Curley, Ruth E (DEC)

From: Kevin Kleaka, PG <kkleaka@impactenvironmental.com>
Sent: Tuesday, June 18, 2019 1:52 PM
To: Curley, Ruth E (DEC)
Cc: Joseph Stern; rb@sbdevelopmentgroup.com
Subject: RE: Former Union Wire Die Corp, Site No. C241163
Attachments: Former Union Wire - Final Geotechnical Boring Work Plan.pdf

Ruth,
Please see attached final work plan for geotechnical borings per your comments. As discussed, we will be sending a separate plan for test pits. Thank you,

KEVIN KLEAKA, PG | Exec. Vice President

From: Curley, Ruth E (DEC) <ruth.curley@dec.ny.gov>
Sent: Wednesday, June 12, 2019 9:47 AM
To: Kevin Kleaka, PG <kkleaka@impactenvironmental.com>
Cc: Curley, Ruth E (DEC) <ruth.curley@dec.ny.gov>
Subject: RE: Former Union Wire Die Corp, Site No. C241163

Kevin

I have reviewed the geotechnical boring workplan you submitted on 6/5/19. It is approved with the following condition for the IDW -Containerize the liquids from the mud rotary drilling rather than "allowing to dry"

Driller should use care to avoid damage to the existing wells in the sidewalk in vicinity of the B3 and B6. I assume that B6 will be on the actual property, rather than on the sidewalk.

The SMP & CAMP should be available on-site for reference, and the VOC and PM levels that will trigger actions by the driller should be tabbed & highlighted to ensure that the monitor is cognizant of the requirements. Impact will be conducting monitoring in accordance with the CAMP for the outside activities.

In paragraph 2, the drawings you brought to Albany show that there ARE exceedances of PCE in the soil on site. PCE was found in the pre-design sampling (July 2016), is not deep, and is being addressed by the SVE system

Please advise the Department of the duration of the fieldwork at 7 days in advance.

Ruth Curley
Professional Engineer 1 (Environmental)
Division of Environmental Remediation
New York State Department of Environmental Conservation
625 Broadway, 12th Floor Albany, NY 12233-7016

P: 518-402-9480 | F: 518-402-9773 | ruth.curley@dec.ny.gov
www.dec.ny.gov | |

From: Kevin Kleaka, PG <kkleaka@impactenvironmental.com>
Sent: Wednesday, June 05, 2019 6:15 PM
To: Curley, Ruth E (DEC) <ruth.curley@dec.ny.gov>
Cc: 'Roni M. Benjamini' <rb@sbdevelopmentgroup.com>; Joseph Stern <js@sbdevelopmentgroup.com>; Kevin Kleaka, PG <kkleaka@impactenvironmental.com>
Subject: Former Union Wire Die Corp, Site No. C241163

Hi Ruth,
Attached please find the Work Plan for the geotechnical borings proposed at the above-referenced Site. This plan is intended to provide the NYSDEC with the required fifteen (15) day notification of activities that are “anticipated to encounter remaining contamination” as per the SMP. Please advise if you have any questions or comments. Thank you,

KEVIN KLEAKA, PG | Exec. Vice President
t: 631-269-8800 x129| m: 516-805-8892
a: 170 Keyland Court|Bohemia| NY|11716
Our email policies

June 18, 2019

Ms. Ruth Curley, Professional Engineer
New York State Department of Environmental Conservation
Division of Environmental Remediation
625 Broadway, 12th Floor Albany, NY 12233-7016

RE: 39-40 30th Street, Long Island City, New York
Former Union Wire Die Corp, Site No. C241163
Geotechnical Work Plan

Dear Ms. Curley:

The site is located at 39-40 30th Street, Long Island City, Queens County, NY (herein referred to as the "Site"). The Site is currently in the New York State Brownfield Cleanup Program (BCP) which is administered by New York State Department of Environmental Conservation (NYSDEC). After completion of the remedial work, some contamination was left at this site, which is hereafter referred to as "remaining contamination". Institutional and Engineering Controls (ICs and ECs) have been incorporated into the site remedy to control exposure to remaining contamination to ensure protection of public health and the environment. This letter serves as a work plan for the geotechnical borings that will be installed on the Site. The basis of this work plan is to conform with the requirements of the Site Management Plan ("SMP"), dated September 2017 prepared by AMC Engineering, PLLC. Specially, this plan is intended to conform with the requirements of the Excavation Work Plan ("EWP"), the Community Air Monitoring Plan ("CAMP") and the Health and Safety Plan ("HASP") contained within the SMP. This plan is intended to provide the NYSDEC with the required fifteen (15) day notification of activities that are "anticipated to encounter remaining contamination" as per the SMP.

SCOPE OF WORK

Four (4) soil borings are planned to be installed at the Site for geotechnical purpose to evaluate the load bearing capacity of the existing soils for foundation design to support the proposed building structure. The borings will be installed by a drilling contractor, PG Environmental Services, Inc. of Hauppauge, New York. The work will be performed in compliance with the EWP and 29 CFR 1910.120. A copy of PG Environmental Services, Inc. HASP can be found as an attachment to this work plan. The schedule of the scope of work is expected to require approximately seven (7) days upon notification of approval by NYSDEC.

Anticipated Remaining Contamination

Chlorinated VOC contamination at the Site consists mainly of trichloroethene (TCE) in shallow soil along the south and east portions of the building to a depth of 0-2 feet extending to 4-6 feet below grade at one location and is expected to be encountered in borings B-4 and B-5 within the interior of the existing building. TCE was not reported above USCOs in any of the deeper samples. PCE was reported above USCOs in shallow soil samples collected on the site. Groundwater is present at a depth of approximately 20 feet below grade. Chlorinated VOCs including tetrachloroethene (PCE) and TCE were detected throughout the Site above NYSDEC groundwater standards.

Utility Clearance

Prior to the start of work, 811 public utility clearance mark-outs will be called in by the contractor. In addition, a ground penetrating radar survey will be completed at each proposed boring location to clear each location of utilities. As a final precaution, soft-dig techniques will be employed at each boring using hand digging tools to clear the boring to five (5) ft below grade surface (bgs). In addition to clearance of underground utilities, including the vertical SVE wells present on the Site, a representative of Impact Environmental will be present during the setup and mobilization for drilling locations within the interior of the building to ensure that above-grade SVE piping is not damaged from drilling activities.

Geotechnical Soil Borings

Two (2) borings will be installed on the exterior of the Site along 30th Street utilizing a 7822DT Geoprobe, and two (2) borings will be installed within the interior of the existing building on the Site utilizing an electric-powered Acker skid mounted drill rig. The drilling rigs will be equipped with a geotechnical hammer. The location of the proposed borings is provided in the attached Boring Location Plan.

Drilling Methods

Each boring will be cored using a closed-bottom casing to twenty (20) ft bgs. The casing will remain in the ground for the remainder of the boring installation. The boring will continue to the required depth using mud rotary drilling techniques in accordance with industry standards. Two borings (b-4 & b-6) shall extend to 100-ft below existing grade, or 5-ft into competent rock, whichever occurs first. The other two borings (B-3 & B-5) shall extend to 50-ft below existing grade, or 5-ft into competent rock, whichever occurs first.

Sampling

Soil samples shall be taken at 5-ft interval with the top 15-ft of soil being continuously sampled. Rock, if encountered, shall be cored using a size diamond-tipped double core barrel. If organic clay/silt are encountered, continuous samples will be collected until the end of the organic layers. Soil & rock samples shall be maintained until the foundation work has been completed and accepted, or until 1 year after the investigation is complete, whichever is longer. Soil sampling will be conducted with standard split-spoon methods. Geotechnical data that will be collected includes blow counts and soil samples collected may be subject to seize analysis based on requirements by the geotechnical engineer.

Boring Abandonment

Each boring will be abandoned using bottom-up grouting techniques with granular bentonite to prevent potential cross-contamination. A grouting Standard Operating Procedure is provided as an attachment to this work plan. Material specifications for the grouting product that will be used is provided as an attachment. Surface restoration of each boring will be finished consistent with the existing pavements. No other import of materials are expected to be required for this SOW.

Investigative Derived Waste

All investigative-derived waste will be properly transferred and containerized into DOT approved 55-gallon drums for proper off-site disposal. No spoils are expected from the drilling activities, with the exception of the samples generated from the split spoon samplers. All liquids generated during mud-rotary drilling will be properly transferred and containerized into DOT approved 55-gallon drums. All investigative-derived waste will be properly disposed of at an approved offsite disposal facility.

Waste Characterization Sampling and Laboratory Analysis

Sampling of investigative derived waste generated from drilling activities will be conducted by a qualified representative of Impact Environmental Closures, Inc. Soil (or liquid, if necessary) samples will be collected in accordance with disposal facility permits and requirements. The laboratory analysis conducted for the waste will include parameters required to determine if the soil is classified as hazardous. The analytical requirements for the soil/sediment disposal will be based on two anticipated disposal facilities; Clean Earth of North Jersey and Bay Shore Soil Management. The sampling matrix with frequency and methods are attached to this work plan. The results and final selected disposal facility will be forward to the NYSDEC prior to shipping material off-site. Legal transportation and manifesting will be performed in accordance with applicable regulations.

Community Air Monitoring

Community air monitoring activities will be conducted during drilling activities on the exterior of the Site (Borings B-3 & B-6) by a qualified representative of Impact Environmental Closures, Inc in accordance with the CAMP outlined in the SMP. Community air monitoring activities will not be conducted during drilling activities within the interior of the existing building.

Please contact me with any questions.

Sincerely,
Impact Environmental Closures, Inc.

Kevin Kleaka, P.G.
Executive Vice President

Cc: Joe Stern, LIC Owner LLC (via Email)
Roni Benjamini, LIC Owner LLC (via Email)

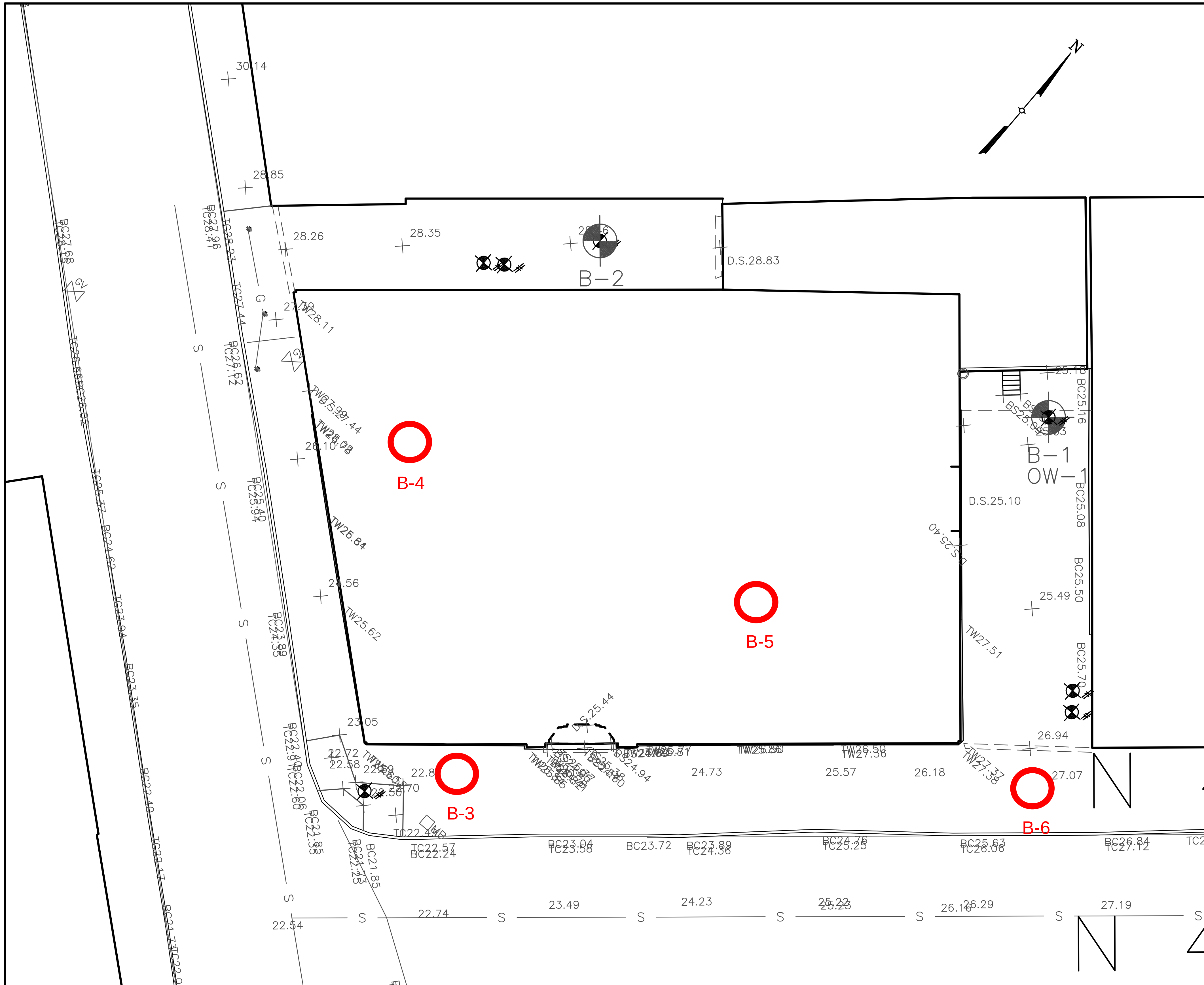
Attachments:

- Boring Location Plan
- Equipment Specifications
- Standard Operating Procedures – Grouting
- Facility Sampling and Analysis Matrix
- PG Environmental HASP

ATTACHMENTS

Former Union Wire Die Corp.

- Boring Location Plan
- Equipment Specifications
- Standard Operating Procedures – Grouting
- Facility Sampling and Analysis Matrix
- PG Environmental HASP



LEGEND

BORING NOTES:

1. TWO BORINGS (B-4 & B-6) SHALL EXTEND TO 100-FT BELOW EXISTING GRADE, OR 5-FT INTO COMPETENT ROCK, WHICHEVER OCCURS FIRST. THE OTHER TWO BORINGS (B-3 & B-5) SHALL EXTEND TO 50-FT BELOW EXISTING GRADE, OR 5-FT INTO COMPETENT ROCK, WHICHEVER OCCURS FIRST.

2. SOIL SAMPLES SHALL BE TAKEN AT 5-FT INTERVAL WITH THE TOP 15-FT OF SOIL BEING CONTINUOUSLY SAMPLED.

3. ROCK, IF ENCOUNTERED, SHALL BE CORED USING AN NX SIZE DIAMOND-TIPPED DOUBLE CORE BARREL.

4. IF ORGANIC CLAY/SILT ARE ENCOUNTERED, TAKE CONTINUOUS SAMPLES TILL THE END OF THE ORGANIC LAYERS.

5. SOIL & ROCK SAMPLES SHALL BE MAINTAINED UNTIL THE FOUNDATION WORK HAS BEEN COMPLETED AND ACCEPTED, OR UNTIL 1 YEAR AFTER THE INVESTIGATION IS COMPLET, WHICHEVER IS LONGER.

0 1 2 3

ORIGINAL SIZE IN INCHES

TECTONIC

- PLANNING
- ENGINEERING
- SURVEYING
- CONSTRUCTION MANAGEMENT

TECTONIC Engineering & Surveying Consultants P.C.
P.O. Box 37, 70 Pleasant Hill Road
Mountainville, NY 10953
Phone: (845) 534-5959
Fax: (845) 534-5999
www.tectonicengineering.com

BORING LOCATION PLAN

39-40 30th STREET
LONG ISLAND CITY
QUEENS
NEW YORK

Date	Work Order	Drawing No.	Rev
1-29-2014	7017.01	1	0
Scale 1'-20'			

7822DT MACHINE OPTIONS

Augerhead

213944	GA4000 2-Speed Augerhead
213945	GA4100 4-Speed Augerhead

Automatic Drop Hammer

213898	DH103 Automatic Drop Hammer, 140 lb.
213899	DH103M Automatic Drop Hammer, 65 kg
213900	DH103 Mounting Kit
216826	Automatic Drop Hammer 340 lb. Expansion Kit
217067	Automatic Drop Hammer 300 lb. Expansion Kit
221820	Automatic Drop Hammer 170 lb. Expansion Kit

Water Swivels

216398	High Speed Water Swivel w/ Float
210873	Float Sub NWJ Pin Asm
210874	Float Sub NWL Pin Asm
213482	Float Sub HWL Pin Asm
212606	Water Swivel 1.625 Hex NWJ Pin Mod
212558	GH60 Series Water Swivel Asm

Mast / Winch

222959	Dual Winch Kit
222623	Winch - 5/16 in. Cable
222624	Winch - 1/4 in. Cable
222625	Winch - 3/16 in. Cable
217508	Fixed Mast Top
216244	Rotating Mast Top
213364	3 ft. Mast Extension

Rotational Safety Cage

213002	Safety Cage for Machines with no Drop Hammer
212896	Safety Cage for Machines with Drop Hammer

Breakout

212785	7 in. Single Clamp Breakout
217024	Coring Upgrade Kit for 7 in. Breakout
213421	Probe Rod Handling Clamp for 3.5 in. - 1.25 in. Probe Rods

Control System

216137	Head Feed Pressure Control Kit
213384	CPT Valve Kit

Water / Mud Pumps

210603	Moyno® 2L4 Pump & Mount Assembly - Helper Side
218263	Moyno® 2L4 Pump & Mount Assembly - Operator Side
209926	Moyno® 3L6 with Table - Helper Side
220556	Moyno® 3L6 with Table - Operator Side
221614	Triplex Pump Kit - Helper Side
219556	SPX40 Pump & Mount Assembly
222823	Control Panel Gauge Mount Kit

Hydraulic Extruder

210107	Hydraulic Extruder Mount w/ Dropdown Work Surface
210729	Hydraulic Extruder Mounts (for Side Rail)
211622	Hydraulic Extruder Mounts (for Rod Rack)
205501	Hydraulic Extruder - 60 in. Stroke
204258	Hydraulic Extruder - 48 in. Stroke
220646	3 in. Shelby Tube Hydraulic Cradle Kit
221929	3 in. Shelby Tube Cradle
215781	Extruder w/ 2L4 Mounting Kit

Rod Racks

212306	Locking Side Mount Rod Rack
209257	Side Mount Rod Rack
221534	Swing Out Rod Rack
211734	Side Rack Mount Blank

Model 7822DT Specifications

UNIT PLATFORM		
Stroke	78 in	1,981 mm
Weight (approximate)	8,000 lb	3,632 kg
Width	64 in	1,626 mm
Length (folded)	133 in	3,378 mm
Height, w/standard mast (folded)	100 in	2,540 mm
Height, w/rotating mast (folded)	86 in	2,184 mm
Height, w/dual mast (folded)	100 in	2,540 mm
Height, no mast (folded)	79 in	2,007 mm
Height, w/mast (unfolded)	187 in	4,750 mm
Height, no mast (unfolded)	118.5 in	3,010 mm
Foot Travel	20.5 in	521 mm
Extension	15.5 in	394 mm
Lateral Movement (side-to-side)	± 7 degrees from centerline	
Oscillation	± 13 degrees from vertical	
Rear Stabilizer Lift	2,000 lb	907 kg
Rear Blade Width	60 in	1,524 mm
Ground Speed	0 - 5 mph	0 - 8 kph
Surface Load	4.6 lb/in2	0.32 kg/cm2
Track Width	12 in	305 mm

PERCUSSION HAMMER		
Hammer System	GH63	
Percussion Rate	32 Hz	
Forward Torque	517 ft-lb	701 N•M
Reverse Torque	637 ft-lb	864 N•M
Rotation Speed	0 - 234 rpm	
Power Cell Weight	90 lb	41 kg

HYDRAULIC SYSTEMS		
Down Force	36,000 lb	160 kN
Retraction Force	48,000 lb	214 kN
Hydraulic Pressure (system)	4,000 psi	275 bar
Hydraulic Flow Rate (system)	40 gpm	151 Lpm

ENGINE		
Engine (diesel)	Kubota, 4-cylinder turbo, Tier 4i	
Engine Power (rated)	58 hp	42 Kw
Fuel Capacity (diesel)	17 gal	64 L

AUGERHEAD		
GA4100 Augerhead, 4-Speed		
High Torque	4,000 ft-lb	5,423 N•M
Low Torque	400 ft-lb	542 N•M
High Speed Rotation	0-750 rpm	
Low Speed Rotation	0-75 rpm	
Hex Adapter	1-5/8 in	41 mm
GA4000 Augerhead, 2-Speed		
High Torque	4,000 ft-lb	5,423 N•M
Low Torque	2,000 ft-lb	2,711 N•M
High Speed Rotation	0-150 rpm	
Low Speed Rotation	0-90 rpm	
Hex Adapter	1-5/8 in	41 mm

HYDRAULIC WINCH		
Primary Winch		
Winch Rating	2,500 lbf	10.5 kN
Winch Speed	0-125 fpm	0-38 m/min
Cable Length	75 ft	23 m
Secondary Winch		
Winch Rating	1,100 lbf	4.4 kN
Winch Speed	0-220 fpm	0-55 m/min
Cable Length	250 ft	46 m

7-in. SINGLE CLAMP BREAKOUT		
Clamp Opening	7 in	178 mm
Clamp Range	1.25 - 6 in	31.75 - 152 mm
Clamp Force	0 - 17,500 lbf	0 - 78 kN
Breakout Torque	6,000 ft-lbf	8,135 N•m
Weight	350 lb	159 kg

7822DT

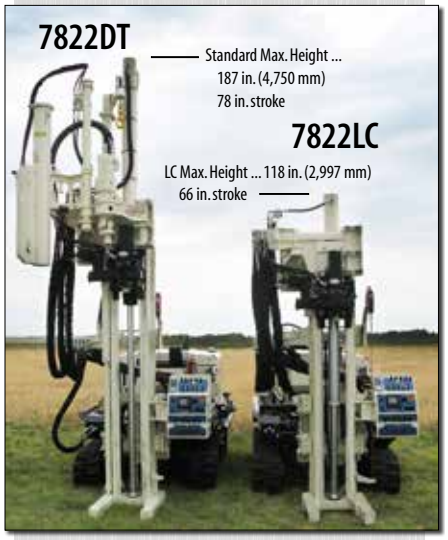
- **Rock Coring Compatible**
- **Reliable Geoprobe® GH60 Series Percussion Hammer**
- **Modular Percussion Power Cell Technology**
- **Two- and Four-Speed Augerhead (optional)**
- **Dual Winch Option**
- **Frame Rail Design for Adding Machine Accessories**
- **Tethered and Wireless Control**
- **Integrated Drill Mast Oscillation**
- **Rear Blade for Stabilization and Tooling Transport**

Geoprobe® Tooling Run with 7822DT

60-in. Direct Push Tooling

- Probe Rod Sizes: 3.75 in., 3.5 in., 3.25 in., 2.25 in., 1.5 in., 1.25 in.
- Direct Image® Tooling
- Macro Core® MC5 Soil Sampling (2.25 in. x 5 ft.)
- DT22 Soil Sampling
- DT325 / DT35 / DT375 Dual Tube Soil Sampling
- SP22 Groundwater Sampling
- SP16 Groundwater Sampling
- 2.0 in., 1.5 in., 1.0 in., 0.75-in. Prepacked Monitoring Well Installations
- DH103 Auto Hammer for SPT
- 4.25 in. and 6.0 in. H S A System

7822DT gathers geotechnical infromation for a new mining site. Installing 17 wells inside building. Squeezing between buildings.

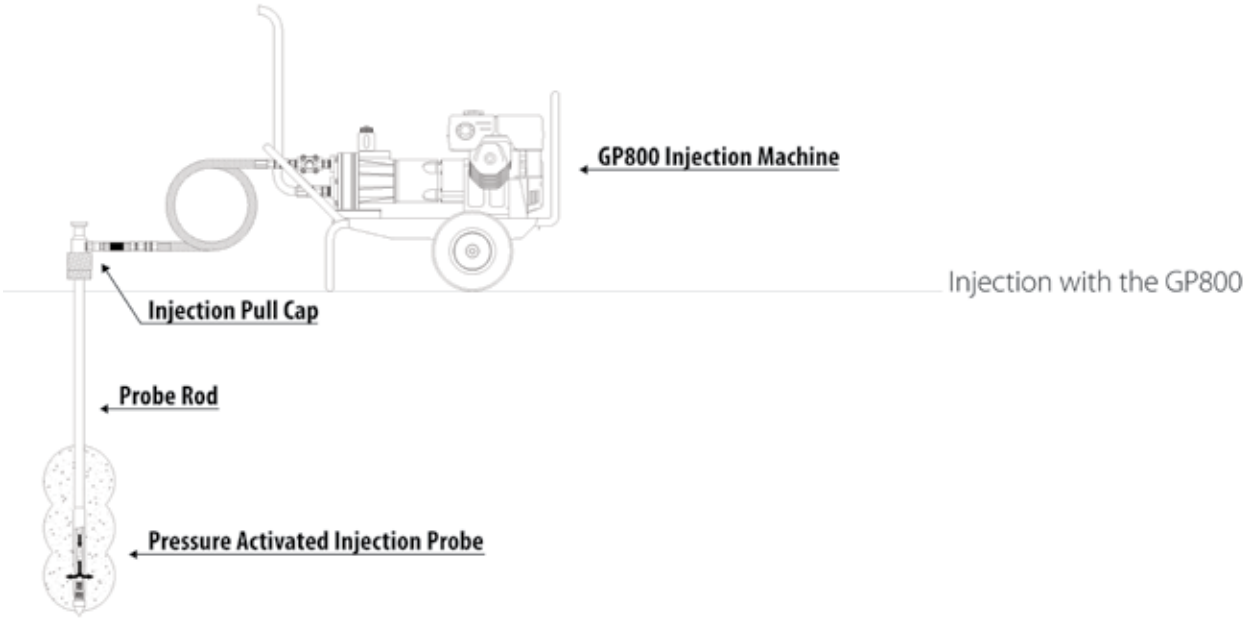


Geoprobe®

Geoprobe Systems®
1-785-825-1842
geoprobe.com

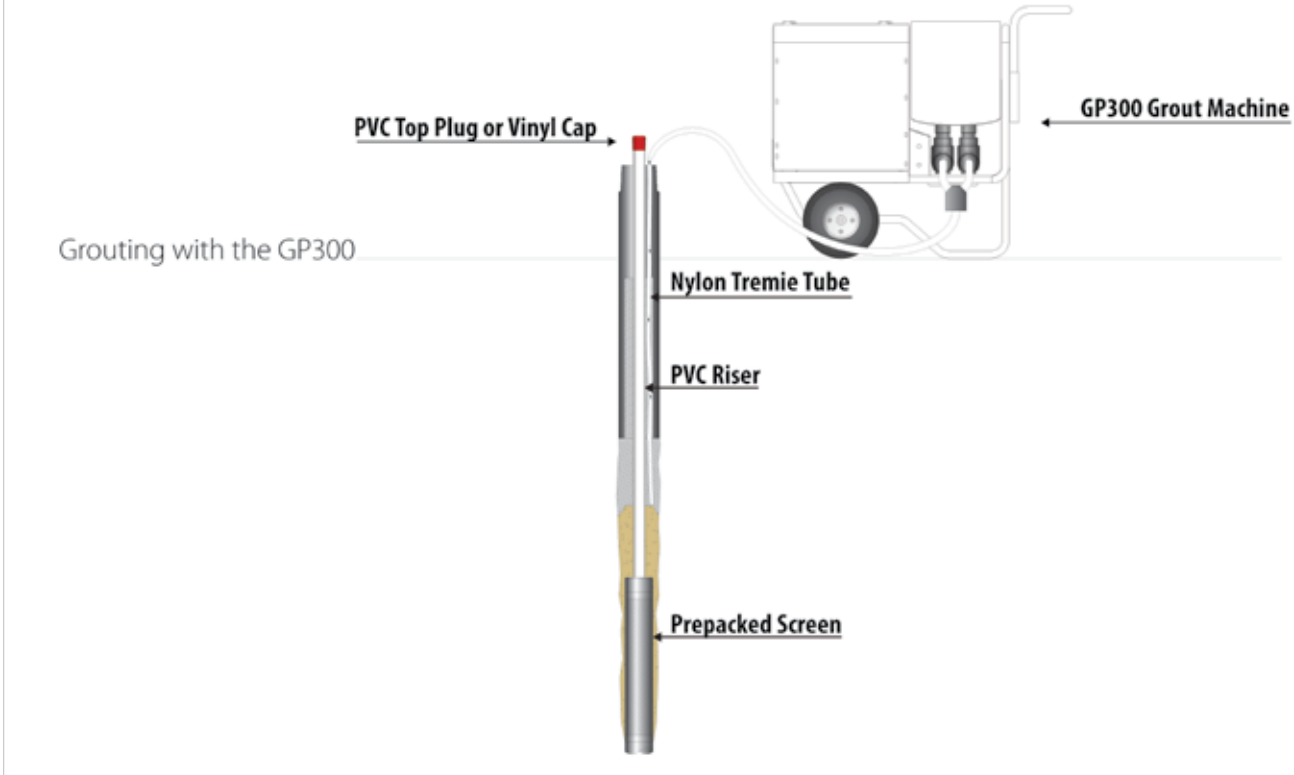
Injection with the GP800

geoprobe.com/**gp800**



Grouting with the GP300

geoprobe.com/**gp300**



GP300

geoprobe.com/**gp300**

GP300 INJECTION/GROUT SYSTEM ASM
MN: ***213987*** PN: GP300

GROUT HOPPER STRAINER
MN: ***202853*** PN: 16222

FLOW COMBINER ASM
MN: ***202926*** PN: 16681

GP350

geoprobe.com/**gp350**

GP350 INJECTION/GROUT SYSTEM ASM
MN: ***213988*** PN: GP350

GROUT HOPPER STRAINER
MN: ***202853*** PN: 16222

POWER CORD/HYD HOSE ASM 20 ft. GP350
MN: ***210736*** PN: 45290

FLOW COMBINER ASM
MN: ***202926*** PN: 16681

GP800

geoprobe.com/**gp800**

GP800 INJECTION PUMP
MN: ***213991*** PN: GP800

DP800 SUCTION HOSE 6 ft.
MN: ***203471*** PN: 19121

DP800 INJECTION HOSE 15 ft. SS JACKET
MN: ***203472*** PN: 19123

DP800 PRESSURE RELIEF HOSE 4 ft.
MN: ***203837*** PN: 21061

DH-Series Automatic Drop Hammer

Collect Standard Penetration Test (SPT) blow counts with your Geoprobe® machine.

- Easy on / Easy off design!
- Conforms to ASTM Standards D1586-99.
- Consistent results with no human error.
- No cables or ropes needed for operation.
- Hammer swings over hollow stem augers...no need to reposition the whole machine.
- Throw height can be adjusted within seconds.
- Use your Geoprobe® track machine for both environmental AND geotechnical projects.
- Used to perform Standard Penetration Test (SPT) which is the most common in situ geotechnical test in the U.S.
- SPT blow count results are used by engineers for obtaining strength and density properties of soil, designing foundations, and defining earthquake sensitive soils.
- Use the Geoprobe® SPT dual tube system with the automatic hammer for SPT testing.
- Mounting options for Geoprobe® 7730DT, 7720DT, 6620DT, 7822DT, & 8040DT machines.

Automatic Drop Hammer Specifications		
Weight (hammer only - ASTM D1586)	140 lb.	63.5 kg
Weight (hammer unit)	470 lb.	213 kg
Height (transport)	63 in.	1,600 m
Width (transport)	20 in.	508 mm
Depth (transport)	14.5 in.	368 mm
Cabinet Float/Travel Distance	31 in.	787 mm
Maximum Percussion Rate	60 blows per minute	
Hydraulic Flow Rate	13 gpm	50 Lpm
Hydraulic Pressure Rating	2,500 psi	172 bar

Drop Hammer Mounting Configurations

- **The DH100 Auto Drop Hammer configures to 6620DT, 7720DT, 7730DT Geoprobe® Machines.**
- **The DH103 Auto Drop Hammer configures to the 7822DT Geoprobe® machine**
- **The DH101 Auto Drop Hammer configures to the 8040DT Geoprobe® machine**
- **The DH104 Auto Drop Hammer configures to the 8140LC Sonic Machine**

The DH103 Automatic Drop Hammer for the Geoprobe® 7822DT

Drop Hammer Operation

- Powered from auxiliary hydraulics on the probing machine
- Drops 140 pound (64 kg) weight 30 inches (762 mm)
- 60 blows per minute driving rate
- Accurate, repeatable results
- The anvil impact surface and all moving parts are enclosed for safety
- Easy on and off requires one pin to be pulled – no bolts to keep track of
- Hammer can be mounted or detached within minutes using the probe machine's winch
- Hammer can safely be stored upright on storage base for small footprint and easy access
- Optional Upgrades for the DH101 & DH103

  217067-AUTO DROP HAMMER 300 LB EXPANSION KIT

  216826-AUTO DROP HAMMER 340 LB EXPANSION KIT

Specs

GP300 Specifications

	Standard	Metric
Weight (with empty hopper)	325 lbs.	148 kg
Hopper Capacity	12.75 gal	48.3 L
Hopper Capacity (3 in. freeboard)	9.5 gal.	36 L
Injection Pump	Hydraulically-driven dual piston pumps	
Hydraulic Power Source	Fixed displacement gear pump	
Hydraulic Power Source Engine	Honda Model GX270 (gasoline)	
Hydraulic Reservoir Capacity	6.75 gal.	25.6 L
Engine Fuel Capacity	1.59 ga.	6.0L
Engine Power	9.0 hp	67 kW
Grout Pump Displacement	13 cu. in.	213 mL
Grout Pump Pressure Rating	1300 psi	89.6 bar
Grout Pump Flow Rate	0.9 - 3.6 gpm	3.4 - 13.6 Lpm

C/S GRANULAR™

30-50 MESH GRANULAR BENTONITE

CETCO® CRUMBLES # 8

8-20 MESH GRANULAR BENTONITE

Certified to NSF/ANSI 60

DESCRIPTION

C/S GRANULAR and CETCO CRUMBLES are granular bentonite products composed of polymer-free, dried bentonite in various mesh sizes. CETCO CRUMBLES are coarser in size than C/S GRANULAR. C/S GRANULAR and CETCO CRUMBLES are certified to NSF/ANSI Standard 60, Drinking Water Treatment Chemicals -Health Effects.

RECOMMENDED USE

May be used as casing seal, hole abandonment material, and for sealing earthen structures.

CHARACTERISTICS

- Less than 10% moisture
- Provide a positive seal
- Re-hydrates
- Will not shrink or crack

MIXING AND APPLICATION	
Grouting Material	One bag CETCO Crumbles to 24 gallons (91 liters) water or 24 gallons water and 8 ounces (0.25 liters) ACCU-VIS
Dry Shallow Abandonment	Pour required amount directly down borehole; hydrate with freshwater
Earthen Structure Seal	Normal treatment is 3-5 pounds per ft^2 (48-80 kg per m2) depending on soil type

BULK DENSITY

65 lbs/ft^3 (1.04 kg/L)

PACKAGING

50 lb (22.7 kg) bag, 48 per pallet. All pallets are plastic-wrapped.

North America: 847.851.1800 | 800.527.9948 | www.CETCO.com

UPDATED: JULY 2015

FORM: TDS_CS_GRANULAR_CETCO_CRUMBLES_AM_EN_201507

WELL GROUTING

Introduction

Grouting is the placement of a sealing material such as neat cement or bentonite into the annular space between a well casing and the borehole created during well construction. Grouting is an effective and necessary measure for the protection of public health and ground water quality.

Proper grouting of the casing into the bedrock to a point below the upper fractured zone prevents contaminants from flowing into the well. Grouting with neat cement is required in areas where bedrock is close to the surface (less than 25 feet from surface) and in situations where upper bedrock formations produce water of unsuitable quality. Wells constructed with methods that produce a borehole larger than the casing (rotary, spiral auger, bored) must be grouted from the bottom of the annular space to the ground surface. Driven wells or those drilled by cable tool or hollow rod, where the casing is driven into the smaller diameter borehole, should be grouted by placing dry granular bentonite around the well casing as it is being driven. In some instances (e.g., drilling through a known contaminated formation using cable tool or similar methods) it is necessary to install a larger temporary conductor pipe, which will be removed during the grouting operation,

Purpose of Grouting

1. Provides sanitary protection for the water supply from surface or near-surface contamination sources.
2. Protects the water bearing formation by preventing movement of water between aquifers.
3. Seals off a formation which is known to have been contaminated or which produces water of undesirable quality.
4. Preserves the hydraulic characteristics of the aquifer and provides a seal against loss of artesian pressure.
5. Increases the life of the well casing by protecting it from corrosion in areas of acid soils or where other corrosive conditions exist.
6. Provides structural support for casing when neat cement is used for grouting PVC plastic well casing.

Grouting Rules

Rule 133a

- No devices to suspend grout.
- No inducing collapse of the borehole wall.
- Grout from bottom to top in a continuous operation.
- Density of grout shall be consistent.
- Borehole shall be at least 2 inches larger than the casing size.
- Borehole shall be at least 2 7/8 inches larger than the casing when a grout pipe outside the casing is used.
- An annular space between a permanent casing and temporary casing shall be grouted during temporary casing removal by pumping neat cement or bentonite grout,

or by pouring bentonite chips, bentonite pellets, or granular bentonite, into the annular space. Granular bentonite shall not be poured into an annular space that contains drilling fluid or water.

- Neat cement shall be allowed to set a minimum of 24 hours. If bentonite is added, the grout shall set a minimum of 48 hours.

Rule 134a Oversized borehole.

- Grout the entire length of the casing for a standard well installation.
- Grout not less than 10 feet above the top of the screen in a gravel-pack well to the level of the pitless adapter.
- The depth of grouting may be increased or decreased by the health officer.

Rule 135 Driven casing

- Maintain dry granular bentonite around the permanent well casing at all times that it is being driven.
- Where a temporary casing or temporary borehole is used, the borehole or temporary casing shall be at least 3 inches larger than the permanent casing and extend not less than 25 feet below the ground surface or into a confining layer identified by the health officer. Grouting of the annular space between the permanent casing and the temporary casing or borehole shall comply with the provisions of Rule 133a.

Rule 137 Bedrock wells.

- Where bedrock is encountered within 25 feet of the ground surface, an oversized borehole shall be drilled and the casing shall be grouted with neat cement for a minimum depth of 25 feet.

Rule 137a Verification of well grouting.

Contractor may be asked to excavate the well head for inspection if:

- Visible open annular space.
- Failure to detect grout 2 feet or more below the water service line.
- Dye detected in the well water after testing.
- Well log indicates that the well has not been grouted or lacks information or contains incomplete information.

Rule 138 Flowing artesian wells.

Shall be grouted to:

- Protect the artesian aquifer from loss of artesian head
- Prevent erosion of the borehole or the area in the vicinity of the well
- Confine the flow to within the casing

Prevent mixing of previously distinct aquifers below grade

Grouting Materials

Neat cement and bentonite are the two main materials used for making grout slurries.

Portland Cement, ASTM Type I or API Class A & B - Portland cement is a mixture of lime, alumina, magnesia, and sulfur trioxide. The components are combined and heated, and the resulting "clinker' is ground up and mixed with gypsum to make various types of cement. Type I cement is used in neat cement grout and concrete grout mixtures. Neat cement slurry is superior to bentonite as a grouting material in high bedrock situations, especially fractured limestone. It forms a hard rock-like seal around the casing which will not wash out from ground water flow in the formation. A curing time of 24 hours is required before resuming drilling.

As the water to cement ratio increases, the compressive strength of the cement will decrease and shrinkage during curing and permeability of the cement will increase. When cement is mixed with water, a number of chemical reactions take place. As the mixture cures and changes from a liquid to a solid, heat is given off. This is referred to as the "heat of hydration" and will result in an increase of the temperature of the casing and the surrounding soil. The amount of heat given off is dependent upon several factors, such as cement composition, use of additives, and thickness of the grout envelope. The American Petroleum Institute (API) recommends a water to cement ratio of 0. 46 by weight or 5.2 gallons of water per 94 lb. sack of cement (5.2 gal. of water x 8.33 lb/gal. = 43.3 lb. divided by 94 lb. of cement = 0.46).

The maximum recommended water to cement ratio for neat cement is 0.53, or 6 gallons of water per 94 lb. sack of cement. Under certain conditions it may be necessary for the well drilling contractor, consulting engineer, or regulatory agency to increase the amount of water used in the grout mixture. Factors, such as temperature, type of geologic formations, extent of fracturing, use of additives, and water quality, will affect performance of the grout material and should be considered when planning the grouting operation.

Portland Cement ASTM Type III or API Class C - This is referred to as high-early strength cement. The cement clinker is finely ground to provide smaller particle size than Type I cement. This increases surface area and provides high-early strength with a faster curing rate. A 24-hour curing time is required before resuming drilling when using either of these. For Class C cement, API recommends a water to cement ratio of 0.56, or 6.3 gallons of water per sack. For Type III cement, the water to cement ratio may range from 0.53 (6 gal./sack) to 0.62 (7 gal,/sack). Bentonite is commonly used as an additive (1-2%) with these types of cement. The amount of water necessary to hydrate the slurry properly increases with addition of bentonite.

Bentonite - Sodium bentonite is the principle ingredient in drilling mud or fluid used in rotary drilling. It is hydrous silicate of alumina and is comprised mainly of the clay mineral montmorillonite. The suitability of sodium bentonite as a grouting material comes from its ability to swell up to 15 times its dry volume when hydrated. It will maintain a gel-like seal around the casing if moisture is retained. Natural clays found in Michigan generally do not have the swelling properties to make them suitable as grouting material. Most bentonite used in the drilling industry is mined in the western United States. Bentonite used in Michigan shall be at least 85 percent montmorillonite and meet API specifications standard 13A. A slurry consisting of bentonite and water

may be used as a grouting material if it has a minimum weight of 9.4 lbs/gal. Field experience has shown that settling of solids frequently occurs, resulting in an open upper annulus and need for the well drilling contractor to regrout.

In recent years several new bentonite products have been marketed that are specifically designed for grouting. These grouts have a solids content of over 20 percent by weight and settling problems are greatly reduced. Therefore, these high solids bentonite grouts are recommended. Slurry weight of 9.4 lbs/gal as measured with a mud scale is required. Bentonite grouts should not be used in some porous formations, such as fractured limestone, where the bentonite may be washed away from the casing due to excessive ground water movement.

Grout Additives

Bentonite - This is added to cement to increase set volume, reduce shrinkage, decrease density, and decrease water loss from the cement. Up to 5 percent bentonite by weight may be added to cement slurries, although 1-2% is the more commonly used, preferred amount.

Calcium chloride ($CaCl_2$) - This accelerator is added to cement to speed up the setting time and increase early strength. Two percent $CaCl_2$ by volume added to cement will result in a compressive strength after 24 hours approximately equal to that of cement without $CaCl_2$ after 48 hours. Calcium chloride is useful when grouting in cold weather since it will speed cement curing. The use of $CaCl_2$ or other accelerators should be avoided when PVC well casing is used. The more rapid hydration of the cement will also be reflected in a rapid increase in temperature of the cement. This may result in deformation of plastic well casing.

Grouting Methods

Most water well grouting methods were developed by the oil well drilling industry. As water well drillers and public health officials became aware of the benefits of grouting, oil well grouting techniques were adapted for the water well industry. Several firms specializing in oil and gas well cementing can provide assistance to the water well driller when a large volume of cement grout is required.

Grout slurries must be placed into the annular space from the bottom of the zone to be sealed, upward to the surface in one continuous operation. Pouring grout directly into the annulus from the surface is not approved since it may result in bridging and prevent the grout from reaching the bottom. Several methods discussed below will provide for placement of grout from the bottom of the annular space.

Cement grout must be adequately mixed and free of lumps prior placement. Equipment to be used for mixing grout may range from a wheelbarrow and shovel to specially designed hoppers and jet-type mixing pumps. The grouting method and amount of grout required for a particular job will dictate the type of equipment to be used. Pumping equipment must be able to handle a viscous slurry, develop high pressures (100-300 pounds per square inch [psi]), and have an adequate capacity. Diaphragm, piston, worm gear, or helical type pumps are best suited for pumping cement slurries, but heavy duty open-vane centrifugal pumps can also be used under some conditions.

It is important that the drilling contractor demonstrate complete organization in his grouting procedure. A successful grouting job requires a sequence of events to occur without mechanical failure of cement mixing and pumping equipment. The contractor must also be prepared by having enough cement on site to complete the grouting without interruption and enough water for grout mixing and cleanup.

Centering guides should be used on the casing to assure centering of the casing within the borehole and complete encasement within the grout envelope. Prior to placement of the grout, the annular space should be checked to make sure that bridging or caving of material from the borehole wall has not occurred. When cement is used as a grouting material, adequate time must be allowed for cement curing prior to resuming drilling operations.

The following grouting methods are visually shown in the Well Construction Code book on page 56:

Displacement Method-In this method a borehole at least 2 inches larger than the nominal casing size is drilled. In caving formations, a temporary conductor casing (or surface casing) is installed to keep the borehole open during the grouting operation. The estimated volume of grout required is placed directly into the bottom of the borehole by shoveling, pouring or the use of a dump bailer after the temporary surface casing is in place. The permanent casing with a drillable plug (a wooden plug is often used) is lowered into the borehole to displace the grout. The plug also prevents grout from entering the inside of the permanent casing. In some cases the weight of the casing alone is not sufficient to displace the grout and the casing must be filled with water and forced into the hole by the pull-down mechanism on the rig. As the casing is lowered, the grout moves up the annular space from the bottom of the borehole toward the surface. The surface casing is removed promptly to expose the grout to the borehole wall. After the required curing time**,** the plug is drilled out and the drilling operations resume. This is one of the simplest grouting methods and is suitable for situations where the bottom of the borehole can be visually inspected prior to grouting (25 - 40 feet deep) and where little or no water is present in the borehole.

Grout Pipe Method (Gravity)-In this method the grout is placed in the annular space by gravity through a funnel attached to a grout pipe (or tremie) that is suspended in the annular space. A 1 inch or 1¼ inch rigid pipe is used as the grout pipe. The borehole diameter must be large enough to accommodate the grout pipe. A two inch or larger annular space will usually be sufficient, which requires a borehole that is 4-5 inches larger than nominal size of the casing. The use of welded casing aids in providing maximum annular space for grouting. The grout pipe is extended down between the permanent casing and conductor casing. The grout is placed through the funnel & tremie in one continuous operation, beginning at the bottom of the zone being sealed. The bottom end of the grout pipe should be kept full of grout and remain submerged in grout during the operation. The grout pipe is gradually withdrawn as the grout fills the annular space. This is accomplished by disjointing it in typically 10 foot sections. The conductor pipe should be removed as the grout is being placed in the annulus. Grout should be added until it appears at ground surface. Where a pitless adapter is to be installed, grout may be terminated a few feet below surface. Drilling is resumed after curing of the cement.

Grout Pipe/External Placement Method (Pumping) – *This is the most commonly used grouting method.* The same procedure as described above is followed except that the grouting material is placed in the annulus with the aid of a grout pump rather than by gravity flow alone. Screening the cement before it is placed into the mixing hopper will help to prevent clogs and interruption of the grout pumping procedure. The grouting procedure begins with the tremie pipe being lowered to the bottom of the annulus. As the grout material is placed by pumping, the tremie pipe should be sequentially raised to prevent it from becoming stuck in the annulus. Typically, thin cement grout appears initially at the surface. Grouting may stop when consistently thick cement grout is observed. A grout scale is useful in determining adequacy of the grout weight. A slurry of neat cement grout, mixed at a ratio of 6 gallons of water to one 94 pound sack of Portland cement will weigh approximately 15 pounds per gallon.

Pressure Cap Method-In this method, the grout is placed through a grout pipe that is inside the permanent casing. An airtight pressure cap is placed in top of the casing with the grout pipe extending through it to the bottom of the casing. The casing is suspended off the bottom of the borehole. A valve on the pressure cap allows water or drilling mud to be circulated down the grout pipe and out through the pressure cap, filling the casing and annulus. The valve is then closed to keep the casing filled with water or drilling mud, without an interruption in pumping, cement is substituted for water or drilling mud and is injected down the grout pipe until the grout appears at the surface. The water or mud in the casing prevents the grout from entering the open casing bottom. After the grout appears at the surface, just enough water or mud is pumped through the grout pipe to flush cement from it. The grout pipe is then pulled back through the pressure cap to raise the end out of the cement and prevent it from being cemented in. Pressure is maintained in the well casing until the grout has cured. Drilling is resumed after the required setting time.

Grout Shoe Method-This method involves pumping the grout through a grout pipe inside the casing, which is fitted with a drillable cementing shoe (or float shoe), and raised above the bottom of the borehole. The cementing shoe has a backpressure valve, which prevents grout from backing up into the casing when the grout pipe is removed. The grout is forced around the bottom of the casing and upward in the annular space until it appears at the surface. The grout pipe is then detached from the cementing shoe and raised to the surface. After the required setting time, the cementing shoe is drilled out and the work on the well continued.

Displacement Plug Method- This method involves pumping the grout directly down the permanent well casing, which is raised off the bottom of the borehole. Grout is forced upward in the annular space to the surface and displaces drilling mud or water that has been circulated prior to grouting. The volume of grout required for the job is pumped into the casing. A displacement plug (or separator plug) is placed on top of the grout column in the casing. The plug is made of a drillable material such as plastic, rubber or wood. A measured volume of water equal to the volume of the casing is pumped into the casing, forcing the plug to the bottom of the casing and expelling the grout into the annular space. Pumping continues until grout appears at the surface. The water in the casing is maintained under pressure until the cement has set. In this method, a zone of weak cement may exist at the interface of the grout and drilling mud if all of the drilling mud is not wasted at the surface. However upon completion this zone will be located at

the upper end of the annulus rather than at the critical location at the bottom of the casing. If additional grout is added, this weak cement may be pumped onto the ground surface. In this method, it is critical that volumes of grout and displacement water be accurate.

Grouting Wells – Volume Calculations

The chart below may be used to estimate the total volume of grout slurry required to fill the annular space between the permanent well casing and the borehole. The bags of grout required can be determined by dividing volume listed in the table below by the grout manufacturers suggested yield per bag. Be sure the yield per bag is in cubic feet (ft) for this calculation. If not, recall that 1 cubic foot of water = 7.48 gallons. An amount equal to 20 percent of the calculated volume may have to be added to allow for borehole irregularities.

ANNUAL SPACE VOLUME
(Cubic Feet)
DIAMETER IN INCHES

WEL CASING DEPTH IN FT.	CASING	2	2	4	4	5	5	6	6	6	8	8
	HOLE	4	6	6	8	8	10	8	10	12	10	12
	25	1.4	4.1	2.1	6.0	4.5	9.4	2.7	7.6	12.6	3.5	9.5
	50	2.8	8.3	4.3	11.9	9.0	18.8	5.5	15.3	27.3	7.0	19.0
	75	4.2	12.4	6.4	17.9	13.5	28.2	8.2	22.9	40.9	10.5	28.5
	100	5.6	16.5	8.6	23.8	18.0	37.6	11.0	30.6	54.6	14.0	37.9
	125	7.2	20.7	10.8	29.8	22.5	47.1	13.7	38.3	68.2	17.5	47.4
	150	8.5	24.8	12.9	35.8	27.0	56.5	16.4	45.9	81.8	20.9	56.9
	175	9.9	29.0	15.1	41.8	31.5	65.9	19.2	53.6	95.5	24.4	66.4
	200	11.3	33.1	17.2	47.7	36.0	75.3	21.9	61.2	109.1	27.9	75.9

Grouting Wells – Neat Cement Requirements

The chart, *'Grouting Wells - Neat Cement Volume Requirements'* may be used for estimating the number of bags of cement required for grouting the annular space between the permanent well casing and the borehole. These figures are based on a mixture of one bag (94 lbs.) of cement to 6.0 gallons of clean water, which yields a volume of 1.28 cubic feet. The quantity of cement is calculated for a clean borehole. It is a common practice to add an amount equal to 20 percent of the calculated volume to allow for borehole irregularities and severely fractured formations.

NEAT CEMENT VOLUME
NUMBER OF BAGS OF CEMENT
(Based on 6 gallons of water per bag of cement that yields 1.28 cu. ft. or 9.5 gallons)

CASING	2	2	2	4	4	4	5	5	5	6	6	6	8	8	8
HOLE	4	5	6	6	7	8	7	8	9	8	9	10	10	11	12
25	1.1	2.1	3.3	1.7	3.1	4.7	2.0	3.5	5.4	2.2	4.0	6.0	2.7	5.0	7.5
30	1.3	2.5	3.9	2.0	3.6	5.6	2.4	4.2	6.5	2.6	4.8	7.2	3.3	6.0	9.0
40	1.8	3.2	5.2	2.7	4.9	7.5	3.2	5.6	8.7	3.5	6.4	9.6	4.4	8.0	12.0
50	2.2	4.1	6.5	3.4	6.2	9.4	4.0	7.0	10.9	4.3	8.0	12.0	5.5	10.0	14.9
60	2.7	5.0	7.8	4.1	7.4	11.3	4.8	8.4	13.1	5.2	9.6	14.5	6.6	12.0	17.9
70	3.1	5.8	9.1	4.7	8.6	13.2	5.6	9.9	15.3	6.0	11.2	16.9	7.7	14.0	20.9
80	3.6	6.6	10.4	5.4	9.9	15.0	6.4	11.3	17.4	6.9	12.3	19.3	8.8	16.0	23.9
90	4.0	7.5	11.7	6.1	11.1	16.9	7.2	12.7	19.6	7.8	14.3	21.7	9.9	18.0	26.9
100	4.4	8.3	13.0	6.8	12.3	18.8	8.1	14.1	21.8	8.6	15.9	24.1	11.0	20.0	29.9
120	5.4	10.0	15.6	8.1	14.8	22.5	9.7	16.9	26.2	10.4	19.1	28.9	13.2	24.0	35.9
140	6.3	11.6	18.3	9.5	17.3	26.3	11.3	19.7	30.5	12.1	22.3	33.7	15.4	28.0	41.9
160	7.1	13.3	20.9	10.8	19.8	30.1	12.9	22.5	34.9	13.8	25.5	38.6	17.6	32.0	47.8
180	8.0	15.0	23.5	12.2	22.2	33.8	14.5	25.3	39.2	15.5	28.7	4..4	19.8	36.0	53.8
200	8.9	16.6	26.1	13.5	24.7	37.6	16.1	28.1	43.6	17.3	31.9	48.2	22.0	40.0	59.8
220	9.8	18.3	28.7	14.9	27.2	41.3	17.7	31.0	48.0	19.0	35.1	53.0	24.2	44.0	65.8
240	10.7	20.0	31.3	16.2	29.6	45.1	19.3	33.8	52.3	20.7	38.3	57.8	26.4	48.0	71.7
260	11.5	21.6	33.9	17.6	32.1	48.9	20.9	36.6	56.7	22.5	41.4	62.7	28.6	52.0	77.7
280	12.4	23.3	36.5	18.9	34.6	52.6	22.5	39.4	61.0	24.2	44.6	67.5	30.8	56.1	83.7
300	13.3	25.0	39.1	20.3	37.0	56.4	24.2	42.2	65.4	25.9	47.8	72.3	33.0	60.1	89.7

These figures are based on a clean borehole, Due to borehole irregularities and other factors, the actual required volume is usually greater. It is a sound practice to have 20 percent to 50 percent more material at the job site.

For additional information on grouting wells refer to *"Michigan Water Well Grouting Manual,"* MDPH, 1988

EVALUATION OF GROUTING

During Well Construction

1. What grouting method and material and mix recipe is being used? Is it in compliance with the well construction code and any permit specifications?

2. Check for suitable grouting equipment (pump, mixer, grout pipe).

3. Determine volume of grout expected to complete the job. Allow for 15-20% loss to the formation. Is there enough grout on job site?

4. Use grout scale (mud balance) to weigh slurry before it is pumped into annulus. Grout scales may be obtained from the sources listed.

5. Observe grout return to surface. Initial return will be a thin, watery consistency. Once the slurry visibly appears like the slurry being pumped into the well, weigh the return to verify that the weight out equals the weight being pumped in.

6. Record the amount of grout used and other grouting-related details needed to complete grouting section of the water well drilling or plugging record.

Office Review of Water Well Record

When reviewing the section concerning grouting of the annulus on the water well record, the following may be indicators that the well has not been properly grouted:

1. The section has not been completed.
2. The section indicates that the annulus was not grouted as required by the well construction code, (i.e., the entire casing length or to within 10 feet of the bottom of the casing for screened wells.)
3. The number of bags of grout used, is not sufficient to fill the estimated volume of the annulus. By calculating the volume of the annulus, and comparing that to the amount of grout used, a determination can be made as to whether or not a sufficient volume of grout was used to seal the annulus. The previous charts show annular space volumes and neat cement volume requirements. Bentonite grout volumes vary by manufacturer. If needed, LHDs should be able to calculate the annular space volume to determine if the amount of grout used was appropriate.

When an office review of a water well record discloses that a well may not have been properly grouted, investigate the violation by field inspection and/or consultation with the well drilling contractor, and order correction as needed.

Field Evaluation of Grouting Upon Well Completion
Two methods of the field evaluation of grouting are generally used: Visual Observation and Probing.

Visual Observation
The initial effectiveness of visual observation of grouting is limited to what can be observed at the ground surface. Any of the listed conditions may lead to the drilling contractor being required to excavate around the casing using a backhoe to allow more complete evaluation of the grout job. Some examples of visual observation include:

1. Look for the presence or absence of grout material laying on the ground surface in the vicinity of the well casing. During the grouting procedure, the well drilling contractor is required to pump the grout material to the bottom of the well using a grout pipe, force the grout upward through the annulus and finish with the grout material appearing at the ground surface. The grouting procedure may stop when the consistency of the grout material at the ground surface is the same as the consistency of the grout material in the grout mixer (i.e., pumped in equals flowing out). There often is thin or access grout visible in the vicinity of the well when the driller is finished grouting. However, a visual evaluation can be limited in effectiveness if the area around the casing has been disturbed since the well was completed, such as when the pitless adapter was installed, when general site grading was conducted, or due to site clean-up in the area around the casing.

2. Soil collapse around the casing may indicate improper grouting. This may suggest that the annulus was not properly sealed and that soil from around the well casing may have collapsed into the open portion of the annulus.

3. Solution channels or washouts that are visible around the well casing may indicate problems with grouting. They suggest that surface water may be flowing downward around the outside of the well casing. The water may be flowing from the surface into a near surface aquifer or all the way down to the bottom of the well. In any case, borehole erosion can occur, resulting in a pathway for surface water-carried contaminants to get into the well.

4. You may be able to see unapproved grout materials in the vicinity of the well, such as bentonite slurry residue, when neat cement was required.

5. You may observe empty bags of an unapproved grout material left lying around the drilling site.

6. You may obtain information from the owner, neighbors, other contractors, or other persons who may have visually observed an improper grouting procedure. For example, the owner may relay to you that they observed the well drilling contractor shoveling cuttings into the annulus or pouring dry granular bentonite from the surface along the side of the well casing.

Use of Soil Probes

IMPORTANT: To reduce the risk of electrocution, it is recommended that probes be used for occasional field checks and to focus on wells that the local health department has reason to believe may not have been grouted. The DNRE advises that probing be limited to installations where the pump has not yet been installed. Lock Out/Tag Out procedures, on the electrical box, pursuant under MIOSHA regulations must be followed when probing after the pump is installed.

Sanitarians are advised to use the following precautions when grout probing:

- Do not probe around wells located beneath overhead electrical lines.
- Have the property owner shut off the power to the submersible pump before you probe.
- Do not use excessive force when an obstruction is encountered. Obstructions are usually rocks, tree roots, pitless adapter clamps, or casing couplings, but you may also encounter electrical or gas lines.
- Use insulated handles on the augers or probes.
- Do not probe around flowing artesian wells. You may cause a break-out of flow around the outside of the casing.
- Use proper lifting techniques when pulling probes out of the hole to avoid back injury.

A small diameter, hollow-core soil probe with extensions is an effective tool for evaluating water well grouting after a well has been completed. Samples of the grouting material can be recovered for identification.

As part of normal well completion practice, grout will be removed from the upper few feet of a well casing during installation of the pitless adapter. We recommend that grouting evaluation begin about 2 feet below the pitless adapter/water service line connection. Taking normal excavation depths into account, you would not expect to find any grout above this level.

The grout probe is used to evaluate the presence of approved grout material, without damaging the seal provided by the grout.

1. Method

Probing should be done on the side of the casing away from the dwelling and offset 90 degrees from the electrical service connection. This will reduce the chances of hitting either the water service line or the electrical power supply wire. Probe carefully in the upper 4 feet until you have determined that you have gotten past these two potential danger/damage possibilities. Note that you may also encounter a pitless adapter U-bolt or a casing coupling within this zone. Once past this zone it is less likely that you will encounter hazards. It may take several tries to get the probe past the pitless adapter or casing couplings.

It may be advantageous to use a shovel or a standard 4 inch diameter bucket soil auger start the grout probe hole. This facilitates getting the end of the probe past the pitless adapter. However, be cautious to avoid cutting or wrapping the power supply electrical wires around the auger.

The probe is guided down along side of the well casing in a vertical position to a point below the pitless adapter. Once the probe is below the pitless adapter, it should be removed and the probe barrel cleared of any soil material. The probe is then reinserted and a sample of any material found below the pitless adapter is collected for evaluation. Again clear the probe barrel, and reinsert the probe to obtain another sample. This process is continued until a good quality grout material has been located. Threaded extension pipes can be used to increase the depth of probing. When an open annulus or material with little resistance has been encountered, use caution when adding extensions to avoid losing the probe string down the hole.

Normally, once a good quality grout material has been found using the probe, it is not necessary to probe any deeper into the annulus. The probe is generally not extended more than 3 feet into the good quality grout material.

Where an open annular space exists or where drilling mud or cuttings were used to seal the annulus, the probe may fall freely or with little effort. Open annular spaces are frequently detected where grout slurries have failed, where formation materials have collapsed creating a bridge, or below bridged grout that was poured into the annulus from the surface.

2. <u>Grout Material Evaluation</u>

The following descriptions are useful for identifying grout samples collected with the soil probe:

a. *Bentonite grout* - An <u>acceptable</u> bentonite grout seal will appear as a pliable clay with a gelatin, oatmeal, or peanut butter consistency, tan to gray in color. If granular bentonite or coarse grade bentonite was used, the individual particle configuration may be recognized. If coarse grade bentonite was poured into the annulus and remained nonhydrated, it will usually be difficult to penetrate with the probe. An <u>unacceptable</u> bentonite drilling mud slurry or drilling mud/cuttings slurry will appear as a thin, watery clay mixture tan to gray in color.

b. *Neat cement grout* - An acceptable neat cement or cement/bentonite grout will be a hard rock-like material, gray to greenish-gray in color that can be penetrated with the probe only for the first few hours after completion of the grouting. After the cement sets, the probe is only useful for identifying the top of the grout.

There may be instances where the use of the hollow core sampler is not practical due to the presence of rocks or other obstructions. In these cases, it may be possible to use a solid rod tile probe to evaluate the presence or absence of an open annulus around a well casing. Most tile probes have a threaded end that the point is threaded on to. Probe extension rods are available. The main drawback of using a tile probe is that you cannot collect samples of material for examination.

After evaluating for the presence of grout using a probe, fill in the hole in the grout that is created by the probe. Pour granular bentonite into the hole and periodically tamp it with the probe. Since the probe generally does not penetrate into the grout material more than 1 to 2 feet, a large quantity of bentonite is generally not needed. When a standard 4 inch

diameter bucket soil auger is used along the upper portion of the annulus (above the pitless adapter), the parent material removed from that portion of the hole may be used to fill the hole.

A pair of wrenches is useful for disassembling the probe extensions and a screwdriver comes in handy for clearing the soil or grout material from the probe core. A wire brush and a can of WD 40 or equivalent are useful for cleaning the threads on the probe extensions and to assure that you can get the sections apart when you are done.

NOTE: Extreme caution must be used to avoid contact with overhead utility lines. Where overhead lines are present, be careful when extracting the probe because you didn't have to worry about it when you were assembling the sections one-by-one at ground level. However, once placed down the annulus it may be 25 feet or more long. When you go to pull it out the probe is now one tall piece! Use common sense and remember safety first.

If using a soil probe where a submersible pump has been installed, be cautious of unprotected buried electrical wires that may be near the well casing. Although you would expect the electrical wire to extend toward the building and away from the well casing the contractor may have looped excess electrical wire around the back side of the casing. Be extremely careful when resistance to the probe is encountered. Treat all wires as "live" and don't take chances by forcing probes through or around them. Always keep probe handles wrapped with electrical tape or non-conductive handle wraps.

3. <u>Interpretation of Grout Probing Results</u>

When a field evaluation determines that a well has not been properly grouted, the sanitarian shall contact the well drilling contractor and order correction of the violation using the following guideline:

a. <u>Condition</u>. Grout not observed directly below pitless. Annulus open part way. Grout found with probe at some distance down hole.

Grout is not observed just below the pitless adapter, and a clean, dry, open annulus is present around the casing. Probing the annulus reveals that approved grout material is present, but is more than a few feet below the pitless adapter. There are no liquids in the open annulus, and the annulus has no obstructions (side wall collapse, bridged material, etc.).

<u>Corrective measures</u>.

Option #1 - Extend a tremie pipe to the depth that the grout was found, and pressure grout from that point back to the ground surface. Neat cement or an approved bentonite grout may be used.

Option #2 - If the grout is within 10 feet of the pitless adapter, pouring grout from the surface is an acceptable corrective measure. Slowly pour coarse grade or granular bentonite into the annulus, tamping with a length of pipe as needed to prevent bridging. Continue this sealing method until the grout material reaches the pitless adapter or the ground surface.

b. <u>Condition</u>. Grout not observed with probe. Annulus contains water. No bridging

observed.

Grout is not observed at the pitless adapter, and the annulus around the casing is open. The annulus contains muddy water or what appears to be a watery bentonite material that has not set-up. Probing the annulus deeper reveals that thicker grout material has settled 25 feet down the annulus. No bridging was found in the upper 25 feet of annulus.

Corrective measure. Extend a tremie pipe to the depth that the grout was found, and pressure grout from that point back to the ground surface or to a point just below the pitless connection. Neat cement or an approved bentonite slurry grout may be used.

c. Condition. Grout not observed. Annulus open. Probing does not find grout.

Grout is not observed at the pitless adapter, and an open annulus is present around the casing. Probing the annulus fails to locate any grout material, but the probing does reveal that the annulus to the depth probed is open (i.e., there is no bridging, sand, or any other material in the annulus.) Muddy water may or may not be present in the annulus.

Corrective measure. The well has not been properly grouted. The well drilling contractor must be contacted to discuss the violation. The contractor has two options:

Option #1 - Meet with the sanitarian at the site, and demonstrate to the satisfaction of the sanitarian that the well was in fact grouted, but that the grout material has settled to a point below where the sanitarian had probed. Generally, the contractor will place a tremie pipe in the annulus and extend the tremie down to the apparent bottom of the open annulus. Through jetting action or other means, it is best if a grout sample can be obtained to demonstrate that grout is present and that the borehole has not simply collapsed. Once that determination is made, the contractor can be authorized to pressure grout from the bottom of the annulus back to the ground surface or level of the pitless adapter. Neat cement or an approved bentonite grout may be used.

Option #2 – Properly plug the deficient well and annulus, then construct a new well. Plugging of the ungrouted well is not an easy task, since the annulus around the casing has not been properly sealed. Sealing the inside of the casing only does not protect the aquifer from surface contamination, since contaminants from the surface may still enter the aquifer through the unsealed annulus. The sealing of this open annulus must be addressed during the abandonment process and may require the removal or perforation of the casing if there is no other way to properly seal the annulus.

d. Condition. Annulus partially plugged with sand, cuttings, etc. Some grout found with probe.

Grout is not observed immediately below the pitless adapter but the annulus around the casing is not open. The annulus contains sand, cuttings, or other consolidated material and some grout. Deeper probing of the annulus reveals that uniform, approved grout material is present 25 feet down hole, but apparently settled in the annulus, above which the wall of the annulus apparently collapsed.

Corrective measure.

Option #1 - Reestablish a clean, open annulus by flushing the annulus (jetting) with water or drilling fluid, and then regrouting the upper 25 feet of now open annulus. Field experience has demonstrated that cleaning material out of a filled annulus to reestablish the open annulus is a difficult and time consuming procedure which is seldom successful. However, it is the well driller's option to pursue this corrective measure, if he/she so chooses.

Option #2 - Plug the well, and drill a new well. Casing removal or perforation is required as part of the sealing procedure to assure that the ungrouted annulus is properly plugged.

e. Condition. Annulus plugged with sand, cuttings, etc. Grout not found.

Grout is not observed just below the pitless adapter. Probing the annulus fails to locate any grout material, and the probing reveals that the annulus contains sand, drill cuttings, or other material that has filled the annulus.

Corrective measure. The well has not been properly grouted, and there is no practical way to reestablish an open annulus along the entire casing length for regrouting purposes. Section R 325.1669(2) of the Rules for Part 127, Act 368, PA 1978, states "If a health officer or the department determines that a registered well drilling contractor has improperly located or constructed a well, the well drilling contractor shall be responsible for plugging the well." The well drilling contractor must be contacted and ordered to plug the well. As noted above, casing removal or perforation is required as part of the sealing procedure to assure that the ungrouted annulus is properly plugged.

Common Problems Associated With Grouting

Bentonite Grout Problems

1. Using too much water. Each bentonite grout product has a specific maximum amount of water to use in the mixing of each bag of the grout. It is extremely important that bentonite grout is mixed according to the manufacture's specifications. Exceeding this maximum amount will lead to the following problems:

    a. Reduction in the percentage of solids in the grout. Instead of the grout having a solids content of 20 to 30 percent, the solids content may be as low as 5 percent.

    b. Reduction in the weight per gallon of the grout. Bentonite grout must meet the manufacturers minimum required weigh, but in no case shall it be less than 9.4 pounds per gallon with 15 percent solids. Some high solids bentonite grouts will exceed this weight.

    c. Preventing the proper "set" or "curing" of the grout material. The grout will remain in a "soupy" consistency, instead of turning into a "peanut butter like" consistency.

    When a bentonite grout with too much water has been placed in the annulus, the bentonite solids will settle to the bottom of the annular space, and excess water is absorbed by the vadose zone of the soil, leaving a long column of open annulus above the solids.

2. Bentonite grout "setting up" before being pumped into the annulus. This may occur because of one of the following reasons:

    a. Taking an excessive amount of time between mixing of the grout and pumping it into the annulus. Each bentonite grout product differs in the time required before "setting" or "curing" starts, ranging from a few minutes to 30 minutes. If pumping is delayed until "setting" has started, the pump may not be able to move the grout because of the high head conditions, or the grout may not flow to the pump intake.

    b. Excessive mixing temperatures. If mix water is warm, the time before "setting" of the grout starts is significantly speeded up because of the more rapid hydration (absorption of water) of the bentonite.

    c. "Sheering" of the bentonite during mixing. Some pumping or mixing methods tend to sheer (grind into smaller particles) the bentonite. This allows the bentonite to hydrate at a rate faster than intended, causing the bentonite grout to set up in a shorter period of time. Use of centrifugal pumps or jet mixers are common causes of sheering.

3. Grout mixture not "setting" properly after being placed in the annulus. This leads to settling of the bentonite solids to the bottom of the annulus, leaving an open annulus around the upper portion of the casing. Causes for grouts not setting properly include:

a. Using too much water in mixing the grout.

b. Excessive chlorine in the mix water (above 50 parts per million).

c. The pH of the mix water is too low. The pH of the mix water should be 8.5 to 9.0.

d. The mix water has hardness (calcium carbonate), which interferes with the hydration of the bentonite. Mix water must be free of hardness. Mix water should be treated with soda ash to remove hardness before being mixed with the dry bentonite.

e. Tannins or excessive salts (greater than 7,000 ppm) in the mix water. Tannins and salt break down the bentonite.

4. Failure to remove drilling mud and cuttings from the annulus prior to grouting. When using the "tremie pipe down the annulus" method of grouting, drilling mud and cuttings must be flushed out of the annulus using clean water prior to grouting.

If only clean water is in the annulus at the beginning of the grouting operation, the water, being lighter than the grout, is pushed up the annulus ahead of the grout as the grout is pumped into the bottom of the annulus.

A drilling mud/cuttings mixture can be heavier than bentonite grout. If it is left in the annulus, the bentonite grout will channel up around the outside of the tremie pipe instead of pushing the column of the drilling mud/cuttings up and out of the hole. When this occurs, a quantity of the cuttings and drilling fluid is left in the annulus. These solids settle to the bottom of the annulus, leaving a water filled or open space where the drilling mud/cuttings once stood. The heavier grout material above the open space then recedes into the opening, leaving an open annulus at the top of the casing.

5. Receding of the grout placed in the annulus, i.e., grout was pumped into the annulus from the bottom to the top, but was not present in the upper annulus a day later. This may be caused by any one or a combination of the following (most were discussed above):

a. Loss of water from the grout mixture into the vadose zone of the soil. The vadose zone is the dry portion of the soil above the saturated portion of the soil. When the grout is placed in the annulus, it has not yet set-up (hydrated). Normally, with time, the bentonite absorbs the water in the grout mix, and the grout solidifies to a peanut butter like consistency. If the water is removed from the grout before it can be absorbed into the bentonite, this hydration does not take place, and the bentonite falls to the bottom of the annulus or attaches to the sidewall of the annulus. Either way, only an open annulus remains.

b. Failure of the grout to properly hydrate (using too much water, poor mix water quality, etc).

c. Failure to remove drilling mud/cuttings from the annulus prior to grouting.

Neat Cement Grout Problems

1. Using too much water. A mixing ratio of not more than 6 gallons of water to one 94# bag of Type I or 1A cement must be used. Too much water will weaken the cement, reduce the solids content (minimum weight must be at least 15 pounds per gallon) and increase the likelihood of settling.

2. Insufficient mixing. The cement slurry must be sufficiently agitated to completely mix the cement with the water. If lumps of dry cement are in the grout when pumping begins, the lumps may plug the grout pump, the tremie pipe, or screens in the mixing tank. All lumps must be broken up or removed with a screen before entering the grout pump.

3. Failure to sufficiently clean equipment after grouting. Obviously, any residuals of the neat cement grout left in the grouting system will harden, causing equipment failure, plugged pipes, etc. Extreme care must be taken to remove <u>all</u> residuals of cement from grout pumps, mixing tanks, pipes, etc., after the grouting operation is completed.

Tremie Pipe Installation Problems

Installation of the tremie pipe to assure grout placement along the entire length of the casing may be a problem for some well drilling contractors. To meet minimum well construction code requirements, the tremie pipe must extend to the bottom of the space to be grouted. The following have proven to be effective methods of tremie pipe placement use by Michigan registered well drilling contractors:

1. Installing the tremie pipe to the bottom of the open bore hole prior to casing placement. Rigid (PVC, galvanized, etc.) tremie pipe is generally used.

2. Installing the tremie pipe at the same time the casing is being placed in the open borehole by attaching the tremie pipe to the bottom of the casing. The tremie pipe is taped to the bottom of the casing, and then tugged free after placement. Generally, polyethylene plastic pipe or collapsible vinyl pipe is used for this tremie pipe placement method.

3. Installing the tremie pipe down the inside of the casing, using draw down seals or a seal on top of the casing to prevent the grout from coming up into the casing.

4. Installing the tremie pipe after the casing has been installed by "fishing" rigid tremie pipe down the annulus. The use of this method is limited to shallower wells. For deep wells the end of the tremie pipe tends to get "hung up" on the side of the borehole, casing couplings, etc., preventing the tremie pipe from getting to the bottom of the casing.

PROPERTIES OF COMMON GROUTING MATERIALS

Material	Description	Attributes
Type I Cement	Most common type of cement used for grouting/plugging.	Forms good seal. Easier to mix and pump than bentonite. Required as grout where bedrock is encountered within 25 ft. of the surface and for plugging all wells terminated in bedrock.
Type III Cement	High early strength.	Not a common cement. Ground to finer particle size which increases surface area and provides faster curing rate.
Type IV Cement	Low heat of hydration.	Not a common cement. Used where the rate and amount of heat generated by cement must be kept to a minimum. Develops strength at a slower rate than Type I.
Type K Cement	Expansive cement.	Not a common cement. Basically Type I cement with additives to provide for rapid expansion. "Type K Komponent" is used for plugging abandoned wells.
Concrete	Neat cement with sand added. 50% sand by weight.	Less costly than neat cement. Provides a good seal. May not be poured from the surface through standing water due to separation problems. Can cause excessive pump wear.
Bentonite powder	Contain mixtures of sodium and calcium bentonite with other clays.	Drilling "gel." Various forms used in Michigan as the main component of most drilling muds.
Bentonite granular	Raw mined and particles are coarse granular (8 mesh is usual).	Intended for slurry applications to grout or plug wells. Low permeability. Slower water absorption and delayed swelling in comparison to powdered bentonite.
Bentonite chips	Large particle versions of granular products (.25-.75 in.).	Intended to be poured into a borehole or casing for plugging. Chips hydrate in place and swell to form a low permeability, highly stable seal. Water needs to be added above the water table.
Bentonite pellets	Powdered bentonite compressed into a pellet (.25-.75 in.).	Uniform in size. Same application as bentonite chips. Bridges easier and are more expensive than chips.

WATER WELL GROUTING MATERIALS SPECIFICATIONS

PRODUCT	WATER RATIO	WEIGHT/GAL.
Neat Cement	6.0 gallons max/sack of cement 5.2 gallons recommended/sack of cement	15.0 pounds 15.6 pounds
Neat Cement & 1% Bentonite	6.0 gallons max/sack of cement	15.0 pounds
Neat Cement & 2% Bentonite	6.5 gallons max/ sack of cement	14.7 pounds
Neat Cement & 3% Bentonite	7.15 gallons max/sack of cement	14.4 pounds
Neat Cement & 4% Bentonite	7.8 gallons max/sack of cement	14.1 pounds
Neat Cement & 5% Bentonite	8.5 gallons max/sack of cement	13.8 pounds
Neat Cement & CaCl (accelerator)	6.0 gallons max/sack of cement CaCl - 2 to 4 lbs/sack of cement	15.0 pounds

Bentonite

Refer to the manufacturers specifications for water ratios and weights.
Refer to www.nsf.org/certified/PwsChemicals for National Sanitation Foundation (NSF) Certification

Concrete	1 sack of cement and an equal volume of sand per maximum 6 gallons water	17.5 pounds

*Calcium chloride accelerates the setting of cement. Rapid mixing and pumping of grout after adding calcium chloride is recommended.

NOTE: Neat cement is required in areas where bedrock is less than 25 feet from ground surface.

Clean Earth Sampling Protocol
North Jersey

PARAMETERS	TOTAL VOLATILE ORGANICS	TOTAL SEMI-VOLATILE ORGANICS	TOTAL METALS - 8 RCRA + Be, Ni, Cu, Zn and Cr+6	TCLP METALS - 8 RCRA + Be, Ni, Cu & Zn)	IGNITABILITY	CORROSIVITY (pH)	REACTIVITY - SULFIDE AND CYANIDE	PCBs	TCLP VOLATILE ORGANICS	TCLP SEMI-VOLATILE ORGANICS	TCLP HERBICIDES	TCLP PESTICIDES
METHODS (1)	8260B	8270D	6010/7471/7196	1311/6010/7470A	1030 or 1010A	9040C or 9045D	SW846 CHAPTER 7.3	8082A	1311/8260B	1311/8270D	1311/8151A	1311/8081B
FREQUENCY												
CENJ Waste Streams — Grab Sample every 750 tons	X								X			
CENJ Waste Streams — 5 point composite sample every 750 tons		X	X	X	X	X	X	X		X	X	X

(1) The methods provided are standard EPA methods. The method revisions are subject to change and the most current method should be utilized by the laboratory.
This is to be used as a guideline for sampling. Sampling frequencies and parameter requirements may be modified at the discretion of the CE Approval staff based on items such as site history, levels of contamination and/or source of contamination, etc..

CENJ Specific compounds - ** Please note that Clean Earth of North Jersey (CENJ) requires that the compounds identified below be assessed/reported for all projects. The concentrations of the compounds cannot exceed the limits identified below. The analysis must include the compounds below OR the generator must certify that the compounds do not exceed the limits below based on generator knowledge.

COMPOUND	Concentration (PPMW)
Arsenic	≤ 4,000
Cadmium	≤ 4,000
Lead	≤ 80,000
Mercury	≤ 80
Beryllium	≤ 800
Nickel	≤ 80,000
Benzene	≤ 400
Chlorobenzene	≤ 400
Cumene (isopropylbenzene)	≤ 960
Ethylene Glycol	≤ 56,000
Methanol	≤ 4,800
Methylene Chloride (Dichloromethane)	≤880
Methyl Ethyl Ketone (2-Butanone, MEK)	≤ 800
Methyl Isobutyl Ketone (MIBK, 4-methyl-2-Pentanone)	≤ 1,360
Phenol	≤ 1,360
Tetrachloroethylene (PCE, perchloroethylene)	≤ 400
Toluene	≤ 560
Trichloroethylene (TCE)	≤ 480
Xylene	≤ 1,200
Hexavalent Chromium (Chromium +6, Cr+6, CrVI)	≤ 21,400

BAYSHORE
Soil Management, LLC

Material Sampling and Laboratory Guide

Site Type / Petroleum Contaminated Soil	Sampling Frequency & Testing Requirements	EPH	Home Gen Cert	Total VOCs 8260B	SRS Metals 6010B	Paint Filter 9095	SVOCs 8270C	PCBs 8080	Sulfur	Pesticides	TCLP
Residential < 20 CY/30T	1 sample per 30T	X	X								
Residential > 20CY/30T	1 Composite Sample per 800 CY / 1200T			X**	X	X					****
	1 Composite Sample per 400CY / 600T	X									
Commercial	1 Composite Sample per 800 CY / 1200T			X**	X	X					****
	1 Composite Sample per 400CY / 600T	X*									
Coal Tar / MGP soil	1 Composite per every 500 CY/ 750T	X		X**	X		X	X	X		****
Unknown Source / Historic or Urban Fill	1 Composite Sample per 800 CY / 1200T			X**	X***	X	X	X		X	****
	1 Composite Sample per 400CY / 600T	X									
Street Sweepings	1 Composite Sample per 800 CY / 1200T			X**	X***	X	X	X		X	****
	1 Composite Sample per 400CY / 600T	X									
Potable Water T.R. / CFM	1 Composite Sample per 800 CY / 1200T	X		X**	X***	X	X	X		X	****

* EPH or DRO is acceptable for Diesel Range contamination. GRO is required for Gasoline contamination. Mixed Fuels require both EPH and GRO.

** Discrete sampling for VOCs per NJDEP requirements is acceptable.

*** TAL Metals List required.

**** TCLP will be required for any parameter which exceeds the RCRA 20X Rule.

Acceptance of all projects are subject to the completion and review of a completed "PROFILE SHEET", the criteria noted above, and approval as granted by Bayshore Soil Management, LLC.

At the discretion of the facility, additional analysis may be required for project acceptance. For soils originating from substations/generating/switching stations or industrial sites, analysis for PCBs and SVOCs are requested.

It should be noted that soil with moisture content in excess of 18% per ASTM Standard Test Method D 2216-05, will be subject to a surcharge.

The amount of debris acceptable is 1% by volume; and any stone, brick, block and/or concrete should be 12 inch minus.

For materials to be considered for acceptance as clean to BRC, TCL/TAL+30 must be provided, along with EPH & PFT

Bayshore Soil Management, LLC
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Revised July 2015

OCCUPATIONAL HEALTH AND SAFETY

POLICY AND PROCEDURES MANUAL

PG Environmental Services, Inc.

Solutions you deserve ; Partners you can trust

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Forward

PG Environmental Services, Inc is committed to the Health and Safety of all our employees.

The purpose of the Health and Safety policies and procedures is to guide and direct all employees to work safely and prevent injury, to themselves and others.

All employees are encouraged to participate in developing, implementing, and enforcing Health and Safety policies and procedures. All employees must take all reasonable steps to prevent accidents and never sacrifice safety for expedience.

Our goal is to eliminate or minimize hazards that can cause accidents.

It is company policy that all employees be given a copy of the policies manual and be familiar with its contents.

This policy will be reviewed annually.

Together we can achieve a safe and happy work environment.

Health and Safety Policy

PG Environmental Services, Inc is committed to the goal of providing and maintaining a healthy and safe working environment, with a view to continuous improvement. This goal is only achievable by adherence to established objectives striving to exceed all obligations under applicable legislation, and by fostering an enthusiastic commitment to health, safety and the environment within *PG Environmental Services, Inc* personnel, contractors and visitors.

In particular:

- Management, working in cooperation with the Joint Health and Safety Committee, will strive to take all reasonable steps to reduce workplace hazards to as low as reasonably achievable.

- Supervisors and managers are held accountable for the health and safety of all employees under their supervision. This includes responsibility for applicable training and instruction, appropriate follow-up on reported health and safety concerns, and implementation of recommended corrective action. This accountability is integrated into the performance appraisal system.

- Supervisors, workers and visitors are expected to perform their duties and responsibilities in a safe and healthful manner, and are accountable for the Health and Safety of themselves and others.

- PG Environmental Services, Inc is committed to providing all necessary training and instruction to ensure that appropriate work practices are followed on the job, and to promote their use off the job.

- If necessary, *PG Environmental Services, Inc* will take disciplinary action where individuals fail to work in a healthy and safe manner, or do not comply with applicable legislation or corporate policies and procedures.

Health, safety, the environment and loss control in the workplace are everyone's responsibility. *PG Environmental Services, Inc* expects that everyone will join in our efforts to provide a healthy and safe working environment on a continuous day to day basis. Only through the dedication and efforts of all individuals can *PG Environmental Services, Inc* succeed in providing a healthy safe working environment.

Occupational Health and Safety In Workplaces Duties of Workers

Occupational Health and Safety and You

One of your most important responsibilities is to protect your Health and Safety as well as that of your co-workers. This booklet will discuss some of your duties under the occupational Health and Safety legislation and help you to make your workplace safer and healthier.

What the law requires

Workplaces under the jurisdiction are governed by your provincial legislation. The legislation places duties on owners, employers, workers, suppliers, the self-employed and contractors, to establish and maintain safe and healthy working conditions. The legislation is administered by your provincial legislation. Your officials are responsible for monitoring compliance.

Duties Of Your Employer

Your employer is responsible for providing you with safe and healthy working conditions. This includes a duty to protect you from violence, discrimination and harassment. You must cooperate with your employer in making your workplace safe and healthy.

Your Responsibilities

You must also comply with the legislation. You have responsibilities to:

- protect your own Health and Safety and that of your co-workers;
- not initiate or participate in the harassment of another worker; and
- co-operate with your supervisor and anyone else with duties under the legislation.

Your Rights

The legislation gives your three rights:

- the right to know the hazards at work and how to control them;
- the right to participate in Occupational Health and Safety; and

- the right to refuse work which you **believe** to be unusually dangerous.

You may not be punished for using these rights. An employer can be required to legally justify any action taken against a worker who is active in Health and Safety.

Your Right To Know

The Act requires your employer to provide you with all the information you need to control the hazards you face at work. For example, chemicals at the workplace must be listed. You are entitled to review this list. Your employer must train you to safely handle the chemicals you will work with. If you are inexperienced, you must receive an orientation which includes;

- What to do in a fire or other emergency;
- First aid facilities;
- Prohibited or restricted areas;
- Workplace hazards; and
- Any other information you should know.

You must also be supervised closely by a competent supervisor.

Your Right To Participate

You have the right to become involved in occupational Health and Safety. The legislation encourages employers and workers to work together to maintain a healthy and safe workplace. Employers at workplaces with (ten or more – consult your provincial act) workers must set up an occupational health committee of employer and worker representatives.

Committees Have Duties To:

- Regularly inspect the workplace;
- Conduct accident investigations;
- Deal with the Health and Safety concerns of employees;
- Investigate refusals to work;

- Meet at least (four times a year – consult your provincial act); and return minutes of each meeting to the Division.

Committee members are entitled to five days (consult your provincial legislation) of unpaid educational leave each year to take occupational Health and Safety courses. They may attend courses provided by the Division without loss of pay or benefits.

Certain types of workplaces with less than (ten) employees must have a worker Health and Safety representative. The representative must be selected by the workers at the workplace. He or she has many of the responsibilities of an occupational health committee.

Your Right To Refuse

You have the right to refuse to do work which you believe is unusually dangerous. The unusual danger may be to you or to anyone else. An unusual danger could include such things as:

- a danger which is not normal for your occupation or the job;
- a danger under which you would not normally carry out your job; and/or
- a situation for which you are not properly trained, equipped or experienced.

To exercise this right, use the following guidelines.

Once you believe that the work you have been asked to do is unusually dangerous, you should inform your supervisor. Make sure that the supervisor understands that you are refusing to do the disputed job for health and safety reasons. Work with the supervisor to attempt to resolve the problem.

If the problem cannot be resolved by the supervisor to your satisfaction, and no worker health and safety representative or occupational health committee exists at the workplace, your supervisor should phone the Division and ask for advice. You also have the right to contact the Division at any time.

The supervisor has the right to assign you to other work (at no loss in pay or benefits) until the matter is resolved.
Do not leave the site without the permission of your employer.

If a committee exists at the workplace, contact your local representative and ask for help. Your supervisor should contact the co-chairpersons and ask them to investigate. They will try to resolve the matter. If they cannot resolve the matter to your satisfaction, they will convene for an emergency

committee meeting. The committee will investigate and prepare a report on the refusal.

You have the right to continue to refuse until:

- measures have been taken to satisfy you that the job is now safe to perform; or
- Your occupational health committee has investigated and ruled against your refusal.

If the committee rules against your refusal, you have the right to appeal the ruling to an occupational health officer. The officer will investigate and prepare a report on the disputed work. If you disagree with the decision of the officer, you may appeal to the director of the Division.

An employer cannot assign another worker to do the disputed job unless the replacement worker is advised in writing:

- of the refusal and the reasons for it;
- of the reasons why the employer believes that there placement worker can do the disputed job safely;
- that the replacement worker also has the right to refuse; and
- of the steps to follow when exercising this right.

Contact Information

PG Environmental Services, Inc
175 N Commerce Drive, Hauppauge NY 11788
T:631-901-1888 F:631-901-1889
Email: Carlos@pgenviro.com

Responsibilities

Our safety program is the responsibility of all levels of company employees. The chain of responsibility is as follows.

1) Warehouse staff and delivery driver report to the warehouse supervisor.
2) Warehouse supervisor, sales staff and suppliers report to the safety officer.
3) Safety officer reports to the branch manager.
4) All employees are responsible for the health and safety of all visitors or contractors brought on site by them, and to insure that they are aware of and follow all company safety rules and procedures at a minimum.

Technicians

Technicians are accountable to the Office Manager for ensuring that all aspects of Occupational Health & Safety policy are followed. Employees must take an active roll in protecting and promoting their health, safety and accident prevention. You must not perform activities that jeopardize your health and safety or that of others.

Drillers and Helpers

The Drillers and Helpers is accountable to the safety officer and is responsible for ensuring the Occupational health & safety policy is followed during the field activities on-site. They must provide leadership in all aspects of Health and Safety including developing policy and procedure. They are also responsible for ensuring proper procedures are followed on-site.

Sales Staff And Suppliers

Sales staff is accountable to the safety officer for ensuring that Occupational Health & Safety policies are followed. They are responsible for all aspects of health and safety in their area of the office and sample areas.
Suppliers are accountable to the safety officer for providing WHMIS and MSDS (Material Safety Data Sheets) sheets for all hazardous products supplied by them.

Safety Officer

The safety officer is accountable to the office manager and is responsible for Occupational Health & Safety performance for all employees at **all levels.**

The safety officer must provide leadership in all aspects of health and safety activities at work or otherwise. The safety officer must take an active roll in all aspects of safety, within their branch.

Office Manager

The Office manager is responsible for the health and safety of all employees within the company. The office manager must ensure all policies and procedures are followed according to Occupational Health & Safety.

Duties

Office Manager

1) Ensure that all reasonable steps are taken to prevent accidents.
2) Ensure that standards and procedures are developed and maintained.
3) Be familiar with the Occupational Health & Safety act and any revised regulations and ensure they are followed.
4) Ensure that all employees are instructed in the procedures and requirements of Occupational Health & Safety.
5) Review accident reports, safety audits and other related material relative to health or safety.

Safety Officer

1. Ensure that all reasonable steps are taken to prevent accidents.
2. Be familiar with Occupational Health & Safety act, the company policy and any other legislation pertaining to health or safety.
3. Ensure all policies and legislation is followed by all levels of employees.
4. Ensure safety meetings are held and minutes are recorded, posted and filed accordingly to Occupational Health & Safety regulations.
5. Ensure all accidents are reported and investigated.

6. Ensure MSDS sheets are provided for all hazardous materials delivered to the workplace and are readily available for employees to review.
6) Review all MSDS and advise/train employees in the safe use, storage and transportation of controlled or dangerous products including what to do in case of an accidental spill or emergency.
7. Ensure employees are instructed in the procedures and requirements of Occupational Health & Safety.
8. Review all accidents and near misses to determine root and basic causes, with suggestion/implementation of changes to prevent re-occurrence.
9. Ensure all employees are trained in WHMIS (Workplace Hazardous Material Information System)

All Other Staff

1) Comply with all Company Procedures, Safety Policy and requirements of Occupational Health & Safety.
2) Be responsible for working safely and carrying out their duties with skill and care as to not cause accidental injury to themselves, fellow employees or the general public.
3) Immediately report all injuries, near misses or potential hazards to their supervisor.
4) Know the location of all fire extinguishers, fire alarms or other warning devices.
5) Ensure all personal safety equipment is being used properly.
6) Never engage in horse play or tomfoolery.
7) Maintain clean and orderly work area.
8) When in doubt…. ASK

Suppliers

1) Provide MSDS for all hazardous material shipped to our warehouse.
2) Ensure all reasonable steps are taken to prevent an accident.
3) Be familiar with Occupational Health & Safety act.

General Safety Rules

1) **All** accidents, injuries or near misses, regardless of their nature, shall be promptly reported to the safety officer.
2) Clothing shall be appropriate to the duties being performed. Long pants, a clean neat shirt and steel toed shoes are the minimum requirements.
3) Hard hats and safety vests are provided for all staff and **must** be worn at all times in the job site, loading or unloading of vehicles in the yard.
4) Running is **not** permitted except in extreme emergencies.
5) Smoking is not permitted in any part of the warehouse, vehicles or office. You may only smoke in designated areas.
6) Visitors and customers are to be escorted by staff while on company property.
7) Hand tools are to be used for their intended purpose only.
8) Riding on equipment is prohibited except where designated for operator.
9) Horseplay, fighting or tomfoolery is strictly prohibited on *PG Environmental Services, Inc* premises.
10) All spacers are to be of equal proportion and undamaged. Damaged spacers are dangerous.
11) All spills will be immediately cleaned up and reported.
12) Drawers and filing cabinets will be kept closed when not in use.
13) Filing cabinet drawers are to be filled from the bottom up or the cabinet is to be securely fastened /anchored.
14) Do not unload a truck alone under any circumstances, if someone can not help you then wait or call someone else for help. (Applies on and off *PG Environmental Services, Inc* property).

Safety Tips

1) If you are not sure…..ask.
2) Follow instructions and don't take chances.
3) Wear your personal safety equipment.
4) Never operate equipment you have not been trained for.
5) Keep your work area clean.
6) Stay clear of forklifts while they are being operated.
7) Avoid injury by lifting correctly. If it's heavy ask for help. Max weight to be lifted is 75lbs.
8) Make sure the job can be done safely.
9) **DO NOT** unload a truck alone.

Portable Ladders

Portable ladders must be secured against movement and placed on a base that is stable; the base of an inclined portable ladder is to be no further from the base of the wall or structure than ¼ of the height to where the ladder contacts the wall or structure.

Pallets & Storage Racks

All employees must ensure that pallets used to transport or store materials/containers are loaded, moved, stacked, arranged and stored in a manner that does not create danger to workers.

PG Environmental Services, Inc must ensure that racks used to store materials or equipment are designed, constructed and maintained to support the load placed on them and are placed on firm foundations that can support the load.

Employees must report any damage to a storage rack to the manager as quickly as is practical. All managers and employees must take all reasonable steps to prevent storage racks from being damaged to the extent that their integrity as a structure is compromised.

First Aid

An employer must ensure that the first aiders at a work site have successfully completed a first aid training course approved by a Director of Medical Services and hold a valid certificate in first aid. (consult with your local medical services)

An employer must keep record at the site of workers who are first aiders and post these names where they are accessible by all employees.

The office must have a first aid kit on site; each kit must contain the following: (see your Provincial legislation)

a) 10 antiseptic cleansing towelettes, individually packaged
b) 25 sterile adhesive dressings, individually packaged
c) 10 - 10cm X 10cm sterile gauze pads, individually packaged
d) 2 - 10cm X 10cm sterile compress dressings, with ties individually packaged
e) 2 - 15cm X 15cm sterile compress dressings, with ties, individually packaged
f) 2 conform gauze bandages – 75mm wide
g) 3 cotton triangular bandages
h) 5 safety pins - assorted sizes
i) 1 pair of scissors
j) 1 pair of tweezers
k) 125mm x 4.5 m of adhesive tape
l) 1 crepe tension bandage – 75mm wide
m) 1 resuscitation barrier device with a one-way valve
n) 4 pairs of disposable surgical gloves
o) 1 first aid instruction manual (condensed)
p) inventory of kit contents
q) 1 waterproof waste bag

Accident And Near Miss Reporting

The following protocol must be followed.

1) All employees must immediately report any occupational injury, accident or near miss to the safety officer or their supervisor.
2) Supervisors must immediately tend to injuries and then report them to the safety officer.
3) Office managers must immediately discuss the incident with the safety officer and injured persons.

The purpose of this procedure is to comply with Occupational Health & Safety act, workers compensation board and to determine the cause of the accident and make recommendations to prevent further re-occurrence. All reports of injury must be filed.

If an injury occurs a record must be kept and include the following:

a) name of worker
b) name and qualifications of person giving first aid
c) a description of illness or injury
d) the first aid given to the worker
e) the date and time the illness or injury
f) the date and time the illness or injury was reported
g) where at the work side the incident occurred
h) the work-related cause of the incident, if any

The employer must retain the records kept for 3 years from the date the incident is recorded. A person who has custody of records must ensure that no person other than the worker has access to a workers records unless:

a) the record is in a form that does not identify worker
b) the worker has given written permission to the person
c) the Director of Medical Services or a person authorized by the director requires to be produced under the act.

An employer must give a worker a copy of the records pertaining to the worker if the worker asks for a copy.

Critical Injury Protocol

First and foremost, always take whatever measures are required to provide proper care of an injured worker.

If a critical injury has occurred and the worker has been cared for, the branch manager, safety officer and W.C.B must be notified. The appropriate report must be completed as soon as possible; this is to ensure that important details are not forgotten.

A critical injury is an injury that….

1) Places life in jeopardy
2) Produces unconsciousness

3) Results in substantial loss of blood
4) Involves the fracture of a leg or arm, but not a finger or toe
5) Involves the amputation of a leg, arm, hand or foot, but not a finger or toe.
6) Consists of burns to major portion of the body.
7) Causes loss of sight in an eye.

Accident Investigation Policy

All accidents that result in injury or property damage or that could have resulted in serious injury or property damage (near miss) must be thoroughly investigated.
The investigation must determine the cause of the incident so that appropriate action can be taken to prevent recurrence.

The safety officer shall be responsible for conducting the investigation. The investigation report shall be completed as soon as possible after the incident and reported to the branch manager. The safety officer and appropriate supervisor shall determine what steps are to be taken to prevent recurrence.
Any disputes arising from the investigation will be investigated and arbitrated by the branch manager.

Alcohol And Drug Policy

It is the responsibility of all employees to ensure an alcohol and drug free environment. If there is any awareness or suspicion that <u>any</u> employee, supplier or visitor is under the influence of illegal narcotics or alcohol, will be removed from the premises immediately.

Should an employee report to work while under the influence of such substances, the employee will be taken home either in a cab or by the Branch Manager.

This is a zero tolerance policy

Disciplinary Action

Careless work and irresponsible behaviour directly affect the quality of health and safety in the workplace. Even absenteeism influences safety by placing more duties on fellow employees.
The following instances shall be cause for verbal or written warning and possible dismissal.

1) Absenteeism without cause
2) Health and safety violations
3) Poor conduct or misconduct
4) Theft
5) Sexual harassment
6) Racial discrimination
7) Carelessness
8) Wilful damage to company property
9) Drug or alcohol use

Compliance with company and legislative safety standards is necessary to maintain a safe and healthy work environment. As with any program non compliance issues must be dealt with.

The following is a guideline for disciplinary actions for safety infractions based on seriousness of the offence.

*First offence, employee will be given a documented verbal warning

*Second offence, employee will be given a written warning and a one day suspension.

*Third offence, employee may be suspended or terminated (suspension or termination to fit seriousness of the offence).

Hazard Warning Signs

When ever possible, warning signs will be displayed where a potential hazard may cause injury. Warning signs must be strictly adhered to.

Warning signs must be posted where hazards exist and must not be removed unless hazard has been controlled.

Environmental Policy

PG Environmental Services, Inc is Committed to the Protection of the Environment for Present and Future Generations. All Employees Are Responsible for incorporating into Their Planning and Work the Actions Necessary to Fulfill this Commitment.

PG Environmental Services, Inc Will Meet These Responsibilities by Endeavouring to Provide the Resources for Continuing To:

- Design and manage our operations to meet or surpass applicable environmental laws.
- Work in partnership with customers, suppliers, trade associations and government agencies to promote the environmentally safe handling and disposition of materials and products.
- Acquire knowledge and technologies to improve the environmentally save efficient use of our processes and products.
- Formulate and implement effective environmental emergency response systems.
- Involve our employees in our environmental programs and keep them informed of our performance.
- Promote employee awareness of this policy and enhance their capabilities to implement this policy.

Acknowledgement & Agreement Receipt

Date _____

I, _____, hereby acknowledge receipt of the *PG Environmental Services, Inc* **"Occupational Health & Safety Manual"**.

I have read, understand and agree to the terms of employment and will carry out and abide by the operational procedures and rules as outlined therein.

I agree:

To adhere to all company policies and procedures.
To the use of safety equipment, at all times, which is required by my safe work procedures and by my clients.

That government and client regulations shall be complied with at all times. That I am responsible and accountable for my health and afety performance.

Employee's Signature:
_____

Manager, *PG Environmental Services, Inc* :_____

This page is to be forwarded to head office at time of signing.