.00	0.00	0.00	6.60	9.29	11.77	12.01	10.24	7.48	4.65	2.09	0.00	64.13
GRAND LAKE 6 SSW	1948-2005	0.00	0.00	0.00	0.00	4.82	7.75	7.81	6.79	5.24	3.10	0.00	0.00	35.51
GREEN MOUNTAIN DAM	1948-2005	0.00	0.00	0.00	0.00	4.96	6.56	6.93	5.90	4.65	2.90	0.00	0.00	31.90
JOHN MARTIN DAM	1941-2005	0.00	0.00	6.40	8.04	9.67	11.30	12.31	10.28	7.82	5.61	2.78	0.00	74.21
LAKE GEORGE 8 SW	1948-2005	0.00	0.00	0.00	0.00	5.15	8.26	7.39	6.02	5.72	0.00	0.00	0.00	32.54
MEREDITH	1963-2005	0.00	0.00	0.00	0.00	7.69	8.26	8.34	6.96	5.25	3.21	0.00	0.00	39.71
MONTROSE 1	1948-1982	1.68	1.49	3.34	5.69	7.49	9.47	9.04	7.39	5.54	3.45	1.61	1.26	57.45
PLATORO	1949-1991	0.00	0.00	0.00	0.00	5.86	8.10	6.57	5.24	5.52	3.33	0.00	0.00	34.62
PUEBLO WSO AP	1954-2005	0.00	0.00	0.00	8.71	9.50	11.51	12.14	10.41	8.17	6.14	0.00	0.00	66.58
PUEBLO CITY RESERVOIR	1948-1971	0.00	5.13	5.86	6.85	8.81	10.09	10.60	8.85	7.43	5.30	2.99	2.71	74.62
PUEBLO RESERVOIR	1975-2005	0.00	0.00	0.00	7.18	9.34	10.87	11.58	9.92	7.90	5.88	0.00	0.00	62.67
PUEBLO 6 SSW	1971-1985	0.00	0.00	4.82	7.47	8.57	10.65	11.30	9.40	7.13	5.53	0.00	0.00	64.87
SAN LUIS LAKES 3W	1948-1955	0.00	0.00	4.50	6.07	8.51	9.88	8.49	7.77	6.57	4.53	0.00	0.00	56.32
SPRINGFIELD 7 WSW	1956-2002	0.00	0.00	0.00	7.85	9.73	11.44	12.69	11.28	8.53	6.29	4.57	0.00	72.38
SUGARLOAF RESERVOIR	1948-2005	0.00	0.00	0.00	0.00	0.00	7.03	6.15	4.97	4.15	2.93	0.00	0.00	25.23
TRINIDAD LAKE	1989-2005	0.00	0.00	0.00	6.75	9.04	10.55	9.88	8.27	7.65	6.17	3.92	2.21	64.44
TWIN LAKES RESERVOIR	1949-2005	0.00	0.00	0.00	0.00	6.93	8.65	7.92	6.79	5.33	3.96	0.00	0.00	39.58
VALLECITO DAM	1948-2005	0.00	0.00	1.91	3.82	5.29	6.22	6.09	5.31	4.39	3.04	1.60	0.00	37.67
WAGON WHEEL GAP 3 N	1948-1972	0.00	0.00	0.00	0.00	6.69	7.90	7.15	5.81	5.30	2.61	0.00	0.00	35.46
WALSH 1 W	1951-2005	0.00	0.00	0.00	0.00	10.78	12.35	12.76	11.63	9.42	6.88	0.00	0.00	63.82
WIGGINS 7 SW	1960-1971	0.00	0.00	0.00	6.82	8.50	8.42	9.97	8.09	5.87	4.22	2.23	0.00	54.12

APPENDIX C

Annual cycle of precipation-evapotranspiration-storage for Broad Canyon Landfill
Norwood - 1 (Norwood Precipitation, Montrose Pan Evaporation, Soil Sample 1)

Annual ave Precip total =	15.41	inches (average annual over last 84 years)
Annual Pan Evaporation =	57.45	inches (including sublimation)
Wilting Point of Soil =	28	% (Moisture Content in Percent of Volume)
Field Capacity of Cover Soil =	16	% (Moisture Content in Percent of Volume)
Runoff =	0	% (Percent of Precipation)
Initial Moisture Content of Cover Soil =	22	% (Percent of Volume)
Thickness of Cover Soil =	12	inches
Penman-Wilson ET Reduction =	0.6	(fraction of total potential evapo-transpiration expressed as actual soil evaporation)
Maximum Storage Capacity of Cover Soil =	1.44	inches [(field capacity - wilting point) x layer thickness]
Initial Storage Capacity =	0.72	inches

MONTH OF YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
percentage of annual precip by month	6.17%	6.04%	7.40%	7.92%	7.27%	5.06%	12.08%	12.73%	11.49%	10.32%	7.21%	6.30%
percentage of annual ET by month	2.92%	2.59%	5.81%	9.90%	13.04%	16.48%	15.74%	12.86%	9.64%	6.01%	2.80%	2.19%
days per month	31	28	31	30	31	30	31	31	30	31	30	31
Beginning Available Storage Capacity (in.)	0.72	0.78	0.74	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.30
Monthly Precipitation (inches)	0.95	0.93	1.14	1.22	1.12	0.78	1.86	1.96	1.77	1.59	1.11	0.97
Monthlry Infiltration = precip-runoff (in.)	0.95	0.93	1.14	1.22	1.12	0.78	1.86	1.96	1.77	1.59	1.11	0.97
Monthly ET Loss (inches)	1.01	0.89	2.00	3.41	4.49	5.68	5.42	4.43	3.32	2.07	0.97	0.76
Change in Storage Capacity (in.)	0.06	-0.04	0.86	2.19	3.37	4.90	3.56	2.47	1.55	0.48	-0.14	-0.21
Ending Storage Capacity (in.)	0.78	0.74	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.30	1.08
Amount of Percolation (in.)	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**
storage consumed	-0.06	0.04	-0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.21

Annual cycle of precipation-evapotranspiration-storage for Broad Canyon Landfill
Norwood - 2 (Norwood Precipitation, Montrose Pan Evaporation, Soil Sample 2)

Annual ave Precip total =	15.41	inches (average annual over last 84 years)
Annual Evapo-Transpiration =	57.45	inches (including sublimation)
Wilting Point of Soil =	20	% (Moisture Content in Percent of Volume)
Field Capacity of Cover Soil =	10	% (Moisture Content in Percent of Volume)
Runoff =	0	% (Percent of Precipation)
Initial Moisture Content of Cover Soil =	15	% (Percent of Volume)
Thickness of Cover Soil =	12	inches
Penman-Wilson ET Reduction =	0.6	(fraction of total potential evapo-transpiration expressed as actual soil evaporation)
Maximum Storage Capacity of Cover Soil =	1.20	inches [(field capacity - wilting point) x layer thickness]
Initial Storage Capacity =	0.60	inches

MONTH OF YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
percentage of annual precip by month	6.17%	6.04%	7.40%	7.92%	7.27%	5.06%	12.08%	12.73%	11.49%	10.32%	7.21%	6.30%
percentage of annual ET by month	2.92%	2.59%	5.81%	9.90%	13.04%	16.48%	15.74%	12.86%	9.64%	6.01%	2.80%	2.19%
days per month	31	28	31	30	31	30	31	31	30	31	30	31
Beginning Available Storage Capacity (in.)	0.60	0.66	0.62	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.06
Monthly Precipitation (inches)	0.95	0.93	1.14	1.22	1.12	0.78	1.86	1.96	1.77	1.59	1.11	0.97
Monthlry Infiltration = precip-runoff (in.)	0.95	0.93	1.14	1.22	1.12	0.78	1.86	1.96	1.77	1.59	1.11	0.97
Monthly ET Loss (inches)	1.01	0.89	2.00	3.41	4.49	5.68	5.42	4.43	3.32	2.07	0.97	0.76
Change in Storage Capacity (in.)	0.06	-0.04	0.86	2.19	3.37	4.90	3.56	2.47	1.55	0.48	-0.14	-0.21
Ending Storage Capacity (in.)	0.66	0.62	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.06	0.84
Amount of Percolation (in.)	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**
storage consumed	-0.06	0.04	-0.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.21

Annual cycle of precipation-evapotranspiration-storage for Broad Canyon Landfill
Uravan- 1 (Uravan Precipitation, Montrose Pan Evaporation, Soil Sample 1)

Annual ave Precip total =	12.6	inches (average annual over last 50 years)
Annual Evapo-Transpiration =	57.45	inches (including sublimation)
Willing Point of Soil =	28	% (Moisture Content in Percent of Volume)
Field Capacity of Cover Soil =	16	% (Moisture Content in Percent of Volume)
Runoff =	0	% (Percent of Precipation)
Initial Moisture Content of Cover Soil =	22	% (Percent of Volume)
Thickness of Cover Soil =	12	inches
Penman-Wilson ET Reduction =	0.6	(fraction of total potential evapo-transpiration expressed as actual soil evaporation)
Maximum Storage Capacity of Cover Soil =	1.44	inches [(field capacity - wilting point) x layer thickness]
Initial Storage Capacity =	0.72	inches

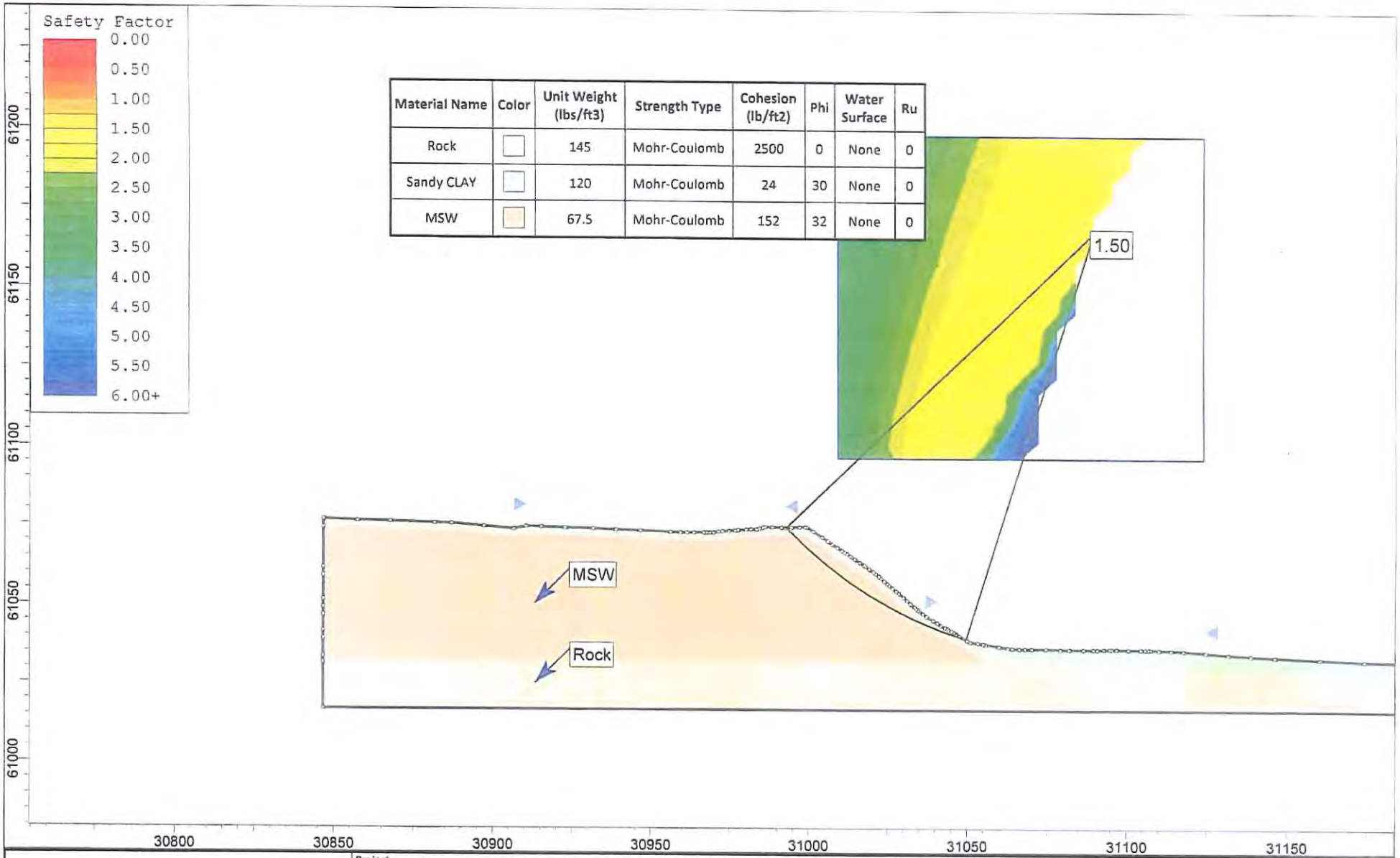
MONTH OF YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
percentage of annual precip by month	6.98%	6.19%	8.17%	7.94%	7.46%	3.89%	9.21%	10.87%	11.75%	11.67%	8.02%	7.86%
percentage of annual ET by month	2.92%	2.59%	5.81%	9.90%	13.04%	16.48%	15.74%	12.86%	9.64%	6.01%	2.80%	2.19%
days per month	31	28	31	30	31	30	31	31	30	31	30	31
Beginning Available Storage Capacity (in.)	0.72	0.85	0.96	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.40
Monthly Precipitation (inches)	0.88	0.78	1.03	1.00	0.94	0.49	1.16	1.37	1.48	1.47	1.01	0.99
Monthlry Infiltration = precip-runoff (in.)	0.88	0.78	1.03	1.00	0.94	0.49	1.16	1.37	1.48	1.47	1.01	0.99
Monthly ET Loss (inches)	1.01	0.89	2.00	3.41	4.49	5.68	5.42	4.43	3.32	2.07	0.97	0.76
Change in Storage Capacity (in.)	0.13	0.11	0.97	2.41	3.55	5.19	4.26	3.06	1.84	0.60	-0.04	-0.23
Ending Storage Capacity (in.)	0.85	0.96	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.40	1.16
Amount of Percolation (in.)	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**
storage consumed	-0.13	-0.11	-0.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.23

Annual cycle of precipation-evapotranspiration-storage for Broad Canyon Landfill
Uravan - 2 (Uravan Precipitation, Montrose Pan Evaporation, Soil Sample 2)

Annual ave Precip total =	12.6	inches (average annual over last 50 years)
Annual Evapo-Transpiration =	57.45	inches (including sublimation)
Wilting Point of Soil =	20	% (Moisture Content in Percent of Volume)
Field Capacity of Cover Soil =	10	% (Moisture Content in Percent of Volume)
Runoff =	0	% (Percent of Precipation)
Initial Moisture Content of Cover Soil =	15	% (Percent of Volume)
Thickness of Cover Soil =	12	inches
Penman-Wilson ET Reduction =	0.6	(fraction of total potential evapo-transpiration expressed as actual soil evaporation)
Maximum Storage Capacity of Cover Soil =	1.20	inches [(field capacity - wilting point) x layer thickness]
Initial Storage Capacity =	0.60	inches

MONTH OF YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
percentage of annual precip by month	6.98%	6.19%	8.17%	7.94%	7.46%	3.89%	9.21%	10.87%	11.75%	11.67%	8.02%	7.86%
percentage of annual ET by month	2.92%	2.59%	5.81%	9.90%	13.04%	16.48%	15.74%	12.86%	9.64%	6.01%	2.80%	2.19%
days per month	31	28	31	30	31	30	31	31	30	31	30	31
Beginning Available Storage Capacity (in.)	0.60	0.73	0.84	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.16
Monthly Precipitation (inches)	0.88	0.78	1.03	1.00	0.94	0.49	1.16	1.37	1.48	1.47	1.01	0.99
Monthlry Infiltration = precip-runoff (in.)	0.88	0.78	1.03	1.00	0.94	0.49	1.16	1.37	1.48	1.47	1.01	0.99
Monthly ET Loss (inches)	1.01	0.89	2.00	3.41	4.49	5.68	5.42	4.43	3.32	2.07	0.97	0.76
Change in Storage Capacity (in.)	0.13	0.11	0.97	2.41	3.55	5.19	4.26	3.06	1.84	0.60	-0.04	-0.23
Ending Storage Capacity (in.)	0.73	0.84	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.16	0.92
Amount of Percolation (in.)	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**	**none**
storage consumed	-0.13	-0.11	-0.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.23

APPENDIX D

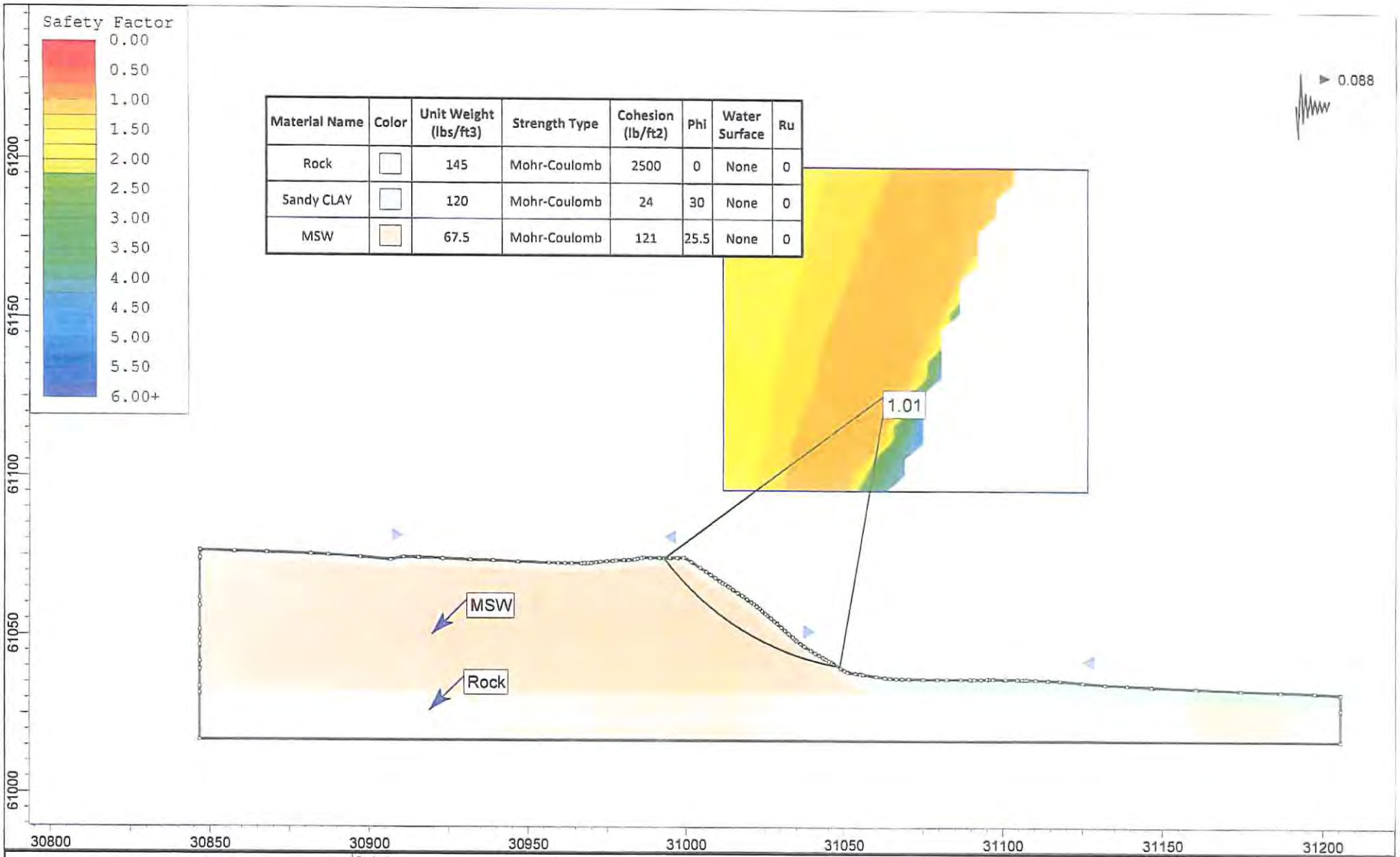


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface	Ru
Rock		145	Mohr-Coulomb	2500	0	None	0
Sandy CLAY		120	Mohr-Coulomb	24	30	None	0
MSW		67.5	Mohr-Coulomb	152	32	None	0

IGES®

SLIDEINTERPRET 6.012

Project	Broad Canyon Landfill		
Analysis Description	North Slope, soil and MSW - Static analysis		
Drawn By	JMG	Scale 1:500	Company IGES, Inc
Date	7/28/2011, 3:42:43 PM		File Name North Slope, soil and MSW mix.slim

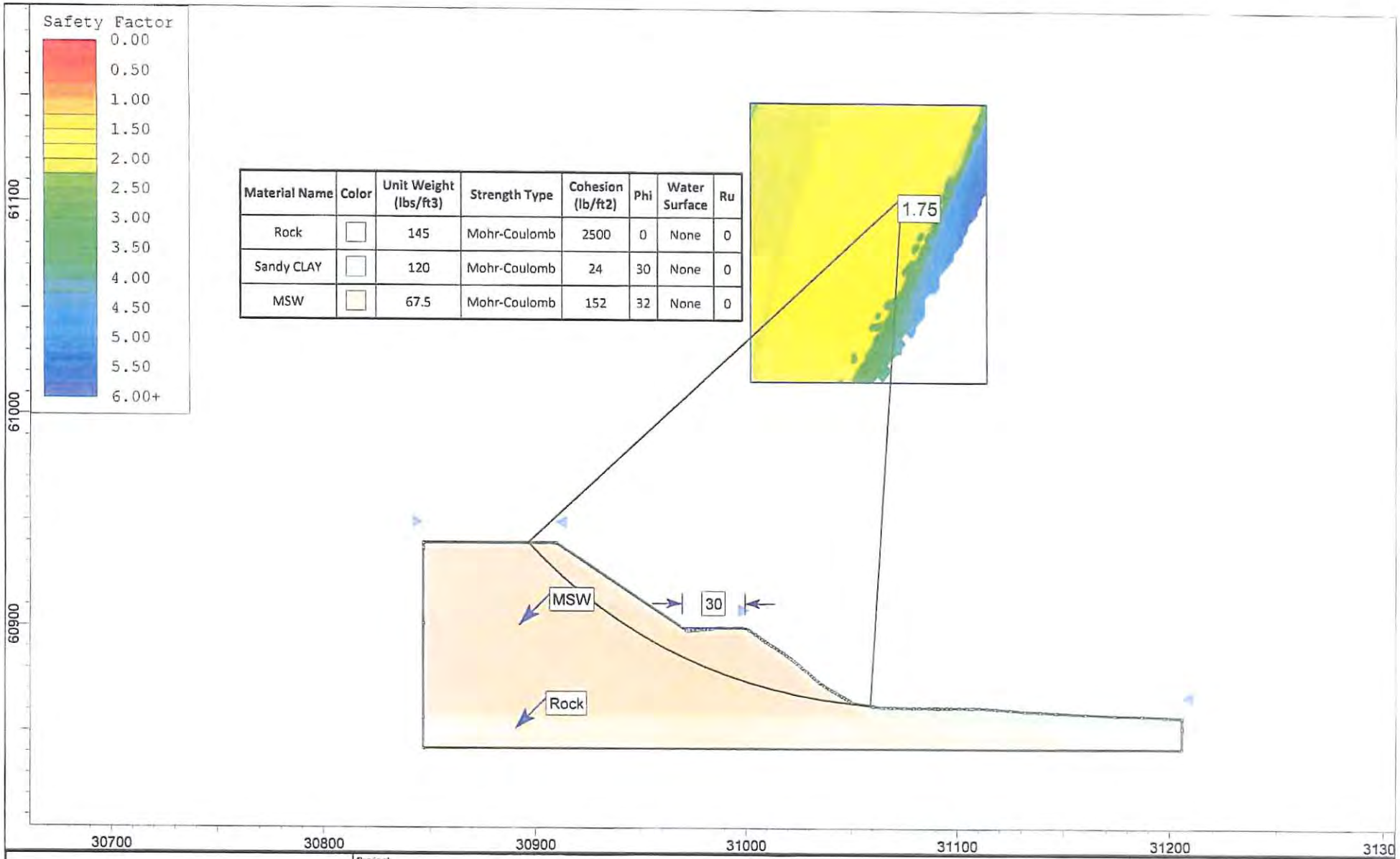


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface	Ru
Rock		145	Mohr-Coulomb	2500	0	None	0
Sandy CLAY		120	Mohr-Coulomb	24	30	None	0
MSW		67.5	Mohr-Coulomb	121	25.5	None	0

IGES®

SLIDEINTERPRET 6.012

Project	Broad Canyon Landfill		
Analysis Description	North Slope, soil and MSW - Pseudo-static analysis		
Drawn By	JMG	Scale	1:500
Company	IGES, Inc		
Date	7/28/2011, 3:42:43 PM	File Name	North Slope, soil and MSW mix - pseudo static.slim

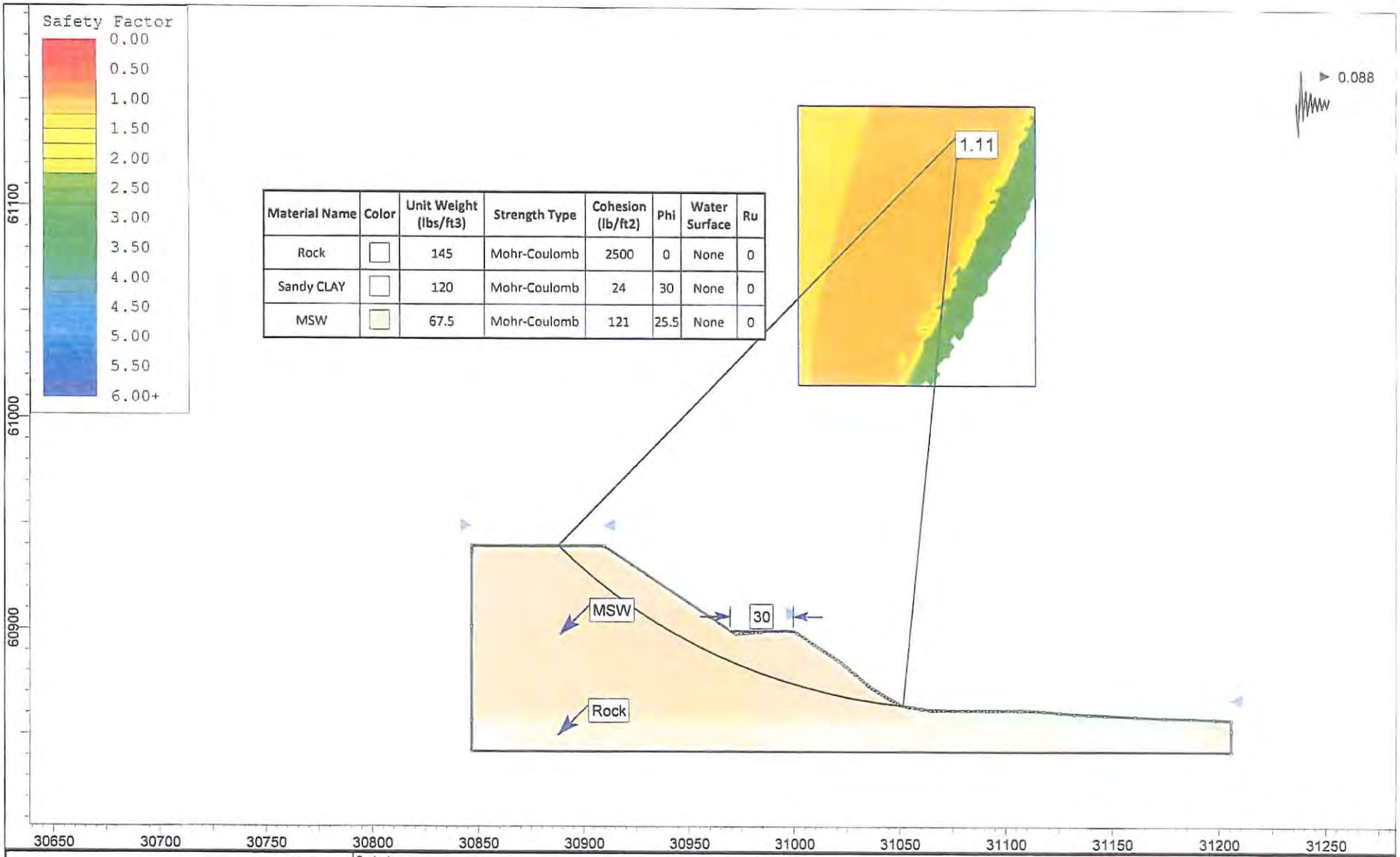


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface	Ru
Rock		145	Mohr-Coulomb	2500	0	None	0
Sandy CLAY		120	Mohr-Coulomb	24	30	None	0
MSW		67.5	Mohr-Coulomb	152	32	None	0

IGES®

SLIDEINTERPRET 6.012

Project	Broad Canyon Landfill		
Analysis Description	North Slope, next phase, whole slope failure - Static analysis		
Drawn By	JMG	Scale 1:750	Company IGES, Inc
Date	8/18/11		File Name North Slope, next phase, whole slope - static.slim

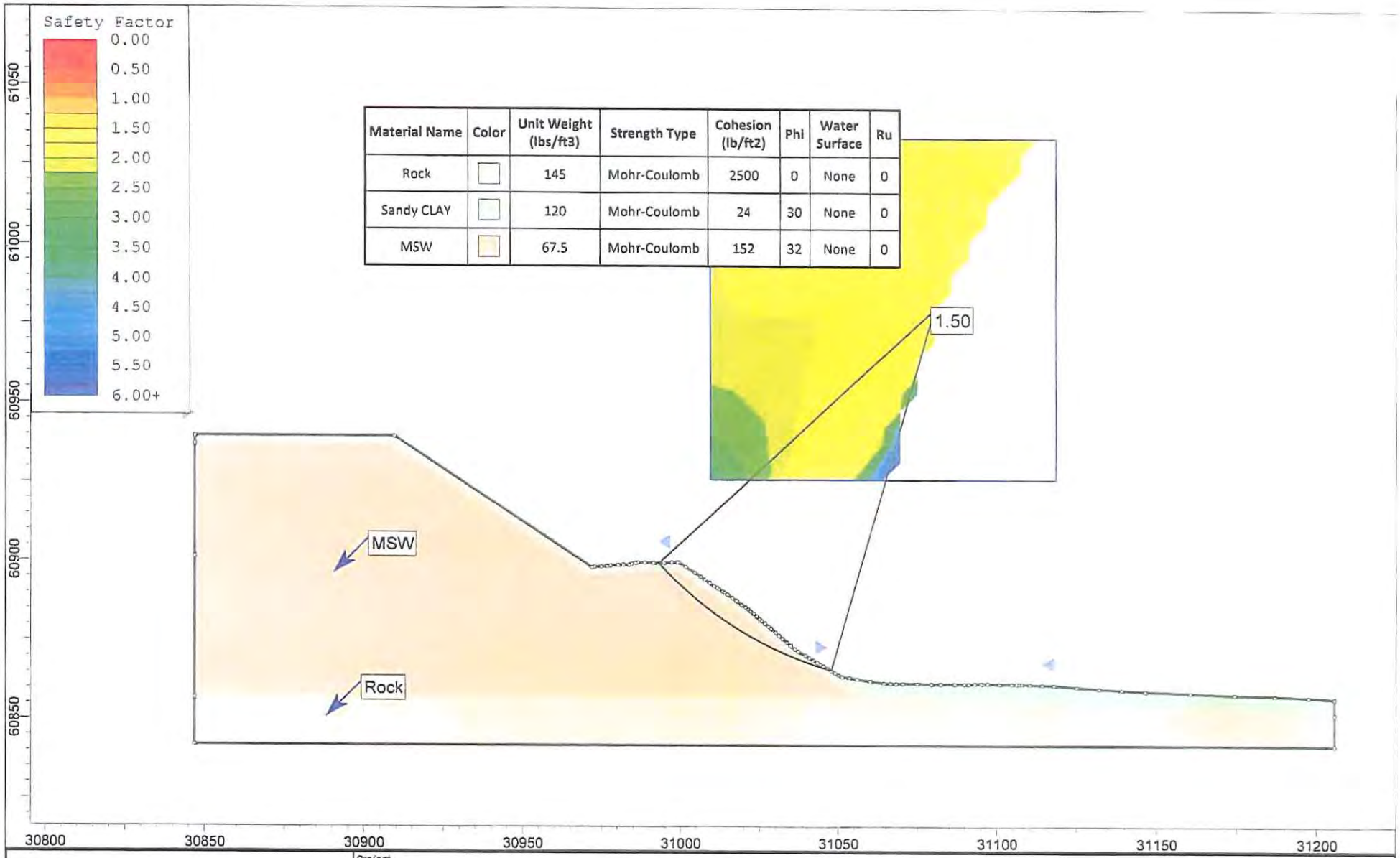


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface	Ru
Rock		145	Mohr-Coulomb	2500	0	None	0
Sandy CLAY		120	Mohr-Coulomb	24	30	None	0
MSW		67.5	Mohr-Coulomb	121	25.5	None	0

IGES®

SLIDEINTERPRET 6.012

Project	Broad Canyon Landfill		
Analysis Description	North Slope, next phase, whole slope failure - Pseudo-static analysis		
Drawn By	JMG	Scale 1:750	Company IGES, Inc
Date	8/18/11		File Name North Slope, next phase, whole slope - pseudo static.slim

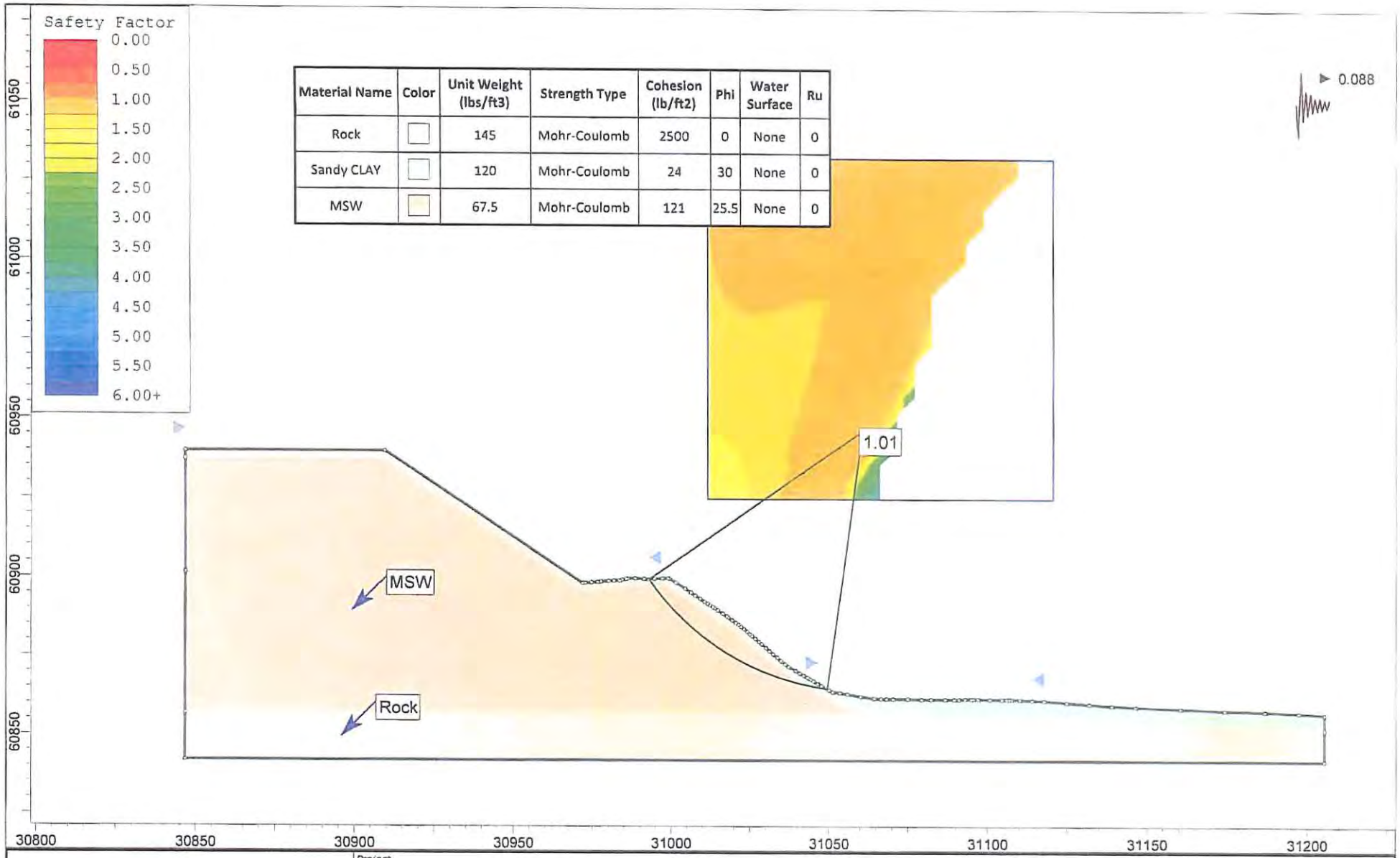


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface	Ru
Rock		145	Mohr-Coulomb	2500	0	None	0
Sandy CLAY		120	Mohr-Coulomb	24	30	None	0
MSW		67.5	Mohr-Coulomb	152	32	None	0

IGES®

SLIDEINTERPRET 6.012

Project	Broad Canyon Landfill		
Analysis Description	North Slope, next phase, lower slope - Static analysis		
Drawn By	JMG	Scale 1:500	Company IGES, Inc
Date	8/18/11		File Name North Slope, next phase, lower slope - static.slim

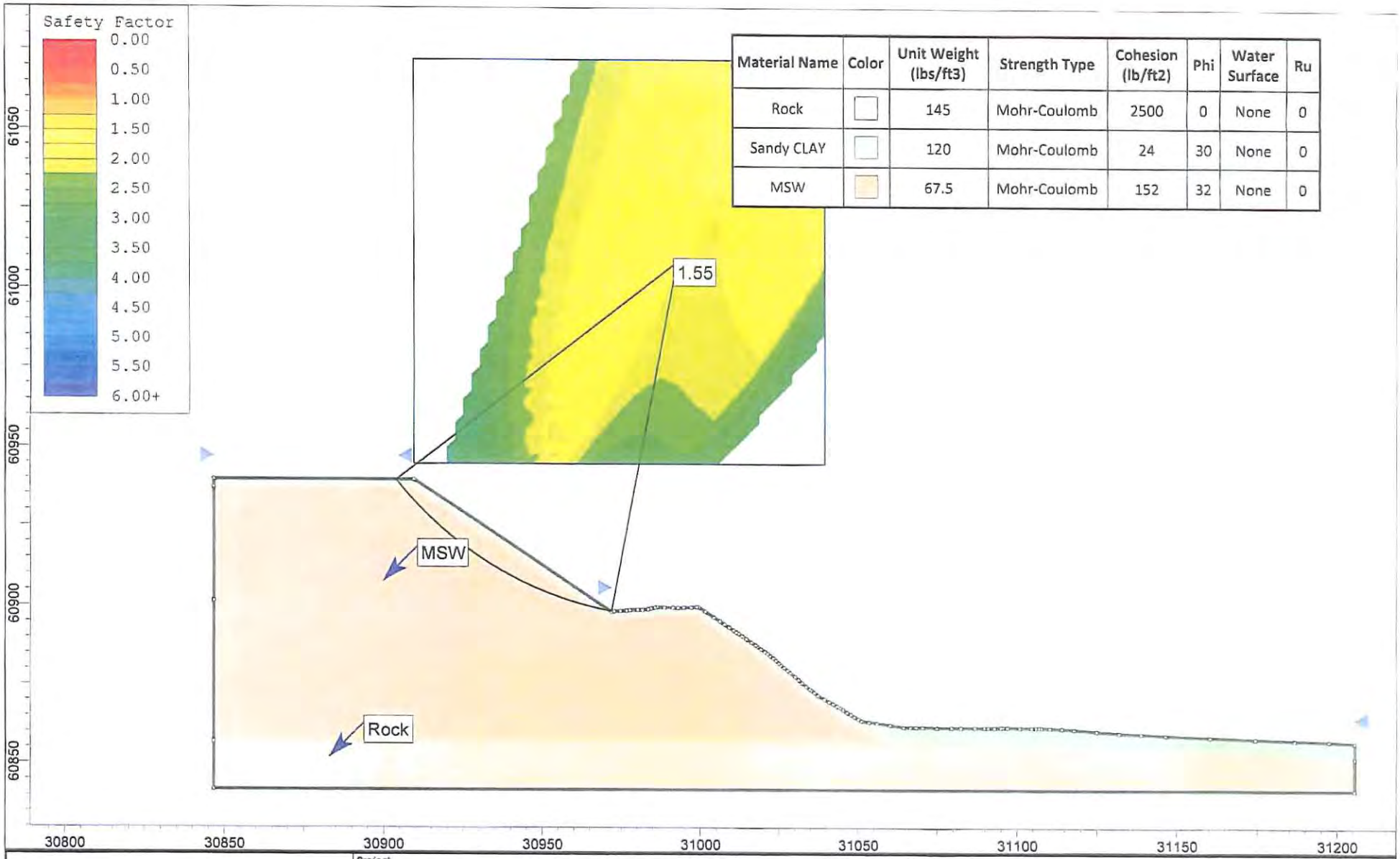


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface	Ru
Rock		145	Mohr-Coulomb	2500	0	None	0
Sandy CLAY		120	Mohr-Coulomb	24	30	None	0
MSW		67.5	Mohr-Coulomb	121	25.5	None	0

IGES®

SLIDEINTERPRET 6.012

Project	Broad Canyon Landfill		
Analysis Description	North Slope, next phase, lower slope - Pseudo-static analysis		
Drawn By	JMG	Scale 1:500	Company IGES, Inc
Date	8/18/11		File Name North Slope, next phase, lower slope - Pseudo static.slim

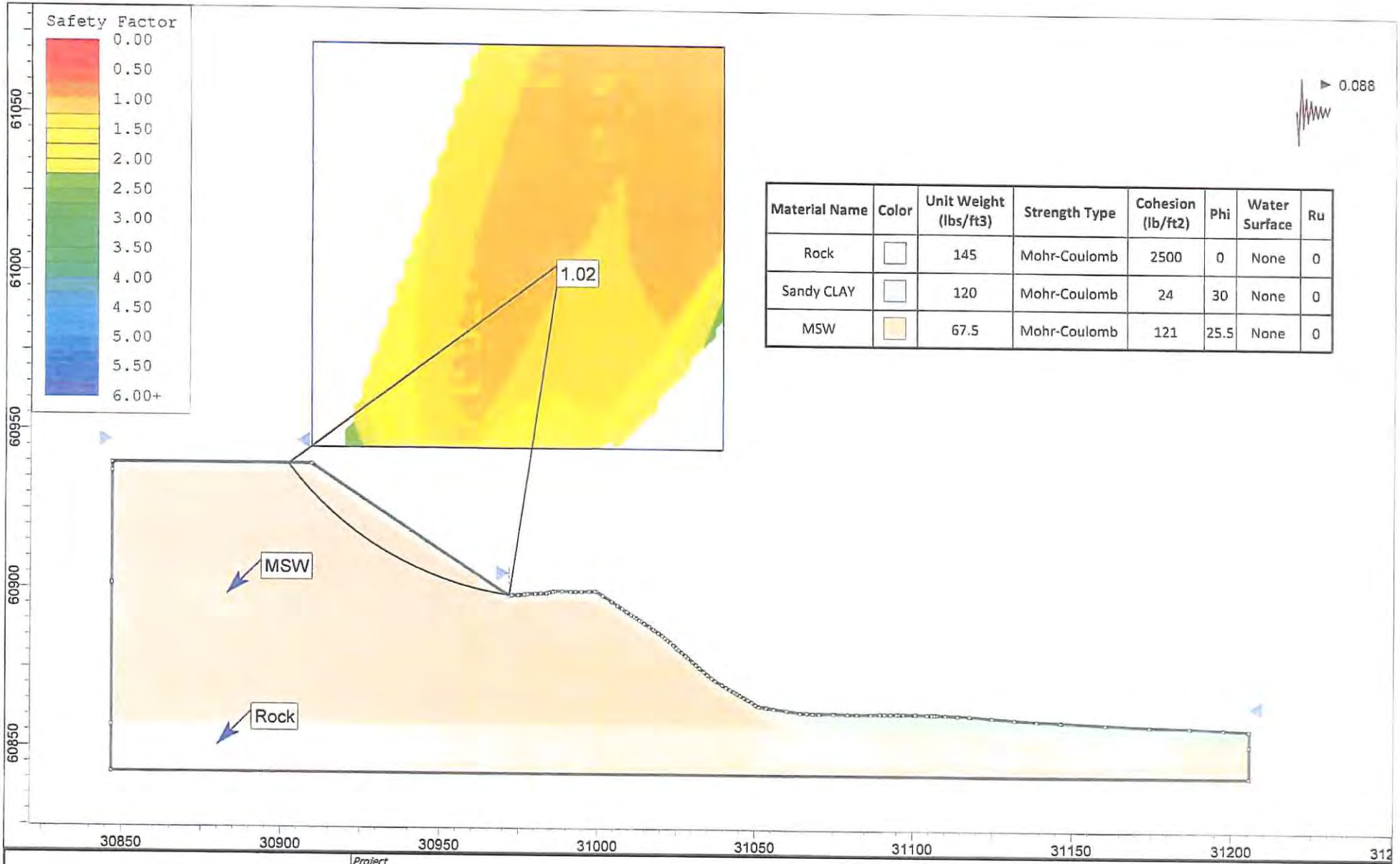


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface	Ru
Rock		145	Mohr-Coulomb	2500	0	None	0
Sandy CLAY		120	Mohr-Coulomb	24	30	None	0
MSW		67.5	Mohr-Coulomb	152	32	None	0

IGES®

SLIDEINTERPRET 6.012

Project	Broad Canyon Landfill		
Analysis Description	North Slope, next phase, upper slope - Static analysis		
Drawn By	JMG	Scale	1:500
Company	IGES, Inc		
Date	8/18/11	File Name	North Slope, next phase, upper slope - static.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface	Ru
Rock		145	Mohr-Coulomb	2500	0	None	0
Sandy CLAY		120	Mohr-Coulomb	24	30	None	0
MSW		67.5	Mohr-Coulomb	121	25.5	None	0

IGES®

SLIDEINTERPRET 6.012

Project	Broad Canyon Landfill		
Analysis Description	North Slope, next phase, upper slope - Pseudo-static analysis		
Drawn By	JMG	Scale	1:500
Company	IGES, Inc		
Date	8/18/11	File Name	North Slope, next phase, upper slope - Pseudo static.slim

APPENDIX 9

OTHER PERMITS

BROAD CANYON LANDFILL

Colorado Department of Public Health and Environment

CERTIFICATION TO DISCHARGE
UNDER
CDPS GENERAL PERMIT COR900000
STORMWATER ASSOCIATED WITH NON-EXTRACTIVE INDUSTRIAL ACTIVITY

Certification Number: **COR901182**

This Certification to Discharge specifically authorizes:

T S Landfill Inc

to discharge stormwater from the facility identified as

Broad Canyon Landfill

to:

Long Draw - Hamilton Creek

Facility Located at: HH31 Road Rural Area, Montrose County, Naturita, CO 81422
Latitude 38.158, Longitude -108.52

Outfalls	Latitude	Longitude
001	38.1604	-108.519
002	38.1603	-108.5173

All discharges must comply with the lawful requirements of federal agencies municipalities, counties, drainage districts and other local agencies regarding any discharges to storm drain systems, conveyances, or other water courses under their jurisdiction.

REQUIRED MONITORING

A. VISUAL MONITORING Part I.I.1 (Quarterly)

B. BENCHMARK MONITORING Part I.I.2 Sector(s) L

Subsector	Parameter	Benchmark Monitoring Concentration	Monitoring Frequency	Sample Type
L1	Total Suspended Solids (TSS) 0530	10 mg/L	Quarterly	grab
L2	Total Iron 01045	1.0 mg/L	Quarterly	grab

C. WATER QUALITY STANDARDS Part I.I.4

Discharges authorized under this permit must be controlled as necessary to meet applicable water quality standards.

Certification Issued: 1/14/2013 **Effective:** 1/14/2013 **Certification Expires:** 6/30/2017

This certification under the permit requires that specific actions be performed at designated times. The certification holder is legally obligated to comply with all terms and conditions of the permit.

Signed,

Nathan Moore, Unit Manager
Water Quality Control Division

STATE OF COLORADO

COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT
AIR POLLUTION CONTROL DIVISION
TELEPHONE: (303) 692-3150

CONSTRUCTION PERMIT

PERMIT NO: **09MO1068**

INITIAL APPROVAL

DATE ISSUED: SEP 29 2009

ISSUED TO: **T S Landfill, Inc**

THE SOURCE TO WHICH THIS PERMIT APPLIES IS DESCRIBED AND LOCATED AS FOLLOWS:

Municipal solid waste landfill known as the Broad Canyon Landfill, located 3.5 miles south east of Naturita, in Montrose County, Colorado.

THE SPECIFIC EQUIPMENT OR ACTIVITY SUBJECT TO THIS PERMIT INCLUDES THE FOLLOWING:

Operation of a municipal solid waste landfill site with a design capacity of 689,100 tons (625,000 Megagrams or 1,400,000 compacted yards) of non-hazardous solid waste (as defined in 6 CCR 1007-2) and a projected closure date of 2018. Fugitive particulate emissions from excavation, waste handling, hauling and stockpiling. Landfill gas generation is uncontrolled.

THIS PERMIT IS GRANTED SUBJECT TO ALL RULES AND REGULATIONS OF THE COLORADO AIR QUALITY CONTROL COMMISSION AND THE COLORADO AIR POLLUTION PREVENTION AND CONTROL ACT C.R.S. (25-7-101 et seq), TO THOSE GENERAL TERMS AND CONDITIONS INCLUDED IN THIS DOCUMENT AND THE FOLLOWING SPECIFIC TERMS AND CONDITIONS:

1. Visible emissions shall not exceed twenty percent (20%) opacity during normal operation of the source. During periods of startup, process modification, or adjustment of control equipment visible emissions shall not exceed 30% opacity for more than six minutes in any sixty consecutive minutes. Opacity shall be measured by EPA Method 9. (Reference: Regulation No. 1, Section II.A.1. & 4.)

2. This source shall be limited to a maximum waste acceptance rate as listed below and all other activities, operational rates and numbers of equipment as stated in the application. Monthly records of the actual waste acceptance rate shall be maintained by the applicant and made available to the Division for inspection upon request. (Reference: Regulation No. 3, Part B, Section II.A.4.)

   Waste received shall not exceed 34,925 tons per year (equivalent to 31,749 Mega grams or 70,000 compacted yards per year).

3. Emissions of air pollutants shall not exceed the following limitations (as calculated in the Division's preliminary analysis): (Reference: Regulation 3, Part B, III.A.4)

Volatile Organic Compounds	8.81 tons per year.

4. The Division's approval of the control plan is based on the Waste Acceptance level as listed in condition no. 3. Prior to any increase in waste acceptance rates, the applicant shall submit an Air Pollutant Emission Notice and Control Plan revision which will be subject to Division review and approval to ensure compliance with the National Ambient Air Quality Standards for particulate matter. Records of the actual waste acceptance rate shall be maintained by the applicant and made available to the Division for inspection upon request. (Reference: Regulation No. 1, III.D.1.b.)

   This activity shall not result in the exceedence of the following emissions of fugitive total suspended particulates (TSP) and fugitive particulate matter of less than ten microns (PM_{10}). These emission limits are based on the waste acceptance rate listed above. The Division assumes that these levels are being met if the control measures stated in the approved control plan are followed and the stated process rates are not exceeded.

Fugitive Particulate Matter:	45.1 tons per year.
Fugitive PM10 (Particulate Matter<10 μm):	10.5 tons per year.

5. This source is subject to the odor requirements of Regulation No. 2. (State only enforceable)

6. Within one hundred and eighty days (180) after commencement of operation, compliance with the conditions contained on this permit shall be demonstrated to the Division. It is the permittee's responsibility to self certify compliance with the conditions. Failure to demonstrate compliance within 180 days may result in revocation of the permit. (Information on how to certify compliance was mailed with the permit.)

7. MSW Landfills that commenced construction, reconstruction or modification or began accepting waste on or after May 30, 1991 are subject to the New Source Performance Standards requirements of Regulation No. 6, Part A, Subpart WWW, Standards of Performance for Municipal Solid Waste Landfills, including, but not limited to, the following:

   a. Each owner or operator shall submit an initial design capacity report to the Administrator as provided in §60.757(a). An amended design capacity report shall be submitted to the Administrator when there is any increase in the design capacity of the landfill (§60.752(a)(1)).

   b. The facility shall comply with the following requirements:

§60.757	Reporting requirements.
§60.758	Recordkeeping requirements.

8. The following requirements of Regulation No. 6, Part A, Subpart A, General Provisions, apply.

   a. At all times, including periods of start-up, shutdown, and malfunction, the facility and control equipment shall, to the extent practicable, be maintained and operated in a manner consistent with good air pollution control practices for minimizing emissions. Determination of whether or not acceptable operating and maintenance procedures are being used will be based on information available to the Division, which may include, but is not limited to, monitoring results, opacity observations, review of operating and maintenance procedures, and inspection of the source. (Reference: Regulation 6, Part A. General Provisions from

40CFR60.11)

b. No article, machine, equipment or process shall be used to conceal an emission which would otherwise constitute a violation of an applicable standard. Such concealment includes, but is not limited to, the use of gaseous diluents to achieve compliance with an opacity standard or with a standard which is based on the concentration of a pollutant in the gases discharged to the atmosphere. (§ 60.12)

c. Written notification of construction and initial startup dates shall be submitted to the Division as required under § 60.7.

e. Written notification of opacity observation or monitor demonstrations shall be submitted to the Division as required under § 60.7.

f. Performance tests shall be conducted as required under § 60.8.

g. Compliance with opacity standards shall be demonstrated according to § 60.11.

9. A Revised Air Pollutant Emission Notice (APEN) shall be filed: (Reference: Reg. 3, Part A,II.C)

a. Annually whenever a significant increase in emissions occurs as follows:

For any criteria pollutant:

For sources emitting **less than 100 tons per year**, a change in actual emissions of five tons per year or more, above the level reported on the last APEN submitted; or

A change in actual emissions, above the level reported on the last APEN submitted, of 50 pounds of lead

For any non-criteria reportable pollutant:

If the emissions increase by 50% or five (5) tons per year, whichever is less, above the level reported on the last APEN submitted to the Division.

b. Whenever there is a change in the owner or operator of any facility, process, or activity; or

c. Whenever new control equipment is installed, or whenever a different type of control equipment replaces an existing type of control equipment; or

d. Whenever a permit limitation must be modified; or

e. No later than 30 days before the existing APEN expires.

Michael Harris, P. E.
Permit Review Engineer

R K Hancock III, P.E.
Construction Permits Unit Leader

Permit History: Initial Approval this issuance

Notes to Permit Holder:

1) The production or raw material processing limits and emission limits contained in this permit are based on the production/processing rates requested in the permit application. These limits may be revised upon request of the permittee providing there is no exceedence of any specific emission control regulation or any ambient air quality standard. A revised air pollution emission notice (APEN) and application form must be submitted with a request for a permit revision.

2) This source is subject to the Common Provisions Regulation Part II, Subpart E, Affirmative Defense Provision for Excess Emissions During Malfunctions. The permittee shall notify the Division of any malfunction condition which causes a violation of any emission limit or limits stated in this permit as soon as possible, but no later than noon of the next working day, followed by written notice to the Division addressing all of the criteria set forth in Part II.E.1. of the Common Provisions Regulation. See:
http://www.cdphe.state.co.us/regulations/airregs/100102aqcccommonprovisionsreg.pdf.

3) The following emissions of non-criteria reportable air pollutants are established based upon the material consumptions as indicated in Condition Number 2. This information is listed to inform the operator of the Division's analysis of the specific compounds. This information is listed on the Division's emission inventory system.

C.A.S.#	SUBSTANCE	EMISSIONS [LB/YR]
71-43-2	Benzene	81.8
79-34-5	1,1,2,2 Tetrachloroethane	102.1
107-13-1	Acrylonitrile	184.1
75-09-2	Methylene chloride	665.5
127-18-4	Tetrachloroethylene (Perchloroethylene)	339.0
108-88-3	Toluene	1983.9
75-01-4	Vinyl chloride	251.3

4) This source is classified as a: Minor Source
At a: Minor, Facility

5) In accordance with C.R.S. 25-7-114.1, the Air Pollutant Emission Notice (APEN) associated with this permit is valid for a term of five years. The five year term for the APEN received with this permit application expires on August 18, 2014. A revised APEN shall be submitted no later than 30 days before the five year term expires.

GENERAL TERMS AND CONDITIONS: (IMPORTANT! READ ITEMS 5,6,7 AND 8)

1. This permit is issued in reliance upon the accuracy and completeness of information supplied by the applicant and is conditioned upon conduct of the activity, or construction, installation and operation of the source, in accordance with this information and with representations made by the applicant or applicant's agents. It is valid only for the equipment and operations or activity specifically identified on the permit.

2. Unless specifically stated otherwise, the general and specific conditions contained in this permit have been determined by the APCD to be necessary to assure compliance with the provisions of Section 25-7-114.5(7)(a), C.R.S.

3. Each and every condition of this permit is a material part hereof and is not severable. Any challenge to or appeal of, a condition hereof shall constitute a rejection of the entire permit and upon such occurrence, this permit shall be deemed denied *ab initio*. This permit may be revoked at any time prior to final approval by the Air Pollution Control Division (APCD) on grounds set forth in the Colorado Air Quality Control Act and regulations of the Air Quality Control Commission (AQCC), including failure to meet any express term or condition of the permit. If the Division denies a permit, conditions imposed upon a permit are contested by the applicant, or the Division revokes a permit, the applicant or owner or operator of a source may request a hearing before the AQCC for review of the Division's action.

4. This permit and any required attachments must be retained and made available for inspection upon request at the location set forth herein. With respect to a portable source that is moved to a new location, a copy of the Relocation Notice (required by law to be submitted to the APCD whenever a portable source is relocated) should be attached to this permit. The permit may be reissued to a new owner by the APCD as provided in AQCC Regulation No. 3, Part B, Section II.B. upon a request for transfer of ownership and the submittal of a revised APEN and the required fee.

5. Issuance (initial approval) of an emission permit does not provide "final" authority for this activity or operation of this source. Final approval of the permit must be secured from the APCD in writing in accordance with the provisions of 25-7-114.5(12)(a) C.R.S. and AQCC Regulation No. 3, Part B, Section III.G. Final approval cannot be granted until the operation or activity commences and has been verified by the APCD as conforming in all respects with the conditions of the permit. If the APCD so determines, it will provide written documentation of such final approval, which does constitute "final" authority to operate. ***Compliance with the permit conditions must be demonstrated within 180 days after commencement of operation.***

6. **THIS PERMIT AUTOMATICALLY EXPIRES IF** you (1) do not commence construction or operation within 18 months after either the date of issuance of this permit or the date on which such construction or activity was scheduled to commence as set forth in the permit, whichever is later; (2) discontinue construction for a period of 18 months or more; or (3) do not complete construction within a reasonable time of the estimated completion date. Extensions of the expiration date may be granted by the APCD upon a showing of good cause by the permittee prior to the expiration date.

7. **YOU MUST notify the APCD no later than thirty days after commencement of the permitted operation or activity by submitting a Notice of Startup (NOS) form to the APCD.** The Notice of Startup (NOS) form may be downloaded online at www.cdphe.state.co.us/ap/downloadforms.html. Failure to do so is a violation of AQCC Regulation No. 3, Part B, Section III.G.1., and can result in the revocation of the permit. *You must demonstrate compliance with the permit conditions within 180 days after commencement of operation as stated in condition 5.*

8. Section 25-7-114.7(2)(a), C.R.S. requires that all sources required to file an Air Pollution Emission Notice (APEN) must **pay an annual fee** to cover the costs of inspections and administration. If a source or activity is to be discontinued, the owner must notify the Division in writing requesting a cancellation of the permit. Upon notification, annual fee billing will terminate.

9. Violation of the terms of a permit or of the provisions of the Colorado Air Pollution Prevention and control Act or the regulations of the AQCC may result in administrative, civil or criminal enforcement actions under Sections 25-7-115 (enforcement), -121 (injunctions), -122 (civil penalties), -122.1 (criminal penalties), C.R.S.

PARTICULATE EMISSIONS CONTROL PLAN

THE FOLLOWING PARTICULATE EMISSIONS CONTROL MEASURES SHALL BE USED FOR COMPLIANCE PURPOSES ON THE ACTIVITIES COVERED BY THIS PERMIT, AS REQUIRED BY THE AIR QUALITY CONTROL COMMISSION REGULATION NO.1, Section III.D.1.b. THIS SOURCE IS SUBJECT TO THE FOLLOWING EMISSION GUIDELINES:

a. **Landfill Activities** - Visible emissions not to exceed 20% opacity, no off-property transport of visible emissions.

b. **Haul Roads** - No off-property transport of visible emissions shall apply to on-site haul roads, the nuisance guidelines shall apply to off-site haul roads.

c. **Haul Trucks** - There shall be no off-property transport of visible emissions from haul trucks when operating on the property of the owner or operator. There shall be no off-vehicle transport of visible emissions from the material in the haul trucks when operating off of the property of the owner or operator.

Control Measures

1. Topsoil and overburden stockpiles shall be compacted and revegetated within one year.

2. Vehicle speed on unpaved roads and disturbed areas shall not exceed a maximum of 25 m.p.h. Speed limit signs shall be posted.

3. Unpaved haul roads shall be graveled.

APPENDIX 10
WASTE CHARATERIZATION PLAN

T S LANDFILL, INC.
BROAD CANYON LANDFILL
WASTE CHARACTERIZATION PLAN

DEFINITIONS

"SOLID WASTE" Solid waste is waste from household, community, commercial and industrial sources that does not contain hazardous wastes as defined in Section 25-15-101(9) of the Colorado Hazardous Waste Act unless otherwise regulated by the Department. Commercial wastes are all solid wastes generated by stores, hotels, markets, offices, restaurants, warehouses, and other non-manufacturing activities.

"HAZARDOUS WASTE" Any liquid, solid, contained gas, or sludge waste which contains properties that are dangerous or potentially harmful to human health or the environment.

"SPECIAL WASTE" Any solid waste requiring special handling or disposal procedures. Special wastes include, but are not limited to, asbestos, bulk tires, contaminated soil, sludge, and medical wastes.

"INDUSTRIAL WASTE" Waste generated by manufacturing or industrial processes that is not a hazardous waste regulated under Subtitle C of the Resource Conservation and Recovery Act (RCRA), parts 264 and 265. Such waste might include, but is not limited to, waste resulting from the following manufacturing processes: electric power generation; fertilizer/agricultural chemicals; food and related products/by-products; inorganic chemicals; iron and steel manufacturing; leather and leather products; non-ferrous metals manufacturing/foundries; organic chemicals; plastics and resins manufacturing; pulp and paper industry; rubber and miscellaneous plastic products; stone, glass, clay, and concrete products; textile manufacturing; transportation equipment; and water treatment. This term does not include mining waste or oil and gas waste.

"E & P WASTE" Wastes that are generated during the drilling and production of oil and gas wells or during the primary field operations and that are exempt from regulation as hazardous wastes under Subtitle C of the "Resource Conservation and Recovery Act of 1976".

"SLUDGE" Any solid, semisolid, waste generated by a municipal, commercial, or industrial wastewater treatment plant, water supply treatment plant, or air pollution control facility.

"TOXICITY" - Toxic wastes are harmful or fatal when ingested or absorbed (e.g., containing mercury, lead, etc.). When toxic wastes are land disposed, contaminated liquid may leach from the waste and pollute ground water. Toxicity is defined through a laboratory procedure called the Toxicity Characteristic Leaching Procedure (TCLP) . The TCLP helps identify wastes likely to leach concentrations of contaminants that may be harmful to human health or the environment. (Ref. EPA)

"REACTIVITY" Reactive wastes are unstable under normally conditions. The can cause explosions, toxic fumes, gases, or vapor when heated, compressed or mixed with water. Examples include lithium-sulfur batteries and explosives. (Ref. EPA)

"CORROSIVITY" Corrosive waste are acids or bases (pH ≤2 or ≤12.5) that are capable or corroding metal containers, such as storage tanks, drums, and barrels. Battery acid is an example. (Ref. EPA)

"IGNITABILITY" Ignitable wastes can create fires under certain conditions, are spontaneously combustible, or have a flash point less than 60 °C (140 °F). Examples include waste oils and used solvents. Test methods that may be used to determine ignitability include the Pensky-Martens Closed Cup Test Method. (Ref. EPA)

"BTEX" Benzene, Toluene, Ethylbenzene, Xylenes
"GRO" Gasoline Range Organics - light-end hydrocarbons C6 - C 10.
"DRO" Diesel Range Organics - heavy-end hydrocarbons C11 - C28.
"TPH" Total Petroleum Hydrocarbons - the sum of all GRO and DRO hydrocarbons.
"TEPH" Total Extractable Petroleum Hydrocarbons - DRO.
"TVH" Total Volatile Hydrocarbon - GRO.

"VOC" Volatile Organic Compounds - Organic chemicals that posses high vapor pressure enabling the ability to evaporate under normal indoor atmospheric conditions of temperature
and pressure.

"SVOC" Semi-Volatile Organic Compounds - Organic compounds that have a boiling point higher than that of water and that might vaporize when exposed to temperatures above room temperature. SVOCs include phenols PAH.

"PAH" Polycyclic Aromatic Hydrocarbon or Polynuclear Aromatic Hydrocarbon - A hazardous class of organic compounds formed during the incomplete burning of coal, oil and gas, garbage or other organic substances. They can also be found in the emissions of any type of fuel burn. Members of this class of compounds have been identified as exhibiting toxic and hazardous properties.

"PCB" Polychlorinated Biphenyls belong to a broad family of man-made organic chemicals known as chlorinated hydrocarbons. Polychlorinated biphenyls were widely used as dielectric and coolant fluids in electrical apparatus, cutting fluids for machining operations, carbonless copy paper and in heat transfer fluids. Manufacture of PCBs were banned in 1979. Aroclor is a PCB mixture produced from approximately 1930 to 1979. It is one of the most commonly known trade names for PCB mixtures.

"RCRA 8 METALS" Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, Silver. Designed to determine the appropriate hazardous classification of waste by establishing the degree of concentration for each metal.

T S LANDFILL, INC.
BROAD CANYON LANDFILL
WASTE CHARACTERIZATION PLAN

This waste characterization plan is prepared to assure the Broad Canyon Landfill does not knowingly receive or accept hazardous waste. The waste characterization plan includes the following items:

1. Incoming loads are continually inspected for hazardous wastes.
2. Transformers and barrels of oil will not be accepted to assure polychlorinated biphenyl (PCB) is not disposed of at the landfill.
3. Facility personnel are trained to recognize hazardous wastes.
4. Prohibited wastes include:

    a. Used tires
    b. Lead acid batteries
    c. All electronic waste (computers, phones, televisions, etc.)
    d. PCB Waste
    e. Waste oil
    f. Biomedical infectious waste
    g. Waste containing free liquid (paint filter test)
    h. Any drums containing free liquids
    i. Septage
    j. Radioactive wastes
    k. Transformers
    l. Mercury containing devices
    m. Fluorescent light tubes
    n. Liquids
    o. Raw Sludge
    p. Special waste not approved for disposal
    q. Electronic waste is set aside to be sent to a recycler.

5. It is the primary responsibility of the waste generated to notify the landfill of special wastes. Wastes shall be categorized and analyzed in accordance with Tables 1 and 2 as appropriate. Table 2 includes the maximum TCLP concentration of constituents that are considered non-hazardous. Waste generators will be required to go through the steps in the following Special Waste Management Plan and have the appropriate tests performed on a representative sample of the special wastes to determine if it can be accepted at the landfill.
6. Hazardous waste that is inadvertently discovered will be removed from the landfill and placed in the bermed area. A liner will be installed in the bermed area if required to contain the hazardous waste.
7. Waste streams that require specific waste handling and or disposal methods and or testing include:
    a. Non-friable asbestos
    b. Friable-asbestos
    c. Biosolids

d. Contaminated soils
e. Medical waste including sharps (non-infectious)

Non-Friable Asbestos
Within 24 hours following receipt of non-friable asbestos waste, the waste shall be covered with a minimum of nine inches (9”) of soil or eighteen inches (18”) of non-asbestos cover material**.** The Operator shall minimize the potential for release from and exposure to asbestos waste after placement in each disposal area and shall not compact the waste prior to application of cover materials. At no time shall compaction equipment come into contact with asbestos waste, containers, or packaging.

Friable Asbestos
See Appendix 15

Biosolids
Biosolids must be screened by the paint filter test and TCLP for Volatiles and Semi-Volatiles.

Contaminated Soils
Soils might be contaminated with anything from pesticides or epoxies, to numerous petroleum products. Contaminated soils will be accepted for disposal at the landfill provided they do not exhibit any hazardous characteristics. Approved contaminated soils might be disposed of as part of the normal waste stream or used as daily cover. Solis contaminated with a pesticide, if it was determined the pesticide was not hazardous, can be used as daily cover. Petroleum Contaminated Soils PCS may be accepted at the landfill providing it is characterized. Waste characterization will typically include benzene, toluene, ethylbenzene and xylenes (BTEX), and toxicity characteristic leaching procedure (TCLP) test for the RCRA eight metals. A paint filter test and ignitability test may be required depending on the consistency of the soil. PCS and E&P waste will not be used as daily cover. See the testing procedures and analytical limits in Tables 1 and 2 for guidance on required analytical testing. E&P Waste exempt from regulation as hazardous wastes under Subtitle C of the "Resource Conservation and Recovery Act of 1976" will be accepted at the landfill at the discretion of the Operator.

Medical waste including sharps (non infectious)
No potentially infectious waste will be accepted at the landfill. Treated medical waste (non infectious waste) that is sent to a solid waste disposal facility must be clearly identified as treated waste, or the waste treater can provide the waste transporter and disposal facility with a written statement that their general solid waste includes infectious wastes that has been treated to render it non-infectious.

The regulations define Sharps as any discarded article that may purposely or accidentally puncture or cut the skin or mucosa. Includes, but is not limited to, used needles; scalpel blades; syringes (with attached needle); pen needles; lancets; pasture pipettes; broken blood vials; needles with attached tubing; suture needles; razor blades; tattoo pens and toothpicks; broken culture tubes and culture dishes, regardless of presence of infectious substances; broken and unbroken glassware that were in contact with infectious substances (e.g., used slides and cover slips); disposable trocars; and

discarded unused or expired hypodermic needles, suture needles, syringes, and scalpel blades.

The sharps generator will treat the sharps to render then non-infectious. The sharps generator will place the sharps in a sharps container that is closable, puncture resistant, leak proof on the sides and bottom, and labeled or color coded in accordance with the Occupational Safety and Health Administration (OSHA) requirements. The sharps containers shall be hand delivered to the landfill. Within 24 hours following receipt, the sharps will be covered with a minimum of nine inches (9”) of soil**.**

Broad Canyon Landfill
Special Waste Management Plan
Waste Characterization Data
Generator Instructions

Step 1.
Complete Section I of the attached Waste Characterization Data Packet. Review the Waste Matrix table within the packet. If the particular waste in question requires analytical testing, complete section II of the packet. Fax or return Section I (and if appropriate Section II information) to the Hazardous Materials Manager (HMM) for review. Contact information for the HMM is as follows:

Fax Number: (970) 242-7908 E-Mail jestover@bresnan.net
Mailing Address: Hazardous Materials Manager, 2352 N 7th St Unit B, Grand Junction, CO 81501
Physical Address: Non-Hazardous Waste Materials Facility, 30120 HH31 Road, Naturita, CO 81422.

Step 2.
If sampling and analytical testing are required as part of the approval process for the waste in question, the HMM will complete Section III. Section III information fine tunes the sampling and analytical information to the specifics of the waste under review. The HMM will return the Section III information to the generator.

Step 3.
Upon receipt of the Section III information from the HMM, the generator will modify their proposed processes (Section II) with the modifications required by inclusion within Section III.

Step 4.
Return the completed Waste Characterization Data packet Sections I, II and III, along with the analytical results to the HMM for Final review. Allow a minimum of one week for this review.

Step 5.
Subsequent to review, the HMM will return a Letter or e-mail of Acceptance or Rejection to the generator.

Step 6.
If the generator receives an acceptance notification from the HMM, the generator may contact the Landfill Manager (LM) to schedule a date and time for acceptance of the material. Contact information for the LM is as follows:

Phone: (970) 258-2014
Mailing and Physical Address: Landfill Manager, 30120 HH31 Road, Naturita, CO 81422.

If the material is rejected, the generator may wish to contact the HMM to discuss other disposal options.

Waste Characterization Data
Section I

In order to determine the acceptability of Industrial & Special wastes the following information must be completed in its entirety.

Please Print
Company Name:_____
Company Address:_____
Phone: Fax: Email:_____
Contact Person: Phone:_____

Waste Information
Attach MSDS or other WCD sheets for the waste if applicable.
Common Name of Waste:_____
Method of waste generation:_____

Location of Waste
Street Address:_____City:_____
Physical State: Solid_____ Liquid_____ Semi-Solid_____
Sludge_____ Other_____
Odor: Strong_____ Mild_____ None_____ Describe_____
Anticipated Volume:_____ Method of delivery:_____

Please complete the attached initial sampling plan.

I certify the information provide it true to the best of my knowledge.

Print Name:_____ Signature:_____ Date:_____

Section II
SAMPLE PLAN

Company Name:_____

Site Location:_____

Type of samples: ( )grab ( )composite ( ) other describe_____
Number of samples to be taken:_____
Depth of samples-denote for each sample:_____
The date the samples are to be taken:_____
Estimated amount of waste:_____

Company representative

Print Name:_____ Signature:_____ Date:_____

Section III
LANDFILL USE ONLY

Modification to Sampling Plan if needed and analytical test required through a State of Colorado certified laboratory.

Number of samples to be taken:_____
Location and depth of samples:_____
Analytical tests required on samples:_____
_____

Approved Signature & Title:_____ Date:_____

To the generator:
Return this completed form with analytical results. Allow one working week for review. A letter of acceptance or denial will be mailed, faxed, or hand delivered one week after the appropriate review time. If accepted, contact the Landfill Manager to schedule a date and time for disposal as denoted on the letter.

CERTIFICATION OF TRIPLE RINSED CONTAINERS

1. PROCEDURE FOR PREPARING CONTAINERS FOR SHIPMENT AND DISPOSAL: Containers may be disposed of in the landfill if handled in the following manner and/or according to the guidelines set forth in 40 CFR 261.7.

   a. The containers MUST be tripled rinsed. TRIPLE RINSED: “Triple Rinsed”, means the flushing of containers three times, each time using a volume of the normal diluents equal to approximately ten percent of the container’s capacity.
   b. One end of the container must be cut out completely in the preparation of drums for disposal.
   c. Small containers must have the caps and/or lids removed in preparation for disposal.
   d. NO RESIDUE can be present in the containers according to the guidelines set forth in 40 CFR 261.7.
   e. Rinsate solution should be used as a product or treated as a hazardous waste.

2. WATE DESCRIPTION:

No. of Containers _____ Size of Container_____
No. of Containers_____ Size of Container_____
No. of Containers_____ Size of Container_____
No. of Containers_____ Size of Container_____

3. GENERATOR’S CERTIFICATION

I herby certify that the containers listed above have been triple rinsed and prepared for disposal as prescribed in the procedure above and/or according to the guidelines set forth in 40 CFR 261.7.

GENERATOR’S AUTHORIZED SIGNATURE

Print Name:_____ Signature:_____ Date:_____

Table 1 Broad Canyon Landfill Waste Management Matrix				
Waste Type	Waste Example	Concerns	Analytical Testing that may be required	Acceptance Standard
Asbestos	Insulation	Dust Born Fibers	None	Operator Discretion
	floor tiles			
	shingles			
	brick			
Biosolids	Digested and dewatered waste	Free Liquids	Paint Filter Test	Table 2
	from a commercial sewage	Hazardous Constituents	TCLP Metals - First time then annual	
	treatment plant.			
Contaminated Soils	Petroleum Impacted Soils	Free Liquids	Radioactivity (gross Alpha)	Table 2
	Car Wash Debris	Dust	Paint Filter Test	
	Pesticide Impacted Soil	Hazardous Constituents	TCLP-Metals	
		Safety Issues	TCLP-Volatiles	
		Ignitable Vapors	TCLP-Semi-Volatiles	
			TCLP-BTEX	
			TCLP-PAH	
			TCLP-Pesticides	
			Reactivity Corrosivity	Not Corrosive
			Ignitability	Not Ignitable
			TEPH TVPH	Remediation Guide Only
E&P Waste	Drill Cuttings	Free Liquids	Exempt from regulation as hazardous	Operator Discretion
	Tank Bottoms	Dust	waste.	
	Pit sludges	Safety Issues		
	Spent Filters, filter media	Ignitable Vapors		
	Produced Sand			
Medical Waste	Materials that are lightly	Disease Exposure	Rendered and Labeled non-infectious	Operator Discretion
	contaminated by blood or			
	body fluids including sharps.			
Bevill Amendment	Mine Tailings	Heavy Metals	TCLP-Metals	Operator Discretion
			Exempt from regulation as hazardous	
			waste.	

Table 2 Acceptance Standards

Analytical Testing	Constituent	TCLP Maximum Concentration	
Metals	Arsenic	5.0	ppm
	Cadmium	1.0	ppm
	Chromium	5.0	ppm
	Lead	5.0	ppm
	Mercury	0.2	ppm
	Selenium	1.0	ppm
	Silver	5.0	ppm
BTEX	Benzene	0.5	ppm
	Toluene	10.0	ppm
	Ethyl-benzene	10.0	ppm
	Xylene	30.0	ppm
PAH	Acenaphthene	3.4	ppm
	Acenaphthylene	3.4	ppm
	Anthracene	3.4	ppm
	Benzo(a)-anthracene	3.4	ppm
	Benzo(a)pyrene	3.4	ppm
	Benzo(b)-fluoranthene	68.0	ppm
	Benzo(g,h,i)-perylene	18.0	ppm
	Benzo(k)-fluoranthene	68.0	ppm
	Chrysene	340.0	ppm
	Dibenzo(a,h)-anthra-cene	8.2	ppm
	Flouranthene	3.4	ppm
	Indeno(1,2,3-CD) pryene	3.4	ppm
	Nephthalene	5.6	ppm
	Phenanthrene	5.6	ppm
	Pyrene	8.2	ppm
Pesticides	Chlordane	0.03	ppm
	Endrin	0.02	ppm
	Heptachlor (& its Epoxide)	0.008	ppm
	Lindane	0.4	ppm
	Methoxychlor	10.0	ppm
	Toxaphene	0.5	ppm

Analytical Testing	Constituent	TCLP Maximum Concentration	
Volatiles	Benzene	0.5	ppm
	Carbon Tetrachloride	0.5	ppm
	Chlorobenzene	100.0	ppm
	Chloroform	6.0	ppm
	1,4-Dichlorobenzene	7.5	ppm
	1,2-Dichlorthane	0.5	ppm
	1,1-Dichlorenthylene	0.7	ppm
	Methyl Ethyl Ketone	200.0	ppm
	Tetrachloroethylene	0.7	ppm
	Trichloroethylene	0.5	ppm
	Vinyl Chloride	0.2	ppm
Semi-Volatiles	o-Cresol	200.0	ppm
	m-Cresol	200.0	ppm
	p-Cresol	200.0	ppm
	Cresol	200.0	ppm
	2,4-Dinintrotoluene	0.1	ppm
	Hexachlorobenzene	0.1	ppm
	Hexachlorobutadine	0.5	ppm
	Hexachloroethane	3.0	ppm
	Nitrobenzene	2.0	ppm
	Pentachlorophenol	100.0	ppm
	Pyridine	5.0	ppm
	2,4,5-Trichlorophenol	400.0	ppm
	2,4,6-Trichlorophenol	2.0	ppm
Radioactivity	Alpha Radiation	0.002	uCi/g
Leachate	Paint Filter Test	Pass	n/a

Reactivity It is normally unstable and readily undergoes violent change without detonating, it reacts violently with water, it generates toxic gases, vapor and/or fumes

Corrosive It is aqueous and has a pH of less than or equal to 2 or greater than or equal to 12.5

Ignitability: It has a flash point of less than 140 degrees F.

Additional testing at the discretion of the Landfill: Specific EPA: F, K, P and U listed wastes

APPENDIX 11

SITE CHARACTERIZATION

BROAD CANYON LANDFILL

WALTER ENVIRONMENTAL
& Engineering Group Inc.

P.O. Box 3967
Grand Junction, Colorado 81502

phone: (970) 255-8017
toll free: (888) 443-8017
fax: (970) 255-8018

January 28, 2016

TS Landfill, Inc.
Attn.: Mr. Jim Stover, President
2352 North 7th Street, Unit B
Grand Junction, Colorado 81501

Subject: Site Characterization Summary
Broad Canyon Landfill
South of the Town of Naturita
Montrose County, Colorado

Dear Jim,

At your request, **Walter Environmental & Engineering Group, Inc.** (***Walter***) completed a site characterization effort at the above-referenced site (subject site) south of Naturita, Colorado. This scope of work was performed in accordance with a "Proposed Site Characterization Plan for Landfill Expansion Area" submitted to the Colorado Department of Public Health & Environment (CDPHE) on July 27, 2015. The CDPHE subsequently approved the Plan in a letter dated July 30, 2015. In that letter, CDPHE states:

> "Upon completion of the field work, please provide a summary of the findings of the site characterization including but not limited to: depth to barrier layer, detailed description of interbeds in the barrier layer, assessment of total thickness of low permeability shale interbeds within the barrier layer, depth to the Burro Canyon formation, and depth to ground water (if) encountered, etc. The summary should include any information that may have a direct impact on the design of the landfill expansion in preparation for the revised EDOP."

The goal of this letter is to provide you with a summary of the site characterization tasks performed, including the information specifically requested in the July 30, 2015 CDPHE letter.

Field Investigation

This recent site characterization included the drilling of eleven borings, and completion of eight borings as wet/dry wells. The locations of these borings and wells are illustrated in Figure 1 (attached). The drilling program was completed during the periods of August 12 through September 17, 2015.

The drilling was performed by Northstar Exploration, LLC (Northstar), from Nucla, Colorado. Northstar utilized a 1963 Franks FJ-3, air-rotary drilling system. To ensure the purity of the drilling air, Northstar employed a Domnick Hunter Pneumatic Coalescing Oil Filter system. The air-

filtration was designed to specifically target air-compressor lubricants and remove them from the air stream. During drilling, continuous rock core was recovered in approximately ten foot sections. The rock core was approximately 3-inches in diameter. Recovered cores were logged by ***Walter***'s Senior Field Geologist, stored in pre-manufactured core boxes, and stored on site. Five representative samples were selected from the cores for laboratory testing (discussed below).

Two of the eleven borings (BL-8 and BL-9) were drilled specifically for the purpose of identifying and characterizing the barrier layer beneath the site. Following drilling activities, the borehole was backfilling with bentonite chips. Eight borings were converted into wet/dry wells following drilling activities. The wet/dry wells were drilled in pairs located approximately 20 feet apart. One well in each pair was completed within the top couple feet of the barrier layer (shallow wells). With the exception of WD-4A, the shallow wells were completed approximately 20 feet below ground surface. Well WD-4A was completed at a depth of 32.5 feet below ground surface. The second well in each pair was completed at the top of the Burro Canyon Formation (deep wells). The deep wells were completed at a depth between 64 and 80 feet below ground surface.

Each wet/dry well was constructed by placing factory-perforated (0.010" slots) 2-inch diameter PVC pipe into the boring and filling the annulus with factory-washed (10-20 grit) silica sand that extended a minimum of one foot above the top of the screen. To minimize the possibility of surface water migrating into the shallow wells, the top four to five feet were completed utilizing solid ("blank") PVC pipe, and the annulus was filled with hydrated bentonite chips to one foot below the surface. Lean concrete was placed in the annulus to the surface and an approximately 2 foot by 2 foot concrete surface completion was installed surrounding the well. The deep wells were completed in a similar fashion with the exception of the top of the screened interval only extending to the bottom of the barrier layer. All wells were completed approximately two to three feet above the ground surface and enclosed in steel, locking, protective casings. The wells were subsequently registered with the Colorado Department of Natural Resources, Division of Water Resources (Attachment A).

Followup Field Monitoring and Well Development

Depth to ground water was gauged in all wells on October 22, 2015. Six wet/dry wells had less than 0.3 feet of water column in the well. One well (WD-2A) had 0.98 feet of water column, and one well (WD-2B) had 7.92 feet of water column. It is likely that the wet/dry wells with less than 0.3 feet of water had bentonite hydration water trapped in the solid end cap that was captured during well construction activities.

A well development program was initiated at wells WD-2A and WD-2B on November 24, 2015. The well development's goal was to remove fine-grained formation material from the well annulus and from the formation adjacent to the well. This was accomplished by utilizing a surge block to introduce a pulsed flow of ground water to/from the well and adjoining material. Following purging activities well WD-2A did not recharge. It is reasonable to assume that the water measured in WD-2A was trapped bentonite hydration water that was introduced during well construction activities. Well WD-2B recharged slowly following purging activities and is likely ground water. The other wet/dry wells did not have any water above the height of the end cap of the well (less than 0.3 feet of water) and were not developed.

The wells were surveyed for elevation (ground surface and top of PVC casing) and location by

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phone: (970) 255-8017 fax: (970) 255-8018

Merritt LS, L.L.C. of Grand Junction, Colorado. Top-of-casing and ground surface elevations are provided in the attached lithologic logs and well-completion figures (Attachment B).

As part of the post-completion monitoring, the atmosphere within the wells were monitored for the presence of landfill-related methane gas. This task was accomplished with the aid of a Landtec Gem 2000 landfill gas monitor. Manufacturer's recommended protocols were performed for equipment calibration and monitoring. Methane was detected in two of the eight wet/dry wells. The detected methane concentrations were 0.3 percent and 0.9 percent in WD-4A and WD-4B, respectively.

Working Hydrogeologic Model

The overall geologic setting has been summarized in the April 2014 Engineering Design and Operations Report (Stover, 2014). Excerpts from that report are presented below. The excerpts describe the Dakota Sandstone and the underlying Burro Canyon formations. The landfill and underlying barrier layers lie within the Dakota Sandstone.

> "The Dakota Sandstone (approx. 100 feet thick) of late Cretaceous age is a coastal-plain deposit laid down in front of the advancing Mancos sea. The Dakota consists of conglomeratic channel sandstone, dark-grey carbonaceous shale, coal, and, in places, a marine sandstone at the top. Some of the sandstone is fine grained and thin bedded and some is course grained and cross bedded occurring scattered through the sandstones are irregular, discontinuous beds and lenses of conglomerate containing chert, quartz and limestone pebbles. Interfingered with the sandstone beds are thin-bedded gray and black carbonaceous shales with coal seams as much as 6 feet thick. The Dakota is preserved on the mesas in the landfill area but the top has been removed by erosion."
>
> "The Burro Canyon Formation (approx. 150 feet thick) of early Cretaceous age overlies the Morrison, and forms either mesa-capping resistant units or ledgy outcrops above the less resistant Morrison shales. The formation generally consists of two conglomeratic sandstone beds 10-40 feet thick separated by light green mudstone and shale. Irregular, dense, pink to gray limestone nodules are locally present in the mudstone. The sandstone is poorly sorted and consists mostly of quartz with some chert grains. The conglomerate consists of pebbles of chert, quartz, limestone, quartzite and sandstone."
>
> "The Burro Canyon Formation is interpreted as an alluvial system deposited across a broad, relatively even surface on top of the Morrison Formation. In many respects, the formation appears to represent a continuation of Morrison deposition. The sandstone and conglomeratic sandstone were deposited from a relatively high energy transport medium and is a distinctly fluvial deposit formed by meandering or sinous streams."

During (and subsequent to) the drilling program, the rock cores were logged. The cores were described in great detail by the site geologist, and those details are presented in the lithologic logs (Attachment B). From that effort, the site geologist was able to group all the samples inspected into six general lithologic units.

- Sandstone - Fine Grained; Interbeds of Carbonaceous Shale and Coal
- Sandstone - Medium - Course Grained; Interbeds of Carbonaceous Shale
- Shale - Siltstone - Fine Grained Sand; Interbeds of Carbonaceous Shale

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- Shale - Siltstone, Interbeds of Fine Grained Sand and Coal
- Shale - Siltstone; Interbeds of mudstone
- Shale - Mudstone with Coal Beds

Two key observations were made from this effort. Firstly, the Dakota sandstone throughout the footprint of the landfill is vertically very heterogeneous. The layers (beds) were typically measured in tenths of a inch. Homogeneous layers thicker than 24 inches were rare. Secondly, the formation is also laterally very heterogenous. Although consistent layers (horizontally) were visible in the core, lithologic correlation between borings (even as close as 20 feet) was rare.

A meaningful geologic cross-section could not be created because of these inconsistencies.

Laboratory Testing

In order to achieve the hydrogeologic characterization goals of this investigation, representative samples of the predominant lithologies were submitted for hydraulic-characterization laboratory testing. ***Walter*** submitted the following five representative samples:

- Sandstone - Fine Grained; Thin Interbeds of Carbonaceous Shale (Sample BL-9 @ 26.5)
- Sandstone - Medium - Course Grained; Interbeds of Carbonaceous Shale and Rip up Clasts (Sample BL-7 @ 29')
- Shale - Siltstone - Fine Grained Sand; Interbeds of Carbonaceous Shale (Sample WD-1 @ 43')
- Shale - Siltstone; Interbeds of Fine Grained Sandstone and Coal; Carbonaceous (Sample WD-2 @ 39')
- Shale - Siltstone; Interbeds of mudstone (Sample BL-9 @ 41')
- Shale - Mudstone - Interbeds of Coal (Not Submitted for Lab Testing)

ASTM Method 5084 analyses were performed by Advanced Terra Testing (ATT) in Lakewood, Colorado (Attachment C). Laboratory results are summarized:

Table One			
Laboratory Results			
Rock Type	Characteristics	Sample Location	Permeability Test Result
Sandstone	Fine Grained; Thin interbeds of Carbonaceous Shale	BL-9 @ 26.5'	4.5×10^{-8} cm/sec
Sandstone	Medium - Course Grained; Interbeds of Carbonaceous Shale	BL-7 (WD-4B) @ 29'	1.1×10^{-4} cm/sec
Shale	Siltstone - Fine Sand; Interbeds of Carbonaceous Shale	WD-1 @ 43'	3.3×10^{-6} cm/sec

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Shale	Siltstone; Interbeds of Fine Grained Sandstone and Coal; Carbonaceous	WD-2 @ 39'	5.5 x 10^{-7} cm/sec
Shale	Siltstone; Interbeds of Mudstone	BL-9 @ 41'	6.3 x 10^{-8} cm/sec

Investigation Result's Impact on Landfill Expansion Design

The data developed and presented so far in this letter were designed to address the CDPHE requested "assessment of total thickness of low permeability shale interbeds within the barrier layer." As discussed above, the lithology beneath the landfill expansion area is laterally and vertically heterogenous. However, predominant lithologic groups were identified, and from those groups the thickness and calculated permeability of the barrier layer can be determined. From these data, ***Walter*** intends to demonstrate that the lithology beneath the landfill exceeds the specifications outlined in:

- *Department of Public Health and Environment Hazardous Materials and Waste Management Division, 6 CCR 1007-2, Part 1; Regulations Pertaining to Solid Waste Sites and Facilities; Part B, Section 3 Standards for Solid Waste Disposal Landfill Sites and Facilities; 3.0 Purpose, Scope and Applicability; 3.2 Design Requirements; Effective 12/30/15*

Specifically, ***Walter*** intends to show that the subsurface conditions more than adequately address the following standard:

- *Section 3.2.5 Liner/Design Components, (C) Barrier Layer, (4) Alternative Designs, (2) Natural Lithology Without Recompaction*.

Walter believes that this adequacy can be demonstrated not by compliance with *Subsection 2.1.15* (as specified in *(4) Alternative Designs*), but rather by comparing laboratory-calculated permeabilities and actual lithologic logs with the requirements of*:*

- *(C) Barrier Layer, (1) Natural Lithology with Recompaction*.

(C) Barrier Layer, (1) Natural Lithology with Recompaction specifies:

- *(a) A minimum thickness of 20 feet of soils and/or bedrock with in-situ hydraulic conductivity demonstrated through field testing to be less than or equal to 1.0 x 10^{-6} cm/sec, are present at the base of an excavation of a sanitary landfill; and*

  (b) The upper 12-inches is recompacted to achieve a hydraulic conductivity of less than or equal to 1 x 10^{-7} cm/sec.

The laboratory-calculated permeabilities and the actual lithologic logs demonstrate that the barrier layer actually exceeds 20 feet of 1.0 x 10^{-7} cm/sec material. These calculations are summarized and illustrated on Table 2. Assuming that the landfill bottom is to be constructed 20 feet below the

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existing grade, the landfill is underlain by a barrier layer (of 1 x 10^{-7} cm/sec material) that varies between 23.5 feet (WD-4B) and 44.3 feet (WD-3B) thick. This characteristic far exceeds the requirements specified in the *(C) Barrier Layer, (1) Natural Lithology with Recompaction* standard.

Walter believes that if adequate protection of the environment is afforded by exceeding the numerical requirements (thickness and permeability) of *(C) Barrier Layer, (1) Natural Lithology with Recompaction*, then adequate environmental protection is afforded by the facility's barrier layer to exceed the requirements of *Section 3.2.5 Liner/Design Components, (C) Barrier Layer, (4) Alternative Designs, (2) Natural Lithology Without Recompaction*.

Thank you for the opportunity to assist you with this matter. If you have any questions, please do not hesitate to call.

Sincerely,
Walter Environmental & Engineering Group, Inc.

Scott Carmichael; *BA*
Registered Environmental Professional, No. 5081, Colorado
Professional Geologist, Colorado

Kenneth L. Walter; *MS, BA*
Registered Environmental Professional, No. 5081, Colorado
Professional Geologist, Colorado

Attachments

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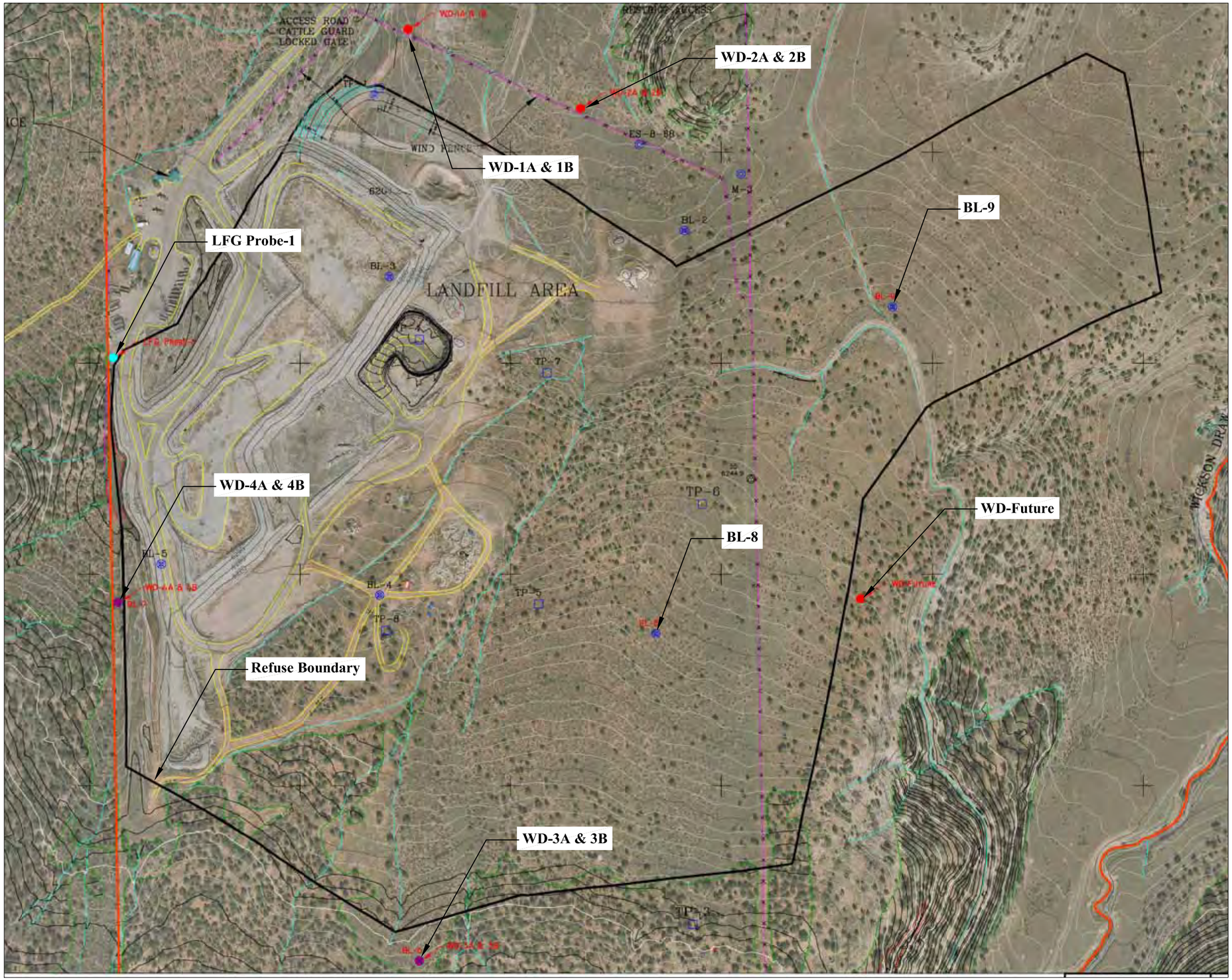

NOT TO SCALE

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WALTER ENVIRONMENTAL
& Engineering Group Inc.

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Boring/Well Locations
Broad Canyon Landfill
Naturita
Montrose County, Colorado

12/01/2015
Project No. 364-01-001

Figure 1

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Barrier Thickness Calculations

Broad Canyon Landfill

WALTER ENVIRONMENTAL & Engineering Group Inc.

Group:	A	B	C	D	E	X
K (cm/sec):	4.50E-08	1.10E-04	3.30E-06	5.50E-07	6.30E-08	1.00E-10
Sample:	BL-9 @ 26.5'	BL-7 @ 29' (WD-4)	WD-1 @ 43'	WD-2 @ 39'	BL-9 @ 41'	Literature

Hole ID	From	To	Thickness	Lithology Group	Group K (cm/sec)	Lithology Keyword	Lithology Description
BL-8	0	2	2	TS		topsoil	topsoil
BL-8	2	16	14	U		sandstone	sandstone, light gray
BL-8	16	21	5	X		shale	shale, dark gray, mud, trace interbedded fine grained sand
BL-8	21	21.5	0.5	A	4.50E-08	sandstone	sandstone, light gray sand with trace dark gray silt and clay, mostly fine grained sand
BL-8	21.5	22	0.5	X	1.00E-10	shale	shale, dark gray, thinly laminated
BL-8	22	27.5	5.5	B	1.10E-04	Csandstone	sandstone, light gray and buff, fine to coarse grained sand, trace interbedded carboniferous material, crossbedded
BL-8	27.5	30	2.5	A	4.50E-08	sandstone	sandstone, light gray, fine grained sand, trace carboniferous material
BL-8	30	34	4	X	1.00E-10	shale	shale, dark gray, mud, trace interbedded fine grained sand
BL-8	34	37.5	3.5	X	1.00E-10	shale	shale, dark gray, some coal, reddish brown and yellowish brown staining along bedding and fracture planes
BL-8	37.5	39	1.5	A	4.50E-08	sandstone	sandstone, light gray, mostly fine grained sand, abundant carboniferous material
BL-8	39	41.5	2.5	X	1.00E-10	shale	shale, dark gray, mud
BL-8	41.5	43.5	2	A	4.50E-08	sandstone	sandstone, light gray, mostly fine grained sand, trace interbedded shale
BL-8	43.5	49	5.5	E	6.30E-08	shale	shale, dark gray, thinly bedded
BL-8	49	52.5	3.5	C	3.30E-06	shale	shale, light gray, silt, thinly bedded
BL-8	52.5	54	1.5	A	4.50E-08	sandstone	sandstone, light gray, mostly fine grained sand
BL-8	54	62	8	A	4.50E-08	sandstone	sandstone, light gray sand with dark gray silt and clay, mostly fine grained sand, abundant carboniferous material
BL-8	62	64	2	BC		Bshale	shale, greenish gray, top of Burro Canyon Formation
			Total Layer Thickness K < E-07 =		**32.0**	Deeper than ~20 ft BGS	
BL-9	0	2	2	TS		topsoil	topsoil
BL-9	2	10	8	U		sandstone	sandstone, light gray
BL-9	10	12	2	A	4.50E-08	sandstone	sandstone, light gray, mostly fine grained sand, interbedded carboniferous material, ripple bedding
BL-9	12	15.5	3.5	D	5.50E-07	shale	shale, dark gray, interbedded fine grained sand, abundant carboniferous material, ripple bedding
BL-9	15.5	18	2.5	A	4.50E-08	sandstone	sandstone, light gray, interbedded dark gray shale
BL-9	18	26	8	X	1.00E-10	shale	shale, dark gray and black, thinly bedded, some coal, trace evaporative mineralization along bedding planes
BL-9	26	28.5	2.5	A	4.50E-08	sandstone	sandstone, light gray, mostly fine grained sand, abundant interbedded carboniferous material
BL-9	28.5	29	0.5	D	5.50E-07	shale	shale, dark gray, trace interbedded fine grained sand
BL-9	29	30	1	A	4.50E-08	sandstone	sandstone, light gray, mostly fine grained sand, abundant interbedded carboniferous material
BL-9	30	34	4	A	4.50E-08	sandstone	sandstone, light gray, mostly fine grained sand, abundant interbedded carboniferous material, wavy bedding
BL-9	34	37.5	3.5	B	1.10E-04	Csandstone	sandstone, light gray and buff, fine to coarse grained sand, some interbedded carboniferous material, crossbedded
BL-9	37.5	40	2.5	X	1.00E-10	shale	shale, dark gray, some gypsum mineralization along bedding planes, thinly laminated
BL-9	40	41	1	A	4.50E-08	sandstone	sandstone, light gray, mostly fine grained sand, abundant carboniferous material
BL-9	41	42.5	1.5	E	6.30E-08	shale	shale, dark gray
BL-9	42.5	46	3.5	A	4.50E-08	sandstone	sandstone, light gray, mostly fine grained sand, abundant interbedded carbonaceous shale, animal burrows, wavy bedded
BL-9	46	47	1	X	1.00E-10	shale	shale, light to medium gray, mud
BL-9	47	47.5	0.5	A	4.50E-08	sandstone	sandstone, light gray, mostly fine grained sand
BL-9	47.5	50	2.5	X	1.00E-10	shale	shale with coal, thinly laminated, reddish brown and yellowish brown staining along bedding and fracture planes
BL-9	50	54	4	A	4.50E-08	sandstone	sandstone, light gray, mostly fine grained sand, interbedded shale (carboniferous), wavy bedded
BL-9	54	54.5	0.5	E	6.30E-08	shale	shale, dark gray, mostly clay, thinly bedded, fissile
BL-9	54.5	56.5	2	E	6.30E-08	shale	shale, dark gray, mostly silt
BL-9	56.5	58.5	2	A	4.50E-08	sandstone	sandstone, light gray, mostly fine grained sand, some carboniferous material
BL-9	58.5	60.5	2	E	6.30E-08	shale	shale, dark gray, thinly bedded
BL-9	60.5	61.75	1.25	A	4.50E-08	sandstone	sandstone, light gray, abundant intebedded carboniferous material
BL-9	61.75	63	1.25	BC		Bsandstone	sandstone, white, mostly fine grained sand, some green interbedded shale, top of Burro Canyon Formation
			Total Layer Thickness K < E-07 =		**38.3**	Deeper than ~20 ft BGS	

Barrier Thickness Calculations
Broad Canyon Landfill

WALTER ENVIRONMENTAL & Engineering Group Inc.

Group:	A	B	C	D	E	X
K (cm/sec):	4.50E-08	1.10E-04	3.30E-06	5.50E-07	6.30E-08	1.00E-10
Sample:	BL-9 @ 26.5'	BL-7 @ 29' (WD-4)	WD-1 @ 43'	WD-2 @ 39'	BL-9 @ 41'	Literature

Hole ID	From	To	Thickness	Lithology Group	Group K (cm/sec)	Lithology Keyword	Lithology Description
WD-1B	0	3	3	TS		topsoil	topsoil
WD-1B	3	4	1	U		sandstone	sandstone, light gray, mostly fine grained sand
WD-1B	4	10	6	U		shale	shale, dark gray
WD-1B	10	11.5	1.5	B	1.10E-04	Csandstone	sandstone, light gray and buff, fine to coarse grained sand, crossbedded
WD-1B	11.5	13	1.5	X	1.00E-10	shale	shale, dark gray, trace interbedded light gray sandstone
WD-1B	13	16.5	3.5	X	1.00E-10	shale	shale, dark gray, mud, trace thin coal seams, calcopyrite
WD-1B	16.5	19.5	3	A	4.50E-08	sandstone	sandstone, light gray and buff, mostly fine grained sand, some interbedded shale (carboniferous), wavy bedded
WD-1B	19.5	20	0.5	X	1.00E-10	coal	coal, black, some calcopyrite
WD-1B	20	20.5	0.5	A	4.50E-08	sandstone	sandstone, light gray, interbedded shale (carboniferous)
WD-1B	20.5	21	0.5	X	1.00E-10	shale	shale, dark gray
WD-1B	21	23.5	2.5	A	4.50E-08	sandstone	sandstone, interbedded shale (carboniferous), wavy bedded
WD-1B	23.5	26.5	3	D	5.50E-07	shale	shale, dark gray, interbedded sandstone, wavy bedded
WD-1B	26.5	29.5	3	A	4.50E-08	sandstone	sandstone, light gray and buff, mostly fine grained sand, interbedded carboniferous material, wavy bedded
WD-1B	29.5	30	0.5	X	1.00E-10	coal	coal, black
WD-1B	30	39	9	X	1.00E-10	shale	shale, dark gray, mud, trace interbedded light gray siltstone, trace thin coal seams
WD-1B	39	40.5	1.5	X	1.00E-10	coal	coal, black, some calcopyrite
WD-1B	40.5	46.5	6	C	3.30E-06	shale	shale, light gray, some interbedded dark gray mudstone, some very fine grained sand
WD-1B	46.5	49	2.5	X	1.00E-10	shale	shale, dark gray, abundant carboniferous material, some thin coal seams
WD-1B	49	50	1	X	1.00E-10	shale & coal	shale and coal, dark gray and black, some calcopyrite
WD-1B	50	52.5	2.5	A	4.50E-08	sandstone	sandstone, light gray, fine to medium grained sand, some interbedded dark gray shale, abundant carboniferous material, trace calcopyrite
WD-1B	52.5	57	4.5	X	1.00E-10	shale	shale, dark gray, trace calcopyrite
WD-1B	57	59	2	C	3.30E-06	shale	shale, light gray, some very fine grained sand, abundant carboniferous material at 58.5'
WD-1B	59	60	1	X	1.00E-10	coal	coal, black, some calcopyrite
WD-1B	60	63.5	3.5	A	4.50E-08	sandstone	sandstone, light gray, fine to medium grained sand, interbedded carboniferous material, wavy bedded
WD-1B	63.5	64.5	1	X	1.00E-10	shale	shale, dark gray
WD-1B	64.5	65.5	1	X	1.00E-10	shale & coal	shale and coal, black, trace calcopyrite
WD-1B	65.5	68.5	3	A	4.50E-08	sandstone	sandstone, light gray, mostly fine grained sand, interbedded shale (carboniferous), wavy bedded, abundant rip-up clasts
WD-1B	68.5	80	11.5	BC		Bsandstone	sandstone, white, mostly fine grained sane, some interbedded greenish gray shale, top of Burro Canyon
			Total Layer Thickness K < E-07 =		**37.5**	Deeper than ~20 ft BGS	
WD-2B	0	3	3	TS		topsoil	topsoil
WD-2B	3	10	7	U		sandstone	sandstone, light gray and buff, fine to medium grained sand
WD-2B	10	11	1	X	1.00E-10	shale	shale, dark gray
WD-2B	11	13.5	2.5	X	1.00E-10	shale	shale, dark gray, mud, some coal
WD-2B	13.5	17.5	4	A	4.50E-08	sandstone	sandstone, light gray, some interbedded shale (carboniferous), wavy bedded, mostly fine grained sand
WD-2B	17.5	20.5	3	D	5.50E-07	shale	shale, dark gray, some light gray sandstone lenses
WD-2B	20.5	22.5	2	A	4.50E-08	sandstone	sandstone, light gray, very fine grained sand, interbedded shale (carboniferous), trace animal burrows
WD-2B	22.5	23	0.5	X	1.00E-10	shale	shale, dark gray
WD-2B	23	23.5	0.5	A	4.50E-08	sandstone	sandstone, light gray, interbedded dark gray shale, abundant carboniferous material
WD-2B	23.5	27	3.5	X	1.00E-10	shale & coal	shale and coal, black
WD-2B	27	32	5	X	1.00E-10	shale	shale, dark gray, interbedded light gray sandstone, trace gypsum, yellowish brown and reddish brown staining
WD-2B	32	33	1	A	4.50E-08	sandstone	sandstone, light gray, interbedded shale (carboniferous), trace animal burrows
WD-2B	33	37	4	X	1.00E-10	shale	shale, dark gray, interbedded light gray sandstone, trace gypsum, yellowish brown and reddish brown staining
WD-2B	37	42.5	5.5	D	5.50E-07	shale	shale, dark gray, interbedded fine grained sand, carbonaceous, trace thin coal seams, trace animal burrows
WD-2B	42.5	44.5	2	X	1.00E-10	shale & coal	shale and coal, black
WD-2B	44.5	47.25	2.75	C	3.30E-06	shale	shale, light gray, some very fine grained sand, grading to no fine grained sand at 50.5'
WD-2B	47.25	48.5	1.25	A	4.50E-08	sandstone	sandstone, light gray, very fine grained sand
WD-2B	48.5	52	3.5	D	5.50E-07	shale	shale, dark gray
WD-2B	52	53.25	1.25	A	4.50E-08	sandstone	sandstone, light gray, very fine grained sand
WD-2B	53.25	55.25	2	X	1.00E-10	shale	shale, dark gray
WD-2B	55.25	57	1.75	A	4.50E-08	sandstone	sandstone, light gray, abundant interbedded carboniferous material
WD-2B	57	60.5	3.5	D	5.50E-07	shale	shale, dark gray, some interbedded light gray sandstone
WD-2B	60.5	64.5	4	BC		Bsandstone	sandstone, white, greenish gray lenses, mostly fine graind sand, abundant carboniferous material in upper 1.5', scour and fill marks in upp
			Total Layer Thickness K < E-07 =		**24.8**	Deeper than ~20 ft BGS	

Barrier Thickness Calculations
Broad Canyon Landfill

WALTER ENVIRONMENTAL & Engineering Group Inc.

Group:	A	B	C	D	E	X
K (cm/sec):	4.50E-08	1.10E-04	3.30E-06	5.50E-07	6.30E-08	1.00E-10
Sample:	BL-9 @ 26.5'	BL-7 @ 29' (WD-4)	WD-1 @ 43'	WD-2 @ 39'	BL-9 @ 41'	Literature

Hole ID	From	To	Thickness	Lithology Group	Group K (cm/sec)	Lithology Keyword	Lithology Description
WD-3B	0	4	4	TS		topsoil	topsoil
WD-3B	4	6	2	U		sandstone	sandstone, light gray and buff, fine to medium grained sand
WD-3B	6	11	5	U		shale	shale, dark gray
WD-3B	11	14	3	U		Csandstone	sandstone, light gray and buff, fine to coarse grained sand, crossbedded
WD-3B	14	16.25	2.25	B	1.10E-04	Csandstone	sandstone, light gray and buff, fine to coarse grained sand, some interbedded carboniferous material, crossbedded
WD-3B	16.25	18	1.75	A	4.50E-08	shale & sandstone	interbedded shale and sandstone, dark gray shale, light gray and buff sandstone
WD-3B	18	19.25	1.25	A	4.50E-08	sandstone	sandstone, light gray, mostly fine grained sand, some interbedded carboniferous material
WD-3B	19.25	23.25	4	D	5.50E-07	shale & sandstone	interbedded dark gray shale and light gray sandstone
WD-3B	23.25	24	0.75	X	1.00E-10	shale	shale, dark gray
WD-3B	24	35.5	11.5	A	4.50E-08	sandstone	sandstone, light gray, mostly fine grained sand, abundant interbedded shale (carboniferous), wavy bedded
WD-3B	35.5	36.5	1	X	1.00E-10	coal	coal, black, abundant pyrite
WD-3B	36.5	37	0.5	A	4.50E-08	sandstone	sandstone, light gray
WD-3B	37	44	7	X	1.00E-10	shale	shale, light gray to medium gray, mud, some very fine grained sand, trace thin coal seams
WD-3B	44	45.5	1.5	X	1.00E-10	shale & coal	coal and shale, black
WD-3B	45.5	46.25	0.75	X	1.00E-10	shale	shale, black
WD-3B	46.25	50.5	4.25	X	1.00E-10	shale	shale, light to medium gray, some very fine grained sand
WD-3B	50.5	56	5.5	A	4.50E-08	sandstone	sandstone, light gray, fine to medium grained sand, some interbedded shale (carboniferous), some animal burrows
WD-3B	56	64	8	E	6.30E-08	shale	shale, dark gray
WD-3B	64	67.5	3.5	A	4.50E-08	sandstone	sandstone, light gray and buff, fine to medium grained sand, interbedded shale (carboniferous), abundant rip-up clasts
WD-3B	67.5	74	6.5	BC		Bshale	shale, green, top of Burro Canyon
			Total Layer Thickness K < E-07 =		**44.3**	Deeper than ~20 ft BGS	
WD-4B	0	3.5	3.5	TS		topsoil	topsoil
WD-4B	3.5	9	5.5	U		sandstone	sandstone, light gray, fine to medium grained sand
WD-4B	9	10	1	U		shale	shale, medium gray
WD-4B	10	12.5	2.5	X	1.00E-10	shale	shale, dark gray, mud, trace interbedded sandstone
WD-4B	12.5	31	18.5	B	1.10E-04	Csandstone	sandstone, light gray and buff, medium to coarse grained sand, interbedded shale (carboniferous), crossbedded, trace rip-up clasts
WD-4B	31	32.5	1.5	X	1.00E-10	shale & coal	shale and coal, dark gray and black, mud
WD-4B	32.5	33	0.5	X	1.00E-10	shale	shale, light gray, some very fine grained sand, yellowish brown staining
WD-4B	33	38.75	5.75	X	1.00E-10	shale	shale, light gray, some fine grained sand, abundant yellowish brown and reddish brown staining, trace gypsum, trace thin coal seams
WD-4B	38.75	40.5	1.75	X	1.00E-10	coal	coal, black, yellow staining, some gypsum
WD-4B	40.5	42.5	2	E	6.30E-08	shale	shale, dark gray, grading to light gray, some gypsum lenses
WD-4B	42.5	51	8.5	D	5.50E-07	shale	shale, light gray, some interbedded dark gray shale, some interbedded coal, trace fine grained sand,
WD-4B	51	56	5	C	3.30E-06	shale	shale, light gray, some fine grained sand
WD-4B	56	59	3	X	1.00E-10	shale	shale, dark gray, some interbedded light gray sandstone, abundant carboniferous material
WD-4B	59	66	7	X	1.00E-10	shale	shale, dark gray, trace interbedded sandstone, trace thin coal seams
WD-4B	66	68	2	A	4.50E-08	sandstone	sandstone, light gray, mostly fine grained sand, interbedded shale (carboniferous), rip-up clasts
WD-4B	68	73	5	BC		Bshale	shale, green, top of Burro Canyon
			Total Layer Thickness K < E-07 =		**23.5**	Deeper than ~20 ft BGS	

ATTACHMENT A

Form No.
GWS-25

OFFICE OF THE STATE ENGINEER
COLORADO DIVISION OF WATER RESOURCES

818 Centennial Bldg., 1313 Sherman St., Denver, Colorado 80203
(303) 866-3581

WD-1A

EXST

WELL PERMIT NUMBER 299771 - - -

DIV. 4 WD 60 DES. BASIN MD WD-1A

APPLICANT

TS LANDFILL INC
2352 N 7TH ST
UNIT B
GRAND JUNCTION, CO 81501-

(970) 245-4101

APPROVED WELL LOCATION
MONTROSE COUNTY
NW 1/4 NW 1/4 Section 15
Township 45 N Range 15 W New Mex P.M.

DISTANCES FROM SECTION LINES
132 Ft. from North Section Line
700 Ft. from West Section Line

UTM COORDINATES (Meters,Zone:13,NAD83)
Easting: Northing:

PERMIT TO USE AN EXISTING WELL

ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT

CONDITIONS OF APPROVAL

1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of this permit does not ensure that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.
2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.
3) Approved pursuant to CRS 37-92-602(3)(b)(I) for uses as described in CRS 37-92-602(1)(f). Use of this well is limited to monitoring water levels and/or water quality sampling.
4) Approved for the use of an existing well acknowledged for construction under monitoring hole notice MH-54136, and known as WD-1A.
5) This well must be equipped with a locking cap or seal to prevent well contamination or possible hazards as an open well. The well must be kept capped and locked at all times except during sampling or measuring.
6) Records of water level measurements and water quality analyses shall be maintained by the well owner and submitted to the Division of Water Resources upon request.
7) Upon conclusion of the monitoring program the well owner shall plug this well in accordance with Rule 16 of the Water Well Construction Rules. A Well Abandonment Report must be completed and submitted to the Division of Water Resources within 60 days of plugging.
8) The owner shall mark the well in a conspicuous place with the well permit number and name of aquifer as appropriate, and shall take necessary means and precautions to preserve these markings.
9) This well must have been constructed by or under the supervision of a licensed well driller or other authorized individual according to the Water Well Construction Rules.
10) This well must be located not more than 200 feet from the location specified on this permit.

NOTE: Issuance of this permit does not guarantee that this well can be converted to a production well under a future permit. Additionally, pursuant to Rule 14.2 of the Water Well Construction Rules (2 CCR 402-2), monitoring holes constructed pursuant to a monitoring hole notice shall not be converted to a production well. (Upon obtaining a permit from the State Engineer, a monitoring hole may be converted to a monitoring well, recovery well for remediation of the aquifer, or a dewatering system for dewatering the aquifer.)

NOTICE: This permit has been approved subject to the following changes: The distances from section lines were calculated from UTM coordinate values provided with the permit application. You are hereby notified that you have the right to appeal the issuance of this permit, by filing a written request with this office within sixty (60) days of the date of issuance, pursuant to the State Administrative Procedures Act. (See Section 24-4-104 through 106, C.R.S.)

AT 12-29-15

APPROVED
AOT

Dick Wolfe
State Engineer

Alex Ford
By

Receipt No. 3672225E DATE ISSUED 12-29-2015 EXPIRATION DATE N/A

Form No.
GWS-25

OFFICE OF THE STATE ENGINEER
COLORADO DIVISION OF WATER RESOURCES

818 Centennial Bldg., 1313 Sherman St., Denver, Colorado 80203
(303) 866-3581

WD-1B

EXST

WELL PERMIT NUMBER 299772 - - -
DIV. 4 WD 60 DES. BASIN MD

APPLICANT

TS LANDFILL INC
2352 N 7TH ST
UNIT B
GRAND JUNCTION, CO 81501-

(970) 245-4101

APPROVED WELL LOCATION
MONTROSE COUNTY
NW 1/4 NW 1/4 Section 15
Township 45 N Range 15 W New Mex P.M.

DISTANCES FROM SECTION LINES
142 Ft. from North Section Line
719 Ft. from West Section Line

UTM COORDINATES (Meters,Zone:13,NAD83)
Easting: Northing:

PERMIT TO USE AN EXISTING WELL

ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT

CONDITIONS OF APPROVAL

1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of this permit does not ensure that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.
2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.
3) Approved pursuant to CRS 37-92-602(3)(b)(I) for uses as described in CRS 37-92-602(1)(f). Use of this well is limited to monitoring water levels and/or water quality sampling.
4) Approved for the use of an existing well acknowledged for construction under monitoring hole notice MH-54136, and known as WD-1B.
5) This well must be equipped with a locking cap or seal to prevent well contamination or possible hazards as an open well. The well must be kept capped and locked at all times except during sampling or measuring.
6) Records of water level measurements and water quality analyses shall be maintained by the well owner and submitted to the Division of Water Resources upon request.
7) Upon conclusion of the monitoring program the well owner shall plug this well in accordance with Rule 16 of the Water Well Construction Rules. A Well Abandonment Report must be completed and submitted to the Division of Water Resources within 60 days of plugging.
8) The owner shall mark the well in a conspicuous place with the well permit number and name of aquifer as appropriate, and shall take necessary means and precautions to preserve these markings.
9) This well must have been constructed by or under the supervision of a licensed well driller or other authorized individual according to the Water Well Construction Rules.
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NOTICE: This permit has been approved subject to the following changes: The distances from section lines were calculated from UTM coordinate values provided with the permit application. You are hereby notified that you have the right to appeal the issuance of this permit, by filing a written request with this office within sixty (60) days of the date of issuance, pursuant to the State Administrative Procedures Act. (See Section 24-4-104 through 106, C.R.S.)

AT 12-29-15

APPROVED
AOT

State Engineer

By

Receipt No. 3672225F DATE ISSUED 12-29-2015 EXPIRATION DATE N/A

Form No.
GWS-25

OFFICE OF THE STATE ENGINEER
COLORADO DIVISION OF WATER RESOURCES

818 Centennial Bldg., 1313 Sherman St., Denver, Colorado 80203
(303) 866-3581

WD-2A

EXST

WELL PERMIT NUMBER 299773 - - -
DIV. 4 WD 60 DES. BASIN MD

APPLICANT

TS LANDFILL INC
2352 N 7TH ST
UNIT B
GRAND JUNCTION, CO 81501-

(970) 245-4101

APPROVED WELL LOCATION
MONTROSE COUNTY
NW 1/4 NW 1/4 Section 15
Township 45 N Range 15 W New Mex P.M.

DISTANCES FROM SECTION LINES
344 Ft. from North Section Line
1134 Ft. from West Section Line

UTM COORDINATES (Meters,Zone:13,NAD83)
Easting: Northing:

PERMIT TO USE AN EXISTING WELL

ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT

CONDITIONS OF APPROVAL

1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of this permit does not ensure that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.
2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.
3) Approved pursuant to CRS 37-92-602(3)(b)(I) for uses as described in CRS 37-92-602(1)(f). Use of this well is limited to monitoring water levels and/or water quality sampling.
4) Approved for the use of an existing well acknowledged for construction under monitoring hole notice MH-54136, and known as WD-2A.
5) This well must be equipped with a locking cap or seal to prevent well contamination or possible hazards as an open well. The well must be kept capped and locked at all times except during sampling or measuring.
6) Records of water level measurements and water quality analyses shall be maintained by the well owner and submitted to the Division of Water Resources upon request.
7) Upon conclusion of the monitoring program the well owner shall plug this well in accordance with Rule 16 of the Water Well Construction Rules. A Well Abandonment Report must be completed and submitted to the Division of Water Resources within 60 days of plugging.
8) The owner shall mark the well in a conspicuous place with the well permit number and name of aquifer as appropriate, and shall take necessary means and precautions to preserve these markings.
9) This well must have been constructed by or under the supervision of a licensed well driller or other authorized individual according to the Water Well Construction Rules.
10) This well must be located not more than 200 feet from the location specified on this permit.

NOTE: Issuance of this permit does not guarantee that this well can be converted to a production well under a future permit. Additionally, pursuant to Rule 14.2 of the Water Well Construction Rules (2 CCR 402-2), monitoring holes constructed pursuant to a monitoring hole notice shall not be converted to a production well. (Upon obtaining a permit from the State Engineer, a monitoring hole may be converted to a monitoring well, recovery well for remediation of the aquifer, or a dewatering system for dewatering the aquifer.)

NOTICE: This permit has been approved subject to the following changes: The distances from section lines were calculated from UTM coordinate values provided with the permit application. You are hereby notified that you have the right to appeal the issuance of this permit, by filing a written request with this office within sixty (60) days of the date of issuance, pursuant to the State Administrative Procedures Act. (See Section 24-4-104 through 106, C.R.S.)

At 12-29-15

APPROVED
AOT

State Engineer

By

Receipt No. 3672225G DATE ISSUED 12-29-2015 EXPIRATION DATE N/A

Form No.
GWS-25

OFFICE OF THE STATE ENGINEER
COLORADO DIVISION OF WATER RESOURCES

818 Centennial Bldg., 1313 Sherman St., Denver, Colorado 80203
(303) 866-3581

WD-2B

EXST

WELL PERMIT NUMBER 299775 - - -
DIV. 4 WD 60 DES. BASIN MD

APPLICANT

TS LANDFILL INC
2352 N 7TH ST
UNIT B
GRAND JUNCTION, CO 81501-

(970) 245-4101

APPROVED WELL LOCATION
MONTROSE COUNTY
NW 1/4 NW 1/4 Section 15
Township 45 N Range 15 W New Mex P.M.

DISTANCES FROM SECTION LINES
351 Ft. from North Section Line
1156 Ft. from West Section Line

UTM COORDINATES (Meters,Zone:13,NAD83)
Easting: Northing:

PERMIT TO USE AN EXISTING WELL

ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT

CONDITIONS OF APPROVAL

1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of this permit does not ensure that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.
2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.
3) Approved pursuant to CRS 37-92-602(3)(b)(I) for uses as described in CRS 37-92-602(1)(f). Use of this well is limited to monitoring water levels and/or water quality sampling.
4) Approved for the use of an existing well acknowledged for construction under monitoring hole notice MH-54136, and known as WD-2B.
5) This well must be equipped with a locking cap or seal to prevent well contamination or possible hazards as an open well. The well must be kept capped and locked at all times except during sampling or measuring.
6) Records of water level measurements and water quality analyses shall be maintained by the well owner and submitted to the Division of Water Resources upon request.
7) Upon conclusion of the monitoring program the well owner shall plug this well in accordance with Rule 16 of the Water Well Construction Rules. A Well Abandonment Report must be completed and submitted to the Division of Water Resources within 60 days of plugging.
8) The owner shall mark the well in a conspicuous place with the well permit number and name of aquifer as appropriate, and shall take necessary means and precautions to preserve these markings.
9) This well must have been constructed by or under the supervision of a licensed well driller or other authorized individual according to the Water Well Construction Rules.
10) This well must be located not more than 200 feet from the location specified on this permit.

NOTE: Issuance of this permit does not guarantee that this well can be converted to a production well under a future permit. Additionally, pursuant to Rule 14.2 of the Water Well Construction Rules (2 CCR 402-2), monitoring holes constructed pursuant to a monitoring hole notice shall not be converted to a production well. (Upon obtaining a permit from the State Engineer, a monitoring hole may be converted to a monitoring well, recovery well for remediation of the aquifer, or a dewatering system for dewatering the aquifer.)

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AN 12-29-15

APPROVED
AOT

Dick Wolfe
State Engineer

Alex
By

Receipt No. 3672225H DATE ISSUED 12-29-2015 EXPIRATION DATE N/A

Form No.
GWS-25

OFFICE OF THE STATE ENGINEER
COLORADO DIVISION OF WATER RESOURCES

818 Centennial Bldg., 1313 Sherman St., Denver, Colorado 80203
(303) 866-3581

LFG-Probe

EXST

WELL PERMIT NUMBER 299776 - - -
DIV. 4 WD 60 DES. BASIN MD

APPLICANT

TS LANDFILL INC
2352 N 7TH ST
UNIT B
GRAND JUNCTION, CO 81501-

(970) 245-4101

APPROVED WELL LOCATION
MONTROSE COUNTY
NW 1/4 NW 1/4 Section 15
Township 45 N Range 15 W New Mex P.M.

DISTANCES FROM SECTION LINES
923 Ft. from North Section Line
17 Ft. from West Section Line

UTM COORDINATES (Meters,Zone:13,NAD83)
Easting: Northing:

PERMIT TO USE AN EXISTING WELL

ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT

CONDITIONS OF APPROVAL

1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of this permit does not ensure that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.
2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.
3) Approved pursuant to CRS 37-92-602(3)(b)(I) for uses as described in CRS 37-92-602(1)(f). Use of this well is limited to monitoring water levels and/or water quality sampling.
4) Approved for the use of an existing well acknowledged for construction under monitoring hole notice MH-54136, and known as LFG-PROBE.
5) This well must be equipped with a locking cap or seal to prevent well contamination or possible hazards as an open well. The well must be kept capped and locked at all times except during sampling or measuring.
6) Records of water level measurements and water quality analyses shall be maintained by the well owner and submitted to the Division of Water Resources upon request.
7) Upon conclusion of the monitoring program the well owner shall plug this well in accordance with Rule 16 of the Water Well Construction Rules. A Well Abandonment Report must be completed and submitted to the Division of Water Resources within 60 days of plugging.
8) The owner shall mark the well in a conspicuous place with the well permit number and name of aquifer as appropriate, and shall take necessary means and precautions to preserve these markings.
9) This well must have been constructed by or under the supervision of a licensed well driller or other authorized individual according to the Water Well Construction Rules.
10) This well must be located not more than 200 feet from the location specified on this permit.

NOTE: Issuance of this permit does not guarantee that this well can be converted to a production well under a future permit. Additionally, pursuant to Rule 14.2 of the Water Well Construction Rules (2 CCR 402-2), monitoring holes constructed pursuant to a monitoring hole notice shall not be converted to a production well. (Upon obtaining a permit from the State Engineer, a monitoring hole may be converted to a monitoring well, recovery well for remediation of the aquifer, or a dewatering system for dewatering the aquifer.)

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AR 12-29-15

APPROVED
AOT

State Engineer

By

Receipt No. 3672225I DATE ISSUED 12-29-2015 EXPIRATION DATE N/A

Form No.
GWS-25

OFFICE OF THE STATE ENGINEER
COLORADO DIVISION OF WATER RESOURCES

818 Centennial Bldg., 1313 Sherman St., Denver, Colorado 80203
(303) 866-3581

WD-3A

EXST

WELL PERMIT NUMBER 299767 - - -
DIV. 4 WD 60 DES. BASIN MD

APPLICANT

TS LANDFILL INC
2352 N 7TH ST
UNIT B
GRAND JUNCTION, CO 81501-

(970) 245-4101

APPROVED WELL LOCATION
MONTROSE COUNTY
SW 1/4 NW 1/4 Section 15
Township 45 N Range 15 W New Mex P.M.

DISTANCES FROM SECTION LINES
2369 Ft. from North Section Line
716 Ft. from West Section Line

UTM COORDINATES (Meters,Zone:13,NAD83)
Easting: Northing:

PERMIT TO USE AN EXISTING WELL

ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT

CONDITIONS OF APPROVAL

1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of this permit does not ensure that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.
2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.
3) Approved pursuant to CRS 37-92-602(3)(b)(I) for uses as described in CRS 37-92-602(1)(f). Use of this well is limited to monitoring water levels and/or water quality sampling.
4) Approved for the use of an existing well acknowledged for construction under monitoring hole notice MH-54135, and known as WD-3A.
5) This well must be equipped with a locking cap or seal to prevent well contamination or possible hazards as an open well. The well must be kept capped and locked at all times except during sampling or measuring.
6) Records of water level measurements and water quality analyses shall be maintained by the well owner and submitted to the Division of Water Resources upon request.
7) Upon conclusion of the monitoring program the well owner shall plug this well in accordance with Rule 16 of the Water Well Construction Rules. A Well Abandonment Report must be completed and submitted to the Division of Water Resources within 60 days of plugging.
8) The owner shall mark the well in a conspicuous place with the well permit number and name of aquifer as appropriate, and shall take necessary means and precautions to preserve these markings.
9) This well must have been constructed by or under the supervision of a licensed well driller or other authorized individual according to the Water Well Construction Rules.
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AT 12-29-15

APPROVED
AOT

Dick Wolfe
State Engineer

By

Receipt No. 3672225A DATE ISSUED 12-29-2015 EXPIRATION DATE N/A

Form No.
GWS-25

OFFICE OF THE STATE ENGINEER
COLORADO DIVISION OF WATER RESOURCES

818 Centennial Bldg., 1313 Sherman St., Denver, Colorado 80203
(303) 866-3581

WD-3B

EXST

WELL PERMIT NUMBER 299768 - -
DIV. 4 WD 60 DES. BASIN MD

APPLICANT

TS LANDFILL INC
2352 N 7TH ST
UNIT B
GRAND JUNCTION, CO 81501-

(970) 245-4101

APPROVED WELL LOCATION
MONTROSE COUNTY
SW 1/4 NW 1/4 Section 15
Township 45 N Range 15 W New Mex P.M.

DISTANCES FROM SECTION LINES
2385 Ft. from North Section Line
726 Ft. from West Section Line

UTM COORDINATES (Meters,Zone:13,NAD83)
Easting: Northing:

PERMIT TO USE AN EXISTING WELL

ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT

CONDITIONS OF APPROVAL

1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of this permit does not ensure that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.
2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.
3) Approved pursuant to CRS 37-92-602(3)(b)(I) for uses as described in CRS 37-92-602(1)(f). Use of this well is limited to monitoring water levels and/or water quality sampling.
4) Approved for the use of an existing well acknowledged for construction under monitoring hole notice MH-54135, and known as WD-3B.
5) This well must be equipped with a locking cap or seal to prevent well contamination or possible hazards as an open well. The well must be kept capped and locked at all times except during sampling or measuring.
6) Records of water level measurements and water quality analyses shall be maintained by the well owner and submitted to the Division of Water Resources upon request.
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AM 12-29-15

APPROVED
AOT

State Engineer

By

Receipt No. 3672225B DATE ISSUED 12-29-2015 EXPIRATION DATE N/A

Form No.
GWS-25

OFFICE OF THE STATE ENGINEER
COLORADO DIVISION OF WATER RESOURCES

818 Centennial Bldg., 1313 Sherman St., Denver, Colorado 80203
(303) 866-3581

WD-4A

EXST

WELL PERMIT NUMBER 299769 - - -
DIV. 4 WD 60 DES. BASIN MD

APPLICANT

TS LANDFILL INC
2352 N 7TH ST
UNIT B
GRAND JUNCTION, CO 81501-

(970) 245-4101

APPROVED WELL LOCATION
MONTROSE COUNTY
SW 1/4 NW 1/4 Section 15
Township 45 N Range 15 W New Mex P.M.

DISTANCES FROM SECTION LINES
1534 Ft. from North Section Line
12 Ft. from West Section Line

UTM COORDINATES (Meters,Zone:13,NAD83)
Easting: Northing:

PERMIT TO USE AN EXISTING WELL

ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT

CONDITIONS OF APPROVAL

1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of this permit does not ensure that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.
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3) Approved pursuant to CRS 37-92-602(3)(b)(I) for uses as described in CRS 37-92-602(1)(f). Use of this well is limited to monitoring water levels and/or water quality sampling.
4) Approved for the use of an existing well acknowledged for construction under monitoring hole notice MH-54135, and known as WD-4A.
5) This well must be equipped with a locking cap or seal to prevent well contamination or possible hazards as an open well. The well must be kept capped and locked at all times except during sampling or measuring.
6) Records of water level measurements and water quality analyses shall be maintained by the well owner and submitted to the Division of Water Resources upon request.
7) Upon conclusion of the monitoring program the well owner shall plug this well in accordance with Rule 16 of the Water Well Construction Rules. A Well Abandonment Report must be completed and submitted to the Division of Water Resources within 60 days of plugging.
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A 12-29-15

APPROVED
AOT

Dick Wolfe
State Engineer

Alx
By

Receipt No. 3672225C DATE ISSUED 12-29-2015 EXPIRATION DATE N/A

Form No.
GWS-25

OFFICE OF THE STATE ENGINEER
COLORADO DIVISION OF WATER RESOURCES

818 Centennial Bldg., 1313 Sherman St., Denver, Colorado 80203
(303) 866-3581

WD-4B

EXST

WELL PERMIT NUMBER 299770 - - -
DIV. 4 WD 60 DES. BASIN MD

APPLICANT

TS LANDFILL INC
2352 N 7TH ST
UNIT B
GRAND JUNCTION, CO 81501-

(970) 245-4101

APPROVED WELL LOCATION
MONTROSE COUNTY
SW 1/4 NW 1/4 Section 15
Township 45 N Range 15 W New Mex P.M.

DISTANCES FROM SECTION LINES
1514 Ft. from North Section Line
13 Ft. from West Section Line

UTM COORDINATES (Meters,Zone:13,NAD83)
Easting: Northing:

PERMIT TO USE AN EXISTING WELL

ISSUANCE OF THIS PERMIT DOES NOT CONFER A WATER RIGHT

CONDITIONS OF APPROVAL

1) This well shall be used in such a way as to cause no material injury to existing water rights. The issuance of this permit does not ensure that no injury will occur to another vested water right or preclude another owner of a vested water right from seeking relief in a civil court action.
2) The construction of this well shall be in compliance with the Water Well Construction Rules 2 CCR 402-2, unless approval of a variance has been granted by the State Board of Examiners of Water Well Construction and Pump Installation Contractors in accordance with Rule 18.
3) Approved pursuant to CRS 37-92-602(3)(b)(I) for uses as described in CRS 37-92-602(1)(f). Use of this well is limited to monitoring water levels and/or water quality sampling.
4) Approved for the use of an existing well acknowledged for construction under monitoring hole notice MH-54135, and known as WD-4B.
5) This well must be equipped with a locking cap or seal to prevent well contamination or possible hazards as an open well. The well must be kept capped and locked at all times except during sampling or measuring.
6) Records of water level measurements and water quality analyses shall be maintained by the well owner and submitted to the Division of Water Resources upon request.
7) Upon conclusion of the monitoring program the well owner shall plug this well in accordance with Rule 16 of the Water Well Construction Rules. A Well Abandonment Report must be completed and submitted to the Division of Water Resources within 60 days of plugging.
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9) This well must have been constructed by or under the supervision of a licensed well driller or other authorized individual according to the Water Well Construction Rules.
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AR 12-29-15

APPROVED
AOT

State Engineer

By

Receipt No. 3672225D DATE ISSUED 12-29-2015 EXPIRATION DATE N/A

ATTACHMENT B

Borehole/Monitoring Well ID: BL-8

WALTER ENVIRONMENTAL & Engineering Group Inc.

Elevation / Depth	Lithology	Lithology Description	Well Construction Diagram
0		topsoil	
6260, 4, 6256, 8, 6252, 12, 6248		sandstone, light gray	
16, 6244, 20		shale, dark gray, mud, trace interbedded fine grained sand	
6240		sandstone, light gray sand with trace dark gray silt and clay, mostly fine grained sand	
24		shale, dark gray, thinly laminated	
6236		sandstone, light gray and buff, fine to coarse grained sand, trace interbedded carboniferous material, crossbedded	
28		sandstone, light gray, fine grained sand, trace carboniferous material	
6232, 32, 6228		shale, dark gray, mud, trace interbedded fine grained sand	
36		shale, dark gray, some coal, reddish brown and yellowish brown staining along bedding and fracture planes	
6224		sandstone, light gray, mostly fine grained sand, abundant carboniferous material	
40		shale, dark gray, mud	
6220		sandstone, light gray, mostly fine grained sand, trace interbedded shale	
44, 6216, 48		shale, dark gray, thinly bedded	
6212, 52		shale, light gray, silt, thinly bedded	
6208		sandstone, light gray, mostly fine grained sand	
56, 6204, 60		sandstone, light gray sand with dark gray silt and clay, mostly fine grained sand, abundant carboniferous material	
6200, 64		shale, greenish gray, top of Burro Canyon Formation	

Project Name: Broad Canyon Landfill
Location: Montrose County, Colorado
Drilling Date: 8/14/2015

Well Completion Details

- bentonite
- bottom cap
- well casing
- concrete
- filter sand
- monument cover
- well screen
- surface completion

Borehole/Monitoring Well ID: BL-9

WALTER ENVIRONMENTAL & Engineering Group Inc.

Elevation	Depth	Lithology Description
6232	0	topsoil
6228	4	sandstone, light gray
6224	8	
6220	12	sandstone, light gray, mostly fine grained sand, interbedded carboniferous material, ripple bedding
		shale, dark gray, interbedded fine grained sand, abundant carboniferous material, ripple bedding
6216	16	sandstone, light gray, interbedded dark gray shale
6212	20	shale, dark gray and black, thinly bedded, some coal, trace evaporative mineralization along bedding planes
6208	24	
6204	28	sandstone, light gray, mostly fine grained sand, abundant interbedded carboniferous material
		shale, dark gray, trace interbedded fine grained sand
		sandstone, light gray, mostly fine grained sand, abundant interbedded carboniferous material
6200	32	sandstone, light gray, mostly fine grained sand, abundant interbedded carboniferous material, wavy bedding
6196	36	sandstone, light gray and buff, fine to coarse grained sand, some interbedded carboniferous material, crossbedded
		shale, dark gray, some gypsum mineralization along bedding planes, thinly laminated
6192	40	sandstone, light gray, mostly fine grained sand, abundant carboniferous material
		shale, light to medium gray, mud
6188	44	sandstone, light gray, mostly fine grained sand, abundant interbedded carbonaceous shale, animal burrows, wavy bedded
		shale, light to medium gray, mud
6184	48	sandstone, light gray, mostly fine grained sand
		shale with coal, thinly laminated, reddish brown and yellowish brown staining along bedding and fracture planes
6180	52	sandstone, light gray, mostly fine grained sand, interbedded shale (carboniferous), wavy bedded
		shale, dark gray, mostly clay, thinly bedded, fissile
6176	56	shale, dark gray, mostly silt
		sandstone, light gray, mostly fine grained sand, some carboniferous material
6172	60	shale, dark gray, thinly bedded
		sandstone, light gray, abundant intebedded carboniferous material
6168	64	sandstone, white, mostly fine grained sand, some green

Project Name: Broad Canyon Landfill
Location: Montrose County, Colorado
Drilling Date: 8/12/2015

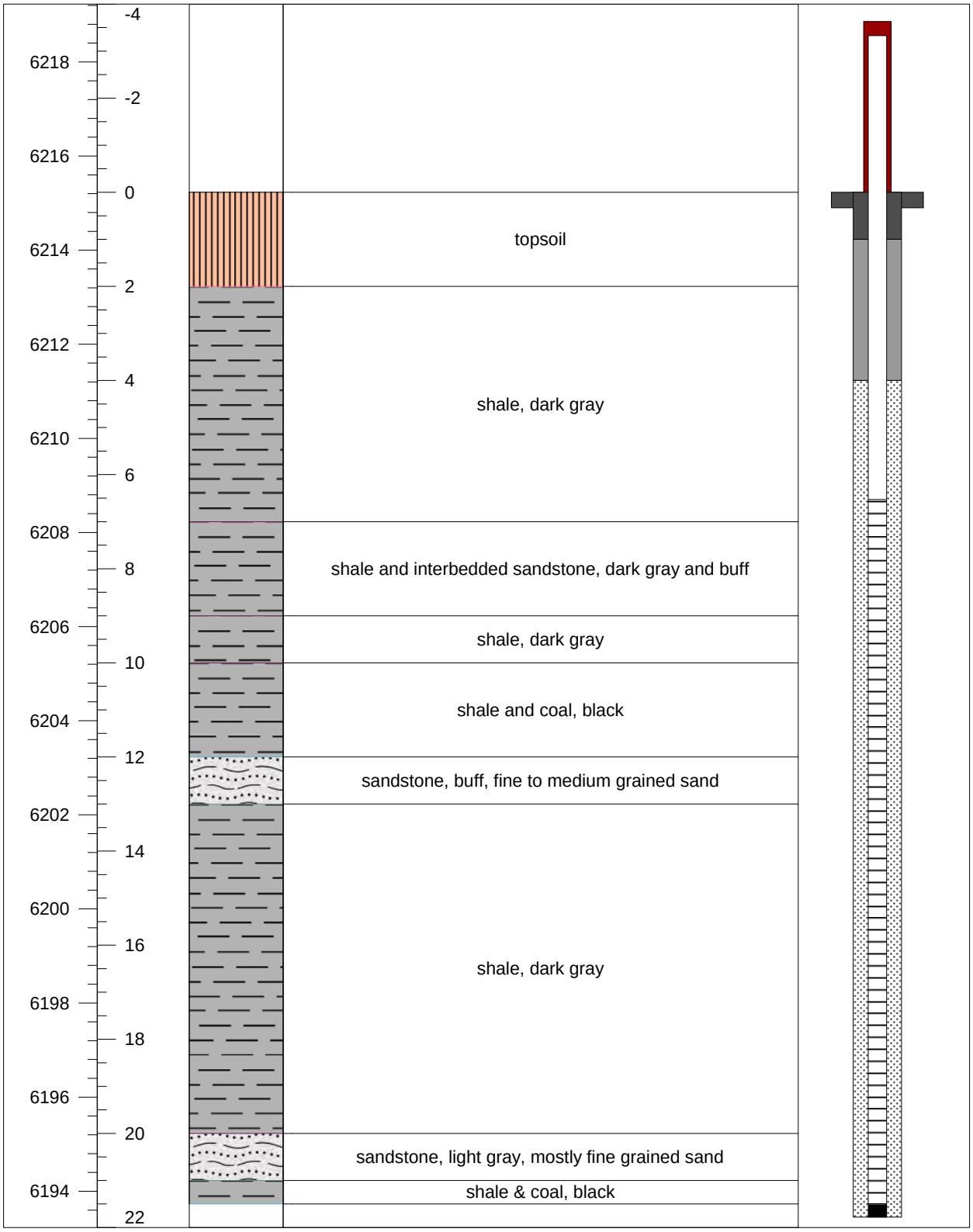
Well Completion Details

- bentonite
- bottom cap
- well casing
- concrete
- filter sand
- monument cover
- well screen
- surface completion

Borehole/Monitoring Well ID: WD-1A

WALTER ENVIRONMENTAL & Engineering Group Inc.

Elevation / Depth	Lithology	Lithology Description	Well Construction Diagram



Project Name: Broad Canyon Landfill
Location: Montrose County, Colorado
Drilling Date: 9/15/2015

Well Completion Details

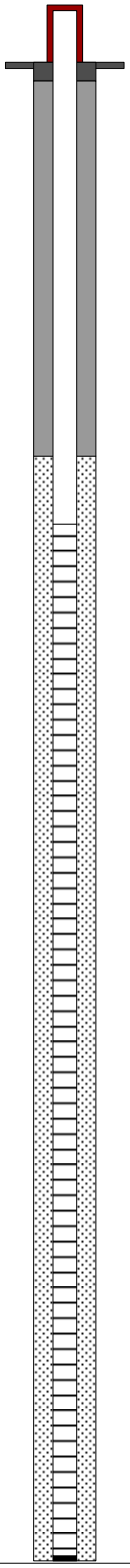
- bentonite
- bottom cap
- well casing
- concrete
- filter sand
- monument cover
- well screen
- surface completion

Borehole/Monitoring Well ID: WD-1B

WALTER ENVIRONMENTAL & Engineering Group Inc.

Elevation	Depth	Lithology Description
6220	-4	
6216	0	topsoil
6212	4	sandstone, light gray, mostly fine grained sand
6208	8	shale, dark gray
6204	12	sandstone, light gray and buff, fine to coarse grained sand, crossbedded
		shale, dark gray, trace interbedded light gray sandstone
		shale, dark gray, mud, trace thin coal seams, calcopyrite
6200	16	sandstone, light gray and buff, mostly fine grained sand, some interbedded shale (carboniferous), wavy bedded
6196	20	coal, black, some calcopyrite
		sandstone, light gray, interbedded shale (carboniferous)
		shale, dark gray
6192	24	sandstone, interbedded shale (carboniferous), wavy bedded
		shale, dark gray, interbedded sandstone, wavy bedded
6188	28	sandstone, light gray and buff, mostly fine grained sand, interbedded carboniferous material, wavy bedded
		coal, black
6184	32	shale, dark gray, mud, trace interbedded light gray siltstone, trace thin coal seams
6180	36	
6176	40	coal, black, some calcopyrite
6172	44	shale, light gray, some interbedded dark gray mudstone, some very fine grained sand
6168	48	shale, dark gray, abundant carboniferous material, some thin coal seams
		shale and coal, dark gray and black, some calcopyrite
6164	52	sandstone, light gray, fine to medium grained sand, some interbedded dark gray shale, abundant carboniferous material, trace calcopyrite
		shale, dark gray, trace calcopyrite
6160	56	shale, light gray, some very fine grained sand, abundant carboniferous material at 58.5'
6156	60	coal, black, some calcopyrite
		sandstone, light gray, fine to medium grained sand, interbedded carboniferous material, wavy bedded
6152	64	shale, dark gray
		shale and coal, black, trace calcopyrite
6148	68	sandstone, light gray, mostly fine grained sand, interbedded shale (carboniferous), wavy bedded, abundant rip-up clasts
6144	72	sandstone, white, mostly fine grained sane, some interbedded greenish gray shale, top of Burro Canyon
6140	76	
	80	

Well Construction Diagram



Project Name: Broad Canyon Landfill
Location: Montrose County, Colorado
Drilling Date: 9/10/2015

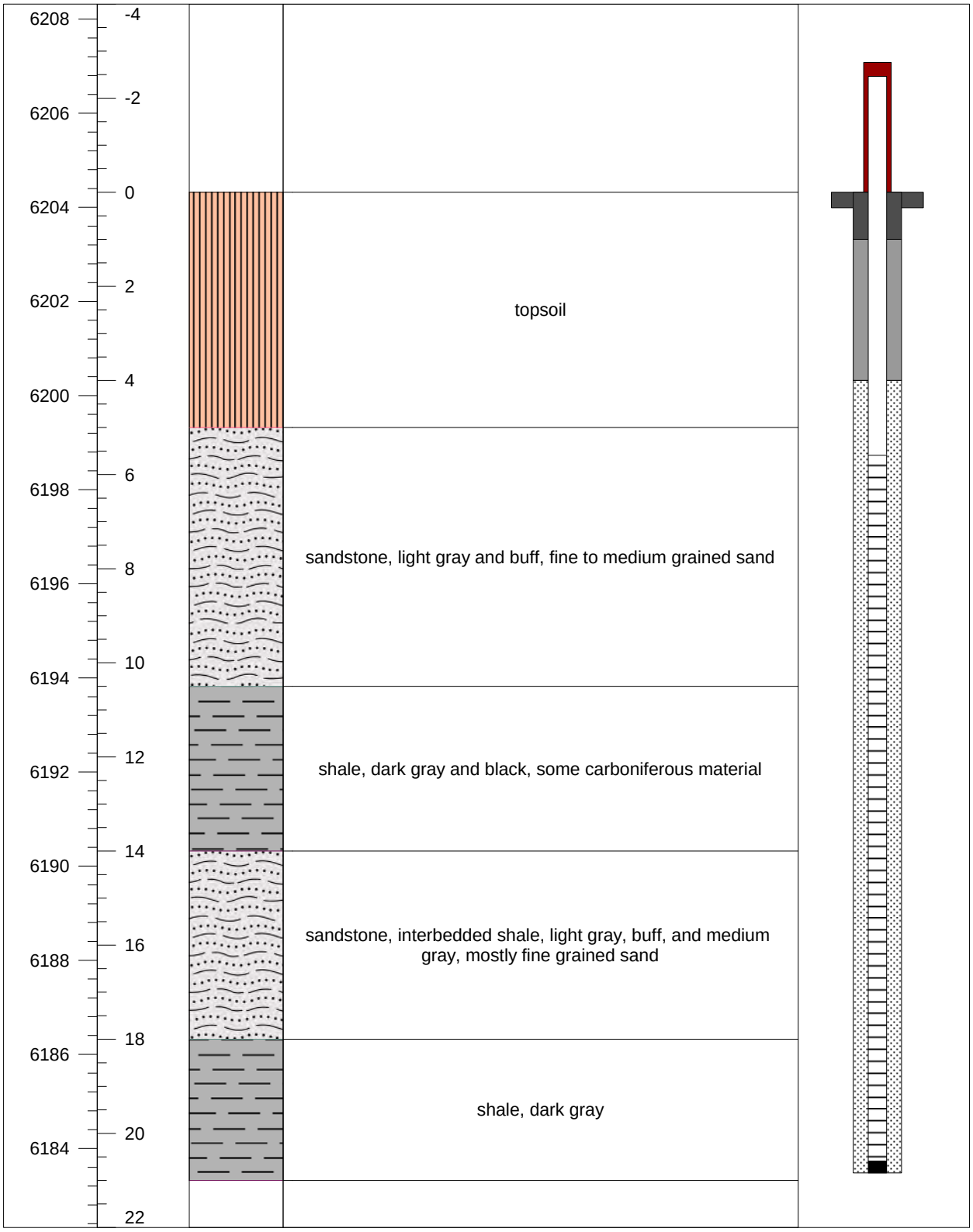
Well Completion Details

- bentonite
- bottom cap
- well casing
- concrete
- filter sand
- monument cover
- well screen
- surface completion

Borehole/Monitoring Well ID: WD-2A

WALTER ENVIRONMENTAL & Engineering Group Inc.

Elevation / Depth	Lithology	Lithology Description	Well Construction Diagram



Project Name: Broad Canyon Landfill
Location: Montrose County, Colorado
Drilling Date: 9/18/2015

Well Completion Details

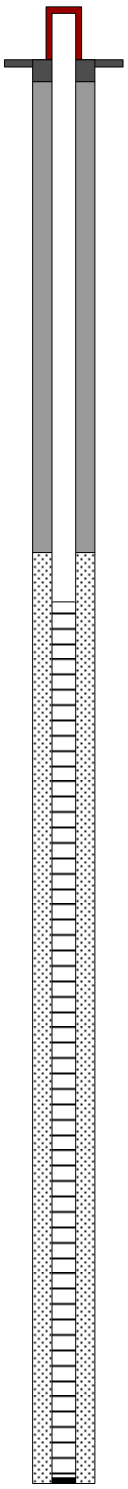
- bentonite
- bottom cap
- well casing
- concrete
- filter sand
- monument cover
- well screen
- surface completion

Borehole/Monitoring Well ID: WD-2B

WALTER ENVIRONMENTAL & Engineering Group Inc.

Elevation / Depth	Lithology	Lithology Description
6208 / -4		
6204 / 0		topsoil
6200 / 4		sandstone, light gray and buff, fine to medium grained sand
6196 / 8		
		shale, dark gray
6192 / 12		shale, dark gray, mud, some coal
6188 / 16		sandstone, light gray, some interbedded shale (carboniferous), wavy bedded, mostly fine grained sand
6184 / 20		shale, dark gray, some light gray sandstone lenses
		sandstone, light gray, very fine grained sand, interbedded shale (carboniferous), trace animal burrows
6180 / 24		shale, dark gray
		sandstone, light gray, interbedded dark gray shale, abundant carboniferous material
		shale and coal, black
6176 / 28		shale, dark gray, interbedded light gray sandstone, trace gypsum, yellowish brown and reddish brown staining
6172 / 32		sandstone, light gray, interbedded shale (carboniferous), trace animal burrows
6168 / 36		shale, dark gray, interbedded light gray sandstone, trace gypsum, yellowish brown and reddish brown staining
6164 / 40		shale, dark gray, interbedded fine grained sand, carbonaceous, trace thin coal seams, trace animal burrows
6160 / 44		shale and coal, black
		shale, light gray, some very fine grained sand, grading to no fine grained sand at 50.5'
6156 / 48		sandstone, light gray, very fine grained sand
		shale, dark gray
6152 / 52		sandstone, light gray, very fine grained sand
		shale, dark gray
6148 / 56		sandstone, light gray, abundant interbedded carboniferous material
		shale, dark gray, some interbedded light gray sandstone
6144 / 60		sandstone, white, greenish gray lenses, mostly fine graind sand, abundant carboniferous material in upper 1.5', scour and fill marks in upper 0.5', top of Burro Canyon Formation
6140 / 64		
68		

Well Construction Diagram



Project Name: Broad Canyon Landfill
Location: Montrose County, Colorado
Drilling Date: 9/16/2015

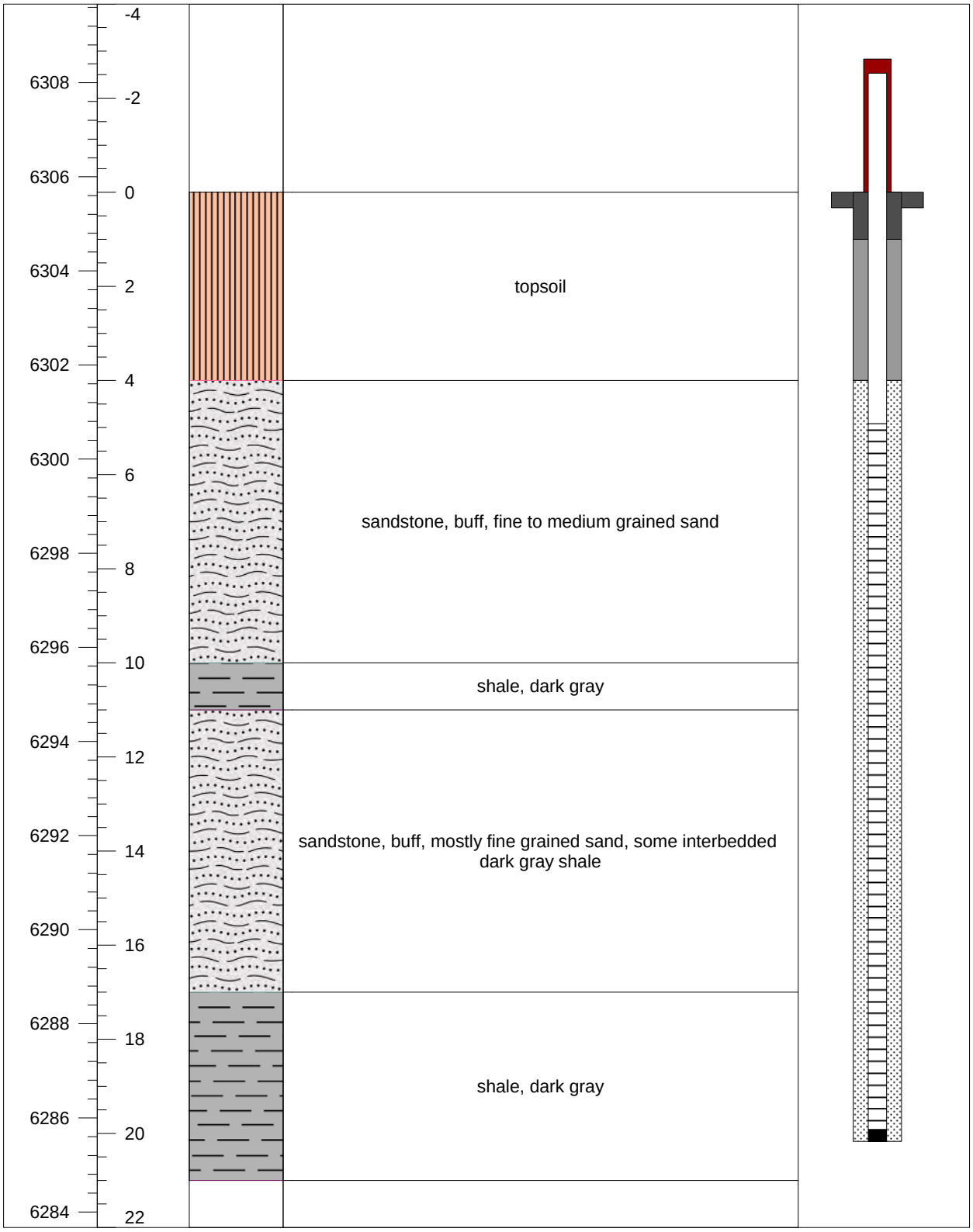
Well Completion Details

- bentonite
- bottom cap
- well casing
- concrete
- filter sand
- monument cover
- well screen
- surface completion

Borehole/Monitoring Well ID: WD-3A

WALTER ENVIRONMENTAL & Engineering Group Inc.

Elevation / Depth	Lithology	Lithology Description	Well Construction Diagram



Project Name: Broad Canyon Landfill
Location: Montrose County, Colorado
Drilling Date: 9/3/2015

Well Completion Details

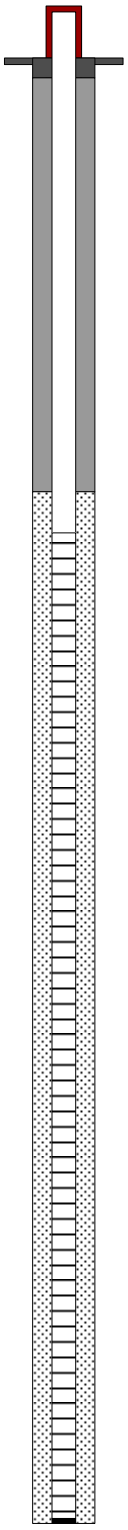
- bentonite
- bottom cap
- well casing
- concrete
- filter sand
- monument cover
- well screen
- surface completion

Borehole/Monitoring Well ID: WD-3B

WALTER ENVIRONMENTAL & Engineering Group Inc.

Elevation / Depth	Lithology	Lithology Description
-4		
6308 / 0		topsoil
6304 / 4		sandstone, light gray and buff, fine to medium grained sand
6300 / 8		shale, dark gray
6296 / 12		sandstone, light gray and buff, fine to coarse grained sand, crossbedded
6292 / 16		sandstone, light gray and buff, fine to coarse grained sand, some interbedded carboniferous material, crossbedded
		interbedded shale and sandstone, dark gray shale, light gray and buff sandstone
6288 / 20		sandstone, light gray, mostly fine grained sand, some interbedded carboniferous material
		interbedded dark gray shale and light gray sandstone
6284 / 24		shale, dark gray
6280 / 28		sandstone, light gray, mostly fine grained sand, abundant interbedded shale (carboniferous), wavy bedded
6276 / 32		
6272 / 36		coal, black, abundant pyrite
		sandstone, light gray
6268 / 40		shale, light gray to medium gray, mud, some very fine grained sand, trace thin coal seams
6264 / 44		coal and shale, black
		shale, black
6260 / 48		shale, light to medium gray, some very fine grained sand
6256 / 52		sandstone, light gray, fine to medium grained sand, some interbedded shale (carboniferous), some animal burrows
6252 / 56		
6248 / 60		shale, dark gray
6244 / 64		sandstone, light gray and buff, fine to medium grained sand, interbedded shale (carboniferous), abundant rip-up clasts
6240 / 68		shale, green, top of Burro Canyon
6236 / 72		
6232 / 76		

Well Construction Diagram



Project Name: Broad Canyon Landfill
Location: Montrose County, Colorado
Drilling Date: 9/2/2015

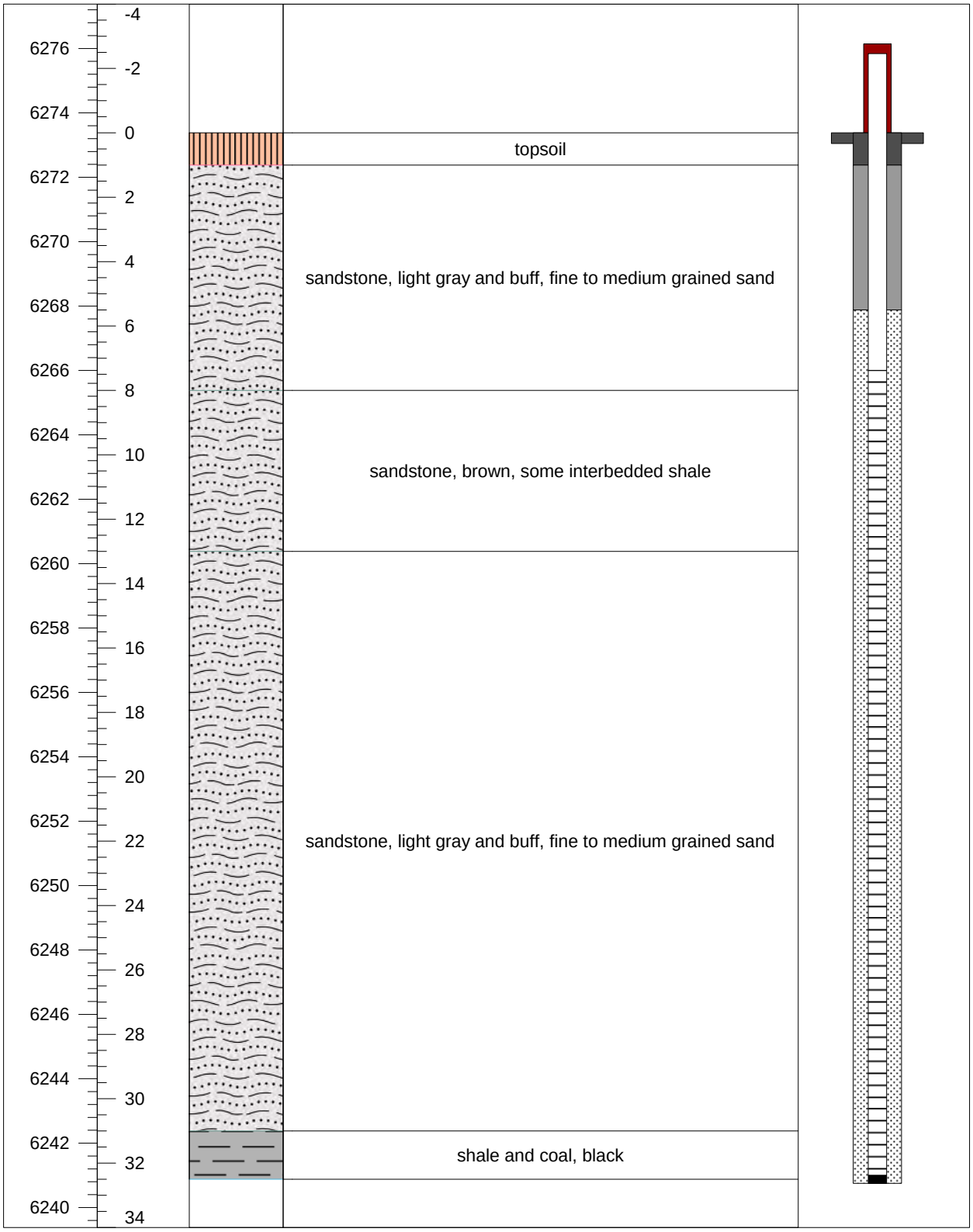
Well Completion Details

- bentonite
- bottom cap
- well casing
- concrete
- filter sand
- monument cover
- well screen
- surface completion

Borehole/Monitoring Well ID: WD-4A

WALTER ENVIRONMENTAL & Engineering Group Inc.

Elevation / Depth	Lithology	Lithology Description	Well Construction Diagram



Project Name: Broad Canyon Landfill
Location: Montrose County, Colorado
Drilling Date: 9/10/2015

Well Completion Details

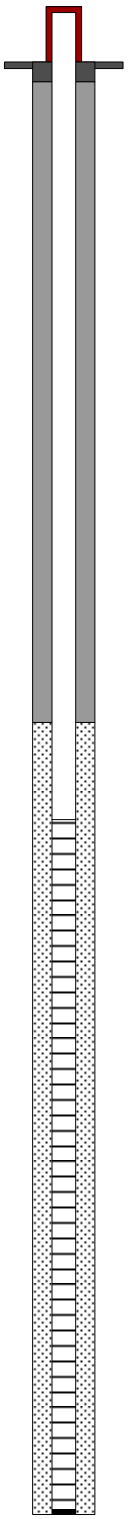
- bentonite
- bottom cap
- well casing
- concrete
- filter sand
- monument cover
- well screen
- surface completion

Borehole/Monitoring Well ID: WD-4B

WALTER ENVIRONMENTAL & Engineering Group Inc.

Elevation	Depth	Lithology Description
6276	-4	
6272	0	topsoil
6268	4	sandstone, light gray, fine to medium grained sand
6264	8	shale, medium gray
		shale, dark gray, mud, trace interbedded sandstone
6260	12	
6256	16	sandstone, light gray and buff, medium to coarse grained sand, interbedded shale (carboniferous), crossbedded, trace rip-up clasts
6252	20	
6248	24	
6244	28	
6240	32	shale and coal, dark gray and black, mud
		shale, light gray, some very fine grained sand, yellowish brown staining
6236	36	shale, light gray, some fine grained sand, abundant yellowish brown and reddish brown staining, trace gypsum, trace thin coal seams
6232	40	coal, black, yellow staining, some gypsum
		shale, dark gray, grading to light gray, some gypsum lenses
6228	44	shale, light gray, some interbedded dark gray shale, some interbedded coal, trace fine grained sand,
6224	48	
6220	52	shale, light gray, some fine grained sand
6216	56	shale, dark gray, some interbedded light gray sandstone, abundant carboniferous material
6212	60	shale, dark gray, trace interbedded sandstone, trace thin coal seams
6208	64	
6204	68	sandstone, light gray, mostly fine grained sand, interbedded shale (carboniferous), rip-up clasts
		shale, green, top of Burro Canyon
6200	72	
	76	

Well Construction Diagram



Project Name: Broad Canyon Landfill
Location: Montrose County, Colorado
Drilling Date: 9/8/2015

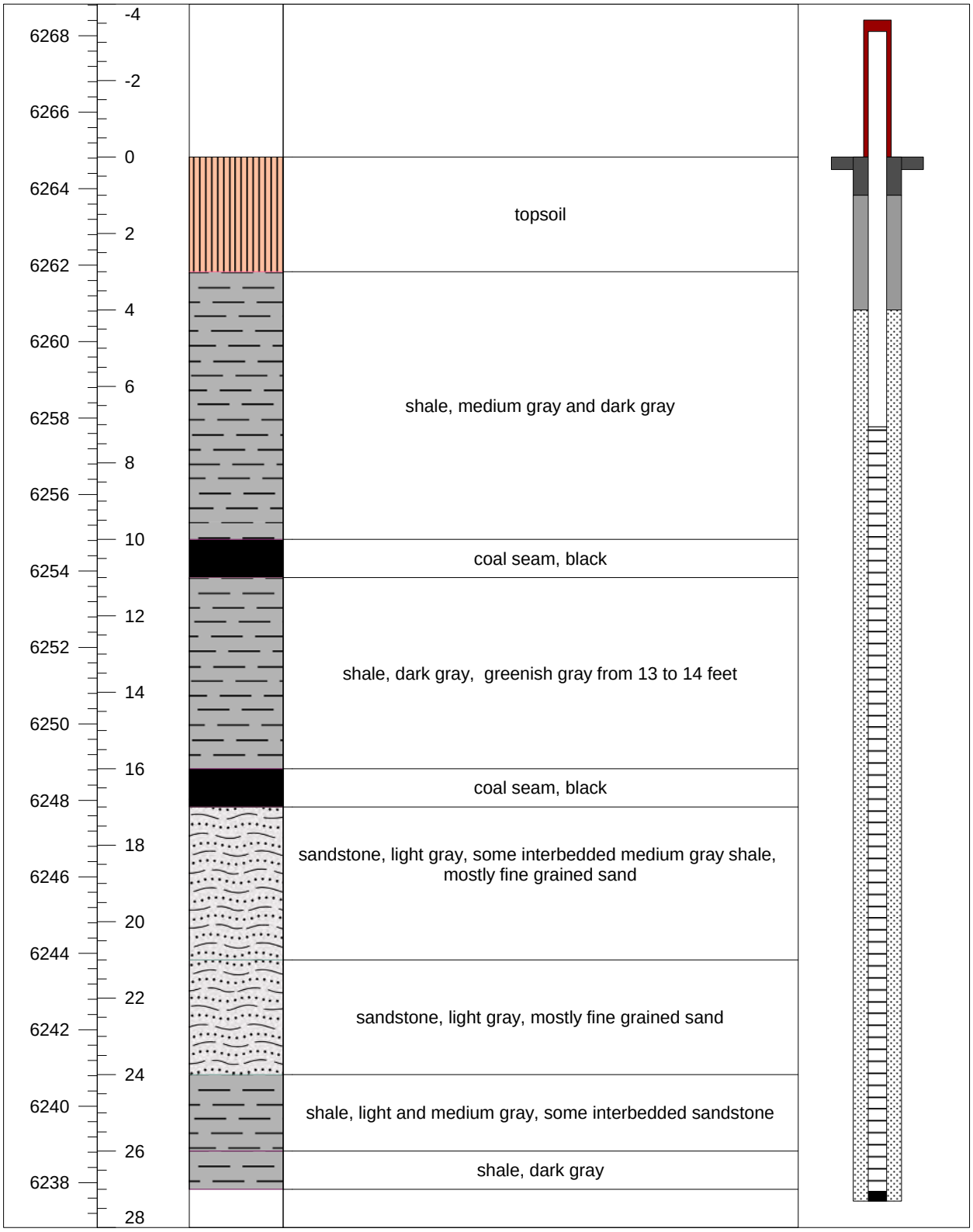
Well Completion Details

- bentonite
- bottom cap
- well casing
- concrete
- filter sand
- monument cover
- well screen
- surface completion

Borehole/Monitoring Well ID: LFG Probe

WALTER ENVIRONMENTAL & Engineering Group Inc.

Elevation / Depth	Lithology	Lithology Description	Well Construction Diagram



Project Name: Broad Canyon Landfill
Location: Montrose County, Colorado
Drilling Date: 9/17/2015

Well Completion Details

- bentonite
- bottom cap
- well casing
- concrete
- filter sand
- monument cover
- well screen
- surface completion

ATTACHMENT C

PERMEABILITY TEST - BACK PRESSURE SATURATED - FLOW PUMP METHOD

ASTM D5084 Method D

CLIENT	Walter Enviromental	JOB NO.	2941-1

PROJECT	--			
PROJECT NO.	--	SAMPLED	--	By: --
BORING NO.	--	TEST STARTED	10/15/2015	By: CAL
DEPTH	26.5	TEST FINISHED	10/22/2015	By: CAL
SAMPLE NO.	BL-9	CELL NUMBER	7P	
LOCATION	--	PERMEANT	Tap Water	
SAMPLE TYPE	Rock Core	CONF. PRES. - (psf)	720	

MOISTURE / DENSITY DATA	BEFORE TEST	AFTER TEST
Wt. Soil + Moisture - (g)	1096.68	1109.26
Wt. Wet Soil & Pan - (g)	1111.13	1123.71
Wt. Dry Soil & Pan - (g)	1105.89	1105.89
Wt. Lost Moisture - (g)	5.24	17.82
Wt. of Pan Only - (g)	14.45	14.45
Wt. of Dry Soil - (g)	1091.44	1091.44
Moisture Content - (%)	0.5	1.6
Wet Density - (pcf)	159.8	162.6
Dry Density - (pcf)	159.0	160.0
Init. Diameter - (in)	2.996	
Init. Area - (sq in)	7.050	
Init. Height - (in)	3.709	
Vol. Bef. Consol. - (cu ft)	0.01513	
Vol. After Consol. - (cu ft)	0.01504	
Porosity - (%)	4.18	

FLOW PUMP CALCULATIONS	
Pump Setting (gear number)	12
Percentage of Pump Setting	100
Q - (cc/s)	2.30E-05
Height - (in)	3.701
Diameter - (in)	2.990
Pressure - (psi)	1.512
Area after consol. - (sq cm)	45.313
Gradient	11.308
Permeability k - (cm/s)	4.5E-08
Permeability k - (m/s)	4.5E-10
Back Pressure - (psi)	58.0
Cell Pressure - (psi)	63.0
Ave. Effective Stress - (psi)	4.244
Average temperature degree - (c°)	21.3

Data entry by:	NN	Date:	10/24/2015
Checked by:	CA	Date:	10/26/15

PERMEABILITY TEST - BACK PRESSURE SATURATED - FLOW PUMP METHOD

ASTM D5084 Method D

CLIENT	Walter Enviromental		JOB NO. 2941-1

PROJECT	--			
PROJECT NO.	--	SAMPLED	--	By: --
BORING NO.	--	TEST STARTED	10/15/2015	By: CAL
DEPTH	26.5	TEST FINISHED	10/22/2015	By: CAL
SAMPLE NO.	BL-9	CELL NUMBER	7P	
LOCATION	--	PERMEANT	Tap Water	
SAMPLE TYPE	Rock Core	CONF. PRES. - (psf)	720	

SATURATION DATA

Cell Press. (psi)	Back Press. (psi)	Burette Reading (cc) Close	Burette Reading (cc) Open	Pore Press. (psi) Close	Pore Press. (psi) Open	Change	B
40.0	38.0	4.8	17.2				
50.0	48.0	19.1	20.2	39.2	48.4	9.2	0.92
60.0	58.0	20.8	21.7	48.9	58.5	9.6	0.96
70.0	68.0	21.9	22.1	58.8	68.6	9.8	0.98

CONSOLIDATION DATA

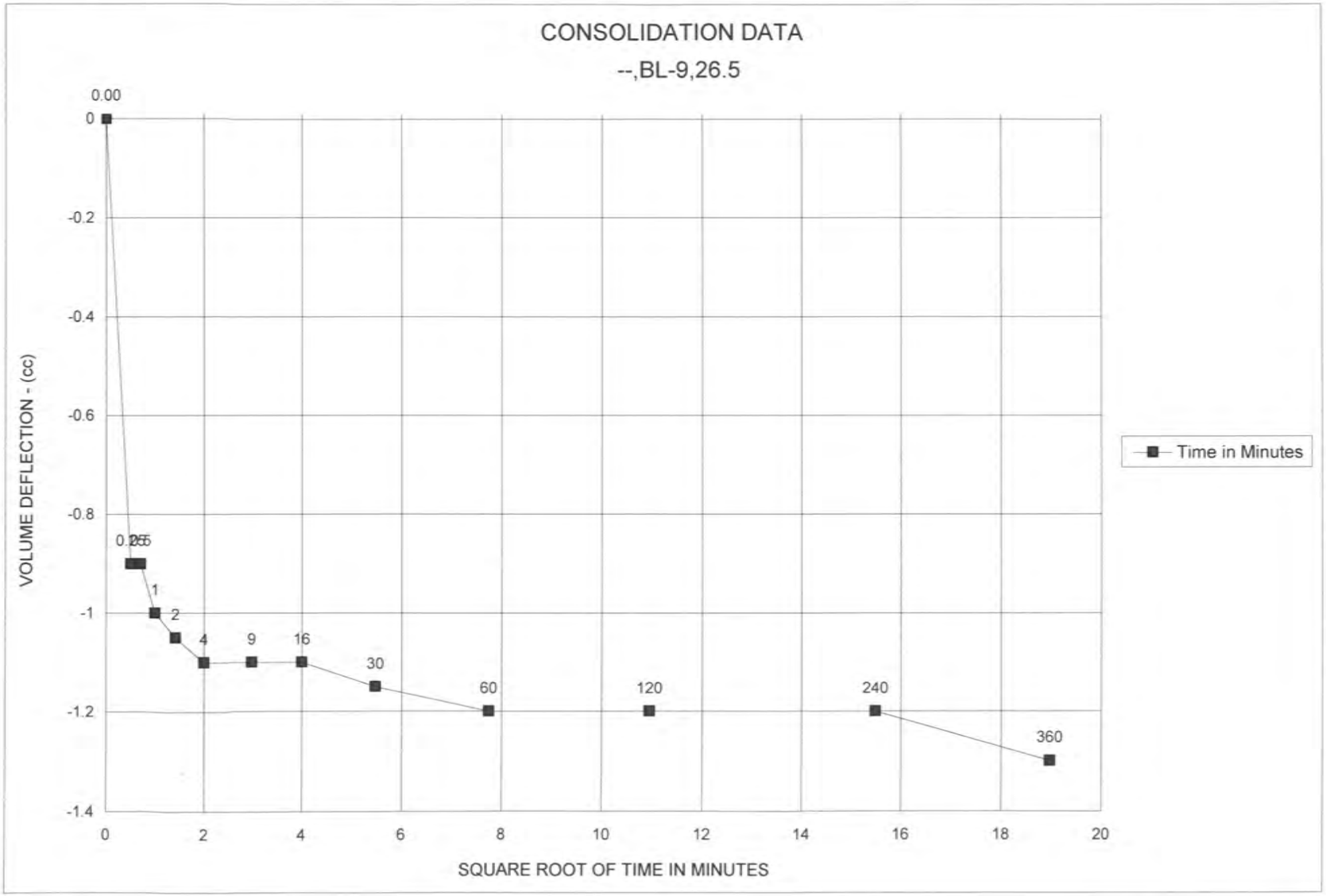
Elapsed Time (Min)	SQRT Time (Min)	Burette Reading (cc)	Volume Defl. (cc)
0.00	0.00	0.30	0.00
0.25	0.50	1.20	-0.90
0.5	0.71	1.20	-0.90
1	1.00	1.30	-1.00
2	1.41	1.35	-1.05
4	2.00	1.40	-1.10
9	3.00	1.40	-1.10
16	4.00	1.40	-1.10
30	5.48	1.45	-1.15
60	7.75	1.50	-1.20
120	10.95	1.50	-1.20
240	15.49	1.50	-1.20
360	18.97	1.60	-1.30

Initial Height - (in)	3.709	Init. Vol. - (cc)	428.56
Height Change - (in)	0.008	Vol. Change - (cc)	19.10
Ht. After Cons. - (in)	3.701	Cell Exp. - (cc)	16.58
Initial Area - (sq in)	7.050	Net Change - (cc)	2.52
Area After Cons. - sq in	7.023	Cons. Vol. - (cc)	426.04

PERMEABILITY TEST - BACK PRESSURE SATURATED - FLOW PUMP METHOD

ASTM D5084 Method D

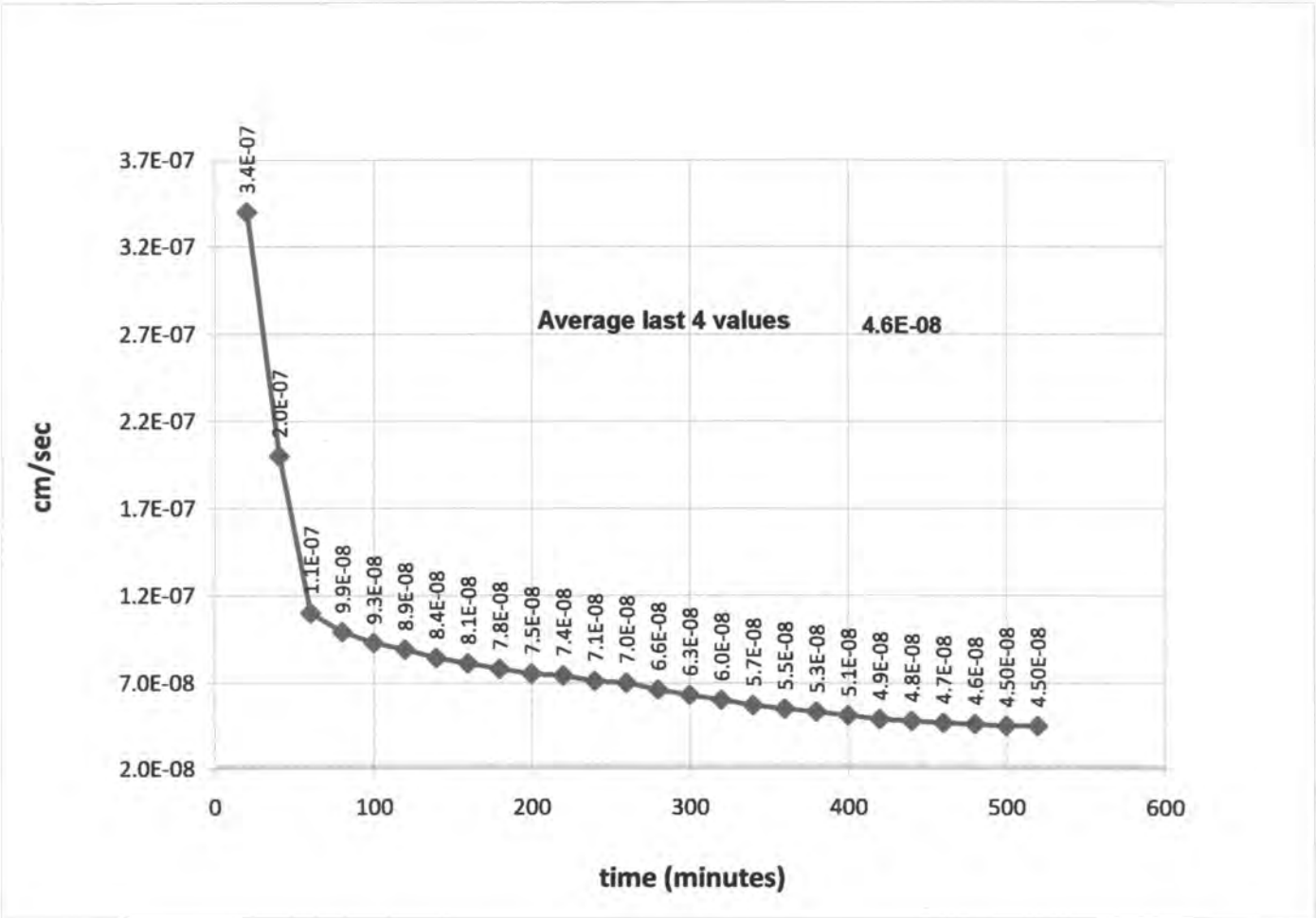
CLIENT	Walter Enviromental		JOB NO.	2941-1



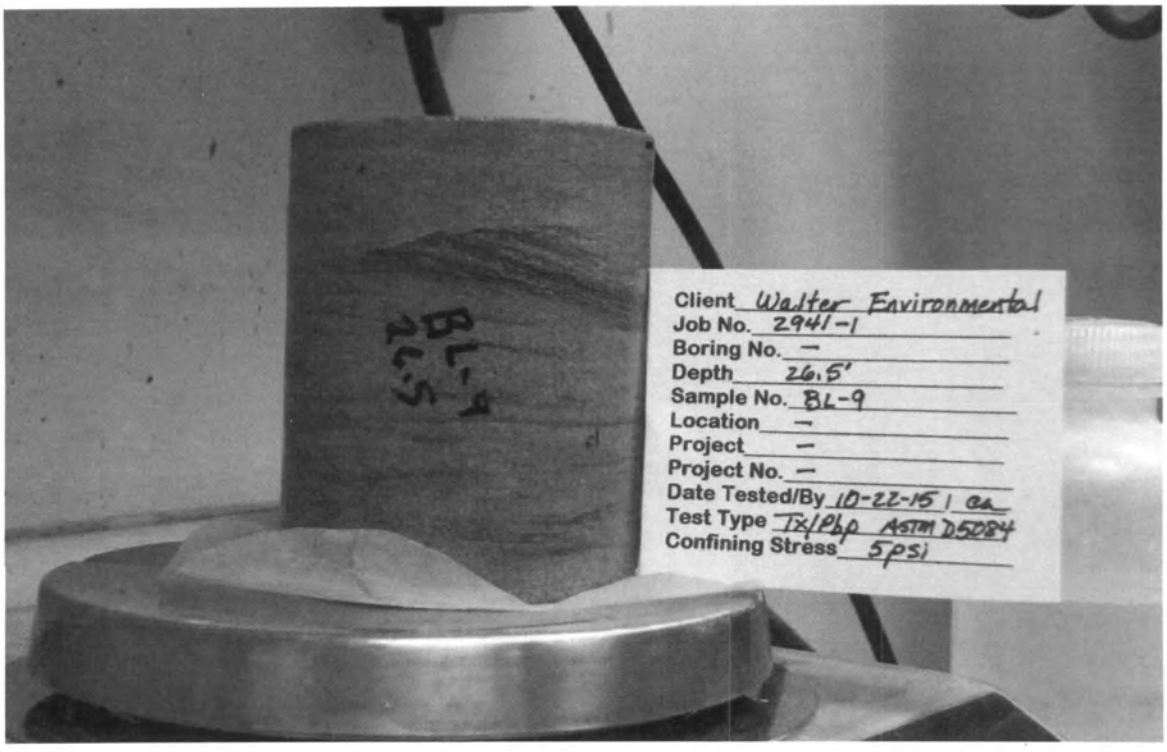
FileName: 2941_1_HarvardFlowPump-Perm-ASTMD-5084-R3_2.xls

Preliminary Flow Pump Test Data
ASTM D5084

Client:	Walter Enviromental	Boring Number:	--		
Job Number:	2941-1	Depth:	26.5'		
Project:	--	Sample Number:	BL-9		
Location:	--	Sampled Date:	--	Sampled By:	--
Project Number:	--	Test Date:	10/22/2015	Technician:	CAL



Data Entered By:	CAL		
Date:	10/22/2015	Checked By:	NN
File Name:	2941_1_PrelimPerm_ASTMD-5084-methodD-R1_2.xls	Date:	10/24/15



Q:\Client Data File\2941\1\PICTURE\DSCF6045

PERMEABILITY TEST - BACK PRESSURE SATURATED - FLOW PUMP METHOD

ASTM D5084 Method D

CLIENT	Walter Enviromental	JOB NO.	2941-1

PROJECT	--			
PROJECT NO.	--	SAMPLED	--	By: --
BORING NO.	--	TEST STARTED	10/16/2015	By: CAL
DEPTH	29'	TEST FINISHED	10/30/2015	By: CAL
SAMPLE NO.	BL-7	CELL NUMBER	10P	
LOCATION	--	PERMEANT	Tap Water	
SAMPLE TYPE	Rock Core	CONF. PRES. - (psf)	720	

MOISTURE / DENSITY DATA	BEFORE TEST	AFTER TEST
Wt. Soil + Moisture - (g)	857.71	900.51
Wt. Wet Soil & Pan - (g)	872.07	914.87
Wt. Dry Soil & Pan - (g)	871.38	871.38
Wt. Lost Moisture - (g)	0.69	43.49
Wt. of Pan Only - (g)	14.36	14.36
Wt. of Dry Soil - (g)	857.02	857.02
Moisture Content - (%)	0.1	5.1
Wet Density - (pcf)	145.8	154.9
Dry Density - (pcf)	145.7	147.4
Init. Diameter - (in)	2.989	
Init. Area - (sq in)	7.017	
Init. Height - (in)	3.193	
Vol. Bef. Consol. - (cu ft)	0.01297	
Vol. After Consol. - (cu ft)	0.01282	
Porosity - (%)	11.98	

FLOW PUMP CALCULATIONS	
Pump Setting (gear number)	5
Percentage of Pump Setting	100
Q - (cc/s)	5.81E-03
Height - (in)	3.193
Diameter - (in)	2.972
Pressure - (psi)	0.139
Area after consol. - (sq cm)	44.760
Gradient	1.205
Permeability k - (cm/s)	1.1E-04
Permeability k - (m/s)	1.1E-06
Back Pressure - (psi)	118.0
Cell Pressure - (psi)	123.0
Ave. Effective Stress - (psi)	4.931
Average temperature degree - (c°)	21.8

Data entry by: NN	Date: 11/02/2015
Checked by: CL	Date: 11/02/15

PERMEABILITY TEST - BACK PRESSURE SATURATED - FLOW PUMP METHOD

ASTM D5084 Method D

CLIENT	Walter Enviromental		JOB NO. 2941-1

PROJECT	--			
PROJECT NO.	--	SAMPLED	--	By: --
BORING NO.	--	TEST STARTED	10/16/2015	By: CAL
DEPTH	29'	TEST FINISHED	10/30/2015	By: CAL
SAMPLE NO.	BL-7	CELL NUMBER	10P	
LOCATION	--	PERMEANT	Tap Water	
SAMPLE TYPE	Rock Core	CONF. PRES. - (psf)	720	

SATURATION DATA

Cell Press.	Back Press.	Burette Reading (cc)		Pore Press. (psi)			
(psi)	(psi)	Close	Open	Close	Open	Change	B
40.0	38.0	3.8	14.4				
50.0	48.0	20.9	22.0	38.6	45.0	6.4	0.64
60.0	58.0	22.5	23.3	48.7	55.5	6.8	0.68
70.0	68.0	23.9	24.8	58.8	66.6	7.8	0.78
80.0	78.0	25.1	26.0	68.7	76.9	8.2	0.82
90.0	88.0	26.1	26.9	78.8	87.3	8.5	0.85
100.0	98.0	27.3	28.0	88.6	97.5	8.9	0.89
110.0	108.0	28.3	29.0	98.8	107.8	9.0	0.90
120.0	118.0	29.3	30.0	108.8	118.2	9.4	0.94
130.0		30.4	30.4	118.7	128.2	9.5	0.95

CONSOLIDATION DATA

Elapsed Time (Min)	SQRT Time (Min)	Burette Reading (cc)	Volume Defl. (cc)
0.00	0.00	0.50	0.00
0.25	0.50	1.20	-0.70
0.5	0.71	1.25	-0.75
1	1.00	1.30	-0.80
2	1.41	1.30	-0.80
4	2.00	1.30	-0.80
9	3.00	1.30	-0.80
16	4.00	1.30	-0.80
30	5.48	1.30	-0.80
60	7.75	1.30	-0.80
120	10.95	1.40	-0.90
240	15.49	1.40	-0.90
360	18.97	1.40	-0.90

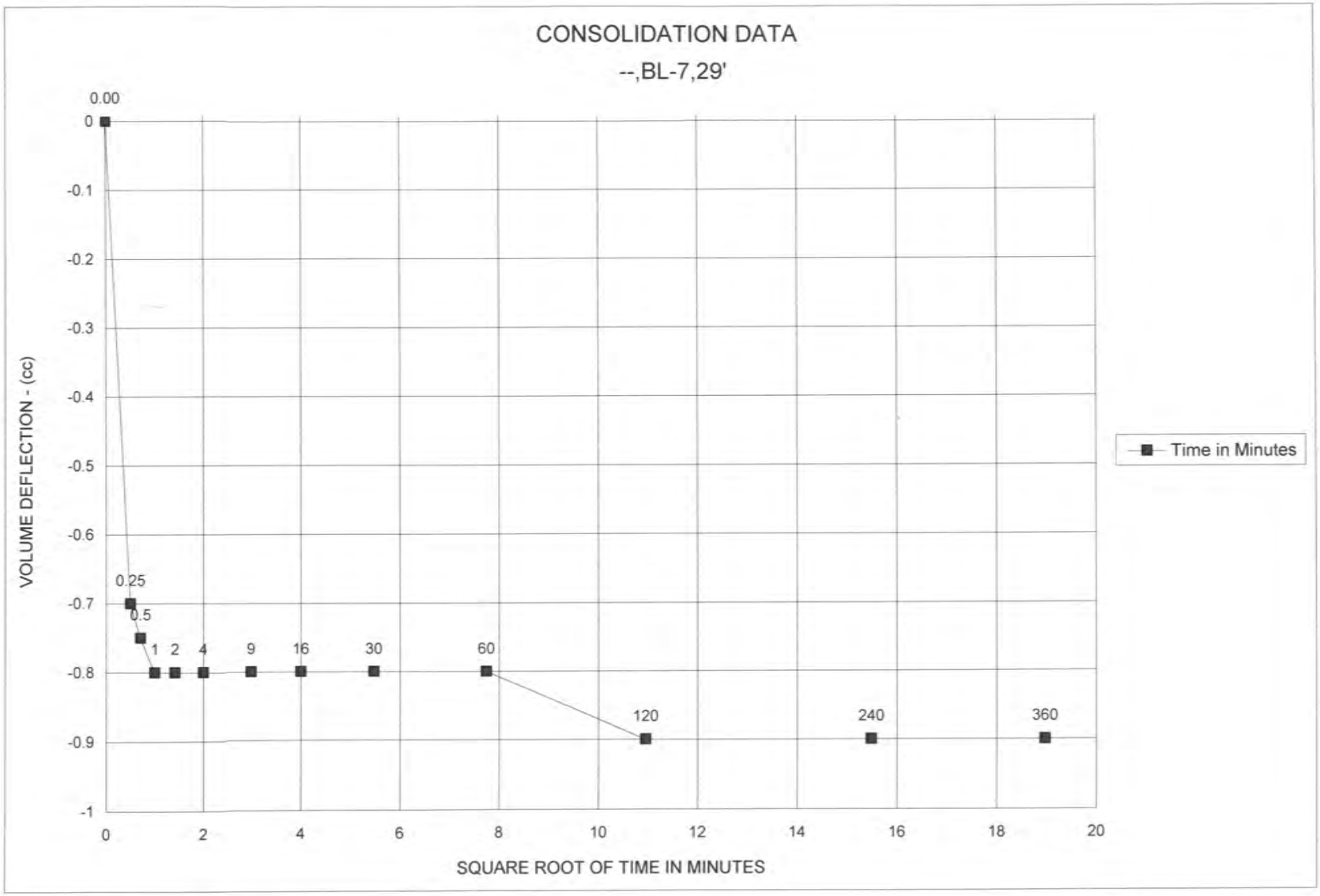
Initial Height - (in)	3.193	Init. Vol. - (cc)	367.21
Height Change - (in)	0.000	Vol. Change - (cc)	28.10
Ht. After Cons. - (in)	3.193	Cell Exp. - (cc)	23.97
Initial Area - (sq in)	7.017	Net Change - (cc)	4.13
Area After Cons. - sq in	6.938	Cons. Vol. - (cc)	363.08

ATT
ADVANCED TERRA TESTING

PERMEABILITY TEST - BACK PRESSURE SATURATED - FLOW PUMP METHOD

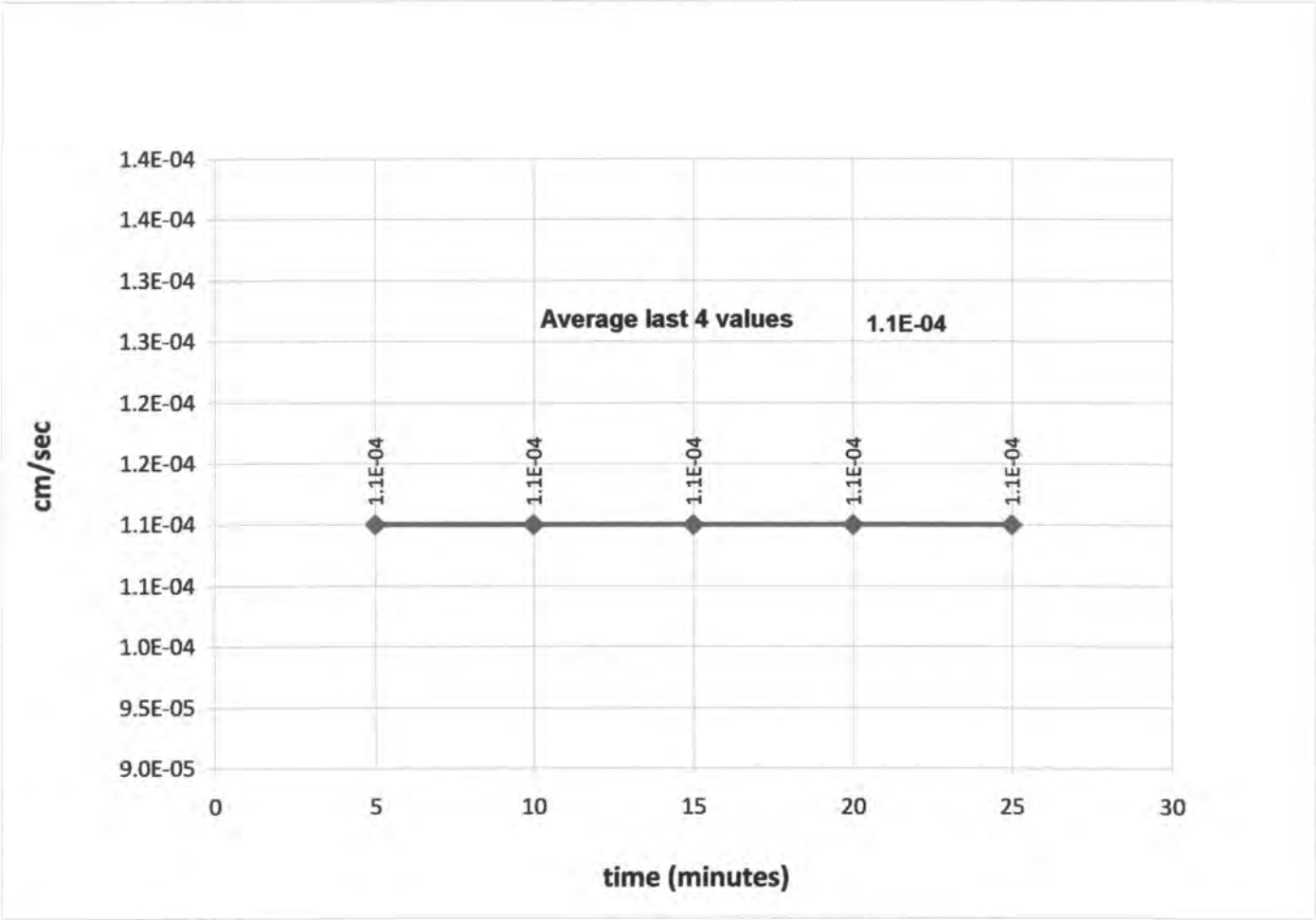
ASTM D5084 Method D

CLIENT	Walter Enviromental		JOB NO.	2941-1



Preliminary Flow Pump Test Data
ASTM D5084

Client:	Walter Enviromental	Boring Number:	--		
Job Number:	2941-1	Depth:	29'		
Project:	--	Sample Number:	BL-7		
Location:	--	Sampled Date:	--	Sampled By:	--
Project Number:	--	Test Date:	10/30/2015	Technician:	CAL



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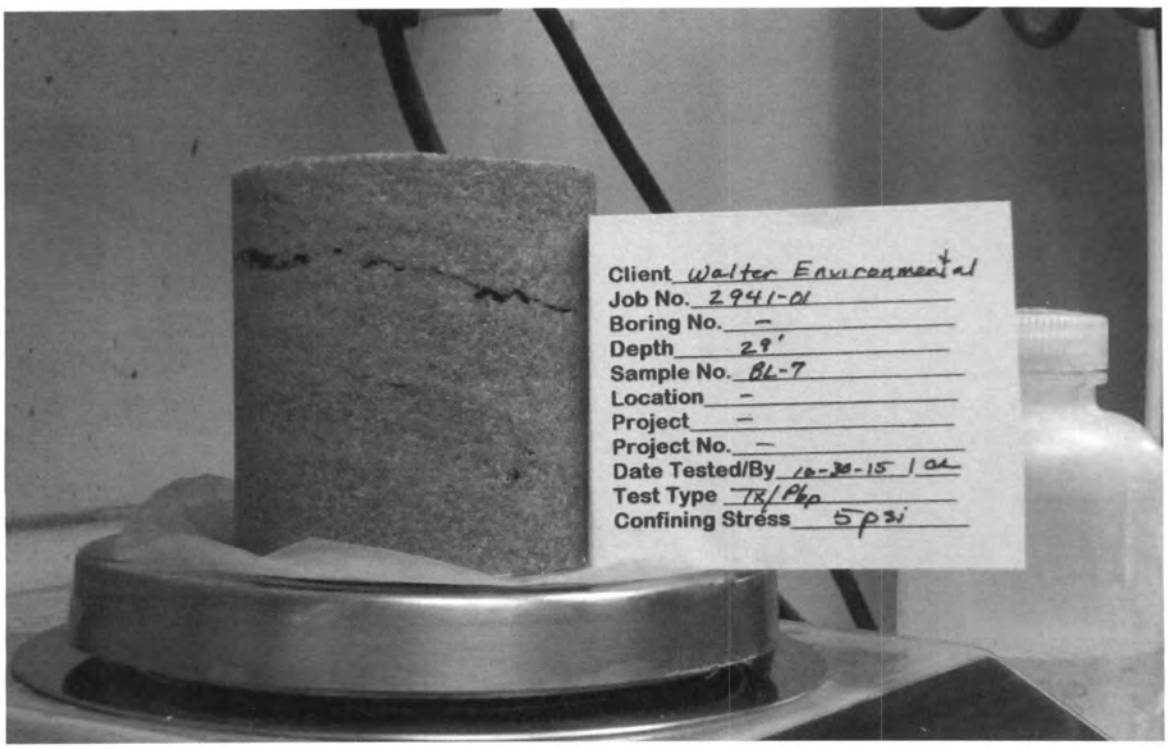
Date: 10/30/2015
File Name: 2941_1_PrelimPerm_ASTMD-5084-methodD-R1_4.xls

Checked By: NN
Date: 11/2/15



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PERMEABILITY TEST - BACK PRESSURE SATURATED - FLOW PUMP METHOD

ASTM D5084 Method D

CLIENT	Walter Enviromental	JOB NO.	2941-1

PROJECT	--			
PROJECT NO.	--	SAMPLED	--	By: --
BORING NO.	--	TEST STARTED	10/14/2015	By: CAL
DEPTH	43'	TEST FINISHED	10/20/2015	By: CAL
SAMPLE NO.	WD-1	CELL NUMBER	27S	
LOCATION	--	PERMEANT	Tap Water	
SAMPLE TYPE	Rock Core	CONF. PRES. - (psf)	720	

MOISTURE / DENSITY DATA	BEFORE TEST	AFTER TEST
Wt. Soil + Moisture - (g)	1111.57	1119.84
Wt. Wet Soil & Pan - (g)	1125.91	1134.18
Wt. Dry Soil & Pan - (g)	1110.50	1110.50
Wt. Lost Moisture - (g)	15.41	23.68
Wt. of Pan Only - (g)	14.34	14.34
Wt. of Dry Soil - (g)	1096.16	1096.16
Moisture Content - (%)	1.4	2.2
Wet Density - (pcf)	160.5	162.4
Dry Density - (pcf)	158.3	158.9
Init. Diameter - (in)	2.995	
Init. Area - (sq in)	7.045	
Init. Height - (in)	3.745	
Vol. Bef. Consol. - (cu ft)	0.01527	
Vol. After Consol. - (cu ft)	0.01521	
Porosity - (%)	5.50	

FLOW PUMP CALCULATIONS	
Pump Setting (gear number)	9
Percentage of Pump Setting	100
Q - (cc/s)	2.28E-04
Height - (in)	3.745
Diameter - (in)	2.989
Pressure - (psi)	0.205
Area after consol. - (sq cm)	45.267
Gradient	1.515
Permeability k - (cm/s)	3.3E-06
Permeability k - (m/s)	3.3E-08
Back Pressure - (psi)	38.0
Cell Pressure - (psi)	43.0
Ave. Effective Stress - (psi)	4.898
Average temperature degree - (c°)	22.6

Data entry by:	NN	Date:	10/21/2015
Checked by:	Cu	Date:	10/22/15

PERMEABILITY TEST - BACK PRESSURE SATURATED - FLOW PUMP METHOD

ASTM D5084 Method D

CLIENT	Walter Enviromental	JOB NO.	2941-1

PROJECT	--			
PROJECT NO.	--	SAMPLED	--	By: --
BORING NO.	--	TEST STARTED	10/14/2015	By: CAL
DEPTH	43'	TEST FINISHED	10/20/2015	By: CAL
SAMPLE NO.	WD-1	CELL NUMBER	27S	
LOCATION	--	PERMEANT	Tap Water	
SAMPLE TYPE	Rock Core	CONF. PRES. - (psf)	720	

SATURATION DATA

Cell Press.	Back Press.	Burette Reading (cc)		Pore Press. (psi)			
(psi)	(psi)	Close	Open	Close	Open	Change	B
40.0	38.0	2.8	12.0				
50.0	48.0	15.6	16.3	37.7	47.3	9.6	0.96

CONSOLIDATION DATA

Elapsed Time (Min)	SQRT Time (Min)	Burette Reading (cc)	Volume Defl. (cc)
0.00	0.00	16.30	0.00
0.25	0.50	16.95	-0.65
0.5	0.71	17.00	-0.70
1	1.00	17.00	-0.70
2	1.41	17.00	-0.70
4	2.00	17.00	-0.70
9	3.00	17.10	-0.80
16	4.00	17.10	-0.80
30	5.48	17.15	-0.85
60	7.75	17.25	-0.95
120	10.95	17.30	-1.00
240	15.49	17.50	-1.20
360	18.97	17.60	-1.30

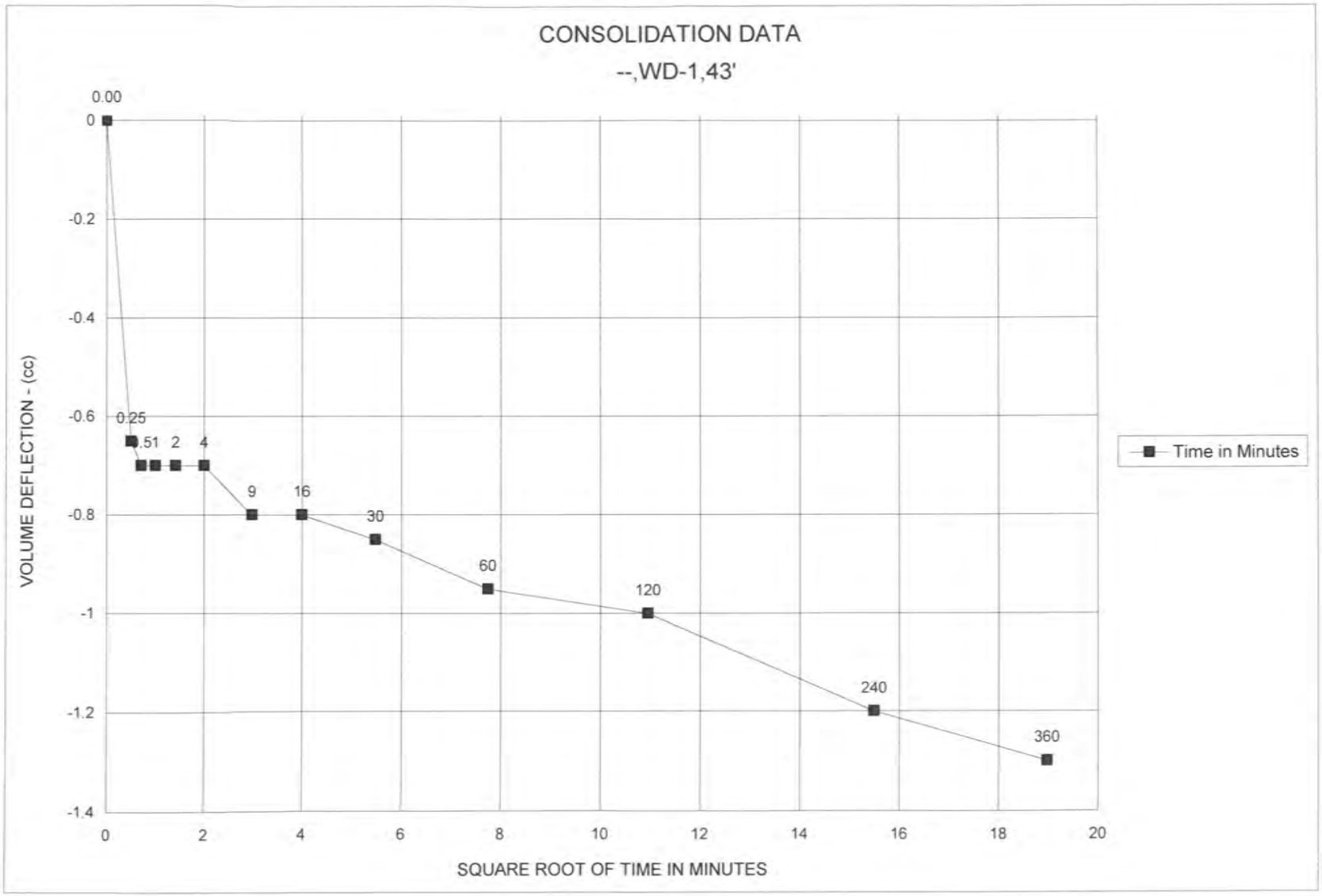
Initial Height - (in)	3.745	Init. Vol. - (cc)	432.43
Height Change - (in)	0.000	Vol. Change - (cc)	17.20
Ht. After Cons. - (in)	3.745	Cell Exp. - (cc)	15.44
Initial Area - (sq in)	7.045	Net Change - (cc)	1.76
Area After Cons. - sq in	7.016	Cons. Vol. - (cc)	430.67

ATT
ADVANCED TERRA TESTING

PERMEABILITY TEST - BACK PRESSURE SATURATED - FLOW PUMP METHOD

ASTM D5084 Method D

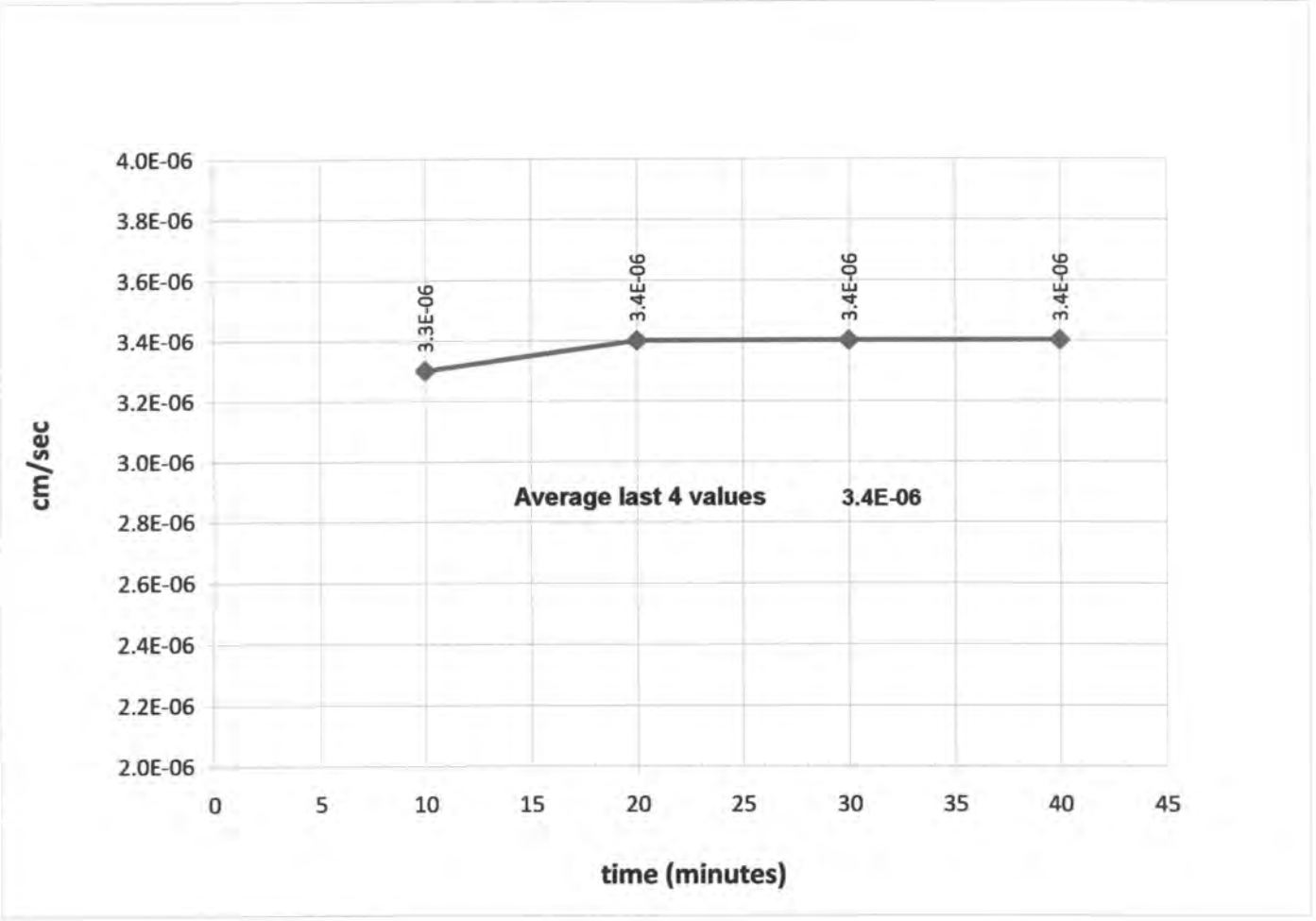
CLIENT	Walter Enviromental		JOB NO.	2941-1



FileName: 2941_1_HarvardFlowPump-Perm-ASTMD-5084-R3_1.xls

Preliminary Flow Pump Test Data
ASTM D5084

Client:	Walter Enviromental	Boring Number:	--		
Job Number:	2941-1	Depth:	42'		
Project:	--	Sample Number:	WD-1		
Location:	--	Sampled Date:	--	Sampled By:	--
Project Number:	--	Test Date:	10/20/2015	Technician:	CAL



Data Entered By:	CAL		
Date:	10/20/2015	Checked By:	NN
File Name:	2941_1_PrelimPerm_ASTMD-5084-methodD-R1_0.xls	Date:	10/21/15

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PERMEABILITY TEST - BACK PRESSURE SATURATED - FLOW PUMP METHOD

ASTM D5084 Method D

CLIENT	Walter Enviromental	JOB NO.	2941-1

PROJECT	--			
PROJECT NO.	--	SAMPLED	--	By: --
BORING NO.	--	TEST STARTED	10/14/2015	By: CAL
DEPTH	39'	TEST FINISHED	10/20/2015	By: CAL
SAMPLE NO.	WD-2	CELL NUMBER	26S	
LOCATION	--	PERMEANT	Tap Water	
SAMPLE TYPE	Rock Core	CONF. PRES. - (psf)	720	

MOISTURE / DENSITY DATA	BEFORE TEST	AFTER TEST
Wt. Soil + Moisture - (g)	969.31	984.68
Wt. Wet Soil & Pan - (g)	983.53	998.90
Wt. Dry Soil & Pan - (g)	962.03	962.03
Wt. Lost Moisture - (g)	21.50	36.87
Wt. of Pan Only - (g)	14.22	14.22
Wt. of Dry Soil - (g)	947.81	947.81
Moisture Content - (%)	2.3	3.9
Wet Density - (pcf)	149.3	153.9
Dry Density - (pcf)	146.0	148.1
Init. Diameter - (in)	3.002	
Init. Area - (sq in)	7.078	
Init. Height - (in)	3.494	
Vol. Bef. Consol. - (cu ft)	0.01431	
Vol. After Consol. - (cu ft)	0.01411	
Porosity - (%)	9.23	

FLOW PUMP CALCULATIONS	
Pump Setting (gear number)	10
Percentage of Pump Setting	100
Q - (cc/s)	1.15E-04
Height - (in)	3.494
Diameter - (in)	2.981
Pressure - (psi)	0.587
Area after consol. - (sq cm)	45.016
Gradient	4.650
Permeability k - (cm/s)	5.5E-07
Permeability k - (m/s)	5.5E-09
Back Pressure - (psi)	38.0
Cell Pressure - (psi)	43.0
Ave. Effective Stress - (psi)	4.707
Average temperature degree - (c°)	22.8

Data entry by:	NN	Date:	10/21/2015
Checked by:	cm	Date:	10/22/15

PERMEABILITY TEST - BACK PRESSURE SATURATED - FLOW PUMP METHOD

ASTM D5084 Method D

CLIENT	Walter Enviromental	JOB NO.	2941-1

PROJECT	--			
PROJECT NO.	--	SAMPLED	--	By: --
BORING NO.	--	TEST STARTED	10/14/2015	By: CAL
DEPTH	39'	TEST FINISHED	10/20/2015	By: CAL
SAMPLE NO.	WD-2	CELL NUMBER	26S	
LOCATION	--	PERMEANT	Tap Water	
SAMPLE TYPE	Rock Core	CONF. PRES. - (psf)	720	

SATURATION DATA

Cell Press.	Back Press.	Burette Reading (cc)		Pore Press. (psi)			
(psi)	(psi)	Close	Open	Close	Open	Change	B
40.0	38.0	2.8	14.8				
50.0		21.6	21.8	38.1	47.9	9.8	0.98

CONSOLIDATION DATA

Elapsed Time (Min)	SQRT Time (Min)	Burette Reading (cc)	Volume Defl. (cc)
0.00	0.00	21.80	0.00
0.25	0.50	22.60	-0.80
0.5	0.71	22.60	-0.80
1	1.00	22.60	-0.80
2	1.41	22.65	-0.85
4	2.00	22.70	-0.90
9	3.00	22.70	-0.90
16	4.00	22.75	-0.95
30	5.48	22.75	-0.95
60	7.75	22.80	-1.00
120	10.95	22.85	-1.05
240	15.49	22.90	-1.10
360	18.97	23.00	-1.20

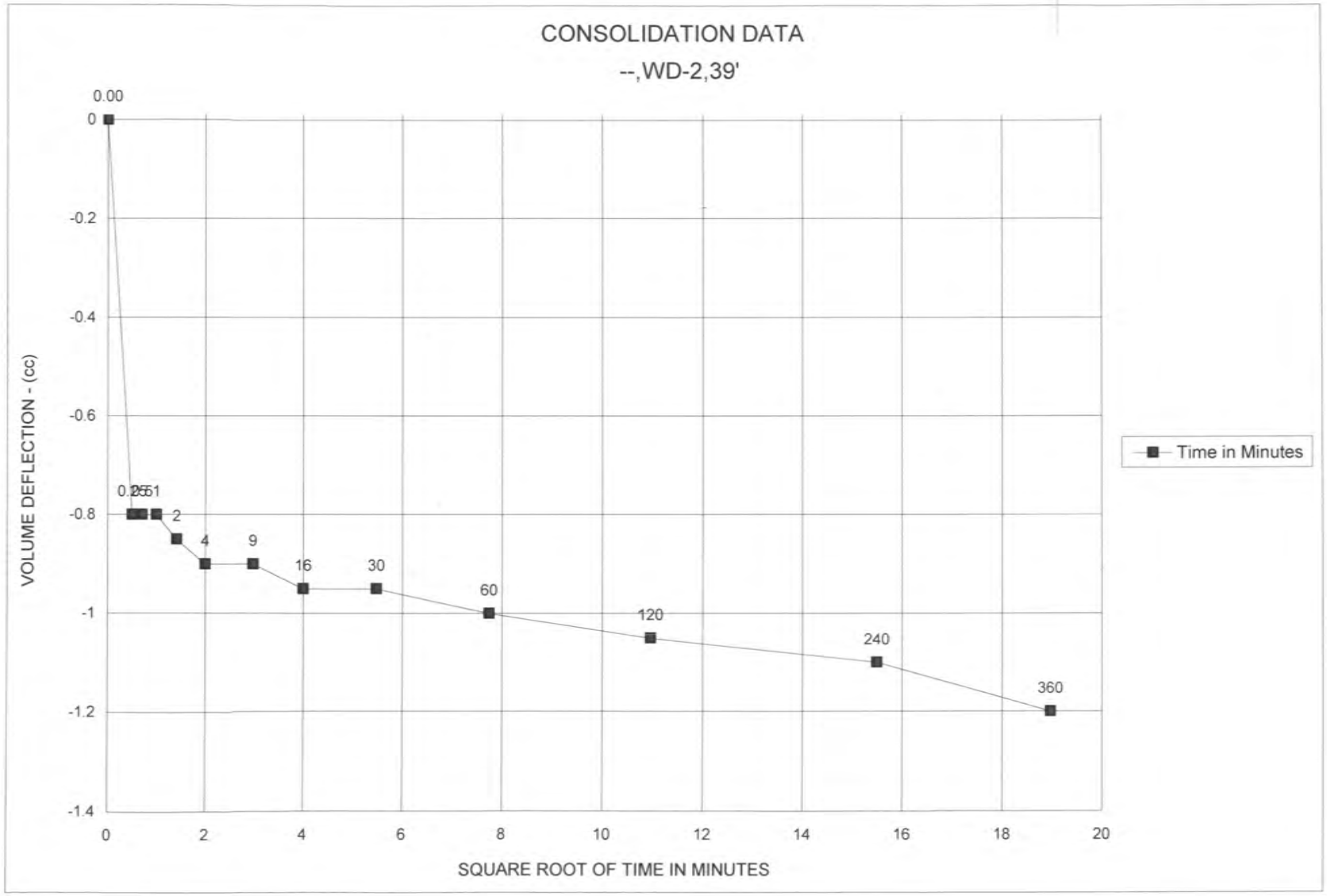
Initial Height - (in)	3.494	Init. Vol. - (cc)	405.33
Height Change - (in)	0.000	Vol. Change - (cc)	20.90
Ht. After Cons. - (in)	3.494	Cell Exp. - (cc)	15.14
Initial Area - (sq in)	7.078	Net Change - (cc)	5.76
Area After Cons. - sq in	6.977	Cons. Vol. - (cc)	399.57

ATT
ADVANCED TERRA TESTING

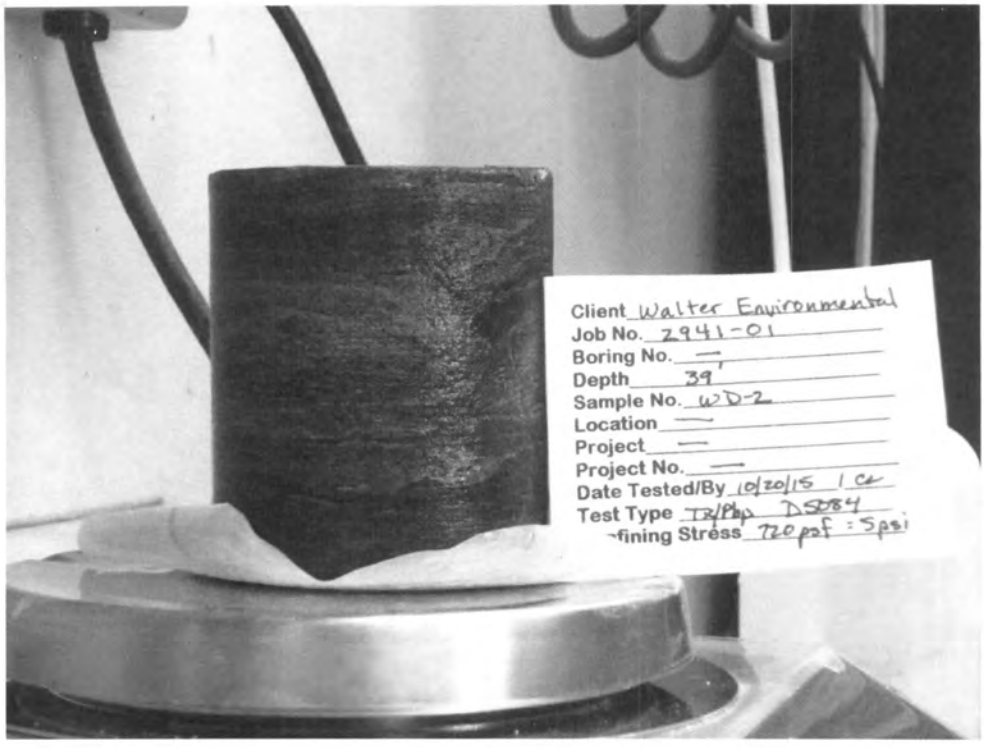
PERMEABILITY TEST - BACK PRESSURE SATURATED - FLOW PUMP METHOD

ASTM D5084 Method D

CLIENT	Walter Enviromental		JOB NO.	2941-1



FileName: 2941_1_HarvardFlowPump-Perm-ASTMD-5084-R3_0.xls



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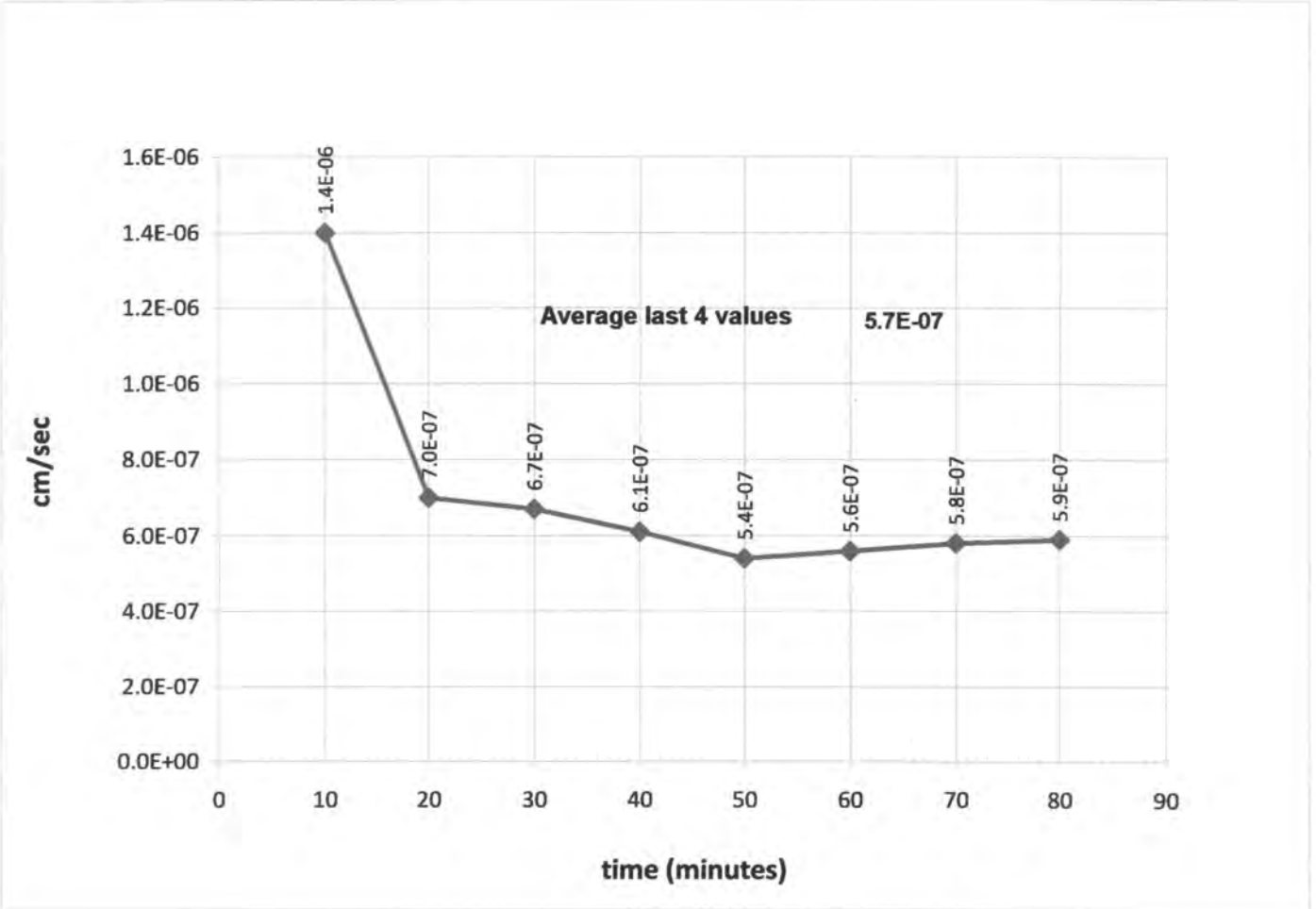
Preliminary Flow Pump Test Data
ASTM D5084

Client:	Walter Enviromental	Boring Number:	--		
Job Number:	2941-1	Depth:	39'		
Project:	--	Sample Number:	WD-2		
Location:	--	Sampled Date:	--	Sampled By:	--
Project Number:	--	Test Date:	10/20/2015	Technician:	CAL



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Date: 10/20/2015
File Name: 2941_1_PrelimPerm_ASTMD-5084-methodD-R1_1.xls

Checked By: NN
Date: 10/21/15

PERMEABILITY TEST - BACK PRESSURE SATURATED - FLOW PUMP METHOD

ASTM D5084 Method D

CLIENT	Walter Enviromental	JOB NO.	2941-1

PROJECT	--			
PROJECT NO.	--	SAMPLED	--	By: --
BORING NO.	--	TEST STARTED	10/16/2015	
DEPTH	41'	TEST FINISHED	10/27/2015	By: CAL
SAMPLE NO.	BL-9	CELL NUMBER	6P	
LOCATION	--	PERMEANT	Tap Water	
SOIL DESC	Rock Core	CONF. PRES. - (psf)	720	

MOISTURE / DENSITY DATA	BEFORE TEST	AFTER TEST
Wt. Soil + Moisture - (g)	1045.16	1083.95
Wt. Wet Soil & Pan - (g)	1060.80	1099.59
Wt. Dry Soil & Pan - (g)	1042.21	1042.21
Wt. Lost Moisture - (g)	18.59	57.38
Wt. of Pan Only - (g)	15.64	15.64
Wt. of Dry Soil - (g)	1026.57	1026.57
Moisture Content - (%)	1.8	5.6
Wet Density - (pcf)	155.1	155.3
Dry Density - (pcf)	152.3	147.1
Init. Diameter - (in)	2.988	
Init. Area - (sq in)	7.012	
Init. Height - (in)	3.661	
Vol. Bef. Consol. - (cu ft)	0.01486	
Vol. After Consol. - (cu ft)	0.01539	
Porosity - (%)	13.17	

FLOW PUMP CALCULATIONS	
Pump Setting	59
Velocity - (cm/sec)	3.90E-04
Q - (cc/s)	1.25E-05
Height - (in)	3.657
Diameter - (in)	3.043
Pressure - (psi)	0.554
Area after consol. - (cm*cm)	46.913
Gradient	4.193
Permeability k - (cm/s)	6.3E-08
Permeability k - (m/s)	6.3E-10
Back Pressure - (psi)	78.0
Cell Pressure - (psi)	83.0
Ave. Effective Stress - (psi)	4.723
Average temperature degree - (c°)	22.0

Data entry by: CAL	Date: 10/29/2015
Checked by: DPM	Date: 10/29/15

FileName: 2941_1_OrganonFlowPumpPerm-ASTMD-5084-R4_0.xls

PERMEABILITY TEST - BACK PRESSURE SATURATED - FLOW PUMP METHOD

ASTM D5084 Method D

CLIENT	Walter Enviromental		JOB NO. 2941-1

PROJECT	--			
PROJECT NO.	--	SAMPLED	--	By: --
BORING NO.	--	TEST STARTED	10/16/2015	
DEPTH	41'	TEST FINISHED	10/27/2015	By: CAL
SAMPLE NO.	BL-9	CELL NUMBER	6P	
LOCATION	--	PERMEANT	Tap Water	
SOIL DESC	Rock Core	CONF. PRES. - (psf)	720	

SATURATION DATA

Cell Pres. (psi)	Back Pres. (psi)	Burette Reading (cc)		Pore Pressure (psi)			
		Close	Open	Close	Open	Change	B
40.0	38.0	3.1	12.4				
50.0	48.0	-1.7	-0.8	37.4	45.5	8.1	0.81
60.0	58.0	-0.9	0.1	48.4	57.6	9.2	0.92
70.0	68.0	0.3	1.0	58.3	67.6	9.3	0.93
80.0	78.0	1.1	1.7	68.3	77.7	9.4	0.94
90.0		1.8	1.9	78.3	87.8	9.5	0.95

CONSOLIDATION DATA

Elapsed Time (Min)	SQRT Time (Min)	Burette Reading (cc)	Volume Defl. (cc)
0.00	0.00	5.90	0.00
0.25	0.50	6.30	-0.40
0.5	0.71	6.30	-0.40
1	1.00	6.40	-0.50
2	1.41	6.40	-0.50
4	2.00	6.45	-0.55
9	3.00	6.50	-0.60
16	4.00	6.50	-0.60
30	5.48	6.55	-0.65
60	7.75	6.60	-0.70
120	10.95	6.60	-0.70
240	15.49	6.60	-0.70
360	18.97	6.60	-0.70

Initial Height - (in)	3.661	Init. Vol. - (cc)	420.76
Height Change - (in)	0.004	Vol. Change - (cc)	-0.20
Ht. After Cons. - (in)	3.657	Cell Exp. - (cc)	14.89
Initial Area - (sq in)	7.012	Net Change - (cc)	-15.09
Area After Cons. - (sq in	7.272	Cons. Vol. - (cc)	435.84

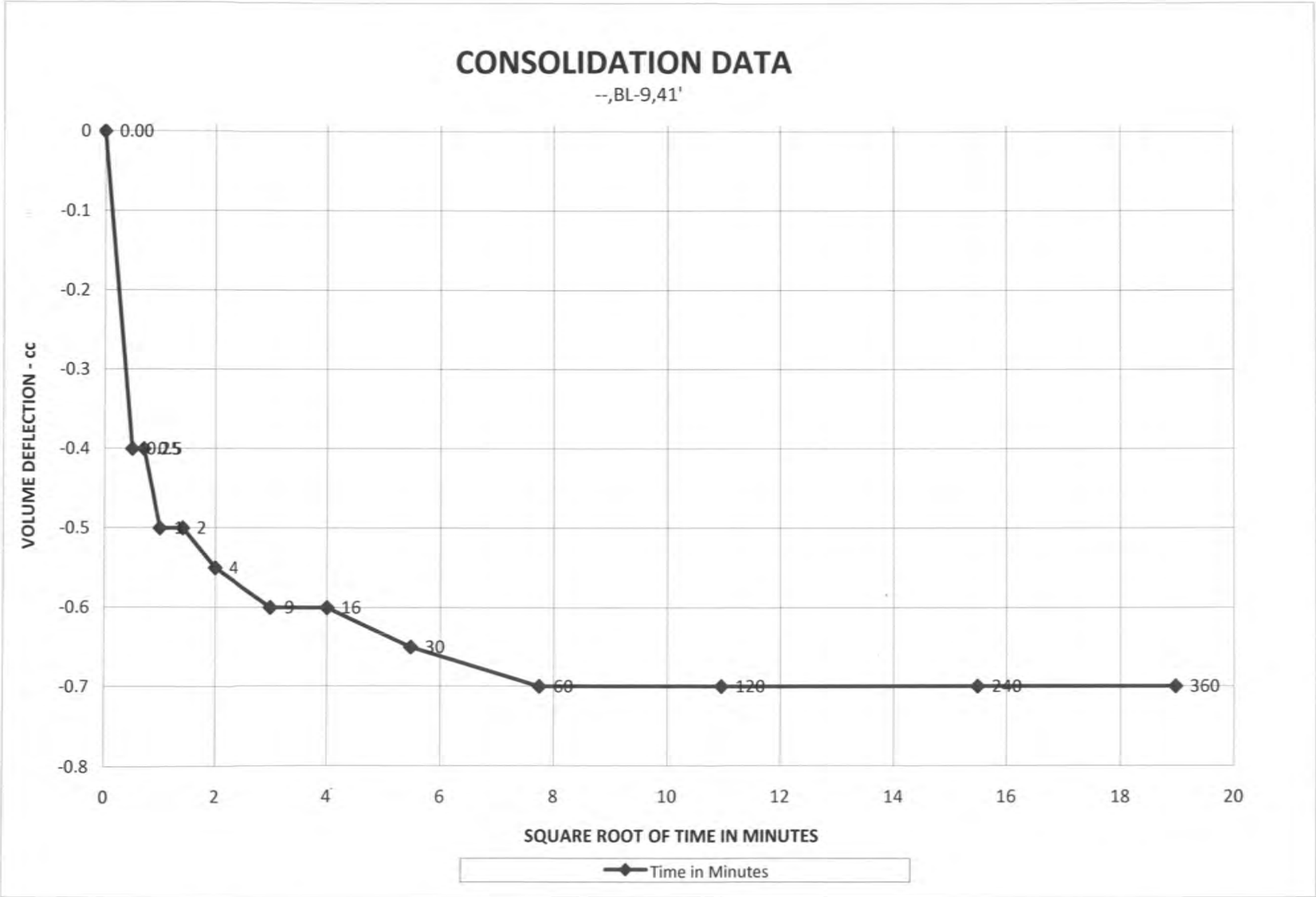
FileName: 2941_1_OrganonFlowPumpPerm-ASTMD-5084-R4_0.xls

ATT
ADVANCED TERRA TESTING

PERMEABILITY TEST - BACK PRESSURE SATURATED - FLOW PUMP METHOD

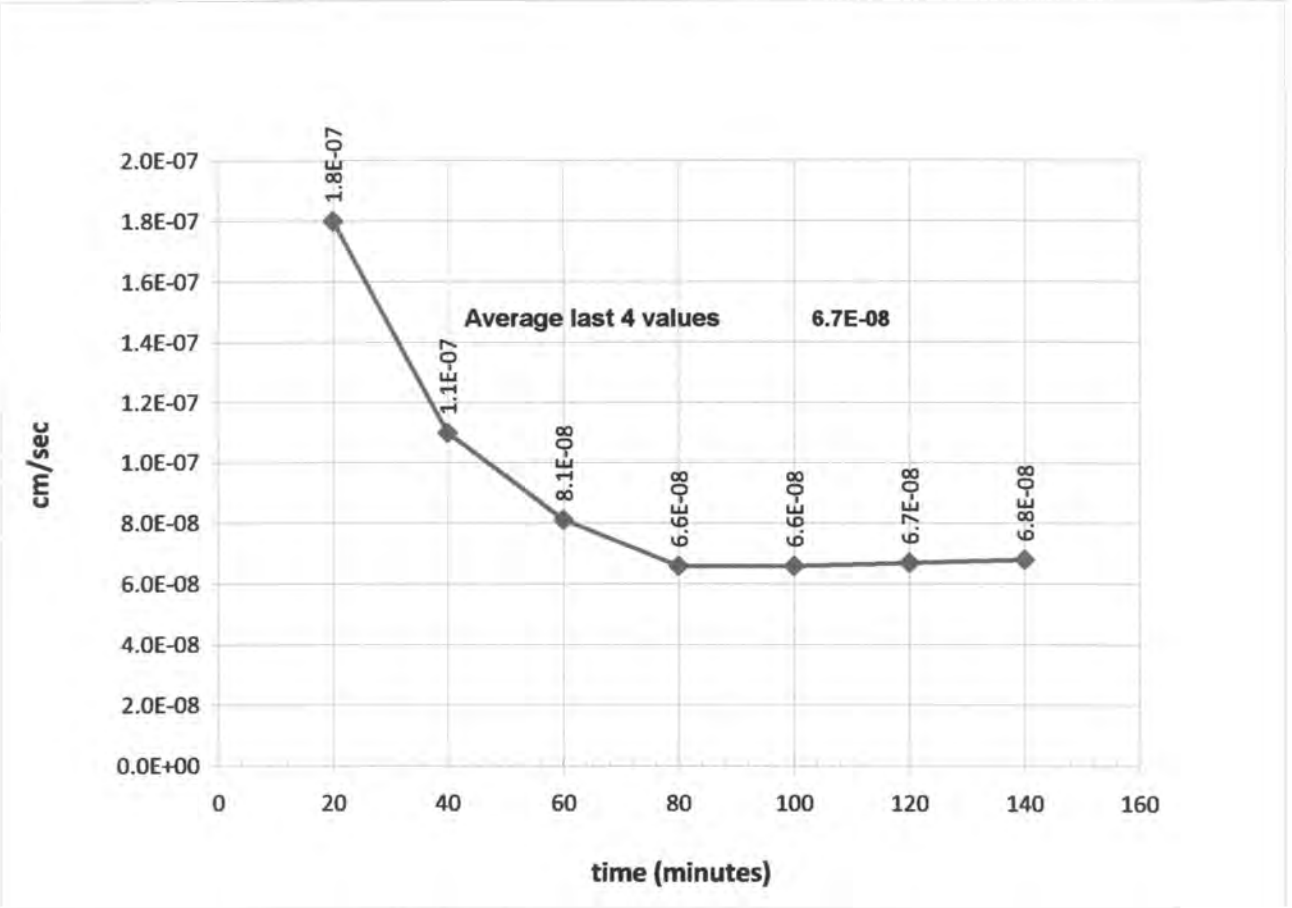
ASTM D5084 Method D

CLIENT	Walter Enviromental		JOB NO.	2941-1



Preliminary Flow Pump Test Data
ASTM D5084 Method D

Client:	Walter Enviromental	Boring Number:	--		
Job Number:	2941-1	Depth:	41'		
Project:	--	Sample Number:	BL-9		
Location:	--	Sampled Date:	--	Sampled By:	--
Project Number:	--	Test Date:	10/27/2015	Technician:	CAL



Data Entered By:	CAL
Date:	10/27/2015
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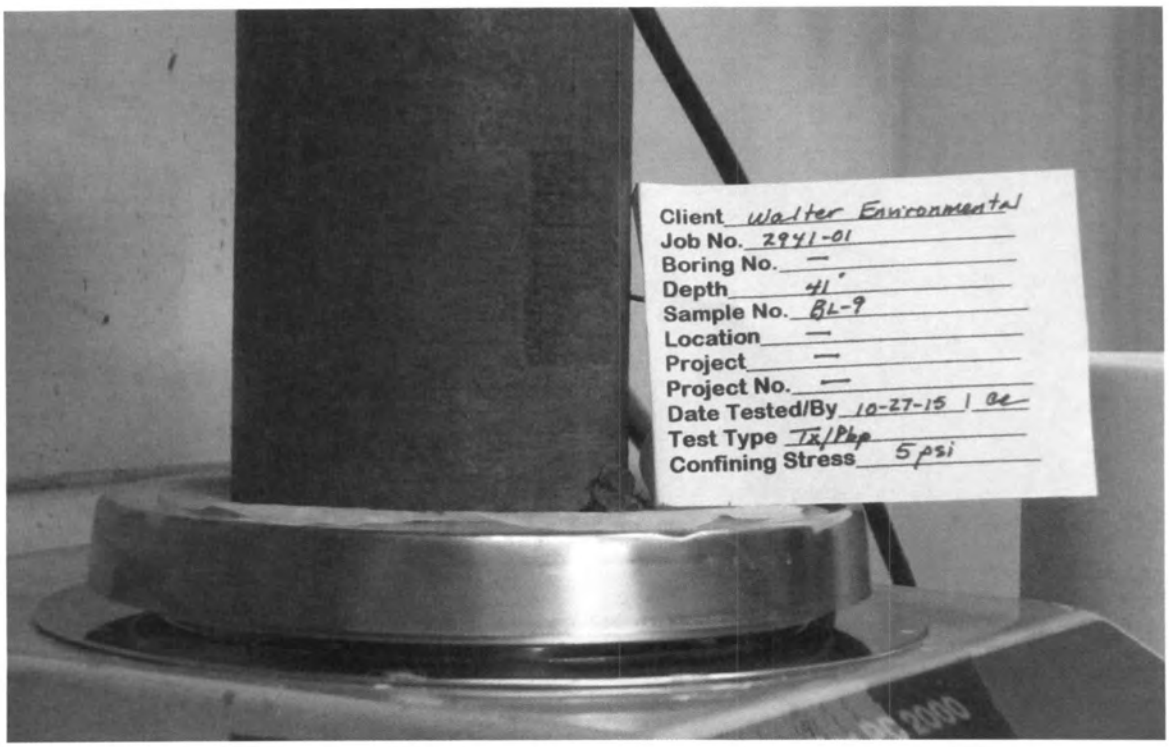
Checked By: NN
Date: 10/28/15



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APPENDIX 12

QUALITY ASSURANCE AND

QUALITY CONTROL PLAN

Appendix 12
Quality Assurance and Quality Control Plan

In accordance with Section 3.3.3 of the Regulations, quality assurance and quality control reports shall be developed and implemented for all engineered structures at the landfill. QA/QC is divided into manufacturing quality assurance (MQA), manufacturing quality control (MQC), construction quality assurance (CQA) and construction quality control (CQC). See Appendix 13 for the QA/QC plan for the clay barrier layer.

An independent Colorado registered professional engineer (Engineer) will oversee and supervise QA/QC activities. The Engineer will provide overall coordination of documentation submitted in support of this plan.

A soils laboratory will be required for the QA/QC plan. The soils laboratory is an independent qualified laboratory hired by the Landfill to perform laboratory QA/QC soils tests.

Section 1.0 Survey

Surveys will be performed by professional survey registered in the State of Colorado. Horizontal and vertical survey accuracies should be a maximum 0.1-foot and a maximum 0.01-foot, respectively.

The Surveyor will use stacked points located vertically above the corresponding subgrade, surface, top of soil liner, top of soil drainage layer and top of protective layer to facilitate layer thickness determinations at a maximum 50-foot grid spacing and at maximum 50-foot intervals along grade break lines (e.g., at top and toe of side slopes) and along leachate collector drain lines.

Leachate collection sumps and grade breaks should be surveyed at intervals sufficient to give a clear three-dimensional presentation of the configuration of sump and its layer component thicknesses.

Section 2 Geosynthetic Clay Liner (GCL)

The GCL liner is tested in the factory (MQA) to confirm quality assurance. The following tests are factory performed.

Test	Test Method	CQA Frequency	Required Values
Swell Index	ASTM D5890	1 per 100,000 SF	24mL/2g min.
Fluid Loss	ASTM D5891	1 per 100,000 SF	18mL/2g min.
Peel Strength	ASTM D6496	1 per 100,000 SF	3.5 lb/in min.
Grab Strength/Elongation	ASTM D6768	1 per 100,000 SF	30 lb/in min.
Bentonite Mass/Unit Area (MARV)	ASTM D5993	1 per 100,000 SF	0.75 lb/SF min.
Permeability/Flux, max	ASTM D5887	1 per 100,000 SF	$5X10^{-9}$ m^3/m^2/sec max.

Subgrade

Upon completion of excavation to establish subgrade, a survey will be performed to document the barrier layer subgrade slope and elevation. The survey will determine elevations at a maximum 50-foot grid spacing.

Placement/Panel Layout

Subgrade soils should range between fines and 1 inch (25 mm). The subgrade surface must be smooth and free of vegetation, sharp-edged rocks, stones, sticks, construction debris, and other foreign matter that could contact the GCL. To facilitate positive drainage towards the leachate collection system, the subgrade should be smooth and free of undulations. The subgrade should be rolled with a smooth-drum compactor if necessary to remove any wheel ruts greater than 1 inch in depth, footprints, or other abrupt grade changes. Furthermore, all protrusions extending more than 0.5 inch (12 mm) from the subgrade surface shall be removed, crushed, or pushed into the surface with a smooth-drum compactor. The GCL may be installed on a frozen subgrade, but the subgrade soil in the unfrozen state should meet the above requirements. The subgrade shall be reworked as necessary to overcome the effects of adverse weather or other undesirable conditions

Prior to GCL liner installation the subgrade will be inspected to assure there is nothing in the subgrade that would be detrimental to the liner.

The GCL should be placed so that seams are parallel to the direction of the slope. End-of-panel seams should also be located at least 3 ft (1 m) from the toe and crest of slopes steeper than 4H:1V. End-of-roll seams on slopes should be used only if the liner is not expected to be in tension. All GCL panels should lie flat, with no wrinkles or folds, especially at the exposed edges of the panels. The GCL

should not be installed in standing water or during rainy weather. Only as much GCL shall be deployed as can be covered at the end of the working day with soil, geomembrane, or a temporary waterproof tarpaulin. The GCL shall not be left uncovered overnight.

The end of the GCL rolls shall be placed in an anchor trench at the top of a slope. The front edge of the trench will be rounded to eliminate any sharp corners that could cause excessive stress on the GCL. Loose soil should be removed or compacted into the floor of the trench.

GCL seams are constructed by overlapping adjacent panel edges and ends. Care must be taken to ensure that the overlap zone is not contaminated with loose soil or other debris. BENTOMAT 200R, BENTOMAT ST, BENTOMAT DN, and BENTOMAT SDN have SUPERGROOVE® which provides self-seaming capabilities in their longitudinal overlaps, and therefore do not require supplemental bentonite. Longitudinal seams should be overlapped a minimum of 6 inches.

End-of-panel overlapped seams are constructed such that they are shingled in the direction of the grade to prevent runoff from entering the overlap zone. End-of-panel seams on slopes are permissible, provided adequate slope stability analysis has been conducted (i.e., the GCL is not expected to be in tension). Bentonite-enhanced seams are required for all BENTOMAT end-of-panel overlapped seams. BENTOMAT end-of-panel, bentonite-enhanced, overlapped seams are constructed first by overlapping the adjacent panels, exposing the underlying panel, and then applying a continuous bead or fillet of granular sodium bentonite 12” from the edge of the underlying panel. The minimum application rate at which the bentonite is applied is one-quarter pound per linear foot (0.4 kg/m).

The GCL will be sealed around pipe penetrations in accordance with manufactures recommendations. Granular bentonite shall be used liberally (approximately 0.25 lbs/ln. ft.) to seal the GCL to these pipe penetrations. See drawing LF-07 for details.

Twelve inches of soil shall be placed over the GCL at the end of each day. The soil must be free of vegetation, sharp-edged rocks, stones, sticks, construction debris, or other foreign matter that could contact the GCL. To verify the soil thickness the Surveyor will use stacked points located vertically above the corresponding subgrade surface.

The Engineer will prepare and submit to the Division a Certification Report to document the installation of the GCL liner. The report will include but not be limited to the following:

- Statement by Registered Professional Engineer discussing conformance of GCL liner installation with the *QA/QC* plan.
- Discussion of construction materials and methods.
- Identify deviations from the approved design if any.
- Pictures documenting the condition of the subgrade.
- Daily pictures of the GCL as it is being placed.
- Pictures of all pipe penetrations.
- Pictures of the anchor trench.
- Results of the survey to confirm soil depth.
- Location and elevation of any leachate line or burrito drain
- Engineer certified as-built drawing of the cell ready to accept waste

No cell will accept waste until after approval of the Certification report by the Division .

Section 3 Burrito Drain

The burrito drain installed along the northwest edge of each line of cells and other appropriate areas will be constructed with 3/4" to 1.5" washed or screened rock wrapped in a geotextile fabric. The washed or screen rock will be placed in the burrito drain at the quantity of 3 cubic foot per foot of length. The geotextile fabric will be CONTECH® C-40NW which is a polypropylene, staple fiber, needle punched nonwoven geotextile. The fibers are needled to form a stable network that retains dimensional stability relative to each other. The geotextile is resistant to ultraviolet degradation and to biological and chemical environments normally found in soils. CONTECH C-40NW conforms to the property values listed below which have been derived from manufacturer quality control testing.

		MARV
PROPERTY	**TEST METHOD**	***English***
Grab Tensile Strength	ASTM D-4632	120 lbs
Grab Elongation	ASTM D-4632	50 %
Trapezoidal Tear	ASTM D-4533	50 lbs
CBR Puncture Resistance	ASTM D-6241	310 lbs
Apparent Opening Size (AOS)[3]	ASTM D-4751	70 US Std. Sieve
Permittivity	ASTM D-4491	1.7 Sec^{-1}
Water Flow Rate	ASTM D-4491	140 gpm/ft^2
UV Resistance (% Retained at 500 hrs)	ASTM D-4355	70%

The Surveyor will document the location and elevation of the Burrito Drain.

The CQA Report should include, but not be limited to, detailed information on the following:

- Photographs of the various construction components;
- Topographic survey and record drawings of the buritto drain (survey reports and record drawings must be stamped and sealed by a professional land surveyor registered in the state of Colorado);

The as-built construction certification report (CQA Report) must contain a statement by the certifying engineer that construction has been completed in accordance with the approved engineering design plans, drawings, and specifications (as modified, if applicable). The certifying engineer must be a professional engineer registered in the State of Colorado and shall properly certify the CQA Report.

Section 4 Water Balance Layer

Borrow Source Analysis

The borrow area for the water balance cover will be in the SW/4SW/4 of Section 10 and northern portions of N/W of Section 15, township 45 North, Range 15 West, N.M.PM. The primary soil type in this area is Barx-Progresso complex, 3 to 12 percent slopes. The secondary soil type in the area is Pinon-Bowdish-Rock outcrop complex 3 to 30 percent slopes. The area where the landfill is being constructed (NW/4 Section 15) is all in the Pinon-Bowdish-Rock outcrop complex 3 to 30 percent slopes. The typical soil profile of the soils are shown below. Soil types and description were obtained from the NRCS website. The source of soils information is a soil survey of the San Miguel Area, Colorado, parts of Dolores, Montrose and San Miguel Counties, Version 7, May 3, 2011.

TABLE 4.1			
Barx		Progresso	
0 to 2 inches	Fine Sandy Loam	0 to 7 inches	Loam
2 to 23 inches	Sandy Clay Loam	7 to 24 inches	Clay Loam
12 to 74 inches	Loam	23 to 36 inches	Sandy Loam
		36 to 40 inches	Bedrock

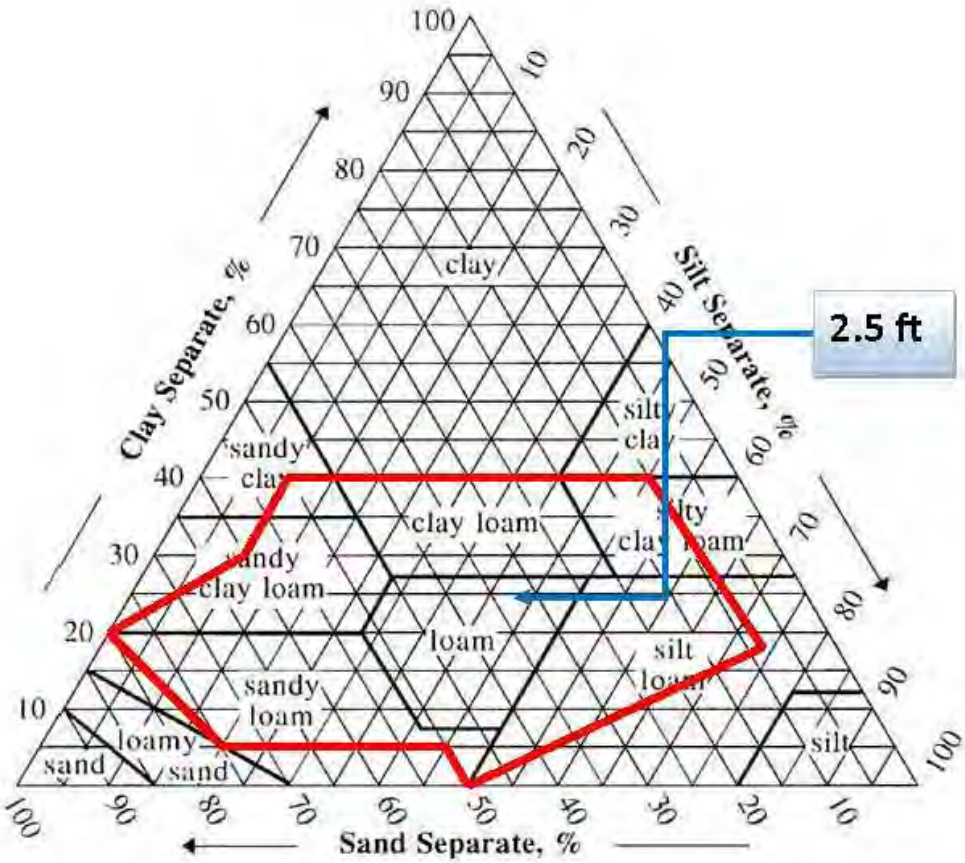
TABLE 4.2			
Pinon		Bowdish	
0 to 5 inches	Loam	0 to 5 inches	Loam
5 to 16 inches	Gravelly loam	5 to 12 inches	Loam
16 to 20 inches	Bedrock	22 to 23 inches	Gravelly loam
		33 to 27 inches	Bedrock

Most of the soil types listed above have a texture that is acceptable for a water balance cover. Additionally IGES performed two texture analysis on some soils from the landfill area. Following is the texture analyses of the two samples.

TABLE 4.3		
IGES Classification		
USDA Grain Size	Brown Sandy Clay	Black Clay with Sand
Gravel >2 mm	17.4%	12.3%
Sand <2 mm >0.053mm	33%	35%
Silt <0.053 mm > 0.002 mm	44%	51%
Clay <0.002 mm	23%	14%
USDA Textural Classification	Gravelly Loam	Silt Loam

The forgoing information shows that the soils on site and in the borrow area are suitable for a water balance layer for Ecozone 1 based on the soil triangle shown below:

Water Storage Layer Thickness For Ecozones 1, 4, and 5



Borrow Source Soil Screening Guidance

At the same time that representative soil samples from each borrow source are analyzed for the standard soil index properties in Table 4.5, an initial screening for the soil vegetative properties as summarized in Table 4.4 also should be performed. The testing described in this sub-section should be performed at the recommended frequency listed in the table for each borrow source. The testing frequency may be adjusted based on the homogeneity of the soil and the facility's previous experience with the same materials. It is important that when soils are placed in the water balance cover, suitable pH and calcium carbonate ($CaCO_3$) content should be attained throughout the entire depth of the water storage layer as opposed to just near the surface.

TABLE 4.4 Initial Screening			
Standard Soil Vegetative Property Preliminary Screening Tests for Each Borrow Source			
Property	Method	Requirement	Frequency
pH	EPA Method SW-846 SW 9045C	6.0 - 8.4	1 per 6,500 CY
$CaCO_3$	USDA Handbook Number 60	< 15% by Weight	1 per 6,500 CY

TABLE 4.5 Site Characterization			
Standard Soil Index Property tests for Each Borrow Source During Initial Site Characterization			
Property	Method	Requirement	Initial Site Characterization Frequency
Water Content	ASTM D 2216	< Optimum	As appropriate
Grain Size Analysis	ASTM D 422 (with full hydrometer)	≤ 15% retained on No. 10 Sieve 2" Max Size	As appropriate
Laboratory Compaction	ASTM D 698	≥80% ≤90% Standard Proctor	As appropriate

Subgrade Preparation

Subgrade is defined as a minimum of a 6-inch foundation layer (daily cover) or a 12-inch intermediate cover composed of earthen material. Subgrade preparation involves:

- Proof rolling subgrade and make repairs as needed to achieve stable surface
- Grade subgrade to achieve a surface consistent with the approved design contours in preparation for the water balance cover
- Roughen relatively steep side slopes > 5%

- Survey the prepared subgrade surface prior to water balance cover construction to establish a basis for the lines, grades and total soil cover thickness to be achieved during the water balance cover construction.

Cover Soil Placement

Soil used for the water storage layer of the water balance cover should meet the following requirements:

- Contain ≤ 15 percent gravel (> 2.00 millimeters, retained on the No. 10 sieve);
- Limit maximum particle size to < 2 inches in longest dimension;
- Limit maximum clod size to < 4 inches in longest dimension, with a clod defined as a soil aggregation that does not break down by hand;
- Should not contain frozen material at the time of placement; and
- Should not contain debris or deleterious materials.

Good practices to achieve placement of a minimally compacted water storage layer (and topsoil layer, as applicable) are listed below.

- Excavate the soil from previously approved borrow sources.
- Place the water storage layer in a single lift.
- Place the soil using non-wheeled equipment to minimize over-compaction.
- Use soil that is at less than (or "dry" of) its optimum moisture content
- Spread, level and track-walk the soil using LGP equipment (ideally, a D6 LGP or D7 LGP bulldozer).
- Track-walk the soil during placement only enough to place and rough-grade the soil.
- If over-compaction occurs at locations, such as beneath haul roads, the soil might need to be ripped or disked and then re-compacted to within the appropriate growth-limiting bulk density range.
- Water balance cover soil component thickness will be determined by field measurements. In-place soil thickness field measurements will be documented under the supervision of the Construction Quality Assurance (CQA) Engineer.
- Use water sparingly (e.g., for haul road dust control).
- Perform revegetation activities while the placed soil still is "dry" of optimum moisture content.

Revegetation

Prior to seeding the soils will be tested for:

1. Salt content of soils > 2 percent can be problematic for vegetation growth;
2. High gypsum content is an indicator that vegetative growth may be inhibited;
3. Manure will not be used as an amendment.
4. pH < 6.0 and > 8.0.
5. Nitrogen content (recommended): 5 to 30 parts per million (ppm) adapted to growth in low-nitrogen conditions. Nitrate nitrogen as low as 5 ppm in

conjunction with 1.5 to 2.0 percent soil organic matter will be satisfactory for most major dryland native plants likely to be used on covers.

6. Phosphorus content: 3 to 7 ppm.
7. Potassium content (recommended): 120 ppm.
8. The conductivity of soils < 4 millisiemens (millimhos) per centimeter.

Soil amendments as necessary will be tilled into the soils.

During the first available planting season (weather dependent) after soil preparation, (September 1 to November 15), seeding of the seed mix shown below will be done using an acceptable state of the art range land drill pulled by a rubber tired farm type tractor or other suitable equipment. Broadcast seeding will be used for situations where drill seeding is not practicable or feasible.

Rangeland Seed Mix

	Seeds /SF	Seeding Rate # PLS/Acre
Indian ricegrass, Oryzopus hymenoides	8.0	2.50
Blue grama, Bouteloua gracilis	11.7	0.60
Needleandthread, Stipa comata	4.0	1.50
*Galleta (floret), Hilaria jamesii	8.8	2.40
Sand Dropseed, Sporobolus cryptandrus	6.0	0.05
**Utah Sweetvetch, Heydsarum boreale	1.0	1.00
Blue Flax, Linum lewisii	2.7	0.40
Fourwing saltbush, Atriplex canescens	0.6	0.50
Winterfat, Eurotia lanata	1.3	0.50
Totals	44.1	9.45

Seeding rate is for drill seeding - rate should be doubled for broadcast seeding.

PLS/Acre - Pounds of pure live seed per acre.

*Sideoats grama, Bouteloua curtipendula, may be substituted for Galleta depending on seed availability. Sideoats grama will be seeded at the rate of 1.6 #/acre which equates to 7.0 seeds per square foot.

**Cicer milkvetch, Astragalus cicer, Lutana may be substituted for Utah Sweetvetch depending on seed availability.

A certified weed free straw mulch will be used to provide surface protection; the application rate will be approximately 2,000 pounds/acre. The straw will be anchored by mechanical crimping or with one of the various tackifying agents available on the market. Mechanical crimping will be done perpendicular to the slope.

The amount of precipitation received during the first winter and spring after seeding will be a key to vegetation success. No irrigation of the revegetated areas will be performed.

Vegetation Monitoring

Year One: Assess the young revegetated stand using a count of seedlings of desirable species per unit area. In general, a satisfactory stand for purposes of arriving at a satisfactory vegetation cover will be represented after the first year (i.e., end of first growing season) by at least four seedlings per square foot. Two to three seedlings per square foot likely will be sufficient but the vegetation will develop more slowly. One to two seedlings per square foot should be reviewed for possible re-seeding. Areas with less than one seedling per square foot are likely to be unsatisfactory in the long run and the situation should be evaluated to determine why the response was so sparse.

Year Two and Beyond: Annually visually assess plant cover by species. Every 5 years a complete vegetation study will be performed using the transect linear intercept method outlined below method. At this point, if the appropriate live vegetation and/or percent cover have not passed the success criteria, additional measures will be implemented to achieve successful revegetation of the site.

Transect Liner Intercept Method – Plot/Quadrat locations, starting points within the plots/quadrats, and transect angles will be selected randomly prior to the inspections. Transects will be 100 feet long with a determination of cover made at 1-foot intervals. Live vegetative cover will be recorded by species, along with litter cover. This will produce 100 points of data per transect. The transects will be continued until statistical adequacy is met. Sample size will be determined statistically adequate using the Snedecor-Cochran sample adequacy formula, as shown below:

$Nmin = (t^2s^2)/(dX)^2$
Where:
Nmin = the minimum number of transects needed;
t = 1.833 (the t-table value for a two-tailed t-test [n-1] degrees of freedom at the 90 percent confidence level);
s^2 = the sample variance;
d = 0.1 (level of precision for estimate of the mean to be within 10 percent of the actual mean); and
X = the sample mean.

The perennial cover of the undisturbed surrounding area is in the order of 20%. This is based on a detailed vegetation study performed for a nearby reclaimed Hamilton Mine. The mine was located in the W/2 Section 33, T46N, R15W, NMPM about 2.5 mines northwest of the landfill. The soil type at the mine site is the same as at the landfill. The vegetation report performed by Cedar Creek Associates, Inc. in 2011 found the sagebrush vegetation reference area had perennial cover of 20.7%.

Vegetative cover will be measured against the following standards beginning five years following initial seeding. The applicable standards are:

- Total live vegetation cover of perennial species in the seed mix or other appropriate live perennial vegetative species (excluding noxious weeds/vegetation) in any year starting five years after initial seeding >20.7%;
- A single live perennial species in the seed mix or other appropriate live perennial species may not comprise more than 60 percent of the vegetative growth of live perennial species.

With percent cover defined as:
Percent cover = 100 – percent bare ground = Percent live vegetation of perennial species in seed mix (i.e., Blue Grama, Buffalo Grass, Thickspike Wheatgrass, Western Wheatgrass, Prairie Clover, Sandberg Blue Grass, Needle and Thread) + Percent appropriate live perennial vegetation by species not in seed mix + Percent inappropriate live vegetation by species (e.g., noxious weeds/vegetation) + Percent standing dead vegetation + Percent rock + Percent litter + Percent cryptogams.

Areas having insufficient vegetation success five years after initial seeding will be repaired and reseeded as necessary as per procedures provided to the Department in the annual vegetation success monitoring report. If the vegetative cover standards are not achieved at five (5) calendar years after initial seeding, the existing vegetation activities shall be revisited and additional remedial procedures shall be submitted to the local governing authority and Department for review and approval within ninety (90) calendar days following such a determination.

QA/QC

Field Sampling and Laboratory Testing

Laboratory testing must be performed incrementally during construction Following the sampling methods and testing frequencies summarized in Table 4.6. Testing frequencies may be increased or reduced based on the homogeneity of the soils. Soil samples collected for texture and laboratory compaction should be obtained from the same location at the same time.

TABLE 4.6			
Laboratory Testing During Placement			
Property	Method	Requirement	QA/QC Frequency
Texture	ASTM D 422 (with full hydrometer)	Inside Acceptable Zone	1 per 1,500 CY
Laboratory Compaction (Standard Procter)	ASTM D 698	Not Applicable (N/A)	1 per 3,000 CY (or change in soil type)

In addition, during excavation/construction of the water balance cover, the borrow source should be sampled and tested as summarized in Table 4.7.

TABLE 4.7			
Standard Soil Index Property tests for Each Borrow Source During Excavation/Construction			
Property	Method	Requirement	Selected Borrow Source Frequency
Water Content	ASTM D 2216	< Optimum	1 per 6,500 CY
Grain Size Analysis	ASTM D 422 (with full hydrometer)	≤ 15% retained on No. 10 Sieve 2" Max Size	1 per 6,500 CY
Laboratory Compaction	ASTM D 698	≥80% ≤90% Standard Proctor	1 per 6,500 CY

Field testing must be performed incrementally during construction following the sampling methods and testing frequencies summarized in Table 4.8.

TABLE 4.8			
Field Testing During and After Placement			
Property	Method	Requirement	Selected Borrow Source Frequency
Compacted thickness	Per Design	< Optimum	3 per Acre per Lift
Dry Density	ASTM D 6938	≥80% ≤90%	3 per Acre per Lift
Moisture Content	ASTM D 6938	< Optimum	3 per Acre per Lift

Notes: 1. QA/QC personnel should monitor the water balance cover during placement for moisture content.
2. Non-nuclear density test methods (e.g., drive cylinder [ASTM D 2937]) well be utilized.
3. QA/QC personnel should record the moisture content and density for each test. The recording of the moisture content solely is to document the moisture content at the time of testing and is not to be used as an acceptance criterion for the water balance cover. Monitoring the moisture content of the water balance cover during placement is to verify that the water balance cover material is at or dry of optimum moisture content during placement. Density is the only acceptance criterion for the water balance cover during moisture-density testing.

Resolution of Failing Tests

Laboratory Tests

When placed soils fail to meet the project requirements regarding soil type and texture, QA/QC personnel should define the failed area by performing delineation sampling and testing, with one test in each of the four cardinal directions (north, south, east and west) at a distance of 10 to 20 feet from the original failed sample location. If the four delineation tests meet project requirements, the soils located in the area defined as halfway between the original failed sample location and each of the four passing delineation sample locations should be re-worked or removed and replaced with suitable material. After soil re-work/replacement is complete, the affected area should be re-sampled and re-tested. If the re-test passes, no further action is needed. If the re-test fails, the procedure should continue until the affected soils meet project requirements. If any of the delineation tests fail, delineation must continue until the extent of the failing area is determined. The soils located in the delineated failed area should undergo the re-work/replacement process and be re-tested until the delineated area meets project requirements. It is possible that local over-compaction can occur due to tracking of equipment and vehicles while resolving soil type and testing issues.

Any over-compacted zones should ripped or disked and then re-compacted to within the appropriate growth-limiting bulk density.

Field Tests

When tests indicate that soils fail to meet the project requirements for in-place dry density, QA/QC personnel must define the failed area by performing delineation testing, with one test in each of the four cardinal directions at a distance of 10 to 20 feet from the original failed test location. If the four delineation tests meet project requirements, the soils located in the area defined as halfway between the original failed test and each of the four passing delineation tests should be re-worked or replaced. After the completion of remedial activities, the soils located in the affected area should be re-tested. If the re-test passes, no further action is needed. If the re-test fails, the area should be remediated and re-tested until the area meets project requirements. If any of the delineation tests fail, delineation must continue until the extent of the failing area is determined. The soils located in the delineated area should be remediated and re-tested until the delineated area meets project requirements.

The owner or operator of the facility shall submit the CQA Report to the local governing authority having jurisdiction and to the Department for review and approval. The CQA Report should be submitted within 60 calendar days of the completion of a construction element. The Department has authority to approve the report in consultation with the local governing authority, although approval by the local governing authority also may be required in some cases. The CQA Report should include, but not be limited to, detailed information on the following:

- Description and disposition of items that did not meet the requirements of the approved project design;
- Copies of daily field reports;
- Photographs of the various construction components;
- Soil sample locations for laboratory testing;
- Results of laboratory testing;
- Field test and measurement locations;
- Results of field testing and measurements;
- Topographic survey and record drawings of the base of the final cover, final cover surface, and associated surface water control features (survey reports

and record drawings must be stamped and sealed by a professional land surveyor registered in the state of Colorado);

- Seeding activities; and
- Significant changes (which require prior Department approval) to Department-approved drawings, specifications, and CQA Plan.

The as-built construction certification report (CQA Report) must contain a statement by the certifying engineer that construction has been completed in accordance with the approved engineering design plans, drawings, and specifications (as modified, if applicable). The certifying engineer must be a professional engineer registered in the State of Colorado and shall properly certify the CQA Report.

APPENDIX 13

QUALITY ASSURANCE AND

QUALITY CONTROL PLAN

CLAY LINER

Huddleston-Berry
Engineering & Testing, LLC

CONSTRUCTION QUALITY ASSURANCE AND CONSTRUCTION QUALITY CONTROL PLAN COMPACTED CLAY LINER CONSTRUCTION BROAD CANYON LANDFILL NATURITA, COLORADO PROJECT#01284-0001

TS LANDFILL
2352 N. 7TH STREET, UNIT B
GRAND JUNCTION, CO 81501

MAY 16, 2016

Huddleston-Berry Engineering and Testing, LLC
640 White Avenue, Unit B
Grand Junction, Colorado 81501

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1.0 INTRODUCTION

In order to increase their capacity, the Broad Canyon Landfill near Naturita proposes to construct new cells with compacted clay liners. As part of the design development process, Huddleston-Berry Engineering and Testing, LLC (HBET) was retained by TS Landfill to prepare a Construction Quality Assurance / Construction Quality Control (CQA/CQC) plan for the proposed compacted clay liner construction.

1.1 Site Location and Description

The site is located along HH 31 Road near Naturita, Colorado. The project location is shown on Figure 1 – Site Location Map.

The site is an active landfill facility. The terrain is undulating; however, the site generally slopes gently down to the northeast. The site is surrounded by open land.

1.2 Proposed Construction

The proposed construction includes new compacted clay liner consisting of twelve inches of weathered shale from on site or off site sources. The shale will be processed and compacted to achieve a hydraulic conductivity of less than or equal to $1x10^{-7}$ cm/sec in accordance with Colorado Department of Public Health and Environment regulations.

1.3 Referenced Documents

The following documents were referenced in preparation of the CQA/CQC plan:

1. *Regulations Pertaining to Solid Waste Sites and Facilities*, 6 CCR 1007-2, Part 1 by the Colorado Department of Public Health and Environment, amended November 15, 2011.
2. *Solid Waste Guidance Document Concerning Solid Waste Site and Facility Engineering Design Quality Assurance/Quality Control Plans for Disposal Cell Subgrade, Liner, Leachate Collection System (including Sumps) and Protective Layer Components* by the Colorado Department of Public Health and Environment, January 14, 2010.

2.0 CQA/CQC ORGANIZATION

2.1 Key Organizations Involved in CQA/CQC

2.1.1 Colorado Department of Public Health and Environment

The Colorado Department of Public Health and Environment (CDPHE) is the agency responsible for final approval of the liner construction.

2.1.2 TS Landfill

TS Landfill is the owner and operator of the subject facility. TS Landfill will be responsible for providing all labor, equipment, and materials necessary to construct the liner. In addition, TS Landfill is responsible for the quality control of their work product as well as any necessary inspections and/or tests required to ensure that their work complies with the facility operations plan.

2.1.3 Huddleston-Berry Engineering and Testing, LLC.

Huddleston-Berry Engineering and Testing, LLC (HBET) is the project geotechnical engineer. HBET is responsible for preparing and implementing this CQA/CQC plan.

2.2 Key Personnel Involved in CQA

2.2.1 *Project Engineer*

The Project Engineer (PE) for this project is Michael A. Berry, P.E. with HBET. The PE is responsible for implementing the CQA program. The PE oversees CQA and CQC testing and/or inspections, reviews test and/or inspection reports, coordinates resolution of unsatisfactory work items, and prepares summary CQA/CQC reports.

2.2.2 *Field Technicians*

Field Technicians are HBET personnel experienced in construction materials testing and/or inspections. The Field Technicians are responsible for completing all field testing and/or inspections in accordance with the CQA plan. The Field Technicians report directly to the Project Engineer.

2.2.3 *Surveyor*

The Surveyor for this project is Merritt LS. The Surveyor is responsible for verifying lines, grades, etc. on the completed construction. The Surveyor reports directly to the Project Engineer.

2.3 Key Personnel Involved in CQC

2.3.1 QC Systems Manager

The QC Systems Manager (QCM) is Dave Andrews with TS Landfill. The QCM is responsible for implementing the CQC program. The QCM oversees CQC testing and/or inspections, reviews test and/or inspection reports, and coordinates with the CQA Project Engineer to resolve unsatisfactory work items.

2.3.2 Field Technicians

Field Technicians are HBET personnel experienced in construction materials testing and/or inspections. The Field Technicians are responsible for completing all field testing and/or inspections in accordance with the CQC plan. The Field Technicians report directly to the QCM and PE.

3.0 CQA/CQC TESTING AND INSPECTIONS

3.1 Compacted Clay Liner

3.1.1 Borrow Materials

Specific materials proposed to be used for the compacted clay liner construction will be submitted by TS Landfill for approval by HBET. Testing on the proposed borrow materials will be conducted in accordance with the following table.

Testing	CQC Frequency	CQA Frequency	Min. Total
Water Content (oven dried)	1 per 2,620 yd^3	10-20% of QC	3
Atterberg Limits	1 per 6,540 yd^3	10-20% of QC	2
Fines Content (Hydrometer)	1 per 6,540 yd^3	10-20% of QC	2
Grain Size Distribution	1 per 6,540 yd^3	10-20% of QC	2
Proctor	1 per 6,540 yd^3	10-20% of QC	2
Hydraulic Conductivity	1 per 13,080 yd^3	10-20% of QC[(1)]	1
Line of Optimums	1 per 10,000 yd^3	10-20% of CQC[(1)]	1
Direct Shear			1

[(1)] For these tests, one total test for CQC and CQA is proposed.

3.1.2 Subgrade

Prior to liner construction, the subgrade will be evaluated to ensure that it is free of unsuitable materials. In addition, the CQA/CQC Field Technicians will observe proofrolling of the subgrade to ensure subgrade stability. Subsequent to proofrolling, but prior to liner placement, the CQA/CQC Field Technicians will verify that subgrade properly scarified.

3.1.3 Liner Construction

Testing during placement of compacted clay liner will be conducted in accordance with the following table.

Testing	CQC Frequency	CQA Frequency	Min. Total
Water Content (Nuke Gauge)	4 per acre per lift	10-20% of CQC	18
Water Content (oven dried)	1 per 2.5 acres	10-20% of CQC	4
Density (Nuke Gauge)	4 per acre per lift	10-20% of CQC	18
Density (Laboratory)	1 per 2.5 acres	10-20% of CQC	4
Atterberg Limits	1 per 1,000 yd^3	10-20% of CQC	4
Fines Content (Hydrometer)	1 per 1,000 yd^3	10-20% of CQC	4
Grain Size Distribution	1 per 1,000 yd^3	10-20% of CQC	4
1- Point Proctor	1 per day	10-20% of CQC	6
Modified Line of Optimums (single Proctor)	1 per 5,000 yd^3	10-20% of CQC	2
Degree of Saturation	1 per 5,000 yd^3	10-20% of CQC	2
Hydraulic Conductivity(1)	1 per 20,000 yd^3	10-20% of CQC(2)	1
Specific Gravity	1 per material type	10-20% of CQC(2)	1

(1) Due to the fact that the proposed liner material includes particles larger than 1/6 the diameter of a Shelby tube sampler, undisturbed sampling of the liner is not proposed. A disturbed sample of the liner material will be collected during construction, compacted to approximately 95% of the maximum dry density, and tested for Hydraulic Conductivity to verify the consistency of the borrow materials during construction.

(2) For these tests, one total test for CQC and CQA is proposed.

3.1.4 Surveying

Prior to placement of compacted clay liner, the subgrade will be surveyed to verify that the bottom of the liner is in conformance with the proposed lines and grades. Subsequently, the top of each lift of compacted clay liner will be surveyed to verify that the lift thickness and total liner thickness are in conformance with the facility operations plan.

In addition, each CQC and CQA test (compaction, moisture, etc.) location will be field located using a hand held GPS unit to ensure proper test frequency has been met.

4.0 REPORTING

4.1 Construction Quality Assurance

CQA Field Technicians will provide testing results to the PE. Failing tests will be immediately reported to the PE and QCM. The PE and QCM will coordinate with the construction personnel to make corrections until passing test results are obtained. Where significant deviations from the operations plan are identified by the CQA Field Technicians, these will be reported to HBET and/or TS Landfill as appropriate to develop a plan for correction.

4.2 Construction Quality Control

CQC Field Technicians will provide testing results to the CQM. Failing tests will be immediately reported to the QCM. The PE and QCM will coordinate with the construction personnel to make corrections until passing test results are obtained. Where significant deviations from the operations plan are identified by the CQC Field Technicians, these will be reported to HBET and/or TS Landfill as appropriate to develop a plan for correction.

5.0 PROJECT CLOSE-OUT

Upon completion of liner construction, HBET will prepare a comprehensive CQA/CQC report. The report will include:

a) Discussion of construction materials and methods.

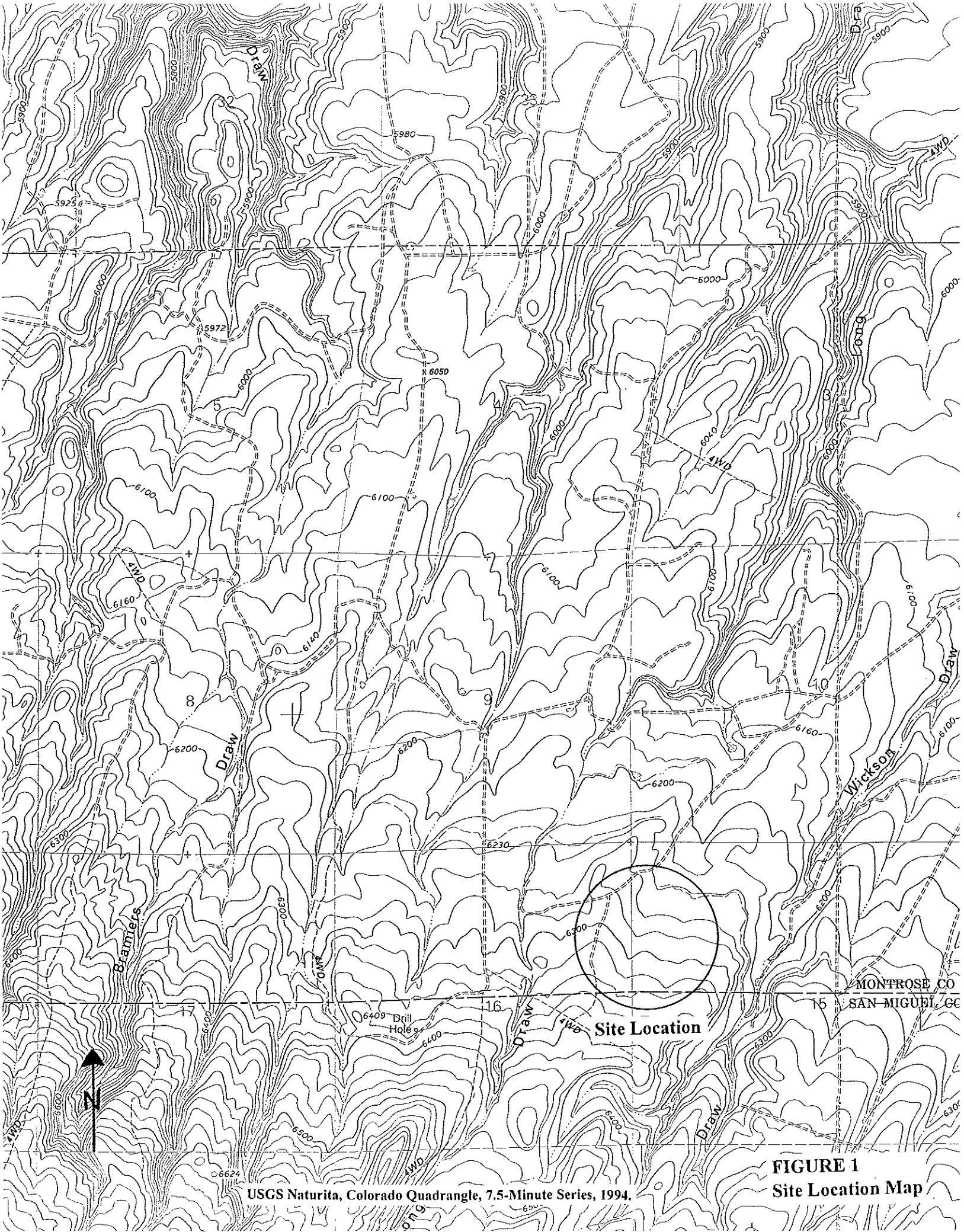
b) Summary of materials testing.

c) Laboratory testing reports.

d) Field testing reports.

e) Plot of testing locations.

f) Statement by Registered Professional Engineer discussing conformance of liner construction with the CQA/CQC plan.



USGS Naturita, Colorado Quadrangle, 7.5-Minute Series, 1994.

FIGURE 1
Site Location Map

APPENDIX 14

GLASS RECYCLING

&

OPERATIONS PLAN

OPERATIONS PLAN
GLASS RECYCLING

Operations

The glass hauled to the landfill for recycling comes from Bruin Waste Management's Montrose recycle center. The glass is stockpiled at the landfill where shown on map LF-02.

Run-off from the stockpiled glass will report to the existing stormwater pond.

The glass recycle process includes stockpiles of raw glass from the recycle center, a glass crusher and screen and finished glass stockpiles. The crushing and screening process can produce 3/8", 1/4" and sand sized rounded glass particles.

The rounded glass particles can be used as decorative landscape material or pipeline backfill. There may be other beneficial uses for the glass particles.

Closure Plan

The closure plan will be to remove all glass from the area and place in the landfill. Some soil will need to be removed to assure most is not all of the glass is removed from the site. The screen and crusher will be moved off site. The approximate one acre site will be vegetated. Closure costs are included in Appendix 4.

APPENDIX 15

Friable Asbestos Disposal

Friable Asbestos Waste Disposal
Broad Canyon Landfill

In accordance with Section 1.5 of the regulations T S Landfill, Inc. hereby requests a waiver so it can dispose of friable asbestos. The friable asbestos will be generated from a clean-up project located in Montrose, CO. The soil to be hauled to the Landfill is soil contaminated with asbestos cement pipe debris and soil/concrete pieces contaminated with friable asbestos containing insulation paper. The clean-up site is located immediately adjacent to the Cimarron Creek Golf Course on the west side of Montrose. It is estimated 3,000 to 4,000 cubic yards of friable asbestos waste will need to be disposed of at the Landfill over a three to six month time period. The cleanup project is scheduled to begin in the spring of 2014. The following information is provided to support the waiver request.

Name and address of the applicant and the owner:

T S Landfill, Inc.
2352 N 7th Street, Unit B
Grand Junction, CO 81501

Site address and legal description:

30120 HH31 Road, Naturita, CO 81422
Township 45 North, Range 15 West, N.M.P.M.
Section 15: NW/4 east of Wickson Draw
Section 10: SW/4SW/4
containing 180 more or less

Site or facility name:

Broad Canyon Landfill

County and township, range, section where the site is located:

Montrose County
Township 45 North, Range 15 West, N.M.P.M.
Sections 10 and 15

Type, size, expected active life and operational history of the facility:

The Broad Canyon Landfill is a municipal solid waste landfill. The currently approved design and operations plan has an area of 28.6 acres. The Landfill has been in operation since 1996. The design and operations plan is in the process of being revised to extend the life of the facility many years.

Geological, hydrologic, and engineering and other such information necessary to support the applicants waiver request:

There are no geologic or hydrologic factors that would preclude the Landfill from accepting friable asbestos. The Landfill sits in a geologically stable area. Surface water is controlled with the use of ditches and a setting pond. Ground water should not be a concern with regard to friable asbestos disposal. The Landfill has a few locations where a friable asbestos waste disposal area could be sited. The attached sketch shows the location of the proposed asbestos disposal area. The Landfill has adequate material to construct the disposal area and cover the asbestos.

The specific regulatory subsections for which the waiver request is being filed:
Section 5.3 Friable Asbestos Waste Disposal Areas

The following point by point narrative explains how the Landfill will manage the friable asbestos waste:

1. A friable asbestos waste disposal area will be constructed. The disposal area will be rectangular in shape and encompass at least 10,000 square feet. The area will either be recessed in the ground or berms will be constructed around the area. Berms will be at least four feet high.
2. The disposal area will be at least in one hundred feet (100’) in all directions from the property line of the Landfill.
3. A four foot high orange barrier fence or other similar fence will be constructed around the entire area where there has been or will be disposal of friable asbestos waste to ensure the restriction of activities in that area and to preclude the entry of unauthorized and unprotected personnel.
4. Warning signs will be displayed as follows: one at each entrance to each asbestos waste disposal area; and one or more on each side of the fenced area based on the length of the side, at a rate of one for every three hundred linear feet (300') of fence.
5. Warning signs will be posted in such a manner and in such locations that the legend can be easily read.
6. Each warning sign will be an upright rectangle with minimum measurements of twenty inches by fourteen inches (20"x14").
7. Each warning sign will display the legend set out below. The letter sizes used in the legend shall be as specified below or of a visibility at least equal to those specified below.

LEGEND	NOTATION
ASBESTOS WASTE DISPOSAL AREA	1 INCH
DO NOT CREATE DUST	0.75 INCH
BREATHING ASBESTOS IS HAZADOUS TO YOUR HEALTH	14 POINT

8. Spacing between any two lines in the legend of the warning signs must be at least equal to the height of the upper of the two lines.

9. No friable asbestos waste will be accepted for disposal unless it is tightly sealed in at least two 6 mil, leak-tight plastic bags.
10. The outermost layer of any containers holding friable asbestos waste will be labeled with either of the following legends in type at least 0.5 inches tall:

1	CAUTION CONTAINS ASBESTOS AVOID OPENING OR BREAKING CONTAINER BREATHING ASBESTOS IS HAZARDOUS TO YOUR HEALTH
2	DANGER CONTAINS ASBESTOS FIBERS AVOID CREATING DUST CANCER AND LUNG DISEASE HAZARD

11. All activities involved in the disposal of friable asbestos waste, including placement in an asbestos waste disposal area, covering the asbestos waste, and compacting the fill will be conducted in a manner that minimizes the potential for the rupture or opening of any bags, wrappers or other containers holding the friable asbestos waste and that prevents the emission of asbestos to the air.
12. Within 24 hours following receipt of friable asbestos waste, the waste will be covered with a minimum of nine inches (9”) of soil. The Landfill has the necessary equipment and soil to cover the asbestos waste.
13. The potential for release from and exposure to asbestos waste will be minimized by not compacting the waste prior to application of cover materials. Compaction equipment will not come into contact with asbestos waste, containers or packaging.
14. All unrelated landfill activities within one hundred (100’) feet in all directions of each asbestos waste disposal area will be stopped during the placement, covering, and compaction of the asbestos waste.
15. No non-essential persons will be allowed within one hundred (100’) feet in all directions of each asbestos waste disposal area during the placement, covering, and compaction of the asbestos waste.
16. Asbestos disposal activities will stop if sustained wind speeds at the asbestos waste disposal area exceed twenty miles per hour (20 mph) or gusts exceed thirty miles per hour (30 mph).
17. The Landfill has a water truck that will be available at the site to facilitate wetting the asbestos wastes if any container is breeched during placement of asbestos waste**.**
18. The Landfill will maintain permanent records of the date and amount of each receipt of asbestos waste, the location of each asbestos waste disposal area within the boundaries of the solid waste disposal facility and the quantity of asbestos waste at each such location. These records shall be of sufficient specificity to identify the location and depth of the asbestos waste.

19. The permanent records will be readily available at all times and are made available to the local governing body having jurisdiction and the Department upon request.
20. The permanent records will be submitted to the local governing body having jurisdiction within thirty (30) days after the closure of the asbestos waste disposal area has been completed.

Note: The Landfill Manager will determine the date and the time of asbestos delivery from a generator. Any generator who does not give prior notification to the Landfill Project Manager of an asbestos disposal will be rejected.