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Emergency Response Plan Design Report

12th Street Landfill/Former Powerhouse Channel Otsego Township, Michigan

Operable Unit No. 4 of the Allied Paper, Inc./ Portage Creek/Kalamazoo River Superfund Site

Revision 0
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Prepared for
Weyerhaeuser Company

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Section 1
Introduction

1.1 Background and Scope

The Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site (Site) located along 80 miles of the Kalamazoo River in western Michigan has been investigated by the United States Environmental Protection Agency (USEPA), Michigan Department of Environmental Quality (MDEQ), and the Kalamazoo River Study Group (KRSG). After the site was listed on the National Priorities List in 1990, the MDEQ took the role of the lead agency addressing Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) related liability. The KRSG, a group consisting of current paper mill property owners, conducted a series of investigation activities and completed a Remedial Investigation/Feasibility Study (RI/FS) in 2001 that was not approved by the MDEQ.

In February 2002, the USEPA assumed the role of lead agency for the Site at the request of the MDEQ, and on April 8, 2004, Weyerhaeuser Company (Weyerhaeuser) was identified as a Potentially Responsible Party (PRP) for the Site in a General Notice letter received by Weyerhaeuser and the two remaining KRSG members, Georgia Pacific and Millenium Holdings, LTD. Concurrently, Weyerhaeuser was negotiating a Consent Decree (CD) with the USEPA to undertake specific activities on the former Plainwell Mill and 12th Street Landfill sites. On February 22, 2005, Weyerhaeuser entered into a CD with the USEPA for the Design and Implementation of Certain Response Activities at the 12th Street Landfill site (Operable Unit No. 4) and the Plainwell Mill site. A Statement of Work (SOW) for the Remedial Design/Remedial Action (RD/RA) at the 12th Street Landfill site was attached to the CD. A SOW for the RI/FS at the Plainwell Mill site was subsequently issued by the USEPA, with an effective date of August 17, 2006.

In late February 2007, after a several year negotiation with the KRSG, the USEPA authorized a Time-Critical Removal Action (TCRA) to remove PCB-contaminated residuals in the former Plainwell Impoundment (a section of Operable Unit No. 5 of the Allied Paper/Portage Creek/Kalamazoo River Superfund Site). This work was to be implemented through an administrative settlement agreement and order on Consent for Removal Action (V-W-07-C-8-63). As part of the TCRA, the earthen section of the Plainwell Dam will be removed and the Kalamazoo River will be rerouted through the former powerhouse channel. This work will be conducted by the KRSG over a 2-year period.

The 12th Street Landfill abuts the river and is located directly downstream of the earthen section of the Plainwell Dam. The Plainwell Mill also abuts the Kalamazoo River and polychlorinated biphenyl (PCB) containing materials have been documented along the river bank at the Mill. The change in the Kalamazoo River channel will result in an increased river gradient and higher velocities upstream and

along the rerouted channel (Rachol, et al., 2005 and Wells, et al., 2003). The modified river flow routing is expected to flush residuals currently present in the powerhouse channel downstream and the increased river gradient may erode bank material in the area of the Mill. Thus, the TCRA scope of activities are actions or occurrences which threaten releases of Waste Material (as defined in the CD) from both the 12th Street Landfill and the Plainwell Mill property. Since any such release may present an immediate threat to public health or welfare of the environment, Weyerhaeuser has been authorized by the USEPA to conduct emergency response actions in conjunction with completing the required work under the CD.

1.2 Objectives of the Former Powerhouse Channel Emergency Response

The necessary work to address the threatened release will be conducted under Section XVII Emergency Response, paragraph 67 of the Weyerhaeuser CD. This Emergency Response Design report documents the appropriate actions and schedule to prevent, abate, and minimize the release of residuals present within the former powerhouse channel adjacent to the 12th Street Landfill and the potential release of waste present on the eastern side of the landfill near the proposed re-routed channel of the Kalamazoo River. The location of the 12th Street Landfill site is depicted on Figure 1. Both removal of residuals and the construction of an erosion control system along the river are identified as components of the selected remedy described in the 2002 Record of Decision (ROD) for the 12th Street Landfill (Operable Unit 04). However, since the approved schedule for the Plainwell Impoundment TCRA involves re-routing of the main channel of the Kalamazoo River before the 2008 construction season, a modified schedule for implementation of these remedy tasks was necessary and is integrated into the Former Powerhouse Channel Emergency Response.

The specific objectives of this Former Powerhouse Channel Emergency Response are:

- To remove visual paper residuals from the channel before the main flow of the Kalamazoo River is re-routed.
- To install a final erosion protection system along the former powerhouse channel west bank that meets the requirements of the existing ROD.
- To construct these systems in a manner compatible with the specified landfill closure requirements as specified in the 2002 Record of Decision.

1.3 Design Report Organization

In addition to this introductory text, the remaining sections of the streamlined design report present the final description of the Former Powerhouse Channel Emergency Response followed by a series of appendices that present the results of supplemental data collection and the design basis for the Emergency Response actions. The sections and appendices consist of the following:

- Section 2 – Design Basis and Description: A description of each element of the emergency action from the construction of access roads and staging areas to the various components of the removal activities (water control, residuals and soil removal, drainage, material processing and disposal) are discussed. The discussions include: the basis of design for elements including delineation of the

removal areas; a description of existing conditions; a summary of the hydraulic analysis conducted in support of the erosion protection and slope stability design; and the selection and development of residuals dewatering and drainage equipment and procedures.

- Section 3 – Monitoring Plan: A description of the various monitoring activities are described, including resuspension monitoring, dewatering system discharge monitoring, residuals removal confirmation, and monitoring of the erosion control system.
- Section 4 – Construction Schedule: Description of the construction and implementation schedule for the emergency response action.
- Section 5 – References: Identification of any references cited in this report.
- Appendix A: Relevant correspondence associated with the 12th Street Landfill site.
- Appendix B: Water depths and extent of residuals identified in the former powerhouse channel.
- Appendix C: Discussion of the results of the geotechnical investigation performed at the 12th Street Landfill to identify the presence and construction details of a reported containment berm.
- Appendix D: The United States Army Corps of Engineers (USACE)/MDEQ joint permit application and National Pollutant Discharge Elimination System (NPDES) permit application to show substantial compliance and equivalence to the permits.
- Appendix E: Slope stability calculations used in the slope design for the east face of the 12th Street Landfill.
- Appendix F: Calculations used in design of the erosion protection system along the former power house channel.
- Appendix G: Construction inspection and quality control for implementation of this design plan.

Section 2
Design Basis and Description

2.1 Overview of the Design Components and Approach

The Former Powerhouse Channel Emergency Response actions have been separated into five primary components that are described in detail in the remainder of this section. These include Site Preparation, Residuals Removal, Landfill Slope Protection, Erosion Protection, and Vegetation. The subparts of each component are described in this section with more detail design support in the referenced appendices. The various monitoring and confirmation sampling activities are discussed in Section 3.

The overall approach to these Emergency Response activities is to complete those actions along the 12th Street Landfill that will minimize the potential for a release of waste. In addition, most of these actions will become part of the completed final remedy for the 12th Street Landfill since certain bank related construction activities will not be practicable once the main channel of the Kalamazoo River is rerouted. Finally, the work efforts will be performed on a schedule that is coordinated with the Plainwell Impoundment TCRA efforts.

2.2 Site Preparation

Construction activities associated with the emergency action will begin in early August 2007. Project support areas, consisting of temporary trailers, material storage areas, and equipment/vehicle parking areas will be established to provide critical support services, such as field engineering, health and safety, construction management, equipment maintenance and refueling, equipment and personnel decontamination, worker sanitation, project area security, and access control. The support areas will be located near the entrance to the 12th Street Landfill. The existing site layout for the 12th Street Landfill is shown on Figure 2.

A temporary access road will be constructed from the entrance to the 12th Street Landfill to both the support areas and the area along the former power house channel. The road will be field located to work with the existing site contours and to minimize disturbance to the existing landfill surface.

Site preparation will involve clearing and grubbing as required to allow placement of the access road, a working area along the channel, and two pad areas for staging of excavated residuals and soils. The access haul road/work platform from the 12th Street Landfill to the powerhouse channel and along the channel adjacent to the landfill will be constructed and reinforced as necessary to accommodate loaded trucks. Two material placement pads will be constructed at the top of the landfill, one to contain residuals from the channel (Area 1) and one for relocation of the excess material from the face of the landfill (Area 2). These pads will be located on the top of the landfill in locations not targeted for re-grading during

final closure (Figure 3). An interim cover will be placed over the excavated materials until final closure of the 12th Street Landfill site.

2.2.1 Clearing and Grubbing

The areas requiring clearing and grubbing include: 1) the east bank face of the landfill, which will be reshaped as part of the erosion control; 2) an area along the north side of the landfill to allow construction of the haul road; and 3) two areas on the top of the landfill each approximately 200 feet wide by 200 feet long. Prior to any clearing along the channel, silt fencing will be placed along the channel to minimize any soil runoff into the river.

Vegetation will be cleared only to the extent required to establish access roads, staging areas, project support areas, and residuals/soil excavations. Cleared vegetation will be chipped and used as mulch for constructing pathways, as temporary vegetative cover to support erosion control efforts in the project area, or as a residuals/soil solidification amendment. Larger tree trunks and stumps derived from clearing will be stockpiled on site for either later beneficial reuse, disposal or incorporation into the landfill. Root wads, to the extent possible, will be disposed within the landfill

2.2.2 Haul Road/Work Platform

A single-lane haul road and work platform will be constructed along the north side of the landfill to allow truck access to the channel for residuals transport. The haul road will be approximately 15 feet wide and constructed at a grade or design slope which will allow trucks to easily traverse from the top of the landfill to the channel. In addition, the road will extend along the channel to the south to allow the excavator access to residuals within the channel. The roads will be constructed by placing a geotextile fabric over prepared ground surface, followed by placing and compacting up to 1 feet of stone and gravel as necessary for support. There will be an area at the top of the landfill for the trucks to turn around and back down to the channel for loading. Once loaded, the trucks will proceed to the residual containment area or soil relocation area for dumping.

2.2.3 Residuals Containment Area

An area designated to dispose of the residuals from the powerhouse channel will be constructed at the top of the landfill (Area 1, Figure 3). The containment area will be approximately 200 feet wide and 200 feet long. The landfill cover material will be graded to a depth of approximately 2 to 3 feet and pushed out to form a containment berm along the edges of the containment pad. Once the area is excavated, a 1-foot sand layer will be placed to assist in dewatering. The grade of the pad will allow any excess water to drain to a constructed sump. The sump will be constructed by excavating a 3-foot deep pit and placing filter material consisting of open graded

crushed stone around an 8-inch perforated PVC standpipe. Run-on water will be pumped from the center of the standpipe to the treatment facility when present in quantities that require management.

Based on the consistency of the material removed, this area could also be used to solidify residuals. The excavated residuals will typically contain approximately 20 to 25 percent water by volume. Also, water from precipitation and storm water flow will require control and potentially additional drainage efforts. The residuals will be drained through gravity drainage, dry soil mixing, decanting, and the addition of solidification agents. The primary solidification agent planned for use during the project will be dry soil generated during the reshaping of the landfill bank. Gravity dewatering and the addition of dry soils may eliminate free liquids, but may not allow the placement of a final cover over the material as part of the landfill closure. If additional solidification is needed to lower moisture contents of the residuals to provide a more compactable material, additives such as lime or cement will be mixed with the residuals using a backhoe at the staging area. The drainage water from the residuals along with run-on water will be directed to the on-site treatment system. A 25-foot by 200-foot area on the upgradient end of the residuals pad will be used for decontamination of equipment as required. Water required for decontamination and/or dust control will be stored in on-site tanks. All water collected during decontamination will be collected in the pad sump and routed through the on-site treatment unit.

2.2.4 Soil Relocation Area

An additional area designated for disposal of material relocated from the eastern slope of the landfill will also be constructed at the top of the landfill (Area 2, Figure 3). The 200 foot by 200 foot area will be located adjacent to the residual relocation pad. Prior to placing excavated material in this area, the soil relocation area will be prepared by removing the existing 2- to 7-foot thick cover to form a containment berm along the edges of the soil relocation area. The material from the eastern slope of the landfill will be placed in the excavated area and graded to provide positive drainage until covered. Water from precipitation events will be contained within the containment berms. Any free liquid will be eliminated by the addition of dry soil or by removing the water by pumping and treating the liquid within the on site treatment system. Once the soils have been relocated and any free liquid removed, the cover soil used to create the containment berms will be placed over the relocated slope soils. A minimum of 1 foot of interim cover soil will be placed over the relocated soils after construction activities are completed.

2.2.5 On-Site Wastewater Treatment

The on site wastewater treatment system will consist of a 20,000 gallon equalization/ sedimentation holding tank, followed by bag filters and carbon adsorption columns. The multimedia filters and carbon columns will be trailer-mounted. A small effluent holding tank

(approximately 250 gallons) will also be used to provide a sampling location and to store clean water for backwashing and decontamination rinsing. General specifications of the wastewater treatment system are identified below:

- Pump system: Two 100 gpm vfd pumps. Includes level sensors within the sump that would turn off the pump when the low level reached and turn on at the high level set point.
- Four LCO8 bag filters
- Ten 900-pound granular activated carbon filters

The on-site wastewater treatment system will have a maximum design capacity of 200 gpm. Flow rates will be maintained by pumping a controlled volume from the holding tank. The volume of water that requires treatment will be controlled primarily by the volume and turbidity of the infiltration water entering the excavation area. The rate and staging of the residual removal activities may be modified to remain within the 200 gpm capacity of the treatment system. Alternatively, additional storage capacity may be added.

2.3 Residuals Removal

2.3.1 Portadam Placement/Dewatering

The Portadam (or equivalent) system is a temporary, portable water diversion and cofferdam structure. The equipment proposed consists of tubular steel structural support members assembled in a line with a continuous vinyl liner membrane placed along the face as a water stop.

To minimize the amount of water entering the Portadam area once it has been dewatered, a clean-water seep collection trench will be excavated along side the Portadam structure. This trench will be 1 to 2 feet deep and the width of the excavator bucket. The installation of the trench will include a sump area that will accumulate the infiltrating water. The sump pit will consist of a standpipe constructed by perforating a 12- to 36-inch diameter pipe, then wrapping it with ½-inch hardware cloth and geotextile Class E. A base of filter material consisting of clean gravel (minimal fines) will be placed in the pit to a depth of 12 inches. After installing the standpipe, the pit surrounding the standpipe will then be backfilled with the same filter material. During excavation activities, a pump will be operated automatically through float switches and the water pumped from the sump to the secondary retention area for further retention and settling (see Section 2.3.2) or to the on-site wastewater treatment system (see Section 2.2.4) if treatment is required..

The attached Figure 3 shows the estimated location of the Portadam structures within the Kalamazoo River. Details of the Portadams are shown of Figure 6. Deployment of the Portadam will begin by placing the Portadam stanchions upstream of the area to be dewatered and run at approximately a 60° angle out to the peninsula between the existing main channel and the former

powerhouse channel. The liner will then be placed on the framing, then secured to the stanchions with pins at the top and then spread out into the river at the base of the structure. The liner will be held in place using sand bags.

All water removal actions will be completed in a manner that minimizes the potential uptake of residuals into the pumps and minimize any accidental discharge of solids into the Kalamazoo River. Water from the initial pump down (to approximately 6 inches above the sediment surface) is expected to be clear decant water that will be pumped directly into the river or into the secondary retention area outside the Portadam as described below.

2.3.2 Secondary Retention Area

A secondary retention area will be constructed by placement of double silt turbidity control curtains adjacent to the isolation area created by the Portadam. (see Figure 3). The purpose of the area is to receive the pumped infiltration water from the sump next to the Portadam and provide additional retention. The water will be pumped from the excavation area into a metal or concrete dispersion unit located within the first silt curtain area. The water will then overflow the dispersion unit and flow through the silt curtains. The size of the area will be established in the field. The two silt curtains will be placed about 2 to 3 feet apart to allow access for monitoring turbidity. These turbidity readings will be compared to background values. If the measured turbidity is greater than 2 times the background value, the water from the Portadam sump will be directed to the holding tank for treatment and a series of response actions will be completed as described in Section 3.1.

2.3.3 Residuals Removal Operations

The 12th Street Landfill ROC and SOW require excavation and relocation of residuals in the former powerhouse discharge channel that are contiguous with the eastern side of the landfill. Based on the information identified in Appendix B, approximately 300 to 500 cubic yards of visually identifiable paper residuals located contiguous to the Landfill will be removed from the former powerhouse channel. Residuals removal operations will be accomplished primarily with a long-reach excavator, which will be positioned as close to the water's edge as possible while still allowing safe operations. From this vantage point, the excavator will reach up to 50 feet horizontally into the river to remove visually impacted residuals contiguous to the landfill. If additional areas of contiguous residuals are identified beyond the safe reach of the excavator, crane mats or constructed pads will be placed out from the shore to allow access to additional material. As the excavator advances toward the shoreline, near-shore residuals will be removed to allow placement of the erosion control system. During excavation activities, the Portadams will be inspected routinely and erosion controls, and water collection and treatment systems will be used to prevent potential impacts to downstream water quality.

The soils adjacent to the river will also be removed to allow placement of an erosion control system and limit the potential for the river to come in contact with paper residuals from the landfill. The landfill bank soil removal activities are discussed in Subsection 2.4.1. The landfill bank soils will be removed in an areas extending 25 feet from the existing bank to an elevation of approximately 700 feet above mean sea level (M.S.L.).

2.3.4 Residuals Dewatering and Disposal

Wet excavated materials will be drained and stabilized at the pad area on top of the landfill (Area 1) through gravity drainage. Water draining from the residuals will be collected, treated, and discharged to the river. Temporary erosion controls (*e.g.*, sumps, silt fence material, earthen berms) will be installed to contain the decant water and storm water runoff and limit uncontrolled discharges to the Kalamazoo River.

The water accumulated from residuals placed into the residuals containment area will be managed via passive filtration and treatment (as necessary) and returned to the Kalamazoo River in a manner equivalent to a permitted NPDES discharge. The residuals will be placed in one end of the containment pad. Filter fabric and sand berms will be constructed within the residuals containment area on the opposite end. Filtered water that migrates through the sand berms into the collection sump areas will be pumped to tanks and then through an on-site mobile treatment plant prior to discharge.

2.4 Landfill Slope Protection

2.4.1 Grading of Eastern Slope of Landfill

Section I.1. of the ROD requires that the eastern side of the landfill along the powerhouse channel be excavated and relocated further into the landfill to create a buffer zone to provide hydraulic separation between the landfill contents and the river (see Subsection 2.4.2 for details), and to provide space in which to construct an access road. The eastern slope of the landfill will be cut back approximately 25 feet from the river[(1)] and graded to a slope of 5 horizontal to 1 vertical (5H:1V). Cutting the eastern slope back 25 feet will provide the airspace needed to place the required final cover (a future activity that will be performed as part of the Remedial Action under the CD for the 12th Street Landfill), which, in conjunction with a clay plug, will provide the requisite hydraulic separation. It will also provide sufficient space to construct an access road. The existing grade along the eastern sideslope, and the proposed cutback and final grades are shown on Figure 3, with a cross section of the slope shown on Figure 4. All materials within the

(1) The location and elevation of the river used as the basis for the proposed design was measured on April 4, 2006, at staff gauge SG-RIVER, next to the 12th Street Landfill.

25-foot setback area (approximately 4,800 cubic yards) will be relocated further into the 12th Street Landfill (Area 2 on Figure 3.)

As described in Appendix C, a geotechnical investigation was performed in May 2007 to determine the location of a previously reported berm along the eastern side of the landfill in order to assist in designing the modifications to the eastern slope of the landfill. Because this investigation did not identify a structural berm along the eastern side of the landfill, cutting the slope back 25 feet and grading the slope to a less steep grade will not adversely affect the future stability of the eastern slope of the landfill. This was verified with a slope stability analysis (refer to Appendix E) that evaluated potential worst-case conditions for the 5H:1V slope along the river.

MDEQ Waste and Hazardous Materials Division regulations (R299.4910) stipulate analysis for landfill slope stability, but do not define required factors of safety against slope failure. Generally a value 1.5 factor of safety with respect to strength under static conditions (*i.e.,* the ratio of the average shear strength of the soil over the average shear stress developed along the potential failure surface) is acceptable and common in geotechnical design of stable constructed slopes (Das, 2002). The slope stability for two slope configurations (4H:1V and 5H:1V) under three different scenarios were modeled (see Appendix E). The most conservative condition modeled incorporated both the assumptions of groundwater conditions at the landfill surface and the presence of destabilized paper residuals caused by construction activities or increased loading from additional residuals and cover materials. These combined conditions resulted in modeled factors of safety of 1.58 for the 5H to 1V slope and 1.30 for the 4H to 1V slope. Given the severe implications of slope failure for the eastern slope adjacent to the rerouted Kalamazoo River, the 5H to 1V slope was used for that slope face. In contrast, the remaining slopes with less dire failure scenarios were preliminarily designed to reflect a 4H to 1V slope. These assumptions were then used to establish preliminary side slope locations and thus provide information needed to locate the two material placement pads at the top of the landfill.

As shown on Figure 4, an approximately 15-foot wide clay plug will be installed along the toe of the regraded eastern sideslope up to approximately 702.5 feet M.S.L. to provide hydraulic separation of the landfill contents from the river, and to provide a low permeable soil in which the final cover can be tied into (a future activity). Directly to the east of the clay plug (toward the river), general fill will be placed to bring the remaining portion of the buffer zone up to elevation 702.5 feet M.S.L. A 6-inch thick topsoil layer will be placed over the clay plug and general fill in order to establish vegetation (grass) over the area. The clay plug, general fill, and topsoil will be placed in accordance with the requirements of the Construction Quality Assurance (CQA) Plan located in Appendix G.

2.4.2 Buffer Zone

The Statement of Work (SOW) for the Remedial Design and Remedial Action at the 12th Street Landfill requires that the excavation along the east side of the landfill be extensive enough to create an adequate buffer zone to ensure no direct contact between the PCB-contaminated waste and the Kalamazoo River and to provide installation and access for groundwater monitoring wells. The buffer zone created along the former powerhouse channel will consist of the regraded slope and the clay plug that extends a minimum of 25 feet from the landfill to the Kalamazoo River bank and provides thus hydraulic separation between the paper residuals and surface water. This area also includes a horizontal working area, which allows future installation of, and access to, groundwater monitoring wells. The elevation of the working platform will be approximately 703 feet M.S.L., which will allow for access during normal river conditions.

2.4.3 Intermediate Cover on Side Slopes

After the eastern slope of the landfill is cut back 25 feet, a 1-foot–thick intermediate cover will be placed up the 5H:1V sideslope. The intermediate cover will consist of a 6-inch thick general fill layer overlain by a 6-inch thick topsoil layer. The intermediate cover will be tied into the existing cover at the top of the slope, the clay plug at the toe of slope, and along the northern and southern end of the work area such that no paper residuals are left exposed (refer to Figure 3).

2.5 Erosion Protection

The ROD requires an erosion protection system to provide protection from a 500-year flood event. The ROD also states that the erosion protection will extend to a minimum elevation of 2 feet above the 100-year flood elevation or to a minimum elevation of 707 feet M.S.L. based upon the current dam in-place scenario. Calculations contained in Appendix F indicate that the Kalamazoo River would rise to approximately elevation 705.5 feet M.S.L. during a 500-year flood event. Modeled river velocities reported in the Plainwell Impoundment TCRA Design Report (Arcadis, 2007), show that erosion and/or undercutting could lead to bank failure in this area. Therefore, erosion protection is necessary as an Emergency Action. The conceptual approach to construction of the erosion protection system is to construct an integrated erosion protection system that will extend from the bottom of the river, following excavation of residuals in the discharge channel, up the regraded eastern slope of the landfill, and extend to elevation 707 feet M.S.L.

2.5.1 Related Emergency Response Decisions and Design Approaches

Other aspects of this 12th Street Landfill Emergency Response were integrated into the design and decision making for the erosion control system. Specific aspects of the Emergency Response and existing ROD that were developed separately and integrated into the erosion control system design are described below:

- Bank Slope at River's Edge: The erosion protection system along the 12th Street Landfill needs to be integrated with the erosion protection system being installed along the adjacent MDNR property (to the south of 12th Street). Thus the design will specify a 3H:1V slope from river's edge to elevation 701 feet M.S.L. which mimics the adjacent design slope.
- RipRap Integration: The riprap material sizes may be different between the landfill and MDNR property, so the riprap will need to be blended to limit abrupt changes along the water flow path. After the majority of the erosion system is placed, rocks will be positioned by hand to create the appropriate flowpath. The rip rap will extend from the MDNR property to approximately 10 feet north of the landfill footprint.
- Placement of a Clay Barrier Zone: The ROD requires creation of a buffer zone to insure that no hydraulic connection exists between PCB-contaminated waste and the Kalamazoo River. The design includes a 2.5 feet deep clay plug behind regraded slope to provide this physical separation between possible fill material and the surface water.
- Access Road: Since the ROD requires on-going groundwater monitoring, a nominally 10-foot wide access road will also be installed along the eastern slope of the landfill to provide a location for final monitoring well construction and access for sampling (refer to Figures 3 and 4). Erosion control matting will be installed over the access road.
- Erosion Control Material Types: Based upon conversations with various agency representatives and review of the Plainwell Impoundment TCRA design report, the state agencies prefer use of as natural erosion protection as possible. Therefore, the erosion system considered is a combination of riprap near the riverbank to an elevation of 703 feet M.S.L. and erosion control matting at higher elevations.

2.5.2 Riverbank Protection

Riverbank protection has been developed based upon resistance to the erosion from the rerouted Kalamazoo River through the former powerhouse channel (see Appendix F) and the impacts of ice and debris. The maximum flow velocity of the 500-year event along the 12th Street Landfill shoreline and landfill sideslope was estimated to be 5.7 feet per second (fps). The calculation for riprap size shows that riprap with a D_{30} of 2 inches will be able to withstand the erosive forces produced along the shoreline and landfill sideslope from the 500-year flood event. The riprap erosion protection has also been designed to resist potential ice and debris (*e.g.*, fallen trees) damage. Ice and debris create greater stresses on riprap revetment by impact and flow concentration effects (USACE, 1994). The USACE recommends that the thickness of the riprap should be increased by 6 to 12 inches, accompanied by appropriate increase in stone size, for riprap subject to attack by large floating debris. Riprap deterioration from debris impacts is usually more extensive on banks lined with steep slopes, therefore, the USACE recommends that riprapped slopes on streams with heavy debris loads should be no steeper than 2.5H:1V. In order to address this concern at the 12th Street Landfill, the stone size and thickness has been increased, and the riverbank slopes will be regraded to 3H:1V. Thus the riverbank protection design has been specified to use a larger stone (D_{50} of 9 inches) to address the greater potential stresses on the riprap caused by ice and debris (*e.g.,* fallen trees).

Riverbank protection will be provided by a minimum 2-foot lift (thickness) of specified riprap from the bottom of the river to the elevation of the access road at approximately 703 feet M.S.L., and by a turf reinforcement mat along the sideslope of the landfill, extending from the top of the riprap to elevation 707 feet M.S.L. The riprap will have a D_{50} of approximately 9 inches and will be angular in shape (rounded stone may be substituted as determined to be appropriate by the Engineer). No stones will be less than 3 inches in diameter or greater than 15 inches in diameter. As recommended in MDOT (2003) guidance, an 8-ounce nonwoven geotextile fabric will be installed under the stones/rocks to prevent erosion of the underlying general fill layer or native soil. If the stable historic river bed is found to occur at the toe of slope, the rock will be placed on the bed and up the slope (this determination will be made in the field with input from the USEPA and MDEQ oversight staff). If a stable bed is not present at the toe of slope, bank toe protection will be provided by keying the rock into the river bed to a depth of 1 foot to protect against bank undercutting. The backup for this riprap design are contained in Appendix F. Erosion protection along the disturbed bank area will be provided by the placement of a turf reinforcement mat (Enkamat® or similar)[(2)] from elevation 703.0 feet M.S.L. across the access road and up the sideslope to elevation 707 feet M.S.L. The turf reinforcement mat will be capable of withstanding river velocities produced by a 500-year flood event (5.7 feet per second) (refer to the hydraulic calculations in Appendix F).

The riprap and the turf reinforcement mat will be installed in accordance with the requirements of the CQA Plan in Appendix G.

The habitat quality and stability of the rock-armored banks may be enhanced by the planting of live willow stakes into the interstices of the river rock. As the willow stakes grow, their roots should stabilize the banks, and the submerged and overhanging foliage would provide flow refuge, shade, and habitat for macroinvertebrates. Root wads (including the root mass the willow stakes would form, as well as buried tree stumps derived from the project area clearing activities) would provide similar functions, but would primarily function to receive and deflect the water away from the bank and towards the center of the channel. The number and locations of the willow stakes will be determined based on field conditions.

2.6 Vegetation

All disturbed areas will either be seeded and mulched, or hydro-seeded based on field conditions. Fertilizer will be applied only if needed. The seed mix will be applied at a rate of approximately 63 pounds per 1,000 square feet. Mulch may be applied at a rate of 2 to 3 tons per acre. The CQA Plan

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(2) Enkamat® is a three-dimensional nylon turf reinforcement mat made of polyamide (nylon) filaments joined at the intersections. Ninety-five percent of the matrix is open space, which supplements natural erosion control by reinforcing the plant roots. As the roots grow, they become entwined within the Enkamat,® creating a stable cover.

(Appendix G) provides additional information about seed, possible fertilizer applications and use, and mulch placement.

The area where the turf reinforcement mat is placed will be seeded and/or hydro-seeded in accordance with the requirements of the CQA Plan, which in general requires seed to be placed on the topsoil prior to the installation of the turf reinforcement mat and then hydro-seeding the turf reinforcement mat after it is installed.

To help establish a more natural look along the river, up to 50 willow stalks may be planted along the river's edge within the riprap. The stalks would be placed just up-slope of the normal river elevation to help promote the growth of the willow trees. Once established, the willow trees and the other plant growth that should naturally fill-in between the riprap, providing additional protection from erosion and ice flows.

Section 3
Monitoring Plan

The emergency response action monitoring plan has multiple components with different objectives. Overall, monitoring will provide information to minimize adverse secondary impacts from the Emergency Actions and to confirm the results of the remedial activities. In general, the monitoring approach is consistent with that being performed under the Plainwell Impoundment TCRA. Modifications to the TCRA approach have been made when monitoring objectives for these Emergency Actions are different. The components of the monitoring plan and the associated Powerhouse Channel Emergency Action objectives are:

- *Resuspension Monitoring and Control* – To provide real time water quality data to minimize the potential for residuals releases to the Kalamazoo River. This sampling will form the basis for adjusting the Emergency Response Actions as necessary.
- *Wastewater Treatment System Discharge Monitoring* – To verify the wastewater treatment system effectiveness and document compliance with ARARs.
- *Residuals Excavation Documentation Sampling*– To document PCB concentrations in residuals remaining in the former powerhouse channel after completion of emergency response activities.
- *Erosion Control and Vegetation Monitoring* – To ensure long term effectiveness of the river bank erosion control system.

3.1 Resuspension Monitoring and Control

The potential exists for secondary release of residuals during the excavation activities being conducted in the former powerhouse channel. As described previously, the design of the excavation actions has been developed to minimize potential adverse effects from this excavation work by completing the residual removal activities and bank re-grading prior to re-routing the river channel. An additional safeguard is to implement a resuspension monitoring program that provides real time water quality data for use in assessing a need for operational changes that minimize any unintended secondary effects.

The approach integrated into the resuspension monitoring and control plan is to compare turbidity data collected upstream and downstream of the former powerhouse channel as a mechanism to track the impacts of the excavation activities on water quality. If the turbidity from the downstream station exceeds twice the measured turbidity as the upstream sampling location, a series of contingency responses are implemented to minimize possible adverse impacts. The turbidity data are also supplemented by weekly PCB analyses and visual inspections of the water barriers associated with the residuals isolation area. Specific components of the resuspension monitoring plan that will be performed during actual excavation actions in the former powerhouse channel are summarized in Table 3-1 located at the end of this section.

The use of turbidity as the real time water quality indicator parameter is based upon the following rationale:

- Turbidity measurements are rapid, easy to instrument, reliable and commonly used to monitor suspended solids during the on-going Plainwell TCRA as well as various residuals excavation projects across the country.
- Turbidity has been shown to be well correlated to Total Suspended Solids (Plainwell Impoundment TCRA Design Report, 2007, Figure 5-2). Furthermore, based upon their physical/chemical characteristics, specifically very low water solubility and hydrophobic nature, PCBs will remain associated with solid particles which are measured both as TSS and turbidity. As such, turbidity provides a good surrogate for PCBs in surface water.

Three YSI 6920 Sonde units, each equipped with probes to measure dissolved oxygen, turbidity, pH, conductivity, and temperature will be used to collect the water quality data. The YSI 6920 logs the above data at predetermined time intervals. The units will be calibrated, operated, and maintained according to the manufacturer's instructions and will be capable of collecting point turbidity readings from water as deep as 15 feet. The meter(s) will be able to measure turbidity at a resolution of +/- 1 nephelometric turbidity unit (NTU). The Sonde units will be places within a perforated PVC pipe to protect the sensor and anchored to the creek bottom. A buoy will be attached to the PVC pipe to mark its location, and the sensor will be connected to a line anchored on shore for security purposes.

Turbidity data will be collected from upstream and downstream of the excavation area and from a location between the silt curtains surrounding the secondary retention area. The upstream and downstream locations will be 200 feet from the work area, along the general flow path to the work area, although the specific locations are subject to change based on field conditions. Turbidity readings will be collected from approximately mid-depth at all locations.

At a minimum, turbidity readings will be taken from the upstream and downstream locations at these times:

- prior to placement of any equipment or materials in a work area;
- following placement of equipment and materials but prior to excavation actions;
- every 1 hour during in-channel excavation actions; and
- other readings may be collected based on field conditions.

Turbidity readings will be taken from the secondary retention area sampling points at these times:

- every 1 hour while water is routed into the secondary retention area; and
- more frequently as dictated by conditions in the field.

An ISCO automated sampler will be used to collect water samples for PCB analysis. The unit will be operated and maintained according to the manufacturer's instructions. PCB samples will be collected in accordance with the procedures outlined in the Field Sampling Plan (FSP) for the site. Analysis will be

performed by Weyerhaeuser Analytical Testing Services (WATS) in accordance with the site-specific Quality Assurance Project Plan (QAPP).

Surface water PCB samples will be co-located with the turbidity monitoring locations 200 feet upstream and downstream of the excavation area. A length of flexible Tygon tubing will be attached to the side of the turbidity monitoring station (PVC pipe) and run up to shore and connected to the ISCO sampler.

Surface water samples will be collected for PCB analysis on a weekly basis. Whenever possible, sampling will be conducted on the same day of the week and at approximately the same time during the day – samples will be taken approximately 2 hours after the start of excavation activities for the particular day. If abnormal events occur (such as noticeable sediment disturbances), additional samples will be taken for PCB analysis.

During the residuals removal activities, visual inspections outside of the secondary retention area and excavation area isolation structures will be performed from a boat at the times described below. The inspections will assess the integrity of the silt curtains, looking for proper anchoring, positioning, and alignment, and for physical damage such as rips or tears. Results will be recorded in a field notebook. If a problem is found, work in that area will cease or flow into the secondary retention area will be diverted to the wastewater treatment system until the problem is corrected. Inspections will be performed at the following times:

- daily prior to the start of work;
- as required after major modifications or maintenance of the structure; and
- as required per turbidity exceedence corrective actions.

If the turbidity at the downstream monitoring location is more than two times the upstream turbidity, then a series of contingency actions will be undertaken until the turbidity has returned to acceptable levels. An exceedence at the secondary retention monitoring location will act as an early warning system and will prompt rerouting the excavation water to the wastewater treatment system. An exceedence at the downstream monitoring station will trigger the following actions to identify and eliminate the cause of the exceedence:

- Inspection of the area downstream of the excavation site and the turbidity curtains and Portadams surrounding the site.
- Next, troubleshooting measures will be implemented based on field conditions to reduce turbidity (*i.e.,* modifying the dewatering pump rate, cleaning or relocating the sump, etc.).
- Finally, excavation rates will be reduced or procedures modified until the turbidity has returned to acceptable levels.

Additional turbidity and PCB samples may be collected, as specified in this section, based on the extent or severity of the exceedence.

3.2 Wastewater Treatment System Discharge Monitoring

Wastewater will be generated during Emergency Response activities. This impacted water will be treated in an on-site wastewater treatment system (see Section 2.2.4 for system details). The wastewater treatment system will be monitored to ensure compliance with ARARs and to ensure that the treated water will not have a negative impact on the water quality in the Kalamazoo River. The discharge monitoring plan is also summarized in Table 3-1 at the end of this section..

The influent sampling point will be located just upstream of the sedimentation basin the intermediate stage sampling point will be located between the first and second granular activated carbon trains, and the effluent sampling point will be located just downstream of the holding tank. The effluent from the sedimentation tank will be monitored to determine if tertiary treatment is necessary. If the turbidity of the overflow from the sedimentation tank is less than two times the river background turbidity, then the water will be routed to the holding tank and discharged through outfall 001. Otherwise the water will be sent for tertiary treatment consisting of fabric filtration followed by granular activated carbon adsorption. River background turbidity will be measured from the upstream turbidity monitoring location described in the resuspension monitoring section.

All of the samples will be collected and handled in accordance with the site FSP (see Appendix G). Samples for PCBs, TSS, and total phosphorus as P will be sent to WATS for analysis following procedures documented in the approved QAPP. Additional sampling or inspections may be conducted based on conditions encountered in the field. Monitoring results will be documented in a field notebook and reported to the agency after the completion of the emergency response work.

3.3 Residuals Excavation Documentation Sampling

As required in the 12th Street Landfill ROD, residuals excavation will be complete when the visible contiguous residuals are removed from the excavation area in the former powerhouse channel. However, residuals sampling will be performed to document post excavation PCB surface concentrations remaining in the powerhouse channel. Based on conditions in the field and the status of the remedial activities, intermediate samples maybe collected for expedited analysis in order to obtain data that will be used to improve excavation performance.

Documentation sampling will be conducted in a manner similar to the confirmation sampling being conducted under the Plainwell Impoundment TCRA. A grid will be established across the excavation area to facilitate the collection of a representative group of samples. The grid will be approximately 10,000 square feet in size and will be broken into 20-foot by 20-foot sampling sections. A minimum of six sample sections from the grid will be randomly selected for sampling using a random number generator/table or other approved means. The random pattern may be modified in the field (in consultation with oversight personnel) to ensure aerial distribution of the samples throughout the grided zone. Once the sample nodes have been identified within each grid, confirmatory sampling will be

performed. Each node will be sampled, visually inspected for the presence of residuals and, if no residuals are observed, sent for laboratory analysis to quantitatively confirm that excavation is complete. If residuals are observed in the samples, then additional sediment (targeting a initial 6-inch depth) will be excavated. A confirmation sample will then be collected after the re-excavation is complete. Samples will be collected by hand using a trowel or similar tool as described in the FSP from the top 6 inches of the sediment surface. Samples will be analyzed at WATS following procedures documented in the QAPP.

3.4 Erosion Control and Vegetation Monitoring

Erosion control monitoring will include visual observations of the erosion protection system including rip rap and matting system, as well as evaluation of seeded and planted vegetation. Monitoring of restored bank areas for signs of detrimental erosion or bank failure will be performed annually until the long term operation and maintenance plan is implemented per the closure requirements for the 12th Street Landfill.

Monitoring activities will include conducting a visual inspection of bank conditions, developing written inspection logs, and photographing any conditions of note, including:

- loss of armoring materials (*i.e.,* loss of stones, erosion control matting, and/or vegetation);
- obvious signs of gullying or rill erosion;
- signs of bank undercutting or sloughing (*i.e.,* cracking or bulging visible at the surface);
- any obvious signs of lateral bank movement (*i.e.,* due to erosion or deposition); and
- any signs of stressed or minimal vegetation growth.

Observed conditions of note will be recorded in a monitoring inspection log and photographed at the time of inspection. If areas of significant erosion or bank failure are observed during the monitoring period, the need for adaptive management or bank repair activities will be discussed with the appropriate oversight agencies. Vegetation issues will be addressed with reseeding or mulching as necessary. Inspection logs and photographs will be provided to the USEPA and MDEQ for review and discussion within 1 month following completion of the monitoring event.

Table 3-1 Monitoring Plan

Section 4
Project Schedule

This section provides details about the anticipated construction schedule, sequencing, and duration of each task of the project. Also refer to Figure 7 for the preliminary schedule, sequencing, and duration of specific work tasks anticipated for implementation of the emergency action activities at the 12th Street Landfill. Section 4.2 discusses important assumptions and potential constraints that may impact the actual timing and duration of construction and overall project implementation.

4.1 Summary of Construction Activities and Schedule

Construction activities are currently scheduled to take place between August and November 2007. Certain restoration activities, such as planting of seasonally dependent vegetation species, may need to occur in the spring of 2008. The construction activities are organized into five major categories summarized below. Section 2 and Figure 7 provides additional detail about the anticipated sequencing of individual work tasks.

- *Mobilization and Site preparation* – These activities will consist of constructing an access roads, installing temporary soil erosion and sedimentation control measures, clearing and grubbing along the Kalamazoo River, and construction of two containment pads on the top of the landfill (3 to 4 weeks).
- *Residual Removal* – These activities will consist of sectioning off and dewatering the former powerhouse channel, constructing a secondary water retention area, remove residuals from the channel and dewatering and disposal of the residuals within the containment pad (4 weeks).
- *Shoreline Construction* – These activities will consist of preparation of the shoreline and placement of clean fill material, a clay barrier zone, geotextile fabric, and erosion control materials consisting of rip rap and turf reinforcement mat (3 weeks).
- *Landfill Slope* – Activities will include reshaping the eastern slope of the landfill and placement of reinforcement mats and intermediate cover material. This task will also include covering of the containment pads to prevent any potential movement of the disposed material. Task also includes seeding and mulching as necessary (4 weeks).
- *Demobilization* – Activities include removal of all in water and shore equipment, any necessary repair of disturbed areas and demobilization of equipment (2 weeks).

Mobilization is scheduled to begin the week of August 6, 2007, with construction completed by the end of October/early November 2007.

4.2 Potential Impacts to Construction Schedule and Sequencing

The construction schedule summarized above and provided on Figure 7 was prepared assuming ideal circumstances and anticipated optimal sediment/soil removal rates. However, it is important to note that the schedule, sequencing, and duration of any one or more construction components may be affected by

inclement weather, high-flow events, technical adjustments to the design, confirmation sampling, and unforeseen agency requirements or other factors largely outside the control of the contractor and owner.

For example, a severe weather pattern could affect both work within the channel as well as the slope construction. In addition, restoration activities are subject to weather and seasonal conditions. Most plant species cannot be successfully planted or germinated late in the fall season, meaning some restoration and habitat reconstruction components may be delayed until the appropriate season or conditions. To manage these potential schedule impacts, an adaptive management approach will be employed to handle schedule modifications with the objective – but not an explicit guarantee – of completing the project by the end of 2007.

Specifically, and as shown on Figure 7, the project schedule has been based on an assumed construction start date of August 6, 2007, which will potentially allow enough time for completion of all construction tasks by late October 2007. Delays in the construction start date will adversely affect all other subsequent or dependent tasks in the sequence, and therefore could prevent the completion of construction activities by the end of the year.

As summarized in Section 3 (but not depicted on Figure 7), post-construction and long-term monitoring activities in the project area will continue for 3 years to confirm successful restoration measures and to monitor bank stability.

Section 5
References

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Table 3-1
Monitoring Plan

Parameter	Sample Type**	Location*	Minimum Frequency
Resuspension Monitoring and Control			
Turbidity	Instantaneous sample collection using hand held meter or auto sampler with resolution of +/- 1 NTU	Mid-depth, approximately 200 feet upstream of construction site/just downstream of the dam spillway along the general flow path going past the removal area; samples taken from a boat or pier	- At the beginning of the work day - Prior to and following equipment placement in the work area - Hourly while work is performed - As needed based on field conditions
		Mid-depth, approximately 200 feet downstream of construction site along the general flow path past the removal area; samples taken from a boat or pier	
		Water collection sump constructed within the removal area	- Hourly while pumps are discharging
		Mid-depth, between the inner and outer silt curtains surrounding the secondary retention area; samples take from a boat or pier	
PCBs	Grab sample, analyzed at off-site lab, quantification limit of 0.2 ug/L	Mid-depth, approximately 200 feet upstream (co-located with turbidity sample); sample from boat or pier	- Once per week (on the same day where possible, 2 hours after the start of removal activities)
		Mid-depth, approximately 300 feet downstream (co-located with Turbidity sample); sample from boat or pier	
Inspections	Visual, looking for integrity and proper function	Entire Portadam structure and silt curtains surrounding the secondary retention area	- Daily prior to start of work - As required, after major modifications or maintenance of the structure - As required, per turbidity exceedence mitigation procedures.
Wastewater Treatment System Discharge Monitoring			
Flow	Record flow meter reading	Effluent to outfall 001	Daily
Total PCBs	Grab sample per EPA Method 608. Analyzed at off-site lab; quantification limit of 0.2 ug/L	Influent, Intermediate Stage and Effluent to Outfall 001	Twice per week (on the same day where possible, 2 hours after the start of removal activities)
TSS	Grab sample per EPA Method 160.2. Analyzed at off-site lab; quantification limit of 5 mg/L	Effluent to Outfall 001	Twice per week (on the same day where possible, 2 hours after the start of removal activities)
Total Phosphorus as P	Grab sample per EPA Method 365.3. Analyzed at off-site lab; quantification limit of 0.2 ug/L	Effluent to Outfall 001	Twice per week (on the same day where possible, 2 hours after the start of removal activities)
Turbidity	Instantaneous sample collection using hand held meter or auto sampler with resolution of +/- 1 NTU	Effluent from the sedimentation tank	Hourly while excavation dewatering water is being routed to the water treatment system.
Equipment Inspection	Visual; looking for equipment integrity and proper function	Entire system	Three times per week
Outfall Observation	Visual; looking for abnormal discharge (*i.e.,* color, clarity, etc)	Outfall 001	Daily (when WTP is operational)
Sediment Removal Confirmation Residual Excavation Documentation Sampling			
PCBs	Grab; analyzed at an off-site lab	Removal area divided into a gird; minimum of six locations randomly selected from the gird for sampling	After initial removal completion then after each successive removal pass until sample results are below 1 mg/kg or historic river bottom is reached.
Erosion Control and Vegetation Monitoring			
Inspections	Visual; looking for detrimental erosion or bank failure	Erosion protection along the 12th Street Landfill	Annually as part of the 12th Street Landfill inspections

* Locations are subject to change based on conditions encountered in the field
** See the FSP for specific sampling procedures and equipment.

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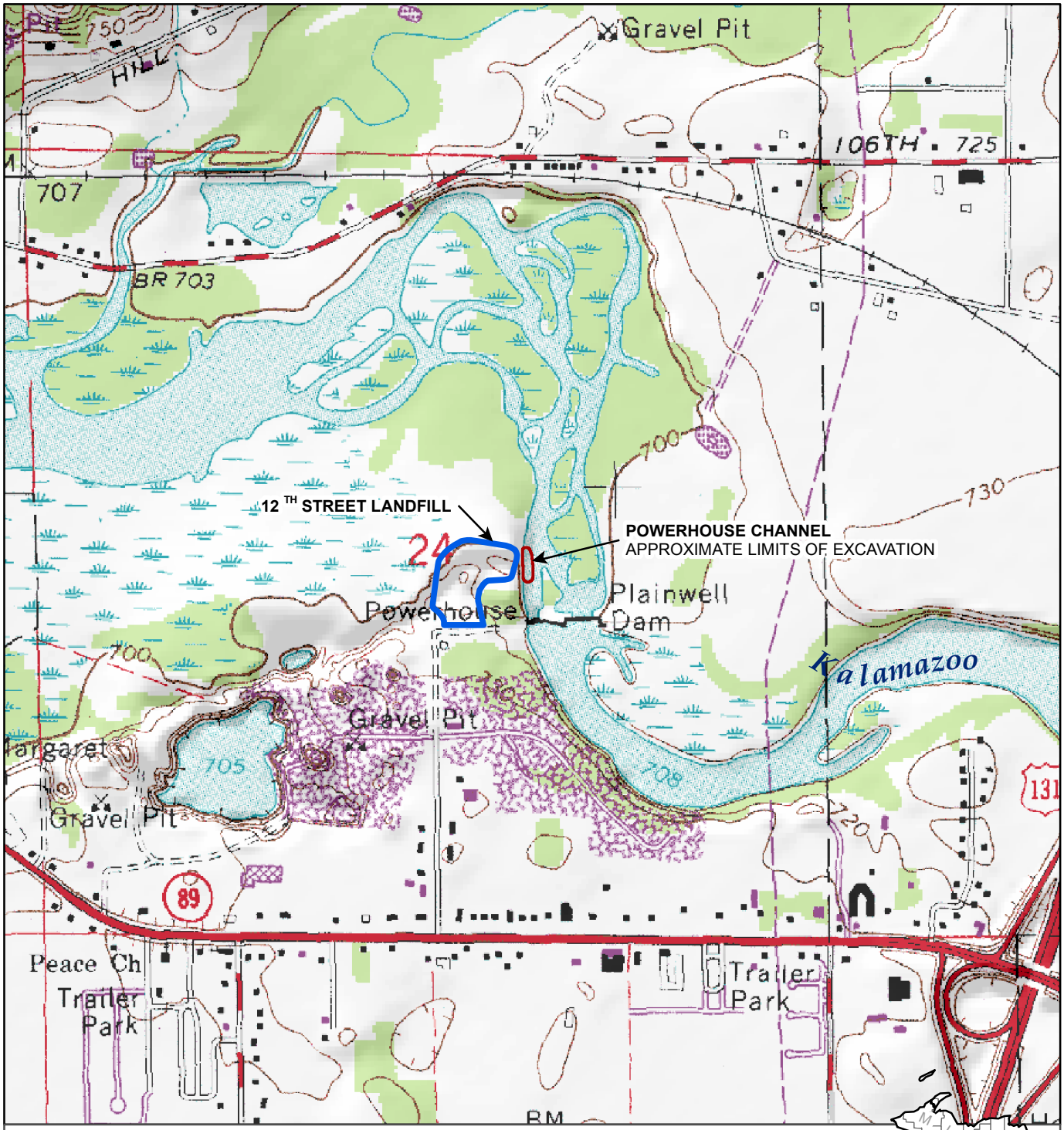

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12TH STREET LANDFILL
EMERGENCY RESPONSE PLAN DESIGN REPORT
OTSEGO TOWNSHIP, MICHIGAN

SITE LOCATION MAP

DRAWN BY:	HANKLEY C
APPROVED BY:	MJA
PROJECT NO:	00-05117.04/ERD
FILE NO.	51170402.mxd
DATE:	JULY 2007

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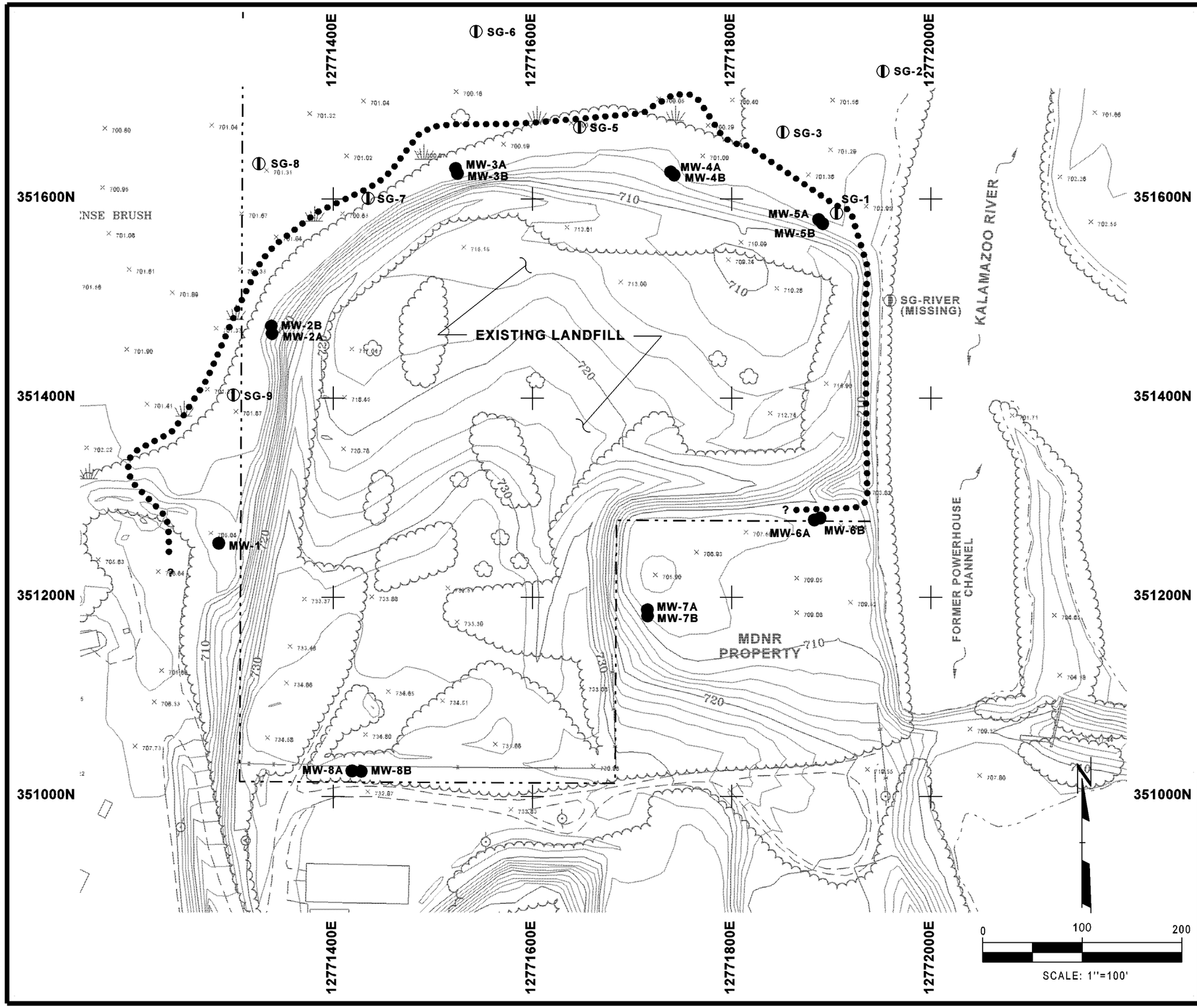
FIGURE 1



LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- GRID LOCATION
- EXISTING UNPAVED ROAD
- EXISTING FENCE
- EXISTING BUILDING
- 730 — EXISTING 10' CONTOUR
- EXISTING 2' CONTOUR
- x 732.1 — EXISTING SPOT ELEVATION
- EXISTING TREES AND/OR BRUSH
- EXISTING WETLAND LIMITS
- EXISTING EDGE OF WATER
- APPROXIMATE LIMITS OF PAPER RESIDUALS USING VISUAL CRITERIA
- MW-10 — EXISTING MONITORING WELL LOCATION
- SG-3 — EXISTING STAFF GAGE

NOTES

1. BASE TOPOGRAPHY PROVIDED BY OAS, INC. OF SEYMOUR, INDIANA BASED ON AERIAL SURVEY DATED 3/30/2005. COORDINATES ARE MICHIGAN STATE PLANE-SOUTH ZONE. THE VERTICAL DATUM IS NGVD 29.
2. PROPERTY BOUNDARY BASED ON LEGAL DESCRIPTION PROVIDED BY USEPA IN A FAX DATED MARCH 30, 2004. COORDINATES FOR S 1/4 CORNER AND N 1/4 CORNER OF SECTION 24 AND NORTH BEARING USED TO PLOT PROPERTY LINE WERE PROVIDED BY HOLLAND ENGINEERING AND ARE BASED ON MICHIGAN STATE PLANE - SOUTH ZONE COORDINATES.

PROJECT: **12TH STREET LANDFILL**
EMERGENCY RESPONSE PLAN DESIGN REPORT
OTSEGO TOWNSHIP, MICHIGAN

SHEET TITLE: **EXISTING CONDITIONS**

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APPROVED BY: MJA	DATE PRINTED:	FIGURE	2
DATE: JULY 2007			

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Levels
(1) 27,29
(2) 1-63
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(4) 1-63

Logical Names
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(2) pro
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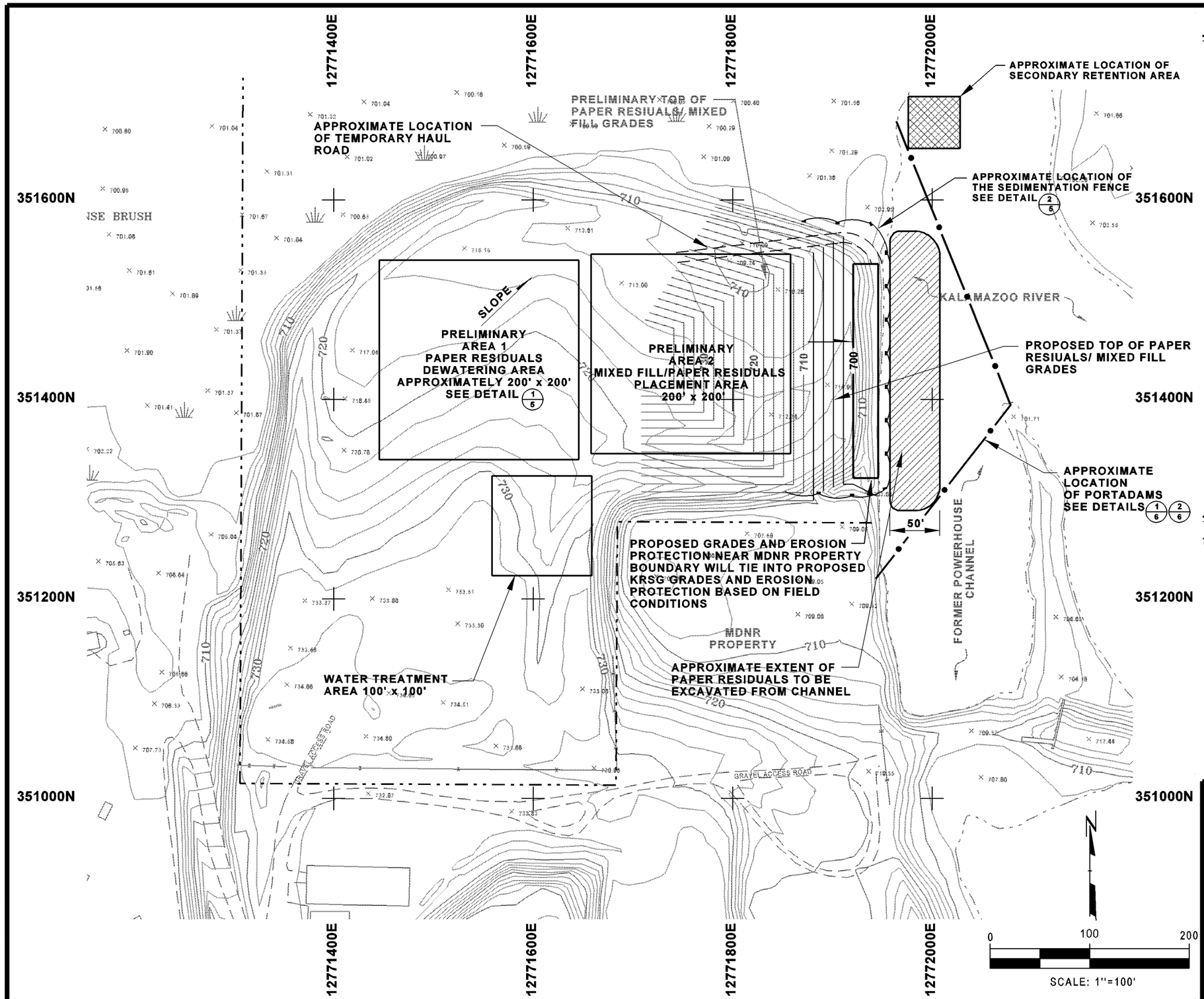

LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- GRID LOCATION
- EXISTING UNPAVED ROAD
- EXISTING FENCE
- EXISTING BUILDING
- 730 — EXISTING 10' CONTOUR
- EXISTING 2' CONTOUR
- x 732.1 — EXISTING SPOT ELEVATION
- EXISTING WETLAND LIMITS
- EXISTING EDGE OF WATER

NOTES

1. REFER TO FIGURE 2 FOR BASE MAP NOTES.

PROJECT: **12TH STREET LANDFILL**
EMERGENCY RESPONSE PLAN DESIGN REPORT
OTSEGO TOWNSHIP, MICHIGAN

SHEET TITLE: **PROJECT SITE PLAN**

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APPROVED BY: MJA	DATE PRINTED:	**FIGURE 3**	
DATE: JULY 2007			

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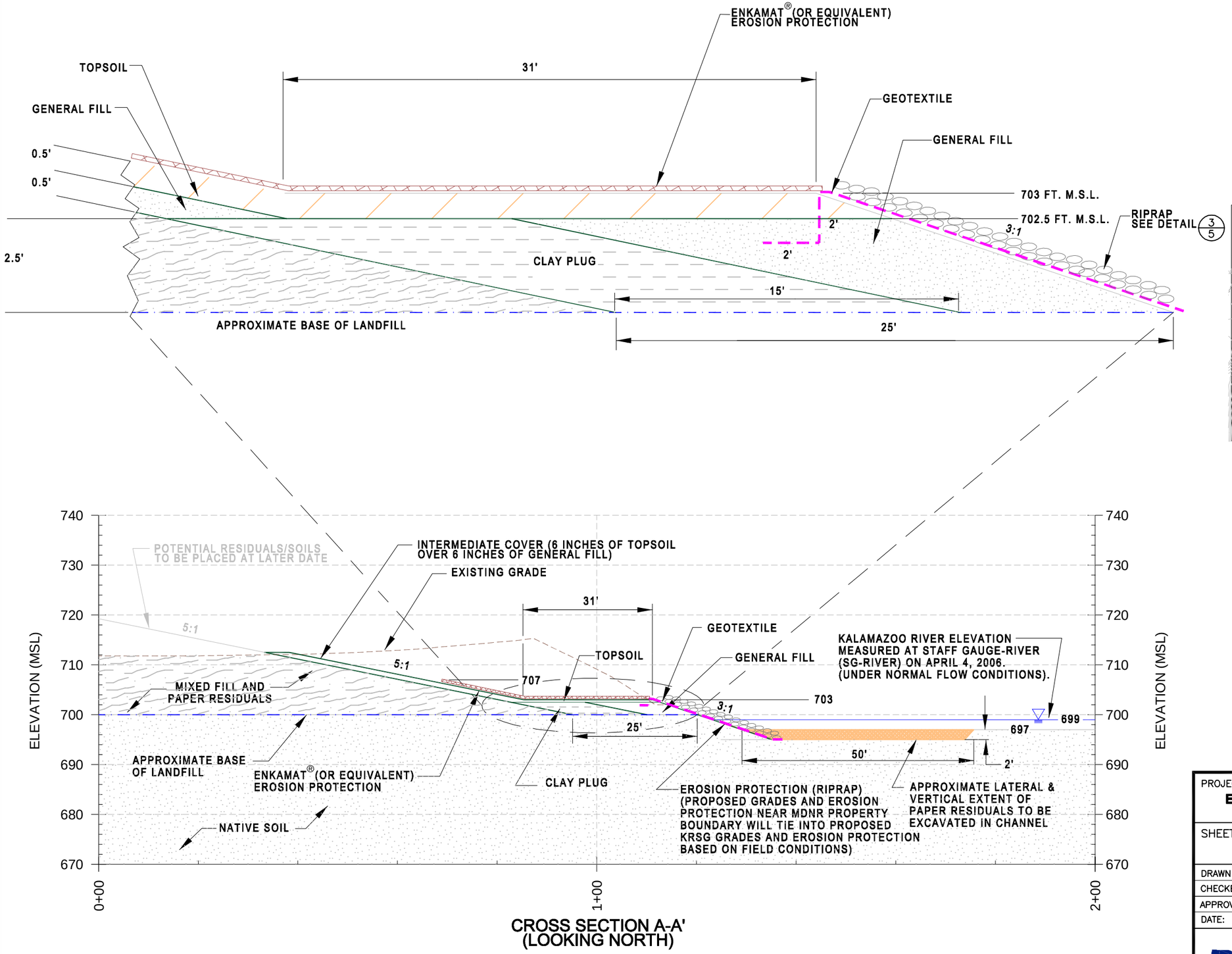
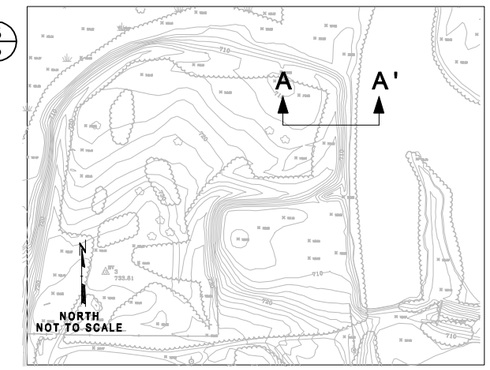
Ref. File 3 = J:\05117\04\ERD\proposed.dgn
Ref. File 4 = J:\05117\04\ERD\11x17bdr.dgn

Logical Names
(1) bmc
(2) bmr
(3) pro
(4) bdr

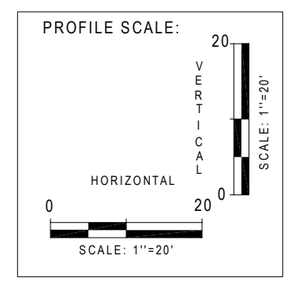
Levels
(1) 27
(2) 1-63
(3) 1-63
(4) 1-63



CROSS SECTION A-A'
(LOOKING NORTH)



CROSS SECTION LOCATOR



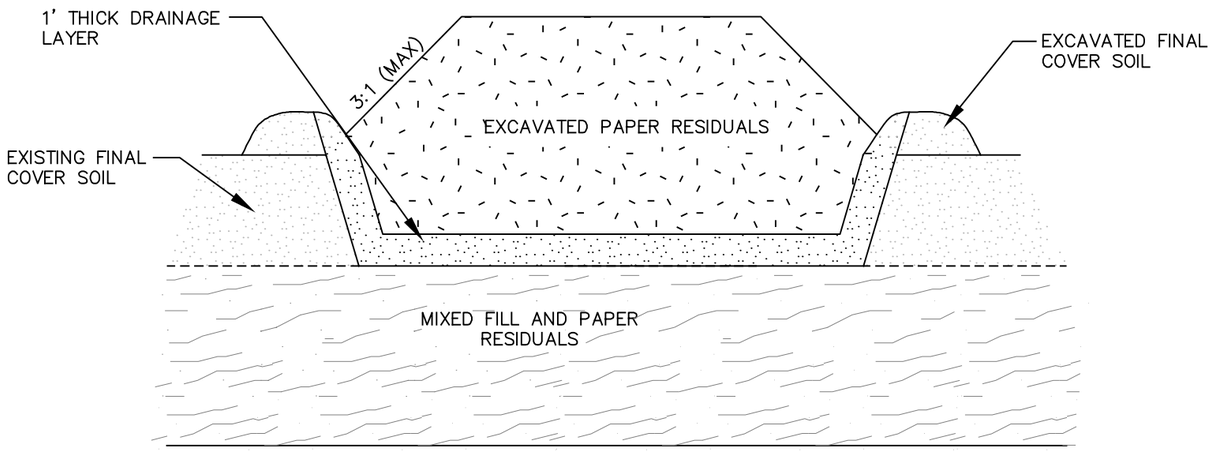
PROJECT: **12TH STREET LANDFILL**
EMERGENCY RESPONSE PLAN DESIGN REPORT
OTSEGO TOWNSHIP, MICHIGAN

SHEET TITLE: **CROSS SECTION A-A'**

DRAWN BY: STORMERL	SCALE:	PROJ. NO. 5117.04\ERD	
CHECKED BY: ECW	AS SHOWN	FILE NO. XSECTION_PLT.DWG	
APPROVED BY: MJA	DATE PRINTED:	**FIGURE 4**	
DATE: JULY 2007			

RMT
744 Heartland Trail
Madison, WI 53717-1934
P.O. Box 8923 53708-8923
Phone: 608-831-4444
Fax: 608-831-3334

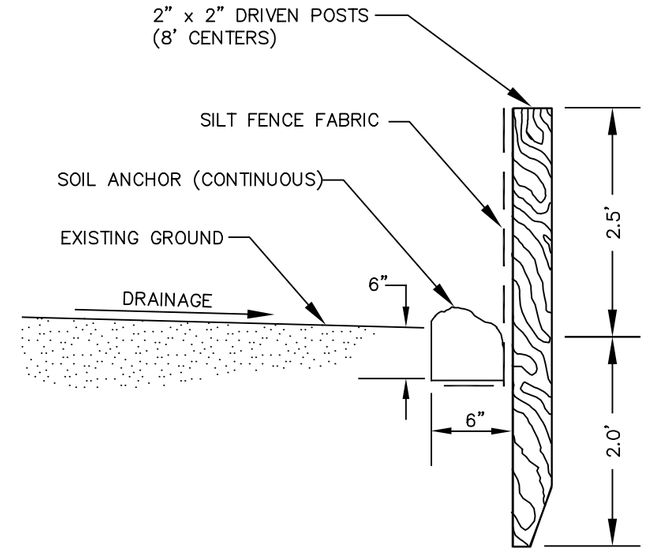
PLOT DATA
Drawing Name: J:\05117\04\ERD\xsection_plt.dwg
Operator Name: stormerl
Scale: 1"=1'



1/5

PAPER RESIDUALS DEWATERING AREA

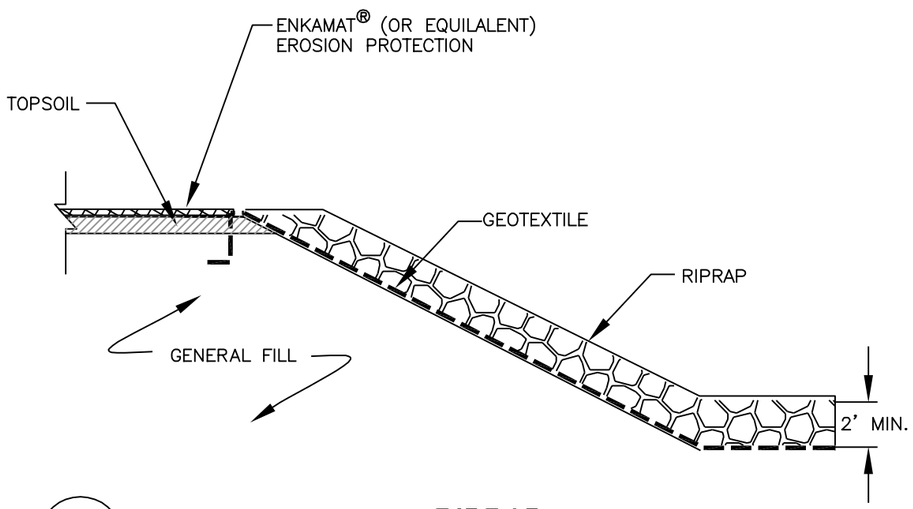
(NOT TO SCALE)



2/5

SEDIMENT CONTAINMENT FENCE

(NOT TO SCALE)



3/5

RIPRAP

(NOT TO SCALE)

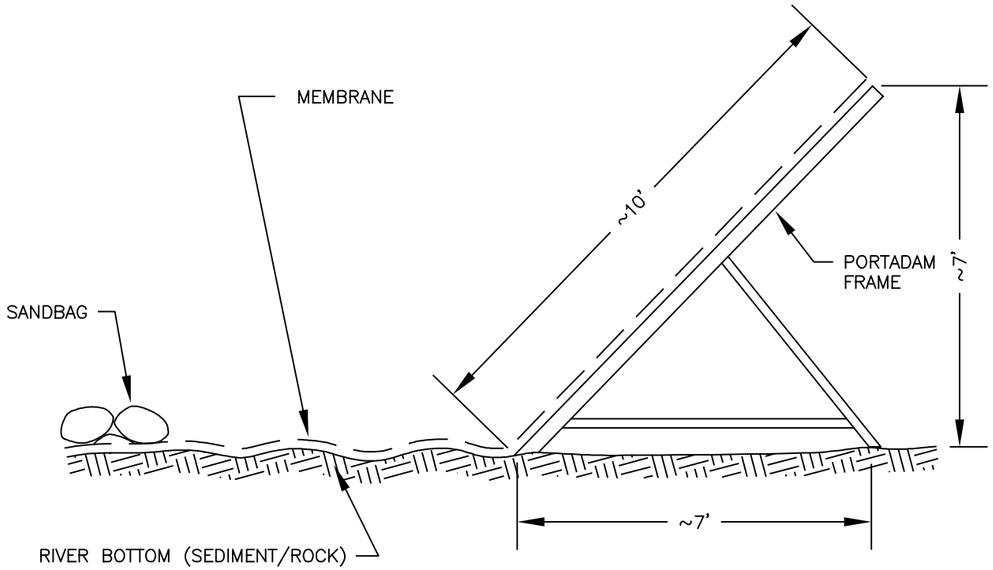
PROJECT: **12TH STREET LANDFILL**
EMERGENCY RESPONSE PLAN DESIGN REPORT
OTSEGO TOWNSHIP, MICHIGAN

SHEET TITLE: **DETAILS**

DRAWN BY: STORMERL	SCALE: NOT TO SCALE	PROJ. NO. 5117.04\ERD
CHECKED BY: ECW		FILE NO. DETAIL1.DWG
APPROVED BY: MJA	DATE PRINTED:	**FIGURE 5**
DATE: JULY 2007		

RMT
744 Heartland Trail
Madison, WI 53717-1934
P.O. Box 8923 53708-8923
Phone: 608-831-4444
Fax: 608-831-3334

PLOT DATA
Drawing Name: x
Operator Name: x
Scale: x



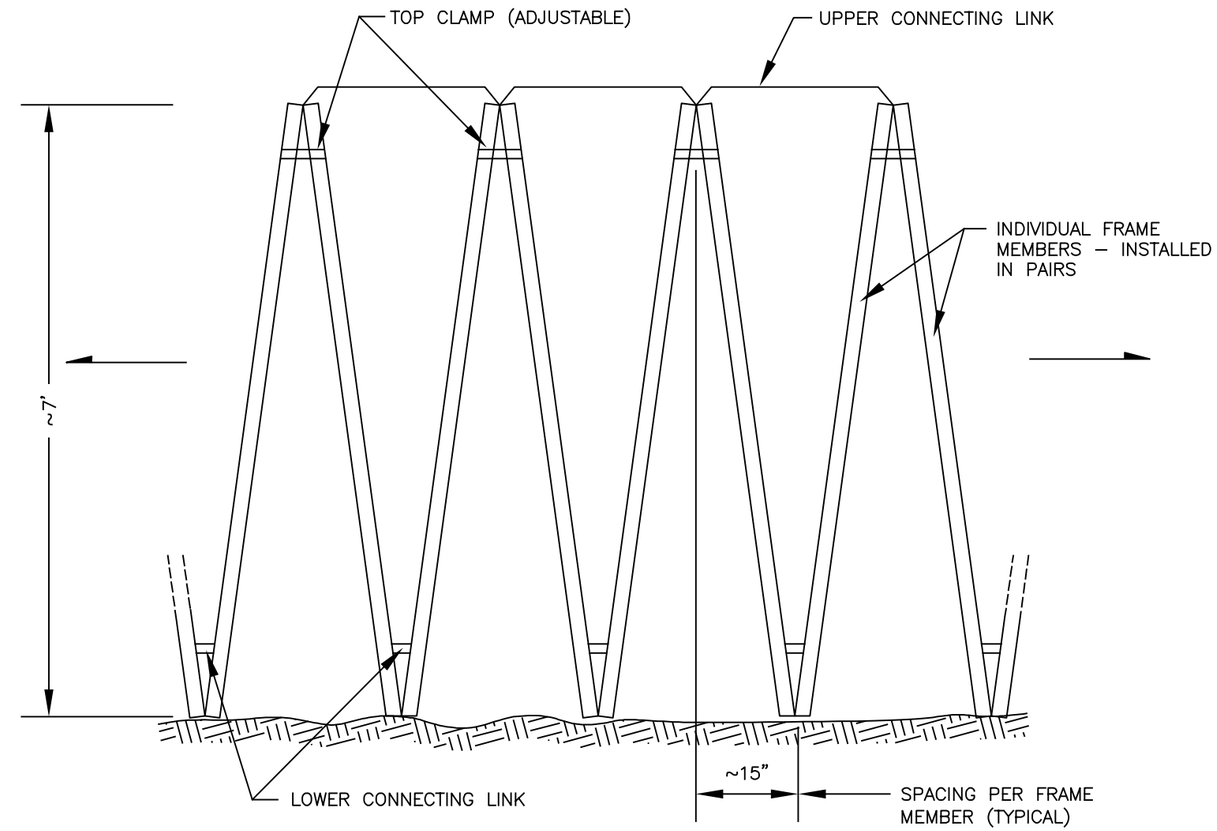
NOTES:

1. MEMBRANE IS A VINYL COATED–NYLON MESH CONTINUOUS FABRIC
2. ALL JOINTS ARE WELDED
3. OPTIONAL ATTACHMENTS:
   - BACK BRACE POLE
   - HORIZONTAL ADDITIONAL BRACING
   - SINGLE FRAME ATTACHMENTS FOR IRREGULAR CONTOURS AND TURNS
4. ANCHOR BOLTS MAY BE NEEDED ON HARD ROCK, FLAT OR CONCRETE SURFACES

1/6

PORTADAM FRAME AND SEALING MEMBRANE

(NOT TO SCALE)



2/6

PORTADAM FRAME ASSEMBLY PROFILE

(NOT TO SCALE)

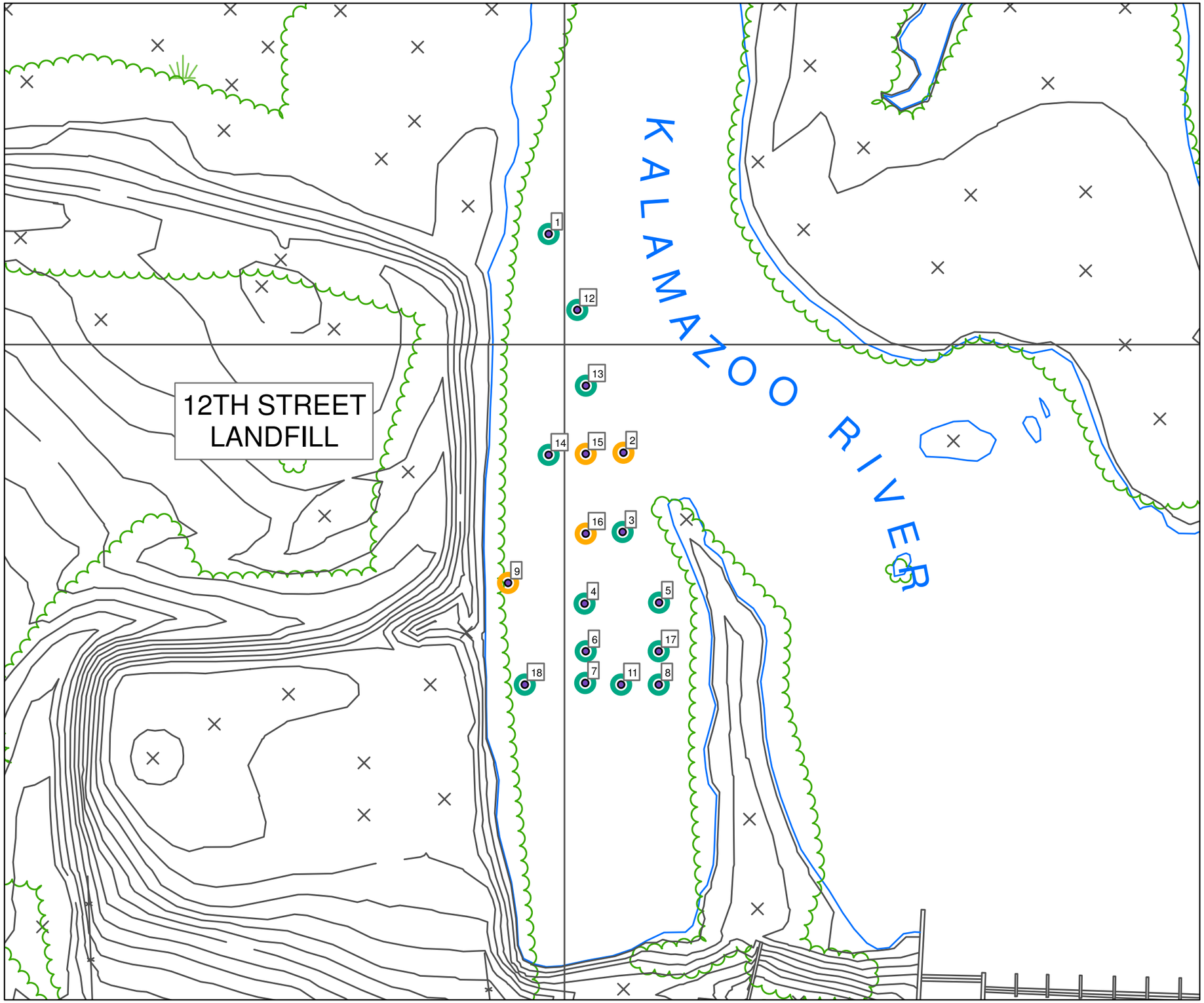
PROJECT: **12TH STREET LANDFILL EMERGENCY RESPONSE PLAN DESIGN REPORT OTSEGO TOWNSHIP, MICHIGAN**

SHEET TITLE: **DETAILS**

DRAWN BY: STORMERL	SCALE:	PROJ. NO.	5117.04\ERD
CHECKED BY: ECW	NOT TO SCALE	FILE NO.	DETAIL2.DWG
APPROVED BY: MJA	DATE PRINTED:	**FIGURE 6**	
DATE: JULY 2007			

RMT
744 Heartland Trail
Madison, WI 53717–1934
P.O. Box 8923 53708–8923
Phone: 608–831–4444
Fax: 608–831–3334

PLOT DATA
Drawing Name: J:\05117\04\ERD\detail2.dwg
Operator Name: stormerl
Scale: 1"=1'



LEGEND

Visual Sediment Assessment

- No Visible Residuals
- Visible Residuals
- Piston Core or Ponar Sample Location & ID

N

0 25 50 100 FEET

1:800

1 INCH EQUALS 67 FEET

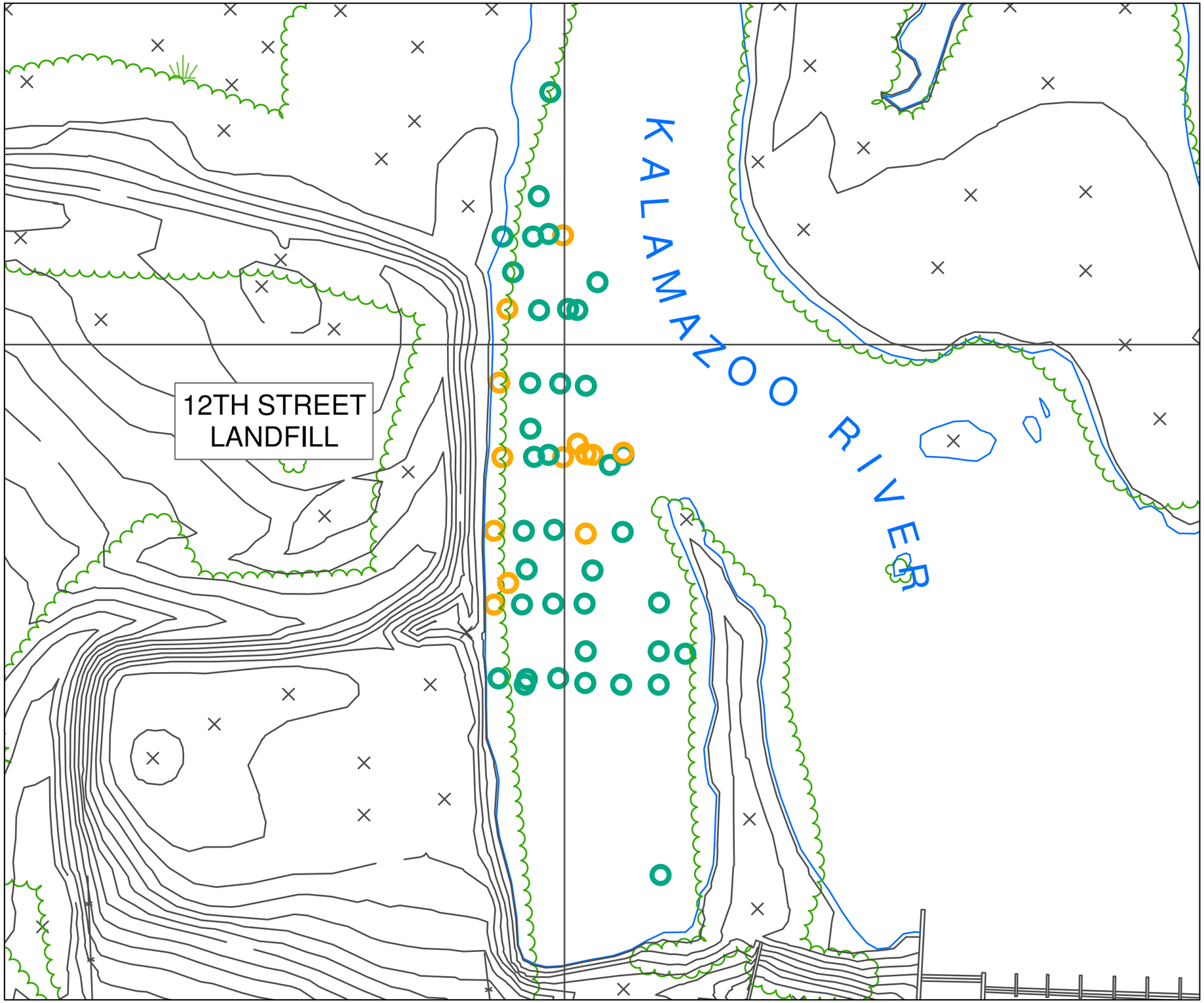
PROJECT: 12TH ST. LANDFILL EMERGENCY RESPONSE DESIGN REPORT OTSEGO TOWNSHIP, MICHIGAN			
SHEET TITLE: RECENT VISUAL ASSESSMENT OF FORMER POWERHOUSE DISCHARGE CHANNEL SEDIMENTS			
DRAWN BY: HANKLEY C	SCALE: AS NOTED	PROJ. NO.: 00-05117.03	
CHECKED BY:		FILE NO.: 51170314.mxd	
APPROVED BY:	DATE PRINTED: 7/16/07	**FIGURE B-2**	
DATE: JULY 2007			

RMT

150 N. Patrick Blvd., Suite 180
Brookfield, WI 53045-5854

Phone: 262-879-1212
Fax: 262-879-1220

D:\05117\03\51170314.mxd



LEGEND

Powerhouse Channel Residuals

- No Visible Residuals
- Visible Residuals

N

0 25 50 100 FEET

1:800

1 INCH EQUALS 67 FEET

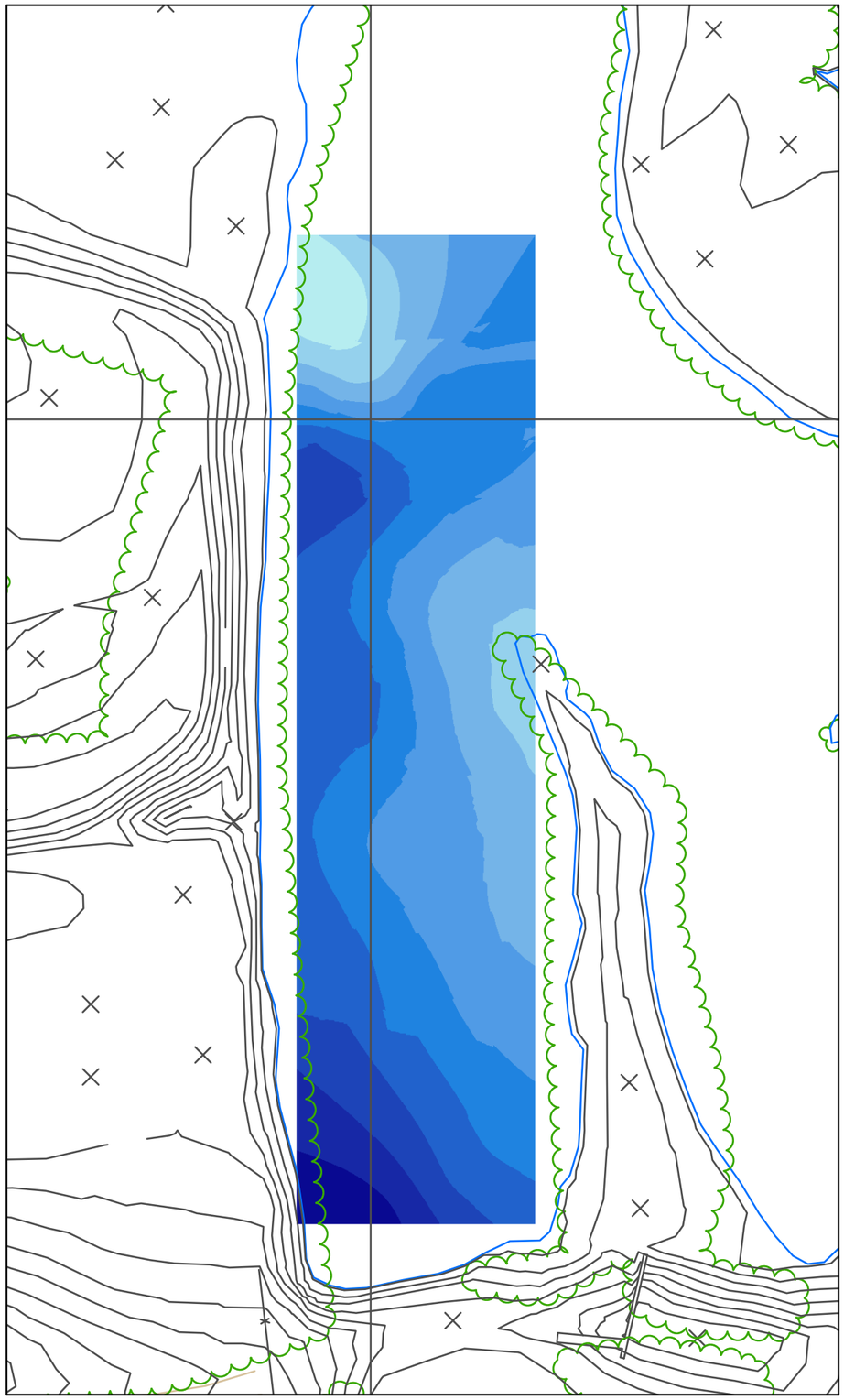
PROJECT: 12TH ST. LANDFILL EMERGENCY ACTION DESIGN REPORT OTSEGO TOWNSHIP, MICHIGAN			
SHEET TITLE: VISUAL EXTENT OF RESIDUALS WITHIN THE FORMER POWERHOUSE CHANNEL (FIGURE INCLUDES ALL HISTORICAL DATA)			
DRAWN BY: HANKLEY C	SCALE: AS NOTED	PROJ. NO.: 00-05117.03	
CHECKED BY:		FILE NO.: 51170313.mxd	
APPROVED BY:	DATE PRINTED: 7/16/07	**FIGURE B-3**	
DATE: JULY 2007			

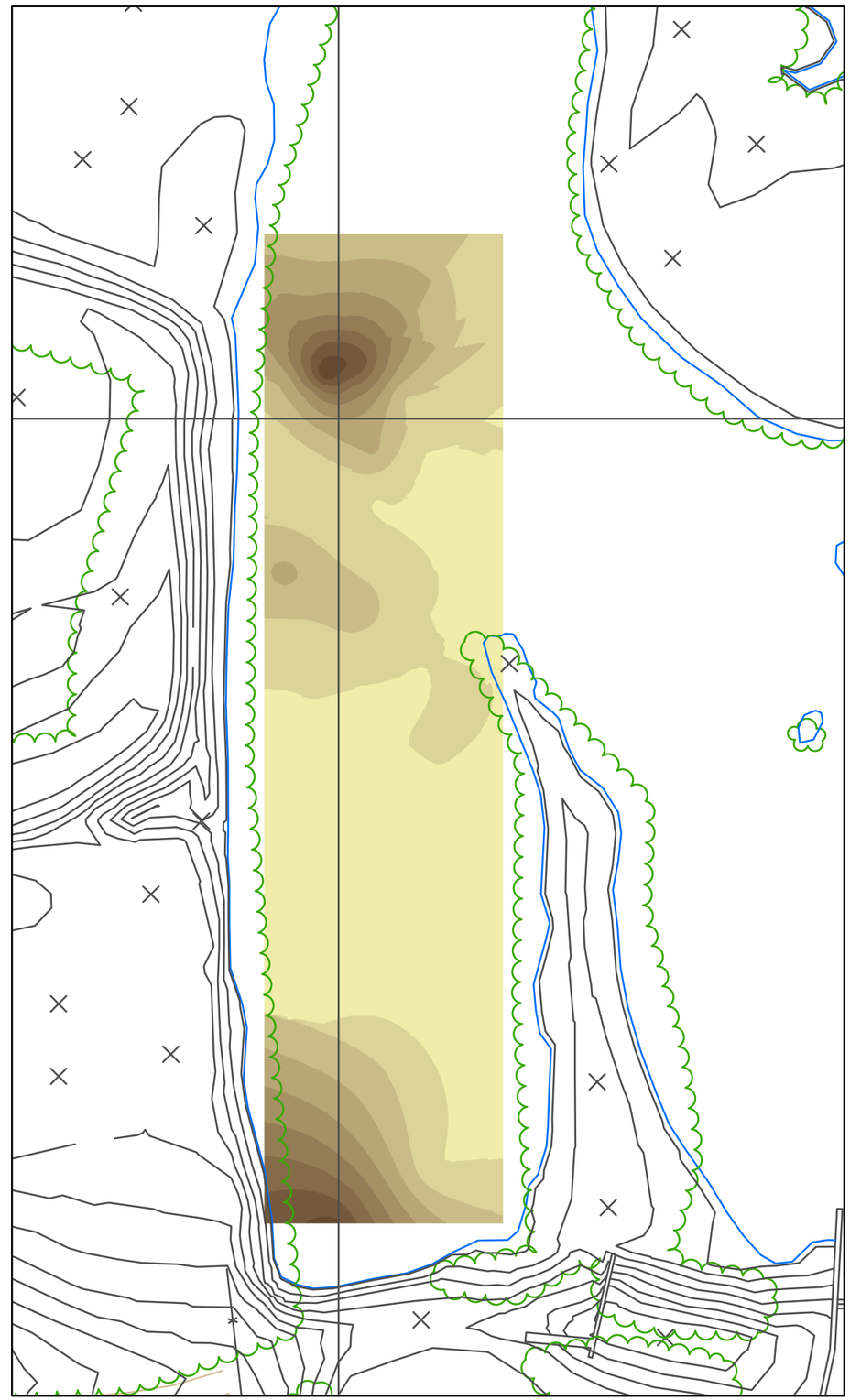
RMT

150 N. Patrick Blvd., Suite 180
Brookfield, WI 53045-5854

Phone: 262-879-1212
Fax: 262-879-1220

D:\05117\03\51170313.mxd





LEGEND

Water Depth (ft)	Soft Sediment Thickness (ft)
0 - 1.3	0 - 0.3
1.4 - 1.7	0.4 - 0.5
1.8 - 2.1	0.6 - 0.7
2.2 - 2.4	0.8 - 0.9
2.5 - 2.8	1 - 1.1
2.9 - 3.2	1.2 - 1.4
3.3 - 3.5	1.5 - 1.6
3.6 - 3.9	1.7 - 1.8
4 - 4.3	1.9 - 2

N

0 25 50 100 FEET

1:800

1 INCH EQUALS 67 FEET

PROJECT: 12TH ST. LANDFILL
EMERGENCY ACTION DESIGN REPORT
OTSEGO TOWNSHIP, MICHIGAN

SHEET TITLE: APPROXIMATE WATER DEPTH AND SOFT SEDIMENT THICKNESS FOR THE FORMER POWERHOUSE DISCHARGE CHANNEL

DRAWN BY: WEBERN	SCALE: AS NOTED	PROJ. NO.: 00-05117.03	
CHECKED BY: MK		FILE NO.: 51170315.mxd	
APPROVED BY: CJ	DATE PRINTED: 06/19/07	FIGURE B-4	
DATE: JULY 2007			

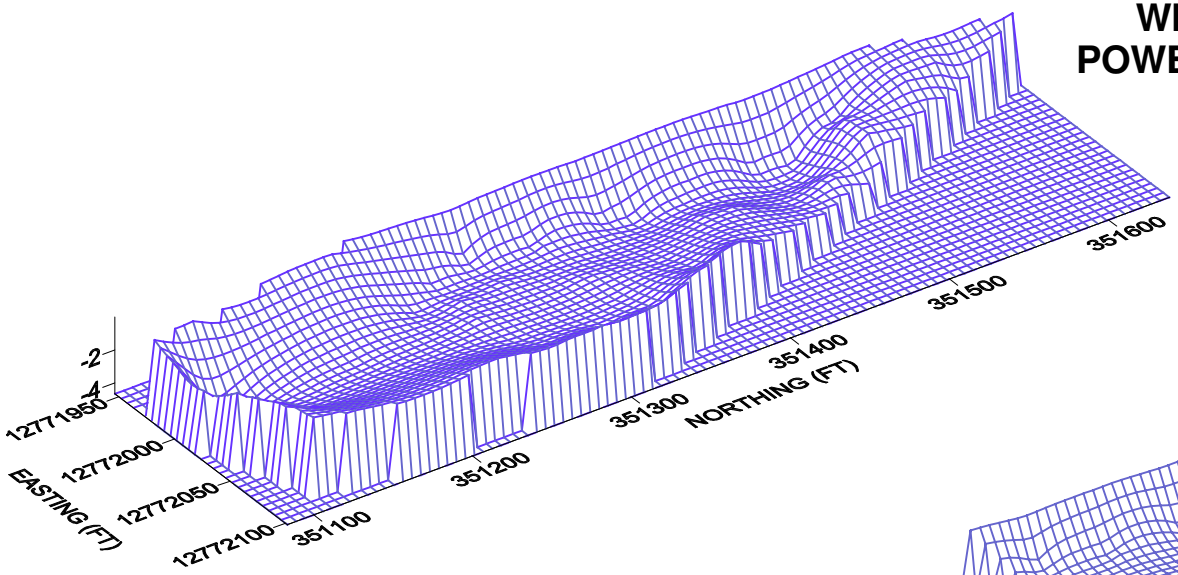
RMT®

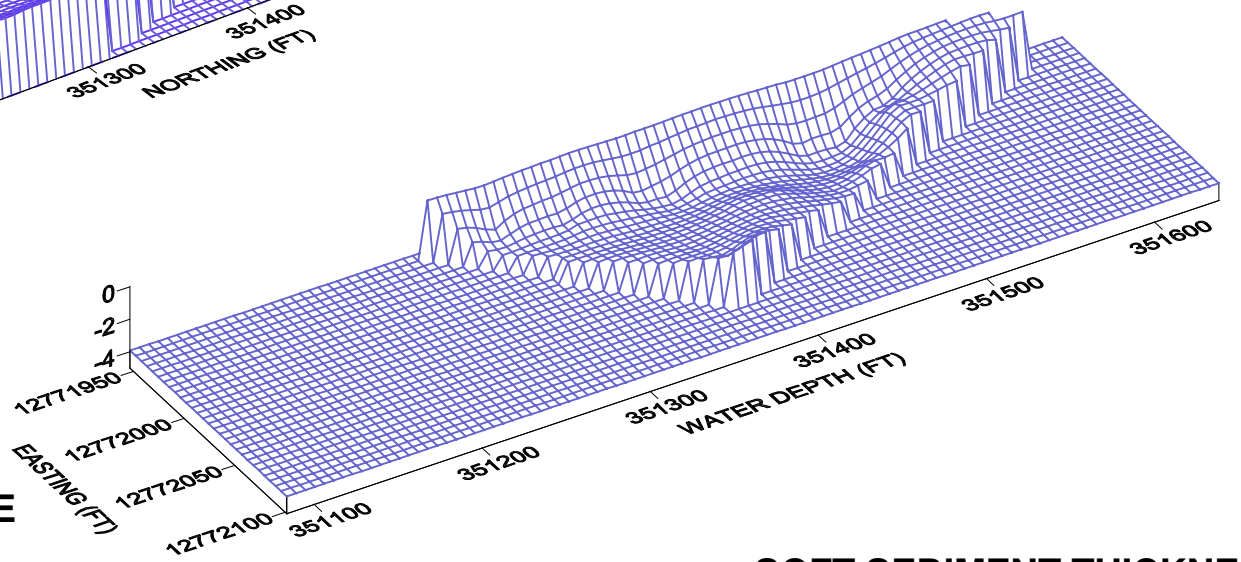
150 N. Patrick Blvd., Suite 180
Brookfield, WI 53045-5854

Phone: 262-879-1212
Fax: 262-879-1220

D:\05117\03\51170315.mxd

WATER DEPTH (FT) WITHIN THE FORMER POWERHOUSE DISCHARGE CHANNEL





WATER DEPTH (FT) WITHIN THE FORMER POWERHOUSE DISCHARGE CHANNEL [EXCAVATION AREA ONLY]

SOFT SEDIMENT THICKNESS (FT) WITHIN THE FORMER POWERHOUSE DISCHARGE CHANNEL [EXCAVATION AREA ONLY]

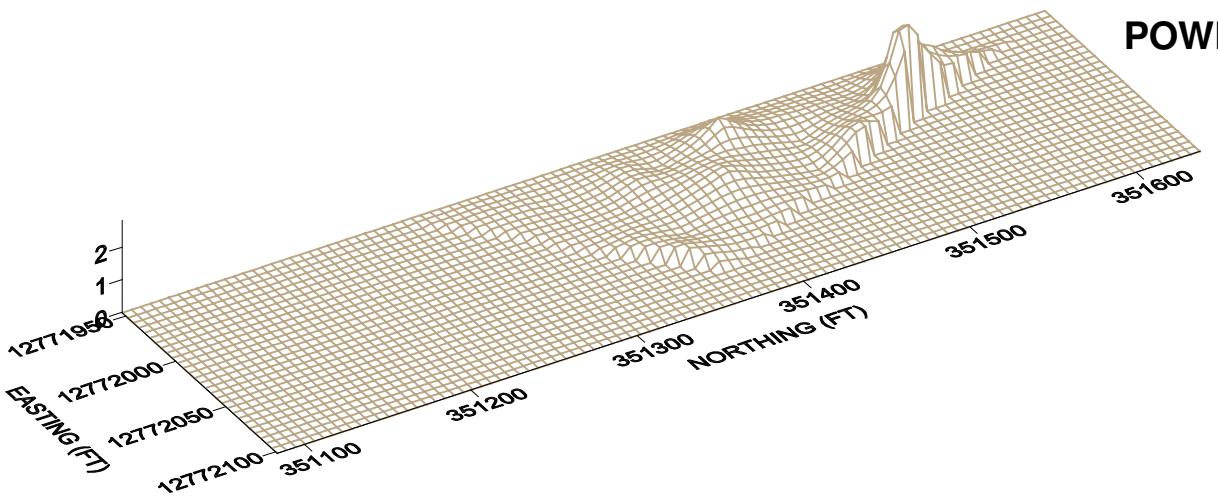
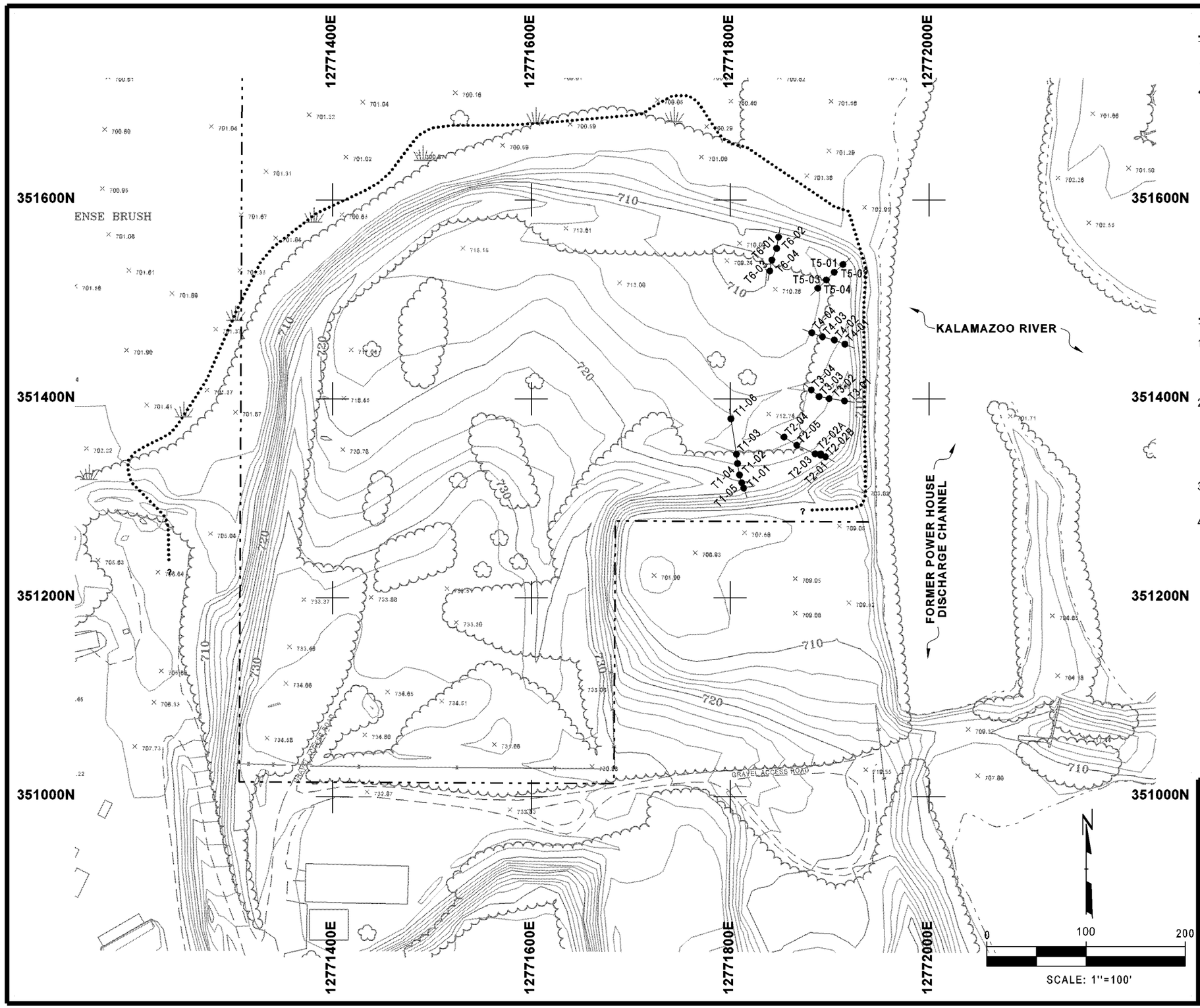


FIGURE B-5



LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- APPROXIMATE LIMITS OF PAPER RESIDUALS USING VISUAL CRITERIA
- GEOPROBE BORING TRANSECT

NOTES

1. BASE TOPOGRAPHY PROVIDED BY OAS, INC. OF SEYMOUR, INDIANA BASED ON AERIAL SURVEY DATED 3/30/2005. COORDINATES ARE MICHIGAN STATE PLANE-SOUTH ZONE. THE VERTICAL DATUM IS NGVD 29.
2. PROPERTY BOUNDARY BASED ON LEGAL DESCRIPTION PROVIDED BY USEPA IN A FAX DATED MARCH 30, 2004. COORDINATES FOR S 1/4 CORNER AND N 1/4 CORNER OF SECTION 24 AND NORTH BEARING USED TO PLOT PROPERTY LINE WERE PROVIDED BY HOLLAND ENGINEERING AND ARE BASED ON MICHIGAN STATE PLANE - SOUTH ZONE COORDINATES.
3. THE GEOPROBE BORINGS WERE COMPLETED BY MATECO DRILLING COMPANY ON MAY 21-23, 2007.
4. THE SURVEY INFORMATION FOR THE GEOPROBE BORINGS WAS PROVIDED BY HOLLAND ENGINEERING ON MAY 25, 2007.

PROJECT:
12TH STREET LANDFILL
OTSEGO TOWNSHIP, MICHIGAN

SHEET TITLE: **LOCATIONS OF GEOPROBE® BORINGS INSTALLED DURING THE MAY 2007 GEOTECHNICAL INVESTIGATION**

DRAWN BY: STORMERL	SCALE: 1"=100'	PROJ. NO. 5117.04	
CHECKED BY: JEO		FILE NO. GEOTECH2.PLT	
APPROVED BY: RKN	DATE PRINTED:	FIGURE C-1	
DATE: JULY 2007			

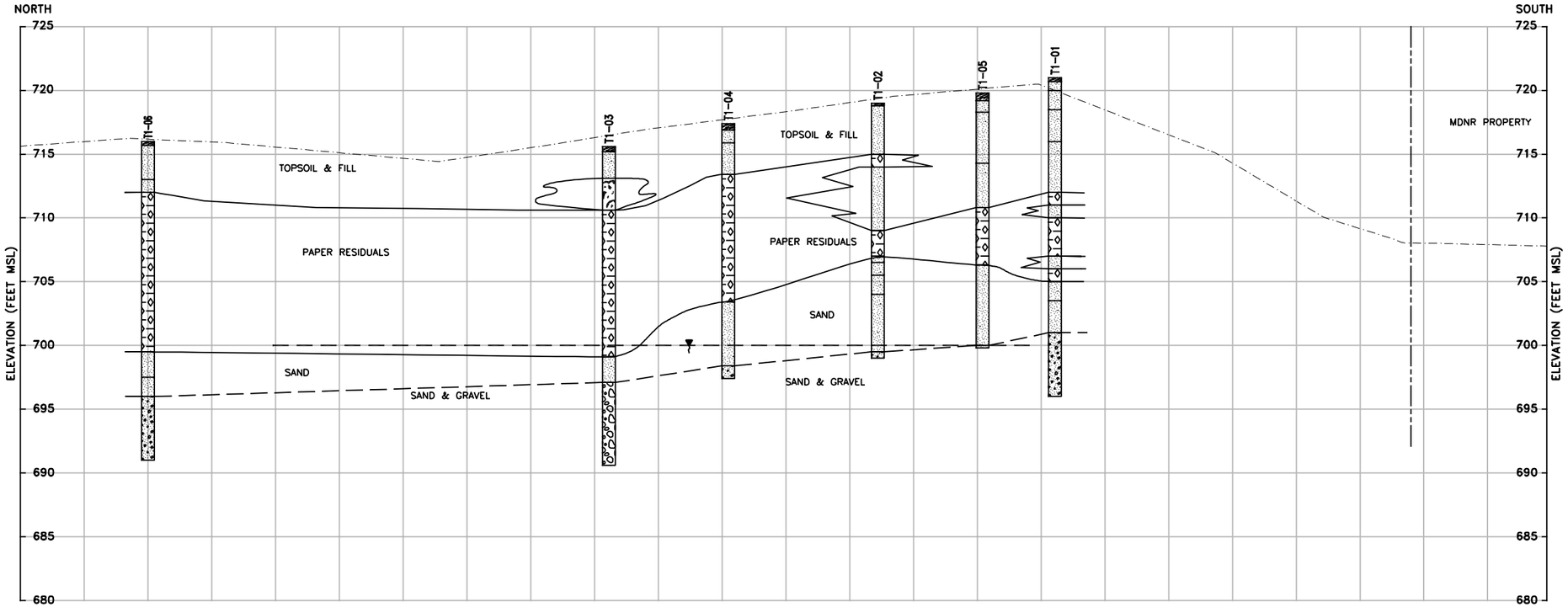
RMT
744 Heartland Trail
Madison, WI 53717-1934
P.O. Box 8923 53708-8923
Phone: 608-831-4444
Fax: 608-831-3334

Levels
(1) 27
(2) 1-63
(3) 1-63
(4) 1-63

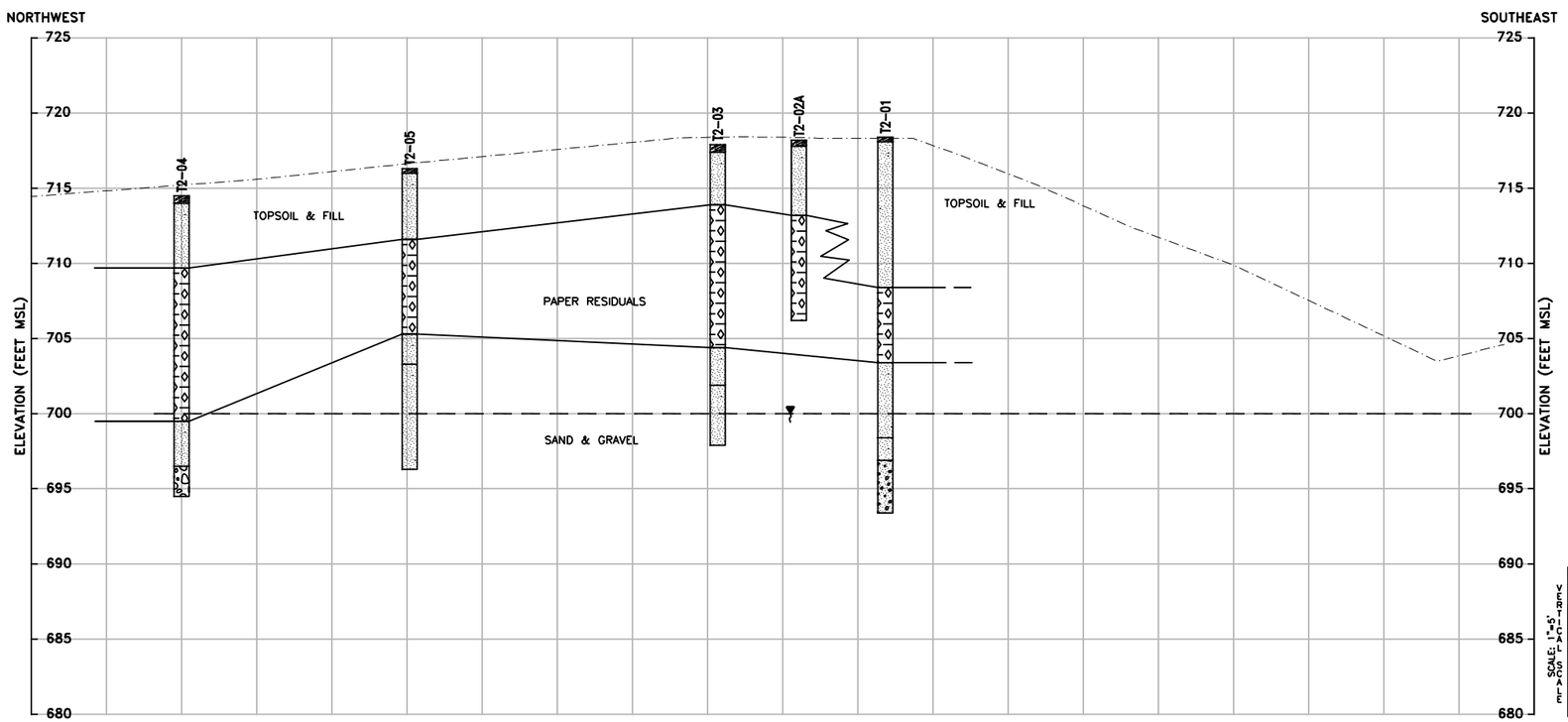
Logical Names
(1) bmc
(2) bmr
(3) pro
(4) bdr

Reference Files
Ref. File 1 - J:\05117\04\bmc033005.dgn
Ref. File 2 - J:\05117\04\bmrmt.dgn
Ref. File 3 - J:\05117\04\proposed.dgn
Ref. File 4 - J:\05117\04\11x17bdr.dgn

Plot Data
Design File J:\05117\04\geotech2.plt
STORMERL Date - Fri Jul 27 14:08:28 2007
Plot File - J:\05117\04\geotech2.prf
Pen Table - \\msn-plot\equorum$\TBL\MSV8Default7000.tbl
Levels On - 1



TRANSECT 1



TRANSECT 2

LEGEND

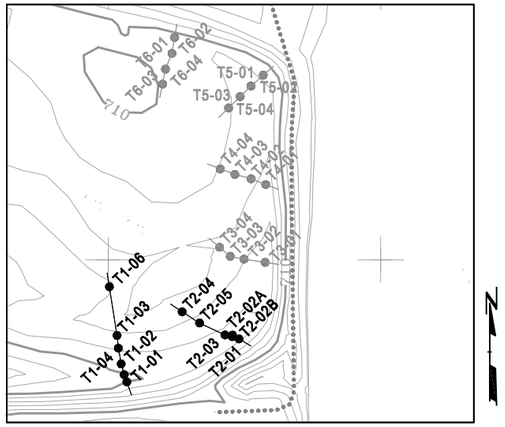
- STRATIGRAPHIC BOUNDARY (DASHED WHERE INFERRED)
- WATER TABLE
- EXISTING GROUND SURFACE
- APPROXIMATE PROPERTY BOUNDARY

SOIL CLASSIFICATION

- TOPSOIL
- CLAY (CL)
- FAT CLAY (CH)
- SILTY CLAY (CL)
- SANDY CLAY
- SILT (ML)
- SANDY SILT (ML)
- PAPER RESIDUAL
- CLAYEY SAND (SC)
- SILTY SAND (SM)
- CLAY AND GRAVEL
- SAND AND GRAVEL (SW-GW)
- SAND
- GRAVEL
- ORGANIC SILT

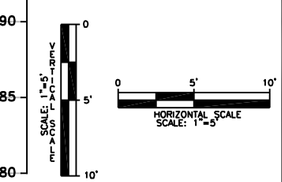
NOTES

1. BASE TOPOGRAPHY PROVIDED BY OAS, INC. OF SEYMOUR, INDIANA BASED ON AERIAL SURVEY DATED 3/30/2005. COORDINATES ARE MICHIGAN STAE PLANE-SOUTH ZONE. THE VERTICAL DATUM IS NGVD 29.
2. PROPERTY BOUNDARIES BASED ON LEGAL DESCRIPTION PROVIDED BY USEPA IN A FAX DATED MARCH 30, 2004. COORDINATES FOR S 1/4 CORNER AND N 1/4 OF SECTION 24 AND NORTH BEARING USED TO PLOT PROPERTY LINE WERE PROVIDED BY HOLLAND ENGINEERING AND ARE BASED ON MICHIGAN STATE PLANE – SOUTH ZONE COORDINATES.
3. THE GEOPROBE BORINGS WERE COMPLETED BY MATECO DRILLING COMPANY ON MAY 21–23, 2007.
4. THE SURVEY INFORMATION FOR THE GEOPROBE BORINGS WAS PROVIDED BY HOLLAND ENGINEERING ON MAY 25, 2007.



CROSS SECTION LOCATOR MAP

(NOT TO SCALE)



NO.	BY	DATE	REVISION	APP'D.
3.				
2.				
1.				

PROJECT:

12TH STREET LANDFILL
OTSEGO TOWNSHIP, MICHIGAN

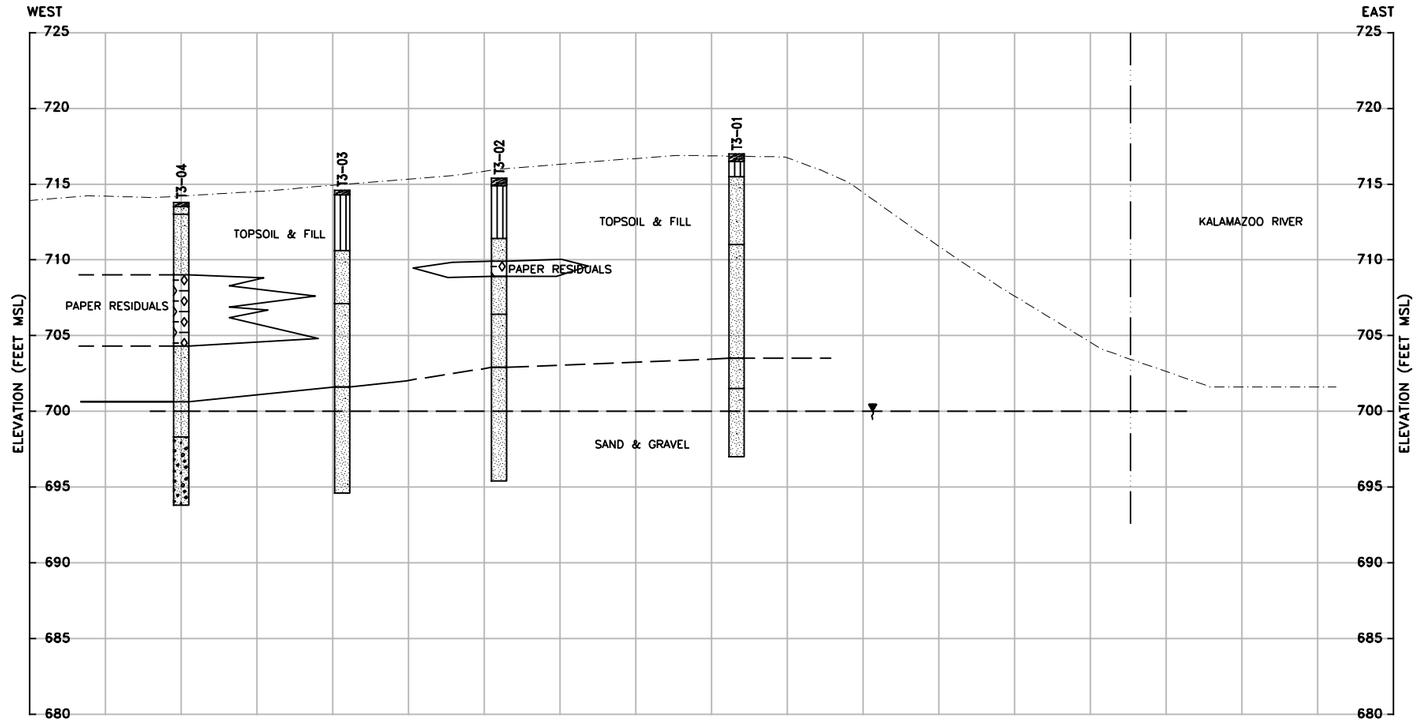
SHEET TITLE:

CROSS SECTIONS FOR TRANSECT 1 AND TRANSECT 2

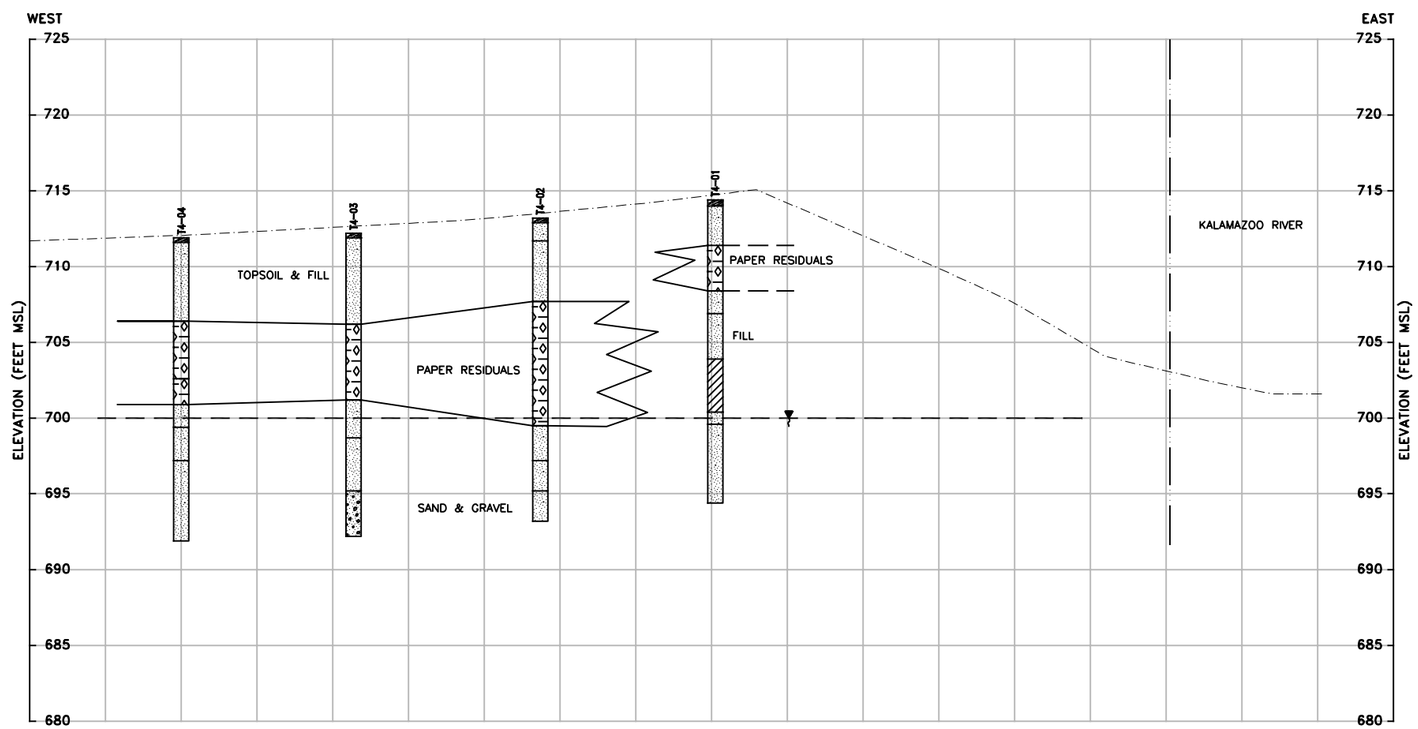
DRAWN BY: NOLDENR	SCALE:	PROJ. NO.	5117.04
CHECKED BY: JEO	AS SHOWN	FILE NO.	51170402.DWG
APPROVED BY: RKN	DATE PRINTED:	FIGURE C-2	
DATE: JULY 2007			

RMT
744 Heartland Trail
Madison, WI 53717-1934
P.O. Box 8923 53708-8923
Phone: 608-831-4444
Fax: 608-831-3334

PLOT DATA
Drawing Name: J:\05117\04\51170402.DWG
Operator Name: noldenr
Scale: 1"=5'
Dwg Size: x x
Plot Date: x x
Plot Time: x x
Attached Xref's: x x
Attached Image's: x x



TRANSECT 3



TRANSECT 4

LEGEND

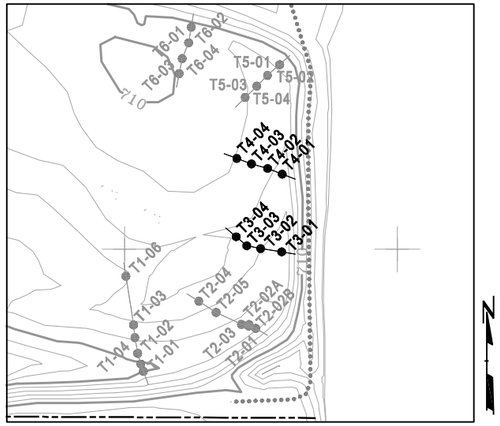
- STRATIGRAPHIC BOUNDARY (DASHED WHERE INFERRED)
- WATER TABLE
- EXISTING GROUND SURFACE
- RIVER'S EDGE

SOIL CLASSIFICATION

- TOPSOIL
- CLAY (CL)
- FAT CLAY (CH)
- SILTY CLAY (CL)
- SANDY CLAY
- SILT (ML)
- SANDY SILT (ML)
- PAPER RESIDUAL
- CLAYEY SAND (SC)
- SILTY SAND (SM)
- CLAY AND GRAVEL
- SAND AND GRAVEL (SW-GW)
- SAND
- GRAVEL
- ORGANIC SILT

NOTES

1. BASE TOPOGRAPHY PROVIDED BY OAS, INC. OF SEYMOUR, INDIANA BASED ON AERIAL SURVEY DATED 3/30/2005. COORDINATES ARE MICHIGAN STAE PLANE-SOUTH ZONE. THE VERTICAL DATUM IS NGVD 29.
2. PROPERTY BOUNDARIES BASED ON LEGAL DESCRIPTION PROVIDED BY USEPA IN A FAX DATED MARCH 30, 2004. COORDINATES FOR S 1/4 CORNER AND N 1/4 OF SECTION 24 AND NORTH BEARING USED TO PLOT PROPERTY LINE WERE PROVIDED BY HOLLAND ENGINEERING AND ARE BASED ON MICHIGAN STATE PLANE - SOUTH ZONE COORDINATES.
3. THE GEOPROBE BORINGS WERE COMPLETED BY MATECO DRILLING COMPANY ON MAY 21-23, 2007.
4. THE SURVEY INFORMATION FOR THE GEOPROBE BORINGS WAS PROVIDED BY HOLLAND ENGINEERING ON MAY 25, 2007.



CROSS SECTION LOCATOR MAP

(NOT TO SCALE)

SCALE: 1"=5' VERTICAL
0 5' 10'

0 5' 10'
HORIZONTAL SCALE
SCALE: 1"=5'

NO.	BY	DATE	REVISION	APP'D.
3.				
2.				
1.				

PROJECT:

12TH STREET LANDFILL
OTSEGO TOWNSHIP, MICHIGAN

SHEET TITLE:

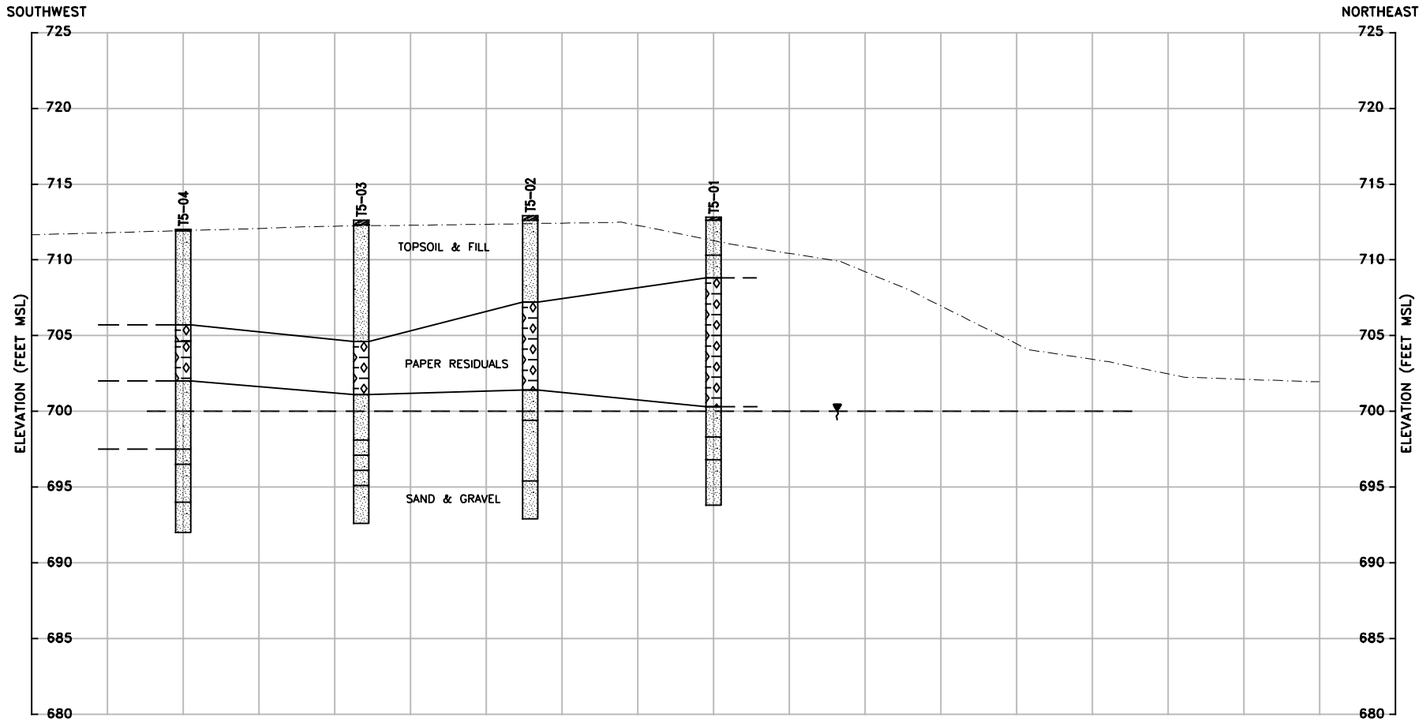
CROSS SECTIONS FOR TRANSECT 3 AND TRANSECT 4

DRAWN BY: NOLDENR	SCALE:	PROJ. NO.	5117.04
CHECKED BY: JEO	AS SHOWN	FILE NO.	51170403.DWG
APPROVED BY: RKN	DATE PRINTED:	FIGURE C-3	
DATE: JULY 2007			

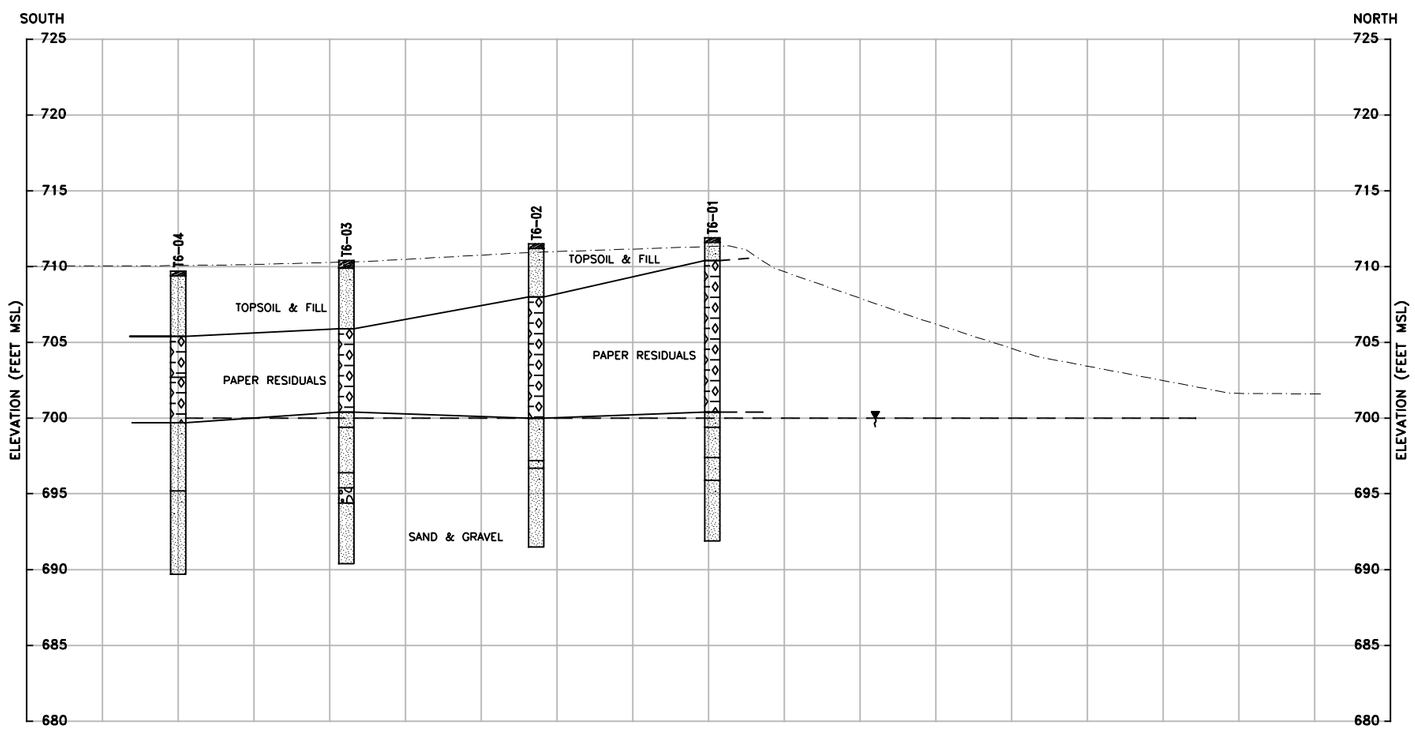
RMT

744 Heartland Trail
Madison, WI 53717-1934
P.O. Box 8923 53708-8923
Phone: 608-831-4444
Fax: 608-831-3334

PLOT JOB:
Drawing Name: J:\051170\04\51170402.DWG
Operator Name: NOLDENR
Scale: 1"=40'
Plot Date: x x x x
Plot Time: x x x x
Plotted By: Inef'e
Attached Image: x x



TRANSECT 5



TRANSECT 6

LEGEND

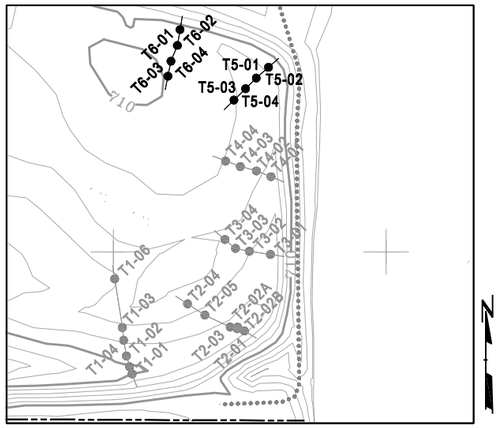
- STRATIGRAPHIC BOUNDARY (DASHED WHERE INFERRED)
- WATER TABLE
- EXISTING GROUND SURFACE

SOIL CLASSIFICATION

- TOPSOIL
- CLAY (CL)
- FAT CLAY (CH)
- SILTY CLAY (CL)
- SANDY CLAY
- SILT (ML)
- SANDY SILT (ML)
- PAPER RESIDUAL
- CLAYEY SAND (SC)
- SILTY SAND (SM)
- CLAY AND GRAVEL
- SAND AND GRAVEL (SW-GW)
- SAND
- GRAVEL
- ORGANIC SILT

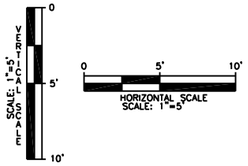
NOTES

1. BASE TOPOGRAPHY PROVIDED BY OAS, INC. OF SEYMOUR, INDIANA BASED ON AERIAL SURVEY DATED 3/30/2005. COORDINATES ARE MICHIGAN STAE PLANE–SOUTH ZONE. THE VERTICAL DATUM IS NGVD 29.
2. PROPERTY BOUNDARIES BASED ON LEGAL DESCRIPTION PROVIDED BY USEPA IN A FAX DATED MARCH 30, 2004. COORDINATES FOR S 1/4 CORNER AND N 1/4 OF SECTION 24 AND NORTH BEARING USED TO PLOT PROPERTY LINE WERE PROVIDED BY HOLLAND ENGINEERING AND ARE BASED ON MICHIGAN STATE PLANE – SOUTH ZONE COORDINATES.
3. THE GEOPROBE BORINGS WERE COMPLETED BY MATECO DRILLING COMPANY ON MAY 21–23, 2007.
4. THE SURVEY INFORMATION FOR THE GEOPROBE BORINGS WAS PROVIDED BY HOLLAND ENGINEERING ON MAY 25, 2007.



CROSS SECTION LOCATOR MAP

(NOT TO SCALE)



NO.	BY	DATE	REVISION	APP'D.
3.				
2.				
1.				

PROJECT:

12TH STREET LANDFILL
OTSEGO TOWNSHIP, MICHIGAN

SHEET TITLE:

CROSS SECTIONS FOR TRANSECT 5 AND TRANSECT 6

DRAWN BY: NOLDENR	SCALE:	PROJ. NO.	5117.04
CHECKED BY: JEO	AS SHOWN	FILE NO.	51170404.DWG
APPROVED BY: RKN	DATE PRINTED:	FIGURE C-4	
DATE: JULY 2007			

RMT
744 Heartland Trail
Madison, WI 53717-1934
P.O. Box 8923 53708-8923
Phone: 608-831-4444
Fax: 608-831-3334

PLOT JOB:
Drawing Name: J:\51170404\51170402.DWG
Operator Name: NOLDENR
Layout: "Layout"
Plot Date: x x x x
Plot Time: x x x x
Plot Scale: 1=1
Plot Time: x x x x
Plot Device: Inv\Fx
Attached Image: x x

Appendix A
Correspondence

Appendix B
Extent of Paper Residuals in Channel

Attachment B

Extent of Paper Residuals in Channel

Subject:	Extent of Paper Residuals in Former Powerhouse Channel
Objective:	1. To determine the extent of residuals in the former powerhouse discharge channel by reviewing information available from previous investigations and combining it with the recent data collected during the Bathymetry and Visual Sediment Assessment. 2. To determine water depths at various transects throughout the former powerhouse channel and total volume. 3. To estimate sediment depth at various locations within the former powerhouse channel and total sediment volume.
Approach:	■ Perform bathymetric assessment of the powerhouse channel adjacent to the 12th Street Landfill by measuring water depth to top of sediment every 25 feet along eight transects along the east edge of the landfill. ■ Estimate sediment thickness at each water depth location by pushing clear lexan tubes into the sediment until refusal. ■ Conduct a visual reconnaissance of sediments collected at selected locations to identify the presence of visible residuals. ■ Prepare a figure detailing the presence of residuals, water depth contours, and estimated sediment thickness in the former powerhouse discharge channel adjacent to the landfill. ■ Refine the current estimate of the quantity of historical residuals present in the former powerhouse discharge channel.
Outcome:	Previous investigations have determined that residuals exist within the former powerhouse discharge channel adjacent to the 12th Street Landfill and extend to approximately 25 feet from the bank. In addition, a small pocket of residuals has also been previously identified near the center of the channel (Figure B-1). This visual assessment of the sediment types utilized a total of 16 sediment cores or ponar samples to confirm and refine the extent of residuals further into the channel. The residuals along the 12th Street Landfill and near the center of the channel were still present. A total of 59 probes were advanced to estimate sediment thickness across the channel. The average sediment thickness, within the excavation area, was 0.4 feet with a total volume of approximately 300 to 500 cubic yards of sediment at the time of the survey. A bathymetry survey including 59 water depth measurements were made to determine the channel depth and contouring. Results indicated that the channel depth varied from 0.5 to 3.5 feet deep in the area of interest with the deepest portion of the channel existing near the bank of the 12th Street Landfill. The average channel depth, within the targeted excavation area, was 2.3 feet with a total volume of approximately 370,000 gallons of water at the time of the survey.

Background and Objectives

The 2001 United States Environmental Protection Agency (USEPA)-issued Record of Decision (ROD) for the 12th Street Landfill included as one of its eleven major components relocation of residuals present in the powerhouse channel to the landfill and construction of an erosion control system protective of a 500-year flood event. As part of the 2007 Time Critical Removal Action (TCRA), the Kalamazoo River will be rerouted through the former powerhouse channel, impacting the paper residuals currently present.

In 2001, BBL performed an investigation of residuals within the former powerhouse channel at 22 locations along seven different transects. The sample locations extended an average of 60 feet from the bank with a maximum of approximately 70 feet. The investigation documented the presence of residuals along the edge of the 12th Street Landfill with an isolated pocket near the center. Twenty-nine samples were collected from seventeen different locations and sent for PCB analysis. Additional samples were collected, but if residuals were visible, were not analyzed for PCBs. A summary of the PCB results and locations are presented in Figure B-1.

The USEPA collected a number of samples in 2003 to investigate the extent of waste associated with the 12th Street Landfill. Samples were located on shore as well as at 15 locations sporadically throughout the channel. Sample results were consistent with those obtained by BBL in 2001, both in concentration and extent of residuals in the channel (Figure B-1).

The objectives of this assessment are as follows:

1. To determine the extent of residuals in the former powerhouse discharge channel by reviewing information available from previous investigations and combining it with additional data collected during this Bathymetry and Visual Sediment Assessment.
2. To determine water depths at various transects throughout the former powerhouse channel.
3. To estimate sediment depths at various locations within the former powerhouse channel.

Bathymetric and Visual Sediment Assessment

The purpose of the bathymetry and visual sediment assessment was to determine the water depth, sediment depth, and visible paper residuals content so that the sediment removal design could be completed. Water depth and sediment characteristics were needed for the design of a water control system to isolate the sediment adjacent to the landfill from the rest of the river. Visual observations of the sediment within the powerhouse channel were used to identify the obvious paper residuals to allow an estimate of removal quantities needed in the design.

The findings of the visual sediment assessment were used to confirm the extent and presence of residuals previously recorded in other investigations. A grid-based sampling plan (see Figure B-2) was proposed in the approved Bathymetry and Visual Sediment Assessment Data Quality Objectives and Work Scope and used as the basis for the sampling locations. Sample locations were selected to obtain information on the grain size of surface sediment along the proposed alignment of the Portadams and to confirm and supplement previous sediment quality information. Sediment samples were collected for visual assessment of residuals by advancing a piston core sampler into the sediment until refusal. If a sample could not be collected, a ponar sampler was used to collect and identify sediment. A total of 16 sediment cores or ponar samples were collected to confirm locations with residuals from the prior assessments and to target areas farther into the channel where historical

data were not available. Table B-1 presents a summary of the coring log indicating the collection method, the length of core recovery, and sediment types observed at each location.

Paper residuals were identified at four of the sixteen locations ranging in thickness from 0.1 to 0.3 feet. Figure B-2 identifies the locations of the sixteen sample locations and also highlights those locations where residuals were present. Figure B-3 presents a summary of all visual data collected to date and identifies the location of residuals within the channel.

The channel bathymetry and sediment thickness was determined by use of a round 2-inch diameter PVC pipe, 10 feet in length, with markings delineating every foot. Determination of water depth was completed by slowly advancing the PVC pipe vertically into the water until the sediment surface was reached, at which time the spot depth was recorded. The sediment depth was then obtained by physically advancing the PVC pipe into the sediment until refusal. Water depth and sediment thickness was determined at 59 locations within the channel. Figure B-4 presents an output of estimated water depth and thickness within the channel based upon these measurements.

Findings and Conclusions

Previous investigations identified residuals at eight locations and have determined that residuals exist within the former powerhouse discharge channel adjacent to the 12th Street Landfill and extend approximately 25 feet from the bank. Near the center of the channel, a small pocket of residuals has also been previously identified (Figure B-1). The visual assessment of the sediment types reported in this memo utilized a total of sixteen sediment cores or ponar samples to confirm and refine the extent of residuals further into the channel. This reconnaissance confirmed the presence of residuals along the 12th Street Landfill and also showed that the previously identified pocket of residuals near the center of the channel is still present (Figure B-4). A total of 59 probes were advanced to estimate sediment thickness across the channel. The average sediment thickness within the excavation area was 0.4 feet. The measured sediment thicknesses and surveyed sample locations were input into a CADD-based computer software Surfer program. The estimated quantity of soft sediments and residuals within the former powerhouse channel adjacent to the 12th Street Landfill was approximately 300 to 500 cubic yards of material above the natural channel base elevation.

A bathymetry survey including 59 water depth measurements was conducted to determine the channel depth and contour. Results indicated that the channel depth varied from 0.5 to 3.5 feet deep in the area of interest with the deepest portion of the channel existing near the bank of the 12th Street Landfill. At the time of the survey, the average channel depth was 1.4 feet with a total volume within the channel between the 12th Street Landfill and the small point between the dam and the spillway was approximately 880,000 gallons of water.

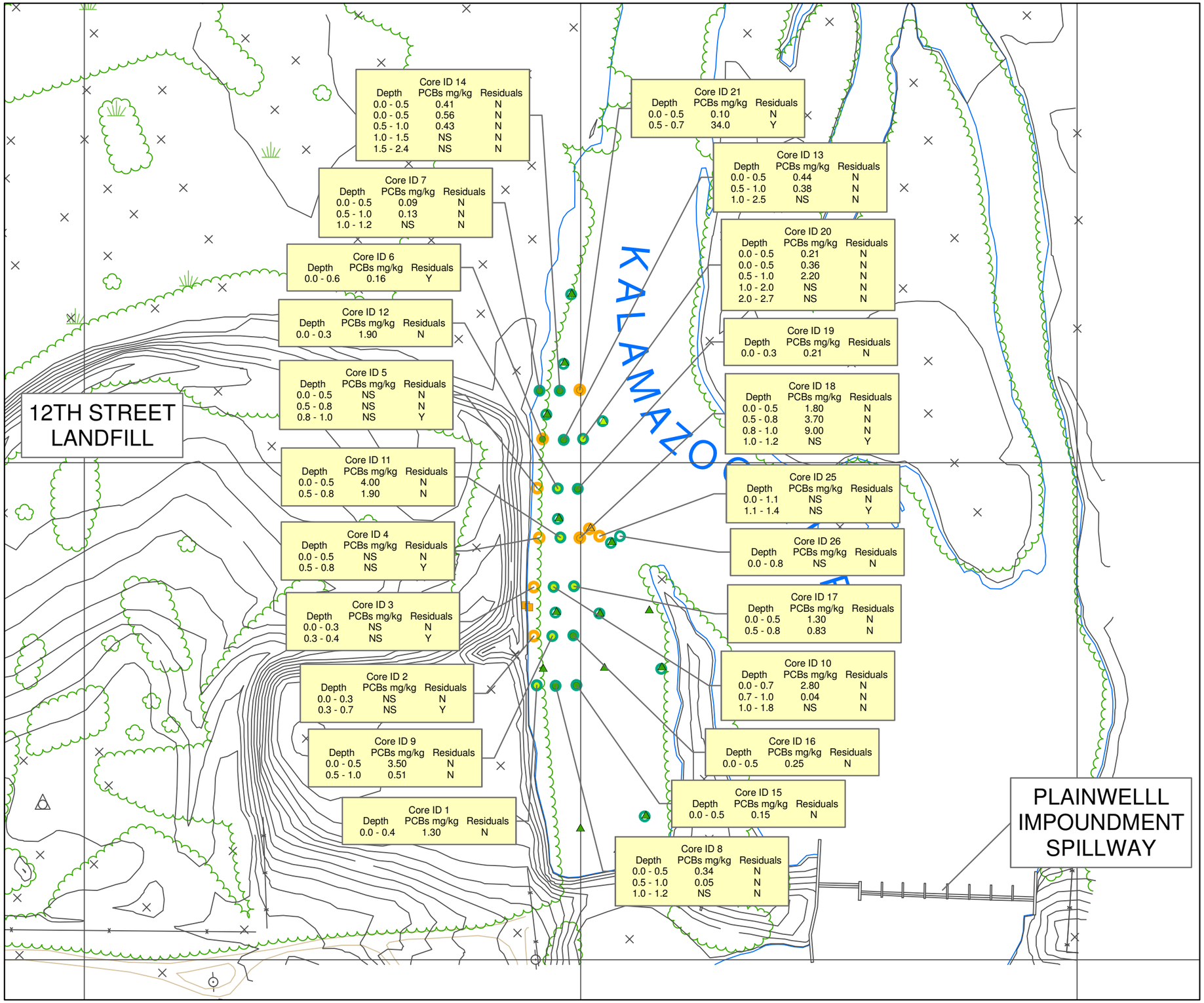
Table B-1
Sample Location and Sediment Description

Location ID and Sample Equipment	Depth Range (ft)	Sediment Description
1 – Piston Core	0.0 to 0.7	Fine Gravel and Sand
	0.7 to 0.9	Sand and Silt (50-50 mix)
	0.9 to 2.0	Dark Gray Sandy Silt
	2.0 to 2.1	Brown Sandy Silt

Location ID and Sample Equipment	Depth Range (ft)	Sediment Description
2 – Piston Core	0.0 to 0.6	Dark Gray Sandy Silt
	0.6 to 0.9	Sand Silt with traces of light gray
	0.9 to 1.1	Mixture of Sand, Silt and Gray Material (potential paper residuals)
3 – Piston Core	0.0 to 0.6	Dark Gray Silty Sand
4 – Ponar Sample	0.0 to 0.5	Sandy silt with Brown Sand and Black Silt
5 – Piston Core	0.0 to 0.1	Very Fine Silt with High Water Content
	0.1 to 0.4	Silty Sand with Some Gravel
6 – Ponar Sample	0.0 to 0.5	Dark Gray with Fine Silt and Trace Sand
7 – Ponar Sample	0.0 to 0.5	Dark Gray with Fine Silt and Trace Sand
8 – Ponar Sample	0.0 to 0.5	Very Fine Silt Black with High Water Content
9 – Piston Core	0.0 to 0.2	Gray Sandy Silt
	0.2 to 0.3	Paper Residuals
11 – Ponar Sample	0.0 to 0.5	Black Silt with some Organics and Trace Sand
12 – Piston Core	0.0 to 0.5	Dark Gray Silty Sand with Organics (Leaves)
	0.5 to 1.3	Brown Sand
13 – Piston Core	0.0 to 0.2	Sand with some Gravel and Organic Matter (Dark Brown) also some Silt
14 – Piston Core	0.0 to 0.6	Dark Gray Fine Silt, No Grains and High Water Content (Trace Sand near 0.6')
15 – Piston Core	0.0 to 0.2	Black Silt with Trace Sand
	0.2 to 0.7	Brown to Gray Sandy Silt
	0.7 to 0.9	Paper Residuals (Light Gray and Clay Like)
16 – Piston Core	0.0 to 0.5	Dark Gray Silt with Trace Sand and High Water Content
	0.5 to 0.8	Light Gray Paper Residuals
17 – Piston Core	0.0 to 0.1	Black Gravel with Silt
18 – No Recovery	---	No Recovery 4"-6" Rubble Visible at Sediment Surface

Notes:

1. If no recovery with the piston core sampler, the ponar sampling equipment was used for sample collection.
2. Ponar samplers typically recover shallow sediments from 0.0 to 0.5 feet, actually sediment thickness may be less.



LEGEND

BBL Data (2001) - Total PCBs mg/kg (USEPA, 2004)

- 0 - 1
- 1 - 4
- 4 - 50
- 50+

USEPA Data 2004 - Total PCBs (mg/kg)

- 0 - 1
- 1 - 4
- 4- 50
- 50+

Geraghty and Miller (1994) - Total PCBs (mg/kg)

- PCB Concentration 17 & 29 ppm

Powerhouse Channel Residuals

- No Visible Residuals
- Visible Residuals

NOTE

1. Concentrations presented are maximum at each sample location.

N

0 40 80 160 FEET

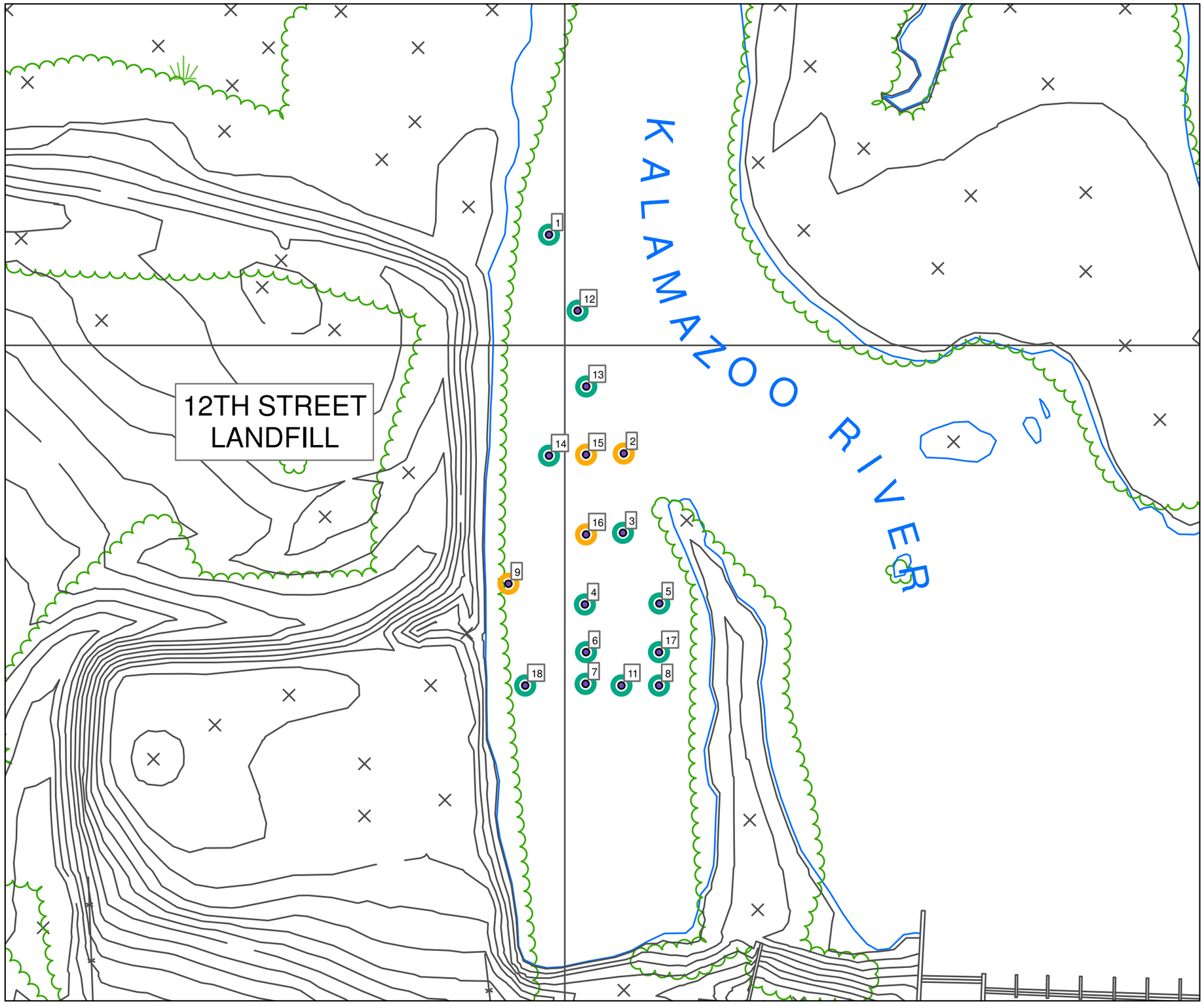
1:1,200

1 INCH EQUALS 100 FEET

PROJECT: WEYERHAEUSER COMPANY 12TH ST. LANDFILL EMERGENCY ACTION DESIGN REPORT PLAINWELL, MICHIGAN			
SHEET TITLE: HISTORICAL SAMPLING DATA FOR THE FORMER POWERHOUSE DISCHARGE CHANNEL			
DRAWN BY: WEBERN	SCALE: AS NOTED	PROJ. NO.: 00-05117.03	
CHECKED BY: MK		FILE NO.: 51170312.mxd	
APPROVED BY: CJ	DATE PRINTED: 07/16/07	FIGURE B-1	
DATE: JULY 2007			

RMT
150 N. Patrick Blvd., Suite 180
Brookfield, WI 53045-5854
Phone: 262-879-1212
Fax: 262-879-1220

D:\05117\03\51170312.mxd



LEGEND

Visual Sediment Assessment

- No Visible Residuals
- Visible Residuals
- Piston Core or Ponar Sample Location & ID

N

0 25 50 100 FEET

1:800

1 INCH EQUALS 67 FEET

PROJECT: WEYERHAEUSER COMPANY
12TH ST. LANDFILL EMERGENCY RESPONSE DESIGN REPORT
PLAINWELL, MICHIGAN

SHEET TITLE: RECENT VISUAL ASSESSMENT OF FORMER POWERHOUSE DISCHARGE CHANNEL SEDIMENTS

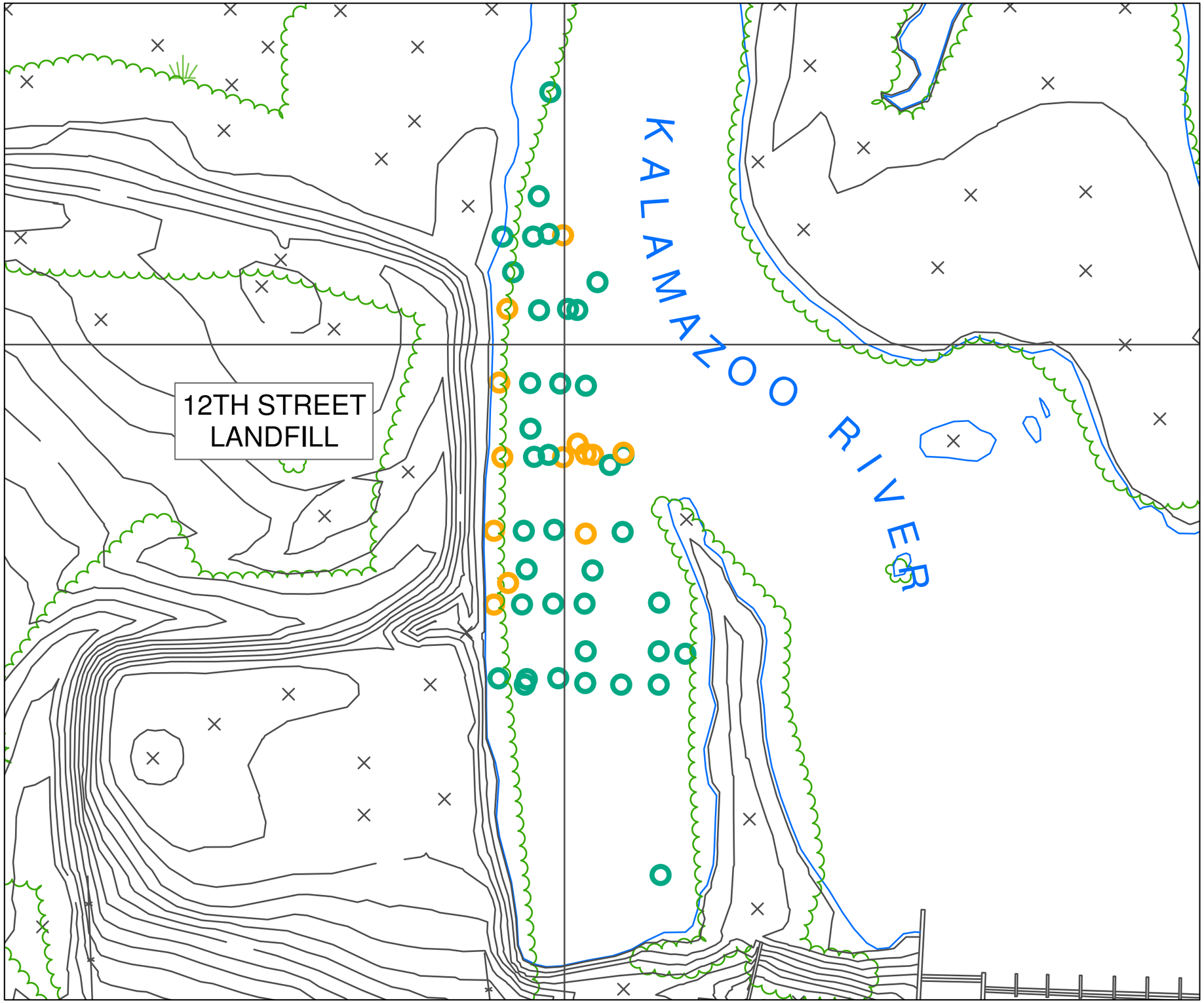
DRAWN BY: HANKLEY C	SCALE: AS NOTED	PROJ. NO.: 00-05117.03	
CHECKED BY:		FILE NO.: 51170314.mxd	
APPROVED BY:	DATE PRINTED: 7/16/07	FIGURE B-2	
DATE: JULY 2007			

RMT

150 N. Patrick Blvd., Suite 180
Brookfield, WI 53045-5854

Phone: 262-879-1212
Fax: 262-879-1220

D:\05117\03\51170314.mxd



LEGEND

Powerhouse Channel Residuals

- No Visible Residuals
- Visible Residuals

N

0 25 50 100 FEET

1:800

1 INCH EQUALS 67 FEET

PROJECT: WEYERHAEUSER COMPANY 12TH ST. LANDFILL EMERGENCY ACTION DESIGN REPORT PLAINWELL, MICHIGAN			
SHEET TITLE: VISUAL EXTENT OF RESIDUALS WITHIN THE FORMER POWERHOUSE CHANNEL (FIGURE INCLUDES ALL HISTORICAL DATA)			
DRAWN BY: HANKLEY C	SCALE: AS NOTED	PROJ. NO.: 00-05117.03	
CHECKED BY:		FILE NO.: 51170313.mxd	
APPROVED BY:	DATE PRINTED: 7/16/07	**FIGURE B-3**	
DATE: JULY 2007			

RMT

150 N. Patrick Blvd., Suite 180
Brookfield, WI 53045-5854

Phone: 262-879-1212
Fax: 262-879-1220

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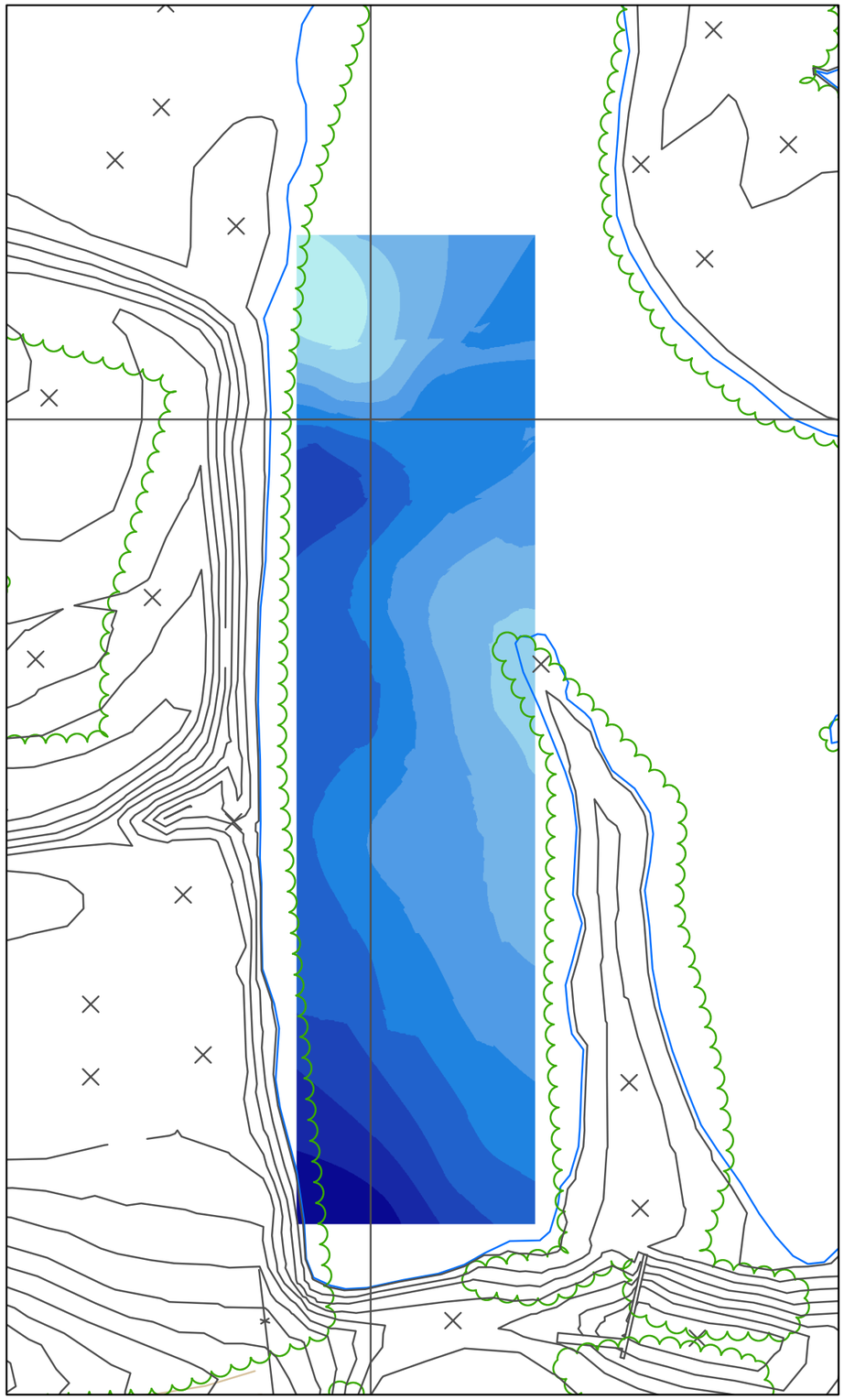
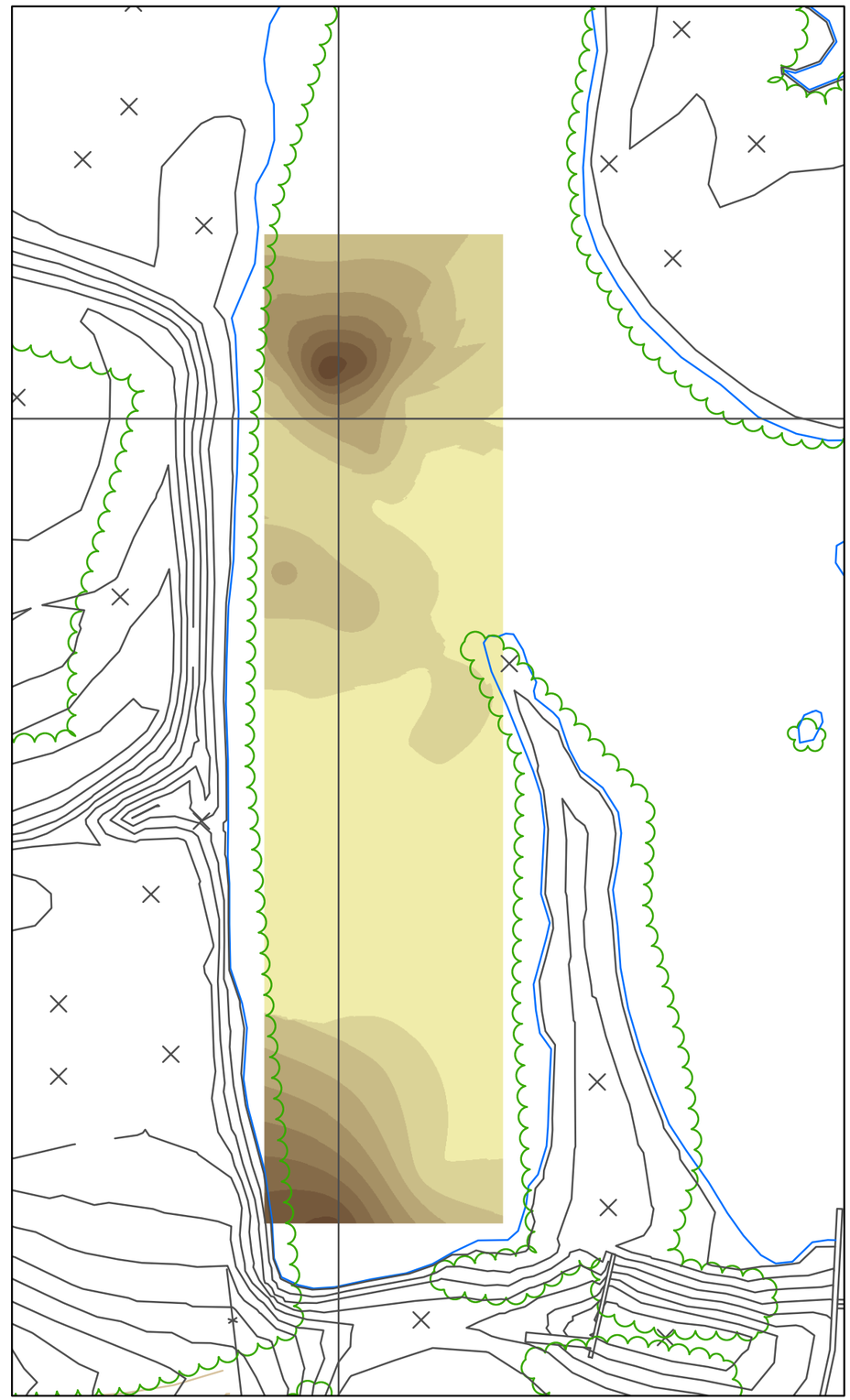




LEGEND

Water Depth (ft)	Sediment Thickness (ft)
0 - 1.3	0 - 0.3
1.4 - 1.7	0.4 - 0.5
1.8 - 2.1	0.6 - 0.7
2.2 - 2.4	0.8 - 0.9
2.5 - 2.8	1 - 1.1
2.9 - 3.2	1.2 - 1.4
3.3 - 3.5	1.5 - 1.6
3.6 - 3.9	1.7 - 1.8
4 - 4.3	1.9 - 2

N

0 25 50 100 FEET

1:800

1 INCH EQUALS 67 FEET

PROJECT: WEYERHAEUSER COMPANY
12TH ST. LANDFILL EMERGENCY ACTION DESIGN REPORT
PLAINWELL, MICHIGAN

SHEET TITLE:
APPROXIMATE WATER DEPTH AND SEDIMENT THICKNESS
FORMER POWERHOUSE DISCHARGE CHANNEL

DRAWN BY: WEBERN	SCALE: AS NOTED	PROJ. NO.:	00-05117.03
CHECKED BY: MK		FILE NO.:	51170315.mxd
APPROVED BY: CJ	DATE PRINTED: 06/19/07	FIGURE B-4	
DATE: JULY 2007			

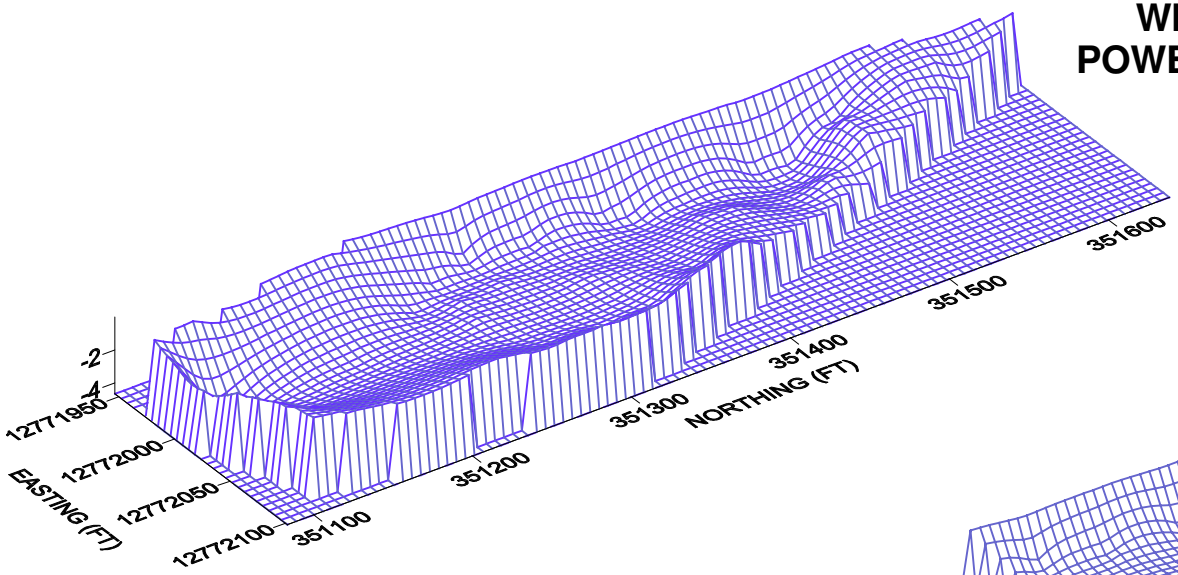
RMT

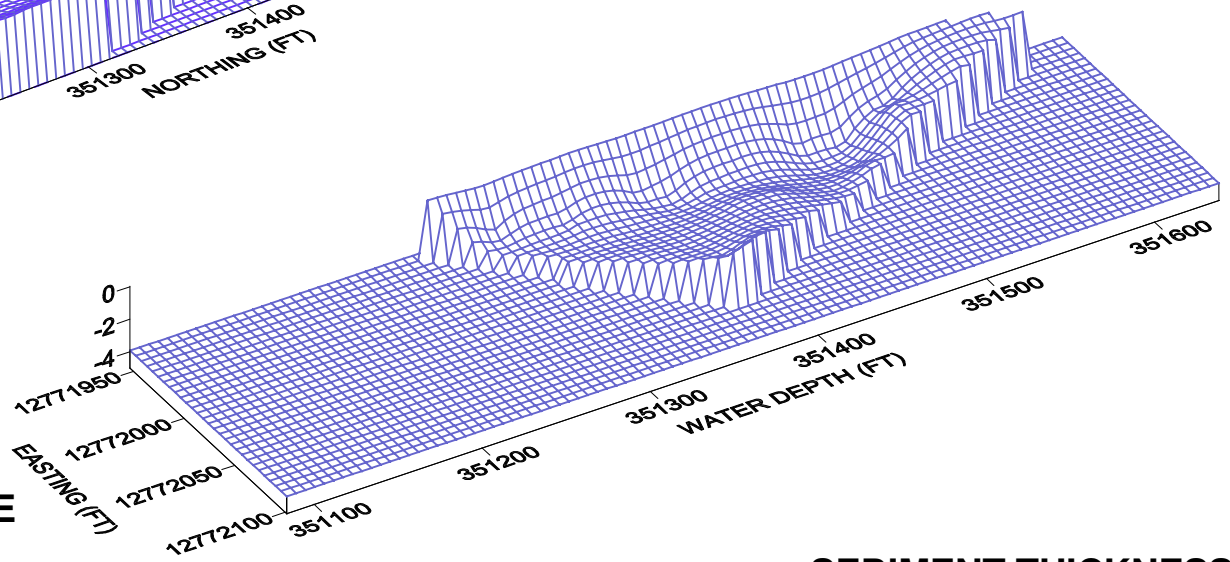
150 N. Patrick Blvd., Suite 180
Brookfield, WI 53045-5854

Phone: 262-879-1212
Fax: 262-879-1220

D:\05117\03\51170315.mxd

WATER DEPTH (FT) WITHIN THE FORMER POWERHOUSE DISCHARGE CHANNEL





WATER DEPTH (FT) WITHIN THE FORMER POWERHOUSE DISCHARGE CHANNEL [EXCAVATION AREA ONLY]

SEDIMENT THICKNESS (FT) WITHIN THE FORMER POWERHOUSE DISCHARGE CHANNEL [EXCAVATION AREA ONLY]

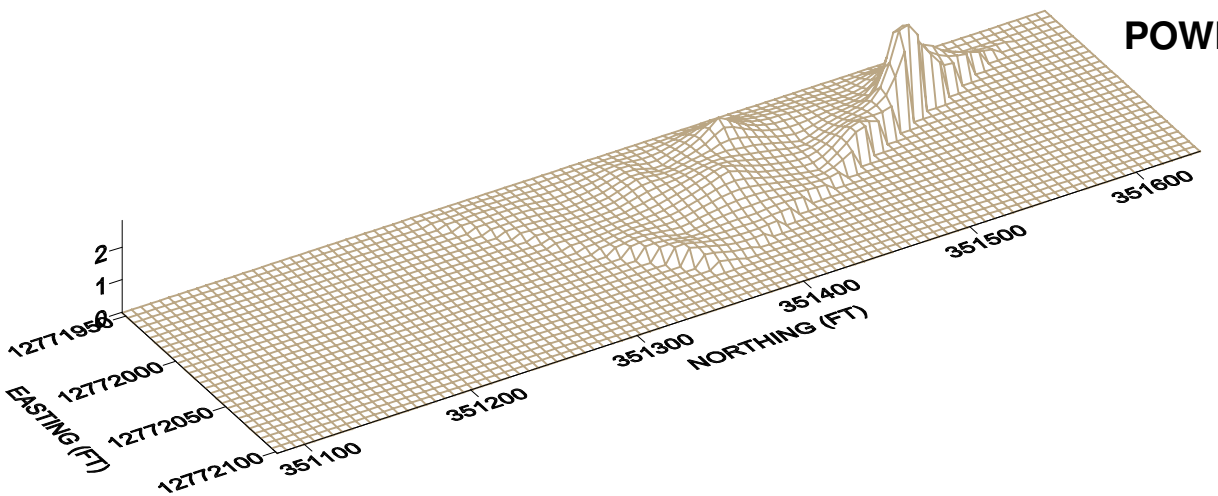


FIGURE B-5

Grid Volume Computations

Wed Jul 25 12:20:43 2007

Upper Surface

Grid File Name:	C:\Documents and Settings\WEBERN\Desktop\sedimenttop.grd
Grid Size:	100 rows x 29 columns
X Minimum:	12771946.59
X Maximum:	12772101.65
X Spacing:	5.5378571428758
Y Minimum:	351083.6461
Y Maximum:	351638.2703
Y Spacing:	5.6022646464643
Z Minimum:	-3.9252274630163
Z Maximum:	0.013853365149562

Lower Surface

Grid File Name:	C:\Documents and Settings\WEBERN\Desktop\sedimentbottom.grd
Grid Size:	100 rows x 29 columns
X Minimum:	12771946.59
X Maximum:	12772101.65
X Spacing:	5.5378571428758
Y Minimum:	351083.6461
Y Maximum:	351638.2703
Y Spacing:	5.6022646464643
Z Minimum:	-4.2236233678412
Z Maximum:	0.031501310421555

Volumes

Z Scale Factor: 1

Total Volumes by:

Trapezoidal Rule:	7894.8830700963
Simpson's Rule:	7864.043990993
Simpson's 3/8 Rule:	7884.1891254355

Cut & Fill Volumes

Positive Volume [Cut]:	7895.2920573373

Negative Volume [Fill]:	0.40898724093838
Net Volume [Cut-Fill]:	7894.8830700963

Areas

Planar Areas

Positive Planar Area [Cut]:	21170.257512428
Negative Planar Area [Fill]:	3.9919171116185
Blanked Planar Area:	64825.779022744
Total Planar Area:	86000.028452283

Surface Areas

Positive Surface Area [Cut]:	21178.421459426
Negative Surface Area [Fill]:	3.9931393133334

Grid Volume Computations

Wed Jul 25 12:20:02 2007

Upper Surface

Level Surface defined by Z = 0

Lower Surface

Grid File Name:	C:\Documents and Settings\WEBERN\Desktop\waterdepth.grd
Grid Size:	100 rows x 29 columns
X Minimum:	12771946.59
X Maximum:	12772101.65
X Spacing:	5.5378571428758
Y Minimum:	351083.6461
Y Maximum:	351638.2703
Y Spacing:	5.6022646464643
Z Minimum:	-3.9252274630163
Z Maximum:	0.013853365149562

Volumes

Z Scale Factor:	1

Total Volumes by:

Trapezoidal Rule:	49306.811309313
Simpson's Rule:	49303.688233496
Simpson's 3/8 Rule:	49352.964935481

Cut & Fill Volumes

Positive Volume [Cut]:	49307.152055523
Negative Volume [Fill]:	0.34074621022795
Net Volume [Cut-Fill]:	49306.811309313

Areas

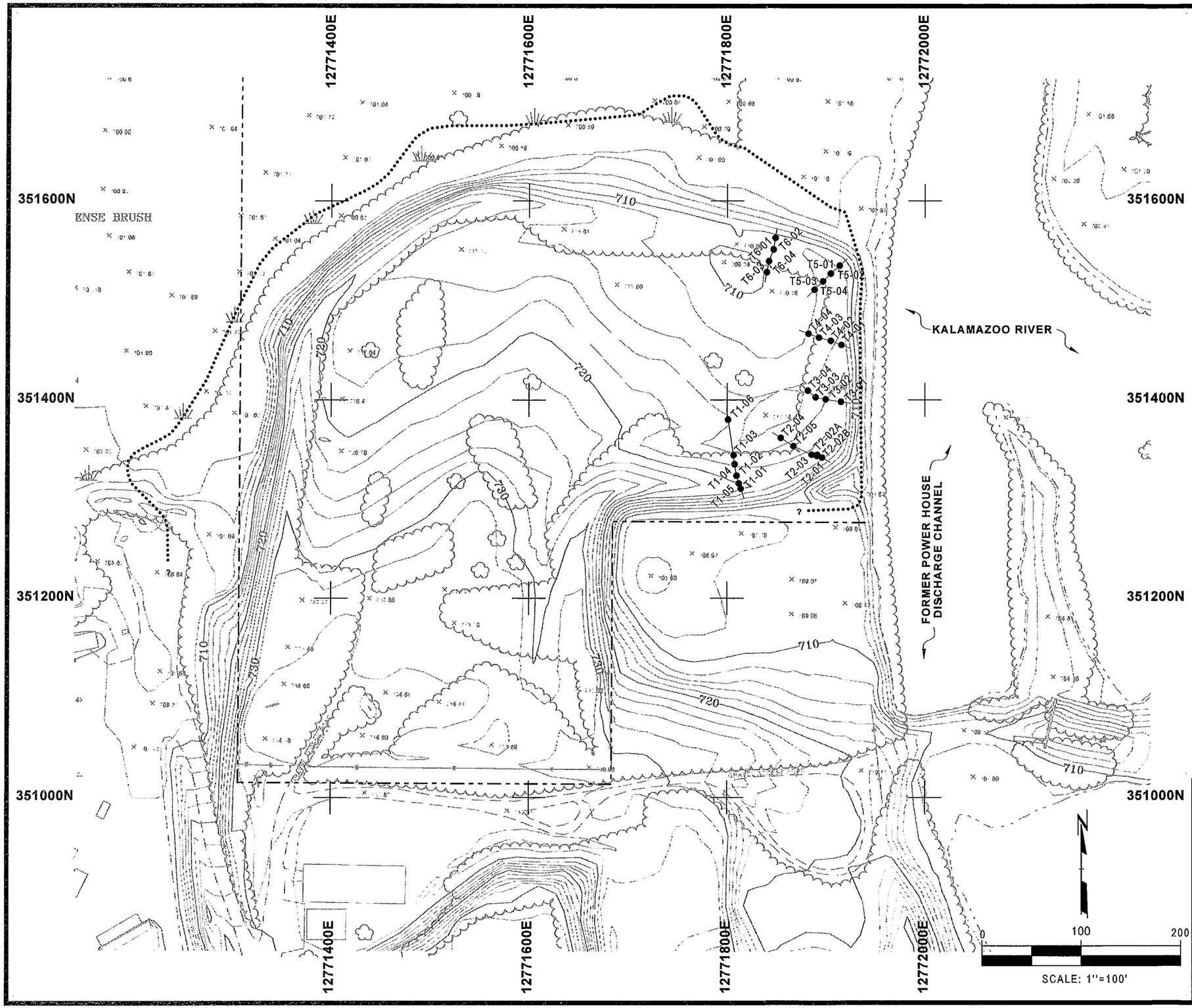
Planar Areas

Positive Planar Area [Cut]:	21169.478295515
Negative Planar Area [Fill]:	4.7711340247994
Blanked Planar Area:	64825.779022744
Total Planar Area:	86000.028452283

Surface Areas

Positive Surface Area [Cut]:	21221.065466751
Negative Surface Area [Fill]:	4.7722206121834

Appendix C
Geotechnical Investigation
Technical Memorandum



LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- APPROXIMATE LIMITS OF PAPER RESIDUALS USING VISUAL CRITERIA
- GEOPROBE BORING TRANSECT

NOTES

1. BASE TOPOGRAPHY PROVIDED BY OAS, INC. OF SEYMOUR, INDIANA BASED ON AERIAL SURVEY DATED 3/30/2005. COORDINATES ARE MICHIGAN STATE PLANE-SOUTH ZONE. THE VERTICAL DATUM IS NGVD 29.
2. PROPERTY BOUNDARY BASED ON LEGAL DESCRIPTION PROVIDED BY USEPA IN A FAX DATED MARCH 30, 2004. COORDINATES FOR S 1/4 CORNER AND N 1/4 CORNER OF SECTION 24 AND NORTH BEARING USED TO PLOT PROPERTY LINE WERE PROVIDED BY HOLLAND ENGINEERING AND ARE BASED ON MICHIGAN STATE PLANE - SOUTH ZONE COORDINATES.

WORKING COPY

PROJECT:	WEYERHAEUSER COMPANY 12TH STREET LANDFILL PLAINWELL, MICHIGAN		
SHEET TITLE:	LOCATIONS OF GEOPROBE® BORINGS INSTALLED INSTALLED DURING THE MAY 2007 GEOTECHNICAL INVESTIGATION		
DRAWN BY: stormerl	SCALE: 1"=100'	PROJ. NO. 5117.04	
CHECKED BY:		FILE NO. GEOTECH2.PLT	
APPROVED BY:	DATE PRINTED:	FIGURE C-1	
DATE: JUNE 2007			

RMT

744 Heartland Trail
Madison, WI 53717-1934

P.O. Box 8923 53708-8923
Phone: 608-831-4444
Fax: 608-831-3334

Levels
(1) 27
(2) 1-63
(3) 1-63
(4) 1-63

Logical Names
(1) bmc
(2) bmr
(3) pro
(4) bar

Reference Files
Ref. File 1 = J:\05117\04\bmc033005.dgn
Ref. File 2 = J:\05117\04\bmrmt.dgn
Ref. File 3 = J:\05117\04\proposed.dgn
Ref. File 4 = J:\05117\04\11x17bar.dgn

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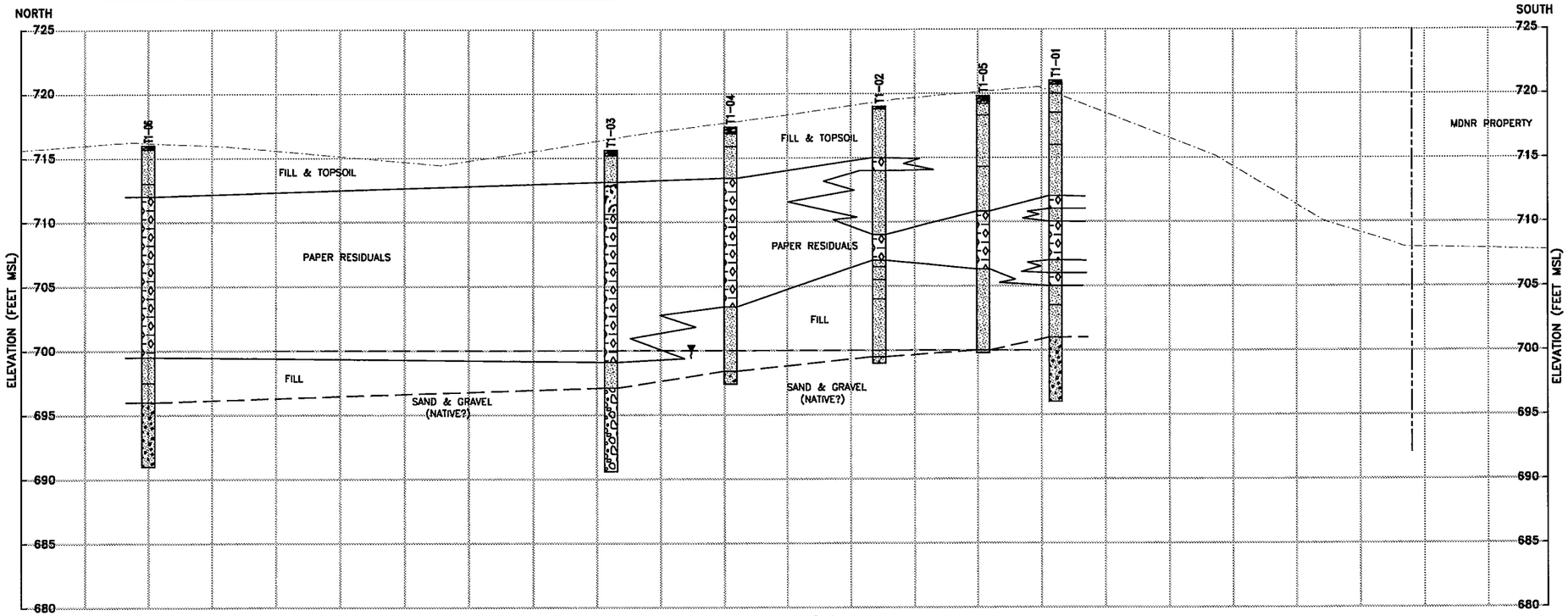
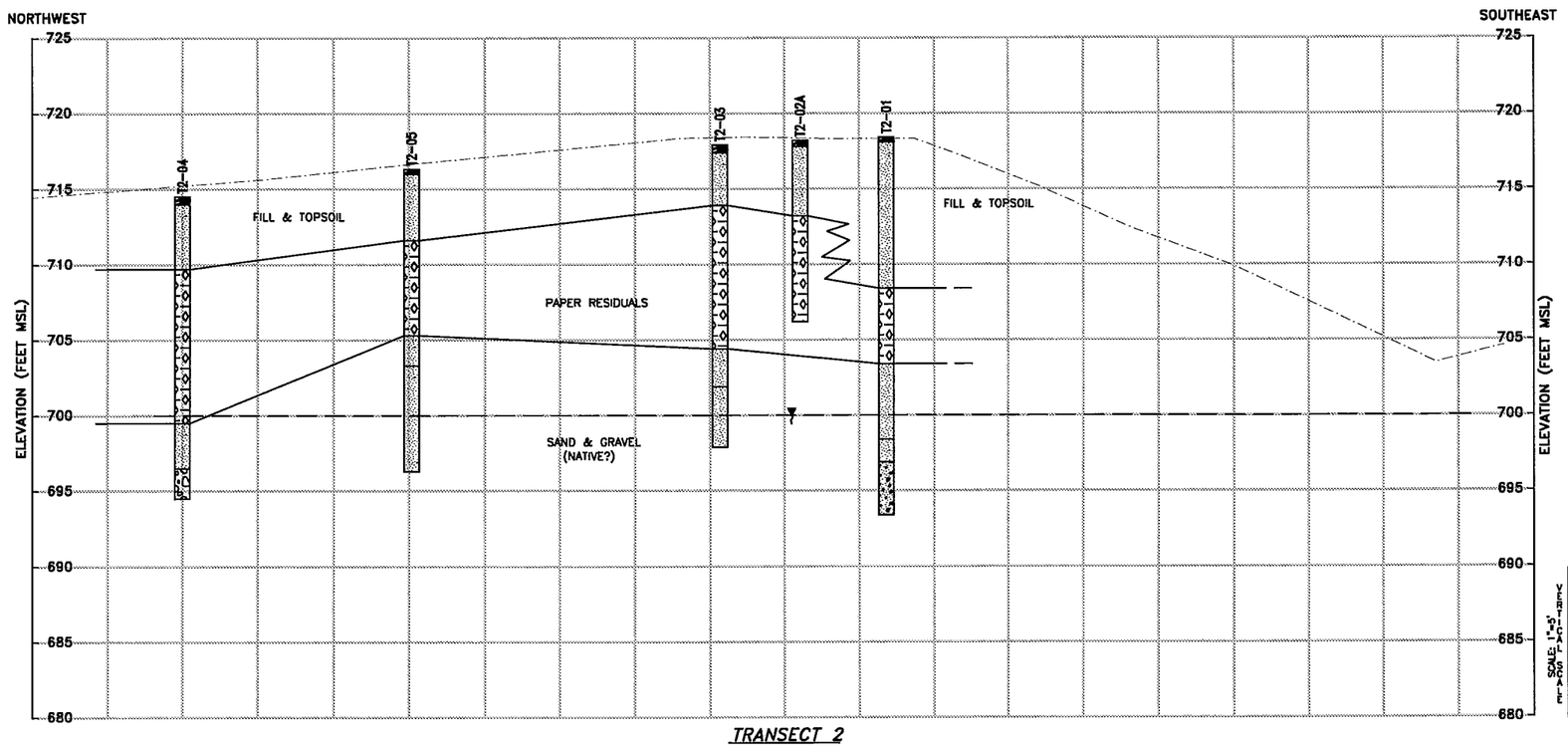


TRANSECT 1



TRANSECT 2

LEGEND

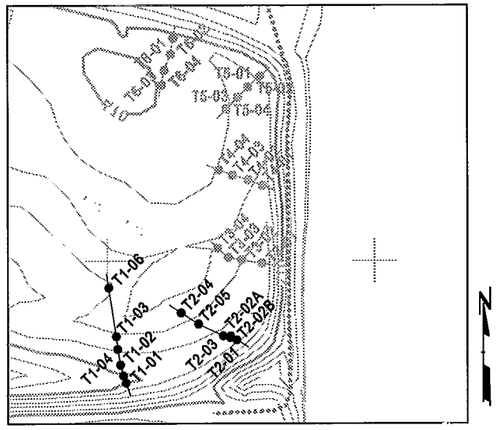
- STRATIGRAPHIC BOUNDARY (DASHED WHERE INFERRED)
- WATER TABLE
- EXISTING GROUND SURFACE
- APPROXIMATE PROPERTY BOUNDARY

SOIL CLASSIFICATION

- TOPSOIL
- CLAY (CL)
- FAT CLAY (CH)
- SILTY CLAY (CL)
- SANDY CLAY
- SILT (ML)
- SANDY SILT (ML)
- CLAYEY SAND (SC)
- SILTY SAND (SM)
- CLAY AND GRAVEL
- SAND AND GRAVEL (SW-GW)
- SAND
- GRAVEL
- ORGANIC SILT

NOTES

1. BASE TOPOGRAPHY PROVIDED BY OAS, INC. OF SEYMOUR, INDIANA BASED ON AERIAL SURVEY DATED 3/30/2005. COORDINATES ARE MICHIGAN STAE PLANE-SOUTH ZONE. THE VERTICAL DATUM IS NGVD 29.
2. PROPERTY BOUNDARIES BASED ON LEGAL DESCRIPTION PROVIDED BY USEPA IN A FAX DATED MARCH 30, 2004. COORDINATES FOR S 1/4 CORNER AND N 1/4 OF SECTION 24 AND NORTH BEARING USED TO PLOT PROPERTY LINE WERE PROVIDED BY HOLLAND ENGINEERING AND ARE BASED ON MICHIGAN STATE PLANE – SOUTH ZONE COORDINATES.
3. THE GEOPROBE BORINGS WERE COMPLETED BY MATECO DRILLING COMPANY ON MAY 21–23, 2007.
4. THE SURVEY INFORMATION FOR THE GEOPROBE BORINGS WAS PROVIDED BY HOLLAND ENGINEERING ON MAY 25, 2007.



CROSS SECTION LOCATOR MAP
(NOT TO SCALE)

WORKING COPY

NO.	BY	DATE	REVISION	APP'D.
3.				
2.				
1.				

PROJECT: WEYERHAEUSER COMPANY
12TH STREET LANDFILL
PLAINWELL, MICHIGAN

SHEET TITLE: CROSS SECTIONS FOR TRANSECT 1 AND TRANSECT 2

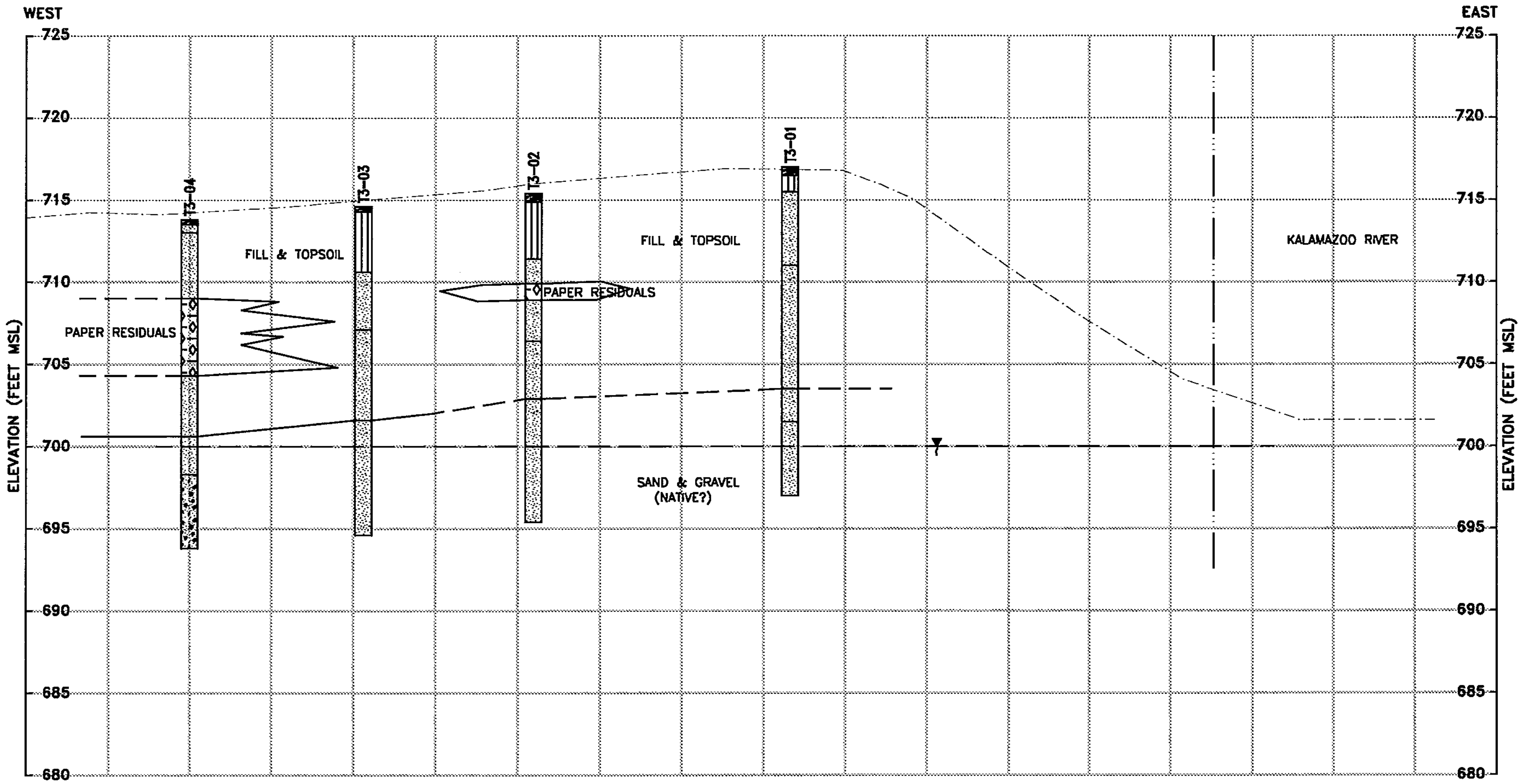
DRAWN BY: NOLDENR	SCALE:	PROJ. NO.	5117.04
CHECKED BY:	AS SHOWN	FILE NO.	51170402.DWG
APPROVED BY:	DATE PRINTED:	FIGURE C-2	
DATE: JULY 2007			

RMT
744 Heartland Trail
Madison, WI 53717-1934
P.O. Box 8923 53708-8923
Phone: 608-831-4444
Fax: 608-831-3334

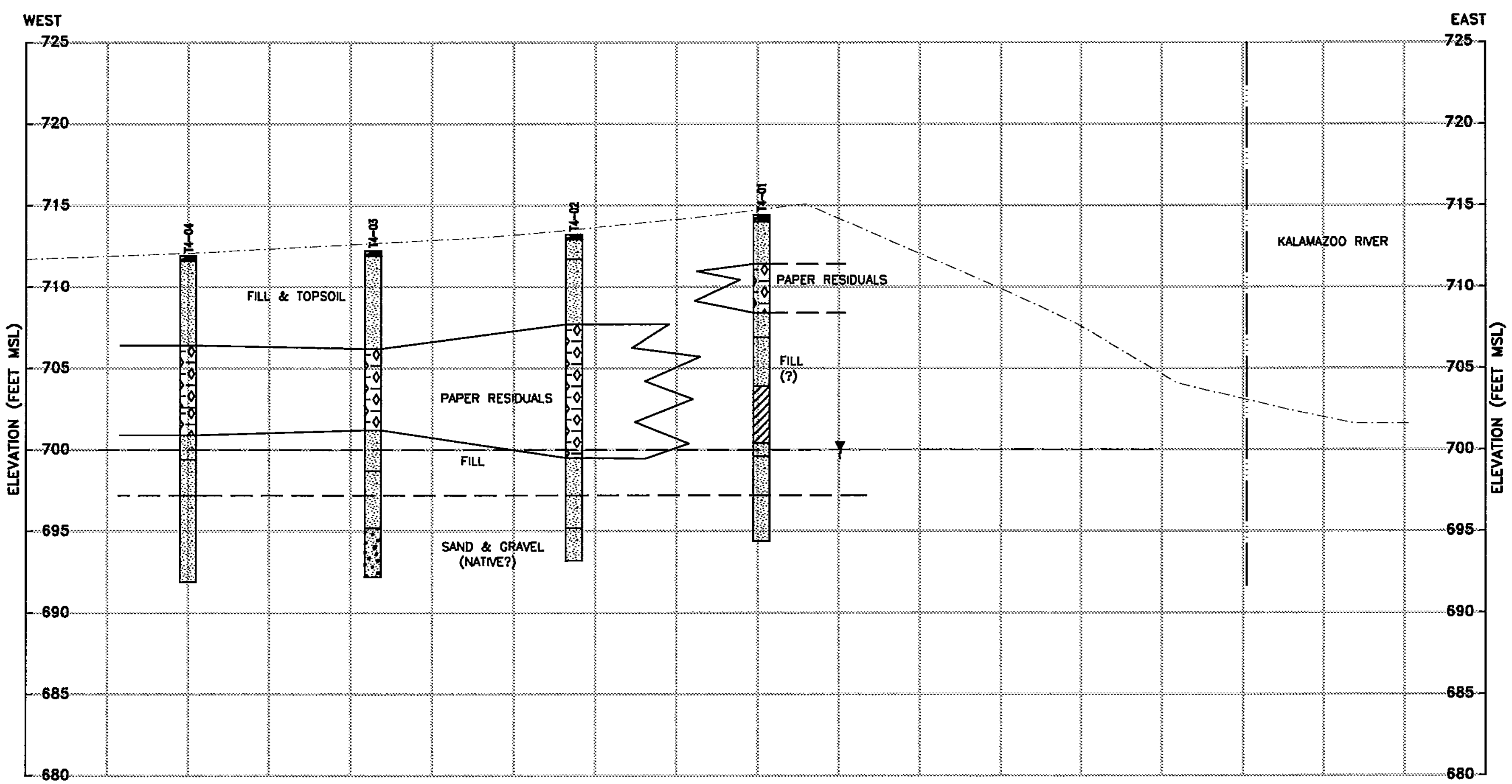
SCALE: 1"=5' FOR 24x36 SHEET

0 5' 10'
HORIZONTAL SCALE
SCALE: 1"=5'

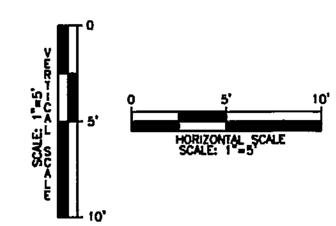
0 5' 10'



TRANSECT 3



TRANSECT 4



LEGEND

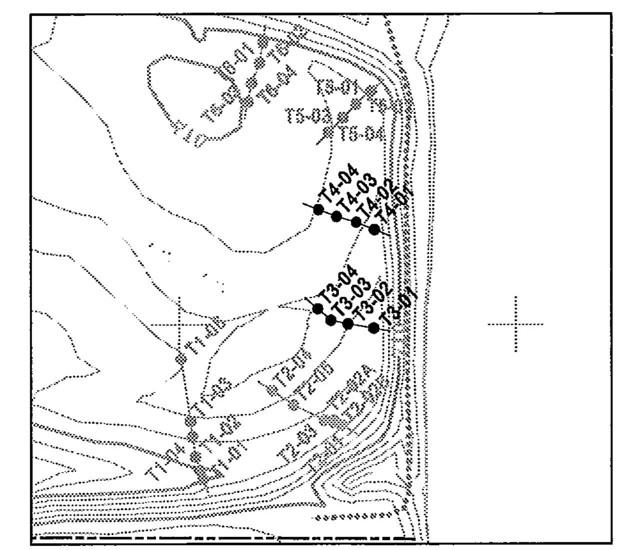
- STRATIGRAPHIC BOUNDARY (DASHED WHERE INFERRED)
- WATER TABLE
- EXISTING GROUND SURFACE
- RIVER'S EDGE

SOIL CLASSIFICATION

TOPSOIL	CLAYEY SAND (SC)
CLAY (CL)	SILTY SAND (SM)
FAT CLAY (CH)	CLAY AND GRAVEL
SILTY CLAY (CL)	SAND AND GRAVEL (SW-GW)
SANDY CLAY	SAND
SILT (ML)	GRAVEL
SANDY SILT (ML)	ORGANIC SILT

NOTES

1. BASE TOPOGRAPHY PROVIDED BY OAS, INC. OF SEYMOUR, INDIANA BASED ON AERIAL SURVEY DATED 3/30/2005. COORDINATES ARE MICHIGAN STATE PLANE-SOUTH ZONE. THE VERTICAL DATUM IS NGVD 29.
2. PROPERTY BOUNDARIES BASED ON LEGAL DESCRIPTION PROVIDED BY USEPA IN A FAX DATED MARCH 30, 2004. COORDINATES FOR S 1/4 CORNER AND N 1/4 OF SECTION 24 AND NORTH BEARING USED TO PLOT PROPERTY LINE WERE PROVIDED BY HOLLAND ENGINEERING AND ARE BASED ON MICHIGAN STATE PLANE – SOUTH ZONE COORDINATES.
3. THE GEOPROBE BORINGS WERE COMPLETED BY MATECO DRILLING COMPANY ON MAY 21-23, 2007.
4. THE SURVEY INFORMATION FOR THE GEOPROBE BORINGS WAS PROVIDED BY HOLLAND ENGINEERING ON MAY 25, 2007.



CROSS SECTION LOCATOR MAP

(NOT TO SCALE)

WORKING COPY

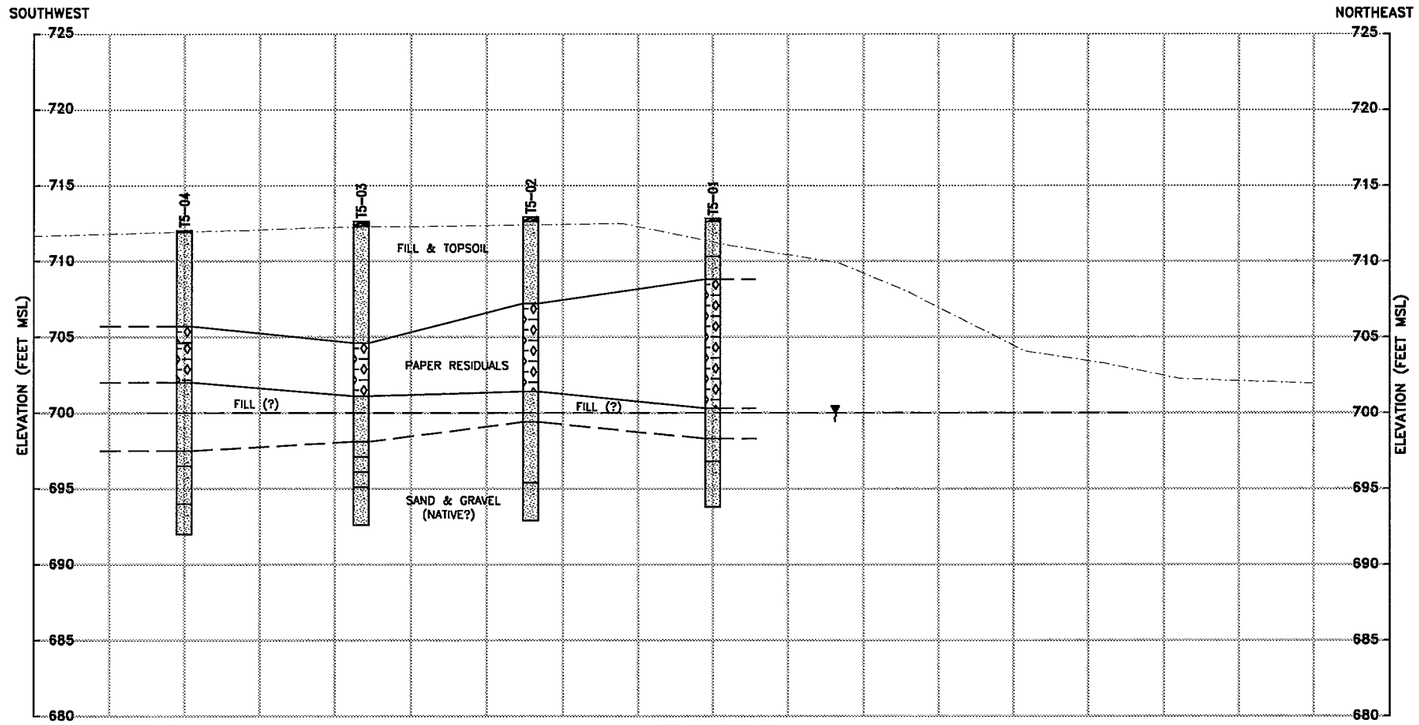
NO.	BY	DATE	REVISION	APP'D.
3.				
2.				
1.				

PROJECT: **WEYERHAEUSER COMPANY 12TH STREET LANDFILL PLAINWELL, MICHIGAN**

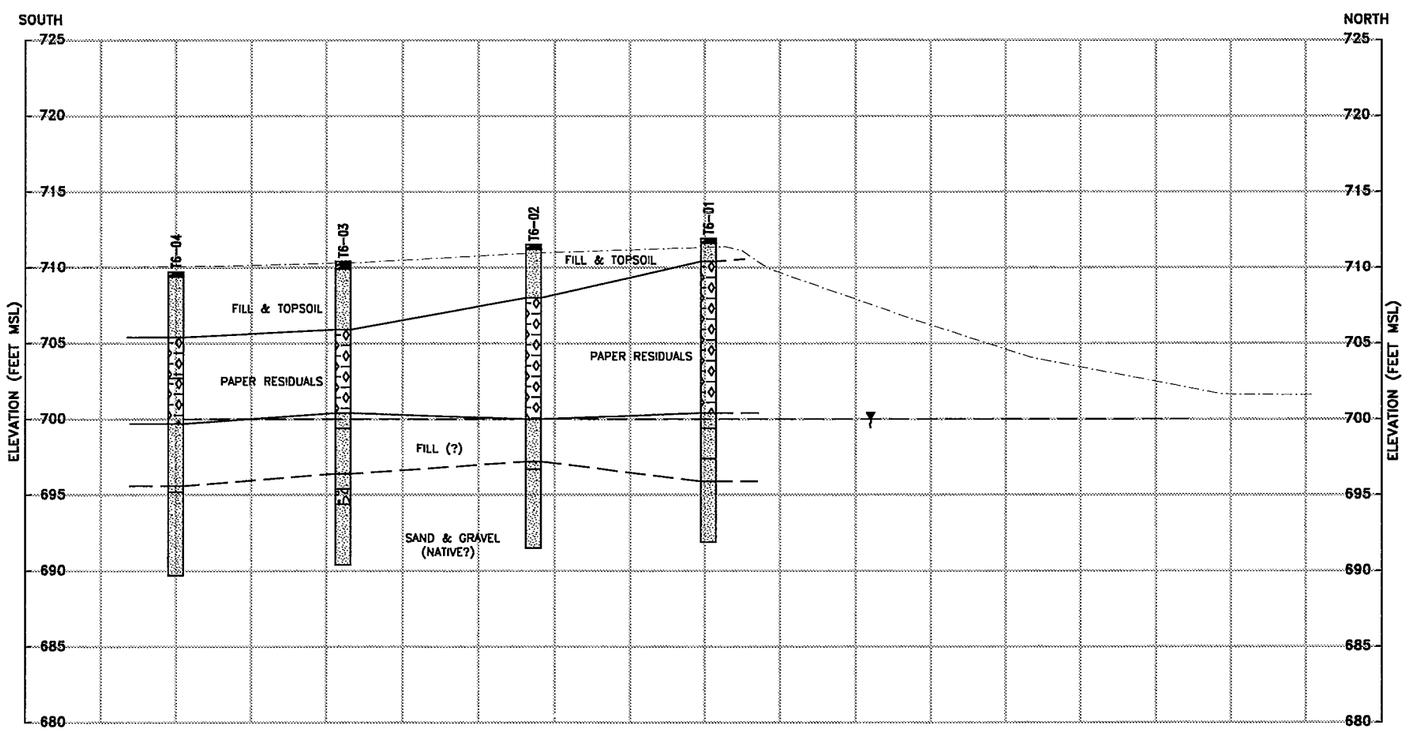
SHEET TITLE: **CROSS SECTIONS FOR TRANSECT 3 AND TRANSECT 4**

DRAWN BY: NOLDENR	SCALE:	PROJ. NO. 5117.04
CHECKED BY:	AS SHOWN	FILE NO. 51170403.DWG
APPROVED BY:	DATE PRINTED:	FIGURE C-3
DATE: JULY 2007		

RMT.
744 Heartland Trail
Madison, WI 53717-1934
P.O. Box 8923 53708-8923
Phone: 608-831-4444
Fax: 608-831-3334



TRANSECT 5



TRANSECT 6

LEGEND

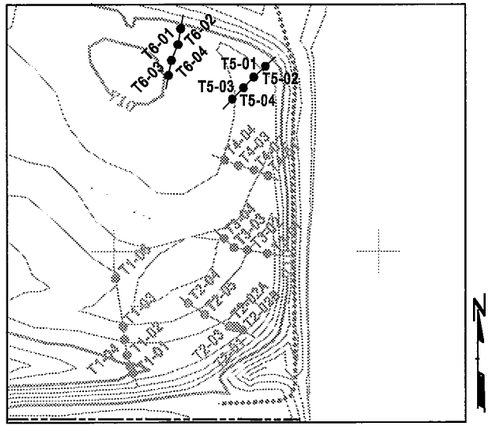
- STRATIGRAPHIC BOUNDARY (DASHED WHERE INFERRED)
- WATER TABLE
- EXISTING GROUND SURFACE

SOIL CLASSIFICATION

- TOPSOIL
- CLAY (CL)
- FAT CLAY (CH)
- SILTY CLAY (CL)
- SANDY CLAY
- SILT (ML)
- SANDY SILT (ML)
- CLAYEY SAND (SC)
- SILTY SAND (SM)
- CLAY AND GRAVEL
- SAND AND GRAVEL (SW-GW)
- SAND
- GRAVEL
- ORGANIC SILT

NOTES

1. BASE TOPOGRAPHY PROVIDED BY OAS, INC. OF SEYMOUR, INDIANA BASED ON AERIAL SURVEY DATED 3/30/2005. COORDINATES ARE MICHIGAN STAE PLANE-SOUTH ZONE. THE VERTICAL DATUM IS NGVD 29.
2. PROPERTY BOUNDARIES BASED ON LEGAL DESCRIPTION PROVIDED BY USEPA IN A FAX DATED MARCH 30, 2004. COORDINATES FOR S 1/4 CORNER AND N 1/4 OF SECTION 24 AND NORTH BEARING USED TO PLOT PROPERTY LINE WERE PROVIDED BY HOLLAND ENGINEERING AND ARE BASED ON MICHIGAN STATE PLANE – SOUTH ZONE COORDINATES.
3. THE GEOPROBE BORINGS WERE COMPLETED BY MATECO DRILLING COMPANY ON MAY 21-23, 2007.
4. THE SURVEY INFORMATION FOR THE GEOPROBE BORINGS WAS PROVIDED BY HOLLAND ENGINEERING ON MAY 25, 2007.



CROSS SECTION LOCATOR MAP
(NOT TO SCALE)

WORKING COPY

NO.	BY	DATE	REVISION	APP'D.
3.				
2.				
1.				

PROJECT: WEYERHAEUSER COMPANY
12TH STREET LANDFILL
PLAINWELL, MICHIGAN

SHEET TITLE: CROSS SECTIONS FOR TRANSECT 5 AND TRANSECT 6

DRAWN BY: NOLDENR	SCALE:	PROJ. NO.	5117.04
CHECKED BY:	AS SHOWN	FILE NO.	51170404.DWG
APPROVED BY:	DATE PRINTED:	FIGURE C-4	
DATE: JULY 2007			

RMT
744 Heartland Trail
Madison, WI 53717-1934
P.O. Box 8923 53708-8923
Phone: 608-831-4444
Fax: 608-831-3334

SCALE: 1"=5'
HORIZONTAL SCALE
SCALE: 1"=5'

SOIL BORING LOG

RMT INC.

BORING NO. T1-01

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
Weyerhaeuser - Plainwell	5/21/07	5/21/07	5117.04

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Mateco	Direct Push	721	---	25.0	2.25

Boring Location:
State Plane N: 351310.444 E: 12771813.729

Personnel
Logged By - E. Vincke
Driller - Scot Middlebrook

Drilling Equipment:
Geoprobe 6620 DT

Civil Town/City/or Village:	County:	State:
Plainwell	Allegan	Michigan

Water Level Observations:
While Drilling: Date/Time 5/21/07 00:00 ▽ Depth (ft bgs) 18.5
After Drilling: Date/Time Depth (ft bgs)

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
				TOPSOIL, organic silt.	OL		
				WELL GRADED SAND (SW), mostly medium sand, some fine sand, little coarse sand, 10YR 5/6 yellowish brown, no odor, moist, loose.	SW		
			2	POORLY GRADED SAND (SP), mostly fine sand, 10YR 5/6 yellowish brown, no odor, moist, hard.	SP		
1 GP	57			WELL GRADED SAND (SW), mostly medium sand, few fine sand, trace coarse sand, 10YR 4/1 dark gray, orange mottling, moist, loose.	SW		
			4				
			6	WELL GRADED SAND (SW), mostly medium sand, some fine sand, little coarse sand, alternating layers of 10YR 6/6 and 10YR 5/6, no odor, moist, loose, driller reported soft and hard intervals.	SW		
2 GP	47		8				
				WELL GRADED SAND (SW), as above, with gray and white gummy paper residuals.	SW		
			10	WELL GRADED SAND (SW), mostly fine sand, little medium sand, trace coarse sand, 10YR 3/3 dark brown, no odor, moist, dense.	SW		
3 GP	68		12	WELL GRADED SAND (SW), as below, mixed with white paper residuals, grading to all white paper residuals.	SW		
			14	WELL GRADED SAND (SW), mostly fine sand, little medium sand, trace coarse sand, 10YR 4/3 dark yellowish brown, no odor, moist, dense.	SW		
				WELL GRADED SAND (SW), and paper residuals.	SW		
			16	POORLY GRADED SAND (SP), fine sand, 10YR 5/6, dense, no odor, moist.	SP		
4 GP	35		18 ▽	WELL GRADED SAND (SW), mostly medium sand, some fine sand, trace coarse sand, 10YR 5/6 grading to 10YR 5/1 gray, no odor, moist grading to wet, dense grading to loose.	SW		
			20	WELL GRADED SAND WITH GRAVEL (SW), as above, mostly medium sand, few coarse sand, little round gravel, trace cobble,10YR	SW		

Signature:	Firm: RMT, Inc
	Fax

Checked By: _____

RMT INC.

SOIL BORING LOG

BORING NO. T1-01

SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
5 GP	10		22 24	5/4, no odor, wet, dense.	SW		
				End of boring at 25.0 feet.			
			26				
			28				
			30				
			32				
			34				
			36				
			38				
			40				
			42				
			44				
			46				
			48				

SOIL BORING LOG

RMT INC.

BORING NO. T1-02

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
Weyerhaeuser - Plainwell	5/21/07	5/21/07	5117.04

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Mateco	Direct Push	719	---	20.0	2.25

Boring Location:
State Plane N: 351323.669 E: 12771809.565

Personnel
Logged By - E. Vincke
Driller - Scot Middlebrook

Drilling Equipment:
Geoprobe 6620 DT

Civil Town/City/or Village:	County:	State:
Plainwell	Allegan	Michigan

Water Level Observations:
While Drilling: Date/Time 5/21/07 00:00 ∇ Depth (ft bgs) 18
After Drilling: Date/Time Depth (ft bgs)

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
1 GP	48		2	TOPSOIL WELL GRADED SAND (SW), mostly medium sand, some fine sand, little coarse sand, 10YR 5/6, no odor, moist, loose.	SW		
			4	PAPER RESIDUALS, 10YR 8/1.			
2 GP	42		6 8	WELL GRADED SAND (SW), mostly medium sand, some fine sand, little coarse sand, 10YR 5/6, no odor, moist, loose. Same as above, 10YR 4/1 dark gray, orange mottling, dense. Same as at 5 feet, 10YR 5/4. Cobble in spoon tip.	SW		
			10	PAPER RESIDUALS			
3 GP	63		12	WELL GRADED SAND (SW), mostly fine sand, few medium sand, trace coarse sand, 10YR 3/1 very dark gray, fuel oil odor, moist, compact.	SW		
			14	POORLY GRADED SAND (SP), mostly fine sand, trace coarse sand, 10YR 4/6, no odor, moist, dense.	SP		
4 GP	63		16 18	WELL GRADED SAND (SW), mostly medium sand, some fine sand, little coarse sand and gravel, 10YR 5/3 brown, no odor, moist, dense. POORLY GRADED SAND (SP), mostly fine sand, trace coarse sand, 10YR 6/3 pale brown, no odor, moist, loose. ∇ Wet at 18 feet.	SW SP		
			20	WELL GRADED SAND (SW), mostly medium sand, some fine sand, little coarse sand and gravel, 10YR 5/3 brown, no odor, wet, loose. End of boring at 20.0 feet.	SW		

Signature:	Firm: RMT, Inc
	Fax

Checked By: _____

SOIL BORING LOG

RMT INC.

BORING NO. T1-03

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
Weyerhaeuser - Plainwell	5/21/07	5/21/07	5117.04

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Mateco	Direct Push	715.6	---	25.0	2.25

Boring Location: State Plane N: 351344.508 E: 12771806.491

Personnel: Logged By - E. Vincke; Driller - Scot Middlebrook

Drilling Equipment: Geoprobe 6620 DT

Civil Town/City/or Village:	County:	State:
Plainwell	Allegan	Michigan

Water Level Observations:
While Drilling: Date/Time 5/21/07 00:00 ▽ Depth (ft bgs) 16.5
After Drilling: Date/Time Depth (ft bgs)

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
				TOPSOIL			
1 GP	55		2	WELL GRADED SAND (SW), mostly fine sand, some medium sand, trace coarse sand and gravel, 10YR 4/4 grading to 10YR 6/4, no odor, moist, dense.	SW		
			4	FLY ASH, 10YR 3/1 very dark gray, dense.			
2 GP	70		6	PAPER RESIDUALS, Gley 5/1 bluish gray.			
			8				
3 GP	75		10	Same as above.			
			12				
			14				
4 GP	43		16	▽			
			18	WELL GRADED SAND (SW), mostly fine sand, some medium sand, trace gravel, 10YR 4/2 dark grayish brown, odor, wet, dense.	SW		
			20	POORLY GRADED GRAVEL (GP), mostly subrounded gravel, little sand, 10YR 4/1 dark gray, wet, compact. No recovery. Driller reported drilling though rock and believes it to be native sediments, as above.	GP		

Signature: Firm: RMT, Inc Fax

Checked By: _____

SOIL BORING LOG

RMT INC.

BORING NO. T1-03

SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
5 GP	0		22		GP		
			24				
				End of boring at 25.0 feet.			
			26				
			28				
			30				
			32				
			34				
			36				
			38				
			40				
			42				
			44				
			46				
			48				

SOIL BORING LOG

RMT INC.

BORING NO. T1-04

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
Weyerhaeuser - Plainwell	5/21/07	5/21/07	5117.04

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Mateco	Direct Push	717.4	---	20.0	2.25

Boring Location:
State Plane N: 351335.211 E: 12771807.508

Personnel
Logged By - E. Vincke
Driller - Scot Middlebrook

Drilling Equipment:
Geoprobe 6620 DT

Civil Town/City/or Village:	County:	State:
Plainwell	Allegan	Michigan

Water Level Observations:
While Drilling: Date/Time 5/21/07 00:00 ▽ Depth (ft bgs) 19
After Drilling: Date/Time Depth (ft bgs)

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
				TOPSOIL			
				WELL GRADED SAND (SW), mostly medium sand, some fine sand, little coarse sand, 10YR 6/6, no odor, moist, loose.	SW		
1 GP	63		2	WELL GRADED SAND (SW), mostly fine sand, some medium sand, little coarse sand, trace gravel, 10YR 3/1 very dark gray, no odor, moist, compact.	SW		
			4	PAPER RESIDUALS, Gley 2 5/1 bluish gray.			
2 GP	73		6				
			8				
			10	Same as above.			
3 GP	52		12				
			14	POORLY GRADED SAND (SP), mostly medium sand, trace coarse sand, 10YR 4/3 brown, no odor, moist, compact.			
4 GP	42		16		SP		
			18	▽			
				WELL GRADED SAND (SW), mostly medium sand, some fine sand, few coarse sand, 10YR 6/6, no odor, wet, loose, driller reported gravel.	SW		
			20	End of boring at 20.0 feet.			

SOIL BORING LOG WITH PHOTO 05117W.GPJ RMT_CORP.GDT 5117.04 7/16/07

Signature:

Firm: RMT, Inc

Fax

Checked By: _____

SOIL BORING LOG

RMT INC.

BORING NO. T1-05

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
Weyerhaeuser - Plainwell	5/21/07	5/21/07	5117.04

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Mateco	Direct Push	719.8	---	20.0	2.25

Boring Location: State Plane N: 351315.785 E: 12771811.796

Personnel: Logged By - E. Vincke; Driller - Scot Middlebrook

Drilling Equipment: Geoprobe 6620 DT

Civil Town/City/or Village:	County:	State:
Plainwell	Allegan	Michigan

Water Level Observations:
While Drilling: Date/Time 5/21/07 00:00 ▽ Depth (ft bgs) 18.5
After Drilling: Date/Time Depth (ft bgs)

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
				TOPSOIL			
				WELL GRADED SAND (SW), mostly fine sand, some medium sand, trace coarse sand, 10YR 5/6, no odor, moist, loose.	SW		
1 GP	67		2, 4	POORLY GRADED SAND (SP), mostly fine sand, trace coarse sand, 10YR 5/8, no odor, moist, compact.	SP		
2 GP	50		6, 8	WELL GRADED SAND (SW), mostly medium sand, some fine sand, little coarse sand, trace gravel, 10YR 5/8, no odor, moist, compact. Cobbles present, red dye.	SW		
3 GP	53		10, 12	PAPER RESIDUAL MIX, clay, sand, gravel, 10YR 4/1 dark gray.			
4 GP	50		14, 16, 18	WELL GRADED SAND (SW), mostly fine sand, few medium sand, trace coarse sand and gravel, 10YR 4/6 dark yellowish brown, moist, dense. ▽ Grades to 10YR 5/1 gray, wet.	SW		
			20	End of boring at 20.0 feet.			

Signature:	Firm: RMT, Inc
	Fax

Checked By: _____

SOIL BORING LOG WITH PHOTO 05117W.GPJ RMT_CORP.GDT 5117.04 7/16/07

SOIL BORING LOG

RMT INC.

BORING NO. T1-06

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
Weyerhaeuser - Plainwell	5/22/07	5/22/07	5117.04

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Mateco	Direct Push	716	---	25.0	2.25

Boring Location:
State Plane N: 351380.184 E: 12771800.949

Personnel
Logged By - E. Vincke
Driller - Scot Middlebrook

Drilling Equipment:
Geoprobe 6620 DT

Civil Town/City/or Village:	County:	State:
Plainwell	Allegan	Michigan

Water Level Observations:
While Drilling: Date/Time 5/22/07 00:00 ▽ Depth (ft bgs) 18.5
After Drilling: Date/Time Depth (ft bgs)

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
				TOPSOIL			
1 GP	50		2	WELL GRADED SAND (SW), mostly fine sand, little medium sand, trace coarse sand, 10YR 6/6, moist, loose.	SW		
				POORLY GRADED SAND (SP), mostly fine sand, little medium sand, trace coarse sand, 10YR 2/1 black, moist, compact.	SP		
			4	PAPER RESIDUALS, with clay.			
2 GP	60		6				
			8	PAPER RESIDUALS, with silt.			
			10	LEAN CLAY (CL), plastic, blue gray, moist, mixed with paper residuals.			
3 GP	72		12	Fuel oil odor.			
			14	Same as above mixed with organic sand and gravel.			
			16				
4 GP	57			POORLY GRADED SAND (SP), mostly fine sand, few silt, trace coarse sand, 10YR 2/1 black, slight odor, moist, dense.	SP		
			18 ▽	WELL GRADED SAND (SW), mostly medium sand, little coarse sand, 10YR 4/1 dark gray, no odor, wet, loose, grades to gravel.	SW		
			20	POORLY GRADED SAND (SP), mostly coarse sand, few gravel, trace cobble, no odor, wet, loose.	SP		

Signature:

Firm: RMT, Inc

Fax

Checked By: _____

RMT INC.

SOIL BORING LOG

BORING NO. T1-06

SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
5 GP	47		22		SP		
			24				
				End of boring at 25.0 feet.			
			26				
			28				
			30				
			32				
			34				
			36				
			38				
			40				
			42				
			44				
			46				
			48				

SOIL BORING LOG

RMT INC.

BORING NO. T2-01

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
Weyerhaeuser - Plainwell	5/21/07	5/21/07	5117.04

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Mateco	Direct Push	718.4	---	25.0	2.25

Boring Location:
State Plane N: 351341.977 E: 12771896.037

Personnel
Logged By - E. Vincke
Driller - Scot Middlebrook

Drilling Equipment:
Geoprobe 6620 DT

Civil Town/City/or Village:	County:	State:
Plainwell	Allegan	Michigan

Water Level Observations:
While Drilling: Date/Time 5/21/07 00:00 ∇ Depth (ft bgs) 18.5
After Drilling: Date/Time Depth (ft bgs)

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
				TOPSOIL			
1 GP	38		2, 4	WELL GRADED SAND (SW), mostly medium sand, some fine sand, little coarse sand, 10YR 5/6 grading to 10YR 4/6, no odor, moist, compact.	SW		
2 GP	52		6, 8	Thin layer of fly ash, dense sand layer beneath, 10YR 4/4.	SW		
3 GP	83		10, 12, 14	PAPER RESIDUALS, mixed in poorly graded sand (SP), mostly fine sand, trace coarse sand and gravel, no odor, moist, dense. Cobble in spoon tip.	SP		
4 GP			16, 18	WELL GRADED SAND (SW), mostly medium sand, some fine sand, trace coarse sand, 10YR 5/4, moist grading to wet. Grading to 10YR 4/1. ∇ Cobble in spoon tip.	SW		
			20	POORLY GRADED SAND (SP), mostly medium sand, trace cobbles, 10YR 3/1 dark gray, no odor, wet, compact.	SP		

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SOIL BORING LOG

BORING NO. T2-01

SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
					SP		
5 GP	42		22	WELL GRADED SAND (SW), mostly coarse sand, little medium sand, few gravel, trace cobble, 10YR 5/8, no odor, wet, compact.	SW		
			24				
				End of boring at 25.0 feet.			
			26				
			28				
			30				
			32				
			34				
			36				
			38				
			40				
			42				
			44				
			46				
			48				

SOIL BORING LOG

RMT INC.

BORING NO. T2-02A

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
Weyerhaeuser - Plainwell	5/21/07	5/21/07	5117.04

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Mateco	Direct Push	718.2	---	12.0	2.25

Boring Location:
State Plane N: 351343.623 E: 12771890.928

Personnel
Logged By - E. Vincke
Driller - Scot Middlebrook

Drilling Equipment:
Geoprobe 6620 DT

Civil Town/City/or Village:	County:	State:
Plainwell	Allegan	Michigan

Water Level Observations:
While Drilling: Date/Time 5/21/07 00:00 Depth (ft bgs)
After Drilling: Date/Time Depth (ft bgs)

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
				TOPSOIL			
1 GP	43		2, 4	WELL GRADED SAND (SW), mostly fine sand, some medium sand, little coarse sand, 10YR 5/6 no odor, moist, compact. Grades to 10YR 4/6, dense. Cobble in spoon tip.	SW		
2 GP	33		6, 8	WELL GRADED SAND (SW), mostly fine sand, few medium sand, trace coarse sand and cobbles, trace fly ash, trace paper residuals, 10YR 4/6, moist, compact.	SW		
3 GP	100		10				
			12	End of boring at 12.0 feet. Refusal.			
			14, 16, 18, 20				

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SOIL BORING LOG

RMT INC.

BORING NO. T2-02B

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
Weyerhaeuser - Plainwell	5/21/07	5/21/07	5117.04

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Mateco	Direct Push	718.1	---	12.0	2.25

Boring Location:
State Plane N: 351344.822 E: 12771891.165

Personnel
Logged By - E. Vincke
Driller - Scot Middlebrook

Drilling Equipment:
Geoprobe 6620 DT

Civil Town/City/or Village:	County:	State:
Plainwell	Allegan	Michigan

Water Level Observations:
While Drilling: Date/Time 5/21/07 00:00 Depth (ft bgs)
After Drilling: Date/Time Depth (ft bgs)

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
				TOPSOIL			
1 GP	42		2, 4	WELL GRADED SAND (SW), mostly fine sand, some medium sand, little coarse sand, 10YR 5/6 no odor, moist, compact. Grades to 10YR 4/6, dense. Cobble in spoon tip.	SW		
2 GP	47		6, 8	WELL GRADED SAND (SW), mostly fine sand, few medium sand, trace coarse sand and cobbles, trace fly ash, trace paper residuals, 10YR 4/6, moist, compact.	SW		
3 GP	75		10				
			12	End of boring at 12.0 feet. Refusal.			
			14, 16, 18, 20				

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SOIL BORING LOG

RMT INC.

BORING NO. T2-03

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
Weyerhaeuser - Plainwell	5/22/07	5/22/07	5117.04

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Mateco	Direct Push	717.9	---	20.0	2.25

Boring Location:
State Plane N: 351344.951 E: 12771885.608

Personnel
Logged By - E. Vincke
Driller - Scot Middlebrook

Drilling Equipment:
Geoprobe 6620 DT

Civil Town/City/or Village:	County:	State:
Plainwell	Allegan	Michigan

Water Level Observations:
While Drilling: Date/Time 5/22/07 00:00 ▽ Depth (ft bgs) 16
After Drilling: Date/Time Depth (ft bgs)

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
				TOPSOIL			
1 GP	45		2	WELL GRADED SAND (SW), mostly fine sand, some medium sand, little coarse sand, 10YR 5/6, no odor, moist, loose.	SP		
			4	POORLY GRADED SAND (SP), mostly fine sand, trace coarse sand, trace paper residuals, 10YR 3/6, moist, compact.	SP		
2 GP	33		6				
			8				
			10	Cobbles in spoon tip. Same as above, trace gravel, orange mottling.			
3 GP	67		12				
			14	WELL GRADED SAND (SW), mostly fine sand, little medium sand, trace coarse sand, 10YR 6/4, no odor, moist, loose.	SW		Appears native.
			16 ▽	WELL GRADED SAND (SW), mostly medium sand, few fine sand, trace coarse sand, 10YR 5/6, wet, loose.	SW		
4 GP	63		18	Color change to 10YR 4/1.			
			20	End of boring at 20 feet.			

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SOIL BORING LOG

RMT INC.

BORING NO. T2-04

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
Weyerhaeuser - Plainwell	5/22/07	5/22/07	5117.04

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Mateco	Direct Push	714.5	---	20.0	2.25

Boring Location: State Plane N: 351361.869 E: 12771854.316

Personnel: Logged By - E. Vincke; Driller - Scot Middlebrook

Drilling Equipment: Geoprobe 6620 DT

Civil Town/City/or Village:	County:	State:
Plainwell	Allegan	Michigan

Water Level Observations:
While Drilling: Date/Time 5/22/07 00:00 ▽ Depth (ft bgs) 15
After Drilling: Date/Time Depth (ft bgs)

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
				TOPSOIL			
1 GP	70		2, 4	WELL GRADED SAND (SW), mostly medium sand, some fine sand, trace coarse sand, 10YR 5/6, no odor, moist, loose.	SW		
2 GP	70		6, 8	PAPER RESIDUALS, with organic material, blue gray.			Paper residuals with organic material in spoon tip.
3 GP	47		10, 12, 14	Same as above.			
4 GP	32		16	WELL GRADED SAND (SW), mostly fine sand, some medium sand, trace coarse sand, 10YR 4/1, wet, loose.	SW		
			18	POORLY GRADED GRAVEL (GP), mostly gravel, little sand, trace cobbles, 10YR 3/2, wet, loose.	GP		Gradational contact.
			20	End of boring at 20.0 feet.			

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SOIL BORING LOG

RMT INC.

BORING NO. T2-05

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
Weyerhaeuser - Plainwell	5/22/07	5/22/07	5117.04

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Mateco	Direct Push	716.3	---	20.0	2.25

Boring Location:
State Plane N: 351353.639 E: 12771867.062

Personnel
Logged By - E. Vincke
Driller - Scot Middlebrook

Drilling Equipment:
Geoprobe 6620 DT

Civil Town/City/or Village:	County:	State:
Plainwell	Allegan	Michigan

Water Level Observations:
While Drilling: Date/Time 5/22/07 00:00 ▽ Depth (ft bgs) 13
After Drilling: Date/Time Depth (ft bgs)

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
				TOPSOIL			
1 GP	63		2, 4	WELL GRADED SAND (SW), mostly fine sand, some medium sand, little coarse sand, 10YR 5/6, no odor, moist, loose.	SW		
2 GP	83		6, 8, 10	PAPER RESIDUALS, white and gray.			
3 GP	30		12	WELL GRADED SAND (SW), mostly fine sand, few medium sand, trace coarse sand, 10YR 5/6, no odor, moist, compact.	SW		
4 GP	33		14, 16, 18	▽ WELL GRADED SAND (SW), mostly medium sand, some fine sand, trace coarse sand, 10YR 4/3 grading to 10YR 4/1, no odor, wet, soft. Same as above. Gravel and cobbles increase with depth.	SW		
			20	End of boring at 20.0 feet.			

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SOIL BORING LOG

RMT INC.

BORING NO. T3-01

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
Weyerhaeuser - Plainwell	5/22/07	5/22/07	5117.04

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Mateco	Direct Push	717	---	20.0	2.25

Boring Location: State Plane N: 351398.095 E: 12771915.132

Personnel: Logged By - E. Vincke; Driller - Scot Middlebrook

Drilling Equipment: Geoprobe 6620 DT

Civil Town/City/or Village:	County:	State:
Plainwell	Allegan	Michigan

Water Level Observations:
While Drilling: Date/Time 5/22/07 00:00 ▽ Depth (ft bgs) 15.5
After Drilling: Date/Time Depth (ft bgs)

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
				TOPSOIL			
				SILT (ML), mostly silt, trace coarse sand, glass, non-plastic, 10YR 4/6, moist, stiff.	ML		
1 GP	40		2, 4	WELL GRADED SAND (SW), mostly medium sand, few coarse sand, little fine sand, trace gravel, 10YR 5/6, no odor, moist, loose.	SW		
2 GP	47		6, 8	WELL GRADED SAND (SW), mostly fine sand, few medium sand, trace coarse sand and gravel, 10YR 5/6, no odor, moist, loose.	SW		
3 GP	62		10, 12	Same as above, color change to 10YR 6/3 pale brown, stiff.			
			14	WELL GRADED SAND (SW), mostly fine sand, some medium sand, trace coarse sand, 10YR 6/6, no odor, moist, compact.	SW		
4 GP	73		▽ 16, 18	WELL GRADED SAND (SW), medium sand, some fine sand, little coarse sand, trace gravel, 10YR 5/6 grading to 10YR 4/1, no odor, wet, loose.	SW		
			20	End of boring at 20.0 feet.			

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SOIL BORING LOG

RMT INC.

BORING NO. T3-02

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
Weyerhaeuser - Plainwell	5/22/07	5/22/07	5117.04

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Mateco	Direct Push	715.4	---	20.0	2.25

Boring Location:
State Plane N: 351400.506 E: 12771899.701

Personnel
Logged By - E. Vincke
Driller - Scot Middlebrook

Drilling Equipment:
Geoprobe 6620 DT

Civil Town/City/or Village:	County:	State:
Plainwell	Allegan	Michigan

Water Level Observations:
While Drilling: Date/Time 5/22/07 00:00 ∇ Depth (ft bgs) 14
After Drilling: Date/Time Depth (ft bgs)

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
				TOPSOIL			
1 GP	28		2	SILT (ML), mostly silt, little very fine sand, trace coarse sand, 10YR 4/6 no odor, moist, stiff.	ML		
			4	WELL GRADED SAND (SW), mostly fine sand, little medium sand, trace coarse sand, 10YR 4/6, no odor, moist, loose, cobbles in spoon tip.	SW		
			6	PAPER RESIDUALS, blue gray.			
2 GP	67		8	POORLY GRADED SAND (SP), mostly fine sand, little medium sand, trace coarse sand, 10YR 4/6 no odor, moist, dense.	SP		
			10	WELL GRADED SAND (SP), mostly medium sand, some fine sand, little coarse sand, 10YR 5/3 brown, no odor, moist, loose.	SW		
3 GP	67		12	WELL GRADED SAND (SW), grades to no coarse sand, moist.			
			14	∇ Wet at 14 feet.			
4 GP	62		16	Same as above, coarse material increases with depth.	SW		
			18				
			20	End of boring at 20.0 feet.			

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SOIL BORING LOG

RMT INC.

BORING NO. T3-03

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
Weyerhaeuser - Plainwell	5/22/07	5/22/07	5117.04

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Mateco	Direct Push	714.6	---	20.0	2.25

Boring Location:
State Plane N: 351402.549 E: 12771889.538

Personnel
Logged By - E. Vincke
Driller - Scot Middlebrook

Drilling Equipment:
Geoprobe 6620 DT

Civil Town/City/or Village:	County:	State:
Plainwell	Allegan	Michigan

Water Level Observations:
While Drilling: Date/Time 5/22/07 00:00 ▽ Depth (ft bgs) 13
After Drilling: Date/Time Depth (ft bgs)

SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
				TOPSOIL			
1 GP	53		2	SILT (ML), mostly silt, some very fine sand, 10YR 4/6, no odor, moist, stiff. Sand content increases along with grain size.	ML		
			4	WELL GRADED SAND (SW), mostly fine sand, some medium sand, trace coarse sand and gravel, 10YR 4/4, no odor, moist, loose. 3" Paper residual layer.	SW		
2 GP	73		6				
			8	WELL GRADED SAND (SW), mostly medium sand, few coarse sand, little fine sand, trace gravel, 10YR 5/4, no odor, moist, loose. Gravel and cobbles increase.	SW		
3 GP	65		10				
			12 ▽	WELL GRADED SAND (SW), no gravel or cobbles, wet.			Appears native.
4 GP	55		14	Grain size increases with depth, 10YR 4/6.	SW		
			16				
			18				
			20	Mostly gravel and coarse sand, 10YR 3/1. End of boring at 20.0 feet.			

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SOIL BORING LOG

RMT INC.

BORING NO. T3-04

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
Weyerhaeuser - Plainwell	5/22/07	5/22/07	5117.04

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Mateco	Direct Push	713.8	----	20.0	2.25

Boring Location:
State Plane N: 351409.159 E: 12771881.732

Personnel
Logged By - E. Vincke
Driller - Scot Middlebrook

Drilling Equipment:
Geoprobe 6620 DT

Civil Town/City/or Village:	County:	State:
Plainwell	Allegan	Michigan

Water Level Observations:
While Drilling: Date/Time 5/22/07 00:00 ∇ Depth (ft bgs) 14.5
After Drilling: Date/Time Depth (ft bgs)

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
				TOPSOIL			
				SILT (ML), with very fine sand.	ML		
1 GP	43		2, 4	WELL GRADED SAND (SW), mostly fine sand, little medium sand, trace coarse sand, 10YR 4/4 dark yellowish brown, no odor, moist, compact.	SW		
2 GP	65		6, 8	PAPER RESIDUALS, blue gray.			
3 GP	70		10, 12, 14	WELL GRADED SAND (SW), mostly medium sand, some fine sand, little coarse sand, trace gravel, 10YR 5/6, no odor, moist, loose. Cobble layer. ∇	SW		Appears native.
4 GP	47		16, 18	WELL GRADED SAND (SW), mostly coarse sand, some fine sand, little gravel, trace cobble, no odor, wet, compact.	SW		
			20	End of boring at 20.0 feet.			

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SOIL BORING LOG

RMT INC.

BORING NO. T4-01

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
Weyerhaeuser - Plainwell	5/22/07	5/22/07	5117.04

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Mateco	Direct Push	714.4	---	20.0	2.25

Boring Location:
State Plane N: 351455.127 E: 12771915.535

Personnel
Logged By - E. Vincke
Driller - Scot Middlebrook

Drilling Equipment:
Geoprobe 6620 DT

Civil Town/City/or Village:	County:	State:
Plainwell	Allegan	Michigan

Water Level Observations:
While Drilling: Date/Time 5/22/07 00:00 ▽ Depth (ft bgs) 15
After Drilling: Date/Time Depth (ft bgs)

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
				TOPSOIL			
1 GP	40		2	WELL GRADED SAND (SW), mostly fine sand, few medium sand, little coarse sand, trace gravel, 10YR 5/6, no odor, moist, compact.	SW		
			4	PAPER RESIDUALS, blue gray, with coarse sand, moist.			
2 GP	63		6	POORLY GRADED SAND (SP), mostly fine sand, 10YR 3/3, no odor, moist, dense.	SP		
			8	POORLY GRADED SAND (SP), mostly fine sand, 10YR 6/3 pale brown, no odor, moist, compact.	SP		
3 GP	70		10	LEAN CLAY (CL), mostly clay, non-plastic, Gley2 5/1 blue gray, brown-orange mottling along sand seams, some black streaks, slight odor, stiff.	CL		
			12				
			14	POORLY GRADED SAND (SP), mostly fine sand, trace medium and coarse sand, 10YR 2/2, no odor, moist, compact.	SP		
4 GP	7		16	WELL GRADED SAND (SW), mostly medium sand, some fine sand, trace coarse sand, 10YR 5/6, no odor, wet.	SW		
			18	Little recovery, mostly wet cobbles and gravel.			
			20	End of boring at 20.0 feet.			

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SOIL BORING LOG

RMT INC.

BORING NO. T4-02

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
Weyerhaeuser - Plainwell	5/23/07	5/23/07	5117.04

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Mateco	Direct Push	713.2	---	20.0	2.25

Boring Location: State Plane N: 351459.33 E: 12771904.856

Personnel: Logged By - E. Vincke; Driller - Scot Middlebrook

Drilling Equipment: Geoprobe 6620 DT

Civil Town/City/or Village:	County:	State:
Plainwell	Allegan	Michigan

Water Level Observations:
While Drilling: Date/Time 5/23/07 00:00 ∇ Depth (ft bgs) 14
After Drilling: Date/Time Depth (ft bgs)

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
				TOPSOIL			
				POORLY GRADED SAND (SP), mostly fine sand, little silt, trace coarse sand, 10YR 3/6, no odor, moist, compact.	SP		
1 GP	55		2, 4	WELL GRADED SAND (SP), mostly fine sand, some medium sand, trace coarse sand and gravel, 10YR 4/4, no odor, moist, loose.	SW		
2 GP	57		6, 8	PAPER RESIDUALS, with clay and sand, Gley 2 4/1 dark blue gray.			
3 GP	57		10, 12	Fuel oil odor.			
			14	∇ POORLY GRADED SAND (SP), mostly fine sand, trace medium sand, trace clay, 10YR 4/2, no odor, wet, loose.	SP		
4 GP	38		16	WELL GRADED SAND (SW), mostly medium sand, some fine sand, trace coarse sand, 10YR 4/2, no odor, loose, wet.	SW		
			18	WELL GRADED SAND (SW), mostly medium sand, some coarse sand, trace gravel, 10YR 2/1, no odor, wet, loose.	SW		
			20	End of boring at 20.0 feet.			

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SOIL BORING LOG

RMT INC.

BORING NO. T4-03

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
Weyerhaeuser - Plainwell	5/23/07	5/23/07	5117.04

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Mateco	Direct Push	712.2	---	20.0	2.25

Boring Location:
State Plane N: 351462.597 E: 12771892.961

Personnel
Logged By - E. Vincke
Driller - Scot Middlebrook

Drilling Equipment:
Geoprobe 6620 DT

Civil Town/City/or Village:	County:	State:
Plainwell	Allegan	Michigan

Water Level Observations:
While Drilling: Date/Time 5/23/07 00:00 ▽ Depth (ft bgs) 11
After Drilling: Date/Time Depth (ft bgs)

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
				TOPSOIL			
1 GP	53		2, 4	POORLY GRADED SAND (SP), mostly fine sand, trace coarse sand and gravel, 10YR 4/6, no odor, moist, loose.	SP		
2 GP	78		6, 8, 10	PAPER RESIDUALS, mostly clay with paper waste residual, Gley 2 5/1 greenish blue, moist.			
3 GP	72		12	POORLY GRADED SAND (SP), mostly fine sand, trace coarse sand, clay, silt, 10YR 3/2, no odor, wet.	SP		
			14, 16	WELL GRADED SAND (SW), mostly medium sand, some fine sand, trace coarse sand and gravel, 10YR 3/1, no odor, wet, loose.	SW		
4 GP	53		18	POORLY GRADED SAND (SP), mostly coarse sand, some gravel, trace cobble, no odor, wet, loose.	SP		
			20	End of boring at 20.0 feet.			

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SOIL BORING LOG

RMT INC.

BORING NO. T4-04

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
Weyerhaeuser - Plainwell	5/23/07	5/23/07	5117.04

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Mateco	Direct Push	711.9	---	20.0	2.25

Boring Location:
State Plane N: 351466.634 E: 12771882.253

Personnel
Logged By - E. Vincke
Driller - Scot Middlebrook

Drilling Equipment:
Geoprobe 6620 DT

Civil Town/City/or Village:	County:	State:
Plainwell	Allegan	Michigan

Water Level Observations:
While Drilling: Date/Time 5/23/07 00:00 ▽ Depth (ft bgs) 11
After Drilling: Date/Time Depth (ft bgs)

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
				TOPSOIL			
1 GP	55		2, 4	WELL GRADED SAND (SW), mostly fine sand, few medium sand, little coarse sand, trace gravel, 10YR 5/6, no odor, moist, loose.	SW		
2 GP	68		6, 8	PAPER WASTE RESIDUAL, gray and white, no odor.			
			10	PAPER WASTE RESIDUALS AND CLAY, blue gray, fuel oil odor.	CL		
3 GP	65		12	▽ POORLY GRADED SAND (SP), mostly fine sand, trace clay, 10YR 3/2, no odor, wet, loose.	SP		
			14	WELL GRADED SAND (SW), mostly medium sand, some fine sand, trace coarse sand, 10YR 4/4, no odor, wet, loose.	SW		
4 GP	100		16, 18	WELL GRADED SAND (SW), mostly medium sand, some coarse sand, little fine sand, no odor, wet, loose.	SW		
			20	End of boring at 20.0 feet.			

Signature:

Firm: RMT, Inc

Fax

Checked By: _____

SOIL BORING LOG

RMT INC.

BORING NO. T5-01

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
Weyerhaeuser - Plainwell	5/23/07	5/23/07	5117.04

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Mateco	Direct Push	712.8	---	19.0	2.25

Boring Location: State Plane N: 351535.392 E: 12771913.709

Personnel: Logged By - E. Vincke; Driller - Scot Middlebrook

Drilling Equipment: Geoprobe 6620 DT

Civil Town/City/or Village:	County:	State:
Plainwell	Allegan	Michigan

Water Level Observations:
While Drilling: Date/Time 5/23/07 00:00 ▽ Depth (ft bgs) 12.5
After Drilling: Date/Time Depth (ft bgs)

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
				TOPSOIL			
1 GP	40		2	POORLY GRADED SAND (SP), mostly fine sand, little medium sand, trace coarse sand and gravel, 10YR 3/6, no odor, moist, loose.	SP		
				WELL GRADED SAND (SW), mostly medium sand, some fine sand, little coarse sand, trace gravel, 10YR 5/6, no odor, moist, loose.	SW		
2 GP	65		4	SILT (ML), paper waste residuals, non-plastic, blue gray, no odor, moist, stiff.	ML		
			6				
			8	Peat, wood, medium and coarse sand mixed in with the paper waste residuals.			
			10				
3 GP	72		12 ▽				
				POORLY GRADED SAND (SP), mostly fine sand, trace coarse sand, clay, 10YR 3/6, no odor, wet, loose.	SP		
			14				
				WELL GRADED SAND (SW), mostly coarse sand, some fine sand, little medium sand, trace gravel and cobbles, 10YR 3/1, no odor, wet, loose.	SW		
4 GP	67		16	WELL GRADED SAND (SW), mostly coarse sand, some medium sand, little fine sand, trace gravel, 10YR 4/4, wet, loose.	SW		
			18				
				End of boring at 19.0 feet. Refusal.			
			20				

Signature: Firm: RMT, Inc Fax

Checked By: _____

SOIL BORING LOG

RMT INC.

BORING NO. T5-02

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
Weyerhaeuser - Plainwell	5/23/07	5/23/07	5117.04

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Mateco	Direct Push	712.9	---	20.0	2.25

Boring Location:
State Plane N: 351527.48 E: 12771904.766

Personnel
Logged By - E. Vincke
Driller - Scot Middlebrook

Drilling Equipment:
Geoprobe 6620 DT

Civil Town/City/or Village:	County:	State:
Plainwell	Allegan	Michigan

Water Level Observations:
While Drilling: Date/Time 5/23/07 00:00 ▽ Depth (ft bgs) 11.5
After Drilling: Date/Time Depth (ft bgs)

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
				TOPSOIL			
1 GP	27		2, 4	WELL GRADED SAND (SW), mostly fine sand, some medium sand, little coarse sand, trace gravel, 10YR 4/4, no odor, moist, compact.	SW		
2 GP	40		6, 8, 10	SILT (ML), paper waste residuals, trace medium sand, coarse sand, gravel, non-plastic, slight odor, moist.	ML		
3 GP	70		12	POORLY GRADED SAND (SP), mostly fine sand, trace coarse sand, medium sand, clay, 10YR 3/4, no odor, wet, loose.	SP		
4 GP	63		14, 16, 18	WELL GRADED SAND (SW), mostly medium sand, few fine sand, little coarse sand, trace gravel, 10YR 3/1, no odor, wet, loose. Coarse sand, gravel, and cobbles increase with depth.	SW		Gradational contact.
				POORLY GRADED SAND (SP), mostly fine sand, 10YR 5/2 with 10YR 6/8 layer, no odor, wet, compact.	SP		
			20	End of boring at 20.0 feet.			

Signature:

Firm: RMT, Inc

Fax

Checked By: _____

SOIL BORING LOG WITH PHOTO 05117W.GPJ RMT_CORP.GDT 5117.04 7/16/07

SOIL BORING LOG

RMT INC.

BORING NO. T5-03

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
Weyerhaeuser - Plainwell	5/23/07	5/23/07	5117.04

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Mateco	Direct Push	712.6	---	20.0	2.25

Boring Location:
State Plane N: 351519.676 E: 12771896.812

Personnel
Logged By - E. Vincke
Driller - Scot Middlebrook

Drilling Equipment:
Geoprobe 6620 DT

Civil Town/City/or Village:	County:	State:
Plainwell	Allegan	Michigan

Water Level Observations:
While Drilling: Date/Time 5/23/07 00:00 ▽ Depth (ft bgs) 11.5
After Drilling: Date/Time Depth (ft bgs)

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
				TOPSOIL			
1 GP	35		2, 4	WELL GRADED SAND (SW), mostly fine sand, few medium sand, trace coarse sand, 10YR 4/6, no odor, moist, loose.	SW		
2 GP	63		6	Grain size increases with depth.			
			8, 10	SILT (ML), paper waste residuals, trace medium sand, coarse sand, blue gray, no odor, moist.	ML		
3 GP	75		12, 14	POORLY GRADED SAND (SP), mostly fine sand, trace medium sand, coarse sand, clay, 10YR 2/2 grades to 10YR 4/4, no odor, wet, loose.	SP		
				WELL GRADED SAND (SW), mostly fine sand, some medium sand, trace coarse sand and gravel, 10YR 3/1, no odor, wet, loose.	SW		
4 GP	43		16	POORLY GRADED SAND (SP), mostly fine sand, 10YR 5/2, no odor, wet, loose.	SP		
				WELL GRADED SAND (SW), as at 14.5 feet.	SW		
			18	POORLY GRADED SAND (SP), as at 15.5 feet.	SP		
			20	End of boring at 20.0 feet.			

Signature:

Firm: RMT, Inc

Fax

Checked By: _____

SOIL BORING LOG

RMT INC.

BORING NO. T5-04

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
Weyerhaeuser - Plainwell	5/23/07	5/23/07	5117.04

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Mateco	Direct Push	712	---	20.0	2.25

Boring Location:
State Plane N: 351511.359 E: 12771888.353

Personnel
Logged By - E. Vincke
Driller - Scot Middlebrook

Drilling Equipment:
Geoprobe 6620 DT

Civil Town/City/or Village:	County:	State:
Plainwell	Allegan	Michigan

Water Level Observations:
While Drilling: Date/Time 5/23/07 00:00 ∇ Depth (ft bgs) 12
After Drilling: Date/Time Depth (ft bgs)

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
				TOPSOIL			
1 GP	50		2, 4	WELL GRADED SAND (SW), mostly fine sand, some medium sand, trace coarse sand, 10YR 4/6, no odor, moist, loose. Grain size increases with depth.	SW		
2 GP	62		6, 8	PAPER WASTE RESIDUALS, white, gray. SILT (ML), paper waste residuals, trace sand, blue gray, no odor.	ML		
3 GP	77		10, 12, 14	POORLY GRADED SAND (SP), mostly fine sand, trace coarse sand, clay, 10YR 4/4 to 10YR 3/1 to 10YR 4/4, no odor, wet, loose. ∇	SP		
4 GP	63		16, 18	WELL GRADED SAND (SW), mostly medium sand, some fine sand, trace coarse sand, 10YR 4/1, no odor, wet, loose. WELL GRADED SAND (SW), mostly medium sand, some coarse sand, little fine sand, trace gravel, 10YR 4/1, no odor, wet, loose. Coarse sand decreases, 10YR 5/6. POORLY GRADED SAND (SP), mostly fine sand, trace medium sand, 10YR 6/6, no odor, wet, loose.	SW, SW, SP		
			20	End of boring at 20.0 feet.			

Signature:	Firm: RMT, Inc
	Fax

Checked By: _____

SOIL BORING LOG

RMT INC.

BORING NO. T6-01

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
Weyerhaeuser - Plainwell	5/23/07	5/23/07	5117.04

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Mateco	Direct Push	711.9	---	20.0	2.25

Boring Location:
State Plane N: 351562.927 E: 12771848.753

Personnel
Logged By - E. Vincke
Driller - Scot Middlebrook

Drilling Equipment:
Geoprobe 6620 DT

Civil Town/City/or Village:	County:	State:
Plainwell	Allegan	Michigan

Water Level Observations:
While Drilling: Date/Time 5/23/07 00:00 ∇ Depth (ft bgs) 11
After Drilling: Date/Time Depth (ft bgs)

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
				TOPSOIL			
				WELL GRADED SAND (SW), mostly fine sand, some medium sand, trace coarse sand, 10YR 5/6, no odor, moist, loose.	SW		
1 GP	72		2	PAPER WASTE RESIDUALS, silty, blue gray, no odor, moist.			
			4				
2 GP	60		6	Same as above, with gravel and cobbles.			
			8				
			10	∇			
			12	WELL GRADED SAND (SW), mostly fine sand, some medium sand, few coarse sand, trace gravel, 10YR 3/1, no odor, wet, loose.	SW		
3 GP	93			POORLY GRADED SAND (SP), mostly fine sand, trace coarse sand, clay, 10YR 3/2, no odor, wet, loose.	SP		
			14				
				POORLY GRADED SAND (SP), mostly fine sand, 10YR 4/1, no odor, wet, loose, shells.	SP		
			16	WELL GRADED SAND (SW), mostly medium sand, some coarse sand, little fine sand, trace gravel, 10YR 5/8, no odor, wet, loose.			
4 GP	33		18		SW		
			20	End of boring at 20.0 feet.			

Signature:	Firm: RMT, Inc
	Fax

Checked By: _____

SOIL BORING LOG

RMT INC.

BORING NO. T6-03

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
Weyerhaeuser - Plainwell	5/24/07	5/24/07	5117.04

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Mateco	Direct Push	710.4	---	20.0	2.25

Boring Location:
State Plane N: 351539.836 E: 12771842.131

Personnel
Logged By - E. Vincke
Driller - Scot Middlebrook

Drilling Equipment:
Geoprobe 6620 DT

Civil Town/City/or Village:	County:	State:
Plainwell	Allegan	Michigan

Water Level Observations:
While Drilling: Date/Time 5/24/07 00:00 ▽ Depth (ft bgs) 11
After Drilling: Date/Time Depth (ft bgs)

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
				TOPSOIL			
1 GP	50		2, 4	WELL GRADED SAND (SW), mostly fine sand, few medium sand, trace coarse sand, gravel, 10YR 4/6, no odor, moist, compact.	SW		
2 GP	52		6, 8	PAPER WASTE RESIDUALS, gray, no odor, soft. Grades to dark gray blue, clay like, fuel oil odor. Peat present.			
3 GP	63		10, 12, 14	POORLY GRADED SAND (SP), mostly fine sand, trace coarse sand and clay, 10YR 3/2, no odor, moist, dense. ▽ WELL GRADED SAND (SW), mostly fine sand, few medium sand, little coarse sand, 10YR 3/1, no odor, wet, compact. Grades back to poorly graded sand above. POORLY GRADED SAND (SP), mostly fine sand, 10YR 3/1, no odor, wet, compact.	SP, SW, SP		
4 GP	73		16, 18, 20	COBBLE LAYER; WELL GRADED SAND (SW), mostly fine sand, some medium sand, trace coarse sand, 10YR 6/8, no odor, wet, loose. Coarse sand content increases with depth. End of boring at 20.0 feet.	GW, SW		

Signature:	Firm: RMT, Inc
	Fax

Checked By: _____

SOIL BORING LOG

RMT INC.

BORING NO. T6-02

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
Weyerhaeuser - Plainwell	5/23/07	5/23/07	5117.04

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Mateco	Direct Push	711.5	---	20.0	2.25

Boring Location:
State Plane N: 351551.422 E: 12771846.865

Personnel
Logged By - E. Vincke
Driller - Scot Middlebrook

Drilling Equipment:
Geoprobe 6620 DT

Civil Town/City/or Village:	County:	State:
Plainwell	Allegan	Michigan

Water Level Observations:
While Drilling: Date/Time 5/23/07 00:00 ▽ Depth (ft bgs) 11.5
After Drilling: Date/Time Depth (ft bgs)

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
				TOPSOIL			
1 GP	48		2	WELL GRADED SAND (SW), mostly fine sand, few medium sand, trace coarse sand, 10YR 4/4, no odor, moist, loose.	SW		
			4	PAPER WASTE RESIDUAL, silty, blue gray, white, no odor, moist.			
2 GP	47		6	Same as above, feels like clay, darker blue gray, slight fuel oil odor.			
			8				
			10				
3 GP	75		12	POORLY GRADED SAND (SP), mostly fine sand, trace coarse sand and silt, 10YR 2/1 black, no odor, wet, compact.	SP		
			14	WELL GRADED SAND (SW), mostly medium sand, some fine sand, few coarse sand, trace gravel, 10YR 3/1, no odor, wet, loose.	SW		
4 GP	2		16	POORLY GRADED SAND (SP), mostly fine sand, little medium sand, trace coarse sand, 10YR 3/1, no odor, wet, compact.	SP		
			18	Little recovery, fine sand and gravel.			
			20	End of boring at 20.0 feet.			

Signature:

Firm: RMT, Inc

Fax

Checked By: _____

SOIL BORING LOG

RMT INC.

BORING NO. T6-04

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
Weyerhaeuser - Plainwell	5/24/07	5/24/07	5117.04

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Mateco	Direct Push	709.7	---	20.0	2.25

Boring Location:
State Plane N: 351528.858 E: 12771839.959

Personnel
Logged By - E. Vincke
Driller - Scot Middlebrook

Drilling Equipment:
Geoprobe 6620 DT

Civil Town/City/or Village:	County:	State:
Plainwell	Allegan	Michigan

Water Level Observations:
While Drilling: Date/Time 5/24/07 00:00 ▽ Depth (ft bgs) 14.5
After Drilling: Date/Time Depth (ft bgs)

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	COMMENTS
				TOPSOIL			
1 GP	55		2, 4	WELL GRADED SAND (SW), mostly fine sand, few medium sand, trace coarse sand and gravel, 10YR 4/6, no odor, moist, compact.	SW		
			6	PAPER WASTE RESIDUALS, white/gray, strong odor.			
2 GP	73		8	LEAN CLAY (CL), paper waste residuals, dark gray, fuel oil odor, moist.	CL		
3 GP	62		10, 12, 14	POORLY GRADED SAND (SP), mostly fine sand, trace coarse sand, peat, 10YR 2/1, moist. Peat layer with wood.	SP		
4 GP	3		16, 18	▽ WELL GRADED SAND (SW), mostly medium sand, some fine sand, trace coarse sand and gravel, 10YR 4/1, no odor, wet, loose. No recovery due to wet cobble in tip.	SW		
			20	End of boring at 20.0 feet.			

Signature:

Firm: RMT, Inc

Fax

Checked By: _____

SOIL BORING LOG WITH PHOTO 05117W.GPJ RMT_CORP.GDT 5117.04 7/16/07

RMT, Inc.

Moisture Content / Dry Density Determination (ASTM D2216 or D4643)

QC: HWW

QA: RW

Project Name: Weyerhaeuser

Project #: 5117.04

	Sample Location	Moisture Tare Wt. (g)	Moisture Wet Wt. + Tare (g)	Moisture Dry Wt. +Tare (g)	Moisture (%)	Sample Diameter (in)	Sample Height (in)	Density Tare Wt. (g)	Density Wet Wt. + Tare (g)	Wet Density (pcf)	Dry Density (pcf)
1	T4-01, 4-5'	265.14	331.70	312.22	41.4						
2	T6-03, 10'	263.11	312.27	285.12	123.4						
3											
4											
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Appendix D
Permit Applications

U.S. COE/MDEQ Joint Permit Application

JOINT PERMIT APPLICATION

U.S. ARMY CORPS OF ENGINEERS (USACE)
Detroit District Office
Phone: 313-226-2218, Fax: 313-226-6763
Website: www.lre.usace.army.mil

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY (MDEQ)
Land and Water Management Division (LWMD)
Phone: 517-373-9244, Fax: 517-241-9003
Website: www.michigan.gov/deq

The MDEQ, LWMD, regulates activities under the following Parts of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. The regulated activities are summarized in Appendix D. The complete statutes and rules can be downloaded from our website at www.michigan.gov/jointpermit.

- Part 301, Inland Lakes and Streams
- Part 303, Wetlands Protection
- Part 325, Great Lakes Submerged Lands
- Floodplain Regulatory Authority found in Part 31, Water Resources Protection
- Part 353, Sand Dunes Protection and Management
- Part 323, Shorelands Protection and Management
- Part 315, Dam Safety

The USACE has the authority to regulate activities within the waters of the United States under the following statutes:

- Section 10, Rivers and Harbors Act of 1899 (33 U.S.C. 403)
- Section 404, Clean Water Act of 1977 (33 U.S.C. 1344)

DIRECTIONS for completing the Joint Permit Application

For additional guidance go to the "Joint Permit Application Training Manual" link on our website at www.michigan.gov/jointpermit.

Complete all items in Sections 1 through 9 on pages 1 and 2 of the application:

Make sure you:

- ❑ Provide the Township, Range, Section, and Property Tax Identification Numbers required in Section 1.
- ❑ Provide the requested information for all adjacent and impacted property owners in Section 8.
- ❑ Print your name and sign and date your application in Section 9. If applicant is a corporation, include title of authorized representative.
- ❑ Provide a letter of authorization if the legal property owner is not the individual who signs the application. A letter of authorization is a letter from the legal landowner(s) authorizing the applicant or agent to apply for the project. The letter should include the signature from the landowner, the project site address, and a brief project description.

Complete project-specific information:

- ❑ Complete items in Sections 10 through 21 on pages 3 through 7 that apply to your project. Follow the instructions at the beginning of each section. The instructions for each sample drawing in Appendix B indicate the application sections you will most likely need to complete. Utilize the application form as much as possible before adding attachments to save on paper resources and to make the review more efficient.

Provide maps and drawings with adequate detail for review. Refer to Appendix B of the application and/or www.michigan.gov/jointpermit for sample drawings.

- ❑ Vicinity Map:
  - A map to the proposed project location that includes ALL streets, roads, intersections, highways, or cross-roads to the project. Include written directions from a well-known landmark or major intersection. Do not assume field staff knows where your project is.
- ❑ Project Site Plan:
  - Overhead drawings to scale or including dimensions, length and width, of the proposed project are required.

- ❑ Section Views (cross and profile to scale or including dimensions, length, width, and height):
  - Cross sectional drawings of the proposed projects are required.
- ❑ Provide descriptive photographs of the proposed work site showing vegetation if wetlands are involved or the shoreline for shore protection projects. All photographs must be labeled with your name and the date of the photograph, indicate what they show, and be referenced to the site plan. Proposed activities or structure(s) may be indicated directly on the photographs using indelible markers or ink pens. Provide aerial photographs 1:400 or larger for major proj*ects.*
- ❑ Provide a reproducible version of maps and drawings if the originals are supplied in color.
- ❑ Elevation data must include a description of the reference point or benchmark used and its corresponding elevation. For projects on the Great Lakes or Section 10 Waters, elevations must be provided in IGLD 85. For observed Great Lake water elevations in IGLD, visit the USACE website under "water levels". If elevations are from still water, provide the observation date and water elevation. On inland sites, elevations can use NAVD 88, NGVD 29, a local datum or an assumed bench mark. The state building code requires an Elevation Certificate for any building construction or addition in the floodplain. A sample form can be found at www.fema.gov/nfip/elvinst.shtm

Flagging/staking project sites and project impacts:

- ❑ Flag the area for site inspection including the property corners, proposed road or driveway centerlines, and areas of proposed impacts. Site must be flagged at the time the application is submitted. A site visit will not be completed or action taken if the project is not flagged.

To prevent processing delays, make sure all the following items are mailed to the LWMD at the address below, label each attachment with applicant's name and date:

- ❑ Pages 1 and 2 of the application.
- ❑ Pages 3 through 7, as applicable, of the application. Do not submit blank application pages. Submit only those pages where you have provided information.
- ❑ The Site Location Map, Overall Site Plan, Plan View and Cross-Section Drawings, and additional information sheets on 8.5" x 11", 8.5" x 14", or 11" x 17" paper suitable for photocopying for public notice purposes. Aerial photographs do not substitute for site plans. If larger drawings or blueprints are required to show adequate detail for review, you may also submit 5 full size copies. The USACE requires one set of drawings on 8.5" x 11" paper, with all notations clearly legible. Larger supplemental drawings may be submitted, as well.
- ❑ An authorization letter from the property owner if someone other than the property owner is signing the application.
- ❑ A check made payable to the **State of Michigan**. Fees typically range from $50.00 to $4,000.00 depending on the type of project. Refer to Appendix C of the application and/or visit our website at http://www.michigan.gov/jointpermit to determine the appropriate fee for your project.

- ❑ Mail to:

  MDEQ
  LWMD-PCU
  P.O. BOX 30204
  LANSING, MI 48909-7704

  DEQ-LWM-PCU@michigan.gov

- ❑ Public Agencies eligible to receive federal and/or state transportation funding for a project involving public roadways, non-motorized paths, airports, or related facilities, do not require an application fee and should submit applications to:

  MDEQ
  LWMD-TFHU
  P.O. Box 30458
  Lansing, MI 48909-7958

APPENDICES

Appendix A: Acronyms and Abbreviations A-1

Appendix B: General Instructions for All Drawings and Sample Drawings

1. General Instructions for all Drawings and Sample Site Location Maps B-1
2. Inland Lake Shore Protection B-2
3. Bulkhead/Seawall B-2
4. Pond Construction B-3
5. Floodplain Fill B-3
6. Wetland Boardwalk B-4
7. Dredging Project B-4
8. Driveway Across Wetland B-5
9. Residential Wetland Fill and Boardwalk Construction B-5
10. Docks - Piers - Mooring Piles B-6
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Appendix C: State Fees, Federal Fees, Minor Permit and General Permit for Minor Activities Categories C-1

Appendix D: State Authority, Federal Authority, Privacy Act Statement, and State and Federal Penalties D-1

Appendix E: Glossary (listed words are italicized in the application package) E-1

Appendix F: Joint Permit Application Withdrawal Guidance F-1

Application status can be viewed on the MDEQ website at www.deq.state.mi.us/CIWPIS. Once the MDEQ/LWMD has received the information necessary for review of the project, **including drawings that have adequate detail for review** and the **full application fee**, the file will be reviewed for final processing. A mailed postcard or a public notice will provide the file number and the telephone number of the office where the application is being processed. The review time to determine if an application is complete for processing ranges from 15 to 30 days. Technical processing times may range from 60 to 90 days. Processing times will be longer if a public hearing is held. A LWMD staff person from your local District/Field Office may visit the project site and may request additional information prior to a decision on the permit. Fees are not refundable on files once a site visit is held, a public notice is posted, or an action is taken, including closure of a file due to no response to a correction request after 30 days. Applications can be reopened within 180 days of an initial correction request, if all the information requested is provided. The application file will be permanently closed if all of the requested information is not provided within 180 days of the initial correction request. A new application can be submitted after 180 days, but fees are not transferable.

If a federal permit will also be required, a copy of the permit application will be sent to the Detroit District Office, USACE, for processing at the federal level. Additional copies of this application form can be downloaded from the MDEQ website at www.michigan.gov/jointpermit or can be photocopied from the original. If you have any questions about the permitting process or if you need to modify your application, you can contact the LWMD by phone, fax, at the addresses on the previous page, or email at DEQ-LWM-PCU@michigan.gov.

AGENCY USE	Previous USACE Permit or File Number	Date Received	Land and Water Management Division, MDEQ File Number	AGENCY USE
	USACE File Number		*Marina* Operating Permit Number	
			Fee received $	

- Complete all items in Sections 1 through 9 and those items in Sections 10 through 21 that apply to the project. Clear drawings and cross sections must be provided.

1 PROJECT LOCATION INFORMATION

- Refer to your property's legal description for the Township, Range, and Section information, and your property tax bill for your Property Tax Identification Number(s).

Address	Township Name(s)	Township(s)	Range(s)	Section(s)
12th Street, Plainwell MI 49080	Otsego	1 North	12 West	24

City/Village	County(ies)	Property Tax Identification Number(s)
City of Plainwell	Allegan	17-024-047-00

Name of Waterbody	Project Name or Job Number	Subdivision/Plat	Lot Number	Private Claim
Kalamazoo River	Emergency Response Plan	N/A	N/A	N/A

Project types (check all that apply)
- ☒ private
- ☐ public/government
- ☐ industrial
- ☐ commercial
- ☐ multi-family
- ☐ building addition
- ☐ new building or *structure*
- ☐ building renovation or restoration
- ☐ river restoration
- ☐ single-family
- ☒ other (explain) Remedial action under CERCLA

The proposed project is on, within, or involves (check all that apply)

☐ a legally established County Drain (date established) (M/D/Y) / /

- ☐ a stream
- ☐ a pond (less than 5 acres)
- ☐ a Great Lake or *Section 10 Waters*
- ☒ a *natural river*
- ☐ a new marina
- ☒ a river
- ☐ a channel/canal
- ☐ a designated *high risk erosion area*
- ☐ a *dam*
- ☐ a *structure* removal
- ☐ a ditch or drain
- ☐ an *inland lake* (5 acres or more)
- ☐ a designated *critical dune area*
- ☒ a wetland
- ☐ a utility crossing
- ☒ a *floodway* area
- ☒ a *100-year floodplain*
- ☐ a designated *environmental area*
- ☒ 500 feet of an existing waterbody

2 DESCRIBE PROPOSED PROJECT AND ASSOCIATED ACTIVITIES, AND THE CONSTRUCTION SEQUENCE AND METHODS

- Attach separate sheets, as needed, including necessary drawings, sketches, photographs, aerials, or plans.

The project site comprises the former powerhouse channel, directly downstream of the Plainwell Dam, in the Kalamazoo River, and the eastern (river side) slope of the 12th Street Landfill (Operable Unit #4 of the Kalamazoo River Superfund Site). In 2001, the United States Environmental Protection Agency (USEPA) issued a Record of Decision (ROD) for the 6.5-acre 12th Street Landfill. The 2001 ROD included eleven major components, including relocation of residuals present in the powerhouse channel to the landfill and the construction of an erosion control system protective of a 500-year flood event. In February 2007, the USEPA authorized a Time-Critical Removal Action (TCRA) to remove PCB-contaminated sediment in the former Plainwell Impoundment (a section of Operable Unit #5 of the Allied Paper/Portage Creek/Kalamazoo River Superfund Site). As part of the TCRA, the earthen section of the Plainwell Dam will be removed and the Kalamazoo River will be rerouted through the former powerhouse channel. The 12th Street Landfill abuts the river and is located directly downstream of the earthen section of the Plainwell Dam.

Rerouting of the Kalamazoo River will impact paper residuals currently present in the channel and will create different erosion and flood conditions along the 12th Street Landfill river bank. Weyerhaeuser Company (Weyerhaeuser) is planning to address these issues under Section XVII (Emergency Response) paragraph 67 of Weyerhaeuser's January 2005 Consent Decree with the USEPA. Weyerhaeuser plans to remove up to 3,000 cubic yards (cy) of sediment/paper residuals from the powerhouse channel and place the removed material on top of the 12th Street Landfill. Following the relocation of the sediments/paper residuals from the powerhouse discharge channel, the western riverbank along the 12th Street Landfill will be graded to a maximum 3H:1V slope and permanent erosion protection will be installed to approximately elevation 707 ft. mean sea level (M.S.L.).

3 APPLICANT, AGENT/CONTRACTOR, AND PROPERTY OWNER INFORMATION

- The applicant can be either the property owner or the person or company that proposes to undertake the activity.
- If the applicant is a corporation, both the corporation and its owner must provide a written document authorizing the agent/contractor to act on their behalf.

Applicant (individual or corporate name)	Agent/Contractor (firm name and contact person)
Weyerhaeuser Company - Jennifer Hale	RMT, Inc. - Kathy Huibregtse
Mailing Address: 32901 Weyerhaeuser Way South	Address: 150 North Patrick Boulevard, Suite 180
City: Federal Way State: WA Zip Code: 98001	City: Brookfield State: WI Zip Code: 53045
Daytime Phone Number with Area Code: 253-924-3746 Cell Phone Number: 253-218-5147	Daytime Phone Number with Area Code: 262-879-1212 Cell Phone Number: 414-687-2430

Fax 253-924-6182 E-mail jennifer.hale@weyerhaeuser.com	Fax 262-879-1220 E-mail kathy.huibregtse@rmtinc.com

Is the applicant the sole owner of all property on which this project is to be constructed and all property involved or impacted by this project? ☒ No ☐ Yes
If No, provide a letter signed by the property owner authorizing the agent/contractor to act on his or her behalf or a copy of easements or right-of-ways. If multiple owners, attach all property owners' names, mailing addresses, and telephone numbers. Disclose any DEQ conservation easements or other easements, deed restrictions, leases, or any other encumbrance upon the property in the project area. A copy of the land restriction must be provided.

Property Owner's Name (If different from applicant) Plainwell, Inc. (a bankrupt entity) Steve Ziesmann, Godfrey & Kahn		Mailing Address 780 North Water Street	
Daytime Phone Number with Area Code 414-287-9543	Cell Phone Number - -	City Milwaukee	State WI / Zip Code 53202-3590

4 PROPOSED PROJECT PURPOSE, INTENDED USE, AND ALTERNATIVES CONSIDERED (Attach additional sheets if necessary)

- The purpose must include any new development or expansion of an existing land use.
- Include a description of alternatives considered to avoid or minimize resource impacts. Include factors such as, but not limited to, alternative construction technologies; alternative project layout and design; alternative locations; local land use regulations and infrastructure; and pertinent environmental and resource issues.
- For utility crossings, include both alternative routes and alternative construction methods.

In 2001, the USEPA issued a ROD for the 6.5-acre 12th Street Landfill. The 2001 ROD included eleven major components, including relocation of residuals present in the powerhouse channel to the landfill and construction of an erosion control system protective of a 500-year flood event. In February 2007, the USEPA authorized a Time-Critical Removal Action (TCRA) to remove PCB-contaminated sediment in the former Plainwell Impoundment (a section of Operable Unit #5 of the Allied Paper/Portage Creek/Kalamazoo River Superfund Site). As part of the TCRA, the earthen section of the Plainwell Dam will be removed and the Kalamazoo River will be rerouted through the former powerhouse channel. The 12th Street Landfill abuts the river and is located directly downstream of the earthen section of the Plainwell Dam.

Rerouting of the Kalamazoo River will impact paper residuals currently present in the channel and will create different erosion and flood conditions along the 12th Street Landfill river bank. Weyerhaeuser is planning to address these issues under Section XVII (Emergency Response) paragraph 67 of Weyerhaeuser's January 2005 Consent Decree with the USEPA.

Alternatives are limited due to the requirements of the USEPA ROD.

Alternative grading designs and erosional protection for the eastern (river side) slope of the 12th Street Landfill have been considered. Slope stability analysis results showed that a minimum 5H:1V slope produced a factor of safety greater than 1.5 against a global slope failure. Other permanent erosion protection, such as sheet pile walls were considered, but will not be used for aesthetic reasons. Alternative temporary erosion control products were also reviewed.

5 LOCATING YOUR PROJECT SITE

- Provide the requested information listed below to help staff locate your project site.
- Attach a copy of a map, such as a plat, county, or USGS topographic map, clearly showing the site location and include an arrow indicating the north direction.
- Project area must be staked at the time of application submittal.

Is there an access road to the project? ☐ No ☒ Yes (If Yes, type of road, check all that apply) ☐ private ☐ public ☐ improved ☒ unimproved

Name of roads at closest main intersection 12th Street and Allegan Street (Michigan State Highway 89)

Directions from main intersection North approximately 0.4 miles on 12th Street

Style of house or other building on site ☐ ranch ☐ 2-story ☐ cape cod ☐ bi-level ☐ cottage/cabin ☐ pole barn ☒ none ☐ other (describe)

Color Color of adjacent property house and/or buildings

House number Address is visible on ☐ house ☐ garage ☐ mailbox ☐ sign ☐ other (describe)

Street name Fire lane number Lot number

How can your site be identified if there is no visible address? Sign at entrance gate

Provide directions to the project site, with distances from the best and nearest visible landmark and waterbody From U.S. 131 take exit #49B/Allegan/Otsego West onto Allegan Street (Michigan State Highway 89). Travel approximately 1 mile west and turn right (north) onto 12 Street. The site entrance is approximately 0.4 miles ahead on 12th Street.

Does project cross boundaries of two or more political jurisdictions? (City/Township, Township/Township, County/County, etc.)
☒ No ☐ Yes (If Yes, list jurisdiction names.)

6 List all other federal, interstate, state, or local agency authorizations required for the proposed activity, including all approvals or denials received.

Agency	Type approval	Identification number	Date applied	Date approved / denied	If denied, reason for denial
U.S. EPA	Authorization to perform the implementation of the emergency response under Section XVII, Paragraph 67 of Weyerhaeuser's January 2005 Consent Decree with the U.S. EPA.				

7 If a permit is issued, date activity will commence (M/D/Y) 08/01/2007

Proposed completion date (M/D/Y) 11/08/2007

Has any construction activity commenced or been completed in a regulated area? ☒ No ☐ Yes
If Yes, identify the portion(s) underway or completed on drawings or attach project specifications and give completion date(s) (M/D/Y) / /

Were the regulated activities conducted under a MDEQ permit? ☐ No ☐ Yes
If Yes, list the MDEQ permit number

Are you aware of any unresolved violations of environmental law or litigation involving the property? ☒ No ☐ Yes (If Yes, explain)

8 **PUBLIC NOTIFICATION** (Attach additional sheets if necessary)

- Complete information for all *adjacent and impacted property owners* and the lake association or established lake board, including the contact person's name.
- If you own the adjacent lot, provide the requested information for the first adjacent parcel beyond your property line.

Property Owner's Name	Mailing Address	City	State	Zip Code
Aggregate Industries	465 12th Street	Plainwell	WI	49080
MDNR	12th Street near Plainwell Dam	Plainwell	WI	49080

Name of ☐ Established Lake Board ☐ or Lake Association
and the Contact Person's name, phone number, and mailing address

9 **APPLICANT'S CERTIFICATION** **READ CAREFULLY BEFORE SIGNING**

I am applying for a permit(s) to authorize the activities described herein. I certify that I am familiar with the information contained in this application, that it is true and accurate, and, to the best of my knowledge, is in compliance with the State *Coastal Zone Management Program* and the *National Flood Insurance Program*. I understand that there are penalties for submitting false information and that any permit issued pursuant to this application may be revoked if information on this application is untrue. I certify that I have the authority to undertake the activities proposed in this application. By signing this application, I agree to allow representatives of the MDEQ, USACE, and/or their agents or contractors to enter upon said property in order to inspect the proposed activity site and the completed project. I understand that I must obtain all other necessary local, county, state, or federal permits and that the granting of other permits by local, county, state, or federal agencies does not release me from the requirements of obtaining the permit requested herein before commencing the activity. I understand that the payment of the application fee does not guarantee the issuance of a permit.

- All applicants must complete **all** of the items in Sections 1 through 9 on pages 1 and 2 of this application.
- Complete those items in Sections 10 through 21 that apply to the project. Submit only those pages where you have provided information.
- Your application will not be processed if the application form is not completely filled out.
- List here the application page numbers being submitted and a brief description of other attachments included with your application.
- Submit 8.5" by 11," 8.5" by 14" or 11" by 17" size drawings with 4 copies. The USACE requires one set of drawings on 8.5" x 11" paper, with all notations clearly legible. Larger copies may be submitted in addition to the standard size copies.
- A letter of authorization from the owner must be included if not signed below by the owner.

	Printed Name	Signature	Date (M/D/Y)
☐ Property Owner ☐ Agent/Contractor ☒ Corporation – Title	Jennifer Hale		/ /

10 PROJECTS IMPACTING WETLANDS OR FLOODPLAINS OR LOCATED ON AN INLAND LAKE OR STREAM OR A GREAT LAKE

- Check boxes A through N that may be applicable to your project and provide the requested information.
- If your project may affect wetlands, also complete Section 12. If your project may impact regulated *floodplains*, also complete Section 13.
- Provide an overall site plan showing existing lakes, streams, wetlands, and other water features; existing *structures*; and the location of all proposed *structures*, land change activities and *soil erosion and sedimentation control measures*. Review sample drawings for guidance in completing site-specific drawings for your project.
- Some projects on the Great Lakes require an application for conveyance prior to Joint Permit Application completeness.
- On a Great Lake use IGLD 85 ☐ surveyed ☐ converted from observed still water elevation. On inland waters, ☒ NGVD 29 ☐ local datum ☐ other
- Observed water elevation (ft) 699.16, date of observation (M/D/Y) 04/04/2006

☒ A. PROJECTS REQUIRING FILL (See All Sample Drawings)

- To calculate volume in cubic yards (cu yd), multiply the average length in feet (ft) times the average width (ft) times the average depth (ft) and divide by 27.
- Attach both plan and *cross-section* views to scale showing maximum and average fill dimensions.

(Check all that apply) ☐ *floodplain* fill ☐ wetland fill ☒ *riprap* ☐ *seawall, bulkhead*, or *revetment* ☐ bridge or culvert
☐ boat launch ☐ off-shore swim area ☐ beach sanding ☐ boatwell ☐ crib *dock* ☐ other

Fill dimensions (ft) Length 300' width 25' maximum depth 2.0'
Total fill volume (cu yd) 565
Maximum water depth in fill area (ft) 4.0

Type of clean fill ☐ pea stone ☐ sand ☐ gravel ☐ wood chips ☒ other
Will *filter fabric* be used under proposed fill? ☐ No ☒ Yes (If Yes, type) Nonwoven geotextile

Source of clean fill ☐ on-site, If on-site, show location on site plan ☒ commercial ☐ other, If other, attach description of location

Fill will extend 12.6 feet into the water from the *shoreline* and *upland* 12.7 feet out of the water.
Fill volume below OHWM (cu yd) 280

☒ B. PROJECTS REQUIRING DREDGING OR EXCAVATION (For dredging projects see Sample Drawing 7, for excavation see other applicable Sample Drawings)

- To calculate volume in cubic yards (cu yd), multiply the average length in feet (ft) times the average width (ft) times the average depth (ft) and divide by 27.
- Attach both plan and *cross-section* views to scale showing maximum and average dredge or excavation dimensions.
- The applicant will be notified if sediment sampling is required.

(Check all that apply) ☐ *floodplain* excavation ☐ wetland dredge or draining ☐ *seawall, bulkhead, or revetment*
☐ navigation ☐ *boat well* ☐ boat launch ☒ other

Total dredge/excavation volume (cu yd) Up to 3,000
Dimensions length 300' width 100' depth 2.5'
Dredge/excavation volume below OHWM (cu yd) Up to 3,000
Method and equipment for dredging Backhoe excavator in the dry

Has proposed dredge material been tested for contaminants? ☐ No ☒ Yes (If Yes, attach testing results)
Will dredged or excavated spoils be placed ☒ on-site ☐ off-site. Attach a detailed disposal area site plan, location map. If dispose off site, provide address and letter of authorization.

Has this same area been previously dredged? ☒ No ☐ Yes (If Yes, provide date and permit number, if available) / / /
If Yes, are you proposing to enlarge the previously dredged area ☐ No ☐ Yes

Is long-term maintenance dredging planned? ☒ No ☐ Yes (If Yes, when and how much?)

☒ C. PROJECTS REQUIRING RIPRAP (See Sample Drawings 2, 3, 8, 12, 14, 17, 22, and 23. Others may apply)

Riprap waterward of the ☐ shoreline OR ☒ *ordinary high water mark* Dimensions (ft) length 300' width 12.6' depth 2' Volume(cu yd) 280

Riprap landward of the ☐ *shoreline* OR ☒ *ordinary high water mark* Dimensions length 300' width 12.7' depth 2' Volume(cu yd) 285

Type of *riprap* ☐ field stone ☒ angular rock ☐ other
Will *filter fabric* be used under proposed *riprap*? ☐ No ☒ Yes (If Yes, type) Nonwoven geotextile

☒ D. SHORE PROTECTION PROJECTS (See Sample Drawings 2, 3, and 17)

(check all that apply) ☒ *riprap* – length (ft.) 300 ☐ *seawall/bulkhead* – length (ft.) ☐ *revetment* – length (ft.)
Distances of project from both property lines (ft)

☐ E. DOCK - PIER – MOORING PILINGS (See Sample Drawing 10)

Type ☐ open pile ☐ filled ☐ crib
Seasonal structure? ☐ No ☐ Yes
Proposed *structure* dimensions (ft) length width
Dimensions of nearest adjacent *structures* (ft) length width

☐ F. BOAT WELL (No Sample Drawing available)

Type of bank stabilization ☐ wood ☐ steel ☐ concrete ☐ vinyl ☐ *riprap* ☐ other

Boat well dimensions (ft) Length width depth
Number of boats

Volume of backfill behind sidewall stabilization (cu yd)
Distances of *boat well* from adjacent property lines (ft)

☐ G. BOAT LAUNCH (No Sample Drawing available) (check all that apply) ☐ new ☐ existing ☐ public ☐ private ☐ commercial ☐ replacement

Proposed overall boat launch dimensions (ft) length width depth
Type of material ☐ concrete ☐ wood ☐ stone ☐ other

Existing overall boat launch dimensions (ft) Length width depth
Boat launch dimensions (ft) below *ordinary high water mark* Length width depth

Distances of launch from both property lines (ft)
Number of skid *piers*
Skid *pier* dimensions (ft) width length

☐ H. BOAT HOIST (No Sample Drawing available)

(Check all that apply) ☐ *seasonal* ☐ permanent ☐ cradle ☐ side lifter ☐ other
located on ☐ *seawall* ☐ *dock* ☐ bottomlands

☐ I. BOARDWALKS AND DECKS IN ☐ WETLANDS - OR - ☐ FLOODPLAINS (See Sample Drawings 5 and 6. Provide table if necessary)

(Check all that apply) ☐ boardwalk ☐ deck
Boardwalk or deck is on ☐ fill ☐ *piling*
Dimensions (ft) length width

10 Continued - PROJECTS IMPACTING WETLANDS OR FLOODPLAINS OR LOCATED ON AN INLAND LAKE OR STREAM OR A GREAT LAKE

☐ **J. INTAKE PIPES** (See Sample Drawing 16) ☐ **OUTLET PIPES** (See Sample Drawing 22)

Type ☐ headwall ☐ end section ☐ pipe ☐ other

If outlet pipe, discharge is to ☐ wetland ☐ *inland lake* ☐ stream, drain, or river ☐ Great Lake ☐ other

Dimensions of headwall OR end section (ft) length width depth

Number of pipes

Pipe diameters and invert elevations

☐ **K. MOORING AND NAVIGATION BUOYS** (No Sample Drawing available)

- Provide an overall site plan showing the distances between each buoy, distances from the shore to each buoy, and depth of water at each buoy in feet.
- Provide cross-section drawing(s) showing anchoring system(s) and dimensions.

Number of buoys

Type of anchor system

Purpose of buoy ☐ mooring ☐ navigation ☐ swimming

Dimensions of buoys (ft) width height

Do you own the property along the *shoreline*? ☐ No ☐ Yes
If No, you must provide an authorization letter from the property owner(s)

☐ **L. GROINS** (No Sample Drawing available)

- Provide an overall site plan showing the distances (ft) of the outermost *groins* from the property lines, distances between *groins*, length and width of each *groin*, and the distance from the existing toe of the bluff to the lakeward end of the *groins*.
- If existing *groins* are located on adjacent properties, provide distances (ft) from closest neighboring *groin* to your property lines on the site plan. Provide *cross-section* views showing the length and height of each *groin* and the height of *groin* ends above the observed water level (date and time). If step down type, show the height of each section above the observed water level.

Number of *groins*

Type of *groin* ☐ steel ☐ wood ☐ other

Will *groin* be placed on a foundation? ☐ No ☐ Yes (If Yes, dimensions of foundation (ft)) length width height

☐ **M. FENCES IN WETLANDS, STREAMS, OR FLOODPLAINS** (No Sample Drawing available)

- Provide an overall site plan showing the proposed fencing through wetlands, streams, or *floodplains*.
- Provide drawing of fence profile showing the design, dimension, post spacing, board spacing, and distance from ground to bottom of fence (if in a *floodplain*).

(check all that apply) ☐ wetlands ☐ streams ☐ *floodplains*

Total length (ft) of fence through wetlands streams *floodplains*

Fence height (ft)

Fence type and material

☒ **N. OTHER** - e.g., *structure* removal, *marine railway*, *low sand trap wall, breakwater*, and structural foundations in wetlands or *floodplains*

Temporary access road along northern slope of landfill

11 EXPANSION OF AN EXISTING OR CONSTRUCTION OF A NEW LAKE OR POND (See Sample Drawings 4 and 15)

Which best describes your proposed waterbody use (check all that apply)
☐ wildlife ☐ *stormwater retention basin* ☐ *stormwater detention basin* ☐ recreation ☐ wastewater basin ☐ other

Water source for lake/pond
☐ groundwater ☐ natural springs ☐ *Inland Lake or Stream* ☐ stormwater runoff ☐ pump ☐ sewage ☐ other

Location Of the lake/basin/pond ☐ floodplain ☐ wetland ☐ upland

Will project involve construction of a *dam*, dike, outlet control *structure*, or *spillway*? ☐ No ☐ Yes (If Yes, complete Section 17)

12 ACTIVITIES THAT MAY IMPACT WETLANDS (See Sample Drawings 8 & 9)

- For information on the MDEQ's *Wetland Assessment* Program, visit the LWMD website or call 517-373-1170.

(check all that apply) ☒ fill (Section 10A) ☐ dredge or excavation (Section 10B) ☐ boardwalk or deck (Section 10I) ☐ dewatering ☐ fences (Section 10M) ☐ bridges and culverts (Section 14) ☐ draining surface water ☐ other

Has a professional wetland delineation been conducted for this parcel? ☒ No ☐ Yes (If Yes, provide a copy; if federal method was used, supply data sheets)

Applicant purchased property ☐ before OR ☐ after October 1, 1980.

Is there a recorded DEQ easement on the property? ☒ No ☐ Yes (If Yes, provide the number)

Has the MDEQ conducted a *wetland assessment* for this parcel? ☒ No ☐ Yes (If Yes, provide a copy)

Describe the wetland impacts, proposed use or development, and efforts to avoid/minimize impacts. Describe the wetland alternatives and provide the type and amount of mitigation proposed if more than 1/3 acre is to be impacted. ***A temporary access road will be constructed along the northern slope of the landfill which may require fill material to be placed within the wetland.***

Is any grading or mechanized land clearing proposed? ☐ No ☒ Yes (If Yes, show locations on site plan)

Has any of the proposed grading or mechanized land clearing been completed? ☒ No ☐ Yes (If Yes, label and show locations on site plan)

- Complete the wetland dredge and wetland fill dimension information for each impacted wetland area.
- Attach additional sheets if necessary and label the impacted wetland areas on a site plan drawn to scale. Attach at least one typical *cross-section* for each wetland dredge and/or fill area. Also complete Section 10A for fill and Section 10B for dredge or excavation activities.
- If dredge material will be disposed of on site, show the location on site plan in an *upland* area and include *soil erosion and sedimentation control measures*.

Wetland dredge dimensions	maximum length (ft)	maximum width (ft)	dredge area ☐ acres ☐ sq ft	average depth (ft)	dredge volume (cu yd)
Wetland fill dimensions	maximum length (ft) ***Varies***	maximum width (ft) ***Varies***	fill area ☐ acres ☐ sq ft ***Varies***	average depth (ft) ***Varies***	fill volume (cu yd) ***Varies***

Total wetland dredge area ☐ acres ☐ sq ft

Total wetland dredge volume (cu yd)

Total wetland fill area ☐ acres ☐ sq ft ***Varies***

Total wetland fill volume (cu yd)

The proposed project will be serviced by ☐ public sewer ☐ private septic system (If septic system, show existing and new or expanded system on plans)

If septic system, has application been made to the County Health Department for a permit? ☐ No ☐ Yes

If Yes, has permit been issued? ☐ No ☐ Yes (If Yes, provide a copy)

13 FLOODPLAIN ACTIVITIES (See Sample Drawing 5. Others may apply.)

- Attach additional sheets with the requested information when multiple *floodplain* activities are included in this application.

(check all that apply) ☒ fill ☒ excavation ☐ other

Site is *approximately 1.0* feet above ☐ *ordinary high water mark* (OHWM) OR ☒ observed water level. *699.16* Date of observation (M/D/Y) *04/04/2006*

Fill volume below the 100-year floodplain elevation (cu yd) *Approximately 50*	Compensating cut volume below the 100-year floodplain elevation (cu yd) *Approximately 50*

14 BRIDGES AND CULVERTS (Including Foot and Cart Bridges)

- Provide detailed site-specific drawings of existing and proposed *Plan View* (Sample Drawing 14A), Elevation View (Sample Drawing 14B), Stream and *Floodplain Cross-Section* (Sample Drawing 14C), Stream Profile (Sample Drawing 14D) and *Floodplain* Fill (Sample Drawing 5) at a scale adequate for detailed review.
- Provide the requested information that applies to your project. If there is not an existing *structure*, leave the "Existing" column blank.
- If you choose to have a Licensed Professional Engineer "certify" that your project will not cause a "*harmful interference*" for a range of flood discharges up to and including the 100-year flood discharge, then you must use the "Required Certification Language." You may request a copy by phone, email, or mail. A hydraulic report supporting this certification may also be required.
- Attach additional sheets with the requested information when multiple crossings are included in this application.

		Existing	Proposed			Existing	Proposed
Culvert type (box, circular, arch) and material (corrugated metal, timber, concrete, etc.)				Bridge span (length perpendicular to stream) OR culvert ☐ width ☐ diameter (ft)			
Bridge type (concrete box beam, timber, concrete I-beam, etc.)				Bridge width (parallel to stream) OR culvert length (ft)			
Entrance design (projecting, mitered, wingwalls, etc.)				Bridge *rise* (from bottom of beam to streambed) OR Culvert *rise* (from top of culvert to streambed) (ft)			
Total *structure waterway opening* above streambed (sq ft)							
☐ elevation of culvert crown	Upstream			Higher elevation of ☐ culvert invert OR	Upstream		
☐ bottom of bridge beam (ft)	Downstream			☐ streambed within culvert (ft)	Downstream		
Elevation of road grade at *structure* (ft)				Distance from low point of road to mid-point of bridge crossing (ft)			
Elevation of low point in road (ft)							

Cross-sectional area of primary channel (sq ft) (See Sample Drawing 14C)	Average stream width at OHWM outside the influence of the structure (ft)	Upstream Downstream

Reference datum used (show on plans with description) ☐ *NGVD 29* ☐ *IGLD 85* (Great Lakes coastal areas) ☐ local

High water elevation – describe reference point and highest known water level above or below reference point and date of observation.

15 STREAM, RIVER, OR DRAIN CONSTRUCTION ACTIVITIES (No sample drawing available)

- Complete Section 10A for fill, Section 10B for dredge or excavation, and Section10C for *riprap* activities.
- If side casting or other proposed activities will impact wetlands or *floodplain*s, complete Sections 12 and 13, respectively.
- Provide an overall site plan showing existing lakes, streams, wetlands, and other water features; existing *structures*; and the location of all proposed *structures* and land change activities. Provide *cross-section* (elevation) drawings necessary to clearly show existing and proposed conditions. Be sure to indicate drawing scales.
- For activities on legally established county drains, provide original design and proposed dimensions and elevations.

(check all that apply) ☐ maintenance ☐ improvement ☐ relocation ☐ enclosure ☐ new drain ☒ wetlands ☒ other

Dimensions (ft) of existing stream/drain channel to be worked on. length *300'* width *100'* depth *2.5'*

Dimensions (ft) of new, relocated, or enclosed stream/drain channel. length width depth	Volume of Dredge/ excavation (cu yds) *Up to 3,000*
Existing channel average water depth in a normal year (ft) *4.0'*	Proposed side *slope*s (vertical / horizontal) *3V:1H*

How will *slope*s and bottom be stabilized?
Geotextile and riprap

Will old/enclosed stream channel be backfilled to top of bank grade? ☒ No ☐ Yes	Length of channel to be abandoned (ft)	Volume of fill (cu yds)

If an enclosed *structure* is proposed, check type ☐ concrete ☐ corrugated metal ☐ plastic ☐ other
Dimensions of the structure size length volume of fill

Will spoils be disposed of on site? ☐ No ☒ Yes (If Yes, show location of spoils on site plan in an *upland* area.)

Reference datum used (show on plans with description) ☒ *NGVD 29* ☐ *IGLD 85* (Great Lakes coastal areas) ☐ local

16 DRAWDOWN OF AN IMPOUNDMENT

- If wetlands will be impacted, also complete Section 12.

Type of drawdown ☐ over winter ☐ temporary ☐ one-time event ☐ annual event ☐ permanent (*dam* removal) ☐ other

Reason for drawdown

Has there been a previous drawdown? ☐ No ☐ Yes (If Yes, provide date (M/D/Y) / /

Previous MDEQ permit number, if known

Does waterbody have established legal lake level? ☐ No ☐ Yes ☐ Not Sure

Dam ID Number, if known

Extent of vertical drawdown (ft)	*Impoundment* design head (ft)	Number of adjacent or impacted property owners
Date drawdown would start (M/D/Y) / /	Date drawdown would stop (M/D/Y) / /	Rate of drawdown (ft/day)
Date refilling would start (M/D/Y) / /	Date refill would end (M/D/Y) / /	Rate of refill (ft/day)
Type of outlet discharge *structure* to be used ☐ surface ☐ bottom ☐ mid-depth	*Impoundment* area at normal water level (acres)	Sediment depth behind *impoundment* discharge *structure* (ft)

17 DAM, EMBANKMENT, DIKE, SPILLWAY, OR CONTROL STRUCTURE ACTIVITIES (See Sample Drawing 15)

- If wetlands will be impacted, also complete Section 12.
- Attach site-specific conceptual plans for construction of a new *dam*, reconstruction of a *failed dam*, or enlargement of an existing *dam* for resource impact review. Detailed engineering plans are required once the activity has been determined to be permitable from an environmental standpoint.
- Attach detailed engineering plans for a *dam* repair, *dam alteration*, *dam abandonment*, or *dam* removal.

Which one best describes your project? ☐ new *dam* construction ☐ reconstruction of a *failed dam* ☐ enlargement of an existing *dam* ☐ *dam repair* ☐ *dam alteration* ☐ *dam abandonment* ☐ *dam* removal ☐ other

Dam ID Number If known	Type of outlet discharge *structure* ☐ surface ☐ bottom ☐ mid depth	Will proposed activities require a drawdown of the waterbody to complete the work? ☐ No ☐ Yes (If Yes, also complete Section 16)	
Riprap Volume (cu yd)	Dredging/excavation Volume (cu yd)	Fill volume (cu yd)	Does *structure* allow complete drainage of waterbody? ☐ No ☐ Yes
Benchmark elevation (ft)	Datum used ☐ Local ☐ *NGVD 29* ☐ other	Describe benchmark and show on plans	

Have you engaged the services of a Licensed Professional Engineer? ☐ No ☐ Yes (If Yes, name, registration number, and mailing address)

Will a water diversion during construction be required? ☐ No ☐ Yes (If Yes, describe how the stream flow will be controlled through the *dam* construction area during the proposed project activities)

- The following additional information is required for a new dam, reconstruction of a failed dam, or enlargement of an existing dam.

Describe the type of *dam* and how you will design the *dam* and embankment to control seepage through and underneath the *dam*.

Embankment top elevation (ft)	Streambed elevation at downstream embankment toe (ft)	Structural height (difference between embankment top elevation and streambed elevation at downstream embankment toe) (ft)	
Embankment length (ft)	Embankment top width (ft)	Embankment bottom width (ft)	Embankment *slopes* (vertical / horizontal) Upstream Downstream
Proposed normal pool elevation (ft)	*Impoundment* flood elevation (ft)	Maximum vertical drawdown capability (ft) (Attach operational procedure of the proposed *structure*, if available)	
Have soil borings been taken at *dam* location? ☐ No ☐ Yes (If Yes, submit results with permit application)	Will a cold water *underspill* be provided? ☐ No ☐ Yes (If Yes, invert elevation (ft.)	Do you have flowage rights to all proposed flooded property at the design flood elevation? ☐ No ☐ Yes	

18 UTILITY CROSSINGS (See Sample Drawings 12 and 13)

- If side casting is required, complete Subsections 10A and 10B. If spoils will be placed in wetlands or wetlands may be impacted, complete Section 12.
- Attach additional sheets with the requested information as needed for multiple crossings.

What method will be used to construct the crossings? ☐ *flume* ☐ *plow* ☐ open trench ☐ jack and bore ☐ directional drilling

Crossing of ☐ *Inland Lake or Stream* ☐ *floodplain* ☐ international waters ☐ wetlands (also complete Section 12)

Type	Number of wetland crossings	Number of inland lake or stream crossings	Pipe diameter (in.)	Pipe length per crossing (ft.)	Distance below streambed or wetland (in.)	Trench width (ft.)
☐ sanitary sewer						
☐ storm sewer						
☐ watermain						
☐ cable						
☐ oil/gas pipeline						

19 MARINA CONSTRUCTION AND OPERATING PERMIT INFORMATION (See Sample Drawing 21)

- *Marinas* located on one of the Great Lakes, including Lake St. Clair, may be required to secure leases or conveyances from the state of Michigan to place *structures* on the bottomlands.
- Enclose a copy on any current pump-out agreement with another *marina* facility.
- Attach a copy of the property legal description or a property boundary survey report to your application.
- Some projects on the Great Lakes require an application for conveyance prior to Joint Permit Application completeness.

Marina owner			Marina name		
Mailing address			Location address		
City	State	Zip Code	City	State	Zip Code
Marina owner's daytime telephone number with area code - -			Marina's daytime telephone number with area code - -		
Check the reasons for submitting this application ☐ Owner's name change ☐ Construction of a new *marina* ☐ Issuance of a new *Marina* Operating Permit ☐ Expansion/modification of an existing *marina* ☐ Reissuance of a *Marina* Operating Permit			Current Marina Operating Permit Number	Expiration Date (M/D/Y) / /	

	Existing	Proposed		Existing	Proposed
Number of boat slips/wells			Are sanitary pump-out facilities available?	☐ No ☐ Yes	☐ No ☐ Yes
Number of launch ramps/lanes			Number of hoist/take-out wells		
Number of mooring buoys			Number of gas pumps		
Lineal feet of broadside dockage			Name of *marina* insurance company		
Number of parking spaces					

20 HIGH RISK EROSION AND CRITICAL DUNE AREAS (See Sample Drawings 19 and 20, also Sample Drawing 9 if wetlands are impacted)

- Construction in *critical dune areas* on *slopes* greater than a 1-foot vertical *rise* in a 3-foot horizontal plane (33 percent) are prohibited without a special exception.
- Construction in *critical dune areas* on *slopes* that measure from a 1-foot vertical *rise* in a 4-foot horizontal plane (25 percent) to less than a 1-foot vertical *rise* in a 3-foot horizontal plane (33 percent) requires plans prepared by a registered architect or licensed professional engineer.
- Construction in critical dune areas requires the following written assurances: 1) permit or letter from county enforcing agent stating project complies with Part 91 (Soil Erosion and Sedimentation Control), 2) permit or letter from County Health Department for work on a septic system, and 3) letter from applicant stating tree/vegetation removal complies with instructions of the local Soil Conservation District.
- All property boundaries and proposed *structure* corners, septic system, water well, and driveway locations must be staked before the MDEQ site inspection.
- Scaled overhead and cross-section plans that include all property boundaries, and the location and dimensions of all structures and terrain alterations must be included.
- Additional information, including the building construction plans, may be required to complete the application review.

Parcel dimensions (ft) width depth	Property is a ☐ platted lot ☐ unplatted parcel	Year current property boundaries created	Date project staked (M/D/Y) / /
Type of construction activities ☐ home ☐ garage ☐ driveway ☐ septic ☐ addition ☐ renovation ☐ other			
The proposed project will be serviced by ☐ public sewer ☐ private septic system (If septic system, show existing and new or expanded system on plans)	If septic system, has application been made to the County Health Department for a permit? ☐ No ☐ Yes If Yes, has permit been issued? ☐ No ☐ Yes	If Yes, critical dune projects require County Health Department approval submitted with application.	Number of individual living-units in proposed building

Existing construction is on ☐ *pilings* ☐ basement ☐ concrete slab ☐ crawl space	Proposed new construction will be on ☐ *pilings* ☐ basement ☐ concrete slab ☐ crawl space
Existing construction material above foundation wall ☐ stud frame ☐ log ☐ block ☐ other	Proposed new construction material above foundation wall ☐ stud frame ☐ log ☐ block ☐ other
Existing siding material ☐ wood ☐ vinyl ☐ block ☐ other	Proposed new siding material ☐ wood ☐ vinyl ☐ block ☐ other
Area of the existing foundation, excluding attached garage (sq ft)	Area of the proposed foundation, excluding attached garage (sq ft)
Area of the existing garage foundation (sq ft)	Area of the proposed garage foundation (sq ft)

If renovating or restoring existing *structure*, renovation or restoration cost $	Current *structure* replacement value $	Tax assessed value of existing *structure* (excluding land value) $	Assessment Year

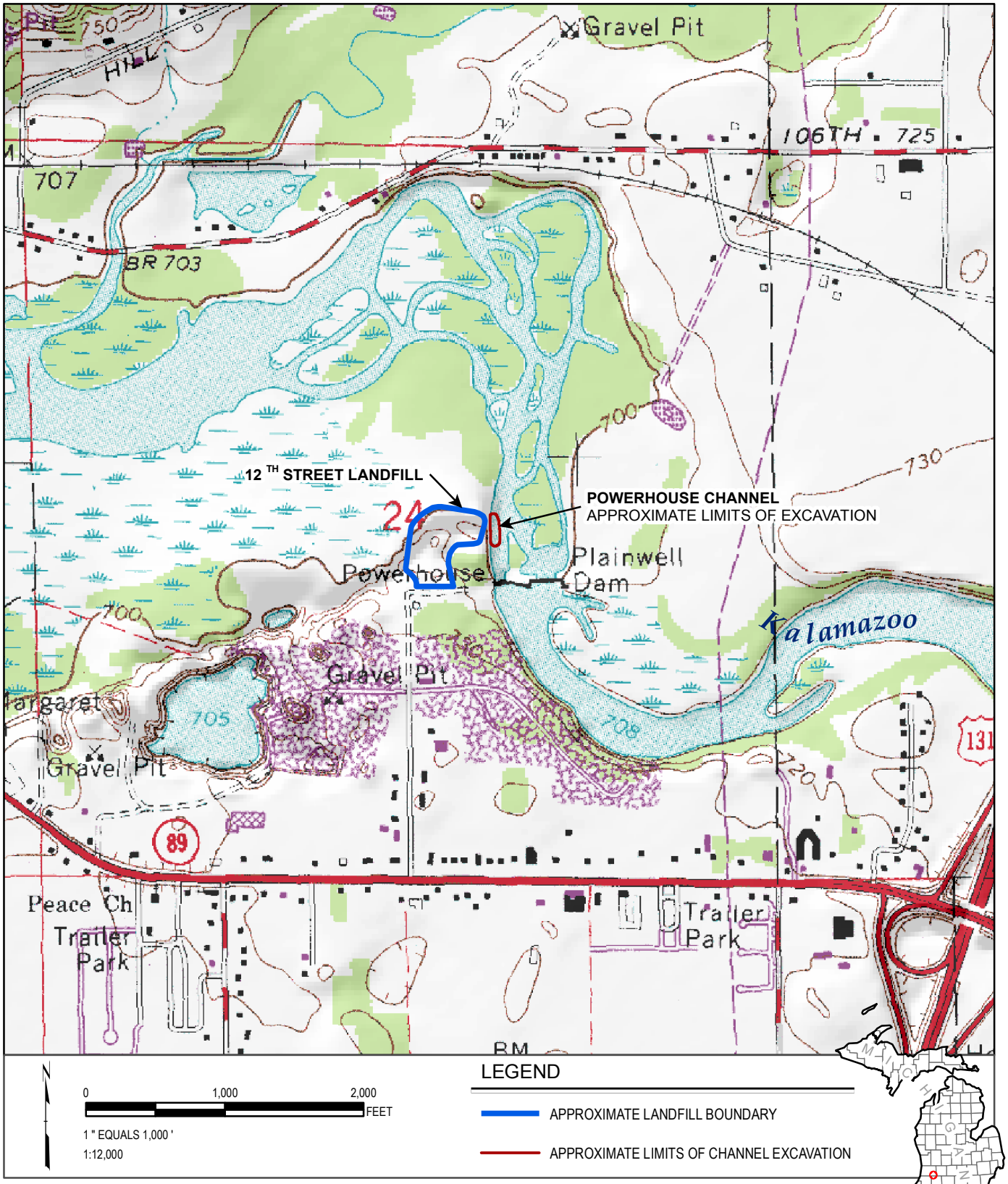
21 ACTIVITIES IN DESIGNATED ENVIRONMENTAL AREAS (No Sample Drawings Available)

- Many designated *environmental areas* are completely or partially wetlands. Be sure to complete Section 12 if your proposed activities will also occur in wetlands.
- If you are proposing any alteration in a designated *environmental area*, attach a detailed site plan.

(Check all that apply) ☐ placement of *structures* ☐ grading or other soil alteration ☐ alteration of natural drainage
☐ alteration of vegetation ☐ boardwalk or deck ☐ driveway or road
☐ dredge ☐ fill ☐ culvert ☐ other

Has the MDEQ staff or anyone else conducted a *wetland assessment* for this parcel? ☐ No ☐ Yes (If Yes, provide copy of response)

Figures



WORKING COPY

RMT

744 Heartland Trail
Madison, WI 53717-1934

P.O. Box 8923 53708-8923
Phone: 608-831-4444
Fax: 608-831-3334

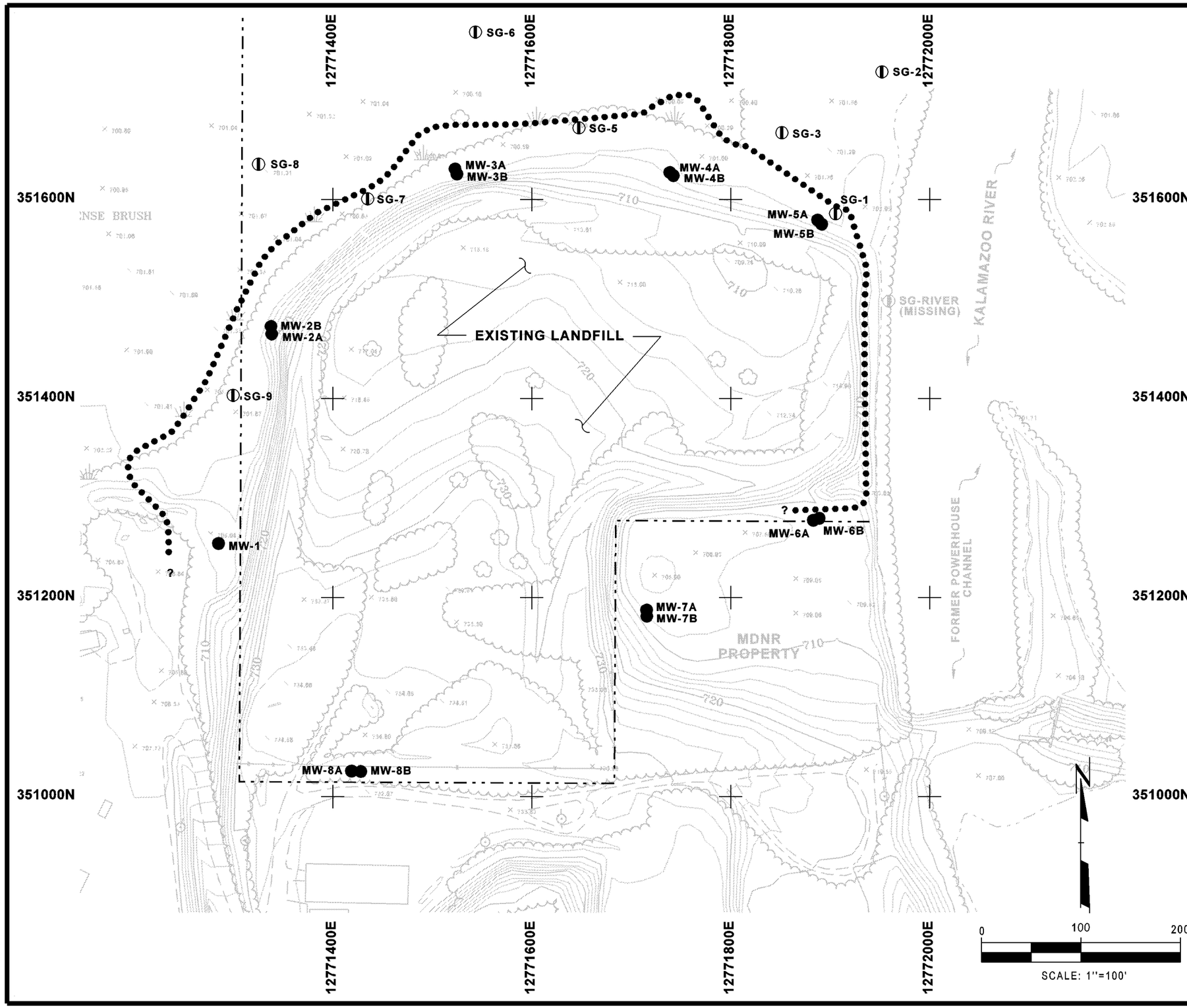
WEYERHAEUSER 12TH STREET LANDFILL
EMERGENCY RESPONSE PLAN DESIGN REPORT
PLAINWELL, MICHIGAN

SITE LOCATION MAP

DRAWN BY:	HANKLEY C
APPROVED BY:	
PROJECT NO:	00-05117.04/ERD
FILE NO.	51170402.mxd
DATE:	JULY 2007

D:\05117\04\51170402.mxd 7/19/2007 09:19:49

FIGURE 1



LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- GRID LOCATION
- EXISTING UNPAVED ROAD
- EXISTING FENCE
- EXISTING BUILDING
- EXISTING 10' CONTOUR
- EXISTING 2' CONTOUR
- EXISTING SPOT ELEVATION
- EXISTING TREES AND/OR BRUSH
- EXISTING WETLAND LIMITS
- EXISTING EDGE OF WATER
- APPROXIMATE LIMITS OF PAPER RESIDUALS USING VISUAL CRITERIA
- MW-10 EXISTING MONITORING WELL LOCATION
- SG-3 EXISTING STAFF GAGE

NOTES

1. BASE TOPOGRAPHY PROVIDED BY OAS, INC. OF SEYMOUR, INDIANA BASED ON AERIAL SURVEY DATED 3/30/2005. COORDINATES ARE MICHIGAN STATE PLANE-SOUTH ZONE. THE VERTICAL DATUM IS NGVD 29.
2. PROPERTY BOUNDARY BASED ON LEGAL DESCRIPTION PROVIDED BY USEPA IN A FAX DATED MARCH 30, 2004. COORDINATES FOR S 1/4 CORNER AND N 1/4 CORNER OF SECTION 24 AND NORTH BEARING USED TO PLOT PROPERTY LINE WERE PROVIDED BY HOLLAND ENGINEERING AND ARE BASED ON MICHIGAN STATE PLANE - SOUTH ZONE COORDINATES.

WORKING COPY

PROJECT: **WEYERHAEUSER 12TH STREET LANDFILL EMERGENCY RESPONSE PLAN DESIGN REPORT PLAINWELL, MICHIGAN**

SHEET TITLE: **EXISTING CONDITIONS**

DRAWN BY: stormerl	SCALE: 1"=100'	PROJ. NO.	5117.04\ERD
CHECKED BY:		FILE NO.	EXISTING.PLT
APPROVED BY:	DATE PRINTED:	FIGURE	2
DATE: JULY 2007			

RMT
744 Heartland Trail
Madison, WI 53717-1934
P.O. Box 8923 53708-8923
Phone: 608-831-4444
Fax: 608-831-3334

Levels
(1) 27,29
(2) 1-63
(3) 1-63
(4) 1-63

Logical Names
(1) bmc
(2) pro
(3) bmr
(4) RF3

Reference Files
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Ref. File 2 = J:\05117\04\ERD\proposed.dgn
Ref. File 3 = J:\05117\04\ERD\bmrmt.dgn
Ref. File 4 = J:\05117\04\ERD\11x17bdr.dgn

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stormerl Plot Date = Wed Jul 18 15:38:46 2007
Plot File = J:\05117\04\ERD\existing.prf
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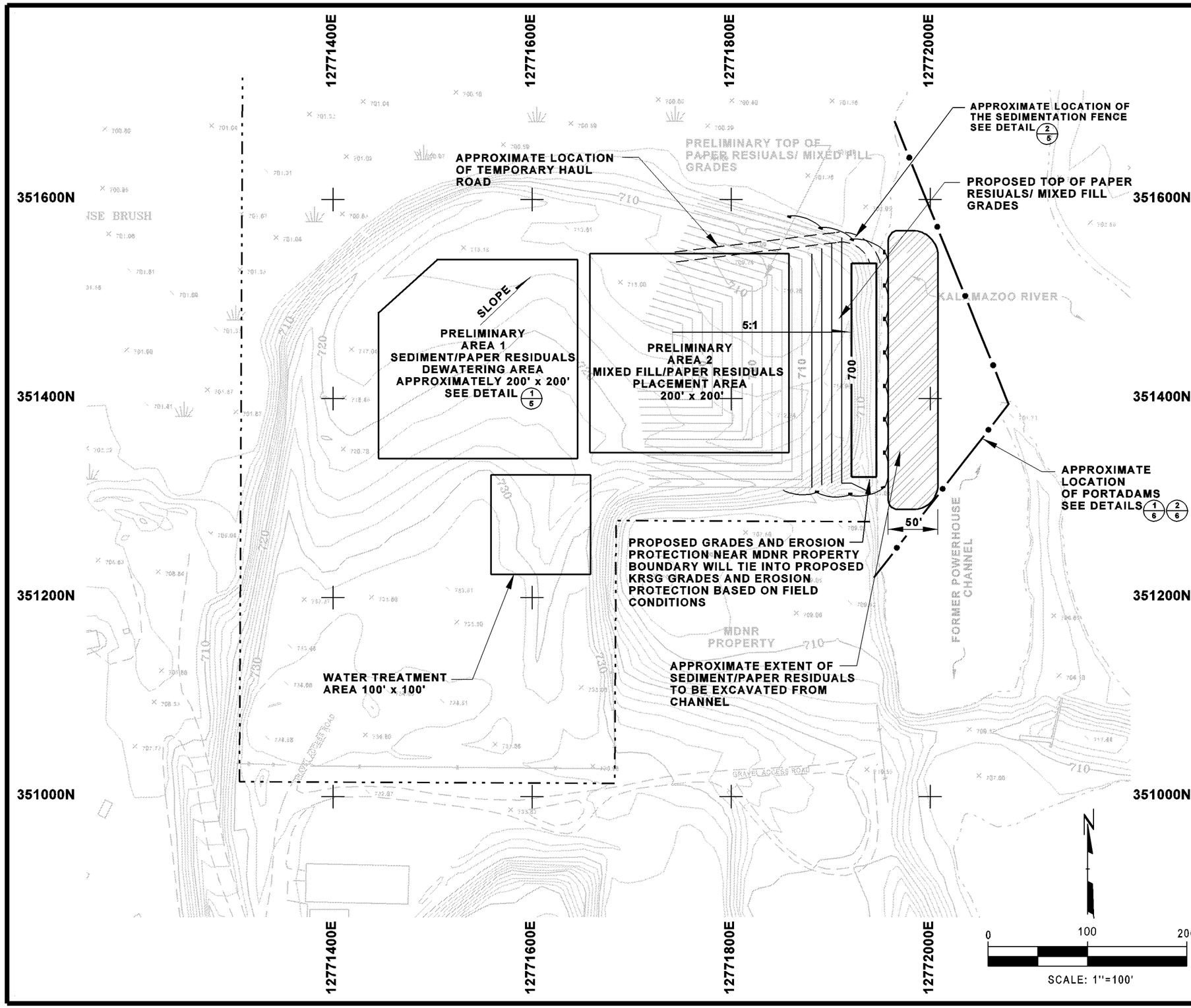

LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- GRID LOCATION
- EXISTING UNPAVED ROAD
- EXISTING FENCE
- EXISTING BUILDING
- EXISTING 10' CONTOUR
- EXISTING 2' CONTOUR
- EXISTING SPOT ELEVATION
- EXISTING WETLAND LIMITS
- EXISTING EDGE OF WATER

NOTES

1. REFER TO FIGURE 2 FOR BASE MAP NOTES.
2. DISCHARGE FROM WATER TREATMENT SYSTEM WILL BE LOCATED APPROXIMATELY 200' DOWNSTREAM OF WORKING AREA, DEPENDING ON SITE CONDITIONS.

WORKING COPY

PROJECT: WEYERHAEUSER 12TH STREET LANDFILL
EMERGENCY RESPONSE PLAN DESIGN REPORT
PLAINWELL, MICHIGAN

SHEET TITLE: PROJECT SITE PLAN

DRAWN BY: stormerl	SCALE: 1"=100'	PROJ. NO.	5117.04\ERD
CHECKED BY:		FILE NO.	SITE PLAN.PLT
APPROVED BY:	DATE PRINTED:	FIGURE 3	
DATE: JULY 2007			

RMT
744 Heartland Trail
Madison, WI 53717-1934
P.O. Box 8923 53708-8923
Phone: 608-831-4444
Fax: 608-831-3334

Plot Data
Design File J:\05117\04\ERD\site plan.plt
stormerl Plot Date = Thu Jul 19 16:06:09 2007
Plot File = J:\05117\04\ERD\site plan.prf
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Levels On = 1-13

Reference Files
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Ref. File 2 = J:\05117\04\ERD\bmrmt.dgn
Ref. File 3 = J:\05117\04\ERD\proposed.dgn
Ref. File 4 = J:\05117\04\ERD\11x17bdr.dgn

Logical Names
(1) bmc
(2) bmr
(3) pro
(4) bdr

Levels
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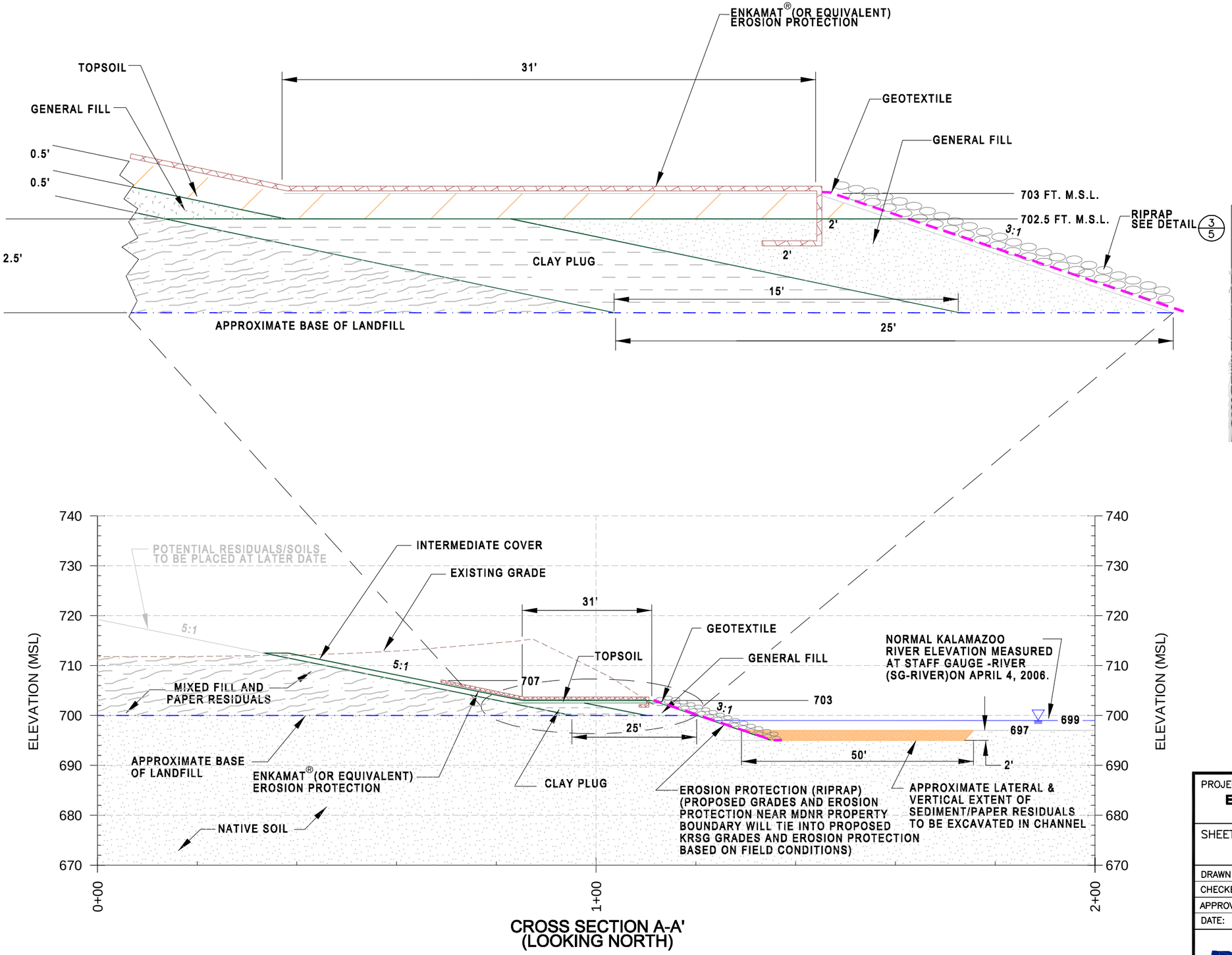
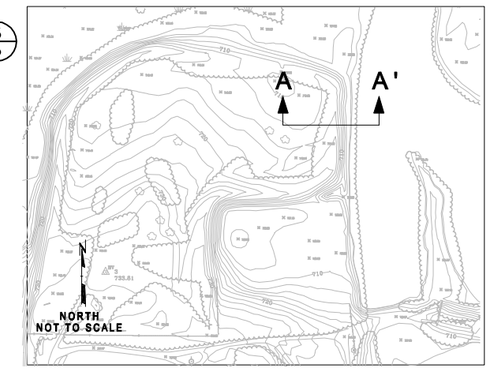
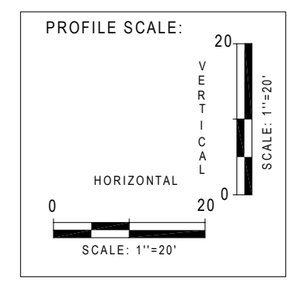
(2) 1-63
(3) 1-63
(4) 1-63



CROSS SECTION A-A'
(LOOKING NORTH)



CROSS SECTION LOCATOR



WORKING COPY

PROJECT: **WEYERHAEUSER 12TH STREET LANDFILL EMERGENCY RESPONSE PLAN DESIGN REPORT PLAINWELL, MICHIGAN**

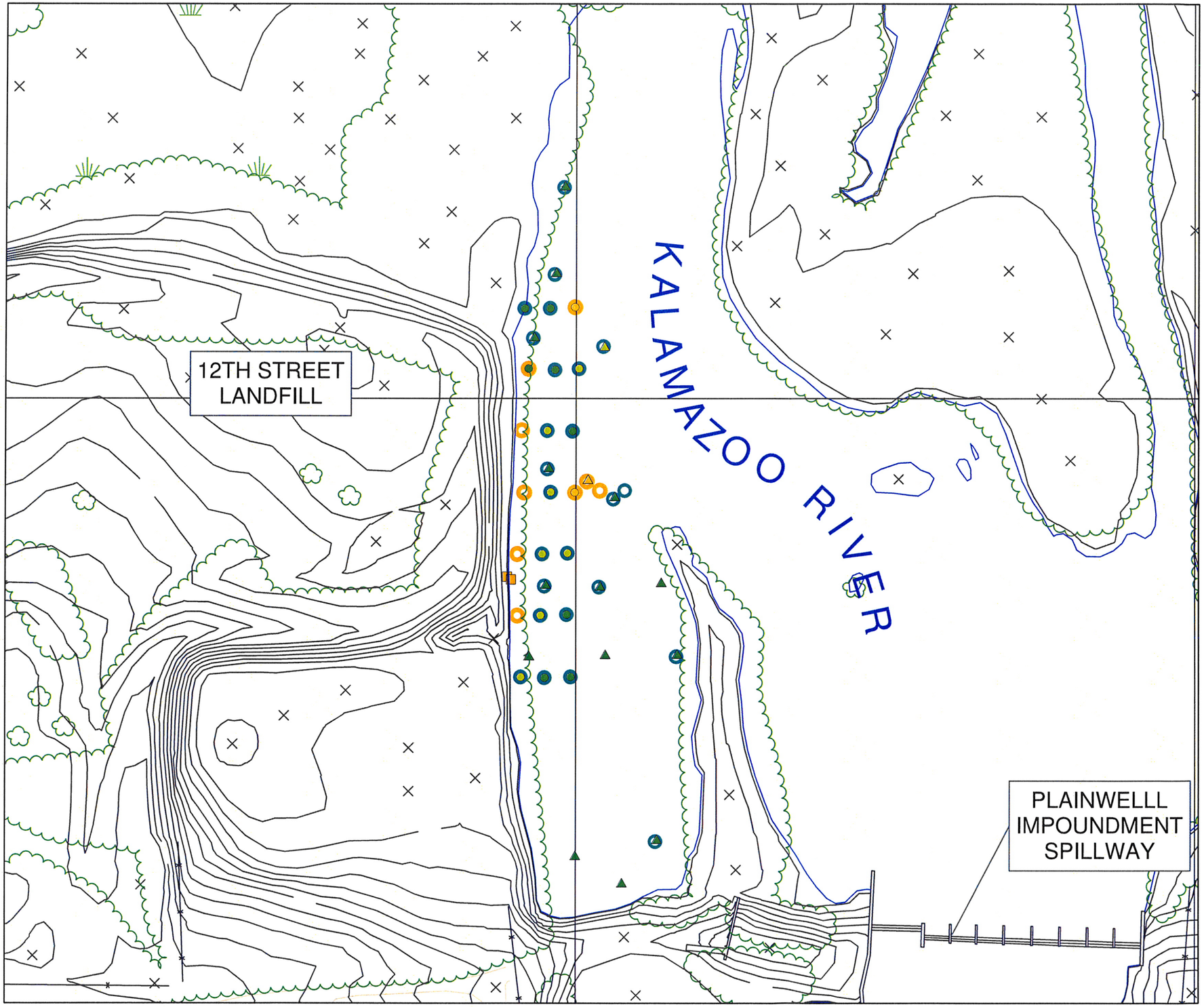
SHEET TITLE: **CROSS SECTION A-A'**

DRAWN BY: STORMERL	SCALE:	PROJ. NO. 5117.04
CHECKED BY:	AS SHOWN	FILE NO. XSECTION_PLT.DWG
APPROVED BY:	DATE PRINTED:	**FIGURE 4**
DATE: JULY 2007		

RMT
744 Heartland Trail
Madison, WI 53717-1934
P.O. Box 8923 53708-8923
Phone: 608-831-4444
Fax: 608-831-3334

PLOT DATA
Drawing Name: J:\05117\04\ERD\xsection_plt.dwg
Operator Name: stormerl
Scale: 1"=1'

Sampling Data for Sediment in Former Powerhouse Discharge Channel



LEGEND

BBL Data (2001) - Total PCBs mg/kg (USEPA, 2004)

- 0 - 1
- 1 - 4
- 4 - 50
- 50+

USEPA Data 2004 - Total PCBs (mg/kg)

- 0 - 1
- 1 - 4
- 4- 50
- 50+

Geraghty and Miller (1994) - Total PCBs (mg/kg)

- PCB Concentration 17 & 29 ppm

Powerhouse Channel Residuals

- No Visible Residuals
- Visible Residuals

NOTE

1. Concentrations presented are maximum at each sample location.

N

0 40 80 160 FEET

1:960

1 INCH EQUALS 80 FEET

PROJECT: WEYERHAEUSER COMPANY MULTI-AREA QAPP PLAINWELL, MICHIGAN			
SHEET TITLE: HISTORICAL SAMPLING DATA FOR THE FORMER POWERHOUSE DISCHARGE CHANNEL			
DRAWN BY: WEBERN	SCALE: AS NOTED	PROJ. NO.: 00-05117.03	
CHECKED BY: MK		FILE NO.: 51170311.mxd	
APPROVED BY: JH	DATE PRINTED: 06/19/07	FIGURE 1	
DATE: JUNE 2007			

RMT

150 N. Patrick Blvd., Suite 180
Brookfield, WI 53045-5854

Phone: 262-879-1212
Fax: 262-879-1220

D:\05117\03\51170311.mxd

Photographic Log

Photographic Log

Client Name:	Site Location:	Project No.:
Weyerhaeuser	12th Street Landfill	5117.04

Photo No.	Date
1	5/4/07

Description
West bank of the channel looking northwest from the southern end of the channel. Photograph taken by Jennifer Overvoorde.

Photo No.	Date
2	5/4/07

Description
View of the east channel bank, looking east. Photograph taken by Jennifer Overvoorde.

Photographic Log

Client Name:	Site Location:	Project No.:
Weyerhaeuser	12th Street Landfill	5117.04

Photo No.	Date
3	5/4/07

Description
View of the north point of the east channel bank, looking east/northeast. Photograph taken by Jennifer Overvoorde.

Photo No.	Date
4	5/4/07

Description
Close-up of the western side of the channel bank, looking down at the channel from the 12thStreet Landfill. Photograph taken by Jennifer Overvoorde.

NPDES Permit Application

State of Michigan

National Pollutant Discharge Elimination System

Permit Application for Discharges to Surface Waters

General Instructions	**Pages i - iii**
Section I - General Facility Information	**Pages 1 - 6**
Section II - Sanitary Wastewater Facilities	**Pages 7 - 21**
Section III - Industrial and Commercial Wastewater Facilities	**Pages 23 – 31**

DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER BUREAU
PERMITS SECTION
P.O. BOX 30273
LANSING, MICHIGAN 48909-7773
TELEPHONE: 517-241-1346
FAX: 517-241-8133

EQP 4659 (Rev. 1/2006)

Do Not Return This Page With the Completed Application

PURPOSE AND AUTHORITY

The National Pollutant Discharge Elimination System (NPDES) Program protects the surface waters of the state by assuring that discharges of domestic and industrial wastewater comply with state and federal regulations. Public or private facilities that discharge, or propose to discharge, wastewater to the surface waters of the state or to land apply biosolids generated in the wastewater treatment process are required to make application for and obtain a valid NPDES permit prior to wastewater discharge or land application of biosolids.

NPDES permits are required under Section 402 of the Federal Clean Water Act (the "Federal Act"), as amended (33 U.S.C. 1251 et seq, P.L. 92-500, 95-217), and under Part 31 of Michigan's "Natural Resources and Environmental Protection Act," 1994 PA 451, as amended (the "Michigan Act"). Part 31 of the Michigan Act also provides authority for the State to issue NPDES permits. The Michigan Department of Environmental Quality (MDEQ) administers the NPDES permit program for the State of Michigan.

This application should be used to apply for any municipal, commercial, or industrial wastewater discharge to the surface waters of the state. Depending on the nature of the discharge, the MDEQ may issue either an Individual Permit or Certificate of Coverage (COC) under a valid General Permit.

This Application **should not** be used to apply for authorization to discharge under the Wastewater Discharge General Permits for "Storm Water from Industrial Activity" or "Storm Water Discharges with Required Monitoring," or the "Permit by Rule for Storm Water from Construction Activities."

Note: In accordance with Section 3120 of the Michigan Act (revised April 2004), application fees are now required with NPDES Permit Applications. The applicant is obligated to submit the appropriate fee with the Application. Application fees are non-refundable. For information on application fees for NPDES Permits, see the Frequently Asked Question Section of the NPDES Permit Application Appendix (Appendix). Information on annual permit fees can be viewed via the Internet (http://www.michigan.gov/deq and on the left side of the screen click on **Water**, click on **Surface Water**, click on **NPDES Permits**; then click on **"NPDES Permit Fees"** which is under the Information banner, then click on NPDES Fees: Frequently Asked Questions and Answers). **Applications submitted without the application fee are administratively incomplete and will not be processed until the fee is received.**

PENALTIES

The information in this Application is required by the Part 21 Rules of the Michigan Act. A municipality, business, or industry which violates the Part 21 Rules may be enjoined by action commenced by the Attorney General in a court of competent jurisdiction.

Federal and State laws provide penalties for submitting false application information. The laws imposing those penalties are cited below.

The Federal Act, Section 309(c)(4): "Any person who knowingly makes false material statement, representation, or certification in any application, record, report, plan, or other document filed or required to be maintained under this act or who knowingly falsifies, tampers with, or renders inaccurate any monitoring device or method required to be maintained under this act, shall upon conviction, be punished by a fine not more than $10,000, or by imprisonment for not more than 2 years, or by both. If a conviction of a person is for a violation committed after a first conviction of such person under this paragraph, punishment shall be a fine of not more than $20,000 per day of violation, or by imprisonment of not more than 4 years, or by both."

The Michigan Act, Section 3115(2): "A person who at the time of the violation knew or should have known that he or she discharged a substance contrary to this part, or contrary to a permit, order, rule, or stipulation of the department, or who intentionally makes a false statement, representation, or certification in an application form pertaining to a permit or in a notice or report required by the terms and conditions of an issued permit, or who intentionally renders inaccurate a monitoring device or record required to be maintained by the department, is guilty of a felony and shall be fined not less than $2,500.00 or more than $25,000.00 for each violation. The court may impose an additional fine of not more than $25,000.00 for each day during which the unlawful discharge occurred. If the conviction is for a violation committed after a first conviction of the person under this subsection, the court shall impose a fine of not less than $25,000.00 per day and not more than $50,000.00 per day of violation. Upon conviction, in addition to a fine, the court, in its discretion, may sentence the defendant to imprisonment for not more than 2 years or impose probation upon a person for a violation of this part. With the exception of the issuance of criminal complaints, issuance of warrants, and the holding of an arraignment, the circuit court for the county in which the violation occurred has exclusive jurisdiction. However, the person shall not be subject to the penalties of this subsection if the discharge of the effluent is in conformance with and obedient to a rule, order, or permit of the department. In addition to a fine, the Attorney General may file a civil suit in a court of competent jurisdiction to recover the full value of the injuries done to the natural resources of the state and the costs of surveillance and enforcement by the state resulting from the violation."

The Michigan Department of Environmental Quality will not discriminate against any individual or group on the basis of race, sex, religion, age, national origin, color, marital status, disability, or political beliefs. Questions or concerns should be directed to the Office of Personnel Services, P.O. Box 30473, Lansing MI 48909.

Do Not Return This Page With the Completed Application

GENERAL PROVISIONS

COMPLETION OF FORMS

If assistance is needed completing this Application, contact the Water Bureau, Permits Section (Permits Section) at 517-241-1346.

1. There are three sections in this Application: All applicants are required to complete Section I and **either** Section II **or** Section III.
   - **Section I** (Pages 1-6) -- General information and application certification signature that is required to be provided by all applicants.
   - **Section II** (Pages 7-21) -- Information to be provided by applicants that discharge treated domestic sanitary wastewater. These facilities include both publicly-owned treatment works (POTWs) and privately-owned treatment facilities such as mobile home parks, campgrounds, condominiums, etc. These facilities are collectively known as **T**reatment **W**orks **T**reating **D**omestic **S**ewage (TWTDS).
   - **Section III** (Pages 23-31) -- Information to be provided by applicants that discharge from industrial and commercial facilities, including process, cooling, and sanitary wastewaters, and concentrated animal feeding operations.
2. The NPDES Permit Application Appendix (Appendix) contains supplemental information that will assist the applicant in completing the Application. **Please do not return the Appendix with the Application.**
3. The applicant is required to provide all requested information, unless otherwise specified**.** If a particular item or choice of answers in the application does not fit the circumstances or characteristics at the facility, enter **"NA" for "Not Applicable"** to indicate that the particular item was considered and not inadvertently omitted.

   It is the applicant's responsibility to adequately characterize the existing or proposed discharge. The applicant is required to provide additional information if the completed Application fails to provide that adequate characterization. Additional information can include, but is not limited to: narratives describing unique situations, additional monitoring performed by the applicant, whole effluent toxicity tests, water treatment additive descriptions, material data sheets, etc., and should be submitted as an attachment to the Application.

   Attachments can be additional copies of Application pages, information submitted on 8½ x 11 paper, or electronic documentation submitted on a CD-R.
4. When there are both existing facilities and proposed expansions of wastewater treatment facilities, or increases or changes in production, provide information for both. Make an extra copy of each Application page where there are differences between the existing and the proposed facility. (Include the "proposed facility" information only if the proposed facility is expected to be constructed and discharging within the next five years.)
5. Pollutant analysis shall be conducted in accordance with the requirements in Title 40 of the Code of Federal Regulations (CFR), Part 136, "Guidelines Establishing Test Procedures for the Analysis of Pollutants." Permitted dischargers that have EPA approval for the use of an alternate test procedure (in accordance with 40 CFR 136.4 and .5) are required to include a copy of the approval letter with their Application.

   Data submitted with the Application shall comply with Quality Assurance / Quality Control (QA/QC) requirements of 40 CFR 136 and other appropriate QA/QC requirements for analytes not addressed by 40 CFR 136. Analytical results shall be no more than five years old.

   When analytical results are below the parameter's quantification level, report the result as less than the value of the quantification level. Do not record the results as zero. Quantification levels for select parameters can be found in the Application Appendix in Table 7. **Analysis for those select parameters must be able to achieve the specified quantification level**.
6. After completing Section I and **either** Section II or Section III of the Application, return it along with any attachments and the **application fee** to one of the addresses below:

Mail Delivery
Michigan Department of Environmental Quality
Cashiers Office
WB-NP2
P.O. Box 30657
Lansing, Michigan 48909-8157

Office Delivery (e.g. UPS, Fed Ex, by hand)
Michigan Department of Environmental Quality
Cashiers Office
WB-NP2
5th Floor South, Constitution Hall
525 West Allegan
Lansing, Michigan 48933

Please Note: An Application that is submitted without the appropriate Application Fee is administratively incomplete and will not be processed until the fee has been received.

Do Not Return This Page With the Completed Application

INSTRUCTIONS FOR COMPLETING SECTION I, ITEMS 1 THROUGH 8

1) NPDES PERMIT NUMBER: Applicants for permit reissuances and modifications should provide the NPDES permit number of the existing permit. Applicants for new discharges should enter NA (not applicable).

2) APPLICANT NAME AND MAILING ADDRESS:
   - For industrial facilities - provide the parent company name and the division name.
   - For federal and state facilities - provide the department name and the division or bureau name.
   - For commercial facilities - provide both the owner's name and business's name.
   - For publicly-owned facilities - identify the legal owner of the facility and their mailing address.

3) FACILITY NAME AND LOCATION: Provide the name of the facility or plant. Provide the street address of the facility or plant. **DO NOT USE** P.O. Box numbers.

4) CONTACTS: Please provide the name, mailing address, telephone number and, where appropriate, the fax number and e-mail address of the following contacts:
   - Application: The person who should be contacted with questions concerning this permit application.
   - Facility: Each facility is required to have a facility contact. The facility contact for a publicly-owned treatment works should be the superintendent or a properly certified operator who is in charge of the day-to-day operation and maintenance of the treatment facility. The facility contact for a corporation should be a principal executive officer of at least the level of vice president, or their designated representative if the representative is responsible for the overall operation of the facility from which the discharge described in this permit application occurs. The facility contact for a partnership should be a general partner. The facility contact for a sole proprietorship should be the proprietor. The facility contact for a municipal, state, or other public facility should be a principal executive officer, the mayor, village president, city or village manager, or other duly authorized employee.
   - Discharge Monitoring Reports (DMRs): The person responsible for completing and returning the facility's Discharge Monitoring Reports.
   - Biosolids Billing: The person responsible for payment of the land application fee required by Section 324.3132 of the Michigan Act.
   - Storm Water Billing: The person responsible for payment of the facility's storm water permit fee required by Section 324.3118 of the Michigan Act.
   - NPDES Annual Billing: The person responsible for payment of the facility's NPDES Permit annual fee required by Section 324.3120 of the Michigan Act.

5) PERMIT ACTION REQUESTED: Indicate what type of permit action is being requested.

6) RULE 98 - ANTIDEGRADATION REQUIREMENTS: If this facility has never discharged wastewater to the surface waters (New Use), or the facility is discharging but has never been issued an NPDES permit (existing unpermitted), or the facility has previously been issued an NPDES permit but the facility is increasing the loading of pollutants to the receiving water, then check "yes" in this section and provide an Antidegradation Demonstration.

7) ADDITIONAL FACILITY LOCATION INFORMATION: Provide the following information.
   A. Is the treatment facility located within municipal boundaries?
   B. Identify the county and, where appropriate, the township where the facility is located.
   C. Identify the location of the facility using State Planar Coordinates (e.g., Town 1 N, Range 12 E, Section 34, SE1/4, NE 1/4), or where applicable, the Private (French) Land Claim designation.
   D. Identify the location of the facility using latitude and longitude, accurate to within 15 seconds (e.g., Latitude = 42°27'15", Longitude = -83°02'30"), or accurate to within 0.004 decimal degrees (e.g., Latitude = 42.454167, Longitude = -83.041667).

8) CERTIFIED OPERATOR: Provide the operator's name, certification number, certification classification(s), address, telephone number(s), and e-mail address. The Michigan Act requires that all dischargers to the surface waters of the State of Michigan employ a properly certified operator. Questions about operator certification should be directed to the Environmental Sciences and Services Division, Operator Training and Certification Unit, at 517-373-4755.

Michigan Department of Environmental Quality- Water Bureau

WASTEWATER DISCHARGE PERMIT APPLICATION

SECTION I - General Information

Section I shall be completed by all permit applicants. See Page iii for instructions on completing Section I, Pages 1 and 2. To submit additional information, see Page ii, Item 3.

Water Bureau Use Only	Cashier Use Only: 37000-40535-9412-481000-00
Receipt Number: _____	
Permit ID #: _____	

PLEASE TYPE OR PRINT

1	NPDES PERMIT NUMBER NA		
2. APPLICANT	Applicant Name Kathryn Huibregtse on behalf of Weyerhaeuser Company		
	Address RMT, Inc.	Address 2 or P.O. Box 150 N. Patrick Blvd., Suite 180	
	City Brookfield	State WI	ZIP Code 53045
	Telephone (with area code) (262) 879-1212	FAX (with area code) (262) 879-1220	
3. FACILITY	Facility Name 1 Operable Unit #4 at the Allied Paper/Portage Creek/Kalamazoo River Superfund Site (12th Street Landfill)		
	Facility Name 2		
	Facility Name 3		
	Street Address (do not use a P.O. Box Number) 480 12th Street		
	City Plainwell	State MI	ZIP Code 49080
	Telephone (with area code) NA	FAX (with area code) NA	

4. CONTACTS	☒ Application Contact ☐ Facility Contact ☐ Discharge Monitoring Reports ☐ Storm Water Billing ☐ Biosolids Billing ☐ NPDES Annual Billing	First Name Kathryn	Last Name Huibregtse
		Title Vice President	Business RMT, Inc
		Address 1 150 N. Patrick Blvd., Suite 180	Address 2
		City Brookfield	State WI	ZIP Code 53045
		Telephone (with area code) (262) 879-1212	FAX (with area code) (262) 879-1220	e-mail address kathryn.huibregtse@rmtinc.com
	☐ Application Contact ☒ Facility Contact ☐ Discharge Monitoring Reports ☐ Storm Water Billing ☐ Biosolids Billing ☐ NPDES Annual Billing	First Name Jennifer	Last Name Overvoorde
		Title Field Sampling Coordinator	Business RMT, Inc
		Address 1 2025 E. Beltline Ave SE, Suite 402	Address 2
		City Grand Rapids	State MI	ZIP Code 49546
		Telephone (with area code) (616) 975-5414	FAX (with area code) (616) 975-1098	e-mail address jennifer.overvoorde@rmtinc.com
	☐ Application Contact ☐ Facility Contact ☒ Discharge Monitoring Reports ☐ Storm Water Billing ☐ Biosolids Billing ☐ NPDES Annual Billing	First Name James	Last Name Hutchens
		Title Senior Project Manager	Business RMT, Inc
		Address 1 150 N. Patrick Blvd., Suite 180	Address 2
		City Milwaukee	State WI	ZIP Code 53045
		Telephone (with area code) (262) 879-1212	FAX (with area code) (262) 879-1220	e-mail address james.hutchens@rmtinc.com

Michigan Department of Environmental Quality- Water Bureau

WASTEWATER DISCHARGE PERMIT APPLICATION

SECTION I - General Information

PLEASE TYPE OR PRINT

FACILITY NAME	NPDES PERMIT NUMBER
Operable Unit #4 at the Allied Paper/Portage Creek/Kalamazoo	NA

5. PERMIT ACTION REQUESTED (Check one box only) - Instructions for this item are on Page iii.

☒ **NEW USE** A proposed discharge OR an existing discharge that is currently unpermitted.

☐ **REISSUANCE** of current permit.

☐ **MODIFICATION** of current permit. Attach a description of the proposed modification.

Note: Applications for **New Use** discharges and applications for either **Reissuance** or **Modification** that include an increased loading of pollutants to the receiving water are required to submit a Rule 98 Demonstration with the Application. See Item 6.

6. RULE 98 - ANTIDEGRADATION REQUIREMENTS - Instructions for this item are on Page iii.

In accordance with Rule 323.1098 of the Michigan Water Quality Standards, the applicant is required to submit an Antidegradation Demonstration for any new or increased loading of pollutants to the surface waters of the state. An Antidegradation Demonstration must contain the information specified in Rule 1098, Antidegradation section of the Appendix. For assistance completing this item, contact the Permits Section.

Will this discharge be an increased loading of pollutants to the surface waters of the state?

☐ Yes. Submit an Antidegradation Demonstration.

☒ No. Continue with Item 7.

7 ADDITIONAL FACILITY LOCATION INFORMATION - Instructions for this item are on Page iii.

A Is the treatment facility within municipal boundaries? ☒ Yes ☐ No

B	County Allegan				Township Otsego	
C.	Town 1N	Range 12W	Section 24	¼ S	¼, ¼ N	Private (French) Land Claim NA
D.	Latitude 42:27:24				Longitude -85:40:11	

8. CERTIFIED OPERATOR Does the facility have a DEQ certified operator? ☒ Yes ☐ No Instructions for this item are on Page iii.

First Name Provided by contractor	Last Name	
Certification Number	Certification Classification(s)	
Address 1	Address 2	
City	State	Zip Code
Telephone Number	Fax Number	e-mail address

9. OTHER ENVIRONMENTAL PERMITS

Provide the information requested below for any other federal, state, or local environmental permits in effect or applied for at the time of submittal of this Application form; including, but not limited to, permits issued under any of the following programs: Air Pollution Control, Hazardous Waste Management, Wetlands Protection, Soil Erosion and Sedimentation Control, and other NPDES permits. To submit additional information, see Page ii, Item 3.

Issuing Agency	Permit or COC Number	Permit Type
US Army Corp of Engineers/MDEQ	NA - submittal	Joint Permit

WASTEWATER DISCHARGE PERMIT APPLICATION

SECTION I - General Information

PLEASE TYPE OR PRINT

FACILITY NAME	NPDES PERMIT NUMBER
Operable Unit #4 at the Allied Paper/Portage Creek/Kalamazoo	NA

10. WATER FLOW DIAGRAM AND NARRATIVE DESCRIPTION

Provide a flow diagram (using **8½" x 11"** paper **if possible**) showing the wastewater flow through the facility (from intake through discharge), including all processes, treatment units, and bypass piping, and include a narrative description that explains the diagram. Show all operations contributing wastewater and the locations of flow meters, chemical feeds, and monitoring and discharge points. The water balance shall show the daily average flow rates at the intake and discharge points, and approximate daily flow rates between treatment units, including influent and treatment rates. Use actual measurements whenever available, otherwise use the best estimate. Show all significant losses of water to products, atmosphere, and discharge. In addition, provide a flow diagram for any storm water discharges from secondary structures that are required by state or federal law, and for storm water runoff from any Site of Environmental Contamination, pursuant to Part 201 of the Michigan Act. **Do not send blueprints.**

Do the treatment facility processes described above include any lagoons or ponds used for wastewater treatment or storage? ☐ Yes ☒ No

If yes, include the ponds or lagoons in the flow diagram.

Municipal Facilities - Include a narrative that briefly describes the history of the wastewater treatment facility and collection system, including the initial construction, the facility improvements that have been made, future plans for upgrade, the location of all constructed emergency overflows, and other pertinent information.

Industrial and Commercial Facilities - The line diagram shall include all operations contributing wastewater, including process and production areas, sanitary flows, cooling water, and storm water runoff. **Also include a narrative** that provides a brief description of the nature of the business and the manufacturing processes.

ATTACH THIS INFORMATION TO THIS APPLICATION. PLEASE DO NOT BIND THIS INFORMATION.

11. MAP OF FACILITY AND DISCHARGE LOCATION

Provide a detailed map on 8½" x 11" paper showing the location of the existing or proposed facility, wastewater and biosolid treatment system(s), and wastewater monitoring and discharge points into receiving waters (including bypasses). Include the exact location of the wastewater monitoring and discharge point(s) and all areas through which the discharge flows (e.g., wetlands, open drains, storm sewers), if applicable, between the discharge point and the receiving water. If the discharge is to a storm sewer, label the storm sewer and show its flow path to the receiving water. Also include the location of any water supply intakes or wells, and groundwater monitoring wells. This map shall be a United States Geological Survey Quadrangle (7.5 minute series) or other map of comparable detail, scale, and quality (which shows surface water bodies, roads, bathing beaches, and other pertinent landmarks). **The minimum area this map shall encompass is approximately one mile beyond the property boundaries.**

ATTACH THIS INFORMATION TO THIS APPLICATION.

12. CONTRACT LABORATORIES THAT PROVIDE ANALYTICAL SUPPORT

Provide the name and address of each contract laboratory or consulting firm that performed any analyses submitted as part of this Application. To submit additional information, see Page ii, Item 3.

Laboratory Name NA			Laboratory Name NA		
Street Address			Street Address		
City	State	ZIP Code	City	State	ZIP Code
Telephone (with area code)	Fax (with area code)		Telephone (with area code)	Fax (with area code)	
Analysis Performed			Analysis Performed		
Laboratory Name NA			Laboratory Name NA		
Street Address			Street Address		
City	State	City	State	City	State
Telephone (with area code)	Fax (with area code)		Telephone (with area code)	Fax (with area code)	
Analysis Performed			Analysis Performed		

Michigan Department of Environmental Quality- Water Bureau

WASTEWATER DISCHARGE PERMIT APPLICATION

SECTION I - General Information

PLEASE TYPE OR PRINT

FACILITY NAME	NPDES PERMIT NUMBER
Operable Unit #4 at the Allied Paper/Portage Creek/Kalamazoo	NA

13. LIST ADJACENT PROPERTY OWNERS

List the names and mailing addresses of all property owners for all properties adjacent to the facility, treatment systems, and discharge locations. For vacant lots or empty buildings supply the owners mailing address not the lot or building property address. To submit additional information, see Page ii, Item 3.

Name	Address	City	State	ZIP Code
MDNR	12th Street at Plainwell Dam	Plainwell	MI	49080
Aggregate Industries	465 12th Street	Plainwell	MI	49080

WASTEWATER DISCHARGE PERMIT APPLICATION

SECTION I - General Information

PLEASE TYPE OR PRINT

FACILITY NAME	NPDES PERMIT NUMBER
Operable Unit #4 at the Allied Paper/Portage Creek/Kalamazoo	NA

14. STORM WATER DISCHARGES

Facilities that discharge storm water must provide the following information. (Please Note: The following discharges are also covered by storm water authorization, provided they are addressed in the facility's Storm Water Pollution Prevention Plan [SWPPP]): Discharges from fire hydrant flushing; potable water sources, including water line flushing; fire system test water; irrigation drainage; lawn watering; routine building wash down which does not use detergents or other compounds; pavement wash waters where spills or leaks of toxic or hazardous materials have not occurred (unless all spilled material has been removed) and where detergents are not used; air conditioning condensate; springs; uncontaminated ground water; and foundation or footing drains where flows are not contaminated with process materials such as solvents. **Unless otherwise specified answer the following questions.**

A. Is the storm water from this facility discharged to the waters of the state either directly or through another conveyance? Note: If storm water is discharged to a municipal wastewater treatment system or a privately owned activated sludge treatment system check the "No" box.

☒ Yes.

☐ No. Continue with Item 15.

B. Is the facility identified in this application primarily engaged in an "industrial activity" as defined in 40 CFR 122.26(b)(14)?

☐ Yes.

☒ No. Continue with Item 15.

C. Are there any industrial activities or materials exposed to storm water at this facility? Storm water discharge requirements may be excluded from an NPDES permit when there are no industrial activities or materials exposed to storm water. To qualify, the applicant shall certify that the facility has met all the eligibility requirements to claim a condition of "no exposure". These requirements are found in the No-Exposure Certification form in the appendix. This form is also available on the DEQ's Internet Page. To access the form, go to http://www.michigan.gov/deq. In the left column click on WATER, click on Surface Water, click on Storm Water, in the middle column click on Industrial Program, then click on No Exposure Certification.

☐ Yes.

☐ No. Complete the No-Exposure Certification form, and submit it with this application. Continue with Item 15.

D. Does this facility have a current and up-to-date SWPPP?

☐ Yes.

☐ No. **Note: The applicant must complete this program element to receive storm water discharge authorization.**

E. Has the facility implemented the nonstructural controls described in the SWPPP?

☐ Yes.

☐ No. **Note: The applicant must complete this program element to receive storm water discharge authorization.**

F. Have all the structural controls described in the SWPPP been constructed and put into operation?

☐ Yes.

☐ No. **Note: The applicant must complete this program element to receive storm water discharge authorization.**

G. Does this facility have a certified industrial storm water operator who supervises the facility's storm water treatment and control measures included in the Storm Water Pollution Prevention Plan?

☐ Yes. _____ Storm Water Operator Name _____ Certification Number

☐ No. **Note: The applicant must complete this program element to receive storm water discharge authorization.**

H. Is any of the storm water discharged from (check all that apply):

☐ Secondary containment structures that are required by state or federal law. On a separate page. provide a list the materials that are stored in this area.

☐ Areas identified on Michigan's list of Sites of Environmental Contamination, pursuant to the Natural Resources and Environmental Protection Act, PA 451 of 1994, Part 201 (formerly 307).

I. The storm water from this facility discharges to the following receiving water(s): _____

Please note that applicants should provide any sample data taken of the storm water discharge as an attachment. To submit additional information, see Page ii, Item 3.

Michigan Department of Environmental Quality- Water Bureau

WASTEWATER DISCHARGE PERMIT APPLICATION

SECTION I - General Information

PLEASE TYPE OR PRINT

FACILITY NAME	NPDES PERMIT NUMBER
Operable Unit #4 at the Allied Paper/Portage Creek/Kalamazoo	NA

15 CERTIFICATION

Rule 323.2114(1-4), promulgated under the Michigan Act, requires that this Application be signed as follows:

A. For an organization, company, corporation, or authority, by a principal executive officer.
B. For a partnership, by a general partner.
C. For a sole proprietor, by the proprietor.
D. For a municipal, state, or other public facility, by a principal executive officer or ranking elected official (such as the mayor, village president, city or village manager, or clerk).

Note: If the signatory is not listed above, but is authorized to sign the Application, please provide documentation of that authorization.

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for having knowledge of violations."

Print Name: _____ Title: _____

Representing: _____

Signature: _____ Date: _____

This completes Section I. Publicly-Owned Treatment Works discharging sanitary and industrial wastewater to the surface waters, and privately-owned treatment works discharging sanitary wastewater to the surface waters should complete Section II. Privately-owned treatment works include, but are not limited to, Mobile Home Parks, Campgrounds, Condominiums, Hotels and Motels, Nursing Homes, etc. All other applicants should complete Section III. If assistance is needed completing this Application, contact the Permits Section.

Permit Application Submittal Checklist

Please confirm the following before submitting the application form:

☒ 1. Section I has been completed, including all diagrams, maps, and the treatment process narrative.

☒ 2. The Application has been signed as required above in Section I.15. (A.-D.) or a copy of the letter authorizing the signatory to sign the letter has been included.

☒ 3. Section II or Section III has been completed, including any additional information or submissions.

☐ 4. A check or Money Order for the appropriate application fee has made out to the "State of Michigan and has been included with the application submittal.

Michigan Department of Environmental Quality- Water Bureau

WASTEWATER DISCHARGE PERMIT APPLICATION

SECTION II - Sanitary Wastewater

Section II is to be completed by Publicly-Owned Treatment Works discharging treated or untreated sanitary and industrial wastewater to the surface waters. Section II is also to be completed by all privately-owned treatment works discharging treated sanitary wastewater to the surface waters. The privately-owned treatment works include, but are not limited to, Mobile Home Parks, Campgrounds, Condominiums, Hotels and Motels, Nursing Homes, etc.

A. Facility Information

PLEASE TYPE OR PRINT

FACILITY NAME	NPDES PERMIT NUMBER

1. WATER SUPPPLY INFORMATION

List the source(s) of water supply in the area served by sewers. Identify groundwater wells and surface water intakes, as well as the name(s) of any surface water(s) from which intake water is drawn.

2. SERVICE AREA INFORMATION

Publicly-Owned Treatment Works are required to provide the following information: List the governmental jurisdictions (cities, townships, villages, etc.) that this facility serves (applicants should include themselves). What is the population in each jurisdiction? Is the jurisdiction's collection system separate, combined, or both? If the collection system is both separate and combined, what percentage is combined? To submit additional information, see Page ii, Item 3.

Name	Type of Collection System	Percent Combined	Population Served

Total population served by this facility: _____

Privately-Owned Treatment Works are required to provide the following information:

Describe the area served by this facility (mobile home park, condominium, nursing home, industrial facility, etc.).

Provide the number of residential units served by this facility: _____

3. BIOMONITORING FOR ACUTE AND CHRONIC TOXICITY

Publicly-Owned Treatment Works (POTWs) meeting one or more of the following criteria are required to submit with this application the **results of four** whole effluent toxicity (WET) tests for each of the facility's discharge points, excluding combined sewer overflows: 1) POTWs with a design flow rate greater than or equal to one (1) million gallons per day; 2) POTWs with an approved Federal Industrial Pretreatment Program (FIPP); and/or 3) POTWs required to develop a FIPP.

The results of the tests shall be reported using the Acute Toxicity Test Report, *Ceriodaphnia Dubia* Chronic Toxicity Test Report and the Fathead Minnow Chronic Toxicity Test Report available in the Appendix. Please do not submit additional forms or paperwork pertaining to WET tests with this application.

At a minimum, the applicant shall submit the results of quarterly WET testing for a 12-month period prior to this application, or the results of annual WET tests conducted during the five years prior to this Application. In addition, the applicant shall submit the results of any other WET tests from the past five years. If a WET test in the past 4-½ years revealed toxicity, provide all the information on the cause of toxicity or the results of all toxicity reduction evaluations, if any were conducted. The applicant does not need to submit results for previously submitted WET Tests. **For assistance, see the "Whole Effluent Toxicity Test Guidance and Requirements" section in the Appendix.**

INSTRUCTIONS FOR COMPLETING SECTION II B. OUTFALL INFORMATION, ITEMS 1 A - H

1. OUTFALL INFORMATION

This item requires detailed information on each outfall at the facility (Wastewater Treatment Plant [WWTP] or Retention Treatment Basin [RTB]). For this item, outfall refers to the point where **treated** wastewater from a WWTP or RTB is discharged to the surface waters of the state. "Surface Waters of the State" include the Great Lakes and their connecting waters, all inland lakes, rivers, streams, impoundments, open drains, and other surface bodies of water within the confines of the state. The applicant will need to complete Pages 9 -17 for each outfall. Fill in the Outfall Number in the top right-hand box, identifying the outfall by number, e.g., 001, 002, etc. Applicants with existing NPDES permits should refer to the facility's current NPDES permit for outfall number identification. For each outfall, provide the location, the expected and/or measured volume of effluent discharged, the frequency of the discharge, and the flow variation of the discharge.

A. Identify the watershed where the outfall is located. See the Upper and Lower Peninsula Hydrologic Maps in the Appendix for the state's watersheds and their Hydrologic Unit Codes (HUC). Then match the HUC code to the watershed name in the associated table of Watershed Names.

B. Identify the receiving water (Waters of the State) to which the facility's outfall(s) discharge.

C. Identify the county and township where the outfall is located.

D. Identify the location of the outfall using State Planar Coordinates. (e.g., Town 1 N, Range 12 E, Section 34. SE 1/4, NE 1/4) or, where applicable, the Private (French) Land Claim designation.

E. Identify the location of the outfall using latitude and longitude, accurate to within 15 seconds (e.g., Latitude = 42°27'15", Longitude = - 83°02'30"), or accurate to within 0.004 decimal degrees (e.g., Latitude = 42.454167, Longitude = -83.041667).

F. Enter the Annual Average Design Flow that the facility is designed to treat. **Continuous Dischargers** are required to enter the Total Volume (million gallons per day [MGD]) of wastewater the facility is designed to treat as discharged per-day. **Seasonal Dischargers** are required to enter the total volume (million gallons per year [MGY]) of wastewater the facility is designed to treat and discharge per year. The design flow is used in determining the appropriate effluent limitations for the discharge.

G. A discharge is considered to be seasonal if the facility treats and then **stores** wastewater throughout the year, or portion of the year, and then discharges it a few days, weeks, or months a year. Provide the dates the facility discharges the treated wastewater (e.g., October 15 through November 10) and the average discharge flows (e.g., 5 MGD).

H. A continuous discharge is any discharge that is not a seasonal discharge. Provide the approximate hours per day and the number of days per year that the discharge occurs from this outfall. Also provide the actual annual average facility flow and the maximum daily facility flow for the past three years. Batch Dischargers are required to provide the peak batch flow rate, the number of batches per day, the per-batch minimum, average, and maximum volumes in gallons, and the per-batch minimum, average, and maximum batch discharges in minutes.

Michigan Department of Environmental Quality- Water Bureau

WASTEWATER DISCHARGE PERMIT APPLICATION

SECTION II - Sanitary Wastewater

B. Outfall Information

Complete a separate Section II. B. Outfall Information (Pages 9 - 17) for each outfall at the facility. Make copies of Section II. B. for each additional outfall that discharges treated wastewater.

PLEASE TYPE OR PRINT

FACILITY NAME	NPDES PERMIT NUMBER	OUTFALL NUMBER

1. OUTFALL INFORMATION - Instructions for this item are on Page 8.

A.	Watershed					HUC Code:
B.	Receiving Water					
C.	County				Township	
D.	Town	Range	Section	¼	¼, ¼	Private (French) Land Claim)
E.	Latitude				Longitude	

F. Facility Annual Average Design Flow: Seasonal Discharge _____ MGY (Continue with Item G).

Continuous Discharge _____ MGD (Continue with Item H).

G. Seasonal Discharge:

List the discharge periods (by month) in the space provided below.

From	Through	Discharge Volume (MGD)	Annual Total
From	Through	Discharge Volume (MGD)	
From	Through	Discharge Volume (MGD)	
From	Through	Discharge Volume (MGD)	

H. Continuous Discharge:

How often is there a discharge from this outfall (on the average)? _____ Hours/Day _____ Days/Year

Provide the actual facility flows for the past three years.	Three Years Ago	Two Years Ago	Last Year
Annual Average Daily Flow (MGD)			
Maximum Daily Flow in a Single Day (MGD)			

Batch dischargers are required to provide the following additional information:

Is there effluent flow equalization? ☐ Yes ☐ No

Batch Peak Flow Rate: _____ Number of batches discharged per day: _____

	Minimum	Average	Maximum
Batch Volume (gallons)			
Batch Duration (minutes)			

Michigan Department of Environmental Quality- Water Bureau

WASTEWATER DISCHARGE PERMIT APPLICATION

SECTION II - Sanitary Wastewater

B. Outfall Information

PLEASE TYPE OR PRINT

FACILITY NAME	NPDES PERMIT NUMBER	OUTFALL NUMBER

2. EFFLUENT CHARACTERISTICS – CONVENTIONAL POLLUTANTS

Existing Treatment Works Treating Domestic Sewage (TWTDS) are required to report **data** from effluent analysis for the parameters listed below. (See the Definition Section in the Appendix for sampling definitions, including "maximum daily concentration" and "maximum monthly concentration.") RTBs are required to provide a summery of influent and effluent data for the last five years. **For analytical test requirements, or if alternate test procedures for any parameter listed below have been approved, see Page ii, Item 5.**

New TWTDS are required to provide **estimated** effluent concentrations for the parameters listed below.

☐ Check this box if additional information is included as an attachment. To submit additional information, see Page ii, Item 3.

Please Note: Rule 323.1062 allows the use of either Escherichia Coliform Bacteria or Fecal Coliform Bacteria as the indicator that effluent has been disinfected. The Department will use the indicator selected below in the permit issued based on this Application.

☐ Use Escherichia Coliform Bacteria as an indicator of disinfection.

☐ Use Fecal Coliform Bacteria as an indicator of disinfection.

Parameter	Maximum Monthly Concentration	Maximum Daily Concentration	Units	Number of Analyses	Sample Type
Biochemical Oxygen Demand - five day (BOD_5)			mg/l		☐ Grab ☐ 24 Hr Comp
BOD_5, Lowest % Removed		~~Do Not Use~~	%		☐ Grab ☐ 24 Hr Comp
Carbonaceous BOD_5 ($CBOD_5$)			mg/l		☐ Grab ☐ 24 Hr Comp
Carbonaceous BOD_5, Lowest % Removed		~~Do Not Use~~	%		☐ Grab ☐ 24 Hr Comp
Ammonia Nitrogen (as N)			mg/l		☐ Grab ☐ 24 Hr Comp
Total Suspended Solids			mg/l		☐ Grab ☐ 24 Hr Comp
Total Suspended Solids, Lowest % Removed		~~Do Not Use~~	%		☐ Grab ☐ 24 Hr Comp
Total Dissolved Solids			mg/l		☐ Grab ☐ 24 Hr Comp
Total Phosphorus (as P)			mg/l		☐ Grab ☐ 24 Hr Comp
Fecal Coliform Bacteria (report geometric means)		max. 7-day	counts/100 ml		Grab
Escherichia Coliform Bacteria (report geometric means)		max. 7-day	counts/100 ml		Grab
Total Residual Chlorine			☐ µg/l ☐ mg/l		Grab
Dissolved Oxygen	~~Do Not Use~~	min. daily	mg/l		☐ Grab ☐ 24 Hr Comp
pH	Minimum	Maximum	standard units		☐ Grab ☐ 24 Hr Comp
Temperature			☐ °F ☐ °C		☐ Grab ☐ 24 Hr Comp
					☐ Grab ☐ 24 Hr Comp
					☐ Grab ☐ 24 Hr Comp

WASTEWATER DISCHARGE PERMIT APPLICATION

SECTION II - Sanitary Wastewater

B. Outfall Information

PLEASE TYPE OR PRINT

FACILITY NAME	NPDES PERMIT NUMBER	OUTFALL NUMBER

3. EFFLUENT CHARACTERISTICS - TOXIC POLLUTANTS

Existing Publicly-Owned Treatment Works (POTWs) with (1) a design flow greater than or equal to 1.0 MGD; or (2) an approved Federal Industrial Pretreatment Program (FIPP); or (3) required to develop a FIPP or otherwise required by the permitting authority shall provide the results of a minimum of three effluent analyses for each parameter listed below for each outfall through which effluent is discharged. Any effluent testing data for pollutants not specifically listed shall be included using the blank rows provided on Page 17. Do not include information on combined sewer overflows in this section.

All existing POTWs (unless already included above) are required to provide (1) the results of at least one effluent analysis (taken in the last five years) for any chemical that is known or believed to be present in facility effluent that is listed in Tables 2, 3, and 4 of the Appendix; (2) a measured or estimated effluent concentration for any chemical that is known or believed to be present that is listed in Table 5 of the Appendix; (3) a measured or estimated concentration for any toxic or otherwise injurious chemical known or believed to be present in facility effluent that is not previously identified in this application; and (4) results of all other effluent analyses that have been performed within the past five years for any chemical listed in Tables 2, 3, 4, and 5 of the Appendix.

New POTWs are required to provide an estimated effluent concentration for any chemical expected to be present in facility effluent that is listed in Tables 2, 3, 4, and 5 of the Appendix, and an estimated effluent concentration for any toxic or otherwise injurious chemical known or believed to be present in facility effluent that has not been previously identified in this Application.

Note: If the effluent concentrations are estimated, place an E in the "Analytical Method" column. In accordance with Rule 323.1211(7), facilities whose supply water contains toxic pollutants that are withdrawn from and discharged to the same body of water may qualify for intake credits for those toxic pollutants. See Rule 1211(7) for qualification and demonstration requirements. All effluent data submitted in response to this part should be recorded on Pages 11 –17. To submit additional information, see Page ii, Item 3. Report all sampling results in ug/l.

For analytical test requirements, or if alternate test procedures for any parameter listed below have been approved, see Page ii, Item 5 and Table 7 in the Appendix.

SAMPLE DATE ➔															
PARAMETER	**CAS No.**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Sample Type**	**Analytic Method**	**QL**	**DL**
METALS (TOTAL RECOVERABLE), CYANIDE, PHENOLS, AND HARDNESS															
Antimony	7440360														
Arsenic	7440382														
Beryllium	7440417														
Cadmium	7440439														
Chromium	7440473														
Copper	7440508														
Lead	7439921														
Mercury (EPA Method 1631)	7439976														
Nickel	7440020														

WASTEWATER DISCHARGE PERMIT APPLICATION

SECTION II - Sanitary Wastewater

B. Outfall Information

PLEASE TYPE OR PRINT

FACILITY NAME	NPDES PERMIT NUMBER	OUTFALL NUMBER

SAMPLE DATE ➔															
PARAMETER	**CAS No.**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Sample Type**	**Analytic Method**	**QL**	**DL**
Selenium	7782492														
Silver	7440224														
Thallium	7440280														
Zinc	7440666														
Available Cyanide (Method OIA 1677)	57125														
Total Phenolic Compounds	None														
Hardness (as $CACO_3$)	None														
VOLATILE ORGANIC COMPOUNDS															
Acrolein	107028														
Acrylonitrile	107131														
Benzene	71432														
Bromoform	75252														
Carbon Tetrachloride	56235														
Chlorobenzene	108907														
Chlorodibromo-methane	124481														
Chloroethane	75003														
2-chloro-ethylvinyl Ether	110758														
Chloroform	67663														
Dichlorobromo-methane	75274														
1,1-dichloroethane	75343														

WASTEWATER DISCHARGE PERMIT APPLICATION

SECTION II - Sanitary Wastewater

B. Outfall Information

PLEASE TYPE OR PRINT

FACILITY NAME	NPDES PERMIT NUMBER	OUTFALL NUMBER

SAMPLE DATE ➔															
PARAMETER	**CAS No.**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Sample Type**	**Analytic Method**	**QL**	**DL**
1,2-dichloroethane	107062														
Trans-1,2-dichloro-ethylene	156605														
1,1-dichloroethylene	75354														
1,2-dichloropropane	78875														
1,3-dichloro-propylene	542756														
Ethylbenzene	100414														
Methyl Bromide	74839														
Methyl Chloride	74873														
Methylene Chloride	75092														
1,1,2,2-tetra-chloro Ethane	79345														
Tetrachloroethylene	127184														
Toluene	108883														
1,1,1-trichloroethane	71556														
1,1,2-trichloroethane	79005														
Trichloroethylene	79016														
Vinyl Chloride	75014														
ACID-EXTRACTABLE COMPOUNDS															
P-chloro-m-creso	None														
2-chlorophenol	95578														
2,4-dichlorophenol	120832														

WASTEWATER DISCHARGE PERMIT APPLICATION

SECTION II - Sanitary Wastewater

B. Outfall Information

PLEASE TYPE OR PRINT

FACILITY NAME	NPDES PERMIT NUMBER	OUTFALL NUMBER

SAMPLE DATE ➔															
PARAMETER	**CAS No.**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Sample Type**	**Analytic Method**	**QL**	**DL**
2,4-dimethylphenol	105679														
4,6-dinitro-o-cresol	534521														
2,4-dinitrophenol	51285														
2-nitrophenol	88755														
4-nitrophenol	100027														
Pentachlorophenol	87865														
Phenol	108952														
2,4,6-trichlorophenol	88062														
BASE-NEUTRAL COMPOUNDS															
Acenaphthene	83329														
Acenaphthylene	208968														
Anthracene	120127														
Benzidine	92875														
Benzo(a)anthracene	56553														
Benzo(a)pyrene	50328														
3,4 benzo-fluoranthene	205992														
Benzo(ghi)perylene	191242														
Benzo(k)-fluoranthene	207089														
Bis (2-chloroethoxy) methane	111911														
Bis (2-chloroethyl)-ether	111444														

WASTEWATER DISCHARGE PERMIT APPLICATION

SECTION II - Sanitary Wastewater

B. Outfall Information

PLEASE TYPE OR PRINT

FACILITY NAME	NPDES PERMIT NUMBER	OUTFALL NUMBER

SAMPLE DATE ➔															
PARAMETER	**CAS No.**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Sample Type**	**analytic method**	**QL**	**DL**
Bis (2-chloroiso-propyl) ether	108601														
Bis (2-ethylhexyl) phthalate	117817														
4-bromophenyl phenyl ether	101553														
Butyl benzyl phthalate	85687														
2-chloronaphthalene	91587														
4-chlorophenyl phenyl ether	7005723														
Chrysene	218019														
Di-n-butyl phthalate	84742														
Di-n-octyl phthalate	117840														
Dibenzo(a,h) anthracene	53703														
1,2-dichlorobenzene	95501														
1,3-dichlorobenzene	541731														
1,4-dichlorobenzene	106467														
3,3-dichlorobenzidine	91941														
Diethyl Phthalate	84662														
Dimethyl Phthalate	131113														
2,4-dinitrotoluene	121142														
2,6-dinitrotoluene	606201														
1,2-diphenylhydrazine	122667														
Fluoranthene	206440														

WASTEWATER DISCHARGE PERMIT APPLICATION

SECTION II - Sanitary Wastewater

B. Outfall Information

PLEASE TYPE OR PRINT

FACILITY NAME	NPDES PERMIT NUMBER	OUTFALL NUMBER

SAMPLE DATE ➔															
PARAMETER	**CAS No.**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Sample Type**	**Analytical**	**QL**	**DL**
Fluorene	86737														
Hexachlorobenzene	118741														
Hexachlorobuta-diene	87683														
Hexachlorocyclo-pentadiene	77474														
Hexachloroethane	67721														
Indeno(1,2,3-cd) pyrene	193395														
Isophorone	78591														
Naphthalene	91203														
Nitrobenzene	98953														
N-nitrosodi-n-propylamine	None														
N-nitrosodi-methylamine	62759														
N-nitrosodi-phenylamine	86306														
Phenanthrene	85018														
Pyrene	129000														
1,2,4-trichlorobenzene	120821														

Michigan Department of Environmental Quality- Water Bureau

WASTEWATER DISCHARGE PERMIT APPLICATION

SECTION II - Sanitary Wastewater

C. Collection System Information

PLEASE TYPE OR PRINT

FACILITY NAME	NPDES PERMIT NUMBER

1. COMBINED SEWER SYSTEM INFORMATION
   Complete this item if there are outfalls at the treatment facility or along the combined sewer collection system from which discharges of untreated or partially treated wastewater occur. Update the information in items A, B, and C below if it has changed since the last application submission.

   A. Estimate the percentage of the collection system that is combined: _____ %

   B. System Map. Provide a map that shows all CSO discharge points.

   C. System Diagram. Provide a diagram, in the above map or on a separate drawing, of the combined sewer collection system. Include the locations of major trunk line sewers, both combined and separate sanitary; the locations of points where separate sanitary sewers feed into the combined sewer system; the locations of in-line and off-line storage structures; locations of flow regulating devices, and the locations of pump stations.

2. COMBINED SEWER OUTFALL INFORMATION
   Identify the outfall(s) from your current permit by number (e.g., 001, 002, etc.). Provide the current status of the outfall (active, inactive, bulk headed, removed), and indicate if continued authorization is required. Attach specific outfall location and discharge information for all outfalls not previously identified.

Outfall Number	**Status of Outfall**	**Continue Authorization**
		☐ **Yes** ☐ **No**
		☐ **Yes** ☐ **No**
		☐ **Yes** ☐ **No**
		☐ **Yes** ☐ **No**
		☐ **Yes** ☐ **No**
		☐ **Yes** ☐ **No**
		☐ **Yes** ☐ **No**
		☐ **Yes** ☐ **No**
		☐ **Yes** ☐ **No**
		☐ **Yes** ☐ **No**
		☐ **Yes** ☐ **No**
		☐ **Yes** ☐ **No**
		☐ **Yes** ☐ **No**
		☐ **Yes** ☐ **No**
		☐ **Yes** ☐ **No**
		☐ **Yes** ☐ **No**
		☐ **Yes** ☐ **No**
		☐ **Yes** ☐ **No**
		☐ **Yes** ☐ **No**
		☐ **Yes** ☐ **No**
		☐ **Yes** ☐ **No**

Michigan Department of Environmental Quality- Water Bureau

WASTEWATER DISCHARGE PERMIT APPLICATION

SECTION II - Sanitary Wastewater

D. Non-Domestic Wastewater Information

PLEASE TYPE OR PRINT

FACILITY NAME	NPDES PERMIT NUMBER

1. SEPTAGE - Does this facility accept septage? (NOTE QUESTIONS 2-4 HAVE BEEN REORDERED)

☐ Yes. On a separate sheet, describe the allocation of the Maximum Allowable Headworks Loading (MAHL) capacity to domestic wastewater, non-domestic wastewater, and septage. The MAHL should include the treatment plant's design and current loading, and at a minimum, the number of gallons and concentrations of the pollutants BOD, TSS, PO4, and NH3 that are attributable to each wastewater.

☐ No. Continue with Item 2.

2. RESOURCE CONSERVATION AND RECOVERY ACT (RCRA) WASTEWATER

Does this facility receive, or has it in the last three years received, RCRA hazardous waste by truck, rail, or dedicated pipe?

☐ Yes. Provide the following information on a separate sheet: The method by which the waste is received (truck, rail, or dedicated pipe); the waste's "EPA Hazardous Waste Number;" and the amount of waste received in either mass or volume.

☐ No. Continue with Item 3.

3. REMEDIATION WASTEWATER

Does this facility receive (or has it been notified that it will receive in the next five years) wastes from remedial activities?

☐ Yes. Provide a list on a separate sheet that contains the following information for each current and future remediation site:

1) Describe the site and type of facility at which the CERCLA/RCRA/or other remedial waste originates or will originate.

2) List the hazardous constituents that are, or are expected to be, received at the POTW. Include data on volume and concentration, if known.

3) Describe in detail any treatment the waste receives before being discharged to the POTW.

4) Provide the schedule for when the remediation wastewater is discharged to the POTW.

☐ No. Continue with Item 4.

4. INDUSTRIAL AND COMMERCIAL SOURCES

A. Does this facility receive any non-domestic wastewater from any industrial or commercial facilities? (Non-domestic wastewater refers to water that carries wastes other than human and household wastes.)

☐ Yes. Continue with Item B.

☐ No. Go to Part E. Biosolids Information.

B. Provide the following information:

1) Estimate the average volume of non-sanitary wastewater received by this facility: _____ gallons/day

2) Describe the type of non-domestic wastewater(s) received by this facility in the space provided below. (Check all that are appropriate.)

Wastewater Type	Volume (MGD)	Wastewater Type	Volume (MGD)
Industrial Process Wastewater	_____	Landfill Leachate	_____
Contact Cooling Water	_____	Trucked Industrial Wastewater	_____
Noncontact Cooling Water	_____	Other _____	_____

C. Is an Industrial Pretreatment Program (IPP) currently required by the DEQ? **Note:** Applicants with an Industrial Pretreatment Program are required to also complete Item 5 on Page 21.

☐ Yes. Provide the most recent approval date for the following elements of your program.

Sewer Use Ordinance _____ Interjurisdictional Agreements _____ Procedures _____

Other Legal Authority _____ Enforcement Response Plan _____ Local Limits _____

☐ No.

WASTEWATER DISCHARGE PERMIT APPLICATION

SECTION II - Sanitary Wastewater

D. Non-Domestic Wastewater Information

PLEASE TYPE OR PRINT

FACILITY NAME	NPDES PERMIT NUMBER

5. SIGNIFICANT INDUSTRIAL USER (SIU) INFORMATION

Supply the following information for each SIU that discharges to the treatment plant. Make additional copies of this page when necessary.

A. SIU location information

Company		
Facility Address		
City	State	ZIP Code

B. Describe all of the industrial processes that affect or contribute to the SIU's discharge.

C. Describe all of the **principal processes** and **raw materials** that affect or contribute to the SIU's discharge.

D. Flow Rate. What are the average daily volume(s) of wastewater discharged to the collection system? Are the discharge(s) continuous or intermittent?

Type of Wastewater	Volume of Discharge (gpd)	Continuous or Intermittent
Process Wastewater		
Non-Process Wastewater		

E. Pretreatment Standards. Indicate whether the SIU is subject to one or both of the following:

☐ Local Limits

☐ Categorical Pretreatment Standards. Category _____ Subcategory _____

Category _____ Subcategory _____

Category _____ Subcategory _____

Category _____ Subcategory _____

F. Describe any problems at the treatment plant or in the collection system (e.g., upsets, pass through, interference, blockages) attributed to waste discharged by this SIU during the last three years.

Michigan Department of Environmental Quality- Water Bureau

WASTEWATER DISCHARGE PERMIT APPLICATION

SECTION II - Sanitary Wastewater

E. Biosolids Information

PLEASE TYPE OR PRINT

FACILITY NAME	NPDES PERMIT NUMBER

1. BIOSOLIDS HANDLING

All facilities that generate or propose to generate biosolids must complete items 1 and 2. Facilities that land apply must also complete items 3-6.

Provide total English dry tons per 365-day period of residuals handled under the following practices:

Amount generated at the facility: _____

Amount received from off-site: _____

Amount treated on-site (including blending): _____

Amount used or disposed by another practice: _____

Amount applied to land in bulk form: _____

Amount fired in incinerator: _____

Amount sent to municipal solid waste landfill: _____

Amount sold or given away in a bag or other container for application to the land: _____

Amount transported to another POTW: _____

Transport Company _____

Receiving POTW _____

2. BIOSOLIDS STORAGE

Enter the volume of residual storage capacity at this facility: _____ ☐ million gallons **or** ☐ cubic feet

3. BIOSOLIDS CHARACTERISTICS

Report one year residuals monitoring data, and in no case less than three sampling events for the following parameters. Provide the actual analytical data sheets as an attachment. Analytical methods shall be in accordance with R 323.2406 (2) "Methods for Biosolids."

Parameter	Average Monthly Concentration	Maximum Concentration	Units	Number of Analyses	Sample Type	Analytical Method	Quantification Level
Total Solids			%		☐Grab ☐ Composite		
Total Arsenic			mg/kg		☐Grab ☐ Composite		
Total Cadmium			mg/kg		☐Grab ☐ Composite		
Total Copper			mg/kg		☐Grab ☐ Composite		
Total Lead			mg/kg		☐Grab ☐ Composite		
Total Mercury			mg/kg		☐Grab ☐ Composite		
Total Molybdenum			mg/kg		☐Grab ☐ Composite		
Total Nickel			mg/kg		☐Grab ☐ Composite		
Total Selenium			mg/kg		☐Grab ☐ Composite		
Total Zinc			mg/kg		☐Grab ☐ Composite		
Total Kjeldahl Nitrogen			mg/kg		☐Grab ☐ Composite		
Ammonium Nitrogen			mg/kg		☐Grab ☐ Composite		
Total Phosphorus			mg/kg		☐Grab ☐ Composite		
Total Potassium			mg/kg		☐Grab ☐ Composite		

WASTEWATER DISCHARGE PERMIT APPLICATION

SECTION II - Sanitary Wastewater

E. Biosolids Information

PLEASE TYPE OR PRINT

FACILITY NAME	NPDES PERMIT NUMBER

4. POLLUTANTS OF CONCERN

Are there currently, or is there potential for, pollutants (other than the parameters listed on the previous page) to be present in the residuals at concentrations that would make them unsuitable for land application?

☐ Yes. On a separate sheet provide representative analytical data for those pollutants.

☐ No. Continue with Item 5.

5. ADDITIONAL BIOSOLIDS MONITORING DATA

Report any biosolids monitoring data from the last permit cycle for parameters not specifically listed on the previous page. Include the actual analytical data sheets as an attachment. Upon submittal review, additional monitoring may be required if the Water Bureau has reason(s) to suspect that the information provided (or not provided) does not adequately characterize the residuals proposed to be land applied. For assistance completing this item, contact the Permits Section. To submit additional information, see Page ii, Item 3.

Parameter	Average Monthly Concentration	Maximum Concentration	Units	Number of Analyses	Sample Type	Analytical Method	Quantification Level
					☐ Grab ☐ Composite		
					☐ Grab ☐ Composite		
					☐ Grab ☐ Composite		
					☐ Grab ☐ Composite		
					☐ Grab ☐ Composite		
					☐ Grab ☐ Composite		
					☐ Grab ☐ Composite		
					☐ Grab ☐ Composite		

6. LAND APPLICATION SITE LIST

Provide the following information for every new or existing site that may be used in the next five years (biosolids permit cycle). Each listed site should have been submitted to the MDEQ on a Site Identification Form (with attachments) since January 1, 1998, or the required information should be included with this form. Additional sites may be added to the Land Application Site List during the biosolids permit cycle by submitting a completed Site Identification Form with the appropriate attachments and waiting the required ten-day notification period. To submit additional information, see Page ii, Item 3.

Site Identification Number	Latitude	Longitude	Acres	Owner's Last Name	New Site	CPLR Site
					☐	☐
					☐	☐
					☐	☐
					☐	☐
					☐	☐
					☐	☐

This completes Section II. Return the completed Application (Sections I and II, and any attachments) to one of the addresses on Page ii of this Application. If assistance is needed to complete this Application, contact the Permits Section.

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Michigan Department of Environmental Quality- Water Bureau

WASTEWATER DISCHARGE PERMIT APPLICATION

SECTION III - Industrial and Commercial Wastewater

Section III is to be completed by all facilities classified as Industrial or Commercial facilities. Industrial and Commercial facilities include, but are not limited to, facilities that discharge or propose to discharge a wastewater generated by a production process, a service provided, or through a remediation project. Municipal and public facilities are not required to complete Section III (unless requesting authorization for discharges other than sanitary wastewater).

A. Facility Information

PLEASE TYPE OR PRINT

FACILITY NAME	NPDES PERMIT NUMBER
Operable Unit #4 at the Allied Paper/Portage Creek/Kalamazoo	NA

1. BUSINESS INFORMATION

A. Provide up to four Standard Industrial Classification (SIC) or North American Industry Classification System (NAICS) codes, in order of economic importance, which best describe the major products or services provided by this facility.

1. 9999	2. NA	3. NA	4. NA

B. Indicate if this facility is a primary industry (refer to Table 1 of the Appendix to determine if this facility is a primary industry).

☐ Yes. This facility is a primary industry. Indicate the primary industry as identified in Table 1 of the Appendix: _____

☒ No. This facility is not a primary industry. Continue with Item C.

C. Is this facility a Concentrated Animal Feeding Operation (CAFO)?

☐ Yes. Continue with Section III.B.11.

☒ No. Continue with Item 2.

2. WATER SUPPLY AND DISCHARGE TYPE

A. Identify all water sources entering the facility and treatment systems, and provide average flows. The volume may be estimated from water supply meter readings, pump capacities, etc. Provide the name of the source where appropriate (i.e., Grand River, Lake Michigan, City of Millpond). To submit additional information, see Page ii, Item 3.

	Name and Location of Source	Average Volume or Flow Rate	Units
Municipal Supply	NA	NA	
Surface Water Intake	NA	NA	
Private Well	NA	NA	
Other:	infiltration/precip/wash/sediment water	60,000	GPD

B. Identify water discharged by the facility and treatment systems, and provide average flows. If water is first used for one purpose and then is subsequently used for another purpose, indicate the type and amount of the last use. For example, if water is initially used for noncontact cooling water and then for process water, indicate the amount of process water. The amount of water from sources should approximate the amount of water usage. If they are different, provide an explanation.

	Average Flow Rate	Units		Average Flow Rate	Units
Process Wastewater	12,000	GPD	Sanitary Wastewater	NA	NA
Contact Cooling Water	NA	NA	Regulated Storm Water	3,000	GPD
Noncontact Cooling Water	NA	NA	High Pressure Test Water	NA	NA
Groundwater Clean-Up	NA	NA	Other: Excav. infilt. water	45,000	GPD

Note: For A and B above, indicate units as MGD (million gallons per day), MGY (million gallons per year), GPD (gallons per day), or other appropriate unit.

INSTRUCTIONS FOR COMPLETING SECTION III B. OUTFALL INFORMATION, ITEMS 1. A - J

1. OUTFALL INFORMATION

This item requires detailed information on each outfall at the facility. For this item, outfall refers to the point where treated wastewater is discharged to the surface waters of the state. "Surface Waters of the State" include the Great Lakes and their connecting waters, all inland lakes, rivers, streams, impoundments, open drains, and other surface bodies of water within the confines of the state. The applicant will need to complete Pages 25 – 31 for each outfall. Fill in the Outfall Number in the top right-hand box, identifying the outfall by number, e.g., 001, 002, etc. Applicants with existing NPDES permits should refer to the facility's current NPDES permit for outfall number identification. For each outfall, provide the location, the type of wastewater, the expected and/or measured volume of effluent discharged, the frequency of discharge, and the flow variation of the discharge.

A. Identify the watershed where the outfall is located. See the Upper and Lower Peninsula Hydrologic Maps in the Appendix for the state's watersheds and their Hydrologic Unit Codes (HUC). Then match the HUC code to the watershed name in the associated table of Watershed Names.

B. Identify the receiving water (Waters of the State) to which the facility's outfall(s) discharge.

C. Identify the county and township where the outfall is located.

D. Identify the location of the outfall using State Planar Coordinates (e.g., Town 1N, Range 12E, Section 34, SE 1/4, NE 1/4) or, where applicable the Private (French) Land Claim designation.

E. Identify the location of the outfall using latitude and longitude, accurate to within 15 seconds (e.g., Latitude = 42°27'15", Longitude = -83°02'30"), or accurate to within 0.004 decimal degrees (e.g., Latitude = 42.454167, Longitude = -83.041667).

F. Identify the type(s) of wastewater the facility will discharge from this outfall. Check as many types of wastewater as are appropriate. If the water is used in multiple areas, such as water that is first used for noncontact cooling water and then for another use, such as process water, indicate the final use only. For other common wastewater types, see "Table 9 - Other Types of Wastewater" - in the Appendix.

G. When reporting the Maximum Design Flow Rate, identify the design flow for this specific outfall (e.g., batch treatment system flow, package treatment system flow, or some other finite treatment system flow). Please provide an explanation if "Pollution Prevention Measures" are expected to provide flow reductions.

H. Identify the Maximum Discharge Flow Rate that the facility is expecting to discharge in the next five years. This flow will be used to determine the facility's effluent limitations and will be the flow authorized in an issued permit. NOTE: Discharges of flows greater than the Discharge Flow Rate authorized in the permit will constitute a violation of the Michigan Act and would be subject to the penalties specified therein.

I. A discharge is considered to be seasonal if the facility treats and then stores wastewater throughout the year, or a portion of the year, and then discharges it a few days, weeks, or months a year. Provide the dates the facility discharges the treated wastewater (e.g., October 15 through November 10) and the average discharge flows (e.g., 5 MGD).

J. A continuous discharge is any discharge that is not a seasonal discharge. Identify the average number of hours per day and the number of days per year that the discharge occurs from this outfall. Batch dischargers are required to provide the peak batch flow rate, the number of batches per day, the per-batch minimum, the average and maximum volumes in gallons, and the per-batch minimum, average, and maximum batch discharges in minutes.

NOTE: The units are as follows: GPD = gallons per day, MGD = millions of gallons per day, MGY = millions of gallons per year.

WASTEWATER DISCHARGE PERMIT APPLICATION

SECTION III - Industrial and Commercial Wastewater

B. Outfall Information

Complete a separate Section III.B. - Outfall Information (Pages 25-31) - for each outfall at the facility. Make copies of this blank section of the Application as necessary for additional outfalls.

PLEASE TYPE OR PRINT

FACILITY NAME	NPDES PERMIT NUMBER	OUTFALL NUMBER
Operable Unit #4 at the Allied Paper/Portage Creek/Kalamazoo	NA	001

1. OUTFALL INFORMATION - Instructions for this item are on Page 23.

A.	Watershed Kalamazoo					HUC Code 04050003
B.	Receiving Water Kalamazoo River					
C.	County Allegan				Township Otsego	
D.	Town 1N	Range 12W	Section 24	¼ S	¼, ¼ N	Private (French) Land Claim) NA
E.	Latitude 42:27:27				Longitude -85:40:10	

F. Type of Wastewater Discharged (check all that apply to this outfall):

☐ Contact Cooling ☐ Groundwater Cleanup ☐ Hydrostatic Pressure Test ☐ Noncontact Cooling Water

☒ Process Wastewater ☐ Sanitary Wastewater ☐ Storm Water - not regulated ☒ Storm Water - regulated

☐ Storm water subject to effluent guidelines (indicate under which category): _____

☒ Other – specify (see "Table 8 - Other Common Types of Wastewater" - in the Appendix) Excavation Infiltration Water

G. What is the Maximum Design Flow Rate for this outfall: 0.144 MGD

H What is the Maximum Authorized Discharge Flow for this outfall for the next five years?

Seasonal Dischargers 3.46 MGY (Continue with Item I)

Continuous Dischargers _____ MGD (Continue with Item J)

I. Seasonal Discharge:

List the discharge periods (by month) and the volume discharged in the space provided below.

From	Through	Discharge Volume	Annual Total
August 2007	November 2007	3.46 MG	
From	Through	Discharge Volume	
From	Through	Discharge Volume	
From	Through	Discharge Volume	

J. Continuous Discharge:

How often is there a discharge from this outfall (on the average)? _____ Hours/Day _____ Days/Year

Batch dischargers are required to provide the following additional information:

Is there effluent flow equalization? ☐ Yes ☐ No

Batch Peak Flow Rate: _____ Number of batches discharged per day: _____

	Minimum	Average	Maximum
Batch Volume (gallons)			
Batch Duration (minutes)			

WASTEWATER DISCHARGE PERMIT APPLICATION

SECTION III - Industrial and Commercial Wastewater

B. Outfall Information

PLEASE TYPE OR PRINT

FACILITY NAME	NPDES PERMIT NUMBER	OUTFALL NUMBER
Operable Unit #4 at the Allied Paper/Portage Creek/Kalamazoo	NA	001

2. PROCESS STREAMS CONTRIBUTING TO OUTFALL DISCHARGE

Federal Regulations require that different industries report different information depending on the type facility. The information below is used to determine the applicable federal regulations for this facility. An abbreviated list is in the Summary of Information to be reported by Industry Type section of the Appendix. Applicants are required to provide the name and the SIC or the NAICS code of each process at the facility. Facilities with production-based limits must report an estimated annual production rate for the next five years or the life of the permit. If the wastestream is not regulated under federal categorical standards, the applicant is required to report all pollutants which have the reasonable potential to be present in the discharge. To submit additional information, see Page ii, Item 3.

PROCESS INFORMATION

A. Name of the process contributing to the discharge: Excavation Area Infiltration Water

B. SIC or NAICS code: 9999

C. Describe the process and provide measures of production:

Turbid water removed from the excavation area will be treated in the on-site water treatment system and discharged into the Kalamazoo River. Contaminates having the reasonable potential to be present in the discharge include: polychlorinated biphenyls (PCBs) & total suspended solids (TSS).

PROCESS INFORMATION

A. Name of the process contributing to the discharge: Excavated Sediment Dewatering

B. SIC or NAICS code: 9999

C. Describe the process and provide measures of production:

Water contained in excavated sediments will be removed and treated in the on-site water treatment system and discharged in to the Kalamazoo River. Contaminates having the reasonable potential to be present in the discharge include: polychlorinated biphenyls (PCBs) & total suspended solids (TSS).

PROCESS INFORMATION

A. Name of the process contributing to the discharge: Stormwater and wash water

B. SIC or NAICS code: 9999

C. Describe the process and provide measures of production:

Collected storm water and spent wash water will be treated in the on-site water treatment system and discharged to the Kalamazoo River. Contaminates having the reasonable potential to be present in the discharge include: polychlorinated biphenyls (PCBs) and total suspended solids (TSS).

PROCESS INFORMATION

A. Name of the process contributing to the discharge: _____

B. SIC or NAICS code: _____

C. Describe the process and provide measures of production:

PROCESS INFORMATION

A. Name of the process contributing to the discharge: _____

B. SIC or NAICS code: _____

C. Describe the process and provide measures of production:

INSTRUCTIONS FOR COMPLETING SECTION III B. OUTFALL INFORMATION, ITEM B.3.

In accordance with 40 CFR 122.21, all applicants are required to report $CBOD_5$, Chemical Oxygen Demand, Total Organic Carbon, Total Suspended Solids, Ammonia as N, Temperature (both summer and winter), and pH. The applicant may, however, request that reporting of data for one or more of these required parameters be waived. Such requests shall be supported by adequate rationale. The request shall be included as an attachment to this Application.

Report available discharge data for the parameters listed in Section III.B.3 of this Application. Actual data shall be provided for existing discharges, and expected or estimated data provided for proposed discharges. Please include an explanation if "Pollution Prevention Measures" are expected to reduce pollutants. Certain types of discharges shall provide a minimum of analytical test date for specific parameters. See "Minimum Analytical Testing Requirements for Various Discharge Requests" in the Appendix for a list of specific discharge types and their specific parameters (e.g., noncontact cooling waters, petroleum groundwater cleanups, etc.). For assistance in determining the appropriate parameters to report, contact the Permits Section. Data for other conventional parameters not listed in Section III.B.3. can be reported on the blank spaces provided. To submit additional information, see Page ii, item 3.

Report all data in the units provided and for the sample types specified in the table. If more than one option is available, check the appropriate box. The units are as follows: µg/l = micrograms per liter, mg/l = milligrams per liter, °F = degrees Fahrenheit, °C = degrees Celsius. **For analytical test requirements, see Page ii, Item 5.**

To analyze for pH, temperature, total residual chlorine, oil and grease, and fecal coliform, use **Grab Samples** unless other frequency-sample type analyses are available. To analyze for total BOD_5, total phosphorus, COD, TOC, ammonia nitrogen, and total suspended solids, use **24-hour composite samples** unless other frequency-sample type analyses are available.

For two or more substantially identical outfalls, permission may be requested from the appropriate district office to sample and analyze only one outfall and submit the results of the analysis for other substantially identical outfalls. If the request is granted by the district office, on a separate sheet attached to the Application, identify which outfall was sampled and describe why the outfalls which were not sampled are substantially identical to the outfall which was sampled. See the Appendix, "Definitions" Section for sampling definitions, including "maximum daily concentration" and "maximum monthly concentration."

REPORTING OF INTAKE DATA

Applicants attempting to demonstrate eligibility for "net" effluent limitations for one or more pollutants are required to report intake water data. A "net" effluent limitation is determined by subtracting the average level of the pollutant(s) present in the intake waters from the average level of the pollutant(s) remaining after treatment. NPDES regulations allow net limitations only in certain circumstances (see 40 CFR, Part 122.45(g)). To demonstrate eligibility, report the average concentration and/or mass of the results of the analyses on the intake water. If the intake water is treated prior to use, report the intake concentrations and/or mass after treatment. In addition to the analytical results, the following information shall be submitted for each parameter:

a) A statement that the intake water is drawn from the body of water into which the discharge is made. If the discharge is not to the same body of water from which the water is withdrawn, the facility is not eligible for net limitations.

b) A statement of the extent to which the level of the pollutant in the intake water is reduced by treatment of the wastewater. Limitations for the net removal of pollutants are adjusted only to the extent that the pollutant is not removed.

c) When applicable (for example, when the pollutant represents a class of compounds, e.g., BOD_5, TSS, etc.), a demonstration of the extent to which the pollutants in the intake vary physically, chemically, and biologically from the pollutants contained in the discharge. Limitations are adjusted only to the extent that the concentrations of the intake pollutants vary from the discharged pollutants.

Note: Applicants for groundwater remediation discharges should also report the intake characteristics of the contaminated groundwater.

WASTEWATER DISCHARGE PERMIT APPLICATION

SECTION III - Industrial and Commercial Wastewater

B. Outfall Information

PLEASE TYPE OR PRINT

FACILITY NAME	NPDES PERMIT NUMBER	OUTFALL NUMBER
Operable Unit #4 at the Allied Paper/Portage Creek/Kalamazoo	NA	001

3. EFFLUENT CHARACTERISTICS - CONVENTIONAL POLLUTANTS - Instructions for this item are on Page 26.

Existing facilities are required to report **data** from effluent analysis for the parameters listed below. **For analytical test requirements, or if alternate test procedures for any parameter listed below have been approved, see Page ii, Item 5**

New facilities are required to provide estimated effluent concentrations for the parameters listed below**.** (See the Definition Section in the Appendix for sampling definitions, including "maximum daily concentration" and "maximum monthly concentration.")

☐ Check this box if additional information is included as an attachment. To submit additional information, see Page ii, Item 3.

Please Note: Rule 323.1062 allows the use of either Escherichia Coliform Bacteria or Fecal Coliform Bacteria as an indicator that effluent has been disinfected. The Department will use the indicator selected below in the permit issued based on this Application.

☐ Use Escherichia Coliform Bacteria as an indicator of disinfection.

☐ Use Fecal Coliform Bacteria as an indicator of disinfection.

Parameter	Maximum Monthly Concentration	Maximum Daily Concentration	Units	Number of Analyses	Sample Type
Biochemical Oxygen Demand – five day (BOD_5)			mg/l		☐ Grab ☐ 24 Hr Comp
Chemical oxygen demand (COD)			mg/l		☐ Grab ☐ 24 Hr Comp
Total organic carbon (TOC)			mg/l		☐ Grab ☐ 24 Hr Comp
Ammonia Nitrogen (as N)			mg/l		☐ Grab ☐ 24 Hr Comp
Total Suspended Solids	30	45	mg/l		☒ Grab ☐ 24 Hr Comp
Total Dissolved Solids			mg/l		☐ Grab ☐ 24 Hr Comp
Total Phosphorus (as P)			mg/l		☐ Grab ☐ 24 Hr Comp
Fecal Coliform Bacteria (report geometric means)		maximum 7-day	counts/100ml		Grab
Escherichia Coliform Bacteria (report geometric means)		maximum 7-day	counts/100 ml		Grab
Total Residual Chlorine			☐ mg/l ☐ µg/l		Grab
Dissolved Oxygen	~~Do Not Use~~	minimum daily	mg/l		☐ Grab ☐ 24 Hr Comp
pH (report maximum and minimum of individual samples)	minimum	maximum	standard units		☐ Grab ☐ 24 Hr Comp
Temperature, Summer			☐ °F ☐ °C		☐ Grab ☐ 24 Hr Comp
Temperature, Winter			☐ °F ☐ °C		☐ Grab ☐ 24 Hr Comp
Oil & Grease			mg/l		Grab
polychlorinated biphenyls (PCBs)	0.000026	NA	ug/L		☒ Grab ☐ 24 Hr Comp
					☐ Grab ☐ 24 Hr Comp
					☐ Grab ☐ 24 Hr Comp

WASTEWATER DISCHARGE PERMIT APPLICATION

SECTION III - Industrial and Commercial Wastewater

B. Outfall Information

PLEASE TYPE OR PRINT

FACILITY NAME	NPDES PERMIT NUMBER	OUTFALL NUMBER
Operable Unit #4 at the Allied Paper/Portage Creek/Kalamazoo	NA	001

Note: For questions on this page, Tables 1-5 are found in the Appendix.

4. PRIMARY INDUSTRY PRIORITY POLLUTANT INFORMATION

Existing primary industries that discharge process wastewater are required to submit the results of at least one effluent analysis for selected organic pollutants identified in Table 2 (as determined from Table 1, Testing Requirements for Organic Toxic Pollutants by Industrial Category), and all of the pollutants identified in Table 3. Existing primary industries are required to also provide the results of at least one effluent analysis for any other chemical listed in Table 2 known or believed to be present in facility effluent.

In addition, submit the results of all other effluent analyses performed within the last five years for any chemical listed in Tables 2 and 3.

New primary industries that propose to discharge process wastewater are required to provide an estimated effluent concentration for any chemical listed in Tables 2 and 3 expected to be present in facility effluent.

5. DIOXIN AND FURAN CONGENER INFORMATION

Existing industries that use or manufacture 2,3,5-trichlorophenoxy acetic acid (2,4,5-T); 2- (2,3,5-trichlorophenoxy) propanoic acid, (Silvex, 2,3,5-TP); 2-(2,4,5-trichlorophenoxy) ethyl 2,2-dichloropropionate (Erbon); 0,0-dimethyl 0-(2,4,5-trichlorophenyl) phosphorothionate (Ronnel); 2,4,5-trichlorophenol (TCP); or hexachlorophrene (HCP), or knows or has reason to believe that 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) is present in facility effluent, are required to submit the results of at least one effluent analysis for the dioxin and furan congeners listed in Table 6. All effluent analyses for dioxin and furan congeners shall be conducted using EPA Method 1613.

In addition, submit the results of all other effluent analyses performed within the last five years for any dioxin and furan congener listed in Table 6.

New industries that expect to use or manufacture 2,3,5-trichlorophenoxy acetic acid (2,4,5-T); 2- (2,3,5-trichlorophenoxy) propanoic acid (Silvex, 2,3,5-TP); 2-(2,4,5-trichlorophenoxy) ethyl 2,2-dichloropropionate (Erbon); 0,0-dimethyl 0-(2,4,5-trichlorophenyl) phosphorothionate (Ronnel); 2,4,5-trichlorophenol (TCP) or hexachlorophrene (HCP), or knows or has reason to believe that 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) is present in facility effluent shall provide estimated effluent concentrations for the dioxin and furan congeners listed in Table 6.

6. OTHER INDUSTRY PRIORITY POLLUTANT INFORMATION

Existing secondary industries, or existing primary industries that discharge non-process wastewater, are required to submit the results of at least one effluent analysis for any chemical listed in Tables 2 and 3 known or believed to be present in facility effluent.

In addition, submit the results of all other effluent analyses performed within the last five years for any chemical listed in Tables 2 and 3.

New secondary industries, or new primary industries that propose to discharge non-process wastewater, are required to provide an estimated effluent concentration for any chemical listed in Tables 2 and 3 expected to be present in facility effluent.

7. ADDITIONAL TOXIC AND OTHER POLLUTANT INFORMATION

All existing industries, regardless of discharge type, are required to provide the results of at least one analysis for any chemical listed in Table 4 known or believed to be present in facility effluent, and a measured or estimated effluent concentration for any chemical listed in Table 5 known or believed to be present in facility effluent. In addition, submit the results of any effluent analysis performed within the last five years for any chemical listed in Tables 4 and 5.

New industries, regardless of discharge type, are required to provide an estimated effluent concentration for any chemical listed in Tables 4 and 5 expected to be present in facility effluent.

8. INJURIOUS CHEMICALS NOT PREVIOUSLY REPORTED

New or existing industries, regardless of discharge type, are required to provide a measured or estimated effluent concentration for any toxic or otherwise injurious chemicals known or believed to be present in facility effluent that have not been previously identified in this Application. Quantitative effluent data that are less than five years old for these chemicals shall be reported.

NOTE: All effluent data submitted in response to questions 4, 5, 6, 7, and 8 above should be recorded on Page 30. To submit additional information, see Page ii, Item 3. If the effluent concentrations are estimated, place an "E in the "Analytical Method" column. The following fields shall be completed for each data row: Parameter, CAS No., Concentration(s), Sample Type, Analytical Method, Quantification Level, and Detection Level. For analytical test requirements, see Page ii, Item 5.

If Alternate Test Procedures have been approved for any parameter listed above (Items 4 through 8), see Page ii, Item 5 for additional instructions.

WASTEWATER DISCHARGE PERMIT APPLICATION

SECTION III - Industrial and Commercial Wastewater

B. Outfall Information

PLEASE TYPE OR PRINT

FACILITY NAME	NPDES PERMIT NUMBER	OUTFALL NUMBER
Operable Unit #4 at the Allied Paper/Portage Creek/Kalamazoo	**NA**	001

SAMPLE DATE ➔																
PARAMETER	**CAS No.**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Conc. (ug/l)**	**Sample Type**	**Analytic Method**	**QL**	**DL**
NA															

WASTEWATER DISCHARGE PERMIT APPLICATION

SECTION III - Industrial and Commercial Wastewater

B. Outfall Information

PLEASE TYPE OR PRINT

FACILITY NAME	NPDES PERMIT NUMBER	OUTFALL NUMBER
Operable Unit #4 at the Allied Paper/Portage Creek/Kalamazoo	NA	001

9. WATER TREATMENT ADDITIVES

Water treatment additives include any material that is added to water used at the facility or to wastewater generated by the facility to condition or treat the water.

Approvals of water treatment additives are authorized by the DEQ under separate correspondence. The issuance of an NPDES permit does not constitute approval of the water treatment additives that are included in this Application.

A. Are there water treatment additives in the discharge from this facility?

☐ Yes.

☒ No. Proceed to Question 10.

B. Have these water treatment additives been previously approved?

☐ Yes. Submit a list of the previously-approved water treatment additives and the date on which they were approved. The information listed in Item C., Items 1-8 shall be updated if it has changed since the previous approval.

☐ No. Continue with Item C.

C. Submit a list of water treatment additives that are or may be discharged from the facility. Applicants are required to submit the information listed below for each additive.

1. The water treatment additive Material Safety Data Sheet.
2. The proposed water treatment additive discharge concentration.
3. The discharge frequency (i.e., number of hours per day, week, etc.).
4. The outfall from which the water treatment additive is to be discharged.
5. The type of removal treatment, if any, that the water treatment additive receives prior to discharge.
6. The water treatment additive function (i.e., microbiocide, flocculant, etc.).
7. A 48-hour LC50 or EC50 for a North American freshwater planktonic crustacean (either Ceriodaphnia sp., Daphnia sp., or Simocephalus sp.).
8. The results of a toxicity test for one other North American freshwater aquatic species (other than a planktonic crustacean) that meets a minimum requirement of Rule 323.1057(2)(a) of the Water Quality Standards. Examples of tests that would meet this requirement include a 96-hour LC50 for rainbow trout, bluegill, or fathead minnow.

The required toxicity information (described in Items 7 and 8 above) is currently available in the Water Bureau files for the water treatment additives listed on the DEQ's Internet page. To access that information, go to http://www.michigan.gov/deq, click on "Site Map," at the bottom of the right column under **Water Quality Monitoring,** click on "Assessment of Michigan Waters." Under the **Information** heading, click on the "Water Treatment Additive List." If you intend to use one of the water treatment additives on this list, only the information in Items 1 through 6 above needs to be submitted to the WD.

Note: The availability of toxicity information for a water treatment additive does not constitute approval to discharge the water treatment additive.

10. WHOLE EFFLUENT TOXICITY TESTS

Have any acute or chronic WET tests been conducted on any discharges or receiving water(s) in relation to facility discharges within the last three years? If yes, identify the tests and summarize the results on a separate sheet, unless the test has been submitted to the DEQ in the last five years. For assistance in WET testing, see "Whole Effluent Toxicity Test Guidance and Requirements" in the Appendix.

11. COMPREHENSIVE ANIMAL FEEDING OPERATION (CAFO) INFORMATION. To be completed by CAFO's only

The applicant shall provide: Specific information about the number and type of animals, and type of housing. The type of containment and storage, and total capacity for CAFO waste storage. CAFO waste storage structure design. The total number of acres under control of the applicant available for land application of CAFO waste. Estimated amounts of CAFO waste generated per year. Estimated amounts of CAFO waste transferred to other persons per year. A list and map(s) showing the location of all land application fields. All potential receiving waters for both the production area and all land application areas. For additional information see "CAFO Guidance and Requirements" in the Appendix..

This completes Section III. Return the completed Application (Sections I and III, and any attachments) to one of the addresses on Page ii of this Application. If assistance is needed to complete this Application, contact the Permits Section.

Section 1, Item 6: Rule 98 – Antidegradation Requirements

Rule 323.1098 of the Michigan Water Quality Standards requires applicants to submit an Antidegradation Demonstration for any new or increased loading of pollutants to the surface waters of the State.

RMT, Inc, on behalf of Weyerhaeuser Company, is requesting an exemption from Rule 323.1098 because the sediment removal activities in the former powerhouse channel are, in accordance with subrule (8)(c): response actions undertaken to alleviate a release of pollutants into the environment that may pose an imminent and substantial danger to the public health or welfare under (i) The comprehensive environmental response, compensation and liability act of 1980, (CERCLA), as amended, 42 U.S.C. §9601 et seq.

Section 1, Item 10: Water Flow Diagram and Narrative Description

Wastewater Treatment System

Wastewater Sources

Wastewater will be generated during Emergency Response activities being performed in the former powerhouse discharge channel of the Kalamazoo River near the 12th Street Landfill site and possibly for Emergency Response activities associated with the Plainwell Mill banks. There are five sources of wastewater that will comprise the influent streams to the treatment system:

- Excavation area infiltrating surface and groundwater water that exceeds the turbidity screening criteria (two times background levels)
- Drainage water from sediment containing residuals and soil excavated during the Emergency response activities.
- Run-on precipitation that accumulates on the containment pads
- Wastewater system backwash and rinse fluids
- Construction and sampling equipment decontamination water

The majority of the wastewater will be generated from infiltrating ground and surface water that enters the residuals excavation area. The excavation design includes segregation of a portion of the former Powerhouse channel with Portadams and then removal of standing water prior to sediment excavation. Water that exceeds the turbidity screening criteria will be directed to the wastewater treatment system for primary settling and further polishing treatment if needed. As the residuals excavation proceeds, additional ground and surface water will infiltrate into the area, be directed into gravity drained sumps and pumped into the secondary retention area. If the turbidity of this infiltration water exceeds twice the measured background turbidity, the water will be directed to the wastewater treatment plant rather than pumped back into the Kalamazoo River downstream of the Plainwell Dam. The residuals excavation activities are expected to take 2 to 4 weeks.

Once the isolated channel excavation area is dewatered, targeted residuals will be removed and placed in an on-site containment pad where water will gravity drain from the residual containing sediments. This drainage water will be collected and pumped to the on-site wastewater treatment system. Other water sources that will be generated from the containment pad area include precipitation run-on water and decontamination/investigative waste water. After dewatering and completion of the Emergency Response, a temporary cover will be placed over the drained sediments prior to placement of the final landfill cap Runoff and run-on water will not be treated after placement of the temporary cover.

Description of the Treatment System

The proposed treatment train consists of primary sedimentation followed by filter/carbon adsorption polishing. (See the process flow diagram, Section III.B, Item 3). The trailer mounted treatment system is designed to handle up to 200 gpm of influent flow.

To better accommodate the expected variability in volumes from the different sources, two parallel 100 gpm treatment systems will be preceded by a 20,000 gallon trailer mounted sedimentation tank. The effluent from the sedimentation tank will be monitored for turbidity and either directed through the portable tertiary treatment system that consists of bag filtration followed by granular activated carbon adsorption or to the effluent discharge location downstream in the Kalamazoo River. Since the flow volumes are primarily controlled by the volume of infiltrating water from the excavation, the residual removal operations can also be modified to ensure that the flow capacity of the existing system is not exceeded. Other options to control the flow rate will include supplementing the sedimentation tank with additional storage tanks or reducing the time or extent of dewatering during actual residuals removal.

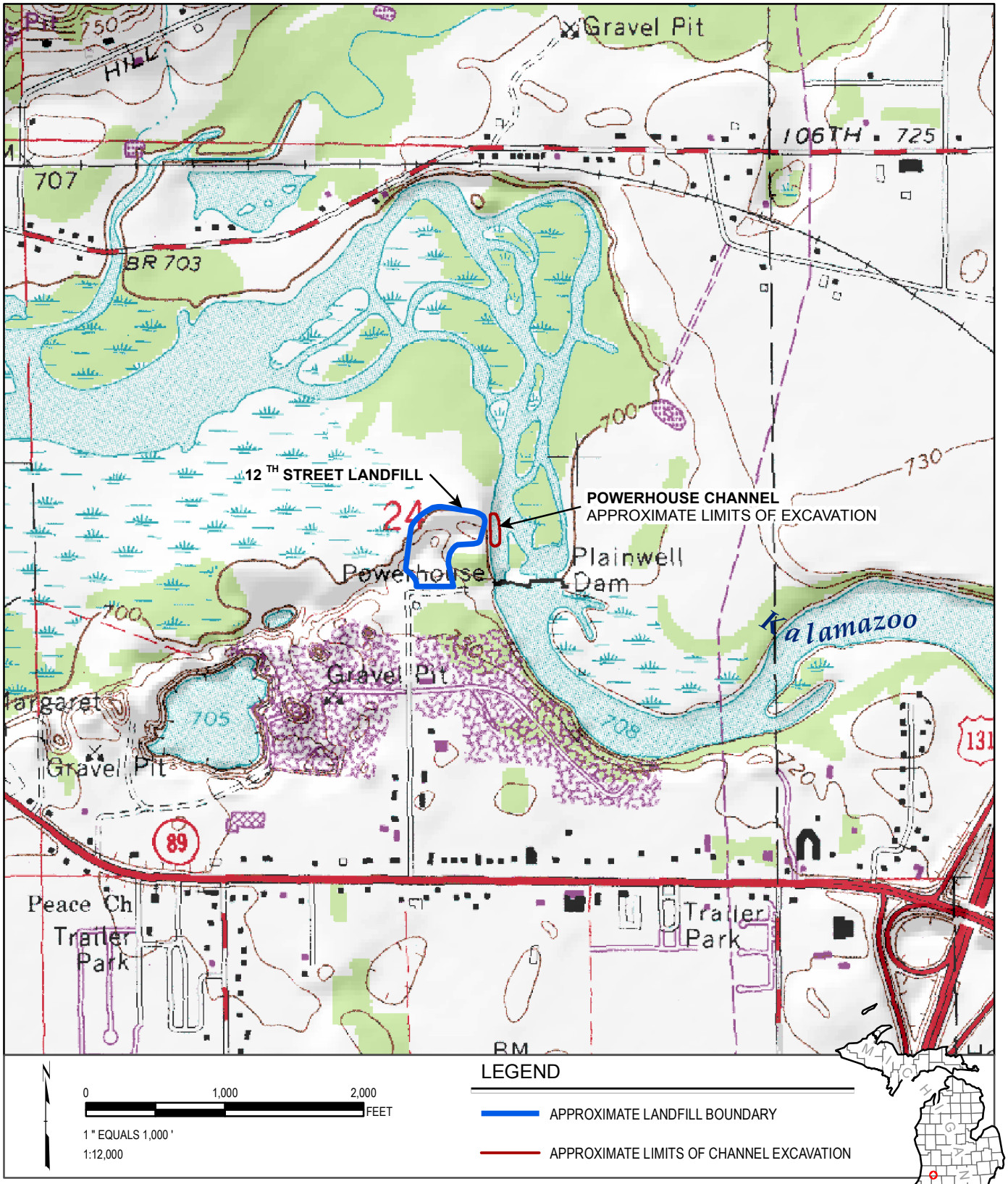
The two parallel 100 gpm tertiary treatment system will each consist of two bag filters in series followed by 5 back-washable carbon columns each containing 900 pounds of granular activated carbon. At the design flow rate of 200 gpm, the retention time will be approximately 100 minutes. Treated water will be discharged directly to Outfall 001 (see Map). Some treated water will be contained on-site for use as backwash and decontamination wash water.

Discharge monitoring will involve tracking the concentrations of polychlorinated biphenyls (PCBs) and total suspended solids (TSS). PCBs will be monitored because it is the contaminant of concern at the Kalamazoo River Superfund site. TSS will be monitored because PCBs will tend to be associated with solids in the water column due to there hydrophobic nature.

A waiver is requested for all other compounds and parameters other that PCBs and TSS. Excluding PCBs and TSS, the sediment removed during the remedial activities is not expected to contain or contribute additional pollutants to the Kalamazoo River.

Section III.B, Items 4-8 and 10

The analytical results of the investigations in the powerhouse discharge channel by Geraghty and Miller in 1994, BBL in 2001, and CDM in 2004 indicate that PCBs are the primary chemical of concern in this area. Additionally, the findings of the remedial investigation, and human health and ecological risk assessments for the entire Allied Paper, Inc/Portage Creek/Kalamazoo River Superfund Site confirm that PCBs is the primary chemical of concern for the Kalamazoo River.



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RMT

744 Heartland Trail
Madison, WI 53717-1934

P.O. Box 8923 53708-8923
Phone: 608-831-4444
Fax: 608-831-3334

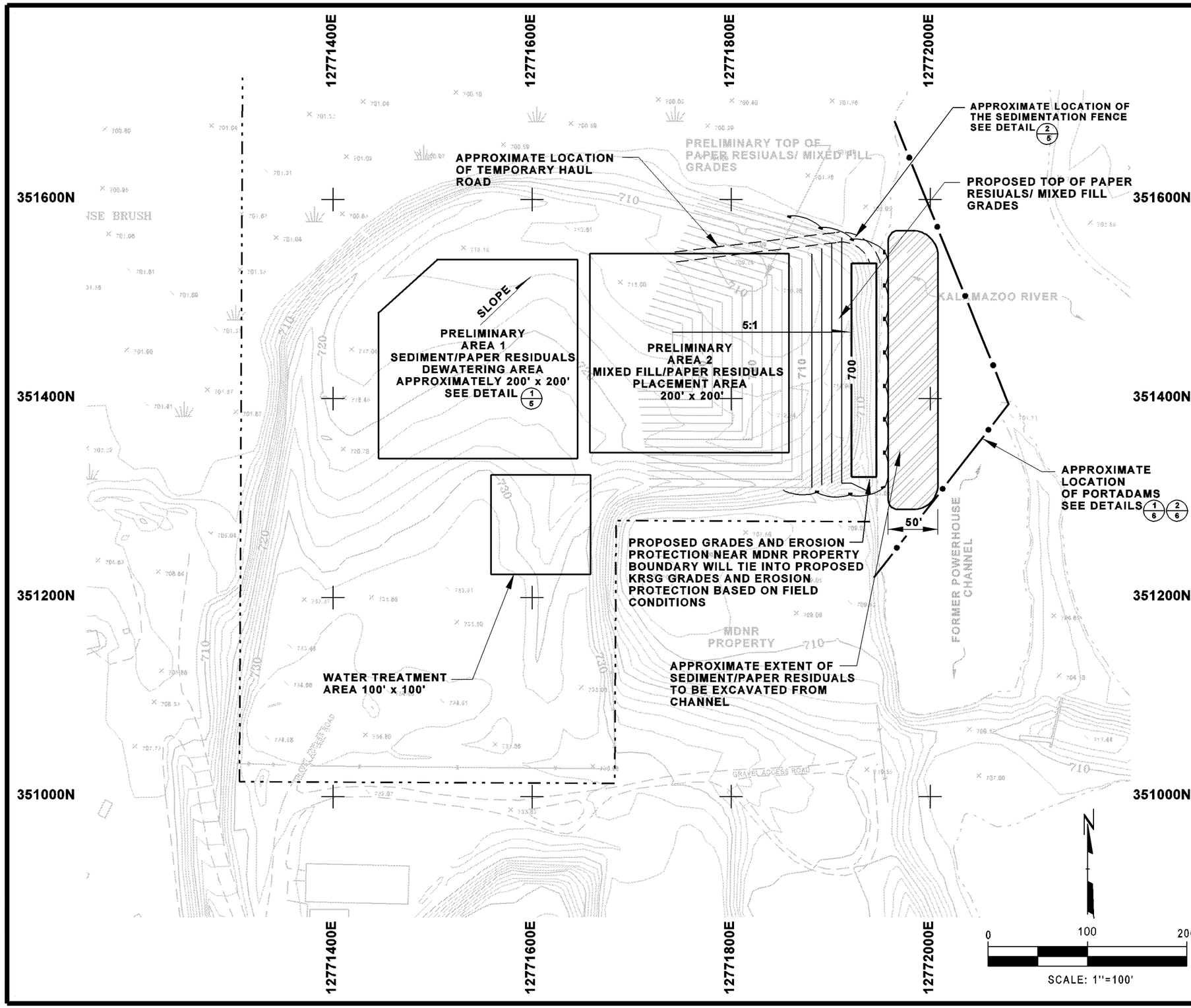
WEYERHAEUSER 12TH STREET LANDFILL
EMERGENCY RESPONSE PLAN DESIGN REPORT
PLAINWELL, MICHIGAN

SITE LOCATION MAP

DRAWN BY:	HANKLEY C
APPROVED BY:	
PROJECT NO:	00-05117.04/ERD
FILE NO.	51170402.mxd
DATE:	JULY 2007

D:\05117\04\51170402.mxd 7/19/2007 09:19:49

FIGURE 1



LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- GRID LOCATION
- EXISTING UNPAVED ROAD
- EXISTING FENCE
- EXISTING BUILDING
- EXISTING 10' CONTOUR
- EXISTING 2' CONTOUR
- EXISTING SPOT ELEVATION
- EXISTING WETLAND LIMITS
- EXISTING EDGE OF WATER

NOTES

1. REFER TO FIGURE 2 FOR BASE MAP NOTES.
2. DISCHARGE FROM WATER TREATMENT SYSTEM WILL BE LOCATED APPROXIMATELY 200' DOWNSTREAM OF WORKING AREA, DEPENDING ON SITE CONDITIONS.

WORKING COPY

PROJECT: WEYERHAEUSER 12TH STREET LANDFILL
EMERGENCY RESPONSE PLAN DESIGN REPORT
PLAINWELL, MICHIGAN

SHEET TITLE: PROJECT SITE PLAN

DRAWN BY: stormerl	SCALE: 1"=100'	PROJ. NO.	5117.04\ERD
CHECKED BY:		FILE NO.	SITE PLAN.PLT
APPROVED BY:	DATE PRINTED:	FIGURE 3	
DATE: JULY 2007			

RMT
744 Heartland Trail
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Plot Data
Design File J:\05117\04\ERD\site plan.plt
stormerl Plot Date = Thu Jul 19 16:06:09 2007
Plot File = J:\05117\04\ERD\site plan.prf
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Levels On = 1-13

Reference Files
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Ref. File 2 = J:\05117\04\ERD\bmrmt.dgn
Ref. File 3 = J:\05117\04\ERD\proposed.dgn
Ref. File 4 = J:\05117\04\ERD\11x17bdr.dgn

Logical Names
(1) bmc
(2) bmr
(3) pro
(4) bdr

Levels
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(3) 1-63
(4) 1-63

Appendix E
Slope Stability Calculations

Appendix E
Slope Stability Technical Memorandum

Subject:	Slope Stability Assessment
Objective:	1. To evaluate the slope stability of the eastern slope of the 12th Street Landfill and determine a conservative final design slope for that side of the site. 2. To determine if the relocation of the paper residuals from the eastern side of the 12th Street Landfill and the sediments from the Kalamazoo River to the proposed relocation areas would pose a slope stability issue. 3. To determine the preliminary design slopes for the remainder of the landfill such that the relocation areas do not extend into areas that may need to be cut as part of the final remedial design for the 12th Street Landfill.
Approach:	■ Identify site specific conditions that impact the stability of 12th Street landfill slopes. ■ Assign a range of assumed conditions to these critical site variables. ■ Select a targeted slope and model the results using the WinSTABL computer program for the range of conditions identified. ■ Assess the calculated safety factors against the implications of slope failure. ■ Select appropriate conservative design slope for the eastern slope along the Kalamazoo River. ■ Select preliminary design slope for other side slopes at the site to be used in future remedial design. ■ Assess the slope stability of existing landfill slopes with the addition of the two proposed staging pads to be constructed as part of the Emergency Response Action.
Outcome:	Critical site-specific conditions that impact slope stability were evaluated to provide inputs to the slope stability model. The Geotechnical Assessment presented in Appendix C identified heterogeneous fill and soil materials present along the eastern slope of the 12th Street Landfill. The fill materials varied but in some instance contained layers of paper residuals. These residuals fill materials had high moisture content and fine grain sizes with resultant low shear strengths. Groundwater conditions in this evaluation included a normal level measured during water table monitoring, and a conservative level condition where river flooding occurs and saturates the fills to the top of slope. In the conservative model case, the phreatic surface in the undrained fill is assumed to follow the profile of the slope, creating excess pore pressure conditions. Finally, the slope configuration assessment considered the additional loading from relocated residuals and 3 feet of required final cover soil. Based upon this information, two design slopes were identified and modeled (*i.e.,* 4H:1V and 5H:1V) with a range of conservative input assumptions. The 5H:1V slope was shown to provide the recommended 1.5 safety factor for the full range of modeled conditions on the eastern slope. For this slope configuration, safety factors for the various conditions were predicted using the WinSTABL computer program and ranged from 1.58 to 4.18. Consideration of failure implications including the unknown nature of the fill materials and the potential implications of slope failure adjacent to the re-located main channel

	of the Kalamazoo River were factored into the selection of the 5:1 final design slope. The preliminary design slope for the remaining sides of the landfill was assumed to be 4:1 recognizing the conservative input assumptions used in this analysis and different implications associated with a possible slope failure compared with the east slope. The material relocation staging areas are not in the areas that will need to be relocated or graded later. The existing landfill side slopes that are not along the Kalamazoo River were determined to be stable with addition of less than 4 feet of fill in the material staging areas on top of the existing landfill.

Background and Overview of Approach

The re-routing of the Kalamazoo River through the former powerhouse channel has an impact on the slope stability design for the eastern side of the 12th Street Landfill in several ways. First, placement of an erosion control system will require removal of trees and re-grading of the riverbank to support the rip-rap required by a permanent erosion protection system that protects the Landfill from a 500-year flood event. The resultant landfill slope needs to be stable both during and after construction and river re-routing. Secondly, the timing of the slope reshaping, originally scheduled to be performed with the Remedial Design/Remedial Action (RD/RA) scope, now needs to coincide with the Plainwell Impoundment Time Critical Removal Action (Plainwell TCRA) so that the erosion protection system can be installed. Therefore, as part of the Emergency Response Action being conducted by Weyerhaeuser at the 12th Street Landfill, a series of geotechnical data collection and design activities were performed to allow completion of the final design for the eastern slope of the 12th Street Landfill.

The overall approach to the design included the following activities:

- Identify site specific conditions that impact the stability of 12th Street landfill slopes.

  This assessment was focused upon assessment of the types of fill and soil materials near the eastern slope and understanding the implications of groundwater and surface water elevations on site.

- Assign a range of assumed conditions to these critical site variables.

  Key variables were assigned values to define conservative input conditions for use in the predictive model.

- Select a targeted slope and model the slope stability safety factor for the range of conditions identified.

  The WinSTABL computer program was used to perform the slope stability analysis. WinSTABL was developed at the University of Wisconsin - Madison (WinSTABL, 2002) as a Windows-based platform for the PCSTABL6 developed previously by Purdue University. WinSTABL was used to perform the iterative task of identifying the factor of safety for the worst-case failure scenario for each case using the simplified Bishop method. The simplified Bishop method was used to analyze circular or rotational failure surfaces. The circular failure surface generator performs a search for the critical failure surface based on failure initiation and termination regions established by the user. The WinSTABL program was run for three different scenarios that reflected different water table elevations and material strengths. These three scenarios were run on two slope geometries 5:1 and 4:1.

- Assess the calculated safety factors against the implications of slope failure.

  A typical conservative geotechnical safety factor for static slope stability at normal conditions is 1.5; however, no factor of safety is set by Michigan planning and guidance documents. A more conservative safety factor at normal conditions is appropriate for the 12th Street Landfill based upon: 1) the heterogeneity of fill types,

volume and locations within the landfill, and 2) the significant negative implications of slope failure due to the site proximity to the Kalamazoo River.

- Select appropriate design slope for the eastern slope along the Kalamazoo River.
- Select preliminary design slope for the other side slopes of the landfill to be used in future remedial design and to identify where the relocation areas should be located.
- Assess the slope stability of existing landfill slopes with the addition of two proposed staging pads to be constructed as part of the Emergency Response Action.

Assumptions and Inputs to Model Runs

The WinSTABL model requires geometric and material strength characteristic input parameters in order to predict safety factors. Thus input parameters were established to represent a range of conditions that included the site specific groundwater conditions as well as various assumptions based upon the findings from the available geotechnical borings. The following assumptions were made to provide the needed information for the model and presented in Tables E-1 through E-3:

- **Groundwater** – Two groundwater table configurations were analyzed, one with groundwater generally matching the adjacent surface water elevation (Kalamazoo River) and wetland surface elevations (701 feet), and the second with groundwater levels at the landfill ground surface to simulate complete saturation of soil materials and rapid drawdown following a flood event. Groundwater elevations measured in monitoring wells at the site are presented in Attachment E-2.
- **Additional fill with residuals** – Additional fill will consist of re-graded existing cover materials, paper residuals, and possibly dredged river sediments. Two cases were modeled for this layer: 1) regraded residuals without additional river sediment at a natural moisture content unit weight, and 2) regraded residuals with additional river sediments at saturated unit weight. The additional fill with river sediment was also conservatively assigned the measured mobilized strength of the paper residuals (250 psf), and the unit weight of a 1:1 mix of native sand (including river sediment) and paper residuals (81.2 pcf).
- **Existing cover –** A thin stratum (2 to 7 feet thick) of sand overlies the paper residuals. This stratum was observed in the field and laboratory investigation to have the same physical properties as the native sand below the paper residuals. Identical geotechnical properties were assigned to both layers based on laboratory results. The existing cover layer was modeled as being 2 feet thick.
- **Fill with residuals –** This fill material will stay undisturbed in place throughout remediation. The paper residuals were observed to be heterogeneous in the field investigation, (performed by RMT in May 2007) changing rapidly both by depth and lateral extent. Paper residual thicknesses for the worst-case cross section of the final slopes were determined from the proposed final regrading and existing base grades found in the field geotechnical investigation.
- **Native sand** - Strength parameters for the sand unit are based on typical values from Das (1990) (Attachment E-4) and RMT experience. The native sand was modeled at an elevation of 700 feet. The native sand was observed in soil borings to begin at this elevation across the site.
- **Material Properties** – The material properties and groundwater conditions for the slope stability analysis derived from the above information are summarized in the tables below.

The three model cases described in the tables reflect the two different groundwater elevations and vary the assumed strength of the deposited paper residual materials.

Table E-1
Model Case 1 Material Properties for 5:1 and 4:1 slopes

MATERIAL	γ_{MOIST} (pcf)	γ_{SAT} (pcf)	SHEAR STRENGTH PARAMETERS (Total Stress Conditions)		REFERENCE
			FRICTION ANGLE φ (degrees)	COHESION C (psf)	
Regraded residuals	47.4	88	10	526	RMT, 2007; BBL, 2001
Cover soil	110	131	32	0	Das, 1990; RMT , 2007
Fill with residuals	47.4	88	10	526	RMT, 2007; BBL, 2001
Sand subbase native soil	110	131	32	0	Das, 1990; RMT , 2007

Notes:

Cases 1 assumes groundwater table elevation of 701 feet.

Results for 5:1 and 4:1 model runs are presented in Attachment E-1.

Table E-2
Model Case 2 Material Properties for 5:1 and 4:1 slopes

MATERIAL	γ_{MOIST} (pcf)	γ_{SAT} (pcf)	SHEAR STRENGTH PARAMETERS (Total Stress Conditions)		REFERENCE
			FRICTION ANGLE φ (degrees)	COHESION C (psf)	
Regraded residuals	81.2	101.5	10	250	RMT, 2007; BBL, 2001
Cover soil	110	131	32	0	Das, 1990; RMT , 2007
Fill with residuals	47.4	88	10	526	RMT, 2007; BBL, 2001
Sand subbase native soil	110	131	32	0	Das, 1990; RMT , 2007

Notes:

Case 2 assumes groundwater table elevation of 701 feet.

Table E-3
Model Case 3 Material Properties for 5:1 and 4:1 slopes

MATERIAL	γ_{MOIST} (pcf)	γ_{SAT} (pcf)	SHEAR STRENGTH PARAMETERS (Total Stress Conditions)		REFERENCE
			FRICTION ANGLE φ (degrees)	COHESION C (psf)	
Regraded residuals	81.2	101.5	10	250	RMT, 2007; BBL, 2001
Cover soil	110	131	32	0	Das, 1990; RMT , 2007
Fill with residuals	47.4	88	10	526	RMT, 2007; BBL, 2001
Sand subbase native soil	110	131	32	0	Das, 1990; RMT , 2007

Notes:

Case 3 assumes groundwater table at landfill ground surface and complete saturation of landfill materials.

Results for 5:1 and 4:1 model runs are presented in Attachment E-1.

Results

The factors of safety predicted by the WinSTABL models are summarized below:

Table E-4
Stability for 5:1 Slopes

CIRCULAR FAILURE (BISHOP)		
FACTOR OF SAFETY	Model Run	CASE MODELED
4.18	Case 1	Existing water table, existing residual strength
2.86	Case 2	Existing water table, remolded residual strength
1.58	Case 3	Water table at landfill ground surface, remolded residual strength

Table E-5
Slope Stability for 4:1 Slopes

CIRCULAR FAILURE (BISHOP)		
FACTOR OF SAFETY	Model Run	CASE MODELED
3.52	Case 1	Existing water table, existing residual strength
2.35	Case 2	Existing water table, remolded residual strength
1.30	Case 3	Water table at landfill ground surface, remolded residual strength

Discussion of Results and Design Conclusions

- Regraded slope adjacent to Kalamazoo River.

  The proposed 5:1 slope is expected to be stable under all of the modeled conditions. Subsurface material conditions likely to be encountered on a short and long term basis have been determined to be stable. Michigan solid waste regulations stipulate analysis of slope stability but do not define a required factor of safety. Traditional geotechnical design practice applies a 1.5 factor of safety requirement, and thus, the calculated factors of safety are consistent with current practice for the modeled conditions.

- Preliminary remedial design landfill side slopes.

  The preliminary proposed 4:1 side slope to be implemented at a later time for regrading the existing landfill is expected to be sufficient for maintaining a stable final slope. This slope has been selected even though the 3rd Case of complete landfill material saturation does not meet the 1.5 factor of safety. The 1.5 factor of safety should be applied to normal conditions with a lower factor of safety acceptable for models of worst case conditions. The worst case conditions of complete saturation are not likely to occur because of the extent and thickness of the hydraulically conductive sand fill that is present in the landfill. The sand will act to convey water away from the landfill and is not likely to stay saturated when above local surface water elevations. The basis for this acceptance decision is the low probability of conditions that could result in potential failure taken together with the recognition that a slope failure away from the Kalamazoo River will not have the same environmental implications. Furthermore, the slope geometery modeled for the worst case cross section along the river was subject to modeling at a 4:1 slope. That slope was determined to be stable and will be reanalyzed with constrained geometry and material properties from a future investigation conducted before final remedial design of the entire landfill. Material properties and identified geometry are expected to increase the accuracy of the model and increase the factor of safety for slope stability. Based on this information, the location of the relocation areas were selected such that relocated material will not have to be moved at a later date.

- Existing slopes of the landfill and staging of material on the landfill.

  Material placed up to 4 feet in height in the two relocation areas on top of the existing landfill proposed in the design report are expected to be stable. A majority of the existing slopes on the landfill are 3:1 to 2:1 which is steeper than proposed grades. These existing slopes have been stable since the time of their placement. Newly placed material is planned to be less than 4 feet in height and set back from the existing slopes such that regrading in the future of slopes back to 4:1 would not require relocation of the new material. The 4:1 slope modeled for future side slopes was safe at material heights in excess of 15 feet, and therefore, the thinly placed staged materials are not expected to produce slope failures.

References

BBL. 2001. Geotechnical sample analytical data, 12th Street Landfill Operable Unit.

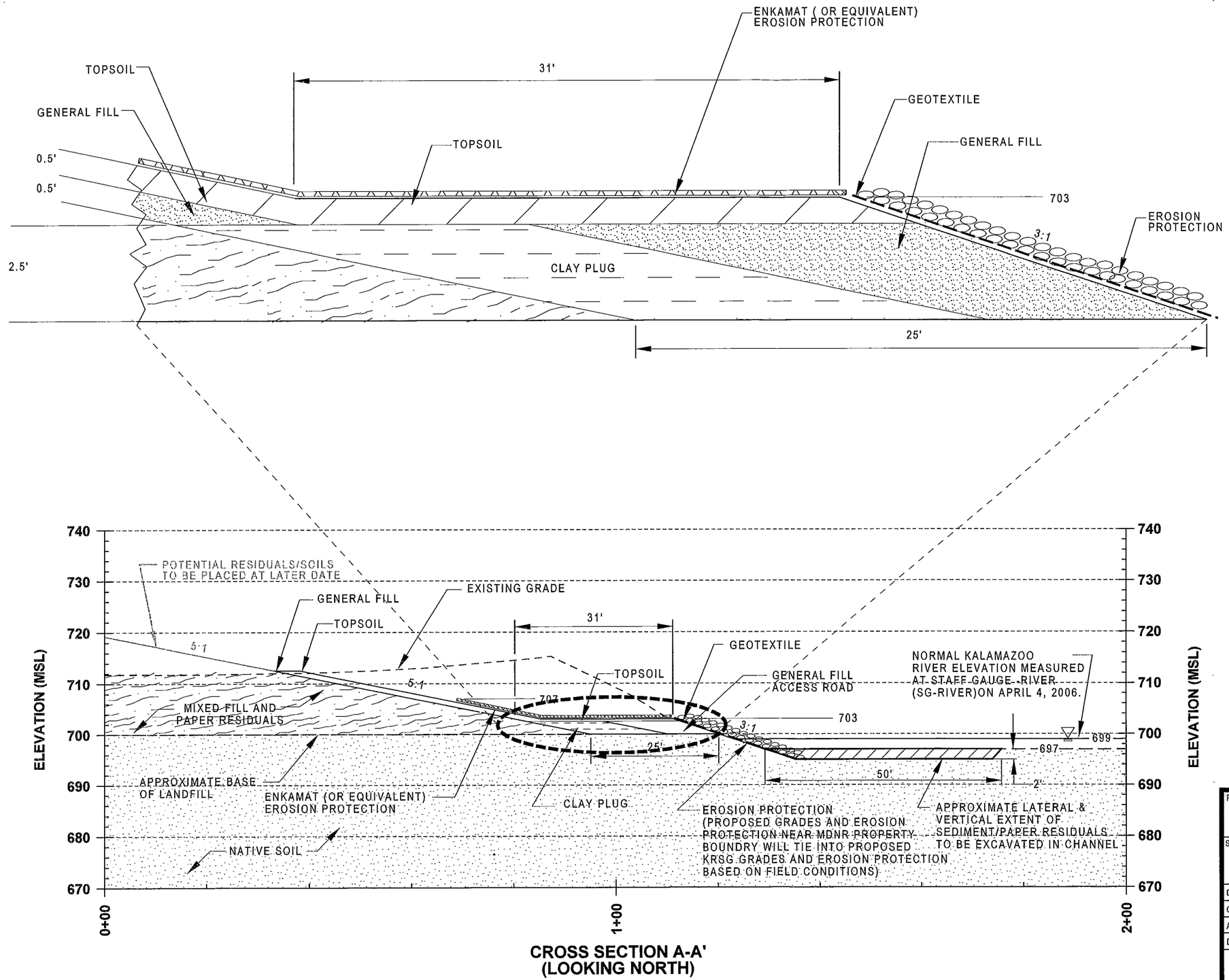
Das, B.M. 1990. Principles of foundation engineering. Second Edition. Boston Massachusetts: International Thomson Publishing.

Geraghty and Miller. 1994. Test Pit Investigation Technical Memorandum, 12th Street Landfill Operable Unit.

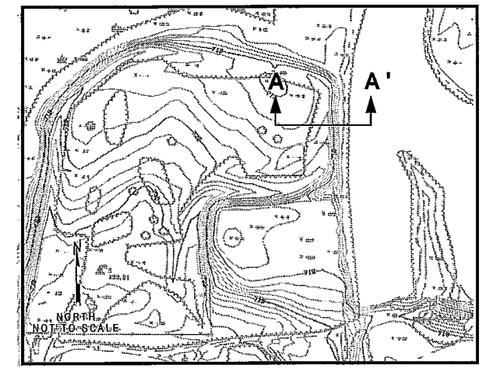
University of Wisconsin, Madison, Wisconsin. 2002. WinSTABL.

RMT, Inc. 2007. Geotechnical Investigation Technical Memorandum

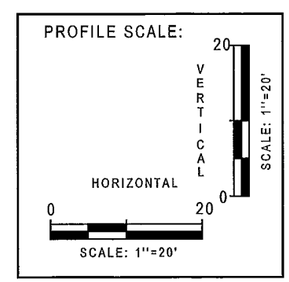
Attachment E-1
Cross Section A-A'



CROSS SECTION A-A'
(LOOKING NORTH)



CROSS SECTION LOCATOR



WORKING COPY

PROJECT: **WEYERHAEUSER 12TH STREET LANDFILL EMERGENCY RESPONSE DESIGN REPORT PLAINWELL, MICHIGAN**

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CHECKED BY:		FILE NO. XSECTION 1.PLT	
APPROVED BY:	DATE PRINTED:	FIGURE 1	
DATE: JULY 2007			

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Phone: 608-831-4444
Fax: 608-831-3334

Levels
(1) 27-29
(2) 1-63
(3) *no ref levels*
(4) *no ref levels*

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(2) bdr
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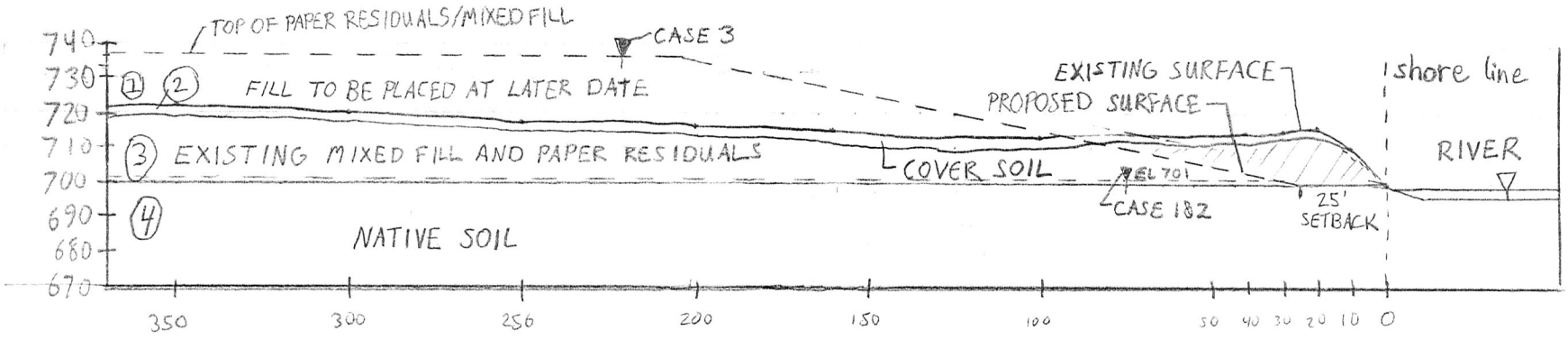
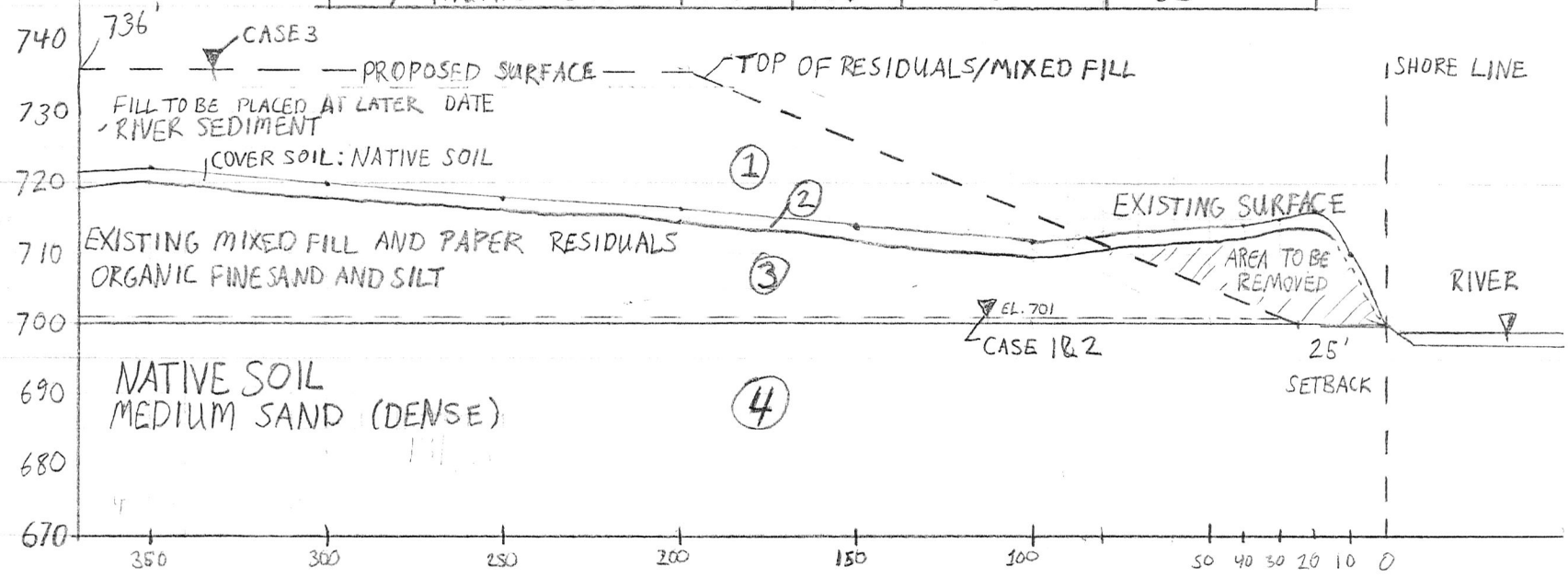


West Cross Section A-A' no vertical exageration East

Unit	Description	γ_{moist}	γ_{sat}	Cohesion (PSF)	Friction Angle (°)
1	Regraded residuals	47.4	188	526 (uu)	10
2	Cover soil	110	131	0	32
3	Fill with residuals	47.4	88	526 (uu)	10
4	Native soil	110	131	0	32



West Cross Section A-A' 2X vertical exageration East

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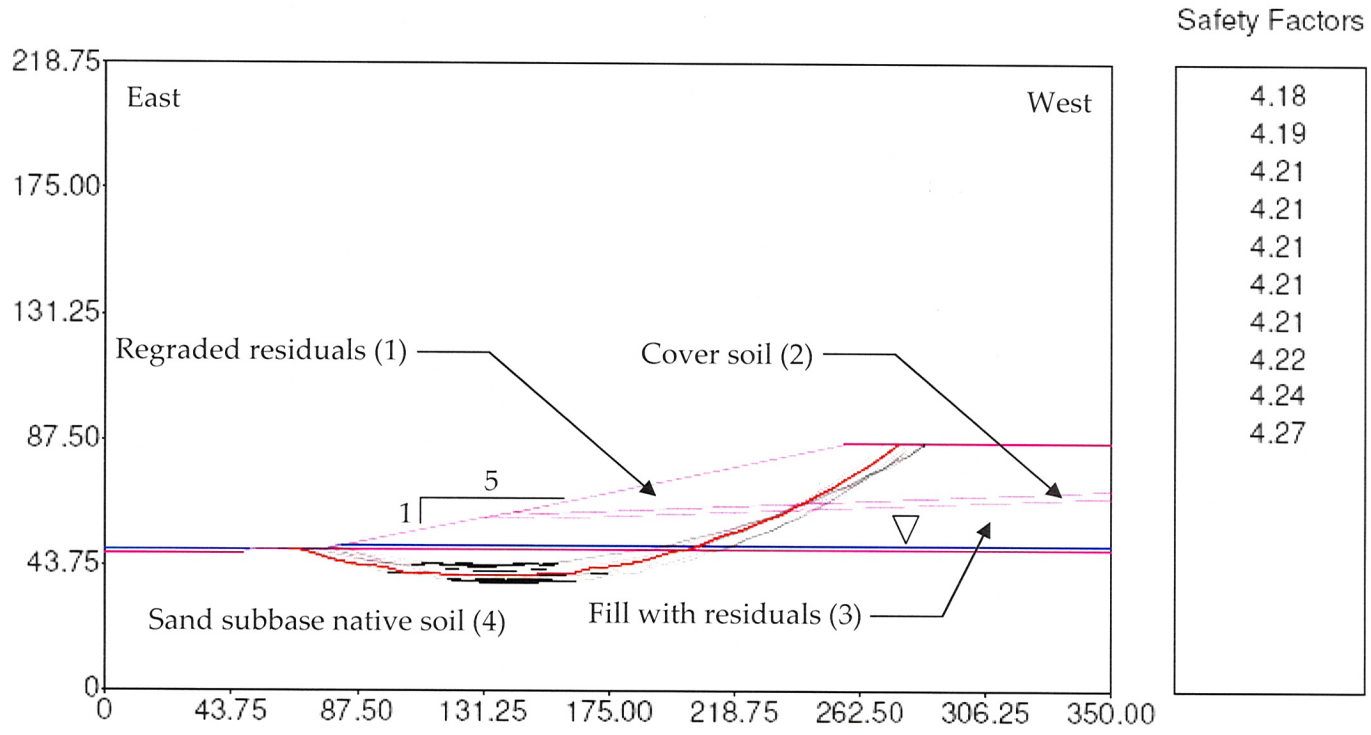
PROJECT/PROPOSAL NAME/LOCATION: 12th St. Landfill			PROJECT/PROPOSAL NO. 5116.02
SUBJECT: Section A-A'			SHEET ____ OF ____
PREPARED BY: HJH	DATE: 6/8/06	FINAL ☐	
CHECKED BY:	DATE:	REVISION ☐	

Weyerhaeuser 12th Street Landfill A-A′
Case 1



Case 2.txt
** PCSTABL6 **

by
Purdue University

modified by
Peter J. Bosscher
University of Wisconsin-Madison

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

PROBLEM DESCRIPTION

BOUNDARY COORDINATES

7 Top Boundaries
12 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	47.50	47.50	47.50	4
2	47.50	47.50	52.50	50.00	4
3	52.50	50.00	77.50	50.00	4
4	77.50	50.00	132.50	61.00	3
5	132.50	61.00	142.50	62.50	2
6	142.50	62.50	257.50	86.00	1
7	257.50	86.00	350.00	86.00	1
8	142.50	62.50	152.50	62.00	2
9	152.50	62.00	350.00	70.00	2
10	132.50	61.00	152.50	60.00	3
11	152.50	60.00	350.00	68.00	3
12	77.50	50.00	350.00	50.00	4

ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.

1	81.2	101.5	250.0	10.0	0.00	0.0	0
2	110.0	131.0	0.0	32.0	0.00	0.0	0
3	47.4	88.0	526.0	10.0	0.00	0.0	1
4	110.0	131.0	0.0	32.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	49.00
2	50.50	49.00
3	77.50	50.00
4	82.50	51.00
5	350.00	51.00

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 60.00 ft.
and X = 80.00 ft.

Each Surface Terminates Between X = 270.00 ft.
and X = 285.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 0.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Restrictions Have Been Imposed Upon The Angle Of Initiation. The Angle Has Been Restricted Between The Angles Of -45.0 And 44.0 deg.

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

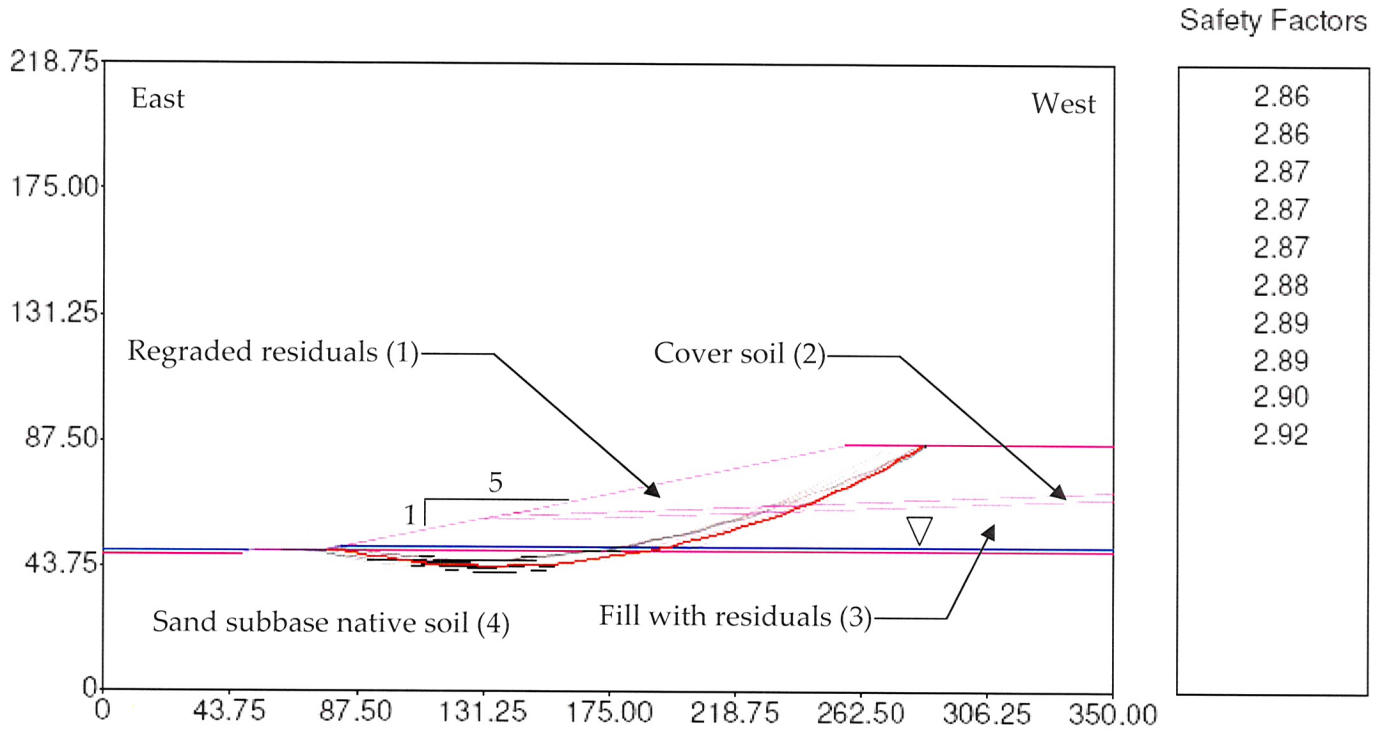
Failure Surface Specified By 44 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	77.78	50.06
2	82.69	49.11
3	87.61	48.24
4	92.55	47.46
5	97.50	46.77
6	102.47	46.17
7	107.44	45.65
8	112.42	45.22
9	117.41	44.87
10	122.40	44.62
11	127.40	44.45
12	132.40	44.36
13	137.40	44.37
14	142.40	44.46
15	147.39	44.64
16	152.39	44.90
17	157.38	45.26
18	162.36	45.70
19	167.33	46.22
20	172.29	46.84
21	177.24	47.54
22	182.18	48.32
23	187.10	49.20
24	192.01	50.15
25	196.90	51.20
26	201.77	52.33
27	206.62	53.54
28	211.45	54.84
29	216.25	56.22
30	221.03	57.69
31	225.79	59.24
32	230.51	60.87
33	235.21	62.58
34	239.88	64.38
35	244.51	66.26
36	249.11	68.21
37	253.68	70.25
38	258.21	72.37
39	262.70	74.57
40	267.15	76.84
41	271.57	79.19
42	275.94	81.62
43	280.26	84.12
44	283.38	86.00

Circle Center At X = 134.7 ; Y = 330.8 and Radius, 286.5

*** 2.858 ***

Weyerhaeuser 12th Street Landfill A-A′
Case 2



Case 1.txt
** PCSTABL6 **

by
Purdue University

modified by
Peter J. Bosscher
University of Wisconsin-Madison

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

PROBLEM DESCRIPTION

BOUNDARY COORDINATES

7 Top Boundaries
12 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	47.50	47.50	47.50	4
2	47.50	47.50	52.50	50.00	4
3	52.50	50.00	77.50	50.00	4
4	77.50	50.00	132.50	61.00	3
5	132.50	61.00	142.50	62.50	2
6	142.50	62.50	257.50	86.00	1
7	257.50	86.00	350.00	86.00	1
8	142.50	62.50	152.50	62.00	2
9	152.50	62.00	350.00	70.00	2
10	132.50	61.00	152.50	60.00	3
11	152.50	60.00	350.00	68.00	3
12	77.50	50.00	350.00	50.00	4

ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.

1	47.4	88.0	526.0	10.0	0.00	0.0	0
2	110.0	131.0	0.0	32.0	0.00	0.0	0
3	47.4	88.0	526.0	10.0	0.00	0.0	1
4	110.0	131.0	0.0	32.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	49.00
2	50.50	49.00
3	77.50	50.00
4	82.50	51.00
5	350.00	51.00

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 60.00 ft.
and X = 80.00 ft.

Each Surface Terminates Between X = 270.00 ft.
and X = 285.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 0.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Restrictions Have Been Imposed Upon The Angle Of Initiation. The Angle Has Been Restricted Between The Angles Of -45.0 And 44.0 deg.

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

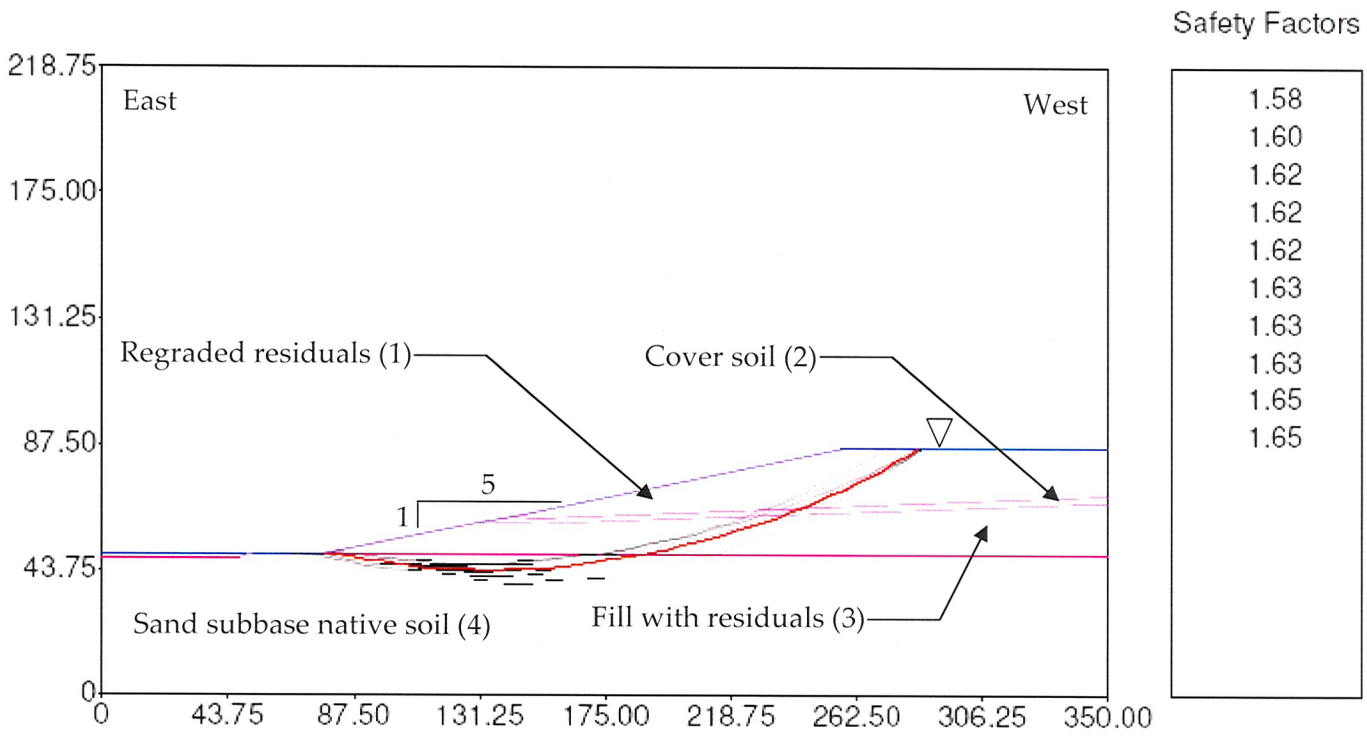
Failure Surface Specified By 46 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	64.44	50.00
2	69.25	48.61
3	74.08	47.32
4	78.94	46.14
5	83.82	45.05
6	88.72	44.06
7	93.64	43.18
8	98.58	42.40
9	103.53	41.72
10	108.50	41.14
11	113.48	40.67
12	118.46	40.30
13	123.46	40.04
14	128.45	39.87
15	133.45	39.81
16	138.45	39.86
17	143.45	40.00
18	148.44	40.26
19	153.43	40.61
20	158.41	41.07
21	163.38	41.63
22	168.34	42.29
23	173.28	43.06
24	178.20	43.93
25	183.11	44.90
26	187.99	45.97
27	192.85	47.14
28	197.68	48.41
29	202.49	49.79
30	207.27	51.26
31	212.02	52.83
32	216.73	54.50
33	221.41	56.26
34	226.05	58.13
35	230.65	60.08
36	235.21	62.14
37	239.72	64.29
38	244.19	66.53
39	248.62	68.86
40	252.99	71.28
41	257.31	73.79
42	261.58	76.40
43	265.80	79.09
44	269.95	81.86
45	274.05	84.73
46	275.80	86.00

Circle Center At X = 133.8 ; Y = 281.2 and Radius, 241.4

*** 4.185 ***

Weyerhaeuser 12th Street Landfill A-A′
Case 3



** PCSTABL6 **

by
Purdue University

modified by
Peter J. Bosscher
University of Wisconsin-Madison

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

PROBLEM DESCRIPTION

BOUNDARY COORDINATES

7 Top Boundaries
12 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	47.50	47.50	47.50	4
2	47.50	47.50	52.50	50.00	4
3	52.50	50.00	77.50	50.00	4
4	77.50	50.00	132.50	61.00	3
5	132.50	61.00	142.50	62.50	2
6	142.50	62.50	257.50	86.00	1
7	257.50	86.00	350.00	86.00	1
8	142.50	62.50	152.50	62.00	2
9	152.50	62.00	350.00	70.00	2
10	132.50	61.00	152.50	60.00	3
11	152.50	60.00	350.00	68.00	3
12	77.50	50.00	350.00	50.00	4

ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.

1	81.2	101.5	250.0	10.0	0.00	0.0	1
2	110.0	131.0	0.0	32.0	0.00	0.0	1
3	47.4	88.0	526.0	10.0	0.00	0.0	1
4	110.0	131.0	0.0	32.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 8 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	49.00
2	50.50	49.00
3	52.50	50.00
4	77.50	50.00
5	132.50	61.00
6	142.50	62.50
7	257.50	86.00
8	350.00	86.00

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 60.00 ft.
and X = 80.00 ft.

Each Surface Terminates Between X = 270.00 ft.
and X = 285.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 0.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Restrictions Have Been Imposed Upon The Angle Of Initiation. The Angle Has Been Restricted Between The Angles Of -45.0 And 44.0 deg.

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical

First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 44 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	77.78	50.06
2	82.69	49.11
3	87.61	48.24
4	92.55	47.46
5	97.50	46.77
6	102.47	46.17
7	107.44	45.65
8	112.42	45.22
9	117.41	44.87
10	122.40	44.62
11	127.40	44.45
12	132.40	44.36
13	137.40	44.37
14	142.40	44.46
15	147.39	44.64
16	152.39	44.90
17	157.38	45.26
18	162.36	45.70
19	167.33	46.22
20	172.29	46.84
21	177.24	47.54
22	182.18	48.32
23	187.10	49.20
24	192.01	50.15
25	196.90	51.20
26	201.77	52.33
27	206.62	53.54
28	211.45	54.84
29	216.25	56.22
30	221.03	57.69
31	225.79	59.24
32	230.51	60.87
33	235.21	62.58
34	239.88	64.38
35	244.51	66.26
36	249.11	68.21
37	253.68	70.25
38	258.21	72.37
39	262.70	74.57
40	267.15	76.84
41	271.57	79.19
42	275.94	81.62
43	280.26	84.12
44	283.38	86.00

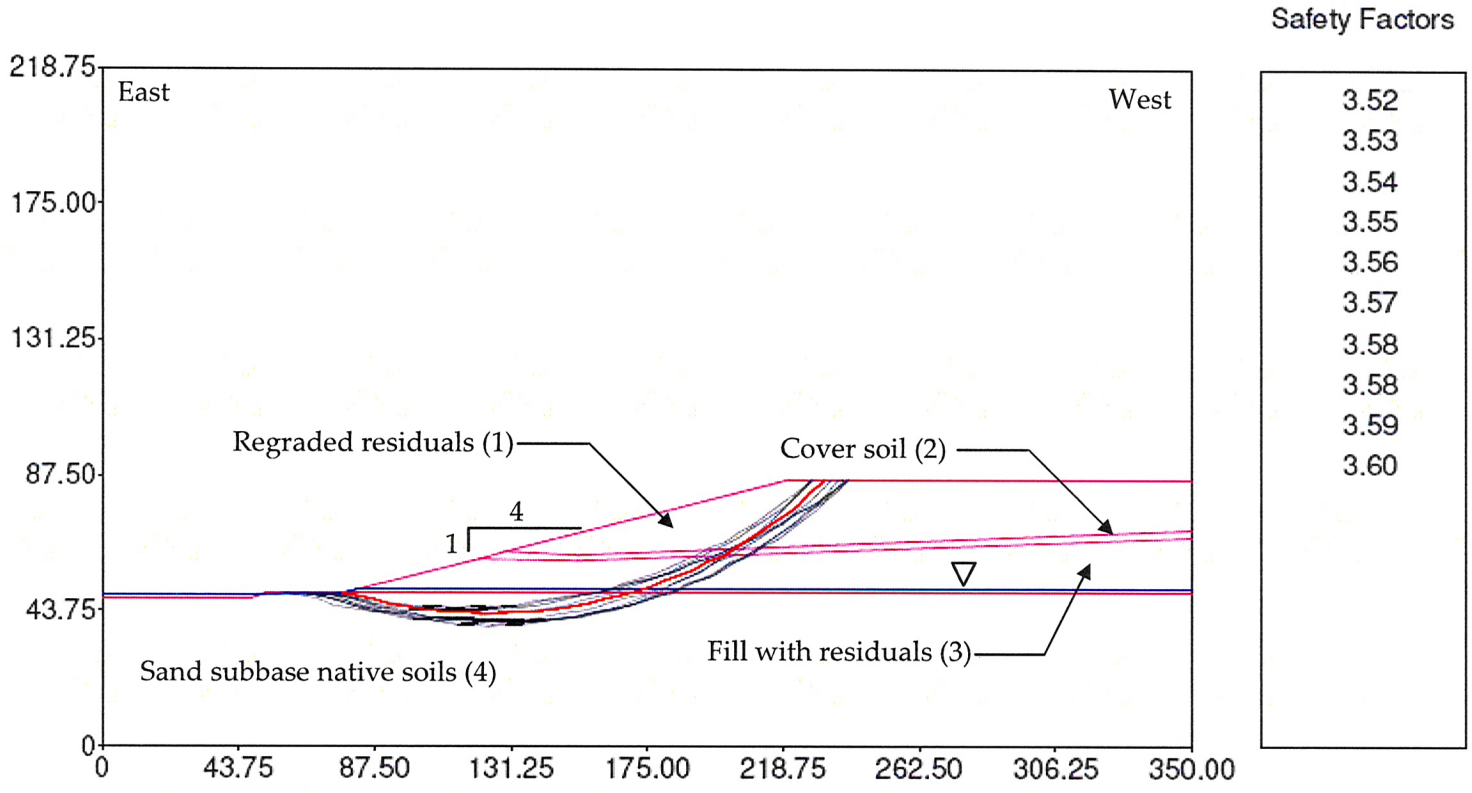
Circle Center At X = 134.7 ; Y = 330.8 and Radius, 286.5

*** 1.582 ***

Weyerhaeuser 12th Street Landfill A-A′

Case 1

4:1 slope



** PCSTABL6 **

by
Purdue University

modified by
Peter J. Bosscher
University of Wisconsin-Madison

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

PROBLEM DESCRIPTION

BOUNDARY COORDINATES

7 Top Boundaries
12 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	47.50	47.50	47.50	4
2	47.50	47.50	52.50	50.00	4
3	52.50	50.00	77.50	50.00	4
4	77.50	50.00	121.50	61.00	3
5	121.50	61.00	129.50	63.00	2
6	129.50	63.00	221.50	86.00	1
7	221.50	86.00	350.00	86.00	1
8	129.50	63.00	152.50	62.00	2
9	152.50	62.00	350.00	70.00	2
10	121.50	61.00	152.50	60.00	3
11	152.50	60.00	350.00	68.00	3
12	77.50	50.00	350.00	50.00	4

ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.

1	47.4	88.0	526.0	10.0	0.00	0.0	0
2	110.0	131.0	0.0	32.0	0.00	0.0	0
3	47.4	88.0	526.0	10.0	0.00	0.0	1
4	110.0	131.0	0.0	32.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	49.00
2	50.50	49.00
3	77.50	50.00
4	82.50	51.00
5	350.00	51.00

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 60.00 ft.
and X = 80.00 ft.

Each Surface Terminates Between X = 220.00 ft.
and X = 240.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 0.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Restrictions Have Been Imposed Upon The Angle Of Initiation. The Angle Has Been Restricted Between The Angles Of -45.0 And 44.0 deg.

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	77.78	50.07
2	82.58	48.66
3	87.42	47.41
4	92.29	46.31
5	97.21	45.37
6	102.14	44.58
7	107.10	43.96
8	112.08	43.49
9	117.07	43.17
10	122.07	43.02
11	127.07	43.03
12	132.07	43.19
13	137.06	43.52
14	142.03	44.00
15	146.99	44.64
16	151.93	45.44
17	156.83	46.40
18	161.71	47.51
19	166.55	48.78
20	171.34	50.20
21	176.09	51.77
22	180.78	53.49
23	185.42	55.36
24	189.99	57.37
25	194.50	59.54
26	198.94	61.84
27	203.30	64.28
28	207.59	66.86
29	211.78	69.58
30	215.89	72.43
31	219.91	75.41
32	223.83	78.51
33	227.65	81.74
34	231.36	85.08
35	232.32	86.00

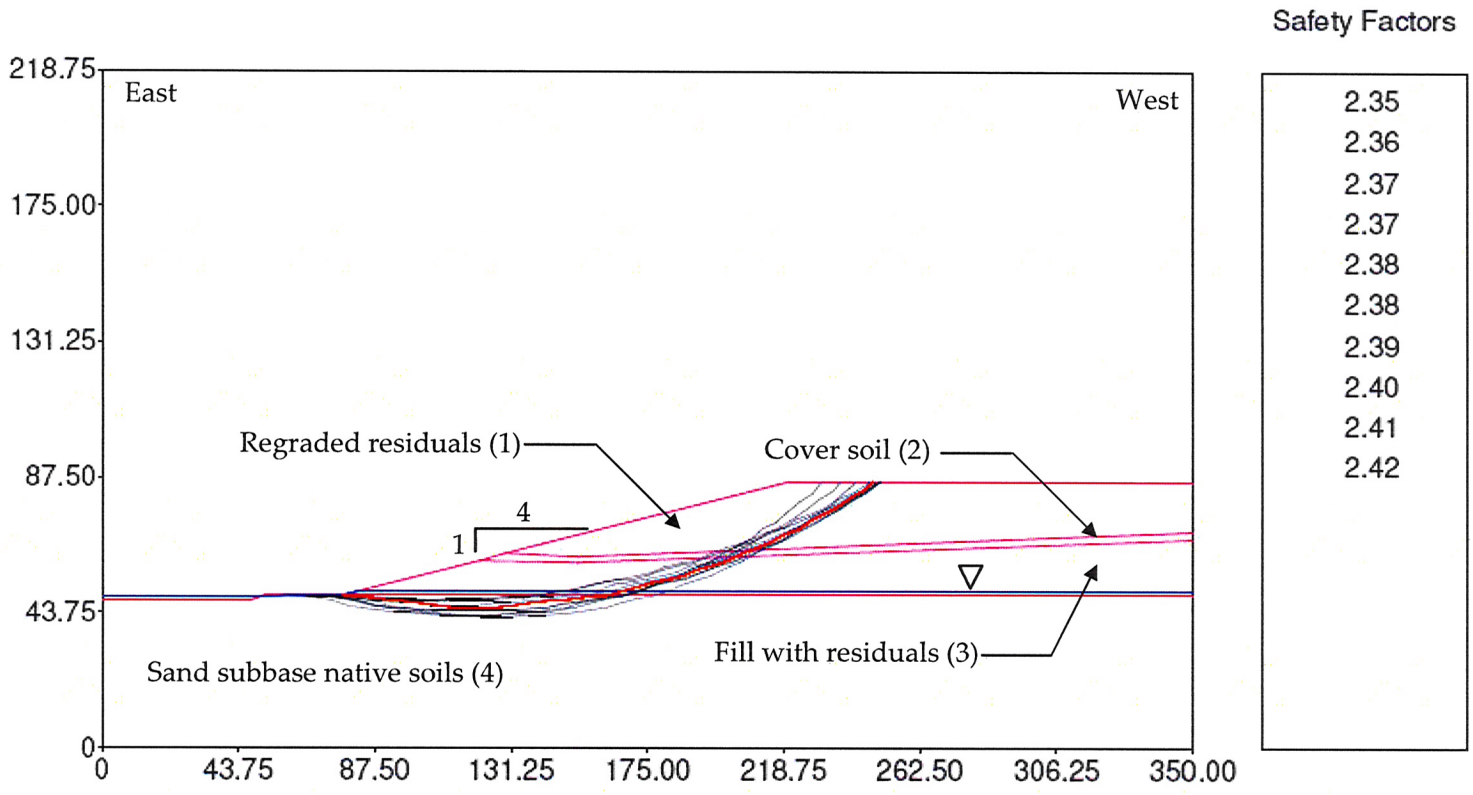
Circle Center At X = 124.4 ; Y = 200.1 and Radius, 157.1

*** 3.515 ***

Weyerhaeuser 12th Street Landfill A-A′

Case 2

4:1 slope



4-1_Case 2.txt
** PCSTABL6 **

by
Purdue University

modified by
Peter J. Bosscher
University of Wisconsin-Madison

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

PROBLEM DESCRIPTION

BOUNDARY COORDINATES

7 Top Boundaries
12 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	47.50	47.50	47.50	4
2	47.50	47.50	52.50	50.00	4
3	52.50	50.00	77.50	50.00	4
4	77.50	50.00	121.50	61.00	3
5	121.50	61.00	129.50	63.00	2
6	129.50	63.00	221.50	86.00	1
7	221.50	86.00	350.00	86.00	1
8	129.50	63.00	152.50	62.00	2
9	152.50	62.00	350.00	70.00	2
10	121.50	61.00	152.50	60.00	3
11	152.50	60.00	350.00	68.00	3
12	77.50	50.00	350.00	50.00	4

ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.

1	81.2	101.5	250.0	10.0	0.00	0.0	0
2	110.0	131.0	0.0	32.0	0.00	0.0	0
3	47.4	88.0	526.0	10.0	0.00	0.0	1
4	110.0	131.0	0.0	32.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 5 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	49.00
2	50.50	49.00
3	77.50	50.00
4	82.50	51.00
5	350.00	51.00

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 60.00 ft.
and X = 80.00 ft.

Each Surface Terminates Between X = 230.00 ft.
and X = 250.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 0.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Restrictions Have Been Imposed Upon The Angle Of Initiation. The Angle Has Been Restricted Between The Angles Of -45.0 And 44.0 deg.

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	77.78	50.07
2	82.70	49.17
3	87.63	48.38
4	92.59	47.70
5	97.56	47.14
6	102.53	46.68
7	107.52	46.34
8	112.52	46.11
9	117.52	45.99
10	122.52	45.99
11	127.52	46.09
12	132.51	46.31
13	137.50	46.65
14	142.48	47.09
15	147.45	47.65
16	152.40	48.32
17	157.34	49.10
18	162.26	49.99
19	167.16	50.99
20	172.04	52.10
21	176.89	53.32
22	181.71	54.65
23	186.49	56.08
24	191.25	57.63
25	195.97	59.28
26	200.65	61.04
27	205.29	62.90
28	209.89	64.86
29	214.44	66.93
30	218.94	69.10
31	223.40	71.37
32	227.80	73.75
33	232.15	76.22
34	236.44	78.78
35	240.67	81.44
36	244.84	84.20
37	247.43	86.00

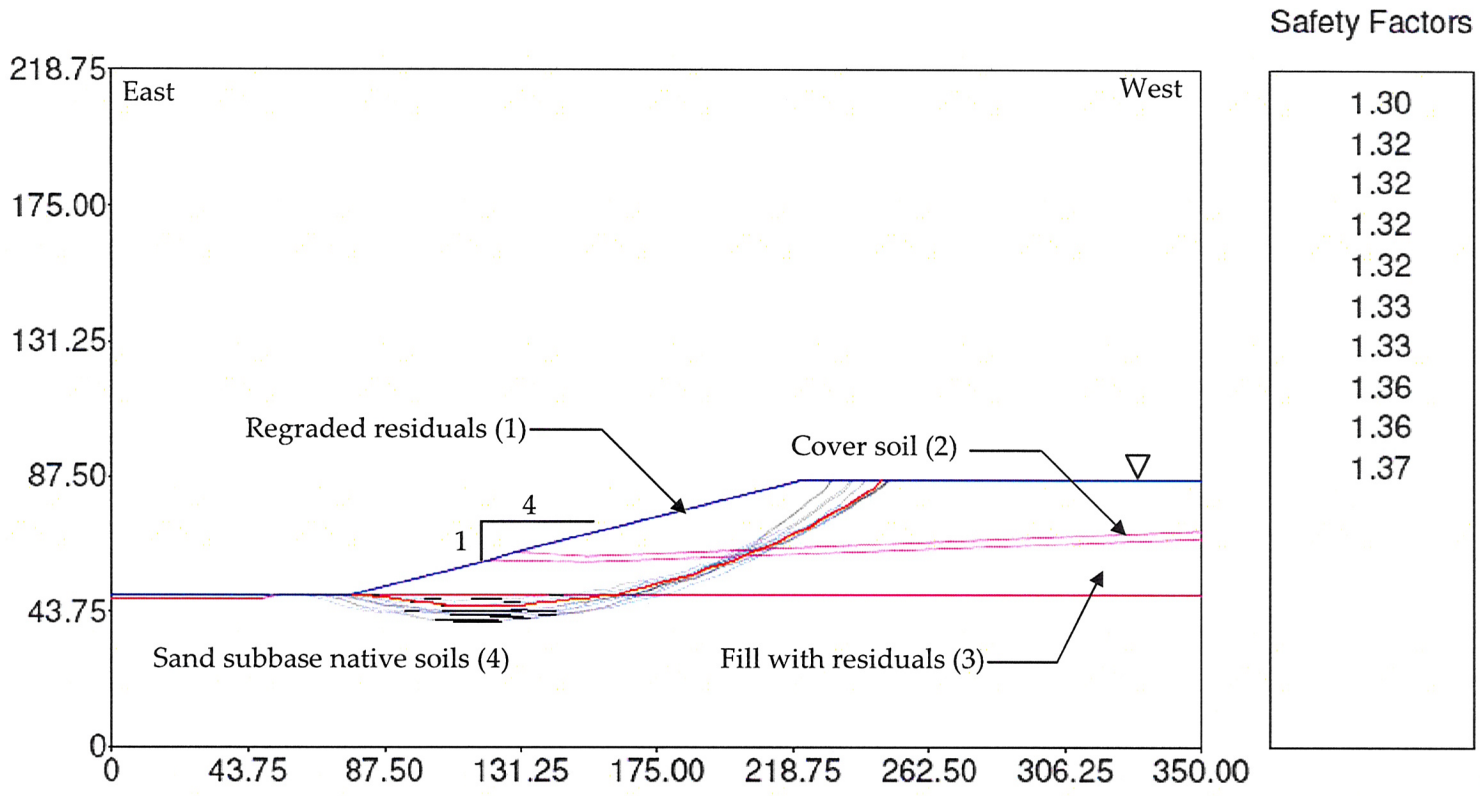
Circle Center At X = 120.2 ; Y = 268.2 and Radius, 222.2

*** 2.346 ***

Weyerhaeuser 12th Street Landfill A-A′

Case 3

4:1 slope



** PCSTABL6 **

by
Purdue University

modified by
Peter J. Bosscher
University of Wisconsin-Madison

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

PROBLEM DESCRIPTION

BOUNDARY COORDINATES

7 Top Boundaries
12 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	47.50	47.50	47.50	4
2	47.50	47.50	52.50	50.00	4
3	52.50	50.00	77.50	50.00	4
4	77.50	50.00	121.50	61.00	3
5	121.50	61.00	129.50	63.00	2
6	129.50	63.00	221.50	86.00	1
7	221.50	86.00	350.00	86.00	1
8	129.50	63.00	152.50	62.00	2
9	152.50	62.00	350.00	70.00	2
10	121.50	61.00	152.50	60.00	3
11	152.50	60.00	350.00	68.00	3
12	77.50	50.00	350.00	50.00	4

ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.

1	81.2	101.5	250.0	10.0	0.00	0.0	1
2	110.0	131.0	0.0	32.0	0.00	0.0	1
3	47.4	88.0	526.0	10.0	0.00	0.0	1
4	110.0	131.0	0.0	32.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 7 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	49.00
2	50.50	49.00
3	77.50	50.00
4	121.50	61.00
5	129.50	63.00
6	221.50	86.00
7	350.00	86.00

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 60.00 ft.
and X = 80.00 ft.

Each Surface Terminates Between X = 230.00 ft.
and X = 250.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 0.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Restrictions Have Been Imposed Upon The Angle Of Initiation. The Angle Has Been Restricted Between The Angles Of -45.0 And 44.0 deg.

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	77.78	50.07
2	82.70	49.17
3	87.63	48.38
4	92.59	47.70
5	97.56	47.14
6	102.53	46.68
7	107.52	46.34
8	112.52	46.11
9	117.52	45.99
10	122.52	45.99
11	127.52	46.09
12	132.51	46.31
13	137.50	46.65
14	142.48	47.09
15	147.45	47.65
16	152.40	48.32
17	157.34	49.10
18	162.26	49.99
19	167.16	50.99
20	172.04	52.10
21	176.89	53.32
22	181.71	54.65
23	186.49	56.08
24	191.25	57.63
25	195.97	59.28
26	200.65	61.04
27	205.29	62.90
28	209.89	64.86
29	214.44	66.93
30	218.94	69.10
31	223.40	71.37
32	227.80	73.75
33	232.15	76.22
34	236.44	78.78
35	240.67	81.44
36	244.84	84.20
37	247.43	86.00

Circle Center At X = 120.2 ; Y = 268.2 and Radius, 222.2

*** 1.302 ***

Attachment E-2
Water Levels

Table 3-1. Groundwater and Leachate Elevations, 12th Street Landfill Operable Unit, Plainwell, Michigan.

Well/River Gauge No.:	RG-4	MW-6A			RG-5	MW-7A		
Date Installed:		03-Aug-93				04-Aug-93		
Date Developed:		23-Aug-93				23-Aug-93		
Volume Developed (gal):		35				60		
Date Sampled:		09-Sep-93				13-Sep-93		
Date	Elevation	Depth to Water	Elevation	Flow Reversal	Elevation	Depth to Water	Elevation	Flow Reversal
31-Aug-93	NR	9.52	700.81	NR	NR	9.38	700.54	NR
03-Sep-93	707.21	9.27	701.06	No	699.86	8.07	701.85	No
12-Sep-93	707.04	9.56	700.77	No	699.63	8.35	701.57	No
28-Sep-93	707.36	9.19	701.14	No	700.08	7.99	701.93	No
15-Dec-93	706.10	9.47	700.86	No	699.70	8.19	701.73	No
			AVE = 700.93		699.82		AVE = 701.52	

Depths are presented in feet below top of inner casing.
Elevations are presented in feet relative to National Adjusted Vertical Datum (NAVD) 1929 Datum.
NR Elevations were not recorded.
Water elevations at stream gauges RG-4 and RG-5 are compared with the nearest wells, MW-6A and MW-7A respectively, for the purpose of determining possible groundwater flow reversals near the river.

KB601056 48

RI/FS, 1994

Table 3-1. Groundwater and Leachate Elevations, 12th Street Landfill Operable Unit, Plainwell, Michigan.

Well/River Gauge No.:	MW-1		MW-2A		MW-2B		MW-3A	
Date Installed:	17-Aug-93		02-Aug-93		02-Aug-93		29-Jul-93	
Date Developed:	23-Aug-93		20-Aug-93		20-Aug-93		19-Aug-93	
Volume Developed (gal):	55		70		80		66	
Date Sampled:	10-Sep-93		08-Sep-93		08-Sep-93		14-Sep-93	
Date	Depth to Water	Elevation	Depth to Water	Elevation	Depth to Water	Elevation	Depth to Water	Elevation
31-Aug-93	6.68	702.03	5.93	701.38	5.26	701.71	3.68	700.57
03-Sep-93	6.44	702.27	5.82	701.49	5.01	701.96	3.41	700.84
12-Sep-93	6.69	702.02	5.97	701.34	5.15	701.82	3.75	700.50
28-Sep-93	6.40	702.31	5.69	701.62	4.96	702.01	3.42	700.83
15-Dec-93	6.55	702.16	5.83	701.48	5.12	701.85	3.59	700.66

Depths are presented in feet below top of inner casing.
Elevations are presented in feet relative to National Adjusted Vertical Datum (NAVD) 1929 Datum.
NR Elevations were not recorded.

KE601056 49

Table 3-1. Groundwater and Leachate Elevations, 12th Street Landfill Operable Unit, Plainwell, Michigan.

Well/River Gauge No.:	MW-3B		MW-4A		MW-4B		MW-5A	
Date Installed:	29-Jul-93		29-Jul-93		28-Jul-93		02-Aug-93	
Date Developed:	19-Aug-93		18-Aug-93		18-Aug-93		20-Aug-93	
Volume Developed (gal):	85		24		176		60	
Date Sampled:	14-Sep-93		07-Sep-93		07-Sep-93		10-Sep-93	
Date	Depth to Water	Elevation	Depth to Water	Elevation	Depth to Water	Elevation	Depth to Water	Elevation
31-Aug-93	3.95	700.59	5.77	700.24	5.37	700.24	3.99	700.08
03-Sep-93	3.81	700.73	5.58	700.43	5.04	700.57	3.75	700.32
12-Sep-93	3.88	700.66	5.84	700.17	5.43	700.18	4.03	700.04
28-Sep-93	3.68	700.86	4.99	701.02	5.42	700.19	3.55	700.52
15-Dec-93	3.85	700.69	5.65	700.36	5.25	700.36	3.85	700.22
		AVE=700.71		700.44		AVE = 700.31		AVE= 700.24

Depths are presented in feet below top of inner casing.
Elevations are presented in feet relative to National Adjusted Vertical Datum (NAVD) 1929 Datum.
NR Elevations were not recorded.

KB601055 50

Table 3-1. Groundwater and Leachate Elevations, 12th Street Landfill Operable Unit, Plainwell, Michigan.

Well/River Gauge No.:	MW-5B		MW-6B		MW-7B		MW-8A	
Date Installed:	30-Jul-93		03-Aug-93		04-Aug-93		17-Aug-93	
Date Developed:	20-Aug-93		23-Aug-93		23-Aug-93		24-Aug-93	
Volume Developed (gal):	70		110		105		135	
Date Sampled:	10-Sep-93		09-Sep-93		13-Sep-93		13-Sep-93	
Date	Depth to Water	Elevation	Depth to Water	Elevation	Depth to Water	Elevation	Depth to Water	Elevation
31-Aug-93	3.93	700.25	9.60	700.61	9.21	701.61	32.61	702.35
03-Sep-93	3.66	700.52	9.34	700.87	9.02	701.80	32.13	702.83
12-Sep-93	3.87	700.31	9.53	700.68	9.16	701.66	32.61	702.35
28-Sep-93	3.44	700.74	9.14	701.07	8.92	701.90	32.44	702.52
15-Dec-93	3.75	700.43	9.43	700.78	9.16	701.66	32.58	702.38
		700.45		700.80		701.73		702.49

Depths are presented in feet below top of inner casing.
Elevations are presented in feet relative to National Adjusted Vertical Datum (NAVD) 1929 Datum.
NR Elevations were not recorded.

KB601055651

Table 3-1. Groundwater and Leachate Elevations, 12th Street Landfill Operable Unit, Plainwell, Michigan.

Well/River Gauge No.:	MW-8B		LH-1		LH-2		LH-3	
Date Installed:	16-Aug-93		13-Aug-93		05-Aug-93		11-Aug-93	
Date Developed:	26-Aug-93		ND		ND		ND	
Volume Developed (gal):	135		ND		ND		ND	
Date Sampled:	13-Sep-93		16-Sep-93		16-Sep-93		15-Sep-93	
Date	Depth to Water	Elevation	Depth to Water	Elevation	Depth to Water	Elevation	Depth to Water	Elevation
31-Aug-93	32.61	702.28	9.00	718.30	5.43	723.48	13.94	714.44
03-Sep-93	32.49	702.40	9.11	718.19	5.32	723.59	13.92	714.46
12-Sep-93	32.61	702.28	9.41	717.89	6.24	722.67	13.43	714.95
28-Sep-93	32.63	702.26	9.64	717.66	5.43	723.48	14.03	714.35
15-Dec-93	32.59	702.30	9.91	717.39	5.52	723.39	14.00	714.38

Depths are presented in feet below top of inner casing.
Elevations are presented in feet relative to National Adjusted Vertical Datum (NAVD) 1929 Datum.
NR Elevations were not recorded.
ND Well was not developed.

CI0091.001 DISK#3\RITABLES\TABLE3-1.WK1\dkc

KB601105652

50 0 50 100

SCALE IN FEET

TOPOGRAPHIC MAPPING PRODUCED USING PHOTOGRAMMETRIC METHODS BY LOCKWOOD, INC. FROM AERIAL PHOTOGRAPHY FLOWN APRIL 17, 1991.

SOURCES: RIVER GAUGE LOCATIONS – AS SURVEYED BY BLASLAND & BOUCK.

LEGEND

- MONITORING WELL/NUMBER
- LEACHATE HEAD WELL/NUMBER – ORIGINAL SOIL BORING NUMBER
- RIVER GAUGE/NUMBER
- WETLAND AREA
- FENCE
- 720 EXISTING CONTOUR
- TREE/BRUSH
- (702.27) WATER ELEVATION/LEACHATE HEAD ELEVATION
- [699.86] SURFACE-WATER ELEVATION
- 702 LINE OF EQUAL WATER-TABLE ELEVATION (DASHED WHERE INFERRED) CONTOUR INTERVAL = VARIABLE

NOTE: TOPOGRAPHIC EFFECTS WERE CONSIDERED IN THE CONSTRUCTION OF THIS MAP.

KB60105733

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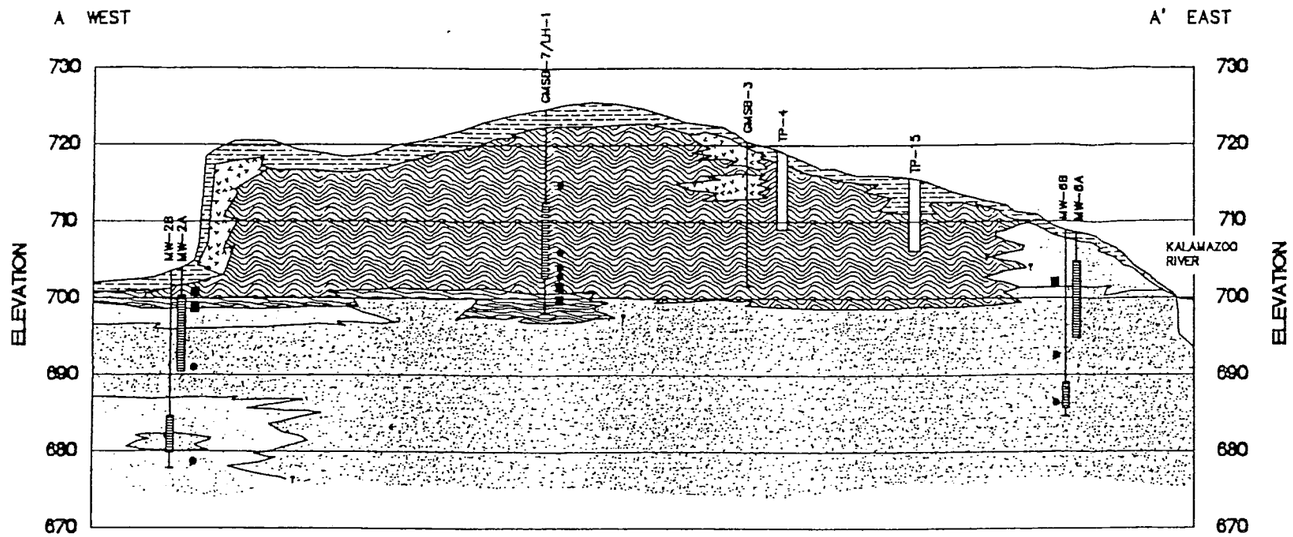
SCALE VERIFICATION: THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING. USE TO VERIFY FIGURE REPRODUCTION SCALE

REV. NO.	DATE	DESCRIPTION	BY	APPR.

WATER-TABLE CONTOUR MAP SEPTEMBER 3, 1993

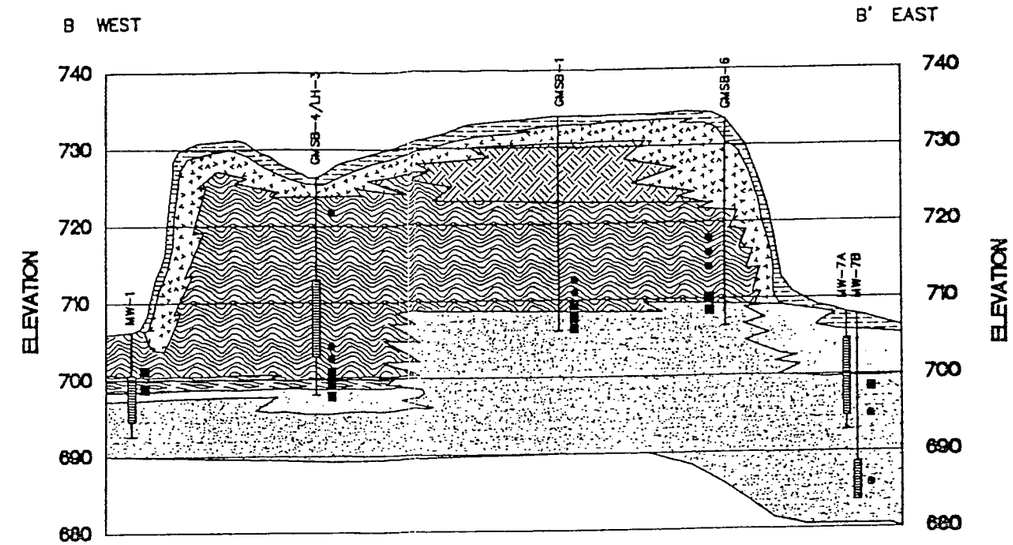
REMEDIAL INVESTIGATION TECHNICAL MEMORANDUM 8
12th STREET LANDFILL OPERABLE UNIT
ALLIED PAPER, INC./PORTAGE CREEK/
KALAMAZOO RIVER SUPERFUND SITE

FIGURE 3-4



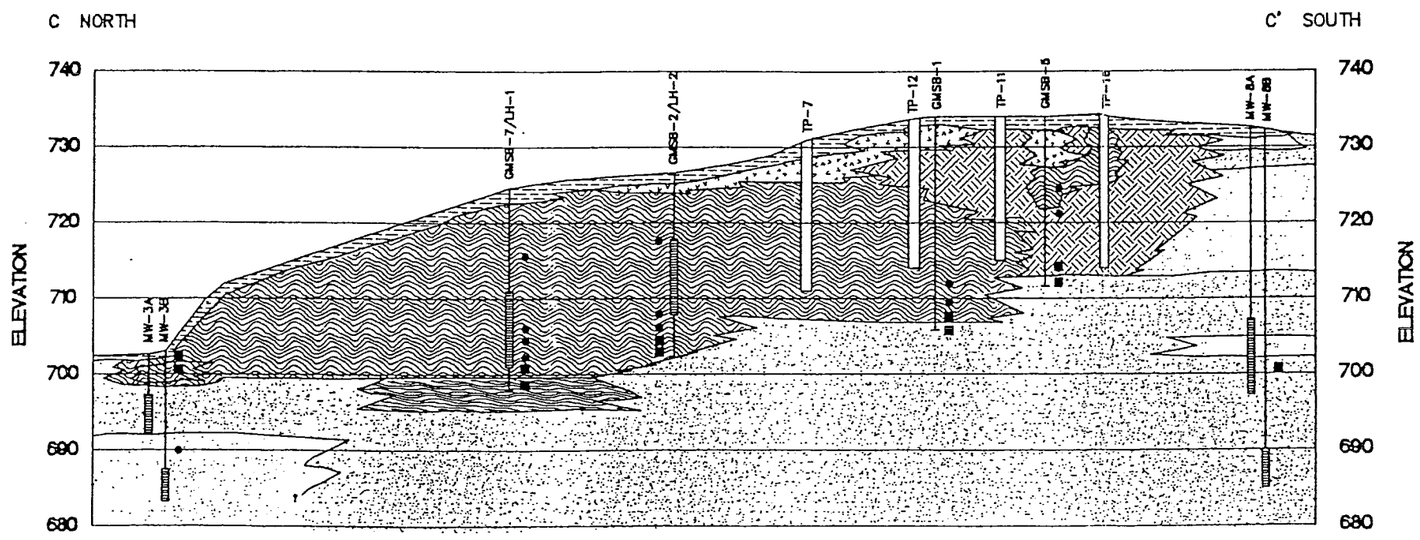
HORIZONTAL SCALE: 1" = 50'
VERTICAL SCALE: 1" = 10'

GEOLOGIC CROSS-SECTION A - A'



HORIZONTAL SCALE: 1" = 50'
VERTICAL SCALE: 1" = 10'

GEOLOGIC CROSS-SECTION B - B'



HORIZONTAL SCALE: 1" = 50'
VERTICAL SCALE: 1" = 10'

GEOLOGIC CROSS-SECTION C - C'

LEGEND

- TOP SOIL: BROWN TO TAN SANDY ORGANIC-RICH TOPSOIL
- FLY ASH
- CONSTRUCTION DEBRIS: MEDIUM SAND, CONCRETE, WOOD, BALE WIRE, CORRUGATED METAL AND MISCELLANEOUS WASTE
- RESIDUALS: GRAY TO BLACK SANDY TO CLAYEY PAPER RESIDUALS
- FINE TO MEDIUM SAND: TAN TO WHITE TO BROWN FINE TO MEDIUM SAND, TRACE COARSE SAND: "SAND UNIT"
- MEDIUM TO COARSE SAND: MULTI-COLORED MEDIUM TO COARSE ROUNDED TO SUB-ROUNDED SAND WITH GRAVEL: "SAND AND GRAVEL UNIT"
- PEAT: DARK BROWN TO BLACK PEAT
- GEOLOGIC CONTOUR (QUESTION MARKS WHERE INFERRED)
- LOCATION OF SOIL SAMPLE SUBMITTED FROM BORING FOR ANALYSIS OF CONSTITUENTS ON TCL AND TAL
- LOCATION OF SOIL SAMPLE SUBMITTED FROM BORING FOR ANALYSIS OF PCBs
- MONITORING WELL WITH SCREENED INTERVAL
- BASE OF BORING

MW-3A	MONITORING WELL DESIGNATION
GMSB-7/LH-1	SOIL BORING/LEACHATE HEAD WELL DESIGNATION
TP-7	TEST PIT OR TRENCH DESIGNATION
GMSB-3	SOIL BORING DESIGNATION

NOTES:
1. TOPOGRAPHIC PROFILE BASED ON BLASLAND & BOUCK WORK PLAN BASE MAP, DRAWING 6459037R/64590G01.DWG.
2. THE DEPTH AND THICKNESS OF SUBSURFACE UNITS ON THE CROSS-SECTIONS WERE GENERALIZED FROM AND INTERPOLATED BETWEEN BORINGS AND TRENCHES. INFORMATION ON THE ACTUAL SUBSURFACE CONDITIONS EXISTS ONLY AT THE INDICATED LOCATIONS.

KB60105732

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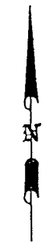
REV. NO.	DATE	DESCRIPTION	BY	APPR.

PROJECT NO.: GC0591.005	FILE NO. 1730-1.DWG
DRAWING NO.: GC0591-GF001-3	PLOT SCALE: 1=10
DRAWN BY: S. GOLDSMITH	DATE: JAN. 18, 1994
CHECKED BY:	DATE:
APPROVED BY:	DATE:
LAST REVISION BY: S. GOLDSMITH	DATE: MARCH 3, 1994

GEOLOGIC CROSS-SECTIONS OF LANDFILL

REMEDIAL INVESTIGATION TECHNICAL MEMORANDUM 8
12th STREET LANDFILL OPERABLE UNIT
ALLIED PAPER, INC./PORTAGE CREEK/
KALAMAZOO RIVER SUPERFUND SITE

FIGURE
3-3



50 0 50 100

SCALE IN FEET

TOPOGRAPHIC MAPPING PRODUCED USING PHOTOGRAMMETRIC METHODS BY LOCKWOOD, INC. FROM AERIAL PHOTOGRAPHY FLOWN APRIL 17, 1991.

SOURCES: RIVER GAUGE LOCATIONS - AS SURVEYED BY BLASLAND & BOUCK.
SAMPLE LOCATIONS - AS SURVEYED BY WADE-TRIM.

LEGEND

- MONITORING WELL/NUMBER
- SOIL BORING/NUMBER
- LEACHATE HEAD WELL/NUMBER - ORIGINAL SOIL BORING NUMBER
- DELINEATION BORING/NUMBER
- RIVER GAUGE/NUMBER
- TEST PIT - TRENCH/NUMBER
- WETLAND AREA
- FENCE
- 720 EXISTING CONTOUR
- TREE/BRUSH
- A —— A' CROSS-SECTION LOCATION/DESIGNATION

KB60105731

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SCALE VERIFICATION
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USE TO VERIFY FIGURE REPRODUCTION SCALE

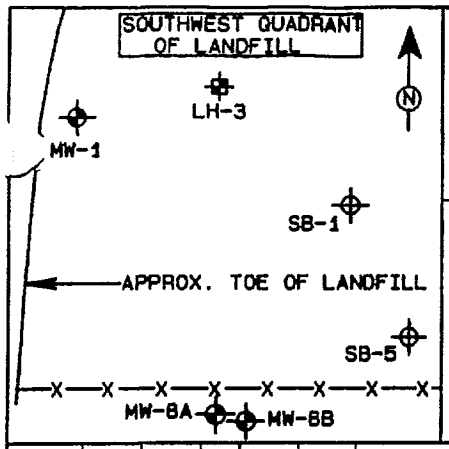
REV. NO.	DATE	DESCRIPTION	BY	APPR.

PROJECT NO.: 0000PL001 — FILE NO.: 1274G-L.DWG
DRAWING NO.: 0000PL001-OFMS-2 — PLOT SCALE: 1:1-05
DRAWN BY: 0 0000-0000 — DATE: JANUARY 26, 1994
CHECKED BY: — DATE:
APPROVED BY: — DATE:
LAST REVISION BY: 0 0000-0000 — DATE: FEBRUARY 28, 1994

CROSS-SECTION LOCATION MAP

REMEDIAL INVESTIGATION TECHNICAL MEMORANDUM 8
12th STREET LANDFILL OPERABLE UNIT
ALLIED PAPER, INC./PORTAGE CREEK/
KALAMAZOO RIVER SUPERFUND SITE

FIGURE
3-2



MONITORING WELL MW-1

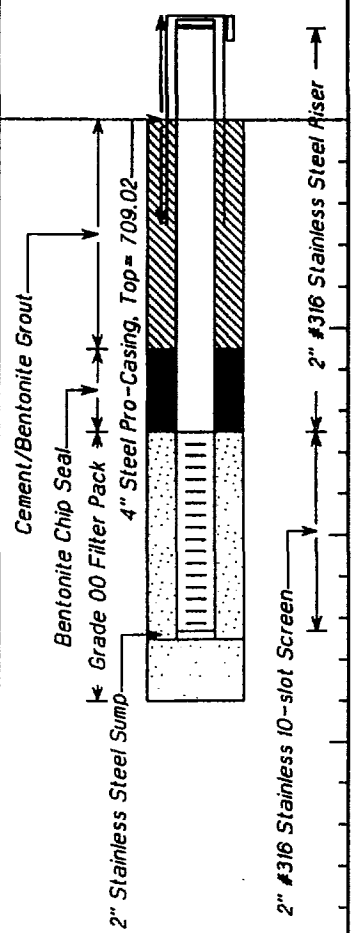
Simpson/12th St. Landfill
Plainwell, Michigan

Project No.: CI0091.001
Logged by: D. Cowin
Drilling Co.: Parratt-Wolff
Driller: Doug R.

Date Drilled: August 17, 1993
Drilling Method: 4 1/4-inch dia. hollow stem
Sampling Method: Split Spoon
Surface Elev.: 706.2

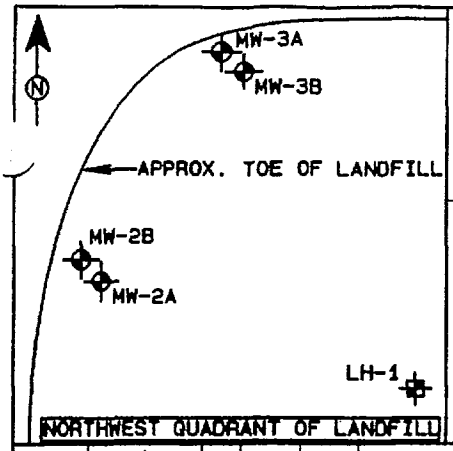
Depth (feet)	Sample Type Recovery (in.)	Blows/ft.	Samples	Graphic Log	Soil Class	GENERALIZED DESCRIPTION
	2"SS (10)	3-2-2-2				Medium gray, clayey residuals, dry
	2"SS (3)	3-3-2-1				
5	2"SS (14)	4-4-3-3				
	2"SS (17)	2-2-3-2			PT	Black, peaty soil, woody, moist
	2"SS (18)	3-8-8-11			SP	Gray-green, fine, well-sorted sand, wet, loose
10	2"SS (13)	3-5-8-11			SP GP	Multicolored, coarse, sand and gravel, rounded, loose, wet
	2"SS (11)	8-9-11-8				
15						*End of Boring at 14 Feet*
20						
25						
30						

WELL DIAGRAM



ELEVATION DATA

Top of Well Casing	*708.71*
Top of Bent. Seal	*700.97*
Top of Filter Pack	*698.97*
Top of Screen	*698.97*
Bottom of Screen	*693.97*



MONITORING WELL MW-2A

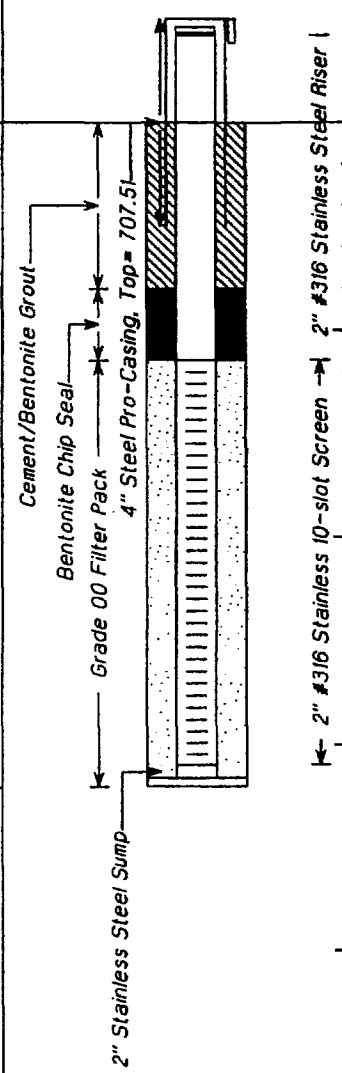
Simpson/12th St. Landfill
Plainwell, Michigan

Project No.: CI0091.001
Logged by: D. Cowin
Drilling Co.: Parratt-Wolff
Driller: Doug R.

Date Drilled: August 2, 1993
Drilling Method: 4 1/4-inch dia. hollow stem
Sampling Method: Split Spoon
Surface Elev.: 704.9

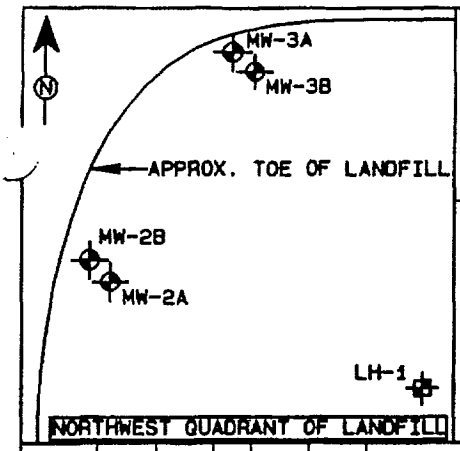
Depth (feet)	Sample Type Recovery (in.)	Blows/ft.	Samples	Graphic Log	Soil Class	GENERALIZED DESCRIPTION
						See Well Log MW-2B for soil descriptions.
5						
10						Drilled augers to 16 feet without sampling, then set well. Boring completed to 16 feet.
15						*End of Boring at 16 Feet*
20						
25						
30						

WELL DIAGRAM



ELEVATION DATA

Top of Well Casing	*707.31*
Top of Bent. Seal	*702.15*
Top of Filter Pack	*700.45*
Top of Screen	*700.45*
Bottom of Screen	*690.45*



MONITORING WELL MW-2B

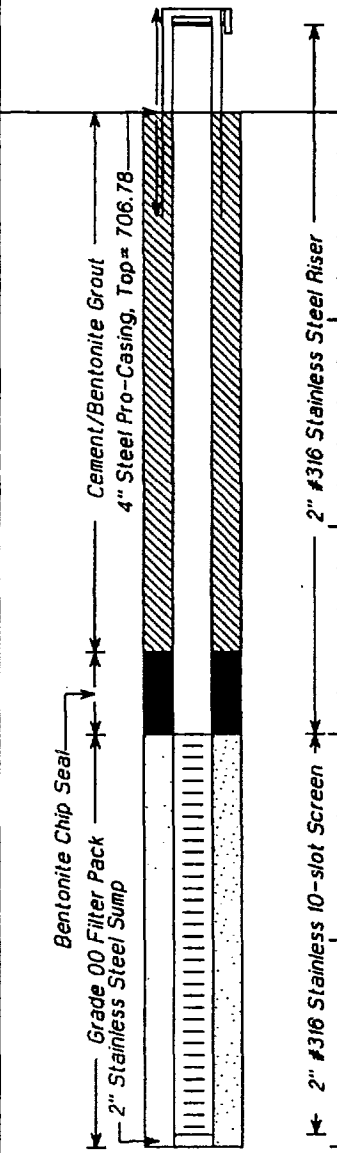
Simpson/12th St. Landfill
Plainwell, Michigan

Project No.: CI0091.001
Logged by: D. Cowin
Drilling Co.: Parratt-Wolff
Driller: Doug R.

Date Drilled: July 29, 1993
Drilling Method: 4 1/4-inch dia. hollow stem
Sampling Method: Split Spoon
Surface Elev.: 704.1

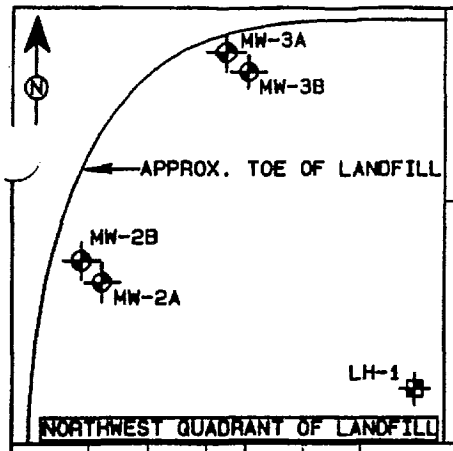
Depth (feet)	Sample Type Recovery (in.)	Blows/ft.	Samples	Graphic Log	Soil Class	GENERALIZED DESCRIPTION
						Coarse sand with high organic matter
						Gray, residuals, high organic content (roots)
5					PT	Dark brown to black, peat
	2"SS (24)	WOH/ 1.5'-1			SP	Coarse sand, wet
	2"SS (12)	WOH-2 6-6				Medium to fine, sand, wet
					SP GP	Medium to coarse, sand and gravel, wet
10	2"SS (17)	4-5- 5-6				Multicolor coarse, sand and gravel, subrounded to subangular grains, wet, loose
	2"SS (13)	9-12 12-12				Multicolor, medium to coarse, sand and gravel, rounded to subrounded grains, wet
15	2"SS (11)	6-5- 9-11				
	2"SS (12)	2-10 15-16			SP	Tan to yellow, well-sorted, fine to medium grained sand, siliceous, wet
20	2"SS (18)	4-7- 16-26				Well-sorted, fine sand
	2"SS (20)	5-13 14-14			SP GP	Multicolored, coarse, sand and gravel, rounded, wet, loose
	2"SS (19)	7-11 16-21			SP	Medium to coarse sand, trace gravel, wet, loose
25	2"SS (24)	5-12 14-24				Tan to yellow, fine sand, well-sorted, siliceous, wet, loose
						Tan to yellow, fine to medium grained sand, well-sorted, trace coarse rounded sand, wet, loose
30						*End of Boring at 26 Feet*

WELL DIAGRAM



ELEVATION DATA

Top of Well Casing	706.97
Top of Bent. Seal	686.69
Top of Filter Pack	684.69
Top of Screen	684.69
Bottom of Screen	679.69



MONITORING WELL MW-3A

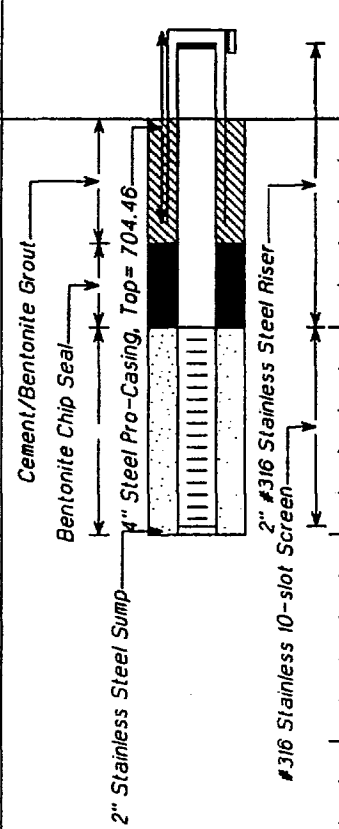
Simpson/12th St. Landfill
Plainwell, Michigan

Project No.: CI0091.001
Logged by: D. Cowin
Drilling Co.: Parratt-Wolff
Driller: Doug R.

Date Drilled: July 29, 1993
Drilling Method: 4 1/4-inch dia. hollow stem
Sampling Method: Split Spoon
Surface Elev.: 702.3

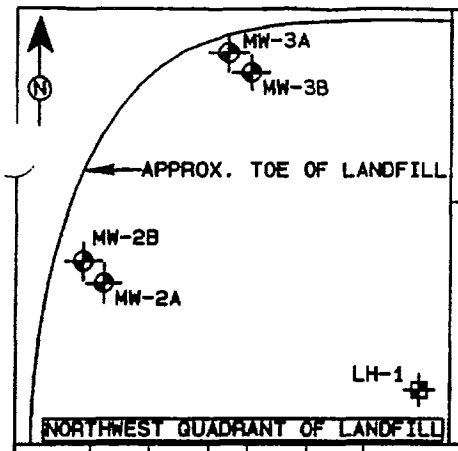
Depth (feet)	Sample Type Recovery (in.)	Blows/ft.	Samples	Graphic Log	Soil Class	GENERALIZED DESCRIPTION
						See Well Log MW-3B for soil descriptions.
						Drilled the augers 10 feet without sampling and installed well.
5						
10						*End of Boring at 10 Feet*
15						
20						
25						
30						

WELL DIAGRAM



ELEVATION DATA

Top of Well Casing	*704.25*
Top of Bent. Seal	*699.75*
Top of Filter Pack	*697.75*
Top of Screen	*697.75*
Bottom of Screen	*692.75*



MONITORING WELL MW-3B

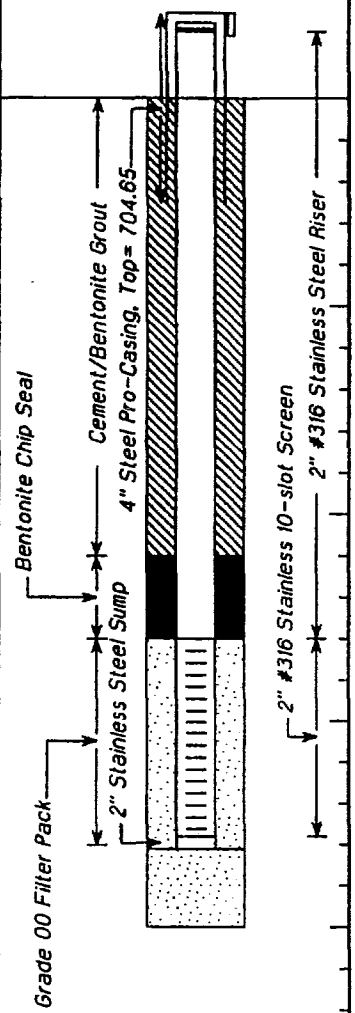
Simpson/12th St. Landfill
Plainwell, Michigan

Project No.: CI0091.001
Logged by: D. Cowin
Drilling Co.: Parratt-Wolff
Driller: Doug R.

Date Drilled: July 29, 1993
Drilling Method: 4 1/4-inch dia. hollow stem
Sampling Method: Split Spoon
Surface Elev.: 702.5

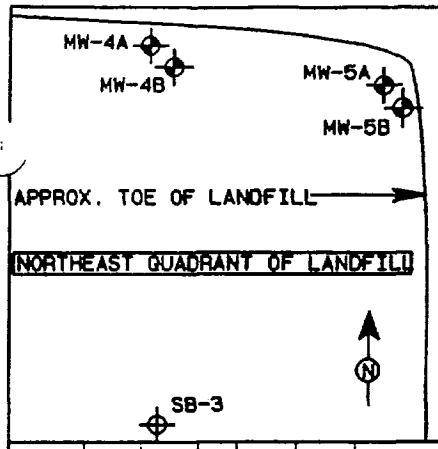
Depth (feet)	Sample Type Recovery (in.)	Blows/ft.	Samples	Graphic Log	Soil Class	GENERALIZED DESCRIPTION
	2"SS (24)	1-2-3-3				Brown, organic topsoil, dry
	2"SS (8)	3-3 4-6				Stiff, gray, clayey residuals, little silt (red) along horizontal fractures, slightly moist
						Dark brown, fine, silty sand, loose, moist
5	2"SS (16)	2-3-3-5			SP GP	*OVM = 2 ppm*
					ML	Gray, clayey residuals, trace fine sand, stiff, moist
	2"SS (18)	10-13 14-10			SP	Light brown, coarse, sand and gravel, little silt, wet
	2"SS (15)	12-10 10-10			SP GP	Gray to light brown, silt, wet
10					SP	Gray/tan to light brown, medium to coarse sand, trace silt, moist at 7'
	2"SS (12)	9-10 12-13				Tan to brown to red to black, sand and gravel, loose, wet; gravel is rounded
	2"SS (12)	3-8-10-11				
15	2"SS (18)	3-9 12-11				Multicolored, fine to medium to coarse sand, some gravel, trace silt, wet
						Medium sand with some fine, little coarse, wet, variegated colors; coarse sand is rounded, medium sand is siliceous
	2"SS (22)	3-3-6-8			SM	
					SP	Silty, fine sand, little coarse to medium sand, wet
	2"SS (20)	7-3-9-9				Tan to light brown, siliceous sand, little coarse rounded sand and gravel, loose, wet
20						*End of Boring at 20 Feet*
25						
30						

WELL DIAGRAM



ELEVATION DATA

Top of Well Casing	704.54
Top of Bent. Seal	692.02
Top of Filter Pack	690.02
Top of Screen	688.02
Bottom of Screen	683.02



MONITORING WELL MW-4A

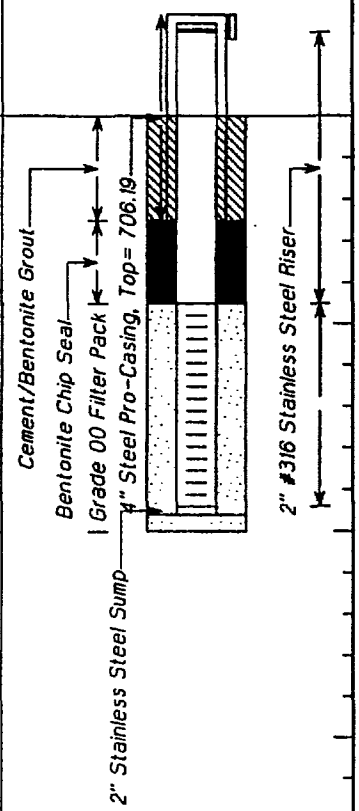
Simpson/12th St. Landfill
Plainwell, Michigan

Project No.: C10091.001
Logged by: D. Cowin
Drilling Co.: Parratt-Wolff
Driller: Doug R.

Date Drilled: July 29, 1993
Drilling Method: 4 1/4-inch dia. hollow stem
Sampling Method: Split Spoon
Surface Elev.: 703.7

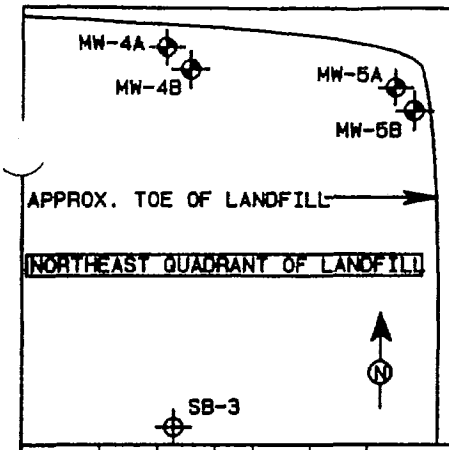
Depth (feet)	Sample Type Recovery (in.)	Blows/ft.	Samples	Graphic Log	Soil Class	GENERALIZED DESCRIPTION
						See Well Log MW-4B for soil descriptions
						Drilled the augers 10 feet without sampling and installed well.
5						
10						*End of Boring at 10 Feet*
15						
20						
25						
30						

WELL DIAGRAM



ELEVATION DATA

Top of Well Casing	*706.01*
Top of Bent. Seal	*701.44*
Top of Filter Pack	*699.44*
Top of Screen	*699.44*
Bottom of Screen	*694.44*



MONITORING WELL MW-4B

Simpson/12th St. Landfill
Plainwell, Michigan

Project No.: CI0091.001
Logged by: D. Cowin
Drilling Co.: Parratt-Wolff
Driller: Doug R.

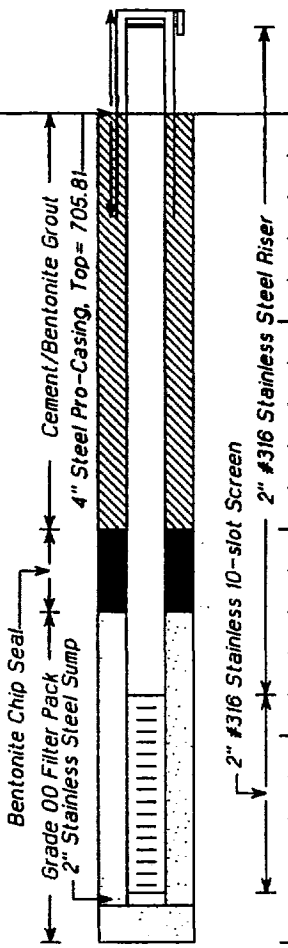
Date Drilled: July 28, 1993
Drilling Method: 4 1/4-inch dia. hollow stem
Sampling Method: Split Spoon
Surface Elev.: 703.6

Depth (feet)	Sample Type Recovery (in.)	Blows/ft.	Soil Class	GENERALIZED DESCRIPTION
	2"SS (4)	1-2-2-3		Stiff medium gray clayey residuals, little to some rounded coarse sand, dry to very slightly moist, low plasticity. OVM = 57 ppm
	3"SS (6.5)	2-2 2-2	SP	Brown medium grained sand, trace silt, trace gravel
5	3"SS (8)	1-3-3-3		Stiff medium gray clayey residuals, little to some rounded coarse sand, dry to very slightly moist, low plasticity. OVM = 72 ppm
	3"SS (21)	2-4-3-3	SP GP	Brown medium grained sand, some gravel, trace silt, wet at 4.7'. OVM = 24 ppm
10	2"SS (12)	5-6-8-8	SP SP GP	Tan to black to gray medium grained sand, little silt, trace rounded coarse sand, wet. OVM = 61 ppm
	2"SS (18)	11-16 8-13		
	2"SS (12)	6-8-6-9	SP	Tan to gray coarse sand and gravel, trace silt, wet; driller introduced water due to heaving sands. OVM = 18.6 ppm
15	2"SS (9)	11-14 17-10		Tan to gray, medium grained sand, some silt, wet
	2"SS (15)	6-12 18-13	CL SP	Tan to brown, coarse, sand and gravel, rounded, trace silt, wet. OVM = 36 ppm
20	2"SS (11)	10-9 11-10		Tan, medium to coarse, sand and gravel, trace silt, loose, wet; gravel is rounded
				Tan, medium sand, some coarse sand and gravel, trace silt, loose, wet
				Light tan, fine sand, some coarse sand, little silt, wet
25				Tan to light brown, clay, stiff, plastic
				Light brown, fine sand, some coarse rounded pebbles
30				

End of Boring at 20 Feet

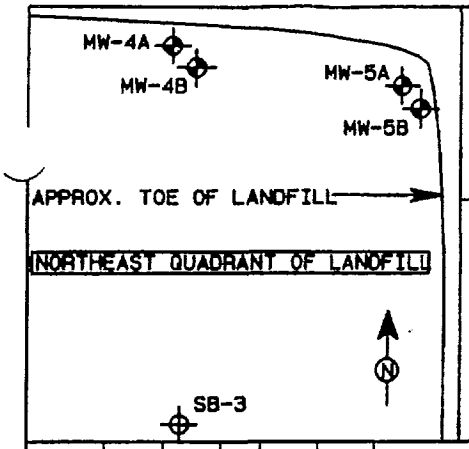
NOTE: Collection of split spoon sample 18-20' may have punctured a locally confining lens of clay. Cannot plug borehole terminus with bentonite because of collapse of surrounding sand and gravel.

WELL DIAGRAM



ELEVATION DATA

Top of Well Casing	705.61
Top of Bent. Seal	694.17
Top of Filter Pack	692.17
Top of Screen	690.17
Bottom of Screen	685.17



MONITORING WELL MW-5A

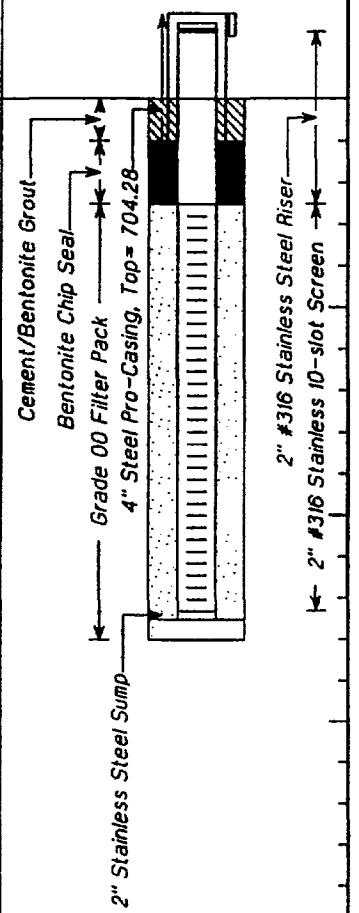
Simpson/12th St. Landfill
Plainwell, Michigan

Project No.: CI0091.001
Logged by: D. Cowin
Drilling Co.: Parratt-Wolff
Driller: Doug R.

Date Drilled: August 2, 1993
Drilling Method: 4 1/4-inch dia. hollow stem
Sampling Method: Split Spoon
Surface Elev.: 702.1

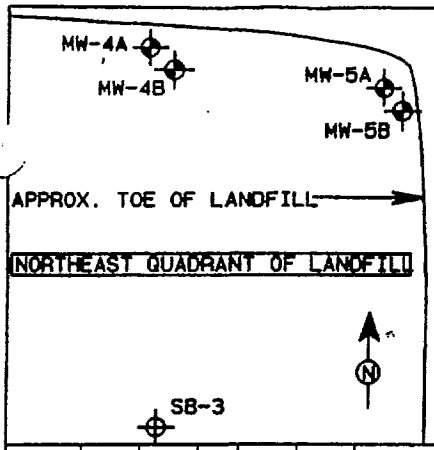
Depth (feet)	Sample Type Recovery (in.)	Blows/ft.	Samples	Graphic Log	Soil Class	GENERALIZED DESCRIPTION
						See Well Log MW-5B for soil descriptions.
						Drilled augers down to 15 feet without sampling.
5						
10						
15						*End of Boring at 15 Feet*
20						
25						
30						

WELL DIAGRAM



ELEVATION DATA

Top of Well Casing	*704.07*
Top of Bent. Seal	*701.11*
Top of Filter Pack	*699.61*
Top of Screen	*699.61*
Bottom of Screen	*689.61*



MONITORING WELL MW-5B

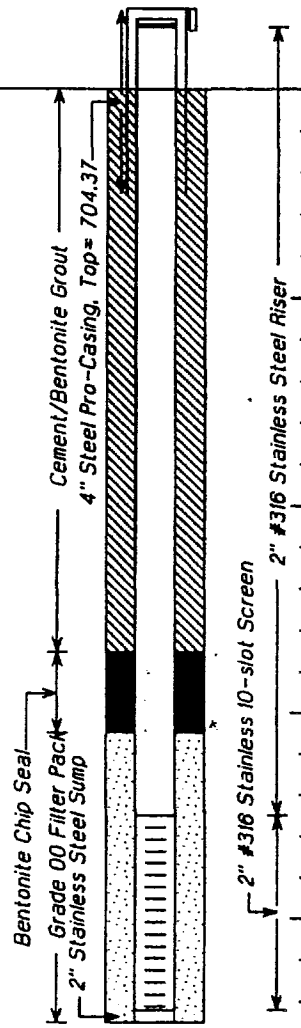
Simpson/12th St. Landfill
Plainwell, Michigan

Project No.: CI0091.001
Logged by: D. Cowin
Drilling Co.: Parratt-Wolff
Driller: Doug R.

Date Drilled: July 30, 1993
Drilling Method: 4 1/4-inch dia. hollow stem
Sampling Method: Split Spoon
Surface Elev.: 702.3

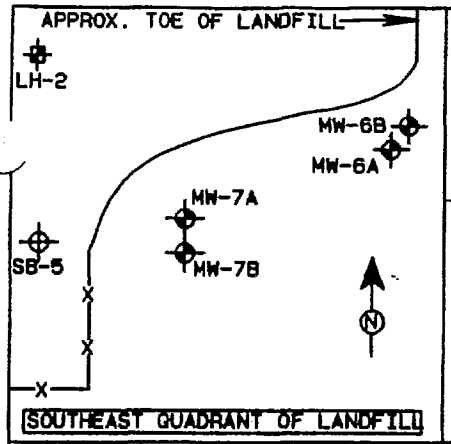
Depth (feet)	Sample Type Recovery (in.)	Blows/ft.	Samples	Graphic Log	Soil Class	GENERALIZED DESCRIPTION
	2"SS (14)	1-2-2-2				Stiff, gray, clayey residuals, few round coarse sand some roots of plants slightly moist
	3"SS (24)				OL	red staining along roots in residuals
	3"SS (10)	2-2-1-1				Black to brown, native organic soil, slightly moist
5	2"SS (10)	2-5-2-2			SP GP	Multicolored, coarse, sand and gravel, rounded grains, trace silt, wet
	2"SS (8)	4-5-8-6				grades with some cobbles
	2"SS (16)	19-36 16-32			SP	Gray to black, medium sand
10	2"SS (13)	1-2-5-6			SP GP	Tan to brown to black, coarse, sand and gravel, rounded coarse grains, wet
	2"SS (24)	8-25 15-13			SP SP GP SP	Tan to brown to gray to black, medium to coarse sand, siliceous, loose, wet
						2" tan fine sand, well-sorted, siliceous, wet, loose at 12.6'
15	2"SS (12)	3-4-8-20				Coarse sand and gravel, little medium grained sand, tighly held, wet
	2"SS (18)	8-12 14-19			SP GP	Reddish-tan to light brown, medium to coarse sand, little silt, wet
20	2"SS (14)	4-10 17-16				Light brown to yellow-brown, fine sand, trace silt, trace coarse rounded sand, wet, loose
	2"SS (18)	3-8-19-24				grades tan to brown to black, well sorted, siliceous
						Fine to medium to coarse sand, variegated colors, wet, loose
25						Tan, coarse sand and gravel, wet
						grades with little fine to medium sand
30						*End of Boring at 22 Feet*

WELL DIAGRAM



ELEVATION DATA

Top of Well Casing	704.18
Top of Bent. Seal	689.04
Top of Filter Pack	687.04
Top of Screen	685.04
Bottom of Screen	680.04



MONITORING WELL MW-6A

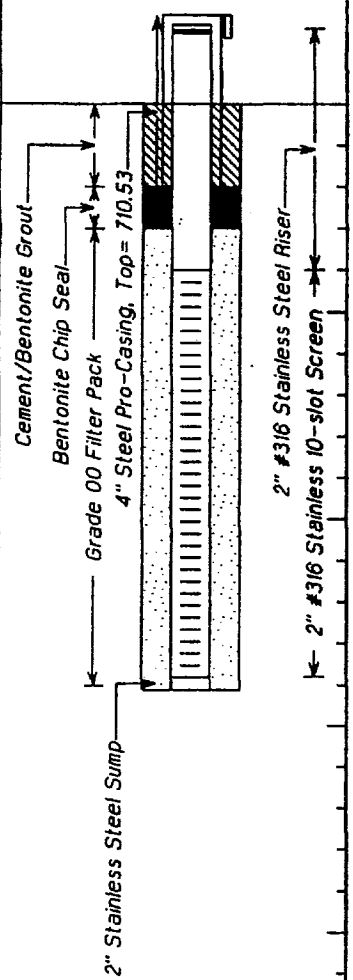
Simpson/12th St. Landfill
Plainwell, Michigan

Project No.: C10091.001
Logged by: D. Cowin
Drilling Co.: Parratt-Wolff
Driller: Doug R.

Date Drilled: August 3, 1993
Drilling Method: 4 1/4-inch dia. hollow stem
Sampling Method: Split Spoon
Surface Elev.: 708.3

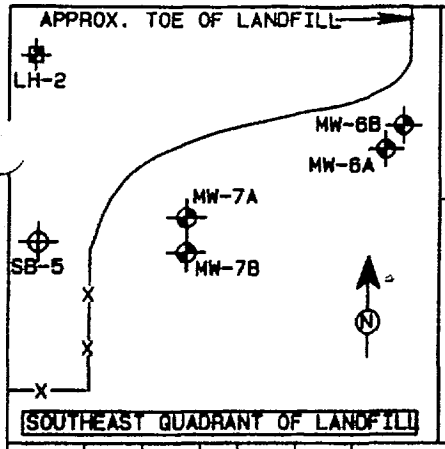
Depth (feet)	Sample Type Recovery (in.)	Blows/ft.	Samples	Graphic Log	Soil Class	GENERALIZED DESCRIPTION
						See Well Log MW-6B for soil descriptions.
5						
10						Drove the augers into what was probably cobble at approximately 13 feet. Boring completed to 14 feet.
15						*End of Boring at 14 Feet*
20						
25						
30						

WELL DIAGRAM



ELEVATION DATA

Top of Well Casing	*710.33*
Top of Bent. Seal	*708.83*
Top of Filter Pack	*705.83*
Top of Screen	*704.83*
Bottom of Screen	*694.83*



MONITORING WELL MW-6B

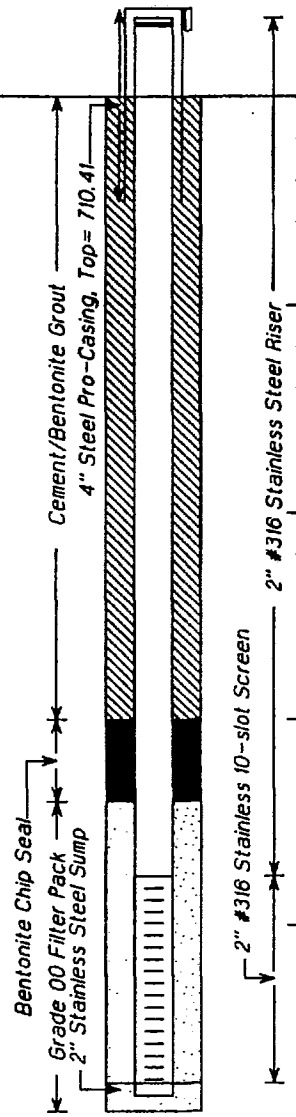
Simpson/12th St. Landfill
Plainwell, Michigan

Project No.: CI0091.001
Logged by: D. Cowin
Drilling Co.: Parratt-Wolff
Driller: Doug R.

Date Drilled: August 3, 1993
Drilling Method: 4 1/4-inch dia. hollow stem
Sampling Method: Split Spoon
Surface Elev.: 708.2

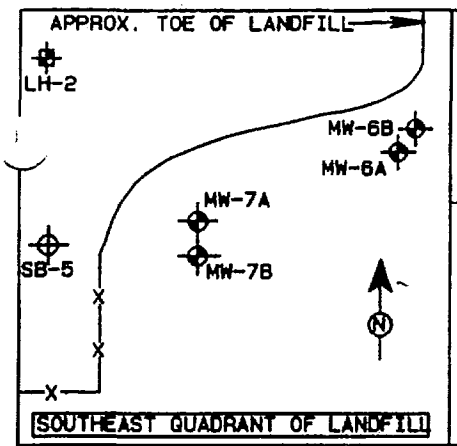
Depth (feet)	Sample Type Recovery (in.)	Blows/ft.	Samples	Graphic Log	Soil Class	GENERALIZED DESCRIPTION
					OL / SP	Sandy, organic topsoil, plant roots to 4", dry
	2"SS (13)	1-1-1-5				Tan, sand, well-sorted, trace coarse rounded sand, dry, loose
	3"SS (3)	9-12 11-10				drove a cobble 4'-6', poor recovery
5	3"SS (3)	10-10 8-8				
	3"SS (11)	5-6-4-4				
					SP / GP	Coarse, sand and gravel, rounded to very rounded, multicolor, loose, wet
10	2"SS (5)	1-2-1-1				
	2"SS (6)	1-1-1-2				
	2"SS (8)	1-2-1-2				
15	2"SS (8)	4-5-8-8				
	2"SS (11)	6-9-11-9				
20	2"SS (9)	7-11 12-14				
	2"SS (9)	7-13 14-9				
	3"SS	9-9				
	NR	10-10				
25						*End of Boring at 24 Feet*
30						

WELL DIAGRAM



ELEVATION DATA

Top of Well Casing	710.21
Top of Bent. Seal	693.18
Top of Filter Pack	691.18
Top of Screen	689.38
Bottom of Screen	684.38



MONITORING WELL MW-7A

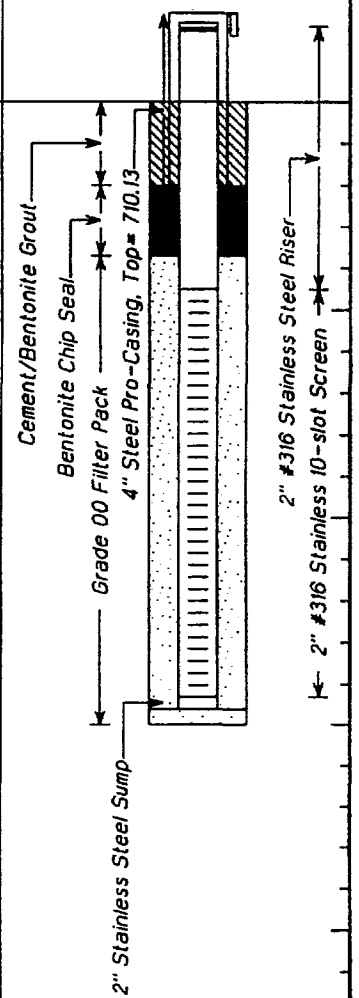
Simpson/12th St. Landfill
Plainwell, Michigan

Project No.: CI0091.001
Logged by: D. Cowin
Drilling Co.: Parratt-Wolff
Driller: Doug R.

Date Drilled: August 4, 1993
Drilling Method: 4 1/4-inch dia. hollow stem
Sampling Method: Split Spoon
Surface Elev.: 707.7

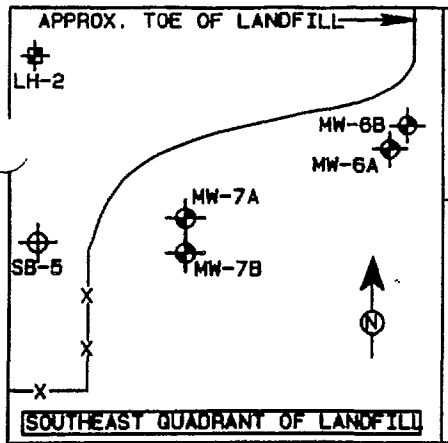
Depth (feet)	Sample Type Recovery (in.)	Blows/ft.	Samples	Graphic Log	Soil Class	GENERALIZED DESCRIPTION
						See Well Log MW-7B for soil descriptions. Drilled augers down to 15 feet without sampling.
5						
10						
15						*End of Boring at 15 Feet*
20						
25						
30						

WELL DIAGRAM



ELEVATION DATA

Top of Well Casing	*709.92*
Top of Bent. Seal	*706.88*
Top of Filter Pack	*705.18*
Top of Screen	*704.38*
Bottom of Screen	*694.38*



MONITORING WELL MW-7B

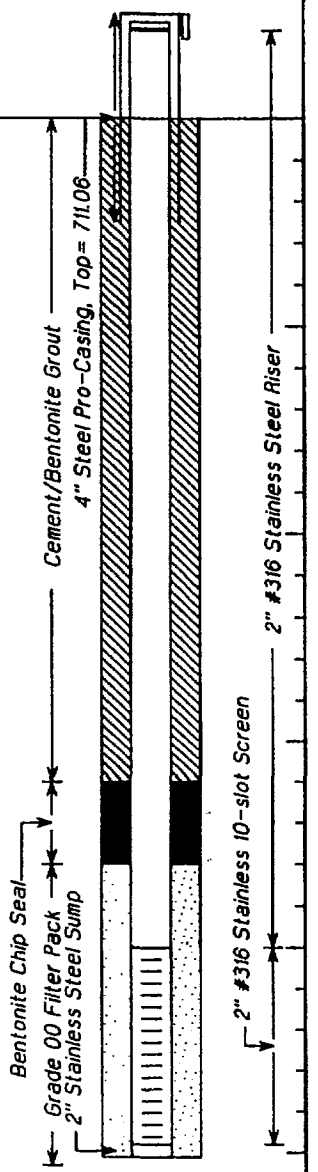
Simpson/12th St. Landfill
Plainwell, Michigan

Project No.: C10091.001
Logged by: D. Cowin
Drilling Co.: Parratt-Wolff
Driller: Doug R.

Date Drilled: August 4, 1993
Drilling Method: 4 1/4-inch dia. hollow stem
Sampling Method: Split Spoon
Surface Elev.: 708.1

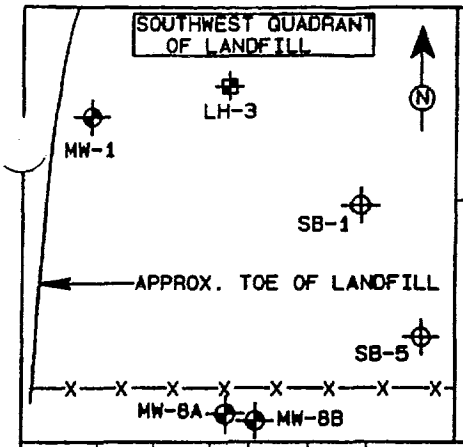
Depth (feet)	Sample Type Recovery (in.)	Blows/ft.	Samples	Graphic Log	Soil Class	GENERALIZED DESCRIPTION
	2"SS (6)	2-3-3-3			OL	Brown to black, sandy, organic topsoil, dry, loose
	2"SS (9)	2-2-1-1			SP	Tan to light brown, medium grained sand, trace coarse subangular sand, loose, dry
5	2"SS (10)	2-4-6-6				Tan to dark brown, medium grained sand, little gravel, dry, loose
	2"SS (11)	10-5-4-4				wet at tip of 6-8' split spoon sample
	2"SS (13)	5-4-6-8			SP GP	Coarse, sand and gravel, rounded, multicolor, loose
10	2"SS (20)	4-11-9-7				increasing content of 3/4" to 1" rounded pebbles
	2"SS (13)	8-9-11-12				
15	2"SS (10)	7-5-4-3				
	2"SS (6)	2-6-4-9				grades with trace silt at 18'
20	2"SS (10)	4-7-17-11				
	2"SS (10)	6-9-12-6				
	2"SS (10)	6-8-11-8				
25	2"SS (7)	4-5-8-12				
						End of Boring at 26 Feet
30						

WELL DIAGRAM



ELEVATION DATA

Top of Well Casing	710.82
Top of Bent. Seal	692.74
Top of Filter Pack	690.74
Top of Screen	688.74
Bottom of Screen	683.74



MONITORING WELL MW-8A

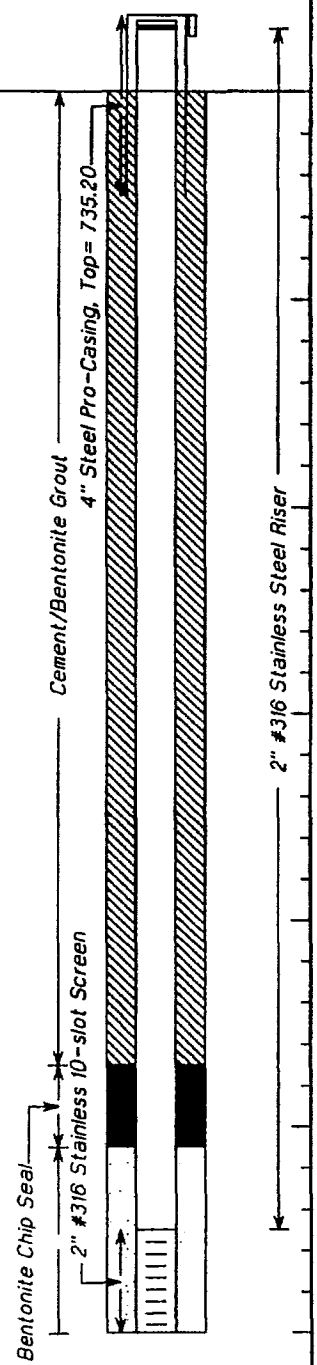
Simpson/12th St. Landfill
Plainwell, Michigan

Project No.: CI0091.001
Logged by: D. Cowin
Drilling Co.: Parratt-Wolff
Driller: Doug R.

Date Drilled: August 17, 1993
Drilling Method: 4 1/4-inch dia. hollow stem
Sampling Method: Split Spoon
Surface Elev.: 733.2

Depth (feet)	Sample Type Recovery (in.)	Blows/ft.	Samples	Graphic Log	Soil Class	GENERALIZED DESCRIPTION
						See Well Log MW-8B for soil descriptions.
5						
10						Drilled augers to 16 feet without sampling, then set well. Boring completed to 16 feet.
15						
20						Drillers had difficulty with sand bridging in the annulus between the well screen and the augers. Resulted in use of approximately 1/2 the expected amount of 00 grade filter pack sand - the remainder of the annulus being filled by natural collapse.
25						
30						

WELL DIAGRAM

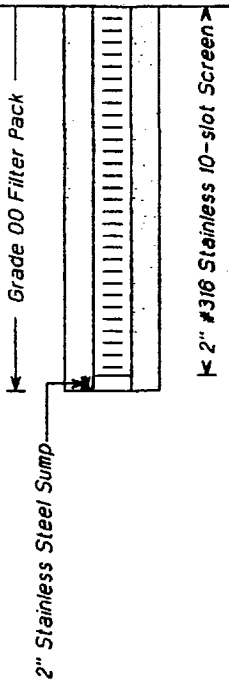


MONITORING WELL MW-8A

Simpson/12th St. Landfill
Plainwell, Michigan

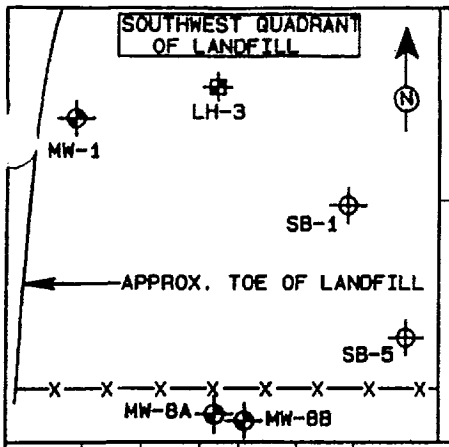
Depth (feet)	Sample Type Recovery (in.)	Blows/ft.	Samples	Graphic Log	Soil Class	GENERALIZED DESCRIPTION
						See Well Log MW-8B for soil descriptions.
35						
						End of Boring at 37.5 Feet
40						
45						
50						
55						
60						

WELL DIAGRAM



ELEVATION DATA

Top of Well Casing	*734.96*
Top of Bent. Seal	*710.15*
Top of Filter Pack	*708.15*
Top of Screen	*706.15*
Bottom of Screen	*696.15*



MONITORING WELL MW-8B

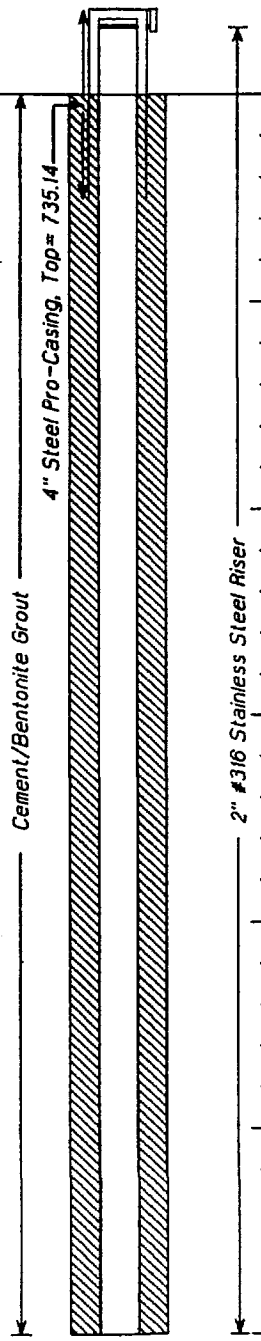
Simpson/12th St. Landfill
Plainwell, Michigan

Project No.: CI0091.001
Logged by: D. Cowin
Drilling Co.: Parratt-Wolff
Driller: Doug R.

Date Drilled: August 16, 1993
Drilling Method: 4 1/4-inch dia. hollow stem
Sampling Method: Split Spoon
Surface Elev.: 733.0

Depth (feet)	Sample Type Recovery (in.)	Blows/ft.	Soil Class	GENERALIZED DESCRIPTION
			OL	
	2"SS (21)	4-7-10-15	SP	Brown, sandy, organic topsoil, trace coarse sand, dry, loose
			SP	Tan, fine to medium grained sand, trace coarse sand, loose, dry
	2"SS (6)	8-12 15-17	GP	Tan to brown, coarse, sand and gravel, some fine sand, dry, loose
			SP	
5	2"SS (13)	11-17 11-10		Brown, fine to medium grained sand, little gravel, dry, loose
	2"SS (14)	20-15 10-10		grades light brown
10	2"SS (13)	31-11 10-16		White, medium grained sand, siliceous, with 1 to 1-1/2" pebbles (Rhyolite)
	2"SS (13)	11-9 12-18		
	2"SS (16)	13-13 14-13		grades moist
15	2"SS (18)	9-11 10-13		
	2"SS (21)	18-19 21-31		
	2"SS (20)	21-13 12-14	SP/GP	Multicolor, coarse, sand and gravel, trace silt, wet
20	2"SS (15)	21-13 15-17		Medium to coarse, sand and gravel, rounded coarse grains, loose, moist
	2"SS (16)	12-14 13-21		Coarse, sand and gravel, rounded, loose, moist
25	2"SS (15)	12-16 21-24		
	2"SS (18)	41-30 24-31		3" gray slate cobble at 26.8'
			SP	Dark brown, fine, sand, moist, loose
30	2"SS (14)	25-13 12-7	SP/GP	gray slate/siltstone cobble silty 1/2" gray layer grades more compacted

WELL DIAGRAM

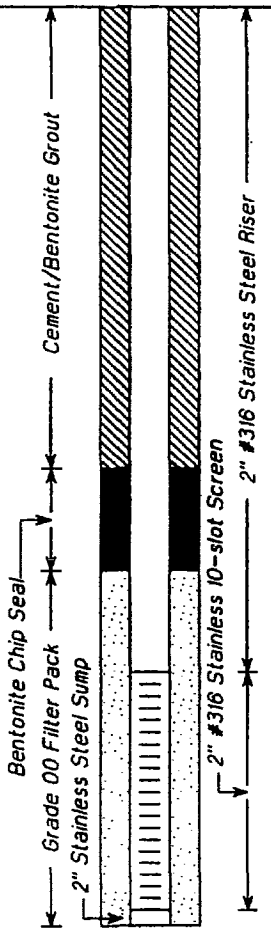


MONITORING WELL MW-8B

Simpson/12th St. Landfill
Plainwell, Michigan

Depth (feet)	Sample Type Recovery (in.)	Blows/ft.	Samples	Graphic Log	Soil Class	GENERALIZED DESCRIPTION
	2"SS (13)	3-3-5-10			SP GP	Coarse, sand and gravel, moist, loose
						grades to wet at 30.4'
	2"SS (4)	NA				
	2"SS (3)	3-3-5-9				
	2"SS (12)	NA				rounded gravel at 34'
35						
	2"SS (6)	11-10 7-10				trace silt at 36'
	2"SS (16)	35-11 13-21				
40	2"SS (15)	27-22 25-28				
	2"SS (10)	11-10 21-24				Tan to multicolored, medium to coarse, sand and gravel, rounded gravel, trace silt, wet, loose
	2"SS (17)	16-18 21-24				
45	2"SS (12)	14-19 21-19				
	2"SS (12)	12-16 23-25				
						End of Boring at 48 Feet
50						
55						
60						

WELL DIAGRAM



ELEVATION DATA

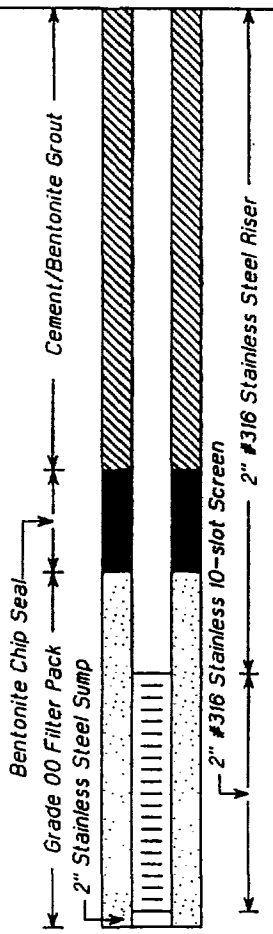
Top of Well Casing	*734.89*
Top of Bent. Seal	*694.16*
Top of Filter Pack	*692.16*
Top of Screen	*690.16*
Bottom of Screen	*685.16*

MONITORING WELL MW-8B

Simpson/12th St. Landfill
Plainwell, Michigan

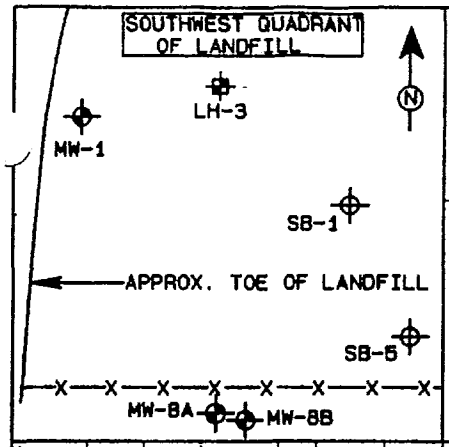
Depth (feet)	Sample Type Recovery (in.)	Blows/ft.	Samples	Graphic Log	Soil Class	GENERALIZED DESCRIPTION
	2"SS (13)	3-3-5-10			SP/GP	Coarse, sand and gravel, moist, loose
	2"SS (4)	NA				grades to wet at 30.4'
	2"SS (3)	3-3-5-9				
	2"SS (12)	NA				rounded gravel at 34'
35	2"SS (6)	11-10 7-10				trace silt at 36'
	2"SS (16)	35-11 13-21				
40	2"SS (15)	27-22 25-28				
	2"SS (10)	11-10 21-24				Tan to multicolored, medium to coarse, sand and gravel, rounded gravel, trace silt, wet, loose
45	2"SS (17)	16-18 21-24				
	2"SS (12)	14-19 21-19				
	2"SS (12)	12-16 23-25				
						End of Boring at 48 Feet
50						
55						
60						

WELL DIAGRAM



ELEVATION DATA

Top of Well Casing	*734.89*
Top of Bent. Seal	*694.16*
Top of Filter Pack	*692.16*
Top of Screen	*690.16*
Bottom of Screen	*685.16*



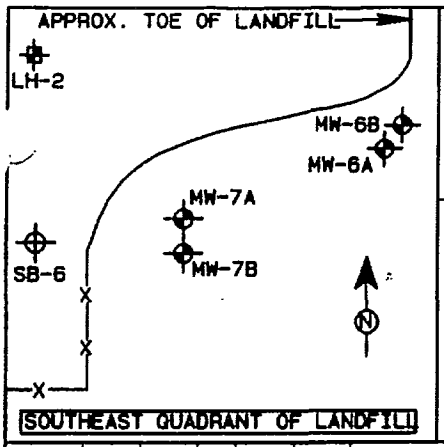
SOIL BORING GMSB-1

Simpson/12th St. Landfill
Plainwell, Michigan

Project No.: CI0091.001
Logged by: D. Cowin
Drilling Co.: Parratt-Wolff
Driller: Doug R.

Date Drilled: August 9, 1993
Drilling Method: 4 1/4-inch dia. hollow stem
Sampling Method: Split Spoon
Surface Elev.: 734.0

Depth (feet)	Sample Type	Recovery (inches)	Blows/ft.	Samples	Graphic Log	Soil Class	GENERALIZED DESCRIPTION
	2" SS	16	3-3-3-3				Brown, sandy, organic topsoil, dry, loose
	2" SS	14	2-2-1-1				White to light tan, sand, medium grained *OVM = 90 ppm*
5	2" SS	20	1-1-2-2				Black fly ash, loose, dry, trace brown sand *OVM = 680 ppm*
	2" SS	14	2-1-1-24				Construction Debris: Dark brown, sand, medium grained, well sorted, loose, slightly moist; not natural *OVM = 320 ppm*
	2" SS	9	36-8-2-1				1/2" lens of light gray clayey residuals
10							Approximately 2" of wet wood at tip of spoon
	2" SS	10	WH-WH 1-2				Wet wood debris
							Gray to tan, sand, well sorted, little wood fragments; 1/2" black fly ash
	2" SS	20	WOH-1-2				Light gray, clayey residuals, moist *OVM = 0.8 ppm*
15	2" SS	2	3-1-1-1				Light gray, pulpy residuals, moist, some clay (plastic lens), trace coarse sand, odor *OVM = 1.8 ppm*
	2" SS	14	WOH/2'				grades more clayey at 14'
	2" SS	12	WOH/2'				
20							
	2" SS	16	WOH/2'				
	2" SS	16	WOH/1.5'-3				
	3" SS	24	WOH/1.5'-3				Medium to coarse grained, sand and gravel, petroleum odor, moist to wet
25	2" SS	16	WOH/1.5'/3				Light gray, pulpy, clayey residuals, trace coarse sand, wet
	2" SS	14	7-10-15-14			SP	
	3" SS	19	11-12-15-38			GP	Medium to coarse grained, sand and gravel; native soil as evidenced by rhyolite
30							*End of Boring at 28 Feet*



LEACHATE HEAD WELL LH-2/GMSB-2

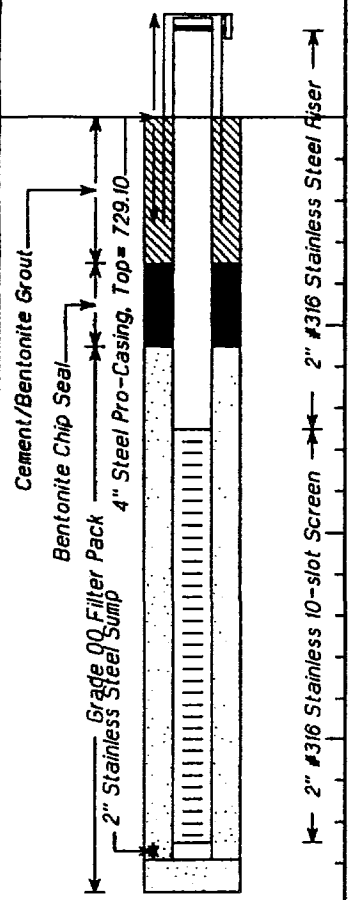
Simpson/12th St. Landfill
Plainwell, Michigan

Project No.: CI0091.001
Logged by: D. Cowin
Drilling Co.: Parratt-Wolff
Driller: Doug R.

Date Drilled: August 5, 1993
Drilling Method: 4 1/4-inch dia. hollow stem
Sampling Method: Split Spoon
Surface Elev.: 726.3

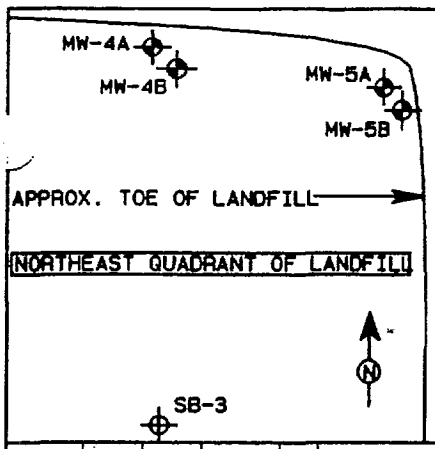
Depth (feet)	Sample Type Recovery (in.)	Blows/ft.	Samples	Graphic Log	Soil Class	GENERALIZED DESCRIPTION
	2"SS (22)	1-2-1-2				Brown, sandy topsoil, trace silt, loose
						Black, fine grained fly ash
	2"SS (18)	1-1-1-1				Medium gray, clayey residuals, moist
5	3"SS (19)	WOH/2'				Light gray, very pulpy residuals, trace coarse sand, moist, strong odor
	2"SS (22)	WOH/2'				
10	3"SS (20)	WOH/2'				
	3"SS (20)	WOH/2'				
	3"SS (16)	WOH/2'				less pulpy, more clayey, medium gray at 13.8-14'
15	3"SS (22)	WOH/2'				grades less pulpy, more clayey
	3"SS (22)	WOH/2'				
	2"SS (0)	WOH/2-3-4				
20	3"SS (14)	WOH/1 3-2				
	2"SS (14)					grades very clayey at 21.3
						with blue fibers 22-23.5'
	3"SS (24)	4-6-11-13				Very dark gray, residuals mixed with coarse fly ash, rounded
25						*End of Boring at 24 Feet*
30						

WELL DIAGRAM



ELEVATION DATA

Top of Well Casing	*728.91*
Top of Bent. Seal	*722.78*
Top of Filter Pack	*720.78*
Top of Screen	*718.78*
Bottom of Screen	*708.78*



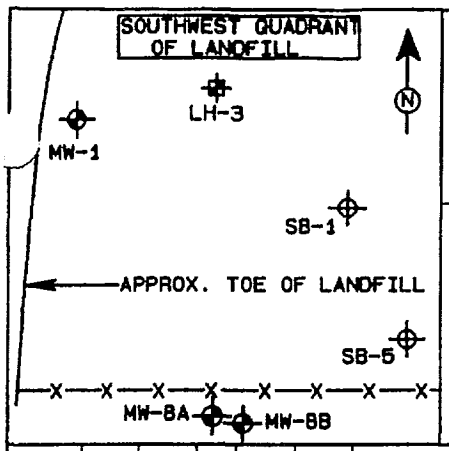
SOIL BORING GMSB-3

Simpson/12th St. Landfill
Plainwell, Michigan

Project No.: CI0091.001
Logged by: D. Cowin
Drilling Co.: Parratt-Wolff
Driller: Doug R.

Date Drilled: August 5, 1993
Drilling Method: 4 1/4-inch dia. hollow stem
Sampling Method: Split Spoon
Surface Elev.: 720.4

Depth (feet)	Sample Type	Recovery (inches)	Blows/ft.	Samples	Graphic Log	Soil Class	GENERALIZED DESCRIPTION
	2" SS	15	4-5-4-4				3" - Light gray, sandy topsoil, dry
							Mixed black fly ash and tan berm sand, fine to medium grained, well sorted, dry
	2" SS	22	1-1-1-1				Light gray, residuals, pulpy, clayey, trace coarse sand, moist, strong odor
5	2" SS	9	WOH/2'				Dark brown to black, fly ash and sand, trace silt, slightly moist
	2" SS	0	WOH/2'				No Sample Recovery 6-8'
	3" SS	8	WOH/2'				Light to dark gray, residuals, clayey, pastey, moist
10							grades with many black fibers 10-10.8'
	3" SS	19	WOH/2'				grades clayey with trace coarse sand
	3" SS	24	WOH/2'				
15	3" SS	24	WOH/2'				increasing content of very rounded coarse sand (10-15%) at 15'
	3" SS	24	3-3-3-4				
							End of Boring at 18 Feet
20							
25							
30							



LEACHATE HEAD WELL LH-3/GMSB-4

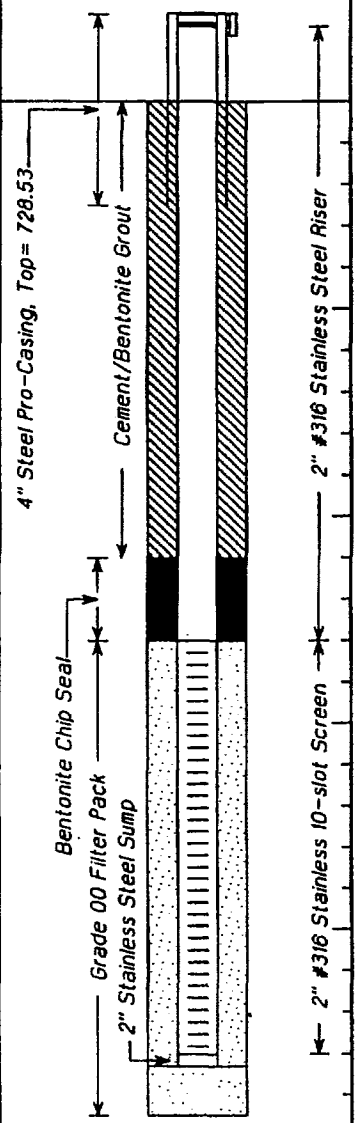
Simpson/12th St. Landfill
Plainwell, Michigan

Project No.: CI0091.001
Logged by: D. Cowin
Drilling Co.: Parratt-Wolff
Driller: Doug R.

Date Drilled: August 10-11, 1993
Drilling Method: 4 1/4-inch dia. hollow stem
Sampling Method: Split Spoon
Surface Elev.: 726.3

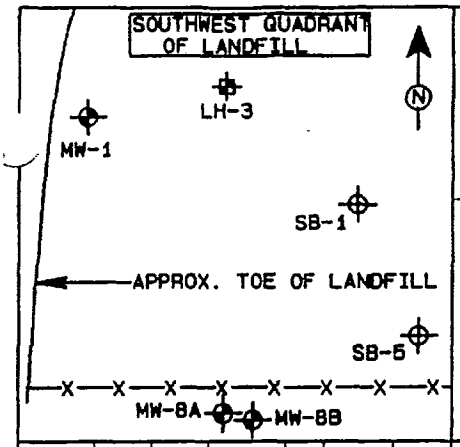
Depth (feet)	Sample Type Recovery (in.)	Blows/ft.	Samples	Graphic Log	Soil Class	GENERALIZED DESCRIPTION
	2"SS (19)	2-14 15-17				Dark brown, organic topsoil, slightly moist
						Black, fly ash, dry
	2"SS (14)	6-2-2-1				Light tan to white, sand and gravel, dry, loose
5	2"SS (11)	WOH/1'-1				Black, fly ash, dry
						Light gray, pulpy, fibrous residuals, trace coarse sand, moist, trace blue fibers
	2"SS (19)	WOH/2'				
10	2"SS (18)	WOH/1 1-1				
	2"SS (20)	1-1-1-1				
	2"SS	2-2-2-1				
15	2"SS (20)	2-1-1-1				Dark gray, clayey residuals, plastic, trace coarse sand, moist
						Light gray, pulpy residuals, trace coarse sand, moist
	2"SS (24)	WOH/1-1				Dark gray, clayey residuals, plastic, trace coarse sand, moist
20	2"SS (14)	WOH/2'				
	3"SS (13)	2-2-3-4				
	3"SS (15)	WOH-3-4-6				
25	3"SS (11)	WOH-3-5-6				
	3"SS (24)	3-5-16-20			PT	Black peat, moist, woody
					SP	Gray medium sand, well sorted, little rounded gravel, moist
30						*End of Boring at 28 Feet*

WELL DIAGRAM



ELEVATION DATA

Top of Well Casing	*728.38*
Top of Bent. Seal	*717.37*
Top of Filter Pack	*715.37*
Top of Screen	*713.37*
Bottom of Screen	*703.37*



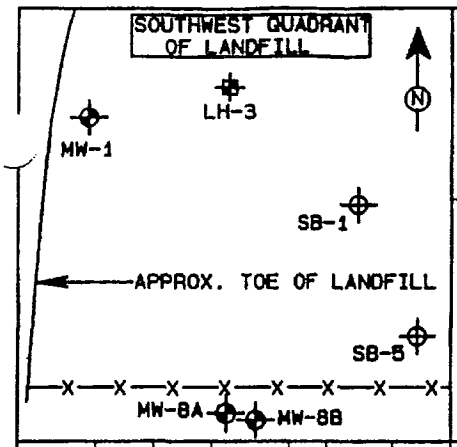
SOIL BORING GMSB-5

Simpson/12th St. Landfill
Plainwell, Michigan

Project No.: C10091.001
Logged by: D. Cowin
Drilling Co.: Parratt-Wolff
Driller: Doug R.

Date Drilled: August 12, 1993
Drilling Method: 4 1/4-inch dia. hollow stem
Sampling Method: Split Spoon
Surface Elev.: 734.1

Depth (feet)	Sample Type	Recovery (inches)	Blows/ft.	Samples	Graphic Log	Soil Class	GENERALIZED DESCRIPTION
	2" SS	4	3-4-4-3				Brown, sandy, organic, topsoil, loose, dry
	2" SS	6	5-3-2-1				mixed with black fly ash at 2'
5	2" SS	9	3-4-3-3				Black fly ash, loose, dry, with 1" lens of residuals at 4.8'
	2" SS	8	2-1-1-1				Light to medium gray to tan, residuals, clayey, trace coarse rounded sand, moist
	2" SS	11	WOH/1.5'-1				
10	2" SS	9	WOH-1-2-3				Little construction debris mixed with residuals, grades dark gray with glass shard and brick fragment at 10.3'
						SP	red/brown piece of slate at 12-12.1'
	2" SS	9	4-9-6-4				Tan, well-sorted, sand, medium to fine grained, moist, loose
15	2" SS	14	WOH-1-1				Tan to gray, very well-sorted, medium grained sand, loose, moist
	2" SS	14	WOH-2-3-4				Tan to gray, well sorted, fine sand, siliceous, loose, moist
	2" SS	18	2-3-3-4				
20	2" SS	9	1-2-2-4			SP/GP	
	3" SS	17					Multicolored, coarse, sand and gravel, rounded: native material
							End of Boring at 22 Feet
25							
30							



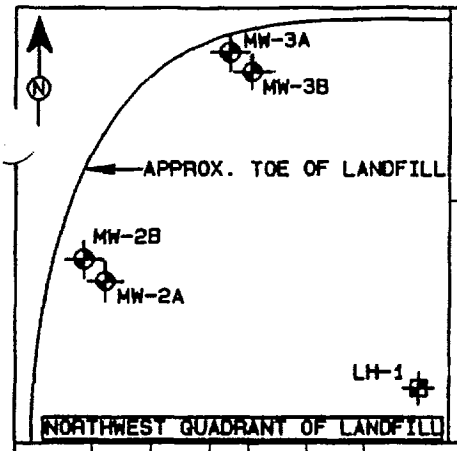
SOIL BORING GMSB-6

Simpson/12th St. Landfill
Plainwell, Michigan

Project No.: CI0091.001
Logged by: D. Cowin
Drilling Co.: Parratt-Wolff
Driller: Doug R.

Date Drilled: August 12, 1993
Drilling Method: 4 1/4-inch dia. hollow stem
Sampling Method: Split Spoon
Surface Elev.: 733.1

Depth (feet)	Sample Type	Recovery (inches)	Blows/ft.	Samples	Graphic Log	Soil Class	GENERALIZED DESCRIPTION
	2" SS	14	WOH-3-4-2				Brown, sandy organic topsoil with 1" lens of black fly ash, loose, slightly moist
	2" SS	10	2-1-1-1				Tan to brown, well sorted, medium grained sand (berm), loose, dry
5	2" SS	13	WOH/2'				Black fly ash, loose, dry, with 1/2" lens of berm sand at 4' grades coarse to fine grained
	2" SS	17	WOH/2'				
	2" SS	1	WOH/-2'				Mixed berm sand and fly ash, loose, dry, wet tip
10	2" SS	24	WOH/2'				Black fly ash, wet
	2" SS	16	WOH/2'				Light to medium gray, residuals, clayey, trace coarse rounded sand, moist grades with trace to little coarse sand, trace fly ash lenses at 14'
15	2" SS	24	WOH/1'1-1				
	2" SS	19	WOH/1-1-1				
	3" SS	16					Tan to brown, sand, medium to coarse grained, wet
	3" SS	14	2-1-2-2				Light gray pulpy residuals
20	2" SS	9	WOH/2'				Medium to light to dark gray, clayey residuals, wet
	3" SS	20					
	3" SS	20	7-12 13-10			SP GP	Multicolored, coarse, sand and gravel, moist, not saturated
25	2"	15	6-7-8-5				
							End of Boring at 26 Feet
30							



LEACHATE HEAD WELL LH-1/GMSB-7

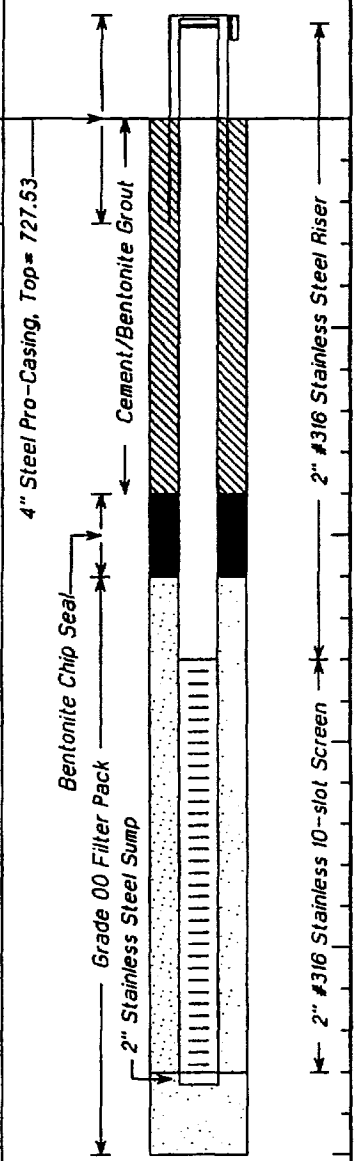
Simpson/12th St. Landfill
Plainwell, Michigan

Project No.: CI0091.001
Logged by: D. Cowin
Drilling Co.: Parratt-Wolff
Driller: Doug R.

Date Drilled: August 11-13, 1993
Drilling Method: 4 1/4-inch dia. hollow stem
Sampling Method: Split Spoon
Surface Elev.: 724.6

Depth (feet)	Sample Type Recovery (in.)	Blows/ft.	Samples	Graphic Log	Soil Class	GENERALIZED DESCRIPTION
	2"SS (10)	2-6-5-3				Brown, sandy, organic topsoil, dry
	2"SS (10)	1-1-1-1				Light gray, clayey residuals, trace coarse sand (black), moist, odorous
5	2"SS (13)	WOH/1-1				Light gray, pulpy residuals, trace coarse sand, moist, odorous
						grades with clayey lenses at 6.0'
	2"SS (20)	WOH/2'				
						layers of very most residuals, trace black fly ash
	2"SS (17)	WOH/2'				
10						grades drier, more pulpy at 10'
	2"SS (20)	WOH/1-2				
						Dark gray, clayey residuals, trace black coarse sand, slightly moist
	2"SS (11)	WOH/2'				
						grades with some clayey/pulpy layers at 14'; moist to wet
15	2"SS (20)	WOH/2'				
	2"SS (20)	WOH/2'				
						observed trace green/yellow substance on fissures in residuals at 18-22'
	2"SS (20)	WOH/2'				
20	3"SS (18)	WOH/2'				
						grades fibrous at 22'
	3"SS (22)	WOH-2'				
25	3"SS (14)	WOH/1.5'-3			PT	
						Brown, peat, moist, contains some clay
						End of Boring at 26 Feet
30						

WELL DIAGRAM



ELEVATION DATA

Top of Well Casing	727.30
Top of Bent. Seal	714.67
Top of Filter Pack	712.67
Top of Screen	712.67
Bottom of Screen	702.67

Attachment E-3
BBL, Former Geotechnical Investigation

004/L2

BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Transmittal

Transmitted Via: Federal Express

BLASLAND, BOUCK & LEE, INC.
200 South Wacker Drive, Suite 3100
Chicago, Illinois 60606-5802

JUN 26 4755

To: Keith M. Krawczyk
MDEQ-ERD
300 S. Washington Sq.
Lansing, MI 48933-2123

Date: June 25, 2001

File: 645.90.685 #2

Re: Geotechnical Sample Analytical Data
12th Street Landfill Operable Unit

We are sending you __x__ herewith ____ under separate cover

____ drawings ____ letters __x__ other

If material received is not as listed, please notify us at once.

Quantity	Title
1	Geotechnical sample analytical results
1	Boring logs
1	Laboratory testing summary table
1	Laboratory data summary table
1	Grain-size analysis data summary table
1	Atterberg limits data summary table
1	Consolidation and strength testing summary table
1	Vane shear test results summary table
1	Geotechnical sampling locations figure

Keith:

We conducted a pre-design geotechnical investigation for the 12th Street Landfill OU between March 28 and March 30, 2001. This investigation included 10 soil borings, as shown on Figure A-1. Locations A through C were selected to evaluate the material in the berms; locations D through H were selected to evaluate the residuals; and locations I and J were chosen to evaluate residual thickness in the southwest corner of the site. Boring logs are provided in Attachment 1. It should be noted that recovery, blow counts, and N-value data are not provided for depth intervals in which Shelby tube samples were collected and vane shear testing was conducted. No samples were collected at Locations H, I, or J. The geotechnical testing results obtained during the pre-design investigation are provided in Attachment 2. The tables include both the laboratory data and the *in situ* testing data.

Sincerely,

BLASLAND, BOUCK & LEE, INC.

Douglas K. Cowin, P.G.
Associate

0005702

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cc: Andrew E. Skroback, Esq. Hunton & Williams
Dawn E. Penniman, P.E., Blasland, Bouck & Lee, Inc.

Tables

Table A-1 Summary of Laboratory Testing

Plainwell, Inc.
Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site
12th Street Landfill Operable Unit

Location/ Depth Interval (feet)	Atterberg Limits	Bulk Density	Grain Size	Moisture Content	Organic Content	Specific Gravity	Consolidation Test	Unconsolidated Undrained Strength Test	Vane Shear Test
A									
4-6 (A-1)			X	X					
14-16 (A-2)			X	X					
B									
4-6 (B-1)		X	X	X		X			
14-16 (B-2)		X	X	X		X			
C									
2-4 (C-1)			X	X		X			
12-14 (C-2)			X	X		X			
D									
2-4									X
4-6 (D-1)	X	X	X	X	X	X	X	X	
8-10 (D-2)				X					
10-12									X
14-16 (D-3)				X					
E									
0-2 (E-1)				X					
4-6									X
6-8 (E-2)	X	X	X	X	X	X	X	X	
10-12 (E-3)				X					
12-14									X
18-20 (E-4)				X		X			
F									
2-4 (F-1)				X					
4-6									X
8-10 (F-2)	X		X	X	X	X			
10-12 (F-3)				X					
12-14 (F-4)	X		X	X	X	X			

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5/15/01

Table A-1 Summary of Laboratory Testing

Plainwell, Inc.
Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site
12th Street Landfill Operable Unit

Location/ Depth Interval (feet)	Atterberg Limits	Bulk Density	Grain Size	Moisture Content	Organic Content	Specific Gravity	Consolidation Test	Unconsolidated Undrained Strength Test	Vane Shear Test
14-16									
G									X
2-4 (G-1)				X					
4-6/6-8 (G-2/G-3)	X	X	X	X	X	X	X	X	
10-12									
14-16 (G-4)	X	X	X	X	X	X	X	X	X
17									
19 (G-5)				X					X

u:\12thstreet\tests
5/15/01

Table A-2 Summary of Laboratory Data

Plainwell, Inc.
Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site
12th Street Landfill Operable Unit

Sample ID	Depth (feet)	Moisture Content (%)	Specific Gravity	Organic Content (%)	Void Ratio	Dry Unit Weight (pcf)	Bulk Density (pcf)	Comments
Berm Samples								
A-1	4-6	13.5	NA	NA	NA	NA	NA	Sand and fly ash.
A-2	14-16	84.7	NA	NA	NA	NA	NA	Fly ash and residuals.
B-1	4-6	78.1	1.94	NA	NA	28.7	51.1	Fly ash.
B-2	14-16	38.6	2.48	NA	NA	75.1	103.3	Residuals.
C-1	2-4	7.7	2.70	NA	NA	NA	NA	Sand.
C-2	12-14	26.5	2.69	NA	NA	NA	NA	Residuals, fly ash, coarse sand.
				Average=	NA	51.9	77.2	
Residuals Samples								
D-1	4-6	96.7	2.26	23.7	2.26	43.7	84.5	Residuals.
D-2	8-10	133.9	NA	NA	NA	NA	NA	Residuals.
D-3	14-16	42.6	NA	NA	NA	NA	NA	Residuals.
E-1	0-2	6.6	NA	NA	NA	NA	NA	Topsoil and sand.
E-2	6-8	65.1	2.36	26.6	1.74	50.4	70.1	Dark grey residuals.
E-3	11	64.7	NA	NA	NA	NA	NA	Residuals.
E-4	18-20	31.6	2.64	NA	NA	NA	NA	Gravel.
F-1	2-4	97.8	NA	NA	NA	NA	NA	Sand and gravel.
F-2	8-10	104	2.14	32.9	NA	NA	NA	Residuals.
F-3	10-12	83.2	NA	NA	NA	NA	NA	Residuals.
F-4	12-14	87.8	2.29	25.8	NA	NA	NA	Residuals.
G-1	4	55.6	NA	NA	NA	NA	NA	Greyish-white residuals.
G-2/G-3	4-8	87.3	2.23	23.0	2.07	46.5	87.3	Residuals.
G-4	14-16	56.8	2.12	28.6	1.86	48.8	87.4	Residuals.
G-5	19	113.1	NA	NA	NA	NA	NA	Dark grey residuals.
Average=		82.6	2.23	26.8	1.98	47.4	82.3	Residuals Only

Notes:

1. pcf - pounds per cubic foot
2. NA - not applicable (i.e., testing was not performed)

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Table A-3 Summary of Grain-Size Analysis Results

Plainwell, Inc.
Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site
12th Street Landfill Operable Unit

Sample ID	Sieve Size - Percent Passing Sieve											
	1"	3/4"	1/2"	3/8"	1/4"	#4	#10	#30	#40	#60	#100	#200
A-1	100	100	99.4	99.4	98.8	98.2	88.4	55.7	48	32.9	22.1	14.6
A-2	100	100	98.8	98.8	97.8	97.5	94	81.5	75.2	64.2	55.4	44.2
B-1	100	100	100	100	100	99.9	99.8	91.6	83.5	69.7	57.8	41
B-2	100	100	100	96.9	92	87.5	74.8	50.1	43.5	32.5	25.5	20.2
C-1	100	100	99.5	97.7	93.4	90.5	78.6	59.5	51.5	26.4	10.3	6
C-2	100	100	98.5	97	92.4	88.7	79.3	62.7	54.5	30.3	16.2	10.8
D-1	100	100	100	100	99.7	99	93	77.1	72.4	64	57.5	51.8
E-2	100	100	100	100	99.2	98.1	90.8	57.4	48.9	38	32.6	29.5
F-2	100	100	100	98.5	76	64	52.3	42.6	40.6	36.6	33.2	30
F-4	100	100	93.9	79	64.3	57.1	45.6	34.9	32.8	29.3	26.6	24.2
G-2/G-3	100	100	100	99.4	97.6	96.1	79.4	51.9	45.2	37.9	32.8	27
G-4	100	94	94	91.1	88.7	88.1	80.4	59.3	52.9	46.4	43	40.3

Berm

residual

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6/22/01

Table A-4 Atterberg Limits Data

Plainwell, Inc.
Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site
12th Street Landfill Operable Unit

	Sample ID	Depth (ft)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index	Liquidity Index	
residuals	D-1	4-6	NP	NP	NP	NP	
dark grey residuals	E-2	6-8	81	68	13	-0.22	brittle
res. duals	F-2	8-10	NP	NP	NP	NP	
residuals	F-4	12-14	71	61	10	2.68	viscous liquid
residuals	G-2/G-3	4-8	68	51	17	2.14	viscous liquid
residuals	G-4	14-16	83	65	18	-0.46	brittle

Note:

1. NP - non-plastic

All plot as MH or OH

2. A liquidity index less than zero indicates that the soil will have a brittle fracture when sheared; a liquidity index between 0 and 1 indicates that the soil will behave like a plastic; and a liquidity index greater than 1 indicates that the soil will behave like a viscous liquid when sheared.

Table A-5 Summary of Consolidation and Strength Testing

Plainwell, Inc.
Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site
12th Street Landfill Operable Unit

	Sample ID	Cohesion (psf)	Compression Index (Cc)	Secondary Compression Index at 1 to 2 tsf (Ca)	Coefficient of Consolidation at 1 to 2 tsf (cv, ft^2/day)	Initial Void Ratio	Dry Density (pcf)
residual	D-1	641 firm	0.71	0.013	0.02	2.27	43.2
different	E-2	1017 stiff	0.62	0.004	0.01	1.74	53.2
residual	G-2/G-3	183 very soft	0.63	0.018	0.01	2.07	
residual	G-4	264 soft	0.70	0.008	0.01	1.86	
	Average	526 soft-firm	0.67	0.011	0.013	1.99	48.2

1.4×10^{-4} cm²/s

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6/22/01

Table A-6 Vane Shear Test Results

Plainwell, Inc.
Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site
12th Street Landfill Operable Unit

Location	Date	Depth (feet)	Vane Constant	Undisturbed Condition		Remolded Condition		Sensitivity	Comments
				Maximum Torque (in-lbs)	Ultimate Shear Strength (psf)	Maximum Torque (in-lbs)	Ultimate Shear Strength (psf)		
D	3/29/01	2'-10"	5.17	250	1293 stiff	40	207 v. soft	6.3	Residuals
D	3/29/01	11'-0"	5.17	300	1551 stiff	80	414 soft	3.8	Sand
E	3/29/01	5'-0"	5.17	190	982 firm	40	207 v. soft	4.8	Residuals
E	3/29/01	13'-0"	5.17	200	1034 stiff	60	310 soft	3.3	Residuals/Sand
F	3/29/01	5'-0"	5.17	190	982 firm	60	310 soft	3.2	Residuals/Sand
F	3/30/01	15'-0"	5.17	150	776 firm	40	207 v. soft	3.8	Residuals
G	3/30/01	10'-0"	5.17	210	1086 stiff	50	259 soft	4.2	Residuals
G	3/30/01	17'-0"	5.17	315	1629 stiff	100	517 firm	3.2	Residuals
			Average=	223	1153 stiff	54	279 soft	4.4	Residuals only

firm to stiff Very soft to soft

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5/15/01

Figure

Attachments

BLASLAND, BOUCK & LEE, INC. *engineers & scientists*

Attachment 1

BLASLAND, BOUCK & LEE, INC. □ *engineers & scientists*

consultants with focus

Date Start/Finish: 3/28/01 - 3/28/01 **Drilling Company:** MATECO **Driller's Name:** Dan V. **Drilling Method:** HSA **Bit Size:** **Auger Size:** 4.25" ID **Rig Type:** CME-750 ATV **Sampling Method:** Varies **Hammer Weight:** 140 lbs.	**Northing:** **Easting:** **Casing Elevation:** **Borehole Depth:** 20 feet **Surface Elevation:** **Geologist:** LKB	**Boring ID:**A **Client:** Kalamazoo River Study Group (KRSG) **Location:** 12th Street Landfill Operable Unit Plainwell, MI

DRAFT

DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	Blows / 6 Inches	N - Value	Geologic Column	Stratigraphic Description
0	0							TOPSOIL with Organics.
		1	SS	1.1	1 2 3 5	5		Medium to coarse SAND, some Gravel.
		2	SS	1.1	4 5 5 6	10		Same as above.
5	5	3	ST	2.0				
								Black fly ASH.
		4	SS	0.1	2 3 2 1	5		Medium to coarse SAND with fly Ash.
		5	SS	0.1	1 1 1 1	2		Black fly ASH.
10	10	6	SS	0.3	1 1 1 1	2		
		7	SS	1.3	WOH WOH 1	<1		Same as above.
15	15	8	ST	2.0				
								Light gray RESIDUALS.
		9	SS	1.3	1 2 2 2	4		Dark gray RESIDUALS.
		10	SS	1.8	WOH 1 2 2	3		RESIDUALS, dark gray to light gray with depth.
20	20							

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engineers & scientists

Remarks: SS - Split Spoon; ST - Shelby Tube;
WOH - Weight of Hammer.

Date Start/Finish: 3/29/01 - 3/29/01 Drilling Company: MATECO Driller's Name: Dan V. Drilling Method: HSA Bit Size: Auger Size: 4.25" ID Rig Type: CME-750 ATV Sampling Method: Varies Hammer Weight: 140 lbs.	Northing: Easting: Casing Elevation: Borehole Depth: 20 feet Surface Elevation: Geologist: LKB	Boring ID:B Client: Kalamazoo River Study Group (KRSG) Location: 12th Street Landfill Operable Unit Plainwell, MI

DRAFT

DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	Blows / 6 Inches	N - Value	Geologic Column	Stratigraphic Description
0	0							TOPSOIL with Organics.
		1	SS	0.6	WOH WOH WOH WOH	<1		Medium to coarse SAND with fine GRAVEL.
		2	SS	1.1	2 2 2 3	4		
								Black fly ASH.
5	5	3	ST					SHELBY TUBE.
		4	SS	1.4	WOH 1 1 1	2		Black fly ASH, dry.
		5	SS	1.4	1 2 3 4	5		Light gray RESIDUALS. Black fly ASH.
10	10	6	SS	0.5	3 4 4 3	8		RESIDUALS with black fly Ash.
		7	SS	0.5	3 4 4 4	8		
15	15	8	ST					SHELBY TUBE.
		9	SS	1.9	3 4 5 6	9		RESIDUALS varying in color from white to dark gray.
		10	SS	1.9	4 6 7 6	13		RESIDUALS with increasing Sand content.
20	20							

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Remarks: SS - Split Spoon; ST - Shelby Tube;
WOH - Weight of Hammer.

Date Start/Finish: 3/28/01 - 3/28/01 **Drilling Company:** MATECO **Driller's Name:** Dan V. **Drilling Method:** HSA **Bit Size:** **Auger Size:** 4.25" ID **Rig Type:** CME-750 ATV **Sampling Method:** Varies **Hammer Weight:** 140 lbs.	**Northing:** **Easting:** **Casing Elevation:** **Borehole Depth:** 20 feet **Surface Elevation:** **Geologist:** LKB	**Boring ID:** C **Client:** Kalamazoo River Study Group (KRSG) **Location:** 12th Street Landfill Operable Unit Plainwell, MI

DRAFT

DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	Blows / 6 Inches	N - Value	Geologic Column	Stratigraphic Description
0	0	1	SS	0.6	WOH WOH WOH 2	<1		Organic Material, Coarse SAND with little fly Ash and trace Residuals.
		2	ST					Shelby Tube.
5	5	3	SS	0.3	3 3 3 2	6		Medium to coarse SAND with Gravel, seam of Residuals.
		4	SS	1.1	2 1 2 3	3		Medium to coarse SAND with Gravel, seam of Residuals.
		5	SS	1.3	WOH 1 2 1	3		White RESIDUALS RESIDUALS with medium to coarse Sand.
10	10	6	SS	1.3	3 4 3 1	7		
		7	ST					Shelby Tube - RESIDUALS with fly Ash and coarse Sand.
15	15	8	SS	1.2	2 1 2 3	3		RESIDUALS with Sand and fly Ash.
		9	SS	0.8	2 3 3 3	6		RESIDUALS with fly Ash.
		10	SS	0.5	3 4 4 5	8		Medium to coarse SAND with Gravel.
20	20							

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Remarks: SS - Split Spoon; ST - Shelby Tube;
WOH - Weight of Hammer.

Date Start/Finish: 3/29/01 - 3/29/01 Drilling Company: MATECO Driller's Name: Dan V. Drilling Method: HSA Bit Size: Auger Size: 4.25" ID Rig Type: CME-750 ATV Sampling Method: Varies Hammer Weight: 140 lbs.	Northing: Easting: Casing Elevation: Borehole Depth: 16 feet Surface Elevation: Geologist: LKB	Boring ID:D Client: Kalamazoo River Study Group (KRSG) Location: 12th Street Landfill Operable Unit Plainwell, MI

DRAFT

DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	Blows / 6 Inches	N - Value	Geologic Column	Stratigraphic Description
0	6							Brown TOPSOIL with Organics.
		1	SS	1.1	3 4 3 3	7		Medium to coarse SAND with Residuals. Residuals in tip.
		2	VS					Vane Shear.
5	5	3	ST					Shelby Tube - Residuals at end.
		4	SS	1.5	WOH 2 WOH WOH	>2		Light gray to darker gray RESIDUALS, wet. Higher Clay content with depth.
		5	SS	1.5	1 1 1 1	2		
10	10	6	VS					Vane Shear.
		7	SS	0.0				No Recovery. Split-spoon filled with water.
15	15	8	ST	0.0				No Sample. Tube crushed.
20	20							

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Remarks: SS - Split Spoon; ST - Shelby Tube; VS - Vane Shear;
WOH - Weight of Hammer.

Project: 645.90.670 Template: J:\rockware\LogPlot2001\Logfiles\64590\Kalamazoo.ldf
Data File:D.dat Date: 4/16/01

Date Start/Finish: 3/29/01 - 3/29/01 **Drilling Company:** MATECO **Driller's Name:** Dan V. **Drilling Method:** HSA **Bit Size:** **Auger Size:** 4.25" ID **Rig Type:** CME-750 ATV **Sampling Method:** Varies **Hammer Weight:** 140 lbs.	**Northing:** **Easting:** **Casing Elevation:** **Borehole Depth:** 20 feet **Surface Elevation:** **Geologist:** LKB	**Boring ID:**E **Client:** Kalamazoo River Study Group (KRSG) **Location:** 12th Street Landfill Operable Unit Plainwell, MI

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DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	Blows / 6 Inches	N - Value	Geologic Column	Stratigraphic Description
0	0	1	SS	1.1	2 2 2 2	4		Brown Organic TOPSOIL. Medium to coarse SAND with GRAVEL, trace Residuals.
		2	ST					Shelby Tube.
5	5	3	VS					Vane Shear.
		4	ST					Shelby Tube - dark Residuals at end of tube.
		5	SS	0.0	13 6 3 1	9		No Sample Recovered.
10	10	6	SS	0.8	1 1 1 1	2		RESIDUALS.
		7	VS					Vane Shear.
15	15	8	ST					Shelby Tube attempted - no sample recovered (tube wet).
			ST					Shelby Tube attempted (wet Gravel).
			SS	0.8	6 15 50	>65		Coarse SAND with some fine Gravel, wet.
20	20							

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Remarks: SS - Split Spoon; ST - Shelby Tube; VS - Vane Shear;
WOH - Weight of Hammer.

Date Start/Finish: 3/29/01 - 3/29/01 Drilling Company: MATECO Driller's Name: Dan V. Drilling Method: HSA Bit Size: Auger Size: 4.25" ID Rig Type: CME-750 ATV Sampling Method: Varies Hammer Weight: 140 lbs.	Northing: Easting: Casing Elevation: Borehole Depth: 18 feet Surface Elevation: Geologist: LKB	Boring ID:F Client: Kalamazoo River Study Group (KRSG) Location: 12th Street Landfill Operable Unit Plainwell, MI

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DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	Blows / 6 Inches	N - Value	Geologic Column	Stratigraphic Description
0	0							Brown organic TOPSOIL.
		1	SS	1.0	2 2 2 3	4		Medium to coarse SAND with fine GRAVEL.
		2	SS	1.3	4 2 1 1	3		
5	5	3	VS					Vane Shear.
		4	SS	0.2	1 1 WOH	>1		RESIDUALS with some Sand.
		5	SS	2.0	1 WOH WOH 2	<1		RESIDUALS.
10	10	6	SS	1.7	1 2 2 1	4		
		7	SS	2.0	WOH 1 1 1	2		
15	15	8	VS					Vane Shear.
			SS	0.0	2 1 2 2	3		Wet RESIDUALS.
20	20							

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Remarks: SS - Split Spoon; VS - Vane Shear;
WOH - Weight of Hammer.

Date Start/Finish: 3/30/01 - 3/30/01 **Drilling Company:** MATECO **Driller's Name:** Dan V. **Drilling Method:** HSA **Bit Size:** **Auger Size:** 4.25" ID **Rig Type:** CME-750 ATV **Sampling Method:** Varies **Hammer Weight:** 140 lbs.	**Northing:** **Easting:** **Casing Elevation:** **Borehole Depth:** 20 feet **Surface Elevation:** **Geologist:** LKB	**Boring ID:**G **Client:** Kalamazoo River Study Group (KRSG) **Location:** 12th Street Landfill Operable Unit Plainwell, MI

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DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	Blows / 6 Inches	N - Value	Geologic Column	Stratigraphic Description
0	0							Brown organic TOPSOIL.
		1	SS	1.0	2 5 8 5	13		Medium lo coarse SAND with GRAVEL and Organics.
		2	SS	0.8	4 2 2 1	4		
								Grayish-white RESIDUALS, dry.
5	5	3	ST					Shelby Tube - Residuals.
		4	ST	1.0				Shelby Tube - Residuals.
		5	SS	1.0	WOH	WOH		Gray RESIDUALS.
10	10	6	VS					Vane Shear.
		7	SS		1 1 2 2	3		Medium gray RESIDUALS.
15	15	8	ST					Shelby Tube - Residuals.
		9	VS					Vane Shear.
		10	SS	2.0	1 3 3 2	6		Dark gray RESIDUALS.
20	20							

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Remarks: SS - Split Spoon; ST - Shelby Tube; VS - Vane Shear; WOH - Weight of Hammer.

DRAFT

Date Start/Finish: 3/30/01 - 3/30/01 Drilling Company: MATECO Driller's Name: Dan V. Drilling Method: HSA Bit Size: Auger Size: 4.25" ID Rig Type: CME-750 ATV Sampling Method: Split-Spoon (2") Hammer Weight: 140 lbs.	Northing: Easting: Casing Elevation: Borehole Depth: 14 feet Surface Elevation: Geologist: LKB	Boring ID:H Client: Kalamazoo River Study Group (KRSG) Location: 12th Street Landfill Operable Unit Plainwell, MI

DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	Blows / 6 Inches	N - Value	Geologic Column	Stratigraphic Description
0	0							Brown organic TOPSOIL.
		1	SS	0.5	2 3 3 3	6		Brown fine to coarse SAND with GRAVEL up to 1" in diameter.
		2	SS	1.0	4 4 4 3	8		
5	5	3	SS	0.5	3 2 2 1	4		Same as above.
		4	SS	0.5	2 2 2 6	4		Same as above.
		5	SS	0.5	5 3 3 4	6		
10	10	6	SS	0.8	3 3 1 1	4		
		7	SS	0.7	1 1 1 1	2		Same as above but wetter.
15	15							
20	20							

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BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Remarks: SS - Split Spoon; WOH - Weight of Hammer.

Date Start/Finish: 3/28/01 - 3/28/01 **Drilling Company:** MATECO **Driller's Name:** Dan V. **Drilling Method:** HSA **Bit Size:** **Auger Size:** 4.25" ID **Rig Type:** CME-750 ATV **Sampling Method:** Split-Spoon (2") **Hammer Weight:** 140 lbs.	**Northing:** **Easting:** **Casing Elevation:** **Borehole Depth:** 30 feet **Surface Elevation:** **Geologist:** LKB	**Boring ID:** I **Client:** Kalamazoo River Study Group (KRSG) **Location:** 12th Street Landfill Operable Unit Plainwell, MI

DRAFT

DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	Blows / 6 Inches	N - Value	Geologic Column	Stratigraphic Description
0	0							Brown organic TOPSOIL.
		1	SS	1.0	2 1 2 2	3		Tan medium to coarse SAND with GRAVEL, seams of black fly Ash.
		2	SS	1.5	1 1 1 1	2		Black fly ASH.
5	5	3	SS	1.0	1 1	1		
		4	SS	0.5	WOH 1	<1		GRAVEL seam. Black fly ASH.
		5	SS	1.2	WOH	WOH		
10	10	6	SS	1.0	1 1	1		
		7	SS	1.5	WOH	WOH		
15	15	8	SS	1.2	1 1 1 1	2		
		9	SS	1.3	3 4 6 6	10		Black fly ASH. Light gray RESIDUALS.
		10	SS	1.4	4 4 4 5	8		
20	20	11	SS	0.5	5 6 3 3	9		Dark gray RESIDUALS.

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engineers & scientists

Remarks: SS - Split Spoon; WOH - Weight of Hammer.

DRAFT

Client:
Kalamazoo River Study Group (KRSG)

Site Location:
12th Street Landfill
Operable Unit
Plainwell, MI

Boring ID:I

Borehole Depth: 30 feet

DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	Blows / 6 Inches	N - Value	Geologic Column	Stratigraphic Description
		12	SS	2.0	2 3 2 4	5		Dark gray RESIDUALS.
25	25	13	SS	1.5	2 6 4 4	10		
		14	SS	1.2	4 5 6 7	11		
		15	SS	1.0	4 4 4 4	8		Medium to coarse SAND with GRAVEL.
30	30							
35	35							
40	40							
45	45							

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Remarks: SS - Split Spoon; WOH - Weight of Hammer.

Date Start/Finish: 3/28/01 - 3/28/01 Drilling Company: MATECO Driller's Name: Dan V. Drilling Method: HSA Bit Size: Auger Size: 4.25" ID Rig Type: CME-750 ATV Sampling Method: Split-Spoon (2") Hammer Weight: 140 lbs.	Northing: Easting: Casing Elevation: Borehole Depth: 12 feet Surface Elevation: Geologist: LKB	Boring ID:J Client: Kalamazoo River Study Group (KRSG) Location: 12th Street Landfill Operable Unit Plainwell, MI

DRAFT

DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Recovery (feet)	Blows / 6 Inches	N - Value	Geologic Column	Stratigraphic Description
0	0				2			Dark brown organic TOPSOIL.
		1	SS	0.5	1 1 1	2		Black fly ASH, dry.
		2	SS	0.3	WOH 3 3 3	6		RESIDUALS, trace coarse Sand and fly Ash.
5	5	3	SS	1.4	3 3 4 4	7		
		4	SS	1.8	3 4 4 7	8		
		5	SS	2.0	9 12 11 15	23		Fine to coarse SAND, little Gravel.
10	10	6	SS	0.8	9 15 16 18	31		
15	15							
20	20							

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engineers & scientists

Remarks: SS - Split-Spoon; WOH - Weight of Hammer.

Attachment 2

BLASLAND, BOUCK & LEE, INC. ◻ *engineers & scientists*

consultants with focus

p-w labs

PW LABORATORIES,INC.
P.O. BOX 56, 5879 FISHER ROAD, EAST SYRACUSE, NY 13057
315-437-1429 • 800-782-7260 • Fax 315-437-1770

April 25, 2001

Ms. Laura Brussel
Blasland, Bouck & Lee, Inc.
6723 Towpath Road
P.O. Box 66
Syracuse, New York 13214-0066

Re: L-01041
12th Street Landfill
Kalamazoo, Michigan
Project #64590

Dear Ms. Brussel:

Enclosed are the results of laboratory testing performed at your request on fifteen bulk material samples delivered to our laboratory on March 29, March 30, and April 2, 2001 for the above referenced project. Results include:

1. Natural Moisture Content ASTM D2216 — 15 each
   Laboratory I.D. #'s 14668 through 14682

2. Sieve Analysis ASTM D422 & D1140 — 6 each
   Laboratory I.D. #'s 14668, 14669, 14670, 14671, 14677, 14679

3. Hydrometer Analysis ASTM D422 — 2 each
   Laboratory I.D. #'s 14677, 14679

4. Atterberg Limits ASTM D4318 — 2 each
   Laboratory I.D. #'s 14677, 14679

5. Specific Gravity ASTM D854 — 5 each
   Laboratory I.D. #'s 14670, 14671, 14675, 14677, 14679

April 25, 2001
Blasland, Bouck & Lee, Inc.

Re: L-01041
12th Street Landfill
Kalamazoo, Michigan
Project #64590

6. Moisture, Ash and Organic matter of Peat and Other Organic Soils ASTM D2974 — 2 each
   Laboratory I.D. #'s 14677, 14679

Additional reports will be forwarded to you as they are completed.

Thank you for this opportunity to work with you.

Very truly yours,

PW LABORATORIES, INC.

Donald P. Blasland, SET
V.P. - Laboratory & Field Services
DPB/bap
encs:

SIEVE ANALYSIS OF
SOIL / AGGREGATE

p-w labs

PROJECT TITLE Laboratory Testing12th Street Landfill - Kalamazoo Michigan
Project # 64590

PROJECT # L-01041
TEST METHOD ASTM D422 & D1140

REPORT # 1
REPORT DATE April 25, 2001

		Sieve Size - Percent Passing Sieve														
Lab I.D. #	Sample	3/4"	1/2"	3/8"	1/4"	#4	#10	#30	#40	#60	#100	#200				
14668	A-1 Location A 4' - 6' deep	100	99.4	99.4	98.8	98.2	88.4	55.7	48.0	32.9	22.1	14.6				
14669	A-2 Location A 14' - 16' deep	100	98.8	98.8	97.8	97.5	94.0	81.5	75.2	64.2	55.4	44.2				
14670	C-1 Location C 2' - 4' deep	100	99.5	97.7	93.4	90.5	78.6	59.5	51.5	26.4	10.3	6.0				
14671	C-2 Location C 12' - 14' deep	100	98.5	97.0	92.4	88.7	79.3	62.7	54.5	30.3	16.2	10.8				
14677	F-2 8' - 10'	--	100	98.5	76.0	64.0	52.3	42.6	40.6	36.6	33.2	30.0				
14679	F-4 12' - 14'	100	93.9	79.0	64.3	57.1	45.6	34.9	32.8	29.3	26.6	24.2				

Sample mass, as received, meets minimum requirements of test method: Yes ____ No X

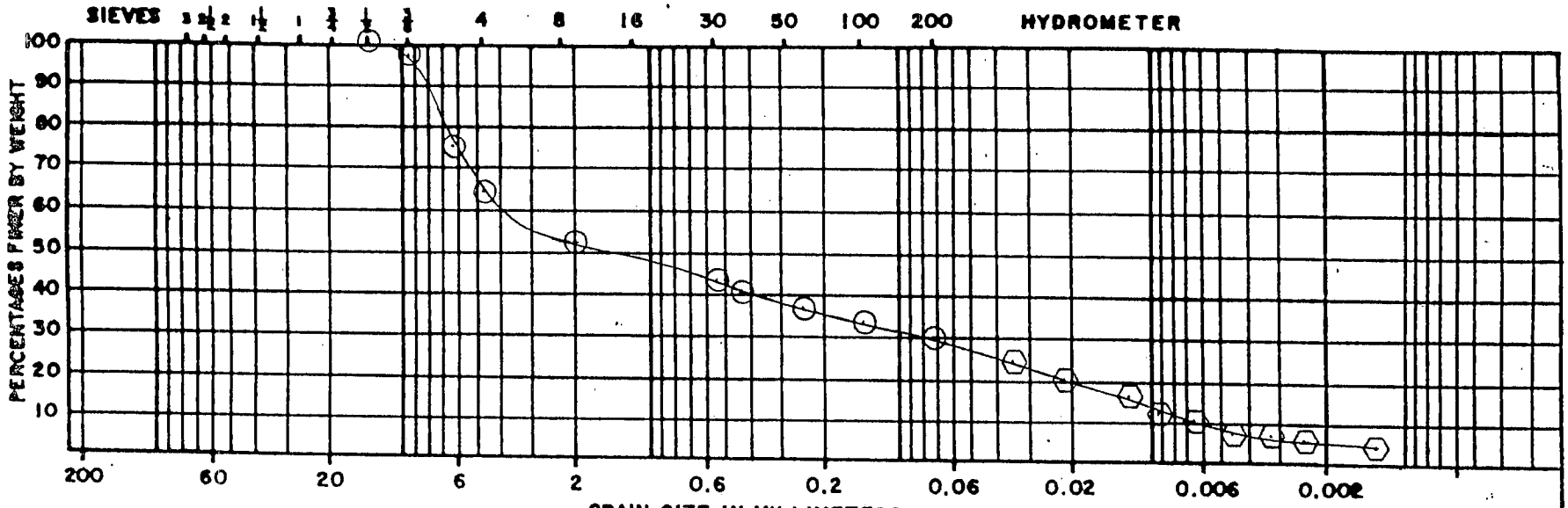
Prewashed: Yes X No ____

Remarks:

Performed By: JE

Checked By: V.J. Thoma

GRAIN SIZE ANALYSIS



BOULDERS COBBLES	GRAVEL C	GRAVEL M	GRAVEL F	SAND C	SAND M	SAND F	SILT-CLAY SOIL

228 76.2 25.4 9.52 2.0 0.59 0.25 0.074 MM. OPENING

9 in. 3 in. 1 in. 3/8 in. Nos. 10 30 60 200 SIEVE

L-01014

Laboratory Testing

12th Street Landfill

Kalamazoo, Michigan

Lab I.D. # 14677

Sample: F-2

8' – 10'

⊙ Sieve Analysis ASTM D422 & D1140

⊙ Hydrometer Analysis ASTM D422

parratt wolff inc

FISHER RD., EAST SYRACUSE, N.Y. 13057

TELEPHONE AREA CODE 315/437-1429

JOB NO. L-01014

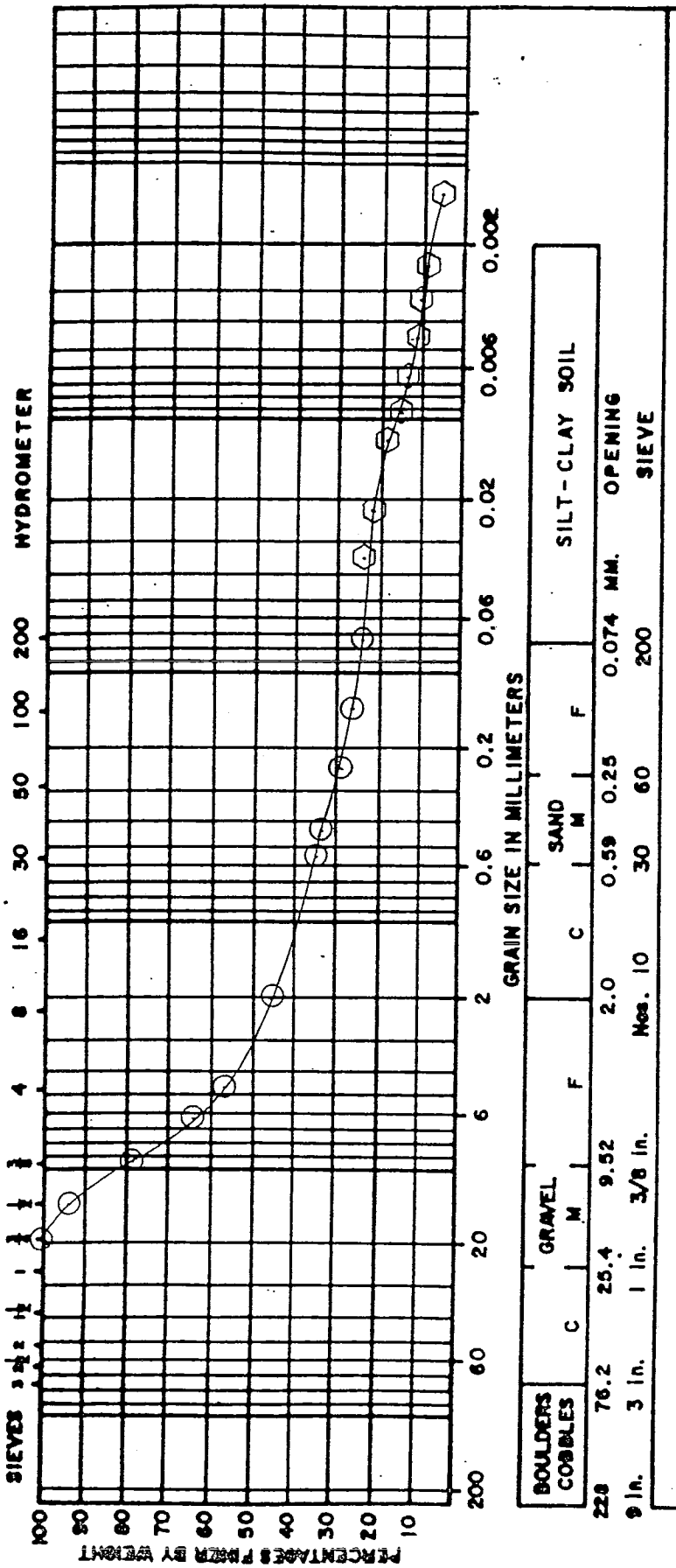
REPORT NO. 1

April 25, 2001

parratt wolff inc
FISHER RD., EAST SYRACUSE, N.Y. 13057
TELEPHONE AREA CODE 315/437-1429

JOB NO. L-01014
REPORT NO. 2
April 25, 2001

GRAIN SIZE ANALYSIS



Lab I.D. # 14679

Sample: F-4

12' - 14'

L-01014

Laboratory Testing

12th Street Landfill

Kalamazoo, Michigan

⊙ Sieve Analysis ASTM D422 & D1140

⬡ Hydrometer Analysis ASTM D422

p-w labs

April 25, 2001

L-01041
12th Street Landfill
Kalamazoo, Michigan
Project # 64590

NATURAL MOISTURE CONTENT
ASTM D2216

Lab I.D. #	Sample #.	Depth (feet)	Moisture Content as a Percent of Dry Weight
14668	A-1	4.0 - 6.0	13.5
14669	A-2	14.0 – 16.0	84.7
14670	C-1	2.0 – 4.0	7.7
14671	C-2	12.0 – 14.0	26.5
14672	D-2	8.0 – 10.0	133.9
14673	D-3	14.0 – 16.0	42.6
14674	E-1	0.0 – 2.0	6.6
14675	E-4	18.0 – 20.0	31.6
14676	F-1	2.0 – 4.0	97.8
14677	F-2	8.0 – 10.0	104.0
14678	F-3	10.0 – 12.0	83.2
14679	F-4	12.0 – 14.0	87.8
14680	E-3	@ 11.0	64.7
14681	G-1	@ 4.0	55.6
14682	G-5	@ 19.0	113.1

p-w labs

April 25, 2001

L-01041
12th Street Landfill
Kalamazoo, Michigan
Project # 64590

ATTERBERG LIMITS
ASTM D4318

Lab ID#	Sample #.	Depth (feet)	Plastic Limit	Liquid Limit	Plasticity Index
14677	F-2	8.0 – 10.0	Non Plastic	--	--
14679	F-~~2~~ 4	12.0 – 14.0	61	71	10

p-w labs

April 25, 2001

L-01041
12th Street Landfill
Kalamazoo, Michigan
Project # 64590

SPECIFIC GRAVITY OF SOILS ASTM D854

Lab I.D. #	Sample	Minus No. 4 Fraction Specific Gravity of Solids (G)
14670	C-1 Location C 2' – 4' Deep	2.70
14671	C-2 Location C 12' – 14' Deep	2.69
14675	E-4 18' – 20'	2.64
14677	F-2 8' – 10'	2.14
14679	F-4 12' – 14'	2.29

p-w labs

April 25, 2001

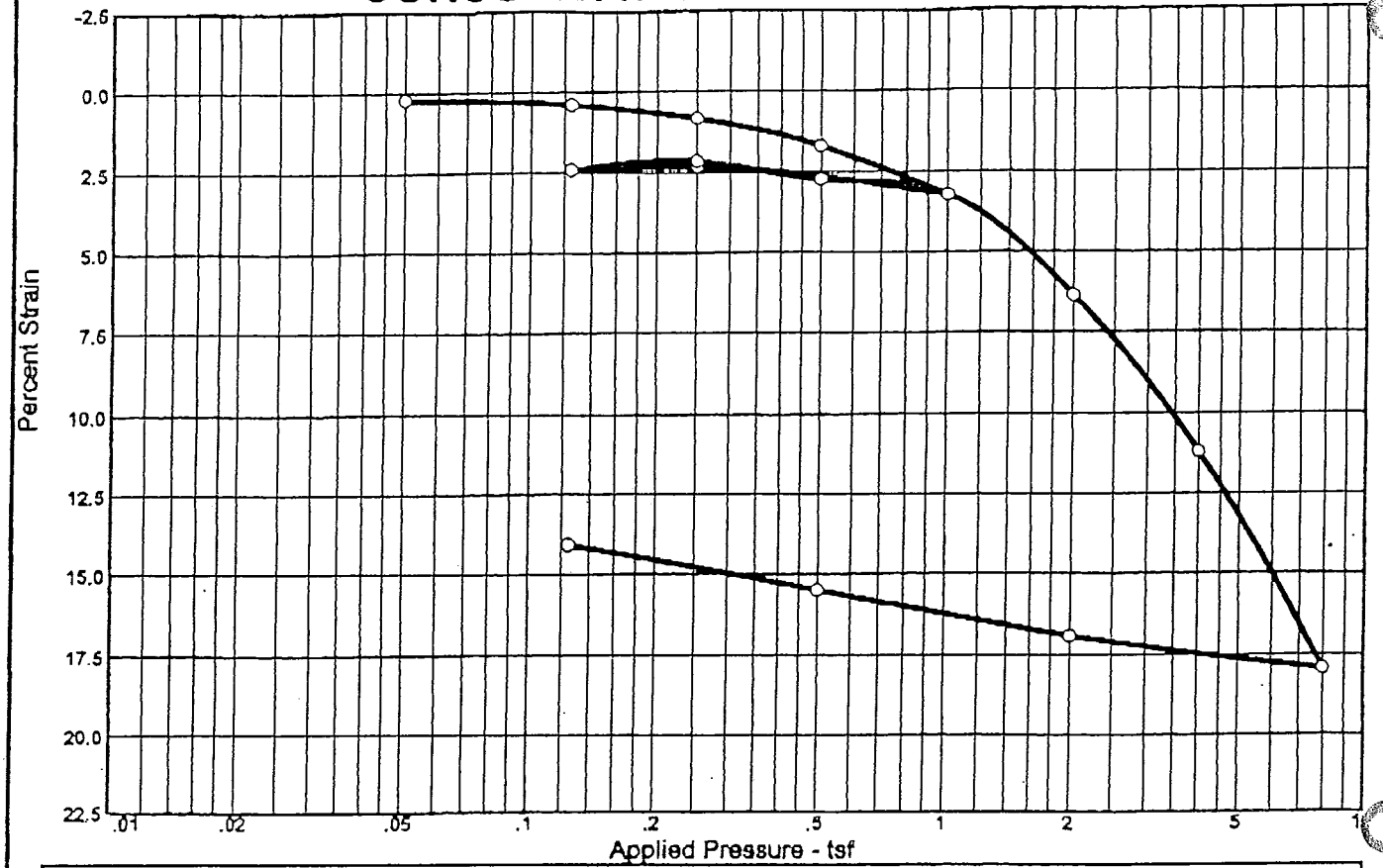
L-01041
12th Street Landfill
Kalamazoo, Michigan
Project # 64590

MOISTURE, ASH, AND ORGANIC MATTER OF
PEAT AND OTHER ORGANIC SOILS
ASTM D2974

Lab I.D. #	Sample	Organic Matter as a Percent of Original Weight
14677	F-2 8' – 10'	32.9
14679	F-4 12' – 14'	25.8

Document4

CONSOLIDATION TEST REPORT



Coefficients of Consolidation and Secondary Consolidation

No.	Load (tsf)	C_v (ft.2/day)	C_α	No.	Load (tsf)	C_v (ft.2/day)	C_α	No.	Load (tsf)	C_v (ft.2/day)	C_α
1	0.05	0.08	0.001	11	2.00	0.17	0.016				
2	0.13	0.09	0.001	12	4.00	0.01	0.014				
3	0.25	0.98	0.001	13	8.00	0.01	0.018				
4	0.50	0.37	0.002	14	2.00	0.27					
5	1.00	0.01	0.004	15	0.50	0.01					
6	0.25	0.01		16	0.13	0.01					
7	0.13	0.02									
8	0.25	0.00	0.001								
9	0.50	0.04	0.001								
10	1.00	0.06	0.002								

Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	P_c (tsf)	C_c	Initial Void Ratio
Saturation	Moisture							
88.3 %	65.1 %	53.2	81	13	2.36	2.05	0.62	1.740

MATERIAL DESCRIPTION	USCS	AASHTO
Grey moist silty sand (paper residue)	OH	

Project No. L-01041 **Client:** BLASLAND BOUCK & LEE

Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN

Location: BORING# E-2 ID# 14703

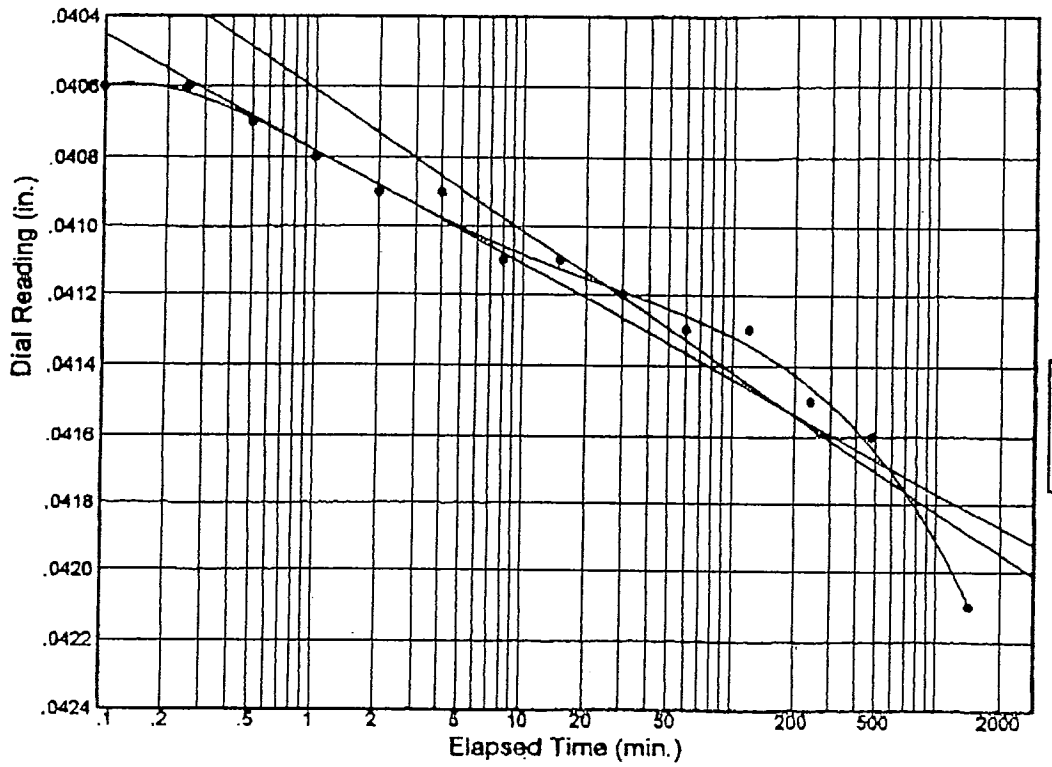
Remarks:

CONSOLIDATION TEST REPORT

PW LABORATORIES, INC.

Dial Reading vs. Log of Time

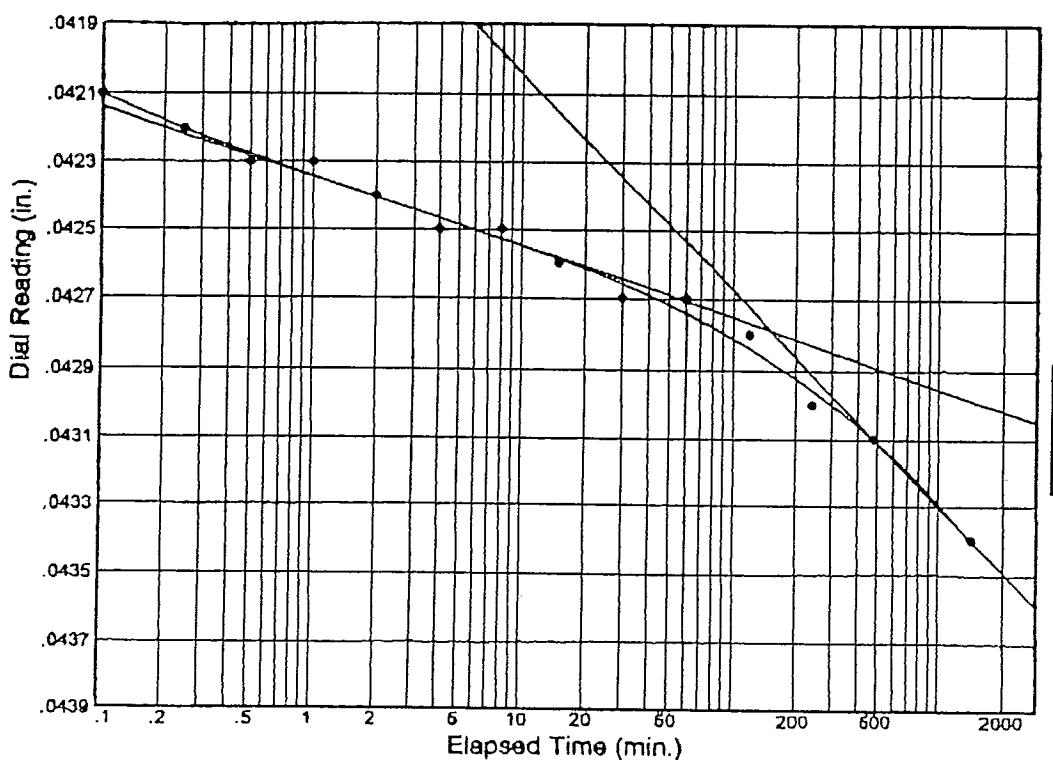
Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# E-2 ID# 14703



Load No.= 1
Load= 0.05 tsf
D_0 = 0.04040
D_{50} = 0.04096
D_{100} = 0.04152
T_{50} = 3.66 min.

C_v @ T_{50}
0.08 ft.^{2}/day

C_α = 0.001



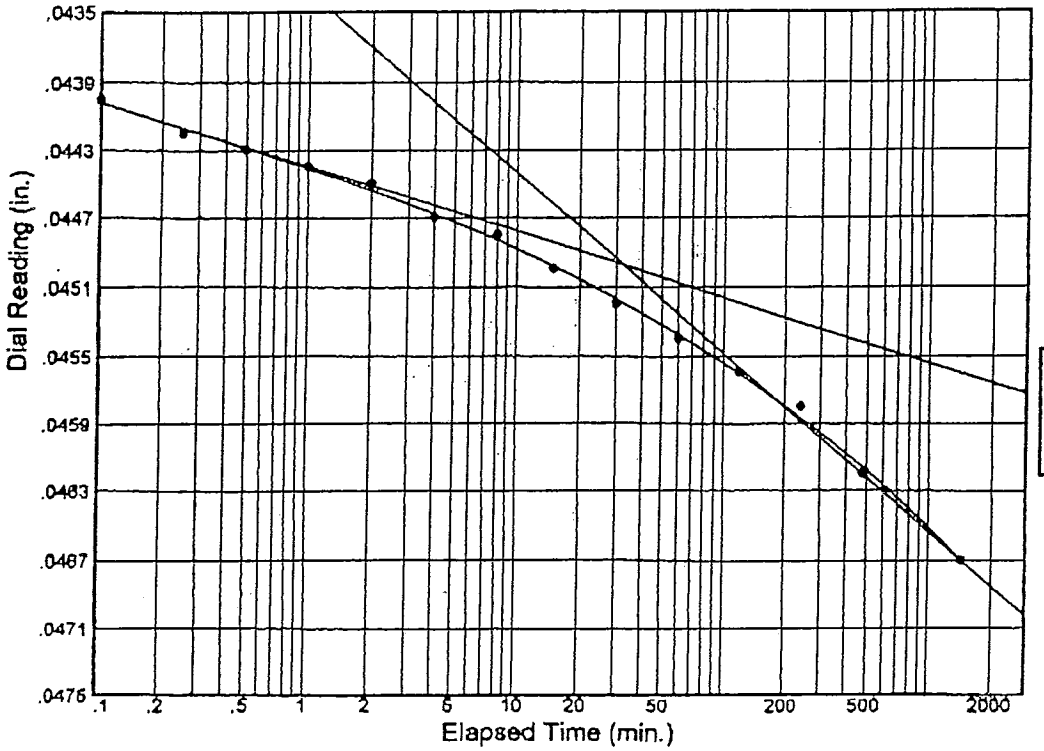
Load No.= 2
Load= 0.13 tsf
D_0 = 0.04210
D_{50} = 0.04245
D_{100} = 0.04279
T_{50} = 3.18 min.

C_v @ T_{50}
0.09 ft.^{2}/day

C_α = 0.001

Dial Reading vs. Log of Time

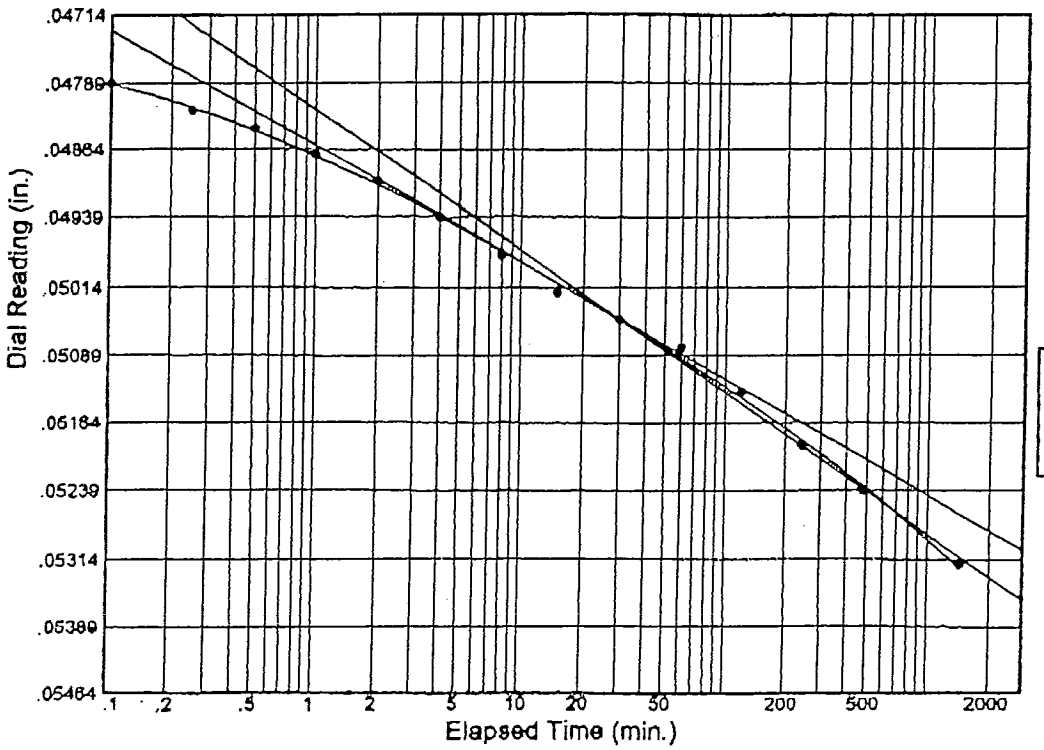
Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# E-2 ID# 14703



Load No.= 3
Load= 0.25 tsf
D_0 = 0.04340
D_{50} = 0.04419
D_{100} = 0.04498
T_{50} = 0.28 min.

C_v @ T_{50}
0.98 ft.^{2}/day

C_α = 0.001



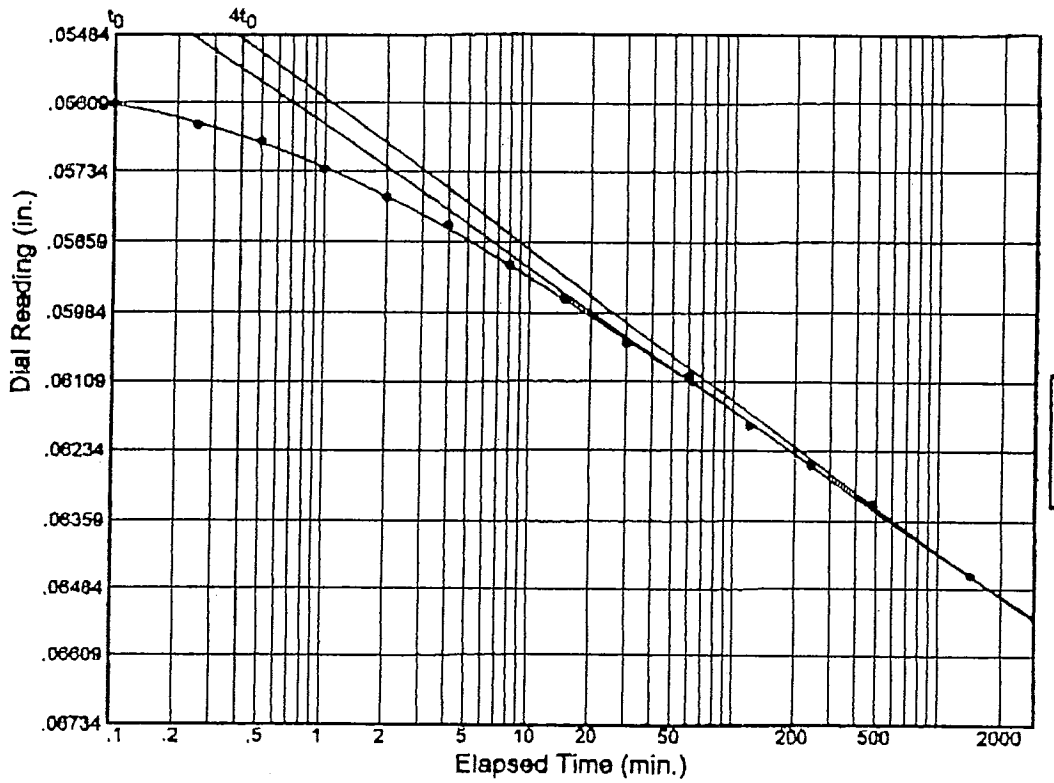
Load No.= 4
Load= 0.50 tsf
D_0 = 0.04670
D_{50} = 0.04858
D_{100} = 0.05046
T_{50} = 0.73 min.

C_v @ T_{50}
0.37 ft.^{2}/day

C_α = 0.002

Dial Reading vs. Log of Time

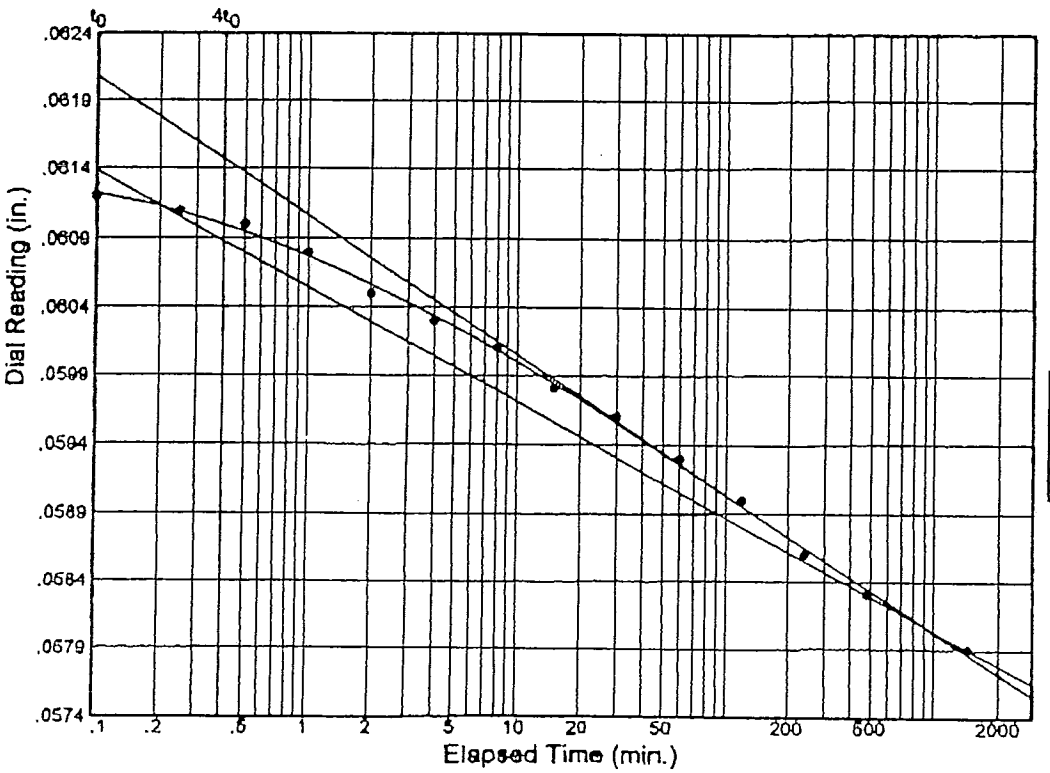
Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# E-2 ID# 14703



Load No.= 5
Load= 1.00 tsf
D_0 = 0.05553
D_{50} = 0.06002
D_{100} = 0.06451
T_{50} = 22.47 min.

C_v @ T_{50}
0.01 ft.^{2}/day

C_α = 0.004

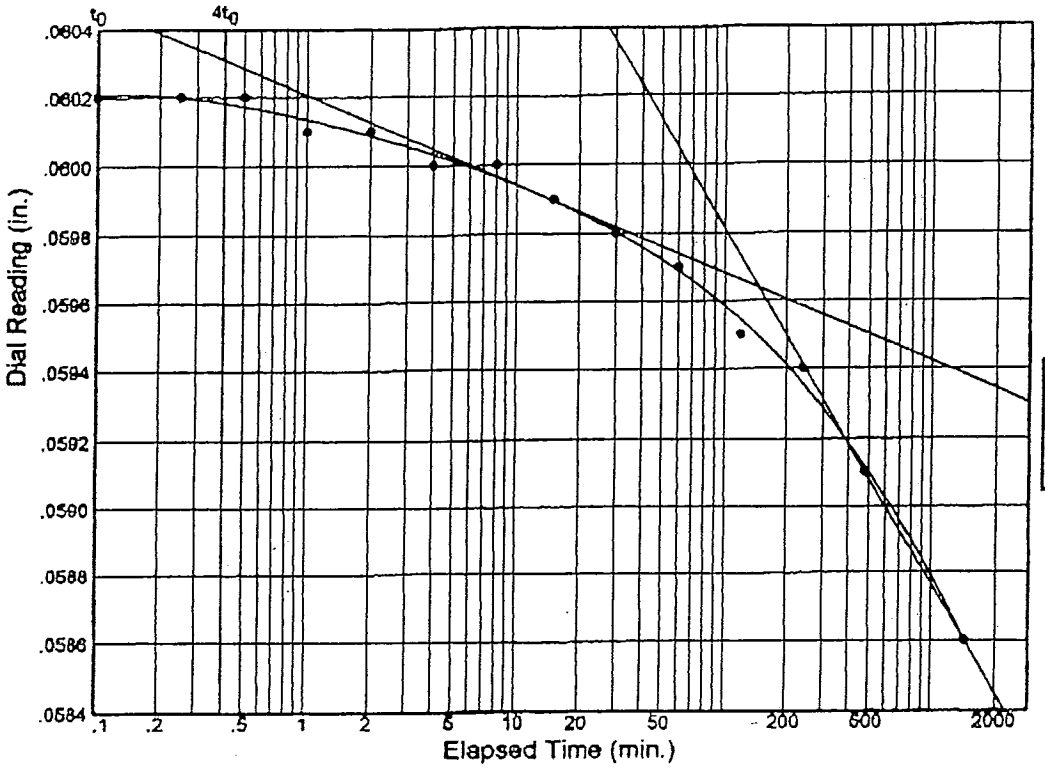


Load No.= 6
Load= 0.25 tsf
D_0 = 0.06144
D_{50} = 0.05976
D_{100} = 0.05809
T_{50} = 18.04 min.

C_v @ T_{50}
0.01 ft.^{2}/day

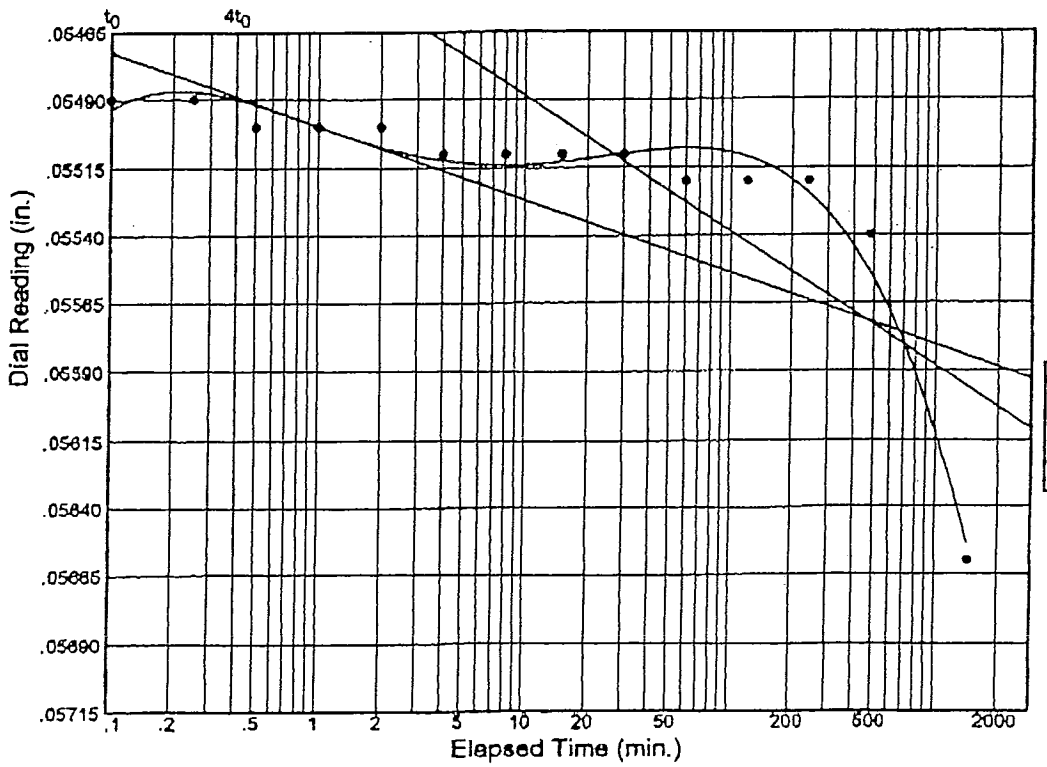
Dial Reading vs. Log of Time

Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# E-2 ID# 14703



Load No.= 7
Load= 0.13 tsf
D_0 = 0.06023
D_{50} = 0.05993
D_{100} = 0.05964
T_{50} = 10.98 min.

C_v @ T_{50}
0.02 ft.^{2}/day



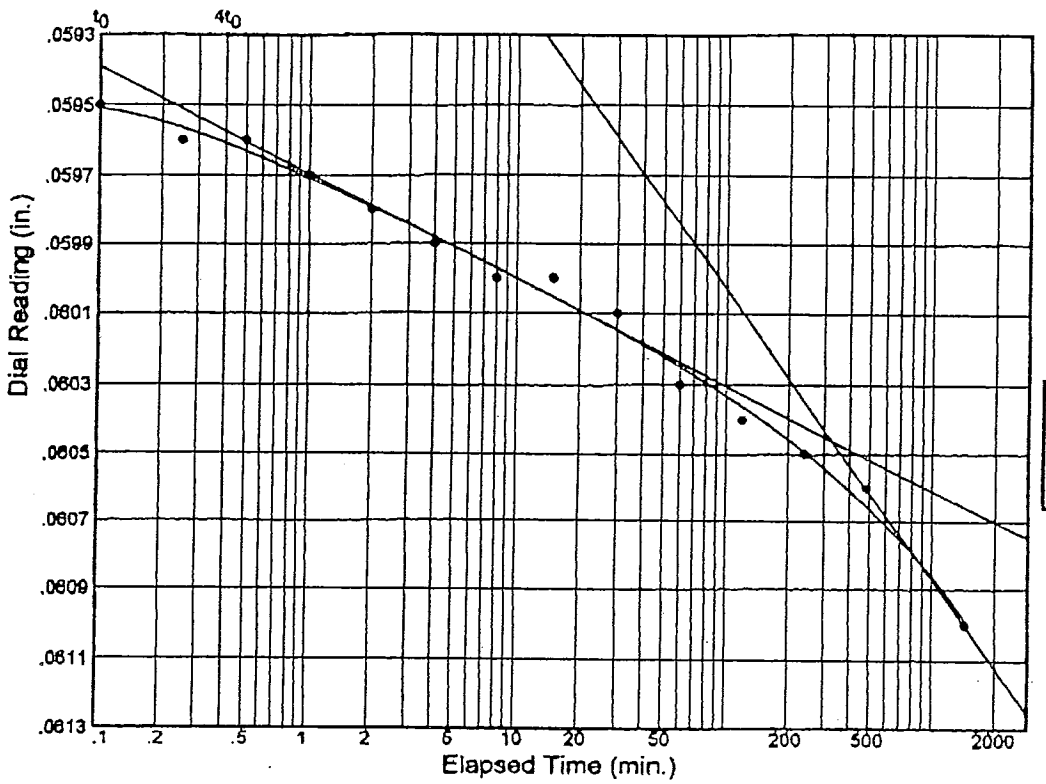
Load No.= 8
Load= 0.25 tsf
D_0 = 0.05497
D_{50} = 0.05535
D_{100} = 0.05572
T_{50} = 322.57 min.

C_v @ T_{50}
0.00 ft.^{2}/day

C_α = 0.001

Dial Reading vs. Log of Time

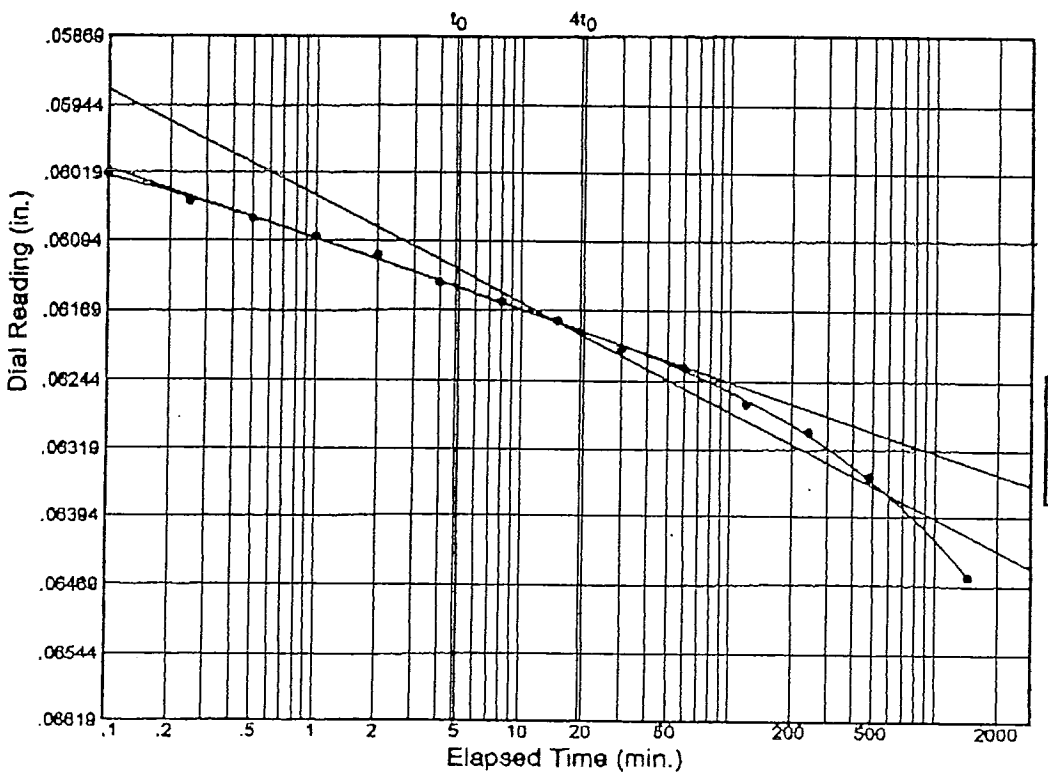
Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# E-2 ID# 14703



Load No.= 9
Load= 0.50 tsf
D_0 = 0.05941
D_{50} = 0.05994
D_{100} = 0.06046
T_{50} = 6.14 min.

C_v @ T_{50}
0.04 ft.^{2}/day

C_α = 0.001



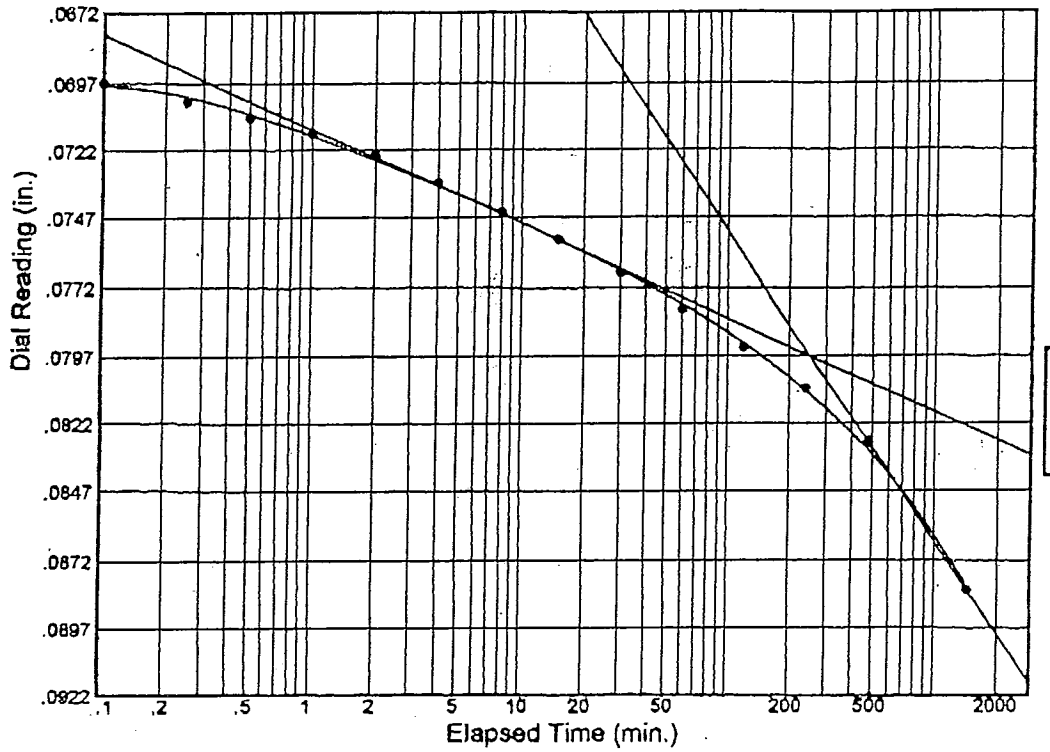
Load No.= 10
Load= 1.00 tsf
D_0 = 0.06098
D_{50} = 0.06141
D_{100} = 0.06184
T_{50} = 4.36 min.

C_v @ T_{50}
0.06 ft.^{2}/day

C_α = 0.002

Dial Reading vs. Log of Time

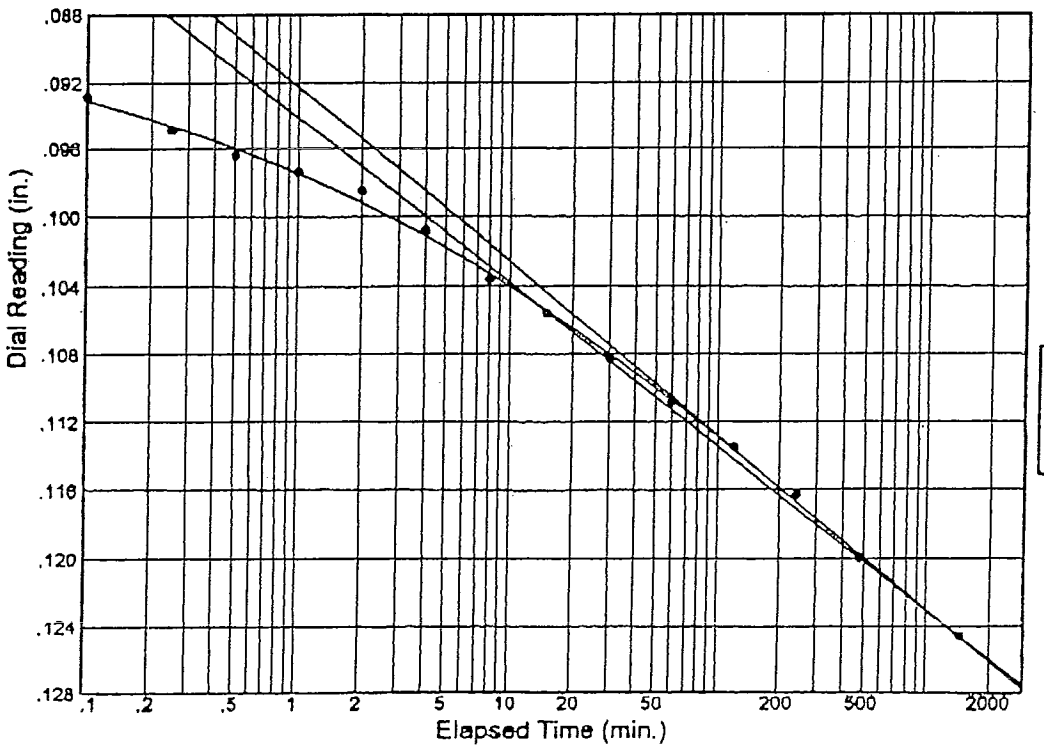
Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# E-2 ID# 14703



Load No.= 11
Load= 2.00 tsf
D_0 = 0.06460
D_{50} = 0.07216
D_{100} = 0.07972
T_{50} = 1.47 min.

C_v @ T_{50}
0.17 ft.^{2}/day

C_α = 0.016



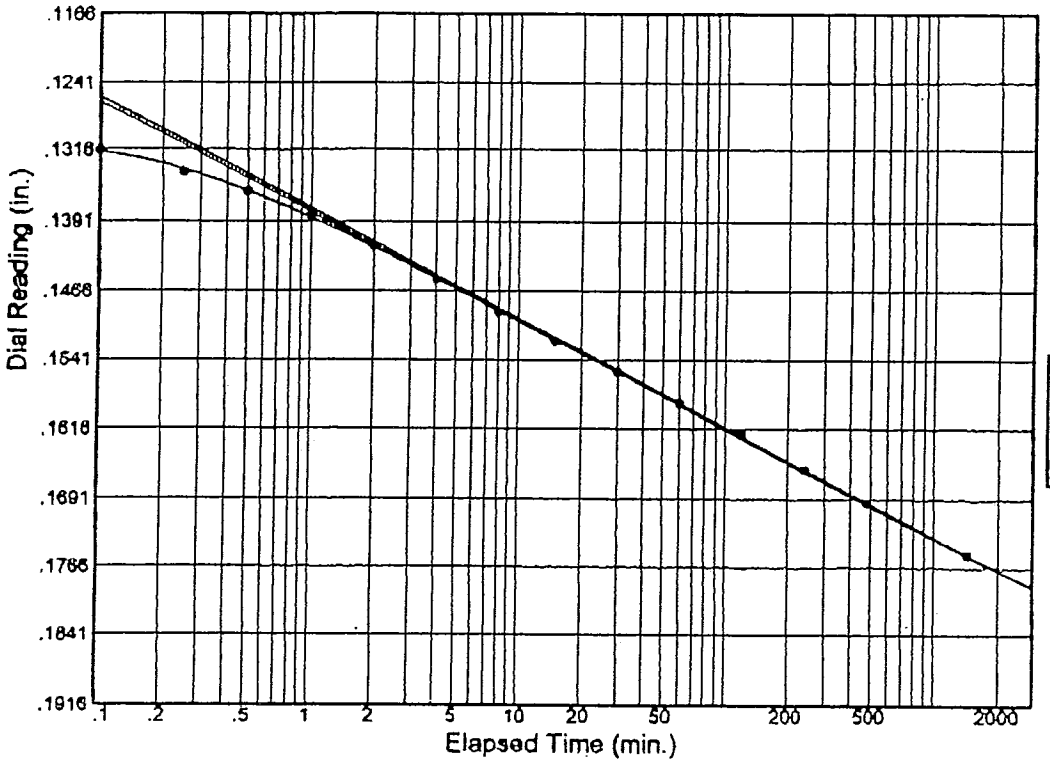
Load No.= 12
Load= 4.00 tsf
D_0 = 0.08830
D_{50} = 0.10598
D_{100} = 0.12366
T_{50} = 17.57 min.

C_v @ T_{50}
0.01 ft.^{2}/day

C_α = 0.014

Dial Reading vs. Log of Time

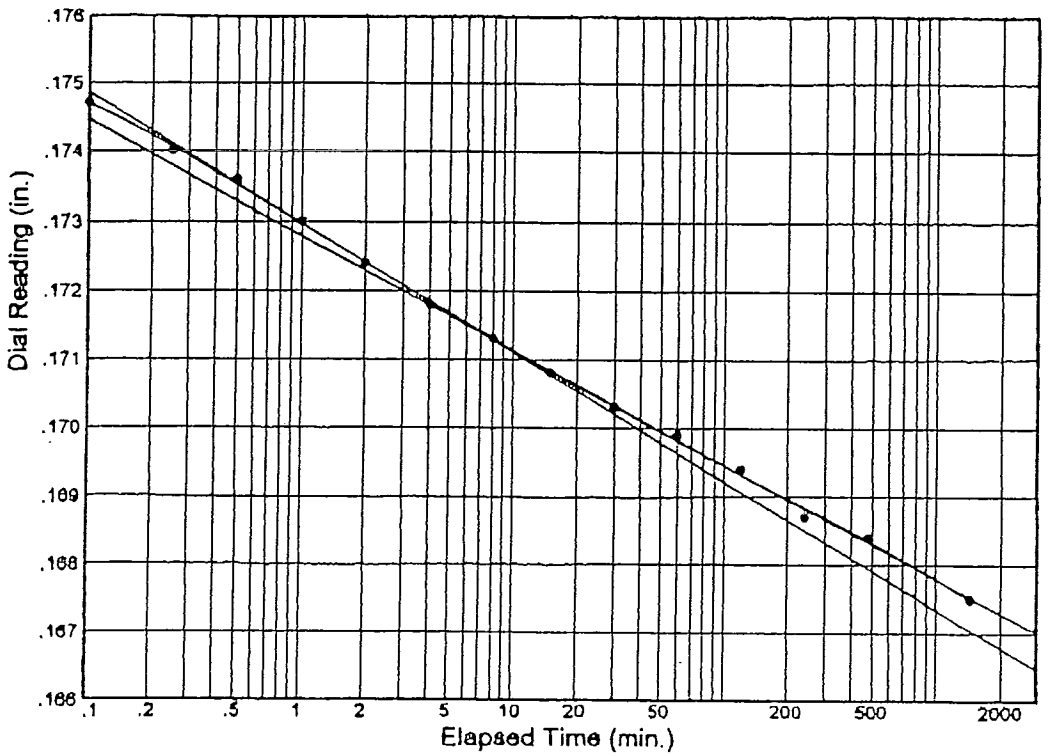
Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# E-2 ID# 14703



Load No.= 13
Load= 8.00 tsf
D_0 = 0.12460
D_{50} = 0.15433
D_{100} = 0.18405
T_{50} = 23.93 min.

C_v @ T_{50}
0.01 ft.^{2}/day

C_α = 0.018

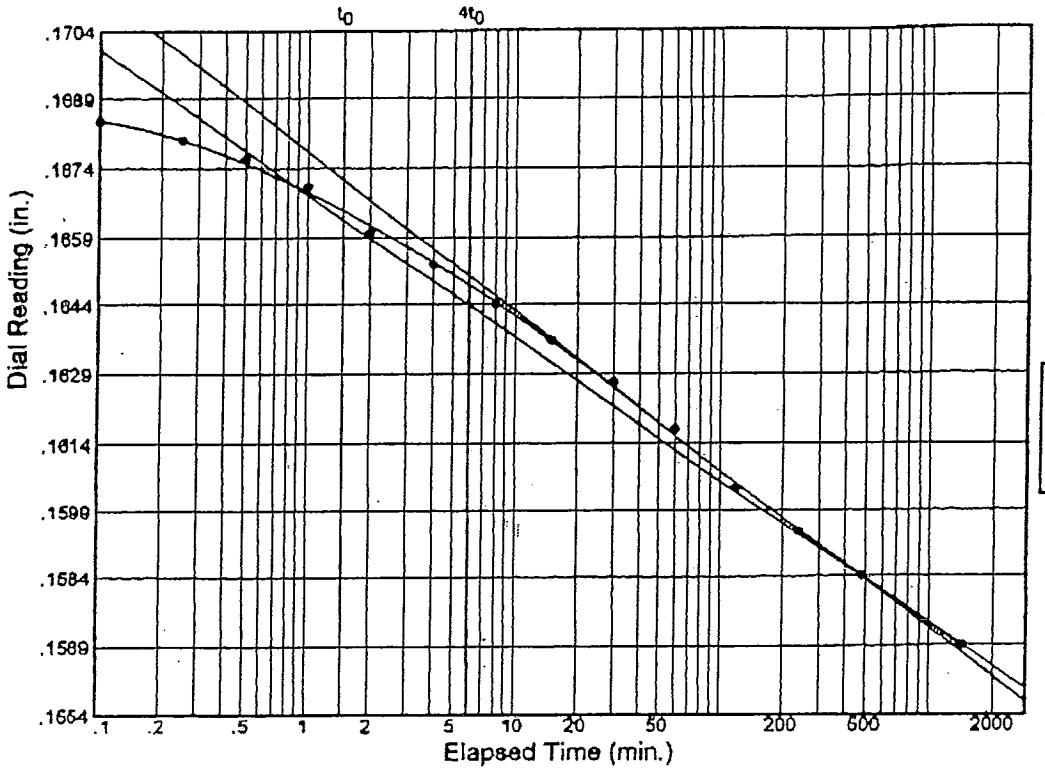


Load No.= 14
Load= 2.00 tsf
D_0 = 0.17520
D_{50} = 0.17327
D_{100} = 0.17134
T_{50} = 0.69 min.

C_v @ T_{50}
0.27 ft.^{2}/day

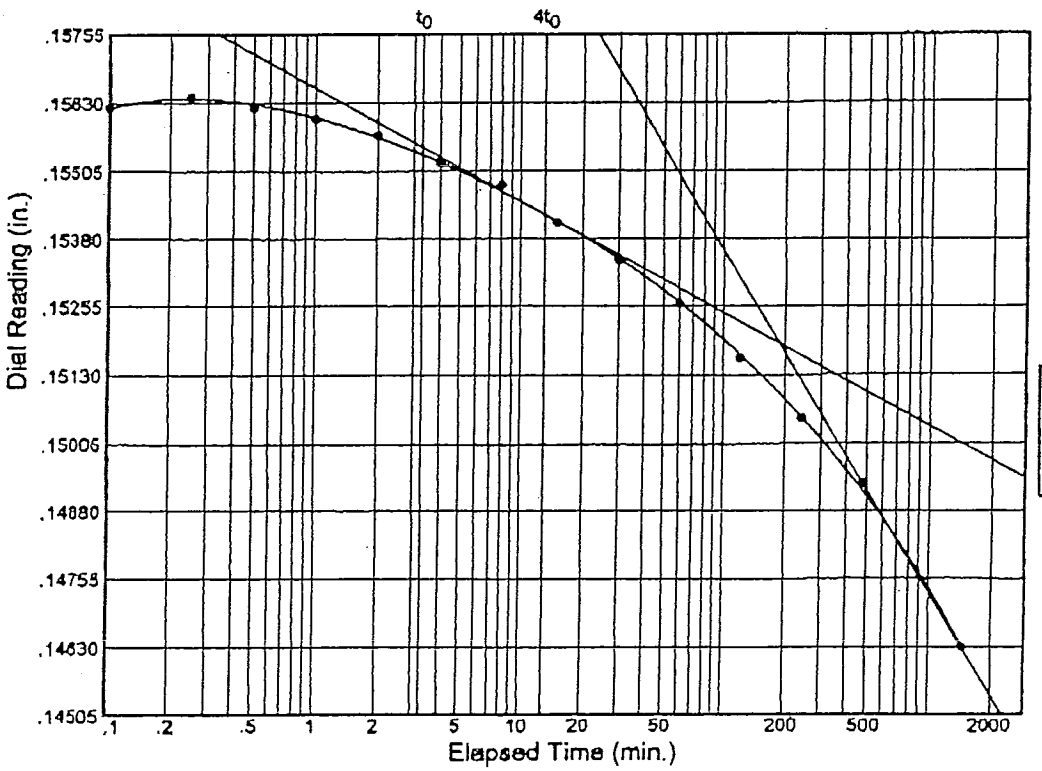
Dial Reading vs. Log of Time

Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# E-2 ID# 14703



Load No.= 15
Load= 0.50 tsf
D_0 = 0.16814
D_{50} = 0.16328
D_{100} = 0.15841
T_{50} = 18.69 min.

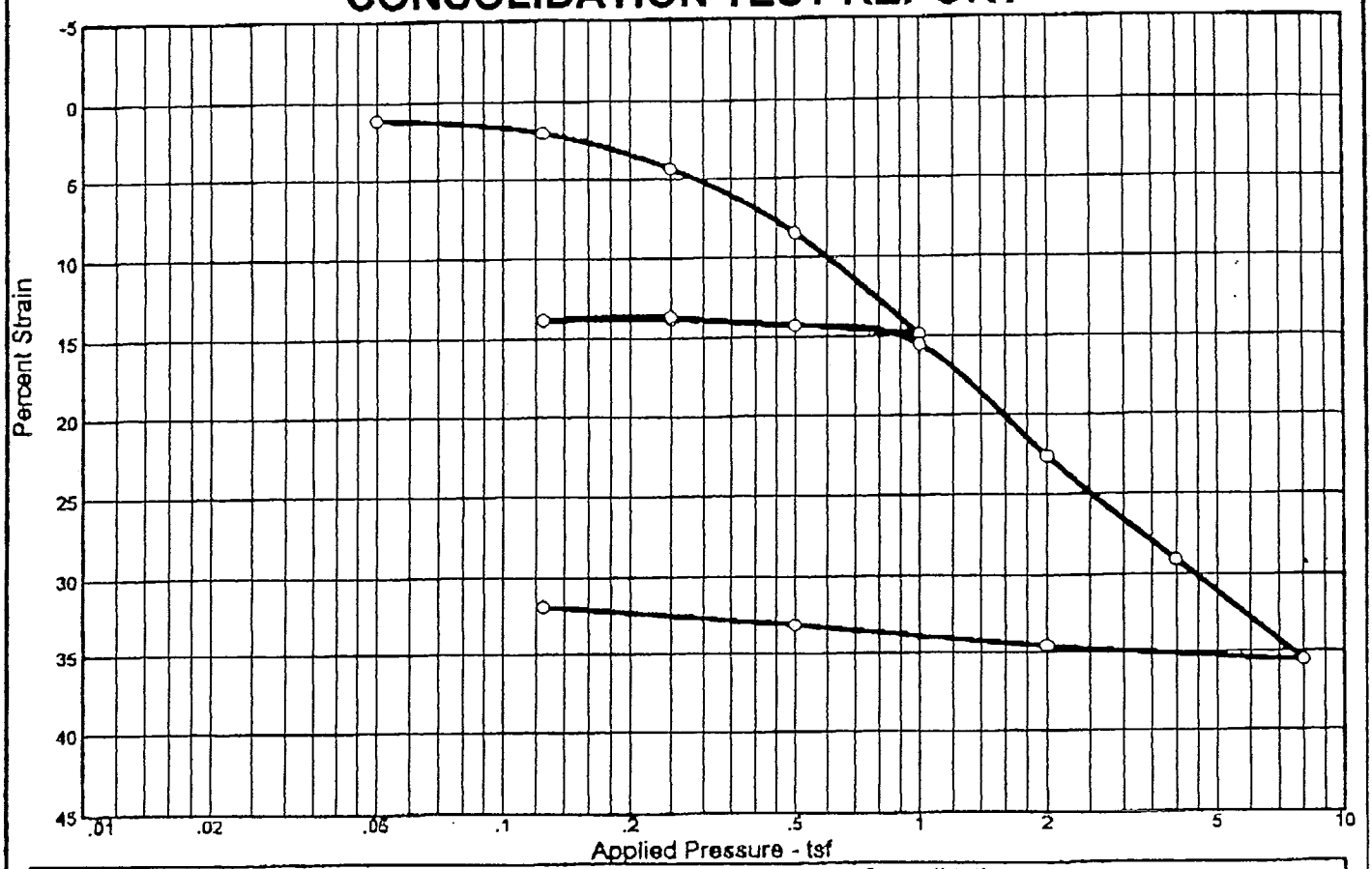
C_v @ T_{50}
0.01 ft.^{2}/day



Load No.= 16
Load= 0.13 tsf
D_0 = 0.15645
D_{50} = 0.15416
D_{100} = 0.15186
T_{50} = 14.49 min.

C_v @ T_{50}
0.01 ft.^{2}/day

CONSOLIDATION TEST REPORT



Coefficients of Consolidation and Secondary Consolidation

No.	Load (tsf)	C_v (ft.2/day)	C_α	No.	Load (tsf)	C_v (ft.2/day)	C_α	No.	Load (tsf)	C_v (ft.2/day)	C_α
1	0.05	0.02	0.003	11	2.00	0.01	0.025				
2	0.13	0.00	0.003	12	4.00	0.03	0.018				
3	0.25	0.03	0.007	13	8.00	0.04	0.018				
4	0.50	0.02	0.010	14	2.00	0.14					
5	1.00	0.02	0.013	15	0.50	0.01					
6	0.25	0.36		16	0.13	0.01					
7	0.13	0.01									
8	0.25	0.04	0.000								
9	0.50	0.57	0.001								
10	1.00	0.02	0.008								

Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	P_c (tsf)	C_c	Initial Void Ratio
Saturation	Moisture							
96.3 %	96.7 %	43.2	N/A	NON-	2.26	0.27	0.71	2.268

MATERIAL DESCRIPTION	USCS	AASHTO
White/grey moist fibrous material(paper residue)	OL	

Project No. L-01041 **Client:** BLASLAND BOUCK & LEE

Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN

Location: BORING# D-1 ID# 14702

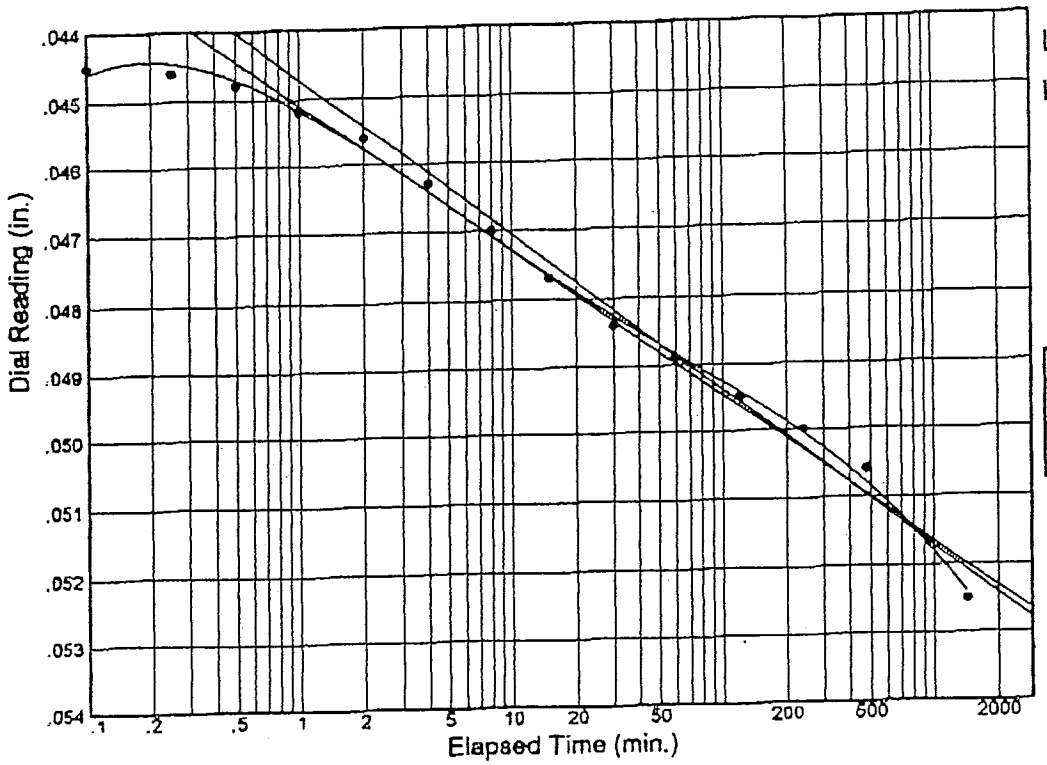
Remarks:

CONSOLIDATION TEST REPORT

PW LABORATORIES. INC.

Dial Reading vs. Log of Time

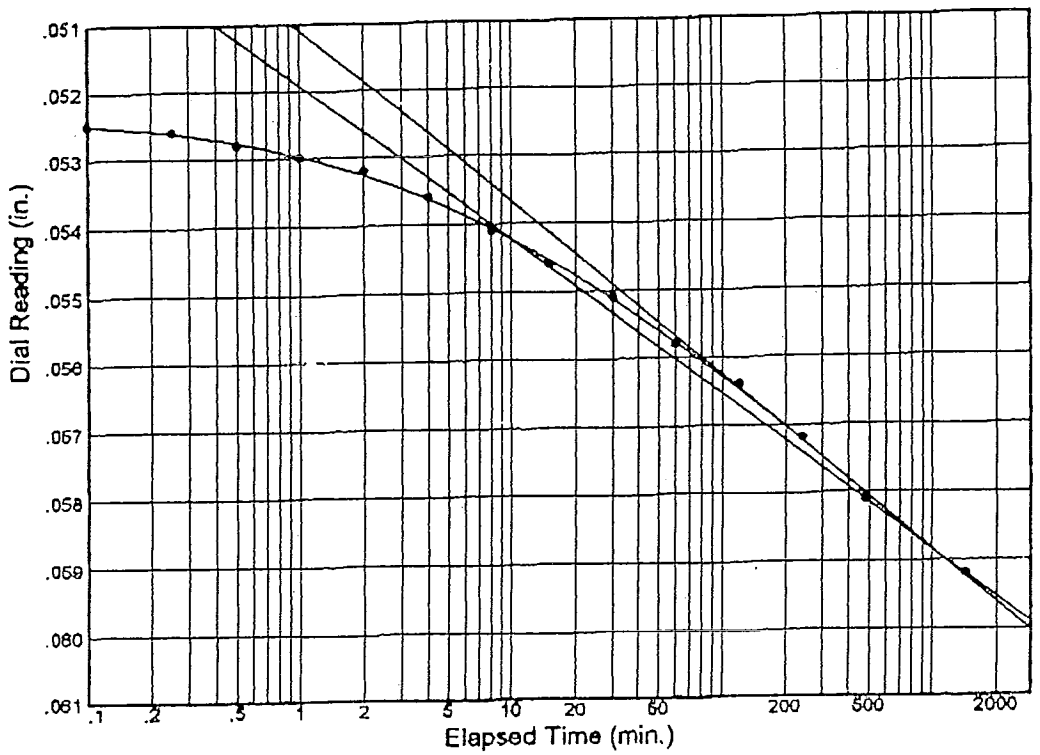
Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# D-1 ID# 14702



Load No.= 1
Load= 0.05 tsf
D_0 = 0.04410
D_{50} = 0.04742
D_{100} = 0.05074
T_{50} = 11.66 min.

C_v @ T_{50}
0.02 ft.^{2}/day

C_α = 0.003



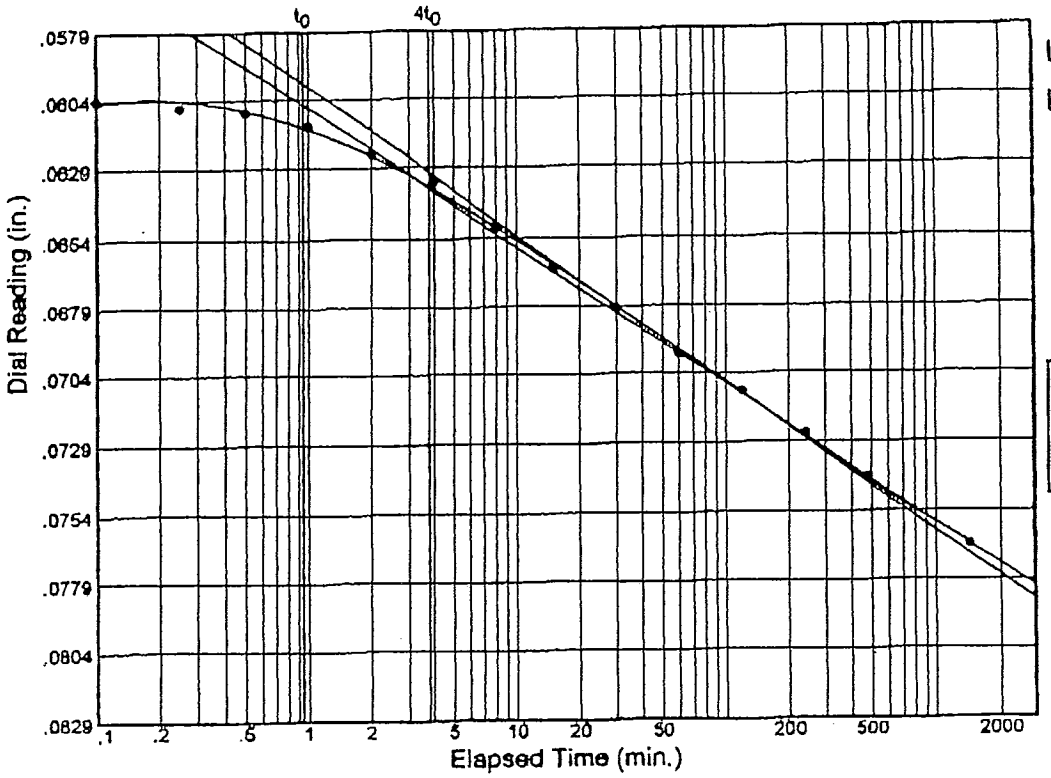
Load No.= 2
Load= 0.13 tsf
D_0 = 0.05250
D_{50} = 0.05569
D_{100} = 0.05888
T_{50} = 54.89 min.

C_v @ T_{50}
0.00 ft.^{2}/day

C_α = 0.003

Dial Reading vs. Log of Time

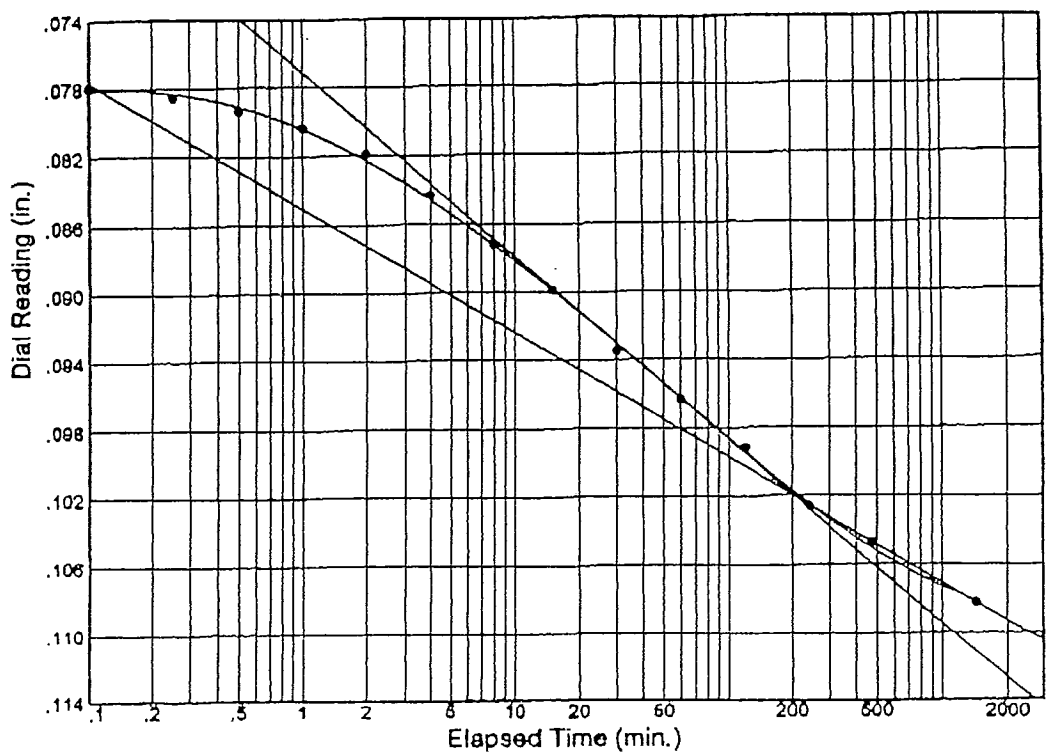
Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# D-1 ID# 14702



Load No.= 3
Load= 0.25 tsf
D_0 = 0.05933
D_{50} = 0.06545
D_{100} = 0.07157
T_{50} = 9.89 min.

C_v @ T_{50}
0.03 ft.^{2}/day

C_α = 0.007



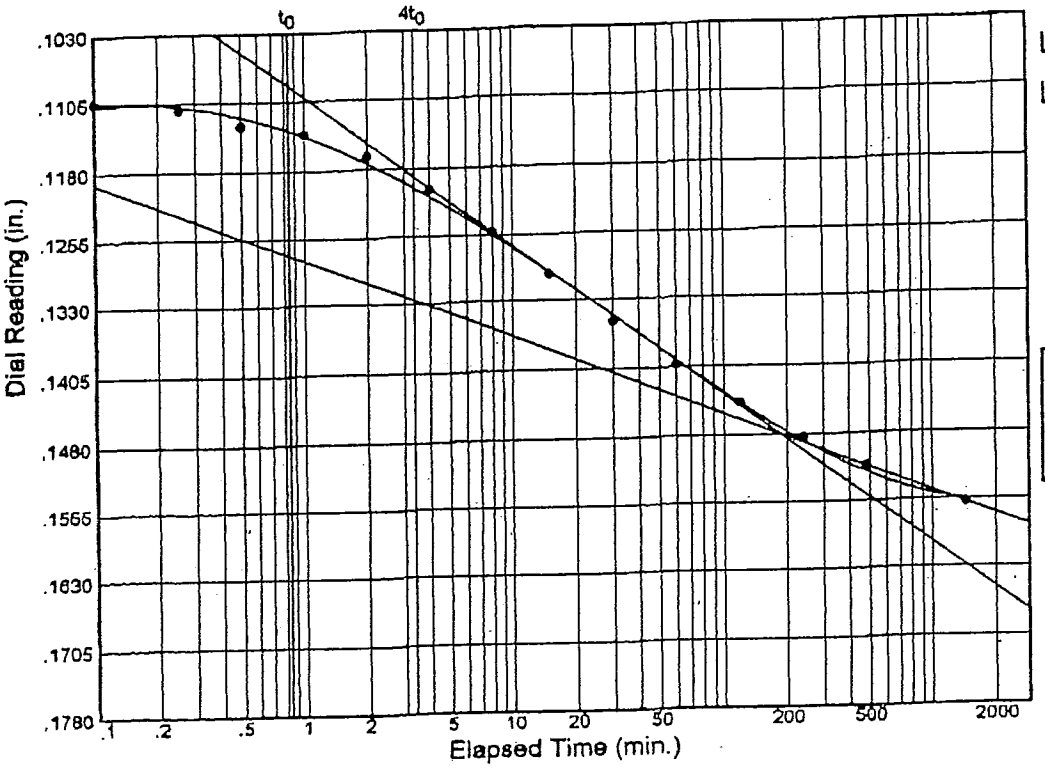
Load No.= 4
Load= 0.50 tsf
D_0 = 0.07660
D_{50} = 0.08928
D_{100} = 0.10197
T_{50} = 13.07 min.

C_v @ T_{50}
0.02 ft.^{2}/day

C_α = 0.010

Dial Reading vs. Log of Time

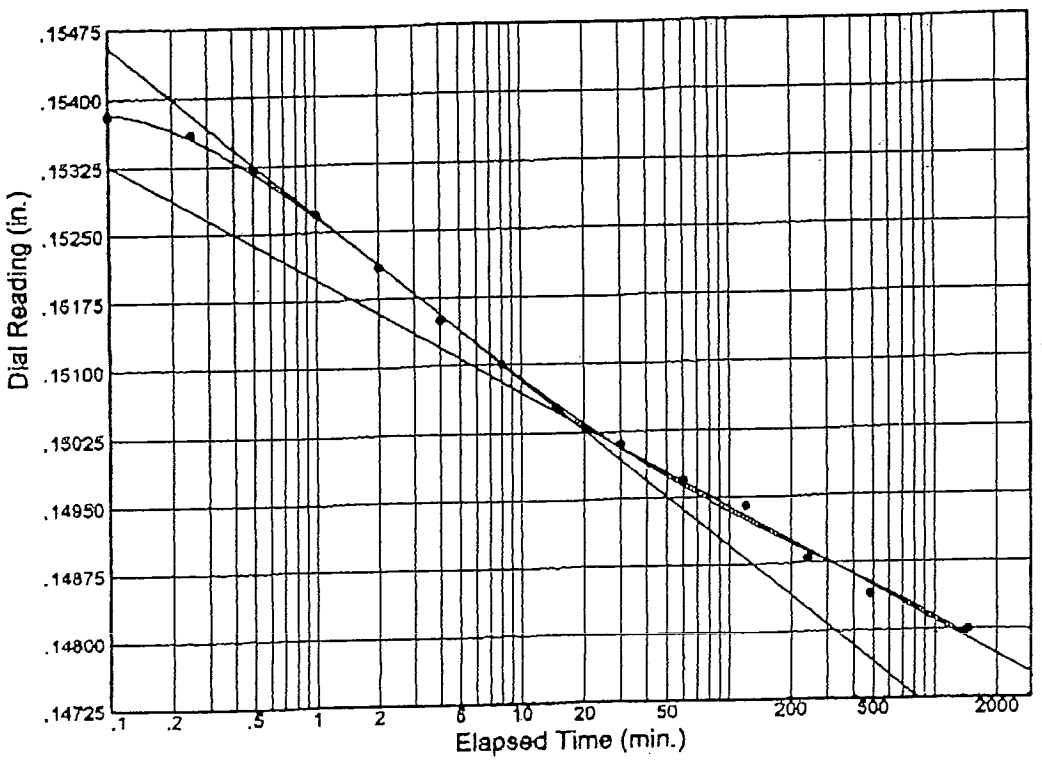
Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# D-1 ID# 14702



Load No.= 5
Load= 1.00 tsf
D_0 = 0.10724
D_{50} = 0.12761
D_{100} = 0.14799
T_{50} = 11.02 min.

C_v @ T_{50}
0.02 ft.^{2}/day

C_α = 0.013

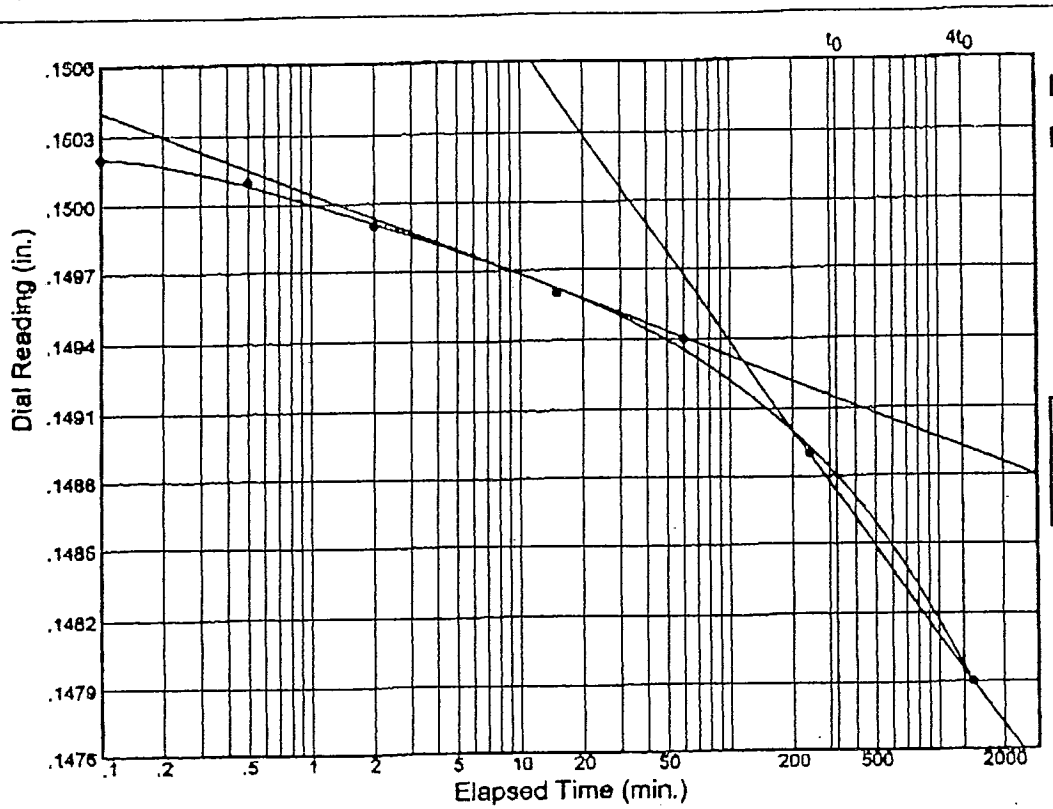


Load No.= 6
Load= 0.25 tsf
D_0 = 0.15580
D_{50} = 0.15309
D_{100} = 0.15037
T_{50} = 0.56 min.

C_v @ T_{50}
0.36 ft.^{2}/day

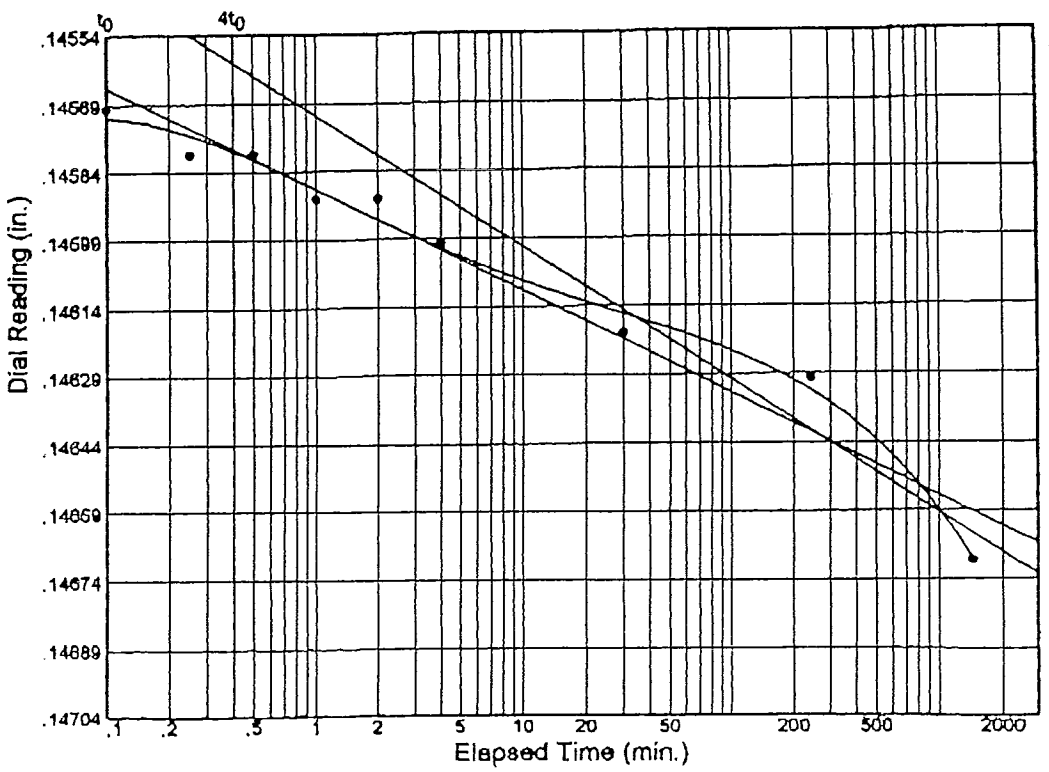
Dial Reading vs. Log of Time

Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# D-1 ID# 14702



Load No.= 7
Load= 0.13 tsf
D_0 = 0.14963
D_{50} = 0.14946
D_{100} = 0.14930
T_{50} = 36.09 min.

C_v @ T_{50}
0.01 ft.^{2}/day



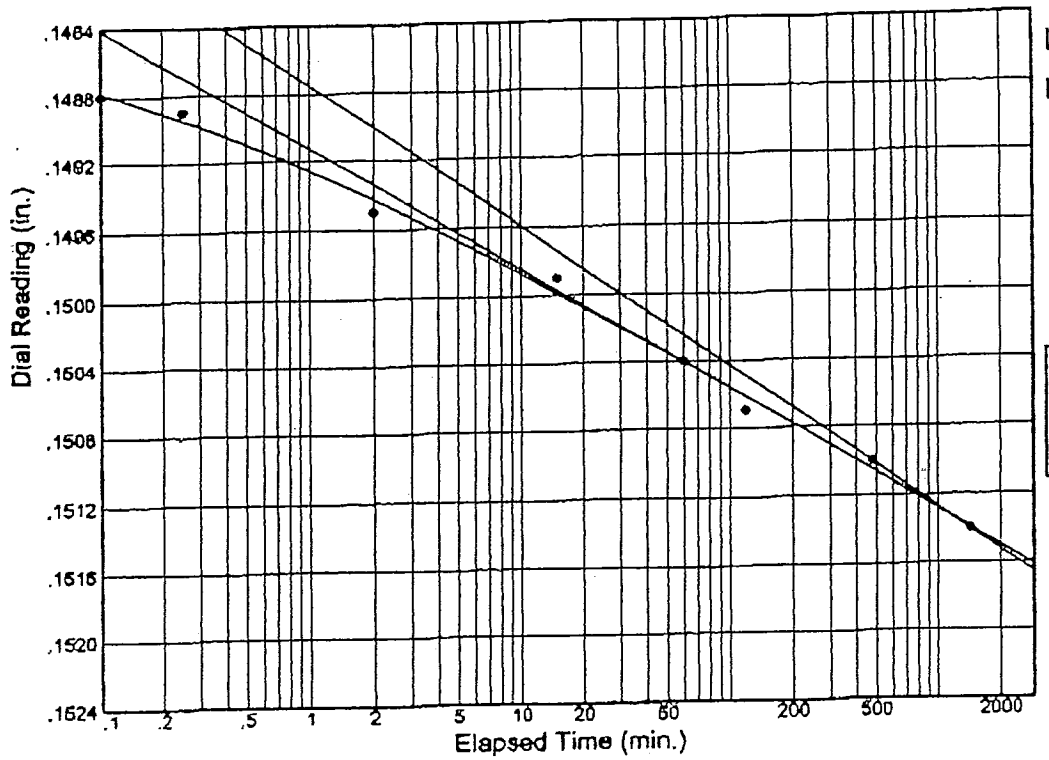
Load No.= 8
Load= 0.25 tsf
D_0 = 0.14564
D_{50} = 0.14604
D_{100} = 0.14643
T_{50} = 5.52 min.

C_v @ T_{50}
0.04 ft.^{2}/day

C_α = 0.000

Dial Reading vs. Log of Time

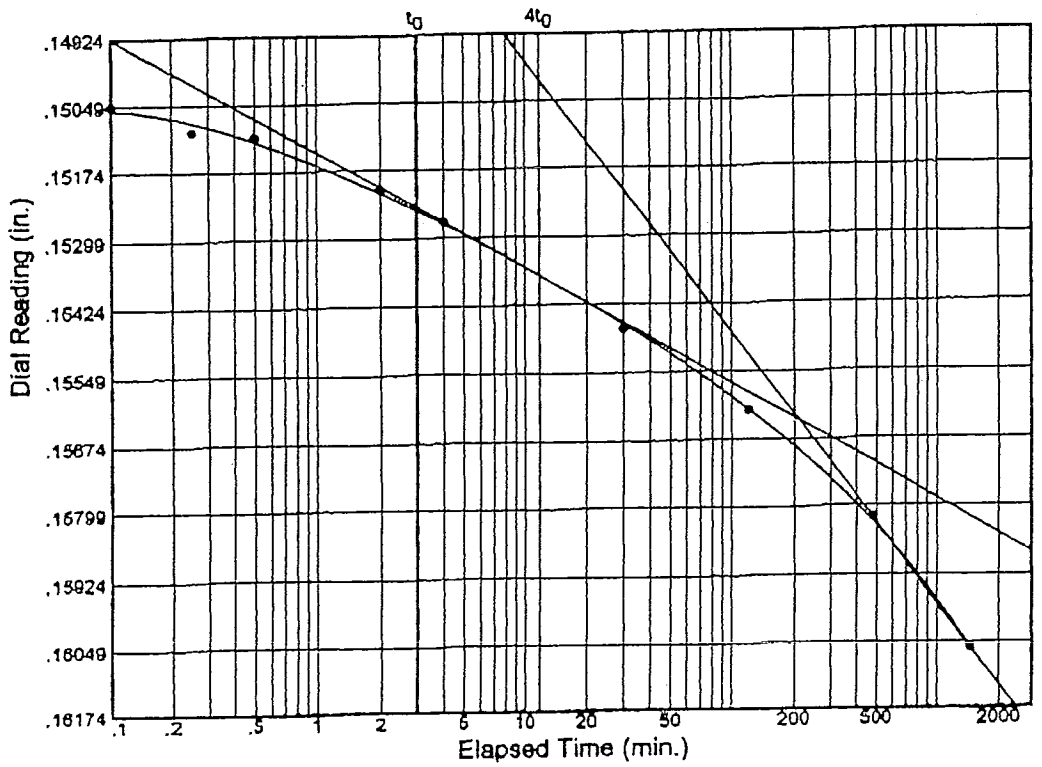
Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# D-1 ID# 14702



Load No.= 9
Load= 0.50 tsf
D_0 = 0.14670
D_{50} = 0.14902
D_{100} = 0.15135
T_{50} = 0.36 min.

C_v @ T_{50}
0.57 ft.^{2}/day

C_α = 0.001



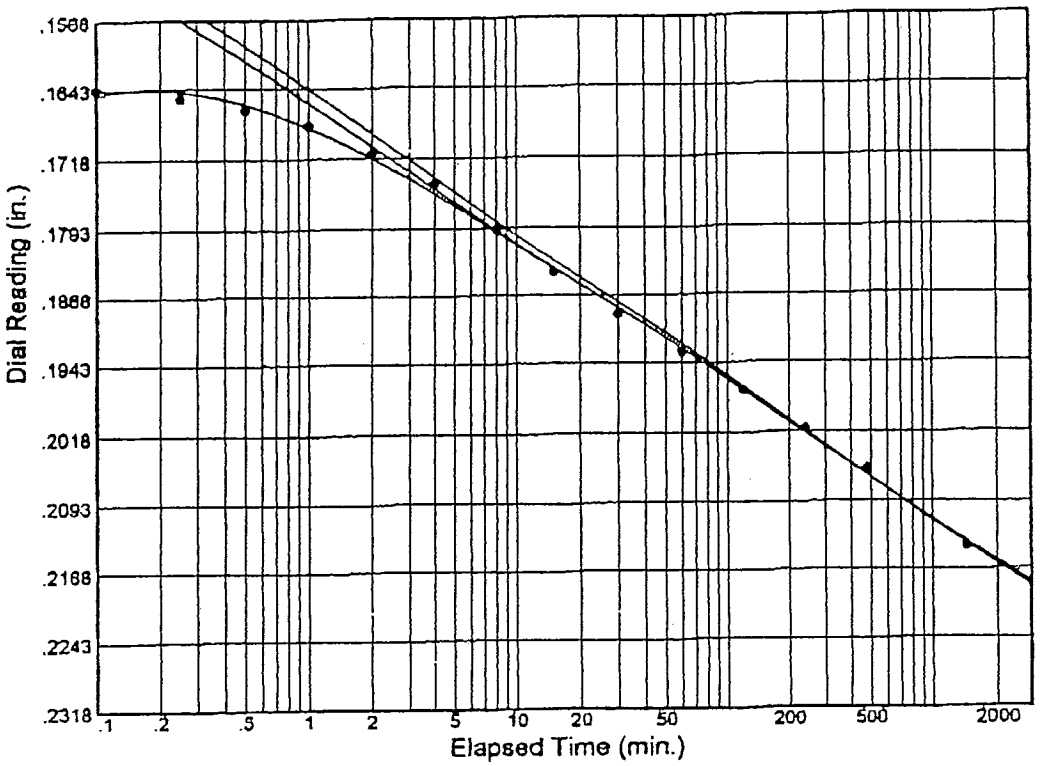
Load No.= 10
Load= 1.00 tsf
D_0 = 0.15125
D_{50} = 0.15382
D_{100} = 0.15639
T_{50} = 13.43 min.

C_v @ T_{50}
0.02 ft.^{2}/day

C_α = 0.008

Dial Reading vs. Log of Time

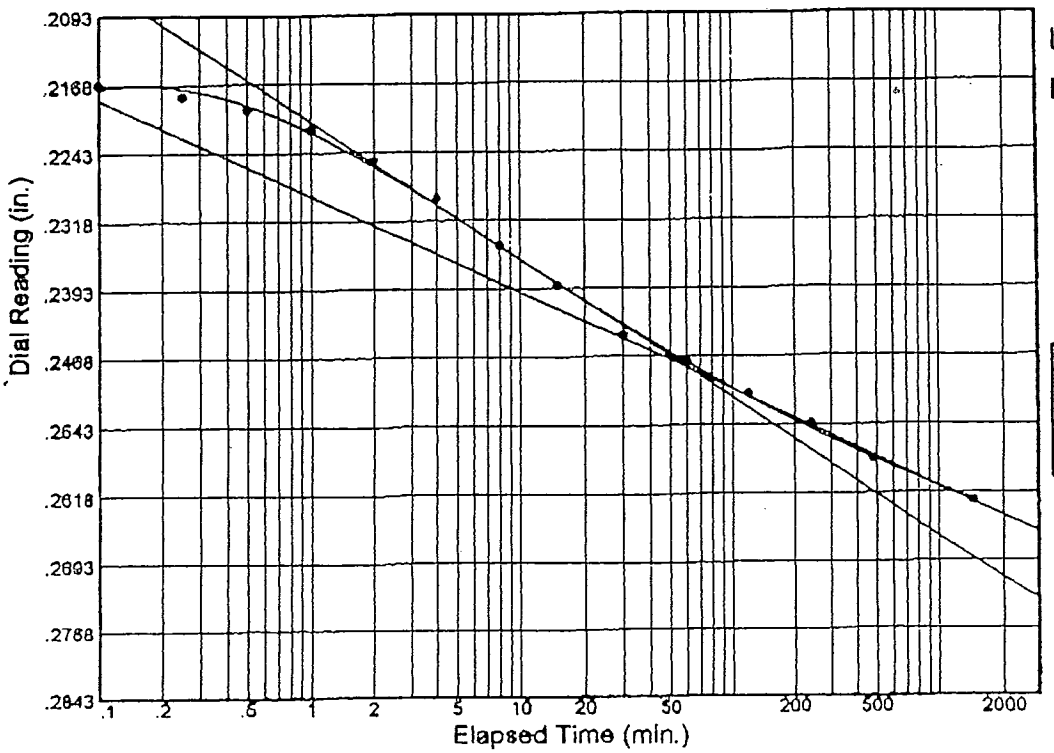
Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# D-1 ID# 14702



Load No.= 11
Load= 2.00 tsf
D_0 = 0.16060
D_{50} = 0.18399
D_{100} = 0.20739
T_{50} = 15.64 min.

C_v @ T_{50}
0.01 ft.^{2}/day

C_α = 0.025



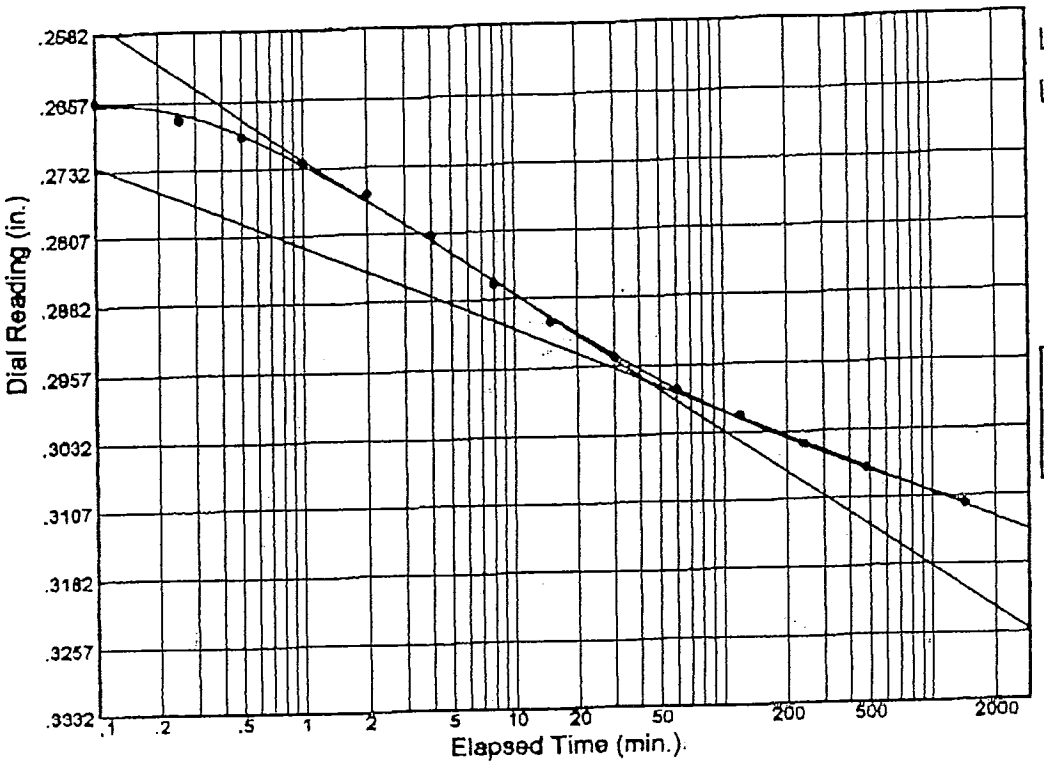
Load No.= 12
Load= 4.00 tsf
D_0 = 0.21430
D_{50} = 0.23128
D_{100} = 0.24826
T_{50} = 4.79 min.

C_v @ T_{50}
0.03 ft.^{2}/day

C_α = 0.018

Dial Reading vs. Log of Time

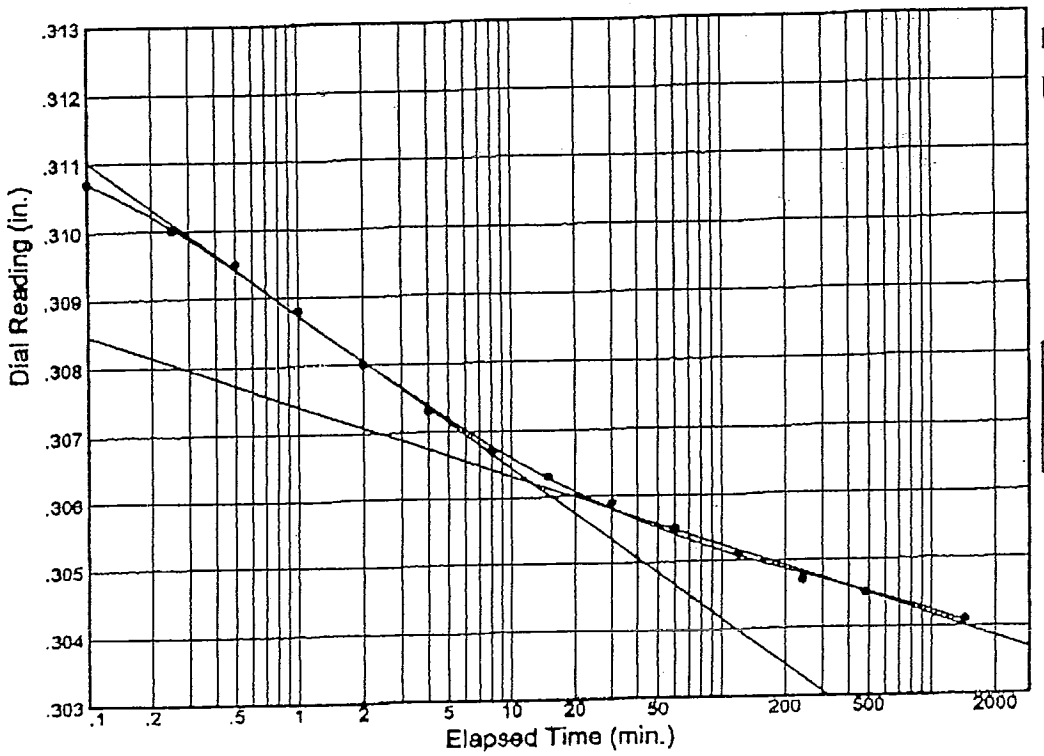
Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# D-1 ID# 14702



Load No.= 13
Load= 8.00 tsf
D_0 = 0.26260
D_{50} = 0.28002
D_{100} = 0.29745
T_{50} = 3.19 min.

C_v @ T_{50}
0.04 ft.^{2}/day

C_α = 0.018

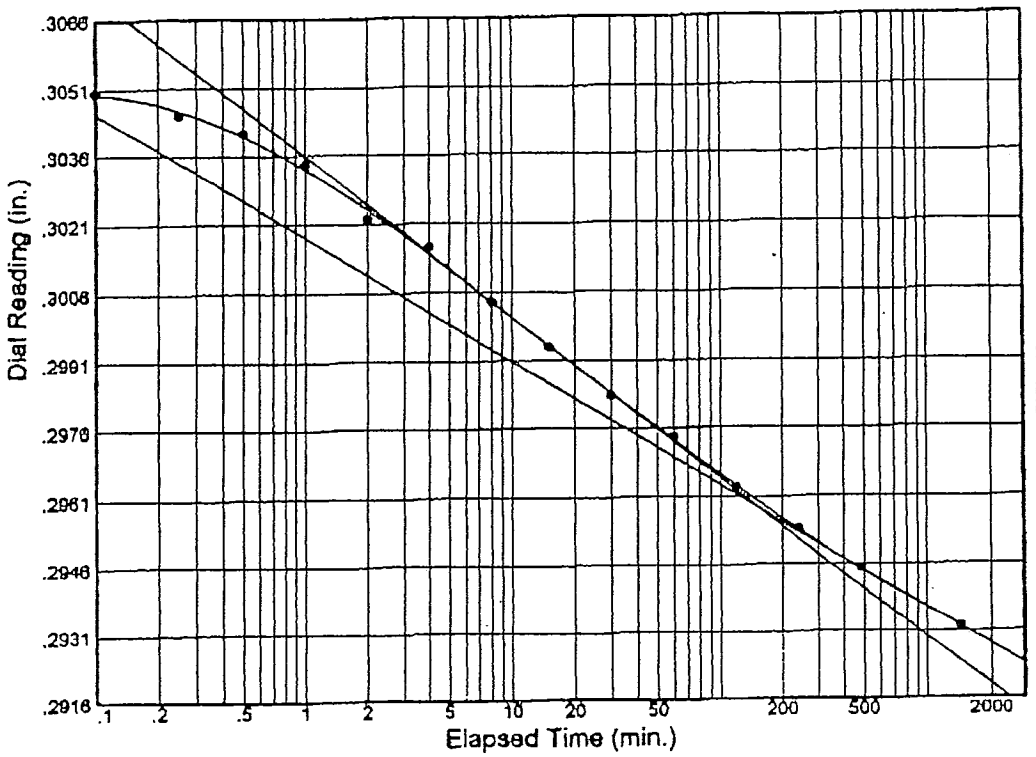


Load No.= 14
Load= 2.00 tsf
D_0 = 0.31160
D_{50} = 0.30891
D_{100} = 0.30621
T_{50} = 0.84 min.

C_v @ T_{50}
0.14 ft.^{2}/day

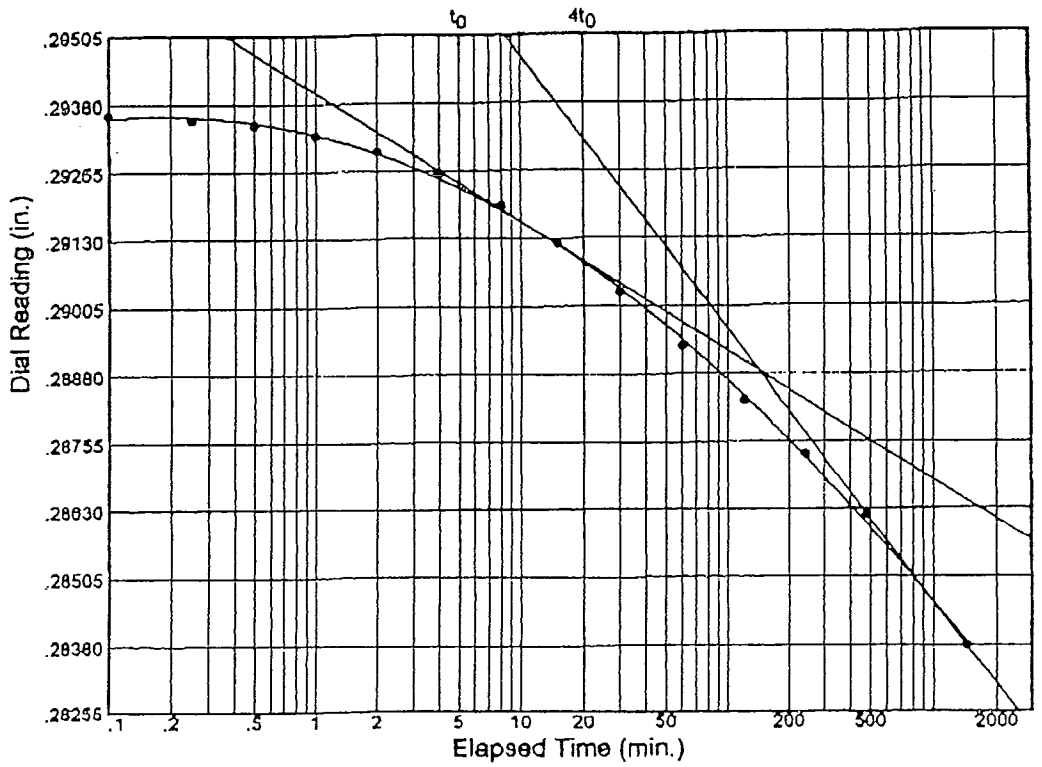
Dial Reading vs. Log of Time

Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# D-1 ID# 14702



Load No.= 15
Load= 0.50 tsf
D_0 = 0.30410
D_{50} = 0.29996
D_{100} = 0.29581
T_{50} = 10.67 min.

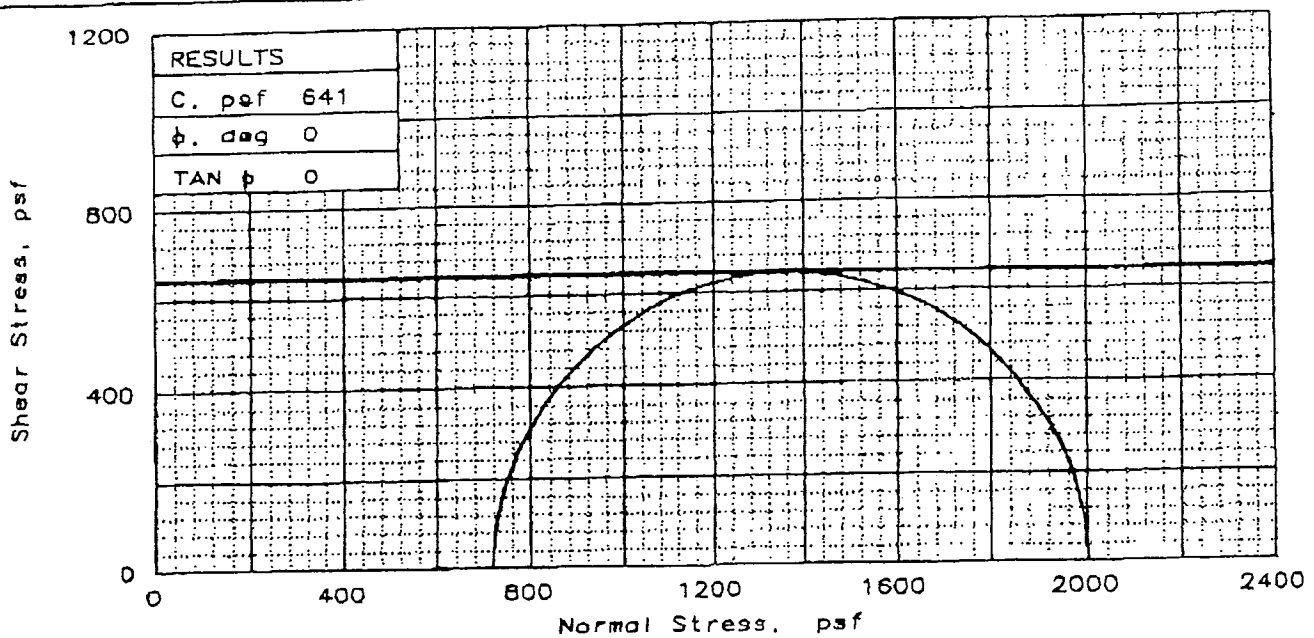
C_v @ T_{50}
0.01 ft.^{2}/day

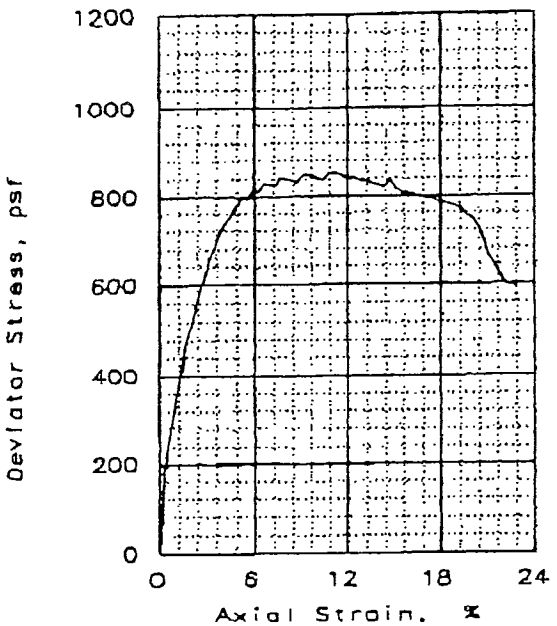


Load No.= 16
Load= 0.13 tsf
D_0 = 0.29360
D_{50} = 0.29122
D_{100} = 0.28885
T_{50} = 14.38 min.

C_v @ T_{50}
0.01 ft.^{2}/day

PW LABORATORIES, INC





SAMPLE NO.		1
INITIAL	WATER CONTENT, %	45.0
	DRY DENSITY, pcf	62.9
	SATURATION, %	73.1
	VOID RATIO	1.631
	DIAMETER, in	2.80
	HEIGHT, in	5.70
AT TEST	WATER CONTENT, %	45.0
	DRY DENSITY, pcf	62.9
	SATURATION, %	73.1
	VOID RATIO	1.631
	DIAMETER, in	2.80
	HEIGHT, in	5.70
Strain rate, in/min		0.050
BACK PRESSURE, psf		0
CELL PRESSURE, psf		720
FAILURE STRESS, psf		1282
PORE PRESSURE, psf		
ULTIMATE STRESS, psf		596
PORE PRESSURE, psf		
σ_1 FAILURE, psf		2002
σ_3 FAILURE, psf		720

TYPE OF TEST:
Unconsolidated undrained
SAMPLE TYPE: TUBE SAMPLE
DESCRIPTION: SAMPLE D-1 (4'-6')

LL= PL= PI=
SPECIFIC GRAVITY= 2.65
REMARKS:

CLIENT: PW LABORATORIES

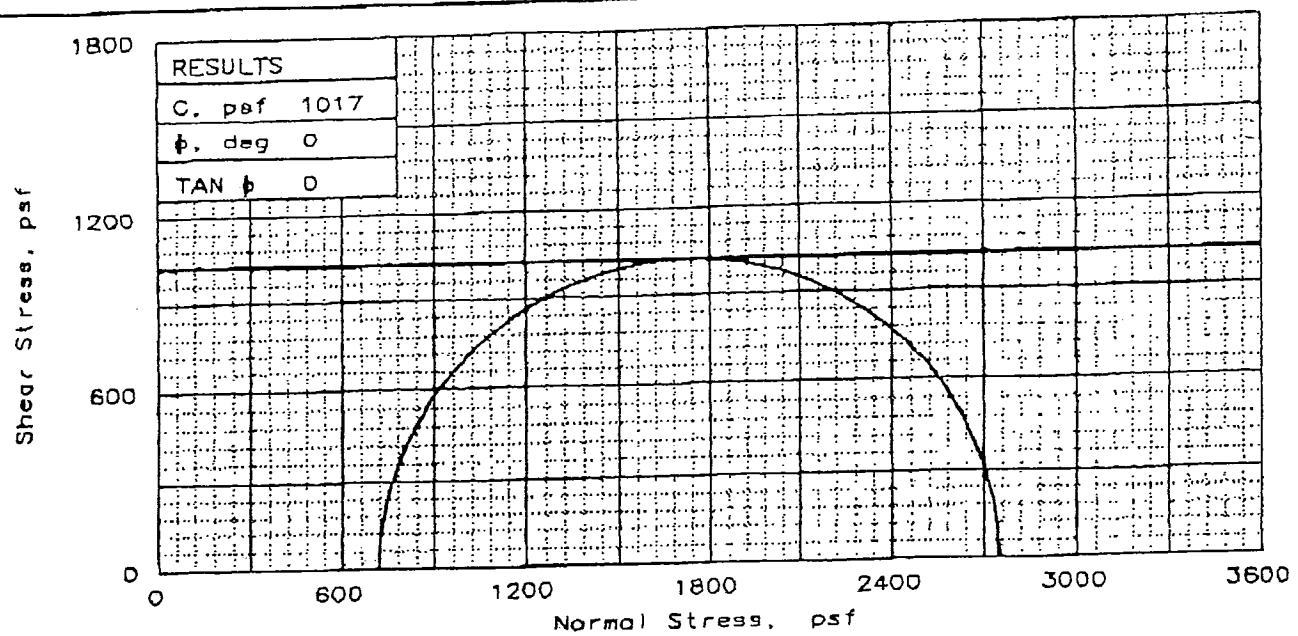
PROJECT: 12 STREET LANDFILL
PROJECT No. L-01041; LAB I.D. No. 14702
SAMPLE LOCATION: KALAMAZOO, MICHICAN

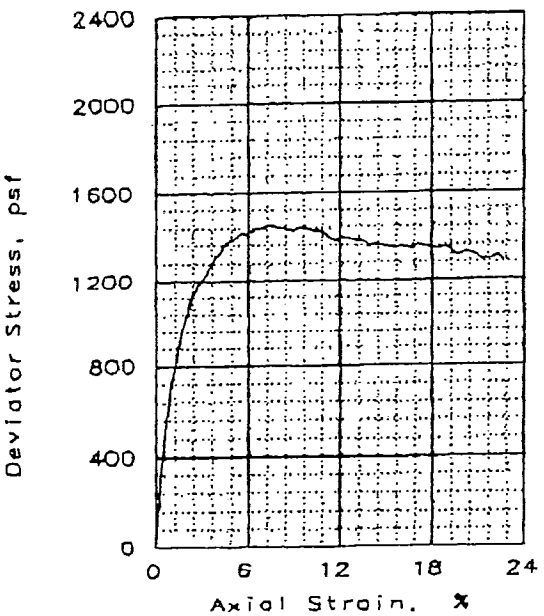
PROJ. NO.: 01S2663-02 DATE: 5/3/01

TRIAXIAL SHEAR TEST REPORT

J & L TESTING CO., INC.

FIG. NO. 1





SAMPLE NO.		1
INITIAL	WATER CONTENT, %	30.5
	DRY DENSITY, pcf	82.2
	SATURATION, %	79.9
	VOID RATIO	1.012
	DIAMETER, in	2.80
	HEIGHT, in	5.75
AT TEST	WATER CONTENT, %	30.5
	DRY DENSITY, pcf	82.2
	SATURATION, %	79.9
	VOID RATIO	1.012
	DIAMETER, in	2.80
	HEIGHT, in	5.75
Strain rate, in/min		0.050
BACK PRESSURE, psf		0
CELL PRESSURE, psf		720
FAILURE STRESS, psf		2034
PORE PRESSURE, psf		
ULTIMATE STRESS, psf		1285
PORE PRESSURE, psf		
σ_1 FAILURE, psf		2754
σ_3 FAILURE, psf		720

TYPE OF TEST:
Unconsolidated undrained
SAMPLE TYPE: TUBE SAMPLE
DESCRIPTION: SAMPLE E-2 (8'-8')

LL= PL= PI=
SPECIFIC GRAVITY= 2.65
REMARKS:

CLIENT: PW LABORATORIES

PROJECT: 12 STREET LANDFILL
PROJECT No. L-01041; LAB I.D. No. 14703
SAMPLE LOCATION: KALAMAZOO, MICHIGAN

PROJ. NO.: 01S2663-02 DATE: 5/3/01

TRIAXIAL SHEAR TEST REPORT

J & L TESTING CO., INC.

FIG. NO. 1

p-w labs

PW LABORATORIES,INC.
P.O. BOX 56, 5879 FISHER ROAD, EAST SYRACUSE, NY 13057
315-437-1429 • 800-782-7260 • Fax 315-437-1770

June 4, 2001

Ms. Laura Brussel
Blasland, Bouck & Lee, Inc.
6723 Towpath Road
P.O. Box 66
Syracuse, New York 13214-0066

Re: L-01041
12th Street Landfill
Kalamazoo, Michigan
Project #64590

Dear Ms. Brussel:

Enclosed are the results of laboratory testing performed at your request on two Shelby tube material samples delivered to our laboratory on April 9, 2001 for the above referenced project. Results include:

1. Consolidation Test ASTM D2435 — 2 each
   Laboratory I.D. #'s 14702, 14703

Additional reports will be forwarded to you as they are completed.

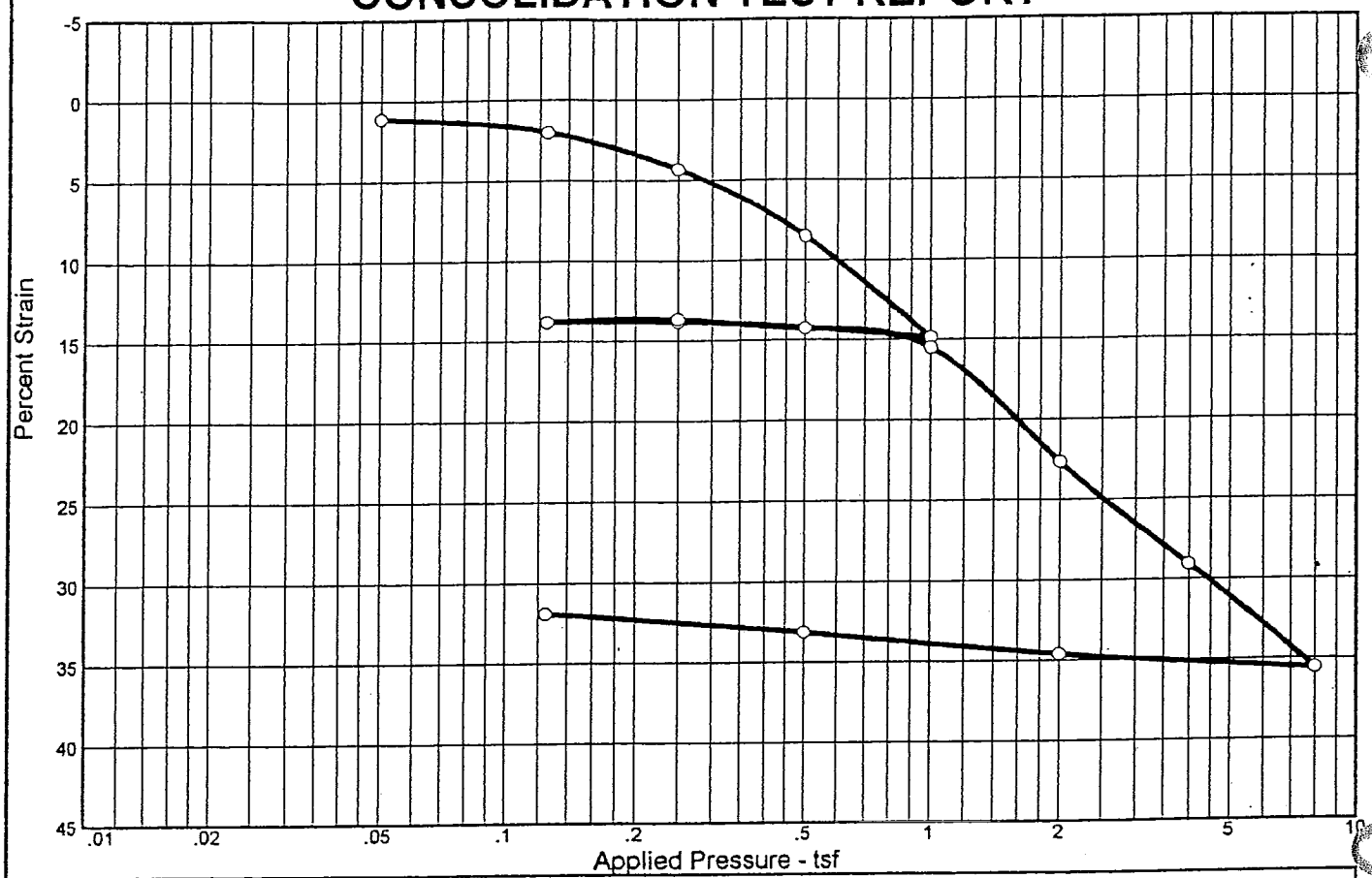
Thank you for this opportunity to work with you.

Very truly yours,

PW LABORATORIES, INC.

Donald P. Blasland, SET
V.P. - Laboratory & Field Services
DPB/bap
encs:

CONSOLIDATION TEST REPORT



Coefficients of Consolidation and Secondary Consolidation

No.	Load (tsf)	C_v (ft.2/day)	C_α	No.	Load (tsf)	C_v (ft.2/day)	C_α	No.	Load (tsf)	C_v (ft.2/day)	C_α
1	0.05	0.02	0.003	11	2.00	0.01	0.025				
2	0.13	0.00	0.003	12	4.00	0.03	0.018				
3	0.25	0.03	0.007	13	8.00	0.04	0.018				
4	0.50	0.02	0.010	14	2.00	0.14					
5	1.00	0.02	0.013	15	0.50	0.01					
6	0.25	0.36		16	0.13	0.01					
7	0.13	0.01									
8	0.25	0.04	0.000								
9	0.50	0.57	0.001								
10	1.00	0.02	0.008								

Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	P_c (tsf)	C_c	Initial Void Ratio
Saturation	Moisture							
96.3 %	96.7 %	43.2	N/A	NON-	2.26	0.27	0.71	2.268

MATERIAL DESCRIPTION	USCS	AASHTO
White/grey moist fibrous material(paper residue)	OL	

Project No. L-01041 **Client:** BLASLAND BOUCK & LEE

Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN

Location: BORING# D-1 ID# 14702

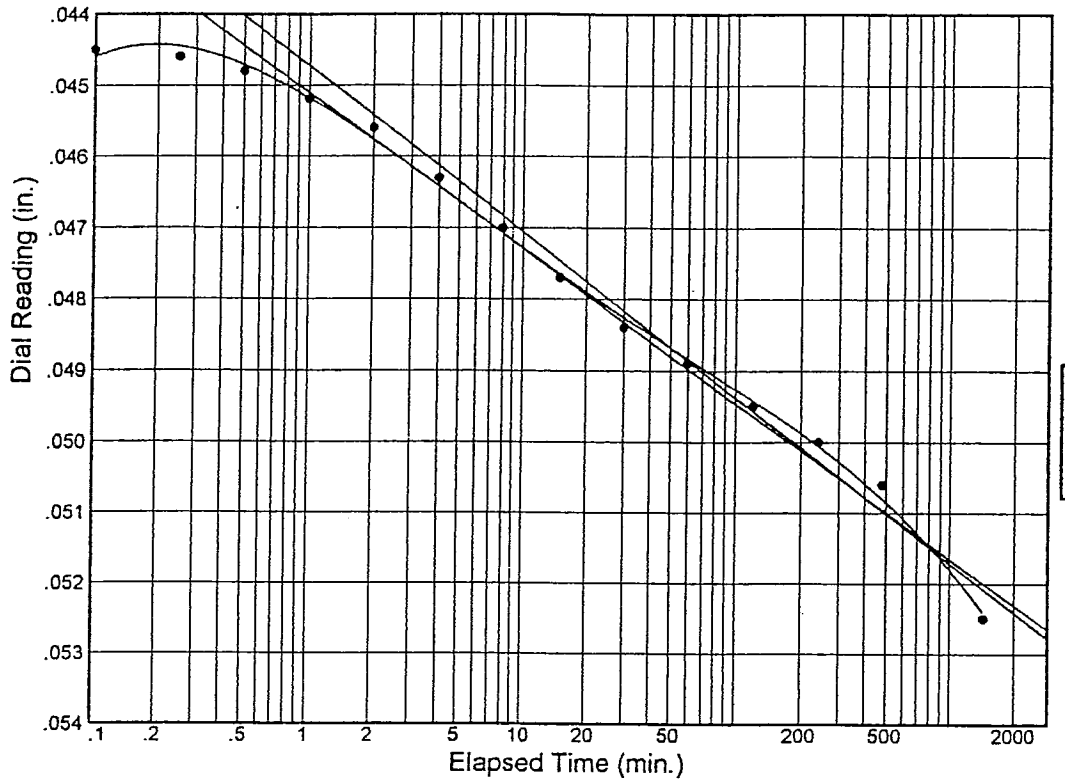
Remarks:

CONSOLIDATION TEST REPORT

PW LABORATORIES. INC.

Dial Reading vs. Log of Time

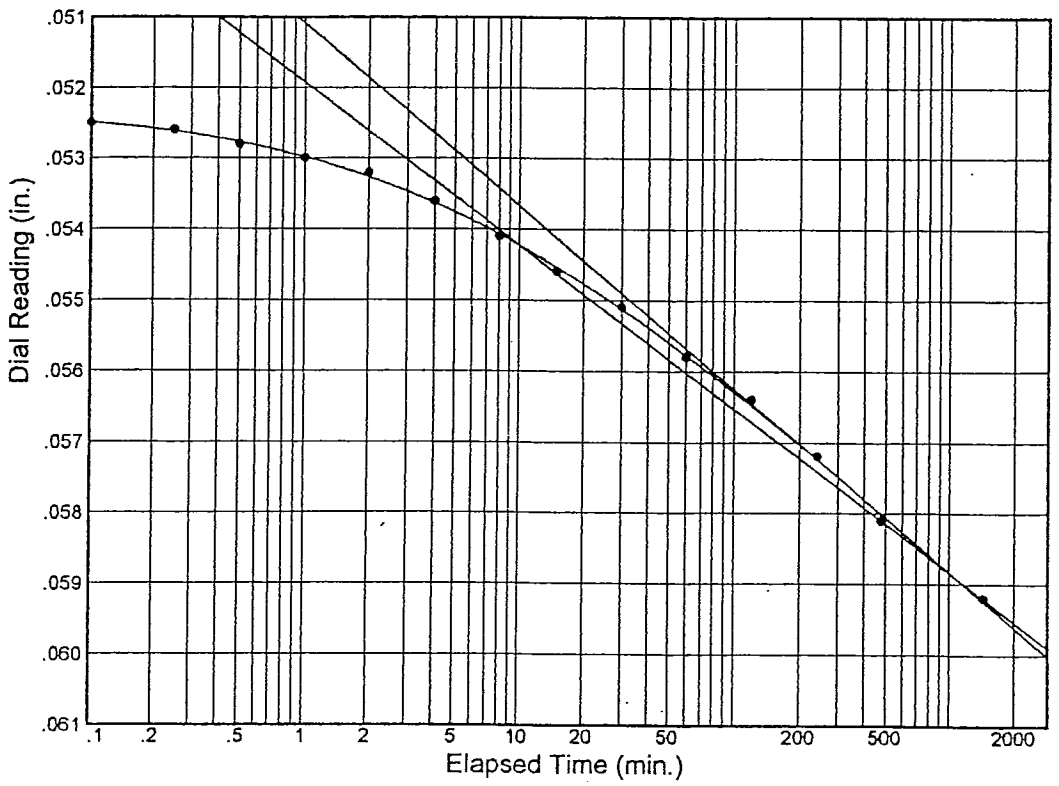
Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# D-1 ID# 14702



Load No.= 1
Load= 0.05 tsf
D_0 = 0.04410
D_{50} = 0.04742
D_{100} = 0.05074
T_{50} = 11.66 min.

C_v @ T_{50}
0.02 ft.^{2}/day

C_α = 0.003



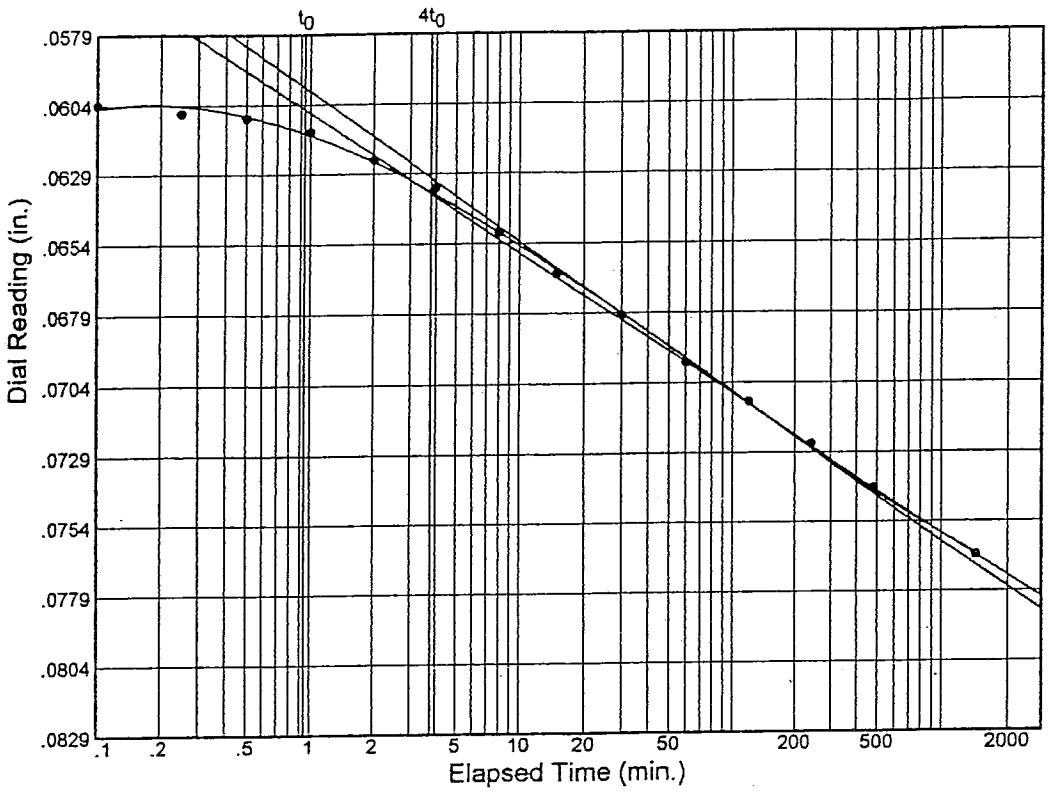
Load No.= 2
Load= 0.13 tsf
D_0 = 0.05250
D_{50} = 0.05569
D_{100} = 0.05888
T_{50} = 54.89 min.

C_v @ T_{50}
0.00 ft.^{2}/day

C_α = 0.003

Dial Reading vs. Log of Time

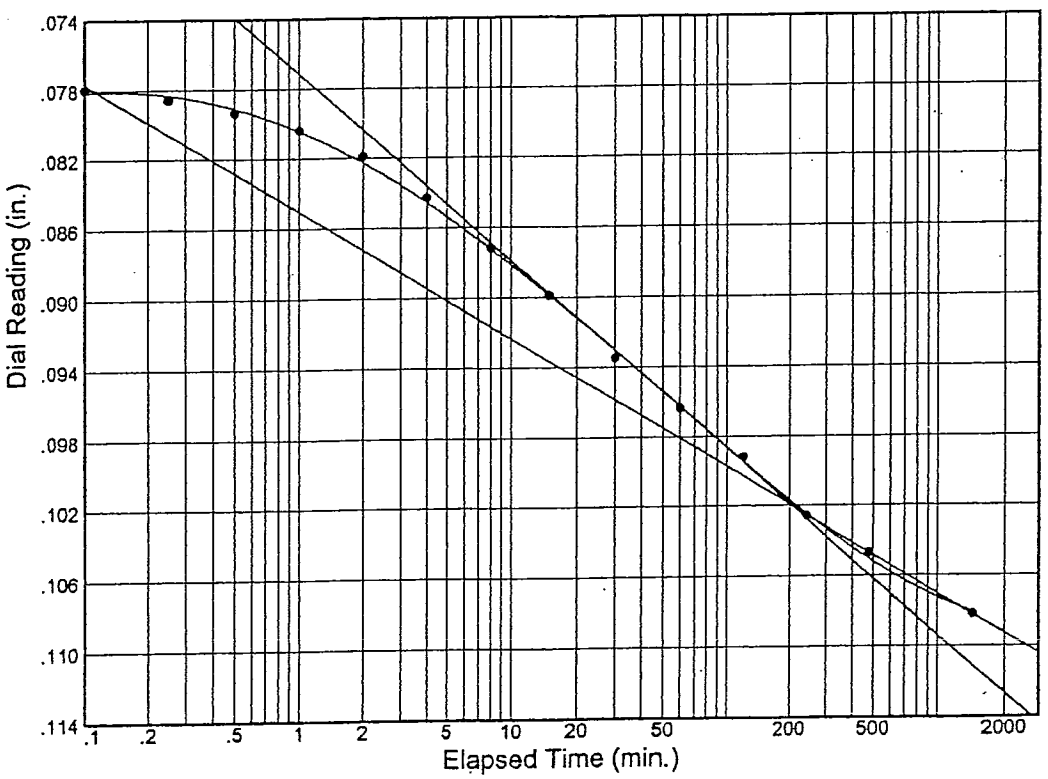
Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# D-1 ID# 14702



Load No.= 3
Load= 0.25 tsf
D_0 = 0.05933
D_{50} = 0.06545
D_{100} = 0.07157
T_{50} = 9.89 min.

C_v @ T_{50}
0.03 ft.^{2}/day

C_α = 0.007



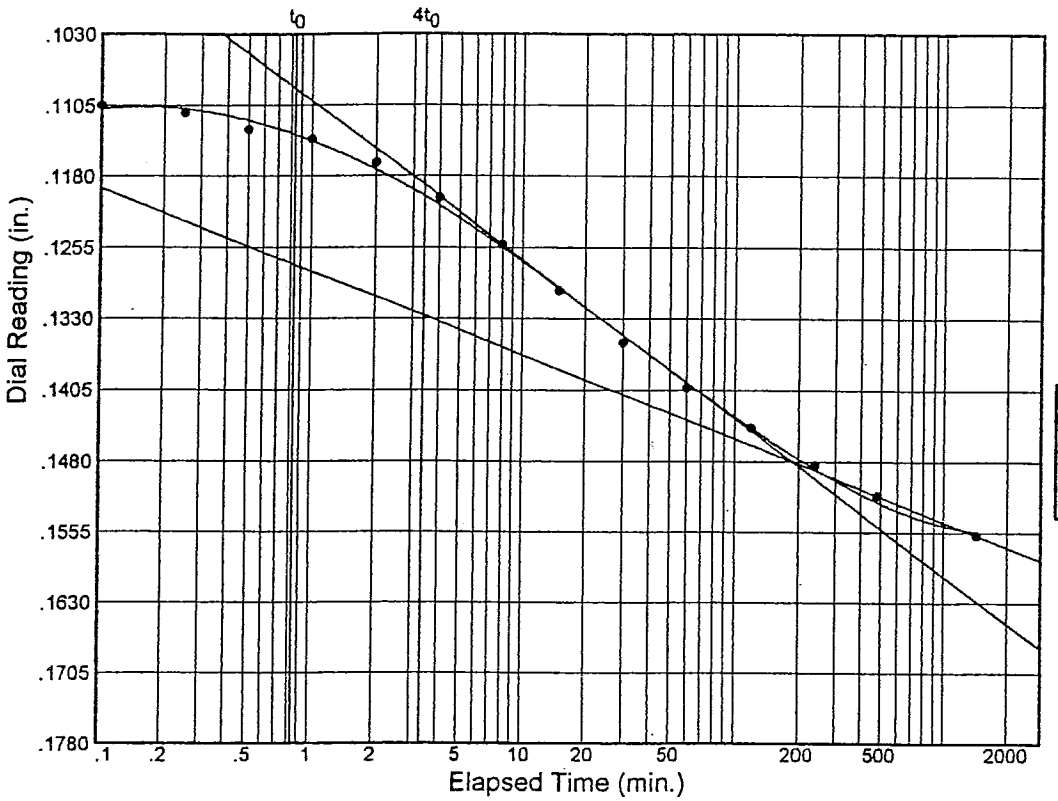
Load No.= 4
Load= 0.50 tsf
D_0 = 0.07660
D_{50} = 0.08928
D_{100} = 0.10197
T_{50} = 13.07 min.

C_v @ T_{50}
0.02 ft.^{2}/day

C_α = 0.010

Dial Reading vs. Log of Time

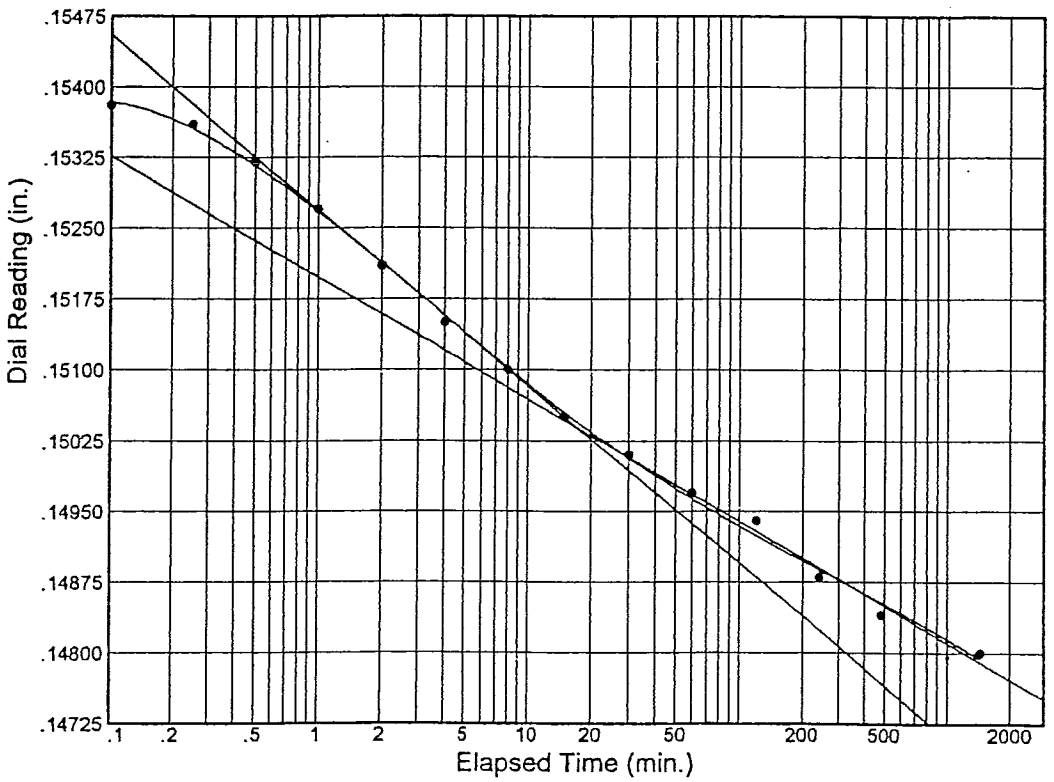
Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# D-1 ID# 14702



Load No.= 5
Load= 1.00 tsf
D_0 = 0.10724
D_{50} = 0.12761
D_{100} = 0.14799
T_{50} = 11.02 min.

C_v @ T_{50}
0.02 ft.^{2}/day

C_α = 0.013

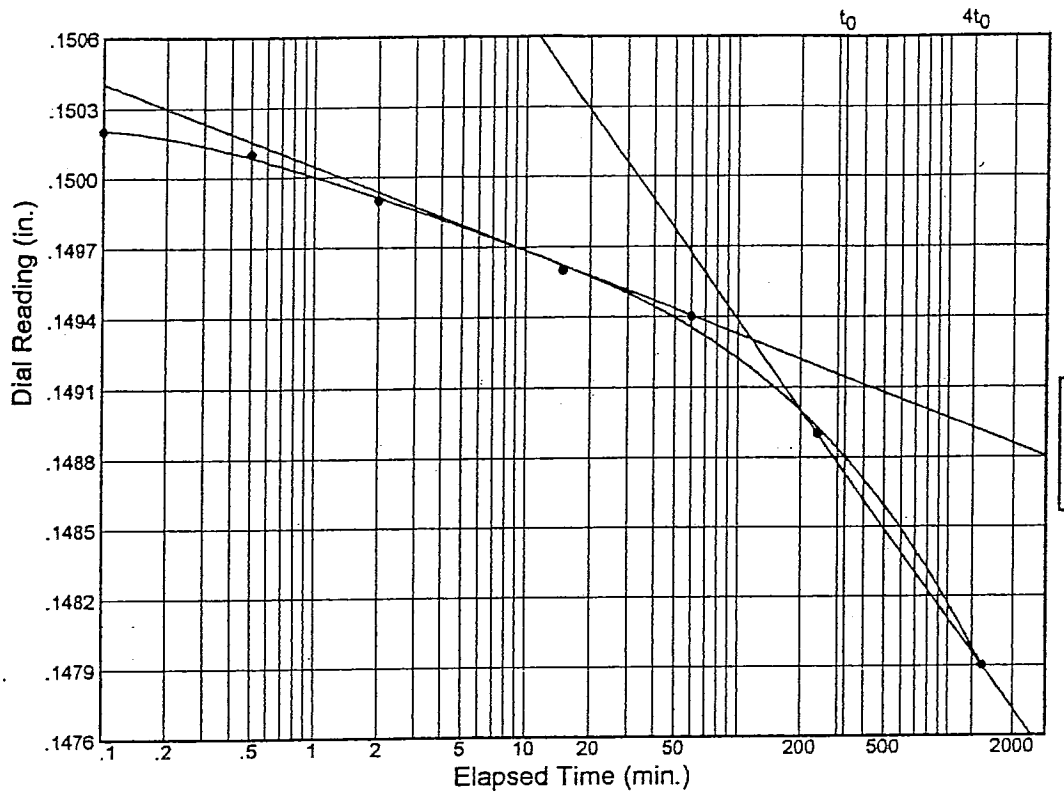


Load No.= 6
Load= 0.25 tsf
D_0 = 0.15580
D_{50} = 0.15309
D_{100} = 0.15037
T_{50} = 0.56 min.

C_v @ T_{50}
0.36 ft.^{2}/day

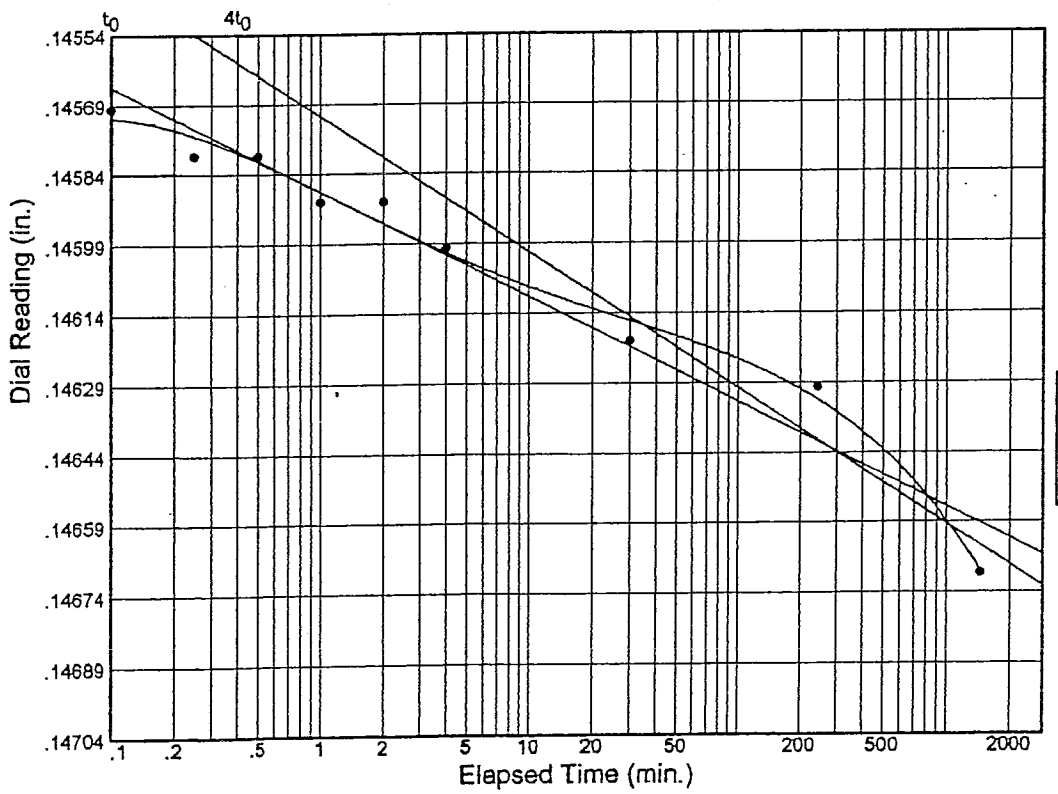
Dial Reading vs. Log of Time

Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# D-1 ID# 14702



Load No.= 7
Load= 0.13 tsf
D_0 = 0.14963
D_{50} = 0.14946
D_{100} = 0.14930
T_{50} = 36.09 min.

C_v @ T_{50}
0.01 ft.^{2}/day



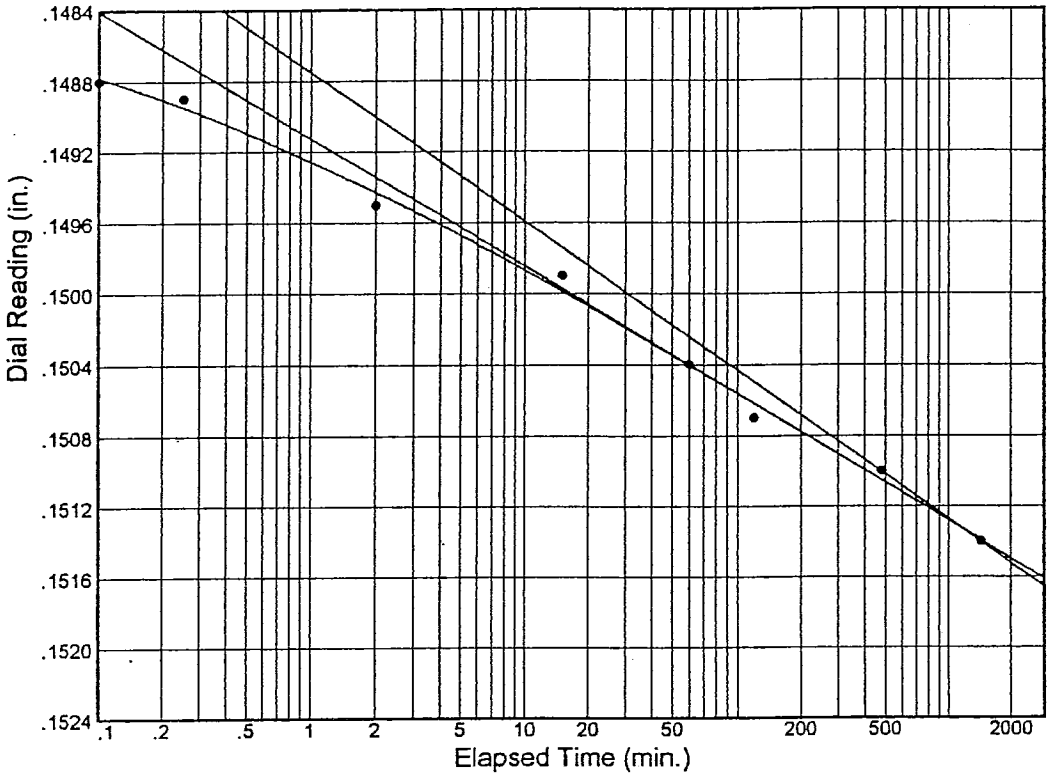
Load No.= 8
Load= 0.25 tsf
D_0 = 0.14564
D_{50} = 0.14604
D_{100} = 0.14643
T_{50} = 5.52 min.

C_v @ T_{50}
0.04 ft.^{2}/day

C_α = 0.000

Dial Reading vs. Log of Time

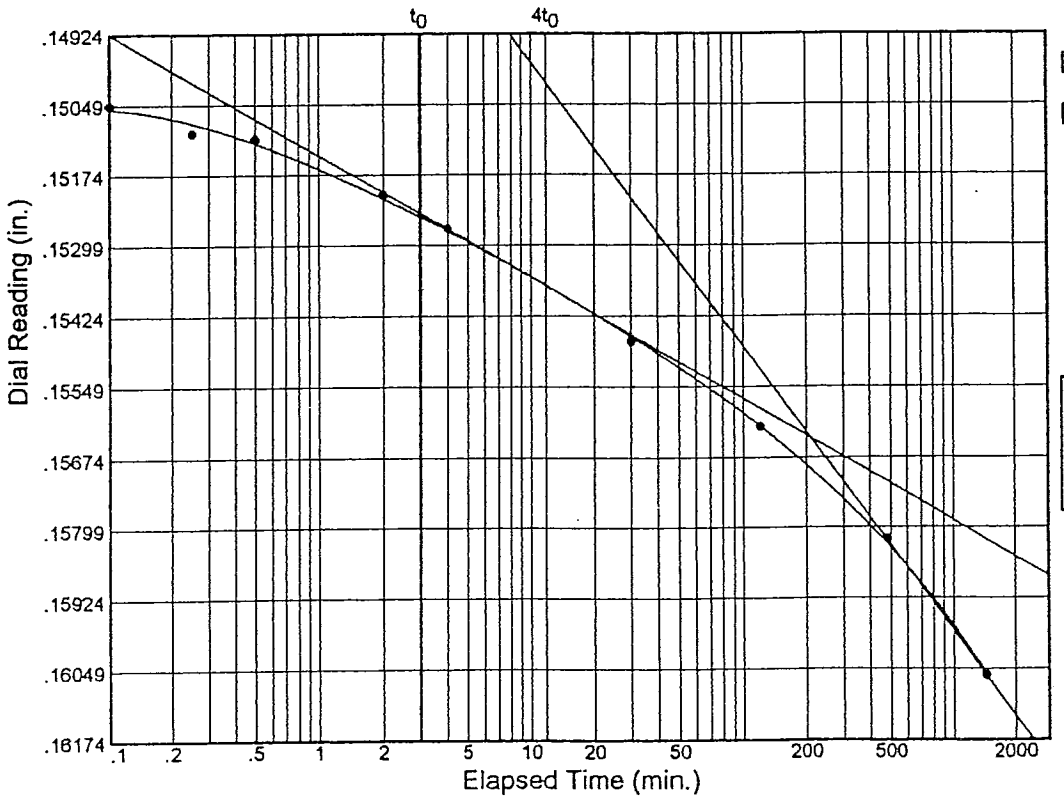
Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# D-1 ID# 14702



Load No.= 9
Load= 0.50 tsf
D_0 = 0.14670
D_{50} = 0.14902
D_{100} = 0.15135
T_{50} = 0.36 min.

C_v @ T_{50}
0.57 ft.^{2}/day

C_α = 0.001



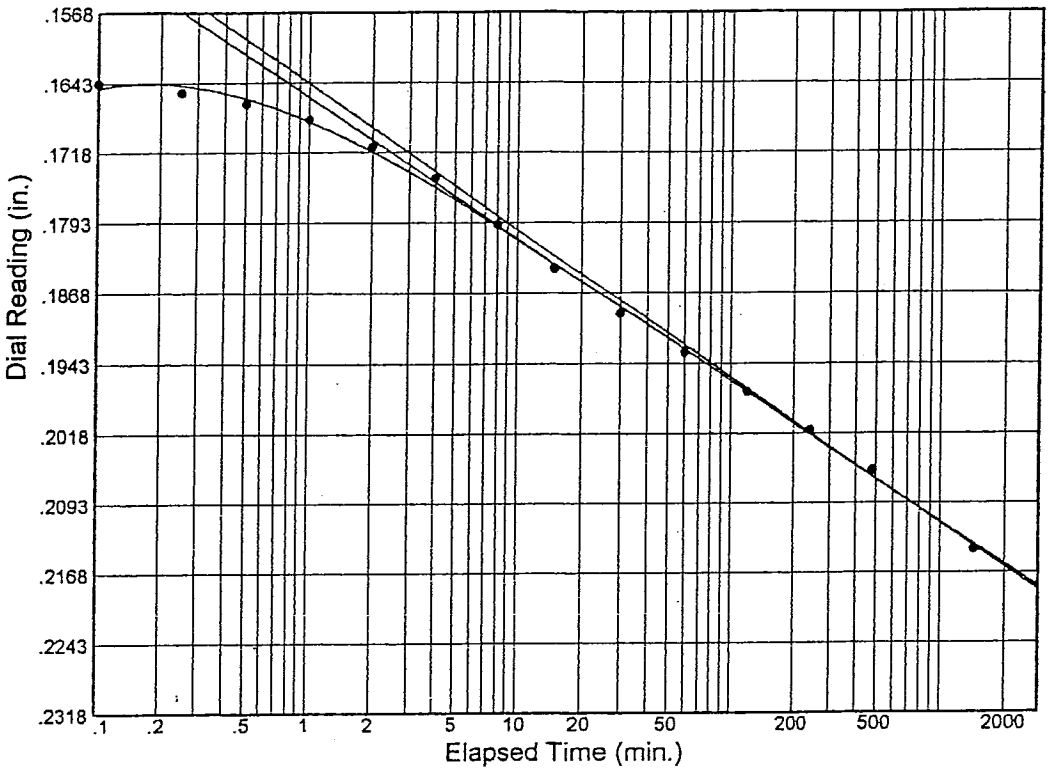
Load No.= 10
Load= 1.00 tsf
D_0 = 0.15125
D_{50} = 0.15382
D_{100} = 0.15639
T_{50} = 13.43 min.

C_v @ T_{50}
0.02 ft.^{2}/day

C_α = 0.008

Dial Reading vs. Log of Time

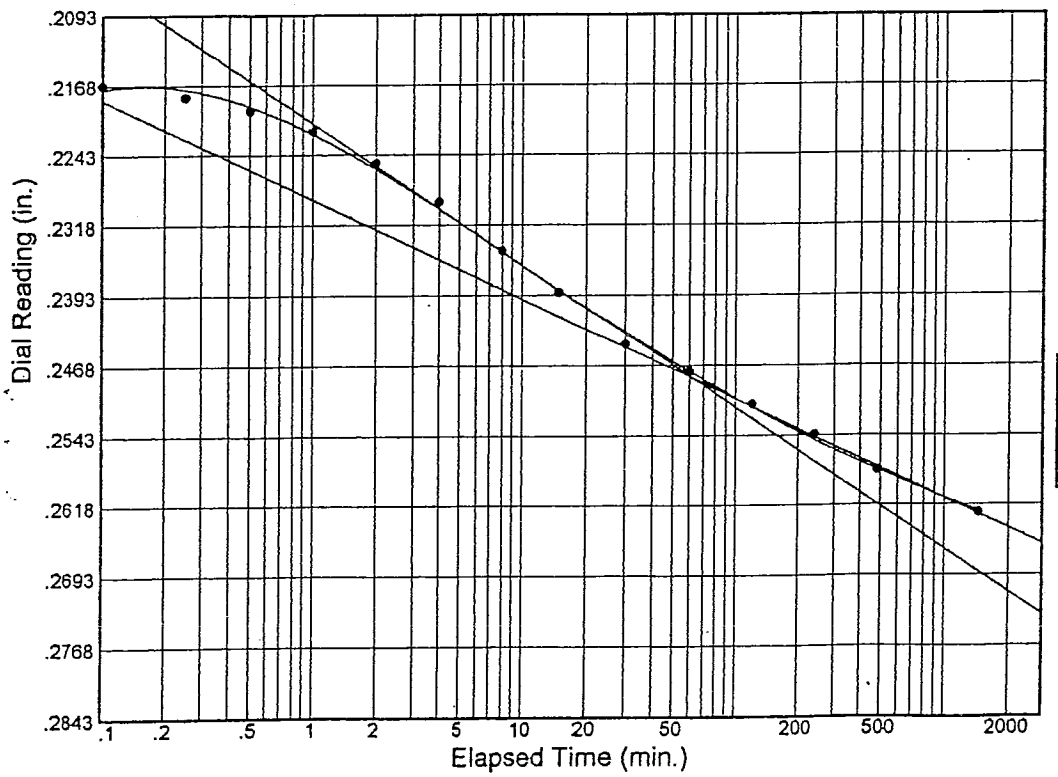
Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# D-1 ID# 14702



Load No.= 11
Load= 2.00 tsf
D_0 = 0.16060
D_{50} = 0.18399
D_{100} = 0.20739
T_{50} = 15.64 min.

C_v @ T_{50}
0.01 ft.^{2}/day

C_α = 0.025



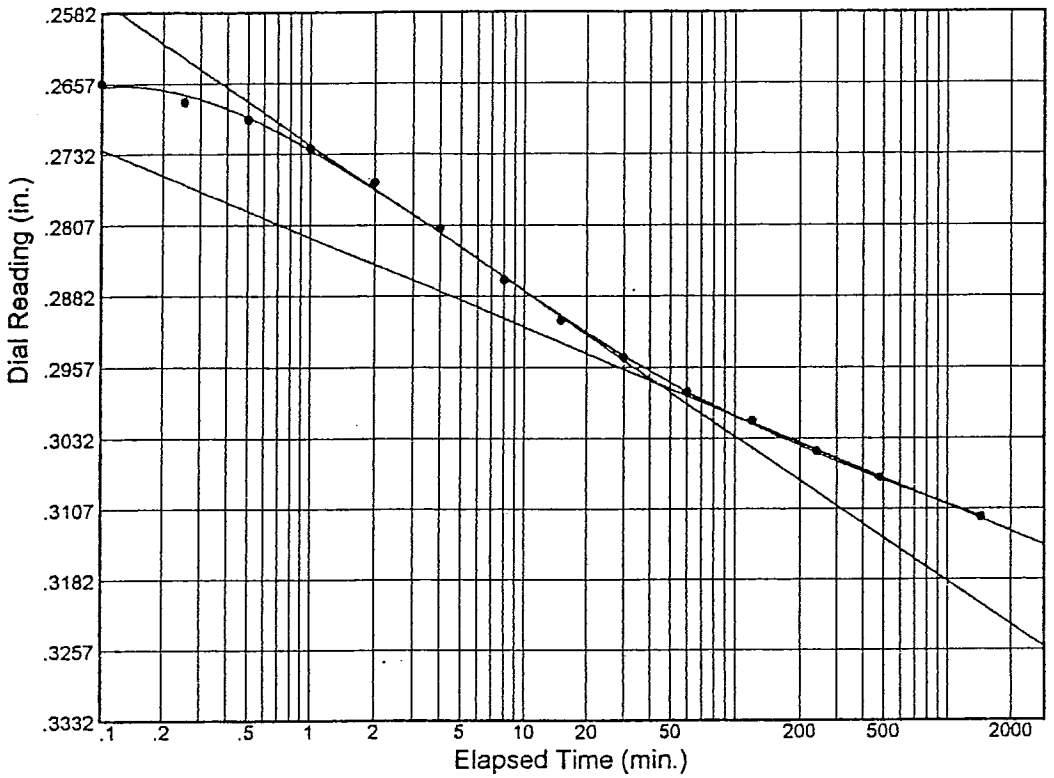
Load No.= 12
Load= 4.00 tsf
D_0 = 0.21430
D_{50} = 0.23128
D_{100} = 0.24826
T_{50} = 4.79 min.

C_v @ T_{50}
0.03 ft.^{2}/day

C_α = 0.018

Dial Reading vs. Log of Time

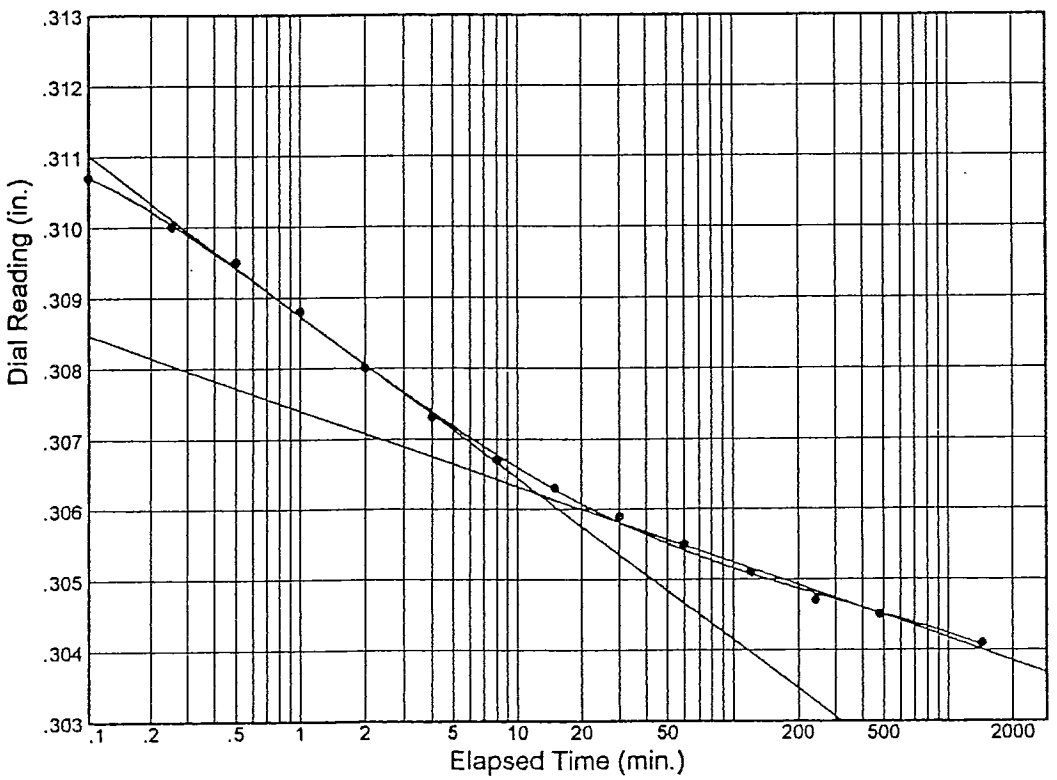
Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# D-1 ID# 14702



Load No.= 13
Load= 8.00 tsf
D_0 = 0.26260
D_{50} = 0.28002
D_{100} = 0.29745
T_{50} = 3.19 min.

C_v @ T_{50}
0.04 ft.^{2}/day

C_α = 0.018

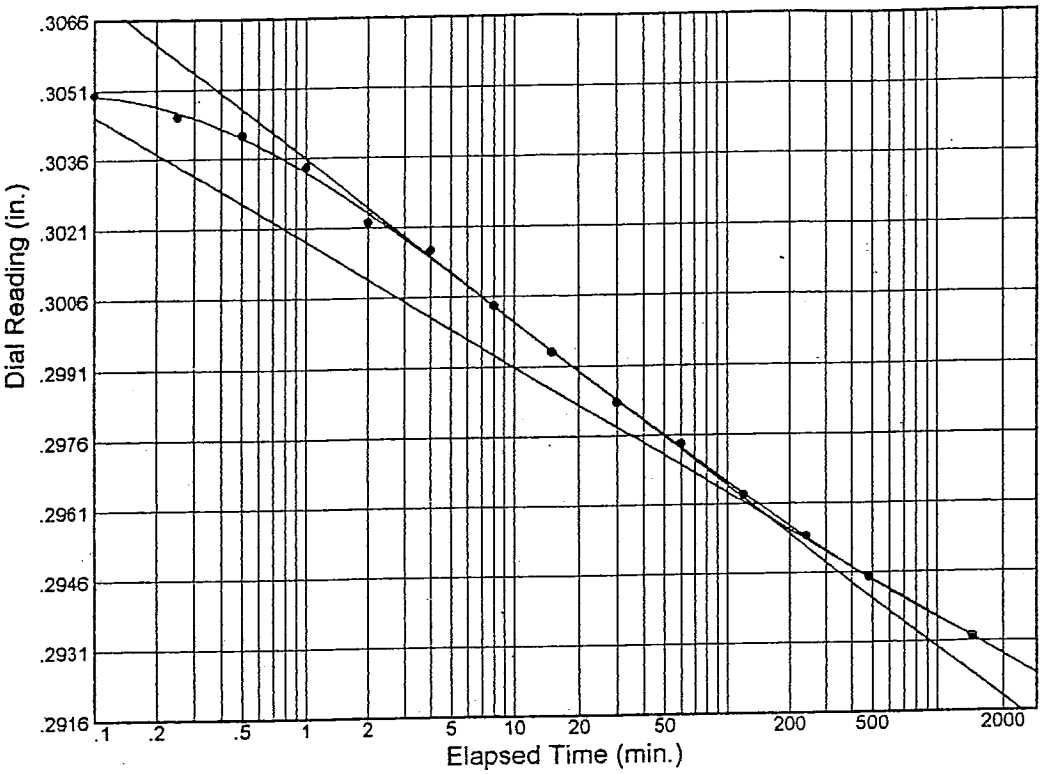


Load No.= 14
Load= 2.00 tsf
D_0 = 0.31160
D_{50} = 0.30891
D_{100} = 0.30621
T_{50} = 0.84 min.

C_v @ T_{50}
0.14 ft.^{2}/day

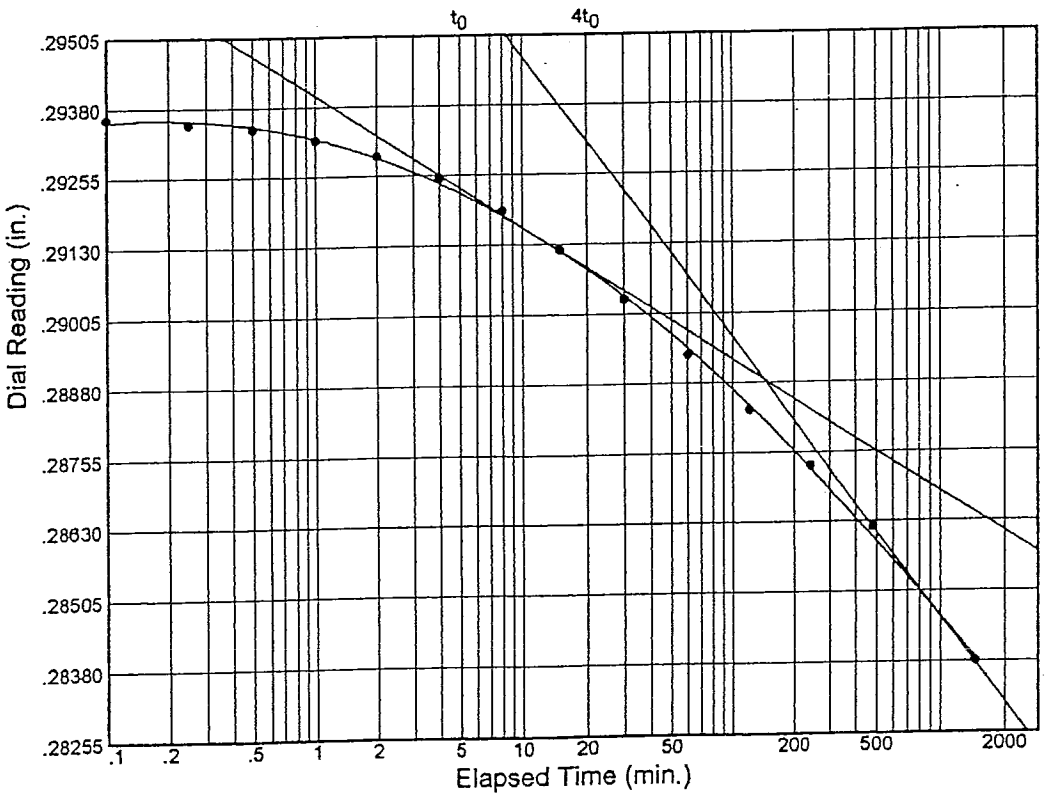
Dial Reading vs. Log of Time

Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# D-1 ID# 14702



Load No.= 15
Load= 0.50 tsf
D_0 = 0.30410
D_{50} = 0.29996
D_{100} = 0.29581
T_{50} = 10.67 min.

C_v @ T_{50}
0.01 ft.^{2}/day

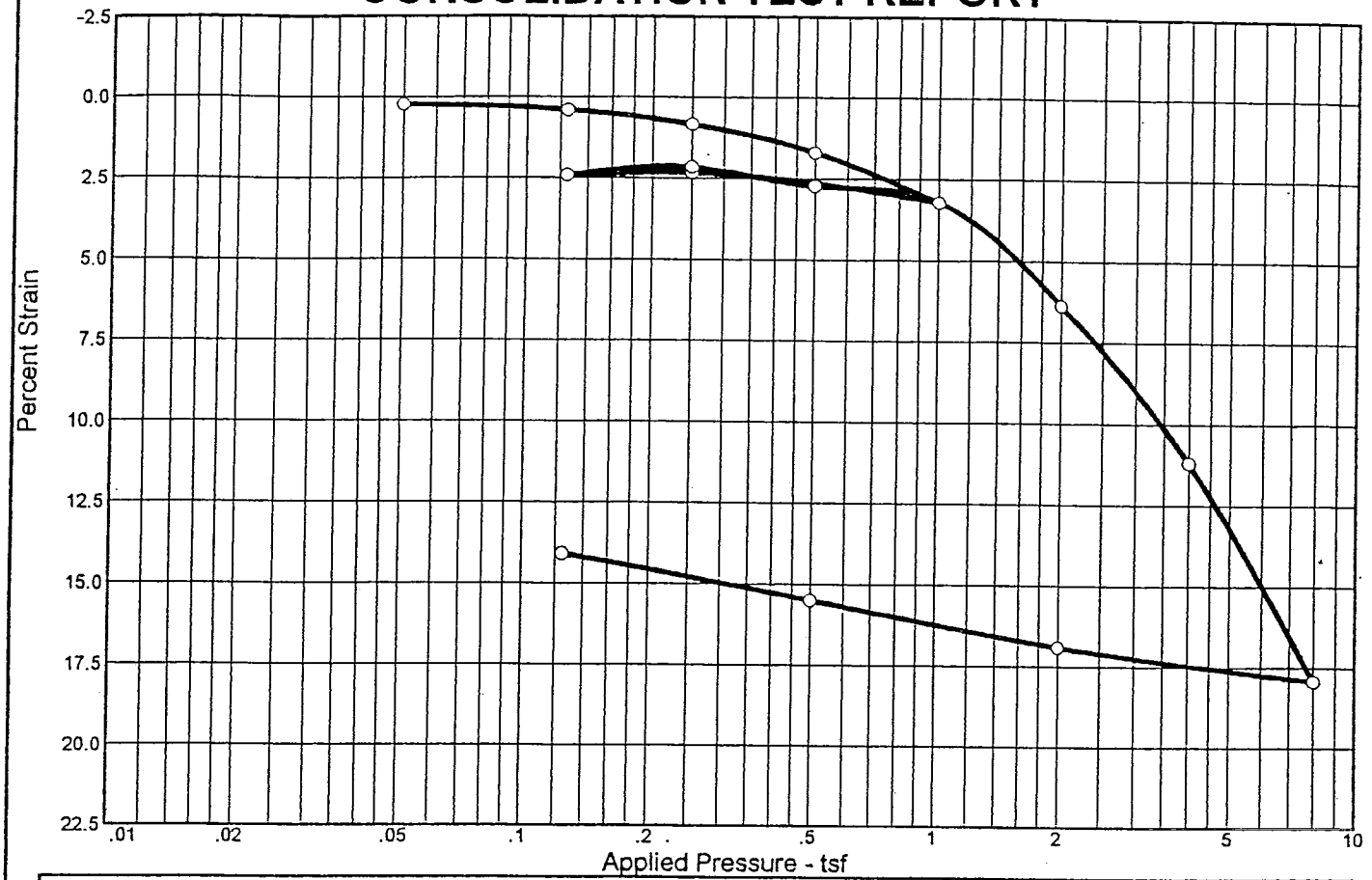


Load No.= 16
Load= 0.13 tsf
D_0 = 0.29360
D_{50} = 0.29122
D_{100} = 0.28885
T_{50} = 14.38 min.

C_v @ T_{50}
0.01 ft.^{2}/day

PW LABORATORIES, INC

CONSOLIDATION TEST REPORT



Coefficients of Consolidation and Secondary Consolidation

No.	Load (tsf)	C_v (ft.2/day)	C_α	No.	Load (tsf)	C_v (ft.2/day)	C_α	No.	Load (tsf)	C_v (ft.2/day)	C_α
1	0.05	0.08	0.001	11	2.00	0.17	0.016				
2	0.13	0.09	0.001	12	4.00	0.01	0.014				
3	0.25	0.98	0.001	13	8.00	0.01	0.018				
4	0.50	0.37	0.002	14	2.00	0.27					
5	1.00	0.01	0.004	15	0.50	0.01					
6	0.25	0.01		16	0.13	0.01					
7	0.13	0.02									
8	0.25	0.00	0.001								
9	0.50	0.04	0.001								
10	1.00	0.06	0.002								

Natural Saturation	Natural Moisture	Dry Dens. (pcf)	LL	PI	Sp. Gr.	P_c (tsf)	C_c	Initial Void Ratio
88.3 %	65.1 %	53.2	81	13	2.36	2.05	0.62	1.740

MATERIAL DESCRIPTION	USCS	AASHTO
Grey moist silty sand (paper residue)	OH	

Project No. L-01041 **Client:** BLASLAND BOUCK & LEE

Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN

Location: BORING# E-2 ID# 14703

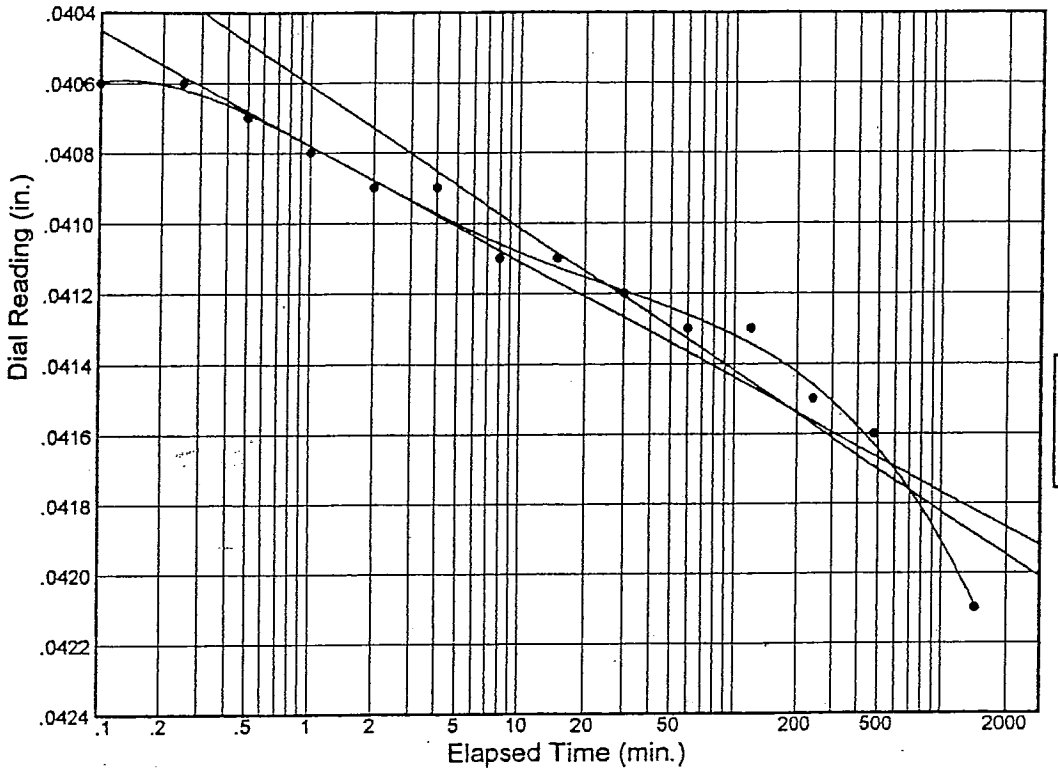
Remarks:

CONSOLIDATION TEST REPORT

PW LABORATORIES, INC.

Dial Reading vs. Log of Time

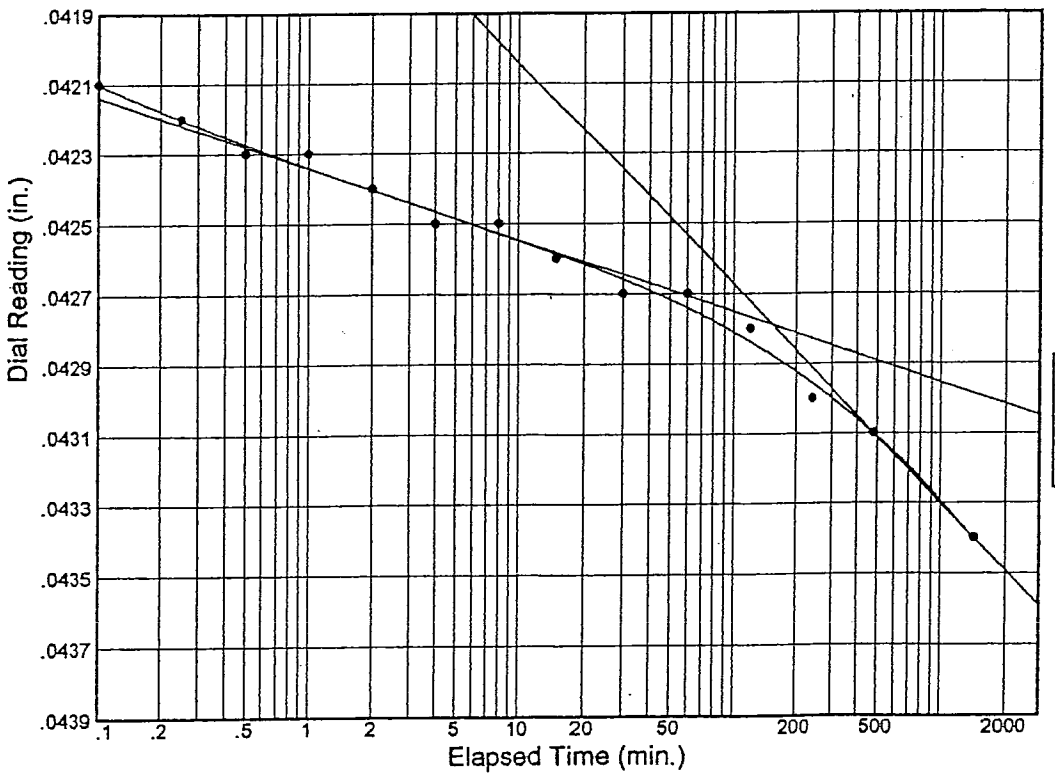
Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# E-2 ID# 14703



Load No.= 1
Load= 0.05 tsf
D_0 = 0.04040
D_{50} = 0.04096
D_{100} = 0.04152
T_{50} = 3.66 min.

C_v @ T_{50}
0.08 ft.^{2}/day

C_α = 0.001



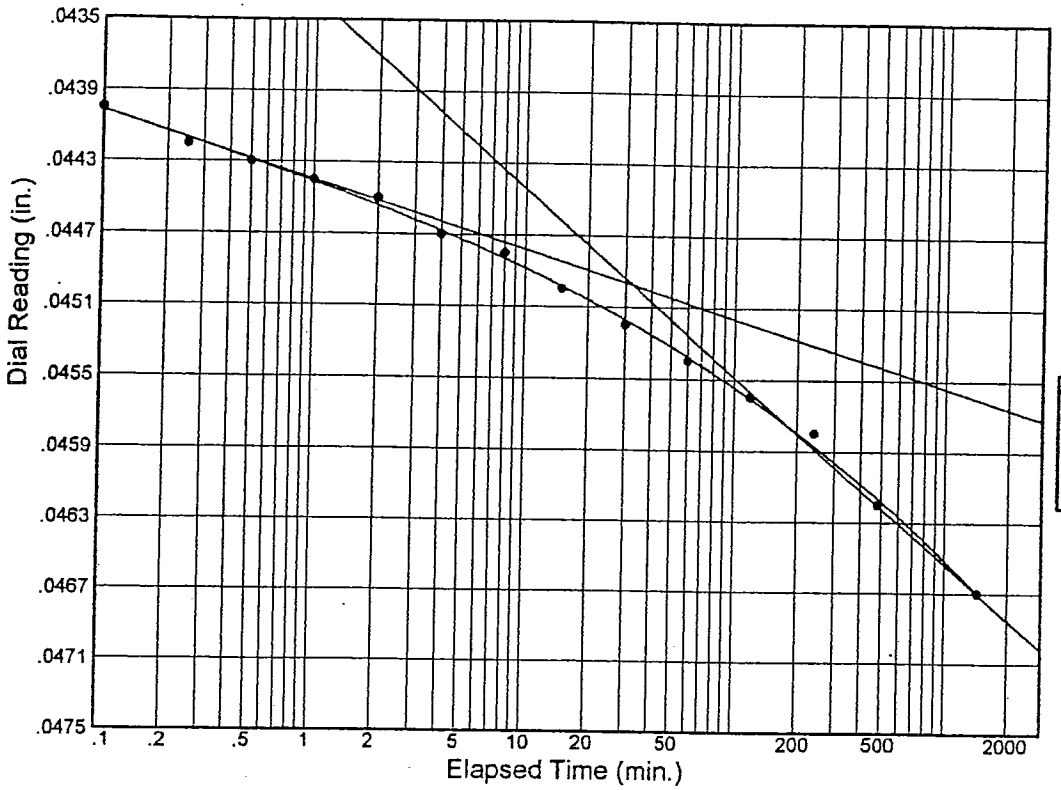
Load No.= 2
Load= 0.13 tsf
D_0 = 0.04210
D_{50} = 0.04245
D_{100} = 0.04279
T_{50} = 3.18 min.

C_v @ T_{50}
0.09 ft.^{2}/day

C_α = 0.001

Dial Reading vs. Log of Time

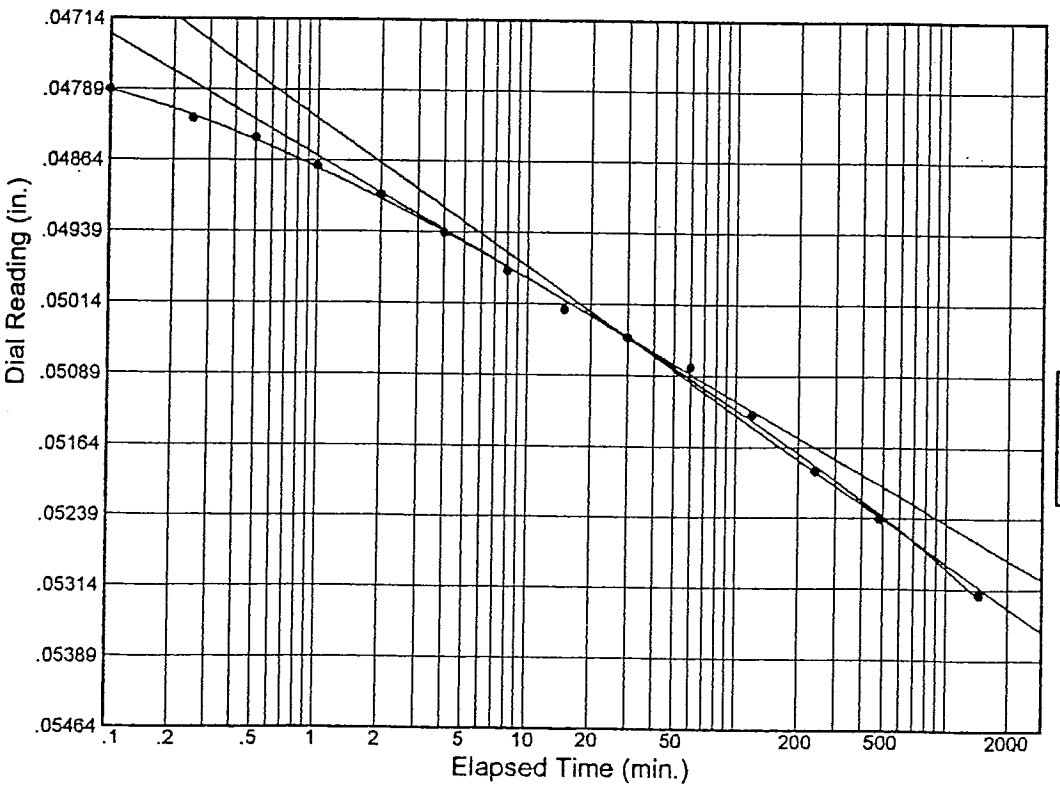
Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# E-2 ID# 14703



Load No.= 3
Load= 0.25 tsf
D_0 = 0.04340
D_{50} = 0.04419
D_{100} = 0.04498
T_{50} = 0.28 min.

C_v @ T_{50}
0.98 ft.^{2}/day

C_α = 0.001



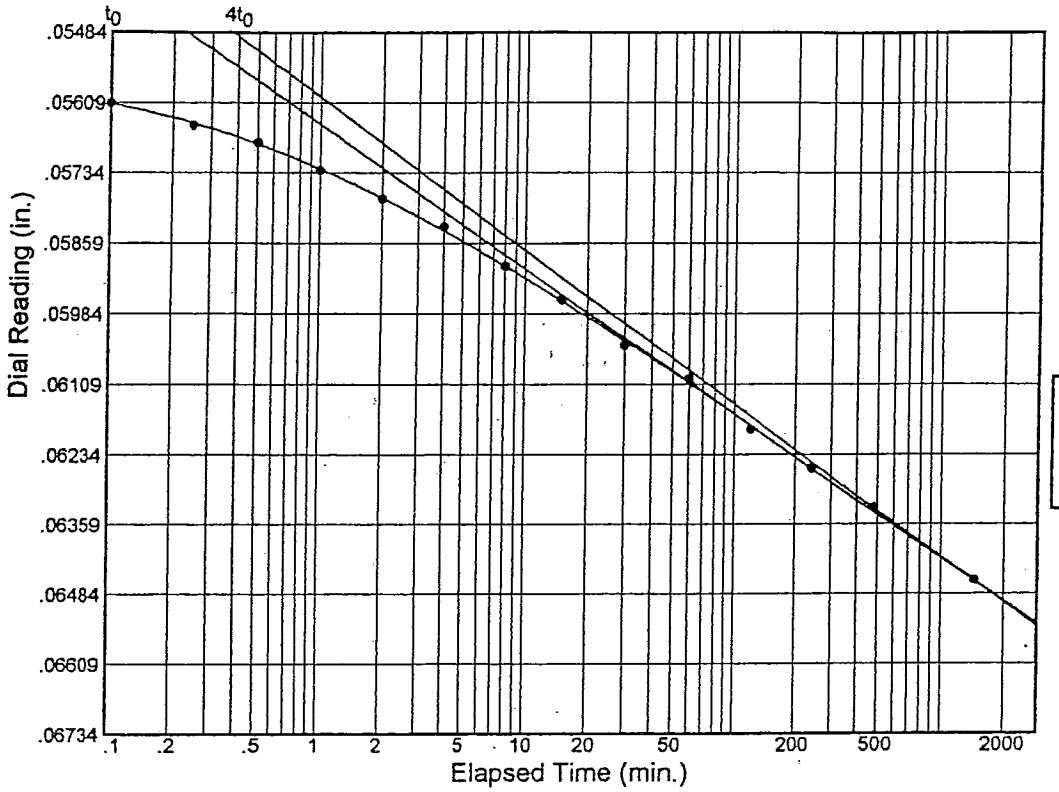
Load No.= 4
Load= 0.50 tsf
D_0 = 0.04670
D_{50} = 0.04858
D_{100} = 0.05046
T_{50} = 0.73 min.

C_v @ T_{50}
0.37 ft.^{2}/day

C_α = 0.002

Dial Reading vs. Log of Time

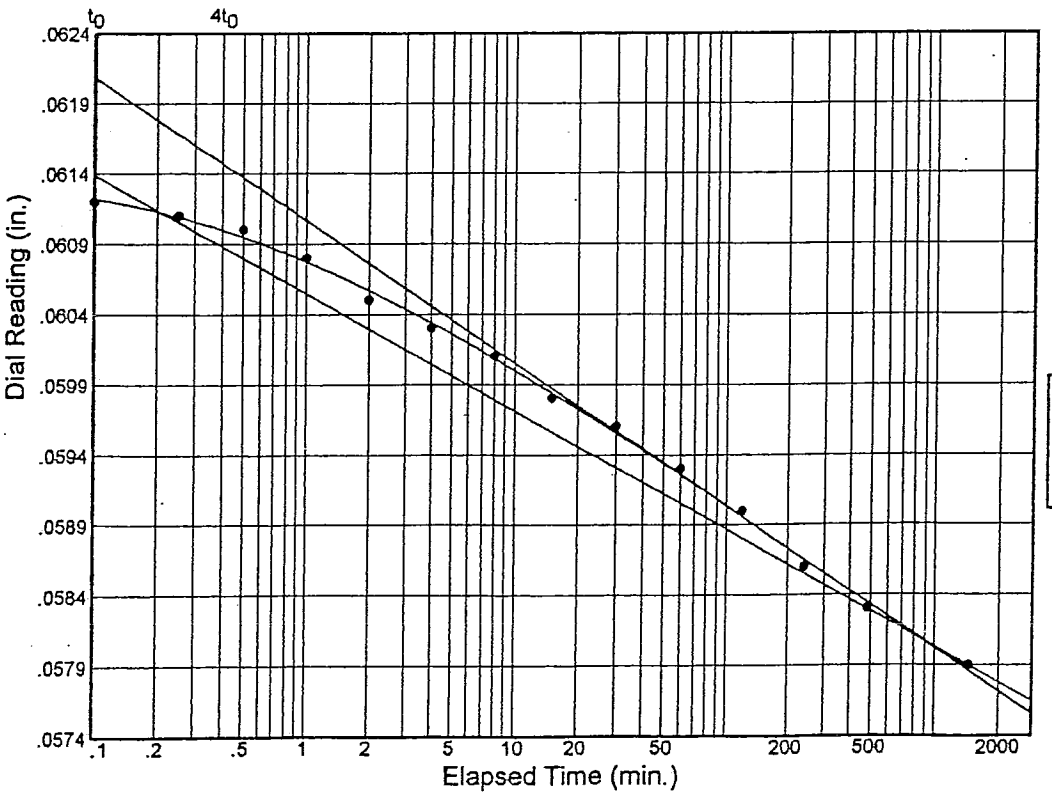
Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# E-2 ID# 14703



Load No.= 5
Load= 1.00 tsf
D_0 = 0.05553
D_{50} = 0.06002
D_{100} = 0.06451
T_{50} = 22.47 min.

C_v @ T_{50}
0.01 ft.^{2}/day

C_α = 0.004

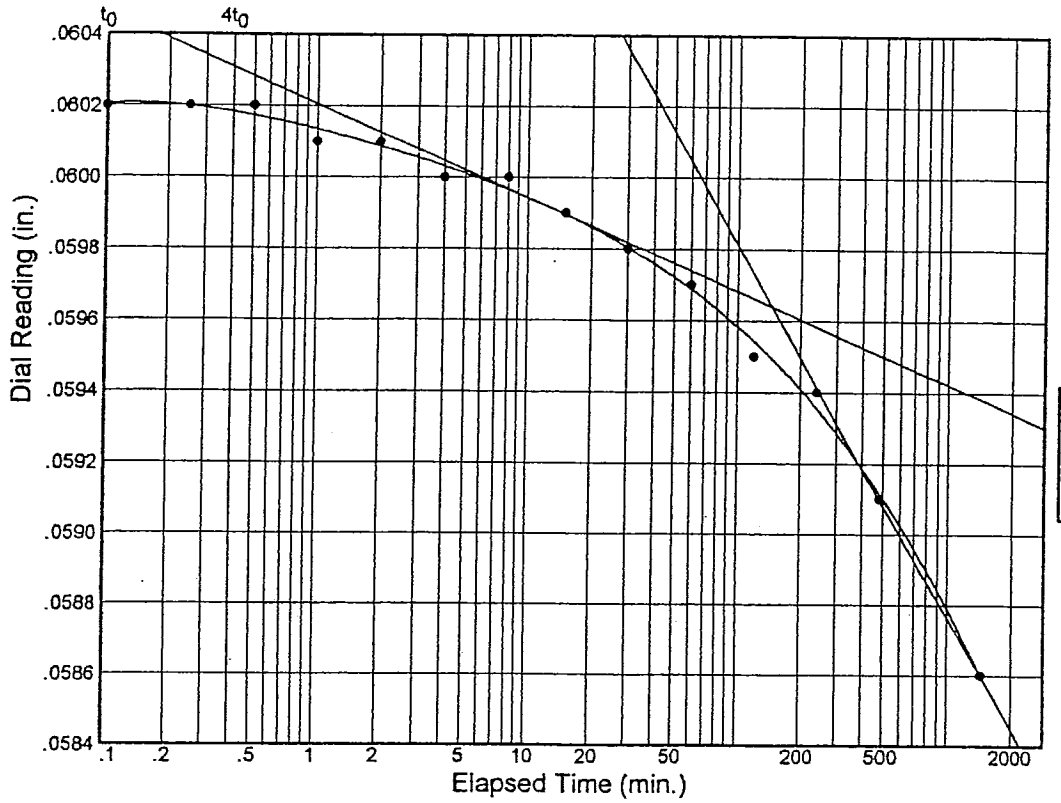


Load No.= 6
Load= 0.25 tsf
D_0 = 0.06144
D_{50} = 0.05976
D_{100} = 0.05809
T_{50} = 18.04 min.

C_v @ T_{50}
0.01 ft.^{2}/day

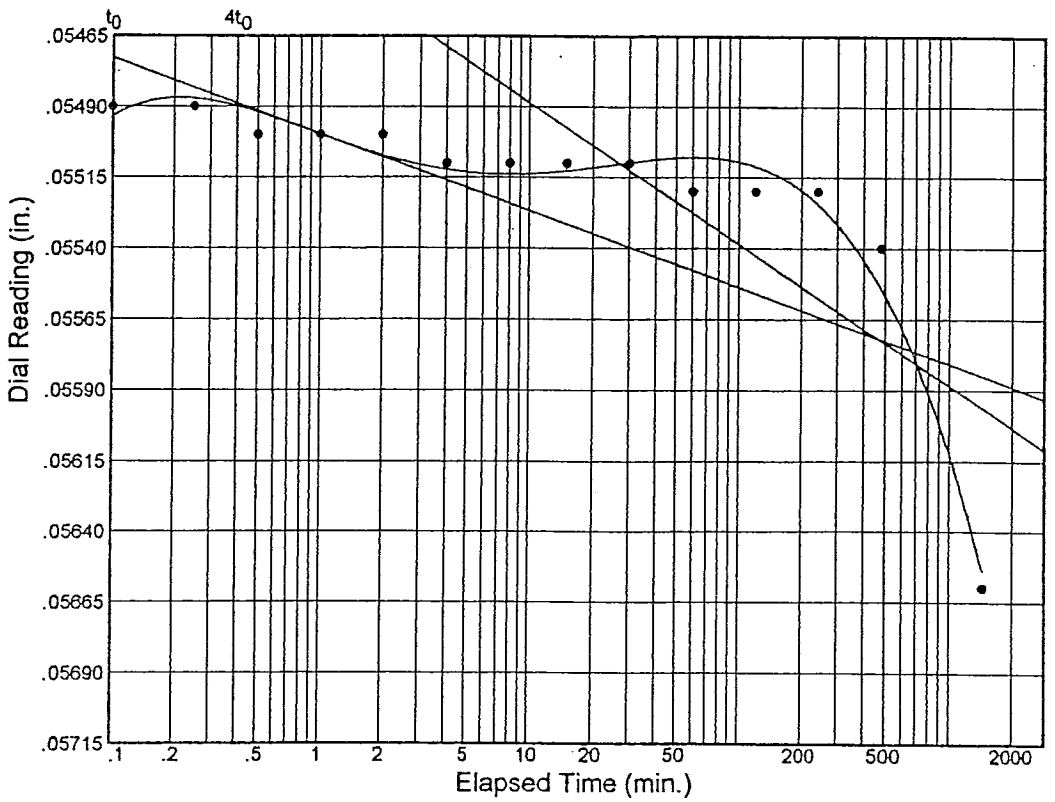
Dial Reading vs. Log of Time

Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# E-2 ID# 14703



Load No.= 7
Load= 0.13 tsf
D_0 = 0.06023
D_{50} = 0.05993
D_{100} = 0.05964
T_{50} = 10.98 min.

C_v @ T_{50}
0.02 ft.^{2}/day



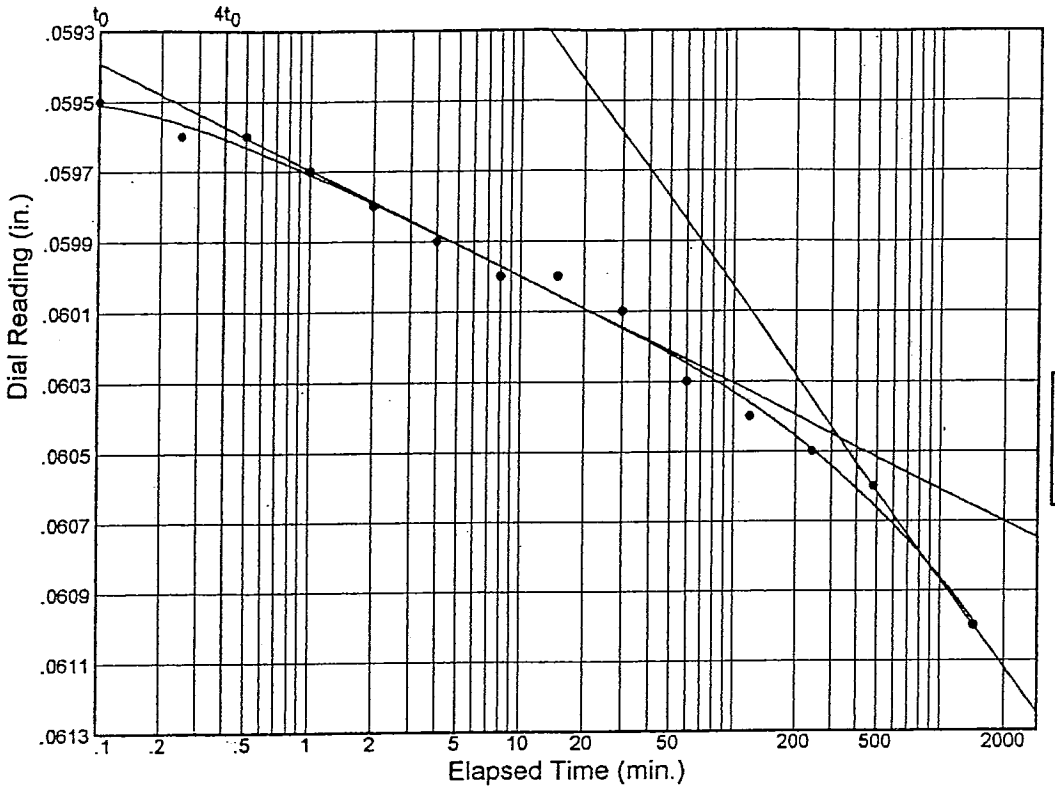
Load No.= 8
Load= 0.25 tsf
D_0 = 0.05497
D_{50} = 0.05535
D_{100} = 0.05572
T_{50} = 322.57 min.

C_v @ T_{50}
0.00 ft.^{2}/day

C_α = 0.001

Dial Reading vs. Log of Time

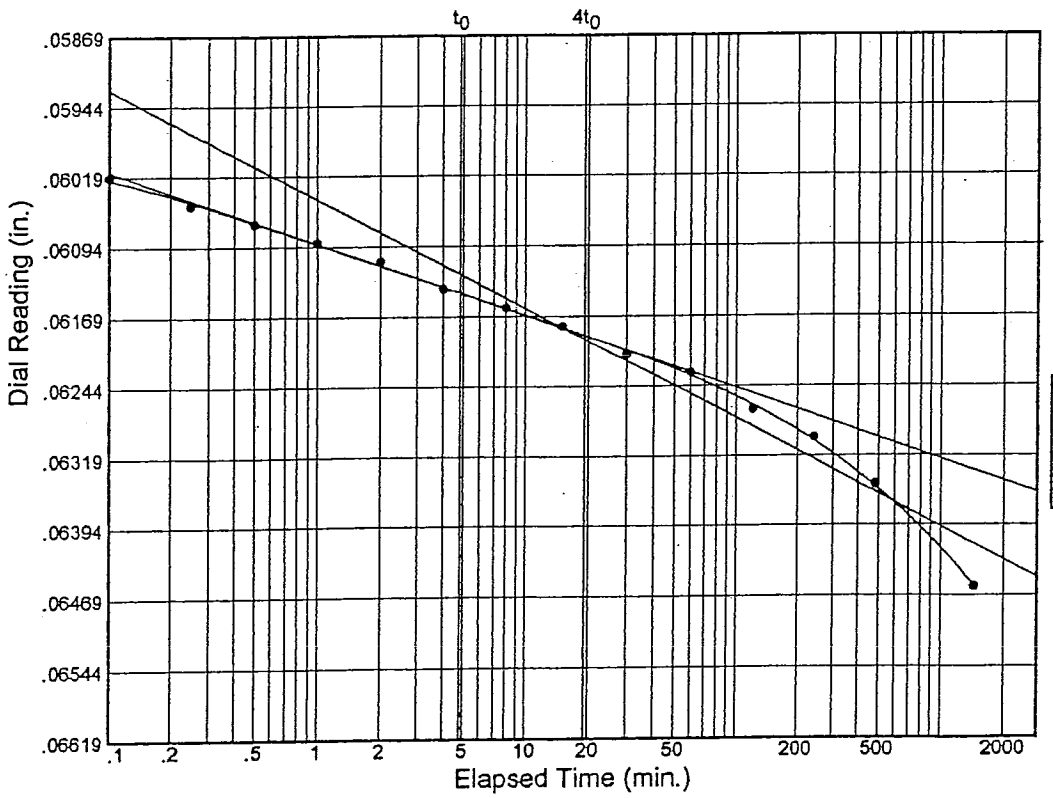
Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# E-2 ID# 14703



Load No.= 9
Load= 0.50 tsf
D_0 = 0.05941
D_{50} = 0.05994
D_{100} = 0.06046
T_{50} = 6.14 min.

C_v @ T_{50}
0.04 ft.^{2}/day

C_α = 0.001



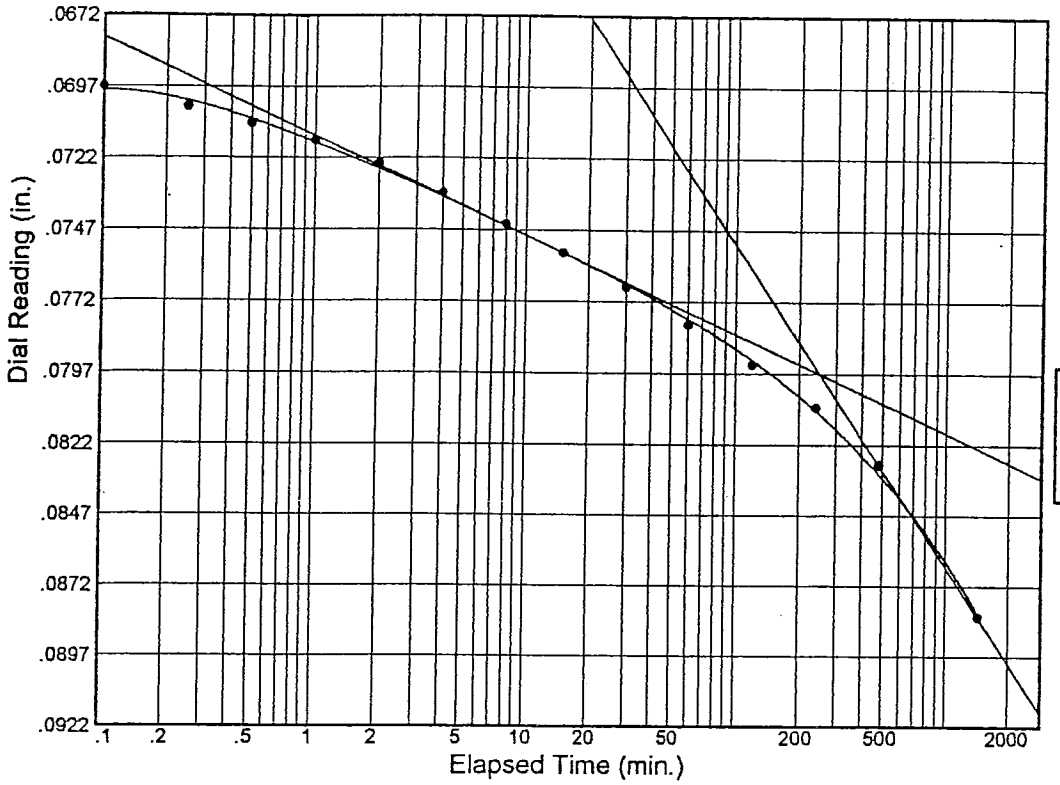
Load No.= 10
Load= 1.00 tsf
D_0 = 0.06098
D_{50} = 0.06141
D_{100} = 0.06184
T_{50} = 4.36 min.

C_v @ T_{50}
0.06 ft.^{2}/day

C_α = 0.002

Dial Reading vs. Log of Time

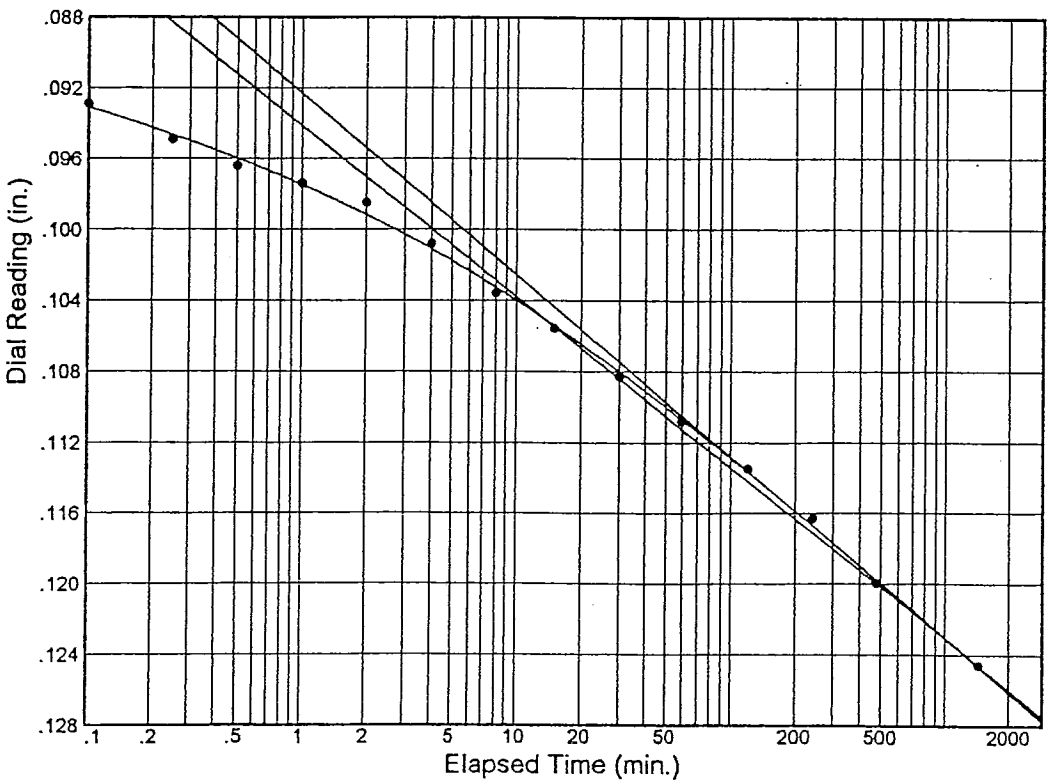
Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# E-2 ID# 14703



Load No.= 11
Load= 2.00 tsf
D_0 = 0.06460
D_{50} = 0.07216
D_{100} = 0.07972
T_{50} = 1.47 min.

C_v @ T_{50}
0.17 ft.^{2}/day

C_α = 0.016



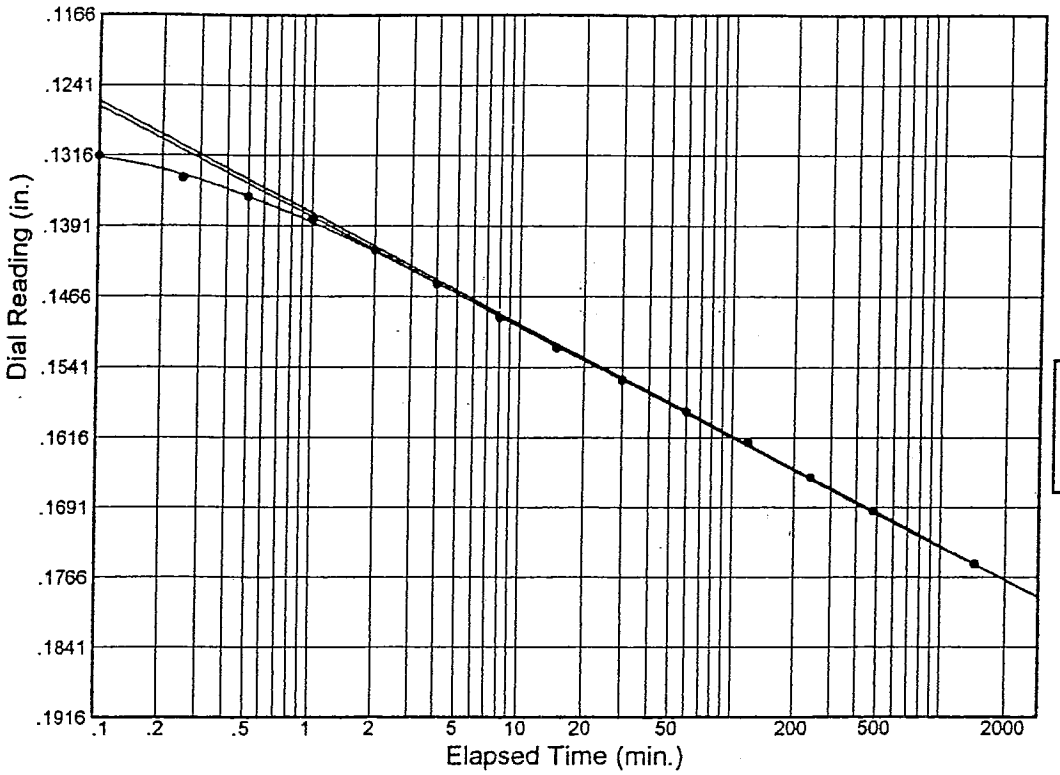
Load No.= 12
Load= 4.00 tsf
D_0 = 0.08830
D_{50} = 0.10598
D_{100} = 0.12366
T_{50} = 17.57 min.

C_v @ T_{50}
0.01 ft.^{2}/day

C_α = 0.014

Dial Reading vs. Log of Time

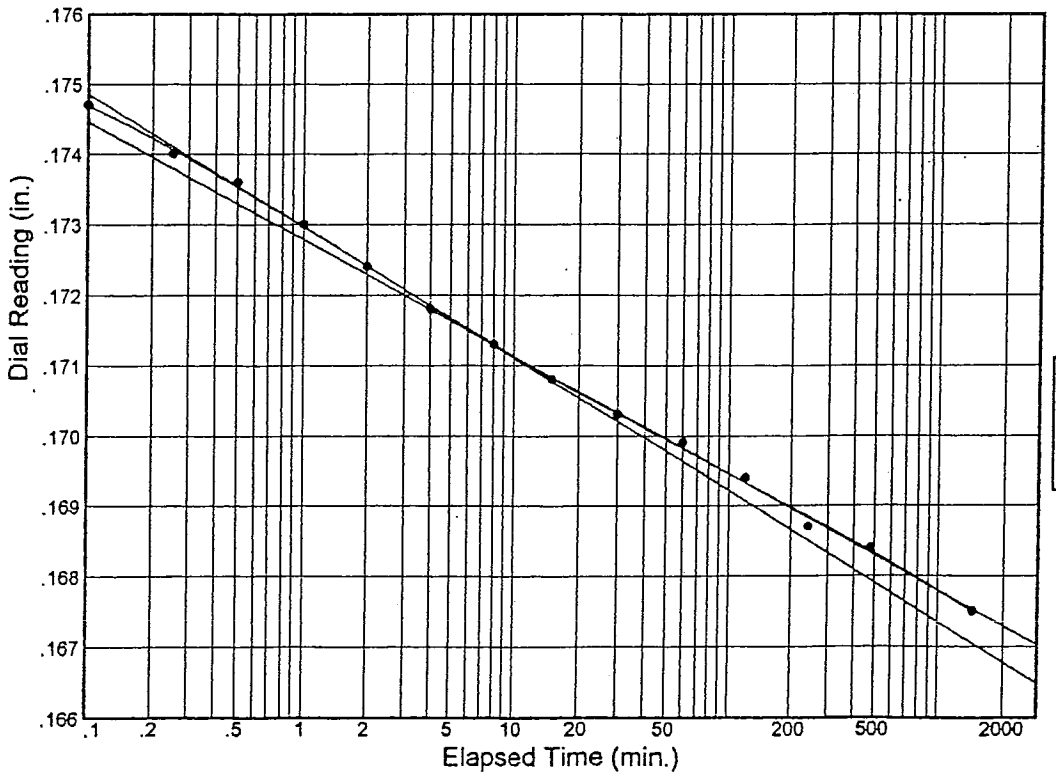
Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# E-2 ID# 14703



Load No.= 13
Load= 8.00 tsf
D_0 = 0.12460
D_{50} = 0.15433
D_{100} = 0.18405
T_{50} = 23.93 min.

C_v @ T_{50}
0.01 ft.^{2}/day

C_α = 0.018

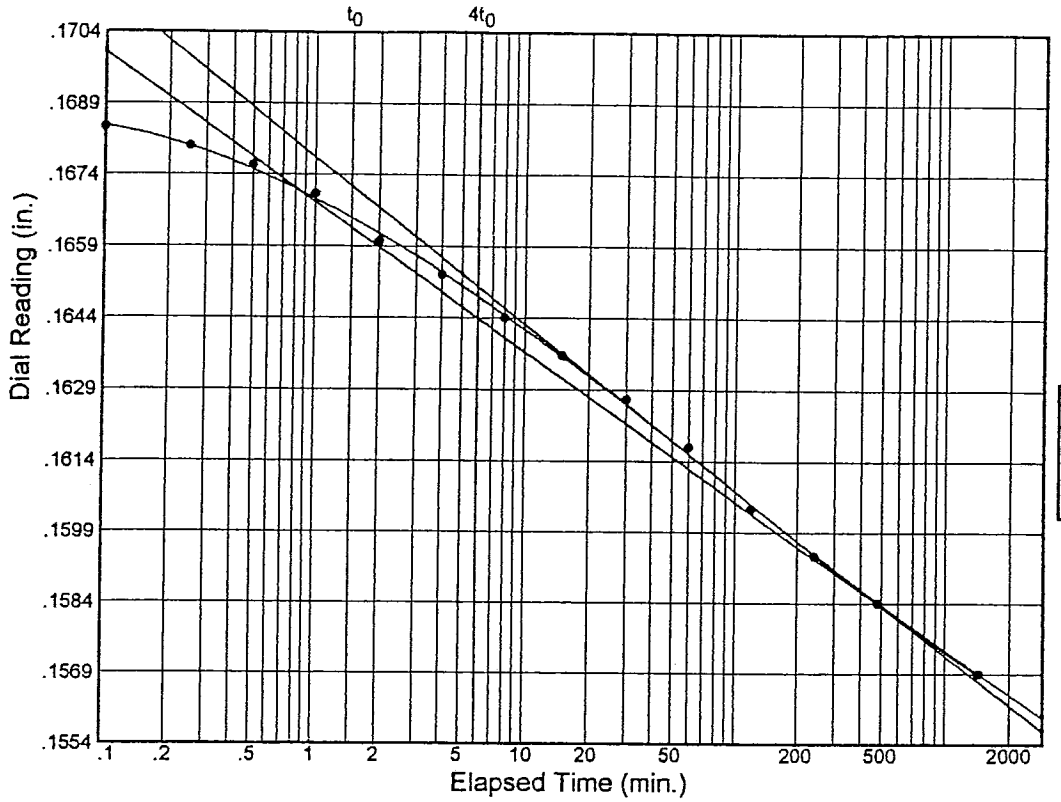


Load No.= 14
Load= 2.00 tsf
D_0 = 0.17520
D_{50} = 0.17327
D_{100} = 0.17134
T_{50} = 0.69 min.

C_v @ T_{50}
0.27 ft.^{2}/day

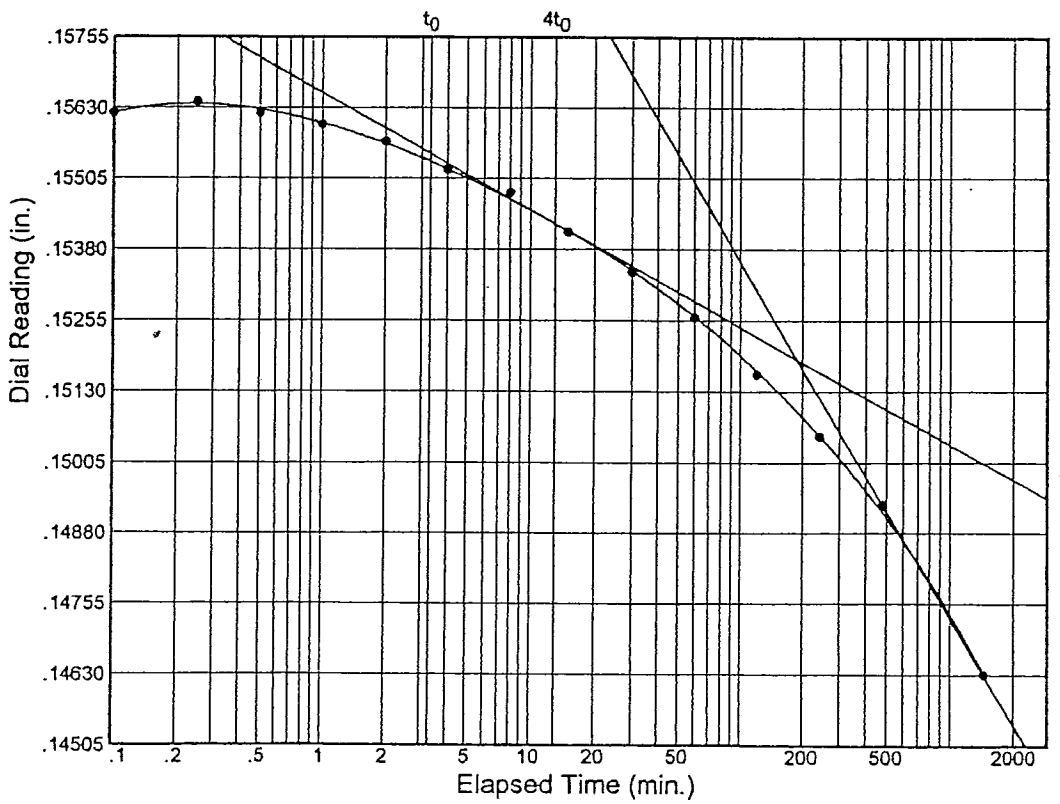
Dial Reading vs. Log of Time

Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# E-2 ID# 14703



Load No.= 15
Load= 0.50 tsf
D_0 = 0.16814
D_{50} = 0.16328
D_{100} = 0.15841
T_{50} = 18.69 min.

C_v @ T_{50}
0.01 ft.^{2}/day



Load No.= 16
Load= 0.13 tsf
D_0 = 0.15645
D_{50} = 0.15416
D_{100} = 0.15186
T_{50} = 14.49 min.

C_v @ T_{50}
0.01 ft.^{2}/day

p-w labs

PW LABORATORIES,INC.
P.O. BOX 56, 5879 FISHER ROAD, EAST SYRACUSE, NY 13057
315-437-1429 • 800-782-7260 • Fax 315-437-1770

June 6, 2001

Ms. Laura Brussel
Blasland, Bouck & Lee, Inc.
6723 Towpath Road
P.O. Box 66
Syracuse, New York 13214-0066

Re: L-01041
12th Street Landfill
Kalamazoo, Michigan
Project #64590

Dear Ms. Brussel:

Enclosed are the results of laboratory testing performed at your request on six Shelby tube material samples delivered to our laboratory on April 9, 2001 for the above referenced project. Results include:

1.	Natural Moisture Content ASTM D2216 Laboratory I.D. #14700, 14701, 14702, 14703, 14704, 14706	6 each
2.	Sieve Analysis ASTM D422 & D1140 Laboratory I.D. #14700, 14701, 14702, 14703, 14704, 14706	6 each
3.	Atterberg Limits ASTM D4318 Laboratory I.D. #14702, 14703, 14704, 14706	4 each
4.	Specific Gravity ASTM D854 Laboratory I.D. #14700, 14701, 14702, 14703, 14704, 14706	6 each
5.	Bulk (Natural) Soil Density Corps of Engineers EM-1110-2-1906 Appendix II, Displacement Method Laboratory I.D. #14700, 14701, 14702, 14703, 14704, 14706	6 each

June 6, 2001
Blasland, Bouck & Lee, Inc.

Re: L-01041
12th Street Landfill
Kalamazoo, Michigan
Project #64590

6.	Moisture, Ash and Organic Matter of Peat and Other Organic Soils ASTM D2974 Laboratory I.D. #14702, 14703, 14704, 14706	4 each
7.	UU Triaxial ASTM D2850 (1 point) Laboratory I.D. #14702, 14703, 14704, 14706	4 each
8.	Consolidation Test ASTM D2435 Laboratory I.D. #14704, 14706	2 each

The UU Triaxial Test was performed by J & L Testing Company, Inc. at the directionof PW Laboratories, Inc.

All requested tests have been completed on the previously received sample(s) for the above project. All sample remains are scheduled to be disposed of on July 7, 2001. Please notify PW Laboratories, Inc. by letter or telephone prior to July 7, 2001 if you would prefer to pick up the sample(s) or that the sample(s) be retained by PW Laboratories, Inc. for an additional period of time.

Additional reports will be forwarded to you as they are completed.

Thank you for this opportunity to work with you.

Very truly yours,

PW LABORATORIES, INC.

Donald P. Blasland, SET
V.P. - Laboratory & Field Services
DPB/bap
encs:

p-w labs

June 6, 2001

L-01041
12th Street Landfill
Kalamazoo, Michigan
Project # 64590

NATURAL MOISTURE CONTENT
ASTM D2216

Lab I.D. #	Boring #.	Depth (feet)	Moisture Content as a Percent of Dry Weight	
14700	B-1	4.0 – 6.0	78.1	
14701	B-2	14.0 – 16.0	38.6	
14702	D-1	4.0 – 6.0	89.6	
14703	E-2	6.0 – 8.0	62.8	
14704	G-2	4.0 – 6.0	81.6	87.3 > Consol.
14706	G-4	14.0 – 16.0	56.8	88.1

SIEVE ANALYSIS OF SOIL / AGGREGATE

p-w labs

PROJECT TITLE: Laboratory Testing12th Street Landfill - Kalamazoo Michigan
Project # 64590

PROJECT # L-01041
TEST METHOD ASTM D422 & D1140

REPORT # 1
REPORT DATE June 6, 2001

			Sieve Size - Percent Passing Sieve														
Lab I.D. #	Boring #	Depth (feet)	1"	3/4"	1/2"	3/8"	1/4"	#4	#10	#30	#40	#60	#100	#200			
14700	B-1	4.0 - 6.0	--	--	--	--	100	99.9	99.8	91.6	83.5	69.7	57.8	41.0			
14701	B-2	14.0 - 16.0	--	--	100	96.9	92.0	87.5	74.8	50.1	43.5	32.5	25.5	20.2			
14702	D-1	4.0 - 6.0	--	--	--	100	99.7	99.0	93.0	77.1	72.4	64.0	57.5	51.8			
14703	E-2	6.0 - 8.0	--	--	--	100	99.2	98.1	90.8	57.4	48.9	38.0	32.6	29.5			
14704	G-2	4.0 - 6.0	--	--	100	99.4	97.6	96.1	79.4	51.9	45.2	37.9	32.8	27.0			
14706	G-4	14.0 - 16.0	100	94.0	94.0	91.1	88.7	88.1	80.4	59.3	52.9	46.4	43.0	40.3			

Sample mass, as received, meets minimum requirements of test method: Yes ____ No X

Prewashed: Yes X No ____

Remarks:

Performed By: CP, LO, JE

Checked By: V.J. Thoma

p-w labs

June 6, 2001

L-01041
12th Street Landfill
Kalamazoo, Michigan
Project # 64590

ATTERBERG LIMITS
ASTM D4318

Lab ID#	Boring #.	Depth (feet)	Plastic Limit	Liquid Limit	Plasticity Index
14702	D-1	4.0 – 6.0	Non-Plastic	--	--
14703	E-2	6.0 – 8.0	68	81	13
14704	G-2	4.0 – 6.0	51	68	17
14706	G-4	14.0 – 16.0	65	83	18

p-w labs

June 6, 2001

L-01041
12th Street Landfill
Kalamazoo, Michigan
Project # 64590

MOISTURE, ASH, AND ORGANIC MATTER OF
PEAT AND OTHER ORGANIC SOILS
ASTM D2974

Lab I.D. #	Boring #	Depth (feet)	Organic Content as a Percent of Original Weight
14702	D-1	4.0 - 6.0	23.7
14703	E-2	6.0 - 8.0	26.6
14704	G-2	4.0 - 6.0	23.0
14706	G-4	14.0 - 16.0	28.6

p-w labs

June 6, 2001

L-01041
12th Street Landfill
Kalamazoo, Michigan
Project # 64590

BULK(NATURAL) SOIL DENSITY
CORPS OF ENGINEERS EM-1110-2-1906
APPENDIX II. DISPLACEMENT METHOD

Lab I.D. #	Boring #	Depth (feet)	Bulk (Natural) Soil Density (PCF) Dry Density	Moist Density
14700	B-1	4.0 - 6.0	28.7	51.1
14701	B-2	14.0 - 16.0	75.1	103.3
14702	D-1	4.0 - 6.0	43.7	84.5
14703	E-2	6.0 - 8.0	50.4	70.1
14704	G-2	4.0 - 6.0	46.5	87.3
14706	G-4	14.0 - 16.0	48.8	87.4

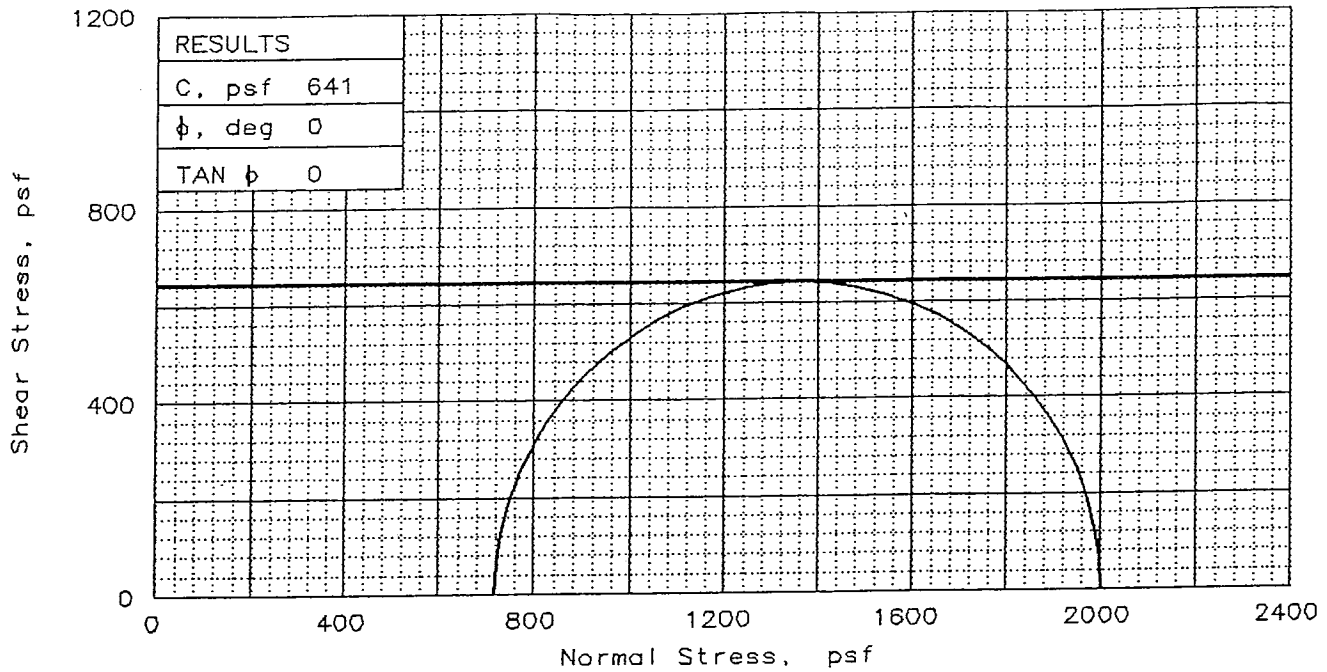
p-w labs

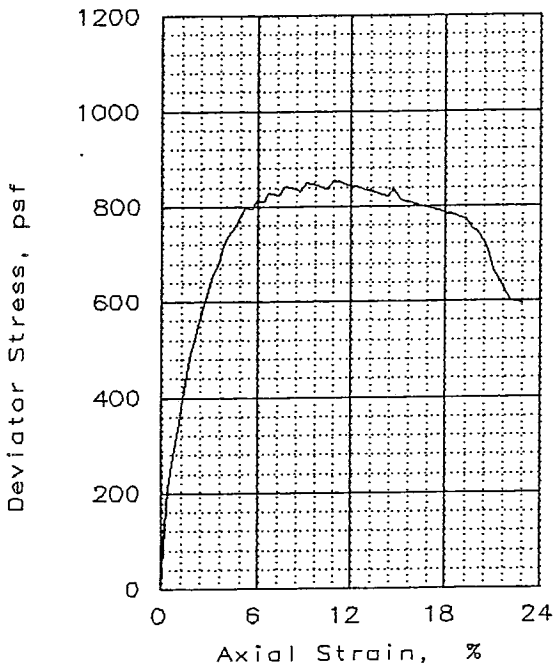
June 6, 2001

L-01041
12th Street Landfill
Kalamazoo, Michigan
Project # 64590

SPECIFIC GRAVITY OF SOILS ASTM D854

Lab I.D. #	Boring #	Depth (feet)	Minus No. 4 Fraction Specific Gravity of Solids (G)
14700	B-1	4.0 – 6.0	1.94
14701	B-2	14.0 – 16.0	2.48
14702	D-1	4.0 – 6.0	2.26
14703	E-2	6.0 – 8.0	2.36
14704	G-2	4.0 – 6.0	2.23
14706	G-4	14.0 – 16.0	2.12





SAMPLE NO.		1
INITIAL	WATER CONTENT, %	45.0
	DRY DENSITY, pcf	62.9
	SATURATION, %	73.1
	VOID RATIO	1.631
	DIAMETER, in	2.80
	HEIGHT, in	5.70
AT TEST	WATER CONTENT, %	45.0
	DRY DENSITY, pcf	62.9
	SATURATION, %	73.1
	VOID RATIO	1.631
	DIAMETER, in	2.80
	HEIGHT, in	5.70
Strain rate, in/min		0.050
BACK PRESSURE, psf		0
CELL PRESSURE, psf		720
FAILURE STRESS, psf		1282
PORE PRESSURE, psf		
ULTIMATE STRESS, psf		596
PORE PRESSURE, psf		
σ_1 FAILURE, psf		2002
σ_3 FAILURE, psf		720

TYPE OF TEST:
Unconsolidated undrained
SAMPLE TYPE: TUBE SAMPLE
DESCRIPTION: SAMPLE D-1 (4'-6')

LL= PL= PI=
SPECIFIC GRAVITY= 2.65
REMARKS:

CLIENT: PW LABORATORIES

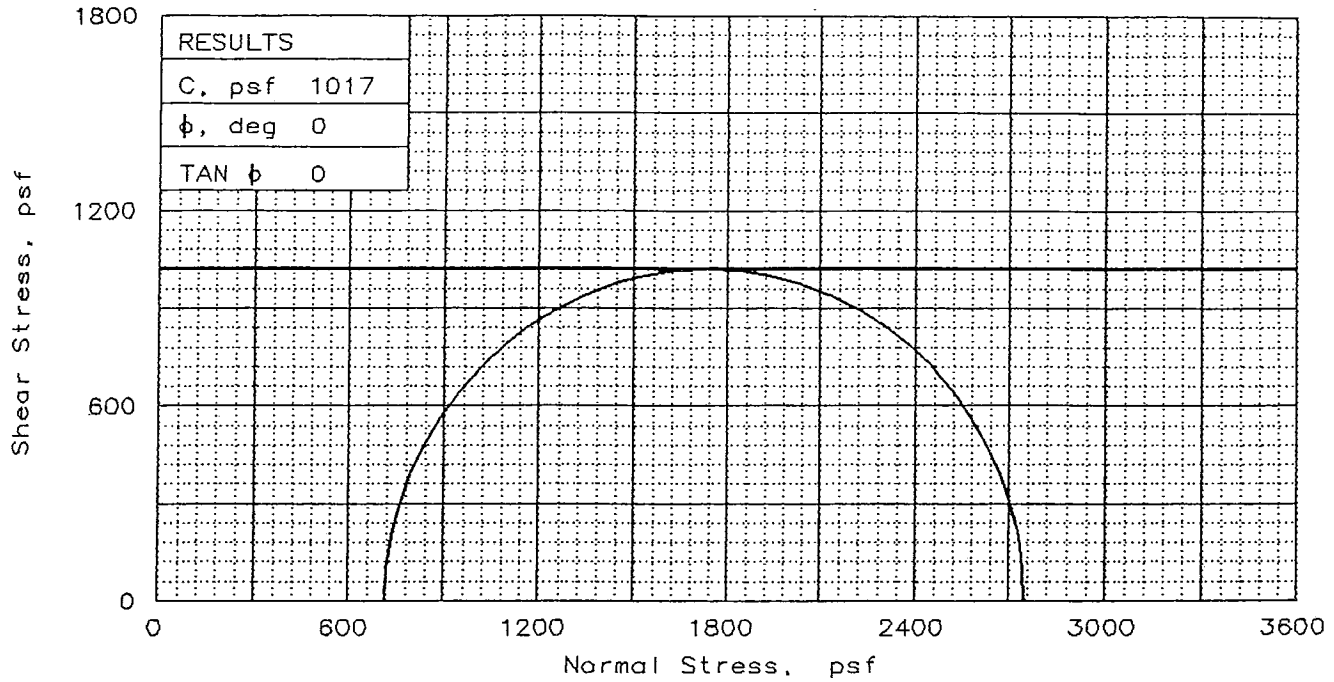
PROJECT: 12 STREET LANDFILL
PROJECT No. L-01041; LAB I.D. No. 14702
SAMPLE LOCATION: KALAMAZOO, MICHICAN

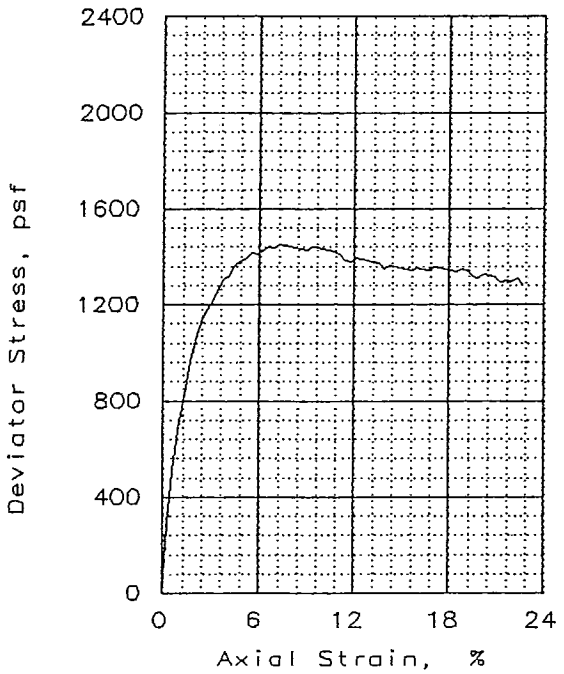
PROJ. NO.: 01S2663-02 DATE: 5/3/01

TRIAXIAL SHEAR TEST REPORT

J & L TESTING CO., INC.

FIG. NO. 1





SAMPLE NO.		1
INITIAL	WATER CONTENT, %	30.5
	DRY DENSITY, pcf	82.2
	SATURATION, %	79.9
	VOID RATIO	1.012
	DIAMETER, in	2.80
	HEIGHT, in	5.75
AT TEST	WATER CONTENT, %	30.5
	DRY DENSITY, pcf	82.2
	SATURATION, %	79.9
	VOID RATIO	1.012
	DIAMETER, in	2.80
	HEIGHT, in	5.75
Strain rate, in/min		0.050
BACK PRESSURE, psf		0
CELL PRESSURE, psf		720
FAILURE STRESS, psf		2034
PORE PRESSURE, psf		
ULTIMATE STRESS, psf		1285
PORE PRESSURE, psf		
σ_1 FAILURE, psf		2754
σ_3 FAILURE, psf		720

TYPE OF TEST:
Unconsolidated undrained
SAMPLE TYPE: TUBE SAMPLE
DESCRIPTION: SAMPLE E-2 (6'-8')

LL= PL= PI=
SPECIFIC GRAVITY= 2.65
REMARKS:

CLIENT: PW LABORATORIES

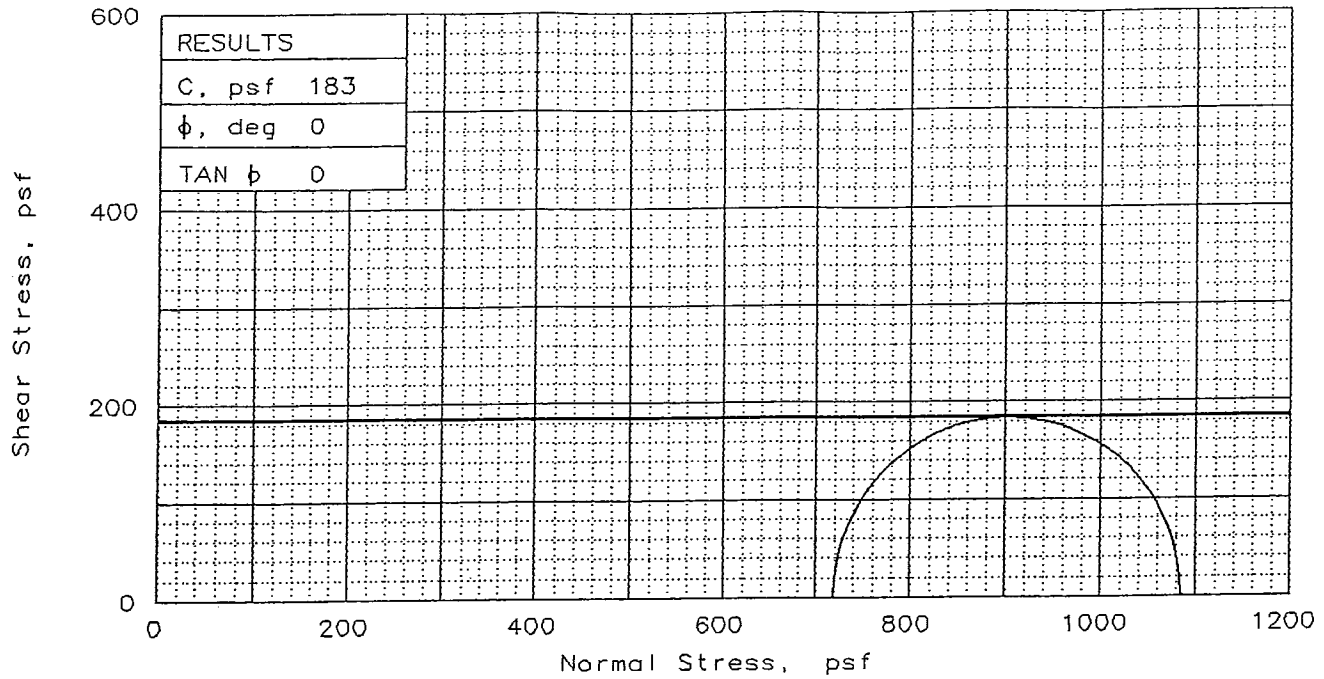
PROJECT: 12 STREET LANDFILL
PROJECT No. L-01041; LAB I.D. No. 14703
SAMPLE LOCATION: KALAMAZOO, MICHIGAN

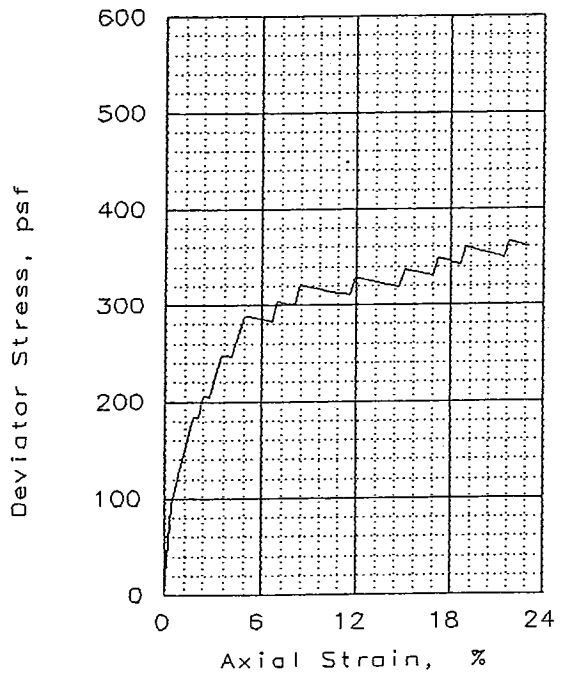
PROJ. NO.: 01S2663-02 DATE: 5/3/01

TRIAXIAL SHEAR TEST REPORT

J & L TESTING CO., INC.

FIG. NO. 1





SAMPLE NO.		1
INITIAL	WATER CONTENT, %	66.1
	DRY DENSITY, pcf	54.9
	SATURATION, %	87.1
	VOID RATIO	2.011
	DIAMETER, in	2.80
	HEIGHT, in	5.70
AT TEST	WATER CONTENT, %	66.1
	DRY DENSITY, pcf	54.9
	SATURATION, %	87.1
	VOID RATIO	2.011
	DIAMETER, in	2.80
	HEIGHT, in	5.70
Strain rate, in/min		0.050
BACK PRESSURE, psf		0
CELL PRESSURE, psf		720
FAILURE STRESS, psf		366
PORE PRESSURE, psf		
ULTIMATE STRESS, psf		361
PORE PRESSURE, psf		
σ_1 FAILURE, psf		1086
σ_3 FAILURE, psf		720

TYPE OF TEST:
Unconsolidated undrained
SAMPLE TYPE: TUBE SAMPLE
DESCRIPTION: SAMPLE G-2 (4-6)

LL= PL= PI=
SPECIFIC GRAVITY= 2.65
REMARKS:

CLIENT: PW LABORATORIES

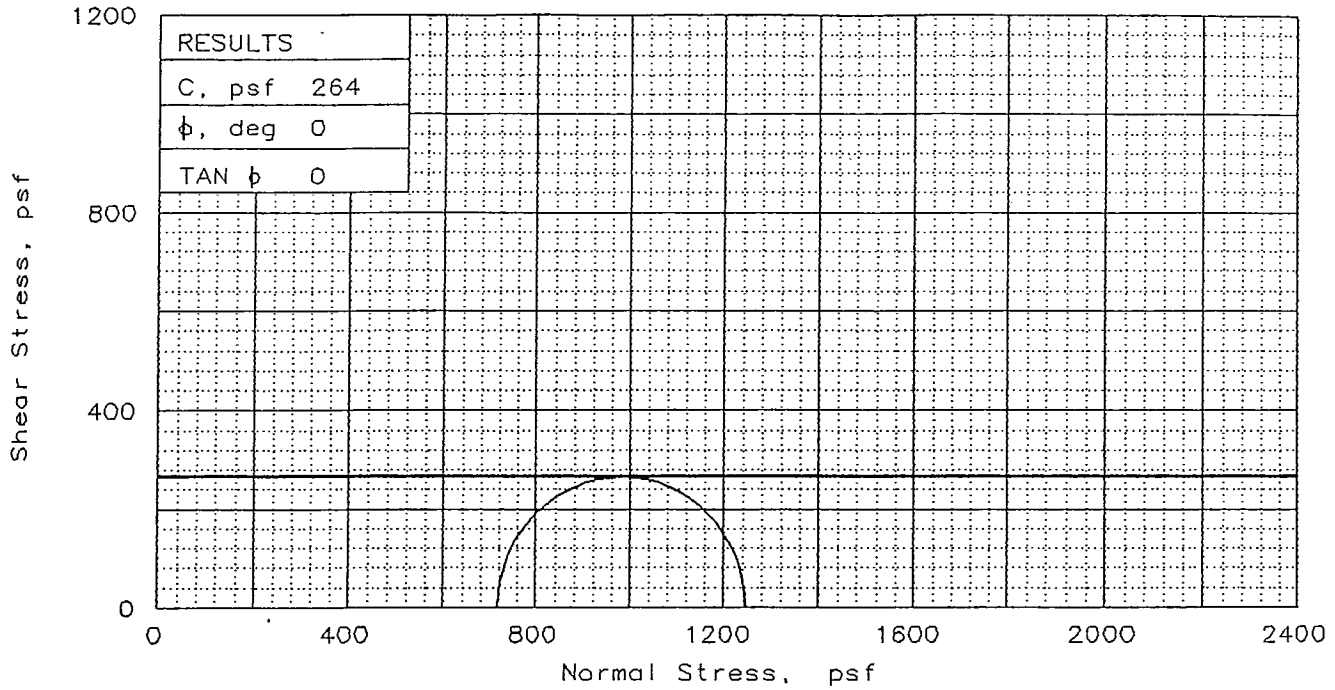
PROJECT: 12th STREET LANDFILL
PROJECT No. L-01041; LAB I.D. No. 14704
SAMPLE LOCATION: KALAMAZOO, MICHIGAN

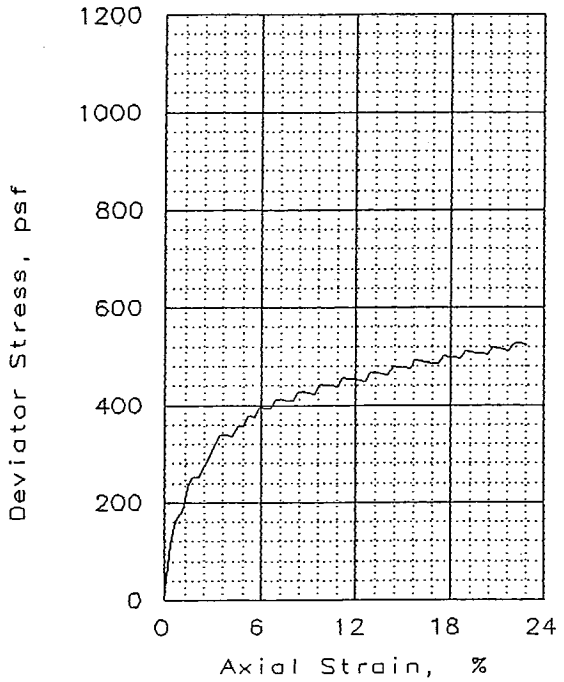
PROJ. NO.: 01S2664-03 DATE: 5/17/01

TRIAXIAL SHEAR TEST REPORT

J & L TESTING CO., INC.

FIG. NO. 1





SAMPLE NO.		1
INITIAL	WATER CONTENT, %	79.8
	DRY DENSITY, pcf	49.7
	SATURATION, %	90.8
	VOID RATIO	2.329
	DIAMETER, in	2.80
	HEIGHT, in	5.70
AT TEST	WATER CONTENT, %	79.8
	DRY DENSITY, pcf	49.7
	SATURATION, %	90.8
	VOID RATIO	2.329
	DIAMETER, in	2.80
	HEIGHT, in	5.70
Strain rate, in/min		0.050
BACK PRESSURE, psf		0
CELL PRESSURE, psf		720
FAILURE STRESS, psf		528
PORE PRESSURE, psf		
ULTIMATE STRESS, psf		524
PORE PRESSURE, psf		
σ_1 FAILURE, psf		1248
σ_3 FAILURE, psf		720

TYPE OF TEST:
Unconsolidated undrained
SAMPLE TYPE: TUBE SAMPLE
DESCRIPTION: SAMPLE G-4 (14-16)

LL= PL= PI=
SPECIFIC GRAVITY= 2.65
REMARKS:

CLIENT: PW LABORATORIES

PROJECT: 12th STREET LANDFILL
PROJECT No. L-01041; LAB I.D. No. 14706
SAMPLE LOCATION: KALAMAZOO, MICHIGAN

PROJ. NO.: 01S2664-03 DATE: 5/17/01

TRIAXIAL SHEAR TEST REPORT

J & L TESTING CO., INC.

FIG. NO. 2

CONSOLIDATION TEST REPORT

Coefficients of Consolidation and Secondary Consolidation

No.	Load (tsf)	C_v (ft.2/day)	C_α	No.	Load (tsf)	C_v (ft.2/day)	C_α	No.	Load (tsf)	C_v (ft.2/day)	C_α
1	0.05	0.31	0.003	11	2.00	0.02	0.017				
2	0.13	0.04	0.005	12	4.00	0.02	0.016				
3	0.25	0.01	0.010	13	8.00	0.02	0.015				
4	0.50	0.04	0.019	14	2.00	0.09					
5	1.00	0.01	0.018	15	0.50	0.01					
6	0.25	0.30		16	0.13	0.01					
7	0.13	0.00									
8	0.25	0.40	0.001								
9	0.50	0.00	0.002								
10	1.00	0.02	0.008								

Natural Saturation	Natural Moisture	Dry Dens. (pcf)	LL	PI	Sp. Gr.	P_c (tsf)	C_c	Initial Void Ratio
94.0 %	87.3 %	41.5	68	17	2.23	0.20	0.63	2.073

MATERIAL DESCRIPTION	USCS	AASHTO
Grey moist silty sand (paper residue)	OH	

Project No. L-01041 **Client:** BLASLAND BOUCK & LEE

Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN

Location: BORING# G-2 ID# 14704

Remarks:

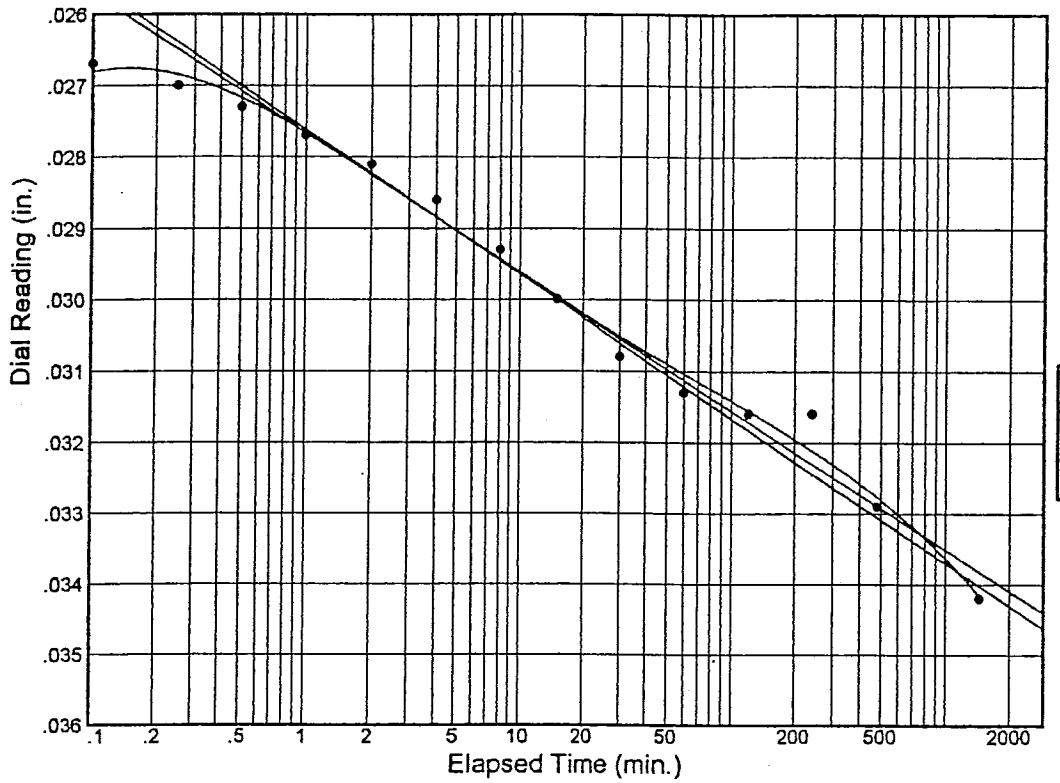
CONSOLIDATION TEST REPORT

PW LABORATORIES, INC.

a

Dial Reading vs. Log of Time

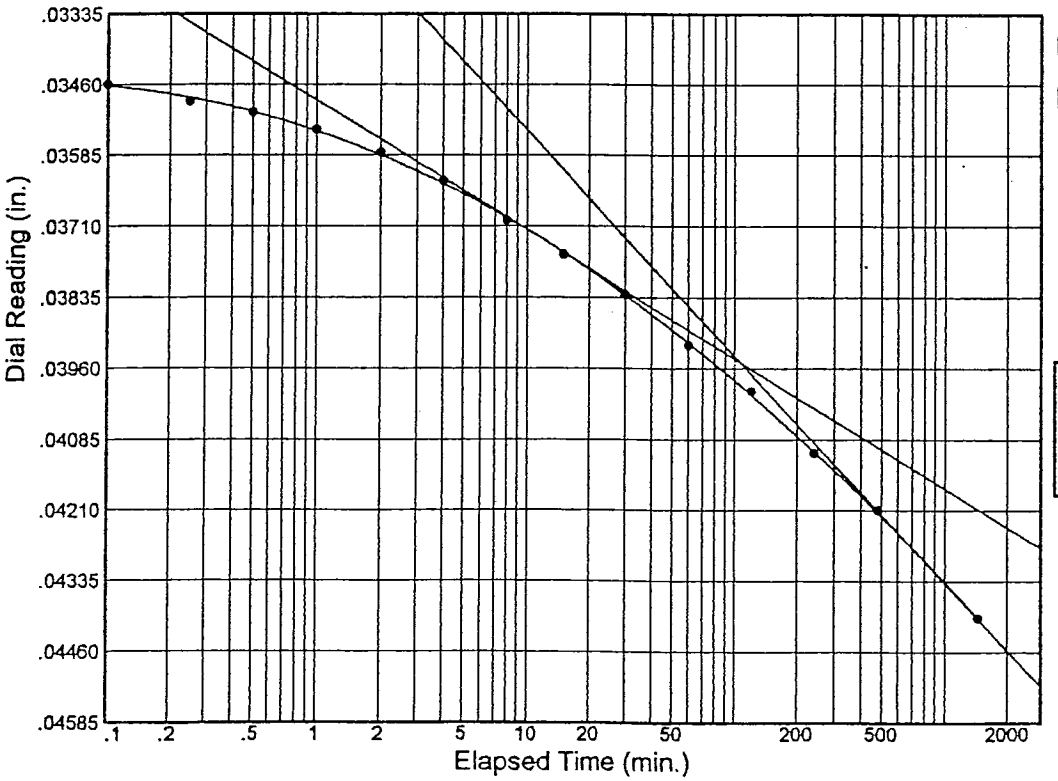
Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# G-2 ID# 14704



Load No.= 1
Load= 0.05 tsf
D_0 = 0.02630
D_{50} = 0.02758
D_{100} = 0.02886
T_{50} = 0.90 min.

C_v @ T_{50}
0.31 ft.^{2}/day

C_α = 0.003



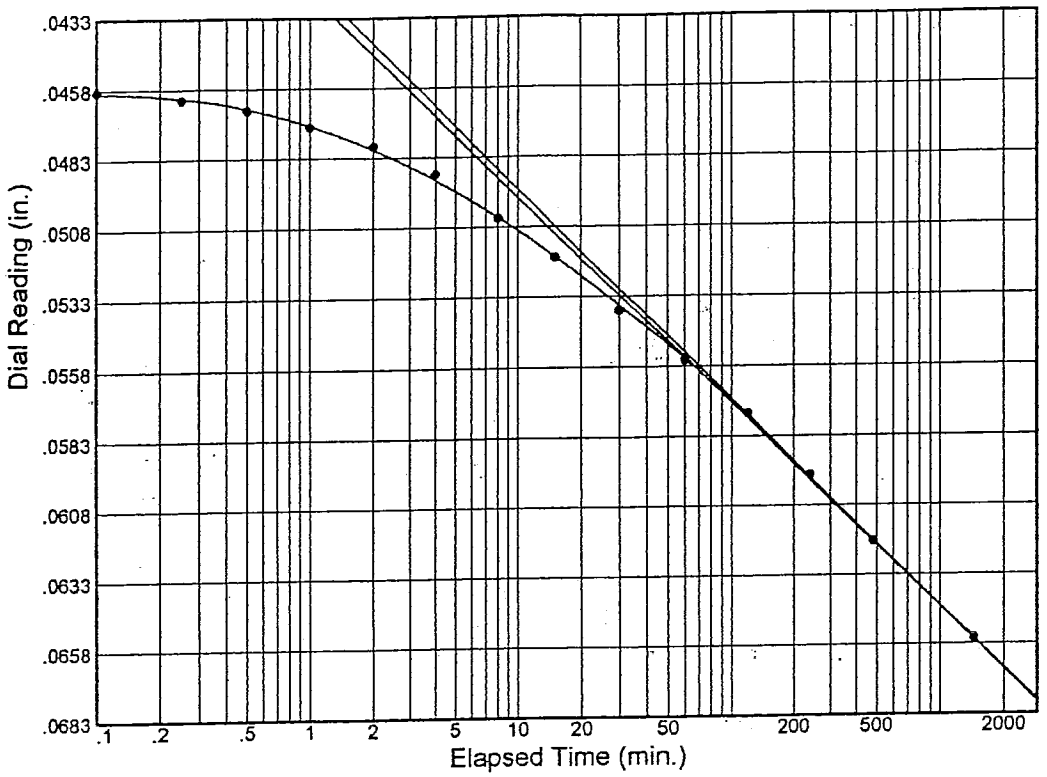
Load No.= 2
Load= 0.13 tsf
D_0 = 0.03420
D_{50} = 0.03685
D_{100} = 0.03949
T_{50} = 7.14 min.

C_v @ T_{50}
0.04 ft.^{2}/day

C_α = 0.005

Dial Reading vs. Log of Time

Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# G-2 ID# 14704



Load No.= 3

Load= 0.25 tsf

D_0 = 0.04400

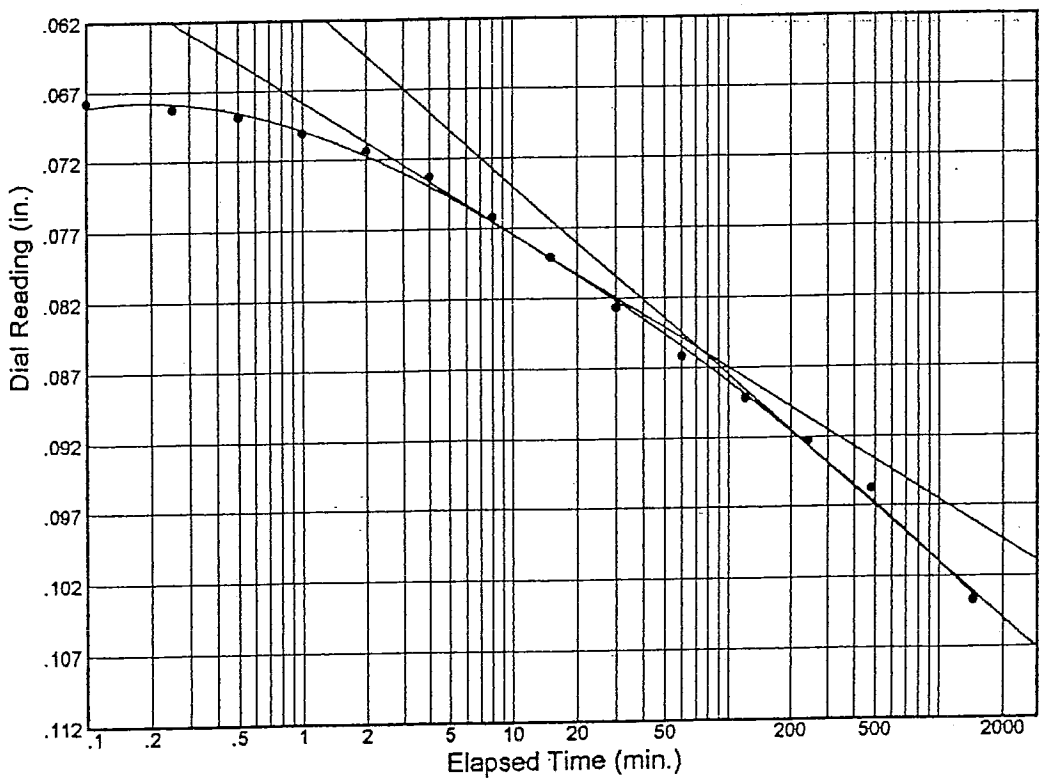
D_{50} = 0.05430

D_{100} = 0.06460

T_{50} = 38.66 min.

C_v @ T_{50}
0.01 ft.^{2}/day

C_α = 0.010



Load No.= 4

Load= 0.50 tsf

D_0 = 0.06560

D_{50} = 0.07567

D_{100} = 0.08574

T_{50} = 6.37 min.

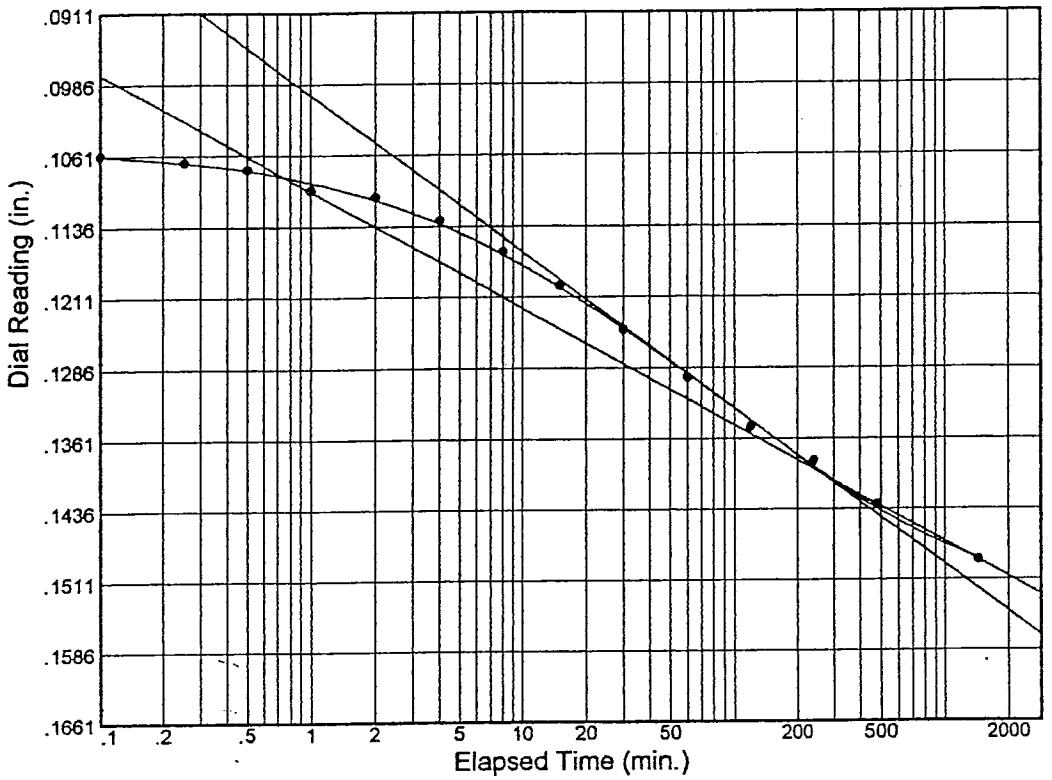
C_v @ T_{50}
0.04 ft.^{2}/day

C_α = 0.019

c

Dial Reading vs. Log of Time

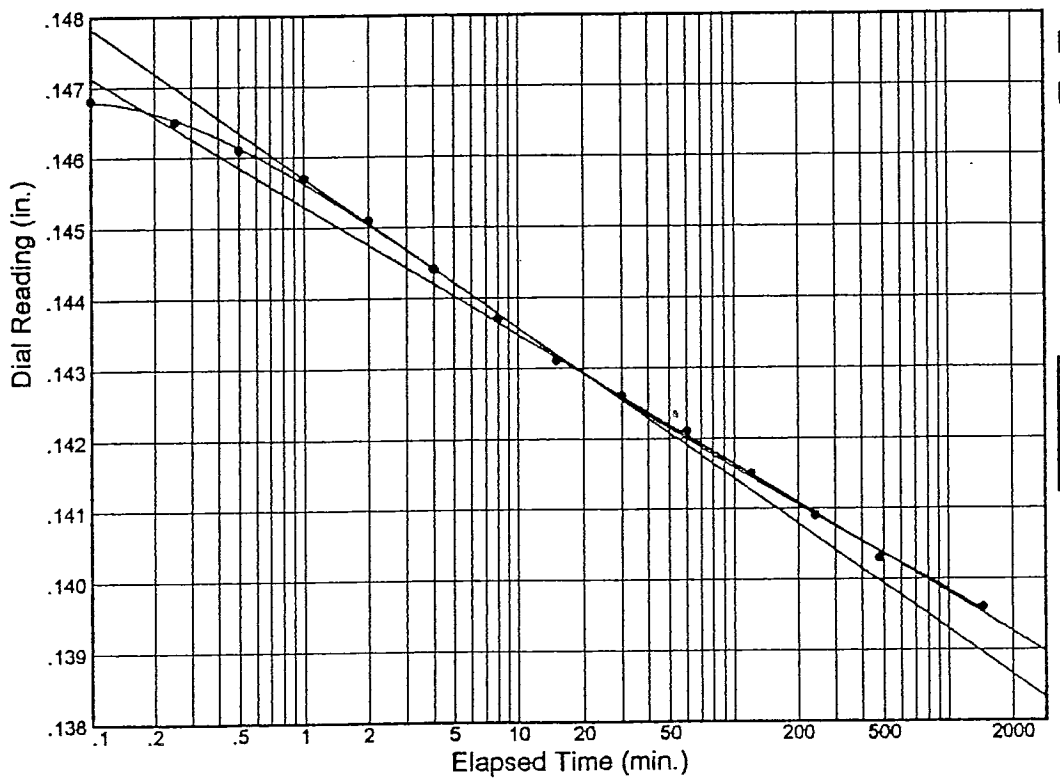
Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# G-2 ID# 14704



Load No.= 5
Load= 1.00 tsf
D_0 = 0.10370
D_{50} = 0.12182
D_{100} = 0.13994
T_{50} = 19.95 min.

C_v @ T_{50}
0.01 ft.^{2}/day

C_α = 0.018



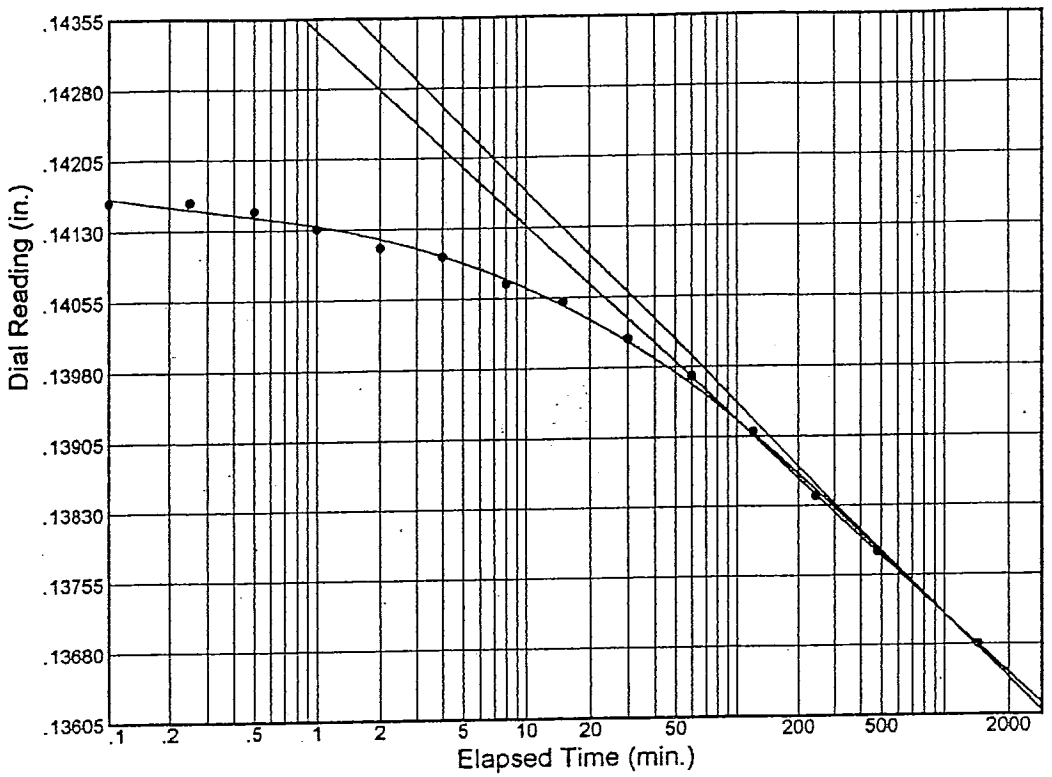
Load No.= 6
Load= 0.25 tsf
D_0 = 0.14900
D_{50} = 0.14595
D_{100} = 0.14289
T_{50} = 0.66 min.

C_v @ T_{50}
0.30 ft.^{2}/day

d

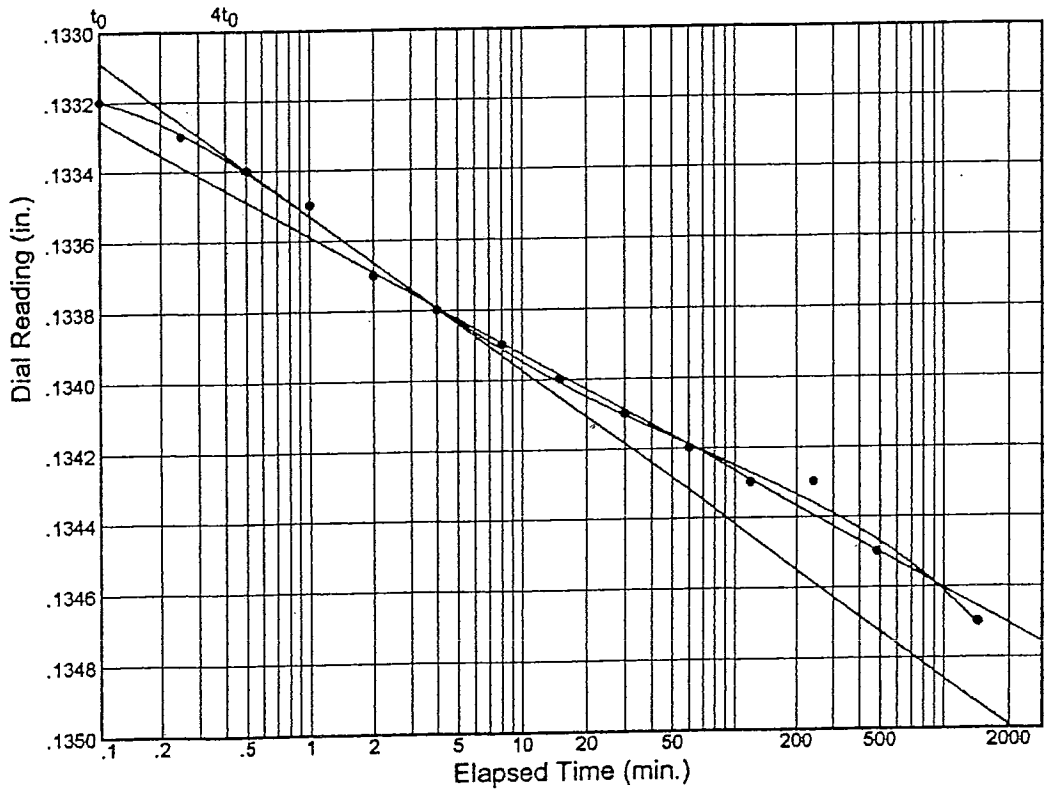
Dial Reading vs. Log of Time

Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# G-2 ID# 14704



Load No.= 7
Load= 0.13 tsf
D_0 = 0.13960
D_{50} = 0.13839
D_{100} = 0.13718
T_{50} = 266.42 min.

C_v @ T_{50}
0.00 ft.^{2}/day



Load No.= 8
Load= 0.25 tsf
D_0 = 0.13304
D_{50} = 0.13341
D_{100} = 0.13378
T_{50} = 0.51 min.

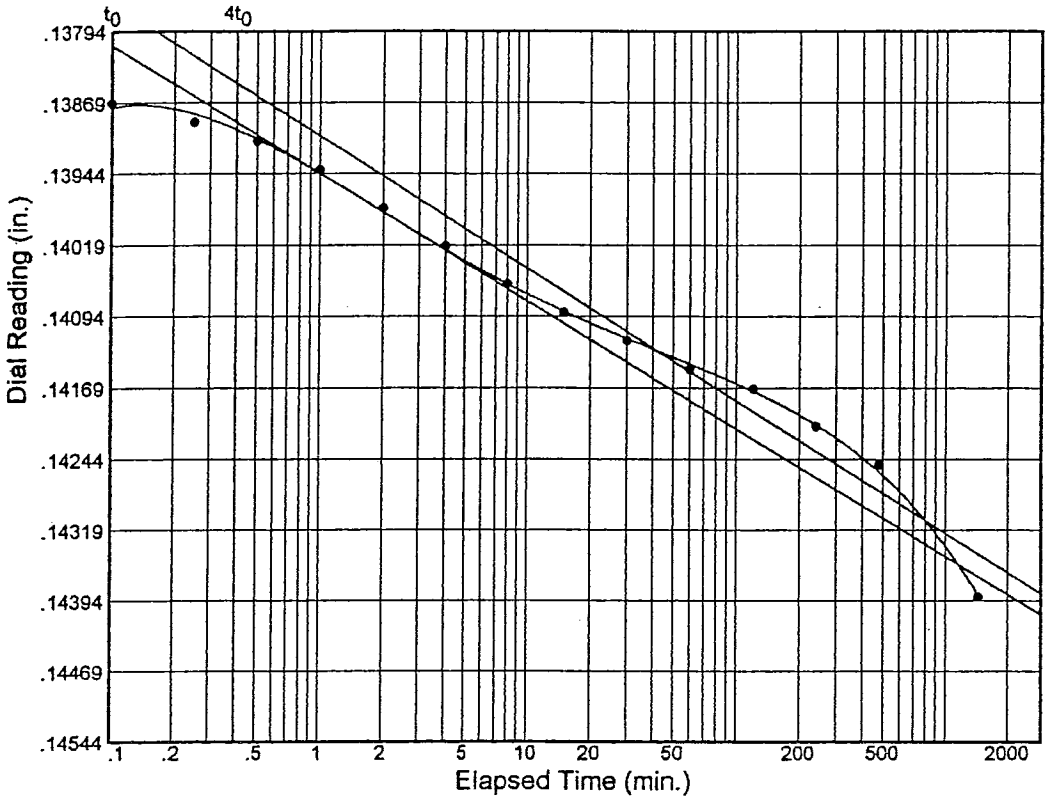
C_v @ T_{50}
0.40 ft.^{2}/day

C_α = 0.001

e

Dial Reading vs. Log of Time

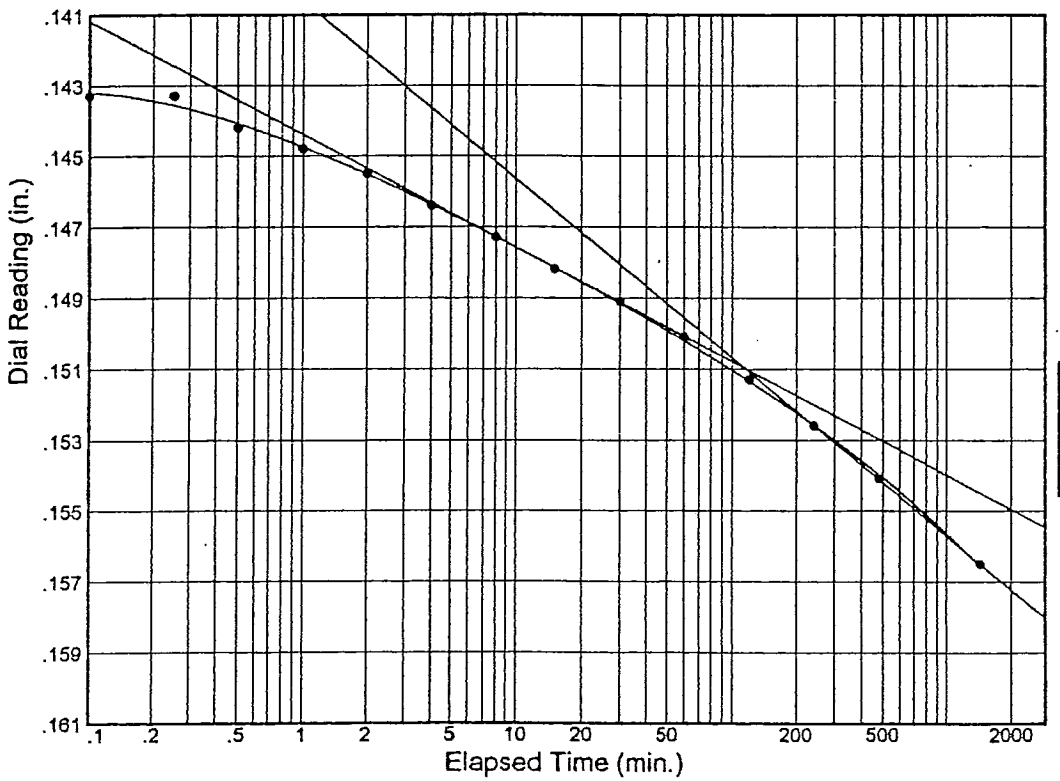
Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# G-2 ID# 14704



Load No.= 9
Load= 0.50 tsf
D_0 = 0.13470
D_{50} = 0.14248
D_{100} = 0.15027
T_{50} = 429.80 min.

C_v @ T_{50}
0.00 ft.^{2}/day

C_α = 0.002



Load No.= 10
Load= 1.00 tsf
D_0 = 0.14390
D_{50} = 0.14744
D_{100} = 0.15097
T_{50} = 8.98 min.

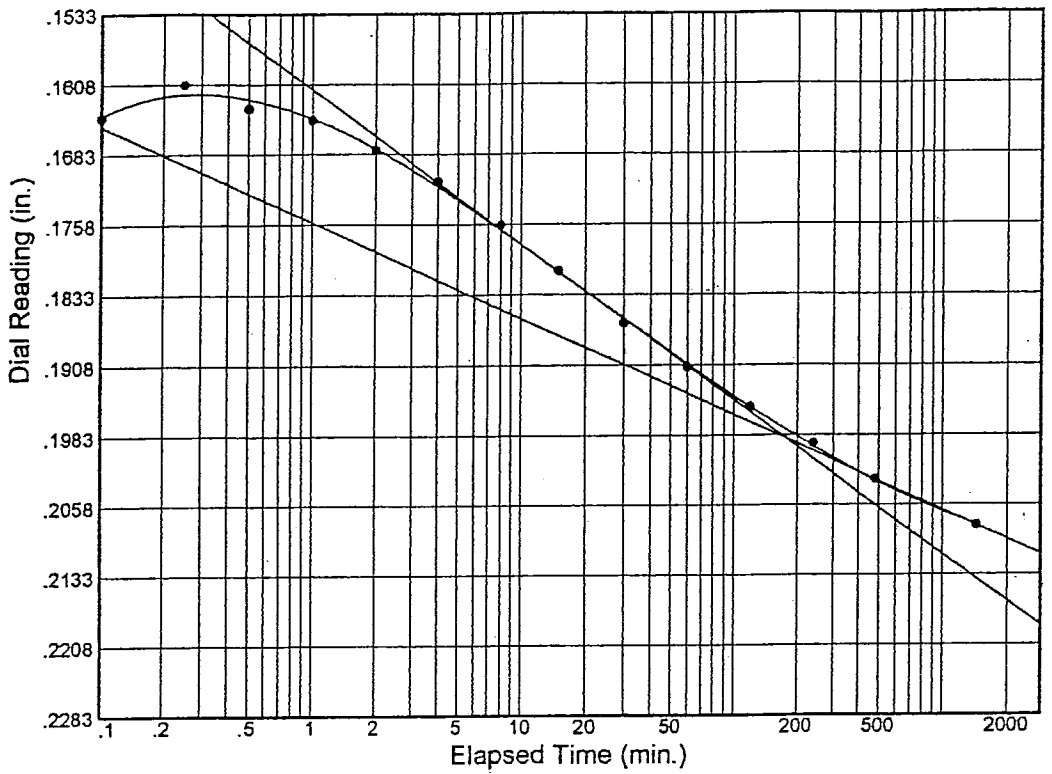
C_v @ T_{50}
0.02 ft.^{2}/day

C_α = 0.008

f

Dial Reading vs. Log of Time

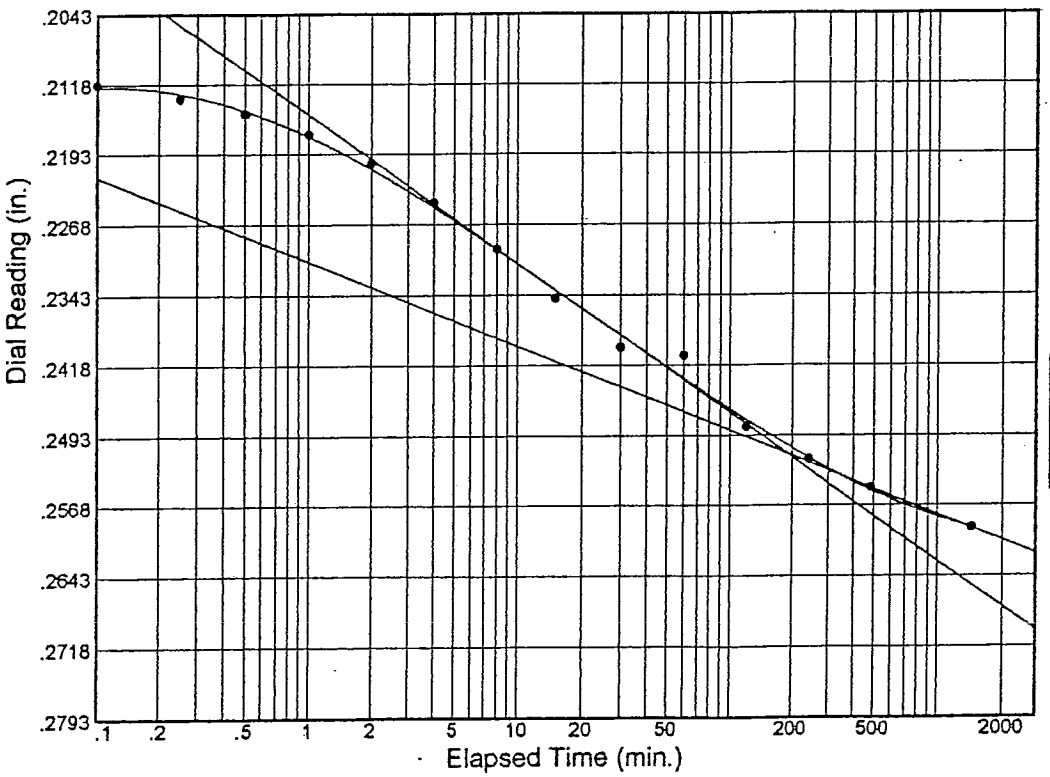
Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# G-2 ID# 14704



Load No.= 11
Load= 2.00 tsf
D_0 = 0.15650
D_{50} = 0.17758
D_{100} = 0.19867
T_{50} = 9.46 min.

C_v @ T_{50}
0.02 ft.^{2}/day

C_α = 0.017



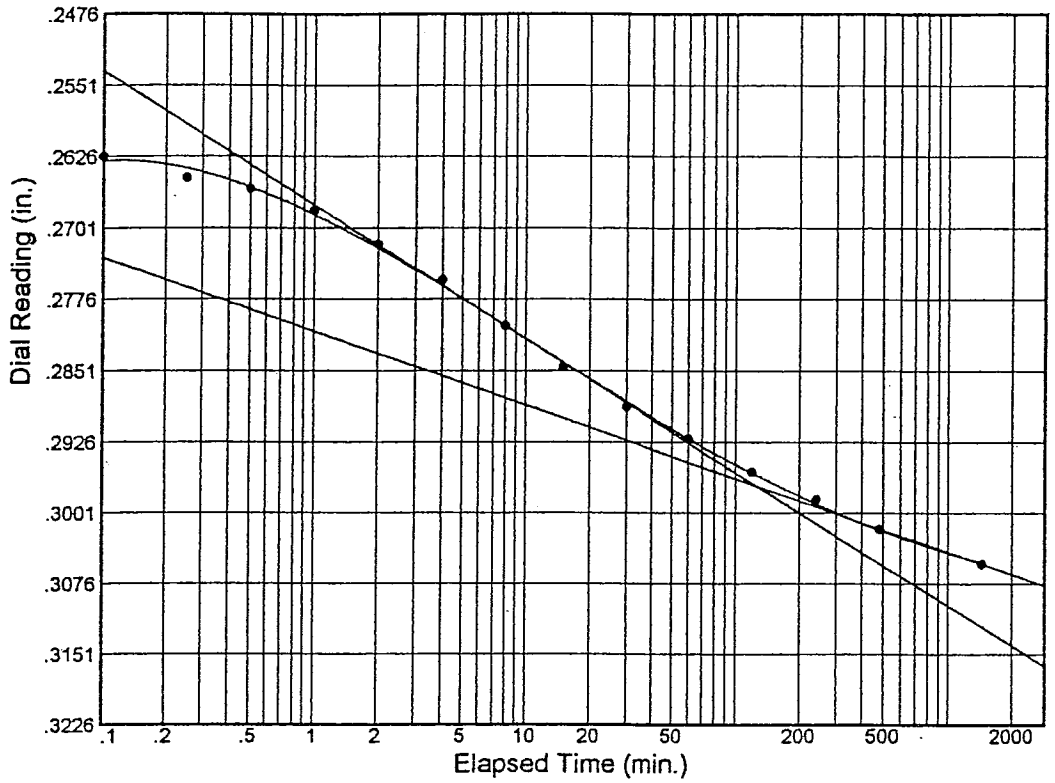
Load No.= 12
Load= 4.00 tsf
D_0 = 0.20800
D_{50} = 0.22964
D_{100} = 0.25127
T_{50} = 8.19 min.

C_v @ T_{50}
0.02 ft.^{2}/day

C_α = 0.016

Dial Reading vs. Log of Time

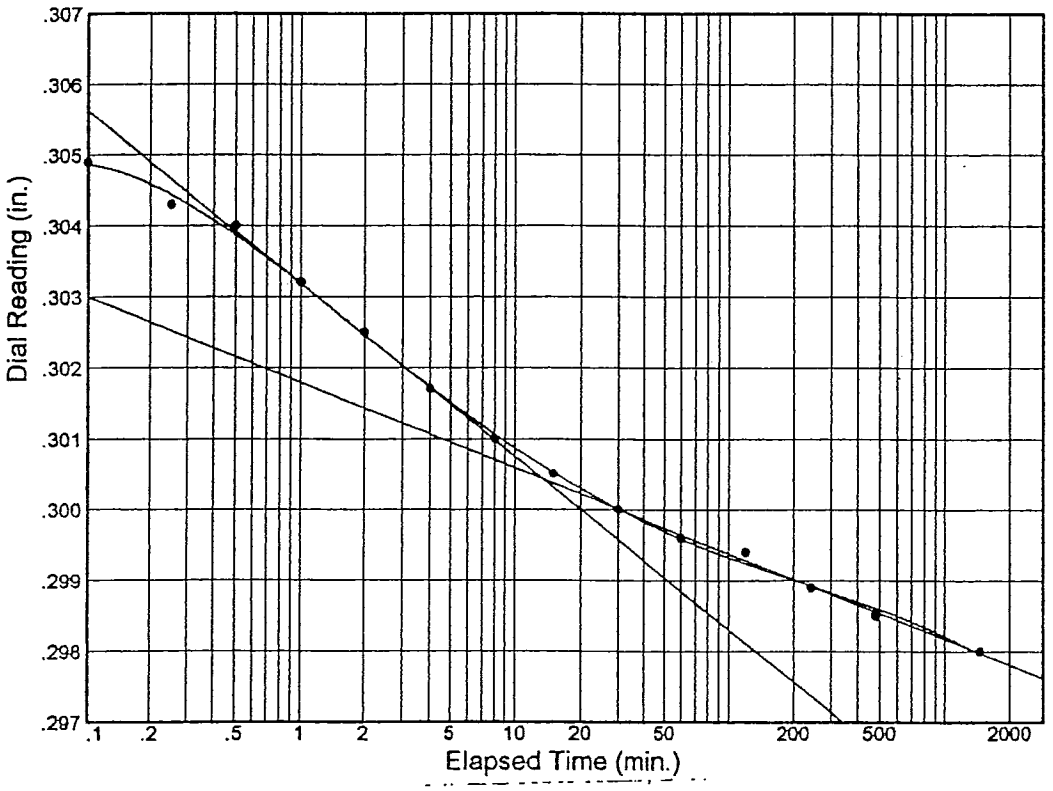
Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# G-2 ID# 14704



Load No.= 13
Load= 8.00 tsf
D_0 = 0.25920
D_{50} = 0.27828
D_{100} = 0.29736
T_{50} = 5.66 min.

C_v @ T_{50}
0.02 ft.^{2}/day

C_α = 0.015



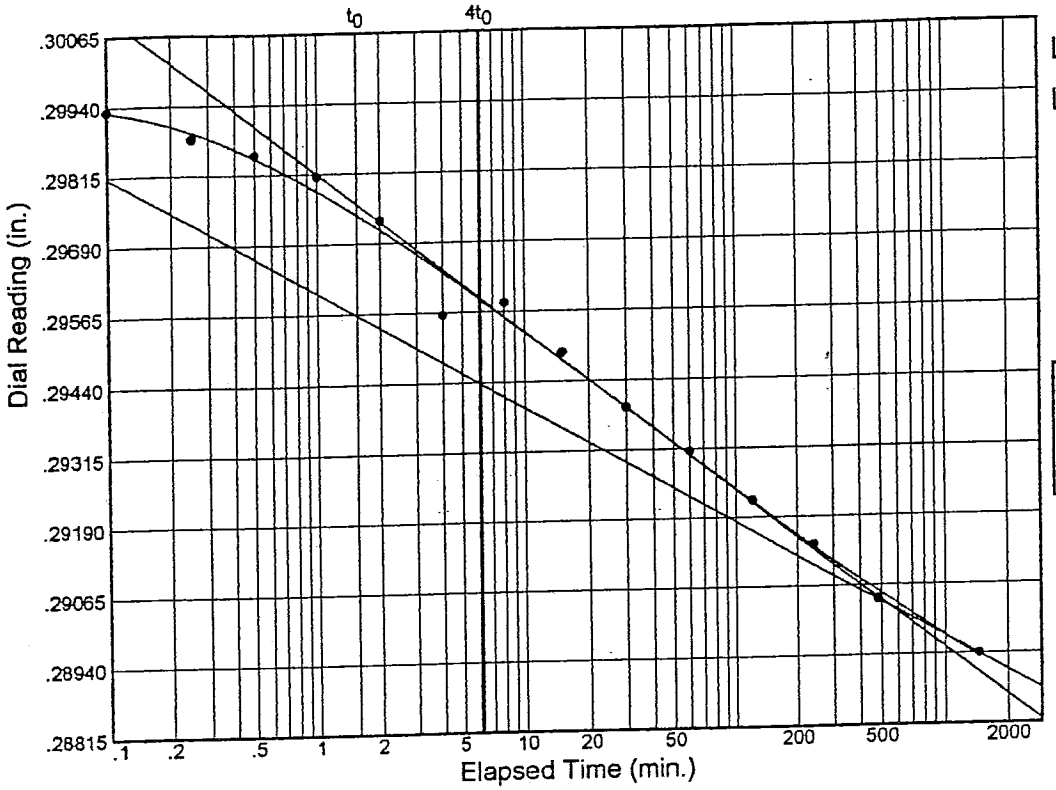
Load No.= 14
Load= 2.00 tsf
D_0 = 0.30550
D_{50} = 0.30296
D_{100} = 0.30043
T_{50} = 1.24 min.

C_v @ T_{50}
0.09 ft.^{2}/day

h

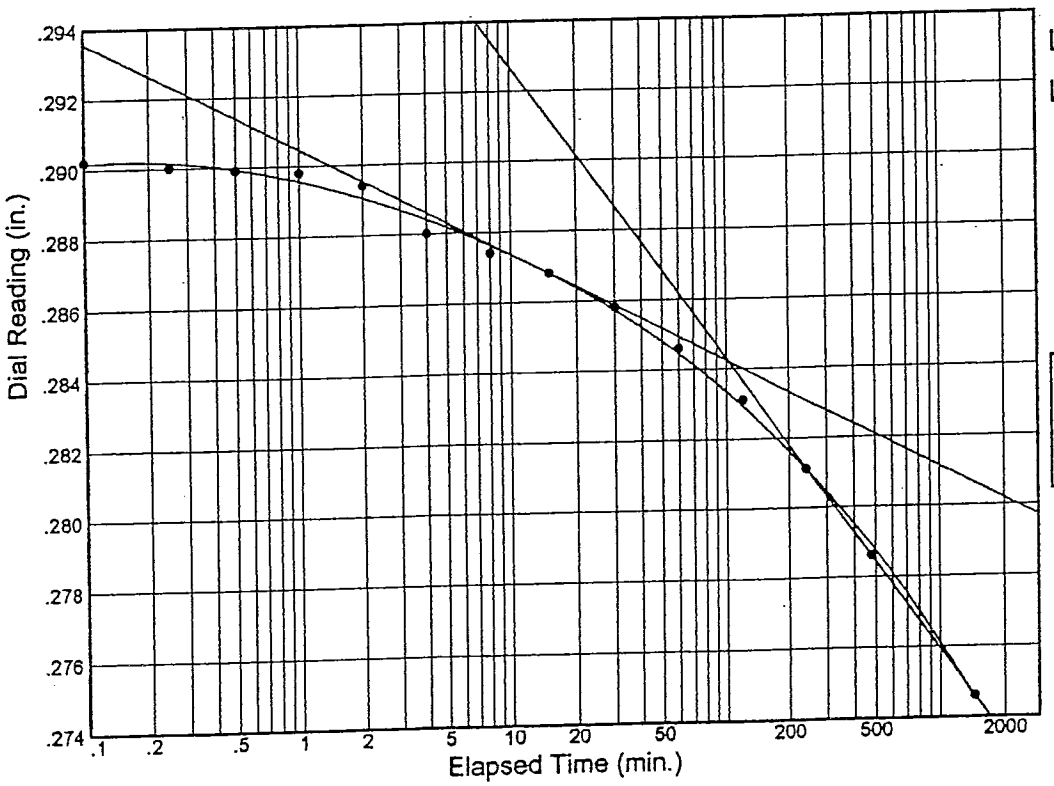
Dial Reading vs. Log of Time

Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# G-2 ID# 14704



Load No.= 15
Load= 0.50 tsf
D_0 = 0.29897
D_{50} = 0.29463
D_{100} = 0.29029
T_{50} = 16.74 min.

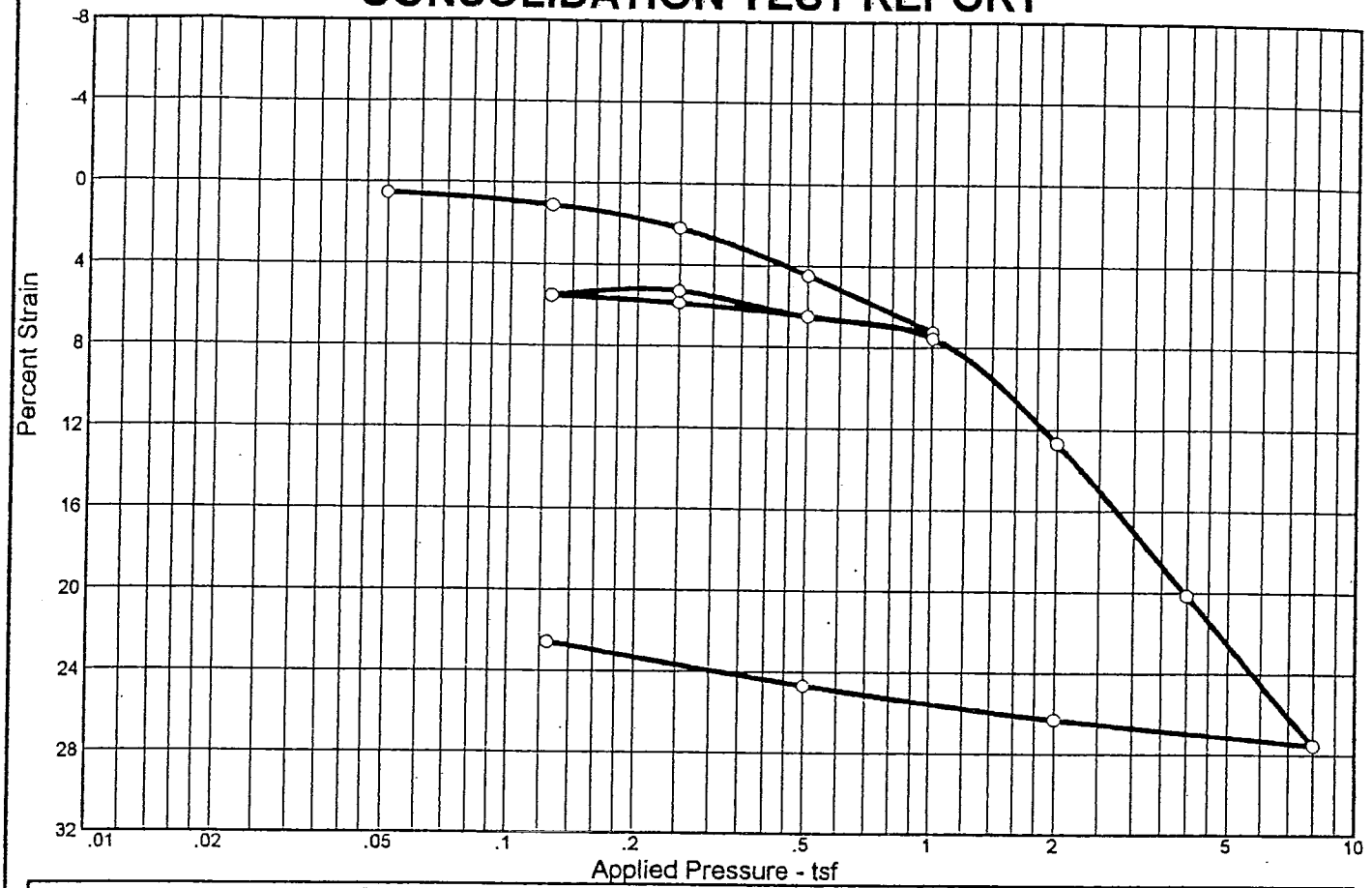
C_v @ T_{50}
0.01 ft.^{2}/day



Load No.= 16
Load= 0.13 tsf
D_0 = 0.28940
D_{50} = 0.28681
D_{100} = 0.28421
T_{50} = 14.96 min.

C_v @ T_{50}
0.01 ft.^{2}/day

CONSOLIDATION TEST REPORT



Coefficients of Consolidation and Secondary Consolidation

No.	Load (tsf)	C_v (ft.2/day)	C_α	No.	Load (tsf)	C_v (ft.2/day)	C_α	No.	Load (tsf)	C_v (ft.2/day)	C_α
1	0.05	0.02	0.001	11	2.00	0.01	0.014				
2	0.13	0.01	0.003	12	4.00	0.02	0.019				
3	0.25	0.01	0.005	13	8.00	0.02	0.017				
4	0.50	0.04	0.010	14	2.00	0.05					
5	1.00	0.01	0.008	15	0.50	0.01					
6	0.25	0.17		16	0.13	0.00					
7	0.13	0.00									
8	0.25	0.10	0.001								
9	0.50	1.10	0.001								
10	1.00	0.02	0.005								

Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	P_c (tsf)	C_c	Initial Void Ratio
Saturation	Moisture							
100.4 %	88.1 %	41.1	83	18	2.12	1.26	0.70	1.861

MATERIAL DESCRIPTION	USCS	AASHTO
Grey moist silty sand (paper residue)	OH	

Project No. L-01041 **Client:** BLASLAND BOUCK & LEE

Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN

Location: BORING# G-4 ID# 14706

Remarks:

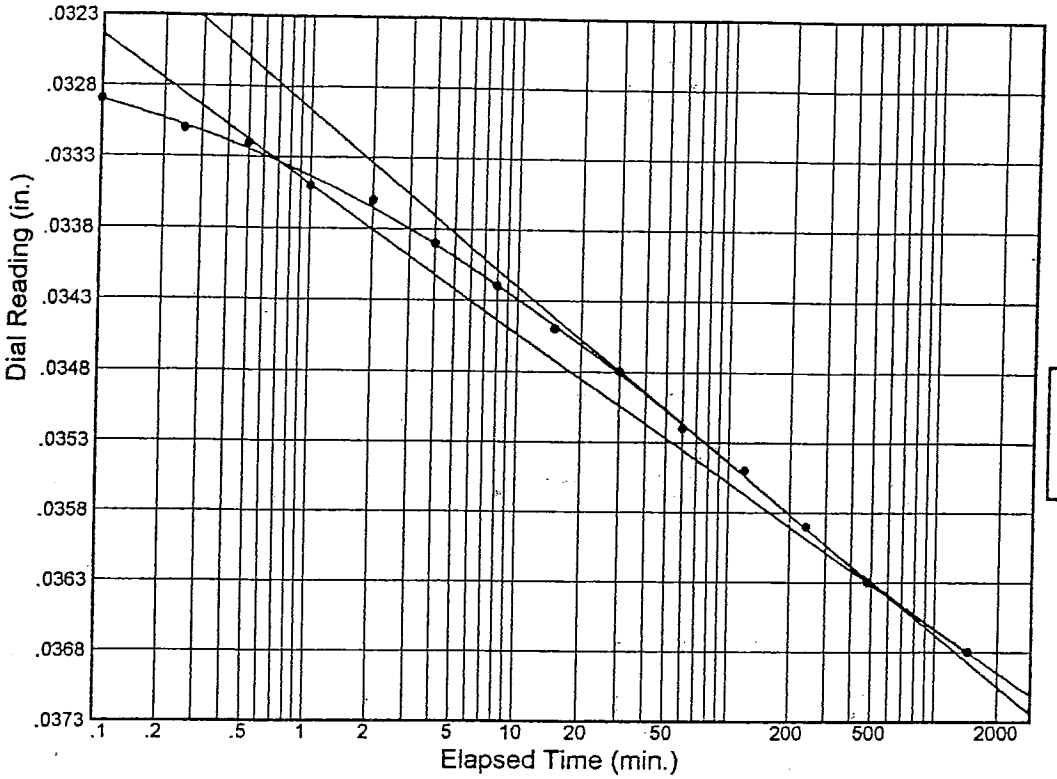
CONSOLIDATION TEST REPORT

PW LABORATORIES, INC.

a

Dial Reading vs. Log of Time

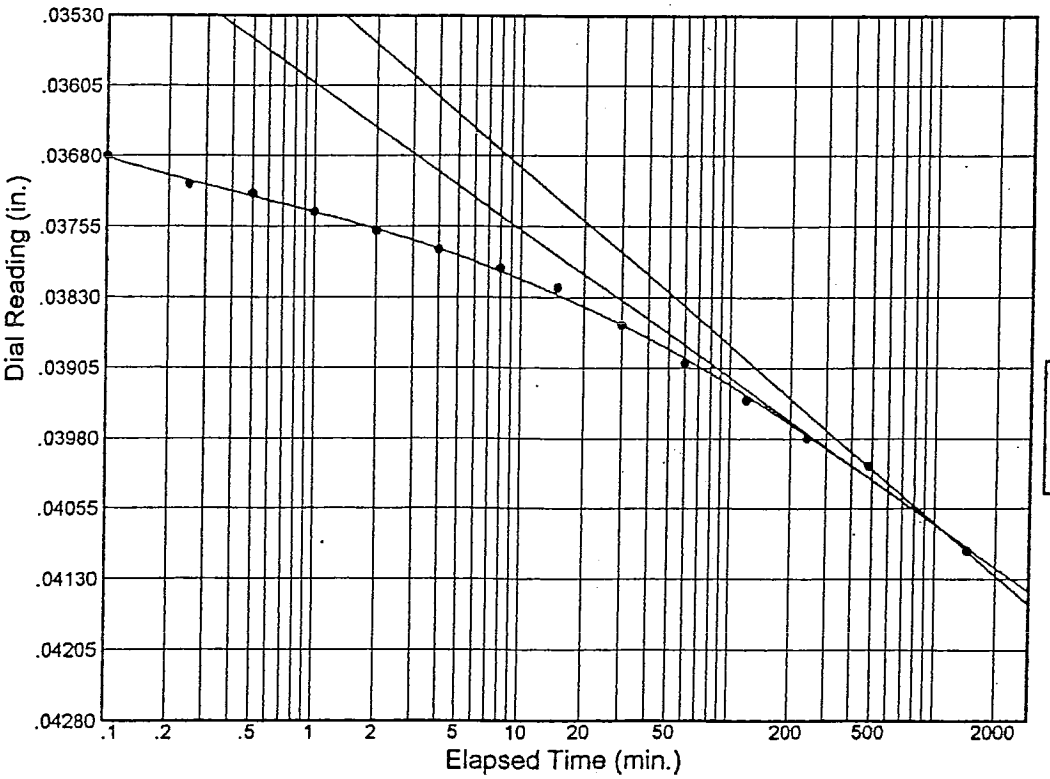
Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# G-4 ID# 14706



Load No.= 1
Load= 0.05 tsf
D_0 = 0.03270
D_{50} = 0.03455
D_{100} = 0.03639
T_{50} = 17.36 min.

C_v @ T_{50}
0.02 ft.^{2}/day

C_α = 0.001



Load No.= 2
Load= 0.13 tsf
D_0 = 0.03680
D_{50} = 0.03879
D_{100} = 0.04078
T_{50} = 44.71 min.

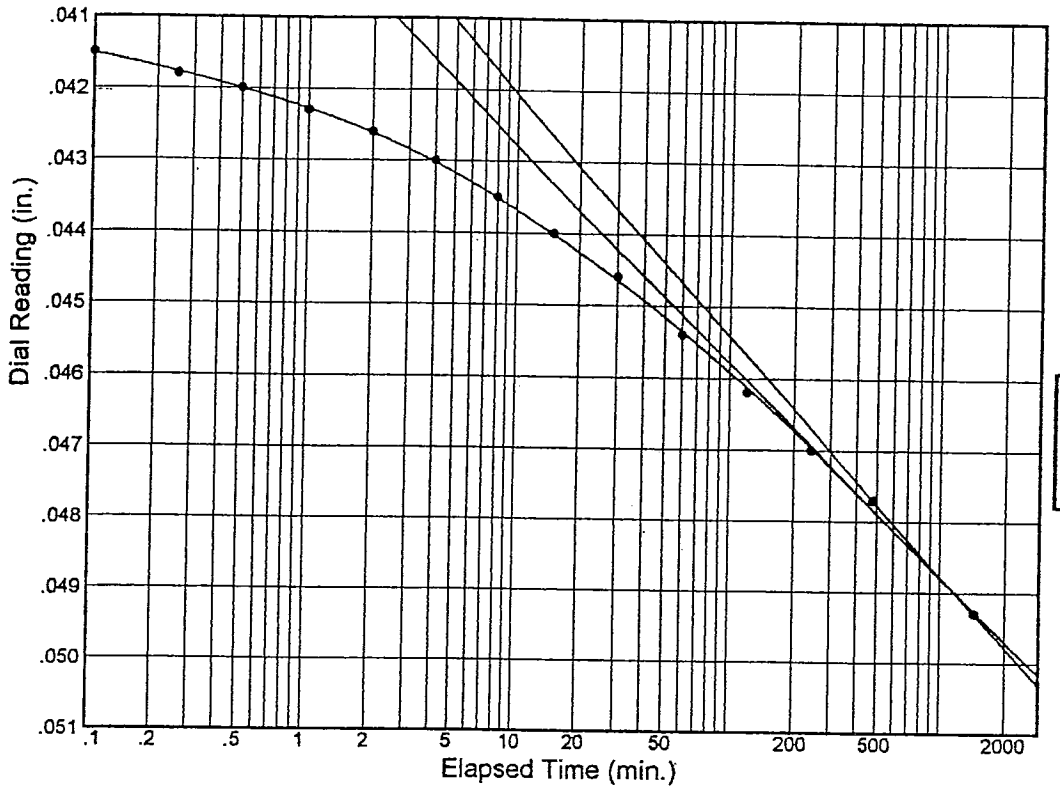
C_v @ T_{50}
0.01 ft.^{2}/day

C_α = 0.003

b

Dial Reading vs. Log of Time

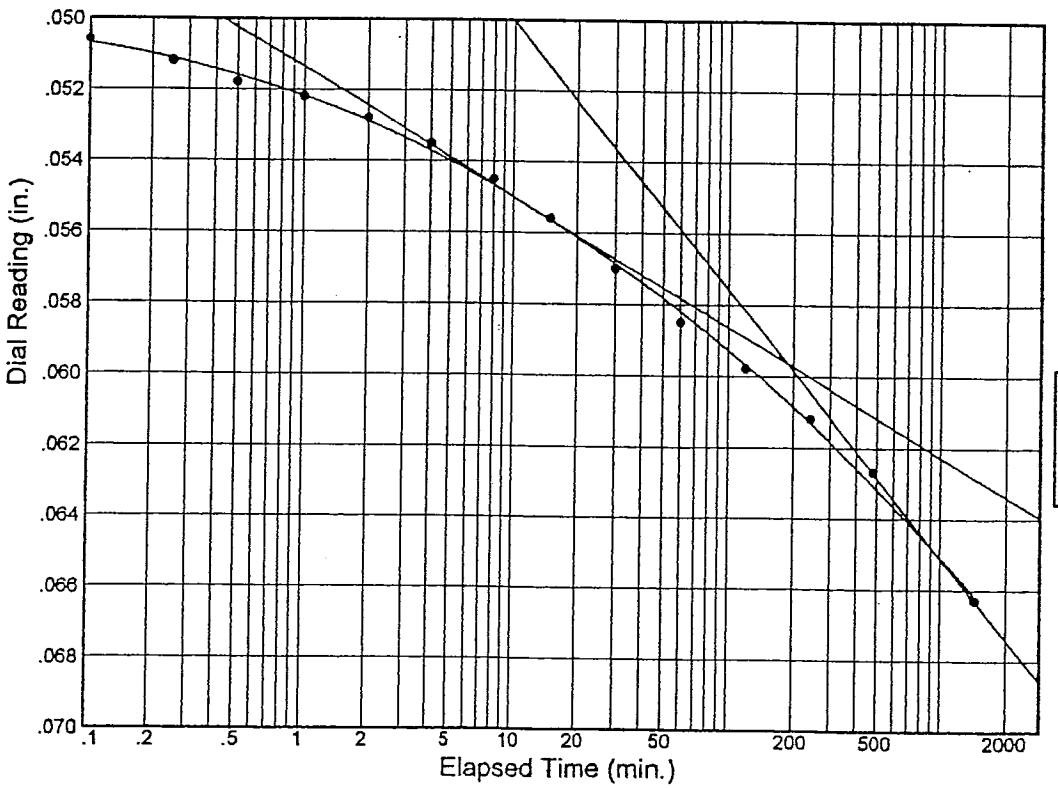
Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# G-4 ID# 14706



Load No.= 3
Load= 0.25 tsf
D_0 = 0.04100
D_{50} = 0.04496
D_{100} = 0.04892
T_{50} = 41.13 min.

C_v @ T_{50}
0.01 ft.^{2}/day

C_α = 0.005



Load No.= 4
Load= 0.50 tsf
D_0 = 0.04930
D_{50} = 0.05447
D_{100} = 0.05965
T_{50} = 7.02 min.

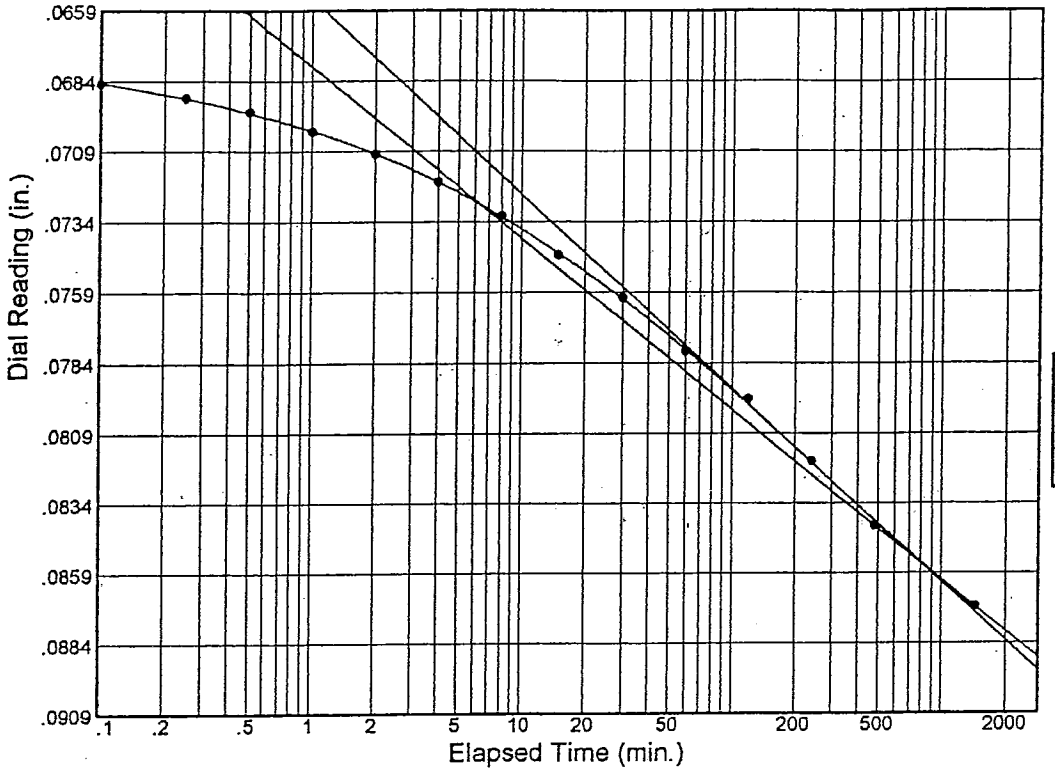
C_v @ T_{50}
0.04 ft.^{2}/day

C_α = 0.010

c

Dial Reading vs. Log of Time

Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# G-4 ID# 14706



Load No.= 5

Load= 1.00 tsf

D_0 = 0.06630

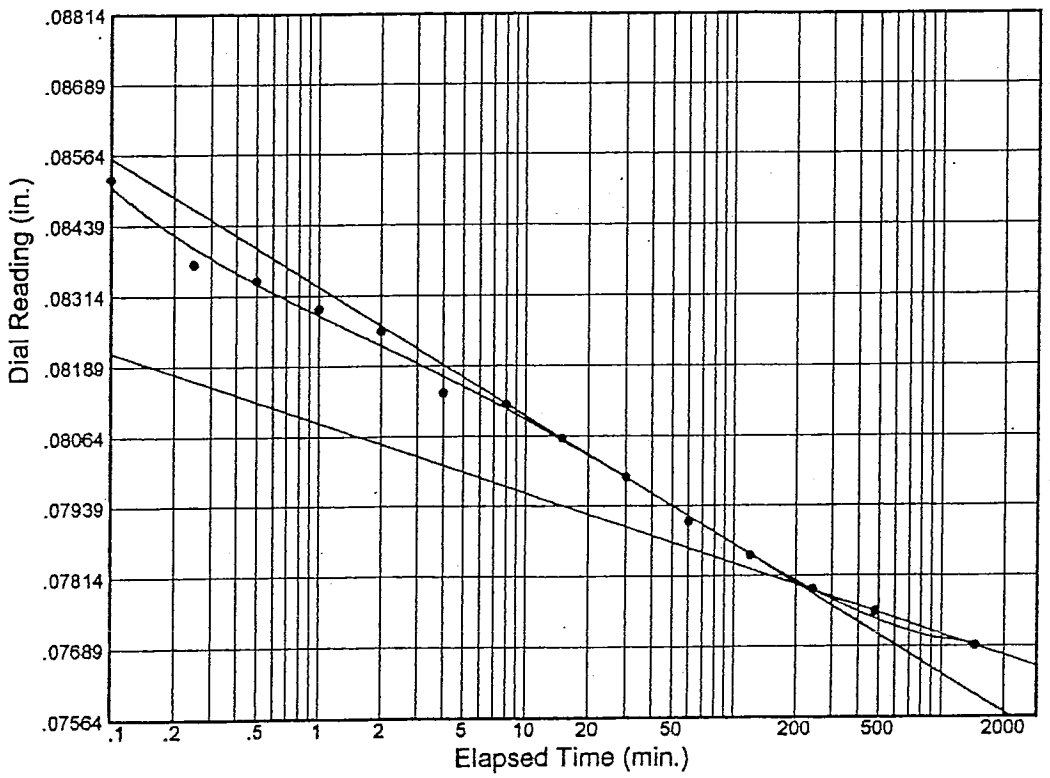
D_{50} = 0.07596

D_{100} = 0.08563

T_{50} = 27.96 min.

C_v @ T_{50}
0.01 ft.^{2}/day

C_α = 0.008



Load No.= 6

Load= 0.25 tsf

D_0 = 0.08710

D_{50} = 0.08252

D_{100} = 0.07794

T_{50} = 1.41 min.

C_v @ T_{50}
0.17 ft.^{2}/day

Dial Reading vs. Log of Time

Project No.: L-01041
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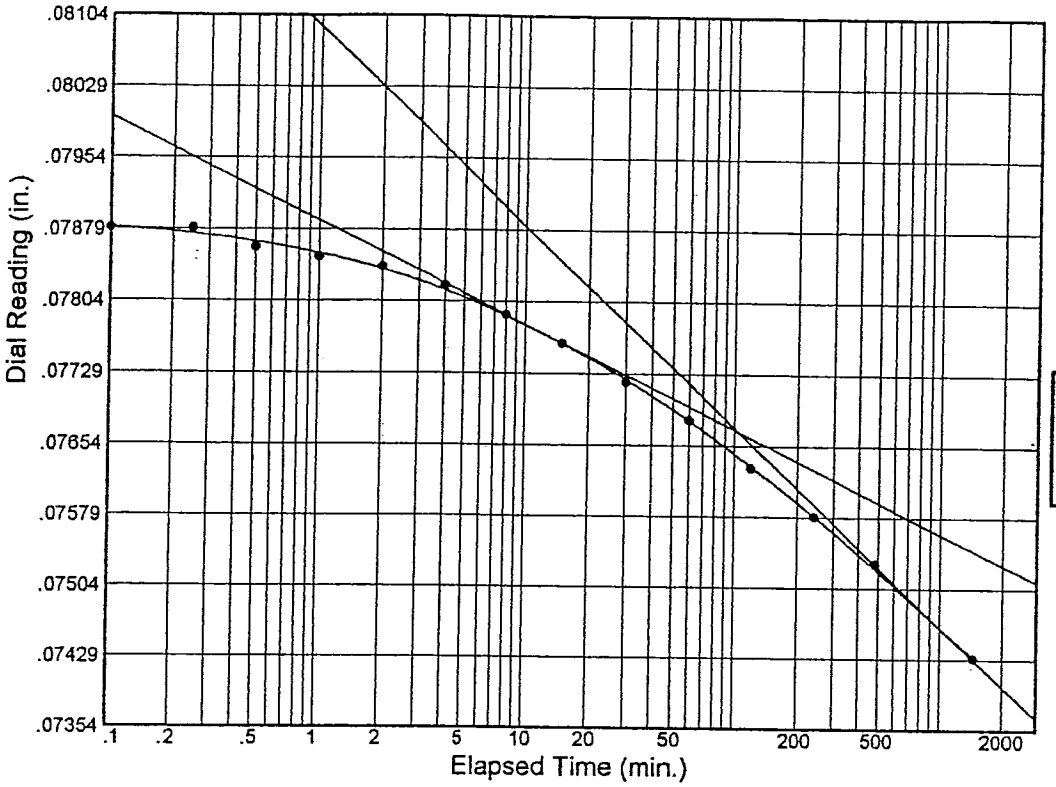
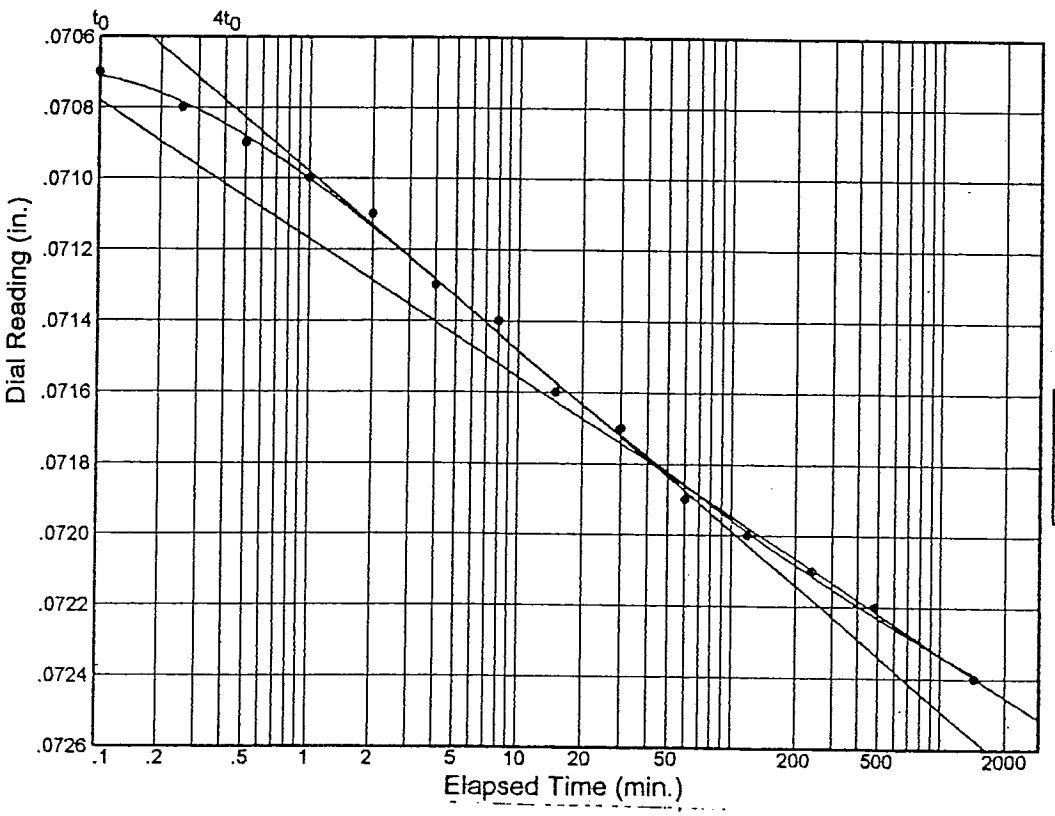
KALAMAZOO,MICHIGAN
Location: BORING# G-4 ID# 14706



Load No.= 7
Load= 0.13 tsf
D_0 = 0.07690
D_{50} = 0.07679
D_{100} = 0.07668
T_{50} = 61.04 min.

C_v @ T_{50}
0.00 ft.^{2}/day



Load No.= 8
Load= 0.25 tsf
D_0 = 0.07058
D_{50} = 0.07119
D_{100} = 0.07180
T_{50} = 2.59 min.

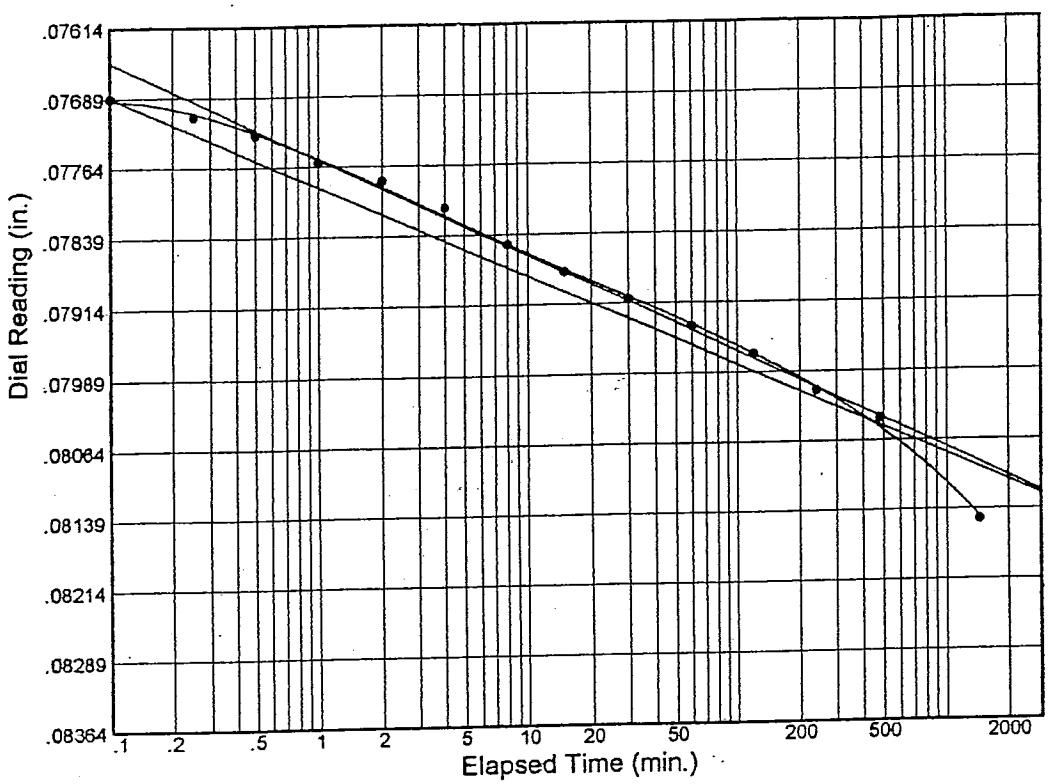
C_v @ T_{50}
0.10 ft.^{2}/day

C_α = 0.001

e

Dial Reading vs. Log of Time

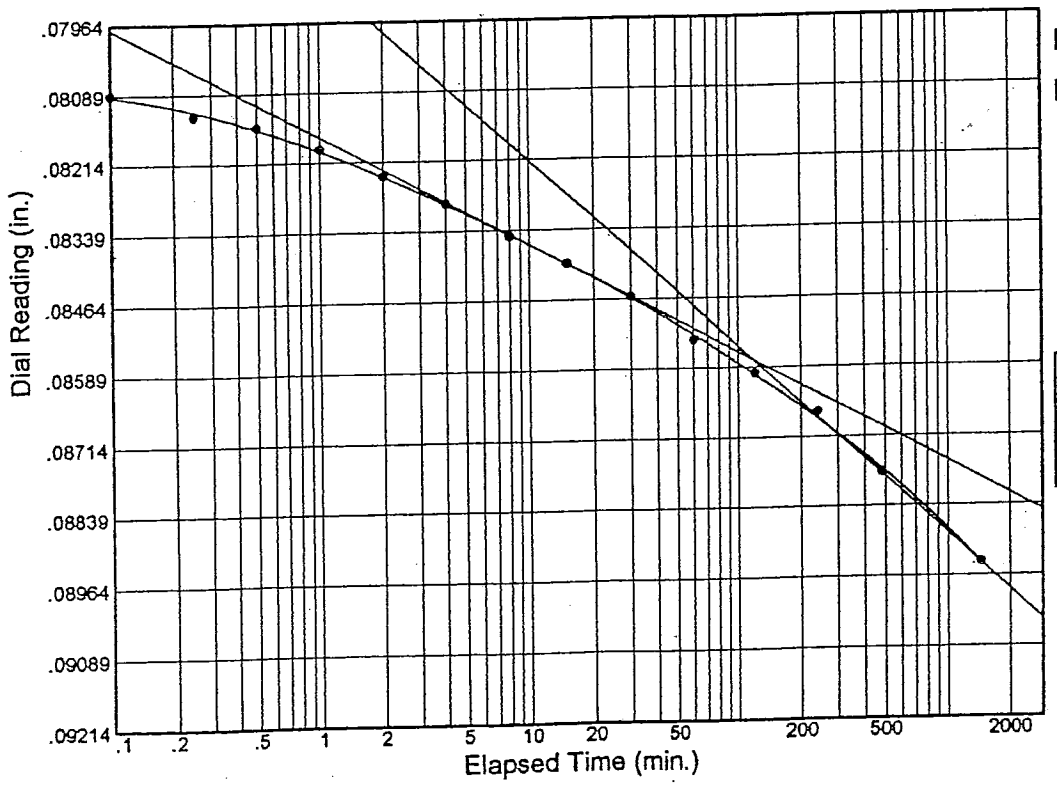
Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# G-4 ID# 14706



Load No.= 9
Load= 0.50 tsf
D_0 = 0.07240
D_{50} = 0.07704
D_{100} = 0.08167
T_{50} = 0.22 min.

C_v @ T_{50}
1.10 ft.^{2}/day

C_α = 0.001



Load No.= 10
Load= 1.00 tsf
D_0 = 0.08150
D_{50} = 0.08364
D_{100} = 0.08577
T_{50} = 9.76 min.

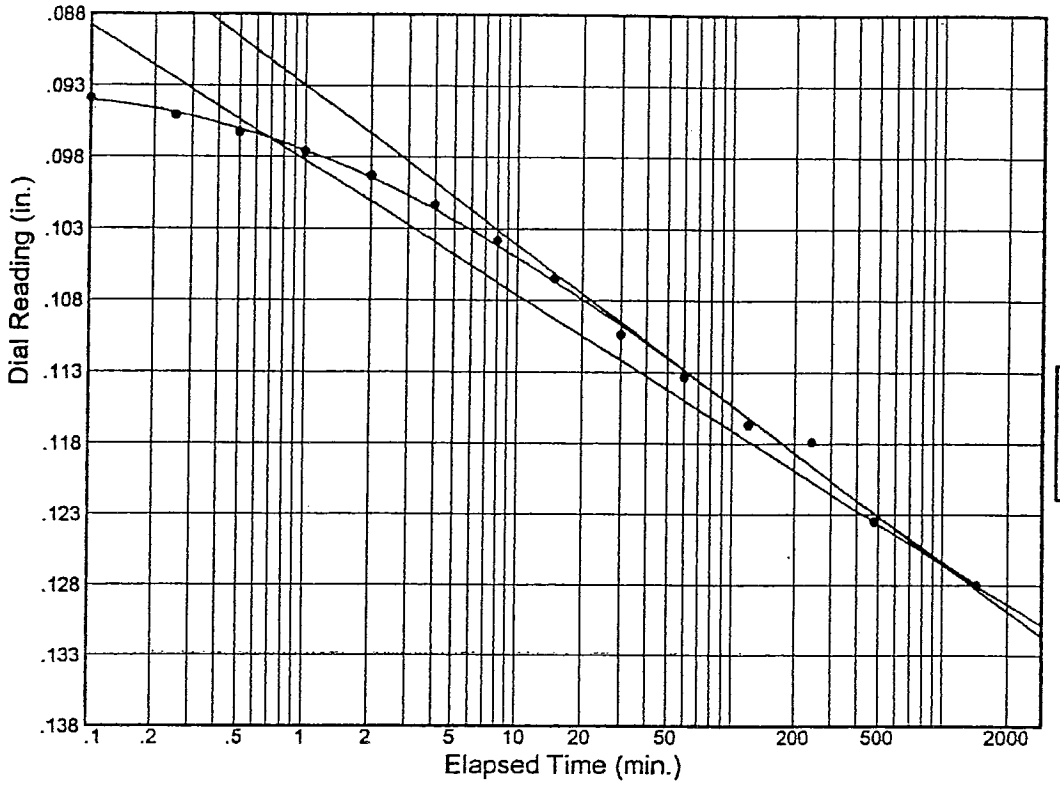
C_v @ T_{50}
0.02 ft.^{2}/day

C_α = 0.005

f

Dial Reading vs. Log of Time

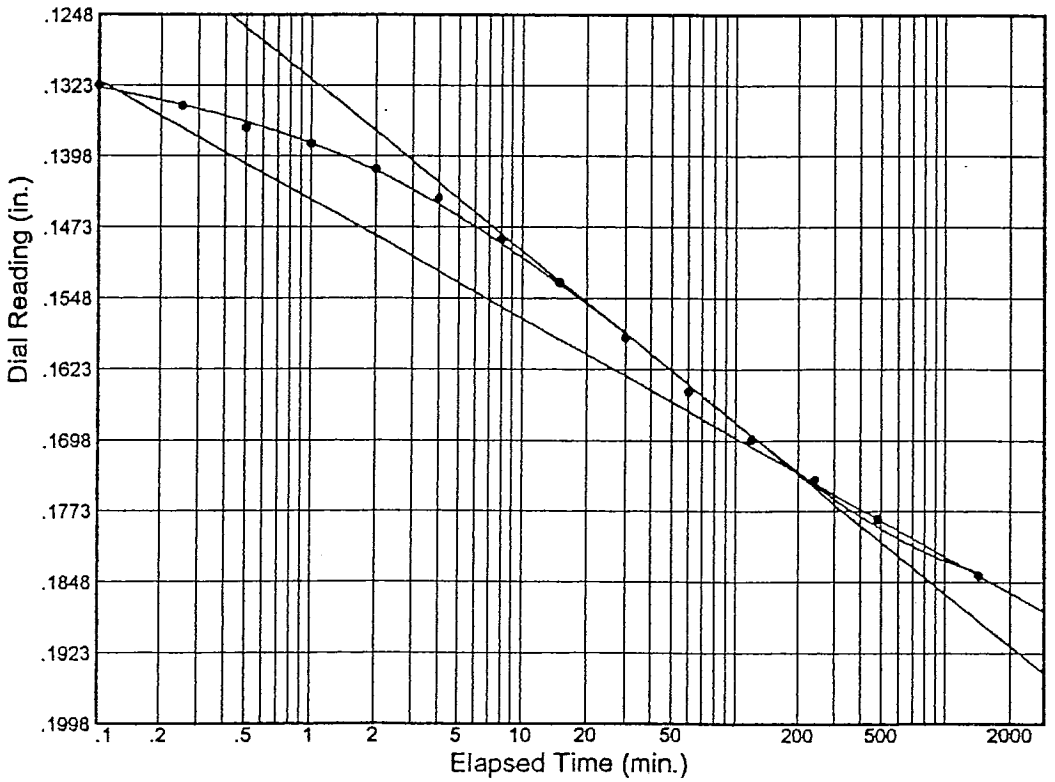
Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# G-4 ID# 14706



Load No.= 11
Load= 2.00 tsf
D_0 = 0.08940
D_{50} = 0.10805
D_{100} = 0.12669
T_{50} = 20.57 min.

C_v @ T_{50}
0.01 ft.^{2}/day

C_α = 0.014



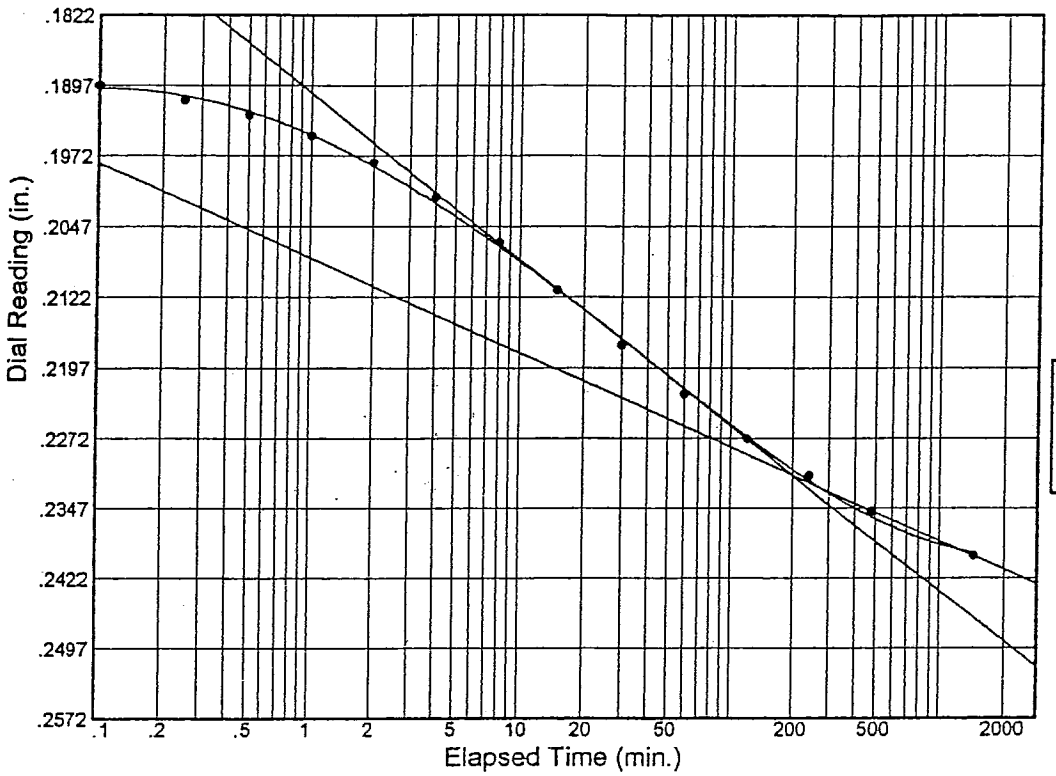
Load No.= 12
Load= 4.00 tsf
D_0 = 0.12800
D_{50} = 0.15061
D_{100} = 0.17322
T_{50} = 10.12 min.

C_v @ T_{50}
0.02 ft.^{2}/day

C_α = 0.019

Dial Reading vs. Log of Time

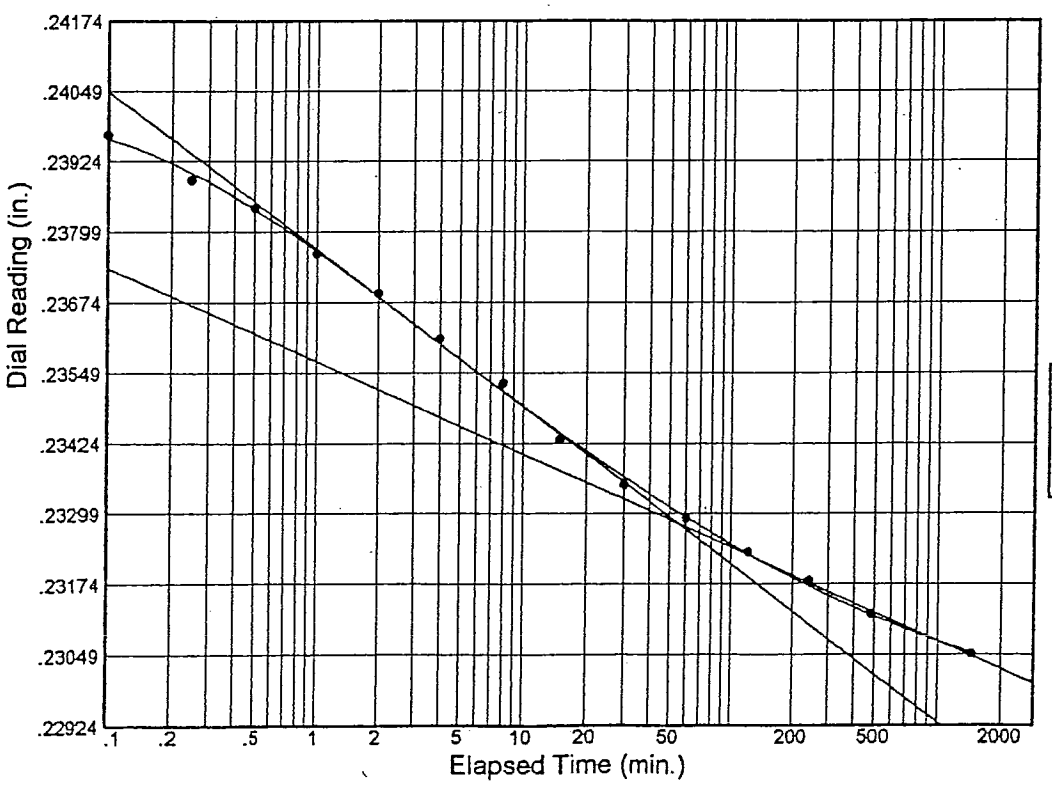
Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# G-4 ID# 14706



Load No.= 13
Load= 8.00 tsf
D_0 = 0.18410
D_{50} = 0.20764
D_{100} = 0.23118
T_{50} = 8.96 min.

C_v @ T_{50}
0.02 ft.^{2}/day

C_α = 0.017

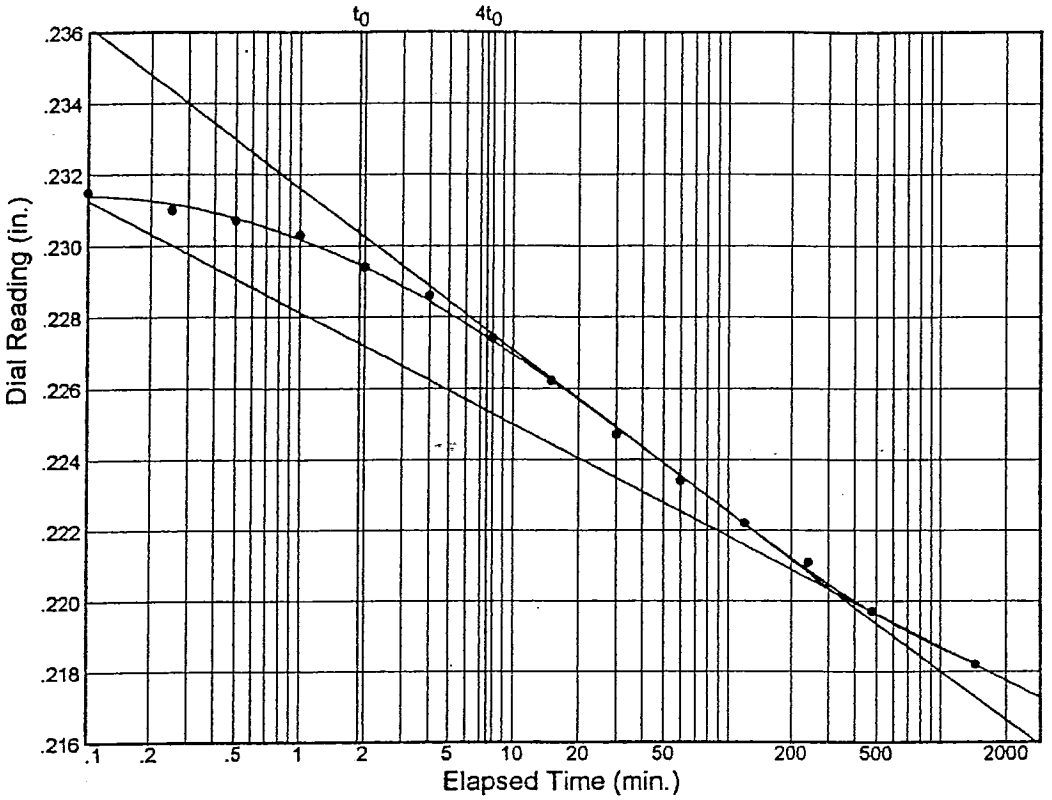


Load No.= 14
Load= 2.00 tsf
D_0 = 0.23980
D_{50} = 0.23631
D_{100} = 0.23282
T_{50} = 3.10 min.

C_v @ T_{50}
0.05 ft.^{2}/day

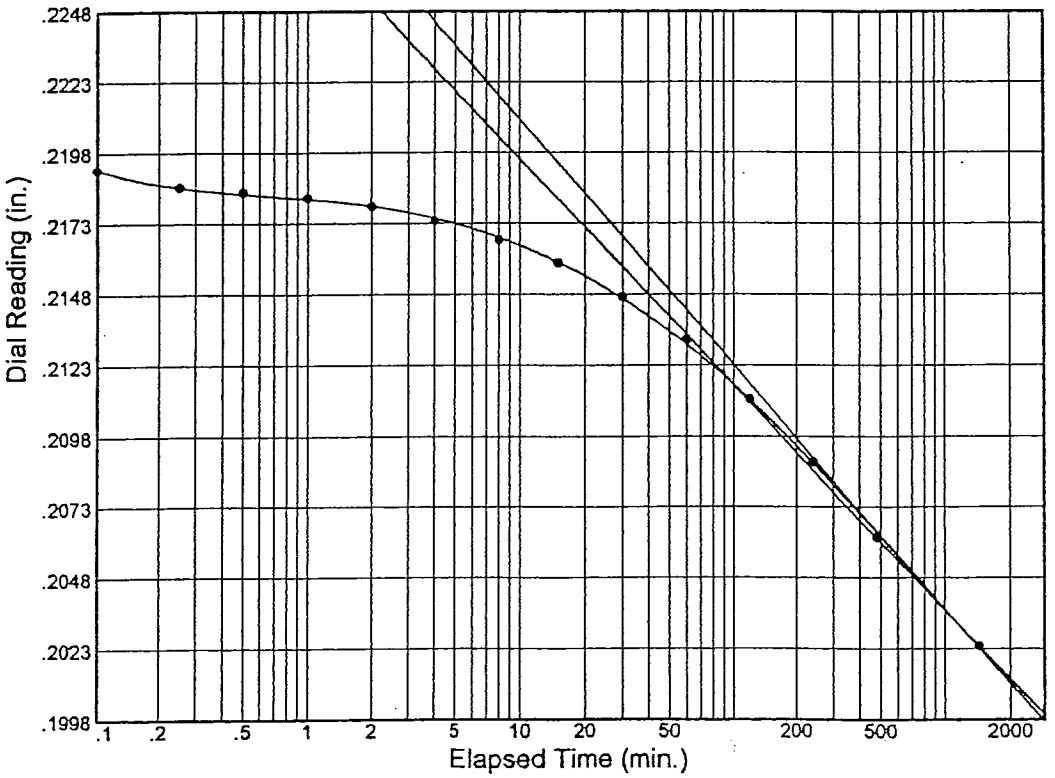
Dial Reading vs. Log of Time

Project No.: L-01041
Project: 12th STREET LANDFILL
KALAMAZOO,MICHIGAN
Location: BORING# G-4 ID# 14706



Load No.= 15
Load= 0.50 tsf
D_0 = 0.23152
D_{50} = 0.22590
D_{100} = 0.22028
T_{50} = 17.81 min.

C_v @ T_{50}
0.01 ft.^{2}/day



Load No.= 16
Load= 0.13 tsf
D_0 = 0.21820
D_{50} = 0.21077
D_{100} = 0.20333
T_{50} = 133.26 min.

C_v @ T_{50}
0.00 ft.^{2}/day

Attachment E-4
Textbook Reference

PWS PUBLISHING COMPANY
20 Park Plaza, Boston, MA 02116-4324

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An appropriate factor of safety should be applied to the ultimate load to obtain the net allowable load, or

$$Q_{u(net)} = \frac{Q_{p(net)} + Q_s}{FS} \tag{9.11}$$

It is extremely important that a reliable estimate of the soil friction angle, ϕ, is made in obtaining the net base resistance, $Q_{p(net)}$. Figure 9.9 shows a conservative correlation between the soil friction angle and the corresponding corrected standard penetration resistance numbers in granular soils. However, these friction angles are valid for low confining pressures. At higher confining pressures, which occur in the case of deep foundations, the value of ϕ can decrease substantially for medium to dense sands. This affects the value of N_q^* or N_σ^* (that is, I_{rr}) to be used for estimation of Q_p. For example, Vesic (1977) has shown that for Chattahoochee River sand at a relative density of about 80%, the triaxial angle of friction is about 45° at a confining pressure of 70 kN/m² (10 lb/in.²). However, at a confining pressure of 10.35 MN/m² (1500 lb/in.²), the friction angle is about 32.5°. This will ultimately result in a tenfold decrease of N_q^* or N_σ^*. So, it is the opinion of the author that, for general working conditions of drilled piers, the estimated friction angle determined from Figure 9.9 should be reduced by

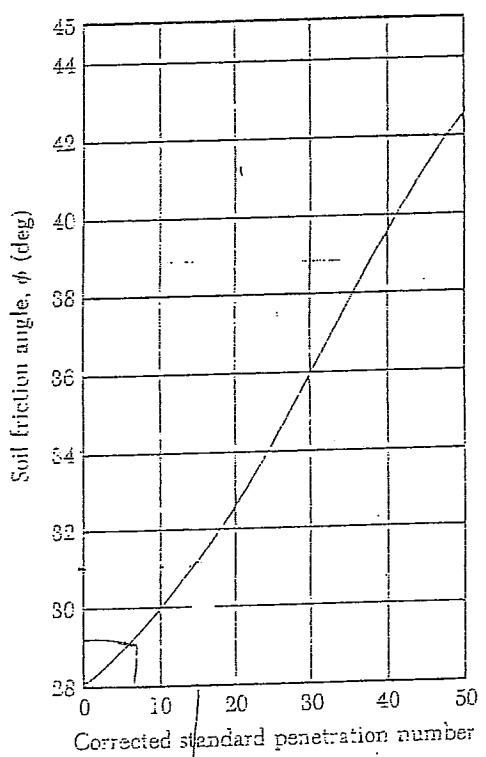

Figure 9.9 Correlation of corrected standard penetration number with the soil friction angle

Appendix F
Erosion Protection

Appendix F
Erosion Protection

Subject	Design of the Erosion Protection System for 12th Street Landfill
Objective:	To design a permanent erosion protection system to protect the landfill containment system from a 500-year flood event after the Kalamazoo River is rerouted through the former powerhouse channel.
Approach:	■ Estimate the elevation and flow velocity of the Kalamazoo River, adjacent to the 12th Street Landfill, during a 500-year floo event based on the results of hydrodynamic modeling performed for the Time-Critical Removal Action (TCRA) Design Report (BBL, 2007) and verified using Manning's Equation. ■ Size the riprap needed along the riverbank to withstand the erosive forces from a 500-year flood event based on the U.S. Army Corp of Engineers' Engineering and Design – Hydraulic Design of Flood Control Channels. ■ Select an appropriate commercial turf reinforced matting for use at the 12th Street Landfill.
Outcomes:	■ Figure 1 indicates the proposed Erosion Control design features for the eastern slope of the 12th Street Landfill. ■ The estimated 500-year flood elevation along the 12th Street Landfill is approximately 705.5 feet mean sea level (M.S.L.). ■ The maximum estimated flow velocity of the 500-year flood event along the 12th Street Landfill shoreline and landfill sideslope is 5.7 feet per second (fps). ■ Riprap with a D_{30} of 2 inches will be able to withstand the erosive forces produced along the shoreline and landfill sideslope from the 500-year flood event. The design will specify larger stone (D_{50} of 9 inches) to withstand the potentially greater stresses on the riprap caused by ice and/or debris. ■ Riprap will be placed from the toe of the 3H:1V slope to an elevation of approximately 703 feet M.S.L. ■ Turf reinforcement matting, Enkamat 7010 (or equivalent), will be placed from elevation 703 feet M.S.L. to 707 feet M.S.L.

Background

The Time-Critical Removal Action (TCRA) in the former Plainwell Impoundment includes rerouting the Kalamazoo River through the former powerhouse channel adjacent to the 12th Street Landfill. This action will change the hydraulic conditions in the channel from a stagnant backwater protected from ice and debris to a flowing river. Because the flow will be directed from the eastern channel (*i.e.,* over the spillway) through the powerhouse channel to the west, the eastern sideslopes of the 12th Street Landfill will be subject to higher river velocities, potentially resulting in erosion of the river bank and adjacent landfill material. Moreover, the Consent Decree between Weyerhaeuser and the United States Environmental Protection Agency (USEPA) to conduct Remedial Design and Remedial Action activities

in connection with the 12th Street Landfill requires that the erosion protection be placed on the east sideslopes of the landfill to provide protection from a 500-year flood event. The erosion protection is required to extend approximately 2 feet above the 100-year flood event or to an elevation of 707.0 feet mean sea level (M.S.L.), whichever is greater. This document presents the design basis and engineering controls for the erosion protection along the river bank adjacent to the landfill. The Record of Decision (ROD) requires placement of erosion and flood protection on the sidewalls of the landfill in a manner consistent with the relevant requirements of the State of Michigan's Part 115, Solid Waste Management Act; Part 301, Inland Lakes and Streams; Part 91, Soil Erosion and Sedimentation Control; and Part 303, Wetlands Protection, of the NREPA.

Related Emergency Response Decisions and Design Approaches

Other aspects of this 12th Street Landfill Emergency Response must be integrated into the design and decision making for the erosion control system. Specific aspects of the Emergency Response and ROD that have been integrated into the erosion control system design are described below:

- Bank slope at river's edge: The erosion protection system along the 12th Street Landfill needs to be integrated with the erosion protection system being installed along the adjacent MDNR property. Thus, the design specifies a 3H:1V slope from river's edge to elevation 703 feet M.S.L., which mimics the adjacent design slope.
- Riprap integration: The riprap size is different along the 12th Street Landfill and the MDNR property, so the riprap will need to be blended to limit abrupt changes along the water flow path. After the majority of the erosion system is placed, rocks will be positioned by hand to create the appropriate flowpath.
- Erosion control material types: Based upon conversations with various agency representatives and review of the Plainwell Impoundment TCRA design report, the state prefers the use of natural erosion protection as much as possible. Therefore, the erosion protection system is a combination of riprap near the riverbank, to an elevation of approximately 703 feet M.S.L. and turf reinforced matting at higher elevations.

Objective

The primary objective for this analysis and design is to develop a final erosion protection system for the eastern slope of the 12th Street Landfill that can withstand a 500-year flood event and be constructed on a schedule consistent with the Plainwell Impoundment TCRA. There were two steps to the design:

1. Estimate the elevation and flow velocity of the Kalamazoo River along the 12th Street Landfill during a 500-year flood event.
2. Determine the size and type of erosion protection needed to withstand the erosive forces produced along the shoreline and landfill sideslope from the 500-year flood event.

Approach

The elevation and flow velocity of the 500-year flood event was estimated based on the hydrodynamic modeling performed for the TCRA (BBL, 2007) and verified using Manning's Equation. Calculations are included in Attachment F-1.

The method presented in the U.S. Army Corp of Engineers' Engineering and Design – Hydraulic Design of Flood Control Channels (U.S. Army Corp of Engineers, 1994) was used to determine the size of the riprap needed to withstand the erosive forces from the flow velocity associated with the 500-year flood event. Calculations are included as Attachment F-2.

Enkagreen e-ngineering with Enkamat design software (Colbond, 2007) was used to determine the type of erosion control matting to be utilized at the 12th Street Landfill above elevation 703 feet M.S.L. The Enkagreen software analyzes channel linings using the Federal Highway Administration's Hydraulic Engineer Circular (HEC-15) design methodology. Calculations are included as Attachment F-2.

Estimation of the 500-Year Flood Event

In order to determine the elevation of the 500-year flood event, RMT reviewed published information and contacted state and federal agencies (*e.g.,* FEMA, USEPA, and MDEQ). Since no information was available, the velocity and elevation of the 500-year flood event was estimated using standard hydrologic statistical procedures. The estimation was performed using the published extreme event flows for the Kalamazoo River that were presented in the TCRA Design Report (Arcadis, 2007). The flow rates and recurrence intervals were plotted on Gumble probability paper and a line was fit through the data and extrapolated to estimate the flow for the 500-year flood event. The data are presented in Table F-1 below and Figure 1 in Attachment F-1.

Table F-1
Extreme Event Flows for the Kalamazoo River at 12th Street Landfill

Recurrence Interval	Flow (cfs)
2-year	3,845
5-year	4,850
10-year	6,500
25-year	7,000
50-year	9,000
100-year	10,000
500-year	12,000*

*Extrapolated

The elevation and flow velocity of the 500-year flood event was estimated using the results of hydrodynamic modeling performed by Arcadis and verified using Manning's Equation. At the request of Weyerhaeuser, Arcadis provided detailed results of model simulations that were performed for the Time-Critical Removal Action Design Report (Arcadis, 2007). The detail that was provided (Arcadis, personal communication, 2007) included the simulated river stage and the simulated velocities along the 12th Street Landfill sideslope at the base of slope, the water surface, and the mid-point between the water surface and the toe of slope. Results were provided for the 2-year, 10-year, and 100-year flood events.

Figure 2 in Attachment F-1 illustrates the elevation of the Kalamazoo River along the upstream edge of the landfill plotted against the log of the recurrence interval for the 2-year, 10-year, and 100-year flood events, as simulated by Arcadis (Arcadis, 2007). Using this data, the elevation for the 500-year flood event is estimated to be 705.5 feet M.S.L. by extrapolation. This estimate was checked by using Manning's Equation for uniform flow in an open channel. Assuming a flow of 12,000 cfs (500-year event), a Manning's "n" of 0.035, a rectangular channel of width 160 feet, and a calculated channel slope of 0.0016; the depth of flow was calculated to be approximately 10 feet. Based on an average channel bottom elevation of 696 feet M.S.L.; the water surface elevation calculated using Manning's equation is 706 feet M.S.L. This estimate compares well to the elevation of 705.5 feet M.S.L. estimated using the results of the Arcadis model simulations. As expected, the elevation calculated using Manning's equation is conservatively higher than the elevation predicted by the model because the equation assumed a rectangular channel.

Figure 3 in Attachment F-1 illustrates the velocity along the left bank of the Kalamazoo River along the upstream edge of the 12th Street Landfill (Cross Section 6) plotted against the log of the recurrence interval for the 2-year, 10-year, and 100-year flood events, as simulated by Arcadis. Velocities at the toe of slope, at the top of bank, and at the mid-point are illustrated on Figure 3 in Attachment F-1. At each location, the velocity is extrapolated for the 500-year flood event. The estimated velocities for the 500-year flood ranged 5.7 feet per second (fps) at the toe of slope to 2.2 fps at the top of bank. As a check, the average velocity for the 500-year flood event was calculated to be 7.7 fps using Manning's equation. While this velocity is not directly comparable, because it is averaged over the entire river cross-sectional area, it provides a conservative check on the possible upper end flow velocity for the 500-year flood event, because the velocities will be highest in the main/deepest part of the channel and lower at the banks.

Because the estimated elevation of the 500-year flood event along the eastern sideslope of the 12th Street Landfill (705.5 feet M.S.L.) is less than the minimum elevation required by the ROD (707.0 feet M.S.L.), Weyerhaeuser will use the elevation of 707.0 feet M.S.L. as the design basis for the interim erosion protection for the Emergency Response Action.

Riprap Design

Riprap will be installed from the toe of the 3H:1V riverbank to elevation 703 feet M.S.L. The calculation for riprap size indicates that riprap with a D_{30} of 2 inches will withstand the erosive forces produced along the shoreline and landfill river sideslope from the 500-year flood event (refer to Attachment F-2). The design has been specified to use a larger stone (D_{50} of 9 inches) to address the greater potential stresses on the riprap caused by ice and debris (*e.g.,* fallen trees). Ice and debris create greater stresses on riprap reventment by impact and flow concentration effects (U.S. Army Corp of Engineers, 1994). The U.S. Army Corp of Engineers recommends that the thickness of the riprap should be increased by 6 to 12 inches, accompanied by an appropriate increase in stone size, for riprap subject to attack by large floating debris. Riprap deterioration from debris impacts is usually more extensive on banks lined with steep slopes, therefore, the U.S. Army Corp of Engineers recommends that riprapped slopes along streams with heavy debris loads should be no steeper than 2.5H:1V. In order to address this concern at the 12th Street Landfill, the stone size and thickness has been increased, and the riverbank slopes will be regraded to 3H:1V.

Erosion Control Matting Design

Turf reinforced matting will be installed on the eastern landfill sideslope and over the site access road along the Kalamazoo River, from the top of the riprap at 703 feet M.S.L. to the estimated 500-year flood event elevation of 707 feet M.S.L. This matting will be designed to withstand the erosive forces of a 500-year flood event. *Enkagreen e-ngineering with Enkamat* design software (Colbond, 2007) was used to select an appropriate commercial erosion control matting. The Enkagreen software analyzes channel linings using the Federal Highway Administration's Hydraulic Engineer Circular (HEC-15) design methodology.

The following assumptions/inputs were used for the Enkagreen design software:

- The channel shape (*i.e.,* the former powerhouse channel along the 12th Street Landfill) is trapezoidal.
- The bottom width of the channel is 100 feet. This is the maximum allowable value for the Enkagreen design software.
- The river bed slope is 0.002 ft/ft.
- The right side slope of the powerhouse channel (*i.e.,* the peninsula) is 3H:1V. This assumes the slope will be graded during the TCRA activities.
- The left side slope (eastern landfill sideslope) is 5H:1V.
- The channel length (along the 12th Street Landfill) is 300 feet.
- The vegetative type is Class C (grass-legume mixture – summer (orchard grass, redtop, Italian rye grass, and common lespedeza), good stand, uncut (6 to 8 inches).
- The flow velocity for the 500-year flood event is 5.7 fps. Refer to Attachment F-1 for the calculation for the 500-year flood event river elevation and flow velocity.
- Flow durations of 0.5 hours and 50 hours were analyzed.

The results of the calculations indicate that Enkamat 7010 will withstand the flow velocities of a 500-year flood event.

References

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BBL. February 2007. Former Plainwell Impoundment Time-Critical Removal Action Design Report. Kalamazoo River Study Group. Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site. February 2007.

U.S. Army Corp of Engineers. 1994. Engineering and Design – Hydraulic Design of Flood Control Channels. EM 1110-2-1601.

Attachment F-1

9-179a
Flood data plot
(March 1949)

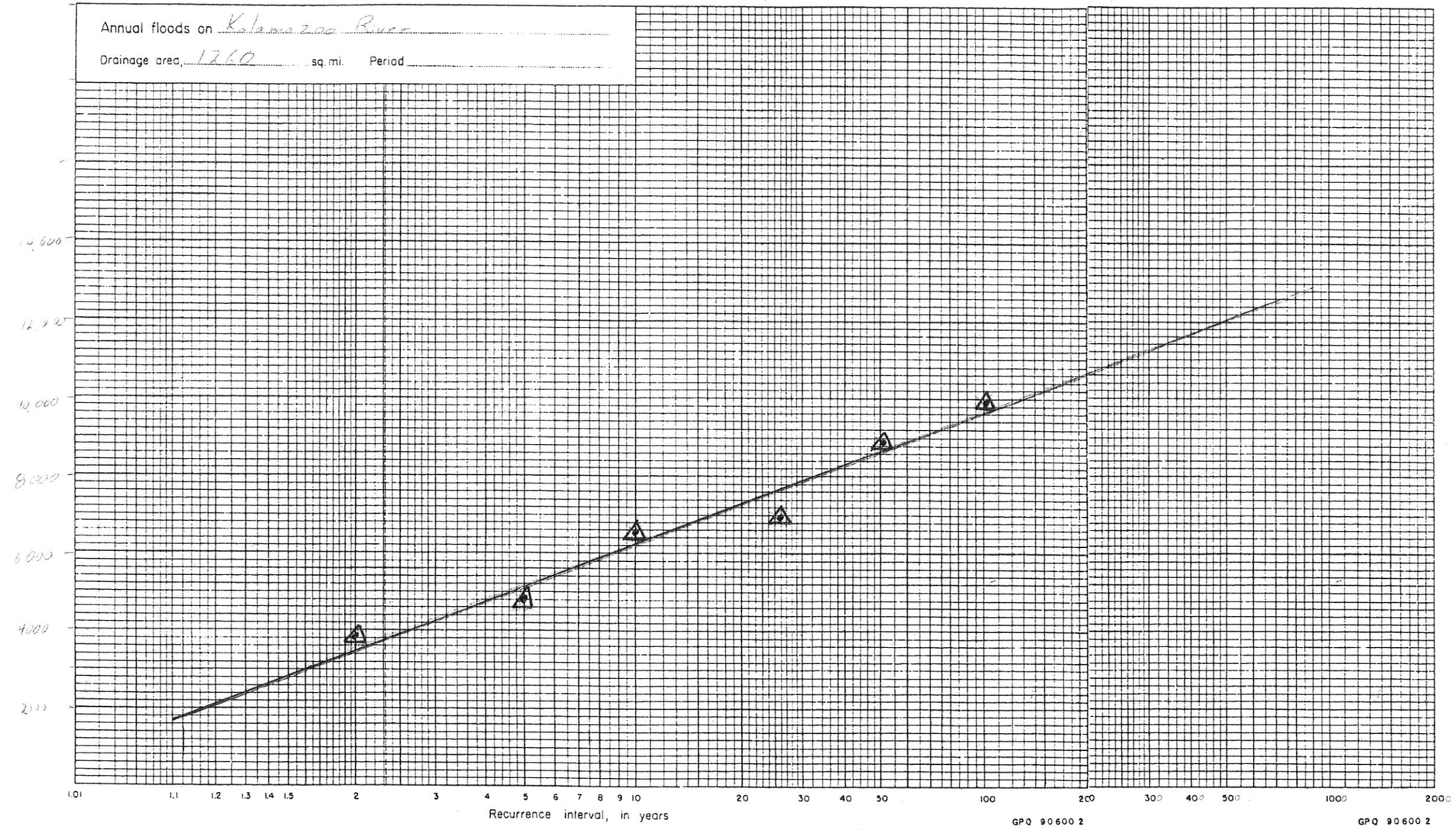
UNITED STATES DEPARTMENT OF THE INTERIOR — GEOLOGICAL SURVEY — WATER RESOURCES DIVISION

File Number ..... R RESOURCES DIVISION

File Number .....

Annual floods on Kalamazoo River

Drainage area, 1260 sq. mi. Period



GPO 90600 2

GPO 90600 2

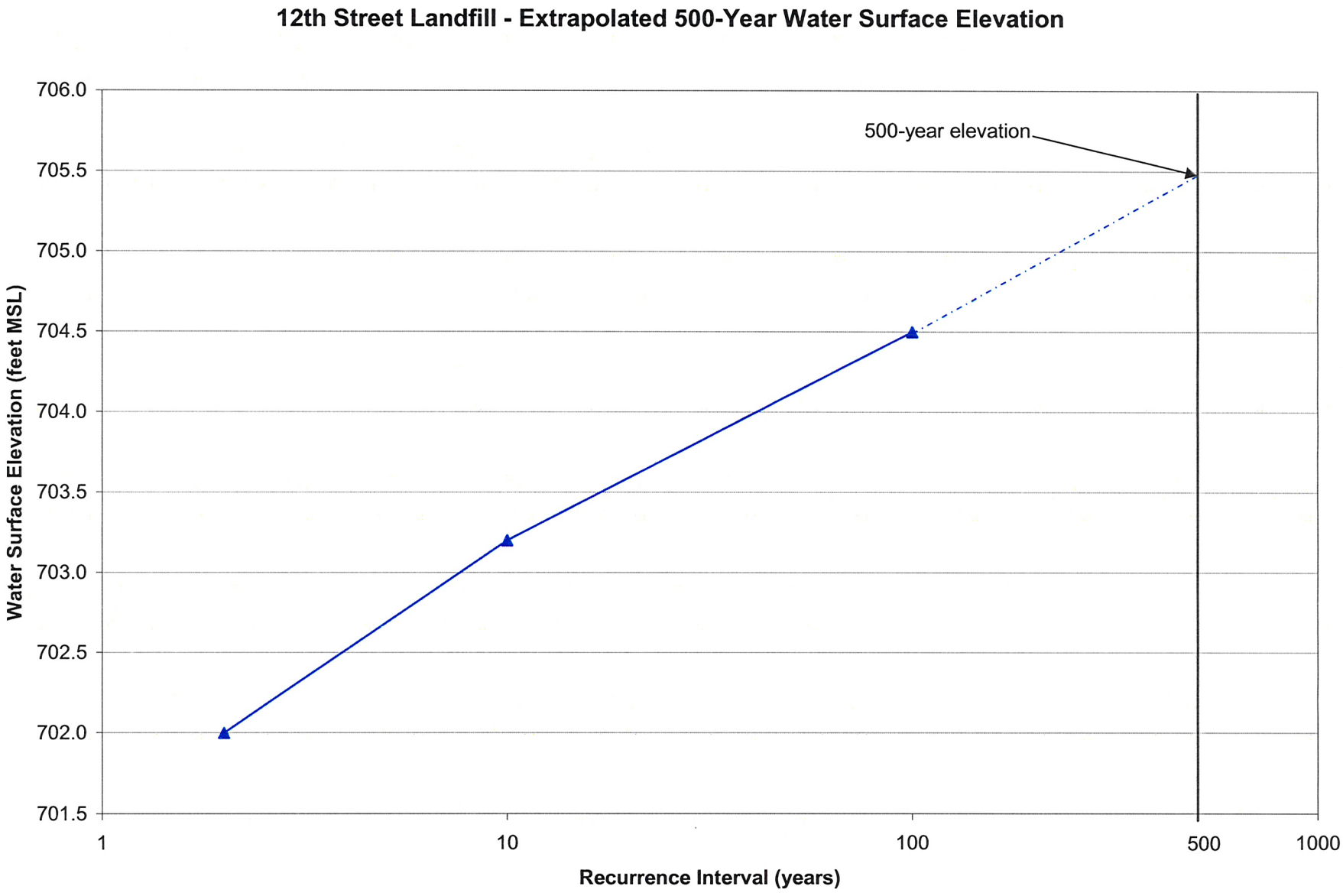

12th Street Landfill - Extrapolated 500-Year Water Surface Elevation
500-year elevation
706.0
705.5
705.0
704.5
704.0
703.5
703.0
702.5
702.0
701.5
Water Surface Elevation (feet MSL)
1
10
100
500
1000
Recurrence Interval (years)

Figure 2

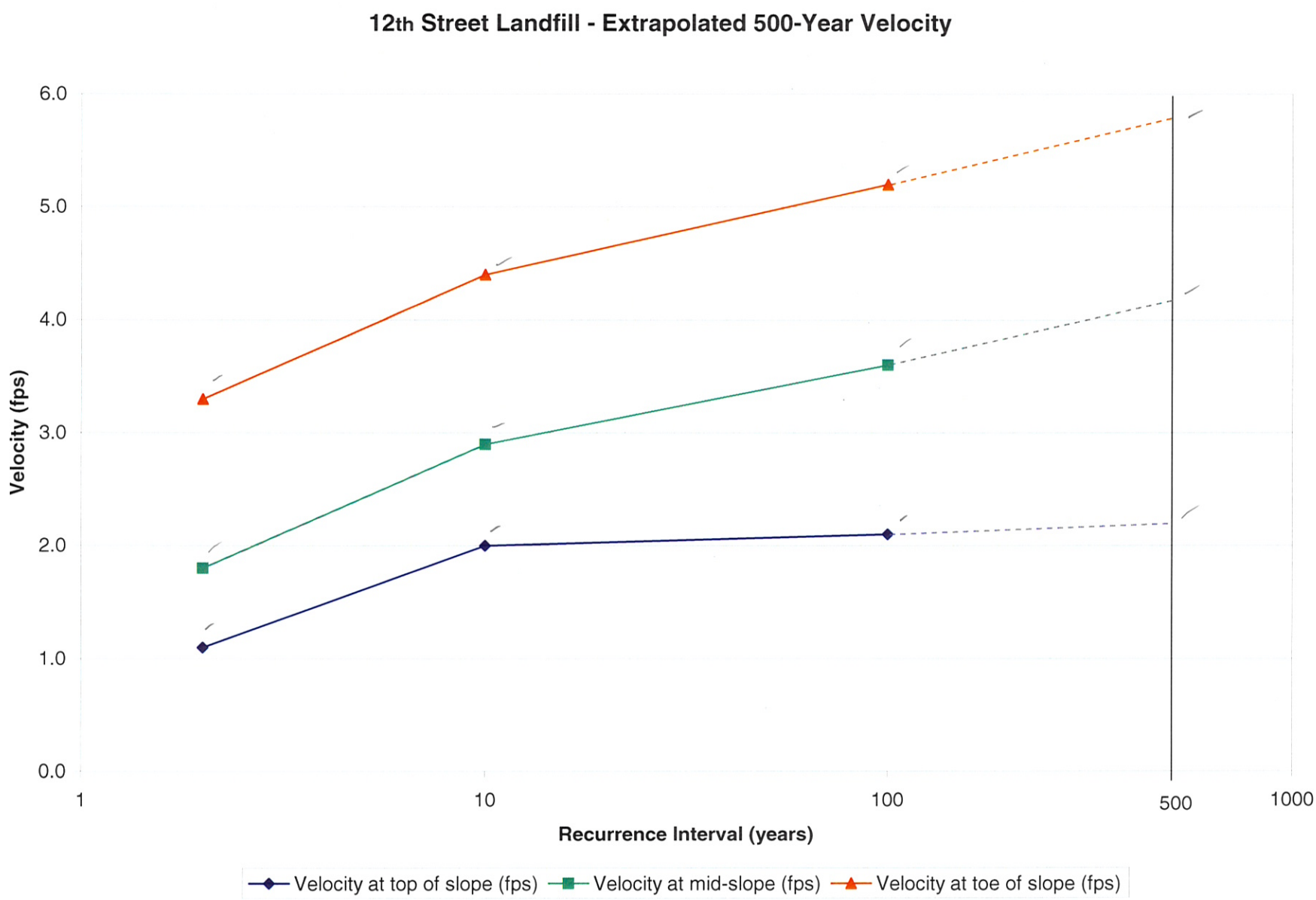

12th Street Landfill - Extrapolated 500-Year Velocity
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Velocity (fps)
1
10
100
500
1000
Recurrence Interval (years)
Velocity at top of slope (fps)
Velocity at mid-slope (fps)
Velocity at toe of slope (fps)

Figure 3

PROJECT/PROPOSAL NAME/LOCATION:		PROJECT/PROPOSAL NO.
SUBJECT:		
PREPARED BY:	DATE:	FINAL ❒
CHECKED BY:	DATE:	REVISION ❒

Weyerhaeuser - 12th St Landfill Powerhouse Channel

Manning Equation - Verification of 500-yr Elevation & Velocity

$$Q = \frac{1.49}{n} A R^{2/3} \sqrt{S}$$ Mannings Eq

n - Mannings coefficient of roughness

A - Area (Depth x Width)

R - hydraulic radius, A/wetted perimeter

S - channel slope

n - 0.035 (Chow, 1959 p. 120)

S - (698.9 - 698.2)/450 = 0.00156

(Sections A5 and A7, USGS WRI Report 03-4218, Appendix A)

W - 160 ft (USGS, 2003)

$Q_{2\text{-}yr}$ - 3,845 cfs (BBL, 2007)

$Q_{10\text{-}yr}$ - 6,500 cfs "

$Q_{100\text{-}yr}$ - 10,000 cfs "

Q_{500} - 12,000 cfs (attached)

PROJECT/PROPOSAL NAME/LOCATION:		PROJECT/PROPOSAL NO.
SUBJECT:		
PREPARED BY:	DATE:	FINAL ❒
CHECKED BY:	DATE:	REVISION ❒

$$Q = \frac{1.49}{n} A R^{2/3} \sqrt{S}$$

Simplify: $R \sim d$

$A = Wd$

$$Q = \frac{1.49}{n} W d^{5/3} \sqrt{S}$$

for the 2-year event

$$3845 = \frac{1.49}{0.035} 160 \, d^{5/3} \sqrt{0.00156} = 269 d^{5/3}$$

$d = \underline{4.9 \text{ ft}}$

for the 10-year event

$6{,}500 = 269 d^{5/3}$

$d = \underline{6.8 \text{ ft}}$

1.9 ft increase

(0.9 ft increase, BBL, 2007)

for the 100-year event

$10{,}000 = 269 d^{5/3}$

$d = \underline{8.8 \text{ ft}}$

2.0 ft increase

(1.3 ft increase, BBL, 2007)

for the 500-year event

$12{,}000 = 269 d^{5/3}$

$d = \underline{9.8 \text{ ft}}$

1.0 ft increase

(0.8 ft increase, projected from BBL, 2007)

PROJECT/PROPOSAL NAME/LOCATION:		PROJECT/PROPOSAL NO.
SUBJECT:		
PREPARED BY:	DATE:	FINAL ❒
CHECKED BY:	DATE:	REVISION ❒

Check Average Velocity and Increase

$\bar{V} = Q/A$, $A = W \times d$

for the 2-year event

$\bar{V} = 3845 \text{ cfs} / 160 \text{ ft} \times 4.9 \text{ ft} = \underline{4.9} \text{ fps}$

for the 10-year event

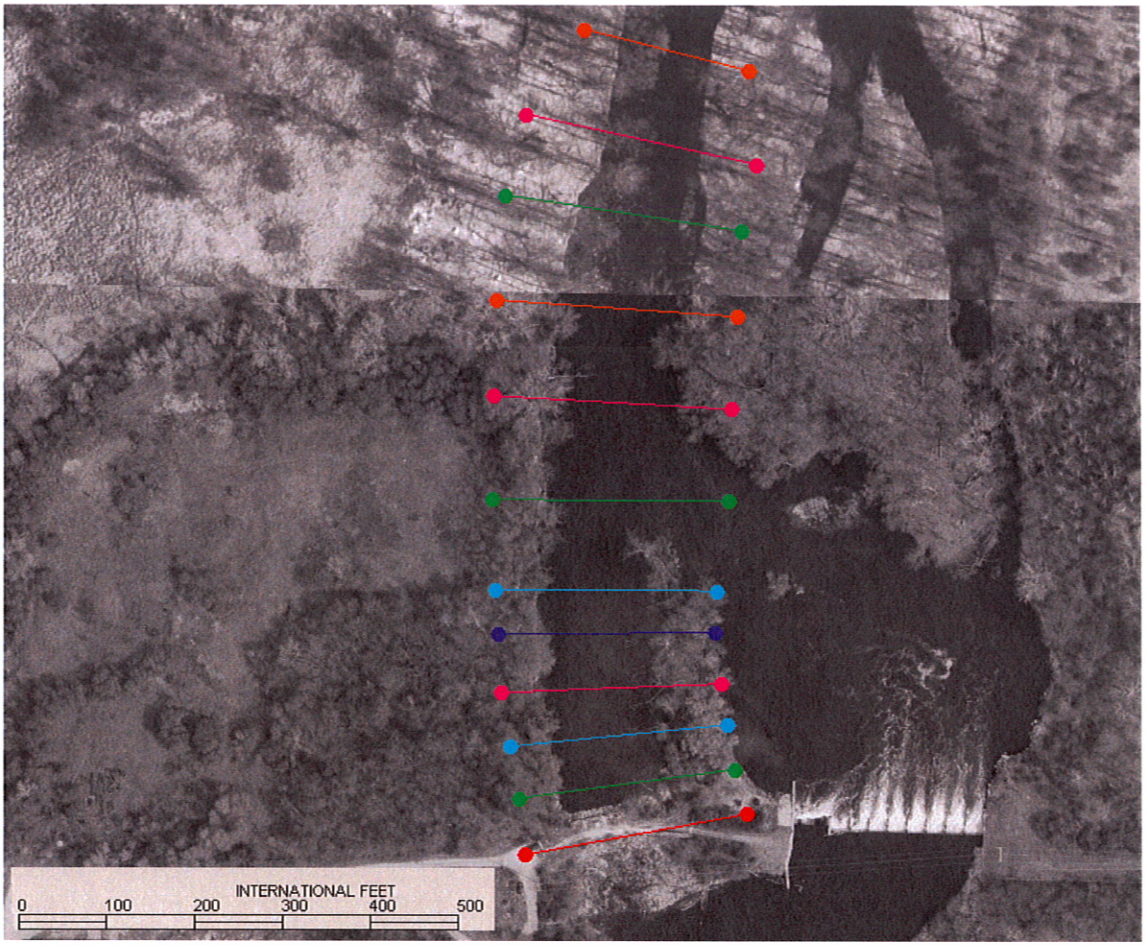
$\bar{V} = 6{,}500 \text{ cfs} / 160 \text{ ft} \times 6.8 \text{ ft} = \underline{6.0} \text{ fps}$

for the 100-year event

$\bar{V} = 10{,}000 \text{ cfs} / 160 \text{ ft} \cdot 8.8 \text{ ft} = \underline{7.1} \text{ fps}$

for the 500-year event

$\bar{V} = 12{,}000 / 160 \text{ ft} \times 9.8 \text{ ft} = \underline{7.7} \text{ fps}$



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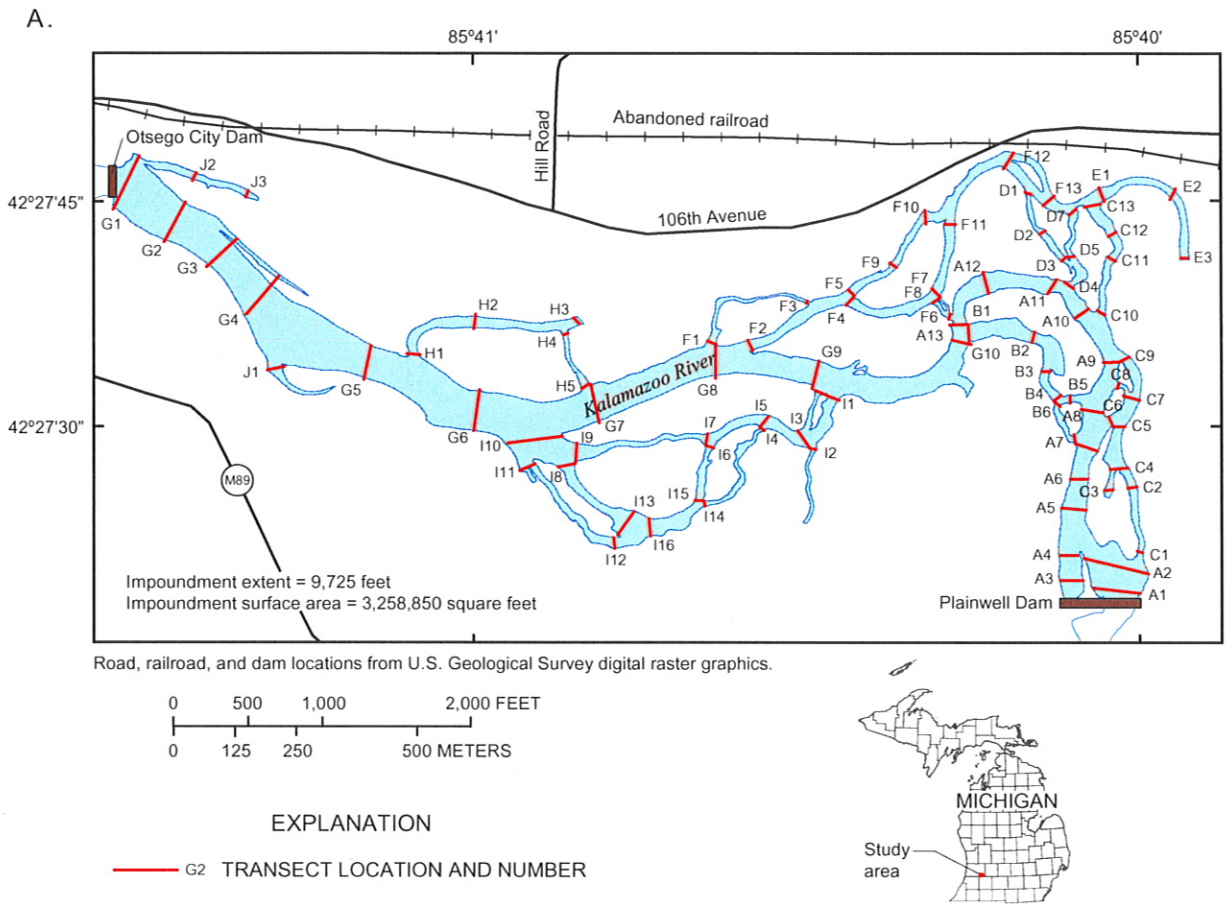

Figure 2a. Location of transects in the Otsego City impoundment on the Kalamazoo River, Mich.

Collection of Data Points and Sediment Cores

Data points (water depth, water velocity, and sediment thickness) were collected across each transect in the impoundment. Water depths and water velocities were measured by standard USGS methods (Rantz and others, 1982) using a boat-cable measuring device equipped with an A-reel, a 15-30-lb weight, and a Price AA standard current meter.

Hand augering along transect lines was performed in order to determine sediment thickness. Thickness of the impoundment sediment was obtained by boring with a 1-ft-long by 1- in.-diameter auger bit with 4-ft extension pipes. The depth of the impoundment sediment that overlay the pre-dam alluvium (altitude prior to dam construction) was indicated when the auger could no longer be advanced. This contact between the pre-dam outwash and the post-dam-sediments was distinct, and could be determined easily by a grinding that could be heard and felt when the auger bit contacted the underlying coarser material of cobbles and stones.

Core samples were collected at one point along selected transects, generally where impoundment sediments were thickest (fig. 2b). Cores were collected at depths where lithology changed by use of a stainless steel 2-in.-diameter sediment corer. Changes in sediment texture and color were observed in the field. A total of 164 samples from 76 core locations were collected and sieved at the Michigan State University Department of Geography Geomorphology Laboratory by use of U.S. Standard Sieves.

Estimation of Sediment Volume

In order to estimate the volume of the instream sediments, a series of grids was generated by use of a geographic information system (GIS). Grid surfaces for water depth and post-dam sediment were interpolated on the basis of auger-point data by use of TOPOGRID in Arc/Info 8.2. Contours were generated from the interpolated grid surfaces. The contours were modified, redrawn manually on the basis of

Appendix 1. Date, location, water velocity, altitude of surfaces, and total thickness of sediment at transect data points in the Otsego City impoundment on the Kalamazoo River at Otsego, Mich.

[Vertical data referenced to the North American Vertical Datum of 1988 (NAVD 88). Water surface normalized to a stage of 2.0 ft. Abbreviations: °, degrees; ′, minutes; ″, seconds; ft, feet; mi, miles; ft/s, feet per second; --, no data. Sediment cores denoted in bold.]

Transect No. (fig. 2a)	Date	Latitude	Longitude	Distance from right edge of water (ft)	River miles from mouth (mi)	Mean velocity (ft/s)	Altitude of water surface (ft)	Altitude of streambed (ft)	Altitude of base sediment (ft)	Total thickness of sediment (ft)
A1	06-13-01	42° 27′ 21.94″	085° 40′ 00.94″	0	54.84	--	700.9	698.4	698.4	0.0
A1	06-13-01	42° 27′ 21.97″	085° 40′ 01.29″	26	54.84	--	700.9	695.0	695.0	.0
A1	06-13-01	42° 27′ 21.99″	085° 40′ 01.59″	50	54.84	--	700.9	691.0	690.0	1.0
A1	06-13-01	42° 27′ 22.01″	085° 40′ 01.86″	70	54.84	--	700.9	691.5	690.5	1.0
A1	06-13-01	42° 27′ 22.03″	085° 40′ 02.17″	93	54.84	--	700.9	691.5	690.5	1.0
A1	06-13-01	42° 27′ 22.04″	085° 40′ 02.50″	118	54.84	--	700.9	692.5	691.5	1.0
A1	06-13-01	42° 27′ 22.07″	085° 40′ 02.80″	140	54.84	--	700.9	693.5	692.5	1.0
A1	06-13-01	42° 27′ 22.09″	085° 40′ 03.14″	166	54.84	--	700.9	695.0	694.0	1.0
A1	06-13-01	42° 27′ 22.12″	085° 40′ 03.48″	191	54.84	--	700.9	695.0	694.0	1.0
A1	06-13-01	42° 27′ 22.13″	085° 40′ 03.80″	216	54.84	--	700.9	696.0	694.0	2.0
A1	06-13-01	42° 27′ 22.15″	085° 40′ 04.15″	242	54.84	--	700.9	698.0	696.0	2.0
A1	06-13-01	42° 27′ 22.18″	085° 40′ 04.39″	260	54.84	--	700.9	699.0	696.0	3.0
A1	06-13-01	42° 27′ 22.19″	085° 40′ 04.61″	277	54.84	--	700.9	699.5	698.5	1.0
A1	06-13-01	42° 27′ 22.20″	085° 40′ 04.85″	295	54.84	--	700.9	700.0	698.5	1.5
A2	06-13-01	42° 27′ 23.22″	085° 40′ 00.22″	0	54.80	--	700.9	700.2	700.2	.0
A2	06-13-01	42° 27′ 23.29″	085° 40′ 00.65″	33	54.80	--	700.9	698.0	698.0	.0
A2	06-13-01	42° 27′ 23.36″	085° 40′ 01.02″	62	54.80	--	700.9	697.5	697.5	.0
A2	06-13-01	42° 27′ 23.41″	085° 40′ 01.37″	89	54.80	--	700.9	698.0	697.0	1.0
A2	06-13-01	42° 27′ 23.48″	085° 40′ 01.80″	122	54.80	--	700.9	698.0	698.0	.0
A2	06-13-01	42° 27′ 23.55″	085° 40′ 02.17″	151	54.80	--	700.9	699.0	698.5	.5
A2	06-13-01	42° 27′ 23.61″	085° 40′ 02.55″	180	54.80	--	700.9	700.0	699.5	.5
A2	06-13-01	42° 27′ 23.68″	085° 40′ 02.99″	214	54.80	--	700.9	699.5	699.2	.3
A2	06-13-01	42° 27′ 23.75″	085° 40′ 03.40″	246	54.80	--	700.9	700.0	700.0	.0
A2	06-13-01	42° 27′ 23.81″	085° 40′ 03.81″	276	54.80	--	700.9	700.2	700.2	.0
A2	06-13-01	42° 27′ 23.94″	085° 40′ 04.54″	333	54.80	--	700.9	700.0	699.7	.3
A2	06-13-01	42° 27′ 24.00″	085° 40′ 04.88″	359	54.80	--	700.9	699.0	699.0	.0
A2	06-13-01	42° 27′ 24.08″	085° 40′ 05.28″	390	54.80	--	700.9	699.5	699.5	.0
A2	06-13-01	42° 27′ 24.12″	085° 40′ 05.65″	419	54.80	--	700.9	697.5	697.5	.0
A3	05-22-01	42° 27′ 22.70″	085° 40′ 05.88″	0	54.83	0.00	700.9	699.4	698.1	1.3
A3	05-22-01	42° 27′ 22.69″	085° 40′ 06.08″	15	54.83	.00	700.9	698.4	697.5	.9
A3	05-22-01	42° 27′ 22.69″	085° 40′ 06.29″	30	54.83	.00	700.9	697.9	697.7	.2
A3	05-22-01	42° 27′ 22.69″	085° 40′ 06.48″	45	54.83	.00	700.9	698.0	697.7	.3
A3	05-22-01	42° 27′ 22.69″	085° 40′ 06.68″	60	54.83	.00	700.9	697.7	697.6	.1
A3	05-22-01	42° 27′ 22.68″	085° 40′ 06.88″	75	54.83	.00	700.9	697.4	697.4	.0

Appendix 1. Date, location, water velocity, altitude of surfaces, and total thickness of sediment at transect data points in the Otsego City impoundment on the Kalamazoo River at Otsego, Mich.--Continued

[Vertical data referenced to the North American Vertical Datum of 1988 (NAVD 88). Water surface normalized to a stage of 2.0 ft. Abbreviations: °, degrees; ′, minutes; ″, seconds; ft, feet; mi, miles; ft/s, feet per second; --, no data. Sediment cores denoted in bold.]

Transect No. (fig. 2a)	Date	Latitude	Longitude	Distance from right edge of water (ft)	River miles from mouth (mi)	Mean velocity (ft/s)	Altitude of water surface (ft)	Altitude of streambed (ft)	Altitude of base sediment (ft)	Total thickness of sediment (ft)
A3	05-22-01	42° 27′ 22.68″	085° 40′ 07.09″	90	54.83	0.00	700.9	696.6	696.5	0.1
A3	05-22-01	42° 27′ 22.68″	085° 40′ 07.29″	105	54.83	.00	700.9	696.8	696.6	.2
A3	05-22-01	42° 27′ 22.67″	085° 40′ 07.49″	120	54.83	.00	700.9	697.3	696.7	.6
A3	05-22-01	42° 27′ 22.67″	085° 40′ 07.75″	140	54.83	.00	700.9	699.1	698.6	.5
A4	05-22-01	42° 27′ 24.32″	085° 40′ 06.23″	0	54.78	.00	700.9	698.9	698.9	.0
A4	05-22-01	42° 27′ 24.32″	085° 40′ 06.31″	10	54.78	.00	700.9	698.7	698.3	.4
A4	05-22-01	42° 27′ 24.32″	085° 40′ 06.45″	20	54.78	.00	700.9	698.4	697.5	.9
A4	05-22-01	42° 27′ 24.32″	085° 40′ 06.58″	30	54.78	.00	700.9	698.1	697.2	.9
A4	**05-22-01**	**42° 27′ 24.32″**	**085° 40′ 06.71″**	**40**	**54.78**	**.00**	**700.9**	**698.0**	**697.1**	**.9**
A4	05-22-01	42° 27′ 24.32″	085° 40′ 06.85″	50	54.78	.00	700.9	698.0	697.1	.9
A4	05-22-01	42° 27′ 24.32″	085° 40′ 06.98″	60	54.78	.00	700.9	697.9	696.7	1.2
A4	05-22-01	42° 27′ 24.31″	085° 40′ 07.11″	70	54.78	.00	700.9	697.7	696.4	1.3
A4	05-22-01	42° 27′ 24.31″	085° 40′ 07.25″	80	54.78	.00	700.9	696.9	696.4	.5
A4	05-22-01	42° 27′ 24.31″	085° 40′ 07.38″	90	54.78	.00	700.9	696.9	696.1	.8
A4	05-22-01	42° 27′ 24.31″	085° 40′ 07.51″	100	54.78	.00	700.9	696.4	696.4	.0
A4	05-22-01	42° 27′ 24.31″	085° 40′ 07.65″	110	54.78	.00	700.9	697.8	697.4	.4
A4	05-22-01	42° 27′ 24.31″	085° 40′ 07.78″	120	54.78	.00	700.9	699.7	699.1	.6
A5	06-11-01	42° 27′ 27.29″	085° 40′ 05.61″	0	54.73	.00	698.9	698.1	696.1	2.0
A5	06-11-01	42° 27′ 27.30″	085° 40′ 05.72″	10	54.73	2.45	698.9	698.1	698.1	.0
A5	06-11-01	42° 27′ 27.31″	085° 40′ 05.85″	20	54.73	3.74	698.9	698.3	698.3	.0
A5	06-11-01	42° 27′ 27.31″	085° 40′ 05.97″	30	54.73	3.28	698.9	698.1	698.1	.0
A5	06-11-01	42° 27′ 27.32″	085° 40′ 06.11″	40	54.73	3.32	698.9	697.5	697.5	.0
A5	06-11-01	42° 27′ 27.33″	085° 40′ 06.23″	50	54.73	3.89	698.9	697.9	697.9	.0
A5	06-11-01	42° 27′ 27.34″	085° 40′ 06.36″	60	54.73	3.12	698.9	697.2	697.2	.0
A5	06-11-01	42° 27′ 27.35″	085° 40′ 06.50″	70	54.73	3.95	698.9	696.4	696.4	.0
A5	06-11-01	42° 27′ 27.35″	085° 40′ 06.64″	80	54.73	4.04	698.9	695.4	695.4	.0
A5	06-11-01	42° 27′ 27.36″	085° 40′ 06.76″	90	54.73	3.82	698.9	693.6	693.6	.0
A5	06-11-01	42° 27′ 27.37″	085° 40′ 06.90″	100	54.73	3.50	698.9	691.9	691.9	.0
A5	06-11-01	42° 27′ 27.38″	085° 40′ 07.03″	110	54.73	2.28	698.9	691.1	691.1	.0
A5	06-11-01	42° 27′ 27.38″	085° 40′ 07.16″	120	54.73	2.25	698.9	691.6	691.6	.0
A5	06-11-01	42° 27′ 27.39″	085° 40′ 07.30″	130	54.73	3.36	698.9	693.4	693.4	.0
A5	06-11-01	42° 27′ 27.40″	085° 40′ 07.43″	140	54.73	1.73	698.9	694.8	694.8	.0
A5	06-11-01	42° 27′ 27.41″	085° 40′ 07.56″	150	54.73	.81	698.9	696.1	696.1	.0
A5	06-11-01	42° 27′ 27.42″	085° 40′ 07.67″	160	54.73	.00	698.9	698.6	698.6	.0

Appendix 1. Date, location, water velocity, altitude of surfaces, and total thickness of sediment at transect data points in the Otsego City impoundment on the Kalamazoo River at Otsego, Mich.--Continued

[Vertical data referenced to the North American Vertical Datum of 1988 (NAVD 88). Water surface normalized to a stage of 2.0 ft. Abbreviations: °, degrees; ′, minutes; ″, seconds; ft, feet; mi, miles; ft/s, feet per second; --, no data. Sediment cores denoted in bold.]

Transect No. (fig. 2a)	Date	Latitude	Longitude	Distance from right edge of water (ft)	River miles from mouth (mi)	Mean velocity (ft/s)	Altitude of water surface (ft)	Altitude of streambed (ft)	Altitude of base sediment (ft)	Total thickness of sediment (ft)
A6	05-15-01	42° 27′ 29.31″	085° 40′ 05.52″	0	54.68	0.66	698.5	697.8	697.8	0.0
A6	05-15-01	42° 27′ 29.31″	085° 40′ 05.64″	10	54.68	2.16	698.5	696.6	696.6	.0
A6	05-15-01	42° 27′ 29.30″	085° 40′ 05.80″	20	54.68	2.44	698.5	696.6	696.6	.0
A6	05-15-01	42° 27′ 29.30″	085° 40′ 05.92″	30	54.68	3.79	698.5	695.6	695.6	.0
A6	05-15-01	42° 27′ 29.30″	085° 40′ 06.04″	40	54.68	5.12	698.5	694.6	694.6	.0
A6	05-15-01	42° 27′ 29.30″	085° 40′ 06.19″	50	54.68	5.58	698.5	693.6	693.6	.0
A6	05-15-01	42° 27′ 29.30″	085° 40′ 06.31″	60	54.68	6.13	698.5	693.6	693.6	.0
A6	05-15-01	42° 27′ 29.30″	085° 40′ 06.46″	70	54.68	6.45	698.5	694.1	694.1	.0
A6	05-15-01	42° 27′ 29.30″	085° 40′ 06.71″	90	54.68	3.76	698.5	695.6	695.6	.0
A6	05-15-01	42° 27′ 29.30″	085° 40′ 06.92″	105	54.68	.00	698.5	698.5	698.5	.0
A7	05-15-01	42° 27′ 31.16″	085° 40′ 04.64″	0	54.65	.00	698.2	697.5	694.5	3.0
A7	05-15-01	42° 27′ 31.19″	085° 40′ 04.76″	10	54.65	.45	698.2	696.3	694.8	1.5
A7	05-15-01	42° 27′ 31.22″	085° 40′ 04.90″	20	54.65	.90	698.2	695.5	695.0	.5
A7	05-15-01	42° 27′ 31.25″	085° 40′ 05.03″	30	54.65	2.73	698.2	695.3	695.3	.0
A7	05-15-01	42° 27′ 31.28″	085° 40′ 05.14″	40	54.65	3.82	698.2	695.3	695.3	.0
A7	05-15-01	42° 27′ 31.31″	085° 40′ 05.27″	50	54.65	5.10	698.2	695.3	695.3	.0
A7	05-15-01	42° 27′ 31.34″	085° 40′ 05.39″	60	54.65	5.27	698.2	695.3	695.3	.0
A7	05-15-01	42° 27′ 31.38″	085° 40′ 05.51″	70	54.65	6.08	698.2	695.3	695.3	.0
A7	05-15-01	42° 27′ 31.41″	085° 40′ 05.66″	80	54.65	5.89	698.2	695.3	695.3	.0
A7	05-15-01	42° 27′ 31.45″	085° 40′ 05.83″	95	54.65	5.23	698.2	695.3	695.3	.0
A7	05-15-01	42° 27′ 31.50″	085° 40′ 06.02″	110	54.65	4.64	698.2	695.3	695.3	.0
A7	05-15-01	42° 27′ 31.55″	085° 40′ 06.21″	125	54.65	3.57	698.2	695.8	695.8	.0
A7	05-15-01	42° 27′ 31.58″	085° 40′ 06.33″	135	54.65	1.76	698.2	695.8	695.8	.0
A7	05-15-01	42° 27′ 31.60″	085° 40′ 06.41″	140	54.65	1.16	698.2	696.3	696.0	.3
A7	**05-15-01**	**42° 27′ 31.65″**	**085° 40′ 06.65″**	**160**	**54.65**	**.00**	**698.2**	**697.3**	**694.8**	**2.5**
A8	05-15-01	42° 27′ 33.66″	085° 40′ 04.23″	0	54.61	3.30	697.8	695.5	695.5	.0
A8	05-15-01	42° 27′ 33.68″	085° 40′ 04.36″	10	54.61	4.04	697.8	695.5	695.5	.0
A8	05-15-01	42° 27′ 33.70″	085° 40′ 04.49″	20	54.61	3.70	697.8	695.5	695.5	.0
A8	05-15-01	42° 27′ 33.71″	085° 40′ 04.60″	30	54.61	4.00	697.8	695.5	695.5	.0
A8	05-15-01	42° 27′ 33.72″	085° 40′ 04.76″	40	54.61	3.90	697.8	695.5	695.5	.0
A8	05-15-01	42° 27′ 33.74″	085° 40′ 04.89″	50	54.61	3.80	697.8	695.5	695.5	.0
A8	05-15-01	42° 27′ 33.75″	085° 40′ 05.01″	60	54.61	3.88	697.8	695.0	695.0	.0
A8	05-15-01	42° 27′ 33.76″	085° 40′ 05.15″	70	54.61	4.31	697.8	695.0	695.0	.0
A8	05-15-01	42° 27′ 33.78″	085° 40′ 05.28″	80	54.61	3.76	697.8	694.5	694.5	.0
A8	05-15-01	42° 27′ 33.79″	085° 40′ 05.42″	90	54.61	4.00	697.8	695.0	695.0	.0

Attachment F-2

744 Heartland Trail
Madison, WI 53717
(608) 831-4444 • Fax (608) 831-3334

PROJECT / PROPOSAL NAME / LOCATION: Weyerhaeuser 12th Street Landfill		PROJECT / PROPOSAL NO. 5117.04
SUBJECT: Riprap design		
PREPARED BY: ECW	DATE: 6/28/07	FINAL
CHECKED BY:	DATE:	REVISION

Riprap Size Calculations

Purpose:

Determine the size of the riprap placed along the riverbank of the Weyerhaeuser 12th Street Landfill that will withstand the erosive forces from a 500-yr flood event.

Method:

The method presented in the U.S. Army Corp of Engineer's Engineering and Design - Hydraulic Design of Flood Control Channels (U.S. Army Corp of Engineers, 1994) was used to determine the size of the riprap that could withstand the erosive forces from a 500-yr flood event. The ability of riprap to resist the erosive forces of channel flow depends on the interaction of the following factors: stone shape, size, weight, and durability; riprap gradation and layer thickness; and channel alignment, cross-section, gradient, and velocity distribution (U.S. Army Corp of Engineers, 1994). A safety factor of 1.3 was used along with a flow velocity of 5.7 feet per second (fps) and a water depth of 7 ft (refer to the attached calculation for flow velocity and elevation).

Ice and debris create greater stresses on riprap reventment by impact and flow concentration effects (U.S. Army Corp of Engineers, 1994). The U.S. Army Corp of Engineers recommends that thickness should be increased by 6 to 12 inches, accompanied by appropriate increase in stone size, for riprap subject to attack by large floating debris. Riprap deterioration from debris impacts is usually more extensive on banks lined with steep slopes. Therefore, riprapped slopes on streams with heavy debris loads should be no steeper than 2.5H:1V (U.S. Army Corp of Engineers, 1994).

Calculation:

The following equation was used to determine the size of the riprap that could withstand the erosive forces from a 500-yr flood event.

$$D_{30} = S_f C_s C_v C_t d \left[\left(\frac{\gamma_w}{\gamma_s - \gamma_w} \right)^{0.5} \left(\frac{V}{\sqrt{Kgd}} \right) \right]^{2.5}$$

(Eq. 3 - 3, U.S. Army Corps of Engineers, 1994)

Where:

Sf safety factor	1.3	
C_s stability coefficient	0.375	(0.3 quarry or 0.375 smooth)
C_v vertical velocity coefficient	1.00	(1.00 for straight section)
C_t thickness coefficient	1	
d depth	7	(696' to 703')
V velocity	5.7	
K side slope factor	0.98	(3:1 sideslope. Refer to the attached Plate B-39 (U.S. Army Corp of Engineers, 1994.))
g gravity constant	32.2	
γ_w unit weight water	62.4	
γ_s unit weight stone	165	(assumed based on experience and recommendations from the U.S. Army Corp of Engineers, 1994.)

D (ft)	**0.17**
D (in)	**2.00**

Conclusion:

This analysis showed that a smooth riprap with a D_{30} of 2 inches will be able to withstand the erosive forces from a 500-yr flood event. Weyerhaeuser is proposing to use a larger stone (D_{50} of 9 inches) as shown in the CQA Plan to address the greater stresses on the riprap caused by ice and debris.

References:

U.S. Army Corp of Engineers. 1994. Engineering and Design - Hydraulic Design of Flood Control Channels. EM 1110-2-1601.

FROM:
Colbond EnkaGreen
e-engineering with
Enkamat V. 2.0

0.5 hr

Project Information

Name
Weyerhaeuser 12th Street Landfill

Number
5117.04

Location
Grand Rapids, Michigan United States

Notes

List of Channels
Eastern slope of 12th St LF

List of Slopes

0.5 hr

Channel Analysis

Eastern slope of 12th St LF

Input Data

Channel Shape:	Trapezoidal	Channel Bend:	No
Bottom Width (ft):	100.0	Bend Radius (ft):	N/A
Bed Slope (ft/ft):	0.002	Bend Location:	N/A
Right Side Slope (H:1V):	3.0		
Left Side Slope (H:1V):	5.0	Velocity (fps):	5.7
Channel Length (ft):	300.0	Flow Duration (hrs):	0.5
Required Freeboard (ft):	0.0	Req'd Factor of Safety:	1.3
Lining Condition:	Vegetated	Vegetation Type:	Class C
Left Lining:	Enkamat 7010		
Bottom Lining:	Enkamat 7010	– Not applicable	
Right Lining:	Enkamat 7010	– Not applicable	

Not applicable

Results

	Left	Bottom	Right	Avg./Total
Flow Rate (cfs):				8,879.11
Depth of Flow (ft):				10.86
Flow Area (sf):				1,557.7
Wetted Perimeter (ft):	55.4	100.0	34.3	189.7
Hydraulic Radius (ft):				8.21
Manning's "n":	0.042	0.042	0.042	0.042
Velocity (fps):				5.7
Shear Stress (psf):	1.01	1.08	0.92	
Permissible Shear Stress (psf):	8.0	8.0	8.0	
Resulting Factor of Safety:	7.96	7.38	8.68	
Pass / Fail:	Pass	Pass	Pass	

Costs

	Left	Bottom	Right	Total
Quantity (sy):	1,845.8	3,333.3	1,144.7	6,323.9
Material Cost:	$0.00	$0.00	$0.00	$0.00
Installation Cost:				$0.00
Channel Cost:				$0.00

50 hr

Project Information

Name

Weyerhaeuser 12th Street Landfill

Number

5117.04

Location

Grand Rapids, Michigan United States

Notes

List of Channels

Eastern slope of 12th St LF

List of Slopes

50 hr

Channel Analysis

Eastern slope of 12th St LF

Input Data

Channel Shape:	Trapezoidal	Channel Bend:	No
Bottom Width (ft):	100.0	Bend Radius (ft):	N/A
Bed Slope (ft/ft):	0.002	Bend Location:	N/A
Right Side Slope (H:1V):	3.0		
Left Side Slope (H:1V):	5.0	Velocity (fps):	5.7
Channel Length (ft):	300.0	Flow Duration (hrs):	50.0
Required Freeboard (ft):	0.0	Req'd Factor of Safety:	1.3
Lining Condition:	Vegetated	Vegetation Type:	Class C
Left Lining:	Enkamat 7010		
Bottom Lining:	Enkamat 7010 - Not applicable		
Right Lining:	Enkamat 7010 - Not applicable		

Not applicable

Results

	Left	Bottom	Right	Avg./Total
Flow Rate (cfs):				8,879.11
Depth of Flow (ft):				10.86
Flow Area (sf):				1,557.7
Wetted Perimeter (ft):	55.4	100.0	34.3	189.7
Hydraulic Radius (ft):				8.21
Manning's "n":	0.042	0.042	0.042	0.042
Velocity (fps):				5.7
Shear Stress (psf):	1.01	1.08	0.92	
Permissible Shear Stress (psf):	6.0	6.0	6.0	
Resulting Factor of Safety:	5.97	5.53	6.51	
Pass / Fail:	Pass	Pass	Pass	

Costs

	Left	Bottom	Right	Total
Quantity (sy):	1,845.8	3,333.3	1,144.7	6,323.9
Material Cost:	$0.00	$0.00	$0.00	$0.00
Installation Cost:				$0.00
Channel Cost:				$0.00

COLBOND

Enkamat 7010 R^2M

Root Reinforcement Mat

Description

Enkamat® 7010 is a three-dimensional turf reinforcement mat (TRM) made of continuous monofilaments fused at their intersections. Ninety-five (95%) percent of the Enkamat is open and available for soil, mulch and root interaction with filaments, creating the most effective Root Reinforcement Mat (R^2M) available. Enkamat is manufactured from nylon to eliminate the buoyancy factor associated with submerged conditions and provide permanent TRM protection in vegetated channels as well as on slopes.

Recommended Applications

- Permanent erosion control for Green (vegetated) channels with expected shear stresses ≤ 8 psf.
- Permanent erosion control for slight to moderate slopes (≤ 2.5H:1V).
- Support and enhance performance of Ecosystem plants.
- Substrate for hydraulically applied Bonded Fiber Matrix (BFM) and other mulches for erosion control applications where low water flow and low to moderate shear stresses are expected

Technical Data

Mechanical Properties	Test Method	Units	Typical Roll Value	
			MD	CD
Tensile Strength	ASTM D 5035 (modified)	kN/m (lbs/ft)	2.3 (160)	1.2 (80)
Thickness	ASTM D 5199	mm (in)	10 (0.4)	
Mass/Unit Area	ASTM D 5261	g/m^2 (oz/yd^2)	271 (8.0)	
UV Stability	ASTM D G53 / ASTM D 5035 (modified)	% strength retained	80	

Performance Properties	Test Method	Units	Typical Roll Value
Permissible Velocity			
Product Only	Flume test[1]	m/s (ft/s)	6.1 (20)
30 minute, vegetated	Flume test[1]	m/s (ft/s)	5.8 (19)
50 hour, vegetated	Flume test[1]	m/s (ft/s)	4.2 (14)
Permissible Shear Stress			
Product Only	Flume test[1]	kN/m^2 (lbs/ft^2)	0.32 (6.7)
30 minute, vegetated	Flume test[1]	kN/m^2 (lbs/ft^2)	0.38 (8.0)
50 hour, vegetated	Flume test[1]	kN/m^2 (lbs/ft^2)	0.29 (6.0)

1. Flume test performed at independent laboratory—data and details available upon request.

Packaging Data

Physical Properties	Units	Nominal Value	
Roll Dimensions *[width x length]*	m (ft)	0.99 x 152 (3.25 x 500)	1.93 x 27.5 (6.33 x 90)
Roll Area	m^2 (yd^2)	150 (180)	53 (63.3)
Estimated Roll Diameter	cm (in)	111 (44)	48 (19)
Estimated Roll Weight	kg (lb)	42 (92)	15 (32)

Colbond Inc.
PO Box 1057
Enka, NC 28728
Tel 800-365-7391
Fax 828-665-5009
www.colbond-usa.com

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Riprap Calculations

Riprap Calculations

744 Heartland Trail
Madison, WI 53717
(608) 831-4444 • Fax (608) 831-3334

PROJECT / PROPOSAL NAME / LOCATION: Weyerhaeuser 12th Street Landfill		PROJECT / PROPOSAL NO. 5117.04
SUBJECT: Riprap design		
PREPARED BY: ECW	DATE: 6/28/07	FINAL
CHECKED BY:	DATE:	REVISION

Riprap Size Calculations

Purpose:

Determine the size of the riprap placed along the riverbank of the Weyerhaeuser 12th Street Landfill that will withstand the erosive forces from a 500-yr flood event.

Method:

The method presented in the U.S. Army Corp of Engineer's Engineering and Design - Hydraulic Design of Flood Control Channels (U.S. Army Corp of Engineers, 1994) was used to determine the size of the riprap that could withstand the erosive forces from a 500-yr flood event. The ability of riprap to resist the erosive forces of channel flow depends on the interaction of the following factors: stone shape, size, weight, and durability; riprap gradation and layer thickness; and channel alignment, cross-section, gradient, and velocity distribution (U.S. Army Corp of Engineers, 1994). A safety factor of 1.3 was used along with a flow velocity of 5.7 feet per second (fps) and a water depth of 7 ft (refer to the attached calculation for flow velocity and elevation).

Ice and debris create greater stresses on riprap reventment by impact and flow concentration effects (U.S. Army Corp of Engineers, 1994). The U.S. Army Corp of Engineers recommends that thickness should be increased by 6 to 12 inches, accompanied by appropriate increase in stone size, for riprap subject to attack by large floating debris. Riprap deterioration from debris impacts is usually more extensive on banks lined with steep slopes. Therefore, riprapped slopes on streams with heavy debris loads should be no steeper than 2.5H:1V (U.S. Army Corp of Engineers, 1994).

Calculation:

The following equation was used to determine the size of the riprap that could withstand the erosive forces from a 500-yr flood event.

$$D_{30} = S_f C_s C_v C_t d \left[\left(\frac{\gamma_w}{\gamma_s - \gamma_w} \right)^{0.5} \left(\frac{V}{\sqrt{Kgd}} \right) \right]^{2.5}$$

(Eq. 3 - 3, U.S. Army Corps of Engineers, 1994)

Where:

Sf safety factor	1.3	
C_s stability coefficient	0.375	(0.3 quarry or 0.375 smooth)
C_v vertical velocity coefficient	1.00	(1.00 for straight section)
C_t thickness coefficient	1	
d depth	7	(696' to 703')
V velocity	5.7	
K side slope factor	0.98	(3:1 sideslope. Refer to the attached Plate B-39 (U.S. Army Corp of Engineers, 1994.))
g gravity constant	32.2	
γ_w unit weight water	62.4	
γ_s unit weight stone	165	(assumed based on experience and recommendations from the U.S. Army Corp of Engineers, 1994.)

D (ft)	**0.17**
D (in)	**2.00**

Conclusion:

This analysis showed that a smooth riprap with a D_{30} of 2 inches will be able to withstand the erosive forces from a 500-yr flood event. Weyerhaeuser is proposing to use a larger stone (D_{50} of 9 inches) as shown in the CQA Plan to address the greater stresses on the riprap caused by ice and debris.

References:

U.S. Army Corp of Engineers. 1994. Engineering and Design - Hydraulic Design of Flood Control Channels. EM 1110-2-1601.

References

EM 1110-2-1601
1 July 1991

US Army Corps
of Engineers

ENGINEERING AND DESIGN

Hydraulic Design of Flood Control Channels

ENGINEER MANUAL

Chapter 3
Riprap Protection

Section I
Introduction

3-1. General

* The guidance presented herein applies to riprap design for open channels not immediately downstream of stilling basins or other highly turbulent areas (for stilling basin riprap, use HDC 712-1, Plates 29 and 30). The ability of riprap slope protection to resist the erosive forces of channel flow depends on the interrelation of the following factors: stone shape, size, weight, and durability; riprap gradation and layer thickness; and channel alignment, cross-section, gradient, and velocity distribution. The bed material and local scour characteristics determine the design of toe protection which is essential for riprap revetment stability. The bank material and groundwater conditions affect the need for filters between the riprap and underlying material. Construction quality control of both stone production and riprap placement is essential for successful bank protection. Riprap protection for flood control channels and appurtenant structures should be designed so that any flood that could reasonably be expected to occur during the service life of the channel or structure would not cause damage exceeding nominal maintenance or replacement (see ER 1110-2-1150). While the procedures presented herein yield definite stone sizes, results should be used for guidance purposes and revised as deemed necessary to provide a practical protection design for the specific project conditions.

3-2. Riprap Characteristics

The following provides guidance on stone shape, size/weight relationship, unit weight, gradation, and layer thickness. Reference EM 1110-2-2302 for additional guidance on riprap material characteristics and construction.

a. Stone shape. Riprap should be blocky in shape rather than elongated, as more nearly cubical stones "nest" together best and are more resistant to movement. The stone should have sharp, angular, clean edges at the intersections of relatively flat faces. Stream rounded stone is less resistant to movement, although the drag force on a rounded stone is less than on angular, cubical stones. As rounded stone interlock is less than that of equal-sized angular stones, the rounded stone mass is more likely to be eroded by channel flow. If used, the rounded stone should be placed on flatter side slopes than angular stone and should be about 25 percent larger in diameter. The following shape limitations should be specified for riprap obtained from quarry operations:

(1) The stone shall be predominantly angular in shape.

(2) Not more than 30 percent of the stones distributed throughout the gradation should have a ratio of a/c greater than 2.5.

(3) Not more than 15 percent of the stones distributed throughout the gradation should have a ratio of a/c greater than 3.0.

(4) No stone should have a ratio of a/c greater than 3.5.

To determine stone dimensions a and c, consider that the stone has a long axis, an intermediate axis, and a short axis, each being perpendicular to the other. Dimension a is the maximum length of the stone, which defines the long axis of the stone. The intermediate axis is defined by the maximum width of the stone. The remaining axis is the short axis. Dimension c is the maximum dimension parallel to the short axis. These limitations apply only to the stone within the required riprap gradation and not to quarry spalls and waste that may be allowed.

b. Relation between stone size and weight. The ability of riprap revetment to resist erosion is related to the size and weight of stones. Design guidance is often expressed in terms of the stone size $D_{\%}$, where % denotes the percentage of the total weight of the graded material (total weight including quarry wastes and spalls) that contains stones of less weight. The relation between size and weight of stone is described herein using a spherical shape by the equation

$$D_{\%} = \left(\frac{6W_{\%}}{\pi\gamma_s}\right)^{1/3} \tag{3-1}$$

where

$D_{\%}$ = equivalent-volume spherical stone diameter, ft

$W_{\%}$ = weight of individual stone having diameter of $D_{\%}$

γ_s = saturated surface dry specific or unit weight of stone, pcf

Plate 31 presents relations between spherical diameter and weight for several values of specific or unit weight. Design procedures for determining the stone size required to resist the erosive forces of channel flow are presented in paragraph 3-5 below.

c. Unit weight. Unit weight of stone γ_s generally varies from 150 to 175 pcf. Riprap sizing relations are relatively sensitive to unit weight of stone, and γ_s should be determined as accurately as possible. In many cases, the unit weight of stone is not known because the quarry is selected from a list of approved riprap sources after the construction contract is awarded. Riprap coming from the various quarries will not be of the same unit weight. Under these circumstances, a unit weight of stone close to the minimum of the available riprap sources can be used in design. Contract options covering specific weight ranges of 5 or 10 pcf should be offered when sufficient savings warrant.

d. Gradation.

(1) The gradation of stones in riprap revetment affects the riprap's resistance to erosion. Stone should be reasonably well graded throughout the in-place layer thickness. Specifications should provide for two limiting gradation curves, and any stone gradation as determined from quarry process, stockpile, and in-place field test samples that lies within these limits should be acceptable. Riprap sizes and weights are frequently used such as D_{30}(min), D_{100}(max), W_{50}(min), etc. The D or W refers to size or weight, respectively. The number is the percent finer by weight as discussed in b above. The (max) or (min) refers to the upper or lower limit gradation curves, respectively. Engineer Form 4794-R is a standard form for plotting riprap gradation curves (Plate 32). The gradation limits should not be so restrictive that production costs would be excessive. The choice of limits also depends on the underlying bank soils and filter requirements if a graded stone filter is used. Filters may be required under riprap revetments. Guidance for filter requirements is given in EM 1110-2-1901. Filter design is the responsibility of the Geotechnical Branch in each District.

(2) Standardized gradations having a relatively narrow range in sizes (D_{85}/D_{15} of 1.4-2.2) are shown in Table 3-1. Other gradations can be used and often have a wider range of allowable sizes than those given in Table 3-1. One example is the Lower Mississippi Valley Division (LMVD) Standardized Gradations presented in Appendix F. The LMVD gradations are similar to the gradations listed in Table 3-1 except the LMVD W_{50}(max) and W_{15}(max) weights are larger, which can make the LMVD gradations easier to produce. Most graded ripraps have ratios of D_{85}/D_{15} less than 3. Uniform riprap ($D_{85}/D_{15} < 1.4$) has been used at sites in the US Army Engineer Division, Missouri River, for reasons of economy and quality control of sizes and placement.

(3) Rather than a relatively expensive graded riprap, a greater thickness of a quarry-run stone may be considered. Some designers consider the quarry-run stone to have another advantage: its gravel- and sand-size components serve as a filter. The gravel and sand sizes should be less by volume than the voids among the larger stone. This concept has resulted in considerable cost savings on large projects such as the Arkansas and Red River Navigation Projects. Not all quarry-run stone can be used as riprap; stone that is gap graded or has a large range in maximum to minimum size is probably unsuitable. Quarry-run stone for riprap should be limited to $D_{85}/D_{15} \leq 7$.

(4) Determining optimum gradations is also an economics problem that includes the following factors:

(a) Rock quality (durability under service conditions)

(b) Cost per ton at the quarry (including capability of quarry to produce a particular size)

(c) Number of tons required

(d) Miles transported

(e) Cost of transportation per ton-mile

(f) Cost per ton for placement

(g) Need for and cost of filter

(h) Quality control during construction (it is easier to ensure even coverage with a narrow gradation than with a wide gradation)

(i) Number of different gradations required. Sometimes cost savings can be realized by using fewer gradations.

See EM 1110-2-2302 for further discussion of these factors.

Table 3-1
Gradations for Riprap Placement in the Dry, Low-Turbulence Zones

	Limits of Stone Weight, lb[1], for Percent Lighter by Weight									
	D_{100}(max)	100		50		15		D_{30}(min)	D_{90}(min)	
	in.	Max	Min	Max[2]	Min	Max[2]	Min	ft	ft	
	Specific Weight = 155 pcf									
*	9	34	14	10	7	5	2	0.37	0.53	*
	12	81	32	24	16	12	5	0.48	0.70	
	15	159	63	47	32	23	10	0.61	0.88	
	18	274	110	81	55	41	17	0.73	1.06	
	21	435	174	129	87	64	27	0.85	1.23	
	24	649	260	192	130	96	41	0.97	1.40	
	27	924	370	274	185	137	58	1.10	1.59	
	30	1,268	507	376	254	188	79	1.22	1.77	
	33	1,688	675	500	338	250	105	1.34	1.94	
	36	2,191	877	649	438	325	137	1.46	2.11	
	42	3,480	1,392	1,031	696	516	217	1.70	2.47	
	48	5,194	2,078	1,539	1,039	769	325	1.95	2.82	
	54	7,396	2,958	2,191	1,479	1,096	462	2.19	3.17	
	Specific Weight = 165 pcf									
*	9	36	15	11	7	5	2	0.37	0.53	*
	12	86	35	26	17	13	5	0.48	0.70	
	15	169	67	50	34	25	11	0.61	0.88	
	18	292	117	86	58	43	18	0.73	1.06	
	21	463	185	137	93	69	29	0.85	1.23	
	24	691	276	205	138	102	43	0.97	1.40	
	27	984	394	292	197	146	62	1.10	1.59	
	30	1,350	540	400	270	200	84	1.22	1.77	
	33	1,797	719	532	359	266	112	1.34	1.96	
	36	2,331	933	691	467	346	146	1.46	2.11	
	42	3,704	1,482	1,098	741	549	232	1.70	2.47	
	48	5,529	2,212	1,638	1,106	819	346	1.95	2.82	
	54	7,873	3,149	2,335	1,575	1,168	492	2.19	3.17	
	Specific Weight = 175 pcf									
*	9	39	15	11	8	6	2	0.37	0.53	*
	12	92	37	27	18	14	5	0.48	0.70	
	15	179	72	53	36	27	11	0.61	0.88	
	18	309	124	92	62	46	19	0.73	1.06	
	21	491	196	146	98	73	31	0.85	1.23	
	24	733	293	217	147	109	46	0.97	1.40	
	27	1,044	417	309	209	155	65	1.10	1.59	
	30	1,432	573	424	286	212	89	1.22	1.77	
	33	1,906	762	565	381	282	119	1.34	1.94	
	36	2,474	990	733	495	367	155	1.46	2.11	
	42	3,929	1,571	1,164	786	582	246	1.70	2.47	
	48	5,864	2,346	1,738	1,173	869	367	1.95	2.82	
	54	8,350	3,340	2,474	1,670	1,237	522	2.19	3.17	

Notes:
1. Stone weight limit data from ETL 1110-2-120 (HQUSACE, 1971 (14 May), "Additional Guidance for Riprap Channel Protection, Ch 1," US Government Printing Office, Washington, DC). Relationship between diameter and weight is based on the shape of a sphere.
2. The maximum limits at the W_{50} and W_{15} sizes can be increased as in the Lower Mississippi Valley Division Standardized Gradations shown in Appendix F.

e. Layer thickness. All stones should be contained within the riprap layer thickness to provide maximum resistance against erosive forces. Oversize stones, even in isolated spots, may result in riprap failure by precluding mutual support and interlock between individual stones, causing large voids that expose filter and bedding materials, and creating excessive local turbulence that removes smaller size stone. Small amounts of oversize stone should be removed individually and replaced with proper size stones. The following criteria apply to the riprap layer thickness:

(1) It should not be less than the spherical diameter of the upper limit W_{100} stone or less than 1.5 times the spherical diameter of the upper limit W_{50} stone, whichever results in the greater thickness.

(2) The thickness determined by (1) above should be increased by 50 percent when the riprap is placed underwater to provide for uncertainties associated with this type of placement. At one location in the US Army Engineer Division, Missouri River, divers and sonic sounders were used to reduce the underwater thickness to 1.25 times the dry placement thickness.

Section II
Channel Characteristics *

3-3. Side Slope Inclination

The stability of riprap slope protection is affected by the steepness of channel side slopes. Side slopes should ordinarily not be steeper than 1V on 1.5H, except in special cases where it may be economical to use larger hand-placed stone keyed well into the bank. Embankment stability analysis should properly address soils characteristics, groundwater and river conditions, and probable failure mechanisms. The size of stone required to resist the erosive forces of channel flow increases when the side slope angle approaches the angle of repose of a riprap slope protection. Rapid water-level recession and piping-initiated failures are other factors capable of affecting channel side slope inclination and needing consideration in design.

3-4. Channel Roughness, Shape, Alignment, and Gradient

As boundary shear forces and velocities depend on channel roughness, shape, alignment, and invert gradient, these factors must be considered in determining the size of stone required for riprap revetment. Comparative cost estimates should be made for several alternative channel plans to determine the most economical and practical combination of channel factors and stone size. Resistance coefficients (Manning's n) for riprap placed in the dry should be estimated using the following form of Strickler's equation:

$$n = K\left[D_{90}(\text{min})\right]^{1/6} \tag{3-2}$$

where

K = 0.036, average of all flume data

= 0.034 for velocity and stone size calculation

= 0.038 for capacity and freeboard calculation

D_{90}(min) = size of which 90 percent of sample is finer, from minimum or lower limit curve of gradation specification, ft

The K values represent the upper and lower bounds of laboratory data determined for bottom riprap. Resistance data from a laboratory channel which had an irregular surface similar to riprap placed underwater show a Manning's n about 15 percent greater than for riprap placed in the dry. Equation 3-2 provides resistance losses due to the surface roughness of the riprap and does not include form losses such as those caused by bends. Equation 3-2 should be limited to slopes less than 2 percent. *

Section III
Design Guidance for Stone Size

3-5. General

Riprap protection for open channels is subjected to hydrodynamic drag and lift forces that tend to erode the revetment and reduce its stability. Undermining by scour beyond the limits of protection is also a common cause of failure. The drag and lift forces are created by flow velocities adjacent to the stone. Forces resisting motion are the submerged weight of the stone and any downward and lateral force components caused by contact with other stones in the revetment. Stone availability and experience play a large part in determining size of riprap. This is particularly true on small projects where hydraulic parameters are ill-defined and the total amount of riprap required is small.

3-6. Design Conditions

Stone size computations should be conducted for flow conditions that produce the maximum velocities at the riprapped boundary. In many cases, velocities continue to increase beyond bank-full discharge; but sometimes backwater effects or loss of flow into the overbanks results in velocities that are less than those at bank-full. Riprap at channel bends is designed conservatively for the point having the maximum force or velocity. For braided channels, bank-full discharges may not be the most severe condition. At lesser flows, flow is often divided into multiple channels. Flow in these channels often impinges
* abruptly on banks or levees at sharp angles.

3-7. Stone Size

This method for determining stone size uses depth-averaged local velocity. The method is based on the idea that a designer will be able to estimate local velocity
* better than local boundary shear. Local velocity and local flow depth are used in this procedure to quantify the imposed forces. Riprap size and unit weight quantify the resisting force of the riprap. This method is based on a large body of laboratory data and has been compared to available prototype data (Maynord 1988). It defines the stability of a wide range of gradations if placed to a thick-
* ness of $1D_{100}$(max). Guidance is also provided for thickness greater than $1D_{100}$(max). This method is applicable * to side slopes of 1V on 1.5H or flatter.

a. Velocity estimation. The characteristic velocity for side slopes V_{SS} is the depth-averaged local velocity over the slope at a point 20 percent of the slope length from
* the toe of slope. Plate 33 presents the ratio V_{SS}/V_{AVG}, where V_{AVG} is the average channel velocity at the upstream end of the bend, as a function of the channel geometry, which is described by R/W, where R is the center-line radius of bend and W is the water-surface width. V_{AVG}, R, and W should be based on flow in the main channel only and should not include overbank areas. The trapezoidal curve for V_{SS}/V_{AVG} shown in Plate 33 is based on the STREMR numerical model described in Bernard (1993). The primary factors affecting velocity distribution in riprap-lined, trapezoidal channel bendways are R/W, bend angle, and aspect ratio (bottom width/depth). Data in Maynord (1992) show a trapezoidal channel having the same bottom width but side slopes ranging from 1V:1.5H to 1V:3H to have the same maximum V_{SS}/V_{AVG} at the downstream end of the bend. Plate 33 should be used for side slopes from 1V:3H to 1V:1.5H. For straight channels sufficiently far (>5W) from upstream bends, large values of R/W should be used, resulting in constant values of V_{SS}/V_{AVG}. Very few channels are straight enough to justify using $V_{SS}/V_{AVG} < 1$. A minimum ratio of $V_{SS}/V_{AVG} = 1$ is recommended for side slopes in straight channels. Rock stability should be checked for both side slopes and the channel bottom. In bendways, the outer bank side slope will generally require the largest rock size. In straight reaches, the channel bottom will often require the largest stone size. Velocities in the center of a straight channel having equal bottom and side slope roughness range from 10 to 20 percent greater than V_{AVG}. Plate 34 describes V_{SS} and Plate 35 shows the location in a trapezoidal channel bend of the maximum V_{SS}. Velocity downstream of bends decays at approximately the following rate: No decay in first channel width downstream of bend exit; decay of $V_{SS}/V_{AVG} = 0.1$ per channel width until $V_{SS}/V_{AVG} = 1.0$. Plate 36 shows the variation in velocity over the side slope in a channel. The straight channel curve in Plate 36 was found applicable to both 1V:2H and 1V:3H side slopes. The bend curve for R/W = 2.6 was taken from a channel having strong secondary currents and represents a severe concentration of high velocity upon the channel side slope. These two curves represent the extremes in velocity distribution to be expected along the outer bank of a channel bend having a riprap side slope from toe of bank to top of bank. Knowing V_{SS} from Plate 33, the side slope
* velocity distribution can be determined at the location of V_{SS}. An alternate means of velocity estimation based on field observation is discussed in Appendix G. The alpha method (Appendix C), or velocities resulting from subsections of a water-surface profile computation, should be used only in straight reaches. When the alpha method is used, velocity from the subsection adjacent to the bank subsection should be used as V_{SS} in design of bank riprap.

b. Stone size relations. The basic equation for the representative stone size in straight or curved channels is

$$D_{30} = S_f C_s C_v C_T d \left[\left(\frac{\gamma_w}{\gamma_s - \gamma_w} \right)^{1/2} \frac{V}{\sqrt{K_1 g d}} \right]^{2.5} \qquad (3\text{-}3)$$

where

D_{30} = riprap size of which 30 percent is finer by weight, length

S_f = safety factor (see *c* below)

* C_s = stability coefficient for incipient failure, D_{85}/D_{15} = 1.7 to 5.2

= 0.30 for angular rock

* = 0.375 for rounded rock

C_V = vertical velocity distribution coefficient

= 1.0 for straight channels, inside of bends

= 1.283 - 0.2 log (R/W), outside of bends (1 for (R/W) > 26)

= 1.25, downstream of concrete channels

= 1.25, ends of dikes

C_T = thickness coefficient (see d(1) below)

* = 1.0 for thickness = $1D_{100}$(max) or 1.5 D_{50}(max), whichever is greater

* d = local depth of flow, length (same location as V)

γ_w = unit weight of water, weight/volume

* V = local depth-averaged velocity, V_{SS} for side slope riprap, length/time

K_1 = side slope correction factor (see *d*(1) below)

g = gravitational constant, length/time^2

* Some designers prefer to use the traditional D_{50} in riprap design. The approximate relationship between D_{50} and D_{30} is $D_{50} = D_{30}\ (D_{85}/D_{15})^{1/3}$. Equation 3-3 can be used with either SI (metric) or non-SI units and should be limited to slopes less than 2 percent.

c. Safety factor. Equation 3-3 gives a rock size that should be increased to resist hydrodynamic and a variety of nonhydrodynamic-imposed forces and/or uncontrollable physical conditions. The size increase can best be accomplished by including the safety factor, which will be a
* value greater than unity. The minimum safety factor is
* $S_f = 1.1$. The minimum safety factor may have to be increased in consideration for the following conditions:

(1) Imposed impact forces resulting from logs, uprooted trees, loose vessels, ice, and other types of large floating debris. Impact will produce more damage to alighter weight riprap section than to a heavier section. For moderate debris impact, it is unlikely that an added
* safety factor should be used when the blanket thickness exceeds 15 in.

(2) The basic stone sizing parameters of velocity,
* unit weight of rock, and depth need to be determined as accurately as possible. A safety factor should be included to compensate for small inaccuracies in these parameters. If conservative estimates of these parameters are used in the analysis, the added safety factor should not be used. The safety factor should be based on the anticipated error in the values used. The following discussion shows the importance of obtaining nearly correct values rather than relying on a safety factor to correct inaccurate or assumed stone sizing parameters. The average velocity over the toe of the riprap is an estimate at best and is the parameter to which the rock size is the most sensitive. A check of the sensitivity will show that a 10 percent change in velocity will result in a nearly 100 percent change in the weight limits of the riprap gradation (based on a sphere) and about a 30 percent change in the riprap
* thickness. The riprap size is also quite sensitive to the unit weight of the rock to be used: a 10 percent change in the
* unit weight will result in a 70 percent change in the weight limits of the riprap gradation (based on a sphere) and about a 20 percent change in the riprap thickness. The natural variability of unit weight of stone from a stone source adds to the uncertainty (EM 1110-2-2302).
* The rock size is not nearly as sensitive to the depth parameter.

(3) Vandalism and/or theft of the stones is a serious problem in urban areas where small riprap has been placed. A W_{50}(min) of 80 lb should help prevent theft and vandalism. Sometimes grouted stone is used around vandalism-prone areas.

(4) The completed revetment will contain some
* pockets of undersized rocks, no matter how much effort is devoted to obtaining a well-mixed gradation throughout the revetment. This placement problem can be assumed to occur on any riprap job to some degree but probably more frequently on jobs that require stockpiling or additional handling. A larger safety factor should be considered with stockpiling or additional hauling and where placement will be difficult if quality control cannot be expected to address these problems.

(5) The safety factor should be increased where severe freeze-thaw is anticipated.

The safety factor based on each of these considerations should be considered separately and then the largest of these values should be used in Equation 3-3.

d. Applications.

(1) The outer bank of straight channels downstream of bends should be designed using velocities computed for the bend. In projects where the cost of riprap is high, a channel model to indicate locations of high velocity might * be justified. Equation 3-3 has been developed into Plate 37, which is applicable to thicknesses equal to * $1D_{100}$(max), γ_s of 165 pcf, and the S_f of 1.1. Plate 38 is used to correct for values of other than γ_s of 165 pcf * (when D_{30} is determined from Plate 37). The K_1 side slope factor is normally defined by the relationship of Carter, Carlson, and Lane (1953)

$$K_1 = \sqrt{1 - \frac{\sin^2 \theta}{\sin^2 \phi}} \qquad (3\text{-}4)$$

where

θ = angle of side slope with horizontal

ϕ = angle of repose of riprap material (normally 40 deg)

Results given in Maynord (1988) show Equation 3-4 to be conservative and that the repose angle is not a constant 40 deg but varies with several factors. The recommended relationship for K_1 as a function of θ is given in Plate 39 along with Equation 3-4 using ϕ = 40 deg. * Using the recommended curve for side slope effects, the least volume of rock per unit length of bank line occurs on a 1V:1.5H to 1V:2H side slope. Also shown on * Plate 39 is the correction for side slope when D_{30} is determined from Plate 37. Correction for the vertical * velocity distribution in bends is shown in Plate 40. Testing has been conducted to determine the effects of blanket * thickness greater than $1D_{100}$(max) on the stability of rip- * rap. Results are shown in Plate 40. The thickness coefficient C_T accounts for the increase in stability that occurs when riprap is placed thicker than the minimum thickness of $1D_{100}$(max) or 1.5 D_{50}(max), whichever is greater. *

* (2) The basic procedure to determine riprap size using the graphical solution of this method is as follows: *

(a) Determine average channel velocity (HEC-2 or other uniform flow computational methods, or measurement).

(b) Find V_{SS} using Plate 33.

(c) Find D_{30} using Plate 37.

(d) Correct for other unit weights, side slopes, vertical velocity distribution, or thicknesses using Plates 38 through 40.

(e) Find gradation having D_{30}(min) ≥ computed * D_{30}. Alternately Equation 3-3 is used with Plates 39 and 40 to replace steps (c) and (d). *

(3) This procedure can be used in both natural channels with bank protection only and prismatic channels having riprap on bed and banks. Most bank protection sections can be designed by direct solution. In these cases, the extent of the bank compared to the total perimeter of the channel means that the average channel velocity is not significantly affected by the riprap. The first example in Appendix H demonstrates this type of bank protection.

(4) In some cases, a large part of the channel perimeter is covered with riprap; the average channel velocity, depth, and riprap size are dependent upon one another; and the solution becomes iterative. A trial riprap gradation is first assumed and resistance coefficients are computed using Equation 3-2. Then the five steps described in (2) above are conducted. If the gradation found in paragraph (e) above is equal to the assumed trial gradation, the solution is complete. If not, a new trial gradation is assumed and the procedure is repeated. The second example in Appendix H demonstrates this type of channel riprap.

(5) In braided streams and some meandering streams, flow is often directed into the bank line at sharp * angles (angled flow impingement). For braided streams having impinged flow, the above stone sizing procedures require modification in two areas: the method of velocity estimation and the velocity distribution coefficient C_V. All other factors and coefficients presented are applicable.

(a) The major challenge in riprap design for braided streams is estimating the imposed force at the impinge- * ment point. Although unproven, the most severe bank *

* attack in braided streams is thought to occur when the water surface is at or slightly above the tops of the midchannel bars. At this stage, flow is confined to the multiple channels that often flow into or "impinge" against bank lines or levees. At lesser flows, the depths and velocities in the multiple channels are decreased. At higher flows, the channel area increases drastically and streamlines are in a more downstream direction rather than into bank lines or levees.

(b) The discharge that produces a stage near the tops of the midchannel bars is Q_{tmcb} . Q_{tmcb} is probably highly correlated with the channel-forming discharge concept. In the case of the Snake River near Jackson, Wyoming, Q_{tmcb} is 15,000-18,000 cfs, which has an average recurrence interval of about 2-5 years. Using cross-section data to determine the channel area below the tops of the midchannel bars and Q_{tmcb} allows determination of the average channel velocity at the top of the midchannel bars, V_{tmcb} .

(c) Field measurements at impingement sites were taken in 1991 on the Snake River near Jackson, Wyoming, and reported in Maynord (1993). The maximum observed ratio $V_{SS}/V_{tmcb} = 1.6$, which is almost identical to the ratio shown in Plate 33 for sharp bendways having $R/W = 2$ in natural channels, and this ratio is recommended for determining V_{SS} for impinged flow. The second area of the design procedure requiring modification for impinged flow is the velocity distribution coefficient C_V , which varies with R/W in bendways as shown in Plate 40. Impinged flow areas are poorly aligned bends having low R/W , and $C_V = 1.25$ is recommended for design.

(6) Transitions in size or shape may also require riprap protection. The procedures in this paragraph are applicable to gradual transitions where flow remains tranquil. In areas where flow changes from tranquil to rapid and then back to tranquil, riprap sizing methods applicable to hydraulic structures (HDC 712-1) should be used. In converging transitions, the procedures based on Equation 3-3 can be used unaltered. In expanding transitions, flow can concentrate on one side of the expansion and design velocities should be increased. For installations immediately downstream of concrete channels, a vertical velocity distribution coefficient of 1.25 should be used due to the difference in velocity profile over the two surfaces.

* *e. Steep slope riprap design.*

In cases where unit discharge is low, riprap can be used on steep slopes ranging from 2 to 20 percent. A typical application is a rock-lined chute. The stone size equation is

$$D_{30} = \frac{1.95\ S^{0.555}\ q^{2/3}}{g^{1/3}} \tag{3-5}$$

where

S = slope of bed

q = unit discharge

Equation 3-5 is applicable to thickness = 1.5 D_{100}, angular rock, unit weight of 167 pcf, D_{85}/D_{15} from 1.7 to 2.7, slopes from 2 to 20 percent, and uniform flow on a downslope with no tailwater. The following steps should be used in application of Equation 3-5:

(1) Estimate $q = Q/b$ where b = bottom width of chute.

(2) Multiply q by flow concentration factor of 1.25. Use greater factor if approach flow is skewed.

(3) Compute D_{30} using Equation 3-5.

(4) Use uniform gradation having $D_{85}/D_{15} \leq 2$ such as Table 3-1.

* (5) Restrict application to straight channels with side slope of 1V:2.5H or flatter.

(6) Use filter fabric beneath rock.

The guidance for steep slope riprap generally results in large riprap sizes. Grouted riprap is often used instead of loose riprap in steep slope applications. *

3-8. Revetment Top and End Protection

Revetment top and end protection requirements, as with all channel protective measures, are to assure the project benefits, to perform satisfactorily throughout the project economic life, and not to exceed reasonable maintenance

costs. Reference is made to ER 1110-2-1405, with emphasis on paragraph 6*c*.

a. Revetment top. When the full height of a levee is to be protected, the revetment will cover the freeboard, i.e., extend to the top of the levee. This provides protection against waves, floating debris, and water-surface irregularities. Similar provisions apply to incised channel banks. A horizontal collar, at the top of the bank, is provided to protect against escaping and returning flows as necessary. The end protection methods illustrated in Plate 41 can be adapted for horizontal collars. Plate 36 provides general guidance for velocity variation over channel side slopes that can assist in evaluating the economics of reducing or omitting revetment for upper bank areas. Revetment size changes should not be made unless a sufficient quantity is involved to be cost effective. Many successful revetments have been constructed where the top of the revetment was terminated below the design flow line. See USACE (1981) for examples.

b. Revetment end protection. The upstream and downstream ends of riprap revetment should be protected against erosion by increasing the revetment thickness T or extending the revetment to areas of noneroding veloci-
* ties and relatively stable banks. A smooth transition should be provided from where the end protection begins to the design riprap section. The keyed-in section should satisfy filter requirements. The following guidance * applies to the alternative methods of end protection illustrated in Plate 41.

(1) Method A. For riprap revetments 12 in. thick or less, the normal riprap layer should be extended to areas where velocities will not erode the natural channel banks.

(2) Method B. For riprap revetments exceeding 12 in. in thickness, one or more reductions in riprap thick-
* ness and stone size may be required (Plate 41) until velocities decrease to a noneroding natural channel velocity.

(3) Method C. For all riprap revetments that do not terminate in noneroding natural channel velocities, the ends of the revetment should be enlarged, as shown in
* Plate 41. The decision to terminate the revetment in erosive velocities should be made with caution since severe erosion can cause the revetment to fail by progressive flanking.

c. Length. Riprap revetment is frequently carried too far upstream and not far enough downstream of a channel bend. In a trapezoidal channel, the maximum velocities along the outer bank are often located in the straight reach immediately downstream of the bend for relatively large distances downstream. In a natural channel, the limit of protection on the downstream end should depend on where the flow crosses to the opposite bank, and should consider future bar building on the opposite bank, resulting in channel constriction and increased velocities. Guidance is generally lacking in this area, but review of aerial photographs of the subject location can provide some insight on where the crossover flow occurs. Model tests in a sand bed and bank flume (USACE 1981) were conducted to determine the limits of protection required to prevent scour that would lead to destruction of the revetment. These tests were conducted in a 110-deg bend having a constant discharge. The downstream end of the revetment had to be 1.5 channel widths downstream of the end of the bend. Geomorphic studies to determine revetment ends should be considered.

Section IV
Revetment Toe Scour Estimation and Protection

3-9. General

Toe scour is probably the most frequent cause of failure of riprap revetments. This is true not only for riprap, but also for a wide variety of protection techniques. Toe * scour is the result of several factors, including these three:

a. Meandering channels, change in cross section that occurs after a bank is protected. In meandering channels the thalweg often moves toward the outer bank after the bank is protected. The amount of change in cross section that occurs after protection is added is related to the erodibility of the natural channel bed and original bank material. Channels with highly erodible bed and banks can experience significant scour along the toe of the new revetment.

b. Meandering channels, scour at high flows. Bed profile measurements have shown that the bed observed at low flows is not the same bed that exists at high flows. At high flows the bed scours in channel bends and builds up in the crossings between bends. On the recession side of the flood, the process is reversed. Sediment is eroded from the crossings and deposited in the bends, thus obscuring the maximum scour that had occurred.

c. Braided channels. Scour in braided channels can reach a maximum at intermediate discharges where flow in the channel braids attacks banks at sharp angles.

Note that local scour is the mechanism being addressed herein. When general bed degradation or headcutting is expected, it must be added to the local scour. When scour mechanisms are not considered in the design of protection works, undermining and failure may result. * Plate 42 may be used for depth of scour estimates. The design curve in Plate 42 represents an upper limit for scour in channels having irregular alignments. For bendways having a relatively smooth alignment, a 10 percent reduction from the design curve is recommended. Neill * (1973) provides additional information on scour depth estimation.

3-10. Revetment Toe Protection Methods

Toe protection may be provided by two methods:

a. Extend to maximum scour depth. Place the lower extremity below the expected scour depth or found it on nonerodible material. These are the preferred methods, but they can be difficult and expensive when underwater excavation is required.

b. Place launchable stone. Place sufficient launchable stone to stabilize erosion. Launchable stone is defined as stone that is placed along expected erosion areas at an elevation above the zone of attack. As the attack and resulting erosion occur below the stone, the stone is undermined and rolls/slides down the slope, stopping the erosion. This method has been widely used on sand bed streams. Successful applications include: *

(1) Windrow revetments: riprap placed at top of bank.

(2) Trench-fill revetments: riprap placed at low water level.

(3) Weighted riprap toes: riprap placed at intersection of channel bottom and side slope.

Trench-fill revetments on the Mississippi River have * successfully launched to protect for a vertical scour depth of up to 50 ft. On gravel bed streams, the use of launchable stone is not as widely accepted as in sand bed streams. Problems with using launchable stone in some gravel bed rivers may be the result of underestimating stone size, scour depth, or launchable stone volume because the concept of launchable stone has been successful on several gravel bed rivers.

3-11. Revetment Toe Protection Design

The following guidance applies to several alternative methods of toe protection illustrated in Plate 43.

a. Method A. When toe excavation can be made in the dry, the riprap layer may be extended below the existing groundline a distance exceeding the anticipated depth of scour. If excavation quantities are prohibitive, the * concept of Method D can be adapted to reduce excavation.

b. Method B. When the bottom of the channel is nonerodible material, the normal riprap should be keyed in at streambed level.

c. Method C. When the riprap is to be placed underwater and little toe scour is expected (such as in straight reaches that are not downstream of bends, unless stream is braided), the toe may be placed on the existing bottom with height a and width c equal to 1.5T and 5T , respectively. This compensates for uncertainties of underwater placement.

d. Method D. An extremely useful technique where water levels prohibit excavation for a toe section is to place a launchable section at the toe of the bank. Even if excavation is practicable, this method may be preferred for cost savings if the cost of extra stone required to produce a launched thickness equal to or greater than * T plus the increase shown in Table 3-2 is exceeded by the cost of excavation required to carry the design thickness T down the slope. This concept simply uses toe scour as a substitute for mechanical excavation. This method also has the advantage of providing a "built-in" scour gage, allowing easy monitoring of high-flow scour and the need for additional stone reinforcement by visual inspection of the remaining toe stone after the high flow subsides or by surveyed cross sections if the toe stone is underwater. It is readily adaptable to emergency protection, where high flow and the requirement for quick action make excava- * tion impractical. Shape of the stone section before launching is not critical, but thickness of the section is important because thickness controls the rate at which rock is released in the launching process. For gradual scour in regular bendways, the height of the stone section before launching should be from 2.5 to 4.0 times the bank protection thickness (T). For rapid scour in impinged flow environments or in gravel bed streams, the stone section height before launching should be 2.5 to 3.0 T. In

*

Table 3-2
Increase in Stone Volume for Riprap Launching Sections

Vertical Launch Distance, ft[1]	Volume Increase, Percent: Dry Placement	Volume Increase, Percent: Underwater Placement
≤ 15	25	50
> 15	50	75

Note:
[1] From bottom of launch section to maximum scour.

any case, the thinner and wider rock sections represented by the lower values of thickness have an apparent advantage in that the rock in the stream end of the before-launch section has a lesser distance to travel in the launching process. Providing an adequate volume of stone is critical. Stone is lost downstream in the launching process; and the larger the scour depth, the greater the percentage of stone lost in the launching process. To compute the required launchable stone volume for Method D, the following assumptions should be used: *

(1) Launch slope = 1V on 2H. This is the slope resulting from rock launched on noncohesive material in both model and prototype surveys. Launch slope is less predictable if cohesive material is present, since cohesive material may fail in large blocks.

(2) Scour depth = existing elevation - maximum scour elevation.

* (3) Thickness after launching = thickness of the bank revetment T .

* To account for the stone lost during launching and for placement underwater, the increases in stone volume listed in Table 3-2 are recommended. Using these assumptions, the required stone volume for underwater placement for vertical launch distance less than 15 ft = 1.5T times launch slope length

= 1.5T times scour depth times $\sqrt{5}$

= 3.35T (scour depth)

Add a safety factor if data to compute scour depth are unreliable, if cohesive bank material is present, or if monitoring and maintenance after construction cannot be guaranteed. Guidance for a safety factor is lacking, so to some extent it must be determined by considering conse-
* quences of failure. Widely graded ripraps are recommended because of reduced rock voids that tend to prevent leaching of lower bank material through the launched riprap. Launchable stone should have $D_{85}/D_{15} \geq 2$. *

3-12. Delivery and Placement

Delivery and placement can affect riprap design. See EM 1110-2-2302 for detailed guidance. The common methods of riprap placement are hand placing; machine placing, such as from a skip, dragline, or some form of bucket; and dumping from trucks and spreading by bulldozer. Hand placement produces the most stable riprap revetment because the long axes of the riprap particles are oriented perpendicular to the bank. It is the most expensive method except when stone is unusually costly and/or labor unusually cheap. Steeper side slopes can be used with hand-placed riprap than with other placing methods. This reduces the required volume of rock. However, the greater cost of hand placement usually makes machine or dumped placement methods and flatter slopes more economical. Hand placement on steep slopes should be con-
* sidered when channel widths are constricted by existing bridge openings or other structures when rights-of-way are costly. In the machine placement method, sufficiently small increments of stone should be released as close to their final positions as practical. Rehandling or dragging operations to smooth the revetment surface tend to result in segregation and breakage of stone. Stone should not be dropped from an excessive height or dumped and spread as this may result in the same undesirable conditions. However, in some cases, it may be economical to increase the layer thickness and stone size somewhat to offset the shortcomings of this placement method. Smooth, compact riprap sections have resulted from compacting the placed stone sections with a broad-tracked bulldozer. This stone must be quite resistant to abrasion. Thickness for underwater placement should be increased by 50 percent to provide for the uncertainties associated with this type of placement. Underwater placement is usually specified in terms of weight of stone per unit area, to be distributed uniformly and controlled by a "grid" established by
* shoreline survey points.

Section V
Ice, Debris, and Vegetation

3-13. Ice and Debris

Ice and debris create greater stresses on riprap revetment by impact and flow concentration effects. Ice attachment to the riprap also causes a decrease in stability. The Cold Regions Research Engineering Laboratory, Hanover, NH, should be contacted for detailed guidance relative to ice

*

effects on riprap. One rule of thumb is that thickness should be increased by 6-12 in., accompanied by appropriate increase in stone size, for riprap subject to attack by large floating debris. Riprap deterioration from debris impacts is usually more extensive on bank lines with steep slopes. Therefore, riprapped slopes on streams with heavy debris loads should be no steeper than 1V on 2.5H.

3-14. Vegetation

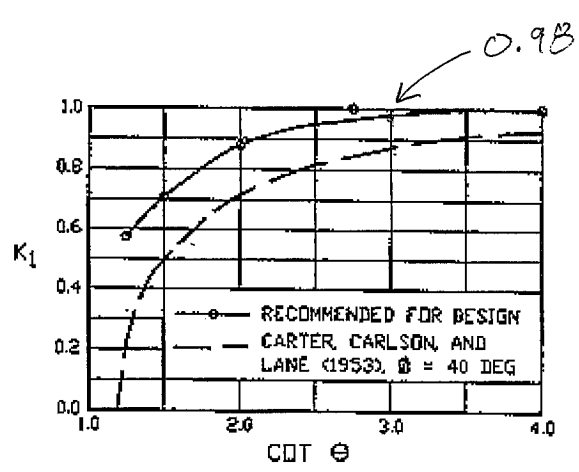
The guidance in this chapter is based on maintaining the riprap free of vegetation. When sediment deposits form lowflow berms on riprap installations, vegetation may be allowed on these berms under the following conditions: roots do not penetrate the riprap; failure of the riprap would not jeopardize project purposes prior to repairs; and the presence of the berm and vegetation does not significantly reduce the discharge capacity of the project. For riprap areas above the 4 or 5 percent exceedence flow line, consideration may be given to overlaying the riprap with soil and sod to facilitate maintenance by mowing rather than by hand or defoliants. This may be particularly appropriate for riprap protecting against eddy action around structures such as gate wells and outlet works in levees that are otherwise maintained by mowing. Recognizing that vegetation is, in most instances, inimical to riprap installations, planned use of vegetation with riprap should serve some justifiable purpose, be accounted for in capacity computations, be controllable throughout the project life, have a strengthened riprap design that will withstand the additional exigencies, and account for increased difficulty of inspection.

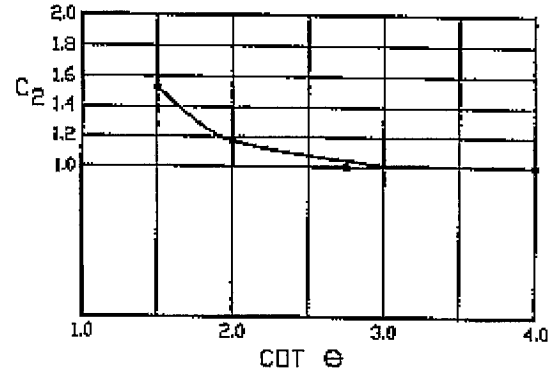
Section VI
Quality Control

3-15. Quality Control

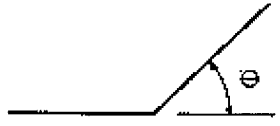
Provisions should be made in the specifications for sampling and testing in-place riprap as representative sections of revetment are completed. Additional sample testing of in-place and in-transit riprap material at the option of the Contracting Officer should be specified. The primary concern of riprap users is that the in-place riprap meets specifications. Loading, transporting, stockpiling, and placing can result in deterioration of the riprap. Coordination of inspection efforts by experienced staff is necessary. Reference EM 1110-2-2302 for detailed sampling guidance and required sample volumes for in-place riprap.

*





K_1 = SIDE SLOPE CORRECTION COEFFICIENT FOR USE IN EQUATION 3-3 ONLY.

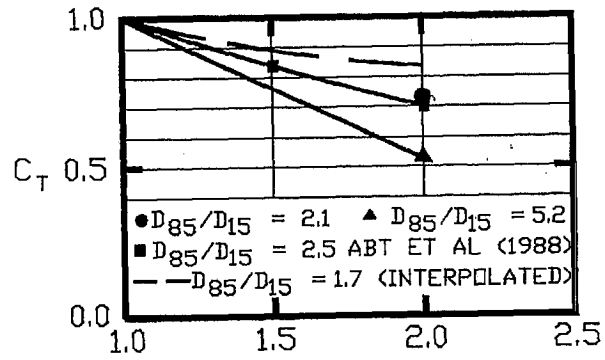


D_{30} = C_2*(D_{30} FROM PLATE 37)

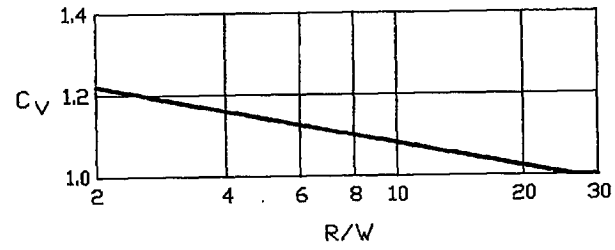
WHERE C_2 = CORRECTION FOR SIDE SLOPE ANGLE

NOTE : DO NOT MAKE THIS CORRECTION IF D_{30} COMPUTED FROM EQUATION 3-3. EQUIVALENT TO 'RECOMMENDED FOR DESIGN' CURVE IN THE PLOT OF K_1 VERSUS COT Θ.

CORRECTION FOR SIDE SLOPE ANGLE



$N = \frac{\text{THICKNESS}}{T*} \simeq 2.0$



$D_{30} = C_V * (D_{30}$ FROM PLATE 37)

WHERE C_V = CORRECTION FOR VERTICAL VELOCITY DISTRIBUTION

WHERE C_T = CORRECTION FOR THICKNESS

$$= \frac{D_{30} \text{ FOR THICKNESS OF } NT*}{D_{30} \text{ FOR THICKNESS OF } T*}$$

$T* = 1D_{100}$ OR $1.5D_{50}$, WHICHEVER IS GREATER

CORRECTION FOR VERTICAL VELOCITY DISTRIBUTION IN BEND AND RIPRAP THICKNESS

Plate B-40

Erosion Control Matting Analysis

744 Heartland Trail (53717-8923) P. O. Box 8923 (53708-8923) Madison, WI (608) 831-4444 FAX: (608) 831-3334 VOICE: (608) 831-1989

PROJECT/PROPOSAL NAME	PREPARED		CHECKED		PROJECT/PROPOSAL NO.
	By:	Date:	By:	Date:	
Weyerhaeuser 12th Street Landfill	ECW	7/6/07			5117.04

Erosion Control Matting Analysis

Purpose:

The purpose of this analysis is to determine the type of erosion control matting to be placed on the eastern landfill sideslope and over the site access road along the Kalamazoo River that will be able to withstand the erosive forces from a 500-year flood event.

Methodology:

Enkagreen E-engineering with Enkamat design software (Colbond, 2007) was used to determine the type of erosion control matting to be utilized at the 12th Street Landfill. The Enkagreen software analyzes channel linings using the Federal Highway Administration's Hydraulic Engineer Circular (HEC-15) design methodology.

Assumptions:

The following assumptions were used for the Enkagreen design software:

- The channel shape (Kalamazoo River powerhouse discharge channel) is trapezoidal.
- The bottom width of the channel is 100 feet. This is the maximum allowable value for the Enkagreen design software. Refer to Figure 1 of this report.
- The river bed slope is 0.002 ft/ft. Refer to the attached calculation for the 500-year flood event river elevation and flow velocity.
- The right side slope of the river channel is 3H:1V. This assumes the slope will be graded during the Time Critical Removal Action (TCRA) activities.
- The left side slope (eastern landfill sideslope) is 5H:1V. Refer to Figure 3 of this report.
- The channel length (along the 12th Street Landfill) is 300 feet. Refer to Figure 1 of this report.
- The required freeboard is 0.0 feet.
- The vegetative type is Class C (grass-legume mixture – summer (orchard grass, redtop, Italian rye grass, and common lespedeza), good stand, uncut (6 to 8 inches).
- The flow velocity is 5.7 feet per second (fps). Refer to the attached calculation for the 500-year flood event river elevation and flow velocity.
- Flow durations of 0.5 hours and 50 hours were analyzed.

Results:

The analysis for both the 0.5-hour and 50-hour flow conditions modeled using the Enkagreen design software for a 500-year flood event showed that Enkamat 7010 would be able to withstand the erosive forces generated along the eastern landfill sideslope.

744 Heartland Trail (53717-8923) P. O. Box 8923 (53708-8923) Madison, WI (608) 831-4444 FAX: (608) 831-3334 VOICE: (608) 831-1989

PROJECT/PROPOSAL NAME	PREPARED		CHECKED		PROJECT/PROPOSAL NO.
	By:	Date:	By:	Date:	
Weyerhaeuser 12th Street Landfill	ECW	7/6/07			5117.04

The flow velocity during the 500-year flood event (5.7 fps) was also below the permissible flow velocities of 19 fps and 14 fps for the Enkamat 7010 for the 0.5-hour and 50-hour flow conditions, respectively, as shown on the Enkamat 7010 Technical Data Sheet.

References:

Colbond 2007. Enkagreen E-engineering with Enkamat. Enka, North Carolina.

Calculations

FROM:
Colbond EnkaGreen
e-engineering with
Enkamat V. 2.0

0.5 hr

Project Information

Name
Weyerhaeuser 12th Street Landfill

Number
5117.04

Location
Grand Rapids, Michigan United States

Notes

List of Channels
Eastern slope of 12th St LF

List of Slopes

0.5 hr

Channel Analysis

Eastern slope of 12th St LF

Input Data

Channel Shape:	Trapezoidal	Channel Bend:	No
Bottom Width (ft):	100.0	Bend Radius (ft):	N/A
Bed Slope (ft/ft):	0.002	Bend Location:	N/A
Right Side Slope (H:1V):	3.0		
Left Side Slope (H:1V):	5.0	Velocity (fps):	5.7
Channel Length (ft):	300.0	Flow Duration (hrs):	0.5
Required Freeboard (ft):	0.0	Req'd Factor of Safety:	1.3
Lining Condition:	Vegetated	Vegetation Type:	Class C
Left Lining:	Enkamat 7010		
Bottom Lining:	Enkamat 7010	– Not applicable	
Right Lining:	Enkamat 7010	– Not applicable	

Not applicable

Results

	Left	Bottom	Right	Avg./Total
Flow Rate (cfs):				8,879.11
Depth of Flow (ft):				10.86
Flow Area (sf):				1,557.7
Wetted Perimeter (ft):	55.4	100.0	34.3	189.7
Hydraulic Radius (ft):				8.21
Manning's "n":	0.042	0.042	0.042	0.042
Velocity (fps):				5.7
Shear Stress (psf):	1.01	1.08	0.92	
Permissible Shear Stress (psf):	8.0	8.0	8.0	
Resulting Factor of Safety:	7.96	7.38	8.68	
Pass / Fail:	Pass	Pass	Pass	

Costs

	Left	Bottom	Right	Total
Quantity (sy):	1,845.8	3,333.3	1,144.7	6,323.9
Material Cost:	$0.00	$0.00	$0.00	$0.00
Installation Cost:				$0.00
Channel Cost:				$0.00

50 hr

Project Information

Name

Weyerhaeuser 12th Street Landfill

Number

5117.04

Location

Grand Rapids, Michigan United States

Notes

List of Channels

Eastern slope of 12th St LF

List of Slopes

50 hr

Channel Analysis

Eastern slope of 12th St LF

Input Data

Channel Shape:	Trapezoidal	Channel Bend:	No
Bottom Width (ft):	100.0	Bend Radius (ft):	N/A
Bed Slope (ft/ft):	0.002	Bend Location:	N/A
Right Side Slope (H:1V):	3.0		
Left Side Slope (H:1V):	5.0	Velocity (fps):	5.7
Channel Length (ft):	300.0	Flow Duration (hrs):	50.0
Required Freeboard (ft):	0.0	Req'd Factor of Safety:	1.3
Lining Condition:	Vegetated	Vegetation Type:	Class C
Left Lining:	Enkamat 7010		
Bottom Lining:	Enkamat 7010 - Not applicable		
Right Lining:	Enkamat 7010 - Not applicable		

Not applicable

Results

	Left	Bottom	Right	Avg./Total
Flow Rate (cfs):				8,879.11
Depth of Flow (ft):				10.86
Flow Area (sf):				1,557.7
Wetted Perimeter (ft):	55.4	100.0	34.3	189.7
Hydraulic Radius (ft):				8.21
Manning's "n":	0.042	0.042	0.042	0.042
Velocity (fps):				5.7
Shear Stress (psf):	1.01	1.08	0.92	
Permissible Shear Stress (psf):	6.0	6.0	6.0	
Resulting Factor of Safety:	5.97	5.53	6.51	
Pass / Fail:	Pass	Pass	Pass	

Costs

	Left	Bottom	Right	Total
Quantity (sy):	1,845.8	3,333.3	1,144.7	6,323.9
Material Cost:	$0.00	$0.00	$0.00	$0.00
Installation Cost:				$0.00
Channel Cost:				$0.00

COLBOND

Enkamat 7010 R^2M

Root Reinforcement Mat

Description

Enkamat® 7010 is a three-dimensional turf reinforcement mat (TRM) made of continuous monofilaments fused at their intersections. Ninety-five (95%) percent of the Enkamat is open and available for soil, mulch and root interaction with filaments, creating the most effective Root Reinforcement Mat (R^2M) available. Enkamat is manufactured from nylon to eliminate the buoyancy factor associated with submerged conditions and provide permanent TRM protection in vegetated channels as well as on slopes.

Recommended Applications

- Permanent erosion control for Green (vegetated) channels with expected shear stresses ≤ 8 psf.
- Permanent erosion control for slight to moderate slopes (≤ 2.5H:1V).
- Support and enhance performance of Ecosystem plants.
- Substrate for hydraulically applied Bonded Fiber Matrix (BFM) and other mulches for erosion control applications where low water flow and low to moderate shear stresses are expected

Technical Data

Mechanical Properties	Test Method	Units	Typical Roll Value	
			MD	CD
Tensile Strength	ASTM D 5035 (modified)	kN/m (lbs/ft)	2.3 (160)	1.2 (80)
Thickness	ASTM D 5199	mm (in)	10 (0.4)	
Mass/Unit Area	ASTM D 5261	g/m^2 (oz/yd^2)	271 (8.0)	
UV Stability	ASTM D G53 / ASTM D 5035 (modified)	% strength retained	80	

Performance Properties	Test Method	Units	Typical Roll Value
Permissible Velocity			
Product Only	Flume test[1]	m/s (ft/s)	6.1 (20)
30 minute, vegetated	Flume test[1]	m/s (ft/s)	5.8 (19)
50 hour, vegetated	Flume test[1]	m/s (ft/s)	4.2 (14)
Permissible Shear Stress			
Product Only	Flume test[1]	kN/m^2 (lbs/ft^2)	0.32 (6.7)
30 minute, vegetated	Flume test[1]	kN/m^2 (lbs/ft^2)	0.38 (8.0)
50 hour, vegetated	Flume test[1]	kN/m^2 (lbs/ft^2)	0.29 (6.0)

1. Flume test performed at independent laboratory—data and details available upon request.

Packaging Data

Physical Properties	Units	Nominal Value	
Roll Dimensions *[width x length]*	m (ft)	0.99 x 152 (3.25 x 500)	1.93 x 27.5 (6.33 x 90)
Roll Area	m^2 (yd^2)	150 (180)	53 (63.3)
Estimated Roll Diameter	cm (in)	111 (44)	48 (19)
Estimated Roll Weight	kg (lb)	42 (92)	15 (32)

Colbond Inc.
PO Box 1057
Enka, NC 28728
Tel 800-365-7391
Fax 828-665-5009
www.colbond-usa.com

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Erosion Control Matting Analysis Calculations

Appendix G
Construction Quality Assurance (CQA)

744 Heartland Trail (53717-1934)
Madison, WI
Telephone (608) 831-4444
Fax (608) 831-3334

Appendix G
Construction Quality Assurance (CQA) Plan

Emergency Response Plan Design Report
12th Street Landfill/Former Powerhouse Discharge Channel

Operable Unit No. 4 of the Allied Paper, Inc./
Portage Creek/Kalamazoo River Superfund Site

Revision 0
July 2007

Prepared for
Weyerhaeuser Company

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Section 1
Introduction

1.1 Project Background

This report presents the Construction Quality Assurance (CQA) Plan for the Emergency Action activities at the 12th Street Landfill. This CQA Plan has been prepared for, and is included in, the submittal of the Emergency Response Plan Design Report for the Weyerhaeuser 12th Street Landfill. This CQA Plan is intended to be a "working document," in other words, one that is updated to reflect changes in specific materials, in installation practices, industry standards, or in tests and test methods.

1.2 Purpose and Scope

The purpose of this CQA Plan is to address the quality assurance procedures and requirements for the emergency action construction at the 12th Street Landfill, including all earthen materials (clay, sand, aggregate, general soil, and topsoil) and synthetic materials (geotextile and erosion protection matting).

This CQA Plan provides procedures that will ensure that all of the landfill components are constructed in a manner that will maximize their performance requirements and that will safeguard components from damage during construction. The Plan procedures will also ensure that the landfill's temporary cover is constructed and documented in accordance with the design criteria and regulatory requirements.

The scope of this Plan includes general CQA requirements in regard to the roles, responsibilities, and qualifications of the parties involved; the preconstruction activities; and the general inspection and documentation procedures. Specifically, this CQA Plan establishes requirements for construction procedures and observation, field and laboratory testing frequencies and methods, and acceptance criteria for each component of the project. Testing and acceptance criteria are based on Part 115, of Act 451 of the Michigan Department of Environmental Quality Waste and Hazardous Materials Division requirements, where applicable.

The CQA Plan addresses the construction activities of the following systems:

- erosion protection system;
- access and maintenance roads; and
- temporary landfill cover.

The following sources were used in the development of this plan:

- Part 115, of Act 451 of the Michigan Department of Environmental Quality Waste and Hazardous Materials Division

- Guidebook of Best Management Practices for Michigan Watersheds, October 1998
- Record of Decision (ROD) 12th Street Landfill (Operable Unit #4 of the Kalamazoo River Superfund Site, 2001
- American Society of Testing Materials, Annual Book of ASTM Standards, 2006

1.3 Quality Assurance and Quality Control

Quality assurance and quality control are defined as follows:

- ***Quality assurance*** - A planned and systematic pattern of all means and actions designed to provide adequate confidence that materials or services meet contractual and regulatory requirements. This is typically performed to assure the purchaser, owner, and/or regulatory agencies that delivered materials or services are of desired quality.
- ***Quality control*** - Those actions that provide a means to measure and regulate the characteristics of a material or service to meet contractual and regulatory requirements. This typically is performed by, or for, the provider of materials or services as a control mechanism on the quality of the provider's efforts.

In the context of this CQA Plan, the terms are further defined as follows:

- ***Quality assurance*** refers to the means and actions employed by the CQA Officer to ensure conformity of the systems' installation with the CQA Plan and the Construction Plans and Specifications. Quality assurance is primarily provided by an independent third party (consultant or laboratory) under the oversight of the CQA Officer.
- ***Quality control*** refers to those actions taken by the Manufacturer, Fabricator, or Contractor/Installer to provide materials and workmanship that meet the requirements of the CQA Plan and the Construction Plans and Specifications. Some testing efforts required by this CQA Plan may serve as both quality control and quality assurance measures.

1.4 General Testing Requirements

This CQA Plan includes references to test procedures of the American Society of Testing and Materials (ASTM). Test procedure references are always to the latest approved version up to the date of this document, unless specifically stated otherwise in this document.

Tests will be performed in strict accordance with the referenced test procedure and the description included in this Plan, unless otherwise indicated. Any deviations to test procedures called out in this Plan must be approved, in writing, by the CQA Officer prior to commencement of any work.

Section 2
CQA Roles, Responsibilities, and Qualifications

2.1 CQA Officer

The CQA Officer will supervise and be responsible for all observation, testing, and related construction documentation as described in this CQA Plan. The CQA Officer will be responsible for preparing the documentation report to certify substantial compliance with appropriate sections of Part 115, of Act 451 of the Michigan Department of Environmental Quality Waste and Hazardous Materials Division. The CQA Officer will be a Professional Engineer registered in the State of Michigan.

The CQA Officer may delegate daily observation and documentation, testing, and sampling duties to a qualified technician or engineer with experience in the assigned aspect of construction who will serve as the Resident Project Representative (RPR). Although these duties may be delegated, the CQA Officer will retain the responsibility for these activities.

2.2 Resident Project Representative (RPR)

The RPR will carry out daily observation, testing, and sampling duties under the direct supervision of the CQA Officer. The RPR will be a qualified technician or engineer with experience in the assigned aspect of construction. The RPR will observe and document construction and installation procedures. The RPR will prepare daily summary reports and will routinely transmit these to the CQA Officer. The RPR will immediately notify the CQA Officer of problems or deviations from the CQA Plan or construction plans and specifications. Reporting, documentation, and resolution of problems and deficiencies will be carried out as described in Section 4. The RPR will not have authority to approve design or specification changes without the consent of the CQA Officer.

2.3 Soil Testing Laboratory

The Soil Testing Laboratory retained will be experienced in landfill construction soil testing, the American Society of Testing and Materials Standards (ASTM), and other applicable standards. The selected laboratory will be required to be responsive to the project needs by providing test results within reasonable time frames. This will include providing verbal communication on the status of ongoing tests and immediate communication of test results as needed to facilitate ongoing construction. Such information may include hydraulic conductivity test data, maximum dry density and optimum moisture content values, and borrow source characterization data. Final laboratory reports will be certified by the soil testing laboratory and submitted to the CQA Officer.

2.4 Construction Contractor

The Construction Contractor's role will be to furnish earthwork and construction, and to provide overall construction responsibility for the completion of the project. The term “Contractor” is used interchangeably with “Construction Contractor” in this Plan.

Section 3
Preconstruction Activities

3.1 Preconstruction Meeting

Prior to commencement of each phase of construction, a preconstruction meeting will be held. This meeting will include the parties involved in the construction, including the CQA Officer or designated representative, the RPR, the Construction Contractor, and potentially the Owner.

The purpose of this meeting is to begin the planning and coordination of construction tasks; to identify potential problems that might cause difficulties and delays in construction; to properly interpret the design intent by the Contractor(s); and to present the CQA Plan to all of the parties involved. It is important that the rules regarding testing, repairs, etc. be known and accepted by each party to this Plan.

Specific activities considered for this meeting include the following:

- Review the project Health and Safety Plan
- Review critical design details of the project, including the plans and specifications.
- Review measures for surface water runoff and runon diversion control, including sump locations, siltation control, and pumping requirements.
- Make appropriate modifications to the Construction Quality Assurance Plan, and develop project-specific addendums (if necessary).
- Review the responsibilities of each party.
- Review lines of authority and communication.
- Review methods for documenting and reporting, and for distributing documents and reports.
- Review requirements of the soil testing laboratory regarding sample sizes, methods of collection, and shipment. Also, review turntimes for sample data and their implications on the construction schedule, pending receipt of acceptance data.
- Review the number and locations of the tests required for soil components.
- Review precautions to be taken to maximize bonding between lifts of compacted clay.
- Review the method for splicing segments of the compacted clay plug.
- Review precautions to be taken to minimize desiccation cracking of clay surfaces.
- Review the time schedule for all operations.
- Observe where the site survey benchmarks are located, and review methods for maintaining vertical and horizontal control.
- Review permit documentation requirements.

- Review the survey documentation tables and plans that identify the locations where survey documentation information is required.
- Conduct a site walk-around to review material storage locations and general conditions relative to construction.
- Set up a time and place for regular construction progress meetings.

The meeting will be documented by the RPR or CQA Officer, and minutes will be distributed to all parties involved in the construction project.

Section 4
General Construction Observation and Documentation

This section describes the general documentation procedures to be implemented, including the use of forms, the identification and resolution of problems or deficiencies, and photographic documentation.

4.1 Progress Meetings

Progress meetings will be held regularly at the work area. At a minimum, the meeting will be attended by field supervisory and CQA personnel. The purposes of the meeting are as follows:

- Review Health and Safety issues associated with any upcoming activities or changes in work conditions.
- Review the work activity since the last progress meeting.
- Discuss the Contractor's personnel and equipment assignments.
- Review the work schedule.
- Discuss possible problems.
- Review any new test data.
- Review data documentation requirements.

The meetings will be documented by a person designated at the beginning of the meeting, and minutes will be transmitted to all appropriate parties involved in the construction project.

4.2 Daily Reports

A daily summary report will be prepared by the CQA Officer, or the RPR under direct supervision of the CQA Officer, for each day of activity and will include the following information:

- The date, project name, location, report preparer's name, and the names of representatives on-site performing CQA under the supervision of the CQA Officer
- The time work starts and ends each construction work day, along with the duration and reason for work stoppages (*i.e.*, weather delay, equipment shortage, labor shortage, unanticipated conditions encountered, etc.)
- Data on weather conditions, including temperature, humidity, wind speed and direction, cloud cover, and precipitation
- The construction contractor's work force, equipment in use, and materials delivered to, or removed from, the job site
- A chronological description of work in progress, including locations and type of work performed

- A summary of meetings held and a list of those in attendance
- A description of materials used and references or results of testing and documentation
- A discussion of problems/deficiencies identified and corrective actions taken as described in Subsection 4.4 (Problem/Deficiency Identification and Corrective Action)
- Identification/List of laboratory samples collected, marked, and delivered to laboratories, or clear reference to the document containing such information
- An accurate record of calibrations, recalibrations, or standardizations performed on field testing equipment, including actions taken as a result of recalibrations, plus the results of other data recording

Field data sheets containing the following information, as necessary, will be prepared daily by each representative:

- Test or sample location and elevation
- Type of documentation (*i.e.*, field moisture/density test, etc.)
- Procedures used
- Test data (*i.e.*, Proctor value, etc.)
- Results
- Names of personnel involved in the documentation and sampling activities
- Signature of the person performing the documentation

4.3 Forms, Checklists, and Data Sheets

Additional forms may be developed during the course of the project to provide specific needs, or simply to improve the efficiency of data collection. New forms will be approved by the CQA Officer prior to their use.

4.4 Problem/Deficiency Identification and Corrective Action

Problem and/or deficiency identification and corrective action will be documented in the daily report when a construction material or activity is observed or tested that does not meet the requirements set forth in this Plan. The daily report should clearly reference other reports, photographs, or forms that contain data or observations leading to the determination of a problem or deficiency. Problem and/or deficiency identification and corrective action documentation may include the following information:

- A description of the problem or deficiency, including reference to supplemental data or observations responsible for determining the problem or deficiency.
- The location of the problem or deficiency, including how and when the problem or deficiency was discovered, and an estimate of how long the problem or deficiency has existed.
- An opinion as to the probable cause of the problem or deficiency.

- A recommended corrective action for resolving the problem or deficiency. If the corrective action has already been implemented, then the observations and documentation to show that the problem or deficiency has been resolved should be included. If the problem or deficiency has not been resolved by the end of the day upon which it was discovered, then the report will clearly state that it is an unresolved problem or deficiency. Subsequent daily reports will indicate the status of problems or deficiencies until they are resolved.

If the problem or deficiency has not been resolved, then the CQA Officer and the RPR will discuss the necessary corrective actions. The CQA Officer will work with the Owner and Construction Contractor to implement actions as necessary to resolve the problem or deficiency. A description of such problems or deficiencies and the corrective actions implemented will be provided in the Construction Documentation Report.

The CQA Officer, working with the Owner and Construction Contractor, will determine if the problem or deficiency is an indication of a situation that might require changes to the Plans and Specifications and/or the CQA Plan. Revisions to the Plans or Specifications or the CQA Plan must be approved by the CQA Officer and the Owner after consultation with the USEPA. Documentation of the USEPA's concurrence and/or conditions regarding proposed changes will be incorporated into the Construction Documentation Report.

4.5 Photographic Documentation

Photographs will be taken to document observations, problems, deficiencies, corrective actions, and work in progress. Photographs will be in 35-mm slide or print format or digital and will be filed in chronological order in a permanent protective file by the CQA Officer or the RPR.

The following information will be documented in the daily report or a log book for each photograph:

- Date and time
- Information regarding the orientation of the photograph itself for proper viewing (*i.e.*, "looking south")
- Description of the subject matter
- Unique identifying number for reference in reports

4.6 Surveying

Documentation surveying requirements for each component of the project are described in their respective report sections. Required surveying will be performed by personnel experienced in construction surveying under the supervision of the CQA Officer. Surveys will be based on survey control points previously established at the site. Elevations will be based on mean sea level (M.S.L.) datum, and coordinates will be based on the site-specific horizontal control. The location of field tests and samples will be recorded. Generally, these locations can be determined by reference to nearby construction stakes or markings; however, if such convenient reference is not readily available, the CQA Officer or the designated RPR will be responsible for providing or requesting survey control.

Section 5
Compacted Select Clay Fill

5.1 General

This section includes the quality assurance requirements for the placement, backfilling, and compaction of select clay fill. Compacted select clay fill will be used in the following manner:

- Constructing the clay plug

The select clay fill will be obtained from an off-site source.

All field tests, soil sample types, and survey measurements will be recorded in the daily construction reports (see Subsection 4.2) as record construction data, including locations (by coordinates) and elevations of all field tests and laboratory sample points.

5.2 Procedures and Observation

The RPR will observe compacted select clay fill construction activities and will document relevant observations to support certification of the following requirements:

- The RPR will confirm the uniformity of the excavated soil to be used as select clay fill. Soil placement will be monitored for segregation and removal of unsuitable material and for changes in soil type, color, texture, and moisture content.
- The Construction Contractor will segregate and/or remove unsuitable materials such as granular soil, silty or sandy clay not meeting acceptance criteria, boulders, cobbles, and organic material.
- The RPR will observe clay placement and will measure field densities and moisture contents, using methods described in Subsection 5.3 (Sampling Requirements and Acceptance Criteria), to document that the compacted clay plug is in substantial conformance with the placement specifications and that soil placement has been conducted in a manner to achieve a uniform, homogeneous clay mass.
- Voids created by nuclear density gauge (NDG) probes or as the result of Shelby tube samples will be backfilled with granular bentonite.
- Areas of unacceptable permeability, density, or moisture content, as defined by Subsection 5.3 (Sampling Requirements and Acceptance Criteria), will be documented by the RPR. Corrective action will consist of moisture-conditioning of the soil and/or additional compactive effort as necessary. Methods for moisture-conditioning soil are described below. Following corrective actions, such areas will be retested.
- If necessary, surfaces of the clay plug to receive successive lifts of clay will be moisture-conditioned either by scarification and addition of water where desiccated, or by discing and air drying where saturated to promote effective bonding of lifts. Following scarification, water will be applied with a spray bar applicator or equivalent method to achieve uniform distribution.

- No frozen soil will be used for select clay fill construction. Frozen soil in the compaction work area will be removed.
- Stones and other penetrating objects 2 inches or larger protruding from the surface of the final lift of compacted select clay fill will be removed. The RPR will observe this process and will document the removal of stones and other objects by the Contractor. Voids made by the removal of stones will be filled with clay soil or bentonite.
- Preconstruction planning will be undertaken to sequence construction activities to minimize the length of time any completed clay surface will be exposed prior to receiving protective cover. Protective cover will be provided by installing the 6-inch–thick topsoil layer over the clay.

5.3 Sampling Requirements and Acceptance Criteria

Field and laboratory sampling frequencies are based on the area or volume of material placed. This section describes the required analyses, methods, sample frequencies, and acceptance limits. The RPR will perform field tests and will collect soil samples for laboratory analysis.

5.3.1 Field Testing

The following field testing methods will be used by the RPR during construction:

PARAMETER	METHOD
Soil density and moisture content	ASTM D6938

Field density and moisture content tests will be performed at a frequency of one test per acre, and a minimum of three tests per day or lift of select clay fill. The testing pattern will be offset on alternate lifts.

Field Testing Acceptance Criteria

Acceptance criteria for field density will require soil compaction to a minimum of 90 percent of the Modified Proctor (ASTM D1557) maximum dry density, or a minimum of 95 percent of the Standard Proctor (ASTM D698) maximum dry density. Moisture content requirements will be at least 2 percent wet of optimum if using the Modified Proctor, and at least wet of optimum if using the Standard Proctor. The acceptable range will be based on Proctor moisture-density relationships and compaction versus permeability relationships.

5.3.2 Laboratory Testing

Routine laboratory testing of the clay soil will be performed on samples from the clay borrow area and on the in-place clay soil samples collected by the RPR. Samples for determining in-place properties will be collected by pushing Shelby tubes. Soil characteristics will be determined from representative samples and from Shelby tube samples.

Undisturbed Sample Analysis

One undisturbed sample will be taken at a frequency of one per every 10,000 cubic yards of clay to be placed or a minimum of three tests and will be submitted to the Soil Testing Laboratory.

The undisturbed samples will be analyzed for hydraulic conductivity as follows:

PARAMETER	TEST METHOD
Hydraulic conductivity	ASTM D5084 or SW 846 EPA Method 9100

Representative Sample Analysis

Representative (grab) samples will be obtained on the basis of three criteria. First, an initial sample will be obtained from the clay borrow source and analyzed prior to construction. This will confirm soil characteristics and provide an initial maximum dry density and optimum moisture content for field moisture/density testing. Second, routine samples will be obtained for every 5,000 cubic yards placed. Third, in the event that changes in physical appearance or soil characteristics are observed, a sample will be obtained and analyzed. The maximum dry density and optimum moisture content values used for compaction testing may be adjusted during the course of construction based on the results of the above sampling.

The following laboratory analyses will be performed on all representative samples obtained:

PARAMETER	TEST METHOD
Moisture-density relationship using Modified/Standard Proctor compaction	ASTM D1557 [(a, b)]/ ASTM D698 [(a, b)]
USCS classification	ASTM D2487

Notes:
[(a)] Five-point Proctor analysis required for first and second sampling criteria.
[(b)] A one-point Proctor analysis may be utilized for representative samples collected for the third sampling criterion (apparent changes in soil quality) to verify applicability of previously analyzed moisture-density relationships. If the result does not verify applicability, then a five-point analysis will be performed in accordance with the first sampling criterion.

Laboratory Testing Acceptance Criteria

The following acceptance criteria will apply to the compacted select clay fill.

- A classification of SC, CH, CL, CL/ML, or ML
- A saturated hydraulic conductivity of 1×10^{-7} cm/s or less, when compacted to 90 percent Modified or 95 percent Standard Proctor density

5.4 Thickness Documentation

The top of the clay plug grades will be surveyed at key locations every 50 feet along the eastern side of the landfill. Key locations include breaks in grade, toes of slopes, and tops of slopes. The clay plug thickness will be determined at surveyed locations and reported in a tabular fashion. The minimum acceptable clay plug thickness will be 2.5 feet (+ 0.1 foot).

Section 6
General Soil

6.1 General

This section includes the quality assurance requirements for the placement, compaction, and grading of general soil (i.e., general fill). General soil may be any inorganic soil except rock. General soil will be used in the construction of the following landfill components:

- Temporary landfill cover
- Access roads

All field tests, soil sample types, and survey measurements will be recorded in the daily summary reports (see Subsection 4.2) as record construction data, including locations (by coordinates) and elevations of all field tests and laboratory sample points.

6.2 Procedures and Observation

The RPR will observe general soil placement activities and will document relevant observations to support certification of the following requirements:

- The RPR will periodically observe loads of general fill for general conformance to material specifications and may randomly sample loads. The RPR will perform routine conformance sampling as defined in Subsection 6.3.2.
- No frozen soil will be used for backfilling. Any frozen soil in the compaction work area will be removed.
- Loose lift thickness for general soil compaction will not exceed 18 inches.
- General soil used as structural fill (*i.e.*, subbase preparation, and roads) will be compacted to a minimum of 90 percent or 95 percent of the maximum dry density as determined by the Modified or Standard Proctor test, respectively.
- Unacceptable compaction density, as defined above, will be reported to the CQA Officer by the RPR. Corrective action will consist of moisture-conditioning of the soil and/or additional compactive effort as necessary.

Field densities using methods described in Subsection 6.3.1 will be measured to document that the in-place soil is in substantial conformance with the required density.

6.3 Sampling Requirements and Acceptance Criteria

No field or laboratory testing of general soil will be required for placement of the temporary landfill cover.

6.3.1 Field Testing

The following field testing method will be used by the RPR during construction:

PARAMETER	TEST METHOD
Soil density	ASTM D6938

The RPR will conduct a minimum of four field density tests on the general fill material placed to construct the access road. A nuclear density gauge will be used for field density determination.

6.3.2 Laboratory Testing

Routine laboratory testing of the general soil will be performed on samples from the general soil borrow area or stockpile. The following laboratory test method will be performed by the Soil Testing Laboratory on samples collected by the RPR:

PARAMETER	TEST METHOD
Moisture/Density using Modified or Standard Proctor compaction	ASTM D1557 or ASTM D698

Samples of the borrow area or stockpiled soil will be collected by the RPR prior to the use of the material and whenever physical appearance or other changes are noticeable. These samples will be submitted to the Soil Testing Laboratory for the above testing.

6.4 Thickness Documentation

The top of the access road along the river will be surveyed at key locations every 50 feet along the eastern side of the landfill. Key locations include breaks in grade, toes of slope, and tops-of-slopes. The minimum acceptable access road thickness along the river is 2.5 feet (+ 0.1 foot).

The subgrade and top of the temporary landfill cover will be surveyed on the same 50-foot grid, and at other key locations. Key locations include breaks in grade. The minimum acceptable thickness will be 1 foot (+ 0.1 foot).

Section 7
Granular Soil

7.1 General

Granular soil includes select granular fill. Select granular fill refers to material used for the paper residuals/river sediment dewatering pad drainage layer.

7.2 Procedures and Observation

The RPR will observe granular soil placement activities and will document relevant observations to support certification of the following requirements:

- The RPR will periodically observe loads of granular soil for general conformance to material specifications and may randomly sample loads.
- If granular soil is stockpiled on-site prior to use, measures will be taken to minimize contamination by fines such as wind-blown particles and surface soil during loading operations.

7.3 Sampling Requirements and Acceptance Criteria

Field sampling and laboratory testing frequencies are based on proportionate sampling of construction areas or volumes of material placed as specified by Part 115, of Act 451 of the Michigan Department of Environmental Quality Waste and Hazardous Materials Division. This section describes the required analyses, methods, sampling frequencies, and acceptance limits. The RPR will collect soil samples for laboratory analysis.

7.3.1 Field Testing

No field testing will be required for select granular fill. However, as stated in Subsection 7.2 above, the RPR will perform a visual inspection of this soil for conformance to material specifications and may randomly sample deliveries.

7.3.2 Laboratory Testing

Representative (grab) samples will be obtained from the proposed select granular fill sources prior to delivery of the material. The source sampling frequency will be dependent on the apparent uniformity of the source and must be approved by the CQA Officer.

Grab samples of granular material placed will be collected and analyzed as follows:

SOIL TYPE	FREQUENCY	PARAMETER	TEST METHOD
Select granular fill	1/1,000 CY[(a)]	Grain size	ASTM D422[(b)]
Select granular fill	1/2,500 CY[(c)]	Remolded hydraulic conductivity	ASTM D2434

Notes:
(a) For lesser volumes, a minimum of four samples will be tested.
(b) Testing is required only to the #200 sieve.
(c) For lesser volumes, a minimum of two samples will be tested.

Laboratory Testing Acceptance Criteria

Select granular fill material will contain no more than 5 percent by weight of fines passing the #200 sieve, will have a uniformity coefficient of less than 4 for gravelly soil and less than 6 for sandy soil, and will have a remolded hydraulic conductivity of 1×10^{-3} cm/s or greater at the anticipated field density.

7.4 Thickness Documentation

The thickness of the select granular fill for the paper residuals/river sediment dewatering pad drainage layer will be documented on a 100-foot grid by hand-shoveling and measuring the observed thickness.

Section 8
Topsoil

8.1 General

This section includes the quality assurance requirements for the excavation and placement of the topsoil and for the seeding, fertilization, mulching, and watering of the topsoil layer for vegetation. Topsoil will be obtained from on-site stockpiles created by the clearing of the landfill cover and associated disturbed perimeter areas.

8.2 Procedures and Observation

Work covered by this section will be performed in accordance with the Construction Plans and Specifications. The RPR will observe topsoil placement activities and will document relevant observations to support certification of the following requirements:

- The RPR will confirm the source and uniformity of topsoil used. Soil excavation and placement will be monitored for minimization of inorganic soil not compatible for establishment of vegetation.
- Prior to seeding, the topsoil will be worked to prepare a suitable seedbed.
- Seeding, fertilizing, and mulching will be performed in a timely manner.

8.3 Sampling Requirements and Acceptance Criteria

The topsoil will be suitable for the establishment and long-term maintenance of the selected vegetation seed mix with appropriate fertilization. At the RPR's discretion, samples may be collected for laboratory testing.

Seeding

The following seed mixture will be used:

- Creeping red fescue 20 lbs
- Kentucky bluegrass 5 lbs
- Redtop 1 lb
- Tall fescue 20 lbs
- Timothy 2 lbs
- Birdsroot trefoil 10 lbs
- Ryegrass 5 lbs
- Total 63 lbs per 1,000 square feet

- Apply seed at a rate of 63 pounds per 1,000 square feet evenly in two intersecting directions. Rake in lightly.
- Planting season: April 1 to May 20 and September 1 to October 5.
- Do not sow (sow-to scatter seed over (land, earth, etc.) for the purpose of growth) immediately following rain, or when ground is too dry, or during windy periods.

Fertilization

- Fertilizer will only be added if needed with type and amount approved by owner and any necessary regulatory agency.

Mulching

- Apply mulch to the seeded at a rate of 2 to 3 tons per acre.
- Immediately following mulching, roll mulched area. On large areas, a cultipacker may be used to roll and cover the seed.

Hydroseeding

- A hydroseeder may be used if deemed more appropriate for seeding, particularly for slopes. If used, the hydroseeder shall have continuous agitating action that keeps the seed uniformly mixed in the slurry until pumped from the tank.
- Apply seed slurry at a rate per the manufacture's recommendations in two intersecting directions, with a hydraulic seeder. If no rates are given, use 150 to 200 lbs/acre. Do not hydroseed area in excess of that which can be mulched on the same day.

8.4 Surveying

The thickness of topsoil placement will be documented on a 50-foot grid by surveying or by hand-shoveling and measuring the observed thickness of topsoil.

Section 9
Riprap

9.1 General

This section includes the quality assurance requirements for the placement of riprap for erosion protection along the riverbank.

9.2 Procedures and Observation

The RPR will observe riprap placement activities and will document relevant observations. The RPR will periodically observe loads of riprap for general conformance to material specifications.

9.3 Sampling Requirements and Acceptance Criteria

This section describes the required analyses, methods, sampling frequencies, and acceptance limits.

9.3.1 Field Testing

No field testing will be required for riprap. However, as stated in Subsection 9.2 above, the RPR will perform a visual inspection of this material for conformance to material specifications.

9.3.2 Laboratory Testing

The riprap will have a D_{50} of approximately 9 inches and will be angular in shape. No stones will be less than 3 inches in diameter, and no stones will be greater than 15 inches in diameter. An alternative locally available riprap may be used as approved by the Engineer.

9.4 Thickness Documentation

The top of the riprap will be surveyed every 50 feet along the eastern side of the landfill at the same locations surveyed for the subbase grades. The riprap thickness will be determined at surveyed locations and reported in a tabular fashion. The minimum acceptable thickness will be 2 feet.

Section 10
Geotextile

10.1 General

This section of the CQA Plan applies to nonwoven geotextile used underneath the riprap along the riverbank.

This section is divided into three major subheadings, which cover the quality assurance requirements for preinstallation (which includes Geotextile Manufacturers), installation, and post-installation (which includes the final examination of the geotextiles prior to placing the appropriate material above the geotextile). The terms preinstallation, installation, and post-installation are applicable only to the geotextile and do not apply to the overall construction of the landfill facility.

10.2 Preinstallation

10.2.1 Manufacturing

The geotextile will be supplied to the site in factory rolls. Prior to the delivery of any geotextile rolls to the site, the Geotextile Manufacturer will provide the CQA Officer with the Manufacturer's Quality Control Plan used for production of the geotextile rolls.

Every roll of geotextile for delivery to the site will be manufactured and inspected by the Geotextile Manufacturer, according to the following requirements:

- The geotextile must be free of holes and any other sign of contamination by foreign matter.

The Geotextile Manufacturer will provide certification, based on tests performed in accordance with the methods listed in Table 10-1 that the geotextile supplied under this Plan will meet the material specifications listed in Table 10-2. These tests may be performed by the Geotextile Manufacturer's laboratory or a laboratory contracted by the manufacturer. Additionally, the Geotextile Manufacturer will provide certification that the Manufacturer's Quality Control Plan was fully implemented for the geotextile materials supplied under this Plan. The Geotextile Manufacturer will provide documentation to verify the results of the Manufacturer's CQA Plan implementation if required by the CQA Officer.

Table 10-1
Geotextile Tests and Test Methods

PROPERTY	TEST METHODS
Apparent opening size [1]	ASTM D4751
Grab tensile properties Tensile strength Break elongation	ASTM D4632
Permittivity [1]	ASTM D4491
Permeability	ASTM D4491
Puncture resistance	ASTM D4833
CBR puncture strength	ASTM D6241
Trapezoidal tear	ASTM D4533
Mullen burst	ASTM D3786
Flow rate	ASTM D4491
UV resistance (500 hours)	ASTM D4355

Notes:
[1] Testing required only for geotextile separator filter.

Table 10-2
Geotextile Filter Acceptance Criteria

PROPERTY	UNITS	TYPE OF CRITERION	ACCEPTABLE VALUE [1]
Apparent opening size	mm	Maximum	0.180
Grab tensile properties[2] Tensile strength Break elongation	 lb %	 Minimum Minimum	 205 50
Permittivity	sec^{-1}	Minimum	1.2
Permeability	cm/sec	Minimum	0.21
Puncture resistance	lb	Minimum	130
CBR puncture strength	lb	Minimum	500
Trapezoidal tear[2]	lb	Minimum	80
Mullen burst	psi	Minimum	380
Flow rate	$gal/min/ft^2$	Minimum	95
UV resistance (500 hours)	% strength retained	Minimum	70

Notes:
(1) Values are based on discussions with acceptable manufacturers and represent production values at the time this document was prepared. Minimum values are based on two standard deviations from average production values.
(2) These tests will be performed and results reported in both the machine and cross directions.

The geotextile rolls will be tested and evaluated prior to acceptance. The CQA Officer may perform/require additional testing (*i.e.*, conformance testing) as required by detailed specifications or as required in the judgment of the CQA Officer to verify that the geotextile meets the specifications.

10.2.2 Delivery, Handling, and Storage of Geotextile Rolls

Each geotextile roll to be used at the landfill facility will be marked by the Geotextile Manufacturer with the following information and in the following manner:

- When fabric is rolled on a core, each roll will be identified with a durable gummed label, or an equivalent, on the inside of the core and on the outside of the protective wrapping for the roll.
- Each roll label will contain the following information at a minimum:
  - Name of manufacturer (or supplier)
  - Style and type number
  - Roll length and width
  - Batch (or lot) number

- Nominal product thickness
- Date of manufacture
- Roll number

The Geotextile Manufacturer will use the following guidelines in packaging, wrapping, and preparing all geotextile rolls for shipment:

- When cores are required, those that have a crushing strength sufficient to avoid collapse or other damage while in use will be used.
- Each roll will be covered with a wrapping material that will protect the geotextile from damage due to shipment, water, sunlight, or contaminants.

The following practices will be used as a minimum in receiving and storing geotextile rolls in the designated storage area at the job site:

- While unloading or transferring the geotextile rolls from one location to another, care will be taken to prevent damage to the wrapping or to the geotextile itself. If practicable, the Installer may use fork lift trucks fitted with poles that can be inserted into the cores of rolls. The poles will be at least two-thirds the length of the rolls, to prevent breaking the cores and possibly damaging the geotextile. Rolls will not be dragged.
- The geotextile rolls will be stored in such a manner so as to ensure that they are adequately protected from the following:
    - Precipitation
    - Ultraviolet radiation, including sunlight
    - Strong oxidizing chemicals, acids or bases
    - Flames, including welding sparks
    - Temperatures in excess of 160°F
    - Soiling

The RPR will observe and document, throughout the preinstallation, installation, and post-installation periods, that the Installer provides adequate handling equipment used for moving geotextile rolls and that the equipment and handling methods used do not pose unnecessary risk of damage. The Installer will be responsible for the means and methods to implement the work.

The Installer will be responsible for ensuring that all materials installed meet specifications (*i.e.*, the roll marking label information indicates required specifications and properly represents materials). The RPR will maintain a log of geotextile roll deliveries. The following information, at a minimum, will be recorded on the log for each shipment received at the job site:

- Date of delivery at job site
- For each geotextile roll, the following information:

- Roll number
- Batch (lot) number

10.3 Installation

This section describes the quality assurance requirements applicable to the installation, observation, and documentation of geotextile.

10.3.1 Placement

The Installer will install all geotextile in such a manner so as to ensure that it is not damaged and in a manner that complies with the following requirements:

- On sideslopes, the geotextile will be securely anchored and then rolled down the slope in such a manner so as to continually keep the geotextile in tension.
- In the presence of wind, all geotextile will be secured by suitable methods. The temporary securing material will be left in place until replaced with cover material as shown on the design plans and specifications.
- The Installer will take the necessary precautions to prevent damage to any underlying layers during placement of the geotextile.
- During placement of the geotextile, care will be taken not to entrap in the geotextile any stones, excessive dust, or moisture that could damage the geotextile.

10.3.2 Overlaps

The following requirements will be met with regard to overlapping of geotextile rolls:

- Geotextile will be overlapped a minimum of 5 feet, per Manufacturer's recommendation.

The RPR will be responsible for observing and documenting that the above provisions are performed by the Installer in an acceptable manner.

10.4 Post-Installation

10.4.1 Final Examination

The RPR will perform a final geotextile examination after the installation of each geotextile layer has been completed. The objectives of the final examination are as follows:

- To examine for the presence of holes, tears, or other deterioration
- To examine geotextile for excessive tension due to stretching of the fabric during installation

If there will be an extended time delay between completion of the geotextile and the start of the installation of any overlying cover, then the Installer will make provisions, by temporarily

covering or using other suitable methods, to protect the geotextile against exposure to sunlight and ultraviolet radiation.

10.4.2 Placement of Soil Materials

The Construction Contractor will place all soil materials located on top of a geotextile in such a manner so as to minimize the following:

- Slippage of the geotextile on underlying layers
- Excessive tensile stresses imposed on the geotextile

Section 11
Erosion Control Matting

11.1 General

This section is divided into three major subheadings, which cover the quality assurance requirements for preinstallation, installation, and post-installation of the erosion control matting. The terms preinstallation, installation, and post-installation are applicable only to the geocomposite and do not apply to the overall construction of the landfill facility.

11.2 Preinstallation

11.2.1 Manufacturing

The erosion control matting will be composed of 100% synthetic material and will contain no biodegradable or photodegradable components or materials. The erosion control matting will be a three-dimensional matrix and will maintain the three-dimensional stability without laminated or stitched layers. The erosion control matting will have a sufficient area holding capacity and a minimum 90 percent open space available for soil and root interaction. The erosion control matting will not lose its structural integrity and will not unravel or separate when cut in the field. The erosion control matting will exhibit no buoyancy factor (the specific gravity of the fibers used should be greater than 1.0) so as to allow the erosion control matting to maintain intimate contact with the soil under low flow conditions. The erosion control matting shall meet the requirements of Table 11-1.

11.2.2 Delivery, Handling, and Storage of Geocomposite Rolls

Each erosion control matting roll, for use at the landfill facility, will be marked by the Manufacturer with the following information and in the following manner:

- When fabric is rolled on a core, each roll will be identified with a durable gummed label, or an equivalent, on the inside of the core and on the outside of the protective wrapping for the roll.

Table 11-1
Erosion Control Matting Specifications

PROPERTY	TEST	UNITS	VALUE
Mass/unit area	ASTM D5261	oz/yd^3	8.0
Thickness	ASTM D5199	Inches	0.4
Tensile strength (MD)	ASTM D5035	lb/ft	160
Area holding capacity	Calculated	in^3/yd^3	450
Porosity	Calculated	%	> 95
UV stability	ASTM D1682	% retained strength	80
Velocity 30 min. vegetated 50 hr. vegetated	Flume testing	ft/sec	 19 14
Shear 30 min. vegetated 50 hr. vegetated	Flume testing	lb/ft^2	 8.0 6.0

- Each roll label will contain the following information, at a minimum:
  - Name of manufacturer (or fabricator)
  - Style and type number
  - Roll length and width
  - Batch (or lot) number, if applicable
  - Date of manufacture
  - Direction for unrolling
  - Roll number
- On the outside of the roll, all lettering will be a minimum ½ inch high; and on the inside of the core, the lettering will be at least ¼ inch high.

The Manufacturer will use the following guidelines in packaging, wrapping, and preparing all erosion control matting rolls for shipment:

- When cores are required, those that have a crushing strength sufficient to avoid collapse or other damage while in use will be used.
- Each roll will be covered with a wrapping material that will protect the erosion control matting from damage due to shipment, water, sunlight, or contaminants.

At a minimum, the following practices will be followed in receiving and storing the erosion control matting rolls in the covered storage area at the job site:

- While unloading or transferring the erosion control matting rolls from one location to another, care will be taken to prevent damage to the erosion control matting. If practicable, fork lift trucks fitted with poles that can be inserted into the cores of rolls will be used. The poles will be at least two-thirds the length of the rolls to avoid breaking the cores and possibly damaging the erosion control matting. Rolls will not be dragged.
- The erosion control matting rolls will be stored in a manner so as to ensure that they are adequately covered to protect the erosion control matting from the following:
    - Precipitation
    - Ultraviolet radiation, including sunlight
    - Strong oxidizing chemicals, acids or bases
    - Flames, including welding sparks
    - Temperatures in excess of 160° F

The RPR will be responsible throughout the preinstallation, installation, and post-installation periods for observing and documenting that the Installer provides adequate handling equipment used for moving the erosion control matting rolls and that the equipment and handling methods used do not pose any risk of damage.

The RPR will maintain a log of erosion control matting roll deliveries. The following information, at a minimum, will be recorded on the log for each shipment received at the job site:

- Date of delivery at job site
- For each erosion control matting roll, the following information:
    - Roll number
    - Batch (lot) number, if applicable

11.3 Installation

11.3.1 Placement

The Installer will install all erosion control matting in such a manner so as to ensure that it is not damaged in any way, and in a manner that complies with the following:

- The erosion control matting will be securely anchored, and then rolled down the slope in such a manner so as to continually keep the erosion control matting in tension, per the Manufacturer's specifications. If necessary, the erosion control matting will be positioned by hand after being unrolled to minimize wrinkles. Horizontal placement of the erosion control matting on sideslopes will not be allowed.
- In the presence of wind, all erosion control matting will be secured by suitable methods. The temporary weighted material will be left in place until replaced with cover material as shown on the design Plans and Specifications.
- Cutting will be done according to Manufacturer's recommendations.

- The Installer will take necessary precautions to prevent damage to any underlying layers during placement of the erosion control matting.
- During placement of the erosion control matting, care will be taken not to entrap any stones, soil clods, or clumps that would prevent the erosion control matting from lying flush to the ground surface.

The RPR will observe and document that each of the above steps is performed by the Installer. Any noncompliance with the above requirements will be reported by the RPR.

11.3.2 Overlaps and Joining

The following requirements will be used with regard to the overlapping and joining of erosion control matting rolls:

- The erosion control matting will be overlapped 4 inches between rolls. The rolls will be shingled in the direction of water flow. The erosion control matting will be overlapped 3 feet between splices of rolls.
- The Installer will pay particular attention to the overlapped areas to ensure that no earthen or foreign materials could be inadvertently trapped beneath the erosion control matting.

11.3.3 Anchor Trench and Pinning

The following requirements will be used with regard to the anchor trench and pinning of erosion control matting rolls:

- The erosion control matting will be installed into the bottom of the trench and fastened with pins spaced 3 feet apart. The anchor trench will then be backfilled and compacted in a manner so as not to damage the erosion control matting.
- Pins will be installed down the center of each mat staggering them between the outside pins with a spacing of 3 to 5 feet.
- Two rows of pins spaced 1.5 x 1.5 feet apart will be installed at all roll splice locations.

11.3.4 Seeding

- Broadcast seed or hydroseed over the installed erosion control matting.
- Hydromulch after seeding.
- Apply supplemental water over the seeded area.

The RPR will observe and document that each of the above steps is performed by the Installer. Any noncompliance with the above requirements will be reported by the RPR to the CQA Officer.

11.3.5 Repairs

Any tears or other defects in the erosion control matting will be repaired by placing a patch with the minimum overlaps described in Subsection 11.3.2. The patch will be secured to the original erosion control matting by pinning every 6 inches. If the tear or other defect width is more than 50 percent of the roll width, the damaged area will be cut out and replaced with new erosion control matting. Pinning devices will be as indicated in Subsection 11.3.2.

The RPR will examine and document that the repair of any erosion control matting is performed according to the above procedure.

11.4 Post-Installation

11.4.1 Final Examination

The RPR will perform a final erosion control matting examination after installation has been completed. The objectives of this step are as follows:

- To examine for the presence of tears or defects
- To examine overlaps to make certain that they are in conformance with the requirements of Subsection 11.3.2

If any portion of the erosion control matting requires repairs due to the above examination, the repairs will then be performed according to the procedures in Subsection 11.3.3.

If there will be an extended delay between completion of the erosion control matting and seeding, then the Installer will make provisions, by temporarily covering, or other suitable methods, to protect the erosion control matting against exposure to sunlight and ultraviolet degradation.