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February 27, 2014

Transmitted via e-mail: February 27, 2014

Tara M. Blum, P.E.
Environmental Engineer
NYSDEC Region 7
Division of Environmental Remediation
615 Erie Blvd. West
Syracuse, New York 13204-2400

Re: Carrier Corporation, Thompson Road Facility, Syracuse, New York
Corrective Action Order — Index No. CO 7-20051118-4
Site Registry Number: 734043
Former Building TR1 Sub-Slab Free Product Evaluation, Bail Down Testing 2014

Ms. Blum:

On behalf of Carrier Corporation, please find enclosed one hard copy and one electronic copy of the *Former TR1 Sub-Slab Free Product Evaluation Report*.

If you have any questions, please feel free to contact me at (615) 255-9300.

Sincerely,

EnSafe Inc.

May M. Heflin

By: May Heflin, PE

cc: (hard copy and electronic copy):
Ms. Krista Anders — New York State Department of Health
Mr. Mark Sergott — New York State Department of Health
Mr. Dan Hayes — NYSDEC Division of Water

cc: (electronic copy only):
Mr. John Wolski — United Technologies Corporation
Mr. Joe Basile — Carrier Corporation
Ms. Kathleen McFadden — United Technologies Corproation

FORMER BUILDING TR-1 SUB-SLAB FREE PRODUCT EVALUATION BAIL DOWN TESTING

CARRIER THOMPSON ROAD FACILITY
CARRIER PARKWAY
SYRACUSE, NEW YORK

EnSafe Project Number
0888814866

Revision: 0

Prepared for:

United Technologies

UTC Shared Remediation Services
United Technologies Building
Hartford, Connecticut 06101

Prepared by:

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February 2014

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1.0 INTRODUCTION

Purchased in 1950, the Carrier Corporation — Syracuse, New York Facility (Site) produces or has produced a variety of products associated with the HVAC (heating, ventilation, and air conditioning) industry for home and commercial application. Located in the northeast portion of Syracuse, New York, the Site covers approximately 173 acres and slightly slopes towards Sanders Creek to the north.

In 2012, a large amount of floating oil accumulated in a storm water pumping station (PS2), which receives storm water, in part, from drains that run below the former building TR-1. Historic site data has shown that groundwater infiltration into the storm sewer system is widespread. In May 2013, Carrier completed a video inspection of the storm sewer lines leading to PS2. This video inspection identified the source of the PS-2 oil to be originating from the two storm lines (Storm Line #1 and Storm Line #2) under the western half of the former TR-1 building (Figure 1). To confirm location of this oil, a groundwater investigative study was conducted by EnSafe in October 2013, resulting in the installation of 18 groundwater monitoring wells and 13 piezometers as shown on Figure 2. Three areas within the former TR-1 building footprint were targeted for sampling given the building layout and historical practices: Area 1 — Floor drain area, Area 2 — Degreaser C/D area, and Area 3 — Sub-Station I area. Oil was detected in monitoring wells and piezometers within Areas 2 and 3, in relatively close proximity to the two western storm drain laterals (Storm Lines #1 and #2 in Figure 2), suggesting that the PS-2 oil originates from under TR-1. Presented in Figure 3 are oil thicknesses and associated groundwater elevations measured within the investigative wells and piezometers. The persistence of oil within MW-25 and SSIPZ04, and the gradual increase of oil thickness within MW-25 suggested that a source of oil may be located within the footprints of Area 2 and/or Area 3 of former building TR-1. To estimate the subsurface free product volume and the transmission rate of free product through the geologic formation, EnSafe performed a bail down test of wells and piezometers found to contain the free product oil. Details of this bail down test are presented in the following sections.

2.0 FIELD INVESTIGATIVE STUDY

EnSafe measured depth to product (DTP), depth to water (DTW), and briefly pumped oil from selected wells (also known as bail down testing) between January 15, 2014, and January 21, 2014. Wells and piezometers selected for this study were those that contained sufficient free product within their respective casings to obtain measurable quantities by pumping and collecting the oil at ground surface. Monitoring well MW-25 and piezometers DCDPZ04 and SSIPZ04 met the criterion.

2.1 Initial Measurements and Free Product Evacuation

On Wednesday, January 15, initial DTP and DTW measurements revealed free product within MW-25, SSIPZ04, and, DCDPZ04, with thicknesses of 3.39 feet (ft), and 2.39 ft, and 0.15 ft, respectively, for a total in-well free product volume of 2.32 gallons. Free product was then removed from MW-25 and SSIPZ04 using a peristaltic pump with a suction line lowered to the oil layer. Accumulated oil was first evacuated from the wells to equilibrate pressures in the casing and surrounding soil prior to performing bail down testing. In this step, EnSafe removed a total of 2.31 gallons of free product from MW-25 and SSIPZ04. Approximately two hours after pumping, free product in MW-25 and SSIPZ04 had recharged to thicknesses of 0.28 ft and 1.91 ft, respectively.

On Thursday, January 16, DTP and DTW measurements were collected again, revealing that free product within MW-25 and SSIPZ04 continued to recharge throughout the night reaching thicknesses of 1.06 ft and 2.38 ft, respectively. Free product was removed from DCDPZ04 to again achieve subsurface pressure equilibrium; oil eventually recharged to a thickness of 0.04 ft approximately six hours after pumping. EnSafe removed a total of 0.01 gallons of free product from DCDPZ04.

DTP and DTW measurements collected on Friday, January 17 revealed free product thicknesses of 0.39 ft, 0.07 ft, and 2.28 ft, for MW-25, DCDPZ04, and SSIPZ04, respectively. Table 1 provides DTP and DTW measurements, and free product volume calculations based on the recorded field measurements.

2.2 Bail Down Testing

After measurements were collected on January 17, EnSafe again removed all free product from both MW-25 and SSIPZ04 using a peristaltic pump set at a reduced flow, initiating the continual measurement of DTP and DTW associated with bail down testing. By the end of day, however, free product was absent from both MW-25 and SSIPZ04. EnSafe removed a total of 0.34 gallons of free product from MW-25 and SSIPZ04, but could not complete free product transmissivity and volume calculations due to lack of free product recharge.

Table 1
Initial DTP and DTW Measurements and Free Product Volume Data
Carrier Corporation — Syracuse, New York

Date	Boring ID	Casing Diameter (inches)	DTP (ft. bgs)	DTW (ft. bgs)	Free Product Thickness (ft)	Free Product Volume within Casing (gallons)	Total Free Product Volume (gallons)
01/15/2014	MW-25	4	7.06	10.45	3.39	2.21	2.32
	DCDPZ04	1	10.21	10.36	0.15	0.01	
	SSIPZ04	1	7.91	10.30	2.39	0.10	
01/16/2014	MW-25	4	7.47	7.71	0.24	0.16	0.26
	DCDPZ04	1	10.25	10.29	0.04	<0.01	
	SSIPZ04	1	8.02	10.55	2.53	0.10	
01/17/2014	MW-25	4	7.57	7.96	0.39	0.25	0.34
	DCDPZ04	1	10.36	10.43	0.07	<0.01	
	SSIPZ04	1	8.15	10.43	2.28	0.09	
01/21/2014	MW-25	4	6.88	7.18	0.30	0.20	0.28
	DCDPZ04	1	10.44	10.55	0.11	<0.01	
	SSIPZ04	1	8.24	10.37	1.95	0.08	

Notes:
ft — feet
bgs — below ground surface

EnSafe returned to the site on Tuesday, January 21, and collected DTP and DTW measurements. Free product was measured in MW-25, SSIPZ04, and DCDPZ04 at thicknesses of 0.30 ft, 1.95 ft, 0.11 ft, respectively.

3.0 ANALYSIS AND DISCUSSION

While slow free product recharge prevented reliable free product transmissivity and volume calculations, the information obtained through the field investigative study has refined and improved EnSafe's conceptual understanding of free product beneath the former Building TR-1 sub-slab.

3.1 Free Product Thickness — Pressure Equilibrium

Prior to performing bail down testing and collecting meaningful DTP and DTW measurements, stagnant free product must be evacuated from well and piezometer casings. As groundwater elevation changes temporally, pressures at the well fluctuate allowing free product to accumulate within casings over time. If this occurs, observed free product thickness is not representative of equilibrium pressure conditions, and all free product must be purged from the casing and allowed to recharge to the pressure equilibrium state prior to measurement collection or bail down testing. While it is likely free product accumulation occurred within MW-25, SSIPZ04, and DCDPZ04, non-equilibrium accumulation is obvious when comparing the free product thickness measured in MW-25 on January 15, 2014 to the thickness measured on January 21, 2014. Free product thicknesses measured on January 21, 2014 are representative of equilibrium pressure conditions, and serve as the starting point for further free product analysis.

3.2 Oil Recharge Rates

After removing free product columns from MW-25 and SSIPZ04 on January 15, 2014, observed recharge rates indicated that that bail down testing within MW-25 and SSIPZ04 would be successful. However, on January 17, 2014, free product did not recharge in MW-25 or SSIPZ04 several hours after the removal of free product from the well and piezometer casings. Without such recharge, flow rates could not be measured, preventing the use of various analytical methods designed to estimate free product thickness within the surrounding geologic formation (Gruszczenski, 1987; Hughes et al., 1988; API, 2001). The recharge rates observed on January 15 were likely the result of removing excess (non-equilibrium) stagnant free product from the well and piezometer sand packs. The removal of excess free product created a larger pressure difference between the casing and formation than what apparently exists at equilibrium, resulting in higher free product recharge rates to MW-25 and SSIPZ04.

3.3 Free Product Thickness — Well vs. Formation

The thickness of the free product column within a well or piezometer at equilibrium is a function of atmospheric and capillary pressure in the geologic formation surrounding the well. Within the formation, mobile free product is confined to the zone immediately above the groundwater capillary fringe and below a similar free product capillary fringe. However, if free product enters a screened well, these pressure forces are no longer acting on the free product, causing free product to appear thicker in wells and piezometers relative to free product thickness within the surrounding formation. It is accepted that free product thickness in a well will exceed the true formation thickness by a factor ranging between two and ten (EPA, 1995). This factor depends on many site-specific properties, but grain size plays a large role — the smaller the grains of the formation, the larger the free product column appears in the well. Given the geology at the site within the screened well and piezometer interval (clay or silty clay), free product columns observed in former building TR-1 wells and piezometers are likely exaggerated by a factor ranging between five and ten. Table 2 contains measured pressure equilibrium free product thicknesses, as well as theoretical thicknesses calculated at factors of five and ten.

Table 2
Pressure Equilibrium Free Product Thickness and Estimated Formation Free Product Thickness
Carrier Corporation — Syracuse, New York

Boring ID	Pressure Equilibrium Free Product Thickness (feet)	Estimated Formation Free Product Thickness — Factor of Five (feet)	Estimated Formation Free Product Thickness — Factor of Ten (feet)
MW-25	0.30	0.06	0.03
DCDPZ04	0.11	0.02	0.01
SSIPZ04	1.95	0.39	0.20

3.4 Free Product Transmissivity

Transmissivity (ft^2/day), or the measure of how much liquid can be transmitted horizontally through a formation, is a major deciding factor when evaluating recovery and remediation technologies. Regardless of contaminant mass, if the host formation transmits little fluid over time, remediation by extraction can be extremely costly and time intensive. As explained in Section 3.2, initially observed recharge suggested relatively high free product transmission rates through the formation; however, these estimates were drawn from a non-equilibrium pressure state. At equilibrium, observed recharge rates and free product transmissivity were much lower than initially estimated.

3.5 Free Product Conceptual Model

Although quantitative bail down testing results were not achieved, the data obtained between January 15, 2014, and January 21, 2014, has improved and refined EnSafe's conceptual understanding of free product beneath the former Building TR-1 sub-slab. Our conceptual understanding of the site is that several, thin (~0.2 ft), isolated lenses of relatively immobile free product are present beneath the former Building TR-1 sub-slab in the Area 2 and Area 3 footprints, approximately seven to eleven feet below ground surface.

This field evidence suggests a relatively small and immobile free product mass beneath former building TR-1. Recommendations based on the current site conceptual understanding are presented in the following section.

4.0 RECOMMENDATIONS

4.1 Oil-Water Separator

EnSafe recommends that Carrier Corporation continue with current plans for the design and installation of an oil-water separator (OWS) to capture storm water and/or free product flowing through the western storm lines beneath former Building TR-1. By installing the OWS, free product flows from TR-1 to PS2 will be intercepted.

4.2 Manual Removal of Free Product

Carrier will deploy passive bailers in MW-25, SSIPZ04, and DCDIPZ04 and periodically conduct manual removal of any accumulated oil.

5.0 REFERENCES

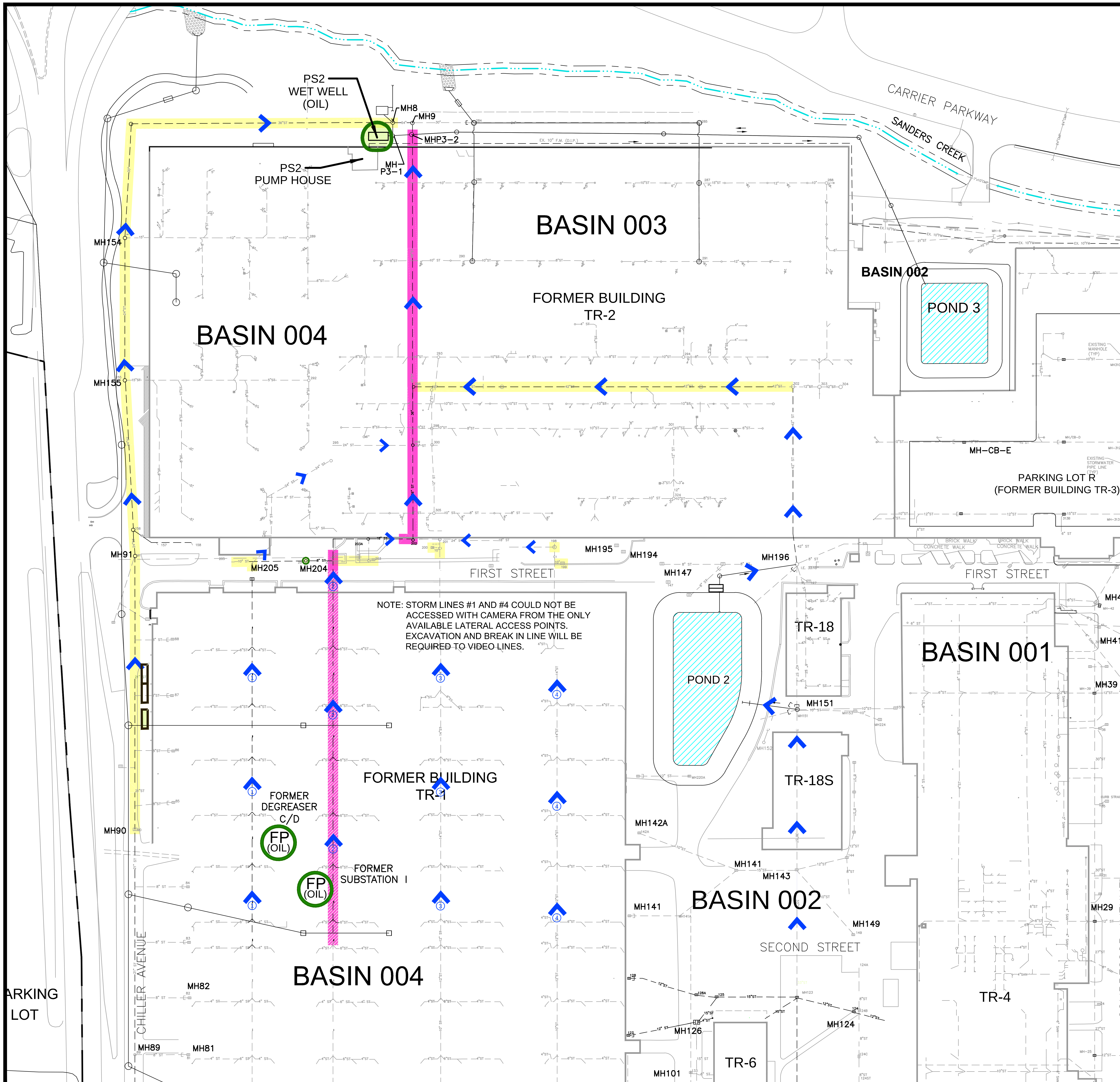
American Petroleum Institute. "Methods for Determining Inputs to Environmental Petroleum Hydrocarbon Mobility and Recovery Models." Regulatory and Scientific Affairs Department. API Publication Number 4711 (2001).

Gruszczenski, Thomas S. "Determination of a realistic estimate of the actual formation product thickness using monitor wells: A field bailout test." Proc. Petroleum Hydrocarbons and Organic Chemicals in Ground Water 235 (1987): 253.

Hughes, J.P., Sullivan, C.R., and Zinner, R.E. "Two techniques for determining the true hydrocarbon thickness in an unconfined sandy aquifer." Proceedings Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water — Prevention, Detection, and Restoration. National Groundwater Association, Dublin, OH (1988): 291-314.

Newell, C.J., Acree, S.D., Ross, R.R., and Huling, S.G. "Ground Water Issue — Light Nonaqueous Phase Liquids." United States Environmental Protection Agency, Office of Research and Development, Office of Solid Waste and Emergency Response. EPA/540/S-95/500 (1995).

Figures



N

GRAPHIC SCALE

100 0 50 100 200

(IN FEET)

LEGEND

- FP (OIL) — FREE-PRODUCT OIL AREA
- OIL / OILY SHEEN
- STORMLINE INSPECTED 5-07-13
  - NO OILY SHEEN OBSERVED
- STORMLINE INSPECTED 5-07-13
  - OIL, OILY SHEEN, OIL GLOBULES, SLUDGE BUILD-UP WERE OBSERVED
- STORMLINE NOT INSPECTED
  - LINE IS SUSPECTED OF BEING ASSOCIATED WITH SOURCE AREA (FORMER SUBSTATION I)
- FLOW DIRECTION

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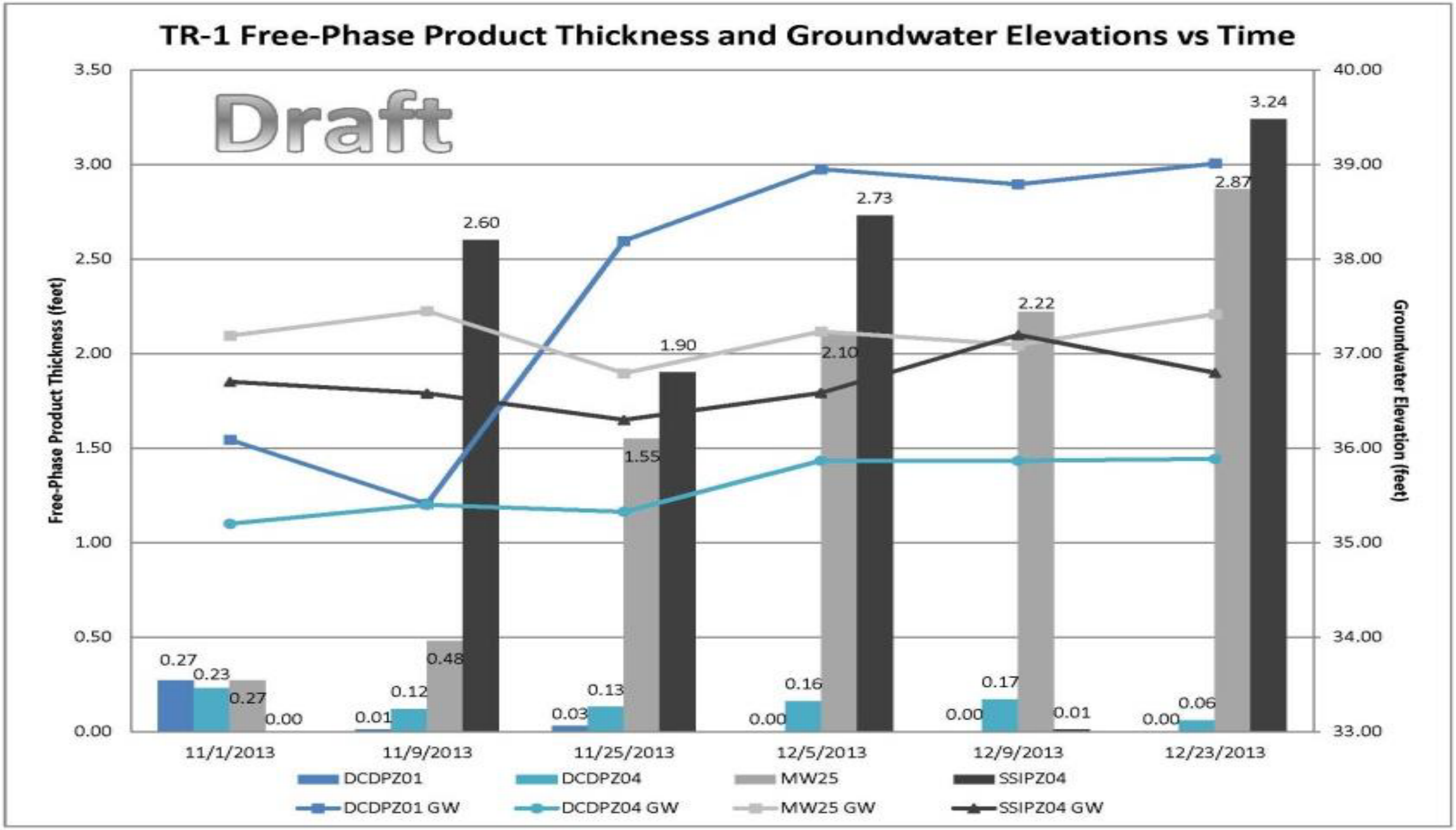
FIGURE 1
VIDEO INSPECTED STORM LINES TRIBUTARY TO PS-2
MAY 2013

CARRIER CORPORATION
SYRACUSE, ONONDAGA COUNTY, NEW YORK

SCALE: 1" = 100'
DRAWN BY: WM
REVIEWED BY: MH
PROJECT #0888814866
DATE: FEBRUARY 20, 2014

File name: I:\2013 Projects BST\13855 Carrier Syracuse, NY – Special Projects\Plans\14866 Video Inspected Storm Lines Tributary to PS-2, May 2013.dwg Plotted By: WADE MAREK Plot Date: 2/20/2014 1:40:34 PM

N
MW10
32.90
MW40D
34.82 (NC)
MW38
33.92
MW06
33.76
FDPZ02
33.73
FDPZ04
34.61
MW37
34.31
MW39
34.50
FDPZ03
34.58
MW36
34.41
FDPZ01
34.53
Floor Drain Area
MW19
34.16
MW23
33.48
TR-1 Vault
MW24
34.46
Storm Line #1
Storm Line #2
Storm Line #3
Storm Line #4
MW35D
34.92 (NC)
DCDPZ02
35.52
MW31
35.10
DCDPZ04
35.32
MW30
35.76
MW33
35.13
DCDPZ01
38.19
MW34
35.64
DCDPZ03
35.72
MW32
36.56
Degreaser C/D Area
MW03D
NM
MW03S
36.61
MW13D2
NM
SSIPZ04
36.30
MW26
36.79
SSIPZ03
36.64
MW28
37.40
Sub-Station I Area
MW29
36.46
SSIPZ01
36.66
MW25
36.79
MW27
37.01
SSIPZ05
0.00
SSIPZ02
38.73
SSIPZ05
NM
Legend
Monitoring Well Network
WellType
Monitoring Well (2" Diameter)
Piezometer (1" Diameter)
Recovery Well (4" Diameter)
Deep Well (2" Diameter)
Storm Lines (Former TR-1)
Site Features
Stormwater Utility
Former Site Building Footprint
Stormwater Ponds
Site Building Footprint
Former TR-1 Building
Features
Former TR-1 Column System
Sub-Station I Excavation (2011)
Super-Slab Storm Lines
Former TR-1 Vault Extent
Investigation Areas
2013 Former TR-1 Investigation Areas
Floor Drain Area
Degreaser C/D Area
Sub-Station I Area
NC = Not Considered for Potentiometric Model
NM = Not Measured During Gauging Event
Aerial Photographic Source:
NYS GIS Clearinghouse
April 2012
0 25 50 75 100 125 Feet
Figure 2
MONITORING WELL AND PIEZOMETER
LOCATIONS AT FORMER BUILDING TR-1 AREA
CARRIER CORPORATION THOMPSON ROAD FACILITY
SYRACUSE, NEW YORK
REQUESTED BY: S. Goodnight
DRAWN BY: S. Goodnight
DATE: 1/10/2014
PROJECT NO: 0888814332
ENSAFE



Findings/Recommendations

- Relatively immobile LNAPL mass beneath former building TR-1
- Slow LNAPL recharge, low transmissivity, remediation by recovery well extraction not effective/efficient
- Use OWS to capture LNAPL in storm sewers
- Monitoring & Manual Removal of LNAP in wells