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CHATHAM, IL 62629
US

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Darrell Hartley
Missouri Dept. of Natural Resources
1730 E ELM ST
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January 10, 2019

Mr. Darrell Hartley
Permits Unit Chief
Solid Waste Management Program
Division of Environmental Quality
Missouri Department of Natural Resources
1730 East Elm Street
Jefferson City, Missouri 65101

RE: Bridgeton Landfill
Response to MDNR Comment Letters Dated December 14, 2018

Dear Mr. Hartley:

Bridgeton Landfill, LLC received correspondence from the Missouri Department of Natural Resource's Solid Waste Management Program (MDNR-SWMP) dated December 14, 2018. The correspondence was comprised of three separate letters presented comments on 1) a May 8, 2018 response letter from Bridgeton Landfill, LLC; 2) the May 29, 2018 *Groundwater Monitoring Plan and Groundwater Sampling and Analysis Plan* (GWMP/GWSAP) prepared by Feezor Engineering, Inc. (FEI); and 3) the June 27, 2018 *Groundwater Statistical Analysis Plan* (StAP) prepared by Jett Environmental Consulting. The letter regarding the GWMP-GWSAP also included comments provided by the Missouri Geological Survey (MDNR-MGS). The MDNR's comments regarding the May 8, 2018 response letter and the May 29, 2018 GWMP/GWSAP are reiterated below in bold, with Bridgeton Landfill, LLC's responses in italics. The MDNR's comments on the June 27, 2018 StAP will be addressed in a separate submittal.

MDNR-SWMP Comments on May 8, 2018 Response Letter

Comment 1: The opinion of the SWMP is that sampling wells PZ-100-KS, PZ-106-KS, or PZ-111-KS should either add credence to the belief that the contamination at well PZ-104-KS is due to well integrity issues or reveal that the Keokuk Zone should indeed be sampled. For this reason, the SWMP requires that the three wells be added to the groundwater monitoring network.

Response: The GWMP/GWSAP has been revised to incorporate the three additional Keokuk Zone groundwater monitoring wells (PZ-100-KS, PZ-106-KS, and PZ-111-KS) into the facility's detection monitoring program. A revised version of the GWMP/GWSAP has been enclosed as Attachment A.

406 East Walnut Street • Chatham, IL 62629
Phone (217) 483-3118 • Fax (217) 483-2356

Comment 2: The SWMP requires that Bridgeton Landfill, LLC submit the sample results of the headspace gas samples taken at well PZ-104-KS for comparison with the groundwater samples from the well in order to determine if the groundwater contamination is possibly due to gas migration and well integrity issues.

Response: The laboratory analytical report for the July 9, 2018 headspace sample collected at PZ-104-KS is enclosed as Attachment B.

Comment 3: The May 8, 2018 response letter and the discussions with Bridgeton representatives note the difficulties of groundwater sampling in deep wells. The SWMP understands the difficulties involved in sampling wells of this depth.

Response: No response necessary.

Comment 4: The SWMP also considers the unusual readings from the nearby gas extraction well 104 as additional reasons for not removing the Keokuk wells. The gas extraction well 104 located in the area has exhibited high temperatures (200°), low methane concentrations, and high carbon dioxide (CO_2) concentrations while other wells have only had readings of low methane and high CO_2.

Response: No response necessary.

The MDNR-SWMP also provided the following (unnumbered) comment on the May 8, 2018 response letter:

Comment: The SWMP requires the Bridgeton Landfill, LLC submit a modified sampling protocol for use at the deep groundwater wells. Please also, submit the deep well sampling protocol within 30 days of receipt of this letter.

Response: The GWMP/GWSAP has been revised to incorporate the three additional Keokuk Zone groundwater monitoring wells (PZ-100-KS, PZ-106-KS, and PZ-111-KS) into the facility's detection monitoring program and to address pump design/installation considerations specific to these wells. No additional sampling protocol changes are necessary for the sampling of Keokuk Zone wells.

MDNR-MGS Comment on GWMP/GWSAP

Comment 1: In section 3, Geology, the bedrock descriptions do not indicate that some of the bedrock at this site, is Karst. Please discuss in the appropriate section(s) about the Karst nature of the bedrock. Previous reports, which include geologic mapping of the high walls within the landfill, show collapse infilled structures, cavities, seeps, and springs.

Response: Section 3 of the GWMP/GWSAP has been revised to more thoroughly address the karst nature of the bedrock formations that underlie the facility. A revised version of the GWMP/GWSAP has been enclosed as Attachment A.

Comment 2: Section 4.2, Deep Salem Zone, paragraph 3 states that, 'Given that the top of the Keokuk formation occurs at….' The top of the Keokuk should be changed to the top of the Salem.

Response: The indicated sentence has been corrected. A revised version of the GWMP/GWSAP has been enclosed as Attachment A.

MDNR-SWMP Comment on GWMP/GWSAP

Comment 1: The GMP/GSAP describes sample collection and purging activities for low-flow purging via pump, volumetric purging via pump, and volumetric purging via bailer. The plan does not, however, discuss the criteria for the determination to use other than low-flow sampling for a particular sample event. Low-flow sampling is the preferred methodology for sampling protocols. Any change of sampling protocols needs to be justified with specific criteria and reasons why such a change in sampling procedures is necessary. Please submit a revised Groundwater Monitoring Plan and Groundwater Sampling and Analysis Plan that includes the criteria to be used for sampling protocols other than low-flow sampling techniques.

Response: The GWMP/GWSAP has been revised to remove references to low-flow purging/sampling alternatives. The plan now specifies that low-flow purging/sampling will be the only method utilized for groundwater sampling at the facility. A revised version of the GWMP/GWSAP has been enclosed as Attachment A.

Comment 2: The section of the Sampling and Analysis plan entitled 6.1 Detection of Static Groundwater Elevation notes that the depth to static groundwater measurement will be measured during each sampling event and that total well depth measurement will be performed annually at each groundwater monitoring well. The plan does not state what criteria will be used to determine if a groundwater well needs to be redeveloped due to sediment build up. Please include all redevelopment criteria in a revised sampling and analysis plan.

Response: The GWMP/GWSAP has been revised to specify the criteria for the redevelopment of groundwater monitoring wells. A revised version of the GWMP/GWSAP has been enclosed as Attachment A.

Should you have any questions or comments, please contact the undersigned at your convenience at 314-202-1538.

Sincerely,

Andrew Wyatt
Senior Hydrogeologist / Residuals Management Team Member

Attachments: A – Revised Groundwater Monitoring Plan / Groundwater Sampling and Analysis Plan
B – Laboratory Analytical Report for PZ-104-KS Headspace Sample

Cc: Chris Nagel – MDNR-SWMP (electronic)
Steve Jett – Jett Environmental Consulting (electronic)
Steve Lombardo – Trihydro Corporation (electronic)
Jessie Merrigan – Lathrop Gage LLP (electronic)
Mark Milward – St. Louis County Department of Public Health (electronic)
Mike Parris – MDNR-SWMP (electronic)
Paul Rosasco – EMSI (electronic)
Dana Sincox – Bridgeton Landfill, LLC
Victoria Warren – Republic Services (electronic)

ATTACHMENT A

REVISED GROUNDWATER MONITORING PLAN / GROUNDWATER SAMPLING AND ANALYSIS PLAN (ENCLOSED IN SEPARATE BINDER)

GROUNDWATER MONITORING PLAN
AND
GROUNDWATER SAMPLING AND ANALYSIS PLAN

BRIDGETON LANDFILL

BRIDGETON, MISSOURI

Prepared For:

Bridgeton Landfill, LLC
13570 St. Charles Rock Rd
Bridgeton, MO 63044

May 24, 2018
(Revised January 10, 2019)

Prepared By:

Feezor Engineering, Inc.
406 East Walnut Street
Chatham, Illinois 62629

GROUNDWATER MONITORING PLAN
AND
GROUNDWATER SAMPLING AND ANALYSIS PLAN

BRIDGETON LANDFILL
BRIDGETON, MISSOURI

Prepared for

Bridgeton Landfill, LLC

May 24, 2018

(Revised January 10, 2019)

Prepared by

Feezor Engineering, Inc.
406 East Walnut Street
Chatham, Illinois 62629

Project BT-179

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1 INTRODUCTION

On behalf of Bridgeton Landfill, LLC (Bridgeton Landfill), Feezor Engineering, Inc. (FEI) has prepared this Groundwater Monitoring Plan (GWMP) and Groundwater Sampling and Analysis Plan (GWSAP) for the facility.

This plan describes the groundwater detection monitoring program that the facility is required to maintain pursuant to Title 10 of the Code of State Regulations (CSR) 80-3.010(11)(C)4. The plan also describes the procedures to be used when collecting samples from the facility's groundwater monitoring wells (the GWSAP). These sampling procedures are applicable to 1) the detection monitoring program required by 10 CSR 80-3.010(11)(C)4 and described in this GWMP; 2) the assessment monitoring program required by 10 CSR 80-3.010(11)(C)6 and described in the companion *Assessment Monitoring Plan*; and 3) corrective action monitoring required by 10 CSR 80-3.010(12).

The following documents were consulted during the preparation of this GWMP/GWSAP: Subpart E of the United States Environmental Protection Agency's (USEPA) *Solid Waste Disposal Facility Criteria* (USEPA 1993); the Missouri Department of Natural Resources (MDNR) fact sheet *Collection, Handling, and Reporting Procedures for Groundwater Samples* (MDNR 2014a); USEPA Region I's *Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells* (USEPA 2017); the USEPA's *Methods for Chemical Analysis of Water and Wastes* (UESPA 1983); and the USEPA's *Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods* (a.k.a. SW-846) (USEPA 2014).

This document constitutes an update to the facility's September 1995 GWMP (Golder 1995a) and its November 1998 GWSAP (Herst 1998). This GWMP/GWSAP updates the groundwater detection monitoring program to reflect revisions made to the well network and sampling schedule. The plan also includes revisions intended to enhance clarity, update terminology, and reflect changes in standard industry practice.

2 PHYSICAL SETTING

This section presents a general description of the geographic location and physical setting of the Bridgeton Landfill.

The Bridgeton Landfill is an approximately 52-acre closed municipal solid waste landfill. The facility is located in the City of Bridgeton, St. Louis County, Missouri. The facility's physical address is 13570 St. Charles Rock Road, St. Louis, Missouri 63044. The landfill is operated under the terms of MDNR Solid Waste Disposal Area Operating Permit Number #118912, issued on November 18, 1985. The facility formerly accepted household, commercial, and industrial solid waste.

The site located on the eastern edge of the Missouri river floodplain. The Missouri River is located approximately two miles to the west of the site. The area is transitional between the alluvial floodplain immediately to the west of the site and the loessial bluffs approximately a half-mile to the east. The edge of the alluvial valley is oriented north to south, roughly through the western side of the site. The natural topography of the area is gently rolling. However, the site's topography has been significantly altered by quarrying activities in the eastern portion of the site and the placement of mine spoils and landfill materials in the western portion of the site.

The site's use was agricultural until 1939, when a limestone quarry and crushing operation was initiated at the site. The limestone quarry was operated between 1939 and 1988, and was closed when economically recoverable reserves were exhausted. The quarry consists of two pits which were excavated to a maximum depth of approximately 240 feet below ground surface, an approximate elevation of 240 feet above mean sea level (ft/msl).

The landfill was operated within the former limestone quarry. Landfilling operations were initiated within the northern pit (North Quarry) in 1979. Expansion of the landfill into the southern pit (South Quarry) was proposed in 1984 and authorized under Permit #118912 in November 1985. Landfilling with the pits continued until December 31, 2004.

3 GEOLOGY

This section presents a general description of the geologic setting of the Bridgeton Landfill. The site's geology has been described in detail in reports previously submitted to the MDNR, including the 1995 *Hydrogeologic Characterization Report* (Golder 1995b). The descriptions presented in this section are partly adapted from that report and others.

For the purposes of groundwater monitoring, the geology underlying the Bridgeton Landfill can be divided into five units of interest, from oldest to youngest: the Keokuk formation bedrock, the Warsaw formation bedrock, the Salem formation bedrock, the St. Louis formation bedrock, and unconsolidated materials consisting of alluvium and loess. Of these, the Warsaw formation is not a groundwater-bearing unit and is therefore not discussed in the description of the site's hydrogeology in **Section 4** below.

The carbonate geology that predominates in the aforementioned formations is susceptible to dissolution and the formation of karst topography. Although the majority of karst in Missouri occurs in south-central and southeastern regions of the state, it can occur anywhere that acidic water encounters joints, fractures, and bedding planes in susceptible forms of bedrock (e.g., limestone, dolomite, or gypsum). Although site-specific structural information for the Keokuk, Warsaw, and Salem formations is not available, portions of the St. Louis formation that were exposed along the southern pit's quarry wall in 1995 were mapped as a part of hydrogeologic characterization activities. This geologic mapping identified seeps, cavities, collapsed infilled structures, and other features associated with karst. See **Section 3.4** below for further details.

The former quarry pits were constructed to a depth consistent with the upper portion of the Salem formation. Accordingly, portions of the Salem formation, St. Louis formation, and unconsolidated materials are absent in those areas where the landfill was constructed.

3.1 Keokuk Formation Bedrock

The Keokuk formation is a part of the Osagean series, which is in turn a part of the Mississippian system. The formation is a fresh to slightly- or moderately-weathered, thinly- to medium-bedded, medium-strong limestone. The color of the formation is generally very light gray to light olive. The limestone is dolomitic, with members that are variously described as siliceous and arenaceous, as well as porous and vuggy. The formation is characterized by chert layers and nodules. Fractures are rare in the Keokuk formation, generally occurring at frequencies of up to two fractures per foot. Where they occur, these fractures are generally irregular and rough, or — alternately — bedded and planar.

The top of the Keokuk formation is encountered at an elevation of approximately 115 to 126 ft/msl in the eastern portion of the landfill and approximately 115 ft/msl in the western

portion of the landfill. The Keokuk formation is underlain by the Burlington formation and overlain by the Warsaw formation.

3.2 Warsaw Formation Bedrock

The Warsaw formation is a part of the Meramecian Series, which is in turn a part of the Mississippian system. The formation is a fresh, thickly-bedded, weak to medium-strong, microcrystalline to coarsely crystalline calcareous claystone and limestone. The formation includes abundant interbedding of dolomite, claystone, siltstone, clayey siltstone, and silty claystone. The lower portion of the Warsaw formation is predominantly thinly- to medium-bedded limestone, grading into the upper portion of the Keokuk formation, with thin chert layers and small chert nodules. The upper portion of the Warsaw formation is characterized by an approximately 2.5- to 10-foot thick claystone or siltstone layer, commonly referred to as the Warsaw Shale. The color of the formation is generally dark greenish gray to olive black. Formation members are variously described as arenaceous or argillaceous, as well as porous and vuggy. Fractures are rare in the Warsaw formation, generally occurring at frequencies of up to one fracture per foot. Where they occur, these fractures are generally jointed, either irregular or planar, and either rough or smooth.

The top of the Warsaw formation is encountered at an elevation of approximately 240 ft/msl in the eastern portion of the landfill and approximately 250 to 260 ft/msl in the western portion of the landfill. The thickness of the Warsaw formation ranges from approximately 130 to 145 feet. The Warsaw formation is underlain by the Keokuk formation and overlain by the Salem formation. As noted above, the Warsaw formation is not a groundwater-bearing unit, and is therefore not monitored under the facility's groundwater monitoring programs.

3.3 Salem Formation Bedrock

The Salem formation is a part of the Meramecian Series, which is in turn a part of the Mississippian system. The formation is a fresh, thinly- to thickly-bedded, medium-strong limestone. The color of the formation is generally pale yellowish brown to light olive gray. The limestone is dolomitic and fossiliferous. The formation is also characterized by widespread interbedded dolomite layers and scattered chert clasts, nodules, and layers. Fractures are rare in the Salem formation, generally occurring at frequencies ranging from zero to one fracture per foot in the lower portion of the formation and up to two fractures per foot in the upper portion of the formation. Where they occur, these fractures are generally jointed, irregular, and rough, or — alternately — jointed, planar, and smooth.

The top of the Salem formation is encountered at an elevation of approximately 320 ft/msl in the eastern portion of the landfill and approximately 328 to 340 ft/msl in the western portion of the landfill. The thickness of the Salem formation ranges from approximately 67 to 83 feet. Portions of the Salem formation were removed during quarrying activities, and as such the unit is partly absent in those areas where the landfill was constructed. The

Salem formation is underlain by the Warsaw formation and overlain by the St. Louis formation.

3.4 St. Louis Formation Bedrock

The St. Louis formation is a part of the Meramecian series, which is in turn a part of the Mississippian system. The formation is generally a fresh to slightly-weathered, thinly- to very thickly-bedded, microcrystalline to medium crystalline, medium-strong to strong limestone. The color of the formation is generally very light gray to olive gray. The limestone is dolomitic, and the upper units of the formation are brecciated, stylolitic, and fossiliferous. The St. Louis formation is also characterized by periodic claystone and siltstone beds and layers. The upper units of the formation contain occasional iron-oxide concretions and chert nodules. Fractures generally occur in the St. Louis formation at a frequency of zero to ten fractures per foot. Where they occur, these fractures are generally jointed, irregular, rough, and infilled with clay.

The top of the St. Louis formation is encountered at an elevation of approximately 425 to 460 ft/msl in the eastern portion of the landfill and approximately 379 to 445 ft/msl in the western portion of the landfill. The thickness of the St. Louis formation ranges from approximately 65 to 130 feet. Portions of the St. Louis formation were removed during quarrying activities, and as such the unit is absent in those areas where the landfill was constructed. The St. Louis formation is underlain by the Salem formation and overlain by unconsolidated materials.

As noted above, geologic mapping of the southern pit's quarry wall was performed in 1995, as a part of hydrogeologic characterization activities. This mapping occurred after quarrying activities has ceased at the site, but before landfilling within the quarry pits had ceased. At that time, only the St. Louis formation was exposed. The mapping effort, as described in Golder (1995b) delineated sub-units within the St. Louis formation and identified major structures such as joints (with their orientation), collapsed infilled structures, cavities, and groundwater seeps.

In general, collapsed infilled structures and cavities were observed at irregular intervals along all four of the major mapping sectors (corresponding to the northeast, southeast, southwest, and northwest sides of the southern pit): 3 collapsed infilled structures and 5 cavities on the northeast side; 3 collapses and 4 cavities on the southeast; 1 collapse and 4 cavities on the southwest; and 2 collapses and 1 cavity on the northwest. Groundwater seeps appeared to occur with greatest frequency on the southeast side of the pit (60 seeps), with lesser frequency on the northwest (10 seeps) and northeast (8 seeps) sides, and with the least frequency on the southwest side (4 seeps). On the southeast side of the pit, the seeps often (but not always) occurred along joints or bedding planes, or within collapsed infilled structures. The more frequent occurrence of seeps on the southeast side of the southern quarry pit is broadly consistent with the expected groundwater flow direction in the corresponding hydrogeologic zone, as the groundwater elevations in the

St. Louis / Upper Salem Zone are generally highest on the southern and eastern sides of the landfill (see **Section 4.3**, below). Further details on the historical quarry wall mapping are presented in Golder (1995b).

3.5 Unconsolidated Materials

The unconsolidated materials that overlie the St. Louis formation at the Bridgeton Landfill are comprised primarily of alluvium overlain by loess. The alluvium ranges from a silty clay and clayey silt to a sand, and the loess ranges from a silty clay to a clayey silt. The loess was redeposited from braided glacial melt-out drainages by westerly winds during the late Pleistocene. The thickness of the loess is greatest in the eastern portion of the landfill. In the eastern portion of the landfill, the thickness of the loess is approximately 13 to 22 feet, and the thickness of the alluvium is approximately 12 to 32 feet. The loess is thinner in the western portion of the site, and occasionally absent, due to quarrying and landfilling activities, as well as erosion within the floodplain. In the western portion of the site, the thickness of the loess (where present) is approximately 10 to 15 feet, and the thickness of the alluvium is up to approximately 110 feet. Portions of the alluvium and loess were removed during quarrying activities, and as such these materials are absent in those areas where the landfill was constructed.

4 HYDROGEOLOGY

This section presents a general description of the hydrogeologic setting of the Bridgeton Landfill. The site's hydrogeology has been described in detail in reports previously submitted to the MDNR, including the 1995 *Hydrogeologic Characterization Report* (Golder 1995b). The descriptions presented in this section are partly adapted from that report and others.

An extensive discussion of the site's groundwater elevations, hydraulic conductivity, secondary permeability, and hydraulic gradients – as well as the spatial and seasonal variation in these parameters – was previously presented in the November 28, 2016 *Groundwater Technical Report* (GWTR) (Feezor 2016). Select data and findings from that report are referenced in this section. The complete details can be found in the GWTR.

Four hydrogeologic zones are monitored at the Bridgeton Landfill, roughly corresponding to the four geologic units of interest described in **Section 3**, above: the Keokuk Zone, the Deep Salem Zone, the St. Louis / Upper Salem Zone, and the Alluvial Zone. Groundwater elevations in these four zones are monitored via a network of monitoring wells (which are sampled under the facility's detection and/or assessment monitoring programs) and piezometers (which are used for groundwater elevation monitoring). The entirety of the facility's groundwater monitoring network is illustrated on **Figure 4-1**.

As noted in **Section 3**, above, the Warsaw formation is not a groundwater-bearing unit, and is therefore not monitored under the facility's groundwater monitoring programs.

4.1 Keokuk Zone

Four wells and piezometers near the Bridgeton Landfill are completed in the Keokuk formation:

- PZ-100-KS
- PZ-104-KS
- PZ-106-KS
- PZ-111-KS

The Keokuk Zone monitoring network is illustrated on **Figure 4-2**.

Horizontal groundwater flow in the Keokuk Zone is generally from the southeastern side to northwestern side of the landfill. Groundwater elevations in the Keokuk Zone ranged from 458.35 to 468.60 ft/msl in 2015 - 2016 (Feezor 2016). Given that the top of the Keokuk formation occurs at approximately 115 to 126 ft/msl, these groundwater elevations indicate confined aquifer conditions in the Keokuk Zone. Based on the results of Packer tests and slug tests conducted as a part of the facility's hydrogeologic characterization, the mean hydraulic conductivity of the Keokuk Zone is 5.5×10^{-6} cm/sec (Golder 1995b).

Horizontal hydraulic gradients in the Keokuk Zone ranged from 0.0048 to 0.0050 in 2015 – 2016, with a mean gradient of 0.0049 (Feezor 2016). Vertical groundwater gradients between the Keokuk and Deep Salem Zones are consistently negative, i.e., upward from the Keokuk into the Deep Salem. The vertical gradient ranged from -0.030 to -0.167 in 2015 – 2016, with a mean gradient of -0.078 (Feezor 2016).

4.2 Deep Salem Zone

Nine wells and piezometers near the Bridgeton Landfill are completed in the deep portions of the Salem formation:

- MW-1204
- PZ-100-SD
- PZ-104-SD
- PZ-106-SD
- PZ-111-SD
- PZ-209-SD
- PZ-210-SD
- PZ-211-SD
- PZ-212-SD

The Deep Salem monitoring network is illustrated on **Figure 4-3**.

Within the limits of the landfill, infiltrated groundwater originating from the Deep Salem Zone (and other zones) is removed via pumping from the quarry, along with landfill leachate. Groundwater elevations in the Deep Salem Zone are generally highest on the southern and southeastern side of the landfill and lowest on the northwestern side of the landfill.

Groundwater elevations in the Deep Salem Zone ranged from 432.06 to 472.65 ft/msl in 2015 – 2016 (Feezor 2016). Given that the top of the Salem formation occurs at approximately 240 to 260 ft/msl, these groundwater elevations indicate confined aquifer conditions in the Deep Salem Zone. Based on the results of Packer tests and slug tests conducted as a part of the facility's hydrogeologic characterization, the mean horizontal hydraulic conductivity of the Deep Salem Zone is 1.1×10^{-6} cm/sec (Golder 1995b).

Horizontal hydraulic gradients in the Deep Salem Zone ranged between 0.0167 to 0.0176 in 2015 – 2016, with a mean gradient of 0.0170 (Feezor 2016). This is approximately three to four times greater than the mean gradients observed in the Keokuk Zone (0.0049).

Vertical groundwater gradients between the Deep Salem and St. Louis / Upper Salem Zones vary in orientation (upward or downward) throughout the site. At two well pairs — PZ-106-SS / PZ-106-SD and PZ-116-SS / MW-1204 — vertical gradients are consistently negative, i.e., upward from the Deep Salem into the St. Louis / Upper Salem. Vertical gradients are consistently positive, (i.e., downward from the St. Louis / Upper Salem into the Deep Salem) at the other five well pairs: PZ-100-SS / PZ-100-SD, PZ-104-SS / PZ-104-SD, PZ-209-SS / PZ-209-SD, PZ-210-SS / PZ-210-SD, and PZ-211-SS / PZ-211-SD (Feezor 2016).

The downward vertical gradient (where it occurred) between the St. Louis / Upper Salem and Deep Salem Zones ranged from 0.006 to 0.021 in 2015 - 2016, with a mean gradient of 0.014. The upward vertical gradient (where it occurred) ranged from 0.000 to -0.042 in

2015 -2016, with a mean gradient of -0.013. In general, the vertical gradients observed between the Deep Salem and St. Louis / Upper Salem Zones (0.019 downward mean, -0.013 upward mean) are smaller in magnitude than those observed between the Keokuk and Deep Salem Zones (-0.078 upward mean) (Feezor 2016).

4.3 St. Louis / Upper Salem Zone

Although the St. Louis formation and upper Salem formation are geologically distinct, they are generally regarded as a single hydrogeologic unit at the Bridgeton Landfill site. Twenty-seven wells and piezometers near the Bridgeton Landfill are completed in the St. Louis formation and upper portions of the Salem formation:

- PZ-100-SS
- PZ-101-SS
- PZ-102-SS
- PZ-102R-SS
- PZ-103-SS
- PZ-104-SS
- PZ-105-SS
- PZ-106-SS
- PZ-107-SS
- PZ-109-SS
- PZ-111-SS
- PZ-113-SS
- PZ-115-SS
- PZ-116-SS
- PZ-200-SS
- PZ-201A-SS
- PZ-202-SS
- PZ-203-SS
- PZ-204-SS
- PZ-204A-SS
- PZ-205-SS
- PZ-206-SS
- PZ-208-SS
- PZ-209-SS
- PZ-210-SS
- PZ-211-SS
- PZ-212-SS

The St. Louis / Upper Salem monitoring network is illustrated on **Figure 4-4**.

Within the limits of the landfill, infiltrated groundwater originating from the St. Louis / Upper Salem Zone (and other zones) is removed via pumping from the quarry, along with landfill leachate. Groundwater elevations in the St. Louis / Upper Salem Zone are generally highest on the southern and eastern sides of the landfill and lowest on the northern and western side of the landfill, although there is some local variation in this pattern.

Groundwater elevations in the St. Louis / Upper Salem Zone ranged from 430.90 to 472.76 ft/msl in 2015 – 2016 (Feezor 2016). Given that the top of the St. Louis formation occurs at approximately 379 to 460 ft/msl, these groundwater elevations indicate semi-confined aquifer conditions in the St. Louis / Upper Salem Zone. Based on the results of Packer tests and slug tests conducted as a part of the facility's hydrogeologic characterization, the mean horizontal hydraulic conductivity of the St. Louis / Upper Salem Zone is 1.0×10^{-6} cm/sec (Golder 1995b).

Horizontal hydraulic gradients in the St. Louis / Upper Salem Zone ranged from 0.0283 to 0.0332 in 2015 - 2016, with a mean gradient of 0.0304 (Feezor 2016). This is approximately six times greater than the mean gradient observed in the Keokuk Zone (0.0049) and two times greater than the mean gradient observed in the Deep Salem Zone (0.0170).

Vertical groundwater gradients between the St. Louis / Upper Salem and Alluvial Zones vary in orientation (upward or downward) throughout the site. At two well pairs — PZ-113-AD / PZ-113-SS and PZ-114-AS / PZ-115-SS — vertical gradients are consistently negative, i.e., upward from the St. Louis / Upper Salem into the Alluvial. However, vertical gradients are consistently positive, (i.e., downward from the Alluvial into the St. Louis / Upper Salem) at well pair PZ-205-AS / PZ-205-SS (Feezor 2016).

The upward vertical gradient (where it occurred) between the Alluvial and St. Louis / Upper Salem Zones ranged from -0.003 to -0.093 in 2015 - 2016, with a mean gradient of -0.044. The downward vertical gradient (where it occurred) ranged from 0.036 to 0.093 in 2015 - 2016, with a mean gradient of 0.064. In general, the vertical gradients observed between the St. Louis / Upper Salem and Alluvial Zones (0.064 downward mean, -0.044 upward mean) are greater in magnitude than those observed between the Deep Salem and St. Louis / Upper Salem Zones (0.019 downward mean, -0.013 upward mean) but smaller than those observed between the Keokuk and Deep Salem Zones (-0.078 upward mean) (Feezor 2016).

4.4 Alluvial Zone

Thirteen wells and piezometers near the Bridgeton Landfill are completed in unconsolidated materials at the Bridgeton Landfill site:

- D-85
- D-87
- I-67
- I-68
- I-73
- LR-103
- PZ-112-AS
- PZ-113-AS
- PZ-113-AD
- PZ-114-AS
- PZ-205-AS
- PZ-207-AS
- S-84

The Alluvial Zone monitoring network is illustrated on **Figure 4-5**.

As shown on this figure, the monitorable extent of the Alluvial Zone is limited to the west-central, northwestern, and northern sides of the landfill. These correspond to the areas where the alluvium is thickest and where perched (unconfined) groundwater occurs consistently and continuously at the interface between the St. Louis formation bedrock and unconsolidated materials. Some perched groundwater is present within the unconsolidated materials on the eastern side of the landfill, but this groundwater is discontinuous and thin (generally less than two feet of saturated thickness).

Within the limits of the landfill, infiltrated groundwater originating from the Alluvial Zone (and other zones) is removed via pumping from the quarry, along with landfill leachate. Groundwater elevations in the Alluvial Zone are generally highest on the west-central side of the landfill and lowest on the northern and northwestern sides of the landfill, but there is substantial local and seasonal variation in this pattern.

Groundwater elevations in the Alluvial Zone ranged from 431.20 to 435.71 ft/msl in 2015 – 2016 (Feezor 2016). Based on the results of slug tests and laboratory permeability tests conducted as a part of the facility's hydrogeologic characterization, the mean horizontal hydraulic conductivity of the Alluvial Zone is 8.4×10^{-5} cm/sec (Golder 1995b).

Horizontal hydraulic gradients in the Alluvial Zone ranged from 0.0010 to 0.0027 in 2015 - 2016, with a mean gradient of 0.0021 (Feezor 2016). This is less than half the mean gradient observed in the Keokuk Zone (0.0049) and substantial lower than the mean gradients observed in the Deep Salem Zone (0.0170), and St. Louis / Upper Salem Zone (0.0328).

5 GROUNDWATER MONITORING WELLS

This section describes the groundwater monitoring well network that is used to evaluate the Bridgeton Landfill. The detection monitoring program is the primary focus of this section, but the assessment monitoring program is also briefly summarized. Further details on the assessment monitoring program can be found in the companion *Assessment Monitoring Plan* (AMP).

5.1 Detection Monitoring Network

The groundwater detection monitoring network for the Bridgeton Landfill is comprised of 41 wells, screened within four separate hydrogeologic zones:

<u>Alluvial Wells</u>

- D-85[(A)]
- I-68
- I-73[(A)]
- PZ-112-AS[(A)]
- PZ-113-AS*
- PZ-113-AD*
- PZ-114-AS[(A)]
- PZ-205-AS[(A)]
- PZ-207-AS[(A)]
- S-84[(A)]

<u>St. Louis / Upper Salem Wells</u>

- PZ-100-SS
- PZ-101-SS[(A)]
- PZ-102-SS
- PZ-102R-SS
- PZ-103-SS[(A)]
- PZ-104-SS[(A)]
- PZ-105-SS
- PZ-106-SS
- PZ-107-SS[(A)]
- PZ-109-SS
- PZ-111-SS
- PZ-113-SS
- PZ-115-SS
- PZ-116-SS[(A)]
- PZ-200-SS*
- PZ-201A-SS
- PZ-202-SS[(A)]
- PZ-203-SS
- PZ-204-SS
- PZ-204A-SS*
- PZ-205-SS
- PZ-206-SS

<u>Deep Salem Wells</u>

- MW-1204[(A)]
- PZ-100-SD
- PZ-104-SD[(A)]
- PZ-106-SD
- PZ-111-SD

<u>Keokuk Wells</u>

- PZ-100-KS
- PZ-104-KS[(A)]
- PZ-111-KS
- PZ-106-KS

Wells indicated with [(A)] are currently under assessment monitoring. When assessment monitoring is no longer required at one of these wells, pursuant to 10 CSR 80-3.010(11)(C)6.G, routine detection monitoring will be reinstated at that well.

Wells indicated with * are currently utilized as detection monitoring wells but may require additional monitoring in the future, based on historic inorganic exceedances of federal primary drinking water standards (maximum contaminant limits, or MCLs).

Table 5-1 summarizes the basic as-built information for the facility's groundwater detection monitoring wells. **Figure 5-1** illustrates the layout of the detection monitoring network.

When available, borehole logs and as-built construction diagrams that were prepared for the wells at the time of installation are presented in **Appendix A**. The borehole logs present information on the geologic materials encountered during well drilling. The as-built diagrams present well construction specifications, such as diameter, total depth, screened interval depth, and screen slot size.

The wells are equipped with dedicated low-flow bladder pumps that will be utilized for purging and sampling of groundwater. Each well has historically yielded sufficient water volume to allow for laboratory analysis of the full suite of analytical constituents (see **Section 5.1.2**, below), and it is anticipated that the wells will continue to do so in the future.

5.1.1 Sampling Frequency

At most solid waste landfills, detection monitoring is performed on a semi-annual basis in May and November in accordance with 10 CSR 80-3.010 (11)4. However, per a July 30, 2014 comment letter from the SWMP (MDNR 2014b), the Bridgeton Landfill is currently sampled on a quarterly basis. Quarterly sampling is normally performed in the months of February, May, August, and November, although a sampling event may be extended into the preceding or following month if necessary due to logistical constraints.

The sampling schedule for the detection monitoring program is summarized on **Table 5-2**. Most of the facility's detection monitoring wells are sampled on a quarterly basis. However, one well is sampled on an annual basis in May: Alluvial well PZ-114-AS.

As described in the GWTR (Feezor 2016) and December 26, 2017 *Groundwater Evaluation Report* (GWER) (Feezor 2017), it has previously been acknowledged by both Bridgeton Landfill, LLC and the SWMP that organic constituent detections observed at well PZ-114-AS are likely attributable to an off-site source. This source originates from the Virbac Animal Health (formerly PM Resources, Inc.) property located across St. Charles Rock Road from the facility (MDNR 2003). In an April 27, 2018 comment letter, the MDNR approved a reduction in sampling frequency at PZ-114-AS from quarterly to annual sampling (MDNR 2018).

Consistent with the MDNR's April 27, 2018 letter, Keokuk Zone wells PZ-100-KS, PZ-106-KS, PZ-111-KS will be sampled on a quarterly basis until sufficient background data are available for statistical evaluation, using the procedures presented in the companion

Statistical Analysis Plan. Afterwards, sampling frequency at these three Keokuk zone wells will be reduced to an annual basis.

5.1.2 Analytical Constituents

During each quarterly detection monitoring event, the detection monitoring wells listed in **Section 5.1** will be analyzed for the constituents specified in 10 CSR 80-3.010(11)(C)4.B, including those listed and Appendix I to 10 CSR 80-3.010. **Appendix B** presents a summary of these routine quarterly analytical constituents and suggested analytical methods.

5.2 Assessment Monitoring Network

The current groundwater assessment monitoring network for the Bridgeton Landfill is comprised of 22 wells, screened within four separate hydrogeologic zones:

<u>Alluvial Wells</u>

- D-85$^{(D)}$
- I-73$^{(D)}$
- PZ-112-AS$^{(D)}$
- PZ-114-AS$^{(D)}$
- PZ-205-AS$^{(D)}$
- PZ-207-AS$^{(D)}$
- S-84$^{(D)}$

<u>St. Louis / Upper Salem Wells</u>

- PZ-101-SS$^{(D)}$
- PZ-103-SS$^{(D)}$
- PZ-104-SS$^{(D)}$
- PZ-107-SS$^{(D)}$
- PZ-116-SS$^{(D)}$
- PZ-202-SS$^{(D)}$
- PZ-209-SS
- PZ-210-SS
- PZ-211-SS

<u>Deep Salem Wells</u>

- MW-1204$^{(D)}$
- PZ-104-SD$^{(D)}$
- PZ-209-SD
- PZ-210-SD
- PZ-211-SD

<u>Keokuk Wells</u>

- PZ-104-KS$^{(D)}$

Wells indicated with $^{(D)}$ are a part of the facility's detection monitoring network, but are also currently used as wells to evaluated the rate and extent of impacts under the assessment monitoring program. When assessment monitoring is no longer required at one of these wells, pursuant to 10 CSR 80-3.010(11)(C)6.G, routine detection monitoring will be reinstated at that well.

Table 5-1 summarizes the basic as-built information for the facility's groundwater assessment monitoring wells. **Figure 5-2** illustrates the layout of the assessment monitoring network. The facility's assessment monitoring program – including sampling frequencies,

analytical constituents, and groundwater protection standards – is discussed in greater detail in the companion AMP.

5.3 Piezometer (Groundwater Elevation) Network

On a quarterly basis – typically as a part of the detection sampling event – a depth to static groundwater measurement is made at each of the facility's monitoring wells and piezometers (see the Groundwater Sampling and Analysis Plan in **Section 6**, below). The facility's piezometers are monitoring locations that are not routinely sampled, but are still used for the purposes of this determination of depth to static groundwater (and groundwater elevation).

The piezometer network for the Bridgeton Landfill is comprised of six wells, screened within three separate hydrogeologic zones:

Alluvial Wells	St. Louis / Upper Salem Wells	Deep Salem Wells
• D-87		• PZ-212-SD
• I-67	• PZ-208-SS	
• LR-103	• PZ-212-SS	

Table 5-1 summarizes the basic as-built information for the facility's groundwater piezometers. **Figure 5-3** illustrates the piezometer network.

6 SAMPLING AND ANALYSIS PLAN

This section and **Section 7** present the groundwater sample collection, handling, and reporting procedures for the Bridgeton Landfill. This section constitutes an update to the facility's November 1998 GWSAP (Herst 1998).

The facility or its designated sampling consultant will adhere to these methods when conducting groundwater monitoring events. These methods are intended to yield representative and comparable groundwater analytical results from each monitoring well during each monitoring event. All field activities will be conducted in a manner that is consistent with the facility's *Health and Safety Plan* (Bridgeton Landfill, LLC 2016).

Laboratory analysis of groundwater samples shall be performed by each laboratory according to their established standard operating procedures. Each laboratory shall produce and maintain complete documentation of its analytical work.

The sampling of a groundwater monitoring well generally consists of the following steps, which are described in more detail in **Sections 6.1** through **6.3**, below:

- Determination of static groundwater elevation;
- Well purging; and
- Collection of samples.

6.1 Determination of Static Groundwater Elevation

A depth to static groundwater measurement will be performed at each groundwater monitoring well prior to purging. Static groundwater elevation will be determined for each well by subtracting the measured depth to static groundwater from the surveyed elevation of the top of the well riser (inner casing).

In addition, a total well depth measurement will be performed annually at each groundwater monitoring well and piezometer. For wells with dedicated pumps installed, a depth to top of pump measurement may be performed in lieu of a total well depth measurement. In such cases, the total well depth may be determined by referencing as-built construction diagrams.

Depth measurements will be recorded to the nearest 0.01 foot, measured from a permanent reference mark located on the top of the well riser. Immediately following the water level measuring device's use at each well, those parts of the device that come into contact with groundwater will be cleaned with a non-phosphate detergent and then rinsed with deionized water. This cleaning is performed to minimize the potential for cross-contamination.

The facility's groundwater monitoring wells and piezometers will be routinely evaluated for indications that sediment is accumulating inside the well in substantial quantities and thereby potentially restricting inflow of groundwater. Monitoring results that may indicate substantial sediment accumulation include reductions in groundwater elevations and yields over time. These indicators or other field observations suggest that there is an issue with sediment accumulation, the facility will investigate further. Other methods that may be used to verify this accumulation include performance of slug tests, inspection via downhole camera, and removal of dedicated pump equipment (where present) for total well depth measurement and comparison to as-built information.

If it is verified that substantial sediment has accumulated in a monitoring well, the well will be redeveloped in a manner consistent with 10 CSR 23-3.030(10). A standard redevelopment methodology consists of alternating sessions of surging via block/disc and pumping to remove sediment. The specific methods used to redevelop a given will be determined on a case-by-case basis, and based in part on well design, sediment character and quantity, aquifer properties, and other factors.

6.2 Well Purging

Purging of monitoring wells prior to sample collection is necessary to remove stagnant or thermally stratified groundwater from the well casing and sandpack that may not be representative of groundwater within the aquifer. If possible, purging of a well should be performed at a rate at or below the well's recovery rate, to minimize the migration of groundwater above the well screen. Purged groundwater water will be containerized and disposed of in the facility' leachate treatment system.

Throughout the purging process, the purged groundwater will be monitored for field parameters: pH, specific conductance, temperature, turbidity, dissolved oxygen, and oxidation-reduction potential (ORP). Field parameter values will be monitored and recorded at regular intervals, with a minimum interval of five minutes. Field instruments utilized for parameter monitoring will be calibrated according to the manufacturers' recommendations.

Purging will continue until field parameter equilibrium is achieved. Equilibrium is achieved when parameters exhibit variation equal to or less than the following, for a minimum of three consecutive field parameter readings:

- pH (0.1 standard pH units)
- Specific conductance (10%)
- Temperature (0.5 °C)

Allowances may be made regarding the definition of equilibrium based on the aquifer's characteristics at individual wells. Turbidity, dissolved oxygen, and ORP will be monitored and recorded, but not used for the determination of equilibrium.

If a well purges dry prior to the achievement of field parameter equilibrium, the well will be purged to the lowest reasonable groundwater elevation, permitted to recover, and then sampled within 24 hours of the completion of purging.

If dedicated or disposable purging equipment is not utilized, the equipment will be cleaned following its use at each well, to minimize the potential for cross-contamination (see **Section 6.4** below).

A pump will be utilized to perform purging of groundwater monitoring wells. Low-flow purging is the recommended method of pump purging at the Bridgeton Landfill. This method utilizes a pump that is capable of relatively low pumping rates. For most of the monitored groundwater zones, the pump is set within the well's screened interval. The exception is wells with exceptionally deep screened intervals (i.e., Keokuk Zone wells PZ-100-KS, PZ-104-KS, PZ-106-KS, and PZ-111-KS). The pump installation at such wells incorporates an intake drop tube that extends to the screened interval, while the pump itself is set at a higher elevation. During low-flow purging, a pumping rate of 200 to 450 mL/min is typically utilized at the Bridgeton Landfill.

During low-flow purging via pump, pumping rates will be regulated or controlled to minimize turbulent flow, prevent damage to monitoring well components, and minimize the introduction of sediments into the well. Prior to recording field parameters, a minimum groundwater volume will be purged from the well, equal to two times the volume of the pump and its associated tubing. Field parameter measurements will be recorded at regular time intervals. A flow-through cell will be used for all field parameter measurements other than turbidity, to ensure that each instrument's sensor is in contact with flowing purge water. When utilizing low-flow purging methods, purging will continue until field parameter equilibrium has been achieved (if possible). Approximate pumping rates and the approximate volume of groundwater removed from the well will be recorded on the well's field log.

6.3 Sample Collection

A groundwater monitoring well may be sampled as soon as field parameters have stabilized, or, if purged to dryness, as soon as it has recovered sufficiently, but typically no more than 24 hours after purging. The same methods utilized for well purging will be utilized for sample collection. The groundwater sample will be transferred to sample containers in such a manner as to minimize agitation and aeration; sample bottles will be filled directly from the pump's discharge tube. Field parameters will be measured and recorded at the time of sampling. If the well is sampled immediately after purging, the final

set of purging parameter values may be used for this purpose. If the well is sampled later, a new set of parameter values will be measured and recorded concurrently with sampling.

Individual sample containers will be filled in order of decreasing sensitivity to potential volatilization of the analytical constituents, as specified on **Table 6-1**. This table is organized according to the preservation methods associated with the suggested analytical methods listed in **Appendix B**.

Sample containers (vials) for volatile organic compound (VOC) analysis should be filled in such a manner as to eliminate head space within the container. If bladder pumps are used for the collection of VOC samples, the pump setting should be set so that one pulse will deliver sufficient water to fill a 40 mL VOC vial.

6.4 Equipment Cleaning

If utilized, non-dedicated, non-disposable purging and sampling equipment will be cleaned following use at each monitoring well. Cleaning will consist of a wash with a non-phosphate detergent solution, followed by a rinse, both inside and out, with distilled water. Disposable equipment will not be reused after its initial use, and will be placed in a trash bag and disposed of properly on-site.

6.5 Sample Handling

As soon as possible after collection, groundwater samples should be placed in a laboratory-provided cooler out of direct sunlight. Sample bottles will be received pre-preserved from the laboratory. Preservation methods include pH adjustment, chemical addition, and cooling of the sample to a minimum temperature. The specific preservation methods associated with the suggested analytical methods are presented with the detection monitoring constituent list in **Appendix B**.

6.6 Sample Documentation and Chain-of-Custody

6.6.1 Field Logs

Field logs will be prepared for each groundwater monitoring event conducted at the facility. In the event that an unexpected or apparently anomalous groundwater analysis result occurs, the logs may assist in determining if the result is attributable to the circumstances of sample collection rather than a true change in groundwater quality. It is recommended that a discrete field log sheet be prepared for each groundwater monitoring well that is sampled. The following information should be recorded on each field log sheet:

- Facility name and location;
- Well name or designation;
- Names and affiliation(s) of sampling personnel;

- Well purging method and equipment (including whether equipment is dedicated or non-dedicated);
- Depth to static groundwater prior to purging, total well depth (measured or as-built), and depth to top of pump (if applicable);
- Calculated groundwater elevation;
- Depth to groundwater and groundwater elevation from the previous measurement/sampling event;
- Well inner casing diameter;
- Purging/sampling equipment settings (e.g., pressure);
- Date and time of well purging (start and end time);
- Approximate well purging rate (if applicable);
- Approximate volume of groundwater purged, including tubing volume;
- Depth to groundwater immediately after purging;
- Field parameter readings;
- Make, model, and serial number of field parameter instruments;
- Documentation of field instrument calibration procedures and calibration checks (if not documented in site field book);
- Sample collection method and equipment (including whether equipment is dedicated or non-dedicated);
- Depth to groundwater at time of sampling (if sampling is not performed immediately after purging);
- Date and time of sample collection;
- Field parameter readings at time of sampling (if different from final set of field parameters from purging);
- Appearance of sample;
- Weather conditions and other field observations at the time of sample collection;
- Number of bottles collected; and
- Type of monitoring event (e.g., detection, assessment, resample, special, etc.)

6.6.2 Sample Labels

A label will be affixed to each sample container to assist in proper sample identification. Sample labels will be sufficiently durable to remain legible even when wet. The following information should be included on each sample label:

- Well name or designation, or other identifying description (e.g., “Trip Blank”);
- Name or initials of sampling personnel;
- Date and time of sample collection (if applicable);
- Preservatives utilized (if applicable); and
- Constituents and/or methods requested for analysis (space permitting) or laboratory code designating same.

6.6.3 Chain-of-Custody Record

A chain-of-custody (CoC) record will accompany each shipment of groundwater samples to the analytical laboratory. The CoC record documents the history of the collection, transfer, and transport of each sample. The record facilitates the tracing of the possession of each groundwater sample from collection through laboratory analysis. Each individual responsible for the samples from the time of field collection through the time of receipt by the analytical laboratory will be consecutively documented on the CoC record. Each sample that is shipped, including quality assurance / quality control samples (see **Section 6.7**, below), will be identified on the CoC record. The CoC record should include sufficient copies such that each individual involved in the chain of possession receives their own copy.

The following information should be included on the CoC record:

- Facility name and location;
- Well name or designation, or other identifying description (e.g., "Trip Blank") for each sample;
- Names, affiliation(s), and signature of sampling personnel;
- Date and time of sample collection (if applicable) for each sample;
- Sample type or matrix (e.g., "Groundwater") for each sample;
- Number of containers for each sample;
- Constituents and/or methods requested for analysis;
- Preservatives utilized (if applicable) for each sample;
- Names and signatures of all persons involved in the chain of possession;
- Inclusive dates and times of possession;
- Internal temperature of shipping container when opened at laboratory (if applicable);
- Comments regarding any unusual circumstances or conditions (e.g., containers that could be filled only partially due to groundwater volume limitations); and
- Any applicable time constraints (e.g., 48-hour turnaround time for sample analysis).

6.7 Field Quality Assurance / Quality Control Samples

The collection and analysis of field quality assurance / quality control (QA/QC) samples allows for verification that the collection and handling process has not affected the quality of the groundwater samples. Quality control relates to the integrity of samples during collection and shipping. QC is addressed through the incorporation of trip blanks, field blanks, and equipment blanks into the analytical program. Quality assurance relates to the accuracy and repeatability of the analytical results. QA is addressed through the incorporation of field duplicate and matrix spike / matrix spike duplicate (MS/MSD) samples into the analytical program.

Field QA/QC samples will be prepared in the same manner as groundwater samples from monitoring wells with respect to sample volume, containers, and preservation.

6.7.1 Trip Blanks

A trip blank is utilized to document potential sample contamination attributable to shipping and handling procedures — specifically, to assess potential contamination associated with VOCs. A trip blank typically consists of deionized water placed into appropriate sample containers by the analytical laboratory. The trip blank is placed in the shipping container with the other (empty) sample containers and shipped to the site. The trip blank is then shipped with the collected groundwater samples and other QA/QC samples back to the laboratory. Trip blanks are not opened during sampling activities. One trip blank sample will be shipped to the analytical laboratory on each day that VOC samples are shipped.

6.7.2 Field (Atmospheric) Blanks

A field (or atmospheric) blank is utilized to document the potential influences on sample quality that are attributable to site conditions at the time of sample collection. A field blank consists of deionized water poured into sample containers at the facility during field sampling activities and under the same general environmental conditions as groundwater monitoring well samples. A minimum of one field blank will be collected and shipped to the analytical laboratory per week during the sampling event.

6.7.3 Equipment Blanks

An equipment (or rinsate) blank is utilized to document adequate decontamination procedures for non-dedicated purging and sampling equipment (this does not apply to water level measuring devices). Following decontamination of equipment (see **Section 6.4**, above), an equipment blank is prepared by pouring deionized water into or over the decontaminated equipment and then collecting this water into sample containers. Equipment blanks are not required if dedicated purging and sampling equipment is utilized, as it typically is at the Bridgeton Landfill. If non-dedicated equipment is used, a minimum of one equipment blank will be collected and shipped to the analytical laboratory per day.

6.7.4 Field Duplicates

A field duplicate sample (or co-located sample) is utilized to document the precision of the sampling procedures. A field duplicate sample consists of an independent sample collected as close as possible to the primary groundwater monitoring well sample in both location and time. The primary and field duplicate sample are collected from the same groundwater monitoring well, stored in separate sample containers, and analyzed independently by the same analytical methods and laboratory. A minimum of one field duplicate will be collected and shipped to the analytical laboratory for every 20 samples shipped.

6.8 Field Logbook

Field logbook(s) will be maintained on an ongoing basis for the facility's groundwater monitoring program. Each day of field activities will be documented in the field logbook,

which will serve as a record of general field observations, significant events, and any information not otherwise documented on the individual sampling field log sheets (see **Section 6.6.1**, above). The following information may be included in the field logbook:

- Facility name and location;
- Names and affiliation(s) of sampling personnel;
- Work start and end times;
- Weather conditions, including changes throughout the sampling day;
- Documentation of field instrument calibration procedures and calibration checks (if not documented on field log sheets);
- Observations of any damage to or suspected tampering of monitoring wells;
- Observations indicating a need for well development; and
- Details regarding any unusual or unexpected occurrences during the monitoring event.

7 REPORTING

For each detection monitoring event, the results generated by field activities and laboratory analysis of samples will be evaluated to determine whether a statistically significant increase (SSI) over background has occurred, in accordance with 10 CSR 80-3.010(11)(C)5. The sampling results and the statistical evaluation will be presented in a groundwater detection monitoring report.

The quarterly depth to static groundwater measurements performed concurrently with groundwater sample collection will be utilized to prepare a set of four potentiometric surface maps for the monitoring event, corresponding to the Alluvial, St. Louis / Upper Salem, Deep Salem, and Keokuk Zones. These potentiometric surface maps will be included in the detection monitoring report.

In accordance with 10 CSR 80-3.010(11)(C)4.C, the detection monitoring report for each sampling event will be submitted to the MDNR within 90 days of the date on which the first sample was collected. In accordance with 10 CSR 80-3.010(11)(C)4.E, an electronic deliverable of the analytical results will also be submitted to the MDNR. The deliverable will be formatted and submitted as described in the MDNR's online instructions:

https://dnr.mo.gov/env/swmp/gdwtrsub.htm

The statistical methods used to evaluate results from the Bridgeton Landfill are described in detail in the companion *Statistical Analysis Plan*.

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TABLES

5-1 Groundwater Monitoring Wells and Piezometers
5-2 Detection Monitoring Schedule
6-1 Recommended Order of Groundwater Sample Container Collection

Table 5-1
Groundwater Monitoring Wells and Piezometers
Bridgeton Landfill, LLC - Bridgeton, Missouri

Well Designation	Alias	Well Type	Installation Date	Original Ground Surface Elev. (ft/msl)	Original Ground Surface Ref.	Current Location Northing	Current Location Easting	Current Ground Surface Elevation (ft/msl)	Current Top of Riser Elevation (ft/msl)	Survey	Inner Casing Diam. (in.)	Riser Material	Screen Material	Screen Length (ft)	Depth to Top of Screen (ft)	Depth to Bottom of Screen (ft)	Top of Screen Elevation (ft/msl)	Bottom of Screen Elevation (ft/msl)	Screen Ref.	Comments
Keokuk Zone																				
PZ-100-KS	1209	D	2/17/1995	483.80	AB	1,068,842.1	517,211.6	485.22	486.36	8/12	2	PVC	PVC	9.80	374.00	383.80	109.80	100.00	AB (Depth)	
PZ-104-KS	1215	D / A	6/19/1995	482.30	AB	1,066,993.0	516,820.5	482.24	484.60	8/12	2	PVC	PVC	9.80	397.37	407.17	84.93	75.13	AB (Depth)	
PZ-106-KS	1219	D	3/23/1995	461.80	AB	1,066,703.7	515,432.2	462.55	464.73	8/12	2	PVC	PVC	9.77	363.75	373.52	98.05	88.28	AB (Depth)	
PZ-111-KS	1225	D	5/6/1995	459.20	AB	1,068,621.0	515,850.5	461.74	465.80	8/12	2	PVC	PVC	9.81	357.15	366.96	102.05	92.24	AB (Depth)	F-1-D is upper geology reference.
Deep Salem Zone																				
MW-1204	1204	D / A	4/5/1991	483.30	AB	1,066,420.2	515,824.3	475.80	478.04	4/16	2	PVC	PVC	10.00	213.50	223.50	269.80	259.80	AB (Depth)	No log available.
PZ-100-SD	1208	D	2/23/1995	484.40	AB	1,068,851.8	517,195.3	484.89	486.49	8/12	2	PVC	PVC	9.80	234.80	244.60	249.60	239.80	AB (Depth)	
PZ-104-SD	1214	D / A	6/17/1995	482.10	AB	1,067,013.2	516,834.6	481.88	484.15	8/12	2	PVC	PVC	9.80	235.20	245.00	246.90	237.10	AB (Depth)	
PZ-106-SD	1218	D	3/26/1995	461.50	AB	1,066,714.7	515,416.0	461.82	463.84	8/12	2	PVC	PVC	9.80	190.79	200.59	270.71	260.91	AB (Depth)	
PZ-111-SD	1224	D	4/21/1995	459.20	AB	1,068,637.2	515,834.3	462.35	466.58	8/12	2	PVC	PVC	9.80	199.40	209.20	259.80	250.00	AB (Depth)	
PZ-209-SD		A	10/4/2013	487.24	AB	1,067,075.7	517,104.4	487.24	489.58	10/13	2	PVC	PVC	10.00	240.00	250.00	247.24	237.24	AB (Depth)	
PZ-210-SD		A	10/16/2013	484.48	AB	1,066,824.0	516,773.1	484.48	487.00	10/13	2	PVC	PVC	10.00	238.00	248.00	246.48	236.48	AB (Depth)	
PZ-211-SD		A	10/8/2013	484.83	AB	1,067,056.7	517,016.6	484.83	487.46	10/13	2	PVC	PVC	110.00	237.00	347.00	247.83	137.83	AB (Depth)	
PZ-212-SD		P	10/21/2013	480.48	AB	1,067,495.7	517,980.4	480.48	482.72	10/13	2	PVC	PVC	10.00	234.00	244.00	246.48	236.48	AB (Depth)	
St. Louis / Upper Salem Zone																				
PZ-100-SS	1207	D	2/25/1995	484.40	AB	1,068,867.8	517,175.0	485.24	486.55	8/12	2	PVC	PVC	19.64	73.96	93.60	410.44	390.80	AB (Depth)	
PZ-101-SS	1210	D / A	3/6/1995	474.90	AB	1,068,473.1	516,622.3	491.68	493.08	1/17	2	PVC	PVC	9.80	129.48	139.28	345.42	335.62	AB (Depth)	
PZ-102-SS		D	3/12/1995	482.10	AB	1,068,087.7	516,887.9	482.46	484.65	8/12	2	PVC	PVC	9.80	79.70	89.50	402.40	392.60	AB (Depth)	
PZ-102R-SS	1211	D	6/18/1995	484.46	AB	1,068,131.6	516,858.4	486.20	488.56	1/17	2	PVC	PVC	9.80	79.83	89.63	404.63	394.83	AB (Depth)	
PZ-103-SS	1212	D / A	2/27/1995	477.80	AB	1,067,660.3	516,723.1	480.31	484.21	8/12	2	PVC	PVC	9.80	134.70	144.50	343.10	333.30	AB (Depth)	
PZ-104-SS	1213	D / A	6/4/1995	481.60	AB	1,067,027.8	516,847.3	482.05	484.00	8/12	2	PVC	PVC	9.80	134.50	144.30	347.10	337.30	AB (Depth)	
PZ-105-SS	1216	D	5/24/1995	481.20	AB	1,066,421.2	516,230.4	481.21	484.04	8/12	2	PVC	PVC	9.80	138.50	148.30	342.70	332.90	AB (Depth)	
PZ-106-SS	1217	D	4/5/1995	461.00	AB	1,066,726.1	515,399.9	461.35	463.12	8/12	2	PVC	PVC	9.80	155.30	165.10	305.70	295.90	AB (Depth)	
PZ-107-SS	1220	D / A	5/22/1995	462.60	AB	1,067,163.1	515,254.6	463.25	465.41	8/12	2	PVC	PVC	9.80	92.60	102.40	370.00	360.20	AB (Depth)	
PZ-109-SS	1222	D	4/25/1995	456.80	AB	1,068,012.0	516,114.1	457.65	460.19	11/14	2	PVC	PVC	9.80	125.70	135.50	331.10	321.30	AB (Depth)	
PZ-111-SS		D	8/29/2017	464.63	AB	1,068,591.0	515,814.7	462.11	464.63	9/17	2	PVC	PVC	10.00	103.00	113.00	361.63	351.63	AB (Depth)	
PZ-113-SS	1229	D	5/20/1995	460.00	AB	1,069,242.0	515,776.6	460.06	462.66	8/12	2	PVC	PVC	9.80	148.57	158.37	311.43	301.63	AB (Depth)	
PZ-115-SS	1231	D	5/21/1995	450.60	AB	1,069,408.7	516,755.2	450.62	453.00	8/12	2	PVC	PVC	9.80	74.68	84.48	375.92	366.12	AB (Depth)	
PZ-116-SS	1232	D / A	6/20/1995	483.10	AB	1,066,410.5	515,843.7	475.80	478.21	4/16	2	PVC	PVC	9.60	151.40	161.00	331.70	322.10	AB (Depth)	
PZ-200-SS		D	2/28/1995	483.60	AB	1,068,496.1	516,971.9	483.95	486.23	8/12	2	PVC	PVC	88.02	9.62	97.64	473.98	385.96	AB (Depth)	
PZ-201A-SS	1233	D	4/23/1995	478.40	AB	1,067,831.8	516,846.5	480.27	482.33	8/12	2	PVC	PVC	9.80	80.00	89.80	398.40	388.60	AB (Depth)	PZ-201-SS is upper geology reference.
PZ-202-SS	1234	D / A	3/12/1995	479.00	AB	1,067,320.2	517,101.4	479.88	481.82	8/12	2	PVC	PVC	48.90	40.20	89.10	438.80	389.90	AB (Depth)	
PZ-203-SS	1235	D	6/3/1995	484.20	AB	1,066,661.4	516,607.8	484.53	487.19	8/12	2	PVC	PVC	9.80	99.60	109.40	384.60	374.80	AB (Depth)	
PZ-204-SS		D	3/10/1995	467.00	AB	1,066,429.5	515,556.6	465.28	465.28	8/12	2	PVC	PVC	78.40	10.95	89.35	456.05	377.65	AB (Depth)	Flush mount surface completion.
PZ-204A-SS	1236	D	6/22/1995	466.70	AB	1,066,426.3	515,533.8	463.09	463.09	8/12	2	PVC	PVC	9.60	79.50	89.10	387.20	377.60	AB (Depth)	Flush mount surface completion.
PZ-205-SS	1238	D	5/21/1995	459.50	AB	1,067,483.7	515,477.0	461.68	465.18	9/17	2	PVC	PVC	9.80	88.57	98.37	370.93	361.13	AB (Depth)	
PZ-206-SS	1239	D	4/24/1995	458.40	AB	1,068,031.0	515,809.1	460.20	463.42	11/14	2	PVC	PVC	9.80	115.00	124.80	343.40	333.60	AB (Depth)	

Table 5-1
Groundwater Monitoring Wells and Piezometers
Bridgeton Landfill, LLC - Bridgeton, Missouri

Well Designation	Alias	Well Type	Installation Date	Original Ground Surface Elev. (ft/msl)	Original Ground Surface Ref.	Current Location Northing	Current Location Easting	Current Ground Surface Elevation (ft/msl)	Current Top of Riser Elevation (ft/msl)	Survey	Inner Casing Diam. (in.)	Riser Material	Screen Material	Screen Length (ft)	Depth to Top of Screen (ft)	Depth to Bottom of Screen (ft)	Top of Screen Elevation (ft/msl)	Bottom of Screen Elevation (ft/msl)	Screen Ref.	Comments
St. Louis / Upper Salem Zone (Continued)																				
PZ-208-SS	1241	P	6/18/1995	472.50	AB	1,069,219.2	517,169.4	472.88	475.19	8/12	2	PVC	PVC	9.80	88.70	98.50	383.80	374.00	AB (Depth)	
PZ-209-SS		A	10/5/2013	487.39	AB	1,067,071.5	517,108.6	487.39	489.68	10/13	2	PVC	PVC	10.00	140.00	150.00	347.39	337.39	AB (Depth)	
PZ-210-SS		A	10/16/2013	484.53	AB	1,066,828.4	516,777.4	484.53	486.90	10/13	2	PVC	PVC	10.00	138.00	148.00	346.53	336.53	AB (Depth)	
PZ-211-SS		A	10/8/2013	485.06	AB	1,067,060.8	517,012.2	485.06	487.41	10/13	2	PVC	PVC	10.00	137.00	147.00	348.06	338.06	AB (Depth)	
PZ-212-SS		P	10/18/2013	480.16	AB	1,067,491.0	517,976.5	480.16	482.79	10/13	2	PVC	PVC	10.00	134.00	144.00	346.16	336.16	AB (Depth)	
Alluvial Zone																				
D-85	WL-105A	D / A	8/22/1984	453.10	BHL	1,069,626.3	516,430.5	454.66	457.67	8/12	2	PVC	PVC	20.00	62.00	82.00	391.10	371.10	BHL (Depth)	No as-built available.
D-87		P	8/10/1984	460.00	BHL	1,069,211.4	515,404.7	461.62	464.41	8/12	2	PVC	PVC	20.00	91.00	111.00	369.00	349.00	BHL (Depth)	No as-built available.
I-67	N-6	P	Oct 1983	436.50	WS	1,070,101.4	516,234.8	439.74	441.78	8/12	2	PVC	PVC	10.00	25.40	35.40	411.10	401.10	WS (Elev)	No log or as-built available.
I-68	N-7	D	Oct 1983	440.90	WS	1,069,572.0	516,686.5	447.81	450.60	8/12	2	PVC	PVC	10.00	21.20	31.20	419.70	409.70	WS (Elev)	No log or as-built available.
I-73	38	D / A	6/23/1978	458.90	WS	1,067,695.2	515,570.7	459.44	461.96	11/14	2	PVC	PVC	3.00	43.20	46.20	415.70	412.70	WS (Elev)	No as-built available.
LR-103		P	10/20/1995	460.10	AB	1,068,526.6	515,217.5	467.27	470.64	8/12	2	PVC	PVC	9.80	28.60	38.40	431.50	421.70	AB (Depth)	
PZ-112-AS	1226	D / A	4/10/1995	457.90	AB	1,069,002.0	515,674.8	458.60	462.29	4/13	2	PVC	PVC	4.80	29.60	34.40	428.30	423.50	AB (Depth)	
PZ-113-AS	1227	D	4/11/1995	459.90	AB	1,069,224.0	515,747.7	459.98	462.19	8/12	2	PVC	PVC	9.80	28.90	38.70	431.00	421.20	AB (Depth)	
PZ-113-AD	1228	D	5/3/1995	459.90	AB	1,069,233.0	515,759.8	459.87	462.24	8/12	2	PVC	PVC	9.80	98.60	108.40	361.30	351.50	AB (Depth)	
PZ-114-AS	1230	D / A	4/20/1995	449.80	AB	1,069,419.0	516,768.3	449.97	452.14	8/12	2	PVC	PVC	9.80	19.90	29.70	429.90	420.10	AB (Depth)	
PZ-205-AS	1237	D / A	5/6/1995	459.30	AB	1,067,463.1	515,462.8	461.48	464.77	11/14	2	PVC	PVC	9.80	38.55	48.35	420.75	410.95	AB (Depth)	
PZ-207-AS	1240	D / A	4/10/1995	461.90	AB	1,069,645.0	516,037.6	460.38	462.17	4/13	2	PVC	PVC	4.80	34.90	39.70	427.00	422.20	AB (Depth)	
S-84		D / A	8/24/1984	452.90	WS	1,069,633.3	516,439.6	454.64	457.45	8/12	2	PVC	PVC	10.00	20.90	30.90	432.00	422.00	BHL (Depth)	No as-built available.

Notes
D: Detection monitoring well.
A: Assessment monitoring well.
P: Piezometer (groundwater elevation monitoring point).
AB: Original as-built diagram.
BHL: Original borehole log.
WS: Well Summary Table. 1997. Original document and author unknown.

Surveys
8/12 - Survey performed on 8/13, 8/21-22, 8/29, and 8/31/12.
4/13 - Survey performed on 4/17/13.
10/13 - Survey performed on 10/21 - 10/22/13.
11/14- Survey performed on 11/12/14.
4/16 - Survey performed on 4/7/16.
9/16 - Survey performed on 9/18/16.
1/17 -Survey performed on 1/30/17.
9/17 - Survey performed on 9/6/17.

Table 5-2
Detection Monitoring Schedule
Bridgeton Landfill, LLC - Bridgeton, Missouri

Well	Sampling Frequency
D-85	Q
I-68	Q
I-73	Q
MW-1204	Q
PZ-100-SS	Q
PZ-100-SD	Q
PZ-100-KS	Q / A*
PZ-101-SS	Q
PZ-102-SS	Q
PZ-102R-SS	Q
PZ-103-SS	Q
PZ-104-SS	Q
PZ-104-SD	Q
PZ-104-KS	Q
PZ-105-SS	Q
PZ-106-SS	Q
PZ-106-SD	Q
PZ-106-KS	Q / A*
PZ-107-SS	Q
PZ-109-SS	Q
PZ-111-SS	Q
PZ-111-SD	Q
PZ-111-KS	Q / A*
PZ-112-AS	Q
PZ-113-AS	Q
PZ-113-AD	Q
PZ-113-SS	Q
PZ-114-AS	A
PZ-115-SS	Q
PZ-116-SS	Q
PZ-200-SS	Q
PZ-201A-SS	Q
PZ-202-SS	Q
PZ-203-SS	Q
PZ-204-SS	Q
PZ-204A-SS	Q
PZ-205-AS	Q
PZ-205-SS	Q
PZ-206-SS	Q
PZ-207-AS	Q
S-84	Q

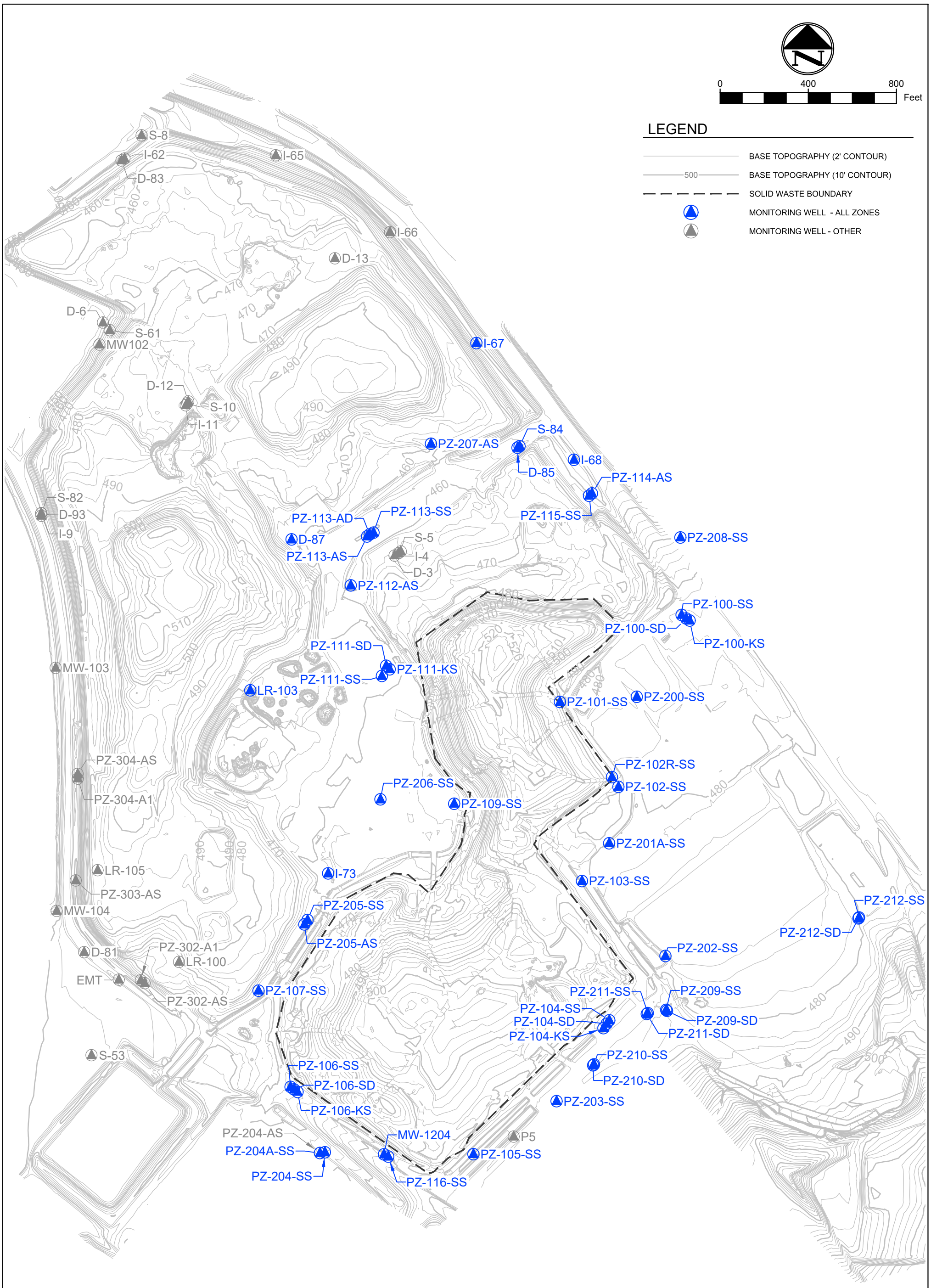
Notes
Q: Quarterly sampling in Feb, May, Aug, and Nov.
A: Annual sampling in May.
Q/A*: Wells PZ-100-KS, PZ-106-KS, and PZ-111-KS will be reduced from quarterly to annual sampling once sufficient background data are available for statistical evaluation.

Table 6-1
Recommended Order of Groundwater Sample Container Collection
Bridgeton Landfill, LLC - Bridgeton, Missouri

Sample Order	Constituents	Suggested Analytical Methods	Preservation Methods for Suggested Analytical Methods
1	VOCs	SW-846 8260	Cooled to ≤ 6 °C; HCl to pH < 2
2	Metals	SW-846 6010; SW-846 6020	HNO_3 to pH < 2
	Mercury	SW-846 7470	
	Hardness (Calculated as $CaCO_3$)	SM 2340	
3	Phosphorus	EPA 365.1	Cooled to ≤ 4 °C; H_2SO_4 to pH < 2
	Total Organic Carbon (TOC)	SM 5310C	
4	Ammonia (as Nitrogen)	SM 4500-NH_3 G	Cooled to ≤ 4 °C; H2SO4 to pH < 2
	Chemical Oxygen Demand (COD)	EPA 410.4	
	Nitrate + Nitrite (as Nitrogen)	EPA 353.2	
5	Chloride	SW-946 9056	Cooled to ≤ 6 °C (≤ 4 °C for SM)
	Fluoride		
	Sulfate		
	Total Dissolved Solids (TDS)	SM 2540C	

FIGURES

4-1 Groundwater Monitoring Network (All Zones)
4-2 Keokuk Zone Monitoring Network
4-3 Deep Salem Zone Monitoring Network
4-4 St. Louis / Upper Salem Zone Monitoring Network
4-5 Alluvial Zone Monitoring Network
5-1 Detection Monitoring Network (All Zones)
5-2 Assessment Monitoring Network (All Zones)
5-3 Piezometer Network (All Zones)



NOTES:

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BRIDGETON LANDFILL, LLC 13570 ST. CHARLES ROCK ROAD BRIDGETON, MISSOURI 63044	BRIDGETON LANDFILL GROUNDWATER MONITORING PLAN	Engineering for a Better World FEEZOR ENGINEERING, INC.	MAY 2018 DESIGNED BY: IN APPROVED BY: ---	DRAWING NO.:
GROUNDWATER MONITORING NETWORK (ALL ZONES)			REVISION DATE	**4-1**
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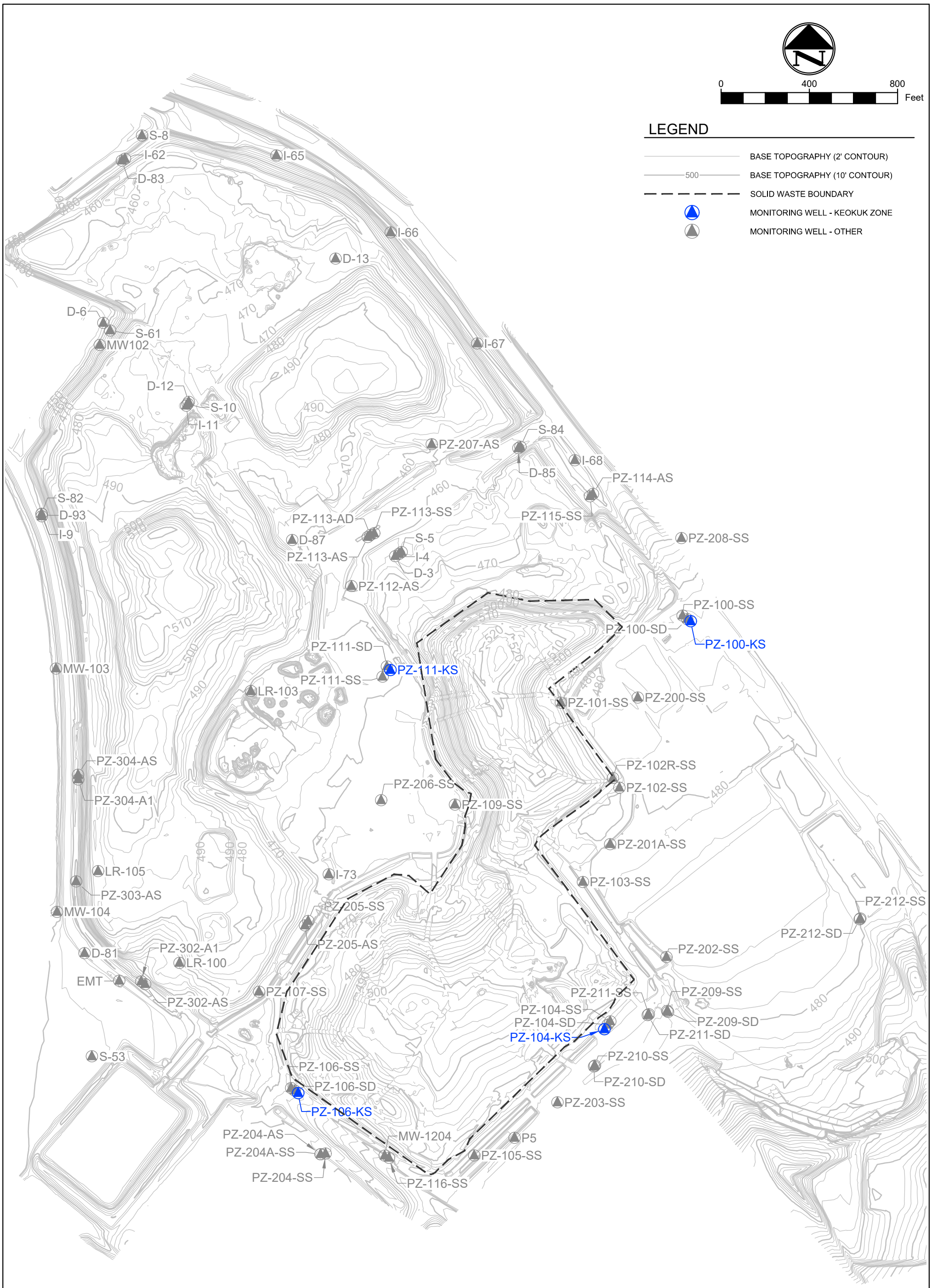

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KEOKUK ZONE MONITORING NETWORK			REVISION DATE	**4-2**
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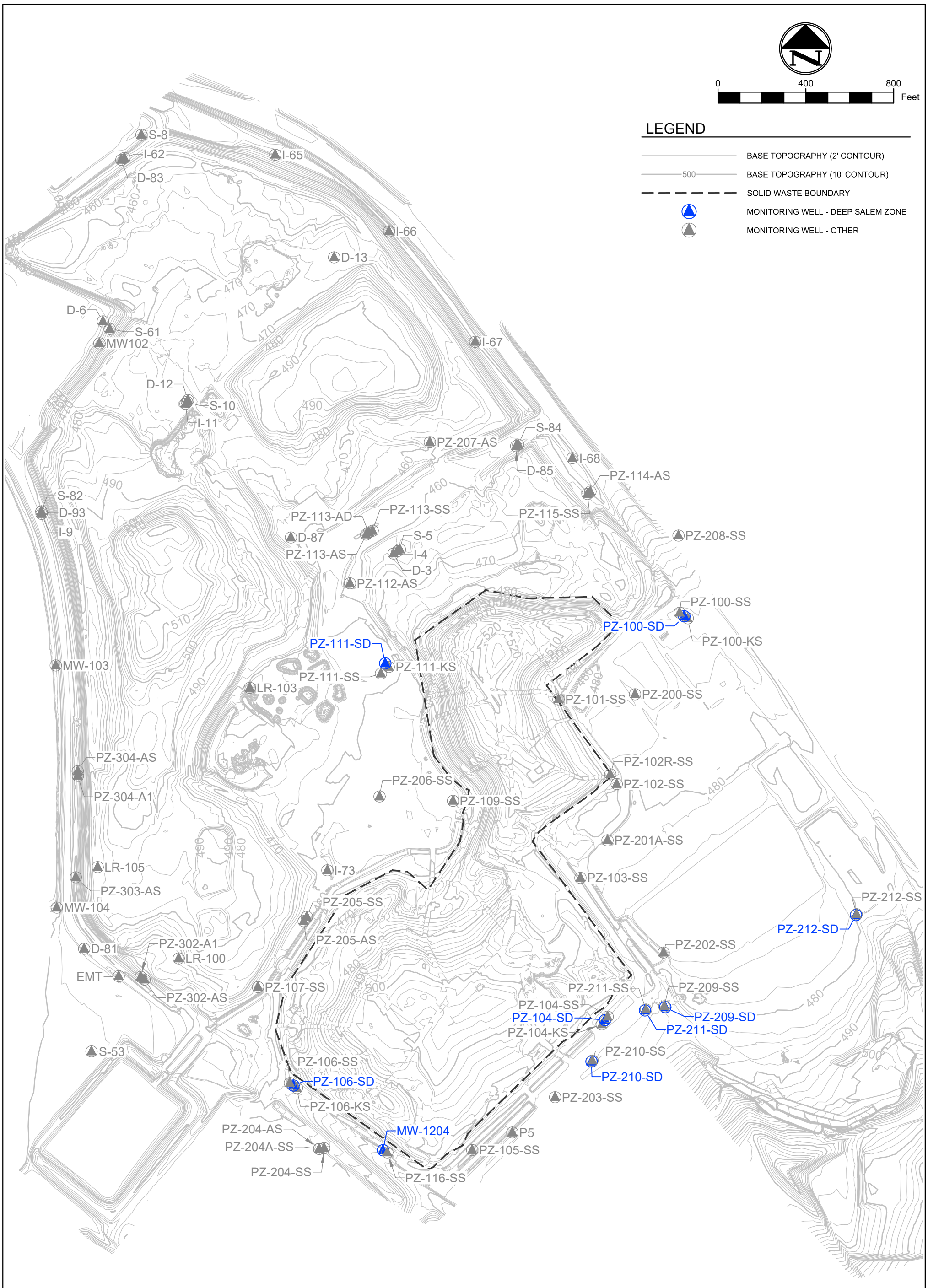

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DEEP SALEM ZONE MONITORING NETWORK			REVISION DATE	**4-3**
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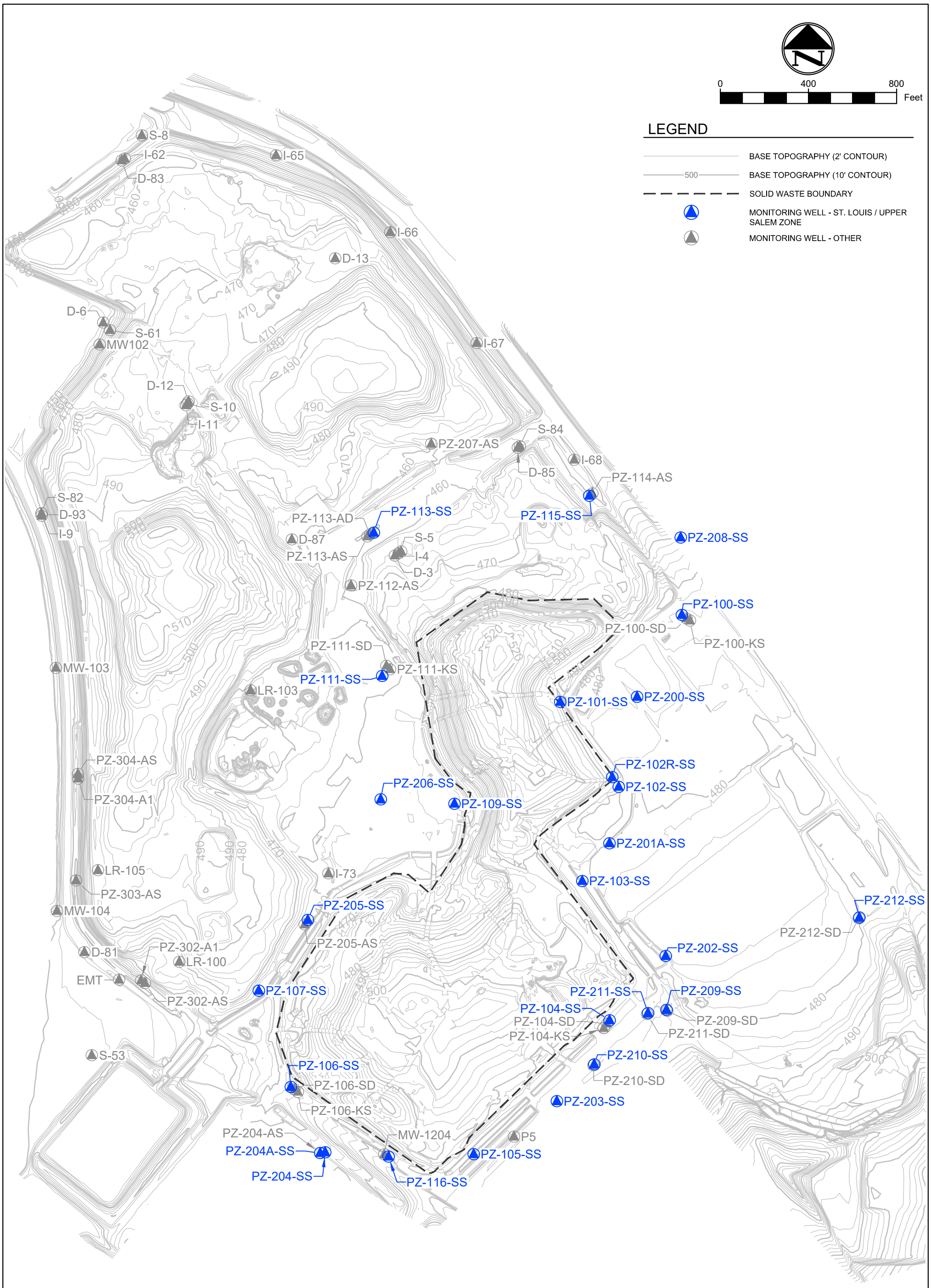

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ST LOUIS / UPPER SALEM ZONE MONITORING NETWORK			REVISION DATE	**4-4**
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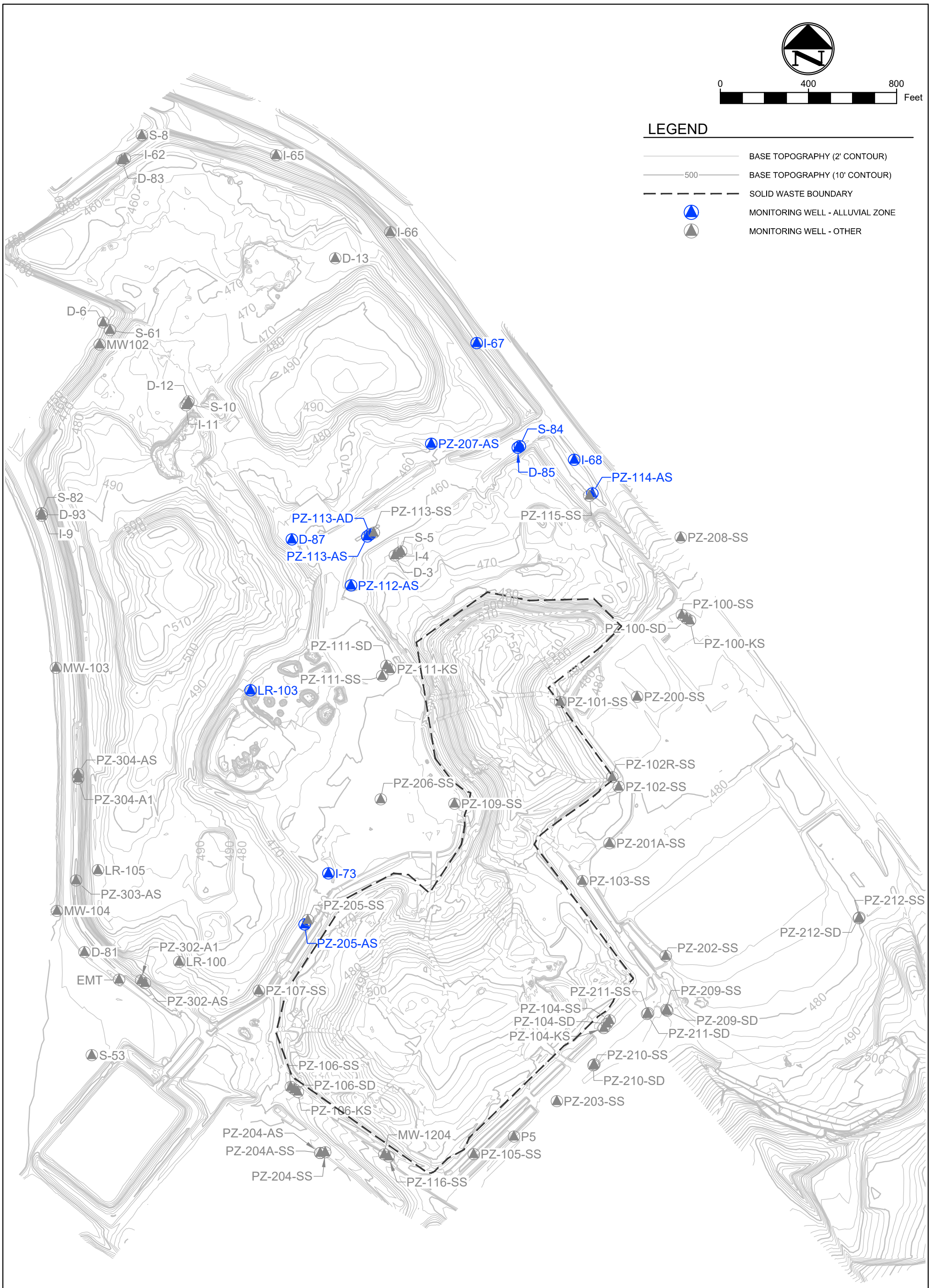

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BRIDGETON LANDFILL, LLC 13570 ST. CHARLES ROCK ROAD BRIDGETON, MISSOURI 63044	BRIDGETON LANDFILL GROUNDWATER MONITORING PLAN	Engineering for a Better World FEEZOR ENGINEERING, INC.	MAY 2018 DESIGNED BY: IN APPROVED BY: ---	DRAWING NO.:
ALLUVIAL ZONE MONITORING NETWORK			REVISION DATE	**4-5**
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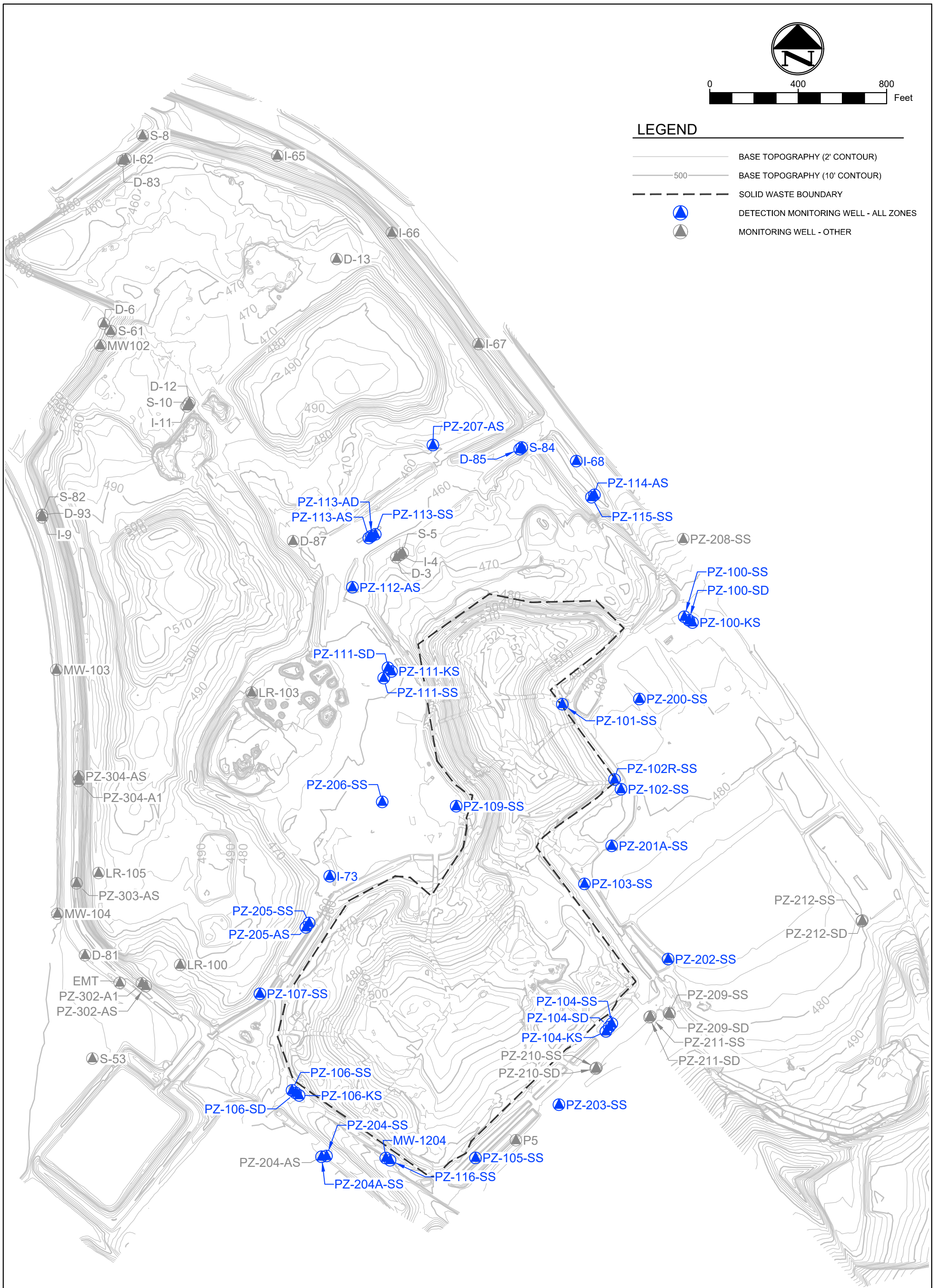

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BRIDGETON LANDFILL, LLC 13570 ST. CHARLES ROCK ROAD BRIDGETON, MISSOURI 63044	BRIDGETON LANDFILL GROUNDWATER MONITORING PLAN	Engineering for a Better World FEEZOR ENGINEERING, INC.	JANUARY 2019 DESIGNED BY: AMR APPROVED BY: ---	DRAWING NO.:
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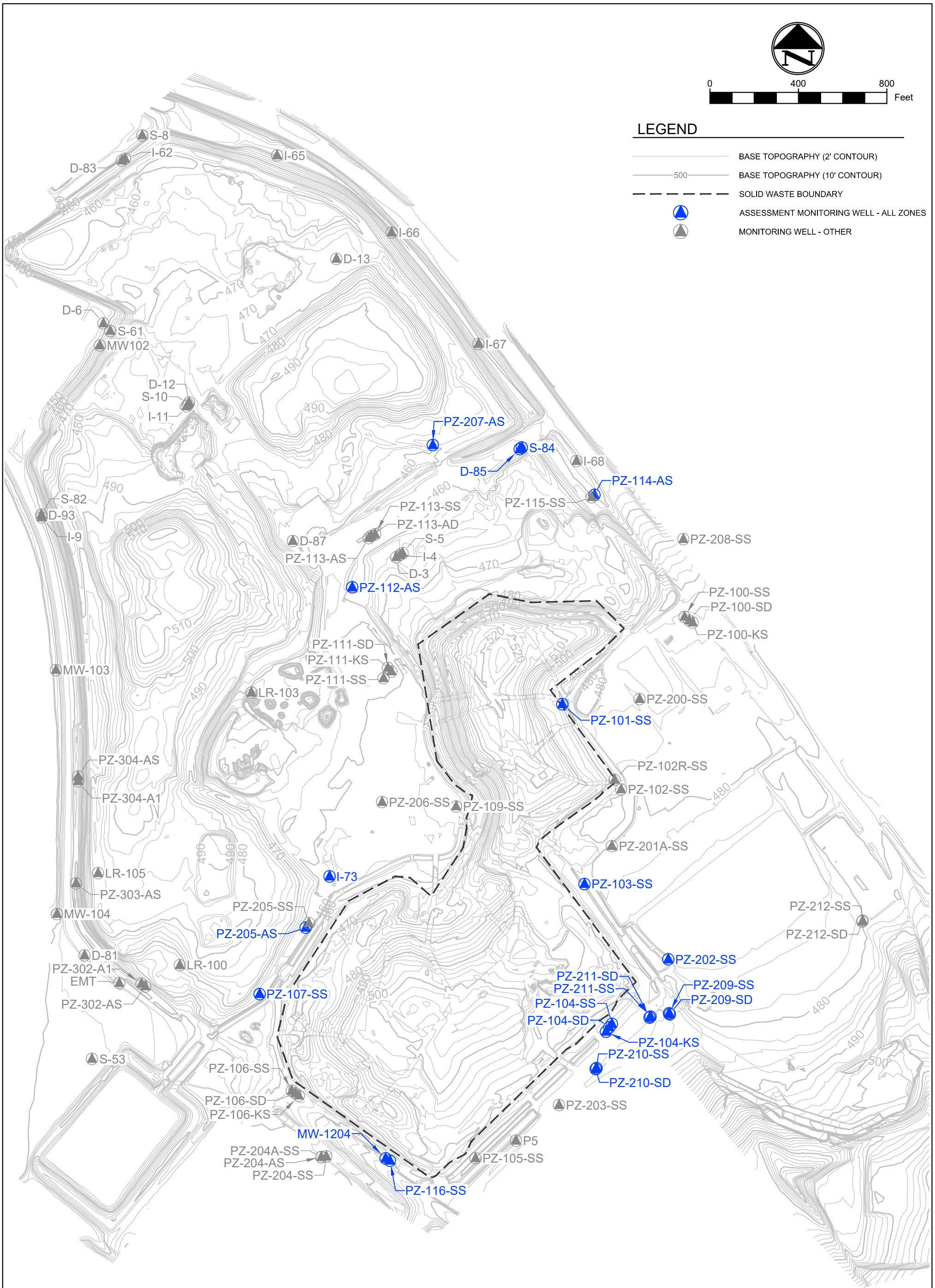
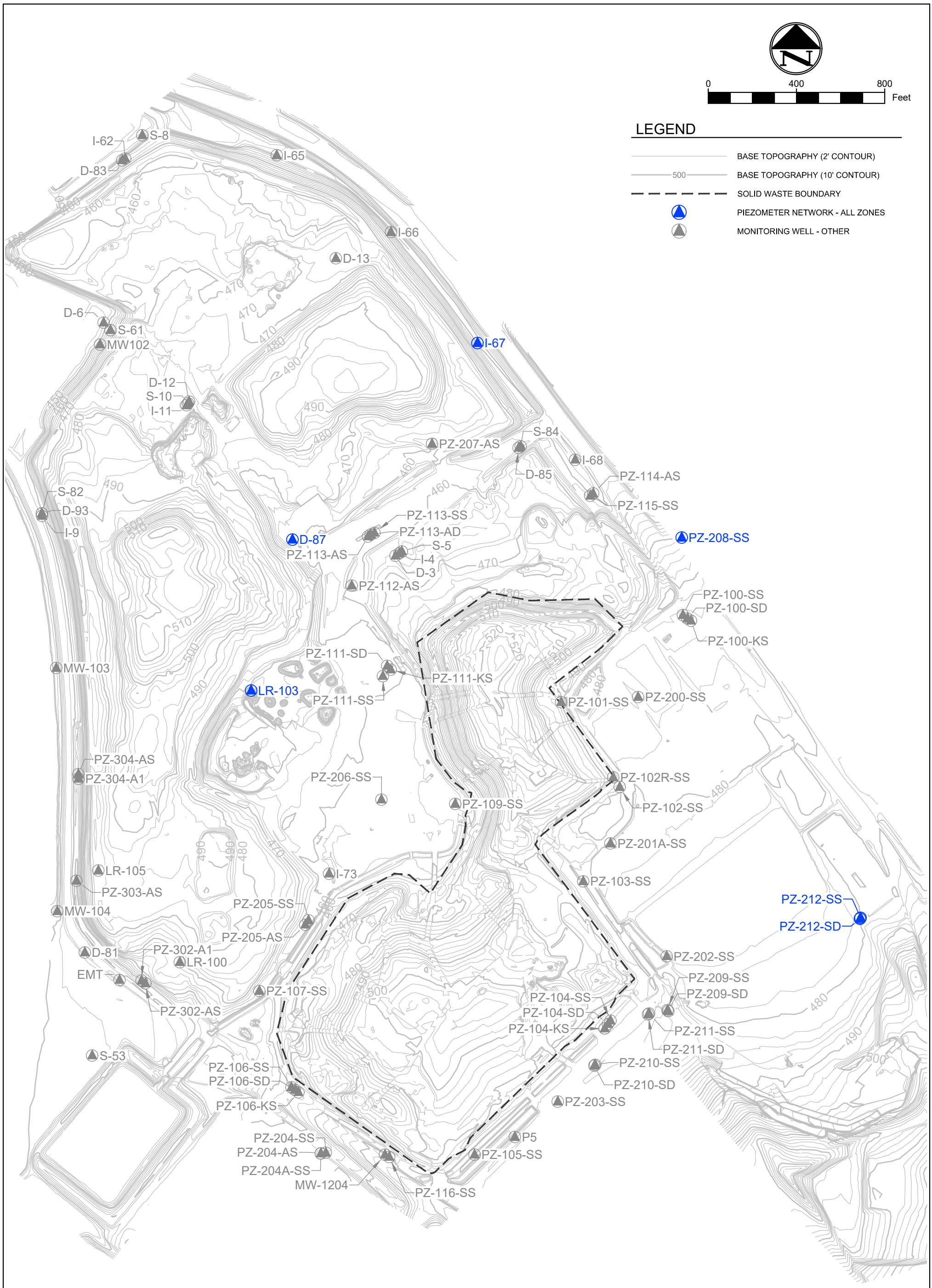


NOTES:

- *AERIAL TOPOGRAPHY PROVIDED BY COOPER AERIAL SURVEYS CO. AND IS DATED DECEMBER 1, 2017*

BRIDGETON LANDFILL, LLC 13570 ST. CHARLES ROCK ROAD BRIDGETON, MISSOURI 63044	BRIDGETON LANDFILL GROUNDWATER MONITORING PLAN	Engineering for a Better World FEEZOR ENGINEERING, INC.	MAY 2018 DESIGNED BY: IN APPROVED BY: ---	DRAWING NO.:
ASSESSMENT MONITORING NETWORK (ALL ZONES)			REVISION DATE	**5-2**
PROJECT NUMBER: BT-179	FILE PATH: C:\Users\plins\Dropbox (Feezor Engineering)\Bridgeton\BT-179 (Groundwater Sampling And Analysis Plan)\drawing\working\BT-179_Figures 5-1 5-2 5-3.dwg			



NOTES:

- *AERIAL TOPOGRAPHY PROVIDED BY COOPER AERIAL SURVEYS CO. AND IS DATED DECEMBER 1, 2017*

BRIDGETON LANDFILL, LLC 13570 ST. CHARLES ROCK ROAD BRIDGETON, MISSOURI 63044	BRIDGETON LANDFILL GROUNDWATER MONITORING PLAN	Engineering for a Better World FEEZOR ENGINEERING, INC.	JANUARY 2019 DESIGNED BY: AMR APPROVED BY: ---	DRAWING NO.:
PIEZOMETER NETWORK (ALL ZONES)			REVISION DATE	**5-3**
PROJECT NUMBER: BT-179	FILE PATH: C:\Users\arobe\Dropbox (Feezor Engineering)\Bridgeton\BT-179 (Groundwater Sampling And Analysis Plan)\drawing\working\BT-179_Figures 5-1 5-2 5-3.dwg			

APPENDIX A

WELL BOREHOLE LOGS AND AS-BUILT DIAGRAMS

Drilling Log

Project Name	WESTLAKE	Boring No.	D - 85
Project No.	84-075-4-002	Page	1 of 6
Ground Elevation	453.1	Location	NE section of Site; Figure I-2
Total Footage	84.1'		

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
SEE REMARKS	SEE REMARKS	83.5	0.6	12	0	SEE REMARKS	—

Drilling Co.	WABASH DRILLING CO.	Driller (s)	DORL THORNTON
Drilling Rig.	ACKER MP-5, TRUCK	Type of Penetration Test	STANDARD
Date	8-21-84 To 8-22-84	Field Observer (s)	GLEN ERNSTMANN

Depth	Description	Class.	Blow Count	Recov.		Sample or Box No.	Remarks
1	LIGHT BROWN SAND, SILT AND GRAVEL, DAMP TO DRY (FILL)						5" SOLID AUGERS 0' TO 10'
2							
3							
4	GREENISH-GRAY TO DARK GRAY SILTY FINE SAND, VERY LOOSE, DAMP (FILL)						
5					5.0		
			3/2/3	7"/18"		SS-1	
6					6.5		
7							
8							
9							
10					10.0		4½" TRI-CONE WASH BORE 10.0' TO 84.1'.
			1/1/1	18"/18"		SS-2	
11					11.5		STOPPED 8-21-84 RESUMED 8-22-84
12							
13	GRAY CLAYEY SILT, AND FINE SAND, LOW PLASTICITY, STIFF, MOIST (FILL)	A-25					

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

Boring No. D-85

Project Name WESTLAKE

Page 2 of 6

Project No. 84-075-4-002

Date 8-21-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss	Box or Sample No.	Remarks
15	GRAY CLAYEY SILT, AND FINE SAND, LOW PLASTICITY, STIFF, MOIST (FILL)		3/4/5	12"/18"	15.0 SS-3	
16					16.5	
17						
18						
19						
20			2/4/4	10"/18"	20.0 SS-4	
21					21.5	SATURATED MATERIAL ENCOUNTERED BETWEEN 18' AND 25'.
22	GRAY-BROWN SILTY FINE SAND, MOIST TO SATURATED					
23						
24						
25				17"/18"	25.0 ST-5	Q_f = NOT OBTAINABLE
26					26.5	
27	GRAY FINE TO COARSE SAND, TRACE SILT, MEDIUM DENSE TO VERY DENSE, SATURATED					
28	PRIMARILY SUBROUNDED QUARTZ GRAINS					
29						
30		A-26	10/10/10	10"/18"	30.0 SS-6	

Drilling Log, continued

	Boring No. D-85
Project Name WESTLAKE	Page 3 of 6
Project No. 84-075-4-002	Date 8-21-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
	GRAY FINE TO COARSE SAND, TRACE SILT, MEDIUM DENSE TO VERY DENSE, SATURATED				31.5	SS-6	
32							
	PRIMARILY SUBROUNDED QUARTZ GRAINS						
33							
34							
35					35.0		
			21/27/26	13"/18"		SS-7	
36					36.5		
37							
38							
39							
	GRAY TO GRAY-BROWN COARSE SAND, SOME FINE TO MEDIUM SAND, FEW FINE GRAVELLY GRAINS, DENSE, SATURATED				40.0		
40			16/23/21	8"/18"		SS-8	
41					41.5		
42							
43							
44							
45							
46							
47							

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

Boring No. D-85
Project Name WESTLAKE
Page 4 of 6
Project No. 84-075-4-002
Date 8-21-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
49	GRAY TO GRAY-BROWN COARSE SAND, SOME FINE TO MEDIUM SAND, FEW FINE GRAVELLY SEAMS, DENSE, SATURATED						
50	GREENISH GRAY TO GRAY FINE TO MEDIUM SAND, TRACE SILT AND COARSE SAND, VERY DENSE, TO DENSE, SATURATED		26/34/24	13"/18"	50.0	SS-9	
51	..... 90% QUARTZ, SUBROUNDED TO SUBANGULAR				51.5		
52							
53							
54							
55							
56							
57							
58							
59							
60			14/16/22	8"/18"	60.0	SS-10	
61					61.5		
62							
63							
64							

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

Boring No. D-85

Project Name WESTLAKE

Page 5 of 6

Project No. 84-075-4-002

Date 8-21-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
66	GREENISH GRAY TO GRAY FINE TO MEDIUM SAND, TRACE SILT AND COARSE SAND, VERY DENSE TO DENSE, SATURATED						
67	90% QUARTZ, SUBROUNDED TO SUBANGULAR						
68							
69							
70					70.0		
			17/20/27	16"/18"		SS-11	
71					71.5		
72							
73							
74							
75							
76							
77							
78							
79							
80					80.0		
			17/21/34	15"/18"		SS-12	VERY SLIGHT LEACHATE LIKE OR ORGANIC ODOR
81		A-29			81.5		

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

Boring No. D-85

Project Name WESTLAKE

Page 6 of 6

Project No. 84-075-4-002

Date 8-21-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss	Box or Sample No.	Remarks
	GRAVEL, COBBLES AND SAND, SATURATED					
83						
	CREAM TO LIGHT BROWN LIMESTONE					A 2" dia. PVC piezometer was installed to 82'.
84						
	TOTAL DEPTH 84.1'					PVC is flush-jointed, threaded couplings.
85						
						Bottom 20' is .010" machine slotted screen.
86						
						Gravel pack from 84.1' to 59.7' with a 2.2' thick bentonite pellet seal above.
87						
88						
						Anulus is grouted from seal to ground surface.
89						
90						T.O.P. is 3.0' above ground surface.
						WATER LEVEL IMMEDIATELY AFTER PIEZOMETER INSTALLATION 20.05' BELOW T.O.P. 10:00am 8-24-84
						WATER LEVEL IS 24.09' BELOW T.O.P. 7:15am 8-27-84.

A-30

Drilling Log

Project Name	WESTLAKE	Boring No.	D - 87
Project No.	84-075-4-002	Page	1 of 7
Ground Elevation	460.0	Location	N 114.45, E. 903.6487
Total Footage	111.7

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
SEE REMARKS	5" @ THE SURFACE	111.0	0.7	22	0	SEE REMARKS	—

Drilling Co.	WABASH DRILLING CO.	Driller (s)	DORL THORNTON
Drilling Rig.	ACKER MP-5, TRUCK	Type of Penetration Test	STANDARD
Date	8-9-84 To 8-10-84	Field Observer (s)	GLEN ERNSTMANN

Depth	Description	Class.	Blow Count	Recov.		Sample or Box No.	Remarks
1	LIGHT BROWN FINE TO COARSE SAND, SOME SILT AND GRAVEL, DAMP (FILL)						5" SOLID AUGERS 0' TO 30.0'
2	LIGHT GRAY GRAVEL (2" MAX. DIA.), SOME SAND, VERY DENSE, DAMP (FILL)						
3							
4							
5			50/3"	2"/3"	5.0 / 5.3	SS-1	
6	MOTTLED LIGHT GRAY TO DARK GRAY TO BROWN SANDY SILTY CLAY, MEDIUM PLASTICITY, STIFF MOIST (FILL						
7	TRACE GRAVEL (2" MAX. DIA.)						
8							
9							
10			2/3/4	12"/18"	10.0	SS-2	
11					11.5		
12							
13							

Drilling Log, continued

Project Name	WESTLAKE
Project No.	84-075-4-002
Boring No.	D-87
Page	2 of 7
Date	8-9-84

Depth	Description	Log or Class	Blow Counts	Core Recov. & Loss		Box or Sample No.	Remarks
15	MOTTLED LIGHT GRAY TO DARK GRAY TO BROWN SANDY, SILTY CLAY, MEDIUM PLASTICITY, STIFF MOIST (FILL				15.0		
16	TRACE GRAVEL (2" MAX. DIA.)			23"/24"		ST-3	Q_p = 1.5 TSF
17					17.0		
18							
19							
20	DARK GRAY SILTY CLAY, MEDIUM TO HIGH PLASTICITY, VERY STIFF, MOIST				20.0		
21				21"/24"		ST-4	Q_p = 2.75 TSF
22					22.0		
23							
24	DARK GRAY SANDY SILT AND SILTY SAND INTERBEDS, SAND IS FINE TO MEDIUM, LOW TO NON-PLASTIC, WET TO SATURATED						
25					25.0		
26				4"/24"		ST-5	Q_p = N.A.
27					27.0		
28							SATURATED MATERIAL FIRST ENCOUNTERED @ APPROXIMATELY 27.0' BELOW G.S.
29							
30	BROWN TO GRAY-BROWN SILTY FINE SAND, MEDIUM DENSE SATURATED, SLIGHTLY MICACEOUS		3/7/8	10"/18"	30.0	SS-6	

Drilling Log, continued

Project Name	WEST LAKE
Project No.	84-075-4-002
Boring No.	D-87
Page	3 of 7
Date	8-9-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
	BROWN TO GRAY-BROWN SILTY FINE SAND, MEDIUM DENSE SATURATED				31.5	SS-6	NOTE: HOLE COLLAPSED TO 26.7' AFTER SAMPLE SS-6 WAS OBTAINED. NO FREE WATER OCCURS ABOVE THIS DEPTH.
32	SLIGHTLY MICACEOUS						
33							
34							BEGAN ROTARY WASH BORING W/ 4½" DIA. TRI-CONE BIT @ 30.0'
	BROWN FINE TO MEDIUM SAND, TRACE SILT, HIGHLY QUARTZOSE, DENSE, SATURATED				35.0		
35			12/14/20	4"/18"		SS-7	
36					36.5		
37							
38	LIGHT BROWN FINE TO COARSE SAND INTERBEDDED WITH THIN (3" TO 10" THICK) GRAVEL SEAMS, TRACE SILT, DENSE TO VERY DENSE, SATURATED						
39							
40					40.0		
41			15/25/25	8"/18"		SS-8	
					41.5		
42							
43							
44							
45					45.0		
46			17/23/14	8"/18"		SS-9	
					46.5		
47							

Drilling Log, continued

Boring No.	D-87
Project Name	WESTLAKE
Page	4 of 7
Project No.	84-075-4-002
Date	8-9-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
49	LIGHT BROWN FINE TO COARSE SAND INTERBEDDED WITH THIN (3" TO 10" THICK) GRAVEL SEAMS, TRACE SILT, DENSE TO VERY DENSE, SATURATED						
50			19/29/50	10"/18"	50.0	SS-10	
51					51.5		
52	GREENISH DARK GRAY FINE TO MEDIUM SAND, TRACE SILT, DENSE TO VERY DENSE, SATURATED						
53							
54							
55					55.0		
56			12/17/23	9"/18"		SS-11	
					56.5		
57							
58							
59							
60					60.0		
61			32/35/50/4"	12"/18"		SS-12	
					61.5		
62							
63							
64							

Drilling Log, continued

Project Name	WESTLAKE
Project No.	84-075-4-002
Boring No.	D-87
Page	5 of 7
Date	8-9-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
	GREENISH DARK GRAY FINE TO MEDIUM SAND, TRACE SILT, DENSE TO VERY DENSE, SATURATED		24/25/36	13"/18"	65.0	SS-13	
66					66.5		STOPPED 8-9-84 RESUMED 8-10-84
67							
68							
69							
70			30/23/24	14"/18"	70.0	SS-14	
71					71.5		
72							
73							
74							
75	GRAY TO DARK GREENISH GRAY FINE TO COARSE SAND, HIGHLY QUARTZOSE, SUBROUNDED GRAINS, VERY DENSE TO MEDIUM DENSE, SATURATED FEW THIN (3" TO 6") GRAVEL SEAMS		23/29/34	14"/18"	75.0	SS-15	
76					76.5		
77							
78							
79							
80					80.0		
81			27/37/26	11"/18"	81.5	SS-16	

Drilling Log, continued

Project Name	WESTLAKE
Project No.	84-075-4-002
Boring No.	D-87
Page	6 of 7
Date	8-9-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
83	GRAY TO DARK GREENISH GRAY FINE TO COARSE SAND, HIGHLY QUARTZOSE, SUBROUNDED GRAINS, VERY DENSE TO MEDIUM DENSE, SATURATED						
84							
85	FEW THIN (3" TO 6" THICK) GRAVEL SEAMS AT INTERVALS OF 1' TO 5'.		15/16/14	9"/18"	85.0	SS-17	
86					86.5		
87							
88	NOTE: SAND IS PREDOMINANTLY COARSE WITH TRACE FINE GRAVEL THROUGHOUT BELOW APPROXIMATELY 88'.						
89							
90			15/17/22	8"/18"	90.0	SS-18	
91					91.5		
92							
93							
94							
95			14/15/18	7"/18"	95.0	SS-19	
96					96.5		
97							
98							

Drilling Log, continued

Project Name	WESTLAKE
Project No.	84-075-4-002
Boring No.	D-87
Page	7 of 7
Date	8-9-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
100	GRAY TO DARK GREENISH GRAY FINE TO COARSE SAND, HIGHLY QUARTZOSE SUBROUNDED GRAINS, VERY DENSE TO MEDIUM DENSE, SATURATED		24/50/6"	6"/12"	100.0	SS-20	
101					101.0		
102	FEW THIN (3" TO 6" THICK) GRAVEL SEAMS AT INTERVALS OF ROUGHLY 1' TO 5'.						
103	NOTE = SAND IS PREDOMINANTLY COARSE WITH TRACE FINE GRAVEL THROUGHOUT BELOW APPROXIMATELY 88'.						
104							A 2" dia. PVC piezometer was installed to 111'.
105			24/31/48	9"/18"	105.0	SS-21	PVC is flush-joint, threaded couplings.
106					106.5		Bottom 20' is .010" machine slotted screen.
107							Bottom 24' is gravel packed with a 3' thick bentonite pellet seal above.
108							
109							Annulus is grouted from seal to ground surface.
110			17/30/50/4"	10"/16"	110.0	SS-22a	T.O.P. is 3' above ground surface.
111	GRAY TO CREAM LIMESTONE, MEDIUM STRONG TO STRONG, SLIGHTLY TO MODERATELY WEATHERED				111.3	SS-22b	
112							111.7'
113	TOTAL DEPTH 111.7'						WATER LEVEL IMMEDIATELY AFTER PIEZOMETER INSTALLATION 8-10-84 IS 4.46 BELOW T.O.P.
114							WATER LEVEL @ 26.05' BELOW T.O.P. 8:15am 8-14-84
115							

SUBSURFACE EXPLORATION DA

by

WABASH DRILLING COMPANY

110 Angelica St. • St. Louis, Mo. 63147 • 421-2460

Date of Drilling:
Started 6-22-78
Finished 6-23-78

Boring No. 38
Coordinates Sheet 1 of 2
Surf. Elev.
Gr. Water Elev. --

Client Westlake Quarry & Material Co.

Job Name Westlake Landfill Client's Job No.

Job Location St. Charles Rock Road City Bridgeton State Mo.

Casing O.D. I.D. Sampler O.D. 2" I.D. 1-3/8"

Casing Hammer lbs. fall Sampler Hammer 140 lbs. 30" fall

W. D. Co. Foreman Gary Johanning Client's Inspector

Depth Below Ground Surface	Blows On Casing	Sample Number	Blows On Sampler	Penetration (ft Sampler (inches)	FIELD IDENTIFICATION OF SOIL (Include relative firmness, relative moisture, color, mention all soil constituents, etc.)	REMARKS
1'6"					Trash & white chat	Used 6" H.S. auger
7'0"					White chat 1" minus	
13'0"					Moist, yellowish-tan, medium stiff clay	
19'0"					Moist, brown, firm, silty-clay with traces of fine sand	
26'6"					Moist, gray, medium stiff, plastic clay with traces of rust stains	
3[illegible]'0"					Moist to wet, brown, loose, fine sand with traces of gravel	
					Wet, gray, medium dense, fine sand	(Cont'd.)

SUBSURFACE EXPLORATION D A
by
WABASH DRILLING COMPANY

110 Angelica St. • St. Louis, Mo. 63147 • 421-2460

Date of Drilling:
Started 6-22-78
Finished 6-23-78

Boring No. 38
Coordinates Sheet 2 of 2
Surf. Elev.
Gr. Water Elev. --

Client Westlake Quarry & Material Co.
Job Name Westlake Landfill Client's Job No.
Job Location St.Charles Rock Road City Bridgeton State Mo.
Casing O.D. I.D. Sampler O.D. 2" I.D. 1-3/8
Casing Hammer lbs. fall Sampler Hammer 140 lbs. 30" fall
W. D. Co. Foreman Gary Johanning Client's Inspector

Depth Below Ground Surface	Blows On Casing	Sample Number	Blows On Sampler	Penetration Of Sampler (inches)	FIELD IDENTIFICATION OF SOIL (Include relative firmness, relative moisture, color, mention all soil constituents, etc.)	REMARKS
					Wet, gray, medium dense, fine sand	Set bottom of well point @ 50'0" and back filled with ½" minus rock.
50'0"					Total depth of boring 50'0"	

AUG 04 '93 08:38AM FVD STL P.14

DRILLING LOG

McLaren Hart

SB/MW #: I-73
Log #:
Page 1 of 2
Geoscientist:

PROJECT: Westlake
PROJECT #: 11.0800556
LOCATION: Bridgeton, Missouri
TOC ELEVATION: 462.6
SAMPLING DATE(S): 6/22/78 6/23/78
START:
FINISH:
SAMPLING METHOD:
MONITORING DEVICE:
SUBCONTRACTOR/EQUIPMENT: /
DRILLING METHOD:
NOTES:

Depth Below Surface (ft.)	Sampler Interval/ Recovery	Sample ID #	PID reading (ppm)	Soil Description Color, Texture, Moisture, Etc.	Unified Classification	Graphic Log	Well Construction Details
				TRASH & white CHAT (FILL)			
2, 4, 6				CHAT; white, 1" minus			
8, 10, 12				CLAY; yellowish tan, med stiff, moist			
14, 16, 18				Silty CLAY; tr fine Sand, brown, firm, moist	CL ML		
20, 22, 24, 26				CLAY; gray, med stiff, tr rust stains, moist			
28, 30, 32, 34				SAND; brown, loose, fine, tr Gravel	SM GM		
36, 38, 40, 42, 44, 46, 48, 50				SAND; gray, med dense, fine, wet			
				See Following Page...			

SIGNATURE OF FIELD SUPERVISOR

Assistant Geoscientist
TITLE

SIGNATURE OF REVIEWER

Project Manager
TITLE

DRILLING LOG

McLaren Hart

SB/MW #: I-73
Log #:
Page 2 of 2
Geoscientist:

PROJECT: Westlake PROJECT #: 11.0800556

Depth Below Surface (ft.)	Sampler Interval/ Recovery	Sample ID #	PID reading (ppm)	Soil Description Color, Texture, Moisture, Etc.	Unified Classification	Graphic Log	Well Construction Details
50.0				Total depth = 50.0'			

SIGNATURE OF FIELD SUPERVISOR

Assistant Geoscientist
TITLE

SIGNATURE OF REVIEWER

Project Manager
TITLE

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 4.25 inch I.D./8.25 inch O.D. Hollow Stem Auger				BORING NO. LR-103
LAIDLAW/OU2 RI-FS/MD WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD:				SHEET 1 OF 3
	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)				DRILLING
	SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)				START / FINISH
	WATER LEVEL	26.74 FT			TIME 14:00 / TIME 9:00
	TIME	9:16			
	DATE	10/20/95			DATE 10/19/95 / DATE 10/20/95
NORTHING: 1068527.38 DATUM EASTING: 515217.07 ELEVATION 460.1	CASING DEPTH	38.0 FT.			
DRILL RIG CME 750	SURFACE CONDITIONS				
ANGLE 90° BEARING NA					
SAMPLE HAMMER					

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1	2 4 6 8	1.0' / 2.0' (50%)			(0.0-2.5 Ft.) Stiff, moderate yellowish brown (10YR 5/4), CLAYEY SILT, trace fine Gravel, occasional cobbles, NR, dry, (CL-ML), (FILL)	SP 1	
2	17 12	1.3' / 2.0' (65%)			(457.6) 2.5		
3	13 16				(2.5-3.5 Ft.) Very stiff, medium gray (N5), SANDY SILT, little c-f Gravel, occasional cobbles, SR, damp, (ML), (FILL)	SP 2	
4	9 10 8 11	0.7' / 2.0' (35%)			(3.5-7.5 Ft.) Very stiff, medium bluish gray (5B 5/1), SILT, little c-f Sand, WR, damp, (ML), (FILL)	SP 3	
6	3 8 5 4	1.2' / 2.0' (60%)				SP 4	
8	3 5 4 4	1.1' / 2.0' (55%)			(7.5-10.0 Ft.) Stiff, medium light gray (N6), SANDY SILT, little c-f Gravel, SR, damp, (ML), (FILL)	SP 5	
10	2 2 3 2	1.6' / 2.0' (80%)			(10.0-19.3 Ft.) Firm, medium gray (N5), SILT, little fine Sand, trace iron staining, SR, damp, (ML), (LOESS)	SP 6	
12	1 2 3 3	1.4' / 2.0' (70%)				SP 7	@ 12.0 Ft. Hole began making gas at low levels
14	2 2 3 4	2.0' / 2.0' (100%)				SP 8	

DRILLING CONTR LAYNE-WESTERN

LOGGED BY M. SANDFORT CHK'D BY B. TILTON

DATE 10/23/95

JOB NO.: 943-2848

FILENAME: LR103

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 4.25 inch I.D./8.25 inch O.D. Hollow Stem Auger	BORING NO. LR-103
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	SHEET 2 OF 3
		DRILLING START TIME 14:00 DATE 10/19/95; FINISH TIME 9:00 DATE 10/20/95
NORTHING: 1068527.38 DATUM EASTING: 515217.07 ELEVATION 460.1	WATER LEVEL 26.74 FT. TIME 9:16 DATE 10/20/95 CASING DEPTH 38.0 FT.	
DRILL RIG CME 750	SURFACE CONDITIONS	
ANGLE 90° BEARING NA		
SAMPLE HAMMER		

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
					(10.0-19.3 ft.) Firm, medium gray (N5), SILT, little fine Sand, trace iron staining, SR, damp, (ML), (LOESS)	SP 8	
16	3 3 4 5	2.0'/2.0' (100%)				SP 9	
17							
18	1 2 2 4	2.0'/2.0' (100%)			From 18.0-19.0 ft, wet zone	SP 10	
19					(440.8) 19.3		
					(19.3-24.2 ft.) Firm, grayish black (N2), SILTY CLAY, NR, damp, (CL), (ALLUVIUM)		
20	2 4 6 7	2.0'/2.0' (100%)				SH 11	
21							
22	2 4 5 8	2.0'/2.0' (100%)			@ 22.3 ft, color changes to medium dark gray (N4)	SP 12	
23							
24					(435.9) 24.2		
	6 12 17 15	2.0'/2.0' (100%)			(24.2-38.0 ft.) Compact, medium gray to medium dark gray (N5 to N4), fine SAND, trace Silt, NR, damp, (SP), (ALLUVIUM)	SP 13	
25							
26	4 4 6 15	1.2'/2.0' (60%)				SP 14	@ 26.0 ft, encountered water
27					From 27.2-27.5 ft, CLAYEY SILT layer		
28	8 8 15 15	2.0'/2.0' (100%)				SP 15	
29							

DRILLING CONTR LAYNE-WESTERN

LOGGED BY M. SANDFORT CHK'D BY B. TILTON

DATE 10/23/95

JOB NO.: 943-2848

FILENAME: LR103

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 4.25 inch I.D./8.25 inch O.D. Hollow Stem Auger	BORING NO. LR-103
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	SHEET 3 OF 3
	WATER LEVEL: 26.74 FT.	DRILLING START TIME 14:00 DATE 10/19/95
	TIME: 9:16	DRILLING FINISH TIME 9:00 DATE 10/20/95
	DATE: 10/20/95	
NORTHING: 1068527.38 DATUM EASTING: 515217.07 ELEVATION 460.1	CASING DEPTH: 38.0 FT.	
DRILL RIG CME 750	SURFACE CONDITIONS	
ANGLE 90° BEARING NA		
SAMPLE HAMMER		

DRILLING CONTR LAYNE-WESTERN

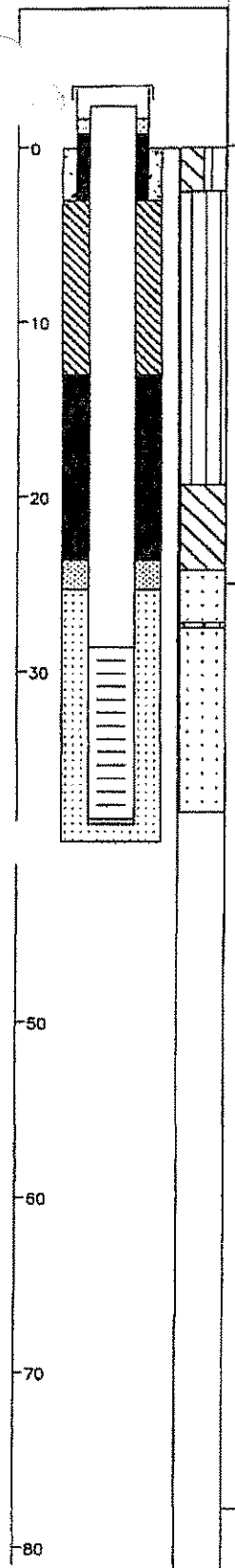
DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
31	4 4 7 10	1.5'/2.0' (75%)			(24.2-38.0 Ft.) Compact, medium gray to medium dark gray (N5 to N4), fine SAND, trace Silt, NR, damp, (SP), (ALLUVIUM)	SP 16	
32 33	5 11 14 27	1.3'/2.0' (65%)			from 32.3-32.5 Ft. layers of decayed vegetation	SP 17	
34 35	6 12 15 15					SP 18	
36 37	5 6 12 14				@ 37.0 Ft., SAND becomes medium to fine grained	SP 19	
					(422.1) 38.0		
38					End of Soil Borehole Log at 38.0 Ft.		
39							
40							
41							
42							
43							
44							

LOGGED BY M. SANDFORT CHK'D BY B. TILTON
DATE 10/23/95
JOB NO.: 943-2848
FILENAME: LR103

Well No. LR-103

Boring No. X-Ref: LR-103

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1068527 ft. Easting: 515217 ft.

Elevation Ground Level 460.1 ft. NGVD

Top of PVC Casing 461.28 ft. NGVD

Drilling Summary:

Total Depth 40.0 ft.

Borehole Diameter 8 1/4" (0.0-40.0')

Casing Stickup Height 1.10 ft.

Driller Layne-Western St. Louis, MO

Rig CME 750

Bit(s) 4 1/4" ID/8 1/4" O.D. Hollow Stem Auger Bit

Drilling Fluid None

Protective Casing 8x8" Square Steel, by 5' long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	10/19/95	14:00	10/20/95	9:00
Geophys.Logging:				
Casing:				
2" I.D. PVC	10/20/95	8:55	10/20/95	8:59
Filter Placement:	10/20/95	9:10	10/20/95	10:25
Cementing:				
Development				
Bentonite Grout	10/20/95	10:35	10/20/95	10:50
Bentonite Seal	10/20/95	10:28	10/20/95	10:35

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.10	-	28.60	C1	461.28	-	431.50
28.60	-	38.40	S1	431.50	-	421.70
38.40	-	38.70	C2	421.70	-	421.40

Casing: C1 2" dia. Schedule 80 PVC, flush threaded with O-rings

C2 2" dia. threaded PVC end cap (4" long or 0.33')

Screen: S1 2" dia. Schedule 80 PVC, 0.010" machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand 25.3-39.7'

Filter Pack: 100 mesh Silica Sand 23.6-25.3'

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry 3.0-13.0'

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry 13.0-23.6'

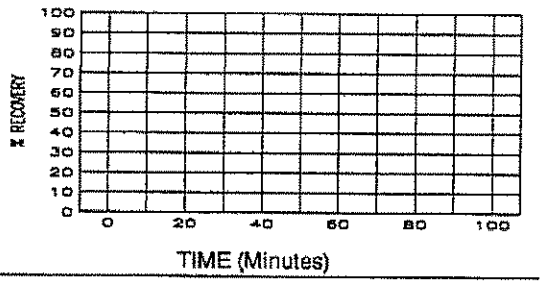
Concrete: 0.0-3.0'

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Supervised by M. Sandfort

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name LR103

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF. NO. 145107	
C.R. NO.	CHECK NO.
STATE WELL NUMBER	TRANSMITTAL NO.
CHECKED BY	ROUTE
APPROVED BY	ENTERED Ph 1 Ph 2 Ph 3

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

SITE/FACILITY NAME: LAIDLAW BRIDGETON SANITARY LANDFILL
WELL NUMBER: LR-103

SITE ADDRESS: ST. CHARLES ROCK RD
CITY: BRIDGETON
STATE: MO
ZIP CODE: 63044

OWNER NAME: LAIDLAW WASTE SYSTEMS, INC.
TELEPHONE: 314-241-3710

OWNER ADDRESS: 1838 N. BROADWAY
CITY: ST. LOUIS
STATE: MO
ZIP CODE: 63102

VARIANCE ISSUED: ☐ YES ☒ NO
DATE ISSUED:
VARIANCE NUMBER: V

DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT
AT WEST BASE OF GRAVEL PILE FOR ASPHALT PLANT.

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT
COUNTY: ST. LOUIS
SURFACE ELEVATION: 460.1
SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST ¼
SEC. ____ TWN. 47 N,RNG. 5 (E OR W)
LAT. 38 ° 46 ' 05 " LONG. 90 ° 26 ' 48 "

MONITORING WELL INSTALLATION CONTRACTOR'S NAME: LAYNE WESTERN CO., INC.
PERMIT NUMBER: 001258 WPM

DRILLING CONTRACTOR'S NAME: LAYNE WESTERN CO., INC.
PERMIT NUMBER: 001258 WPM

WELL CONSTRUCTION INFORMATION

TYPE OF WELL: ☐ MONITORING WELL ☒ PIEZOMETER ☐ OTHER ____
TYPE OF POTENTIAL SITE: ☐ HAZARDOUS MATERIAL ☒ LANDFILL ☐ L.U.S.T. ☐ OTHER ____
MONITORING FOR: (CHECK ALL THAT APPLY) ☒ V.O.C. ☐ METALS ☐ PETROLEUM PRODUCT ☐ OTHER ____ ONLY

PROTECTIVE CASING DETAILS (IF USED): LENGTH 5 FT. | DIAMETER OF CASING 8x8 IN. | WEIGHT OR SDR # 0.188 | DIAMETER AND DEPTH OF DRILL HOLE 8¼ IN. 40 FT. | JOINTS ☐ THREADED ☐ MECHANICAL ☐ WELDED ☐ OTHER ____ | MATERIAL ☐ THERMO PLASTIC ☒ STEEL ☐ FLUORO POLYMER TYPE ____ | LOCKING CAP? ☒ YES ☐ NO

CAP VENTED: ☒ YES ☐ NO
WEEP HOLE? ☒ YES ☐ NO
CASING GROUT DETAILS: MATERIAL ☐ CEMENT ☒ CONCRETE ☐ OTHER ____
DEPTH FROM THE SURFACE TO THE BOTTOM OF THE CASING GROUT SEAL: 3.0 FT.
TYPE OF SURFACE COMPLETION: ☒ ABOVE GROUND ☐ FLUSH MOUNT
DESCRIBE HOW THE FLUSH MOUNT WAS CONSTRUCTED

CENTRALIZER USED ON RISER: ☒ NO ☐ YES LOCATED AT ____
MATERIAL: ☐ STAINLESS STEEL ☐ OTHER ____

RISER PIPE DETAILS: LENGTH 31.2 FT. | DIAMETER OF RISER PIPE 2 IN. | WEIGHT OR SDR # SCH80 | DIAMETER OF DRILL HOLE 8¼ IN. | JOINTS ☒ THREADED ☐ MECHANICAL ☐ WELDED ☐ OTHER ____ | MATERIAL ☒ THERMO PLASTIC ☐ STEEL ☐ FLUORO POLYMER ☐ OTHER ____

ANNULAR SEAL: ☐ CEMENT SLURRY ☒ BENTONITE SLURRY ☐ NON SLURRY BENTONITE TYPE: ____ ☐ CEMENT/BENTONITE SLURRY BAGS OF CEMENT USED ____ % BENTONITE USED ____ WATER USED/BAG ____ GAL.
BENTONITE SEAL: MATERIAL BENTONITE ☒ SLURRY ☐ CHIPS ☐ GRANULAR ☐ PELLETS | LENGTH OF SEAL 10.6 | BENTONITE SEAL INSTALLED IN ☐ UNSATURATED ZONE ☒ SATURATED ZONE

	TYPE	GRAIN SIZE	LENGTH OF FILTER PACK	METHOD OF INSTALLATION	Information in this column to be supplied in the Feet from Surface column	FEET FROM SURFACE	FORMATION DESCRIPTION
PRIMARY FILTER PACK	☒ SAND ☐ MANUFACTURED ☐ NATURAL	16-35	14.7 FT.	H.S.A. POUR			
SECONDARY FILTER PACK	☒ SAND ☐ MANUFACTURED ☐ NONE	100	1.7 FT.	H.S.A. POUR	Depth to bottom of Protective Casing Seal:	3.0	0-7 Gravelly clay
WELL SCREEN	LENGTH OF SCREEN 10 FT.	DIAMETER 2 IN.	SLOT SIZE 10	WEIGHT OR SDR # SCH 80	MATERIAL ☒ PLASTIC ☐ STEEL ☐ FLUORO POLYMER	Depth to Base of Annular Seal: 13.0	7-26 Silty clay
SUMP DETAILS	LENGTH OF SUMP	DIAMETER OF SUMP		MATERIAL ☐ PVC ☐ STEEL ☐ FLUORO POLYMER ☐ OTHER ____	Depth to Base of Bentonite Seal:	23.6	
BACK FILL	WAS THE WELL BACK FILLED? ☐ YES ☒ NO	MATERIAL USED		LENGTH OF BACK FILLED BORE HOLE	Depth to Top of Primary Filter Pack:	25.3	
					Depth to Top of the Screen:	30.0	26-40 Silty sand
					Depth to Bottom of the Screen:	40.0	
					Total Depth:	40.0	

STATIC WATER LEVEL: FEET FROM MEASURING POINT
DATE OF STATIC WATER LEVEL
MEASURING POINT FOR STATIC WATER LEVEL IS: ☒ TOP OF RISER PIPE ☐ OTHER ____
ELEVATION OF MEASURING POINT: 461.28

MULTIPLE CASED WELLS: SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DRILLING EQUIPMENT: ☐ AIR ROTARY ☒ AUGER TYPE 4¼ H.S.A. ☐ REVERSE ROTARY ☐ OTHER ____

DATE WELL DRILLING WAS COMPLETED: 10-20-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE PRIMARY CONTRACTOR/PERMIT #	DATE	SIGNATURE DRILLER/PERMIT #	DATE
[signature]	11-15-95	[signature]	11-15-95

MO 780-1415 (7-95)

DISTRIBUTION: WHITE/DIVISION CANARY/MONITORING WELL CONTRACTOR PINK/OWNER
MAIL WHITE COPY TO: DEPARTMENT OF NATURAL RESOURCES, P.O. BOX 250, ROLLA, MO 65402
ENCLOSE $35 PER MONITORING WELL FOR THE CERTIFICATION FEE WITHIN 60 DAYS AFTER WELL COMPLETION

RECYCLED PAPER

Foth & Van Dyke

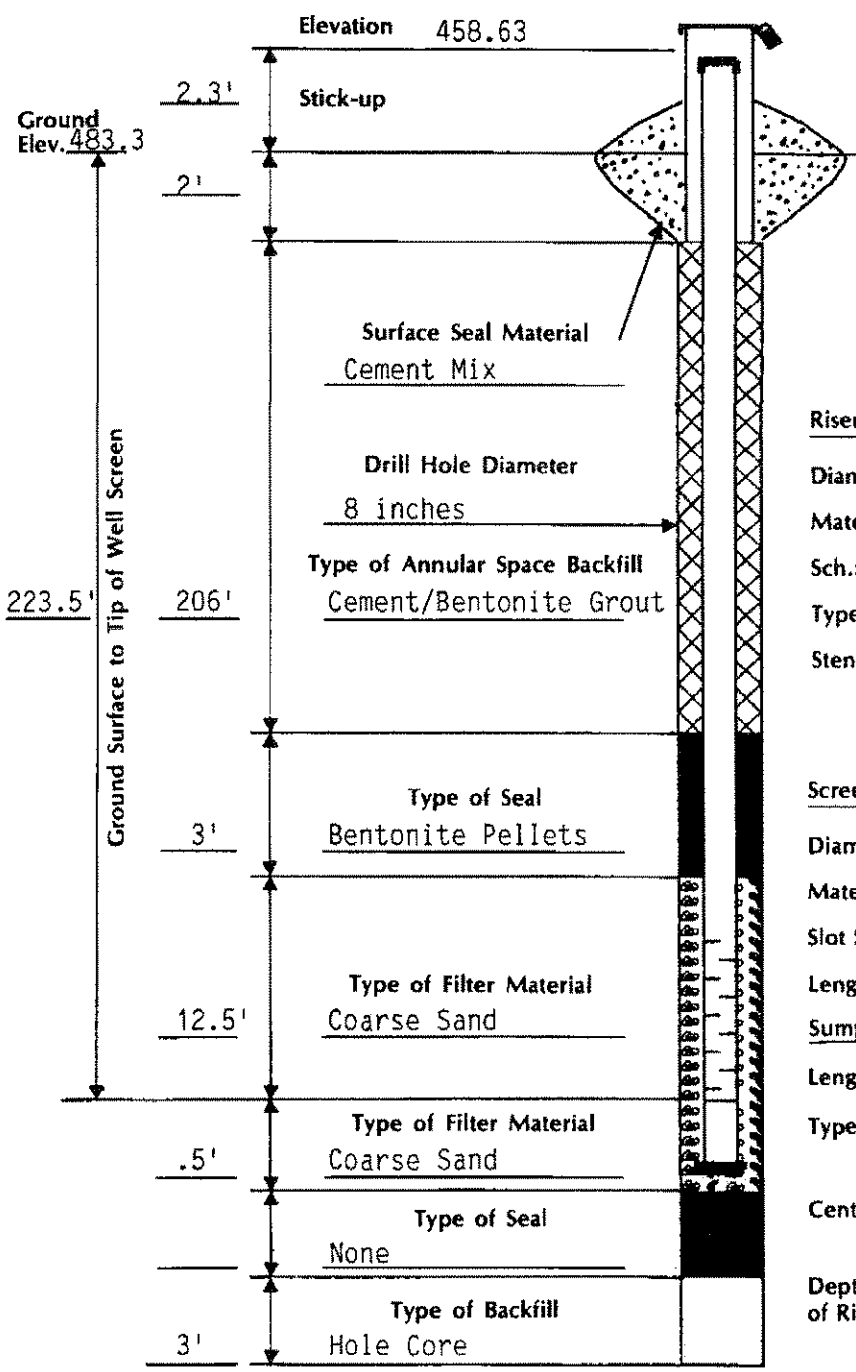
Client: LAIDLAW WASTE SYSTEMS Scope I.D.: 89L46
Project: Bridgeton Monitor Wells Page: 1
Prepared by: RTB Date: 4/15/91
Checked by: RTB Date: 4/24/91

MONITORING WELL CONSTRUCTION DIAGRAM

Driller: John Mathes and Associates, Inc. Well No.: 1204
Drilling Method: Air Rotary Date Installed: 4/5/91

Coordinates: 1,066,420.96N, 515,823.27E

Protector Pipe:
Size: 4 inch
Material: Steel
Lock No.: Master



Riser:
Diameter: 2 inch
Material: PVC
Sch.: 80
Type of Joints: Flush Threaded
Stenciled? Yes

Screen:
Diameter: 2 inch
Material: PVC
Slot Size: 0.010 inch
Length: 10 feet

Sump:
Length: None
Type of Cap: PVC Flush Threaded

Centralizer: Used ☐
Not Used ☒

Depth to Water From Top of Riser at Completion: Dry

NOTE: Not to Scale

FORM #309 GEM (Rev. 1/89)

RECORD OF DRILLHOLE PZ-100-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/24/95
DRILL RIG: SCHRAMM

DATUM: MSL
COORDINATES N: 1068867.81
AZIMUTH: 0

COLLAR ELEV: 484.35
E: 517175.03
INCLINATION: -90

ROCK TYPE

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular

P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough

Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DISCONTINUITY DATA

DEPTH SCALE (FT)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (80 60 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DIP wrt CORE AXIS (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR MW HW CW)	STRENGTH INDEX (R6 R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 30 R2 150 R3 300 R4 600 R5 1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
64	0.0-78.9 ft. No sampling conducted See Record of Drillhole for PZ-100-KS														0.0-51.0 ft. Drilling conducted with 6 1/4 in. ID hollow stem auger, then borehole advanced to 78.9 ft. with 5 7/8 in. air rotary bit
66															
68															
70															
72															
74															
76															
78															
	78.9-81.8 ft. 405.45 / 78.90 Moderately weathered, medium bedded, light brownish gray (5Y 6/1), fine grained, strong, ARENACEOUS DOLOMITE, open vugs (<1/2 mm), (ST. LOUIS FORMATION)		405.45 / 78.90	1	100 %										
80															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: M. VOGT

LOGGED: B. TILTON
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/24/95
DRILL RIG: SCHRAMM

DATUM: MSL
COORDINATES N: 1088887.81
AZIMUTH: 0

COLLAR ELEV: 484.35
E: 517175.03
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP w/ CORE AXIS	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80	78.9-81.8 ft. Moderately weathered, medium bedded, light brownish gray (5Y 6/1), fine grained, strong, ARENACEOUS DOLOMITE, open vugs (<1/2 mm.), (ST. LOUIS FORMATION)														
	402.55 / 81.80														
82	81.8-90.6 ft. Slightly weathered, thickly bedded, light olive gray (5Y 6/1), very finely crystalline, strong ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)			1	100 %										
	Below 82.3 ft. Stylolites common								J,I,SM						
	@ 83.9 and 84.5 ft.														
84	Chert zones (<2 in.)								J,P,SM						
	84.4-84.7 ft. Silicified and finely disseminated pyrite		399.65						J,P,SM						
	84.7-84.9 ft. Medium gray chert zone	399.25	84.70												
	85.1-85.5 ft. Olive gray (5Y 3/2), DOLOMITIC LIMESTONE layer, low porosity, vugs (<1/4 mm)	398.85 / 85.10 / 85.50							J,C,SM,CL						
86									J,C,SM						
				2	86%				J,I,R						
88			385.35						Core Loss						
			89.00												
90	90.6-94.0 ft. Moderately weathered, thickly bedded, light brownish gray (5Y 6/1), f-m grained, medium strong BIOCLASTIC LIMESTONE, (ST. LOUIS FORMATION)			3	100 %				J,I,R						
92															
									J,I,R,CL						
	390.35		390.35												
94	End of Record of Drillhole at 94.0 ft.	94.00	94.00												2/25/95 @ 11:15 Completed drilling
96															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: M. VOGT

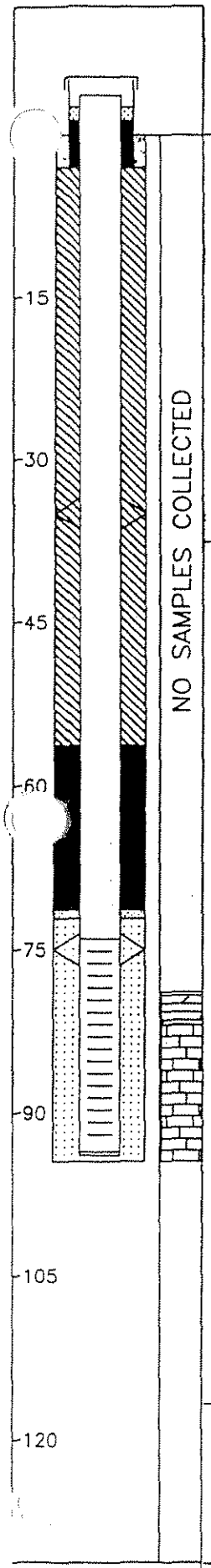
LOGGED: B. TILTON
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

Well No. PZ-100-SS

Boring No. X-Ref: PZ-100-SS

PIEZOMETER CONSTRUCTION SUMMARY



Survey Coords: Northing: 1068868 ft. Easting: 517175 ft.

Elevation Ground Level 484.4 ft. NGVD

Top of PVC Casing 485.84 ft. NGVD

Drilling Summary:

Total Depth 94.5 ft.

Borehole Diameter 10 1/4 in. (0.0-51.0 ft.) 5 7/8 in. (51.0-94.5 ft.)

Casing Stickup Height 1.49 ft.

Driller Layne-Western St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit for Reaming

Drilling Fluid Auger-None, NX Core Water, Air Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	2/20/95	16:00	2/20/95	16:40
Schramm Rotary	2/24/95	7:30	2/25/95	11:30
Geophys.Logging:				
Casing:	2/25/95	11:30	2/25/95	11:45
Filter Placement:	2/25/95	11:45	2/25/95	12:30
Cementing:				
Development				
Bentonite Grout	2/25/95	12:50	2/25/95	14:00
Bentonite Seal	2/25/95	12:30	2/25/95	12:50

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.49	-	73.96	C1	485.84	-	410.39
73.96	-	93.60	S1	410.39	-	390.75
93.60	-	93.93	C2	390.75	-	390.42

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 72.1-94.5 ft.

Filter Pack: Less than 50 mesh Silica Sand, 71.3-72.1 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-56.3 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 56.3-71.3 ft.

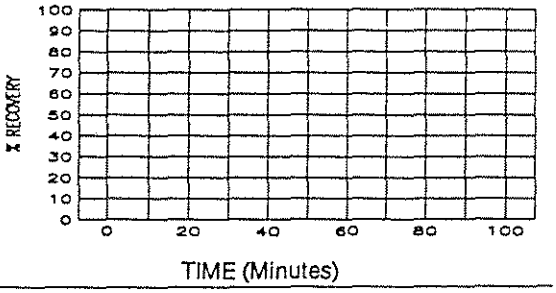
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Not to Scale

Supervised by B. Tilton

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ100SS

661574

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 115082	CHECK NO.
ROUTE	TRANSMITTAL NO.
STATE WELL NUMBER	CROSS REFERENCE NO.
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME: LAIDLAW BRIDGETON SANITARY LANDFILL		WELL NUMBER: PZ-100-SS	
SITE ADDRESS: ST. CHARLES ROCK RD.	CITY: BRIDGETON	STATE: MO.	ZIP CODE: 63044
NAME: LAIDLAW WASTE SYSTEMS, INC.		TELEPHONE: 314-341-3710	
ADDRESS: 1838 N. BROADWAY	CITY: ST. LOUIS	STATE: MO.	ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

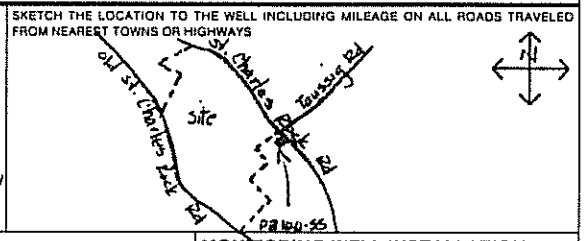
COUNTY: ST. LOUIS
ELEVATION: 414.35
AREA NO.

SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST ¼

SEC. ____ TWN. 47 N,RNG. 5 E OR W

LAT. 38 ° 46 ' 09 " LONG. 90 ° 36 ' 23 "

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN CO., INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN CO, INC

TYPE OF INSTALLATION
☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT

MEASURING POINT IS
☐ TOP OF RISER PIPE
☐ OTHER

DRILLING EQUIPMENT
☒ AIR ROTARY ☒ AUGER TYPE 6¼ H.S.A.
☐ REVERSE ROTARY ☐ OTHER

CENTRALIZERS USED
☒ YES, AT 3 TOTAL
☐ STAINLESS STEEL
☐ OTHER
☐ NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
2-25-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR) Michael P. Vogl
PERMIT NUMBER 001256 WIA DATE 4-11-95
SIGNATURE (DRILLING CONTRACTOR) Michael P. Vogl
PERMIT NUMBER 001256 WIA DATE 4-11-95

NOTE: Record the fraction of a foot in decimal, not in inches.

Top of Riser Elevation: 415.84

Ground Surface Elevation: 414.35 Ft

Information in this column to be supplied in the Feet from Surface column	Feet from Surface	Description of Formation
		0-31 Silty clay
Depth to bottom of Protective Casing Seal:	3	
		31-51 Sand & gravel
Depth to Base of Annular Seal:	56.3	
		51-77.5 Limestone
Depth to Base of Bentonite Seal:	71.3	
Depth to Base of Secondary Filter Pack:	72.1	
Depth to Top of the Screen:	73.6	
Depth to Bottom of the Screen:	73.6	
Plug Back Total Depth:		
Original Total Depth:	77.5	

LOCKING CAP - Y / N (Circle one)
CAP VENT - Y / N (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8" x 8" x 9'
Bore Hole Diameter: 10.25"
WEEP HOLE - Y / N (Circle one)

PROTECTIVE CASING SEAL
Type: ☒ Concrete ☐ Cement Slurry

RISER PIPE
Length: 73.09'
Diameter: 2"
Type of Material: SCH80 PVC

BOREHOLE DIAMETER: 5 7/8 In.

ANNULAR SEAL
Type: ☒ Bentonite Slurry ☐ Cement Slurry ☐ Non Slurry Bentonite

BENTONITE SEAL
Type: ☒ Bentonite Slurry ☐ Non Slurry Bentonite
Length of Seal: 15 Ft.

SECONDARY FILTER PACK (Optional)
Type: ☒ Sand ☐ Manufactured
Grain Size: SUGAR
Length: 0.8

PRIMARY FILTER PACK
Type: ☒ Sand ☐ Manufactured
Grain Size: 20/40
Length: 22.4

WELL SCREEN
Length: 20'
Slot Size: 0.010
Type: SCH80 PVC

SUMP DETAILS
Length: 0.3 Ft.
Diameter: 2 In.
Type: PVC

TYPE OF BACKFILL: SAND

MO 780-1415 (2-94) DISTRIBUTION: WHITE-DIVISION CANARY-MONITORING WELL CONTRACTOR PINK-OWNER

RECORD OF DRILLHOLE PZ-100-SD

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/22/95
DRILL RIG: SCHRAMM

DATUM: MSL
COORDINATES N: 1068851.6
AZIMUTH: 0

COLLAR ELEV: 484.3
E: 517185.4
INCLINATION: -90

ROCK TYPE: J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular

P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough

Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DL SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (80 60 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR MW HW CW)	STRENGTH INDEX (R6 R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 30 R2 150 R3 300 R4 600 R5 1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
224	0.0-235.0 ft. No sampling conducted See Record of Drillhole for PZ-100-KS														0.0-34.0 ft. Drilling conducted with 6 1/4 in. ID hollow stem augers 34.0-235.0 ft. Borehole drilled with 5 7/8 in. bit using compressed air
228															
228															
230															
232															
234															
	248.00		248.00												
	235.3-237.3 ft. 235.30 Fresh, thinly bedded, very light gray (N8) to light gray (N7), coarse grained, medium strong, ARENACEOUS LIMESTONE (SALEM FORMATION)		235.30												
236															
	237.3-242.4 ft. Fresh, thickly bedded, pale yellowish brown (10YR 6/2), m-c grained, medium strong, BIOCLASTIC LIMESTONE, (SALEM FORMATION)			1	97%										
238															
	238.7-238.8 ft. Very light gray (N8), coarse grained Dolomite layer							●	B,PL,SM						
40															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: M. VOGT

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-SD

PROJECT: LA/DLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/22/95
DRILL RIG: SCHRAMM

DATUM: MSL
COORDINATES N: 1066851.8
AZIMUTH: 0

COLLAR ELEV: 484.3
E: 517195.4
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP w/t CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
240	237.3-242.4 ft. Fresh, thickly bedded, pale yellowish brown (10YR 6/2), m-c grained, medium strong, BIOCLASTIC LIMESTONE, (SALEM FORMATION)							J,I,SM					
	240.9-214.3 ft. Fossiliferous, stylolitic												
242	241.3-241.7 ft. Thinly laminated												
	242.1-242.4 ft. Thinly laminated												
	242.4-245.3 ft. Fresh, thickly bedded, light gray (N7), very coarse grained, medium strong, ARENACEOUS LIMESTONE (SALEM FORMATION)		1	97%									
244								J,U,R					
		239.00											
	245.3-246.0 ft. Fresh, thickly bedded, olive gray (5Y 4/1), very fine grained, medium strong, (WARSAW FORMATION) 238.30 248.00	245.30	2	100 %									
248		238.30											
	End of Record of Drillhole at 246.0 ft.	248.00											
248													
250													
252													
254													
258													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: M. VOGT

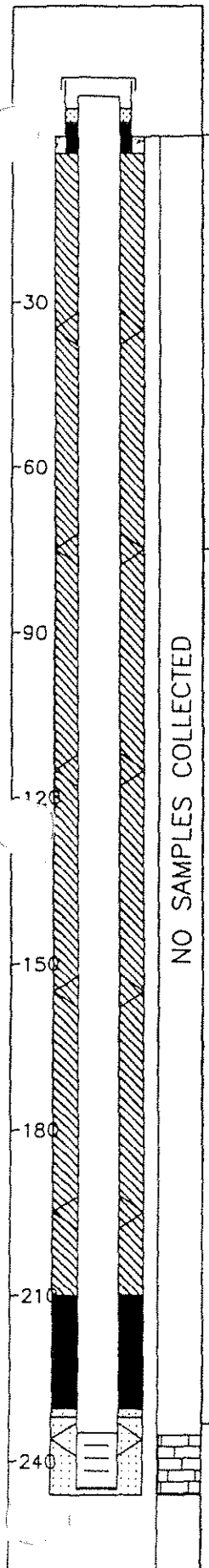
LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

Well No. PZ-100-SD

Boring No. X-Ref: PZ-100-SD

PIEZOMETER WELL CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1088852 ft. Easting: 517195 ft.

Elevation Ground Level 484.4 ft. NGVD

Top of PVC Casing 485.82 ft. NGVD

Drilling Summary:

Total Depth 246.0 ft.

Borehole Diameter 10 1/4 in. (0.0-51.0 ft.) 5 7/8 in. (51.0-246.0 ft.)

Casing Stickup Height 1.47 ft.

Driller Layne-Western St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit for Reaming

Drilling Fluid Auger-None, NX Core Water, Air Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	1/25/95	14:00	1/25/95	14:45
Schramm Rotary	2/21/95	8:30	2/22/95	15:00
Geophys.Logging:				
Casing:	2/23/95	9:50	2/23/95	10:15
Filter Placement:	2/23/95	10:35	2/23/95	11:40
Cementing:				
Development				
Bentonite Grout	2/23/95	13:45	2/23/95	15:30
Bentonite Seal	2/23/95	13:15	2/23/95	13:45

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.47	-	234.80	C1	485.82	-	249.55
234.80	-	244.60	S1	249.55	-	239.75
244.60	-	244.93	C2	239.75	-	239.42

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 232.0-246. ft.

Filter Pack: Less than 50 mesh Silica Sand, 230.5-232.0 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-210.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 210.0-230.5 ft.

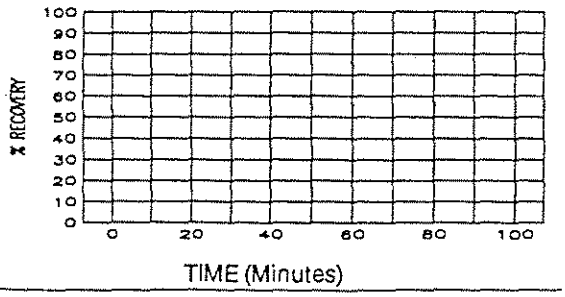
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Supervised by B. Tilton

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ100SD

661574

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 115081	CHECK NO
ROUTE	TRANSMITTAL NO.
STATE WELL NUMBER	CROSS REFERENCE NO.
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME: LAIDLAW BRIDGETON SANITARY LANDFILL		WELL NUMBER: PZ-100-SD	
SITE ADDRESS: ST. CHARLES ROCK RD.	CITY: BRIDGETON	STATE: MO	ZIP CODE: 63044
NAME: LAIDLAW WASTE SYSTEMS, INC.		TELEPHONE: 314-341-3710	
ADDRESS: 1838 N. BROADWAY	CITY: ST. LOUIS	STATE: MO	ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

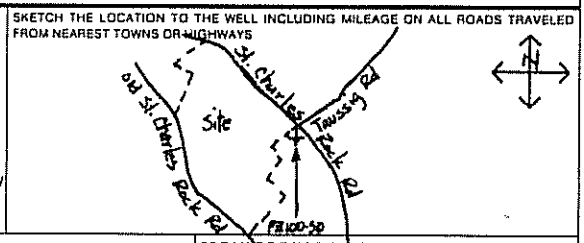
COUNTY: ST. LOUIS
ELEVATION: 484.35
AREA NO:

SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST ¼

SEC. ____ TWN. 47 N,RNG. 5 (E) OR W

LAT. 38° 46' 09" LONG. 90° 26' 23"

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

NOTE: Record the fraction of a foot in decimal, not in inches.

Top of Riser Elevation: 485.82

LOCKING CAP - Y / N (Circle one)
CAP VENT Y / N (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8"x8"x5'
Bore Hole Diameter: 10.25"
WEEP HOLE - Y / N (Circle one)

Ground Surface Elevation: 484.35 Ft

Information in this column to be supplied in the Feet from Surface column	Feet from Surface	Description of Formation
		0-13 Clay
Depth to bottom of Protective Casing Seal:	3	
		13-36 Silt
		36-88 Limestone
		88-94 Shale
		94-143 Dolomite
		143-159 Limestone
		159-165 Dolomite
		165-210 Limestone
Depth to Base of Annular Seal:	210.0	
		210-234 Dolomite
Depth to Base of Bentonite Seal:	230.5	
Depth to Base of Secondary Filter Pack:	232.0	
Depth to Top of the Screen:	234.8	
		234-246 Limestone
Depth to Bottom of the Screen:	244.8	
Plug Back Total Depth:		
Original Total Depth:	246.0	

PROTECTIVE CASING SEAL
Type: [X] Concrete [ ] Cement Slurry

RISER PIPE
Length: 236.27'
Diameter: 2"
Type of Material: SCH80 PVC

BOREHOLE DIAMETER: 5 7/8 in.

ANNULAR SEAL
Type: [X] Bentonite Slurry [ ] Cement Slurry [ ] Non Slurry Bentonite

BENTONITE SEAL
Type: [X] Bentonite Slurry [ ] Non Slurry Bentonite
Length of Seal: 20.5 Ft.

SECONDARY FILTER PACK (Optional)
Type: [X] Sand [ ] Manufactured
Grain Size: SUGAR
Length: 1.5'

PRIMARY FILTER PACK
Type: [X] Sand [ ] Manufactured
Grain Size: 2440
Length: 14'

WELL SCREEN
Length: 10'
Slot Size: 0.010"
Type: SCH.80 PVC

SUMP DETAILS
Length: 0.3 Ft.
Diameter: 2 In.
Type: PVC

TYPE OF BACKFILL: SAND

MONITORING WELL INSTALLATION CONTRACTOR'S NAME: LAYNE WESTERN CO., INC.

DRILLING CONTRACTOR'S NAME: LAYNE WESTERN CO., INC.

TYPE OF INSTALLATION: [X] ABOVE GROUND [ ] FLUSH MOUNT

STATIC WATER LEVEL: FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT

MEASURING POINT IS: [X] TOP OF RISER PIPE [ ] OTHER

DRILLING EQUIPMENT: [X] AIR ROTARY [X] AUGER TYPE 6¼ H.S.A. [ ] REVERSE ROTARY [ ] OTHER

CENTRALIZERS USED: [X] YES, AT 5 TOTAL [ ] STAINLESS STEEL [ ] OTHER [ ] NO

MULTIPLE CASED WELLS: SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED: 2-23-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR): Michael P. Vogt
PERMIT NUMBER: 001256 WM DATE: 4-11-95

SIGNATURE (DRILLING CONTRACTOR): Michael P. Vogt
PERMIT NUMBER: 001256 WM DATE: 4-11-95

MO 780-1415 (2-94) DISTRIBUTION: WHITE-DIVISION CANARY-MONITORING WELL CONTRACTOR PINK-OWNER

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-100-KS
		SHEET 1 OF 3
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	DRILLING START / FINISH
	WATER LEVEL / TIME / DATE / CASING DEPTH	TIME 13:20 / TIME 17:42 DATE 1/25/95 / DATE 1/25/95
NORTHING: 1068842.03 DATUM EASTING: 517211.63 ELEVATION 483.8		

DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS
ANGLE BEARING	
SAMPLE HAMMER	

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1	6 3 4 6	1.6'/2.0' (80%)			(0.0-7.2 ft.) Firm, dusky yellowish brown (10YR 2/2), SILTY CLAY, little organics, NR, moist, (CL), (LOESS)	SP 1	
2 3	4 6 7 8	1.8'/2.0' (90%)				SP 2	
4 5	2 5 5 5	1.7'/2.0' (85%)			@ 4.0 ft., color changes to moderate yellowish brown (10YR 5/4)	SP 3	
6 7	2 2 2 3	1.8'/2.0' (90%)			(7.2-11.6 ft.) Firm, moderate yellowish brown (10YR 5/4), mottled SILTY CLAY, NR, moist, (CL), (LOESS)	SP 4	
8 9	3 4 5 5	1.7'/2.0' (85%)				SP 5	
10 11	4 4 5 5	1.4'/2.0' (70%)			(472.2) 11.6	SP 6	
12 13	3 4 3 3	2.0'/2.0' (100%)			(11.6-19.2 ft.) Loose, moderate yellowish brown (10YR 5/4), mottled CLAYEY SILT, NR, moist, (ML), (LOESS)	SP 7	
14	1 3 6 7	1.8'/2.0' (90%)				SP 8	

DRILLING CONTR LAYNE-WESTERN

LOGGED BY J. MILLER CHK'D BY W. HERST

DATE 1/25/95

JOB NO.: 943-2848

FILENAME: PZ100KS

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-100-KS
		SHEET 2 OF 3
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	DRILLING START TIME 13:20 DATE 1/25/95; FINISH TIME 17:42 DATE 1/25/95
NORTHING: 1068842.03 DATUM EASTING: 517211.63 ELEVATION 483.8	WATER LEVEL / TIME / DATE / CASING DEPTH	
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS	
ANGLE BEARING		
SAMPLE HAMMER		

DRILLING CONTR LAYNE-WESTERN

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
16	3 4 7 10	1.2' / 2.0' (60%)			(11.6-19.2 ft.) Loose, moderate yellowish brown (10YR 5/4), mottled CLAYEY SILT, NR, moist, (ML), (LOESS)	SP 8	
17						SP 9	
18	3 4 5 7	1.9' / 2.0' (95%)					
19					(19.2-22.4 ft.) Loose, light olive gray (5Y 6/1), CLAYEY SILT, NR, moist, (ML), (LOESS)	SP 10	
20	5 6 7 8	1.5' / 2.0' (75%)					
21						SP 11	
22	2 7 9 10	1.2' / 2.0' (60%)			(461.4) 22.4 (22.4-28.2 ft.) Compact light olive gray (5Y 6/1), fine SANDY SILT, NR, dry, (SM), (ALLUVIAL)		
23						SP 12	
24	5 10 9 14	1.7' / 2.0' (85%)					
25					@ 25.4 ft., partings of light olive gray (5Y 6/1), CLAYEY SILT	SP 13	
26	3 9 14 15	1.4' / 2.0' (70%)					
27						SP 14	
28	3 5 7 11	0.0' / 2.0' (0%)			(455.6) 28.2 (28.2-32.1 ft.) Compact, light olive gray (5Y 6/1), mottled CLAYEY SILT, organics wet at 29.0 ft., NR, moist-wet, (ML), (ALLUVIAL)		
29						SP 15	

LOGGED BY J. MILLER CHK'D BY W. HERST

DATE 1/25/95

JOB NO.: 943-2848

FILENAME: PZ100KS

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	6.25 inch I.D. Hollow Stem Auger	PZ-100-KS
		SHEET 3 OF 3
	SAMPLING METHOD:	
	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)	DRILLING
	SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	START / FINISH
	WATER LEVEL	TIME / TIME
	TIME	13:20 / 17:42
	DATE	DATE / DATE
NORTHING: 1068842.03 DATUM EASTING: 517211.63 ELEVATION 483.8	CASING DEPTH	1/25/95 / 1/25/95

DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS
ANGLE BEARING	
SAMPLE HAMMER	

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
31	4 9 10 19	1.5'/2.0' (75%)			(28.2-32.1 Ft.) Compact light olive gray (5Y 6/1), mottled CLAYEY SILT, NR, moist-wet, (ML), (ALLUVIAL) @ 31.6 ft, ~1 inch of fine SAND (451.7) 32.1	SP 16	
32–33	15 14 12 14	1.1'/2.0' (55%)			(32.1-33.9 Ft.) Compact, brownish gray, (5YR 4/1), fine SAND, NR, wet, (SM), (ALLUVIAL)	SP 17	
34	50/6"	0.6'/2.0' (30%)			(33.9 Ft.) Loose, light gray (5Y 6/1), CLAYEY SILT, NR, moist, (ALLUVIAL) (449.3) 34.5	SP 18	
35					End of Soil Borehole Log at 34.5 Ft. See PZ-100-KS Record of Drillhole for rock descriptions		Augers chatter, spoon refusal, hit bedrock at 34.5 ft.
36							
37							
38							
39							
40							
41							
42							
43							
44							

DRILLING CONTR LAYNE-WESTERN

LOGGED BY J. MILLER CHK'D BY W. HERST

DATE 1/25/95

JOB NO.: 943-2848

FILENAME: PZ100KS

RECORD OF DRILLHOLE PZ-100-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2646
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.8
E: 517211.8
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
32	0.0-34.0 ft. See Soil Borehole Log PZ-100-KS														0.0-34.0 ft. Drilling conducted with 6.25 inch ID hollow stem augers
	449.80		449.80												
34	34.0-52.3 ft. 34.00 Slightly weathered, very thickly bedded, very light gray (N8), medium crystalline, weak, LIMESTONE, (ST. LOUIS FORMATION) 1 mm. iron concretions common, thin calcite vein (1 cm.), irregular joints, stylolitic		34.00						J,ST,R						1/27/95 Began coring
									J,I,R						
									J,I,R (2)						
									J,PL,R						
									J,C,R						
									J,I,R						
									J,PL,R						
36									J,I,R						
				1	100 %				J,I,R-CL						
									J,I,R						
38									J,PL,R						
			444.30												
			39.50						J,I,R						
40									J,PL,R						
									J,I,R						
									J,C,R						
									J,I,R						
42									J,C,R						
									J,PL,SM-CL (2)						
	42.9 ft. 1 in. thick clay seam								J,C,R						
				2	100 %				J,C,R						
44									J,ST,R						
									J,ST,R						
									J,PL,R						
46									J,PL,R						
									J,PL,R						
									J,C,R						
48															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2846
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 3

COLLAR ELEV: 483.8
E: 517211.8
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
48	34.0-52.3 ft. Slightly weathered, very thickly bedded, very light gray (N8), medium crystalline, weak, LIMESTONE, (ST. LOUIS FORMATION), 1 mm. iron concretions common, thin calcite vein (1 cm.), irregular joints, stylolitic							J,PL,R					
								J,PL,R					
			2	100 %				J,PL,R					
								J,ST,R					
		434.30 / 49.50											
								J,PL,R					
50								J,ST,R					
								J,C,R					
								J,PL,R (3)					
52								J,PL,R (2)					
	52.3-62.5 ft. Fresh, medium bedded, light gray (N7), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Stylolitic, numerous clay filled discontinuities, some iron oxide staining												
54													
			3	100 %				J,PL,R					
								J,C,R					
56													
								J,I,R					
58													
								J,C,R					
								J,U,R					
		424.30 / 59.50											
60								J,F,S (2)					1/27/95 @ 17:15 Measured water level in hole at 34.49 ft. below ground surface 1/28/95 @ 8:18 Measured water level in hole at 36.6 ft. below ground surface
								J,I,R					
								J,PL,R-CL (2)					
			4	100 %				J,I,R (2)					
62													
	62.5-67.5 ft. Fresh, medium bedded, medium light gray (N6), crypto-crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION)							J,C,R (2)					
64													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/8/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066842.0
AZIMUTH: 0

COLLAR ELEV: 483.8
E: 517211.8
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
64	62.5-37.5 ft. Fresh, medium bedded, medium light gray (N6), crypto-crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION)		418.70 / 65.10	4	100 %			90	J,I,R						
								90	J,C,R						1/27/95 @ 17:15 Quit drilling for the day @ 65.1 ft.
	1-2 in. chert nodules common														
66								90	J,PL,SM						
								90	J,I,R-CL (2)						
68	67.5-76.0 ft. Slightly weathered, medium bedded, olive gray (5Y 4/1), m-c grained, medium strong rock, CLASTIC LIMESTONE (ST. LOUIS FORMATION)														
								90	J,I,R						
								90	J,C,R						
70				5	99%			90	J,I,R (2)						
								90	J,C,R						
								90	J,I,R						
								90	J,C,R						
	Shaley partings common, fossiliferous							90	J,I,R (2)						
72								90	J,PL,R						
								90	J,ST,R						
74															
			408.70 / 75.10					90	J,PL,SM-CL (2)						
								90	J,C,R (2)						
76	76.0-88.5 ft. Slightly weathered, medium to thickly bedded, medium gray (N5) to light gray (N7), coarse grained, medium strong, CLASTIC LIMESTONE, (ST. LOUIS FORMATION)							90	J,PL,R-CL						
				6	99%										
78								90	J,C,R-CL						
								90	J,ST,R						
80	Stylolitic, shaley partings, sandy, more porous than above														

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.8
E: 517211.6
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
80	76.0-88.5 ft. Slightly weathered, medium to thickly bedded, medium gray (N5) to light grat (N7), coarse grained, medium strong, CLASTIC LIMESTONE, (ST. LOUIS FORMATION)				J,C,SM	
					J,PL,SM-CL	
82			8	99%		
					J,PL,SM (2)	
84					J,I,R-CL	
					J,I,VR (2)	
		398.70 / 85.10				
86					J,I,R	
					J,PL,R	
			7	100 %		
88		395.30 / 88.50				
	88.5-94.0 ft. Slightly weathered, thickly laminated to thinly bedded, medium gray (N5), fine grained, extremely weak to very weak, SILTY CLAYSTONE and SILTSTONE, (ST. LOUIS FORMATION) Pyrite in claystone, cross-bedded, fine sandy siltstone interbeds				J,I,R	
					J,I,R-CL	
90					J,PL,SM	
		393.40 / 90.40				
					J,I,R (3)	
					J,I,R	
					J,I,R (3)	
					J,I,R (2)	
92			9	79%	J,ST,SM	
					J,I,SM	92.7-93.3 ft. Core Loss
		390.50 / 93.30				
					J,I,R	
					J,I,R	
		389.80 / 94.00			J,C,R	
94	94.0-98.0 ft. Slightly weathered, thickly bedded, very light gray (N8), fine grained, medium strong, DOLOMITE (ST. LOUIS FORMATION)				J,ST,R (2)	
					J,I,R	
			9	98%		
					J,PL,R-CH	
96						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.8
E: 517211.8
INCLINATION: -90

ROCK TYPE

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular

P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough

Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DISCONTINUITY DATA

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (80 60 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DIP wrt CORE AXIS (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR MW HW CW)	STRENGTH INDEX (R5 R6 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 30 R2 150 R3 300 R4 600 R5 1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
96	94.0-98.0 ft. Slightly weathered, thickly bedded, very light gray (N8), fine grained, medium strong, DOLOMITE, (ST. LOUIS FORMATION) Vuggy, highly silicified, bioturbated								J,I,R-CL						
98	98.0-116.4 ft. Slightly weathered, very thickly bedded, light brownish gray (5Y 6/1), fine grained, medium strong, DOLOMITE, (ST. LOUIS FORMATION)			9	98%										
100	Laminae, vuggy in places, clay infilling, some silicification														
	101.0-103.0 ft. Vuggy								J,C,S-CL						
102			380.50 / 103.30												
									J,PL,R						
104	104.5-106.4 ft. Vuggy, some silicification in veins, clay partings								J,PL,R						
106									J,PL,R						
				10	99%										
108															
110									J,I,R						
112															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.8
E: 517211.6
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
112	98.0-116.4 ft. Slightly weathered, very thickly bedded, light brownish gray (5Y 6/1), fine grained, medium strong, DOLOMITE, (ST. LOUIS FORMATION)		370.40 / 113.40	10	99%				J,I,VR						
114															
116	116.4-119.6 ft. Fresh, thickly bedded, medium light gray (N6), medium crystalline, medium strong, DOLOMITE, (ST. LOUIS FORMATION)														
118				11	100 %										
120	364.20 / 119.60 119.6-120.7 ft. Fresh, thinly bedded, medium gray (N5), finely crystalline, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) 363.10 / 120.70 Bioturbated, calcite infilling								J,PL,R-CL						
122	120.7-123.7 ft. Fresh, thickly bedded, medium light gray (N6), f-m crystalline, medium strong, DOLOMITE, (ST. LOUIS FORMATION)		360.30 / 123.50												1/28/95 @ 17:32 Finish drilling for the day at 123.5 ft., we blow out hole and measure water level at 72.77 ft. below ground surface
124	123.7-147.5 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine crystalline, medium strong, DOLOMITE, (ST. LOUIS FORMATION) Stylolitic								J,I,R J,I,R J,I,R						
126				12	100 %										
	126.9 ft. 1 in. clay seam, fractures at ~124.5 and 127.6 ft.								J,C,R J,I,R						
128															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.8
E: 517211.6
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
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DEPTH (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
128	123.7-147.5 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine crystalline, medium strong, DOLOMITE, (ST. LOUIS FORMATION) Stylolitic							J,I,R-CL,CH					
								J,C,SM					
130				12	100 %								
								J,ST,R					
132			351.60 / 132.20										
								J,PL,R-CL					
								J,I,R					
134													
138													
								J,PL,S-CL					Note: rock breaks along stylolites and clay partings
				13	100 %								
138													
								J,PL,S					
140													
142			341.60 / 142.20										
				14	100 %								
144													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.8
E: 517211.6
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
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DEPTH (FEET)	ROCK TYPE DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
144	123.7-147.5 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine crystalline, medium strong, DOLOMITE, (ST. LOUIS FORMATION)												
146													
	147.5-159.5 ft. (338.30 / 147.50) Fresh, thickly bedded, pale yellowish brown (10YR 6/2), m-c crystalline, strong, LIMESTONE, (ST. LOUIS FORMATION) 147.5 ft. 1 in. clay partings							J,C,R-CL					
148			14	100 %				J,C,SM-CL					148.1-149.0 ft. 1 in. clay filled vertical fracture
150													
152		331.60 / 152.20											1/29/95 @ 16:06 Drillers quit drilling for the day, they blew out the hole, measured water level @ 80.4 ft. below ground surface, drilled to 152.2 ft.,
	Stylolitic							J,I,R					
								J,I,R					
154								J,I,R					1/30/95 @ 9:38 Measured water level in hole @ 48.3 ft. 1/30/95 @ 9:51 Begin Run 15
								J,I,R					
								J,I,VR					
156	Brecciated, glauconitic, clay and silt sized infilling		15	100 %									
								J,I,R-CL					
158													
								J,I,R					
	159.5-165.5 ft. (324.30 / 159.50) Fresh, thickly bedded, greenish gray (5GY 6/1), coarsely crystalline, medium strong, DOLOMITE, (ST. LOUIS FORMATION)							J,PL,R					
160								J,I,R					

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1058842.0
AZIMUTH: 0

COLLAR ELEV: 483.6
E: 517211.6
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
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DEPTH (FEET)	ROCK TYPE DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
160	159.5-165.5 ft. Fresh, thickly bedded, greenish gray (5GY 6/1), coarsely crystalline, medium strong, DOLOMITE, (ST. LOUIS FORMATION)		15	100 %			80	J,I,VR		R5 R4 R3			
162		321.50 / 162.30											
	Some dark gray organic laminae												
164													
	165.5-173.0 ft. (318.30 / 165.50) Fresh, thickly bedded, pale yellowish brown (10YR 6/2), f-m grained, strong, LIMESTONE, (SALEM FORMATION)						80	J,C,R		R5 R4 R3			@ 165.5 ft. Inferred contact between ST. LOUIS FORMATION and SALEM FORMATION
166	167.3-169.6 ft. Brecciated, glauconite and gray clay infilling, stylolitic, some calcite filled veins		16	100 %									
168							80	J,C,R					
170													
172		311.50 / 172.30											
174	173.0-181.2 ft. Fresh, thinly bedded, pale yellowish brown (10YR 6/2), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (SALEM FORMATION)		17	100 %									
176													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.8
E: 517211.6
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
Pl-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
176	173.0-181.2 ft. Fresh, thinly bedded, pale yellowish brown (10YR 6/2), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (SALEM FORMATION)														
178				17	100 %										
180															
182	181.2-183.0 ft. Thickly bedded, pale yellowish brown (10YR 6/2), coarse grained, strong, (SALEM FORMATION)		301.60 / 182.20												
184	183.0-190.5 ft. Fresh, thinly laminated, pale yellowish brown (10YR 6/2), fine grained, medium strong, ARGILLACEOUS LIMESTONE (SALEM FORMATION)								J,I,R-CL						
				18	100 %										
186	185.9-186.7 ft. Clay rich horizons, becoming siltier. 186.7 ft. Chert nodules, stylolitic														
188									J,I,R						
			295.30 / 188.50												
190				19	100 %				J,PL,S						
	190.5-205.5 ft. Fresh, thickly bedded, pale yellowish brown (10YR 6/2), medium grained, strong, ARENACEOUS LIMESTONE, (SALEM FORMATION)		292.80 / 191.00												1/31/95 @ 8:00 Measure water level in hole at 38.05 ft. @ 8:10 resume coring on Run 20
192				20	100 %				J,I,VR						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.6
E: 517211.6
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA (DIP wrt CORE AXIS)	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
192	190.5-205.5 ft. Fresh, thickly bedded, pale yellowish brown (10YR 6/2), medium grained, strong, ARENACEOUS LIMESTONE, (SALEM FORMATION)							J,I,S					
	Silty, fine sand, fossil fragments, organic laminae, some clayey laminae, cherty, bioturbated												
194													
196			20	100 %									
198													
		283.90 / 199.90											
200													
202	202.0 ft. Silicified horizons		21	100 %									
204		279.70 / 205.10											1/31/95 @ 17:15 Finish coring @ 205.1 ft., driller tried 1/2 day to get past the chert at this depth and failed
206	205.5-210.0 ft. Fresh, thinly bedded, pale yellowish brown (10YR 6/2), fine grained, medium strong, ARENACEOUS LIMESTONE, (SALEM FORMATION)		22	100 %				J,I,R-CL; J,I,R (2); J,I,R; J,I,R-CL					
	206.0-206.3 ft. Clay interbed												
	Silty, cherty, some clay horizons, silicified, coarse grained interbeds												
208													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.8
E: 517211.8
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
208	205.5-210.0 ft. Fresh, thinly bedded, pale yellowish brown (10YR 6/2), fine grained, medium strong, ARENACEOUS LIMESTONE, (SALEM FORMATION)		22	100 %									
	Silty, cherty, some clay horizons, silicified, coarse grained interbeds 273.80	273.70											
210	210.0-220.7 ft. 210.00 Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARGILLACEOUS DOLOMITE (SALEM FORMATION)	210.10											
212													
214			23	91%									
216													
218													
								Core Loss					
220		263.70											
		220.10											
	263.10												
	220.7-222.5 ft. 220.70 Fresh, thickly bedded, light olive gray (5Y 6/1), medium grained, medium strong, ARENACEOUS DOLOMITE, (SALEM FORMATION) shell debris in lower .5 ft., coarser downward, organic laminae 261.30		24	100 %									
222	222.5-233.8 ft. 222.50 Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARGILLACEOUS DOLOMITE, (SALEM FORMATION)							J,PL,SM					
224													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2548
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.6
E: 517211.6
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filed

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
224	222.5-233.8 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARGILLACEOUS DOLOMITE, (SALEM FORMATION) Chert nodules common, bioturbated, organic laminae, some texture laminae								J,I,SM						
226				24	100 %										
228															
230			253.50 / 230.30												
									J,C,SM						
									J,PL,SM						
232	233.7 ft. Organic clay lense			25	100 %										
			250.00 / 233.80						J,I,R-CL						
234	233.8-241.4 ft. Fresh, thickly bedded, light gray (N7), coarse grained, medium strong, BIOCLASTIC LIMESTONE, (SALEM FORMATION)								J,PL,R						
236			247.60 / 236.20												2/1/95 End drilling @ 16:30, 2/6/95 @ 8:26 Measure water level at 80.8 ft. below ground surface 2/6/95 @ 9:50 Begin coring Run 26
				26	100 %				J,PL,R						
	Stylolitic, sandy, dark gray laminae		246.20 / 237.60												
238									J,PL,R						
				27	75%										
									J,PL,S						
240	239.8 ft. Medium sand, 1 cm. thick layer														

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.6
E: 517211.6
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filed

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
240	233.6-241.4 ft. Fresh, thickly bedded, light gray (N7), coarse grained, medium strong, BIOCLASTIC LIMESTONE, (SALEM FORMATION)					
					J,I,R	
242	241.4-245.6 ft. Fresh, thickly bedded, light gray (N7) to dark gray (N3), coarse grained, medium strong, ARENACEOUS LIMESTONE (SALEM FORMATION)		27	75%	J,I,R	
	242.8 ft. Silty sand, fossiliferous, 1 in. thick clayey horizon				Core Loss	Core loss occurred due to barrel falling down hole
244		239.20 / 244.60				
	245.6-249.8 ft. Fresh, thickly bedded, olive gray (5Y 4/1), fine grained, medium strong, SILTSTONE, (WARSAW FORMATION)	238.20 / 245.60				Run 28 recovery poor, because core barrel fell in hole and core was lost after Run 27. Run 28 core is broken up due to damage during its retrieval. Contacts @ 245.6 and 249.8 ft. are approximate because of core loss
246						
248			28	81%		
	249.8-254.5 ft. Fresh, thickly bedded, olive gray (5Y 4/1), fine grained, medium strong, CLAYSTONE, (WARSAW FORMATION) Grades to siltstone near base	234.00 / 249.80				
250					Core Loss	
252		231.20 / 252.60				
254			29	96%		
	254.5-256.4 ft. Fresh, thickly bedded, medium dark gray (N4), coarse grained, medium strong, FOSSILIFEROUS LIMESTONE, (WARSAW FORMATION)	229.30 / 254.50				
256						

DISCONTINUITY DATA: DIP wrt CORE AXIS (0, 30, 60, 90); FRACTURES PER FOOT (2, 4, 6, 8, 10)

WEATHERING INDEX: SW, FR, MW, HW, CW
STRENGTH INDEX: R6, R5, R4, R3, R2, R1
POINT LOAD INDEX (psi): R1 30, R2 150, R3 300, R4 600, R5 1500, R6

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.8
E: 517211.6
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
Pl.-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
256															
	227.40 / 256.40														
	256.4-261.3 ft. Fresh, thickly bedded, olive black (5Y 6/1), fine grained, medium strong, SILTSTONE, (WARSAW FORMATION) Black organic laminae, slightly pitted, dolomitic			29	96%										
258															
			224.10 / 258.70						Minor Core Loss						2/6/95 @ 16:50 Quit for the day 2/7/95 @ 8:30 Start coring Run 30
260									J,I,SM						
	222.50 / 261.30														
	261.3-264.8 ft. Fresh, thickly bedded, olive gray (5Y 4/1), medium crystalline, medium strong, DOLOMITE, (WARSAW FORMATION)														
262															
264															
	219.00 / 264.80														
	264.8-276.7 ft. Fresh, thickly bedded, dark gray (N3), microcrystalline, medium strong, LIMESTONE, (WARSAW FORMATION)			30	100 %										
268															
269															
	Packstone, fossiliferous		213.90 / 269.90												
270															
				31	100 %										
									J,PL,VR						
272															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2846
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.8
E: 517211.6
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
272	264.8-276.7 ft. Fresh, thickly bedded, dark, gray (N3), microcrystalline, medium strong, LIMESTONE, (WARSAW FORMATION)												
274													
276			31	100 %									
	276.7-278.5 ft. Fresh, medium bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARENACEOUS DOLOMITE (WARSAW FORMATION)	207.10 / 278.70											
278		205.30 / 278.50											
	278.5-287.2 ft. Fresh, thickly bedded, medium light gray (N6), coarsely crystalline, medium strong, FOSSILIFEROUS LIMESTONE, (WARSAW FORMATION)	203.90 / 279.90											
280													
282							90	J,I,VR					
284			32	100 %									
286													
288	287.2-301.0 ft. Fresh, thickly bedded, olive black (5Y 2/1), coarse crystalline, medium strong, LIMESTONE, (WARSAW FORMATION)												

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.8
E: 517211.6
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
288	287.2-301.0 ft. Fresh, thickly bedded, olive black (5Y 2/1), coarse crystalline, medium strong, LIMESTONE, (WARSAW FORMATION)		32	100 %				J,PL,VR-Calcite mineralization	Possible water producer
		183.90 / 289.90							
290									2/7/95 @ 15:07 Start Run 33
	Stylolitic common, fossiliferous							J,I,VR-Calcite mineralization	
292									
								J,PL,VR-Calcite mineralization	
294			33	100 %					
	295.4-295.7 ft. Vuggy porosity								
296									
298									
		184.50 / 299.30						J,I,R	2/7/95 @ 16:30 Quit drilling @ 299.3 ft. after Run 33 2/8/95 @ 9:10 Start coring Run 34, measured water level @ 18.8 ft. below ground surface
300								J,I,R	
								J,I,R	
	182.60 / 301.00 301.0-304.3 ft. Fresh, thickly bedded, olive black (5Y 2/1), medium grained, medium strong, DOLOMITE, (WARSAW FORMATION) Argillaceous, vuggy 301.0-304.3 ft. Vuggy porosity		34	99%					
302									
304									

GRAPHIC LOG | WEATHERING INDEX (FR, SW, MW, HW, CW) | STRENGTH INDEX (R6, R5, R4, R3, R2, R1) | POINT LOAD INDEX (psi) (R1 30, R2 150, R3 300, R4 600, R5 1500, R6) | TEST ORIENTATION

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

PROJECT: LA/DLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.8
E: 517211.8
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
304			179.50												
	304.3-306.1 ft. Fresh, thickly bedded, medium dark gray (N4), coarsely crystalline, medium strong, LIMESTONE, (WARSAW LIMESTONE)		304.30												
306			177.70												
	306.1-313.0 ft. Fresh, thinly bedded, grayish black (N2), fine grained, weak, CLAYEY SILTSTONE, (WARSAW FORMATION) Pyrite crystals, calcite mineralization		306.10	34	99%										
308									J,I,SM						
			174.60 / 309.20												
310															
312															
									J,PL,R						312.5-313.5 ft. 90 and 50 degree fractures are not open
			170.80												
	313.0-316.5 ft. Fresh, thickly bedded, dark greenish gray (5GY 4/1), medium crystalline, medium strong, ARENACEOUS DOLOMITE, (WARSAW FORMATION), glauconitic, stylolitic, vuggy, silty shale interbeds		313.00						J,I,VR						314.5-315.5 ft. Second fracture not open
314				35	100 %				J,PL,SM-CL (2)						
									J,PL,R						2/8/95 Finish in Run 36, break down due to hydraulic leaks
316			167.30												
	316.5-341.0 ft. Fresh, thinly bedded, olive black (5Y 2/1), fine grained, weak, CLAYEY SILTSTONE, (WARSAW FORMATION)		316.50												
318															
			164.70 / 319.10												2/9/95 @ 7:40 Resume coring Run 36
				36	100 %										
320															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 843-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.8
E: 517211.8
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	ROCK TYPE: DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
320	316.5-341.0 ft. Fresh, thinly bedded, olive black (5Y 2/1), fine grained, weak, CLAYEY SILTSTONE, (WARSAW FORMATION)														
	321.1-322.1 ft. 1-2 in. thick limey and dolomite interbeds														
322									J,PL,SM						
									J,I,SM						
									J,PL,SM						
									J,C,SM						
									J,PL,SM						
324				36	100 %										
326															
328	Very fine pyrite crystals, calcite infilled veins, thin (0.2-0.3 in.) dolomite interbeds		154.60 / 329.20												
330									J,ST,SM-CL						
332				37	98%										
334															4 drill induced fractures in Run 37, especially at point core was lost
			146.40 / 335.40	38	99%										
336															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 463.8
E: 517211.8
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
336	316.5-341.0 ft. Fresh, thinly bedded, olive black (5Y 2/1), fine grained, weak, CLAYEY SILTSTONE, (WARSAW FORMATION)														
338															5 drill induced fractures in upper 5 ft. of Run 38
340				38	99%				J,PL,SM						
	142.60 / 341.0-344.6 ft. 341.00 Fresh, medium bedded, greenish black (5GY 2/1), fine grained, medium strong, ARGILLACEOUS DOLOMITE, (WARSAW FORMATION)								J,PL,SM						
342															
344	Black organic laminae, calcite filled vugs		139.50												
	139.20 / 344.6-348.8 ft. 344.60 Fresh, thinly bedded, olive black (5Y 2/1), fine grained, weak, SILTY CLAYSTONE, (WARSAW FORMATION)		344.30												Two drilling induced fractures in upper 2 ft. of Run 39
346	Calcite filled vugs														
348				39	100 %										
	135.00 / 348.8-352.8 ft. 348.80 Fresh, medium bedded, olive gray (5Y 4/1), fine grained, medium strong, ARGILLACEOUS DOLOMITE, (WARSAW FORMATION)														
350	Vuggy, fossil fragments														
352															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.8
E: 517211.6
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (Feet)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
352													
	131.00 / 352.80												
	352.8-357.6 ft. Fresh, medium bedded, olive gray (5Y 4/1), medium grained, medium strong, LIMESTONE, some fossils, race thin chert layers (<1 in.), (WARSAW FORMATION)		39	100 %									2/9/95 @ 15:15 Finish Run 39, quit work on the hole 2/11/95 @ 13:15 Corehole reamed out with 6 in. bit using Schramm Rotadrill to 354.5 ft.
354		129.60 / 354.20											
		129.30 / 354.50											
	354.8-355.0 ft. and 355.4-355.7 ft. Thinly bedded, medium dark gray (N4), Claystone layers												
356								J,I,R					
	126.20 / 357.60												
	357.6-386.6 ft. Fresh, thin to medium bedded, medium light gray (N6), very coarse grained, medium strong, FOSSILIFEROUS LIMESTONE, (KEOKUK FORMATION) Predominantly argillaceous, shaley partings common, numerous light bluish gray (5B 7/1) chert layers (1-2 in. thick), chert nodules (1-10 mm.)		40	100 %				J,I,R; J,I,R					@ 357.6 ft. Inferred top of KEOKUK FORMATION
358													
360								J,I,R					
362		121.80 / 362.00											
													363.0-372.0 ft. Numerous drilling induced fractures (2-3 per foot)
364			41	100 %									
366													
368													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068842.0
AZIMUTH: 0

COLLAR ELEV: 483.6
E: 517211.6
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
368	357.6-386.6 ft. Fresh, thin to medium bedded, medium light gray (N6), very coarse grained, medium strong, FOSSILIFEROUS LIMESTONE. (KEOKUK FORMATION) Predominantly argillaceous, shaley partings common, numerous light bluish gray (5B 7/1) chert layers (1-2 in. thick), chert nodules (1-10 mm.)					
370			41	100 %		
372		111.80 / 372.00				
374	374.2-375.2 ft. Moderately weathered, medium bedded, light olive gray (5Y 6/1), medium strong, ARENACEOUS DOLOMITE layer, (KEOKUK FORMATION) 109.60 374.20 / 108.60 375.20		42	100 %	J,I,S,CL; B,I,R; B,I,R (2)	
376		106.60 / 377.20			J,I,R	
378					B,C,R,CL; J,R,R	
380	380.7-381.0 ft. Thinly laminated, dark greenish gray (5G 4/1), SILTY CLAYSTONE layer		43	100 %	B,PL,S; B,PL,R	
382					B,U,CL	
384						

WEATHERING INDEX: SW FR, MW, HW, CW
STRENGTH INDEX: R6, R5, R4, R3, R2, R1
POINT LOAD INDEX (psi): R1 30, R2 150, R3 300, R4 600, R5 1500, R6
TEST ORIENTATION

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-100-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 1/27/95 - 2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068642.0
AZIMUTH: 0

COLLAR ELEV: 483.8
E: 517211.6
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
384	357.6-386.6 ft. Fresh, thin to medium bedded, medium light gray (N6), very coarse grained, medium strong, FOSSILIFEROUS LIMESTONE, (KEOKUK FORMATION) Predominantly argillaceous, shaley partings common, numerous light bluish gray (5B 7/1) chert layers (1-2 in. thick), chert nodules (1-10 mm.)			43	100 %				B,PL,CL						
386									B,I,VR; J,I,VR; J,I,R						
	386.6-391.2 ft. Slightly weathered, thinly bedded, light gray (N7), coarse grained, medium strong to strong, ARENACEOUS LIMESTONE, (KEOKUK FORMATION), Thin dolomite layers layers (<6 in.), argillaceous in some zones, stylolitic, chert nodules (<1 in.), silicified zones (<6 in.), some joints highly weathered, fossiliferous @ 389.0 ft. Open vug with calcite crystals (1/2 in. dia.)		96.60 / 387.00												2/12/95 @ 16:00 Complete Run 43 2/13/95 @ 9:00 Resume coring Run 44
388									B,I,R; B,I,R; J,I,VR						
				44	100 %				J,I,VR; J,I,R						
390									J,I,R						
	92.60		92.60												
	End of Record of Drillhole at 391.2 ft. 391.20		391.20												
392															
394															
396															
398															
400															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

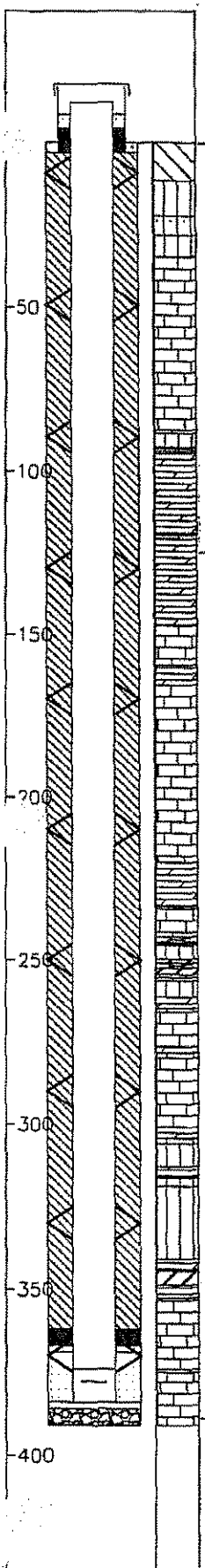
LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

Well No. PZ-100-KS

Boring No. X-Ref: PZ-100-KS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords:	Northing: 1068842 ft.	Elevation Ground Level	483.8 ft. NGVD
	Easting: 517212 ft.	Top of PVC Casing	485.64 ft. NGVD

Drilling Summary:

Total Depth 390.0 ft.

Borehole Diameter 10 1/4 in. (0.0-34.0 ft.) 5 7/8 in. (34.0-391.0 ft.)

Casing Stickup Height 1.88 ft.

Driller Layne-Western St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit for Reaming

Drilling Fluid Auger-None, NX Core Water, Air Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	1/25/95	13:20	2/9/95	15:15
Schramm Rotary	2/11/95	11:00	2/13/95	15:30
Geophys.Logging:	2/9/95	16:15	2/9/95	18:15
Casing:	2/17/95	7:55	2/17/95	11:00
Filter Placement:	2/17/95	11:00	2/17/95	13:30
Cementing:				
Development				
Bentonite Grout	2/20/95	7:30	2/20/95	11:30
Bentonite Seal	2/17/95	13:30	2/17/95	13:45

Well Design & Specifications

Basis: Geologic Log X Geophysical Log X

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.88	-	374.00	C1	485.64	-	109.76
374.00	-	383.80	S1	109.76	-	99.96
383.80	-	384.13	C2	99.96	-	99.63

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 369.0-384.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 367.0-369.0 ft. and 384.0-386.0 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-362.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 362.0-367.0 ft.

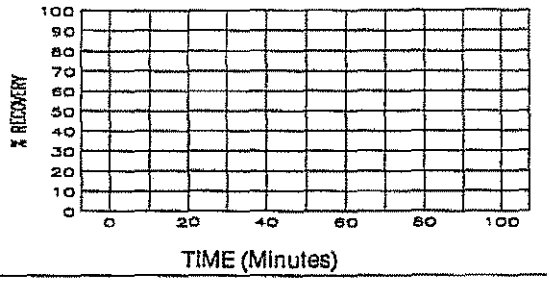
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments: Prior to well installation, there was about 4 ft. of slough at base of borehole which could not be removed.

Supervised by	W. Herst	Site	LAIDLAW/OU2 RI-FS/MO
Job Number	943-2848	File Name	PZ100KS

661574

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 115080	CHECK NO.
ROUTE	TRANSMITTAL NO.
STATE WELL NUMBER	CROSS REFERENCE NO.
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME: LANDFILL BRIDGETON SANITARY LANDFILL		WELL NUMBER: PZ-100-KS	
SITE ADDRESS: ST CHARLES ROCK ROAD	CITY: BRIDGETON	STATE: MO	ZIP CODE: 63044
NAME: LANDFILL WASTE SYSTEMS, INC		TELEPHONE: 314-241-3710	
ADDRESS: 1838 N BROADWAY	CITY: ST. LOUIS	STATE: MO	ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

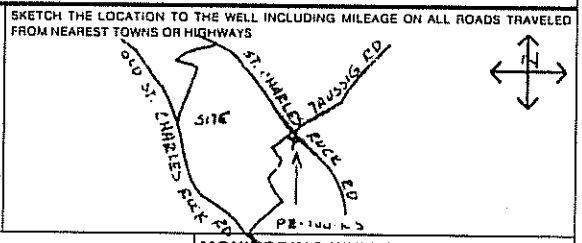
COUNTY: ST. LOUIS
ELEVATION: 493.76
AREA NO.

SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST ¼

SEC. ____ TWN. 47 N,RNG. 5 (E) OR W

LAT. 38 ° 46 ' 69 " LONG. 90 ° 26 ' 32 "

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN CO, INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN CO, INC.

TYPE OF INSTALLATION: [X] ABOVE GROUND [ ] FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT: 495.64

MEASURING POINT IS: [X] TOP OF RISER PIPE [ ] OTHER

DRILLING EQUIPMENT: [X] AIR ROTARY [X] AUGER TYPE 6 1/4 HSA [ ] REVERSE ROTARY [ ] OTHER

CENTRALIZERS USED: [X] YES, AT 8 TOTAL [X] STAINLESS STEEL [ ] OTHER [ ] NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED: 3-20-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR): Michael P. Vogt
PERMIT NUMBER: UC1256WM DATE: 4-11-95
SIGNATURE (DRILLING CONTRACTOR): Michael P. Vogt
PERMIT NUMBER: UC1256WM DATE: 4-11-95

NOTE: Record the fraction of a foot in decimal, not in inches

Top of Riser Elevation: 495.64

LOCKING CAP - Y / N (Circle one): Y
CAP VENT - Y / N (Circle one): Y

PROTECTIVE CASING
Type: STEEL
Size: 8"x8"x5'
Bore Hole Diameter: 10.25"

WEEP HOLE - Y / N (Circle one)

Ground Surface Elevation: 493.76 Ft

Feet from Surface	Description of Formation
Information in this column to be supplied in the Feet from Surface column	0-13 clay
Depth to bottom of Protective Casing Seal: 3	13-36 silt 36-88 Limestone 88-94 Shale 94-143 Dolomite 143-159 Limestone 159-165 Dolomite 165-210 Limestone 210-234 Dolomite
Depth to Base of Annular Seal: 360	234-246 Limestone 246-267 Shale 267-307 Dolomite 307-312 Limestone
Depth to Base of Bentonite Seal: 367	312-367 Shale
Depth to Base of Secondary Filter Pack: 369	367-314 Dolomite
Depth to Top of the Screen: 374	314-317 Dolomite
Depth to Bottom of the Screen: 394.2	317-343 Shale 343-346 Dolomite 346-351 Shale 351-354 Dolomite 354-394 Limestone
Plug Back Total Depth	
Original Total Depth: 394.2	

PROTECTIVE CASING SEAL
Type: [X] Concrete [ ] Cement Slurry

RISER PIPE
Length: 375.88'
Diameter: 2"
Type of Material: PVC SCH.80

BOREHOLE DIAMETER: 5 7/8 In.

ANNULAR SEAL
Type: [X] Bentonite Slurry [ ] Cement Slurry [ ] Non Slurry Bentonite

BENTONITE SEAL
Type: [X] Bentonite Slurry [ ] Non Slurry Bentonite
Length of Seal: 5 Ft.

SECONDARY FILTER PACK (Optional)
Type: [X] Sand [ ] Manufactured
Grain Size: 30-60
Length: 2'

PRIMARY FILTER PACK
Type: [X] Sand [ ] Manufactured
Grain Size: 16-35
Length: 15

WELL SCREEN
Length: 10'
Slot Size: 0.010"
Type: SCH. 80 PVC

SUMP DETAILS
Length: 0.2 Ft.
Diameter: 2 In.
Type: PVC

TYPE OF BACKFILL: SAND/SLURRY

MO 780-1415 (2-94) DISTRIBUTION: WHITE/DIVISION CANARY/MONITORING WELL CONTRACTOR PINK/OWNER

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-101-SS
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	SHEET 1 OF 1
		DRILLING START / FINISH
NORTHING: 1068472.89 DATUM EASTING: 516622.94 ELEVATION 474.9	WATER LEVEL / TIME / DATE / CASING DEPTH	TIME 13:35 / TIME 14:30 DATE 2/23/95 / DATE 2/23/95
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS	
ANGLE BEARING		
SAMPLE HAMMER		

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1	2 2 3 3	1.1'/2.0' (55%)			(0.0-0.2 ft.) Firm, olive gray (5Y 4/1), SILT, trace clay, NR, damp, (CL-ML), (LOESS) (0.2-2.7 ft.) Firm, mottled dark yellowish brown (10YR 4/2), CLAYEY SILT, some roots, NR, damp, (CL-ML), (LOESS)	SP 1	
2 3	5 4 5 4	1.6'/2.0' (80%)			(2.7-8.0 ft.) Firm, stiff, olive gray (5Y 3/2), CLAYEY SILT, NR, damp, (CL-ML), (LOESS)	SP 2	
4 5	1 1 3 5	1.7'/2.0' (85%)				SP 3	
6 7		1.7'/2.0' (85%)				SH 4	
8 9	1 3 6 6	1.7'/2.0' (85%)			(8.0-8.9 ft.) Stiff, mottled olive gray (5Y 3/2) and dark yellowish brown (10YR 4/2), CLAYEY SILT, NR, damp, (CL-ML), (LOESS) (8.9-10.3 ft.) Stiff, mottled moderate yellowish brown (10YR 5/4) and dark yellowish brown (10YR 4/2), CLAYEY SILT, NR, damp, (CL-ML), (LOESS)	SP 5	Iron oxide staining from 8.0-14.0 ft.
10 11	3 5 5 5	1.7'/2.0' (85%)			(10.3-13.2 ft.) Stiff, mottled light olive gray (5Y 5/2) and moderate yellowish brown (10YR 4/2), CLAYEY SILT, NR, damp, (CL-ML), (LOESS)	SP 6	
12 13	1 1 2 6	1.6'/2.0' (80%)			(13.2-14.0 ft.) Soft, dark greenish gray (5GY 4/1), CLAYEY SILT, NR, damp, (CL-ML), (LOESS) (460.9) 14.0	SP 7	
14					End of Soil Borehole Log at 14 ft. See PZ-101-SS Record of Drillhole for rock descriptions		Auger refusal at 14.0 ft.

DRILLING CONTR LAYNE-WESTERN

LOGGED BY M. HIRT

DATE 2/23/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ101SS

RECORD OF DRILLHOLE PZ-101-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/23/95-2/25/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068472.9
AZIMUTH: 0

COLLAR ELEV: 474.6
E: 518622.9
INCLINATION: -90

ROCK TYPE: J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation; PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular; P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough; Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DISCONTINUITY DATA

DEPTH SCALE (Feet)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
0	0.0-14.0 ft. See Soil Borehole Log PZ-101-SS														
2															
4															
6															
8															
10															
12															
14	460.80 / 14.00 — 14.0-27.6 ft. Slightly weathered to fresh, medium bedded, very light gray (N8), medium grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Brachiopod fossils, iron staining, 1 in. thick clay filled joint at 15.4 ft.		460.80 / 14.00	1	55%				Broken Zone Broken Zone						
16															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-101-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/23/95-2/25/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068472.9
AZIMUTH: 0

COLLAR ELEV: 474.8
E: 516822.9
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
16	14.0-27.6 ft. Slightly weathered to fresh, medium bedded, very light gray (N8), medium grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic		1	55%	Core Loss	Core loss due to highly fractured rock
		456.80 / 18.00			J,I,R,Fe (2)	
18					J,I,R,Fe (2)	
					J,I,R,Fe (2)	
					J,I,R (2)	
					J,I,R	
					J,I,R	
					J,I,R	
					J,I,R	
					J,I,R (2)	
					J,I,R	
20					J,I,R	
					J,I,R,CL (3)	
			2	100	J,I,R,CL (2)	
					J,I,R,CL (2)	
22					J,I,R,CL (2)	
					J,I,R,CL	
					J,I,R	
					J,I,SM	
					J,I,R,CL	
24					J,I,R,CL	
		450.30 / 24.50			J,ST,R,Fe	
					J,I,R,CL (3)	
26					J,I,R,CL (2)	
					J,I,SM,CL (3)	
			3	96%	J,I,SM,CL	
					J,U,SM,CL	
	27.6-40.5 ft. Fresh, medium bedded, very light gray (N8), very fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Some braciopod fossils				J,I,R,CL	
28					J,PL,SM,CL (2)	
					J,I,R,CL	
					J,I,SM,CL (2)	
		445.30 / 29.50			J,I,SM,CL (2)	
30					J,I,SM (2)	
					J,U,SM	
			4	98%	J,I,R	
					J,I,R,chert	
					J,PL,SM	
					J,I,R,CL (2)	
32					J,I,R (2)	

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-101-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/23/95-2/25/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068472.9
AZIMUTH: 0

COLLAR ELEV: 474.8
E: 516622.9
INCLINATION: -90

ROCK TYPE: J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular

P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough

Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DISCONTINUITY DATA

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	DISCONTINUITY DATA (TYPE AND SURFACE DESCRIPTION)
32	27.6-40.5 ft. Fresh, medium bedded, very light gray (N8), very fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)				J,PL,SM,CL
					J,PL,R (2)
	32.7 ft. Calcite and pyrite crystals				J,PL,SM
	33.8 ft. Chert nodule				
34	34.1 ft. Crinoid fossils				J,PL,SM
	35.0-35.6 ft. Moderately weathered				
			4	98%	J,PL,SM,CL
36	36.1 ft. Stylolitic				
38	37.7-40.5 ft. Large chert nodules				J,I,R (2)
					J,U,SM,CL
					J,I,SM
		435.30 / 39.50			J,I,SM
40	40.3-40.5 ft. Joints intersecting large chert nodules, some pyrite				J,I,R (2)
	40.5-50.2 ft. Fresh, medium bedded, very light gray (N8) to light gray (N7), m-c grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)				J,PL,R
42	42.2-45.1 ft. Stylolitic				
			5	100 %	J,I,R
44					J,I,R
					J,I,R (2)
					J,I,R (3)
46					J,PL,R (4)
					J,PL,R (2)
	47.5-49.3 ft. Stylolitic				
48					

GRAPHIC LOG; RQD (80 60 40 20); FRACTURES PER FOOT (2 4 6 8 10); DIP wrt CORE AXIS (0 30 60 90); WEATHERING INDEX (FR SW MW HW CW); STRENGTH INDEX (R6 R5 R4 R3 R2 R1); POINT LOAD INDEX (psi) (R1 30 R2 150 R3 300 R4 600 R5 600 R6 1500); TEST ORIENTATION

NOTES
WATER LEVELS
INSTRUMENTATION

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-101-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/23/95-2/25/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068472.9
AZIMUTH: 0

COLLAR ELEV: 474.8
E: 515622.9
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
FL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
48	40.5-50.2 ft. Fresh, medium bedded, very light gray (N8) to light gray (N7), m-c grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)		5	100 %				J,I,R (2)					
	49.1 ft. Brachiopoda fossil							J,U,R					
		425.30 / 49.50						J,PL,R					
50	50.2-52.7 ft. Fresh, very thinly to medium bedded, medium light gray (N6) to medium gray (N5), coarse grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)							J,I,R (3)					
	51.2-52.2 ft. Numerous calcite veins at 20 degrees to core axis in healed fractures												
52	52.7-54.5 ft. Fresh, medium bedded, light olive gray (5Y 6/1), medium grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)							J,PL,SM					
								J,PL,SM					
								J,I,R					
54		420.30 / 54.50											
	54.5-58.0 ft. Slightly weathered, medium light olive gray (5Y 6/1), fine to medium grained, medium strong, DOLOMITE, (ST. LOUIS FORMATION) Very porous/vuggy, vugs <1 mm. in diameter		6	98%				J,I,R					
56													
58	58.0-61.9 ft. Fresh, medium bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARENACEOUS DOLOMITE, (ST. LOUIS FORMATION)							J,I,SM					
		415.30 / 59.50											
	59.7-60.0 ft. Weathered, crumbly chert							J,I,R (2)					
60	60.0-61.9 ft. Porous/vuggy (vugs < 1 mm.)							J,I,R					
	61.4 ft. Calcite filled (healed) fracture		7	100 %									
		412.90 / 61.90						J,PL,SM,CL					
62	61.9-66.3 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARENACEOUS LIMESTONE, (ST. LOUIS FORMATION)							J,PL,R					
64													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-101-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/23/95-2/25/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068472.9
AZIMUTH: 0

COLLAR ELEV: 474.8
E: 516622.9
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
64	61.9-66.3 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARENACEOUS LIMESTONE, (ST. LOUIS FORMATION)		410.30 / 64.50	7	100 %				J,U,SM,CL						
66	66.3-72.7 ft. Slightly weathered, medium to thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Very stylolitic, numerous chert nodules, slightly porous/vuggy (vugs <1 mm. in diameter)								J,I,R,CL; J,ST,R,CL						
68									J,I,R						
				8	100 %										
70															
									J,I,R,CL						
72															
	72.7-78.9 ft. Slightly weathered, medium bedded, pinkish gray (5YR 8/1) to light brownish gray (5YR 6/1), coarse grained, medium strong, ARENACEOUS DOLOMITE, (ST. LOUIS FORMATION)		402.10 / 72.70						J,I,R,CL						
74	74.0-74.3 ft. Crumbly texture, porous, limestone 74.4 ft. Cross bedding		400.30 / 74.50						J,PL,SM,CL; J,I,SM; J,PL,SM,CL						
76	76.4-76.8 ft. Crystalline Limestone layer			9	100 %										
78			395.90 / 78.90						J,U,SM						
80	78.9-83.2 ft. Fresh, medium bedded, light brownish gray (5YR 6/1), medium grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic to 80.1 ft.								J,U,SM; J,I,R						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-101-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/23/95-2/25/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068472.9
AZIMUTH: 0

COLLAR ELEV: 474.8
E: 516622.9
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA (DIP wrt CORE AXIS)	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80	78.9-83.2 ft. Fresh, medium bedded, light brownish gray (5YR 6/1), medium grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) 80.1-80.5 ft. Dolomite							J,PL,R,CL					
82			9	100 %									
	391.60 / 83.20												
	83.2-92.0 ft. Slightly weathered, thickly bedded, yellowish gray (5Y 7/2) to light olive gray (5Y 5/2), fine grained, medium strong, ARENACEOUS DOLOMITE, (ST. LOUIS FORMATION) Porous/vuggy (vugs <1 mm.)												
		390.30 / 84.50											
84													
86													
88													
	89.7-91.3 ft. Stylolitic 89.9-90.9 ft. Limestone (crystalline)		10	99%				J,PL,R					
90								J,PL,R; J,ST,SM; J,PL,R					
	382.80 / 92.00												
92	92.0-94.5 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), micro-crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION)												
94	93.9-94.1 ft. Thickly laminated							J,PL,SM,CL					
		380.30 / 94.50											
	94.5-101.0 ft. Fresh, thickly bedded, pale yellowish brown (10YR 6/2), coarse to very coarse grained, strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)		11	100 %									
96													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-101-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2846
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & Water
DRILLING DATE: 2/23/95-2/25/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068472.9
AZIMUTH: 0

COLLAR ELEV: 474.8
E: 516622.9
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
96	94.5-101.0 ft. Fresh, thickly bedded, pale yellowish brown (10YR 6/2), coarse to very coarse grained, strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)								J,PL,SM						
	96.3 ft. Calcite crystals								J,PL,SM,CL						
									J,PL,SM						
98	97.1-97.3 ft. Moderately weahtered zone, thickly laminated														
	98.8-99.0 ft. Chert nodules														
									J,PL,SM						
100				11	100 %										
	100.7 ft. Calcite crystals								J,I,R						
	101.0-119.9 ft. Fresh, medium bedded, light olive gray (5Y 6/1), micro-crystalline, strong, LIMESTONE, (ST. LOUIS FORMATION)								J,I,SM						
102	101.7-103.0 ft. Stylolitic								J,PL,SM						
									J,PL,SM						
104	104.1-104.8 ft. Slightly weathered dolomite layer, porous/vuggy		370.30 / 104.50						J,PL,SM						
	104.8-106.2 ft. Stylolitic								J,I,R						
									J,I,R						
106															
	106.7-109.2 ft. Some arenaceous zones								J,PL,R						
108	107.8-108.3 ft. Bioturbated zone, some calcite crystallization			12	100 %										
									J,PL,SM						
110	110.1-111.5 ft. Slightly to moderately weathered dolomite, porous/vuggy								J,I,R						
112															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-101-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/23/95-2/25/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068472.9
AZIMUTH: 0

COLLAR ELEV: 474.8
E: 516822.9
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filed

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
112	101.0-119.9 ft. Fresh, medium bedded, light olive gray (5Y 6/1), micro-crystalline, strong, LIMESTONE, (ST. LOUIS FORMATION)												
	112.9-113.1 ft. Thinly laminated 361.20		12	100 %			90	J,I,R,CL					
	113.1-113.2 ft. 113.80 Bioturbated, calcite crystallization												
114	113.6-115.3 ft. Slightly to moderately weathered, dolomite, porous/vuggy	360.30 / 114.50											
	359.50 / 115.30												
116	116.5 ft. Becoming fine to medium grained												
	116.8-117.7 ft. Some arenaceous laminae						90	J,PL,SM					
118	118.3-118.7 ft. Stylolitic						90	J,PL,SM					
	354.90 / 119.90		13	100 %									
120	119.9-121.7 ft. Slightly weathered, medium bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARGILLACEOUS DOLOMITE, (ST. LOUIS FORMATION) Porous/vuggy (<1 mm. in diameter)												
122	121.7-125.0 ft. Slightly weathered, medium bedded, light olive gray (5Y 6/1), fine grained, strong, DOLOMITE, (ST. LOUIS FORMATION)												
124							90	J,I,R,CL					
		350.30 / 124.50											
	349.80 / 125.00												
126	125.0-128.3 ft. Fresh, thinly bedded, light olive gray (5Y 6/1) to olive gray (5Y 4/1), interbedded microcrystalline and m-c grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)		14	99%			90	J,I,SM					
							90	J,PL,SM,CL (2)					
							90	J,ST,SM					
28													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-101-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/23/95-2/25/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1088472.9
AZIMUTH: 0

COLLAR ELEV: 474.8
E: 516822.9
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
128	348.50 / 128.30 128.3-130.5 ft. Slightly weathered, medium bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARENACEOUS DOLOMITE, (ST. LOUIS FORMATION) 129.3-130.3 ft. Porous/vuggy							J,PL,SM,CL	SW FR MW HW CW	R5 R6 R4 R3 R2 R1	R1 R2 30 R3 150 R4 300 R5 600 R6 1500		
130	344.30 / 130.50 130.5-140.5 ft. Fresh, medium bedded, light olive gray (5Y 6/1), coarse grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)		14	99%				J,I,R					
132								J,I,SM,CL					
134	133.5-133.9 ft. Stylolitic, bioturbated, calcite crystals 133.9-135.3 ft. Microcrystalline	340.30 / 134.50						J,PL,SM					
136	134.9-135.2 ft. Small pyrite crystals 135.0-135.1 ft. Large chert nodules 135.7-137.1 ft. Slightly weathered, some calcite crystals and stylolites							J,I,R,CL					
138	137.1-138.9 ft. Stylolites 137.4-138.5 ft. Microcrystalline, arenaceous, thickly laminated		15	100 %				J,I,R,CL; J,I,SM; J,PL,R					
140	334.30 / 140.50 End of Record of Drillhole at 140.5 ft.	334.30 / 140.50											
142													
144													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

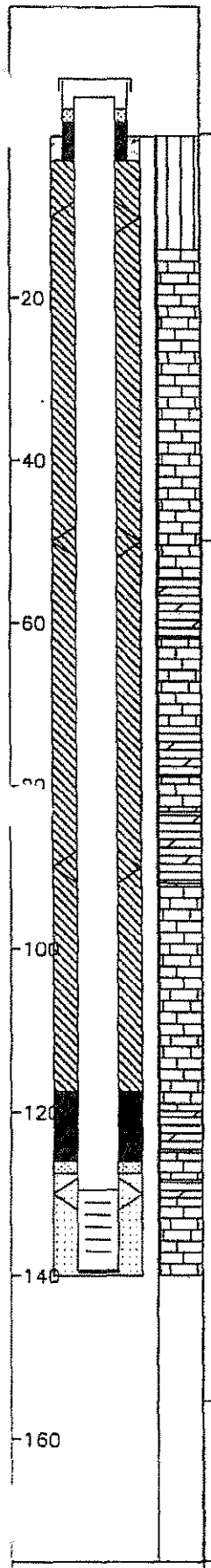
LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/13/95

Golder Associates

Well No. PZ-101-SS

Boring No. X-Ref: PZ-101-SS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1068473 ft. Easting: 516623 ft.

Elevation Ground Level 474.9 ft. NGVD

Top of PVC Casing 476.68 ft. NGVD

Drilling Summary:

Total Depth 140.0 ft.

Borehole Diameter 10 1/4 in. (0.0–14.0 ft.) 5 7/8 in. (14.0–140.0 ft.)

Casing Stickup Height 1.79 ft.

Driller Layne-Western, St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit for Reaming

Drilling Fluid Auger-None, NX Core Water, Air Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	2/23/95	13:35	2/23/95	14:30
Schramm Rotary	3/6/95	8:15	3/6/95	9:45
Geophys.Logging:				
Casing:	3/6/95	9:50	3/6/95	10:10
Filter Placement:	3/6/95	10:20	3/6/95	10:50
Cementing:				
Development				
Bentonite Grout	3/6/95	11:30	3/6/95	12:30
Bentonite Seal	3/6/95	10:50	3/6/95	11:30

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.79	-	129.48	C1	476.68	-	345.41
129.48	-	139.28	S1	345.41	-	335.61
139.28	-	139.61	C2	335.61	-	335.28

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 127.5-140.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 126.0-127.5 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-117.5 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 117.5-126.0 ft.

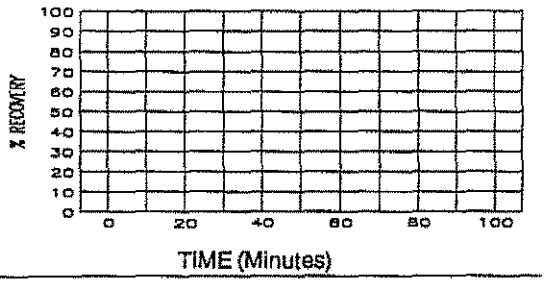
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Supervised by B. Tilton

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ101SS

66574

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 15086	CHECK NO.
ROUTE	TRANSMITTAL NO.
STATE WELL NUMBER	CROSS REFERENCE NO.
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME: LAIDLAW BRIDGETON SANITARY LANDFILL
WELL NUMBER: PZ-101-SS
SITE ADDRESS: ST. CHARLES ROCK RD.
CITY: BRIDGETON
STATE: MO
ZIP CODE: 63044
NAME: LAIDLAW WASTE SYSTEMS, INC
TELEPHONE: 314-341-3710
ADDRESS: 1335 N. KLAMOONY
CITY: ST LOUIS
STATE: MO
ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

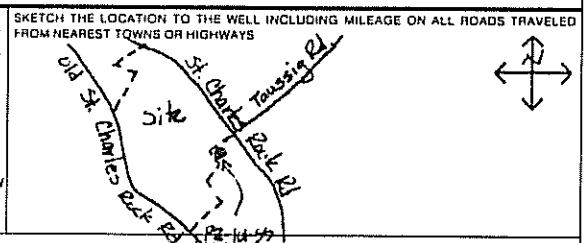
COUNTY: ST. LOUIS
ELEVATION: 474.7
AREA NO:

SMALLEST ¼ ___ ¼ ___ ¼ ___ ¼ LARGEST ¼

SEC. ___ TWN 47 N,RNG 5 E OR W

LAT. 38° 46' 06" LONG. 90° 16' 30"

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

NOTE: Record the fraction of a foot in decimal, not in inches

Top of Riser Elevation: 477.4

Ground Surface Elevation: 474.1 Ft

LOCKING CAP - Y / N (Circle one)
CAP VENT - Y / N (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8"x8"x5'
Bore Hole Diameter: 10.25"
WEEP HOLE - Y / N (Circle one)

Information in this column to be supplied in the Feet from Surface column	Feet from Surface	Description of Formation
		0-14 Silt
Depth to bottom of Protective Casing Seal:	3	
		14-55 Limestone
		55-62 Dolomite
		62-73 Limestone
		73-77 Dolomite
Depth to Base of Annular Seal:	117.5	77-84 Limestone
		84-93 Dolomite
Depth to Base of Bentonite Seal:	124	93-120 Limestone
Depth to Base of Secondary Filter Pack:	127.5	120-125 Dolomite
Depth to Top of the Screen:	127.5	
		125-142 Limestone
Depth to Bottom of the Screen:	137.5	
Plug Back Total Depth		
Original Total Depth:	142	

PROTECTIVE CASING SEAL
Type: [X] Concrete [ ] Cement Slurry

RISER PIPE
Length: 132
Diameter: 2
Type of Material: SCH80 PVC

BOREHOLE DIAMETER: 5 7/8 In.

ANNULAR SEAL
Type: [X] Bentonite Slurry [ ] Cement Slurry [ ] Non Slurry Bentonite

BENTONITE SEAL
Type: [X] Bentonite Slurry [ ] Non Slurry Bentonite
Length of Seal: 9.5 Ft.

SECONDARY FILTER PACK (Optional)
Type: [X] Sand [ ] Manufactured
Grain Size: SUGAR
Length: 1.5

PRIMARY FILTER PACK
Type: [X] Sand [ ] Manufactured
Grain Size: 16-35
Length: 12.5

WELL SCREEN
Length: 10'
Slot Size: 0.010"
Type: WELLPO PVC

SUMP DETAILS
Length: 0.3 Ft.
Diameter: 2 In.
Type: PVC

TYPE OF BACKFILL: SAND

MONITORING WELL INSTALLATION CONTRACTOR'S NAME: LAYNE WESTERN CO, INC.

DRILLING CONTRACTOR'S NAME: LAYNE WESTERN CO, INC.

TYPE OF INSTALLATION: [X] ABOVE GROUND [ ] FLUSH MOUNT

STATIC WATER LEVEL: FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT

MEASURING POINT IS: [ ] TOP OF RISER PIPE [ ] OTHER

DRILLING EQUIPMENT: [X] AIR ROTARY [X] AUGER TYPE 6 1/4 H.S.A. [ ] REVERSE ROTARY [ ] OTHER

CENTRALIZERS USED: [X] YES, AT 4 TOTAL [ ] STAINLESS STEEL [ ] OTHER [ ] NO

MULTIPLE CASED WELLS: SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED: 3-06-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR): Michael P. Vogt
PERMIT NUMBER: OU1256WIM DATE: 4-11-95

SIGNATURE (DRILLING CONTRACTOR): Michael P. Vogt
PERMIT NUMBER: OU1256WIM DATE: 4-11-95

MO 780-1415 (2-94) DISTRIBUTION: WHITE DIVISION CANARY MONITORING WELL CONTRACTOR PINK OWNER

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-102-SS
		SHEET 1 OF 3
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	DRILLING START TIME 15:21 DATE 2/13/95; FINISH TIME 17:33 DATE 2/13/95
NORTHING: 1068087.67 DATUM EASTING: 516887.97 ELEVATION 482.1	WATER LEVEL / TIME / DATE / CASING DEPTH	
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS	
ANGLE BEARING		
SAMPLE HAMMER		

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL / SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1	3 2 2 3	1.3'/2.0' (65%)		(0.0-2.6 ft.) Firm, dark yellowish brown (10YR 4/2), homogenous, CLAYEY SILT, NR, damp, (CL-ML), (LOESS)	SP 1	2/13/95 - 15:21 Begin drilling PZ-102-SS Air monitoring 15:27 21% O2 0.0 ppm H2S 0% LEL 0.0 ppm PID
2	2 2 2 4	1.4'/2.0' (70%)		(479.5) 2.6		
3				(2.6-5.0 ft.) Firm, moderate yellowish brown (10YR 5/4), homogenous, SILTY CLAY, NR, damp, (CL), (LOESS)	SP 2	
4		2.3'/2.0' (115%)				
5				(477.1) 5.0	SH 3	
6	1 2 3 4	1.6'/2.0' (80%)		(5.0-13.0 ft.) Firm, moderate yellowish brown (10YR 5/4), trace light gray (N7), homogenous, CLAYEY SILT, NR, damp, (CL-ML), (LOESS)	SP 4	15:43 @ 6 ft. 21.1% O2 0.0 ppm H2S 0% LEL 0.3 ppm PID
7						
8	1 3 3 5	1.9'/2.0' (95%)			SP 5	
9						
10		1.9'/2.0' (95%)			SH 6	15:49 @ 10 ft. 21% O2 1.0 ppm H2S 0% LEL 0.3 ppm PID
11						
12	3 4 5 6	1.6'/2.0' (80%)			SP 7	
13				(469.1) 13.0 (13.0-15.0 ft.) Compact, dark yellowish orange (10YR 6/6), homogenous, fine SAND, trace Silt, NR, dry, (SP), (ALLUVIUM)		
14	5 5 7 7	1.5'/2.0' (75%)			SP 8	

DRILLING CONTR LAYNE-WESTERN

LOGGED BY J. MILLER CHK'D BY W. HERST

DATE 2/13/95

JOB NO.: 943-2848

FILENAME: PZ102SS

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-102-SS
		SHEET 2 OF 3
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	DRILLING
	WATER LEVEL / TIME / DATE / CASING DEPTH	START TIME 15:21, DATE 2/13/95; FINISH TIME 17:33, DATE 2/13/95
NORTHING: 1068087.67 DATUM EASTING: 516887.97 ELEVATION 482.1		
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS	
ANGLE BEARING		
SAMPLE HAMMER		

DRILLING CONTR LAYNE-WESTERN

LOGGED BY J. MILLER DATE 2/13/95 CHK'D BY W. HERST

JOB NO.: 943-2848 FILENAME: PZ102SS

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SAMPLER TYPE	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	REMARKS
16	4 4 6 7	1.3'/2.0' (65%)	SP 8	(15.0-23.6 ft.) Loose to compact, pale yellowish brown (10YR 6/2), homogenous, fine SAND, NR, dry, (SP), (ALLUVIUM)	16:03 @ 16 ft. 21.1% O2 1.0 ppm H2S 0% LEL 0.0 ppm PID
17			SP 9		
18	4 4 5 5	1.4'/2.0' (70%)	SP 10		
19					
20	3 3 4 6	1.6'/2.0' (80%)	SP 11		
21					
22	6 5 4 8	1.5'/2.0' (75%)	SP 12		
23				(458.5) 23.6	
24	5 6 7 10	1.5'/2.0' (75%)	SP 13	(23.6-25.6 ft.) Stiff, light gray (N7) to light brown (5YR 5/6), laminated CLAYEY SILT, trace fine Sand, some rootlets, NR, moist, (CL-ML), (ALLUVIUM)	16:20 @ 24 ft. 21% O2 0.0 ppm H2S 0% LEL 0.0 ppm PID
25					
26	5 7 10 11	1.6'/2.0' (80%)	SP 14	(25.6-28.1 ft.) Very stiff, medium gray (N5), stratified, CLAYEY SILT, some fine SAND, thin organic rootlet beds (<1 cm.), NR, moist, (CL-ML), (ALLUVIUM)	
27					
28	4 5 5 7	1.7'/2.0' (85%)	SP 15	(28.1-29.9 ft.) Stiff, medium gray (N5), stratified, CLAYEY SILT and fine SAND, 1-15 cm. beds, NR, moist, (CL-ML), (ALLUVIUM)	16:40 @ 28 ft. 21.1% O2 0.0 ppm H2S 0% LEL 0.0 ppm PID
29				(452.2) 29.9 (29.9-34.5 ft.) Hard, light olive gray (5Y 6/1), fractured LIMESTONE, SR, (WEATHERED BEDROCK)	

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-102-SS
		SHEET 3 OF 3
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	DRILLING START / FINISH
NORTHING: 1068087.67 DATUM EASTING: 516887.97 ELEVATION 482.1	WATER LEVEL / TIME / DATE / CASING DEPTH	START TIME 15:21, DATE 2/13/95; FINISH TIME 17:33, DATE 2/13/95
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS	
ANGLE BEARING		
SAMPLE HAMMER		

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
31	5, 5, 5, 20	1.7'/2.0' (85%)			(29.9-34.5 Ft.) Hard, light olive gray (5Y 6/1), fractured LIMESTONE, SR, (WEATHERED BEDROCK) @ 30.2 ft., wood fragments	SP 16	
32							
33	13, 23, 55, 31	1.1'/2.0' (55%)				SP 17	
34					(447.6) 34.5		
35	12, 18, 21, 18	0.5'/2.0' (25%)			(34.5-37.0 Ft.) Hard, dark greenish gray (5GY 4/1), SILTY CLAY, trace to little fine sand, little fine gravel, NR, moist, (CL), (WEATHERED BEDROCK)	SP 18	17:07 @ 35 ft. 21.3% O2 2.0 ppm H2S 0% LEL 0.0 ppm PID
36							
37					(445.1) 37.0 End of Soil Borehole Log at 37.0 ft.		
38					See PZ-102-SS Record of Drillhole for rock descriptions		
39							
40							
41							
42							
43							
44							

DRILLING CONTR LAYNE-WESTERN

LOGGED BY J. MILLER CHK'D BY W. HERST

DATE 2/13/95

JOB NO.: 943-2848

FILENAME: PZ102SS

RECORD OF DRILLHOLE PZ-102-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/14/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1088087.7
AZIMUTH: 0

COLLAR ELEV: 482.1
E: 516887.9
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, X-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
32	0.0-37.0 ft. See Soil Borehole Log PZ-102-SS 37.0-37.8 ft. No samples collected														
34															
36															
	444.30		444.30												
38	37.8-41.0 ft. Highly weathered, thickly bedded, dark yellowish orange (10YR 6/6), fine grained, extremely weak, SANDSTONE, (ST. LOUIS FORMATION)		37.80						J,PL,SM-GRF						2/14/95 @ 8:09 Began coring Run 1
									J,I,SM-CL						
									J,PL,SM-CL (2)						
									J,I,SM-GRF						
40									J,PL,SM-Intact						
									J,PL,SM-GRF						Fractures in upper portion of Run 1, are mapped in highly weathered sandstone, very clayey, likely drilling induced
	41.0-44.6 ft. Moderately weathered, dark yellowish orange (10YR 6/6), fine grained, weak, SANDSTONE, (ST. LOUIS FORMATION)			1	91%				J,PL,SM-Intact						
									J,I,SM						
42									J,I,SM						
									J,I,SM (2)						
									J,I,R (2)						
	438.10														
44	44.00								Core Loss						Core loss due to weak rock
			437.50												
	44.6-59.6 ft. Slightly to moderately weathered, thickly bedded, light olive gray, micro-crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION)		44.60						J,I,SM						
									J,I,R-CL						Fractures in Run 2, along contacts between lithologies of clay and limestone
									J,I,R-CL						
46				2	70%				J,I,R-CL (2)						
	435.10														
	47.00 @ 47.0 ft. Solutioned, in-filled with unlithified sandy clay, in Run 2, approximately 50%, competent rock								Core Loss						
			434.20												
48			47.90	3	85%										

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-102-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/14/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068087.7
AZIMUTH: 0

COLLAR ELEV: 482.1
E: 516887.6
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FT)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
48	44.6-59.6 ft. Slightly to moderately weathered, thickly bedded, light olive gray, micro-crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION)						J,I,R-CL; J,I,R-CL; J,PL,SM (2); J,PL,SM; J,I,R; J,PL,SM; J,I,R; J,PL,R	Core loss in Run 2 due to problem with barrel
50	48.8-49.0 ft. Glauconitic clay and limestone fragment infilled collapse zone, stylolitic							
			3	85%			J,I,R; J,PL,SM-CL-intact; J,ST,R-Fe; J,PL,R-solutioned	
52	51.8-52.2 ft. Infilled zone 52.0-52.9 ft. Brecciated, collapsed, infilled with limestone fragments, sand and clay							
							Core Loss	Core loss due to fractures/lugging of bit, some rock recovered in this interval, but broken up
54		428.00 / 54.10					J,PL,R; J,PL,R-Fe; J,C,SM-CL-intact; J,PL,R; J,I,R-Fe; J,PL,R	
56	56.9-56.9 ft. Collapse, infilling clay						J,ST,R; J,I,R-CL; J,I,SM; J,PL,SM-CL; J,I,R	Numerous intact, very small, clay filled, irregular fractures 54.7-60.3 ft. Not mapped on graphic log
	57.4-57.5 ft. Infilled fraction 57.6-59.8 ft. Solutioned, infilled with limestone fragments, glauconitic clay, sand		4	100 %			J,I,R; J,I,R; J,PL,SM-Fe; J,PL,SM; J,I,R; J,I,R; J,I,SM,CL	
58							J,PL,R; J,PL,R-CL	
60	59.6-80.8 ft. Fresh to moderately weathered, thinly bedded, light olive gray (5Y 6/1), medium crystalline, extremely weak to medium strong, LIMESTONE, (ST. LOUIS FORMATION)	421.80 / 60.30					J,PL,SM-CL; J,I,R	
62	61.8-62.4 ft. Collapse filled with limestone fragments, clay and sand		5	98%			J,I,R; J,PL,R; J,C,VR; J,I,R	
64								

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-102-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/14/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1088087.7
AZIMUTH: 0

COLLAR ELEV: 482.1
E: 516887.8
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
64	59.6-60.8 ft. Fresh to moderately weathered, thinly bedded, light olive gray (5Y 6/1), medium crystalline, extremely weak to medium strong, LIMESTONE, (ST. LOUIS FORMATION)							J,PL,R					
66	64.0-65.4 ft. Collapse fraction infilled with clay, limestone fragments, sand		5	98%				J,I,R-SM					Numerous very small intact, clay and sand filled fractures 65.5-68.6 ft. Not mapped
								J,I,R					
								J,I,R					
	67.3-67.4 ft. Clay, sand and limestone fragment infilled fracture							J,I,R-CL and sand filled					
								J,I,R-intact					
68	67.9-68.0 ft. Clay and limestone framgent infilled fracture							J,I,R-CL					
		413.50 / 68.60											
								J,I,R-calcite filled					
								J,PL,R					
70								J,I,R					
	70.1-70.5 ft. Collapse infilled with limestone fragments, black clay, pyrite crystals, sand							J,C,SM					
								J,C,R					
	71.3-71.7 ft. Breccia filled zone, pyrite, limestone fragments, black clay infilling							J,I,R-Fe					
			6	98%				J,I,R					
72	72.1-73.2 ft. Collapse zone												
								J,I,R-CL (3)					Numerous small intact fractures not mapped 73.2-74.9 ft. Infilled clay, sand, limestone fragments
74								J,I,R (2)					
								J,I,R					
		407.20 / 74.90											
76								J,I,R-calcite					
			7	99%				J,I,R-calcite					
78													
								J,I,R-calcite					
80													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-102-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/14/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068087.7
AZIMUTH: 0

COLLAR ELEV: 482.1
E: 516887.9
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	NOTES WATER LEVELS INSTRUMENTATION
80	80.3-80.5 ft. Solutioned rock, infilled with limestone fragments, clay					J,I,R				
	401.30 / 80.80					J,I,R				
	80.8-82.3 ft. Moderately weathered, interbedded, light gray (N7), weak, SILTY CLAYSTONE, (ST. LOUIS FORMATION) Cherty					J,I,R				
82	399.80 / 82.30		7	99%		J,I,R				
	82.3-84.0 ft. Slightly weathered, thinly bedded, light olive gray (5Y 6/1), finely cyrstalline, medium strong, ARENACEOUS LIMESTONE, (ST. LOUIS FORMATION)					J,I,R				
	398.10 / 84.00					J,PL,SM				
84	84.0-84.4 ft. Slightly weathered, thinly bedded, very light gray (N8), fine grained, medium strong, SANDSTONE, (ST. LOUIS FORMATION)	397.70 / 84.40				J,PL,SM (2)				
	84.4-87.0 ft. Slightly weathered, thinly bedded, dark gray (N3) to medium gray (N5), weak, CLAYSTONE and SILTY CLAYSTONE, (ST. LOUIS FORMATION) Carbonaceous	397.50 / 84.60				J,PL,SM				
86	395.10 / 87.00					J,I,R				
	87.0-89.9 ft. Slightly weathered to fresh, light brownish gray (5YR 6/1), microcrystalline, medium strong, CRYSTALLINE LIME -STONE, (ST. LOUIS FORMATION) Upper 1 ft. and lower 3 in. bioturbated, pyrite mineralization		8	100 %		J,PL,SM (3)				
88						J,PL,SM-CL				
	392.20 / 89.90	392.20 / 89.90				J,PL,SM-CL				
						J,I,SM-CL				2/14/95 @ 14:25 Complete drilling
90	End of Record of Drillhole at 89.9 ft.									
92										
94										
96										

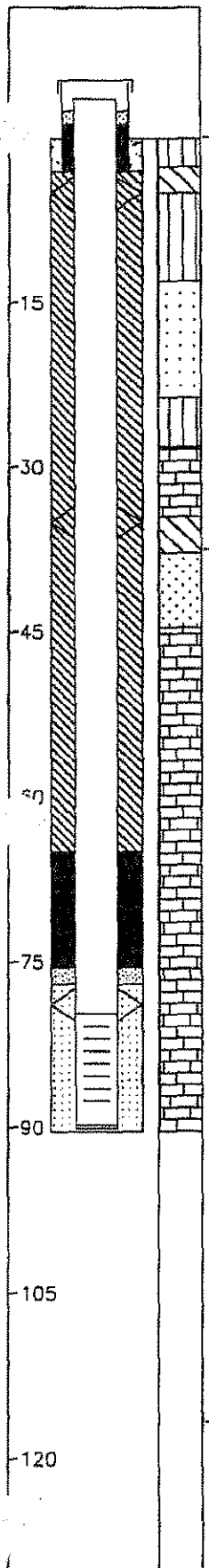
DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/13/95

Golder Associates

Well No. PZ-102-SS
Boring No. X-Ref: PZ-102-SS

PIEZOMETER CONSTRUCTION SUMMARY



Survey Coords: Northing: 1088088 ft.
Easting: 516888 ft.

Elevation Ground Level 482.1 ft. NGVD
Top of PVC Casing 483.85 ft. NGVD

Drilling Summary:

Total Depth 90.4 ft.
Borehole Diameter 10 1/4 in. (0.0-37.0 ft.) 5 7/8 in. (37.0-90.4 ft.)
Casing Stickup Height 1.80 ft.
Driller Layne-Western
St. Louis, MO

Rig CME 75, Schramm Portadrill T660H
Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit,
NX Core, 5 7/8 in. Button Bit for Reaming
Drilling Fluid Auger-None, NX Core Water,
Air Rotary
Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	2/13/95	15:21	2/13/95	14:25
Schramm Rotary	3/12/95	12:45	3/12/95	13:45
Geophys.Logging:				
Casing:	3/12/95	13:40	3/12/95	13:50
Filter Placement:	3/12/95	13:55	3/12/95	14:10
Cementing:				
Development				
Bentonite Grout	3/12/95	14:15	3/12/95	14:30
Bentonite Seal	3/12/95	14:30	3/12/95	15:30

Well Design & Specifications

Basis: Geologic Log X Geophysical Log
Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.80	-	79.70	C1	483.85	-	402.35
79.70	-	89.50	S1	402.35	-	392.55
89.50	-	90.83	C2	392.55	-	391.22
	-				-	
	-				-	
	-				-	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings
C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)
Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings
Sand Pack: 16-35 mesh Silica Sand, 77.0-90.4 ft.

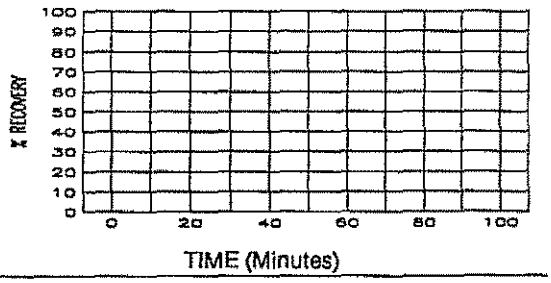
Filter Pack: Less than 50 mesh Silica Sand, 75.5-77.0 ft.
Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-65.0 ft.
Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 65.0-75.5 ft.
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Not to Scale

Supervised by B. Tilton
Job Number 943-2848
Site LAIDLAW/OU2 RI-FS/MO
File Name PZ102SS

661574

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO. 115088	CHECK NO.
ROUTE	TRANSMITTAL NO.
STATE WELL NUMBER	CROSS REFERENCE NO.
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME: LAIDLAW BRIDGETON SANITARY LANDFILL		WELL NUMBER: PZ-102-55	
SITE ADDRESS: ST. CHARLES ROCK RD.	CITY: BRIDGETON	STATE: MO	ZIP CODE: 63044
NAME: LAIDLAW WASTE SYSTEMS, INC.		TELEPHONE: 314-341-3710	
ADDRESS: 1838 N. BROADWAY	CITY: ST. LOUIS	STATE: MO	ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

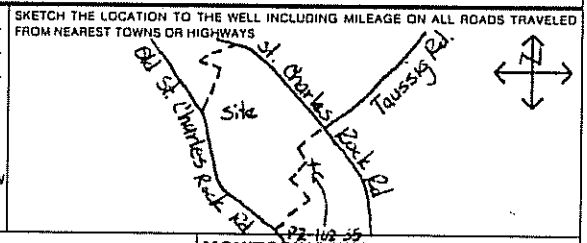
COUNTY: ST. LOUIS
ELEVATION: 482.0
AREA NO.:

SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST ¼

SEC. ____ TWN. 47 N.RNG. 5 E OR W

LAT. 38 ° 46 ' 02 " LONG. 90 ° 26 ' 27 "

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



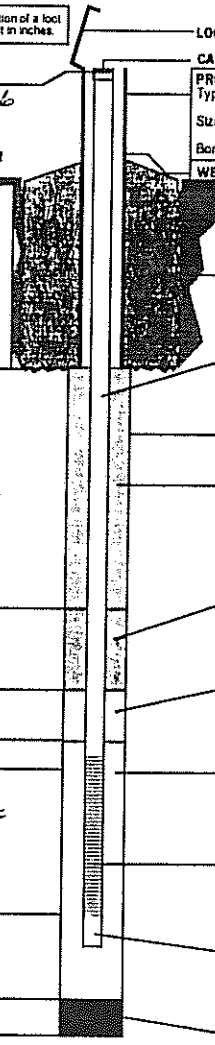
DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

NOTE: Record the fraction of a foot in decimal, not in inches.

Top of Riser Elevation: 484.6

Ground Surface Elevation: 482.0 Ft

Information in this column to be supplied in the Feet from Surface column	Feet from Surface	Description of Formation
		0-2.5 Silt
Depth to bottom of Protective Casing Seal:	3	2.5-5 Clay
		5-13 Silt
		13-24 Sandstone
		24-28 Silt
Depth to Base of Annular Seal:	65.0	28-35 Limestone
		35-38 Clay
Depth to Base of Bentonite Seal:	75.5	
Depth to Base of Secondary Filter Pack:	77.0	38-45 Sandstone
Depth to Top of the Screen:	79.75	
		45-90 Limestone
Depth to Bottom of the Screen:	89.75	
Plug Back Total Depth:		
Original Total Depth:	90.4	



LOCKING CAP - Y / N (Circle one)
CAP VENT - Y / N (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8" x 3" x 5'
Bore Hole Diameter: 10.25"
WEEP HOLE - Y / N (Circle one)

PROTECTIVE CASING SEAL
Type: [X] Concrete [ ] Cement Slurry

RISER PIPE
Length: 32.35'
Diameter: 2
Type of Material: SCH80 PVC

BOREHOLE DIAMETER: 5 7/8 in.

ANNULAR SEAL
Type: [X] Bentonite Slurry [ ] Cement Slurry [ ] Non Slurry Bentonite

BENTONITE SEAL
Type: [X] Bentonite Slurry [ ] Non Slurry Bentonite
Length of Seal: 10.5 Ft.

SECONDARY FILTER PACK (Optional)
Type: [X] Sand [ ] Manufactured
Grain Size: SUGAR
Length: 1.5'

PRIMARY FILTER PACK
Type: [X] Sand [ ] Manufactured
Grain Size: 16-35
Length: 13.4'

WELL SCREEN
Length: 10'
Slot Size: 0.010"
Type: SCH 80 PVC

SUMP DETAILS
Length: 0.3 Ft.
Diameter: 2 In.
Type: PVC

TYPE OF BACKFILL: SAND

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN Co., INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN Co., INC.

TYPE OF INSTALLATION
[X] ABOVE GROUND [ ] FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT

MEASURING POINT IS
[ ] TOP OF RISER PIPE
[ ] OTHER

DRILLING EQUIPMENT
[X] AIR ROTARY [X] AUGER TYPE 6¼ H.S.A.
[ ] REVERSE ROTARY [ ] OTHER

CENTRALIZERS USED
[X] YES, AT 3 TOTAL
[ ] STAINLESS STEEL
[ ] OTHER
[ ] NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
3-12-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR) Michael P. Vogt
PERMIT NUMBER 001256WM DATE 4-11-95

SIGNATURE (DRILLING CONTRACTOR) Michael P. Vogt
PERMIT NUMBER 001256WM DATE 4-11-95

MO 780-1415 (2-94) DISTRIBUTION: WHITE-DIVISION CANARY-MONITORING WELL CONTRACTOR PINK-OWNER

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-102R-SS
		SHEET 1 OF 3
LAIDLAW/OU2 RI-FS/MD WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	DRILLING
	WATER LEVEL / TIME / DATE / CASING DEPTH	START TIME 8:30, DATE 6/15/95; FINISH TIME 10:45, DATE 6/15/95
DATUM NORTHING: 1068131.86 EASTING: 516658.81 ELEVATION 484.5		
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS Flat, grass covered area	
ANGLE BEARING		
SAMPLE HAMMER		

DRILLING CONTR LAYNE-WESTERN

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1	5 5 3 5	1.5'/2.0' (75%)			(0.0-6.0 ft.) Firm, dark yellowish brown (10YR 4/2), CLAYEY SILT, trace organics (fine roots), NR, damp, (CL-ML), (TOPSOIL)	SP 1	
2 3	2 4 5 5	1.8'/2.0' (90%)				SP 2	
4 5	2 3 4 5	1.8'/2.0' (90%)			@ 4.0 ft., color changes to moderate yellowish brown (10YR 5/4)	SP 3	
					(478.5) 6.0		
6 7	2 2 4 5	1.5'/2.0' (75%)			(6.0-14.0 ft.) Loose, mottled, moderate yellowish brown (10YR 5/4) to pale yellowish brown (10YR 6/2), SILT, NR, damp, (ML), (LOESS)	SP 4	
8 9	5 5 5 5	1.4'/2.0' (70%)				SP 5	
10 11	4 5 6 9	1.5'/2.0' (75%)			@ 10.0 ft., Silt becomes compact	SP 6	
12 13	3 5 8 11	1.8'/2.0' (90%)				SP 7	
14	6 6 8 8	2.0'/2.0' (100%)			(14.0-17.8 ft.) Compact, light olive gray (5Y 6/1), SILT, trace iron staining, NR, damp, (ML), (LOESS)	SP 8	

LOGGED BY B. TILTON
DATE 7/14/95
CHK'D BY W. HERST
JOB NO.: 943-2848
FILENAME: PZ102RSS

SOIL BOREHOLE LOG

LAIDLAW WASTE SYSTEMS INC.

SITE NAME AND LOCATION	DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-102R-SS
		SHEET 2 OF 3
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	DRILLING START TIME 8:30 / FINISH TIME 10:45
	WATER LEVEL / TIME / DATE / CASING DEPTH	DATE 6/15/95 / DATE 6/15/95
NORTHING: 1068131.86 DATUM EASTING: 516858.81 ELEVATION 484.5		
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS Flat, grass covered area	
ANGLE BEARING		
SAMPLE HAMMER		

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
16	3 4 5 8	1.8' / 2.0' (90%)			(14.0-17.8 ft.) Compact, light olive gray (5Y 6/1), SILT, trace iron staining, NR, damp, (ML), (LOESS)	SP 8	
17					From 17.0-17.8 ft., Silt becomes wet	SP 9	
					(466.7) 17.8		
18	9 9 6 10	1.6' / 2.0' (80%)			(17.8-22.7 ft.) Compact, pale yellowish brown (10YR 6/2), fine SAND, trace Silt, trace iron oxide staining, NR, dry, (SP), (ALLUVIUM)	SP 10	
19							
20	4 6 7 9	1.5' / 2.0' (75%)				SP 11	
21							
22	4 4 8 6	1.8' / 2.0' (90%)					
					(461.8) 22.7		
23					(22.7-24.0 ft.) Compact, pale yellowish brown (10YR 6/2), fine SANDY SILT, NR, damp, (ML), (LOESS)	SP 12	
24	5 6 6 6	1.6' / 2.0' (80%)			(24.0-28.0 ft.) Compact, mottled moderate yellowish brown (10YR 5/4) to light olive gray (5Y 6/1), SILT, some iron oxide staining, NR, damp, (ML), (LOESS)	SP 13	
25							
26	5 3 5 8	1.8' / 2.0' (90%)			@ 26.0 ft., color changes to olive gray (5Y 4/1) and Silt becomes moist	SP 14	
27							
					(456.5) 28.0		
28	4 6 10 10	2.0' / 2.0' (100%)			(28.0-30.8 ft.) Stiff, olive gray (5Y 4/1) CLAYEY SILT, NR, moist, (CL-ML), (LOESS)	SP 15	
29					@ 29.6 ft., thin silty fine sand seam, damp (<1 in. thick)		

DRILLING CONTR LAYNE-WESTERN

LOGGED BY B. TILTON CHK'D BY W. HERST

DATE 7/14/95

JOB NO.: 943-2848

FILENAME: PZ102RSS

SOIL BOREHOLE LOG

LAIDLAW WASTE SYSTEMS INC.

SITE NAME AND LOCATION	DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-102R-SS
		SHEET 3 OF 3
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	DRILLING START TIME 8:30 DATE 6/15/95; FINISH TIME 10:45 DATE 6/15/95
NORTHING: 1068131.86 DATUM EASTING: 516858.81 ELEVATION 484.5	WATER LEVEL / TIME / DATE / CASING DEPTH	
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS Flat, grass covered area	
ANGLE BEARING		
SAMPLE HAMMER		

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
31	5 5 9 14	1.8' 2.0' (90%)			(28.0-30.8 ft.) Stiff, olive gray (5Y 4/1) CLAYEY SILT, NR, moist, (CL-ML), (LOESS) (453.7) 30.8 (30.8-32.0 ft.) Compact, olive gray (5Y 4/1), SILT, NR, moist, (ML), (LOESS) (452.5) 32.0	SP 16	
32 33	47 44 26 27	1.2' 2.0' (60%)			(32.0-35.0 ft.) Very dense, light olive gray (5Y 6/1), fine GRAVEL and SILTY f-c SAND, trace pieces of lignite, NR, wet, (GP), (WEATHERED BEDROCK)	SP 17	@ 32.0 ft., first water encountered overlying bedrock
34 35	16 50/2"	0.4' 1.0' (40%)			(449.5) 35.0	SP 18	
36 37 38 39 40 41 42 43 44					End of Soil Borehole Log at 35.0 ft. See PZ-102R-SS Record of Drillhole for rock descriptions		

DRILLING CONTR LAYNE-WESTERN

LOGGED BY B. TILTON CHK'D BY W. HERST

DATE 7/14/95

JOB NO.: 943-2848

FILENAME: PZ102RSS

RECORD OF DRILLHOLE PZ-102R-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/15/95 - 6/16/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068087.87
AZIMUTH: 0

COLLAR ELEV: 482.1
E: 516887.97
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

Depth Scale (Feet)	ROCK TYPE DESCRIPTION	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: Dip wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
32	0.0-35.0 ft. See Soil Borehole Log PZ-102R-SS												
34													
	447.10	447.10											
	35.0-37.0 ft. Highly weathered, thinly bedded, light olive gray (5Y 6/1), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic	35.00	1	100 %									6/15/95 @ 11:00 Began coring Highly broken rock due to weathering and drilling
36		445.90											
		36.20						J,I,R (6)					
	37.0-55.8 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), micro-crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION)							J,I,R (6)					
38			2	97%				J,PL,SM					
								J,I,R (3)					
								J,I,R (2)					
		442.60						J,I,R,CL (2)					6/15/95 @ 11:50 End Run 2
		39.50						B,I,R (2)					
40								J,I,R,CL (2)					
								J,I,R (4)					
42								J,I,R					
								J,I,R,CL					
								J,I,R (4)					
								J,I,R (3)					
			3	94%									
44								J,I,R (5)					
								J,I,R,CL					
								J,I,R (2)					
								J,I,R,CL (3)					
46								J,PL,SM					
								J,I,R (4)					
								J,I,R,CL (4)					
								J,I,R (2)					
								J,I,R,CL (3)					
48													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: B. TILTON
CHECKED: R. BOOTH
DATE: 7/12/95

Golder Associates

RECORD OF DRILLHOLE PZ-102R-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/15/95 - 6/16/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068087.67
AZIMUTH: 0

COLLAR ELEV: 482.1
E: 516887.97
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
FL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

Depth Scale (Feet)	Rock Type Description	Graphic Log	Elev / Depth (Ft)	Run No.	Core Recovery	RQD	Fractures per Foot	Discontinuity Data: Dip wrt Core Axis	Type and Surface Description	Graphic Log	Weathering Index	Strength Index	Point Load Index (psi)	Test Orientation	Notes, Water Levels, Instrumentation
48	37.0-55.8 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), micro-crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION)			3	94%				B,I,R,CL						
			433.20						B,I,SM,CL						6/15/95 @ 13:45 End Run 3
			48.90												Core loss possibly due to wash out of clay seams in joints
			432.60												
			49.50						B,I,R (2)						
50									J,I,R-intact						
									J,I,SM						
									B,PL,SM						
									J,I,R (2)						
									J,I,R						
52				4	100 %				B,I,R						
									B,I,R						
54									J,I,R						
									J,I,R (2)						
			426.30												6/15/95 @ 15:00 End Run 3
56	55.8-61.3 ft. Fresh, medium bedded, light olive gray (5Y 6/1), medium crystalline, strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic		55.80						B,I,R						
	55.8-56.1 ft. Chert layer														
				5	100 %				B,I,R						
58	57.8-58.0 ft. Hard, greenish gray (5G 6/1), Siltstone layer								B,I,R (2)						
									J,I,R-intact						
									J,I,R						
			422.60						J,I,R-intact						6/15/95 @ 16:15 End Run 5
			59.50												Stop drilling for the day 6/16/95 @ 7:15 Began Run 6
60									B,PL,SM,CL (3)						
	61.3-70.4 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), finely crystalline, medium strong, FOSSILIFEROUS LIMESTONE, (ST. LOUIS FORMATION) Stylolitic			6	100 %				B,I,R (3) J,PL,SM,Fe						
62									J,PL,SM (2)						
64															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: B. TILTON
CHECKED: R. BOOTH
DATE: 7/12/95

Golder Associates

RECORD OF DRILLHOLE PZ-102R-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/15/95 - 6/16/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068087.67
AZIMUTH: 0

COLLAR ELEV: 482.1
E: 518887.97
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
64	61.3-70.4 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), finely crystalline, medium strong, FOSSILIFEROUS LIMESTONE, (ST. LOUIS FORMATION) Stylolitic						90	B,PL,SM					
66							90	B,PL,SM,CL					
			6	100 %									
68							90	J,PL,SM					
							90	B,PL,SM (2)					
		412.60 / 69.50											6/16/95 @ 8:25 End Run 6
70							90	B,I,SM					
	70.4-75.2 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), finely crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic						90	B,I,R					
72			7	100 %									
							90	B,I,SM					
74	@ 74.2 ft. Stiff, dark greenish gray (5G 4/1), clay seam, (~1/2 in. thick) 75.2-76.0 ft. Fresh, thinly bedded, medium bluish gray (5B 5/1), micro-crystalline, very strong, Silicified Limestone, (ST. LOUIS FORMATION) 406.10						90	J,PL,SM,CL					
		406.90 / 75.20					90	B,PL,SM					6/16/95 @ 9:15 End Run 7
							90	J,I,R					
76	76.0-77.4 ft. 76.00 Fresh, medium bedded, brownish gray (5YR 4/1), microcrystalline, strong, DOLOMITE, (ST. LOUIS FORMATION) Moderately porous, (open vugs <1 mm.) 404.70						90	B,I,SM					
	77.4-88.6 ft. 77.40 Fresh, very thinly bedded, light olive gray (5Y 6/1), very fine crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Some very thinly laminated shaley partings		8	98%			90	J,PL,SM					
78							90	J,I,R					
							90	J,I,R					
80													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: B. TILTON
CHECKED: R. BOOTH
DATE: 7/12/95

Golder Associates

RECORD OF DRILLHOLE PZ-102R-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2846
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/15/95 - 6/16/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1059087.67
AZIMUTH: 0

COLLAR ELEV: 482.1
E: 516887.97
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	DISCONTINUITY DATA / TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
80	77.4-88.6 ft. Fresh, very thinly bedded, light olive gray (5Y 6/1), very fine crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Some very thinly laminated shaley partings				B,PL,SM	
82			8	98%	J,I,R; B,I,R; J,I,R	
84		388.10 / 84.00				6/16/95 @ 12:00 End Run 8
86			9	100 %	J,I,SM; B,I,SM; J,I,R	
88					J,I,R (2)	
	393.50 / 88.60 88.6-90.0 ft. Fresh, medium bedded, medium dark gray (N4), very weak, CLAYSTONE, (ST. LOUIS FORMATION)					
	392.10	392.10				6/16/95 @ 15:00 Completed drilling
90	End of Record of Drillhole at 90.0 ft. 90.00	90.00				
92						
94						
96						

Columns: GRAPHIC LOG; RQD (85 40 20); FRACTURES PER FOOT (2 4 6 8 10); DIP wrt CORE AXIS (0 30 60 90); GRAPHIC LOG; WEATHERING INDEX (SW FR MW RW CW); STRENGTH INDEX (R6 R5 R4 R3 R2 R1); POINT LOAD INDEX (psi) (R1 30 R2 150 R3 300 R4 600 R5 1500 R6); TEST ORIENTATION

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

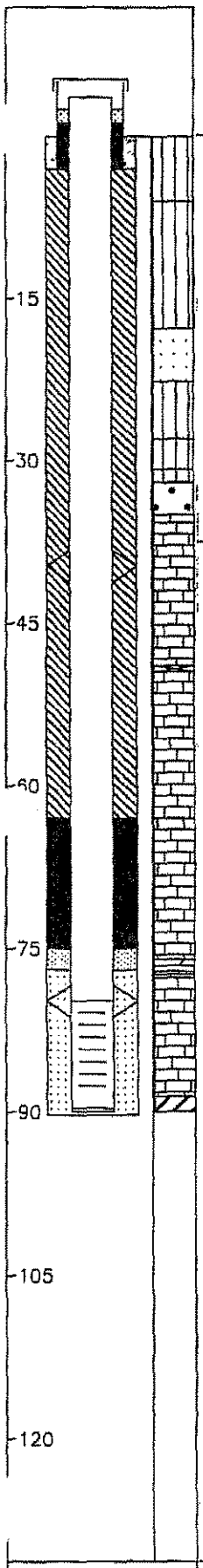
LOGGED: B. TILTON
CHECKED: R. BOOTH
DATE: 7/12/95

Golder Associates

Well No. PZ-102R-SS

Boring No. X-Ref: PZ-102R-SS

PIEZOMETER CONSTRUCTION SUMMARY



Survey Coords: Northing: 1068132 ft. Easting: 516859 ft.

Elevation Ground Level 484.5 ft. NGVD

Top of PVC Casing 485.62 ft. NGVD

Drilling Summary:

Total Depth 90.3 ft.

Borehole Diameter 10 1/4" (0.0-35.0') 5 7/8" (35.0-90.3')

Casing Stickup Height 1.12 ft.

Driller Layne-Western St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4" ID Hollow Stem Auger Bit, NX Core, 5 7/8" Button Bit for Reaming

Drilling Fluid Auger-None, NX Core Water, Air Rotary

Protective Casing 8x8" Square Steel, by 5' long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	6/15/95	8:30	6/16/95	13:00
Schramm Rotary	6/18/95	13:00	6/18/95	13:45
Geophys.Logging:				
Casing:				
Filter Placement:	6/18/95	13:45	6/18/95	14:30
Cementing:				
Development				
Bentonite Grout	6/18/95	14:50	6/18/95	15:15
Bentonite Seal	6/18/95	14:35	6/18/95	14:55

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.12	-	79.83	C1	485.62	-	404.67
79.83	-	89.63	S1	404.67	-	394.87
89.63	-	89.96	C2	394.87	-	394.54

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 77.0-90.3 ft.

Filter Pack: Less than 50 mesh Silica Sand, 75.0-77.0 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-63.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 63.0-75.0 ft.

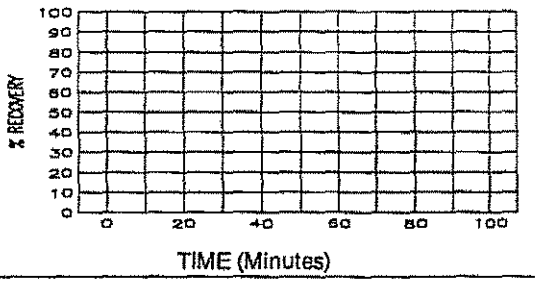
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Not to Scale

Supervised by B. Tilton

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ102RSS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122513	CHECK NO
ROUTE	TRANSMITTAL NO
STATE WELL NUMBER	CROSS REFERENCE NO.
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME: LAIDLAW BRIDGETON SANITARY LANDFILL		WELL NUMBER: PZ-102-R-SS	
SITE ADDRESS: ST. CHARLES ROCK RD.	CITY: BRIDGETON	STATE: MO	ZIP CODE: 63044
NAME: LAIDLAW WASTE SYSTEMS, INC.		TELEPHONE: 314-241-3710	
ADDRESS: 1938 N. BROADWAY	CITY: ST. LOUIS	STATE: MO	ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

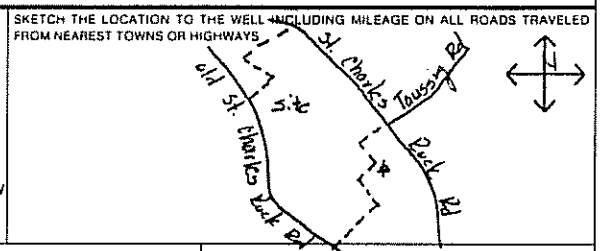
COUNTY: ST. LOUIS
ELEVATION: 484.46
AREA NO.

SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST ¼

SEC. ____ TWN. 47 N, RNG. 5 E OR W

LAT. 38° 46' 01" LONG. 90° 26' 27"

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN Co., Inc.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN Co., Inc.

NOTE: Record the fraction of a foot in decimal, not in inches.

Top of Riser Elevation: 485.58

LOCKING CAP - Y / N (Circle one)
CAP VENT - Y / N (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8" x 8" x 5'
Bore Hole Diameter: 10¼"
WEEP HOLE - Y / N (Circle one)

Ground Surface Elevation: 484.46 Ft

Feet from Surface	Description of Formation
Information in this column to be supplied in the Feet from Surface column	0-17 Silt
Depth to bottom of Protective Casing Seal: 3.0	
	17-22 Sand
	22-32 Silt
	32-35 Sand
Depth to Base of Annular Seal: 63.0	
	35-75 Limestone
Depth to Base of Bentonite Seal: 75.0	75-77
Depth to Base of Secondary Filter Pack: 77.0	Dolomite
Depth to Top of the Screen: 77.4	
	77-87 Limestone
	87-90.3 Shale
Depth to Bottom of the Screen: 87.4	
Plug Back Total Depth	
Original Total Depth: 90.3	

PROTECTIVE CASING SEAL
Type: ☒ Concrete ☐ Cement Slurry

RISER PIPE
Length: 83'
Diameter: 3"
Type of Material: SCH 80 PVC

BOREHOLE DIAMETER: 5⅛ In.

ANNULAR SEAL
Type: ☐ Bentonite Slurry ☒ Cement Slurry ☐ Non Slurry Bentonite

BENTONITE SEAL
Type: ☒ Bentonite Slurry ☐ Non Slurry Bentonite
Length of Seal: 12 Ft.

SECONDARY FILTER PACK (Optional)
Type: ☒ Sand ☐ Manufactured
Grain Size: < 50
Length: 2'

PRIMARY FILTER PACK
Type: ☒ Sand ☐ Manufactured
Grain Size: 16-35
Length: 13.3'

WELL SCREEN
Length: 10'
Slot Size: 0.010
Type: SCH 80 PVC

SUMP DETAILS
Length: 0.3 Ft.
Diameter: 2 In.
Type: PVC

TYPE OF BACKFILL: SAND

DRILLING EQUIPMENT
☒ AIR ROTARY ☒ AUGER TYPE 6¼ H.S.A.
☐ REVERSE ROTARY ☐ OTHER

CENTRALIZERS USED
☒ YES, AT 2 TOTAL
☒ STAINLESS STEEL
☐ OTHER
☐ NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
6-18-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR): Michael P. Vogt
PERMIT NUMBER: 001256 WM DATE: 7-07-95

SIGNATURE (DRILLING CONTRACTOR): Michael P. Vogt
PERMIT NUMBER: 001256 WM DATE: 7-07-95

MO 780-1792 (9-90) DISTRIBUTION: WHITE DIVISION CANARY MONITORING WELL CONTRACTOR PINK/OWNER

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-103-SS
		SHEET 1 OF 4
LAIDLAW/OU2 RI-FS/MD WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	DRILLING
	WATER LEVEL / TIME / DATE / CASING DEPTH	START: TIME 07:30, DATE 2/21/95 — FINISH: TIME 12:00, DATE 2/23/95
NORTHING: 1067660.40 DATUM EASTING: 516723.54 ELEVATION 477.8		
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS	
ANGLE BEARING		
SAMPLE HAMMER		

DRILLING CONTR LAYNE-WESTERN

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
					(0.0-2.0 ft.) No samples collected due to coarse gravel placed for temporary road (475.8) 2.0		
2–3	1 2 3 4	1.6'/2.0' (80%)			(2.0-16.0 ft.) Firm, dusky yellowish brown (10YR 2/2), CLAYEY SILT, trace fine Sand, NR, damp, (CL-ML), (LOESS)	SP 2	
4–5	2 4 4 4	1.3'/2.0' (65%)			@ 4.0 ft., color changes to pale yellowish brown (10YR 6/2) with moderate amount of iron oxide staining	SP 3	
6–7	1 2 2 4	1.3'/2.0' (65%)				SP 4	
8–9	1 2 3 4	1.8'/2.0' (90%)				SP 5	
10–11	2 3 5 6	2.0'/2.0' (100%)			@ 10.0 ft., intermittent moist zones (<2 inches thick)	SP 6	
12–13	1 2 2 3	1.7'/2.0' (85%)			Below 12.0 ft., increase in iron oxide staining (~50%)	SP 7	
14		1.8'/2.0' (90%)				SH 8	

LOGGED BY B. TILTON

DATE 2/21/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ103SS

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-103-SS
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	SHEET 2 OF 4
		DRILLING START TIME 07:30 DATE 2/21/95 / FINISH TIME 12:00 DATE 2/23/95
NORTHING: 1067660.40 DATUM EASTING: 516723.54 ELEVATION 477.8	WATER LEVEL / TIME / DATE / CASING DEPTH	
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS	
ANGLE BEARING		
SAMPLE HAMMER		

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
					(2.0-16.0 ft.) Firm, dusky yellowish brown (10YR 2/2), CLAYEY SILT, trace fine Sand, NR, damp, (CL-ML), (LOESS) (461.8) 16.0	SH 8	
16	7 11 10 11	1.3' / 2.0' (65%)			(16.0-20.0 ft.) Loose to compact yellowish orange (10YR 6/6), SILTY fine SAND, NR, damp, (SM), (ALLUVIAL)	SP 9	
17							
18	1 4 3 8	1.1' / 2.0' (55%)			@ 18.0 ft., silty sand becomes moist	SP 10	
19							
20	2 6 10 10	2.0' / 2.0' (100%)			(457.8) 20.0 (20.0-22.0 ft.) Stiff to very stiff, pale yellowish brown (10YR 6/2) to moderate yellowish brown (10YR 5/4) CLAYEY SILT with silty fine sand layers (<2 inches), WR, moist, (CL-ML), (ALLUVIUM)	SP 11	
21							
22	1 3 6 7	1.1' / 2.0' (55%)			(22.0-28.0 ft.) Stiff, medium dark gray (N4), CLAYEY SILT, some thin silty fine sand zones (<1 inch), SR, damp to moist, (CL-ML), (ALLUVIUM)	SP 12	
23							
24		0.4' / 2.0' (20%)				SH 13	
25							
26	15 47 50/5"	0.9' / 2.0' (45%)			@ 26.0-27.5 ft., limestone boulder or layer encountered, first water identified in borehole	SP 14	Wet zone appears to be isolated
27							
28	2 6 7 10	1.4' / 2.0' (70%)			(28.0-32.0 ft.) Stiff, greenish gray (5G 6/1) CLAYEY SILT, trace to little fine Sand, NR, damp, (CL-ML), (ALLUVIUM)	SP 15	
29							

DRILLING CONTR LAYNE-WESTERN

LOGGED BY B. TILTON

DATE 2/21/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ103SS

SOIL BOREHOLE LOG

LAIDLAW WASTE SYSTEMS INC.

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
LAIDLAW/OU2 RI-FS/MD WEST LAKE LANDFILL OPERABLE UNIT 2	6.25 inch I.D. Hollow Stem Auger	PZ-103-SS
		SHEET 3 OF 4
	SAMPLING METHOD:	
	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)	DRILLING
	SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	START / FINISH
	WATER LEVEL	TIME / TIME
	TIME	07:30 / 12:00
	DATE	DATE / DATE
NORTHING: 1067660.40 DATUM EASTING: 516723.54 ELEVATION 477.8	CASING DEPTH	2/21/95 / 2/23/95

DRILL RIG CME 75 - TRUCK MOUNT

ANGLE BEARING

SAMPLE HAMMER

SURFACE CONDITIONS

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
31	2 4 7 9	1.5'/2.0' (75%)			(28.0-32.0 ft.) Stiff, greenish gray (5G 6/1) CLAYEY SILT, trace to little fine Sand, NR, damp, (CL-ML), (ALLUVIUM) @ 31.6 ft. moderate reddish brown (10R 4/6) CLAYEY medium SAND layer (~1/2 inch) (445.8) 32.0	SP 16	
32, 33	2 4 5 11	1.6'/2.0' (80%)			(32.0-47.5 ft.) Stiff to very stiff, pale yellowish green (10G 7/2) SILTY CLAY, trace to little medium Sand, NR, damp, (CL) @ 33.4-33.8 ft. clayey medium grained sand layer, damp, (SC)	SP 17	
34, 35	2 7 8 11	1.8'/2.0' (90%)				SP 18	
36, 37	1 3 7 11	1.5'/2.0' (75%)			@ 36.0 ft., color varies from very pale orange (10R 8/2) to moderate yellowish brown (10R 5/4) to pale green (5G 7/2), trace fine gravel	SP 19	
38, 39	3 4 6 15	2.0'/2.0' (100%)				SP 20	
40, 41	3 5 20 11	2.0'/2.0' (100%)				SP 21	
42, 43	9 19 50/5"	1.0'/2.0' (50%)			@ 43.0 ft., extremely weathered limestone boulder or layer encountered	SP 22	
44	3 36 24 50/2"	0.5'/2.0' (25%)				SP 23	

DRILLING CONTR LAYNE-WESTERN

LOGGED BY B. FILTON

DATE 2/21/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ103SS

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-103-SS
		SHEET 4 OF 4
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	DRILLING
	WATER LEVEL / TIME / DATE / CASING DEPTH	START: TIME 07:30, DATE 2/21/95 — FINISH: TIME 12:00, DATE 2/23/95
NORTHING: 1067660.40 DATUM EASTING: 516723.54 ELEVATION 477.8		
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS	
ANGLE BEARING		
SAMPLE HAMMER		

DRILLING CONTR LAYNE-WESTERN

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL			SAMPLER TYPE	REMARKS
46	4 6 8 50/3"	2.0' 2.0' (100%)			(32.0-47.5 ft.) Stiff to very stiff, pale yellowish green (10G 7/2) SILTY CLAY, trace to little medium Sand, NR, damp, (CL) @ 45.5 ft., weathered limestone boulder or layer encountered			SP 23	
47					@ 47.1 ft., thin silty fine sand layer (~1 inch), moist	(430.3)	47.5	SP 24	
48	23 5 2 48	1.8' 2.0' (90%)			(47.5-48.0 ft.) Hard, dark yellowish orange (10R 6/6), weathered SILTY CLAYSTONE, NR, damp, (CH)	(429.8)	48.0		
49					@ 48.0 ft., weathered limestone boulder encountered (48.0-50.0 ft.) Hard, moderate yellowish brown (10YR 5/4) SILTY CLAY, some weathered limestone pieces (<1 inch), WR-SR, moist, (CL)	(427.8)	50.0	SP 25	
50					End of Soil Borehole Log at 50.0 ft. See PZ-103-SS Record of Drillhole for rock descriptions				
51									
52									
53									
54									
55									
56									
57									
58									
59									

LOGGED BY B. TILTON
DATE 2/21/95 CHK'D BY W. HERST
JOB NO.: 943-2848
FILENAME: PZ103SS

RECORD OF DRILLHOLE PZ-103-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/21/95-2/22/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1087660.4
AZIMUTH: 0

COLLAR ELEV: 477.8
E: 516723.5
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
48	0.0-50.0 ft. See Soil Borehole Log PZ-103-SS 50.0-51.5 ft. No samples collected													
50														
	426.30		426.30											
	51.5-62.7 ft. Moderately weathered, medium bedded, yellowish gray (5Y 8/1), medium crystalline, weak to medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolites with iron oxide staining		51.50						Core Loss					Core loss possibly from 51.5-52.7 ft. in highly fractured rock and clay zones on top of bedrock
52	53.4-53.9 ft. Pinkish gray (5YR 8/1), siltstone layer								J,I,R					
54	54.7 ft. Oxidized pyrite nodules (<3 mm.)			1	84%									
56	56.4 ft. Vertical calcite filled vein (4 in.) 57.0 ft. Calcite filled vein at 90 degrees (1 in. thick)													
58									J,I,R					
									J,I,R,CL					
			418.80 58.00											59.0-60.0 ft. Five breaks that had been spun
60									J,I,R (2)					
				2	69%				J,PL,R					
62	62.7-62.9 ft. Extremely weak, greenish gray (5GY 6/1), glauconite clay layer													
	414.90 62.90 62.9-71.0 ft. Highly weathered, medium bedded, moderate yellowish brown (10YR 5/4), fine grained, weak, ARGILLACEOUS SANDSTONE, (ST. LOUIS FORMATION)													Core loss in soft formation or possible open void
64									Core Loss					

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: B. TILTON
CHECKED: W. HERST
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-103-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/21/95-2/22/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1067860.4
AZIMUTH: 0

COLLAR ELEV: 477.8
E: 516723.5
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX (SW, FR, MW, HW, CW)	STRENGTH INDEX (R6, R5, R4, R3, R2, R1)	POINT LOAD INDEX (psi) (R1 30, R2 150, R3 300, R4 600, R5 1500, R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
64	62.9-71.0 ft. Highly weathered, medium bedded, moderate yellowish brown (10YR 5/4), fine grained, weak, ARGILLACEOUS SANDSTONE, (ST. LOUIS FORMATION)							Core Loss					
66	411.80 / 66.00 — 66.0-66.5 ft. Highly weathered, dark yellowish orange (10YR 6/6) extremely weak, SILTSTONE layer — 411.30 / 66.50		2	69%				Core Loss					Core loss in soft formation or possible open void
68		408.80 / 69.00											
70	69.6 ft. Very soft, dark yellowish orange (10YR 6/6), clay layer (2 in. thick) — 406.80		3	100 %									
	71.0-71.7 ft. Slightly weathered, medium bedded, dark greenish gray (5GY 4/1), very fine crystalline, medium strong, DOLOMITIC LIMESTONE, moderate porosity, (ST. LOUIS FORMATION) — 71.00 / 406.10 / 71.70							J,PL,SM; J,ST,SM; J,PL,SM					Run 3 stopped short, bit plugged off in claystones
72	71.7-78.7 ft. Highly weathered, thinly bedded, medium dark gray (N4) to grayish black (N2), very weak, CLAYEY SILTSTONE, (ST. LOUIS FORMATION) Some disseminated pyrite, some thin layers of claystone (<3 in.)	405.80 / 72.00											2/21/95 @ 16:00 Stopped drilling in Run 3 2/22/95 @ 7:30 Began Run 4
74								B,I,R; B,I,R					
76	75.6-76.3 ft. Brownish gray (5YR 4/1), argillaceous LIMESTONE layer — 402.20 / 75.60 — 401.50 / 76.30		4	100 %				J,I,R; J,PL,SM,CL; J,PL,SM; J,PL,SM; J,PL,SM-intact; J,I,R (2); B,I,R					
78	78.7-87.5 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), micro-crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic — 399.10 / 78.70 — 397.80 / 80.00	398.60 / 79.20	5	100 %				B,I,R					
80													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: B. TILTON
CHECKED: W. HERST
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-103-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/21/95-2/22/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1067560.4
AZIMUTH: 0

COLLAR ELEV: 477.8
E: 518723.5
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP WRT CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80	397.80 / 80.00														
	80.0-81.2 ft. Thinly laminated, olive gray (5Y 4/1), CLAYEY SILTSTONE layer														
	398.60 / 81.20														
	78.7-87.5 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), micro-crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic														
82				5	100 %				J,PL,SM,CL (2)						
84															
86			391.80 / 86.00												9:45 Stopped Run 5 short, bit plugged off
	87.3-87.5 ft. Soft, greenish gray (5GY 6/1), glauconite Clay layer								B,PL,SM						
88	87.5-103.8 ft. Fresh, thinly bedded, light olive green (5Y 6/1) to olive gray (5Y 4/1), very fine grained, medium strong, ARENACEOUS DOLOMITE, (ST. LOUIS FORMATION) Trace disseminated pyrite								J,I,R,CL; J,I,R (2); J,PL,SM						
90	89.0-91.5 ft. Moderate porosity, open vugs (<3 mm.), glauconite in some vugs (<1%) 90.4 ft. Thin silicified zone (~1/2 in.)			6	98%				J,PL,SM						
92															
									J,PL,SM,CL						
94			383.30 / 94.50												
				7	98%				J,I,SM (2)						
96															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: B. TILTON
CHECKED: W. HERST
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-103-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/21/95-2/22/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1067660.4
AZIMUTH: 0

COLLAR ELEV: 477.8
E: 516723.5
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
96	87.5-103.8 ft. Fresh, thinly bedded, light olive green (5Y 6/1) to olive gray (5Y 4/1), very fine grained, medium strong, ARENACEOUS DOLOMITE, (ST. LOUIS FORMATION) Trace disseminated pyrite							J,I,R					
								J,I,SM					
								J,I,R					
								J,I,R					
98								J,P,SM					
								J,P,SM					
								J,P,SM					
								B,I,SM,CL					
100			7	98%									
	101.3-103.6 ft. Moderate porosity, open vugs (<2 mm.)												
102													
	374.00												
104	103.8-105.6 ft. 103.80 Freshly medium bedded, pale yellowish brown (10YR 6/2) to light brownish gray (5YR 6/1), medium crystalline, medium strong, DOLOMITIC LIMESTONE, (ST. LOUIS FORMATION)	373.30						J,U,SM					
		104.50						J,PL,R					
								J,PL,SM-healed with calcite					
	372.10 105.6 ft. 105.70 Brownish gray (5YR 4/1), Claystone layer, (~1 in. thick)												
106	105.7-107.2 ft. Fresh, thickly bedded, olive gray (5Y 4/1), finely grained, strong, ARENACEOUS DOLOMITE, (ST. LOUIS FORMATION) 370.60 107.20												
	107.2-109.6 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), finely crstalline, medium strong, DOLOMITIC LIMESTONE, (ST. LOUIS FORMATION) Trace disseminated pyrite												
108			8	100 %				J,U,SM					
110	109.6-128.4 ft. Fresh, medium bedded, olive gray (5Y 4/1), micro-crystalline, medium strong to strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolites common, some glauconite stringers							J,I,SM,CL					
112													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: B. TILTON
CHECKED: W. HERST
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-103-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/21/95-2/22/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1067660.4
AZIMUTH: 0

COLLAR ELEV: 477.8
E: 516723.5
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
112	112.0-113.5 ft. Becomes argillaceous 109.6-128.4 ft. Fresh, medium bedded, olive gray (5Y 4/1), micro-crystalline, medium strong to strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolites common, some glauconite stringers		8	100 %									
114		353.30 / 114.50						J,I,R,CL					
								J,I,SM					
116													
								J,PL,SM					
								J,I,VR					
								J,PL,SM,CL					
118								J,PL,VR					
	119.2-124.0 ft. Thin chert zone generally less than 2 in. thick		9	100 %									
120	120.0-120.5 ft. Moderate siliceous							J,I,R,CL					
122								J,I,R,CL					
								J,I,SM,CL					
124		353.30 / 124.50											
	Two stylolites												
126			10	100 %									
								J,PL,SM (2)					
								J,P,SM					
128													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: B. TILTON
CHECKED: W. HERST
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-103-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/21/95-2/22/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1067660.4
AZIMUTH: 0

COLLAR ELEV: 477.8
E: 516723.5
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
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Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
128			349.40												
	128.4-133.9 ft. 128.40 Slightly weathered, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARENACEOUS DOLOMITE, (ST. LOUIS FORMATION)														
130				10	100 %										
132															
			343.90												2/22/95 16:45 Stopped drilling on Run 10
134	133.9-136.5 ft. 133.90 Fresh, medium bedded, light olive gray (5Y 5/2), micro-crystalline to fine crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Trace disseminated pyrite, some thin veins of calcite (<1/4 in.)		343.50 / 134.30						J,PL,SM,CL						2/23/95 7:40 Resumed drilling Measured water level at 52.15 ft. below ground surface
									J,U,SM						
136			341.30						B,PL,SM						
	136.5-139.7 ft. 136.50 Slightly weathered, thickly bedded, light olive gray (5Y 6/1), very fine grained, medium strong, ARENACEOUS DOLOMITE, (<1 in.), (ST. LOUIS FORMATION) Thin Limestone layers														
138				11	100 %										
			338.10												
	139.7-142.3 ft. 139.70 Slightly weathered, medium bedded, light olive gray (5Y 5/2), fine crystalline, medium strong, DOLOMITIC LIMESTONE, (ST. LOUIS FORMATION)								J,C,SM						
140									J,PL,SM						
									J,I,R						
142									J,I,R,CL						
			335.50												
	142.3-144.3 ft. 142.30 Fresh, thickly bedded, light olive gray (5Y 6/1), micro-crystalline, strong, LIMESTONE, (ST. LOUIS FORMATION) 144.0-144.2 ft. Soft, grayish green (5G 5/2), glauconitic clay layer														Highly broken rock.
144															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: B. TILTON
CHECKED: W. HERST
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-103-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/21/95-2/22/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1067860.4
AZIMUTH: 0

COLLAR ELEV: 477.8
E: 516723.5
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
144	333.50		333.50	11	100 %				J,I,SM (2)						
	End of Record of Drillhole at 144.3 ft. 144.30		144.30												2/23/95 @ 9:00 Finish drilling corehole.
146															
148															
150															
152															
154															
156															
158															
160															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

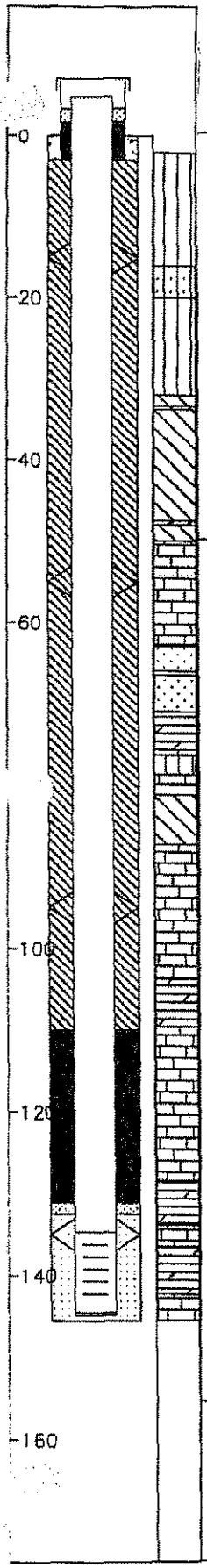
LOGGED: B. TILTON
CHECKED: W. HERST
DATE: 3/13/95

Golder Associates

Well No. PZ-103-SS

Boring No. X-Ref: PZ-103-SS

PIEZOMETER CONSTRUCTION SUMMARY



Survey Coords: Northing: 1067660 ft. Easting: 516724 ft.

Elevation Ground Level 477.8 ft. NGVD

Top of PVC Casing 480.17 ft. NGVD

Drilling Summary:

Total Depth 145.5 ft.

Borehole Diameter 10 1/4 in. (0.0-51.0 ft.) 5 7/8 in. (51.0-145.5 ft.)

Casing Stickup Height 2.39 ft.

Driller Layne-Western St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit for Reaming

Drilling Fluid Auger-None, NX Core Water, Air Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	2/21/95	7:30	2/23/95	9:45
Schramm Rotary	2/26/95	9:30	2/26/95	11:20
Geophys.Logging:				
Casing:	2/26/95	11:20	2/26/95	11:40
Filter Placement:	2/26/95	11:45	2/26/95	12:00
Cementing:				
Development				
Bentonite Grout	2/26/95	13:30	2/26/95	14:30
Bentonite Seal	2/26/95	12:30	2/26/95	13:00

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 2.39	-	134.70	C1	480.17	-	343.08
134.70	-	144.50	S1	343.08	-	333.28
144.50	-	144.83	C2	333.28	-	332.95

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 132.5-145.5 ft.

Filter Pack: Less than 50 mesh Silica Sand, 131.1-132.5 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-35.0 ft. and 60.0-110.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 110.0-131.1 ft.

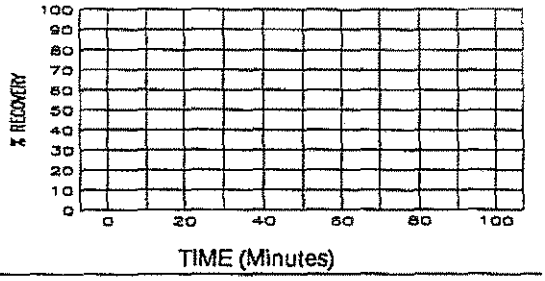
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments: Due to grout slurry lose above 60.0 ft., bentonite chips were placed from 35.0-60.0 ft. to seal borehole. The chips were hydrated at 1 ft. intervals during placement and were monitored with a weighted tape measure.

Not to Scale

Supervised by B. Tilton

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ103SS

661574

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO. 115083	CHECK NO.
ROUTE	TRANSMITTAL NO
STATE WELL NUMBER	CROSS REFERENCE NO.
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME: LAIDLAW BRIDGETON SANITARY LANDFILL		WELL NUMBER: PZ-103-SS	
SITE ADDRESS: ST. CHARLES ROCK RD.	CITY: BRIDGETON	STATE: Mo	ZIP CODE: 63044
NAME: LAIDLAW WASTE SYSTEMS, INC.		TELEPHONE: 314-341-3710	
ADDRESS: 1838 N. BROADWAY	CITY: ST. LOUIS	STATE: Mo.	ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

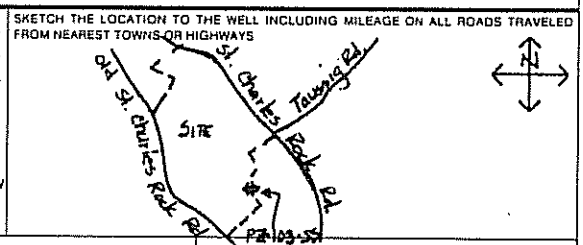
COUNTY: ST. LOUIS
ELEVATION: 477.78
AREA NO.

SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST ¼

SEC. ____ TWN. 47 N.RNG. 5 (E) OR W

LAT. 38° 45' 57" LONG. 90° 26' 29"

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

NOTE: Record the fraction of a foot in decimal, not in inches

LOCKING CAP - Y / N (Circle one)
CAP VENT - Y / N (Circle one)

Top of Riser Elevation: 480.17

Ground Surface Elevation: 477.78 Ft

Feet from Surface	Description of Formation
Information in this column to be supplied in the Feet from Surface column	0-15 Silt
Depth to bottom of Protective Casing Seal: 3	
	15-20 Sandy silt
	20-32 Silt
	32-51 Clay
	51-64 Limestone
Depth to Base of Annular Seal: 110.0	64-72 Sandy silt
	72-78 Shale
Depth to Base of Bentonite Seal: 131.1	78-87 Limestone
Depth to Base of Secondary Filter Pack: 132.5	87-111 Dolomite
Depth to Top of the Screen: 134.5	
	111-128 Limestone
	128-135 Dolomite
Depth to Bottom of the Screen: 144.5	135-137 Limestone
	137-143 Dolomite
Plug Back Total Depth	143-144.5 Limestone
Original Total Depth: 145.5	

PROTECTIVE CASING
Type: STEEL
Size: 8" x 8" x 5'
Bore Hole Diameter: 10.25"
WEEP HOLE - Y / N (Circle one)

PROTECTIVE CASING SEAL
Type: [X] Concrete [ ] Cement Slurry

RISER PIPE
Length: 136.87'
Diameter: 2"
Type of Material: SCH80 PVC

BOREHOLE DIAMETER: 5 7/8 In.

ANNULAR SEAL
Type: [X] Bentonite Slurry [ ] Cement Slurry [ ] Non Slurry Bentonite

BENTONITE SEAL
Type: [X] Bentonite Slurry [ ] Non Slurry Bentonite
Length of Seal: 21.1 Ft.

SECONDARY FILTER PACK (Optional)
Type: [X] Sand [ ] Manufactured
Grain Size: SUGAR
Length: 1.4'

PRIMARY FILTER PACK
Type: [X] Sand [ ] Manufactured
Grain Size: 20/40
Length: 13'

WELL SCREEN
Length: 10'
Slot Size: 0.010"
Type: SCH80 PVC

SUMP DETAILS
Length: 0.3 Ft.
Diameter: 2 In.
Type: PVC

TYPE OF BACKFILL: SAND

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN Co., INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN Co., INC.

TYPE OF INSTALLATION
[X] ABOVE GROUND [ ] FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT

MEASURING POINT IS
[ ] TOP OF RISER PIPE
[ ] OTHER

DRILLING EQUIPMENT
[X] AIR ROTARY [X] AUGER TYPE 6¼ H.S.A.
[ ] REVERSE ROTARY [ ] OTHER

CENTRALIZERS USED
[X] YES, AT 4 TOTAL
[ ] STAINLESS STEEL
[ ] OTHER
[ ] NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
2-27-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR): Michael P. Vogt
PERMIT NUMBER: 001256 WM DATE: 4-11-95

SIGNATURE (DRILLING CONTRACTOR): Michael P. Vogt
PERMIT NUMBER: 001256 WM DATE: 4-11-95

MO 780-1415 (2-94) DISTRIBUTION: WHITE/DIVISION CANARY/MONITORING WELL CONTRACTOR PINK/OWNER

RECORD OF DRILLHOLE PZ-104-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/4/95
DRILL RIG: SCHRAMM

DATUM: MSL
COORDINATES N: 1067028.01
AZIMUTH: 0

COLLAR ELEV: 481.6
E: 518847.19
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
128	0.0-135.0 ft. No sampling conducted See Record of Drillhole for PZ-104-KS														0.0-38.0 ft. Drilling conducted with 6 1/4 in. ID hollow stem augers, then borehole advanced to 135.0 ft. with 5 7/8 in. air rotary bit
130															
132															
134															
	346.60		346.60												
	135.0-138.1 ft. 135.00 Fresh, medium bedded, pale yellowish brown (10YR 6/2), very fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)		135.00						J,PL,R						6/4/95 @ 9:30 Begin Run 1
136									J,I,R						
									J,P,R						
138	343.50								J,I,R,CL						
	138.1-138.7 ft. 138.10 Slightly weathered, finely bedded, dark greenish gray (5GY 4/1), very fine grained, very weak, CLAYSTONE, (ST. LOUIS FORMATION) 342.90 138.70								J,I,R,CL						
									J,PL,SM,CL						
									J,I,VR,calcite						
	138.7-145.0 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), very fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)			1	100 %				J,C,R						
140															
142									J,PL,SM (2)						
									J,I,SM						
144															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: M. VOGT

LOGGED: E. SWANSON
CHECKED: B. TILTON
DATE: 6/4/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/4/95
DRILL RIG: SCHRAMM

DATUM: MSL
COORDINATES N: 1067028.01
AZIMUTH: 0

COLLAR ELEV: 481.6
E: 516847.19
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (80 60 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0 30 50 90)	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR MW HW CW)	STRENGTH INDEX (R6 R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 30 R2 150 R3 300 R4 600 R5 1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
144	138.7-145.0 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), very fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) 336.60 145.00		336.60 145.00	1	100 %										
	End of Record of Drillhole at 145.0 ft.														
146															
148															
150															
152															
154															
156															
158															
160															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: M. VOGT

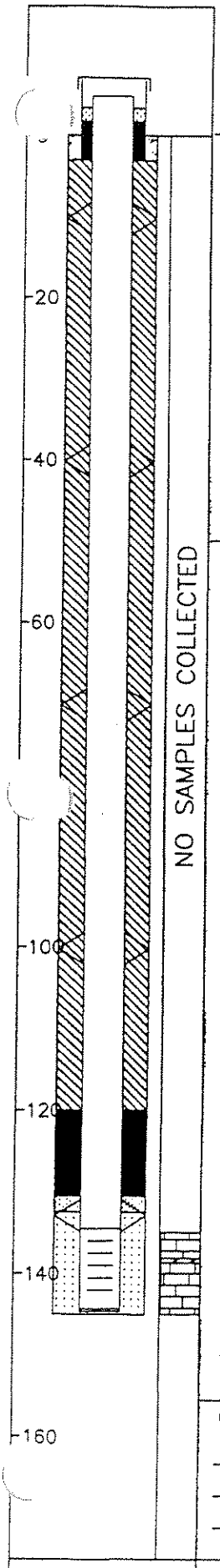
LOGGED: E. SWANSON
CHECKED: B. TILTON
DATE: 6/4/95

Golder Associates

Well No. PZ-104-SS

Boring No. X-Ref: PZ-104-SS

PIEZOMETER CONSTRUCTION SUMMARY



Survey Coords: Northing: 1067028 ft. Easting: 516847 ft.

Elevation Ground Level 481.6 ft. NGVD

Top of PVC Casing 483.63 ft. NGVD

Drilling Summary:

Total Depth 145.0 ft.

Borehole Diameter 10 1/4" (0.0-37.0') 5 7/8" (37.0-145.0')

Casing Stickup Height 2.07 ft.

Driller Layne-Western, St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4" ID Hollow Stem Auger Bit, NX Core, 5 7/8" Button Bit for Reaming

Drilling Fluid Auger-None, NX Core Water, Air Rotary

Protective Casing 8x8" Square Steel, by 5' long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75				
Schramm Rotary	6/3/95	12:30	6/4/95	11:45
Geophys.Logging:				
Casing:	6/4/95	11:45	6/4/95	12:00
Filter Placement:	6/4/95	12:00	6/4/95	12:45
Cementing:				
Development				
Bentonite Grout	6/4/95	13:05	6/4/95	13:25
Bentonite Seal	6/4/95	12:45	6/4/95	13:05

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 2.07	-	134.50	C1	483.63	-	347.06
134.50	-	144.30	S1	347.06	-	337.26
144.30	-	144.63	C2	337.26	-	336.93

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 132.5-145.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 130.5-132.5 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-120.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 120.0-130.5 ft.

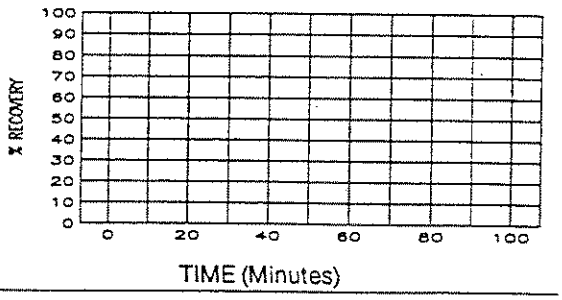
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Not to Scale

Supervised by B. Tilton

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ104SS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122511	CHECK NO
ROUTE	TRANSMITTAL NO
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME	WELL NUMBER
LAIDLAW BRIDGETON SANITARY LANDFILL	PZ-104-35

SITE ADDRESS	CITY	STATE	ZIP CODE
ST. CHARLES ROCK RD.	BRIDGETON	MO	63044

NAME	TELEPHONE
LAIDLAW WASTE SYSTEMS, INC.	314-241-3710

ADDRESS	CITY	STATE	ZIP CODE
1638 N. BROADWAY	ST. LOUIS	MO	63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

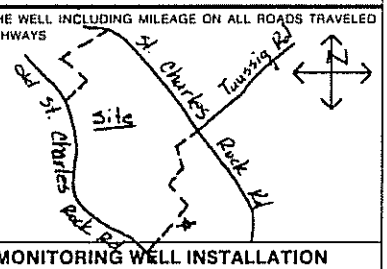
COUNTY ST. LOUIS
ELEVATION 481.6
AREA NO

SMALLEST ¼ LARGEST ¼

SEC. TWN. 47 N.RNG. 5 E OR W

LAT. 38 · 45 · 50 · LONG. 90 · 26 · 27 ·

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN CO., INC.

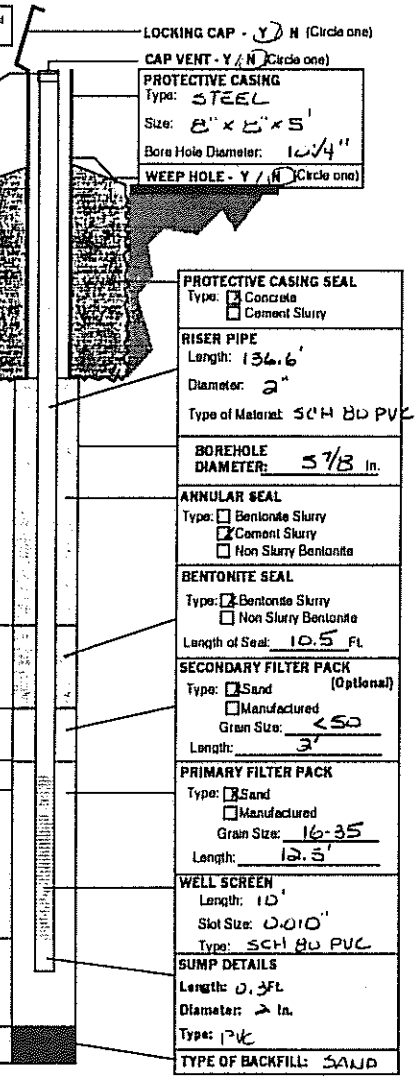
DRILLING CONTRACTOR'S NAME
LAYNE WESTERN CO., INC.

NOTE: Record the fraction of a foot in decimal, not in inches.

Top of Riser Elevation: 483.6

Ground Surface Elevation: 481.6

Feet from Surface	Description of Formation
Information in this column to be supplied in the Feet from Surface column	
Depth to bottom of Protective Casing Seal: 3.0	
Depth to Base of Annular Seal: 120.0	
Depth to Base of Bentonite Seal: 130.5	
Depth to Base of Secondary Filter Pack: 132.5	
Depth to Top of the Screen: 134.5	
Depth to Bottom of the Screen: 144.5	
Plug Back Total Depth:	
Original Total Depth: 145.0	



LOCKING CAP - (Y) N (Circle one)
CAP VENT - Y / (N) (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8" x 5" x 5'
Bore Hole Diameter: 10¼"

WEEP HOLE - Y / (N) (Circle one)

PROTECTIVE CASING SEAL
Type: [X] Concrete [ ] Cement Slurry

RISER PIPE
Length: 136.6'
Diameter: 2"
Type of Material: SCH 80 PVC

BOREHOLE DIAMETER: 5 7/8 in.

ANNULAR SEAL
Type: [ ] Bentonite Slurry [X] Cement Slurry [ ] Non Slurry Bentonite

BENTONITE SEAL
Type: [X] Bentonite Slurry [ ] Non Slurry Bentonite
Length of Seal: 10.5 FL

SECONDARY FILTER PACK (Optional)
Type: [X] Sand [ ] Manufactured
Grain Size: <50
Length: 3'

PRIMARY FILTER PACK
Type: [X] Sand [ ] Manufactured
Grain Size: 16-35
Length: 12.5'

WELL SCREEN
Length: 10'
Slot Size: 0.010"
Type: SCH 80 PVC

SUMP DETAILS
Length: 0.3FL
Diameter: 2 in.
Type: PVC

TYPE OF BACKFILL: SAND

TYPE OF INSTALLATION
[X] ABOVE GROUND [ ] FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT
483.6

MEASURING POINT IS
[X] TOP OF RISER PIPE
[ ] OTHER

DRILLING EQUIPMENT
[X] AIR ROTARY [X] AUGER TYPE 6¼ H.S.A.
[ ] REVERSE ROTARY [ ] OTHER

CENTRALIZERS USED
[X] YES, AT 5 TOTAL
[X] STAINLESS STEEL
[ ] OTHER
[ ] NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
6-04-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR) Michael P. Vogt

PERMIT NUMBER	DATE
001256 WM	7-07-95

SIGNATURE (DRILLING CONTRACTOR) Michael P. Vogt

PERMIT NUMBER	DATE
001256 WM	7-07-95

MO 780-1415 (2-94) DISTRIBUTION: WHITE DIVISION CANARY MONITORING WELL CONTRACTOR PINK/OWNER

RECORD OF DRILLHOLE PZ-104-SD

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/6/95
DRILL RIG: SCHRAMM

DATUM: MSL
COORDINATES N: 1067013.26
AZIMUTH: 0

COLLAR ELEV: 482.1
E: 516634.43
INCLINATION: -90

ROCK TYPE: J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation; PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular; P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough; Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DISCONTINUITY DATA: DIP wrt CORE AXIS (0, 30, 60, 90)

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (80, 60, 40, 20)	FRACTURES PER FOOT (2, 4, 6, 8, 10)	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX (SW, FR, MW, HW, CW)	STRENGTH INDEX (R6, R5, R4, R3, R2, R1)	POINT LOAD INDEX (psi) (R1 30, R2 150, R3 300, R4 600, R5 1500, R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
240	0.0-245.3 ft. No sampling conducted See Soil Borehole Log and Record of Drillhole for PZ-104-KS											0.0-38.0 ft. Drilling conducted with 6 1/4 in. ID hollow stem augers, then borehole advanced to 245.3 ft. with 5 7/8 in. air rotary bit
242												
244												
	238.80	238.80										
	245.3-252.8 ft. 245.30 Fresh, thickly bedded, medium dark gray (N4), coarse grained, medium strong, FOSSILIFEROUS LIMESTONE, (SALEM FORMATION) Coarse grained calcite crystals common	245.30										6/6/95 @ 8:30 Began coring
246												
	247.4-250.1 ft. Limestone is moderate yellowish brown (10YR 5/4) due to iron oxide											
248												
250			1	94%								
252												
	229.30											
	252.8-255.0 ft. 252.80 Slightly weathered, thinly bedded, moderate yellowish brown (10YR 5/4), very fine grained, weak, SILTSTONE, (WARSAW FORMATION)											
254												
	254.4-255.0 ft. Siltstone becomes highly weathered	227.70 254.40					Core Loss					Core Loss due to highly weathered SILTSTONE 6/6/95 @ 11:30 Coring completed
	227.10											
	End of Record of Drillhole at 255.0 ft. 255.00											
256												

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: M. VOGT

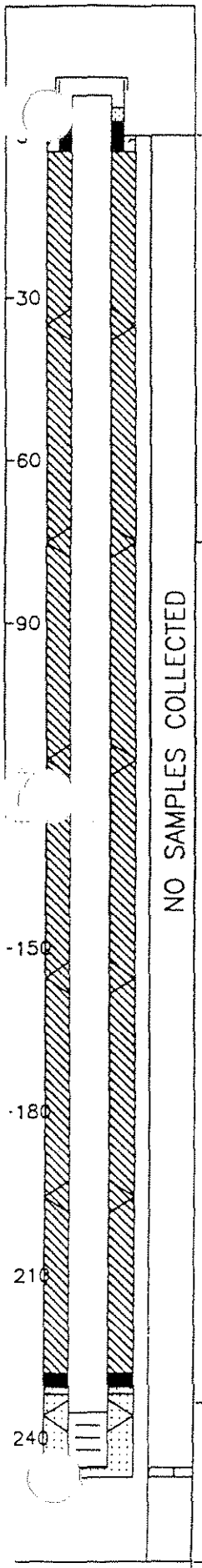
LOGGED: S. TILTON
CHECKED: R. BOOTH
DATE: 7/12/95

Golder Associates

Well No. PZ-104-SD

Boring No. X-Ref: PZ-104-SD

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords:	Northing: 1067013 ft.	Elevation Ground Level	482.1 ft. NGVD
	Easting: 516834 ft.	Top of PVC Casing	483.69 ft. NGVD

Drilling Summary:

Total Depth 252.5 ft.

Borehole Diameter 10 1/4 in. (0.0-38.0 ft.) 5 7/8 in. (38.0-252.5 ft.)

Casing Stickup Height 1.59 ft.

Driller Layne-Western, St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit for Reaming

Drilling Fluid Auger-None, NX Core Water, Air Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75				
Schramm Rotary	5/5/95	15:00	5/6/95	14:00
Geophys.Logging:	6/8/95	12:30	6/8/95	15:00
Casing:	6/17/95	12:10	6/17/95	12:30
Filter Placement:	6/17/95	12:30	6/17/95	13:00
Cementing:				
Development				
Bentonite Grout	6/17/95	13:20	6/17/95	15:00
Bentonite Seal	6/17/95	13:00	6/17/95	13:20

Well Design & Specifications

Basis: Geologic Log X Geophysical Log X

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.59	-	235.20	C1	483.69	-	248.90
235.20	-	245.00	S1	246.90	-	237.10
245.00	-	245.33	C2	237.10	-	236.77

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 231.8-247.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 230.5-231.8 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-220.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 220.0-230.5 ft.

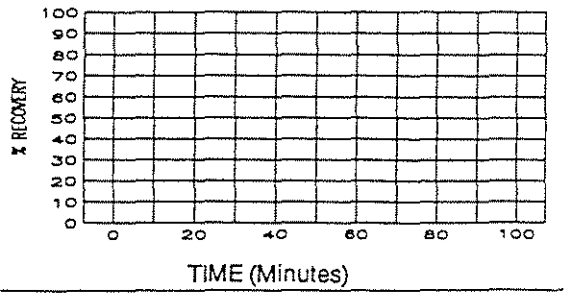
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments: When PVC casing was installed, it was observed that there was about 5.0 ft. of sluff in borehole from 247.5-252.5 ft. It did not appear that the sluff could be removed from the borehole since the borehole had remained open to allow for geophysical logging and packer testing and slaking of shale units and argillaceous limestones in the borehole. Two feet of sand pack was used to seperate the bottom of the piezometer from the sluff at the bottom of the borehole.

Supervised by	B. Tilton	Site	LAIDLAW/OU2 RI-FS/MO
Job Number	943-2848	File Name	PZ104SD

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122512	CHECK NO
ROUTE	TRANSMITTAL NO
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME	WELL NUMBER
LANDFILL BRIDGETON SANITARY LANDFILL	PZ-104-SD

SITE ADDRESS	CITY	STATE	ZIP CODE
31 CHARLES ROCK RD	BRIDGETON	MO.	63044

NAME	TELEPHONE
LANDFILL WASTE SYSTEMS, INC.	314-241 3110

ADDRESS	CITY	STATE	ZIP CODE
1530 N BROADWAY	ST LOUIS	MO	63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

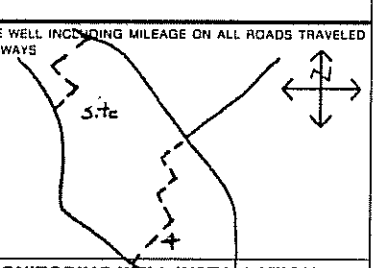
COUNTY: ST LOUIS
ELEVATION: 453.69
AREA NO:

SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST ¼

SEC. ____ TWN. 47 N, RNG. 5 E OR W

LAT. 38° 45' 50" LONG. 90° 26' 27"

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN CO, INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN CO., INC.

TYPE OF INSTALLATION
☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT
453.69

MEASURING POINT IS
☒ TOP OF RISER PIPE
☐ OTHER

DRILLING EQUIPMENT
☒ AIR ROTARY ☒ AUGER TYPE 6¼ H.S.A.
☐ REVERSE ROTARY ☐ OTHER

CENTRALIZERS USED
☒ YES, AT 6 TOTAL
☒ STAINLESS STEEL
☐ OTHER
☐ NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
6-17-75

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR) Michael P. Vogt

PERMIT NUMBER	DATE
001256 W.M.	7-07-75

SIGNATURE (DRILLING CONTRACTOR) Michael P. Vogt

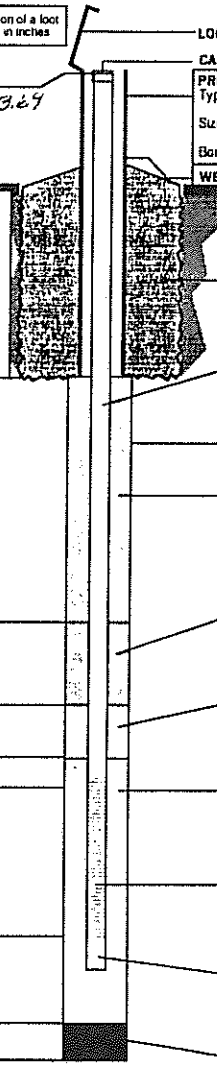
PERMIT NUMBER	DATE
001256 W.M.	7-07-75

NOTE: Record the fraction of a foot in decimal, not in inches

Top of Riser Elevation: 453.69

Ground Surface Elevation: 453.69 Ft

Feet from Surface	Description of Formation
Information in this column to be supplied in the Feet from Surface column	
Depth to bottom of Protective Casing Seal: 3.0	
Depth to Base of Annular Seal: 228.0	
Depth to Base of Bentonite Seal: 230.5	
Depth to Base of Secondary Filter Pack: 231.8	
Depth to Top of the Screen: 235.0	
Depth to Bottom of the Screen: 245.0	
Plug Back Total Depth	
Original Total Depth: 252.5	



LOCKING CAP - Y / N (Circle one)
CAP VENT - Y / N (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8" x 8'-5'
Bore Hole Diameter: 10¼"
WEEP HOLE - Y / N (Circle one)

PROTECTIVE CASING SEAL
Type: ☒ Concrete ☐ Cement Slurry

RISER PIPE
Length: 237'
Diameter: 2"
Type of Material: SCH 80 PVC

BOREHOLE DIAMETER: 5⅛ In.

ANNULAR SEAL
Type: ☐ Bentonite Slurry ☒ Cement Slurry ☐ Non Slurry Bentonite

BENTONITE SEAL
Type: ☒ Bentonite Slurry ☐ Non Slurry Bentonite
Length of Seal: 2.5 Ft.

SECONDARY FILTER PACK (Optional)
Type: ☒ Sand ☐ Manufactured
Grain Size: 4-50
Length: 1.3'

PRIMARY FILTER PACK
Type: ☒ Sand ☐ Manufactured
Grain Size: 16-35
Length: 227'

WELL SCREEN
Length: 10
Slot Size: 0.010"
Type: PVC

SUMP DETAILS
Length: 0.5 Ft.
Diameter: 2 In.
Type: PVC

TYPE OF BACKFILL: WATER

MO 780-1415 (2-94)

DISTRIBUTION: WHITE DIVISION CANARY MONITORING WELL CONTRACTOR PINK/OWNER

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger		BORING NO. PZ-104-KS
			SHEET 1 OF 3
LAIDLAW/OU2 RI-FS/MD WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)		DRILLING
	WATER LEVEL		START / FINISH
	TIME		TIME: 15:40 / TIME: 17:58
	DATE		DATE: 2/12/95 / DATE: 2/12/95
NORTHING: 1066993.15 DATUM EASTING: 516820.50 ELEVATION 482.3	CASING DEPTH		
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS		
ANGLE BEARING			
SAMPLE HAMMER			

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1	4 5 4 4	1.6'/2.0' (80%)			(0.0-2.4 ft.) Stiff, dark yellowish brown (10YR 4/2), homogenous, CLAYEY SILT, rootlets, NR, moist, (ML-CL), (LOESS)	SP 1	2/12/95 - 15:40 Began drilling
2 3	2 2 2 2	1.2'/2.0' (60%)			(2.4-7.0 ft.) Soft to firm, dusky yellowish brown (10YR 2/2), homogenous, CLAYEY SILT, NR, moist, (ML-CL), (LOESS)	SP 2	
4 5	2 2 3 3	1.5'/2.0' (75%)				SP 3	
6 7		2.2'/2.0' (110%)			(7.0-15.4 ft.) Stiff, light olive gray (5Y 6/1) to light brown (5YR 5/6), homogenous, mottled CLAYEY SILT, NR, damp, (ML-CL), (LOESS)	SH 4	
8 9	3 4 5 8	0.9'/2.0' (45%)				SP 5	
10 11	3 4 5 7	1.1'/2.0' (55%)				SP 6	
12 13	4 4 6 7	1.1'/2.0' (55%)				SP 7	
14	3 5 8 9	1.2'/2.0' (60%)				SP 8	

DRILLING CONTR LAYNE-WESTERN

LOGGED BY J. MILLER CHK'D BY W. HERST

DATE 2/12/95

JOB NO.: 943-2848

FILENAME: PZ104KS

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-104-KS
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	SHEET 2 OF 3
		DRILLING START TIME 15:40 DATE 2/12/95 / FINISH TIME 17:58 DATE 2/12/95
NORTHING: 1066993.15 DATUM EASTING: 516820.50 ELEVATION 482.3	WATER LEVEL / TIME / DATE / CASING DEPTH	
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS	
ANGLE BEARING		
SAMPLE HAMMER		

DRILLING CONTR LAYNE-WESTERN

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
					(7.0-15.4 ft.) Stiff, light olive gray (5Y 6/1) to light brown (5YR 5/6), homogenous, mottled CLAYEY SILT, NR, damp, (ML-CL), (LOESS) (466.9) 15.4	SH 8	
16		1.7'/2.0' (85%)			(15.4-20.8 ft.) Compact, light gray (N7), homogenous, SILT, NR, dry, (ML), (LOESS)	SH 9	
17							
18	6 5 6 8	1.1'/2.0' (55%)				SP 10	
19							
20	4 4 6 8	1.2'/2.0' (60%)			(461.5) 20.8	SP 11	
21					(20.8-22.4 ft.) Stiff, light olive gray (5Y 6/1), homogenous, CLAYEY SILT, SR, dry, (CL-ML), (LOESS)		
22	6 6 7 8	1.6'/2.0' (80%)			(459.9) 22.4	SP 12	
23					(22.4-23.31 ft.) Compact, pale yellowish brown (10YR 6/2), homogenous, SILTY coarse SAND, NR, dry, (SM), (ALLUVIUM) (459.0) 23.3		
24	6 5 7 9	1.1'/2.0' (55%)			(23.31-24.8 ft.) Compact, light olive gray (5Y 6/1), homogenous, SILT, NR, dry, (ML), (ALLUVIUM) (457.5) 24.8	SP 13	
25					(24.8-31.0 ft.) Compact to stiff, medium gray (N5), stratified very fine SAND and CLAYEY SILT, NR, dry, (SC), (ALLUVIUM)		
26	2 5 5 6	1.3'/2.0' (65%)				SP 14	
27							
28	4 4 5 4	1.6'/2.0' (80%)			@ 28.0 ft., 5-6 inch clayey silt layers, (0.5-2.0 inch fine SAND layers	SP 15	
29							

LOGGED BY J. MILLER
DATE 2/12/95
CHK'D BY W. HERST
JOB NO.: 943-2848
FILENAME: PZ104KS

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-104-KS
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	SHEET 3 OF 3
		DRILLING START TIME 15:40 DATE 2/12/95 / FINISH TIME 17:58 DATE 2/12/95
NORTHING: 1066993.15 DATUM EASTING: 516820.50 ELEVATION 482.3	WATER LEVEL / TIME / DATE / CASING DEPTH	
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS	
ANGLE BEARING		
SAMPLE HAMMER		

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
31	4 7 7 10	1.6'/2.0' (80%)			(24.8-31.0 Ft.) Compact to stiff, medium gray (N5), stratified very fine SAND and CLAYEY SILT, NR, dry, (SC), (ALLUVIUM) (451.3) 31.0	SP 16	
32	10 5 4 12	0.9'/2.0' (45%)			(31.0-33.1 Ft.) Compact, medium dark gray (N4), homogenous, f-m SAND, trace Silt and Clay, NR, moist, (SP), (ALLUVIUM) @ 28.0 ft., 6 inch clayey silt layer, (0.5-2.0 inch fine SAND layers (449.2) 33.1	SP 17	
34	6 17 28 52	1.6'/2.0' (80%)			(33.1-36.0 Ft.) Very stiff, light gray (N7), homogenous, SILTY CLAY, NR, dry, (CL), (WEATHERED BEDROCK) (446.3) 36.0	SP 18	
36					End of Soil Borehole Log at 36.0 ft. See PZ-104-KS Record of Drillhole for rock descriptions		
37							
38							
39							
40							
41							
42							
43							
44							

DRILLING CONTR LAYNE-WESTERN

LOGGED BY J. MILLER CHK'D BY W. HERST

DATE 2/12/95

JOB NO.: 943-2848

FILENAME: PZ104KS

RECORD OF DRILLHOLE PZ-104-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066993.15
AZIMUTH: 0

COLLAR ELEV: 462.3
E: 516820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
32	0.0-36.0 ft. See Soil Borehole Log PZ-104-KS 36.0-38.0 ft. No samples collected													
34														
36														
38	444.30 / 38.00 38.0-84.7 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), f-m grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)		444.30 / 38.00						J,PL,SM; J,PL,R (2); J,PL,R; J,PL,R,CL					5/22/95 @ 14:00 Began drilling
40				1	100 %				J,PL,R,Fe; J,PL,SM,CL					
42			439.30 / 43.00						J,PL,SM,CL; J,P,R,CL					5/22/95 @ 14:40 End of Run 1
44	44.9-45.0 ft. Clay layer 437.00 / 45.3-46.6 ft. Clay layer 45.30			2	100 %				J,I,R,Fe; J,I,R,Fe; J,PL,R,Fe; J,PL,R,CL					
46	435.70 / 46.60								J,PL,SM,CL; J,I,R,CL; J,C,R,Fe					
48														

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2846
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 516820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
48	38.0-84.7 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), f-m grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)								J,PL,SM,CL						
	48.0-54.5 ft. Stylolites common, very thinly bedded clay layers common								J,PL,SM,CL (3)						
50				2	100 %				J,PL,SM,CL; J,I,R						
52									J,PL,SM,CL						
			429.30 / 53.00						J,PL,SM,CL						5/22/95 @ 16:00 End of Run 2
	53.5-63.0 ft. Joints have approximately 1/2 in. of clay								B,PL,SM (3)						
54									J,I,R (4)						
									J,PL,SM,CL (7)						
56									J,PL,SM,CL (2); J,PL,SM,CL (4)						
									J,PL,SM,CL (2)						
58				3	100 %				J,PL,SM,CL (4)						
									J,PL,SM,CL (4)						
60									J,I,R,CL; J,PL,R						
									J,PL,SM,CL						
62	61.9-62.6 ft. Abundant argillaceous partings								J,PL,SM,CL (2)						
	62.6-62.7 ft. Clay layer		419.30 / 63.00												5/22/95 @ 17:00 End of Run 3
				4	100 %										
64															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

PROJECT: LAIDLAW/RI-FB
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 518820.50
INCLINATION: -90

ROCK TYPE

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular

P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough

Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DISCONTINUITY DATA

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
64	38.0-84.7 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), f-m grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)							J,PL,SM					
	@ 65.6 ft. Chert layer												
66													
	67.3-73.0 ft. Stylolites common							J,PL,SM,CL					
68			4	100 %				J,PL,SM					
								J,PL,SM,CL (2)					
70								J,PL,SM,CL					
72		409.30 / 73.00											5/22/95 @ 17:45 End of Run 4
	73.4-83.3 ft. Abundant argillaceous partings												
74								J,I,R					
								B,I,SM					
								J,PL,SM,CL					
76			5	100 %				J,PL,SM,CL					
								J,PL,SM,CL					
								J,PL,SM,CL					
78								J,PL,SM,CL					
	79.1-79.2 ft. Clay layer							J,PL,SM,CL (2)					
80													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 518820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
80	38.0-84.7 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), f-m grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)				J,PL,SM,CL	
			5	100 %		
82		399.30 / 83.00				5/22/95 @ 18:30 End of Run 5 Ended drilling for the day 5/23/95 @ 7:25 Began drilling
84					J,I,R,CL	
	84.7-84.9 ft. Medium light gray (N6), fine grained, SANDSTONE layer, (ST. LOUIS FORMATION)				J,I,R,CL	
86	84.9-91.4 ft. Slightly weathered, medium bedded, pale yellowish brown (10YR 6/2), f-m crystalline, medium strong, LIMESTONE (ST. LOUIS FORMATION) Calcite filled fractures, clay filled fractures 86.3-86.6 ft. Clay layer		6	83%	J,I,SM-intact	
					J,I,VR	
					J,I,R,CL	
					J,I,R	
					J,I,R	
88					J,I,R,CL	
		392.90 / 89.40				
90					Core Loss	Core Loss, possible soft rock
		391.50 / 90.70				5/23/95 @ 8:30 End of Run 6
	390.90 / 91.40 91.4-91.9 ft. Slightly weathered, thinly bedded, medium gray (N5), fine grained, medium strong, SANDSTONE, (ST. LOUIS FORMATION) Thickly laminated clay layers 390.40 / 91.90				B,PL,SM (2)	
92	91.9-103.0 ft. Slightly weathered, medium bedded, pale yellowish brown (10YR 6/2), microcrystalline to fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Abundant argillaceous layers		7	100 %	J,I,R,CL	
94					J,I,R	
96						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2849
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 516820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP w/r CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
96	91.9-103.0 ft. Slightly weathered, medium bedded, pale yellowish brown (10YR 6/2), microcrystalline to fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Abundant argillaceous layers							J,PL,R; J,PL,R,CL					
			7	100 %									
98		383.10 / 99.20											5/23/95 @ 9:00 End of Run 7
100													
	101.1-103.0 ft. Abundant chert												
102			8	80%									
		379.30 / 103.00											
104	103.0-108.0 ft. Slightly weathered, thickly laminated, medium dark gray (N4), fine grained, very weak, SILTSTONE grades to sandy SILTSTONE with depth, (ST. LOUIS FORMATION)												
106		376.20 / 106.10											Core Loss, soft rock
		374.50 / 107.80											5/23/95 @ 10:10 End of Run 8
108	108.0-118.2 ft. Fresh, medium bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Stylolites present							B,PL,SM,CL; B,PL,SM,CL (5); J,U,SM,CL					
			9	100 %									
110													
112													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

PROJECT: LA/DLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 516820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
112	108.0-118.2 ft. Fresh, medium bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Stylolites present			9	100 %				B,PL,SM,CL						
114			388.10 / 114.20												5/23/95 @ 10:40 End of Run 9
116															
118			364.10 / 118.20												
	118.2-119.8 ft. Slightly weathered, medium bedded, olive gray (5Y 4/1), medium grained, medium strong, DOLOMITE, (ST. LOUIS FORMATION)			10	100 %				J,PL,SM,CL						
			362.50 / 119.80												
120	119.8-121.7 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), medium crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION)								J,PL,SM,CL						
122	121.7-123.2 ft. Fresh, medium bedded, light olive gray (5Y 6/1), m-c grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)								J,PL,SM,CL (2)						
	123.2-133.8 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), medium crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Pyrite at contact								J,I,R						
124			358.10 / 124.20												5/23/95 @ 11:40 End of Run 10
126				11	100 %				J,PL,SM,CL						
128															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 8/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 516820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
128	123.2-133.8 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), medium crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Pyrite at contact							90	J,PL,SM,CL						
130				11	100 %			90	J,PL,SM,CL						
132								60	J,I,SM,CL						
	348.50 / 133.80														
134	133.8-135.3 ft. Slightly weathered, thinly bedded, light olive gray (5Y 6/1) fine grained, weak, SANDSTONE, (ST. LOUIS FORMATION) Thickly laminated, argillaceous layers		348.10 / 134.20					60	J,I,SM,CL						5/23/95 @ 12:20 End of Run 11
								60	B,PL,SM						
	347.00 / 135.30														
136	135.3-137.5 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic							90	J,PL,SM						
138	137.5-140.0 ft. Fresh, thinly bedded, pale yellowish brown (10YR 6/2), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Includes fine sand and silt			12	100 %			90	J,PL,SM,CL						
140	140.0-144.7 ft. Fresh, thickly bedded, pale yellowish brown (10YR 6/2), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic							90	J,PL,SM						
142								90	J,PL,SM						
144															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 516820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
144			338.10 / 144.20	12	100 %				J,PL,SM						5/23/95 @ 13:00 End of Run 12
	144.7-149.2 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), f-m grained crystalline, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)								J,PL,R						
146															
148									J,PL,R						
	149.2-152.2 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2) to medium gray (N5), fine crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolites and argillaceous partings common			13	100 %				J,PL,R						
150									B,PL,SM,CL (3)						
									B,PL,SM,CL (2)						
152	152.3-154.6 ft. Fresh, medium bedded, light olive gray (5Y 6/1), f-m grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)														
154			328.10 / 154.20												5/23/95 @ 14:10 End of Run 13
	154.6-162.3 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic, argillaceous partings								B,PL,SM (2)						
156				14	100 %				J,PL,SM						
158															
									B,I,R						
160															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 516820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
160	160.2-161.2 ft. Abundant clay zones, slightly weathered rock														
162	162.3-167.6 ft. 320.00 / 162.30 Fresh, medium bedded, grayish orange (10YR 7/4), f-m crystalline, medium strong, ARENACEOUS LIMESTONE, (SALEM FORMATION)			14	100 %										@ 162.3 ft. Inferred top of SALEM FORMATION
164			318.10 / 164.20												5/23/95 @ 15:00 End of Run 14
166															
168	167.6-171.7 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), m-c grained, medium strong, ARGILLACEOUS LIMESTONE, (SALEM FORMATION)			15	100 %										
170															
172	171.7-185.0 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), f-m crystalline, medium strong, LIMESTONE, (SALEM FORMATION)								J,I,R						
174			308.10 / 174.20												5/23/95 @ 16:00 End of Run 15
									B,PL,SM,CL (4)						
	175.3-190.1 ft. Abundant argillaceous layers and partings			16	100 %				B,PL,SM						
176															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 516820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
176	171.7-185.0 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), fine to medium crystalline, medium strong, LIMESTONE, (SALEM FORMATION)								J,PL,SM						
178	178.4-185.0 ft. Abundant chert layers and nodules														
180				16	100 %										
182									J,PL,R						
									J,PL,R						
184			298.10 / 184.20												5/23/95 @ 16:45 End of Run 16 Finished drilling for the day 5/24/95 @ 7:30 Began drilling Run 17 Water level before drilling @ 112.0 ft.
186	185.0-186.7 ft. Fresh, thickly bedded, pale yellowish brown (10YR 6/2), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (SALEM FORMATION) Chert nodules abundant														
	186.7-189.0 ft. Slightly weathered, thinly bedded, medium gray (N5), fine and medium grained, medium strong LIMESTONE, (SALEM FORMATION) Abundant argillaceous partings and layers								B,PL,SM,CL						
188				17	100 %										
									B,PL,SM,CL (2)						
190	189.0-197.2 ft. Fresh, thinly bedded to thickly bedded (with depth), pale yellowish brown (10YR 6/2), f-m grained, medium strong, ARGILLACEOUS LIMESTONE, (SALEM FORMATION) Abundant chert nodules														
192															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2948
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 8/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 516820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
192	189.0-197.2 ft. Fresh, thinly bedded to thickly bedded (with depth), pale yellowish brown (10YR 6/2), f-m grained, medium strong, ARGILLACEOUS LIMESTONE, (SALEM FORMATION) Abundant chert nodules		17	100 %									
194		288.10 / 194.20											5/24/95 @ 8:40 End of Run 17
196													
198	197.2-204.0 ft. Fresh, thickly bedded, pale yellowish brown (10YR 6/2) and medium gray (N5), fine grained, medium strong, LIMESTONE, (SALEM FORMATION) Abundant large, strong nodules and layers of chert		18	100 %			90	J,PL,SM,CL					
							90	J,PL,SM,CL					
							90	J,PL,SM					
							90	J,I,R					
							90	J,PL,R					
200		281.70 / 200.60											5/24/95 @ 10:15 End of Run 18
202													
204	204.0-222.7 ft. Fresh, medium bedded, grayish orange (10YR 7/4), medium crystalline, medium strong, LIMESTONE, (SALEM FORMATION) Silicified zones and abundant chert		19	99%			90	J,PL,SM (3)					
206													
							90	J,PL,SM					
208													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 8/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068983.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 518620.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (60 80 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR MW HW CW)	STRENGTH INDEX (R6 R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 30 R2 150 R3 300 R4 600 R5 1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
208	204.0-222.7 ft. Fresh, medium bedded, grayish orange (10YR 7/4), medium crystalline, medium strong, LIMESTONE, (SALEM FORMATION) Silicified zones and abundant chert			19	99%				J,PL,SM						
			273.10						J,PL,SM (2)						5/24/95 @ 11:40 End of Run 19
			209.20						J,PL,SM (2)						
210				20	49%										
									J,I,R						
									J,PL,SM (2)						
	270.60		270.60												
	211.50		211.50												
212									Core Loss						Core Loss
			268.40												
214			213.90												Core Loss, washed out 5/24/95 @ 13:20 End of Run 20
									B,PL,SM (2)						
216				21	92%										
218															
			263.50												
			218.60												
			263.10												Core Loss (clay ?) 5/24/95 @ 14:00 End of Run 21
			219.20												
220															
				22	100 %										
222															
	222.7-228.0 ft. Slightly weathered, medium bedded, grayish orange (10YR 7/4), coarse crystalline, weak, FOSSILIFEROUS LIMESTONE, (SALEM FORMATION) Highly silicious, argillaceous														> 10 mechanical breaks/foot
224															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 516820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
224	222.7-228.0 ft. Slightly weathered, medium bedded, grayish orange (10YR 7/4), coarse crystalline, weak, FOSSILIFEROUS LIMESTONE, (SALEM FORMATION) Highly silicious, argillaceous					
226			22	100 %	J,PL,R	
228	228.0-230.7 ft. Slightly weathered, medium bedded, grayish orange (10YR 7/4), f-m crystalline, medium strong, LIMESTONE, (SALEM FORMATION)	253.10 / 228.20				5/24/95 @ 15:30 End of Run 22
230	230.7-238.9 ft. Slightly weathered, medium bedded, grayish orange (10YR 7/4), m-c crystalline, medium strong, LIMESTONE, (SALEM FORMATION) Argillaceous, silicious				F,U,R (2)	
232						
234			23	100 %	J,PL,R	
236					J,PL,R (2)	236.0-237.0 ft. Additional mechanical breaks
238					J,PL,R	
	238.9-247.4 ft. Slightly weathered, medium bedded, grayish orange (10YR 7/4), m-c crystalline, medium strong, LIMESTONE, (SALEM FORMATION) Argillaceous, silicious, includes fossiliferous zones	243.10 / 239.20	24	100 %	B,PL,SM,CL	5/24/95 @ 16:00 End of Run 23
240						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 516820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
240	238.9-247.7 ft. Slightly weathered, medium bedded, grayish orange (10YR 7/4), m-c crystalline, medium strong, LIMESTONE, (SALEM FORMATION) Argillaceous, silicious, includes fossiliferous zones														
242															
244				24	100 %										
246									J,PL,R						
248	247.4-256.8 ft. Fresh, medium bedded, light to medium gray (N6 to N5), m-c crystalline, strong, FOSSILIFEROUS LIMESTONE, (SALEM FORMATION)														
			233.10 / 249.20												5/24/95 @ 16:45 End of Run 24
250															
252				25	100 %										
254															
256															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2548
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 8/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066983.15
AZIMUTH: 0

COLLAR ELEV: 462.3
E: 516820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
256	226.00								
	256.3-258.8 ft. 258.30 Fresh, thinly bedded, medium dark gray (N4), fine grained, medium strong, SILTSTONE, (WARSAW FORMATION)		25	100 %				B,PL,SM,CL (2)	256.3 ft. Top of WARSAW FORMATION encountered
258	223.50								
	258.8-260.8 ft. 258.80 Fresh, medium bedded, medium gray (N5), m-c crystalline, strong, FOSSILIFEROUS LIMESTONE, (WARSAW FORMATION) Argillaceous, silicious	223.10 259.20							5/24/95 @ 17:30 End of Run 25
260	221.50								5/26/95 6 in steel casing installed to 257.0 ft. in 9 7/8 in. borehole and sealed with cement Core drilling resumed 6/1/95 @ 11:00
	260.8-264.6 ft. 260.80 Fresh, thinly bedded, olive gray (5Y 4/1), very fine grained, medium strong, SILTSTONE, (WARSAW FORMATION)		26	100 %					
262									
264	217.70	218.10 264.20							
	264.6-267.2 ft. 264.60 Fresh, thinly bedded, medium dark gray (N4), coarse crystalline, strong, DOLOMITIC LIMESTONE, (WARSAW FORMATION) Chert nodules common (<5 mm.)							B,PL,SM (2)	
266								J,I,R	
	267.2-271.9 ft. Fresh, medium bedded, olive gray (5Y 4/1), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (WARSAW FORMATION)		27	100 %				J,U,SM	
268								J,PL,SM	
270									
	271.9-274.0 ft. Fresh, thinly bedded, medium dark gray (N4), coarse crystalline, strong, DOLOMITIC LIMESTONE, (WARSAW FORMATION) Chert nodules common (<5 mm.)								
272									

WEATHERING INDEX: SW FR, MW, HW, CW
STRENGTH INDEX: R6, R5, R4, R3, R2, R1
POINT LOAD INDEX (psi): R1 30, R2 150, R3 300, R4 600, R5 1500, R6
TEST ORIENTATION

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066993.15
AZIMUTH: 0

COLLAR ELEV: 462.3
E: 518820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE / DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (80 60 40 20)	FRACTURES (2 4 6 8 PER FOOT 10)	DISCONTINUITY DATA: DIP WRT CORE AXIS (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR HW MW CW)	STRENGTH INDEX (R6 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 30 R2 150 R3 300 R4 600 R5 1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
272	271.9-274.0 ft. Fresh, thinly bedded, medium dark gray (N4), coarse crystalline, strong, DOLOMITIC LIMESTONE, (WARSAW FORMATION) Chert nodules common (<5 mm.)			27	100 %				J,PL,SM						
274	274.0-279.9 ft. Fresh, thin to medium bedded, olive gray (5Y 4/1), very fine grained, medium strong, ARGILLACEOUS LIMESTONE, (WARSAW FORMATION) Porous, (<1 mm. open vugs) 274.4-275.5 ft. Several partially calcite crystal filled voids (<2 in.)		208.10 / 274.20						J,C,SM; J,I,R; J,I,R; J,I,R (4)						274.4-275.5 ft. Possible high porosity zone
276															
278				28	100 %				B,I,SM						
280	279.9-295.7 ft. Fresh, medium bedded, light olive gray (5Y 6/1), coarse crystalline, medium strong to strong, DOLOMITIC LIMESTONE, (WARSAW FORMATION) Abundant chert nodules (<2 mm.), fossiliferous with some silicified zones, stylolitic								J,I,VR; J,PL,SM,Fe						
282															
284	284.2-285.4 ft. Olive gray (5Y 4/1), Argillaceous Limestone layer		198.10 / 284.20												6/1/95 @ 15:25 End of Run 28
286				29	100 %				J,PL,SM						
288															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1086993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 516820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (60 80 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0 30 60 90)	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR MW HW CW)	STRENGTH INDEX (R6 R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 30 R2 150 R3 300 R4 600 R5 1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
288	279.9-295.7 ft. Fresh, medium bedded, light olive gray (5Y 6/1), coarse crystalline, medium strong to strong, DOLOMITIC LIMESTONE, (WARSAW FORMATION) Abundant chert nodules (<2 mm.) fossiliferous with some silicified zones, stylolitic														
290				29	100 %										
292															
294			188.10 / 294.20												6/1/95 @ 16:20 End of Run 29
296	295.7-303.7 ft. Fresh, thinly bedded, medium dark gray (N4), very fine grained, medium strong, ARGILLACEOUS LIMESTONE, (WARSAW FORMATION)														
298	297.5-299.3 ft. Partially silicified, porous (open vugs <3 mm.)								● J,PL,SM						
300	299.3-303.7 ft. Rock becomes weak due to high clay content			30	100 %				● J,PL,SM,CL						
302															
304	303.7-305.0 ft. Fresh, thinly bedded, medium gray (N5), coarse crystalline, medium strong, LIMESTONE, (WARSAW FORMATION)														

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 516820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
304		178.10 / 304.20	30	100 %									6/1/95 @ 17:00 End of Run 30 Stop drilling 6/2/95 @ 8:30 Begin Run 31
	177.30 / 305.00 305.0-309.7 ft. Fresh, thinly bedded, medium dark gray (N4), very fine grained, weak, SILTSTONE, (WARSAW FORMATION)												
306													
308			31	100 %				B,PL,SM					
	172.60 / 309.70 309.7-313.5 ft. Fresh, thinly bedded, medium gray (N5), m-c crystalline, medium strong, LIMESTONE, (WARSAW FORMATION) Numerous clay partings, stylolitic												
310								B,PL,SM					
312								B,PL,SM,CL					
	313.5-322.0 ft. Fresh, thinly to medium bedded, light olive gray (5Y 6/1) to dark gray (N3), very fine to medium grained medium strong, alternating layers of ARGILLACEOUS LIMESTONE and SILTSTONE (2-6 in. thick) (WARSAW FORMATION)							B,U,SM,CL					
314	168.10 / 314.20	168.10 / 314.20											6/2/95 @ 11:30 End of Run 31 Slow drilling, a lot of rod wobble
	167.30 / 315.00							B,PL,SM,CL					
316	166.30 / 316.00												
	165.30 / 317.00		32	98%				B,PL,SM (4)					
318	164.30 / 318.00												
	163.30 / 319.00												
320	162.30 / 320.00												

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 516820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
320	162.30 / 320.00 313.5-322.0 ft. Fresh, thinly to medium bedded, light olive gray (5Y 6/1) to dark gray (N3), very fine to medium grained; medium strong, alternating layers of ARGILLACEOUS LIMESTONE and SILTSTONE (2-6 in. thick) (WARSAW FORMATION) 161.30 / 321.00; 160.30 / 322.00							B,I,R					
322	322.0-347.4 ft. Fresh, thickly bedded, dark gray (N3), very fine grained, medium strong, SILTSTONE, (WARSAW FORMATION)		32	95%									
324		158.10 / 324.20											6/2/95 @ 12:40 End Run 32
326													
328			33	100 %				J,PL,SM,CL					
330													
332		148.10 / 333.20											6/2/95 @ 14:00 End of Run 33
334			34	100 %									
338													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 818820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
336	322.0-347.4 ft. Fresh, thickly bedded, dark gray (N3), very fine grained, medium strong, SILTSTONE, (WARSAW FORMATION)														
				34	100 %										
338	338.0-347.2 ft. Siltstone becomes weak														
			143.10 / 339.20												
	339.3-339.5 ft. Soft, medium gray (N5), Clay seam														
340															
342															
				35	100 %										
344															
346															
	134.90 / 347.40														
348	347.4-358.3 ft. Fresh, thinly bedded, medium dark gray (N4), fine crystalline, medium strong, DOLOMITIC LIMESTONE, (WARSAW FORMATION) Argillaceous, numerous shaley partings, some thin interbeds of Siltstone (<4 in. thick), fossiliferous, coarse chert nodules common		134.10 / 348.20												
350				36	100 %										
352															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 516820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (80 60 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR MW HW CW)	STRENGTH INDEX (R5 R6 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 30 R2 150 R3 300 R4 600 R5 1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
352	347.4-358.3 ft. Fresh, thinly bedded, medium dark gray (N4), fine crystalline, medium strong. DOLOMITIC LIMESTONE, (WARSAW FORMATION) Argillaceous, numerous shaley partings, some thin interbeds of Siltstone (<4 in. thick), fossiliferous, coarse chert nodules common														
354				36	100 %										
356															
358			124.00 / 358.30												@ 358.3 ft. Inferred top of KEOKUK FORMATION Drilling rate slows significantly due to chert layers 6/2/95 @ 17:00 End of Run 36
360	358.3-384.7 ft. Fresh, thinly bedded, medium gray (N5), alternating fine crystalline and coarse crystalline layers, medium strong to strong, ARGILLACEOUS LIMESTONE, (KEOKUK FORMATION) Some zones fossiliferous, abundant medium bluish gray (5B 5/1), chert layers, coarse grained chert nodules common, thinly laminated, shaley partings common, trace disseminated pyrite								J,I,R						
362				37	100 %										
364															
366															
368															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
E: 516820.50
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
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368	357.7-384.7 ft. Fresh, thinly bedded, medium gray (N5), alternating fine crystalline and coarse crystalline layers, medium strong to strong, ARGILLACEOUS LIMESTONE, (KEOKUK FORMATION) Some zones fossiliferous, abundant medium bluish gray (5B 5/1), chert layers, coarse grained chert nodules common, thinly laminated, shaley partings, common, trace disseminated pyrite		114.00 / 368.30	37	100 %										6/2/95 @ 18:00 End of Run 37
370				38	98%										
372															
374			108.00 / 374.30												6/2/95 @ 19:15 End of Run 38 Stop drilling 6/3/95 @ 7:00 Drilling resumed
376				39	100 %										
378	Below 378.5 ft. Only occasional shaley partings								B,U,SM,CL						
			103.00 / 379.30												6/3895 @ 13:30 End of Run 39
380															
382				40	100 %										
384															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

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LOCATION: BRIDGETON, MO

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COLLAR ELEV: 482.3
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ROCK TYPE: J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
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DISCONTINUITY DATA

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
384			98.00 / 384.30	40	100 %										6/3/95 @ 15:00 End of Run 40 Stop drilling 6/4/95 @ 8:00 Drilling resumed
	384.7-393.8 ft. Slightly weathered, thinly bedded, pinkish gray (5Y 8/1) to light olive gray (5Y 6/1), f-m crystalline, medium strong to strong, LIMESTONE, (KEOKUK FORMATION) Some zones coarse grained, chert layers common (<6 in.), stylolitic, some zones silicified														
386															
388				41	100 %										
390															
392	@ 392.0 ft. Three open vugs with quartz crystals (<1 in. dia.)														
	393.8-406.5 ft. Moderate to highly weathered, thinly bedded, light gray (N7), f-c crystalline, medium strong to weak, SILICIFIED LIMESTONE, (KEOKUK FORMATION) Chert nodules and layers common, stylolitic		88.50 / 393.80												
394															
396				42	94%										
398	398.5-399.1 ft. Highly weathered, very porous, (open vugs <5 mm.), weak rock														
400															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-104-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/22/95 - 6/4/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066993.15
AZIMUTH: 0

COLLAR ELEV: 482.3
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INCLINATION: -90

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DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
400	393.8-408.5 ft. Moderate to highly weathered, thinly bedded, light gray (N7), f-c crystalline, medium strong to weak, SILICIFIED LIMESTONE, (KEOKUK FORMATION) Chert nodules and layers common, stylolitic			42	94%	85 40 20	2 4 5 8 10	0 30 60 90			SW FR MW HW CW	R6 R5 R4 R3 R2 R1	R1 30 R2 150 R3 300 R4 600 R5 1500 R6		
402			79.10												
			403.20												Core Loss in highly weathered rock 6/4/95 @ 14:10 End Run 42
			78.50												
404	@ 403.8 ft. Highly weathered, very porous, weak rock		403.80												
406				43	96%										
408															
	73.50		73.50												6/4/95 @ 14:45 Drilling completed
	End of Record of Drillhole at 408.8 ft. 408.80		408.80												
410															
412															
414															
416															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

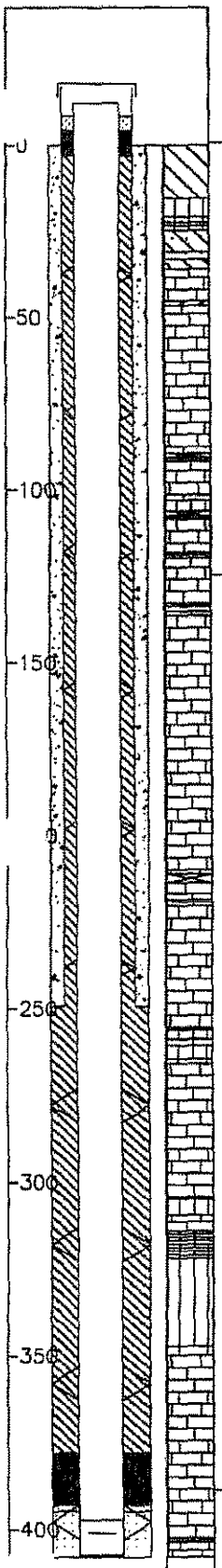
LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 7/13/95

Golder Associates

Well No. PZ-104-KS

Boring No. X-Ref: PZ-104-KS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1066993 ft. Easting: 516821 ft.

Elevation Ground Level 482.3 ft. NGVD

Top of PVC Casing 484.04 ft. NGVD

Drilling Summary:

Total Depth 408.0 ft.

Borehole Diameter 10 in. (0.0-249.0 ft.) 5 7/8 in. (249.0-408.0 ft.)

Casing Stickup Height 1.72 ft.

Driller Layne-Western, St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. and 10 in. Button Bits

Drilling Fluid Auger-None, NX Core Water, Air Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75 (augers)	2/21/95	15:40	2/21/95	17:58
CME 75 (core)	5/22/95	14:00	5/22/95	14:45
Schramm Rotary	6/7/95	7:15	6/7/95	11:30
Geophys.Logging:	6/8/95	10:30	6/8/95	12:15
Casing:				
2" PVC	6/19/95	9:30	6/19/95	11:00
6" Steel	5/25/95	12:30	5/25/95	13:30
Filter Placement:	6/19/95	11:05	6/19/95	13:00
Cementing:				
Development				
Bentonite Grout	6/19/95	13:15	6/19/95	17:00
Bentonite Seal	6/19/95	13:00	6/19/95	13:15

Well Design & Specifications

Basis: Geologic Log X Geophysical Log X

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.72	-	397.37	C1	484.04	-	84.95
397.37	-	407.17	S1	84.95	-	75.15
407.17	-	407.50	C2	75.15	-	74.82
+ 1.00	-	249.00	C3	483.30	-	233.32
	-				-	
	-				-	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.) (C3-see comments)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 395.0-408.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 393.0-395.0 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-378.0 ft., Neat cement, 3.0-249.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 378.0-393.0 ft.

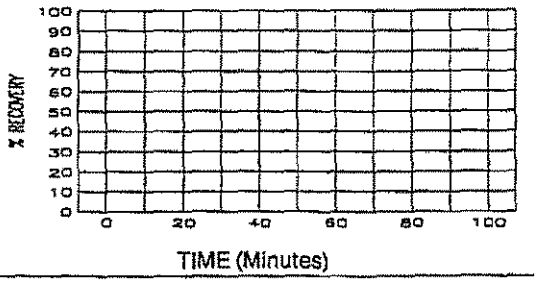
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments: Surface Casing C3: 6 1/8 in. ID / 6 5/8 in. OD Steel Casing

Supervised by B. Tilton

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ104KS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122504	CHECK NO.
ROUTE	TRANSMITTAL NO
STATE WELL NUMBER	CROSS REFERENCE NO.
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME: LAIDLAW BRIDGETON SANITARY LANDFILL		WELL NUMBER: ~~XXXXXXXX~~ PZ-104-KS	
SITE ADDRESS: ST. CHARLES ROCK RD	CITY: BRIDGETON	STATE: MO	ZIP CODE: 63044
NAME: LAIDLAW WASTE SYSTEMS, INC.		TELEPHONE: 314-241-3710	
ADDRESS: 1838 N. BROADWAY	CITY: ST. LOUIS	STATE: MO	ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

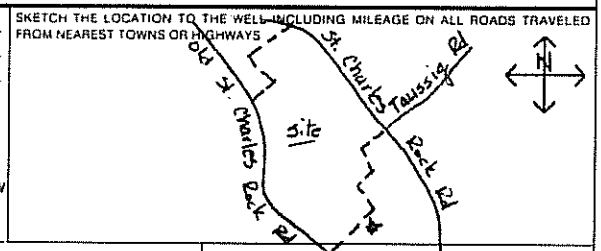
COUNTY: ST. LOUIS
ELEVATION: 482.32
AREA NO.:

SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST ¼

SEC. ____ TWN. 47 N,RNG 5 (E) OR W

LAT. 38 ° 45 ' 50 " LONG. 90 ° 36 ' 27 "

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN CO., INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN CO., INC.

TYPE OF INSTALLATION
☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT
484.04

MEASURING POINT IS
☒ TOP OF RISER PIPE
☐ OTHER

DRILLING EQUIPMENT
☒ AIR ROTARY ☒ AUGER TYPE 6¼ H.S.A.
☐ REVERSE ROTARY ☐ OTHER

CENTRALIZERS USED
☒ YES, AT 9 TOTAL
☒ STAINLESS STEEL
☐ OTHER
☐ NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
6-19-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR) Michael P. Vogl
PERMIT NUMBER 001256 WM DATE 7-07-95

SIGNATURE (DRILLING CONTRACTOR) Michael P. Vogl
PERMIT NUMBER 001256 WM DATE 7-07-95

NOTE: Record the fraction of a foot in decimal, not in inches

Top of Riser Elevation: 484.04

LOCKING CAP - (Y) N (Circle one)
CAP VENT - Y / (N) (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8" x 5" x 5'
Bore Hole Diameter: 9 7/8"
WEEP HOLE - Y / N (Circle one)

Ground Surface Elevation: 482.32 Ft

	Feet from Surface	Description of Formation
Information in this column to be supplied in the Feet from Surface column		0-37 No sampling
Depth to bottom of Protective Casing Seal:	3.0	
		37-100 Limestone
		100-105 Shale
		105-250 Limestone
		250-253 Shale
		253-256 Limestone
		256-264 Shale
		264-266 Limestone
Depth to Base of Annular Seal:	378.0	266-276 Dolomite
		276-297 Limestone
		297-304 Shale
Depth to Base of Bentonite Seal:	343.0	304-317 Limestone
Depth to Base of Secondary Filter Pack:	345.0	317-342 Shale
		342-406 Limestone
Depth to Top of the Screen:	347.5	
Depth to Bottom of the Screen:	407.5	
Plug Back Total Depth		
Original Total Depth:	408.0	

PROTECTIVE CASING SEAL
Type: ☒ Concrete ☐ Cement Slurry

RISER PIPE
Length: 349.2'
Diameter: 2"
Type of Material: SCH 80 PVC

BOREHOLE DIAMETER: 9 7/8 In.

ANNULAR SEAL
Type: ☒ Bentonite Slurry 245-378
☒ Cement Slurry 3-245
☐ Non Slurry Bentonite

BENTONITE SEAL
Type: ☒ Bentonite Slurry
☐ Non Slurry Bentonite
Length of Seal: 15 Ft.

SECONDARY FILTER PACK (Optional)
Type: ☒ Sand ☐ Manufactured
Grain Size: < 50
Length: 2.0'

PRIMARY FILTER PACK
Type: ☒ Sand ☐ Manufactured
Grain Size: 16-35
Length: 13.0'

WELL SCREEN
Length: 10'
Slot Size: 0.010
Type: SCH 80 PVC

SUMP DETAILS
Length: 0.5 Ft.
Diameter: 2 In.
Type: PVC

TYPE OF BACKFILL: SAND

MO 780-1415 (2-90)

DISTRIBUTION: WHITE-DIVISION CANARY-MONITORING WELL CONTRACTOR PINK-OWNER

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-105-SS
		SHEET 1 OF 3
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	DRILLING START TIME 14:20 DATE 5/19/95; FINISH TIME 17:15 DATE 5/19/95
NORTHING: 1066421.35 DATUM EASTING: 516230.23 ELEVATION 481.2	WATER LEVEL / TIME / DATE / CASING DEPTH	
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS Grassy field	
ANGLE -90 BEARING NA		
SAMPLE HAMMER		

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1	1 3 3 2	1.3'/2.0' (65%)			(0.0-4.4 ft.) Firm, moderate yellowish brown (10YR 5/4), SILT, with trace fine Sand, NR, moist, (ML), (LOESS)	SP 1	
2	2 2 3 2	1.8'/2.0' (90%)				SP 2	
4	2 3 5 7	2.0'/2.0' (100%)			(476.8) 4.4 (4.4-18.5 ft.) Very soft to stiff, moderate yellowish brown (10YR 5/2), SILTY CLAY, NR, moist, (CL), (LOESS)	SP 3	
6	1 2 4 5	1.5'/2.0' (75%)			From 7.0-16.0 ft., grades to include trace fine sand, color grades to light olive gray (5Y 6/1) and moderate yellowish brown (10YR 5/2) (mottled)	SP 4	
8	0 2 3 2	2.0'/2.0' (100%)				SP 5	
10	1 2 1 2	2.0'/2.0' (100%)				SP 6	
12	0 0 1 3	2.0'/2.0' (100%)				SP 7	
14	2 2 5 8	1.9'/2.0' (95%)				SP 8	

DRILLING CONTR LAYNE-WESTERN

LOGGED BY D. ALLDWAY CHK'D BY W. HERST

DATE 7/14/95

JOB NO.: 943-2848

FILENAME: PZ105SS

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-105-SS
		SHEET 2 OF 3
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	DRILLING

					START	FINISH
WATER LEVEL					TIME	TIME
TIME					14:20	17:15
DATE					DATE	DATE
CASING DEPTH					5/19/95	5/19/95

NORTHING: 1066421.35
DATUM EASTING: 516230.23 ELEVATION 481.2

DRILL RIG CME 75 - TRUCK MOUNT
SURFACE CONDITIONS Grassy field
ANGLE -90 BEARING NA
SAMPLE HAMMER

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
16	1 4 7 8	1.9' / 2.0' (95%)			from 16.0-18.5 ft., grades to little fine sand, color grades to medium light gray (N6)	SP 8	
17						SP 9	
18	5 5 8 9	1.5' / 2.0' (75%)			(18.5-20.5 ft.) Stiff, olive gray (5Y 4/1), fine SANDY CLAY, NR, wet, (CL), (ALLUVIUM)	SP 10	
19							
20	3 6 9 13	1.7' / 2.0' (85%)			(460.7) 20.5 (20.5-27.1 ft.) Compact, medium gray (N5), f-m poorly graded SAND, NR, wet, (SP), (ALLUVIUM)	SP 11	
21							
22	1 4 8 9	1.3' / 2.0' (65%)			@ 22.5 ft., grades to less silt	SP 12	
23							
24	4 8 18 19	1.5' / 2.0' (75%)			@ 24.7 ft., grades to more silt	SP 13	
25							
26	1 4 5 9	1.3' / 2.0' (65%)				SP 14	
27					(454.1) 27.1 (27.1-29.6 ft.) Loose to compact, medium gray (N5), SILT with little fine Sand, NR, wet, (ML), (ALLUVIUM)		
28	1 1 3 12	1.7' / 2.0' (85%)				SP 15	
29					(451.6) 29.6 (29.6-33.8 ft.) Very loose to dense, medium gray (N5), f-m poorly graded SAND, NR, wet, (SP), (ALLUVIUM)		

DRILLING CONTR LAYNE-WESTERN

LOGGED BY D. ALLOWAY

DATE 7/14/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ105SS

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-105-SS
		SHEET 3 OF 3
LAIDLAW/OU2 RI-FS/MD WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	DRILLING START TIME 14:20 DATE 5/19/95 / FINISH TIME 17:15 DATE 5/19/95
	WATER LEVEL / TIME / DATE / CASING DEPTH	
NORTHING: 1066421.35 DATUM EASTING: 516230.23 ELEVATION 481.2		
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS Grassy field	
ANGLE -90 BEARING NA		
SAMPLE HAMMER		

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
31	2 8 18 29	2.0' 2.0' (100%)			(29.6-33.8 ft.) Very loose to dense, medium gray (N5), f-m poorly graded SAND, NR, wet, (SP), (ALLUVIUM)	SP 16	
32 33	1 10 37 33	2.0' 2.0' (100%)				SP 17	
34	45 50/3'	0.5' 1.0' (50%)			(33.8-35.0 ft.) Very dense, light olive gray (5Y 6/1), LIMESTONE GRAVEL, SR, wet, (WEATHERED LIMESTONE BEDROCK) (446.2) 35.0	SP 18	
35					End of Soil Borehole Log at 35.0 ft. See PZ-105-SS Record of Drillhole for rock descriptions		
36							
37							
38							
39							
40							
41							
42							
43							
44							

DRILLING CONTR LAYNE-WESTERN

LOGGED BY D. ALLOWAY CHK'D BY V. HERST

DATE 7/14/95

JOB NO.: 943-2848

FILENAME: PZ105SS

RECORD OF DRILLHOLE PZ-105-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NS Core & water
DRILLING DATE: 5/20/95 - 5/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066421.35
AZIMUTH: 0

COLLAR ELEV: 481.2
E: 516230.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
32	0.0-35.0 ft. See Soil Borehole Log PZ-105-SS					
34	35.0-39.0 ft. Slightly weathered, thinly bedded, medium light gray (N6), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) 446.20	446.20				
	35.2-35.9 ft. 35.20 Dark yellowish orange (10YR 6/6), Claystone layer	35.00				5/20/95 @ 8:20 Began drilling Run 1
36			1	73%		
38					Core Loss	
	39.0-52.9 ft. Slightly weathered, medium bedded, medium light gray (N6), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Clay filled joints and layers of Claystone	442.20 39.00				5/20/95 @ 9:00 End of Run 1
40			2	77%		
42		438.30			Core Loss	5/20/95 @ 9:45 End of Run 2
		42.90				
44					J,I,VR,Fe (2)	43.0-44.0 ft. Healed seam at 0°
			3	93%		
46					J,PL,R,CL (3)	
48						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-105-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NS Core & water
DRILLING DATE: 5/20/95 - 5/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068421.35
AZIMUTH: 0

COLLAR ELEV: 481.2
E: 516230.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
48	39.0-52.9 ft. Slightly weathered, medium bedded, medium light gray (N6), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)		3	93%	J,PL,R,CL	
		432.20 / 49.00			Core Loss	5/20/95 @ 10:20 End of Run 3
	49.0 ft. Color grades to pale yellowish brown (10YR 6/2)					
50					J,P,R (2)	
	50.5 ft. Pyrite present				J,P,R (2)	
	51.0-51.2 ft. Sandstone layer		4	100 %		
52	51.9-52.3 ft. Sandstone layer					
	52.9-65.2 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), fine to microcrystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION)	428.30 / 52.90			J,PL,VR	
54	Zones of thin clay or siliceous laminations				J,PL,VR	
	54.6-54.8 ft. Chert layer					
56			5	98%		
					J,I,R,CL	
58	57.8-57.9 ft. Clay layer					
	57.9-58.6 ft. Sandstone layer					
		422.20 / 59.00				5/20/95 @ 12:00 End of Run 5
60					J,PL,R	
					J,C,SM,CL	
			6	100 %	J,PL,R (3)	
62					J,PL,R (2)	
					J,PL,R	
64						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 5/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-105-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NS Core & water
DRILLING DATE: 5/20/95 - 5/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066421.35
AZIMUTH: 0

COLLAR ELEV: 481.2
E: 518230.23
INCLINATION: -90

ROCK TYPE: J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD (80 60 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR MW HW CW)	STRENGTH INDEX (R5 R6 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 10 R2 150 R3 300 R4 600 R5 1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
64	52.9-65.2 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), fine to microcrystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) 416.00								J,PL,R						
									J,PL,R						
	65.2-79.0 ft. 65.20 Fresh, medium bedded, medium gray (N5), microcrystalline to fine grained, medium strong, ARENACEOUS DOLOMITE, (ST. LOUIS FORMATION) Pyrite and calcite filled fractures								J,PL,R (2)						
66				6	100 %										
68									J,I,R (2)						5/20/95 @ 13:00 End of Run 6
			412.20 69.00												
									J,ST,SM						
70															
72															
									J,ST,R						
74				7	100 %										
									J,I,R						
76															
	77.6-78.5 ft. Clayey layer														
78															
	79.0-80.3 ft. 402.20 79.00 Fresh, thinly bedded, light olive gray (5Y 6/1), fine grained, medium strong, SANDSTONE, (ST. LOUIS FORMATION) Includes thickly laminated clay layers		402.20 79.00	8	99%										5/20/95 @ 14:00 End of Run 7

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 9/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-105-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NS Core & water
DRILLING DATE: 5/20/95 - 5/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068421.35
AZIMUTH: 0

COLLAR ELEV: 481.2
E: 518230.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

Depth Scale (Feet)	Rock Type Description	Elev / Depth (Ft)	Run No	Core Recovery	RQD	Fractures per Foot	Dip wrt Core Axis	Type and Surface Description	Weathering Index	Strength Index	Point Load Index (psi)	Test Orientation	Notes, Water Levels, Instrumentation
80	400.90 / 80.30												
	80.3-89.3 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), fine to medium crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION)							J,I,R					
								J,I,SM,CL					
82								J,ST,CL (2)					
								J,I,R,CL (2)					
84	84.0-86.8 ft. Abundant chert, some clay layers (green clay)		8	99%									
								J,PL,SM					
								J,PL,SM,CL					
86								J,PL,SM,CL					86.7-86.8 ft. Broken zone
								J,PL,SM,CL					
88								J,PL,SM,CL					
		392.20 / 89.00											
	89.3-118.6 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) 89.3-92.7 ft. Silicified							J,I,R					5/20/95 @ 15:00 End of Run 8
90													
92			9	100 %				J,PL,SM,CL					
94													
96													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 8/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-105-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NS Core & water
DRILLING DATE: 5/20/95 - 5/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066421.35
AZIMUTH: 0

COLLAR ELEV: 481.2
E: 516230.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
96	89.3-118.6 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)					
			9	100 %	J,PL,SM	
98					J,PL,SM	
		382.20 / 99.00				5/20/95 @ 15:30 End of Run 9
100					J,PL,SM	
	101.5-105.0 ft. Silicified					
102						
					F,PL,SM	
104			10	100 %	J,C,SM,CL	
	105.0-115.5 ft. Scattered stylolites, chert					
106					J,PL,SM,CL	
					J,PL,SM,CL	
108		372.20 / 109.00				5/20/95 @ 16:15 End of Run 10
					J,PL,R,CL	
110			11	100 %	J,PL,R,CL	
					J,PL,SM	
112						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-105-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NS Core & water
DRILLING DATE: 5/20/95 - 5/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066421.35
AZIMUTH: 0

COLLAR ELEV: 461.2
E: 516230.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

Depth (Feet)	Rock Type / Description	Graphic Log	Elev / Depth (Ft)	Run No	Core Recovery	RQD	Fractures per Foot	Discontinuity Data: Dip wrt Core Axis	Type and Surface Description	Graphic Log	Weathering Index	Strength Index	Point Load Index (psi)	Test Orientation	Notes, Water Levels, Instrumentation
112	89.3-118.6 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)								J,PL,SM						
									J,PL,SM (3)						
114									J,ST,R						
				11	100 %				J,PL,SM,CL (2)						
116															
									J,PL,SM						
118															5/20/95 @ 17:15 End of Run 11 Ended drilling for the day 5/21/95 @ 7:30 Resume drilling
	118.6-131.5 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), microcrystalline, medium strong, LIMESTONE, fossiliferous, (ST. LOUIS FORMATION)		362.20 / 119.00						J,PL,SM,CL						
120	120.5-121.4 ft. Claystone layer														
122	123.0 ft. Calcite crystals on fracture			12	100 %				B,PL,SM,CL J,PL,R						
124	123.7-125.3 ft. ARGILLACEOUS LIMESTONE 124.0 ft. Calcite crystals on fractures														
126									B,PL,SM,CL						
									B,PL,SM,CL						
128	128.0 ft. Calcite crystals on fractures														

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-105-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NS Core & water
DRILLING DATE: 5/20/95 - 5/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066421.35
AZIMUTH: 0

COLLAR ELEV: 481.2
E: 516230.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
128	128.0 ft. Calcite crystals on fractures		12	100 %				J,PL,R; B,PL,SM,CL					5/21/95 @ 8:30 End of Run 12
		352.20 / 129.00											
130	129.5 ft. Color grades to light olive gray (5Y 5/2)							B,PL,SM,CL (2)					
132	131.5-141.6 ft. Fresh, medium bedded, light olive gray (5Y 5/2), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)												
134			13	100 %									
136								J,PL,SM,CL					
138								J,PL,SM,CL					
		342.20 / 139.00											5/21/95 @ 9:40 End of Run 13
140													
142	141.6-148.7 ft. Fresh, medium bedded, pale yellowish brown (10Y 6/2) to light olive gray (5Y 5/2), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic, clay filled fractures		14	100 %				J,PL,SM,CL; J,PL,SM,CL					
144													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-105-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NS Core & water
DRILLING DATE: 5/20/95 - 5/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066421.35
AZIMUTH: 0

COLLAR ELEV: 481.2
E: 518230.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (FEET)	DESCRIPTION (ROCK TYPE)	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
144	141.6-148.7 ft. Fresh, medium bedded, pale yellowish brown (10Y 6/2) to light olive gray (5Y 5/2), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic, clay filled fractures								J,PL,SM,CL (2)						
146	146.0-147.0 ft. Clay filled vugs and fractures abundant			14	100 %				J,PL,SM,CL; J,PL,SM,CL						
148	148.7-149.0 ft. Slightly weathered, thinly bedded, grayish orange (10YR 7/4), fine grained, medium strong DOLOMITE, very shallow vugs, (ST. LOUIS FORMATION) 332.50 / 148.70 / 332.20		332.20						J,PL,SM,CL						5/21/95 @ 10:30 End of drilling
	End of Record of Drillhole at 149.00 ft.		149.00												
150															
152															
154															
156															
158															
160															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

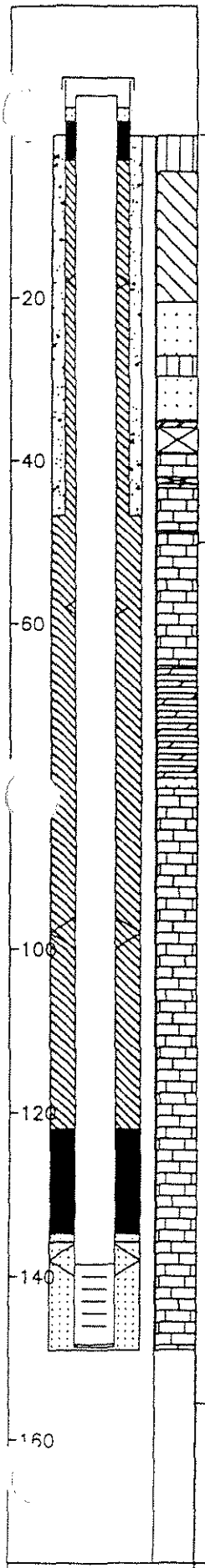
LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/13/95

Golder Associates

Well No. PZ-105-SS

Boring No. X-Ref: PZ-105-SS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1066421 ft. Easting: 516230 ft.

Elevation Ground Level 481.2 ft. NGVD

Top of PVC Casing 483.61 ft. NGVD

Drilling Summary:

Total Depth 149.0 ft.

Borehole Diameter 9 7/8 in. (0.0-45.0 ft.) 5 7/8 in. (45.0-149.0 ft.)

Casing Stickup Height 2.39 ft.

Driller Layne-Western, St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit and 7 7/8 in. Tricone Bit

Drilling Fluid Auger-None, NX Core Water, Air and Mud Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	5/19/95	14:20	5/21/95	10:30
Schramm Rotary	5/24/95	7:45	5/24/95	12:00
Geophys.Logging:				
Casing:				
2" PVC	5/24/95	12:00	5/24/95	12:20
6" Steel	5/23/95	7:30	5/23/95	13:00
Filter Placement:	5/24/95	12:30	5/24/95	13:05
Cementing:				
Development				
Bentonite Grout	5/24/95	14:15	5/24/95	15:00
Bentonite Seal	5/24/95	14:00	5/24/95	14:15

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 2.39	-	138.50	C1	483.61	-	342.72
138.50	-	148.30	S1	342.72	-	332.92
148.30	-	148.63	C2	332.92	-	332.59
+ 1.50	-	45.00	C3	482.70	-	438.22
	-				-	
	-				-	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.) (C3-see comments)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 135.8-149.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 134.8-135.8 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-122.0 ft., Neat cement, 3.0-45.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 122.0-134.8 ft.

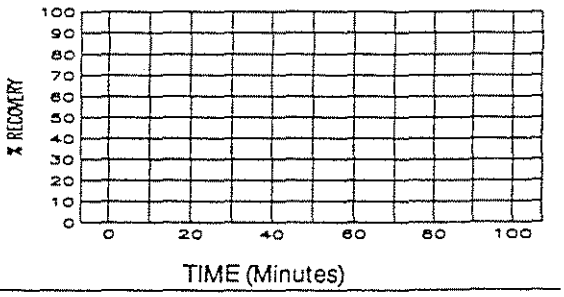
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments: Surface Casing C3: 6 1/2 in. ID / 6 5/8 in. OD Steel Casing

Supervised by B. Tilton

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ105SS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122510	CHECK NO.
ROUTE	TRANSMITTAL NO
STATE WELL NUMBER	CROSS REFERENCE NO.
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME: LAIDLAW BRIDGETON SANITARY LANDFILL		WELL NUMBER: PZ-1055S	
SITE ADDRESS: 51. CHARLES ROCK RD.	CITY: BRIDGETON	STATE: MO	ZIP CODE: 63044
NAME: LAIDLAW WASTE SYSTEMS, INC.		TELEPHONE: 314-241-3710	
ADDRESS: 10 S N BROADWAY	CITY: ST. LOUIS	STATE: MO	ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

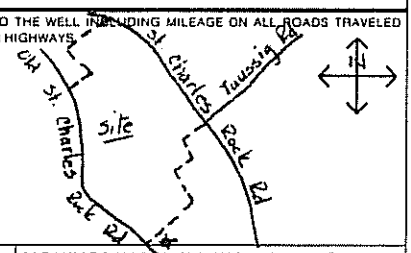
COUNTY: ST LOUIS
ELEVATION: 481.2
AREA NO.

SMALLEST ¼ LARGEST ¼

SEC. TWN. 47 N,RNG 5 E OR W

LAT. 38 45 44 LONG. 90 30 35

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN CO, INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN CO, INC.

TYPE OF INSTALLATION
☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT
483.60

MEASURING POINT IS
☒ TOP OF RISER PIPE
☐ OTHER

DRILLING EQUIPMENT
☒ AIR ROTARY ☒ AUGER TYPE 6¼ HSA
☐ REVERSE ROTARY ☐ OTHER

CENTRALIZERS USED
☒ YES, AT 4 TOTAL
☒ STAINLESS STEEL
☐ OTHER
☐ NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
5-24-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR) Michael P. Vogl
PERMIT NUMBER 001256WM DATE 7-07-95

SIGNATURE (DRILLING CONTRACTOR) Michael P. Vogl
PERMIT NUMBER 001256WM DATE 7-07-95

NOTE: Record the fraction of a foot in decimal, not in inches

Top of Riser Elevation: 483.6

LOCKING CAP - Y / N (Circle one)
CAP VENT - Y / N (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8"x8"x5'
Bore Hole Diameter: 9 1/8
WEEP HOLE - Y / N (Circle one)

Ground Surface Elevation: 481.2 Ft

Information in this column to be supplied in the Feet from Surface column	Feet from Surface	Description of Formation
		0-35 No sample
Depth to bottom of Protective Casing Seal:	3.0	
		35-144 Limestone
Depth to Base of Annular Seal:	122.0	
Depth to Base of Bentonite Seal:	134.8	
Depth to Base of Secondary Filter Pack:	135.8	
Depth to Top of the Screen:	138.5	
Depth to Bottom of the Screen:	148.5	
Plug Back Total Depth		
Original Total Depth:	144.0	

PROTECTIVE CASING SEAL
Type: ☒ Concrete ☐ Cement Slurry

RISER PIPE
Length: 140.7'
Diameter: 2"
Type of Material: SCH 80 PVC

BOREHOLE DIAMETER: 5 7/8 in.

ANNULAR SEAL
Type: ☐ Bentonite Slurry ☒ Cement Slurry ☐ Non Slurry Bentonite

BENTONITE SEAL
Type: ☒ Bentonite Slurry ☐ Non Slurry Bentonite
Length of Seal: 12.8 FL

SECONDARY FILTER PACK (Optional)
Type: ☒ Sand ☐ Manufactured
Grain Size: < 50
Length: 1'

PRIMARY FILTER PACK
Type: ☒ Sand ☐ Manufactured
Grain Size: 16-35
Length: 13.2'

WELL SCREEN
Length: 10'
Slot Size: 0.010
Type: SCH 80 PVC

SUMP DETAILS
Length: 0.5 FL
Diameter: 2 in.
Type: PVC

TYPE OF BACKFILL: SAND

MO 780-1415 (2-94) DISTRIBUTION: WHITE DIVISION CANARY/MONITORING WELL CONTRACTOR PINK/OWNER

RECORD OF DRILLHOLE PZ-106-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/4/95 - 4/5/95
DRILL RIG: SCHRAMM

DATUM: MSL
COORDINATES N: 1066726.3
AZIMUTH: 0

COLLAR ELEV: 461.0
E: 515399.9
INCLINATION: -90

ROCK TYPE: J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation; PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular; P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough; Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (60 80 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR MW HW CW)	STRENGTH INDEX (R6 R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 30 R2 150 R3 300 R4 600 R5 1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
144	0.0-154.9 ft. No sampling conducted See Record of Drillhole for PZ-106-KS														0.0-30.0 ft. Drilling conducted with 6 1/4 in. ID hollow stem augers, then borehole advanced to 154.9 ft. with 5 7/8 in. air rotary bit
146															
148															
150															
152															
154	306.10		306.10												
156	154.9-160.3 ft. 154.90 Fresh, thinly bedded to thinly laminated, light olive gray (5Y 6/1), f-m grained, medium strong, AGILLACEOUS LIMESTONE, (SALEM FORMATION) Chert nodules, silt lenses, stylolitic, fossiliferous		154.90						J,I,R						4/4/95 @ 12:20 Begin Run 1 @ 13:30 Rig breaks down
158				1	100 %				J,C,R; J,I,R						
160									J,I,SM						4/5/95 @ 7:30 Resume drilling at 159.5 ft.

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: M. VOGT

LOGGED: J. MILLER
CHECKED: B. TILTON
DATE: 5/26/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/4/95 - 4/5/95
DRILL RIG: SCHRAMM

DATUM: MSL
COORDINATES N: 1066726.3
AZIMUTH: 0

COLLAR ELEV: 481.0
E: 515399.9
INCLINATION: -90

ROCK TYPE

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
160	160.3-165.0 ft. Slightly weahtered, thickly laminated, yellowish gray (5Y 7/2), coarse grained, strong, ARENACEOUS LIMESTONE, (SALEM FORMATION)							90	J,C,SM						
162				1	100 %			90	J,I,R (2)						
164	Fossil fragments, sandy														4/5/95 @ 10:00 End Run 1
	296.00		296.00												
	End of Record of Drillhole at 165.0 ft. 165.00		165.00												
166															
168															
170															
172															
174															
176															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: M. VOGT

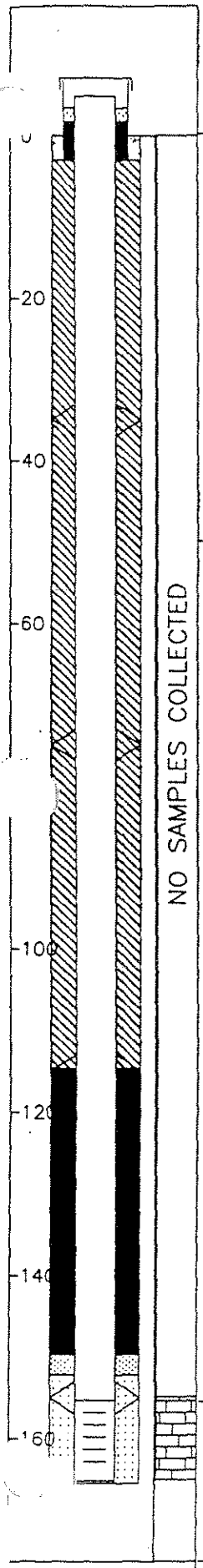
LOGGED: J. MILLER
CHECKED: B. TILTON
DATE: 5/26/95

Golder Associates

Well No. PZ-106-SS

Boring No. X-Ref: PZ-106-SS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1068726 ft. Easting: 515400 ft.

Elevation Ground Level 461.0 ft. NGVD

Top of PVC Casing 462.70 ft. NGVD

Drilling Summary:

Total Depth 165.4 ft.

Borehole Diameter 10 1/4 in. (0.0-23.0 ft.) 5 7/8 in. (23.0-165.4 ft.)

Casing Stickup Height 1.75 ft.

Driller Layne-Western, St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit for Reaming

Drilling Fluid Auger-None, NX Core Water, Air Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75				
Schramm Rotary	4/4/95	8:25	4/5/95	10:00
Geophys.Logging:				
Casing:	4/5/95	11:45	4/5/95	12:10
Filter Placement:	4/5/95	12:15	4/5/95	12:30
Cementing:				
Development				
Bentonite Grout	4/5/95	13:05	4/5/95	13:41
Bentonite Seal	4/5/95	12:30	4/5/95	13:05

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.75	-	155.30	C1	462.70	-	305.65
155.30	-	165.10	S1	305.65	-	295.85
165.10	-	165.43	C2	295.85	-	295.52

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 152.2-165.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 149.7-152.2 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-114.7 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 114.7-149.7 ft.

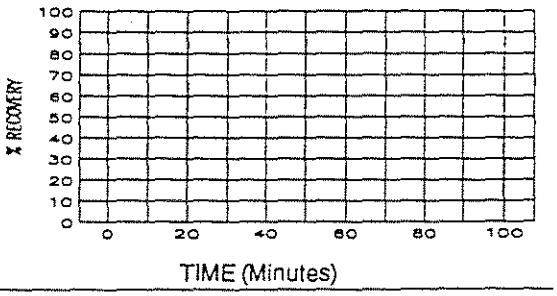
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Supervised by J. Miller

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ106SS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122480	CHECK NO.
ROUTE	TRANSMITTAL NO.
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME	WELL NUMBER
LAIDLAW BRIDGETON SANITARY LANDFILL	PZ-106-SS

SITE ADDRESS	CITY	STATE	ZIP CODE
ST. CHARLES ROCK RD.	BRIDGETON	MO	63044

NAME	TELEPHONE
LAIDLAW WASTE SYSTEMS, INC	314-241-3710

ADDRESS	CITY	STATE	ZIP CODE
1838 N. BROADWAY	ST. LOUIS	MO	63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

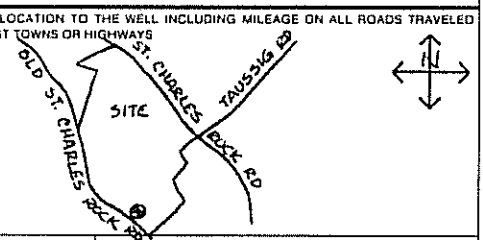
COUNTY ST. LOUIS
ELEVATION 460.9
AREA NO.

SMALLEST ¼ LARGEST ¼

SEC. TWN. 47 N.RNG 5 (E) OR W

LAT. 38 - 45 - 47 - LONG. 90 - 26 - 46 -

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN Co., INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN Co., INC.

TYPE OF INSTALLATION
☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT
462.70

MEASURING POINT IS
☒ TOP OF RISER PIPE
☐ OTHER

DRILLING EQUIPMENT
☒ AIR ROTARY ☒ AUGER TYPE 6¼ H.S.A.
☐ REVERSE ROTARY ☐ OTHER

CENTRALIZERS USED
☒ YES, AT 15', 35', 75', 115', 155'
☒ STAINLESS STEEL
☐ OTHER
☐ NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
4-05-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR) Michael P. Vogl
PERMIT NUMBER 001256WM DATE 5-10-95
SIGNATURE (DRILLING CONTRACTOR) Michael P. Vogl
PERMIT NUMBER 001256WM DATE 5-10-95

NOTE. Record the fraction of a foot in decimal, not in inches

Top of Riser Elevation: 462.7

Ground Surface Elevation: 460.9 Ft

Feet from Surface	Description of Formation
Information in this column to be supplied in the Feet from Surface column	
Depth to bottom of Protective Casing Seal: 3.0	
Depth to Base of Annular Seal: 114.7	
Depth to Base of Bentonite Seal: 147.7	
Depth to Base of Secondary Filter Pack: 152.2	
Depth to Top of the Screen: 155.1	Limestone
Depth to Bottom of the Screen: 165.1	
Plug Back Total Depth	
Original Total Depth: 165.4	

LOCKING CAP - (Y) / N (Circle one)
CAP VENT - Y / N (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8"x8"x5'
Bore Hole Diameter: 16.25'
WEEP HOLE - Y / N (Circle one)

PROTECTIVE CASING SEAL
Type: ☒ Concrete ☐ Cement Slurry

RISER PIPE
Length: 156.9'
Diameter: 2"
Type of Material: SCH. 80 PVC

BOREHOLE DIAMETER: 5 7/8 In.

ANNULAR SEAL
Type: ☒ Bentonite Slurry ☐ Cement Slurry ☐ Non Slurry Bentonite

BENTONITE SEAL
Type: ☒ Bentonite Slurry ☐ Non Slurry Bentonite
Length of Seal: 35 Ft.

SECONDARY FILTER PACK (Optional)
Type: ☒ Sand ☐ Manufactured
Grain Size: SUGAR < 50
Length: 2.5'

PRIMARY FILTER PACK
Type: ☒ Sand ☐ Manufactured
Grain Size: 16-35
Length: 13.2'

WELL SCREEN
Length: 10'
Slot Size: 0.010"
Type: SCH. 80 PVC

SUMP DETAILS
Length: 0.3 Ft.
Diameter: 2 In.
Type: PVC

TYPE OF BACKFILL: SAND

MO 780-1479 (2-93) DISTRIBUTION: WHITE-DIVISION CANARY-MONITORING WELL CONTRACTOR PINK-OWNER

RECORD OF DRILLHOLE PZ-106-SD

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/24/95
DRILL RIG: SCRAMM

DATUM: MSL
COORDINATES N: 1068715.1
AZIMUTH: 0

COLLAR ELEV: 481.5
E: 515418.0
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (80 60 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (FR SW MW HW CW)	STRENGTH INDEX (R6 R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 30 R2 150 R3 300 R4 600 R5 1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
178	0.0-189.9 ft. No sampling conducted See Record of Drillhole for PZ-106-KS														0.0-30.0 ft. Drilling conducted with 6 1/4 in. ID hollow stem augers, then borehole advanced to 189.9 ft. with 5 7/8 in. air rotary bit
176															
180															
182															
184															
186															
188															
190	271.60		271.60												
	189.9-199.9 ft. 189.90 Fresh, thinly laminated, light olive gray (5Y 6/1), f-m grained, medium strong, ARENACEOUS LIMESTONE, (SALEM FORMATION) Fossiliferous		189.90	1	99%				J,I,R						3/24/95 @ 11:00 Began coring
192															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: M. VOGT

LOGGED: B. TILTON
CHECKED: R. BOOTH
DATE: 5/26/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-SD

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/24/95
DRILL RIG: SCRAMM

DATUM: MSL
COORDINATES N: 1068715.1
AZIMUTH: 0

COLLAR ELEV: 461.5
E: 515416.0
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW, FR, MW, HW, CW)	STRENGTH INDEX (R6, R5, R4, R3, R2, R1)	POINT LOAD INDEX (psi) (R1, R2 30, R3 150, R4 300, R5 600, R6 1500, R8)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
192	189.9-199.9 ft. Fresh, thinly laminated, light olive gray (5Y 6/1), f-m grained, medium strong, ARENACEOUS LIMESTONE, (SALEM FORMATION) Fossiliferous								J,I,SM						
									J,I,R						
194															
196				1	93%										
198															
	261.60		261.60												3/24/95 @ 13:15 Finish Run 1
200	End of Record of Drillhole at 208.0 ft. 199.90		199.90												
202															
204															
206															
208															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: M. VOGT

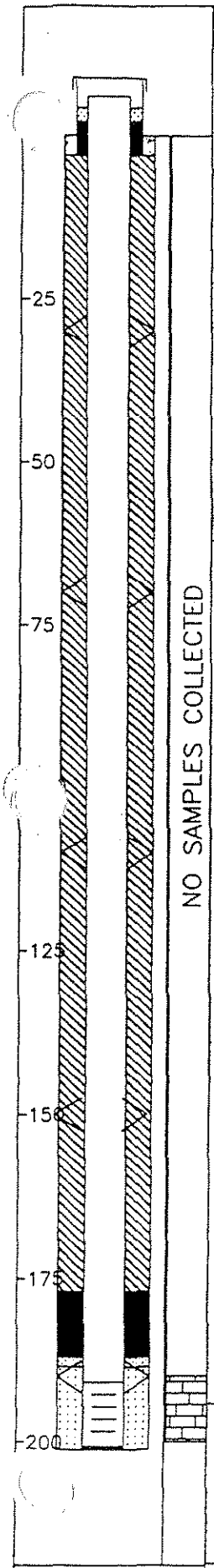
LOGGED: B. TILTON
CHECKED: R. BOOTH
DATE: 5/26/95

Golder Associates

Well No. PZ-106-SD

Boring No. X-Ref: PZ-106-SD

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords:	Northing: 1066715 ft.	Elevation Ground Level	461.5 ft. NGVD
	Easting: 515416 ft.	Top of PVC Casing	463.42 ft. NGVD

Drilling Summary:

Total Depth 201.1 ft.

Borehole Diameter 10 1/4 in. (0.0-26.0 ft.) 5 7/8 in. (26.0-201.1 ft.)

Casing Stickup Height 1.97 ft.

Driller Layne-Western
St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit,
NX Core, 5 7/8 in. Button Bit for Reaming

Drilling Fluid Auger-None, NX Core Water,
Air Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75				
Schramm Rotary	3/23/95	16:15	3/24/95	13:00
Geophys.Logging:	3/24/95	16:15	3/24/95	18:30
Casing:	3/24/95	12:40	3/24/95	13:00
Filter Placement:	3/24/95	13:10	3/24/95	13:40
Cementing:				
Development				
Bentonite Grout	3/24/95	14:00	3/24/95	14:45
Bentonite Seal	3/24/95	13:40	3/24/95	13:55

Well Design & Specifications

Basis: Geologic Log X Geophysical Log X

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.97	-	190.79	C1	463.42	-	270.66
190.79	-	200.59	S1	270.66	-	260.86
200.59	-	200.93	C2	260.86	-	260.52

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings
C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 188.5-201.1 ft.

Filter Pack: Less than 50 mesh Silica Sand, 187.0-188.5 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-177.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 177.0-187.0 ft.

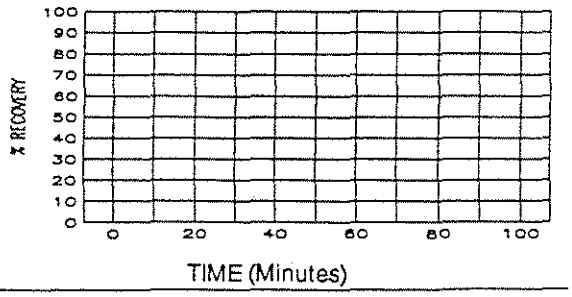
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Supervised by	W. Herst	Site	LAIDLAW/OU2 RI-FS/MO
Job Number	943-2848	File Name	PZ106SD

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY		DATE RECEIVED
REF NO	115091	CHECK NO.
ROUTE		TRANSMITTAL NO.
STATE WELL NUMBER		CROSS REFERENCE NO
CHECKED BY		ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY		DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME: LAIDLAW BRIDGETON SANITARY LANDFILL		WELL NUMBER: PZ-106-SD	
SITE ADDRESS: St. Charles Rock Rd.	CITY: BRIDGETON	STATE: Mo.	ZIP CODE: 63044
NAME: LAIDLAW WASTE SYSTEMS, INC.		TELEPHONE: 314-241-3710	
ADDRESS: 1838 N. BROADWAY	CITY: St. LOUIS	STATE: Mo.	ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

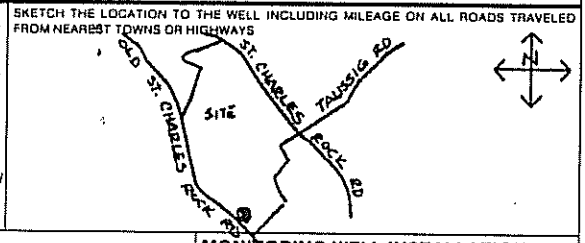
COUNTY: St. LOUIS
ELEVATION: 461.4
AREA NO.

SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST ¼

SEC. ____ TWN. 47 N.RNG. 5 (E) OR W

LAT. 35 ° 45 ' 47 " LONG. 90 ° 26 ' 46 "

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME: LAYNE WESTERN Co., INC.

DRILLING CONTRACTOR'S NAME: LAYNE WESTERN Co., INC.

TYPE OF INSTALLATION: ☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL: FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT: 463.42

MEASURING POINT IS: ☒ TOP OF RISER PIPE ☐ OTHER

DRILLING EQUIPMENT: ☒ AIR ROTARY ☒ AUGER TYPE 6¼ H.S.A. ☐ REVERSE ROTARY ☐ OTHER

CENTRALIZERS USED: ☒ YES, AT 6 TOTAL ☒ STAINLESS STEEL ☐ OTHER ☐ NO

MULTIPLE CASED WELLS: SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED: 3-26-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR): Michael P. Vogl
PERMIT NUMBER: 001256WM DATE: 5-10-95

SIGNATURE (DRILLING CONTRACTOR): Michael P. Vogl
PERMIT NUMBER: 001256WM DATE: 5-10-95

NOTE: Record the fraction of a foot in decimal, not in inches.

Top of Riser Elevation: 463.4

LOCKING CAP - (Y) / N (Circle one)
CAP VENT - Y / (N) (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8"x8"x5'
Bore Hole Diameter: 10.25"

WEEP HOLE - Y / (N) (Circle one)

Ground Surface Elevation: 461.4 Ft

	Feet from Surface	Description of Formation
Information in this column to be supplied in the Feet from Surface column		
Depth to bottom of Protective Casing Seal	3.0	
Depth to Base of Annular Seal	177.0	
Depth to Base of Bentonite Seal	197.0	
Depth to Base of Secondary Filter Pack	188.5	
Depth to Top of the Screen	190.6	
		Limestone
Depth to Bottom of the Screen	200.6	
Plug Back Total Depth		
Original Total Depth	201.1	

PROTECTIVE CASING SEAL
Type: ☒ Concrete ☐ Cement Slurry

RISER PIPE
Length: 192.6'
Diameter: 2"
Type of Material: SCH. 80 PVC

BOREHOLE DIAMETER: 5 7/8 In.

ANNULAR SEAL
Type: ☒ Bentonite Slurry ☐ Cement Slurry ☐ Non Slurry Bentonite

BENTONITE SEAL
Type: ☒ Bentonite Slurry ☐ Non Slurry Bentonite
Length of Seal: 10 Ft.

SECONDARY FILTER PACK (Optional)
Type: ☒ Sand ☐ Manufactured
Grain Size: SUGAR (50
Length: 1.5'

PRIMARY FILTER PACK
Type: ☒ Sand ☐ Manufactured
Grain Size: 16-35
Length: 12.6'

WELL SCREEN
Length: 10'
Slot Size: 0.010"
Type: SCH. 80 PVC

SUMP DETAILS
Length: 0.3 Ft.
Diameter: 2 In.
Type: PVC

TYPE OF BACKFILL: SAND

MO 780 1415 (2 94)

DISTRIBUTION: WHITE DIVISION CANARY MONITORING WELL CONTRACTOR PINK OWNER

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
LAIDLAW\RI-FS\MO WEST LAKE LANDFILL OPERABLE UNIT 2	4.25 inch I.D. Hollow Stem Auger	PZ-106-KS
		SHEET 1 OF 2
	SAMPLING METHOD:	
	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)	DRILLING
	SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	START / FINISH
	WATER LEVEL	TIME 10:30 / TIME 13:55
	TIME	
	DATE	DATE 2/28/95 / DATE 2/28/95
	CASING DEPTH	

DATUM NORTHING: 1066704.02 EASTING: 515431.62 ELEVATION 460.8

DRILL RIG CME 75 - TRUCK MOUNT

ANGLE BEARING

SAMPLE HAMMER

SURFACE CONDITIONS

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1					(0.0-2.0 ft.) No sample collected		Note: All depth measured from top of 1 foot thick gravel pad
					(458.8) 2.0		
2	2 2 2 4	1.5' / 2.0' (75%)			(2.0-4.7 ft.) Firm, brownish gray (5YR 4/1), CLAYEY SILT, NR, damp, (CL-ML), (LOESS)	SP 2	
3							
4	2 4 8 10	1.7' / 2.0' (85%)					
					(456.1) 4.7		
5					(4.7-8.8 ft.) Very stiff, brownish gray (5YR 4/1), CLAY, little silt, NR, damp, (CH), (LOESS)	SP 3	
6		2.0' / 2.0' (100%)					
7						SH 4	
8	3 6 8 9	1.2' / 2.0' (60%)					
9					(8.8-11.9 ft.) Very stiff, mottled pale yellowish brown (10YR 6/2) and moderate yellowish brown (10YR 5/4), CLAY, little silt, iron stained, NR, damp, (CL), (LOESS)	SP 5	
10	4 4 6 7	0.1' / 2.0' (5%)			@ 10.0-12.0 ft., stiff		
11						SP 6	
					(448.9) 11.9		
12	1 5 5 5	0.9' / 2.0' (45%)			(11.9-15.0 ft.) Stiff, light olive gray (5Y 5/2), CLAYEY SILT, iron stained, NR, damp, (CL-ML), (LOESS)		
13						SP 7	
14	8 13 23 19	1.0' / 2.0' (50%)				SP 8	

DRILLING CONTR LAYNE-WESTERN

LOGGED BY H. HIRT CHK'D BY W. HERST

DATE 2/28/95

JOB NO.: 943-2948

FILENAME: PZ106KS

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-106-KS
LAIDLAW\RI-FS\MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	SHEET 2 OF 2
		DRILLING START TIME 10:30 DATE 2/28/95 / FINISH TIME 13:55 DATE 2/28/95
NORTHING: 1066704.02 DATUM EASTING: 515431.62 ELEVATION 460.8	WATER LEVEL / TIME / DATE / CASING DEPTH	
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS	
ANGLE BEARING		
SAMPLE HAMMER		

DRILLING CONTR LAYNE-WESTERN

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
					(15.0-15.5 Ft.) Compact, pale yellowish brown (10YR 6/2), Fine SAND, to gravel, NR, dry, (SP), (ALLUVIAL) (445.3) 15.5	SP 8	
16	50/5"	0.0" / 2.0" (0%)			(15.5-21.2 Ft.) Dense, very light gray (N8), LIMESTONE GRAVEL interbedded, with medium dark gray (N4), Fine SAND, (SR gravel, NR sand), dry, (GP), (ALLUVIAL)		
17						SP 9	
18	10 26 14 15	0.8" / 2.0" (40%)					
19						SP 10	
20	6 15 23 32	1.0" / 2.0" (50%)					
21					(439.6) 21.2	SP 11	
					(21.2-27.7 Ft.) Hard, medium dark gray (N4), CLAY, NR, damp, (CH), (ALLUVIUM)		
22	8 18 24 30	0.6" / 2.0" (30%)					
23						SP 12	
24	6 13 20 29	1.3" / 2.0" (65%)					
25					@ 24.7 ft., becoming dark gray (N3)	SP 13	
26	9 17 38 40	0.8" / 2.0" (40%)					
27					(433.1) 27.7	SP 14	
					(27.7-29.3 Ft.) Hard, medium light gray (N6), SILTY CLAY, NR, dry, (CL), (ALLUVIUM) (431.5) 29.3		
28	19 39 50/3"	0.9" / 2.0" (45%)			(29.3-30.0 Ft.) Very dense, very light gray, (N8), LIMESTONE GRAVEL, SR, dry, (GP)		
29					End of Soil Borehole Log at 30.0 ft. See PZ-106-KS Record of Drillhole for rock descriptions	SP 15	Auger/split spoon refusal at 30.0 Feet

LOGGED BY M. HIRT
DATE 2/28/95
CHK'D BY W. HERST
JOB NO.: 943-2848
FILENAME: PZ106KS

RECORD OF DRILLHOLE PZ-106-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 481.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD (80 60 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0 30 60 90)	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR MW HW CW)	STRENGTH INDEX (R5 R6 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 30 R2 150 R3 300 R4 600 R5 1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
16	0.0-30.0 ft. See Soil Borehole Log PZ-106-KS														
18															
20															
22															
24															
26															
28															
30	431.80 / 30.00 30.0-36.5 ft. Fresh, medium bedded, yellowish gray (5Y 8/1) to light olive gray (5Y 6/1), medium grained, medium strong, ARENACEOUS LIMESTONE, (ST. LOUIS FORMATION)		431.80 / 30.00	1	69%				J,I,R (2); J,ST,R; J,I,R; J,PL,SM						2/28/95 @ 14:45 Begin coring
32															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 481.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, X-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
32	30.0-36.5 ft. Fresh, medium bedded, yellowish gray (5Y 8/1) to light olive gray (5Y 6/1), medium grained, medium strong, ARENACEOUS LIMESTONE, (ST. LOUIS FORMATION)								J,I,R; J,ST,R; J,PL,R,CL						
	33.5-34.0 ft. Hard clay infilling														
34	34.0-34.5 ft. ARENACEOUS DOLOMITE 427.30			1	69%										Core loss probably due to highly fractured nature of rock
	34.50														
									Core Loss						
36			425.30												
	36.5-37.9 ft. Highly weathered, thickly laminated, medium dark gray (N4), fine grained, medium strong, SILTSTONE, (ST. LOUIS FORMATION)		36.50												
	Cross bedded, Limestone breccia 423.90 37.90														
38	37.9-41.5 ft. Completely weathered, thinly laminated, grayish black (N2), very fine grained, extremely weak, CLAYSTONE. (ST. LOUIS FORMATION)														
	38.5-38.8 ft. 60° silt crossbeds, pyrite crystals abundant			2	93%			60	B,PL,SM (3)						
40									J,I,SM (5)						
	41.0-41.5 ft. Greenish gray (5GY 6/1) clay layer 420.30								J,I,SM (2)						
	41.5-42.7 ft. Fresh, medium bedded, light greenish gray (5GY 8/1), medium grained, medium strong, ARENACEOUS LIMESTONE, (ST. LOUIS FORMATION) 419.10		41.50						J,I,R; B,PL,SM						
42			419.30												
	42.5-42.7 ft. Clay infilling 42.70		42.50												Bit getting plugged off
	42.7-46.4 ft. Fresh, thickly bedded, medium light gray (N6), medium grained, medium strong, SANDSTONE, (ST. LOUIS FORMATION)														
44				3	96%										
46	46.0-46.5 ft. Siltstone														
	46.7-46.8 ft. Claystone								B,I,R						
	46.8-47.1 ft. Chert								J,I,R						
	47.3-47.5 ft. Siltstone		414.50												
	47.5-48.1 ft. Clay layer		47.30	4	96%										
48															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 461.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
48		413.40											
	48.4-52.3 ft. Moderately weathered, medium bedded, medium light gray (N6), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic	48.40											
50	49.6-50.6 ft. Chert nodules 50.0-50.1 ft. Claystone 50.3-50.6 ft. Claystone 51.0-51.5 ft. Claystone		4	98%				J,I,R,CL					
52		409.50											
	52.3-55.7 ft. Slightly weathered, medium bedded, light olive gray (5Y 6/1), microcrystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic, numerous pyrite crystals	52.30						J,I,R (2)					
								J,I,R					
								J,I,R					
								J,I,R,CL					
								J,I,R (2)					
54													
								J,I,R (2)					
56	55.7-59.6 ft. Slightly weathered, medium bedded, medium light gray (N6), fine grained, medium strong, ARENACEOUS LIMESTONE, (ST. LOUIS FORMATION) Porous/vuggy, some pyrite crystals and chert nodules, vugs <1 mm. diameter		5	99%				J,PL,R,CL					
58													
		402.40											
		402.20											
	59.6-70.0 ft. Slightly weathered, medium bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARENACEOUS DOLOMITE, (ST. LOUIS FORMATION) Porous/vuggy, vugs <1 mm.	59.60											
60													
			6	98%				J,PL,SM					
62	62.2-62.8 ft. Claystone 62.8-63.4 ft. Calcite crystals							B,PL,SM					
								B,PL,SM					
								J,I,R, calcite crystals					
								J,I,R					
64													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 481.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
64									J,I,R calcite crystals						
	64.7-65.2 ft. calcite crystals								J,I,R						
									J,I,R						
									J,I,R calcite crystals						
66	65.9-66.9 ft. Calcite crystals and iron staining			6	98%										
			394.20 / 67.60												8:45 End Core Run 6
68	67.8-68.6 ft. Calcite crystals, some iron staining								J,I,SM						
									J,I,R						
									J,I,SM						
	69.7-70.7 ft. Calcite crystals		391.80 / 70.00						J,PL,SM						
70	70.0-98.0 ft. Fresh, medium bedded, light olive gray (5Y 6/1), medium grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)								J,PL,SM						
									J,I,SM						
									J,I,R,CL						
									J,I,R,Fe						
				7	99%				J,I,R						
72															
	72.6-73.3 ft. 0° calcite vein														
	73.4-73.6 ft. Arenaceous, slightly weathered								J,I,R,CL (2)						
74			387.40 / 74.40												9:30 End Core Run 7
									J,I,R (2)						
76	76.4-80.9 ft. Microcrystalline, stylolitic								J,I,R						
				8	100				J,I,SM (3)						
78									J,I,R (2)						
	79.6-79.8 ft. Dolomite layer								J,PL,SM,CL						
80															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 481.6
E: 815432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80	70.0-98.0 ft. Fresh, medium bedded, light olive gray (5Y 6/1), medium grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)												
	80.9-82.8 ft. Fine grained, arenaceous		8	100 %				J,I,R (2)					
82		379.00 / 82.80											10:15 End Core Run 8
								J,PL,SM,CL; J,I,R					
84	83.9-84.2 ft. Calcite filled vugs												
	85.0-87.1 ft. Microcrystalline, stylolitic							J,I,R					
86			9	100 %				J,PL,SM					
	87.1-88.3 ft. Porous/vuggy Dolomite							J,PL,SM					
88	88.3-90.5 ft. Microcrystalline, stylolitic							B,I,R; J,I,R					
		372.40 / 89.40						J,I,R					11:05 End Core Run 9
90	90.6-92.0 ft. Porous/vuggy Dolomite												
								J,PL,R					
92	92.2-94.1 ft. Microcrystalline, some silty laminae		10	95%				J,I,R,CL; J,I,SM; J,I,R; J,I,R					
94								J,I,R,CL					
								J,I,R,CL					
96	95.9-96.1 ft. Moderately weathered, arenaceous												

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 461.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

LENGTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
96	70.0-98.0 ft. Fresh, medium bedded, light olive gray (5Y 6/1), medium grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)								J,PL,SM,CL						
	97.5-97.8 ft. Dolomitic			10	99%										
	363.80 / 98.00														
98	98.0-119.3 ft. Slightly weathered, medium bedded, light olive gray (5Y 6/1), fine grained, medium strong, DOLOMITE, (ST. LOUIS FORMATION) Porous/vuggy		362.40 / 98.40												11:55 End Core Run 10
100															
	101.2-104.3 ft. Medium grained Limestone								J,PL,SM,CL; J,PL,SM; J,I,R						
102									J,PL,R; J,PL,R (2)						
104				11	100 %				J,PL,SM,CL						
106															
	107.1-108.0 ft. Interbedded Limestone and Dolomite														
108	108.0-110.9 ft. Arenaceous Limestone								J,I,R; J,I,SM,CL						
			352.40 / 109.40					0	J,I,R						13:25 End Core Run 11
									J,I,R (2)						
110	110.0-110.3 ft. 45° healed fracture								J,I,R						
				12	95%			0	J,I,R,CL						
	111.0-111.9 ft. Moderate to highly weathered, arenaceous Dolomite, some chert														
112															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 481.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SN-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filed

DEPTH SCALE (FEET)	ROCK TYPE: DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (80 60 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR MW HW CW)	STRENGTH INDEX (R6 R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 30 R2 150 R3 300 R4 600 R5 1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
112	112.0-112.4 ft. Crystalline Limestone, moderately weathered								J,I,R,CL						
									J,ST,SM						
									J,I,SM (2)						
	113.2-115.0 ft. Crystalline Limestone								J,I,SM,CL (2)						
									J,PL,SM						
114									J,I,SM						
	115.0-115.3 ft. 10° calcite filled vein (2 mm. thick)								J,I,SM						
				12	98%										
116															
									J,I,SM						
	117.0-119.0 ft. 10° calcite filled veins (2 mm. thick)														
118															
	342.50		342.40												
	119.3-133.8 ft. Fresh, medium bedded, light olive gray (5Y 5/2), medium grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Some braciopod fossils		119.30 / 119.40												14:05 End Core Run 12
120															
122															
	123.1-124.9 ft. Greenish gray (5GY 6/1) to dark greenish gray (5GY 4/1). Dolomite with calcite veins and vugs			13	98%										
124															
									J,I,R						
	124.9-126.0 ft. 10° calcite filled veins								J,I,R,calcite						
	125.6-133.2 ft. Microcrystalline to fine grained, thinly laminated, Silt and Dolomite interbeds								J,PL,R (2)						
126									J,I,R,CL (2)						
	127.6-131.7 ft. Large chert nodules														
128															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 481.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filed

DEPTH SCALE (FEET)	DESCRIPTION	ELEV DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP WRT CORE AXIS	TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
128	119.3-133.8 ft. Fresh, medium bedded, light olive gray (5Y 5/2), medium grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Some braciopod fossils	332.40 129.40	13	98%			90	J,PL,SM	14:50 End Core Run 13
130								J,PL,SM	
							60	J,I,SM	
								J,I,SM (2)	
132	132.4-132.5 ft. Claystone							B,PL,SM	
	328.00 133.80								
134	133.8-146.6 ft. Fresh, thinly bedded, light olive gray (5Y 5/2), very coarse grained, medium strong, FOSSILIFEROUS LIMESTONE, (SALEM FORMATION)		14	100 %					@ 133.8 ft. Inferred top of SALEM FORMATION
136									
138	138.7-139.7 ft. Fine to medium grained arenaceous Limestone, cross bedded	322.60 139.20					60	J,I,SM	8:45 End Core Run 14
								J,PL,SM	
140	139.7-142.1 ft. Fine grained to microcrystalline								
	140.4-140.7 ft. Chert layer								
							60	J,PL,SM	
			15	99%				J,PL,SM,CL	
142	142.1-142.4 ft. Clay layer						60	J,I,SM,CL (2)	
	142.5-142.7 ft. Chert nodules						60	J,I,R	
	143.4-146.1 ft. Medium grained Limestone								
144									

GRAPHIC LOG

WEATHERING INDEX: SW, FR, MW, HW, CW

STRENGTH INDEX: R6, R5, R4, R3, R2, R1

POINT LOAD INDEX (psi): R1, R2 30, R3 150, R4 300, R5 600, R6 1500

TEST ORIENTATION

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 461.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
128	119.3-133.8 ft. Fresh, medium bedded, light olive gray (5Y 5/2), medium grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Some braciopod fossils	332.40	13	98%	J,PL,SM	
		129.40				14:50 End Core Run 13
130					J,PL,SM	
					J,I,SM	
					J,I,SM (2)	
132	132.4-132.5 ft. Claystone				B,PL,SM	
	326.00 / 133.80					
134	133.8-146.6 ft. Fresh, thinly bedded, light olive gray (5Y 5/2), very coarse grained, medium strong, FOSSILIFEROUS LIMESTONE, (SALEM FORMATION)		14	100 %		@ 133.8 ft. Inferred top of SALEM FORMATION
136						
138	138.7-139.7 ft. Fine to medium grained arenaceous Limestone, cross bedded	322.60			J,I,SM	
		139.20			J,PL,SM	8:45 End Core Run 14
140	139.7-142.1 ft. Fine grained to microcrystalline					
	140.4-140.7 ft. Chert layer					
					J,PL,SM	
			15	99%	J,PL,SM,CL	
142	142.1-142.4 ft. Clay layer					
					J,I,SM,CL (2)	
	142.5-142.7 ft. Chert nodules					
					J,I,R	
	143.4-146.1 ft. Medium grained Limestone					
144						

Columns: GRAPHIC LOG; RQD (80 60 40 20); FRACTURES PER FOOT (2 4 6 8 10); DISCONTINUITY DATA (0 DIP wrt CORE AXIS 90); GRAPHIC LOG; WEATHERING INDEX (FR SW MW HW CW); STRENGTH INDEX (R6 R5 R4 R3 R2 R1); POINT LOAD INDEX (psi) (R1 39 R2 150 R3 300 R4 600 R5 1500 R6); TEST ORIENTATION

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 481.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filed

Depth Scale (Feet)	Rock Type Description	Graphic Log	Elev / Depth (Ft)	Run No.	Core Recovery	RQD	Fractures Per Foot	Discontinuity Data: Dip wrt Core Axis	Type and Surface Description	Weathering Index	Strength Index	Point Load Index (psi)	Test Orientation	Notes Water Levels Instrumentation
144	144.0-144.4 ft. Chert layer													
	146.1-146.2 ft. Chert nodule													
146	146.2-146.6 ft. Thinly laminated, arenaceous Limestone, cross bedded 315.20			15	99%				J,I,R (2)					
	146.6-152.6 ft. 146.60 Slightly weathered, medium bedded, pale yellowish brown (10YR 6/2) to dark yellowish brown (10YR 4/2), fine grained, medium strong, ARGILLACEOUS DOLOMITE, (SALEM FORMATION) Slightly porous/vuggy, interbedded chert nodules													
148			313.00 148.80											9:50 End Core Run 15
	148.8-149.0 ft. Chert zone													
150														
	150.4-150.7 ft. Chert zone								J,U,R					
				16	100 %				J,I,SM					Driller reports rock is very hard
	151.8-152.0 ft. Chert zone								J,I,R (2)					
152	152.5 ft. 1 in. diameter, black claystone clast 309.20								J,I,R					
	152.6-160.5 ft. 152.60 Fresh, thinly laminated, light olive gray (5Y 5/2), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (SALEM FORMATION) Crossbedded, numerous chert nodules/beds		308.70 153.10						J,PL,SM					10:40 End Core Run 16
154	153.0-153.6 ft. Chert zone								J,PL,SM					
									J,I,R					Driller reports rock is very hard
	155.5-155.6 ft. Chert zone													
156	156.1-157.5 ft. Pale yellowish brown (10YR 6/2) to dark yellowish brown (10YR 4/2) 156.4 ft. Brachiopod fossils 157.0-157.2 ft. Chert zone			17	97%									
									J,I,SM					
158	158.2-158.4 ft. Chert zone								J,U,SM					
									J,U,SM (2)					
	159.0-159.4 ft. Chert zone		302.50 159.30						J,U,SM					
									J,PL,SM					11:50 End Core Run 17
	159.6-159.7 ft. Chert nodule			18	100 %				J,I,SM					
160														

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 481.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filed

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
160	160.2-160.4 ft. Chert zone 160.5-174.3 ft. Fresh, thickly laminated, medium light gray (N6), coarse grained, medium strong, FOSSILIFEROUS DOLOMITIC LIMESTONE, (SALEM FORMATION)							80	J,I,SM					
								80	J,U,R					
162														
164				18	100 %			80	J,ST,R					
166														
								80	J,PL,SM					
168			292.50 / 169.30											13:45 End Core Run 18
170														
172				19	100 %									
174	287.50 / 174.30 174.3-178.8 ft. Fresh, thinly bedded, pale yellowish brown (10YR 6/2) to medium light gray (N6), f-c grained, medium strong, CALCAREOUS DOLOMITE, (SALEM FORMATION) Some fossils, cross bedding													
176														

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 461.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
176	174.3-178.8 ft. Fresh, thinly bedded, pale yellowish brown (10YR 6/2) to medium light gray (N6), fine to coarse grained, medium strong, CALCAREOUS DOLOMITE, (SALEM FORMATION) Some fossils, cross bedding								J,PL,SM; J,PL,R						
				19	100 %										
178	176.9-177.2 ft. Chert zone; 178.3-178.5 ft. Chert zone														
	178.8-187.0 ft. Slightly weathered, medium bedded, moderate yellowish brown (10YR 5/4), medium grained, medium strong, DOLOMITE, (SALEM FORMATION) Some fossils, calcite crystals, porous/vuggy		282.50 / 179.30						J,I,R						14:30 End Core Run 19
180	180.2-180.3 ft. Chert nodule								J,PL,R						
182															
184	183.9-184.1 ft. Chert zone								J,I,R						
				20	99%				J,I,R						
186															
	274.80								J,I,SM (2)						
	187.0-189.3 ft. Fresh, thinly laminated, pale yellowish brown (10YR 6/2), medium grained, medium strong, DOLOMITIC LIMESTONE, (SALEM FORMATION) Some cross bedding, fossils		187.00												
188			272.50 / 189.30												15:30 End Core Run 20
190	189.3-201.3 ft. Fresh, thickly laminated, light olive gray (5Y 6/1), interbedded medium and very coarse grained, medium strong, ARGILLACEOUS FOSSILIFEROUS LIMESTONE, (SALEM FORMATION) 190.8-191.4 ft. Brecciated			21	98%										
192															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/26/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 481.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
192	189.3-201.3 ft. Fresh, thickly laminated, light olive gray (5Y 6/1), interbedded medium and very coarse grained, medium strong, ARGILLACEOUS FOSSILIFEROUS LIMESTONE, (SALEM FORMATION)														
194															
	195.4-195.7 ft. Cross bedded, brecciated			21	98%										
196															
198															
			262.60 / 199.30												16:35 End Core Run 21
200	200.5-201.2 ft. Cross bedded, brecciated														
	260.60 / 201.20														
202	201.2-209.2 ft. Fresh, thinly laminated, medium dark gray (N4), very fine grained, weak, CALCAREOUS CLAYSTONE, (WARSAW FORMATION) Brachiopod fossils								J,PL,SM,CL						201.9-202.5 ft. GTS-1 collected for perm. testing at laboratory
				22	99%										
204	205.1-207.2 ft. Medium gray (N5), fine to medium grained														
206									J,I,R,CL						
	207.1-207.2 ft. Brecciated								J,PL,SM,CL						
208	207.3-End of Borehole Olive gray (5Y 4/1), medium strong														

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 481.6
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
208	201.2-209.2 ft. Fresh, thinly laminated, medium dark gray (N4), very fine grained, weak, CALCAREOUS CLAYSTONE, (WARSAW FORMATION) 252.60			22	99%										17:35 End Core Run 22
	Brachiopod fossils 209.20		252.50 / 209.30												
	209.2-225.4 ft. Fresh, medium bedded, olive gray (5Y 4/1), very coarse grained, medium strong, FOSSILIFEROUS LIMESTONE, (WARSAW FORMATION)							90	J,PL,SM						3/11/95 @ 10:15 Begin coring Run 23 after installing 6 in. dia. casing to 204 ft.
210															
212	212.2-213.7 ft. Slightly weathered, porous/vuggy, calcareous Dolomite, some fossils							90	B,PL,SM						
									J,I,SM (2)						
								90	J,I,SM						
214				23	98%										
216															
	217.3-218.5 ft. Medium grained														
218			242.50 / 219.30												12:30 End Core Run 23
220	220.1-221.9 ft. Medium grained							90	J,PL,R						
									J,I,R						
				24	101 %										
222															
224															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 461.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
224	209.2-225.4 ft. Fresh, medium bedded, olive gray (5Y 4/1), very coarse grained, medium strong, FOSSILIFEROUS LIMESTONE, (WARSAW FORMATION)														
	236.40 / 225.40														
226	225.4-233.2 ft. Fresh, medium bedded, olive gray (5Y 4/1), fine grained, weak, CALCAREOUS CLAYSTONE, (WARSAW FORMATION) Some calcite crystals, fossils 225.4-228.3 ft. Slightly porous/vuggy (<1 mm.)			24	101 %				J,ST,SM,CL						
228															
			232.50 / 229.30												13:55 End Core Run 24 229.6-230.1 ft. GTS-2 collected for perm. testing at laboratory
230															
232									J,I,SM,CL						
	228.60 / 233.20														
234	233.2-251.3 ft. Fresh, medium bedded, olive gray (5Y 4/1), very coarse grained, medium strong, FOSSILIFEROUS LIMESTONE, (WARSAW FORMATION) Stylolitic, some calcite crystals			25	98%				J,PL,SM						
236	235.9-238.3 ft. Slightly weathered								J,I,R						
238															
	239.0-240.0 ft. Slightly weathered		222.50 / 239.30	26	100 %				J,I,R; J,I,R; J,I,R						14:50 End Core Run 25
240															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 481.6
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD 80 60 40 20	FRACTURES PER FOOT 2 4 6 8 10	DISCONTINUITY DATA: DIP WRT CORE AXIS 0 30 60 90	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX SW FR MW HW CW	STRENGTH INDEX R6 R5 R4 R3 R2 R1	POINT LOAD INDEX (psi) R1 R2 30 R3 300 R4 600 R5 1500 R6	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
240	233.2-251.3 ft. Fresh, medium bedded, olive gray (5Y 4/1), very coarse grained, medium strong, FOSSILIFEROUS LIMESTONE, (WARSAW FORMATION) Stylolitic, some calcite crystals								J,I,R						
242															
244				26	100 %										
246	246.3-246.5 ft. Fine grained, Dolomitic Limestone														
248			212.50 / 249.30				2								15:40 End Core Run 26
250	250.3-251.3 ft. Medium grained								J,I,R						
			210.50 / 251.30						J,I,R; J,I,R						
252	251.3-257.7 ft. Slightly weathered, medium bedded, olive gray (5Y 4/1), fine grained, weak, CALCAREOUS CLAYSTONE, (WARSAW FORMATION) Porous/vuggy (<1 mm.)			27	98%				J,PL,SM,CL (2)						
254															
256															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 461.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
256	251.3-257.7 ft. Slightly weathered, medium bedded, olive gray (5Y 4/1), fine grained, weak, CALCAREOUS CLAYSTONE, (WARSAW FORMATION) Porous/vuggy (<1 mm.)				J,PL,SM	
	204.10 / 257.70		27	98%		
258	257.7-259.7 ft. Fresh, medium bedded, olive gray (5Y 4/1), medium grained, medium strong, FOSSILIFEROUS LIMESTONE, (WARSAW FORMATION)	202.50			J,PL,SM,CL	
	202.10 / 259.70	259.30				16:25 End Core Run 27
260	259.7-263.7 ft. Fresh, medium bedded, olive gray (5Y 4/1), fine grained, weak, CALCAREOUS CLAYSTONE, (WARSAW FORMATION)				B,I,SM,CL	
262	261.8-262.3 ft. Calcite crystals, some large vugs (>10 mm.)				J,PL,SM	
					J,I,SM brecciated	
	263.5-163.7 ft. Highly weathered				B,I,SM (4)	
	198.10 / 263.70					
264	263.7-269.3 ft. Fresh, medium bedded, olive gray (5Y 4/1), coarse grained, strong, FOSSILIFEROUS LIMESTONE, (WARSAW FORMATION)		28	98%	J,I,SM,CL	
266	266.3-266.4 ft. Claystone				J,I,SM,CL	
268	268.3-269.3 ft. Calcareous claystone				J,I,SM,CL; J,PL,SM	
	192.50 / 269.30	192.50				
270	269.3-284.2 ft. Fresh, medium bedded, medium dark gray (N4), very fine grained, very weak, CLAYSTONE, (WARSAW FORMATION) Some calcite crystals	269.30	29	96%	J,PL,SM	17:15 End Core Run 28
272	271.3-271.7 ft. Slightly wethered, porous				J,PL,SM (2)	

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 109703.9
AZIMUTH: 0

COLLAR ELEV: 461.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infil, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
272	269.3-284.2 ft. Fresh, medium bedded, medium dark gray (N4), very fine grained, very weak, CLAYSTONE, (WARSAW FORMATION) Some calcite crystals		29	96%	J,PL,SM	
274		187.50 / 274.30				8:45 End Core Run 29 Problems coring, drill string very wobbly due to large diameter casing
	275.1-276.0 ft. Slightly weathered, porous					
276						
	277.6 ft. Calcite filled vug (3 cm.)					
278			30	103 %		
280						
282						
	282.7-283.2 ft. Calcareous, weak					
	283.3-284.1 ft. Slightly weathered, porous					
284	284.2-301.4 ft. Fresh, medium bedded, medium dark gray (N4), fine grained, medium strong, CALCAREOUS CLAYSTONE, (WARSAW FORMATION)	177.60 / 284.20			J,I,SM	10:00 End Core Run 30 Cuttings not coming out with return; flush hole
286			31	100 %	J,PL,SM	
					J,I,SM	
288						

DISCONTINUITY DATA: DIP wrt CORE AXIS (0, 30, 60, 90)

WEATHERING INDEX: SW, FR, MW, HW, CW

STRENGTH INDEX: R6, R5, R4, R3, R2, R1

POINT LOAD INDEX (psi): R1 30, R2 150, R3 300, R4 600, R5 1500, R6

TEST ORIENTATION

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 461.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filed

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
288	284.2-301.4 ft. Fresh, medium bedded, medium dark gray (N4), fine grained, medium strong, CALCAREOUS CLAYSTONE, (WARSAW FORMATION)	172.60 / 289.20	31	100 %									12:00 End Core Run 31
	289.2-290.6 ft. Dolomite												
290													
292								J,I,SM; J,I,SM,CL					
294	293.4-295.6 ft. Dolomite		32	99%									
296													
298		162.60 / 299.20											13:50 End Core Run 32
300													
	160.40 / 301.40												
302	301.4-346.4 ft. Fresh, thinly bedded, medium dark gray (N4), m-vc grained, medium strong, LIMESTONE, (WARSAW FORMATION) Some Claystone partings		33	100 %									
	302.6-304.3 ft. Dolomitic Claystone, some fossils												
304													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 461.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE: DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
304	301.4-346.4 ft. Fresh, thinly bedded, medium dark gray (N4), m-vc grained, medium strong, LIMESTONE, (WARSAW FORMATION) Some Claystone partings		157.80 / 304.20	33	100 %										14:15 End Core Run 33
306															
308	307.9 ft. Calcite filled vug (3 cm.)														
				34	99%										
310															
312															
314			147.80 / 314.20												14:50 End Core Run 34
	315.5 ft. Chert zone														
316	316.2 ft. Chert zone														
				35	100 %										
318									J,U,SM,CL						
320															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 843-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 461.8
E: 515432.1
INCLINATION: -90

ROCK TYPE

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DISCONTINUITY DATA

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
320	301.4-346.4 ft. Fresh, thinly bedded, medium dark gray (N4), m-vc grained, medium strong, LIMESTONE, (WARSAW FORMATION) Some Claystone partings								
322			35	100 %					
	323.2-323.3 ft. Chert zone								
324		137.60 / 324.20							15:45 End Core Run 35
	324.8 ft. Chert zone								
	325.3, 325.8, and 326.3 ft. Chert zones								
326									
	327.4 ft. Chert zone								
328									
	328.5 ft. Chert zone								
	329.1 ft. Chert zone		36	99%					
	329.6-329.9 ft. Chert zone								
330									
332									
	333.4 ft. Chert zone							J,I,SM,CL	
334		127.50 / 334.20						J,I,SM	16:40 End Core Run 36
			37	100 %					
336	335.8 ft. Chert zone								

WEATHERING INDEX: SW FR, MW, HW, CW
STRENGTH INDEX: R6, R5, R4, R3, R2, R1
POINT LOAD INDEX (psi): R1 30, R2 150, R3 300, R4 600, R5 1500, R6
TEST ORIENTATION

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 481.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
336	301.4-346.4 ft. Fresh, thinly bedded, medium dark gray (N4), m-vc grained, medium strong, LIMESTONE, (WARSAW FORMATION) Some Claystone partings					
	336.6-346.4 ft. No more claystone partings					
	336.9 ft. Chert zone					
338	337.9-339.2 ft. Chert zone				J,I,R calcite crystals	
340	339.9 ft. Chert zone		37	100 %		
	340.9-341.3 ft. Chert zone					
342	342.0-342.2 ft. Chert zone				J,I,SM,chert	
	342.3-343.5 ft. Chert zone					
344	343.8 ft. Chert zone				J,I,SM J,I,SM	
		117.60 344.20				8:30 End Core Run 37
	344.6 ft. Chert zone					
					J,I,R,fossils	
346	115.40 346.4-363.6 ft. 346.40 Slightly weathered, thinly to medium bedded, light gray (N7), medium grained, medium strong, CALCAREOUS DOLOMITE, (KEOKUK FORMATION) Interbedded with chert zones and nodules; porous/vuggy; some filled with calcite crystals; some calcite veins				J,I,R,chert	
348			38	98%		
350					J,I,SM	
352					J,I,SM,chert	

GRAPHIC LOG; RQD; FRACTURES PER FOOT; DIP wrt CORE AXIS; WEATHERING INDEX (SW, MW, HW, CW); STRENGTH INDEX (R6, R5, R4, R3, R2, R1); POINT LOAD INDEX (psi) (R1, R2 30, R3 150, R4 300, R5 500, R6 1500); TEST ORIENTATION

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 481.8
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filed

DEPTH (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
352	346.4-363.6 ft. Slightly weathered, thinly to medium bedded, light gray (N7), medium grained, medium strong, CALCAREOUS DOLOMITE (KEOKUK FORMATION) Interbedded with chert zones and nodules; porous/vuggy: some filled with calcite crystals; some calcite veins		38	98%	J,I,R	
354		107.60 / 354.20			J,I,SM; J,I,R	9:30 End Core Run 38
					J,I,R	
356					J,I,R	
358	358.0-361.1 ft. Moderately weathered, very vuggy		39	95%	J,I,R; J,I,R; calcite crystals; J,I,R	
360						
					J,I,R (2)	Drilling rate much slower due to presence of chert
362					J,PL,R (2)	
	98.80 / 363.00	98.40 / 363.40			Core Loss	362.9-363.4 ft. Core loss 11:00 End Core Run 39
364	363.6-370.1 ft. Slightly weathered, thinly bedded, light gray (N7), m-vc grained, medium strong, DOLOMITIC LIMESTONE, (KEOKUK FORMATION) Slightly vuggy, some chert nodules		40	100 %	J,I,R (3); J,I,SM; J,I,R	
366						
368						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-106-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95-3/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 106703.9
AZIMUTH: 0

COLLAR ELEV: 481.6
E: 515432.1
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
368	363.6-370.1 ft. Slightly weathered, thinly bedded, light gray (N7), m-vc grained, medium strong, DOLOMITIC LIMESTONE, (KEOKUK FORMATION) Slightly vuggy, some chert nodules								J,I,SM,chert						
									J,PL,SM						
370	369.4-370.1 ft. Chert layer 91.70 / 370.10														
	370.1-373.4 ft. Moderately weathered, medium bedded, medium light gray (N6), fine grained, medium strong, DOLOMITE, (KEOKUK FORMATION) Porous/vuggy, some chert nodules and calcite crystals			40	100 %										
372									J,I,SM (2)						
															3/13/95 @ 12:05 Core Run 40
	88.40		88.40						J,I,SM						
									J,I,SM						
	End of Record of Drillhole at 373.4 ft. 373.40		373.40												
374															
376															
378															
380															
382															
384															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

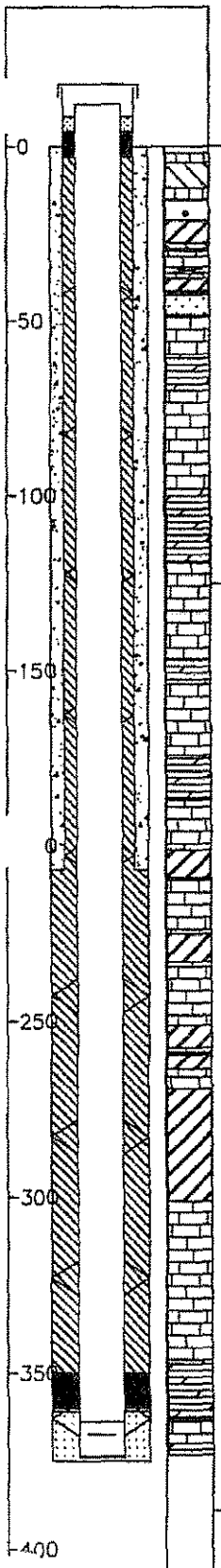
LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/29/95

Golder Associates

Well No. PZ-106-KS

Boring No. X-Ref: PZ-106-KS

PIEZOMETER CONSTRUCTION SUMMARY



Survey Coords: Northing: 1066704 ft. Easting: 515432 ft.

Elevation Ground Level 461.8 ft. NGVD

Top of PVC Casing 464.26 ft. NGVD

Drilling Summary:

Total Depth 375.0 ft.

Borehole Diameter 9 7/8 in. (0.0-204.0 ft.) 5 7/8 in. (204.0-375.0 ft.)

Casing Stickup Height 2.49 ft.

Driller Layne-Western St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. and 9 7/8 in. Button Bits

Drilling Fluid Auger-None, NX Core Water, Air Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	2/28/95	10:30	3/6/95	17:30
Schramm Rotary	3/20/95	7:30	3/20/95	11:30
Geophys.Logging:	3/20/95	12:45	3/20/95	16:30
Casing:				
2" PVC	3/23/95	8:30	3/23/95	9:40
6" Steel	3/9/95	11:45	3/10/95	9:00
Filter Placement:	3/23/95	9:40	3/23/95	10:45
Cementing:	3/9/95	14:15	3/9/95	9:00
Development				
Bentonite Grout	3/23/95	11:16	3/23/95	13:15
Bentonite Seal	3/23/95	10:45	3/23/95	11:15

Well Design & Specifications

Basis: Geologic Log X Geophysical Log X

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 2.49	-	363.75	C1	464.26	-	98.02
363.75	-	373.57	S1	98.02	-	88.20
373.57	-	373.90	C2	88.20	-	87.87
+ 1.50	-	204.00	C3	463.30	-	257.77
	-				-	
	-				-	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.) (C3-see comments)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 361.0-375.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 360.0-361.0 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-350.0 ft., Neat cement, 3.0-204.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 350.0-360.0 ft.

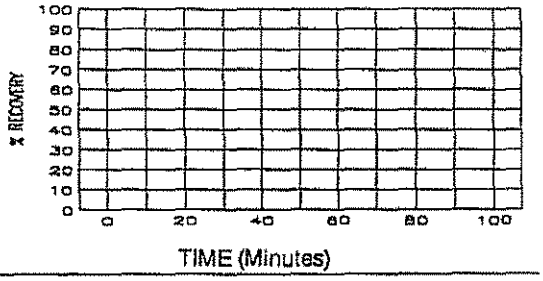
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments: Surface Casing C3: 6 1/8 in. ID / 6 5/8 OD Steel Casing

Not to Scale

Supervised by B. Tilton

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ106KS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	
REF NO 115092	DATE RECEIVED
ROUTE	CHECK NO.
STATE WELL NUMBER	TRANSMITTAL NO.
CHECKED BY	CROSS REFERENCE NO
APPROVED BY	ENTERED Ph 1 Ph 2 Ph 3
	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME: LAIDLAW BRIDGETON SANITARY LANDFILL		WELL NUMBER: PZ-106-KS	
SITE ADDRESS: ST. CHARLES ROCK RD.	CITY: BRIDGETON	STATE: MO	ZIP CODE: 63044
NAME: LAIDLAW WASTE SYSTEMS, INC.		TELEPHONE: 314-241-3710	
ADDRESS: 1838 N. BROADWAY	CITY: ST. LOUIS	STATE: MO	ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

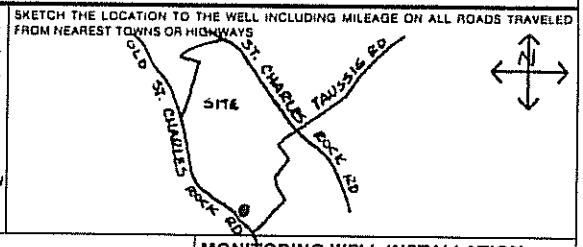
COUNTY: ST. LOUIS
ELEVATION: 461.8
AREA NO.

SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST ¼

SEC. ____ TWN. 47 N.RNG. 5 E OR W

LAT. 38 - 45 - 47 " LONG. 90 - 26 - 45 -

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN CO., INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN CO., INC.

TYPE OF INSTALLATION
☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT
464.26

MEASURING POINT IS
☒ TOP OF RISER PIPE
☐ OTHER

DRILLING EQUIPMENT
☒ AIR ROTARY ☒ AUGER TYPE 6¼" H.S.A.
☐ REVERSE ROTARY ☐ OTHER

CENTRALIZERS USED
☒ YES, AT 10 TOTAL
☒ STAINLESS STEEL
☐ OTHER
☐ NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
3-23-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR) Michael P. Vogl
PERMIT NUMBER 001256WM DATE 5-10-95
SIGNATURE (DRILLING CONTRACTOR) Michael P. Vogl
PERMIT NUMBER 001256WM DATE 5-10-95

NOTE: Record the fraction of a foot in decimal, not in inches.

Top of Riser Elevation: 464.3

LOCKING CAP - Y / N (Circle one)
CAP VENT - Y / N (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8"x8"x5'
Bore Hole Diameter: 10.25"
WEEP HOLE - Y / N (Circle one)

Ground Surface Elevation: 461.8 Ft

Information in this column to be supplied in the Feet from Surface column	Feet from Surface	Description of Formation
Depth to bottom of Protective Casing Seal:	2.5	
Depth to Base of Annular Seal:	350.0	
Depth to Base of Bentonite Seal:	360.0	
Depth to Base of Secondary Filter Pack:	361.0	
Depth to Top of the Screen:	363.6	Limestone
Depth to Bottom of the Screen:	373.6	
Plug Back Total Depth:		
Original Total Depth:	375.0	

PROTECTIVE CASING SEAL
Type: ☒ Concrete ☐ Cement Slurry

RISER PIPE
Length: 366.1
Diameter: 2"
Type of Material: PVC

BOREHOLE DIAMETER: 5 7/8 in.

ANNULAR SEAL
Type: ☐ Bentonite Slurry ☒ Cement Slurry ☐ Non Slurry Bentonite

BENTONITE SEAL
Type: ☒ Bentonite Slurry ☐ Non Slurry Bentonite
Length of Seal: 10 Ft.

SECONDARY FILTER PACK (Optional)
Type: ☒ Sand ☐ Manufactured
Grain Size: SUGAR
Length: 1'

PRIMARY FILTER PACK
Type: ☒ Sand ☐ Manufactured
Grain Size: 16-35
Length: 14'

WELL SCREEN
Length: 10'
Slot Size: 0.010"
Type: PVC

SUMP DETAILS
Length: 0.3 Ft.
Diameter: 2 in.
Type: PVC

TYPE OF BACKFILL: SAND

MO 780-1415 (2-94) DISTRIBUTION: WHITE DIVISION CANARY MONITORING WELL CONTRACTOR PINK OWNER

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	6.25 inch I.D. Hollow Stem Auger	PZ-107-SS
		SHEET 1 OF 3
	SAMPLING METHOD:	
	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)	DRILLING
	SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	START / FINISH
	WATER LEVEL	TIME 13:00 / TIME 16:25
	TIME	
	DATE	DATE 3/26/95 / DATE 3/26/95
NORTHING: 1067163.45 DATUM EASTING: 515254.52 ELEVATION 462.6	CASING DEPTH	

DRILL RIG CME 75	SURFACE CONDITIONS
ANGLE -90° BEARING	
SAMPLE HAMMER	

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1	3 5 5 5	0.9' / 2.0' (45%)			(0.0-2.0 ft.) Stiff, moderate yellowish brown (10YR 5/4), SILTY CLAY, trace of very fine Sand, WR, damp, (CL), (FILL)	SP 1	
2 3	2 2 4 18	1.0' / 2.0' (50%)			(2.0-4.0 ft.) Firm, yellowish brown (10YR 5/4), SILTY CLAY, little Gravel, trace amount of trash at bottom, WR, damp, (CL), (FILL)	SP 2	
4 5	3 8 11 10	1.1' / 2.0' (55%)			(4.0-6.0 ft.) Very stiff, medium light gray (N5) to dark greenish gray (5GY 4/1), SILTY CLAY, some Gravel, SR, moist, (CL), (FILL)	SP 3	
					(456.6) 6.0		
6 7	4 8 23 5	1.1' / 2.0' (55%)			(6.0-8.0 ft.) Mixed damp waste and silty clay	SP 4	
8 9	7 2 4 1	0.3' / 2.0' (15%)			(8.0-10.0 ft.) Trash	SP 5	
10 11	3 3 4 4	0.0' / 2.0' (0%)			(10.0-12.0 ft.) Waste becomes wet	SP 6	
					(450.6) 12.0		
12 13	8 32 15 9	0.0' / 2.0' (0%)	NO RECOVERY		(12.0-14.0 ft.) No Recovery	SP 7	From 12.0-28.0 ft. no samples recovered, but drilling indicated mixed waste and silty clay layers
14	6 12 8 5	0.0' / 2.0' (0%)			(14.0-15.0 ft.) No Recovery	SP 8	

DRILLING CONTR LAYNE-WESTERN

LOGGED BY S. COSIO CHK'D BY W. HERST

DATE 6/1/95

JOB NO.: 943-2848

FILENAME: PZ107SS

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	6.25 inch I.D. Hollow Stem Auger	PZ-107-SS
		SHEET 2 OF 3
	SAMPLING METHOD:	
	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)	DRILLING
	SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	START / FINISH
NORTHING: 1067163.45 DATUM EASTING: 515254.52 ELEVATION 462.6	WATER LEVEL / TIME / DATE / CASING DEPTH	START TIME 13:00 DATE 3/26/95 FINISH TIME 16:25 DATE 3/26/95

DRILL RIG CME 75	SURFACE CONDITIONS
ANGLE -90° BEARING	
SAMPLE HAMMER	

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
					(15.0-16.0 ft.) No Recovery	SP 8	
16	5 8 13 6	0.0'/2.0' (0%)			(16.0-18.0 ft.) No Recovery	SP 9	
17							
18	5 7 35 41	0.0'/2.0' (0%)			(18.0-20.0 ft.) No Recovery	SP 10	
19							
20	5 5 5 3	0.0'/2.0' (0%)			(20.0-22.0 ft.) No Recovery	SP 11	
21							
22	5 4 7 9	0.0'/2.0' (0%)	NO RECOVERY		(22.0-24.0 ft.) No Recovery	SP 12	
23							
24	6 7 7 10	0.0'/2.0' (0%)			(24.0-26.0 ft.) No Recovery	SP 13	
25							
26	5 5 9 12	0.4'/2.0' (20%)			(26.0-28.0 ft.) Waste	SP 14	
27							
28					(434.6) 28.0 (28.0-32.0 ft.) Stiff, dark greenish gray (5GY 4/1), SILTY CLAY, NR, wet, (CL), (LOESS)		
29							

DRILLING CONTR LAYNE-WESTERN

LOGGED BY S. GUSIO CHK'D BY W. HENSI

DATE 6/1/95

JOB NO.: 943-2848

FILENAME: PZ107SS

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	6.25 inch I.D. Hollow Stem Auger	PZ-107-SS
		SHEET 3 OF 3
	SAMPLING METHOD:	
	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)	DRILLING
	SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	START / FINISH
	WATER LEVEL	TIME / TIME
	TIME	13:00 / 16:25
	DATE	DATE / DATE
NORTHING: 1067163.45 DATUM EASTING: 515254.52 ELEVATION 462.6	CASING DEPTH	3/26/95 / 3/26/95

DRILL RIG CME 75 | SURFACE CONDITIONS

ANGLE -90° BEARING

SAMPLE HAMMER

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE		REMARKS
31					(28.0-32.0 ft.) Stiff, dark greenish gray (5GY 4/1), SILTY CLAY, NR, wet, (CL), (LOESS)			
32					(430.6) 32.0 End of Soil Borehole Log at 32.0 ft. See PZ-107-SS Record of Drillhole for rock descriptions below 55.0 ft.			
33								
34								
35								
36								
37								
38								
39								
40								
41								
42								
43								
44								

DRILLING CONTR LAYNE-WESTERN

LOGGED BY S. COSIO

DATE 6/1/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ107SS

RECORD OF DRILLHOLE PZ-107-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/21/95 - 5/22/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1067163.45
AZIMUTH: 0

COLLAR ELEV: 482.6
E: 515254.52
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
48	0.0-32.0 ft. See Soil Borehole Log PZ-107-SS 32.0-54.0 ft. No samples collected												5/18/95 - 5/19/95 A 9 7/8 in. borehole (air rotary) was advanced through 10 1/4 in. ID hollow stem augers from 30.0-55.0 ft., and 6 in. steel was sealed in borehole from surface to 55.0 ft. with neat cement. Bedrock was encountered at 51.0 ft. BGS during drilling
50													
52													
54	408.60 / 54.00 54.0-59.0 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)	408.60 / 54.00											5/21/95 @ 15:30 Began coring
56			1	92%				J,PL,SM,CL					
58								J,PL,SM					5/21/95 @ 15:50 End of Run 1
	59.0-63.5 ft. Slightly weathered, medium bedded, light olive gray (5Y 5/2), medium grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)	403.60 / 59.00											
60	60.0 ft. Fossiliferous							J,PL,R B,PL,SM					
			2	98%				J,PL,SM,CL J,PL,R					
62	63.5-82.3 ft. Fresh, medium to thinly bedded, pale yellowish brown (10YR 6/2), m-c grained, medium strong LIMESTONE, (ST. LOUIS FORMATION)							B,PL,SM					
64													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/20/95

Golder Associates

RECORD OF DRILLHOLE PZ-107-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2646
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/21/95 - 5/22/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1067183.45
AZIMUTH: 0

COLLAR ELEV: 462.6
E: 515254.52
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
64	63.5-62.3 ft. Fresh, medium to thinly bedded, pale yellowish brown (10YR 6/2), m-c grained, medium strong LIMESTONE, (ST. LOUIS FORMATION)				B,PL,SM	
	64.3 ft. Argillaceous layers common, stylolites common				B,PL,SM,CL	
66			2	98%		
					J,PL,SM	
					J,PL,SM,CL	
68					J,PL,SM,CL	5/21/95 @ 16:15 End of Run 2
		383.60 / 69.00				
					J,PL,R	
70					B,PL,SM,CL (5)	
72	72.1-72.6 ft. Argillaceous layer				B,PL,SM,CL	
					J,I,R	
74			3	100 %	B,PL,SM,CL	
76	76.7-77.2 ft. Argillaceous layer					
78	78.4-79.9 ft. Argillaceous layer				J,PL,SM (2)	5/21/95 @ 17:40 End of Run 3
		383.60 / 79.00				
			4	100 %	J,PL,SM	
80						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/20/95

Golder Associates

RECORD OF DRILLHOLE PZ-107-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/21/95 - 5/22/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1087163.45
AZIMUTH: 0

COLLAR ELEV: 482.6
E: 515254.52
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRP-Gravel Filled

DEPTH (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (80 60 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0 30 60 90)	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (FR SW MW HW CW)	STRENGTH INDEX (R6 R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 30 R2 150 R3 300 R4 600 R5 1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80	63.5-82.3 ft. Fresh, medium to thinly bedded, pale yellowish brown (10YR 6/2), m-c grained, medium strong LIMESTONE, (ST. LOUIS FORMATION)								J,PL,SM (3)						
									J,PL,SM (2)						
82	82.3-84.6 ft. Slightly weathered, medium bedded, light olive gray (5Y 5/2), medium grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)														
84	84.6-88.5 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Thinly laminated Clay layers abundant			4	100 %										
86									J,PL,SM,CL (2)						
									J,C,SM						
88	88.5-94.1 ft. Fresh, medium bedded, light olive gray (5Y 5/2), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Stylolites abundant		373.60 / 89.00												5/21/95 @ 18:40 End of Run 4 Quit drilling for the day 5/22/95 @ 7:30 Began drilling
90															
92				5	100 %										
94	94.1-97.2 ft. Fresh, thinly bedded, pale yellowish brown (10YR 6/2), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Abundant thinly laminated Clay layers								B,PL,SM,CL (3)						
96															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/20/95

Golder Associates

RECORD OF DRILLHOLE PZ-107-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/21/95 - 5/22/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1087163.45
AZIMUTH: 0

COLLAR ELEV: 462.6
E: 515254.52
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	ROCK TYPE / DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
96	94.1-97.2 ft. Fresh, thinly bedded, pale yellowish brown (10YR 6/2), fine grained, medium strong, LIMESTONE,(ST. LOUIS FORMATION) Abundant thinly laminated Clay layers								B,PL,SM						
				5	100 %										
98	97.2-100.7 ft. Slightly weathered, medium bedded, light olive gray (5Y 5/2), fine to medium grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Calcite filled healed fractures common		363.60 / 99.00												5/22/95 @ 8:10 End of Run 5
100									J,PL,R,CL						
	100.7-104.0 ft. Fresh, thinly bedded, pale yellowish brown (10YR 6/2), f-m grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Abundant thinly laminated clay layers			6	100 %				J,PL,R						
102									J,PL,R						
									J,PL,R						5/22/95 @ 8:30 Finished coring
104	358.60 End of Record of Borehole at 104.0 ft.		358.60 / 104.00												
106															
108															
110															
112															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

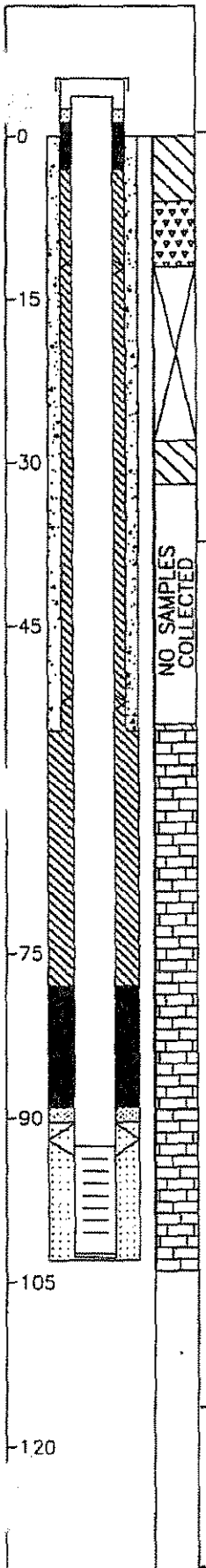
LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/20/95

Golder Associates

Well No. PZ-107-SS

Boring No. X-Ref: PZ-107-SS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords:	Northing: 1067163 ft.	Elevation Ground Level	462.6 ft. NGVD
	Easting: 515255 ft.	Top of PVC Casing	464.66 ft. NGVD

Drilling Summary:

Total Depth 103.0 ft.

Borehole Diameter 14 1/4 in. (0.0-32.0 ft.) 5 7/8 in. (32.0-103.0 ft.)

Casing Stickup Height 2.03 ft.

Driller Layne-Western, St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit for Reaming

Drilling Fluid Auger-None, NX Core Water, Air and Mud Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75 (augers)	3/28/95	13:00	3/28/95	16:25
CME 75 (core)	5/21/95	15:30	5/22/95	8:30
Schramm Rotary	5/22/95	11:00	5/22/95	11:30
Geophys.Logging:				
Casing:				
2" PVC	5/22/95	11:30	5/22/95	11:35
6" Steel	5/18/95	9:00	5/18/95	14:00
Filter Placement:	5/22/95	11:40	5/22/95	11:55
Cementing:				
Development				
Bentonite Grout	5/22/95	12:10	5/22/95	12:45
Bentonite Seal	5/22/95	11:55	5/22/95	12:10

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 2.03	-	92.60	C1	464.86	-	370.03
92.60	-	102.40	S1	370.03	-	360.23
102.40	-	102.73	C2	360.23	-	359.90
+ 1.00	-	55.00	C3	463.60	-	407.63
	-				-	
	-				-	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.) (C3-see comments)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 90.4-103.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 89.0-90.4 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-78.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 78.0-89.0 ft.

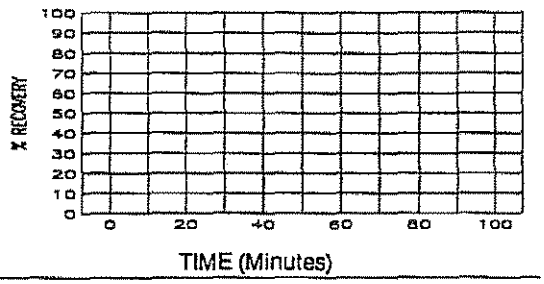
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Surface Casing C3: 6 1/8 ID / 6 5/8 in. OD Steel Casing

Supervised by	B. Tilton	Site	LAIDLAW/OU2 RI-FS/MO
Job Number	943-2848	File Name	PZ107SS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122508	CHECK NO.
ROUTE	TRANSMITTAL NO
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME	WELL NUMBER
LAIDLAW BRIDGETON SANITARY LANDFILL	PZ - 107SS

SITE ADDRESS	CITY	STATE	ZIP CODE
ST CHARLES ROCK RD	BRIDGETON	MO	63044

NAME	TELEPHONE
LAIDLAW WASTE SYSTEMS, INC.	314-241-3710

ADDRESS	CITY	STATE	ZIP CODE
1838 N. BROADWAY	ST. LOUIS	MO	63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

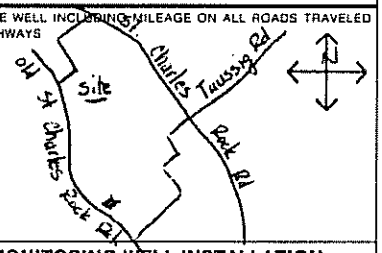
COUNTY ST. LOUIS
ELEVATION 450.6
AREA NO.

SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST ¼

SEC. ____ TWN. 47 N,RNG. 5 E OR W

LAT. 38° 45' 52" LONG. 90° 26' 48"

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN Co, INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN Co, INC.

TYPE OF INSTALLATION
☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT
464.7

MEASURING POINT IS
☒ TOP OF RISER PIPE
☐ OTHER

DRILLING EQUIPMENT
☒ AIR ROTARY ☒ AUGER TYPE 6¼ HSA
☐ REVERSE ROTARY ☐ OTHER

CENTRALIZERS USED
☒ YES, AT 4 TOTAL
☒ STAINLESS STEEL
☐ OTHER
☐ NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
5-22-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR) Michael P. Veit
PERMIT NUMBER 001256WM DATE 6-02-95
SIGNATURE (DRILLING CONTRACTOR) Michael P. Veit
PERMIT NUMBER 001256WM DATE 6-02-95

NOTE: Record the fraction of a foot in decimal, not in inches.

Top of Riser Elevation: 464.7

Ground Surface Elevation: 462.4

Feet from Surface	Description of Formation
Information in this column to be supplied in the Feet from Surface column	0-5 Clay
Depth to bottom of Protective Casing Seal: 3.0	5-38 Trash
	38-54 Not sampled
	54-103 Limestone
Depth to Base of Annular Seal: 18.0	
Depth to Base of Bentonite Seal: 89.0	
Depth to Base of Secondary Filter Pack: 90.4	
Depth to Top of the Screen: 92.6	
Depth to Bottom of the Screen: 102.6	
Plug Back Total Depth	
Original Total Depth: 103.0	

LOCKING CAP - Y / N (Circle one)
CAP VENT - Y / N (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8"x8"x8'
Bore Hole Diameter: 9 7/8"
WEEP HOLE - Y / N (Circle one)

PROTECTIVE CASING SEAL
Type: ☒ Concrete ☐ Cement Slurry

RISER PIPE
Length: 94.10
Diameter: 2"
Type of Material: SCH. 80 PVC

BOREHOLE DIAMETER: 5 7/8 In.

ANNULAR SEAL
Type: ☒ Bentonite Slurry ☐ Cement Slurry ☐ Non Slurry Bentonite

BENTONITE SEAL
Type: ☒ Bentonite Slurry ☐ Non Slurry Bentonite
Length of Seal: 11 FT.

SECONDARY FILTER PACK (Optional)
Type: ☒ Sand ☐ Manufactured
Grain Size: 4-50
Length: 1.4'

PRIMARY FILTER PACK
Type: ☒ Sand ☐ Manufactured
Grain Size: 16-35
Length: 12.6'

WELL SCREEN
Length: 10'
Slot Size: 0.010"
Type: SCH. 80 PVC

SUMP DETAILS
Length: 0.5 FT.
Diameter: 2 In.
Type: PVC

TYPE OF BACKFILL: SLAID

MO 780-1415 (2-94) DISTRIBUTION: WHITE DIVISION CANARY MONITORING WELL CONTRACTOR PINK/OWNER

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	BORING NO. PZ-109-SS SHEET 1 OF 2

WATER LEVEL					DRILLING START	DRILLING FINISH
TIME					TIME 7:48	TIME 8:48
DATE					DATE 4/7/95	DATE 4/7/95
CASING DEPTH						

NORTHING: 1068011.70
DATUM EASTING: 516144.36 ELEVATION 456.8

DRILL RIG CME 75 - TRUCK MOUNT
ANGLE -90° BEARING NA
SAMPLE HAMMER 140 lbs.
SURFACE CONDITIONS

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1	1 1 1 2	2.0'/2.0' (100%)			(0.0-2.0 Ft.) Very loose, light olive gray (5Y 6/1), SILT, trace of fine to coarse Gravel, trace very fine Sand, NR, moist, (ML), (FILL)	SP 1	
2	50/4"	0.4'/2.0' (20%)			(454.8) 2.0 (2.0-6.0 Ft.) Very dense, light olive gray (5Y 6/1), f-c GRAVEL, little fines, SR, damp, (GP), (FILL)	SP 2	
3							
4	50/3"	0.2'/2.0' (10%)				SP 3	
5							
6	5 6 8 8	1.8'/2.0' (90%)			(450.8) 6.0 (6.0-12.0 Ft.) Stiff, dark yellowish brown (10YR 4/2), mottled CLAYEY SILT, NR, damp, (CL-ML), (LOESS)	SP 4	
7							
8	5 7 8 11	1.6'/2.0' (80%)				SP 5	
9							
10	4 5 6 8	2.0'/2.0' (100%)				SP 6	
11							
12	4 3 5 7	1.8'/2.0' (90%)			(12.0-16.0 Ft.) Firm, mottled moderate yellowish brown (10YR 5/4) to light olive gray (5Y 6/1), CLAYEY SILT, NR, damp, (CL-ML), (LOESS)	SP 7	
13							
14	4 8 39 50/2"	1.9'/2.0' (95%)			@ 14.5 Ft., little fine Gravel	SP 8	

DRILLING CONTR LAYNE-WESTERN
LOGGED BY S. COSIO
DATE 5/31/95
CHK'D BY W. HERST
JOB NO.: 943-2848
FILENAME: PZ109SS

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	6.25 inch I.D. Hollow Stem Auger	PZ-109-SS
		SHEET 2 OF 2
	SAMPLING METHOD:	
	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)	DRILLING
	SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	START / FINISH
	WATER LEVEL	TIME / TIME
	TIME	7:48 / 8:48
	DATE	DATE / DATE
	CASING DEPTH	4/7/95 / 4/7/95

NORTHING: 1068011.70
DATUM EASTING: 516144.36 ELEVATION 456.8

DRILL RIG CME 75 - TRUCK MOUNT
ANGLE -90° BEARING NA
SAMPLE HAMMER 140 lbs.
SURFACE CONDITIONS

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE		REMARKS
16					(12.0-16.0 Ft.) Firm, mottled moderate yellowish brown (10YR 5/4) to light olive gray (5Y 6/1), CLAYEY SILT, NR, damp, (CL-ML), (LOESS) (440.8) 16.0	SP 8		Top of weathered bedrock encountered @ 15.7 ft.
					End of Soil Borehole Log at 16.0 ft.			
17					See PZ-109-SS Record of Drillhole for rock descriptions			
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								

DRILLING CONTR LAYNE-WESTERN

LOGGED BY S. COSIO CHK'D BY W. HERST

DATE 5/31/95

JOB NO.: 943-2848

FILENAME: PZ109SS

RECORD OF DRILLHOLE PZ-109-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/7/95-4/8/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068011.70
AZIMUTH: 0

COLLAR ELEV: 456.8
E: 516144.38
INCLINATION: -90

ROCK TYPE: J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation; PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular; P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough; Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (80 60 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR MW HW CW)	STRENGTH INDEX (R6 R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 30 R2 150 R3 300 R4 600 R5 900 R6 1500)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
0	0.0-15.7 ft. See Soil Borehole Log PZ-109-SS														
2															
4															
6															
8															
10															
12															
14	15.7-20.7 ft. Moderately weathered, thickly bedded, light olive gray (5Y 6/1), f-m grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)														
	441.10 / 15.70		441.10 / 15.70	1	100 %										4/7/95 @ 9:47 Begin coring Run 1
16	Fossiliferous, pyrite and calcite crystals common, stylolitic, abundant clay filled intact joints														

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: R. BOOTH
DATE: 5/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-109-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/7/95-4/8/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068011.70
AZIMUTH: 0

COLLAR ELEV: 456.8
E: 518144.38
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
16	15.7-20.7 ft. Moderately weathered, thickly bedded, light olive gray (5Y 6/1), f-m grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Fossiliferous, pyrite and calcite crystals common, stylolitic, abundant clay filled intact joints				J,PL,SM (2)	
					J,I,R (2)	
					J,I,R (2)	
					J,PL,SM	
18					J,I,R (2)	
					J,U,R	
20	19.8-20.0 ft. Layer of brown chert		1	100 %	J,PL,R (2)	
	20.7-31.5 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), f-m grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Fossiliferous, stylolitic, pyrite and calcite crystals common, abundant argillaceous partings				J,PL,R	
					J,I,R	
22						
24		432.30 / 24.50			J,I,R	4/7/95 @ 10:47 Begin coring Run 2
	25.0-25.5 ft. Bioclastic Limestone				J,I,CL	
	25.5-27.2 ft. Microcrystalline Limestone				J,U,SM (2)	
					J,I,R	
28					J,I,R (3)	
					J,PL,R (3)	
					J,I,CL (2)	
28			2	100 %	J,I,CL (2)	
					J,I,R	
					J,I,CL (2)	
30	29.9-31.3 ft. Dark greenish gray (5GY 4/1), intraclastic Limestone				J,I,CL (3)	
	31.3-31.4 ft. Layer of dark greenish yellow clay				J,I,R	
					J,I,CL	
	31.5-32.5 ft. Fresh, thinly bedded, greenish black (5G 2/1), fine grained, medium strong, DOLOMITE, (ST. LOUIS FORMATION) Large (3 mm.) calcite veins	425.30 / 31.50			J,I,CL (2)	
32					J,I,CL	

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: R. BOOTH
DATE: 5/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-109-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/7/95-4/8/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068011.70
AZIMUTH: 0

COLLAR ELEV: 456.8
E: 516144.36
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DL SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
32			424.30						J,I,R						
	32.5-34.9 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Little argillaceous partings, pyrite crystals present		32.50	2	100 %				J,PL,CL; J,I,CL						
34			422.30												
			34.50												4/7/95 @ 12:55 Begin coring Run 3
36	34.9-40.5 ft. Slightly weathered, thickly bedded, grayish orange (10YR 7/4) to light olive gray (5Y 6/1), f-m grained, strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Vugs up to 2 mm., calcite crystals and veins up to 3 mm. present, little pyrite crystals														
	35.0-38.7 ft. Very porous material								J,I,R						
38									J,I,CL						
	39.0-39.2 ft. Layer of brown chert			3	99%				J,I,R						
40									J,I,CL						
42	40.5-45.6 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Fossiliferous, chert nodules common, abundant argillaceous partings, calcite veins up to 8 mm., pyrite crystals scattered								J,I,R						
44			412.30												
			44.50												4/7/95 @ 13:50 Begin coring Run 4
46	45.6-58.2 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained to microcrystalline, medium strong to strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic, abundant calcite crystals and veins up to 2 mm., little pyrite crystals			4	99%				J,I,CL; J,I,CL; J,I,R (2)						
48															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: R. BOOTH
DATE: 5/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-109-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/7/95-4/8/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068011.70
AZIMUTH: 0

COLLAR ELEV: 456.6
E: 516144.38
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, Fr-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
48	48.5-51.6 ft. Abundant argillaceous partings and clay filled intact open joints				J,I,R	
	48.9-53.8 ft. Highly brecciated Limestone, cemented with a greenish gray clayey material					
50			4	99%	J,I,CL	
					J,I,CL	
52	52.0-53.3 ft. Intraclastic Limestone					
					J,PL,SM	
		403.00			J,I,R	
54	53.8-54.2 ft. Greenish black (5G 2/1), fine grained Dolomite	53.60 / 402.60 / 54.20				
		402.30 / 54.50				4/7/95 @ 14:42 Begin coring Run 5
	54.9-55.3 ft. Intraclastic Limestone					
	55.5-58.2 ft. Fossiliferous Limestone, abundant argillaceous partings					
58						
	58.2-74.6 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), f-m grained, strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Little fossils, vugs up to 8 mm., calcite veins with pyrite common, some calcite crystals				J,I,CL (2)	
					J,I,R	
			5	100 %		
60	58.2-62.3 ft. Limestone shows high porosity					
					J,I,R	
62						
					J,I,R	
					J,I,R	
					J,I,R	
64						

Columns: GRAPHIC LOG; ROD (50, 60, 40, 20); FRACTURES PER FOOT (2, 4, 6, 8, 10); DISCONTINUITY DATA — DIP wrt CORE AXIS (0, 30, 60, 90); GRAPHIC LOG; WEATHERING INDEX (SW, FR, HW, HW, CW); STRENGTH INDEX (R6, R5, R4, R3, R2, R1); POINT LOAD INDEX (psi) (R1 35, R2 150, R3 300, R4 600, R5 1500, R6); TEST ORIENTATION

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHJURIN

LOGGED: S. COSIO
CHECKED: R. BOOTH
DATE: 5/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-109-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/7/95-4/8/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1058011.70
AZIMUTH: 0

COLLAR ELEV: 458.8
E: 518144.38
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
64			392.30 / 64.50	5	100 %										4/7/95 @ 15:30 Begin coring Run 6
	65.0-69.4 ft. Apparent low porosity Limestone, vugs <1 mm.														
66	65.7-66.7 ft. Stylolitic Limestone, becomes medium strong								J,I,R						
68															
	69.4-72.8 ft. Apparent moderate porosity Limestone, vugs 1-2 mm.			6	100 %				J,PL,SM						
70									J,I,R						
									J,I,R						
									J,I,R						
									J,I,CL						
72	72.0-73.2 ft. Large (25 mm.) calcite crystals observed														
	72.8-74.3 ft. Apparent high porosity Limestone, vugs up to 8 mm.								J,I,CL						
74									J,I,R						
	74.6-75.7 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, strong, LIMESTONE, (ST. LOUIS FORMATION) Oolitic, little fossils, abundant calcite crystals, little chert		382.30 / 74.50						J,I,CL (2)						4/7/95 @ 16:21 Begin coring Run 7
									J,I,R						
76	75.7-77.8 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Vugs up to 5 mm., abundant calcite crystals, glauconite in defined places, Limestone has an apparent moderate to high porosity			7	100 %										
78	77.8-90.8 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained to microcrystalline, medium strong to strong, LIMESTONE, (ST. LOUIS FORMATION) Some fossils, little chert, stylolites, large calcite crystals, some pyrite								J,I,CL						
80															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: R. BOOTH
DATE: 5/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-109-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/7/95-4/8/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068011.70
AZIMUTH: 0

COLLAR ELEV: 456.6
E: 516144.36
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80	80.0-82.4 ft. Some intact joings filled with clayey material								J,I,CL						
	81.1-82.6 ft. Interbedded layers of argillaceous Limestone (5 mm.)								J,I,CL; J,PL,CL						
82				7	100 %										
	83.0-84.2 ft. Argillaceous Limestone, large calcite crystals, vugs up to 1 mm., relative low porosity								J,I,R						
84			372.30 / 84.50						J,I,R						4/7/95 @ 15:05 Stop coring; 4/8/95 @ 8:00 Begin coring Run 8
	85.5-87.3 ft. Limestone with numerous argillaceous partings and intact joints filled with clayey material								J,I,R						
86															
	87.3-88.2 ft. Argillaceous Limestone, bioturbated top 2 in.														
88	88.2-89.0 ft. Limestone, stylolitic microcrystalline								J,PL,CL						
	89.4-90.8 ft. Medium bluish gray (5B 5/1), fine grained, Argillaceous Limestone			8	100 %				J,I,R						
90									J,PL,SM						
	90.8-93.3 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), micro-crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION)								J,I,R; J,I,CL						
92	Interbedded with Argillaceous Limestone and bluish gray Limestone, stylolites present, calcite veins and pyrite crystals observed								J,I,CL						
	93.3-95.3 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)														
94	Few layers (up to 20 mm.) of Dolomitic Limestone, argillaceous partings present, pyrite and calcite common		362.30 / 94.50						J,I,CL						4/8/95 @ 9:04 Begin coring Run 9
				9	100 %										
	95.3-99.8 ft. (see next page)								J,PL,SM						
96															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: R. BOOTH
DATE: 5/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-109-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/7/95-4/8/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1088011.70
AZIMUTH: 0

COLLAR ELEV: 458.6
E: 516144.36
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filed

SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
98	95.3-99.8 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained to microcrystalline, strong LIMESTONE, (ST. LOUIS FORMATION) Stylolites not common, pyrite anc calcite veins <1 mm. observed, argillaceous partings common, few open joints filled with clayey material				J,PL,CL	
					J,PL,CL	
98					J,I,CL	
					J,I,CL	
100	99.8-104.7 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Vugs up to 2 mm. present, bioturbated in places, calcite crystals common		9	100 %		
102						
					J,U,CL	
104		352.30 / 104.50				4/8/95 @ 9:52 Begin coring Run 10
	104.7-107.9 ft. Fresh, thickly bedded, olive gray (5Y 6/1), micro-crystalline, strong, LIMESTONE, (ST. LOUIS FORMATION) Pyrite and calcite veins common, few large calcite crystals					
106	106.5-106.6 ft. Layer of olive black (5Y 2/1), clayey material, folliated 106.9-107.9 ft. Fossils common				J,C,R	
108	107.9-111.0 ft. Fresh, thickly bedded, olive gray (5Y 6/1), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolites present, vugs up to 1 mm., bioturbated in places, calcite crystals are common, more porous in bottom foot		10	100 %	J,PL,CL	
110	111.0-118.0 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic, little fossils, abundant pyrite and calcite crystals, abundant argillaceous partings, intra-clasts common				J,I,CL	
112						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: R. BOOTH
DATE: 5/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-109-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 843-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/7/95-4/8/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068011.70
AZIMUTH: 0

COLLAR ELEV: 458.8
E: 518144.38
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, X-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
112	111.0-118.0 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic, little fossils, abundant pyrite and calcite crystals, abundant argillaceous partings, intra-clasts common		343.10 / 113.70	10	100 %										4/8/95 @ 10:55 Begin coring Run 11
114															
	115.3-115.6 ft. Layer of grayish green (10G 4/6) Shale, intra-clastic								J,I,CL						
								30	J,I,CL						
116									J,I,CL						
									J,I,CL						
	116.5-117.1 ft. Slightly weathered Limestone							30	J,I,R						
									J,I,R						
									J,I,R						
									J,PL,CL						
118	118.0-123.2 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARENACEOUS LIMESTONE, (ST. LOUIS FORMATION) Banded with fine to medium grained Limestone, large crystals of calcite, few calcite veins and little pyrite			11	100 %										
120															
									J,I,CL						
122															
	333.60 / 123.20														
	123.2-130.0 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained to microcrystalline, strong to medium strong, LIMESTONE, (SALEM FORMATION) Stylolites observed, abundant fossils, oolitic, chert nodules common, large calcite crystals, little pyrite crystals scattered, calcite veins present but not abundant		333.10 / 123.70						J,PL,SM						123.2 ft. Top of SALEM FORMATION encountered
124															4/8/95 @ 12:50 Begin coring Run 12
									J,I,R						
	125.4-125.5 ft. Bed of chert								J,I,R						
126				12	99%										
	127.6-128.3 ft. Intraclastic Limestone cemented with dark greenish gray (5GY 4/1) clayey material								J,I,R						
128															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: R. BOOTH
DATE: 5/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-109-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/7/95-4/8/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068011.70
AZIMUTH: 0

COLLAR ELEV: 456.8
E: 516144.38
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (80 60 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP WRT CORE AXIS (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR MW HW CW)	STRENGTH INDEX (R6 R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 10 R2 150 R3 300 R4 600 R5 1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
128									J,I,CL						
	129.0-129.3 ft. Intraclastic Limestone and chert cemented with dark greenish gray (5Y 4/1) clayey material								J,PL,SM						
130	130.0-135.7 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, LIMESTONE, (SALEM FORMATION)								J,PL,SM						
									J,PL,R						
				12	99%										
	Chert nodules and layers up to 15 mm. are abundant, abundant calcite crystals, pyrite common, some very thin calcite veins								J,PL,SM (2)						
									J,I,R						
132									J,PL,SM						
									J,PL,SM						
									J,PL,R						
			323.10												Fragmented rock may be drill induced
			133.70												
134									J,PL,SM						
									J,PL,SM						
				13	100%				J,I,CL						
									J,I,R						4/8/95 @ 15:30 Coring completed
	321.10		321.10												
136	End of Record of Drillhole at 135.7 ft. 135.70		135.70												
138															
140															
142															
144															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

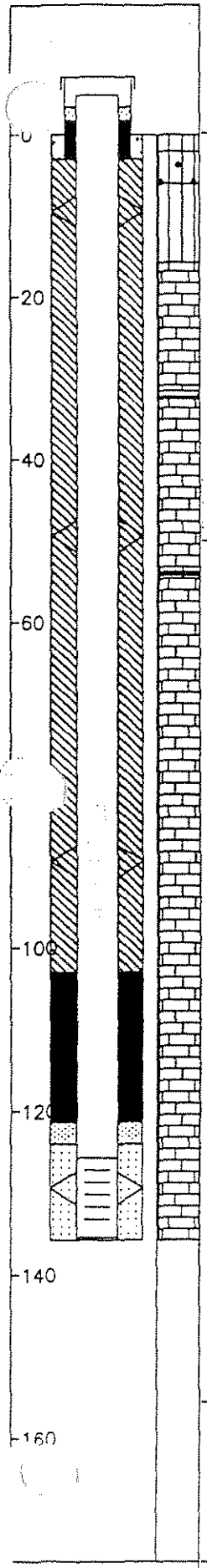
LOGGED: S. COSIO
CHECKED: R. BOOTH
DATE: 5/5/95

Golder Associates

Well No. PZ-109-SS

Boring No. X-Ref: PZ-109-SS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords:	Northing:	1068012 ft.	Elevation Ground Level	456.8 ft. NGVD
	Easting:	516144 ft.	Top of PVC Casing	458.50 ft. NGVD

Drilling Summary:

Total Depth 135.7 ft.

Borehole Diameter 10 1/4 in. (0.0-15.0 ft.) 5 7/8 in. (15.0-135.7 ft.)

Casing Stickup Height 1.73 ft.

Driller Layne-Western, St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit for Reaming

Drilling Fluid Auger-None, NX Core Water, Air Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	4/7/95	7:48	4/8/95	15:30
Schramm Rotary	4/25/95	9:30	4/25/95	11:40
Geophys.Logging:				
Casing:	4/25/95	12:00	4/25/95	12:10
Filter Placement:	4/25/95	12:10	4/25/95	12:20
Cementing:				
Development				
Bentonite Grout	4/25/95	12:45	4/25/95	13:15
Bentonite Seal	4/25/95	12:20	4/25/95	12:45

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.73	-	125.70	C1	458.50	-	331.07
125.70	-	135.50	S1	331.07	-	321.27
135.50	-	135.83	C2	321.27	-	320.94

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 124.0-135.7 ft.

Filter Pack: Less than 50 mesh Silica Sand, 121.3-124.0 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-103.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 103.0-121.3 ft.

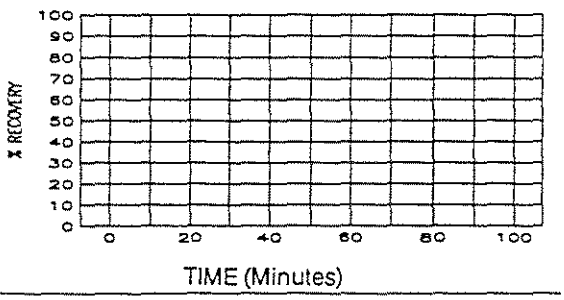
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Supervised by D. Alloway

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ109SS

61574

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122485	CHECK NO
ROUTE	TRANSMITTAL NO
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME: LAIDLAW BRIDGETON SANITARY LANDFILL		WELL NUMBER: PZ-109-SS	
SITE ADDRESS: ST. CHARLES ROCK RD.	CITY: BRIDGETON	STATE: MO	ZIP CODE: 63044
NAME: LAIDLAW WASTE SYSTEMS, INC.		TELEPHONE: 314-241-3710	
ADDRESS: 1838 N. BROADWAY	CITY: ST. LOUIS	STATE: MO	ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

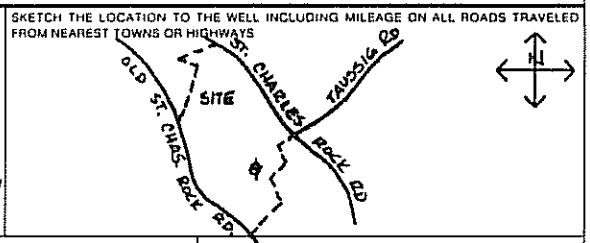
COUNTY: ST. LOUIS
ELEVATION:
AREA NO.:

SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST ¼

SEC. ____ TWN. 47 N.RNG. 5 (E) OR W

LAT. 38 ° 46 ' 00 " LONG. 90 ° 26 ' 36 "

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME: LAYNE WESTERN CO., INC.

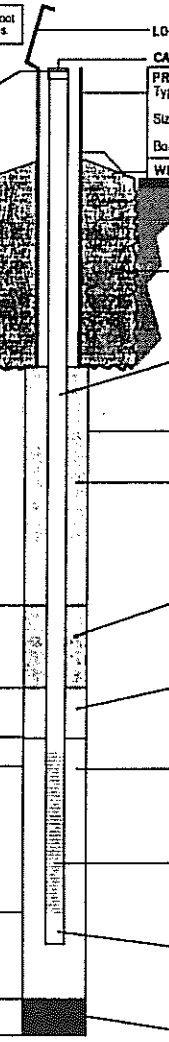
DRILLING CONTRACTOR'S NAME: LAYNE WESTERN CO., INC.

NOTE: Record the fraction of a foot in decimal, not in inches.

Top of Riser Elevation:

LOCKING CAP - (Y) N (Circle one)
CAP VENT (Y) N (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8"x8"x5'
Bore Hole Diameter: 10"
WEEP HOLE - Y / N (Circle one)



Ground Surface Elevation: Ft	Feet from Surface	Description of Formation
Information in this column to be supplied in the Feet from Surface column		0-2' silt
		2'-6' Silt & gravel
Depth to bottom of Protective Casing Seal:	3.0	
		6'-14' silt
		6'-135.7' Limestone
Depth to Base of Annular Seal:	103	
Depth to Base of Bentonite Seal:	121.3	
Depth to Base of Secondary Filter Pack:	124.0	
Depth to Top of the Screen:	125.4	
Depth to Bottom of the Screen:	135.4	
Plug Back Total Depth		
Original Total Depth:	135.7	

PROTECTIVE CASING SEAL
Type: [X] Concrete [ ] Cement Slurry

RISER PIPE
Length: 127.1'
Diameter: 2"
Type of Material: Sch. 80 PVC

BOREHOLE DIAMETER: 5 7/8 In.

ANNULAR SEAL
Type: [X] Bentonite Slurry [ ] Cement Slurry [ ] Non Slurry Bentonite

BENTONITE SEAL
Type: [X] Bentonite Slurry [ ] Non Slurry Bentonite
Length of Seal: 18.3 FL

SECONDARY FILTER PACK (Optional)
Type: [X] Sand [ ] Manufactured
Grain Size: < 50
Length: 2.7'

PRIMARY FILTER PACK
Type: [X] Sand [ ] Manufactured
Grain Size: 16/35
Length: 11.7

WELL SCREEN
Length: 10'
Slot Size: 0.010"
Type: Sch. 80 PVC

SUMP DETAILS
Length: 0.3 FL
Diameter: 2 In.
Type: PVC

TYPE OF BACKFILL: SAND

TYPE OF INSTALLATION: [X] ABOVE GROUND [ ] FLUSH MOUNT

STATIC WATER LEVEL: FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT

MEASURING POINT IS: [ ] TOP OF RISER PIPE [ ] OTHER

DRILLING EQUIPMENT: [X] AIR ROTARY [X] AUGER TYPE 6¼ H.S.A. [ ] REVERSE ROTARY [ ] OTHER

CENTRALIZERS USED: [X] YES, AT 4 TOTAL [X] STAINLESS STEEL [ ] OTHER [ ] NO

MULTIPLE CASED WELLS: SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED: 4-25-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR): Michael P. Vogl
PERMIT NUMBER: 001256WM DATE: 6-02-95

SIGNATURE (DRILLING CONTRACTOR): Michael P. Vogl
PERMIT NUMBER: 001256WM DATE: 6-02-95

BRIDGETON LANDFILL
MONITORING WELL INSTALLATION

Log of Boring

PZ-111-SS

Permit Number:	MO 004440	Northing (ft):	
Drilling Method:	T75 Track	Easting (ft):	
Drilling Contactor:	Roberts Environmental Drilling, Inc.	Driller:	Eric Wetzal
Start Date:	August 16, 2017	Ground Surface Elevation (ft msl):	
Finish Date:	August 22, 2017	Water Level:	
Logger:	FBP	Date Logged:	

Depth Below Surface (ft)	Water Level	Sample: Sample or Box Number	Sample: Recovery	Sample: Standard Penetration 6"- 6"- 6"- (N)	Sample: Rock Quality Designation	Sample: Runtime	Sample Description: Depth Below Surface (ft)	Sample Description: Comments
1 2							0-2' 10 YR 4/4 Dark Yellowish Brown Top soil w/organics	Begin Drilling@ 7:15 4 1/4" I.D. HSA 2" O.D. Split Spoon
3 4		Bag 1	1.6 2.0	10/20 30/31			2-4 10 YR 6/2 Dense Light Brownish Gray, Sandy Clay with some Gravel, Dry $(CL)_H$	
5 6		Bag 2	1.5 2.0	10/10 10/8			4-6 10 YR 4/2 Dark Grayish Brown, Silty Clay Trace Sand, Moist $(CL)_H$	
7 8		Bag 3	0 2.0	>50			No Recovery	
9 10		Bag 4	1.7 2.0	8/6 4/3			8.0-9.3 10 YR 6/1 Gray Silty Clay with some Gravel, Soft, Wet, $(CL)_H$ 9.3-10 10YR 6/6 Brownish Yellow Silty Clay with trace Sand, Soft, Wet $(CL)_H$	encountered water around 8' bgs
11 12		Bag 5	1.4 2.0	3/4 5/3				
13 14		Bag 6	2.0 2.0	4/5 5/5			10.3-16.2 10 YR 5/2 Grayish Brown, Silty Clay, soft, moist $(CL)_4$	
15 16		Bag 7	1.6 2.0	1/1 2/3				
17 18		Bag 8	1.0 2.0	1/1 >50			16.2-17 10YR 6/2 Light Brownish Gray, Silty Clay Trace Sand and Gravel, Soft, Moist	
19							No splitspoon possible due to gravel. Continued splitspoon at 19' bgs.	
20		Bag 9	1.4 2.0	3/5 3/5			19-19.7 10YR 6/2 Light Brownish Gray, Silty Clay Trace Sand and Gravel, Soft, Moist	

BRIDGETON LANDFILL
MONITORING WELL INSTALLATION

Log of Boring

PZ-111-SS

Permit Number: MO 004440
Drilling Method: T75 Track
Drilling Contactor: Roberts Environmental Drilling, Inc.
Start Date: August 16, 2017
Finish Date: August 22, 2017
Logger: FBP

Northing (ft):
Easting (ft):
Driller: Eric Wetzal
Ground Surface Elevation (ft msl):
Water Level:
Date Logged:

Depth Below Surface (ft)	Water Level	Sample: Sample or Box Number	Sample: Recovery	Sample: Standard Penetration 6"- 6"- 6"- (N)	Sample: Rock Quality Designation	Sample: Runtime	Sample Description: Depth Below Surface (ft)	Comments
21							19.0-21.3 10 YR 5/2 Grayish Brown, Silty Clay, soft, moist $(CL)_4$	
22		Bag 10	1.6 / 2.0	3/5 9/10			21.3-25.5 10 YR 6/1 Gray, Silty Clay with Trace Sand, Soft, Wet $(CL)_4$	
23								
24		Bag 11	1.6 / 2.0	3/3 5/12				
25								
26		Bag 12	1.4 / 2.0	17/10 14/19			25.5 -33.8 10 YR 5/1 Gray Fine Grained Silty Sand, Compacted,Wet (Alluvial)	
27								
28		Bag 13	1.6 / 2.0	14/22 20/20				
29								
30		Bag 14	1.2 / 2.0	5/10 14/21				
31								
32		Bag 15	1.5 / 2.0	10/14 13/10				
33								
34		Bag 16	1.6 / 2.0	1/1 3/10			33.8-34.2 10 YR 5/2 Grayish Brown, Silty Clay, soft, moist $(CL)_4$	
35							34.2-35.5 10 YR 5/6 Yellowish Brown Fine Grained Sand, Mottled with Silt, Dense, Wet (Alluvial)	
36		Bag 17	1.5 / 2.0	10/10 13/18			35.5-41 10 YR 4/2 Dark Yellowish Brown Fine to Medium grained sand, Dense, Wet (Alluvial)	
37								
38		Bag 18	1.2 / 2.0	1/1 1/3				
39								
40		Bag 19	1.3 / 2.0	0/0 0/1				

BRIDGETON LANDFILL
MONITORING WELL INSTALLATION

Log of Boring

PZ-111-SS

Permit Number: MO 004440
Drilling Method: T75 Track
Drilling Contactor: Roberts Environmental Drilling, Inc.
Start Date: August 16, 2017
Finish Date: August 22, 2017
Logger: FBP

Northing (ft):
Easting (ft):
Driller: Eric Wetzal
Ground Surface Elevation (ft msl):
Water Level:
Date Logged:

Depth Below Surface (ft)	Water Level	Sample: Sample or Box Number	Sample: Recovery	Sample: Standard Penetration 6"- 6"- 6"- (N)	Sample: Rock Quality Designation	Sample: Runtime	Sample Description: Depth Below Surface (ft)	Sample Description: Comments
41								
42		NA	0 / 2.0	5/6 12			No Recovery	Borehole Collapsing use tremie pipe w/water to stabilize sand.
43								
44		Bag 20	1.2 / 2.0	6/9 10/20				
45								
46		Bag 21	2.0 / 2.0	12/17 18/25			43-47 10 YR 4/2 Dark Yellowish Brown Fine to Medium grained sand, Dense, Wet (Alluvial)	see comment above
47								
48		NA	0 / 2.0	9/25 35/50			No Recovery	
49								
50		Bag 22	0.6 / 2.0	10/20 25/30				see comment above
51								
52		Bag 23	1.0 / 2.0	4/6 10/8				
53								
54		Bag 24	1.0 / 2.0	5/5 5/10			49-58 10 YR 4/2 Dark Yellowish Brown Fine to Medium grained sand, Dense, Wet (Alluvial)	
55								
56		Bag 25	0.3 / 2.0	10/15 16/20				
57								
58		Bag 26	1.0 / 2.0	0/1 0/1				
59							58-59.5 5Y 4/1 Dark Gray, Silty Clay, Soft, Wet $(CL)_H$	
60		Bag 27	2.0 / 2.0	1/2 3/5			59.5-60.5 10YR 3/1 Very Dark Gray Silty Clay, with fibrous wood, Stiff, Moist $(CH)_L$	

BRIDGETON LANDFILL
MONITORING WELL INSTALLATION

Log of Boring

PZ-111-SS

Permit Number: MO 004440
Drilling Method: T75 Track
Drilling Contactor: Roberts Environmental Drilling, Inc.
Start Date: August 16, 2017
Finish Date: August 22, 2017
Logger: FBP

Northing (ft):
Easting (ft):
Driller: Eric Wetzal
Ground Surface Elevation (ft msl):
Water Level:
Date Logged:

Depth Below Surface (ft)	Water Level	Sample: Sample or Box Number	Sample: Recovery	Sample: Standard Penetration 6"- 6"- 6"- (N)	Sample: Rock Quality Designation	Sample: Runtime	Sample Description: Depth Below Surface (ft)	Sample Description: Comments
61							60.5-61 10YR 3/1 Very Dark Gray, Silty Clay, Soft, Moist $(CL)_H$	
62		Bag 28	1.8 / 2.0	1/1 / 1/1				
63								
64		Bag 29	0.8 / 2.0	1/1 / 2/2			61-65.5 10YR 3/1 Very Dark Gray, Silty Clay, trace sand Wood Fragments, Soft, Moist $(CL)_H$	End drilling @ 15:38
65								
66		Bag 30	0.8 / 2.0	0/2 / 4/6			65.5-69 10YR 3/1 Very Dark Gray, Silty Fine Grained Sand with some 10 YR 2/1 Black Shale Partings, Loose, Moist (SM)	Resume drilling 8/17/17 around 08:34
67								
68		Bag 31	1.2 / 2.0	4/6 / 7/20				
69								
70		Bag 32	0.9 / 2.0	6/8 / 7/10				
71								
72		Bag 33	0.8 / 2.0	8/8 / 10/15			65.5-75 10YR 3/1 Very Dark Gray, Silty Fine to Medium Grained Sand, Loose, Moist (SM)	
73								
74		Bag 34	0.4 / 2.0	4/10 / 15/15				
75								
76		NA	0.0 / 2.0	6/6 / 8/9			No Recovery	Attempted to flush sand from borehole.
77								
78							Blind Drilled from 77' bgs to bedrock (88' bgs). Received approval from MDNR.	
79								
80								

BRIDGETON LANDFILL
MONITORING WELL INSTALLATION

Log of Boring

PZ-111-SS

Permit Number:	MO 004440	Northing (ft):	
Drilling Method:	T75 Track	Easting (ft):	
Drilling Contactor:	Roberts Environmental Drilling, Inc.	Driller:	Eric Wetzal
Start Date:	August 16, 2017	Ground Surface Elevation (ft msl):	
Finish Date:	August 22, 2017	Water Level:	
Logger:	FBP	Date Logged:	

Depth Below Surface (ft)	Water Level	Sample: Sample or Box Number	Sample: Recovery	Sample: Standard Penetration 6"- 6"- 6"- (N)	Sample: Rock Quality Designation	Sample: Runtime	Sample Description: Depth Below Surface (ft)	Sample Description: Comments
81								
82								
83								
84								
85								
86								
87								
88								
89		Box 1 Row 1				8:12	88-91 Missing Core	begin coring @ 88' bgs NQ Wireline and Water
90			1.7		0			Light Gray to Dark Gray water return
91		Box 1 Row 2	5.0		5.0	Run # 1	91-92 N8 to N7 Very light to light Gray Coarse Grained Gravel	
92							92-92.1 5Y 6/1 Light Olive Gray Siltstone, Very Weak Moderately Weathered, Fine Grained	
93		Box 1 Row 3				8:38	92.1-93.2 Light Olive Gray Siltstone, Weak Moderately Weathered, Fine Grained	
94						9:19	93.2-93.7 N7 light Gray Limestone, Moderately Strong, Slightly Weathered, Fine Grained.	
95		Box 1 Row 4	4.7		1.2		93.7-94.0 10YR 3/1 Very Dark Gray, Silty Clay, Soft with 1" sized gravel	
96			5.0		5.0	Run # 2	94-99 N6 Medium Light Gray, Siltstone Weak, Moderately Weathered, Thinly Bedded	Light Gray Water Return
97		Box 1 Row 5						
98						9:30		
99		Box 2 Row 1				9:45		
100						Run # 3	99-100.4 N7 light Gray Limestone, Moderately Strong, Slightly Weathered, Fine Grained. (St. Louis Formation)	

BRIDGETON LANDFILL
MONITORING WELL INSTALLATION

Log of Boring

PZ-111-SS

Permit Number:	MO 004440	Northing (ft):	
Drilling Method:	T75 Track	Easting (ft):	
Drilling Contactor:	Roberts Environmental Drilling, Inc.	Driller:	Eric Wetzal
Start Date:	August 16, 2017	Ground Surface Elevation (ft msl):	
Finish Date:	August 22, 2017	Water Level:	
Logger:	FBP	Date Logged:	

Depth Below Surface (ft)	Water Level	Sample: Sample or Box Number	Sample: Recovery	Sample: Standard Penetration 6"- 6"- 6"- (N)	Sample: Rock Quality Designation	Sample: Runtime	Sample Description: Depth Below Surface (ft)	Sample Description: Comments
101		Box 2 Row 2					100.4-104.8 N6 Medium Gray, Dolomitic Limestone, Moderately Strong, Slightly Weathered, Fine Grained (St. Louis Formation)	
102								
103		Box 2 Row 3						
104			10.0		5.8	Run # 3		
			10.0		10.0		104.8-113.0 N7 Light Gray Limestone, Moderately Strong, Slightly Weathered, Fine to Medium Crystalline with Pyrite and calcite filled fractures (St. Louis Formation)	
105		Box 2 Row 4						
106								
107		Box 2 Row 5					107.6 GLEY 1 8/1 Light Greenish Gray Shale Parting	
108						10:20		
109		Box 3 Row 1					109.7-110 missing core	
110			4.7		3.4	Run # 4		
			5.0		5.0		110-110.2 GLEY 1 8/1 Light Greenish Gray Shale Parting 110.2-110.7 calcite filled fractures throughout core. 111-111.6 Stylolites	
111		Box 3 Row 1						
112								
113		Box 3 Row 3				10:45		
114							End of Boring 113' bgs	
115								
116								
117								
118								
119								
120								

DRILLING CONTRACTOR: ROBERTS ENVIRONMENTAL DRILLING, INC.

DRILLING METHOD: MUD ROTARY

MO REGISTERED PROFESSIONAL GEOLOGIST: BILL ABERNATHY P.G. □R.G.

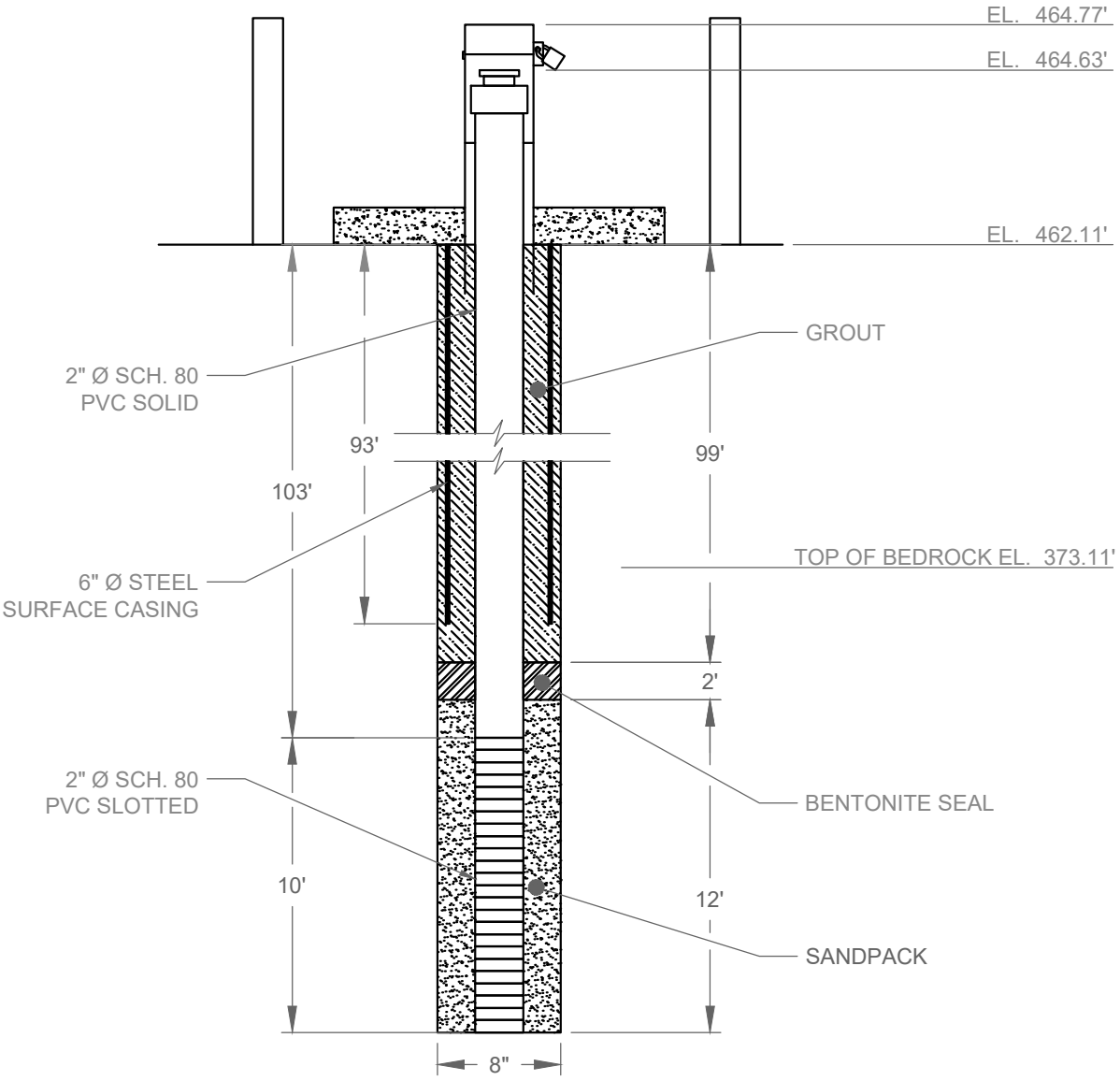
INSTALLATION SUPERVISOR: ERIC WETZEL

INSTALLATION DATE: 8□25□2017 THRU 8□29□2017

SURVEYOR: WEAVER CONSULTANTS GROUP

NORTHING: 1,068,590.96

EASTING: 515,814.70



PZ-111-SS
NOT TO SCALE

BRIDGETON LANDFILL LLC 13570 ST. CHARLES ROCK ROAD BRIDGETON, MO 63044	BRIDGETON LANDFILL PZ-111-SS INSTALLATION	Engineering for a Better World FEEZOR ENGINEERING, INC.	OCTOBER 2017 DRAWN BY: BJV APPROVED BY: WJA	FIGURE: 2
PZ-111-SS AS-BUILT DRAWING			REVISION DATE	
PROJECT NUMBER: BT-163	FILE PATH: D:\Bridgeton Land□ill\PZ-111-SS.dwg			

MISSOURI DEPARTMENT OF NATURAL RESOURCES
MISSOURI GEOLOGICAL SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY		DATE RECEIVED	
REFERENCE NO. 528467		CHECK NO.	
STATE WELL NO.		REVENUE NO.	
ENTERED	APPROVED	DATE	ROUTE / /

INFORMATION SUPPLIED BY PRIMARY CONTRACTOR OR DRILLING CONTRACTOR (THIS FORM IS NOT TO BE USED FOR NESTED WELLS)

OWNER NAME	CONTACT NAME		TELEPHONE WITH AREA CODE
BRIDGETON LANDFILL (BRIDEGETON LANDFILL, LLC)	N/A		N/A
OWNER ADDRESS (MAILING ADDRESS)	CITY	STATE	ZIP CODE
13570 ST. CHARLES ROCK RD.	ST. LOUIS	MO	63044
SITE NAME	REGULATORY ID NUMBER	WELL NUMBER	VARIANCE NUMBER (IF ISSUED)
ABANDONMENT/BEDROCK WELLS BRIDGETON L/F		PZ-111-SS	
SITE ADDRESS (PHYSICAL ADDRESS IF DIFFERENT THAN MAILING)		CITY	COUNTY
13570 ST. CHARLES ROCK RD.		ST. LOUIS	ST. LOUIS

SURFACE COMPLETION

TYPE: ☑ ABOVE GROUND ☐ FLUSH MOUNT

LENGTH AND DIAMETER OF SURFACE COMPLETION: LENGTH 5 FT. DIAMETER 4X4 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: DIAMETER 24sq IN. LENGTH 2 FT.

SURFACE COMPLETION GROUT: ☑ CONCRETE ☐ OTHER _____

LOCATION OF WELL (D/M/S FORMAT ONLY): LAT. 38° 46' 12.1" LONG. 90° 26' 51.8"

SMALLEST ___ ¼ ___ ¼ LARGEST ___ ¼

SECTION ___ TOWNSHIP ___ NORTH

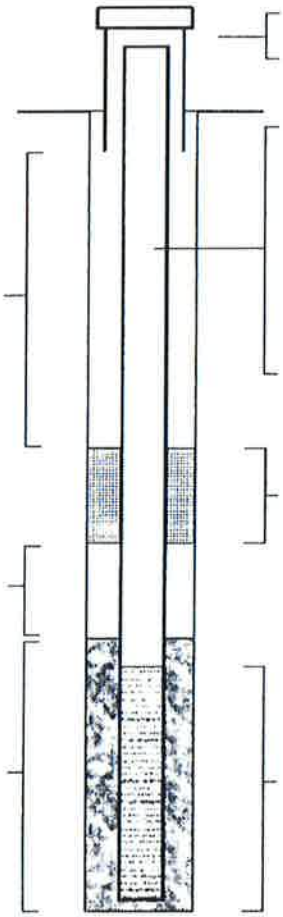
RANGE ___ ☐ EAST ☐ WEST

MONITORING FOR: (CHECK ALL THAT APPLY)
☐ RADIONUCLIDES ☐ PETROLEUM PRODUCTS ONLY
☐ EXPLOSIVES ☑ METALS ☑ VOCS
☑ SVOCS ☐ PESTICIDES/HERBICIDES

TYPE OF WELL
☐ GAS MIGRATION WELL ☑ OBSERVATION
☐ EXTRACTION WELL ☐ OPEN HOLE
☐ PIEZOMETERS ☐ INJECTION WELL
☐ DIRECT PUSH

☑ LOCKING CAP
☑ WEEP HOLE

ELEVATION _____ FT.



SURFACE COMPLETION
☑ STEEL ☐ ALUMINUM ☐ PLASTIC

RISER
RISER PIPE DIAMETER 1 IN.
RISER PIPE LENGTH 105.5 FT.
DIAMETER OF DRILL HOLE 10 IN.
WEIGHT OR SDR# 40

MATERIAL
☑ STEEL ☐ THERMOPLASTIC (PVC)
☐ OTHER _____

ANNULAR SEAL
LENGTH 96 FT.
☐ SLURRY ☑ CHIPS
☐ PELLETS ☐ GRANULAR
☐ CEMENT/SLURRY

IF CEMENT/BENTONITE MIX:
BAGS OF CEMENT USED _____
% OF BENTONITE USED _____
WATER USED PER BAG _____ GAL.

BENTONITE SEAL
LENGTH 3 FT
☑ CHIPS ☐ PELLETS ☐ GRANULAR
☐ SATURATED ZONE ☐ HYDRATED

SECONDARY FILTER PACK
LENGTH NA FT.

DEPTH TO TOP OF PRIMARY FILTER PACK 101 FT.

LENGTH OF PRIMARY FILTER PACK 12 FT.

SCREEN
SCREEN DIAMETER 1 IN.
SCREEN LENGTH 10 FT.
DIAMETER OF DRILL HOLE 6 IN.
DEPTH TO TOP 105.5 FT.

SCREEN MATERIAL
☐ STEEL ☑ THERMOPLASTIC (PVC)
☐ OTHER _____

DEPTH TO	DEPTH FROM	FORMATION DESCRIPTION
(REDI	JOB#	172157-AB/D-AR)
2'	0	Top Soil w/Organics
10'	2'	Silty Clay w/Gravel/Sand
34'	10'	Silty Clay w/Sand
60'	34'	Silty Clay w/Fine Sand /Silt
90'	60'	Limestone/Siltstone/
113'	90'	Grav./SiltyClay/Limestne/Shal
***1'	93'	10" CASING
***93'	113'	6" CASING
		PORTLAND TYPE III

TOTAL DEPTH: 113'

STATIC WATER LEVEL 31.98 FT.

PUMP INSTALLED ☐ YES ☑ NO

FOR CASED WELLS, SUBMIT ADDITIONAL AS-BUILT DIAGRAMS SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE & SIZE OF ALL CASING, HOLE DIAMETER & GROUT USED.

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH MISSOURI DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

PRIMARY CONTRACTOR SIGNATURE (IF DIFFERENT THAN DRILLER)	PERMIT NUMBER	DATE	WELL COMPLETION DATE
		10/10/17	08/29/2017

WELL DRILLER SIGNATURE	PERMIT NUMBER	DATE	APPRENTICE SIGNATURE	PERMIT NUMBER
Eric Wetzel	4255-M			

MO 780-1415 (02-14) SEND COMPLETED FORM ALONG WITH $100 CERTIFICATION FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, MISSOURI GEOLOGICAL SURVEY, WELLHEAD PROTECTION SECTION, PO BOX 250, ROLLA, MO 65402 PHONE: 573-368-2165 FAX: 573-368-2317 EMAIL: welldrillers@dnr.mo.gov

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL PLUGGING REGISTRATION RECORD

OFFICE USE ONLY		
REF NO. 531858	DATE RECEIVED	
C.R. NO.	CHECK NO.	TRANSMITTAL NO.
STATE WELL NUMBER	APPROVED BY	DATE APPROVED
ENTERED Ph1 Ph2 Ph3	ROUTE	

INFORMATION SUPPLIED BY WELL OR PUMP INSTALLATION CONTRACTOR

OWNER NAME	TELEPHONE NUMBER	VARIANCE NUMBER (IF APPLICABLE)
BRIDGETON LANDFILL (BRIDGETON LANDFILL, LLC)	N/A	

OWNER ADDRESS	CITY	STATE	ZIP CODE
13570 ST. CHARLES ROCK RD.	ST. LOUIS	MO	63044

ADDRESS OF WELL SITE	CITY	STATE	ZIP CODE	REFERENCE NUMBER OF ORIGINAL WELL (IF KNOWN)
13570 ST. CHARLES ROCK RD.	ST. LOUIS	MO	63044	

SITE NAME	WELL NUMBER	DATE
ABADONMENT/BEDROCK WELLS BRIDGETON L/F	PZ 111 - SS	

LOCATION OF WELL
LAT. 38 ° 46 ' 12.2 "
LONG. 90 ° 26 ' 51.8 "

DRILL AREA: AREA 1
COUNTY: ST. LOUIS

SMALLEST ____ ¼ LARGEST ____ ¼ ____ ¼
Sec. Township North Range ☐ East ☐ West

PLUGGING INFORMATION

ORIGINAL DRILLER (IF KNOWN)	DATE ORIGINALLY DRILLED	STATIC WATER LEVEL	DRILLER NOTES
N/A	N/A	N/A	N/A

☐ **MONITORING WELL**

DEPTH OF WELL	LENGTH OF RISER
____ FT.	____ FT. BGS

SCREEN/RISER DIAMETER	WELL SCREEN AND RISER REMOVED?
____ IN.	☐ Yes ☐ No

PUMP AND SAMPLING EQUIPMENT REMOVED?	CASING REMOVED?
☐ Yes ☐ N/A ☐ No	☐ Yes ☐ N/A ☐ No

☐ **SOIL BORING(S)** Boring Diameter:____IN.

QUANTITY	DEPTH
1	113'
TOTAL 1 BORING(S)	TOTAL 113 FT.

TYPE OF FILL MATERIAL: ☐ Gravel ☐ Sand ☐ Other

AMOUNT OF FILL USED: ____ ☐ TONS ☐ CUBIC YARDS

DEPTH TO TOP OF FILL: ____ FT.

GROUT INSTALLATION METHOD	GROUT MATERIAL USED	HOW MANY GALLONS OF WATER MIXED PER BAG OF CEMENT OR BENTONITE?	TOTAL NUMBER OF BAGS OF GROUT USED
☑ Gravity ☐ Tremie ☐ Excavation	Neat Cement Bentonite ☐ Hi-Early ☐ Slurry ☐ Granular ☐ Pellets ☐ Type 1 ☑ Chips ☐ Other ____	5 ☐ Hydrated to Saturation	6
			POUNDS OF GROUT PER BAG: 50

DATE 1st WELL PLUGGED	DATE LAST WELL PLUGGED	FINISHED SURFACE MATERIAL	SURFACE MATERIAL LENGTH
08/22/2017	08/29/2017	☑ Soil ☐ Concrete ☐ Asphalt ☐ Other	____ FT.____ IN.

REMARKS	REASON FOR ABANDONMENT
(REDI JOB 172157-AB/D-AR)	

I hereby certify that the monitoring well herein described was plugged in accordance with the Department of Natural Resources requirements for the plugging of wells.

SIGNATURE (PRIMARY CONTRACTOR)	SIGNATURE (CONTRACTOR)	PERMIT NUMBER	DATE
	Eric Wetzel	4255-M	10/25/2017
PERMIT NUMBER / DATE	SIGNATURE (APPRENTICE)	PERMIT NUMBER	DATE

MO-780-2161 (1-12)

REMIT TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, DIVISION OF GEOLOGY AND LAND SURVEY
WELLHEAD PROTECTION SECTION, PO BOX 250, ROLLA, MO 65402 573-368-2165
ENCLOSE $50 FEE WITH REGISTRATION RECORD WITHIN 60 DAYS AFTER WELL PLUGGING OR WITHIN 180 DAYS AFTER THE PLUGGING OF TEMPORARY WELLS

RECORD OF DRILLHOLE PZ-111-SD

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/11/95
DRILL RIG: Schramm

DATUM: MSL
COORDINATES N: 1068638.1
AZIMUTH: 0

COLLAR ELEV: 459.2
E: 515834.8
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (80 60 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0 30 60 90)	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR MW HW CW)	STRENGTH INDEX (R6 R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R3 30 R2 150 R2 300 R4 600 R5 1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
192	0.0-199.9 ft. No sampling conducted See Record of Drillhole for PZ-111-KS														0.0-98.0 ft. On 4/10/95 borehole advanced with 9 7/8 in. bit using mud rotary then 6 in. steel casing grouted in annulas with neat cement, at 91.0 ft. component bedrock encountered
194															
196															
198															
	259.30		259.30												
200	199.9-209.9 ft. 199.90 Fresh, very thickly bedded, medium gray (N5), coarsely crystalline, medium strong, FOSSILIFEROUS LIMESTONE Upper 0.1 ft. abundantly fossiliferous		199.90						J,PL,SM (3)						4/11/95 @ 10:24 Began Run 1
202	Argillaceous, arenaceous, abundantly fossiliferous, few stylolites, few calcite filled vugs								J,PL,R						
204				1	99%										
206															
208															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: M. VOGT

LOGGED: J. MILLER
CHECKED: B. TILTON
DATE: 5/24/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-SD

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/11/95
DRILL RIG: Schramm

DATUM: MSL
COORDINATES N: 1068638.1
AZIMUTH: 0

COLLAR ELEV: 459.2
E: 515834.6
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
208	199.9-209.9 ft. Fresh, very thickly bedded, medium gray (N5), coarsely crystalline, medium strong, FOSSILIFEROUS LIMESTONE Upper 0.1 ft. abundantly fossiliferous			1	99%										4/11/95 @ 12:08 End Run 1
	249.30		249.30												
210	End of Record of Drillhole at 209.9 ft. 209.90		209.90												
212															
214															
216															
218															
220															
222															
224															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: M. VOGT

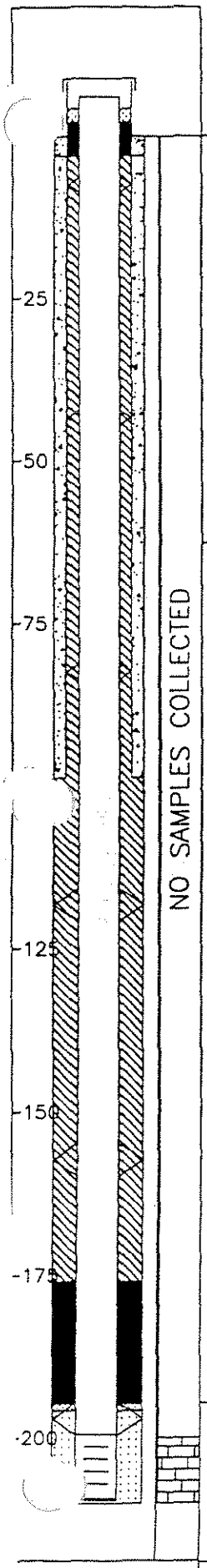
LOGGED: J. MILLER
CHECKED: B. TILTON
DATE: 5/24/95

Golder Associates

Well No. PZ-111-SD

Boring No. X-Ref: PZ-111-SD

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1068638 ft. Easting: 515835 ft.

Elevation Ground Level 459.2 ft. NGVD

Top of PVC Casing 461.55 ft. NGVD

Drilling Summary:

Total Depth 210.0 ft.

Borehole Diameter 10 in. (0.0-98.0 ft.) 5 7/8 in. (98.0-210.0 ft.)

Casing Stickup Height 2.33 ft.

Driller Layne-Western, St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core; 5 7/8 in. Button Bit and 9 7/8 in. Tricone Bit

Drilling Fluid Auger-None, NX Core Water, Air and Mud Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75				
Schramm Rotary	4/10/95	9:45	4/11/95	13:38
Geophys.Logging:	4/14/95	13:00	4/14/95	16:00
Casing:				
2" PVC	4/21/95	8:00	4/21/95	8:18
6" Steel	4/10/95	14:05	4/10/95	16:21
Filter Placement:	4/21/95	8:32	4/21/95	9:12
Cementing:				
Development				
Bentonite Grout	4/21/95	9:20	4/21/95	9:50
Bentonite Seal	4/21/95	9:15	4/21/95	9:18

Well Design & Specifications

Basis: Geologic Log X Geophysical Log X

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 2.33	-	199.40	C1	461.55	-	259.82
199.40	-	209.20	S1	259.82	-	250.02
209.20	-	209.50	C2	250.02	-	249.72
+ 0.50	-	98.00	C3	459.70	-	361.22
	-				-	
	-				-	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.) (C3-see comments)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 195.8-210.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 194.7-195.8 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-176.0 ft., Neat cement, 3.0-98.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 176.0-194.7 ft.

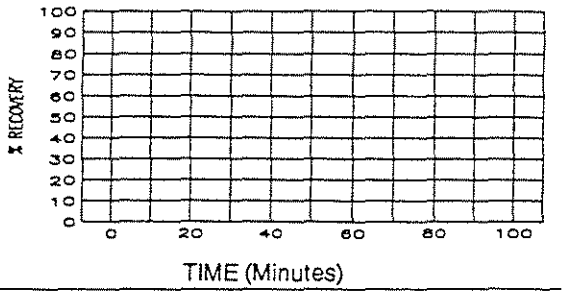
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments: Surface Casing C3: 6 1/8 in. ID / 6 5/8 in. OD Steel Casing

Supervised by J. Miller

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ111SD

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122482	CHECK NO
ROUTE	TRANSMITTAL NO
STATE WELL NUMBER	CROSS REFERENCE NO.
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME: LAIDLAW BRIDGETON SANITARY LANDFILL		WELL NUMBER: PZ-111-SD	
SITE ADDRESS: ST. CHARLES ROCK RD.	CITY: BRIDGETON	STATE: Mo	ZIP CODE: 63044
NAME: LAIDLAW WASTE SYSTEMS, INC.		TELEPHONE: 314-241-3710	
ADDRESS: 1838 N. BROADWAY	CITY: ST. LOUIS	STATE: Mo.	ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

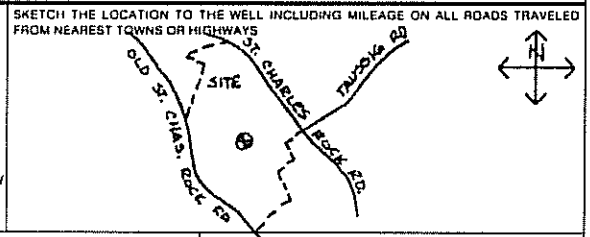
COUNTY: ST. LOUIS
ELEVATION: 459.2
AREA NO.:

SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST ¼

SEC. ____ TWN. 47 N,RNG. 5 (E) OR W

LAT. 38 - 46 - 06 " LONG. 90 - 26 - 39 -

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN Co, INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN Co, INC.

TYPE OF INSTALLATION
☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT
461.55

MEASURING POINT IS
☒ TOP OF RISER PIPE
☐ OTHER

DRILLING EQUIPMENT
☒ AIR ROTARY ☐ AUGER TYPE
☐ REVERSE ROTARY ☐ OTHER

CENTRALIZERS USED
☒ YES, AT 5 TOTAL
☒ STAINLESS STEEL
☐ OTHER
☐ NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
4-21-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR) Michael P. Vogt

PERMIT NUMBER	DATE
001256WM	5-10-95

SIGNATURE (DRILLING CONTRACTOR) Michael P. Vogt

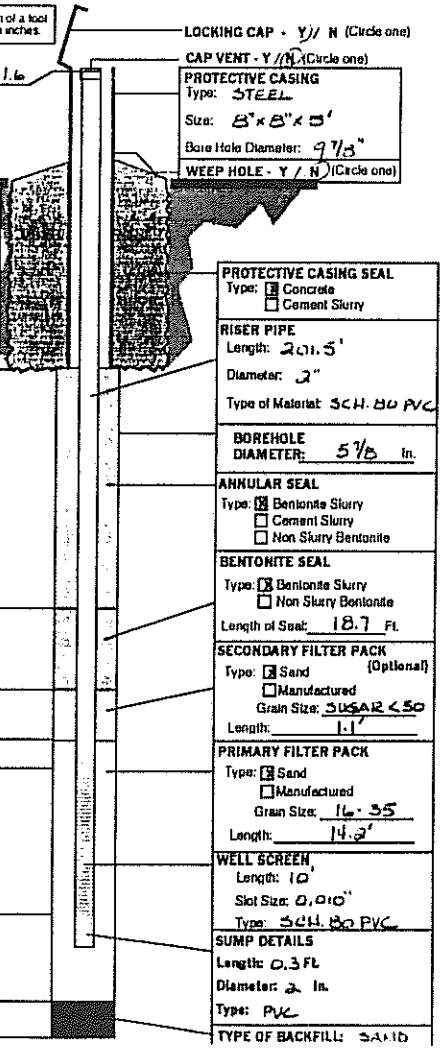
PERMIT NUMBER	DATE

NOTE: Record the fraction of a foot in decimal, not in inches.

Top of Riser Elevation: 461.6

Ground Surface Elevation: 457.2

	Feet from Surface	Description of Formation
Information in this column to be supplied in the Feet from Surface column		
Depth to bottom of Protective Casing Seal:	2.5	
Depth to Base of Annular Seal:	176.0	
Depth to Base of Bentonite Seal:	194.7	
Depth to Base of Secondary Filter Pack:	195.8	
Depth to Top of the Screen:	199.2	
		Limestone
Depth to Bottom of the Screen:	209.2	
Plug Back Total Depth		
Original Total Depth:	210	



LOCKING CAP - Y / N (Circle one)
CAP VENT - Y / N (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8"x8"x5'
Bore Hole Diameter: 9 7/8"
WEEP HOLE - Y / N (Circle one)

PROTECTIVE CASING SEAL
Type: ☒ Concrete ☐ Cement Slurry

RISER PIPE
Length: 201.5'
Diameter: 2"
Type of Material: SCH. 80 PVC

BOREHOLE DIAMETER: 5 7/8 in.

ANNULAR SEAL
Type: ☒ Bentonite Slurry ☐ Cement Slurry ☐ Non Slurry Bentonite

BENTONITE SEAL
Type: ☒ Bentonite Slurry ☐ Non Slurry Bentonite
Length of Seal: 18.7 Ft.

SECONDARY FILTER PACK (Optional)
Type: ☒ Sand ☐ Manufactured
Grain Size: SUGAR < 50
Length: 1.1'

PRIMARY FILTER PACK
Type: ☒ Sand ☐ Manufactured
Grain Size: 16-35
Length: 14.2'

WELL SCREEN
Length: 10'
Slot Size: 0.010"
Type: SCH. 80 PVC

SUMP DETAILS
Length: 0.3 Ft.
Diameter: 2 in.
Type: PVC

TYPE OF BACKFILL: SAND

RECORD OF DRILLHOLE PZ-111-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2846
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068620.78
AZIMUTH: 0

COLLAR ELEV: 459.2
E: 515850.23
INCLINATION: -90

ROCK TYPE: J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation; PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular; P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough; Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Heated, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	NOTES WATER LEVELS INSTRUMENTATION
60	0.0-79.5ft. No sampling conducted See Foth & Van Dyke log F-1-D dated 9/1/90 79.5-80.0 ft. No samples collected										0.0-84.0 ft. Borehole advanced with 14 3/4 in. tricone bit using mud rotary, then 10 in. steel casing set in borehole to seal off saturated alluvial deposits. Extremely weathered bedrock encountered @ ~79.0 ft. and bedrock encountered @ 84.0 ft.
82											
84	374.60	374.60									
	84.6-86.8 ft. 84.60 Slightly weathered, medium bedded, light olive gray (5Y 5/2), very fine grained, medium strong, DOLOMITE, (ST. LOUIS FORMATION) 85.1-85.3 ft. Limestone 85.7 ft. Calcite crystals	84.60					Broken Zone J,U,SM J,PL,SM				3/15/95 @ 7:45 Began coring
86	372.40										
	86.8-91.5 ft. 86.80 Fresh, medium bedded, light olive gray (5Y 5/2), very fine grained, strong, DOLOMITIC LIMESTONE, (ST. LOUIS FORMATION)		1	96%							
88							J,PL,SM J,I,R J,PL,SM,CL				
		369.80 89.40					J,I,R				End core Run 1 @ 8:20
90	90.4-90.5 ft. Argillaceous partings						J,I,SM (2)				
	367.70										
92	91.5-96.8 ft. 91.50 Fresh, medium bedded, light olive gray (5Y 5/2), very fine grained, medium strong, DOLOMITE, (ST. LOUIS FORMATION) 92.1-93.6 ft. Slightly porous/vuggy, some calcite crystals		2	100 %							
94											

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: B. TILTON
DATE: 8/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-KS

PROJECT: LA/DLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066620.78
AZIMUTH: 0

COLLAR ELEV: 459.2
E: 515850.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
96						
	362.40 / 96.80 96.8-99.5 ft. Fresh, medium bedded, light olive gray (5Y 5/2), very fine grained, strong DOLOMITIC LIMESTONE, (ST. LOUIS FORMATION)		2	100 %	J,U,SM	
98					J,PL,SM	
	98.7-98.9 ft. Argillaceous partings				J,PL,SM,CL (2)	
	359.70 / 99.50	359.80 / 99.40				End core Run 2 @ 9:20
	99.5-103.7 ft. Fresh, medium bedded, light olive gray (5Y 5/2), very fine grained, medium strong, DOLOMITE, (ST. LOUIS FORMATION) Some calcite filled veins, pyrite crystals					
100						
102						
	355.50 / 103.70					
	103.7-106.9 ft. Fresh, medium bedded, light olive gray (5Y 5/2), medium grained, medium strong, DOLOMITIC LIMESTONE, (ST. LOUIS FORMATION) Some stylolites, argillaceous partings		3	98%	J,I,SM,CL	
104						
106					J,I,R	
	106.9-110.0 ft. Fresh, medium bedded, light olive gray (5Y 6/1), micro-crystalline, strong, LIMESTONE, (ST. LOUIS FORMATION)					
108	108.1-108.5 ft. Slightly weathered, some stylolites, argillaceous partings				J,U,SM J,I,SM,CL (2)	
		349.80 / 109.40				
					J,I,SM (2)	
110	110.0-112.1 ft. Fresh, medium bedded, light olive gray (5Y 6/1), medium grained, medium strong, DOLOMITIC LIMESTONE, (ST. LOUIS FORMATION)		4	100 %		End Core Run 3 @ 10:25
112						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: B. TILTON
DATE: 8/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068820.78
AZIMUTH: 0

COLLAR ELEV: 459.2
E: 515850.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
112	347.10 / 112.10 112.1-115.8 ft. Fresh, medium bedded, light olive gray (5Y 6/1), very fine grained, weak, ARGILLACEOUS DOLOMITE, (ST. LOUIS FORMATION)							J,I,SM					
114													
	343.40 / 115.80 115.8-120.6 ft. Fresh, medium bedded, olive gray (5Y 4/1), fine grained, medium strong, DOLOMITIC LIMESTONE, (ST. LOUIS FORMATION)		4	100 %									
116													
118	119.0-119.4 ft. Some calcite filled vugs (<2 mm)	339.60 / 119.40											
	119.4-120.3 ft. Argillaceous, weak												
120	120.6-127.0 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), very fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Some calcite crystals							J,I,SM; J,I,SM; J,I,R; J,PL,SM,CL					
122	123.0-127.0 ft. Thinly laminated argillaceous partings		5	98%				J,U,SM,CL; J,PL,SM					
124								J,PL,SM					
126								J,PL,SM; J,PL,SM; J,I,R					
	127.0-136.9 ft. Fresh, medium bedded, light olive gray (5Y 6/1), fine to medium grained, medium strong, DOLOMITIC LIMESTONE, (SALEM FORMATION) 127.0-128.5 ft. Numerous chert zones	332.20 / 127.00											127.0 ft. Inferred top of SALEM FORMATION encountered
128													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: B. TILTON
DATE: 6/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068620.76
AZIMUTH: 0

COLLAR ELEV: 458.2
E: 515850.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
128	127.0-136.9 ft. Fresh, medium bedded, light olive gray (5Y 6/1), fine to medium grained, medium strong, DOLOMITIC LIMESTONE, (SALEM FORMATION)		329.60 / 129.40	5	98%										
130								90	J,PL,SM						
132								90	J,I,SM (2)						
								90	J,I,SM (2)						
134	134.4-135.4 ft. Chert zones (<1/2 in. thick)			6	99%										
								90	B,P,SM (2)						
136	136.9-144.3 ft. Fresh, medium bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) 322.00														
	137.2-137.7 ft. ARGILLACEOUS DOLOMITE layer 137.20							90	J,I,R,CL						
138	137.0 ft. Stylolites							60	J,PL,R						
	138.0-139.4 ft. Numerous stylolites							90	J,I,SM,CL						
								80	J,I,R						
	139.4-141.8 ft. Four chert zones (1-5 in. thick)		319.80 / 139.40					80	B,PL,SM						139.4-141.8 ft. Very slow drilling
140				7	100 %			90	J,I,SM (2)						3/15/95 @ 15:00 Stop drilling for the day 3/20/95 @ 7:30 Began Run 8
			317.40 / 141.80												
142								90	B,I,R						
								90	B,U,SM						
	142.9 and 143.6 ft. Light olive gray (5Y 6/1), arenaceous DOLOMITE layers (<4 in. thick)			8	92%			60	J,I,R						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: B. TILTON
DATE: 6/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068620.78
AZIMUTH: 0

COLLAR ELEV: 459.2
E: 515850.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION
144	314.90	314.90	8	92%		
	144.3-147.5 ft. 144.30 Fresh, thinly bedded, olive gray (5Y 4/1), fine grained, strong, CHERT, (SALEM FORMATION) Arenaceous	144.30			90	J,I,SM
146	146.5 and 146.8 ft. Thin olive gray (5Y 4/1), arenaceous Dolomite layers (<3 in. thick)		9	100%	90	J,I,R
	311.70 147.50 147.5-157.5 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARENACEOUS DOLOMITE, (SALEM FORMATION) Some chert nodules (5-10 mm. dia.), some thin chert layers (<2 in. thick)				90	J,I,R
148					90	J,I,R
		309.90 149.30				
	149.3-149.6 ft. Chert layers 149.7 ft. Coarse calcite crystals (<1/2 in. dia.)					
150						B,PL,SM
						B,I,R
152						J,I,R (2)
						J,I,SM
	152.5-153.5 ft. Porous zone, open vugs (<1 in. dia.)					
	153.4 and 154.2 ft. Chert layers (<5 in.)					
154						J,C,SM
			10	100%		
156	155.8 and 156.9 ft. Chert layers (<5 in.)					J,I,R
						J,I,R
						J,I,R
158	157.5-174.5 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARENACEOUS DOLOMITE, (SALEM FORMATION) Few chert nodules, (~5 mm.), scattered chert (thin layers of chert <3 mm.)					J,PL,SM
						J,PL,SM
		299.70 159.50				
	159.5-159.8 ft. Chert layer		11	100%		

GRAPHIC LOG; RQD (80, 60, 40, 20); FRACTURES PER FOOT (2, 4, 6, 8, 10); GRAPHIC LOG; WEATHERING INDEX (SW FR, MW, HW, CW); STRENGTH INDEX (R6, R5, R4, R3, R2, R1); POINT LOAD INDEX (psi) (R1 30, R2 150, R3 300, R4 600, R5 1500, R6); TEST ORIENTATION; NOTES WATER LEVELS INSTRUMENTATION

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: B. TILTON
DATE: 6/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-KS

PROJECT: LAIDLAW/R-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068620.78
AZIMUTH: 0

COLLAR ELEV: 459.2
E: 515850.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, X-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

Length Scale (Feet)	Rock Type / Description	Graphic Log	Elev / Depth (Ft)	Run No.	Core Recovery	RQD	Fractures per Foot	Discontinuity Data: Dip wrt Core Axis	Type and Surface Description	Graphic Log	Weathering Index	Strength Index	Point Load Index (psi)	Test Orientation	Notes, Water Levels, Instrumentation
160	157.5-174.5 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARENACEOUS DOLOMITE, (SALEM FORMATION) Few chert nodules, (~5 mm.), scattered chert (thin layers of chert <3 mm.)								J,PL,SM (3)						Most fractures observed are characterized as drill induced
162	160.5-160.7 ft. Chert layer 161.5-161.7 ft. Chert layer			11	100 %										
	163.3-163.6 ft. Calcite crystals layer (large crystals)								J,I,R (2)						
164			294.70 / 164.50						J,I,R						
	294.20 / 165.00														
	165.0-167.0 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (SALEM FORMATION)														165.1-169.5 ft. 4-6 breaks per foot that were drill incuded
166															
168				12	100 %										
170	Scattered chert clasts throughout the sample 170.0-171.5 ft. Zone showing moderate porosity, open vugs (<2 mm.)														
172	172.8-173.2 ft. Conglomerate limestone with shale fragments 173.2-174.5 ft. Abundant fossil fragments replaced by silica														
174	174.5-176.6 ft. Fresh, thickly bedded, pale olive (10Y 6/2), fine to medium crystalline, strong, ARGILACEOUS LIMESTONE, (SALEM FORMATION) Abundant fossil fragments		284.70 / 174.50	13	100 %										
176															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: B. TILTON
DATE: 6/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068820.78
AZIMUTH: 0

COLLAR ELEV: 459.2
E: 515850.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

Depth Scale (Feet)	Rock Type: Description	Graphic Log	Elev / Depth (Ft)	Run No.	Core Recovery	RQD	Fractures per Foot	Discontinuity Data: Dip wrt Core Axis	Type and Surface Description	Graphic Log	Weathering Index	Strength Index	Point Load Index (psi)	Test Orientation	Notes, Water Levels, Instrumentation
178															
	176.6-179.1 ft. Fresh, medium bedded, pale olive (10Y 6/2), fine to medium grained, strong, SILICEOUS LIMESTONE, (SALEM FORMATION) Abundant fossil fragments														
176															
	179.1-184.5 ft. Fresh, thickly bedded, pale olive (10Y 6/2), fine to medium coarse, strong, ARENACEOUS LIMESTONE, (SALEM FORMATION) Abundant fossil fragments Some layers of grayish yellow (5Y 8/4), clay material			13	100 %										
180															
182															
184															
	184.5-188.5 ft. Fresh, medium bedded, yellowish gray (5Y 7/2), f-c grained, strong ARENACEOUS LIMESTONE, (SALEM FORMATION) Some fossil fragments, and some grayish yellow (5Y 2/4), clay material layers		274.70 / 184.50												
186															
188				14	100 %										
	188.5-194.5 ft. Slightly weathered, pale olive (10Y 6/2), medium bedded, very coarse, strong, BIOCLASTIC LIMESTONE, (SALEM FORMATION) Few chert nodules, few stylolites in bottom 4 ft., abundant layers of grayish yellow (5Y 8/4) clay, fossiliferous								B,PL,SM						
190									B,PL,SM						Stopped drilling for the day
192															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: B. TILTON
DATE: 6/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068620.78
AZIMUTH: 0

COLLAR ELEV: 459.2
E: 515850.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
192	188.5-194.5 ft. Slightly weathered, pale olive (10Y 6/2), medium bedded, very coarse, strong, BIOCLASTIC LIMESTONE, (SALEM FORMATION) Few chert nodules, few stylolites in bottom 4 ft., abundant layers of grayish yellow (5Y 8/4) clay, fossiliferous		14	100 %									
194	194.5-197.5 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), fine grained, strong, ARGILLACEOUS LIMESTONE, (SALEM FORMATION) Few chert nodules stylolitic, abundant fossil fragments	264.70 / 194.50											3/21/95 @ 7:30 Water level = 20.1 ft. BGS
196													
198	197.5-204.5 ft. Fresh, thinly bedded, light olive gray (5Y 4/1), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (SALEM FORMATION) Few chert nodules, few stylolites, abundant fossil fragments and abundant layers of grayish yellow (5Y 8/4) clay throughout sample		15	100 %									
200													
202													
204	204.5-210.8 ft. Fresh, thinly bedded, dark greenish gray (5GY 4/1), f-c grained, medium strong, LIMESTONE, (SALEM FORMATION) Few chert nodules, stylolites, few clay layers of a grayish yellow color, <3 mm. vugs, with calcite crystals	254.70 / 204.50											
206			16	100 %									
208													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: B. TILTON
DATE: 6/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068820.78
AZIMUTH: 0

COLLAR ELEV: 459.2
E: 515850.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
208	204.5-210.8 ft. Fresh, thinly bedded, dark greenish gray (5GY 4/1), f-c grained, medium strong, LIMESTONE, (SALEM FORMATION) Few chert nodules, stylolites, few clay layers of a grayish yellow color, <3 mm. vugs, with calcite crystals														
210															
	248.40 / 210.80														
	210.8-212.8 ft. Fresh, thickly bedded, dark greenish gray (5GY 4/1) to greenish black (5GY 2/1), very fine grained, weak, SILTSTONE, (WARSAW FORMATION)			18	100 %										210.8 ft. Encountered top of WARSAW FORMATION
212															
	246.40 / 212.80														
	212.8-219.7 ft. Fresh, thinly bedded, light olive gray, fine to coarse grained, medium strong, DOLOMITIC LIMESTONE, (WARSAW FORMATION) Fossiliferous, few chert nodules, stylolites		244.70 / 214.50												
214															
216				17	100 %										
218															3/21/95 @ 11:00 End Run 17 Drilling stopped until surface casing installed to top of WARSAW FORMATION 4/9/95 Borehole reamed out to 84.0 ft. with 14 3/4 in. tricone bit and mud rotary then 10 in. casing set in hole
	239.50 / 219.70		239.50 / 219.70												
220	220.2-224.3 ft. Slightly weathered, thickly bedded, light olive gray (5Y 6/1), finely crystalline, medium strong, DOLOMITE, (WARSAW FORMATION)								J,PL,SM,CL						
222				18	100 %										4/9/95 6 in. steel casing set to 215.3 ft. and sealed with neat cement. A 10 in. air rotary bit was used to drill borehole. 4/22/95 @ 11:02 Begin drilling Run 18 with NX core
									J,U,SM-calcite						
224															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: B. TILTON
DATE: 6/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068620.78
AZIMUTH: 0

COLLAR ELEV: 459.2
E: 515850.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
224	234.90														
	224.3-227.4 ft. 224.30 Fresh, thickly bedded, light brownish gray (5YR 6/1) to medium gray (N5), coarse grained, medium strong, FOSSILIFEROUS LIMESTONE. (WARSAW FORMATION) Not porous, sandy, fine fossil debris, clast supported								J,I,SM						
226				18	100 %				J,U,SM,CL						
	231.80														
	227.4-231.6 ft. 227.40 Slightly weathered, thickly bedded, light olive gray (5Y 6/1), finely crystalline, medium strong, DOLOMITE, (WARSAW FORMATION) Porous-vuggy, crystallized, numerous calcite filled vugs and veins														
228									J,I,R						
			230.10												
			229.10												
230															
	227.60								J,I,R						
	231.6-233.3 ft. 231.60 Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARGILLACEOUS LIMESTONE. (WARSAW FORMATION) Bioturbated														
232									J,I,SM,CL						
	233.3-236.1 ft. Fresh, thickly laminated, medium dark gray (N4), very fine grained, weak, ARGILLACEOUS LIMESTONE, (WARSAW FORMATION) Bioturbated, almost Claystone														
234				19	100 %										
236	223.10														
	236.1-239.4 ft. 236.10 Fresh, thickly laminated to thinly bedded, medium gray (N5), very fine grained, medium strong, ARGILLACEOUS CALCAREOUS DOLOMITE, (WARSAW FORMATION) Stylolitic, greenish clay infilled vug and vein @ 238.6 ft.								J,PL,SM,CL						
238															
	239.4-243.5 ft. Fresh, thickly bedded, medium dark gray (N4), coarse grained, medium strong, FOSSILIFEROUS LIMESTONE, (WARSAW FORMATION) Few stylolites, <0.1 ft. clay seams		220.10					●	J,PL,R-calcite						
	219.80 239.40		239.10						J,I,SM,CL						
				20	100 %										
240															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: B. TILTON
DATE: 6/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-KS

PROJECT: LA/DLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068820.78
AZIMUTH: 0

COLLAR ELEV: 459.2
E: 515850.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP WRT CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
240													
242													
244	215.70 / 243.50 / 215.20 / 244.00 243.5-244.0 ft. Fresh, thickly bedded, medium dark gray (N4), fine grained, medium strong, ARGILLACEOUS DOLOMITE, (WARSAW FORMATION)		20	100 %									
246	244.0-250.3 ft. Fresh, thickly bedded, medium dark gray (N4), coarse grained, medium strong, FOSSILIFEROUS LIMESTONE, (WARSAW FORMATION) 246.1-246.5 ft. Argillaceous Limestone, stylolitic						90	J,PL,SM,CL					
248		210.00 / 249.20											
250	208.50 / 250.70 / 207.90 / 251.30 250.7-251.3 ft. Fresh, thinly to thickly laminated, medium gray (N5), very fine grained, medium strong, ARGILLACEOUS DOLOMITE, (WARSAW FORMATION)						60	J,I,SM,CL					
252	251.3-256.5 ft. Fresh, thickly bedded, medium light gray (N6) to light olive gray (5Y 2/1), coarse grained, medium strong, FOSSILIFEROUS LIMESTONE, (WARSAW FORMATION)		21	100 %									
254	Fossil fragments at 255.6 ft., few Clay partings, some porosity, vugs in lower 2 in.							J,I,SM					
256													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: B. TILTON
DATE: 6/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2846
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068820.78
AZIMUTH: 0

COLLAR ELEV: 459.2
E: 515850.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
256					J,I,R,CL	
	202.70 / 256.50 — 256.5-260.1 ft. Slightly weathered, thickly bedded, medium gray (N5), very finely crystalline, medium strong, ARGILLACEOUS DOLOMITE, (WARSAW FORMATION)		21	100 %	J,PL,SM,CL	
258						
	Some porosity, large vug @ 258.8 ft., some smaller vugs elsewhere, some calcite filled, black organic laminae	200.10 / 259.10				4/22/95 @ 17:45 End Run 21 Quit drilling for the day 4/23/95 @ 7:30 Begin Run 22
260	260.1-265.5 ft. Fresh, thinly to thickly laminated, greenish black (5GY 2/1), very fine grained, weak, DOLOMITIC SILTSTONE, (WARSAW FORMATION)				J,I,SM,CL	
262						
264			22	98%		
	193.70 / 265.50 — 265.5-269.0 ft. Fresh, thickly bedded, medium light gray (N6) to light olive gray (5Y 6/1), coarse grained, medium strong, FOSSILIFEROUS LIMESTONE, (WARSAW FORMATION)				J,PL,SM,CL	
266						
268						
	190.20 / 269.00 — 269.0-272.8 ft. Fresh, thickly laminated to thinly bedded, medium dark gray (N4), very fine grained, medium strong, DOLOMITIC SILTSTONE, (WARSAW FORMATION) Abundant 0.1-0.4 ft. interbeds of coarse crystalline arenaceous Dolomite	190.10 / 269.10				
270			23	98%		
					J,PL,SM,CL	
272						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: B. TILTON
DATE: 8/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1088820.78
AZIMUTH: 0

COLLAR ELEV: 459.2
E: 515850.23
INCLINATION: -90

ROCK TYPE

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular

P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough

Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (80 60 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0 30 60 90)	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR MW HW CW)	STRENGTH INDEX (R6 R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 30 R2 150 R3 300 R4 600 R5 1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
272									J,PL,SM,CL						
	166.40														
	272.8-274.0 ft. 272.80 Fresh, thickly laminated, greenish black (SGY 2/1), very fine grained, weak, CLAYSTONE, (WARSAW FORMATION)								J,PL,SM,CL (2)						
	185.20														
274	274.0-290.2 ft. 274.00 Fresh, thickly laminated to medium bedded, medium light gray (N6) to medium dark gray (N4), vf-m grained, weak to medium strong, SILTSTONE, (WARSAW FORMATION) Calcite filled vugs, interbeds of Silty to Sandy Dolomitic Siltstone								J,U,SM,CL						
				23	98%										
276															
278															
			180.20 / 279.00												
280															
282															
				24	100 %										
284									J,I,SM						
286															
288															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: B. TILTON
DATE: 8/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2846
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068620.76
AZIMUTH: 0

COLLAR ELEV: 459.2
E: 515850.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
Pl-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
288	274.0-290.2 ft. Fresh, thickly laminated to medium bedded, medium light gray (N6) to medium dark gray (N4), vf-m grained, weak to medium strong, SILTSTONE, (WARSAW FORMATION) Calcite filled vugs, interbeds of Silty to Sandy Dolomitic Siltstone		170.30	24	100 %										
			288.90	25	100 %										
290	169.00		169.00												
	290.2-293.7 ft. Fresh, thickly laminated to thinly bedded, medium gray (N5), finely crystalline, medium strong, ARENACEOUS DOLOMITE, (WARSAW FORMATION) Dark gray (N3) argillaceous laminae, bioturbated		290.20												
292	165.50														
294	293.7-295.2 ft. Fresh, thinly laminated, medium dark gray (N8), very fine grained, weak, SILTSTONE, (WARSAW FORMATION)		293.70	26	100 %										
	164.00														
	295.2-306.8 ft. Fresh, thickly laminated to thinly bedded, medium gray (N5), finely crystalline, medium strong, ARENACEOUS DOLOMITE, (WARSAW FORMATION) Argillaceous laminae, no porosity		295.20						J,U,SM						
298															
296			160.20												
			299.00												
300															
				27	100 %										
302	302.8-303.6 ft. Fossiliferous Dolomite interbed														
304															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: B. TILTON
DATE: 6/6/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1088620.78
AZIMUTH: 0

COLLAR ELEV: 458.2
E: 515650.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
304	295.2-306.8 ft. Fresh, thickly laminated to thinly bedded, medium gray (N5), finely crystalline, medium strong, ARENACEOUS DOLOMITE, (WARSAW FORMATION) Argillaceous laminae, no porosity														
306				27	100 %										
	306.8-315.2 ft. Fresh, thickly laminated to thinly bedded, very light gray (N8) to dark greenish gray (5GY 4/1), f-m grained, medium strong, FOSSILIFEROUS LIMESTONE and DOLOMITIC SILTSTONE, (WARSAW FORMATION) Interbedded fossiliferous beds and shaley beds		150.30 / 308.90												
308															
310									J,PL,SMC,L						
312									J,PL,SM,CL						
									J,PL,SM,CL						
314				28	100 %										
	315.2-328.7 ft. Fresh, thickly laminated to medium bedded, medium light gray (N6) to olive gray (5Y 4/1), ? to medium sand, medium strong, FOSSILIFEROUS LIMESTONE and CALCAREOUS SILTSTONE, (WARSAW FORMATION)								J,PL,SM						
316															
318									J,PL,SM,CL						4/23/95 @ 15:02 End Run 28 Quit drilling for the day 4/24/95 @ 12:00 Begin Run 29
			140.10 / 319.10												
				29	100 %										
0															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: B. TILTON
DATE: 6/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068620.75
AZIMUTH: 0

COLLAR ELEV: 459.2
E: 515850.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
320	315.2-328.7 ft. Fresh, thickly laminated to medium bedded, medium light gray (N6) to olive gray (5Y 4/1), medium sand, medium strong, FOSSILIFEROUS LIMESTONE and CALCAREOUS SILTSTONE, (WARSAW FORMATION)								J,PL,R						
322	Calcareous Shale interbeds <0.1-0.5 ft. thick, some lithographic textures, commonly silicified														
324				29	100 %										
326															
328	328.7-330.8 ft. Fresh, thickly laminated, light gray (N7) to light olive gray (5Y 6/1), clay sized to coarse silt sized, medium strong, ARGILLACEOUS LIMESTONE, (WARSAW FORMATION) Chert common, calcite vugs		130.10 / 329.10												
330									J,I,SM,CL						
332	330.8-336.4 ft. Fresh, thickly laminated to medium bedded, medium light gray (N6), clay sized to very coarse sand sized, medium strong, LITHOCLASTIC LIMESTONE and CALCAREOUS SILTSTONE, (WARSAW FORMATION) Interbedded <0.1-0.3 lithoclastic beds with clayey shales, silicification common, few stylolites			30	100 %										
334									J,I,R-open						
336									J,U,SM						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: B. TILTON
DATE: 6/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2846
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068620.78
AZIMUTH: 0

COLLAR ELEV: 459.2
E: 515850.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	ROCK TYPE / DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
336	336.4-343.7 ft. Fresh, thickly laminated to medium bedded, medium light gray (N6), clay sized to very coarse sand sized, medium strong, ARENACEOUS LIMESTONE and ARGILLACEOUS LIMESTONE, (WARSAW FORMATION) Highly silicified, some lithographic textures			30	100 %				J,PL,SM						
338									J,U,SM,CL						
			120.10 / 338.10												
340															
342															
	115.50 / 343.70														
344	343.7-368.8 ft. Fresh, thickly laminated to medium bedded, very light gray (N8) to medium light gray (N6), fine silt sized to coarse silt sized, medium strong, SILICEOUS LIMESTONE and ARENACEOUS LIMESTONE, (KEOKUK FORMATION) Disseminated chert abundant, calcareous dolomitic, silty Clay interbeds, differential compaction features			31	100 %										343.7 ft. Top of KEOKUK FORMATION encountered
346															
									J,I,R						
348			110.60 / 348.60												
350	350.5-350.9 ft. Porous			32	100 %				J,I,R						
352	351.6-363.8 ft. Porous, vuggy														

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: B. TILTON
DATE: 6/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068820.78
AZIMUTH: 0

COLLAR ELEV: 458.2
E: 515850.23
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V, Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE / DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
352	343.7-368.8 ft. Fresh, thickly laminated to medium bedded, very light gray (N8) to medium light gray (N6), fine silt sized to coarse silt sized, medium strong, SILICIOUS LIMESTONE and ARENACEOUS LIMESTONE, (KEOKUK FORMATION) Disseminated chert abundant, calcareous dolomitic, silty Clay interbeds, differential compaction features														
354															
				32	100 %										
356															
358									J,I,R (2)						
			100.40 / 358.80												
									J,I,VR						
360									J,I,VR						
362									J,PL,VR						
				33	100 %				J,PL,R						
364									J,I,R						
366															
368															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: B. TILTON
DATE: 6/5/95

Golder Associates

RECORD OF DRILLHOLE PZ-111-KS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/15/95-3/21/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068620.78
AZIMUTH: 0

COLLAR ELEV: 459.2
E: 515850.23
INCLINATION: -90

ROCK TYPE: J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation; PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular; P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough; Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (80 60 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP w/ CORE AXIS (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR MW HW CW)	STRENGTH INDEX (R6 R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R5 30 R3 150 R4 300 R5 600 R6 1500)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
368				33	100 %										4/24/95 @ 18:45 End Run 33
	90.40		90.40												
	End of Record of Drillhole at 368.8 ft. 368.80		368.80												
370															
372															
374															
376															
378															
380															
382															
384															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: B. TILTON
DATE: 6/5/95

Golder Associates

Foth & Van Dyke & Associates, Inc.

LOG OF TEST BORING NO.: F-1-D

CLIENT: LAIDLAW/BRIDGETON
PROJECT: AUG 90 WELL INSTALL
PROJECT NUMBER: 89L46
LOCATION:

SURFACE ELEVATION:
BORING DEPTH: 79.5
DATE: 9-1-90

MSL ELEV	DEPTH FR LND SURF	SAMP DEPTH INTERVAL	TYPE	#	N	REC (ft)	DESCRIPTION OF MATERIAL	CLASS	FIELD INSTRUMENTS	DRILLING AND SAMPLING NOTES
0.0	--0									
		0-5	SB	1	-	4.8	Top 4' dark yellowish brown (10YR-4/4) lean CLAY w/ sand, some silt and little gravel; (FILL) Bottom 1' dk. grey (5Y 4/1) SILT w/ some black colored intermixing.	FILL	RAD = < 0.01 mR/hr. TIP = 0 ppm	
-5.0	--5									
		5-10	SB	2	-	3.5	Intermixed grey silt (as above) w/ gravel, sand, and some clay (FILL)		RAD = < 0.01 mR/hr. TIP = 0 ppm	
-10.0	--10									
		10-15	SB	3	-	3.5	Mottled dk. grey (5Y 4/1), greenish grey (5BG 5/1) & dk. yellowish brown (10YR 4/4) lean CLAY w/ some silt.	cl	RAD = < 0.01 mR/hr. TIP = 0 ppm	Becomes v.moist to wet at 13.5'.
-15.0	--15									
		15-20	SB	4	-	3.9	Same as above w/ increasing silt content w/ depth.		RAD = < 0.01 mR/hr. TIP = 0 ppm	
-20.0	--20							ml		
		20-25	SB	5	-	4.8	Top is dk. Grey (2.5Y 4/0) SILT w/ little clay. Bottom 2' grey (5Y 4/1), v.fine to fine, SAND stratified (lamina) w/ darker layers.		RAD = < 0.01 mR/hr.	
-25.0	--25									
		25-30	SB	6	-	2.0	Dk. grey (5Y 4/1), f. to v. fine SAND a litter coarse than above.		RAD = < 0.01 mR/hr.	
-30.0	--30	30-32	SS	7	-	1.5	Same as above.			Water added and maintained in augers to prevent sand blows.
		32.5-34.5	SS	8	38	1.1	Same as above.			
-35.0	--35	34.5-36.5	SS	9	50	1.0	Grey (5Y 5/1), f. to v.fine SAND; contains little gravel upto 1/4" in diameter bottom 3".			50 blows for 6"
		37.5-39.5	SS	10	100	0.9	Grey (5Y 5/1), f. to v.fine SAND very dense (without gravel).	sp		
-40.0	--40									
		39.5-41.5	SS	11	11	0.8	Same as above but not as dense although density seems higher than blow counts indicate.		SAMPLE #12 OXY = 21.1% H2S = 1 ppm CO = 0 ppm EXP = 0% TIP = 0 ppm	
		42.5-44.5	SS	12	18	0.8	Grey (5Y 5/1), v.f. to c., poorly graded SAND w/ trace of f. gravel.			
-45.0	--45	44.5-46.5	SS	13	86	0.7	Same as above.			
-50.0	--50	49.5-51.5	SS	14	19	1.4	Top is same as above. Bottom 12" Dark grey (5Y 4/1) v.f. to fine SAND w/ some v. dark grey layers (?) stratified or intermixed (?).			

DRILLING DATA

START DATE: 8/6/90
COMPLETION DATE: 8/8/90
LOGGED BY: LDA
DRILLING METHOD: 4-1/4" I.D. HSA's
DRILLING CONTRACTOR: BROTCKE ENGR.

WATER LEVEL INFORMATION

DEPTH AT COMPLETION: approx. 20'
LATER TIME/DEPTH: 15 hrs / 25.2'
LATER TIME/DEPTH:
CAVE IN DEPTH:
DRILLING LOSSES:

LOG OF TEST BORING NO.: F-1-D

CLIENT: LAIDLAW/BRIDGETON
PROJECT: AUG 90 WELL INSTALL
PROJECT NUMBER: 89L46
LOCATION:

SURFACE ELEVATION:
BORING DEPTH: 79.5
DATE: 9-2-90

MSL ELEV	DEPTH FR LND SURF	SAMP DEPTH INTERVAL	TYPE	#	N	REC (ft)	DESCRIPTION OF MATERIAL	CLASS	FIELD INSTRUMENTS	DRILLING AND SAMPLING NOTES
-55.0	--55	54.5-56.5	SS	15	21	1.4	Upper 3.5" v.dark grey (2.5Y 3/0) lean CLAY w/ no to some sand. Bottom v.dark grey, v.fine to c, stratified SAND; tind pc of wood.	cl		
-60.0	--60	59.5-61.5	SS	16	27	0.8	Very dark grey (2.5Y 3/0), v.fine to coarse, poorly graded SAND.	sp		
-65.0	--65	64.5-66.5	SS	17	37	2.0	2" v.f. to f. v.dark grey SAND. 2" v.f. to v.c., v.dk grey SAND. 3" v.dk grey lean CLAY. 1/2" fine GRAVEL; sub rnded. 1" v.c. to c., grey SAND. Bottom f. to v.f., v.dk grey SAND.	cl / gp		
-70.0	--70	69.5-71.5	SS	18	28	0.0	No recovery.			
-75.0	--75	74.5-76.5	SS	19	25	1.8	Top is v.dark to dark grey (2.5Y-3/0 to 4/0), m. to v.f. SAND. Middle 3" is v.f. to v.c. SAND w/ tr. to little v.f. gravel. Bottom 7" is black to v. dk. grey (2.5Y 2/0 to 3/0) v.f. to f. SAND w/ silt & organics (black color).	sp		
-80.0	--80	78.5-79.5	SS	20	100	0.9	Fine to coarse, poorly graded GRAVEL (rnded to angular) w/ v.f. to c. sand. Limestone bedrx @ 79.4	gp / ls		100 blows for last 1"
-85.0	--85						E.O.B. = 79.5'			Auger refusal at 79.5'
-90.0	--90						Piezometer F-1-D installed.			
-95.0	--95									
-100.0	--100									
-105.0	--105									

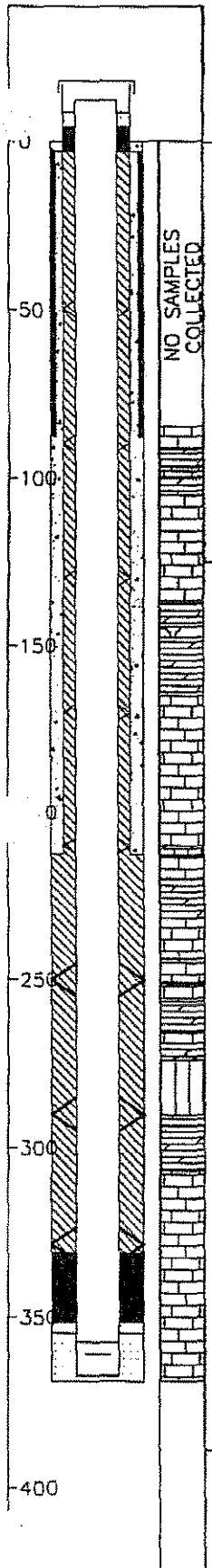
DRILLING DATA
START DATE: 8/6/90
COMPLETION DATE: 8/8/90
LOGGED BY: LDA
DRILLING METHOD: 4-1/4" I.D. HSA's
DRILLING CONTRACTOR: BROTCKE ENGR.

WATER LEVEL INFORMATION
DEPTH AT COMPLETION: approx. 20'
LATER TIME/DEPTH: 15 hrs / 25.2'
LATER TIME/DEPTH:
CAVE IN DEPTH:
DRILLING LOSSES:

Well No. PZ-111-KS

Boring No. X-Ref: PZ-111-KS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1068621 ft. Easting: 515850 ft.

Elevation Ground Level 459.2 ft. NGVD

Top of PVC Casing 460.87 ft. NGVD

Drilling Summary:

Total Depth 368.8 ft.

Borehole Diameter See comments

Casing Stickup Height 1.69 ft.

Driller Layne-Western St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 14 3/4 in. Tricone Bit, 10 in. and 5 7/8 in. Button Bits

Drilling Fluid Auger-None, NX Core Water, Air and Mud Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	3/15/95	7:45	4/24/95	18:45
Schramm Rotary	4/26/95	8:20	4/26/95	10:30
Geophys.Logging:				
Casing:				
2" PVC	5/6/95	7:30	5/6/95	9:00
6" Steel	4/9/95	11:00	4/9/95	15:15
10" Steel	4/8/95	8:00	4/8/95	11:00
Filter Placement:	5/6/95	9:00	5/6/95	10:15
Cementing:				
Development				
Bentonite Grout	5/6/95	10:30	5/6/95	12:30
Bentonite Seal	5/6/95	10:15	5/6/95	10:30

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.69	-	357.15	C1	460.87	-	102.03
357.15	-	366.96	S1	102.03	-	92.22
366.96	-	367.30	C2	92.22	-	91.88
+ 0.50	-	83.80	C3	459.70	-	375.38
+ 1.00	-	215.30	C4	460.20	-	243.88
	-				-	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.) (C3&C4-see comments)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 354.7-368.8 ft.

Filter Pack: Less than 50 mesh Silica Sand, 351.4-354.7 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-330.97 ft., Neat cement, 3.0-215.3 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 330.97-351.4 ft.

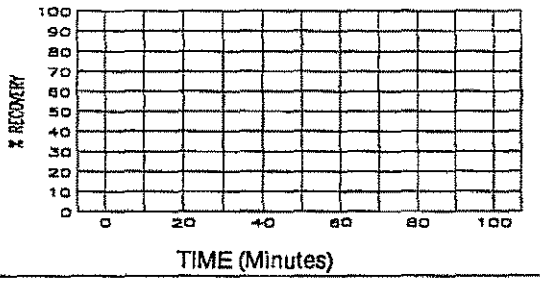
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments: 14 3/4 in. (0.0-84.0 ft.), 10 in. (84.0-215.5 ft.), 5 7/8 in. (215.5-368.8 ft.)

Surface Casing C3: 10 in. ID / 10 7/8 in. OD Steel Casing

Surface Casing C4: 6 1/8 in. ID / 6 5/8 in. OD Steel Casing

Supervised by D. Alloway

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ111KS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122481	CHECK NO.
ROUTE	TRANSMITTAL NO
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME	WELL NUMBER
LAIDLAW BRIDGETON SANITARY LANDFILL	P2-111-KS

SITE ADDRESS	CITY	STATE	ZIP CODE
ST. CHARLES ROCK RD.	BRIDGETON	MO.	63044

NAME	TELEPHONE
LAIDLAW WASTE SYSTEMS, INC.	314-241-3710

ADDRESS	CITY	STATE	ZIP CODE
1838 N. BROADWAY	ST. LOUIS	MO.	63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

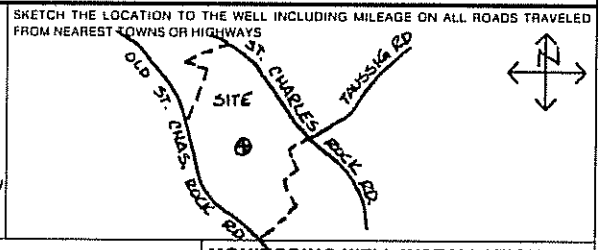
COUNTY ST. LOUIS
ELEVATION 459.2
AREA NO.

SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST ¼

SEC. ____ TWN. 47 N,RNG. 5 (E) OR W

LAT. 38° 46' 06" LONG. 90° 26' 40"

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

NOTE: Record the fraction of a foot in decimal, not in inches.

Top of Riser Elevation: 460.87

Ground Surface Elevation: 457.0

Information in this column to be supplied in the Feet from Surface column	Feet from Surface	Description of Formation
Depth to bottom of Protective Casing Seal:	3.0	
		84-272 ~~Shale~~ Limestone
		272-300 Shale
		300-302 Limestone
Depth to Base of Annular Seal:	331.0	
		302-329 Shale
Depth to Base of Bentonite Seal:	351.4	
Depth to Base of Secondary Filter Pack:	354.7	329-368.8 Limestone
Depth to Top of the Screen:	357.0	
Depth to Bottom of the Screen:	367.0	
Plug Back Total Depth		
Original Total Depth:	368.8	

LOCKING CAP - (Y) N (Circle one)
CAP VENT - (Y) N (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8" x 8" x 5'
Bore Hole Diameter: 15"
WEEP HOLE - Y / (N) (Circle one)

PROTECTIVE CASING SEAL
Type: [X] Concrete [ ] Cement Slurry

RISER PIPE
Length: 368.7'
Diameter: 2"
Type of Material: SCH. 80 PVC

BOREHOLE DIAMETER: 5 7/8 In.

ANNULAR SEAL
Type: [X] Bentonite Slurry [ ] Cement Slurry [ ] Non Slurry Bentonite

BENTONITE SEAL
Type: [X] Bentonite Slurry [ ] Non Slurry Bentonite
Length of Seal: 20.4 Ft.

SECONDARY FILTER PACK (Optional)
Type: [X] Sand [ ] Manufactured
Grain Size: <50
Length: 3.3

PRIMARY FILTER PACK
Type: [X] Sand [ ] Manufactured
Grain Size: 16-35
Length: 14.1'

WELL SCREEN
Length: 10
Slot Size: 0.010"
Type: SCH. 80 PVC

SUMP DETAILS
Length: 0.3FL
Diameter: 2 In.
Type: PVC

TYPE OF BACKFILL: SAND

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN CO., INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN CO., INC.

TYPE OF INSTALLATION
[X] ABOVE GROUND [ ] FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT
460.87

MEASURING POINT IS
[X] TOP OF RISER PIPE
[ ] OTHER

DRILLING EQUIPMENT
[X] AIR ROTARY [X] AUGER TYPE 6 1/4 H.S.A.
[ ] REVERSE ROTARY [ ] OTHER

CENTRALIZERS USED
[X] YES, AT 10 TOTAL
[X] STAINLESS STEEL
[ ] OTHER
[ ] NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
5-06-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR)
Michael P. Vogl

PERMIT NUMBER	DATE
001256WM	6-02-95

SIGNATURE (DRILLING CONTRACTOR)
Michael P. Vogl

PERMIT NUMBER	DATE
001256WM	6-02-95

MO 780-1415 (2-94)

DISTRIBUTION: WHITE-DIVISION CANARY-MONITORING WELL CONTRACTOR PINK/OWNER
BLUE-WHITE COPY TO THE DEPARTMENT OF NATURAL RESOURCES P.O. BOX 250 ROLLA, MO 65401

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
	4.25 inch I.D. Hollow Stem Auger	PZ-112-AS
		SHEET 1 OF 3
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	DRILLING

					START	FINISH
WATER LEVEL					TIME	TIME
TIME					13:20	15:29
DATE					DATE	DATE
CASING DEPTH					4/10/95	4/10/95

NORTHING: 1069002.00
DATUM EASTING: 515674.01 ELEVATION 457.9

DRILL RIG CME 75 | SURFACE CONDITIONS
ANGLE VERTICAL BEARING
SAMPLE HAMMER 140 lbs.

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1	2, 2, 2, 7	1.1'/2.0' (55%)			(0.0-4.0 ft.) Loose to compact, moderate yellowish brown (10YR 5/4) to dark greenish gray (5G 4/1), SILT, trace fine Gravel, NR, damp, (ML), (FILL)	SP 1	
2, 3	5, 12, 7, 6	0.0'/2.0' (0%)				SP 2	
					(453.9) 4.0		
4, 5	6, 50/6"	0.8'/2.0' (40%)			(4.0-8.5 ft.) Very dense, medium bluish gray (5GY 5/1), f-c SAND, trace of fine Gravel, SR, damp, (SP), (FILL)	SP 3	
6					@ 5.0 ft., cobbles and rock encountered		Drilling very hard from 5.0-8.0 ft. Split Spoons not collected
7							
8	6, 7, 11, 9	1.6'/2.0' (80%)					
					(449.4) 8.5		
9					(8.5-10.0 ft.) Waste	SP 4	
					(447.9) 10.0		
10	3, 4, 9, 5	0.6'/2.0' (30%)			(10.0-10.6 ft.) Compact, medium bluish gray (5B 5/1), f-c SAND, trace of fine Gravel, SR, moist, (SP), (FILL)	SP 5	
					(447.3) 10.6		
11					(10.6-20.0 ft.) Waste		
12	4, 20, 14, 9	0.8'/2.0' (40%)				SP 6	
13							
14	3, 3, 8, 18	0.2'/2.0' (10%)				SP 7	

DRILLING CONTR LAYNE-WESTERN
LOGGED BY S. CUSID CHK'D BY W. HERST
DATE 5/31/95
JOB NO.: 943-2848
FILENAME: PZ112AS

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-112-AS
		SHEET 2 OF 3
LAIDLAW/OU2 RI-FS/MD WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	DRILLING START TIME 13:20 DATE 4/10/95; FINISH TIME 15:29 DATE 4/10/95
	WATER LEVEL / TIME / DATE / CASING DEPTH	
DATUM NORTHING: 1069002.00 EASTING: 515674.01 ELEVATION 457.9		
DRILL RIG CME 75	SURFACE CONDITIONS	
ANGLE VERTICAL BEARING		
SAMPLE HAMMER 140 lbs.		

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SAMPLER TYPE	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	REMARKS
16, 17	9, 10, 11, 25	0.8'/2.0' (40%)	SP 7, SP 8	(10.6-20.0 ft.) Waste	
18, 19	50/5"	0.1'/2.0' (5%)	SP 9		
				(437.9) 20.0	
20, 21	5, 3, 3, 3	1.5'/2.0' (75%)	SP 10	(20.0-20.5 ft.) Firm, greenish black (5G 2/1), CLAYEY SILT, NR, damp, (CL-ML), (FILL) (437.4) 20.5 (20.5-22.0 ft.) Loose, medium light gray (N6), f-c SAND, NR, damp to moist, (SP), (FILL)	
				(435.9) 22.0	
22, 23	3, 4, 6, 8	0.4'/2.0' (20%)	SP 11	(22.0-24.0 ft.) Stiff, greenish black (5G 2/1), CLAYEY SILT, NR, wet, (CL-ML), (ALLUVIUM)	First water encountered @ 23.0 ft.
				(433.9) 24.0	
24, 25	12, 17, 16, 15	2.0'/2.0' (100%)	SP 12	(24.0-26.0 ft.) Dense, dark greenish gray (5GY 4/1), fine SAND, NR, wet, (SP), (ALLUVIUM)	
				(431.9) 26.0	
26, 27	4, 2, 3, 7	1.8'/2.0' (90%)	SP 13	(26.0-28.0 ft.) Loose, olive gray (5Y 4/1), CLAYEY fine SAND, NR, wet, (SC), (ALLUVIUM)	
				(429.9) 28.0	
28, 29	3, 3, 10, 21	1.3'/2.0' (65%)	SP 14	(28.0-36.0 ft.) Compact to dense, olive gray (5Y 4/1), fine SAND, NR, wet, (SP), (ALLUVIUM)	

DRILLING CONTR LAYNE-WESTERN

LOGGED BY S. COSID CHK'D BY W. HERST

DATE 5/31/95

JOB NO.: 943-2848

FILENAME: PZ112AS

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-112-AS
		SHEET 3 OF 3
	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	DRILLING START / FINISH
	WATER LEVEL / TIME / DATE / CASING DEPTH	TIME 13:20 / TIME 15:29 DATE 4/10/95 / DATE 4/10/95
NORTHING: 1069002.00 DATUM EASTING: 515674.01 ELEVATION 457.9		

DRILL RIG CME 75
ANGLE VERTICAL BEARING
SAMPLE HAMMER 140 lbs.
SURFACE CONDITIONS

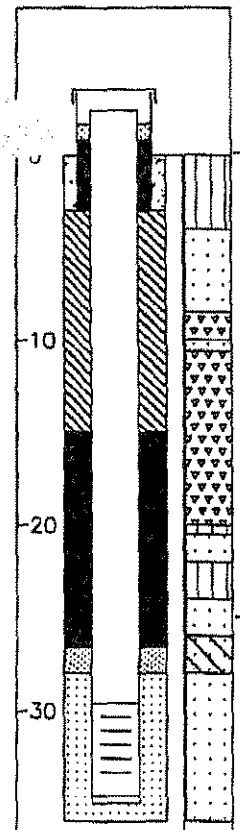
DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
31	10 30 50/6"	1.2'/2.0' (60%)			(28.0-36.0 Ft.) Compact to dense, olive gray (5Y 4/1), fine SAND, NR, wet, (SP), (ALLUVIUM)	SP 15	
32 33	9 11 11 16	1.0'/2.0' (50%)			from 32.0-34.0 ft., sand becomes f-m grained	SP 16	
34 35	10 13 15 20	2.0'/2.0' (100%)			from 34.0-36.0 ft., sand becomes f-c grained	SP 17	
36					(421.9) 36.0 End of Soil Borehole Log at 36.0 ft.		
37 38 39 40 41 42 43 44							

DRILLING CONTR LAYNE-WESTERN
LOGGED BY S. COSID
DATE
CHK'D BY
JOB NO.: 943-2848
FILENAME: PZ112AS

Well No. PZ-112-AS

Boring No. X-Ref: PZ-112-AS

PIEZOMETER CONSTRUCTION SUMMARY



Survey Coords: Northing: 1069002 ft. Easting: 515674 ft.

Elevation Ground Level 457.9 ft. NGVD

Top of PVC Casing 459.83 ft. NGVD

Drilling Summary:

Total Depth 36.0 ft.

Borehole Diameter 8 1/4 in.

Casing Stickup Height 1.90 ft.

Driller Layne-Western, St. Louis, MO

Rig CME 75

Bit(s) 4 1/4 in. ID Hollow Stem Auger Bit

Drilling Fluid Auger-None

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	4/10/95	13:20	4/10/95	15:45
Schramm Rotary				
Geophys.Logging:				
Casing:	4/10/95	16:30	4/10/95	16:40
Filter Placement:	4/10/95	16:40	4/10/95	16:59
Cementing:				
Development				
Bentonite Grout	4/10/95	17:15	4/10/95	17:40
Bentonite Seal	4/10/95	17:12	4/10/95	17:15

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.90	-	29.60	C1	459.83	-	428.33
29.60	-	34.40	S1	428.33	-	423.53
34.40	-	34.73	C2	423.53	-	423.20

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 28.0-36.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 26.6-28.0 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-15.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 15.0-26.6 ft.

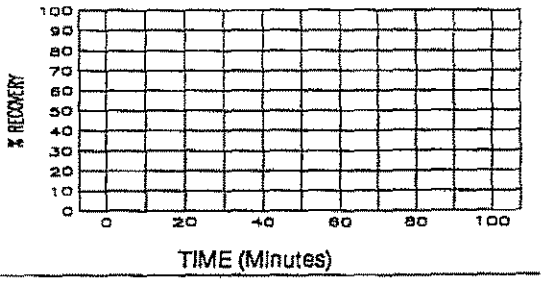
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Not to Scale

Supervised by S. Cosio

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ112AS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122489	CHECK NO
ROUTE	TRANSMITTAL NO.
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME		WELL NUMBER	
LAIDLAW BRIDGETON SANITARY LANDFILL		PZ-112-AS	
SITE ADDRESS	CITY	STATE	ZIP CODE
ST. CHARLES ROCK RD.	BRIDGETON	MO	63044
NAME		TELEPHONE	
LAIDLAW WASTE SYSTEMS, INC.		314-241-3710	
ADDRESS	CITY	STATE	ZIP CODE
1838 N. BROADWAY	ST. LOUIS	MO	63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

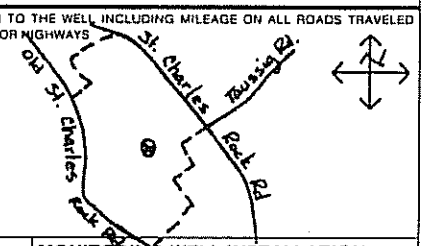
COUNTY ST. LOUIS
ELEVATION 457.9
AREA NO.

SMALLEST ¼ LARGEST ¼

SEC. TWN. 47 N.RNG. 5 (E) OR W

LAT. 38 - 46 - 10 " LONG. 90 - 36 - 42 -

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN CO., INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN CO, INC.

TYPE OF INSTALLATION
☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT
457.83

MEASURING POINT IS
☒ TOP OF RISER PIPE
☐ OTHER

DRILLING EQUIPMENT
☐ AIR ROTARY ☒ AUGER TYPE 4¼ H.S.A.
☐ REVERSE ROTARY ☐ OTHER

CENTRALIZERS USED
☐ YES, AT
☐ STAINLESS STEEL
☐ OTHER
☒ NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
4-10-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR)
Terrence L. Tilmanning

PERMIT NUMBER	DATE
00125BWPM	5-10-95

SIGNATURE (DRILLING CONTRACTOR)
Thomas J. Mahon Jr.

PERMIT NUMBER	DATE
00125BWPM	5-10-95

NOTE: Record the fraction of a foot in decimal, not in inches.

Top of Riser Elevation: 459.8

LOCKING CAP - Y / N (Circle one)
CAP VENT - Y / N (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8"x8"x5'
Bore Hole Diameter: 8"
WEEP HOLE - Y / N (Circle one)

Ground Surface Elevation: 457.9 Ft

Information in this column to be supplied in the Feet from Surface column	Feet from Surface	Description of Formation
Depth to bottom of Protective Casing Seal:	3.0	
Depth to Base of Annular Seal:	34.6	
Depth to Base of Bentonite Seal:	26.6	
Depth to Base of Secondary Filter Pack:	28.0	
Depth to Top of the Screen:	29.6	
		Alluvium
Depth to Bottom of the Screen:	34.6	
Plug Back Total Depth:		
Original Total Depth:	36.0	

PROTECTIVE CASING SEAL
Type: ☒ Concrete ☐ Cement Slurry

RISER PIPE
Length: 31.5'
Diameter: 2"
Type of Material: SCH. 80 PVC

BOREHOLE DIAMETER: 8 In.

ANNULAR SEAL
Type: ☒ Bentonite Slurry ☐ Cement Slurry ☐ Non Slurry Bentonite

BENTONITE SEAL
Type: ☒ Bentonite Slurry ☐ Non Slurry Bentonite
Length of Seal: 2 Ft.

SECONDARY FILTER PACK (Optional)
Type: ☒ Sand ☐ Manufactured
Grain Size: SILICA SAND #50
Length: 1.4'

PRIMARY FILTER PACK
Type: ☒ Sand ☐ Manufactured
Grain Size: 16-35
Length: 18'

WELL SCREEN
Length: 5'
Slot Size: 0.010'
Type: SCH. 80 PVC

SUMP DETAILS
Length: 0.3 Ft.
Diameter: 2 In.
Type: PVC

TYPE OF BACKFILL: SAND

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-113-AS
		SHEET 1 OF 3
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	DRILLING START TIME 11:07 DATE 4/11/95; FINISH TIME 14:55 DATE 4/11/95
NORTHING: 1069224.31 DATUM EASTING: 515747.72 ELEVATION 459.9	WATER LEVEL / TIME / DATE / CASING DEPTH	
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS	
ANGLE VERTICAL BEARING NA		
SAMPLE HAMMER 140 lbs.		

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1, 2					(0.0-2.5 Ft.) Asphalt (457.4) 2.5		
3	10 11 11	1.5' / 1.5' (100%)			(2.5-4.0 Ft.) Compact, light olive gray (5Y 6/1), CLAYEY GRAVEL, little f-c Sand, SR, damp, (GC), (FILL) (455.9) 4.0	SP 1	
4	6 10 11 13	1.7' / 2.0' (85%)			(4.0-4.8 Ft.) Compact, olive gray (5Y 4/1), SILTY fine SAND, mottled NR, damp, (SM), (FILL) (455.1) 4.8	SP 2	
5					(4.8-10.0 Ft.) Stiff, mottled, light olive gray (5Y 6/1) to greenish black (5GY 2/1), CLAYEY SILT, mottled, NR, damp, (CL-ML), (LOESS)		
6, 7	5 8 7 9	1.7' / 2.0' (85%)				SP 3	
8, 9	2 3 5 6	1.2' / 2.0' (60%)			(449.9) 10.0	SP 4	
10, 11	3 3 3 4	1.4' / 2.0' (70%)			(10.0-18.0 Ft.) Loose, light olive gray (5Y 4/1), mottled SILT, NR, damp, (ML), (LOESS)	SP 5	
12, 13	3 2 3 6	1.3' / 2.0' (65%)				SP 6	
14	4 3 3 3	1.3' / 2.0' (65%)				SP 7	

DRILLING CONTR LAYNE-WESTERN

LOGGED BY J. MILLER CHK'D BY W. HERSI

DATE 1/24/95

JOB NO.: 943-2848

FILENAME: PZ113AS

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-113-AS
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	SHEET 2 OF 3
		DRILLING START / FINISH
	WATER LEVEL	TIME 11:07 / TIME 14:55
	TIME	
	DATE	DATE 4/11/95 / DATE 4/11/95
	CASING DEPTH	

NORTHING: 1069224.31
DATUM EASTING: 515747.72 ELEVATION 459.92

DRILL RIG CME 75 - TRUCK MOUNT
ANGLE VERTICAL BEARING NA
SAMPLE HAMMER 140 lbs.
SURFACE CONDITIONS

DRILLING CONTR LAYNE-WESTERN

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
16	2 2 2 3	1.6'/2.0' (80%)			(10.0-18.0 ft.) Loose, light olive gray (5Y 4/1), SILT, mottled, NR, damp, (ML), (LOESS)	SP 7	
17						SP 8	
18	1 2 4 2	2.0'/2.0' (100%)			(441.9) 18.0 (18.0-21.3 ft.) Firm to soft, dark greenish gray (5GY 4/1), mottled CLAYEY SILT, NR, moist, (CL-ML), (ALLUVIUM)	SP 9	
19							
20	0 0 3 6	2.0'/2.0' (100%)				SP 10	
21					(438.6) 21.3 (21.3-26.2 ft.) Firm to stiff, greenish black (5GY 2/1), CLAY, NR, moist, (CH), (ALLUVIUM)		
22	5 6 8 9	1.6'/2.0' (80%)				SP 11	
23							
24	2 3 4 8	1.9'/2.0' (95%)				SP 12	First water encountered @ 24.5 ft.
25							
26	7 9 12 14	2.0'/2.0' (100%)			(433.7) 26.2 (26.2-40.0 ft.) Compact to dense, dark greenish gray (5GY 4/1), fine SAND, trace Silt, NR, wet, (SP), (ALLUVIUM)	SP 13	
27							
28	8 11 11 18	1.8'/2.0' (90%)				SP 14	
29							

LOGGED BY J. MILLER CHK'D BY W. HERST
DATE 1/25/95

JOB NO.: 943-2848
FILENAME: PZ113AS

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	4.25 inch I.D. Hollow Stem Auger	PZ-113-AS
		SHEET 3 OF 3
	SAMPLING METHOD:	DRILLING
	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)	START / FINISH
	SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	
	WATER LEVEL	TIME 11:07 / TIME 14:55
	TIME	
	DATE	DATE 4/11/95 / DATE 4/11/95
	CASING DEPTH	

NORTHING: 1069224.31
DATUM EASTING: 515747.72 ELEVATION 459.92

DRILL RIG CME 75 - TRUCK MOUNT
ANGLE VERTICAL BEARING NA
SAMPLE HAMMER 140 lbs.
SURFACE CONDITIONS

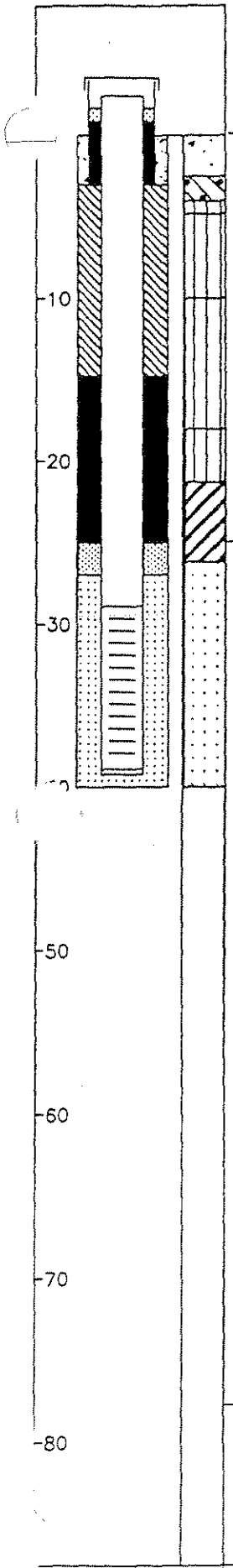
DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
31	10 14 18 21	1.8'/2.0' (90%)			(26.2-40.0 ft.) Compact to dense, dark greenish gray (5GY 4/1), fine SAND, trace Silt, NR, wet, (SP), (ALLUVIUM)	SP 15	
32	8 12 17 15	1.2'/2.0' (60%)			from 32.0-34.0 ft., color changes to pale yellowish brown (10YR 6/2)	SP 16	
34	8 10 15 16	2.0'/2.0' (100%)			from 34.0-34.5 ft., sand becomes fine to medium grained	SP 17	
36	6 7 7 10	1.9'/2.0' (95%)				SP 18	
37					from 37.5-38.0 ft., some coarse sand		
38							from 38.0-40.0 ft., unable to collect split spoon samples due to heaving sands
39							
40					(419.9) 40.0 End of Soil Borehole Log at 40.0 ft.		
41							
42							
43							
44							

DRILLING CONTR LAYNE-WESTERN
LOGGED BY J. MILLER
DATE 1/25/95 CHK'D BY W. HERST
JOB NO.: 941-2849
FILENAME: PZ113AS

Well No. PZ-113-AS

Boring No. X-Ref: PZ-113-AS

PIEZOMETER CONSTRUCTION SUMMARY



Survey Coords: Northing: 1069224 ft. Easting: 515748 ft.

Elevation Ground Level 459.9 ft. NGVD

Top of PVC Casing 461.42 ft. NGVD

Drilling Summary:

Total Depth 40.0 ft.

Borehole Diameter 8 1/4 in.

Casing Stickup Height 1.50 ft.

Driller Layne-Western, St. Louis, MO

Rig CME 75

Bit(s) 4 1/4 in. ID Hollow Stem Auger Bit

Drilling Fluid Auger-None

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	4/11/95	11:07	4/11/95	14:58
Schramm Rotary				
Geophys.Logging:				
Casing:	4/11/95	15:00	4/11/95	15:10
Filter Placement:	4/11/95	15:12	4/11/95	15:29
Cementing:				
Development				
Bentonite Grout	4/11/95	15:48	4/11/95	16:20
Bentonite Seal	4/11/95	15:40	4/11/95	15:48

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.50	-	28.90	C1	461.42	-	431.02
28.90	-	38.70	S1	431.02	-	421.22
38.70	-	39.03	C2	421.22	-	420.89

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 27.0-40.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 25.0-27.0 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-15.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 15.0-25.0 ft.

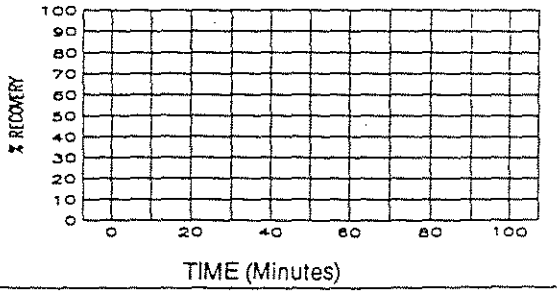
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Not to Scale

Supervised by S. Cosio

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ113AS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122488	CHECK NO
ROUTE	TRANSMITTAL NO.
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME: LANDLAND BRIDGETON SANITARY LANDFILL		WELL NUMBER: P2-113-A5	
SITE ADDRESS: ST. CHARLES ROCK RD	CITY: BRIDGETON	STATE: MO	ZIP CODE: 63044
NAME: LANDLAND WASTE SYSTEMS, INC.		TELEPHONE: 314-241-3710	
ADDRESS: 1438 N. BROADWAY	CITY: ST. LOUIS	STATE: MO	ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

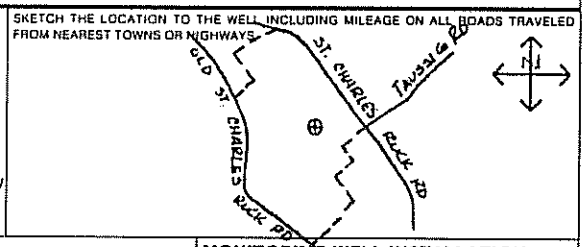
COUNTY: ST. LOUIS
ELEVATION: 454.9
AREA NO.

SMALLEST ¼ LARGEST ¼

SEC. TWN. 47 N.RNG. 5 E OR W

LAT. 38 - 46 - 12 - LONG. 90 - 26 - 41 -

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN Co., INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN Co., INC.

NOTE: Record the fraction of a foot in decimal, not in inches.

Top of Riser Elevation: 461.4

LOCKING CAP - Y / N (Circle one)
CAP VENT - Y / N (Circle one)

Ground Surface Elevation: 454.1 Ft	Feet from Surface	Description of Formation
Information in this column to be supplied in the Feet from Surface column		
Depth to bottom of Protective Casing Seal:	3.0	
Depth to Base of Annular Seal:	23.0	
Depth to Base of Bentonite Seal:	25.0	
Depth to Base of Secondary Filter Pack:	27.0	
Depth to Top of the Screen:	28.7	
		Alluvium
Depth to Bottom of the Screen:	38.7	
Plug Back Total Depth:		
Original Total Depth:	40.0	

PROTECTIVE CASING
Type: STEEL
Size: 8"x8"x5'
Bore Hole Diameter: 8"
WEEP HOLE - Y / N (Circle one)

PROTECTIVE CASING SEAL
Type: [X] Concrete [ ] Cement Slurry

RISER PIPE
Length: 30.4'
Diameter: 2"
Type of Material: SCH. 80 PVC

BOREHOLE DIAMETER: 8 In.

ANNULAR SEAL
Type: [X] Bentonite Slurry [ ] Cement Slurry [ ] Non Slurry Bentonite

BENTONITE SEAL
Type: [X] Bentonite Slurry [ ] Non Slurry Bentonite
Length of Seal: 2 Ft.

SECONDARY FILTER PACK (Optional)
Type: [X] Sand [ ] Manufactured
Grain Size: SUGAR (50
Length: 3'

PRIMARY FILTER PACK
Type: [X] Sand [ ] Manufactured
Grain Size: 16-35
Length: 13'

WELL SCREEN
Length: 10'
Slot Size: 0.010"
Type: SCH. 80 PVC

SUMP DETAILS
Length: 0.3 Ft.
Diameter: 2 In.
Type: PVC

TYPE OF BACKFILL: SAND

TYPE OF INSTALLATION
[X] ABOVE GROUND [ ] FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT
461.42

MEASURING POINT IS
[X] TOP OF RISER PIPE
[ ] OTHER

DRILLING EQUIPMENT
[ ] AIR ROTARY [X] AUGER TYPE 4¼ H.S.A.
[ ] REVERSE ROTARY [ ] OTHER

CENTRALIZERS USED
[ ] YES, AT
[ ] STAINLESS STEEL
[ ] OTHER
[X] NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
4-11-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR)
Terrence A. Tilahuber Jr.

PERMIT NUMBER	DATE
OD1253WPM	5-10-95

SIGNATURE (DRILLING CONTRACTOR)
Terrence A. Tilahuber Jr.

PERMIT NUMBER	DATE
OD1253WPM	5-10-95

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	0.0-40.0 ft.: 4.25 inch I.D. Hollow Stem Auger	PZ-113-AD
	40.0-108.3 ft.: 3.875 inch Mud Rotary (Tricone)	SHEET 1 OF 7
	SAMPLING METHOD:	
	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)	DRILLING
	SPLIT SPOON: 3.0 inch O.D./.375 inch I.D. (HD)	START / FINISH
	WATER LEVEL	TIME 11:03 / TIME 15:50
	TIME	
	DATE	DATE 4/26/95 / DATE 4/27/95
	CASING DEPTH	

DATUM NORTHING: 1069233.33 EASTING: 515759.85 ELEVATION 459.9

DRILL RIG CME 75 - TRUCK MOUNT

SURFACE CONDITIONS Paved road

ANGLE VERTICAL BEARING NA

SAMPLE HAMMER 140

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
16					(0.0-20.0 ft.) No samples collected, see Soil Borehole Log PZ-113-AS for descriptions		
17							
18							
19							
20					(439.9) 20.0		
	2 5 9	0.9' 1.5' (60%)			(20.0-27.0 ft.) Stiff, olive gray (5Y 4/1), SILTY CLAY, trace very fine Sand, NR, moist, (CH), (ALLUVIUM)	SP 1	
21							
22	6 8 13	1.0' 1.5' (67%)				SP 2	
23	5 7 7	1.5' 1.5' (100%)				SP 3	
24							
25	2 7 7	1.3' 1.5' (87%)				SP 4	
26	4 6 8	1.2' 1.5' (80%)				SP 5	
27					(432.9) 27.0		
					(27.0-40.0 ft.) Compact, dark greenish gray (5GY 4/1), fine SAND, some Clay, NR, wet, (SC), (ALLUVIUM)		
28							
29							

DRILLING CONTR LAYNE-WESTERN

LOGGED BY J. MILLER DATE 6/21/95 CHK'D BY W. HERST

JOB NO.: 943-2848 FILENAME: PZ113AD

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	0.0-40.0 ft.: 4.25 inch I.D. Hollow Stem Auger 40.0-108.3 ft.: 3.875 inch Mud Rotary (Tricone)	PZ-113-AD
	SAMPLING METHOD:	SHEET 2 OF 7
	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SPLIT SPOON: 3.0 inch O.D./.375 inch I.D. (HD)	DRILLING START / FINISH
NORTHING: 1069233.33 DATUM EASTING: 515759.85 ELEVATION 459.9	WATER LEVEL / TIME / DATE / CASING DEPTH	TIME 11:03 / TIME 15:50 DATE 4/26/95 / DATE 4/27/95

DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS Paved road
ANGLE VERTICAL BEARING NA	
SAMPLE HAMMER 140	

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
31					(27.0-40.0 ft.) Compact, dark greenish gray (5GY 4/1), fine SAND, some Clay, NR, wet, (SC), (ALLUVIUM)		
32							
33							
34							
35							
36							
37							
38							
39							
40					(419.9) 40.0		
	4 8 9	0.5' 1.5' (33%)			(40.0-41.5 ft.) Compact, light brown (5YR 5/6) to pale yellowish brown (10YR 6/2), medium SAND, trace very fine Sand, NR, wet, (SP), (ALLUVIUM)	SP 6	
41					(418.4) 41.5		
42	6 6 8	0.3' 1.5' (17%)			(41.5-44.0 ft.) Compact, light brown (5YR 5/6) to light brown (5YR 6/4), fine GRAVEL, NR, wet, (GW), (ALLUVIUM)	SP 7	
43	4 7 11 13	0.9' 2.0' (45%)			(415.9) 44.0	SP 8	
44					(44.0-48.5 ft.) Compact, dark yellowish brown (10YR 4/2), medium SAND, trace coarse Sand, trace fine Sand, NR, wet, (SP), (ALLUVIUM)		

DRILLING CONTR LAYNE-WESTERN

LOGGED BY J. MILLER

DATE 6/21/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ113AD

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
	0.0-40.0 ft: 4.25 inch I.D. Hollow Stem Auger	PZ-113-AD
	40.0-108.3 ft: 3.875 inch Mud Rotary (Tricone)	SHEET 3 OF 7
LAIDLAW/OU2 RI-FS/MD WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD:	
	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)	DRILLING
	SPLIT SPOON: 3.0 inch O.D./.375 inch I.D. (HD)	START / FINISH

WATER LEVEL					TIME	TIME
TIME					11:03	15:50
DATE					DATE	DATE
CASING DEPTH					4/26/95	4/27/95

DATUM NORTHING: 1069233.33 EASTING: 515759.85 ELEVATION 459.9

DRILL RIG CME 75 - TRUCK MOUNT

SURFACE CONDITIONS Paved road

ANGLE VERTICAL BEARING NA

SAMPLE HAMMER 140

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
46	5 6 9 2	0.7' / 2.0' (35%)			(44.0-48.5 ft.) Compact, dark yellowish brown (10YR 4/2), medium SAND, trace coarse Sand, trace Fine Sand, NR, wet, (SP), (ALLUVIUM)	SP 9	
47 48	8 13 15 19	1.1' / 2.0' (55%)				SP 10	
49	10 10 10 11	0.9' / 2.0' (45%)			(48.5-49.5 ft.) Compact, olive gray (5Y 4/1), Fine SAND, some medium Sand, NR, wet, (SP), (ALLUVIUM)		
50					(49.5-53.0 ft.) Compact, olive gray (5Y 4/1), medium SAND, trace Fine Sand, trace coarse Sand and Fine Gravel, trace Silt, NR, wet, (SP), (ALLUVIUM)	SP 11	
51 52	6 7 9 7	0.9' / 2.0' (45%)				SP 12	
53					(406.9) 53.0		
53 54	3 6 5 6	0.9' / 2.0' (45%)			(53.0-61.5 ft.) Compact, olive gray (5Y 4/1), medium SAND, little Sand, trace Fine Gravel, trace Fine Sand and Silt, NR, wet, (SW), (ALLUVIUM)	SP 13	
55 56	6 4 5 6	0.9' / 2.0' (45%)				SP 14	
57 58	4 4 5 6	0.9' / 2.0' (45%)				SP 15	
59	5 6 6 7	1.0' / 2.0' (50%)				SP 16	

DRILLING CONTR LAYNE-WESTERN

LOGGED BY J. MILLER

DATE 6/21/95

CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ113AD

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
	0.0-40.0 ft: 4.25 inch I.D. Hollow Stem Auger	PZ-113-AD
	40.0-108.3 ft: 3.875 inch Mud Rotary (Tricone)	SHEET 4 OF 7
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD:	
	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)	DRILLING
	SPLIT SPOON: 3.0 inch O.D./.375 inch I.D. (HD)	START / FINISH
	WATER LEVEL	TIME / TIME
	TIME	11:03 / 15:50
	DATE	DATE / DATE
NORTHING: 1069233.33 DATUM EASTING: 515759.85 ELEVATION 459.9	CASING DEPTH	4/26/95 / 4/27/95

DRILL RIG CME 75 - TRUCK MOUNT
ANGLE VERTICAL BEARING NA
SAMPLE HAMMER 140
SURFACE CONDITIONS Paved road

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
61	6 10 10 12	0.9'/2.0' (45%)			(53.0-61.5 ft.) Compact, olive gray (5Y 4/1), medium SAND, little Sand, trace Fine Gravel, trace fine Sand and Silt, NR, wet, (SW), (ALLUVIUM) (398.4) 61.5	SP 16	
62					(61.5-65.0 ft.) Compact, dark greenish gray (5GY 4/1), >95% fine to medium grained subrounded SAND, <5% Silt, NR, saturated, (SP), (ALLUVIUM), grades finer	SP 17	
63	10 20 27 45	1.2'/2.0' (60%)				HD 18	
64							
65		1.7'/2.0' (85%)			(65.0-92.0 ft.) Compact to very dense, dark greenish gray (5GY 4/1), 75% fine SAND, 20% medium Sand, 5% Silt, NR, saturated, (SP), (ALLUVIUM)	SP 19	
66							
67	7 20 25 28	0.9'/2.0' (45%)				SP 20	
68							
69	10 15 26 26	1.4'/2.0' (70%)				HD 21	
70							
71	8 10 14 22	1.2'/2.0' (60%)				SP 22	
72							
73	6 10 13 17	1.2'/2.0' (60%)				SP 23	
74							

DRILLING CONTR LAYNE-WESTERN
LOGGED BY J. MILLER CHK'D BY W. HENRY
DATE 6/21/95
JOB NO.: 943-2848
FILENAME: PZ113AD

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
	0.0-40.0 ft: 4.25 inch I.D. Hollow Stem Auger	PZ-113-AD
	40.0-108.3 ft: 3.875 inch Mud Rotary (Tricone)	SHEET 5 OF 7
	SAMPLING METHOD:	
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)	DRILLING
	SPLIT SPOON: 3.0 inch O.D./.375 inch I.D. (HD)	START / FINISH
	WATER LEVEL	TIME 11:03 / TIME 15:50
	TIME	
	DATE	DATE 4/26/95 / DATE 4/27/95
NORTHING: 1069233.33 DATUM EASTING: 515759.85 ELEVATION 459.9	CASING DEPTH	

DRILL RIG CME 75 - TRUCK MOUNT
SURFACE CONDITIONS Paved road
ANGLE VERTICAL BEARING NA
SAMPLE HAMMER 140

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
76	17 25 35 36	1.1' / 2.0' (55%)			(65.0-92.0 Ft.) Compact to very dense, dark greenish gray (5GY 4/1), 75% fine SAND, 20% medium Sand, 5% Silt, NR, saturated, (SP), (ALLUVIUM)	HD (24)	
77–78	17 25 34 39	1.8' / 2.0' (90%)				HD (25)	
79–80	22 28 28 31	1.3' / 2.0' (65%)				SP (26)	
81–82	15 24 24 36	1.2' / 2.0' (60%)				SP (27)	
83–84	20 48 48 60	1.5' / 2.0' (75%)				HD (28)	
85–86	12 24 34 38	1.0' / 2.0' (50%)				SP (29)	
87–88	18 22 32 50+	1.2' / 2.0' (60%)				SP (30)	
89	48 50	0.6' / 0.8' (75%)				HD (31)	

DRILLING CONTR LAYNE-WESTERN
LOGGED BY J. MILLER
DATE 6/21/95
CHK'D BY W. HERST
JOB NO.: 943-2848
FILENAME: PZ113AD

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	0.0-40.0 ft: 4.25 inch I.D. Hollow Stem Auger 40.0-108.3 ft: 3.875 inch Mud Rotary (Tricone)	PZ-113-AD
	SAMPLING METHOD:	SHEET 6 OF 7
	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SPLIT SPOON: 3.0 inch O.D./.375 inch I.D. (HD)	DRILLING

WATER LEVEL					START TIME	FINISH TIME
TIME					11:03	15:50
DATE					DATE 4/26/95	DATE 4/27/95
CASING DEPTH						

DATUM NORTHING: 1069233.33 EASTING: 515759.85 ELEVATION 459.9

DRILL RIG CME 75 - TRUCK MOUNT

SURFACE CONDITIONS Paved road

ANGLE VERTICAL BEARING NA

SAMPLE HAMMER 140

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
91					(65.0-92.0 ft.) Compact to very dense, dark greenish gray (5GY 4/1), 75% fine SAND, 20% medium Sand, 5% Silt, NR, saturated, (SP), (ALLUVIUM)		
					(367.9) 92.0		
92					(92.0-108.3 ft.) Dense, dark greenish gray (5GY 4/1), fine to coarse subrounded to well rounded SAND, NR, saturated, (SW), (ALLUVIUM)		
93							
94	10 15 20 22	1.0' / 1.0' (100%)				SP (32)	
95							
96							
97							
98							
99	9 13 17 23	1.1' / 2.0' (55%)				SP (33)	
100							
101							
102							
103							
104	10 11 14 12	0.6' / 2.0' (30%)				SP (34)	

DRILLING CONTR LAYNE-WESTERN

LOGGED BY J. MILLER

DATE 6/21/95

CHK'D BY W. HERST

JOB NO.: 943-284B

FILENAME: PZ113AD

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	0.0-40.0 ft.: 4.25 inch I.D. Hollow Stem Auger 40.0-108.3 ft.: 3.875 inch Mud Rotary (Tricone)	PZ-113-AD
	SAMPLING METHOD:	SHEET 7 OF 7
	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SPLIT SPOON: 3.0 inch O.D./.375 inch I.D. (HD)	DRILLING

WATER LEVEL					START	FINISH
TIME					TIME 11:03	TIME 15:50
DATE					DATE 4/26/95	DATE 4/27/95
CASING DEPTH						

NORTHING: 1069233.33
DATUM EASTING: 515759.85 ELEVATION 459.9

DRILL RIG CME 75 - TRUCK MOUNT
ANGLE VERTICAL BEARING NA
SAMPLE HAMMER 140

SURFACE CONDITIONS Paved road

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE		REMARKS
106					(92.0-108.3 ft.) Dense, dark greenish gray (5GY 4/1), fine to coarse subrounded to well rounded SAND, NR, saturated, (SW), (ALLUVIUM)	SP (34)		
107								
108					(351.6) 108.3			
109					End of Soil Borehole Log at 108.3 ft. See PZ-113-AD Record of Drillhole for rock descriptions			
110								
111								
112								
113								
114								
115								
116								
117								
118								
119								

DRILLING CONTR LAYNE-WESTERN

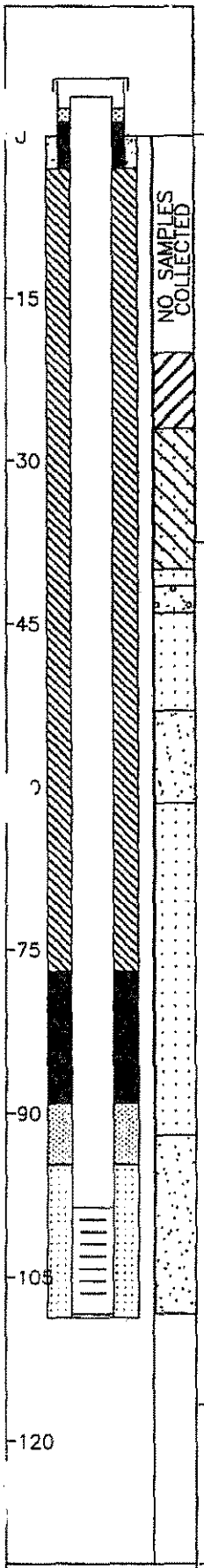
LOGGED BY J. MILLER
DATE 6/21/95 CHK'D BY W. HERST

JOB NO.: 943-2848
FILENAME: PZ113AD

Well No. PZ-113-AD

Boring No. X-Ref: PZ-113-AD

PIEZOMETER CONSTRUCTION SUMMARY



Survey Coords: Northing: 1069233 ft. Easting: 515760 ft.

Elevation Ground Level 459.9 ft. NGVD

Top of PVC Casing 461.46 ft. NGVD

Drilling Summary:

Total Depth 108.7 ft.

Borehole Diameter 10 1/4 in.

Casing Stickup Height 1.60 ft.

Driller Layne-Western, St. Louis, MO

Rig CME 75

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit

Drilling Fluid Auger-None

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	5/3/95	8:00	5/3/95	9:30
Schramm Rotary				
Geophys.Logging:				
Casing:	5/3/95	13:20	5/3/95	13:30
Filter Placement:	5/3/95	13:30	5/3/95	15:10
Cementing:				
Development				
Bentonite Grout	5/3/95	15:30	5/3/95	18:30
Bentonite Seal	5/3/95	15:10	5/3/95	15:30

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.60	-	98.60	C1	461.46	-	361.26
98.60	-	108.40	S1	361.26	-	351.46
108.40	-	108.73	C2	351.46	-	351.13

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 94.7-108.7 ft.

Filter Pack: Less than 50 mesh Silica Sand, 89.1-94.7 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-77.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 77.0-89.1 ft.

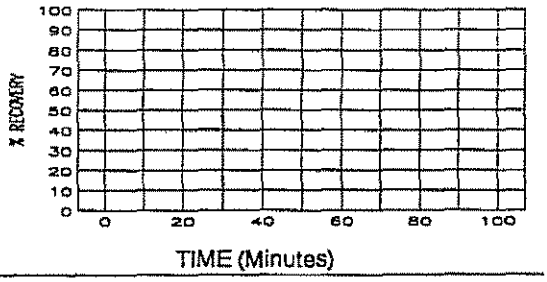
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Not to Scale

Supervised by D. Alloway

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ113AD

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

REF. NO. 122527	CHECK NO.
ROUTE	TRANSMITTAL NO.
STATE WELL NUMBER	CROSS REFERENCE NO.
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME: LAIDLAW BRIDGETON SANITARY LANDFILL		WELL NUMBER: P2-113-AD	
SITE ADDRESS: ST. CHARLES ROCK RD.	CITY: BRIDGETON	STATE: MO	ZIP CODE: 63044
NAME: LAIDLAW WASTE SYSTEMS, INC.		TELEPHONE: 314-241-3700	
ADDRESS: 1838 N. BROADWAY	CITY: ST. LOUIS	STATE: MO	ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

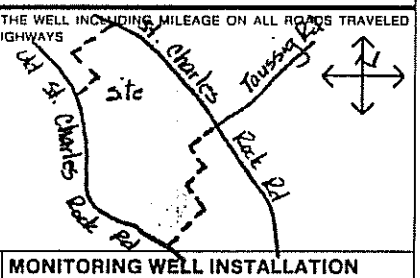
COUNTY: ST. LOUIS
ELEVATION: 459.9
AREA NO.:

SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST ¼

SEC. ____ TWN. 47 N, RNG. 5 (E) OR W

LAT. 38 ° 46 ' 12 " LONG. 90 ° 36 ' 41 "

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN Co., Inc.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN Co., Inc.

NOTE: Record the fraction of a foot in decimal, not in inches.

Top of Riser Elevation: 461.46

Ground Surface Elevation: 459.9 Ft.

Feet from Surface	Description of Formation
Information in this column to be supplied in the Feet from Surface column	0-20 No Samples
Depth to bottom of Protective Casing Seal: 3.0	
	20-37 Clay
	37-39 Clay w/ sand
	39-41 Sand
	41-44 Sand and gravel
Depth to Base of Annular Seal: 77.0	44-53 Sandstone
	53-66 Sand
Depth to Base of Bentonite Seal: 89.1	"
Depth to Base of Secondary Filter Pack: 94.7	66-91 Sandstone
Depth to Top of the Screen: 98.6	
	91-108.7 Sand
Depth to Bottom of the Screen: 108.6	
Plug Back Total Depth:	
Original Total Depth: 108.7	

LOCKING CAP - Y / N (Circle one)
CAP VENT - Y / N (Circle one)
PROTECTIVE CASING
Type: STEEL
Size: 8"x8"x5'
Bore Hole Diameter: 10¼"
WEEP HOLE - Y / N (Circle one)

PROTECTIVE CASING SEAL
Type: [X] Concrete [ ] Cement Slurry

RISER PIPE
Length: 100.2'
Diameter: 2"
Type of Material: SCH80 PVC

BOREHOLE DIAMETER: 10¼ in.

ANNULAR SEAL
Type: [X] Bentonite Slurry [ ] Cement Slurry [ ] Non Slurry Bentonite

BENTONITE SEAL
Type: [X] Bentonite Slurry [ ] Non Slurry Bentonite
Length of Seal: 12.1 Ft.

SECONDARY FILTER PACK
Type: [X] Sand [ ] Manufactured (Optional)
Grain Size: < 50
Length: 5.6'

PRIMARY FILTER PACK
Type: [X] Sand [ ] Manufactured
Grain Size: 16-35
Length: 14'

WELL SCREEN
Length: 10'
Slot Size: 0.010"
Type: SCH80 PVC

SUMP DETAILS
Length: 0.3 Ft.
Diameter: 2 in.
Type: PVC

TYPE OF BACKFILL: SAND

TYPE OF INSTALLATION
[X] ABOVE GROUND [ ] FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT
461.46

MEASURING POINT IS
[X] TOP OF RISER PIPE
[ ] OTHER

DRILLING EQUIPMENT
[ ] AIR ROTARY [X] AUGER TYPE 6¼ H.S.A.
[ ] REVERSE ROTARY [ ] OTHER

CENTRALIZERS USED
[X] YES, AT 2 TOTAL
[X] STAINLESS STEEL
[ ] OTHER
[ ] NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
5-03-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR): Lemon H. Mahurin Jr.
PERMIT NUMBER: 001258 WPM DATE: 7-31-95

SIGNATURE (DRILLING CONTRACTOR): Lemon H. Mahurin Jr.
PERMIT NUMBER: 001258WPM DATE: 7-31-95

MO 780-1415 (2-94)

DISTRIBUTION: WHITE/DIVISION CANARY/MONITORING WELL CONTRACTOR PINK/OWNER
MAIL WHITE COPY TO: DEPARTMENT OF NATURAL RESOURCES, P.O. BOX 250, ROLLA, MO 65401

RECYCLED PAPER

RECORD OF DRILLHOLE PZ-113-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/9/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1069242.39
AZIMUTH: 0

COLLAR ELEV: 460.0
E: 515776.57
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
112	0.0-114.6 ft. See Soil Borehole Log PZ-113-AD														0.0-114.5 ft. Borehole advanced using 9 7/8 in. diameter mud rotary bit then 6 in. casing sealed in borehole with neat cement
114	345.40 / 114.60		345.40												
	114.6-120.2 ft. Fresh, thickly to medium bedded, light olive gray (5Y 6/1), very fine grained, medium strong LIMESTONE, (ST. LOUIS FORMATION) Trace fossils, trace silicious zones		114.60						J,PL,SM						5/9/95 @ 9:30 Began coring
									J,PL,R						
									J,PL,R						
116									J,C,R,CL						
									J,C,R,CL						
	117.1-118.5 ft. Increase grain size and clay fraction, medium light gray (N6)			1	71%				J,PL,R						
									J,PL,R,CL						
118															
	118.5-120.0 ft. Medium light gray (N6) to light gray (N7)								J,C,VR (3)						
									J,C,VR (2)						
									J,C,VR						
									J,ST,R (2)						5/9/95 @ 9:50 End of Run 1
			340.00						Core Loss						
120	120.2-142.3 ft. Fresh, medium bedded, light olive gray (5Y 6/1), fine grained, strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Scattered 1 in. thick chert nodules		120.00						J,PL,R (4)						
									J,PL,R (4)						
									J,PL,SM						
122															
									J,PL,R (3)						
									J,PL,R,CL						
									J,PL,SM (5)						
124				2	100 %				J,PL,SM						
									J,PL,SM						
126									J,PL,R						
128															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/15/95

Golder Associates

RECORD OF DRILLHOLE PZ-113-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/9/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1069242.39
AZIMUTH: 0

COLLAR ELEV: 460.0
E: 515778.57
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	ROCK TYPE DESCRIPTION	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP w/r CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
128	120.2-142.3 ft. Fresh, medium bedded, light olive gray (5Y 6/1), fine grained, strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Scattered 1 in. thick chert nodules	330.60 / 129.40	2	100 %				J,PL,R					5/9/95 @ 11:00 End of Run 2
130								B,PL,SM (4)					
								B,PL,SM					
132			3	100 %									
134	134.2-134.8 ft. Coarse grained	325.60 / 134.40											5/9/95 @ 11:50 End of Run 3
	134.8-135.4 ft. Occasional stylolites present, fine to medium grained												
136								J,C,SM					
								J,I,R					
138	137.8-139.1 ft. Silty Claystone interbedded with Limestone							J,PL,R					
			4	100 %				B,I,R,CL					
								B,PL,SM (3)					
140													
	141.4-142.3 ft. Chert zone							J,PL,SM					
142		317.70 / 142.30											142.3 ft. Inferred top of SALEM FORMATION encountered
144	142.3-159.4 ft. Fresh, thickly bedded, light olive gray (5Y 5/2) to pale yellowish brown (10YR 6/2), very fine grained, medium strong, DOLOMITIC LIMESTONE, (SALEM FORMATION) Scattered 1/2 in. -1 in. chert nodules, vuggy												5/9/95 @ 12:40 End of Run 4

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/15/95

Golder Associates

RECORD OF DRILLHOLE PZ-113-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/9/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1069242.39
AZIMUTH: 0

COLLAR ELEV: 460.0
E: 515776.57
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (80 60 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR MW HW CW)	STRENGTH INDEX (R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 30 R2 150 R3 300 R4 600 R5 1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
144	142.3-159.4 ft. Fresh, thickly bedded, light olive gray (5Y 5/2) to pale yellowish brown (10YR 6/2), very fine grained, medium strong, DOLOMITIC LIMESTONE, (SALEM FORMATION) Scattered 1/2 in. - 1 in. chert nodules, vuggy		315.60	4	100 %										5/9/95 @ 12:40 End of Run 4
			144.40												
146															
148															
				5	99%										
150	149.7-150.2 ft. Increased percentage of Dolomite 150.2-150.7 ft. Chert zone														
152															
	152.9-155.5 ft. Fresh, thickly bedded, medium dark gray (N4), vf-f grained, medium strong, LIMESTONE, (SALEM FORMATION)														
154			305.60												5/9/95 @ 14:30 End of Run 5
			154.40												
	304.50														
156	155.5-155.8 ft. Fresh, thinly bedded, medium dark gray (N4), very weak, CLAYSTONE, (SALEM FORMATION) 304.20 155.80														
	155.8-159.4 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), fine grained, strong, DOLOMITIC LIMESTONE with abundant chert nodules 157.0-159.4 ft. Scattered chert nodules			6	100 %				B,PL,SM (2) J,PL,R						
158															
	300.60		300.60												5/9/95 @ 15:40 Ended coring
	End of Record of Drillhole at 159.4 ft. 159.40		159.40												
160															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

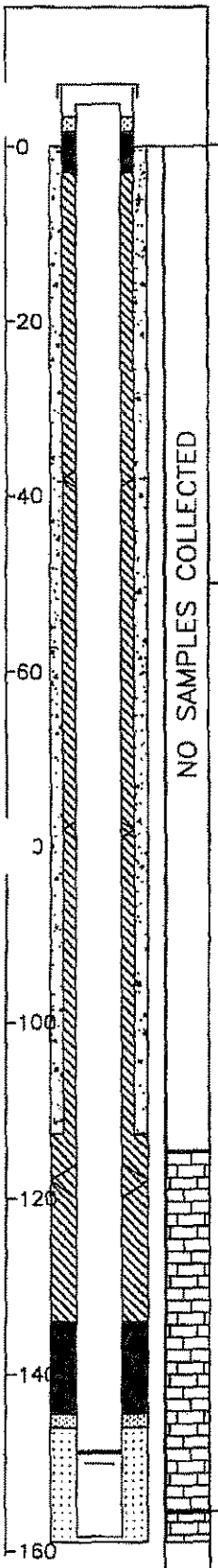
LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 8/15/95

Golder Associates

Well No. PZ-113-SS

Boring No. X-Ref: PZ-113-SS

PIEZOMETER CONSTRUCTION SUMMARY



Survey Coords: Northing: 1069242 ft. Easting: 515777 ft.

Elevation Ground Level 460.0 ft. NGVD

Top of PVC Casing 461.77 ft. NGVD

Drilling Summary:

Total Depth 159.0 ft.

Borehole Diameter 9 3/4 in. (0.0-115.0 ft.) 6 7/8 in. (115.0-159.0 ft.)

Casing Stickup Height 1.81 ft.

Driller Layne-Western St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit and 9 3/4 in. Tricone Bit

Drilling Fluid Auger-None, NX Core Water, Air and Mud Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	5/9/95	9:30	5/9/95	15:40
Schramm Rotary	5/20/95	13:30	5/20/95	14:30
Geophys.Logging:				
Casing:				
2" PVC	5/20/95	14:35	5/20/95	14:45
6" Steel	5/7/95	7:30	5/7/95	16:00
Filter Placement:	5/20/95	14:50	5/20/95	15:40
Cementing:				
Development				
Bentonite Grout	5/20/95	16:05	5/20/95	16:30
Bentonite Seal	5/20/95	15:55	5/20/95	16:05

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.81	-	148.57	C1	461.77	-	311.39
148.57	-	158.37	S1	311.39	-	301.59
158.37	-	158.70	C2	301.59	-	301.26
+ 0.50	-	115.00	C3	460.40	-	344.96
	-				-	
	-				-	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.) (C3-see comments)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 146.0-159.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 144.5-146.0 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-134.0 ft., Neat cement, 3.0-115.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 134.0-144.5 ft.

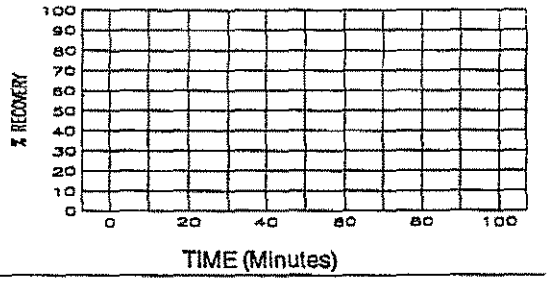
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments: Surface Casing C3: 6 1/8 in. ID / 6 5/8 in. OD Steel Casing

Not to Scale

Supervised by B. Tilton

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ113SS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122509	CHECK NO.
ROUTE	TRANSMITTAL NO.
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME: LAIDLAW WASTE SYSTEMS SANITARY LANDFILL		WELL NUMBER: PZ-113SS	
SITE ADDRESS: ST. CHARLES ROCK RD.	CITY: BRIDGETON	STATE: MO	ZIP CODE: 63044
NAME: LAIDLAW WASTE SYSTEMS, INC.		TELEPHONE: 314-241-3710	
ADDRESS: 1038 N. BROADWAY	CITY: ST. LOUIS	STATE: MO	ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

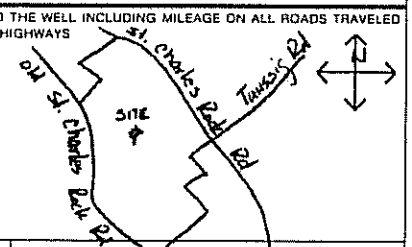
COUNTY: ST. LOUIS
ELEVATION: 459.4
AREA NO.

SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST ¼

SEC. ____ TWN. 47 N, RNG. 5 E OR W

LAT. 38 - 46 - 12 - LONG. 90 - 26 - 41 -

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN CO, INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN CO., INC.

TYPE OF INSTALLATION: ☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL: FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL:

ELEVATION OF MEASURING POINT: 461.8

MEASURING POINT IS: ☒ TOP OF RISER PIPE ☐ OTHER

DRILLING EQUIPMENT: ☒ AIR ROTARY ☒ AUGER TYPE 6¼ H.S.A. ☐ REVERSE ROTARY ☐ OTHER

CENTRALIZERS USED: ☒ YES, AT 5 TOTAL ☒ STAINLESS STEEL ☐ OTHER ☐ NO

MULTIPLE CASED WELLS: SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED: 5-20-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR): Michael P. Vogt
PERMIT NUMBER: 001256 WM DATE: 6-02-95

SIGNATURE (DRILLING CONTRACTOR): Michael P. Vogt
PERMIT NUMBER: 001256 WM DATE: 6-02-95

NOTE: Record the fraction of a foot in decimal, not in inches

Top of Riser Elevation: 461.8

LOCKING CAP - (Y) N (Circle one)
CAP VENT - Y / N (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8"x8"x5'
Bore Hole Diameter: 9 7/8
WEEP HOLE - Y / N (Circle one)

Ground Surface Elevation: 459.4

	Feet from Surface	Description of Formation
Information in this column to be supplied in the Feet from Surface column		
Depth to bottom of Protective Casing Seal:	3.0	
		111-159 Limestone
Depth to Base of Annular Seal:	134.0	
Depth to Base of Bentonite Seal:	144.5	
Depth to Base of Secondary Filter Pack:	146.0	
Depth to Top of the Screen:	148.4	
Depth to Bottom of the Screen:	158.4	
Plug Back Total Depth:	158.7	
Original Total Depth:	159.0	

PROTECTIVE CASING SEAL
Type: ☒ Concrete ☐ Cement Slurry

RISER PIPE
Length: 150.2'
Diameter: 3"
Type of Material: PVC

BOREHOLE DIAMETER: 5 7/8 in.

ANNULAR SEAL
Type: ☒ Bentonite Slurry ☐ Cement Slurry ☐ Non Slurry Bentonite

BENTONITE SEAL
Type: ☒ Bentonite Slurry ☐ Non Slurry Bentonite
Length of Seal: 10.5 Ft.

SECONDARY FILTER PACK (Optional)
Type: ☒ Sand ☐ Manufactured
Grain Size: < 50
Length: 1.5'

PRIMARY FILTER PACK
Type: ☒ Sand ☐ Manufactured
Grain Size: 16/35
Length: 13'

WELL SCREEN
Length: 10'
Slot Size: 0.010"
Type: PVC

SUMP DETAILS
Length: 0.5 Ft.
Diameter: 2 in.
Type: PVC

TYPE OF BACKFILL: SAND

MO 780-1415 (2-94)

DISTRIBUTION: WHITE-DIVISION CANARY-MONITORING WELL CONTRACTOR PINK-OWNER

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-114-AS
		SHEET 1 OF 2
LAIDLAW/OU2 RI-FS/MD WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	DRILLING START TIME 11:50 DATE 4/20/95 FINISH TIME 12:40 DATE 4/20/95
	WATER LEVEL / TIME / DATE / CASING DEPTH	
DATUM NORTHING: 1069418.88 EASTING: 516768.25 ELEVATION 449.8		
DRILL RIG CME 75	SURFACE CONDITIONS Grassy	
ANGLE -90° BEARING NA		
SAMPLE HAMMER 140 lbs.		

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1	3 4 8 9	1.7' / 2.0' (85%)			(0.0-2.0 Ft.) Compact, dark yellowish brown (10YR 4/2), f-m SAND, some clayey Silt, NR, moist, (SM), (FILL)	SP 1	
					(447.8) 2.0		
2 3	8 14 10 5	1.3' / 2.0' (65%)			(2.0-4.0 Ft.) Concrete, (FILL)	SP 2	
					(445.8) 4.0		
4 5	2 7 7 5	1.3' / 2.0' (65%)			(4.0-6.0 Ft.) Loose, moderate gray (N5), moist, f-c subrounded SAND, some clayey Silt, (SM), (FILL), lower 0.3 Ft. is concrete	SP 3	
					(443.8) 6.0		
6 7	1 2 1 3	0.7' / 2.0' (35%)			(6.0-8.0 Ft.) Soft to firm, medium dark gray (N4) to olive gray (5Y 4/1), clayey SILT, some fine and medium Sand, trace subrounded coarse Sand, (ML), (FILL)	SP 4	
					(441.8) 8.0		
8 9	2 2 3 3	0.7' / 2.0' (35%)			(8.0-12.0 Ft.) Soft, greenish black (5GY 2/1) to medium gray (N5), silty CLAY, little fine Sand, NR, moist, (CL), (FILL)	SP 5	
10 11	1 1 2 2	2.0' / 2.0' (100%)				SP 6	
12 13	1 3 4 6	1.8' / 2.0' (90%)			(12.0-15.5 Ft.) Firm, medium dark gray (N4), SILTY CLAY, little fine Sand, NR, moist, (CL), (ALLUVIUM) below 14.0 Ft., grades sandier with depth	SP 7	
14	1 3 4 2	1.9' / 2.0' (95%)				SP 8	

DRILLING CONTR LAYNE-WESTERN

LOGGED BY D. ALLOWAY CHK'D BY

DATE 4/20/95

JOB NO.: 943-2848

FILENAME: PZ114AS

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-114-AS
		SHEET 2 OF 2
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	DRILLING START / FINISH
	WATER LEVEL / TIME / DATE / CASING DEPTH	TIME 11:50 / TIME 12:40
		DATE 4/20/95 / DATE 4/20/95
DATUM NORTHING: 1069418.88 EASTING: 516768.25	ELEVATION 449.8	
DRILL RIG CME 75	SURFACE CONDITIONS Grassy	
ANGLE -90° BEARING NA		
SAMPLE HAMMER 140 lbs.		

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SAMPLER TYPE	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	REMARKS
16	0 1 3 4	2.0' / 2.0' (100%)	SP 8	(12.0-15.5 ft.) Firm, medium dark gray (N4), SILTY CLAY, little fine Sand, NR, moist, (CL), (ALLUVIUM) (15.5-17.4 ft.) Firm, medium gray (N5), SILTY CLAY, some f-m Sand, NR, moist to wet, (CL), (ALLUVIUM), grades sandier	
17			SP 9	(432.4) 17.4 (17.4-18.5 ft.) Loose, medium gray (N5), f-m SAND, some silty Clay, NR, wet, (SP), (ALLUVIUM), grades sandier and coarser	
18	3 3 5 2	1.2' / 2.0' (60%)	SP 10	(18.5-30.0 ft.) Loose to compact, medium gray (N5), f-m SAND, trace fines, thin layers of mica (<1/4" thick), NR, moist, (SP), (ALLUVIUM)	
19					
20	2 3 3 3	1.8' / 2.0' (90%)	SP 11		
21					
22	3 2 5 3	1.3' / 2.0' (65%)	SP 12		
23					
24	4 7 8 13	1.5' / 2.0' (75%)	SP 13	@ 23.7 ft. color changes to moderate brown (5YR 4/4) and moderate yellowish brown (10YR 5/2)	
25					
26	9 7 4 3	0.3' / 2.0' (15%)	SP 14		
27					
28	2 6 6 7	1.6' / 2.0' (80%)	SP 15		
29				@ 29.1-29.6 ft., organics present, bits of wood and grass	

DRILLING CONTR LAYNE-WESTERN

LOGGED BY D. ALLOWAY CHK'D BY W. HERST

DATE 4/20/95

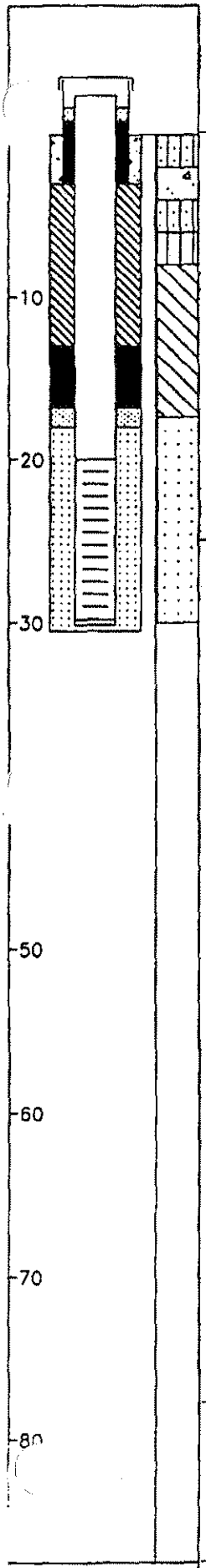
JOB NO.: 943-2848

FILENAME: PZ114AS

Well No. PZ-114-AS

Boring No. X-Ref: PZ-114-AS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1069419 ft. Easting: 516768 ft.

Elevation Ground Level 449.8 ft. NGVD

Top of PVC Casing 451.31 ft. NGVD

Drilling Summary:

Total Depth 30.5 ft.

Borehole Diameter 10 1/4 in.

Casing Stickup Height 1.53 ft.

Driller Layne-Western, St. Louis, MO

Rig CME 75

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit

Drilling Fluid Auger-None

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	4/20/95	11:50	4/20/95	12:40
Schramm Rotary				
Geophys.Logging:				
Casing:	4/20/95	13:00	4/20/95	13:30
Filter Placement:	4/20/95	13:15	4/20/95	14:00
Cementing:				
Development				
Bentonite Grout	4/20/95	13:45	4/20/95	14:45
Bentonite Seal	4/20/95	13:30	4/20/95	13:45

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.53	-	19.90	C1	451.31	-	429.88
19.90	-	29.70	S1	429.88	-	420.08
29.70	-	30.03	C2	420.08	-	419.75

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 18.0-30.5 ft.

Filter Pack: Less than 50 mesh Silica Sand, 16.8-18.0 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-13.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 13.0-16.8 ft.

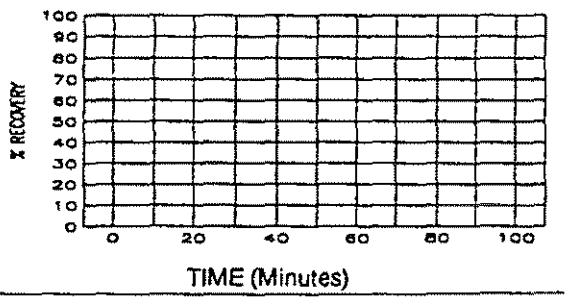
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Supervised by D. Alloway

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ114AS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122487	CHECK NO
ROUTE	TRANSMITTAL NO
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME: LAIDLAW BRIDGETON SANITARY LANDFILL		WELL NUMBER: PZ-114-AS	
SITE ADDRESS: ST. CHARLES ROCK RD	CITY: BRIDGETON	STATE: Mo	ZIP CODE: 63044
NAME: LAIDLAW WASTE SYSTEMS, INC.		TELEPHONE: 314-241-3710	
ADDRESS: 1838 N. BROADWAY	CITY: ST. LOUIS	STATE: Mo	ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

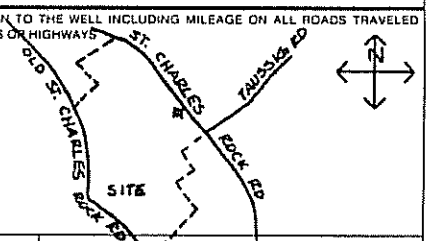
COUNTY: ST. LOUIS
ELEVATION: 447.8
AREA NO.

SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST ¼

SEC. ____ TWN. 47 N.RNG. 5 (E) OR W

LAT. 38° 46' 14" LONG. 90° 26' 28"

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

NOTE: Record the fraction of a foot in decimal, not in inches.

Top of Riser Elevation: 451.3

Ground Surface Elevation: 447.8 ft.

Feet from Surface	Description of Formation
Information in this column to be supplied in the Feet from Surface column	0-12.0 Fill
Depth to bottom of Protective Casing Seal: 3.0	
	12-17.5 Clay
Depth to Base of Annular Seal:	
Depth to Base of Bentonite Seal: 16.8	
Depth to Base of Secondary Filter Pack: 18.0	17.5-18.5 Sandy silt
Depth to Top of the Screen: 19.7	
	18.5-30 Sand
Depth to Bottom of the Screen: 29.7	
Plug Back Total Depth	
Original Total Depth: 30.0	

LOCKING CAP - (Y) / N (Circle one)
CAP VENT - Y / N (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8"x8"x5'
Bore Hole Diameter: 8"

WEEP HOLE - Y / N (Circle one)

PROTECTIVE CASING SEAL
Type: [X] Concrete [ ] Cement Slurry

RISER PIPE
Length: 31.2'
Diameter: 2"
Type of Material: SCH 80 PVC

BOREHOLE DIAMETER: 8 in.

ANNULAR SEAL
Type: [ ] Bentonite Slurry [ ] Cement Slurry [ ] Non Slurry Bentonite

BENTONITE SEAL
Type: [X] Bentonite Slurry [ ] Non Slurry Bentonite
Length of Seal: 13.8 FL

SECONDARY FILTER PACK (Optional)
Type: [X] Sand [ ] Manufactured
Grain Size: SUGAR 250
Length: 1.2'

PRIMARY FILTER PACK
Type: [X] Sand [ ] Manufactured
Grain Size: 16-35
Length: 12'

WELL SCREEN
Length: 10'
Slot Size: 0.010"
Type: SCH 80 PVC

SUMP DETAILS
Length: 0.3 FL
Diameter: 2 in.
Type: PVC

TYPE OF BACKFILL: SAND

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN Co., INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN Co., INC.

TYPE OF INSTALLATION
[X] ABOVE GROUND [ ] FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT
451.31

MEASURING POINT IS
[X] TOP OF RISER PIPE
[ ] OTHER

DRILLING EQUIPMENT
[ ] AIR ROTARY [X] AUGER TYPE 8 1/4 HSA
[ ] REVERSE ROTARY [ ] OTHER

CENTRALIZERS USED
[ ] YES, AT
[ ] STAINLESS STEEL
[ ] OTHER
[X] NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
4-20-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR) Kenan H. Nichols Jr.
PERMIT NUMBER 001258 WPM DATE 5-10-95

SIGNATURE (DRILLING CONTRACTOR) Kenan H. Nichols Jr.
PERMIT NUMBER 001259 WPM DATE 5-18-95

MO 780-1415 (2-94)

DISTRIBUTION: WHITE/DIVISION CANARY-MONITORING WELL CONTRACTOR PINK/OWNER
MAIL WHITE COPY TO: DEPARTMENT OF NATURAL RESOURCES, P.O. BOX 250 ROLLA, MO 65401

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
	4.25 inch I.D. Hollow Stem Auger	PZ-115-SS
	4.0 inch Tricone Bit with Bentonite	SHEET
	SAMPLING METHOD:	1 OF 1
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)	DRILLING
	SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	START / FINISH
	WATER LEVEL	TIME / TIME
	TIME	8:30 / 9:55
	DATE	DATE / DATE
NORTHING: 1069408.54 DATUM EASTING: 516755.35 ELEVATION 450.6	CASING DEPTH	5/5/95 / 5/5/95

DRILL RIG CME 75 - TRUCK MOUNT
ANGLE -90° BEARING NA
SAMPLE HAMMER

SURFACE CONDITIONS

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
31	6 7 7 6	1.0'/2.0' (50%)			(0.0-30.0 ft.) No samples collected, see Soil Borehole Log PZ-114-AS for descriptions (30.0-33.5 ft.) Compact, olive gray (5Y 4/1), SILTY f-m SAND, wet, NR, (SM), (ALLUVIUM)	SP 1	0.0-30.0 ft. Drilling conducted with 4.25-inch augers Below 30.0 ft. Drilling conducted with mud rotary techniques to control heaving sands.
32	8 8 50/3"	1.0'/1.5' (67%)				SP 2	
33					(417.1) 33.5		
34					End of Soil Borehole Log at 33.5 ft. See PZ-115-SS Record of Drillhole for rock descriptions		
35							
36							
37							
38							
39							
40							
41							
42							
43							
44							

DRILLING CONTR LAYNE-WESTERN

LOGGED BY B. TILTON
DATE 6/21/95 CHK'D BY W. HERST

JOB NO.: 943-2848
FILENAME: PZ115SS

RECORD OF DRILLHOLE PZ-115-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/10/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1069408.54
AZIMUTH: 0

COLLAR ELEV: 450.6
E: 516755.35
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD 60 40 20	FRACTURES PER FOOT 2 4 6 8 10	DISCONTINUITY DATA: DIP wrt CORE AXIS 0 30 60 90	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX SW FR MW HW CW	STRENGTH INDEX R6 R5 R4 R3 R2 R1	POINT LOAD INDEX (psi) H1 30 R2 150 R3 300 R4 600 R5 1500 R6	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
32	0.0-33.5 ft. See Soil Borehole Log PZ-115-SS 33.5-38.0 ft. No samples collected														3/9/95 9 7/8 in. mud rotary bit used to drill into bedrock then 6 in. steel casing grouted into borehole with neat cement
34															
36															
38	412.60 38.00 38.0-47.3 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), very fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)		412.50 38.00	1	100%										5/10/95 @ 8:30 Began drilling
			410.90 39.70												5/10/95 @ 8:50 End of Run 1
40	40.0-41.8 ft. Scattered silica zones and veins								J,PL,VR (2)						
									J,PL,VR (3)						
	41.2-47.7 ft. Microcrystalline, pale yellowish brown (10YR 6/2), slightly weathered 41.8-42.8 and 43.6-47.3 ft. Layers of green clay and clay filling around inplace pieces of rock								J,IR,VR (4)						
42															
									J,PL,VR (2)						
									J,IR,VR (3)						
44				2	97%				J,IR,VR (7)						
									J,IR,VR (6)						
46									J,IR,VR (7)						
	47.7-49.0 ft. Slightly weathered, thickly bedded, pale yellowish brown (10YR 6/2), microcrystalline, strong, DOLOMITIC LIMESTONE, (ST. LOUIS FORMATION) Vuggy (1 mm. to 5 mm. in diameter), some vugs filled with calcite or quartz								J,I,VR (7)						
48															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/15/95

Golder Associates

RECORD OF DRILLHOLE PZ-115-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/10/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1069408.54
AZIMUTH: 0

COLLAR ELEV: 450.8
E: 516755.35
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
48	48.8-48.9 ft. Claystone layers 49.0-50.2 ft. Slightly weathered, thickly bedded, pale yellowish brown (10YR 6/2), microcrystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Dolomite and clay zones, vuggy	400.90	2	97%		5/10/95 @ 10:10 End of Run 2
50	50.2-58.5 ft. Fresh, thickly bedded, pale yellowish brown (10YR 6/2), microcrystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION)	49.70			J,PL,VR	
52	50.2-51.4 ft. Thin clay laminations within rock visible but no preferential breaks or weak zones are associated 53.0-55.1 ft. Thin clay laminations, healed and unhealed bedding partings				B,PL,SM B,PL,SM (3) J,PL,R,CL	
54			3	100 %	J,PL,SM	
56	55.1-55.4 ft. Highly weathered, extremely weak Claystone zone 55.4-58.5 ft. Thin clay laminations and healed bedding partings, trace stylolites				J,PL,SM J,PL,SM J,PL,SM	
58	58.5-64.6 ft. Fresh, thickly bedded, pale yellowish brown (10YR 6/2), very fine, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Vuggy	390.90				5/10/95 @ 11:45 End of Run 3
60		59.70				
62			4	100 %		
64						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/15/95

Golder Associates

RECORD OF DRILLHOLE PZ-115-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/10/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1069408.54
AZIMUTH: 0

COLLAR ELEV: 450.6
E: 516755.35
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filed

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
64									J,IR,VR						
									J,C,SM						
	64.6-65.8 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), fine grained, strong, LIMESTONE, (ST. LOUIS FORMATION) Scattered stylolites and silica replacement of stylolites								J,PL,VR						
66	65.8-66.7 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Vuggy			4	100 %				J,PL,VR						
									J,PL,SM						
68	66.7-69.7 ft. Slightly weathered, medium bedded, pale yellowish brown (10YR 6/2), f-vf grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Zones of Claystone interbedded (1/2 in. - 1 1/2 in.)								B,PL,R						
			380.90						B,PL,R,CL						5/10/95 @ 12:30 End of Run 4
	69.7-84.7 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), microcrystalline to fine grained, strong, LIMESTONE, (ST. LOUIS FORMATION)		69.70						J,PL,VR						
70	69.7-75.7 ft. Fine to medium grained, trace fossils								J,IR,R						
72	72.0-72.2 ft. Highly weathered, weak, Claystone seam								B,PL,SM (2)						
	72.2-73.3 ft. Scattered chert								B,PL,SM						
74				5	100 %				J,C,SM (2)						
									J,PL,SM						
76	76.2 ft. Void filled with calcite crystals								J,PL,R						
	77.2-78.0 ft. Abundant stylolites								J,PL,R						
									J,I,R						
78									J,I,R						
									J,PL,SM						
	79.1-84.7 ft. Dolomite content increases, slightly weathered								J,I,R (2)						5/10/95 @ 13:50 End of Run 5
	79.4-81.0 ft. Abundant stylolites		370.90 79.70	6	100 %				J,I,R						
80															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/15/95

Golder Associates

RECORD OF DRILLHOLE PZ-115-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/10/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1069408.54
AZIMUTH: 0

COLLAR ELEV: 450.6
E: 516755.35
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE: DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP w/r CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80	69.7-84.7 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), microcrystalline to fine grained, strong, LIMESTONE, (ST. LOUIS FORMATION)								J,I,R						
									J,I,R (2)						
82				6	100 %				J,I,R						
									J,I,R (2)						
84	84.2-84.7 ft. Abundant stylolites								B,PL,R						5/10/95 @ 15:00 End of coring
	365.90		365.90												
	End of Record of Drillhole at 84.7 ft. 84.70		84.70												
86															
88															
90															
92															
94															
96															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

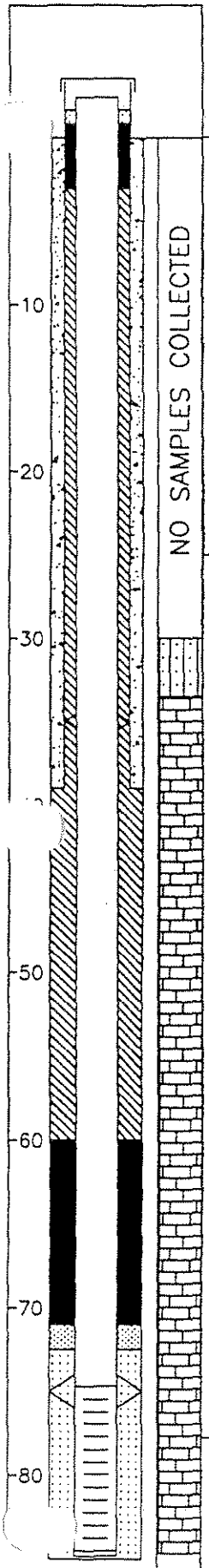
LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/15/95

Golder Associates

Well No. PZ-115-SS

Boring No. X-Ref: PZ-115-SS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1069409 ft. Easting: 516755 ft.

Elevation Ground Level 450.6 ft. NGVD

Top of PVC Casing 452.30 ft. NGVD

Drilling Summary:

Total Depth 85.0 ft.

Borehole Diameter 9 7/8 in. (0.0-39.0 ft.) 5 7/8 in. (39.0-85.0 ft.)

Casing Stickup Height 1.69 ft.

Driller Layne-Western, St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit and 9 7/8 in. Tricone Bit

Drilling Fluid Auger-None, NX Core Water, Air and Mud Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	5/5/95	8:30	5/5/95	10:00
Schramm Rotary	5/21/95	8:30	5/21/95	10:00
Geophys.Logging:				
Casing:				
2" PVC	5/21/95	10:15	5/21/95	10:20
6" Steel	5/9/95	9:15	5/9/95	12:00
Filter Placement:	5/21/95	10:40	5/21/95	11:00
Cementing:				
Development				
Bentonite Grout	5/21/95	11:10	5/21/95	11:30
Bentonite Seal	5/21/95	11:00	5/21/95	11:10

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.69	-	74.68	C1	452.30	-	375.93
74.68	-	84.48	S1	375.93	-	366.13
84.48	-	84.81	C2	366.13	-	365.80
+ 1.00	-	39.00	C3	451.60	-	411.81
	-				-	
	-				-	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.) (C3-see comments)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 72.5-85.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 71.0-72.5 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-60.0 ft., Neat cement, 3.0-39.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 60.0-71.0 ft.

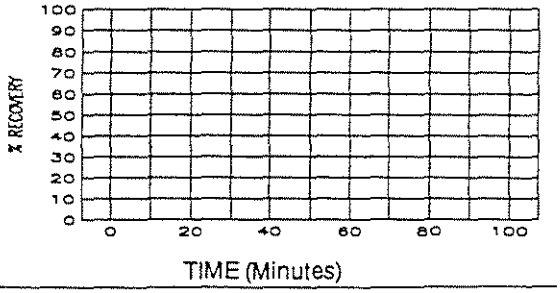
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments: Surface Casing C3: 6 1/8 in. ID / 6 5/8 in. OD Steel Casing

Supervised by B. Tilton

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ115SS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122507	CHECK NO
ROUTE	TRANSMITTAL NO.
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME	WELL NUMBER
LAIDLAW BRIDGETON SANITARY LANDFILL	PZ-1155S

SITE ADDRESS	CITY	STATE	ZIP CODE
ST. CHARLES ROCK RD.	BRIDGETON	MO	63044

NAME	TELEPHONE
LAIDLAW WASTE SYSTEMS, INC.	314-241-3710

ADDRESS	CITY	STATE	ZIP CODE
1838 N. BROADWAY	ST. LOUIS	MO.	63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

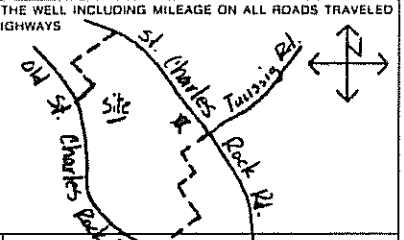
COUNTY ST. LOUIS
ELEVATION 450.6
AREA NO.

SMALLEST ¼ LARGEST ¼

SEC. TWN. 47 N,RNG. 5 E OR W

LAT. 38° 46' 14" LONG. 90° 26' 29"

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

NOTE: Record the fraction of a foot in decimal, not in inches.

Top of Riser Elevation: 452.3

Ground Surface Elevation: 450.6

Information in this column to be supplied in the Feet from Surface column	Feet from Surface	Description of Formation
Depth to bottom of Protective Casing Seal:	3.0	
		33-85 Limestone
Depth to Base of Annular Seal:	60.0	
Depth to Base of Bentonite Seal:	71.0	
Depth to Base of Secondary Filter Pack:	72.5	
Depth to Top of the Screen:	74.7	
Depth to Bottom of the Screen:	84.7	
Plug Back Total Depth:		
Original Total Depth:	85.0	

LOCKING CAP - (Y) N (Circle one)
CAP VENT - (Y) N (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8"x8"x5'
Bore Hole Diameter: 9 7/8"
WEEP HOLE - Y / N (Circle one)

PROTECTIVE CASING SEAL
Type: [X] Concrete [ ] Cement Slurry

RISER PIPE
Length: 76.4'
Diameter: 2"
Type of Material: Sch. 80 PVC

BOREHOLE DIAMETER: 5 7/8 in.

ANNULAR SEAL
Type: [ ] Bentonite Slurry [X] Cement Slurry [ ] Non Slurry Bentonite

BENTONITE SEAL
Type: [X] Bentonite Slurry [ ] Non Slurry Bentonite
Length of Seal: 11 FL

SECONDARY FILTER PACK (Optional)
Type: [ ] Sand [ ] Manufactured
Grain Size: < 50
Length: 1.5

PRIMARY FILTER PACK
Type: [X] Sand [ ] Manufactured
Grain Size: 16/35
Length: 12.5

WELL SCREEN
Length: 10'
Slot Size: 0.010"
Type: Sch. 80 PVC

SUMP DETAILS
Length: 0.3 FL
Diameter: 2 in.
Type: PVC

TYPE OF BACKFILL: SAND

MONITORING WELL INSTALLATION CONTRACTOR'S NAME

LAYNE WESTERN Co., INC.

DRILLING CONTRACTOR'S NAME

LAYNE WESTERN Co., INC.

TYPE OF INSTALLATION
[X] ABOVE GROUND [ ] FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT
452.3

MEASURING POINT IS
[X] TOP OF RISER PIPE
[ ] OTHER

DRILLING EQUIPMENT
[X] AIR ROTARY [X] AUGER TYPE 6¼ H.S.A.
[ ] REVERSE ROTARY [ ] OTHER

CENTRALIZERS USED
[X] YES, AT 3 TOTAL
[X] STAINLESS STEEL
[ ] OTHER
[ ] NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
5-21-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR) Michael P. Vogt

PERMIT NUMBER	DATE
001256 WM	6-02-95

SIGNATURE (DRILLING CONTRACTOR) Michael P. Vogt

PERMIT NUMBER	DATE
001256 WM	6-02-95

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger	BORING NO.	PZ-116-SS
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	SHEET	1 OF 3
		DRILLING START	DRILLING FINISH
	WATER LEVEL	TIME	TIME
	TIME	12:45	15:00
	DATE	DATE	DATE
NORTHING: 1066410.28 DATUM EASTING: 515843.88 ELEVATION 483.1	CASING DEPTH	6/5/95	6/5/95

DRILL RIG CME 75 - TRUCK MOUNT
SURFACE CONDITIONS Edge of haul road and flat fill area.
ANGLE BEARING
SAMPLE HAMMER

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
					(0.0-1.0 ft.) No samples collected, gravel road base encountered (482.1) 1.0		
1	5 6 4 5	0.9'/2.0' (45%)			(1.0-5.0 ft.) Stiff, dark yellowish brown (10YR 4/2), CLAYEY SILT, trace Gravel, WR, damp, (ML), (FILL)	SP 1	
3	2 2 4 5	0.7'/2.0' (35%)				SP 2	
5	3 3 5 5	1.5'/2.0' (75%)			(5.0-15.0 ft.) Loose, moderate yellowish brown (10YR 5/4), thinly laminated, SILT, SR, (ML), (LOESS)	SP 3	
7	3 5 8 9	1.7'/2.0' (85%)			@ 7.0 ft., color changes to mottled pale yellowish brown (10YR 6/2) to moderate yellowish brown (10YR 5/4), and silt becomes compact	SP 4	
9	7 8 8 9	1.6'/2.0' (80%)				SP 5	
11	5 8 9 10	1.2'/2.0' (60%)			@ 11.0 ft., color is predominantly pale yellowish brown (10YR 6/2)	SP 6	
13	6 7 7 6	1.3'/2.0' (65%)				SP 7	

DRILLING CONTR LAYNE-WESTERN
LOGGED BY B. TILTON
DATE 6/20/95
CHK'D BY W. HERST
JOB NO.: 943-2848
FILENAME: PZ116SS

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:				BORING NO.	
	6.25 inch I.D. Hollow Stem Auger				PZ-116-SS	
					SHEET	
	SAMPLING METHOD:				2 OF 3	
LAIDLAW/OU2 RI-FS/MO	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)				DRILLING	
WEST LAKE LANDFILL	SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)				START	FINISH
OPERABLE UNIT 2	WATER LEVEL				TIME	TIME
	TIME				12:45	15:00
	DATE				DATE	DATE
NORTHING: 1066410.28	CASING DEPTH				6/5/95	6/5/95
DATUM EASTING: 515843.88 ELEVATION 493.1						

DRILL RIG CME 75 - TRUCK MOUNT
SURFACE CONDITIONS Edge of haul road and flat fill area.
ANGLE BEARING
SAMPLE HAMMER

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
	5 6 6 10	1.4' 2.0' (70%)			(15.0-22.8 Ft.) Compact, pale yellowish brown (10YR 6/2), SILT, SR-NR, damp, (ML), (LOESS)	SP 8	
16							
17	9 5 4 6	1.3' 2.0' (65%)				SP 9	
18							
19	4 6 5 4	1.7' 2.0' (85%)				SP 10	
20							
21	1 4 6 9	1.6' 2.0' (80%)				SP 11	
22					(460.3) 22.8		
23	6 7 5 6	2.0' 2.0' (100%)			(22.8-24.2 Ft.) Compact, moderate yellowish brown (10YR 5/4), SILTY fine SAND, WR, damp, (SM), (ALLUVIUM)	SP 12	
24					(458.9) 24.2		
25	8 14 22 14	2.0' 2.0' (100%)			(24.2-25.6 Ft.) Compact, medium gray (N5), SILT, trace iron oxide staining, NR, moist, (ML), (LOESS)		
					(457.5) 25.6		
26					(25.6-27.0 Ft.) Dense, pale yellowish brown (10YR 6/2), fine SAND, trace Silt, NR, damp (SP), (ALLUVIUM)	SP 13	
					(456.1) 27.0		
27	4 11 17 18	2.0' 2.0' (100%)			(27.0-28.0 Ft.) Compact, medium gray (N5), SILT, NR, moist, (ML), (ALLUVIUM)		
					(455.1) 28.0		
28					(28.0-32.0 Ft.) Compact, medium light gray (N6), fine SAND, trace Silt, NR, moist, (SP)	SP 14	
29	8 9 11 10	2.0' 2.0' (100%)				SP 15	

DRILLING CONTR LAYNE-WESTERN
LOGGED BY B. TILTON
DATE 6/20/95
CHK'D BY W. HENSI
JOB NO.: 943-2848
FILENAME: PZ116SS

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-116-SS
		SHEET 3 OF 3
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	DRILLING START TIME 12:45 DATE 6/5/95; FINISH TIME 15:00 DATE 6/5/95
NORTHING: 1066410.28 DATUM EASTING: 515843.88 ELEVATION 483.1	WATER LEVEL / TIME / DATE / CASING DEPTH	

DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS Edge of haul road and flat fill area.
ANGLE BEARING	
SAMPLE HAMMER	

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
31	15 50/5"	0.5' 1.0" (50%)			(28.0-32.0 ft.) Compact, medium light gray (N6), fine SAND, trace Silt, NR, moist, (SP) @ 30.8 ft, some black organic material in sand	SP (15)	
32					@ 31.5 ft, gravel size pieces of Limestone in Sand, water encountered at 31.0 ft, on top of bedrock (451.1) 32.0	SP (16)	
33					End of Soil Borehole Log at 32.0 ft. See PZ-116-SS Record of Drillhole for rock descriptions		
34							
35							
36							
37							
38							
39							
40							
41							
42							
43							
44							

DRILLING CONTR LAYNE-WESTERN

LOGGED BY B. TILTON CHK'D BY W. HERST

DATE 6/20/95

JOB NO.: 943-2848

FILENAME: PZ116SS

RECORD OF DRILLHOLE PZ-116-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/5/95 - 6/14/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066410.28
AZIMUTH: 0

COLLAR ELEV: 483.1
E: 515843.88
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEP. SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
32	0.0-32.0 ft. See Soil Borehole Log PZ-116-SS 32.0-33.4 ft. No samples collected	449.70											
34	33.4-60.2 ft. Fresh, thickly laminated, light olive gray (5Y 6/1), very fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Occasional 0.5 - 2 mm. pyrite grains, weathered and grading into fresh at depth	33.40 / 447.10	1	71%									RQD of Run 1 was unassesable due to uncertainty in fracture origin. Drill bit was worn, poor quality recovery
36		36.00 / 446.20											
		36.90					90	J,I,R,Fe					
	37.6-38.7 ft. Stiff, Clay layer, light olive gray (5Y 6/1)	445.50 / 37.60					90	J,I,R					
38		444.40 / 38.70											
			2	51%									
40								J,I,R (3)					
42		440.90											
		42.20 / 439.90											
	43.2-43.4 ft. Very stiff, Clay layer, light olive gray (5Y 6/1)	439.70 / 43.40											
44			3	88%				J,PL,R					
								J,PL,R,CL					
		438.20					60	J,I,R					
	45.1-45.3 ft. Soft Clay layer	437.80 / 45.30					60	J,I,R					6/8/95 @ 13:10 Began Run 4
							60	J,I,R,CL					
46		436.90											
	46.2-48.0 ft. Highly weathered, thinly bedded, medium light gray (N6), fine grained, weak, BRECCIATED LIMESTONE in medium bluish gray (5B 5/1), clay matrix, (COLLAPSE ZONE)	46.20 / 435.10	4	96%									
48		48.00											

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: E. SWANSON
CHECKED: B. TILTON
DATE: 7/12/95

== Golder Associates

RECORD OF DRILLHOLE PZ-116-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/5/95 - 6/14/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066410.28
AZIMUTH: 0

COLLAR ELEV: 483.1
E: 515843.68
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
	435.10 / 48.00 — 48.0-60.2 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), micro-crystalline, strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic									
48			4	96%	J,I,R,CL					
					J,PL,SM,Fe					
		433.20 / 49.90								
50					J,PL,R					
					J,U,R					
52					J,PL,R					
					J,PL,R (3)					
					J,PL,R,CL					
54					J,C,R					
					J,PL,R,CL					
			5	100%	J,I,R					
56										
					J,PL,R,CL (2)					
					J,PL,R					
					J,PL,R,CL					
58					J,PL,R (3)					
					J,PL,R (2)					
		423.10 / 60.00								
60	422.90 / 60.20 — 60.2-64.8 ft. Fresh, thinly bedded, olive gray (5Y 4/1), fine grained, very strong, DOLOMITE, (ST. LOUIS FORMATION)				J,I,R					
62	61.9-62.5 ft. Light olive gray (5Y 6/1), very fine grained Limestone layer		6	100%	J,I,R					
					J,PL,R					
					J,PL,R,CL					
					J,PL,R,CL					
64										

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: E. SWANSON
CHECKED: B. TILTON
DATE: 7/12/95

Golder Associates

RECORD OF DRILLHOLE PZ-116-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & Water
DRILLING DATE: 6/5/95 - 6/14/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066410.28
AZIMUTH: 0

COLLAR ELEV: 483.1
E: 515843.88
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation: PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular: P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough: Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD (80 60 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR MW HW CW)	STRENGTH INDEX (R6 R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 30 R2 150 R3 300 R4 600 R5 1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
64															
	418.30 / 64.80														
	64.8-71.2 ft. Fresh, medium bedded, light olive ray (5Y 6/1), very fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)														
66									J,PL,R,CL						
				6	100 %										
									J,PL,R,CL						
68															
			413.10 / 70.00												
70															
72									J,PL,R,CL						
	72.4-87.0 ft. Fresh, medium bedded, light olive gray (5Y 6/1), micro-crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic								J,PL,R,CL						
									B,PL,R						
									J,PL,R,CL						
74	72.6-73.0 ft. Abundant chert zones (<3 in. thick)														
	408.00 / 75.10			7	99%										
	75.1-75.8 ft. Hard, Clay layer														
	407.30 / 75.80														
76									J,PL,R,CL (2)						
78									J,PL,R,CL (2)						
									J,I,R,CL						
80			403.10 / 80.00												

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: E. SWANSON
CHECKED: B. TILTON
DATE: 7/12/95

Golder Associates

RECORD OF DRILLHOLE PZ-116-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2846
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/5/95 - 6/14/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1056410.28
AZIMUTH: 0

COLLAR ELEV: 483.1
E: 515843.86
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (80 60 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0 30 60 90)	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR MW HW CW)	STRENGTH INDEX (R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 30 R2 150 R3 300 R4 600 R5 1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80	72.4-87.0 ft. Fresh, medium bedded, light olive gray (5Y 6/1), micro-crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic		403.10 / 80.00						J,C,R						
									J,PL,R (2)						
82	82.2-83.3 ft. Glauconitic intraclasts, argillaceous								B,PL,R						
									J,U,R,CL						
									J,I,R						
84									J,I,R,CL						
				8	100 %				J,PL,R,CL						
86									B,C,R,CL						
									J,I,R,CL						
	87.0-101.3 ft. Fresh, medium bedded, light olive gray (5Y 6/1), very fine crystalline, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) 87.8-91.3 ft. Porous zone, open vugs (<2 mm. dia.)								J,PL,R,CL						
									J,I,R						
90			393.00 / 90.10												
92				9	100 %										
94															
96															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: E. SWANSON
CHECKED: B. TILTON
DATE: 7/12/95

Golder Associates

RECORD OF DRILLHOLE PZ-116-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/5/95 - 6/14/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066410.28
AZIMUTH: 0

COLLAR ELEV: 483.1
E: 515843.88
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP vrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
96	87.0-101.3 ft. Fresh, medium bedded, light olive gray (5Y 6/1), very fine crystalline, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)												
98			9	100 %									
		383.10											
100		100.00											
	101.3-106.3 ft. Fresh, thickly bedded, light brownish gray (5YR 6/1), medium crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION)							B,PL,R,CL					
102								B,PL,R,CL					
			10	98%				J,PL,R					
104								J,PL,R					
	105.1-105.7 ft. Abundant, thinly laminated, shaley partings							J,PL,R (3)					
								J,PL,R,CL					
106								J,PL,R,CL					
		376.80											
	106.3-108.8 ft. Fresh, thinly bedded, light brownish gray (5YR 6/1), fine crystalline, extremely strong, SILICIFIED LIMESTONE, (ST. LOUIS FORMATION)	106.30											
			11	100 %									
108								J,I,R,SPUN					
		374.30											
	108.8-135.5 ft. Fresh, medium bedded, light olive gray (5Y 6/1), micro-crystalline, medium strong to strong, LIMESTONE (ST. LOUIS FORMATION) Stylolitic	108.80						J,PL,R					
								J,I,R (2)					
110			12	100 %									
								B,PL,SM					
								B,PL,SM					
112													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: E. SWANSON
CHECKED: B. TILTON
DATE: 7/12/95

Golder Associates

RECORD OF DRILLHOLE PZ-116-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/5/95 - 6/14/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068410.28
AZIMUTH: 0

COLLAR ELEV: 483.1
E: 515843.88
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP WRT CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
112	108.8-135.5 ft. Fresh, medium bedded, light olive gray (5Y 6/1), micro-crystalline, medium strong to strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic		12	100 %				J,PL,R,CL (3)					
114		369.10 / 114.00						J,PL,R (2)					
116			13	100 %				J,PL,R; J,I,R (2); PL,R (6)					
118		364.10 / 119.00											6/9/95 @ 14:30 Completed Run 13 6/14/95 @ 8:00 Began Run 4 Water level in open corehole = 21.1 ft. bgs prior to drilling
120	121.2-122.2 ft. Argillaceous Limestone							J,I,R; B,I,R (3); J,I,R (2)					@ 120.3, 122.8, 123.3, 125.5 and 126.7 ft., possible open intact joints, (<5 breaks/in.)
122	@ 122.5 ft. Very stiff, light olive gray (5Y 6/1), Silt layer (< 1/2 in. thick)		14	100 %				J,I,R					
124	124.7-127.0 ft. Limestone becomes fine to medium crystalline							J,I,SM; B,I,SM,CL; J,I,R					
126	126.4-127.0 ft. Moderately weathered zone							J,I,R					
128													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: E. SWANSON
CHECKED: B. TILTON
DATE: 7/12/95

Golder Associates

RECORD OF DRILLHOLE PZ-116-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2846
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/5/95 - 6/14/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1065410.28
AZIMUTH: 0

COLLAR ELEV: 483.1
E: 515843.88
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
128	108.8-135.5 ft. Fresh, medium bedded, light olive gray (5Y 6/1), micro-crystalline, medium strong to strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic		354.10 / 129.00	14	100 %			90	J,PL,SM						6/14/95 @ 9:10 Completed Run 14
130															
								90	J,PL,SM						
132								30	J,PL,SM						
								90	J,I,R (3)						
															133.0-133.5 ft. Possible open intact joints, highly broken zone
								90	J,I,R						
134				15	98%										
								90	B,I,R,CL						
	134.9-135.7 ft. Limestone becomes fine grained		347.60												
	135.5-139.1 ft. Fresh, thickly bedded, olive gray (5Y 4/1), very fine grained, medium strong, ARGILLACEOUS LIMESTONE, (SALEM FORMATION)		135.50												@ 135.5 ft. Inferred top of Salem Formation
136															
138															
			344.10 / 139.00												6/14/95 @ 10:11 Completed Run 15
	139.1-141.8 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARENACEOUS LIMESTONE, (SALEM FORMATION)							90	B,PL,SM,CL						
140	@ 139.6 ft. Very stiff, olive gray (5Y 4/1), Silt layer (<1 in. thick)														
								90	J,PL,SM						
				16	92%			60	J,I,R (2)						
142	141.8-151.2 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), micro-crystalline, medium strong LIMESTONE, (SALEM FORMATION) Thin layers of glauconite Clay, surrounding Limestone matrix							90	J,I,R						
								90	J,I,R,CL (2)						
								90	B,I,SM						6/14/95 @ 11:00 Completed Run 16 Stopped short as bit plugged, core loss in highly broken rock
144			339.10 / 144.00												

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: E. SWANSON
CHECKED: B. TILTON
DATE: 7/12/95

Golder Associates

RECORD OF DRILLHOLE PZ-116-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/5/95 - 6/14/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066410.28
AZIMUTH: 0

COLLAR ELEV: 483.1
E: 515843.88
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
144	141.8-151.2 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), micro-crystalline, medium strong LIMESTONE, (SALEM FORMATION) Thin layers of glauconite Clay, surrounding Limestone matrix	339.10 / 144.00						B,U,R,CL					
								J,I,R (2)					
								J,I,R (3)					
146	@ 144.7 ft. Vug with calcite crystals (<1/2 in. dia.) 146.0-151.2 ft. Limestone becomes argillaceous												
148			17	100 %									
150													
	151.2-162.5 ft. Fresh, thinly bedded, olive gray (5Y 4/1), fine crystalline, medium strong, FOSSILIFEROUS LIMESTONE, (SALEM FORMATION) Thinly laminated, shaley partings common, some chert nodules (<2 in. dia.)							J,I,R					
152													
								J,I,R					
154		329.10 / 154.00											6/14/95 @ 12:00 End Run 17
	154.5-155.2 ft. Limestone becomes argillaceous							J,I,R (2)					
								B,PL,SM,CL					
156			18	100 %									@ 157.0 and 158.8 ft. Possible open/intact joints, highly broken zone
	157.5-162.5 ft. Abundant chert zones (<2 in. thick)							J,I,R (2)					
								B,I,SM					
158													
								J,PL,SM					
								B,PL,SM					
160													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: E. SWANSON
CHECKED: B. TILTON
DATE: 7/12/95

Golder Associates

RECORD OF DRILLHOLE PZ-116-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/5/95 - 6/14/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066410.28
AZIMUTH: 0

COLLAR ELEV: 483.1
E: 515843.68
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (80 60 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0 30 60 90)	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR MW HW CW)	STRENGTH INDEX (R5 R6 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 30 R2 150 R3 300 R4 600 R5 1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
160	151.2-162.5 ft. Fresh, thinly bedded, olive gray (5Y 4/1), fine crystalline, medium strong, FOSSILIFEROUS LIMESTONE, (SALEM FORMATION) Thinly laminated, shaley partings common, some chert nodules (<2 in. dia.)			18	100 %										
162	320.60		320.60												6/14/95 @ 13:25 End Run 18
	End of Record of Drillhole at 162.5 ft. 162.50		162.50												
164															
166															
168															
170															
172															
174															
176															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

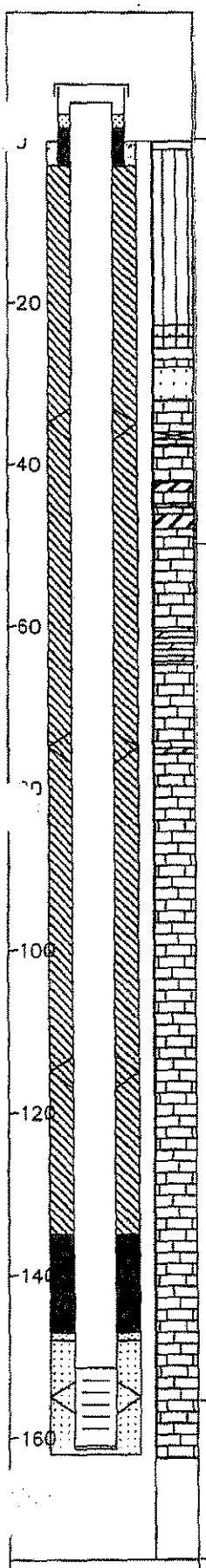
LOGGED: E. SWANSON
CHECKED: B. TILTON
DATE: 7/12/95

Golder Associates

Well No. PZ-116-SS

Boring No. X-Ref: PZ-116-SS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1066410 ft. Easting: 515844 ft.

Elevation Ground Level 483.1 ft. NGVD

Top of PVC Casing 484.87 ft. NGVD

Drilling Summary:

Total Depth 162.0 ft.

Borehole Diameter 10 1/4 in. (0.0–33.0 ft.) 5 7/8 in. (33.0–162.0 ft.)

Casing Stickup Height 1.80 ft.

Driller Layne-Western, St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit for Reaming

Drilling Fluid Auger-None, NX Core Water, Air Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	6/5/95	7:30	6/14/95	13:25
Schramm Rotary	6/20/95	8:00	6/20/95	11:45
Geophys.Logging:				
Casing:	6/20/95	12:30	6/20/95	12:50
Filter Placement:	6/20/95	12:55	6/20/95	13:00
Cementing:				
Development				
Bentonite Grout	6/20/95	13:30	6/20/95	15:30
Bentonite Seal	6/20/95	13:15	6/20/95	13:30

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.80	-	151.40	C1	484.87	-	331.67
151.40	-	161.00	S1	331.67	-	322.07
161.00	-	161.33	C2	322.07	-	321.74

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 148.0–162.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 147.0–148.0 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0–135.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 135.0–147.0 ft.

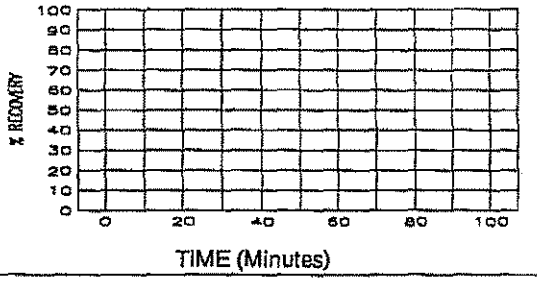
Concrete: 0.0–3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Supervised by B. Tilton

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ116SS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122519	CHECK NO
ROUTE	TRANSMITTAL NO
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME		WELL NUMBER	
LAIDLAW BRIDGETON SANITARY LANDFILL		PZ-116-55	
SITE ADDRESS: ST. CHARLES ROCK RD.	CITY: BRIDGETON	STATE: MO	ZIP CODE: 63044
NAME: LAIDLAW WASTE SYSTEMS, INC.		TELEPHONE: 314-241-3710	
ADDRESS: 1230 N BROADWAY	CITY: ST. LOUIS	STATE: MO	ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

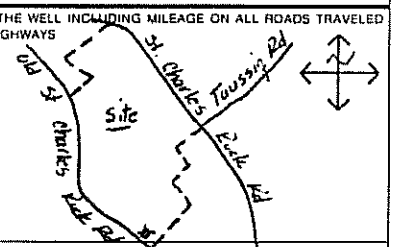
COUNTY: ST. LOUIS
ELEVATION: 483.07
AREA NO.:

SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST ¼

SEC. ____ TWN. 47 N,RNG 5 E OR W

LAT. 38° 45' 44" LONG. 90° 26' 40"

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN Co., Inc.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN Co., Inc.

TYPE OF INSTALLATION: ☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL: FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL:

ELEVATION OF MEASURING POINT: 484.87

MEASURING POINT IS: ☒ TOP OF RISER PIPE ☐ OTHER

DRILLING EQUIPMENT: ☒ AIR ROTARY ☒ AUGER TYPE 6¼ H.S.A. ☐ REVERSE ROTARY ☐ OTHER

CENTRALIZERS USED: ☒ YES, AT 5 TOTAL ☒ STAINLESS STEEL ☐ OTHER ☐ NO

MULTIPLE CASED WELLS: SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED: 6-20-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR): Michael P. Vogt
PERMIT NUMBER: 001256WM DATE: 7-27-95

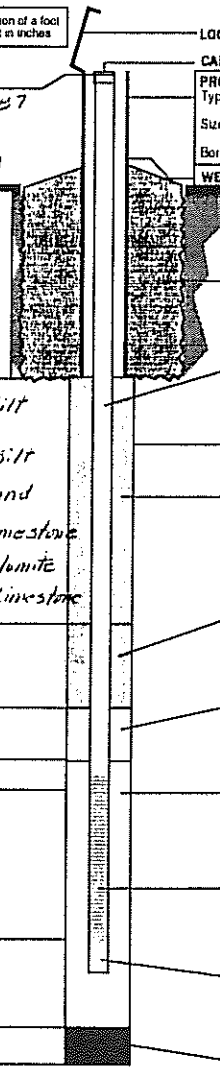
SIGNATURE (DRILLING CONTRACTOR): Michael P. Vogt
PERMIT NUMBER: 001256WM DATE: 7-27-95

NOTE: Record the fraction of a foot in decimal, not in inches

Top of Riser Elevation: 484.87

Ground Surface Elevation: 483.07 Ft

Feet from Surface	Description of Formation
Information in this column to be supplied in the Feet from Surface column	0-24' Silt
Depth to bottom of Protective Casing Seal: 3.0	
	24-28 Silt w/sand
	28-30 Silt
	30-34 Sand
	34-61 Limestone
	61-65 Dolomite
Depth to Base of Annular Seal: 135.0	65-162 Limestone
Depth to Base of Bentonite Seal: 147.0	
Depth to Base of Secondary Filter Pack: 148.0	
Depth to Top of the Screen: 151.0	
Depth to Bottom of the Screen: 161.0	
Plug Back Total Depth:	
Original Total Depth: 162.0	



LOCKING CAP - Y / N (Circle one)

CAP VENT - Y / N (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8" x 8" x 5'
Bore Hole Diameter: 10¼"

WEEP HOLE - Y / N (Circle one)

PROTECTIVE CASING SEAL
Type: ☒ Concrete ☐ Cement Slurry

RISER PIPE
Length: 153'
Diameter: 3"
Type of Material: SCH 80 PVC

BOREHOLE DIAMETER: 5⅞ In.

ANNULAR SEAL
Type: ☐ Bentonite Slurry ☒ Cement Slurry ☐ Non Slurry Bentonite

BENTONITE SEAL
Type: ☒ Bentonite Slurry ☐ Non Slurry Bentonite
Length of Seal: 12 Ft.

SECONDARY FILTER PACK (Optional)
Type: ☒ Sand ☐ Manufactured
Grain Size: <50
Length: 1'

PRIMARY FILTER PACK
Type: ☒ Sand ☐ Manufactured
Grain Size: 16-35
Length: 14'

WELL SCREEN
Length: 10'
Slot Size: 0.010
Type: SCH 80 PVC

SUMP DETAILS
Length: 0.3 Ft.
Diameter: 2 In.
Type: PVC

TYPE OF BACKFILL: SAND

DISTRIBUTION: WHITE DNR/GGS CANARY MONITORING WELL CONTRACTOR PINK/OWNER

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-200-SS
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	SHEET 1 OF 2
		DRILLING START TIME 10:56 DATE 2/10/95; FINISH TIME 14:05 DATE 2/10/95
NORTHING: 1068496.19 DATUM EASTING: 516972.30 ELEVATION 483.6	WATER LEVEL / TIME / DATE / CASING DEPTH	
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS	
ANGLE BEARING		
SAMPLE HAMMER		

DRILLING CONTR LAYNE-WESTERN

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1							No sample 0.0-2.0 ft., due to gravel pad
2					(481.6) 2.0		
2–3	6 8 8 6	0.8'/2.0' (40%)			(2.0-8.1 ft.) Very stiff, dark yellowish brown (10YR 4/2), homogenous, CLAYEY SILT, NR, moist, (CL-ML), (LOESS)	SP ②	
4–5	3 8 12 15	1.3'/2.0' (65%)				SP ③	
6–7		2.3'/2.0' (115%)				SH ④	
8–9	6 8 10 13	2.0'/2.0' (100%)			(8.1-16.5 ft.) Stiff to very stiff, light olive gray (5Y 6/1) to light brown (5YR 5/6), homogenous, mottled CLAYEY SILT, NR, damp, (CL-ML), (LOESS)	SP ⑤	
10–11	3 7 11 13	1.7'/2.0' (85%)				SP ⑥	
12–13	8 6 7 8	1.9'/2.0' (95%)				SP ⑦	
14		2.3'/2.0' (115%)				SH ⑧	

LOGGED BY J. MILLER

DATE 2/10/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ200SS

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	4.25 inch I.D. Hollow Stem Auger	PZ-200-SS
		SHEET 2 OF 2
	SAMPLING METHOD:	
	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)	DRILLING
	SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	START / FINISH
	WATER LEVEL	TIME / TIME
	TIME	10:56 / 14:05
	DATE	DATE / DATE
	CASING DEPTH	2/10/95 / 2/10/95

NORTHING: 1068496.19
DATUM EASTING: 516972.30 ELEVATION 483.6

DRILL RIG CME 75 - TRUCK MOUNT
SURFACE CONDITIONS
ANGLE BEARING
SAMPLE HAMMER

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
16	4 5 7 9	1.5' / 2.0' (75%)			(8.1-16.5 ft.) Stiff to very stiff, light olive gray (5Y 6/1) to light brown (5YR 5/6), homogenous, mottled CLAYEY SILT, NR, damp, (CL-ML), (LOESS)	SH 8	
17					(16.5-19.7 ft.) Stiff, light olive gray (5Y 6/1) to moderate brown (5YR 4/4), homogenous, mottled CLAYEY SILT, NR, moist, (CL-ML), (LOESS)	SP 9	
18	3 5 15 18	1.5' / 2.0' (75%)					
19					(463.9) 19.7	SP 10	
20	5 15 14 12	0.0' / 2.0' (0%)			(19.7-20.5 ft.) Compact, moderate yellowish brown (10YR 5/4), homogenous, fine SAND, trace Silt, NR, dry, (SM), (ALLUVIUM) (463.1) 20.5		
21					(20.5-25.5 Ft.) Very stiff, light olive gray (5Y 6/1) to light brown (5YR 5/6), stratified, CLAYEY SILT, mottled with black manganese stains, NR, moist, (CL-ML), (ALLUVIUM)	SP 11	
22	5 6 9 9	1.2' / 2.0' (60%)					
23						SP 12	
24	8 14 26 28	1.4' / 2.0' (70%)			@ 24.3 ft., <1 inch fine sand lenses		
25					(458.1) 25.5	SP 13	
26	14 33 40/4"	0.7' / 1.3' (54%)			(25.5-27.6 ft.) Dense, light brown (5YR 5/6), stratified, fine SAND, NR, dry, (SP), (ALLUVIUM)	SP 14	
27					@ 27.3 ft., <1 inch clayey silt lenses (456.3) 27.3		
28					End of Soil Borehole Log at 27.3 ft. See PZ-200-SS Record of Drillhole for rock descriptions		2/10/95 - 14:05 Finish drilling at 27.3 ft. - hit bedrock End of soil borehole at 27.3 ft.
29							

DRILLING CONTR LAYNE-WESTERN
LOGGED BY J. MILLER CHK'D BY W. HERST
DATE 2/10/95
JOB NO.: 943-2848
FILENAME: PZ200SS

RECORD OF DRILLHOLE PZ-200-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2846
LOCATION: BRIDGETON, MO

BORING METHOD: NX core & water
DRILLING DATE: 2/10/95 -2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068496.2
AZIMUTH: 0

COLLAR ELEV: 483.61
E: 516972.2
INCLINATION: -90

ROCK TYPE: J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation; PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular; P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough; Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP w/r CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
16	0.0-27.3 ft. See Soil Borehole Log PZ-200-SS												
18													
20													
22													
24													
26													2/10/95 @ 16:12 Start Run 1 16:16 Stop-no circulation, pull core, quit for the day at 16:30
	456.31	456.31											
	27.3-44.5 ft. 27.30 Slightly weathered, medium bedded, light olive gray (5Y 6/1), medium crystalline, weak, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic, iron staining, calcite mineralization, 1 in. clay parting at 30.1 ft.	27.30						J,C,R (3)					2/11/95 Measure water level in augers, dry to 27.0 ft.
28								J,I,R,calcite					
								J,PL,R-CL					
								J,PL-J,R					
			1	68%				J,PL,R (3)					
								J,I,R					
								J,PL,R (3)					
								J,PL,R (2)					
30								J,I,R					
		453.11						Core Loss					
		30.50						J,I,R					2/11/95 @ 10:50
								J,PL,R-CL					
			2	100 %				J,I,R (4)					
32								J,I,R (3)					

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-200-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX core & water
DRILLING DATE: 2/10/95 -2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068496.2
AZIMUTH: 3

COLLAR ELEV: 483.61
E: 516972.2
INCLINATION: -90

ROCK TYPE

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular

P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough

Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DISCONTINUITY DATA

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
32	27.3-44.5 ft. Slightly weathered, medium bedded, light olive gray (5Y 6/1), medium crystalline, weak, LIMESTONE, (ST. LOUIS FORMATION)								J,ST,R						
									J,I,R-calcite						
									J,PL,R-open						
									J,PL,R						
									J,I,R-open						
									J,I,R (4)						
									J,C,R						
34									J,PL,SM (2)						
									J,C,R-CL						
									J,C,R						
									J,I,R						
									J,PL,R						
									J,C,R-CL						
36				2	100 %										
									J,I,R,CL (2)						
									J,I,R-open						
38									J,I,R-CL (2)						
									J,I,R (2)						
									J,PL,R-open						
									J,PL,SM						
40			443.51 / 40.10						J,PL,R (2)						
									J,I,R-CL (2)						
									J,PL,SM-open						
									J,I,R (2)						
42									J,I,R (3)						
									J,I,R-CL-open (5)						
									J,I,R (2)						
44				3	100 %				J,PL,SM-open (3)						
	44.5-68.7 ft. Fresh, medium bedded, light olive gray (5Y 6/1), medium crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION)								J,I,R						
									J,PL,R-open						
									J,I,R (2)						
									J,I,R						
46									J,I,R-open						
									J,I,R (2)						
48									J,I,R-CL						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-200-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX core & water
DRILLING DATE: 2/10/95 -2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1058496.2
AZIMUTH: 0

COLLAR ELEV: 483.61
E: 518972.2
INCLINATION: -90

ROCK TYPE

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular

P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough

Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
48	44.5-68.7 ft. Fresh, medium bedded, light olive gray (5Y 6/1), medium crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION)		3	100 %	J,I,R	
50	Argillaceous laminae, clay partings, stylolitic, brachiopod fossils	433.51 / 50.10				
52					J,PL,SM	
					J,PL,SM	
54					J,PL,SM	
			4	99%		
56					J,PL,SM	
					J,I,R	
					J,I,R	
58					J,I,R	
					J,I,R-CL (3)	
					J,I,R (2)	
					J,PL,SM-open	
					J,PL,SM-CL (3)	
60		423.51 / 60.10				
					J,PL,SM-CL (5)	
					J,PL,R	
					J,PL,R (2)	
62					J,PL,SM-CL (2)	
			5	85%		
					J,PL,R (2)	
					J,ST,R	
	Argillaceous laminae, clay partings, stylolitic, brachiopods				J,PL,R	
64					J,PL,SM	

DISCONTINUITY DATA: DIP wrt CORE AXIS (0, 30, 60, 90)

RQD (80, 60, 40, 20); FRACTURES PER FOOT (2, 4, 6, 8, 10)

WEATHERING INDEX: SW, FR, MW, HW, CW

STRENGTH INDEX: R6, R5, R4, R3, R2, R1

POINT LOAD INDEX (psi): R1, R2 30, R3 150, R4 300, R5 600, R6 1500

TEST ORIENTATION

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-200-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX core & water
DRILLING DATE: 2/10/95 -2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068498.2
AZIMUTH: 0

COLLAR ELEV: 483.61
E: 518972.2
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filed

DEPTH (FEET)	ROCK TYPE DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
64	44.5-68.7 ft. Fresh, medium bedded, light olive gray (5Y 6/1), medium crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION)							J,PL,SM-CL					
								J,PL,SM-CL					
66			5	85%				J,I,R-open (2)					
								J,PL,SM-CL					
								J,PL,R					
68													
	414.91 / 68.70	415.01 / 68.60						J,I,R-intact					2/11/95 @ 16:30 Quit drilling for the day at 68.6 ft. after Run 5 2/12/95 @ 8:00 Begin coring Run 6
	68.7-76.0 ft. Slightly weathered, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARENACEOUS DOLOMITE, (ST. LOUIS FORMATION)							J,I,R-intact					
70								J,I,R					
	Vuggy, fossiliferous							J,I,R-intact					
72								J,I,R-intact					
								J,PL,SM					
	73.0-74.0 ft. Medium crystalline, non-vuggy							J,I,R					
	Chert at 74.2-74.5 ft., fractured, solutionized immediately below		6	100 %				J,I,R					
74								J,I,R					
								J,I,R					
								J,I,R (2)					
								J,I,R					
								J,C,R-CL					
76	407.81 / 76.00 76.0-78.5 ft. Fresh, thinly bedded, light olive gray (5Y 5/2), microcrystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION)							J,I,R-intact					
								J,I,SM-CL					
78													
	78.5-86.0 ft. Fresh, thinly bedded, yellowish gray (5Y 7/2), medium crystalline, weak, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)	404.91 / 78.70	7	100 %				J,I,R-CL					
80													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-200-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX core & water
DRILLING DATE: 2/10/95 -2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068486.2
AZIMUTH: 0

COLLAR ELEV: 483.61
E: 518972.2
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80	78.5-86.0 ft. Fresh, thinly bedded, yellowish gray (5Y 7/2), medium crystalline, weak, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)							J,I,R-CL					
								J,I,R					
								J,I,R					
								J,I,R-calcite					
82								J,I,R					
								J,I,R					
								J,I,R					
								J,I,R					
								J,I,R					
84			7	100 %				J,I,R-CL					
								J,I,R-CL					
86	86.0-92.0 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), microcrystalline, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)							J,I,R-CL					
								J,I,R-CL-intact					
								J,PL,SM					
88								J,I,R-CL					
		394.91 / 88.70											
	Stylolitic, brecciated, glauconite infillings 89.0-90.2 ft. Moderately weathered							J,I,R-CL					
90								J,I,R					
								J,I,R-CL					
			8	100 %				J,PL,SM-CL (2)					
	391.61												
92	92.0-98.7 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), microcrystalline, medium strong, ARENACEOUS DOLOMITE, (ST. LOUIS FORMATION) 92.00							J,PL,SM (2)					2/13/95 @ 12:53 Measure water level at 54.3 ft. below ground surface
		389.91 / 93.70											2/14/95 @ 8:02 Measure water level at 69.5 ft. below ground surface
94			9	100 %									2/14/95 @ 17:15 Measure water level at 70.42 ft. below ground surface
								J,I,R					
96													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

RECORD OF DRILLHOLE PZ-200-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX core & water
DRILLING DATE: 2/10/95 -2/13/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068496.2
AZIMUTH: 0

COLLAR ELEV: 483.61
E: 518972.2
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE: DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (80 60 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR MW HW CW)	STRENGTH INDEX (R6 R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 30 R2 150 R3 300 R4 600 R5 1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
96	92.0-98.7 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), microcrystalline, medium strong, ARENACEOUS DOLOMITE, (ST. LOUIS FORMATION)			9	100 %				J,I,R; J,I,R-CL; J,I,R; J,I,R-CL; J,PL,SM						
98			384.91												
	End of Record of Drillhole at 98.7 ft. 98.70		98.70												
100															
102															
104															
106															
108															
110															
112															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

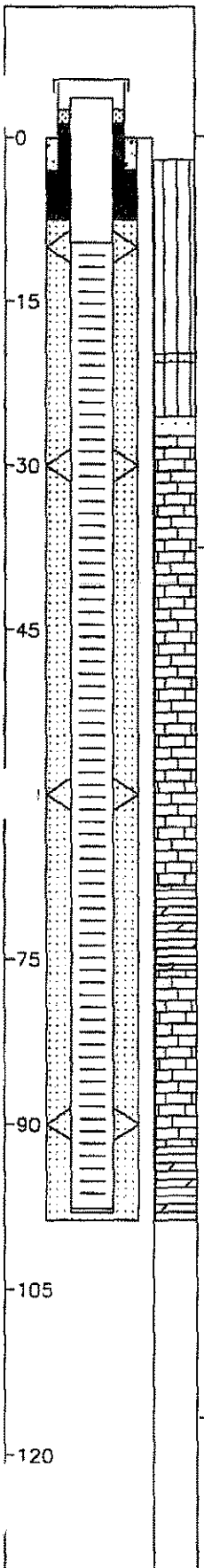
LOGGED: J. MILLER
CHECKED: R. BOOTH
DATE: 3/9/95

Golder Associates

Well No. PZ-200-SS

Boring No. X-Ref: PZ-200-SS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1068496 ft. Easting: 516972 ft.

Elevation Ground Level 483.6 ft. NGVD

Top of PVC Casing 485.63 ft. NGVD

Drilling Summary:

Total Depth 98.7 ft.

Borehole Diameter 10 1/4 in. (0.0-27.5 ft.) 5 7/8 in. (27.5-98.3 ft.)

Casing Stickup Height 2.02 ft.

Driller Layne-Western St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit for Reaming

Drilling Fluid Auger-None, NX Core Water, Air Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	2/10/95	10:56	2/10/95	14:05
Schramm Rotary	2/28/95	7:30	2/28/95	9:30
Geophys.Logging:				
Casing:	2/28/95	9:45	2/28/95	10:10
Filter Placement:	2/28/95	10:30	2/28/95	11:30
Cementing:				
Development				
Bentonite Grout Bentonite Seal	2/28/95	11:30	2/28/95	11:45

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 2.02	-	9.62	C1	485.63	-	473.99
9.62	-	97.64	S1	473.99	-	385.97
97.64	-	97.97	C2	385.97	-	385.64

Casing: C1 2 in. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 7.5-98.7 ft.

Filter Pack:

Grout Seal:

Bentonite Seal: Medium Bentonite Chips, 3.0-7.5 ft.

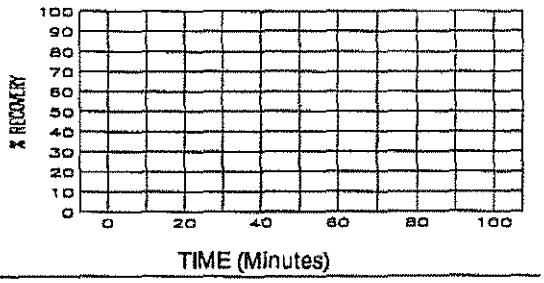
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Supervised by B. Tilton

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ200SS

561574

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF. NO. 115084	CHECK NO.
ROUTE	TRANSMITTAL NO.
STATE WELL NUMBER	CROSS REFERENCE NO.
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME: LAIDLAW BRIDGETON SANITARY LANDFILL		WELL NUMBER: ~~[illegible]~~ PZ-200-55	
SITE ADDRESS: ST. CHARLES ROCK RD.	CITY: BRIDGETON	STATE: MO	ZIP CODE: 63044
NAME: LAIDLAW WASTE SYSTEMS, INC		TELEPHONE: 314-241-3710	
ADDRESS: 1838 N. BROADWAY	CITY: ST. LOUIS	STATE: MO.	ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

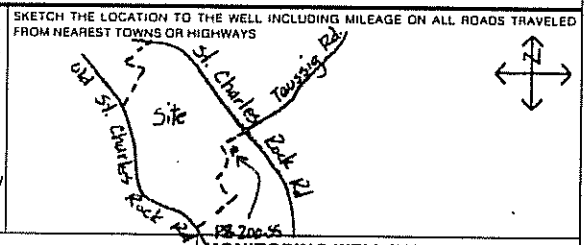
COUNTY: ST. LOUIS
ELEVATION: 433.61
AREA NO.

SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST ¼

SEC. ____ TWN. 47 N, RNG. 5 E OR W

LAT. 38° 46' 07" LONG. 90° 26' 26"

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



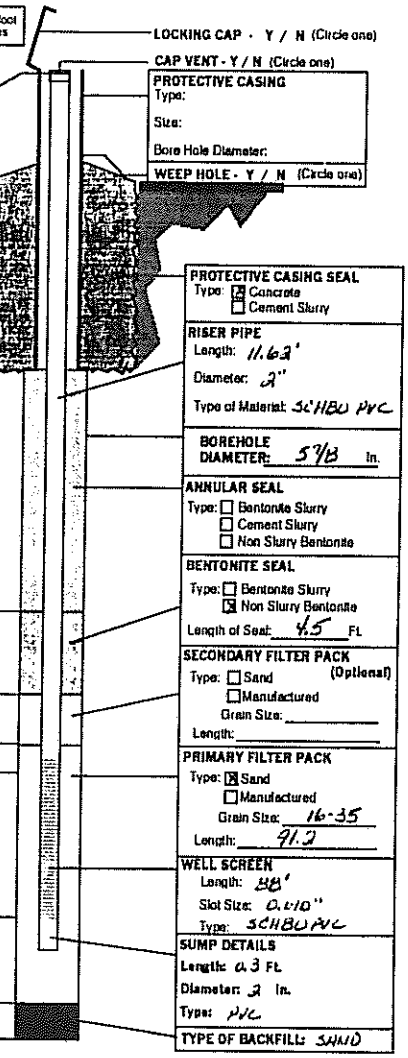
DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

NOTE: Record the fraction of a foot in decimal, not in inches

Top of Riser Elevation: 435.63

Ground Surface Elevation: 433.61 Ft

Information in this column to be supplied in the Feet from Surface column	Feet from Surface	Description of Formation
		0-27 Silt
Depth to bottom of Protective Casing Seal:	3	
Depth to Base of Annular Seal:	3	
Depth to Base of Bentonite Seal:	7.5	
Depth to Base of Secondary Filter Pack:		
Depth to Top of the Screen:	9.6	
		27-37 Sandstone
		37-68 Limestone
Depth to Bottom of the Screen:	97.6	68-76 Dolomite
		76-93 Limestone
Plug Back Total Depth:		93-95 Dolomite
Original Total Depth:	99.7	



LOCKING CAP - Y / N (Circle one)
CAP VENT - Y / N (Circle one)
PROTECTIVE CASING
Type:
Size:
Bore Hole Diameter:
WEEP HOLE - Y / N (Circle one)

PROTECTIVE CASING SEAL
Type: ☒ Concrete ☐ Cement Slurry

RISER PIPE
Length: 11.62'
Diameter: 2"
Type of Material: SCH80 PVC

BOREHOLE DIAMETER: 5 7/8 In.

ANNULAR SEAL
Type: ☐ Bentonite Slurry ☐ Cement Slurry ☐ Non Slurry Bentonite

BENTONITE SEAL
Type: ☐ Bentonite Slurry ☒ Non Slurry Bentonite
Length of Seal: 4.5 Ft.

SECONDARY FILTER PACK (Optional)
Type: ☐ Sand ☐ Manufactured
Grain Size:
Length:

PRIMARY FILTER PACK
Type: ☒ Sand ☐ Manufactured
Grain Size: 16-35
Length: 91.2

WELL SCREEN
Length: 88'
Slot Size: 0.010"
Type: SCH80 PVC

SUMP DETAILS
Length: 0.3 Ft.
Diameter: 2 In.
Type: PVC

TYPE OF BACKFILL: SAND

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN CO, INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN CO, INC.

TYPE OF INSTALLATION
☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT

MEASURING POINT IS
☐ TOP OF RISER PIPE
☐ OTHER

DRILLING EQUIPMENT
☒ AIR ROTARY ☒ AUGER TYPE 6¼ H.S.A.
☐ REVERSE ROTARY ☐ OTHER

CENTRALIZERS USED
☐ YES, AT 4 TOTAL
☐ STAINLESS STEEL
☐ OTHER
☐ NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
2-28-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR): Michael P. Vogl
PERMIT NUMBER: 001256 WIA DATE: 4-11-95

SIGNATURE (DRILLING CONTRACTOR): Michael P. Vogl
PERMIT NUMBER: 001256 WIA DATE: 4-11-95

MO 780-1415 (2-94)

DISTRIBUTION: WHITE DIVISION CANARY MONITORING WELL CONTRACTOR PINK OWNER

RECORD OF DRILLHOLE PZ-201A-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2846
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/22/95
DRILL RIG: SCHRAMM

DATUM: MSL
COORDINATES N: 1067831.8
AZIMUTH: 0

COLLAR ELEV: 478.4
E: 516846.4
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80	0.0-80.0 ft. See Soil Borehole Log PZ-201-SS (398.20 / 80.20)	398.40 / 80.00											3/22/95 6 1/4 in. ID hollow stem auger advanced to 31.0 ft. then advanced borehole to 80.0 ft. with 5 7/8 in. air rotary bit
	80.0-80.2 ft. Slightly weathered, thinly laminated, dark greenish gray (5GY 4/1), very fine grained, extremely weak, SILTSTONE, (ST. LOUIS FORMATION)							B,U,SM-CL					
								J,U,VR,CL					
								J,I,VR,CL,Fe					4/22/95 @ 13:45 Began coring
82	80.2-88.3 ft. Fresh, thickly bedded, light brownish gray (5YR 6/1), microcrystalline, weak, LIMESTONE, (ST. LOUIS FORMATION)							J,C,R,CL					
								J,ST,R,CL					
								J,ST,R,CL					
84								J,I,R					
			1	97%				J,ST,R					
								J,I,R					
86													
								J,U,ST,CL (3)					
88		390.10											
	88.3-90.0 ft. Fresh, thickly bedded, dark yellowish orange (10YR 6/6) grading to moderate yellowish brown (10YR 5/2), very fine grained, extremely weak to very weak, SILTSTONE, (ST. LOUIS FORMATION) Grades stronger with depth (388.40 / 90.00)	88.30						B,I,R					4/22/95 @ 16:30 Ended coring
90	End of Record of Drillhole at 90.0 ft.	388.40 / 90.00											
92													
94													
96													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: M. VOGT

LOGGED: B. TILTON
CHECKED: B. TILTON
DATE: 5/16/95

Golder Associates

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
LAIDLAW\RI-FS\MO WEST LAKE LANDFILL OPERABLE UNIT 2	4.25 inch I.D. Hollow Stem Auger	PZ-201-SS
		SHEET 1 OF 3
	SAMPLING METHOD:	
	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)	DRILLING
	SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	START / FINISH
NORTHING: 1067819.55	WATER LEVEL / TIME / DATE / CASING DEPTH	TIME 8:30 / TIME 10:30
DATUM EASTING: 516862.06 ELEVATION 478.0		DATE 2/15/95 / DATE 2/15/95

DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS
ANGLE BEARING	
SAMPLE HAMMER	

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1	2 2 3 3	2.0' 2.0' (100%)			(0.0-3.4 Ft.) Firm, dark yellowish brown (10YR 4/2), CLAYEY SILT, NR, damp, (CL-ML), (LOESS)	SP 1	
2 3	2 2 4 5	1.4' 2.0' (65%)				SP 2	
4 5	1 2 3 3	2.0' 2.0' (100%)			(3.4-17.4 Ft.) Soft to firm, yellowish brown (10YR 6/2), CLAYEY SILT, trace fine Sand, little iron staining and black organic nodules, NR, moist, (CL-ML), (LOESS)	SP 3	
6 7	1 2 3 4	2.0' 2.0' (100%)				SP 4	Air monitoring 9:00 20% O2 0.0 ppm H2S 0% LEL 0.0 ppm PID
8 9	2 4 3 4	2.0' 2.0' (100%)				SP 5	
10 11	1 2 2 2	2.0' 2.0' (100%)				SP 6	
12 13	1 1 1 2	2.0' 2.0' (100%)				SP 7	Air monitoring 9:15 20% O2 0.0 ppm H2S 0% LEL 0.0 ppm PID
14	1 1 2 3	2.0' 2.0' (100%)				SP 8	

DRILLING CONTR LAYNE-WESTERN

LOGGED BY J. MILLER CHK'D BY W. HERST

DATE 2/15/95

JOB NO.: 943-2848

FILENAME: PZ201SS

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-201-SS
		SHEET 2 OF 3
LAIDLAW\RI-FS\MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	DRILLING START / FINISH
	WATER LEVEL	TIME 8:30 / TIME 10:30
	TIME	
	DATE	DATE 2/15/95 / DATE 2/15/95
NORTHING: 1067819.55 DATUM EASTING: 516862.06 ELEVATION 478.0	CASING DEPTH	
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS	
ANGLE BEARING		
SAMPLE HAMMER		

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
16	1 5 6 7	1.3'/2.0' (65%)	(3.4-17.4 ft.) Soft to firm, yellowish brown (10YR 6/2), CLAYEY SILT, trace fine Sand, little iron staining and black organic nodules, NR, moist, (CL-ML), (LOESS) @ 15.5-16.0 ft., CLAYEY SILT becomes wet	SP (8)	
17			(460.6) 17.4	SP (9)	
18		0.5'/2.0' (25%)	(17.4-20.5 ft.) Compact, pale yellowish brown (10YR 5/4), fine SAND, little Silt, NR, damp, (SP), (ALLUVIUM)		
19				SH (10)	
20	3 3 5 6	1.5'/2.0' (75%)	(457.5) 20.5		
21			(20.5-30.0 ft.) Firm to stiff, olive gray (5Y 4/1) to moderate yellowish brown (10YR 5/4), laminated CLAYEY SILT, NR, moist, (CL-ML), (LACUSTRINE)	SP (11)	
22	3 5 6 7	1.2'/2.0' (60%)			
23				SP (12)	
24	3 5 7 8	1.7'/2.0' (85%)	@ 23.7-24.0 ft., medium dark gray (N4), SILTY fine sand layer, damp, (SM)		
25			@ 24.8, 25.2, and 25.6 ft., thin silty fine sand layers (<1 inch)	SP (13)	
26		1.8'/2.0' (90%)			
27				SH (14)	
28	13 50/3"	0.6'/2.0' (30%)			
29			@ 29.0 ft., limestone rock encountered	SP (15)	

DRILLING CONTR LAYNE-WESTERN

LOGGED BY J. MILLER CHK'D BY W. HERST

DATE 2/15/95

JOB NO.: 943-2848

FILENAME: PZ201SS

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
	4.25 inch I.D. Hollow Stem Auger	PZ-201-SS
		SHEET 3 OF 3
	SAMPLING METHOD:	
LAIDLAW\RI-FS\MO WEST LAKE LANDFILL OPERABLE UNIT 2	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	DRILLING START / FINISH
	WATER LEVEL / TIME / DATE / CASING DEPTH	TIME 8:30 / TIME 10:30
		DATE 2/15/95 / DATE 2/15/95
NORTHING: 1067819.55 DATUM EASTING: 516862.06 ELEVATION 478.0		

DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS
ANGLE BEARING	
SAMPLE HAMMER	

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
31	10 12 6 6	1.5'/2.0' (75%)			(30.0-30.7 ft.) Very stiff, medium gray (N4), CLAYEY SILT, some fine Gravel, little fine to coarse Sand, NR, moist, (CL-ML), (ALLUVIUM) (447.3) 30.7	SP 16	
32	50/5"	0.3'/1.0' (30%)			(30.7-32.0 ft.) Stiff, dark greenish gray (5G 4/1), SILTY CLAY, trace fine sand, contains pieces of weathered limestone, NR-SR, damp, (CL), (ALLUVIUM) (445.0) 33.0	SP 17	Air monitoring 10:30 20% O2 0.0 ppm H2S 0% LEL 0.0 ppm PID
33					End of Soil Borehole Log at 32.0 ft. See PZ-201-SS Record of Drillhole for rock descriptions		
34							
35							
36							
37							
38							
39							
40							
41							
42							
43							
44							

DRILLING CONTR LAYNE-WESTERN

LOGGED BY J. MILLER CHK'D BY W. HERST

DATE 2/15/95

JOB NO.: 943-2848

FILENAME: PZ201SS

RECORD OF DRILLHOLE PZ-201-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2846
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/15/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1067819.55
AZIMUTH: 0

COLLAR ELEV: 481.05
E: 518862.08
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	NOTES WATER LEVELS INSTRUMENTATION
32	0.0-32.8 ft. See Soil Borehole Log PZ-201-SS	448.25										
	32.8-38.7 ft. Slightly weathered, thinly bedded, light olive gray (5Y 6/1), medium crystalline, weak, CRYSTALLINE LIMESTONE, (ST. LOUIS FORMATION) Stylolitic, calcite crystals (<1 cm.)	32.80	1	94%			90	J,PL,R,CL (2)				
34		448.55 / 34.50					90	J,I,R				
							90	J,I,R				
							90	J,PL,SM-intact				
36							90	J,I,R				
							90	J,I,R,CL				
							90	J,PL,SM,CL-intact				
							90	J,I,R,CL				
			2	100%			90	J,PL,S,CL				
38							90	J,PL,SM,CL				
							90	J,I,R,CL				
							90	J,PL,SM,CL-intact				
	38.7-49.5 ft. Slightly weathered, medium bedded, light olive gray (5Y 6/1) to greenish gray (5GY 6/1), fine crystalline, medium strong, CRYSTALLINE LIMESTONE, (ST. LOUIS FORMATION) Weathered, pyrite nodules (<2 mm.), stylolitic						90	J,I,R,CL (2)				
		441.55 / 39.50					90	J,I,R,CL				
							90	J,I,R				
40							60	J,I,R,CL				
							90	J,I,R				
							90	J,I,R,CL				
42							90	J,I,R,CL (3)				
							90	J,P,SM,CL				
							90	J,I,R,CL (2)				
							90	J,P,SM,CL (2)				
			3	100%			90	J,I,R,CL (3)				
44							90	J,PL,SM,CL				
							90	J,PL,SM,CL				
							90	J,PL,SM,CL				
							90	J,PL,SM,CL				
							90	J,PL,SM,CL				
							90	J,PL,SM,CL (2)				
46							90	J,PL,SM,CL				
							90	J,PL,SM,CL				
							90	J,PL,SM,CL (3)				
							90	J,PL,SM,CL (2)				
							90	J,PL,SM,CL				
48							90	J,PL,SM				

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: B. TILTON
CHECKED: W. HERST
DATE: 3/2/95

Golder Associates

RECORD OF DRILLHOLE PZ-201-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/15/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1067819.55
AZIMUTH: 0

COLLAR ELEV: 481.05
E: 516862.08
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed

DEPTH (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	NOTES WATER LEVELS INSTRUMENTATION
48	38.7-49.5 ft. Slightly weathered, medium bedded, light olive gray (5Y 6/1) to greenish gray (5GY 6/1), fine crystalline, medium strong, CRYSTALLINE LIMESTONE, (ST. LOUIS FORMATION)		3	100 %			90	J,PL,SM,CL				
								J,PL,SM,CL				@ 49.5 ft. Drilling rate slows down
		431.55 / 49.50										
	Weathered, pyrite nodules (<2 mm.), stylolitic							J,I,R (2)				
50	49.5-59.5 ft. Fresh, medium bedded, olive gray (5Y 6/1), micro-crystalline, strong, CRYSTALLINE LIMESTONE, (ST. LOUIS FORMATION) Fossiliferous, stylolites							B,I,R				
52	50.9-51.8 ft. Argillaceous Limestone @ 51.5 ft. Light olive gray (5Y 6/1), Clay seam (~1/2 in.)						0	J,P,R				
54	54.0-55.0 ft. Moderately silicified Limestone		4	100 %				B,I,R (3)				
							0	J,C-intact				
	55.0-55.1 ft. Light brown (5YR 5/6), chert zone							B,PL,R				
56								B,PL,SM				
								J,PL,SM,CL (2)				
								J,PL,SM,CL (2)				
58								J,I,R				
	@ 58.4 ft. Light brown (5G 6/1). Clay seam (~1/2 in.)											
							0	J,P,R				
		421.55 / 59.50										
60	59.5-69.5 ft. Fresh, medium to thinly bedded, light olive gray (5Y 6/1), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolites common, medium grained calcite crystals							J,I,VR				2/15/95 @ 16:00 Stop drilling 2/20/95 @ 8:30 Begin drilling @ 59.5 ft.
								J,I,VR (3)				
			5	100 %				J,I,R (3)				
62								J,I,R				
								J,I,R (2)				
								J,I,R (2)				
64												

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: B. TILTON
CHECKED: W. HERST
DATE: 3/2/95

Golder Associates

RECORD OF DRILLHOLE PZ-201-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2846
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/15/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1067819.55
AZIMUTH: 0

COLLAR ELEV: 481.05
E: 518882.06
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed

DEPTH (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
64	59.5-69.5 ft. Fresh, medium to thinly bedded, light olive gray (5Y 6/1), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolites common, medium grained calcite crystals												
66			5	100 %									
68								J,I,R,CL,Fe					
		411.55 / 69.50											
70	69.5-89.5 ft. Fresh, medium bedded, light olive gray (5Y 6/1), f-m grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolites common							J,I,R,Fe					
								J,I,R					
72								J,I,R					
								J,I,R					
74								J,I,R					
	@ 75.0 and 76.5 ft. Medium bluish gray (5B 5/1), glauconite zones (less than 1 in.)		6	100 %				J,U,K,CL					
								B,U,K,CL					
	75.2-75.6 ft. Medium bluish gray (5B 5/1), chert layer							J,U,SM					
76	75.6-77.1 ft. Argillaceous, moderately porous, some open vugs (<2 mm.)												
								B,I,R,CL					
								J,I,R					
78	78.0-79.5 ft. Moderate to highly weathered fractures							J,I,R					
								J,I,R					
								J,I,R					
		401.55 / 79.50	7	96%									
80													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: B. TILTON
CHECKED: W. HERST
DATE: 3/2/95

Golder Associates

RECORD OF DRILLHOLE PZ-201-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/15/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1067819.55
AZIMUTH: 0

COLLAR ELEV: 481.05
E: 516862.06
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed

DEPTH (FEET)	DESCRIPTION	ELEV DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80	69.5-89.5 ft. Fresh, medium bedded, light olive gray (5Y 6/1), f-m grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolites common						90	J,U,R,Fe					
								J,I,R					@ 80.7 ft. Core loss
							90	J,PL,SM					
							60	J,I,R					
	81.3-81.4 ft. Medium dark gray (N4), Claystone laminae						90	J,I,K					
82	@ 81.6 ft. Becoming intermittently siliceous (zones <1 in. thick), some pyritized fractures/vugs						90	J,I,R					
			7	96%									
84							60	J,I,R					
							60	J,I,R					
						30		J,I,R					
							90	J,I,R					
	@ 85.5 and 86.5 ft. Thin zones of glauconite in fractures						60	J,I,R,CL					
86													
							90	J,I,R,CL					
		393.55 / 87.50											
							90	J,I,R					
88							90	J,I,R					
			8	85%									
							90	J,I,R,CL					
	391.55	391.55											
	End of Record of Drillhole at 89.5 ft. 89.50	89.50											
90													
92													
94													
96													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

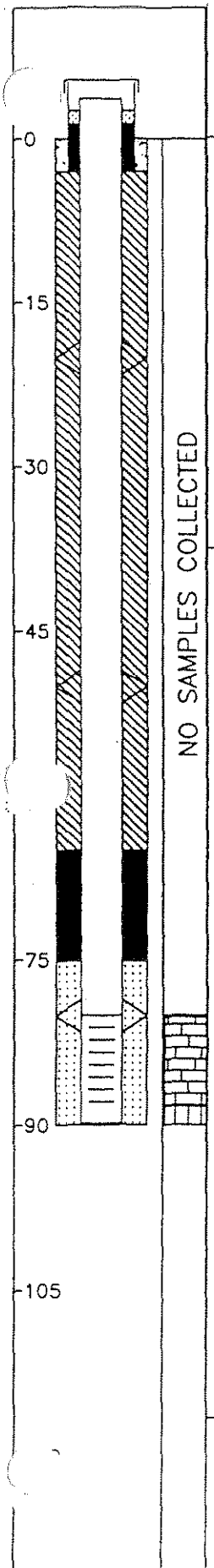
LOGGED: B. TILTON
CHECKED: W. HERST
DATE: 3/2/95

Golder Associates

Well No. PZ-201A-SS

Boring No. X-Ref: PZ-201A-SS

PIEZOMETER CONSTRUCTION SUMMARY



Survey Coords: Northing: 1067832 ft. Easting: 516746 ft.

Elevation Ground Level 478.4 ft. NGVD

Top of PVC Casing 480.16 ft. NGVD

Drilling Summary:

Total Depth 90.0 ft.

Borehole Diameter 10 1/4 in. (0.0-33.0 ft.) 5 7/8 in. (33.0-90.0 ft.)

Casing Stickup Height 1.81 ft.

Driller Layne-Western, St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit for Reaming

Drilling Fluid Auger-None, NX Core Water, Air Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75				
Schramm Rotary	4/22/95	11:00	4/23/95	7:45
Geophys.Logging:				
Casing:	4/23/95	7:50	4/22/95	8:00
Filter Placement:	4/23/95	8:00	4/23/95	9:10
Cementing:				
Development				
Bentonite Grout	4/23/95	9:20	4/23/95	11:00
Bentonite Seal	4/23/95	9:00	4/23/95	9:20

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.81	-	80.00	C1	480.16	-	398.35
80.00	-	89.80	S1	398.35	-	388.55
89.80	-	90.13	C2	388.55	-	388.22

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 75.1-90.0 ft.

Filter Pack:

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-65.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 65.0-75.1 ft.

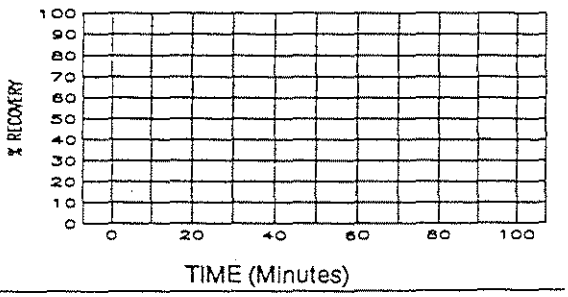
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Not to Scale

Supervised by D. Alloway

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ201ASS

66574

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	
REF NO 122484	DATE RECEIVED
ROUTE	CHECK NO
STATE WELL NUMBER	TRANSMITTAL NO
CHECKED BY	CROSS REFERENCE NO
APPROVED BY	ENTERED Pn 1 Pn 2 Pn 3
	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME: LAIDLAW BRIDGETON SANITARY LANDFILL		WELL NUMBER: PZ-201-A-SS	
SITE ADDRESS: St. CHARLES ROCK RD.	CITY: BRIDGETON	STATE: Mo.	ZIP CODE: 63044
NAME: LAIDLAW WASTE SYSTEMS, INC.		TELEPHONE: 314-241-3710	
ADDRESS: 1638 N. BROADWAY	CITY: ST. LOUIS	STATE: Mo	ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

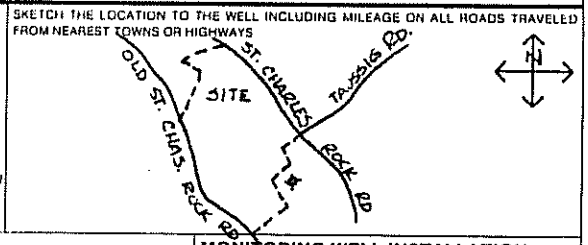
COUNTY: St. Louis
ELEVATION: 472.4
AREA NO

SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST ¼

SEC. ____ TWN. 47 N.RNG. 5 (E) OR W

LAT. 38 ° 45 ' 58 " LONG. 90 ° 26 ' 28 "

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN Co, INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN Co., INC.

TYPE OF INSTALLATION: ☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT

MEASURING POINT IS: ☐ TOP OF RISER PIPE ☐ OTHER

DRILLING EQUIPMENT: ☒ AIR ROTARY ☒ AUGER TYPE 6.25" HSA, NX CORE ☐ REVERSE ROTARY ☐ OTHER

CENTRALIZERS USED: ☒ YES, AT 3 TOTAL ☒ STAINLESS STEEL ☐ OTHER ☐ NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
4-23-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR) Michael P. Vogl
PERMIT NUMBER 001256WM DATE 6-02-95

SIGNATURE (DRILLING CONTRACTOR) Michael P. Vogl
PERMIT NUMBER 001256WM DATE 6-02-95

NOTE: Record the fraction of a foot in decimal, not in inches

Top of Riser Elevation: 470.5

LOCKING CAP - Y / N (Circle one)
CAP VENT - Y / N (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8" x 8" x 5'
Bore Hole Diameter: 10.25"
WEEP HOLE - Y / N (Circle one)

Ground Surface Elevation: 472.4 Ft.

Information in this column to be supplied in the Feet from Surface column	Feet from Surface	Description of Formation
		0-18' Silt
Depth to bottom of Protective Casing Seal:	3.0	
		18'-21' Sand
		21'-23.5' Silt
		23.5'-24' Sand
Depth to Base of Annular Seal:	63.0	24'-33' Silt
Depth to Base of Bentonite Seal:	75.1	33'-34' Clay
Depth to Base of Secondary Filter Pack:		34'-40' Limestone
Depth to Top of the Screen:	79.7	
Depth to Bottom of the Screen:	89.7	
Plug Back Total Depth		
Original Total Depth:	90'	

PROTECTIVE CASING SEAL
Type: ☒ Concrete ☐ Cement Slurry

RISER PIPE
Length: 81.8'
Diameter: 2"
Type of Material: SCH. 80 PVC

BOREHOLE DIAMETER: 5 7/8 in.

ANNULAR SEAL
Type: ☒ Bentonite Slurry ☐ Cement Slurry ☐ Non Slurry Bentonite

BENTONITE SEAL
Type: ☒ Bentonite Slurry ☐ Non Slurry Bentonite
Length of Seal: 9.9 Ft.

SECONDARY FILTER PACK (Optional)
Type: ☐ Sand ☐ Manufactured
Grain Size:
Length:

PRIMARY FILTER PACK
Type: ☒ Sand ☐ Manufactured
Grain Size: 16/35
Length: 14.9'

WELL SCREEN
Length: 10'
Slot Size: 0.010"
Type: SCH. 80 PVC

SUMP DETAILS
Length: 0.3 Ft.
Diameter: 2 In.
Type: PVC

TYPE OF BACKFILL: SAND

MO 780-1415 (2-94)

DISTRIBUTION: WHITE DIVISION CANARY MONITORING WELL CONTRACTOR PINK OWNER

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
	6.25 inch I.D. Hollow Stem Auger	PZ-202-SS
		SHEET 1 OF 3
LAIDLAW/OU2 RI-FS/MD WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	DRILLING START / FINISH

WATER LEVEL					START TIME	FINISH TIME
TIME					07:50	09:45
DATE					DATE 2/26/95	DATE 2/26/95
CASING DEPTH						

NORTHING: 1067320.25
DATUM EASTING: 517101.58 ELEVATION 479.0

DRILL RIG CME 75 - TRUCK MOUNT | SURFACE CONDITIONS

ANGLE BEARING

SAMPLE HAMMER

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1	1, 2, 2, 3	1.6'/2.0' (80%)			(0.0-4.6 Ft.) Firm, dark yellowish brown (10YR 4/2), homogenous, CLAYEY SILT, NR, moist, (CL-ML), (LOESS)	SP 1	
2, 3	6, 2, 2, 4	1.4'/2.0' (70%)			@ 3.4 Ft., color changes to dusky yellowish brown (10YR 2/2)	SP 2	
4	1, 3	1.6'/2.0' (80%)			(474.4) 4.6		
5	6, 7				(4.6-8.3 Ft.) Stiff, mottled light olive gray (5Y 5/2) and olive gray (5Y 4/1), CLAY, little Silt, trace Gravel, NR, moist, (CL), (LOESS)	SP 3	
6, 7		0.0'/2.0' (0%)				SH 4	
8	1	1.7'/2.0' (85%)			(470.7) 8.3		
9	2, 4, 4				(8.3-19.1 Ft.) Soft to firm, light olive gray (5Y 6/1), SILTY CLAY, iron stained, NR, moist, (CL-ML), (LOESS)	SP 5	
10, 11	2, 4, 4, 4	1.6'/2.0' (80%)				SP 6	
12	2, 2, 4	1.1'/2.0' (55%)				SP 7	
13	6						
14	weight of hammer (for 12") 1, 2	1.5'/2.0' (75%)			@ 13.5 Ft., becoming increasingly iron stained @ 14.0 Ft., becoming wet, very soft	SP 8	

DRILLING CONTR LAYNE-WESTERN

LOGGED BY M. HIRT CHK'D BY V. HERST

DATE 2/26/95

JOB NO.: 943-2848

FILENAME: PZ202SS

SOIL BOREHOLE LOG

LAIDLAW WASTE SYSTEMS INC.

SITE NAME AND LOCATION	DRILLING METHOD:	BORING NO.
	6.25 inch I.D. Hollow Stem Auger	PZ-202-SS
		SHEET 2 OF 3
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	DRILLING

					START	FINISH
WATER LEVEL					TIME	TIME
TIME					07:50	09:45
DATE					DATE	DATE
CASING DEPTH					2/26/95	2/26/95

NORTHING: 1067320.25
DATUM EASTING: 517101.58 ELEVATION 479.0

DRILL RIG CME 75 - TRUCK MOUNT
ANGLE BEARING
SAMPLE HAMMER

SURFACE CONDITIONS

DRILLING CONTR LAYNE-WESTERN

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
			(8.3-19.1 ft.) Soft to firm, light olive gray (5Y 6/1), SILTY CLAY, iron stained, NR, moist, (CL-ML), (LOESS)	SP 8	
16	weight of hammer for 18"	1.4'/2.0' (70%)		SP 9	
17	1				
18	weight of hammer for 6"	2.0'/2.0' (100%)		SP 10	
19	2 3 5		(19.1-19.4 ft.) Firm, light olive gray (5Y 5/2), SILTY CLAY, NR, moist, (CL-ML), (LOESS)		
20	2 3 5	1.4'/2.0' (70%)	(19.4-21.9 ft.) Firm, olive gray (5Y 4/1), SILTY CLAY, iron stained, NR, moist, (CL-ML), (LOESS)	SP 11	
21	6				
22	1 3	0.4'/2.0' (20%)	(21.9-24.5 ft.) Loose, olive gray (5Y 4/1), fine SANDY SILT, NR, damp, (ML), (LOESS)	SP 12	
23	4 5				
24	1 5	1.5'/2.0' (75%)	(24.5-25.0 ft.) Firm, olive gray (5Y 4/1), laminated, SILTY CLAY, NR, damp, (CL-ML), (LOESS) (454.0) 25.0	SP 13	
25	9 12		(25.0-29.5 ft.) Compact, olive gray (5Y 4/1), laminated, fine SANDY SILT, NR, dry, (SM), (ALLUVIUM)		
26	2 8	0.1'/2.0' (5%)	@ 25.5 ft., becoming moist	SP 14	
27	9 9				
28	5 7	1.5'/2.0' (75%)		SP 15	
29	6 9		(29.5-30.8 ft.) Compact, olive gray (5Y 4/1), fine SAND interbedded with SILT, NR, moist, (SM), (ALLUVIUM)		

LOGGED BY M. HIRT
DATE 2/26/95
CHK'D BY W. HERST

JOB NO.: 943-2848
FILENAME: PZ202SS

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-202-SS
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	SHEET 3 OF 3
NORTHING: 1067320.25 DATUM EASTING: 517101.58 ELEVATION 479.0	WATER LEVEL / TIME / DATE / CASING DEPTH	DRILLING START TIME 07:50 DATE 2/26/95; FINISH TIME 09:45 DATE 2/26/95
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS	
ANGLE BEARING		
SAMPLE HAMMER		

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
	2 50/2"	0.8" 0.8" (100%)			(29.5-30.8 ft.) Compact, olive gray (5Y 4/1), Fine SAND interbedded with SILT, NR, moist, (SM), (ALLUVIUM) (448.2) 30.8	SP (16)	
31					End of Soil Borehole Log at 30.8 ft. See PZ-202-SS Record of Drillhole for rock descriptions		Split spoon and auger refusal at 30.8 ft.
32							
33							
34							
35							
36							
37							
38							
39							
40							
41							
42							
43							
44							

DRILLING CONTR LAYNE-WESTERN

LOGGED BY M. HIRT CHK'D BY W. HERST

DATE 2/26/95

JOB NO.: 943-2848

FILENAME: PZ202SS

RECORD OF DRILLHOLE PZ-202-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/26/95 - 2/27/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1067320.2
AZIMUTH: 0

COLLAR ELEV: 479.01
E: 517101.8
INCLINATION: -90

ROCK TYPE

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (80 55 20 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR MW HW CW)	STRENGTH INDEX (R6 R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R3 30 R2 150 R3 300 R4 600 R5 1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
16	0.0-30.8 ft. See Soil Borehole Log PZ-202-SS														
18															
20															
22															
24															
26															
28															
30															
	30.8-44.1 ft. 448.21 Slightly weathered, medium bedded, light olive gray (5Y 6/1), medium grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) 31.4 and 31.9 ft. Iron stained clay infilling		448.21 30.80	1	63%				Broken Zone						Some sand in return water; driller says material seems to be very rubbly
32															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-202-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95 - 2/27/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1067320.2
AZIMUTH: 0

COLLAR ELEV: 479.01
E: 517101.6
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
32	30.8-44.1 ft. Slightly weathered, medium bedded, light olive gray (5Y 6/1), medium grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)					
					J,I,R (2)	
					J,U,R	
					J,U,R	
34	33.4-34.7 ft. Limestone becomes moderately weathered, grayish orange (10YR 7/4) with dark yellowish orange (10YR 6/6) staining and cross bedded					
					J,PL,SM	
			1	63%	J,PL,SM	
					J,U,R	
36					Core Loss	35.8 ft. Drilling is slow due to rubbly conditions
		441.41 / 37.60				37.0 ft. Water pump keeps shutting down, driller reports that bit is getting plugged off
38					J,C,SM	
					J,C,SM	
					J,I,R	
					J,C,SM (2)	
					J,PL,SM	
					J,I,R	
					J,I,R,Fe	
					J,C,SM (3)	
40						
					J,C,SM	
					J,I,SM	
			2	82%	J,C,SM (2)	
					J,I,SM (3)	
42					Core Loss	
44		434.91 / 44.10				
	44.1-59.1 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), micro-crystalline, strong, LIMESTONE, (ST. LOUIS FORMATION)				J,I,R (4)	
					J,I,R	
					J,C,R	
	45.1-46.1 ft. Large pyrite crystals Some calcite crystals				J,U,SM,CL	
					J,I,SM	
					J,I,SM,CL	
46			3	96%	J,I,SM,CL	
					J,I,SM	
					J,C,SM	
					J,PL,SM	
					J,PL,SM,CL	
					J,I,R	
					J,I,SM,CL (2)	
					J,I,SM (2)	
48						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-202-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95 - 2/27/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1067320.2
AZIMUTH: 0

COLLAR ELEV: 479.01
E: 517101.8
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	NOTES, WATER LEVELS, INSTRUMENTATION
48	44.1-59.1 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), micro-crystalline, strong, LIMESTONE, (ST. LOUIS FORMATION)		3	96%	J,I,SM; J,I,SM; J,PL,SM,CL	
		429.91 / 49.10				
	49.4-49.8 ft. Medium to coarse grained				J,I,R,CL; J,C,SM,CL; J,I,R	
50					J,I,R; J,I,SM; J,I,R; J,C,R	
	51.0 ft. Iron stained nodules; 51.0-51.6 ft. 0° healed fractures; 51.6-52.4 ft. Slightly weathered, arenaceous, thinly laminated					
52					J,PL,R,CL	
	52.9-53.9 ft. 0° healed fracture					
54			4	99%	J,I,R	
	55.3-56.6 ft. Medium to coarse grained; 55.9 ft. Chert filled vein				J,PL,R (2)	
56					J,PL,R	
					J,I,SM,CL	
58					J,I,SM,CL; J,I,SM; J,I,R,CL	
		419.91 / 59.10				
	59.1-67.8 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), coarse grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION); 60.3-61.3 ft. Stylolitic				J,I,R (4)	
60						
			5	100 %	J,I,R; J,I,SM; J,I,SM (2)	
62					J,I,R; J,I,R	
					J,I,SM,CL; J,I,R; J,I,R	
	63.8-64.3 ft. 20° healed fracture					
64						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-202-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/28/95 - 2/27/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1067320.2
AZIMUTH: 0

COLLAR ELEV: 479.01
E: 517101.6
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
64	59.1-67.8 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), coarse grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) 64.5-65.1 ft. Silty interbeds 64.3-66.4 ft. Fine to medium grained								J,I,R						
66				5	100 %				J,PL,SM (3)						
	412.01 / 67.00														
	67.0-69.7 ft. Fresh thickly bedded, light olive gray (5Y 6/1) to greenish gray (5GY 6/1), medium grained, medium strong, DOLOMITE (ST. LOUIS FORMATION)								J,PL,SM (3)						
68	69.0-69.2 ft. Becomes slightly weathered, dark yellowish orange (10YR 6/6) to moderate yellowish brown (10YR 5/4)								J,I,SM						
			409.91 / 69.10												
70	67.6-67.8 ft. Clay infilling 69.7-78.9 ft. Moderately weathered, medium bedded, dark yellowish orange (10YR 6/6) to moderate yellowish brown (10YR 5/4), m-c grained, medium strong, ARGILLACEOUS DOLOMITE, (ST. LOUIS FORMATION)			6	94%										
72	72.5-76.1 ft. Vuggy, moderately to highly weathered, some calcite crystals								J,I,R (3)						
									J,I,R						
									J,I,R						
									J,I,R						
74			404.91 / 74.10						Core Loss						
									J,I,R (2)						
									J,I,R (4)						
76				7	87%				J,I,R						
	76.9-77.2 ft. Chert 77.3-77.4 ft. Highly weathered 78.0-78.1 ft. Highly weathered								J,I,R,CL						
									J,I,R						
									J,PL,R,CL						
									J,I,R						
78	400.91 / 78.10														
			400.31 / 78.70						Core Loss						
									J,C,R,CL						
	78.9-89.2 ft. Fresh, medium bedded, yellowish gray (5Y 7/2), very fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)			8	100 %				J,U,SM						
									J,I,SM						
80															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-202-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 2/26/95 - 2/27/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1067320.2
AZIMUTH: 0

COLLAR ELEV: 479.01
E: 517101.6
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80	78.9-89.2 ft. Fresh, medium bedded, yellowish gray (5Y 7/2), very fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)							J,PL,SM; J,PL,SM					
82	82.1-82.2 ft. Porous/vuggy							J,I,SM,CL					
	83.6 ft. 1" thick clay infilling							J,I,R,CL					
84	83.7-84.3 ft. Micrycrystalline		8	100 %				J,I,R (3)					
	85.0-85.2 ft. Moderately weathered between joints							J,I,R (2)					
	85.6-87.1 ft. Pyrite crystals												
86	85.7-86.4 ft. Slightly weathered, some cross bedding							J,I,SM (2); J,I,SM					
								J,PL,SM; J,U,R; J,I,R					
88	88.4-88.9 ft. Coarse grained	390.31											
	89.0-89.2 ft. Moderately weathered	389.81 / 88.70						J,PL,SM					
	89.2-89.9 ft. Moderately weathered, thinly laminated, medium dark gray (N4), very fine grained, extremely weak rock, SILTSTONE, with claystone interbeds, (ST. LOUIS FORMATION)	89.20 / 389.11 / 89.90											
90			9	97%				J,I,SM,CL					
	89.9-92.0 ft. Fresh, thickly laminated to medium bedded, medium gray (N5), fine grained, medium strong, SANDSTONE, (ST. LOUIS FORMATION)	387.01											
92	End of Record of Drillhole at 92.0 ft.	92.00 / 387.01 / 92.00											
94													
96													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

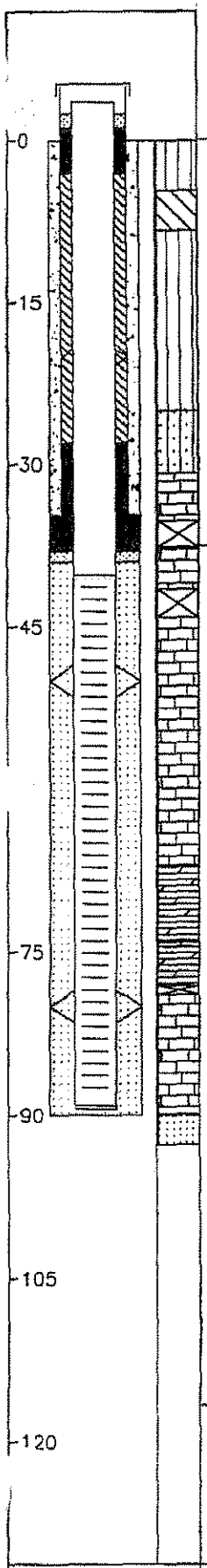
LOGGED: M. HIRT
CHECKED: R. BOOTH
DATE: 3/13/95

Golder Associates

Well No. PZ-202-SS

Boring No. X-Ref: PZ-202-SS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1067320 ft. Easting: 517102 ft.

Elevation Ground Level 479.0 ft. NGVD

Top of PVC Casing 481.17 ft. NGVD

Drilling Summary:

Total Depth 90.0 ft.

Borehole Diameter 10 1/4 in. (0.0-33.5 ft.) 5 7/8 in. (33.5-90.0 ft.)

Casing Stickup Height 2.16 ft.

Driller Layne-Western St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit for Reaming

Drilling Fluid Auger-None, NX Core Water, Air Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	2/26/95	7:50	2/27/95	11:05
Schramm Rotary	3/11/95	10:30	3/12/95	8:00
Geophys.Logging:				
Casing:				
2" PVC	3/12/95	8:10	3/12/95	8:30
6" Steel	3/11/95	14:15	3/11/95	14:30
Filter Placement:	3/12/95	8:35	3/12/95	9:10
Cementing:				
Development				
Bentonite Grout	3/12/95	9:35	3/12/95	10:30
Bentonite Seal	3/12/95	9:20	3/12/95	9:35

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 2.16	-	40.20	C1	481.17	-	438.81
40.20	-	89.10	S1	438.81	-	389.91
89.10	-	89.43	C2	389.91	-	389.58
+ 1.00	-	34.00	C3	480.00	-	445.01
	-				-	
	-				-	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.) (C3-see comments)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 39.0-90.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 38.0-39.0ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-28.0 ft., Neat cement, 3.0-34.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 28.0-38.0 ft.

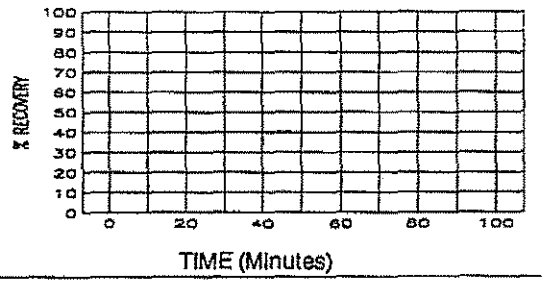
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments: Surface Casing C3: 6 1/8 in. ID / 6 5/8 in. OD Steel Casing

Supervised by B. Tilton

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ202SS

661574

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 115089	CHECK NO
ROUTE	TRANSMITTAL NO.
STATE WELL NUMBER	CROSS REFERENCE NO.
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME: LAIDLAW BRIDGETON SANITARY LANDFILL		WELL NUMBER: PZ-302-SS	
SITE ADDRESS: ST. CHARLES ROCK ROAD	CITY: BRIDGETON	STATE: MO	ZIP CODE: 63044
NAME: LAIDLAW WASTE SYSTEMS, INC.		TELEPHONE: 314-241-3710	
ADDRESS: 1838 N. BROADWAY	CITY: ST. LOUIS	STATE: MO	ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

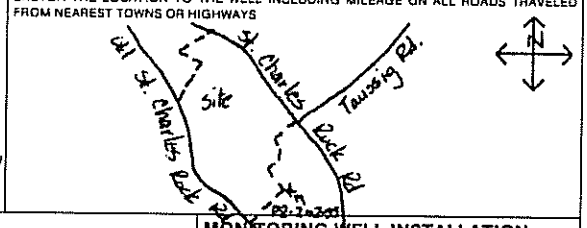
COUNTY: ST. LOUIS
ELEVATION: 474.0
AREA NO.

SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST ¼

SEC. ____ TWN. 47 N.RNG. 5 E OR W

LAT. 38 · 45 · 54 · LONG. 90 · 26 · 24 ·

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

NOTE: Record the fraction of a foot in decimal, not in inches.

Top of Riser Elevation: 481.8

Ground Surface Elevation: 474.0 Ft

Information in this column to be supplied in the Feet from Surface column:	Feet from Surface	Description of Formation
		0-3 Silt
Depth to bottom of Protective Casing Seal:	3	
		3-22 Clay
		22-32 Silt
Depth to Base of Annular Seal:	38.0	
		32-67 Limestone
Depth to Base of Bentonite Seal:	38.0	
Depth to Base of Secondary Filter Pack:	39.0	
Depth to Top of the Screen:	40.2	
		67-78 Dolomite
Depth to Bottom of the Screen:	90.2	78-90.2 Limestone
Plug Back Total Depth		
Original Total Depth:	90.2	

LOCKING CAP - Y / N (Circle one)
CAP VENT - Y / N (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8" x 8" x 5'
Bore Hole Diameter: 10.25"
WEEP HOLE - Y / N (Circle one)

PROTECTIVE CASING SEAL
Type: ☒ Concrete ☐ Cement Slurry

RISER PIPE
Length: 43'
Diameter: 2
Type of Material: SCH80 PVC

BOREHOLE DIAMETER: 5 1/8 In.

ANNULAR SEAL
Type: ☒ Bentonite Slurry ☐ Cement Slurry ☐ Non Slurry Bentonite

BENTONITE SEAL
Type: ☒ Bentonite Slurry ☐ Non Slurry Bentonite
Length of Seal: 10' Ft.

SECONDARY FILTER PACK (Optional)
Type: ☒ Sand ☐ Manufactured
Grain Size: SUGAR
Length: 1'

PRIMARY FILTER PACK
Type: ☒ Sand ☐ Manufactured
Grain Size: 16-35
Length: 51.2'

WELL SCREEN
Length: 50'
Slot Size: 0.010"
Type: SCH80 PVC

SUMP DETAILS
Length: 0.3 Ft.
Diameter: 2 In.
Type: PVC

TYPE OF BACKFILL: SAND

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN CO., INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN CO., INC.

TYPE OF INSTALLATION
☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT

MEASURING POINT IS
☐ TOP OF RISER PIPE
☐ OTHER

DRILLING EQUIPMENT
☒ AIR ROTARY ☒ AUGER TYPE 6" H.S.A.
☐ REVERSE ROTARY ☐ OTHER

CENTRALIZERS USED
☒ YES, AT 3 TOTAL
☐ STAINLESS STEEL
☐ OTHER
☐ NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
3-12-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR) Michael P. Vogt
PERMIT NUMBER 001256 WM DATE 4-11-95

SIGNATURE (DRILLING CONTRACTOR) Michael P. Vogt
PERMIT NUMBER 001256 WM DATE 4-11-95

MO 780-1411b (2-94)

DISTRIBUTION: WHITE-DIVISION CANARY-MONITORING WELL CONTRACTOR PINK-OWNER
ONE WHITE COPY TO DEPARTMENT OF NATURAL RESOURCES, P.O. BOX 250, ROLLA, MO 65401

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-203-SS
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)	SHEET 1 OF 3
		DRILLING
	WATER LEVEL	START TIME 15:00 / FINISH TIME 18:00
	TIME	
	DATE	START DATE 5/25/95 / FINISH DATE 5/25/95
	CASING DEPTH	
DATUM NORTHING: 1066661.50 EASTING: 516607.70	ELEVATION 484.2	
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS	
ANGLE -90 BEARING NA		
SAMPLE HAMMER 140 lb. - Falling 30 inches		

DRILLING CONTR LAYNE-WESTERN

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1					(0.0-4.2 ft.) Soft, dark yellowish brown (10YR 4/2), fine sandy SILT, moist, (ML), (LOESS)		
2	1 2 2 2	1.3' / 2.0' (65%)				SP 1	
3							
4	1 2 3 3	0.8' / 2.0' (40%)			(480.0) 4.2 (4.2-16.2 ft.) Firm, moderate yellowish brown (10YR 5/2) to light gray (N7), silty CLAY, moist, (CL), (ALLUVIUM)	SP 2	
5							
6	1 3 3 5	2.0' / 2.0' (100%)				SP 3	
7							
8	1 3 3 6	1.7' / 2.0' (85%)				SP 4	
9							
10	2 4 3 5	2.0' / 2.0' (100%)			@ 10.4-16.0 ft., wet	SP 5	
11							
12	0 1 2 3	1.5' / 2.0' (75%)				SP 6	
13							
14	1 1 2 3	2.0' / 2.0' (100%)				SP 7	

LOGGED BY D. ALLOWAY
DATE 6/20/95
CHK'D BY W. HERST
JOB NO.: 943-2848
FILENAME: PZ203SS

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-203-SS
		SHEET 2 OF 3
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)	DRILLING
		START / FINISH
	WATER LEVEL	TIME / TIME
	TIME	15:00 / 18:00
	DATE	DATE / DATE
NORTHING: 1066661.50 DATUM EASTING: 516607.70 ELEVATION 484.2	CASING DEPTH	5/25/95 / 5/25/95

DRILL RIG CME 75 - TRUCK MOUNT
ANGLE -90 BEARING NA
SAMPLE HAMMER 140 lb. - falling 30 inches
SURFACE CONDITIONS

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
					(4.2-16.2 ft.) Firm, moderate yellowish brown (10YR 5/2) to light gray (N7), silty CLAY, moist, (CL), (ALLUVIUM) (468.0) 16.2	SP 7	
16	0 0 3 4	1.2'/2.0' (60%)			(16.2-26.4 ft.) Soft to Firm, medium yellowish brown (10YR 5/2) and light gray (N7), clayey SILT, trace Fine Sand, moist, (ML), (LOESS)	SP 8	
17							
18	2 2 5 6	1.0'/2.0' (50%)				SP 9	
19							
20	4 3 5 6	2.0'/2.0' (100%)				SP 10	
21							
22	1 2 5 6	0.9'/2.0' (45%)			@ 22.0-25.8 ft., color changes to medium yellowish brown (10YR 5/2)	SP 11	
23							
24	3 4 4 5	1.8'/2.0' (90%)				SP 12	
25							
26	1 4 6 9	1.4'/2.0' (70%)			@ 25.8-26.4 ft., color is medium gray (N5) (457.8) 26.4	SP 13	
					(26.4-41.2 ft.) Loose to very dense, medium gray (N5), fine SAND, trace Silt, saturated, (SP), (ALLUVIUM)		
27							
28	3 4 5 7	1.4'/2.0' (70%)				SP 14	
29					@ 29.0-41.2 ft., occasional beds of SILT interbedded		

DRILLING CONTR LAYNE-WESTERN

LOGGED BY D. ALLOWAY
DATE 6/20/95 CHK'D BY W. HERST

JOB NO.: 943-2848
FILENAME: PZ203SS

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-203-SS
		SHEET 3 OF 3
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP)	DRILLING
		START / FINISH
	WATER LEVEL	
	TIME	START TIME 15:00 / FINISH TIME 18:00
	DATE	START DATE 5/25/95 / FINISH DATE 5/25/95
NORTHING: 1066661.50 DATUM EASTING: 516607.70 ELEVATION 484.2	CASING DEPTH	
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS	
ANGLE -90 BEARING NA		
SAMPLE HAMMER 140 lb. - falling 30 inches		

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
31	5 6 7 12	1.5'/2.0' (75%)			@ 29.0-41.2 ft., occasional beds of SILT interbedded	SP 15	
32	4 5 12 10	1.7'/2.0' (85%)				SP 16	
33							
34	1 4 5 10	1.6'/2.0' (80%)				SP 17	
35							
36	4 7 11 13	0.8'/2.0' (40%)			@ 36.0-41.2 ft., includes little medium sand	SP 18	
37							
38	5 10 25 50	1.6'/2.0' (80%)				SP 19	
39							
40	15 30 30 50	1.9'/1.9' (100%)				SP 20	
41					(443.0) 41.2		
					(41.2-42.0 ft.) Hard, medium gray (N5) and dark reddish brown (10R 3/4), mottled, SILT, (ML), (ALLUVIUM) (442.2) 42.0		
42					End of Soil Borehole Log at 42.0 ft. See Record of Drillhole PZ-203-SS for rock descriptions		
43							
44							

DRILLING CONTR LAYNE-WESTERN

LOGGED BY B. ALLOWAY

DATE 6/20/95 CHK'D BY W. HERST

JOB NO.: 943-2848

FILENAME: PZ203SS

RECORD OF DRILLHOLE PZ-203-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/26/95 & 5/31/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066661.50
AZIMUTH: 0

COLLAR ELEV: 484.2
E: 516607.70
INCLINATION: -90

ROCK TYPE: J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation; PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular; P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough; Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (80 60 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR MW HW CW)	STRENGTH INDEX (R6 R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 30 R2 150 R3 300 R4 600 R5 1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
32	0.0-42.0 ft. See Soil Borehole Log PZ-203-SS 42.0-44.8 ft. No samples collected														
34															
36															
38															
40															
42															
44															
	439.40		439.40												
	44.8-53.4 ft. Hard, medium light gray (N6) to dark reddish brown (10R 3/4), SILTY CLAY, moist, (CL), (ALLUVIAL)		44.80												5/26/95 @ 9:15 Began drilling
46				1	100										
48															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-203-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/26/95 & 5/31/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066661.50
AZIMUTH: 0

COLLAR ELEV: 484.2
E: 516607.70
INCLINATION: -90

ROCK TYPE: J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation; PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular; P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough; Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
48	46.1-57.5 ft. Pale green (10G 6/2)					
			1	100		
50						
		433.40 / 50.80				50.8-52.0 ft. and 52.3-53.7 ft. Core loss due to Clay washing out End of Run 1 @ 10:15
52					Core Loss	
	53.4-73.6 ft. Moderately weathered, thickly bedded, yellowish gray (5Y 7/2), f-m grained, medium strong, BRECCIATED LIMESTONE, (ST. LOUIS FORMATION) Clay and poorly lithified Sandstone around pieces of Limestone	430.80 / 53.40				
54					J,I,R,CL	
					J,I,R	
					J,I,R	
					J,I,R	
56					J,P,SM	
			2	66%		
58					J,I,R	
					J,I,R	
					J,I,R,CL	
					J,I,R,CL	
60		423.40 / 60.80			J,C,SM (2)	5/26/95 @ 11:00 End of Run 2
					J,PL,SM	
62			3	97%		
64						

WEATHERING INDEX: SW FR, MW, HW, CW
STRENGTH INDEX: R6, R5, R4, R3, R2, R1
POINT LOAD INDEX (psi): R1 30, R2 150, R3 300, R4 600, R5 1500, R6
TEST ORIENTATION

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-203-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/26/95 & 5/31/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066661.50
AZIMUTH: 0

COLLAR ELEV: 484.2
E: 515607.70
INCLINATION: -90

ROCK TYPE: J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation; PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular; P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough; Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DISCONTINUITY DATA

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
64	53.4-73.6 ft. Moderately weathered, thickly bedded, yellowish gray (5Y 7/2), f-m grained, medium strong, BRECCIATED LIMESTONE, (ST. LOUIS FORMATION) Clay and poorly lithified Sandstone around pieces of Limestone					
66					J,PL,SM	
			3	97%	J,PL,SM,CL	
68					J,PL,SM,CL (2)	
					B,PL,SM,CL	
70					J,I,R,CL	5/26/95 @ 12:00 End of Run 3
		413.40 / 70.60				
					J,PL,R,CL	
72					J,C,SM	
74	73.6-81.5 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2) to grayish orange pink (5YR 7/2), m-c grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic		4	100 %		
76	76.1-77.1 ft. Clay layer					
	77.8-77.9 ft. Clay layer	406.50 / 77.70				
78			5	100 %		
80						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 8/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-203-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/26/95 & 5/31/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1086681.50
AZIMUTH: 0

COLLAR ELEV: 484.2
E: 516807.70
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
80	73.6-81.5 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2) to grayish orange pink (5YR 7/2), m-c grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic	402.70 / 81.50				
82	81.5-98.0 ft. Highly weathered, pale yellowish brown (10YR 6/2), f-c grained, very weak, LIMESTONE boulders in SILT matric (Collapse Zone)	400.20 / 84.00	5	100 %		81.5-98.0 ft. Collapse Zone, RQD measurements not valid
84	84.0-85.5 ft. Limestone boulder	398.70 / 85.50				
86	85.5-87.2 ft. Weak, dark gray (N3), thinly laminated Siltstone	397.00 / 87.20	6	100 %		
	87.2-90.0 ft. Limestone boulder	394.20 / 90.00				5/26/95 @ 15:00 Stop drilling
90	90.0-90.5 ft. Weak, light olive gray (5Y 6/1), Siltstone	393.70 / 90.50				5/31/95 @ 8:30 Resume drilling after 4-day break, water level in open hole @ 34.1 ft. bgs
	90.5-92.4 ft. Limestone boulder	392.50 / 91.70				
92	92.4-95.0 ft. Very weak, medium dark gray (N4) to grayish black (N2), thinly laminated, Siltstone layer	389.20 / 95.00	7	82%	Core Loss	92.5-93.4 ft. Core loss in soft unit
94	95.0-96.0 ft. Limestone boulder	388.20 / 96.00	8	100 %		
96						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/13/95

Golder Associates

RECORD OF DRILLHOLE PZ-203-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2948
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/26/95 & 5/31/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1086661.50
AZIMUTH: 0

COLLAR ELEV: 484.2
E: 516607.70
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE / DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (80 60 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0 30 60 90)	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (FR SW MW HW CW)	STRENGTH INDEX (R6 R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 30 R2 150 R3 300 R4 600 R5 1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
98	96.0-98.0 ft. Very weak, light olive gray (5Y 6/1), thinly laminated, Siltstone layer		386.20 / 96.00												
98	98.0-104.2 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), very fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)		386.20 / 98.00	8	100 %										
100	100.3-100.7 ft. Chert zone		384.20 / 100.00						J,PL,SM						
									B,PL,SM,CL						
									J,I,VR,Calcite						
102									B,I,R						
									J,I,R						
104	104.2-110.0 ft. Slightly weathered, thinly bedded, olive gray (5Y 4/1), very fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) 104.4-105.0 ft. Highly weathered zone and weak 105.0-108.8 ft. Intermittent vuggy zone (<3 mm.), zones <2 in. thick								J,I,R						
				9	98%				J,I,VR calcite crystals						
108															
108															5/31/95 @ 11:00 Complete coring
110			374.20												
	End of Record of Drillhole at 110.0 ft.		374.20 / 110.00												
112															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

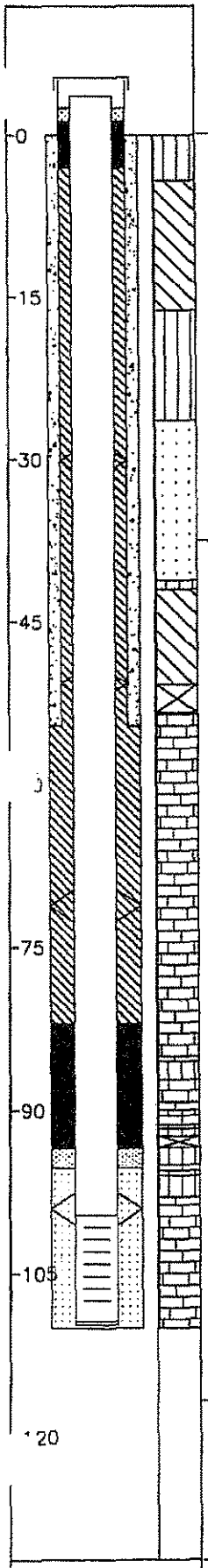
LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/13/95

Golder Associates

Well No. PZ-203-SS

Boring No. X-Ref: PZ-203-SS

PIEZOMETER CONSTRUCTION SUMMARY



Survey Coords: Northing: 1066662 ft. Easting: 516608 ft.

Elevation Ground Level 484.2 ft. NGVD

Top of PVC Casing 486.59 ft. NGVD

Drilling Summary:

Total Depth 110.0 ft.

Borehole Diameter 10 1/4 in. (0.0-56.0 ft.) 5 7/8 in. (56.0-110.0 ft.)

Casing Stickup Height 2.41 ft.

Driller Layne-Western St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit and 9 7/8 in. Tricone Bit

Drilling Fluid Auger-None, NX Core Water, Air and Mud Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	5/25/95	15:00	5/25/95	11:00
Schramm Rotary	6/3/95	7:20	6/3/95	8:30
Geophys.Logging:				
Casing:				
2" PVC	6/3/95	8:20	6/3/95	8:50
6" Steel	6/2/95	10:30	6/2/95	13:00
Filter Placement:	6/3/95	8:50	6/3/95	9:40
Cementing:				
Development				
Bentonite Grout	6/3/95	10:30	6/3/95	11:00
Bentonite Seal	6/3/95	9:40	6/3/95	10:30

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 2.41	-	99.60	C1	486.59	-	384.58
99.60	-	109.40	S1	384.58	-	374.78
109.40	-	109.70	C2	374.78	-	374.48
+ 0.50	-	56.10	C3	484.70	-	428.08
	-				-	
	-				-	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.) (C3-see comments)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 95.3-110.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 93.5-95.3 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-82.0 ft., Neat cement, 3.0-56.1 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 82.0-93.5 ft.

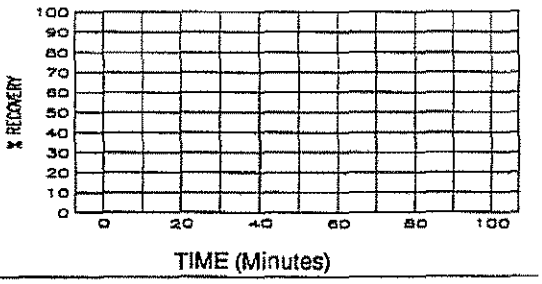
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments: Surface Casing C3: 6 1/8 in. ID / 6 5/8 in. OD Steel Casing

Not to Scale

Supervised by E. Swanson

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ203SS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122505	CHECK NO
ROUTE	TRANSMITTAL NO
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME	WELL NUMBER
LAIDLAW BRIDGETON SANITARY LANDFILL	~~[illegible]~~ PZ-203-SS

SITE ADDRESS	CITY	STATE	ZIP CODE
ST. CHARLES ROCK RD.	BRIDGETON	MO	63044

NAME	TELEPHONE
LAIDLAW WASTE SYSTEMS, INC.	314-241-3710

ADDRESS	CITY	STATE	ZIP CODE
1838 N. BROADWAY	ST. LOUIS	MO	63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

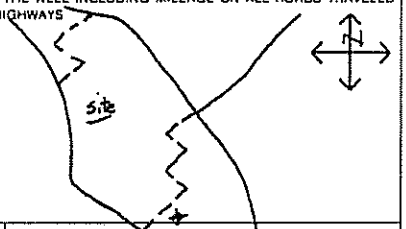
COUNTY ST. LOUIS
ELEVATION 484.2
AREA NO.

SMALLEST ¼ LARGEST ¼

SEC. ____ TWN. 47 N,RNG. 5 (E) OR W

LAT. 38° 45' 47" LONG. 90° 26' 30"

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN CO., INC

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN CO., INC.

TYPE OF INSTALLATION
☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT
486.6

MEASURING POINT IS
☒ TOP OF RISER PIPE
☐ OTHER

DRILLING EQUIPMENT
☒ AIR ROTARY ☒ AUGER TYPE 6¼ H.S.A.
☐ REVERSE ROTARY ☐ OTHER

CENTRALIZERS USED
☒ YES, AT 4 TOTAL
☒ STAINLESS STEEL
☐ OTHER
☐ NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
6-23-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR) Michael P. Vogt

PERMIT NUMBER	DATE
001256WM	7-07-95

SIGNATURE (DRILLING CONTRACTOR) Michael P. Vogt

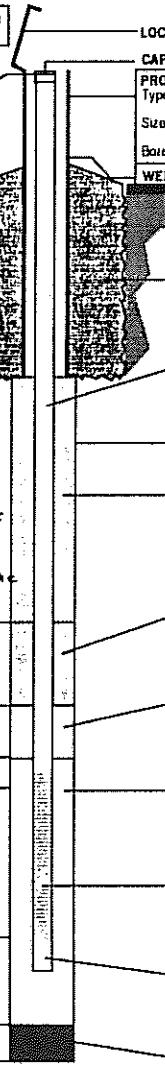
PERMIT NUMBER	DATE
001256 WM	7-07-95

NOTE: Record the fraction of a foot in decimal, not in inches

Top of Riser Elevation: 486.6

Ground Surface Elevation: 484.2

Feet from Surface	Description of Formation
Information in this column to be supplied in the Feet from Surface column	0-44 No sampling
Depth to bottom of Protective Casing Seal: 3.0	
	44-51 Silt
	51-67 Dolomite
	67-110 Limestone
Depth to Base of Annular Seal: 82.0	
Depth to Base of Bentonite Seal: 43.5	
Depth to Base of Secondary Filter Pack: 95.3	
Depth to Top of the Screen: 99.6	
Depth to Bottom of the Screen: 109.6	
Plug Back Total Depth	
Original Total Depth: 110.0	



LOCKING CAP - Y / N (Circle one)
CAP VENT - Y / N (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8"x8"x5'
Bore Hole Diameter: 9 7/8
WEEP HOLE - Y / N (Circle one)

PROTECTIVE CASING SEAL
Type: ☒ Concrete ☐ Cement Slurry

RISER PIPE
Length: 102'
Diameter: 2"
Type of Material: SCH 80 PVC

BOREHOLE DIAMETER: 5 7/8 in.

ANNULAR SEAL
Type: ☐ Bentonite Slurry ☒ Cement Slurry ☐ Non Slurry Bentonite

BENTONITE SEAL
Type: ☒ Bentonite Slurry ☐ Non Slurry Bentonite
Length of Seal: 11.5 Ft.

SECONDARY FILTER PACK (Optional)
Type: ☒ Sand ☐ Manufactured
Grain Size: <50
Length: 1.0'

PRIMARY FILTER PACK
Type: ☒ Sand ☐ Manufactured
Grain Size: 16-35
Length: 14.7

WELL SCREEN
Length: 10'
Slot Size: 0.010
Type: SCH 80 PVC

SUMP DETAILS
Length: 0.3 Ft.
Diameter: 2 in.
Type: PVC

TYPE OF BACKFILL: SAND

MO 780-1415 (2-94) DISTRIBUTION: WHITE DIVISION CANARY/MONITORING WELL CONTRACTOR PINK/OWNER

SOIL BOREHOLE LOG

LAIDLAW WASTE SYSTEMS INC.

SITE NAME AND LOCATION	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-204-SS
LAIDLAW\RI-FS\MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	SHEET 1 OF 1
		DRILLING START TIME 15:50 DATE 3/7/95
		DRILLING FINISH TIME 07:45 DATE 3/7/95
NORTHING: 1066426.61 DATUM EASTING: 515533.49 ELEVATION 467.0	WATER LEVEL / TIME / DATE / CASING DEPTH	
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS Muddy, no vegetation.	
ANGLE BEARING		
SAMPLE HAMMER		

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
					(0.0-6.0 ft.) CONCRETE, (FILL)		Auger from 0.0-6.5 feet with no sampling
1							
2							
3							
4							
5							
6							
7	1 2 2	0.5' / 1.5' (33%)			@ 6.5-7.9 ft., crushed CONCRETE, (FILL)	SP 1	Begin split spoon sampling at 6.5 feet
					(459.1) 7.9		
8	2 4 6 5	1.1' / 2.0' (55%)			(7.9-9.3 ft.) Stiff, mottled moderate yellowish brown (10YR 5/4) and dark yellowish orange (10YR 6/6), CLAYEY SILT, iron stained, some roots, NR, damp, (CL-ML), (LOESS)	SP 2	
9					(9.3-10.5 ft.) Stiff, pale yellowish brown (10YR 6/2) and medium dark gray (N4), CLAYEY SILT, some fine sand, NR, damp, (CL-ML), (LOESS)		
10	3 4 5 5	1.5' / 2.0' (75%)			(10.5-14.6 ft.) Stiff, medium dark gray (N4), CLAYEY SILT, little fine sand, NR, damp, (CL-ML), (LOESS)	SP 3	
11					@ 11.2-11.5 ft., silty CLAY		
12	1 6 8 9	0.8' / 2.0' (40%)				SP 4	
13							
					(453.0) 14.0		
14					End of Soil Borehole Log at 14.0 Ft. See PZ-204-SS Record of Drillhole for rock descriptions		Auger/split spoon refusal at 14.0 feet

DRILLING CONTR LAYNE-WESTERN

LOGGED BY M. HIRT CHK'D BY W. HERST

DATE 3/7/95

JOB NO.: 943-2848

FILENAME: PZ204SS

RECORD OF DRILLHOLE PZ-204-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: HX Core & water
DRILLING DATE: 3/8/95 - 3/8/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066426.81
AZIMUTH: 0

COLLAR ELEV: 467.0
E: 515533.49
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
FL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE: DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (80 60 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP WRT CORE AXIS (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR MW HW CW)	STRENGTH INDEX (R5 R6 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 30 R2 150 R3 300 R4 600 R5 1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
0	0.0-14.0 ft. See Soil Borehole Log PZ-204-SS 14.0-14.6 ft. No samples collected														
2															
4															
6															
8															
10															
12															
14															
	452.40		452.40												
	14.6-45.1 ft. 14.60 Fresh, medium bedded, light olive gray (5Y 6/1), micro-crystalline, strong, LIMESTONE, (ST. LOUIS FORMATION) Some calcite crystal veins (<1 mm. thick), few fossils		14.60	1	89%										3/8/95 @ 8:15 Begin coring
16															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: W. HERST
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-204-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/6/95 - 3/9/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066426.61
AZIMUTH: 0

COLLAR ELEV: 467.0
E: 515533.49
INCLINATION: -90

ROCK TYPE

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DISCONTINUITY DATA

DEPTH (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
16	14.6-45.1 ft. Fresh, medium bedded, light olive gray (5Y 6/1), micro-crystalline, strong, LIMESTONE, (ST. LOUIS FORMATION) Some calcite crystal veins (<1 mm. thick), few fossils				J,PL,SM,CL	
					J,I,SM,CL	
					J,I,SM	
					J,I,SM,CL	
					J,I,SM,CL	
					J,I,SM	
					J,ST,SM,CL	
			1	69%	J,I,SM,CL	
18					J,I,SM	
					J,I,SM	
					J,PL,SM,CL	
					J,I,SM	
		447.70 / 19.30			Core Loss	Core loss due to highly fractured rock; core End Run 1 @ 9:50
					J,I,SM (2)	
20					J,I,SM (2)	
					J,I,SM,CL (3)	
					J,U,SM,CL	
					J,I,SM,CL (3)	
			2	96%	J,U,SM,CL (2)	
22					J,I,SM,CL (2)	
	22.6-28.0 ft. Very fine grained				J,I,SM	
					J,I,SM,CL (2)	
24		443.00 / 24.00				3/8/95 @ 10:50 End Run 2
					J,I,R	Use new bit during Run 3; slightly larger diameter, therefore hole reamed slightly
26					J,PL,SM	
					J,I,SM,CL	
			3	98%	J,I,SM,CL,	
					J,I,SM	
					J,I,SM,Fe	
					J,U,SM	
28	28.0-30.7 ft. Medium grained 28.1-28.5 ft. 0 iron stained vein (1 mm. thick)					
	29.3-29.8 ft. Slightly weathered, iron stained	437.70 / 29.30			J,PL,SM,Fe	3/8/95 @ 13:15 End Run 3
30					J,I,R	
					J,PL,SM (2)	
			4	98%	J,I,R	
					J,I,R	
					J,U,SM	
					J,I,R	
32						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: W. HERST
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-204-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/8/95 - 3/9/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066426.61
AZIMUTH: 0

COLLAR ELEV: 487.0
E: 515533.49
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
32	14.6-45.1 ft. Fresh, medium bedded, light olive gray (5Y 6/1), micro-crystalline, strong, LIMESTONE, (ST. LOUIS FORMATION) Some calcite crystal veins (<1 mm. thick), few fossils								J,I,R						
34									J,I,R (4)						
				4	98%				J,I,SM,CL (4)						
36									J,I,SM,CL (5)						
									J,I,SM,CL (2)						
38			427.70 / 39.30						J,I,SM,CL						3/5895 @ 14:05 End Run 4
40									J,I,SM						
									J,I,SM,CL (6)						
									J,I,SM						
									J,I,SM,CL						
42	41.8-42.8 ft. Fine grained, calcareous dolomite														
	42.8-45.1 ft. Medium grained, dolomitic limestone								J,I,SM						
				5	102 %										
44									J,I,R (4)						
			421.90 / 45.10												
46	45.1-49.3 ft. Slightly weathered, medium bedded, light olive gray (5Y 5/2), very fine grained, medium strong, DOLOMITE, (ST. LOUIS FORMATION) Porous/vuggy (vugs ~1 mm. thick); some 10 degree calcite veins (<2 mm. thick)								B,U,R						
48															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: W. HERST
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-204-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/8/95 - 3/9/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1068428.61
AZIMUTH: 0

COLLAR ELEV: 467.0
E: 515533.49
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
48	48.8-49.3 ft. Fine grained, dolomitic limestone 417.70	417.70	5	102 %				3/8/95 @ 14:40 End Run 5
	49.3-64.3 ft. 49.30 Fresh, medium bedded, light olive gray (5Y 6/1), very fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)	49.30					J,I,SM (6); J,I,SM (2)	
50	49.3-49.8 ft. Thinly laminated 49.8-50.9 ft. Chert zone						J,I,R,CL	
52							J,I,R,CL	
	52.8-54.5 ft. Intricate pattern of calcite veins							
54			6	98%			J,I,R,CL	
	54.8-55.9 ft. Moderately weathered						J,I,R,CL	
56								
	56.6-58.1 ft. Moderately weathered						J,PL,SM,CL	
	57.5-57.7 ft. 409.50 Claystone 57.70						J,I,R,CL; B,U,R,CL; B,U,SM,CL	
58	408.90 58.1-58.5 ft. 58.10 Claystone 408.50 58.5-59.9 ft. 58.50 Siltstone, 45 degree crossbed						B,I,R,CL; J,PL,SM,CL (2); J,I,SM,CL	
		407.70 59.30					J,I,R; J,I,SM (2); J,I,R	3/8/95 @ 15:35 End Run 6
60	407.10 59.90 60.0-60.4 ft. Calcareous dolomite						J,I,R; J,PL,SM,CL; J,U,SM,CL; J,PL,R,CL	
	405.40 61.60 61.6-62.4 ft. Calcareous dolomite, slightly weathered		7	100 %			J,PL,SM	
62	404.60 62.40						J,I,SM,CL (5)	
	63.0-64.3 ft. Microcrystalline							
64								

WEATHERING INDEX: FR, SW, MW, HW, CW
STRENGTH INDEX: R6, R5, R4, R3, R2, R1
POINT LOAD INDEX (psi): R1, R2 30, R3 150, R4 300, R5 600, R6 1500
TEST ORIENTATION

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: W. HERST
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-204-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2846
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/8/95 - 3/9/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066426.61
AZIMUTH: 0

COLLAR ELEV: 467.0
E: 515533.49
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE: DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (80 60 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (FR SW MW HW CW)	STRENGTH INDEX (R6 R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 30 R2 150 R3 300 R4 600 R5 1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
64			402.70 / 64.30												
	64.3-79.9 ft. Moderately weathered, thinly bedded, pale to dark yellowish brown (10YR 6/2-10YR 4/2), very fine grained, medium strong, DOLOMITE, (ST. LOUIS FORMATION) Very porous/vuggy (<1 mm.-5 mm.)								J,I,SM,CL (2)						
									J,U,R; J,I,SM,CL						
66				7	100 %										
68															
			397.70 / 69.30												3/8/95 @ 16:20 End Run 7
70	69.6-70.3 ft. Slightly weathered														
72															
74				8	100 %										
76															
78															
			387.70 / 79.30												3/8/95 @ 16:55 End Run 8
				9	98%										
80	387.10 / 79.90								J,I,R						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: W. HERST
DATE: 3/29/95

Golder Associates

RECORD OF DRILLHOLE PZ-204-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 3/8/95 - 3/9/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1066428.61
AZIMUTH: 0

COLLAR ELEV: 487.0
E: 515533.49
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filed

DEPTH (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80	79.9-90.3 ft. Fresh, medium bedded, pale yellowish brown (10YR 6/2), coarse grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Some calcite crystals, stylolites												
82				9	98%			J,PL,SM,CL; J,U,SM,CL; J,I,SM,CL					
84			382.70 / 84.30										3/8/95 @ 17:20 End Run 9
								J,I,R					
	85.7-89.6 ft. Microcrystalline							J,PL,SM					
86								J,I,SM (2)					
								J,I,SM					
				10	100								
88								J,I,SM					
								J,I,SM,CL (2)					
								J,I,R,CL (2)					
90			378.70 / 90.30					J,PL,SM					3/8/95 @ 17:50 End Run 10
	End of Record of Drillhole at 90.3 ft.												
92													
94													
96													

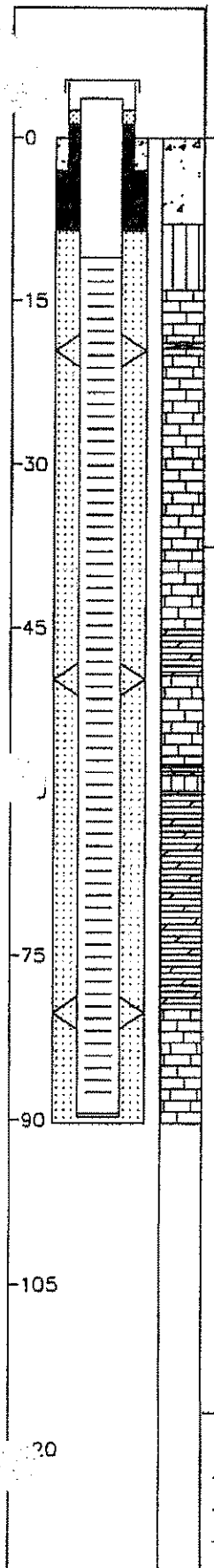
DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: M. HIRT
CHECKED: W. HERST
DATE: 3/29/95

Golder Associates

Well No. PZ-204-SS
Boring No. X-Ref: PZ-204-SS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1066427 ft. Easting: 515533 ft.

Elevation Ground Level 467.0 ft. NGVD
Top of PVC Casing 469.63 ft. NGVD

Drilling Summary:

Total Depth 90.3 ft.
Borehole Diameter 10 1/4 in. (0.0-14.0 ft.) 5 7/8 in. (14.0-90.3 ft.)
Casing Stickup Height 2.60 ft.
Driller Layne-Western
St. Louis, MO

Rig CME 75, Schramm Portadrill T660H
Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit,
NX Core, 5 7/8 in. Button Bit for Reaming
Drilling Fluid Auger-None, NX Core Water,
Air Rotary
Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	3/7/95	15:50	3/8/95	7:45
Schramm Rotary	3/10/95	12:15	3/10/95	14:15
Geophys.Logging:				
Casing:	3/10/95	14:15	3/10/95	14:35
Filter Placement:	3/10/95	14:35	3/10/95	15:05
Cementing:				
Development				
Bentonite Grout				
Bentonite Seal	3/10/95	15:05	3/10/95	15:15

Well Design & Specifications

Basis: Geologic Log X Geophysical Log
Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 2.60	-	10.95	C1	469.63	-	456.08
10.95	-	89.35	S1	456.08	-	377.68
89.35	-	89.68	C2	377.68	-	377.35

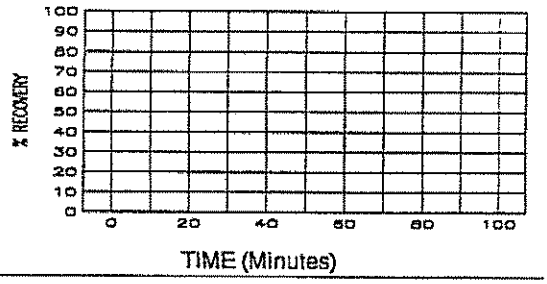
Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings
C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)
Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings
Sand Pack: 16-35 mesh Silica Sand, 8.5-90.3 ft.
Filter Pack:
Grout Seal:
Bentonite Seal: Medium Bentonite Chips, 3.0-8.5 ft.
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Supervised by B. Tilton
Job Number 943-2848
Site LAIDLAW/OU2 RI-FS/MO
File Name PZ204SS

66154

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF. NO 115087	CHECK NO.
ROUTE	TRANSMITTAL NO
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME: LAIDLAW BRIDGETON SANITARY LANDFILL
WELL NUMBER: PZ-204-SS
SITE ADDRESS: ST. CHARLES ROCK RD.
CITY: BRIDGETON
STATE: MO.
ZIP CODE: 63044
NAME: LAIDLAW WASTE SYSTEMS, INC.
TELEPHONE:
ADDRESS: 1338 N. BROADWAY
CITY: ST. LOUIS
STATE: MO.
ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

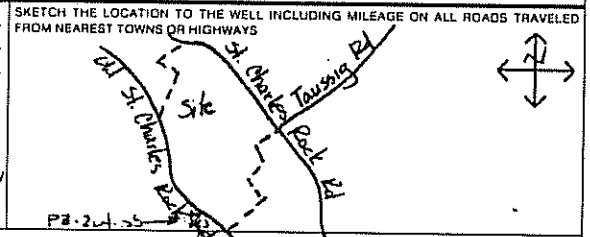
COUNTY: ST. LOUIS
ELEVATION: 467.0
AREA NO.:

SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST ¼

SEC. ____ TWN. 47 N.RNG 5 (E) OR W

LAT. 38° 45' 45" LONG. 90° 36' 44"

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

NOTE: Record the fraction of a foot in decimal, not in inches

Top of Riser Elevation: 470.25

Ground Surface Elevation: 467.0 Ft

Feet from Surface	Description of Formation
Information in this column to be supplied in the Feet from Surface column	0-7 Fill
Depth to bottom of Protective Casing Seal: 3	
Depth to Base of Annular Seal: 3	
Depth to Base of Bentonite Seal: 3.5	7-14 Silt
Depth to Base of Secondary Filter Pack:	
Depth to Top of the Screen: 10	
	14-64 Limestone
Depth to Bottom of the Screen: 90	64-81 Dolomite
	81-90.3 Limestone
Plug Back Total Depth:	
Original Total Depth: 90.3	

LOCKING CAP: (Y) N (Circle one)
CAP VENT: (Y) N (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8" x 8" x 5'
Bore Hole Diameter: 10.25"
WEEP HOLE - Y / N (Circle one)

PROTECTIVE CASING SEAL
Type: [X] Concrete [ ] Cement Slurry

RISER PIPE
Length: 13.25'
Diameter: 2"
Type of Material: SCH 80 PVC

BOREHOLE DIAMETER: 5 1/8 In.

ANNULAR SEAL
Type: [ ] Bentonite Slurry [ ] Cement Slurry [X] Non Slurry Bentonite

BENTONITE SEAL
Type: [ ] Bentonite Slurry [X] Non Slurry Bentonite
Length of Seal: 5.5 Ft.

SECONDARY FILTER PACK (Optional)
Type: [ ] Sand [ ] Manufactured
Grain Size:
Length:

PRIMARY FILTER PACK
Type: [X] Sand [ ] Manufactured
Grain Size: 16-35
Length: 81.8

WELL SCREEN
Length: 80'
Slot Size: 0.010"
Type: SCH 80 PVC

SUMP DETAILS
Length: 0.3 Ft.
Diameter: 2 In.
Type: PVC

TYPE OF BACKFILL: SAND

MONITORING WELL INSTALLATION CONTRACTOR'S NAME: LAYNE WESTERN CO., INC.

DRILLING CONTRACTOR'S NAME: LAYNE WESTERN CO., INC.

TYPE OF INSTALLATION: [X] ABOVE GROUND [ ] FLUSH MOUNT

STATIC WATER LEVEL: FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT

MEASURING POINT IS: [ ] TOP OF RISER PIPE [ ] OTHER

DRILLING EQUIPMENT: [X] AIR ROTARY [X] AUGER TYPE 6¼ H.S.A. [ ] REVERSE ROTARY [ ] OTHER

CENTRALIZERS USED: [X] YES, AT 4 TOTAL [ ] STAINLESS STEEL [ ] OTHER [ ] NO

MULTIPLE CASED WELLS: SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED: 3-10-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR): Michael P. Vogl
PERMIT NUMBER: 001256WM DATE: 4-11-95

SIGNATURE (DRILLING CONTRACTOR): Michael P. Vogl
PERMIT NUMBER: 001256WM DATE: 4-11-95

MO 780-1415 (2-94)

DISTRIBUTION: WHITE DIVISION CANARY MONITORING WELL CONTRACTOR PINK/OWNER

RECORD OF DRILLHOLE PZ-204A-SS

Sheet 1 of 1

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/21/95
DRILL RIG: SCHRAMM

DATUM: MSL
COORDINATES N: 1066429.82
AZIMUTH: 0

COLLAR ELEV: 466.7
E: 515556.26
INCLINATION: -90

ROCK TYPE: J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation; PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular; P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough; Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD (60 80 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG3	WEATHERING INDEX (FR SW MW HW CW)	STRENGTH INDEX (R6 R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R1 30 R2 150 R3 300 R4 600 R5 1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80	0.0-80.0 ft. See Soil Borehole Log and Record of Drillhole for PZ-204-SS		386.70 / 80.00												0.0-14.0 ft. Borehole advanced with 6 1/4 in. ID hollow stem augers
	80.0-90.0 ft. Fresh, medium to thickly bedded, light olive gray (5Y 6/1), finely crystalline, strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic								J,PL,R,CL						14.0-80.0 ft. Borehole advanced with 5 7/8 in. dia. air rotary bit
									J,PL,R,CL						6/21/95 @ 13:00 Began coring
82	82.5-83.1 ft. Thinly laminated, fossiliferous								J,C,R,CL (3)						
	82.3-85.8 ft. Small vugs (1/4 in.) filled with glauconite														
84									J,C,VR-CL						
				1	96%				J,PL,R,CL						
	@ 85.4 ft. Grades to microcrystalline Limestone								J,C,SM,CL						
86									J,ST,R,CL						
									J,C,R,CL						
									J,C,R,CL (2)						
88															
			377.10 / 89.60						J,P,R						6/21/95 @ 15:45 Ended coring
50	376.70 / 90.00 End of Record of Drillhole at 90.0 ft.								Core Loss						
92															
94															
96															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

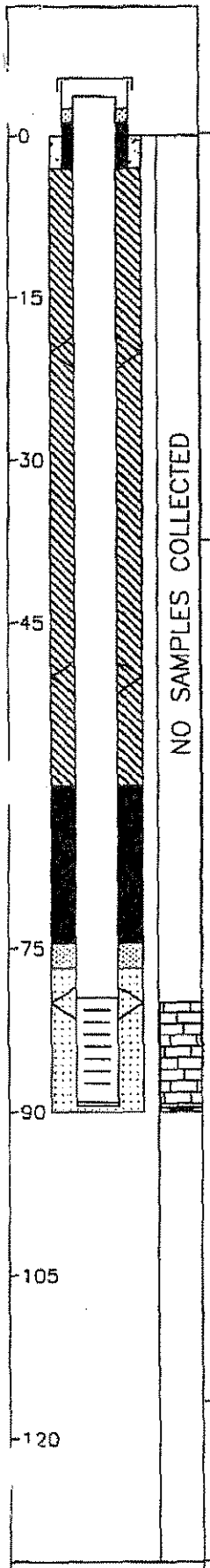
LOGGED: R. BOOTH
CHECKED: B. TILTON
DATE: 7/12/95

Golder Associates

Well No. PZ-204A-SS

Boring No. X-Ref: PZ-204A-SS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1066430 ft. Easting: 515556 ft.

Elevation Ground Level 466.7 ft. NGVD

Top of PVC Casing 468.16 ft. NGVD

Drilling Summary:

Total Depth 90.0 ft.

Borehole Diameter 10 1/4 in. (0.0-14.0 ft.) 5 7/8 in. (14.0-90.0 ft.)

Casing Stickup Height 1.50 ft.

Driller Layne-Western St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit for Reaming

Drilling Fluid Auger-None, NX Core Water, Air Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75				
Schramm Rotary	6/21/95	8:00	6/21/95	14:00
Geophys.Logging:				
Casing:	6/22/95	7:30	6/22/95	7:36
Filter Placement:	6/22/95	7:35	6/22/95	7:45
Cementing:				
Development				
Bentonite Grout	6/22/95	8:00	6/22/95	9:00
Bentonite Seal	6/22/95	7:45	6/22/95	8:00

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.50	-	79.50	C1	468.16	-	387.16
79.50	-	89.10	S1	387.16	-	377.56
89.10	-	89.43	C2	377.56	-	377.23

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 76.8-90.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 74.5-76.8 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-60.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 60.0-74.5 ft.

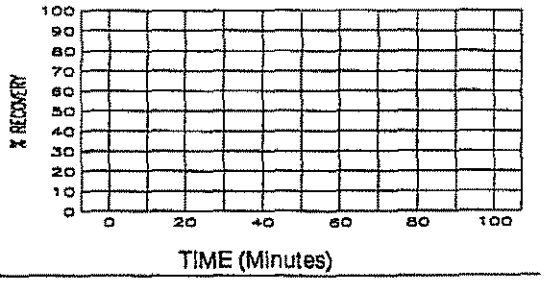
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Supervised by B. Tilton

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ204ASS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO. 122518	CHECK NO
ROUTE	TRANSMITTAL NO.
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME: LANDFILL BRIDGETON SANITARY LANDFILL		WELL NUMBER: PZ-204A-55	
SITE ADDRESS: ST. CHARLES ROCK RD.	CITY: BRIDGETON	STATE: MO	ZIP CODE: 63044
NAME: LANDFILL WASTE SYSTEMS, INC		TELEPHONE: 314 241-3710	
ADDRESS: 1835 N. SCHUMACHER	CITY: ST LOUIS	STATE: MO	ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

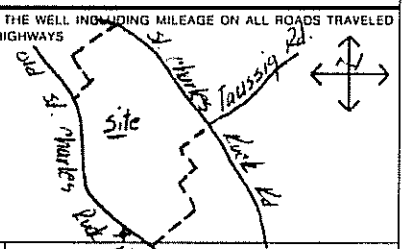
COUNTY: ST. LOUIS
ELEVATION: 468.66
AREA NO

SMALLEST ¼ LARGEST ¼

SEC. ____ TWN. 47 N.RNG. 5 E OR W

LAT. 38 - 45 - 44" LONG. 90 - 26 - 44"

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN Co., Inc

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN Co., Inc.

TYPE OF INSTALLATION
☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT
468.66

MEASURING POINT IS
☒ TOP OF RISER PIPE
☐ OTHER

DRILLING EQUIPMENT
☒ AIR ROTARY ☒ AUGER TYPE 6¼ H.S.A.
☐ REVERSE ROTARY ☐ OTHER

CENTRALIZERS USED
☒ YES, AT 3 TOTAL
☒ STAINLESS STEEL
☐ OTHER
☐ NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
6-22-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR) Michael P. Vogt
PERMIT NUMBER 001256 WMI DATE 7-07-95

SIGNATURE (DRILLING CONTRACTOR) Michael P. Vogt
PERMIT NUMBER 001256 WMI DATE 7-07-95

NOTE: Record the fraction of a foot in decimal, not in inches

Top of Riser Elevation: 468.66

LOCKING CAP - Y / N (Circle one)
CAP VENT - Y / N (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8"x5"x5'
Bore Hole Diameter: 10¼"
WEEP HOLE - Y / N (Circle one)

Ground Surface Elevation: 466.66 Ft

Information in this column to be supplied in the Feet from Surface column	Feet from Surface	Description of Formation
Depth to bottom of Protective Casing Seal:	3.0	
Depth to Base of Annular Seal:	6.0	
Depth to Base of Bentonite Seal:	74.5	
Depth to Base of Secondary Filter Pack:	76.8	
Depth to Top of the Screen:	79.5	
Depth to Bottom of the Screen:	84.5	
Plug Back Total Depth		
Original Total Depth:	90.0	

PROTECTIVE CASING SEAL
Type: ☒ Concrete ☐ Cement Slurry

RISER PIPE
Length: 81'
Diameter: 2"
Type of Material: SCH 80 PVC

BOREHOLE DIAMETER: 5 7/8 In.

ANNULAR SEAL
Type: ☐ Bentonite Slurry ☒ Cement Slurry ☐ Non Slurry Bentonite

BENTONITE SEAL
Type: ☒ Bentonite Slurry ☐ Non Slurry Bentonite
Length of Seal: 14.5 Ft.

SECONDARY FILTER PACK (Optional)
Type: ☒ Sand ☐ Manufactured
Grain Size: <50
Length: 2.3'

PRIMARY FILTER PACK
Type: ☒ Sand ☐ Manufactured
Grain Size: 16-35
Length: 13.2'

WELL SCREEN
Length: 10'
Slot Size: 0.010
Type: SCH 80 PVC

SUMP DETAILS
Length: 0.3 Ft.
Diameter: 2 In.
Type: PVC

TYPE OF BACKFILL: SAND

DISTRIBUTION: WHITE DIVISION CANARY MONITORING WELL CONTRACTOR PINK/OWNER

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-205-AS
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	SHEET 1 OF 4
		DRILLING START / FINISH
	WATER LEVEL	TIME 16:35 / TIME 11:00
	TIME	
	DATE	DATE 3/25/95 / DATE 3/25/95
	CASING DEPTH	
DATUM NORTHING: 1067463.60 EASTING: 515463.34 ELEVATION 459.3		
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS	
ANGLE -90° BEARING		
SAMPLE HAMMER		

DRILLING CONTR LAYNE-WESTERN

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1	4 7 7 10	1.5' / 2.0' (75%)			(0.0-2.2 ft.) Stiff, dark greenish gray (5GY 4/1) to olive gray (5Y 6/1), SILTY CLAY, trace fine Sand, SR, damp, (CL), (FILL)	SP 1	
2 (457.1) 2.2	1 2 2 4	0.5' / 2.0' (25%)			(2.2-6.0 ft.) Soft, black (N1), CLAYEY SILT, trace fine Sand, WR, moist to wet, (CL-ML), (FILL)	SP 2	
4	2 2 2 3	1.5' / 2.0' (75%)				SP 3	Soil becomes wet @ 4.0 ft.
6 (453.3) 6.0	1 4 4 3	0.1' / 2.0' (5%)			(6.0-12.0 ft.) Mixed wet waste and clayey silt	SP 4	
8	6 5 6 4	0.1' / 2.0' (5%)			(8.0-10.0 ft.) Mixed wet waste and clayey silt	SP 5	
10	2 2 3 3	0.6' / 2.0' (30%)				SP 6	
12 (447.3) 12.0	2 9 3 2	0.0' / 2.0' (0%)	NO RECOVERY		(12.0-14.0 ft.) No Recovery	SP 7	From 12.0-28.0 ft., no samples recovered, but drilling indicated mixed waste and silty clay layers
14	6 8 8 7	0.0' / 2.0' (0%)			(14.0-15.0 ft.) No Recovery	SP 8	

LOGGED BY S. COSIO CHK'D BY W. HERST

DATE 6/1/95

JOB NO.: 943-2848

FILENAME: PZ205AS

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-205-AS
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	SHEET 2 OF 4
		DRILLING START TIME 16:35 DATE 3/25/95; FINISH TIME 11:00 DATE 3/25/95
NORTHING: 1067463.60 DATUM EASTING: 515463.34 ELEVATION 459.3	WATER LEVEL / TIME / DATE / CASING DEPTH	
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS	
ANGLE -90° BEARING		
SAMPLE HAMMER		

DRILLING CONTR LAYNE-WESTERN

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
					(15.0-16.0 ft.) No Recovery	SP 8	
16	5 5 5 4	0.0' / 2.0' (0%)	NO RECOVERY		(16.0-18.0 ft.) No Recovery	SP 9	
17							
18	5 2 1 5	0.0' / 2.0' (0%)			(18.0-20.0 ft.) No Recovery	SP 10	
19							
20	1 2 3 3	0.0' / 2.0' (0%)			(20.0-22.0 ft.) No Recovery	SP 11	
21							
22	3 2 1 4	0.0' / 2.0' (0%)			(22.0-24.0 ft.) No Recovery	SP 12	
23							
24	3 3 23 50/1"	0.0' / 2.0' (0%)			(24.0-26.0 ft.) No Recovery	SP 13	
25							
26	8 6 8 10	0.0' / 2.0' (0%)			(26.0-28.0 ft.) No Recovery	SP 14	
27					(431.3) 28.0		
28	1 2 4 5	0.0' / 2.0' (0%)			(28.0-30.0 ft.) Loose, dark greenish gray (5GY 4/1), SANDY SILT, NR, wet, (ML)	SP 15	
29							

LOGGED BY S. CUSIO
DATE 6/1/95
CHK'D BY W. HERSI

JOB NO.: 943-2848
FILENAME: PZ205AS

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-205-AS
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	SHEET 3 OF 4
		DRILLING START TIME 16:35 DATE 3/25/95; FINISH TIME 11:00 DATE 3/25/95
NORTHING: 1067463.60 DATUM EASTING: 515463.34 ELEVATION 459.3	WATER LEVEL / TIME / DATE / CASING DEPTH	
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS	
ANGLE -90° BEARING		
SAMPLE HAMMER		

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
					(30.0-31.0 ft.) No samples collected (428.3) 31.0		5/21/95, 10.0 in. ID steel casing installed through 10.25 in. ID augers to 29.0 ft. Casing sealed in borehole with neat cement grout to surface.
31	6 5 5 8	1.2'/2.0' (60%)			(31.0-36.5 ft.) Stiff, medium dark gray (N4), SILTY CLAY, with thin fine sand layers (1' thick), moist, NR, (CL), (ALLUVIUM)	SP (16)	
32							
33	9 3 5 12	1.3'/2.0' (65%)				SP (17)	
34							
35	7 7 9 9	1.0'/2.0' (50%)				SP (18)	
36					(422.8) 36.5		
37	7 14 21 17	1.1'/2.0' (55%)			(36.5-39.0 ft.) Dense, olive gray (5Y 4/1), SILTY fine SAND, wet, NR, (SM), (ALLUVIUM)	SP (19)	
38							
39	4 3 3 4	1.4'/2.0' (70%)			(420.3) 39.0 (39.0-44.2 ft.) Firm, olive gray (5Y 4/1), SILTY CLAY, moist to wet, NR, (CL) from 40.2-40.4 ft., wet, fine, sandy clay layer	SP (20)	
40							
41	3 4 4 5	1.7'/2.0' (85%)			from 41.8-42.0 ft., wet, fine, sandy clay layer	SP (21)	
42							
43	2 7 11 18	1.3'/2.0' (65%)				SP (22)	
44					(415.1) 44.2 (44.2-49.0 ft.) Compact, olive gray (5Y 4/1), fine SAND, trace silt, wet, NR, (SM), (ALLUVIUM)		

DRILLING CONTR LAYNE-WESTERN

LOGGED BY S. COSID CHK'D BY W. HERST

DATE 6/1/95

JOB NO.: 943-2848

FILENAME: PZ205AS

LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-205-AS
LAIDLAW/OU2 RI-FS/MD WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	SHEET 4 OF 4
		DRILLING START / FINISH
	WATER LEVEL	TIME 16:35 / TIME 11:00
	TIME	
	DATE	DATE 3/25/95 / DATE 3/25/95
	CASING DEPTH	
DATUM NORTHING: 1067463.60 EASTING: 515463.34	ELEVATION 459.3	
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS	
ANGLE -90° BEARING		
SAMPLE HAMMER		

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
46	6 8 12 16	1.6'/2.0' (80%)			(44.2-49.0 ft.) Compact, olive gray (5Y 4/1), fine SAND, trace silt, wet, NR, (SM), (ALLUVIUM)	SP (23)	
47	3 5 50/4"	1.1'/2.0' (55%)				SP (24)	
48							
49					(410.3) 49.0 End of Soil Borehole Log at 49.0 ft.		Top of weathered bedrock encountered @ 48.5 Ft.
50							
51							
52							
53							
54							
55							
56							
57							
58							
59							

DRILLING CONTR LAYNE-WESTERN

LOGGED BY S. CDSID

DATE 6/1/95

CHK'D BY W. HERST

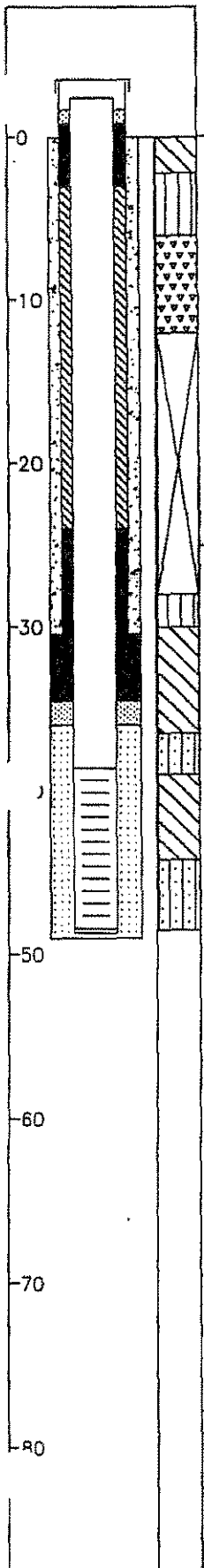
JOB NO.: 243-2849

FILENAME: PZ205AS

Well No. PZ-205-AS

Boring No. X-Ref: PZ-205-AS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1087464 ft. Easting: 515463 ft.

Elevation Ground Level 459.3 ft. NGVD

Top of PVC Casing 460.99 ft. NGVD

Drilling Summary:

Total Depth 49.0 ft.

Borehole Diameter 14 1/4 in. (0.0–29.0 ft.) 8 1/4 in. (29.0–49.0 ft.)

Casing Stickup Height 1.66 ft.

Driller Layne-Western St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. and 10 1/4 in. ID Hollow Stem Auger Bits

Drilling Fluid Auger-None

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	3/25/95	16:35	3/25/95	11:00
CME 75	4/21/95	14:10	4/21/95	15:30
CME 75	5/5/95	13:30	5/5/95	15:30
Geophys.Logging:				
Casing:				
2" PVC	5/5/95	16:00	5/5/95	16:05
10" Steel	4/21/95	15:29	4/21/95	16:30
Filter Placement:	5/5/95	16:05	5/5/95	16:45
Cementing:				
Development				
Bentonite Grout	5/5/95	17:00	5/5/95	17:30
Bentonite Seal	5/5/95	16:45	5/5/95	17:00

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.66	-	38.55	C1	460.99	-	420.78
38.55	-	48.35	S1	420.78	-	410.98
48.35	-	48.68	C2	410.98	-	410.65
+ 0.70	-	29.00	C3	460.00	-	430.33
	-				-	
	-				-	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.) (C3-see comments)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 36.0-49.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 34.5-36.0 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-24.0 ft., Neat cement, 3.0-29.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 24.0-34.5 ft.

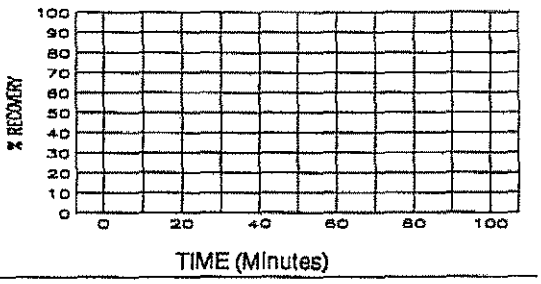
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments: Surface Casing C3: 10 in. ID / 10 7/8 in. OD Steel Casing

Supervised by B. Tilton

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ205AS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122496	CHECK NO
ROUTE	TRANSMITTAL NO
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME	WELL NUMBER
LAIDLAW BRIDGETON SANITARY LANDFILL	PZ-205AS

SITE ADDRESS	CITY	STATE	ZIP CODE
ST. CHARLES ROCK RD.	BRIDGETON	MO.	63044

NAME	TELEPHONE
LAIDLAW WASTE SYSTEMS, INC.	314-241-3710

ADDRESS	CITY	STATE	ZIP CODE
1838 N. BROADWAY	ST. LOUIS	MO	63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

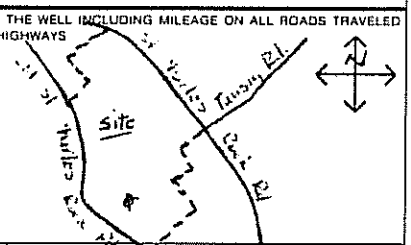
COUNTY ST. LOUIS
ELEVATION 454.3
AREA NO.

SMALLEST ¼ LARGEST

SEC. TWN. 47 N.RNG. 5 (E OR W)

LAT. 38 ° 45 ' 55 " LONG. 90 ° 36 ' 45 "

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN CO, INC.

NOTE: Record the fraction of a foot in decimal, not in inches.

Top of Riser Elevation: 461.0

LOCKING CAP - (Y) N (Circle one)
CAP VENT (Y) N (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8"x8"x5'
Bore Hole Diameter: 14"
WEEP HOLE - Y / (N) (Circle one)

Ground Surface Elevation: 454.3 Ft

Feet from Surface	Description of Formation
Information in this column to be supplied in the Feet from Surface column	0-2 Clay
	2-6 Silt
Depth to bottom of Protective Casing Seal: 4.0	
	6-27 Trash
Depth to Base of Annular Seal: 34.0	
	27-31 Silt
Depth to Base of Bentonite Seal: 34.5	
Depth to Base of Secondary Filter Pack: 36.0	31-38 Clay
Depth to Top of the Screen: 38.4	
	38-47 Silt w/ sand
Depth to Bottom of the Screen: 48.4	
Plug Back Total Depth	
Original Total Depth: 47.0	

PROTECTIVE CASING SEAL
Type: [X] Concrete [ ] Cement Slurry

RISER PIPE
Length: 40.1'
Diameter: 2"
Type of Material: SCH. 80 PVC

BOREHOLE DIAMETER: 8 In.

ANNULAR SEAL
Type: [X] Bentonite Slurry [X] Cement Slurry [ ] Non Slurry Bentonite

BENTONITE SEAL
Type: [X] Bentonite Slurry [ ] Non Slurry Bentonite
Length of Seal: 10.5 Ft.

SECONDARY FILTER PACK (Optional)
Type: [X] Sand [ ] Manufactured
Grain Size: 2 50
Length: 1.5'

PRIMARY FILTER PACK
Type: [X] Sand [ ] Manufactured
Grain Size: 16-35
Length: 13'

WELL SCREEN
Length: 10
Slot Size: 0.010"
Type: SCH. 80 PVC

SUMP DETAILS
Length: 0.3 Ft.
Diameter: 2 In.
Type: PVC

TYPE OF BACKFILL: SAND

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN CO, INC.

TYPE OF INSTALLATION
[X] ABOVE GROUND [ ] FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT
461.0

MEASURING POINT IS
[X] TOP OF RISER PIPE
[ ] OTHER

DRILLING EQUIPMENT
[ ] AIR ROTARY [X] AUGER TYPE 4¼ H.S.A.
[ ] REVERSE ROTARY [ ] OTHER

CENTRALIZERS USED
[X] YES, AT 2 TOTAL
[X] STAINLESS STEEL
[ ] OTHER
[ ] NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
5-06-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR)
[signature]

PERMIT NUMBER	DATE
001258 WMA	6-02-95

SIGNATURE (DRILLING CONTRACTOR)
[signature]

PERMIT NUMBER	DATE
001258 WMA-1	6-02-95

DISTRIBUTION: WHITE DIVISION CANARY MONITORING WELL CONTRACTOR PINK/OWNER

RECORD OF DRILLHOLE PZ-205-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/17/95 - 5/19/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1067483.54
AZIMUTH: 0

COLLAR ELEV: 459.5
E: 515477.78
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
48	0.0-49.0 ft. See Soil Borehole Log PZ-205-AS 49.0-54.0 ft. No samples collected														0.0-49.0 ft. Borehole advanced with 10.25 in. ID hollow stem augers 49.0-54.0 ft. Borehole advanced with 9 7/8 in. bit using mud rotary then 6 in. steel casing grouted into annulas with neat cement Bedrock encountered @ 48.5 ft.
50															
52															
54	405.50 54.00 54.0-67.5 ft. Fresh, medium to thinly bedded, pale yellowish brown (10YR 6/2), very fine grained, weak, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)		405.50 54.00												5/18/95 @ 8:15 Began coring
56				1	93%			56	J,PL,SM,Fe						
									J,PL,SM						
									J,ST,SM						
58								58	J,C,SM,Fe						
	400.50 59.00		400.10 59.40												5/18/95 @ 8:40 End of Run 1
									B,PL,SM						
60															
62	62.3-69.5 ft. Grain size is medium grained			2	89%				J,PL,SM (2)						
									J,PL,SM						
64															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/20/95

Golder Associates

RECORD OF DRILLHOLE PZ-205-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/17/95 - 5/19/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N. 1067483.54
AZIMUTH: 0

COLLAR ELEV: 459.5
E: 515477.78
INCLINATION: -90

ROCK TYPE: J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation; PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular; P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough; Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DISCONTINUITY DATA

DEPTH SCALE (Feet)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
64	54.0-67.5 ft. Fresh, medium to thinly bedded, pale yellowish brown (10YR 6/2), very fine grained, weak, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)				J,PL,R	
	65.0-75.9 ft. Scattered chert nodules				B,PL,SM (2)	
66	65.8-66.0 ft. Claystone layer				J,PL,SM,Fe	
			2	99%		
68	67.5-99.5 ft. Fresh, medium to thinly bedded, pale yellowish brown (10YR 6/2), very fine grained, weak, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic					5/18/95 @ 10:40 End of Run 2
		390.10			J,PL,R,Fe	
		69.40			J,PL,R	
70	69.8-75.9 ft. Very fine to microcrystalline zones of thinly laminated layers of clay within the limestone, color is medium light gray (N6)				J,PL,R (2)	
					J,I,R	
72			3	100 %		
					J,PL,R	
					J,I,R	
74						5/18/95 @ 11:45 End of Run 3 Ended drilling for the day due to bad weather. 5/19/95 @ 7:40 Began drilling
		385.00			J,I,R (3)	
		74.50			J,PL,R	
					J,PL,R,Fe	
76					J,PL,R	
	76.6-77.4 ft. Argillaceous layer					
			4	100 %	J,PL,R	
78					J,I,R	
	78.7-80.0 ft. Argillaceous zone, unfilled vugs (1-3 mm. in diameter)				J,PL,R	
					J,PL,R (2)	
80						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/20/95

Golder Associates

RECORD OF DRILLHOLE PZ-205-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2846
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/17/95 - 5/19/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1087483.54
AZIMUTH: 0

COLLAR ELEV: 459.5
E: 515477.78
INCLINATION: -90

ROCK TYPE: J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation; PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular; P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough; Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DISCONTINUITY DATA: DIP wrt CORE AXIS 0 30 60 90

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
80	67.5-99.5 ft. Fresh, medium to thinly bedded, pale yellowish brown (10YR 6/2), very fine grained, weak, LIMESTONE. (ST. LOUIS FORMATION) Stylolitic				J,PL,R (2)	
					J,PL,R	
82	81.8-86.4 ft. Argillaceous zone, unfilled vugs, (1-3 mm. in diameter)		4	100 %		
					J,PL,R	
84					J,PL,R	5/19/95 @ 9:15 End of Run 4
	84.5-86.4 ft. Color grades to light olive gray (5GY 6/1)	375.00 / 84.50			J,PL,R	
86					B,PL,SM	
					J,PL,SM	
					J,PL,SM	
					J,C,SM	
					J,PL,R	
88	88.6-93.8 ft. Argillaceous, vuggy, color is light olive gray (5GY 6/1)					
			5	100 %		
90						
92					B,PL,SM	
94						5/19/95 @ 10:40 End of Run 5
	94.5-97.5 ft. Argillaceous, color is light olive gray (5GY 6/1)	365.00 / 94.50				
			6	100 %	J,PL,SM	
96						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/20/95

Golder Associates

RECORD OF DRILLHOLE PZ-205-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 5/17/95 - 5/19/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1087483.54
AZIMUTH: 0

COLLAR ELEV: 459.5
E: 515477.78
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD 80 60 40 20	FRACTURES PER FOOT 2 4 6 8 10	DISCONTINUITY DATA: DIP wrt CORE AXIS 0 30 60 90	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX: FR SW MW HW CW	STRENGTH INDEX: R6 R5 R4 R3 R2 R1	POINT LOAD INDEX (psi): R1 30 R2 150 R3 300 R4 600 R5 1500 R6	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
96	67.5-99.5 ft. Fresh, medium to thinly bedded, pale yellowish brown (10YR 6/2), very fine grained, weak, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic														
	97.5-99.5 ft. Thin clay laminae			6	100 %				J,I,R,Fe						
98									J,PL,SM,CL						
			360.00						J,I,R						5/19/95 @ 11:30 Finished drilling
	End of Record of Drillhole at 99.5 ft. 99.50		99.50												
100															
102															
104															
106															
108															
110															
112															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

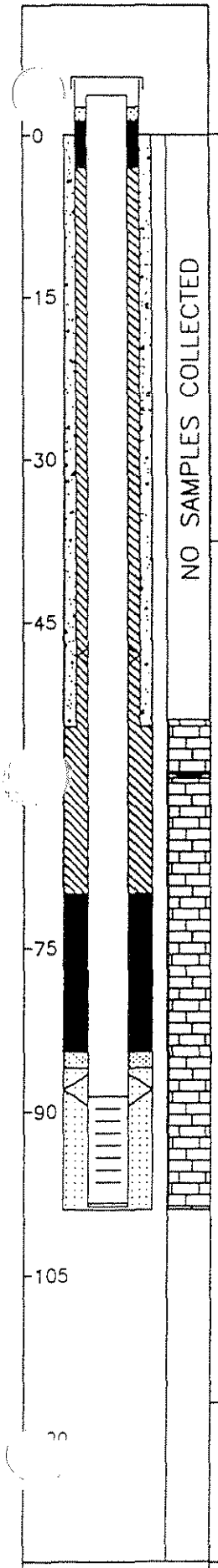
LOGGED: D. ALLOWAY
CHECKED: B. TILTON
DATE: 6/20/95

Golder Associates

Well No. PZ-205-SS

Boring No. X-Ref: PZ-205-SS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1067484 ft. Easting: 515478 ft.

Elevation Ground Level 459.5 ft. NGVD

Top of PVC Casing 461.78 ft. NGVD

Drilling Summary:

Total Depth 99.0 ft.

Borehole Diameter 9 3/4 in. (0.0-54.0 ft.) 5 7/8 in. (54.0-99.0 ft.)

Casing Stickup Height 1.66 ft.

Driller Layne-Western, St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit and 9 3/4 in. Tricone Bit

Drilling Fluid Auger-None, NX Core Water, Air and Mud Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	5/18/95	8:15	5/19/95	11:30
Schramm Rotary	5/21/95	13:30	5/21/95	14:30
Geophys.Logging:				
Casing:				
2" PVC	5/21/95	14:25	5/21/95	14:30
6" Steel	5/11/95	7:30	5/11/95	11:00
Filter Placement:	5/21/95	14:40	5/21/95	15:15
Cementing:				
Development				
Bentonite Grout	5/21/95	15:20	5/21/95	15:35
Bentonite Seal	5/21/95	15:15	5/21/95	15:20

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.66	-	88.57	C1	461.78	-	370.96
88.57	-	98.37	S1	370.96	-	361.16
98.37	-	98.70	C2	361.16	-	360.83
+ 1.00	-	54.00	C3	460.50	-	405.53
	-				-	
	-				-	

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.) (C3-see comments)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 86.0-99.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 84.5-86.0 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-70.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 70.0-84.5 ft.

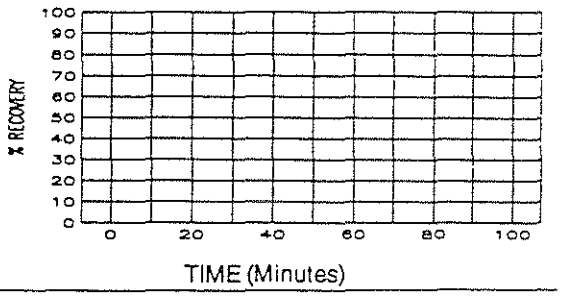
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments: Surface Casing C3: 6 1/8 in. ID / 6 5/8 in. OD Steel Casing

Supervised by W. Herst

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ205SS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122506	CHECK NO.
ROUTE	TRANSMITTAL NO
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME	WELL NUMBER
LAIDLAW BRIDGETON SANITARY LANDFILL	PZ-20555

SITE ADDRESS	CITY	STATE	ZIP CODE
ST. CHARLES ROCK RD.	BRIDGETON	MO	63044

NAME	TELEPHONE
LAIDLAW WASTE SYSTEMS, INC.	314-241-3710

ADDRESS	CITY	STATE	ZIP CODE
1838 N. BROADWAY	ST. LOUIS	MO	63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

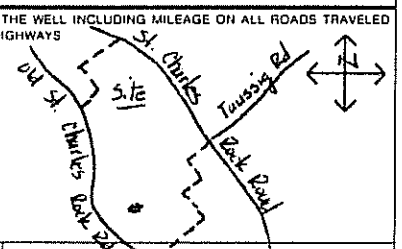
COUNTY ST. LOUIS
ELEVATION 454.5
AREA NO

SMALLEST ¼ LARGEST ¼

SEC. TWN. 47 N.RNG. 5 E OR W

LAT. 38 ° 45 ' 35 " LONG. 90 ° 36 ' 45 "

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN CO., INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN CO., INC.

TYPE OF INSTALLATION
☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT
461.8

MEASURING POINT IS
☒ TOP OF RISER PIPE
☐ OTHER

DRILLING EQUIPMENT
☐ AIR ROTARY ☐ AUGER TYPE
☐ REVERSE ROTARY ☐ OTHER

CENTRALIZERS USED
☒ YES, AT 4 TOTAL
☒ STAINLESS STEEL
☐ OTHER
☐ NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
5-21-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR) Michael P. Vogt

PERMIT NUMBER	DATE
001256 VIM	6-02-95

SIGNATURE (DRILLING CONTRACTOR) Michael P. Vogt

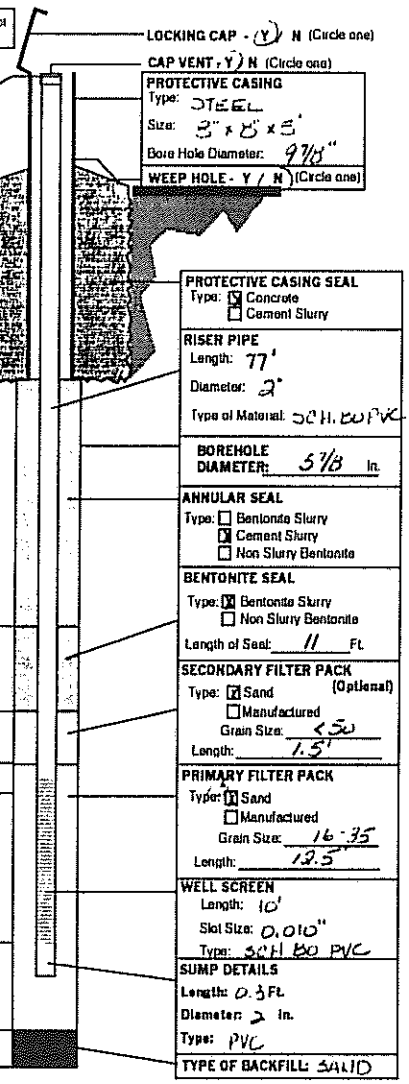
PERMIT NUMBER	DATE
001256 VIM	6-02-95

NOTE: Record the fraction of a foot in decimal, not in inches.

Top of Riser Elevation: 461.8

Ground Surface Elevation: 454.5

	Feet from Surface	Description of Formation
Information in this column to be supplied in the Feet from Surface column		
Depth to bottom of Protective Casing Seal:	3.0	
		50-85 Limestone
Depth to Base of Annular Seal:	60.0	
Depth to Base of Bentonite Seal:	71.0	
Depth to Base of Secondary Filter Pack:	72.5	
Depth to Top of the Screen:	74.7	
Depth to Bottom of the Screen:	84.7	
Plug Back Total Depth:		
Original Total Depth:	85.0	



LOCKING CAP - (Y) N (Circle one)
CAP VENT - (Y) N (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 3" x 8' x 5'
Bore Hole Diameter: 9 7/8"
WEEP HOLE - Y / N (Circle one)

PROTECTIVE CASING SEAL
Type: ☒ Concrete ☐ Cement Slurry

RISER PIPE
Length: 77'
Diameter: 2"
Type of Material: SCH. 80 PVC

BOREHOLE DIAMETER: 5 7/8 in.

ANNULAR SEAL
Type: ☐ Bentonite Slurry ☒ Cement Slurry ☐ Non Slurry Bentonite

BENTONITE SEAL
Type: ☒ Bentonite Slurry ☐ Non Slurry Bentonite
Length of Seal: 11 Ft.

SECONDARY FILTER PACK (Optional)
Type: ☒ Sand ☐ Manufactured
Grain Size: <50
Length: 1.5'

PRIMARY FILTER PACK
Type: ☒ Sand ☐ Manufactured
Grain Size: 16-35
Length: 12.5'

WELL SCREEN
Length: 10'
Slot Size: 0.010"
Type: SCH. 80 PVC

SUMP DETAILS
Length: 0.3 Ft.
Diameter: 2 in.
Type: PVC

TYPE OF BACKFILL: SOLID

MO 780-1415 (2-94) DISTRIBUTION: WHITE-DIVISION CANARY-MONITORING WELL CONTRACTOR PINK-OWNER

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-206-SS
LAIDLAW\RI-FS\MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	SHEET 1 OF 3
	WATER LEVEL / TIME / DATE / CASING DEPTH	DRILLING START: TIME 14:30, DATE 3/9/95; FINISH: TIME 8:50, DATE 3/10/95
NORTHING: 1068030.83 DATUM EASTING: 515809.45 ELEVATION 458.4		
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS Wet to muddy sand adjacent to access road; no vegetation.	
ANGLE VERTICAL BEARING		
SAMPLE HAMMER		

DRILLING CONTR LAYNE-WESTERN

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1	23, 29, 20, 22	0.8' / 2.0' (40%)			(0.0-6.0 Ft.) Dense, medium light gray (N6), LIMESTONE GRAVEL and SAND, SR, dry, (GP), (FILL)	SP 1	
2, 3	3, 15, 10, 30	0.9' / 2.0' (45%)				SP 2	
4, 5	33, 25, 16, 18	0.1' / 2.0' (5%)			(452.4) 6.0	SP 3	
6, 7	6, 5, 3, 4	0.4' / 2.0' (20%)			(6.0-15.6 Ft.) Firn, moderate yellowish brown (10YR 5/4), CLAYEY SILT, little fine sand, iron stained, laminated, NR, damp, (CL-ML), (LOESS)	SP 4	
8, 9	3, 3, 3, 5	0.9' / 2.0' (45%)				SP 5	
10, 11	2, 2, 3, 4	1.1' / 2.0' (55%)				SP 6	
12, 13	1, 2, 3, 3	1.6' / 2.0' (80%)			@ 12.7 Ft., becoming moist @ 13.2-13.3 Ft., medium dark gray (N4), SILTY CLAY	SP 7	
14	2, 3, 5, 3	0.8' / 2.0' (40%)				SP 8	

LOGGED BY M. HIRT
DATE 3/9/95
CHK'D BY W. HERST
JOB NO.: 943-2848
FILENAME: PZ206SS

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-206-SS
LAIDLAW\RI-FS\MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	SHEET 2 OF 3
	WATER LEVEL / TIME / DATE / CASING DEPTH	DRILLING START TIME 14:30 DATE 3/9/95; FINISH TIME 8:50 DATE 3/10/95
NORTHING: 1068030.83 DATUM EASTING: 515809.45 ELEVATION 458.4		
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS Wet to muddy sand adjacent to access road; no vegetation.	
ANGLE VERTICAL BEARING		
SAMPLE HAMMER		

DRILLING CONTR LAYNE-WESTERN

DEPTH IN FEET (ELEVATION)	BLOW/6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
					(6.0-15.6 ft.) Firm, moderate yellowish brown (10YR 5/4), CLAYEY SILT, little fine sand, iron stained, laminated, NR, damp, (CL-ML), (LOESS) (442.8) 15.6	SP 8	
16	1 2 5 7	1.2'/2.0' (60%)			(15.6-17.6 ft.) Firm, dark gray (N3), SILTY CLAY, damp, (CL), (LOESS)	SP 9	
17					(440.8) 17.6		
18	1 3 3 4	2.0'/2.0' (100%)			(17.6-18.0 ft.) Stiff, olive gray (5Y 4/1), CLAY, little silt, NR, moist, (CL), (LOESS) (18.0-22.8 ft.) Firm, olive gray (5Y 4/1), CLAYEY SILT, trace fine sand, NR, moist, (CL-ML), (LOESS)	SP 10	
19							
20	hammer weight 2 4 4	1.7'/2.0' (85%)				SP 11	
21							
22	2 2 2 3	1.5'/2.0' (75%)			@ 22.0 ft., becoming some fine sand	SP 12	
23					(22.8-29.7 ft.) Firm, light olive gray (5Y 5/2), CLAYEY SILT, iron stained, laminated, NR, moist, (CL-ML), (LOESS)		
24	3 2 3 5	1.5'/2.0' (75%)			@ 24.5-24.8 ft., some sand, wet	SP 13	
25					@ 25.2-25.4 ft., some sand, wet		
26	1 1 5 5	1.2'/2.0' (60%)				SP 14	
27					@ 27.2-29.7 ft., wet @ 27.4-27.6 ft., fine to medium sand layers		
28	1 2 3 3	1.7'/2.0' (85%)			@ 28.6-29.7 ft., little sand	SP 15	
29					(29.7-31.3 ft.) Firm, medium dark gray (N4), CLAYEY SILT, NR, damp, (CL-ML), (LOESS)		

LOGGED BY M. HIRT
DATE 3/9/95
CHK'D BY W. HERST
JOB NO.: 943-2808
FILENAME: PZ206SS

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	LAIDLAW\RI-FS\MO WEST LAKE LANDFILL OPERABLE UNIT 2
DRILLING METHOD:	6.25 inch I.D. Hollow Stem Auger
SAMPLING METHOD:	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)
BORING NO.	PZ-206-SS
SHEET	3 OF 3
DRILLING START TIME	14:30
DRILLING FINISH TIME	8:50
DRILLING START DATE	3/9/95
DRILLING FINISH DATE	3/10/95
WATER LEVEL / TIME / DATE / CASING DEPTH	
NORTHING: 1068030.83	
DATUM EASTING: 515809.45	ELEVATION 458.4
DRILL RIG	CME 75 - TRUCK MOUNT
ANGLE	VERTICAL
BEARING	
SAMPLE HAMMER	
SURFACE CONDITIONS	Wet to muddy sand adjacent to access road; no vegetation.

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
31	1 4 12 16	1.8'/2.0' (90%)	(29.7-31.3 Ft.) Firm, medium dark gray (N4), CLAYEY SILT, NR, damp, (CL-ML), (LOESS) @ 31.1-31.3 ft., wet (427.1) 31.3	SP 16	
32	2 6 7 8	2.0'/2.0' (100%)	(31.3-36.9 Ft.) Compact to loose, moderate to dark yellowish brown (10YR 5/4-10YR 4/2), f-m SAND, trace silt, NR, wet, (SP), (ALLUVIAL)	SP 17	Split spoon wet
34	0 2 2 4	2.0'/2.0' (100%)	@ 34.0 Ft., becoming medium sand	SP 18	Split spoon wet
36	7 8 7 8	1.3'/2.0' (65%)	@ 35.9-36.9 ft., SAND and CLAY (421.5) 36.9	SP 19	Add water to inside of augers to prevent sand blow
37			(36.9-37.7 Ft.) Stiff, olive gray (5Y 4/1), CLAYEY f-m SAND, NR, MOIST, (SC), (ALLUVIAL) (420.7) 37.7		
38	6 12 14 11	0.7'/2.0' (35%)	(37.7-41.1 Ft.) Stiff, olive gray (5Y 4/1), CLAYEY SILT, trace sand, laminated, NR, wet, (CL-ML), (LOESS)	SP 20	
40	6 7 12 16	1.0'/2.0' (50%)	(417.3) 41.1	SP 21	
42	2 23 50/0"	0.7'/2.0' (35%)	(41.1-43.0 Ft.) Compact, olive gray (5Y 4/1), fine SAND, trace silt, NR, wet, (SM), (ALLUVIAL) (415.4) 43.0	SP 22	Split spoon refusal at 43.0 feet; auger to 44.0 feet
43			End of Soil Borehole Log at 43.0 ft. See PZ-206-SS Record of Drillhole for rock descriptions		
44	50/1"	0.0'/1.0' (0%)		SP 23	Split spoon refusal at 44.0 feet

DRILLING CONTR LAYNE-WESTERN

LOGGED BY M. HIRT

CHK'D BY W. HERST

DATE 3/9/95

JOB NO.: 943-2848

FILENAME: PZ206SS

RECORD OF DRILLHOLE PZ-206-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/5/95 - 4/8/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1060830.8
AZIMUTH: 0

COLLAR ELEV: 458.4
E: 515809.5
INCLINATION: -90

ROCK TYPE

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular

P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough

Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FT)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (20 40 60 80)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP w/t CORE AXIS (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR MW HW CW)	STRENGTH INDEX (R6 R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (RT 30 R2 150 R3 300 R4 600 R5 1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
32	0.0-43.0 ft. See Soil Borehole Log PZ-206-SS														
34															
36															
38															
40															
42															
	415.40														
	43.0-44.5 ft. No samples collected 43.00														Advanced 4" diam. HW casing to 46.0 ft., begin coring on top of rubble at 44.5 ft.
44	413.90		413.90												
	44.5-51.7 ft. Slightly weathered, medium bedded, light olive gray (5Y 6/1), microcrystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) 44.50		44.50												
46	44.5-46.1 ft. Some chlorite on broken surfaces			1	77%				J,I,SM,CL (2)						
									J,I,SM						
									J,U,SM,Fe						
48	47.7-49.4 ft. Moderately weathered, porous/ vuggy								J,I,SM,Fe						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: J. MILLER
DATE: 5/16/95

Golder Associates

RECORD OF DRILLHOLE PZ-206-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2648
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/5/95 - 4/6/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1060830.8
AZIMUTH: 0

COLLAR ELEV: 458.4
E: 515809.5
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
48	44.5-51.7 ft. Slightly weathered, medium bedded, light olive gray (5Y 6/1), microcrystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION)		409.40 / 49.00	1	77%				Core Loss						Core loss due to fractured, weathered rock Core Run 1 at 11:55
50									J,I,SM (6)						
									J,PL,SM						
									J,I,R (2)						
	408.70 / 51.70								J,I,SM						
52	51.7-52.7 ft. Completely weathered, thickly laminated, greenish gray (5GY 6/1), very fine grained, extremely weak, CLAYSTONE, (ST. LOUIS FORMATION) 406.10 / 52.30								J,I,SM,CL						
									Core Loss						Core loss due to presence of weak claystone
	52.7-59.2 ft. Slightly weathered, medium bedded, light olive gray (5Y 5/2), very fine grained, medium strong, DOLOMITE, (ST. LOUIS FORMATION)								J,I,R						
54	54.2-55.3 ft. Moderately weathered, very porous/vuggy. (<1-3 mm.)			2	96%										
									J,I,R						
56															
58			399.40 / 59.00												
	399.20 / 59.20														End Core Run 2 at 14:10 4/5/95 @ 13:15 Begin coring Run 3
60	59.2-66.5 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), f-m grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) 1-2 mm. calcite veins common, stylolitic, few zones showing up to 5 mm. vugs, little pyrite crystals, few Arenaceous Limestone beds throughout up to 10 mm.								J,I,R						
				3	100 %				J,I,R						
62									J,I,R (2)						
									J,I,R						
64			394.40 / 64.00												4/5/95 @ 13:40 Begin coring Run 4

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: J. MILLER
DATE: 5/16/95

Golder Associates

RECORD OF DRILLHOLE PZ-206-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2846
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/5/95 - 4/6/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1060830.6
AZIMUTH: 0

COLLAR ELEV: 458.4
E: 515809.5
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	NOTES WATER LEVELS INSTRUMENTATION
64		394.40 / 64.00				4/5/95 @ 13:40 Begin coring Run 4
	64.5-67.3 ft. Small (up to 1 mm.), glauconite lenses, few pyrite veins <1 mm., but abundant crystals				J,I,CL (3); J,I,R; J,I,R	
66	66.5-68.5 ft. Fresh, thickly bedded, olive gray (5Y 4/1), f-m grained, medium strong, ARENACEOUS LIMESTONE, (ST. LOUIS FORMATION) Abundant calcite crystals <1 mm.				J,I,R (2)	
68	66.6 ft. A large >20 mm. calcite crystals				J,I,R	
	68.5-70.0 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), f-m grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)		4	100 %	J,I,CL; J,I,CL (2)	
70	Calcite crystals common, argillaceous partings observed 70.2-71.8 ft. Arenaceous Limestone with abundant calcity crystals					
72	71.8-80.0 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), f-m grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Calcite crystals common, fossils present but not abundant, stylolitic, pyrite crystals and veins up to 1 mm. abundant	384.40			J,I,R	
74		74.00			J,I,SM,CL; J,I,R; J,I,SM,CL; J,I,R (5)	4/5/95 @ 14:25 Begin coring Run 5
76			5	100 %		
	77.3-77.8 ft. Argillaceous Limestone				J,I,R (2); J,I,SM,CL	
78	77.8-78.1 ft. Chert nodules				J,I,SM,CL (2); J,I,R (2)	
80						

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: J. MILLER
DATE: 5/16/95

Golder Associates

RECORD OF DRILLHOLE PZ-206-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2846
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/5/95 - 4/8/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1060830.8
AZIMUTH: 0

COLLAR ELEV: 458.4
E: 515809.5
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE / DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80	80.0-85.0 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), f-m grained to microcrystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Large calcite veins up to 12 mm., abundant pyrite crystals and veins up to 1 mm., argillaceous partings scattered throughout, stylolitic								J,I,R (2)						
									J,I,SM,CL						
82				5	100 %				J,I,SM,CL						
									J,I,R						
			374.40												
84			84.00												4/5/95 @ 15:24 Begin coring Run 6
	85.0-87.5 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), finely crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolites common, calcite and pyrite veins present, trace of glauconite, few chert nodules								J,I,SM,CL (2)						
86									J,I,R,CL						
	87.5-89.5 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Calcite and pyrite crystals abundant, few calcite veins <1 mm.								J,I,R						
88				6	100 %										
	89.5-93.3 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained to crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Calcite and pyrite crystals abundant, few calcite veins <1 mm.								J,I,R						
90									J,I,R,CL						
									J,I,R,CL						
92									J,I,CL (2)						
	93.3-99.1 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Stylolitic, bioturbated, abundant calcite veins up to 1 mm., few pyrite crystals		364.40												
94			94.00												4/5/95 @ 16:16 Begin coring Run 7
				7	100 %										
96															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: J. MILLER
DATE: 5/16/95

Golder Associates

RECORD OF DRILLHOLE PZ-206-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/5/95 - 4/6/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1060830.8
AZIMUTH: 0

COLLAR ELEV: 456.4
E: 515609.5
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
96	93.3-99.1 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Stylolitic, bioturbated, abundant calcite veins up to 1 mm., few pyrite crystals							J,I,R					
98													
100	99.1-102.5 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained to crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Abundant argillaceous partings, calcite veins up to 10 mm., pyrite crystals scattered		7	100 %				J,I,R,CL					
								J,I,R					
102	102.5-105.0 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic, calcite and pyrite crystals common, small <2 mm. vugs/porous, calcite veins <1 mm. scattered							J,I,R,CL					4/5/95 @ 17:00 Stop coring for the day
		354.40 / 104.00											4/6/95 @ 8:13 Begin coring Run 8
104													
106	105.0-108.0 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), f-m grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic, abundant calcite and pyrite veins up to 2 mm., fossiliferous, argillaceous partings common, few large crystals of calcite up to 8 mm.		8	100 %				J,I,R,CL (2)					
								J,I,R					
								J,I,R					
								J,I,R,CL					
108	108.0-113.0 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), micro-crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic abundant calcite and pyrite veins, chert nodules common							J,I,R					4/6/95 @ 9:17 Begin coring Run 9
		349.40 / 109.00											
								J,I,SM,CL					
110	109.4-110.1 ft. Bed of bluish green, clayey material, foliated, intra-clasts of Limestone		9	97%				J,I,SM,CL					
								J,I,SM,CL (2)					
								J,I,R					
112													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: S. COSIO
CHECKED: J. MILLER
DATE: 5/16/95

Golder Associates

RECORD OF DRILLHOLE PZ-206-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 4/5/95 - 4/6/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1060830.8
AZIMUTH: 0

COLLAR ELEV: 458.4
E: 515809.5
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-Fe Oxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH (FT)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
112									J,I,SM,CL						
	113.0-117.0 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Banded with fine to medium grained Limestone up to 8 mm. thick, calcite crystals and veins up to 1 mm. present, stylolites rare but present														
114									J,I,R,CL						
									J,I,R,CL						
				8	97%										
116															
	341.40														
	117.0-120.7 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic, fossiliferous, pyrite and calcite veins common, oolitic, fossils are brachiopods and crinoids. Argillaceous partings from 119.0-119.7 ft.		117.00												117.0 ft. Inferred top of SALEM FORMATION encountered
118									J,I,R,CL						
			339.40												
			119.00												4/6/95 @ 10:23 Begin coring Run 10
									J,I,R,CL						
120															
	120.7-122.5 ft. Fresh, thickly bedded, olive gray (5Y 6/1), fine grained, strong, ARGILLACEOUS LIMESTONE, (SALEM FORMATION) Abundant argillaceous partings and calcite crystals, partings appear like spider form														
122				10	98%										
	122.5-125.0 ft. Fresh, thickly bedded, light olive gray (5Y 6/1), fine grained, medium strong, LIMESTONE, (SALEM FORMATION) Beds of chert up to 60 mm., stylolitic, abundant argillaceous partings								J,I,R,CL						
									J,I,R						
									J,I,R,CL						
124									J,I,R						
									J,I,R (2)						4/6/95 @ 11:05 Coring completed
	333.40		333.40												
	End of Record of Drillhole at 125.0 ft.		125.00												
126															
128															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

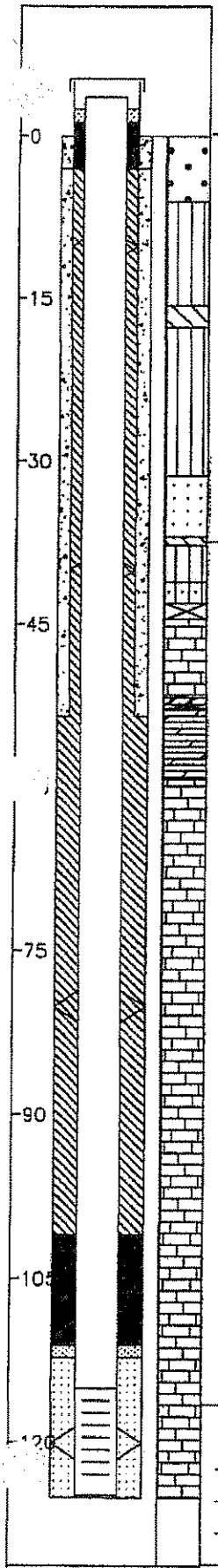
LOGGED: S. COSIO
CHECKED: J. MILLER
DATE: 5/16/95

Golder Associates

Well No. PZ-206-SS

Boring No. X-Ref: PZ-206-SS

PIEZOMETER CONSTRUCTION SUMMARY



Not to Scale

Survey Coords: Northing: 1068031 ft. Easting: 515809 ft.

Elevation Ground Level 458.4 ft. NGVD

Top of PVC Casing 460.20 ft. NGVD

Drilling Summary:

Total Depth 125.5 ft.

Borehole Diameter 10 in. (0.0-52.0 ft.) 5 7/8 in. (52.0-125.5 ft.)

Casing Stickup Height 1.82 ft.

Driller Layne-Western St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 6 1/4 in. and 10 1/4 in. ID Hollow Stem Auger Bits, NX Core, 5 7/8 in. and 10 in. Button Bits

Drilling Fluid Auger-None, NX Core Water, Air Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	3/9/95	14:30	3/10/95	11:05
Schramm Rotary	4/24/95	11:30	4/24/95	13:30
Geophys.Logging:				
Casing:				
2" PVC	4/24/95	13:45	4/24/95	14:02
6" Steel	3/27/95	9:30	3/23/95	10:15
Filter Placement:	4/24/95	14:00	4/24/95	14:15
Cementing:				
Development				
Bentonite Grout	4/24/95	14:20	4/24/95	15:30
Bentonite Seal	4/24/95	14:10	4/24/95	14:20

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.82	-	115.00	C1	460.20	-	343.38
115.00	-	124.80	S1	343.38	-	333.58
124.80	-	125.00	C2	333.58	-	333.38
+ 0.70	-	52.00	C3	459.10	-	406.38

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.) (C3-see comments)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 112.2-125.5 ft.

Filter Pack: Less than 50 mesh Silica Sand, 111.1-112.2 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-101.0 ft., Neat cement, 3.0-52.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 101.0-111.1 ft.

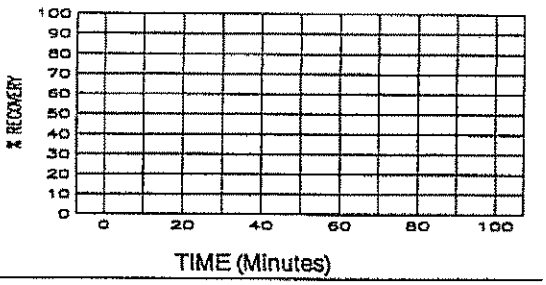
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments: Surface Casing C3: 6 1/8 in. ID / 6 5/8 in. OD Steel Casing

Supervised by D. Alloway

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ206SS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF. NO 115096	CHECK NO.
ROUTE	TRANSMITTAL NO
STATE WELL NUMBER	CROSS REFERENCE NO.
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME: LAIDLAW BRIDGETON SANITARY LANDFILL
WELL NUMBER: PZ-206-55
SITE ADDRESS: ST. CHARLES ROCK RD.
CITY: BRIDGETON
STATE: MO.
ZIP CODE: 63044
NAME: LAIDLAW WASTE SYSTEMS, INC
TELEPHONE: 314-241-3710
ADDRESS: 1888 N. BROADWAY
CITY: ST. LOUIS
STATE: MO
ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

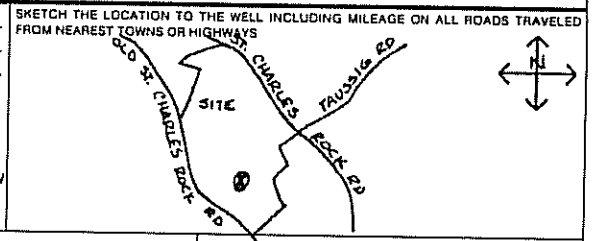
COUNTY: ST. LOUIS
ELEVATION: 458.4
AREA NO.

SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST ¼

SEC. ____ TWN. 47 N.RNG. 5 E OR W

LAT. 38 - 46 - 00 - LONG. 90 - 26 - 40 -

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME: LAYNE WESTERN CO., INC.

DRILLING CONTRACTOR'S NAME: LAYNE WESTERN CO., INC.

NOTE: Record the fraction of a foot in decimal, not in inches

Top of Riser Elevation: 460.2

LOCKING CAP - Y / N (Circle one)
CAP VENT - Y / N (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8" x 5" x 5'
Bore Hole Diameter: 10.75"
WEEP HOLE - Y / N (Circle one)

Ground Surface Elevation: 458.4 Ft.

Feet from Surface	Description of Formation
Information in this column to be supplied in the Feet from Surface column	0-6 Fill
Depth to bottom of Protective Casing Seal: 3.0	6-16 Clayey silt
	16-32 Sand
	32-37.5 Sandy clay
	37.5-41 Silt
	41-43.5 Sandy silt
Depth to Base of Annular Seal: 101.0	43.5-125.5 Limestone
Depth to Base of Bentonite Seal: 111.1	
Depth to Base of Secondary Filter Pack: 112.2	
Depth to Top of the Screen: 115.2	
Depth to Bottom of the Screen: 125.2	
Plug Back Total Depth	
Original Total Depth: 125.5	

PROTECTIVE CASING SEAL
Type: [X] Concrete [ ] Cement Slurry

RISER PIPE
Length: 117.0'
Diameter: 2"
Type of Material: SCH. 80 PVC

BOREHOLE DIAMETER: 5 7/8 in.

ANNULAR SEAL
Type: [X] Bentonite Slurry [ ] Cement Slurry [ ] Non Slurry Bentonite

BENTONITE SEAL
Type: [X] Bentonite Slurry [ ] Non Slurry Bentonite
Length of Seal: 10.1 Ft.

SECONDARY FILTER PACK (Optional)
Type: [X] Sand [ ] Manufactured
Grain Size: SUGAR 1 x 50
Length: 1.1'

PRIMARY FILTER PACK
Type: [X] Sand [ ] Manufactured
Grain Size: 16-35
Length: 13.3'

WELL SCREEN
Length: 10'
Slot Size: 0.010"
Type: SCH 80 PVC

SUMP DETAILS
Length: 0.3 Ft.
Diameter: 2 in.
Type: PVC

TYPE OF BACKFILL: SAND

TYPE OF INSTALLATION
[X] ABOVE GROUND [ ] FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT: 460.20

MEASURING POINT IS
[X] TOP OF RISER PIPE
[ ] OTHER

DRILLING EQUIPMENT
[X] AIR ROTARY [X] AUGER TYPE 6¼ HSA
[ ] REVERSE ROTARY [ ] OTHER

CENTRALIZERS USED
[X] YES, AT 4 TOTAL
[X] STAINLESS STEEL
[ ] OTHER
[ ] NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED: 4-24-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR): Richard P. Vogt
PERMIT NUMBER: 001256WM1 DATE: 5-10-95
SIGNATURE (DRILLING CONTRACTOR): Richard P. Vogt
PERMIT NUMBER: 001256WM1 DATE: 5-10-95

MO 780-1415 (2-94)

DISTRIBUTION: WHITE/DIVISION CANARY/MONITORING WELL CONTRACTOR PINK/OWNER

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2
DRILLING METHOD:	4.25 inch I.D. Hollow Stem Auger
BORING NO.	PZ-207-AS
SHEET	1 OF 3
SAMPLING METHOD:	SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)
DRILLING START TIME	12:35
DRILLING FINISH TIME	17:42
DRILLING START DATE	4/9/95
DRILLING FINISH DATE	4/9/95
WATER LEVEL / TIME / DATE / CASING DEPTH	
NORTHING	1069644.67
DATUM EASTING	516037.64
ELEVATION	461.9
DRILL RIG	CME 75 - TRUCK MOUNT
ANGLE	VERTICAL
BEARING	NA
SAMPLE HAMMER	140 lbs.
SURFACE CONDITIONS	

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1	3 50/6"	0.0'/2.0' (0%)			(0.0-2.0 ft.) Concrete	SP 1	
2 (459.9)	11 10 7 6	1.1'/2.0' (55%)			(2.0-4.0 ft.) Very stiff, mottled, moderate yellowish brown (10YR 5/4) to dark greenish gray (5GY 4/1), SILT, NR, damp, (ML), (LOESS)	SP 2	
4 (457.9)	3 4 5 6	1.5'/2.0' (75%)			(4.0-5.8 ft.) Stiff, dark greenish gray (5GY 4/1), CLAYEY SILT, some fine Gravel, mottled, NR, damp, (CL-ML), (LOESS)	SP 3	
6 (456.1)	16 4 1 2	0.1'/2.0' (5%)			(5.8-12.0 ft.) Waste	SP 4	
8	3 3 7 8	0.1'/2.0' (5%)				SP 5	
10	5 2 4 23	0.3'/2.0' (15%)			below 9.5 ft., waste becomes wet	SP 6	First water encountered @ 9.5 ft.
12 (449.9)	4 14 18 3	0.7'/2.0' (35%)			(12.0-12.7 ft.) Hard, dark greenish gray (5GY 4/1), CLAY, trace fine Gravel, NR, wet, (CL), (FILL) (449.2) 12.7 (12.7-14.0 ft.) Waste	SP 7	
14	4 6 1 4	0.0'/2.0' (0%)			(14.0-16.0 ft.) No Recovery	SP 8	From 14.0-20.0 ft., no samples recovered, but drilling indicates waste

DRILLING CONTR LAYNE-WESTERN

LOGGED BY S. COSIO CHK'D BY W. HERST

DATE 6/1/95

JOB NO.: 943-2848

FILENAME: PZ207AS

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-207-AS
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	SHEET 2 OF 3
		DRILLING START TIME 12:35 DATE 4/9/95; FINISH TIME 17:42 DATE 4/9/95
NORTHING: 1069644.67 DATUM EASTING: 516037.64 ELEVATION 461.9	WATER LEVEL / TIME / DATE / CASING DEPTH	
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS	
ANGLE VERTICAL BEARING NA		
SAMPLE HAMMER 140 lbs.		

DRILLING CONTR LAYNE-WESTERN

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
					(12.7-20.0 ft.) Waste	SP 8	
16	3 1 5 7	0.0'/2.0' (0%)			(16.0-18.0 ft.) No Recovery	SP 9	
17							
18	4 5 6 11	0.0'/2.0' (0%)			(18.0-20.0 ft.) No Recovery	SP 10	
19							
20	6 5 5 6	1.0'/2.0' (50%)			(441.9) 20.0 (20.0-20.4 ft.) Stiff, dark greenish gray (5GY 4/1), SILT, trace Fine Gravel, NR, wet, (ML), (FILL) (441.5) 20.4 (20.4-20.6 ft.) Loose, dark greenish gray (5GY 4/1), Fine SAND, NR, wet, (SW), (FILL) (441.3) 20.6	SP 11	
21							
22	10 18 8 4	0.9'/2.0' (45%)			(20.6-22.0 ft.) Waste (22.0-24.0 ft.) No Recovery	SP 12	from 22.0-28.0 ft., no samples recovered, but drilling indicates waste
23							
24	3 3 3 18	0.0'/2.0' (0%)			(24.0-26.0 ft.) No Recovery	SP 13	
25							
26	30 31 14 5	0.0'/2.0' (0%)			(26.0-28.0 ft.) No Recovery	SP 14	
27							
28	1 9 10 5	0.6'/2.0' (30%)			(433.9) 28.0 (28.0-32.0 ft.) Firm to very stiff, greenish black (5G 4/1) to dusky blue-green (5BG 3/2), SILT, little Sand and Gravel, NR, wet, (ML), (FILL)	SP 15	
29							

LOGGED BY S. CUSIO
DATE 6/1/95
CHK'D BY W. HERST
JOB NO.: 943-2848
FILENAME: PZ207AS

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-207-AS
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	SHEET 3 OF 3
		DRILLING START TIME 12:35 DATE 4/9/95 / FINISH TIME 17:42 DATE 4/9/95
NORTHING: 1069644.67 DATUM EASTING: 516037.64 ELEVATION 461.9	WATER LEVEL / TIME / DATE / CASING DEPTH	
DRILL RIG CME 75 - TRUCK MOUNT	SURFACE CONDITIONS	
ANGLE VERTICAL BEARING NA		
SAMPLE HAMMER 140 lbs.		

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
31	4 1 4 4	0.1' / 2.0' (5%)			(28.0-32.0 ft.) Firm to very stiff, greenish black (5G 4/1) to dusky blue-green (5BG 3/2), SILT, little Sand and Gravel, NR, wet, (ML), (FILL) (429.9) 32.0	SP 16	
32	3 10 15 20	1.1' / 2.0' (55%)			(32.0-40.0 ft.) Very loose to compact, dark greenish gray (5GY 4/1), Fine SAND, NR, wet, (SW), (ALLUVIUM)	SP 17	
34	10 8 18 15	1.3' / 2.0' (65%)				SP 18	
36	0 0 0 0	2.0' / 2.0' (100%)				SP 19	
38	1 4 5 7	0.5' / 2.0' (25%)			(421.9) 40.0	SP 20	
40					End of Soil Borehole Log at 40.0 ft.		
41							
42							
43							
44							

DRILLING CONTR LAYNE-WESTERN

LOGGED BY S. COSIO CHK'D BY W. HERST

DATE 6/1/95

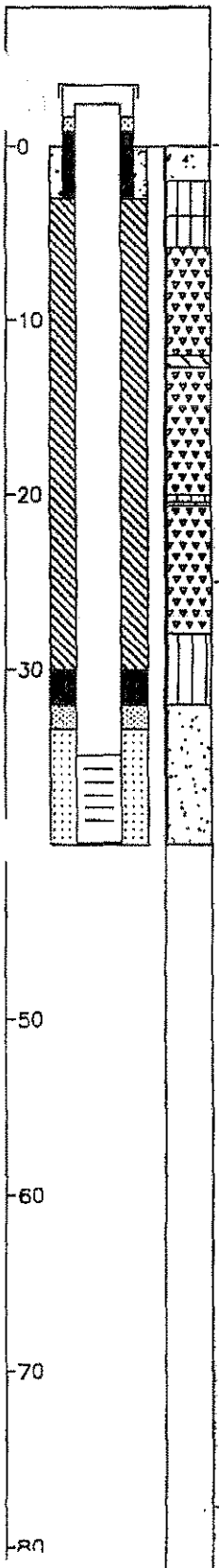
JOB NO.: 943-2848

FILENAME: PZ207AS

Well No. PZ-207-AS

Boring No. X-Ref: PZ-207-AS

PIEZOMETER CONSTRUCTION SUMMARY



Survey Coords: Northing: 1069645 ft. Easting: 516038 ft.

Elevation Ground Level 461.9 ft. NGVD

Top of PVC Casing 463.57 ft. NGVD

Drilling Summary:

Total Depth 40.0 ft.

Borehole Diameter 8 1/4 in.

Casing Stickup Height 1.69 ft.

Driller Layne-Western St. Louis, MO

Rig CME 75

Bit(s) 6 1/4 in. ID Hollow Stem Auger Bit,

Drilling Fluid Auger-None

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	4/9/95	12:35	4/9/95	17:45
Schramm Rotary				
Geophys.Logging:				
Casing:	4/10/95	9:45	4/10/95	10:00
Filter Placement:	4/10/95	10:00	4/10/95	10:17
Cementing:				
Development				
Bentonite Grout	4/10/95	10:35	4/10/95	11:10
Bentonite Seal	4/10/95	10:32	4/10/95	10:35

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.69	-	34.90	C1	463.57	-	428.98
34.90	-	39.70	S1	428.98	-	422.18
39.70	-	40.03	C2	422.18	-	421.85

Casing: C1 2 in. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 in. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 33.4-40.0 ft.

Filter Pack: Less than 50 mesh Silica Sand, 32.0-33.4 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-20.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 20.0-32.0 ft.

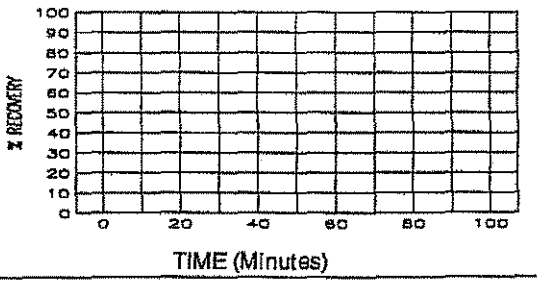
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Not to Scale

Supervised by S. Cosio

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ207AS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122486	CHECK NO
ROUTE	TRANSMITTAL NO
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME: LAIDLAW BRIDGETON SANITARY LANDFILL		WELL NUMBER: PZ-207-AS	
SITE ADDRESS: St. CHARLES ROCK RD.	CITY: BRIDGETON	STATE: MO	ZIP CODE: 63044
NAME: LAIDLAW WASTE SYSTEMS, INC.		TELEPHONE: 314-241-3710	
ADDRESS: 1222 N BROADWAY	CITY: ST LOUIS	STATE: MO	ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

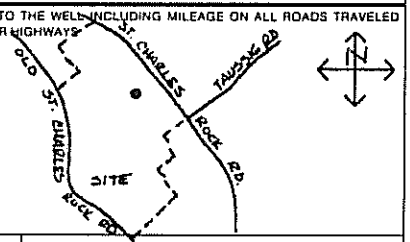
COUNTY: ST. LOUIS
ELEVATION: 460.7
AREA NO.

SMALLEST ¼ ____ ¼ ____ ¼ ____ ¼ LARGEST ¼

SEC. ____ TWN. 47 N.RNG. 5 E OR W

LAT. 38 ° 46 ' 06 " LONG. 90 ° 26 ' 38 "

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN Co, INC.

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN Co, INC.

TYPE OF INSTALLATION
☒ ABOVE GROUND ☐ FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT
463.57

MEASURING POINT IS
☒ TOP OF RISER PIPE
☐ OTHER

DRILLING EQUIPMENT
☐ AIR ROTARY ☒ AUGER TYPE 4¼ H.S.A.
☐ REVERSE ROTARY ☐ OTHER

CENTRALIZERS USED
☒ YES, AT 1 TWIN
☒ STAINLESS STEEL
☐ OTHER
☐ NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
4-10-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR)
[signature]
PERMIT NUMBER 001382 WPM DATE 5-10-95

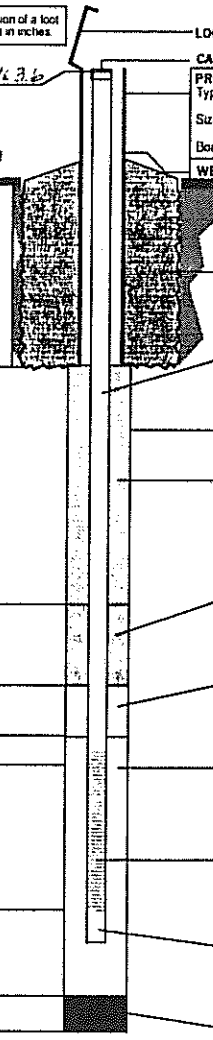
SIGNATURE (DRILLING CONTRACTOR)
[signature]
PERMIT NUMBER 001458 WPM DATE 5-10-95

NOTE: Record the fraction of a foot in decimal, not in inches.

Top of Riser Elevation: 463.6

Ground Surface Elevation: 460.7 Ft

Feet from Surface	Description of Formation
Information in this column to be supplied in the Feet from Surface column	
Depth to bottom of Protective Casing Seal:	
Depth to Base of Annular Seal: 30.0	
Depth to Base of Bentonite Seal: 31.0	
Depth to Base of Secondary Filter Pack: 33.4	
Depth to Top of the Screen: 34.7	
	Alluvium
Depth to Bottom of the Screen: 39.7	
Plug Back Total Depth:	
Original Total Depth: 40.2	



LOCKING CAP - Y / N (Circle one)
CAP VENT - Y / N (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8"x8"x5'
Bore Hole Diameter: 8"

WEEP HOLE - Y / N (Circle one)

PROTECTIVE CASING SEAL
Type: ☒ Concrete ☐ Cement Slurry

RISER PIPE
Length: 36.6'
Diameter: 2"
Type of Material: SCH 80 PVC

BOREHOLE DIAMETER: 8 In.

ANNULAR SEAL
Type: ☒ Bentonite Slurry ☐ Cement Slurry ☐ Non Slurry Bentonite

BENTONITE SEAL
Type: ☒ Bentonite Slurry ☐ Non Slurry Bentonite
Length of Seal: 2 Ft.

SECONDARY FILTER PACK (Optional)
Type: ☒ Sand ☐ Manufactured
Grain Size: SUGAR SAND
Length: 1.4'

PRIMARY FILTER PACK
Type: ☒ Sand ☐ Manufactured
Grain Size: 12-35
Length: 6.8'

WELL SCREEN
Length: 5'
Slot Size: 0.010"
Type: SCH 80 PVC

SUMP DETAILS
Length: 0.3 FT.
Diameter: 2 In.
Type: NC

TYPE OF BACKFILL: SAND

MO 780-1415 (2-94) DISTRIBUTION: WHITE/DIVISION CANARY/MONITORING WELL CONTRACTOR PINK/OWNER

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-208-SS
		SHEET 1 OF 2
LAIDLAW/OU2 RI-FS/MO WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	DRILLING START / FINISH
	WATER LEVEL / TIME / DATE / CASING DEPTH	TIME 8:15 / TIME 9:45
NORTHING: 1069219.14 DATUM EASTING: 517169.45 ELEVATION 472.5		DATE 6/17/95 / DATE 6/17/95

DRILL RIG CME 75 - TRUCK MOUNT
SURFACE CONDITIONS Grass covered lawn
ANGLE BEARING
SAMPLE HAMMER

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1	2 2 2 3	1.1'/2.0' (55%)			(0.0-4.0 ft.) Firm, dark yellowish brown (10YR 4/2), SILT CLAY, trace organics consisting of fine roots, NR, damp, (CL), (TOPSOIL)	SP 1	
2 3	2 2 2 3	1.7'/2.0' (85%)			@ 2.0 ft., color changes to moderate yellowish brown (10YR 5/4)	SP 2	
					(468.5) 4.0		
4 5	2 2 4 4	1.7'/2.0' (85%)			(4.0-7.5 ft.) Loose, moderate yellowish brown (10YR 5/4) to pale yellowish brown (10YR 6/2), CLAYEY SILT, NR, moist, (CL-ML), (LOESS)	SP 3	
6 7	2 3 4 5	0.9'/2.0' (45%)				SP 4	
					(465.0) 7.5		
8 9	2 3 3 4	1.5'/2.0' (75%)			(7.5-15.0 ft.) Loose, pale yellowish brown (10YR 6/2), SILT, trace iron oxide staining, occasional thin, damp, fine sand seams (<1 1/2 in. thick), (ML), (LOESS)	SP 5	
10 11	4 5 3 5	1.9'/2.0' (95%)				SP 6	
12 13	1 2 3 8	0.5'/2.0' (25%)			From 12.0-14.0 ft., little fine sand throughout silt	SP 7	
14	5 6 7 7	1.8'/2.0' (90%)				SP 8	

DRILLING CONTR LAYNE-WESTERN
LOGGED BY J. MILLER
DATE 7/14/95
CHK'D BY W. HERST
JOB NO.: 943-2848
FILENAME: PZ208SS

LAIDLAW
LAIDLAW WASTE SYSTEMS INC.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger	BORING NO. PZ-208-SS
LAIDLAW/OU2 RI-FS/MD WEST LAKE LANDFILL OPERABLE UNIT 2	SAMPLING METHOD: SPLIT SPOON: 2.0 inch O.D./1.5 inch I.D. (SP) SHELBY TUBE: 3.0 inch O.D./2 13/16 inch I.D. (SH)	SHEET 2 OF 2
		DRILLING

					START	FINISH
WATER LEVEL					TIME	TIME
TIME					8:15	9:45
DATE					DATE	DATE
CASING DEPTH					6/17/95	6/17/95

NORTHING: 1069219.14
DATUM EASTING: 517169.45 ELEVATION 472.5

DRILL RIG CME 75 - TRUCK MOUNT
SURFACE CONDITIONS Grass covered lawn
ANGLE BEARING
SAMPLE HAMMER

DEPTH IN FEET (ELEVATION)	BLOW/ 6 IN. ON SAMPLER	RECOVERY	SYMBOL	SAMPLER SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
16	7 50	0.5' 1.0' (50%)			(15.0-17.0 Ft.) Compact, pale yellowish brown (10YR 6/2) to moderate yellowish brown (10YR 6/2), Fine SAND, trace Silt, trace iron oxide staining, NR, damp, (SP), (ALLUVIUM) @ 16.0 Ft., fine sand becomes wet	SP 8 SP 9	
17					(455.5) 17.0 End of Soil Borehole Log at 17.0 ft. See PZ-208-SS Record of Drillhole for rock descriptions		
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							

DRILLING CONTR LAYNE-WESTERN
LOGGED BY J. MILLER
DATE 7/14/95
CHK'D BY W. HERST
JOB NO.: 943-2848
FILENAME: PZ208SS

RECORD OF DRILLHOLE PZ-208-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/17/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1069219.14
AZIMUTH: 0

COLLAR ELEV: 472.5
E: 517189.45
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	DESCRIPTION	ELEV / DEPTH (FT)	RUN NO	CORE RECOVERY	ROD	FRACTURES PER FOOT	DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
16	0.0-17.0 ft. See Soil Borehole Log PZ-202-SS 17.0-17.4 ft. No samples collected	455.10											
	17.4-24.3 ft. Slightly weathered, thinly bedded, light olive gray (5Y 6/1), fine crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Some fossils	17.40											6/17/95 @ 10:15 Begain Run 1
18			1	100 %				J,I,R (4)					
								J,PL,SM					
		453.30 19.20											6/17/95 @ 10:30 End Run 1
								B,I,R (2)					
								J,PL,SM,CL					
								J,PL,SM					
20								J,PL,SM (3)					
								J,I,SM					
								J,I,SM,Fe					
								J,I,R (3)					
22								J,I,R					
								J,I,SM (4)					
								J,I,R (2)					
								J,I,SM,CL					
								J,I,R (2)					
24	24.3-59.8 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), f-m grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Some fossiliferous zones		2	100 %				J,I,R,CL					
								J,I,R,CL (4)					
								J,I,R					
								J,I,R					
								J,I,R,CL (4)					
26								J,I,R,CL					
								J,I,R					
								J,I,SM,CL (2)					
								J,I,R (3)					
								J,I,R,CL (2)					
28								J,I,R,CL (2)					
								J,I,R					
		443.30 29.20						J,I,R,CL					6/17/95 @ 11:00 End Run 2
	Below 29.2 ft. no fossils present							J,P,SM,CL					
								J,I,R					
								J,I,R					
30								J,I,R,CL					
								J,I,R					
			3	100 %				J,I,R,CL (2)					
								J,I,SM,CL (4)					
								J,I,R,CL					
32													

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: B. TILTON
CHECKED: R. BOOTH
DATE: 7/12/95

Golder Associates

RECORD OF DRILLHOLE PZ-208-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/17/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1069219.14
AZIMUTH: 0

COLLAR ELEV: 472.5
E: 517169.45
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (80 60 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DIP wrt CORE AXIS (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX (SW FR HW MW CW)	STRENGTH INDEX (R5 R4 R3 R2 R1)	POINT LOAD INDEX (psi) (R5 >10 R4 >150 R3 >300 R2 >600 R1 >1500 R6)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
32	24.3-59.8 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), f-m grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Some fossiliferous zones Below 33.0 ft. Limestone becomes microcrystalline with intermittent zones that are very fine to fine crystalline								J,I,SM,CL						
									J,I,R						
									J,I,R,CL						
									J,I,R,CL						
									J,I,R,CL (2)						
									J,I,R						
34									J,I,R,CL						
									J,I,R,CL						
									J,I,R,CL						
									J,I,R						
				3	100 %				J,PL,SM,CL (3)						
36									J,I,R,CL (6)						
									J,U,SM,CL						
									J,I,SM,CL (5)						
38									J,PL,SM,CL (3)						6/17/95 @ 11:40 End Run 3
			433.30 / 39.20						J,I,R						
									J,I,SM						
									J,C,SM						
40									J,I,R,Fe						
	40.7-41.5 ft. Moderately weathered zone								J,I,R,Fe						
									J,PL,SM,CL						
									J,PL,SM,CL						
42	42.4-46.7 ft. Intermittent dark gray (N3) chert nodules (1/2 to 2 in. dia.)														
				4	100 %				J,PL,R,Fe						
44									J,I,SM,Fe						
									J,PL,SM						
46									J,PL,SM						
	Below 46.5 ft. stylolites common								J,PL,SM (2)						
									J,I,R,CL						
48															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: B. TILTON
CHECKED: R. BOOTH
DATE: 7/12/95

Golder Associates

RECORD OF DRILLHOLE PZ-208-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/17/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1069219.14
AZIMUTH: 0

COLLAR ELEV: 472.5
E: 517169.45
INCLINATION: -90

ROCK TYPE: J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DISCONTINUITY DATA

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
48	24.3-59.8 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), f-m grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Some fossiliferous zones		423.30 / 49.20	4	100 %			90	J,I,R,CL					6/17/95 @ 12:40 End Run 4
								90	J,I,SM					
50								90	B,PL,SM					
								90	B,PL,SM					
								90	J,I,R,CL					
52														
54				5	100 %									
								90	J,PL,SM,CL					
56														
								90	B,PL,SM					
								90	J,C,SM,CL					
58			413.30 / 59.20											
60	59.8-65.9 ft. Moderately weathered, thickly bedded, dark yellowish orange (10YR 6/6), fine grained, weak, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Heavy iron oxide staining			6	100 %			90	B,PL,SM,Fe					
62														
64														

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: B. TILTON
CHECKED: R. BOOTH
DATE: 7/12/95

Golder Associates

RECORD OF DRILLHOLE PZ-208-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/17/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1069219.14
AZIMUTH: 0

COLLAR ELEV: 472.5
E: 517169.45
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
64	59.8-65.9 ft. Moderately weathered, thickly bedded, dark yellowish orange (10YR 6/6), fine grained, weak, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION) Heavy iron oxide staining								B,I,R,Fe						
	65.4-65.7 ft. Very porous zone, open vugs, (<1 mm.), highly weathered								B,I,SM						
66	65.9-71.4 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), micro-crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Stylolitic			6	100 %				B,I,SM						
68									J,I,SM						
	@ 68.8 ft. Very stiff, greenish gray (5G 6/1), glauconite clay seam (~1/2 in.)		403.50 / 69.00												
70									J,I,R,CL; J,U,SM,CL; J,PL,SM,CL						
	71.4-74.8 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), micro-crystalline, medium strong, BIOTURBATED LIMESTONE, (ST. LOUIS FORMATION) Glauconite clay seams surrounding Limestone pieces, Limestone														
72															
74				7	100 %				B,I,R,CL; J,I,SM						
	74.8-76.8 ft. Slightly weathered, thinly bedded, light olive gray (5Y 6/1), very fine grained, medium strong, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)								J,I,R,CL; J,PL,SM,CL						
76									J,I,R,CL						
	76.8-78.5 ft. Fresh, thinly bedded, light olive gray (5Y 6/1), micro-crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION)								B,I,R,CL; J,I,SM,CL (2)						
78									J,PL,SM,CL						
	78.5-84.5 ft. Slightly weathered, medium bedded, pale yellowish brown (10YR 6/2), fine grained, weak, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)		393.50 / 79.00	8	100 %				B,PL,SM						6/17/95 @ 15:45 End Run 7
80															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: B. TILTON
CHECKED: R. BOOTH
DATE: 7/12/95

Golder Associates

RECORD OF DRILLHOLE PZ-208-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/17/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1069219.14
AZIMUTH: 0

COLLAR ELEV: 472.5
E: 517169.45
INCLINATION: -90

ROCK TYPE

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular

P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough

Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

DISCONTINUITY DATA

SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	WEATHERING INDEX	STRENGTH INDEX	POINT LOAD INDEX (psi)	TEST ORIENTATION	NOTES WATER LEVELS INSTRUMENTATION
80	78.5-84.5 ft. Slightly weathered, medium bedded, pale yellowish brown (10YR 6/2), fine grained, weak, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)														
	81.5-83.0 ft. Low porosity zone, open vugs (<1 mm. dia.)														
82									B,PL,SM,CL						
	82.5-83.2 ft. Moderately weathered zone								J,PL,SM,CL						
									J,I,R,CL						
84				8	100 %										
	84.8-85.8 ft. Fresh, medium bedded, light olive gray (5Y 6/1), finely crystalline, medium strong, LIMESTONE, (ST. LOUIS FORMATION)														
86	85.8-92.8 ft. Slightly weathered, medium bedded, pale yellowish brown (10YR 6/2), very finely grained, weak, ARGILLACEOUS LIMESTONE, (ST. LOUIS FORMATION)														
	86.0-88.0 ft. Low porosity zone, intermittent zones with open vugs (<1 mm. - 2 m. dia.) with iron oxide staining														
88	@ 88.0 ft. Firm, clay seam (~1/2 in.)								B,I,SM,CL						
			383.50 / 88.00												6/17/95 @ 16:50 End Run 8
90															
92				9	100 %				B,PL,SM,CL						
	92.8-99.0 ft. Fresh, medium bedded, light olive gray (5Y 6/1), very fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION)														
94	Slightly argillaceous, stylolitic														
	94.1-94.8 ft. Argillaceous Limestone layer														
96															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

LOGGED: B. TILTON
CHECKED: R. BOOTH
DATE: 7/12/95

Golder Associates

RECORD OF DRILLHOLE PZ-208-SS

PROJECT: LAIDLAW/RI-FS
PROJECT NO: 943-2848
LOCATION: BRIDGETON, MO

BORING METHOD: NX Core & water
DRILLING DATE: 6/17/95
DRILL RIG: CME 75

DATUM: MSL
COORDINATES N: 1069219.14
AZIMUTH: 0

COLLAR ELEV: 472.5
E: 517169.45
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
Fe-FeOxide, CL-Clay Infill, CH-Chlorite, H-Healed, GRF-Gravel Filled

Depth Scale (Feet)	Rock Type Description	Graphic Log	Elev / Depth (Ft)	Run No.	Core Recovery	RQD	Fractures per Foot	Discontinuity Data: Dip w/r Core Axis	Type and Surface Description	Graphic Log	Weathering Index	Strength Index	Point Load Index (psi)	Test Orientation	Notes, Water Levels, Instrumentation
96	92.8-99.0 ft. Fresh, medium bedded, light olive gray (5Y 6/1), very fine grained, medium strong, LIMESTONE, (ST. LOUIS FORMATION) Slightly argillaceous, stylolitic			9	100 %				B,PL,SM,CL						
98	98.0-99.0 ft. Limestone becomes coarsely crystalline														
	373.50		373.50												6/17/95 @ 17:40 Coring completed
	End of Record of Drillhole 99.00 at 99.0 ft.		99.00												
100															
102															
104															
106															
108															
110															
112															

DEPTH SCALE: 1:2
DRILLING CONTRACTOR: LAYNE-WESTERN
DRILLER: D. MAHURIN

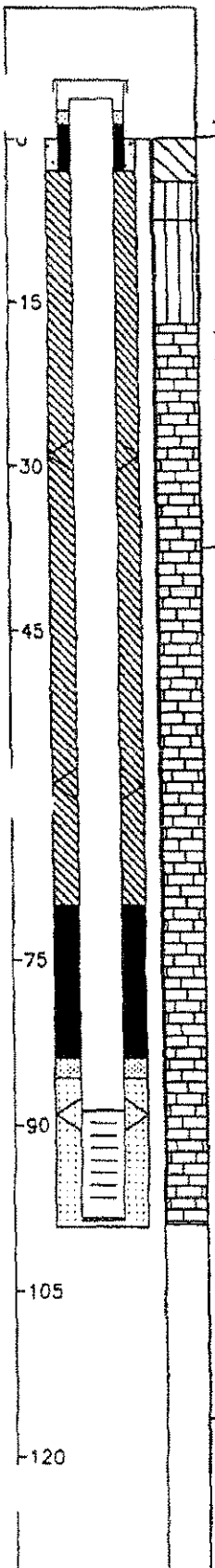
LOGGED: B. TILTON
CHECKED: R. BOOTH
DATE: 7/12/95

Golder Associates

Well No. PZ-208-SS

Boring No. X-Ref: PZ-208-SS

PIEZOMETER CONSTRUCTION SUMMARY



Survey Coords: Northing: 1069219 ft. Easting: 517169 ft.

Elevation Ground Level 472.5 ft. NGVD

Top of PVC Casing 474.25 ft. NGVD

Drilling Summary:

Total Depth 99.2 ft.

Borehole Diameter 10 1/4 in. (0.0-17.0 ft.) 5 7/8 in. (17.0-99.2 ft.)

Casing Stickup Height 1.72 ft.

Driller Layne-Western St. Louis, MO

Rig CME 75, Schramm Portadrill T660H

Bit(s) 5 1/4 in. ID Hollow Stem Auger Bit, NX Core, 5 7/8 in. Button Bit for Reaming

Drilling Fluid Auger-None, NX Core Water, Air Rotary

Protective Casing 8x8 in. Square Steel, by 5 ft. long

Construction Time log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
CME 75	6/17/95	8:15	6/17/95	17:35
Schramm Rotary	6/18/95	8:50	6/18/95	10:00
Geophys.Logging:				
Casing:	6/18/95	10:10	6/18/95	10:20
Filter Placement:	6/18/95	10:30	6/18/95	10:55
Cementing:				
Development				
Bentonite Grout	6/18/95	11:15	6/18/95	14:00
Bentonite Seal	6/18/95	11:05	6/18/95	11:15

Well Design & Specifications

Basis: Geologic Log X Geophysical Log

Casing string(s): C = Casing S = Screen

Depth			String(s)	Elevation		
+ 1.72	-	88.70	C1	474.25	-	383.83
88.70	-	98.50	S1	383.83	-	374.03
98.50	-	98.83	C2	374.03	-	373.70

Casing: C1 2 ft. dia. Schedule 80 PVC, flush threaded with O-rings

C2 2 ft. dia. threaded PVC end cap (4 in. long or 0.33 ft.)

Screen: S1 2 in. dia. Schedule 80 PVC, 0.010 in. machine cut slot, flush threaded with O-rings

Sand Pack: 16-35 mesh Silica Sand, 85.65-99.2 ft.

Filter Pack: Less than 50 mesh Silica Sand, 83.90-85.65 ft.

Grout Seal: Wyo-Ben Grout Well Bentonite Slurry, 3.0-70.0 ft.

Bentonite Seal: Extra high yield Wyo-Ben (100%) Slurry, 70.0-83.90 ft.

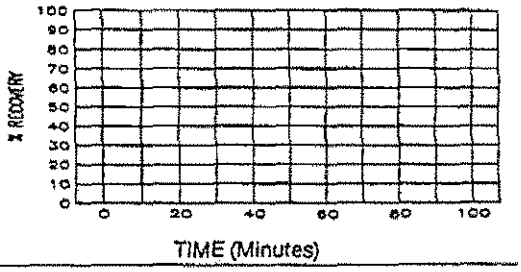
Concrete: 0.0-3.0 ft.

Well Development

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (°C)

Recovery Data:



Comments:

Not to Scale

Supervised by B. Tilton

Job Number 943-2848

Site LAIDLAW/OU2 RI-FS/MO

File Name PZ208SS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND LAND SURVEY

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REF NO 122514	CHECK NO
ROUTE	TRANSMITTAL NO
STATE WELL NUMBER	CROSS REFERENCE NO
CHECKED BY	ENTERED Ph 1 Ph 2 Ph 3
APPROVED BY	DATE APPROVED

INFORMATION SUPPLIED BY OWNER

SITE NAME		WELL NUMBER	
LANDFILL BRIDGETON SANITARY LANDFILL		PZ-208-SS	
SITE ADDRESS: ST. CHARLES ROCK RD	CITY: BRIDGETON	STATE: MO	ZIP CODE: 63044
NAME: LANDFILL WASTE SYSTEMS, INC.		TELEPHONE: 314-241-3710	
ADDRESS: [illegible] N. [illegible]	CITY: ST. LOUIS	STATE: MO	ZIP CODE: 63102

INFORMATION SUPPLIED BY MONITORING WELL CONTRACTOR

LOCATION OF WELL
SHOW LOCATION IN SECTION PLAT

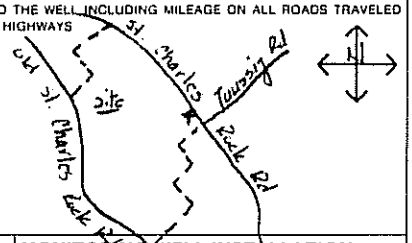
COUNTY: ST. LOUIS
ELEVATION: 472.23
AREA NO.

SMALLEST ¼ LARGEST ¼

SEC. ____ TWN. 47 N,RNG 5 (E) OR W

LAT. 38° 46' 12" LONG. 90° 26' 22"

SKETCH THE LOCATION TO THE WELL INCLUDING MILEAGE ON ALL ROADS TRAVELED FROM NEAREST TOWNS OR HIGHWAYS



DESCRIBE LOCATION OF THE WELL SO WE WOULD BE ABLE TO VISIT IT

MONITORING WELL INSTALLATION CONTRACTOR'S NAME
LAYNE WESTERN CO., INC.

NOTE: Record the fraction of a foot in decimal, not in inches.

Top of Riser Elevation: 474.15

Ground Surface Elevation: 471.53 Ft

Information in this column to be supplied in the Feet from Surface column	Feet from Surface	Description of Formation
		0-4 Clay
Depth to bottom of Protective Casing Seal:	3.0	
		4-16 Silt
		16-47.1 Limestone
Depth to Base of Annular Seal:	70.0	
Depth to Base of Bentonite Seal:	83.7	
Depth to Base of Secondary Filter Pack:	85.7	
Depth to Top of the Screen:	88.7	
Depth to Bottom of the Screen:	98.7	
Plug Back Total Depth		
Original Total Depth:	47.1	

LOCKING CAP - (Y) / N (Circle one)
CAP VENT - Y / N (Circle one)

PROTECTIVE CASING
Type: STEEL
Size: 8"x5"x5'
Bore Hole Diameter: 10¼"
WEEP HOLE - Y / N (Circle one)

PROTECTIVE CASING SEAL
Type: [x] Concrete [ ] Cement Slurry

RISER PIPE
Length: 40.5'
Diameter: 2"
Type of Material: SCH 80 PVC

BOREHOLE DIAMETER: 5 7/8 In.

ANNULAR SEAL
Type: [ ] Bentonite Slurry [x] Cement Slurry [ ] Non Slurry Bentonite

BENTONITE SEAL
Type: [x] Bentonite Slurry [ ] Non Slurry Bentonite
Length of Seal: 13.7 Ft.

SECONDARY FILTER PACK (Optional)
Type: [x] Sand [ ] Manufactured
Grain Size: < 50
Length: 1.8'

PRIMARY FILTER PACK
Type: [x] Sand [ ] Manufactured
Grain Size: 16-35
Length: 13.5'

WELL SCREEN
Length: 10
Slot Size: 0.010
Type: SCH 80 PVC

SUMP DETAILS
Length: 0.3 Ft.
Diameter: 2 In.
Type: PVC

TYPE OF BACKFILL: NATIVE

DRILLING CONTRACTOR'S NAME
LAYNE WESTERN CO., INC.

TYPE OF INSTALLATION
[x] ABOVE GROUND [ ] FLUSH MOUNT

STATIC WATER LEVEL
FEET FROM MEASURING POINT

DATE OF STATIC WATER LEVEL

ELEVATION OF MEASURING POINT
474.15

MEASURING POINT IS
[x] TOP OF RISER PIPE
[ ] OTHER

DRILLING EQUIPMENT
[x] AIR ROTARY [x] AUGER TYPE 6¼ HSA
[ ] REVERSE ROTARY [ ] OTHER

CENTRALIZERS USED
[x] YES, AT 3 TOTAL
[x] STAINLESS STEEL
[ ] OTHER
[ ] NO

MULTIPLE CASED WELLS
SUBMIT ADDITIONAL AS BUILT DIAGRAM SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE AND SIZE OF ALL CASING, HOLE DIAMETERS, AND GROUT USED.

DATE WELL CONSTRUCTION WAS COMPLETED
6-18-95

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH THE DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS.

SIGNATURE (MONITORING WELL CONTRACTOR) Michael F. Vogt
PERMIT NUMBER 00125 KW1 DATE 7-07-95

SIGNATURE (DRILLING CONTRACTOR) Michael F. Vogt
PERMIT NUMBER 00125 KW1 DATE 7-07-95

MO 780-1415 (2-94) DISTRIBUTION: WHITE-DIVISION CANARY-MONITORING WELL CONTRACTOR PINK-OWNER

HERST & ASSOCIATES, INC.®

Hole Number: PZ-209-SS

Rock Log

Local Site Coordinates: 1067071.07 N, 517108.12 E Ground Surface Elevation: 487.38

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 15, 2013

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular

P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-Very Rough

Fe-Iron, CL-Clay, CaCO3-Calcite

FR-Fresh, SW-Slightly Weathered, MW-Moderately Weathered, HW- Highly Weathered, CW-Completely Weathered

R6- Extremely Strong, R5- Very Strong, R4- Strong, R3- Medium Strong, R2- Weak, R1-Very Weak, R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
0.0	**0.0 to 135.0 ft.** - Blind drilled. No sample collected.									Meter: Solinst Model 107 TLC	Blind-drilled from 0 - 135 ft; no samples collected. 0 - 60 ft drilled via air rotary. O_2 (%), methane (%LEL), and VOCs (ppm) monitored at borehole. 20.9% O_2, 0% LEL, 0 ppm.
5.0										59.1	
10.0										58.7	20.9% O_2, 0% LEL, 0 ppm.
15.0										58.7	
20.0										58.7	20.9% O_2, 0% LEL, 0 ppm.
25.0										58.5	
30.0										58.5	20.9% O_2, 0% LEL, 0 ppm.
35.0										58.5	
40.0										58.2	20.9% O_2, 0% LEL, 0 ppm.
45.0										58.0	Competent bedrock encountered.
50.0										57.9	

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helper: Rob Underwood
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt, Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-209-SS

Rock Log

Local Site Coordinates: 1067071.07 N, 517108.12 E Ground Surface Elevation: 487.38

Project: Bridgeton Landfill Groundwater Assessment Well Installations

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Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 15, 2013

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular

P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-Very Rough

Fe-Iron, CL-Clay, CaCO3-Calcite

FR-Fresh, SW-Slightly Weathered, MW-Moderately Weathered, HW- Highly Weathered, CW-Completely Weathered

R6- Extremely Strong, R5- Very Strong, R4- Strong, R3- Medium Strong, R2- Weak, R1-Very Weak, R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
50.0										57.9	
	0.0 to 135.0 ft. - Blind drilled. No sample collected.										Set temporary 12-in. D casing 5 ft into bedrock. Continued drilling through casing. 20.9% O_2, 0% LEL, 0 ppm.
55.0										57.6	
60.0										57.4	Switched to sonic drilling. 20.9% O_2, 0% LEL, 0 ppm..
65.0										57.4	
70.0										57.4	
75.0										57.1	
80.0										57.1	20.9% O_2, 0% LEL, 0 ppm.
85.0										57.1	
90.0										56.9	
95.0										56.9	
100.0										56.7	20.9% O_2, 0% LEL, 0 ppm.

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helper: Rob Underwood
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt, Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-209-SS

Rock Log

Local Site Coordinates: 1067071.07 N, 517108.12 E Ground Surface Elevation: 487.38

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 15, 2013

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
100.0										56.7	20.9% O_2, 0% LEL, 0 ppm.
	0.0 to 135.0 ft. - Blind drilled. No sample collected.										
105.0										56.5	
110.0										56.5	
115.0										56.2	
120.0										56.2	20.9% O_2, 0% LEL, 0 ppm.
125.0										56.2	
130.0										56.0	
135.0										56.0	

Change in scale see sheet 4 of 5

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helper: Rob Underwood
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
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LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-209-SS

Rock Log

Local Site Coordinates: 1067071.07 N, 517108.12 E Ground Surface Elevation: 487.38

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J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular

P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-Very Rough

Fe-Iron, CL-Clay, CaCO3-Calcite

FR-Fresh, SW-Slightly Weathered, MW-Moderately Weathered, HW- Highly Weathered, CW-Completely Weathered

R6- Extremely Strong, R5- Very Strong, R4- Strong, R3- Medium Strong, R2- Weak, R1-Very Weak, R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
135.0										56.0	20.9% O_2, 0% LEL, 0 ppm.
	135.0 to 136.0 ft. - LIMESTONE, yellowish gray (5Y 8/1) to light olive gray (5Y 6/1) with pale yellowish brown (10YR 6/2), very light gray, (N9) and medium dark gray (N4) mottling; light bluish gray (5B 7/1) banding. Microcrystalline; massive; competent. Requires multiple hammer blows to fracture, but easily scratched with knife. Reactive with with 10% HCl solution.		1 of 2	4.8/5.0	4.8/4.8	0		FR	R4		
136.0										56.0	
	136.0 to 137.0 ft. - LIMESTONE, as above, but yellowish gray (5Y 8/1), light olive gray (5Y 6/1), light gray (N7), and medium gray (N5).					0		FR	R4		
137.0										56.0	
	137.0 to 138.0 ft. - LIMESTONE, as above, but laminated beginning at 137.6 ft. Large number of mechanical breaks from 137.7 - 138.8 ft.					0		FR	R3 to R4		
138.0										56.9	
	138.0 to 139.0 ft. - LIMESTONE, as above, but massive beginning at 138.8 ft.					0		FR	R3 to R4		
139.0										56.9	
	139.0 to 140.0 ft. - LIMESTONE, as above, with greenish-gray (5G 8/1) mottling.					0		FR	R4		
140.0										55.7	20.9% O_2, 0% LEL, 0 ppm.
	140.0 to 141.0 ft. - LIMESTONE, light olive gray (5Y 6/1) and greenish gray (5GY 6/1) with yellowish gray (5Y 8/1) and olive gray (5Y 4/1) mottling. With faint grayish orange (10YR 7/4) staining. Microcrystalline; massive; competent. Requires multiple hammer blows to fracture, but easily scratched with knife. Reactive with with 10% HCl solution.		2 of 2	9.9/10.0	9.9/9.9	0		FR to SW	R4		
141.0											
	141.0 to 142.0 ft. - LIMESTONE, as above, but laminated from 141.7 - 142 ft.					0		FR to SW	R4		
142.0											
	142.0 to 143.0 ft. - LIMESTONE, as above, but microcrystalline to fine-grained. Large number of mechanical breaks from 142.4 - 142.6 ft.					0		FR to SW	R3		
143.0											
	143.0 to 144.0 ft. - LIMESTONE, as above, but dark gray (N3), light olive gray (5Y 6/1), and greenish gray (5GY 6/1)					0		FR to SW	R4		
144.0											
	144.0 to 145.0 ft. - LIMESTONE, as above, but medium gray (N5) and light olive gray (5Y 6/1). No staining.					0		FR	R4		
145.0										56.0	

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helper: Rob Underwood
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt, Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-209-SS

Rock Log

Local Site Coordinates: 1067071.07 N, 517108.12 E Ground Surface Elevation: 487.38

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Drilling Date(s): October 15, 2013

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular

P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-Very Rough

Fe-Iron, CL-Clay, CaCO3-Calcite

FR-Fresh, SW-Slightly Weathered, MW-Moderately Weathered, HW- Highly Weathered, CW-Completely Weathered

R6- Extremely Strong, R5- Very Strong, R4- Strong, R3- Medium Strong, R2- Weak, R1-Very Weak, R0- Extremely Weak

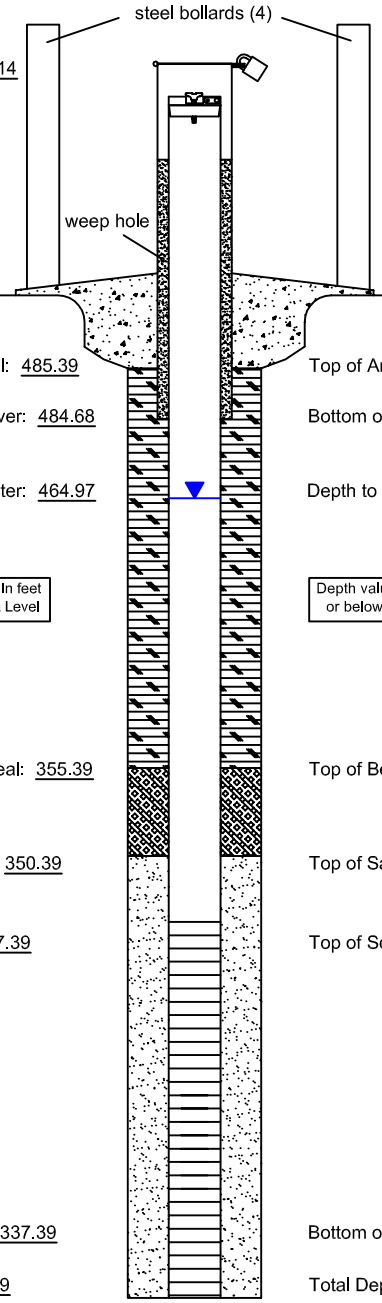
Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
145.0										56.0	
146.0	**145.0 to 146.0 ft.** - LIMESTONE, as above.					0		FR	R4		
147.0	**146.0 to 147.0 ft.** - LIMESTONE, as above, but microcrystalline.					0		FR	R4		
148.0	**147.0 to 148.0 ft.** - LIMESTONE, as above.					0		FR	R4		
149.0	**148.0 to 149.0 ft.** - LIMESTONE, as above.					0		FR	R4		
150.0	**149.0 to 150.0 ft.** - LIMESTONE, as above.					0		FR	R4	56.0	≤20.3% O_2, ≤6.3% LEL, ≤9.8 ppm. Readings fluctuating rapidly.
151.0											**Boring Depth: 150 ft. bgs.**
152.0											
153.0											
154.0											
155.0											

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helper: Rob Underwood
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt, Herst & Associates, Inc.

LIMESTONE

Well Coordinates:
N 1067071.541
E 517108.567

Drilling Contractor: Frontz Drilling
Lead Driller: Rob Hamilton
Drilling Dates: October 5, 2013



Top of Steel Cover: 490.14

Top of Casing: 489.68

Ground Surface Elevation: 487.39

Top of Steel Cover: + 2.75

Top of Casing: + 2.29

Lock installed: (yes)/ no

Ground Surface: 0.0

Top of Annular Seal: 485.39

Bottom of Steel Cover: 484.68

Depth to Groundwater: 464.97

Elevation values, In feet above Mean Sea Level

Top of Annular Seal: - 2.0

Bottom of Steel Cover: - 2.71

Depth to Groundwater: - 22.42

Depth values, In feet above (+) or below (-) Ground Surface

Top of Bentonite Seal: 355.39

Top of Sand Pack: 350.39

Top of Screen: 347.39

Bottom of Screen: 337.39

Total Depth: 337.39

Top of Bentonite Seal: - 132.00

Top of Sand Pack: - 137.00

Top of Screen: - 140.00

Bottom of Screen: - 150.00

Total Depth: - 150.00

(Not to Scale)

Borehole Diameter: 9-inch OD for Soil
6-inch OD for Rock

Centralizer (s): Yes, at base of Screen and 5 feet above top of Screen

Type of Annular Seal: Bentonite Grout

Grouting Method: Tremie
Grout Thickness: 130 feet

Casing Material: Schedule 80 PVC
Casing Diameter: 2 inches
Casing Length (including Screen): 150 feet

Date of Groundwater Measurement: October 5, 2013

Type of Bentonite Seal: Bentonite Plug Chips

Bentonite Seal Thickness: 5 feet

Type of Sand Pack: Silica Sand

Sand Pack Thickness: 13 feet
Number of Bags of Sand: 4

Screen Slot Size: 0.01 in.
Screen Material: Schedule 80 PVC
Screen Diameter: 2 inches
Screen Length: 10 feet

Depth of Borehole Backfill: N/A
Collapse Footage: N/A

4631 North St. Peters Parkway
St. Charles, Missouri 63304
Phone (636) 939-9111
Fax (636) 939-9757
HERST & ASSOCIATES, INC.®

Bridgeton Landfill
Bridgeton, Missouri

PZ-209-SS
As-Built Diagram

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED	
REFERENCE NO		
C R NO	CHECK NO	
STATE WELL NUMBER	REVENUE NO	
ENTERED Ph1 Ph2 Ph3	APPROVED BY	ROUTE

INFORMATION SUPPLIED BY PRIMARY CONTRACTOR OR DRILLING CONTRACTOR

NOTE: THIS FORM IS NOT TO BE USED FOR NESTED WELLS

OWNER NAME: Republic Services	CONTACT NAME: Bryan Sehie		VARIANCE GRANTED BY DNR NUMBER
OWNER ADDRESS: 13570 Saint Charles Rock Rd.	CITY: Bridgeton	STATE: MO	ZIP CODE: 63044
SITE NAME: Bridgeton Sanitary Landfill	WELL NUMBER: PZ-209-55	COUNTY: Saint Louis	
SITE ADDRESS: 13570 Saint Charles Rock Rd.	CITY: Bridgeton	STATIC WATER LEVEL: 29.75	

SURFACE COMPLETION

TYPE: ☑ ABOVE GROUND ☐ FLUSH MOUNT

LENGTH AND DIAMETER OF SURFACE COMPLETION: LENGTH 2.5 FT. DIAMETER 5 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: DIAMETER 5 IN. LENGTH 2.5 FT.

SURFACE COMPLETION GROUT: ☑ CONCRETE ☐ OTHER

LOCATION OF WELL (D/M/S FORMAT ONLY): LAT. 38 . 45 . 51.1 . LONG. 90 . 26 . 24.4 .

SMALLEST ___ ¼ ___ ¼ LARGEST ___ ¼

SECTION ___ TOWNSHIP 47 NORTH

RANGE 5 ☑ EAST ☐ WEST

MONITORING FOR: (CHECK ALL THAT APPLY)
☑ RADIONUCLIDES ☐ PETROLEUM PRODUCTS ONLY
☐ EXPLOSIVES ☑ METALS ☑ VOC
☑ SVOCS ☑ PESTICIDES/HERBICIDES

PROPOSED USE OF WELL
☐ GAS MIGRATION WELL ☑ OBSERVATION
☐ EXTRACTION WELL ☐ OPEN HOLE
☐ PIEZOMETERS ☐ INJECTION WELL
☐ DIRECT PUSH

☑ LOCKING CAP
☑ WEEP HOLE

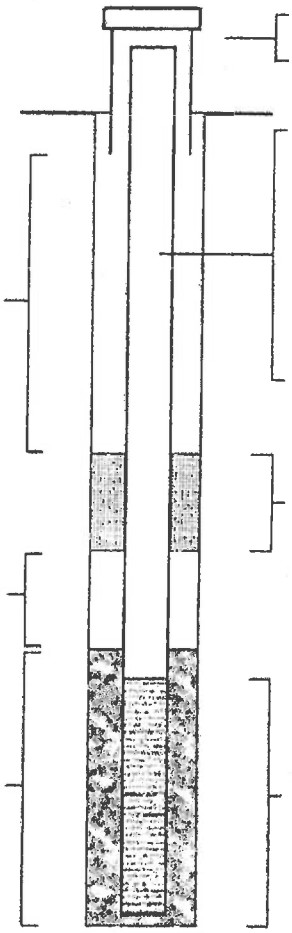
ELEVATION 487.27 FT.

ANNULAR SEAL
LENGTH 130 FT.
☑ SLURRY ☐ CHIPS
☐ PELLETS ☐ GRANULAR
☐ CEMENT/SLURRY
IF CEMENT/BENTONITE MIX:
BAGS OF CEMENT USED ___
% OF BENTONITE USED ___
WATER USED/BAG 250 GAL.

SECONDARY FILTER PACK
LENGTH Ø FT.

DEPTH TO TOP OF PRIMARY FILTER PACK 137 FT.

LENGTH OF PRIMARY FILTER PACK 13 FT.



SURFACE COMPLETION
☑ STEEL ☐ ALUMINUM ☐ PLASTIC

RISER
RISER PIPE DIAMETER 2 IN.
RISER PIPE LENGTH 142 FT.
DIAMETER OF DRILL HOLE 6 IN.
WEIGHT OR SDR# Sch 80

MATERIAL
☐ STEEL ☑ THERMOPLASTIC (PVC)
☐ OTHER

BENTONITE SEAL
LENGTH 5 Foot
☑ CHIPS ☐ PELLETS ☐ GRANULAR
☐ SLURRY
☑ SATURATED ZONE ☐ HYDRATED

SCREEN
SCREEN DIAMETER 2 IN.
SCREEN LENGTH 10 FT.
DIAMETER OF DRILL HOLE 6 IN.
DEPTH TO TOP 140 FT.

SCREEN MATERIAL
☐ STEEL ☑ THERMOPLASTIC (PVC)
☐ OTHER

DEPTH TO	DEPTH FROM	FORMATION DESCRIPTION
0'	45'	Silty Clay
45'	150'	Limestone
TOTAL DEPTH:		150 Foot

FOR CASED WELLS, SUBMIT ADDITIONAL AS BUILT DIAGRAMS SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE & SIZE OF ALL CASING, HOLE DIAMETER & GROUT USED.

SIGNATURE (PRIMARY CONTACTOR)	PERMIT NUMBER	DATE WELL DRILLING WAS COMPELTED
[signature]	003839 M	10-5-13

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH MISSOURI DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS. ☐ PUMP INSTALLED

SIGNATURE (WELL DRILLER)	PERMIT NUMBER	SIGNATURE (OF APPRENTICE)	APPRENTICE PERMIT NUMBER
[signature]	003456-M		

MO 780-1415 (07-11) DISTRIBUTION: WHITE/DIVISION CANARY/CONTACTOR PINK/OWNER

RETURN WHITE COPY WITH APPROPRIATE FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, DIVISION OF GEOLOGY AND LAND SURVEY, WELLHEAD PROTECTION SECTION, PO BOX 250, ROLLA, MO 65402 573-368-2165

HERST & ASSOCIATES, INC.®

Hole Number: PZ-209-SD

Rock Log

Local Site Coordinates: 1067075.74 N, 517103.75 E Ground Surface Elevation: 487.24

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 2-4, 2013

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular

P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-Very Rough

Fe-Iron, CL-Clay, CaCO3-Calcite

FR-Fresh, SW-Slightly Weathered, MW-Moderately Weathered, HW- Highly Weathered, CW-Completely Weathered

R6- Extremely Strong, R5- Very Strong, R4- Strong, R3- Medium Strong, R2- Weak, R1-Very Weak, R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
0.0	**0.0 to 235.0 ft.** - Blind drilled. No sample collected.									Meter: Solinst Model 107 TLC	Blind-drilled from 0 - 235 ft; no samples collected. 0 - 80 ft drilled via air rotary. O_2 (%), methane (%LEL), and VOCs (ppm) monitored at borehole. 20.6% O_2, 0% LEL, 0 ppm.
5.0										59.9	
10.0										59.6	20.6% O_2, 0% LEL, 0 ppm.
15.0										59.6	
20.0										59.6	20.6% O_2, 0% LEL, 0 ppm.
25.0										59.4	
30.0										59.4	20.6% O_2, 0% LEL, 0 ppm.
35.0										59.1	
40.0										59.1	20.6% O_2, 0% LEL, 0 ppm.
45.0										59.1	Competent bedrock encountered.
50.0										59.1	

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helpers: Rob Underwood, Ben Williams
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt & Steve Jett, Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-209-SD

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Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
50.0	**0.0 to 235.0 ft.** - Blind drilled. No sample collected.									59.1	Set temporary 8-in. D casing 5 ft into bedrock. Continued drilling through casing.
55.0										58.7	
60.0										58.7	20.9% O_2, 0% LEL, 0 ppm.
65.0										58.7	
70.0										58.7	20.9% O_2, 0% LEL, 0 ppm.
75.0										58.5	
80.0										58.5	Very difficult drilling from 80 to 100 feet, driller switched to Sonic rest of way. 20.9% O_2, 0% LEL, 0 ppm.
85.0										58.5	
90.0										58.5	
95.0										58.5	
100.0										58.5	20.9% O_2, 0% LEL, 0 ppm.

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Hole Number: PZ-209-SD

Rock Log

Local Site Coordinates: 1067075.74 N, 517103.75 E Ground Surface Elevation: 487.24

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 2-4, 2013

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular

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R6- Extremely Strong, R5- Very Strong, R4- Strong, R3- Medium Strong, R2- Weak, R1-Very Weak, R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
100.0	**0.0 to 235.0 ft.** - Blind drilled. No sample collected.									58.5	20.9% O_2, 0% LEL, 0 ppm.
105.0										58.5	
110.0										58.5	
115.0										58.5	
120.0										58.5	20.9% O_2, 0% LEL, 0 ppm..
125.0										58.5	
130.0										58.2	
135.0										58.2	
140.0										58.0	20.9% O_2, 0% LEL, 0 ppm.
145.0										58.0	
150.0										58.0	

Drilling Contractor: Frontz Drilling, Inc.
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LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-209-SD

Rock Log

Local Site Coordinates: 1067075.74 N, 517103.75 E Ground Surface Elevation: 487.24

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Drilling Date(s): October 2-4, 2013

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular

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Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
150.0										58.0	
	0.0 to 235.0 ft. - Blind drilled. No sample collected.										
155.0										57.9	
160.0										57.9	20.9% O_2, 0% LEL, 0 ppm.
165.0										57.6	
170.0										57.6	
175.0										57.6	
180.0										57.6	20.9% O_2, 0% LEL, 0 ppm.
185.0										57.4	
190.0										57.4	
195.0										57.4	
200.0										57.4	20.9% O_2, 0% LEL, 0 ppm.

Drilling Contractor: Frontz Drilling, Inc.
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LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-209-SD

Rock Log

Local Site Coordinates: 1067075.74 N, 517103.75 E Ground Surface Elevation: 487.24

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 2-4, 2013

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
200.0										57.4	20.9% O_2, 0% LEL, 0 ppm.
	0.0 to 235.0 ft. - Blind drilled. No sample collected.										
205.0										57.4	
210.0										57.1	
215.0										56.9	
220.0										56.9	20.9% O_2, 0% LEL, 0 ppm.
225.0										56.7	
230.0										56.2	
235.0										56.2	20.9% O_2, 0% LEL, 0 ppm.

Change in scale see sheet 6 of 7

Drilling Contractor: Frontz Drilling, Inc.
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LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-209-SD

Rock Log

Local Site Coordinates: 1067075.74 N, 517103.75 E Ground Surface Elevation: 487.24

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Drilling Date(s): October 2-4, 2013

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

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Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
235.0										56.2	20.9% O_2, 0% LEL, 0 ppm.
	235.0 to 236.0 ft. - LIMESTONE, medium gray (N6). Medium-grained; massive; competent; fresh.		1 of 2	5.0/5.0	4.5/5.0	0		FR	R5		
236.0											
						0		FR	R5		
237.0											
						0		FR	R5		
238.0											
	238.0 to 239.0 ft. - LIMESTONE, as above, 238.3 to 238.4 ft but more fossilized. 238.4 to 240.0 ft, gray (N5). Medium-grained; thinly to intensely bedded; competent, fresh.					1	85°, PL	FR	R5		
239.0											
						0		FR	R5		
240.0										55.7	20.9% O_2, 0% LEL, 0 ppm.
	240.0 to 241.0 ft. - LIMESTONE, as above.		2 of 2	10.0/10.0	7.2/10.0	0		FR	R5		
241.0											
						0		FR	R5		
242.0											
						0		FR	R5		
243.0											
						0		FR	R5		
244.0											
						0		FR	R5		
245.0										55.6	

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helpers: Rob Underwood, Ben Williams
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt & Steve Jett, Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-209-SD

Rock Log

Local Site Coordinates: 1067075.74 N, 517103.75 E Ground Surface Elevation: 487.24

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Drilling Date(s): October 2-4, 2013

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-Very Rough
Fe-Iron, CL-Clay, CaCO3-Calcite
FR-Fresh, SW-Slightly Weathered, MW-Moderately Weathered, HW- Highly Weathered, CW-Completely Weathered
R6- Extremely Strong, R5- Very Strong, R4- Strong, R3- Medium Strong, R2- Weak, R1-Very Weak, R0- Extremely Weak

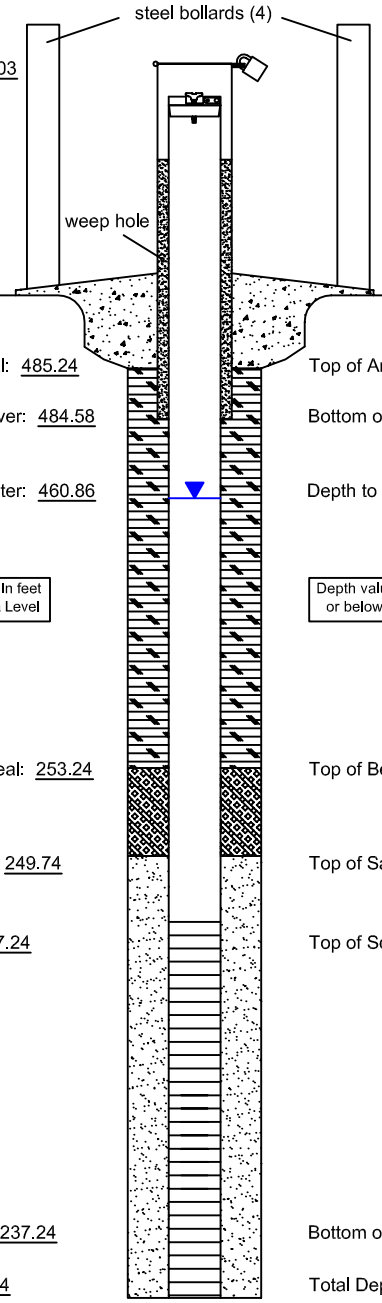
Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
245.0										55.6	
246.0						0		FR	R5		
247.0						1	45°, PL	FR	R5		
248.0						0		FR	R5		
249.0	**248.0 to 249.0 ft.** - LIMESTONE, as above, but thinly bedded.					0		FR	R5		
250.0						0		FR	R5	55.4	20.9% O_2, 0% LEL, 0 ppm.
											Boring Depth: 250 ft. bgs.
251.0											
252.0											
253.0											
254.0											
255.0											

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helpers: Rob Underwood, Ben Williams
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt & Steve Jett, Herst & Associates, Inc.

LIMESTONE

Well Coordinates:
N 1067075.739
E 517104.415

Drilling Contractor: Frontz Drilling
Lead Driller: Rob Hamilton
Drilling Dates: October 4, 2013



Top of Steel Cover: 490.03

Top of Casing: 489.58

Ground Surface Elevation: 487.24

Top of Steel Cover: + 2.79

Top of Casing: + 2.34

Lock installed: (yes)/ no

Ground Surface: 0.0

Top of Annular Seal: 485.24

Bottom of Steel Cover: 484.58

Depth to Groundwater: 460.86

Elevation values, In feet above Mean Sea Level

Top of Annular Seal: - 2.0

Bottom of Steel Cover: - 2.66

Depth to Groundwater: - 26.38

Depth values, In feet above (+) or below (-) Ground Surface

Top of Bentonite Seal: 253.24

Top of Sand Pack: 249.74

Top of Screen: 247.24

Bottom of Screen: 237.24

Total Depth: 237.24

Top of Bentonite Seal: - 234.00

Top of Sand Pack: - 237.50

Top of Screen: - 240.00

Bottom of Screen: - 250.00

Total Depth: - 250.00

(Not to Scale)

Borehole Diameter: 9-inch OD for Soil
6-inch OD for Rock

Centralizer (s): Yes, at base of Screen and 5 feet above top of Screen

Type of Annular Seal: Bentonite Grout

Grouting Method: Tremie
Grout Thickness: 232 feet

Casing Material: Schedule 80 PVC
Casing Diameter: 2 inches
Casing Length (including Screen): 250 feet

Date of Groundwater Measurement: October 8, 2013

Type of Bentonite Seal: Bentonite Plug Chips

Bentonite Seal Thickness: 3.5 feet

Type of Sand Pack: Silica Sand

Sand Pack Thickness: 12.5 feet
Number of Bags of Sand: 5

Screen Slot Size: 0.01 in.
Screen Material: Schedule 80 PVC
Screen Diameter: 2 inches
Screen Length: 10 feet

Depth of Borehole Backfill: N/A
Collapse Footage: N/A

4631 North St. Peters Parkway
St. Charles, Missouri 63304
Phone (636) 939-9111
Fax (636) 939-9757
HERST & ASSOCIATES, INC.®

Bridgeton Landfill
Bridgeton, Missouri

PZ-209-SD
As-Built Diagram

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED	
REFERENCE NO		
C.R. NO	CHECK NO	
STATE WELL NUMBER	REVENUE NO.	
ENTERED Ph1 Ph2 Ph3	APPROVED BY	ROUTE

INFORMATION SUPPLIED BY PRIMARY CONTRACTOR OR DRILLING CONTRACTOR

NOTE: THIS FORM IS NOT TO BE USED FOR NESTED WELLS

OWNER NAME	CONTACT NAME	VARIANCE GRANTED BY DNR
Repulic Seruices	Bryan Sehie	NUMBER

OWNER ADDRESS	CITY	STATE	ZIP CODE
13570 Saint Charles Rock Rd.	Bridgeton	MO	63044

SITE NAME	WELL NUMBER	COUNTY
Bridgeton Sanitary Landfill	PZ-209-SD	Saint Louis

SITE ADDRESS	CITY	STATIC WATER LEVEL
13570 Saint Charles Rock Rd.	Bridgeton	27.09

SURFACE COMPLETION

TYPE: ☑ ABOVE GROUND ☐ FLUSH MOUNT

LENGTH AND DIAMETER OF SURFACE COMPLETION: LENGTH 2.5 FT. DIAMETER 5 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: DIAMETER 5 IN. LENGTH 2.5 FT.

SURFACE COMPLETION GROUT: ☑ CONCRETE ☐ OTHER _____

LOCATION OF WELL (D/M/S FORMAT ONLY): LAT. 38 . 45 . 51.2 " LONG. 90 . 26 . 24.4 "

SMALLEST ___ ¼ ___ ¼ LARGEST ___ ¼

SECTION ___ TOWNSHIP 47 NORTH

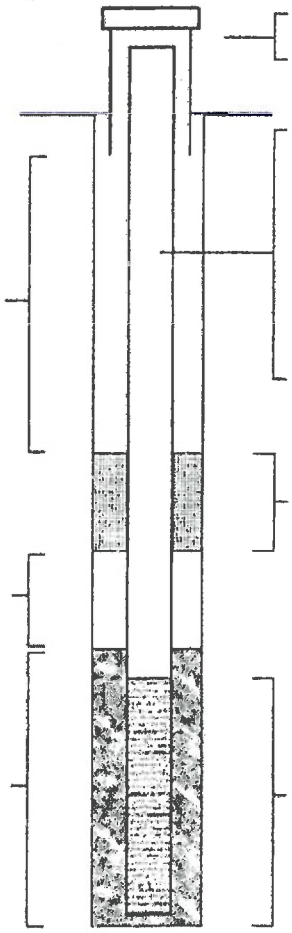
RANGE 5 ☑ EAST ☐ WEST

MONITORING FOR: (CHECK ALL THAT APPLY)
☑ RADIONUCLIDES ☐ PETROLEUM PRODUCTS ONLY
☐ EXPLOSIVES ☑ METALS ☑ VOC
☑ SVOCS ☑ PESTICIDES/HERBICIDES

PROPOSED USE OF WELL
☐ GAS MIGRATION WELL ☑ OBSERVATION
☐ EXTRACTION WELL ☐ OPEN HOLE
☐ PIEZOMETERS ☐ INJECTION WELL
☐ DIRECT PUSH

☑ LOCKING CAP
☑ WEEP HOLE

ELEVATION 487.27 FT.



SURFACE COMPLETION
☑ STEEL ☐ ALUMINUM ☐ PLASTIC

RISER
RISER PIPE DIAMETER 2 IN.
RISER PIPE LENGTH 242 FT.
DIAMETER OF DRILL HOLE 6 IN.
WEIGHT OR SDR# Sch 80

MATERIAL
☐ STEEL ☑ THERMOPLASTIC (PVC)
☐ OTHER _____

ANNULAR SEAL
LENGTH 234 FT.
☑ SLURRY ☐ CHIPS
☐ PELLETS ☐ GRANULAR
☐ CEMENT/SLURRY
IF CEMENT/BENTONITE MIX:
BAGS OF CEMENT USED ___
% OF BENTONITE USED ___
WATER USED/BAG 440 GAL.

BENTONITE SEAL
LENGTH 2 Foot
☑ CHIPS ☐ PELLETS ☐ GRANULAR
☐ SLURRY
☑ SATURATED ZONE ☐ HYDRATED

SECONDARY FILTER PACK
LENGTH ___ FT.

SCREEN
SCREEN DIAMETER 2 IN.
SCREEN LENGTH 10 FT.
DIAMETER OF DRILL HOLE 6 IN.
DEPTH TO TOP 240 FT.

SCREEN MATERIAL
☐ STEEL ☑ THERMOPLASTIC (PVC)
☐ OTHER _____

DEPTH TO TOP OF PRIMARY FILTER PACK 238 FT.

LENGTH OF PRIMARY FILTER PACK 12 FT.

DEPTH TO	DEPTH FROM	FORMATION DESCRIPTION
0'	45'	Silty Clay
45'	250'	Limestone
TOTAL DEPTH:		250 Foot

FOR CASED WELLS, SUBMIT ADDITIONAL AS BUILT DIAGRAMS SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE & SIZE OF ALL CASING, HOLE DIAMETER & GROUT USED.

SIGNATURE (PRIMARY CONTACTOR)	PERMIT NUMBER	DATE WELL DRILLING WAS COMPELTED
[signature]	003839 M	10-4-13

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH MISSOURI DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS. ☐ PUMP INSTALLED

SIGNATURE (WELL DRILLER)	PERMIT NUMBER	SIGNATURE (OF APPRENTICE)	APPRENTICE PERMIT NUMBER
[signature]	003456-M		

MO 780-1413 (07-11)

DISTRIBUTION: WHITE/DIVISION CANARY/CONTACTOR PINK/OWNER

RETURN WHITE COPY WITH APPROPRIATE FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, DIVISION OF GEOLOGY AND LAND SURVEY, WELLHEAD PROTECTION SECTION, PO BOX 250, ROLLA, MO 65402 573-368-2165

HERST & ASSOCIATES, INC.®

Hole Number: PZ-210-SS

Rock Log

Local Site Coordinates: 1066828.73 N, 516777.04 E Ground Surface Elevation: 484.52

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 16, 2013

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
0.0	**0.0 to 133.0 ft.** - Blind drilled. No sample collected.									Meter: Solinst Model 107 TLC	Blind-drilled from 0 - 133 ft; no samples collected. 0 - 50 ft drilled via air rotary. O_2 (%), methane (%LEL), and VOCs (ppm) monitored at borehole. 20.9% O_2, 0% LEL, 0 ppm.
5.0										58.2	
10.0										57.9	20.9% O_2, 0% LEL, 0 ppm. Very wet.
15.0										57.9	
20.0										57.9	20.9% O_2, 0% LEL, 0 ppm.
25.0										57.6	
30.0										57.6	20.9% O_2, 0% LEL, 0 ppm.
35.0										57.6	
40.0										57.6	20.9% O_2, 0% LEL, 0 ppm.
45.0										57.6	Competent bedrock encountered.
50.0										57.6	

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helpers: Rob Underwood, Ben Williams
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt, Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-210-SS

Rock Log

Local Site Coordinates: 1066828.73 N, 516777.04 E Ground Surface Elevation: 484.52

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Drilling Date(s): October 16, 2013

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular

P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-Very Rough

Fe-Iron, CL-Clay, CaCO3-Calcite

FR-Fresh, SW-Slightly Weathered, MW-Moderately Weathered, HW- Highly Weathered, CW-Completely Weathered

R6- Extremely Strong, R5- Very Strong, R4- Strong, R3- Medium Strong, R2- Weak, R1-Very Weak, R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
50.0	**0.0 to 133.0 ft.** - Blind drilled. No sample collected.									57.6	Set temporary 8-in. D casing 5 ft into bedrock. Switched to sonic drilling. Continued drilling through casing. 20.9% O_2, 0% LEL, 0 ppm.
55.0										57.6	
60.0										57.6	20.9% O_2, 0% LEL, 0 ppm..
65.0										57.6	
70.0										57.6	
75.0										57.6	
80.0										57.6	20.9% O_2, 0% LEL, 0 ppm.
85.0										57.6	
90.0										57.6	
95.0										57.6	
100.0										57.9	20.9% O_2, 0% LEL, 0 ppm.

Drilling Contractor: Frontz Drilling, Inc.
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LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-210-SS

Rock Log

Local Site Coordinates: 1066828.73 N, 516777.04 E Ground Surface Elevation: 484.52

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Drilling Date(s): October 16, 2013

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular

P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-Very Rough

Fe-Iron, CL-Clay, CaCO3-Calcite

FR-Fresh, SW-Slightly Weathered, MW-Moderately Weathered, HW- Highly Weathered, CW-Completely Weathered

R6- Extremely Strong, R5- Very Strong, R4- Strong, R3- Medium Strong, R2- Weak, R1-Very Weak, R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
100.0	**0.0 to 133.0 ft.** - Blind drilled. No sample collected.									57.9	20.9% O_2, 0% LEL, 0 ppm.
105.0										57.9	
110.0										57.6	
115.0										57.4	
120.0										57.4	20.9% O_2, 0% LEL, 0 ppm.
125.0										57.4	
130.0										57.1	
133.0											

Change in scale see sheet 4 of 5

Drilling Contractor: Frontz Drilling, Inc.
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LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-210-SS

Rock Log

Local Site Coordinates: 1066828.73 N, 516777.04 E Ground Surface Elevation: 484.52

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 16, 2013

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular

P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-Very Rough

Fe-Iron, CL-Clay, CaCO3-Calcite

FR-Fresh, SW-Slightly Weathered, MW-Moderately Weathered, HW- Highly Weathered, CW-Completely Weathered

R6- Extremely Strong, R5- Very Strong, R4- Strong, R3- Medium Strong, R2- Weak, R1-Very Weak, R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
133.0											
134.0	**133.0 to 134.0 ft.** - LIMESTONE, light olive gray (5Y 6/1) to olive gray (5Y 4/1). With very light gray (N9) and yellowish gray (5Y 8/1) mottling and spotting. Microcrystalline to fine-grained; massive to laminated; competent. Requires one to multiple hammer blows to fracture, but easily scratched with knife. Reactive with with 10% HCl solution.		1 of 2	5.0/5.0	4.3/5.0	0	[134.2] 90°, B, PL, R [134.3] 85°, B, PL, R [134.75] 90°, B, I, R [134.8] 85°, B, PL, R [134.85] 90°, B, PL, R	FR	R3 to R4	56.9	
135.0	**134.0 to 135.0 ft.** - LIMESTONE, as above, but with medium bluish gray (5B 5/1) spotting. Slightly weathered from 134.1 to 134.9 ft; surface discoloration on fractures, weaker along bedding planes, can easily be broken by hand in spots. Surface discoloration of dark yellowish brown (10YR 4/2), moderate yellowish brown (10YR 5/4) on fractures. Partial healing/filling of cavities at 134.2 ft. Medium bluish gray (5B 5/1) mineralization at 134.8 ft.					5		SW	R3 to R4		
136.0	**135.0 to 136.0 ft.** - LIMESTONE, as above, but yellowish gray (5Y 8/1) to light olive gray (5Y 6/1). With greenish gray (5G 6/1) mottling. Microcrystalline beginning at 135.6 ft. Flint-or chert-like. Very uniform in color. Dark greenish gray (5GY 4/1) dendritic mineralization at 135.9 ft.					0		FR	R3-R4		
137.0	**136.0 to 137.0 ft.** - LIMESTONE, as above. Moderately healed bedding plane joint at 136.6 ft.					0		FR	R3-R4		
138.0	**137.0 to 138.0 ft.** - LIMESTONE, as above. Medium dark-gray (N4) dendritic mineralization at 137.1-137.2 ft. Multiple moderatly healed bedding plane joints at 137.7 ft. Slightly weathered from 137.9-140 ft; surface discoloration on fractures. Surface discoloration of dark yellowish brown (10YR 4/2), brownish gray (5YR 4/1), medium bluish gray (5B 5/1) on fractures.					2	[137.9] 60°, B, PL, R [137.95] 80°, B, PL, R	FR to SW	R3-R4		
139.0	**138.0 to 139.0 ft.** - LIMESTONE, yellowish gray (5Y 8/1) and light gray (5Y 6/1). With very light gray (N8) and dark gray (N3) mottling. With dark yellowish brown (10YR 4/2) from 138-138.2 ft. Microcrystalline; massive to laminated; competent. Requires one to multiple hammer blows to fracture, but easily scratched with knife. Reactive with with 10% HCl solution.		2 of 2	9.7/10.0	9.1/9.7	0	[139.15] 90°, B, PL, R [139.65] 90°, B, PL, S Other fractures evident, but difficult to discern.	FR	R3-R4		
140.0	**139.0 to 140.0 ft.** - LIMESTONE, as above, but microcrystalline to fine-grained. Slightly weathered from 139.1-139.7 ft; surface discoloration on fractures, weaker along bedding planes, can be broken by hand in spots. Surface discoloration of pale yellowish brown (10YR 6/2), brownish gray (5YR 4/1), and olive gray (5Y 4/1) on fractures. Vitreous, medium bluish gray (5B 5/1) mineralization at approx. 139.5 ft. Multiple mechanical breaks mixed with bedding plane joints, Core has little cross-sectional integrity; gravel-like. Difficult to discern individual joints.					2+		FR to SW	R3-R4	56.9	
141.0						0		FR	R4		
142.0	**140.0 to 141.0 ft.** - LIMESTONE, as above, but with little mottling. Microcrystalline, massive. **141.0 to 142.0 ft.** - LIMESTONE, as above.					0		FR	R4		
143.0	**142.0 to 143.0 ft.** - LIMESTONE, as above, 0.2 ft band of medium light gray (N6) at 142.5 ft. Laminated from 142.5 to 143 ft. With very light gray (N8) and medium dark gray (N4) mottling. Multiple mechanical breaks.					0		FR	R4 to R3		

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helpers: Rob Underwood, Ben Williams
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt, Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-210-SS

Rock Log

Local Site Coordinates: 1066828.73 N, 516777.04 E Ground Surface Elevation: 484.52

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 16, 2013

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

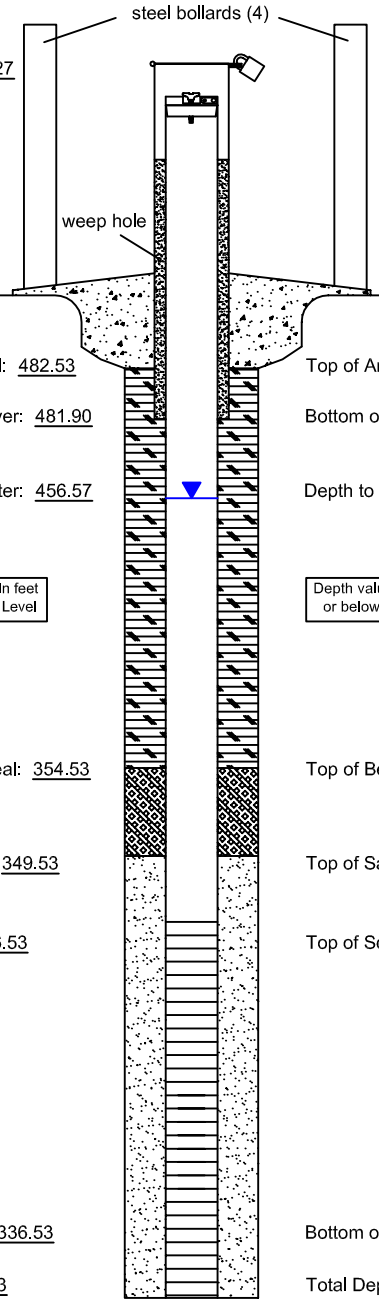
Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
143.0	**143.0 to 144.0 ft.** - LIMESTONE, as above, but massive to laminated. Multiple mechanical breaks from 143.2 - 143.7 ft. Surface discoloration on bottom face of fracture at 143.7 ft. Medium dark gray (N4) and olive gray (5Y 4/1). (No discoloration on top face; possible mechanical destruction.)					1	[143.7] 85°, B, PL, S	FR to SW	R3 to R4		
144.0	**144.0 to 145.0 ft.** - LIMESTONE, as above, but massive; microcrystalline to fine-grained.					0		FR	R4		
145.0	**145.0 to 146.0 ft.** - LIMESTONE, as above, but yellowish gray (5Y 8/I), light olive gray (5Y 6/1), and olive gray (5Y 4/1). With greenish gray (5G 6/1) mottling at 145.5 ft. Massive to laminated. Can be broken by hand from 145.7 to 145.9 ft. Likely mechanical destruction and weakening. (No weathering evident.)					0		FR	R4 to R3	56.7	
146.0	**146.0 to 147.0 ft.** - LIMESTONE, as above, but yellowish gray (5Y 8/I) and light olive gray (5Y 6/1), massive, microcrystalline beginning 1t 146.4 ft. Slightly weathered at 146.1 ft: surface discoloration on fracture, weaker along bedding planes, can be broken by hand in spots. Vitreous, planar mineralization roughly parallel to core axis (90 to 80°) from 146.7 - 146.8 ft.					1	[146.1] 90°, B, PL, VR	FR to SW	R4 to R3		
147.0	**147.0 to 148.0 ft.** - LIMESTONE, as above.					0		FR	R4		
148.0										56.7	
149.0											**Boring Depth: 148 ft. bgs.**
150.0											
151.0											
152.0											
153.0											

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helpers: Rob Underwood, Ben Williams
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt, Herst & Associates, Inc.

LIMESTONE

Well Coordinates:
N 1066828.381
E 516777.407

Drilling Contractor: Frontz Drilling
Lead Driller: Rob Hamilton
Drilling Dates: October 16-17, 2013



Top of Steel Cover: 487.27

Top of Casing: 486.90

Ground Surface Elevation: 484.53

Top of Steel Cover: + 2.74

Top of Casing: + 2.37

Lock installed: (yes)/ no

Ground Surface: 0.0

Top of Annular Seal: 482.53

Bottom of Steel Cover: 481.90

Depth to Groundwater: 456.57

Elevation values, In feet above Mean Sea Level

Top of Annular Seal: - 2.0

Bottom of Steel Cover: - 2.63

Depth to Groundwater: - 27.96

Depth values, In feet above (+) or below (-) Ground Surface

Top of Bentonite Seal: 354.53

Top of Sand Pack: 349.53

Top of Screen: 346.53

Top of Bentonite Seal: - 130.00

Top of Sand Pack: - 135.00

Top of Screen: - 138.00

Bottom of Screen: 336.53

Total Depth: 336.53

Bottom of Screen: - 148.00

Total Depth: - 148.00

(Not to Scale)

Borehole Diameter: 9-inch OD for Soil
6-inch OD for Rock

Centralizer (s): Yes, at base of Screen and 5 feet above top of Screen

Type of Annular Seal: Bentonite Grout

Grouting Method: Tremie
Grout Thickness: 128 feet

Casing Material: Schedule 80 PVC
Casing Diameter: 2 inches
Casing Length (including Screen): 148 feet

Date of Groundwater Measurement: October 24, 2013

Type of Bentonite Seal: Bentonite Plug Chips

Bentonite Seal Thickness: 5 feet

Type of Sand Pack: Silica Sand

Sand Pack Thickness: 13 feet
Number of Bags of Sand: 4

Screen Slot Size: 0.01 in.
Screen Material: Schedule 80 PVC
Screen Diameter: 2 inches
Screen Length: 10 feet

Depth of Borehole Backfill: N/A
Collapse Footage: N/A

4631 North St. Peters Parkway
St. Charles, Missouri 63304
Phone (636) 939-9111
Fax (636) 939-9757
HERST & ASSOCIATES, INC.®

Bridgeton Landfill
Bridgeton, Missouri

PZ-210-SS
As-Built Diagram

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM
MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED	
REFERENCE NO		
C.R. NO	CHECK NO	
STATE WELL NUMBER	REVENUE NO	
ENTERED Ph1 Ph2 Ph3	APPROVED BY	ROUTE

INFORMATION SUPPLIED BY PRIMARY CONTRACTOR OR DRILLING CONTRACTOR
NOTE: THIS FORM IS NOT TO BE USED FOR NESTED WELLS

OWNER NAME: Republic Services	CONTACT NAME: Bryan Schie		VARIANCE GRANTED BY DNR NUMBER
OWNER ADDRESS: 13570 Saint Charles Rock Rd.	CITY: Bridgeton	STATE: MO	ZIP CODE: 63044
SITE NAME: Bridgeton Sanitary Landfill	WELL NUMBER: PZ-210-SS		COUNTY: Saint Louis
SITE ADDRESS: 13570 Saint Charles Rock Rd.	CITY: Bridgeton		STATIC WATER LEVEL: 30.33

SURFACE COMPLETION

TYPE: ☑ ABOVE GROUND ☐ FLUSH MOUNT

LENGTH AND DIAMETER OF SURFACE COMPLETION: LENGTH 2.5 FT. DIAMETER 5 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: DIAMETER 5 IN. LENGTH 2.5 FT.

SURFACE COMPLETION GROUT: ☑ CONCRETE ☐ OTHER _____

LOCATION OF WELL (D/M/S FORMAT ONLY): LAT. 38 . 45 . 49.4 LONG. 90 . 26 . 25.8

SMALLEST ____ ¼ ____ ¼ LARGEST ____ ¼
SECTION ____ TOWNSHIP 47 NORTH
RANGE 5 ☑ EAST ☐ WEST

MONITORING FOR: (CHECK ALL THAT APPLY)
☑ RADIONUCLIDES [redacted]
☐ EXPLOSIVES ☑ METALS ☑ VOC
☑ SVOCS ☑ PESTICIDES/HERBICIDES

PROPOSED USE OF WELL
☐ GAS MIGRATION WELL ☑ OBSERVATION
☐ EXTRACTION WELL ☐ OPEN HOLE
☐ PIEZOMETERS ☐ INJECTION WELL
☐ DIRECT PUSH

☑ LOCKING CAP
☑ WEEP HOLE

ELEVATION 481.29 FT.

ANNULAR SEAL
LENGTH 128 FT.
☑ SLURRY ☐ CHIPS
☐ PELLETS ☐ GRANULAR
☐ CEMENT/SLURRY
IF CEMENT/BENTONITE MIX:
BAGS OF CEMENT USED ____
% OF BENTONITE USED ____
WATER USED/BAG 340 GAL.

SECONDARY FILTER PACK
LENGTH 0 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK 135 FT.

LENGTH OF PRIMARY FILTER PACK 13 FT.

SURFACE COMPLETION
☑ STEEL ☐ ALUMINUM ☐ PLASTIC

RISER
RISER PIPE DIAMETER 2 IN.
RISER PIPE LENGTH 140 FT.
DIAMETER OF DRILL HOLE 6 IN.
WEIGHT OR SDR# Sch 80

MATERIAL
☐ STEEL ☑ THERMOPLASTIC (PVC)
☐ OTHER _____

BENTONITE SEAL
LENGTH 5 Foot
☑ CHIPS ☐ PELLETS ☐ GRANULAR
☐ SLURRY
☑ SATURATED ZONE ☐ HYDRATED

SCREEN
SCREEN DIAMETER 2 IN.
SCREEN LENGTH 10 FT.
DIAMETER OF DRILL HOLE 6 IN.
DEPTH TO TOP 138 FT.

SCREEN MATERIAL
☐ STEEL ☑ THERMOPLASTIC (PVC)
☐ OTHER _____

DEPTH TO	DEPTH FROM	FORMATION DESCRIPTION
0'	45'	Silty Clay
45'	148'	Limestone
TOTAL DEPTH:		148 Foot

FOR CASED WELLS, SUBMIT ADDITIONAL AS BUILT DIAGRAMS SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE & SIZE OF ALL CASING, HOLE DIAMETER & GROUT USED.

SIGNATURE (PRIMARY CONTACTOR)	PERMIT NUMBER	DATE WELL DRILLING WAS COMPELTED
	003839M	10-16-13

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH MISSOURI DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS. ☐ PUMP INSTALLED

SIGNATURE (WELL DRILLER)	PERMIT NUMBER	SIGNATURE (OF APPRENTICE)	APPRENTICE PERMIT NUMBER
	003456-M		

MO 780-1415 (07-11)
DISTRIBUTION: WHITE/DIVISION CANARY/CONTACTOR PINK/OWNER
RETURN WHITE COPY WITH APPROPRIATE FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, DIVISION OF GEOLOGY AND LAND SURVEY, WELLHEAD PROTECTION SECTION, PO BOX 250, ROLLA, MO 65402 573-368-2165

HERST & ASSOCIATES, INC.®

Hole Number: PZ-210-SD

Rock Log

Local Site Coordinates: 1066824.04 N, 516772.85 E Ground Surface Elevation: 484.48

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Drilling Date(s): October 15, 2013

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular

P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-Very Rough

Fe-Iron, CL-Clay, CaCO3-Calcite

FR-Fresh, SW-Slightly Weathered, MW-Moderately Weathered, HW- Highly Weathered, CW-Completely Weathered

R6- Extremely Strong, R5- Very Strong, R4- Strong, R3- Medium Strong, R2- Weak, R1-Very Weak, R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
0.0	**0.0 to 233.0 ft.** - Blind drilled. No sample collected.									Meter: Solinst Model 107 TLC	Blind-drilled from 0 - 233 ft; no samples collected. 0 - 50 ft drilled via air rotary. O_2 (%), methane (%LEL), and VOCs (ppm) monitored at borehole. 20.6% O_2, 0% LEL, 0 ppm.
5.0										58.2	
10.0										58.2	20.6% O_2, 0% LEL, 0 ppm.
15.0										58.2	
20.0										58.0	20.6% O_2, 0% LEL, 0 ppm.
25.0										58.0	
30.0										58.0	20.9% O_2, 0% LEL, 0 ppm.
35.0										58.0	
40.0										58.0	20.9% O_2, 0% LEL, 0 ppm.
45.0										58.0	Competent bedrock encountered.
50.0										58.0	

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helpers: Rob Underwood, Ben Williams
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt, Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-210-SD

Rock Log

Local Site Coordinates: 1066824.04 N, 516772.85 E Ground Surface Elevation: 484.48

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Fe-Iron, CL-Clay, CaCO3-Calcite

FR-Fresh, SW-Slightly Weathered, MW-Moderately Weathered, HW- Highly Weathered, CW-Completely Weathered

R6- Extremely Strong, R5- Very Strong, R4- Strong, R3- Medium Strong, R2- Weak, R1-Very Weak, R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
50.0	**0.0 to 233.0 ft.** - Blind drilled. No sample collected.									58.0	Set temporary 8-in. D casing 5 ft into bedrock. Switched to sonic drilling. Continued drilling through casing.
55.0										58.0	20.9% O_2, 0% LEL, 0 ppm.
60.0										58.0	20.9% O_2, 0% LEL, 0 ppm..
65.0										58.0	
70.0										58.0	
75.0										58.0	
80.0										58.0	20.9% O_2, 0% LEL, 0 ppm.
85.0										58.0	
90.0										58.0	
95.0										58.0	
100.0										58.0	20.9% O_2, 0% LEL, 0 ppm.

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Hole Number: PZ-210-SD

Rock Log

Local Site Coordinates: 1066824.04 N, 516772.85 E Ground Surface Elevation: 484.48

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Drilling Date(s): October 15, 2013

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular

P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-Very Rough

Fe-Iron, CL-Clay, CaCO3-Calcite

FR-Fresh, SW-Slightly Weathered, MW-Moderately Weathered, HW- Highly Weathered, CW-Completely Weathered

R6- Extremely Strong, R5- Very Strong, R4- Strong, R3- Medium Strong, R2- Weak, R1-Very Weak, R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
100.0	**0.0 to 233.0 ft.** - Blind drilled. No sample collected.									58.0	20.9% O_2, 0% LEL, 0 ppm.
105.0										58.0	
110.0										58.0	
115.0										58.0	
120.0										58.0	
125.0										58.0	
130.0										58.0	
135.0										58.0	
140.0										58.0	20.9% O_2, 0% LEL, 0 ppm.
145.0										58.0	
150.0										57.9	

Drilling Contractor: Frontz Drilling, Inc.
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LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-210-SD

Rock Log

Local Site Coordinates: 1066824.04 N, 516772.85 E Ground Surface Elevation: 484.48

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 15, 2013

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular

P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-Very Rough

Fe-Iron, CL-Clay, CaCO3-Calcite

FR-Fresh, SW-Slightly Weathered, MW-Moderately Weathered, HW- Highly Weathered, CW-Completely Weathered

R6- Extremely Strong, R5- Very Strong, R4- Strong, R3- Medium Strong, R2- Weak, R1-Very Weak, R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
150.0										57.9	
	0.0 to 233.0 ft. - Blind drilled. No sample collected.										
155.0										57.9	
160.0										57.9	20.9% O_2, 0% LEL, 0 ppm.
165.0										57.9	
170.0										57.6	
175.0										57.6	
180.0										57.6	20.9% O_2, 0% LEL, 0 ppm.
185.0										57.6	
190.0										57.6	
195.0										57.6	
200.0										57.6	20.9% O_2, 0% LEL, 0 ppm.

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LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-210-SD

Rock Log

Local Site Coordinates: 1066824.04 N, 516772.85 E Ground Surface Elevation: 484.48

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Drilling Date(s): October 15, 2013

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered

R6- Extremely Strong
R5- Very Strong
R4- Strong
R3- Medium Strong
R2- Weak
R1-Very Weak
R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
200.0	**0.0 to 233.0 ft.** - Blind drilled. No sample collected.									57.6	20.9% O_2, 0% LEL, 0 ppm.
205.0										57.6	
210.0										57.6	
215.0										57.6	
220.0										57.4	20.9% O_2, 0% LEL, 0 ppm.
225.0										57.4	
230.0										57.4	
233.0											20.9% O_2, 0% LEL, 0 ppm.

Change in scale see sheet 6 of 7

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LIMESTONE

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Rock Log

Local Site Coordinates: 1066824.04 N, 516772.85 E Ground Surface Elevation: 484.48

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 15, 2013

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R6- Extremely Strong, R5- Very Strong, R4- Strong, R3- Medium Strong, R2- Weak, R1-Very Weak, R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
233.0	**233.0 to 234.0 ft.** - LIMESTONE, light olive gray (5Y 6/1) and olive gray (5Y 4/1) with medium dark gray (N4) and yellowish gray (5Y 8/1) mottling. Microcrystalline to fine grained; massive to laminated; competent. Requires multiple hammer blows to fracture, but easily scratched with knife. Reactive with 10% HCl solution. Slightly weathered from 233.4 to 233.7 ft; moderate surface discoloration on fractures, weaker along bedding planes, can easily be broken by hand in spots. Moderate surface discoloration of dark yellowish brown (10YR 4/2) and olive gray (5Y 4/1) on fractures.		1 of 2	4.9/5.0	4.6/4.9	3	[233.4] 90°, B, PL, S [233.65] 85°, B, PL, R [233.7] 85°, B, PL, S	FR to SW	R4		20.9% O_2, 0% LEL, 0 ppm.
234.0	**234.0 to 235.0 ft.** - LIMESTONE, as above, but light olive gray (5Y 6/1). With pale yellowish brown (10YR 6/2), light gray (N7), and olive gray (5Y 4/1) mottling. Massive. Mineralization at 234.0 ft.					0		FR	R4		
235.0	**235.0 to 236.0 ft.** - LIMESTONE, as above, but pale yellowish brown (10YR 6/2), light olive gray (5Y 4/1). Light gray (N7) mineralization within cavities at 235.5 ft.					0		FR	R4	57.1	
236.0	**236.0 to 237.0 ft.** - LIMESTONE, as above, but yellowish gray (5Y 8/1) to light olive gray (5Y 6/1). With light gray (N7) mottling. Slightly weathered at 236.1 ft; surface discoloration on bottom face of fracture, weaker along bedding planes, easily flakes away when scratched with fingernail. Surface discoloration of pale yellowish brown (10YR 6/2) and olive gray (5Y 4/1) on fracture. Massive with lamination around fracture at 236.1 ft.					1	[236.1] 85°, B, PL, R	FR to SW	R4		
237.0	**237.0 to 238.0 ft.** - LIMESTONE, as above, but yellowish gray (5Y 8/1) to light olive gray (5Y 6/1). Color is uniform; little mottling, spotting, or banding.					0		FR	R4		20.9% O_2, 0% LEL, 0 ppm.
238.0	**238.0 to 239.0 ft.** - LIMESTONE, yellowish gray (5Y 8/1), light olive gray (5Y 6/1) and olive gray (5Y 4/1). With moderate yellowish brown (10YR 5/4) and light gray (N8) mottling. Microcrystalline to fine-grained; massive; competent. Requires one or multiple hammer blows to fracture, but easily scratched with knife. Reactive with 10% HCl solution. Laminated from 238.9 ft; weaker (R1 to R2) along bedding planes, easily flakes away when scratched with fingernail.		2 of 2	10.0/10.0	10.0/10.0	0		FR	R4 to R3		
239.0	**239.0 to 240.0 ft.** - LIMESTONE, as above, but with pale yellowish brown (10YR 6/2) and light gray (N8) mottling. Massive to laminated. Slightly weathered at 239.85 ft; surface discoloration on fracture, weaker along bedding planes, can easily be broken by hand in spots. Surface discoloration of brownish gray (5YR 4/1) to olive gray (5Y 4/1) on fracture.					1	[239.85] 80°, B, PL, S	FR to SW	R3		
240.0	**240.0 to 241.0 ft.** - LIMESTONE, as above, but with light gray (N8) mottling. Slightly weathered from 240.2 to 240.3 ft; weaker along bedding planes, can easily be broken by hand in spots. Moderate surface discoloration of olive gray (5Y 4/1) along planes when broken by hand.					0		FR to SW	R3	56.9	
241.0	**241.0 to 242.0 ft.** - LIMESTONE, as above. Slightly weathered at 241.35 ft; weaker along bedding planes, olive gray (5Y 4/1) discoloration on mechanical break surfaces.					0		FR to SW	R3		
242.0	**242.0 to 243.0 ft.** - LIMESTONE, as above, but fine to medium-grained. Slightly weathered at 242-242.1 ft and 242.3 ft; weaker along bedding planes, olive gray (5Y 4/1) discoloration on mechanical break surfaces.					0		FR to SW	R3		
243.0											

Drilling Contractor: Frontz Drilling, Inc.
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Certifying Geologist: Brian Fingers, Geotechnology, Inc.
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LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-210-SD

Rock Log

Local Site Coordinates: 1066824.04 N, 516772.85 E Ground Surface Elevation: 484.48

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

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Drilling Date(s): October 15, 2013

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Fe-Iron, CL-Clay, CaCO3-Calcite

FR-Fresh, SW-Slightly Weathered, MW-Moderately Weathered, HW- Highly Weathered, CW-Completely Weathered

R6- Extremely Strong, R5- Very Strong, R4- Strong, R3- Medium Strong, R2- Weak, R1-Very Weak, R0- Extremely Weak

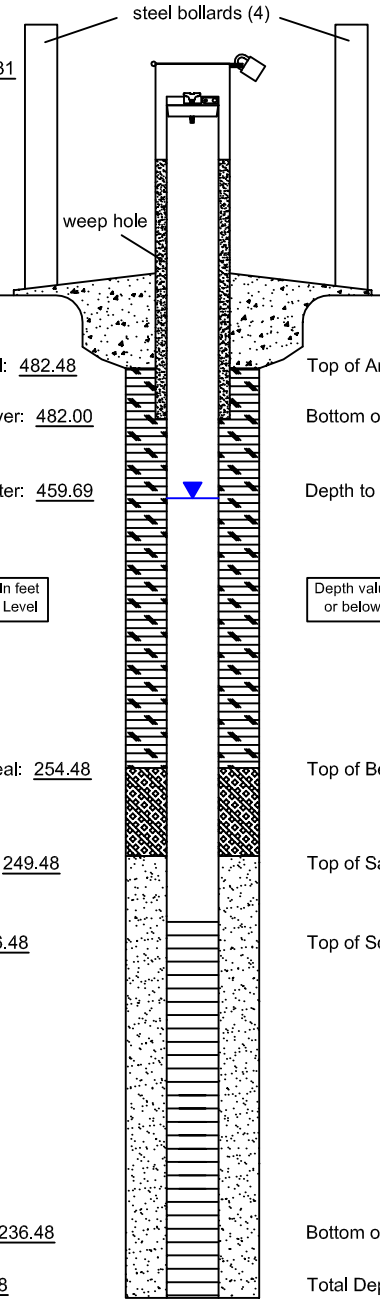
Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
243.0											
244.0	**243.0 to 244.0 ft.** - LIMESTONE, as above, but light olive gray (5Y 6/1). With pale yellowish brown (10YR 6/2), olive gray (5Y 4/1) mottling and white (N9), yellowish gray (5Y 8/1), medium bluish gray (5B 5/1) speckling.					0		FR	R3 to R4		
245.0	**244.0 to 245.0 ft.** - LIMESTONE, as above, but also with medium dark gray (N4) mottling.					0		FR	R3 to R4	56.9	
246.0	**245.0 to 246.0 ft.** - LIMESTONE, as above.					0		FR	R3 to R4		
247.0	**246.0 to 247.0 ft.** - LIMESTONE, as above.					0		FR	R3 to R4		
248.0	**247.0 to 248.0 ft.** - LIMESTONE, as above.					0		FR	R3 to R4		20.9% O_2, 0% LEL, 0 ppm.
151.0											**Boring Depth: 248 ft. bgs.**
152.0											
153.0											
154.0											
155.0											

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helpers: Rob Underwood, Ben Williams
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt, Herst & Associates, Inc.

LIMESTONE

Well Coordinates:
N 1066824.035
E 516773.117

Drilling Contractor: Frontz Drilling
Lead Driller: Rob Hamilton
Drilling Dates: October 15-16, 2013



Top of Steel Cover: 487.31

Top of Casing: 487.00

Ground Surface Elevation: 484.48

Top of Steel Cover: + 2.83

Top of Casing: + 2.52

Lock installed: (yes)/ no

Ground Surface: 0.0

Top of Annular Seal: 482.48

Bottom of Steel Cover: 482.00

Depth to Groundwater: 459.69

Elevation values, In feet above Mean Sea Level

Top of Annular Seal: - 2.0

Bottom of Steel Cover: - 2.48

Depth to Groundwater: - 24.79

Depth values, In feet above (+) or below (-) Ground Surface

Top of Bentonite Seal: 254.48

Top of Sand Pack: 249.48

Top of Screen: 246.48

Bottom of Screen: 236.48

Total Depth: 236.48

Top of Bentonite Seal: - 230.00

Top of Sand Pack: - 235.00

Top of Screen: - 238.00

Bottom of Screen: - 248.00

Total Depth: - 248.00

(Not to Scale)

Borehole Diameter: 9-inch OD for Soil
6-inch OD for Rock

Centralizer (s): Yes, at base of Screen and 5 feet above top of Screen

Type of Annular Seal: Bentonite Grout

Grouting Method: Tremie
Grout Thickness: 228 feet

Casing Material: Schedule 80 PVC
Casing Diameter: 2 inches
Casing Length (including Screen): 248 feet

Date of Groundwater Measurement: October 24, 2013

Type of Bentonite Seal: Bentonite Plug Chips

Bentonite Seal Thickness: 5 feet

Type of Sand Pack: Silica Sand

Sand Pack Thickness: 13 feet
Number of Bags of Sand: 4

Screen Slot Size: 0.01 in.
Screen Material: Schedule 80 PVC
Screen Diameter: 2 inches
Screen Length: 10 feet

Depth of Borehole Backfill: N/A
Collapse Footage: N/A

4631 North St. Peters Parkway
St. Charles, Missouri 63304
Phone (636) 939-9111
Fax (636) 939-9757
HERST & ASSOCIATES, INC.®

Bridgeton Landfill
Bridgeton, Missouri

PZ-210-SD
As-Built Diagram

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM
MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED	
REFERENCE NO		
C.R. NO	CHECK NO	
STATE WELL NUMBER	REVENUE NO	
ENTERED Ph1 Ph2 Ph3	APPROVED BY	ROUTE

INFORMATION SUPPLIED BY PRIMARY CONTRACTOR OR DRILLING CONTRACTOR
NOTE: THIS FORM IS NOT TO BE USED FOR NESTED WELLS

OWNER NAME: Republic services
CONTACT NAME: Bryan Sehie
VARIANCE GRANTED BY DNR NUMBER:
OWNER ADDRESS: 13570 Saint Charles Rock Rd.
CITY: Bridgeton
STATE: MO
ZIP CODE: 63044
SITE NAME: Bridgeton Sanitary Landfill
WELL NUMBER: PZ-210-SD
COUNTY: Saint Louis
SITE ADDRESS: 13570 Saint Charles Rock Rd.
CITY: Bridgeton
STATIC WATER LEVEL: 27.31

SURFACE COMPLETION
TYPE: ☑ ABOVE GROUND ☐ FLUSH MOUNT
LENGTH AND DIAMETER OF SURFACE COMPLETION: LENGTH 2.5 FT. DIAMETER 5 IN.
DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: DIAMETER 5 IN. LENGTH 2.5 FT.
SURFACE COMPLETION GROUT: ☑ CONCRETE ☐ OTHER

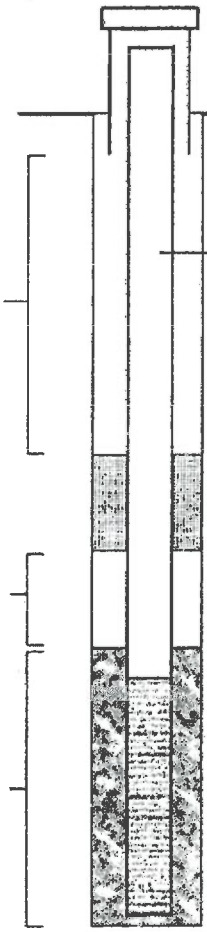
LOCATION OF WELL (D/M/S FORMAT ONLY)
LAT. 38 · 45 · 49.4 "
LONG. 90 · 26 · 21.8 "

SMALLEST ___ ¼ ___ ¼ LARGEST ___ ¼
SECTION ___ TOWNSHIP 47 NORTH
RANGE 5 ☑ EAST ☐ WEST

MONITORING FOR: (CHECK ALL THAT APPLY)
☑ RADIONUCLIDES ☐ PETROLEUM PRODUCTS ONLY
☐ EXPLOSIVES ☑ METALS ☑ VOC
☑ SVOCS ☑ PESTICIDES/HERBICIDES

PROPOSED USE OF WELL
☐ GAS MIGRATION WELL ☑ OBSERVATION
☐ EXTRACTION WELL ☐ OPEN HOLE
☐ PIEZOMETERS ☐ INJECTION WELL
☐ DIRECT PUSH

☑ LOCKING CAP
☑ WEEP HOLE



ELEVATION 481.29 FT.

ANNULAR SEAL
LENGTH 228 FT.
☑ SLURRY ☐ CHIPS
☐ PELLETS ☐ GRANULAR
☐ CEMENT/SLURRY
IF CEMENT/BENTONITE MIX:
BAGS OF CEMENT USED ___
% OF BENTONITE USED ___
WATER USED/BAG 360 GAL.

SECONDARY FILTER PACK
LENGTH Ø FT.

DEPTH TO TOP OF PRIMARY FILTER PACK 235 FT.

LENGTH OF PRIMARY FILTER PACK 13 FT.

SURFACE COMPLETION
☑ STEEL ☐ ALUMINUM ☐ PLASTIC

RISER
RISER PIPE DIAMETER 2 IN.
RISER PIPE LENGTH 240 FT.
DIAMETER OF DRILL HOLE 6 IN.
WEIGHT OR SDR# Sch80
MATERIAL: ☐ STEEL ☑ THERMOPLASTIC (PVC) ☐ OTHER

BENTONITE SEAL
LENGTH 5 Foot
☑ CHIPS ☐ PELLETS ☐ GRANULAR ☐ SLURRY
☑ SATURATED ZONE ☐ HYDRATED

SCREEN
SCREEN DIAMETER 2 IN.
SCREEN LENGTH 10 FT.
DIAMETER OF DRILL HOLE 6 IN.
DEPTH TO TOP 238 FT.
SCREEN MATERIAL: ☐ STEEL ☑ THERMOPLASTIC (PVC) ☐ OTHER

DEPTH TO	DEPTH FROM	FORMATION DESCRIPTION
0'	45'	Silty Clay
45'	248'	Limestone
TOTAL DEPTH:		248 Foot

FOR CASED WELLS, SUBMIT ADDITIONAL AS BUILT DIAGRAMS SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE & SIZE OF ALL CASING, HOLE DIAMETER & GROUT USED.

SIGNATURE (PRIMARY CONTACTOR) | PERMIT NUMBER 003839M | DATE WELL DRILLING WAS COMPELTED 10-16-13

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH MISSOURI DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS. ☐ PUMP INSTALLED

SIGNATURE (WELL DRILLER) | PERMIT NUMBER 003456-M | SIGNATURE (OF APPRENTICE) | APPRENTICE PERMIT NUMBER

MO 780-1415 (07-11)
DISTRIBUTION: WHITE/DIVISION CANARY/CONTACTOR PINK/OWNER
RETURN WHITE COPY WITH APPROPRIATE FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, DIVISION OF GEOLOGY AND LAND SURVEY, WELLHEAD PROTECTION SECTION, PO BOX 250, ROLLA, MO 65402 573-368-2165

HERST & ASSOCIATES, INC.®

Hole Number: PZ-211-SS

Rock Log

Local Site Coordinates: 1067061.27 N, 517021.26 E Ground Surface Elevation: 485.05

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 7, 2013

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
0.0	**0.0 to 132.0 ft.** - Blind drilled. No sample collected.									Meter: Solinst Model 107 TLC	Blind-drilled from 0 - 132 ft; no samples collected. 0 - 50 ft drilled via air rotary. O_2 (%), methane (%LEL), and VOCs (ppm) monitored at borehole.
5.0										57.4	
10.0										57.4	20.9% O_2, 0% LEL, 0 ppm.
15.0										57.4	
20.0										57.4	20.9% O_2, 0% LEL, 0.8 ppm (peak).
25.0										57.4	
30.0										57.1	20.9% O_2, 0% LEL, 0 ppm.
35.0										57.1	
40.0										57.1	20.9% O_2, 0% LEL, 0 ppm.
45.0										57.1	
50.0										57.1	

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helpers: Rob Underwood, Ben Williams
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt, Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-211-SS

Rock Log

Local Site Coordinates: 1067061.27 N, 517021.26 E Ground Surface Elevation: 485.05

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Drilling Date(s): October 7, 2013

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular

P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-Very Rough

Fe-Iron, CL-Clay, CaCO3-Calcite

FR-Fresh, SW-Slightly Weathered, MW-Moderately Weathered, HW- Highly Weathered, CW-Completely Weathered

R6- Extremely Strong, R5- Very Strong, R4- Strong, R3- Medium Strong, R2- Weak, R1-Very Weak, R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
50.0	**0.0 to 132.0 ft.** - Blind drilled. No sample collected.									57.1	Set temporary 8-in. D casing 5 ft into bedrock. Switched to sonic drilling. Continued drilling through casing. 20.9% O_2, 0% LEL, 0 ppm.
55.0										57.1	
60.0										57.1	20.9% O_2, 0% LEL, 0 ppm..
65.0										57.1	
70.0										57.1	
75.0										57.1	
80.0										57.1	20.9% O_2, 0% LEL, 0 ppm.
85.0										57.1	
90.0										57.1	
95.0										56.9	
100.0										56.9	20.9% O_2, 0% LEL, 0 ppm.

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
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LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-211-SS

Rock Log

Local Site Coordinates: 1067061.27 N, 517021.26 E Ground Surface Elevation: 485.05

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 7, 2013

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular

P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-Very Rough

Fe-Iron, CL-Clay, CaCO3-Calcite

FR-Fresh, SW-Slightly Weathered, MW-Moderately Weathered, HW- Highly Weathered, CW-Completely Weathered

R6- Extremely Strong, R5- Very Strong, R4- Strong, R3- Medium Strong, R2- Weak, R1-Very Weak, R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
100.0										56.9	20.9% O_2, 0% LEL, 0 ppm.
	0.0 to 132.0 ft. - Blind drilled. No sample collected.										
105.0											
110.0										56.9	
115.0										56.9	
120.0										56.9	20.9% O_2, 0% LEL, 0 ppm.
125.0										56.7	
130.0										56.7	
132.0											20.9% O_2, 0% LEL, 0 ppm.

Change in scale see sheet 4 of 5

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helpers: Rob Underwood, Ben Williams
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt, Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-211-SS

Rock Log

Local Site Coordinates: 1067061.27 N, 517021.26 E Ground Surface Elevation: 485.05

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Drilling Date(s): October 7, 2013

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular

P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-Very Rough

Fe-Iron, CL-Clay, CaCO3-Calcite

FR-Fresh, SW-Slightly Weathered, MW-Moderately Weathered, HW- Highly Weathered, CW-Completely Weathered

R6- Extremely Strong, R5- Very Strong, R4- Strong, R3- Medium Strong, R2- Weak, R1-Very Weak, R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
132.0											
133.0	**132.0 to 133.0 ft.** - LIMESTONE, yellowish gray (5Y 8/1) to light olive gray (5Y 6/1). With pale yellowish brown (10YR 6/2), dark yellowish brown (10YR 4/2), dark gray (N3), brownish gray (5YR 4/1), olive gray (5Y 4/1) mottling. Microcrystalline; massive to laminated; competent. Requires multiple hammer blows to fracture, but easily scratched with knife. Reactive with with 10% HCl solution.		1 of 2	4.9 / 5.0	4.9 / 4.9	0		FR	R4		20.9% O_2, 0% LEL, 0 ppm.
134.0	**133.0 to 134.0 ft.** - LIMESTONE, as above, but pale yellowish brown (10YR 6/2), yellowish gray (5Y 8/1), and light olive gray (5Y 6/1). Slightly weathered at 133.8 ft: surface discoloration on fracture, weaker along bedding planes, can easily be broken by hand in spots (R1 to R2). Surface discoloration of olive gray (5Y 4/1) and dark greenish gray (5GY 4/1) on fracture. Light gray(N7) to yellowish gray (5Y 8/1) filling of cavities near fracture; some mineralization.					1	[133.8] 70°, J or B, I, R	FR to SW	R3		
135.0	**134.0 to 135.0 ft.** - LIMESTONE, as above, but yellowish gray (5Y 8/1) to light olive gray (5Y 6/1). With some blotches of greenish gray (5G 6/1). Little mottling or spotting; more uniform in color than above. Massive.					0		FR	R4	56.7	
136.0	**135.0 to 136.0 ft.** - LIMESTONE, as above, but yellowish gray (5Y 8/1), light olive gray (5Y 6/1), and greenish gray (5G 6/1).					0		FR	R3 to R4		
137.0	**136.0 to 137.0 ft.** - LIMESTONE, as above, but with white (N9) spotting. Massive, with some lamination and very thin bedding from 136.6 - 136.8 ft. Moderately healed irregular bedding joints from 136.6 - 136.7 ft. Very light gray (N8), light olive gray (5Y 6/1), and olive gray (5Y 4/1) near joints.					0		FR	R4		20.9% O_2, 0% LEL, 0 ppm.
138.0	**137.0 to 138.0 ft.** - LIMESTONE, light olive gray (5Y 6/1). With pale yellowish brown (10YR 6/2), dark yelloish brown (10YR 4/2), white (N9), medium gray (N5), medium bluish gray (5B 5/1) mottling and spotting. Microcrystalline; massive; competent. Requires one hammer blow to fracture, but easily scratched with knife. Reactive with with 10% HCl solution. Some lamination at 137.8 ft.		2 of 2	9.1 / 10.0	9.1 / 9.1	0		FR	R3		
139.0	**138.0 to 139.0 ft.** - LIMESTONE, as above, but pale yellowish brown (10YR 6/2) and light olive gray (5Y 6/1). With dark yellowish brown (10YR 4/2), white (N9), olive gray (5Y 4/1) mottling. Microcrystalline to fine-grained. Slightly weathered from 138.4 - 138.9 ft: some lamination, weaker along bedding planes, can be broken by hand with difficulty (R2). With olive gray (5Y 4/1) in weathered interval.					0		FR to SW	R3		
140.0	**139.0 to 140.0 ft.** - LIMESTONE, as above, but light olive gray (5Y 6/1). With white (N9), light gray (N7), and olive gray (5Y 4/1) mottling and spots. Microcrystalline to fine-grained; massive to laminated. Possible moderate healing of bedding joints from 139.3 - 139.4 ft.					0		FR	R4	56.7	
141.0	**140.0 to 141.0 ft.** - LIMESTONE, as above, but very light gray (N8), yellowish gray (5Y 8/1), and light olive gray (5Y 6/1). With mottling of olive gray (5Y 4/1) and greenish gray (5G 6/1). Moderately healed irregular bedding joint at 140.3 ft.					0		FR	R4		
142.0	**141.0 to 142.0 ft.** - LIMESTONE, as above, but yellowish gray (5Y 8/1) to light olive gray (5Y 6/1). Little mottling; more uniform in color than above. Microcrystalline; massive.					0		FR	R4		

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helpers: Rob Underwood, Ben Williams
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt, Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-211-SS

Rock Log

Local Site Coordinates: 1067061.27 N, 517021.26 E Ground Surface Elevation: 485.05

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 7, 2013

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

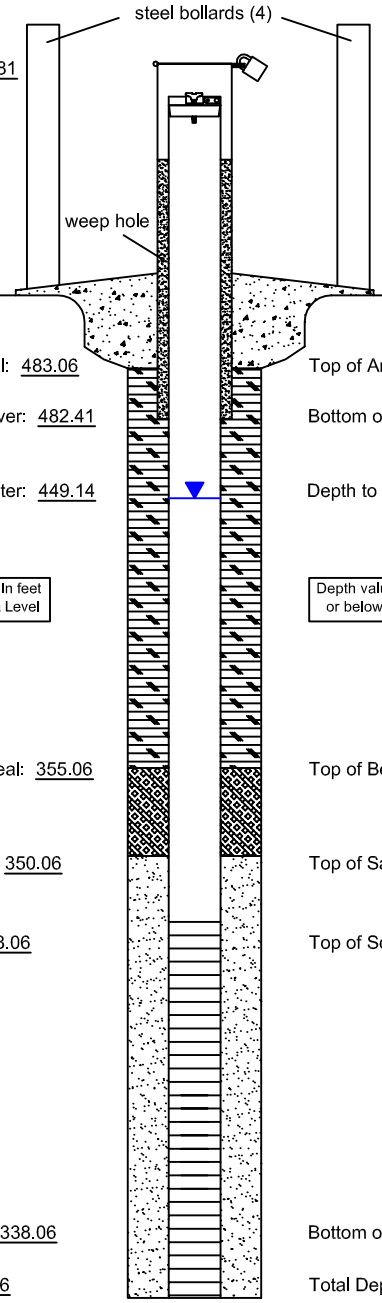
Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
142.0											
143.0	**142.0 to 143.0 ft.** - LIMESTONE, as above, but yellowish gray (5Y 8/1). Fine (< 1 mm) veins, pale green (10G 6/2) and medium bluish gray (5B 5/1).					0		FR	R4		
144.0	**143.0 to 144.0 ft.** - LIMESTONE, as above, but yellowish gray (5Y 8/1). Uniform in color.					0		FR	R4		
145.0	**144.0 to 145.0 ft.** - LIMESTONE, as above.					0		FR	R3		
146.0	**145.0 to 146.0 ft.** - LIMESTONE, as above, but yellowish gray (5Y 8/1) to light olive gray (5Y 6/1). With olive gray (5Y 4/1), pale yellowish brown (10YR 6/2), white (N9), and medium bluish gray (5B 5/1) spots.					0		FR	R3	56.7	
147.0	**146.0 to 147.0 ft.** - LIMESTONE, as above, but with some lamination from 146 - 146.1 ft.					0		FR	R3 to R4	56.7	20.9% O_2, 0% LEL, 0 ppm.
											Boring Depth: 147 ft. bgs.
151.0											
152.0											
153.0											
154.0											
155.0											

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helpers: Rob Underwood, Ben Williams
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt, Herst & Associates, Inc.

LIMESTONE

Well Coordinates:
N 1067060.785
E 517021.151

Drilling Contractor: Frontz Drilling
Lead Driller: Rob Hamilton
Drilling Dates: October 7-8, 2013



Top of Steel Cover: 487.81

Top of Casing: 487.41

Ground Surface Elevation: 485.06

Top of Steel Cover: + 2.75

Top of Casing: + 2.35

Lock installed: (yes)/ no

Ground Surface: 0.0

Top of Annular Seal: 483.06

Bottom of Steel Cover: 482.41

Depth to Groundwater: 449.14

Elevation values, In feet above Mean Sea Level

Top of Annular Seal: - 2.0

Bottom of Steel Cover: - 2.65

Depth to Groundwater: - 35.92

Depth values, In feet above (+) or below (-) Ground Surface

Top of Bentonite Seal: 355.06

Top of Sand Pack: 350.06

Top of Screen: 348.06

Top of Bentonite Seal: - 130.00

Top of Sand Pack: - 135.00

Top of Screen: - 137.00

Bottom of Screen: 338.06

Total Depth: 338.06

Bottom of Screen: - 147.00

Total Depth: - 147.00

(Not to Scale)

Borehole Diameter: 9-inch OD for Soil
6-inch OD for Rock

Centralizer (s): Yes, at base of Screen and 5 feet above top of Screen

Type of Annular Seal: Bentonite Grout

Grouting Method: Tremie
Grout Thickness: 128 feet

Casing Material: Schedule 80 PVC
Casing Diameter: 2 inches
Casing Length (including Screen): 147 feet

Date of Groundwater Measurement: October 9, 2013

Type of Bentonite Seal: Bentonite Plug Chips

Bentonite Seal Thickness: 5 feet

Type of Sand Pack: Silica Sand

Sand Pack Thickness: 12 feet
Number of Bags of Sand: 4

Screen Slot Size: 0.01 in.
Screen Material: Schedule 80 PVC
Screen Diameter: 2 inches
Screen Length: 10 feet

Depth of Borehole Backfill: N/A
Collapse Footage: N/A

4631 North St. Peters Parkway
St. Charles, Missouri 63304
Phone (636) 939-9111
Fax (636) 939-9757
HERST & ASSOCIATES, INC.®

Bridgeton Landfill
Bridgeton, Missouri

PZ-211-SS
As-Built Diagram

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED	
REFERENCE NO		
C.R. NO	CHECK NO	
STATE WELL NUMBER	REVENUE NO	
ENTERED Ph1 Ph2 Ph3	APPROVED BY	ROUTE

INFORMATION SUPPLIED BY PRIMARY CONTRACTOR OR DRILLING CONTRACTOR

NOTE: THIS FORM IS NOT TO BE USED FOR NESTED WELLS

OWNER NAME: Republic Services	CONTACT NAME: Bryan Sehie		VARIANCE GRANTED BY DNR NUMBER
OWNER ADDRESS: 13570 Saint Charles Rock Rd.	CITY: Bridgeton	STATE: MO	ZIP CODE: 63044
SITE NAME: Bridgeton Sanitary Landfill	WELL NUMBER: PZ-211-55		COUNTY: Saint Louis
SITE ADDRESS: 13570 Saint Charles Rock Rd.	CITY: Bridgeton		STATIC WATER LEVEL: 23.95

SURFACE COMPLETION

TYPE: ☑ ABOVE GROUND ☐ FLUSH MOUNT

LENGTH AND DIAMETER OF SURFACE COMPLETION: LENGTH 2.5 FT. DIAMETER 5 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: DIAMETER 5 IN. LENGTH 2.5 FT.

SURFACE COMPLETION GROUT: ☑ CONCRETE ☐ OTHER _____

LOCATION OF WELL (D/M/S FORMAT ONLY): LAT. 38 . 45 . 47.8 . LONG. 90 . 26 . 34.6 .

SMALLEST ___ ¼ ___ ¼ LARGEST ___ ¼

SECTION ___ TOWNSHIP 47 NORTH

RANGE 5 ☑ EAST ☐ WEST

MONITORING FOR: (CHECK ALL THAT APPLY)
☑ RADIONUCLIDES ☐ PETROLEUM PRODUCTS ONLY
☐ EXPLOSIVES ☑ METALS ☑ VOC
☑ SVOCS ☑ PESTICIDES/HERBICIDES

PROPOSED USE OF WELL
☐ GAS MIGRATION WELL ☑ OBSERVATION
☐ EXTRACTION WELL ☐ OPEN HOLE
☐ PIEZOMETERS ☐ INJECTION WELL
☐ DIRECT PUSH

☑ LOCKING CAP
☑ WEEP HOLE

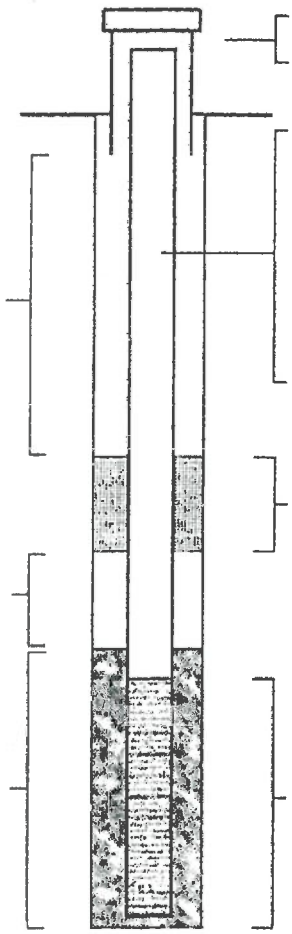
ELEVATION 485.21 FT.

ANNULAR SEAL
LENGTH 128 FT.
☑ SLURRY ☐ CHIPS
☐ PELLETS ☐ GRANULAR
☐ CEMENT/SLURRY
IF CEMENT/BENTONITE MIX:
BAGS OF CEMENT USED ___
% OF BENTONITE USED ___
WATER USED/BAG 360 GAL.

SECONDARY FILTER PACK
LENGTH 0 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK 135 FT.

LENGTH OF PRIMARY FILTER PACK 12 FT.



SURFACE COMPLETION
☑ STEEL ☐ ALUMINUM ☐ PLASTIC

RISER
RISER PIPE DIAMETER 2 IN.
RISER PIPE LENGTH 139 FT.
DIAMETER OF DRILL HOLE 6 IN.
WEIGHT OR SDR# Sch 80
MATERIAL
☐ STEEL ☑ THERMOPLASTIC (PVC)
☐ OTHER _____

BENTONITE SEAL
LENGTH 5 Foot
☑ CHIPS ☐ PELLETS ☐ GRANULAR
☐ SLURRY
☑ SATURATED ZONE ☐ HYDRATED

SCREEN
SCREEN DIAMETER 2 IN.
SCREEN LENGTH 10 FT.
DIAMETER OF DRILL HOLE 6 IN.
DEPTH TO TOP 137 FT.
SCREEN MATERIAL
☐ STEEL ☑ THERMOPLASTIC (PVC)
☐ OTHER _____

DEPTH TO	DEPTH FROM	FORMATION DESCRIPTION
0'	45'	Silty Clay
45'	147'	Limestone
TOTAL DEPTH:		147 Foot

FOR CASED WELLS, SUBMIT ADDITIONAL AS BUILT DIAGRAMS SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE & SIZE OF ALL CASING, HOLE DIAMETER & GROUT USED.

SIGNATURE (PRIMARY CONTACTOR)	PERMIT NUMBER	DATE WELL DRILLING WAS COMPELTED
	003839-M	10-8-13

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH MISSOURI DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS. ☐ PUMP INSTALLED

SIGNATURE (WELL DRILLER)	PERMIT NUMBER	SIGNATURE (OF APPRENTICE)	APPRENTICE PERMIT NUMBER
	003456-M		

MO 780-1415 (07-11)

DISTRIBUTION: WHITE/DIVISION CANARY/CONTACTOR PINK/OWNER
RETURN WHITE COPY WITH APPROPRIATE FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, DIVISION OF GEOLOGY AND LAND SURVEY, WELLHEAD PROTECTION SECTION, PO BOX 250, ROLLA, MO 65402 573-368-2165

HERST & ASSOCIATES, INC.®

Hole Number: PZ-211-SD

Rock Log

Local Site Coordinates: 1067056.90 N, 517015.98 E Ground Surface Elevation: 484.82

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 6, 2013

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular

P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-Very Rough

Fe-Iron, CL-Clay, CaCO3-Calcite

FR-Fresh, SW-Slightly Weathered, MW-Moderately Weathered, HW- Highly Weathered, CW-Completely Weathered

R6- Extremely Strong, R5- Very Strong, R4- Strong, R3- Medium Strong, R2- Weak, R1-Very Weak, R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
0.0	**0.0 to 232.0 ft.** - Blind drilled. No sample collected.									Meter: Solinst Model 107 TLC	Blind-drilled from 0 - 232 ft; no samples collected. 0 - 50 ft drilled via air rotary. O_2 (%), methane (%LEL), and VOCs (ppm) monitored at borehole.
5.0										57.9	
10.0										57.6	20.4% O_2, 40% LEL, 18.1 ppm.
15.0										57.6	
20.0										57.6	20.9% O_2, 0% LEL, 0 ppm.
25.0										57.6	
30.0										57.6	
35.0										57.6	
40.0										57.6	
45.0										57.4	Competent bedrock encountered.
50.0										57.4	

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helpers: Rob Underwood, Ben Williams
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Steve Jett, Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-211-SD

Rock Log

Local Site Coordinates: 1067056.90 N, 517015.98 E Ground Surface Elevation: 484.82

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

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Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
50.0	**0.0 to 232.0 ft.** - Blind drilled. No sample collected.									57.4	Set temporary 8-in. D casing 5 ft into bedrock. Continued drilling through casing.
55.0										57.4	
60.0										57.4	
65.0										57.4	
70.0										57.4	
75.0										57.4	
80.0										57.4	20.9% O_2, 0% LEL, 0 ppm.
85.0										57.4	
90.0										57.4	
95.0										57.4	
100.0										57.4	20.9% O_2, 0% LEL, 0 ppm.

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LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-211-SD

Rock Log

Local Site Coordinates: 1067056.90 N, 517015.98 E Ground Surface Elevation: 484.82

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Drilling Date(s): October 6, 2013

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular

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FR-Fresh, SW-Slightly Weathered, MW-Moderately Weathered, HW- Highly Weathered, CW-Completely Weathered

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Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
100.0	**0.0 to 232.0 ft.** - Blind drilled. No sample collected.									57.4	20.9% O_2, 0% LEL, 0 ppm.
105.0										57.4	
110.0										57.4	
115.0										57.4	
120.0										57.4	20.9% O_2, 0% LEL, 0 ppm..
125.0										57.4	
130.0										57.4	
135.0										57.4	
140.0										57.4	20.9% O_2, 0% LEL, 0 ppm.
145.0										57.4	
150.0										57.4	

Drilling Contractor: Frontz Drilling, Inc.
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LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-211-SD

Rock Log

Local Site Coordinates: 1067056.90 N, 517015.98 E Ground Surface Elevation: 484.82

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 6, 2013

Project No.: 120131675

Site Location: Bridgeton, Missouri

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
150.0										57.4	
	0.0 to 232.0 ft. - Blind drilled. No sample collected.										
155.0										57.1	
160.0										57.1	20.9% O_2, 0% LEL, 0 ppm.
165.0										57.1	
170.0										56.9	
175.0										56.7	
180.0										56.5	20.9% O_2, 0% LEL, 0 ppm.
185.0										56.5	
190.0										56.2	
195.0										56.2	
200.0										56.2	20.9% O_2, 0% LEL, 0 ppm.

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
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LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-211-SD

Rock Log

Local Site Coordinates: 1067056.90 N, 517015.98 E Ground Surface Elevation: 484.82

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Drilling Date(s): October 6, 2013

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular

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Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
200.0	**0.0 to 232.0 ft.** - Blind drilled. No sample collected.									56.2	20.9% O_2, 0% LEL, 0 ppm.
205.0										56.2	
210.0										56.2	
215.0										56.2	
220.0										56.2	20.9% O_2, 0% LEL, 0 ppm.
225.0										56.2	
230.0										56.0	20.9% O_2, 0% LEL, 0 ppm. Weathered fracture.
232.0											

Change in scale see sheet 6 of 7

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helpers: Rob Underwood, Ben Williams
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Steve Jett, Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-211-SD

Rock Log

Local Site Coordinates: 1067056.90 N, 517015.98 E Ground Surface Elevation: 484.82

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Drilling Date(s): October 6, 2013

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
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Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
232.0	**232.0 to 233.0 ft.** - LIMESTONE, medium gray (N6). Medium-grained; massive; competent; fresh.		1 of 2	4.8/5.0	3.2/5.0	1	85°, PL	FR	R5	55.6	20.9% O_2, 0% LEL, 0 ppm. Weathered fracture.
233.0						0		FR	R5		
234.0						2	90°, PL; 90°, PL	FR	R5		Weathered fracture with very dark gray deposits; slightly weathered fracture with small amounts of dark gray deposits.
235.0						0		FR	R5		
236.0						0		FR	R5		
237.0											
238.0	**240.0 to 241.0 ft.** - LIMESTONE, as above.		2 of 2	9.6/10.0	6.8/10.0	5	90°, PL (all 5)	FR	R5	55.4	
239.0						4	90°, PL (all 4)	FR	R5		
240.0						3	80°, PL (all 3)	FR	R5		
241.0						2	90°, PL; 90°, PL	FR	R5		
242.0						1	90°, PL	FR	R5		

Drilling Contractor: Frontz Drilling, Inc.
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Helpers: Rob Underwood, Ben Williams
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Steve Jett, Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-211-SD

Rock Log

Local Site Coordinates: 1067056.90 N, 517015.98 E Ground Surface Elevation: 484.82

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Drilling Date(s): October 6, 2013

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

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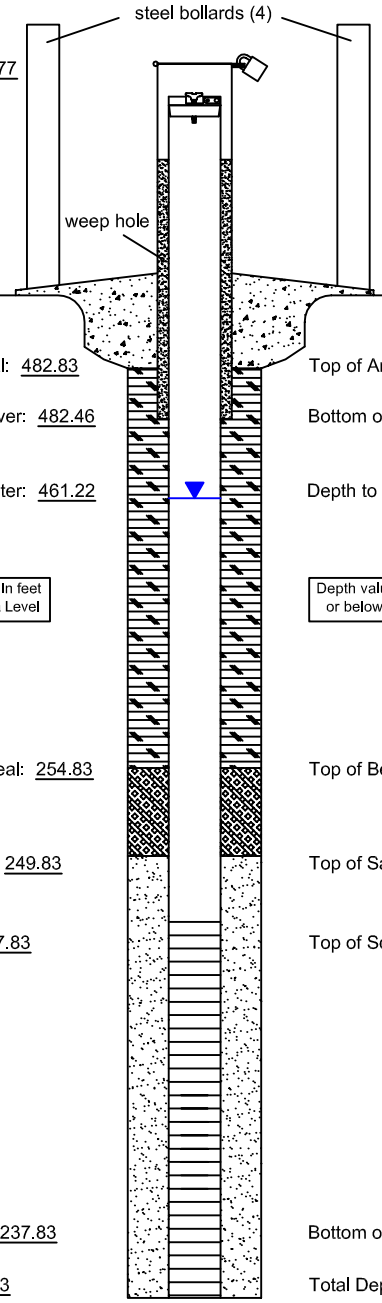
Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
242.0											
243.0						2	90°, PL; 90°, PL	FR	R5		
244.0						1	90°, PL	FR	R5		
245.0	**244.0 to 245.0 ft.** - LIMESTONE, medium gray (N6) with light brownish gray (5YR 6/1). Medium-grained; massive; competent; fresh.					0		FR	R5	55.6	
246.0	**245.0 to 246.0 ft.** - LIMESTONE, 245.2 to 246 ft. light brownish gray (5YR 6/1) with mixture of dark gray (N4). Medium to coarse-grained; massive; competent; fresh.					2	90°, PL; 90°, PL	FR	R5		
247.0	**246.0 to 247.0 ft.** - LIMESTONE, dark gray (N4). Coarse-grained; massive; competent; fresh.					3	80°, PL; 90°, PL; 75°, PL	FR	R5	55.6	20.9% O_2, 0% LEL, 0 ppm.
248.0											**Boring Depth: 247 ft. bgs.**
249.0											
250.0											
251.0											
252.0											

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helpers: Rob Underwood, Ben Williams
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Steve Jett, Herst & Associates, Inc.

LIMESTONE

Well Coordinates:
N 1067056.698
E 517016.608

Drilling Contractor: Frontz Drilling
Lead Driller: Rob Hamilton
Drilling Dates: October 6-7, 2013



Top of Steel Cover: 487.77

Top of Casing: 487.46

Ground Surface Elevation: 484.83

Top of Steel Cover: + 2.94

Top of Casing: + 2.63

Lock installed: (yes)/ no

Ground Surface: 0.0

Top of Annular Seal: 482.83

Bottom of Steel Cover: 482.46

Depth to Groundwater: 461.22

Elevation values, In feet above Mean Sea Level

Top of Annular Seal: - 2.0

Bottom of Steel Cover: - 2.37

Depth to Groundwater: - 23.61

Depth values, In feet above (+) or below (-) Ground Surface

Top of Bentonite Seal: 254.83

Top of Sand Pack: 249.83

Top of Screen: 247.83

Bottom of Screen: 237.83

Total Depth: 237.83

Top of Bentonite Seal: - 230.00

Top of Sand Pack: - 235.00

Top of Screen: - 237.00

Bottom of Screen: - 247.00

Total Depth: - 247.00

(Not to Scale)

Borehole Diameter: 9-inch OD for Soil
6-inch OD for Rock

Centralizer (s): Yes, at base of Screen and 5 feet above top of Screen

Type of Annular Seal: Bentonite Grout

Grouting Method: Tremie
Grout Thickness: 228 feet

Casing Material: Schedule 80 PVC
Casing Diameter: 2 inches
Casing Length (including Screen): 247 feet

Date of Groundwater Measurement: October 9, 2013

Type of Bentonite Seal: Bentonite Plug Chips

Bentonite Seal Thickness: 5 feet

Type of Sand Pack: Silica Sand

Sand Pack Thickness: 12 feet
Number of Bags of Sand: 4

Screen Slot Size: 0.01 in.
Screen Material: Schedule 80 PVC
Screen Diameter: 2 inches
Screen Length: 10 feet

Depth of Borehole Backfill: N/A
Collapse Footage: N/A

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Bridgeton, Missouri

PZ-211-SD
As-Built Diagram

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

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ENTERED Ph1 Ph2 Ph3	APPROVED BY	ROUTE

INFORMATION SUPPLIED BY PRIMARY CONTRACTOR OR DRILLING CONTRACTOR

NOTE THIS FORM IS NOT TO BE USED FOR NESTED WELLS

OWNER NAME: Republic Services	CONTACT NAME: Bryan Sehie		VARIANCE GRANTED BY DNR NUMBER
OWNER ADDRESS: 13570 Saint Charles Rock Rd.	CITY: Bridgeton	STATE: MO	ZIP CODE: 63044
SITE NAME: Bridgeton Sanitary Landfill	WELL NUMBER: PZ-211-SD		COUNTY: Saint Louis
SITE ADDRESS: 13570 Saint Charles Rock Rd.	CITY: Bridgeton		STATIC WATER LEVEL: 26.24

SURFACE COMPLETION

TYPE: ☑ ABOVE GROUND ☐ FLUSH MOUNT

LENGTH AND DIAMETER OF SURFACE COMPLETION: LENGTH 2.5 FT. DIAMETER 5 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: DIAMETER 5 IN. LENGTH 2.5 FT.

SURFACE COMPLETION GROUT: ☑ CONCRETE ☐ OTHER _____

LOCATION OF WELL (D/M/S FORMAT ONLY): LAT. 38 . 45 . 47.8 . LONG. 90 . 26 . 30.6

SMALLEST ____ ¼ ____ ¼ LARGEST ____ ¼

SECTION ____ TOWNSHIP 47 NORTH

RANGE 5 ☑ EAST ☐ WEST

MONITORING FOR: (CHECK ALL THAT APPLY)
☑ RADIONUCLIDES ☐ PETROLEUM PRODUCTS ONLY
☐ EXPLOSIVES ☑ METALS ☑ VOC
☑ SVOCS ☑ PESTICIDES/HERBICIDES

PROPOSED USE OF WELL
☐ GAS MIGRATION WELL ☑ OBSERVATION
☐ EXTRACTION WELL ☐ OPEN HOLE
☐ PIEZOMETERS ☐ INJECTION WELL
☐ DIRECT PUSH

☑ LOCKING CAP
☑ WEEP HOLE

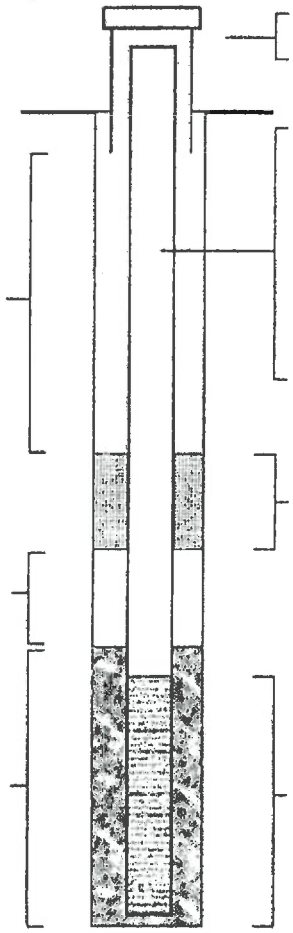
ELEVATION 485.21 FT.

ANNULAR SEAL
LENGTH 228 FT.
☑ SLURRY ☐ CHIPS
☐ PELLETS ☐ GRANULAR
☐ CEMENT/SLURRY
IF CEMENT/BENTONITE MIX:
BAGS OF CEMENT USED ____
% OF BENTONITE USED ____
WATER USED/BAG 440 GAL.

SECONDARY FILTER PACK
LENGTH Ø FT.

DEPTH TO TOP OF PRIMARY FILTER PACK 235 FT.

LENGTH OF PRIMARY FILTER PACK 12 FT.



SURFACE COMPLETION
☑ STEEL ☐ ALUMINUM ☐ PLASTIC

RISER
RISER PIPE DIAMETER 2 IN.
RISER PIPE LENGTH 239 FT.
DIAMETER OF DRILL HOLE 6 IN.
WEIGHT OR SDR# Sch 80

MATERIAL
☐ STEEL ☑ THERMOPLASTIC (PVC)
☐ OTHER _____

BENTONITE SEAL
LENGTH 5 Foot
☑ CHIPS ☐ PELLETS ☐ GRANULAR
☐ SLURRY
☑ SATURATED ZONE ☐ HYDRATED

SCREEN
SCREEN DIAMETER 2 IN.
SCREEN LENGTH 10 FT.
DIAMETER OF DRILL HOLE 6 IN.
DEPTH TO TOP 237 FT.

SCREEN MATERIAL
☐ STEEL ☑ THERMOPLASTIC (PVC)
☐ OTHER _____

DEPTH TO	DEPTH FROM	FORMATION DESCRIPTION
0'	45'	Silty Clay
45'	247'	Limestone
TOTAL DEPTH:		247 Foot

FOR CASED WELLS, SUBMIT ADDITIONAL AS BUILT DIAGRAMS SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE & SIZE OF ALL CASING, HOLE DIAMETER & GROUT USED.

SIGNATURE (PRIMARY CONTACTOR)	PERMIT NUMBER	DATE WELL DRILLING WAS COMPELTED
[signature]	003859M	10-7-13

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH MISSOURI DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS. ☐ PUMP INSTALLED

SIGNATURE (WELL DRILLER)	PERMIT NUMBER	SIGNATURE (OF APPRENTICE)	APPRENTICE PERMIT NUMBER
[signature]	003456-M		

MO 780-1415 (07-11)

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HERST & ASSOCIATES, INC.®

Hole Number: PZ-212-SS

Rock Log

Local Site Coordinates: 1067490.67 N, 517977.49 E Ground Surface Elevation: 480.15

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Drilling Date(s): October 18, 2013

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular

P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-Very Rough

Fe-Iron, CL-Clay, CaCO3-Calcite

FR-Fresh, SW-Slightly Weathered, MW-Moderately Weathered, HW- Highly Weathered, CW-Completely Weathered

R6- Extremely Strong, R5- Very Strong, R4- Strong, R3- Medium Strong, R2- Weak, R1-Very Weak, R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
0.0	**0.0 to 150.0 ft.** - Blind drilled. No sample collected.									Meter: Solinst Model 107 TLC	Blind-drilled enitire boring; no samples collected. Set 10 feet of 12-inch diameter steel temporary casing, then set 35 feet of 8-inch diameter steel temporary casing. Switched from air rotary to sonic and back as needed. O_2 (%), methane (%LEL), and VOCs (ppm) monitored at borehole.
5.0											
10.0	Cuttings tan/brown silty clay.										20.3% O_2, 0% LEL, 0 ppm. Very wet cuttings at 10 feet below ground surface.
15.0											
20.0	Cuttings gray/tan sand, silit, clay.										20.3% O_2, 0% LEL, 0 ppm. Wet cuttings 20 - 30 feet.
25.0											
30.0	Cuttings contain larage limestone/sandstone cobbles and wood fragments										20.3% O_2, 0% LEL, 0 ppm.
35.0											Appear to hit rock at 34 feet.
40.0											20.3% O_2, 0% LEL, 0 ppm.
45.0											
50.0											

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helper: Rob Underwood
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Steve Jett, Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-212-SS

Rock Log

Local Site Coordinates: 1067490.67 N, 517977.49 E Ground Surface Elevation: 480.15

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Drilling Date(s): October 18, 2013

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular

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FR-Fresh, SW-Slightly Weathered, MW-Moderately Weathered, HW- Highly Weathered, CW-Completely Weathered

R6- Extremely Strong, R5- Very Strong, R4- Strong, R3- Medium Strong, R2- Weak, R1-Very Weak, R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
50.0	**0.0 to 150.0 ft.** - Blind drilled. No sample collected.										
55.0											
60.0											20.9% O_2, 0% LEL, 0 ppm.
65.0											
70.0											
75.0											
80.0	Cuttings change from light gray limestone chips to brown sands and gravels.										
85.0											
90.0	Cuttings indicate back into Limestone.										Difficult to keep hole open since gravel appears to keep intruding the hole.
95.0											
100.0											20.9% O_2, 0% LEL, 0 ppm.

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helper: Rob Underwood
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Steve Jett, Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-212-SS

Rock Log

Local Site Coordinates: 1067490.67 N, 517977.49 E Ground Surface Elevation: 480.15

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 18, 2013

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular

P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-Very Rough

Fe-Iron, CL-Clay, CaCO3-Calcite

FR-Fresh, SW-Slightly Weathered, MW-Moderately Weathered, HW- Highly Weathered, CW-Completely Weathered

R6- Extremely Strong, R5- Very Strong, R4- Strong, R3- Medium Strong, R2- Weak, R1-Very Weak, R0- Extremely Weak

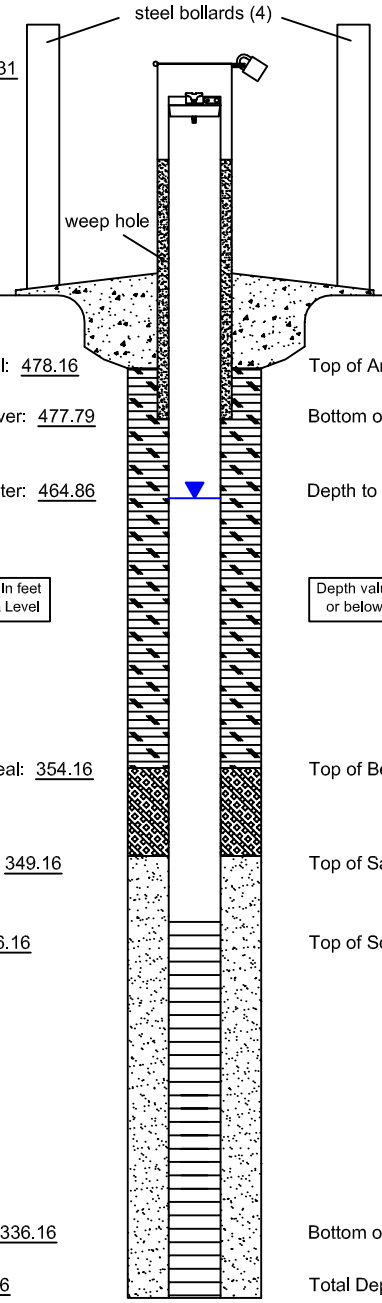
Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
100.0	**0.0 to 150.0 ft.** - Blind drilled. No sample collected.										20.9% O_2, 0% LEL, 0 ppm.
105.0											
110.0											
115.0											Decided to use this borehole for PZ-212-SS and not core, since can't keep hole open to allow coring devices.
120.0											20.9% O_2, 0% LEL, 0 ppm.
125.0											
130.0											
135.0											
140.0											20.9% O_2, 0% LEL, 0 ppm.
145.0											
150.0											

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helper: Rob Underwood
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Steve Jett, Herst & Associates, Inc.

LIMESTONE

Well Coordinates:
N 1067490.987
E 517976.455

Drilling Contractor: Frontz Drilling
Lead Driller: Rob Hamilton
Drilling Dates: October 18, 2013



Top of Steel Cover: 483.31

Top of Casing: 482.79

Ground Surface Elevation: 480.16

Top of Steel Cover: + 3.15

Top of Casing: + 2.63

Lock installed: yes / no

Ground Surface: 0.0

Top of Annular Seal: 478.16

Bottom of Steel Cover: 477.79

Depth to Groundwater: 464.86

Elevation values, In feet above Mean Sea Level

Top of Annular Seal: - 2.0

Bottom of Steel Cover: - 2.37

Depth to Groundwater: - 15.30

Depth values, In feet above (+) or below (-) Ground Surface

Top of Bentonite Seal: 354.16

Top of Sand Pack: 349.16

Top of Screen: 346.16

Top of Bentonite Seal: - 126.00

Top of Sand Pack: - 131.00

Top of Screen: - 134.00

Bottom of Screen: 336.16

Total Depth: 330.16

Bottom of Screen: - 144.00

Total Depth: - 150.00

(Not to Scale)

Borehole Diameter: 9-inch OD for Soil
6-inch OD for Rock

Centralizer (s): Yes, at base of Screen and 5 feet above top of Screen

Type of Annular Seal: Bentonite Grout

Grouting Method: Tremie
Grout Thickness: 124 feet

Casing Material: Schedule 80 PVC
Casing Diameter: 2 inches
Casing Length (including Screen): 144 feet

Date of Groundwater Measurement: October 24, 2013

Type of Bentonite Seal: Bentonite Plug Chips

Bentonite Seal Thickness: 5 feet

Type of Sand Pack: Silica Sand

Sand Pack Thickness: 13 feet
Number of Bags of Sand: 7

Screen Slot Size: 0.01 in.
Screen Material: Schedule 80 PVC
Screen Diameter: 2 inches
Screen Length: 10 feet

Depth of Borehole Backfill: 144 - 148 feet
Collapse Footage: 2 feet

4631 North St. Peters Parkway
St. Charles, Missouri 63304
Phone (636) 939-9111
Fax (636) 939-9757
HERST & ASSOCIATES, INC.®

Bridgeton Landfill
Bridgeton, Missouri

PZ-212-SS
As-Built Diagram

PZ-212-SS

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM
MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED	
REFERENCE NO		
C.R. NO	CHECK NO	
STATE WELL NUMBER	REVENUE NO	
ENTERED Ph1 Ph2 Ph3	APPROVED BY	ROUTE

INFORMATION SUPPLIED BY PRIMARY CONTRACTOR OR DRILLING CONTRACTOR
NOTE: THIS FORM IS NOT TO BE USED FOR NESTED WELLS

OWNER NAME	CONTACT NAME	VARIANCE GRANTED BY DNR
Republic Services	Bryan Sehie	NUMBER

OWNER ADDRESS	CITY	STATE	ZIP CODE
13570 Saint Charles Rock Rd.	Bridgeton	MO	63044

SITE NAME	WELL NUMBER	COUNTY
Bridgeton Sanitary Landfill	PZ-212-SS	Saint Louis

SITE ADDRESS	CITY	STATIC WATER LEVEL
13570 Saint Charles Rock Rd.	Bridgeton	19.11

SURFACE COMPLETION

TYPE: ☑ ABOVE GROUND ☐ FLUSH MOUNT

LENGTH AND DIAMETER OF SURFACE COMPLETION: LENGTH 2.5 FT. DIAMETER 5 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: DIAMETER 5 IN. LENGTH 2.5 FT.

SURFACE COMPLETION GROUT: ☑ CONCRETE ☐ OTHER _____

LOCATION OF WELL (D/M/S FORMAT ONLY)
LAT. 38 · 45 · 55.2"
LONG. 90 · 26 · 13"

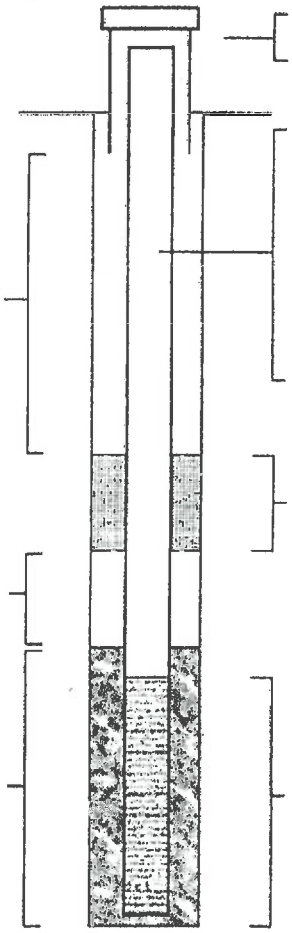
SMALLEST ___ ¼ ___ ¼ LARGEST ___ ¼
SECTION ___ TOWNSHIP 47 NORTH
RANGE 5 ☑ EAST ☐ WEST

MONITORING FOR: (CHECK ALL THAT APPLY)
☑ RADIONUCLIDES ☐ PETROLEUM PRODUCTS ONLY
☐ EXPLOSIVES ☑ METALS ☑ VOC
☑ SVOCs ☑ PESTICIDES/HERBICIDES

PROPOSED USE OF WELL
☐ GAS MIGRATION WELL ☑ OBSERVATION
☐ EXTRACTION WELL ☐ OPEN HOLE
☐ PIEZOMETERS ☐ INJECTION WELL
☐ DIRECT PUSH

☑ LOCKING CAP
☑ WEEP HOLE

ELEVATION 484.18 FT.



SURFACE COMPLETION
☑ STEEL ☐ ALUMINUM ☐ PLASTIC

RISER
RISER PIPE DIAMETER 2 IN.
RISER PIPE LENGTH 136 FT.
DIAMETER OF DRILL HOLE 6 IN.
WEIGHT OR SDR# Sch 80

MATERIAL
☐ STEEL ☑ THERMOPLASTIC (PVC)
☐ OTHER _____

ANNULAR SEAL
LENGTH 124 FT.
☑ SLURRY ☐ CHIPS
☐ PELLETS ☐ GRANULAR
☐ CEMENT/SLURRY
IF CEMENT/BENTONITE MIX:
BAGS OF CEMENT USED ___
% OF BENTONITE USED ___
WATER USED/BAG 380 GAL.

BENTONITE SEAL
LENGTH 5 Foot
☑ CHIPS ☐ PELLETS ☐ GRANULAR
☐ SLURRY
☑ SATURATED ZONE ☐ HYDRATED

SECONDARY FILTER PACK
LENGTH ___ FT.

SCREEN
SCREEN DIAMETER 2 IN.
SCREEN LENGTH 10 FT.
DIAMETER OF DRILL HOLE 6 IN.
DEPTH TO TOP 134 FT.

DEPTH TO TOP OF PRIMARY FILTER PACK 131 FT.

SCREEN MATERIAL
☐ STEEL ☑ THERMOPLASTIC (PVC)
☐ OTHER _____

LENGTH OF PRIMARY FILTER PACK 13 FT.

DEPTH TO	DEPTH FROM	FORMATION DESCRIPTION
0'	34'	Silty clay
34'	80'	Limestone
80'	85'	Sandstone Gravel
85'	144	Limestone
TOTAL DEPTH:		144 Foot

FOR CASED WELLS, SUBMIT ADDITIONAL AS BUILT DIAGRAMS SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE & SIZE OF ALL CASING, HOLE DIAMETER & GROUT USED.

SIGNATURE (PRIMARY CONTACTOR)	PERMIT NUMBER	DATE WELL DRILLING WAS COMPELTED
[signature]	003839M	10-18-13

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH MISSOURI DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS. ☐ PUMP INSTALLED

SIGNATURE (WELL DRILLER)	PERMIT NUMBER	SIGNATURE (OF APPRENTICE)	APPRENTICE PERMIT NUMBER
[signature]	003456-M		

MO 780-1415 (07-11)
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HERST & ASSOCIATES, INC.®

Hole Number: PZ-212-SD

Rock Log

Local Site Coordinates: 1067494.79 N, 517980.49 E Ground Surface Elevation: 480.48

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 19, 2013

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
0.0	**0.0 to 129.0 ft.** - Blind drilled. No sample collected.									Meter: Solinst Model 107 TLC	Blind-drilled from 0 - 129 ft; no samples collected. Switched from air rotary to sonic and back as needed. O_2 (%), methane (%LEL), and VOCs (ppm) monitored at borehole.
5.0										60.2	
10.0										60.2	20.9% O_2, 0% LEL, 0 ppm.
15.0										60.2	
20.0										60.2	20.9% O_2, 0% LEL, 0 ppm.
25.0										60.2	
30.0										60.2	20.9% O_2, 0% LEL, 0 ppm.
35.0										60.2	20.9% O_2, 0% LEL, 0 ppm.
40.0										60.2	
45.0										60.2	
50.0										60.5	20.4% O_2, 0% LEL, 0 ppm.

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helper: Rob Underwood
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt & Steve Jett Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-212-SD

Rock Log

Local Site Coordinates: 1067494.79 N, 517980.49 E Ground Surface Elevation: 480.48

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Drilling Date(s): October 19, 2013

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular

P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-Very Rough

Fe-Iron, CL-Clay, CaCO3-Calcite

FR-Fresh, SW-Slightly Weathered, MW-Moderately Weathered, HW- Highly Weathered, CW-Completely Weathered

R6- Extremely Strong, R5- Very Strong, R4- Strong, R3- Medium Strong, R2- Weak, R1-Very Weak, R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
50.0	**0.0 to 129.0 ft.** - Blind drilled. No sample collected.									60.5	20.4% O_2, 0% LEL, 0 ppm.
55.0										60.5	
60.0										60.5	20.9% O_2, 0% LEL, 0 ppm.
65.0										60.5	
70.0										60.5	20.9% O_2, 0% LEL, 0 ppm.
75.0										60.5	
80.0										60.5	Set temporary 8-in. D casing to 80 ft. Continued drilling through casing. 20.9% O_2, 0% LEL, 0 ppm.
85.0										60.5	
90.0										60.5	
95.0										60.7	
100.0										60.7	20.9% O_2, 0% LEL, 0 ppm.

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helper: Rob Underwood
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt & Steve Jett Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-212-SD

Rock Log

Local Site Coordinates: 1067494.79 N, 517980.49 E Ground Surface Elevation: 480.48

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 19, 2013

J-Joint	PL-Planar	P-Polished	Fe-Iron	FR-Fresh	R6- Extremely Strong
F-Fault	C-Curved	K-Slickensided	CL-Clay	SW-Slightly Weathered	R5- Very Strong
S-Shear	U-Undulating	SM-Smooth	CaCO3-Calcite	MW-Moderately Weathered	R4- Strong
B-Bedding	ST-Stepped	R-Rough		HW- Highly Weathered	R3- Medium Strong
F-Foliation	I-Irregular	VR-Very Rough		CW-Completely Weathered	R2- Weak
					R1-Very Weak
					R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
100.0										60.7	20.9% O_2, 0% LEL, 0 ppm.
	0.0 to 129.0 ft. - Blind drilled. No sample collected.										
105.0										60.7	
110.0										60.7	
115.0										60.7	
120.0										60.7	21.2% O_2, 0% LEL, 0 ppm.
125.0										60.7	
129.0											20.9% O_2, 0% LEL, 0 ppm.

Change in scale see sheet 4 of 5

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helper: Rob Underwood
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt & Steve Jett Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-212-SD

Rock Log

Local Site Coordinates: 1067494.79 N, 517980.49 E Ground Surface Elevation: 480.48

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Drilling Date(s): October 19, 2013

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

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P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-Very Rough

Fe-Iron, CL-Clay, CaCO3-Calcite

FR-Fresh, SW-Slightly Weathered, MW-Moderately Weathered, HW- Highly Weathered, CW-Completely Weathered

R6- Extremely Strong, R5- Very Strong, R4- Strong, R3- Medium Strong, R2- Weak, R1-Very Weak, R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
129.0											
130.0	**129.0 to 130.0 ft.** - LIMESTONE, light olive gray (5Y 6/1). With white (N9), greenish gray (5GY 6/1), and olive gray (5GY 4/1) spotting. Microcrystalline to fine-grained; massive; competent. Requires multiple hammer blows to fracture, but easily scratched with knife. Reactive with with 10% HCl solution.		1 of 4	4.7/5.0	4.7/4.7	0		F	R4	60.7	20.9% O_2, 0% LEL, 0 ppm.
131.0	**130.0 to 131.0 ft.** - LIMESTONE, as above, but with some lamination.					0		F	R3		
132.0	**131.0 to 132.0 ft.** - LIMESTONE, as above, but massive. With addition of very light gray (N8) spotting.					0		F	R4		
133.0	**132.0 to 133.0 ft.** - LIMESTONE, as above, but with addition of grenish gray (5G 6/1) spotting.					0		F	R4 to R5		
134.0	**133.0 to 134.0 ft.** - LIMESTONE, as above, but with faint grayish orange (10YR 7/4) staining at 133.5 ft. Some lamination from 133.5 - 133.7 ft. Possible moderately healed planar bedding joints. Olive gray (5Y 4/1) at healed joints.					0		F	R4 to R5		20.9% O_2, 0% LEL, 0 ppm.
135.0	**134.0 to 135.0 ft.** - LIMESTONE, light olive gray (5Y 6/1). With pale yellowish brown (10YR 6/2), white (N9), medium dark gray (N4), and olive gray (5Y 4/1) spotting. Microcrystalline; massive to laminated; competent. Easily broken by hand, easily scratched with knife. Reactive with 10% HCl solution. Slightly weathered: faint moderate yellowish brown (10YR 5/4) staining; weak along bedding planes, crumbly, can be flaked away with fingernail.		2 of 4	10.0/10.0	10.0/10.0	0		F to SW	R2 to R3	60.7	
136.0	**135.0 to 136.0 ft.** - LIMESTONE, as above, but greater lamination and more significant weathering. Surface discoloration of pale yellowish brown (10YR 6/2) and olive gray (5Y 4/1) on fracture.					1	[135.25] 90°, B, U, VR	SW	R2		
137.0	**136.0 to 137.0 ft.** - LIMESTONE, as above, but with white (N9), very light gray (N8), and olive black (5Y 2/1) spotting.					0		F to SW	R2		
138.0	**137.0 to 138.0 ft.** - LIMESTONE, as above, but with addition of pale yellowish brown (10YR 6/2), dark yellowish brown (10YR 4/2), and greenish gray (5G 6/1) spotting.					0		F	R2 to R3		
139.0	**138.0 to 139.0 ft.** - LIMESTONE, as above, but yellowish gray (5Y 8/1), light olive gray (5Y 6/1), and olive gray (5Y 4/1). With pale yellowish brown (10YR 6/2), grayish green (10G 4/2), white (N9), and greenish gray (5GY 6/1) spotting. Microcrystalline to fine-grained. Slightly weathered: weak along bedding planes, crumbly, can be flaked away with fingernail. However, less lamination than above.					0		F to SW	R2		

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helper: Rob Underwood
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt & Steve Jett Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-212-SD

Rock Log

Local Site Coordinates: 1067494.79 N, 517980.49 E Ground Surface Elevation: 480.48

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 19, 2013

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation

PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular

P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-Very Rough

Fe-Iron, CL-Clay, CaCO3-Calcite

FR-Fresh, SW-Slightly Weathered, MW-Moderately Weathered, HW- Highly Weathered, CW-Completely Weathered

R6- Extremely Strong, R5- Very Strong, R4- Strong, R3- Medium Strong, R2- Weak, R1-Very Weak, R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
139.0	**139.0 to 140.0 ft.** - LIMESTONE, as above, but microcrystalline. Surface discoloration of olive gray (5Y 4/1) on fracture.					1	[139.3] 85°, B P, R	F to SW	R2 to R3	60.7	
140.0	**140.0 to 141.0 ft.** - LIMESTONE, as above, but pale yellowish brown (10YR 6/2) and light olive gray (5Y 6/1). With dark yellowish brown (10YR 4/2) and white (N9) spotting.					0		F to SW	R2 to R3		
141.0	**141.0 to 142.0 ft.** - LIMESTONE, as above, but light olive gray (5Y 6/1). With addition of medium gray (N5) and greenish gray (5GY 6/1) mottling. More lamination than above. Very weak along bedding planes, can easily be pulled apart by hand at bedding joints. Surface discoloration of olive gray (5Y 4/1) to dark greenish gray (5GY 4/1) on fracture. Fracture somewhat conchoidal in appearance.					1	[141.7] 85°, B, I, S	F to SW	R2		
142.0	**142.0 to 143.0 ft.** - LIMESTONE, as above, but with pale yellowish brown (10YR 6/2) and white (N9) spotting; rarely, grayish black (N2) flecks.					0		F to SW	R2		
143.0	**143.0 to 144.0 ft.** - LIMESTONE, as above, but yellowish gray (5Y 8/1) and light olive gray (5Y 6/1). With greenish gray (5GY 6/1) mottling. Faint grayish orange (10YR 7/4) staining from 143.6 - 143.7 ft. Moderately healed planar bedding joint at 143.65 ft. More massive and stronger (R4) after 143.7 ft.					0		F to SW	R2 to R3		20.9% O_2, 0% LEL, 0 ppm.
144.0											

Boring Depth: 244 ft. bgs.

Change in scale see sheet 6 of 7

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helper: Rob Underwood
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt & Steve Jett Herst & Associates, Inc.

LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-212-SD

Rock Log

Local Site Coordinates: 1067494.79 N, 517980.49 E Ground Surface Elevation: 480.48

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Drilling Date(s): October 19, 2013

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-Very Rough
Fe-Iron, CL-Clay, CaCO3-Calcite
FR-Fresh, SW-Slightly Weathered, MW-Moderately Weathered, HW- Highly Weathered, CW-Completely Weathered
R6- Extremely Strong, R5- Very Strong, R4- Strong, R3- Medium Strong, R2- Weak, R1-Very Weak, R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
144.0	**144.0 to 229.0 ft.** - Blind drilled. No sample collected.									Meter: Solinst Model 107 TLC	
145.0										60.7	Blind-drilled from 144 - 229 ft; no samples collected; Borehole reamed to 6-inch diameter before setting well. 20.9% O_2, 0% LEL, 0 ppm.
150.0										60.7	
155.0										60.7	
160.0										60.7	
165.0										60.7	
170.0										60.7	
175.0										60.7	
180.0										60.7	
185.0										60.7	
190.0										60.5	20.9% O_2, 0% LEL, 0 ppm.

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
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LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-212-SD

Rock Log

Local Site Coordinates: 1067494.79 N, 517980.49 E Ground Surface Elevation: 480.48

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Drilling Date(s): October 19, 2013

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

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Fe-Iron, CL-Clay, CaCO3-Calcite
FR-Fresh, SW-Slightly Weathered, MW-Moderately Weathered, HW- Highly Weathered, CW-Completely Weathered
R6- Extremely Strong, R5- Very Strong, R4- Strong, R3- Medium Strong, R2- Weak, R1-Very Weak, R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
190.0	**0.0 to 129.0 ft.** - Blind drilled. No sample collected.									60.5	20.9% O_2, 0% LEL, 0 ppm.
195.0										60.5	
200.0										60.5	20.9% O_2, 0% LEL, 0 ppm.
205.0										60.5	
210.0										60.2	
215.0										60.2	
220.0										60.2	20.9% O_2, 0% LEL, 0 ppm.
225.0										60.1	
229.0											20.9% O_2, 0% LEL, 0 ppm.

Change in scale see sheet 8 of 9

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helper: Rob Underwood
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LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-212-SD

Rock Log

Local Site Coordinates: 1067494.79 N, 517980.49 E Ground Surface Elevation: 480.48

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Drilling Date(s): October 19, 2013

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
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P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-Very Rough
Fe-Iron, CL-Clay, CaCO3-Calcite
FR-Fresh, SW-Slightly Weathered, MW-Moderately Weathered, HW- Highly Weathered, CW-Completely Weathered
R6- Extremely Strong, R5- Very Strong, R4- Strong, R3- Medium Strong, R2- Weak, R1-Very Weak, R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
229.0											
230.0	**229.0 to 230.0 ft.** - LIMESTONE, medium gray (N6). Medium-grainied, massive; strong		3 of 4	5.0/5.0	3.4/5.0	1	90°, U	F	R5	60.1	20.9% O_2, 0% LEL, 0 ppm.
231.0						3	90°, U; 90°, U; 90°, I	F	R5		
232.0						2	90°, I; 90°, I	F	R5		
233.0						3	90°, I; 45°, I; 45°, I	F	R5		
234.0	**233.0 to 234.0 ft.** - LIMESTONE, as above, but Crystalline (233-234 ft).					1	90°, PL	F	R5		Extremely fractured, majority are 90 degrees and undulating; 1 vertical fracture at 240.1 feet, which is 0.4 ft long.
235.0	**234.0 to 235.0 ft.** - LIMESTONE, gray (N7). Medium-grained and crystalline; massive; strong (where not fractured); laminated to thinly bedded.		4 of 4	10.0/10.0	1.1/10.0	7	90°, U	F	R5	60.1	
236.0						10	90°, U	F	R5		
237.0						9	90°, U	F	R5		
238.0						10	90°, U	F	R5		
239.0						10	90°, U	F	R5		

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helper: Rob Underwood
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LIMESTONE

HERST & ASSOCIATES, INC.®

Hole Number: PZ-212-SD

Rock Log

Local Site Coordinates: 1067494.79 N, 517980.49 E Ground Surface Elevation: 480.48

Project: Bridgeton Landfill Groundwater Assessment Well Installations

Project No.: 120131675

Site Location: Bridgeton, Missouri

Method of Drilling: 6 inch Dia. Air Rotary and Sonic

Rig Type: Versa-Drill Versa Sonic, 50K Sonicor Head

Drilling Date(s): October 19, 2013

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-Very Rough
Fe-Iron, CL-Clay, CaCO3-Calcite
FR-Fresh, SW-Slightly Weathered, MW-Moderately Weathered, HW- Highly Weathered, CW-Completely Weathered
R6- Extremely Strong, R5- Very Strong, R4- Strong, R3- Medium Strong, R2- Weak, R1-Very Weak, R0- Extremely Weak

Depth Scale (feet)	Rock Description	Graphic Log	Run No.	Core Recovery	RQD	Discontinuity Data: Fractures per Foot	Discontinuity Data: Type and Description	Weathering Index (FR SW MW HW CW)	Strength Index (R6 R5 R4 R3 R2 R1 R0)	Temperature Profile (°F)	Notes
239.0											
240.0						7	90°, U	F	R5	59.9	
241.0	**240.0 to 241.0 ft.** - LIMESTONE, tan-gray (5Y 7/2). Aphantitic to fine-grained; massive; strong; dark gray (N5) layers 241.3-241.6 ft and 242.4-243.3 ft).					6	90°, U	F	R5		
242.0						3	90°, U	F	R5		
243.0						7	90°, U	F	R5		
244.0	**244.0 ft.** - LIMESTONE, aphantitic to fine-grained; massive; strong; dark gray (N5) layers 241.3-241.6 ft and 242.4-243.3 ft).					7	90°, U	F	R5	59.9	Temperature readings in open borehole with no water.

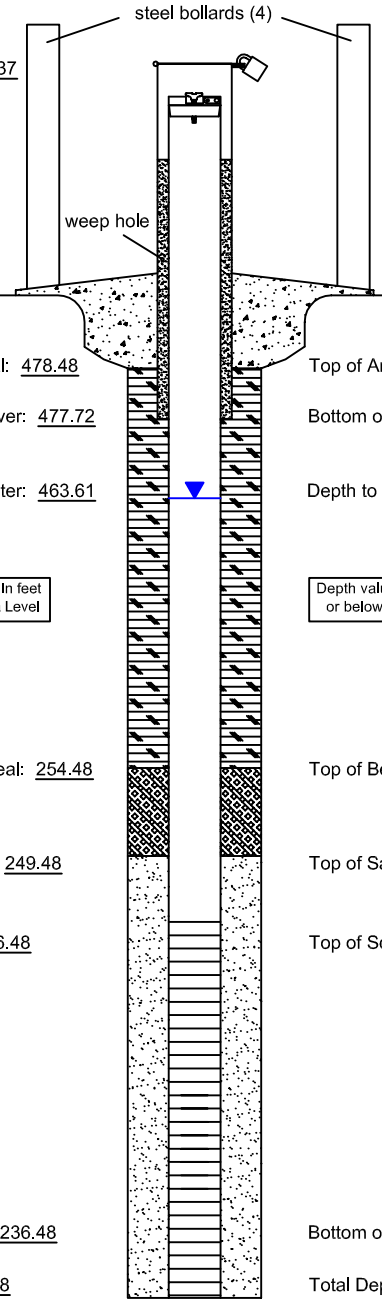
Boring Depth: 244 ft. bgs.

Drilling Contractor: Frontz Drilling, Inc.
Driller: Rob Hamilton
Helper: Rob Underwood
Certifying Geologist: Brian Fingers, Geotechnology, Inc.
Logged By: Andrew Wyatt & Steve Jett Herst & Associates, Inc.

LIMESTONE

Well Coordinates:
N 1067495.693
E 517980.384

Drilling Contractor: Frontz Drilling
Lead Driller: Rob Hamilton
Drilling Dates: October 19 - 21, 2013



Top of Steel Cover: 483.37
Top of Casing: 482.72
Ground Surface Elevation: 480.48

Top of Steel Cover: + 2.89
Top of Casing: + 2.24
Ground Surface: 0.0

Lock installed: (yes)/ no

Top of Annular Seal: 478.48
Bottom of Steel Cover: 477.72
Depth to Groundwater: 463.61

Top of Annular Seal: - 2.0
Bottom of Steel Cover: - 2.76
Depth to Groundwater: - 16.87

Elevation values, In feet above Mean Sea Level

Depth values, In feet above (+) or below (-) Ground Surface

Top of Bentonite Seal: 254.48
Top of Sand Pack: 249.48
Top of Screen: 246.48
Bottom of Screen: 236.48
Total Depth: 235.48

Top of Bentonite Seal: - 226.00
Top of Sand Pack: - 231.00
Top of Screen: - 234.00
Bottom of Screen: - 244.00
Total Depth: - 245.00

(Not to Scale)

Borehole Diameter: 7.25-inch OD for Soil
7.25-inch OD for Rock

Centralizer (s): Yes, at base of Screen and 5 feet above top of Screen

Type of Annular Seal: Bentonite Grout

Grouting Method: Tremie
Grout Thickness: 224 feet

Casing Material: Schedule 80 PVC
Casing Diameter: 2 inches
Casing Length (including Screen): 244 feet

Date of Groundwater Measurement: October 24, 2013

Type of Bentonite Seal: Bentonite Plug Chips

Bentonite Seal Thickness: 5 feet

Type of Sand Pack: Silica Sand

Sand Pack Thickness: 13 feet
Number of Bags of Sand: 7

Screen Slot Size: 0.01 in.
Screen Material: Schedule 80 PVC
Screen Diameter: 2 inches
Screen Length: 10 feet

Depth of Borehole Backfill: N/A
Collapse Footage: 1 foot

4631 North St. Peters Parkway
St. Charles, Missouri 63304
Phone (636) 939-9111
Fax (636) 939-9757
HERST & ASSOCIATES, INC.®

Bridgeton Landfill
Bridgeton, Missouri

PZ-212-SD
As-Built Diagram

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED	
REFERENCE NO.		
C.R. NO.	CHECK NO.	
STATE WELL NUMBER	REVENUE NO.	
ENTERED Ph1 Ph2 Ph3	APPROVED BY	ROUTE

INFORMATION SUPPLIED BY PRIMARY CONTRACTOR OR DRILLING CONTRACTOR

NOTE: THIS FORM IS NOT TO BE USED FOR NESTED WELLS

OWNER NAME	CONTACT NAME	VARIANCE GRANTED BY DNR
Republic Services	Bryan Sehie	NUMBER

OWNER ADDRESS	CITY	STATE	ZIP CODE
13570 Saint Charles Rock Rd.	Bridgeton	MO	63044

SITE NAME	WELL NUMBER	COUNTY
Bridgeton Sanitary Landfill	PZ-212-SD	Saint Louis

SITE ADDRESS	CITY	STATIC WATER LEVEL
13570 Saint Charles Rock Rd.	Bridgeton	17.93

SURFACE COMPLETION

TYPE: ☑ ABOVE GROUND ☐ FLUSH MOUNT

LENGTH AND DIAMETER OF SURFACE COMPLETION: LENGTH 2.5 FT. DIAMETER 5 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: DIAMETER 5 IN. LENGTH 2.5 FT.

SURFACE COMPLETION GROUT: ☑ CONCRETE ☐ OTHER _____

LOCATION OF WELL (D/M/S FORMAT ONLY): LAT. 38 . 45 . 55.2 LONG. 90 . 26 . 19.1

SMALLEST ___ ¼ ___ ¼ LARGEST ___ ¼

SECTION ___ TOWNSHIP 47 NORTH

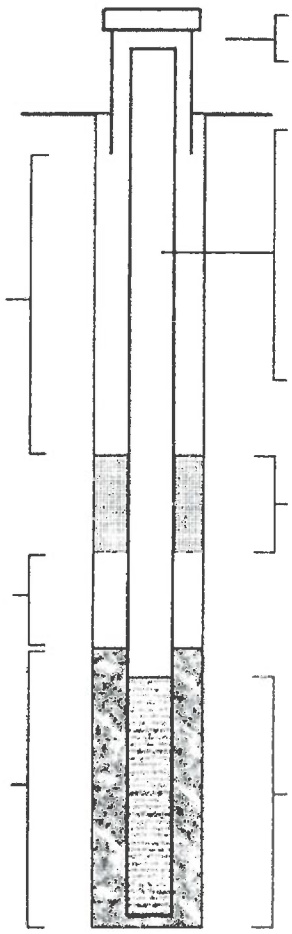
RANGE 5 ☑ EAST ☐ WEST

MONITORING FOR: (CHECK ALL THAT APPLY)
☑ RADIONUCLIDES ☐ PETROLEUM PRODUCTS ONLY
☐ EXPLOSIVES ☑ METALS ☑ VOC
☑ SVOCS ☑ PESTICIDES/HERBICIDES

PROPOSED USE OF WELL
☐ GAS MIGRATION WELL ☑ OBSERVATION
☐ EXTRACTION WELL ☐ OPEN HOLE
☐ PIEZOMETERS ☐ INJECTION WELL
☐ DIRECT PUSH

☑ LOCKING CAP
☑ WEEP HOLE

ELEVATION 484.18 FT.



SURFACE COMPLETION
☑ STEEL ☐ ALUMINUM ☐ PLASTIC

RISER
RISER PIPE DIAMETER 2 IN.
RISER PIPE LENGTH 236 FT.
DIAMETER OF DRILL HOLE 6 IN.
WEIGHT OR SDR# Sch 80

MATERIAL
☐ STEEL ☑ THERMOPLASTIC (PVC)
☐ OTHER _____

ANNULAR SEAL
LENGTH 224 FT.
☑ SLURRY ☐ CHIPS
☐ PELLETS ☐ GRANULAR
☐ CEMENT/SLURRY

IF CEMENT/BENTONITE MIX:
BAGS OF CEMENT USED ___
% OF BENTONITE USED ___
WATER USED/BAG 780 GAL.

BENTONITE SEAL
LENGTH 5 Foot
☑ CHIPS ☐ PELLETS ☐ GRANULAR
☐ SLURRY
☑ SATURATED ZONE ☐ HYDRATED

SECONDARY FILTER PACK
LENGTH 0 FT.

SCREEN
SCREEN DIAMETER 2 IN.
SCREEN LENGTH 10 FT.
DIAMETER OF DRILL HOLE 6 IN.
DEPTH TO TOP 234 FT.

SCREEN MATERIAL
☐ STEEL ☑ THERMOPLASTIC (PVC)
☐ OTHER _____

DEPTH TO TOP OF PRIMARY FILTER PACK 231 FT.

LENGTH OF PRIMARY FILTER PACK 13 FT.

DEPTH TO	DEPTH FROM	FORMATION DESCRIPTION
0'	34'	Silty clay
34'	129'	Limestone
129'	244'	Limestone
TOTAL DEPTH:		244 Foot

FOR CASED WELLS, SUBMIT ADDITIONAL AS BUILT DIAGRAMS SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE & SIZE OF ALL CASING, HOLE DIAMETER & GROUT USED.

SIGNATURE (PRIMARY CONTACTOR)	PERMIT NUMBER	DATE WELL DRILLING WAS COMPELTED
[signature]	003839 M	10-21-13

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH MISSOURI DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS. ☐ PUMP INSTALLED

SIGNATURE (WELL DRILLER)	PERMIT NUMBER	SIGNATURE (OF APPRENTICE)	APPRENTICE PERMIT NUMBER
[signature]	003456-M		

MO 780-1445 (07-11)

DISTRIBUTION: WHITE/DIVISION CANARY/CONTACTOR PINK/OWNER

RETURN WHITE COPY WITH APPROPRIATE FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, DIVISION OF GEOLOGY AND LAND SURVEY, WELLHEAD PROTECTION SECTION, PO BOX 250, ROLLA, MO 65402 573-368-2165

Drilling Log

Project Name: WESTLAKE			Boring No. 5-84
Project No. 84-075-4-002			Page 1 of 3
Ground Elevation 452.9	Location NE section of Site; Fig I-2		Total Footage 31.5'

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
SEE REMARKS	5"	31.5	0	4	0	SEE REMARKS	—

Drilling Co.	WABASH DRILLING CO.	Driller (s)	DORL THORNTON
Drilling Rig.	ACKER MP-5, TRUCK	Type of Penetration Test	STANDARD
Date	8-24-84 To 8-24-84	Field Observer (s)	GLEN ERNSTMANN

Depth	Description	Class.	Blow Count	Recov.		Sample or Box No.	Remarks
1	LIGHT BROWN SAND, SILT AND GRAVEL, DAMP TO DRY (FILL)						5" DIA. SOLID AUGERS 0' TO 30'.
2							
3							
4	GREENISH GRAY TO DARK GRAY SILTY FINE SAND, VERY LOOSE, DAMP (FILL)						
5					5.0		
			2/2/2	18"/18"		SS-1	
6					6.5		
7							
8							
9							
10							
11							FEW THIN SATURATED SANDY ZONES BELOW 13'.
12	GREENISH GRAY SILTY FINE SAND, ZONES OF DARK GRAY CLAYEY SILT, MOIST TO SATURATED (FILL)						
13		A-22					

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

Boring No. S-84

Project Name: WESTLAKE

Page 2 of 3

Project No.: 84-075-4-002

Date: 8-24-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
15					15.0		
	GREENISH GRAY SILTY FINE SAND, ZONES OF DARK GRAY CLAYEY SILT, MOIST TO SATURATED (FILL)			24"/24"		ST-2	Q_p = N.A.
16							
17					17.0		
18							
19							ALL MATERIAL SATURATED BELOW APPROX. 20'.
20							
21							
22							
23	GRAY-BROWN FINE TO MEDIUM SAND, TRACE SILT, MEDIUM DENSE						
24							
25					25.0		
26			9/9/12	18"/18"		SS-3	
					26.5		
27							APPROX. 6 FT. OF SLOUGH IN HOLE WHEN SAMPLE SS-4 WAS FIRST ATTEMPTED.
28							
29	GRAY MEDIUM TO COARSE SAND, MEDIUM DENSITY, SATURATED						CASING WAS DRIVEN TO 30' THEN SLOUGH WASH-BORED OUT W/ TRICONE BIT.
30		A-23	5/6/9	12"/18"	30.0	SS-4	NO BENTONITE WAS USED.

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

	Boring No. S-84
Project Name WESTLAKE	Page 3 of 3
Project No. 84-075-4-002	Date 8-24-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
	(SEE ABOVE)				31.5	SS-4	
32	TOTAL DEPTH 31.5'						
33							A 2" dia. PVC piezometer was installed to 30.9'.
34							PVC is flush-jointed, threaded couplings. Bottom 10' is .010" machine slotted screen.
35							
36							Gravel pack 31.5' to 20.0' with a 1.8' thick bentonite pellet seal above.
37							
38							Anulus is grouted from seal to ground surface.
39							T.O.P. is 4.0 above ground surface.
40							
							WATER LEVEL IMMEDIATELY AFTER PIEZOMETER INSTALLATION IS 23.7' BELOW T.O.P. 12:20pm 8-24-84.
							WATER LEVEL IS 23.91' BELOW T.O.P. 7:15am 8-27-84

A-24

APPENDIX B

GROUNDWATER DETECTION MONITORING CONSTITUENTS

Appendix B
Groundwater Detection Monitoring Constiutents
Bridgeton Landfill, LLC - Bridgeton, Missouri

Field Parameters	
Constituent	**Suggested Analytical Method**
Dissolved Oxygen, Field	Field Measurement
Oxidation-Reduction Potential, Field	Field Measurement
pH, Field	Field Measurement
Specific Conductance, Field	Field Measurement
Temperature, Field	Field Measurement
Turbidity, Field	Field Measurement

Inorganic Constituents	
Constituent	**Suggested Analytical Method**
Ammonia as Nitrogen	SM 4500-NH_3 G
Chemical Oxygen Demand (COD)	EPA 410.4
Chloride	SW-946 9056
Fluoride	SW-946 9056
Hardness, Total	SM 2340
Nitrate + Nitrite as Nitrogen	EPA 353.2
Phosphorus, Total	EPA 365.1
Solids, Total Dissolved (TDS)	SM 2540C
Sulfate	SW-946 9056
Total Organic Carbon (TOC)	SM 5310C

Metals	
Constituent	**Suggested Analytical Method**
Antimony, Total	SW-846 6020
Arsenic, Total	SW-846 6020
Barium, Total	SW-846 6010
Beryllium, Total	SW-846 6020
Boron, Total	SW-846 6010
Cadmium, Total	SW-846 6020
Calcium, Total	SW-846 6010
Chromium, Total	SW-846 6020
Cobalt, Total	SW-846 6010
Copper, Total	SW-846 6020
Iron, Total	SW-846 6010
Lead, Total	SW-846 6020
Magnesium, Total	SW-846 6010
Manganese, Total	SW-846 6010
Mercury, Total	SW-846 7470
Nickel, Total	SW-846 6010
Selenium, Total	SW-846 6020
Silver, Total	SW-846 6020
Sodium, Total	SW-846 6010
Thallium, Total	SW-846 6020
Vanadium, Total	SW-846 6020
Zinc, Total	SW-846 6010

Appendix B
Groundwater Detection Monitoring Constiutents
Bridgeton Landfill, LLC - Bridgeton, Missouri

Volatile Organic Compounds	
Constituent	**Suggested Analytical Method**
Acetone	SW-846 8260
Acrylonitrile	SW-846 8260
Benzene	SW-846 8260
Bromochloromethane	SW-846 8260
Bromodichloromethane	SW-846 8260
Bromoform (Tribromomethane)	SW-846 8260
Carbon Disulfide	SW-846 8260
Carbon Tetrachloride	SW-846 8260
Chlorobenzene	SW-846 8260
Chloroethane (Ethyl Chloride)	SW-846 8260
Chloroform (Trichloromethane)	SW-846 8260
Dibromochloromethane (Chlorodibromomethane)	SW-846 8260
1,2-Dibromo-3-chloropropane (DBCP)	SW-846 8260
1,2-Dibromoethane (Ethylene Dibromide; EDB)	SW-846 8260
o-Dichlorobenzene (1,2-Dichlorobenzene)	SW-846 8260
p-Dichlorobenzene (1,4-Dichlorobenzene)	SW-846 8260
trans-1,4-Dichloro-2-butene	SW-846 8260
1,1-Dichloroethane (Ethylidene Chloride)	SW-846 8260
1,2-Dichloroethane (Ethylene Dichloride)	SW-846 8260
1,1-Dichloroethylene (1,1-Dichloroethene; Vinylidene Chloride)	SW-846 8260
cis-1,2-Dichloroethylene (cis-1,2-Dichloroethene)	SW-846 8260
trans-1,2-Dichloroethylene (trans-1,2-Dichloroethene)	SW-846 8260
1,2-Dichloropropane (Propylene Dichloride)	SW-846 8260
cis-1,3-Dichloropropene	SW-846 8260
trans-1,3-Dichloropropene	SW-846 8260
Ethylbenzene	SW-846 8260
2-Hexanone (Methyl Butyl Ketone)	SW-846 8260
Methyl Bromide (Bromomethane)	SW-846 8260
Methyl Chloride (Chloromethane)	SW-846 8260

Appendix B
Groundwater Detection Monitoring Constiutents
Bridgeton Landfill, LLC - Bridgeton, Missouri

Volatile Organic Compounds (Continued)	
Constituent	**Suggested Analytical Method**
Methylene Bromide (Dibromomethane)	SW-846 8260
Methylene Chloride (Dichloromethane)	SW-846 8260
Methyl Ethyl Ketone (MEK; 2-Butanone)	SW-846 8260
Methyl Iodide (Iodomethane)	SW-846 8260
4-Methyl-2-pentanone (Methyl Isobutyl Ketone)	SW-846 8260
Styrene	SW-846 8260
1,1,1,2-Tetrachloroethane	SW-846 8260
1,1,2,2-Tetrachloroethane	SW-846 8260
Tetrachloroethylene (Tetrachloroethene; Perchloroethylene)	SW-846 8260
Toluene	SW-846 8260
1,1,1-Trichloroethane	SW-846 8260
1,1,2-Trichloroethane	SW-846 8260
Trichloroethylene (Trichloroethene)	SW-846 8260
Trichlorofluoromethane (CFC-11)	SW-846 8260
1,2,3-Trichloropropane	SW-846 8260
Vinyl Acetate	SW-846 8260
Vinyl Chloride	SW-846 8260
Xylenes, Total	SW-846 8260

Notes

EPA: Methods of Chemical Analysis of Water and Wastes (March 1983)

SW-846: Test Methods for Evaluating Solid Waste: Physical/Chemical Methods.

SM: Standard Methods for the Examination of Water and Wastewater

ATTACHMENT B

LABORATORY ANALYTICAL REPORT FOR PZ-104-KS HEADSPACE SAMPLE

AirTECHNOLOGY
Laboratories, Inc.

July 24, 2018

LA Cert #04140
EPA Methods TO3, TO14A, TO15, 25C/3C, RSK-175

TX Cert T104704450-14-6
EPA Methods TO14A, TO15

UT Cert CA0133332015-3
EPA Methods TO3, TO14A, TO15, RSK-175

Republic Services
ATTN: Dana Sincox
13570 St. Charles Rock Rd.
Bridgeton, MO 63044

LABORATORY TEST RESULTS

Project Reference: Bridgeton Landfill
Lab Number: J071106-01/03

Enclosed are results for sample(s) received 7/11/18 by Air Technology Laboratories. Samples were received intact. Analyses were performed according to specifications on the chain of custody provided with the sample(s).

Report Narrative:

- Unless otherwise noted in the report, sample analyses were performed within method performance criteria and meet all requirements of the TNI Standards.
- The enclosed results relate only to the sample(s).

Preliminary results were e-mailed to Dana Sincox, Anthony Kimutis and David Randall, Weaver Consultants Group, on 7/23/18.

ATL appreciates the opportunity to provide testing services to your company. If you have any questions regarding these results, please call me at (626) 964-4032.

Sincerely,

Mark Johnson
Operations Manager
MJohnson@AirTechLabs.com

Enclosures

Note: The cover letter is an integral part of this analytical report.

AirTECHNOLOGY Laboratories, Inc.

18501 E. Gale Ave., Suite 130
City of Industry, CA 91748
Ph: 626-964-4032
Fx: 626-964-5832

CHAIN OF CUSTODY RECORD

TURNAROUND TIME				DELIVERABLES	PAGE: 1 OF 1
Standard	■	48 hours	☐	EDD ■	Condition upon receipt:
Same Day	☐	72 hours	☐	EDF ☐	Sealed Yes ☐ No ☐
24 hours	☐	96 hours	☐	Level 3 ☐	Intact Yes ☐ No ☐
Other:		5 day	☐	Level 4 ☐	Chilled _____ deg C

Project No.:
Project Name: Bridgeton Landfill
Report To: Dana Sincox
Company: Republic Services
Street: 13570 St. Charles Rock Rd
City/State/Zip: Bridgeton, MO 63044
Phone& Fax:
e-mail: dsincox@republicservices.com

BILLING
P.O. No.: 6605567
Bill to: Republic Services
Attn: Dana Sincox
13570 St. Charles Rock Rd.
Bridgeton, MO 63044

ANALYSIS REQUEST

LAB USE ONLY	Canister Pressures ("hg) Canister ID	Sample Start	Sample End	Lab Receive	SAMPLE IDENTIFICATION	SAMPLE DATE	SAMPLE TIME	CONTAINER QTY/TYPE	MATRIX	PRESERVATION	TO-15 (Benzene only)	ASTM D1946				
J071106-01	A7747	-20.06	-3.97	-5	GEW 175	7/9/2018	13:24	C	LFG	He	X	X				
-02	A7748	-20.08	-3.98	-5	GEW 178	7/9/2018	13:58	C	LFG	He	X	X				
-03	5318	-19	-3.98	-5	PZ-104-KS	7/9/2018	14:30	C	LFG	He	X	X				

AUTHORIZATION TO PERFORM WORK: Dave Penoyer — COMPANY: Republic Services — DATE/TIME: 7/9/18
SAMPLED BY: Anthony Kimutis — COMPANY: Republic Services — DATE/TIME: 7/9/18
RELINQUISHED BY: [signature] — DATE: 7/10/18 — RECEIVED BY: — DATE/TIME:
RELINQUISHED BY: FedEx — DATE: — RECEIVED BY: [signature] — DATE/TIME: 7/10/18 1317
RELINQUISHED BY: — DATE: — RECEIVED BY: — DATE/TIME:

METHOD OF TRANSPORT (circle one): Walk-In FedEx UPS Courier ATLI Other_____

COMMENTS

DISTRIBUTION: White & Yellow - Lab Copies / Pink - Customer Copy

Preservation: H=HCl N=None / Container: B=Bag C=Can V=VOA O=Other *Rev. 03 - 5/7/09*

Client: Republic Services
Attn: Dana Sincox
Project Name: Bridgeton Landfill
Project No.: NA
Date Received: 07/11/18
Matrix: Air
Reporting Units: % v/v

ASTM D1946

Lab No.:	J071106-01		J071106-02		J071106-03			
Client Sample I.D.:	GEW 175		GEW 178		PZ-104-KS			
Date/Time Sampled:	7/9/18 13:24		7/9/18 13:58		7/9/18 14:30			
Date/Time Analyzed:	7/12/18 11:54		7/12/18 12:09		7/12/18 12:24			
QC Batch No.:	180712GC8A1		180712GC8A1		180712GC8A1			
Analyst Initials:	AS		AS		AS			
Dilution Factor:	3.2		3.2		3.2			
ANALYTE	Result % v/v	RL % v/v	Result % v/v	RL % v/v	Result % v/v	RL % v/v		
Carbon Dioxide	**52**	0.032	**63**	0.032	**2.6**	0.032		
Oxygen/Argon	**2.3**	1.6	**2.3**	1.6	**21**	1.6		
Nitrogen	**7.9**	3.2	**7.9**	3.2	**76**	3.2		
Methane	**4.5**	0.0032	**24**	0.0032	**0.19**	0.0032		

Results normalized including non-methane hydrocarbons
ND = Not Detected (below RL)
RL = Reporting Limit

Reviewed/Approved By: _____ Date 7-23-18
Mark Johnson
Operations Manager

The cover letter is an integral part of this analytical report

AirTECHNOLOGY Laboratories, Inc.
18501 E. Gale Avenue, Suite 130 ♦ City of Industry, CA 91748 ♦ Ph: (626) 964-4032 ♦ Fx: (626) 964-5832

QC Batch No: 180712GC8A1
Matrix: Air
Reporting Units: % v/v

ASTM D1946
LABORATORY CONTROL SAMPLE SUMMARY

Lab No.:	METHOD BLANK			LCS		LCSD					
Date Analyzed:	7/12/18 10:27			7/12/18 9:35		7/12/18 9:50					
Analyst Initials:	AS			AS		AS					
Dilution Factor:	1.0			1.0		1.0			Limits		
ANALYTE	Result % v/v	RL % v/v	SPIKE AMT. % v/v	Result % v/v	% Rec.	Result % v/v	% Rec.	RPD %	Low %Rec	High %Rec	Max. RPD
Carbon Dioxide	ND	0.010	10	9.48	95	9.17	91	3.3	70	130	30
Oxygen/Argon	ND	0.50	15	16.2	109	15.7	106	2.9	70	130	30
Nitrogen	ND	1.0	70	73.0	104	70.9	101	2.8	70	130	30
Methane	ND	0.0010	0.10	0.111	111	0.110	110	0.3	70	130	30

ND = Not Detected (below RL)
RL = Reporting Limit

Reviewed/Approved By: _____ Date 7-23-18
Mark Johnson
Operations Manager

The cover letter is an integral part of this analytical report

Client: Republic Services
Attn: Dana Sincox
Project Name: Bridgeton Landfill
Project No.: NA
Date Received: 07/11/18
Matrix: Air
Reporting Units: ppbv

EPA Method TO15

Lab No.:	J071106-01		J071106-02		J071106-03			
Client Sample I.D.:	GEW 175		GEW 178		PZ-104-KS			
Date/Time Sampled:	7/9/18 13:24		7/9/18 13:58		7/9/18 14:30			
Date/Time Analyzed:	7/18/18 14:33		7/18/18 15:16		7/18/18 16:43			
QC Batch No.:	180718MS2A1		180718MS2A1		180718MS2A1			
Analyst Initials:	DT		DT		DT			
Dilution Factor:	630		1,300		63			
ANALYTE	Result ppbv	RL ppbv	Result ppbv	RL ppbv	Result ppbv	RL ppbv		
Benzene	140,000	630	200,000	1,300	13,000	63		

MDL = Method Detection Limit
ND= Not Detected (below MDL)
RL = Reporting Limit

Reviewed/Approved By: _____ Date 7-23-18
Mark Johnson
Operations Manager

The cover letter is an integral part of this analytical report

AirTECHNOLOGY Laboratories, Inc.
18501 E. Gale Avenue, Suite 130 ♦ City of Industry, CA 91748 ♦ Ph: (626) 964-4032 ♦ Fx: (626) 964-5832

Client: Republic Services
Attn: Dana Sincox
Project Name: Bridgeton Landfill
Project No.: NA
Date Received: 07/11/18
Matrix: Air
Reporting Units: ppbv

EPA Method TO15

Lab No.:	METHOD BLANK										
Client Sample I.D.:	-										
Date/Time Sampled:	-										
Date/Time Analyzed:	7/18/18 12:09										
QC Batch No.:	180718MS2A1										
Analyst Initials:	DT										
Dilution Factor:	0.20										
ANALYTE	Result ppbv	RL ppbv									
Benzene	ND	0.20									

MDL = Method Detection Limit
ND= Not Detected (below MDL)
RL = Reporting Limit
J = Trace amount. Analyte concentration between RL and MDL.

Reviewed/Approved By: _____ Date 7-23-18
Mark Johnson
Operations Manager

The cover letter is an integral part of this analytical report

AirTECHNOLOGY Laboratories, Inc.
18501 E. Gale Avenue, Suite 130 ♦ City of Industry, CA 91748 ♦ Ph: (626) 964-4032 ♦ Fx: (626) 964-5832

LCS/LCSD Recovery and RPD Summary Report

QC Batch #: 180718MS2A1

Matrix: Air

EPA Method TO-14/TO-15

Lab No:	Method Blank		LCS		LCSD						
Date/Time Analyzed:	7/18/18 12:09		7/18/18 10:44		7/18/18 11:24						
Data File ID:	18JUL005.D		18JUL003.D		18JUL004.D						
Analyst Initials:	DT		DT		DT						
Dilution Factor:	0.2		1.0		1.0			Limits			
ANALYTE	Result ppbv	Spike Amount	Result ppbv	% Rec	Result ppbv	% Rec	RPD	Low %Rec	High %Rec	Max. RPD	Pass/ Fail
1,1-Dichloroethene	0.0	10.0	10.2	102	10.4	104	2.4	70	130	30	Pass
Methylene Chloride	0.0	10.0	10.4	104	11.1	111	7.0	70	130	30	Pass
Trichloroethene	0.0	10.0	11.1	111	11.2	112	0.5	70	130	30	Pass
Toluene	0.0	10.0	10.8	108	10.9	109	1.2	70	130	30	Pass
1,1,2,2-Tetrachloroethane	0.0	10.0	9.4	94	9.8	98	4.2	70	130	30	Pass

RPD = Relative Percent Difference

Reviewed/Approved By: _____ Date: 7-23-18

Mark Johnson
Operations Manager

The cover letter is an integral part of this analytical report