BRIDGETON LANDFILL

NORTH QUARRY CONTINGENCY PLAN – PART 2

Submitted Pursuant to Section 17.A and 22.B of Agreed Order
Case No. 13SL-CC01088, Effective May 13, 2013

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

<u>Technical Contributors:</u>

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Note: Individual construction plans prepared by these technical contributors have been signed and sealed by a professional engineer licensed in the State of Missouri where required.

July 26, 2013

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APPENDICES

1.0 INTRODUCTION

On May 13, 2013, Bridgeton Landfill entered into an Agreed Order with the State of Missouri which requires actions to address what was called a subsurface smoldering event (SSE). One of the requirements of the Agreed Order is the preparation of a "North Quarry Contingency Plan" (Plan). The Plan is intended to build on prior contingency and response evaluations and put in place defined triggers and response actions to allow prompt and proactive response to the SSE.

The Agreed Order required the Plan to be prepared in two parts; Part 1 was submitted on June 27, 2013 and is still under review, Part 2 is the subject of this report. The requirements for Part 2 are presented below:

<u>Part 2 – Agreed Order Section 22.B</u>

B) Within seventy-five days of entry of this Agreed Order, Bridgeton Landfill shall submit Part 2 which shall include:

- *i) Construction Plans for the installation of additional interceptor wells in the North Quarry, if triggered;*
- *ii) Construction Plans for installation of an EVOH geomembrane cap over the North Quarry, if triggered;*
- *iii) Establishment of trigger criteria for an isolation break between the North Quarry and radiological materials contained in West Lake Landfill Site OU-1 Area 1, along with a schedule for such break, if triggered.*

Part 1 addressed the requirements of Section 22.B.iii by establishing triggers for the construction of an isolation barrier.

The remainder of the required submissions for this Part 2 Plan is presented in Appendices as described below:

- 2.0 Installation of Contingent Gas Interceptor Wells (GIWs) and Temperature Monitoring Probes (TMPs): Installation Plans submitted as Appendices A and B.
- 3.0 Construction Plan for Contingent Temporary Cap and Enhanced Gas Management System: Construction Plans submitted as Appendix C.
- 4.0 Preliminary Plan for Contingent Isolation Barrier: Schedule for Isolation Barrier and Isolation Barrier Investigation Plan submitted as Appendix D, Table 1.

In addition to the Construction Plans required by the Agreed Order, Bridgeton Landfill has prepared this narrative summary. While not required by the Agreed Order, this narrative introduction and summary was prepared for the benefit of the reader and to facilitate discussions regarding the plans and submissions. Additionally, to assist the Lambert-St. Louis Airport Authority in its ongoing review of bird mitigation and monitoring measures, Bridgeton Landfill has compiled the materials handling and monitoring procedures developed to ensure appropriate monitoring and mitigation of bird hazards.

The Plan and its requirements will be part of the Bridgeton Landfill closure and post closure operations until it is determined that the SSE is no longer presenting operational challenges or Bridgeton Landfill has been released from the requirements of the Agreed Order.

2.0 INSTALLATION OF CONTINGENT GAS INTERCEPTOR WELLS (GIWS) AND TEMPERATURE MONITORING PROBES (TMPS)

Part 1 of the Plan described the triggers that would require concurrent installation of the contingent Gas Interceptor Wells (GIWs) and Temperature Monitoring Probes (TMPs). As required by the Agreed Order, a plan that provides construction details for the installation of contingent GIWs is provided in Appendix A. As required by the Agreed Order, a plan for the installation of additional TMPs is contained in Appendix B.

The bird mitigation procedures contained in Appendix F would be followed during installation of the GIWs and TMPs if triggered; this appendix was developed to follow the materials management procedures utilized for existing GIW and TMP installation. These processes, as observed by USDA, were effective preventing bird attraction during this work in the South Quarry.

The schedule for installation of these items is contained in Part 1 of the Plan. Bridgeton Landfill has standing contracts with experienced installation contractors and is prepared to meet the agreed-upon schedule.

3.0 CONSTRUCTION PLAN FOR CONTINGENT TEMPORARY CAP AND ENHANCED GAS MANAGEMENT

Part 1 of the Plan described triggers that would require installation of the contingent Temporary Cap and Enhanced Gas Management System. As required by the Agreed Order, a construction plan for the temporary cap and the enhanced gas management system is provided in Appendix C. The bird mitigation procedures contained in Appendix F would be followed during installation of the temporary cap and enhanced GCCS. These processes, as observed by USDA, were effective preventing bird attraction during this work in the South Quarry.

The schedule for installation of these items is contained in Part 1 of the Plan. Bridgeton Landfill has standing contracts with experienced installation contractors and is prepared to meet the agreed-upon schedule.

4.0 PRELIMINARY PLAN FOR CONTINGENT ISOLATION BARRIER

Part 1 of the Plan described the triggers that would require installation of the contingent Isolation Barrier. The Agreed Order requires:

> *iii) Establishment of trigger criteria for an isolation break between the North Quarry and radiological materials contained in West Lake Landfill Site OU-1 Area 1, along with a schedule for such break, if triggered.*

This Part 2 will address the remaining requirements of the Agreed Order--the schedule for such break. Consistent with that schedule, Bridgeton Landfill is submitting the Gamma Cone Penetration Test (GCPT) Work Plan, as discussed below. Both of these documents are submitted in Appendix D, with the Schedule as Table 1 of the GCPT Work Plan. In addition to that submission, in compliance with the Agreed Order, Bridgeton Landfill has prepared the following narrative discussion for the purpose of facilitating discussion regarding the process and schedule for an isolation barrier design and, if triggered, construction.

4.1 CONCEPTUAL DESIGN OF CONTINGENT ISOLATION BARRIER

The northern limit of the North Quarry was selected as an isolation barrier location because the natural limestone bedrock exists at a relatively shallow depth. As discussed in the feasibility screening included in Part 1 of the North Quarry Contingency Plan, the northern isolation barrier was the preferred contingency alternative in order to provide a proven barrier, while best balancing feasibility challenges and applicable requirements. This barrier location provides for the ultimate protection of the radiological materials located in West Lake OU-1 Area 1 from a subsurface smoldering event, because it establishes an inert barrier between those materials and the permitted landfill cells. It is proposed that the Isolation Barrier be located at the shallowest practical location outside of the radiological materials.

The proposed location would allow construction of a barrier tied into the natural rock, soil material, or inert fill material at a relatively shallow depth. This reduces construction time and minimizes waste excavation. In addition to allowing for prompt installation if triggered, minimization of waste excavation also helps reduce or avoid any inconvenience to surrounding community resulting from waste disturbance, and best addresses relevant requirements that activities on site not create a bird attractant, which could be a hazard to the nearby Lambert St. Louis International Airport.

Preliminary location and conceptual design of the Isolation Barrier is provided with the Construction Plan for the Contingent North Quarry Temporary Cap and Enhanced Gas Management System in Appendix C of this Plan.

4.2 SCHEDULE FOR CONTINGENT ISOLATION BARRIER

Since the triggers were established in Part 1 of the Plan, this submission presents the "schedule for such a break." Because the isolation barrier will be placed in an area of joint jurisdiction, a number of steps are likely necessary prior to its actual construction, if triggered. A possible schedule and timeline is presented within Appendix D; portions of the schedule that can be controlled by Bridgeton Landfill are indicated with schedule commitments.

The first step in the construction plan for a contingent isolation barrier is an investigation called the "Gamma Cone Penetration Test (GCPT) Work Plan." The purpose of the Gamma Cone Penetration Test (GCPT) Work Plan is to gather sufficient information to establish the precise location and develop detailed construction plans for the Isolation Barrier. The GCPT Work Plan is included as Appendix D of this Plan. Appendix E contains the Gamma Cone Penetration Test (GCPT) Health and Safety Plan.

As discussed in more detail in the GCPT Work Plan, this investigation will include surficial radiological screening followed by Cone Penetrometer Testing (CPT) of the proposed barrier locations. This CPT investigation will be used to confirm that the subsurface does not contain radiologically impacted materials. A detailed screening methodology is included in that GCPT Work Plan.

It is important to confirm at this stage the absence of radiological impact at the proposed barrier location so that detailed construction plans and timelines may be developed in order to allow for efficient execution of the Isolation Barrier Construction Plan, if triggered. The GCPT Work Plan is being submitted for both MDNR and EPA review in order to ensure that activities comply with appropriate requirements of both agencies given the shared jurisdiction.

As discussed in the GCPT Work Plan, the investigation will also confirm the depth to native material and provide additional information on the general contents of the subsurface material (i.e. rock, municipal solid waste, construction and demolition waste, etc.). This information will be important in order to confirm depth and construction details, as well as to best assess the potential for the construction activities to present a bird attractant. When prepared, the Isolation Barrier Construction Plan will include appropriate bird mitigation measures in order to satisfy applicable requirements associated with prevention of hazard to the nearby airport.

APPENDIX A

INSTALLATION PLAN FOR CONTINGENT GAS INTERCEPTOR WELLS (GIWs)

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and Contractors

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SCS ENGINEERS

July 24, 2013
File No. 23211003.02

Mr. Brian Power
Environmental Manager
Bridgeton Landfill, LLC
13570 St, Charles Rock Road
Bridgeton, MO 63044

Subject: Installation Plan for Contingent Gas Interceptor Wells (GIWs)
Bridgeton Landfill, Bridgeton, Missouri

Dear Mr. Power:

Attached please find our Installation Plan for Contingent Gas Interceptor Wells (GIWs) for the Bridgeton Landfill. This Contingent Plan is an expansion of the permit (Permit #0118912) approved on January 11, 2013 and previously expanded on February 11, 2013.

1 INTRODUCTION

In an effort to minimize or stop movement of subsurface heat from the South Quarry to the North Quarry, additional special purpose, interceptor gas wells have been proposed and installed. Currently there are 13 GIWs installed at the Bridgeton Landfill in the South Quarry area. A Contingency Plan for additional GIWs installed near the narrow passage between the North Quarry and the South Quarry is the purpose of this submittal. A description of the design approach and contingencies are described below. Drawings depicting the proposed contingency GIWs are attached to this letter.

2 DESIGN APPROACH

The current GIWs are installed in the South Quarry, generally in two rows of wells along the northern face of the Quarry. The GIWs will represent a third row of wells close to the narrow boundary that represents the change from the South Quarry to the North Quarry. This new row of wells is located approximately along the same line as the Temperature Monitoring Probes (TMPs) TMP-10 and TMP-11. The placement of the wells is similar to the previous design, with each proposed well having approximately 50 feet spacing between them.

There is a common header that connects all 6 of the proposed wells, and each end of the common header will be connected to the existing gas collection system. Each end connection has a main header valve and the potential for a bypass to a cooling device if needed, and each well has a control valve. Additionally, each well has a 6-inch tee which has been designed to accommodate the use of a phase separation tank, if required.

The well spacing design will provide heavy vacuum overlap from well to well. This will create a low pressure area "wall" (vacuum curtain) that will allow heated and pressurized gas a controlled means of escape where it can be safely destructed in the current GCCS.

3 WELL DESIGN

The wells are designed to be drilled a maximum depth of 150 feet below ground surface. However, due to the proposed well placement in the narrow "throat" between the two quarries, the maximum well depths are only achieved for GIW-16, GIW-17 and GIW-18. GIW-14, GIW-15 and GIW-19 are along the sides of the quarry area and are proposed to be drilled to the bottom of the landfill. A well schedule has been provided on the detail sheet drawing.

The wells will be constructed of carbon steel, and will be 6-inch in diameter. The wells will have 25 feet of solid pipe and the rest will be perforated pipe, as shown on the well detail (Detail 3 on Sheet 3). Each well will have a flanged cast iron knife valve (McMaster-Carr Model #6312T35 or equivalent) for control of heated gas and potential liquids that may be collected. This knife valve provides flexibility in adjusting to actual conditions that may be encountered. The top of each well will be a steel flange that can either accept a custom steel wellhead or a Landtec wellhead. Each well head will be approximately 4-5 feet above ground when completely constructed.

The existing GIWs are located on the site map (Drawing 2 of 3) and highlighted in a light purple. The proposed six GIWs are shown on the same plan drawing highlighted in yellow.

The new gas interceptor wells will be constructed using the same configuration and well components that were previously approved by MDNR on January 11, 2013.

4 WELL DESIGN CONTINGENCIES

Due to the nature of the heat generating reaction at the Bridgeton Landfill, it is possible that the collected gas may be heated above normal operating temperatures or may be heated gas along with liquids. Both of these situations have been identified and worked into the design of the system.

If the collected gas is a heated gas with the extra liquids, each GIW has been designed with a tee and blind flange that can be utilized to direct the collected gas to a phase separation device and then be re-inserted into the header piping. If the collected gas is only a heated gas (without the extra liquids) then a bypass line has been designed into each well group header that can direct the gas into a cooling device before continuing to the blower/flare station.

5 HEADER SYSTEM

The header system for the proposed contingency GIW collection system will be tied into the existing 16-inch diameter header located approximately at the North/South Quarry boundary and the 18-inch header along the western perimeter in the amphitheater area. The existing header is located approximately 4 feet below ground surface and slopes both to the east and the west from the high point approximately at the midpoint of the header. The connection headers from the new well group will be sloped downhill to the existing headers (16-inch and 18-inch headers), running above ground until they get close to the tie-in with the existing headers, where they will go below ground to make the connection to the existing headers.

The main header and piping from the new well group as well as the common collector pipe for the new well group will be a 10-inch diameter pipe. The lateral to each GIW will be a 4-inch diameter pipe. Steel piping for the header and the common collection manifolds will be used on the well-side of the contingency cooling device flange. High density polyethylene (HDPE) pipe will be used from this flange north to the 16-inch header tie-in. The 4-inch lateral lines will also be constructed of steel (See detail drawing).

Should you have any questions, please feel free to contact Dan Brennan at (513) 421-5353.

Sincerely,

F. Daniel Brennan

F. Daniel Brennan, P.E.
Ohio PE#57,293
Senior Project Engineer
SCS ENGINEERS

Matthew S. Ballance, P.E.
Missouri PE#E-28264
Project Director
SCS ENGINEERS

STATE OF MISSOURI
MATTHEW
SCOTT
BALLANCE
NUMBER
E-28264
REGISTERED PROFESSIONAL ENGINEER

07/24/13

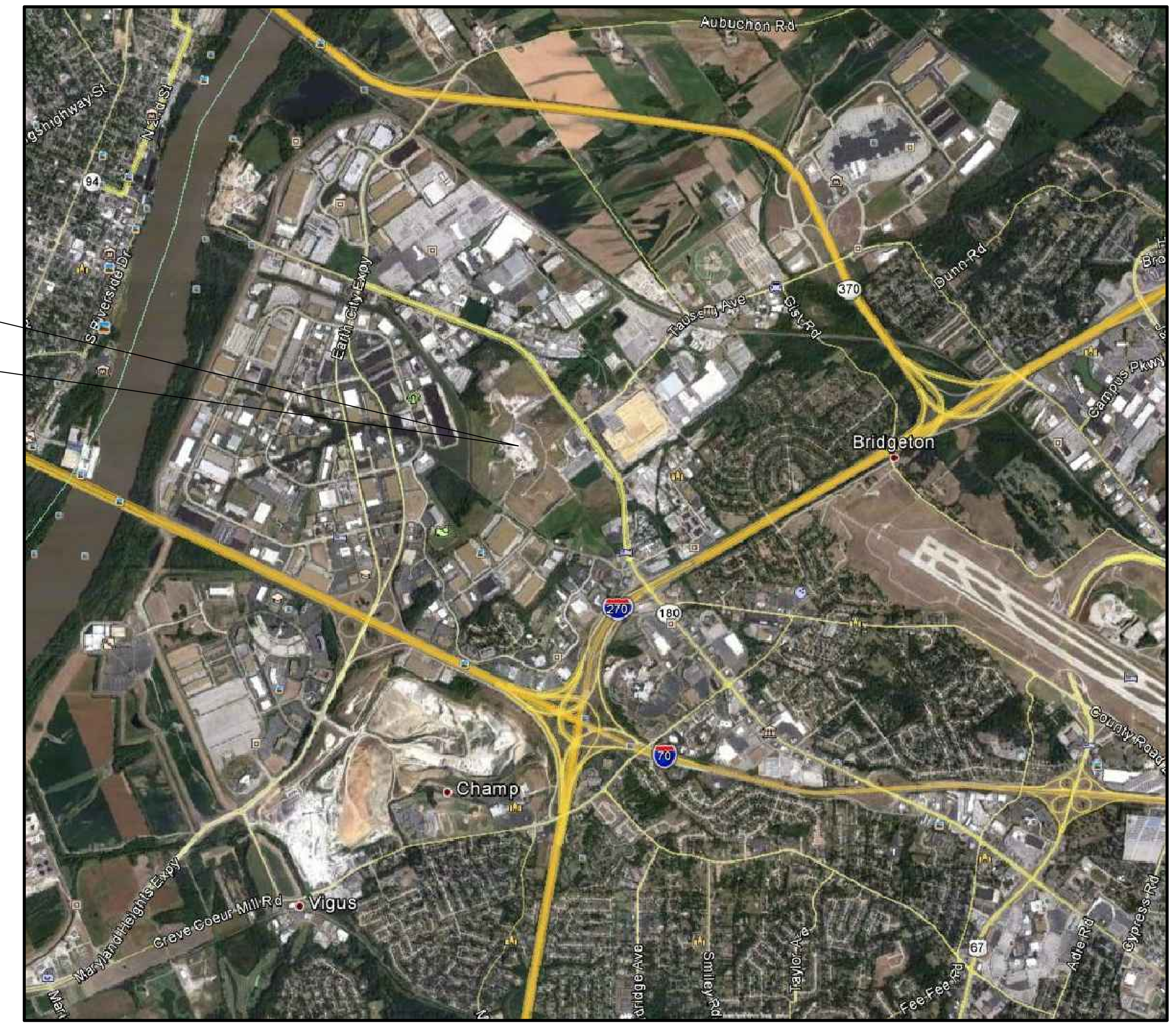
cc Craig Almanza, Bridgeton Landfill, LLC

DRAWINGS

2013 GAS INTERCEPTOR WELL SYSTEM - EXPANDED DESIGN
BRIDGETON LANDFILL
BRIDGETON, ST. LOUIS COUNTY, MISSOURI

DRAWING INDEX

DRAWING NO.		DRAWING TITLE
1	–	COVER SHEET
2	–	CONTINGENCY GAS INTERCEPTOR WELL PLAN
3	–	CARBON STEEL INTERCEPTOR WELL DETAILS



LOCATION MAP

0.5 mi. 0 0.5 mi. 1 mi.
SCALE FEET

PREPARED FOR:

BRIDGETON LANDFILL, LLC
13570 ST. CHARLES ROCK ROAD
BRIDGETON, MO 63044

PREPARED BY:

SCS ENGINEERS
2060 READING ROAD
SUITE #200
CINCINNATI, OHIO 45202-1497
PHONE (513) 421-5353
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JULY 17, 2013

REV.	DATE	DESCRIPTION	CK. BY

SHEET TITLE: COVER SHEET

PROJECT TITLE: BRIDGETON LANDFILL 2013 GAS INTERCEPTOR WELL SYSTEM - EXPANDED DESIGN

CLIENT: BRIDGETON LANDFILL, LLC
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13570 ST. CHARLES ROCK ROAD
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PROJ. NO. 23211003.02
DSN. BY: FDB
DWN. BY: FDB
CHK. BY: JJW
Q/A RVW BY: DAE

CADD FILE: COVER SHEET
DATE: 7/17/13
SCALE: NONE
DRAWING NO. 1 of 3

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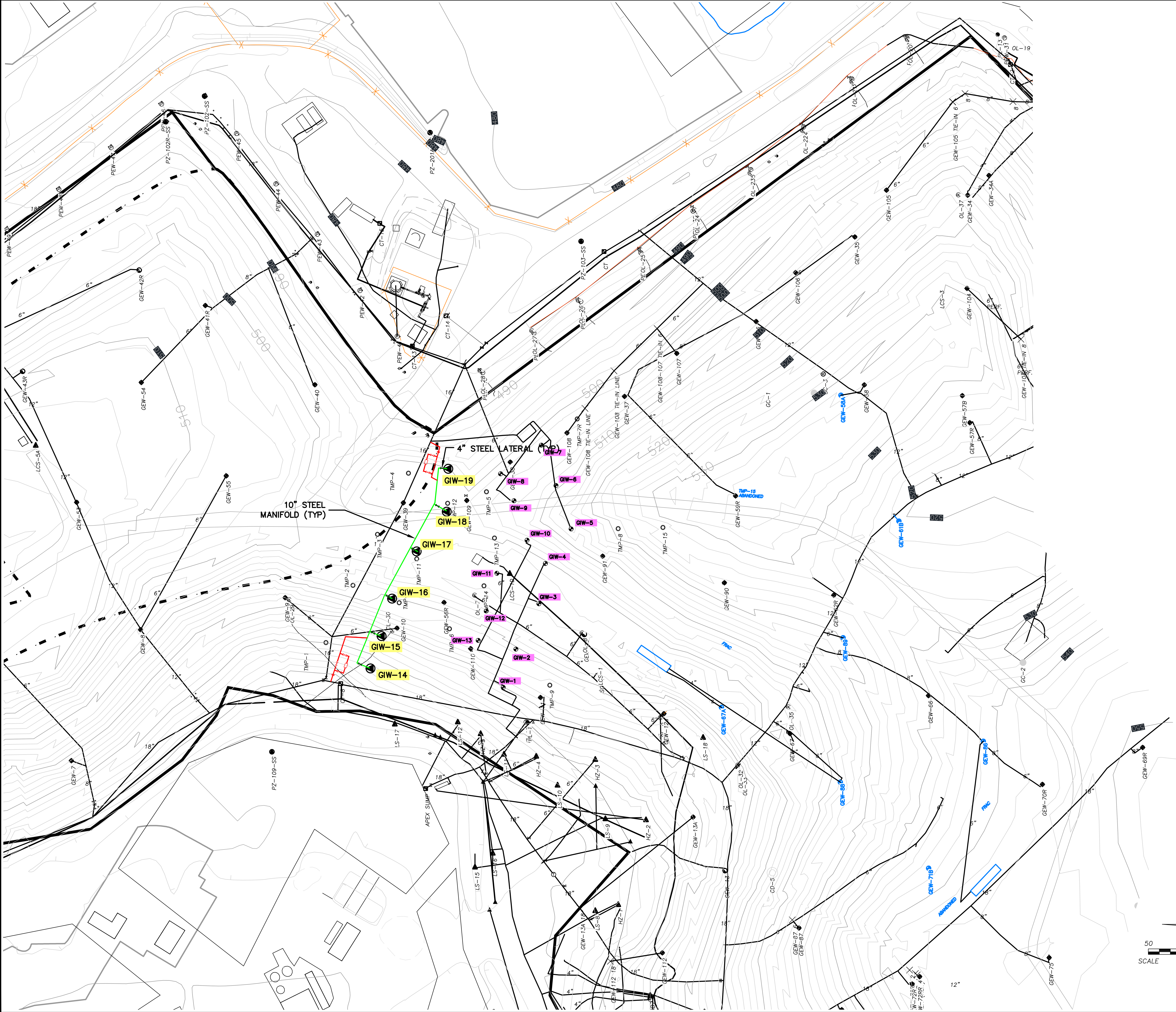

NEW PROPOSED GAS INTERCEPTOR WELLS (GIW-14 THRU GIW-19)

TMP-x EXISTING TEMPERATURE MONITORING PROBE

NEW MANIFOLD HEADER

GIW-1 EXISTING GAS INTERCEPTOR WELLS (GIW-1 THRU GIW-13)

REV.	DATE	DESCRIPTION	CK. BY

SHEET TITLE
CONTINGENCY GAS INTERCEPTOR WELL PLAN

PROJECT TITLE
BRIDGETON LANDFILL
2013 GAS INTERCEPTOR WELL SYSTEM – EXPANDED DESIGN

CLIENT:
BRIDGETON LANDFILL, LLC
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PROJ. NO. 23211003.00 | DSN. BY: FDB | DWN. BY: FDB | CHK. BY: JJW | Q/A RVW BY: MSB

CADD FILE: SITE MAP

DATE: 1/10/2013

SCALE: AS SHOWN

DRAWING NO. 2 of 3

I:\PROJECT\2011 PROJECTS\23211003.02 BRIDGETON LF ENG ASSISTANCE 2013\DELIVERABLES\TASK 1 - GIW DESIGN 2013\2-SITE PLAN.DWG

WELL SCHEDULE

	Well No.	Location Coordinates		Surface Elevation (ft MSL)	Waste Bottom Elevation (ft MSL)	Landfill Depth (ft)	Borehole Depth (ft)	Well Pipe Depth (ft)	Slotted Pipe Depth (ft)	Solid Pipe Depth (ft)	Above Grade Riser (ft)	Thickness of Gravel Pack (ft)
		N-S	E-W									
	GIW-14	1,067,901	516,238	466.7	402.3	64	64	63	38	25	5	41
	GIW-15	1,067,888	516,275	476.9	351.6	125	125	124	99	25	5	102
	GIW-16	1,067,876	516,317	489.9	302.2	188	150	149	124	25	5	127
	GIW-17	1,067,848	516,371	498.4	260.8	238	150	149	124	25	5	127
	GIW-18	1,067,814	516,416	500.1	264.6	235	150	149	124	25	5	127
	GIW-19	1,067,812	516,464	500.0	443.8	56	56	55	30	25	5	33
Total							696	690	540	150	30	558

NOTES:

1. THIS DRAFT WELL SCHEDULE IS NOT INTENDED FOR CONSTRUCTION UNTIL ACTUAL SURVEY DATA IS OBTAINED AND THE WELL SCHEDULE IS REVISED BY THE ENGINEER.
2. SURVEYOR SHALL LOCATE WELLS AND VERIFY SURFACE ELEVATIONS BEFORE CONSTRUCTION. A PRE-CONSTRUCTION SURVEY (NORTHING/EASTING/ELEVATION DATA) SHALL BE PROVIDED TO THE ENGINEER A MINIMUM OF 2 WEEKS PRIOR TO CONSTRUCTION. ENGINEER SHALL VERIFY THE WELL SCHEDULE BASED ON THE PRE-CONSTRUCTION SURVEY.
3. FOLLOWING REVIEW OF SURVEY DATA, CONTRACTOR SHALL GET AUTHORIZATION FROM OWNER AND ENGINEER PRIOR TO DRILLING.
4. WELL DEPTHS BASED ON TOPOGRAPHIC SURVEYED BY SHERBERT-CARSON-CLAXTON, DATED MAY 2011, AND BASE GRADES OBTAINED FROM MIDWEST ENVIRONMENTAL CONSULTANTS APRIL 1998 LANDFILL GAS RECOVERY SYSTEM DESIGN.

DESIGN FIRM QA/QC REVIEWER ACKNOWLEDGEMENT: ____________ DATE ______

DESIGN FIRM PROJECT MANAGER ACKNOWLEDGEMENT: ____________ DATE ______

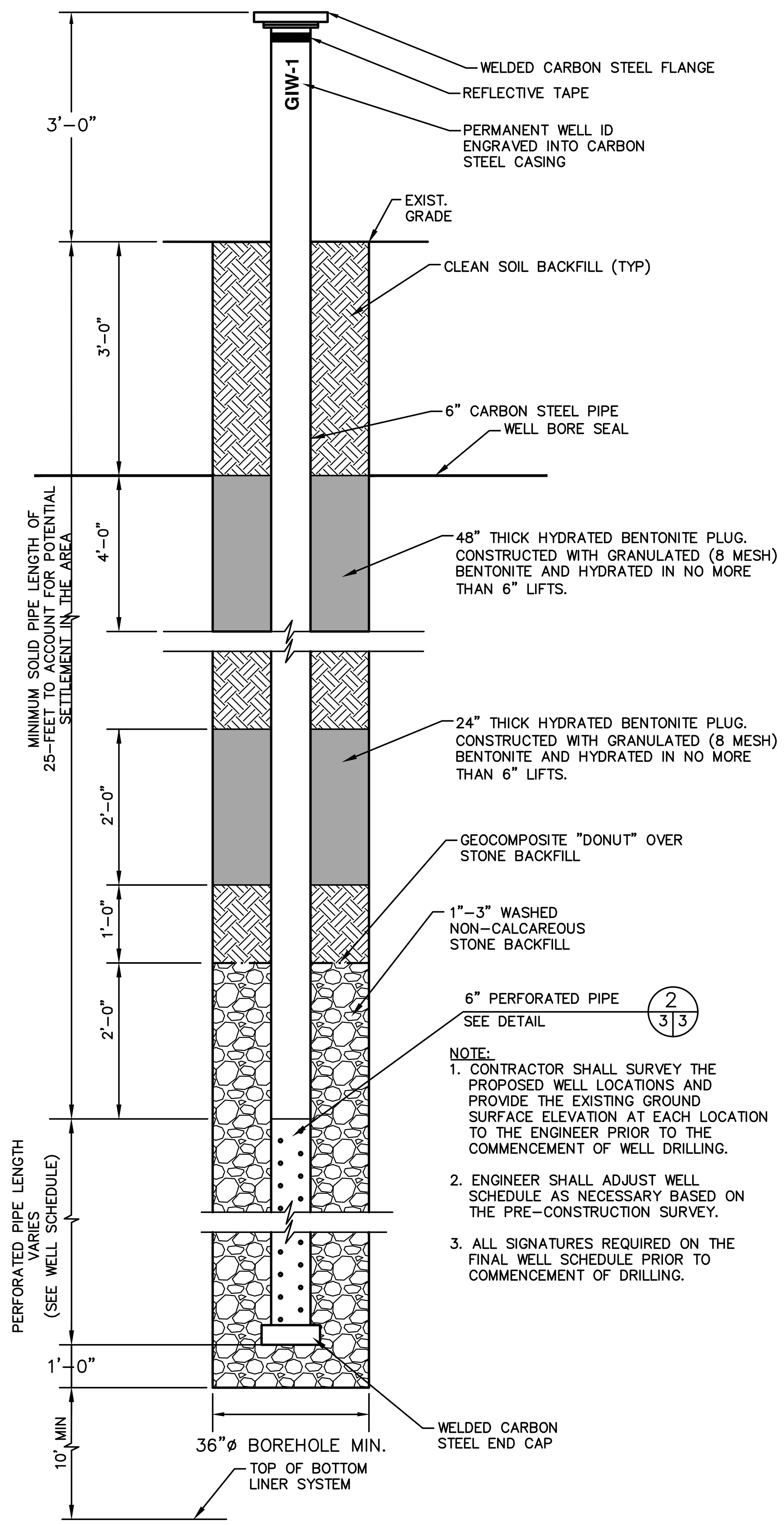
ENVIRONMENTAL MANAGER: ____________ DATE ______

CQA INSPECTOR: ____________ DATE ______

SURVEYOR ACKNOWLEDGEMENT: ____________ DATE ______

DRILLER ACKNOWLEDGEMENT: ____________ DATE ______

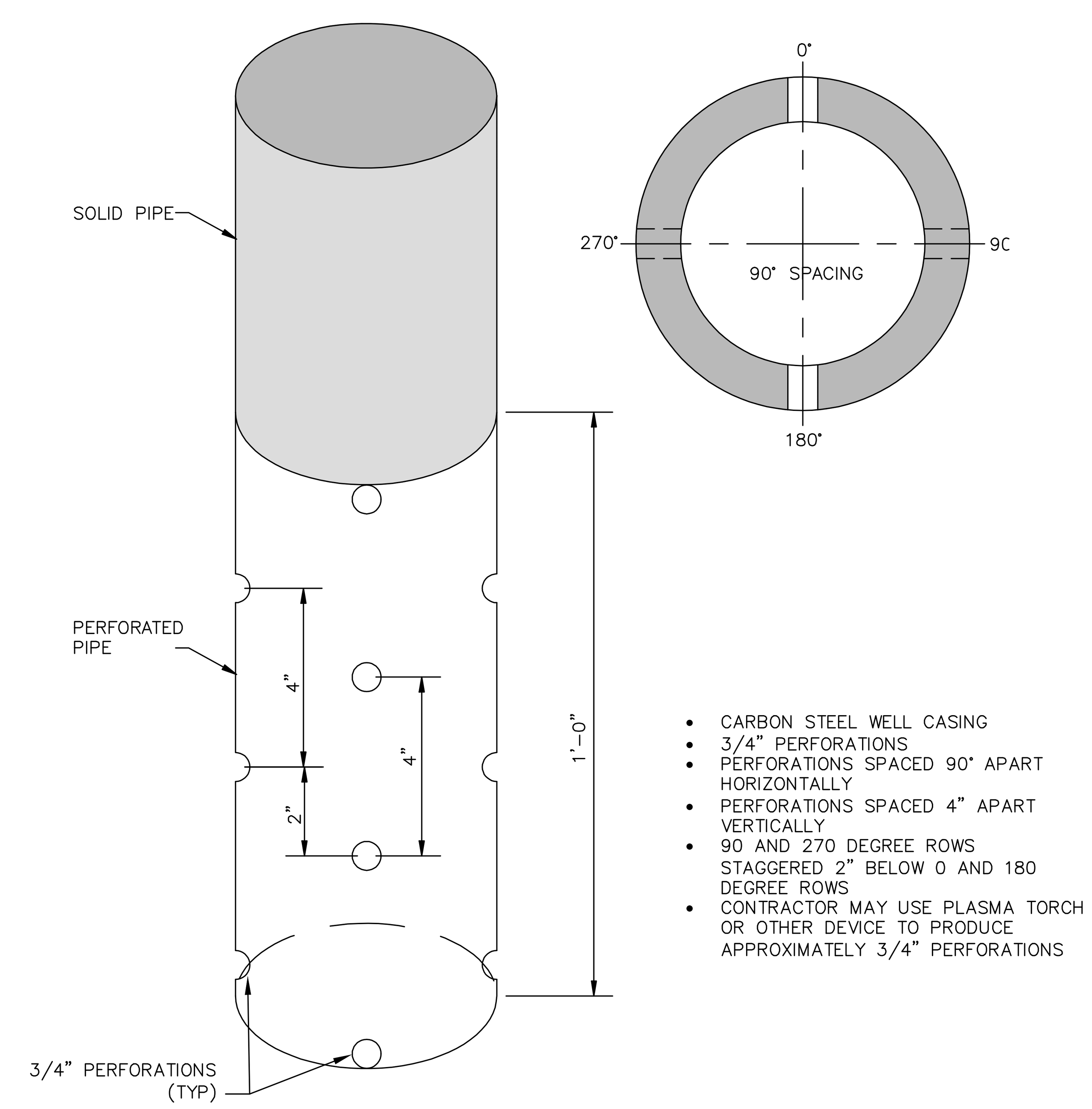
UNDER NO CIRCUMSTANCES SHALL DRILLING ACTIVITIES BEGIN WITHOUT PROVIDING THE ABOVE SIGNATURES. ANY CHANGES TO WELL LOCATIONS OR DEPTHS SHALL REQUIRE THESE SIGNATURES TO BE OBTAINED AGAIN.



NOTE:
1. CONTRACTOR SHALL SURVEY THE PROPOSED WELL LOCATIONS AND PROVIDE THE EXISTING GROUND SURFACE ELEVATION AT EACH LOCATION TO THE ENGINEER PRIOR TO THE COMMENCEMENT OF WELL DRILLING.
2. ENGINEER SHALL ADJUST WELL SCHEDULE AS NECESSARY BASED ON THE PRE-CONSTRUCTION SURVEY.
3. ALL SIGNATURES REQUIRED ON THE FINAL WELL SCHEDULE PRIOR TO COMMENCEMENT OF DRILLING.

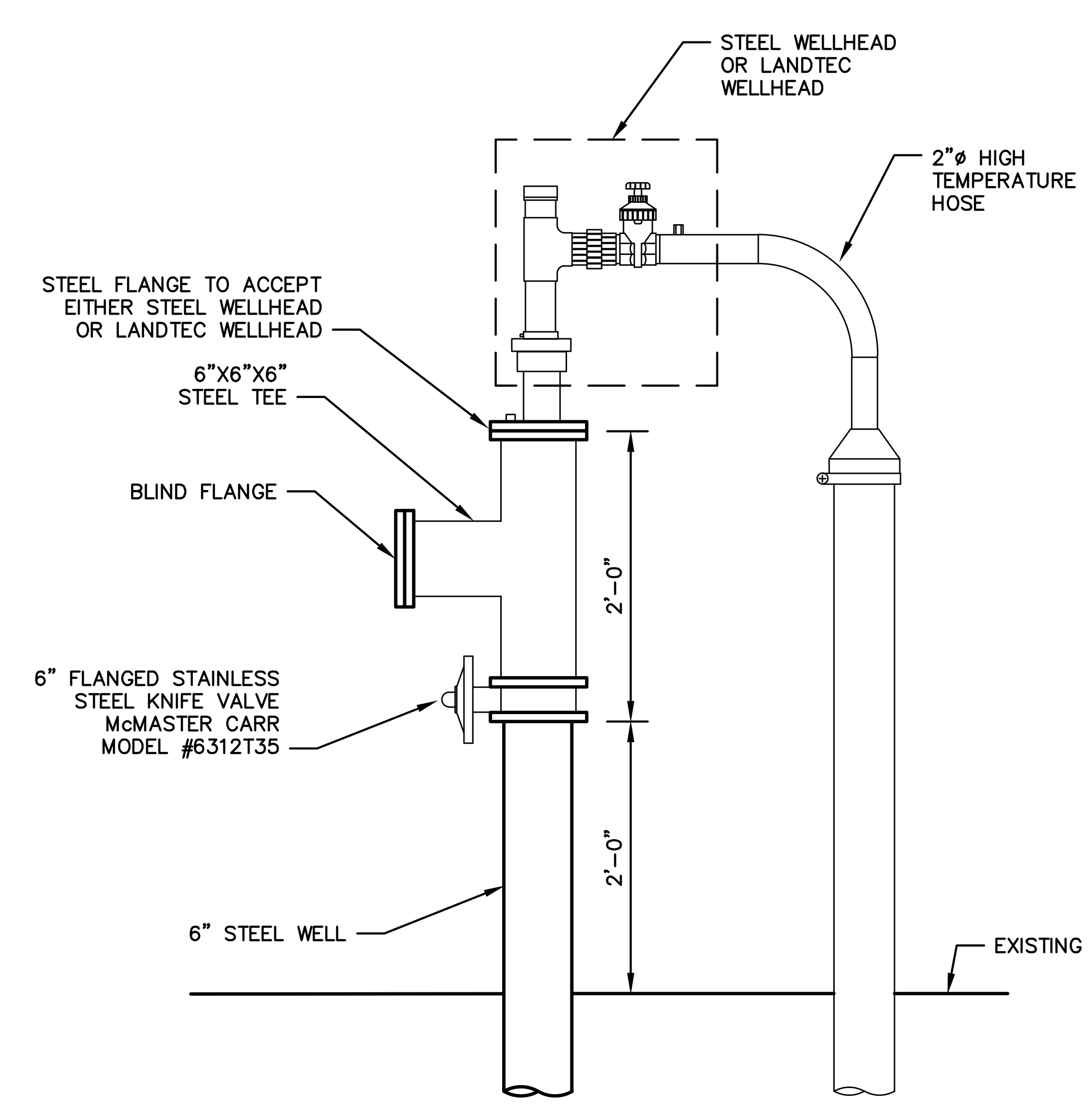
NOTE:
1. CARBON STEEL WELL SECTIONS CAN BE CONNECTED USING OUTSIDE THREADED COUPLERS, OR WELDED STEEL FLANGES.

GAS INTERCEPTOR WELL DETAIL 1 2|3
NOT TO SCALE



- CARBON STEEL WELL CASING
- 3/4" PERFORATIONS
- PERFORATIONS SPACED 90° APART HORIZONTALLY
- PERFORATIONS SPACED 4" APART VERTICALLY
- 90 AND 270 DEGREE ROWS STAGGERED 2" BELOW 0 AND 180 DEGREE ROWS
- CONTRACTOR MAY USE PLASMA TORCH OR OTHER DEVICE TO PRODUCE APPROXIMATELY 3/4" PERFORATIONS

PERFORATION DETAIL 2 3|3
NOT TO SCALE



WELLHEAD DETAIL 3 3|3
NOT TO SCALE

REV.	DATE	DESCRIPTION	CK. BY

SHEET TITLE: CARBON STEEL INTERCEPTOR WELL DETAILS

PROJECT TITLE: BRIDGETON LANDFILL 2013 GAS INTERCEPTOR WELL SYSTEM – EXPANDED DESIGN

CLIENT: BRIDGETON LANDFILL, LLC. BRIDGETON LANDFILL 13570 ST. CHARLES ROCK ROAD BRIDGETON, MO 63044

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CADD FILE: SHEET 3

DATE: 7/17/13

SCALE: NONE

DRAWING NO. 3 of 3

I:\PROJECT\2011 PROJECTS\23211003.02 BRIDGETON LF ENG ASSISTANCE 2013\DELIVERABLES\TASK 1 – GIW DESIGN 2013\SHEET 34 – DETAILS 07-17-13.DWG

APPENDIX B

INSTALLATION PLAN FOR CONTINGENT TRMPERATURE MONITORING PROBES (TMPs)

ENGINEERING FOR A BETTER WORLD
FEEZOR
ENGINEERING, INC.

INSTALLATION PLAN FOR CONTINGENT TEMPERATURE MONITORING PROBES (TMPS)

BRIDGETON LANDFILL

BRIDGETON, ST. LOUIS COUNTY, MISSOURI

Prepared For:
Bridgeton Landfill, LLC
13570 St. Charles Rock Road
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July 25, 2013

Project No.: BT-013

STATE OF MISSOURI
DANIEL
RICHARD FEEZOR
NUMBER
E-30292
REGISTERED PROFESSIONAL ENGINEER

7/26/13

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Missouri Professional Engineer
Number 030292

INSTALLATION PLAN FOR CONTINGENT TEMPERATURE MONITORING PROBES (TMPS)

BRIDGETON LANDFILL

PREPARED FOR:

BRIDGETON LANDFILL, LLC

Prepared by

P.J. Carey & Associates, P.C.

Sugar Hill, Georgia

7/25/2013

TABLE OF CONTENTS

1.1 INTRODUCTION

This report has been prepared to address the requirements of installation of temperature monitoring devices in the waste as per the North Quarry Contingency Plan for the Bridgeton Landfill. The proposed temperature monitoring system has been developed based discussions with the MDNR and the installation and operation of the existing 14 TMP units within in the South Quarry area. The locations of the proposed devices are depicted in Figure 1. The proposed methods of installation and equipment are based on temperature monitoring at this and other landfills experiencing elevated temperatures.

1.2 PROPOSED LOCATIONS

The intent of the proposed temperature monitoring system is to provide subsurface measurement of the waste temperatures at specific locations within the southern portion of the North Quarry. These contingent TMPs are included in the set of metrics that will be used to trigger further action at the site. The locations selected for the contingent TMPs are the result of discussions with MDNR following the submittal of proposed locations included in the North Quarry Contingency Plan submitted by Bridgeton Landfill in June of 2013.

A total of 14 thermocouple strings with a thermocouple not less than every 20 vertical feet are proposed at the locations shown in Figure 1.

1.3 PROPOSED DEVICES

The measuring devices proposed are type T thermocouples of the type successfully used under similar circumstances for this purpose. Thermocouples were found to have longer in ground lifetimes than thermistors. The thermocouples will consist of 20 gauge type T wire with Teflon coating. The junctions will be pre formed by the supplier and wires cut to length prior to delivery. Wires will be inserted into an abrasion resistant sheath with each junction at the prescribed depth prior to installing sheath in a bore hole. A steel, fiberglass or other rigid rod will be used to stand the assembly in the hole while the casings are extracted. The entire assembly will be grouted in place with a cement bentonite grout. A typical arrangement is also shown in Figure 1. Each wire will be labeled with a crimped on numbered band to identify it. Upon completion of the installation, the leads will be attached to a readout terminal box with each lead numbered the same as the crimped on band. Details for the terminal box and conduit seals are provided in Figure 1.

1.4 INSTALLATION

The strings of thermocouples encased in the abrasive sheath will be inserted inside drill rods that are advanced to the target depths. The drill rods will be advanced using roto-sonic drilling techniques without sampling. Given the contingent TMPs will be installed in areas not yet experiencing elevated temperatures, no sampling or special drilling procedures are required.. Borings will be advanced to the target depth of the bottom of the proposed unit. Based on the TMP measurements taken within the South Quarry the bottom of the contingent TMPs has been based on the following:

- For total waste thickness of 80 feet or less, to the quarry floor.

- For total waste thickness of greater than 80 ft but less than 120 feet, to within 20 feet of the quarry floor

- For total waste thickness depths greater than 160 ft, to within 40 feet above the quarry floor

No less than 3 thermocouples will be installed in any TMP and thermocouple spacing will not exceed 20 feet in the vertical direction. The closest unit to the surface will typically be 20 feet below grade but not less than 15 feet. In the event the less than 20 foot distance is used the CPVC conduit will be shortened accordingly. A preliminary depth of installation table is attached. The proposed units will have approximately 94 thermocouples in total.

Any cuttings from the boring program will placed in a dumpster and disposed offsite and at a permitted facility.

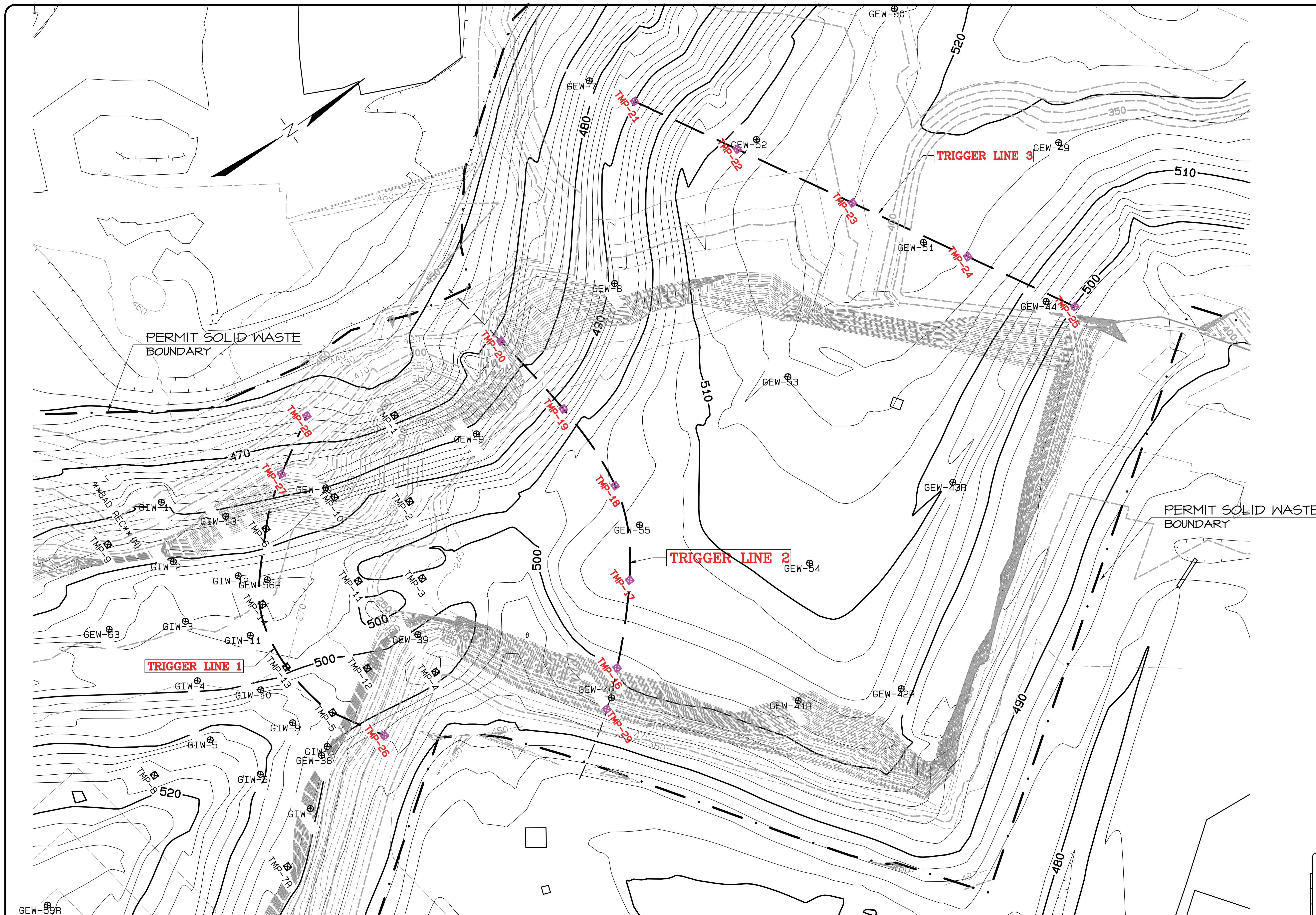
TABLE 1

Bridgeton Lanfdill
Temperature Monitoring Points
Approximate Depths and Schedule of Instruments
North Quarry Contingency Plan

To be adjusted once drill pad elevation is surveyed

Name	**Northing**	**Easting**	**Approx GS El.**	**Approx. Quarry Bottom**	**Approx Depth of Boring**
			using 2013 Aerial	Qbott based on 79 topo	see text for conditions
TMP-16	1067980.457	516542.1736	501	240	221
TMP-17	1068030.349	516488.9227	506	240	226
TMP-18	1068065.188	516418.3502	504	240	224
TMP-19	1068066.545	516342.2863	494	240	214
TMP-20	1068056.445	516267.1001	472	347	104
TMP-21	1068259.767	516168.3478	490	400	70
TMP-22	1068306.317	516249.0709	511	400	91
TMP-23	1068358.495	516339.5532	518	405	93
TMP-24	1068410.805	516430.2642	518	320	158
TMP-25	1068459.25	516514.2737	500	320	140
TMP-26	1067791.755	516478.1747	495	451	44
TMP-27	1067845.995	516253.151	475	363	93
TMP-28	1067890.525	516225.9327	465	417	48
TMP-29	1067954.143	516565.2073	496	431	64
			Minimum Anticipated Drilling footage		**1791**

FIGURE



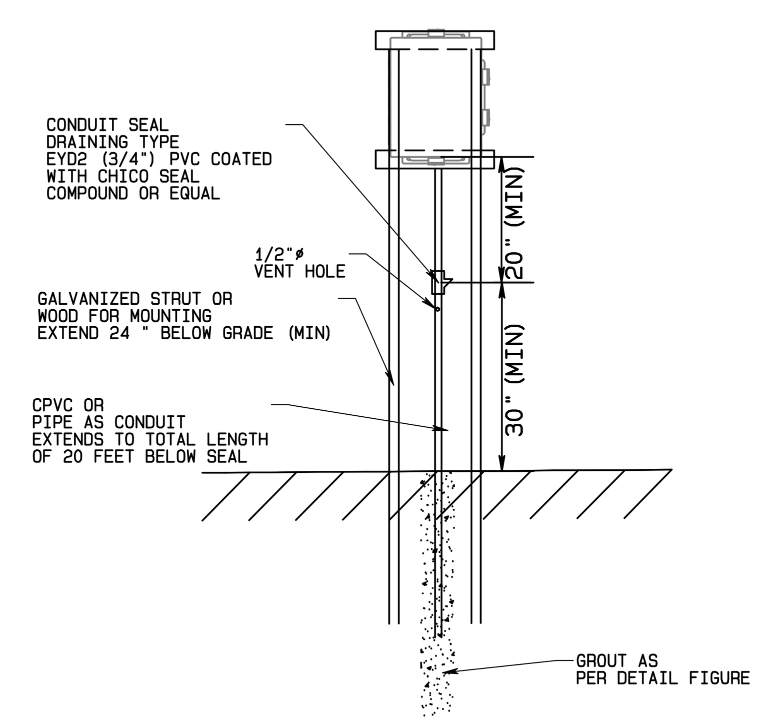
PLAN VIEW

GRAPHIC SCALE 1"=50'
0 50 100 150

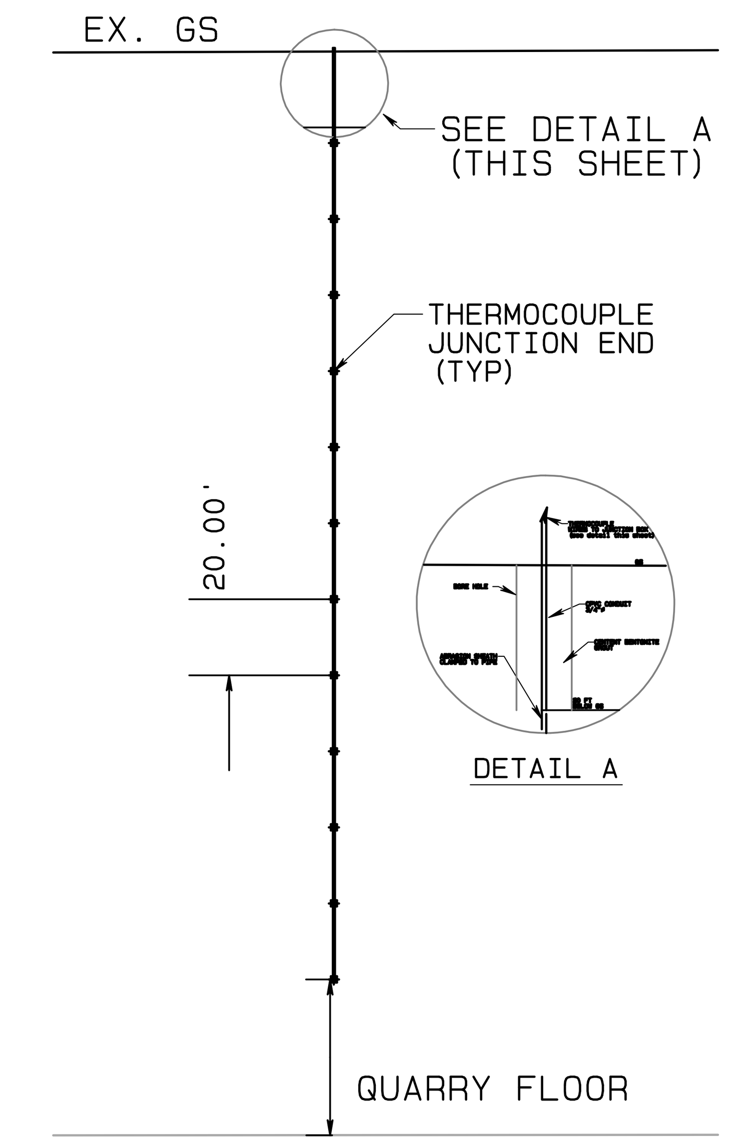
LEGEND

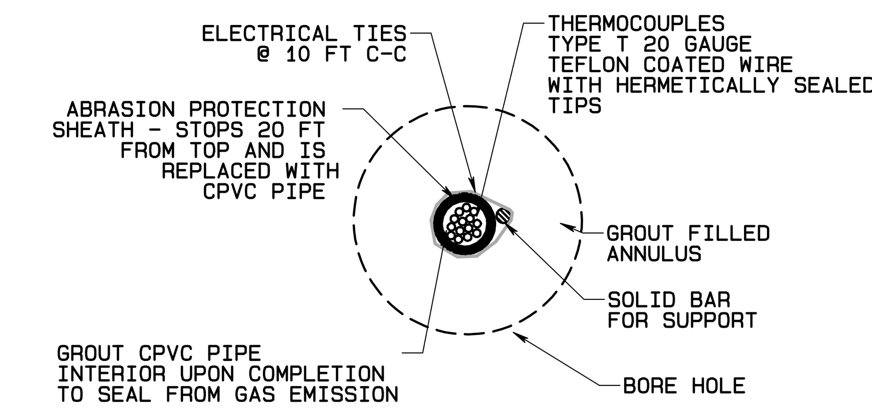
- EXISTING TOPOGRAPHIC CONTOUR
- QUARRY BOTTOM CONTOUR
- GAS WELL
- EXISTING TMP
- TMP-20 CONTINGENT TMP

NOTES:
TMPs TO BE INSTALLED AT APPROXIMATE LOCATIONS SHOWN
TMPs DEPTHS TO QUARRY FLOOR OR REFUSAL FOR TOTAL WASTE DEPTHS < 80' FOR TOTAL WASTE DEPTH EXCEEDING < 120' A 20' DEPTH ABOVE THE QUARRY FLOOR IS ACCEPTABLE. FOR TOTAL WASTE DEPTHS > 160 FEET A 40 ' DEPTH ABOVE THE QUARRY FLOOR IS ACCEPTABLE.
A SCHEDULE OF THE DEPTH OF EACH UNIT AND THERMOCOUPLE TIP DEPTHS WILL BE PROVIDED FOLLOWING THE CONSTRUCTION OF DRILL PADS

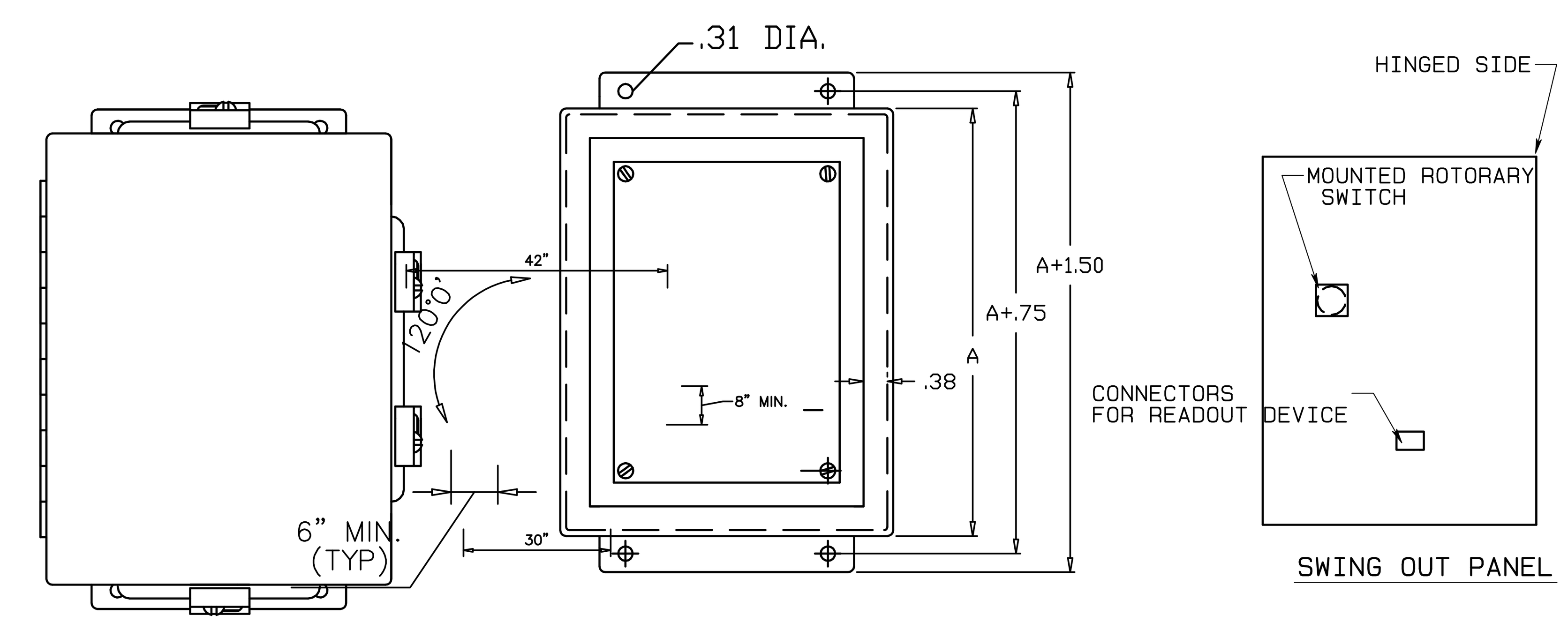


NOTE
ALL CONDUIT CONNECTIONS TO BOX TO BE NEMA 4 RATED





TMP
SECTION VIEW



SWING OUT PANEL

FRONT VIEW WITH NO COVER AND CLAMPS REMOVED

PANEL
Right Hand Mount using JIC Swing - Out Panel Kit all external connections NEMA 4 PANEL to be drilled for Rotary Switch mounting and plug in for readout units
See cut sheet for dimensions

NOTES:
ENCLOSURE SHOW IS AUSTIN ELECTRICAL ENCLOSURE AB-10 x 10 x 6 - PANEL IS AB-1010JP WITH JIC SWING OUT PANEL KIT - MOUNTED WITH HINGE ON RT.

HOLE FOR ROTARY SWITCH TO ACCOMODATE SW142-** SWITCH 2 POLE PANEL CUTOUT OUT 92 mmø FACE HEIGHT PROTRUDES 28 mm (REQUIRED CLEARENCE WHEN DOOR IS SHUT

SWITCH TO BE MOUNTED LEFT OF CENTER TO ALLOW FULL ACCESS TO CONNECTIONS WHEN PANEL IS SWUNG OPEN

PROVIDE ADEQUATE SLACK IN THERMOCOUPLE WIRES TO ALLOW EASY ASSEMBLY

PROVIDE QUICK RELEASE TOGGLES INSTEAD OF SCREWS FOR PANEL DOOR

ALL PERFORATION AND CLAMPS NEMA 4 RATED

TMP DETAILS

BRIDGETON LANDFILL, LLC

REVISION	DATE
1	
2	
3	
4	
5	

P. J. CAREY & ASSOCIATES, P.C.
5878 VALINE WAY, SUGAR HILL, GA. 30518

PROJ. NO.: 179.003
DATE: 7/25/2013
DESIGNED BY: PJC
DRAWN BY: PJC/KLCH
CHECKED BY: PJC
APPROVED BY: PJC

CONTINGENT TMPS LOCATION PLAN &DETAILS

CONTINGENT TMP INSTALLATION
BRIDGETON LANDFILL

DRAWING
CPTMP-1

SHEET 1
OF 1

APPENDIX C

CONSTURCTION PLAN FOR CONTINGENT NORTH QUARRY TEMPORARY CAP AND ENHANCED GAS MANAGEMENT SYSTEM

EVOH Geomembrane Cap and Cap Integrity System Plan Narrative

North Quarry – Contingency Plan

Project 130520
July 2013

Prepared for:
Bridgeton Landfill, LLC
13570 St. Charles Rock Rd.
Bridgeton, Missouri 63044

STATE OF MISSOURI
ADAM STEVEN
[illegible]
NUMBER
E-26635
REGISTERED PROFESSIONAL ENGINEER

7/26/13

CORNERSTONE
Environmental Group, LLC

39395 W. Twelve Mile Rd., Suite 103, Farmington Hills, MI 48331

Building lifetime relationships with our clients and employees.

EVOH GEOMEMBRANE CAP AND CAP INTEGRITY SYSTEM PLAN NARRATIVE

NORTH QUARRY – CONTINGENCY PLAN BRIDGETON LANDFILL

Prepared for

Bridgeton Landfill, LLC
13570 St. Charles Rock Road
Bridgeton, Missouri 63044

July 2013

Prepared by

CORNERSTONE
Environmental Group, LLC
39395 W. Twelve Mile Rd. Suite 103
Farmington Hills, MI 48331

Project 130520

EVOH Geomembrane Cap and Cap Integrity System Plan Narrative
North Quarry - Contingency Plan
Bridgeton Landfill

The material and data in this report were prepared under the supervision and direction of the undersigned.

Cornerstone Environmental Group, LLC

Bruce O. Schmucker
Client Manager

James Walker
Senior Client Manager

Adam Larky, P.E.
Client Manager

TABLE OF CONTENTS

1 INTRODUCTION AND BACKGROUND

1.1 Introduction and Background

Cornerstone Environmental Group, LLC (Cornerstone) has prepared this EVOH Geomembrane Cap and Cap Integrity System Plan for the North Quarry at the Bridgeton Landfill located in Bridgeton, Missouri. This plan will supplement existing systems in existence at this time for the conditions within this quarry of this landfill. This plan presents the systems that may be installed sometime in the future (depending monitoring triggers described in the Contingency Plan), including the following:

- EVOH Geomembrane Cap
- Liquid and Vapor Cap Integrity System to protect the temporary cap
- Enhanced stormwater management system
- Light-duty access roads

Each of these engineered components will be discussed in subsequent sections of this plan along with installation considerations, construction quality control, and operations and maintenance considerations. This plan has been prepared to address the State of Missouri's First Agreed Order of Preliminary Injunction (filed May 13, 2013), section 22.B.ii. for the North Quarry Contingency Plan.

2 KEY SYSTEM COMPONENTS

2.1 EVOH Geomembrane Cap

The geomembrane cap will consist of a green 60 mil Ethylene Vinyl Alcohol (EVOH) textured geomembrane underlain be a minimum 6 ounce per square yard (oz/sy) geotextile. EVOH geomembrane is manufactured as a “sandwich”, the outside layers are composed of HDPE with an inner layer of semi-crystalline thermoplastic resin - EVOH manufacturer’s information describing the EVOH geomembrane is included in Appendix A.

The proposed EVOH geomembrane cap will be installed over the North Quarry Unit as shown in Sheet 2. The EVOH geomembrane cap will be continuously seamed and continuously tied into the existing perimeter HDPE or EVOH geomembrane along the South Quarry boundary or anchored along the perimeter as presented in the Construction Plans for the North Quarry EVOH Geomembrane Cap and Cap Integrity System (engineering plans) included in Appendix B of this narrative. The total area proposed EVOH geomembrane cap area for the North Quarry is approximately 21.1 acres.

The geotextile underlying the EVOH geomembrane will be installed on a prepared subgrade as described on Sheets 3 through Sheet 4C. Cap integrity components discussed in this narrative will be constructed below and above the EVOH geomembrane cap to help preserve the temporary cap.

The EVOH geomembrane cap will be installed with panels orientated up and down slopes. The installation is planned to proceed in two relatively equal phases from the southeast to northwest parts of the North Quarry although this may be modified during construction due to field conditions.

Locations and details of liner edge termination are provided on Sheets 5 and 11 of the engineering plans.

The EVOH geomembrane cap will be installed by an experienced contractor and crews in accordance with the project specifications and QA/QC Plan. The installation of the EVOH Geomembrane cap will be monitored in accordance with the QA/QC Plan by an experienced third-party engineering firm. A final certification report will be prepared under the direction of a certified engineer and will be submitted to MDNR.

Additional pertinent EVOH geomembrane cap information will be presented in the following subsections including:

2.1.1 Tie-in with existing South Quarry EVOH or HDPE cap

2.1.2 Anchorage, ballast and light duty roads

2.1.3 Pipe boots and above cap piping

Each will be discussed subsequently.

2.1.1 Tie-in with Existing Temporary Cap

The EVOH geomembrane cap is manufactured as a "sandwich", the outside layers being composed of HDPE; therefore, the proposed temporary cap can be welded to an existing HDPE or EVOH geomembrane with traditional welding equipment.

2.1.2 Anchorage, Ballast & Light Duty Roads

The perimeter edge of the new EVOH geomembrane cap will either be welded to the existing temporary HDPE or EVOH cap or anchored at the perimeter as shown on Sheets 5 and 11 of the engineering plans. Light duty access roads will be constructed above the EVOH geomembrane cap to provide ballast for the FML and allow for maintenance activities by light duty vehicles such as a one ton pickup truck or less. The roads will be 24-inch thick and constructed of a lower base layer comprised of 2 to 4 inch sized crushed limestone capped-off with a 2 to 3 inch thickness of Missouri Department of Transportation (MDOT) Type V Dense Graded Aggregate. Calculations were performed to ensure that the proposed light-duty access roads and header piping above the EVOH geomembrane cap would provide adequate ballast weight against wind uplift. The results of the calculations showed that the proposed design would prevent uplift from a 75 mph wind.

2.1.3 Pipe Boots and Above Cap Piping

Pipe penetrations of the EVOH geomembrane cap will be sealed utilizing a pipe boot. These boots, comprised of HDPE will be welded to the temporary cap and mechanically clamped to the riser pipe penetrating the membrane utilizing a worm-gear clamp or comparable securing mechanism. The position of the pipe boot relative to the riser pipe can be adjusted by monitoring personnel in the event that the local area experiences settlement. These boot seals can also be visually inspected during periodic monitoring of the cap for vapor emissions.

2.2 Integrity System

The intent of the cap integrity system is to provide a means of conveying any gas or liquid that may develop beneath the EVOH geomembrane cap to a dedicated perimeter collection system. The relatively low-permeability of this cap component, compared to the accompanying soils, provides a barrier to liquid and gas movement and requires removal mechanisms below this geosynthetic cap component to insure its integrity.

The existing landfill gas (LFG) management components (as shown on Sheet 1A of the engineering drawings), including extraction wells, and extraction piping will be incorporated into the cap integrity system. Those components that are currently installed below grade will be maintained in this relative position, with existing access points penetrating the new temporary cap and secured to the FML via pipe boot seals. Additional or supplemental LFG management components will be installed above the EVOH geomembrane cap and connected to the existing infrastructure by means of welded, flanged or flexible connectors as appropriate for each connection point.

A discussion of the major integrity system components is included the following subsections:

2.2.1 Collector berms and access risers

2.2.2 Perimeter collection trench and collection sumps

2.2.3 Above cap piping

An evaluation of the gas collection and control system (GCCS) and proposed modifications to the system in the event the reaction progresses to the North Quarry are contained in Appendix C of this Plan.

2.2.1 Collector Berms & Access Risers

Gas and liquids that may collect below the EVOH geomembrane cap will be intercepted and controlled by several components of the cap integrity system, including the strip drains and collector berms (refer to Sheet 3 and the "4" Series Sheets for the proposed berm collector locations and the corresponding Details 2 and 3 can be found on Sheet 10 of the engineering drawings). Strip drains (as shown in Detail 5, Sheet 11) will be installed on the surface of the cap soils, at a diagonal to the slope – these will serve as interceptors for any liquids/gas moving along the soil/geomembrane interface between collector berms. Liquids/gas collected by the strip drains will be directed to the collector berms (See Details 2 and 3 on Sheet 10), consisting of both perforated piping and stone. These collectors will provide periodic points (riser locations a minimum of every 500 feet) for gas extraction and a direct conduit for gravity drainage of liquids to the perimeter collection trench. The collector berms will be trenched into the existing cap soils as shown on Details 2 and 3 on Sheet 10.

Liquids that are directed to the perimeter collection trench will be removed at a series of collection sumps installed along the perimeter collection trench. These sumps will be installed at both natural and artificial low points within this trench and will allow for removal of collected liquids utilizing a pneumatic pumping system. The perimeter collection trench will also serve to intercept any liquids/gases collected near the perimeter of the area. Liquids will be discharged to the proposed forcemain, which will convey these liquids to the leachate management system for treatment and disposal.

Collected gas will be directed to the existing GCCS for treatment and disposal via the landfill's flaring system. Supplemental lateral piping will be constructed above the temporary EVOH geomembrane cap to provide vacuum, to the extraction points and convey gas to the existing GCCS.

Component construction will generally consist of the following:

- Strip drains will be laid on the surface of the cap soil (subsequent to subgrade preparations, refer to Section 3.2) at a diagonal to the slope.

- Collector berms will be trenched into the surface of the cap soils (See Detail 2 and 3 on Sheet 10 of the revised design drawings), perpendicular to the slope to promote maximum drainage potential, and intercepting the strip drains. The collector berms will incorporate both perforated piping and 2 to 3 inch washed river stone to collect both gas and liquids. The collector berms will drain liquids to the perimeter collection trench. Collected gas will be directed to the existing GCCS for treatment and disposal. Extraction points will be installed a minimum of every 500 feet as noted on Details 2 and 3 on Sheet 10 of the design Plan set. Extraction points will be provided with a wellhead for control of both applied vacuum as well as gas flow. These extraction points will also serve as risers to allow periodic jetting of the lines in the event that they become clogged.

- The perimeter collection trench (See Sheet 3 and Details 1 and 2 on Sheet 8 of the engineering plans) will be excavated near the perimeter of the project area or along the interface of the existing South Quarry EVOH geomembrane or HDPE cap and will serve to collect liquids and gas intercepted by the trench itself as well as from the strip drains and collector berms. The perimeter collection trench will incorporate both 2 to 3 inch washed river stone and perforated piping. Cleanouts will be incorporated into the piping to allow periodic jetting of the lines in the event that they become clogged. These cleanouts will be installed at intervals of approximately 500 feet or at midpoints between the collection sumps.

- Perimeter collection sumps will be excavated into the refuse utilizing a tracked excavator, common to landfill construction applications. The sump structure will be set into place and backfilled with 2 to 3 inch washed river stone to provide a conduit for liquids/gas entry into the sump. Liquids/gas will be capable of entering the sumps from the collection components by means of both the stone backfill as well as piping connections directly to the sump structure. The sumps will also be fitted with mechanisms for the vacuum extraction of collected gas and the discharge of collected liquids via a pneumatic pumping system.

2.2.2 Perimeter Collection Trench, and Collection Sumps

The perimeter trench will be outfitted with a 6-inch diameter perforated SDR 17 HDPE pipe which will be connected to each collection sump (refer to Detail 2 on Sheet 8 of the engineering plans). Clean-outs will be provided between sumps to flush the piping each way ("Y" connection). Perimeter collection sumps will be installed to a depth of 20 feet below existing grade.

2.2.3 Above Cap Piping

Above cap piping will largely run perpendicular to the landfill slope and adjacent to the collector berms and access roads. The piping will be secured by means of FML straps wrapping the piping and welded to the EVOH geomembrane cap. These straps will be installed at a frequency as necessary to prevent pipe movement as field conditions dictate the need. The above cap piping will be connected to the existing GCCS piping by means of standard fusion joints, flanges or flexible connectors as warranted by the conditions of individual extraction points. Refer to Sheet 6 of the engineering plans for the proposed locations of this piping.

2.3 Collection Sumps and Wastewater Force Main

The collection sumps will have an extraction pump driven by air pressure similar to the units currently being used in extraction wells around the perimeter of the North Quarry. A new double-walled 3-inch SDR 11 / 6-inch SDR 17 HDPE perimeter forcemain will be constructed to covey the liquid pumped from the collection sumps to the leachate management system for disposal as described in Note 3 on Sheet 6. Detail 1 on Sheet 9 shows the details of the connection of the collection sump to the forcemain and airline. The forcemain will be constructed above the temporary cap to provide access for maintenance and other possible tie-ins if additional pumping units are necessary in the future. The forcemain will have cleanout risers spaced at approximately 500 feet per Detail 4, Sheet 9. The location of the forcemain will be field fit at the perimeter of the landfill for access to the proposed collection sumps.

Additionally, each sump will be fabricated with a 2-inch diameter suction line and a tank fitting. This will allow the sump to be evacuated manually during emergency situations or in the event that the pump malfunctions.

2.4 Stormwater Management System

The stormwater management system design has been described in detail in the Stormwater Management System Design Report, dated July 2013 and included with this Plan as Appendix D. The report describes the techniques that the North Quarry will employ to manage the increased runoff from the temporary cap. The stormwater management system has been designed for a 24-hour / 25-year storm event in accordance with the Missouri Rules of Natural Resources, Division 80 Solid Waste Management Chapter 3 Sanitary Landfill Section 10 CSR 80-3.010(8)(F) Water Quality. The stormwater management features for the North Quarry EVOH geomembrane cap include:

- Regrading of the existing benches to promote sheet flow
- Existing and proposed perimeter channels and culverts to collect and convey the runoff
- Conveyance of stormwater to two existing detention basin located at the north and southwest sides of the South Quarry
- One proposed detention basin located southeast of the North Quarry
- Other miscellaneous details to deflect runoff or dissipate energy

3 INSTALLATION CONSIDERATIONS

3.1 Phased Installation

Bridgeton Landfill and its contractors are planning to utilize a phased installation approach for the EVOH geomembrane cap and the cap integrity system. The approximate phase boundaries are presented on the engineering drawings and may vary depending upon field and weather conditions. Since the entire EVOH geomembrane cap and integrity system requires installation as the reaction monitoring thresholds are triggered, the entire project is essentially on critical path for completion; and therefore, multiple contractor crews may be working simultaneously to complete this work. The project has been divided into three phases designated 1A, 1B and 2 as shown on the engineering plans. Phases 1A and 1B would be constructed upon the monitoring results reaching established criteria set forth in the Contingency Plan. Phase 2 would be constructed upon completion of the isolation barrier cutoff trench as shown in Detail 7, Sheet 11. Therefore, the limit of the EVOH Geomembrane Cap for Phases 1B and 2 and associated cap components may be revised upon completion of the isolation barrier cutoff trench design.

A phased approach for phases 1A and 1B allows for both construction management and scheduling of the work as well as the facilitation of more than one contractor crew to work on the North Quarry area of the landfill. Each phase will have construction tasks completed sequentially to prepare for the installation of the EVOH geomembrane cap. These preparatory tasks include the following:

1. Subgrade preparations including vegetative layer stripping and existing stormwater bench and localized settlement zone re-grading.
2. Installation of replacement leachate sumps
3. Installation of the perimeter toe collection trench (with geomembrane seal), sump, forcemain and airline
4. Installation of strip drains and collector berms and risers
5. Below EVOH geomembrane cap geotextile and below and above EVOH geomembrane cap geocomposite placement in proposed access road areas

Subsequent to the “under” EVOH geomembrane cap preparations, the EVOH geomembrane cap and above cap piping will be installed. Concurrently, with this phased construction on the North quarry, stormwater management system enhancements will occur. It is anticipated that one contractor would be used to install the EVOH geomembrane cap / cap integrity system and a separate civil earthworks contractor will be used for the major stormwater management features.

3.2 Subgrade Preparations

Bridgeton Landfill and its contractors are planning to strip as much of the vegetative cap as practically possible, but at a minimum a 20 foot strip immediately below the proposed light-duty access roads will be cleared of the existing vegetative layer. The vegetative layer is expected to range in depth from 2 inches to 8 inches depending upon the area of the landfill. The vegetative layer will be only stripped immediately prior to the placement of the EVOH geomembrane cap. This existing vegetative layer is an important erosion control and stormwater best management practice and therefore timely removal may not be possible depending upon weather conditions and the temporary cap placement progress. The stripped vegetative layer may be re-used for random fill in localized settlement areas in preparation for the EVOH geomembrane cap placement.

Re-grading will occur at a minimum at the existing stormwater benches to promote positive drainage down across these zones. Other localized settlement areas will be re-graded as needed to maintain positive surface drainage across these portions of the landfill soil cap. A field decision will be made by the Bridgeton Landfill engineer’s representative during subgrade preparations to identify those areas that require additional random fill or just a re-grading effort. These decisions will be governed by the overlying integrity components and their required minimum slopes during placement. Re-grading areas to maintain positive drainage will be surveyed and documented in the CQA report and system as-built drawings.

3.3 Waste Management

It is expected that minimal waste will be generated from construction of the EVOH geomembrane cap project. Solid waste will be generated during the installation of the perimeter collection sumps. From work completed in the South Quarry, it can be assumed that approximately 10 feet of soil cover underlain by solid waste will be disturbed. Therefore, 10 foot depth of solid waste with a three foot diameter hole at each perimeter collection sump equates to approximately 2.6 bank cubic yards of solid waste from each sump location. During the excavation of the waste, the material will be placed directly into lined roll-off containers or in a haul truck provided by Bridgeton Landfill. Once the containers are full, they will be tarped and transported to the on-site transfer station or hauled directly to Roxanna Landfill. Bridgeton Landfill will be handling the transportation of these wastes either from the transfer station or the direct haul to Roxanna Landfill.

The waste handling protocol at the Transfer Station is to place the initial lifts with the excavated spoil material in each transfer trailer or truck, and then spoil material will be capped with waste that has been received at the Transfer Station from other sources. This approach minimizes odors from emanating to the atmosphere during waste transport to the landfill.

4 CONSTRUCTION QUALITY CONTROL AND SURVEYING

4.1 Construction Quality Control & Surveying

A detailed construction quality assurance / quality control (QA/QC) plan has been prepared for the Bridgeton Landfill in a separate document. This plan has addressed the measures to confirm industry accepted practices for the installation of the geosynthetic products and earthworks related to the installation of the EVOH geomembrane cap and cap integrity system.

5 OPERATIONS MAINTENANCE PLAN

5.1 Operations Maintenance Plan

A detailed operations maintenance and monitoring plan (OM&M Plan) will be prepared and submitted under separate cover to MDNR. The OM&M Plan addresses the measures and guidelines for maintaining the integrity and operations of the EVOH Geomembrane cap and its underlying integrity system.

LIMITATIONS

The work product included in the attached was undertaken in full conformity with generally accepted professional consulting principles and practices and to the fullest extent as allowed by law we expressly disclaim all warranties, express or implied, including warranties of merchantability or fitness for a particular purpose. The work product was completed in full conformity with the contract with our client and this document is solely for the use and reliance of our client (unless previously agreed upon that a third party could rely on the work product) and any reliance on this work product by an unapproved outside party is at such party's risk.

The work product herein (including opinions, conclusions, suggestions, etc.) was prepared based on the situations and circumstances as found at the time, location, scope and goal of our performance and thus should be relied upon and used by our client recognizing these considerations and limitations. Cornerstone shall not be liable for the consequences of any change in environmental standards, practices, or regulations following the completion of our work and there is no warrant to the veracity of information provided by third parties, or the partial utilization of this work product.

APPENDIX A

MANUFACTURER'S INFORMATION FOR EVOH GEOMEMBRANE

RAVEN
INDUSTRIES

TO: Republic Services

SUBJECT: Raven X60FC1 QA testing methods and frequency (rev. 3)

DATE: April 12, 2013

IN REFERENCE TO: Bridgeton Landfill project, Bridgeton, MO

Raven X60FC1 geomembrane and its components undergo an extensive array of testing and measurement during the manufacturing process. The required tests, methods, and sampling frequency are based on the requirements set forth in GRI GM 13 ('Test Methods, Test Properties and Testing Frequency for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes')

The minimum test values for X60FC1 using these test methods are listed the table provided with this letter.

Clint Boerhave

Clint Boerhave
Quality Manager
Raven Industries - Engineered Films Division

RAVEN
INDUSTRIES

STATEMENT OF PERFORMANCE

SUBJECT: Raven X60FC1

IN REFERENCE TO: Seam testing minimum values and material separation in plane (SIP)
Republic Services Landfill cap project - Bridgeton, Missouri
SO# 195942-195948, 195950-195954

DATE: April 5, 2013

Absolute Barrier™ X60FC1 is a seven layer co-extruded textured geomembrane consisting of polyethylene with a core layer designed specifically as a barrier against radon, methane and VOCs on brownfield sites, residential and commercial buildings, and geomembrane containment and covering systems. A robust stabilization package provides long-term protection from thermal oxidation and ultraviolet degradation in exposed applications.

Due to the multilayer construction and the presence of a barrier core in this product, some separation in plane may occur during destructive seam testing. This is normal and should not be of concern as long as the tested peel and shear results meet the minimum values for this product:

Hot Wedge Seams	Minimum value
Shear Strength (lb/in)	80
Peel Strength (lb/in)	60
Extrusion Fillet Seams	
Shear Strength (lb/in)	80
Peel Strength (lb/in)	52

Clint Boerhave

Clint Boerhave
Quality Manager
Engineered Films Division

Test methods, minimum values, and test frequency for Raven X60FC1

Properties	Test Method	Test Value	Testing Frequency (minimum)
Thickness mils (min. ave.) • lowest individual for 8 out of 10 values • lowest individual for any of the 10 values	D 5994	50 mils 45 mils 35 mils	per roll
Asperity Height mils (min. ave.)	GM 12	10 mils	per roll
Tensile Properties (3) (min. ave.) • break strength – lb/in. • MD break elongation - % (min. avg.) • TD break elongation - % (min. avg.)	6693 Type IV	 75 200 30	20,000 lb
Tear Resistance – lb (min. ave.)	D 1004	27	45,000 lb
Puncture Resistance – lb (min. ave.)	D 4833	55	45,000 lb
Oxidative Induction Time (OIT) (min. ave.) (a) Standard OIT — or — (b) High Pressure OIT	 D 3895 D 5885	 100 400	200,000 lb

APPENDIX B

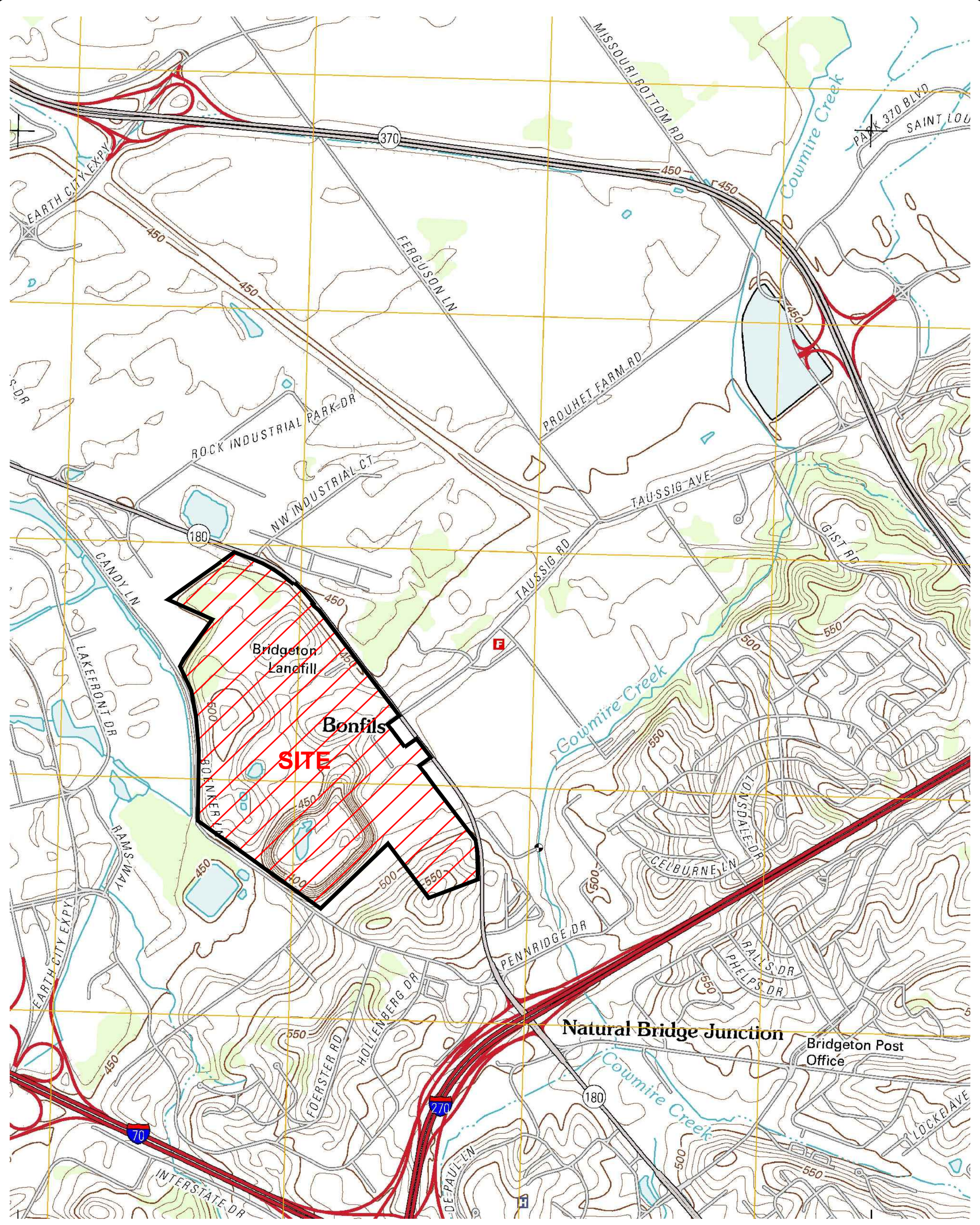
CONSTRUCTION PLANS FOR THE NORTH QUARRY - EVOH GEOMEMBRANE CAP AND CAP INTEGRITY SYSTEM

CONSTRUCTION PLANS FOR THE

NORTH QUARRY - EVOH GEOMEMBRANE CAP AND CAP INTEGRITY SYSTEM AT BRIDGETON LANDFILL

BRIDGETON, MISSOURI

JULY 2013



LOCATION MAP

SOURCE: SAINT CHARLES, MO. 7.5 MIN. U.S.G.S. QUADRANGLE MAPS

PREPARED FOR:

BRIDGETON LANDFILL, LLC

PREPARED BY:

CORNERSTONE Environmental Group, LLC

39395 W. TWELVE MILE RD.
SUITE 103
FARMINGTON HILLS, MICHIGAN 48331
Tel. (630) 633-5520
Fax. (248) 994-5456

INDEX OF DRAWINGS

CEG PROJECT # 130520

STATE OF MISSOURI ADAM STEVEN LACY NUMBER E-22636 REGISTERED PROFESSIONAL ENGINEER

7/26/13

LEGEND

- EXISTING PROPERTY BOUNDARY
- SOLID WASTE PERMIT 118912 BOUNDARY
- EXISTING 10' CONTOUR
- EXISTING 2' CONTOUR
- EXISTING HDPE GEOMEMBRANE
- SOUTH QUARRY EVOH GEOMEMBRANE (UNDER CONSTRUCTION)
- LIGHT-DUTY ACCESS ROADS (UNDER CONSTRUCTION)
- OU-1 HAZARDOUS DISPOSAL AREA AS DEFINED BY ROD (LIMIT OF STUDY AREA)
- LIMIT OF RADIOLOGICALLY IMPACTED MATERIAL BOUNDARY
- PROPOSED EVOH GEOMEMBRANE CAP BOUNDARY
- PROPOSED CAP PHASE BOUNDARY
- 1A PROPOSED CAP PHASE DESIGNATION
- OUTFALL 001
- OUTFALL 003
- OUTFALL 004
- OUTFALL 005

NOTES:

1. THE 2013 TOPOGRAPHIC MAP WAS PROVIDED BY COOP AERIAL SURVEYORS, CO., PHOENIX, AZ. DATE OF PHOTO: 02/13/2013.
2. UTILITIES SHOWN TAKEN FROM DRAWING 1 OF 1 "SITE INFRASTRUCTURE" BY AQUATERRA DATED 07/03/12.
3. THE PROPERTY BOUNDARY WAS OBTAINED FROM A DRAWING FILE ENTITLED, "BRIDGETON AND WESTLAKE LANDFILLS LANDFILL PARCEL REFERENCE MAP" PREPARED BY SHERBUT-CARSON-CLAYTON LLC, DATED JUNE 2011.
4. THE OU-1 HAZARDOUS DISPOSAL AREA AS DEFINED BY ROD BOUNDARY WAS OBTAINED FROM A DRAWING ENTITLED, "REVISED WASTE BOUNDARIES BRIDGETON LANDFILL WASTE INVESTIGATION" PREPARED BY AQUATERRA ENVIRONMENTAL SOLUTIONS, INC. DATED 7/9/10, REVISED 7/1/11.
5. THE LIMIT OF RADIOLOGICALLY IMPACTED MATERIAL BOUNDARY WAS PROVIDED BY CIVIL & ENVIRONMENTAL CONSULTANTS, INC. IN AN EMAIL DATED 7/19/2013.
6. THE SOLID WASTE PERMIT BOUNDARY WAS OBTAINED FROM A DRAWING FILE ENTITLED BRIDGETON AND WESTLAKE LANDFILLS LANDFILL PARCEL REFERENCE MAP PREPARED BY SHERBUT-CARSON-CLAYTON LLC, DATED JUNE 2011.

STATE OF MISSOURI
ADAM STEVEN LOCKY
NUMBER E-22838
REGISTERED PROFESSIONAL ENGINEER
7/26/13

REV	DATE	DESCRIPTION	DWN BY	DES BY	CHK BY	APP BY

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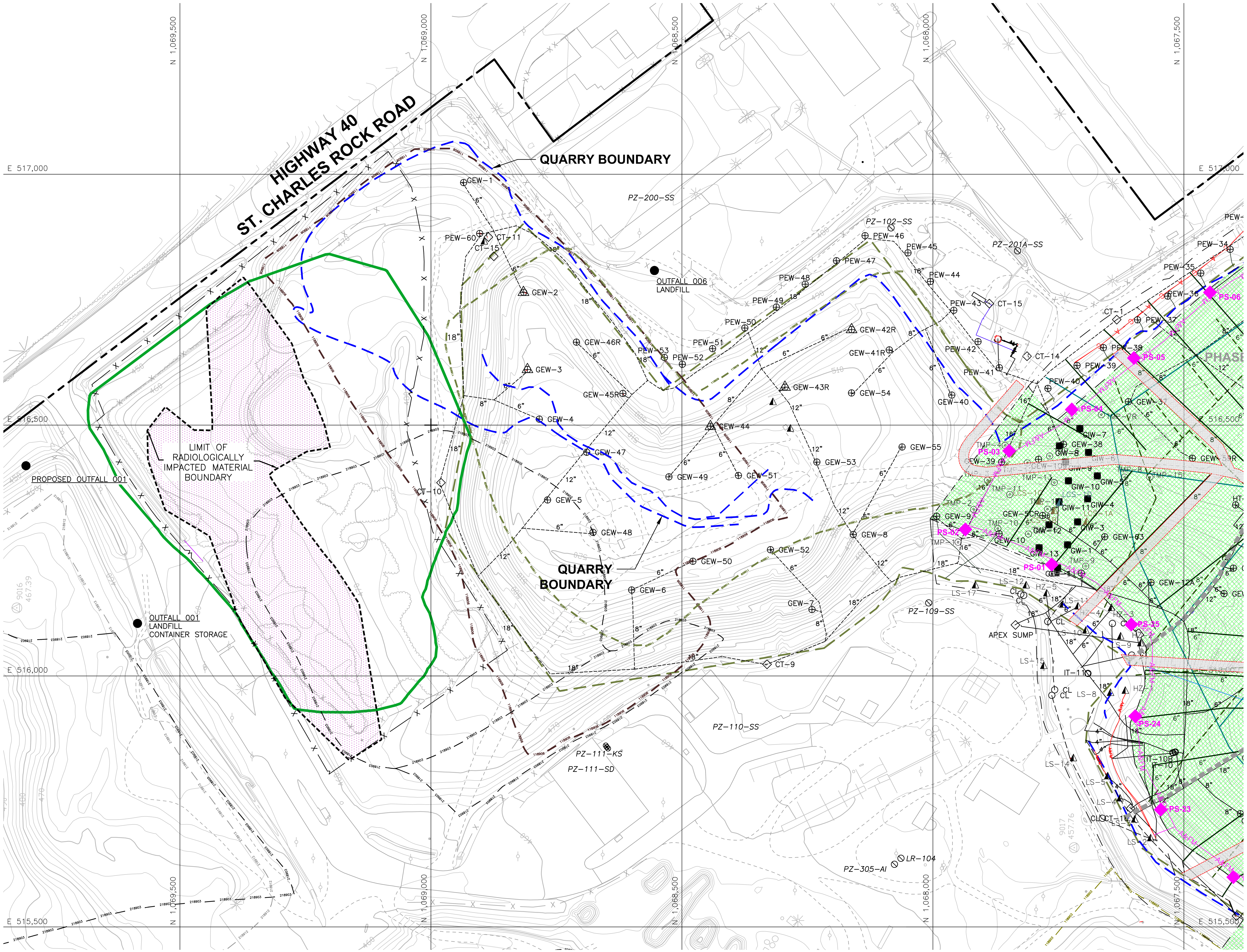
CORNERSTONE Environmental Group, LLC

BRIDGETON LANDFILL, LLC.
BRIDGETON LANDFILL
BRIDGETON, MISSOURI

NORTH QUARRY - EVOH GEOMEMBRANE CAP AND CAP INTEGRITY SYSTEM
SITE PLAN

SHEET NO. 1
PROJECT NO. 130520



0 100 200
SCALE IN FEET

LEGEND

- EXISTING PROPERTY BOUNDARY
- EXISTING QUARRY HIGH WALL
- EXISTING 10' CONTOUR
- EXISTING 2' CONTOUR
- 2013 FENCING
- EXISTING HDPE GEOMEMBRANE
- SOUTH QUARRY EVOH GEOMEMBRANE (UNDER CONSTRUCTION)
- LIGHT-DUTY ACCESS ROADS (UNDER CONSTRUCTION)
- GEW-81 EXISTING LFG EXTRACTION WELL
- GEW-2 EXISTING LFG EXTRACTION WELL - COMBO
- PEW-4 EXISTING LFG PERIMETER EXTRACTION WELL
- CT-1 EXISTING CONDENSATE PUMP STATION
- TMP-1 EXISTING TEMPERATURE MONITORING PROBE
- GMP-11 EXISTING GAS MONITORING PROBE
- GIW-10 EXISTING LFG INTERCEPTOR WELL
- PZ-109-SS EXISTING PIEZOMETER
- EXISTING LFG HEADER/LATERAL
- SOLID WASTE PERMIT 118912 BOUNDARY
- PERMIT #118903 BOUNDARY
- PERMIT #118906 BOUNDARY
- PERMIT #118908 BOUNDARY
- PERMIT #118909 BOUNDARY
- PERMIT #218912 BOUNDARY
- PERMIT #218903 BOUNDARY
- LIMIT OF RADIOLOGICALLY IMPACTED MATERIAL BOUNDARY
- OU-1 HAZARDOUS DISPOSAL AREA AS DEFINED BY ROD (LIMIT OF STUDY AREA)
- LFG LATERAL - UNDER CONSTRUCTION
- PS-07 CONDENSATE PUMP STATION (UNDER CONSTRUCTION)
- A&FM AIR AND FORCEMAIN (UNDER CONSTRUCTION)

NOTES:

1. THE 2013 TOPOGRAPHIC MAP WAS PROVIDED BY COOP AERIAL SURVEYORS, CO., PHOENIX, AZ. DATE OF PHOTO: 02/13/2013.
2. UTILITIES SHOWN TAKEN FROM DRAWING 1 OF 1 "SITE INFRASTRUCTURE" BY AQUATERRA ENVIRONMENTAL SOLUTIONS, INC. DATED 01/09/2013.
3. THE OU-1 HAZARDOUS DISPOSAL AREA AS DEFINED BY ROD (LIMIT OF STUDY AREA) WAS OBTAINED FROM A DRAWING TITLED, "REVISED WASTE BOUNDARIES BRIDGETON LANDFILL WASTE INVESTIGATION" PREPARED BY AQUATERRA ENVIRONMENTAL SOLUTIONS, INC. DATED 7/9/10, REVISED 7/1/11.
4. THE LIMIT OF RADIOLOGICALLY IMPACTED MATERIAL BOUNDARY WAS PROVIDED BY CIVIL & ENVIRONMENTAL CONSULTANTS, INC. IN AN EMAIL DATED 7/19/2013.
5. THE PROPERTY BOUNDARY, SOLID WASTE PERMIT BOUNDARIES AND QUARRY BOUNDARY WERE OBTAINED FROM A DRAWING FILE TITLED "BRIDGETON AND WESTLAKE LANDFILLS LANDFILL PARCEL REFERENCE MAP" PREPARED BY SHERBUT-CARSON-CLAYTON LLC, DATED JUNE 2011.

STATE OF MISSOURI
ADAM STEVEN LACEY
NUMBER E-2...
REGISTERED PROFESSIONAL ENGINEER
7/26/13

REV	DATE	DESCRIPTION	DWN BY	DES BY	CHK BY	APP BY

DATE OF ISSUE 07/26/13
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DESIGNED BY JGW
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APPROVED BY ASL

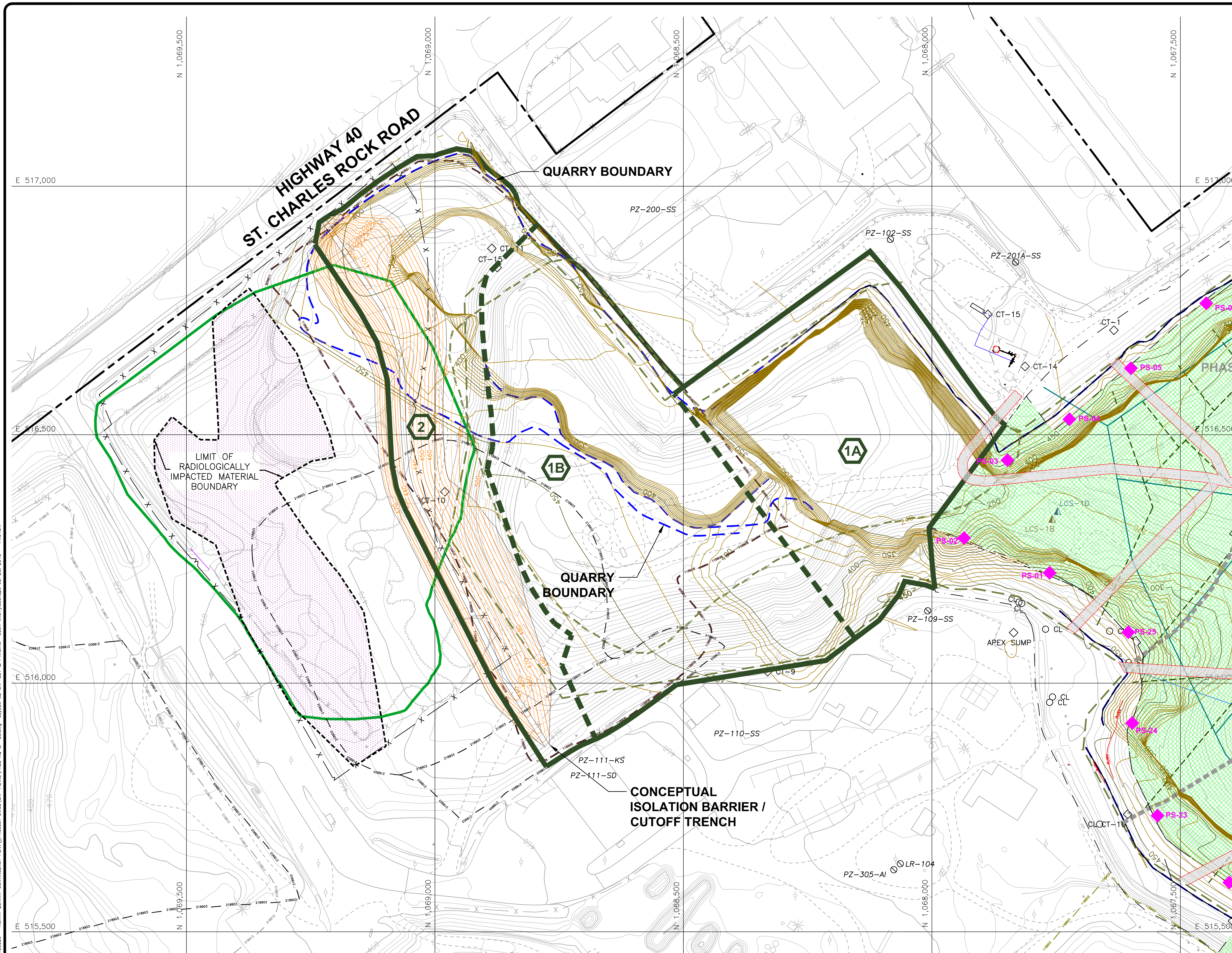
CORNERSTONE Environmental Group, LLC

BRIDGETON LANDFILL, LLC.
BRIDGETON LANDFILL
BRIDGETON, MISSOURI

NORTH QUARRY - EVOH GEOMEMBRANE CAP AND CAP INTEGRITY SYSTEM
EXISTING NORTH QUARRY PLAN

SHEET NO. **1A**

PROJECT NO. 130520



N

0 100 200

SCALE IN FEET

LEGEND

- EXISTING PROPERTY BOUNDARY
- EXISTING QUARRY BOUNDARY
- EXISTING 10' CONTOUR
- EXISTING 2' CONTOUR
- QUARRY BOTTOM 50' CONTOUR
- QUARRY BOTTOM 10' CONTOUR
- SOLID WASTE PERMIT 118912 BOUNDARY
- PERMIT #118906 BOUNDARY
- PERMIT #118908 BOUNDARY
- PERMIT #118909 BOUNDARY
- PERMIT #218912 BOUNDARY
- PERMIT #218903 BOUNDARY
- 2013 FENCING
- EXISTING SOUTH QUARRY HDPE GEOMEMBRANE CAP
- SOUTH QUARRY EVOH GEOMEMBRANE CAP (UNDER CONSTRUCTION)
- GEW-81 EXISTING LFG EXTRACTION WELL
- GEW-2 EXISTING LFG EXTRACTION WELL – COMBO
- PEW-4 EXISTING LFG PERIMETER EXTRACTION WELL
- CT-1 EXISTING CONDENSATE PUMP STATION
- TMP-1 EXISTING TEMPERATURE MONITORING PROBE
- GMP-11 EXISTING GAS MONITORING PROBE
- PZ-109-SS EXISTING PIEZOMETER
- LIMIT OF RADIOLOGICALLY IMPACTED MATERIAL BOUNDARY
- OU-1 HAZARDOUS DISPOSAL AREA AS DEFINED BY ROD (LIMIT OF STUDY AREA)
- PROPOSED EVOH GEOMEMBRANE CAP BOUNDARY
- PROPOSED CAP PHASE BOUNDARY
- 1A PROPOSED CAP PHASE DESIGNATION

CAP PHASE SUMMARY TABLE

CAP PHASE	AREA (ACRES)	TRIGGER EVENT	COMMENT
1A	6.10	TRIGGER #1	INCLUDES WASTE AREA FOR DEEP QUARRY UP TO ABOUT TRIGGER LINE #3
1B	8.94	TRIGGER #1	INCLUDES WASTE AREA UP TO ISOLATION BARRIER / CUTOFF TRENCH AND ALLOWS FOR CUTOFF TRENCH CONSTRUCTION
2	6.05	COMPLETION OF ISOLATION BARRIER / CUTOFF TRENCH CONSTRUCTION	INCLUDES WASTE AREA REMAINING SOUTH OF ISOLATION BARRIER / CUTOFF TRENCH FOLLOWING TRENCH CONSTRUCTION
TOTAL	**21.09**	**ALL**	

NOTES:

1. THE 2013 TOPOGRAPHIC MAP WAS PROVIDED BY COOP AERIAL SURVEYORS, CO., PHOENIX, AZ. DATE OF PHOTO: 02/13/2013.
2. THE CONCEPTUAL ISOLTION BARRIER /CUTOFF TRENCH SHOWN IS THE PROPOSED EXCAVATION ALIGNMENT N-3 DESIGN PREPARED BY P.J. CAREY & ASSOCIATES, P.C. DATED 3/28/2013. THE ISOLATION BARRIER /CUTOFF TRENCH DESIGN AND LOCATION WILL BE FINALIZED AFTER SUBMISSION OF THE NORTH QUARRY EVOH GEOMEMBRANE CAP AND CAP INTEGRITY SYSTEM DESIGN FOLLWING A FIELD SUBSURFACE INVESTIGATION. THEREFORE THE LIMIT OF CAPPING FOR PHASES 1B AND 2 AND ASSOCIATED CAP COMPONENTS MAY BE REVISED UPON COMPLETION OF THE CUTOFF TRENCH DESIGN.
3. THE SOLID WASTE PERMIT BOUNDARIES WERE OBTAINED FROM A DRAWING FILE TITLED "BRIDGETON AND WESTLAKE LANDFILLS LANDFILL PARCEL REFERENCE MAP" PREPARED BY SHERBUT-CARSON-CLAYTON LLC, DATED JUNE 2011.
4. THE QUARRY BOTTOM CONTOURS WERE DEVELOPED FROM AN ELECTRONIC FILE PROVIDED B P.J. CAREY & ASSOCIATES, P.C. WHICH WAS DERIVED FROM A 1997 AERIAL MAP PROVIDED BY AQUATERRA ENVIRONMENTAL SOLUTIONS, INC.

STATE OF MISSOURI ADAM STEVEN ... NUMBER E-... REGISTERED PROFESSIONAL ENGINEER

7/26/13

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CORNERSTONE Environmental Group, LLC

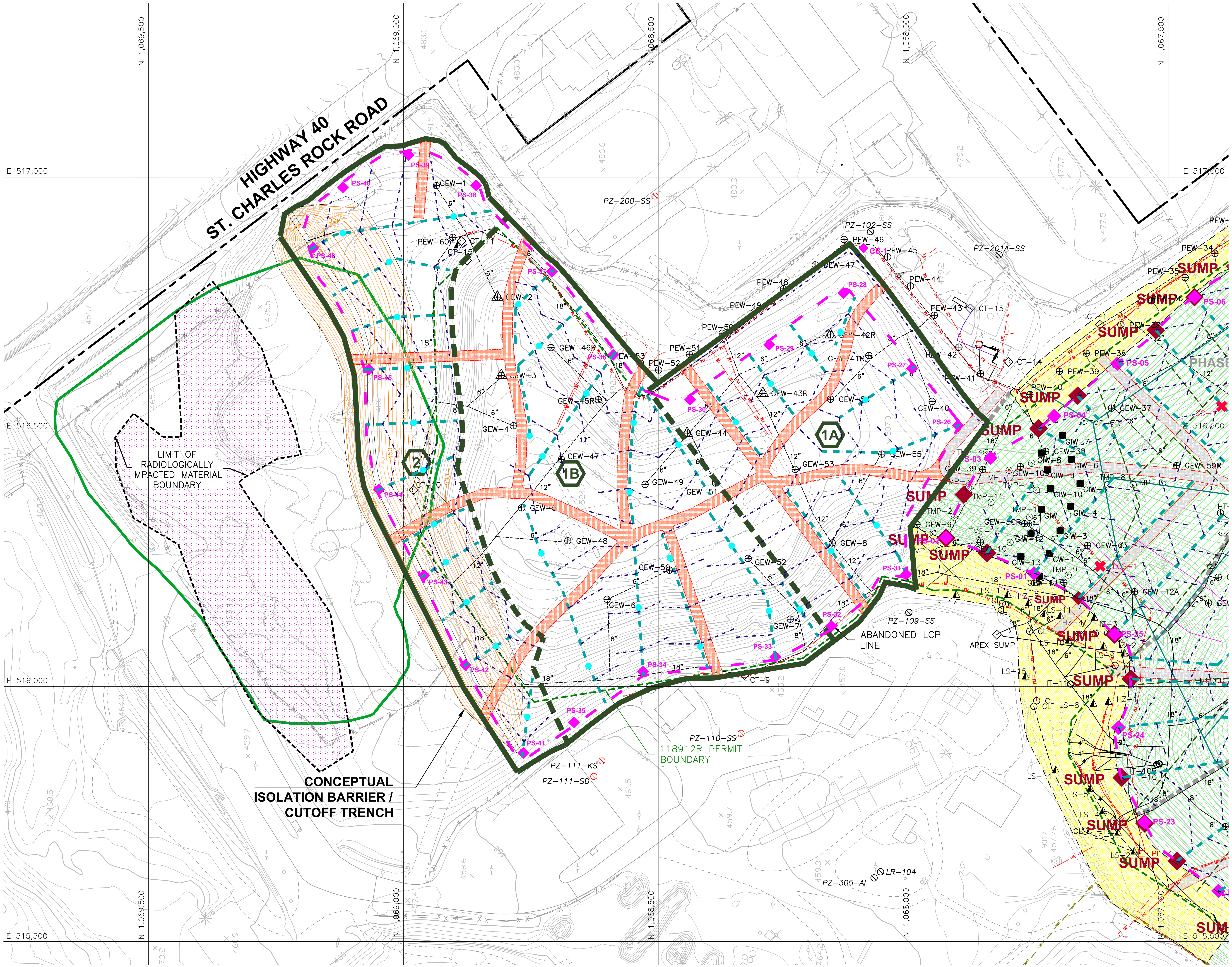
BRIDGETON LANDFILL, LLC.
BRIDGETON LANDFILL
BRIDGETON, MISSOURI

NORTH QUARRY - EVOH GEOMEMBRANE CAP AND CAP INTEGRITY SYSTEM
CAP BOUNDARY AND PHASING PLAN

SHEET NO. 2

PROJECT NO. 130520

File: X:\PROJECTS\BRIDGETON (MO)\130520 – NORTH QUARRY CONTINGENCY PLAN_PROJECT DWGS\CAP PLANS\FIBE NQ SP-EC.dwg Layout: 02 CAP BDY & PHASING User: thierry.dechope Jul 26, 2013 – 11:01am



N

0 100 200
SCALE IN FEET

LEGEND

- SOLID WASTE PERMIT 118912 BOUNDARY
- EXISTING 10' CONTOUR
- EXISTING 2' CONTOUR
- EXISTING HORIZONTAL LFG COLLECTOR
- EXISTING LEACHATE FORCEMAIN
- EXISTING CONDENSATE DRAIN LINE
- EXISTING AIR LINE
- EXISTING UNDERGROUND ELECTRIC
- LIMIT OF RADIOLOGICALLY IMPACTED MATERIAL BOUNDARY
- OU-1 HAZARDOUS DISPOSAL AREA AS DEFINED BY ROD (LIMIT OF STUDY AREA)
- EXISTING HDPE GEOMEMBRANE
- SOUTH QUARRY EVOH GEOMEMBRANE (UNDER CONSTRUCTION)
- LIGHT-DUTY ACCESS ROADS (UNDER CONSTRUCTION)
- PROPOSED LIGHT-DUTY ACCESS ROADS
- GEW-81 EXISTING LFG EXTRACTION WELL
- GEW-2 EXISTING LFG EXTRACTION WELL - COMBO
- PEW-4 EXISTING LFG PERIMETER EXTRACTION WELL
- CT-1 EXISTING CONDENSATE PUMP STATION
- TMP-1 EXISTING TEMPERATURE MONITORING PROBE
- GMP-11 EXISTING GAS MONITORING PROBE
- IT-3 EXISTING INTERCEPTION TRENCH WELL
- GIW-10 EXISTING LFG INTERCEPTOR WELL
- PZ-109-SS EXISTING PIEZOMETER
- PROPOSED PERIMETER TOE COLLECTOR (SEE DETAIL 2/8)
- PROPOSED BELOW CAP BERM COLLECTOR (SEE DETAILS 2/10 & 3/10)
- PROPOSED STRIP DRAINS (SEE DETAIL 5/11)
- PS-26 PROPOSED PERIMETER COLLECTION SUMP (SEE DETAIL 1/8)
- WELLHEAD RISER (SEE DETAIL 3/10)
- CS-1 PROPOSED CONTAINMENT PUMP STATION (SEE DETAIL 6/11)
- PROPOSED EVOH GEOMEMBRANE CAP BOUNDARY
- PROPOSED CAP PHASE BOUNDARY
- 1A PROPOSED CAP PHASE DESIGNATION

NOTES:

1. THE 2013 TOPOGRAPHIC MAP WAS PROVIDED BY COOP AERIAL SURVEYORS, CO., PHOENIX, AZ. DATE OF PHOTO: 02/13/2013.
2. UTILITIES SHOWN TAKEN FROM DRAWING 1 OF 1 "SITE INFRASTRUCTURE" BY AQUATERRA ENVIRONMENTAL SOLUTIONS, INC. DATED 01/09/2013.
3. THE PROPOSED NORTH QUARRY EVOH GEOMEMBRANE CAP SHALL BE CONTINUOUSLY WELDED TO THE SOUTH QUARRY GEOMEMBRANE CAP BEING CONSTRUCTED.
4. A STRIP DRAIN SHALL BE CONSTRUCTED BELOW THE TEMPORARY CAP AT THE TOE OF SLOPE PER DETAIL 3, SHEET 11 AT LOCATIONS INDICATED ON SHEET 4A. THE STRIP DRAIN SHALL OUTLET TO A DOUBLE-WALLED CONTAINMENT SUMP PUMP STATION SHOWN IN DETAIL 6, SHEET 11. THE CONTAINMENT SUMP SHALL BE FIELD FIT AT TIME OF CONSTRUCTION.
5. PROPOSED PERIMETER TOE COLLECTOR TO BE CONSTRUCTED WITH MINIMUM 0.5% SLOPE TO SUMPS.
6. SUBGRADE PREPARATION FOR THE PROPOSED NORTH QUARRY EVOH GEOMEMBRANE CAP SHALL INCLUDE THE FOLLOWING:
   A. REGRADING OF THE BENCHES, WHERE INDICATED, PER DETAIL 2, SHEET 11.
   B. INSTALLATION OF AN ADDITIONAL PROTECTIVE GEOTEXTILE OVER RIP-RAP AT EXISTING DOWNCHUTE RIP-RAP CHANNELS IF RIP-RAP IS LEFT IN PLACE.
   C. STRIPPING OF VEGETATION WITHIN THE AREAS SHOWN WHERE "ABOVE CAP" LIGHT DUTY ACCESS ROAD SHALL BE CONSTRUCTED.
   D. STRIPPING OF VEGETATIVE AREAS IN OTHER AREAS EXCEPT WHERE ABOVE GROUND PIPES EXIST, ACCESS IS LIMITED, OR STRIPPING OPERATIONS MAY DELAY CONSTRUCTION OF THE EVOH GEOMEMBRANE CAP.
   E. MINOR GRADING SHALL BE DONE WHERE REQUIRED TO PROMOTE POSITIVE DRAINAGE.

STATE OF MISSOURI
ADAM STEVEN
NUMBER
E-
REGISTERED PROFESSIONAL ENGINEER
7/26/13

REV	DATE	DESCRIPTION	DWN BY	DES BY	CHK BY	APP BY

DATE OF ISSUE 07/26/13
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DESIGNED BY JGW
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CORNERSTONE Environmental Group, LLC

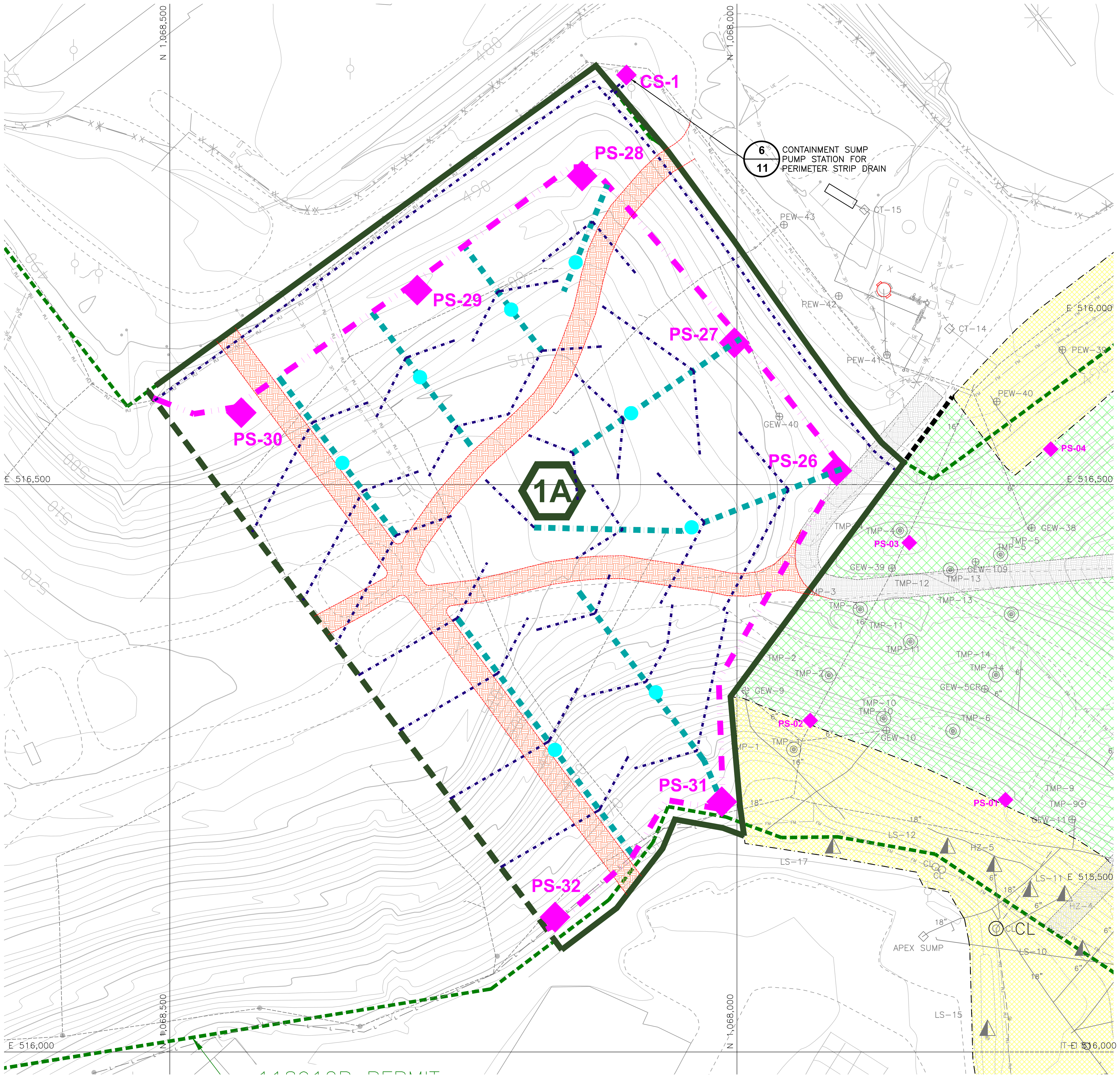
BRIDGETON LANDFILL, LLC.
BRIDGETON LANDFILL
BRIDGETON, MISSOURI

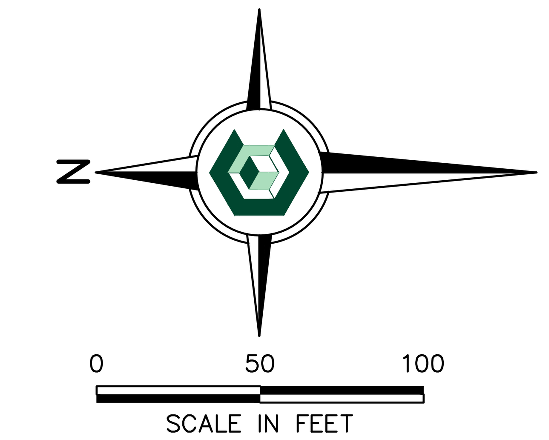
NORTH QUARRY - EVOH GEOMEMBRANE CAP AND CAP INTEGRITY SYSTEM

SUBGRADE/CAP INTEGRITY SYSTEM PLAN - BELOW FINAL CAP

SHEET NO. 3

PROJECT NO. 130520





LEGEND

	SOLID WASTE PERMIT 118912 BOUNDARY
	EXISTING 10' CONTOUR
	EXISTING 2' CONTOUR
	EXISTING LFG HEADER/LATERAL
	EXISTING LEACHATE FORCEMAIN
	EXISTING CONDENSATE DRAIN LINE
	EXISTING AIR LINE
	EXISTING UNDERGROUND ELECTRIC
	EXISTING HDPE GEOMEMBRANE
	SOUTH QUARRY EVOH GEOMEMBRANE (UNDER CONSTRUCTION)
	LIGHT-DUTY ACCESS ROADS (UNDER CONSTRUCTION)
	PROPOSED STRIPPING AREA FOR LIGHT DUTY ACCESS ROAD
GEW-81	EXISTING LFG EXTRACTION WELL
GEW-81	EXISTING LFG EXTRACTION WELL - COMBO
PEW-4	EXISTING LFG PERIMETER EXTRACTION WELL
CT-1	EXISTING CONDENSATE PUMP STATION
TMP-1	EXISTING TEMPERATURE MONITORING PROBE
GMP-11	EXISTING GAS MONITORING PROBE
IT-3	EXISTING INTERCEPTION TRENCH WELL
	PROPOSED CAP LIMIT
	PROPOSED CAP PHASE BOUNDARY
	PROPOSED PERIMETER TOE COLLECTOR (SEE DETAIL 2/8)
	PROPOSED BELOW CAP BERM COLLECTOR (SEE DETAILS 2/10 & 3/10)
	PROPOSED STRIP DRAINS (SEE DETAIL 5/11)
PS-32	PROPOSED PERIMETER COLLECTION SUMP (SEE DETAIL 1/8)
	WELLHEAD RISER (SEE DETAIL 3/10)
CS-1	PROPOSED CONTAINMENT PUMP STATION (SEE DETAIL 6/11)
1A	PROPOSED CAP PHASE DESIGNATION

NOTES:

1. THE 2013 TOPOGRAPHIC MAP WAS PROVIDED BY COOP AERIAL SURVEYORS, CO., PHOENIX, AZ. DATE OF PHOTO: 02/13/2013.
2. UTILITIES SHOWN TAKEN FROM DRAWING 1 OF 1 "SITE INFRASTRUCTURE" BY AQUATERRA ENVIRONMENTAL SOLUTIONS, INC. DATED 01/09/2013.
3. SEE SHEET 5 FOR THE AREA AND LIMITS OF EVOH GEOMEMBRANE.
4. SEE SHEET 6 FOR LOCATIONS OF ABOVE CAP COMPONENTS TO BE CONSTRUCTED ABOVE THE EVOH GEOMEMBRANE.
5. SUBGRADE PREPARATION FOR THE TEMPORARY CAP SHALL INCLUDE:
   A. REGRADING OF THE BENCHES PER DETAIL 1, SHEET 11
   B. INSTALLATION OF AN ADDITIONAL PROTECTIVE GEOTEXTILE OVER RIPRAP AT EXISTING DOWNCHUTE RIPRAP CHANNELS IF RIPRAP IS LEFT IN PLACE
   C. STRIPPING OF VEGETATION WITHIN THE AREAS SHOWN WHERE ABOVE CAP LIGHT-DUTY ACCESS ROADS SHALL BE CONSTRUCTED
   D. STRIPPING OF VEGETATIVE AREAS IN OTHER AREAS EXCEPT WHERE ABOVE GROUND PIPES EXIST, ACCESS IS LIMITED, OR STRIPPING OPERATIONS MAY DELAY CONSTRUCTION OF THE EVOH GEOMEMBRANE
   E. MINOR GRADING SHALL BE DONE WHERE REQUIRED TO PROMOTE POSITIVE DRAINAGE
6. A STRIP DRAIN SHALL BE CONSTRUCTED BELOW THE EVOH GEOMEMBRANE CAP AT THE TOE OF SLOPE PER DETAIL 3, SHEET 11 AT LOCATIONS INDICATED ON THIS SHEET. THE STRIP DRAIN SHALL OUTLET INTO A DOUBLE-WALLED CONTAINMENT SUMP PUMP STATION SHOWN IN DETAIL 6, SHEET 11. THE CONTAINMENT SUMP SHALL BE FIELD FIT AT TIME OF CONSTRUCTION

STATE OF MISSOURI — ADAM STEVEN — NUMBER E-22696 — PROFESSIONAL ENGINEER
7/26/13

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CORNERSTONE Environmental Group, LLC

BRIDGETON LANDFILL, LLC.
BRIDGETON LANDFILL
BRIDGETON, MISSOURI

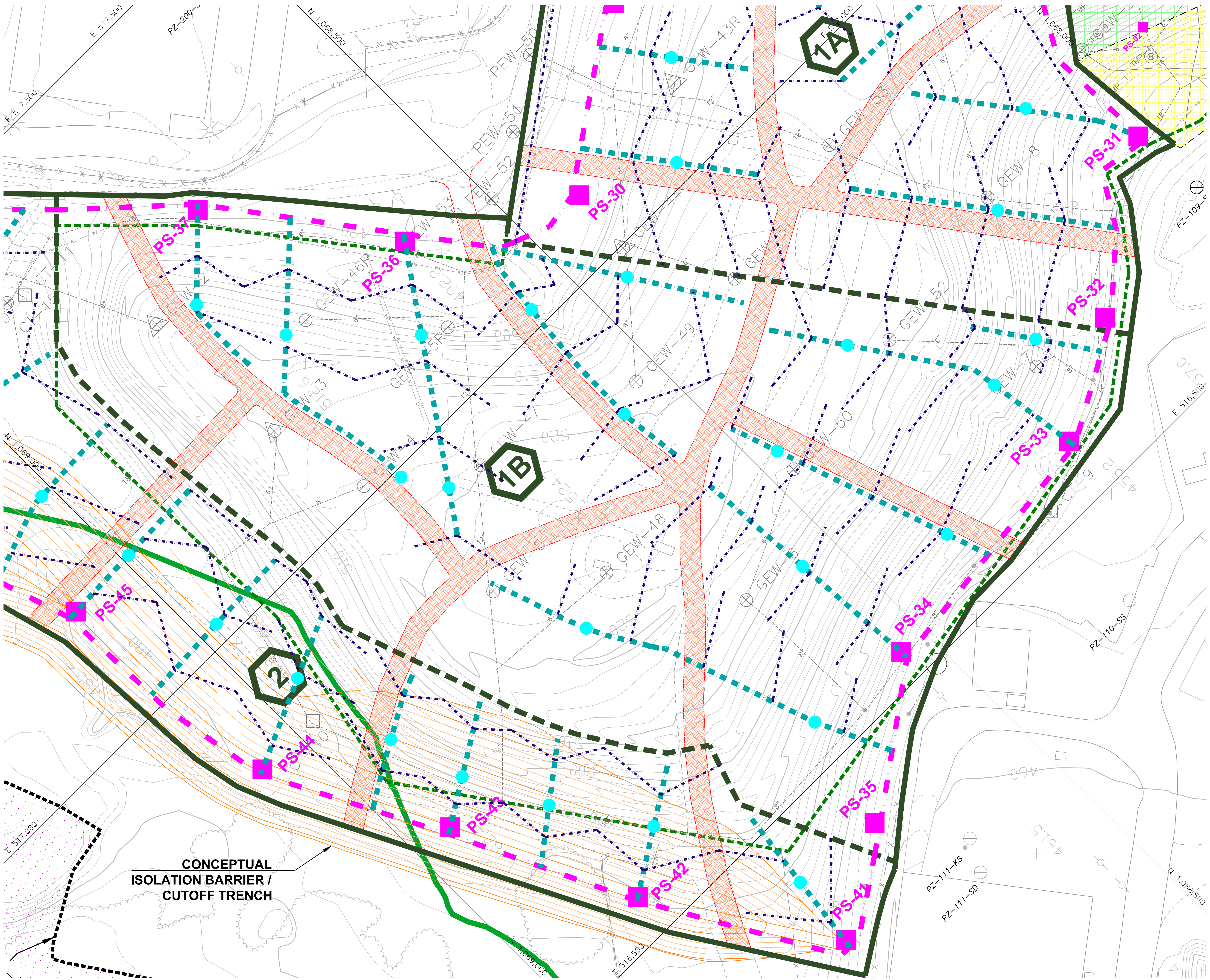
NORTH QUARRY - EVOH GEOMEMBRANE CAP AND CAP INTEGRITY SYSTEM

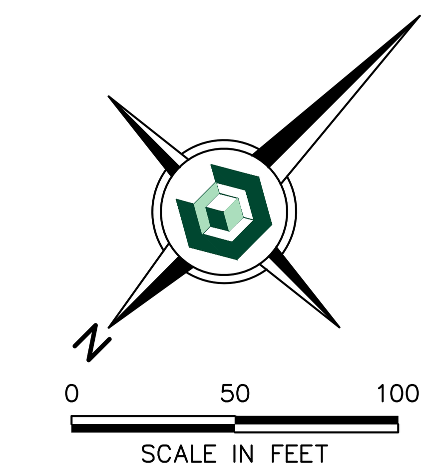
CAP SUBGRADE PHASING PLAN - PHASE 1A

SHEET NO. **4A**

PROJECT NO. 130520

File: X:\PROJECTS\BRIDGETON (MO)\130520 — NORTH QUARRY CONTINGENCY PLAN_PROJECT DWGS\CAP PLANS\PHASING.dwg Layout: C4A-phasing User: thierry.dechope Jul 26, 2013 — 4:32pm





LEGEND

- SOLID WASTE PERMIT 118912 BOUNDARY
- EXISTING 10' CONTOUR
- EXISTING 2' CONTOUR
- EXISTING LFG HEADER/LATERAL
- EXISTING LEACHATE FORCEMAIN
- EXISTING CONDENSATE DRAIN LINE
- EXISTING AIR LINE
- EXISTING UNDERGROUND ELECTRIC
- LIMIT OF RADIOLOGICALLY IMPACTED MATERIAL BOUNDARY
- OU-1 HAZARDOUS DISPOSAL AREA AS DEFINED BY ROD (LIMIT OF STUDY AREA)
- EXISTING HDPE GEOMEMBRANE
- SOUTH QUARRY EVOH GEOMEMBRANE (UNDER CONSTRUCTION)
- PROPOSED STRIPPING AREA FOR LIGHT DUTY ACCESS ROAD
- GEW-81 — EXISTING LFG EXTRACTION WELL
- GEW-81 — EXISTING LFG EXTRACTION WELL - COMBO
- PEW-4 — EXISTING LFG PERIMETER EXTRACTION WELL
- CT-1 — EXISTING CONDENSATE PUMP STATION
- TMP-1 — EXISTING TEMPERATURE MONITORING PROBE
- GMP-11 — EXISTING GAS MONITORING PROBE
- IT-3 — EXISTING INTERCEPTION TRENCH WELL
- PROPOSED CAP LIMIT
- PROPOSED CAP PHASE BOUNDARY
- PROPOSED PERIMETER TOE COLLECTOR (SEE DETAIL 2/8)
- PROPOSED BELOW CAP BERM COLLECTOR (SEE DETAILS 2/10 & 3/10)
- PROPOSED STRIP DRAINS (SEE DETAIL 5/11)
- PS-32 — PROPOSED PERIMETER COLLECTION SUMP (SEE DETAIL 1/8)
- WELLHEAD RISER (SEE DETAIL 3/10)
- 1A — PROPOSED CAP PHASE DESIGNATION

NOTES:

1. THE 2013 TOPOGRAPHIC MAP WAS PROVIDED BY COOP AERIAL SURVEYORS, CO., PHOENIX, AZ. DATE OF PHOTO: 02/13/2013.
2. UTILITIES SHOWN TAKEN FROM DRAWING 1 OF 1 "SITE INFRASTRUCTURE" BY AQUATERRA ENVIRONMENTAL SOLUTIONS, INC. DATED 01/09/2013.
3. SUBGRADE PREPARATION FOR THE EVOH GEOMEMBRANE CAP SHALL INCLUDE:
   A. REGRADING OF THE BENCHES PER DETAIL 1, SHEET 11
   B. INSTALLATION OF AN ADDITIONAL PROTECTIVE GEOTEXTILE OVER RIPRAP AT EXISTING DOWNCHUTE RIPRAP CHANNELS IF RIPRAP IS LEFT IN PLACE
   C. STRIPPING OF VEGETATION WITHIN THE AREAS SHOWN WHERE ABOVE CAP LIGHT-DUTY ACCESS ROADS SHALL BE CONSTRUCTED
   D. STRIPPING OF VEGETATIVE AREAS IN OTHER AREAS EXCEPT WHERE ABOVE GROUND PIPES EXIST, ACCESS IS LIMITED, OR STRIPPING OPERATIONS MAY DELAY CONSTRUCTION OF THE EVOH GEOMEMBRANE
   E. MINOR GRADING SHALL BE DONE WHERE REQUIRED TO PROMOTE POSITIVE DRAINAGE

STATE OF MISSOURI — ADAM STEVEN — NUMBER E-22686 — REGISTERED PROFESSIONAL ENGINEER

7/26/13

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CORNERSTONE Environmental Group, LLC

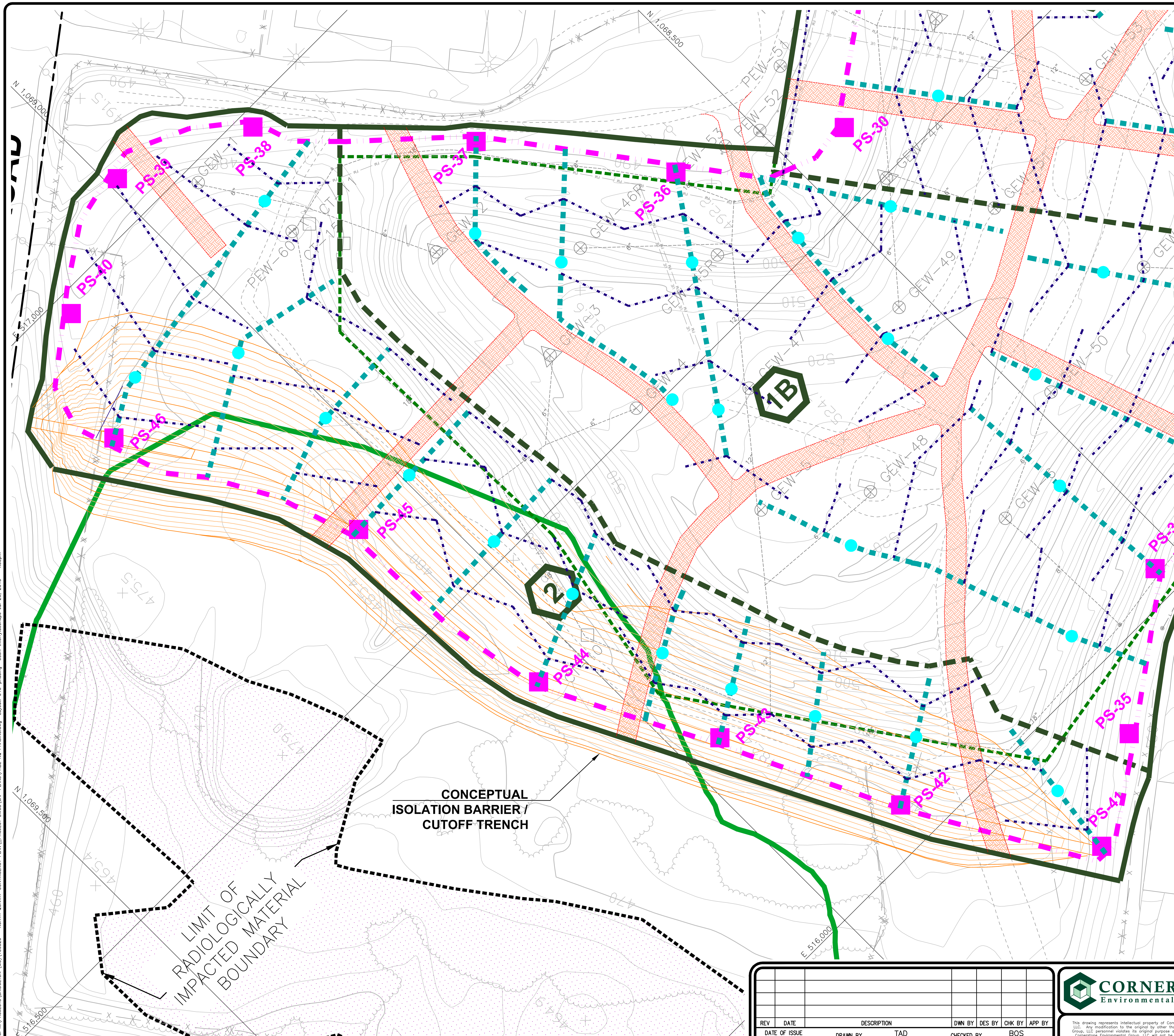
BRIDGETON LANDFILL, LLC.
BRIDGETON LANDFILL
BRIDGETON, MISSOURI

NORTH QUARRY - EVOH GEOMEMBRANE CAP AND CAP INTEGRITY SYSTEM

CAP SUBGRADE PHASING PLAN - PHASE 1B

SHEET NO. **4B**

PROJECT NO. 130520



0 50 100
SCALE IN FEET

LEGEND

	SOLID WASTE PERMIT 118912 BOUNDARY
480	EXISTING 10' CONTOUR
	EXISTING 2' CONTOUR
	EXISTING LFG HEADER/LATERAL
FM	EXISTING LEACHATE FORCEMAIN
C	EXISTING CONDENSATE DRAIN LINE
A	EXISTING AIR LINE
UE	EXISTING UNDERGROUND ELECTRIC
	LIMIT OF RADIOLOGICALLY IMPACTED MATERIAL BOUNDARY
	OU-1 HAZARDOUS DISPOSAL AREA AS DEFINED BY ROD (LIMIT OF STUDY AREA)
	EXISTING HDPE GEOMEMBRANE
	SOUTH QUARRY EVOH GEOMEMBRANE (UNDER CONSTRUCTION)
	PROPOSED STRIPPING AREA FOR LIGHT DUTY ACCESS ROAD
GEW-81	EXISTING LFG EXTRACTION WELL
GEW-81	EXISTING LFG EXTRACTION WELL - COMBO
PEW-4	EXISTING LFG PERIMETER EXTRACTION WELL
CT-1	EXISTING CONDENSATE PUMP STATION
TMP-1	EXISTING TEMPERATURE MONITORING PROBE
GMP-11	EXISTING GAS MONITORING PROBE
IT-3	EXISTING INTERCEPTION TRENCH WELL
	PROPOSED CAP LIMIT
	PROPOSED CAP PHASE BOUNDARY
	PROPOSED PERIMETER TOE COLLECTOR (SEE DETAIL 2/8)
	PROPOSED BELOW CAP BERM COLLECTOR (SEE DETAILS 2/10 & 3/10)
	PROPOSED STRIP DRAINS (SEE DETAIL 5/11)
PS-32	PROPOSED PERIMETER COLLECTION SUMP (SEE DETAIL 1/8)
	WELLHEAD RISER (SEE DETAIL 3/10)
1A	PROPOSED CAP PHASE DESIGNATION

NOTES:

1. THE 2013 TOPOGRAPHIC MAP WAS PROVIDED BY COOP AERIAL SURVEYORS, CO., PHOENIX, AZ. DATE OF PHOTO: 02/13/2013.
2. UTILITIES SHOWN TAKEN FROM DRAWING 1 OF 1 "SITE INFRASTRUCTURE" BY AQUATERRA ENVIRONMENTAL SOLUTIONS, INC. DATED 01/09/2013.
3. SUBGRADE PREPARATION FOR THE EVOH GEOMEMBRANE CAP SHALL INCLUDE:
   A. REGRADING OF THE BENCHES PER DETAIL 1, SHEET 11
   B. INSTALLATION OF AN ADDITIONAL PROTECTIVE GEOTEXTILE OVER RIPRAP AT EXISTING DOWNCHUTE RIPRAP CHANNELS IF RIPRAP IS LEFT IN PLACE
   C. STRIPPING OF VEGETATION WITHIN THE AREAS SHOWN WHERE ABOVE CAP LIGHT-DUTY ACCESS ROADS SHALL BE CONSTRUCTED
   D. STRIPPING OF VEGETATIVE AREAS IN OTHER AREAS EXCEPT WHERE ABOVE GROUND PIPES EXIST, ACCESS IS LIMITED, OR STRIPPING OPERATIONS MAY DELAY CONSTRUCTION OF THE EVOH GEOMEMBRANE
   E. MINOR GRADING SHALL BE DONE WHERE REQUIRED TO PROMOTE POSITIVE DRAINAGE

STATE OF MISSOURI
ADAM STEVEN LUCAS
NUMBER
E-25595
PROFESSIONAL ENGINEER
7/26/13

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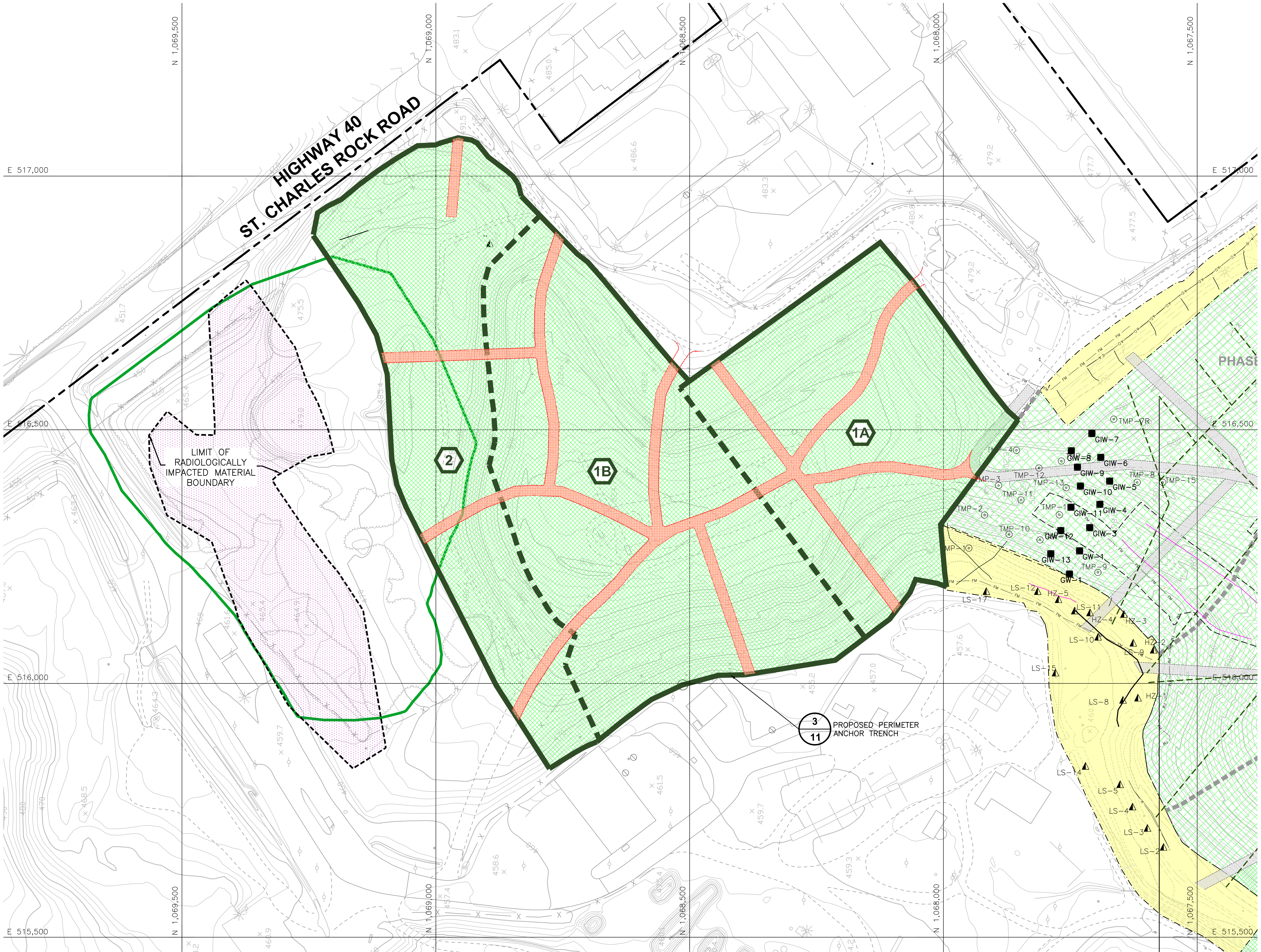
CORNERSTONE
Environmental Group, LLC

BRIDGETON LANDFILL, LLC.
BRIDGETON LANDFILL
BRIDGETON, MISSOURI

NORTH QUARRY - EVOH GEOMEMBRANE CAP AND CAP INTEGRITY SYSTEM
CAP SUBGRADE PHASING PLAN - PHASE 2

SHEET NO. 4C
PROJECT NO. 130520



N

0 100 200
SCALE IN FEET

LEGEND

	SOLID WASTE PERMIT 118912 BOUNDARY
480	EXISTING 10' CONTOUR
	EXISTING 2' CONTOUR
■ GW-7	EXISTING LFG INTERCEPTOR WELL
	EXISTING HDPE GEOMEMBRANE
	SOUTH QUARRY EVOH GEOMEMBRANE (UNDER CONSTRUCTION)
	PROPOSED NORTH QUARRY EVOH GEOMEMBRANE
	LIGHT-DUTY ACCESS ROADS (UNDER CONSTRUCTION)
	LIGHT-DUTY ACCESS ROADS (SEE DETAIL 1/10)
	LIMIT OF RADIOLOGICALLY IMPACTED MATERIAL BOUNDARY
	OU-1 HAZARDOUS DISPOSAL AREA AS DEFINED BY ROD (LIMIT OF STUDY AREA)
	PROPOSED CAP LIMIT
	PROPOSED CAP PHASE BOUNDARY
1A	PROPOSED CAP PHASE DESIGNATION

NOTES:

1. THE 2013 TOPOGRAPHIC MAP WAS PROVIDED BY COOP AERIAL SURVEYORS, CO., PHOENIX, AZ. DATE OF PHOTO: 02/13/2013.
2. THE PROPOSED TEMPORARY FINAL CAP GEOMEMBRANE SHALL BE CONTINUOUSLY WELDED TO THE EXISTING GEOMEMBRANE.

STATE OF MISSOURI ADAM STEVEN ... NUMBER E-2 ... PROFESSIONAL ENGINEER

7/26/13

File: X:\PROJECTS\BRIDGETON (MO)\130520 - NORTH QUARRY CONTINGENCY PLAN_PROJECT DWGS\CAP PLANS\PH8L NQ CAP.dwg Layout: 05-CAP PLAN User: thierry.dechape Jul 26, 2013 - 2:40pm

1" 1/2" 0"

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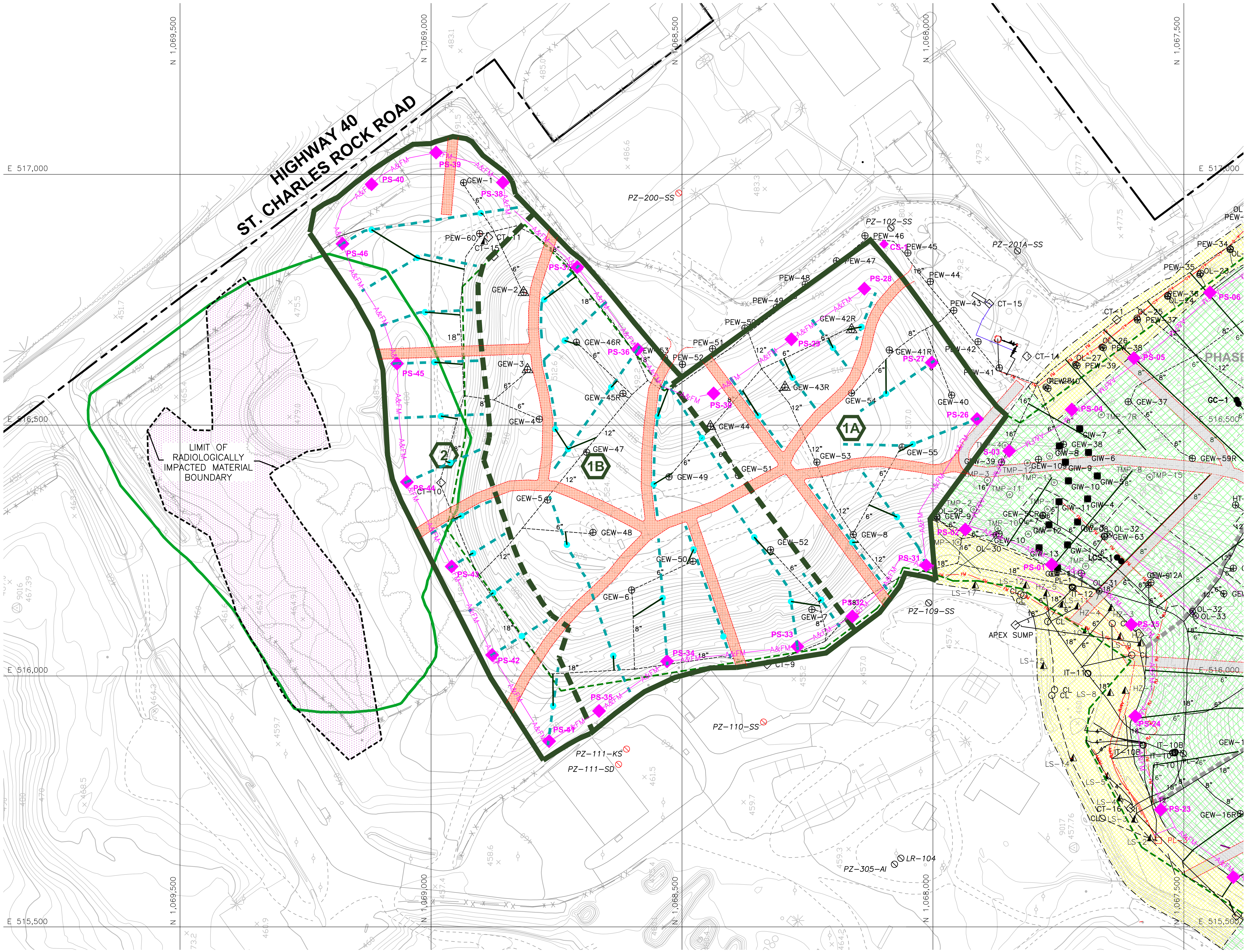
BRIDGETON LANDFILL, LLC.
BRIDGETON LANDFILL
BRIDGETON, MISSOURI

NORTH QUARRY - EVOH GEOMEMBRANE CAP AND CAP INTEGRITY SYSTEM
FINAL CAP PLAN

SHEET NO.
5

PROJECT NO.
130520



LEGEND

	SOLID WASTE PERMIT 118912 BOUNDARY
	EXISTING 10' CONTOUR
	EXISTING 2' CONTOUR
	EXISTING LFG HEADER/LATERAL
FM	EXISTING LEACHATE FORCEMAIN
C	EXISTING CONDENSATE DRAIN LINE
A	EXISTING AIR LINE
UE	EXISTING UNDERGROUND ELECTRIC
	LIMIT OF RADIOLOGICALLY IMPACTED MATERIAL BOUNDARY
	OU-1 HAZARDOUS DISPOSAL AREA AS DEFINED BY ROD (LIMIT OF STUDY AREA)
	EXISTING BUBBLE SUCKER
	EXISTING HDPE GEOMEMBRANE
	SOUTH QUARRY EVOH GEOMEMBRANE (UNDER CONSTRUCTION)
	LIGHT-DUTY ACCESS ROADS (UNDER CONSTRUCTION)
	PROPOSED STRIPPING AREA FOR LIGHT DUTY ACCESS ROAD
GEW-81	EXISTING LFG EXTRACTION WELL
	EXISTING LFG EXTRACTION WELL - COMBO
PEW-4	EXISTING LFG PERIMETER EXTRACTION WELL
CT-1	EXISTING CONDENSATE PUMP STATION
TMP-1	EXISTING TEMPERATURE MONITORING PROBE
GMP-11	EXISTING GAS MONITORING PROBE
IT-3	EXISTING INTERCEPTION TRENCH WELL
GIW-10	EXISTING LFG INTERCEPTOR WELL
PZ-109-SS	EXISTING PIEZOMETER
	PROPOSED LFG LATERAL (SEE DETAILS 2/10 AND 3/10)
	PROPOSED BELOW CAP BERM COLLECTOR (SEE DETAILS 2/10 & 3/10)
PS-07	PROPOSED PERIMETER COLLECTION SUMP (SEE DETAIL 1/8)
	WELLHEAD RISER (21 IN PHASE 2)
	PROPOSED DEFLECTOR PIPE BERM (SEE DETAIL 9/10)
	PROPOSED CULVERT PROTECTION FOR GAS LATERAL
A&FM	PROPOSED AIR AND FORCEMAIN (SEE NOTE 3, THIS SHEET)
	PROPOSED CAP LIMIT
	PROPOSED CAP PHASE BOUNDARY
1A	PROPOSED CAP PHASE DESIGNATION

NOTES:

1. THE 2013 TOPOGRAPHIC MAP WAS PROVIDED BY COOP AERIAL SURVEYORS, CO., PHOENIX, AZ. DATE OF PHOTO: 02/13/2013.
2. UTILITIES SHOWN TAKEN FROM DRAWING 1 OF 1 "SITE INFRASTRUCTURE" BY AQUATERRA ENVIRONMENTAL SOLUTIONS, INC. DATED 01/09/13.
3. A NEW DOUBLE-WALLED 3" HDPE SDR 11 / 6" HDPE SDR 17 FORCEMAIN AND 2" AIR MAIN SHALL BE CONSTRUCTED ABOVE THE CAP AROUND THE PERIMETER OF THE SOUTH QUARRY AS NECESSARY TO CONVEY LIQUID FROM THE PERIMETER COLLECTION SUMPS AND 2" AIR MAIN (SHOWN IN DETAIL 1, SHEET 8) TO THE LEACHATE MANAGEMENT SYSTEM.
4. ALL OVER LINER TIE IN POINTS, PERIMETER LINE COLLECTION RISERS, AND INTERCEPTION TRENCH WELLS TO BE MAINTAINED AND BOOTED THROUGH THE NEW FML.
5. PROPOSED BELOW CAP BERM COLLECTORS AND EXISTING LANDFILL GAS HEADERS ARE BELOW CAP FEATURES SHOWN FOR CLARITY OF PROPOSED ABOVE CAP LFG LATERALS.
6. PROPOSED ABOVE CAP LFG LATERALS TO CONNECT TO EXISTING BELOW CAP HEADERS. LATERALS TO BE BOOTED TO CAP AT CAP PENETRATION POINT.

STATE OF MISSOURI
ADAM STEVEN LAKY
NUMBER
E-2006
PROFESSIONAL ENGINEER
7/26/13

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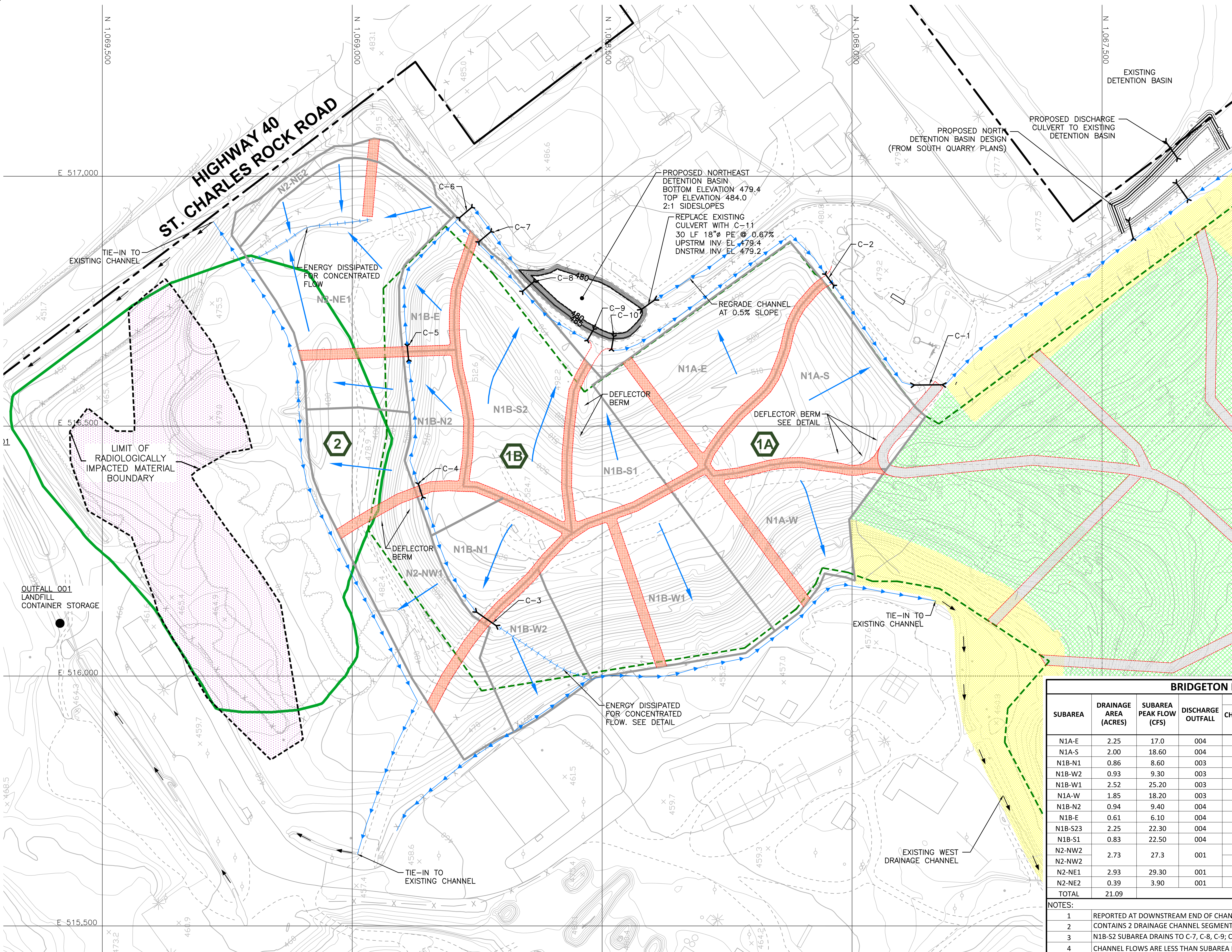
BRIDGETON LANDFILL, LLC.
BRIDGETON LANDFILL
BRIDGETON, MISSOURI

NORTH QUARRY - EVOH GEOMEMBRANE CAP AND CAP INTEGRITY SYSTEM
CAP INTEGRITY SYSTEM - ABOVE TEMPORARY CAP

SHEET NO. 6
PROJECT NO. 130520



LEGEND

- SOLID WASTE PERMIT 118912 BOUNDARY
- DRAINAGE AREA BOUNDARY
- EXISTING 10' CONTOUR
- EXISTING 2' CONTOUR
- EXISTING HDPE GEOMEMBRANE
- SOUTH QUARRY EVOH GEOMEMBRANE (UNDER CONSTRUCTION)
- LIGHT-DUTY ACCESS ROADS (UNDER CONSTRUCTION)
- PROPOSED LIGHT-DUTY ACCESS ROADS
- N1A-E — DRAINAGE SUB-AREA DESIGNATION
- N1A-E — PROPOSED DRAINAGE CHANNEL
- EXISTING DRAINAGE CHANNEL
- PROPOSED CULVERT (SEE SHEET 13)
- SHEET FLOW DIRECTION ARROW
- OUTFALL 001 (EXISTING PERMITTED OUTFALL)
- 1A — PROPOSED CAP PHASE DESIGNATION

NOTES:

1. THE STORMWATER MANAGEMENT PLAN HAS BEEN DESIGNED TO MANAGE RUNOFF FROM THE EVOH GEOMEMBRANE CAP FOR A 24-HOUR, 25-YEAR FREQUENCY STORM EVENT. STORMWATER RUNOFF FROM PHASES 1A AND 1B WILL BE COLLECTED IN PERIMETER CHANNELS AND DIRECTED TO EITHER THE NORTH OR SOUTH PROPOSED DETENTION BASINS DESIGNED AS PART OF THE SOUTH QUARRY CAP PLANS. STORMWATER RUNOFF FROM PHASE 2 WILL BE COLLECTED IN PERIMETER CHANNELS AND ROUTED TO AN EXISTING DRAINAGE CHANNEL.
2. SEE SHEET 1 FOR LOCATIONS OF PERMITTED OUTFALLS AND SOUTH QUARRY DETENTION BASINS.

STATE OF MISSOURI
ADAM STEVEN LAKE
NUMBER E-25935
REGISTERED PROFESSIONAL ENGINEER
7/26/13

BRIDGETON NORTH QUARRY CAP STORMWATER SUMMARY

SUBAREA	DRAINAGE AREA (ACRES)	SUBAREA PEAK FLOW (CFS)	DISCHARGE OUTFALL	DRAINAGE CHANNEL DESIGN							
				CHANNEL PEAK FLOW (CFS)1	DEPTH (FT)	LEFT SIDESLOPE X:1 HOR	BOTTOM WIDTH (FT)	RIGHT SIDESLOPE X:/1 HOR	CHANNEL SLOPE (%)	CHANNEL VELOCITY (FT/SEC)	CHANNEL LINING
N1A-E	2.25	17.0	004	17.0	1.50	1.00	3.00	1.00	0.20	2.78	GRASSED
N1A-S	2.00	18.60	004	31.7	2.00	1.00	3.00	1.00	0.20	3.28	GRASSED
N1B-N1	0.86	8.60	003	8.6	1.50	5.00	0.00	4.00	6.70	11.0	GEOMEMBRANE
N1B-W2	0.93	9.30	003	9.3	1.00	1.00	3.00	1.00	0.50	2.58	GRASSED
N1B-W1	2.52	25.20	003	38.3	2.00	1.50	5.00	1.50	0.21	2.63	GRASSED
N1A-W	1.85	18.20	003	53.4	2.00	2.00	5.00	2.00	0.30	3.15	GRASSED
N1B-N2	0.94	9.40	004	9.4	1.50	5.00	0.00	4.00	0.08	11.90	GEOMEMBRANE
N1B-E	0.61	6.10	004	11.8	1.50	5.00	0.00	4.00	0.02	7.60	GEOMEMBRANE
N1B-S23	2.25	22.30	004	7.4	1.00	1.00	3.00	1.00	0.50	2.60	GRASSED
N1B-S1	0.83	22.50	004	DRAINS TO CULVERT C-10 WITHOUT CHANNEL							GRASSED
N2-NW2	2.73	27.3	001	24.1	2.00	3.00	2.00	2.00	0.50	1.35	GRASSED
N2-NW2				23.9	1.50	3.00	2.00	2.00	8.00	6.37	GRASSED
N2-NE1	2.93	29.30	001	30.7	2.00	2.00	3.00	2.00	0.30	3.25	GRASSED
N2-NE2	0.39	3.90	001	SHEET FLOWS							
TOTAL	21.09										

NOTES:

1	REPORTED AT DOWNSTREAM END OF CHANNEL
2	CONTAINS 2 DRAINAGE CHANNEL SEGMENTS, N2-NW1 AND N2-NW2.
3	N1B-S2 SUBAREA DRAINS TO C-7, C-8, C-9; CHANNEL DESIGN BASED ON N1B-W2
4	CHANNEL FLOWS ARE LESS THAN SUBAREA FLOWS IN SOME CASES DUE TO STORAGE EFFECTS FROM STORMWATER ROUTING

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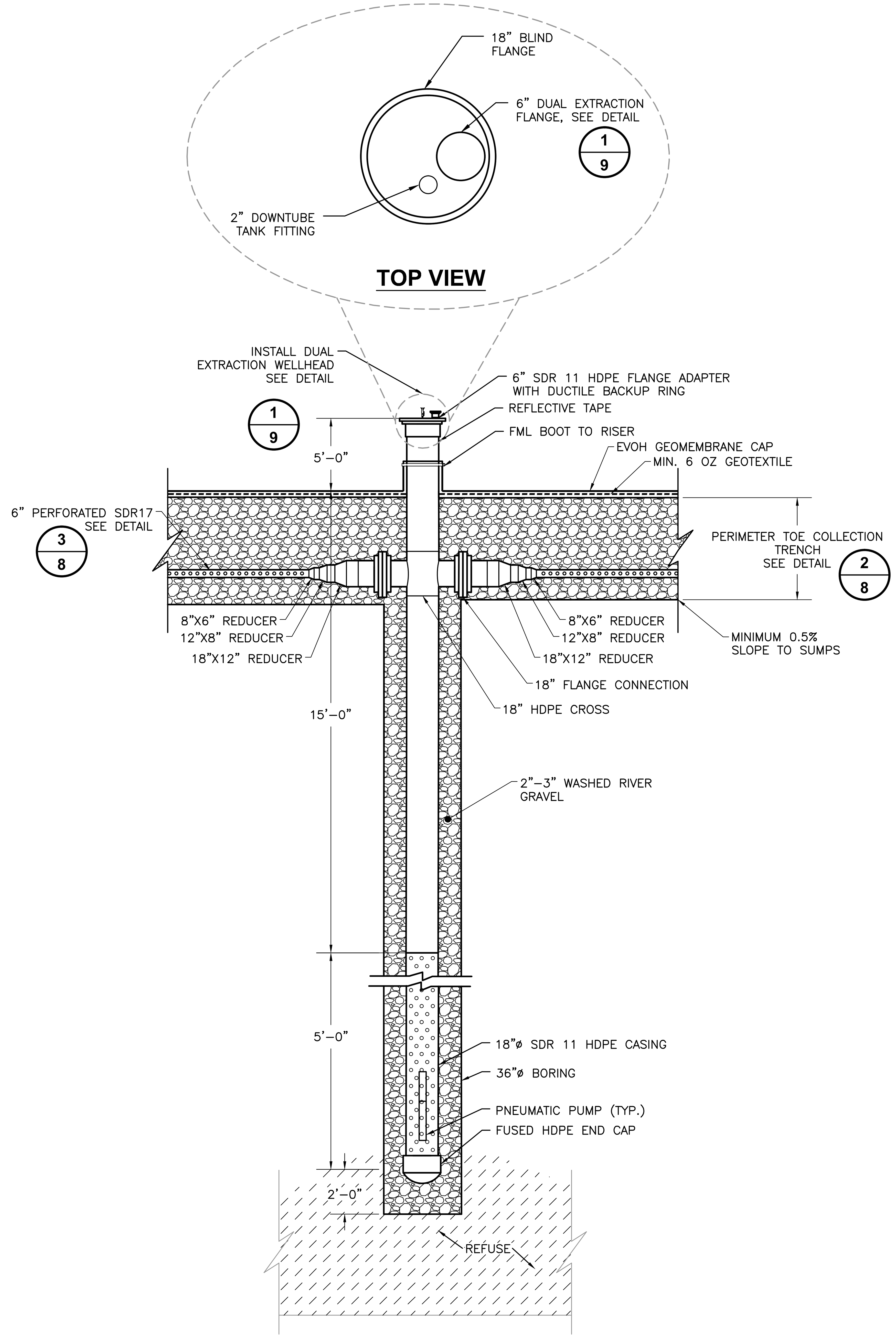
CORNERSTONE Environmental Group, LLC

BRIDGETON LANDFILL, LLC.
BRIDGETON LANDFILL
BRIDGETON, MISSOURI

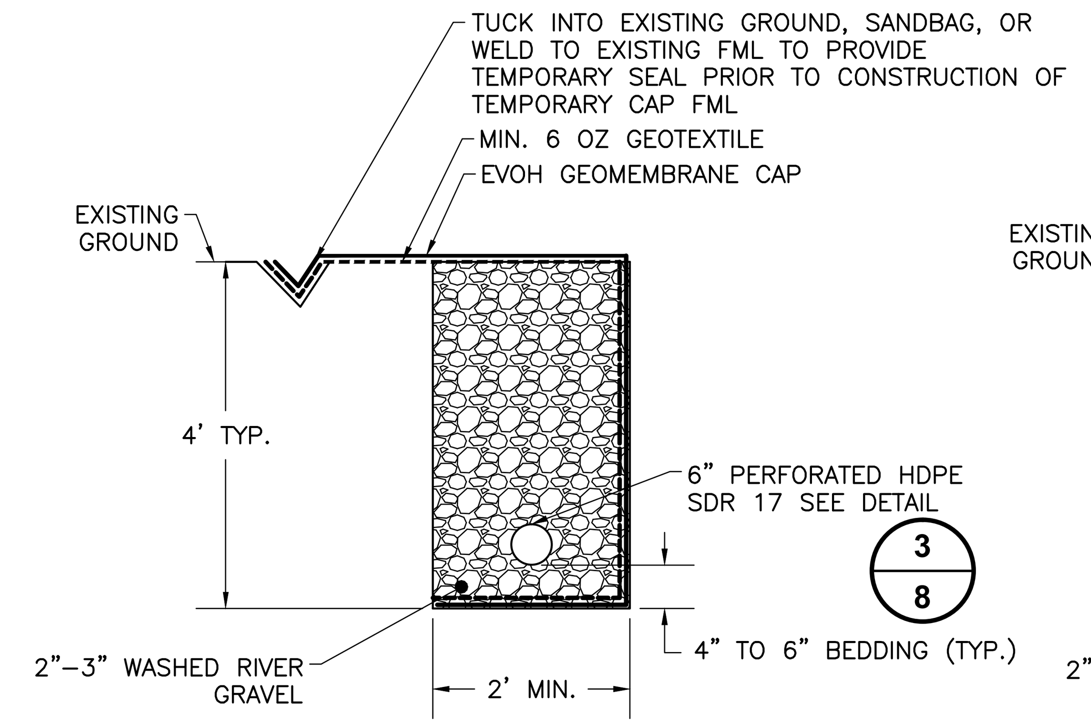
NORTH QUARRY - EVOH GEOMEMBRANE CAP AND CAP INTEGRITY SYSTEM
STORMWATER MANAGEMENT PLAN

SHEET NO. 7
PROJECT NO. 130520

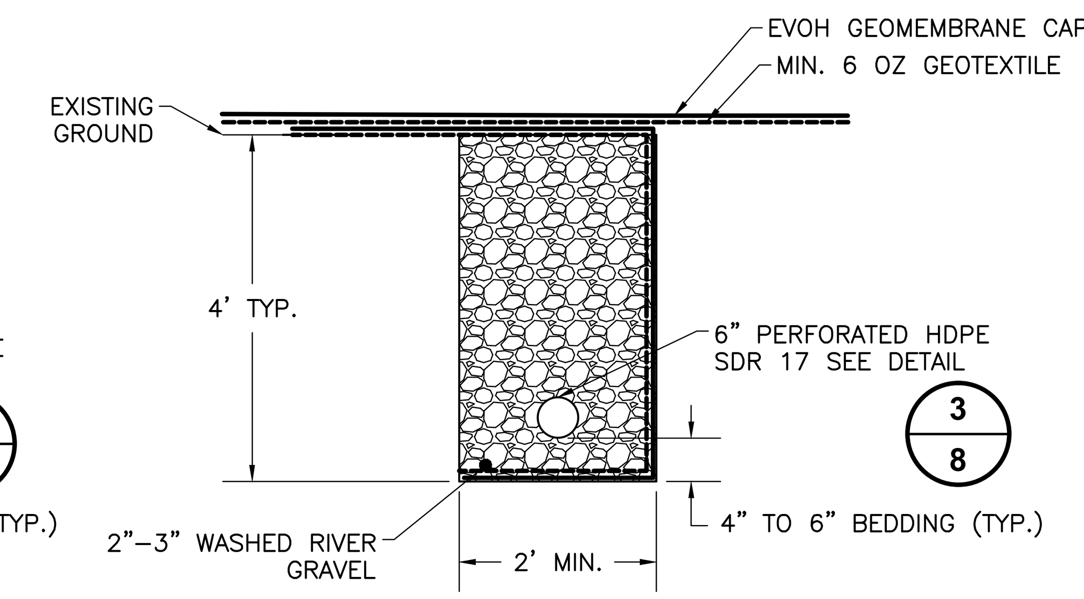


PERIMETER COLLECTION SUMP

DETAIL 1/8
SCALE: NOT TO SCALE



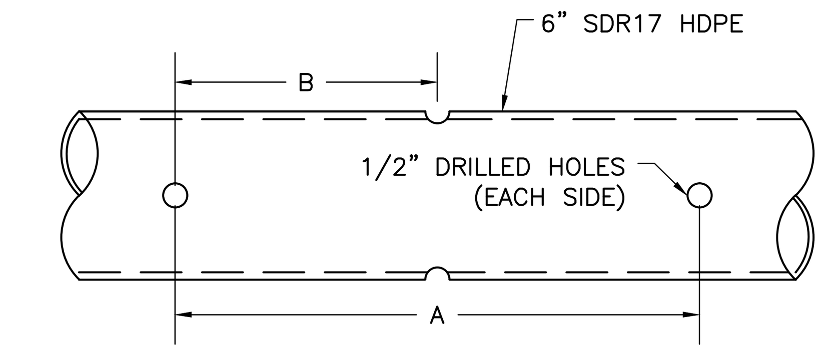
TEMPORARY CONFIGURATION DURING CONSTRUCTION



COMPLETED CONSTRUCTION

PERIMETER TOE COLLECTION TRENCH

DETAIL 2/8
SCALE: NOT TO SCALE



NOTES:

1. A=20"
   B=10"
   90° ROTATION BETWEEN ROWS
2. ALTERNATE PATTERN MAY BE USED WITH APPROVAL OF ENGINEER.

PERIMETER TOE COLLECTION PIPE

DETAIL 3/8
SCALE: NOT TO SCALE

PERIMETER COLLECTION SUMP SCHEDULE

SUMP	NORTHING	EASTING	APPROXIMATE GROUND ELEVATION
PS-01	1067763.3	516222.2	477
PS-02	1067935.5	516292.1	478
PS-03	1067848.1	516448.7	502
PS-04	1067723.4	516531.2	493
PS-05	1067599.6	516633.9	492
PS-06	1067448.2	516764.6	491
PS-07	1067286.9	516882.5	490
PS-08	1067173.8	516744.6	512
PS-09	1067099.2	516649.2	497
PS-10	1066959.1	516506.5	497
PS-11	1066782.8	516414.4	495
PS-12	1066635.2	516279.3	498
PS-13	1066483.9	516148.6	495
PS-14	1066381.5	516031.8	486
PS-15	1066507.5	515812.1	480
PS-16	1066618.4	515655.5	478
PS-17	1066727.4	515491.1	470
PS-18	1066773.0	515422.6	464
PS-19	1066964.9	515356.4	471
PS-20	1067072.2	515382.3	467
PS-21	1067252.4	515467.1	468
PS-22	1067401.6	515599.2	475
PS-23	1067546.0	515733.7	474
PS-24	1067597.2	515919.7	471
PS-25	1067604.9	516102.5	471

STATE OF MISSOURI
ADAM STEVEN LAZY
NUMBER E-22606
REGISTERED PROFESSIONAL ENGINEER
7/26/13

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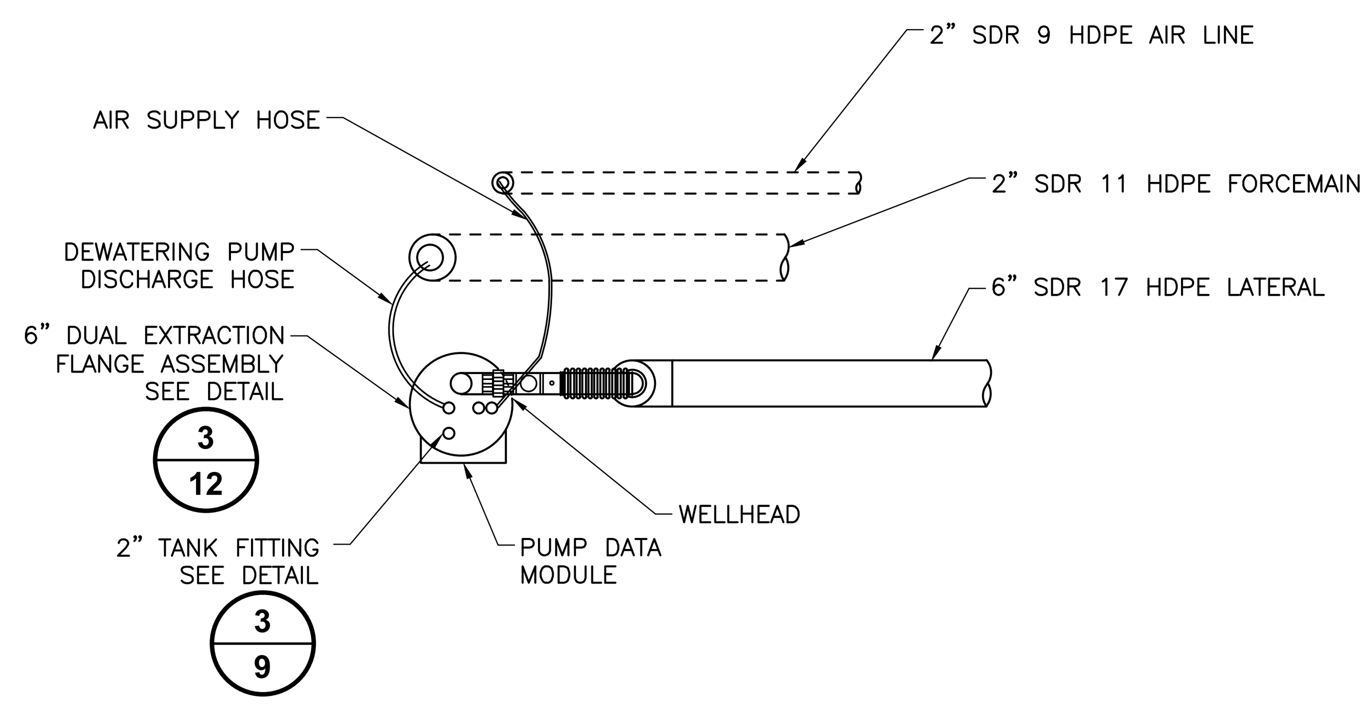
BRIDGETON LANDFILL, LLC.
BRIDGETON LANDFILL
BRIDGETON, MISSOURI

NORTH QUARRY - EVOH GEOMEMBRANE CAP AND CAP INTEGRITY SYSTEM
DETAILS

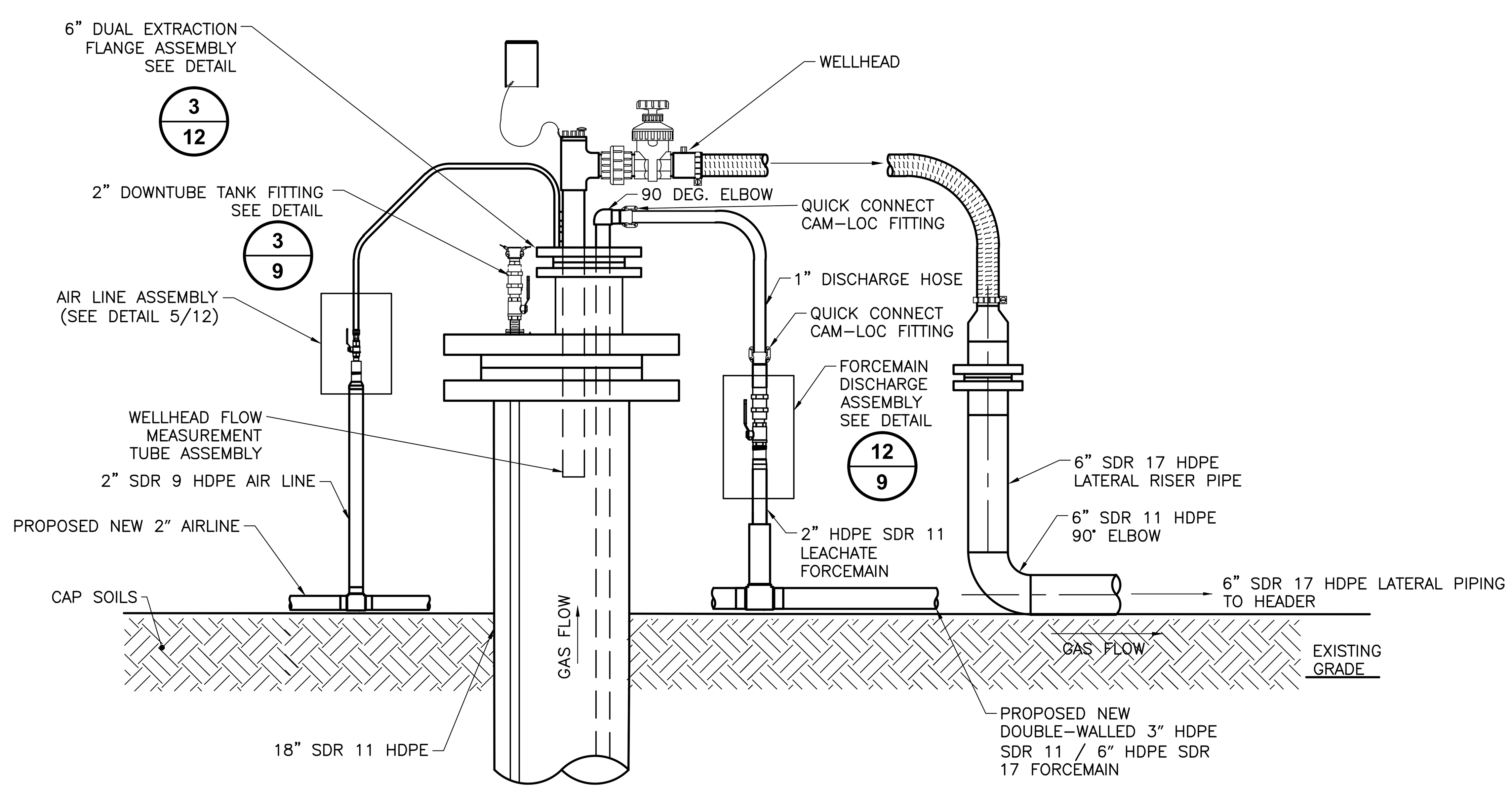
SHEET NO. 8
PROJECT NO. 130520

File: X:\PROJECTS\BRIDGETON (MO)\130520 – NORTH QUARRY CONTINGENCY PLAN_PROJECT DWGS\CAP PLANS\FHBL NQ DETS.dwg Layout: 08-DETAILS User: ed.jonkun Jul 26, 2013 – 2:15pm

1" 1/2" 0" 1"



TOP VIEW



PROFILE VIEW

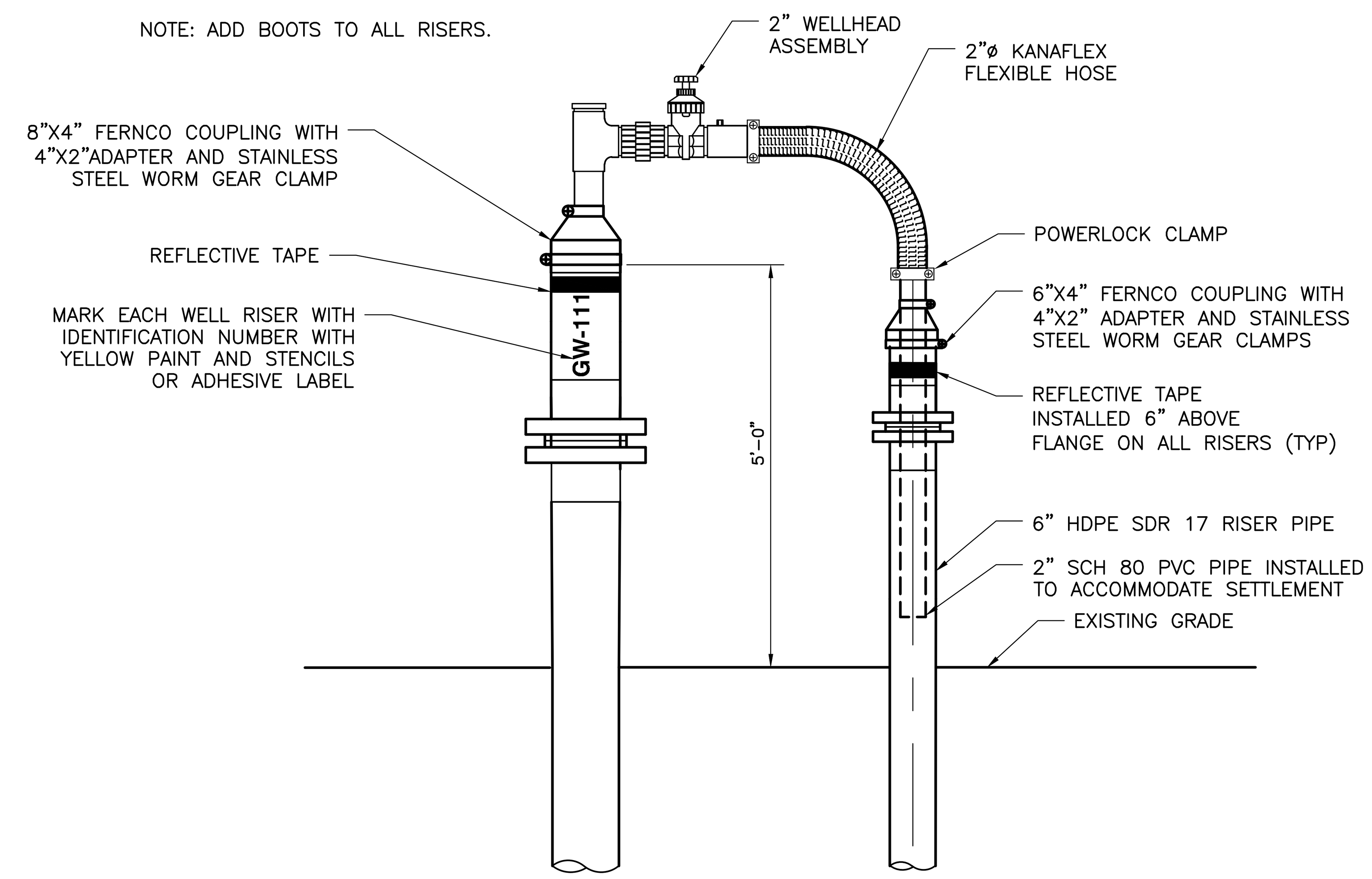
COLLECTION SUMP

DETAIL 1/9
SCALE: NOT TO SCALE

NOTES:

1. CONTRACTOR TO UTILIZE OWNER-APPROVED WELLHEAD ASSEMBLY. CONTRACTOR TO OBTAIN OWNER PREFERENCE FOR WELLHEAD ASSEMBLY.
2. PROVIDE HIGH VISIBILITY TAPE OR PAINT AROUND TOP 1-FOOT OF WELL CASING AND LATERAL PIPE.
3. AIR AND FORCEMAIN RISERS TO BE INSTALLED TO WITHIN 2' FROM SUMP.

NOTE: ADD BOOTS TO ALL RISERS.

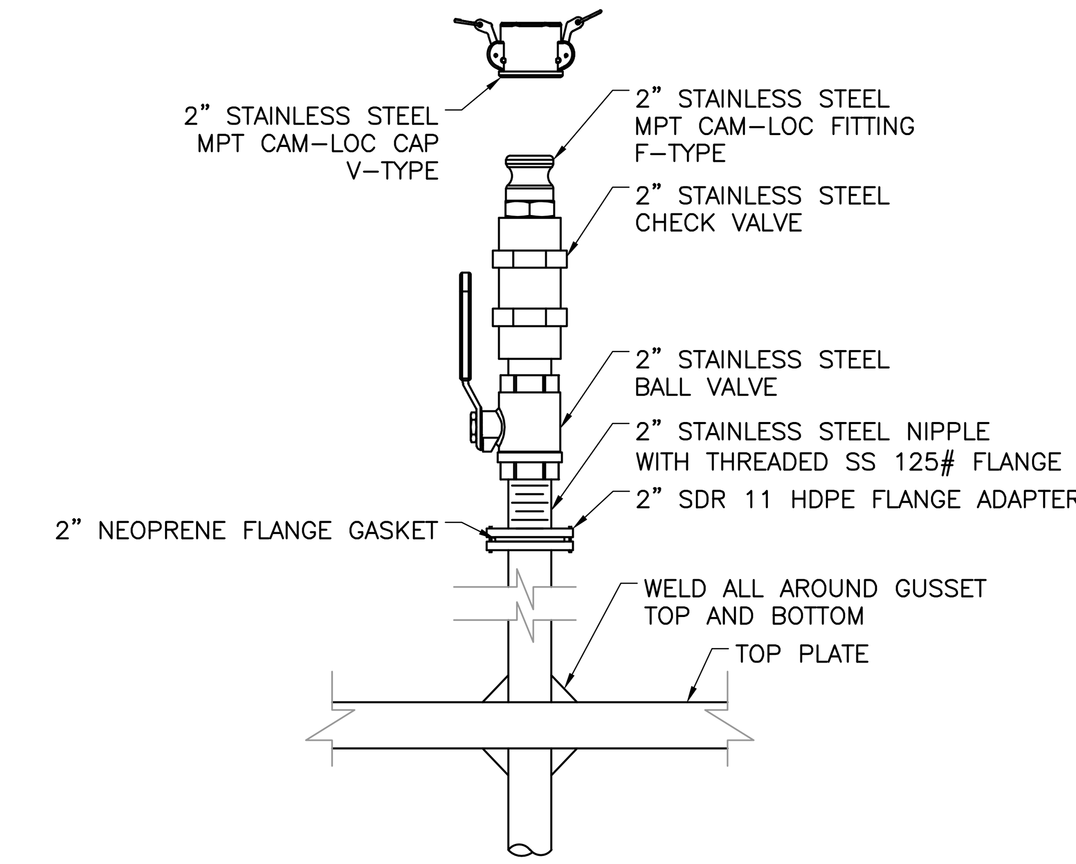


WELLHEAD

DETAIL 2/9
SCALE: NOT TO SCALE

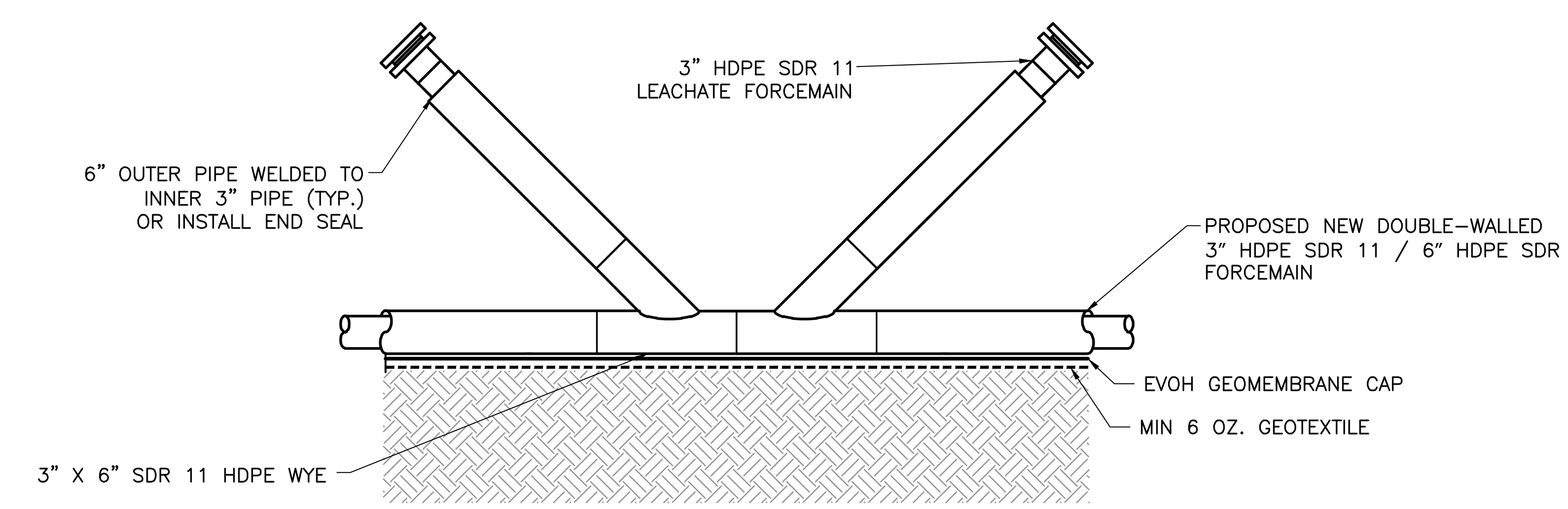
NOTES:

1. CONTRACTOR TO UTILIZE OWNER-APPROVED WELLHEAD ASSEMBLY. CONTRACTOR TO OBTAIN OWNER PREFERENCE FOR WELLHEAD ASSEMBLY.
2. PROVIDE HIGH VISIBILITY TAPE OR PAINT AROUND TOP 1-FOOT OF WELL CASING AND LATERAL PIPE.
3. CONTRACTOR TO INSURE DRAINAGE OF SURFACE WATER AWAY FROM THE WELLHEAD.
4. LATERAL PIPING MUST DRAIN TO THE MAIN HEADER, AWAY FROM THE WELLHEAD, AT A MINIMUM SLOPE OF 3%.



2" DOWNTUBE TANK FITTING

DETAIL 3/9
SCALE: NOT TO SCALE



FORCEMAIN CLEANOUT RISERS

DETAIL 4/9
SCALE: NOT TO SCALE

STATE OF MISSOURI ADAM STEVEN LOCY NUMBER E-25626 REGISTERED PROFESSIONAL ENGINEER
7/26/13

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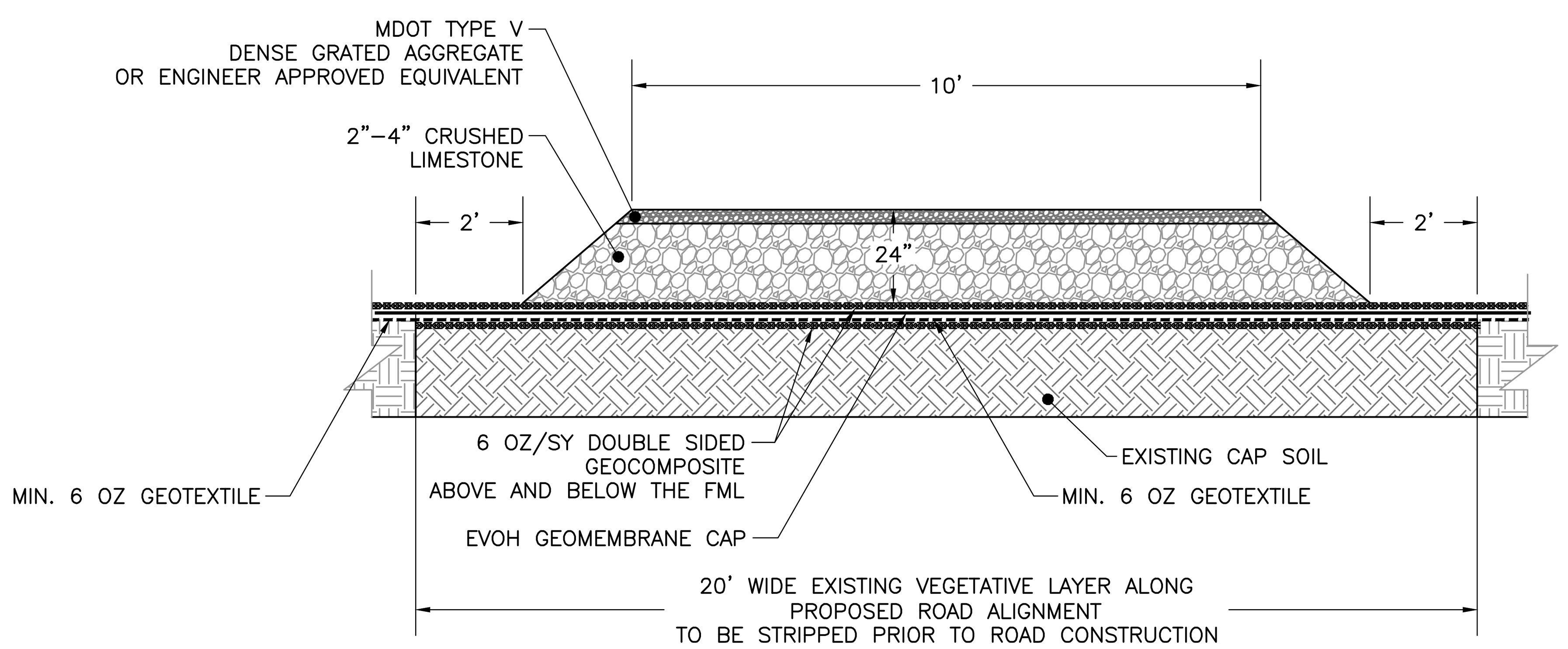
BRIDGETON LANDFILL, LLC.
BRIDGETON LANDFILL
BRIDGETON, MISSOURI

NORTH QUARRY - EVOH GEOMEMBRANE CAP AND CAP INTEGRITY SYSTEM
DETAILS

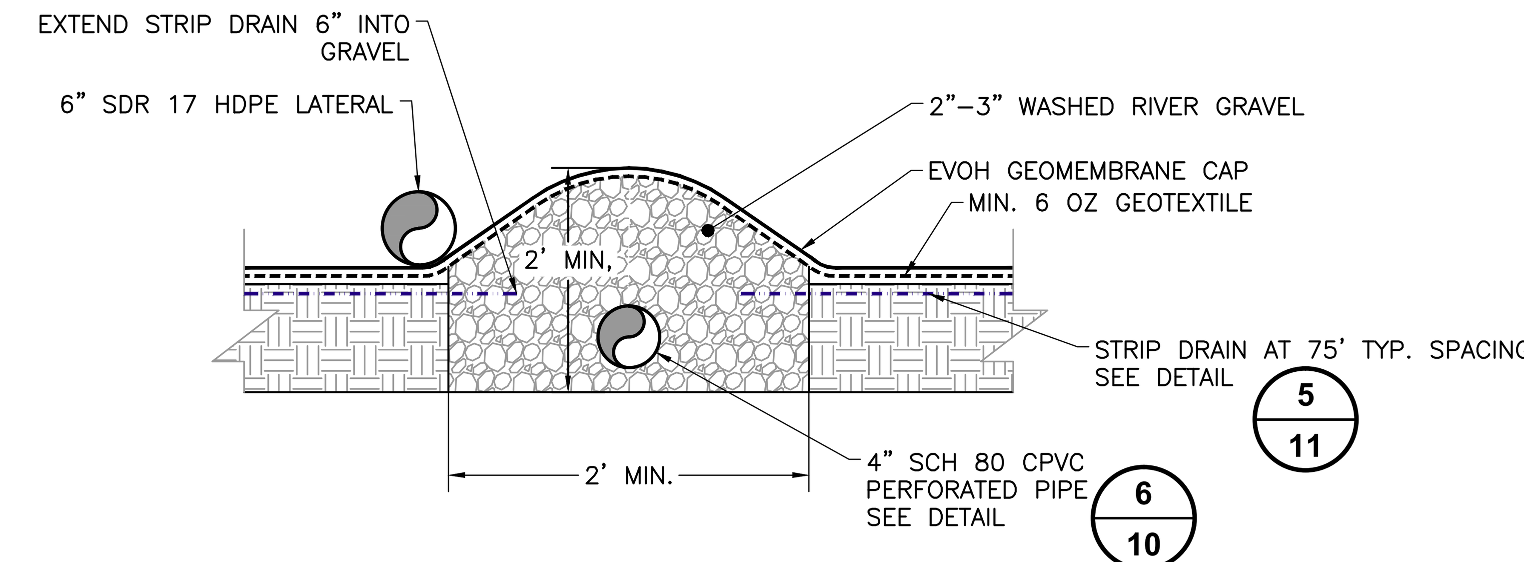
SHEET NO. 9
PROJECT NO. 130520

File: K:\PROJECTS\BRIDGETON (MO)\130520 - NORTH QUARRY CONTINGENCY PLAN_PROJECT DWGS\CAP PLANS\PHBL NQ DETS.dwg Layout: 09 - DETAILS User: edjenkun Jul 26, 2013 - 2:15pm



LIGHT-DUTY ACCESS ROAD

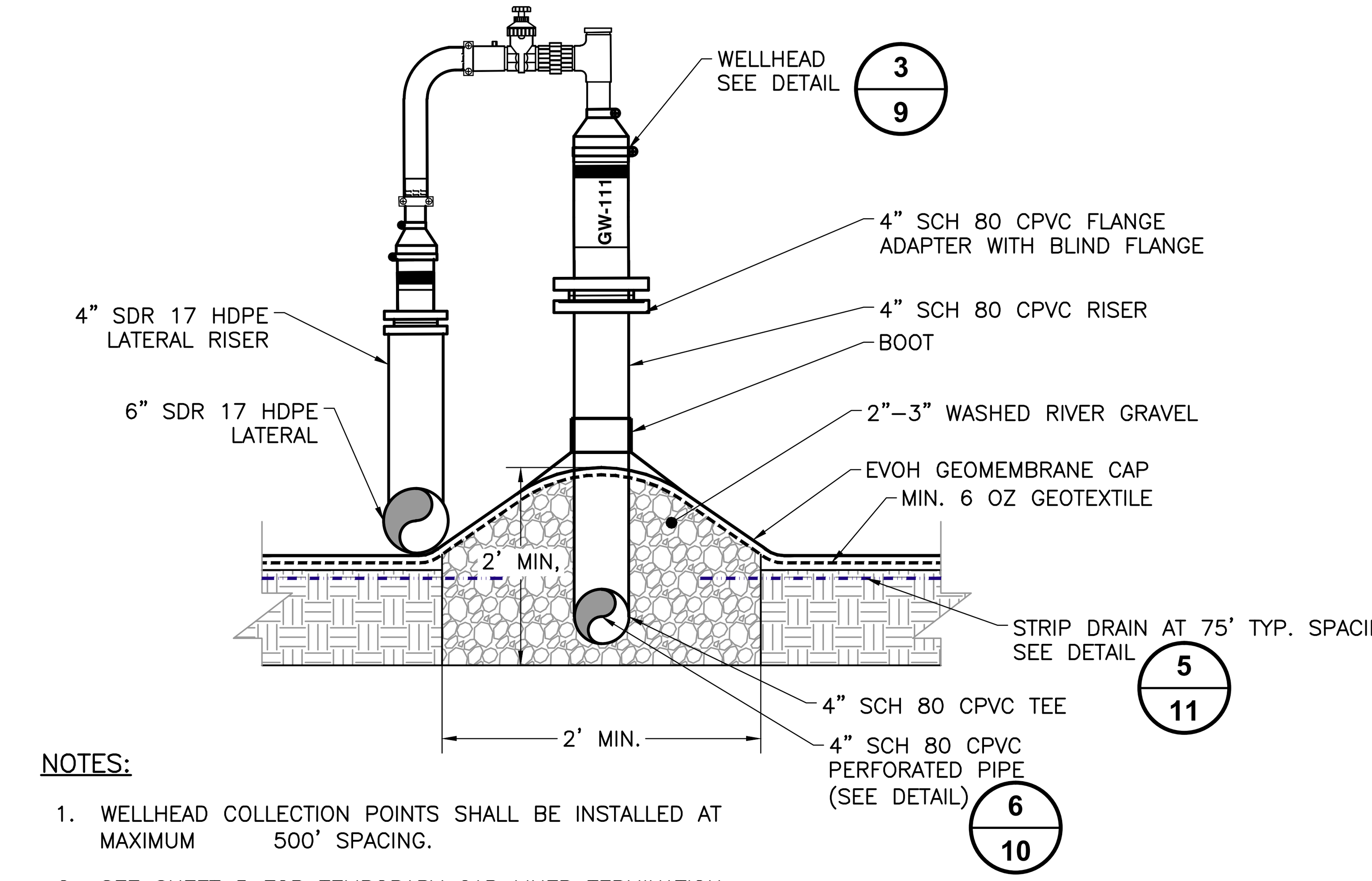
DETAIL 1/10
SCALE: NOT TO SCALE



NOTE:
WELLHEAD COLLECTION POINTS SHALL BE
INSTALLED AT MAXIMUM 500' SPACING

TEMPORARY CAP INTEGRITY BERM COLLECTOR

DETAIL 2/10
SCALE: NOT TO SCALE

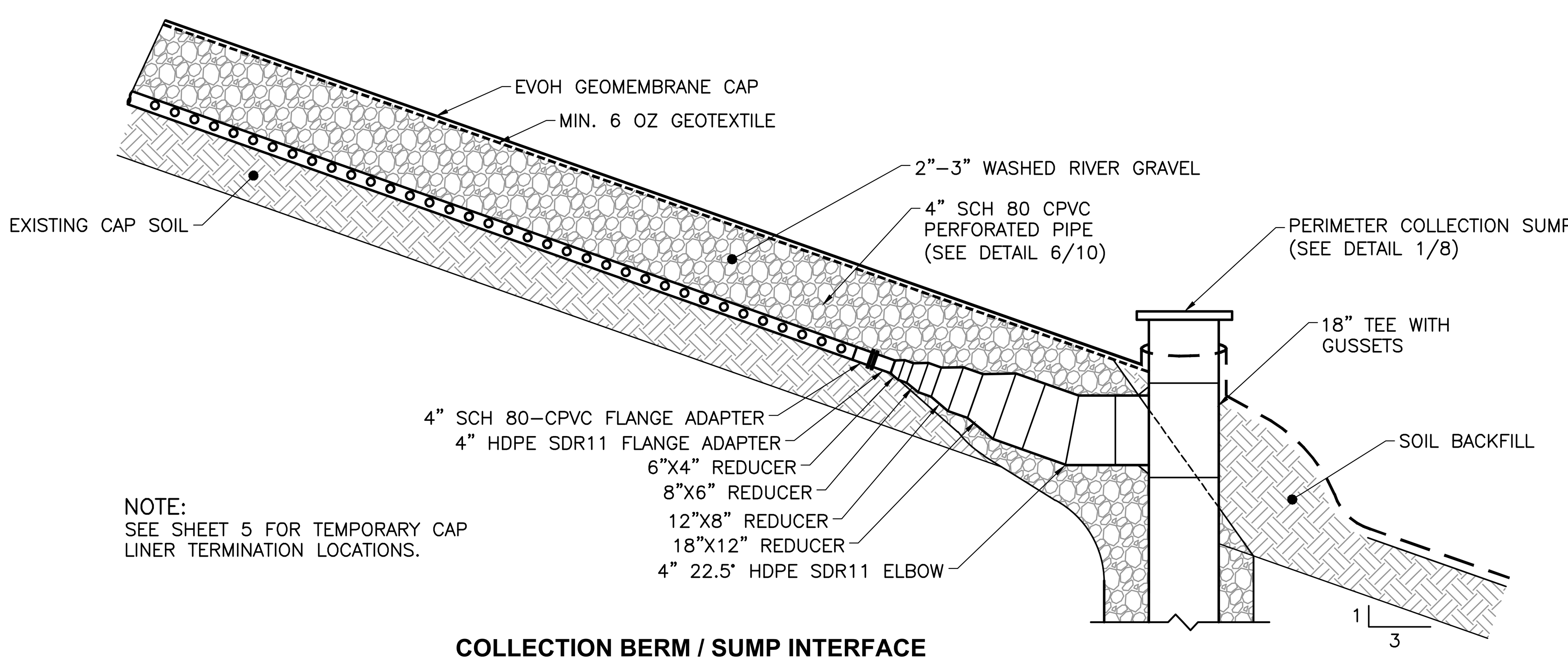


NOTES:

1. WELLHEAD COLLECTION POINTS SHALL BE INSTALLED AT MAXIMUM 500' SPACING.
2. SEE SHEET 5 FOR TEMPORARY CAP LINER TERMINATION LOCATIONS.

TEMPORARY CAP INTEGRITY BERM COLLECTOR WITH RISER

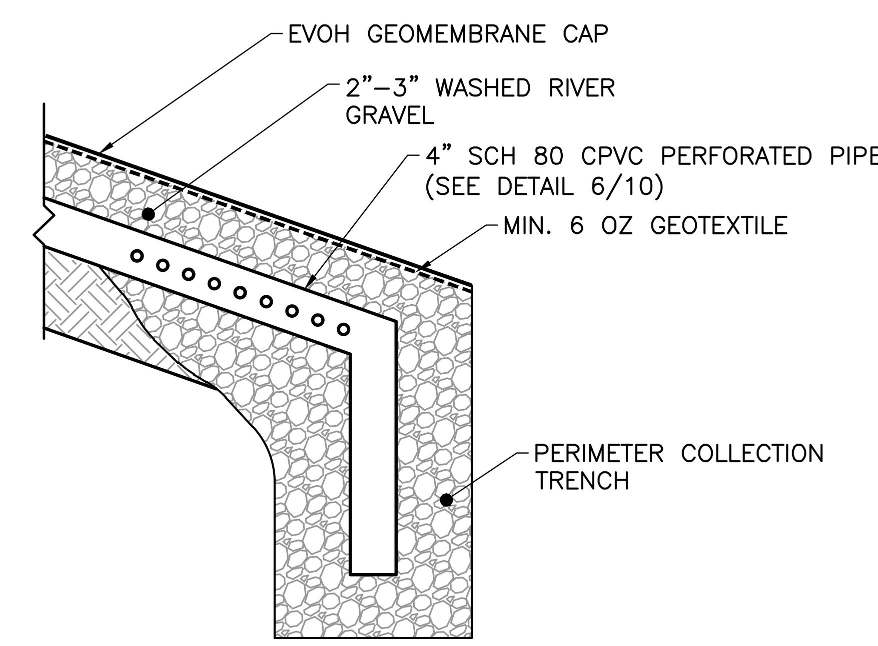
DETAIL 3/10
SCALE: NOT TO SCALE



NOTE:
SEE SHEET 5 FOR TEMPORARY CAP
LINER TERMINATION LOCATIONS.

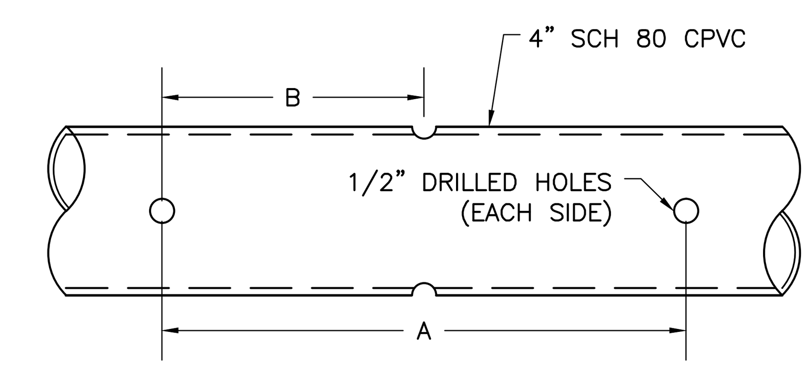
COLLECTION BERM / SUMP INTERFACE

DETAIL 4/10
SCALE: NOT TO SCALE



COLLECTOR BERM TERMINATION

DETAIL 5/10
SCALE: NOT TO SCALE

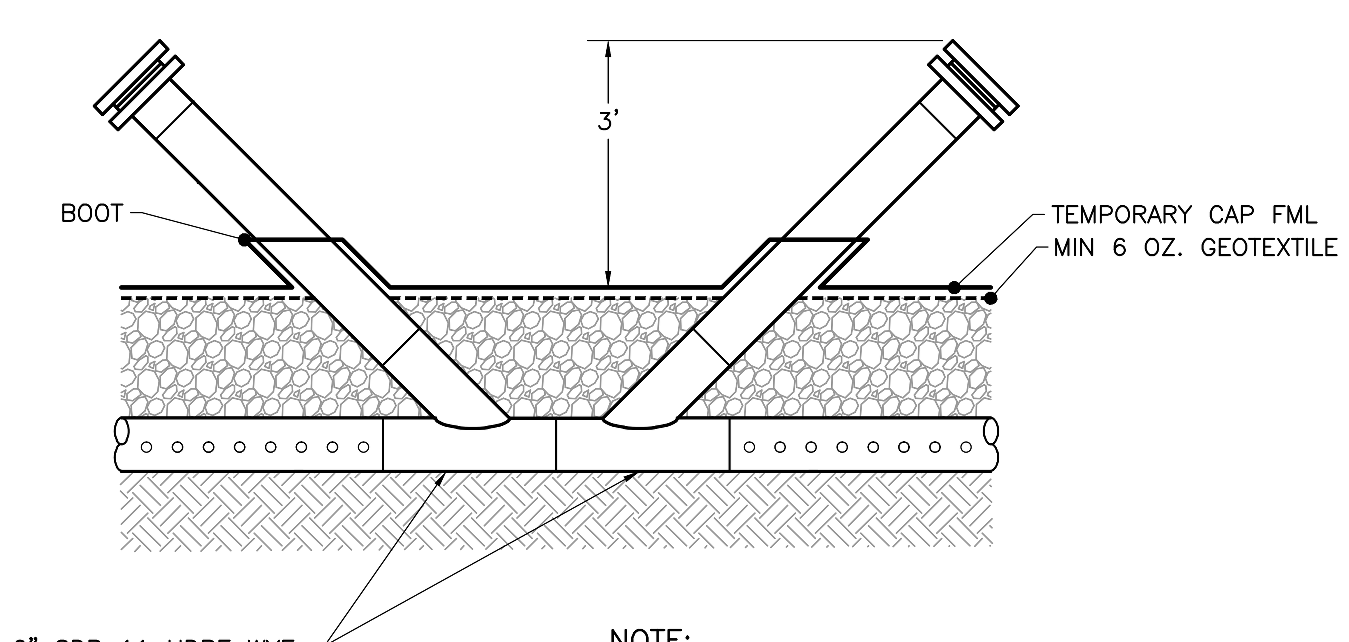


NOTES:

1. A=20"
B=10"
90' ROTATION BETWEEN ROWS
2. ALTERNATE PATTERN MAY BE USED WITH APPROVAL OF EM.

HORIZONTAL COLLECTION PIPE

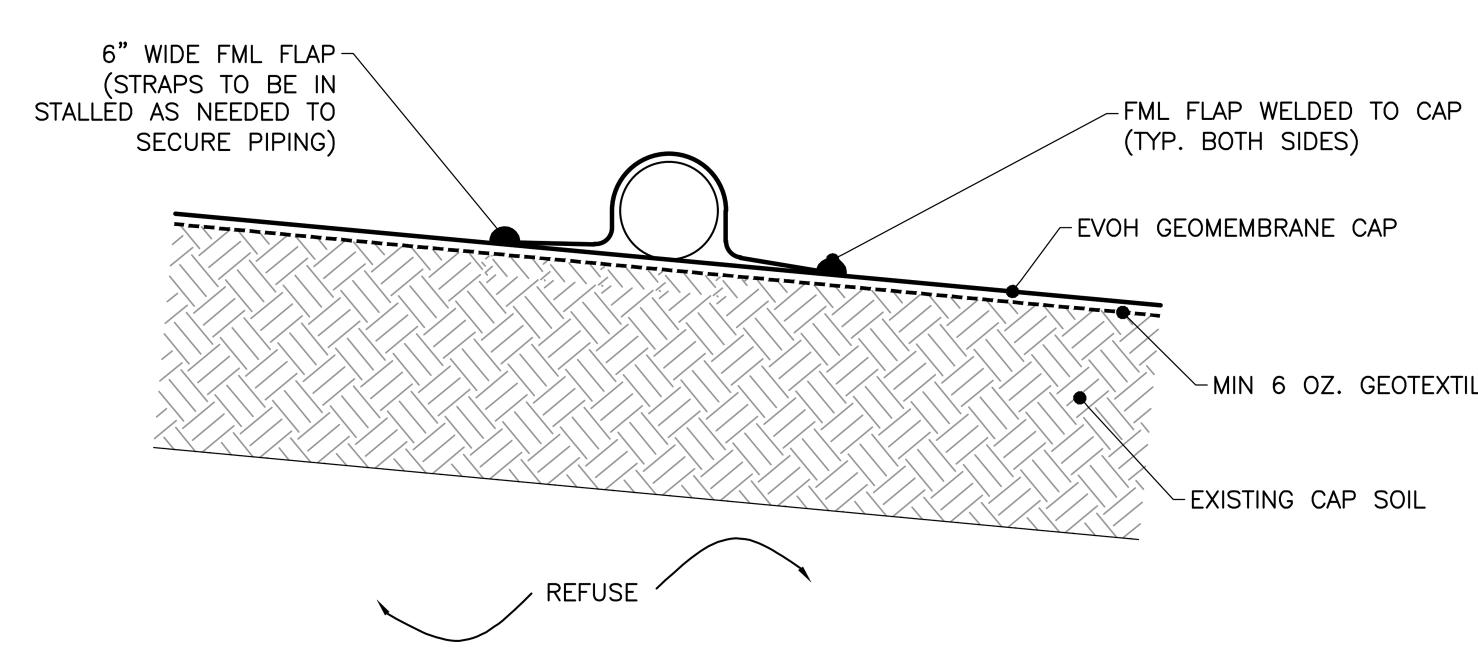
DETAIL 6/10
SCALE: NOT TO SCALE



NOTE:
INSTALL AT 500' INTERVAL OR
MID-POINT BETWEEN SUMPS.

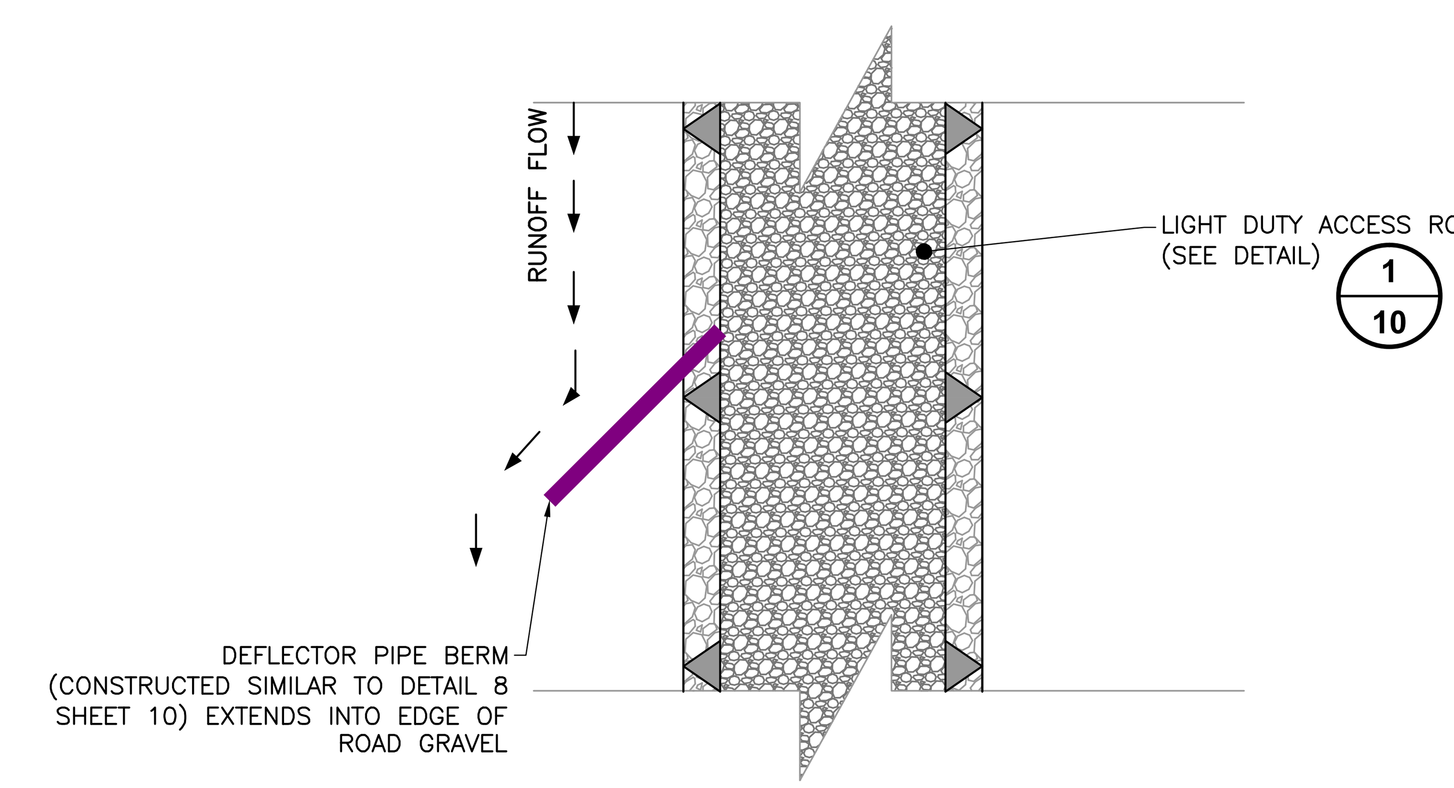
PERIMETER COLLECTOR TRENCH CLEANOUT RISERS

DETAIL 7/10
SCALE: NOT TO SCALE



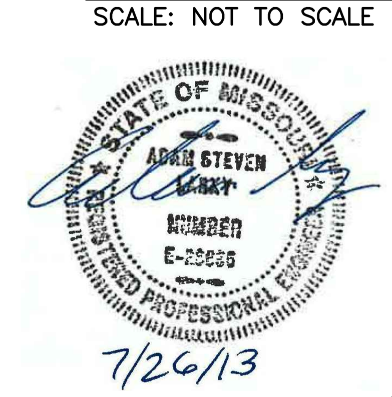
ABOVE CAP PIPE ANCHOR

DETAIL 8/10
SCALE: NOT TO SCALE



DEFLECTOR PIPE BERM

DETAIL 9/10
SCALE: NOT TO SCALE



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BRIDGETON, MISSOURI

NORTH QUARRY - EVOH GEOMEMBRANE CAP AND CAP INTEGRITY SYSTEM
DETAILS

SHEET NO. **10**

PROJECT NO. 130520

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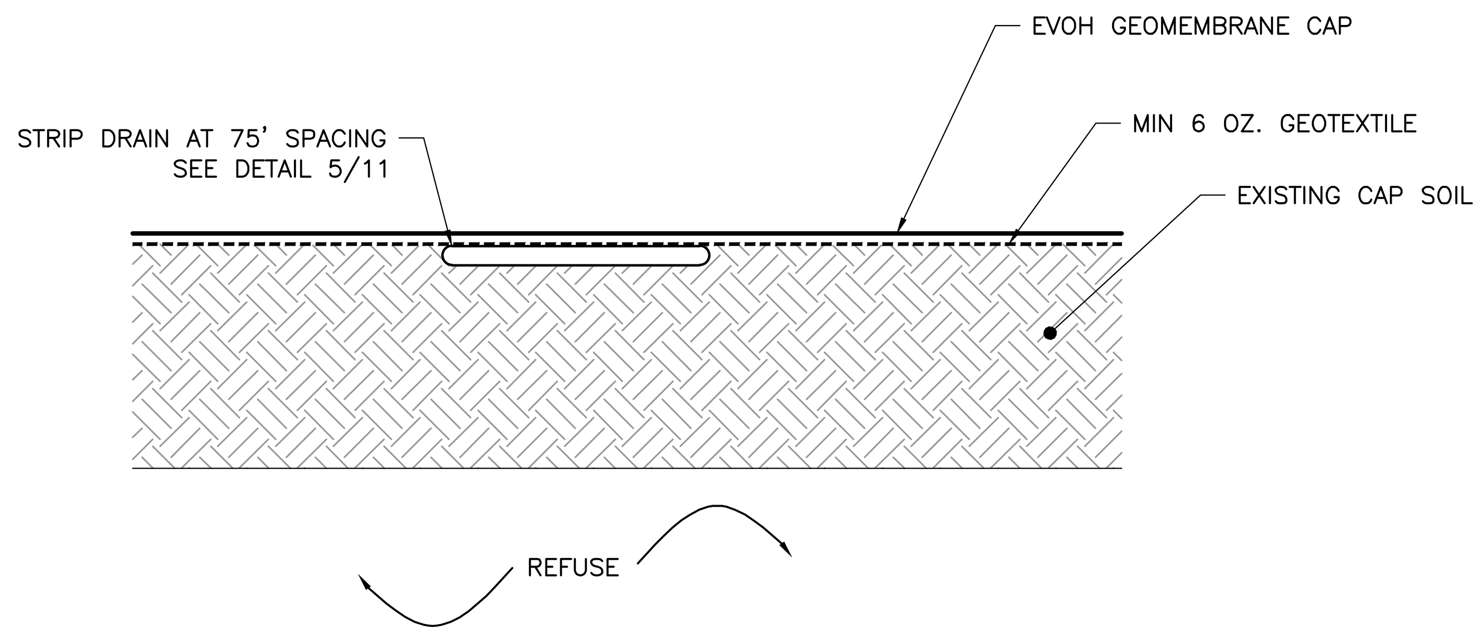
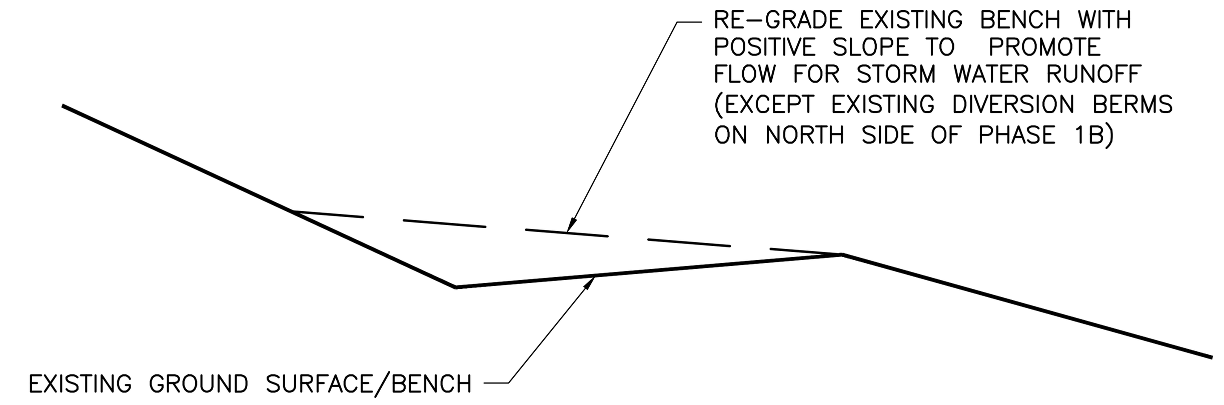


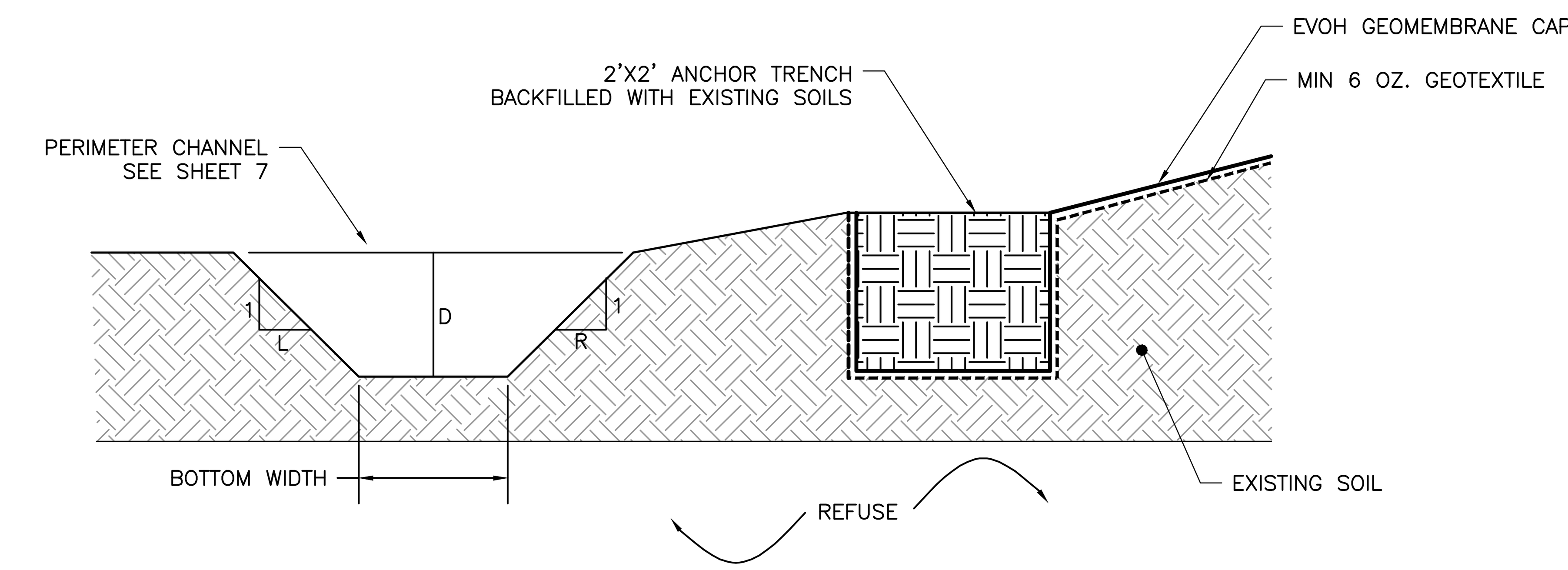
TYPICAL EVOH GEOMEMBRANE CAP

DETAIL 1/11
SCALE: NOT TO SCALE



EXISTING BENCH RE-GRADE

DETAIL 2/11
SCALE: NOT TO SCALE

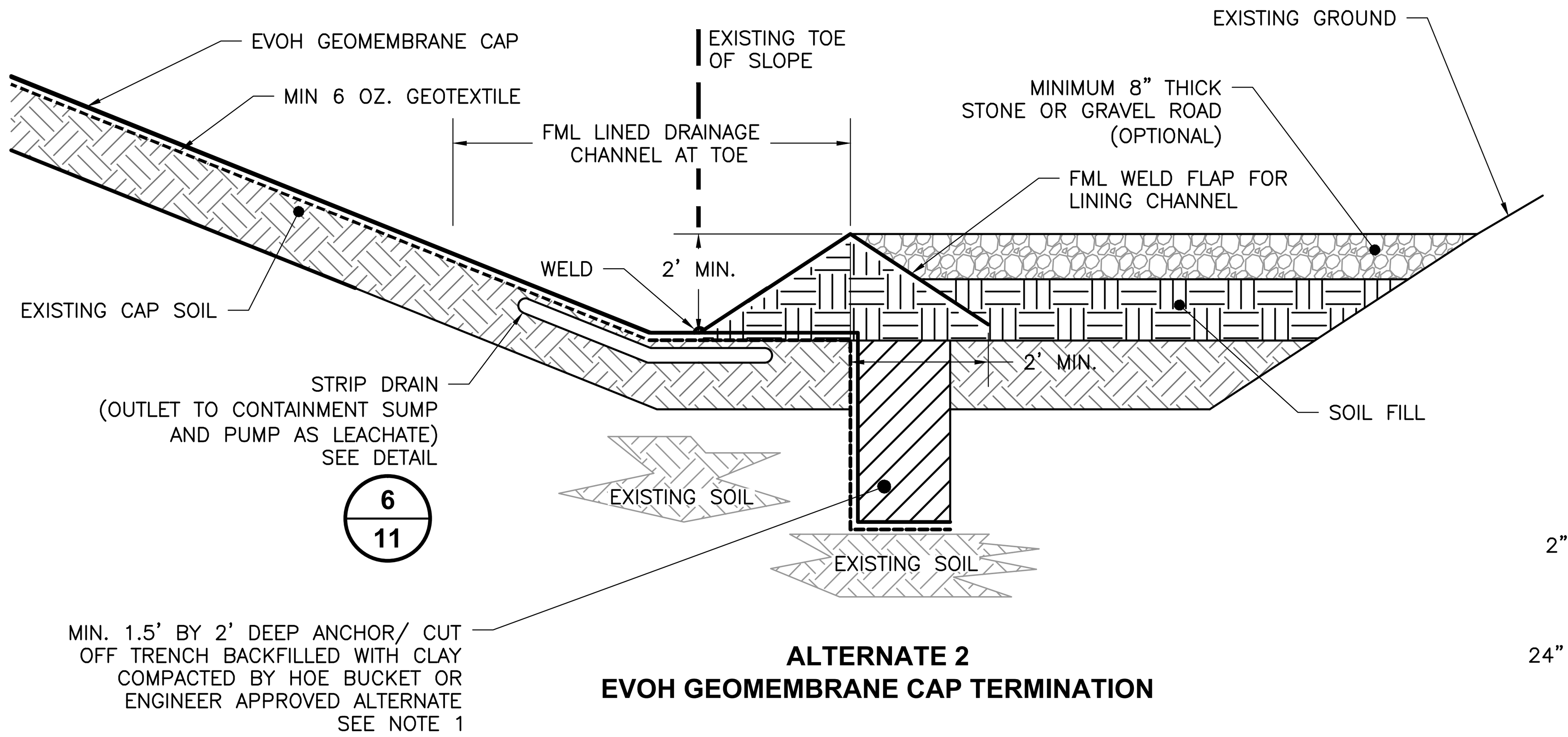


ALTERNATE 1 EVOH GEOMEMBRANE CAP TERMINATION

DETAIL 3/11
SCALE: NOT TO SCALE

NOTES:

1. ALTERNATE 1 LINER TERMINATION DETAIL IS TO BE USED FOR THE TYPICAL LINER TERMINATION.
2. ALTERNATE 2 LINER TERMINATION DETAIL IS PROVIDED FOR USE AT LOCATIONS WHERE A PERIMETER CHANNEL MAY NEED TO BE BUILT UP ON THE LOWER EDGE OF CAP (DUE TO UNDULATING TOPOGRAPHY) TO ACHIEVE POSITIVE DRAINAGE SLOPE FOR THE PERIMETER CHANNEL.

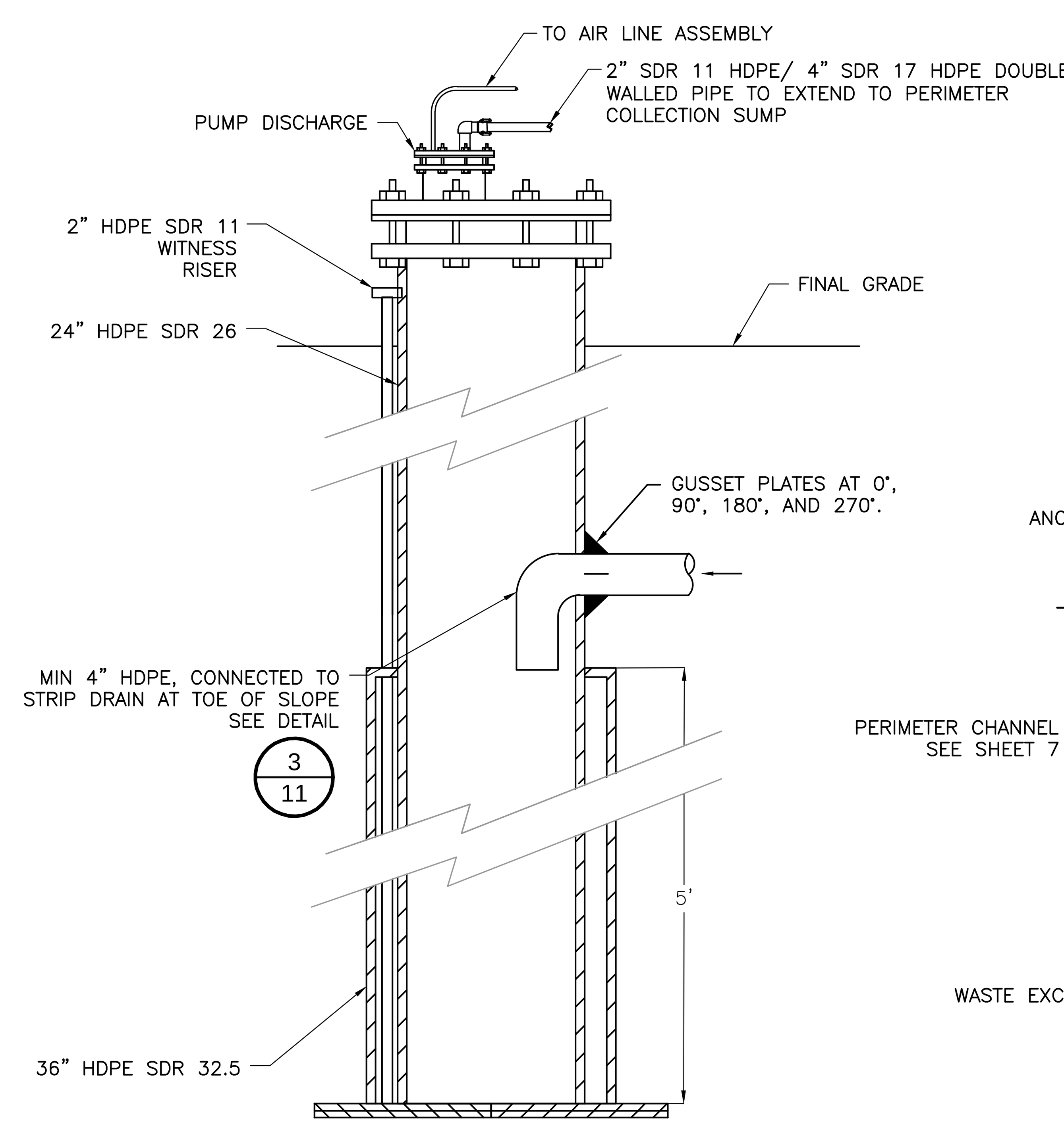


ALTERNATE 2
EVOH GEOMEMBRANE CAP TERMINATION

DETAIL 4/11
SCALE: NOT TO SCALE

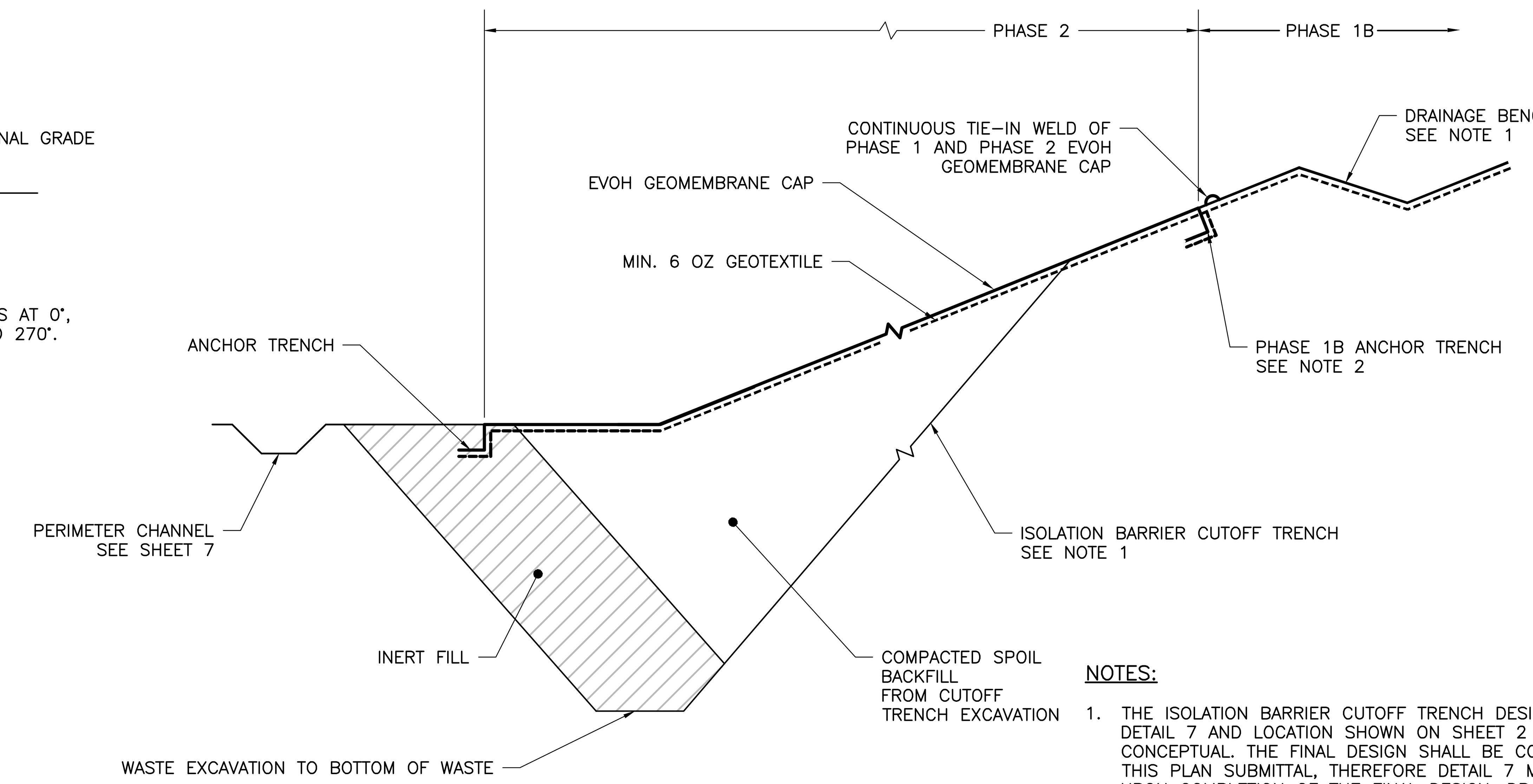
NOTES:

1. ALTERNATE 1 LINER TERMINATION DETAIL IS TO BE USED FOR THE TYPICAL LINER TERMINATION.
2. ALTERNATE 2 LINER TERMINATION DETAIL IS PROVIDED FOR USE AT LOCATIONS WHERE A PERIMETER CHANNEL MAY NEED TO BE BUILT UP ON THE LOWER EDGE OF CAP (DUE TO UNDULATING TOPOGRAPHY) TO ACHIEVE POSITIVE DRAINAGE SLOPE FOR THE PERIMETER CHANNEL.



CONTAINMENT SUMP PUMP STATION
FOR TOE STRIP DRAIN

DETAIL 6/11
SCALE: NOT TO SCALE

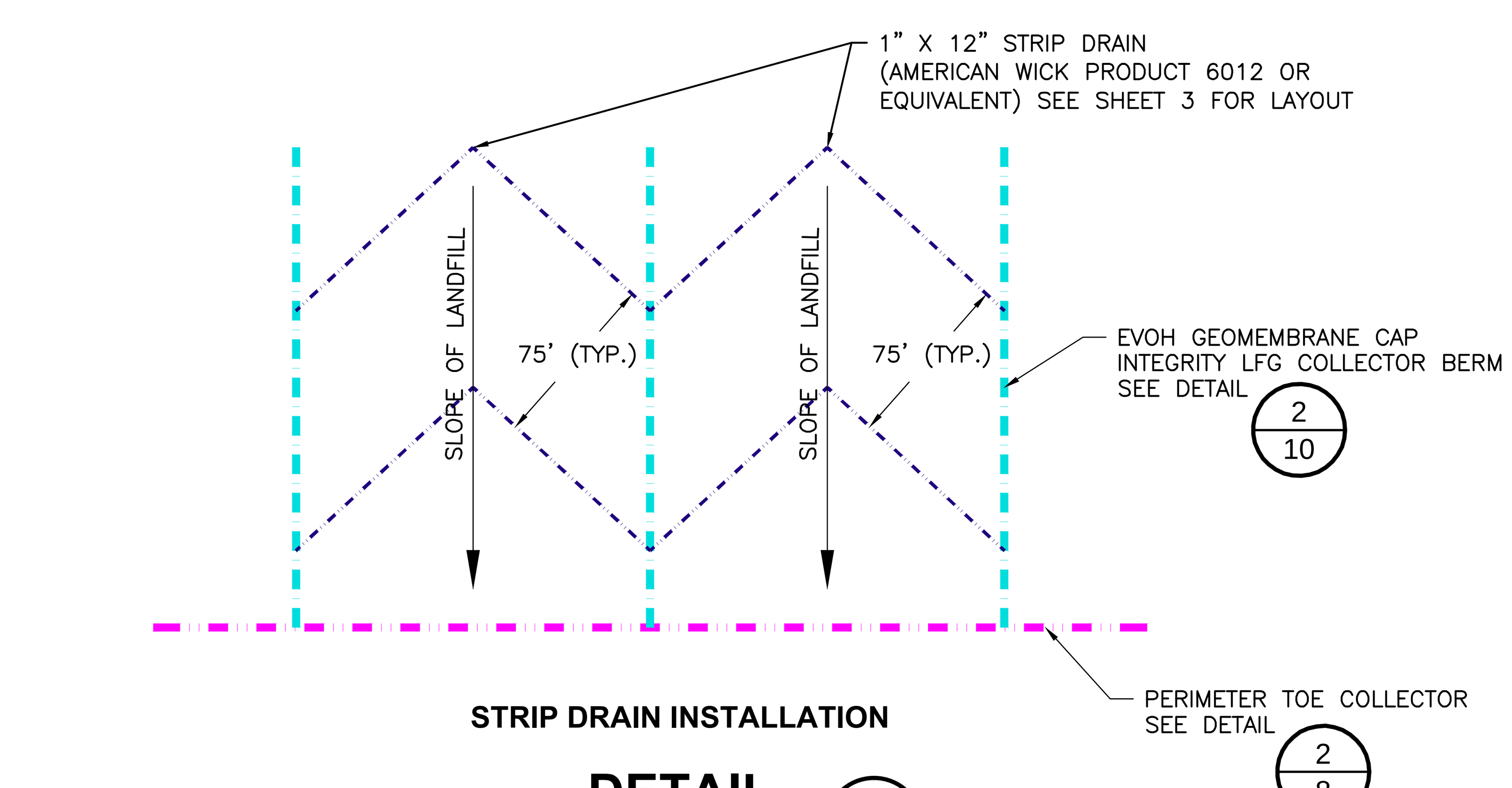


PHASE 1B/PHASE 2
TYPICAL CROSS SECTION

DETAIL 7/11
SCALE: NOT TO SCALE

NOTES:

1. THE ISOLATION BARRIER CUTOFF TRENCH DESIGN SHOWN IN DETAIL 7 AND LOCATION SHOWN ON SHEET 2 ARE CONCEPTUAL. THE FINAL DESIGN SHALL BE COMPLETED AFTER THIS PLAN SUBMITTAL, THEREFORE DETAIL 7 MAY BE REVISED UPON COMPLETION OF THE FINAL DESIGN. DRAINAGE BENCHES HAVE BEEN DESIGNED UP SLOPE OF THE ISOLATION BARRIER CUTOFF TRENCH EXCAVATION TO COLLECT AND DIVERT STORM WATER AWAY FROM THE TRENCH EXCAVATION LIMIT. THE DRAINAGE BENCH IS DESIGNED WITH A 1.5 FOOT DEPTH AND BENCH SLOPE OF 6H : 1V. LOCATIONS OF THE DRAINAGE BENCH SHALL BE FINALIZED AFTER FINAL DESIGN OF THE ISOLATION BARRIER CUTOFF TRENCH.
2. THE PHASE 2 EVOH GEOMEMBRANE CAP SHALL BE CONTINUOUSLY WELDED TO THE PHASE 1B EVOH GEOMEMBRANE CAP. THE PHASE 1B ANCHOR TRENCH SHALL BE LEFT IN PLACE AND THE NEW EVOH GEOMEMBRANE FOR PHASE 2 OVERLAPPED OVER THE PHASE 1 EVOH GEOMEMBRANE AND THEN WELDED CONTINUOUSLY.



STRIP DRAIN INSTALLATION

DETAIL 5/11
SCALE: NOT TO SCALE

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SHEET NO. 11
PROJECT NO. 130520

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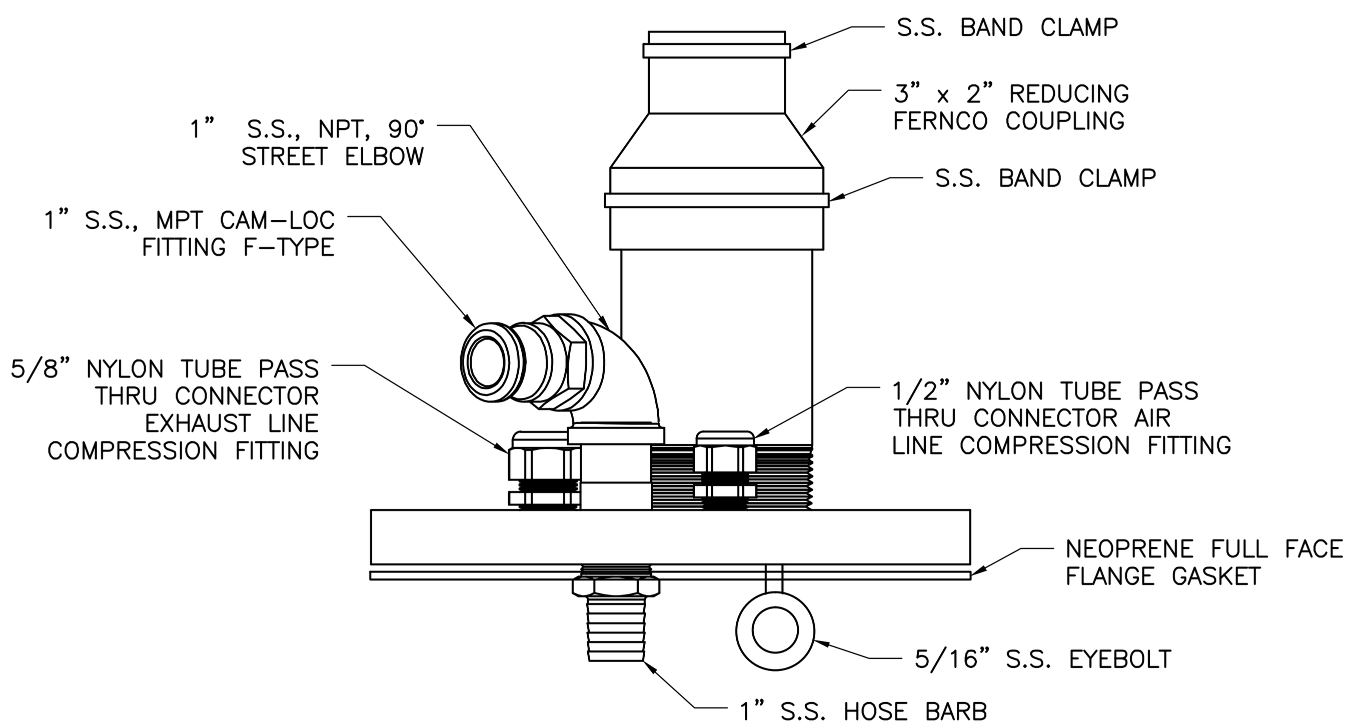
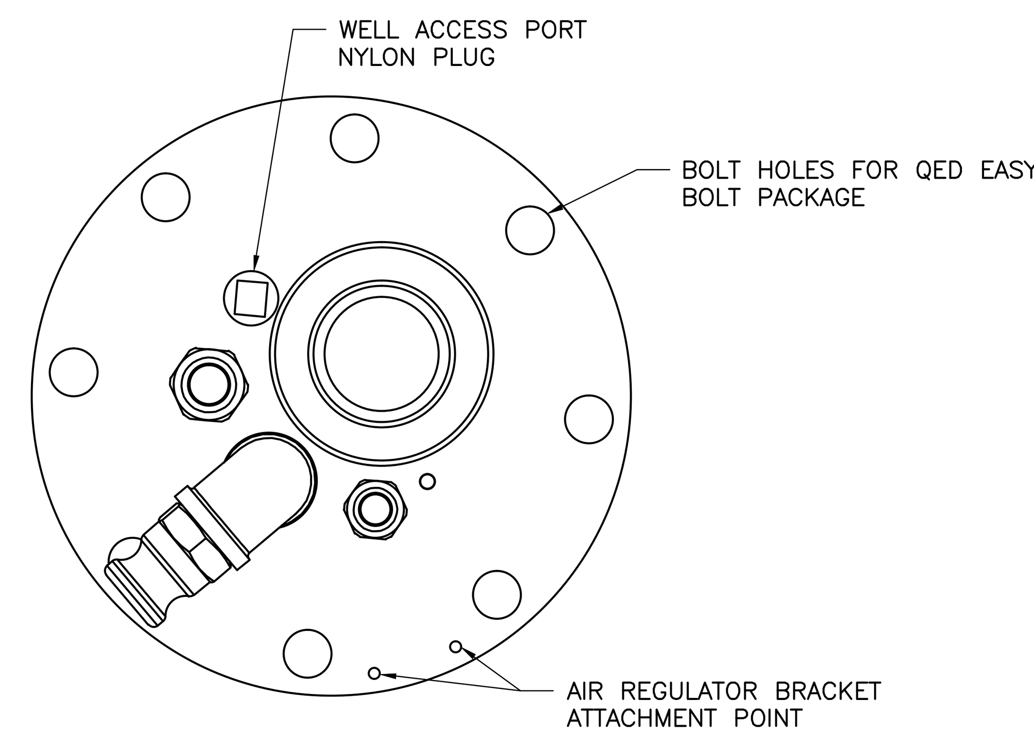
1" 1/2" 0" 1"



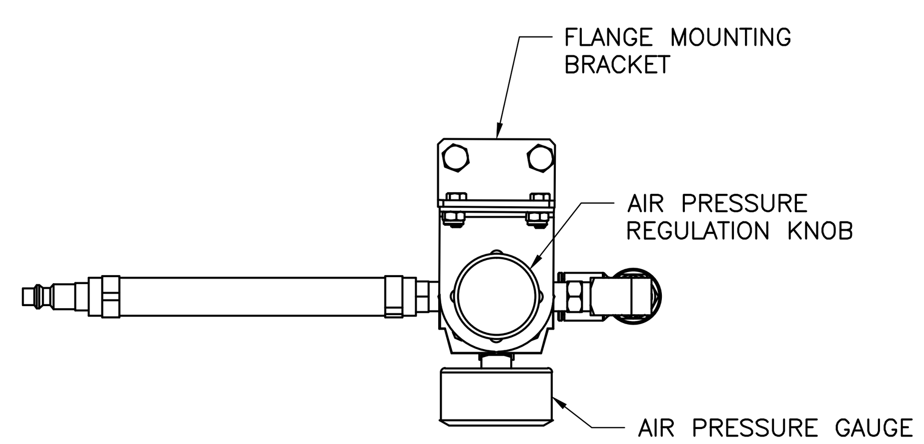
SIDE VIEW



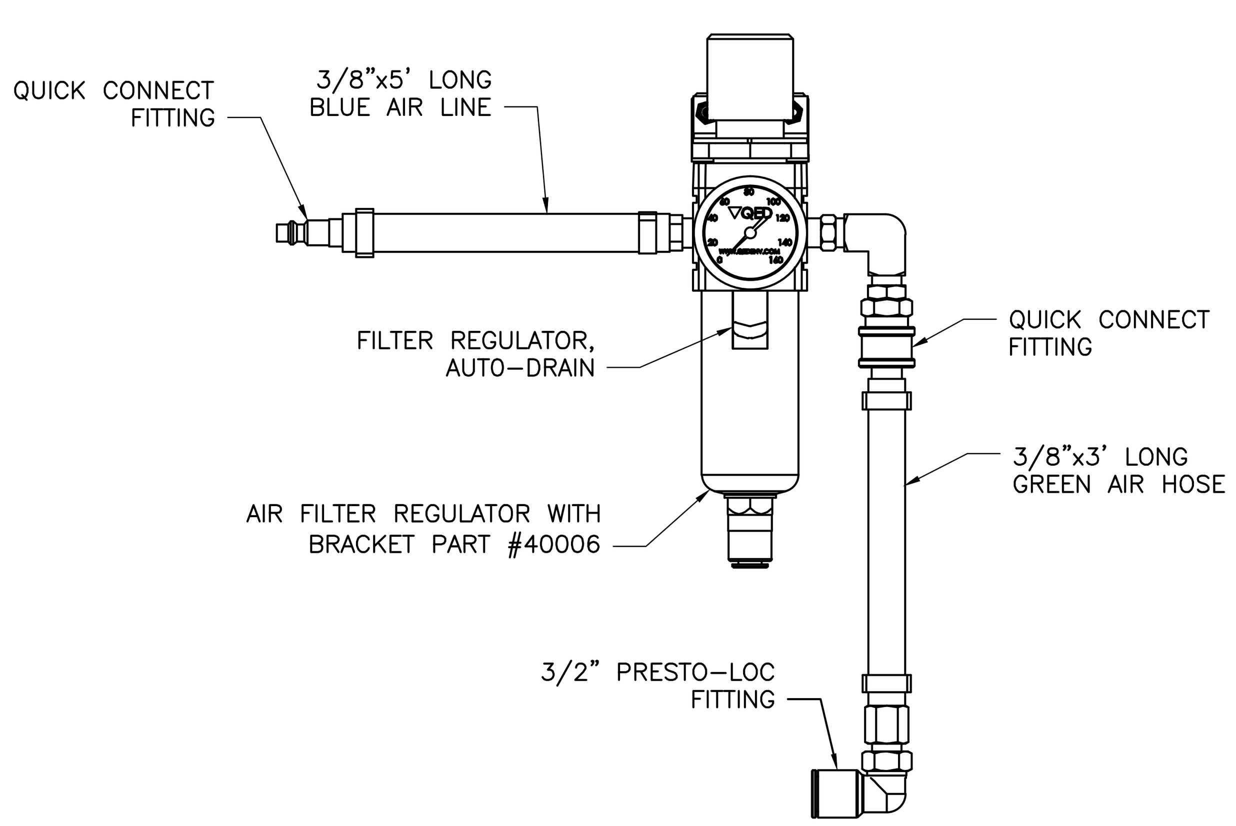
PLAN VIEW

DUAL EXTRACTION FLANGE COMPONENTS

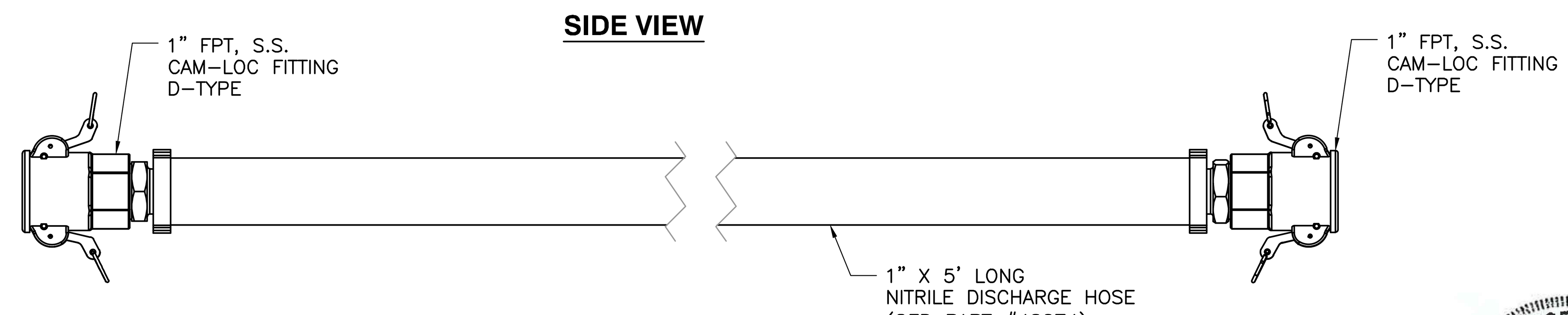
DETAIL 1/12
SCALE: NOT TO SCALE



PLAN VIEW

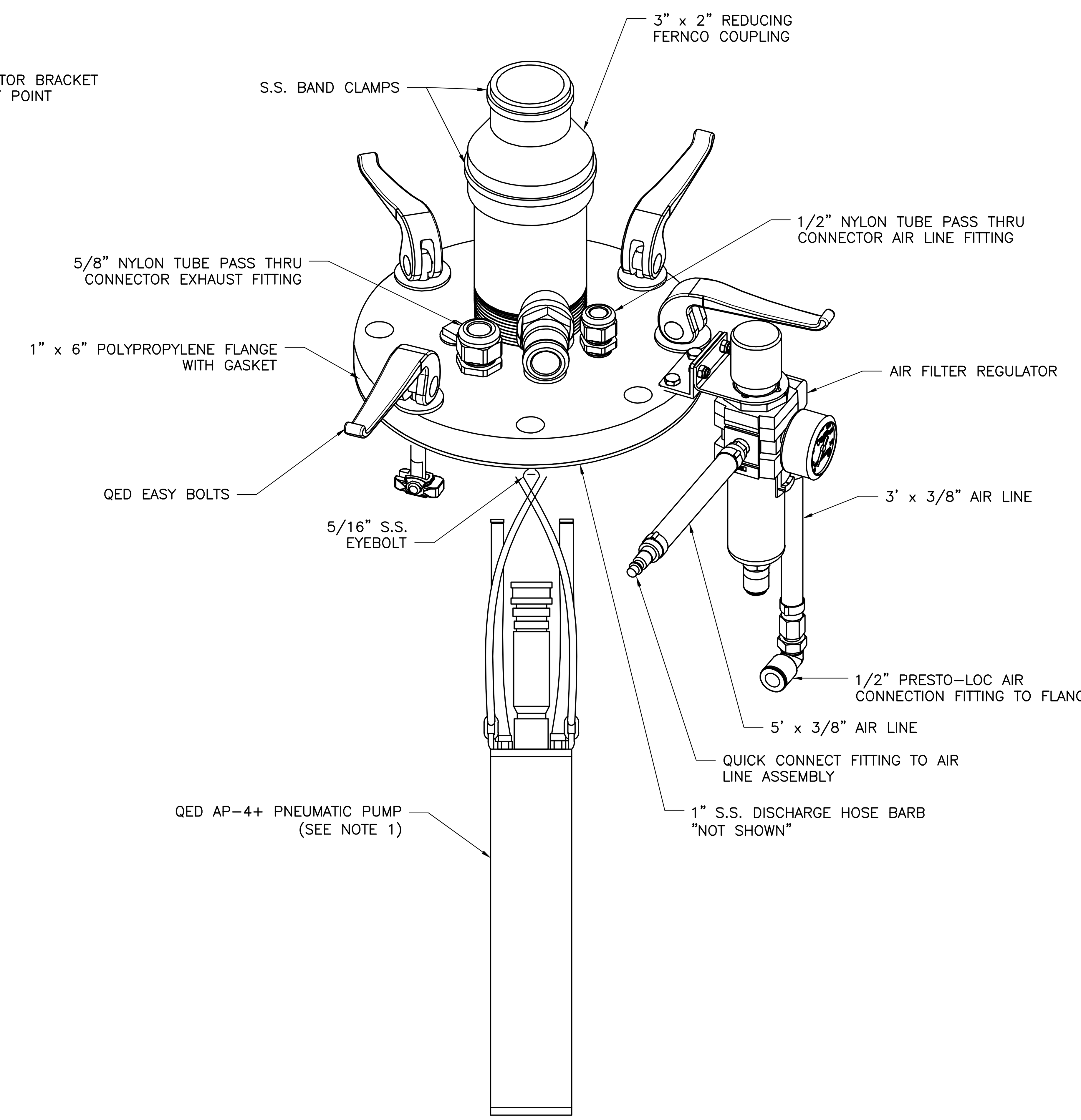


SIDE VIEW



DUAL EXTRACTION WELL AIR REGULATOR AND DISCHARGE LINE

DETAIL 2/12
SCALE: NOT TO SCALE

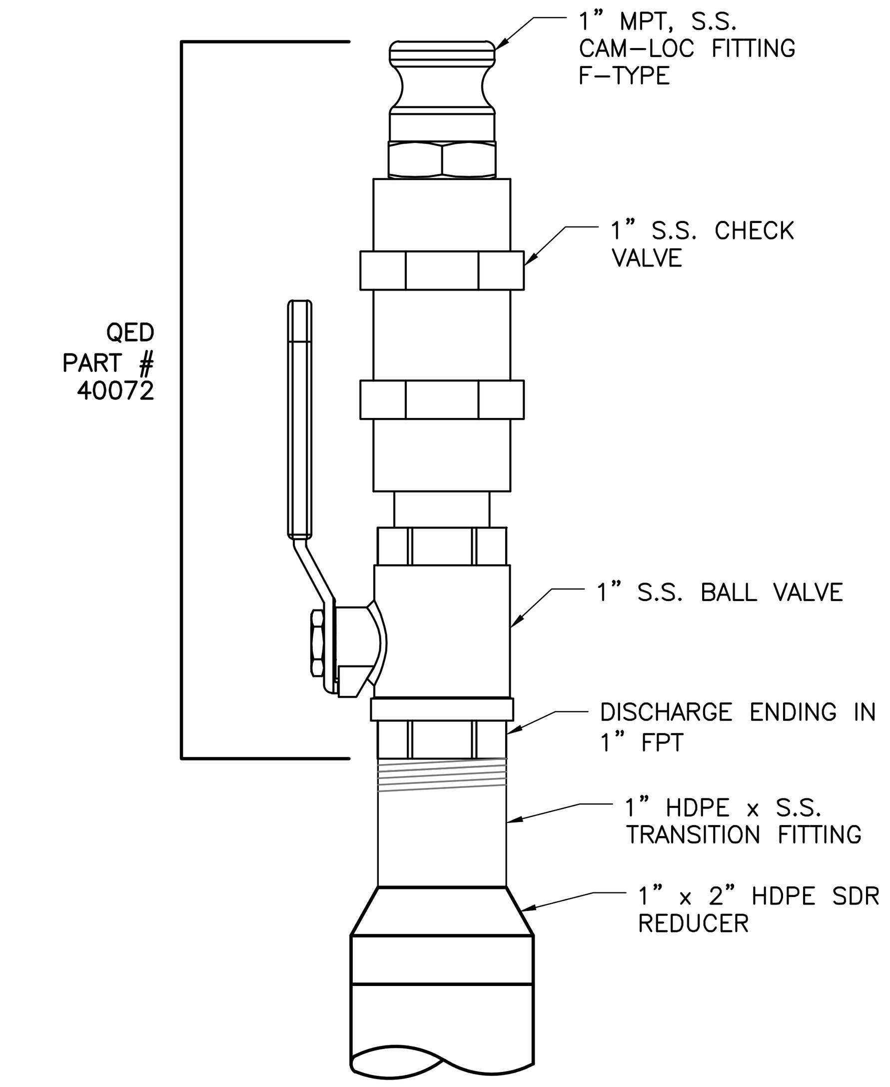


CONDENSATE EXTRACTION FLANGE ASSEMBLY (COLD CLIMATE PACKAGE)

DETAIL 3/12
SCALE: NOT TO SCALE

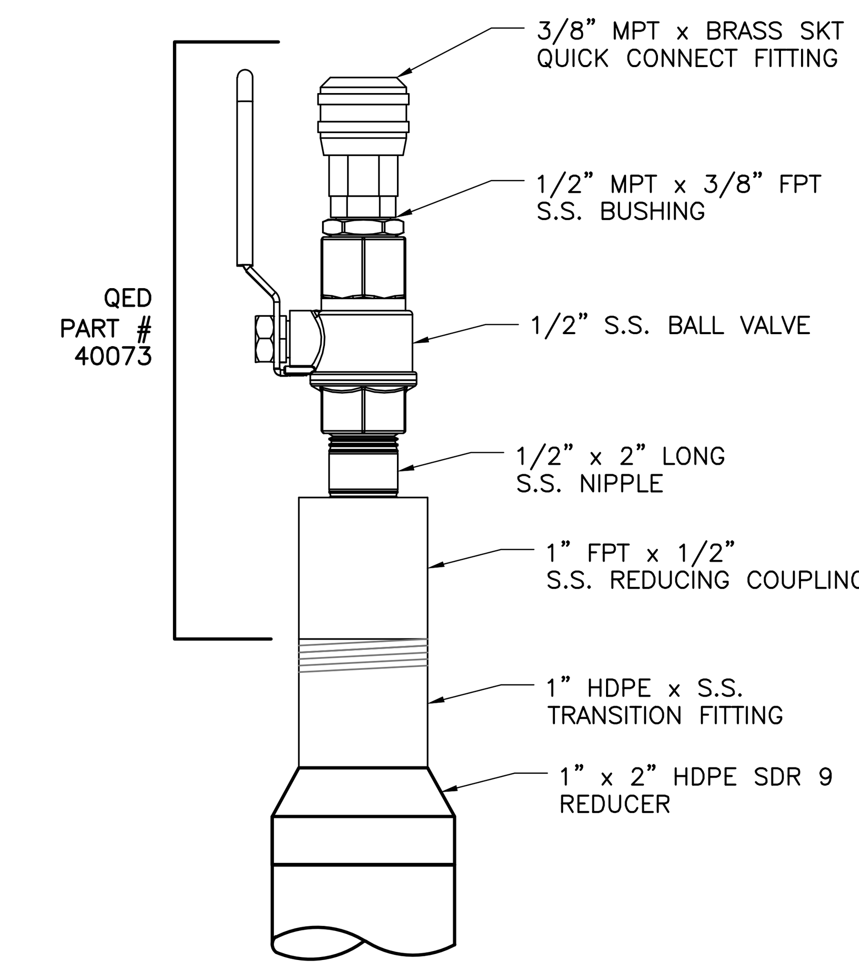
NOTES:

1. QED AP-4+ PNEUMATIC PUMP SHOWN FOR REFERENCE PURPOSES ONLY. PUMP IS NOT INCLUDED WITH FLANGE PACKAGE.
2. AIR LINE AND FORCE MAIN ASSEMBLIES TO BE CONFIGURED FOR COLD CLIMATES.
3. PUMP TO BE SET 1-FT OFF THE BOTTOM OF THE SUMP.
4. PUMP EXHAUST PORTS TO BE FITTED WITH THROTTLING NEEDLE VALVE.



PUMP DISCHARGE ASSEMBLY

DETAIL 4/12
SCALE: NOT TO SCALE



AIR SUPPLY LINE VALVE

DETAIL 5/12
SCALE: NOT TO SCALE

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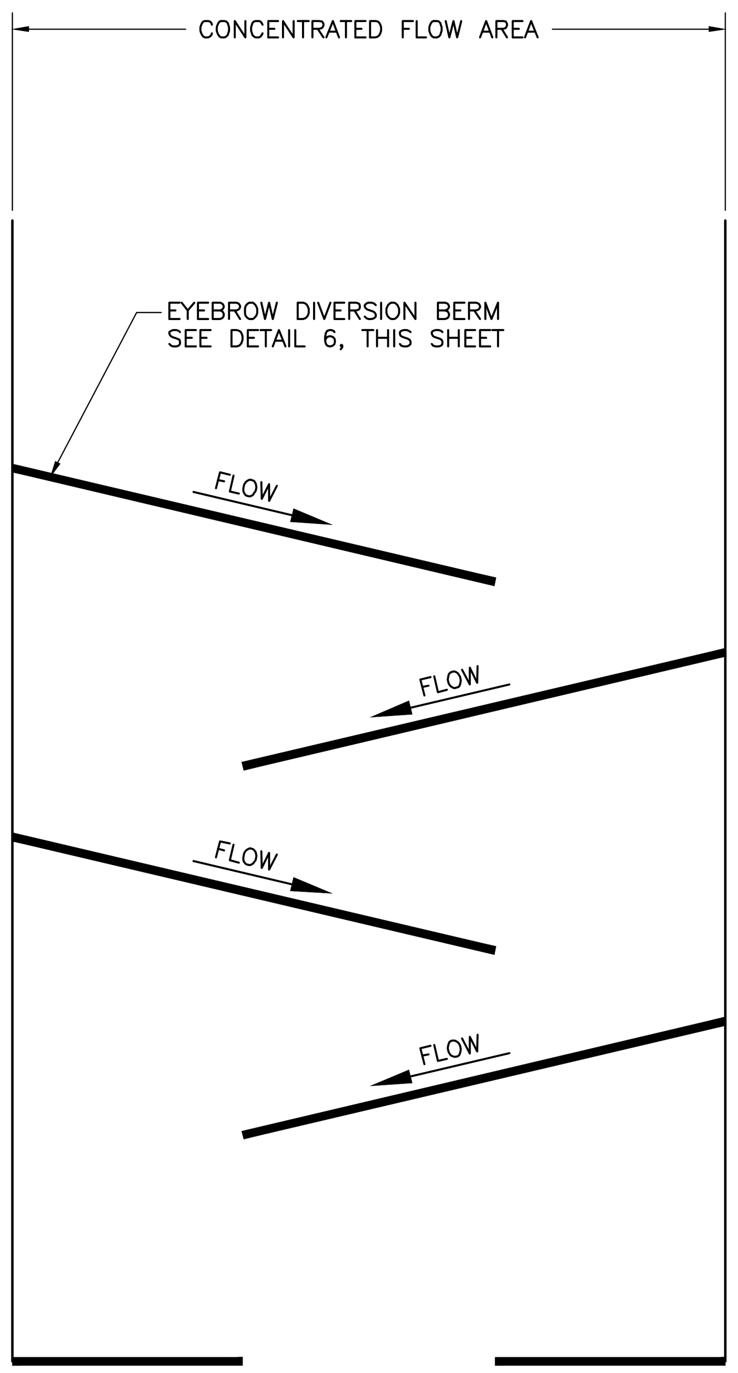
NORTH QUARRY - EVOH GEOMEMBRANE CAP AND CAP INTEGRITY SYSTEM
DETAILS

SHEET NO. **12**
PROJECT NO. 130520

1" 0" 1/2" 1"

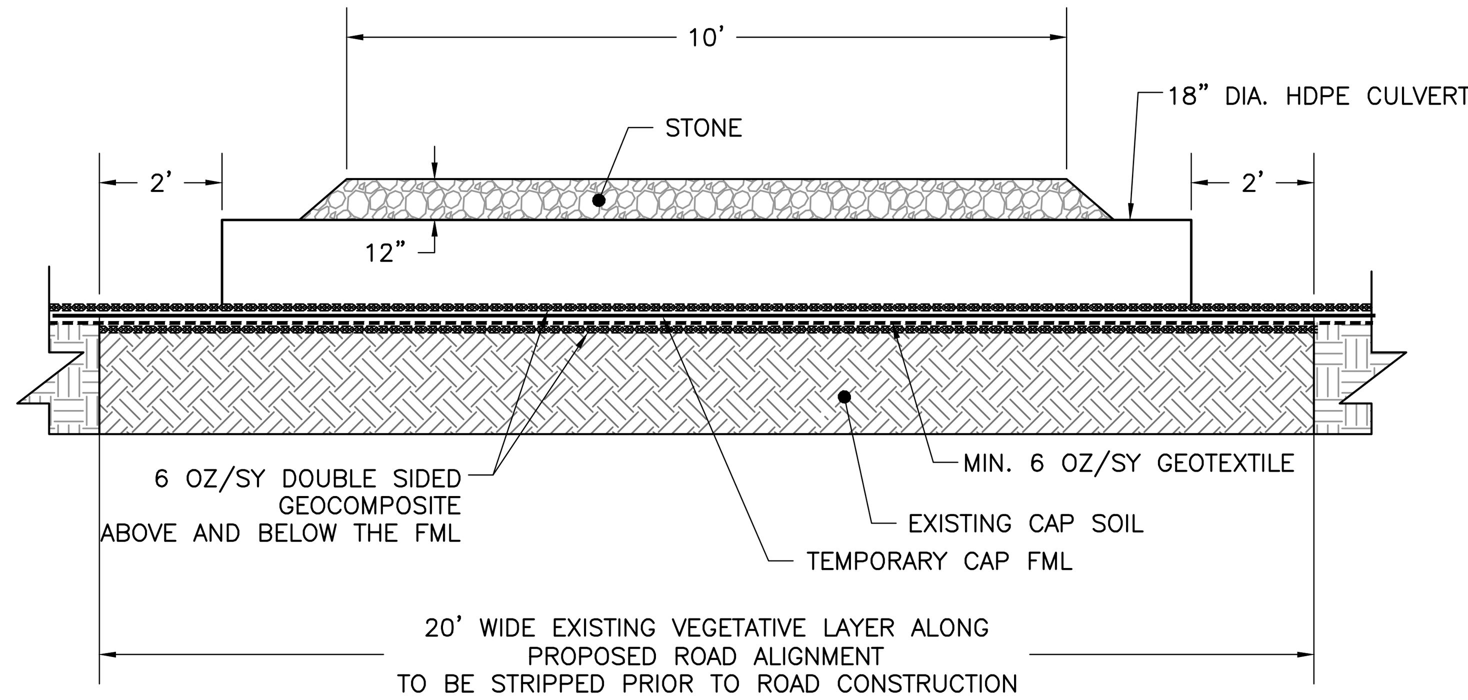


ENERGY DISSIPATER FOR CONCENTRATED FLOW AREAS

DETAIL 1/13
SCALE: NOT TO SCALE

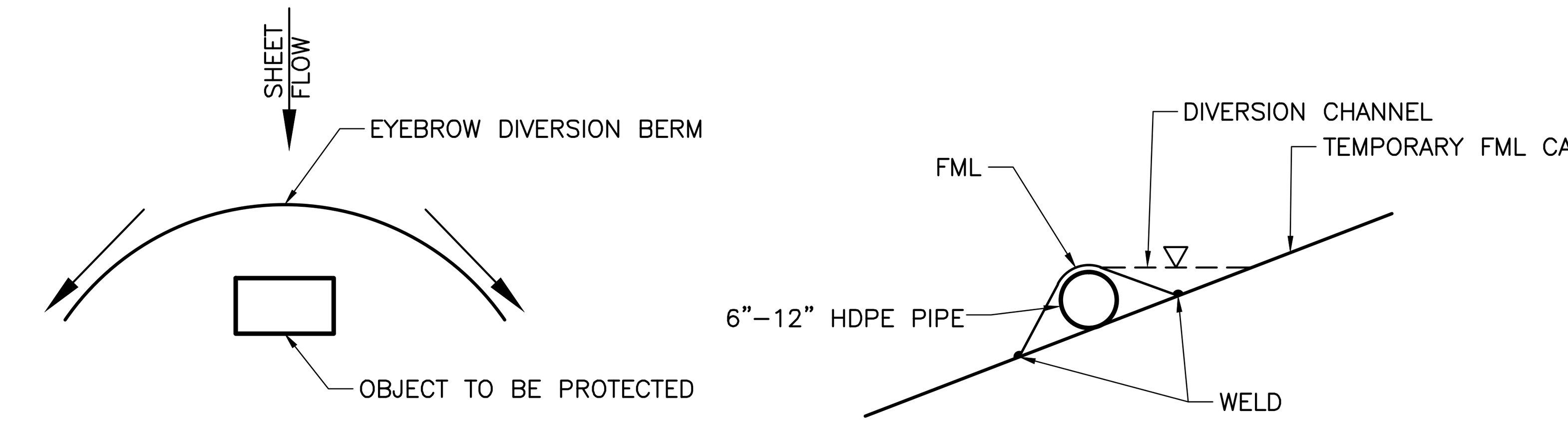
NOTE:

THIS DETAIL MAY BE USED WHERE CONCENTRATED FLOW IS OBSERVED UPON CONSTRUCTION OF EVOH GEOMEMBRANE CAP TO DISSIPATE FLOW.



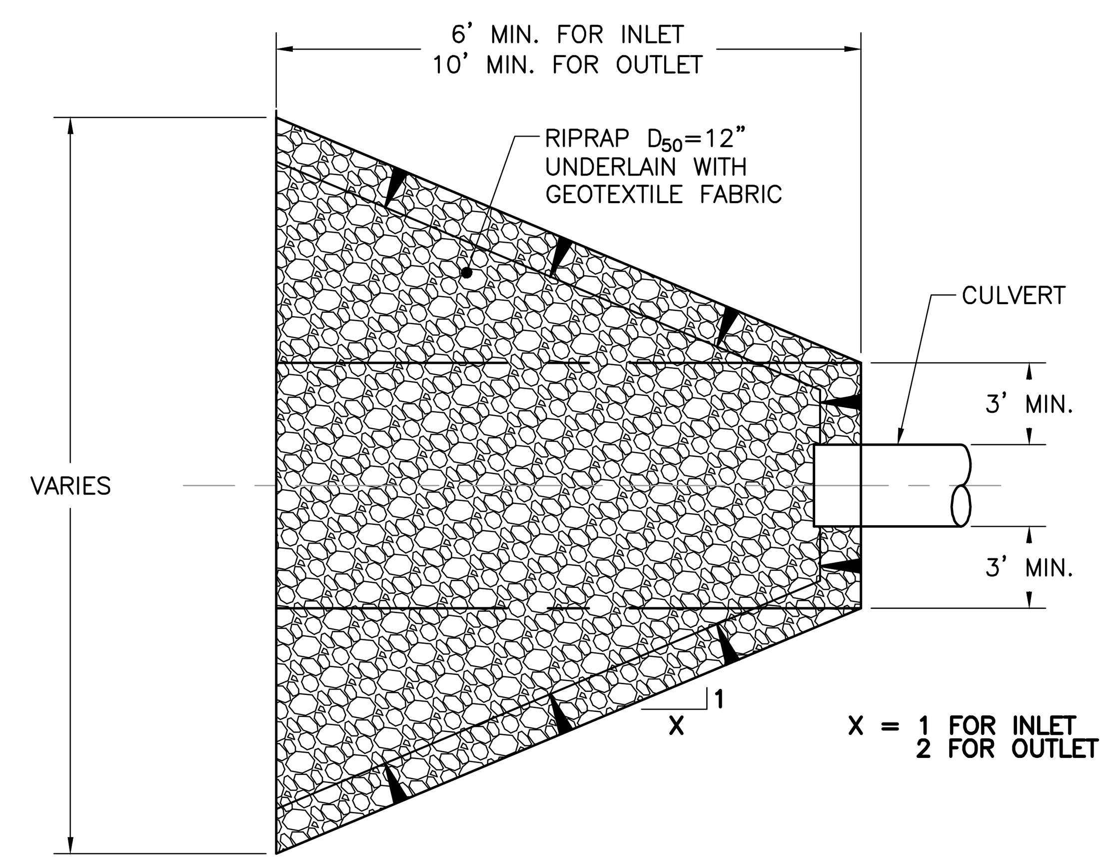
CULVERT CROSSING AT LIGHT-DUTY ACCESS ROAD

DETAIL 2/13
SCALE: NOT TO SCALE



EYEBROW DIVERSION BERM

DETAIL 3/13
SCALE: NOT TO SCALE

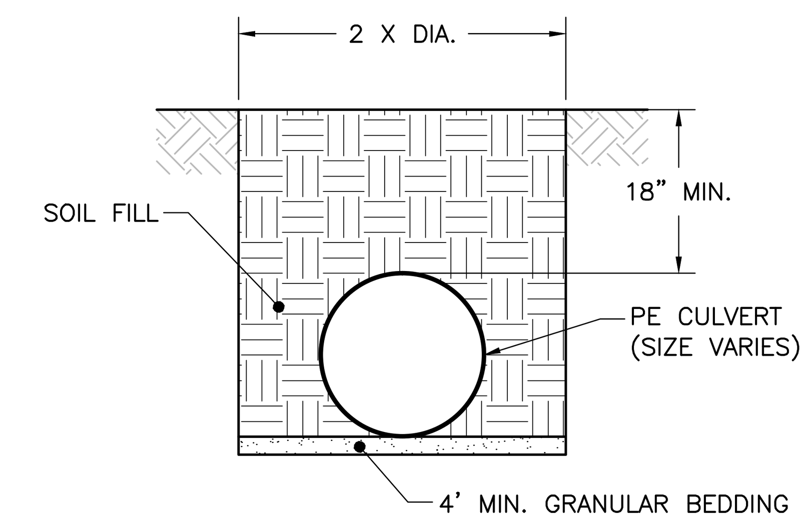


CULVERT INLET/OUTLET PROTECTION

DETAIL 4/13
SCALE: NOT TO SCALE

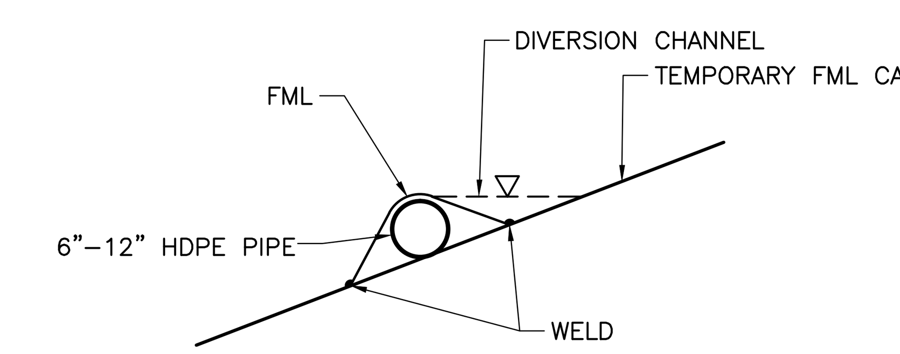
NOTE:

SEE CULVERT SCHEDULE FOR APPLICABLE CULVERTS.



TYPICAL CULVERT

DETAIL 5/13
SCALE: NOT TO SCALE



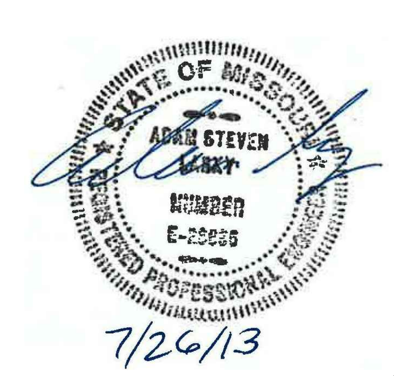
ENERGY DISSIPATOR DIVERSION BERM

DETAIL 6/13
SCALE: NOT TO SCALE

CULVERT SCHEDULE

CULVERT #	TYPE	DIAMETER (IN)	LENGTH (FT)	INLET ELEV.	OUTLET ELEV.	SLOPE (%)	INLET PROTECTION	OUTLET PROTECTION
C-1	PE	24	80	FF	FF	0.60	Y	Y
C-2	PE	24	30	FF	FF	1.80	Y	Y
C-3	PE	18	30	FF	FF	1.00	N	N
C-4	PE	18	30	FF	FF	1.00	N	N
C-5	PE	18	30	FF	FF	1.00	N	N
C-6	PE	18	30	FF	FF	1.00	N	Y
C-7	PE	18	30	FF	FF	1.00	N	Y
C-8	PE	18	30	FF	FF	1.00	N	Y
C-9	PE	18	30	FF	FF	1.00	Y	Y
C-10	PE	18	30	FF	FF	1.00	Y	Y
C-11	PE	18	30	479.40	479.20	0.67	Y	Y

NOTES:
1. PE CULVERTS TO HAVE SMOOTH INTERIOR WALL.
2. FF = FIELD FIT TO OBTAIN DESIGN SLOPE



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NORTH QUARRY - EVOH GEOMEMBRANE CAP AND CAP INTEGRITY SYSTEM
DETAILS

SHEET NO. **13**

PROJECT NO. 130520

APPENDIX C

LANDFILL GAS COLLECTION AND CONTROL SYSTEM EVALUATION

LANDFILL GAS COLLECTION AND CONTROL SYSTEM EVALUATION

BRIDGETON LANDFILL – NORTH QUARRY AREA

BRIDGETON, MISSOURI

Prepared for

Bridgeton Landfill
June 26, 2013

Prepared by

CORNERSTONE
Environmental Group, LLC
400 Quadrangle Drive, Suite E
Bolingbrook, Illinois 60440

Project 130557

Landfill Gas Collection and Control System Evaluation
Bridgeton Landfill - North Quarry Area
Bridgeton, Missouri

The material and data in this report were prepared under the supervision and direction of the undersigned.

Cornerstone Environmental Group, LLC

Thomas A. Bilgri, P.E.
Manager - LFG Engineering Services

STATE OF MISSOURI
ADAM STEVEN LARKY
NUMBER
REGISTERED PROFESSIONAL ENGINEER

Adam Larky, P.E.
Certifying Engineer

7/26/13

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The Bridgeton Landfill South Quarry area is experiencing a subsurface smoldering event (SSE). The North Quarry Area is not exhibiting symptoms of an SSE. Cornerstone Environmental Group, LLC (CEG) has been requested to undertake an evaluation of the existing landfill gas (LFG) collection and control system in the North Quarry and to make recommendations for the following conditions:

- Determine if the existing gas collection and control system (GCCS) is adequate for the current conditions and that it can continue to be operated in a manner that prevents oxygen intrusion due to overdraw, and

- If monitoring (described in a separate document) determines that certain triggers have been achieved that require capping and enhancement of the GCCS, the existing GCCS must be enhanced to be able to collect gas and perform adequately under the conditions of a potential SSE in the North Quarry.

The existing GCCS is generally operating satisfactorily, considering its current status as a “flare only” landfill gas collection and control system. It is believed that the existing system can be operated in a manner consistent with requirements for LFG control and that it can continue to be operated in a manner that prevents oxygen intrusion due to overdraw without any additional enhancements.

In the event that temporary capping and enhancement of the GCCS is triggered due to a potential SSE in the North Quarry, there are several items that would specifically require enhancement, including:

- Replacement of certain existing gas extraction wells to accommodate operations in an elevated temperature environment;

- Installation of supplemental gas extraction wells to accommodate anticipated additional gas volume due to an SSE;

- Expanded header capacity in certain areas; and

- Modifications to the gas flare infrastructure.

A summary of the findings and recommendations is provided in detail in **Section 5** of the evaluation.

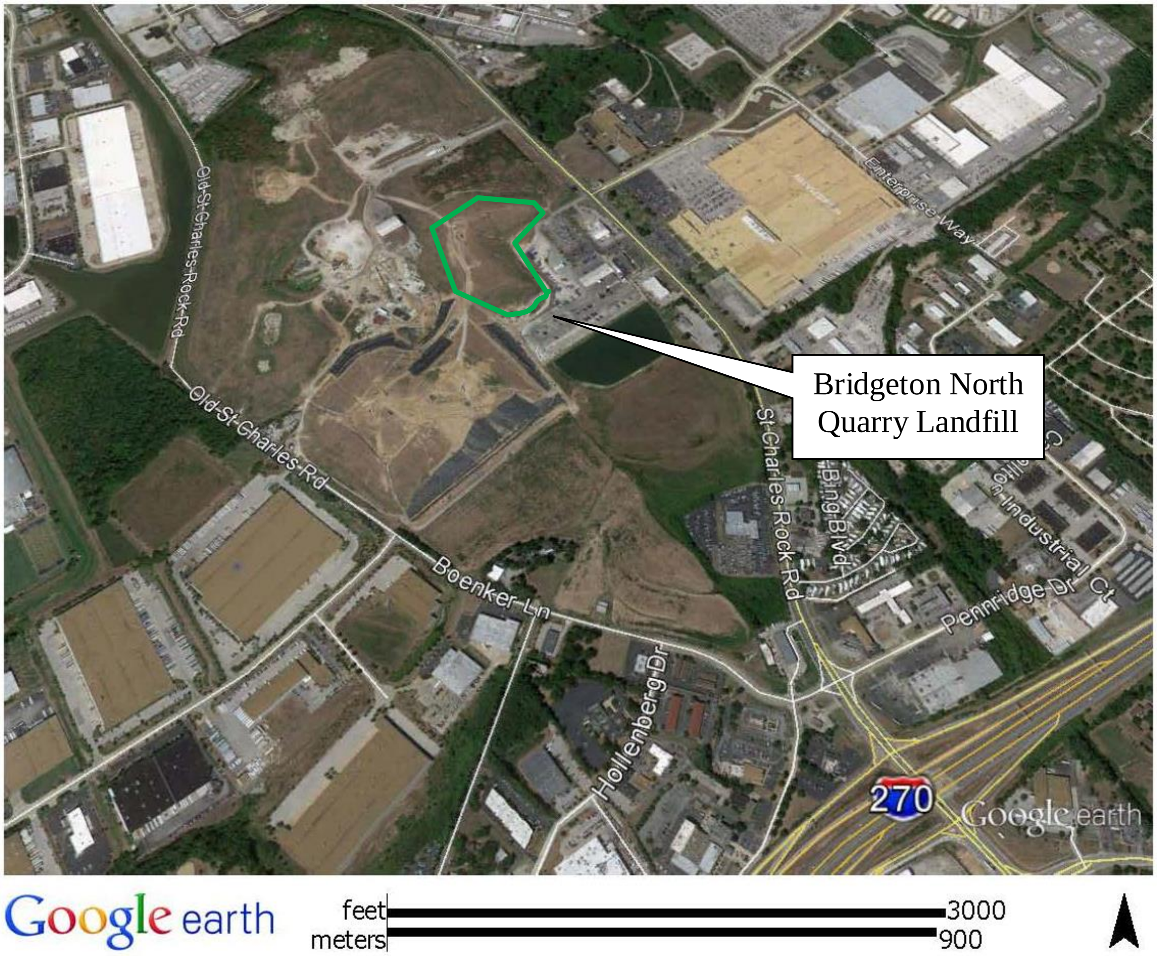
1 INTRODUCTION

The Bridgeton Landfill is located at 13570 St. Charles Rock Road, Bridgeton, Missouri. The North Quarry includes approximately 3.64 million cubic yards of waste materials, primarily deposited into an excavated limestone quarry. This portion of the site reportedly began disposal operations in the mid-1950's and continued until approximately 1990. Minor areas of waste placement reportedly occurred after 1990, however documentation of the volume of waste placed during this time period is not currently available. A review of historic aerial photos indicates all portions of the North Quarry were under were final soil cover and vegetated prior to March 31, 2004 (US Geologic Survey aerial photo).

The disposal area will be capped by installing a composite geomembrane cover system over the existing soil cover. Please refer to **Appendix C, Sheet No. 1** for the Existing Site Conditions.

The existing GCCS has been constructed in all portions of the disposal area and consists generally of vertical extraction wells, a buried HDPE header and lateral system and a condensate management system. LFG extracted from the North Quarry GCCS is disposed of coincidentally with LFG extracted from the South Quarry GCCS at the Flare Station.

Figure 1 – Site Location



2 WASTE MASS ASSESSMENT

2.1 Waste Composition

The waste composition is largely municipal solid waste (MSW). It is anticipated that some industrial and inert wastes were deposited in this area, however for purposes of LFG modeling and this evaluation, all waste materials are assumed to be putrescible.

2.2 Waste Intake

2.2.1 Historical Intake Rates

Historical waste intakes were provided by site personnel and previous reports by others. It is estimated that waste placement was initiated in the mid-1950's and was largely complete prior to 1990. An isopach developed from the recorded bottom of waste elevations to the current surface topography indicates that there is approximately 3.64 million cubic yards of airspace available in this part of the disposal area. Assuming an in-place density of 1,600 pounds per cubic yard (lbs/cyd), a total mass of approximately 3 million tons can be inferred.

For purposes of this evaluation, the total waste mass was averaged across the reported operating period – approximately 1955 through 1989 – to generate an annual waste intake rate.

2.2.2 Future Intake Rates

This area is "closed" and no future waste receipts are currently anticipated.

2.3 Landfill Cover

Soil cover is currently in place over the entire disposal area. The design for a supplemental composite cover system is currently being developed, consisting of low-permeability soils and a synthetic cover component.

The presence of a sealed, well-functioning final cover system can be a tremendous benefit to long-term, effective LFG management. The maintenance of the cover system and the corresponding interface with the GCCS is a critical component to minimize the potential for air intrusion as well as to minimize the potential for surficial emissions of LFG.

3 LFG RECOVERY PROJECTIONS

3.1 Landfill Gas Modeling Basis

The LFG generation and recovery model projections reflect the currently permitted disposal area and status of operations, and provide a long-term view of future LFG generation and recovery potentials.

Landfill gas generation projections have been made utilizing the USEPA's Landfill Gas Emission Model (LandGEM) V3.02. LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of land filled waste in municipal solid waste (MSW) landfills. The model provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at http://www.epa.gov/ttnatw01/landfill/landflpg.html.

First Order Decomposition Rate Equation

$$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} kL_0 \left[\frac{M_i}{10} \right] (e^{-kt_{ij}})$$

Where:

- Q_{CH4} = annual methane generation in the year of the calculation (*m³/year*)
- i = 1-year time increment
- n = (year of the calculation) – (initial year of waste acceptance)
- j = 0.1-year time increment
- k = methane generation rate ($year^{-1}$)
- M_i = mass of waste accepted in the i^{th} year (*Mg*)
- t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th}year (*decimal years*, e.g., 3.2 years)
- L_o = potential methane generation capacity (*m³/Mg*)

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate.

In addition to the waste mass inputs, there are two variables within this equation – *k* and L_0. These factors vary based upon refuse types and the moisture of the waste mass. The USEPA provides the following guidance on these factors in their *Compilation of Air Pollutant Emission Factors, Section 2.4 (AP-42)*:

Scenario	*k value*	*L_0 value*
• *NSPS Compliance*	*0.05/yr*	*170 m^3/Mg*
• *Typical Landfills*	*0.04/yr*	*100 m^3/Mg*
• *Arid Landfills*	*0.02/yr*	*100 m^3/Mg*

Notes: 1. Arid Sites are considered those receiving less than 635 mm/year (25"/yr) of precipitation.

2. The variables noted above are typical for estimating LFG generation rates, not recovery rates

The values noted above are considered baseline defaults and may or may not reflect actual conditions at a given facility. While appropriate for regulatory screening and assessment purposes, these defaults may under-predict or over-predict actual conditions based upon the moisture content, waste characteristics and configuration of the disposal area/GCCS.

Refer to **Appendix B** for the complete LFG generation projection and background information used for the modeling efforts.

3.2 LFG Modeling Projections

3.2.1 Existing Conditions – North Quarry

Based upon the historical waste receipts and industry average rates of decomposition, a projection for the LFG recovery potential for the entire facility can be established.

This data should also be corrected for the percentage of the waste mass that is anticipated to be impacted by the GCCS in the given time period. For example, if the waste mass is anticipated to have a recovery potential of 1,000 scfm, but a GCCS has been constructed on only 50% of the waste mass, then the rate of LFG recovery that can reasonably be expected would be approximately 500 scfm.

The *k* and L_0 values for the Bridgeton North Quarry Landfill are based upon the relative moisture of the waste mass and the organic content of the waste mass. The annual precipitation rate can be utilized to approximate a *k* value for the recovery projection. The site location, near Saint Louis in eastern Missouri, receives an annual normal rate of precipitation of approximately 39 inches per year.

While there are several liquid extraction pumps installed in LFG extraction wells throughout the North Quarry, the liquid levels in the wells as a whole do not appear to be adversely impacting LFG extraction (levels measured second quarter 2013); nor do the levels indicate that the waste mass is inordinately wet. As such, a value of $k=0.04/year$ can be anticipated for this evaluation.

Similarly, the L_0 value can be estimated based upon the composition of the waste stream. Discrete MSW characteristics are not available and no pre-sorting of waste was reported to have been conducted prior to delivery to the landfill. Considering these conditions, a value of $L_0 = 100\ m^3/Mg$ or $3{,}204\ ft^3/ton$ can be utilized for the total LFG generation potential of the MSW fraction, based upon default values for typical landfill. In the event that a more discrete analysis of the waste stream composition becomes available, i.e. the relative percentages of food waste, green waste, paper, etc., the value of L_0 for this facility may be modified.

Based upon provided waste intake data and the defined k and L_0 values, the projected LFG generation rate for the year 2013 is approximately 315 scfm (at 50% CH_4). This compares to the normalized recovery rate of approximately 600 scfm that is reported by the site (June-July 2013). The noted recovery rate is a summary of the flow readings recorded at the individual wellheads and is not a measurement of the composite flow at a single point. As such, the measured flow rate is potentially subject to compound errors in flow monitoring. Given the potential variances in flow readings inherent in field monitoring of wellheads, the relative comparison of generation versus recovery is representative. Additionally, the gas quality monitoring (included in **Appendix A**) indicates typical LFG constituent concentrations and does not indicate the presence of an SSE in the North Quarry.

3.2.2 Potential SSE Conditions - North Quarry

By comparison, the LandGEM projection of LFG generation for the South Quarry is approximately 1,400 scfm for 2013. Due to the effects of the subsurface event in the South Quarry, approximately 9,400 scfm of gas is being recovered from the entire facility. Allowing for the rate of extraction from the North Quarry, the site is realizing an extraction rate of approximately 8,800 scfm of gas from the South Quarry – a variance of approximately 630%. If this relative increase is applied to the current LFG generation projection for the North Quarry, a potential gas generation rate of approximately 2,200 scfm may be realized. Note that this value assumes that the subsurface event spreads throughout the entire North Quarry waste mass (a very conservative assumption).

Note that these models, like any other mathematical projection, should be used only as a tool, and not an absolute declaration of the rate of LFG generation. Fluctuations in the rate and types of incoming waste, site operating conditions, refuse moisture and temperature may provide substantial variations in the actual rates of LFG generation and recovery.

4 EXISTING WELLFIELD INTEGRITY

4.1 Header and Lateral Network

All LFG flow is directed to the blower/flare station (common extraction point) along the eastern perimeter of the disposal area, with the header piping sized and designed accordingly. LFG from all laterals are commingled into a common 18" perimeter header. The perimeter header branches into an 18" header which leads to the blower/flare station. Lateral piping ranges in size from 6" to 8" HDPE, and is generally installed in an alignment that should promote the positive drainage of condensate to the perimeter header. Additionally, two 12" sub-headers loop over the disposal area from east to west, interconnecting the 18" main header on both sides of the North Quarry.

4.2 Wellfield Data

Wellfield data is summarized in **Appendix A**. The relative status of the wells is color-coded for available perforated casing, degree of liquid impact and gas quality.

4.2.1 Good quality wells

Good quality wells are defined as wells possessing low levels of oxygen or balance gas. Wells with an oxygen level less than 1% are coded in green, as are wells with less than 5% balanced gas.

Coded in yellow are wells with less than 3% oxygen or 10% balance gas.

4.2.2 Poor quality wells

Wells that are not currently included in the "good" or "suitable" categories, as noted above, are primarily poor in terms of the percentage of balance gas.

4.2.3 Available vacuum assessment

Vacuum availability is very consistent throughout the existing wellfield. Wells nearest the main flare header currently (July 2013) have an available vacuum of approximately 7.5" water column (wc). The lowest degree of available vacuum is at well GEW50 – an available vacuum of approximately 3.2"wc.

A large degree of vacuum application is currently not required in the North Quarry, due to the relatively large size of the main header piping (18") versus the observed extraction rate (624 scfm).

4.2.4 Existing Header Sizing

The existing GCCS transports all extracted gas from an 18” perimeter main to the flare station. As the header is graded for both concurrent (gas and condensate draining the same direction) and countercurrent (gas and condensate draining in opposite directions), the system was evaluated for a worst-case condition of counter-current flow. Utilizing a generally accepted industry value of 20 fps velocity these conditions, an 18” header would have the capacity to transport a minimum of 2,900 scfm of LFG.

This assumes that all LFG is directed to either the east or west perimeter headers for transport to the blower/flare station. If LFG is directed through both headers, a combined flow rate of at least 5,800 scfm should be practical.

This value far exceeds the observed rate of LFG extraction and thus is appropriate for the current operating conditions.

4.2.5 Liquid level assessment

Liquid level readings indicate that the wellfield is relatively dry. The impact of liquids should be reassessed on a regular basis, especially for wells that may be re-drilled to lower elevations than are currently monitored.

There are pumps currently employed in several LFG extraction wells. With the exception of wells GEW3, GEW9, GEW41R, GEW42R, GEW43R, GEW46R and GEW53, all well casings have more than 50% of their available perforations “dry” capable of extracting LFG.

4.3 Well Spacing

Extraction wells are currently spaced at a frequency of approximately 150 feet to 350 feet. The spacing is denser in the interior of the disposal areas frequent along the perimeter of the disposal area where waste is placed in significantly thinner layers.

In the event that control of surface emissions becomes more difficult, or air intrusion at extraction wells becomes more prevalent, the installation of wells at a greater frequency may be warranted, but at this time does not appear to be necessary.

4.4 Material Evaluation

The material utilized for all observed/reported components meets or exceeds industry expectations, including PVC for well casings, HDPE for all header and lateral piping, and HDPE for all condensate management structures.

4.5 Overall Wellfield – Current Conditions

The overall condition of the wellfield and associated components is good and should provide a sound basis for continued LFG control. The wells seem to be in relatively good condition and functioning well, with few wells apparently impacted by waste consolidation and differential settlement.

Liquids impacts are minimal as the waste mass itself appears to be not suspending liquids that could impact the operation of the extraction wells.

5 RECOMMENDED MODIFICATIONS FOR POTENTIAL SSE (IF TRIGGERED)

Although the wellfield is generally operating well, and appears to be in good condition from a maintenance perspective, there are a number of items which should be considered in the event that the SSE involves the North Quarry disposal area. Proposed modifications are outlined below and in the plan set entitled "*Construction Plan for Contingent North Quarry Enhanced Gas Collection and Control System (GCCS)*", included as **Appendix C** of this evaluation.

These recommendations assume that all existing components remain operable under future conditions. Select components may require replacement or maintenance as a result of age and settlement.

5.1 Extraction Well Replacement

Existing well casings should be replaced with steel casings in order to withstand the elevated temperatures that may accompany the subsurface event. This would likely include, but not be limited to, wells installed within the limits of the deeper quarry areas. These wells are typically constructed in thicker deposits of waste and are more likely to be impacted by elevated temperatures as a result of the potential subsurface event.

5.2 Additional Extraction Wells

The potential for additional extraction wells should be considered. There are portions of the disposal area in which wells are spaced at distances exceeding 300 feet. These areas are typically outside the limits of the quarry excavation and possess relatively thin waste lenses. The gas extraction capacity of the Cap Integrity System (described in a separate report) is anticipated to accommodate the majority of additional gas extraction in the perimeter areas, however additional wells may be required in select locations based upon field conditions.

5.3 Wellfield Pumps

Compressed air and force main piping should be extended to all future extraction wells to enable the application of the liquids removal on an as-needed basis. As the existing air and forcemain piping was not designed for the relative volume of pumping that would be anticipated under subsurface event conditions, a supplemental air and forcemain system is proposed, including (nominally) a 2" compressed air main and a 3"x6" forcemain. The size of both components should be reevaluated based upon actual needs at the time of construction.

5.4 Header Pipe Modifications

As noted in Section 4.2.4, the existing perimeter header is sized to accommodate at least 5,800 scfm of LFG under counter-current flow conditions. However, there is a single 18" header from the perimeter piping system to the blower/flare station, effectively limiting the flow from the North Quarry to the blower/flare station to approximately 1,640 scfm. Additionally, in the event that a blockage occurs along the perimeter header, the two 12" headers that traverse the North Quarry disposal area have the capacity to transport approximately 820 cfm under counter-current flow conditions and a velocity limitation of 20 fps – providing a total of 1,640 cfm of "bypass" capacity from the western perimeter to the eastern perimeter.

For the potential extraction rate of 2,200 cfm, as described in Section 3.2, additional header capacity for bypass of LFG from the western perimeter to the eastern perimeter, as well as to the blower/flare station, should be considered. It is proposed to install a (nominal) 24" header traversing the North Quarry disposal area and extending to the inlet of the blower/flare station. This would provide a minimum of 2,900 cfm of additional bypass capacity, bringing the total bypass capacity to approximately 4,540 cfm. It would also increase the inlet capacity to the blower/flare station to a minimum of 4,540 cfm.

New extraction wells should be connected to the GCCS piping with a minimum of 6" lateral piping.

Additional condensate management structures may also be required, depending upon the routing and available topography at the time of construction.

Unless prohibited by future operating conditions, all proposed piping would be constructed utilizing HDPE, including the LFG, compressed air and liquid forcemain piping.

5.5 Flare Capacity

The currently proposed flare arrangement that includes two utility flares in the flare compound area, and one utility flare on the east side of the South Quarry has potential capacity of 12,000 cfm. As previously discussed, the current gas volume, including additional gas related to the SSE in the South Quarry is 9,400 cfm. This leaves an excess capacity of 2,600 cfm.

The potential North Quarry gas generation under full SSE conditions is 2,200 cfm, or slightly less than the current excess capacity. It is likely that the increased gas generation in the North Quarry would occur gradually, allowing the existing excess capacity to accommodate extra gas while an evaluation is undertaken to determine if conditions warrant addition of flare capacity. It is also possible that the gas generation rate in the

South Quarry will be in decline at this point, as the SSE consumes available organic materials, providing additional flare capacity for gas management from the North Quarry.

LIMITATIONS

The work product included in the attached was undertaken in full conformity with generally accepted professional consulting principles and practices and to the fullest extent as allowed by law we expressly disclaim all warranties, express or implied, including warranties of merchantability or fitness for a particular purpose. The work product was completed in full conformity with the contract with our client and this document is solely for the use and reliance of our client (unless previously agreed upon that a third party could rely on the work product) and any reliance on this work product by an unapproved outside party is at such party's risk.

The work product herein (including opinions, conclusions, suggestions, etc.) was prepared based on the situations and circumstances as found at the time, location, scope and goal of our performance and thus should be relied upon and used by our client recognizing these considerations and limitations. Cornerstone shall not be liable for the consequences of any change in environmental standards, practices, or regulations following the completion of our work and there is no warrant to the veracity of information provided by third parties, or the partial utilization of this work product.

APPENDIX A

WELLFIELD DATA

CORNERSTONE Environmental Group, LLC

PROJECT TITLE: Bridgeton GCCS Evaluation
DESCRIPTION: Wellfield Data Compilation
North Quarry
PREPARED BY: PJL DATE: 7/23/2013

PROJECT NO: 130557

80%	Greater than 75% available
23%	Less than 25% available
1	Less than 1%
3	Less than 3%
5	Less than 5%
10	Less than 10%

Well ID	Boring Depth (Ft. from GS)	Bottom Elevation at Installation (MSL)	Ground Surface at Installation (MSL)	Ground Surface - Current (MSL)	Latest Depth to Bottom or Refusal - Current (Ft. from GS)	Depth to Liquid (Ft. from GS)	Total Liquid Column (Ft.)	Perforated Length (Ft.) from drillling logs	Solid Length (Ft.) at Installation	Solid Length (Ft.) from Measurement	Pump (Y/N)	Perforated Length Available (Ft.)	Perforated Length Dry (Ft.)	Percentage of Original Perf. Length Available	Percentage of Available Perf. Length Dry	CH4	CO2	O2	BalGas	Applied Vacuum ("wc)	Flow (scfm)	Temp (°F)	Normalized Flow	Flow per Ft. of Available Perf.	Available System Pressure ("wc)
GEW1	n/a	n/a	n/a	480.0	24.1	24.1	0.0	60	n/a	n/a	N	n/a	n/a	n/a	n/a	48.2	27.7	2.6	21.5	-0.9	8	110	8	n/a	-6.5
GEW2	136	379.7	515.7	515.7	77	57	20.0	111	25	25	N	52.0	32.0	46.85%	62%	55.2	44.6	0	0.2	-0.7	49	129	54	1.7	-5.06
GEW3	100	423.0	523.0	519.8	104	59.5	44.5	75	25	22	N	82.2	37.7	100.00%	46%	55.2	41.8	0	3	-0.3	53	119	59	1.6	-5.13
GEW4	72	455.1	527.1	522.9	75	63.4	11.6	49	22	18	N	57.2	45.6	100.00%	80%	44.3	39.3	0	16.4	-0.3	24	120	21	0.5	-5.96
GEW5	37	486.2	523.2	523.2	38	38	0.0	21	15	15	N	23.0	23.0	100.00%	100%	42	35	0	23	-0.4	33	106	28	1.2	-6.3
GEW6	46	n/a	n/a	512.0	53	44	9.0	30	15	15	N	38.0	29.0	100.00%	76%	48.3	39.7	0	12	0	26	100	25	0.9	-5.95
GEW7	67	417.0	484.0	481.8	67	44.6	22.4	47	19	17	N	50.3	27.9	100.00%	55%	56	43.9	0	0.1	-4	31	110	35	1.2	-5.26
GEW8	66	426.4	492.4	492.4	82	59.6	22.4	40	25	25	N	57.0	34.6	100.00%	61%	56.5	43.4	0	0.1	-0.8	28	120	32	0.9	-5.43
GEW40	31	470.7	501.7	502.4	38.1	38.1	0.0	16	14	15	N	23.4	23.4	100.00%	100%	49.1	50.8	0	0.1	-0.5	17	100	17	0.7	-7.54
GEW41R	109	398.0	507.0	507.0	121.0	50.1	70.9	88	24	24	Y	97.0	26.1	100.00%	27%	55.2	44.7	0	0.1	-0.9	62	105	68	2.6	-5.82
GEW42R	101	406.1	507.1	507.1	107.2	51.6	55.6	80	24	24	Y	83.2	27.6	100.00%	33%	56.4	43.5	0	0.1	-0.7	8	105	9	0.3	-6.28
GEW43R	118	393.6	511.6	511.6	123.9	64.7	59.2	97	24	24	Y	99.9	40.7	100.00%	41%	55.6	44.3	0	0.1	-0.2	12	129	13	0.3	-7.14
GEW44	111	411.7	522.7	517.0	57.2	48.1	9.1	86	25	19	N	37.9	28.8	44.02%	76%	57.4	41.2	0	1.4	-0.5	13	110	15	0.5	-6.52
GEW45R	77	424.2	501.2	501.2	84.0	70.4	13.6	56	24	24	Y	60.0	46.4	100.00%	77%	57.1	41.4	0	1.5	-4.4	31	110	35	0.8	-6.24
GEW46R	87	419.2	506.2	506.2	83.1	48.9	34.2	66	24	24	N	59.1	24.9	89.55%	42%	46.8	38.4	0	14.8	-0.6	11	102	10	0.4	-5.99
GEW47R	65	456.9	521.9	521.9	75.0	65.2	9.8	44	24	24	N	51.0	41.2	100.00%	81%	32.4	34.5	0.1	33	-0.3	25	120	16	0.4	-6.2
GEW48	64	n/a	n/a	522.0	65.0	65.0	0.0	48	15	15	N	50.0	50.0	100.00%	100%	52.8	41	0	6.2	-0.4	28	111	30	0.6	-6
GEW49	67	451.5	518.5	518.5	75.5	75.5	0.0	50	16	16	N	59.5	59.5	100.00%	100%	33.1	36.4	0	30.5	-0.3	27	108	18	0.3	-7.69
GEW50	54	475.4	529.4	523.6	56.0	50.7	5.3	37	16	10	N	45.7	40.4	100.00%	88%	58.6	38	0	3.4	0	29	109	34	0.8	-3.17
GEW51	71	447.4	518.4	518.4	75.0	67.8	7.2	40	30	30	N	45.0	37.8	100.00%	84%	52.6	42.7	0	4.7	-0.5	29	125	31	0.8	-6.54
GEW52	62	465.1	527.1	521.7	68.0	60.9	7.1	44	18	13	N	55.4	48.3	100.00%	87%	55.5	39.3	0	5.2	-0.3	10	120	11	0.2	-4.36
GEW53	137	377.3	514.3	514.3	132.0	78.9	53.1	100	36	36	Y	96.0	42.9	96.00%	45%	49.6	40.8	0	9.6	-0.1	7	135	7	0.2	-6.18
GEW54	137	373.3	510.3	510.3	132.1	86.5	45.6	100	36	36	Y	96.1	50.5	96.10%	53%	49.8	44.6	0	5.6	-0.1	12	150	12	0.2	-8.21
GEW55	n/a	n/a	n/a	507.1	88.2	88.2	0.0	60	24	24	N	64.2	64.2	100.00%	100%	51	45.4	0	3.6	-0.1	16	135	16	0.3	-6.7
																				SUM	589	SUM	603		

Flow data from June 2013
Flow data from May 2013

APPENDIX B

LANDGEM MODELS – NORTH AND SOUTH QUARRIES

Summary Report

Landfill Name or Identifier: Bridgeton North Quarry

Date: Wednesday, July 24, 2013

Description/Comments:

Period of operation is estimated between approximately 1955 and 1989, based on site information. Volume is approximately 3.65 million cubic yards or approximately 3 million tons at a density of 1600 lb/cyd. Waste input is averaged over the relative operating period.

About LandGEM:

First-Order Decomposition Rate Equation:

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

Where,

Q_{CH4} = annual methane generation in the year of the calculation *(m^3/year)*
i = 1-year time increment
n = (year of the calculation) - (initial year of waste acceptance)
j = 0.1-year time increment
k = methane generation rate *($year^{-1}$)*
L_o = potential methane generation capacity *(m^3/Mg)*

M_i = mass of waste accepted in the i^{th} year *(Mg)*
t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year *(decimal years*, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at http://www.epa.gov/ttnatw01/landfill/landflpg.html.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for convential landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

Input Review

LANDFILL CHARACTERISTICS

Landfill Open Year	**1955**	
Landfill Closure Year (with 80-year limit)	**1989**	
Actual Closure Year (without limit)	***1989***	
Have Model Calculate Closure Year?	**No**	
Waste Design Capacity	**3,000,000**	*short tons*

MODEL PARAMETERS

Methane Generation Rate, k	**0.040**	*$year^{-1}$*
Potential Methane Generation Capacity, L_o	**100**	*m^3/Mg*
NMOC Concentration	**4,000**	*ppmv as hexane*
Methane Content	**50**	*% by volume*

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1:	**Total landfill gas**
Gas / Pollutant #2:	**Methane**
Gas / Pollutant #3:	**Carbon dioxide**
Gas / Pollutant #4:	**NMOC**

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
1955	77,922	85,714	0	0
1956	77,922	85,714	77,922	85,714
1957	77,922	85,714	155,844	171,428
1958	77,922	85,714	233,765	257,142
1959	77,922	85,714	311,687	342,856
1960	77,922	85,714	389,609	428,570
1961	77,922	85,714	467,531	514,284
1962	77,922	85,714	545,453	599,998
1963	77,922	85,714	623,375	685,712
1964	77,922	85,714	701,296	771,426
1965	77,922	85,714	779,218	857,140
1966	77,922	85,714	857,140	942,854
1967	77,922	85,714	935,062	1,028,568
1968	77,922	85,714	1,012,984	1,114,282
1969	77,922	85,714	1,090,905	1,199,996
1970	77,922	85,714	1,168,827	1,285,710
1971	77,922	85,714	1,246,749	1,371,424
1972	77,922	85,714	1,324,671	1,457,138
1973	77,922	85,714	1,402,593	1,542,852
1974	77,922	85,714	1,480,515	1,628,566
1975	77,922	85,714	1,558,436	1,714,280
1976	77,922	85,714	1,636,358	1,799,994
1977	77,922	85,714	1,714,280	1,885,708
1978	77,922	85,714	1,792,202	1,971,422
1979	77,922	85,714	1,870,124	2,057,136
1980	77,922	85,714	1,948,045	2,142,850
1981	77,922	85,714	2,025,967	2,228,564
1982	77,922	85,714	2,103,889	2,314,278
1983	77,922	85,714	2,181,811	2,399,992
1984	77,922	85,714	2,259,733	2,485,706
1985	77,922	85,714	2,337,655	2,571,420
1986	77,922	85,714	2,415,576	2,657,134
1987	77,922	85,714	2,493,498	2,742,848
1988	77,922	85,714	2,571,420	2,828,562
1989	77,931	85,724	2,649,342	2,914,276
1990	0	0	2,727,273	3,000,000
1991	0	0	2,727,273	3,000,000
1992	0	0	2,727,273	3,000,000
1993	0	0	2,727,273	3,000,000
1994	0	0	2,727,273	3,000,000

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	**(short tons/year)**	**(Mg)**	**(short tons)**
1995	0	0	2,727,273	3,000,000
1996	0	0	2,727,273	3,000,000
1997	0	0	2,727,273	3,000,000
1998	0	0	2,727,273	3,000,000
1999	0	0	2,727,273	3,000,000
2000	0	0	2,727,273	3,000,000
2001	0	0	2,727,273	3,000,000
2002	0	0	2,727,273	3,000,000
2003	0	0	2,727,273	3,000,000
2004	0	0	2,727,273	3,000,000
2005	0	0	2,727,273	3,000,000
2006	0	0	2,727,273	3,000,000
2007	0	0	2,727,273	3,000,000
2008	0	0	2,727,273	3,000,000
2009	0	0	2,727,273	3,000,000
2010	0	0	2,727,273	3,000,000
2011	0	0	2,727,273	3,000,000
2012	0	0	2,727,273	3,000,000
2013	0	0	2,727,273	3,000,000
2014	0	0	2,727,273	3,000,000
2015	0	0	2,727,273	3,000,000
2016	0	0	2,727,273	3,000,000
2017	0	0	2,727,273	3,000,000
2018	0	0	2,727,273	3,000,000
2019	0	0	2,727,273	3,000,000
2020	0	0	2,727,273	3,000,000
2021	0	0	2,727,273	3,000,000
2022	0	0	2,727,273	3,000,000
2023	0	0	2,727,273	3,000,000
2024	0	0	2,727,273	3,000,000
2025	0	0	2,727,273	3,000,000
2026	0	0	2,727,273	3,000,000
2027	0	0	2,727,273	3,000,000
2028	0	0	2,727,273	3,000,000
2029	0	0	2,727,273	3,000,000
2030	0	0	2,727,273	3,000,000
2031	0	0	2,727,273	3,000,000
2032	0	0	2,727,273	3,000,000
2033	0	0	2,727,273	3,000,000
2034	0	0	2,727,273	3,000,000

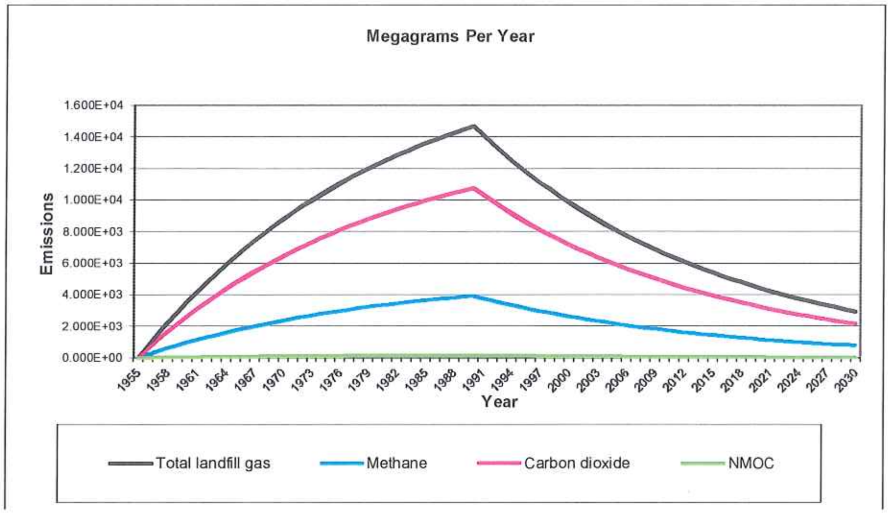
Pollutant Parameters

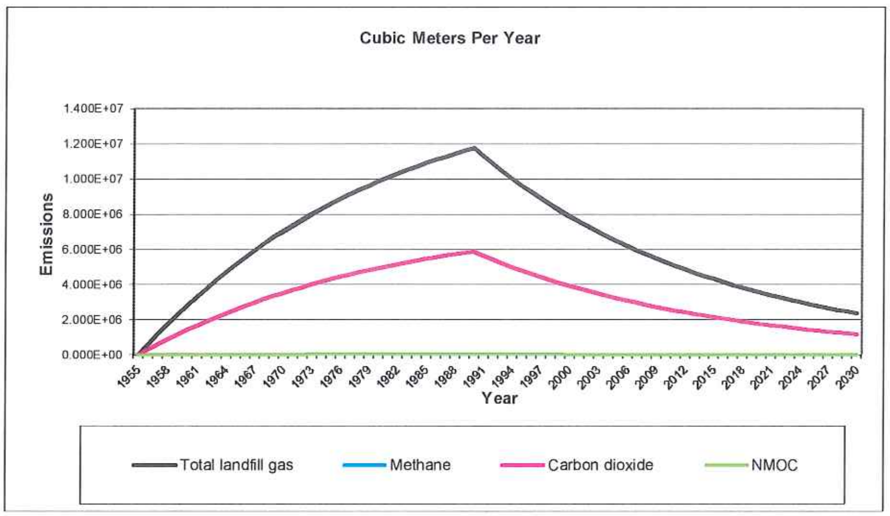
	Compound	Gas / Pollutant Default Parameters: Concentration (*ppmv*)	Molecular Weight	User-specified Pollutant Parameters: Concentration (*ppmv*)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl chloroform) - HAP	0.48	133.41		
	1,1,2,2-Tetrachloroethane - HAP/VOC	1.1	167.85		
	1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC	2.4	98.97		
	1,1-Dichloroethene (vinylidene chloride) - HAP/VOC	0.20	96.94		
	1,2-Dichloroethane (ethylene dichloride) - HAP/VOC	0.41	98.96		
	1,2-Dichloropropane (propylene dichloride) - HAP/VOC	0.18	112.99		
	2-Propanol (isopropyl alcohol) - VOC	50	60.11		
	Acetone	7.0	58.08		
	Acrylonitrile - HAP/VOC	6.3	53.06		
	Benzene - No or Unknown Co-disposal - HAP/VOC	1.9	78.11		
	Benzene - Co-disposal - HAP/VOC	11	78.11		
	Bromodichloromethane - VOC	3.1	163.83		
	Butane - VOC	5.0	58.12		
	Carbon disulfide - HAP/VOC	0.58	76.13		
	Carbon monoxide	140	28.01		
	Carbon tetrachloride - HAP/VOC	4.0E-03	153.84		
	Carbonyl sulfide - HAP/VOC	0.49	60.07		
	Chlorobenzene - HAP/VOC	0.25	112.56		
	Chlorodifluoromethane	1.3	86.47		
	Chloroethane (ethyl chloride) - HAP/VOC	1.3	64.52		
	Chloroform - HAP/VOC	0.03	119.39		
	Chloromethane - VOC	1.2	50.49		
	Dichlorobenzene - (HAP for para isomer/VOC)	0.21	147		
	Dichlorodifluoromethane	16	120.91		
	Dichlorofluoromethane - VOC	2.6	102.92		
	Dichloromethane (methylene chloride) - HAP	14	84.94		
	Dimethyl sulfide (methyl sulfide) - VOC	7.8	62.13		
	Ethane	890	30.07		
	Ethanol - VOC	27	46.08		

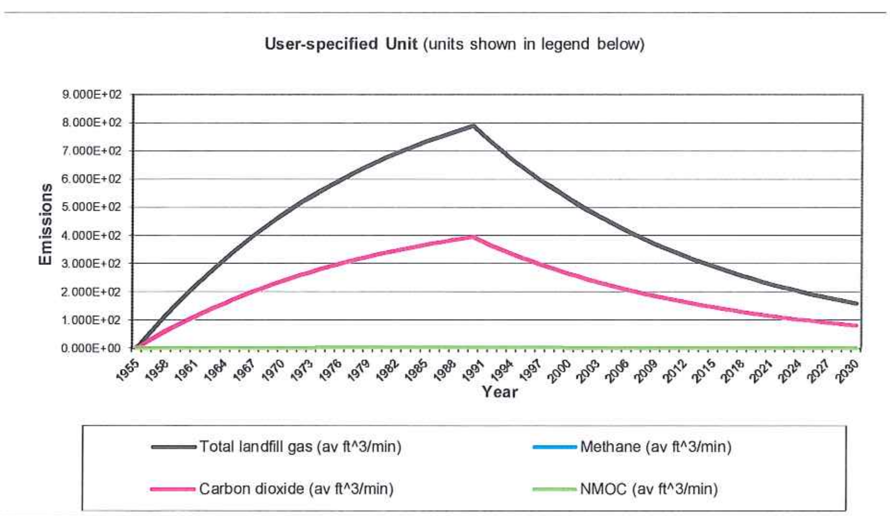
Pollutant Parameters (Continued)

	Gas / Pollutant Default Parameters:			User-specified Pollutant Parameters:	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Pollutants	Ethyl mercaptan (ethanethiol) - VOC	2.3	62.13		
	Ethylbenzene - HAP/VOC	4.6	106.16		
	Ethylene dibromide - HAP/VOC	1.0E-03	187.88		
	Fluorotrichloromethane - VOC	0.76	137.38		
	Hexane - HAP/VOC	6.6	86.18		
	Hydrogen sulfide	36	34.08		
	Mercury (total) - HAP	2.9E-04	200.61		
	Methyl ethyl ketone - HAP/VOC	7.1	72.11		
	Methyl isobutyl ketone - HAP/VOC	1.9	100.16		
	Methyl mercaptan - VOC	2.5	48.11		
	Pentane - VOC	3.3	72.15		
	Perchloroethylene (tetrachloroethylene) - HAP	3.7	165.83		
	Propane - VOC	11	44.09		
	t-1,2-Dichloroethene - VOC	2.8	96.94		
	Toluene - No or Unknown Co-disposal - HAP/VOC	39	92.13		
	Toluene - Co-disposal - HAP/VOC	170	92.13		
	Trichloroethylene (trichloroethene) - HAP/VOC	2.8	131.40		
	Vinyl chloride - HAP/VOC	7.3	62.50		
	Xylenes - HAP/VOC	12	106.16		

Graphs


Megagrams Per Year
Emissions
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


Cubic Meters Per Year
Emissions
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


User-specified Unit (units shown in legend below)
Emissions
Year
Total landfill gas (av ft^3/min)
Methane (av ft^3/min)
Carbon dioxide (av ft^3/min)
NMOC (av ft^3/min)

Results

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
1955	0	0	0	0	0	0
1956	7.646E+02	6.123E+05	4.114E+01	2.042E+02	3.061E+05	2.057E+01
1957	1.499E+03	1.201E+06	8.067E+01	4.005E+02	6.003E+05	4.033E+01
1958	2.205E+03	1.766E+06	1.186E+02	5.890E+02	8.829E+05	5.932E+01
1959	2.883E+03	2.309E+06	1.551E+02	7.702E+02	1.154E+06	7.757E+01
1960	3.535E+03	2.831E+06	1.902E+02	9.442E+02	1.415E+06	9.509E+01
1961	4.161E+03	3.332E+06	2.239E+02	1.111E+03	1.666E+06	1.119E+02
1962	4.762E+03	3.814E+06	2.562E+02	1.272E+03	1.907E+06	1.281E+02
1963	5.340E+03	4.276E+06	2.873E+02	1.426E+03	2.138E+06	1.437E+02
1964	5.896E+03	4.721E+06	3.172E+02	1.575E+03	2.360E+06	1.586E+02
1965	6.429E+03	5.148E+06	3.459E+02	1.717E+03	2.574E+06	1.730E+02
1966	6.942E+03	5.559E+06	3.735E+02	1.854E+03	2.779E+06	1.867E+02
1967	7.434E+03	5.953E+06	4.000E+02	1.986E+03	2.976E+06	2.000E+02
1968	7.907E+03	6.332E+06	4.254E+02	2.112E+03	3.166E+06	2.127E+02
1969	8.362E+03	6.696E+06	4.499E+02	2.234E+03	3.348E+06	2.249E+02
1970	8.799E+03	7.046E+06	4.734E+02	2.350E+03	3.523E+06	2.367E+02
1971	9.218E+03	7.382E+06	4.960E+02	2.462E+03	3.691E+06	2.480E+02
1972	9.621E+03	7.704E+06	5.177E+02	2.570E+03	3.852E+06	2.588E+02
1973	1.001E+04	8.015E+06	5.385E+02	2.673E+03	4.007E+06	2.693E+02
1974	1.038E+04	8.313E+06	5.585E+02	2.773E+03	4.156E+06	2.793E+02
1975	1.074E+04	8.599E+06	5.778E+02	2.868E+03	4.300E+06	2.889E+02
1976	1.108E+04	8.874E+06	5.963E+02	2.960E+03	4.437E+06	2.981E+02
1977	1.141E+04	9.138E+06	6.140E+02	3.048E+03	4.569E+06	3.070E+02
1978	1.173E+04	9.392E+06	6.311E+02	3.133E+03	4.696E+06	3.155E+02
1979	1.203E+04	9.636E+06	6.475E+02	3.214E+03	4.818E+06	3.237E+02
1980	1.233E+04	9.871E+06	6.632E+02	3.293E+03	4.935E+06	3.316E+02
1981	1.261E+04	1.010E+07	6.784E+02	3.368E+03	5.048E+06	3.392E+02
1982	1.288E+04	1.031E+07	6.929E+02	3.440E+03	5.156E+06	3.465E+02
1983	1.314E+04	1.052E+07	7.069E+02	3.509E+03	5.260E+06	3.534E+02
1984	1.339E+04	1.072E+07	7.203E+02	3.576E+03	5.360E+06	3.601E+02
1985	1.363E+04	1.091E+07	7.332E+02	3.640E+03	5.456E+06	3.666E+02
1986	1.386E+04	1.110E+07	7.456E+02	3.702E+03	5.548E+06	3.728E+02
1987	1.408E+04	1.127E+07	7.575E+02	3.761E+03	5.637E+06	3.787E+02
1988	1.429E+04	1.144E+07	7.689E+02	3.817E+03	5.722E+06	3.845E+02
1989	1.450E+04	1.161E+07	7.799E+02	3.872E+03	5.804E+06	3.900E+02
1990	1.469E+04	1.176E+07	7.905E+02	3.924E+03	5.882E+06	3.952E+02
1991	1.412E+04	1.130E+07	7.595E+02	3.771E+03	5.652E+06	3.797E+02
1992	1.356E+04	1.086E+07	7.297E+02	3.623E+03	5.430E+06	3.649E+02
1993	1.303E+04	1.043E+07	7.011E+02	3.481E+03	5.217E+06	3.505E+02
1994	1.252E+04	1.003E+07	6.736E+02	3.344E+03	5.013E+06	3.368E+02
1995	1.203E+04	9.632E+06	6.472E+02	3.213E+03	4.816E+06	3.236E+02
1996	1.156E+04	9.255E+06	6.218E+02	3.087E+03	4.627E+06	3.109E+02
1997	1.110E+04	8.892E+06	5.974E+02	2.966E+03	4.446E+06	2.987E+02
1998	1.067E+04	8.543E+06	5.740E+02	2.850E+03	4.272E+06	2.870E+02
1999	1.025E+04	8.208E+06	5.515E+02	2.738E+03	4.104E+06	2.757E+02
2000	9.849E+03	7.886E+06	5.299E+02	2.631E+03	3.943E+06	2.649E+02
2001	9.462E+03	7.577E+06	5.091E+02	2.527E+03	3.789E+06	2.545E+02
2002	9.091E+03	7.280E+06	4.891E+02	2.428E+03	3.640E+06	2.446E+02
2003	8.735E+03	6.994E+06	4.700E+02	2.333E+03	3.497E+06	2.350E+02
2004	8.392E+03	6.720E+06	4.515E+02	2.242E+03	3.360E+06	2.258E+02

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2005	8.063E+03	6.457E+06	4.338E+02	2.154E+03	3.228E+06	2.169E+02
2006	7.747E+03	6.204E+06	4.168E+02	2.069E+03	3.102E+06	2.084E+02
2007	7.443E+03	5.960E+06	4.005E+02	1.988E+03	2.980E+06	2.002E+02
2008	7.151E+03	5.727E+06	3.848E+02	1.910E+03	2.863E+06	1.924E+02
2009	6.871E+03	5.502E+06	3.697E+02	1.835E+03	2.751E+06	1.848E+02
2010	6.602E+03	5.286E+06	3.552E+02	1.763E+03	2.643E+06	1.776E+02
2011	6.343E+03	5.079E+06	3.413E+02	1.694E+03	2.540E+06	1.706E+02
2012	6.094E+03	4.880E+06	3.279E+02	1.628E+03	2.440E+06	1.639E+02
2013	5.855E+03	4.689E+06	3.150E+02	1.564E+03	2.344E+06	1.575E+02
2014	5.626E+03	4.505E+06	3.027E+02	1.503E+03	2.252E+06	1.513E+02
2015	5.405E+03	4.328E+06	2.908E+02	1.444E+03	2.164E+06	1.454E+02
2016	5.193E+03	4.158E+06	2.794E+02	1.387E+03	2.079E+06	1.397E+02
2017	4.989E+03	3.995E+06	2.684E+02	1.333E+03	1.998E+06	1.342E+02
2018	4.794E+03	3.839E+06	2.579E+02	1.280E+03	1.919E+06	1.290E+02
2019	4.606E+03	3.688E+06	2.478E+02	1.230E+03	1.844E+06	1.239E+02
2020	4.425E+03	3.544E+06	2.381E+02	1.182E+03	1.772E+06	1.190E+02
2021	4.252E+03	3.405E+06	2.288E+02	1.136E+03	1.702E+06	1.144E+02
2022	4.085E+03	3.271E+06	2.198E+02	1.091E+03	1.636E+06	1.099E+02
2023	3.925E+03	3.143E+06	2.112E+02	1.048E+03	1.571E+06	1.056E+02
2024	3.771E+03	3.020E+06	2.029E+02	1.007E+03	1.510E+06	1.014E+02
2025	3.623E+03	2.901E+06	1.949E+02	9.678E+02	1.451E+06	9.747E+01
2026	3.481E+03	2.787E+06	1.873E+02	9.298E+02	1.394E+06	9.364E+01
2027	3.345E+03	2.678E+06	1.799E+02	8.934E+02	1.339E+06	8.997E+01
2028	3.213E+03	2.573E+06	1.729E+02	8.583E+02	1.287E+06	8.644E+01
2029	3.087E+03	2.472E+06	1.661E+02	8.247E+02	1.236E+06	8.305E+01
2030	2.966E+03	2.375E+06	1.596E+02	7.923E+02	1.188E+06	7.980E+01
2031	2.850E+03	2.282E+06	1.533E+02	7.613E+02	1.141E+06	7.667E+01
2032	2.738E+03	2.193E+06	1.473E+02	7.314E+02	1.096E+06	7.366E+01
2033	2.631E+03	2.107E+06	1.415E+02	7.027E+02	1.053E+06	7.077E+01
2034	2.528E+03	2.024E+06	1.360E+02	6.752E+02	1.012E+06	6.800E+01
2035	2.429E+03	1.945E+06	1.307E+02	6.487E+02	9.724E+05	6.533E+01
2036	2.333E+03	1.868E+06	1.255E+02	6.233E+02	9.342E+05	6.277E+01
2037	2.242E+03	1.795E+06	1.206E+02	5.988E+02	8.976E+05	6.031E+01
2038	2.154E+03	1.725E+06	1.159E+02	5.754E+02	8.624E+05	5.794E+01
2039	2.070E+03	1.657E+06	1.113E+02	5.528E+02	8.286E+05	5.567E+01
2040	1.988E+03	1.592E+06	1.070E+02	5.311E+02	7.961E+05	5.349E+01
2041	1.910E+03	1.530E+06	1.028E+02	5.103E+02	7.649E+05	5.139E+01
2042	1.836E+03	1.470E+06	9.875E+01	4.903E+02	7.349E+05	4.938E+01
2043	1.764E+03	1.412E+06	9.488E+01	4.711E+02	7.061E+05	4.744E+01
2044	1.694E+03	1.357E+06	9.116E+01	4.526E+02	6.784E+05	4.558E+01
2045	1.628E+03	1.304E+06	8.759E+01	4.348E+02	6.518E+05	4.379E+01
2046	1.564E+03	1.252E+06	8.415E+01	4.178E+02	6.262E+05	4.208E+01
2047	1.503E+03	1.203E+06	8.085E+01	4.014E+02	6.017E+05	4.043E+01
2048	1.444E+03	1.156E+06	7.768E+01	3.857E+02	5.781E+05	3.884E+01
2049	1.387E+03	1.111E+06	7.464E+01	3.705E+02	5.554E+05	3.732E+01
2050	1.333E+03	1.067E+06	7.171E+01	3.560E+02	5.336E+05	3.586E+01
2051	1.281E+03	1.025E+06	6.890E+01	3.421E+02	5.127E+05	3.445E+01
2052	1.230E+03	9.852E+05	6.620E+01	3.286E+02	4.926E+05	3.310E+01
2053	1.182E+03	9.466E+05	6.360E+01	3.158E+02	4.733E+05	3.180E+01
2054	1.136E+03	9.095E+05	6.111E+01	3.034E+02	4.547E+05	3.055E+01
2055	1.091E+03	8.738E+05	5.871E+01	2.915E+02	4.369E+05	2.936E+01

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2056	1.048E+03	8.396E+05	5.641E+01	2.801E+02	4.198E+05	2.820E+01
2057	1.007E+03	8.066E+05	5.420E+01	2.691E+02	4.033E+05	2.710E+01
2058	9.678E+02	7.750E+05	5.207E+01	2.585E+02	3.875E+05	2.604E+01
2059	9.299E+02	7.446E+05	5.003E+01	2.484E+02	3.723E+05	2.502E+01
2060	8.934E+02	7.154E+05	4.807E+01	2.386E+02	3.577E+05	2.403E+01
2061	8.584E+02	6.874E+05	4.618E+01	2.293E+02	3.437E+05	2.309E+01
2062	8.247E+02	6.604E+05	4.437E+01	2.203E+02	3.302E+05	2.219E+01
2063	7.924E+02	6.345E+05	4.263E+01	2.117E+02	3.173E+05	2.132E+01
2064	7.613E+02	6.096E+05	4.096E+01	2.034E+02	3.048E+05	2.048E+01
2065	7.315E+02	5.857E+05	3.936E+01	1.954E+02	2.929E+05	1.968E+01
2066	7.028E+02	5.628E+05	3.781E+01	1.877E+02	2.814E+05	1.891E+01
2067	6.752E+02	5.407E+05	3.633E+01	1.804E+02	2.704E+05	1.816E+01
2068	6.488E+02	5.195E+05	3.491E+01	1.733E+02	2.598E+05	1.745E+01
2069	6.233E+02	4.991E+05	3.354E+01	1.665E+02	2.496E+05	1.677E+01
2070	5.989E+02	4.796E+05	3.222E+01	1.600E+02	2.398E+05	1.611E+01
2071	5.754E+02	4.608E+05	3.096E+01	1.537E+02	2.304E+05	1.548E+01
2072	5.528E+02	4.427E+05	2.974E+01	1.477E+02	2.213E+05	1.487E+01
2073	5.312E+02	4.253E+05	2.858E+01	1.419E+02	2.127E+05	1.429E+01
2074	5.103E+02	4.087E+05	2.746E+01	1.363E+02	2.043E+05	1.373E+01
2075	4.903E+02	3.926E+05	2.638E+01	1.310E+02	1.963E+05	1.319E+01
2076	4.711E+02	3.772E+05	2.535E+01	1.258E+02	1.886E+05	1.267E+01
2077	4.526E+02	3.624E+05	2.435E+01	1.209E+02	1.812E+05	1.218E+01
2078	4.349E+02	3.482E+05	2.340E+01	1.162E+02	1.741E+05	1.170E+01
2079	4.178E+02	3.346E+05	2.248E+01	1.116E+02	1.673E+05	1.124E+01
2080	4.014E+02	3.215E+05	2.160E+01	1.072E+02	1.607E+05	1.080E+01
2081	3.857E+02	3.089E+05	2.075E+01	1.030E+02	1.544E+05	1.038E+01
2082	3.706E+02	2.967E+05	1.994E+01	9.899E+01	1.484E+05	9.969E+00
2083	3.561E+02	2.851E+05	1.916E+01	9.511E+01	1.426E+05	9.578E+00
2084	3.421E+02	2.739E+05	1.841E+01	9.138E+01	1.370E+05	9.203E+00
2085	3.287E+02	2.632E+05	1.768E+01	8.779E+01	1.316E+05	8.842E+00
2086	3.158E+02	2.529E+05	1.699E+01	8.435E+01	1.264E+05	8.495E+00
2087	3.034E+02	2.430E+05	1.632E+01	8.104E+01	1.215E+05	8.162E+00
2088	2.915E+02	2.334E+05	1.568E+01	7.787E+01	1.167E+05	7.842E+00
2089	2.801E+02	2.243E+05	1.507E+01	7.481E+01	1.121E+05	7.535E+00
2090	2.691E+02	2.155E+05	1.448E+01	7.188E+01	1.077E+05	7.239E+00
2091	2.585E+02	2.070E+05	1.391E+01	6.906E+01	1.035E+05	6.955E+00
2092	2.484E+02	1.989E+05	1.337E+01	6.635E+01	9.946E+04	6.683E+00
2093	2.387E+02	1.911E+05	1.284E+01	6.375E+01	9.556E+04	6.420E+00
2094	2.293E+02	1.836E+05	1.234E+01	6.125E+01	9.181E+04	6.169E+00
2095	2.203E+02	1.764E+05	1.185E+01	5.885E+01	8.821E+04	5.927E+00

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
1955	0	0	0	0	0	0
1956	5.604E+02	3.061E+05	2.057E+01	8.779E+00	2.449E+03	1.646E-01
1957	1.099E+03	6.003E+05	4.033E+01	1.721E+01	4.802E+03	3.227E-01
1958	1.616E+03	8.829E+05	5.932E+01	2.532E+01	7.063E+03	4.746E-01
1959	2.113E+03	1.154E+06	7.757E+01	3.310E+01	9.235E+03	6.205E-01
1960	2.591E+03	1.415E+06	9.509E+01	4.059E+01	1.132E+04	7.608E-01
1961	3.050E+03	1.666E+06	1.119E+02	4.777E+01	1.333E+04	8.955E-01
1962	3.490E+03	1.907E+06	1.281E+02	5.468E+01	1.525E+04	1.025E+00
1963	3.914E+03	2.138E+06	1.437E+02	6.131E+01	1.711E+04	1.149E+00
1964	4.321E+03	2.360E+06	1.586E+02	6.769E+01	1.888E+04	1.269E+00
1965	4.712E+03	2.574E+06	1.730E+02	7.381E+01	2.059E+04	1.384E+00
1966	5.087E+03	2.779E+06	1.867E+02	7.970E+01	2.223E+04	1.494E+00
1967	5.448E+03	2.976E+06	2.000E+02	8.535E+01	2.381E+04	1.600E+00
1968	5.795E+03	3.166E+06	2.127E+02	9.078E+01	2.533E+04	1.702E+00
1969	6.128E+03	3.348E+06	2.249E+02	9.600E+01	2.678E+04	1.800E+00
1970	6.448E+03	3.523E+06	2.367E+02	1.010E+02	2.818E+04	1.894E+00
1971	6.756E+03	3.691E+06	2.480E+02	1.058E+02	2.953E+04	1.984E+00
1972	7.051E+03	3.852E+06	2.588E+02	1.105E+02	3.082E+04	2.071E+00
1973	7.335E+03	4.007E+06	2.693E+02	1.149E+02	3.206E+04	2.154E+00
1974	7.608E+03	4.156E+06	2.793E+02	1.192E+02	3.325E+04	2.234E+00
1975	7.870E+03	4.300E+06	2.889E+02	1.233E+02	3.440E+04	2.311E+00
1976	8.122E+03	4.437E+06	2.981E+02	1.272E+02	3.550E+04	2.385E+00
1977	8.364E+03	4.569E+06	3.070E+02	1.310E+02	3.655E+04	2.456E+00
1978	8.596E+03	4.696E+06	3.155E+02	1.347E+02	3.757E+04	2.524E+00
1979	8.820E+03	4.818E+06	3.237E+02	1.382E+02	3.855E+04	2.590E+00
1980	9.034E+03	4.935E+06	3.316E+02	1.415E+02	3.948E+04	2.653E+00
1981	9.241E+03	5.048E+06	3.392E+02	1.448E+02	4.038E+04	2.713E+00
1982	9.439E+03	5.156E+06	3.465E+02	1.479E+02	4.125E+04	2.772E+00
1983	9.629E+03	5.260E+06	3.534E+02	1.508E+02	4.208E+04	2.827E+00
1984	9.812E+03	5.360E+06	3.601E+02	1.537E+02	4.288E+04	2.881E+00
1985	9.987E+03	5.456E+06	3.666E+02	1.565E+02	4.365E+04	2.933E+00
1986	1.016E+04	5.548E+06	3.728E+02	1.591E+02	4.439E+04	2.982E+00
1987	1.032E+04	5.637E+06	3.787E+02	1.616E+02	4.510E+04	3.030E+00
1988	1.047E+04	5.722E+06	3.845E+02	1.641E+02	4.578E+04	3.076E+00
1989	1.062E+04	5.804E+06	3.900E+02	1.664E+02	4.643E+04	3.120E+00
1990	1.077E+04	5.882E+06	3.952E+02	1.687E+02	4.706E+04	3.162E+00
1991	1.035E+04	5.652E+06	3.797E+02	1.621E+02	4.521E+04	3.038E+00
1992	9.940E+03	5.430E+06	3.649E+02	1.557E+02	4.344E+04	2.919E+00
1993	9.550E+03	5.217E+06	3.505E+02	1.496E+02	4.174E+04	2.804E+00
1994	9.176E+03	5.013E+06	3.368E+02	1.437E+02	4.010E+04	2.694E+00
1995	8.816E+03	4.816E+06	3.236E+02	1.381E+02	3.853E+04	2.589E+00
1996	8.470E+03	4.627E+06	3.109E+02	1.327E+02	3.702E+04	2.487E+00
1997	8.138E+03	4.446E+06	2.987E+02	1.275E+02	3.557E+04	2.390E+00
1998	7.819E+03	4.272E+06	2.870E+02	1.225E+02	3.417E+04	2.296E+00
1999	7.512E+03	4.104E+06	2.757E+02	1.177E+02	3.283E+04	2.206E+00
2000	7.218E+03	3.943E+06	2.649E+02	1.131E+02	3.154E+04	2.120E+00
2001	6.935E+03	3.789E+06	2.545E+02	1.086E+02	3.031E+04	2.036E+00
2002	6.663E+03	3.640E+06	2.446E+02	1.044E+02	2.912E+04	1.957E+00
2003	6.402E+03	3.497E+06	2.350E+02	1.003E+02	2.798E+04	1.880E+00
2004	6.151E+03	3.360E+06	2.258E+02	9.635E+01	2.688E+04	1.806E+00

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2005	5.909E+03	3.228E+06	2.169E+02	9.258E+01	2.583E+04	1.735E+00
2006	5.678E+03	3.102E+06	2.084E+02	8.895E+01	2.481E+04	1.667E+00
2007	5.455E+03	2.980E+06	2.002E+02	8.546E+01	2.384E+04	1.602E+00
2008	5.241E+03	2.863E+06	1.924E+02	8.211E+01	2.291E+04	1.539E+00
2009	5.036E+03	2.751E+06	1.848E+02	7.889E+01	2.201E+04	1.479E+00
2010	4.838E+03	2.643E+06	1.776E+02	7.579E+01	2.115E+04	1.421E+00
2011	4.649E+03	2.540E+06	1.706E+02	7.282E+01	2.032E+04	1.365E+00
2012	4.466E+03	2.440E+06	1.639E+02	6.997E+01	1.952E+04	1.312E+00
2013	4.291E+03	2.344E+06	1.575E+02	6.722E+01	1.875E+04	1.260E+00
2014	4.123E+03	2.252E+06	1.513E+02	6.459E+01	1.802E+04	1.211E+00
2015	3.961E+03	2.164E+06	1.454E+02	6.206E+01	1.731E+04	1.163E+00
2016	3.806E+03	2.079E+06	1.397E+02	5.962E+01	1.663E+04	1.118E+00
2017	3.657E+03	1.998E+06	1.342E+02	5.728E+01	1.598E+04	1.074E+00
2018	3.513E+03	1.919E+06	1.290E+02	5.504E+01	1.535E+04	1.032E+00
2019	3.376E+03	1.844E+06	1.239E+02	5.288E+01	1.475E+04	9.912E-01
2020	3.243E+03	1.772E+06	1.190E+02	5.081E+01	1.417E+04	9.524E-01
2021	3.116E+03	1.702E+06	1.144E+02	4.881E+01	1.362E+04	9.150E-01
2022	2.994E+03	1.636E+06	1.099E+02	4.690E+01	1.308E+04	8.791E-01
2023	2.876E+03	1.571E+06	1.056E+02	4.506E+01	1.257E+04	8.447E-01
2024	2.764E+03	1.510E+06	1.014E+02	4.329E+01	1.208E+04	8.115E-01
2025	2.655E+03	1.451E+06	9.747E+01	4.160E+01	1.160E+04	7.797E-01
2026	2.551E+03	1.394E+06	9.364E+01	3.997E+01	1.115E+04	7.491E-01
2027	2.451E+03	1.339E+06	8.997E+01	3.840E+01	1.071E+04	7.198E-01
2028	2.355E+03	1.287E+06	8.644E+01	3.689E+01	1.029E+04	6.916E-01
2029	2.263E+03	1.236E+06	8.305E+01	3.545E+01	9.889E+03	6.644E-01
2030	2.174E+03	1.188E+06	7.980E+01	3.406E+01	9.501E+03	6.384E-01
2031	2.089E+03	1.141E+06	7.667E+01	3.272E+01	9.129E+03	6.133E-01
2032	2.007E+03	1.096E+06	7.366E+01	3.144E+01	8.771E+03	5.893E-01
2033	1.928E+03	1.053E+06	7.077E+01	3.021E+01	8.427E+03	5.662E-01
2034	1.853E+03	1.012E+06	6.800E+01	2.902E+01	8.096E+03	5.440E-01
2035	1.780E+03	9.724E+05	6.533E+01	2.788E+01	7.779E+03	5.227E-01
2036	1.710E+03	9.342E+05	6.277E+01	2.679E+01	7.474E+03	5.022E-01
2037	1.643E+03	8.976E+05	6.031E+01	2.574E+01	7.181E+03	4.825E-01
2038	1.579E+03	8.624E+05	5.794E+01	2.473E+01	6.899E+03	4.636E-01
2039	1.517E+03	8.286E+05	5.567E+01	2.376E+01	6.629E+03	4.454E-01
2040	1.457E+03	7.961E+05	5.349E+01	2.283E+01	6.369E+03	4.279E-01
2041	1.400E+03	7.649E+05	5.139E+01	2.193E+01	6.119E+03	4.111E-01
2042	1.345E+03	7.349E+05	4.938E+01	2.107E+01	5.879E+03	3.950E-01
2043	1.292E+03	7.061E+05	4.744E+01	2.025E+01	5.649E+03	3.795E-01
2044	1.242E+03	6.784E+05	4.558E+01	1.945E+01	5.427E+03	3.646E-01
2045	1.193E+03	6.518E+05	4.379E+01	1.869E+01	5.214E+03	3.504E-01
2046	1.146E+03	6.262E+05	4.208E+01	1.796E+01	5.010E+03	3.366E-01
2047	1.101E+03	6.017E+05	4.043E+01	1.725E+01	4.813E+03	3.234E-01
2048	1.058E+03	5.781E+05	3.884E+01	1.658E+01	4.625E+03	3.107E-01
2049	1.017E+03	5.554E+05	3.732E+01	1.593E+01	4.443E+03	2.985E-01
2050	9.768E+02	5.336E+05	3.586E+01	1.530E+01	4.269E+03	2.868E-01
2051	9.385E+02	5.127E+05	3.445E+01	1.470E+01	4.102E+03	2.756E-01
2052	9.017E+02	4.926E+05	3.310E+01	1.413E+01	3.941E+03	2.648E-01
2053	8.664E+02	4.733E+05	3.180E+01	1.357E+01	3.786E+03	2.544E-01
2054	8.324E+02	4.547E+05	3.055E+01	1.304E+01	3.638E+03	2.444E-01
2055	7.998E+02	4.369E+05	2.936E+01	1.253E+01	3.495E+03	2.348E-01

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2056	7.684E+02	4.198E+05	2.820E+01	1.204E+01	3.358E+03	2.256E-01
2057	7.383E+02	4.033E+05	2.710E+01	1.157E+01	3.227E+03	2.168E-01
2058	7.093E+02	3.875E+05	2.604E+01	1.111E+01	3.100E+03	2.083E-01
2059	6.815E+02	3.723E+05	2.502E+01	1.068E+01	2.978E+03	2.001E-01
2060	6.548E+02	3.577E+05	2.403E+01	1.026E+01	2.862E+03	1.923E-01
2061	6.291E+02	3.437E+05	2.309E+01	9.855E+00	2.749E+03	1.847E-01
2062	6.044E+02	3.302E+05	2.219E+01	9.469E+00	2.642E+03	1.775E-01
2063	5.807E+02	3.173E+05	2.132E+01	9.098E+00	2.538E+03	1.705E-01
2064	5.580E+02	3.048E+05	2.048E+01	8.741E+00	2.439E+03	1.638E-01
2065	5.361E+02	2.929E+05	1.968E+01	8.398E+00	2.343E+03	1.574E-01
2066	5.151E+02	2.814E+05	1.891E+01	8.069E+00	2.251E+03	1.513E-01
2067	4.949E+02	2.704E+05	1.816E+01	7.753E+00	2.163E+03	1.453E-01
2068	4.755E+02	2.598E+05	1.745E+01	7.449E+00	2.078E+03	1.396E-01
2069	4.568E+02	2.496E+05	1.677E+01	7.157E+00	1.997E+03	1.341E-01
2070	4.389E+02	2.398E+05	1.611E+01	6.876E+00	1.918E+03	1.289E-01
2071	4.217E+02	2.304E+05	1.548E+01	6.606E+00	1.843E+03	1.238E-01
2072	4.052E+02	2.213E+05	1.487E+01	6.347E+00	1.771E+03	1.190E-01
2073	3.893E+02	2.127E+05	1.429E+01	6.098E+00	1.701E+03	1.143E-01
2074	3.740E+02	2.043E+05	1.373E+01	5.859E+00	1.635E+03	1.098E-01
2075	3.594E+02	1.963E+05	1.319E+01	5.630E+00	1.571E+03	1.055E-01
2076	3.453E+02	1.886E+05	1.267E+01	5.409E+00	1.509E+03	1.014E-01
2077	3.317E+02	1.812E+05	1.218E+01	5.197E+00	1.450E+03	9.741E-02
2078	3.187E+02	1.741E+05	1.170E+01	4.993E+00	1.393E+03	9.359E-02
2079	3.062E+02	1.673E+05	1.124E+01	4.797E+00	1.338E+03	8.992E-02
2080	2.942E+02	1.607E+05	1.080E+01	4.609E+00	1.286E+03	8.640E-02
2081	2.827E+02	1.544E+05	1.038E+01	4.428E+00	1.235E+03	8.301E-02
2082	2.716E+02	1.484E+05	9.969E+00	4.255E+00	1.187E+03	7.975E-02
2083	2.609E+02	1.426E+05	9.578E+00	4.088E+00	1.140E+03	7.663E-02
2084	2.507E+02	1.370E+05	9.203E+00	3.928E+00	1.096E+03	7.362E-02
2085	2.409E+02	1.316E+05	8.842E+00	3.774E+00	1.053E+03	7.073E-02
2086	2.314E+02	1.264E+05	8.495E+00	3.626E+00	1.011E+03	6.796E-02
2087	2.224E+02	1.215E+05	8.162E+00	3.483E+00	9.718E+02	6.530E-02
2088	2.136E+02	1.167E+05	7.842E+00	3.347E+00	9.337E+02	6.274E-02
2089	2.053E+02	1.121E+05	7.535E+00	3.216E+00	8.971E+02	6.028E-02
2090	1.972E+02	1.077E+05	7.239E+00	3.090E+00	8.619E+02	5.791E-02
2091	1.895E+02	1.035E+05	6.955E+00	2.968E+00	8.281E+02	5.564E-02
2092	1.821E+02	9.946E+04	6.683E+00	2.852E+00	7.957E+02	5.346E-02
2093	1.749E+02	9.556E+04	6.420E+00	2.740E+00	7.645E+02	5.136E-02
2094	1.681E+02	9.181E+04	6.169E+00	2.633E+00	7.345E+02	4.935E-02
2095	1.615E+02	8.821E+04	5.927E+00	2.530E+00	7.057E+02	4.741E-02

Summary Report

Landfill Name or Identifier: Bridgeton South Quarry

Date: Wednesday, July 24, 2013

Description/Comments:

Period of operation is estimated between approximately 1955 and 2003, based on site information. Volume is approximately 11.45 million cubic yards or approximately 9.2 million tons at a density of 1600 lb/cyd. Waste input is averaged over the relative operating period.

About LandGEM:

First-Order Decomposition Rate Equation:

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

Where,

Q_{CH4} = annual methane generation in the year of the calculation (*m^3/year*)
i = 1-year time increment
n = (year of the calculation) - (initial year of waste acceptance)
j = 0.1-year time increment
k = methane generation rate (*$year^{-1}$*)
L_o = potential methane generation capacity (*m^3/Mg*)

M_i = mass of waste accepted in the i^{th} year (*Mg*)
t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year (*decimal years*, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at http://www.epa.gov/ttnatw01/landfill/landflpg.html.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for convential landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

Input Review

LANDFILL CHARACTERISTICS

Landfill Open Year	**1955**	
Landfill Closure Year (with 80-year limit)	**2003**	
Actual Closure Year (without limit)	***2003***	
Have Model Calculate Closure Year?	**No**	
Waste Design Capacity	**9,200,000**	*short tons*

MODEL PARAMETERS

Methane Generation Rate, k	**0.040**	*year^{-1}*
Potential Methane Generation Capacity, L_o	**100**	*m^3/Mg*
NMOC Concentration	**4,000**	*ppmv as hexane*
Methane Content	**50**	*% by volume*

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1:	**Total landfill gas**
Gas / Pollutant #2:	**Methane**
Gas / Pollutant #3:	**Carbon dioxide**
Gas / Pollutant #4:	**NMOC**

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
1955	170,686	187,755	0	0
1956	170,686	187,755	170,686	187,755
1957	170,686	187,755	341,373	375,510
1958	170,686	187,755	512,059	563,265
1959	170,686	187,755	682,745	751,020
1960	170,686	187,755	853,432	938,775
1961	170,686	187,755	1,024,118	1,126,530
1962	170,686	187,755	1,194,805	1,314,285
1963	170,686	187,755	1,365,491	1,502,040
1964	170,686	187,755	1,536,177	1,689,795
1965	170,686	187,755	1,706,864	1,877,550
1966	170,686	187,755	1,877,550	2,065,305
1967	170,686	187,755	2,048,236	2,253,060
1968	170,686	187,755	2,218,923	2,440,815
1969	170,686	187,755	2,389,609	2,628,570
1970	170,686	187,755	2,560,295	2,816,325
1971	170,686	187,755	2,730,982	3,004,080
1972	170,686	187,755	2,901,668	3,191,835
1973	170,686	187,755	3,072,355	3,379,590
1974	170,686	187,755	3,243,041	3,567,345
1975	170,686	187,755	3,413,727	3,755,100
1976	170,686	187,755	3,584,414	3,942,855
1977	170,686	187,755	3,755,100	4,130,610
1978	170,686	187,755	3,925,786	4,318,365
1979	170,686	187,755	4,096,473	4,506,120
1980	170,686	187,755	4,267,159	4,693,875
1981	170,686	187,755	4,437,845	4,881,630
1982	170,686	187,755	4,608,532	5,069,385
1983	170,686	187,755	4,779,218	5,257,140
1984	170,686	187,755	4,949,905	5,444,895
1985	170,686	187,755	5,120,591	5,632,650
1986	170,686	187,755	5,291,277	5,820,405
1987	170,686	187,755	5,461,964	6,008,160
1988	170,686	187,755	5,632,650	6,195,915
1989	170,686	187,755	5,803,336	6,383,670
1990	170,686	187,755	5,974,023	6,571,425
1991	170,686	187,755	6,144,709	6,759,180
1992	170,686	187,755	6,315,395	6,946,935
1993	170,686	187,755	6,486,082	7,134,690
1994	170,686	187,755	6,656,768	7,322,445

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	(short tons/year)	(Mg)	(short tons)
1995	170,686	187,755	6,827,455	7,510,200
1996	170,686	187,755	6,998,141	7,697,955
1997	170,686	187,755	7,168,827	7,885,710
1998	170,686	187,755	7,339,514	8,073,465
1999	170,686	187,755	7,510,200	8,261,220
2000	170,686	187,755	7,680,886	8,448,975
2001	170,686	187,755	7,851,573	8,636,730
2002	170,686	187,755	8,022,259	8,824,485
2003	170,691	187,760	8,192,945	9,012,240
2004	0	0	8,363,636	9,200,000
2005	0	0	8,363,636	9,200,000
2006	0	0	8,363,636	9,200,000
2007	0	0	8,363,636	9,200,000
2008	0	0	8,363,636	9,200,000
2009	0	0	8,363,636	9,200,000
2010	0	0	8,363,636	9,200,000
2011	0	0	8,363,636	9,200,000
2012	0	0	8,363,636	9,200,000
2013	0	0	8,363,636	9,200,000
2014	0	0	8,363,636	9,200,000
2015	0	0	8,363,636	9,200,000
2016	0	0	8,363,636	9,200,000
2017	0	0	8,363,636	9,200,000
2018	0	0	8,363,636	9,200,000
2019	0	0	8,363,636	9,200,000
2020	0	0	8,363,636	9,200,000
2021	0	0	8,363,636	9,200,000
2022	0	0	8,363,636	9,200,000
2023	0	0	8,363,636	9,200,000
2024	0	0	8,363,636	9,200,000
2025	0	0	8,363,636	9,200,000
2026	0	0	8,363,636	9,200,000
2027	0	0	8,363,636	9,200,000
2028	0	0	8,363,636	9,200,000
2029	0	0	8,363,636	9,200,000
2030	0	0	8,363,636	9,200,000
2031	0	0	8,363,636	9,200,000
2032	0	0	8,363,636	9,200,000
2033	0	0	8,363,636	9,200,000
2034	0	0	8,363,636	9,200,000

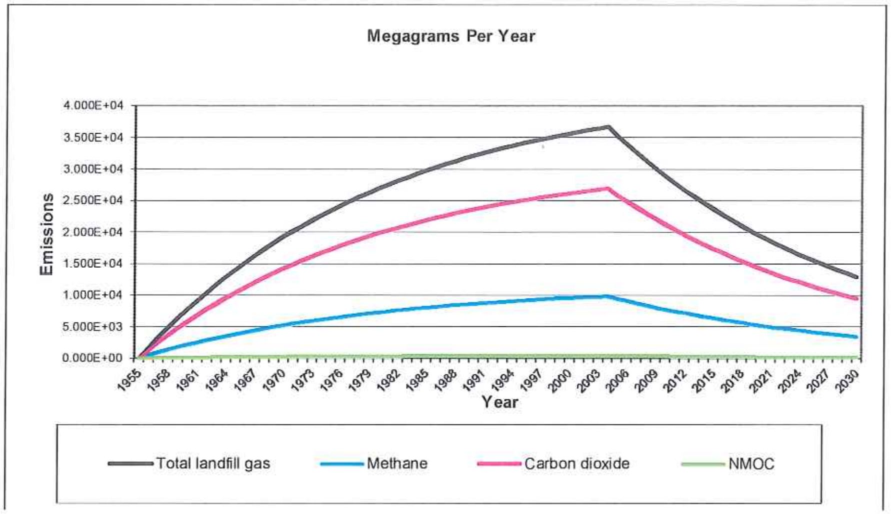
Pollutant Parameters

	Compound	Gas / Pollutant Default Parameters: Concentration (*ppmv*)	Molecular Weight	User-specified Pollutant Parameters: Concentration (*ppmv*)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl chloroform) - HAP	0.48	133.41		
	1,1,2,2-Tetrachloroethane - HAP/VOC	1.1	167.85		
	1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC	2.4	98.97		
	1,1-Dichloroethene (vinylidene chloride) - HAP/VOC	0.20	96.94		
	1,2-Dichloroethane (ethylene dichloride) - HAP/VOC	0.41	98.96		
	1,2-Dichloropropane (propylene dichloride) - HAP/VOC	0.18	112.99		
	2-Propanol (isopropyl alcohol) - VOC	50	60.11		
	Acetone	7.0	58.08		
	Acrylonitrile - HAP/VOC	6.3	53.06		
	Benzene - No or Unknown Co-disposal - HAP/VOC	1.9	78.11		
	Benzene - Co-disposal - HAP/VOC	11	78.11		
	Bromodichloromethane - VOC	3.1	163.83		
	Butane - VOC	5.0	58.12		
	Carbon disulfide - HAP/VOC	0.58	76.13		
	Carbon monoxide	140	28.01		
	Carbon tetrachloride - HAP/VOC	4.0E-03	153.84		
	Carbonyl sulfide - HAP/VOC	0.49	60.07		
	Chlorobenzene - HAP/VOC	0.25	112.56		
	Chlorodifluoromethane	1.3	86.47		
	Chloroethane (ethyl chloride) - HAP/VOC	1.3	64.52		
	Chloroform - HAP/VOC	0.03	119.39		
	Chloromethane - VOC	1.2	50.49		
	Dichlorobenzene - (HAP for para isomer/VOC)	0.21	147		
	Dichlorodifluoromethane	16	120.91		
	Dichlorofluoromethane - VOC	2.6	102.92		
	Dichloromethane (methylene chloride) - HAP	14	84.94		
	Dimethyl sulfide (methyl sulfide) - VOC	7.8	62.13		
	Ethane	890	30.07		
	Ethanol - VOC	27	46.08		

Pollutant Parameters (Continued)

	Gas / Pollutant Default Parameters:			User-specified Pollutant Parameters:	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Pollutants	Ethyl mercaptan (ethanethiol) - VOC	2.3	62.13		
	Ethylbenzene - HAP/VOC	4.6	106.16		
	Ethylene dibromide - HAP/VOC	1.0E-03	187.88		
	Fluorotrichloromethane - VOC	0.76	137.38		
	Hexane - HAP/VOC	6.6	86.18		
	Hydrogen sulfide	36	34.08		
	Mercury (total) - HAP	2.9E-04	200.61		
	Methyl ethyl ketone - HAP/VOC	7.1	72.11		
	Methyl isobutyl ketone - HAP/VOC	1.9	100.16		
	Methyl mercaptan - VOC	2.5	48.11		
	Pentane - VOC	3.3	72.15		
	Perchloroethylene (tetrachloroethylene) - HAP	3.7	165.83		
	Propane - VOC	11	44.09		
	t-1,2-Dichloroethene - VOC	2.8	96.94		
	Toluene - No or Unknown Co-disposal - HAP/VOC	39	92.13		
	Toluene - Co-disposal - HAP/VOC	170	92.13		
	Trichloroethylene (trichloroethene) - HAP/VOC	2.8	131.40		
	Vinyl chloride - HAP/VOC	7.3	62.50		
	Xylenes - HAP/VOC	12	106.16		

Graphs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Emissions
Year
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3.500E+04
3.000E+04
2.500E+04
2.000E+04
1.500E+04
1.000E+04
5.000E+03
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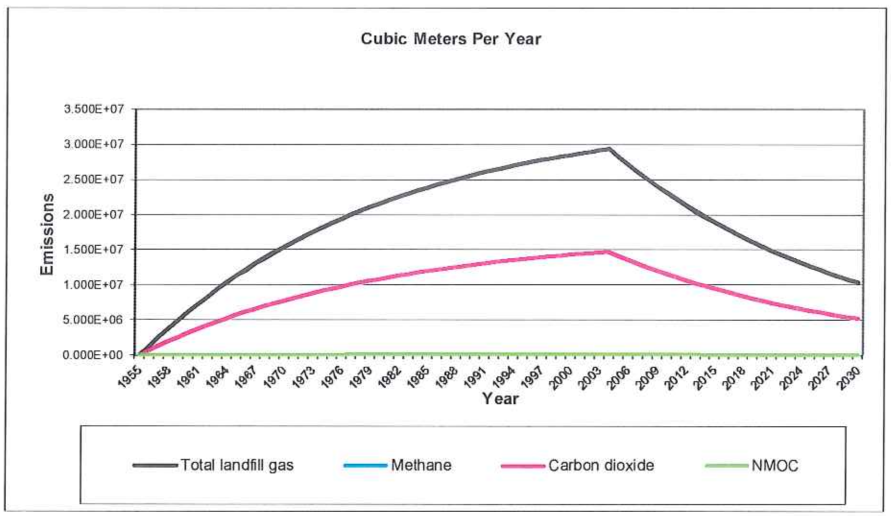
1955 1958 1961 1964 1967 1970 1973 1976 1979 1982 1985 1988 1991 1994 1997 2000 2003 2006 2009 2012 2015 2018 2021 2024 2027 2030
Total landfill gas
Methane
Carbon dioxide
NMOC


Cubic Meters Per Year
Emissions
Year
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1.500E+07
1.000E+07
5.000E+06
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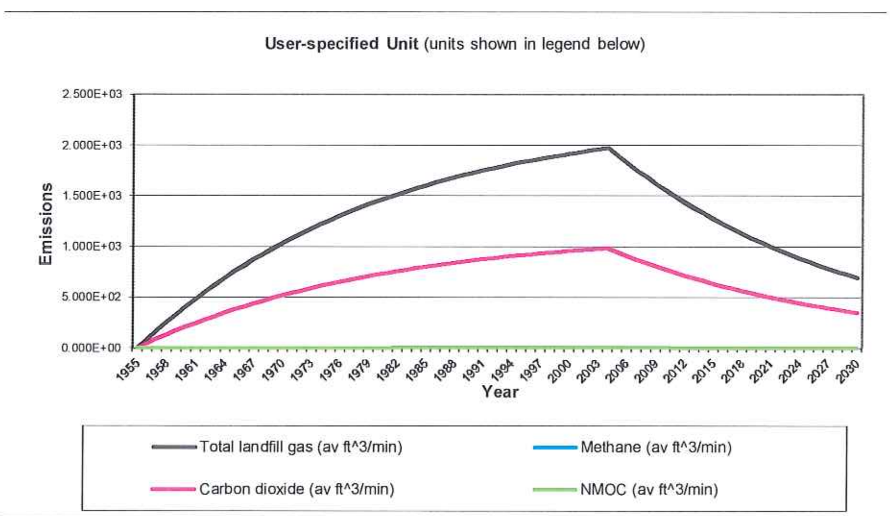
1955 1958 1961 1964 1967 1970 1973 1976 1979 1982 1985 1988 1991 1994 1997 2000 2003 2006 2009 2012 2015 2018 2021 2024 2027 2030
Total landfill gas
Methane
Carbon dioxide
NMOC


User-specified Unit (units shown in legend below)
Emissions
Year
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1.500E+03
1.000E+03
5.000E+02
0.000E+00
1955 1958 1961 1964 1967 1970 1973 1976 1979 1982 1985 1988 1991 1994 1997 2000 2003 2006 2009 2012 2015 2018 2021 2024 2027 2030
Total landfill gas (av ft^3/min)
Methane (av ft^3/min)
Carbon dioxide (av ft^3/min)
NMOC (av ft^3/min)

Results

Year	Total landfill gas			Methane		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
1955	0	0	0	0	0	0
1956	1.675E+03	1.341E+06	9.012E+01	4.474E+02	6.706E+05	4.506E+01
1957	3.284E+03	2.630E+06	1.767E+02	8.773E+02	1.315E+06	8.835E+01
1958	4.830E+03	3.868E+06	2.599E+02	1.290E+03	1.934E+06	1.299E+02
1959	6.316E+03	5.058E+06	3.398E+02	1.687E+03	2.529E+06	1.699E+02
1960	7.743E+03	6.200E+06	4.166E+02	2.068E+03	3.100E+06	2.083E+02
1961	9.115E+03	7.299E+06	4.904E+02	2.435E+03	3.649E+06	2.452E+02
1962	1.043E+04	8.354E+06	5.613E+02	2.787E+03	4.177E+06	2.806E+02
1963	1.170E+04	9.367E+06	6.294E+02	3.125E+03	4.684E+06	3.147E+02
1964	1.291E+04	1.034E+07	6.948E+02	3.450E+03	5.171E+06	3.474E+02
1965	1.408E+04	1.128E+07	7.577E+02	3.762E+03	5.638E+06	3.788E+02
1966	1.521E+04	1.218E+07	8.181E+02	4.062E+03	6.088E+06	4.091E+02
1967	1.628E+04	1.304E+07	8.761E+02	4.350E+03	6.520E+06	4.381E+02
1968	1.732E+04	1.387E+07	9.319E+02	4.627E+03	6.935E+06	4.660E+02
1969	1.832E+04	1.467E+07	9.855E+02	4.893E+03	7.334E+06	4.927E+02
1970	1.927E+04	1.543E+07	1.037E+03	5.148E+03	7.717E+06	5.185E+02
1971	2.019E+04	1.617E+07	1.086E+03	5.394E+03	8.085E+06	5.432E+02
1972	2.108E+04	1.688E+07	1.134E+03	5.630E+03	8.438E+06	5.670E+02
1973	2.192E+04	1.756E+07	1.180E+03	5.856E+03	8.778E+06	5.898E+02
1974	2.274E+04	1.821E+07	1.223E+03	6.074E+03	9.104E+06	6.117E+02
1975	2.352E+04	1.884E+07	1.266E+03	6.283E+03	9.418E+06	6.328E+02
1976	2.428E+04	1.944E+07	1.306E+03	6.484E+03	9.719E+06	6.530E+02
1977	2.500E+04	2.002E+07	1.345E+03	6.677E+03	1.001E+07	6.725E+02
1978	2.569E+04	2.057E+07	1.382E+03	6.863E+03	1.029E+07	6.912E+02
1979	2.636E+04	2.111E+07	1.418E+03	7.041E+03	1.055E+07	7.091E+02
1980	2.700E+04	2.162E+07	1.453E+03	7.213E+03	1.081E+07	7.264E+02
1981	2.762E+04	2.212E+07	1.486E+03	7.377E+03	1.106E+07	7.430E+02
1982	2.821E+04	2.259E+07	1.518E+03	7.535E+03	1.129E+07	7.589E+02
1983	2.878E+04	2.304E+07	1.548E+03	7.687E+03	1.152E+07	7.742E+02
1984	2.933E+04	2.348E+07	1.578E+03	7.833E+03	1.174E+07	7.889E+02
1985	2.985E+04	2.390E+07	1.606E+03	7.973E+03	1.195E+07	8.030E+02
1986	3.036E+04	2.431E+07	1.633E+03	8.108E+03	1.215E+07	8.166E+02
1987	3.084E+04	2.470E+07	1.659E+03	8.238E+03	1.235E+07	8.296E+02
1988	3.131E+04	2.507E+07	1.684E+03	8.362E+03	1.253E+07	8.422E+02
1989	3.175E+04	2.543E+07	1.708E+03	8.482E+03	1.271E+07	8.542E+02
1990	3.218E+04	2.577E+07	1.732E+03	8.596E+03	1.289E+07	8.658E+02
1991	3.260E+04	2.610E+07	1.754E+03	8.707E+03	1.305E+07	8.769E+02
1992	3.299E+04	2.642E+07	1.775E+03	8.813E+03	1.321E+07	8.875E+02
1993	3.337E+04	2.672E+07	1.796E+03	8.915E+03	1.336E+07	8.978E+02
1994	3.374E+04	2.702E+07	1.815E+03	9.012E+03	1.351E+07	9.077E+02
1995	3.409E+04	2.730E+07	1.834E+03	9.106E+03	1.365E+07	9.171E+02
1996	3.443E+04	2.757E+07	1.852E+03	9.197E+03	1.379E+07	9.262E+02
1997	3.476E+04	2.783E+07	1.870E+03	9.284E+03	1.392E+07	9.350E+02
1998	3.507E+04	2.808E+07	1.887E+03	9.367E+03	1.404E+07	9.434E+02
1999	3.537E+04	2.832E+07	1.903E+03	9.447E+03	1.416E+07	9.514E+02
2000	3.566E+04	2.855E+07	1.918E+03	9.524E+03	1.428E+07	9.592E+02
2001	3.593E+04	2.877E+07	1.933E+03	9.598E+03	1.439E+07	9.666E+02
2002	3.620E+04	2.899E+07	1.948E+03	9.669E+03	1.449E+07	9.738E+02
2003	3.645E+04	2.919E+07	1.961E+03	9.737E+03	1.460E+07	9.807E+02
2004	3.670E+04	2.939E+07	1.975E+03	9.803E+03	1.469E+07	9.873E+02

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2005	3.526E+04	2.824E+07	1.897E+03	9.419E+03	1.412E+07	9.486E+02
2006	3.388E+04	2.713E+07	1.823E+03	9.049E+03	1.356E+07	9.114E+02
2007	3.255E+04	2.606E+07	1.751E+03	8.694E+03	1.303E+07	8.756E+02
2008	3.127E+04	2.504E+07	1.683E+03	8.353E+03	1.252E+07	8.413E+02
2009	3.005E+04	2.406E+07	1.617E+03	8.026E+03	1.203E+07	8.083E+02
2010	2.887E+04	2.312E+07	1.553E+03	7.711E+03	1.156E+07	7.766E+02
2011	2.774E+04	2.221E+07	1.492E+03	7.409E+03	1.111E+07	7.462E+02
2012	2.665E+04	2.134E+07	1.434E+03	7.118E+03	1.067E+07	7.169E+02
2013	2.560E+04	2.050E+07	1.378E+03	6.839E+03	1.025E+07	6.888E+02
2014	2.460E+04	1.970E+07	1.324E+03	6.571E+03	9.850E+06	6.618E+02
2015	2.364E+04	1.893E+07	1.272E+03	6.313E+03	9.463E+06	6.358E+02
2016	2.271E+04	1.818E+07	1.222E+03	6.066E+03	9.092E+06	6.109E+02
2017	2.182E+04	1.747E+07	1.174E+03	5.828E+03	8.736E+06	5.870E+02
2018	2.096E+04	1.679E+07	1.128E+03	5.600E+03	8.393E+06	5.639E+02
2019	2.014E+04	1.613E+07	1.084E+03	5.380E+03	8.064E+06	5.418E+02
2020	1.935E+04	1.550E+07	1.041E+03	5.169E+03	7.748E+06	5.206E+02
2021	1.859E+04	1.489E+07	1.000E+03	4.966E+03	7.444E+06	5.002E+02
2022	1.786E+04	1.430E+07	9.611E+02	4.772E+03	7.152E+06	4.806E+02
2023	1.716E+04	1.374E+07	9.234E+02	4.584E+03	6.872E+06	4.617E+02
2024	1.649E+04	1.320E+07	8.872E+02	4.405E+03	6.602E+06	4.436E+02
2025	1.584E+04	1.269E+07	8.524E+02	4.232E+03	6.343E+06	4.262E+02
2026	1.522E+04	1.219E+07	8.190E+02	4.066E+03	6.095E+06	4.095E+02
2027	1.463E+04	1.171E+07	7.869E+02	3.907E+03	5.856E+06	3.934E+02
2028	1.405E+04	1.125E+07	7.560E+02	3.753E+03	5.626E+06	3.780E+02
2029	1.350E+04	1.081E+07	7.264E+02	3.606E+03	5.406E+06	3.632E+02
2030	1.297E+04	1.039E+07	6.979E+02	3.465E+03	5.194E+06	3.490E+02
2031	1.246E+04	9.980E+06	6.705E+02	3.329E+03	4.990E+06	3.353E+02
2032	1.197E+04	9.589E+06	6.443E+02	3.198E+03	4.794E+06	3.221E+02
2033	1.150E+04	9.213E+06	6.190E+02	3.073E+03	4.606E+06	3.095E+02
2034	1.105E+04	8.851E+06	5.947E+02	2.953E+03	4.426E+06	2.974E+02
2035	1.062E+04	8.504E+06	5.714E+02	2.837E+03	4.252E+06	2.857E+02
2036	1.020E+04	8.171E+06	5.490E+02	2.726E+03	4.085E+06	2.745E+02
2037	9.804E+03	7.850E+06	5.275E+02	2.619E+03	3.925E+06	2.637E+02
2038	9.419E+03	7.543E+06	5.068E+02	2.516E+03	3.771E+06	2.534E+02
2039	9.050E+03	7.247E+06	4.869E+02	2.417E+03	3.623E+06	2.435E+02
2040	8.695E+03	6.963E+06	4.678E+02	2.323E+03	3.481E+06	2.339E+02
2041	8.354E+03	6.690E+06	4.495E+02	2.232E+03	3.345E+06	2.247E+02
2042	8.027E+03	6.427E+06	4.319E+02	2.144E+03	3.214E+06	2.159E+02
2043	7.712E+03	6.175E+06	4.149E+02	2.060E+03	3.088E+06	2.075E+02
2044	7.410E+03	5.933E+06	3.987E+02	1.979E+03	2.967E+06	1.993E+02
2045	7.119E+03	5.701E+06	3.830E+02	1.902E+03	2.850E+06	1.915E+02
2046	6.840E+03	5.477E+06	3.680E+02	1.827E+03	2.739E+06	1.840E+02
2047	6.572E+03	5.262E+06	3.536E+02	1.755E+03	2.631E+06	1.768E+02
2048	6.314E+03	5.056E+06	3.397E+02	1.687E+03	2.528E+06	1.699E+02
2049	6.066E+03	4.858E+06	3.264E+02	1.620E+03	2.429E+06	1.632E+02
2050	5.829E+03	4.667E+06	3.136E+02	1.557E+03	2.334E+06	1.568E+02
2051	5.600E+03	4.484E+06	3.013E+02	1.496E+03	2.242E+06	1.506E+02
2052	5.380E+03	4.308E+06	2.895E+02	1.437E+03	2.154E+06	1.447E+02
2053	5.169E+03	4.139E+06	2.781E+02	1.381E+03	2.070E+06	1.391E+02
2054	4.967E+03	3.977E+06	2.672E+02	1.327E+03	1.989E+06	1.336E+02
2055	4.772E+03	3.821E+06	2.567E+02	1.275E+03	1.911E+06	1.284E+02

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2056	4.585E+03	3.671E+06	2.467E+02	1.225E+03	1.836E+06	1.233E+02
2057	4.405E+03	3.527E+06	2.370E+02	1.177E+03	1.764E+06	1.185E+02
2058	4.232E+03	3.389E+06	2.277E+02	1.131E+03	1.695E+06	1.139E+02
2059	4.066E+03	3.256E+06	2.188E+02	1.086E+03	1.628E+06	1.094E+02
2060	3.907E+03	3.129E+06	2.102E+02	1.044E+03	1.564E+06	1.051E+02
2061	3.754E+03	3.006E+06	2.020E+02	1.003E+03	1.503E+06	1.010E+02
2062	3.607E+03	2.888E+06	1.940E+02	9.634E+02	1.444E+06	9.702E+01
2063	3.465E+03	2.775E+06	1.864E+02	9.256E+02	1.387E+06	9.322E+01
2064	3.329E+03	2.666E+06	1.791E+02	8.893E+02	1.333E+06	8.956E+01
2065	3.199E+03	2.561E+06	1.721E+02	8.544E+02	1.281E+06	8.605E+01
2066	3.073E+03	2.461E+06	1.654E+02	8.209E+02	1.231E+06	8.268E+01
2067	2.953E+03	2.365E+06	1.589E+02	7.887E+02	1.182E+06	7.944E+01
2068	2.837E+03	2.272E+06	1.526E+02	7.578E+02	1.136E+06	7.632E+01
2069	2.726E+03	2.183E+06	1.467E+02	7.281E+02	1.091E+06	7.333E+01
2070	2.619E+03	2.097E+06	1.409E+02	6.995E+02	1.049E+06	7.045E+01
2071	2.516E+03	2.015E+06	1.354E+02	6.721E+02	1.007E+06	6.769E+01
2072	2.418E+03	1.936E+06	1.301E+02	6.458E+02	9.679E+05	6.504E+01
2073	2.323E+03	1.860E+06	1.250E+02	6.204E+02	9.300E+05	6.249E+01
2074	2.232E+03	1.787E+06	1.201E+02	5.961E+02	8.935E+05	6.004E+01
2075	2.144E+03	1.717E+06	1.154E+02	5.727E+02	8.585E+05	5.768E+01
2076	2.060E+03	1.650E+06	1.108E+02	5.503E+02	8.248E+05	5.542E+01
2077	1.979E+03	1.585E+06	1.065E+02	5.287E+02	7.925E+05	5.325E+01
2078	1.902E+03	1.523E+06	1.023E+02	5.080E+02	7.614E+05	5.116E+01
2079	1.827E+03	1.463E+06	9.831E+01	4.881E+02	7.316E+05	4.915E+01
2080	1.756E+03	1.406E+06	9.445E+01	4.689E+02	7.029E+05	4.723E+01
2081	1.687E+03	1.351E+06	9.075E+01	4.505E+02	6.753E+05	4.537E+01
2082	1.621E+03	1.298E+06	8.719E+01	4.329E+02	6.488E+05	4.360E+01
2083	1.557E+03	1.247E+06	8.377E+01	4.159E+02	6.234E+05	4.189E+01
2084	1.496E+03	1.198E+06	8.049E+01	3.996E+02	5.989E+05	4.024E+01
2085	1.437E+03	1.151E+06	7.733E+01	3.839E+02	5.755E+05	3.867E+01
2086	1.381E+03	1.106E+06	7.430E+01	3.689E+02	5.529E+05	3.715E+01
2087	1.327E+03	1.062E+06	7.139E+01	3.544E+02	5.312E+05	3.569E+01
2088	1.275E+03	1.021E+06	6.859E+01	3.405E+02	5.104E+05	3.429E+01
2089	1.225E+03	9.808E+05	6.590E+01	3.272E+02	4.904E+05	3.295E+01
2090	1.177E+03	9.423E+05	6.331E+01	3.143E+02	4.712E+05	3.166E+01
2091	1.131E+03	9.054E+05	6.083E+01	3.020E+02	4.527E+05	3.042E+01
2092	1.086E+03	8.699E+05	5.845E+01	2.902E+02	4.349E+05	2.922E+01
2093	1.044E+03	8.357E+05	5.615E+01	2.788E+02	4.179E+05	2.808E+01
2094	1.003E+03	8.030E+05	5.395E+01	2.679E+02	4.015E+05	2.698E+01
2095	9.635E+02	7.715E+05	5.184E+01	2.573E+02	3.857E+05	2.592E+01

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
1955	0	0	0	0	0	0
1956	1.228E+03	6.706E+05	4.506E+01	1.923E+01	5.365E+03	3.605E-01
1957	2.407E+03	1.315E+06	8.835E+01	3.771E+01	1.052E+04	7.068E-01
1958	3.540E+03	1.934E+06	1.299E+02	5.546E+01	1.547E+04	1.040E+00
1959	4.629E+03	2.529E+06	1.699E+02	7.251E+01	2.023E+04	1.359E+00
1960	5.675E+03	3.100E+06	2.083E+02	8.890E+01	2.480E+04	1.666E+00
1961	6.680E+03	3.649E+06	2.452E+02	1.046E+02	2.919E+04	1.962E+00
1962	7.646E+03	4.177E+06	2.806E+02	1.198E+02	3.341E+04	2.245E+00
1963	8.573E+03	4.684E+06	3.147E+02	1.343E+02	3.747E+04	2.518E+00
1964	9.465E+03	5.171E+06	3.474E+02	1.483E+02	4.136E+04	2.779E+00
1965	1.032E+04	5.638E+06	3.788E+02	1.617E+02	4.511E+04	3.031E+00
1966	1.114E+04	6.088E+06	4.091E+02	1.746E+02	4.870E+04	3.272E+00
1967	1.193E+04	6.520E+06	4.381E+02	1.870E+02	5.216E+04	3.505E+00
1968	1.269E+04	6.935E+06	4.660E+02	1.989E+02	5.548E+04	3.728E+00
1969	1.342E+04	7.334E+06	4.927E+02	2.103E+02	5.867E+04	3.942E+00
1970	1.413E+04	7.717E+06	5.185E+02	2.213E+02	6.173E+04	4.148E+00
1971	1.480E+04	8.085E+06	5.432E+02	2.318E+02	6.468E+04	4.346E+00
1972	1.545E+04	8.438E+06	5.670E+02	2.420E+02	6.751E+04	4.536E+00
1973	1.607E+04	8.778E+06	5.898E+02	2.517E+02	7.022E+04	4.718E+00
1974	1.667E+04	9.104E+06	6.117E+02	2.611E+02	7.284E+04	4.894E+00
1975	1.724E+04	9.418E+06	6.328E+02	2.701E+02	7.534E+04	5.062E+00
1976	1.779E+04	9.719E+06	6.530E+02	2.787E+02	7.775E+04	5.224E+00
1977	1.832E+04	1.001E+07	6.725E+02	2.870E+02	8.007E+04	5.380E+00
1978	1.883E+04	1.029E+07	6.912E+02	2.950E+02	8.230E+04	5.529E+00
1979	1.932E+04	1.055E+07	7.091E+02	3.027E+02	8.443E+04	5.673E+00
1980	1.979E+04	1.081E+07	7.264E+02	3.100E+02	8.649E+04	5.811E+00
1981	2.024E+04	1.106E+07	7.430E+02	3.171E+02	8.846E+04	5.944E+00
1982	2.068E+04	1.129E+07	7.589E+02	3.239E+02	9.036E+04	6.071E+00
1983	2.109E+04	1.152E+07	7.742E+02	3.304E+02	9.218E+04	6.194E+00
1984	2.149E+04	1.174E+07	7.889E+02	3.367E+02	9.393E+04	6.311E+00
1985	2.188E+04	1.195E+07	8.030E+02	3.427E+02	9.561E+04	6.424E+00
1986	2.225E+04	1.215E+07	8.166E+02	3.485E+02	9.723E+04	6.533E+00
1987	2.260E+04	1.235E+07	8.296E+02	3.541E+02	9.878E+04	6.637E+00
1988	2.294E+04	1.253E+07	8.422E+02	3.594E+02	1.003E+05	6.737E+00
1989	2.327E+04	1.271E+07	8.542E+02	3.646E+02	1.017E+05	6.834E+00
1990	2.359E+04	1.289E+07	8.658E+02	3.695E+02	1.031E+05	6.926E+00
1991	2.389E+04	1.305E+07	8.769E+02	3.742E+02	1.044E+05	7.015E+00
1992	2.418E+04	1.321E+07	8.875E+02	3.788E+02	1.057E+05	7.100E+00
1993	2.446E+04	1.336E+07	8.978E+02	3.832E+02	1.069E+05	7.182E+00
1994	2.473E+04	1.351E+07	9.077E+02	3.874E+02	1.081E+05	7.261E+00
1995	2.499E+04	1.365E+07	9.171E+02	3.914E+02	1.092E+05	7.337E+00
1996	2.523E+04	1.379E+07	9.262E+02	3.953E+02	1.103E+05	7.410E+00
1997	2.547E+04	1.392E+07	9.350E+02	3.990E+02	1.113E+05	7.480E+00
1998	2.570E+04	1.404E+07	9.434E+02	4.026E+02	1.123E+05	7.547E+00
1999	2.592E+04	1.416E+07	9.514E+02	4.061E+02	1.133E+05	7.611E+00
2000	2.613E+04	1.428E+07	9.592E+02	4.094E+02	1.142E+05	7.673E+00
2001	2.633E+04	1.439E+07	9.666E+02	4.125E+02	1.151E+05	7.733E+00
2002	2.653E+04	1.449E+07	9.738E+02	4.156E+02	1.159E+05	7.790E+00
2003	2.672E+04	1.460E+07	9.807E+02	4.185E+02	1.168E+05	7.845E+00
2004	2.690E+04	1.469E+07	9.873E+02	4.214E+02	1.175E+05	7.898E+00

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2005	2.584E+04	1.412E+07	9.486E+02	4.048E+02	1.129E+05	7.588E+00
2006	2.483E+04	1.356E+07	9.114E+02	3.890E+02	1.085E+05	7.291E+00
2007	2.386E+04	1.303E+07	8.756E+02	3.737E+02	1.043E+05	7.005E+00
2008	2.292E+04	1.252E+07	8.413E+02	3.591E+02	1.002E+05	6.730E+00
2009	2.202E+04	1.203E+07	8.083E+02	3.450E+02	9.624E+04	6.466E+00
2010	2.116E+04	1.156E+07	7.766E+02	3.314E+02	9.247E+04	6.213E+00
2011	2.033E+04	1.111E+07	7.462E+02	3.185E+02	8.884E+04	5.969E+00
2012	1.953E+04	1.067E+07	7.169E+02	3.060E+02	8.536E+04	5.735E+00
2013	1.877E+04	1.025E+07	6.888E+02	2.940E+02	8.201E+04	5.510E+00
2014	1.803E+04	9.850E+06	6.618E+02	2.824E+02	7.880E+04	5.294E+00
2015	1.732E+04	9.463E+06	6.358E+02	2.714E+02	7.571E+04	5.087E+00
2016	1.664E+04	9.092E+06	6.109E+02	2.607E+02	7.274E+04	4.887E+00
2017	1.599E+04	8.736E+06	5.870E+02	2.505E+02	6.989E+04	4.696E+00
2018	1.536E+04	8.393E+06	5.639E+02	2.407E+02	6.715E+04	4.512E+00
2019	1.476E+04	8.064E+06	5.418E+02	2.312E+02	6.451E+04	4.335E+00
2020	1.418E+04	7.748E+06	5.206E+02	2.222E+02	6.198E+04	4.165E+00
2021	1.363E+04	7.444E+06	5.002E+02	2.135E+02	5.955E+04	4.001E+00
2022	1.309E+04	7.152E+06	4.806E+02	2.051E+02	5.722E+04	3.844E+00
2023	1.258E+04	6.872E+06	4.617E+02	1.971E+02	5.497E+04	3.694E+00
2024	1.209E+04	6.602E+06	4.436E+02	1.893E+02	5.282E+04	3.549E+00
2025	1.161E+04	6.343E+06	4.262E+02	1.819E+02	5.075E+04	3.410E+00
2026	1.116E+04	6.095E+06	4.095E+02	1.748E+02	4.876E+04	3.276E+00
2027	1.072E+04	5.856E+06	3.934E+02	1.679E+02	4.685E+04	3.148E+00
2028	1.030E+04	5.626E+06	3.780E+02	1.613E+02	4.501E+04	3.024E+00
2029	9.895E+03	5.406E+06	3.632E+02	1.550E+02	4.324E+04	2.906E+00
2030	9.507E+03	5.194E+06	3.490E+02	1.489E+02	4.155E+04	2.792E+00
2031	9.134E+03	4.990E+06	3.353E+02	1.431E+02	3.992E+04	2.682E+00
2032	8.776E+03	4.794E+06	3.221E+02	1.375E+02	3.835E+04	2.577E+00
2033	8.432E+03	4.606E+06	3.095E+02	1.321E+02	3.685E+04	2.476E+00
2034	8.101E+03	4.426E+06	2.974E+02	1.269E+02	3.541E+04	2.379E+00
2035	7.784E+03	4.252E+06	2.857E+02	1.219E+02	3.402E+04	2.286E+00
2036	7.478E+03	4.085E+06	2.745E+02	1.172E+02	3.268E+04	2.196E+00
2037	7.185E+03	3.925E+06	2.637E+02	1.126E+02	3.140E+04	2.110E+00
2038	6.903E+03	3.771E+06	2.534E+02	1.081E+02	3.017E+04	2.027E+00
2039	6.633E+03	3.623E+06	2.435E+02	1.039E+02	2.899E+04	1.948E+00
2040	6.373E+03	3.481E+06	2.339E+02	9.983E+01	2.785E+04	1.871E+00
2041	6.123E+03	3.345E+06	2.247E+02	9.592E+01	2.676E+04	1.798E+00
2042	5.883E+03	3.214E+06	2.159E+02	9.216E+01	2.571E+04	1.727E+00
2043	5.652E+03	3.088E+06	2.075E+02	8.854E+01	2.470E+04	1.660E+00
2044	5.430E+03	2.967E+06	1.993E+02	8.507E+01	2.373E+04	1.595E+00
2045	5.217E+03	2.850E+06	1.915E+02	8.173E+01	2.280E+04	1.532E+00
2046	5.013E+03	2.739E+06	1.840E+02	7.853E+01	2.191E+04	1.472E+00
2047	4.816E+03	2.631E+06	1.768E+02	7.545E+01	2.105E+04	1.414E+00
2048	4.627E+03	2.528E+06	1.699E+02	7.249E+01	2.022E+04	1.359E+00
2049	4.446E+03	2.429E+06	1.632E+02	6.965E+01	1.943E+04	1.306E+00
2050	4.272E+03	2.334E+06	1.568E+02	6.692E+01	1.867E+04	1.254E+00
2051	4.104E+03	2.242E+06	1.506E+02	6.429E+01	1.794E+04	1.205E+00
2052	3.943E+03	2.154E+06	1.447E+02	6.177E+01	1.723E+04	1.158E+00
2053	3.789E+03	2.070E+06	1.391E+02	5.935E+01	1.656E+04	1.113E+00
2054	3.640E+03	1.989E+06	1.336E+02	5.702E+01	1.591E+04	1.069E+00
2055	3.497E+03	1.911E+06	1.284E+02	5.479E+01	1.528E+04	1.027E+00

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2056	3.360E+03	1.836E+06	1.233E+02	5.264E+01	1.469E+04	9.867E-01
2057	3.228E+03	1.764E+06	1.185E+02	5.058E+01	1.411E+04	9.480E-01
2058	3.102E+03	1.695E+06	1.139E+02	4.859E+01	1.356E+04	9.109E-01
2059	2.980E+03	1.628E+06	1.094E+02	4.669E+01	1.302E+04	8.751E-01
2060	2.863E+03	1.564E+06	1.051E+02	4.486E+01	1.251E+04	8.408E-01
2061	2.751E+03	1.503E+06	1.010E+02	4.310E+01	1.202E+04	8.079E-01
2062	2.643E+03	1.444E+06	9.702E+01	4.141E+01	1.155E+04	7.762E-01
2063	2.540E+03	1.387E+06	9.322E+01	3.978E+01	1.110E+04	7.457E-01
2064	2.440E+03	1.333E+06	8.956E+01	3.822E+01	1.066E+04	7.165E-01
2065	2.344E+03	1.281E+06	8.605E+01	3.673E+01	1.025E+04	6.884E-01
2066	2.252E+03	1.231E+06	8.268E+01	3.529E+01	9.844E+03	6.614E-01
2067	2.164E+03	1.182E+06	7.944E+01	3.390E+01	9.458E+03	6.355E-01
2068	2.079E+03	1.136E+06	7.632E+01	3.257E+01	9.087E+03	6.106E-01
2069	1.998E+03	1.091E+06	7.333E+01	3.130E+01	8.731E+03	5.866E-01
2070	1.919E+03	1.049E+06	7.045E+01	3.007E+01	8.389E+03	5.636E-01
2071	1.844E+03	1.007E+06	6.769E+01	2.889E+01	8.060E+03	5.415E-01
2072	1.772E+03	9.679E+05	6.504E+01	2.776E+01	7.744E+03	5.203E-01
2073	1.702E+03	9.300E+05	6.249E+01	2.667E+01	7.440E+03	4.999E-01
2074	1.636E+03	8.935E+05	6.004E+01	2.562E+01	7.148E+03	4.803E-01
2075	1.571E+03	8.585E+05	5.768E+01	2.462E+01	6.868E+03	4.615E-01
2076	1.510E+03	8.248E+05	5.542E+01	2.365E+01	6.599E+03	4.434E-01
2077	1.451E+03	7.925E+05	5.325E+01	2.273E+01	6.340E+03	4.260E-01
2078	1.394E+03	7.614E+05	5.116E+01	2.183E+01	6.091E+03	4.093E-01
2079	1.339E+03	7.316E+05	4.915E+01	2.098E+01	5.852E+03	3.932E-01
2080	1.287E+03	7.029E+05	4.723E+01	2.016E+01	5.623E+03	3.778E-01
2081	1.236E+03	6.753E+05	4.537E+01	1.937E+01	5.403E+03	3.630E-01
2082	1.188E+03	6.488E+05	4.360E+01	1.861E+01	5.191E+03	3.488E-01
2083	1.141E+03	6.234E+05	4.189E+01	1.788E+01	4.987E+03	3.351E-01
2084	1.096E+03	5.989E+05	4.024E+01	1.718E+01	4.792E+03	3.219E-01
2085	1.053E+03	5.755E+05	3.867E+01	1.650E+01	4.604E+03	3.093E-01
2086	1.012E+03	5.529E+05	3.715E+01	1.585E+01	4.423E+03	2.972E-01
2087	9.724E+02	5.312E+05	3.569E+01	1.523E+01	4.250E+03	2.855E-01
2088	9.343E+02	5.104E+05	3.429E+01	1.464E+01	4.083E+03	2.743E-01
2089	8.976E+02	4.904E+05	3.295E+01	1.406E+01	3.923E+03	2.636E-01
2090	8.624E+02	4.712E+05	3.166E+01	1.351E+01	3.769E+03	2.533E-01
2091	8.286E+02	4.527E+05	3.042E+01	1.298E+01	3.621E+03	2.433E-01
2092	7.961E+02	4.349E+05	2.922E+01	1.247E+01	3.479E+03	2.338E-01
2093	7.649E+02	4.179E+05	2.808E+01	1.198E+01	3.343E+03	2.246E-01
2094	7.349E+02	4.015E+05	2.698E+01	1.151E+01	3.212E+03	2.158E-01
2095	7.061E+02	3.857E+05	2.592E+01	1.106E+01	3.086E+03	2.073E-01

APPENDIX D

PROPOSED WELLFIELD MODIFICATIONS

APPENDIX C

CONSTRUCTION PLAN FOR CONTINGENT NORTH QUARRY ENHANCED GAS COLLECTION AND CONTROL SYSTEM (GCCS)

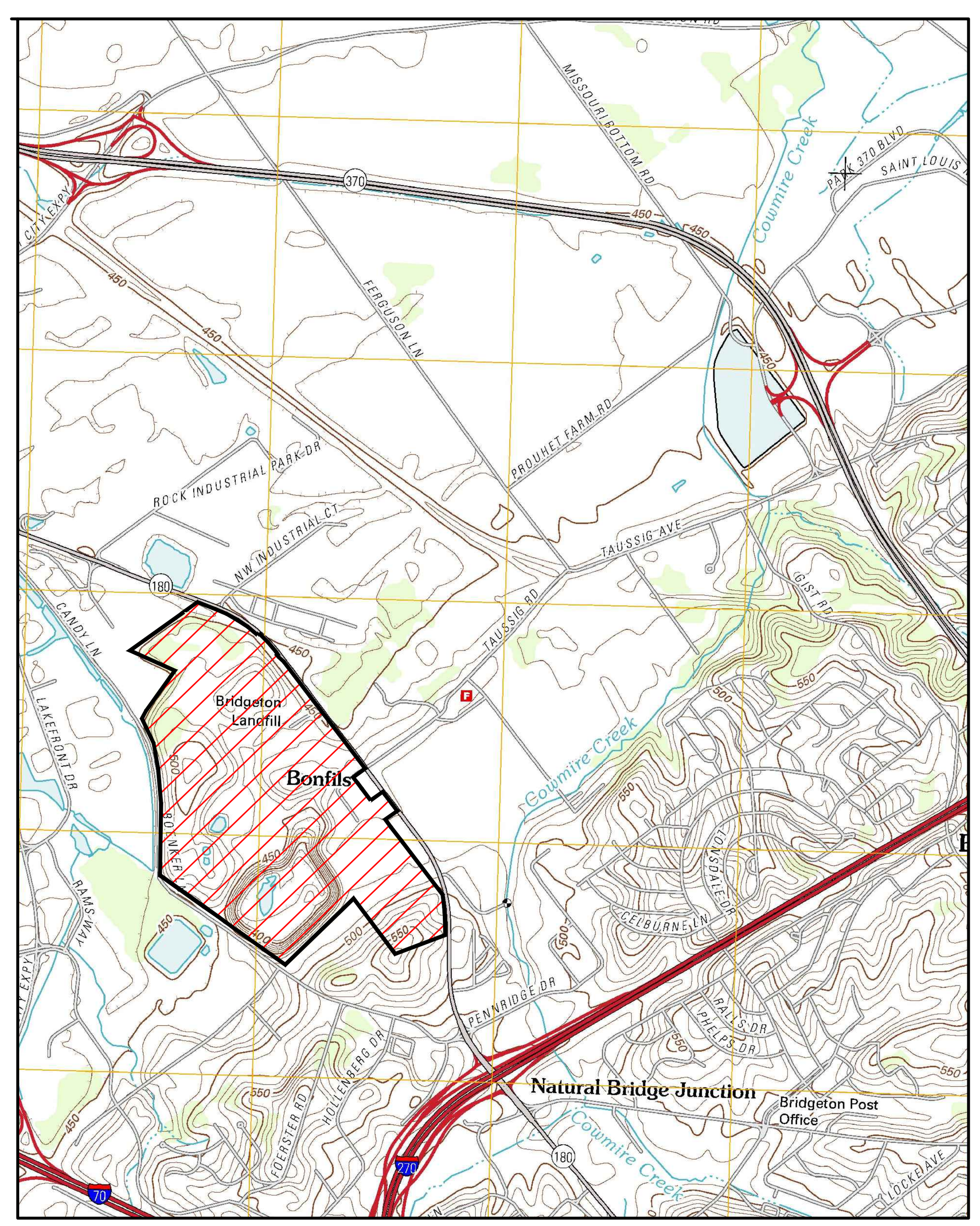
CONSTRUCTION PLANS FOR

CONTINGENT NORTH QUARRY ENHANCED GAS COLLECTION AND CONTROL SYSTEM (GCCS)

BRIDGETON LANDFILL

BRIDGETON, MISSOURI

JULY 2013



LOCATION MAP

SOURCE: SAINT CHARLES, MO. 7.5 MIN. U.S.G.S. QUADRANGLE MAPS

0 1000 2000

SCALE IN FEET

PREPARED FOR:

BRIDGETON LANDFILL, LLC

PREPARED BY:

CORNERSTONE

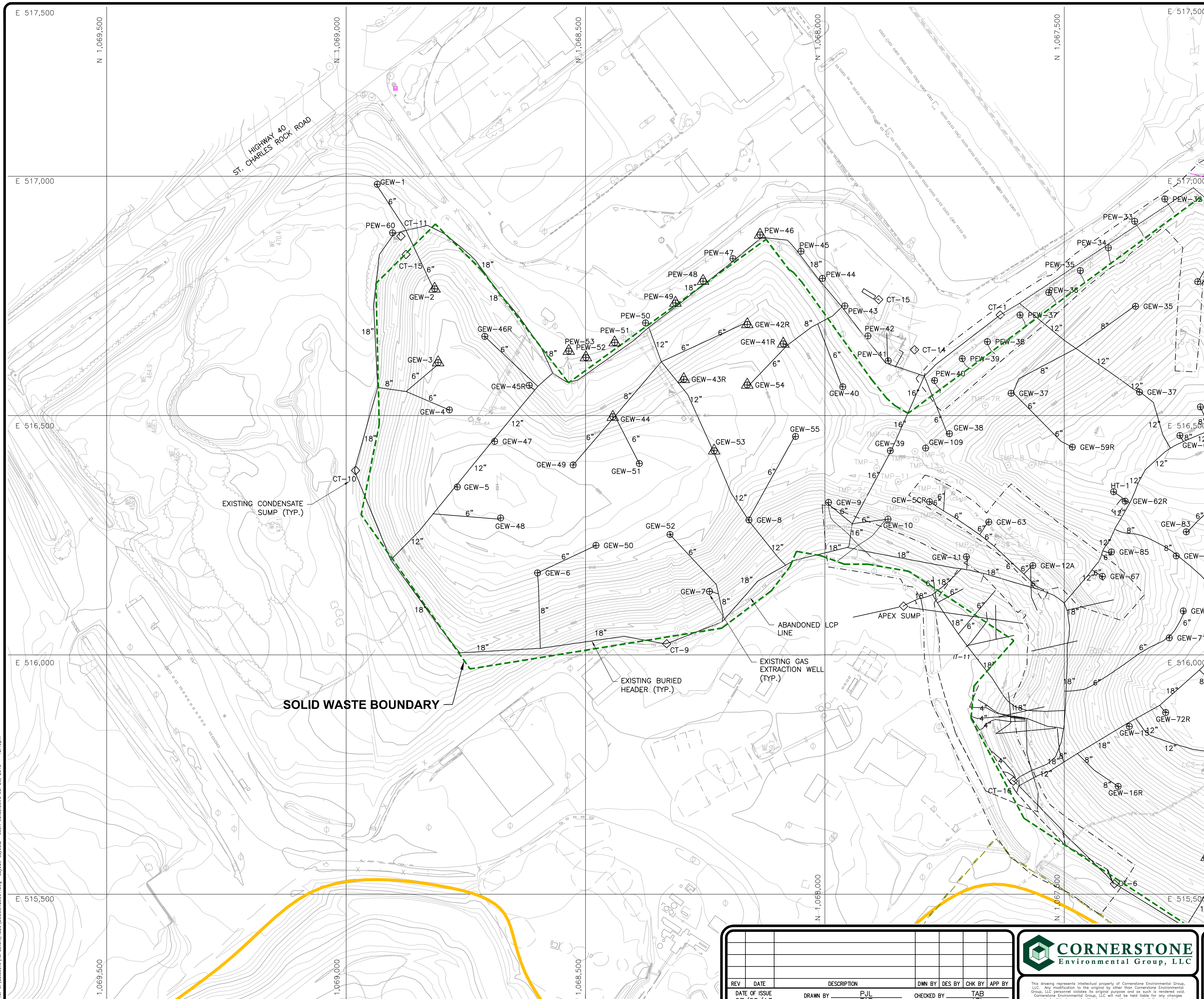
Environmental Group, LLC

400 QUADRANGLE DRIVE
SUITE E
BOLINGBROOK, ILLINOIS 60440
Tel. (630) 633-5520
Fax. (630) 378-2640

INDEX OF DRAWINGS

CEG PROJECT # 130557

7/26/13



N

0 100 200
SCALE IN FEET

LEGEND

	EXISTING SOLID WASTE BOUNDARY
	PHASE BOUNDARY
1400	EXISTING 10' CONTOUR
	EXISTING 2' CONTOUR
12"	EXISTING LANDFILL GAS HEADER – UNDERGROUND
FM	EXISTING LEACHATE FORCEMAIN
C	EXISTING CONDENSATE DRAIN LINE
A	EXISTING AIR LINE
UE	EXISTING UNDERGROUND ELECTRIC
GEW–81	EXISTING LFG EXTRACTION WELL
GEW–2	EXISTING LFG EXTRACTION WELL – COMBO
PEW–4	EXISTING LFG PERIMETER EXTRACTION WELL
CT–1	EXISTING CONDENSATE PUMP STATION
TMP–1	EXISTING TEMPERATURE MONITORING PROBE
GMP–11	EXISTING GAS MONITORING PROBE
IT–3	EXISTING INTERCEPTION TRENCH WELL
GEW–55	EXISTING NORTH QUARRY LFG EXTRACTION WELL
GEW–54	EXISTING NORTH QUARRY LFG EXTRACTION WELL – COMBO

NOTES:

1. THE 2013 TOPOGRAPHIC MAP WAS PROVIDED BY COOP AERIAL SURVEYORS, CO., PHOENIX, AZ. DATE OF PHOTO: 02/13/2013.
2. UTILITIES SHOWN TAKEN FROM DRAWING 1 OF 1 "SITE INFRASTRUCTURE" BY AQUATERRA ENVIRONMENTAL SOLUTIONS, INC. DATED 01/09/2013.

STATE OF MISSOURI
ADAM STEVEN
NUMBER
PROFESSIONAL ENGINEER
7/26/13

REV	DATE	DESCRIPTION	DWN BY	DES BY	CHK BY	APP BY

DATE OF ISSUE 07/25/13
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DESIGNED BY TAB
CHECKED BY TAB
APPROVED BY ASL

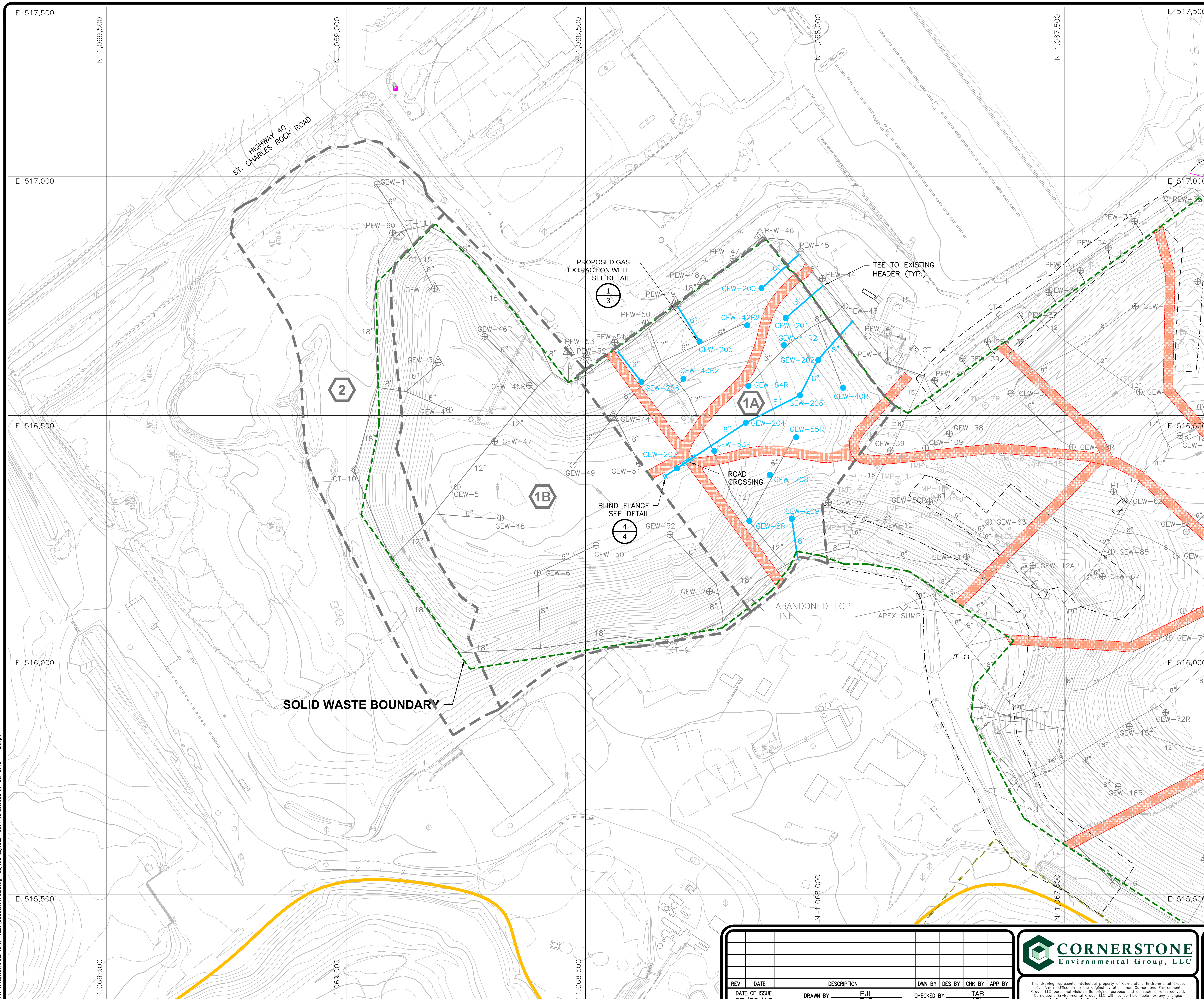
CORNERSTONE
Environmental Group, LLC

BRIDGETON LANDFILL, LLC.
BRIDGETON LANDFILL
BRIDGETON, MISSOURI

CONSTRUCTION PLAN FOR
CONTINGENT NORTH QUARRY ENHANCED GCCS
EXISTING CONDITIONS

SHEET NO.
1

PROJECT NO.
130557



N

0 100 200
SCALE IN FEET

LEGEND

- EXISTING SOLID WASTE BOUNDARY
- PHASE BOUNDARY
- EXISTING 10' CONTOUR
- EXISTING 2' CONTOUR
- LIGHT-DUTY ACCESS ROADS
- EXISTING LANDFILL GAS HEADER – UNDERGROUND
- EXISTING LEACHATE FORCEMAIN
- EXISTING CONDENSATE DRAIN LINE
- EXISTING AIR LINE
- EXISTING UNDERGROUND ELECTRIC
- GEW-81 EXISTING LFG EXTRACTION WELL
- GEW-2 EXISTING LFG EXTRACTION WELL – COMBO
- PEW-4 EXISTING LFG PERIMETER EXTRACTION WELL
- CT-1 EXISTING CONDENSATE PUMP STATION
- TMP-1 EXISTING TEMPERATURE MONITORING PROBE
- GMP-11 EXISTING GAS MONITORING PROBE
- IT-3 EXISTING INTERCEPTION TRENCH WELL
- GEW-55 EXISTING NORTH QUARRY LFG EXTRACTION WELL
- GEW-54 EXISTING NORTH QUARRY LFG EXTRACTION WELL – COMBO
- 6" PROPOSED NORTH QUARRY LANDFILL GAS HEADER
- GEW-72 PROPOSED NORTH QUARRY LFG EXTRACTION WELL
- 1A PROPOSED CAP PHASE DESIGNATION

NOTES:

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5. MINIMUM 3% SLOPE FOR LFG PIPING WITHIN LIMITS OF WASTE PLACEMENT. MINIMUM 1% SLOPE FOR LFG PIPING OUTSIDE LIMITS OF WASTE PLACEMENT.
6. PROPOSED CAP PHASES REFERENCED FROM "CONSTRUCTION PLANS FOR THE NORTH QUARRY – EVOH GEOMEMBRANE CAP AND CAP INTEGRITY SYSTEM AT BRIDGETON LANDFILL", JULY 2013, BY CORNERSTONE ENVIRONMENTAL GROUP, LLC.

STATE OF MISSOURI
ADAM STEVEN LOUNT
NUMBER E-22699
LICENSED PROFESSIONAL ENGINEER
7/26/13

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APPROVED BY ASL

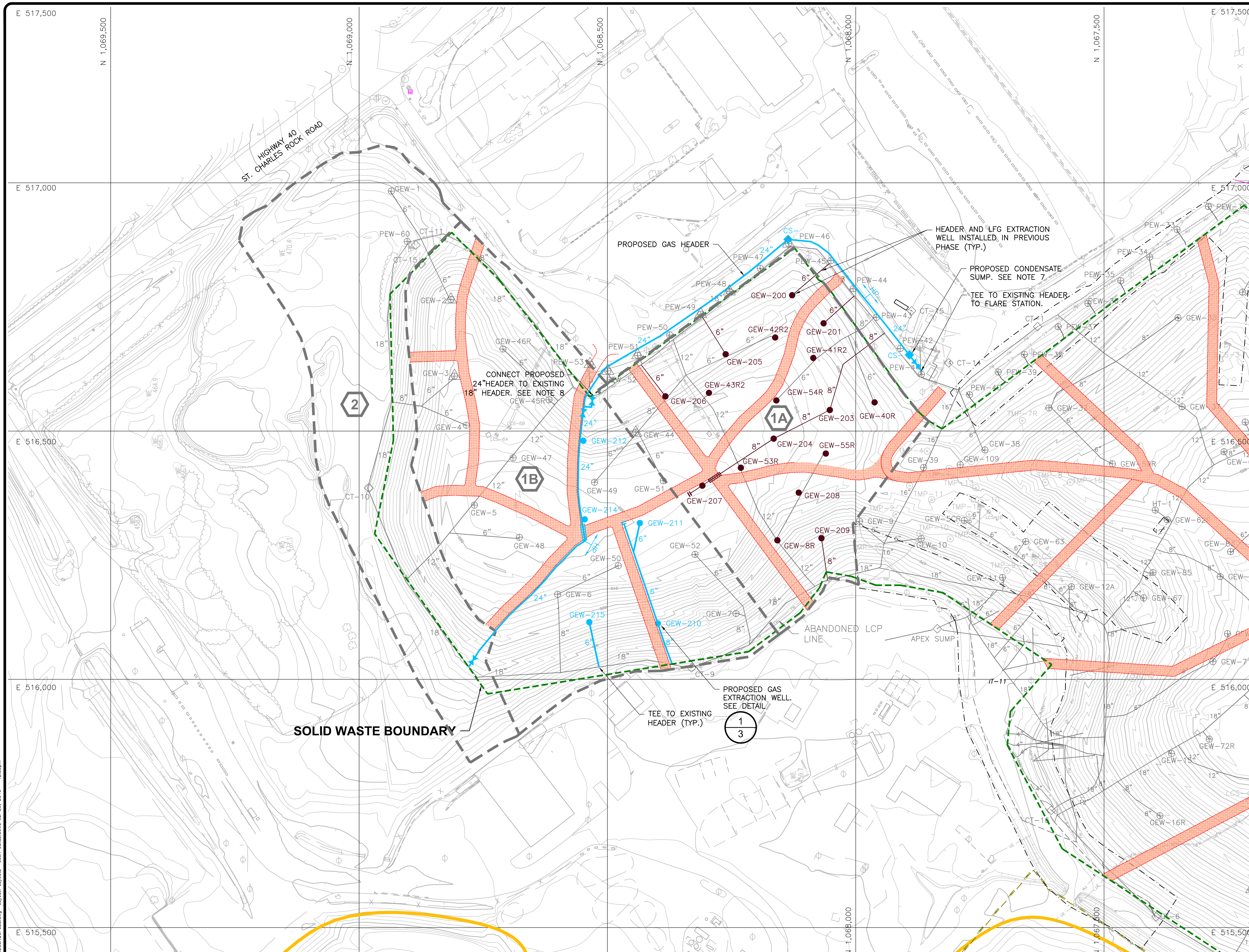
CORNERSTONE Environmental Group, LLC

BRIDGETON LANDFILL, LLC.
BRIDGETON LANDFILL
BRIDGETON, MISSOURI

CONSTRUCTION PLAN FOR CONTINGENT NORTH QUARRY ENHANCED GCCS PHASE 1A

SHEET NO. 2A

PROJECT NO. 130557



N
0 100 200
SCALE IN FEET

LEGEND

	EXISTING SOLID WASTE BOUNDARY
	PHASE BOUNDARY
1400	EXISTING 10' CONTOUR
	EXISTING 2' CONTOUR
	LIGHT-DUTY ACCESS ROADS
12"	EXISTING LANDFILL GAS HEADER – UNDERGROUND
FM	EXISTING LEACHATE FORCEMAIN
C	EXISTING CONDENSATE DRAIN LINE
A	EXISTING AIR LINE
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PEW-4	EXISTING LFG PERIMETER EXTRACTION WELL
CT-1	EXISTING CONDENSATE PUMP STATION
TMP-1	EXISTING TEMPERATURE MONITORING PROBE
GMP-11	EXISTING GAS MONITORING PROBE
IT-3	EXISTING INTERCEPTION TRENCH WELL
GEW-55	EXISTING NORTH QUARRY LFG EXTRACTION WELL
GEW-54	EXISTING NORTH QUARRY LFG EXTRACTION WELL – COMBO
6"	PROPOSED NORTH QUARRY LANDFILL GAS HEADER
GEW-72	PROPOSED NORTH QUARRY LFG EXTRACTION WELL
	PROPOSED ISOLATION VALVE
1A	PROPOSED CAP PHASE DESIGNATION

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7. CONDENSATE SUMP SHOWN FOR REFERENCE. NEED TO BE DETERMINED AT THE TIME OF CONSTRUCTION BASED UPON FIELD CONDITIONS.
8. TEE TO EXISTING HEADER. INCLUDE 18" ISOLATION VALVE BETWEEN HEADERS. WHERE CONNECTED TO BELOW CAP HEADERS, INSTALL BOOT AT CAP PENETRATION POINT.

STATE OF MISSOURI
ADAM STEVEN ...
NUMBER E-22595
PROFESSIONAL ENGINEER
7/26/13

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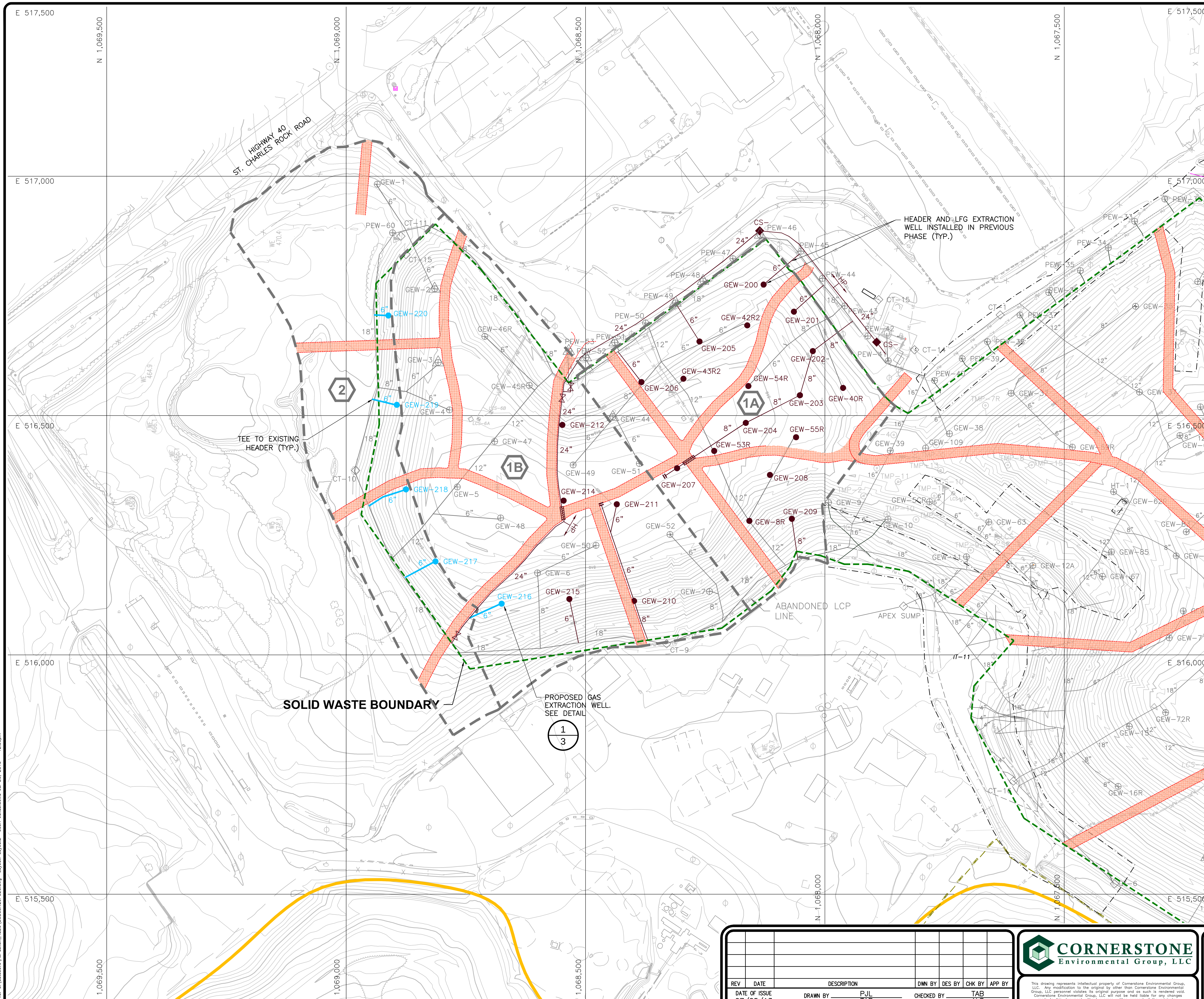
CORNERSTONE Environmental Group, LLC

BRIDGETON LANDFILL, LLC.
BRIDGETON LANDFILL
BRIDGETON, MISSOURI

CONSTRUCTION PLAN FOR CONTINGENT NORTH QUARRY ENHANCED GCCS PHASE 1B

SHEET NO. **2B**

PROJECT NO. 130557



0 100 200
SCALE IN FEET

LEGEND

- EXISTING SOLID WASTE BOUNDARY
- PHASE BOUNDARY
- EXISTING 10' CONTOUR
- EXISTING 2' CONTOUR
- LIGHT-DUTY ACCESS ROADS
- EXISTING LANDFILL GAS HEADER – UNDERGROUND
- EXISTING LEACHATE FORCEMAIN
- EXISTING CONDENSATE DRAIN LINE
- EXISTING AIR LINE
- EXISTING UNDERGROUND ELECTRIC
- GEW-81 EXISTING LFG EXTRACTION WELL
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- PEW-4 EXISTING LFG PERIMETER EXTRACTION WELL
- CT-1 EXISTING CONDENSATE PUMP STATION
- TMP-1 EXISTING TEMPERATURE MONITORING PROBE
- GMP-11 EXISTING GAS MONITORING PROBE
- IT-3 EXISTING INTERCEPTION TRENCH WELL
- GEW-55 EXISTING NORTH QUARRY LFG EXTRACTION WELL
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- GEW-72 PROPOSED NORTH QUARRY LFG EXTRACTION WELL
- 1A PROPOSED CAP PHASE DESIGNATION

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STATE OF MISSOURI
ADAM STEVEN
NUMBER
PROFESSIONAL ENGINEER
7/26/13

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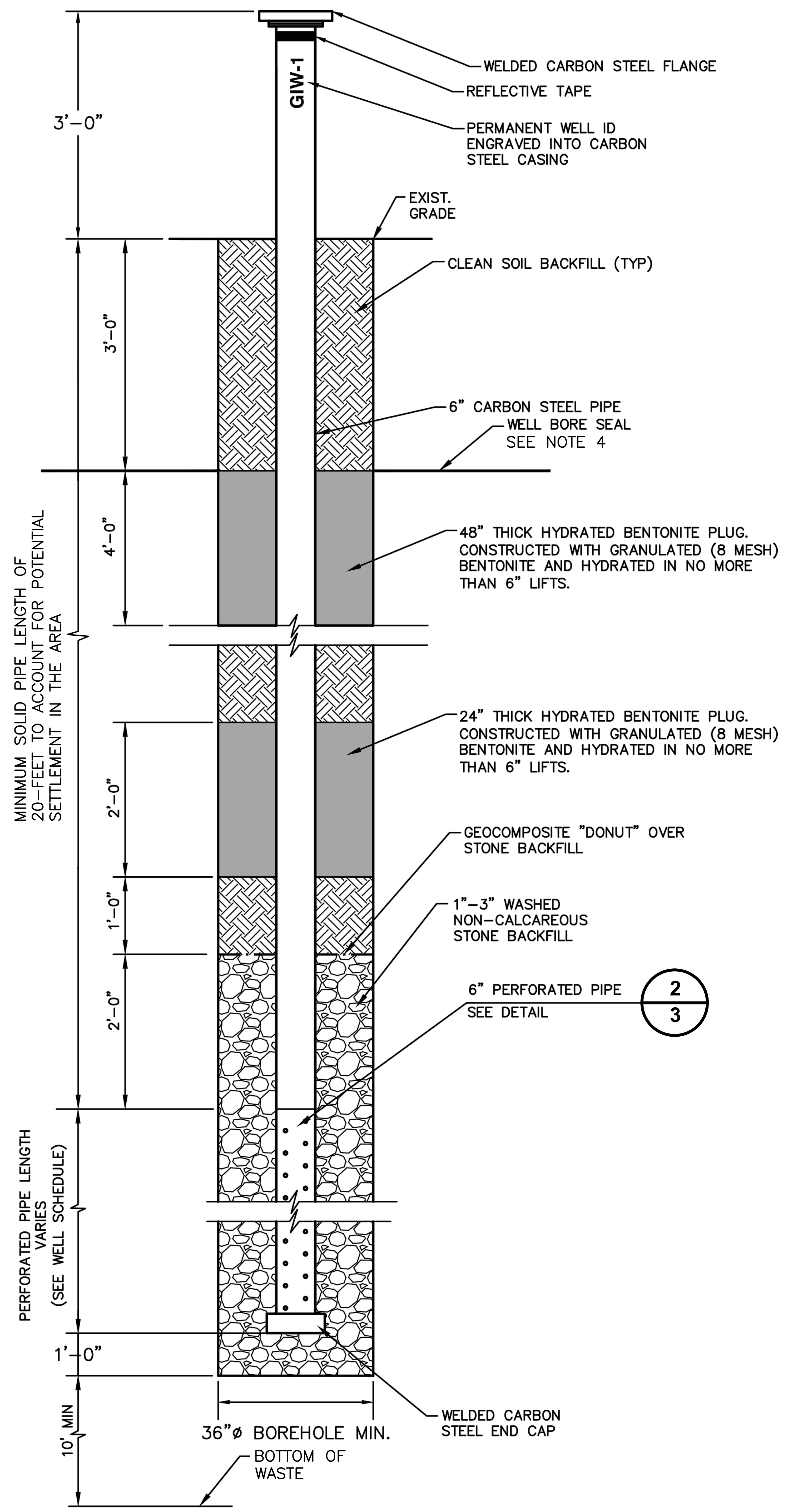
CORNERSTONE Environmental Group, LLC

BRIDGETON LANDFILL, LLC.
BRIDGETON LANDFILL
BRIDGETON, MISSOURI
CONSTRUCTION PLAN FOR
CONTINGENT NORTH QUARRY ENHANCED GCCS
PHASE 2

SHEET NO. **2C**

PROJECT NO. 130557

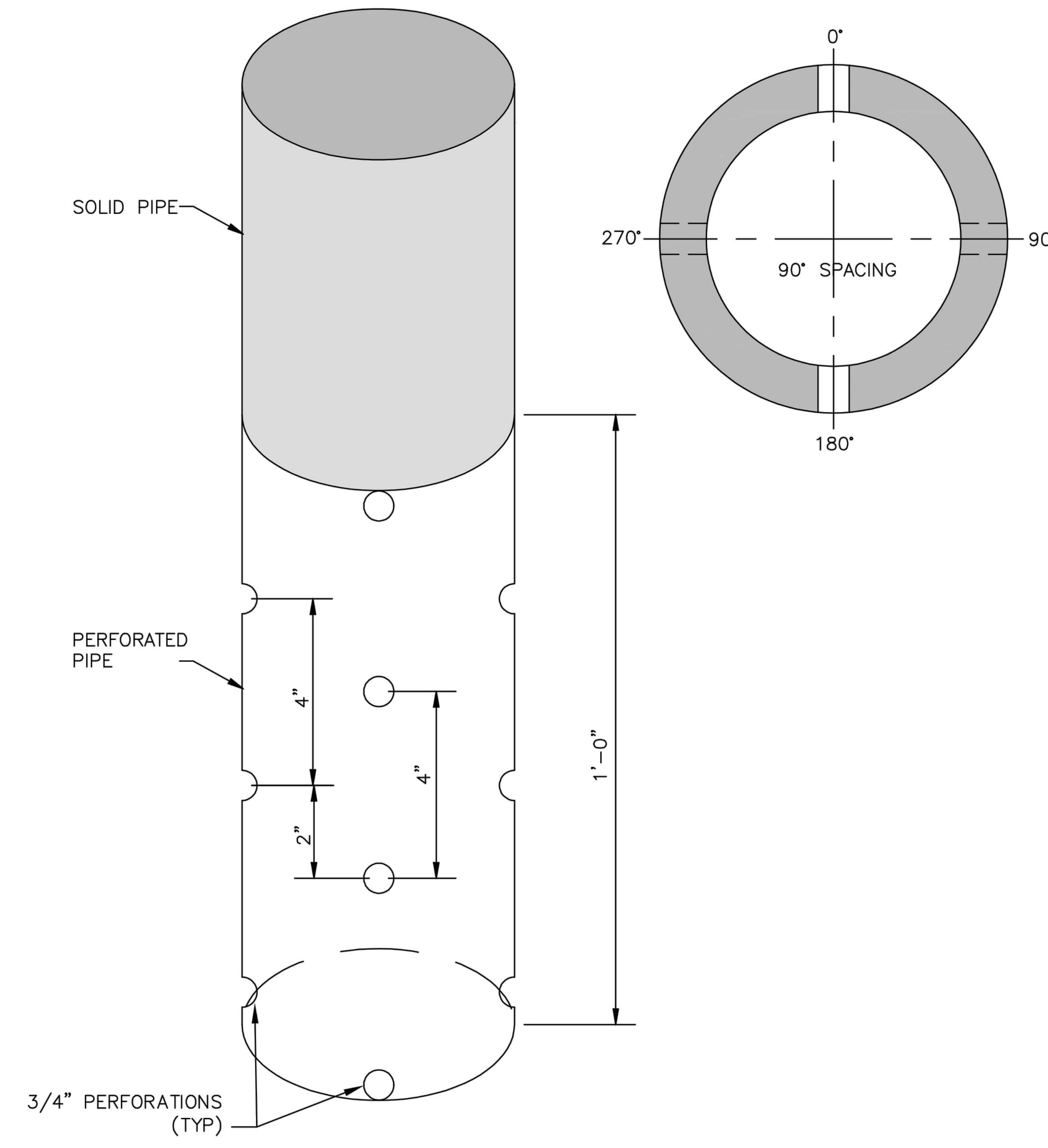


NOTES:

1. CONTRACTOR SHALL SURVEY THE PROPOSED WELL LOCATIONS AND PROVIDE THE EXISTING GROUND SURFACE ELEVATION AT EACH LOCATION TO THE ENGINEER PRIOR TO THE COMMENCEMENT OF WELL DRILLING.
2. ENGINEER SHALL ADJUST WELL SCHEDULE AS NECESSARY BASED ON THE PRE-CONSTRUCTION SURVEY.
3. ALL SIGNATURES REQUIRED ON THE FINAL WELL SCHEDULE PRIOR TO THE COMMENCEMENT OF DRILLING.
4. WELL BORE SEAL: NOMINAL 10'X10' FML WITH BOOT CLAMPED TO WELL CASING. HELD IN PLACE BY SOIL BACKFILL.

EXTRACTION WELL

DETAIL 1/3
SCALE: NOT TO SCALE



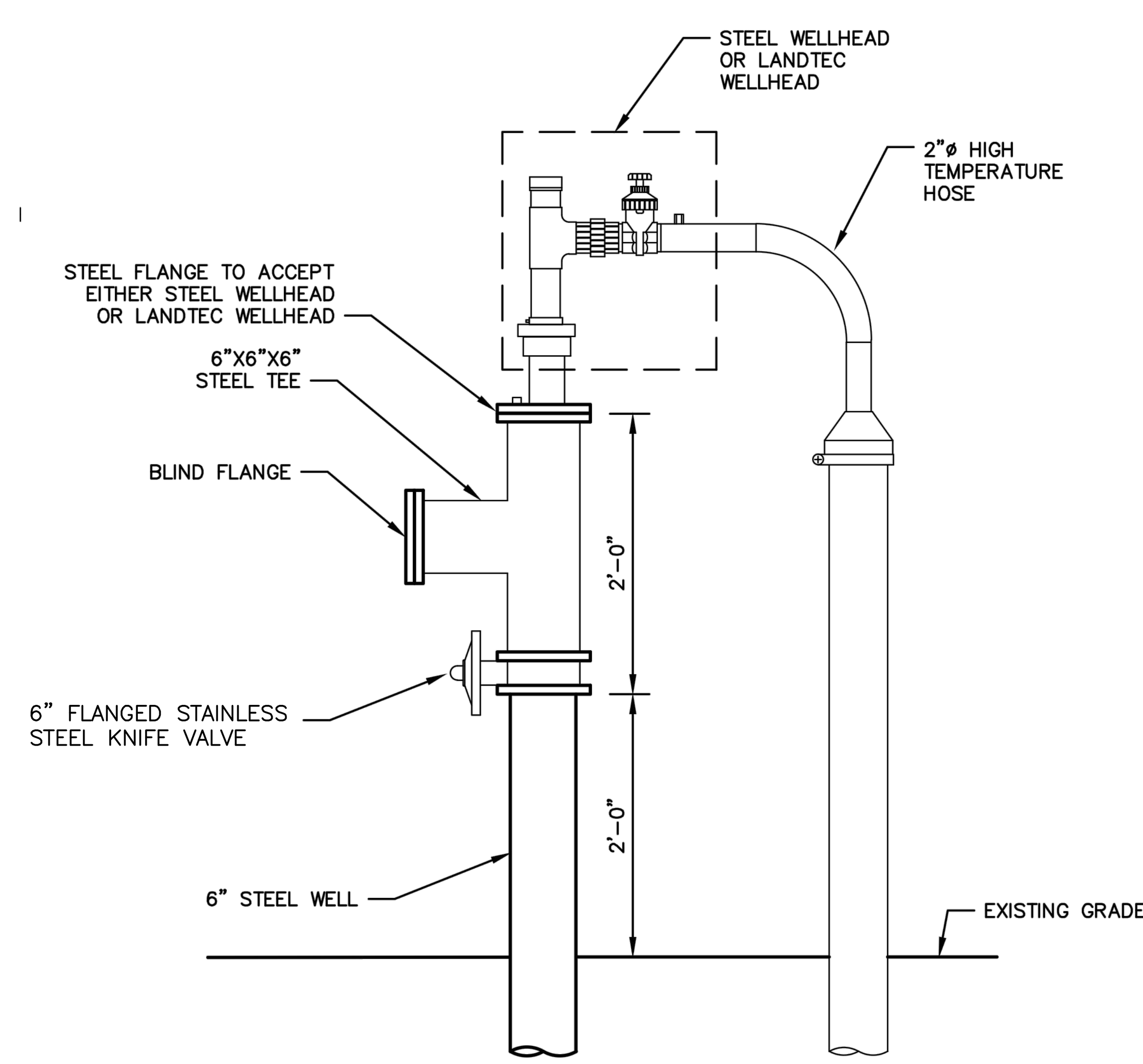
PERFORATION DETAIL

DETAIL 2/3
SCALE: NOT TO SCALE

NOTES:

1. CARBON STEEL WELL CASING WITH 3/4" PERFORATIONS SPACED 90' PART HORIZONTALLY AND 4" APART VERTICALLY. 90 AND 270 DEGREE ROWS STAGGERED 2" BELOW 0 AND 180 DEGREE ROWS.

2.CONTRACTOR MAY USE PLASMA TORCH OR OTHER DEVICE TO PRODUCE APPROXIMATELY 3/4" PERFORATIONS



WELLHEAD

DETAIL 3/3
SCALE: NOT TO SCALE

Bridgeton Landfill
Construction Plan for Contingent North Quarry GCCS
Proposed Well Schedule

Well ID	Northing	Easting	Bottom of Waste	Ground Surface	Depth of Refuse (D_R)[1]	Well Depth[4] (D_B)	Solid Length (D_S)	Perf. Length (D_P)
			ft. msl	ft. msl	ft.	ft.	ft.	ft.
GEW-200	1,068,132	516,766	400	495	95	75	20	53
GEW-201	1,068,082	516,703	440	500	60	40	20	18
GEW-202	1,068,014	516,616	380	498	118	98	20	76
GEW-203	1,068,052	516,542	240	505	265	100	20	78
GEW-204	1,068,165	516,485	240	514	274	100	20	78
GEW-205	1,068,262	516,655	240	497	257	100	20	78
GEW-206	1,068,383	516,570	240	497	257	100	20	78
GEW-207	1,068,309	516,390	390	516	126	100	20	78
GEW-208	1,068,115	516,376	240	504	264	100	20	78
GEW-209	1,068,069	516,284	280	480	200	100	20	78
GEW-210	1,068,399	516,113	440	496	56	36	20	14
GEW-211	1,068,435	516,315	425	518	93	73	20	51
GEW-212	1,068,548	516,480	320	502	182	100	20	78
GEW-214	1,068,546	516,322	435	520	85	65	20	43
GEW-215	1,068,536	516,114	445	496	51	31	20	9
GEW-216	1,068,667	516,119	455	506	51	31	20	9
GEW-217	1,068,813	516,195	460	510	50	30	20	8
GEW-218	1,068,875	516,346	460	510	50	30	20	8
GEW-219	1,068,894	516,522	435	496	61	41	20	19
GEW-220	1,068,912	516,709	315	482	167	100	20	78
GEW-8R	1,068,158	516,280	370	492	122	100	20	78
GEW-40R	1,067,962	516,558	380	496	116	96	20	74
GEW-41R2	1,068,085	516,647	250	502	252	100	20	78
GEW-42R2	1,068,162	516,688	240	502	262	100	20	78
GEW-43R2	1,068,296	516,577	240	498	258	100	20	78
GEW-53R	1,068,231	516,426	240	504	264	100	20	78
GEW-54R	1,068,160	516,562	240	510	270	100	20	78
GEW-55R	1,068,060	516,455	240	506	266	100	20	78
					TOTALS:	**2246**	**560**	**1630**

Notes:
FT. - Feet
FT. MSL - Feet above Mean Sea Level
FT. BGS - Feet below ground surface

DESIGN FIRM QA/QC REVIEWER ACKNOWLEDGEMENT: ____________ DATE
DESIGN FIRM PROJECT MANAGER ACKNOWLEDGEMENT: ____________ DATE
ENVIRONMENTAL MANAGER: ____________ DATE
CQA INSPECTOR: ____________ DATE
SURVEYOR ACKNOWLEDGEMENT: ____________ DATE
DRILLER ACKNOWLEDGEMENT: ____________ DATE

UNDER NO CIRCUMSTANCES SHALL DRILLING ACTIVITIES BEGIN WITHOUT PROVIDING THE ABOVE SIGNATURES. ANY CHANGES TO WELL LOCATIONS OR DEPTHS SHALL REQUIRE THESE SIGNATURES TO BE OBTAINED AGAIN.

STATE OF MISSOURI
ADAM STEVEN
NUMBER E-22666
PROFESSIONAL ENGINEER
7/26/13

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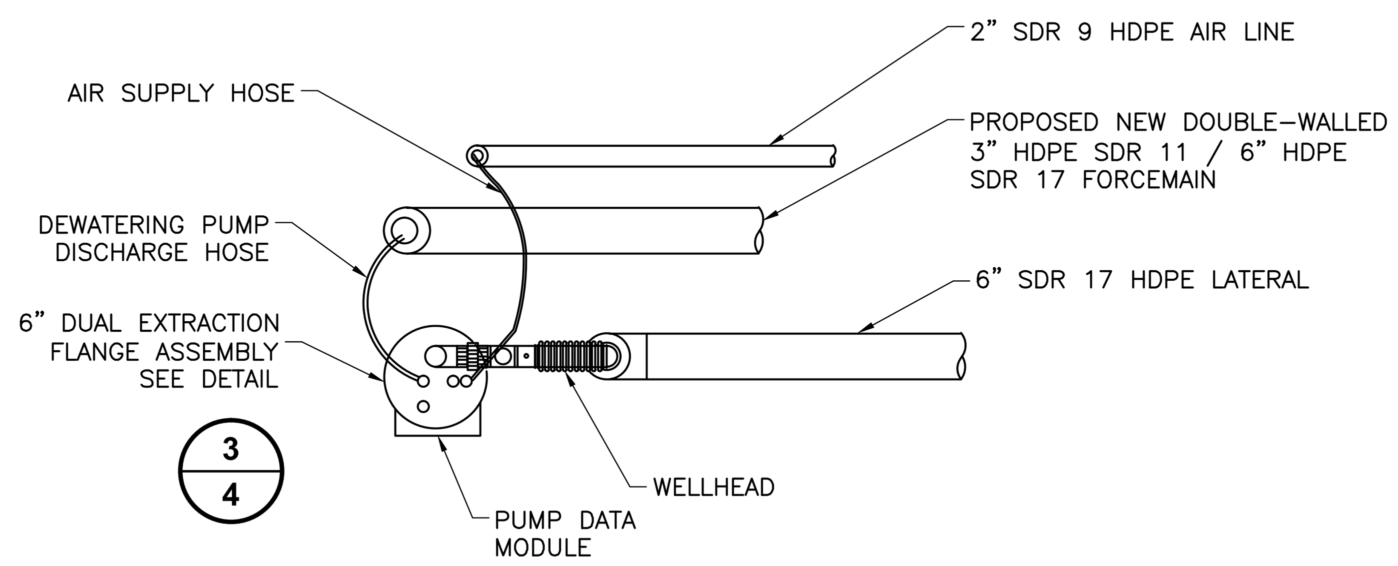
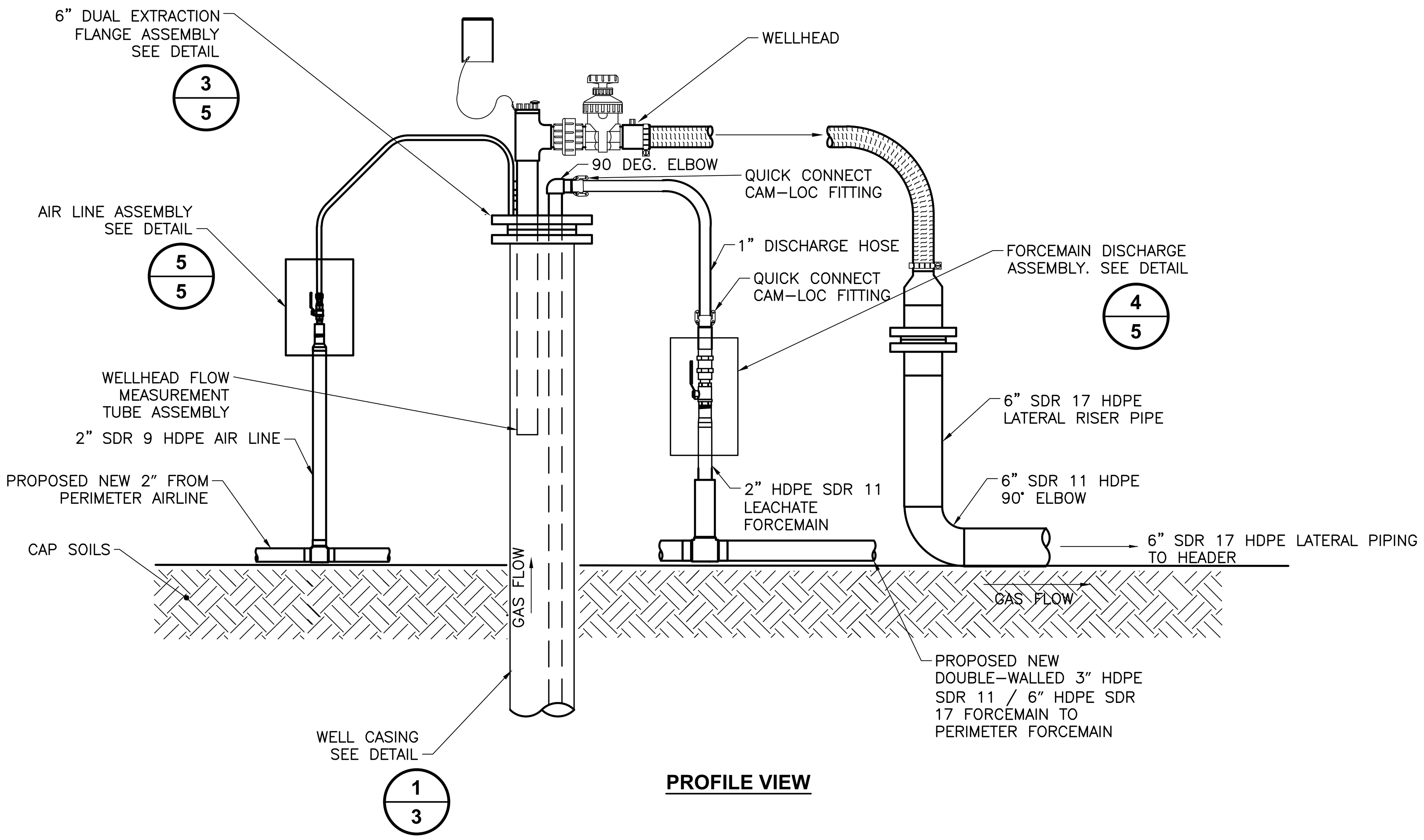
CORNERSTONE Environmental Group, LLC

BRIDGETON LANDFILL, LLC.
BRIDGETON LANDFILL
BRIDGETON, MISSOURI
CONSTRUCTION PLAN FOR CONTINGENT NORTH QUARRY ENHANCED GCCS
DETAILS

SHEET NO. 3
PROJECT NO. 130557



TOP VIEW



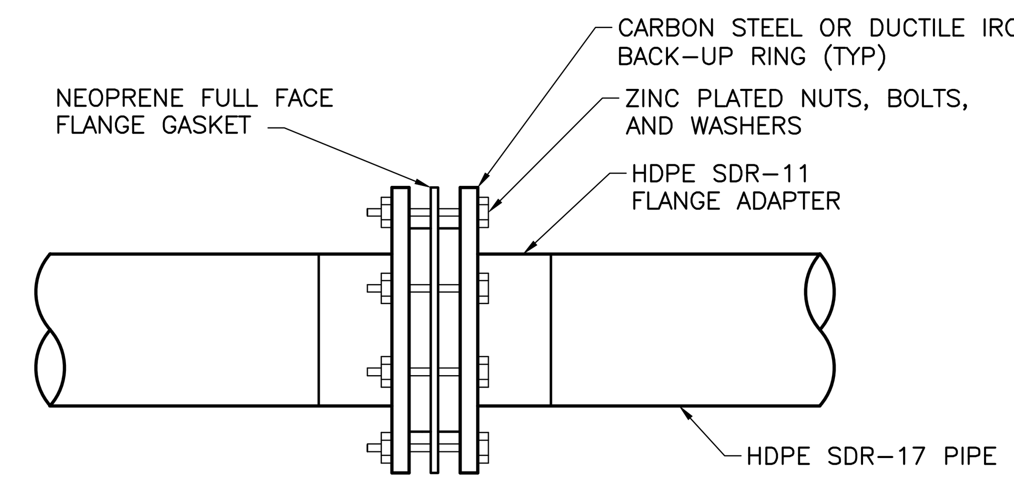
PROFILE VIEW

DUAL-EXTRACTION WELLHEAD

DETAIL 1/4
SCALE: NOT TO SCALE

NOTES:

1. TO BE INSTALLED AS LIQUID LEVELS INDICATE NEED.
2. CONTRACTOR TO UTILIZE OWNER-APPROVED WELLHEAD ASSEMBLY. CONTRACTOR TO OBTAIN OWNER PREFERENCE FOR WELLHEAD ASSEMBLY.
3. PROVIDE HIGH VISIBILITY TAPE OR PAINT AROUND TOP 1-FOOT OF WELL CASING AND LATERAL PIPE.
4. AIR AND FORCEMAIN RISERS TO BE INSTALLED TO WITHIN 2' FROM SUMP.

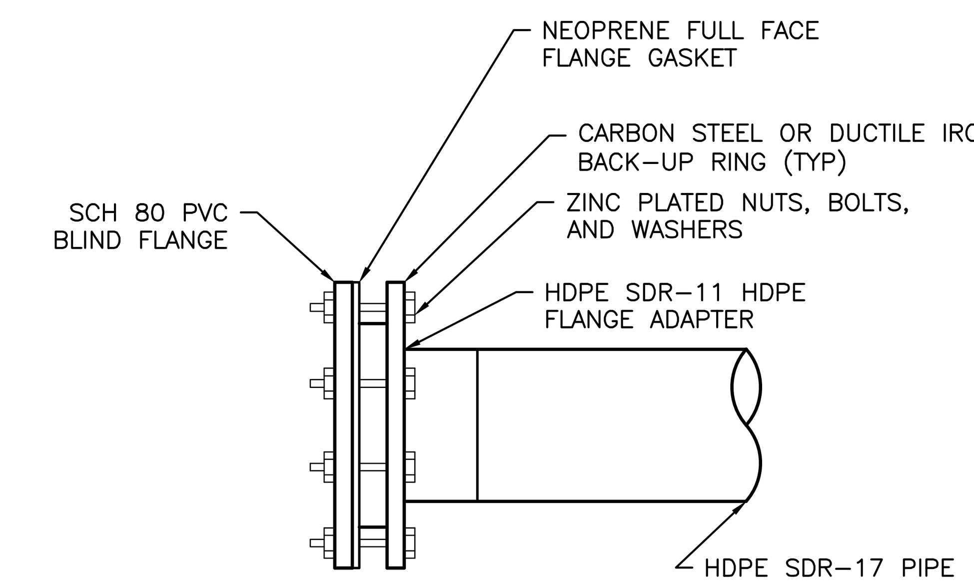


FLANGE CONNECTION

DETAIL 2/4
SCALE: NOT TO SCALE

NOTE:

INSTALL 2'x2' FML RUB SHEET OR HDPE FLAT STOCK UNDER FLANGE TO CUSHION FML COVER.

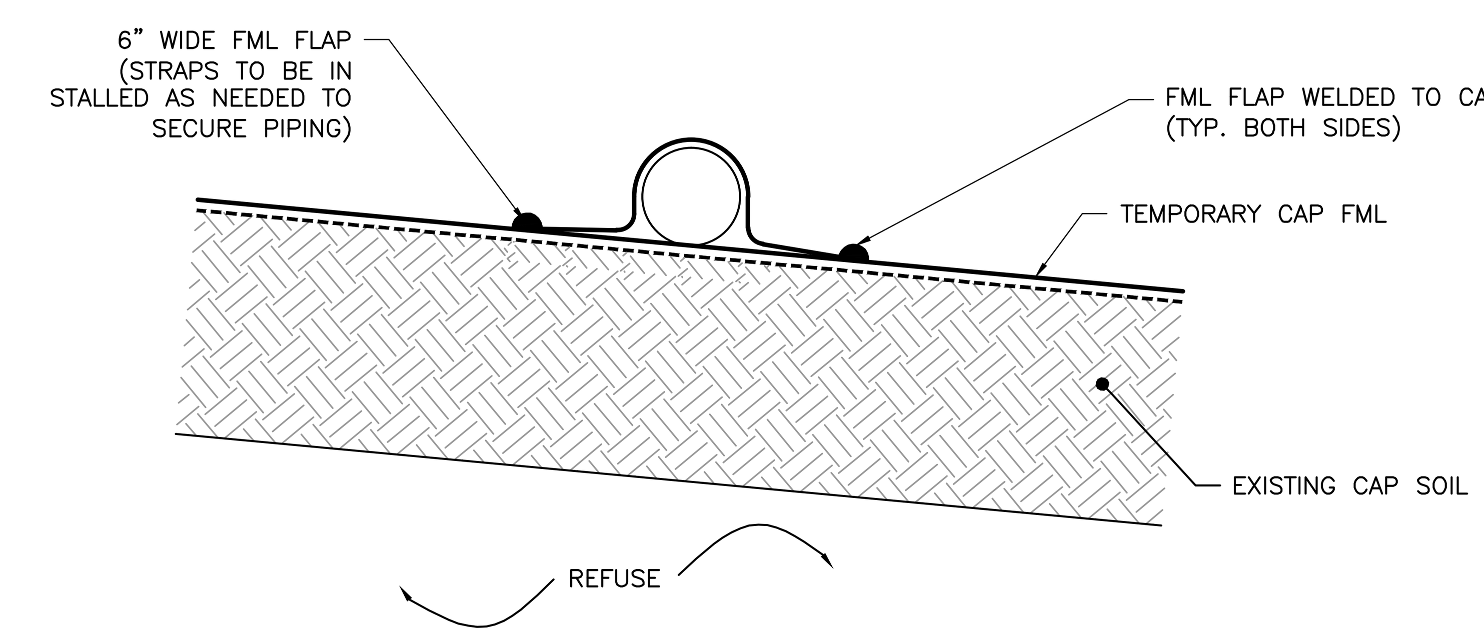


BLIND FLANGE

DETAIL 4/4
SCALE: NOT TO SCALE

NOTE:

INSTALL 2'x2' FML RUB SHEET OR HDPE FLAT STOCK UNDER FLANGE TO CUSHION FML COVER.



ABOVE CAP PIPE ANCHOR

DETAIL 3/4
SCALE: NOT TO SCALE

STATE OF MISSOURI · ADAM STEVEN LAZAR · NUMBER E-22686 · REGISTERED PROFESSIONAL ENGINEER

7/26/13

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CORNERSTONE Environmental Group, LLC

BRIDGETON LANDFILL, LLC.
BRIDGETON LANDFILL
BRIDGETON, MISSOURI
CONSTRUCTION PLAN FOR CONTINGENT NORTH QUARRY ENHANCED GCCS
DETAILS

SHEET NO. 4

PROJECT NO. 130557

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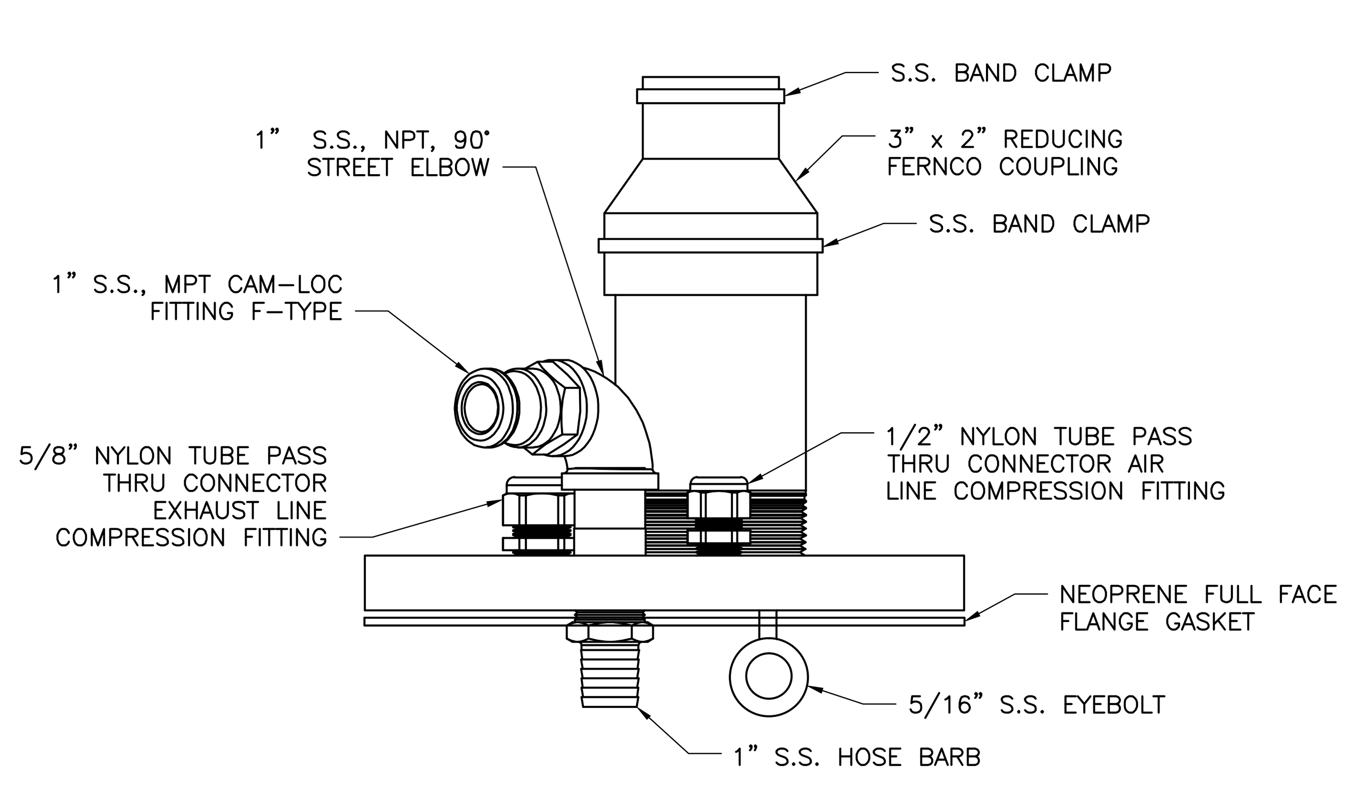
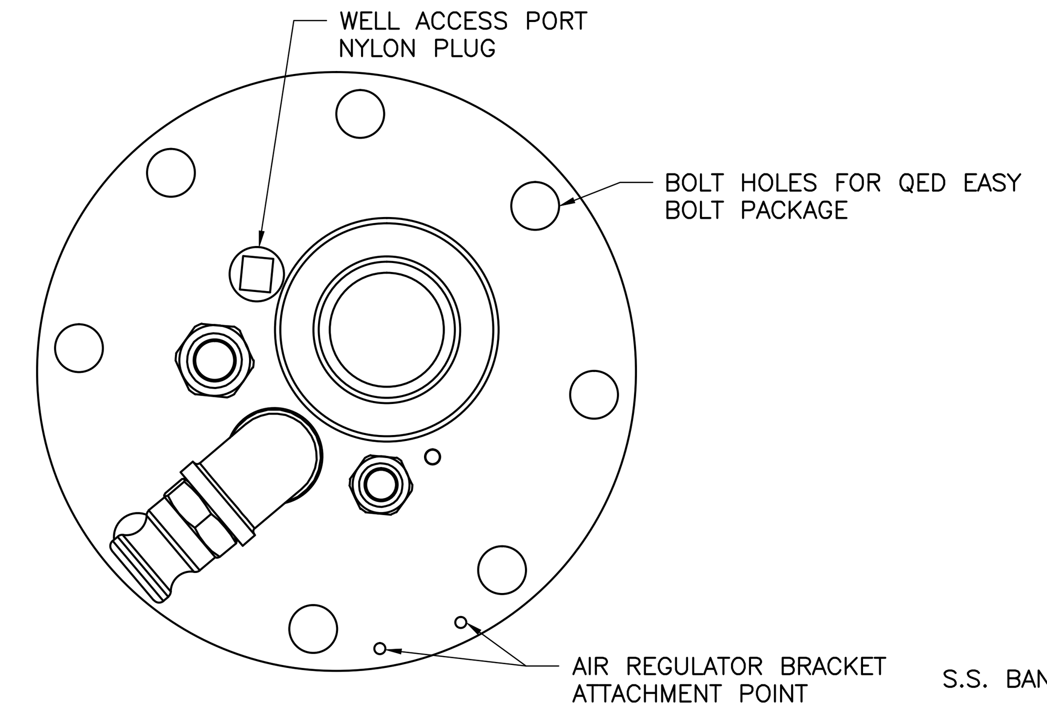


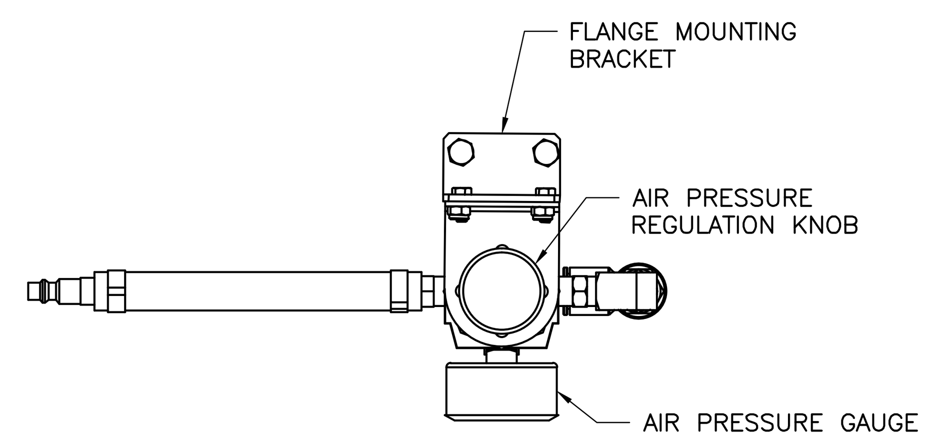
SIDE VIEW



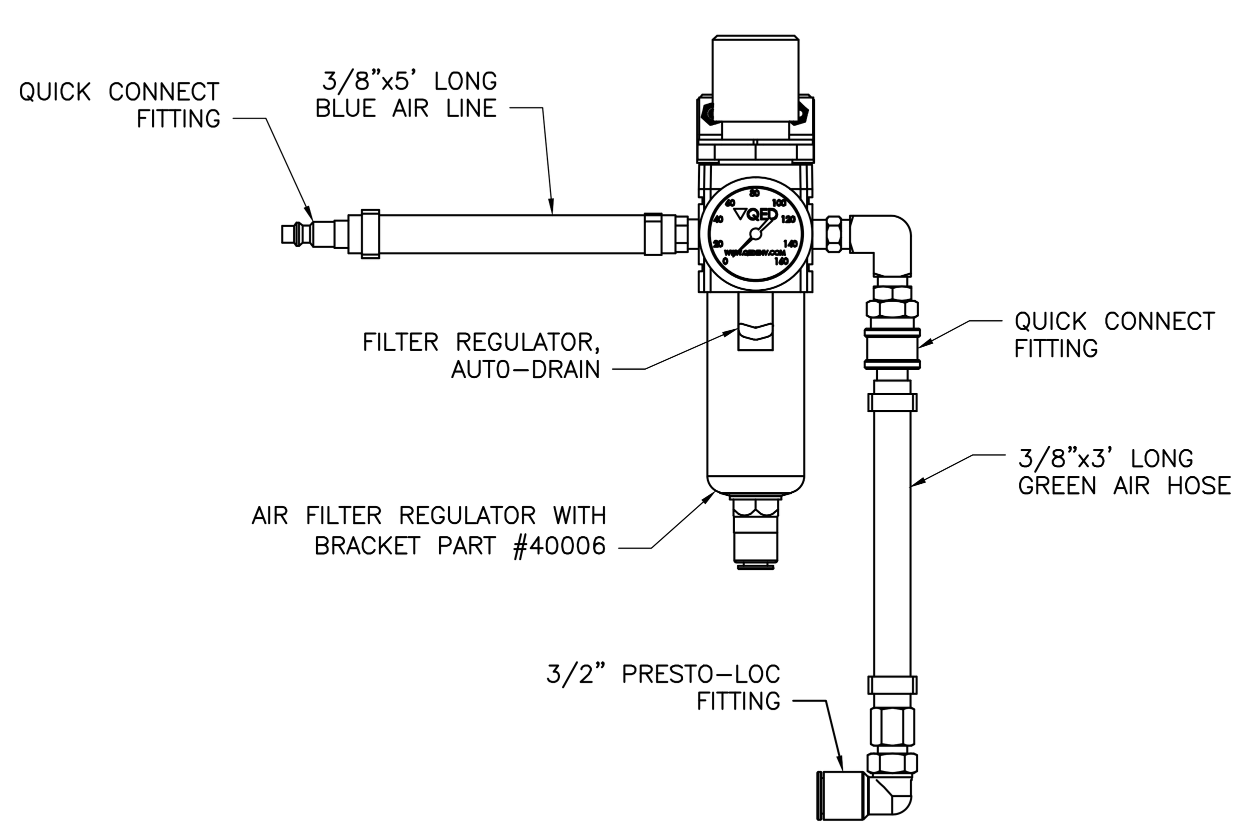
PLAN VIEW

DUAL EXTRACTION FLANGE COMPONENTS

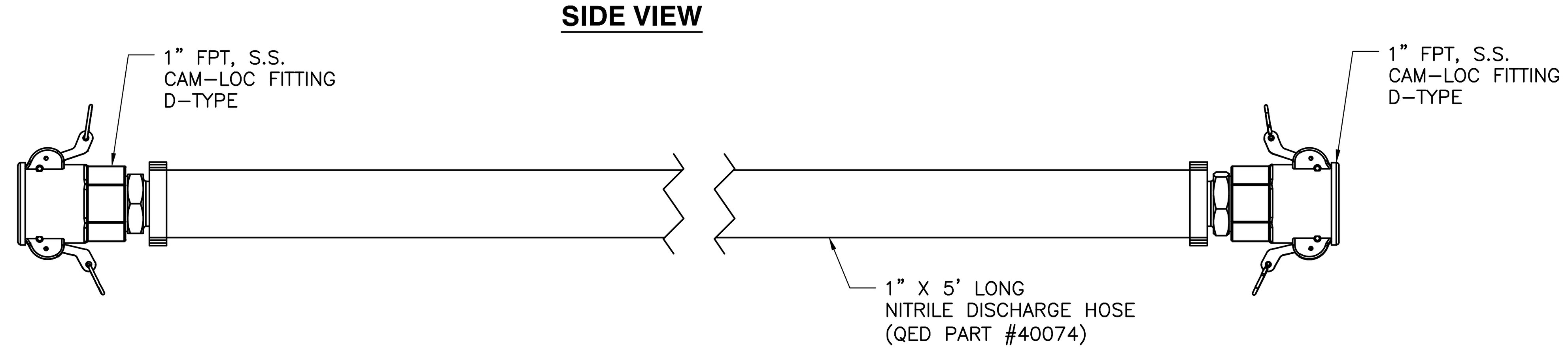
DETAIL 1/5
SCALE: NOT TO SCALE



PLAN VIEW

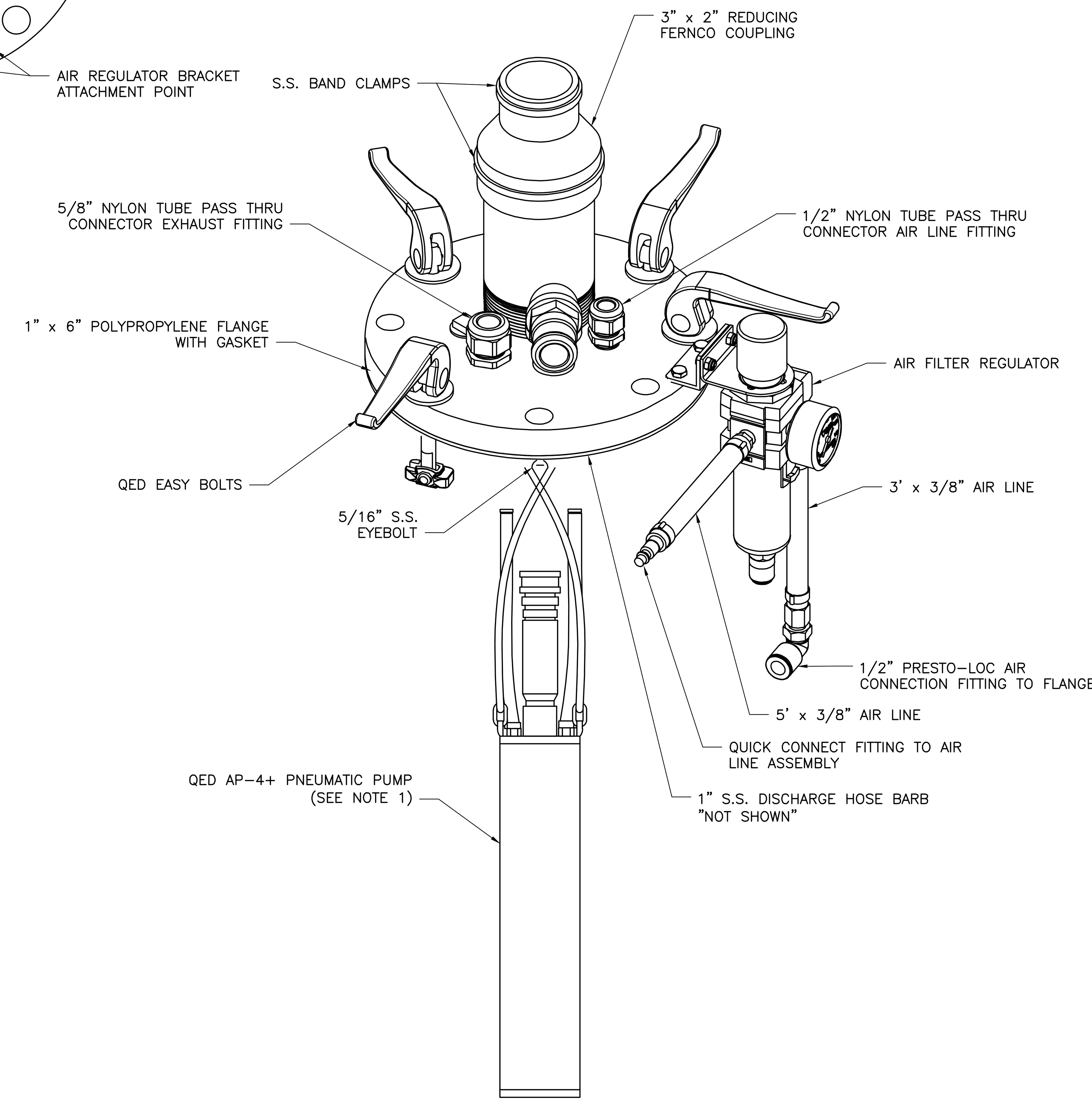


SIDE VIEW



DUAL EXTRACTION WELL AIR REGULATOR AND DISCHARGE LINE

DETAIL 2/5
SCALE: NOT TO SCALE

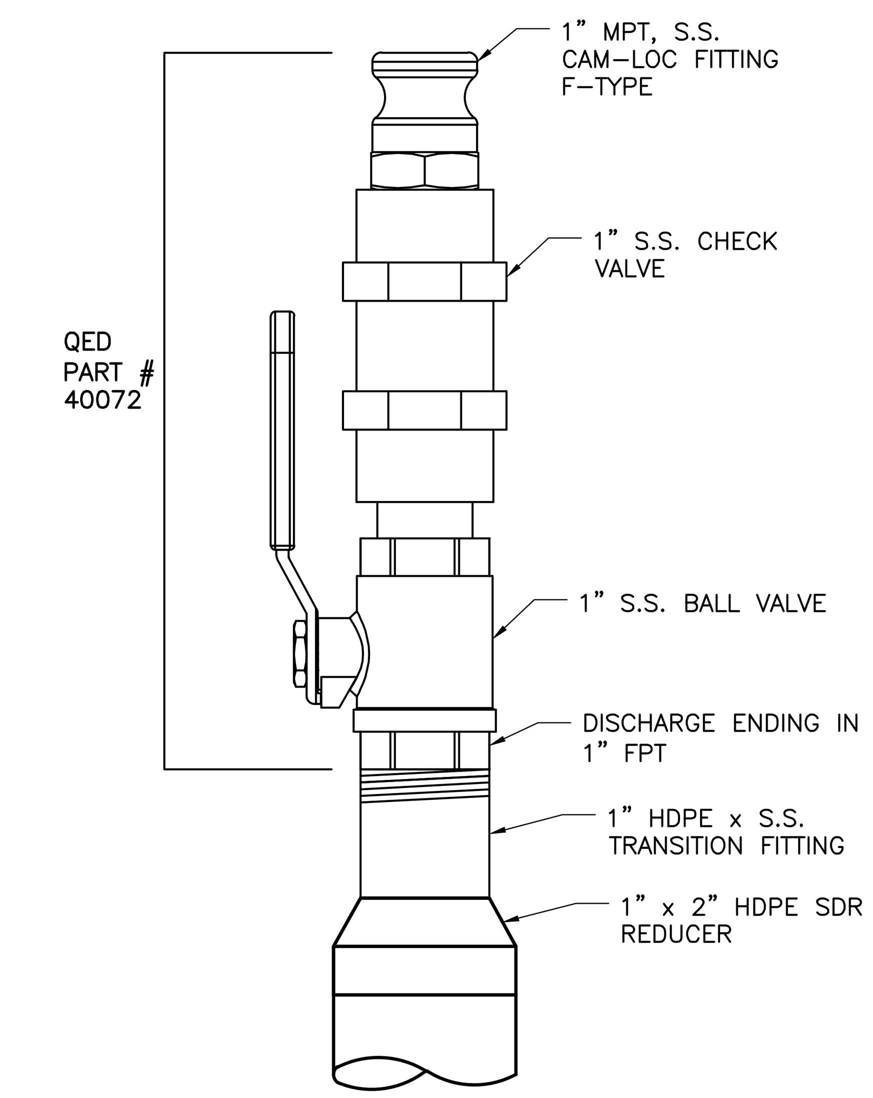


CONDENSATE EXTRACTION FLANGE ASSEMBLY (COLD CLIMATE PACKAGE)

DETAIL 3/5
SCALE: NOT TO SCALE

NOTES:

1. QED AP-4+ PNEUMATIC PUMP SHOWN FOR REFERENCE PURPOSES ONLY. PUMP IS NOT INCLUDED WITH FLANGE PACKAGE.
2. AIR LINE AND FORCE MAIN ASSEMBLIES TO BE CONFIGURED FOR COLD CLIMATES.
3. PUMP TO BE SET 1-FT OFF THE BOTTOM OF THE SUMP.
4. PUMP EXHAUST PORTS TO BE FITTED WITH THROTTLING NEEDLE VALVE.



PUMP DISCHARGE ASSEMBLY

DETAIL 4/5
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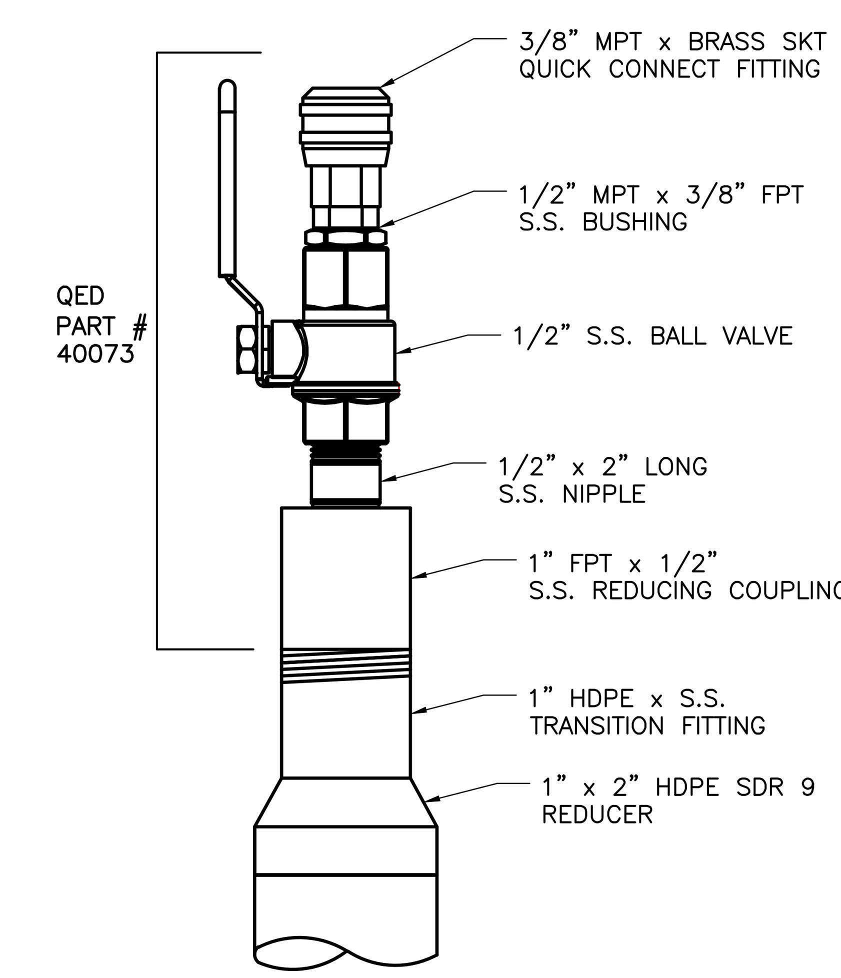
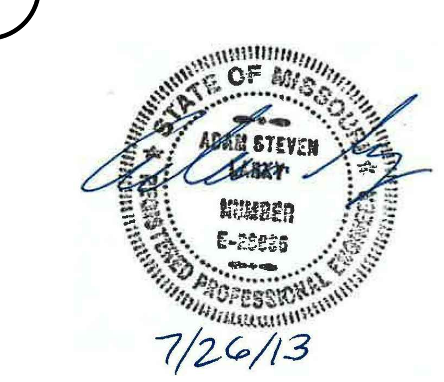


AIR SUPPLY LINE VALVE

DETAIL 5/5
SCALE: NOT TO SCALE



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DATE OF ISSUE 07/25/13
DRAWN BY EJJ
DESIGNED BY TAB
CHECKED BY TAB
APPROVED BY ASL

CORNERSTONE Environmental Group, LLC

BRIDGETON LANDFILL, LLC.
BRIDGETON LANDFILL
BRIDGETON, MISSOURI
CONSTRUCTION PLAN FOR CONTINGENT NORTH QUARRY ENHANCED GCCS
DETAILS

SHEET NO. 5

PROJECT NO. 130557

APPENDIX D

STORMWATER DESIGN REPORT

APPENDIX D

STORMWATER MANAGEMENT DESIGN REPORT

BRIDGETON LANDFILL NORTH QUARRY
EVOH GEOMEMBRANE CAP DESIGN

BRIDGETON, MISSOURI

Prepared for

Bridgeton Landfill, LLC
13570 St. Charles Rock Road
Bridgeton, Missouri 63044

July 2013

Prepared by

CORNERSTONE
Environmental Group, LLC
39395 W. Twelve Mile Road, Suite 103
Farmington Hills, Michigan 48331

Project 130520

Stormwater Management Design Report
Bridgeton Landfill North Quarry EVOH Geomembrane Cap Design
Bridgeton, Missouri

The material and data in this report were prepared under the supervision and direction of the undersigned.

Cornerstone Environmental Group, LLC

James Walker, P.E.
Senior Client Manager

Adam Larky, P.E.
Senior Client Manager

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Tables

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1 INTRODUCTION

The stormwater management system for the proposed EVOH geomembrane cap design of the North Quarry Unit of Bridgeton Landfill has been designed based on the stormwater requirements of Missouri Rules of Natural Resources, Division 80 Solid Waste Management Chapter 3 Sanitary Landfill Section 10 CSR 80-3.010 (8) Water Quality (F). This rule requires:

(I) Areas of the watershed which will be affected by the sanitary landfill shall be specified.
(II) On-site drainage structures and channels shall be designed to prevent flow onto the active portion of the sanitary landfill during at least a twenty-five (25) year storm. The engineering calculations and assumptions shall be included and explained in an engineering report.
(III) On-site drainage structures and channels shall be designed to collect and control at least the water volume from a twenty-four (24) hour, twenty-five (25) year storm.
(IV) On-site drainage channels shall be designed to empty expeditiously after storms to maintain the design capacity of the system.
(V) Contingency plans for on-site management of surface water which comes into contact with solid waste shall be specified.

This report provides a summary of the how the stormwater design meets the MDNR rule requirements listed above and includes corresponding supporting design calculations.

The existing conditions of the North Quarry are shown on Sheets 1 and 1A of the Construction Plans for the EVOH Geomembrane Cap and Cap Integrity System of Bridgeton Landfill North Quarry (Cap Engineering Plans). The proposed EVOH geomembrane cap for the North Quarry is comprised of three phases totaling 21 acres as shown in Sheet 2 of the Cap Engineering Plans.

The Bridgeton Landfill has three permitted outfalls (001, 006 and 004) on the north side and two permitted outfalls (003 and 005) on the south side. Stormwater for the North Quarry Unit currently drains to outfalls 001, 004 and 003 and will continue to outfall at the existing outfalls for the proposed cap design (note: southeast permitted outfall 003 at the southwest is in the process of being relocated to the outlet of the proposed southwest detention basin discharge culvert).

2 STORMWATER MANAGEMENT DESIGN

The EVOH geomembrane cap has been designed to control both stormwater run-on to the landfill and stormwater runoff from the landfill. Due to the elevated topography of the North Quarry, no stormwater run-on to the landfill occurs.

Stormwater runoff from phases 1A and 1B of the North Quarry EVOH geomembrane cap area is designed to sheet flow down the landfill slopes to perimeter drainage channels which convey the runoff through culverts to a detention basin before being discharged off-site. Except for the north existing benches of Phase 1B, the benches will be regraded to provide a positive outward slope to facilitate sheet flow. The existing benches on the north side of phase 1B will be regraded and used to divert stormwater away from the cutoff trench excavation should the cutoff trench be necessary (as determined by monitoring results of temperature monitoring probes along trigger line 2).

Stormwater management for phase 2 will be affected by the final design of the isolation barrier cutoff trench. The cutoff trench design shown on the Cap Engineering Plans is a conceptual design and the design will be finalized after the Cap Engineering Plans are completed. Therefore, the stormwater design will be finalized following completion of the isolation barrier cutoff trench design and revisions will be submitted to the MDNR for approval. For the present phase 2 design, stormwater runoff from the phase 2 area is designed to sheet flow to perimeter channels and then drain to existing drainage channels.

Proposed light-duty access roads which will be constructed above the EVOH Geomembrane cap to serve as ballast against wind uplift have been designed generally in an up/down slope orientation so as to not impede sheet flow runoff. Eyebrow diversion berms will be used where it is necessary to protect features such as extraction wells, valves risers, etc. from stormwater runoff. These may be installed both initially during the EVOH Geomembrane cap construction and during the subsequent operation and maintenance of the facility. Energy dissipaters will be used in specific locations where stormwater flow concentrates to help dissipate the energy of the concentrated flow. The locations of the eyebrow diversion berms and energy dissipaters will be included in the EVOH geomembrane cap certification report which will be submitted to the MDNR following completion of the construction. Locations of the eyebrow diversion berms and energy dissipaters installed following construction of the EVOH geomembrane cap certification report, which will be included in the as-built updates submitted to the MDNR quarterly. Specific stormwater management design details for subareas of the north quarry unit are described in Sections 2.1.1 through 2.1.4 of this report.

Stormwater runoff flow estimates and channel analyses found in this report, unless otherwise indicated, were calculated using HydroCAD version 10 (HydroCAD). This program is an industry standard program utilizing the TR-20 Methodology developed by the Soil Conservation Service. The program develops runoff hydrographs for subareas based on inputs of drainage area, time of concentration and rainfall. For the Bridgeton Landfill area, the recommended type II rainfall distribution with antecedent moisture condition II was used in the analyses. The program was also used to perform both hydrograph routing and design drainage channels, culverts, and detention basins.

Drainage subareas for the north quarry were developed for stormwater design and analyses of channels, culverts and detention basins. The subareas are shown and summarized in Sheet 7 of the Cap Engineering Plans. Separate stormwater models were developed for each discharge location as shown in Figure 1 and summarized in Table 1. Proposed cap areas were analyzed with a runoff curve number of 100 which results in 100 percent of the precipitation generating stormwater runoff.

Peak runoff flows for each sub-area were obtained using HydroCAD for the 25-year, 24-hour storm event. The 25-year 24-hour rainfall for Bridgeton Landfill was obtained from Bulletin 71 (MCC Research Report 92-03), Rainfall Frequency Atlas of the Midwest, 1992. A copy of the figure showing this rainfall frequency information is included in Appendix A of this report. The peak flows are based on stormwater slopes developed using the topographic map dated February 13, 2013 prepared by Coop Aerial Surveyors Company.

Table 1 – Summary of North Quarry Unit Stormwater Model Drainage Areas

NORTH QUARRY CAP AREA	SUBAREAS INCLUDED	TOTAL CAP AREA (ACRES)	DISCHARGE LOCATION
South	N1A-S, N1A-E	4.25	North Detention Basin of South Quarry (to Outfall 004)
East	N1B-N2, N1B-E, N1B-S1, N1B-S2	4.63	Proposed Northeast Detention Basin (to Outfall 004)
West	N1A-W, N1B-W1, N1B-W2, N1B-N1	6.16	Southwest Detention Basin of South Quarry (to Outfall 003)
Northwest	N2-NW1	2.73	Existing Channel (to Outfall 001)
Northeast	N2-NE1, N2-NE2	3.32	Existing Channel (to Outfall 001)
Total		21.09	

2.1.1 North Quarry South Drainage Area (Subareas N1A-S, N1A-E)

The south drainage area collects stormwater from subareas N1A-S and N1A-E and conveys it through perimeter channels and culverts to the South Quarry north channel which then drains into the South Quarry north detention basin. The stormwater design features for the North Quarry south drainage area include the following:

1. Proposed perimeter drainage channels N1A-S and N1A-E
2. Proposed culverts C-1 and C-2
3. Impact on the South Quarry north perimeter drainage channel and north detention basin

The proposed perimeter channels proposed culverts C-1 and C-2 and South Quarry north perimeter channel and detention basin are shown on Sheet 7 of the Cap Engineering Plans. Details of the proposed drainage channels and culverts are provided on Sheets 7, 11, and 13 of the Cap Engineering Plans.

Calculations for the south drainage area are provided in Appendix B of this report. The results of the of the 24-hour 25-year stormwater calculations are summarized below and include both the previous results for the South Quarry design and the results with the additional North Quarry subareas. The peak water surface elevation is below the top of the north detention basin (el 480) and the outlet peak flow will increase only slightly with the additional North Quarry cap areas.

Table 2 – Stormwater Calculation Results for South Drainage Area (at North Detention Basin)

NORTH DETENTION BASIN DESIGN	RESULTS WITH ADDITIONAL NORTH QUARRY SUBAREAS	RESULTS FOR PREVIOUS SOUTH QUARRY DESIGN
Approximate Basin Dimensions	60 feet x 260 feet	60 feet x 260 feet
Basin Volume at Peak Elevation	1.325 acre-feet	0.883 acre-feet
Detention Time	0.22 hours (13 minutes)	0.23 hours (14 minutes)
Peak Inflow (cfs)	65.2 cfs	39.2 cfs
Peak Outflow (cfs)	14.3 cfs	11.8 cfs
Peak Water Surface Elevation	478.79	477.33

2.1.2 North Quarry East Drainage Area (Subareas N1B-N2, N1B-E, N1B-S1 and N1B-S2)

The stormwater design features for the east drainage area include the following:

1. Proposed perimeter drainage channels N1B-N1, N1B-N2, N1B-E, N1B-S1 and N1B-S2
2. Proposed culverts C-4 through C-11
3. Proposed northeast detention basin

The locations of the proposed channels, culverts and northeast detention basin are shown on Sheet 7 of the Cap Engineering Plans. Details of the proposed channels and culverts are provided on Sheets 7, 11 and 13 of the Cap Engineering Plans. Channels N1B-N1, N1B-N2 and N1B-E are designed to collect and divert drainage from the proposed cutoff trench in phase 2 to facilitate construction of the trench excavation and backfill. The location of the cutoff trench is conceptual at present and design will be finalized after submittal of the cap design, therefore channels N1B-N1, N1B-N2 and N1B-E may be revised upon completion of the cutoff trench design.

The proposed perimeter channels, proposed culverts C-4 through C-11 and proposed northeast detention basin are shown on Sheet 7 of the Cap Engineering Plans. Details of the proposed drainage channels and culverts are provided on Sheets 7, 11 and 13 of the Cap Engineering Plans.

Calculations for the east drainage area are provided in Appendix C of this report. The results of the 24-hour 25-year stormwater calculations are summarized below. The peak water surface elevation 482.42 is lower than the top of the basin elevation 484 and the ground elevation at the solid waste boundary el 488; therefore no run-on to the landfill will occur. Outflow from the northeast detention basin will outlet to an existing drainage channel which flows to the hauling company detention basin. The proposed northeast detention basin is effective in reduction of the peak flow from the proposed cap area.

Table 3 – Stormwater Calculation Results for Proposed East Drainage Area

PROPOSED NORTHEAST DETENTION BASIN DESIGN	RESULTS
Approximate Basin Dimensions	80 feet x 200 feet
Basin Volume at Peak Elevation	1.144 acre-feet
Detention Time	0.21 hours (12 minutes)
Peak Inflow (cfs)	44.8 cfs
Peak Outflow (cfs)	12.8 cfs
Peak Water Surface Elevation	482.42

2.1.3 North Quarry West Drainage Area (Subareas N1A-W, N1B-W1, N1B-W2, N1B-N1)

Stormwater form the North Quarry west drainage area currently drains along the west side of the South Quarry to the southwest detention basin. The stormwater drainage will increase for the proposed North Quarry cap due to the imperviousness of the cap. The stormwater model prepared previously for the southwest drainage basin was modified for the proposed North Quarry west drainage area to design the proposed channels and culvert C-3 and also to evaluate the impacts to the South Quarry drainage system. The locations of the proposed west perimeter channels and culvert C-3 are shown on Sheet 7 of the Cap Engineering Plans. Details of the structures are provided on Sheets 7, 11 and 13 of the Cap Engineering Plans. The location of the southwest detention basin included in the design of the South Quarry cap is shown on Sheet 1 of the Cap Engineering Plans.

Calculations for the North Quarry west drainage area are provided in Appendix D of this report. The results of the 24-hour 25-year stormwater calculations at the southwest detention basin are summarized in Table 5. The calculations show that the additional drainage from the North Quarry west drainage area will not have a significant effect on the offsite discharge. The results listed for the previous South Quarry design include field changes made during construction of the South Quarry cap which will be included with the certification report for the South Quarry cap.

Table 4 – Stormwater Calculation Results for Proposed West Drainage Area (at the Southwest Detention Basin)

SOUTHWEST DETENTION BASIN DESIGN	RESULTS WITH NORTH QUARRY CAP	RESULTS FOR PREVIOUS SOUTH QUARRY DESIGN
Approximate Basin Dimensions	420 feet x 580 feet (el. 450)	420 feet x 580 feet (el. 450)
Basin Volume at Peak Elevation	15.924 acre-feet	15.263 acre-feet
Detention Time	1.32 hours (79 minutes)	1.32 hours (79 minutes)
Peak Inflow (cfs)	276 cfs	269 cfs
Peak Outflow (cfs)	24 cfs	24 cfs
Peak Water Surface Elevation	444.54	444.45

2.1.4 North Quarry Northwest Drainage Area (Subarea N2-NW1)

The North Quarry northwest drainage area consists of the northwest part of the phase 2 cap. The stormwater design for this area consists of a perimeter channel designated as N2-NW1 which is designed to collect runoff from the cap and drain it to the west to a proposed downslope riprap channel N2-NW1 which then discharges to an existing onsite channel near the entrance road to the transfer station.

The subarea N2-NW1 and proposed channels are shown on Sheet 7 of the Cap Engineering Plans and stormwater calculations are provided in Appendix E of this report. The proposed cap would increase the peak flow for the 24-hour 25-year storm from 14 cfs to 24 cfs for this subarea N2-NW1. No area is available for design of a detention basin for this subarea; however, the drainage area is limited to the phase 2 cap. The design of the proposed channels for this subarea will be reevaluated once the isolation barrier cutoff trench design is completed.

2.1.5 North Quarry Northeast Drainage Area (Subarea N2-NE1)

The North Quarry Northeast Drainage Area consists of the northeast part of the phase 2 cap. The stormwater design for this area consists of a perimeter channel designated as N2-NE1 which is designed to collect runoff from the cap and drain it to the east to the existing channel on the west side of St Charles Rock Road.

The subarea N2-NE1 and proposed channel is shown on Sheet 7 of the Cap Engineering Plans and stormwater calculations are provided in Appendix F. A significant part of the existing North Quarry which drains to the northeast will be routed to the proposed northeast detention basin which drains to the south. The calculations for the 24-hour 25-year storm under existing conditions result in a peak flow of 30 cfs while under the proposed cap design the peak flow would be 31 cfs. The design of the proposed channels for this subarea will be reevaluated once the isolation barrier cutoff trench design is completed.

3 CONCLUSIONS

Based on the descriptions and calculations included in this engineering report, the proposed stormwater management design for the EVOH geomembrane cap proposed for the North Quarry Unit at the Bridgeton Landfill meet the requirements of Missouri Rules of Natural Resources, Division 80 Solid Waste Management Chapter 3 Sanitary Landfill Section 10 CSR 80-3.010 (8) Water Quality (F) as described below.

(I) Areas of the watershed that will be affected by the sanitary landfill have been specified in Figure 1.

(II) On-site drainage structures and channels have been designed to prevent flow onto the active portion of the sanitary landfill during at least a twenty-five (25) year storm. The engineering calculations and assumptions are included and explained in this engineering report.

(III) On-site drainage structures and channels have been designed to collect and control at least the water volume from a twenty-hour (24) hour, twenty-five (25) year storm. Perimeter channels either exist or are designed to collect the runoff and direct it to detention basins (except subareas N2-NW1 and N2-NE1 and N2-NE2 in the case of a phase 2 cap installation) for discharge off-site.

(IV) On-site drainage channels have been designed to empty expeditiously after storms to maintain the design capacity of the system. Hydrographs included with the design calculations show that the conveyance structures including detention basins will drain in less than 24 hours.

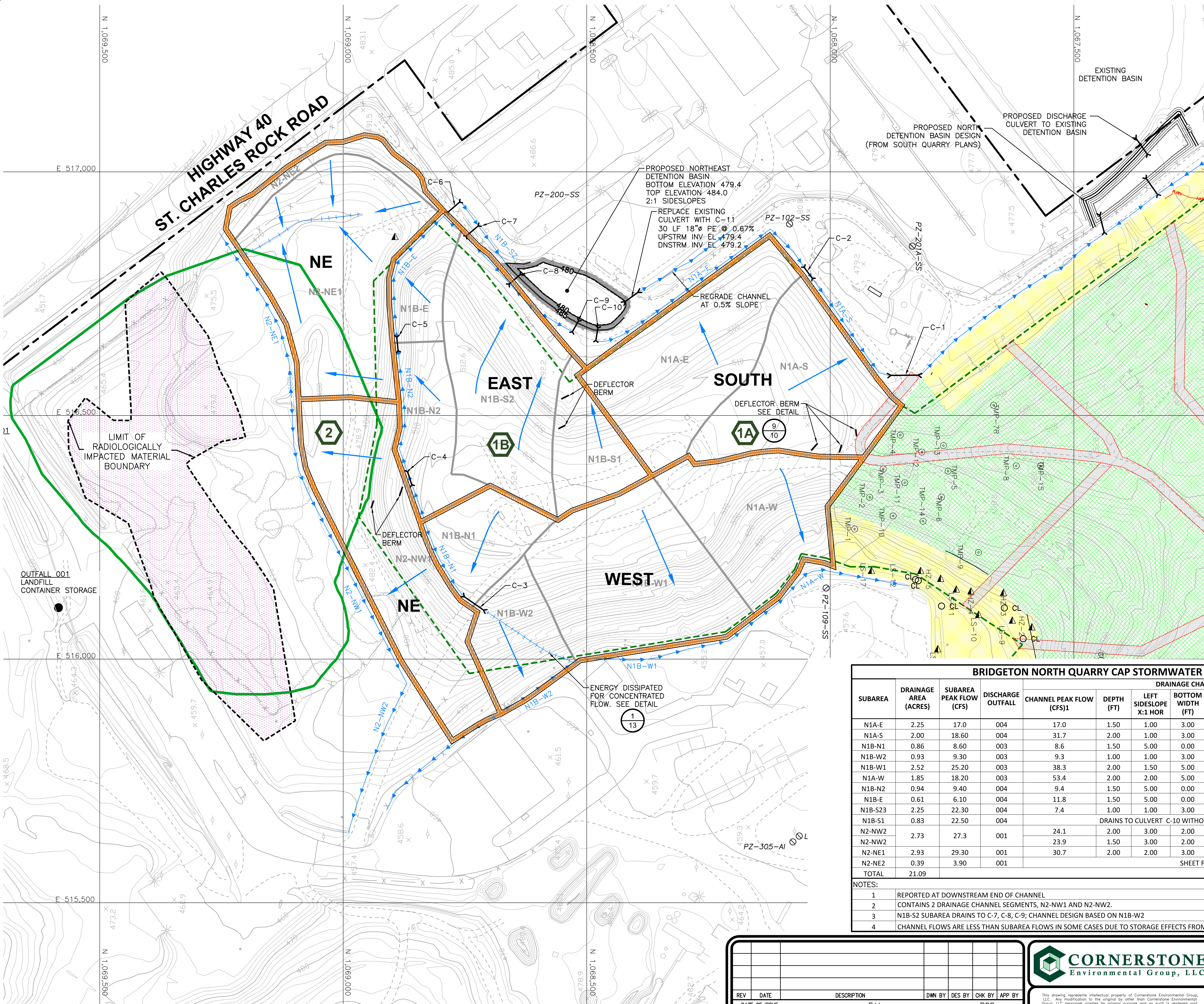
Contingency plans for on-site management of storm water which comes into contact with solid waste are available. The proposed stormwater management system includes detention basins for phase 1 cap subareas that can be used as contingency measures for on-site management of stormwater water that may come into contact with solid waste including leachate. In addition, if warranted perimeter channels can be lined with a geomembrane to provide additional contingency measures to manage impacted stormwater water and minimize infiltration into the ground around the landfill. Bridgeton Landfill maintains an assortment of equipment on site to address operations and maintenance of the facility. In the event that leachate or gas condensate is detected above the temporary cap, it will be isolated immediately using soil stockpiled onsite and pumped to a storage container for removal as leachate and the temporary cap will be repaired. If leachate or gas condensate is observed in the lined channel or a detention basin, the liquid will be pumped and removed as quickly as possible using high volume pumping equipment and load-out trucks maintained on site to provide this contingency.

LIMITATIONS

The work product included in the attached was undertaken in full conformity with generally accepted professional consulting principles and practices and to the fullest extent as allowed by law we expressly disclaim all warranties, express or implied, including warranties of merchantability or fitness for a particular purpose. The work product was completed in full conformity with the contract with our client and this document is solely for the use and reliance of our client (unless previously agreed upon that a third party could rely on the work product) and any reliance on this work product by an unapproved outside party is at such party's risk.

The work product herein (including opinions, conclusions, suggestions, etc.) was prepared based on the situations and circumstances as found at the time, location, scope and goal of our performance and thus should be relied upon and used by our client recognizing these considerations and limitations. Cornerstone shall not be liable for the consequences of any change in environmental standards, practices, or regulations following the completion of our work and there is no warrant to the veracity of information provided by third parties, or the partial utilization of this work product.

FIGURES



0 100 200
SCALE IN FEET

LEGEND

- SOLID WASTE PERMIT 118912 BOUNDARY
- DRAINAGE AREA BOUNDARY
- EXISTING 10' CONTOUR
- EXISTING 2' CONTOUR
- EXISTING HDPE GEOMEMBRANE
- SOUTH QUARRY EVOH GEOMEMBRANE (UNDER CONSTRUCTION)
- LIGHT-DUTY ACCESS ROADS (UNDER CONSTRUCTION)
- STORMWATER MODEL AREAS BOUNDARY
- N1A-E — DRAINAGE SUB-AREA DESIGNATION
- N1A-E — PROPOSED DRAINAGE CHANNEL
- EXISTING DRAINAGE CHANNEL
- PROPOSED CULVERT (SEE SHEET 13)
- SHEET FLOW DIRECTION ARROW
- OUTFALL 001 (EXISTING PERMITTED OUTFALL)
- 1A — PROPOSED CAP PHASE DESIGNATION
- SOUTH — STORMWATER MODEL AREA DESIGNATION

NOTES:

1. THE STORMWATER MANAGEMENT PLAN HAS BEEN DESIGNED TO MANAGE RUNOFF FROM THE EVOH GEOMEMBRANE CAP FOR A 24-HOUR, 25-YEAR FREQUENCY STORM EVENT. STORMWATER RUNOFF FROM PHASES 1A AND 1B WILL BE COLLECTED IN PERIMETER CHANNELS AND DIRECTED TO EITHER THE NORTH OR SOUTH PROPOSED DETENTION BASINS DESIGNED AS PART OF THE SOUTH QUARRY CAP PLANS. STORMWATER RUNOFF FROM PHASE 2 WILL BE COLLECTED IN PERIMETER CHANNELS AND ROUTED TO AN EXISTING DRAINAGE CHANNEL.
2. SEE SHEET 1 FOR LOCATIONS OF PERMITTED OUTFALLS AND SOUTH QUARRY DETENTION BASINS.

STATE OF MISSOURI
ADAM STEVEN LOEHR
NUMBER E-2005
PROFESSIONAL ENGINEER
7/26/13

BRIDGETON NORTH QUARRY CAP STORMWATER SUMMARY

SUBAREA	DRAINAGE AREA (ACRES)	SUBAREA PEAK FLOW (CFS)	DISCHARGE OUTFALL	DRAINAGE CHANNEL DESIGN							
				CHANNEL PEAK FLOW (CFS)1	DEPTH (FT)	LEFT SIDESLOPE X:1 HOR	BOTTOM WIDTH (FT)	RIGHT SIDESLOPE X:/1 HOR	CHANNEL SLOPE (%)	CHANNEL VELOCITY (FT/SEC)	CHANNEL LINING
N1A-E	2.25	17.0	004	17.0	1.50	1.00	3.00	1.00	0.20	2.78	GRASSED
N1A-S	2.00	18.60	004	31.7	2.00	1.00	3.00	1.00	0.20	3.28	GRASSED
N1B-N1	0.86	8.60	003	8.6	1.50	5.00	0.00	4.00	6.70	11.0	GEOMEMBRANE
N1B-W2	0.93	9.30	003	9.3	1.00	1.00	3.00	1.00	0.50	2.58	GRASSED
N1B-W1	2.52	25.20	003	38.3	2.00	1.50	5.00	1.50	0.21	2.63	GRASSED
N1A-W	1.85	18.20	003	53.4	2.00	2.00	5.00	2.00	0.30	3.15	GRASSED
N1B-N2	0.94	9.40	004	9.4	1.50	5.00	0.00	4.00	0.08	11.90	GEOMEMBRANE
N1B-E	0.61	6.10	004	11.8	1.50	5.00	0.00	4.00	0.02	7.60	GEOMEMBRANE
N1B-S23	2.25	22.30	004	7.4	1.00	1.00	3.00	1.00	0.50	2.60	GRASSED
N1B-S1	0.83	22.50	004	DRAINS TO CULVERT C-10 WITHOUT CHANNEL							GRASSED
N2-NW2	2.73	27.3	001	24.1	2.00	3.00	2.00	2.00	0.50	1.35	GRASSED
N2-NW2				23.9	1.50	3.00	2.00	2.00	8.00	6.37	GRASSED
N2-NE1	2.93	29.30	001	30.7	2.00	2.00	3.00	2.00	0.30	3.25	GRASSED
N2-NE2	0.39	3.90	001	SHEET FLOWS							
TOTAL	21.09										

NOTES:

1	REPORTED AT DOWNSTREAM END OF CHANNEL
2	CONTAINS 2 DRAINAGE CHANNEL SEGMENTS, N2-NW1 AND N2-NW2.
3	N1B-S2 SUBAREA DRAINS TO C-7, C-8, C-9; CHANNEL DESIGN BASED ON N1B-W2
4	CHANNEL FLOWS ARE LESS THAN SUBAREA FLOWS IN SOME CASES DUE TO STORAGE EFFECTS FROM STORMWATER ROUTING

REV	DATE	DESCRIPTION	DWN BY	DES BY	CHK BY	APP BY

DATE OF ISSUE 07/26/13 DRAWN BY EJJ DESIGNED BY JGW CHECKED BY BOS APPROVED BY ASL

CORNERSTONE Environmental Group, LLC

BRIDGETON LANDFILL, LLC.
BRIDGETON LANDFILL
BRIDGETON, MISSOURI

NORTH QUARRY - EVOH GEOMEMBRANE CAP AND CAP INTEGRITY SYSTEM DRAINAGE SUB-AREAS AND STORM WATER MODEL AREAS

FIGURE NO. 1
PROJECT NO. 130520

File: X:\PROJECTS\BRIDGETON (MO)\130520 - NORTH QUARRY CONTINGENCY PLAN_PROJECT DWGS\CAP PLANS\PHS. N2 SW MODEL AREAS.dwg Layout: 07-STORMWATER User: ed.jonkun Jul 26, 2013 - 2:55pm

APPENDIX A

25-YEAR 24-HOUR RAINFALL AND RAINFALL INTENSITY DURATION

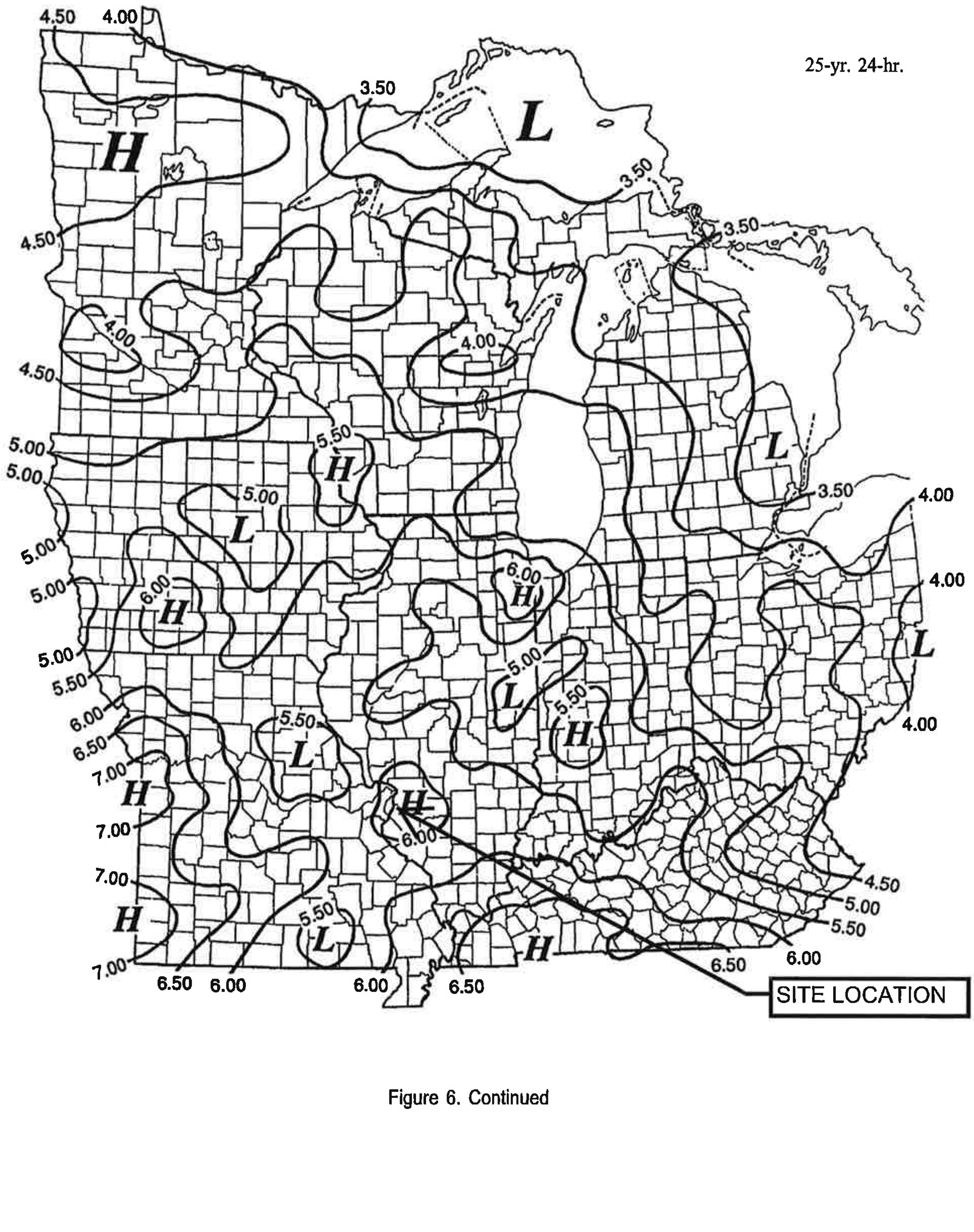
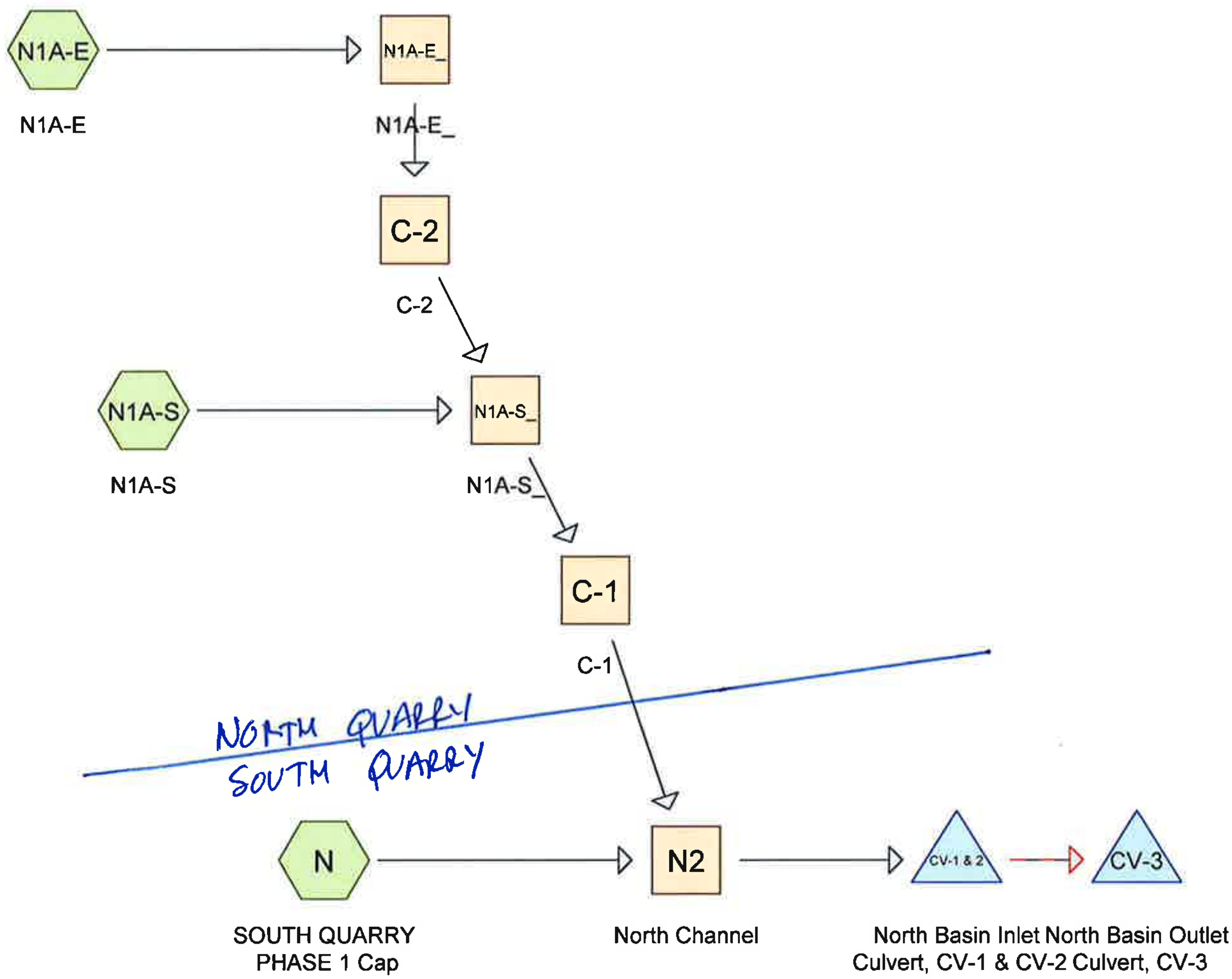


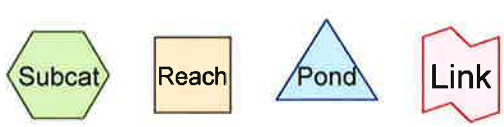
Figure 6. Continued

APPENDIX B

STORMWATER CALCULATIONS FOR NORTH QUARRY SOUTH DRAINAGE AREA



NORTH QUARRY CAP SOUTH STORMWATER MODEL



Routing Diagram for North Cap Proposed
Prepared by Cornerstone, Printed 7/26/2013
HydroCAD® 10.00 s/n 04282 © 2011 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
8.200	100	(N, N1A-E, N1A-S)
8.200	**100**	**TOTAL AREA**

Pipe Listing (selected nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	C-1	0.00	-1.44	80.0	0.0180	0.012	24.0	0.0	0.0
2	C-2	0.00	-0.18	30.0	0.0060	0.012	24.0	0.0	0.0
3	CV-1 & 2	478.50	473.50	40.0	0.1250	0.012	24.0	0.0	0.0
4	CV-3	473.50	472.00	40.0	0.0375	0.012	18.0	0.0	0.0

Time span=0.00-120.00 hrs, dt=0.01 hrs, 12001 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment N: SOUTH QUARRY Runoff Area=3.950 ac 100.00% Impervious Runoff Depth=6.00"
Flow Length=620' Tc=5.1 min CN=100 Runoff=34.89 cfs 1.975 af

Subcatchment N1A-E: N1A-E Runoff Area=2.250 ac 100.00% Impervious Runoff Depth=6.00"
Flow Length=690' Tc=7.6 min CN=100 Runoff=18.37 cfs 1.125 af

Subcatchment N1A-S: N1A-S Runoff Area=2.000 ac 100.00% Impervious Runoff Depth=6.00"
Flow Length=500' Tc=3.4 min CN=100 Runoff=18.62 cfs 1.000 af

Reach C-1: C-1 Avg. Flow Depth=1.58' Max Vel=11.92 fps Inflow=31.68 cfs 2.125 af
24.0" Round Pipe n=0.012 L=80.0' S=0.0180 '/' Capacity=32.88 cfs Outflow=31.68 cfs 2.125 af

Reach C-2: C-2 Avg. Flow Depth=1.48' Max Vel=6.83 fps Inflow=17.02 cfs 1.125 af
24.0" Round Pipe n=0.012 L=30.0' S=0.0060 '/' Capacity=18.98 cfs Outflow=17.01 cfs 1.125 af

Reach N1A-E_: N1A-E_ Avg. Flow Depth=1.39' Max Vel=2.78 fps Inflow=18.37 cfs 1.125 af
n=0.022 L=580.0' S=0.0020 '/' Capacity=19.45 cfs Outflow=17.02 cfs 1.125 af

Reach N1A-S_: N1A-S_ Avg. Flow Depth=1.95' Max Vel=3.28 fps Inflow=32.00 cfs 2.125 af
n=0.022 L=190.0' S=0.0020 '/' Capacity=33.26 cfs Outflow=31.68 cfs 2.125 af

Reach N2: North Channel Avg. Flow Depth=1.75' Max Vel=5.72 fps Inflow=66.43 cfs 4.100 af
n=0.012 L=460.0' S=0.0020 '/' Capacity=86.19 cfs Outflow=65.15 cfs 4.100 af

Pond CV-1 & 2: North Basin Inlet Culvert, Peak Elev=479.58' Storage=412 cf Inflow=65.15 cfs 4.100 af
Primary=4.87 cfs 1.957 af Secondary=60.28 cfs 2.143 af Outflow=65.15 cfs 4.100 af

Pond CV-3: North Basin Outlet Culvert, Peak Elev=478.79' Storage=1.325 af Inflow=65.15 cfs 4.100 af
Primary=14.32 cfs 4.099 af Secondary=0.00 cfs 0.000 af Outflow=14.32 cfs 4.099 af

Total Runoff Area = 8.200 ac Runoff Volume = 4.100 af Average Runoff Depth = 6.00"
0.00% Pervious = 0.000 ac 100.00% Impervious = 8.200 ac

Summary for Subcatchment N: SOUTH QUARRY PHASE 1 Cap

Runoff = 34.89 cfs @ 11.96 hrs, Volume= 1.975 af, Depth= 6.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 year adj Rainfall=6.00"

	Area (ac)	CN	Description
*	3.950	100	
	3.950		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	300	0.1500	3.74		**Sheet Flow, North** n= 0.012 P2= 3.50"
3.8	320	0.0200	1.41		**Shallow Concentrated Flow, Concentrated Channel Flow** Nearly Bare & Untilled Kv= 10.0 fps
5.1	620	Total			

Summary for Subcatchment N1A-E: N1A-E

Runoff = 18.37 cfs @ 11.98 hrs, Volume= 1.125 af, Depth= 6.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 year adj Rainfall=6.00"

	Area (ac)	CN	Description
*	2.250	100	
	2.250		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	110	0.0545	2.04		**Sheet Flow,** n= 0.012 P2= 3.50"
6.7	580	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
7.6	690	Total			

Summary for Subcatchment N1A-S: N1A-S

Runoff = 18.62 cfs @ 11.94 hrs, Volume= 1.000 af, Depth= 6.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 year adj Rainfall=6.00"

	Area (ac)	CN	Description
*	2.000	100	
	2.000		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.1	300	0.0500	2.41		**Sheet Flow,** n= 0.012 P2= 3.50"
0.3	115	0.1040	6.55		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.0	85	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.4	500	Total			

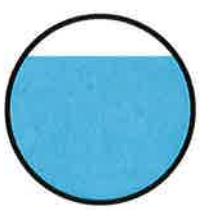
Summary for Reach C-1: C-1

Inflow Area = 4.250 ac,100.00% Impervious, Inflow Depth = 6.00" for 25 year adj event
Inflow = 31.68 cfs @ 11.97 hrs, Volume= 2.125 af
Outflow = 31.68 cfs @ 11.97 hrs, Volume= 2.125 af, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 11.92 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.56 fps, Avg. Travel Time= 0.4 min

Peak Storage= 213 cf @ 11.97 hrs
Average Depth at Peak Storage= 1.58'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 32.88 cfs

24.0" Round Pipe
n= 0.012
Length= 80.0' Slope= 0.0180 '/'
Inlet Invert= 0.00', Outlet Invert= -1.44'



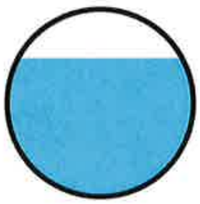
Summary for Reach C-2: C-2

Inflow Area = 2.250 ac,100.00% Impervious, Inflow Depth = 6.00" for 25 year adj event
Inflow = 17.02 cfs @ 12.02 hrs, Volume= 1.125 af
Outflow = 17.01 cfs @ 12.02 hrs, Volume= 1.125 af, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.83 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.00 fps, Avg. Travel Time= 0.3 min

Peak Storage= 75 cf @ 12.02 hrs
Average Depth at Peak Storage= 1.48'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 18.98 cfs

24.0" Round Pipe
n= 0.012
Length= 30.0' Slope= 0.0060 '/'
Inlet Invert= 0.00', Outlet Invert= -0.18'



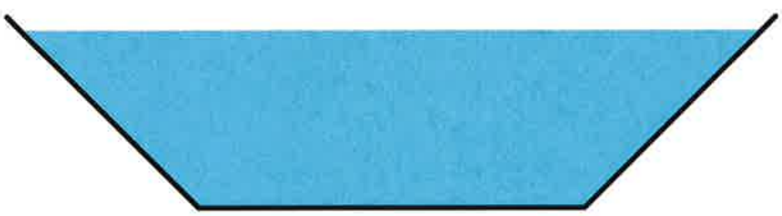
Summary for Reach N1A-E_: N1A-E_

Inflow Area = 2.250 ac,100.00% Impervious, Inflow Depth = 6.00" for 25 year adj event
Inflow = 18.37 cfs @ 11.98 hrs, Volume= 1.125 af
Outflow = 17.02 cfs @ 12.02 hrs, Volume= 1.125 af, Atten= 7%, Lag= 2.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.78 fps, Min. Travel Time= 3.5 min
Avg. Velocity = 0.65 fps, Avg. Travel Time= 14.8 min

Peak Storage= 3,552 cf @ 12.02 hrs
Average Depth at Peak Storage= 1.39'
Bank-Full Depth= 1.50' Flow Area= 6.8 sf, Capacity= 19.45 cfs

3.00' x 1.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 1.0 '/' Top Width= 6.00'
Length= 580.0' Slope= 0.0020 '/'
Inlet Invert= 0.00', Outlet Invert= -1.16'



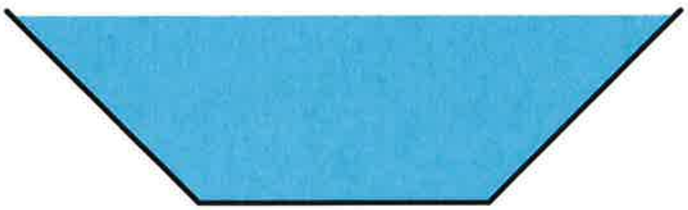
Summary for Reach N1A-S_: N1A-S_

Inflow Area = 4.250 ac,100.00% Impervious, Inflow Depth = 6.00" for 25 year adj event
Inflow = 32.00 cfs @ 11.95 hrs, Volume= 2.125 af
Outflow = 31.68 cfs @ 11.97 hrs, Volume= 2.125 af, Atten= 1%, Lag= 0.7 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.28 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 0.82 fps, Avg. Travel Time= 3.9 min

Peak Storage= 1,833 cf @ 11.97 hrs
Average Depth at Peak Storage= 1.95'
Bank-Full Depth= 2.00' Flow Area= 10.0 sf, Capacity= 33.26 cfs

3.00' x 2.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 1.0 '/' Top Width= 7.00'
Length= 190.0' Slope= 0.0020 '/'
Inlet Invert= 0.00', Outlet Invert= -0.38'



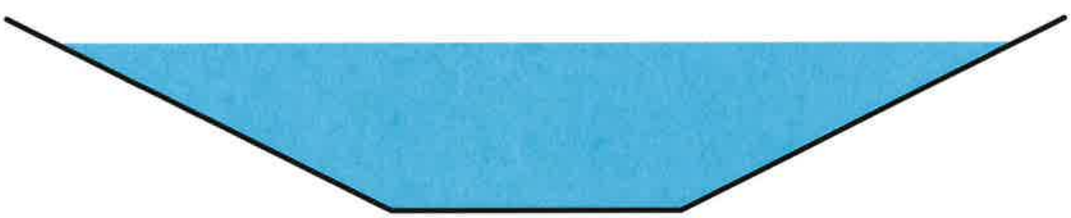
Summary for Reach N2: North Channel

Inflow Area = 8.200 ac,100.00% Impervious, Inflow Depth = 6.00" for 25 year adj event
Inflow = 66.43 cfs @ 11.96 hrs, Volume= 4.100 af
Outflow = 65.15 cfs @ 11.98 hrs, Volume= 4.100 af, Atten= 2%, Lag= 0.9 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.72 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 1.47 fps, Avg. Travel Time= 5.2 min

Peak Storage= 5,235 cf @ 11.98 hrs
Average Depth at Peak Storage= 1.75'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 86.19 cfs

3.00' x 2.00' deep channel, n= 0.012
Side Slope Z-value= 2.0 '/' Top Width= 11.00'
Length= 460.0' Slope= 0.0020 '/'
Inlet Invert= 479.42', Outlet Invert= 478.50'



Summary for Pond CV-1 & 2: North Basin Inlet Culvert, CV-1 & CV-2

Inflow Area = 8.200 ac,100.00% Impervious, Inflow Depth = 6.00" for 25 year adj event
Inflow = 65.15 cfs @ 11.98 hrs, Volume= 4.100 af
Outflow = 65.15 cfs @ 11.98 hrs, Volume= 4.100 af, Atten= 0%, Lag= 0.1 min
Primary = 4.87 cfs @ 11.98 hrs, Volume= 1.957 af
Secondary = 60.28 cfs @ 11.98 hrs, Volume= 2.143 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Peak Elev= 479.58' @ 11.98 hrs Surf.Area= 0 sf Storage= 412 cf

Plug-Flow detention time= 0.6 min calculated for 4.100 af (100% of inflow)

Center-of-Mass det. time= 0.4 min (727.8 - 727.3)

Volume	Invert	Avail.Storage	Storage Description
#1	478.50'	4,828 cf	**Custom Stage Data** Listed below

Elevation (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
478.50	0	0
478.70	8	8
479.10	68	76
479.70	416	492
480.50	1,568	2,060
481.00	2,768	4,828

Device	Routing	Invert	Outlet Devices
#1	Primary	478.50'	**24.0" Round Culvert** L= 40.0' Ke= 0.900 Inlet / Outlet Invert= 478.50' / 473.50' S= 0.1250 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#2	Secondary	479.00'	**50.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=4.86 cfs @ 11.98 hrs HW=479.58' TW=477.43' (Dynamic Tailwater)
↑**1=Culvert** (Inlet Controls 4.86 cfs @ 2.80 fps)

Secondary OutFlow Max=60.19 cfs @ 11.98 hrs HW=479.58' TW=477.43' (Dynamic Tailwater)
↑**2=Broad-Crested Rectangular Weir** (Weir Controls 60.19 cfs @ 2.06 fps)

Summary for Pond CV-3: North Basin Outlet Culvert, CV-3

Inflow Area = 8.200 ac,100.00% Impervious, Inflow Depth = 6.00" for 25 year adj event
Inflow = 65.15 cfs @ 11.98 hrs, Volume= 4.100 af
Outflow = 14.32 cfs @ 12.20 hrs, Volume= 4.099 af, Atten= 78%, Lag= 13.5 min
Primary = 14.32 cfs @ 12.20 hrs, Volume= 4.099 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Peak Elev= 478.79' @ 12.20 hrs Surf.Area= 0.324 ac Storage= 1.325 af

Plug-Flow detention time= 61.5 min calculated for 4.099 af (100% of inflow)
Center-of-Mass det. time= 61.7 min (789.5 - 727.8)

Volume	Invert	Avail.Storage	Storage Description
#1	473.50'	1.738 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
473.50	0.180	0.000	0.000
474.00	0.193	0.093	0.093
476.00	0.245	0.438	0.531
478.00	0.301	0.546	1.077
480.00	0.360	0.661	1.738

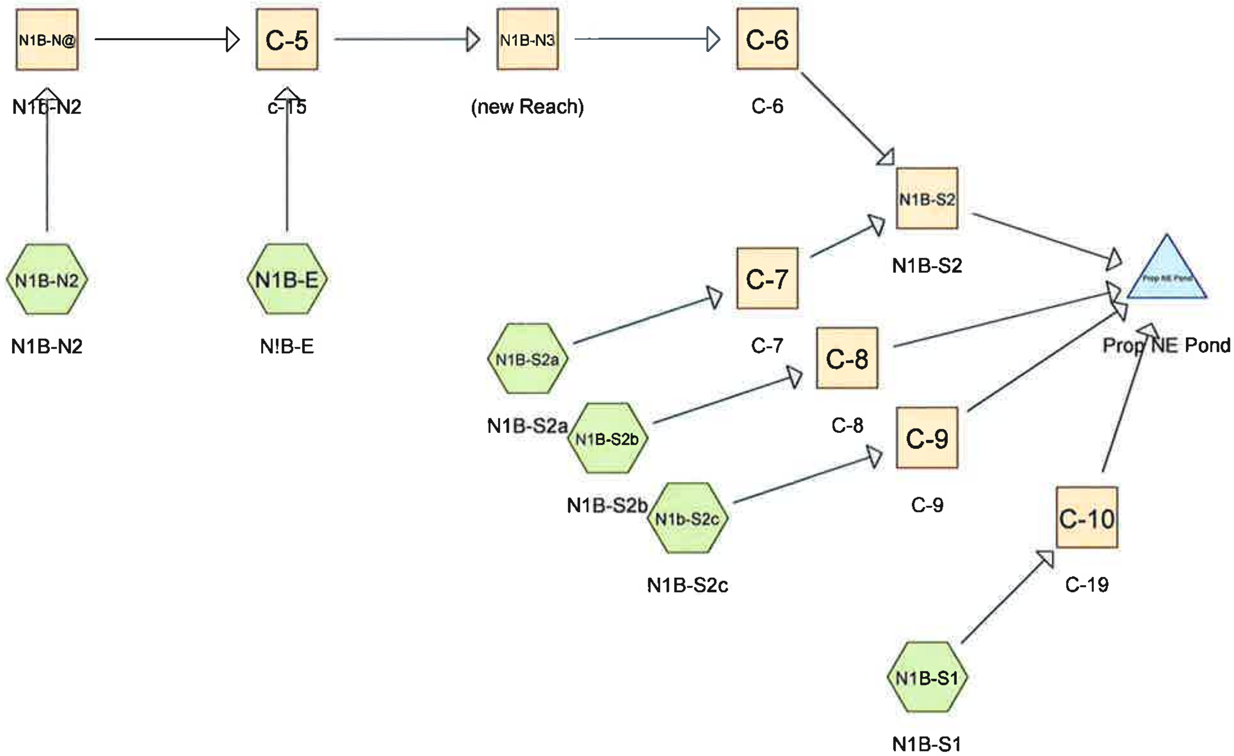
Device	Routing	Invert	Outlet Devices
#1	Primary	473.50'	**18.0" Round Culvert** L= 40.0' Ke= 0.900 Inlet / Outlet Invert= 473.50' / 472.00' S= 0.0375 '/' Cc= 0.900 n= 0.012 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Secondary	479.00'	**20.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=14.32 cfs @ 12.20 hrs HW=478.79' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 14.32 cfs @ 8.10 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=473.50' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

APPENDIX C

STORMWATER CALCULATIONS FOR NORTH QUARRY EAST DRAINAGE AREA



NORTH QUARRY CAP EAST STORMWATER MODEL

Subcat Reach Pond Link

Routing Diagram for North Cap Proposed
Prepared by Cornerstone, Printed 7/26/2013
HydroCAD® 10.00 s/n 04282 © 2011 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
6.029	100	(N1B-E, N1B-N2, N1B-S1, N1B-S2a, N1B-S2b, N1b-S2c)
6.029	**100**	**TOTAL AREA**

Pipe Listing (selected nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	C-10	0.00	-0.30	30.0	0.0100	0.012	18.0	0.0	0.0
2	C-5	0.00	-0.30	30.0	0.0100	0.012	18.0	0.0	0.0
3	C-6	0.00	-0.30	30.0	0.0100	0.012	18.0	0.0	0.0
4	C-7	0.00	-0.30	30.0	0.0100	0.012	18.0	0.0	0.0
5	C-8	0.00	-0.30	30.0	0.0100	0.012	18.0	0.0	0.0
6	C-9	0.00	-0.30	30.0	0.0100	0.012	18.0	0.0	0.0
7	Prop NE Pond	479.40	479.20	30.0	0.0067	0.012	18.0	0.0	0.0

Time span=0.00-120.00 hrs, dt=0.01 hrs, 12001 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment N1B-E: N!B-E Runoff Area=0.610 ac 100.00% Impervious Runoff Depth=6.00"
Tc=1.0 min CN=100 Runoff=6.09 cfs 0.305 af

Subcatchment N1B-N2: N1B-N2 Runoff Area=0.940 ac 100.00% Impervious Runoff Depth=6.00"
Tc=1.0 min CN=100 Runoff=9.39 cfs 0.470 af

Subcatchment N1B-S1: N1B-S1 Runoff Area=2.250 ac 100.00% Impervious Runoff Depth=6.00"
Tc=1.0 min CN=100 Runoff=22.47 cfs 1.125 af

Subcatchment N1B-S2a: N1B-S2a Runoff Area=0.743 ac 100.00% Impervious Runoff Depth=6.00"
Tc=1.0 min CN=100 Runoff=7.42 cfs 0.372 af

Subcatchment N1B-S2b: N1B-S2b Runoff Area=0.743 ac 100.00% Impervious Runoff Depth=6.00"
Tc=1.0 min CN=100 Runoff=7.42 cfs 0.372 af

Subcatchment N1b-S2c: N1B-S2c Runoff Area=0.743 ac 100.00% Impervious Runoff Depth=6.00"
Tc=1.0 min CN=100 Runoff=7.42 cfs 0.372 af

Reach C-10: C-19 Avg. Flow Depth=1.50' Max Vel=7.33 fps Inflow=22.47 cfs 1.125 af
18.0" Round Pipe n=0.012 L=30.0' S=0.0100 '/' Capacity=11.38 cfs Outflow=11.80 cfs 1.125 af

Reach C-5: c-15 Avg. Flow Depth=1.50' Max Vel=7.33 fps Inflow=15.31 cfs 0.775 af
18.0" Round Pipe n=0.012 L=30.0' S=0.0100 '/' Capacity=11.38 cfs Outflow=12.16 cfs 0.775 af

Reach C-6: C-6 Avg. Flow Depth=1.28' Max Vel=7.34 fps Inflow=11.76 cfs 0.775 af
18.0" Round Pipe n=0.012 L=30.0' S=0.0100 '/' Capacity=11.38 cfs Outflow=11.77 cfs 0.775 af

Reach C-7: C-7 Avg. Flow Depth=0.88' Max Vel=6.86 fps Inflow=7.42 cfs 0.372 af
18.0" Round Pipe n=0.012 L=30.0' S=0.0100 '/' Capacity=11.38 cfs Outflow=7.40 cfs 0.372 af

Reach C-8: C-8 Avg. Flow Depth=0.88' Max Vel=6.86 fps Inflow=7.42 cfs 0.372 af
18.0" Round Pipe n=0.012 L=30.0' S=0.0100 '/' Capacity=11.38 cfs Outflow=7.40 cfs 0.372 af

Reach C-9: C-9 Avg. Flow Depth=0.88' Max Vel=6.86 fps Inflow=7.42 cfs 0.372 af
18.0" Round Pipe n=0.012 L=30.0' S=0.0100 '/' Capacity=11.38 cfs Outflow=7.40 cfs 0.372 af

Reach N1B-N3: (new Reach) Avg. Flow Depth=0.59' Max Vel=7.60 fps Inflow=12.16 cfs 0.775 af
n=0.012 L=300.0' S=0.0200 '/' Capacity=144.01 cfs Outflow=11.76 cfs 0.775 af

Reach N1B-N@: N1b-N2 Avg. Flow Depth=0.42' Max Vel=11.93 fps Inflow=9.39 cfs 0.470 af
n=0.012 L=360.0' S=0.0780 '/' Capacity=284.40 cfs Outflow=9.28 cfs 0.470 af

Reach N1B-S2: N1B-S2 Avg. Flow Depth=0.99' Max Vel=3.77 fps Inflow=18.78 cfs 1.147 af
n=0.030 L=150.0' S=0.0100 '/' Capacity=77.09 cfs Outflow=18.69 cfs 1.146 af

Pond Prop NE Pond: Prop NE Pond Peak Elev=482.42' Storage=1.144 af Inflow=44.80 cfs 3.014 af
18.0" Round Culvert n=0.012 L=30.0' S=0.0067 '/' Outflow=12.82 cfs 2.991 af

Total Runoff Area = 6.029 ac Runoff Volume = 3.015 af Average Runoff Depth = 6.00"
0.00% Pervious = 0.000 ac 100.00% Impervious = 6.029 ac

Summary for Subcatchment N1B-E: N!B-E

Runoff = 6.09 cfs @ 11.91 hrs, Volume= 0.305 af, Depth= 6.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 year adj Rainfall=6.00"

	Area (ac)	CN	Description
*	0.610	100	
	0.610		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0					**Direct Entry,**

Summary for Subcatchment N1B-N2: N1B-N2

Runoff = 9.39 cfs @ 11.91 hrs, Volume= 0.470 af, Depth= 6.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 year adj Rainfall=6.00"

	Area (ac)	CN	Description
*	0.940	100	
	0.940		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0					**Direct Entry,**

Summary for Subcatchment N1B-S1: N1B-S1

Runoff = 22.47 cfs @ 11.91 hrs, Volume= 1.125 af, Depth= 6.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 year adj Rainfall=6.00"

	Area (ac)	CN	Description
*	2.250	100	
	2.250		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0					**Direct Entry,**

Summary for Subcatchment N1B-S2a: N1B-S2a

Runoff = 7.42 cfs @ 11.91 hrs, Volume= 0.372 af, Depth= 6.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 year adj Rainfall=6.00"

	Area (ac)	CN	Description
*	0.743	100	
	0.743		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0					**Direct Entry,**

Summary for Subcatchment N1B-S2b: N1B-S2b

Runoff = 7.42 cfs @ 11.91 hrs, Volume= 0.372 af, Depth= 6.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 year adj Rainfall=6.00"

	Area (ac)	CN	Description
*	0.743	100	
	0.743		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0					**Direct Entry,**

Summary for Subcatchment N1b-S2c: N1B-S2c

Runoff = 7.42 cfs @ 11.91 hrs, Volume= 0.372 af, Depth= 6.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 year adj Rainfall=6.00"

	Area (ac)	CN	Description
*	0.743	100	
	0.743		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0					**Direct Entry,**

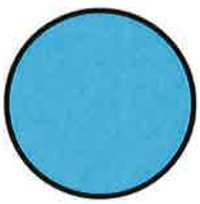
Summary for Reach C-10: C-19

Inflow Area = 2.250 ac,100.00% Impervious, Inflow Depth = 6.00" for 25 year adj event
Inflow = 22.47 cfs @ 11.91 hrs, Volume= 1.125 af
Outflow = 11.80 cfs @ 11.79 hrs, Volume= 1.125 af, Atten= 47%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.33 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.84 fps, Avg. Travel Time= 0.2 min

Peak Storage= 53 cf @ 11.80 hrs
Average Depth at Peak Storage= 1.50'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 11.38 cfs

18.0" Round Pipe
n= 0.012
Length= 30.0' Slope= 0.0100 '/'
Inlet Invert= 0.00', Outlet Invert= -0.30'



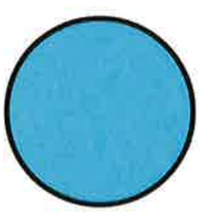
Summary for Reach C-5: c-15

Inflow Area = 1.550 ac,100.00% Impervious, Inflow Depth = 6.00" for 25 year adj event
Inflow = 15.31 cfs @ 11.91 hrs, Volume= 0.775 af
Outflow = 12.16 cfs @ 11.86 hrs, Volume= 0.775 af, Atten= 21%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.33 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.52 fps, Avg. Travel Time= 0.2 min

Peak Storage= 53 cf @ 11.87 hrs
Average Depth at Peak Storage= 1.50'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 11.38 cfs

18.0" Round Pipe
n= 0.012
Length= 30.0' Slope= 0.0100 '/'
Inlet Invert= 0.00', Outlet Invert= -0.30'



Summary for Reach C-6: C-6

Inflow Area = 1.550 ac,100.00% Impervious, Inflow Depth = 6.00" for 25 year adj event
Inflow = 11.76 cfs @ 11.87 hrs, Volume= 0.775 af
Outflow = 11.77 cfs @ 11.87 hrs, Volume= 0.775 af, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.34 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.51 fps, Avg. Travel Time= 0.2 min

Peak Storage= 48 cf @ 11.87 hrs
Average Depth at Peak Storage= 1.28'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 11.38 cfs

18.0" Round Pipe
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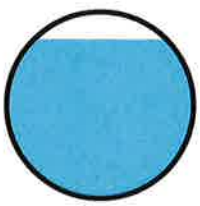
Length= 30.0' Slope= 0.0100 '/'
Inlet Invert= 0.00', Outlet Invert= -0.30'



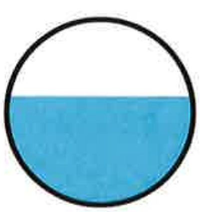
Summary for Reach C-7: C-7

Inflow Area = 0.743 ac,100.00% Impervious, Inflow Depth = 6.00" for 25 year adj event
Inflow = 7.42 cfs @ 11.91 hrs, Volume= 0.372 af
Outflow = 7.40 cfs @ 11.91 hrs, Volume= 0.372 af, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.86 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.05 fps, Avg. Travel Time= 0.2 min

Peak Storage= 32 cf @ 11.91 hrs
Average Depth at Peak Storage= 0.88'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 11.38 cfs

18.0" Round Pipe
n= 0.012
Length= 30.0' Slope= 0.0100 '/'
Inlet Invert= 0.00', Outlet Invert= -0.30'



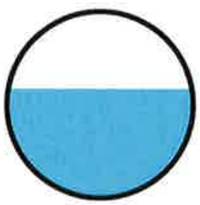
Summary for Reach C-8: C-8

Inflow Area = 0.743 ac,100.00% Impervious, Inflow Depth = 6.00" for 25 year adj event
Inflow = 7.42 cfs @ 11.91 hrs, Volume= 0.372 af
Outflow = 7.40 cfs @ 11.91 hrs, Volume= 0.372 af, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.86 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.05 fps, Avg. Travel Time= 0.2 min

Peak Storage= 32 cf @ 11.91 hrs
Average Depth at Peak Storage= 0.88'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 11.38 cfs

18.0" Round Pipe
n= 0.012
Length= 30.0' Slope= 0.0100 '/'
Inlet Invert= 0.00', Outlet Invert= -0.30'



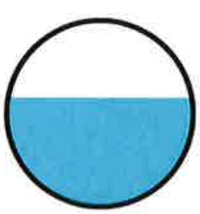
Summary for Reach C-9: C-9

Inflow Area = 0.743 ac,100.00% Impervious, Inflow Depth = 6.00" for 25 year adj event
Inflow = 7.42 cfs @ 11.91 hrs, Volume= 0.372 af
Outflow = 7.40 cfs @ 11.91 hrs, Volume= 0.372 af, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.86 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.05 fps, Avg. Travel Time= 0.2 min

Peak Storage= 32 cf @ 11.91 hrs
Average Depth at Peak Storage= 0.88'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 11.38 cfs

18.0" Round Pipe
n= 0.012
Length= 30.0' Slope= 0.0100 '/'
Inlet Invert= 0.00', Outlet Invert= -0.30'



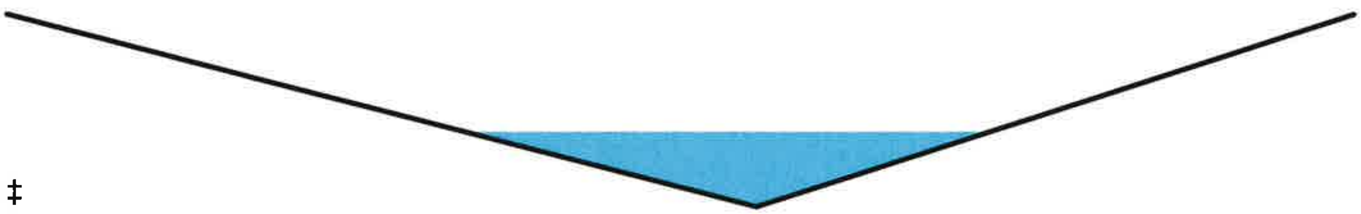
Summary for Reach N1B-N3: (new Reach)

Inflow Area = 1.550 ac,100.00% Impervious, Inflow Depth = 6.00" for 25 year adj event
Inflow = 12.16 cfs @ 11.86 hrs, Volume= 0.775 af
Outflow = 11.76 cfs @ 11.87 hrs, Volume= 0.775 af, Atten= 3%, Lag= 0.5 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.60 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 2.79 fps, Avg. Travel Time= 1.8 min

Peak Storage= 464 cf @ 11.87 hrs
Average Depth at Peak Storage= 0.59'
Bank-Full Depth= 1.50' Flow Area= 10.1 sf, Capacity= 144.01 cfs

0.00' x 1.50' deep channel, n= 0.012
Side Slope Z-value= 5.0 4.0 '/' Top Width= 13.50'
Length= 300.0' Slope= 0.0200 '/'
Inlet Invert= 0.00', Outlet Invert= -6.00'



‡

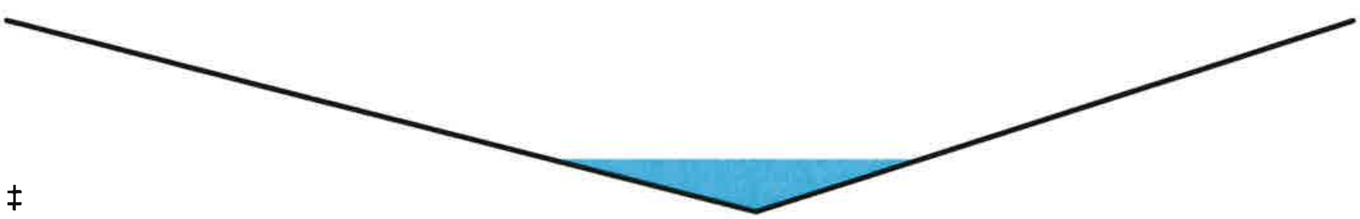
Summary for Reach N1B-N@: N1b-N2

Inflow Area = 0.940 ac,100.00% Impervious, Inflow Depth = 6.00" for 25 year adj event
Inflow = 9.39 cfs @ 11.91 hrs, Volume= 0.470 af
Outflow = 9.28 cfs @ 11.92 hrs, Volume= 0.470 af, Atten= 1%, Lag= 0.3 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 11.93 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 4.15 fps, Avg. Travel Time= 1.4 min

Peak Storage= 280 cf @ 11.92 hrs
Average Depth at Peak Storage= 0.42'
Bank-Full Depth= 1.50' Flow Area= 10.1 sf, Capacity= 284.40 cfs

0.00' x 1.50' deep channel, n= 0.012
Side Slope Z-value= 5.0 4.0 '/' Top Width= 13.50'
Length= 360.0' Slope= 0.0780 '/'
Inlet Invert= 0.00', Outlet Invert= -28.08'



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Summary for Reach N1B-S2: N1B-S2

Inflow Area = 2.293 ac,100.00% Impervious, Inflow Depth = 6.00" for 25 year adj event
Inflow = 18.78 cfs @ 11.91 hrs, Volume= 1.147 af
Outflow = 18.69 cfs @ 11.92 hrs, Volume= 1.146 af, Atten= 0%, Lag= 0.4 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.77 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.01 fps, Avg. Travel Time= 2.5 min

Peak Storage= 743 cf @ 11.92 hrs
Average Depth at Peak Storage= 0.99'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 77.09 cfs

3.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 11.00'
Length= 150.0' Slope= 0.0100 '/'
Inlet Invert= 0.00', Outlet Invert= -1.50'

Summary for Pond Prop NE Pond: Prop NE Pond

Inflow Area = 6.029 ac,100.00% Impervious, Inflow Depth = 6.00" for 25 year adj event
Inflow = 44.80 cfs @ 11.91 hrs, Volume= 3.014 af
Outflow = 12.82 cfs @ 12.12 hrs, Volume= 2.991 af, Atten= 71%, Lag= 12.3 min
Primary = 12.82 cfs @ 12.12 hrs, Volume= 2.991 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Peak Elev= 482.42' @ 12.12 hrs Surf.Area= 0.391 ac Storage= 1.144 af

Plug-Flow detention time= 123.7 min calculated for 2.991 af (99% of inflow)
Center-of-Mass det. time= 118.2 min (836.3 - 718.1)

Volume	Invert	Avail.Storage	Storage Description
#1	479.35'	1.732 af	**Custom Stage Data (Prismatic)** Listed below

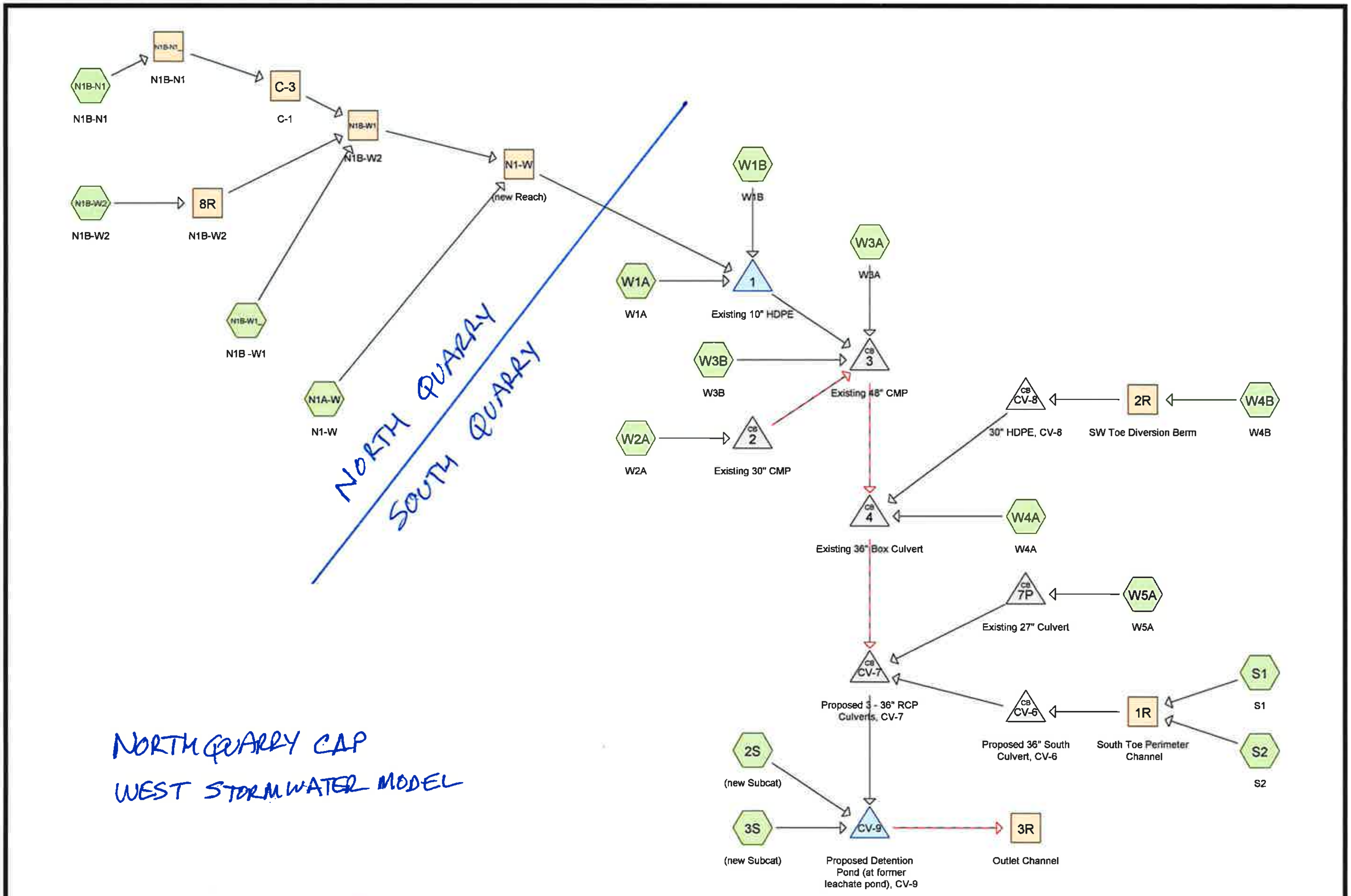
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
479.35	0.315	0.000	0.000
484.00	0.430	1.732	1.732

Device	Routing	Invert	Outlet Devices
#1	Primary	479.40'	**18.0" Round Culvert** L= 30.0' Ke= 0.500 Inlet / Outlet Invert= 479.40' / 479.20' S= 0.0067 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf

Primary OutFlow Max=12.82 cfs @ 12.12 hrs HW=482.42' (Free Discharge)
└─**1=Culvert** (Inlet Controls 12.82 cfs @ 7.25 fps)

APPENDIX D

STORMWATER CALCULATIONS FOR NORTH QUARRY WEST DRAINAGE AREA



Routing Diagram for WSW Stormwater Model SW basin 3-36 inch @ weir el 453_15 w_NQCap twin 24

Prepared by Cornerstone, Printed 7/26/2013

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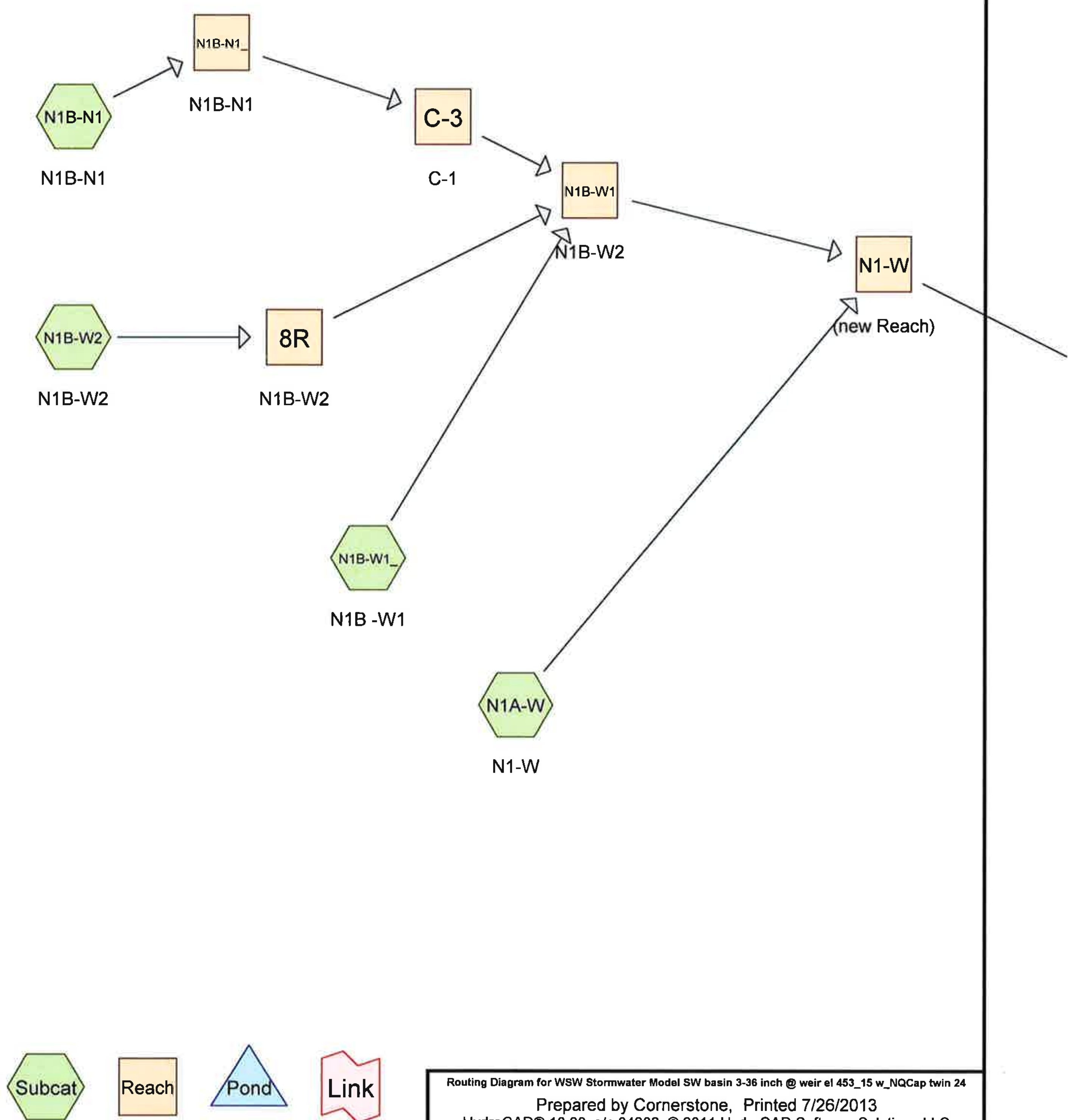


Routing Diagram for WSW Stormwater Model SW basin 3-36 inch @ weir el 453_15 w_NQCap twin 24
Prepared by Cornerstone, Printed 7/26/2013
HydroCAD® 10.00 s/n 04282 © 2011 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
4.310	100	(N1B-N1, N1B-W1_, N1B-W2)
1.850	100	North Quarry Cap (N1A-W)
6.160	**100**	**TOTAL AREA**

Pipe Listing (selected nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	C-3	0.00	-0.30	30.0	0.0100	0.012	18.0	0.0	0.0

Time span=0.00-120.00 hrs, dt=0.01 hrs, 12001 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment N1A-W: N1-W Runoff Area=1.850 ac 100.00% Impervious Runoff Depth=6.00"
Flow Length=300' Tc=1.5 min CN=100 Runoff=18.23 cfs 0.925 af

Subcatchment N1B-N1: N1B-N1 Runoff Area=0.860 ac 100.00% Impervious Runoff Depth=6.00"
Tc=1.0 min CN=100 Runoff=8.59 cfs 0.430 af

Subcatchment N1B-W1_: N1B -W1 Runoff Area=2.520 ac 100.00% Impervious Runoff Depth=6.00"
Tc=1.0 min CN=100 Runoff=25.16 cfs 1.260 af

Subcatchment N1B-W2: N1B-W2 Runoff Area=0.930 ac 100.00% Impervious Runoff Depth=6.00"
Tc=1.0 min CN=100 Runoff=9.29 cfs 0.465 af

Reach 8R: N1B-W2 Avg. Flow Depth=0.90' Max Vel=2.58 fps Inflow=9.29 cfs 0.465 af
n=0.030 L=180.0' S=0.0050 '/' Capacity=10.90 cfs Outflow=9.00 cfs 0.465 af

Reach C-3: C-1 Avg. Flow Depth=0.97' Max Vel=7.06 fps Inflow=8.52 cfs 0.430 af
18.0" Round Pipe n=0.012 L=30.0' S=0.0100 '/' Capacity=11.38 cfs Outflow=8.54 cfs 0.430 af

Reach N1-W: (new Reach) Avg. Flow Depth=1.92' Max Vel=3.15 fps Inflow=55.88 cfs 3.080 af
n=0.030 L=350.0' S=0.0030 '/' Capacity=57.90 cfs Outflow=53.40 cfs 3.080 af

Reach N1B-N1_: N1B-N1 Avg. Flow Depth=0.41' Max Vel=11.03 fps Inflow=8.59 cfs 0.430 af
n=0.012 L=180.0' S=0.0670 '/' Capacity=263.58 cfs Outflow=8.52 cfs 0.430 af

Reach N1B-W1: N1B-W2 Avg. Flow Depth=1.87' Max Vel=2.63 fps Inflow=42.51 cfs 2.155 af
n=0.030 L=480.0' S=0.0021 '/' Capacity=43.53 cfs Outflow=38.31 cfs 2.155 af

Total Runoff Area = 6.160 ac Runoff Volume = 3.080 af Average Runoff Depth = 6.00"
0.00% Pervious = 0.000 ac 100.00% Impervious = 6.160 ac

Summary for Subcatchment N1A-W: N1-W

Runoff = 18.23 cfs @ 11.92 hrs, Volume= 0.925 af, Depth= 6.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-year adjusted Rainfall=6.00"

	Area (ac)	CN	Description
*	1.850	100	North Quarry Cap
	1.850		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	130	0.0600	2.35		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.50"
0.6	170	0.2700	4.53		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.50"
1.5	300	Total			

Summary for Subcatchment N1B-N1: N1B-N1

Runoff = 8.59 cfs @ 11.91 hrs, Volume= 0.430 af, Depth= 6.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-year adjusted Rainfall=6.00"

	Area (ac)	CN	Description
*	0.860	100	
	0.860		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0					**Direct Entry,**

Summary for Subcatchment N1B-W1_: N1B -W1

Runoff = 25.16 cfs @ 11.91 hrs, Volume= 1.260 af, Depth= 6.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-year adjusted Rainfall=6.00"

	Area (ac)	CN	Description
*	2.520	100	
	2.520		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0					**Direct Entry,**

Summary for Subcatchment N1B-W2: N1B-W2

Runoff = 9.29 cfs @ 11.91 hrs, Volume= 0.465 af, Depth= 6.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-year adjusted Rainfall=6.00"

	Area (ac)	CN	Description
*	0.930	100	
	0.930		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0					**Direct Entry,**

Summary for Reach 8R: N1B-W2

Inflow Area = 0.930 ac,100.00% Impervious, Inflow Depth = 6.00" for 25-year adjusted event
Inflow = 9.29 cfs @ 11.91 hrs, Volume= 0.465 af
Outflow = 9.00 cfs @ 11.92 hrs, Volume= 0.465 af, Atten= 3%, Lag= 0.6 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.58 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 0.58 fps, Avg. Travel Time= 5.2 min

Peak Storage= 629 cf @ 11.92 hrs
Average Depth at Peak Storage= 0.90'
Bank-Full Depth= 1.00' Flow Area= 4.0 sf, Capacity= 10.90 cfs

3.00' x 1.00' deep channel, n= 0.030
Side Slope Z-value= 1.0 '/' Top Width= 5.00'
Length= 180.0' Slope= 0.0050 '/'
Inlet Invert= 0.00', Outlet Invert= -0.90'

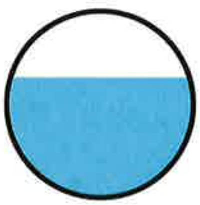
Summary for Reach C-3: C-1

Inflow Area = 0.860 ac,100.00% Impervious, Inflow Depth = 6.00" for 25-year adjusted event
Inflow = 8.52 cfs @ 11.91 hrs, Volume= 0.430 af
Outflow = 8.54 cfs @ 11.92 hrs, Volume= 0.430 af, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.06 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.13 fps, Avg. Travel Time= 0.2 min

Peak Storage= 36 cf @ 11.92 hrs
Average Depth at Peak Storage= 0.97'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 11.38 cfs

18.0" Round Pipe
n= 0.012
Length= 30.0' Slope= 0.0100 '/'
Inlet Invert= 0.00', Outlet Invert= -0.30'



Summary for Reach N1-W: (new Reach)

Inflow Area = 6.160 ac,100.00% Impervious, Inflow Depth = 6.00" for 25-year adjusted event
Inflow = 55.88 cfs @ 11.92 hrs, Volume= 3.080 af
Outflow = 53.40 cfs @ 11.94 hrs, Volume= 3.080 af, Atten= 4%, Lag= 1.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.15 fps, Min. Travel Time= 1.9 min
Avg. Velocity = 0.72 fps, Avg. Travel Time= 8.1 min

Peak Storage= 5,939 cf @ 11.94 hrs
Average Depth at Peak Storage= 1.92'
Bank-Full Depth= 2.00' Flow Area= 18.0 sf, Capacity= 57.90 cfs

5.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 13.00'
Length= 350.0' Slope= 0.0030 '/'
Inlet Invert= 0.00', Outlet Invert= -1.05'

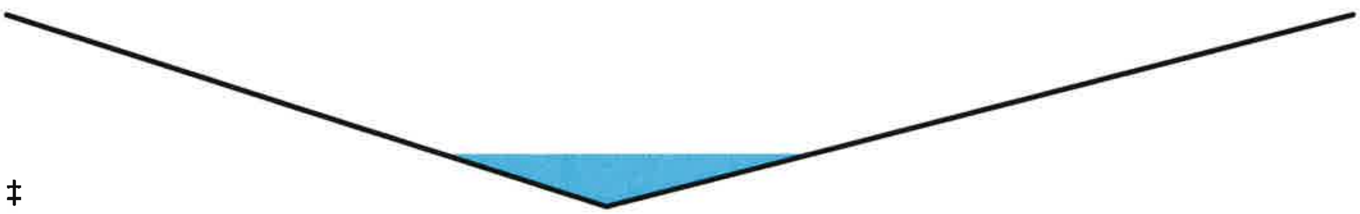
Summary for Reach N1B-N1_: N1B-N1

Inflow Area = 0.860 ac,100.00% Impervious, Inflow Depth = 6.00" for 25-year adjusted event
Inflow = 8.59 cfs @ 11.91 hrs, Volume= 0.430 af
Outflow = 8.52 cfs @ 11.91 hrs, Volume= 0.430 af, Atten= 1%, Lag= 0.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 11.03 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 3.85 fps, Avg. Travel Time= 0.8 min

Peak Storage= 139 cf @ 11.91 hrs
Average Depth at Peak Storage= 0.41'
Bank-Full Depth= 1.50' Flow Area= 10.1 sf, Capacity= 263.58 cfs

0.00' x 1.50' deep channel, n= 0.012
Side Slope Z-value= 4.0 5.0 '/' Top Width= 13.50'
Length= 180.0' Slope= 0.0670 '/'
Inlet Invert= 0.00', Outlet Invert= -12.06'



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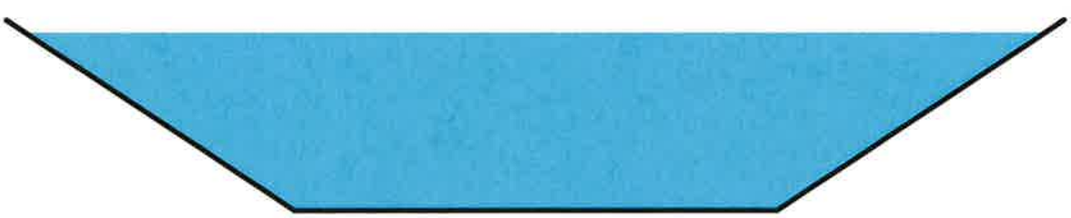
Summary for Reach N1B-W1: N1B-W2

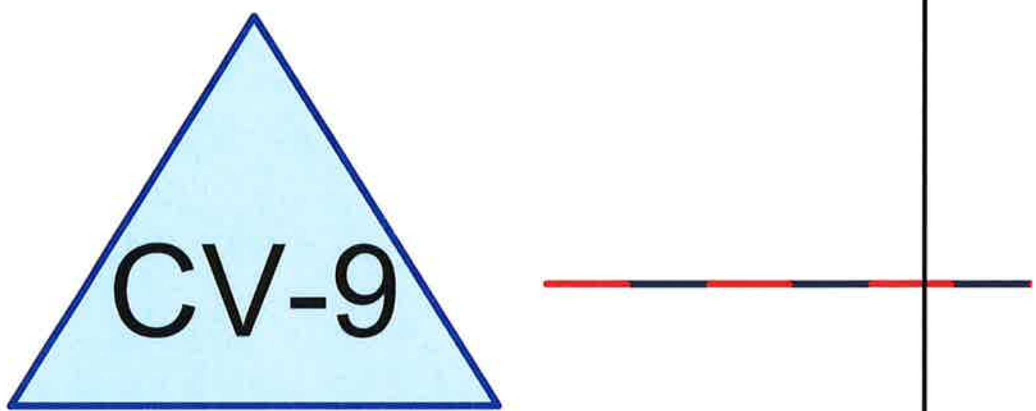
Inflow Area = 4.310 ac,100.00% Impervious, Inflow Depth = 6.00" for 25-year adjusted event
Inflow = 42.51 cfs @ 11.91 hrs, Volume= 2.155 af
Outflow = 38.31 cfs @ 11.93 hrs, Volume= 2.155 af, Atten= 10%, Lag= 1.3 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.63 fps, Min. Travel Time= 3.0 min
Avg. Velocity = 0.58 fps, Avg. Travel Time= 13.8 min

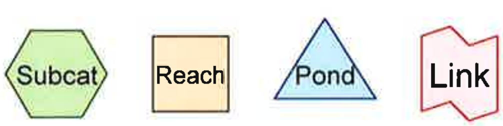
Peak Storage= 7,002 cf @ 11.93 hrs
Average Depth at Peak Storage= 1.87'
Bank-Full Depth= 2.00' Flow Area= 16.0 sf, Capacity= 43.53 cfs

5.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 1.5 '/' Top Width= 11.00'
Length= 480.0' Slope= 0.0021 '/'
Inlet Invert= 0.00', Outlet Invert= -1.01'





Proposed Detention Pond (at former leachate pond), CV-9



Routing Diagram for WSW Stormwater Model SW basin 3-36 inch @ weir el 453_15 w_NQCap twin 24
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Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.000	**0**	**TOTAL AREA**

Pipe Listing (selected nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	CV-9	441.00	440.50	65.5	0.0076	0.012	24.0	0.0	0.0

Time span=0.00-120.00 hrs, dt=0.01 hrs, 12001 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Pond CV-9: Proposed Detention Pond Peak Elev=444.54' Storage=15.687 af Inflow=275.65 cfs 26.313 af
Primary=24.09 cfs 25.926 af Secondary=0.00 cfs 0.000 af Outflow=24.09 cfs 25.926 af

Summary for Pond CV-9: Proposed Detention Pond (at former leachate pond), CV-9

Inflow Area = 63.080 ac, 55.31% Impervious, Inflow Depth = 5.01" for 25-year adjusted event
Inflow = 275.65 cfs @ 11.93 hrs, Volume= 26.313 af
Outflow = 24.09 cfs @ 13.23 hrs, Volume= 25.926 af, Atten= 91%, Lag= 78.2 min
Primary = 24.09 cfs @ 13.23 hrs, Volume= 25.926 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Peak Elev= 444.54' @ 13.23 hrs Surf.Area= 4.655 ac Storage= 15.687 af

Plug-Flow detention time= 554.6 min calculated for 25.924 af (99% of inflow)
Center-of-Mass det. time= 545.1 min (1,301.8 - 756.6)

Volume	Invert	Avail.Storage	Storage Description
#1	441.00'	43.047 af	**350.00'W x 525.00'L x 9.00'H Prismatoid Z=3.0**

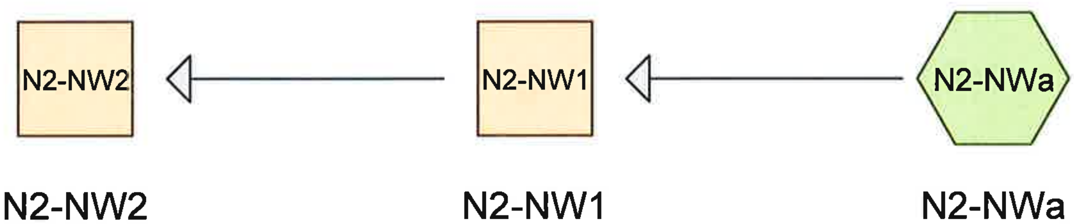
Device	Routing	Invert	Outlet Devices
#1	Primary	441.00'	**24.0" Round Culvert** L= 65.5' Ke= 0.500 Inlet / Outlet Invert= 441.00' / 440.50' S= 0.0076 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#2	Secondary	449.00'	**20.0' long x 16.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=24.09 cfs @ 13.23 hrs HW=444.54' TW=441.38' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 24.09 cfs @ 7.67 fps)

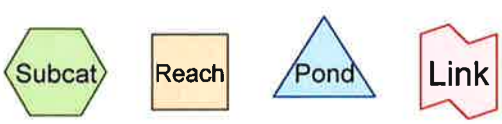
Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=441.00' TW=440.50' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

APPENDIX E

STORMWATER CALCULATIONS FOR NORTH QUARRY NORTHWEST DRAINAGE AREA



NORTH QUARRY CAP NORTHWEST STORMWATER MODEL



Routing Diagram for North Cap Proposed
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Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
2.730	100	(N2-NWa)
2.730	**100**	**TOTAL AREA**

Time span=0.00-120.00 hrs, dt=0.01 hrs, 12001 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment N2-NWa: N2-NWa Runoff Area=2.730 ac 100.00% Impervious Runoff Depth=6.00"
Tc=1.0 min CN=100 Runoff=27.26 cfs 1.365 af

Reach N2-NW1: N2-NW1 Avg. Flow Depth=1.35' Max Vel=3.14 fps Inflow=27.26 cfs 1.365 af
n=0.030 L=620.0' S=0.0050 '/' Capacity=54.51 cfs Outflow=24.14 cfs 1.365 af

Reach N2-NW2: N2-NW2 Avg. Flow Depth=0.95' Max Vel=6.37 fps Inflow=24.14 cfs 1.365 af
n=0.050 L=335.0' S=0.0800 '/' Capacity=54.14 cfs Outflow=23.86 cfs 1.365 af

Total Runoff Area = 2.730 ac Runoff Volume = 1.365 af Average Runoff Depth = 6.00"
0.00% Pervious = 0.000 ac 100.00% Impervious = 2.730 ac

Summary for Subcatchment N2-NWa: N2-NWa

Runoff = 27.26 cfs @ 11.91 hrs, Volume= 1.365 af, Depth= 6.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 year adj Rainfall=6.00"

	Area (ac)	CN	Description
*	2.730	100	
	2.730		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0					**Direct Entry,**

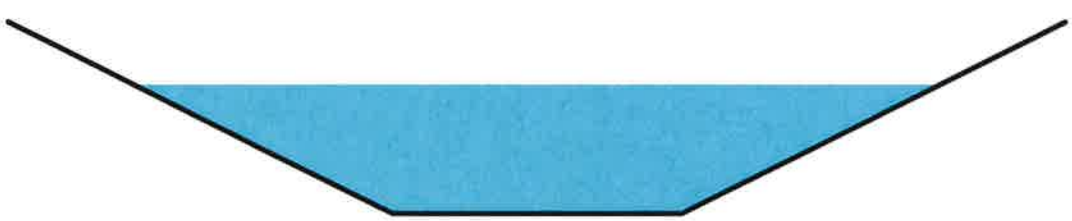
Summary for Reach N2-NW1: N2-NW1

Inflow Area = 2.730 ac,100.00% Impervious, Inflow Depth = 6.00" for 25 year adj event
Inflow = 27.26 cfs @ 11.91 hrs, Volume= 1.365 af
Outflow = 24.14 cfs @ 11.93 hrs, Volume= 1.365 af, Atten= 11%, Lag= 1.3 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.14 fps, Min. Travel Time= 3.3 min
Avg. Velocity = 0.78 fps, Avg. Travel Time= 13.3 min

Peak Storage= 4,761 cf @ 11.93 hrs
Average Depth at Peak Storage= 1.35'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 54.51 cfs

3.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 11.00'
Length= 620.0' Slope= 0.0050 '/'
Inlet Invert= 0.00', Outlet Invert= -3.10'



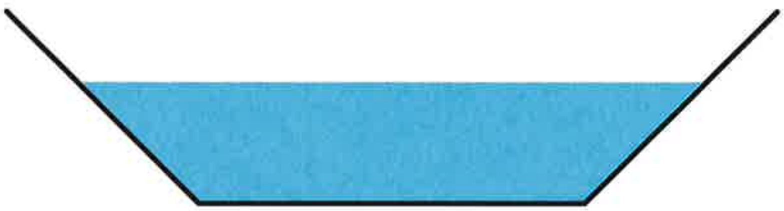
Summary for Reach N2-NW2: N2-NW2

Inflow Area = 2.730 ac,100.00% Impervious, Inflow Depth = 6.00" for 25 year adj event
Inflow = 24.14 cfs @ 11.93 hrs, Volume= 1.365 af
Outflow = 23.86 cfs @ 11.94 hrs, Volume= 1.365 af, Atten= 1%, Lag= 0.6 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.37 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 1.41 fps, Avg. Travel Time= 4.0 min

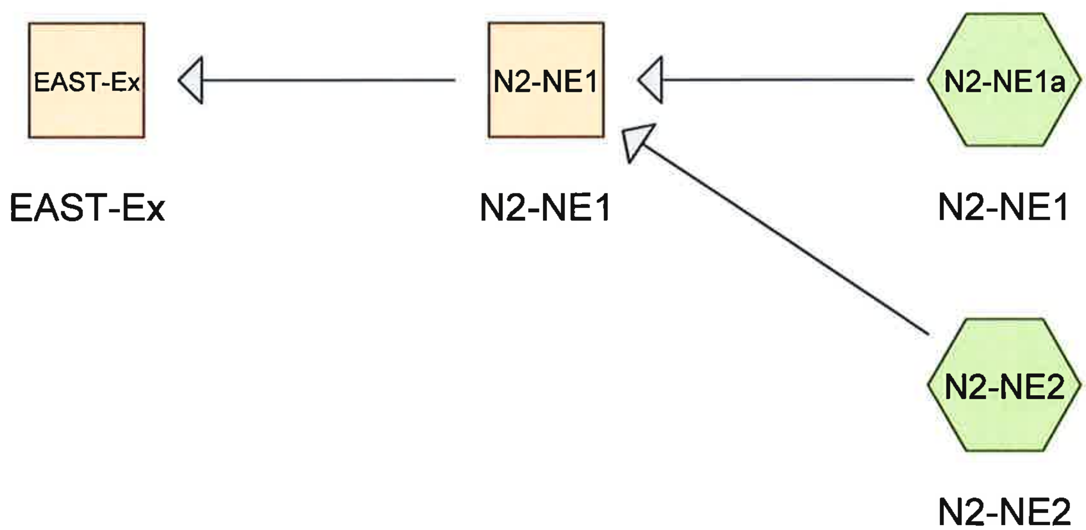
Peak Storage= 1,255 cf @ 11.94 hrs
Average Depth at Peak Storage= 0.95'
Bank-Full Depth= 1.50' Flow Area= 6.8 sf, Capacity= 54.14 cfs

3.00' x 1.50' deep channel, n= 0.050
Side Slope Z-value= 1.0 '/' Top Width= 6.00'
Length= 335.0' Slope= 0.0800 '/'
Inlet Invert= 0.00', Outlet Invert= -26.80'

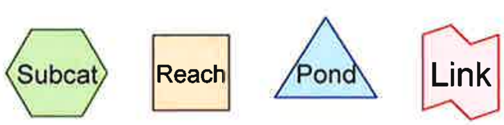


APPENDIX F

STORMWATER CALCULATIONS FOR NORTH QUARRY NORTHEAST DRAINAGE AREA



NORTH QUARRY CAP NORTHEAST STORMWATER MODEL



Routing Diagram for North Quarry Cap Proposed
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Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
3.320	100	(N2-NE1a, N2-NE2)
3.320	**100**	**TOTAL AREA**

Time span=0.00-120.00 hrs, dt=0.01 hrs, 12001 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment N2-NE1a: N2-NE1 Runoff Area=2.930 ac 100.00% Impervious Runoff Depth=6.00"
Tc=1.0 min CN=100 Runoff=29.25 cfs 1.465 af

Subcatchment N2-NE2: N2-NE2 Runoff Area=0.390 ac 100.00% Impervious Runoff Depth=6.00"
Tc=1.0 min CN=100 Runoff=3.89 cfs 0.195 af

Reach EAST-Ex: EAST-Ex Avg. Flow Depth=0.83' Max Vel=5.90 fps Inflow=30.72 cfs 1.660 af
n=0.030 L=100.0' S=0.0330 '/' Capacity=1,125.72 cfs Outflow=30.67 cfs 1.660 af

Reach N2-NE1: N2-NE1 Avg. Flow Depth=1.52' Max Vel=3.35 fps Inflow=33.15 cfs 1.660 af
n=0.030 L=450.0' S=0.0050 '/' Capacity=54.51 cfs Outflow=30.72 cfs 1.660 af

Total Runoff Area = 3.320 ac Runoff Volume = 1.660 af Average Runoff Depth = 6.00"
0.00% Pervious = 0.000 ac 100.00% Impervious = 3.320 ac

Summary for Subcatchment N2-NE1a: N2-NE1

Runoff = 29.25 cfs @ 11.91 hrs, Volume= 1.465 af, Depth= 6.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 year adj Rainfall=6.00"

	Area (ac)	CN	Description
*	2.930	100	
	2.930		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0					**Direct Entry,**

Summary for Subcatchment N2-NE2: N2-NE2

Runoff = 3.89 cfs @ 11.91 hrs, Volume= 0.195 af, Depth= 6.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type II 24-hr 25 year adj Rainfall=6.00"

	Area (ac)	CN	Description
*	0.390	100	
	0.390		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0					**Direct Entry,**

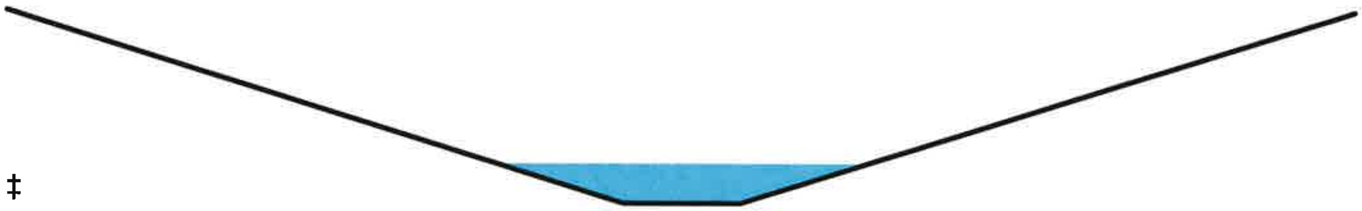
Summary for Reach EAST-Ex: EAST-Ex

Inflow Area = 3.320 ac,100.00% Impervious, Inflow Depth = 6.00" for 25 year adj event
Inflow = 30.72 cfs @ 11.93 hrs, Volume= 1.660 af
Outflow = 30.67 cfs @ 11.93 hrs, Volume= 1.660 af, Atten= 0%, Lag= 0.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.90 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.61 fps, Avg. Travel Time= 1.0 min

Peak Storage= 520 cf @ 11.93 hrs
Average Depth at Peak Storage= 0.83'
Bank-Full Depth= 4.00' Flow Area= 76.0 sf, Capacity= 1,125.72 cfs

3.00' x 4.00' deep channel, n= 0.030
Side Slope Z-value= 4.0 '/' Top Width= 35.00'
Length= 100.0' Slope= 0.0330 '/'
Inlet Invert= 0.00', Outlet Invert= -3.30'



‡

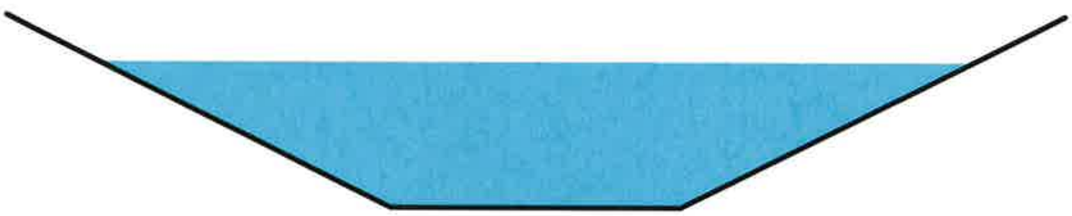
Summary for Reach N2-NE1: N2-NE1

Inflow Area = 3.320 ac,100.00% Impervious, Inflow Depth = 6.00" for 25 year adj event
Inflow = 33.15 cfs @ 11.91 hrs, Volume= 1.660 af
Outflow = 30.72 cfs @ 11.93 hrs, Volume= 1.660 af, Atten= 7%, Lag= 1.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.35 fps, Min. Travel Time= 2.2 min
Avg. Velocity = 0.86 fps, Avg. Travel Time= 8.7 min

Peak Storage= 4,124 cf @ 11.93 hrs
Average Depth at Peak Storage= 1.52'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 54.51 cfs

3.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 2.0 '/' Top Width= 11.00'
Length= 450.0' Slope= 0.0050 '/'
Inlet Invert= 0.00', Outlet Invert= -2.25'



APPENDIX D

ISOLATION BARRIER SCHEDULE AND GAMMA CONE PENETRATION TEST (GCPT) WORK PLAN

ENGINEERING FOR A BETTER WORLD
FEEZOR
ENGINEERING, INC.

BRIDGETON LANDFILL - WEST LAKE LANDFILL

GAMMA CONE PENETRATION TEST (GCPT) WORK PLAN

BRIDGETON, ST. LOUIS COUNTY, MISSOURI

STATE OF MISSOURI
DANIEL RICHARD FEEZOR
NUMBER E-30292
REGISTERED PROFESSIONAL ENGINEER

7/25/13

Prepared For:
Bridgeton Landfill, LLC
13570 St. Charles Rock Road
Bridgeton, MO 63044

July 25, 2013

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Knoxville, TN 37932

GCPT Work Plan

Bridgeton Landfill, LLC

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1 INTRODUCTION

A detailed subsurface investigation is proposed in Area 1 of Operable Unit 1 of the West Lake Landfill Superfund Site in order to identify the optimum location and obtain geotechnical data for a possible contingent isolation barrier immediately to the north of the Bridgeton Landfill - North Quarry Area. The investigation is the first step in a process that may ultimately lead to the construction of the thermal barrier. Table 1 presents a preliminary plan and schedule for this process.

This document prescribes the location, technology, and methodology of this investigation. In particular, Cone Penetration Testing is selected for gathering detailed data to evaluate the southern extent of impacted material.

1.1 SITE CONDITIONS

In the 1970's West Lake Landfill received contaminated waste, including soil mixed with leached barium sulfate residues containing traces of uranium, thorium and their long-lived daughter products. The presence of the radiologically impacted material (RIM) resulted in the West Lake Landfill being designated as a Superfund site. The RIM is located in two areas at the site: Area 1, which is adjacent to the North Quarry Landfill and thus is pertinent to this investigation; and Area 2, which is located along the northern portion of the site. Area 2 is approximately 1,000 feet (at the closest) from the outer boundary of the North Quarry Area and is separated from it by a road and a closed demolition landfill (Figure 1). Collectively, these two areas have been designated as Operable Unit 1 for the Superfund investigation and remediation activities while the rest of the site was designated as Operable Unit 2.

The southern border of Area 1 is contiguous to the waste mass of Bridgeton Landfill, a quarry-fill landfill containing municipal waste. At the present time, Bridgeton Landfill is experiencing a Subsurface Smoldering Event (SSE) in its South Quarry Area. While the SSE is currently a significant distance from OU-1 Area 1, Bridgeton Landfill wishes to develop a response strategy to ensure that the SSE does not spread into the Area 1 RIM. One contingency under consideration is a subsurface thermal barrier located between Bridgeton Landfill's waste mass and the West Lake OU-1 Area 1.

1.2 PROPOSED ISOLATION BARRIER

Bridgeton Landfill has evaluated the possibility of an excavated isolation barrier to prevent the SSE from advancing into the radiologically-impacted material in West Lake OU-1 Area 1. Specifically, Bridgeton Landfill evaluated the excavation of waste to create an isolation barrier south of the southern limit of radiologically-impacted material. Such an approach would also limit the volume of waste excavation, consistent with concerns raised by the Lambert-St. Louis

International Airport Authority. Finally the relative speed of construction, about three months, allows such a system to be implemented quickly. This isolation barrier would provide the physical barrier that Missouri Department of Natural Resources (MDNR) has requested.

In order to develop the design plans for the isolation barrier, additional subsurface data is needed between the Radiological Impacted Material (RIM) within West Lake OU-1 landfill and the Bridgeton Landfill - North Quarry Area. This work plan proposes advancing several Cone Penetration Tests (CPTs) to determine the characteristics of the subsurface materials within proposed alignments of the isolation barrier. The CPT device proposed within the work plan will also be capable of measuring gamma counts which will provide a fairly high degree of certainty that the proposed isolation barrier can be constructed without encountering RIM.

1.3 GOALS OF THE INVESTIGATION

Therefore, the primary goals of this investigation are:

- Determine the stratigraphy, nature, and geotechnical properties of subsurface materials for design purposes,
- Determine liquid levels, and
- Determine if RIM exists within the proposed alignments.

2 PREVIOUS INVESTIGATIONS

Previous investigations in the vicinity of the contingent thermal barrier did not contemplate construction of a physical structure; therefore, high-quality geotechnical data does not exist. However, previous investigations have evaluated presence of radioactive materials at West Lake Landfill using downhole gamma radiation logging of soil borings, collection and analysis of surface and subsurface soil samples, and overland gamma surveys.

2.1 PRIOR INVESTIGATION METHODS

Downhole gamma radiation logging and overland gamma surveys were used as the primary detection methods for these investigations. In addition, soil samples were collected for analysis of uranium, radium, thorium isotopes and their decay products as well as for non-radiological constituents. Results of these investigations are presented in the Soil Boring/Surface Sample Investigation Report (McLaren/Hart, 1996) and the OU-1 Remedial Investigation Report (EMSI, 2000). Eight radionuclides were identified as contaminants of concern based on their long half-lives: U238, U234, Th230, Ra226 and Pb210 from the U238 series; U235 and Pa231 from the U235 series. Isotopes from the Thorium-232 decay series are also present at levels above background, although to a lesser extent.

2.2 EXTENT OF AREA 1 CONTAMINATION

Downhole gamma logging by McLaren/Hart found elevated radiation levels varying from zero to sixteen feet below ground surface (bgs), while the thickness of the materials generally ranged from one to five feet in Area 1. In the northwest region of Area 1, elevated readings ranged from zero to six feet bgs, while to the southeast, elevated readings were found as deep as 15 feet bgs. The impacted area is illustrated in Figure 2.

An overland gamma survey also detected gamma radiation above background at the ground surface. Laboratory analyses of surface soil samples (the upper 6 inches) detected radionculides at levels above 5 pCi/g above background at boring locations WL-106 and WL-114. Results of the overland gamma survey are also shown in Figure 2.

2.3 SFS ESTIMATE OF RIM BOUNDARY

The 2011 Supplemental Feasibility Study (SFS) included a detailed estimate of the limits of the impacted material. An outline of the known impacted material was created using the available boring data, as well as an outline of the known non-impacted area (see SFS Appendix B-1, Figures 3 and 4). Based on these boundary conditions, the estimated border of the RIM was interpolated between these two boundaries. These boundaries, the interpolated RIM limits, and borings used to estimate the limits are shown in Figure 2 of this Work Plan.

The SFS delineation of the extent of RIM was sufficient for purposes of developing and evaluating potential remedial alternatives for OU-1. However, construction of the proposed thermal barrier requires a high degree of confidence that the alignment for proposed thermal barrier is located outside of the extent of RIM. Therefore, as part of geotechnical investigation of the proposed alignment, data will also be obtained to confirm that the selected alignment is not located in areas where RIM is present.

3 PROPOSED INVESTIGATION

3.1 OVERVIEW OF TECHNIQUE

The goals of the investigation are to gather the required geotechnical data for design and to provide confirmatory observations that material within the proposed excavation areas does not contain radiologically impacted material above background levels. The approximate limits of the materials containing materials higher than the standard for unrestricted use (5 pCi/g above background) were delineated in the 2011 Supplemental Feasibility Study. The general approach is to increase the number of observations in situ to verify that the selected alignment for the thermal barrier is located outside of areas of RIM. In addition, information is to be collected at each location regarding the stratigraphy, nature, and geotechnical properties of the materials as well as liquid levels, as relates to the design of the barrier system. Cone penetration with piezometer pressure readings (Piezo-Cone or CPT) along with a gamma radiation (G) sensor in a tool string has been selected as the most effective means of obtaining all the desired information within the area of interest.

The GCPT technique does not generate waste or bring physical material to the surface, does not generate dust or airborne emissions, and does not require introduction or collection of water or liquids (other than decontamination procedures). Therefore, it is a very suitable method for investigating areas that have the potential to contain radiological materials above background and landfill refuse.

Conceptual evaluation of barrier designs, reported in the March 29, 2013, letter to Mrs. Fitch of MDNR from Craig Almanza identified potential alignments along which the barrier could be constructed. The conceptual evaluation also identified that the amount of material requiring excavation and the depth of such a barrier would be substantially lessened – along with all the negative impacts associated with waste excavation – if the barrier alignment were moved toward the north. This would allow avoiding the existing slopes of the North Quarry fill and would reduce the depth of excavation along the eastern portion of the alignment, where quarry activity followed by landfilling would require a much deeper excavation the farther south the barrier is located. The proposed investigation allows collection of information south of and, in some locations, up to the projected line of RIM material, in order to confirm the absence of RIM above background in the selected location.

3.2 GAMMA CONE PENETRATION TESTING (GCPT)

GCPT (Piezo-Cone) soundings are a standard means of subsurface investigation and have been in widespread use since the 1980's. The general methodology and equipment used is described in ASTM D5778 and consists of an instrumented conical tip and friction sleeve of approximately 37.5 mm in diameter, fitted on the lower end of push rods that are forced at a constant rate into the subgrade. An electrical pressure transducer is included in the interval between the conical tip and the friction sleeve. A typical cone assembly is shown in Appendix A.

Tip force, sleeve force and pressure are all recorded as the push rods are advanced. Reading intervals are taken at intervals not exceeding 50 mm. The advance rate is approximately 1 inch per minute.

The type of soils, including waste materials, is inferred based on the analysis of combination of tip, sleeve and pore pressure while advancing (referred to as dynamic pore pressure). Work at other sites has demonstrated that interfaces between waste material and natural soil can be identified.

While the dynamic pore pressure is useful in the determination of soil types, static pore pressures can also be measured by performance of pore pressure equalization tests. These are performed by temporarily halting the progress of the cone and monitoring the pore pressure change with time. Given the typically sandy nature of the natural overburden it is anticipated that such tests will be of limited duration prior to attaining near steady state readings.

The gamma radiation logging will be performed using a proprietary device that is included in the equipment tool string behind the GCPT head. The device uses Cesium Iodide crystals. The device differs from a typical downhole logging gamma detector in that it is part of the push rod system and therefore has greater shielding from the thicker rod walls and is smaller in diameter for the same reason. However the device has been used successfully on other projects to detect the differences between clays and silts. A site specific empirical relationship will be developed using previously logged holes, as described in Section 3.2.1.2.

3.2.1 CPT Techniques

3.2.1.1 Cone Rig

A track mounted rig is proposed for the project. The rig will be able to supply 25 to 30 tons of down pressure. The track mounted rig exerts a limited ground pressure (less than 4 psi) and does not require hold-down anchors. This should avoid breaking the ground surface other than at the probe hole. The rig is self-contained, with all equipment readout, recording and on-board electricity within the equipment cab.

3.2.1.2 Calibration

3.2.1.2.1 CPT Device (Lithology Calibration)

These units will calibrated and tested in accordance with ASTM D5778. Correlation to in situ conditions for verification of the various zonation algorithms that may be applied will occur at soundings proximate to WL-108, WL-111, and WL-119 as well as at the gamma sensor calibration holes, as described below.

3.2.1.2.2 Gamma Sensor (Radiological Impacted Material Calibration)

The gamma sensor readings will be correlated to site conditions in two ways. Soundings near the locations listed above, which are well outside the estimated RIM limits, will be used to establish a range of counts that are typical of background. This initial background value will be used to determine what readings obtained in the sounding locations trigger decontamination procedures. The value may be modified as the work progresses in non-RIM soundings.

In addition, soundings will be performed at the PVC-38 location, where previous gamma logging measured levels above background. The resulting readings will be used to evaluate a relationship between previous counts and the GCPT unit. If the original casing can be found, attempts will be made to advance the GCPT head within the existing casing. Otherwise two soundings will be performed, located at a 2-foot offset from the hole to the north or south, and will be advanced to a depth of 20 feet. Depending on the results found, the Project Manager will determine whether readings at additional locations are needed (for example, near PVC-28).

The sensor calibration readings will be taken prior to performance of the other soundings.

3.2.1.3 GCPT Rig Decontamination

Contamination will be evaluated per the CPT rig operator's decontamination procedure, and will at a minimum consist of scanning all rods which were advanced below the ground surface.

The CPT rig is equipped with a rod cleaning system. The system passes the rods, upon extraction, through a chamber with a wiper at the top and bottom. Heated wash water can be introduced as needed into the chamber to clean the rods more thoroughly. The wash water is piped to the exterior of the rig, where it is then collected outside the CPT rig and retained in a portable tank. The washwater will be discharged onto the ground within the Area 1 decontamination pad and allowed to infiltrate into the gravel surface. Upon completion of the soundings the washing chamber will be washed with Alconox and triple rinsed, and the wipers will be replaced. All solid waste generated from the testing and decontamination procedures will be transported to and disposed of at licensed facilities.

3.3 INVESTIGATION PROCEDURES

3.3.1 Land Clearing

As depicted on Figure 3, there will be 58 GCPT locations, in addition to GCPT calibration locations. The existing conditions of Area 1 include woody overgrowth and trees. Paths will be developed to minimize the clearing, but to allow access to all the GCPT locations. The vegetation will be cleared by selective woody vegetation removal techniques which allow small track mounted machines to cut and grind the vegetation in place. This should also minimize soil disturbance.

The path for the GCPT test locations will be determined by connecting nearby clearing paths which will originate from a cleared baseline (approximately following the N-1 Alignment). Paths connecting consecutive GCPT locations will start from this baseline, as depicted in Figure 3. The paths will be guided by an onsite surveyor, and an onsite health physicist who will conduct an overland gamma scan. If the overland gamma scan indicates a radiological level over background, the health physicist will notify the clearing crew that they could be in an area that has surface RIM, and to proceed in a manner that avoids ground disturbance. The path will be cleared of vegetation 10-20 feet in the general direction dictated by the onsite surveyor, then the cleared path and the path to be cleared (as much as practicable) will be scanned with the overland gamma scan, then the next section will be cleared. This procedure will be used in the same sequence until the desired test location has been reached. It is envisioned that paths to each test location will be approximately 10-15 feet wide, while a larger area (25-30 feet diameter) will be cleared at each test location.

The brush clearing will be accomplished by using a skid steer rotary brush and tree cutter. This device is an attachment to a track mounted skid steer tractor in the front of the machine, so the cutting and grinding platform will advance before the tractor and operator. The operator will place the cutting surface a few inches about the ground surface, and the ground wood chips will be coarsely ground and left in place. This should provide an adequate surface for the geotextile. Small trees a few inches in truck diameter will be shred in place. If larger tree diameters are encountered, an attempt will be made to alter the path around the tree. If it is impossible to avoid the large diameter tree, then a logger will be tasked to cut the tree at the surface. The tree will then be pushed to the side of the alignment by the skid steer and left in place.

3.3.2 Near-Surface Preparation

Once the path is cleared, a crew will deploy a minimum 6 ounce per square yard non woven geotextile, and then approximately 6-8 inches of rock aggregate will be spread to advance gravel roads to each test location along the cleared alignments. This should greatly reduce the risk that soil contamination may be transmitted to the field crew, and minimize any rutting due to ingress and egress.

The area of investigation is known to contain small surficial layers of concrete and other inert rubble which in some locations may extend below the ground surface several feet. A small trackhoe will be used to push rubble aside and, if necessary, remove near surface material below grade. Such an excavation, if required, will be kept to minimum practical dimensions and the resulting void will be backfilled with clean soil material which is tracked or pounded in place to create a stable surface for the geotextile and gravel pad described above. The rubble that is removed to the side of the CPT investigation area will be radiologically screened as described in Appendix C and allowed to remain in place if screening is negative.

3.3.3 Surveying

Once the final location for the GCPT has been cleared and the gravel access corridor has been constructed, the surveyor will affix a stake at the proposed location. The stake will be marked with a high visibility flag and the GCPT number, the Northing, Easting, and final ground surface elevation will be documented with permanent marker onto the stake. This information will also be recorded by the surveyor onto his/her field book or data logger.

3.3.4 GCPT Logging

Once the locations have been staked and checked, the GCPT rig will be deployed. It is envisioned that the GCPT rig will proceed to the first location, WL-111. This was a previously logged boring from the 1996 McLaren/Hart field investigation that included both lithology and downhole gamma logging. The rig operator will check the location and elevation information that is marked on the survey lathe to the information within the operator's notes. If there is any deviation, the operator will notify the Project Manager, who will determine if additional surveying is needed. If there is no conflict in the data, the GCPT rig operator will conduct the GCPT and log the data. The GCPT operator and the Project Manager will then determine if the gamma logging confirmed the absence of RIM material, consistent with the 1996 gamma log. In addition, the Project Manager will compare lithology from the new GCPT log and the 1996 McLaren/Hart boring for general consistency. After the boring is completed, the GCPT rig will be decontaminated within the non-radiological decontamination area if no RIM was encountered. If RIM is encountered within this boring, the GCPT rig will be decontaminated within the radiological contamination area. Please note that it is expected that WL-111 will contain no RIM due to the 1996 McLaren/Hart information.

This same procedure will be repeated at the WL-108 and WL-119 boring locations for consistency review with the previous work.

The GCPT rig will then be deployed to PVC-38, where RIM is expected to be found. After the GCPT log is obtained from this location, the data will be downloaded and analyzed to determine if the GCPT was able to detect elevated gamma counts as the 1996 McLaren/Hart gamma log did, as shown on the original NGamma log included in Appendix B. The GCPT operator will then move the rig to the decontamination area for proper decontamination and radiological survey in accordance with this Work Plan. Based on the data collected, the Project Manager will determine whether readings at additional locations are needed.

Once it has been determined that the procedure is adequate for the determination of RIM and non-RIM materials, the GCPT rig will advance to each of the GCPT boring locations. After each GCPT test, the rig will be scanned, decontaminated, and rescanned within the appropriate decontamination areas before proceeding to the next test location. Each sounding hole will be filled with bentonite-coated pea gravel from the surface.

3.3.5 Decontamination

Two separate decontamination pads will be constructed directly from the gravel clearing pads. These pads will be constructed using a geotextile and 8 inches of gravel. One pad will be placed close to the entrance to the OU-1 Area 1 fence and will be used to clean equipment that has not been exposed to RIM materials. After pressure washing the equipment, the equipment will be surveyed, the operator frisked (see Section 3.3.6), and if no radiological contamination exists, the operator will be free to remove the equipment from the gate, and the gate will be locked. The washwater will be discharged onto the ground within Area 1 decontamination pad and allowed to infiltrate into the gravel surface.

The radiological decontamination pad will be constructed near PVC-38 and this will be considered the radiological decontamination pad. The same procedures will be used, but this pad would only be used if a machine encounters RIM material as per the onsite health physicist. Because this location is within the center of Area 1, this would ensure that any washwater for decontamination of radiological material is contained within Area 1.

Decontamination procedures for rig decontamination and radiological screening are discussed in Sections 3.2.1.3 and 3.3.6 respectively.

3.3.6 Radiological Contamination Screening and Exit Procedures

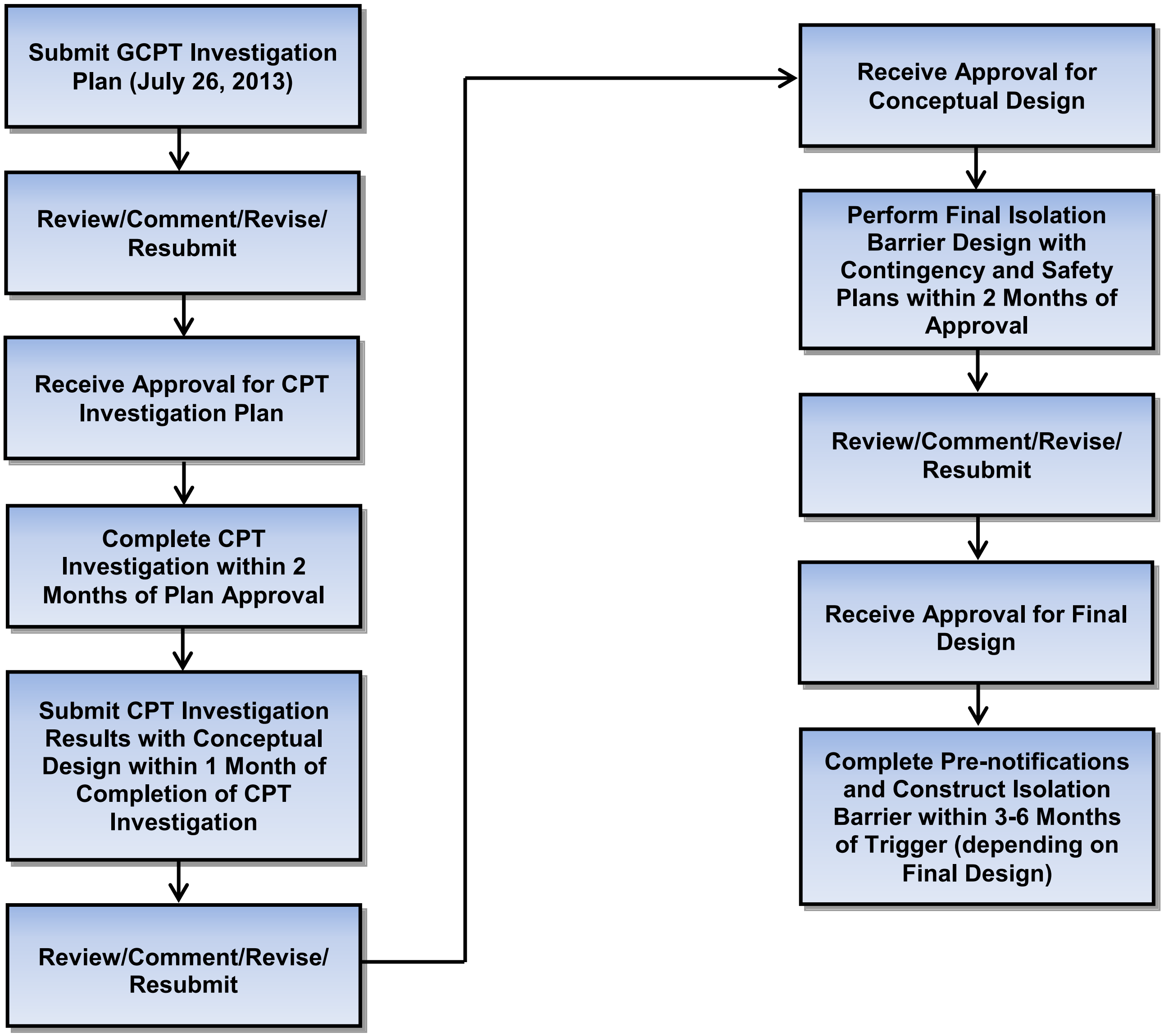
The onsite health physicist for this project is responsible for the frisking of people and equipment before they leave the fenced OU-1 Area. This procedure is described in Appendix C (and also reiterated in the Health and Safety Plan). The onsite health physicist will take measurements to determine the background concentrations to establish the "baseline" of no contamination. The onsite health physicist will pass the detector slowly over the surface of the machine or the person. The detector should be kept as close to the surface as conditions allow. The speed of detector movement will vary depending upon the radionuclide of concern and the experience of the surveyor. While scanning for alpha or beta activity, the detector is typically moved about one detector width per second. The onsite health physicist will note increases in count rate as indicated by the audible meter output. Identifiable increases in the audible response suggest possible contamination and should be resurveyed at a slower rate to confirm findings.

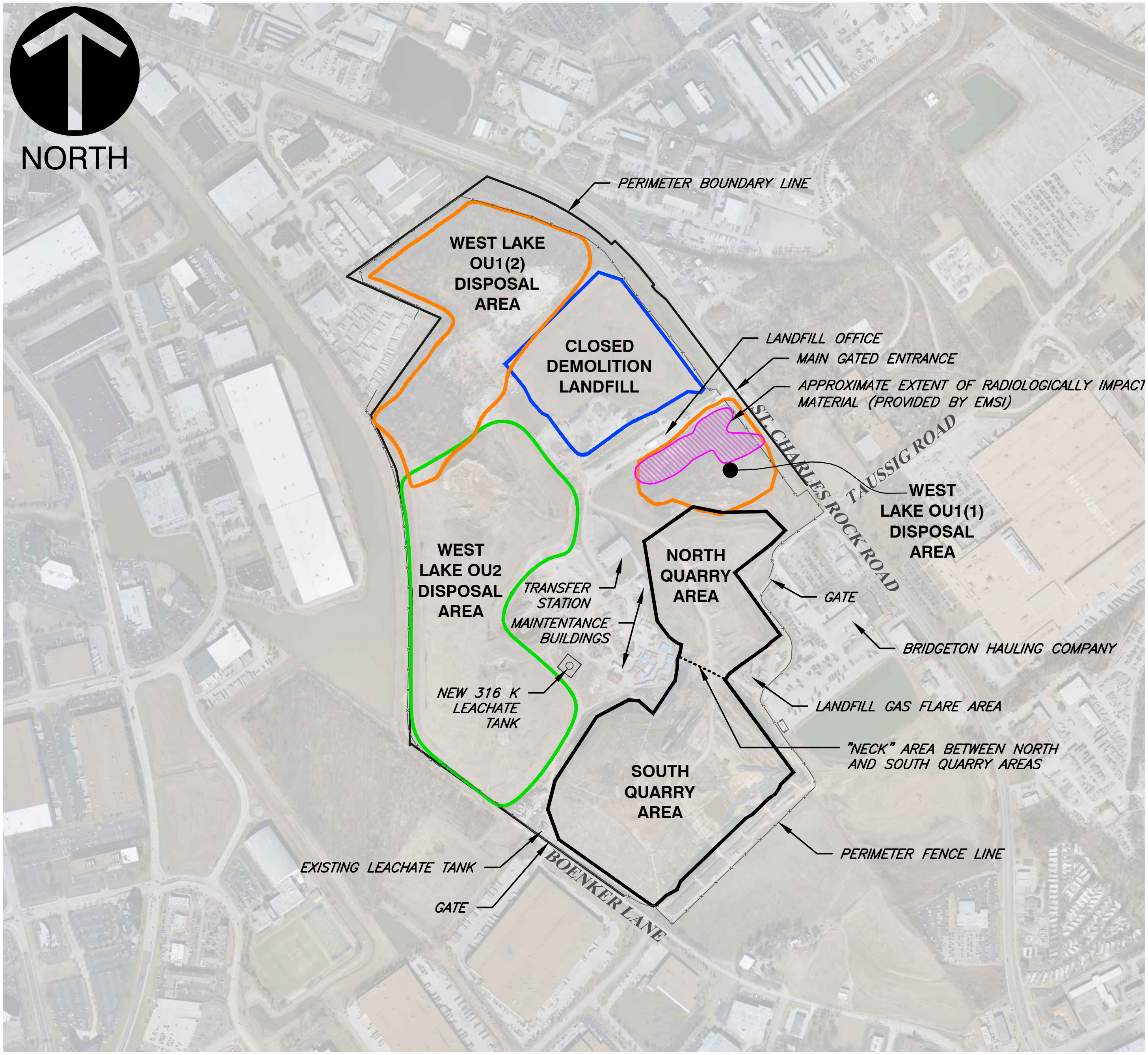
When monitoring for skin or clothing contamination, the onsite health physicist will give particular attention to the hands, shoes, pant and shirt cuffs, knees, and other surfaces which have a high likelihood of contamination.

If there is detectable contamination, it should be removed as directed by the onsite health physicist. Decontamination guidance will occur as specified in Appendix C: Contaminated clothing should be removed and stored for further evaluation by the onsite health physicist. If the spill is on the skin, flush thoroughly and then wash with mild soap and lukewarm water. Injured persons should be decontaminated and first aid performed as necessary. If life threatening injuries are present, the individual should be given immediate life-saving first aid and transported to a hospital for further medical treatment regardless of any contamination present. The hospital should be given prior notification that the patient is contaminated so that the appropriate controls can be implemented.

All solid waste generated from the testing and decontamination procedures will be transported to and disposed of at licensed facilities.

TABLE 1
PLAN AND SCHEDULE FOR CONTINGENT ISOLATION BARRIER





REFERENCE

1. AERIAL IMAGERY PROVIDED BY EAST WEST GATEWAY COORDINATING COUNCIL OF MISSOURI AND ILLINOIS, COLLECTED IN LATE FEBRUARY AND EARLY MARCH OF 2012.
2. BOUNDARY INFORMATION PROVIDED BY SHERBUT–CARSON & ASSOCIATES, P.C. DRAWING NAME–1111 LEASE EXHIBIT.DWG RECEIVED ON 03/04/2013

SCALE IN FEET

0 1000 2000

BRIDGETON LANDFILL, LLC
13570 ST. CHARLES ROCK ROAD
BRIDGETON, MISSOURI

FACILITY MAP

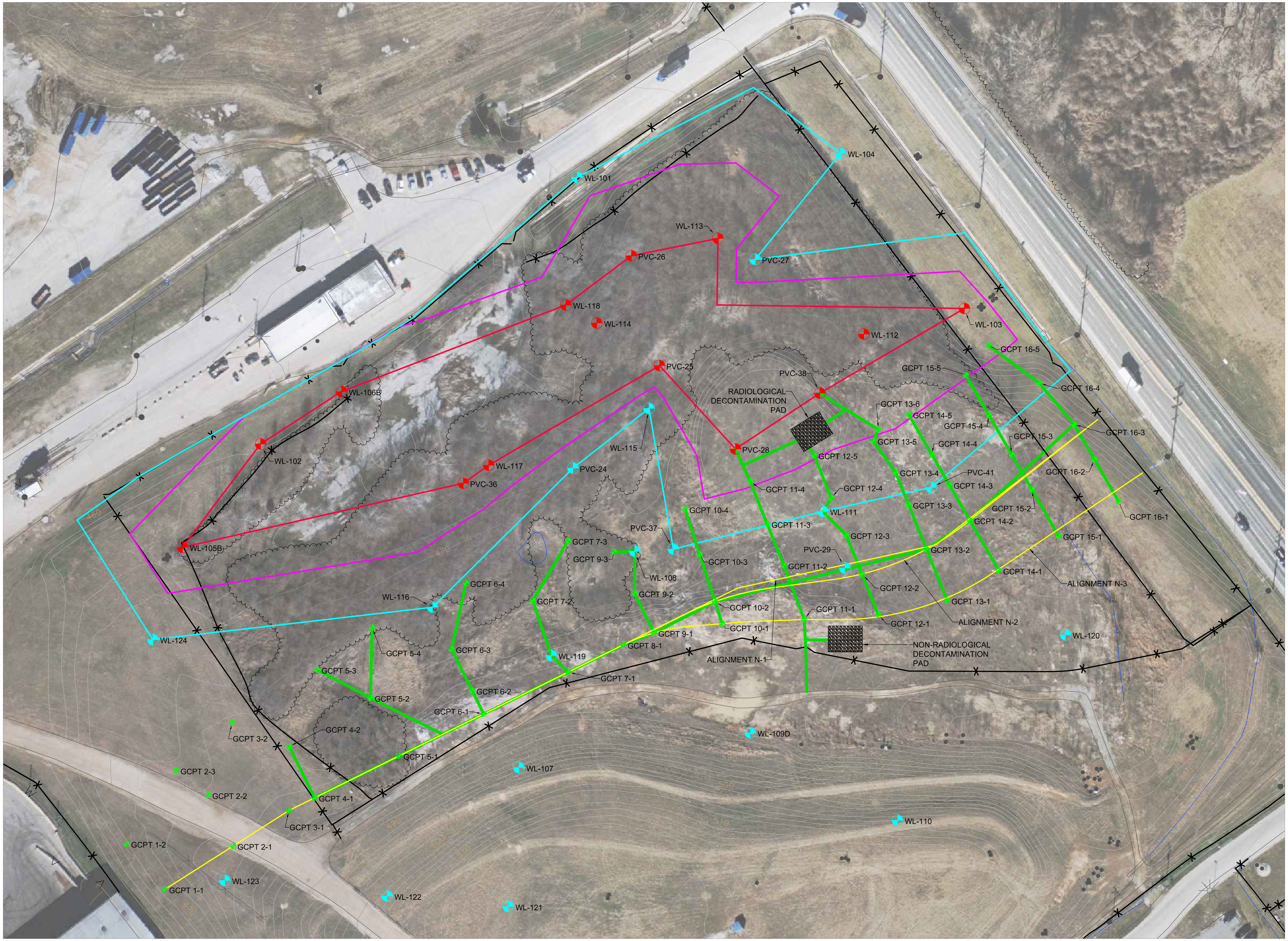
DRAWN BY: MSP	CHECKED BY: MRB	APPROVED BY: DRAFT	FIGURE NO.: 1
DATE: JUN. 2013	DWG SCALE: 1"=1000'	PROJECT NO: 131-178.0001	

P:\2013\130-484\-CADD\Dwg\SolidWaste\131178-Figure_1.dwg{FACILITY MAP} LS:(6/27/2013 - ccolthorp) - LP: 6/27/2013 11:02 AM

LEGEND

- EXISTING GRADE (2' CONTOUR)
- 500 EXISTING GRADE (10' CONTOUR)
- ELEVATED DOWNHOLE GAMMA READING
- BOUNDARY OF ELEVATED DOWNHOLE READINGS
- NON-ELEVATED DOWNHOLE GAMMA READING
- BOUNDARY OF NON-ELEVATED DOWNHOLE READINGS
- INTERPOLATED RIM LIMITS
- OVERLAND GAMMA READING, BACKGROUND OR LESS
- OVERLAND GAMMA READING, 2X BACKGROUND OR LESS
- OVERLAND GAMMA READING, MORE THAN 2X BACKGROUND
- FENCE

WEST LAKE LANDFILL 13570 ST. CHARLES ROCK ROAD BRIDGETON, MISSOURI 63044	WEST LAKE LANDFILL OU-1 AREA 1 RIM INVESTIGATION	Engineering for a Better World FEEZOR ENGINEERING, INC.	DATE: JULY 2013 DESIGNED BY: DPE APPROVED BY: DRF	FIGURE
PREVIOUS INVESTIGATIONS			REVISION / DATE	2
PROJECT NUMBER: BT-012	FILE PATH: P:\Bridgeton Landfill\BT-012 (OU-1 A1 South RIM Determination)\Step 3 - Drawings\BT-012 GCPT INVESTIGATION.dwg			



0 40 80 Feet

SCALE: 1" = 40'

LEGEND

- EXISTING GRADE (2' CONTOUR)
- 500 EXISTING GRADE (10' CONTOUR)
- POTENTIAL BARRIER ALIGNMENT
- GCPT LOCATION
- CLEARING PATH
- ELEVATED DOWNHOLE GAMMA READING
- BOUNDARY OF ELEVATED DOWNHOLE READINGS
- NON-ELEVATED DOWNHOLE GAMMA READING
- BOUNDARY OF NON-ELEVATED DOWNHOLE READINGS
- INTERPOLATED RIM LIMITS
- FENCE

WEST LAKE LANDFILL 13570 ST. CHARLES ROCK ROAD BRIDGETON, MISSOURI 63044	WEST LAKE LANDFILL OU-1 AREA 1 RIM INVESTIGATION	Engineering for a Better World FEEZOR ENGINEERING, INC.	DATE: JULY 2013 DESIGNED BY: DPE APPROVED BY: DRF	FIGURE
PROPOSED INVESTIGATION			REVISION / DATE	3
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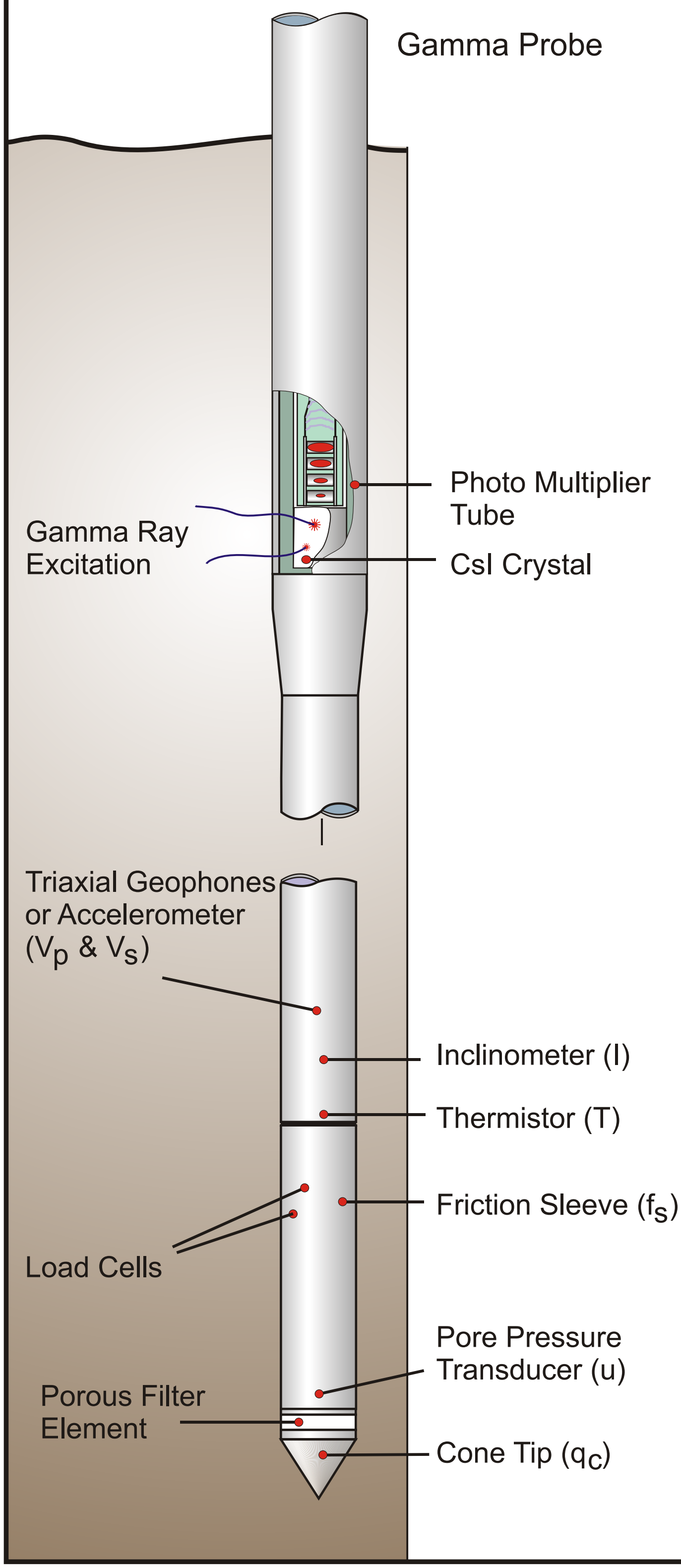
APPENDIX A

GAMMA CONE PENETRATION TEST (GCPT)
VENDOR INFORMATION

ConeTec

Geotechnical, Environmental and Marine Site Investigation Services

Gamma Cone Penetrometer (GCPT)



GCPT Description

The Gamma Cone Penetrometer (GCPT) can be used to better identify soil stratigraphy in conjunction with the CPT using natural gamma radiation which is present in all soil. Finer soils contain a greater amount of the radioactive elements; potassium, uranium and thorium. A continuous gamma ray profile can be logged and used to improve the CPT interpreted stratigraphy.

In addition, the GCPT has environmental applications. It can be used to locate radioactive contamination based on a gross gamma ray count. Once the contamination is located, the GCPT can develop a gamma energy spectrum in order to identify a contaminant. Since the GCPT is a penetration tool, there are no cuttings brought to the surface and worker exposure is minimized.


CPT Tracks

Features

- 25-30 Ton Thrust Capacity
- 4 Point Leveling Jacks
- Low Ground Pressure
- Stainless Steel Laboratory Interior
- Onboard Air & 110 v Electricity
- Built In Automatic Seismic Beam
- Positive Air Shut Off
- M2.5 Drill for CPT Drillouts

Services

- CPT Testing
- Seismic CPT Testing
- Push-in Electronic Piezometers & Dataloggers
- RCPT, UVIF-CPT, Gamma CPT
- Direct Push Soil & Water Sampling
- Direct Push Well Installations
- MIP(Membrane Interface probe) Testing
- Shallow Auger Drilling
- SDMT Testing

Advantages

- 30 ton Thrust Capacity
- Unprecedented Penetration Capabilities
- Clean, Dry & Warm Working Space
- No Anchoring Required
- Excellent Production Rates
- CPT Engineer & Technician Teams
- Environmental & Geotechnical Services
- 3.8 PSI Ground Pressure

APPENDIX B

SOIL BORINGS AND DOWNHOLE GAMMA LOGS
WL-108, WL-111, WL-119

DOWNHOLE GAMMA LOG PVC-38

Soil Boring Log

McLaren Hart

Boring No.	Project No./Name	Page:
WL-108	07.0803035.003.002	1 of 1

Start/Finish Date	Site Name and Location
9/5/95	West Lake Landfill; Bridgeton, Missouri

Drilling Contractor	**Boring Location:**	Area 1
Drilling Service Company	**Ground Surface Elevation:**	472.5
Driller	**Northing:**	1069144.21
Bruce Murphy	**Easting:**	516379.68

Drilling Equipment	McLaren/Hart Geologist/Office
LDH-80T Drill Rig, Large Diameter Auger	Tim Biggs / St. Louis

Bit Size/Type	Sample Method	T.D. Borehole	Well Installed?
24" OD Solid Auger	Grab from Auger	22'	None Installed

Remarks:

Depth (ft)	Sample ID #	Geiger Reading (mR/hr)	Description
5	WL-108 5'	Background (0.02-0.04)	0.0-22.0' <u>Landfill Debris</u>: trashy debris consisting of wood, plastic, paper, rubber, metal, and cardboard; soil consisting of olive brown to dark gray silt, and rock; dry to wet.
10	None Taken	None Taken	
15	None Taken	None Taken	@ 12' wet
20	None Taken	None Taken	
25	None Taken	None Taken	Boring abandoned @ 22.0'

Notes:

Radiological sample collected at 5 feet below ground surface.
Non-radiological grab sample collected from perched water.
Perched water encountered at 12 feet below ground surface.
Groundwater not encountered during boring activities

Soil Boring Log

McLaren Hart

Boring No.	Project No./Name	Page:
WL-111	07.0803035.003.002	1 of 1

Start/Finish Date	Site Name and Location
9/11/95	West Lake Landfill; Bridgeton, Missouri

Drilling Contractor Drilling Service Company	**Boring Location:**	Area 1
	Ground Surface Elevation:	474.5
Driller Bruce Murphy	**Northing:**	1069187.35
	Easting:	516583.61

Drilling Equipment	McLaren/Hart Geologist/Office
LDH-80T Drill Rig, Large Diameter Auger	Tim Biggs / St. Louis

Bit Size/Type	Sample Method	T.D. Borehole	Well Installed?
24" OD Solid Auger	Grab from Augers	52'	None Installed

Remarks:

Depth (ft)	Sample ID #	Geiger Reading (mR/hr)	Description
5	WL-111 5'	Background (0.02-0.04)	0.0-50.0' <u>Landfill Debris</u>: trashy debris consisting of wood, plastic, cloth, brick, rubber, paper, wire, glass, and metal; soil consisting of olive brown to gray silt, dark gray to grayish brown silty clay, and crushed rock; dry to wet.
10	WL-111 10'	Background (0.02-0.04)	
15	WL-111 15'	Background (0.02-0.04)	
20	WL-111 20'	Background (0.02-0.04)	
25	WL-111 25'	Background (0.02-0.04)	
30	WL-111 30'	Background (0.02-0.04)	
35	WL-111 35'	Background (0.02-0.04)	
40	WL-111 40'	Background (0.02-0.04)	
45	WL-111 45'	Background (0.02-0.04)	@ 45' wet
50	WL-111 50'	Background (0.02-0.04)	
55	WL-111 51'	Background (0.02-0.04)	50.0-52.0' <u>Native Alluvium</u>: dark gray, silty, very fine-grained sand; wet. Boring terminated @ 52.0'.

Notes:

Radiological samples collected at 5 and 51 feet below ground surface.

Non-radiological samples not collected during boring activities.

Perched water not encountered during boring activities.

Groundwater encountered at 45 feet below ground surface.

Soil Boring Log

McLaren Hart

Boring No.	Project No./Name	Page:
WL-119	07.0803035.003.002	1 of 1

Start/Finish Date 9/29/95	**Site Name and Location** West Lake Landfill; Bridgeton, Missouri
Drilling Contractor Drilling Service Company	**Boring Location:** Area 1
	Ground Surface Elevation: 477.4
Driller Bruce Murphy	**Northing:** 1069031.14
	Easting: 516289.26
Drilling Equipment LDH-80T Drill Rig, Large Diameter Auger	**McLaren/Hart Geologist/Office** Tim Biggs / St. Louis

Bit Size/Type	Sample Method	T.D. Borehole	Well Installed?
24" OD Solid Auger	Grab from Augers	50'	None Installed

Remarks:

Depth (ft)	Sample ID #	Geiger Reading (mR/hr)	Description
5	WL-119 5'	Background (0.01-0.04)	0.0-44.0' Landfill Debris: trashy debris consisting of yard waste, insulation, wire, wood, plastic, shingles, cloth, carpet, paper, glass, and metal; soil consisting of light brown to dark gray, silty, plastic clay to sandy silt; dry to moist.
10	None Taken	Background (0.01-0.04)	
15	WL-119 15'	Background (0.01-0.04)	
20	None Taken	Background (0.01-0.04)	
25	WL-119 25'	Background (0.01-0.04)	
30	None Taken	Background (0.01-0.04)	
35	None Taken	Background (0.01-0.04)	
40	None Taken	Background (0.01-0.04)	
45	WL-119 45'	Background (0.01-0.04)	44.0-50.0' Native Alluvium: dark gray, silty, fine to medium-grained sand; moist.
50	WL-119 50'	Background (0.01-0.04)	Boring terminated @ 50.0'

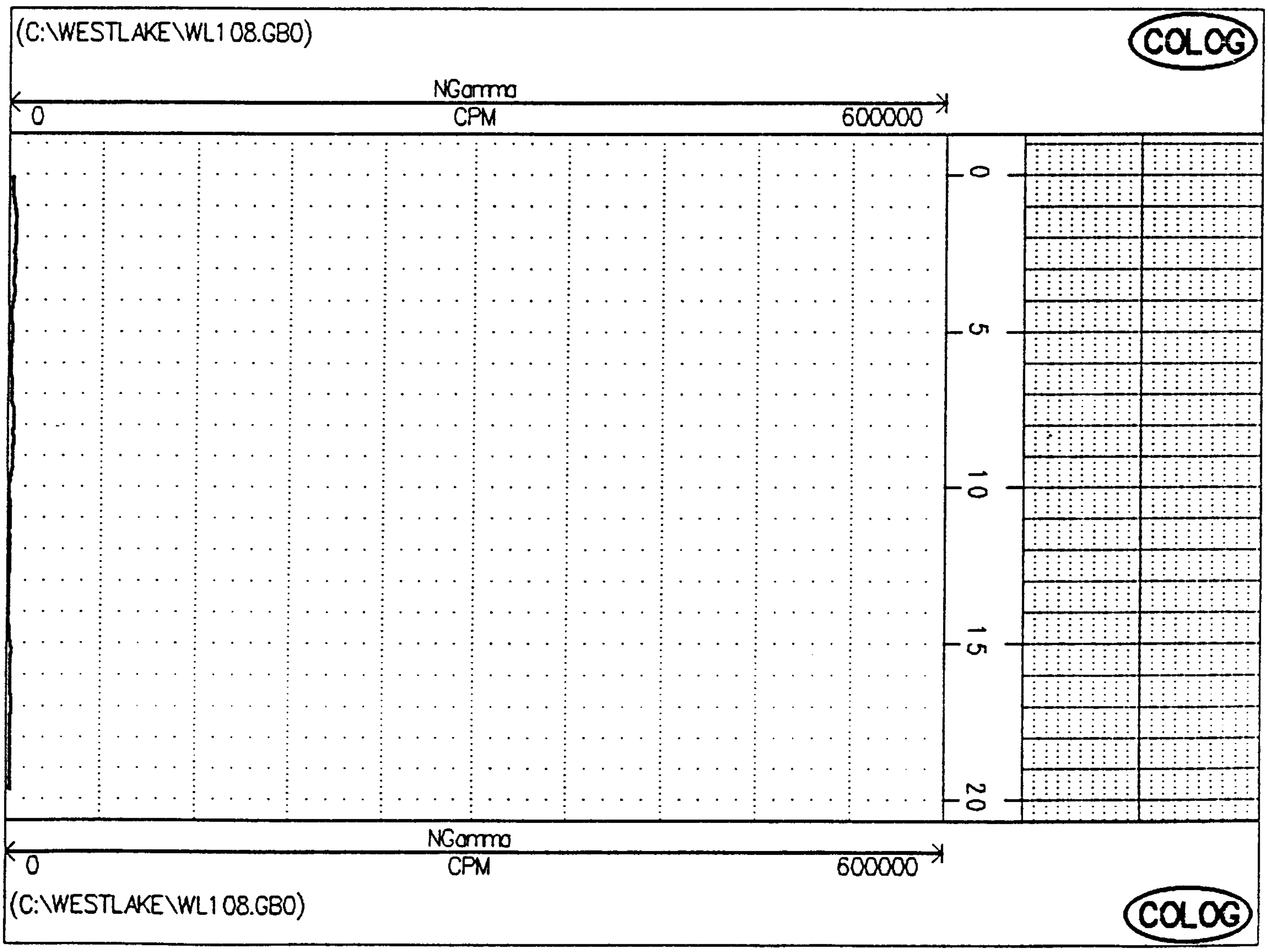
Notes:

Radiological samples collected at 5 and 50 feet below ground surface; duplicate collected and analyzed for 50' sample.

Non-radiological samples collected at 50 feet below ground surface; priority pollutant and priority pollutant duplicate sample collected and analyzed.

Perched water not encountered during boring activities.

Groundwater not encountered during boring activities.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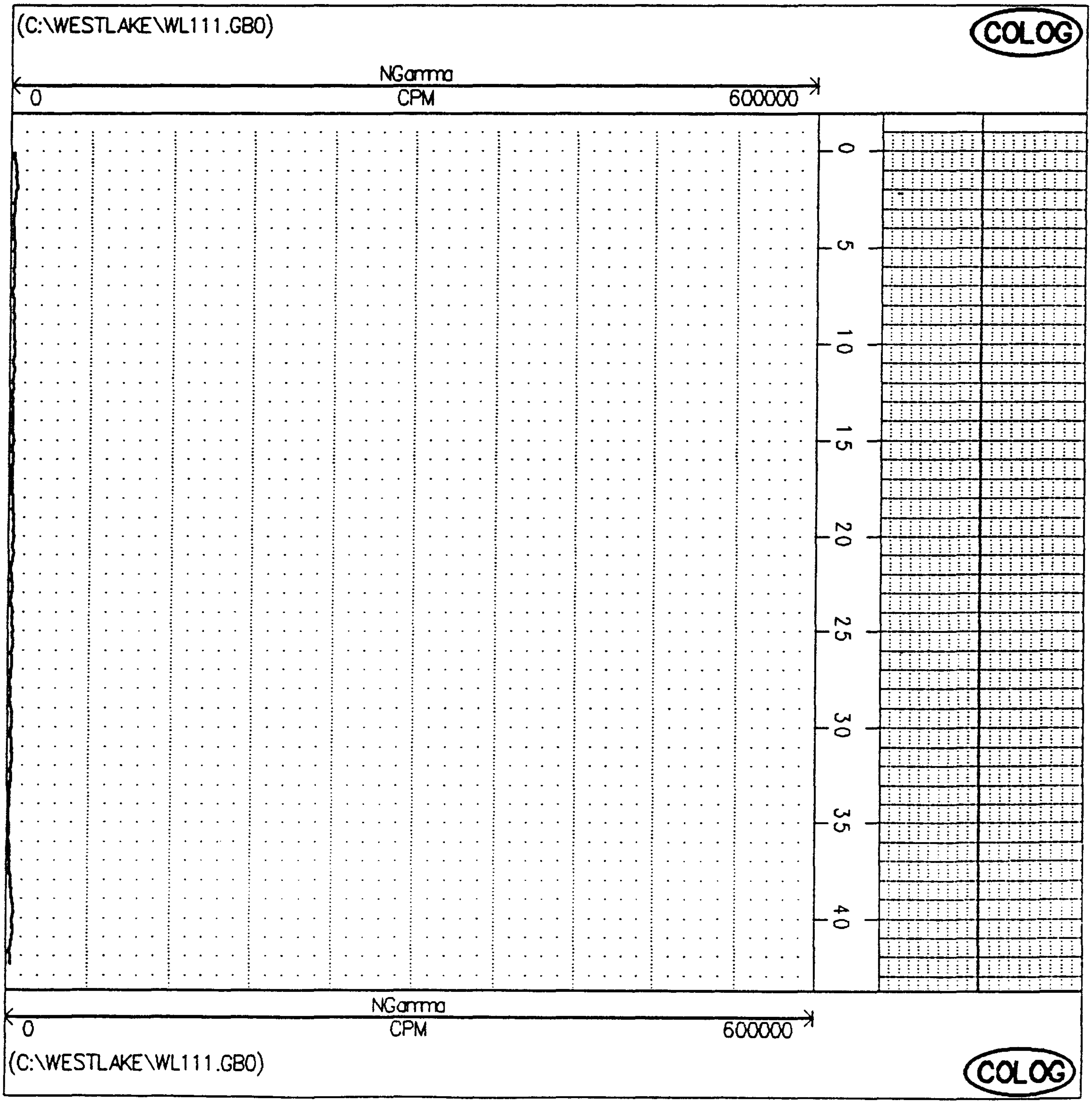
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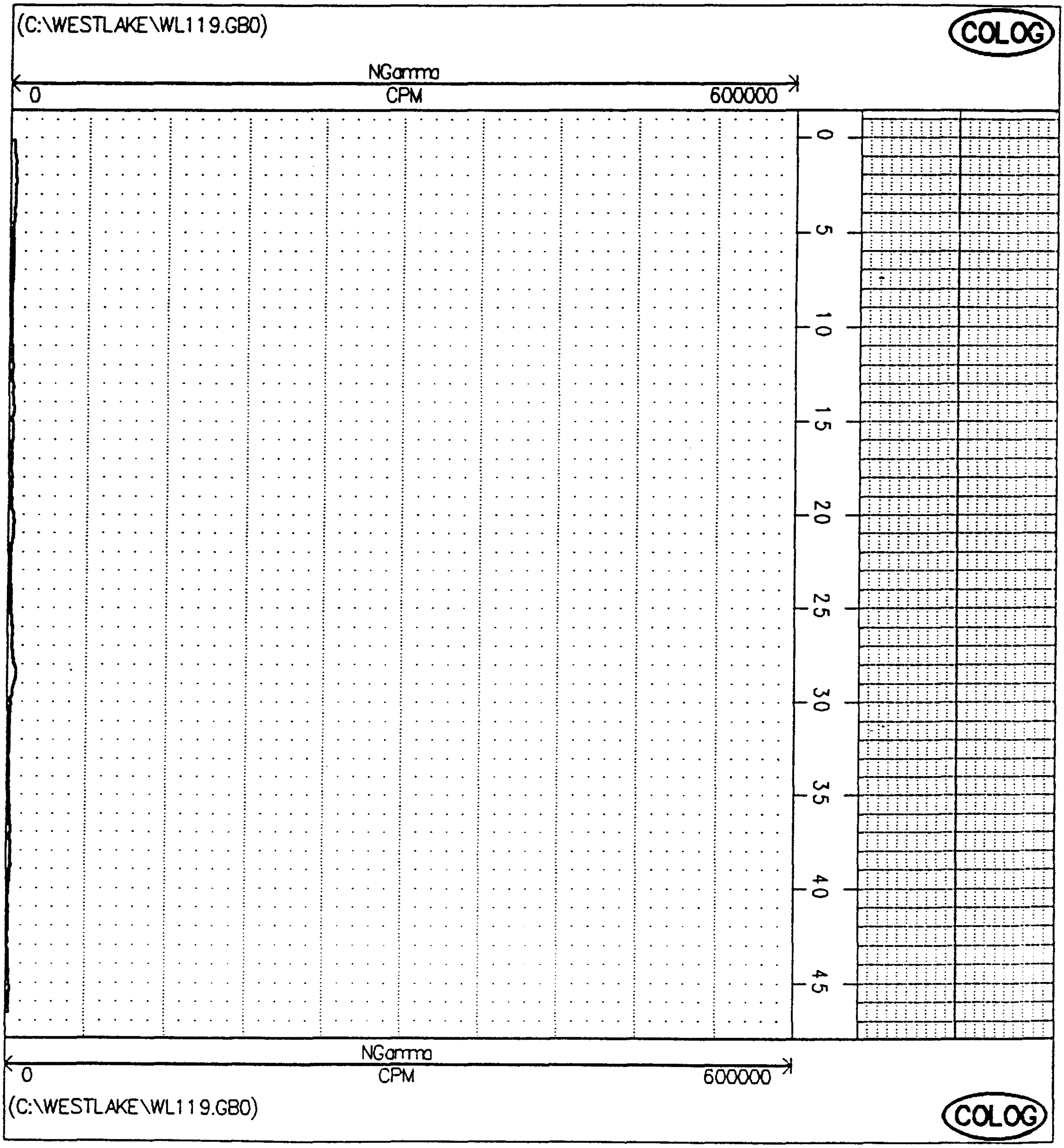
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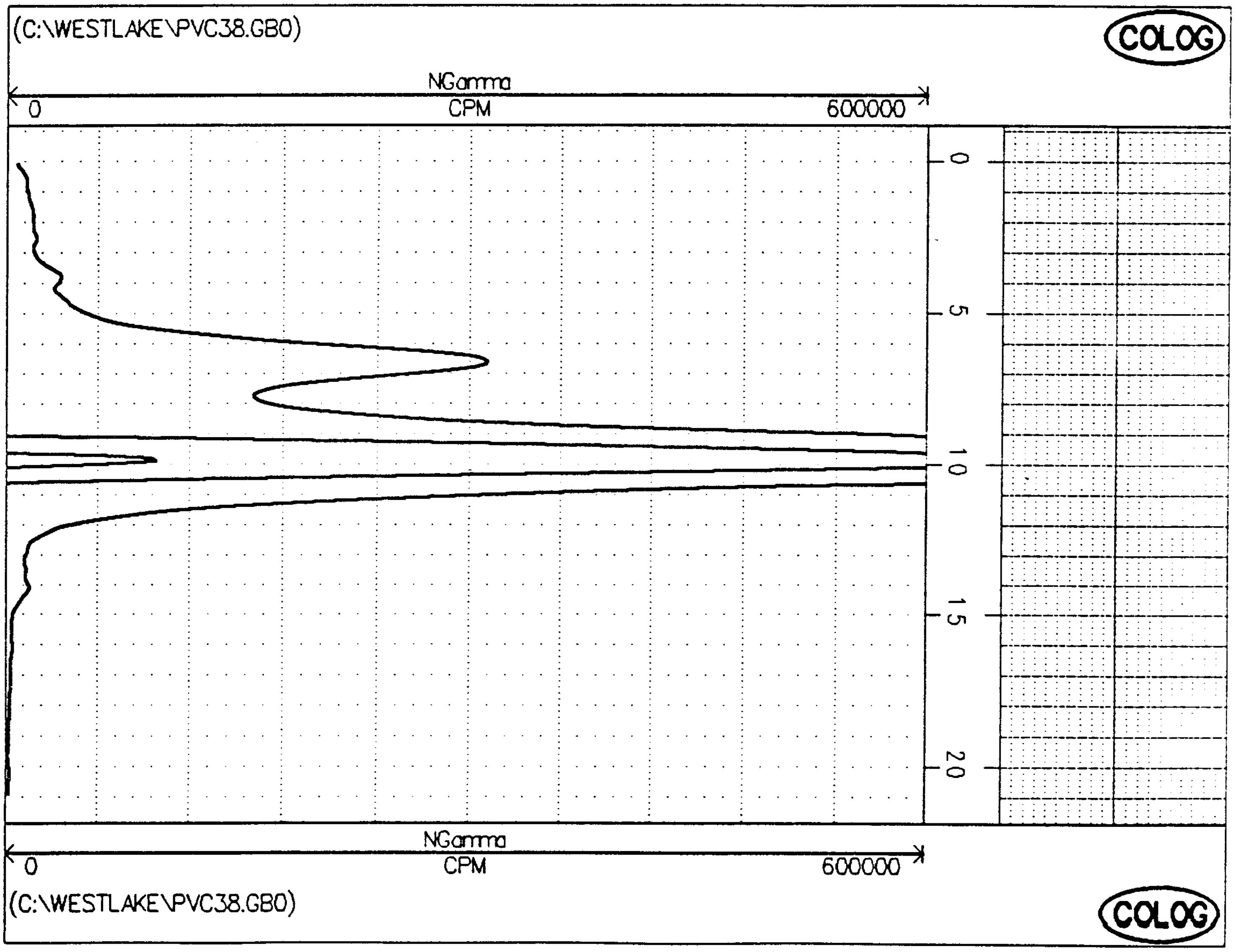

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APPENDIX C

RADIOLOGICAL FRISKING PROCEDURES

PROCEDURE 2.7
MONITORING PERSONNEL AND EQUIPMENT FOR RADIOACTIVE CONTAMINATION

1.0 PURPOSE

1.1 To describe the general approach for monitoring personnel and equipment for radioactive contamination.

2.0 RESPONSIBILITIES

2.1 The Site Survey Manager is responsible for assuring that this procedure is implemented.

2.2 Survey team members are responsible for following this procedure.

3.0 PROCEDURE

3.1 Upon exiting potentially contaminated areas, monitoring of clothing and exposed skin surfaces will be performed. Equipment and materials will also be monitored and shown to be free of contamination before release for use without radiological restrictions or controls.

3.2 Equipment

3.2.1 Ratemeter-scaler: Model 3 or Model 2221, Ludlum Measurements, Inc.; or equivalent, equipped with audible speaker or headphones.

3.2.2 Detector: Selected detectors are indicated below. Equivalent detectors are also acceptable.

Activity	**Detector Type**	**Model**
Alpha	ZnS scintillator	Ludlum 43-1 or 43-5, Eberline AC3-7 or AC3-8
	Gas proportional	Ludlum 43-68, Ludlum 239-1
Beta	Gas proportional	Ludlum 43-68, Ludlum 239-1
	Geiger-Mueller	Ludlum 44-9, Eberline HP-260

3.2.3 Instrument cables

3.2.4 Check sources

3.2.5 Record Forms and/or field logbook

3.3 Quality Control Check

Assemble instrument, turn on, check battery, and adjust high voltage and threshold, if necessary. Check background and source responses following Procedure 2.1.

3.4 Surface Scanning

3.4.1 Headphones or other audible signal operating modes are used for scanning.

3.4.2 Set the instrument response for "FAST", response where possible.

3.4.3 Pass the detector slowly over the surface. The detector should be kept as close to the surface as conditions allow. The speed of detector movement will vary depending upon the radionuclide of concern and the experience of the surveyor. While scanning for alpha or beta activity, the detector is typically moved about one detector width per second.

3.4.3 Note increases in count rate as indicated by the audible meter output. Identifiable increases in the audible response suggest possible contamination and should be resurveyed at a slower rate to confirm findings.

3.5 Personnel Monitoring

3.5.1 When monitoring for skin or clothing contamination, give particular attention to the hands, shoes, pant and shirt cuffs, knees, and other surfaces which have a high likelihood of contamination.

3.5.2 If there is detectable contamination, it should be removed as directed by the Health and Safety Committee (HSC) Chairperson. Decontamination guidance will be provided in the Survey Work Plan. The Site Safety Officer will implement decontamination or other contamination control actions at the project site.

3.6 Equipment Monitoring

3.6.1 For equipment surveys, attention should be given to monitoring cracks, openings, joints, and other areas where contamination might accumulate.

3.6.2 Measure levels of total and removable surface contamination (see Procedures 2.3 and 3.6) at locations of elevated direct radiation identified by the scan and at additional representative surface locations.

3.6.3 Acceptable surface contamination levels will be established on a project-specific basis, with details, including decontamination instructions, provided in the Survey Work Plan.

3.7 Document results of contamination surveys in field records

PROCEDURE 2.3
DIRECT RADIATION MEASUREMENT

1.0 PURPOSE

1.1 To describe the method for measuring total alpha and beta radiation levels on equipment and building surfaces.

2.0 RESPONSIBILITIES

2.1 The Site Survey Manager is responsible for assuring that this procedure is implemented.

2.2 Survey team members are responsible for following this procedure.

3.0 PROCEDURE

3.1 Equipment

3.1.1 Ratemeter-scaler: Model 3, Model 2220 or 2221, Ludlum Instrument Corporation; or equivalent

3.1.2 Detector: Selected detectors are listed below: Equivalent detectors are also acceptable

Activity	Detector Type	Model
alpha	ZnS scintillator	Ludlum 43-1 or 43-5, Eberline AC3-7 or AC3-8
	gas proportional	Ludlum 43-68
beta	Geiger-Mueller	Ludlum 44-9, Eberline HP-260
	gas proportional	Ludlum 43-68

3.1.3 Cables

3.1.4 Check source

3.1.5 Record forms

3.2 Quality Control Check

3.2.1 Assemble instrument, turn on, check battery, and adjust high voltage and threshold, if necessary. Check background and check source responses. Follow the procedures described in Procedure 2.1.

3.3 Direct Measurement

3.3.1 When applicable, team members performing instrument checks will calculate the average and maximum "field action levels" for instrument combination based on the specific site criteria and background.

Action level (cpm) = [site criteria (dpm/100 cm^2) x E x G x T] + B

T = count time (minutes)
E = operating efficiency (counts/disintegration)
G = geometry (total detector area (cm^2)/100)

	Total Area	Active Area
43-5 detector area =	80 cm^2	60 cm^2
43-1 detector area =	80 cm^2	50 cm^2
43-68 detector area =	126 cm^2	100 cm^2
44-9 detector area =	20 cm^2	15.5 cm^2
HP-260 detector area =	20 cm^2	15.5 cm^2

B = background (cpm)

A field count at or above this value indicates that further investigation in this location is necessary.

NOTE: For a particular site, the action level may be established as any activity exceeding background.

3.3.2 Select an appropriate counting time. A counting time is desired which will achieve a minimum detectable activity (see Procedure 4.2) value less than 50% of the applicable criteria. For most radionuclides a 1-minute count, using the instruments listed above, is adequate to achieve this sensitivity. For radionuclides having guidelines of 5000 dpm/100 cm^2, average and 15,000 dpm/100 cm^2, maximum, 0.5 minute counting times may be acceptable.

3.3.3 Place the detector face in contact with the surface to be surveyed. The detector face is typically constructed of a very thin and fragile material, so care must be exercised to avoid damage by rough surfaces or sharp objects. (Scans should have been performed, prior to this point, to identify representative locations and locations of elevated direct surface radiation for measurement.)

3.3.4 Set the meter timer switch, press the count-reset button, and accumulate the count events until the meter display indicates that the count cycle is complete.

3.3.5 Record the count and time on the appropriate record form.

3.3.6 If the location has a surface activity level above background, the area around the measurement locations should be scanned to determine the homogeneity of the measured activity level in the area. Dimensions and activity levels of inhomogeneities should be documented on the appropriate record form.

3.3.7 The surface activity may be calculated according to Procedure 4.3.

PROCEDURE 3.6
REMOVABLE ACTIVITY SAMPLING

1.0 PURPOSE

1.1 To provide guidelines for measuring removable alpha and beta radioactivity on equipment and building surfaces.

2.0 RESPONSIBILITIES

2.1 The Site Survey Manager is responsible for assuring this procedure is implemented.

2.2 Survey team members are responsible for following this procedure.

3.0 PROCEDURE

3.1 Equipment and Materials

3.1.1 Smears, Mazlin wipes, filter papers (like Whatman 47 mm dia. glass fiber) or equivalent

3.1.2 Glassine or paper envelopes

3.1.3 Record forms

3.1.4 Counting equipment

3.2 Sample Collection

NOTE: Direct measurements will be completed before a smear sample is taken.

3.2.1 Grasp the smear (filter) paper by the edge, between the thumb and index finger.

3.2.2 Applying moderate pressure with two or three fingers, wipe the numbered side of the paper over approximately 100 cm^2 of the surface.

3.2.3 Place the filter in an envelope.

3.2.4. Record the smear number, site, date, location of the smear, and name of sample collector on the envelope.

3.2.5 Label and secure in accordance with Procedures 3.7 and 3.8. Record pertinent information on the Chain-of-Custody Form.

3.2.6 If the direct measurement was elevated, the smear should be monitored (procedures 2.2 and 2.3) to determine whether contaminated material was transferred to the smear. If an activity level greater than 250 cpm is detected, the smear envelope should be marked as such.

NOTE: Smears having activity levels greater than 2500 cpm should be counted using field instrumentation. Decisions regarding further analyses and method of disposal of contaminated smears will be made by the PM and SSM on a case-by-case basis.

3.3 Field Sample Measurement

3.3.1 If the object of the survey is to determine if radon or thoron daughter products or other short half-life radionuclides are present, the smears should be counted within 1-2 hours before significant decay of short-lived radionuclides has occurred.

3.3.2 If necessary, smears can be counted in the field using portable instrumentation (see Procedure 2.3).

3.3.3 Record count and counting time data on the appropriate record form.

3.3.4 Subtract the background count (determined by counting blank or unused smear) and convert net count to dpm/100 cm^2, using proper time and detector efficiency values.

$$\frac{DPM}{100\,CM^2} = \left(\frac{NETCOUNT}{TIME(\mathrm{MIN}) * EFFICIENCY * \left(\frac{COUNT}{DISINTEGRATION} \right) * OTHERMODIFIYINGFACTORS} \right)$$

APPENDIX E

GAMMA CONE PENETRATION TEST (GCPT) HEALTH AND SAFETY PLAN

BRIDGETON LANDFILL - WEST LAKE LANDFILL

GAMMA CONE PENETRATION TEST (GCPT) HEALTH AND SAFETY PLAN

BRIDGETON, ST. LOUIS COUNTY, MISSOURI

Prepared For:
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13570 St. Charles Rock Road
Bridgeton, MO 63044

July 25, 2013

Project No.: BT-012

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GCPT Health and Safety Plan
Bridgeton Landfill, LLC

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1 INTRODUCTION

This Health and Safety Plan (HSP) was developed for Feezor Engineering, Inc. (FEI) employees and subcontractors under agreement with FEI for subsurface investigations in the southern portion of Operable Unit 1 (OU-1), Radiological Area 1 (Area 1) of the West Lake Landfill immediately to the north of Permitted North Quarry Landfill at the Bridgeton Landfill.

The purpose of this HSP to provide background information and establish standard personal protection standards and health and safety policies/procedures for work practices of FEI and Subcontractor employees during performance of subsurface investigations along the south side of Area 1. Prior to any work, a copy of this HSP will be distributed to all FEI employees and subcontractor personnel involved with this work. Prior to anyone beginning work, they will be required to read this HSP and sign the Compliance Agreement included in Appendix A.

The levels of protection and the procedures specified in this HASP are based on information available at this time, and represent the minimum health and safety requirements to be observed by all FEI and Subcontractor employees while engaged in this project. Unforeseeable site conditions may warrant the use of higher levels of protection. Subcontractors are required to provide the necessary safety equipment and safety training to their personnel in compliance with the Occupational Safety and Health Administration (OSHA) regulations provided in 29 CFR 1926.

The content of this HSP may change or undergo revision as additional information is obtained during the field activities. Any changes to this HSP must be reviewed by the Project Health and Safety Officer and are subject to approval by the Project Manager.

Field personnel must read this document carefully. If you have any questions or concerns that you feel are not adequately addressed, ask your supervisor or the Project Health and Safety Officer. Follow the designated health and safety procedures, be alert to the hazards associated with working on any construction site in close proximity to heavy equipment, and above all else, use common sense and exercise reasonable caution at all times.

The HSP is organized as follows:

- Section 2 describes the project safety personnel;
- Section 3 provides information regarding the West Lake Landfill site;
- Section 4 summarizes the field activities to be conducted as part of the subsurface investigations;
- Section 5 presents an evaluation of the hazards that may be encountered during the performance of the field activities and includes control measures for the hazards;
- Section 6 includes general training requirements;

- Section 7 describes the general health and safety procedures to be employed during the field activities; and
- Section 8 lists the emergency contacts and the procedures to be implemented in the event of an accident or other emergency.

2 PROJECT SAFETY PERSONNEL

Personnel responsible for project safety during performance of the subsurface investigations along the south side of Area 1 are the Project Manager, the Project Health and Safety Officer, and the On-Site Health and Safety Officer for each subcontractor.

The Project Health and Safety Officer has responsibility for establishing appropriate health and safety procedures for the project (as presented in this Health and Safety Plan) and has the authority to implement those procedures including, if necessary, the authority to temporarily shut down the project for health and safety reasons. The On-site Health and Safety Officer for each subcontractor will be responsible for assuring that the procedures specified in this Health and Safety Plan are implemented in the field and also has the authority to temporarily shut down the project for health and safety reasons. The Project Manager will have overall responsibility for project health and safety and has the authority to take whatever actions may be necessary to provide a safe working environment for all Subcontractor personnel. The personnel fulfilling these responsibilities and their mobile telephone numbers are included in Table 1.

The ultimate responsibility for the health and safety of the individual employee rests with the employee. Each employee is responsible for exercising the utmost care and good judgment in protecting his or her own health and safety, and that of fellow employees. Should any employee observe a potentially unsafe condition or situation, it is the responsibility of that employee to immediately bring the observed condition to the attention of their fellow employees and the appropriate health and safety personnel.

Should an employee find himself or herself in a potentially hazardous situation, the employee shall immediately discontinue the hazardous procedure(s) and personally take appropriate preventative or corrective action, and immediately notify the Site Health and Safety Officer of the nature of the hazard. Any site personnel may stop any work activity that is assessed to be an imminent safety hazard, emergency situation, or other potentially dangerous situation. Once work has been halted for any safety reason, the On-site Health and Safety Officer for the specific contractor and Project Manager must be notified immediately by the party calling for the stop. The reasons for the work stoppage will be discussed with the On-site Health and Safety Officer and the Project Manager. The Project Manager will make the decision as to whether work may continue or if actions need to be taken to correct an unsafe situation or activity.

3 SITE INFORMATION

This section includes discussions on the site location and surrounding areas, historical landfill operations and disposal areas, the Superfund Operable Units, and current site uses. Information regarding climate in the area and surface water runoff drainage patterns are also provided.

3.1 Site Location and Surrounding Area

The site includes the permitted North and South Quarry Landfills that make up the Bridgeton Sanitary Landfill and the former Demolition Landfill, Inactive Sanitary Landfill and Radiological Areas 1 and 2 that make up the West Lake Landfills. The site is located within the western portion of the St. Louis metropolitan area on the east side of the Missouri River floodplain approximately two miles east of the river. The landfills are located approximately one mile north of the intersection of Interstate 70 and Interstate 270 within the city limits of the City of Bridgeton in northwestern St. Louis County.

The site is bounded to the east and northeast by St. Charles Rock Road (State Highway 115) [Figure 1]. Commercial and industrial properties bound the site immediately to the north, across St. Charles Rock Road to the north and east, and to the south. The site is bounded on the west by Old St. Charles Rock Road (vacated) and the Earth City Industrial Park stormwater/flood control pond. The Earth City commercial and industrial complex continues to the west and north of the stormwater/flood control pond and extends from the site to the Missouri River. Earth City is separated from the Missouri River by an engineered levee system.

3.2 Historic Landfill Operations and Disposal Areas

The West Lake Landfill is an approximately 200-acre parcel containing multiple areas of past operations. The site was used agriculturally until a limestone quarrying and crushing operation began in 1939. The quarrying operation continued until 1988 and resulted in two quarry pits, the North Quarry Pit and the South Quarry Pit (Figure 1), which were excavated to maximum depth of 240 feet below ground surface (bgs) (Herst & Associates, 2005).

The West Lake Landfill is the site of several areas where solid wastes have been disposed. Beginning in the early 1950s or perhaps the later 1940s, portions of the quarried areas and adjacent areas were used for landfilling municipal refuse, industrial solid wastes, and construction/demolition debris. In 1974 landfilling began in the portion of the site described as the North Quarry Pit. Landfilling continued in this area until 1985 when the landfill underwent expansion to the southwest into the area described as the South Quarry Pit (Herst & Associates, 2005). In August 2005, the Bridgeton Sanitary Landfill stopped receiving waste pursuant to an agreement with the City of St. Louis to reduce the potential for birds to interfere with airport operations. The Bridgeton Sanitary Landfill is inactive and closure and post-closure activities are proceeding under Missouri Department of Natural Resources (MDNR) supervision.

In addition to the Bridgeton Sanitary Landfill north and south quarry pits currently in the process of closure/post-closure, the West Lake Landfill property contains four other areas where solid wastes were disposed (Figure 1):

- Area 1 where solid wastes and radiologically-impacted materials were disposed;
- Area 2 where solid wastes and radiologically-impacted materials were disposed;
- A closed demolition landfill; and
- An inactive sanitary landfill.

The adjacent Bridgeton Landfill includes the North and South Quarry Permitted Landfill cells. Waste disposal activities in these areas began in 1985 with filling of the North Quarry Landfill and continued with placement of solid wastes progressing to the south until the South Quarry Landfill was filled. Waste disposal activities at the Bridgeton Landfill ceased in 2004 and a final soil cover was placed over the North and South Quarry Landfills in 2008. In 2013, a geosynthetic cover composed of a green 60 mil Ethylene Vinyl Alcohol (EVOH) liner was (is being) installed over the South Quarry Landfill to reduce the potential for odor emissions. Enhancements to the landfill gas extraction and leachate collection systems at the South Quarry Landfill were also installed at this time.

3.3 Superfund Operable Units

Superfund-program remedial action at the site is divided into two operable units (OUs). OU-1 is comprised of the solid wastes and radiologically-impacted materials disposed in Areas 1 and 2 and portions of an adjacent property, the Buffer Zone/Crossroad Property.

OU-2 consists of the other landfill areas that are not impacted by radionuclides and includes the inactive sanitary landfill located adjacent to Area 2, the closed demolition landfill, and the Bridgeton Sanitary Landfill located in the North and South Quarry Pits. The closed demolition landfill and the Bridgeton Sanitary Landfill, while designated as part of OU-2, are regulated by the MDNR pursuant to State of Missouri solid waste regulations and are not being actively addressed by the Superfund program.

Area 1 is situated on the northern and western slopes of a topographic high within the overall West Lake landfill property. Ground surface elevation in Area 1 varies from 490 feet above mean sea level (AMSL) on the south to 452 feet AMSL at the roadway near the transfer station entrance (Figure 2).

Area 2 is situated between a topographic high of landfilled materials on the south and east, and the Buffer Zone/Crossroad Property on the west. The highest topographic level in Area 2 is about 500 feet AMSL on the southwest side of Area 2, sloping to approximately 470 feet AMSL near the top of the landfill berm (Figure 2). The upper surface of the berm along the western edge of Area 2 is located approximately 20 to 30 feet above the adjacent Buffer Zone/Crossroad Property and approximately 30 to 40 feet higher than the water surface in the flood control channel located to the south-west of Area 2. A berm on the northern portions of Area 2 controls runoff to the adjacent properties.

Municipal solid waste, construction and demolition debris, quarry spoil material and possibly other wastes were disposed of in Areas 1 and 2. Reportedly, 38,000 to 39,000 tons of soil were mixed with approximately 8,700 tons of leached barium-sulfate residue, and of this amount, 43,000 tons were sent to West Lake Landfill over the period from July through October 1973 (Nuclear Regulatory Commission [NRC], 1976 and 1988 and RMC, 1982). Post-disposal investigations by the NRC suggest that the 43,000 tons of soil mixed with leached barium-sulfate residue were spread and used as cover material for the landfill operations. Per the NRC, "This material was hauled to the landfill area and used as cover for part of the several hundred truckloads of garbage and refuse that are shipped to the landfill area site every week." Landfilling of waste materials continued to be performed both during and after disposal of the radiologically-impacted soil mixture .

Radiological constituents in Areas 1 and 2 occur in soil materials that are intermixed with and interspersed within the overall matrix of landfilled refuse, debris and fill materials, and unimpacted soil and quarry spoils. In some portions of Areas 1 and 2, radiologically-impacted materials are present at the surface; however, the majority of the radiological occurrences are present in the subsurface beneath these two areas. At the Buffer Zone/Crossroads properties the radiologically-impacted materials are found in soils believed to have been carried by erosion from the Area 2 berm prior to growth of the current on-site vegetation.

In general, the primary radionuclides detected at levels above background concentrations at the West Lake Landfill are part of the uranium-238 and uranium-235 decay series. Thorium-232 and radium-224 isotopes from the thorium-232 decay series are also present above background levels but at a lesser frequency.

3.4 Current Site Uses

The West Lake Landfill is located in a predominantly industrial area. The entire landfill area, including the areas investigated under OU-1 and OU-2, has been the site of historic quarry operations to remove limestone, and landfill operations. Other activities on the OU-2 portion of the property include a solid waste transfer facility, concrete and asphalt batch plant operations, and an auto repair facility (Figure 1).

With the exception of the Buffer Zone, all of the site area has previously been developed and was used for or in conjunction with disposal of solid wastes at the site or is currently being used in conjunction with the various industrial operations conducted at the Site. Areas 1 and 2, the closed demolition landfill, the inactive sanitary landfill, and the former Bridgeton Sanitary

Landfill located in the North and South Quarry pits (Figure 1) were all used for disposal of solid wastes. Current activities in these areas consist of maintenance of the landfill covers and environmental monitoring. Extraction of groundwater/leachate continues to be performed on an ongoing basis from the North and South Quarry Pits.

In addition to the area containing the transfer station entrance road and site office trailer/weigh station, there are two areas located outside of the solid waste disposal units in which industrial activities are conducted at the site. These include the area in the central portion of the site where the solid waste transfer station and the concrete and asphalt batch plants are located, and a small area near the southwestern portion of the site in which an automobile repair facility is located (Figure 1). In addition to these areas, the Republic Services district office and refuse collection vehicle parking and repair lots are located outside of but adjacent to the site. The landfill stormwater retention pond and OU-2 on-site soil borrow and stockpile area are also located on property outside of but adjacent to the site (Figure 1).

3.5 Climate and Meteorology

The climate of the landfill area is typical of the Midwestern United States with a modified continental climate that has four distinct seasons.

Winter temperatures are generally not severe with the first frost usually occurring in October and freezing temperatures generally not persisting past March. Records since 1870 show that temperatures drop to zero °F or below an average of two or three days per year. Temperatures remain at or below freezing less than 25 days in most years. Summers in the St. Louis area are hot and humid. The long-term record since 1870 indicates that temperatures of 90 degrees Fahrenheit or higher occur on about 35 to 40 days per year. Extremely hot days of 100 degrees Fahrenheit or more generally occur no more than five days per year.

Normal annual precipitation as measured at nearby Lambert Field International Airport based on records dating back to 1871 is a little less than 34 inches. The three winter months are usually the driest, with an average total of approximately 6 inches of precipitation. Average snowfall per winter season is slightly greater than 18 inches. Snowfall of an inch or more is received on five to ten days in most years. Record snowfall accumulation over the past 30 years was 66.0 inches recorded during the 1977 –78 winter season. The spring months of March through May are the wettest with normal total precipitation of just under 10.5 inches. Thunderstorms normally occur 40 to 50 days per year. During any given year, a few of these storms can be classified as severe with hail and damaging wind. Tornadoes have occurred in the St. Louis area.

Between December and April, the predominant wind direction at Lambert Field is from the northwest and west-northwest. Throughout the remainder of the year, the predominant wind direction is from the south. Considering potential differences in topography between Lambert Field and the West Lake Landfill, the actual wind directions at the landfill may be slightly different, possibly skewed in a northeast-southwest direction parallel to the Missouri River valley.

4 DESCRIPTION OF WORK

Additional subsurface investigation may be conducted to provide data to assist in locating and designing a possible subsurface thermal barrier that may be installed in the future, if determined to be necessary, between the North Quarry Landfill and the radiologically-impacted material (RIM) in Area 1. The objective of the subsurface investigation is to assist in locating a suitable alignment for a subsurface barrier for limiting migration of a subsurface smoldering event that may occur in the North Quarry Landfill from migrating into the RIM in Area 1. The subsurface investigations will be performed using a cone penetrometer drilling rig equipped with a cesium-iodide detector for characterization of gamma radiation. The Gamma Cone Penetrometer Testing (GCPT) will provide data on nature and geotechnical properties of the subsurface materials encountered while inclusion of the cesium iodide detector will allow for detection of RIM materials.

The general activities to be conducted during the GCPT investigation in the southern portion of Area 1 include the following:

- Surveying of the proposed GCPT boring locations and the alignments to be used to reach each of the GCPT boring locations;.
- Performance of surficial gamma survey around each of the proposed soil boring locations and along the alignments to be used to access the boring locations;
- Clearing of vegetation around the GCPT boring locations and along the alignments to be used to reach each of the locations using a forestry mower and/or bulldozer;
- Placement of road base or gravel along the access alignments and around the GCPT boring locations to support vehicle access to each GCPT boring location;
- Clearing of vegetation as necessary, performance of overland gamma survey, and placement of gravel/road base as necessary to allow access to existing location PVC-38 (or others) and performance of downhole gamma logging of PVC-38 (or others) to calibrate the GCPT cesium iodide detector prior to performance of the GCPT investigation;
- Performance of GCPT testing at each boring location; and
- Final surveying of the actual GCPT boring locations.

With the exception of the calibration run(s), all of these activities are expected to be conducted outside of the estimated extent of the radiologically impacted material in Area 1 (Figure 2).

5 HAZARD EVALUATION AND CONTROLS

There exists a limited potential for biological, physical, chemical, and radiological hazards during implementation of the GCPT investigation at the West Lake Landfill site. An activity-specific hazard analysis and control measures to mitigate the potential hazards are included in this section.

5.1 Biological Hazards

Possible biological hazards include venomous insects (e.g., bees, wasps, spiders) that can produce allergic reactions; plants such as poison ivy, oak, and sumac that elicit allergic skin reactions in sensitive individuals, and other invertebrates such as fire ants and biting flies which can produce painful irritations. Exposure to these hazards will be minimized with appropriate protective clothing.

5.2 Physical Hazards

Physical hazards that may be encountered include:

☒ Slip/trip/fall hazards	☒ Head hazards	☒ Eye hazards
☒ Thermal stresses	☒ Foot hazards	☒ Hand hazards
☒ Mechanical hazards	☒ Electrical hazards	☒ Fire and explosion
☒ Falling objects	☒ Heavy equip hazards	☒ Extreme weather
☒ Excavation hazards	☒ Material handling	☒ High noise levels

Control measures for these hazards are provided in Table 2 and in Section 7.

5.3 Chemical Hazards

Chemicals that will be used during the work activities include diesel fuel and gasoline. In addition to the information below regarding these chemicals, refer to the National Institute for Occupational Safety and Health (NIOSH) Guide to Chemical Hazards.

Chemical Name	Concentration	Exposure Limits REL/PEL (8/10 hr/day; 40 hr/ wk)	IDLH	MSDS if (available)	OSHA Carcinogen	Routes of Exposure *
Diesel fuel	NA	300 ppm	900 ppm	Yes	Yes	Inh, Abs, con
Gasoline	NA	300 ppm	900 ppm	Yes	No	Inh, abs, con

NA – not applicable, REL – Recommended Exposure Limit, PEL – Permissible Exposure Limit, IDLH – Immediately Dangerous to Life & Health, ppm – parts per million, MSDS - material safety data sheet
Routes of Exposure: Inh – Inhalation, Abs – Skin Absorption, Ing – Ingestion, Con – Contact (Skin / Eye)
The Thirteen OSHA –Regulated Carcinogens are found in Appendix B, NIOSH Guide to Chemical Hazards

Material Safety Data Sheets (MSDSs) for diesel fuel and gasoline are included in Appendix B.

5.4 Radiological Hazards and Controls

5.4.1 Radiological Hazards

All radiological hazards are associated with the radiologically-impacted soil within Area 1. The radionuclides are primarily comprised of isotopes of thorium and radium and their decay products. Potential exposures from working in and on top of radiologically-impacted soil include:

- External (Direct) Exposure. The radiologically-impacted soil on the surface will emit penetrating radiation in the form of gamma rays.
- Internal Exposure. Internal exposures occur when a worker ingests impacted soil or inhales dust containing radioactive particles.
- Spreading Contamination. It is likely that skin, clothing, and tools that contact radiologically-impacted surface soil within the extent of radiologically-impacted material in Areas 1 and 2 could become contaminated. The dose for such radiological contamination is likely to be very low. To prevent potentially contaminated materials from being carried to vehicles and off-site locations, the materials should be examined with a radiation ratemeter-scaler coupled to a pancake detector (e.g., Ludlum Model 44-9). The standard procedure for monitoring personnel and equipment for radioactive contamination is provided in Appendix C.

5.4.2 Radiological Controls

The purpose of the radiological hazard controls is to lay out procedures that will avoid any significant exposure to the workers involved with the GCPT investigation. During the initial safety meeting, workers will be apprised of the radiological contamination hazard both in extent and degree. The controls to be used to mitigate the hazard will then be presented.

As a general approach, the surveyor will layout the proposed GCPT boring locations and alignments to be used to access the locations. Vegetation clearing will then be conducted along the alignments and around the GCPT boring locations. The Project Health and Safety Officer or

Radiation Safety Officer will then walk the cleared alignment and boring locations with a scintillation detector, which measures gamma radiation, to identify any radiological anomalies. The road base/gravel will then be placed over the access alignments and the GCPT boring sites following which, the CPT investigation will be conducted.

There are two primary and possibly conflicting goals of the GCPT investigation. The first is to locate an alignment for the possible subsurface barrier that is outside of the extent of RIM in Area 1. The second is to locate an alignment as far to the north as possible due to the anticipated lower thickness of refuse the further north from the North Quarry Landfill and the resultant reduced cost and time necessary for implementation of the subsurface barrier if such a barrier is determined to be necessary. Consequently, although the majority of the proposed GCPT boring location are planned to be located outside of the line where no RIM has previously been identified or is otherwise expected to be present (i.e., the line connecting soil borings that did not contain elevated levels of radionuclides or surface or downhole gamma readings), some of the GCPT borings may be drilled between this line and the interpolated line of the extent of RIM (i.e., the line connecting the midpoints between soil borings with no indications of RIM occurrences and soil borings within observed occurrences of RIM). Therefore, there is a possibility that some of the workers could traverse areas where radionuclides may be present in the surface or subsurface soil.

Because the surveyors, vegetation clearing personnel and gamma scan personnel may potential enter the radiologically-impacted areas to complete their work, a potential risk exits for these workers for being exposed to radiation. Such exposures will be limited by limiting the amount to which these workers may intrude into the potential areas containing RIM, limiting the amount of time that these workers may be present within the possible areas of RIM, use of appropriate personnel protective equipment (e.g., boots, gloves, safety glasses, etc.) and adherence to the procedures set forth in this HSP in particular the frisking and decontamination procedures.

Exposure by other workers is not likely to occur if the anticipated procedures described above to prepare and access the GCPT boring locations (i.e., placement of gravel) and the procedures and precautions delineated in this Health and Safety Plan are followed. It is important that all workers understand they may become exposed if they leave the gravel roads/drill pads and enter the area of RIM occurrences within Area 1 without training and appropriate health and safety equipment and procedures. If a worker suspects that they may have contacted surface soil in a radiologically-impacted area (e.g., soil collected on the bottom of work boots), the potentially contaminated area will be examined with a radiation ratemeter-scaler coupled to a pancake detector. If the scan indicates the collected soil is contaminated, the contaminated surface should be washed with water and the soil/water solution collected in a plastic container or bag.

6 TRAINING

All personnel performing work described in this HSP must attend a site/project orientation session, conducted by an FEI representative. The session will cover, at a minimum, site restrictions, health and safety regulations, required personal protective equipment, potential site hazards, constituents of concern, decontamination and emergency procedures. All personnel attending the site/project orientation session must sign the Compliance Agreement provided in Appendix A of this HSP.

Visitors who stay at the site for less than one hour or subcontractors performing routine work not directly related to work described in this HSP (e.g., delivery of equipment and materials) will not require a health and safety orientation.

Each subcontractor must designate a qualified person to be responsible for the health and safety of their employees, and will cooperate with FEI in implementing this HSP.

7 GENERAL HEALTH AND SAFETY PROCEDURES

This section presents general health safety procedures to be followed during the GCPT investigation activities. The measures contained herein will be supplemented as necessary with standard safe work practices.

7.1 ONSITE CONTROL

Onsite control at Areas 1 and 2 of the West Lake Landfill is currently provided by six-foot high chain-link security fences that surround Areas 1 and 2.

7.2 PERSONAL PROTECTIVE EQUIPMENT

The level of personnel protective equipment (PPE) required for the GCPT investigation will consist of the following:

- Steel-toed boots (mandatory),
- High visibility traffic vest or high visibility work shirt (mandatory);
- Hard hat (mandatory),
- Safety glasses (mandatory),
- Gloves, as necessary based on the specific activity, and
- Hearing protection, as necessary based on the specific activity.

Visitors shall be required to wear PPE equivalent to the above.

7.3 ENVIRONMENTAL MONITORING

If it is suspected that a worker or equipment has contacted soil within the radiologically-impacted areas within Area 1, monitoring of the contacted surface will be conducted with a radiation ratemeter-scaler coupled to a pancake detector by the On-site Health and Safety Officer.

7.4 COMMUNICATION

A cellular telephone will be carried by the On-site Health and Safety Officer at all times. The following standard hand signals will be used in the event that verbal communication becomes impossible:

Hand Signal	Explanation
Hand gripping throat	Out of air, can't breathe
Grip partner's wrist or both hands around waist	Leave area immediately
Hands on top of head	Need assistance
Thumbs up	OK, I am all right, I understand
Thumbs down	No, negative

7.5 Safe Work Practices and Limitations

Site Activities will be conducted during daylight hours only. The On-site Health and Safety Officer must provide permission for field work conducted beyond daylight hours or on weekends and holidays. The On-site Health and Safety Officer will review pertinent health and safety matters with onsite personnel in daily health and safety meetings. Additional work practices and limitations are listed as follows:

- All site personnel shall acknowledge in the Compliance Agreement (Appendix A) that they have read, understood, and agree to comply with the HSP.
- In addition to an initial health and safety meeting the project, daily health and safety may be conducted by the On-site Health and Safety Officer at the start of each work day to discuss the day's upcoming activities and to address the health and safety procedures to be followed.
- Applicable OSHA guidelines will be followed for all site activities.
- Dress in accordance with the activity-specific level of protection.
- Smoking will be prohibited except in designated areas.
- Any person under a physician's care, taking medication, or those who experience allergic reactions must inform the On-site Health and Safety Officer.
- If a single individual is working at the site, they must have a cellular phone on their person that is turned on.
- The wearing of contact lenses for onsite personnel is prohibited by best management practice and OSHA.
- Be aware of symptoms of heat or cold stress, exposure to hazardous chemicals or dangerous atmospheres, and work-related injuries. Standard Operating Procedures for Heat Stress are included in Appendix D.
- If trenching activities are conducted, proper excavation and trenching procedures must be followed as outlined in 29 CFR 1926.650 through .653 (Subpart P. Excavations,

Trenching, and Shoring). In particular, the requirements for shoring, sloping, and access/egress must be followed.

- In addition, all underground utilities (gas, electric, water, cable, telephone) at the site must be identified and marked prior to the commencement of any GCPT boring, excavation and/or trenching activity. None are expected to be present in Area 1
- Good personal hygiene practices are especially important when working in the proximity of the potential radiologically-impacted areas within Areas 1 and 2. Of particular importance is the need to keep fingers away from the face unless they have been carefully washed. Cuts and abrasions should be covered by a band-aid.
- All accidents and hazardous material exposure incidents will be reported on the appropriate forms, included in Appendix A.

7.6 Heavy Equipment

Working around heavy equipment can be dangerous because of the size and power of the equipment, the limited operatory field of vision, and the noise levels that can be produced by the equipment. The following practices shall be followed by operators when using heavy equipment:

- Equipment should be inspected daily by the operator to ensure that the equipment is in safe operating condition.
- When not in use, hydraulic and pneumatic components should be left in down or "dead" position.
- Roll-over protection shall be provided on uneven terrain sites.
- No riding on vehicles or equipment except in fixed seats.
- Seat belts should be worn at all times.
- Backup alarms, automatically activated and loud enough to be heard above background noise, are required to be operational on all heavy equipment.
- Parking brakes should always be applied on parked equipment.
- Equipment should never be operated closer than 10 feet from utility lines.
- Windshields must be maintained, clean, and free of visual obstructions.

To ensure the safety of personnel in the work area, the following safety procedures regarding heavy equipment must be reviewed prior to and followed during work activities:

- Ensure that equipment operators are trained and/or experienced in the operation of the specific equipment.
- Personnel should never approach a piece of heavy equipment without the operators' acknowledgment and stoppage of work or yielding to the employee.

- Never walk under the load of a bucket or stand beside an opening truck bed.
- Maintain visual contact with the operator when in close proximity to the heavy equipment.
- Wear hearing protection while on or around heavy equipment, when normal conversation cannot be heard above work operations.
- Steel-toed shoes, safety glasses, and a hard hat shall be worn for all work conducted near heavy equipment.

7.7 Heavy Lifting

When lifting objects, use the following proper lifting techniques:

- Keep your feet shoulder width apart to get the best footing possible.
- Bend at the knees, not at the waist.
- Tighten stomach muscles to offset the force of the load.
- Grasp the object at opposite corners.
- Lift with the legs instead of the back muscles.
- Keep the back upright and avoid twisting.
- Most importantly, think before lifting.

7.8 Slip/Trip/Hit/Fall

Slip, trip, hit, and fall injuries are the most frequent of all injuries to workers. They occur for a wide variety of reasons, but can be minimized by the following prudent practices:

- Spot check the work area to identify hazards.
- Establish and utilize a pathway which is most free of slip and trip hazards.
- Beware of trip hazards such as wet floors, slippery floors, and uneven surfaces or terrain.
- Carry only loads which you can see over.
- Keep work areas clean and free of clutter, especially in storage rooms and walkways.
- Communicate hazards to on-site personnel.
- Secure all loose clothing, ties, and remove jewelry while around machinery.
- Report and/or remove hazards.
- Keep safe buffer zones between workers using equipment and tools.

7.9 ELECTRICAL HAZARDS

No individual shall be permitted to work on any part of an electrical power circuit unless the person is protected against electric shock by de-energizing the circuit and grounding it, or by locking and tagging it out:

- All electrical wiring and equipment shall be intrinsically safe for use in potentially explosive environments and atmospheres.
- All electrical wiring and equipment shall be a type listed by Underwriters' Laboratories (UL) or Factory Mutual (FM) for the specific application.
- All installations shall comply with the National Electric Code (NEC) and the National Electric Safety Code (NESC).
- All electrical circuits shall be grounded according to NEC and NESC Code. Ground fault circuit interrupters shall be used in the absence of properly grounded circuitry or when portable tools must be used around wet areas.
- All live wiring or equipment shall be guarded to protect all persons or objects from harm.

7.10 BIOLOGICAL HAZARDS

Biological hazards include tick-borne diseases and poisonous plants.

7.10.1 Tick-borne Diseases

Lyme disease is caused by a bacterial parasite called spirochete, and is spread by infected ticks that live in and near wooded areas, tall grass, and brush. Once the tick deposits the spirochete, it must feed on the host blood for 12 to 24 hours before it can transmit the disease. The ticks that cause the disease in the Northeast and Midwest are often no bigger than a poppy seed or a comma in a newsprint. The peak months for human infection are June through October. There are many other tick borne diseases such as Rocky Mountain Spotted Fever which can be carried by a variety of ticks. The prevention and treatment of these diseases are similar to those of Lyme disease.

7.10.1.1 Prevention.

Ticks hang on blades of grass or shrubs waiting for a host to come by. When a host brushes against the vegetation, the tick grabs on. They typically climb onto an individual's legs and then crawl up looking to attach in a body crevice. Preventative measures include wearing light-colored clothing, keeping clothing buttoned, tucking pant legs into socks, pulling socks up past the knee, pulling the pant waist up above the naval area with a tight belt, and keeping shirt tails tucked in. Periodic checks for ticks should be made during the day, and especially at night. Hair should also be checked by parting it and combing through it to make sure that no ticks have attached to the scalp. Also, check clothing when it is first removed, before ticks have a chance to crawl off. It is common for ticks to be carried home on clothing and attach to others in the household.

The most common repellent recommended for ticks is N,N-dimethyl-m-toluamide, or DEET. It is important to follow the manufacturer's instructions found on the container for use with all insecticides especially those containing DEET. In general, DEET insect repellent should only be applied to clothing, not directly on the skin. Do not apply to sunburns, cuts or abrasions. Use soap and water to remove DEET once indoors.

7.10.1.2 Removal.

The best way to remove a tick is removal by tweezers. If tweezers are not available, cover your fingers (tissue paper) while grasping the tick. It is important to grasp the tick as close as possible to the site of attachment and use a firm steady pull to remove it. When removing the tick, be certain to remove all the mouth parts from your skin so as not to cause irritation or infection. Wash hands immediately after with soap and water, and apply antiseptic to the area where tick was removed.

7.10.1.3 Testing and Symptoms of Lyme Disease.

A variety of tests exist for determining Lyme Disease infection. However, most of these tests are not exact. The first symptoms of Lyme Disease usually appear from two days to a few weeks after a person is bitten by an infected tick. Symptoms usually consist of a ring-like red rash on the skin where the tick attached. The rash is often bull's eye-like with red on the outside and clear in the center. The rash may be warm, itchy, tender, and/or "doughy". Unfortunately, this rash appears in only 60 to 80 percent of infected persons. An infected person also has flu-like symptoms of fever, fatigue, chills, headaches, a stiff neck, and muscle aches and pains (especially knees). Rashes may be found some distance away from the site of actual attachment. These symptoms often disappear after a few weeks.

7.10.2 Poisonous Plants

Common Poison Ivy (Rhus radicans) grows as a small plant, a vine, and a shrub. Poison Ivy occurs in every state. The leaves always consist of three glossy leaflets. Poison Sumac (Rhus vernix) grows as a woody shrub or small tree 5 to 25 feet tall. It usually contains nine leaves, with eight paired leaves and one on top, and is common in swampy areas. The plants are potent sensitizers and can cause a mild to severe allergic reaction. This reaction is called contact dermatitis.

Dermatitis, in Rhus-sensitive persons, can result from contact with the milky sap found in the roots, stems, leaves, and fruit. The sap may retain its potency for months or years in a dry atmosphere, and can occur during any time of the year. The sap may also be carried by animals, equipment or apparel.

The best form of prevention is to avoid contact. This can occur by wearing long sleeves and gloves if necessary. Disposable clothing, such as Tyvek, is recommended in high risk areas to avoid exposure from contaminated apparel. Barrier creams and cleaners are also recommended.

7.10.3 Fire Prevention

All flammable and/or combustible liquids (i.e., gasoline) will be stored in approved safety containers that meet the specifications of National Fire Protection Association (NFPA) Code 30 and OSHA 29 CFR 1910.106(a)(29). Smoking or open flames are not permitted within 20 feet of any flammable liquid container.

All personnel performing work must be trained in the proper use of fire extinguishers. OSHA-approved, portable fire extinguishers will be located in every field vehicle. These extinguishers are rated for Class A (wood, paper), B (flammable liquid), and C (electrical) fires, and their locations are clearly identified with signs and/or labels. As required by 29 CFR 1910.157(d), at least one fire extinguisher with the appropriate rating must be located within 75 feet of a class A fire hazard and 50 feet of a Class B or C fire hazard.

7.11 Authorized Project Field Personnel

Only authorized project personnel will be granted access to active work areas during field activities. Authorized personnel may include designated representatives from FEI, subcontractors, Republic Services, the U.S. Environmental Protection Agency, and the Missouri Department of Natural Resources. A Log Book will be maintained onsite to record the personnel performing work at or visiting the Site.

7.12 Record Keeping and Reporting

The following records and/or logs will be maintained in the field vehicle of the On-site Health and Safety Officer and will be available for inspection:

- This Health and Safety Plan;
- A Log Book that documents all personnel entering and exiting the Site;
- Accident Report Forms that document any accidents and/or injuries at the Site, including corrective actions; and
- Material Safety Data Sheets that provide health and safety and emergency response information on all chemicals and materials used at the site.

All accidents (including vehicular accidents while traveling to/from the Site), injuries, illnesses, chemical exposures, fires, and/or deviations from the HSP will be reported to the On-site Health and Safety Officer and Project Manager. The On-site Health and Safety Officer must complete an Accident Report Form for all accidents or injuries occurring at the Site. The accident or injury must be reported to the Project Manager and appropriate actions taken.

8 EMERGENCY CONTACTS, PROCEDURES AND CONTINGENCY PLAN

This section includes the telephone numbers for emergency contacts and the procedures to be implemented in the event of an emergency.

8.1 EMERGENCY CONTACTS

In the event of an emergency related to field activities, notification of the appropriate contacts listed on Table 3 should be made.

8.2 HOSPITAL ROUTE

Should the need for emergency medical care arise, the closest medical facility is:

SSM DePaul Health Center
12303 DePaul Drive
St. Louis, MO 63044-2588

A hospital route map is included as Figure 3. Travel time to the hospital from the West Lake Landfill site is approximately 7 minutes. The direct route to SSM DePaul Health Center is as follows:

- Exit the landfill and head SE on St Charles Rock Road (MO 180) toward Taussig Ave;
- Turn Right at Mareschal Lane;
- Take a slight Left at DePaul Circle; and
- Turn Left to stay on DePaul Drive to the SSM DePaul Health Center.

8.3 STANDARD EMERGENCY PROCEDURES

The following standard emergency procedures will be used by onsite personnel. The On-site Health and Safety Officer shall be notified of any onsite emergencies and be responsible for ensuring that the appropriate procedures are followed.

8.3.1.1 Pre Emergency Planning

The provisions of this section of the HSP will be discussed with onsite field personnel during the health and safety orientation meeting.

8.3.1.2 Personnel Injury in the Work Zone

Upon noticing any apparent serious injury, all work must be halted. The On-site Health and Safety Officer should evaluate the nature of the injury. If the accident is deemed serious (i.e., bodily harm has occurred), an ambulance should be requested as the first action item.

8.3.1.3 Fire/Explosion

Proper storage of gasoline and other flammable liquids should be maintained to prevent or avoid spreading of a fire. Upon notification of a fire or explosion onsite, all site personnel should assemble at a designated meeting place and follow the directions below in Sections 8.7 and 8.8.

8.3.1.4 Other Equipment Failure

If any other equipment fails to operate properly, the On-site Health and Safety Officer will be notified to evaluate the effect of this failure on continuing operations onsite. If the failure affects the safety of personnel or prevents completion of the work activities, all personnel will leave the work zone until the situation is evaluated and appropriate actions taken.

8.3.1.5 Site Re-entry

In all situations when an onsite emergency results in evacuation of the work zone, personnel will not re-enter until any of the following conditions have been met, as appropriate:

- The conditions resulting in the emergency have been corrected.
- The hazards have been reassessed by the On-site Health and Safety Officer or a person designated by him.
- The HSP has been reviewed and revised, if necessary.
- Site personnel have been briefed on any changes in the HSP.

8.4 Location of Site Resources

The following items will be maintained in the field vehicle of the On-site Health and Safety Officer used to support each field activity:

- A cellular telephone;
- A copy of this HSP;
- A Log Book;
- Monitoring instrument manuals,
- A copy of the hospital route map and emergency contact list;
- Fire extinguisher;
- Safety supplies, and
- Any other item deemed necessary for personnel health and safety.

8.5 Response Sequence for First Arrivals

If you are the first on the scene, respond as follows:

- Evacuate the incident area (if necessary). Remember that your safety must be the primary consideration;
- Restrict access to the incident area;
- Restrict the use of ignition sources for incidents involving flammable substances;
- Call the On-site Health and Safety Officer or the local emergency response organization. Report the following information:
    - Your name
    - Company affiliation
    - Telephone number from which you are calling
    - Location and type of incident
    - Injuries, if any, and the number and type of injuries
    - Details concerning the substances(s) involved (identification, amount, spill rate, size of area involved), if known
    - If a spill, the direction the spill is moving and the direction the wind may be dispersing airborne contaminants
    - Surficial material on which the spill occurred (i.e., asphalt, gravel, etc.)
    - Any first response action that has been taken
    - The time the incident occurred or when you discovered it
    - Any additional pertinent information
- Notify the On-site Health and Safety Officer after the emergency response team has been contacted; and
- Coordinate with emergency response personnel when they arrive.

8.6 Emergency Response for Severe Weather Conditions

The Environmental Manager for Republic Services shall decide on the continuation or discontinuation of work based on current and pending weather conditions. Electrical storms, strong winds, and tornados are examples of conditions that would call for the discontinuation of work and evacuation of the site. No work will be permitted during any type of electrical storm. This section specifies what should be done in the event of a severe weather emergency, including electrical storms, high winds, heavy rain or hail, and tornados.

8.6.1 Electrical Storms

The procedures include the following:

- Seek shelter in the field vehicles;
- Do not stand near or under high objects.

8.6.2 High Winds

The procedures include the following:

- Seek shelter at the field vehicles;
- Do not drive high profile vehicles at high speeds;
- Park vehicles heading into the wind; and
- Wear safety goggles and a kerchief or dustmask covering your nose and mouth.

8.6.3 Heavy Rain or Hail

The procedures include the following:

- Seek shelter in the field vehicles; and
- Do not attempt to drive a vehicle if you are in an area that is or has the potential for flooding unless you are moving out of a low area.

8.6.4 Tornados

The procedures include the following:

- Seek shelter underground or in a closet, bathroom, or interior wall of a substantial building. Get under something sturdy and cover your head;
- Do not stay in a trailer or vehicle. Leave the trailer or vehicle and lie flat in the nearest ditch if substantial shelter is not available;
- Stay away from large areas of glass; and
- Stay away from large unsupported roofs.

8.7 Emergency Response for Fires

If a small fire occurs, extinguish it with the fire extinguisher in the field vehicle. Remember to follow these directions to put out the fire:

- Aim at the base of the flame;
- Use the appropriate type of fire extinguisher; and
- Remember that the spray only lasts a few seconds.

If a large fire occurs at the Site, follow these instructions:

- Move flammable and combustible items out of the path of the fire, if such action can be performed safely;
- Call the Fire Department and report the information outlined in Section 8.5;
- Do not attempt to put out a large fire with the field vehicle fire extinguisher;
- Report the incident to the On-site Health and Safety Officer and Project Manager.

8.8 Emergency Response for Explosions

If an explosion occurs, follow these instructions:

- Evacuate the site immediately;
- If feasible, decontaminate yourself and others;
- Do not address medical emergencies until you are out of danger;
- Call the On-site Health and Safety Officer or local emergency response organization when you are out of danger to report the incident. Report the information outlined in Section 8.5.

Tables

Table 1 - Project Safety Personnel and Contact Information

Title	Company	Name	Mobile Telephone
Project Manager	FEI	Dan Feezor	(217) 836-8842
Project Health and Safety Officer	FEI	Paul Eastvold	(217) 691-6836
Project Radiation Safety Officer	Auxier & Associates	Mike Bollenbacher	(865) 414-0378
On-site Health and Safety Officer	ConeTech	Rob Coates	(780) 908-1872
Environmental Manager (EM)	Republic Services	Bryan Sehie	(314) 443-0179

Table 2 – Hazard and Control Matrix

Task	Potential Hazard	Control Measures
Driving Safety	• Vehicle traffic • Off-road Hazards (stationary objects, uneven terrain, etc) • Exposure to unfamiliar vehicle, streets, and/or directions • Changes in weather or traffic conditions	• Inspect car and maps before driving • Adjust mirrors and seat positions • Make sure luggage, supplies are secure • Wear seatbelt • Pull over to talk on cell phone • Listen to weather and traffic reports before leaving
Mobilize/Demobilize Equipment to Jobsite	• Insecure loads • Unsafe lifts • Blind spots	• Check load straps and chains after loading and before moving truck • Use spotter when backing vehicles or equipment • Notify workers in the area of planned equipment placement • Have workers move out of path if necessary when spotting equipment • Make eye contact and exchange signals with operator when moving near load • Use level, dry area to unload & store equipment and materials • PPE – Modified Level D, no coveralls required.
General Construction	• Caught between pinch points • Incorrect lifting techniques • Overexertion • Fall, same level • Heat Stress	• Use work gloves if pinch points could be a factor in unloading and loading supplies • Use proper bending/lifting techniques-use your legs, not your back • Ask for help if something is too heavy or uncomfortable to lift alone • Look before you step • Inspect ties for integrity • Take necessary breaks • Consume adequate amounts of fluids • Access pickup beds from the rear of the truck only • Do not jump into or out of pickup beds • PPE – Modified Level D, no coveralls required.

Table 2 – Hazard and Control Matrix (cont.)

Task	Potential Hazard	Control Measures
General Construction, continued	• Slipping and Tripping Hazards	• Travel directly to and from permitted work areas • Walking paths to be kept free of tripping hazards • Extension cords and hoses should be placed together and marked to increase awareness • Care to be taken when walking, especially on wet surfaces. • Use three point contact when getting on or off the equipment • Move equipment to dryer grounds if surface is muddy or has standing water
	• High Noise Levels	• Use hearing protection when exposed to excessive noise levels (greater than 85 dBA over an 8-hour work periods) or when ever you must raise your voice for others to hear. (Double hearing protection when $\geq$ 90 dba)
	• Struck by/Against Heavy Equipment	• Wear reflective warning vests when exposed to vehicular traffic. • Isolate equipment swing areas • Make eye contact with operators before approaching equipment. • Understand and review hand signals • Warning vests, hard hat, safety glasses and steel toe work boots.
	• Use of Hand Tools	• All tools should be inspected prior to use • No damaged equipment should be used until repaired or replaced. • Damaged equipment must be tagged and taken out of service • Use the proper tool for the task • Know how to use tools safely • Utilize non spark tools around flammable chemicals

Table 2 – Hazard and Control Matrix (cont.)

Task	Potential Hazard	Control Measures
General Construction, continued	• Fueling of Vehicles	• Put vehicle in park or neutral with parking brake set • Turn off engine and remove key from ignition • Smoking is prohibited within 50 feet of fueling operations • Never leave the nozzle unattended. • Do not overfill vehicle tank or container • Never use a cell phone or other personal electronic device while refueling. • Upon exiting vehicle always touch a metal part of the vehicle away from the fill point before handling the nozzle to prevent static discharges.
	• Placing Fuel in Portable Containers	• Use only UL approved portable container with vapor -tight cap • When filling container, follow same rules as when fueling car: turn off engine; extinguish smoking materials, etc.… • Place portable fuel container on the ground during filling, and keep the metal nozzle spout in contact with the container to prevent build up and discharge of static electricity. Never fill a container in the bed of a pickup, in the back of a station wagon, or in the trunk of a car. • Manually control the nozzle valve throughout the filling process. Fill a portable container slowly to decrease the chance of static electricity buildup and minimize spilling or splattering. • Seal contain tightly before loading into vehicle • Secure container in an upright position to prevent sliding or tipping.
	• Horseplay	• Prohibit horseplay anywhere on jobsite • Review rules about horseplay with workers • Remind workers not to respond/participate in horseplay started by others
	• Chemical Exposure	• Avoid inhalation of vapors from fuel • Wash skin with soap and cool water if fuel contacts skin.

Table 2 – Hazard and Control Matrix (cont.)

Task	Potential Hazard	Control Measures
General Construction, continued	• Radiologically-impacted Areas 1 and 2	Untrained workers may not enter radiologically restricted area except during rescue operations. No other access to this area is allowed for any reason. Additional precautions for untrained workers working outside the radiologically restricted area include: • Wear gloves when disturbing or handling soil • No eating, drinking, smoking or using smokeless tobacco products within 50 feet of proposed fence line • Radiation workers may enter with proper preparation and monitoring.
Weather Conditions	• Evaluate prevailing weather conditions for the Site. • Contingency plans developed for likely severe weather conditions such as tornado, and extreme thunderstorm. • Provide for daily weather forecast service in extreme weather areas.	• Employees trained in contingency plan for severe weather conditions. • Weather service contacted regularly during storm conditions. • Supervisory personnel cease operations during extreme storm conditions, personnel evacuate to safe assembly area.
	• Heat Stress • Rain	• Workers are encouraged to increase fluid intake while working. • Workers will increase the frequency and duration of rest breaks while working in heat stress situations. • Workers will watch each other for signs and symptoms of heat exhaustion, fatigue. • If necessary, contractors will plan work in heat stress situations for early morning or evening during hot months. • Implement heat stress control program when necessary • Have proper rain gear available (i.e. Slickers, rubber boots, etc.)

Table 2 – Hazard and Control Matrix (cont.)

Task	Potential Hazard	Control Measures
Biological	• Injuries associated with insects, snakes, spiders and poisonous plants	• Be alert for signs of snakes, insect nests, ant hills and poisonous plants when walking. • Use extreme caution when moving or lifting objects that could be used by snakes or spiders as cover. Always wear leather gloves. • Never reach under or behind objects, or into other areas where snakes may hide. • Workers will tuck pants into socks and wear long sleeves and sturdy leather boots when walking in tall grass to protect against bio hazards. • Workers will use insect repellent when necessary. • Workers will use buddy system to check for signs of insect and spider bites, such as redness, swelling, and flu-like symptoms. • Workers will remove ticks immediately with fine tipped tweezers by grasping the tick as close to your skin as possible and gently pulling straight out. Do not squeeze the tick's body as this may inject fluids into you. Wash the bite area of skin and apply antiseptic. • Workers will immediately wash any areas that were exposed to poisonous plants. • Be aware that oil from poisonous plants can be carried on boots.

Table 3 - List of Emergency Telephone Contacts

Agency/Facility	Telephone No.	Contact
Police (Bridgeton Police Department)	911 Emergency (314) 739-7557 non-emergency	
Fire Department (Pattonville Fire Protection District)	911 Emergency (314) 291-6072 non-emergency	
Ambulance (Robertson Fire Protection District)	911	
Emergency Medical Facility/Hospital	(314) 344-6000	SSM DePaul Health Center 12303 DePaul Drive St. Louis, MO 63044-2588
Poison Control Center (Chemtrec)	(800) 424-9300	
Republic Services (On-site Representative and Environmental Manager)	(618) 410-0157 cell (314) 744-8165 office	Brian Power
Feezor Engineering, Inc.	(217) 836-8842 cell (217) 483-3118 office	Dan Feezor
Auxier & Associates (Radiological Health, Safety, and Risk Assessment)	(865) 414-0378 cell	Mike Bollenbacher
ConeTech (GCPT borings)	(780) 908-1872	Rob Coates

Figures

Source: MyTopo.com Date of Photograph 8/9/2007

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SCALE IN FEET

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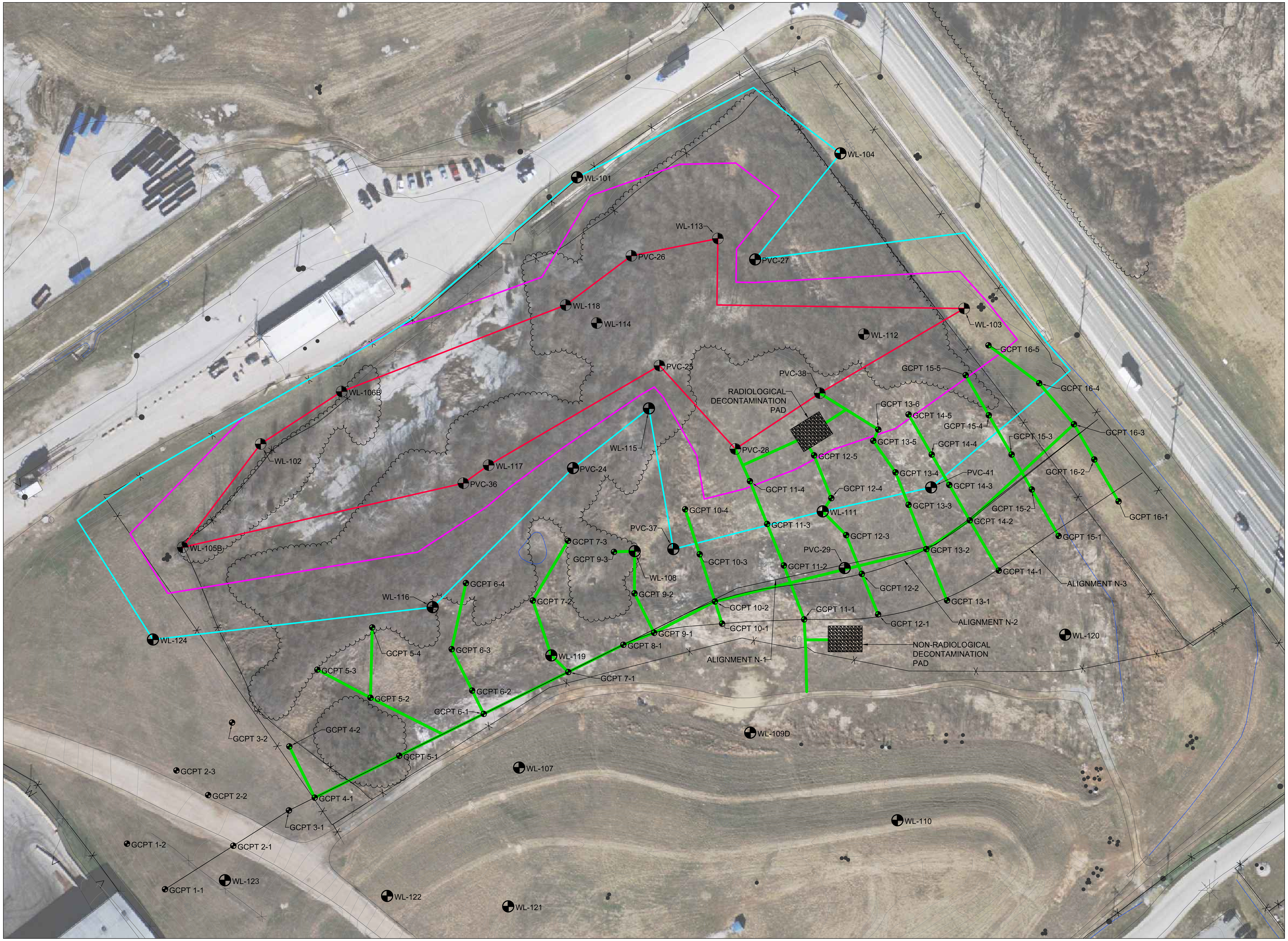
Figure 1

West Lake Landfill Features

West Lake Landfill OU-1 Additional Fencing and Signage

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\2013\Fencing\WL-Fig-1-Site Features.dwg plotted: 05/15/2013



0 40 80 Feet

SCALE: 1" = 40'

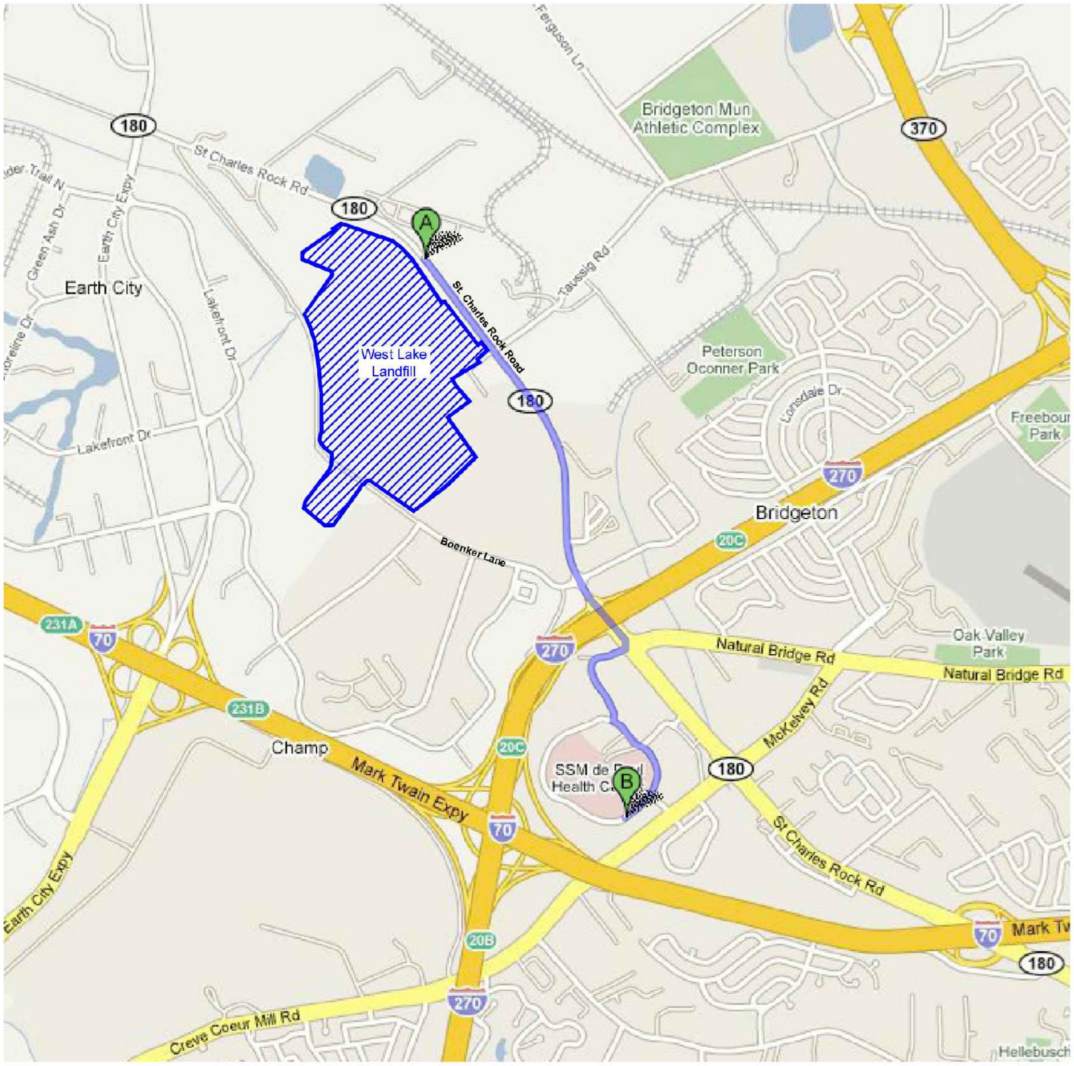
LEGEND

- EXISTING GRADE (2' CONTOUR)
- 500 EXISTING GRADE (10' CONTOUR)
- POTENTIAL BARRIER ALIGNMENT
- GCPT LOCATION
- CLEARING PATH
- ELEVATED DOWNHOLE GAMMA READING
- BOUNDARY OF ELEVATED DOWNHOLE READINGS
- NON-ELEVATED DOWNHOLE GAMMA READING
- BOUNDARY OF NON-ELEVATED DOWNHOLE READINGS
- INTERPOLATED RIM LIMITS
- FENCE

WEST LAKE LANDFILL 13570 ST. CHARLES ROCK ROAD BRIDGETON, MISSOURI 63044	WEST LAKE LANDFILL OU-1 AREA 1 RIM INVESTIGATION	Engineering for a Better World FEEZOR ENGINEERING, INC.	DATE: JULY 2013 DESIGNED BY: DPE APPROVED BY: DRF	FIGURE **2**
PROPOSED INVESTIGATION			REVISION / DATE	
PROJECT NUMBER: BT-012	FILE PATH: P:\Bridgeton Landfill\BT-012 (OU-1 A1 South RIM Determination)\Step 3 - Drawings\BT-012 GCPT INVESTIGATION.dwg			

Google Maps

Directions to 12303 De Paul Dr, Bridgeton, MO 63044
2.1 mi – about **7** mins



13570 St Charles Rock Rd
Bridgeton, MO 63044

1.	Head **southeast** on **MO-180/St Charles Rock Rd** toward **Taussig Ave** About 5 mins	go **1.3** mi total 1.3 mi
2.	Turn **right** at **Mareschal Ln**	go **0.1** mi total 1.5 mi
3.	Slight **left** at **De Paul Dr**	go **0.2** mi total 1.7 mi
4.	Turn **left** to stay on **De Paul Dr** Destination will be on the right About 2 mins	go **0.4** mi total 2.1 mi

12303 De Paul Dr
Bridgeton, MO 63044

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

NOT TO SCALE

Figure 3

Directions to Hospital from West Lake Landfill

West Lake Landfill OU-1 Additional Fencing and Signage

EMSI Engineering Management Support, Inc.

M:\clients\EMSI\westlake\2013\Fencing\WL-Fig-3-Hospital-Dir.dwg plotted: 05/15/2013

Appendix A:

Forms/Logs

Health and Safety Compliance Agreement

I have read, understand, and agree to comply with the health and safety procedures in this Health and Safety Plan (HSP). In addition, I have attended, understand, and agree to comply with the information presented in the health and safety pre-activity meeting. I hereby agree that (1) compliance with the HSP is a condition of entry to the site, and (2) non-compliance with the HSP may result in work stoppage and/or dismissal from the Site.

Printed Name	Organization	Signature	Date

Personnel health and safety pre-activity meeting conducted by:

Name	**Organization**	**Signature**	**Date**

Accident/Incident Report

Date ________ Project Location ____

Description of accident/incident, including injuries, property damage, emergency action taken and personnel involved (use additional sheets if needed):

____
____
____
____
____
____
____
____
____
____
____
____
____
____
____

Witnesses of Accident/Incident:

____
____
____

Possible or known causes:

____
____
____

What actions are needed to prevent a similar incident?

____
____
____

______________________________ ____________________________________

Reporter On-site Health and Safety Officer

____

Project Manager

Appendix B:
Material Safety Data Sheets

Safety Data Sheet

Material Name: Diesel Fuel, All Types

SDS No. 9909
US GHS

Synonyms: Ultra Low Sulfur Diesel; Low Sulfur Diesel; No. 2 Diesel; Motor Vehicle Diesel Fuel; Non-Road Diesel Fuel; Locomotive/Marine Diesel Fuel

* * * Section 1 - Product and Company Identification * * *

Manufacturer Information

Hess Corporation
1 Hess Plaza
Woodbridge, NJ 07095-0961

Phone: 732-750-6000 Corporate EHS
Emergency # 800-424-9300 CHEMTREC
www.hess.com (Environment, Health, Safety Internet Website)

* * * Section 2 - Hazards Identification * * *

GHS Classification:

Flammable Liquids - Category 3
Skin Corrosion/Irritation – Category 2
Germ Cell Mutagenicity – Category 2
Carcinogenicity - Category 2
Specific Target Organ Toxicity (Single Exposure) - Category 3 (respiratory irritation, narcosis)
Aspiration Hazard – Category 1
Hazardous to the Aquatic Environment, Acute Hazard – Category 3

GHS LABEL ELEMENTS

Symbol(s)

Signal Word

DANGER

Hazard Statements

Flammable liquid and vapor.
Causes skin irritation.
Suspected of causing genetic defects.
Suspected of causing cancer.
May cause respiratory irritation.
May cause drowsiness or dizziness.
May be fatal if swallowed and enters airways.
Harmful to aquatic life.

Precautionary Statements

Prevention

Keep away from heat/sparks/open flames/hot surfaces. No smoking
Keep container tightly closed.
Ground/bond container and receiving equipment.

Use explosion-proof electrical/ventilating/lighting/equipment.
Use only non-sparking tools.
Take precautionary measures against static discharge.
Wear protective gloves/protective clothing/eye protection/face protection.
Wash hands and forearms thoroughly after handling.
Obtain special instructions before use.
Do not handle until all safety precautions have been read and understood.
Avoid breathing fume/mist/vapours/spray.

Response
In case of fire: Use water spray, fog or foam to extinguish.
IF ON SKIN (or hair): Wash with plenty of soap and water. Remove/Take off immediately all contaminated clothing and wash it before reuse. If skin irritation occurs: Get medical advice/attention.
IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a poison center/doctor if you feel unwell.
If swallowed: Immediately call a poison center or doctor. Do NOT induce vomiting.
IF exposed or concerned: Get medical advice/attention.

Storage
Store in a well-ventilated place. Keep cool.
Keep container tightly closed.
Store locked up.

Disposal
Dispose of contents/container in accordance with local/regional/national/international regulations.

* * * Section 3 - Composition / Information on Ingredients * * *

CAS #	Component	Percent
68476-34-6	Fuels, diesel, no. 2	100
91-20-3	Naphthalene	<0.1

A complex mixture of hydrocarbons with carbon numbers in the range C9 and higher.

* * * Section 4 - First Aid Measures * * *

First Aid: Eyes
In case of contact with eyes, immediately flush with clean, low-pressure water for at least 15 min. Hold eyelids open to ensure adequate flushing. Seek medical attention.

First Aid: Skin
Remove contaminated clothing. Wash contaminated areas thoroughly with soap and water or with waterless hand cleanser. Obtain medical attention if irritation or redness develops. Thermal burns require immediate medical attention depending on the severity and the area of the body burned.

First Aid: Ingestion
DO NOT INDUCE VOMITING. Do not give liquids. Obtain immediate medical attention. If spontaneous vomiting occurs, lean victim forward to reduce the risk of aspiration. Monitor for breathing difficulties. Small amounts of material which enter the mouth should be rinsed out until the taste is dissipated.

First Aid: Inhalation

Remove person to fresh air. If person is not breathing, provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.

* * * Section 5 - Fire Fighting Measures * * *

General Fire Hazards

See Section 9 for Flammability Properties.

Vapors may be ignited rapidly when exposed to heat, spark, open flame or other source of ignition. When mixed with air and exposed to an ignition source, flammable vapors can burn in the open or explode in confined spaces. Being heavier than air, vapors may travel long distances to an ignition source and flash back. Runoff to sewer may cause fire or explosion hazard.

Hazardous Combustion Products

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke).

Extinguishing Media

SMALL FIRES: Any extinguisher suitable for Class B fires, dry chemical, CO2, water spray, fire fighting foam, and other gaseous agents.

LARGE FIRES: Water spray, fog or fire fighting foam. Water may be ineffective for fighting the fire, but may be used to cool fire-exposed containers.

Unsuitable Extinguishing Media

None

Fire Fighting Equipment/Instructions

Small fires in the incipient (beginning) stage may typically be extinguished using handheld portable fire extinguishers and other fire fighting equipment. Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH/MSHA- approved pressure-demand self-contained breathing apparatus with full facepiece and full protective clothing. Isolate area around container involved in fire. Cool tanks, shells, and containers exposed to fire and excessive heat with water. For massive fires the use of unmanned hose holders or monitor nozzles may be advantageous to further minimize personnel exposure. Major fires may require withdrawal, allowing the tank to burn. Large storage tank fires typically require specially trained personnel and equipment to extinguish the fire, often including the need for properly applied fire fighting foam.

* * * Section 6 - Accidental Release Measures * * *

Recovery and Neutralization

Carefully contain and stop the source of the spill, if safe to do so.

Materials and Methods for Clean-Up

Take up with sand or other oil absorbing materials. Carefully shovel, scoop or sweep up into a waste container for reclamation or disposal. Caution, flammable vapors may accumulate in closed containers.

Emergency Measures

Evacuate nonessential personnel and remove or secure all ignition sources. Consider wind direction; stay upwind and uphill, if possible. Evaluate the direction of product travel, diking, sewers, etc. to confirm spill areas. Spills may infiltrate subsurface soil and groundwater; professional assistance may be necessary to determine the extent of subsurface impact.

Personal Precautions and Protective Equipment

Response and clean-up crews must be properly trained and must utilize proper protective equipment (see Section 8).

Environmental Precautions

Protect bodies of water by diking, absorbents, or absorbent boom, if possible. Do not flush down sewer or drainage systems, unless system is designed and permitted to handle such material. The use of fire fighting foam may be useful in certain situations to reduce vapors. The proper use of water spray may effectively disperse product vapors or the liquid itself, preventing contact with ignition sources or areas/equipment that require protection.

Prevention of Secondary Hazards

None

* * * Section 7 - Handling and Storage * * *

Handling Procedures

Handle as a combustible liquid. Keep away from heat, sparks, excessive temperatures and open flame! No smoking or open flame in storage, use or handling areas. Bond and ground containers during product transfer to reduce the possibility of static-initiated fire or explosion.

Special slow load procedures for "switch loading" must be followed to avoid the static ignition hazard that can exist when higher flash point material (such as fuel oil) is loaded into tanks previously containing low flash point products (such as this product) - see API Publication 2003, "Protection Against Ignitions Arising Out Of Static, Lightning and Stray Currents."

Storage Procedures

Keep away from flame, sparks, excessive temperatures and open flame. Use approved vented containers. Keep containers closed and clearly labeled. Empty product containers or vessels may contain explosive vapors. Do not pressurize, cut, heat, weld or expose such containers to sources of ignition.

Store in a well-ventilated area. This storage area should comply with NFPA 30 "Flammable and Combustible Liquid Code". Avoid storage near incompatible materials. The cleaning of tanks previously containing this product should follow API Recommended Practice (RP) 2013 "Cleaning Mobile Tanks In Flammable and Combustible Liquid Service" and API RP 2015 "Cleaning Petroleum Storage Tanks."

Incompatibilities

Keep away from strong oxidizers.

* * * Section 8 - Exposure Controls / Personal Protection * * *

Component Exposure Limits

Fuels, diesel, no. 2 (68476-34-6)

ACGIH: 100 mg/m3 TWA (inhalable fraction and vapor, as total hydrocarbons, listed under Diesel fuel)
Skin - potential significant contribution to overall exposure by the cutaneous route (listed under Diesel fuel)

Naphthalene (91-20-3)

ACGIH:	10 ppm TWA
	15 ppm STEL
	Skin - potential significant contribution to overall exposure by the cutaneous route
OSHA:	10 ppm TWA; 50 mg/m3 TWA
NIOSH:	10 ppm TWA; 50 mg/m3 TWA
	15 ppm STEL; 75 mg/m3 STEL

Engineering Measures

Use adequate ventilation to keep vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces.

Personal Protective Equipment: Respiratory

A NIOSH/MSHA-approved air-purifying respirator with organic vapor cartridges or canister may be permissible under certain circumstances where airborne concentrations are or may be expected to exceed exposure limits or for odor or irritation. Protection provided by air-purifying respirators is limited.

Use a positive pressure, air-supplied respirator if there is a potential for uncontrolled release, exposure levels are not known, in oxygen-deficient atmospheres, or any other circumstance where an air-purifying respirator may not provide adequate protection.

Personal Protective Equipment: Hands

Gloves constructed of nitrile, neoprene, or PVC are recommended.

Personal Protective Equipment: Eyes

Safety glasses or goggles are recommended where there is a possibility of splashing or spraying.

Personal Protective Equipment: Skin and Body

Chemical protective clothing such as of E.I. DuPont TyChem®, Saranex® or equivalent recommended based on degree of exposure. Note: The resistance of specific material may vary from product to product as well as with degree of exposure. Consult manufacturer specifications for further information.

* * * Section 9 - Physical & Chemical Properties * * *

Appearance:	Clear, straw-yellow.	**Odor:**	Mild, petroleum distillate odor
Physical State:	Liquid	**pH:**	ND
Vapor Pressure:	0.009 psia @ 70 °F (21 °C)	**Vapor Density:**	>1.0
Boiling Point:	320 to 690 °F (160 to 366 °C)	**Melting Point:**	ND
Solubility (H2O):	Negligible	**Specific Gravity:**	0.83-0.876 @ 60°F (16°C)
Evaporation Rate:	Slow; varies with conditions	**VOC:**	ND
Percent Volatile:	100%	**Octanol/H2O Coeff.:**	ND
Flash Point:	>125 °F (>52 °C) minimum	**Flash Point Method:**	PMCC
Upper Flammability Limit (UFL):	7.5	**Lower Flammability Limit (LFL):**	0.6
Burning Rate:	ND	**Auto Ignition:**	494°F (257°C)

* * * Section 10 - Chemical Stability & Reactivity Information * * *

Chemical Stability

This is a stable material.

Hazardous Reaction Potential

Will not occur.

Conditions to Avoid

Avoid high temperatures, open flames, sparks, welding, smoking and other ignition sources.

Incompatible Products

Keep away from strong oxidizers.

Hazardous Decomposition Products

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke).

* * * Section 11 - Toxicological Information * * *

Acute Toxicity

A: General Product Information

Harmful if swallowed.

B: Component Analysis - LD50/LC50

Naphthalene (91-20-3)

Inhalation LC50 Rat >340 mg/m3 1 h; Oral LD50 Rat 490 mg/kg; Dermal LD50 Rat >2500 mg/kg; Dermal LD50 Rabbit >20 g/kg

Potential Health Effects: Skin Corrosion Property/Stimulativeness

Practically non-toxic if absorbed following acute (single) exposure. May cause skin irritation with prolonged or repeated contact. Liquid may be absorbed through the skin in toxic amounts if large areas of skin are repeatedly exposed.

Potential Health Effects: Eye Critical Damage/ Stimulativeness

Contact with eyes may cause mild irritation.

Potential Health Effects: Ingestion

Ingestion may cause gastrointestinal disturbances, including irritation, nausea, vomiting and diarrhea, and central nervous system (brain) effects similar to alcohol intoxication. In severe cases, tremors, convulsions, loss of consciousness, coma, respiratory arrest, and death may occur.

Potential Health Effects: Inhalation

Excessive exposure may cause irritations to the nose, throat, lungs and respiratory tract. Central nervous system (brain) effects may include headache, dizziness, loss of balance and coordination, unconsciousness, coma, respiratory failure, and death.

WARNING: the burning of any hydrocarbon as a fuel in an area without adequate ventilation may result in hazardous levels of combustion products, including carbon monoxide, and inadequate oxygen levels, which may cause unconsciousness, suffocation, and death.

Respiratory Organs Sensitization/Skin Sensitization

This product is not reported to have any skin sensitization effects.

Generative Cell Mutagenicity

This material has been positive in a mutagenicity study.

Carcinogenicity

A: General Product Information

Suspected of causing cancer.

Studies have shown that similar products produce skin tumors in laboratory animals following repeated applications without washing or removal. The significance of this finding to human exposure has not been determined. Other studies with active skin carcinogens have shown that washing the animal's skin with soap and water between applications reduced tumor formation.

B: Component Carcinogenicity

Fuels, diesel, no. 2 (68476-34-6)

ACGIH: A3 - Confirmed Animal Carcinogen with Unknown Relevance to Humans (listed under Diesel fuel)

Naphthalene (91-20-3)

ACGIH: A4 - Not Classifiable as a Human Carcinogen
NTP: Reasonably Anticipated To Be A Human Carcinogen (Possible Select Carcinogen)
IARC: Monograph 82 [2002] (Group 2B (possibly carcinogenic to humans))

Reproductive Toxicity

This product is not reported to have any reproductive toxicity effects.

Specified Target Organ General Toxicity: Single Exposure

This product is not reported to have any specific target organ general toxicity single exposure effects.

Specified Target Organ General Toxicity: Repeated Exposure

This product is not reported to have any specific target organ general toxicity repeat exposure effects.

Aspiration Respiratory Organs Hazard

The major health threat of ingestion occurs from the danger of aspiration (breathing) of liquid drops into the lungs, particularly from vomiting. Aspiration may result in chemical pneumonia (fluid in the lungs), severe lung damage, respiratory failure and even death.

* * * Section 12 - Ecological Information * * *

Ecotoxicity

A: General Product Information

Keep out of sewers, drainage areas and waterways. Report spills and releases, as applicable, under Federal and State regulations.

B: Component Analysis - Ecotoxicity - Aquatic Toxicity

Fuels, diesel, no. 2 (68476-34-6)

Test & Species		Conditions
96 Hr LC50 Pimephales promelas	35 mg/L [flow-through]	

Naphthalene (91-20-3)

Test & Species		Conditions
96 Hr LC50 Pimephales promelas	5.74-6.44 mg/L [flow-through]	
96 Hr LC50 Oncorhynchus mykiss	1.6 mg/L [flow-through]	
96 Hr LC50 Oncorhynchus mykiss	0.91-2.82 mg/L [static]	
96 Hr LC50 Pimephales promelas	1.99 mg/L [static]	

96 Hr LC50 Lepomis macrochirus	31.0265 mg/L [static]
72 Hr EC50 Skeletonema costatum	0.4 mg/L
48 Hr LC50 Daphnia magna	2.16 mg/L
48 Hr EC50 Daphnia magna	1.96 mg/L [Flow through]
48 Hr EC50 Daphnia magna	1.09 - 3.4 mg/L [Static]

Persistence/Degradability
No information available.

Bioaccumulation
No information available.

Mobility in Soil
No information available.

* * * Section 13 - Disposal Considerations * * *

Waste Disposal Instructions
See Section 7 for Handling Procedures. See Section 8 for Personal Protective Equipment recommendations.

Disposal of Contaminated Containers or Packaging
Dispose of contents/container in accordance with local/regional/national/international regulations.

* * * Section 14 - Transportation Information * * *

DOT Information
Shipping Name: Diesel Fuel
NA #: 1993 **Hazard Class:** 3 **Packing Group:** III
Placard:

* * * Section 15 - Regulatory Information * * *

Regulatory Information

Component Analysis

This material contains one or more of the following chemicals required to be identified under SARA Section 302 (40 CFR 355 Appendix A), SARA Section 313 (40 CFR 372.65) and/or CERCLA (40 CFR 302.4).

Naphthalene (91-20-3)

CERCLA: 100 lb final RQ; 45.4 kg final RQ

SARA Section 311/312 – Hazard Classes

Acute Health	Chronic Health	Fire	Sudden Release of Pressure	Reactive
X	X	X	--	--

SARA SECTION 313 - SUPPLIER NOTIFICATION

This product may contain listed chemicals below the de minimis levels which therefore are not subject to the supplier notification requirements of Section 313 of the Emergency Planning and Community Right- To-Know Act (EPCRA) of 1986 and of 40 CFR 372. If you may be required to report releases of chemicals listed in 40 CFR 372.28, you may contact Hess Corporate Safety if you require additional information regarding this product.

State Regulations

Component Analysis - State

The following components appear on one or more of the following state hazardous substances lists:

Component	CAS	CA	MA	MN	NJ	PA	RI
Fuels, diesel, no. 2	68476-34-6	No	No	No	Yes	No	No
Naphthalene	91-20-3	Yes	Yes	Yes	Yes	Yes	No

The following statement(s) are provided under the California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65):

WARNING! This product contains a chemical known to the state of California to cause cancer.

Component Analysis - WHMIS IDL

No components are listed in the WHMIS IDL.

Additional Regulatory Information

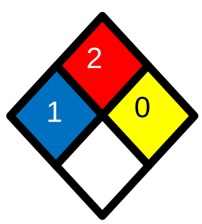
Component Analysis - Inventory

Component	CAS #	TSCA	CAN	EEC
Fuels, diesel, no. 2	68476-34-6	Yes	DSL	EINECS
Naphthalene	91-20-3	Yes	DSL	EINECS

* * * Section 16 - Other Information * * *

NFPA® Hazard Rating

Health	1	
Fire	2	
Reactivity	0	



HMIS® Hazard Rating

Health	1*	Slight
Fire	2	Moderate
Physical	0	Minimal
		*Chronic

Key/Legend

ACGIH = American Conference of Governmental Industrial Hygienists; ADG = Australian Code for the Transport of Dangerous Goods by Road and Rail; ADR/RID = European Agreement of Dangerous Goods by Road/Rail; AS = Standards Australia; DFG = Deutsche Forschungsgemeinschaft; DOT = Department of Transportation; DSL = Domestic Substances List; EEC = European Economic Community; EINECS = European Inventory of Existing Commercial Chemical Substances; ELINCS = European List of Notified Chemical Substances; EU = European Union; HMIS = Hazardous Materials Identification System; IARC = International Agency for Research on Cancer; IMO = International Maritime Organization; IATA = International Air Transport Association; MAK = Maximum Concentration Value in the Workplace; NDSL = Non-Domestic Substances List; NFPA = National Fire Protection Association; NOHSC = National Occupational Health & Safety Commission; NTP = National Toxicology Program; STEL = Short-term Exposure Limit; TDG = Transportation of Dangerous Goods; TLV = Threshold Limit Value; TSCA = Toxic Substances Control Act; TWA = Time Weighted Average

Literature References

None

Other Information

Information presented herein has been compiled from sources considered to be dependable, and is accurate and reliable to the best of our knowledge and belief, but is not guaranteed to be so. Since conditions of use are beyond our control, we make no warranties, expressed or implied, except those that may be contained in our written contract of sale or acknowledgment.

Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material, even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in their use of the material.

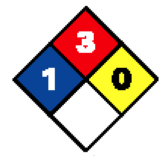
End of Sheet

AMERADA HESS CORPORATION

MATERIAL SAFETY DATA SHEET

Gasoline, All Grades **MSDS No. 9950**

EMERGENCY OVERVIEW
DANGER!
EXTREMELY FLAMMABLE - EYE AND MUCOUS MEMBRANE IRRITANT - EFFECTS CENTRAL NERVOUS SYSTEM - HARMFUL OR FATAL IF SWALLOWED - ASPIRATION HAZARD



NFPA 704 (Section 16)

High fire hazard. Keep away from heat, spark, open flame, and other ignition sources.

If ingested, do NOT induce vomiting, as this may cause chemical pneumonia (fluid in the lungs). Contact may cause eye, skin and mucous membrane irritation. Harmful if absorbed through the skin. Avoid prolonged breathing of vapors or mists. Inhalation may cause irritation, anesthetic effects (dizziness, nausea, headache, intoxication), and respiratory system effects.

Long-term exposure may cause effects to specific organs, such as to the liver, kidneys, blood, nervous system, and skin. Contains benzene, which can cause blood disease, including anemia and leukemia.

1. CHEMICAL PRODUCT and COMPANY INFORMATION (rev. Jan-04)

Amerada Hess Corporation
1 Hess Plaza
Woodbridge, NJ 07095-0961

EMERGENCY TELEPHONE NUMBER (24 hrs):	**CHEMTREC (800)424-9300**
COMPANY CONTACT (business hours):	Corporate Safety (732)750-6000
MSDS Internet Website	www.hess.com/about/environ.html

SYNONYMS: Hess Conventional (Oxygenated and Non-oxygenated) Gasoline; Reformulated Gasoline (RFG); Reformulated Gasoline Blendstock for Oxygenate Blending (RBOB); Unleaded Motor or Automotive Gasoline

See Section 16 for abbreviations and acronyms.

2. COMPOSITION and INFORMATION ON INGREDIENTS * (rev. Jan-04)

INGREDIENT NAME (CAS No.)	CONCENTRATION PERCENT BY WEIGHT
Gasoline (86290-81-5)	100
Benzene (71-43-2)	0.1 - 4.9 (0.1 - 1.3 reformulated gasoline)
n-Butane (106-97-8)	< 10
Ethyl Alcohol (Ethanol) (64-17-5)	0 - 10
Ethyl benzene (100-41-4)	< 3
n-Hexane (110-54-3)	0.5 to 4
Methyl-tertiary butyl ether (MTBE) (1634-04-4)	0 to 15.0
Tertiary-amyl methyl ether (TAME) (994-05-8)	0 to 17.2
Toluene (108-88-3)	1 - 25
1,2,4- Trimethylbenzene (95-63-6)	< 6
Xylene, mixed isomers (1330-20-7)	1 - 15

A complex blend of petroleum-derived normal and branched-chain alkane, cycloalkane, alkene, and aromatic hydrocarbons. May contain antioxidant and multifunctional additives. Non-oxygenated Conventional Gasoline and RBOB do not have oxygenates (Ethanol or MTBE and/or TAME). Oxygenated Conventional and Reformulated Gasoline will have oxygenates for octane enhancement or as legally required.

3. HAZARDS IDENTIFICATION (rev. Dec-97)

EYES
Moderate irritant. Contact with liquid or vapor may cause irritation.

SKIN
Practically non-toxic if absorbed following acute (single) exposure. May cause skin irritation with prolonged or repeated contact. Liquid may be absorbed through the skin in toxic amounts if large areas of skin are exposed repeatedly.

INGESTION
The major health threat of ingestion occurs from the danger of aspiration (breathing) of liquid drops into the lungs, particularly from vomiting. Aspiration may result in chemical pneumonia (fluid in the lungs), severe lung damage, respiratory failure and even death.

Ingestion may cause gastrointestinal disturbances, including irritation, nausea, vomiting and diarrhea, and central nervous system (brain) effects similar to alcohol intoxication. In severe cases, tremors, convulsions, loss of consciousness, coma, respiratory arrest, and death may occur.

INHALATION
Excessive exposure may cause irritations to the nose, throat, lungs and respiratory tract. Central nervous system (brain) effects may include headache, dizziness, loss of balance and coordination, unconsciousness, coma, respiratory failure, and death.

WARNING: the burning of any hydrocarbon as a fuel in an area without adequate ventilation may result in hazardous levels of combustion products, including carbon monoxide, and inadequate oxygen levels, which may cause unconsciousness, suffocation, and death.

CHRONIC EFFECTS and CARCINOGENICITY
Contains benzene, a regulated human carcinogen. Benzene has the potential to cause anemia and other blood diseases, including leukemia, after repeated and prolonged exposure. Exposure to light hydrocarbons in the same boiling range as this product has been associated in animal studies with systemic toxicity. See also Section 11 - Toxicological Information.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE
Irritation from skin exposure may aggravate existing open wounds, skin disorders, and dermatitis (rash). Chronic respiratory disease, liver or kidney dysfunction, or pre-existing central nervous system disorders may be aggravated by exposure.

4. FIRST AID MEASURES (rev. Dec-97)

EYES
In case of contact with eyes, immediately flush with clean, low-pressure water for at least 15 min. Hold eyelids open to ensure adequate flushing. Seek medical attention.

SKIN
Remove contaminated clothing. Wash contaminated areas thoroughly with soap and water or waterless hand cleanser. Obtain medical attention if irritation or redness develops.

INGESTION
DO NOT INDUCE VOMITING. Do not give liquids. Obtain immediate medical attention. If spontaneous vomiting occurs, lean victim forward to reduce the risk of aspiration. Small amounts of material which enter the mouth should be rinsed out until the taste is dissipated.

INHALATION
Remove person to fresh air. If person is not breathing, ensure an open airway and provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.

5. FIRE FIGHTING MEASURES (rev. Dec-97)

FLAMMABLE PROPERTIES:

FLASH POINT:	-45 ^{o}F (-43^{o}C)
AUTOIGNITION TEMPERATURE:	highly variable; > 530 ^{o}F (>280 ^{o}C)
OSHA/NFPA FLAMMABILITY CLASS:	1A (flammable liquid)
LOWER EXPLOSIVE LIMIT (%):	1.4%
UPPER EXPLOSIVE LIMIT (%):	7.6%

FIRE AND EXPLOSION HAZARDS

Vapors may be ignited rapidly when exposed to heat, spark, open flame or other source of ignition. Flowing product may be ignited by self-generated static electricity. When mixed with air and exposed to an ignition source, flammable vapors can burn in the open or explode in confined spaces. Being heavier than air, vapors may travel long distances to an ignition source and flash back. Runoff to sewer may cause fire or explosion hazard.

EXTINGUISHING MEDIA

SMALL FIRES: Any extinguisher suitable for Class B fires, dry chemical, CO2, water spray, fire fighting foam, or Halon.

LARGE FIRES: Water spray, fog or fire fighting foam. Water may be ineffective for fighting the fire, but may be used to cool fire-exposed containers.

During certain times of the year and/or in certain geographical locations, gasoline may contain MTBE and/or TAME. Firefighting foam suitable for polar solvents is recommended for fuel with greater than 10% oxygenate concentration - refer to NFPA 11 “Low Expansion Foam - 1994 Edition.”

FIRE FIGHTING INSTRUCTIONS

Small fires in the incipient (beginning) stage may typically be extinguished using handheld portable fire extinguishers and other fire fighting equipment.

Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH/MSHA- approved pressure-demand self-contained breathing apparatus with full facepiece and full protective clothing.

Isolate area around container involved in fire. Cool tanks, shells, and containers exposed to fire and excessive heat with water. For massive fires the use of unmanned hose holders or monitor nozzles may be advantageous to further minimize personnel exposure. Major fires may require withdrawal, allowing the tank to burn. Large storage tank fires typically require specially trained personnel and equipment to extinguish the fire, often including the need for properly applied fire fighting foam.

See Section 16 for the NFPA 704 Hazard Rating.

6. ACCIDENTAL RELEASE MEASURES (rev. Dec-97)

ACTIVATE FACILITY SPILL CONTINGENCY or EMERGENCY PLAN.

Evacuate nonessential personnel and remove or secure all ignition sources. Consider wind direction; stay upwind and uphill, if possible. Evaluate the direction of product travel, diking, sewers, etc. to confirm spill areas. Spills may infiltrate subsurface soil and groundwater; professional assistance may be necessary to determine the extent of subsurface impact.

Carefully contain and stop the source of the spill, if safe to do so. Protect bodies of water by diking, absorbents, or absorbent boom, if possible. Do not flush down sewer or drainage systems, unless system is designed and permitted to handle such material. The use of fire fighting foam may be useful in certain situations to reduce vapors. The proper use of water spray may effectively disperse product vapors or the liquid itself, preventing contact with ignition sources or areas/equipment that require protection.

Take up with sand or other oil absorbing materials. Carefully shovel, scoop or sweep up into a waste container for reclamation or disposal - caution, flammable vapors may accumulate in closed containers. Response and clean-up crews must be properly trained and must utilize proper protective equipment (see Section 8).

7. HANDLING and STORAGE (rev. Dec-97)

HANDLING PRECAUTIONS

******USE ONLY AS A MOTOR FUEL******

******DO NOT SIPHON BY MOUTH******

Handle as a flammable liquid. Keep away from heat, sparks, and open flame! Electrical equipment should be approved for classified area. Bond and ground containers during product transfer to reduce the possibility of static-initiated fire or explosion.

Special slow load procedures for "switch loading" must be followed to avoid the static ignition hazard that can exist when higher flash point material (such as fuel oil) is loaded into tanks previously containing low flash point products (such as this product) - see API Publication 2003, "Protection Against Ignitions Arising Out Of Static, Lightning and Stray Currents.

STORAGE PRECAUTIONS

Keep away from flame, sparks, excessive temperatures and open flame. Use approved vented containers. Keep containers closed and clearly labeled. Empty product containers or vessels may contain explosive vapors. Do not pressurize, cut, heat, weld or expose such containers to sources of ignition.

Store in a well-ventilated area. This storage area should comply with NFPA 30 "Flammable and Combustible Liquid Code". Avoid storage near incompatible materials. The cleaning of tanks previously containing this product should follow API Recommended Practice (RP) 2013 "Cleaning Mobile Tanks In Flammable and Combustible Liquid Service" and API RP 2015 "Cleaning Petroleum Storage Tanks".

WORK/HYGIENIC PRACTICES

Emergency eye wash capability should be available in the near proximity to operations presenting a potential splash exposure. Use good personal hygiene practices. Avoid repeated and/or prolonged skin exposure. Wash hands before eating, drinking, smoking, or using toilet facilities. Do not use as a cleaning solvent on the skin. Do not use solvents or harsh abrasive skin cleaners for washing this product from exposed skin areas. Waterless hand cleaners are effective. Promptly remove contaminated clothing and launder before reuse. Use care when laundering to prevent the formation of flammable vapors which could ignite via washer or dryer. Consider the need to discard contaminated leather shoes and gloves.

8. EXPOSURE CONTROLS and PERSONAL PROTECTION (rev. Jan-04)

EXPOSURE LIMITS

Component (CAS No.)	Exposure Limits			
	Source	TWA (ppm)	STEL (ppm)	Note
Gasoline (86290-81-5)	ACGIH	300	500	A3
Benzene (71-43-2)	OSHA	1	5	Carcinogen
	ACGIH	0.5	2.5	A1, skin
	USCG	1	5	
n-Butane (106-97-8)	ACGIH	800	--	2003 NOIC: 1000 ppm (TWA) Aliphatic Hydrocarbon Gases Alkane (C1-C4)
Ethyl Alcohol (ethanol) (64-17-5)	OSHA	1000	--	
	ACGIH	1000	--	A4
Ethyl benzene (100-41-4)	OSHA	100	--	
	ACGIH	100	125	A3

Component (CAS No.)	Source	TWA (ppm)	STEL (ppm)	Exposure Limits Note
n-Hexane (110-54-3)	OSHA	500	--	
	ACGIH	50	--	skin
Methyl-tertiary butyl ether [MTBE] (1634-04-4)	ACGIH	50		A3
Tertiary-amyl methyl ether [TAME] (994-05-8)				None established
Toluene (108-88-3)	OSHA	200		Ceiling: 300 ppm; Peak: 500 ppm (10 min.)
	ACGIH	50	--	A4 (skin)
1,2,4- Trimethylbenzene (95-63-6)	ACGIH	25	--	
Xylene, mixed isomers (1330-20-7)	OSHA	100	--	
	ACGIH	100	150	A4

ENGINEERING CONTROLS
Use adequate ventilation to keep vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces.

EYE/FACE PROTECTION
Safety glasses or goggles are recommended where there is a possibility of splashing or spraying.

SKIN PROTECTION
Gloves constructed of nitrile or neoprene are recommended. Chemical protective clothing such as that made of of E.I. DuPont Tychem ®, products or equivalent is recommended based on degree of exposure.

Note: The resistance of specific material may vary from product to product as well as with degree of exposure. Consult manufacturer specifications for further information.

RESPIRATORY PROTECTION
A NIOSH-approved air-purifying respirator with organic vapor cartridges or canister may be permissible under certain circumstances where airborne concentrations are or may be expected to exceed exposure limits or for odor or irritation. Protection provided by air-purifying respirators is limited. Refer to OSHA 29 CFR 1910.134, NIOSH Respirator Decision Logic, and the manufacturer for additional guidance on respiratory protection selection and limitations.

Use a positive pressure, air-supplied respirator if there is a potential for uncontrolled release, exposure levels are not known, in oxygen-deficient atmospheres, or any other circumstance where an air-purifying respirator may not provide adequate protection.

9. PHYSICAL and CHEMICAL PROPERTIES (rev. Jan-04)

APPEARANCE
A translucent, straw-colored or light yellow liquid

ODOR
A strong, characteristic aromatic hydrocarbon odor. Oxygenated gasoline with MTBE and/or TAME may have a sweet, ether-like odor and is detectable at a lower concentration than non-oxygenated gasoline.

ODOR THRESHOLD

	Odor Detection	Odor Recognition
Non-oxygenated gasoline:	0.5 - 0.6 ppm	0.8 - 1.1 ppm
Gasoline with 15% MTBE:	0.2 - 0.3 ppm	0.4 - 0.7 ppm
Gasoline with 15% TAME:	0.1 ppm	0.2 ppm

BASIC PHYSICAL PROPERTIES

BOILING RANGE:	85 to 437 °F (39 to 200 °C)
VAPOR PRESSURE:	6.4 - 15 RVP @ 100 °F (38 °C) (275-475 mm Hg @ 68 °F (20 °C)
VAPOR DENSITY (air = 1):	AP 3 to 4
SPECIFIC GRAVITY (H_2O = 1):	0.70 – 0.78
EVAPORATION RATE:	10-11 (n-butyl acetate = 1)
PERCENT VOLATILES:	100 %

SOLUBILITY (H_2O): Non-oxygenated gasoline - negligible (< 0.1% @ 77 ^oF). Gasoline with 15% MTBE - slight (0.1 - 3% @ 77 ^oF); ethanol is readily soluble in water

10. STABILITY and REACTIVITY (rev. Dec-94)

STABILITY: Stable. Hazardous polymerization will not occur.

CONDITIONS TO AVOID

Avoid high temperatures, open flames, sparks, welding, smoking and other ignition sources

INCOMPATIBLE MATERIALS

Keep away from strong oxidizers.

HAZARDOUS DECOMPOSITION PRODUCTS

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke). Contact with nitric and sulfuric acids will form nitrocresols that can decompose violently.

11. TOXICOLOGICAL PROPERTIES (rev. Dec-97)

ACUTE TOXICITY

Acute Dermal LD50 (rabbits): > 5 ml/kg
Primary dermal irritation (rabbits): slightly irritating
Guinea pig sensitization: negative

Acute Oral LD50 (rat): 18.75 ml/kg
Draize eye irritation (rabbits): non-irritating

CHRONIC EFFECTS AND CARCINOGENICITY

Carcinogenicity: OSHA: NO IARC: YES - 2B NTP: NO ACGIH: YES (A3)

IARC has determined that gasoline and gasoline exhaust are possibly carcinogenic in humans. Inhalation exposure to completely vaporized unleaded gasoline caused kidney cancers in male rats and liver tumors in female mice. The U.S. EPA has determined that the male kidney tumors are species-specific and are irrelevant for human health risk assessment. The significance of the tumors seen in female mice is not known. Exposure to light hydrocarbons in the same boiling range as this product has been associated in animal studies with effects to the central and peripheral nervous systems, liver, and kidneys. The significance of these animal models to predict similar human response to gasoline is uncertain.

This product contains benzene. Human health studies indicate that prolonged and/or repeated overexposure to benzene may cause damage to the blood-forming system (particularly bone marrow), and serious blood disorders such as aplastic anemia and leukemia. Benzene is listed as a human carcinogen by the NTP, IARC, OSHA and ACGIH.

This product may contain methyl tertiary butyl ether (MTBE): animal and human health effects studies indicate that MTBE may cause eye, skin, and respiratory tract irritation, central nervous system depression and neurotoxicity. MTBE is classified as an animal carcinogen (A3) by the ACGIH.

12. ECOLOGICAL INFORMATION (rev. Jan-04)

Keep out of sewers, drainage areas and waterways. Report spills and releases, as applicable, under Federal and State regulations. If released, oxygenates such as ethers and alcohols will be expected to exhibit fairly high mobility in soil, and therefore may leach into groundwater. The API (www.api.org) provides a number of useful references addressing petroleum and oxygenate contamination of groundwater.

13. DISPOSAL CONSIDERATIONS (rev. Dec-97)

Consult federal, state and local waste regulations to determine appropriate disposal options.

14. TRANSPORTATION INFORMATION (rev. Jan-04)

DOT PROPER SHIPPING NAME:	Gasoline
DOT HAZARD CLASS and PACKING GROUP:	3, PG II
DOT IDENTIFICATION NUMBER:	UN 1203
DOT SHIPPING LABEL:	FLAMMABLE LIQUID

PLACARD:

15. REGULATORY INFORMATION (rev. Jan-04)

U.S. FEDERAL, STATE, and LOCAL REGULATORY INFORMATION

This product and its constituents listed herein are on the EPA TSCA Inventory. Any spill or uncontrolled release of this product, including any substantial threat of release, may be subject to federal, state and/or local reporting requirements. This product and/or its constituents may also be subject to other federal, state, or local regulations; consult those regulations applicable to your facility/operation.

CLEAN WATER ACT (OIL SPILLS)

Any spill or release of this product to "navigable waters" (essentially any surface water, including certain wetlands) or adjoining shorelines sufficient to cause a visible sheen or deposit of a sludge or emulsion must be reported immediately to the National Response Center (1-800-424-8802) or, if not practical, the U.S. Coast Guard with follow-up to the National Response Center, as required by U.S. Federal Law. Also contact appropriate state and local regulatory agencies as required.

CERCLA SECTION 103 and SARA SECTION 304 (RELEASE TO THE ENVIRONMENT)

The CERCLA definition of hazardous substances contains a “petroleum exclusion” clause which exempts crude oil, refined, and unrefined petroleum products and any indigenous components of such. However, other federal reporting requirements (e.g., SARA Section 304 as well as the Clean Water Act if the spill occurs on navigable waters) may still apply.

SARA SECTION 311/312 - HAZARD CLASSES

ACUTE HEALTH	CHRONIC HEALTH	FIRE	SUDDEN RELEASE OF PRESSURE	REACTIVE
X	X	X	--	--

SARA SECTION 313 - SUPPLIER NOTIFICATION

This product contains the following toxic chemicals subject to the reporting requirements of section 313 of the Emergency Planning and Community Right-To-Know Act (EPCRA) of 1986 and of 40 CFR 372:

INGREDIENT NAME (CAS NUMBER)	CONCENTRATION WT. PERCENT
Benzene (71-43-2)	0.1 to 4.9 (0.1 to 1.3 for reformulated gasoline)
Ethyl benzene (100-41-4)	< 3
n-Hexane (110-54-3)	0.5 to 4
Methyl-tertiary butyl ether (MTBE) (1634-04-4)	0 to 15.0
Toluene (108-88-3)	1 to 15
1,2,4- Trimethylbenzene (95-63-6)	< 6
Xylene, mixed isomers (1330-20-7)	1 to 15

US EPA guidance documents (www.epa.gov/tri) for reporting Persistent Bioaccumulating Toxics (PBTs) indicate this product may contain the following deminimis levels of toxic chemicals subject to Section 313 reporting:

INGREDIENT NAME (CAS NUMBER)	CONCENTRATION - Parts per million (ppm) by weight
Polycyclic aromatic compounds (PACs)	17
Benzo (g,h,i) perylene (191-24-2)	2.55
Lead (7439-92-1)	0.079

CANADIAN REGULATORY INFORMATION (WHMIS)
Class B, Division 2 (Flammable Liquid)
Class D, Division 2A (Very toxic by other means) and Class D, Division 2B (Toxic by other means)

16. OTHER INFORMATION (rev. Jan-04)

NFPA® HAZARD RATING	HEALTH:	1	Slight
	FIRE:	3	Serious
	REACTIVITY:	0	Minimal
HMIS® HAZARD RATING	HEALTH:	1 *	Slight
	FIRE:	3	Serious
	REACTIVITY:	0	Minimal
	* CHRONIC		

SUPERSEDES MSDS DATED: 12/30/97

ABBREVIATIONS:

AP = Approximately	< = Less than	> = Greater than
N/A = Not Applicable	N/D = Not Determined	ppm = parts per million

ACRONYMS:

ACGIH	American Conference of Governmental Industrial Hygienists
AIHA	American Industrial Hygiene Association
ANSI	American National Standards Institute (212)642-4900
API	American Petroleum Institute (202)682-8000
CERCLA	Comprehensive Emergency Response, Compensation, and Liability Act
DOT	U.S. Department of Transportation [General Info: (800)467-4922]
EPA	U.S. Environmental Protection Agency
HMIS	Hazardous Materials Information System
IARC	International Agency For Research On Cancer
MSHA	Mine Safety and Health Administration
NFPA	National Fire Protection Association (617)770-3000
NIOSH	National Institute of Occupational Safety and Health
NOIC	Notice of Intended Change (proposed change to ACGIH TLV)
NTP	National Toxicology Program
OPA	Oil Pollution Act of 1990
OSHA	U.S. Occupational Safety & Health Administration
PEL	Permissible Exposure Limit (OSHA)
RCRA	Resource Conservation and Recovery Act
REL	Recommended Exposure Limit (NIOSH)
SARA	Superfund Amendments and Reauthorization Act of 1986 Title III
SCBA	Self-Contained Breathing Apparatus
SPCC	Spill Prevention, Control, and Countermeasures
STEL	Short-Term Exposure Limit (generally 15 minutes)
TLV	Threshold Limit Value (ACGIH)
TSCA	Toxic Substances Control Act
TWA	Time Weighted Average (8 hr.)
WEEL	Workplace Environmental Exposure Level (AIHA)
WHMIS	Workplace Hazardous Materials Information System (Canada)

Appendix C:
Standard Procedure for Monitoring for Radioactive Contamination

PROCEDURE 2.7
MONITORING PERSONNEL AND EQUIPMENT FOR RADIOACTIVE CONTAMINATION

1.0 PURPOSE

1.1 To describe the general approach for monitoring personnel and equipment for radioactive contamination.

2.0 RESPONSIBILITIES

2.1 The Site Survey Manager is responsible for assuring that this procedure is implemented.

2.2 Survey team members are responsible for following this procedure.

3.0 PROCEDURE

3.1 Upon exiting potentially contaminated areas, monitoring of clothing and exposed skin surfaces will be performed. Equipment and materials will also be monitored and shown to be free of contamination before release for use without radiological restrictions or controls.

3.2 Equipment

3.2.1 Ratemeter-scaler: Model 3 or Model 2221, Ludlum Measurements, Inc.; or equivalent, equipped with audible speaker or headphones.

3.2.2 Detector: Selected detectors are indicated below. Equivalent detectors are also acceptable.

Activity	**Detector Type**	**Model**
Alpha	ZnS scintillator	Ludlum 43-1 or 43-5, Eberline AC3-7 or AC3-8
	Gas proportional	Ludlum 43-68, Ludlum 239-1
Beta	Gas proportional	Ludlum 43-68, Ludlum 239-1
	Geiger-Mueller	Ludlum 44-9, Eberline HP-260

3.2.3 Instrument cables

3.2.4 Check sources

3.2.5 Record Forms and/or field logbook

3.3 Quality Control Check

Assemble instrument, turn on, check battery, and adjust high voltage and threshold, if necessary. Check background and source responses following Procedure 2.1.

3.4 Surface Scanning

3.4.1 Headphones or other audible signal operating modes are used for scanning.

3.4.2 Set the instrument response for "FAST", response where possible.

3.4.3 Pass the detector slowly over the surface. The detector should be kept as close to the surface as conditions allow. The speed of detector movement will vary depending upon the radionuclide of concern and the experience of the surveyor. While scanning for alpha or beta activity, the detector is typically moved about one detector width per second.

3.4.3 Note increases in count rate as indicated by the audible meter output. Identifiable increases in the audible response suggest possible contamination and should be resurveyed at a slower rate to confirm findings.

3.5 Personnel Monitoring

3.5.1 When monitoring for skin or clothing contamination, give particular attention to the hands, shoes, pant and shirt cuffs, knees, and other surfaces which have a high likelihood of contamination.

3.5.2 If there is detectable contamination, it should be removed as directed by the Health and Safety Committee (HSC) Chairperson. Decontamination guidance will be provided in the Survey Work Plan. The Site Safety Officer will implement decontamination or other contamination control actions at the project site.

3.6 Equipment Monitoring

3.6.1 For equipment surveys, attention should be given to monitoring cracks, openings, joints, and other areas where contamination might accumulate.

3.6.2 Measure levels of total and removable surface contamination (see Procedures 2.3 and 3.6) at locations of elevated direct radiation identified by the scan and at additional representative surface locations.

3.6.3 Acceptable surface contamination levels will be established on a project-specific basis, with details, including decontamination instructions, provided in the Survey Work Plan.

3.7 Document results of contamination surveys in field records

PROCEDURE 2.3
DIRECT RADIATION MEASUREMENT

1.0 PURPOSE

1.1 To describe the method for measuring total alpha and beta radiation levels on equipment and building surfaces.

2.0 RESPONSIBILITIES

2.1 The Site Survey Manager is responsible for assuring that this procedure is implemented.

2.2 Survey team members are responsible for following this procedure.

3.0 PROCEDURE

3.1 Equipment

3.1.1 Ratemeter-scaler: Model 3, Model 2220 or 2221, Ludlum Instrument Corporation; or equivalent

3.1.2 Detector: Selected detectors are listed below: Equivalent detectors are also acceptable

Activity	Detector Type	Model
alpha	ZnS scintillator	Ludlum 43-1 or 43-5, Eberline AC3-7 or AC3-8
	gas proportional	Ludlum 43-68
beta	Geiger-Mueller	Ludlum 44-9, Eberline HP-260
	gas proportional	Ludlum 43-68

3.1.3 Cables

3.1.4 Check source

3.1.5 Record forms

3.2 Quality Control Check

3.2.1 Assemble instrument, turn on, check battery, and adjust high voltage and threshold, if necessary. Check background and check source responses. Follow the procedures described in Procedure 2.1.

3.3 Direct Measurement

3.3.1 When applicable, team members performing instrument checks will calculate the average and maximum "field action levels" for instrument combination based on the specific site criteria and background.

Action level (cpm) = [site criteria (dpm/100 cm^2) x E x G x T] + B

T = count time (minutes)
E = operating efficiency (counts/disintegration)
G = geometry (total detector area (cm^2)/100)

	Total Area	Active Area
43-5 detector area =	80 cm^2	60 cm^2
43-1 detector area =	80 cm^2	50 cm^2
43-68 detector area =	126 cm^2	100 cm^2
44-9 detector area =	20 cm^2	15.5 cm^2
HP-260 detector area =	20 cm^2	15.5 cm^2

B = background (cpm)

A field count at or above this value indicates that further investigation in this location is necessary.

NOTE: For a particular site, the action level may be established as any activity exceeding background.

3.3.2 Select an appropriate counting time. A counting time is desired which will achieve a minimum detectable activity (see Procedure 4.2) value less than 50% of the applicable criteria. For most radionuclides a 1-minute count, using the instruments listed above, is adequate to achieve this sensitivity. For radionuclides having guidelines of 5000 dpm/100 cm^2, average and 15,000 dpm/100 cm^2, maximum, 0.5 minute counting times may be acceptable.

3.3.3 Place the detector face in contact with the surface to be surveyed. The detector face is typically constructed of a very thin and fragile material, so care must be exercised to avoid damage by rough surfaces or sharp objects. (Scans should have been performed, prior to this point, to identify representative locations and locations of elevated direct surface radiation for measurement.)

3.3.4 Set the meter timer switch, press the count-reset button, and accumulate the count events until the meter display indicates that the count cycle is complete.

3.3.5 Record the count and time on the appropriate record form.

3.3.6 If the location has a surface activity level above background, the area around the measurement locations should be scanned to determine the homogeneity of the measured activity level in the area. Dimensions and activity levels of inhomogeneities should be documented on the appropriate record form.

3.3.7 The surface activity may be calculated according to Procedure 4.3.

PROCEDURE 3.6
REMOVABLE ACTIVITY SAMPLING

1.0 PURPOSE

1.1 To provide guidelines for measuring removable alpha and beta radioactivity on equipment and building surfaces.

2.0 RESPONSIBILITIES

2.1 The Site Survey Manager is responsible for assuring this procedure is implemented.

2.2 Survey team members are responsible for following this procedure.

3.0 PROCEDURE

3.1 Equipment and Materials

3.1.1 Smears, Mazlin wipes, filter papers (like Whatman 47 mm dia. glass fiber) or equivalent

3.1.2 Glassine or paper envelopes

3.1.3 Record forms

3.1.4 Counting equipment

3.2 Sample Collection

NOTE: Direct measurements will be completed before a smear sample is taken.

3.2.1 Grasp the smear (filter) paper by the edge, between the thumb and index finger.

3.2.2 Applying moderate pressure with two or three fingers, wipe the numbered side of the paper over approximately 100 cm^2 of the surface.

3.2.3 Place the filter in an envelope.

3.2.4. Record the smear number, site, date, location of the smear, and name of sample collector on the envelope.

3.2.5 Label and secure in accordance with Procedures 3.7 and 3.8. Record pertinent information on the Chain-of-Custody Form.

3.2.6 If the direct measurement was elevated, the smear should be monitored (procedures 2.2 and 2.3) to determine whether contaminated material was transferred to the smear. If an activity level greater than 250 cpm is detected, the smear envelope should be marked as such.

NOTE: Smears having activity levels greater than 2500 cpm should be counted using field instrumentation. Decisions regarding further analyses and method of disposal of contaminated smears will be made by the PM and SSM on a case-by-case basis.

3.3 Field Sample Measurement

3.3.1 If the object of the survey is to determine if radon or thoron daughter products or other short half-life radionuclides are present, the smears should be counted within 1-2 hours before significant decay of short-lived radionuclides has occurred.

3.3.2 If necessary, smears can be counted in the field using portable instrumentation (see Procedure 2.3).

3.3.3 Record count and counting time data on the appropriate record form.

3.3.4 Subtract the background count (determined by counting blank or unused smear) and convert net count to dpm/100 cm^2, using proper time and detector efficiency values.

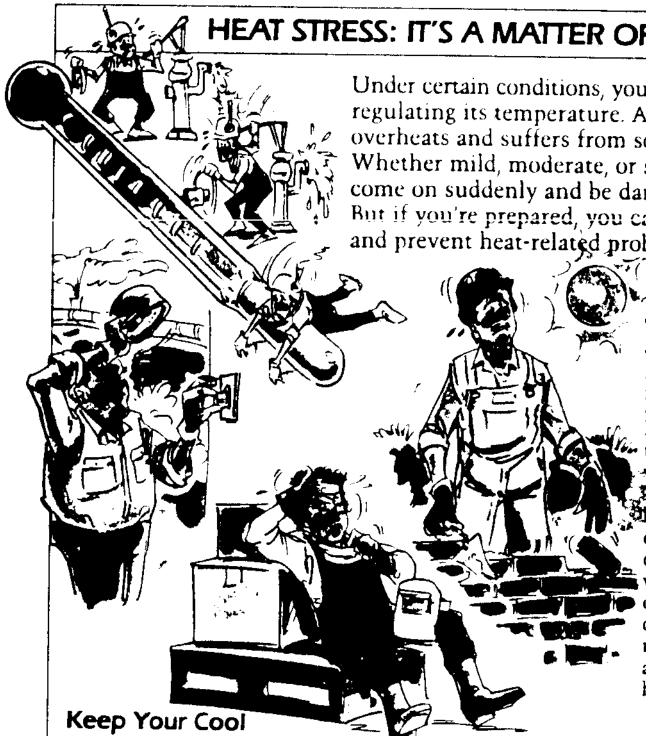
$$\frac{DPM}{100\,CM^2} = \left(\frac{NETCOUNT}{TIME(\mathrm{MIN}) * EFFICIENCY * \left(\frac{COUNT}{DISINTEGRATION} \right) * OTHERMODIFIYINGFACTORS} \right)$$

Appendix D:
Understanding and Preventing Heat Stress

UNDERSTANDING AND PREVENTING

HEAT STRESS

HEAT STRESS: IT'S A MATTER OF DEGREE



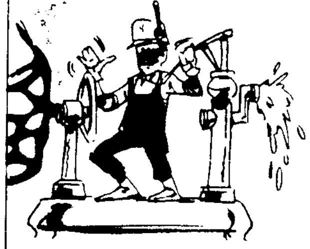
Under certain conditions, your body may have trouble regulating its temperature. As a result, your body overheats and suffers from some degree of heat stress. Whether mild, moderate, or severe, heat stress can come on suddenly and be dangerous to your health. But if you're prepared, you can "keep your cool" and prevent heat-related problems.

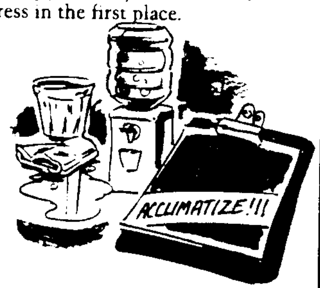
When It's Too Hot for You to Handle

Hard work or play can overload your body with extra heat—especially if you're active in a hot, humid, or poorly ventilated environment. These conditions make it harder for your body to handle heat—the sweat pours out, you don't feel well or work well, and you may feel dizzy or faint. If these signs of heat stress go unrecognized and untreated, serious—and sometimes permanent—health problems can occur.

Keep Your Cool

Our bodies vary in their ability to handle heat. But everyone can learn to avoid the adverse health and safety effects of heat stress. Keep your cool by knowing your body and its limitations, by understanding heat stress, and by preventing heat stress in the first place.





Know Your Body

Your body has a "heat regulator" that controls body temperature. But activity, heat, humidity, or lack of air movement can overwork this mechanism.

Understand Heat Stress

Protect yourself from heat stress. Learn to recognize warning signs—such as heavy sweating, fatigue, and dizziness—and know how heat stress is treated.

Prevent Heat Stress

Take an active role to prevent heat problems. Know the factors that increase your risk and take steps to reduce them, such as drinking water and acclimatizing to the heat.

This booklet is not intended to replace your company's health and safety policies or professional medical care.

HOW YOUR BODY HANDLES HEAT

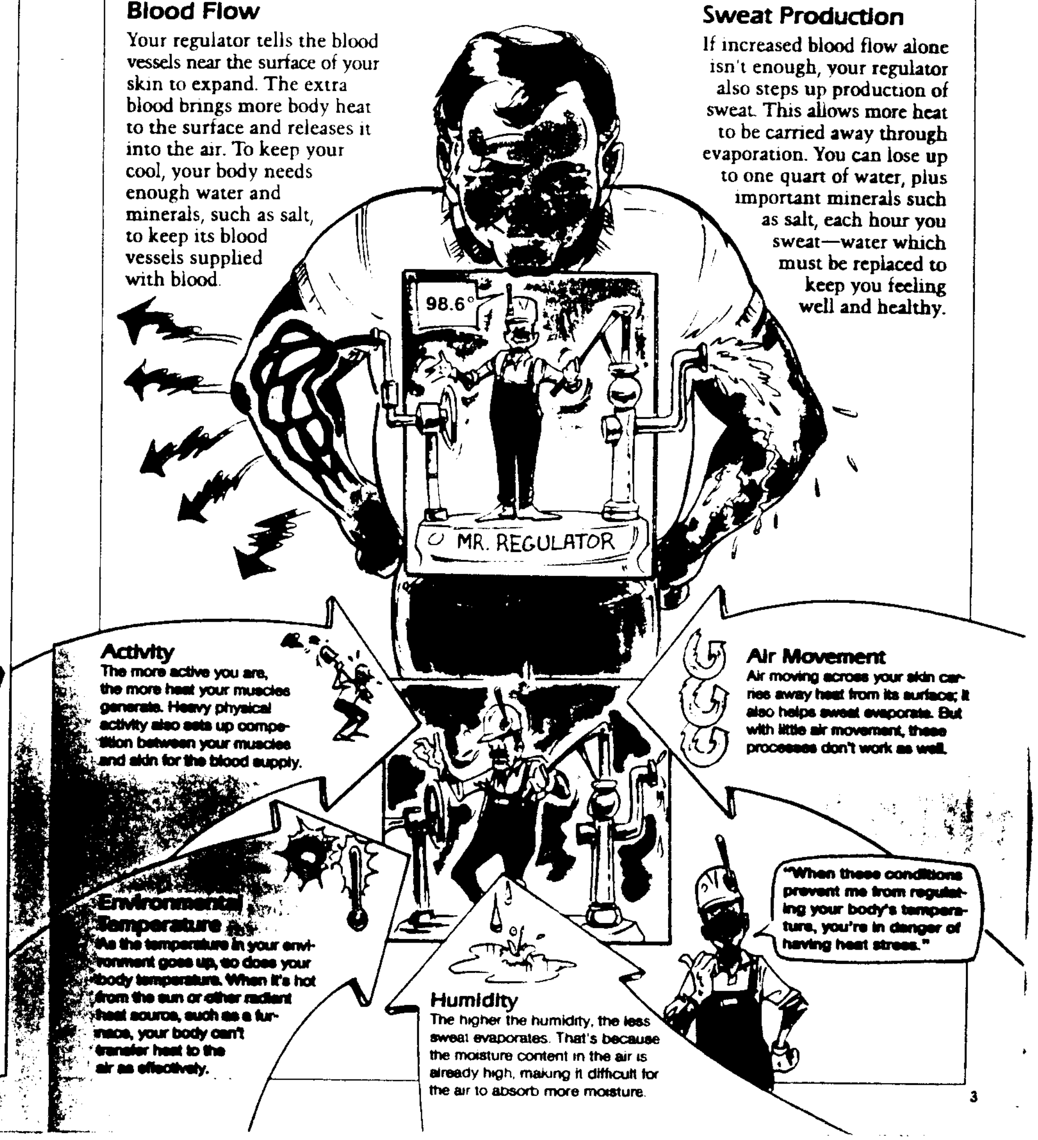
You have a natural mechanism that regulates the **core temperature** deep inside your body. You maintain a normal core temperature of 98.6° F by releasing excess heat into the air. The heat leaves your body through the blood vessels near the skin's surface and through the evaporation of sweat. Your level of activity and certain environmental conditions make the regulator work harder to increase your body's blood flow and sweat production.

Blood Flow

Your regulator tells the blood vessels near the surface of your skin to expand. The extra blood brings more body heat to the surface and releases it into the air. To keep your cool, your body needs enough water and minerals, such as salt, to keep its blood vessels supplied with blood.

Sweat Production

If increased blood flow alone isn't enough, your regulator also steps up production of sweat. This allows more heat to be carried away through evaporation. You can lose up to one quart of water, plus important minerals such as salt, each hour you sweat—water which must be replaced to keep you feeling well and healthy.

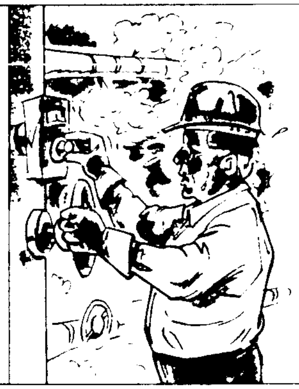


UNDERSTAND HEAT STRESS

When your body's heat regulator is pushed too far and your body overheats, some form of heat stress occurs. It may be mild, moderate, or severe; symptoms may range from excessive sweating to dizziness to unconsciousness. Since even severe heat stress can appear suddenly, learn the warning signs and how they're treated, so you can be more comfortable and productive, and prevent heat problems from occurring.

Mild: Minor Heat Problems

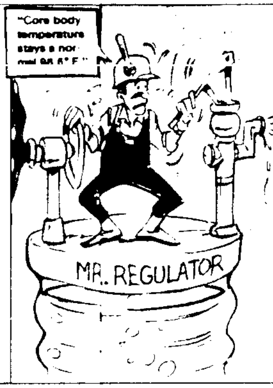
This is usually the earliest and least serious form of heat stress. Mild heat stress is always reversible and usually isn't dangerous unless the symptoms persist. Although you usually can continue work soon after treatment, always inform your supervisor if you have symptoms of mild heat stress.



Signs and Symptoms

You may have one or more of these symptoms.

- Excessive sweating.
- Painful spasms in muscles during or several hours after activity (**heat cramps**).
- Tiny red bumps on skin and a prickling sensation (**called prickly heat**).
- Irritability, mild dizziness, or weakness.



What's Going On

Sweating causes your body to lose too much water and minerals. This imbalance may cause muscles to cramp. Your sweat glands may become blocked and inflamed, causing a rash. Too little blood flowing to the brain causes irritability, dizziness and other symptoms.

Treatment

Follow this self-care.

- Rest in a cool or shady area.
- Drink water or other fluids.
- Use warm, moist compresses over cramping muscles, followed by gentle massage.
- Use a mild drying lotion to relieve the rash; keep skin dry and clean.

Taking additional salt is usually **not** necessary.

Signs and Symptoms

You may have one or more of these symptoms.

- Excessive sweating.
- Cold, moist, pale skin (or flushed skin).
- Thirst.
- Extreme weakness or fatigue.
- Headache, nausea, or loss of appetite.
- Dizziness or giddiness.
- A rapid, weak pulse.

What's Going On

Losing too much water and minerals reduces the blood supply to major organs, such as the brain, muscles, and skin. Your heart works harder to maintain the blood supply, straining your cardiovascular system. Some organs, such as the brain, may not get enough blood.

Treatment

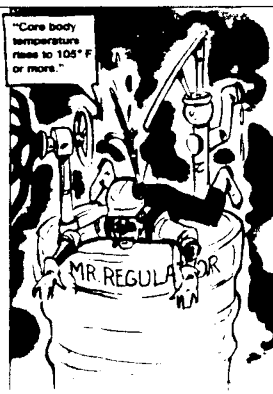
You may need medical treatment, as well as this self-care:

- Rest in a cool or shady area.
- Drink water or other fluids.
- Take additional salt only if advised.
- Use cool compresses on forehead, around the neck, and under armpits.

Signs and Symptoms

You may have one or more of these symptoms.

- Lack of sweating.
- Hot, dry, flushed skin.
- Deep, rapid breathing.
- A rapid, weak, and possibly irregular pulse.
- Headache, nausea.
- Dizziness, confusion, or delirium.
- Loss of consciousness.
- Convulsions.



What's Going On

Your regulator becomes so overburdened that blood flow and sweat cannot cool your body enough. Your body becomes so overheated that sweat glands and other organs don't function normally. This can affect vital organs, including your heart and brain, and may cause permanent damage.

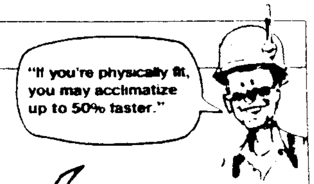
Treatment

Call for medical help right away. While waiting for medical treatment, begin first aid:

- Rest in a cool or shady area.
- Remove outer clothing.
- Lower body temperature with cool compresses, increasing air movement, or both.
- Drink water or other fluids (if conscious).

CHECKPOINTS FOR PREVENTING HEAT STRESS

There are several steps you and your employer can take to prevent heat stress. Both supervisors and employees can recognize risks and follow safety procedures to reduce them. Be sure to inform your employer about any medical conditions you have and discuss whether you might be at increased risk.



Know Your Environment

Your company controls the work environment so it's safe. You can help by knowing which factors increase your risk of heat stress. Talk with your supervisor about ways to reduce them, so you can take special precautions to protect yourself when the risk is especially high, such as on hot, humid days.

Drink Plenty of Water

Increase the water you drink to replenish the water you lose from sweating. Drink more than you need to satisfy your thirst. It's best to replenish regularly by drinking small amounts frequently throughout the day. You may need to drink a glass of water or more every hour.

Take Appropriate Breaks

Whether you need rest breaks depends on conditions such as air temperature, sun exposure, and how hard you're working. Your company monitors these conditions and establishes a safe work/rest regimen for you and your coworkers.

Wear Proper Clothing

Your employer supplies you with heat-protective clothing and equipment, such as heat shields, if needed. When possible, wear loose, lightweight clothing, which encourages heat to be released.

Acclimatize Yourself

Your employer may give you guidelines to help you adapt to the heat. This natural process, called **acclimatization,** takes about 7 to 10 days. It usually consists of short periods of working in the heat, which gradually increase in time and intensity. If you spend time out of the heat due to vacation or reassignment, you may need to acclimatize yourself again.

Stay in Good Shape

Conditioned muscles work more efficiently and generate less body heat, while extra body weight makes you work harder. People in good condition tend to acclimatize better because their cardiovascular systems respond better.

Eat Wisely

Hot, heavy meals add heat to your body and divert blood to your digestive system so eat lightly during your workday. Remember, too, a normal diet usually supplies all the salt you need to replace the salt lost through sweating.

Know Special Risks

Alcohol (including beer), **caffeine, medications** such as those used to control high blood pressure or allergies, **medical conditions** including diabetes, **recent illnesses** such as flu, and increasing **age** all increase your risk of heat stress.

"TEAMWORK HELPS YOU BEAT THE HEAT"

In many jobs, heat is a fact of life. Since too much heat can be harmful to your health and be a safety problem, your company wants to help you reduce the risk of heat stress by monitoring and controlling the work environment. Be sure to follow company procedures, such as adjusting gradually to working in the heat and drinking plenty of water. You'll feel better on and off the job knowing what heat stress is and how to prevent it.

KRAMES
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MORE THAN INFORMATION

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APPENDIX F

BIRD MITIGATION PLAN

Bridgeton Landfill, LLC

APPENDIX TO NORTH QUARRY CONTINGENCY PLAN PART 2

BIRD HAZARD MONITORING AND MITIGATION PLANS

July 26, 2013

Bridgeton Landfill, LLC
Bird Hazard Monitoring and Mitigation Plans

This Bird Hazard Monitoring and Mitigation Plan has been compiled by Bridgeton Landfill to summarize the steps that will be taken to ensure compliance with 10 CSR § 80-3.010(4)(B)1 and 40 CFR § 258.10, the terms of the Negative Easement and consistency with discussions with the City of St. Louis Lambert-St. Louis Airport. While not required by the Agreed Order, Bridgeton Landfill has summarized in this Plan the relevant bird hazard monitoring and mitigation measures that are or will be incorporated into the construction plans for the contingent work projects addressed by the North Quarry Contingency Plan. This compilation has been prepared for the convenience of the Airport in its review.

This Plan addresses measures applicable to installation of temperature monitoring probes, installation of gas interceptor wells and installation of the EVOH capping system in the North Quarry of the Bridgeton Landfill. Each of these tasks has already been conducted in the South Quarry of the Bridgeton Landfill, and materials handling methods observed and approved by the USDA. This Plan proposes to incorporate those same materials management measures, together with continued cooperation with the Airport, to ensure that these activities, if conducted in the North Quarry, continue to be conducted in a manner that does not present bird hazard conditions.

An additional contingent remedy considered as part of the North Quarry Contingency Plan is the installation of the isolation break between the North Quarry and the radiological materials in West Lake OU-1, Area 1. Such a project would involve excavation of waste material and would require that appropriate bird hazard monitoring and mitigation be evaluated in advance of such work. Because appropriate measures are dependent upon the construction details, including depth and volume of excavation and the schedule for construction, a bird hazard monitoring and mitigation plan will be prepared separately when that work plan is created.

Coordination with Airport

In order to ensure ongoing compliance with applicable requirements and provide for optimal coordination on monitoring and mitigation, Bridgeton Landfill will continue to provide Airport representatives with updates on site work as needed based upon changes in site conditions or planned activities. Bridgeton Landfill will also continue to provide the Airport with applicable work plans in advance of initiation of invasive work in order to allow for evaluation of sufficiency of bird monitoring and mitigation measures.

In advance of initiation of work under the contingent work plans, Bridgeton Landfill will notify the airport of the planned schedule and initiation so that appropriate monitoring can be assessed.

Mitigation Measures for TMP Installation:

Minimal waste removal is expected due to the limited volume of waste removed for TMP installation. However, to ensure this activity does not pose a risk of bird attractant the following steps will be employed, consistent with the process undertaken during installation of existing TMPs.

Odor Management during Drilling

1. Each TMP will be installed as quickly as possible to minimize the amount of time the borehole is exposed. That means no borehole will be started that cannot be completed without breaks (either end of the day or a lunch break).

Control Measures during Handling and Transportation of Excavated Wastes

1. The excavated wastes will be placed in a roll-off container or dump truck to transport to the Bridgeton transfer station. The container or dump truck will be tarped following placement of waste.
2. In all cases, the waste must be covered with an odor control product in the container used for transport. If wastes require mixing, then the product can be applied following mixing if odors persist from these waste materials. The product must be applied to completely cover the wastes with a thin coating.

Solid wastes removed from the TMP installation will be handled the same way the drill cuttings have been handled throughout work at the Bridgeton Landfill. Monday through Friday until 6:00 PM, spoils will be transported from the work area to the transfer station as they are excavated. We will not excavate after 6:00 PM Monday through Friday. This spoil handling procedure will also occur on Saturday until 1:00 PM. After 1:00 PM on Saturday, and all day on Sunday (if work is being performed), excavation spoils will be containerized in a lined roll-off box. Once the container is full, it will be covered to minimize any odors from escaping the box. The box will be stored on-site until Monday morning when it will be direct hauled to Roxana Landfill.

This was the handling process utilized for the prior activities, based upon the approval of St. Louis County. Provided St. Louis County approves this process again, this is how materials will be managed for this project. If St. Louis County does not approve this waste handling approach, roll-off boxes will be staged to receive the waste, and those roll-off boxes will then be transported to Roxana Landfill the next day. This process would still include the same materials handling methods as noted above (spray on product, cover with tarps, etc.) only the material will be stored in lined roll-off boxes.

Monitoring and Mitigation Measures for Gas System Expansion

Limited waste removal is expected during installation of gas extraction wells. In order to ensure this activity does not pose a risk of bird attractant the following steps will be employed, consistent with the process undertaken during installation of existing gas extraction wells.

Odor Management during Drilling

1. Each gas extraction well will be installed as quickly as possible to minimize the amount of time the borehole is exposed. That means no borehole will be started that cannot be completed without breaks (either end of the day or a lunch break).
2. During drilling, a vacuum box will be installed and operated at the borehole location to collect as much gas as possible during the drilling operations.
3. The vacuum will be applied to the Vacuum Drilling Box via a small blower. The exhaust of this blower will be connected to carbon vessels that will remove the odors.

Control Measures during Handling and Transportation of Excavated Wastes

1. The excavated wastes will be placed in a roll-off container or dump truck to transport to the Bridgeton transfer station. The container or dump truck will be tarped following placement of waste.
2. In all cases, the waste must be covered with an odor control product in the container used for transport. If wastes require mixing, then the product can be applied following mixing if odors persist from these waste materials. The product must be applied to completely cover the wastes with a thin coating.

Solid wastes removed from the gas extraction well installation will be handled the same way the drill cuttings have been handled throughout work at the Bridgeton Landfill. Monday through Friday until 6:00 PM, spoils will be transported from the work area to the transfer station as they are excavated. We will not excavate after 6:00 PM Monday through Friday. This spoil handling procedure will also occur on Saturday until 1:00 PM. After 1:00 PM on Saturday, and all day on Sunday (if work is being performed), excavation spoils will be containerized in a lined roll-off box. Once the container is full, it will be covered to minimize any odors from escaping the box. The box will be stored on-site until Monday morning when it will be direct hauled to Roxana Landfill.

This was the handling process utilized for the prior activities, based upon the approval of St. Louis County. Provided St. Louis County approves this process again, this is how materials will be managed for this project. If St. Louis County does not approve this waste handling approach, roll-off boxes will be staged to receive the waste, and those roll-off boxes will then be transported to Roxana Landfill the next day. This process would still include the same materials handling methods as noted above (spray on product, cover with tarps, etc.) only the material will be stored in lined roll-off boxes.

Monitoring and Mitigation Measures for Gas Interceptor Well Expansion

Limited waste removal is expected during installation of the gas interceptor wells. In order to ensure this activity does not pose a risk of bird attractant the following steps will be employed, consistent with the process undertaken during installation of existing gas interceptor wells.

Odor Management during Drilling

1. Each gas interceptor well will be installed as quickly as possible to minimize the amount of time the borehole is exposed.
2. Because installation of gas interceptor wells may take more than one day, the open boring will be covered at the end of each work day to control odors and prevent exposed material from creating a bird attractant.
3. During drilling, a vacuum box will be installed and operated at the borehole location to collect as much gas as possible during the drilling operations.
4. The vacuum will be applied to the Vacuum Drilling Box via a small blower. The exhaust of this blower will be connected to carbon vessels that will remove the odors.

Control Measures during Handling and Transportation of Excavated Wastes

1. The excavated wastes will be placed in a roll-off container or dump truck to transport to the Bridgeton transfer station. The container or dump truck will be tarped following placement of waste.

2. In all cases, the waste must be covered with an odor control product in the container used for transport. If wastes require mixing, then the product can be applied following mixing if odors persist from these waste materials. The product must be applied to completely cover the wastes with a thin coating.

Solid wastes removed from the gas interceptor well installation will be handled the same way the drill cuttings have been handled throughout work at the Bridgeton Landfill. Monday through Friday until 6:00 PM, spoils will be transported from the work area to the transfer station as they are excavated. We will not excavate after 6:00 PM Monday through Friday. This spoil handling procedure will also occur on Saturday until 1:00 PM. After 1:00 PM on Saturday, and all day on Sunday (if work is being performed), excavation spoils will be containerized in a lined roll-off box. Once the container is full, it will be covered to minimize any odors from escaping the box. The box will be stored on-site until Monday morning when it will be direct hauled to Roxana Landfill.

This was the handling process utilized for the prior activities, based upon the approval of St. Louis County. Provided St. Louis County approves this process again, this is how materials will be managed for this project. If St. Louis County does not approve this waste handling approach roll-off boxes will be staged to receive the waste, and those roll-off boxes will then be transported to Roxana Landfill the next day. This process would still include the same materials handling methods as noted above (spray on product, cover with tarps, etc.) only the material will be stored in lined roll-off boxes.

Monitoring and Mitigation for EVOH Cap Installation

It is expected that minimal waste will be generated from construction of the temporary cap project. Solid waste may be generated during the installation of the perimeter collection sumps. It is anticipated that approximately 10 feet of soil cover underlain by solid waste will be disturbed. Therefore 10 foot depth of solid waste with a three foot diameter at each perimeter collection sump could generate approximately 2.6 bank cubic yards of solid waste from each sump location. During the excavation of any waste, the material will be placed directly into lined roll-off containers or in a haul truck provided by Bridgeton Landfill. The following handling and transportation measures would be employed, consistent with the measures undertaken for sump installation for the existing EVOH cap.

Control Measures during Handling and Transportation of Excavated Wastes

1. The excavated wastes will be placed in a roll-off container or dump truck to transport to the Bridgeton transfer station. The container or dump truck will be tarped following placement of waste.
2. In all cases, the waste must be covered with an odor control product in the container used for transport. If wastes require mixing, then the product can be applied following mixing if odors persist from these waste materials. The product must be applied to completely cover the wastes with a thin coating.

This was the handling process utilized for the prior activities, based upon the approval of St. Louis County. Provided St. Louis County approves this process again, this is how materials will be managed for this project. If St. Louis County does not approve this waste handling approach, roll-off boxes will be staged to receive the waste, and those roll-off boxes will then be transported to Roxana Landfill the next day. This process would still include the same materials handling methods as noted above (spray on product, cover with tarps, etc.) only the material will be stored in lined roll-off boxes.