HydroEnvironmental SOLUTIONS, INC.

November 21, 2018

Mr. Kevin Carpenter, P.E.
Chief, Remedial Section B, Bureau C
Division of Environmental Remediation
New York State Department of Environmental Conservation
625 Broadway
Albany, New York 12233-7014

RE: Brownfield Cleanup Program No. C360143
Groundwater Remediation Work Plan
109 Marbledale Road
Tuckahoe, New York

Dear Mr. Carpenter:

As per your letter dated September 17, 2018, and recent email correspondence, HydroEnvironmental Solutions, Inc. (HES) has compiled the following Work Plan for the remediation of dissolved chlorinated volatile organic compounds (VOCs) in groundwater to be performed at the above referenced Brownfield Cleanup Site. The site location is shown on **Figure 1**.

Background

As part of the site's approved supplemental Remedial Action Work Plan (RAWP), HES conducted four rounds of groundwater sampling at monitoring wells across the site in order to monitor groundwater quality in the overburden and bedrock aquifers. The four rounds of sampling were conducted in November 2016, May 2017, July 2017, and August 2018. Laboratory analytical results from groundwater samples collected during each of the four sampling events from the bedrock monitoring well BW-2 (located in the southern part of the site, in front of the future hotel) have indicated the presence of elevated concentrations of chlorinated VOCs including tetrachloroethylene (PCE), and its breakdown components: trichloroethylene (TCE), cis-1,2-dichloroethylene (DCE), and vinyl chloride. Samples from a second bedrock aquifer monitoring well, MW-11, which was installed immediately downgradient of BW-2 in May 2018 in order to vertically delineate the chlorinated compounds, was found to contain significantly lower (although still elevated) concentrations of chlorinated VOCs when sampled in August 2018. A summary of analytical results for concentrations of VOCs exceeding applicable New York State Department of Environmental Conservation (NYSDEC) water quality standards in wells BW-2 and MW-11 are included on **Table 1**. A site plan showing approximate locations of the monitoring wells is included as **Figure 2**. Well construction details for BW-2 and MW-11 are included in **Attachment 1**.

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In a letter dated September 17, 2018, the NYSDEC determined it necessary for Bilwin Development Affiliates, LLC (Bilwin) as the Brownfield Cleanup Program volunteer to develop and implement a remedy to address dissolved chlorinated VOCs found at the BW-2/MW-11 location and to perform post implementation groundwater sampling at the wells to determine effectiveness of the remedy. At this time, the NYSDEC is only requiring the remediation activities at the BW-2/MW-11 location; however, remediation may be required in other locations based on the results of ongoing monitoring. In order to meet these requirements, HES has prepared the following Work Plan:

Groundwater Remediation Work Plan

Task 1: Bedrock Well Reagent Injection

In order to mitigate chlorinated VOC concentrations in the bedrock aquifer, HES will utilize a combination of a 40% zero valance iron (ZVI) suspension and emulsified vegetable oil (EVO). Each of the reagent products will be mixed with water (separately) and injected under pressure into well BW-2 with the use of a trash pump and a well head manifold. The specifications and SDS sheets for the zero-valence iron (ZVI) and Electron Donor Solution Extended Release (EDS-ER) EVO injection products are included in **Attachment 1**. The reagent will enter the well through an inflatable well packer installed at the top of the well screen at BW-2 to ensure that reagent is applied directly to the surrounding bedrock fractures. Based on the lower concentrations of chlorinated solvents observed at monitor well MW-11 (when compared to BW-2), this well will be used as a monitoring point during at least the first injection round. During future injections, this well may also be used. The specifications for the proposed packer are attached at the end of this letter in **Attachment 1**. The application of the ZVI suspension and EVO mixture will produce a reducing environment beneficial to microbes which breakdown the dissolved chlorinated solvents in the bedrock aquifer. Over time EVO and ZVI will be attenuated in the bedrock aquifer by the bioremediation process and dilution through groundwater flow. Iron and manganese concentrations will be monitored as part of the post injection sampling as described later in this Work Plan.

HES reviewed the rock coring logs for monitor wells BW-2 and MW-11. The results of our rock core analysis are included on **Table 2** and were used by HES and the manufacturer to determine dosing amounts and approach. The rock core analysis of bedrock well BW-2 indicated that Rock Quality Designation (RQD) ranged from 29%-54% from 62 to 82 ftbg, while results from MW-11 rock cores indicate that RQD varies between 45% and 63% from 80 to 95 ftbg. Given these results HES and the manufacturer used a conservative estimate of 5% for the porosity of the marble bedrock. The reagent dosage for the first round of injections to be performed at BW-2 was calculated as described below:

Product Dosing Calculations – Electron Donor Solution Extended Release and Zero Valence Iron

Given a 20 ft thick column of bedrock (thickness of well screen), a 20-foot radius of influence (ROI) around BW-2, and a 5% bedrock porosity, total pore volume (PV) was

calculated to be 9,400 gallons. A reagent dosage of 55 gallons (420 pounds) of EDS-ER and 36 gallons (96 pounds) of ZVI were determined to be a suitable quantity for the first round of injections at BW-2 and would produce *in-situ* concentrations of 5.35 grams per liter (g/L) and 1.22 g/L in the 9,400-gallons of pore volume, respectively. According to the manufacturer these concentrations fit within the 1 to 8 g/L range which are typical for most field applications for the reagent products. A total injection volume of 1,175 gallons (combined volume of product and water) was calculated based on 12.5% of the total 9,400 gallon pore volume. Pore volume and product volumes and concentrations are summarized in the table below.

Points	Thickness	ROI	Porosity	Total PV	EDS-ER			ZVI		
#	ft	ft	%	gallons	Lbs	gal	g/L	Lbs	Gal	g/L
1	20	20	5	9,400	420	55	5.35	96.00	36	1.22

Injection Procedure

Using a trash pump the ZVI will be mixed with water in a 275-gallon tote. The contents of the tote will be mixed through recirculation using the trash pump before being injected into BW-2 through the inflatable packer and a well head manifold. EVO will be mixed and injected into BW-2 in the same manner. Following reagent injection, as much as 1,100 gallons of water (to meet the 1,175- gallon volume, 12.5% of total pore volume) will be injected through the packer in order to force reagent into the surrounding fractured bedrock. The ZVI, EVO, and water injection process will be repeated in the same order and quantities in future injections if deemed necessary.

During each injection round, water levels will be monitored in nearby wells along with the reagent injection rate and pressure at the injection well head. All injection field work will be conducted in accordance with the site-wide Quality Assurance Project Plan (QAPP) and the Site Management Plan (SMP) in accordance with the NYSDEC BCP. Post-injection groundwater monitoring and sampling will take place three months after the first round of injections as described below. Additional rounds of injections will be scheduled, if deemed necessary, based on sampling results.

Task 2: Groundwater Monitoring and Sampling

Three months after the completion of the initial injection round, HES will collect groundwater samples in accordance with the QAPP and SMP from wells BW-2 and MW-11 to be analyzed for VOCs via EPA method 8260. In addition, samples from the two wells will also be analyzed for iron and manganese. Before commencing sampling activities, water level measurements will be recorded in all on-site monitor wells using an electronic interface tape. Standing water will be evacuated from each well using a submersible variable rate pump and dedicated polyethylene tubing. All purge water will be contained on-site using 55-gallon drums and/or a 275-gallon tote. Following on-site containment, purge water will be transported to an appropriate disposal facility via vacuum truck by a NYSDEC licensed contractor.

Using a low-flow water quality meter and flow-through cell, standard groundwater sampling field parameters will be collected during evacuation activities at each well including pH, dissolved oxygen, specific conductance, turbidity, temperature, and oxidation/reduction potential. Field parameters will be recorded at 5-minute intervals and pumping rate and depth to water level will be monitored during purging. Purging will be considered complete and sampling may commence when all field parameters have stabilized. As per EPA standards, stabilization is considered to be achieved when three consecutive readings are within the following limits for each parameter:

- pH: +/- 0.1 standard unit
- Dissolved Oxygen: 10% for values greater than 0.5 mg/L or three readings below 0.5 mg/L.
- Specific Conductance: 3%
- Turbidity: 10% for values greater than 5 NTU, or three readings below 5 NTU
- Temperature: 3%
- Oxidation/Reduction Potential: +/-10 millivolts

Following stabilization of parameters, a groundwater sample will be collected from each well via a submersible or bladder pump and dedicated tubing. The samples will be collected in the appropriate laboratory provided glassware and will be delivered on-ice to a New York State certified ELAP laboratory. Trip blank and field equipment blank samples will be prepared prior to leaving for the site and on-site respectively and submitted to the laboratory for analysis along with the groundwater samples. Strict chain of custody and Quality Assurance/Quality Control (QA/QC) protocols will be adhered to during all sampling events.

Task 3: Groundwater Remedial Action Report

Following completion of the above outlined groundwater remediation activities and groundwater monitoring and sampling, HES will compile a letter report for submittal to NYSDEC. The report will summarize the completed remedial activities and results of post-implementation sampling in addition to recommendations for further groundwater remediation activities, if deemed necessary.

Please contact HES at (914) 276-2560 if you have any questions regarding the proposed Groundwater Remediation Work Plan. Following NYSDEC approval, HES will commence with field activities as soon as the necessary reagent products can be delivered to the site, typically within four to six weeks of ordering.

Very truly yours,
HydroEnvironmental Solutions, Inc.

Patrick W. Montuori
Geologist/Hydrogeologist

William A. Canavan, PG, LSRP
President

Enclosures

cc: Mr. Bill Weinberg – Bilwin Development Affiliates, LLC
Mr. Mike Musso, PE – HDR, Village Consultant
Mr. Bill Williams – Village Building Inspector
Mr. Jonathan Ashley, PE – D&K Consulting Engineers, P.C.
File

Table 1

109 Marbledale Road
Tuckahoe, New York
NYSDEC BCP Site No. C360143

Summary of VOC Concentrations Exceeding TOGS
at Monitoring Wells BW-2 and MW-11

Sample ID York ID Sampling Date Client Matrix	NYSDEC TOGS Standards and Guidance Values	Round 1 BW-2 16K0935-01 11/21/2016 Water	Round 2 BW-2 17E0340-04 5/8/2017 Water	Round 3 BW-2 17G0184-02 7/7/2017 Water	Round 4 BW-2 18H0520-01 8/9/2018 Water	Round 4 MW-11 18H0520-03 8/9/2018 Water
Compound		**Result**	**Result**	**Result**	**Result**	**Result**
Volatile Organics EPA Method 8260	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Acetone	50	2.3	75	120	2.2	ND
1,1-Dichloroethylene	5	11	ND	ND	7.7	7.3
Benzene	1	5.3	ND	ND	3	ND
cis-1,2-Dichloroethylene (DCE)	5	4,100	4,200	4,900	4,400	50
Dichlorodifluoromethane	5	5.4	ND	ND	6.6	3
trans-1,2-Dichloroethylene	5	150	ND	27	79	57
Tetrachloroethylene (PCE)	5	6,000	4,000	4,500	590	77
Trichloroethylene (TCE)	5	6,600	3,300	3,600	1,700	47
Vinyl Chloride	2	490	700	740	2,700	3.9

Indicates concentration exceeds applicable TOGS value

Table 2

109 Marbledale Road
Tuckahoe, New York
NYSDEC BCP Site No. C360143

Summary of Total Core Recovery, Rock Quality Designation and Solid Core Recovery

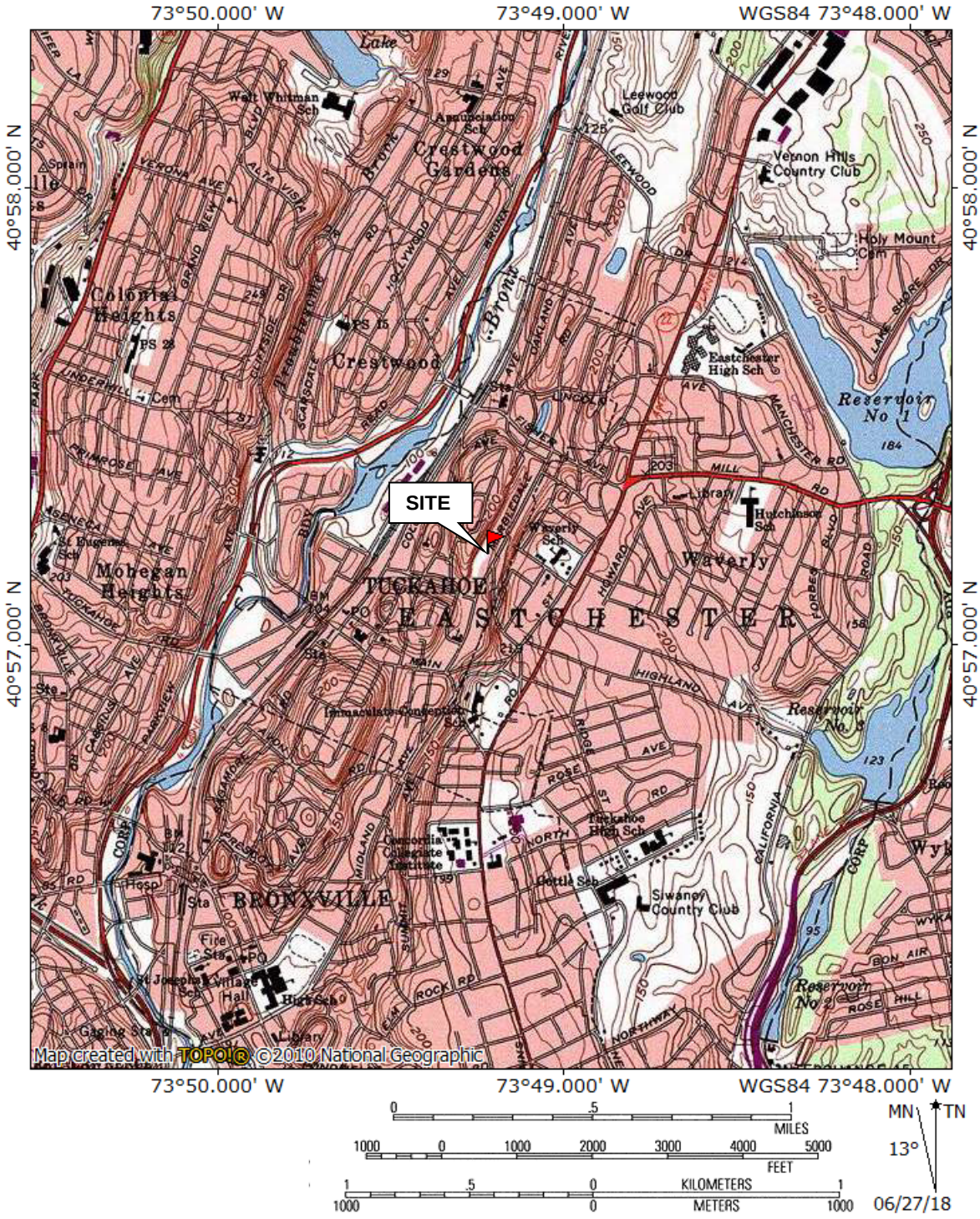
BW-2					
Depth (ftbg)	Core Length (ft)	TCR (in/in)	SCR (in/in)	RQD (in/in)	Quality
62-67	5	38/60 = 63%	52.75/60 = 55%	17.5/60 = 29%	Poor
67-72	5	39/60 = 65%	36.25/60 = 60%	27/60 = 45%	Poor
72-77	5	56/60 = 93%	46/60 = 77%	25.5/60 = 43%	Poor
77-82	5	60/60 = 100%	53/60 = 88%	32.5/60 = 54%	Fair
82-87	5	60/60 = 100%	60/60 = 100%	60/60 = 100%	Very Good

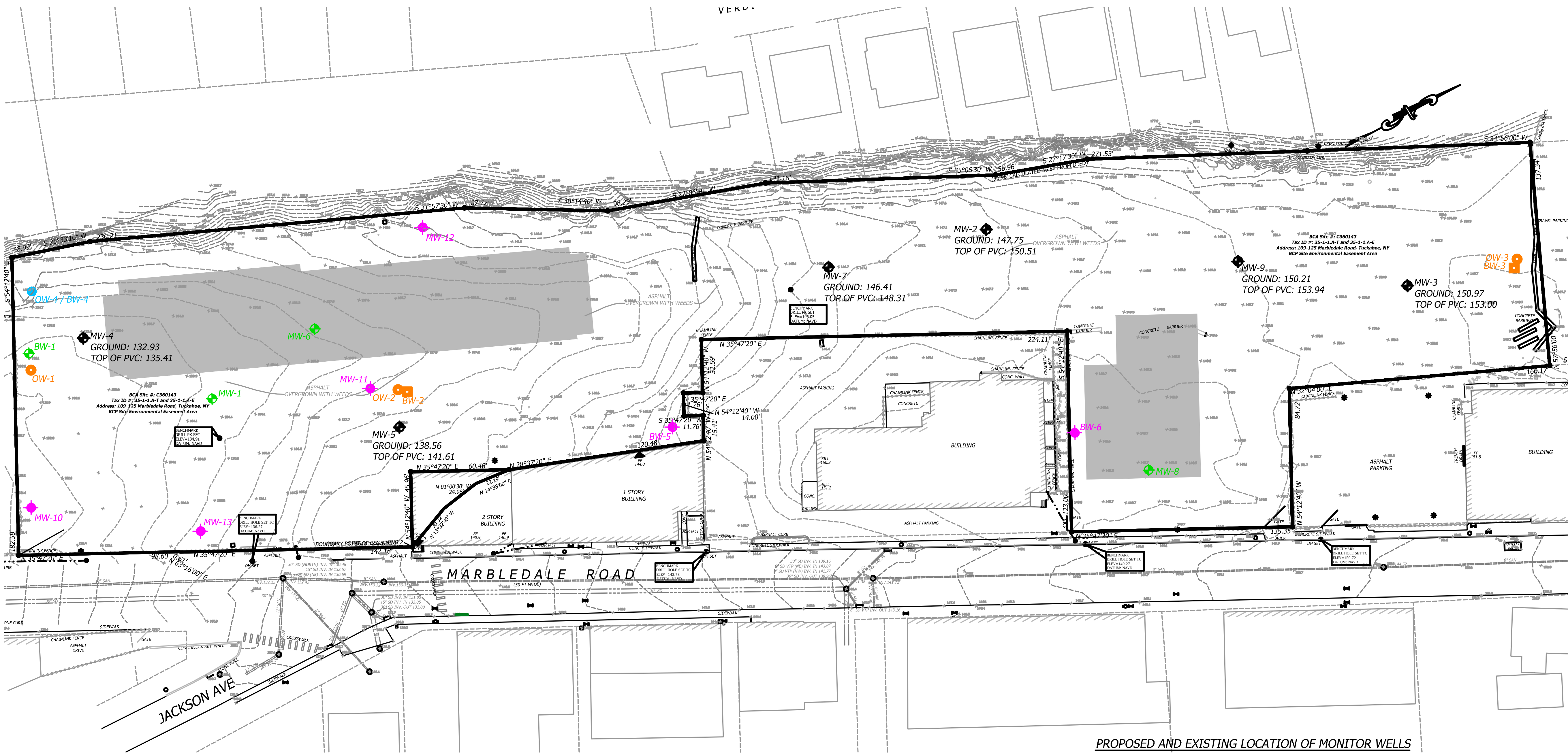
MW-11					
Depth (ftbg)	Core Length (ft)	TCR (in/in)	SCR (in/in)	RQD (in/in)	Quality
80-85	5	50/60 = 83%	41/60 = 68%	38/60 = 63%	Fair
85-90	5	48/60 = 80%	39/60 = 65%	37/60 = 62%	Fair
90-95	5	55/60 = 92%	35/60 = 58%	27/60 = 45%	Poor

Note: ftbg = feet below grade

FIGURE 1
SITE LOCATION MAP

109 MARBLEDALE ROAD
TUCKAHOE, NEW YORK





SITE PLAN

SCALE: 1" - 20'

PROPOSED AND EXISTING LOCATION OF MONITOR WELLS

- MW-7= 113.48 ft — Monitoring Well Location
- Nested Well Approximate Location
- Single Well Approximate Location
- BW-1 — BEDROCK — Location of NYSDEC Required Monitor Wells
- OW-1 — OVERBURDEN — Location of NYSDEC Required Monitor Wells
- MW-6 — Abandoned Monitor Well Location

FIGURE ADAPTED FROM SURVEY BY MR. MICHAEL W. FINKBEINER

109 MARBLEDALE ROAD TUCKAHOE, NEW YORK	SITE PLAN SHOWING MONITORING WELL LOCATIONS	FIGURE 2	HydroEnvironmental SOLUTIONS, INC. One Deans Bridge Road Somers, New York 10589

Attachment 1

GEOLOGIC LOG HydroEnvironmental SOLUTIONS, INC.	**OWNER**: BILWIN DEVELOPMENT
	WELL NO.: BW-2
	PAGE 1 **OF** 3 **PAGES**
SITE LOCATION: 109-125 Marbledale Road Tuckahoe, New York	**SCREEN SIZE & TYPE:** 2-inch Schedule 40 PVC **SLOT NO.:** 20 **SETTING**: 87-72 ftbg
DATE COMPLETED: 10/17/16	**SAND PACK SIZE & TYPE:** No. 2 Filter Sand
DRILLING COMPANY: SoilTesting, Inc. Oxford, Connecticut	**SETTING:** 87-67 ftbg
	CASING SIZE & TYPE: 2-inch Schedule 40 PVC
DRILLING METHOD: Truck Mounted Diedrich D-120	**SETTING:** 72-0 ftbg
SAMPLING METHOD: Stainless Steel Split Spoon	**SEAL TYPE:** Bentonite
OBSERVER: MJS	**SETTING:** 67-65 ftbg
REFERENCE POINT (RP): Grade	**BACKFILL TYPE**: Portland Cement (65-0 ftbg)
ELEVATION OF RP:	**STATIC WATER LEVEL**: 32 ftbg
STICK-UP: 3 ft	**DEVELOPMENT METHOD**:
SURFACE COMPLETION:	**DURATION**: – **YIELD**: –
NOTES: 2- inch bedrock well installation	
ABBREVIATIONS: SS = split spoon W = wash C = cuttings G = grab ST = shelby tube **REC = Recovery PPM = parts per million ftbg = feet below grade MC = macro core sampler**	

DEPTH (FEET)		SAMPLE TYPE	Blow Count	REC. (FEET)	PID READING (PPM)	FID READING (PPM)	DESCRIPTION
FROM	TO						
0	2	SS	9-31-81-85	1.5	0.7	7.45	Fill Consisting of: SILT and GRAVEL (large, angular-subangular), some ASPHALT; brown; dry; no hydrocarbon odor
2	4	SS	54-71-80-88	1.5	5.2	18.68	Fill Consisting of: ASH and GRAVEL (small – large, angular – subangular); brown; dry; no hydrocarbon odor
4	6	SS	7-30-31-16	0.75	26.7	43.36	Fill Consisting of: ASPHALT, some GRAVEL (medium – large, angular), some CONCRETE; gray; moist; no hydrocarbon odor
6	8	SS	15-9-10-9	1.25	9.4	48.83	Fill Consisting of: SILT and SAND (fine – medium), some GRAVEL (small – large, angular – subangular); black; moist; no hydrocarbon odor
8	10	SS	21-10-30-15	0.25	3.0	13.4	Fill Consisting of: SILT and SAND (fine – medium), some GRAVEL (medium – large, angular), some ASH; black; moist; no hydrocarbon odor
10	12	--	--	--	--	--	Hollow Stem Auger

OWNER: BILWIN DEVELOPMENT

WELL NO.: BW-2 **PAGE** 2 **OF** 3 **PAGES**

DEPTH (FEET)		SAMPLE TYPE	Blow Count	REC. (FEET)	PID READING (PPM)	FID READING (PPM)	DESCRIPTION
FROM	TO						
12	14	SS	15-13-14-10	1.0	13.3	52.59	Fill Consisting of: ASH and WOOD, some GRAVEL (small – medium, subangular); black; moist; no hydrocarbon odor
14	16	SS	9-5-3-4	0.5	8.5	40.16	Fill Consisting of: WOOD and ASH, some CONCRETE; black; dry; no hydrocarbon odor
16	18	SS	4-2-2-4	1.0	11.5	11.53	Fill Consisting of: LEAVES and WOOD; dark brown; dry; no hydrocarbon odor
18	20	SS	2-5-5-5	1.5	7.7	29.69	Fill Consisting of: ASH, some GLASS, trace BRICK; black; dry; no hydrocarbon odor
20	22	SS	3-8-4-5	1.5	2.5	33.02	Fill Consisting of: SILT, trace WOOD and GLASS; black; moist; no hydrocarbon odor
22	24	SS	5-10-5-10	1.5	6.0	41.81	Fill Consisting of: ASH, some SAND (fine – medium), some GRAVEL (small – large, subangular), trace GLASS, trace BRICK, trace WOOD; black; moist; no hydrocarbon odor
25	27	SS	4-5-7-8	--	6.8	39.24	Fill Consisting of: SILT and ASH, trace GLASS, trace CONCRETE; black; moist; no hydrocarbon odor
27	29	SS	7-10-6-4	--	8.0	45.75	Fill Consisting of: SILT and ASH, some GRAVEL (small – medium, angular – subangular), trace GLASS, trace WOOD, trace BRICK; black; moist; no hydrocarbon odor
30	32	SS	4-2-2-8	1.0	6.0	407	Fill Consisting of: SILT and ASH, trace WOOD, trace GLASS,; black; moist; no hydrocarbon odor
32	34	SS	15-13-8-50/4	1.0	1.7	109	Fill Consisting of: SAND (fine) and GRAVEL (small – medium, angular), some SILT, some ASH, trace, GLASS, trace WOOD, trace METAL, trace NYLON; black; wet; no hydrocarbon odor
35	37	SS	5-9-24-11	0.75	19.3	334	Fill Consisting of: SAND (medium – coarse) and WOOD, some ROPE, some SILT; black; wet; no hydrocarbon odor
37	39	SS	10-14-13-20	0.25	3.8	98.0	Fill Consisting of: SAND (medium – coarse), and WOOD; black; wet; no hydrocarbon odor
40	42	SS	23-11-13-15	0.25	7.9	53.48	Fill Consisting of: SAND (medium – course) and GRAVEL (small – medium, subangular), with some WOOD; black; wet; no hydrocarbon odor

OWNER: BILWIN DEVELOPMENT

WELL NO.: BW-2 **PAGE** 3 **OF** 3 **PAGES**

DEPTH (FEET)		SAMPLE TYPE	Blow Count	REC. (FEET)	PID READING (PPM)	FID READING (PPM)	DESCRIPTION
FROM	TO						
42	44	SS	7-8-8-5	0.5	5.0	210	Fill Consisting of: SAND (coarse), some WOOD; black; wet; no hydrocarbon odor
45	47	SS	9-5-6-3	0.25	1.6	135	Fill Consisting of: SILT and SAND (fine – coarse), some GRAVEL (small – medium, subangular), some WOOD; black; wet; no hydrocarbon odor
47	49	SS	2-5-50/2	--	1.8	28.7	Fill Consisting of: SAND (medium – coarse) and GRAVEL (small – large, angular); black; wet; no hydrocarbon odor
42	44	SS	7-8-8-5	0.5	5.0	210	Fill Consisting of: SAND (coarse), some WOOD; black; wet; no hydrocarbon odor
52	54	SS	100/2	0.75	4.7		Fill Consisting of: SAND (fine), trace GRAVEL (small – medium, angular – subangular); black; wet; no hydrocarbon odor
55	56	SS	100/3	0.75	14.0	112	Fill Consisting of: SAND (coarse) and WEATHERED ROCK, some METAL, trace GLASS, trace BRICK; gray; wet; no hydrocarbon odor
56	56.5	SS	100/1	0.5	12.5	65	WASH/ REFUSAL
Downhole Readings: PID: 0.9 PPM, FID: 592 PPM, FOUR-GAS: 0% LEL							
							Auger/ Split Spoon refusal @ 56.5 ftbg
							Bedrock cored from 56 – 87 ftbg

GEOLOGIC LOG

HydroEnvironmental SOLUTIONS, INC.

OWNER: BILWIN DEVELOPMENT

WELL NO.: MW-11

PAGE 1 **OF** 1 **PAGES**

SITE LOCATION: 109-125 Marbledale Road
Tuckahoe, New York
BCP Site #C360143

SCREEN SIZE & TYPE: 2-inch Schedule 40 PVC

SLOT NO.: 20 **SETTING**: 110 – 90 ftbg

DATE COMPLETED: 11/13/17, 11/14/17, 11/15/17, 11/16/17, 5/25/18

SAND PACK SIZE & TYPE: No. 2 Filter Sand

SETTING: 110 – 88 ftbg

DRILLING COMPANY: SoilTesting, Inc.
Oxford, Connecticut

CASING SIZE & TYPE: 2-inch Schedule 40 PVC

DRILLING METHOD: Dietrich D-120 Hollow Stem Auger

SETTING: 90 – 0 ftbg

SAMPLING METHOD: N/A

SEAL TYPE: Bentonite Chips

OBSERVER: MJS, PWD, PWM

SETTING: 88 – 56 ftbg

REFERENCE POINT (RP): Grade

BACKFILL TYPE: None

ELEVATION OF RP:

STATIC WATER LEVEL: 30.7 ftbg

STICK-UP:

DEVELOPMENT METHOD:

SURFACE COMPLETION:

DURATION: – **YIELD**: –

NOTES: Need to grout well to surface completion.

ABBREVIATIONS: SS = split spoon W = wash C = cuttings G = grab ST = shelby tube
REC = Recovery PPM = parts per million ftbg = feet below grade MC = macro core sampler

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	REC. (FEET)	PID/FID READING (PPM)	DESCRIPTION
FROM	TO					
0	70	-	-	-	-	**Bedrock refusal**
90	110					**No core recovery**
	110					**Final depth**

Inflatable Packers

OPERATIONS & SERVICE MANUAL

MANUFACTURED BY:

QSP Packers, LLC

Quality, Service, and Price is our Commitment to You

2316 Inter Ave. Ste. D
Puyallup, WA 98372
USA

Phone: 253-770-0315
Fax: 253-770-0327

Email: info@QSPPackers.com
www.QSPPackers.com

Inflatable Packer Operating Procedures

Basics

The QSP Inflatable Packer is made up of four major components: FIXED HEAD; CENTER TUBE; GLAND ELEMENT; and SLIDING HEAD. The gland element is the key component that expands as air or water pressure is applied, and contracts as pressure is decreased. The packer gland element used by QSP is made of natural rubber with two layers of steel cable reinforcement. It expands evenly within the hole which allows the outer rubber cover to protrude into borehole imbalances, thereby causing a tight seal over the full length of the packer gland element.

The packer heads both have ports to allow concurrent use of multiple packers. The inflation air or fluid is transmitted thru the packer in the annulus between the center tube and the gland element. The packers assembly includes a plug in the sliding head that needs to be replaced with a tube connector for multiple packer use.

QSP offers either 1/4" or 3/16" outside diameter (OD) nylon tubing rated at 2,500 psi burst. This tubing is recommended as the inflation pressure is pumped thru a port on the packer head that is tapped for a standard male tube connector. The user is able to operate the packer under extreme hydrostatic head conditions not recommended when using a lower pressure-rated tubing.

You will notice on the perimeter of the fixed head a stamped indication of the maximum internal pressure that can be applied when the packer is inflated to its maximum diameter. This is the pressure at which the maximum gland element expansion occurs. The warranty will be voided if excess pressure is used. (Within an open or cased borehole of known diameter, it is possible to exceed the rated free-air pressure without jeopardizing the integrity of the packer. Please refer to the pressure curve charts in this booklet.)

If it is necessary to test or inflate the packer above ground, do not test or inflate above 25% of the unconfined rated pressure that is stamped on the fixed head. It is imperative that everyone stay clear of either end of the packer if testing or inflating above ground.

WARNING: When using compressed gasses, such as nitrogen or compressed air, please use extreme caution. They are extremely dangerous and misuse of the gasses or the packers that they operate has potential to cause serious injury. *Follow instructions closely as directed on the containers.*

Using either Air or Water to inflate the packer is satisfactory. The most common choices for inflation would be nitrogen, compressed air or water. When using air inflation, nitrogen is recommended because it is the cleanest. Compressed air may be used, but it is necessary to filter it before inflating the packer to prevent oil and dirt from getting inside the gland which causes accelerated break down of the rubber.

The packer gland element can be damaged by exposure to hydrocarbons and could potentially void the warranty.

Before the first use of the packer, all connections made on site need to be tested at low pressure for leaks. It is also necessary to have the gauge or regulator on the source of inflation pressure tested and calibrated to insure the readings are accurate. A common cause of packer failure is a faulty or improperly calibrated regulator.

All QSP Packers are tested in shop prior to shipping. Each packer is also assigned a serial number that appears on the perimeter of the fixed head, located next to the stamp of the maximum internal packer pressure.

Operating a Single Packer

It is most common to have the fixed head up during single packer operation. Connect the inflation tube to the fixed packer head via the connector. Using drill rods, grout rods or iron pipe, insert the packer to the desired depth and then connect the other end of the inflation tube to the pressure regulator.

Back the regulator adjustment lever to zero pressure and open the supply valve on the source of inflation pressure. The pressure should be slowly and gradually increased to the packer by adjusting the regulator. REMINDER: the final gauge pressure should never exceed the total of rated packer pressure plus hydrostatic pressure above the packer. We are available to answer questions about inflation pressure, please contact us.

At this point, you should have the packer inserted and inflated properly, complete your testing or grouting at this time. When complete, release the inflation pressure. It is important to allow ample time for the gland element to relax to its at-rest diameter and this can be tested by inserting the inflation tubing into a cup of water. When there are no longer bubbles in the water, the element is deflated. You may now carefully retrieve the packer or, if necessary, reposition it in the bore-hole if you have further testing to do.

Systems that include a pump and do not use in-line adapters must allow extra wire between the sliding head and the pump.

It is acceptable to insert the packer with the sliding head up, but extreme care must be taken when retrieving the packer. In a hole that is uncased or irregular there is potential for the sliding head to catch on a fracture during retrieval. If upward force is continued it will likely cause the gland element to expand mechanically and become lodged in the hole.

Operating a Straddle Packer

It is recommended to have the fixed head up on the lower packer in straddle or zone packer operation. The center tube should be capped. Lengths of perforated steel tubing should be added consistent with the desired zone length to the fixed head of the lower packer. An appropriate length of inflation tubing should be connected to the lower packer for use in joining the two packers.

The upper packer should have the sliding head up and then connect it with the lower packer via the perforated steel tubing and the inflation tubing that is coming from the lower packer. When the inflation tubing is properly connected to the sliding head of the upper packer you may start running the packers into the bore-hole.

As with single packer operation, back the regulator adjustment lever to zero pressure and open the supply valve on the source of inflation pressure. The pressure should be slowly and gradually increased to the packer by adjusting the regulator. The gauge should stabilize on reading that does not exceed rated packer pressure plus hydro-static head. Your zone is now packed off, and the injection of water or grout can begin. . When complete, release the inflation pressure. It is important to allow ample time for the gland elements to relax to their at-rest diameters. You may now carefully retrieve the packers or, if necessary, reposition them in the bore-hole if you have further testing to do.

While not common due to potential bore-hole irregularities, other orientations are possible for each of the packers in a straddle system. A potential result is that the packed off bore-hole length would not be fixed and could vary according to bore-hole irregularities.

An example for testing in open or unstable formations, it is recommended that both packers have their fixed head up. This will cause the sliding head of the upper packer to move away from the fixed head of the lower packer during the packer inflation process. You must be careful to take the proper allowance for this movement, and using the coiled inflation tube to connect the two packers across the zone is encouraged. The vertical movement could range from two to twelve inches depending on the packer model, the packer length and the size of the borehole.

In conclusion, whether your zone length is defined by distance between packer heads or between gland element seals, the actual zone length will be greater than the as-measured zone length if the packers are used with both fixed heads up.

NOTES

PACKER INFLATION PRESSURE FORMULA
For Inflation with Air or Nitrogen Gas

G = *Inflation pressure at gauge (PSI)*
D_P = *Depth to top of packer (feet)*
D_W = *Depth to static water level in well (feet)*
Sp = *Unconfined packer pressure rating for the well size (PSI)*
P_P = *Injection pump pressure (PSI)*

(1) To calculate Packer Inflation Pressure for a withdraw test (pump out):

$$G = [(D_P - D_W) \times .43] + Sp + [(D_P - D_W) \times .43 \times .2]$$

NOTE: This total must not exceed confined packer pressure rating for the well size.

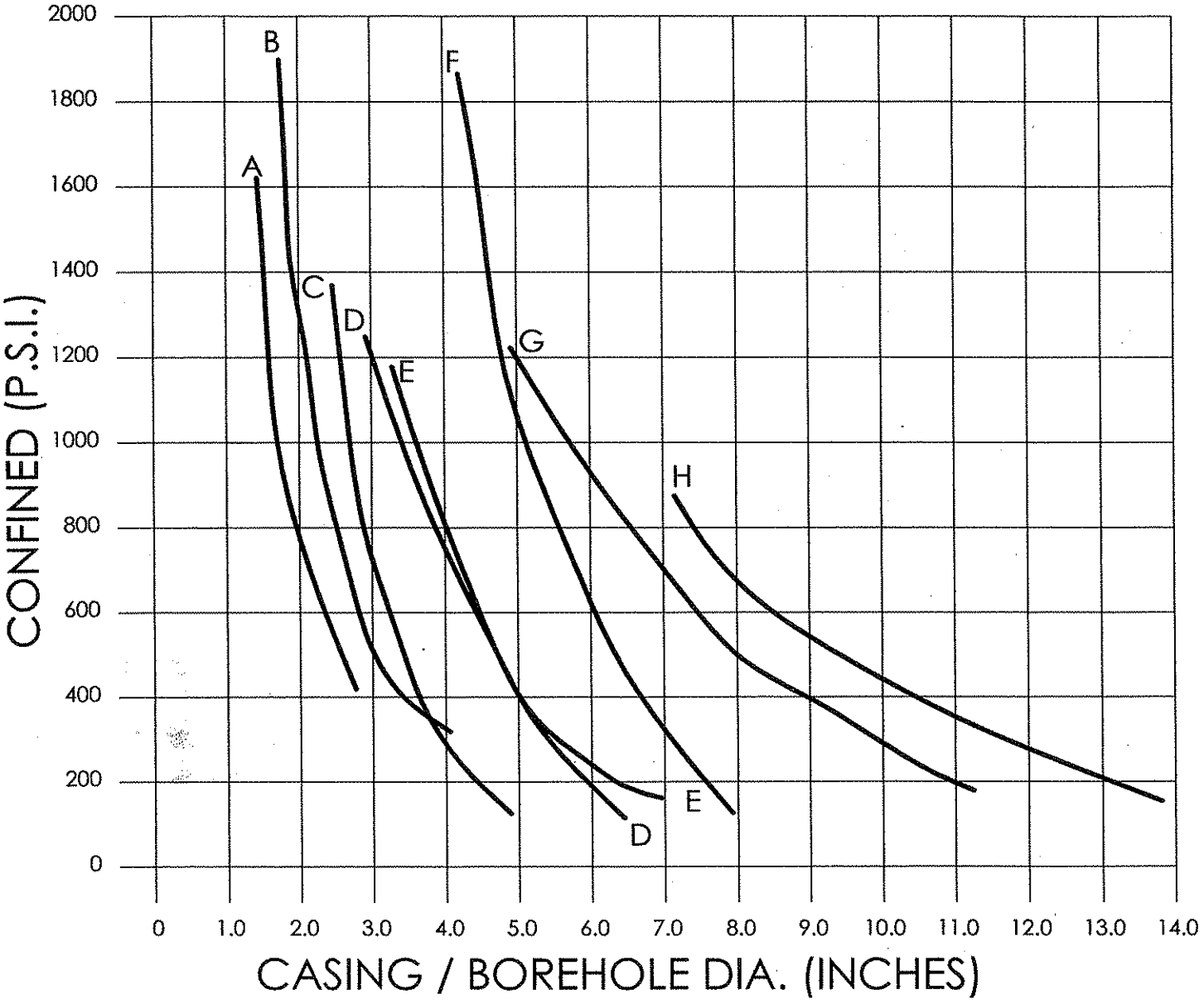
(2) To calculate Packer Inflation Pressure for an injection test (pump in):

$$G = [(D_P \times \text{PSI per foot of Injected Fluid*}) + Sp + P_P] \times 1.1$$

*.43 for Water or .6 for grout

NOTE: This total must not exceed confined packer pressure rating plus $(D_P - D_W) \times .43$

CONFINED PRESSURE CURVES

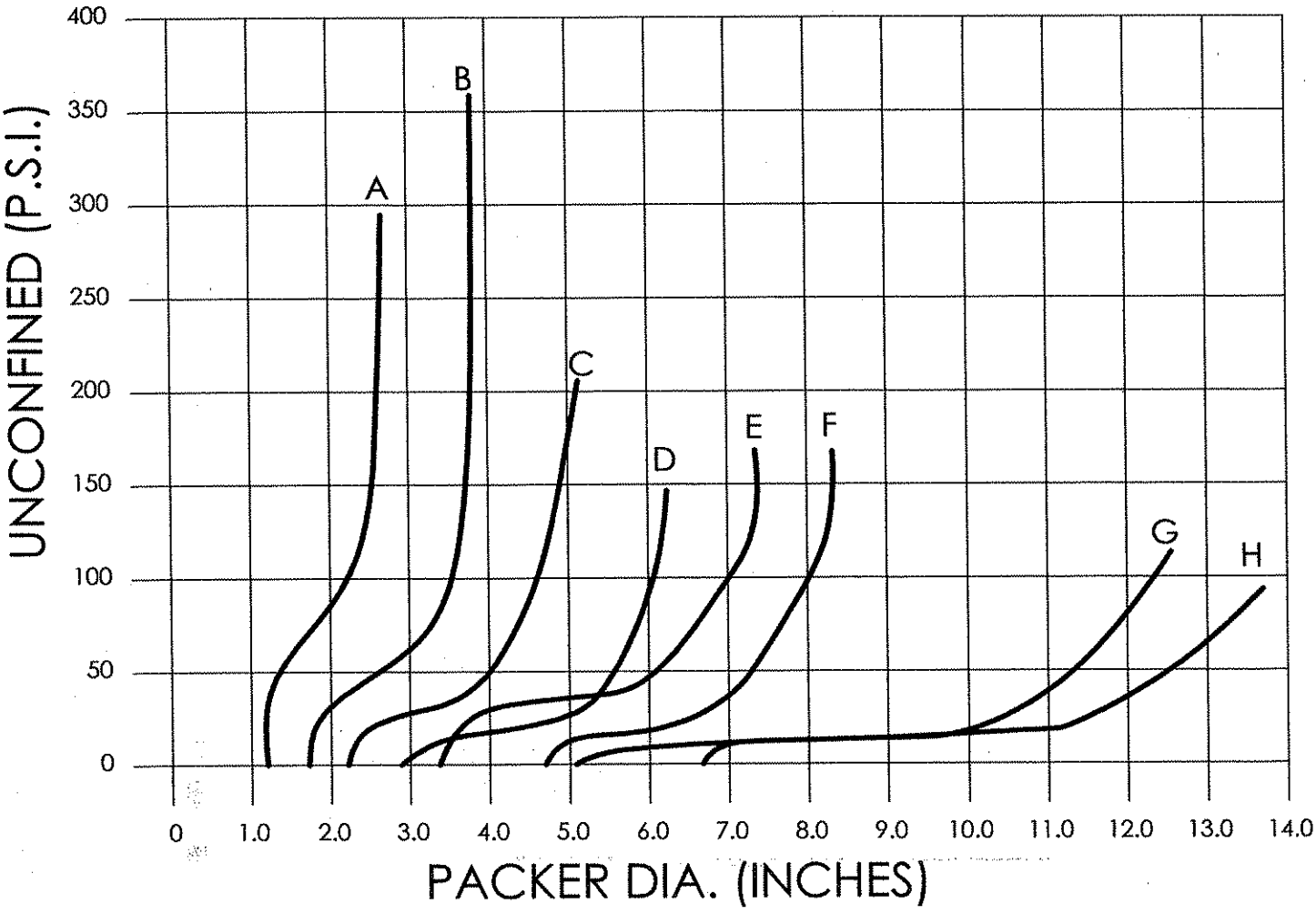


LEGEND

	NO.	MODEL
	A	1" - 2"
	B	2" - 3"
	C	3" - 4"
	D	3" - 6"
	E	4" - 7"
NEW→	F	5" - 8"
	G	6" - 10"
	H	7" - 13"

QSP PACKERS, LLC

UNCONFINED PRESSURE CURVES



LEGEND

	NO.	MODEL
	A	1" - 2"
	B	2" - 3"
	C	3" - 4"
	D	3" - 6"
	E	4" - 7"
NEW→	F	5" - 8"
	G	6" - 10"
	H	7" - 13"

QSP PACKERS, LLC

QSP Packers

STANDARD Inflatable Packers Replacement Parts List

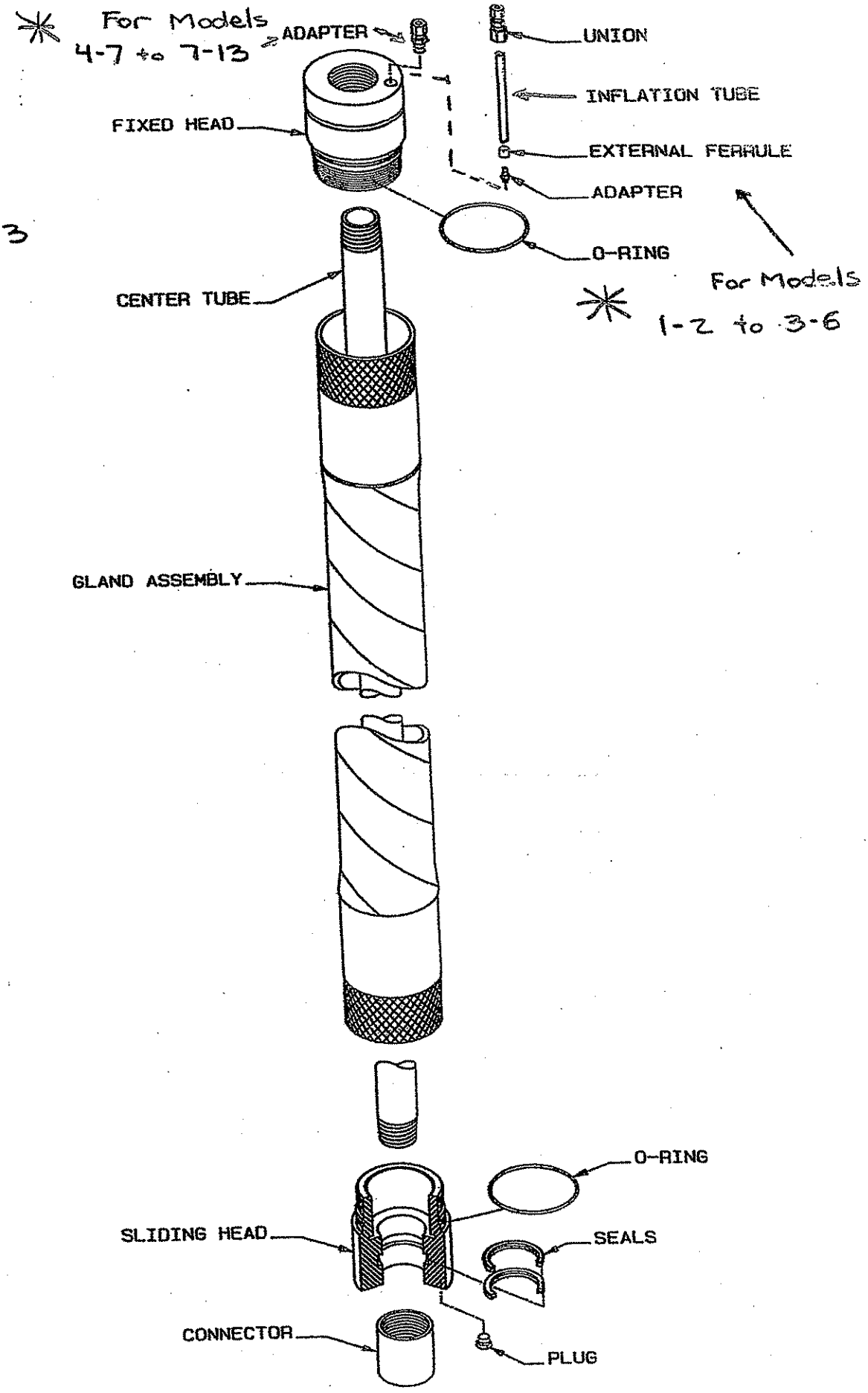
PACKER MODEL #	2-3	3-4	3-6	4-7	5-8	6-10	7-13
GLAND LENGTH	15", 30", 60"	15", 30", 60"	15", 30", 60"	30"	30"	49"	49"
CENTER TUBE ID	.510"	1.0"	1.25"	1.25"	1.25	2.5"	3.5"
Item	*P/N*	*P/N*	*P/N*	*P/N*	*P/N*	*P/N*	*P/N*
* *UNION*	* TU3/161/4B	TU3/161/4B	TU3/161/4B	-	-	-	-
* *INFLATION TUBE*	* TBN.250-4	TBN.250-4	TBN.250-4	-	-	-	-
* *EXTERNAL FERRULE*	* EF117-110	EF117-110	EF117-110	-	-	-	-
* *ADAPTER*	* BA10/32SS	BA10/32SS	BA10/32SS	TA3/16T1/8MB	TA3/16T1/8MB	TA1/4T1/8MB	TA1/4T1/8MB
FIXED HEAD	FH2-3	FH3-4	FH3-6	FH4-7	FH5-8	FH6-10	FH7-13
CENTER TUBE 15"	CT2315	CT3415	CT3615	-	-	-	-
30"	CT2330	CT3430	CT3630	CT4730	CT5830	-	-
60"	CT2360	CT3460	CT3660	-	-	-	-
49"	-	-	-	-	-	CT61049	CT71349
GLAND ASSEMBLY 15"	GA2315	GA3415	GA3615	-	-	-	-
30"	GA2330	GA3430	GA3630	GA4730	GA5830	-	-
60"	GA2360	GA3460	GA3660	-	-	-	-
49"	-	-	-	-	-	GA61049	GA71349
SLIDING HEAD	SH2-3	SH3-4	SH3-6	SH4-7	SH5-8	SH6-10	SH7-13
O-RING	ORA-123	ORA-130	ORA-140	ORA-150	ORA-152	ORA-346	ORA-433
SEALS	PPS.750	PPS1.25	PPS1.625	PPS1.625	PPS1.625	PPS3.00	PPS3.50
PLUG	P10/32MB	P10/32MB	P10/32MB	P1/8MB	P1/8MB	P1/8MB	P1/8MB
CONNECTOR	CPLG.375FM	CPLG1.00FM	CPLG1.25FM	CPLG1.25FM	CPLG1.25FM	CPLG2.50FM	CPLG3.00FM

** These four parts may also be ordered together as a kit, P/N* **ITJ** **for 2-3, 3-4 or 3-6 models.**

Inflatable Packer

ASSEMBLY

Models
1-2 to 7-13



QSP Packers

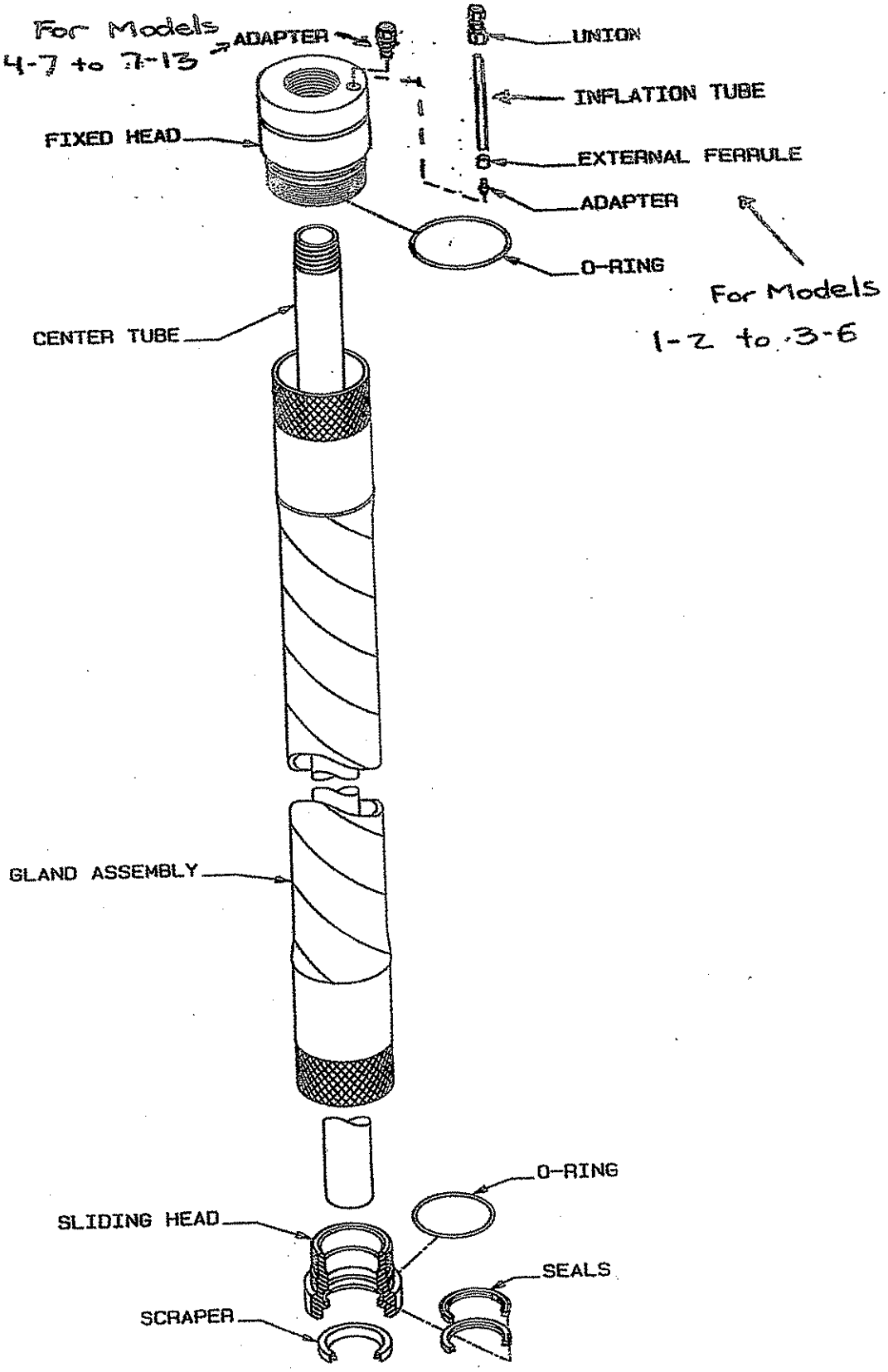
GROUT Inflatable Packers Replacement Parts List

PACKER MODEL #		2-3	3-4	3-6	4-7	5-8
GLAND LENGTH		15", 30", 60"	15", 30", 60"	15", 30", 60"	30"	30"
Item		*P/N*	*P/N*	*P/N*	*P/N*	*P/N*
* *UNION*		* TU3/161/4B	TU3/161/4B	TU3/161/4B	-	-
* *INFLATION TUBE*		* TBN.250-4	TBN.250-4	TBN.250-4	-	-
* *EXTERNAL FERRULE*		* EF117-110	EF117-110	EF117-110	-	-
* *ADAPTER*		* BA10/32SS	BA10/32SS	BA10/32SS	TA3/16T1/8MB	TA3/16T1/8MB
FIXED HEAD		-	FH3-4	FH3-6	FH4-7	FH5-8
CENTER TUBE	15"	-	GCT3415	GCT3615	-	-
	30"	-	GCT3430	GCT3630	GCT4730	GCT5830
	60"	-	GCT3460	GCT3660	-	-
CENTER TUBE WELDMENT	15"	GCTW2315	-	-	-	-
	30"	GCTW2330	-	-	-	-
	60"	GCTW2360	-	-	-	-
GLAND ASSEMBLY	15"	GGA2315	GA3415	GA3615	-	-
	30"	GGA2330	GA3430	GA3630	GA4730	GA5830
	60"	GGA2360	GA3460	GA3660	-	-
SLIDING HEAD		GSH2-3	GSH3-4	GSH3-6	GSH4-7	GSH5-8
O-RING		ORA-123	ORA-130	ORA-140	ORA-150	ORA-152
SEALS		PPS.875	PPS1.25	PPS1.625	PPS1.625	PPS1.625
SCRAPER		CW.875	CW1.25	CW1625	CW1626	CW1627

** These four parts may also be ordered together as a kit, P/N* **ITJ** **for 2-3, 3-4 or 3-6 models.**

Inflatable Grout Packer Assembly

Models
2-3 to 7-13



Care & Maintenance of Inflatable Packers

For best results and less damage, when working with Inflatable packers, it is recommended to use a combination of two chain wrenches when tightening or taking apart.

Replacing the Gland Element:

1. Using an emery cloth or file, remove wrench marks and/or burrs from the surface of the center tube. (If this is not done you may cause damage to the seal when performing step 2.

2. Remove sliding head from the packer by unthreading it from the gland element.

3. Remove the gland element from the packer by unthreading it from the fixed head and sliding it off of the center tube.

4. The O-rings should be inspected on each packer head and replaced if any wear is visible.

5. The seals in the sliding head should be inspected and replaced if any wear is visible.

6. Now the new gland can be installed by sliding it over the center tube and threading it to the fixed packer head.

7. The sliding head can now be returned to the center tube and threaded to the gland element.

8. It is recommended to attach the inflation tube to the fixed head and check for air leaks at all connections when you complete the replacement of the gland element and before running the packer into the borehole. REMINDER: When testing packers above ground, DO NOT test or inflate above 25% of the unconfined rated pressure that is stamped on the fixed head. It is imperative that everyone stay clear of either end of the packer if testing or inflating above ground.

Cleaning Packers after use:

1. With Inflation ports covered, pressure wash packer as soon as possible when removed from the hole.

Storing Packers to prolong life of the gland element:

1. Keep packers in a cool, dark area when not in use. (UV light causes rubber to break down quicker over time.)

Terms, Conditions & Warranty

Pricing is subject to change without notice, please call to confirm if you have the current price list. Special packaging for overseas shipments or other requirements may incur an additional handling fee to be quoted at time of order.

We offer open account terms of Net 30 days on approval of credit. A finance charge of 1-1/2% per month is applied to accounts exceeding 30 days. ***Credit Card*** payments may receive an additional discount.

Freight charges can be prepaid or collect and all shipments will be FOB Puyallup. The carrier accepts all responsibility upon accepting the shipment at our shop. Any claims for loss or damage must be settled without delay between you and the carrier.

QSP requires that any claim for shortages or incorrect filing of orders must be made within 5 days after receipt of product. You must call and receive an authorization number to return any goods. A copy of the invoice and bill of lading must be included to expedite the correction or credit. A 25% charge for restocking will apply on items returned for exchange or credit if the error is not ours. Items must have preauthorization to be returned or they will be refused.

When using QSP products, buyers assume all risk and liability which may result from said use of any material, when used either singly or with other products. Although QSP may furnish advice either verbally or in print, we make no guarantees and assume no obligation or liability for the results obtained. No suggestion for product use shall be construed as a recommendation for its use in infringement on any existing patent.

Warranty is in effect for a period of four (4) months from the date of purchase. All packers that are manufactured and sold by QSP Packers will be of workman-like quality and will operate properly if used and maintained properly.

There shall be no warranties, express or implied, that extend beyond the description on the face thereof.

QSP Packers will not be responsible for any incidental or consequential damages that occur to their products . Any item proven to be defective shall be replaced or repaired under this warranty. The claim must be made within the four (4) months of date of purchase directly to QSP Packers. From that time, QSP Packers will take a reasonable time in which to determine if repair or replacement shall be the option it chooses. The item must be returned to QSP at the buyers expense for this determination to be properly assessed before recognizing any claim. If any alterations or attempted repairs have been done without written consent of QSP, or it is determined that the item was subject to misuse, neglect or accident, then the Warranty shall be null & void for that item.

Additional copies of this booklet are available. Please contact QSP,

mail: PO Box 1544; Sumner, WA 98390; USA
email: info@QSPPackers.com
website: www.QSPPACKERS.com
phone: 253-770-0315
fax: 253-770-0327

We appreciate the trust you have placed in us and our products.

NOTES

Standard, Grout, & Wireline Packers

Specification / Weight Charts

PACKER SIZE		1.2"-2"	2"-3" (NQ)	3"-4" (HQ)	3"-6" (PQ)	4"-7"	5"-8"	6"-10"	7"-13"
At-rest Diameter	(in/mm)	1.20 / 30.5	1.66 / 42.2	2.13 / 54.1	2.84 / 72.1	3.35 / 85.1	4.03 / 102.4	5.12 / 130	6.69 / 169.9
Maximum Recommended Diameter	(in/mm)	1.97 / 50	3.54 / 90	4.33 / 110	5.90 / 150	6.69 / 170	7.48 / 190	9.45 / 240	12.99 /330
Mandrel Inside Diameter*	(in/mm)	.375 / 9.53	.51 / 12.95	1.0 / 25.4	1.25 / 31.8	1.25 / 31.8	1.25 / 31.8	2.5 / 63.5	3.0 / 76.2
Exposed Element Length**	(in/mm)	28 / 711.2	25.5 / 647.7	24.5 / 622.3	24.5 / 622.3	24.5 / 622.3	24.5 / 622.3	39.4 /1000.8	41 / 1041.4
Overall Standard Packer Length	(in/m)	45 / 1.143	45 / 1.143	48 / 1.22	48 / 1.22	48 / 1.22	48 / 1.22	75 / 1.91	76 / 1.93
Overall Grout Packer Length	(in/m)	***	44 / 1.12	39 / 1.0	40 / 1.02	40 / 1.02	40 / 1.02	69 / 1.75	70 / 1.78
Overall Wireline Packer Length	(in/m)		86 / 2.18	92 / 2.34	92 / 2.34				
Thread Connection	(NPT)	1/4"	3/8"	1"	1-1/4"	1-1/4"	1-1/4"	2-1/2"	3"
Maximum Pressure Unconfined	(psi/bar)	436 / 30	360 / 24.8	185 / 12.8	145 / 10	160 / 11	145 / 10	115 / 7.9	85 / 5.9

NOTE: Measurement Formula Used Above - 1" x 25.4 = mm 1" x .0254 = m 1 psi x .0689 = bar

* Larger I.D. Mandrels available. Call for Sizes.
** Standard Lengths. Other lengths available. Call for Sizes.
*** Can be ordered as Tube-a-Manchettes or Single Grout Packer. Call for Availability

NOTE: As we strive to improve our products, it may be necessary to adjust the above specifications.

Packer Size	Gland Weight lbs. / kgs.	Packer Weight lbs. / kgs.
1"-2" x 30"	5 / 2.3	7 / 3.2
2"-3" x 15"	3 / 1.4	6 / 2.7
2"-3" x 30"	4 / 1.8	8 / 3.6
2"-3" x 60"	6 / 2.7	12 / 5.5
3"-4" x 15"	4 / 1.8	11 / 4.9
3"-4" x 30"	5 / 2.3	14 / 6.4
3"-4" x 60"	7 / 3.1	19 / 8.6
3"-6" x 15"	6 / 2.7	19 / 8.6
3"-6" x 30"	8 / 3.6	23 / 10.5
3"-6" x 60"	12 / 5.5	31 / 14.1
4"-7" x 30"	10 / 4.5	26 / 11.8
5"-8" x 30"	16.5 / 7.5	32 / 14.6
6"-10" x 49"	38 / 17.3	95 / 43.2
7"-13" x 49"	59 / 26.8	132 / 60
	NQ Wireline Packer	18 / 8.2
	HQ Wireline Packer	26 / 11.8
	PQ Wireline Packer	37 / 16.8
Composite Cable Assembly		
9.8 lbs. / 100' 4.45kgs. /304 m		
(does not include spool weight)		

NOTE: Measurement Formula Used Above - 1lb x .4536 = kg

QSP Packers. LLC

Safety Data Sheet

Electron Donor Solution Extended Release

SDS Revision Date: **06/02/2015**

1. Identification

1.1. Product identifier

Product Identity	Electron Donor Solution Extended Release
Alternate Names	EDS-ER

1.2. Relevant identified uses of the substance or mixture and uses advised against

Intended use	See Technical Data Sheet.
Application Method	See Technical Data Sheet.

1.3. Details of the supplier of the safety data sheet

Company Name	Tersus Environmental, LLC 1116 Colonial Club Rd. Wake Forest, NC 27587
Emergency	
CHEMTREC (USA)	(800) 424-9300
24 hour Emergency Telephone No.	1-703-527-3887
Customer Service: Tersus Environmental, LLC	(919) 453-5577 info@tersusenv.com

2. Hazard(s) identification

2.1. Classification of the substance or mixture

No applicable GHS categories.

2.2. Label elements

Using the Toxicity Data listed in section 11 and 12 the product is labeled as follows.

.

[Prevention]:

No GHS prevention statements

[Response]:

No GHS response statements

[Storage]:

No GHS storage statements

[Disposal]:

No GHS disposal statements

3. Composition/information on ingredients

This product contains the following substances that present a hazard within the meaning of the relevant State and Federal Hazardous Substances regulations.

Ingredient/Chemical Designations	Weight %	GHS Classification	Notes
Soybean Oil **CAS Number: 8001-22-7**	**93**		
Vegetable Oil Derived Fatty Acid Esters **CAS Number: Proprietary**	**7**	**Not Classified**	**[1]**

In accordance with paragraph (i) of §1910.1200, the specific chemical identity and/or exact percentage (concentration) of composition has been withheld as a trade secret.
[1] Substance classified with a health or environmental hazard.
[2] Substance with a workplace exposure limit.
[3] PBT-substance or vPvB-substance.
*The full texts of the phrases are shown in Section 16.

4. First aid measures

4.1. Description of first aid measures

General In all cases of doubt, or when symptoms persist, seek medical attention. Never give anything by mouth to an unconscious person.

Inhalation Remove to fresh air, keep patient warm and at rest. If breathing is irregular or stopped, give artificial respiration. If unconscious place in the recovery position and obtain immediate medical attention. Give nothing by mouth.

Eyes Irrigate copiously with clean water for at least 15 minutes, holding the eyelids apart and seek medical attention.

Skin Remove contaminated clothing. Wash skin thoroughly with soap and water or use a recognized skin cleanser.

Ingestion If swallowed obtain immediate medical attention. Keep at rest. Do NOT induce vomiting.

4.2. Most important symptoms and effects, both acute and delayed

Overview Inhalation Health Risks and Symptoms of Exposure: Excessive inhalation of oil mist may affect the respiratory system. Oil mist is classified as a nuisance particulate by ACGIH.

Skin Absorption Health Risks and Symptoms of Exposure: Not classified as a primary skin irritant or corrosive material. Sensitive individuals may experience dermatitis after long

exposure of oil on skin.

Health Hazards (Acute and Chronic):
Acute: None observed by inhalation.
Chronic: None reported.

5. Fire-fighting measures

5.1. Extinguishing media

CO2, dry chemical, foam, sand.

5.2. Special hazards arising from the substance or mixture

Hazardous decomposition: No hazardous decomposition data available.

5.3. Advice for fire-fighters

Special Firefighting Procedures: Avoid use of water as it may spread fire by dispersing oil. Use water to keep fire-exposed containers cool. Water spray may be used to flush spills away from fire.

Unusual Fire and Explosion Hazards: Rags soaked with any oil or solvent can present a fire hazard and should always be stored in UL Listed or Factory Mutual approved, covered containers. Improperly stored rags can create conditions that lead to oxidation. Oxidation, under certain conditions can lead to spontaneous combustion.

ERG Guide No. ----

6. Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Put on appropriate personal protective equipment (see section 8).

6.2. Environmental precautions

Do not allow spills to enter drains or waterways.

Use good personal hygiene practices. Wash hands before eating, drinking, smoking or using toilet. Promptly remove soiled clothing and wash thoroughly before reuse.

6.3. Methods and material for containment and cleaning up

Wear appropriate respiratory protection and protective clothing as described in Section 8. Depending on quantity of spill: (a) Small spill: Add solid adsorbent, shovel into disposable container and wash the area. Clean area with detergent. (b) Large spill: Squeegee or pump into holding container. Clean area with detergent. In the event of an uncontrolled release of this material, the user should determine if this release is reportable under applicable laws and regulations.

All recovered material should be packaged, labeled, transported, and disposed or reclaimed in accordance with local, state, and federal regulations and good engineering practices.

7. Handling and storage

7.1. Precautions for safe handling

Handle containers carefully to prevent damage and spillage.

7.2. Conditions for safe storage, including any incompatibilities

Incompatible materials: No data available.

Store away from flame, fire, and excessive heat.

7.3. Specific end use(s)

No data available.

8. Exposure controls and personal protection

8.1. Control parameters

Exposure

CAS No.	Ingredient	Source	Value
Proprietary	Vegetable Oil Derived Fatty Acid Esters	OSHA	No Established Limit
		ACGIH	No Established Limit
		NIOSH	No Established Limit
		Supplier	No Established Limit

Carcinogen Data

CAS No.	Ingredient	Source	Value
Proprietary	Vegetable Oil Derived Fatty Acid Esters	OSHA	Select Carcinogen: No
		NTP	Known: No; Suspected: No
		IARC	Group 1: No; Group 2a: No; Group 2b: No; Group 3: No; Group 4: No;

8.2. Exposure controls

Respiratory Not normally needed. A qualified health specialist should evaluate whether there is a need for respiratory protection under specific conditions.

Eyes Eye protection is always recommended when handling chemicals. Wear safety glasses meeting the specifications established in ANSI Standard Z87.1.

Skin	Not normally needed. However, protective clothing is always recommended when handling chemicals.
Engineering Controls	Provide adequate ventilation. Where reasonably practicable this should be achieved by the use of local exhaust ventilation and good general extraction. If these are not sufficient to maintain concentrations of particulates and any vapor below occupational exposure limits suitable respiratory protection must be worn.
Other Work Practices	Use good personal hygiene practices. Wash hands before eating, drinking, smoking or using toilet. Promptly remove soiled clothing and wash thoroughly before reuse.

9. Physical and chemical properties

Appearance	Pale Yellow Liquid
Odor	Faint
Odor threshold	Not determined
pH	Not Measured
Melting point / freezing point	Not Measured
Initial boiling point and boiling range	Not Measured
Flash Point	Greater than 550F (288C)
Evaporation rate (Ether = 1)	Not Measured
Flammability (solid, gas)	Not Applicable
Upper/lower flammability or explosive limits	**Lower Explosive Limit:** Not Measured **Upper Explosive Limit:** Not Measured
Vapor pressure (Pa)	Not Measured
Vapor Density	Exceeds 1.0
Specific Gravity	0.92 - 0.925
Solubility in Water	Miscible
Partition coefficient n-octanol/water (Log Kow)	Not Measured
Auto-ignition temperature	Not Measured
Decomposition temperature	Not Measured
Viscosity (cSt)	Not Measured
% Volatile (by volume)	0%
Weight per gallon	7.7lbs at 60F

9.2. Other information

No other relevant information.

10. Stability and reactivity

10.1. Reactivity

Hazardous Polymerization will not occur.

10.2. Chemical stability

Stable under normal circumstances.

10.3. Possibility of hazardous reactions

No data available.

10.4. Conditions to avoid

No data available.

10.5. Incompatible materials

No data available.

10.6. Hazardous decomposition products

No hazardous decomposition data available.

11. Toxicological information

Acute toxicity

Ingredient	Oral LD50, mg/kg	Skin LD50, mg/kg	Inhalation Vapor LC50, mg/L/4hr	Inhalation Dust/Mist LC50, mg/L/4hr	Inhalation Gas LC50, ppm
Vegetable Oil Derived Fatty Acid Esters - (Proprietary)	No data available	No data available	No data available	No data available	No data available

Note: When no route specific LD50 data is available for an acute toxin, the converted acute toxicity point estimate was used in the calculation of the product's ATE (Acute Toxicity Estimate).

Classification	Category	Hazard Description
Acute toxicity (oral)	---	Not Applicable
Acute toxicity (dermal)	---	Not Applicable
Acute toxicity (inhalation)	---	Not Applicable
Skin corrosion/irritation	---	Not Applicable
Serious eye damage/irritation	---	Not Applicable
Respiratory sensitization	---	Not Applicable

Skin sensitization	---	Not Applicable
Germ cell mutagenicity	---	Not Applicable
Carcinogenicity	---	Not Applicable
Reproductive toxicity	---	Not Applicable
STOT-single exposure	---	Not Applicable
STOT-repeated exposure	---	Not Applicable
Aspiration hazard	---	Not Applicable

12. Ecological information

12.1. Toxicity

No additional information provided for this product. See Section 3 for chemical specific data.

Aquatic Ecotoxicity

Ingredient	96 hr LC50 fish, mg/l	48 hr EC50 crustacea, mg/l	ErC50 algae, mg/l
Vegetable Oil Derived Fatty Acid Esters - (Proprietary)	Not Available	Not Available	Not Available

12.2. Persistence and degradability

There is no data available on the preparation itself.

12.3. Bioaccumulative potential

Not Measured

12.4. Mobility in soil

No data available.

12.5. Results of PBT and vPvB assessment

This product contains no PBT/vPvB chemicals.

12.6. Other adverse effects

No data available.

13. Disposal considerations

13.1. Waste treatment methods

Observe all federal, state and local regulations when disposing of this substance.

14. Transport information

	DOT (Domestic Surface Transportation)	IMO / IMDG (Ocean Transportation)	ICAO/IATA
14.1. UN number	Not Applicable	Not Regulated	Not Regulated
14.2. UN proper shipping name	Not Regulated	Not Regulated	Not Regulated
14.3. Transport hazard class(es)	**DOT Hazard Class:** Not Applicable	**IMDG:** Not Applicable **Sub Class:** Not Applicable	**Air Class:** Not Applicable
14.4. Packing group	Not Applicable	Not Applicable	Not Applicable

14.5. Environmental hazards

IMDG Marine Pollutant: No

14.6. Special precautions for user

No further information

15. Regulatory information

Regulatory Overview The regulatory data in Section 15 is not intended to be all-inclusive, only selected regulations are represented.

Toxic Substance Control Act (TSCA) All components of this material are either listed or exempt from listing on the TSCA Inventory.

WHMIS Classification Not Regulated

US EPA Tier II Hazards

Fire: No

Sudden Release of Pressure: No

Reactive: No

Immediate (Acute): No

Delayed (Chronic): No

EPCRA 311/312 Chemicals and RQs:
To the best of our knowledge, there are no chemicals at levels which require reporting under this statute.

EPCRA 302 Extremely Hazardous:
To the best of our knowledge, there are no chemicals at levels which require reporting under this statute.

EPCRA 313 Toxic Chemicals:
To the best of our knowledge, there are no chemicals at levels which require reporting under this statute.

Proposition 65 - Carcinogens (>0.0%):
To the best of our knowledge, there are no chemicals at levels which require reporting under this statute.

Proposition 65 - Developmental Toxins (>0.0%):
To the best of our knowledge, there are no chemicals at levels which require reporting under this statute.

Proposition 65 - Female Repro Toxins (>0.0%):
To the best of our knowledge, there are no chemicals at levels which require reporting under this statute.

Proposition 65 - Male Repro Toxins (>0.0%):
To the best of our knowledge, there are no chemicals at levels which require reporting under this statute.

New Jersey RTK Substances (>1%) :
To the best of our knowledge, there are no chemicals at levels which require reporting under this statute.

Pennsylvania RTK Substances (>1%):

Soybean oil

16. Other information

The information and recommendations contained herein are based upon data believed to be correct. However, no guarantee or warranty of any kind, expressed or implied, is made with respect to the information contained herein. We accept no responsibility and disclaim all liability for any harmful effects which may be caused by exposure to our products. Customers/users of this product must comply with all applicable health and safety laws, regulations, and orders.

The full text of the phrases appearing in section 3 is: Not applicable

This is the first version in the GHS SDS format. Listings of changes from previous versions in other formats are not applicable.

We suggest that containers be either professionally reconditioned for re-use by certified firms or properly disposed of by certified firms to help reduce the possibility of an accident. Disposal of containers should be in accordance with applicable federal, state and local laws and regulations. "Empty" drums should not be given to individuals.

The conditions of handling, storage, use and disposal of the product are beyond our control and may be beyond our knowledge. For this and other reasons, we do not assume responsibility and expressly disclaim liability for loss, damage or expense arising out of or in any way connected with the handling, storage, use or disposal of the product.

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall Tersus Environmental be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Tersus Environmental has been advised of the possibility of such damages.

End of Document

Safety Data Sheet

mZVI Suspension

SDS Revision Date: **04/27/2018**

SECTION 1: PRODUCT AND COMPANY IDENTIFICATION

1.1. Product identifier

Product Identity	mZVI Suspension
Alternate Names	mZVI Suspension

1.2. Relevant identified uses of the substance or mixture and uses advised against

Intended use	See Technical Data Sheet.
Application Method	See Technical Data Sheet.

1.3. Details of the supplier of the safety data sheet

Company Name	Tersus Environmental, LLC 1116 Colonial Club Rd. Wake Forest, NC 27587
Emergency	
CHEMTREC (USA)	(800) 424-9300
24 hour Emergency Telephone No.	1-703-527-3887
Customer Service: Tersus Environmental, LLC	(919) 453-5577 info@tersusenv.com

SECTION 2: HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW:

ROUTES OF ENTRY:

ABSORBTION (SKIN) (EYES): YES

INGESTION: YES

INJECTION: NO

INHALATION: NO

ACUTE HEALTH HAZARDS: None Known – Not believed to have harmful health effects

INGESTION/SWALLOWED: (Unknown)

- Accidental ingestion of the material may be damaging to the health of the individual.
- No harmful effects expected in amounts likely to be ingested by accident.
- Overexposure is unlikely in this form.
- Nonionic surfactants may produce localized irritation of the oral or gastrointestinal lining and induce vomiting and mild diarrhea.

EYE: (Unknown)

- Evidence exists, or practical experience predicts, that the material may cause eye irritation in a substantial number of individuals.
- Prolonged eye contact may cause inflammation characterized by a temporary redness of the conjunctiva (similar to windburn).
- Non-ionic surfactants can cause numbing of the cornea, which masks discomfort normally caused by other agents and leads to corneal injury. Irritation varies depending on the duration of contact, the nature and concentration of the surfactant.

SKIN: (Unknown)

- The material may cause moderate inflammation of the skin either following direct contact or after a delay of some time. Repeated exposure can cause contact dermatitis which is characterized by redness, swelling and blistering.
- Prolonged contact may cause dryness of the skin.
- Skin contact is not thought to have harmful health effects, however the material may still produce health damage following entry through wounds, lesions or abrasions.
- Repeated exposure may cause skin cracking, flaking or drying following normal handling and use.
- Open cuts, abraded or irritated skin should not be exposed to this material.
- Entry into the blood-stream through, for example, cuts, abrasions or lesions, may produce systemic injury with harmful effects.
- Examine the skin prior to the use of the material and ensure that any external damage is suitably protected.

INHALATION: (Unknown)

- The material is not thought to produce either adverse health effects or irritation of the respiratory tract following inhalation (as classified using animal models). Nevertheless, adverse effects have been produced following exposure of animals by at least one other route and good hygiene practice requires that exposure be kept to a minimum and that suitable control measures be used in an occupational setting.
- In high concentrations, vapors may be irritating to the respiratory system.

CHRONIC HEALTH HAZARDS: None Known – Not believed to have harmful chronic health effects

- Long-term exposure to the product is not thought to produce chronic effects adverse to the health (as classified using animal models); nevertheless, exposure by all routes should be minimized as a matter of course. Prolonged or repeated skin contact may cause degreasing with drying, cracking and dermatitis following.

CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. Repeated or prolonged exposure is not known to aggravate medical condition.

OSHA Regulatory Status: Some ingredients of this product are hazardous according to OSHA 29CFR 1910.1200.

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE: None Known

CARCINOGENICITY

OSHA:	ACGIH:	NTP:	IARC:	OTHER:
NA	NA	NA	NA	NA

SECTION 2 NOTES:

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

PRODUCT NAME: mZVI – Electron Donor Suspension
CASE NO.: None Known
SYNONYMS: None Known
PRODUCT CODES: None Known

INGREDIENT:	CAS NO.	% WT	% VOL	SARA 313 REPORTABLE
Zero Valent Iron	7439-89-6	10 - 40	NA	NA
Glycerol	8001-22-7	40 - 80	NA	NA
Calcium carbonate	471-34-1	<10%	NA	NA

mZVI	ppm	mg/m3
OSHA PEL-TWA:	NA	NA
OSHA PEL STEL :	NA	NA
OSHA PEL CEILING:	NA	NA
ACGIH TLV-TWA:	NA	NA
ACGIH TLV STEL:	NA	NA
ACGIH TLV CEILING:	NA	NA

IMPURITIES: NONE

STABILIZING ADDITIVES: NONE

SECTION 3 NOTES:

SECTION 4: FIRST AID MEASURES

EYES:

- In case of eye contact, rinse opened eye for 15 minutes then consult a doctor.

SKIN:

- Remove contaminated clothing. Wash contaminated clothing before reuse.
- In case of skin contact, immediately wash with water and soap, then rinse thoroughly.
- Seek medical assistance if redness, itching or a burning sensation develops.

INGESTION:

- In case of ingestion, after swallowing seek immediate medical advice.
- Make doctor aware that the following symptoms may occur: nausea, cramps, gastric or intestinal disorders.
- Drink 2 to 3 glasses of whole milk.

INHALATION:

- Move individual to fresh air. Not an expected route of exposure.
- If cough or other respiratory symptoms develop, consult medical personnel.

SECTION 4 NOTES:

SECTION 5: FIRE-FIGHTING MEASURES

FLAMMABLE LIMITS IN AIR, UPPER: NA
(% BY VOLUME) LOWER: NA

FLASH POINT:
F: >482°F
C: >250°C

METHOD USED: Closed Cup

AUTOIGNITION TEMPERATURE:
F: >760°F
C: >404°C

NFPA HAZARD CLASSIFICATION *SCALE: 4-extreme, 3-High, 2-Moderate, 1-Low, 0- Insignificant

HEALTH: 1 FLAMMABILITY: 2 REACTIVITY: 1
OTHER: None

HMIS HAZARD CLASSIFICATION

HEALTH: 1 FLAMMABILITY: 2 REACTIVITY: 1
PROTECTION:

EXTINGUISHING MEDIA: Extinguishing Powder – Class D Fire Extinguisher

SPECIAL FIRE FIGHTING PROCEDURES: Do NOT use water, carbon dioxide, or halogenated extinguishers.

UNUSUAL FIRE AND EXPLOSION HAZARDS: NA

HAZARDOUS DECOMPOSITION PRODUCTS: NA

SECTION 5 NOTES:

SECTION 6: ACCIDENTAL RELEASE MEASURES

ACCIDENTAL RELEASE MEASURES:
Person Related Safety Measures: Wear protective equipment, keep unprotected persons away, ensure adequate ventilation
Environmental Safety Measures: NA
Measures for cleaning/collecting: Dispose of contaminated material as waste according to section 7

SECTION 6 NOTES:

SECTION 7: HANDLING AND STORAGE

HANDLING AND STORAGE:

- Contain spilled material and recover into drums. Plastic drums are recommended.
- All drums should be placed out of direct sunlight.
- Ensure good ventilation at the workplace.
- Keep ignition sources away.
- Do not store together with oxidizing and acidic materials.
- Store away from halogens.

SECTION 7 NOTES:

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS: Block off area from unprotected persons

VENTILATION : Ensure adequate ventilation

RESPIRATORY PROTECTION: NA

EYE PROTECTION: Safety Goggles

PROTECTIVE GLOVES: Rubberized gloves (neoprene or pvc)

PROTECTIVE FOOTWEAR: Slip resistant footwear

SKIN PROTECTION: Outer clothing to minimize dermal contact.

WORK HYGIENIC PRACTICES: Surfaces covered with EZVI are very slick. Exercise care in handling or clean up to avoid injury due to falls.

SECTION 8 NOTES:

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE: Grey to black, viscous liquid

ODOR: Soybean Oil (cooking oil) odor

PHYSICAL STATE: Liquid

pH AS SUPPLIED:

pH (Other):

BOILING POINT:

F: >572 ^{o}F

C: >300 ^{o}C

MELTING POINT:
F: -4 °F
C: -20 °C
FREEZING POINT:
F: NA
C: NA
VAPOR PRESSURE (mmHg):
@
F: NA
C: NA
VAPOR DENSITY (AIR = 1):
@
F: NA
C: NA
SPECIFIC GRAVITY (H2O = 1):
@
1.05 – 1.10 g/cm^3
EVAPORATION RATE (Butyl Acetate = 1): NA

SOLUBILITY IN WATER: Insoluble

PERCENT SOLIDS BY WEIGHT: 10 – 17%

PERCENT VOLATILE:
BY WT/ BY VOL @
F: NA
C: NA
VOLATILE ORGANIC COMPOUNDS (VOC):

WITH WATER: NA LBS/GAL
WITHOUT WATER: NA LBS/GAL

MOLECULAR WEIGHT: NA

SECTION 9 NOTES:

SECTION 10: STABILITY AND REACTIVITY

	STABLE	UNSTABLE
STABILITY:	X	

CONDITIONS TO AVOID (STABILITY): Avoid improper handling and storage conditions.

INCOMPATIBILITY (MATERIAL TO AVOID): Acids, oxidizing agents, halogens

HAZARDOUS DECOMPOSITION OR BY-PRODUCTS: If combined with halogens will produce hydrogen gas.

HAZARDOUS POLYMERIZATION: NA

CONDITIONS TO AVOID (POLYMERIZATION): None

SECTION 10 NOTES:

SECTION 11: TOXICOLOGICAL INFORMATION

TOXICOLOGICAL INFORMATION: NA

IRON Toxicity to Animals: Acute oral toxicity (LD50): 30000 mg/kg [Rat].

Routes of Entry: Eye contact, inhalation, ingestion, and absorption.

LD50: Not available.
LC50: Not available.

Possible Toxic Effects on Humans: Hazardous in case of skin contact (irritant), of ingestion, of inhalation.

Special Remarks on Chronic Effects on Humans: Not available.
Special Remarks on other Toxic Effects on Humans: Not available.

SECTION 11 NOTES:

SECTION 12: ECOLOGICAL INFORMATION

ECOLOGICAL INFORMATION: NA

SECTION 12 NOTES:

SECTION 13: DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHOD: Store waste materials int appropriately labeled drums out of direct sunlight. Moist conditions are preferred. Waste materials should be doused with water while in drums.

RCRA HAZARD CLASS: NA

SECTION 13 NOTES:

SECTION 14: TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION
- PROPER SHIPPING NAME: Emulsified Zero Valent Iron
- HAZARD CLASS: NA
- ID NUMBER: NA
- PACKING GROUP: None
- LABEL STATEMENT:

WATER TRANSPORTATION
- PROPER SHIPPING NAME: Emulsified Zero Valent Iron
- HAZARD CLASS: NA
- ID NUMBER: NA
- PACKING GROUP: None

LABEL STATEMENTS:

AIR TRANSPORTATION
PROPER SHIPPING NAME: Emulsified Zero Valent Iron
HAZARD CLASS: NA
ID NUMBER: NA
PACKING GROUP: None
LABEL STATEMENTS:

OTHER AGENCIES:

SECTION 14 NOTES:

SECTION 15: REGULATORY INFORMATION

U.S. FEDERAL REGULATIONS (No known regulations are in place for this product)
TSCA (TOXIC SUBSTANCE CONTROL ACT): NA

CERCLA (COMPREHENSIVE RESPONSE COMPENSATION, AND LIABILITY ACT): NA

SARA TITLE III (SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT): NA

311/312 HAZARD CATEGORIES: NA

313 REPORTABLE INGREDIENTS: NA

STATE REGULATIONS: NA

INTERNATIONAL REGULATIONS: NA

OSHA Regulatory Status: Some ingredients of this product are hazardous according to OSHA 29CFR 1910.1200. These specific ingredients are in lower amounts than the OSHA Permissible Exposure Limits and ACGIH Time Weighted Average.

IMPORTANT: The information contained herein relates only to the specific material identified. RemQuest believes that such information is accurate and reliable as of the date of this material safety data sheet, but no representation, guarantee or warranty, express or implied, is made as to the accuracy, reliability, or completeness of the information. RemQuest urges persons receiving this information to make their own determination as to the information's suitability and completeness for their particular application.

SECTION 16: OTHER INFORMATION

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The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall Tersus Environmental be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Tersus Environmental has been advised of the possibility of such damages.

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