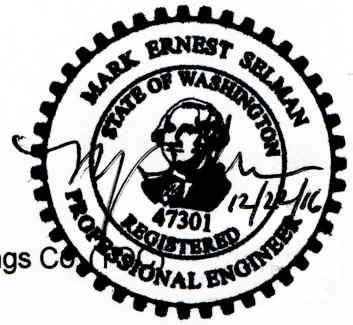
HydroCon

TECHNICAL MEMORANDUM



To: Mr. Mark Chandler, Vice President Environmental Services; TOC Holdings Co.

From: HydroCon Environmental, LLC

Date: December 22, 2016

Subject: Enhanced Fluid Recovery Methods and Results; TOC Facility No. 01-176; 24205, 24225, 24309 56th Avenue West; Mountlake Terrace, WA

HydroCon Environmental, LLC (HydroCon) prepared this memorandum to describe the methods and results of enhanced fluid recovery (EFR) performed at selected intermediate zone groundwater monitoring wells at the subject Site on February 24, 2016. The EFR event was performed in accordance with a work plan approved by the Washington State Department of Ecology (Ecology)[1]. The objective of the EFR was to conduct focused remediation techniques in areas where intermediate zone groundwater concentrations continue to exceed MTCA cleanup levels on a consistent basis despite operation of the remediation systems.

Background

The multi-phase extraction (MPE) remedial systems that have been operating at the Site since 2012 have been effective in reducing concentrations of the chemicals of concern (COCs) in intermediate zone groundwater within the Interim Remedial Action Project Area (IRAPA), except in three isolated areas. Figure 11 from the 2015 annual groundwater monitoring report [2] titled "GRPH Concentrations in Groundwater, Intermediate Zone, March 2015, illustrates the locations of all wells and the three areas of the IRAPA that exceeded the Model Toxics Control Act (MTCA) Method A cleanup level, at that time, for gasoline-range petroleum hydrocarbons (GRPH) in the intermediate zone groundwater. The three areas are identified as:

- Vicinity of well MW90 on the TOC Property,
- Vicinity of well MW48 located in the 56th Avenue West ROW
- Vicinity of well MW69 located on the Drake Property

EFR is a remedial technique that uses high capacity vacuum to rapidly recover contaminated media from the vicinity of a well including: groundwater, separate phase hydrocarbons, formation materials (i.e., silt and solids), and soil vapor. The presumed remedial benefit of EFR is to permanently remove residual source(s) of contamination from a well, as well as stimulate airflow in the formation in the saturated zone. The effectiveness of EFR events is typically evaluated by comparing the pre- and post-EFR concentrations of COCs in groundwater from a well.

---

[1] *HydroCon. 2015. Work Plan for Minor Modifications to Agreed Order DE 8661; TOC Facility No. 01-176. Addressed to Sunny Becker of Ecology, Northwest Regional Office, Toxics Cleanup Program; 3190 160th Avenue SE; Bellevue, WA 98008. September 29.*

[2] *Stantec Consulting Services, Inc. 2015. Groundwater Monitoring Report, 2015 Annual Event. TOC Holdings Co. Facility No. 01-176. July 31.*

Methods

HydroCon implemented the EFR work plan on February 24, 2016 by contracting with a vacuum truck vendor (MARVAC) to provide the vacuum and waste disposal necessary to complete the plan. MARVAC's mobile vacuum blower (Fruitland Model RCF500) produces an approximate air flow rate of 320 cubic feet per minute at a maximum vacuum of 28.5 inches of mercury. The daily field notes documenting these events are provided in Attachment A. A summary chronology of the EFR field methods is provided below.

February 24, 2016; 0830 to 0845 hours: Messrs. Rob Honsberger, Warren Rajkovich, and Mark Selman of HydroCon arrived onsite to meet the MARVAC operator. HydroCon prepared a 50-foot length of 1" diameter polyvinyl chloride (PVC) hose to use as a stinger to focus the suction at the targeted depths within the three wells. It was decided to start the EFR at well MW69. Because well MW69 was a remediation well that housed a pneumatic well pump and tubing, the existing pump and tubing were pulled from the well prior to inserting the stinger tubing for EFR.

0900 to 0925 hours: The end of the stinger tube was inserted into the 2-inch diameter well MW69 to a depth of approximately of 43 feet below ground surface (bgs), which is the approximate mid-point of the screened interval of 37.3 to 47.3 feet bgs. Vacuum was slowly increased to 15 inches of mercury (iom) to recover water and solids from well. The vacuum was sustained in the well from 0910 to 0925 hours while HydroCon personnel monitored the induced vacuum on nearby monitoring wells MW84 and MW89. Induced vacuums were measured at 3.8 and 0.6 inches of water (iow), respectively. The approximate distances of each well from well MW69 are 30 and 35 feet, respectively. Vacuum on well MW69 was discontinued at 0925 hours to prevent pulling contamination existing from the south adjacent property (Herman) upgradient onto the Drake property. Just prior to ceasing vacuum on this well, HydroCon advanced the stinger to the bottom of the well to remove accumulated sediment. Approximately 100 gallons of water and solids were recovered from this well during the EFR as determined by a gauge on the vacuum truck.

0930 to 1046 hours: HydroCon setup on well MW48 at 0930 by inserting the stinger tube to a depth of approximately 40 feet based on the depth to water measured in this well on February 19th of 40.33 feet bgs and a total well depth of 46.91 feet bgs. Prior to initiating EFR on well MW48, baseline vacuum readings were collected from the target well MW48 and nearby wells MW57, MW42, and MW96 to measure the induced vacuum on these wells from the existing remedial systems. The baseline vacuum readings were 36, 22, 12, and 60 iow for wells MW57, 42, 48, and 96, respectively. Wells MW57 and 96 are connected directly to the Units 2 and 3 remediation system soil vapor extraction blowers, respectively.

At 0946 hours, EFR was started by applying 18 iom vacuum to the stinger tube in well MW48. While the vacuum was slowly increased, HydroCon measured the changes in induced vacuum at wells MW42, 57 and 96. The vacuum applied to well MW48 was gradually increased to a steady vacuum of 20 iom and not increased further because MARVAC's vacuum blower was laboring above 20 iom. The maximum incremental increases in induced vacuums above baseline in wells MW42, 57, and 96 were 16, 12, and 4 iow, respectively during the one-hour of elevated EFR vacuum applied to well MW48 (0946 to 1045 hours). At the conclusion of EFR, the depth to water was recorded at 42.65 feet bgs and the total depth of the well measured at 46.90 feet bgs. Just prior to ceasing vacuum on this well, HydroCon advanced the stinger to the bottom of the well to remove accumulated sediment. Approximately 650 gallons of water and solids were recovered from this well during the EFR.

1055 to 1120 hours: HydroCon setup on well MW90 and inserted the stinger to a depth of approximately 22 feet bgs, which was the approximate depth to water. The initial vacuum applied to the well was 10 iom. The well casing was sealed off by wrapping duct tape around the stinger tube and the well casing to increase the applied vacuum to the well. The resulting vacuum after sealing the well casing increased to 25 iom indicating that the screened part of the formation has an extremely low air-flow-permeability. During this time, induced vacuums at nearby wells MW18 and MW27 were measured. Inexplicably, a small pressure of 0.2 iow was recorded at these wells, further indicating the extremely low air-flow-permeability of the formation materials in this portion of the IRAPA. At 1120 hours, the EFR was stopped because the vacuum pump was laboring and cavitating at this vacuum, but was not recovering fluids from the well. Just prior to ceasing vacuum on this well HydroCon advanced the stinger to the bottom of the well to remove accumulated sediment. Approximately 10 to 20 gallons of water and solids were recovered from this well during the EFR.

Results and Conclusions

The pre- and post-EFR concentrations of gasoline-range petroleum hydrocarbons (GRPH) in the wells subjected to EFR are tabulated below for samples collected at the close of 2015 and 2016.

Pre- and Post-EFR GRPH Concentrations

Well ID	Pre EFR GRPH Concentration (µg/L)		Post EFR GRPH Concentration (µg/L)		
	Dec 2015	February 2016	March 2016	May 2016	September 2016
MW48	11,000	1,800	980	4,800	3,100
MW69	2,700	3,700	NS	3,300	5,800
MW90	3,100[1]	530	NS	4,600	<100

[1]MW90 sample collected in March 2015
NS = not sampled

The pre- and post-EFR results indicate that there is no apparent correlation between EFR and a corresponding longer-term reduction in COC concentrations in the wells in which EFR was performed. The post-EFR sample collected within a month of the EFR event in well MW48 showed a significant decrease in GRPH concentration compared to the pre-EFR sample. However, this reduction was short-lived and actually increased above the pre-EFR sample concentration in the May and September 2016 samples. The results for well MW69 were similar in that they showed a slight and short-lived reduction in concentration after the EFR followed by a significant increase in concentration in September 2016. The results for well MW90 are also mixed insofar as they show a significant increase in the Second Quarter 2016 followed by a significant decrease in GRPH concentration in the Third Quarter 2016 sample.

Induced vacuum monitoring performed at monitoring wells near the targeted EFR wells revealed that the intermediate zone in the vicinity of wells MW48 and 69 exhibits relatively high air-flow-permeability. The reverse is true for the zone in the vicinity of well MW90. The very low air-flow-permeability and continuing high concentrations of GRPH in the area of well MW90 suggests that the existing multiphase extraction technology has not been and will not be an effective remedial technology for this area in the future. Alternative remedial techniques are currently under evaluation and will be presented in an upcoming technical memorandum.

FIGURE

Notes:

1. ND = Not Detected
   NS = Well Not Sampled
   NA = Constituent Not Analyzed
2. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation
3. If a duplicate sample was collected, the higher result between the original and the duplicate is shown.
4. Well symbols displayed in purple indicate wells that are screened across multiple zones.

242nd Street Southwest

56th Avenue West

MW16 ND
MW38 ND
MW27 3200
MW90 3100
MW11 190
MW50 ND
MW91 160
MW24 ND
MW37 ND
MW29 790
MW09 120
MW08 ND
MW32 680
MW25 ND
*MW28 ND
MW35 Dry
MW36 Dry
MW20 ND
MW10 ND
MW18 Dry/TP
MW15 Dry
MW53 ND
MW22 ND
MW33 Dry
MW23 Dry
MW31 Dry/TP
MW94 Dry/TP
MW93 ND
MW43 ND
MW60 ND
MW13 Dry
MW56 ND
MW59 ND
MW66 ND
MW92 ND
MW82 ND
MW41 Dry
MW45 Dry
MW49 ND
MW100 ND
MW81 ND
MW46 Dry
MW57 110
MW42 Dry
MW58 ND
MW55 ND
MW48 12000
MW96 ND
MW88 ND
MW76 ND
MW97 ND
MW70 ND
MW63 ND
MW44 Dry
MW98 600
MW47 Dry
MW52 ND
MW95 ND
MW99 ND
MW65 ND
MW75 ND
MW69 2700
MW101 ND
MW77 ND
MW87 ND
MW89 ND
MW84 (Pump Removed 2013) 630
MW86 ND
MW85 ND
MW51 ND
MW105 ND
MW103 120
MW107 ND
MW74 11000
MW73 70000

TOC Holdings Co. Property
TOC/Farmasonis Property
Drake Property
Herman Property
Mountlake Senior Property
Shin/Choi Property

N

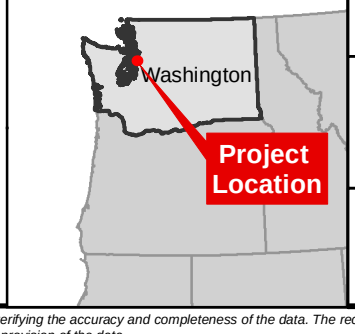
50 25 0 50
Feet

Basemap: Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

X:\WA\Clients\Time_Oil\TOC-MountlakeTerrace_BA\402800\MXDs\WorkingMXDs\1Q15 Annual GW Report\fig-11_1q15_grph_iz_map_20150507.mxd

Legend

- Parcels
- MW88 — Well Location Where Screen Intersects Multiple Groundwater Zones
- MW73 — Intermediate Groundwater Zone Well Location
- 343.04 — GRPH Concentration (µg/L)
- Minimum Preliminary Screening Level For GRPH(800 µg/L;MTCA Method A Cleanup Level)
- Site Boundary
- Compound Fence
- Equipment Shed
- System Compound
- System Piping
- Historic Excavation



TOC Holdings Co. Facility 01-176
24205 56th Avenue West
Mountlake Terrace, Washington

FIGURE 11: GRPH CONCENTRATIONS IN GROUNDWATER, INTERMEDIATE ZONE, MARCH 2015

Stantec

DRAWN BY	D.H.	DATE DRAWN	6/4/2015
SCALE	1 in = 50 feet		
PROJECT	203714085		

ATTACHMENT A

Daily Field Notes

Hydro Con	**DAILY FIELD REPORT**	Hydrocon Job Number: 01-176
	Project Name: TOC HOLDINGS CO FACILITY NO 01-176	Date: 2/24/16
360.703.6079/Fax 360.703.6086 510 Allen Street, Suite B; Kelso, WA 98626	Client: TOC HOLDINGS CO	Page: 1 Of 4
Prepared By: M SELMAN	Location: 24205 56TH AVE WEST MOUNTLAKE TERRACE, WA	Arrival: 0830 Departure: 1600
Purpose: EFR AND O&M	Weather: FAIR, COOL UPPER 40'S F	Permit:

RAH MES, WRA

ONSITE @ 0830 - MET MARVAC TO CONDUCT EFR AT OUR DIRECTION

0830-0845 READIED VACUUM GAUGES AND PREPARED STINGER PIPE/HOSE OUT OF 1" SPIRALITE HOSE. DECIDED TO START EFR

0845-0900 AT MW69. DECIDED TO PULL PUMP FROM MW69 SINCE WE ARE CONCERNED ABOUT CREATING TOO MUCH DRAWDOWN OVER THE LONG TERM AND PULLING CONTAMINATED SHALLOW GROUNDWATER FROM PROPERTY TO THE SOUTH. PUMP WAS COVERED IN BIOSLIMES. PUT ASIDE FOR LATER CLEANING. CAPPED MW69 W/ J PLUG

0900 - 0910 PLACED STINGER IN WELL MW69

0910 - 0920 PULLED 15 IN HG VACUUM ON MW69 @ VAC TRUCK RECORDED 3.8 IOW @ MW84; 0.2 INCHES 0.2 - 0.6 IOW @ MW89

0925 - CEASED VACUUM @ MW69 FOR FEAR OF PULLING CONTAMINATED TOWARDS MW69 FROM SOUTHERN ADJACENT PROPERTY

0930 - SETUP EFR @ MW48 D.I DID NOT MEASURE DTW TODAY, HOWEVER DTW ON 2/19 WAS 40.33' W/ TD @ 46.91. SET STINGER AT INTERFACE OF WATER TABLE.

0940 - TOOK BASELINE VACUUM READINGS W/ ALL THREE UNITS RUNNING AND ALL VENTS 100% OPEN (EXCEPT AS PREVIOUSLY CLOSED)

MW57 - 36 IOW
MW42 - 22 IOW
MW48 - 12 IOW
MW96 - 60 IOW

0946 STARTED VACUUM ON MW48 @ 18 IN HG

Hydro Con	**DAILY FIELD REPORT**	Hydrocon Job Number: 01-176
	Project Name: TOL HOLDINGS CO FACILITY NO. 01-176	Date: 2/24/16
360.703.6079/Fax 360.703.6086 510 Allen Street, Suite B; Kelso, WA 98626	Client: TOL HOLDINGS CO.	Page: 2 Of 4
Prepared By: M SELMAN	Location: 24205 56TH AVE WEST MOUNTLAKE TERRACE, WA	Arrival: 0830 Departure: 1600
Purpose: EFER + SYSTEM OPT.	Weather: FAIR, COOL UPPER 40°F	Permit:

0952	-19 IN HG @ TRUCK	-38 IOW @ MW57 -22 IOW @ MW42
1003	-20 IN HG @ TRUCK	-40 IOW @ MW57
1014	-20.5 IN HG @ TRUCK	-30 IOW @ MW42 -46 IOW @ MW57 -64 IOW @ MW96
1024	-20 IN HG @ TRUCK	-36 IOW @ MW42 -46 IOW @ MW57 -64 IOW @ MW96
1034	-20 IN HG @ TRUCK	-37 IOW @ MW42 -48 IOW @ MW57 -64 IOW @ MW96
1045	-20 IN HG @ TRUCK	-38 IOW @ MW42 -47 IOW @ MW57 -63 IOW @ MW96
1046	SHUTDOWN EFR @ MW48; BTW 42.65' W/ TD @ 46.90'	
1055	SETUP ON MW90; SUCTION STARTED @ ~10 IN HG.	
1100	INCREASED VACUUM TO 19 IN HG @ TRUCK	
1100-1115	RAH SEALED OFF WELLCASING W/ DUCT TAPE TO INCREASE VACUUM IN WELL — VACUUM WENT TO -25 IN HG	

Hydro Con	**DAILY FIELD REPORT**	Hydrocon Job Number: 01-176
	Project Name: TOR HOLDINGS CO FACILITY NO 01-176	Date: 2/24/16
360.703.6079/Fax 360.703.6086 510 Allen Street, Suite B; Kelso, WA 98626	Client: TOR HOLDINGS CO	Page: 3 Of 4
Prepared By: M SEIMAN	Location: 24205 56TH AVE WEST MOUNTLAKE TERRACE, WA	Arrival: 0830 Departure: 1600
Purpose: EFR & SYSTEM OPT.	Weather: FAIR COOL — MID 40°S	Permit:

VACUUM TRUCK LABORING

MEASURED VAC @ MW-18 — ACTUALLY HAD PRESSURE ≈0.2 IOW
- CANT EXPLAIN WHY, WELL IS PRESSURED
- SAME PHENOMENON @ MW27

1120 — SHUTDOWN EFR @ MW90 BECAUSE OF EXTREMELY HIGH VACUUM AND LITTLE WATER RECOVERY PLUS INEXPLICABLE PRESSURE MEASURED AT NEARBY WELLS MW18 + MW27.

TOOK VAC TRUCK TO UNIT 1 TO VACUUM SVE VENT LINES THAT WERE SHOWING NO VACUUM AT WELLHEADS.

1132 SETUP ON UNIT 1 INFL MW27 @ MANIFOLD; DISASSEMBLED TU BALL VALVE TO STICK STINGER INTO 2" PIPE BUT COULDN'T MAKE THIS WORK. USED 1/4" POLY TUBING TO SNAKE DOWN INTO 90° ELBOW ON EACH WELL VENT TO CLEAR WATER

1150 FINISHED CLEARING WATER FROM MW27; START MW90

1155 FINISHED MW90; STARTED MW91

1157 FINISHED MW91; STARTED MW24

1205 FINISHED MW24; STARTED MW32

1210 FINISHED MW32; STARTED MW18

} READ @ 60 IOW ON VAC GAUGES @ MANIFOLD

1210 - 1300 CHECKED WELLHEAD VACUUMS AFTER CLEARING CONDENSATE FROM SVE LINES. EACH WELL EXCEPT MW91 & MW29 SHOWED 60 IOW @ WELLHEADS. MW91 WAS 50 IOW. MW29 WAS 30 IOW. VAC TRUCK CAME BACK TO RED'O MW29 AND WE WERE ABLE TO CLEAR MOST WATER OUT SUCH THAT WELLHEAD VACUUM MATCHED MANIFOLD VACUUM (60 IOW)

ALSO, CHECKED PUMP CYCLE MAGNETS — SEVERAL WELLS NOT CYCLING SO RESET MAGNETS.

DAILY FIELD REPORT

Hydro Con	Project Name: TOC HOLDINGS CO FACILITY NO 01-176	Hydrocon Job Number: 01-176
		Date: 2/24/16
360.703.6079/Fax 360.703.6086 510 Allen Street, Suite B; Kelso, WA 98626	Client: TOC HOLDINGS CO.	Page: 4 Of 4
Prepared By: MSELMAN	Location: 24205 56TH AVE WEST MOUNTLAKE TERRACE, WA	Arrival: 0930 Departure: 1600
Purpose: EFR & SYSTEM OPT.	Weather: FAIR COOL ~ 50-60°F	Permit:

	RECOMMENDATIONS
1245 TO 1415 - CLEANED CONDENSATES FROM SVE VENTS @ UNITS 2+3 USING SAME METHOD - VACTRUCK W/ 1/4 POLY TUBING SNAKED DOWN INTO 90° ELBOW	- REPLACE VACUUM GAUGES - CONSIDER INSTALLING WYES FOR FUTURE CLEANOUTS - WRAP SVE MANIFOLDS W/ INSULATION TO REDUCE CONDENSATION
1420 SETUP ON WELL MW15 W/ STINGER & VAC TRUCK: WELL WAS COMPLETELY DRY SO ABANDONED EFR ATTEMPT	- MAYBE BREAK PIPE/INSTALL FERNCO COUPLERS TO ALLOW UNION REMOVAL

1430 TO 1600 IMPLEMENTED MANIFOLD OPTIMIZATIONS FOR FLOW AT UNITS 2&3. DUE TO LACK OF TIME, WILL DO FURTHER OPTIMIZATION FOR VAPOR PID READINGS LATER THIS WEEK AND NEXT. CLOSED SPECIFIC WELL VENTS BASED ON RECENT CO_2 VELOCITY & VOC MEASUREMENTS. BALANCED AIR FLOWS/VELOCITY AND VACUUMS IN REMAINING VENTS. CONFIGURATIONS WILL CHECKED AGAIN THIS WEEK. MODIFICATIONS MADE THIS AFTERNOON:

set to 150-200 fpm

UNIT #2 SET @ ~ 50 IOW AT MANIFOLD	MW93 (CLOSED)	MW31 (CLOSED)	MW94 OPEN	MW92 OPEN	MW57 THROTTLED >50%	MW41 (CLOSED)	
UNIT #3 SET @ ~ 60 IOW @ MAN. FOLD	MW101 (CLOSED)	MW99 (CLOSED)	MW70 (CLOSED)	MW97 OPEN	MW98 OPEN	MW84 (CLOSED)	MW69 OPEN — STOPPED PUMPING WATER
	MW95 OPEN	MW96 (CLOSED)	— THROTTLED OPEN VALVES TO BALANCE VELOCITY IN OPEN VENTS TO 150-200 fpm				