University of Maryland Shore Regional Health

Chester River Hospital Remediation Briefing: Mayor and Chestertown Town Council

Ken Guttman, PE, PMP
Rob Scrafford, PE, PMP, ENV SP

November 20, 2020

Gannett Fleming
Excellence Delivered As Promised

AGENDA

1. Introductions
2. Status of Compliance
3. Status of Containment System
4. Status of Groundwater Conditions
5. Paleochannel Study Results
6. Recoverable Liquid-Phase Hydrocarbon (LPH) Study Results
7. Silica Gel Method Purpose and Results
8. Wrap Up
9. Questions

1. Introductions – Gannett Fleming

Ken Guttman, PE, PMP
Principal in Charge

- 23 years experience
- Professional Engineer & Professional Project Manager
- BS, Chemical Engineering
- Managed: > 20 petroleum release sites in MD; > 100 petroleum sites nationwide
- Managed one of largest LPH/ DRO plumes in MD

Rob Scrafford, PE, PMP
Project Manager

- 23 years experience
- Professional Engineer & Professional Project Manager
- BS, Environmental Studies MS, Environmental Science
- Managed complex petroleum plumes beneath residential neighborhoods
- Achieved case closure at 10 sites in MD

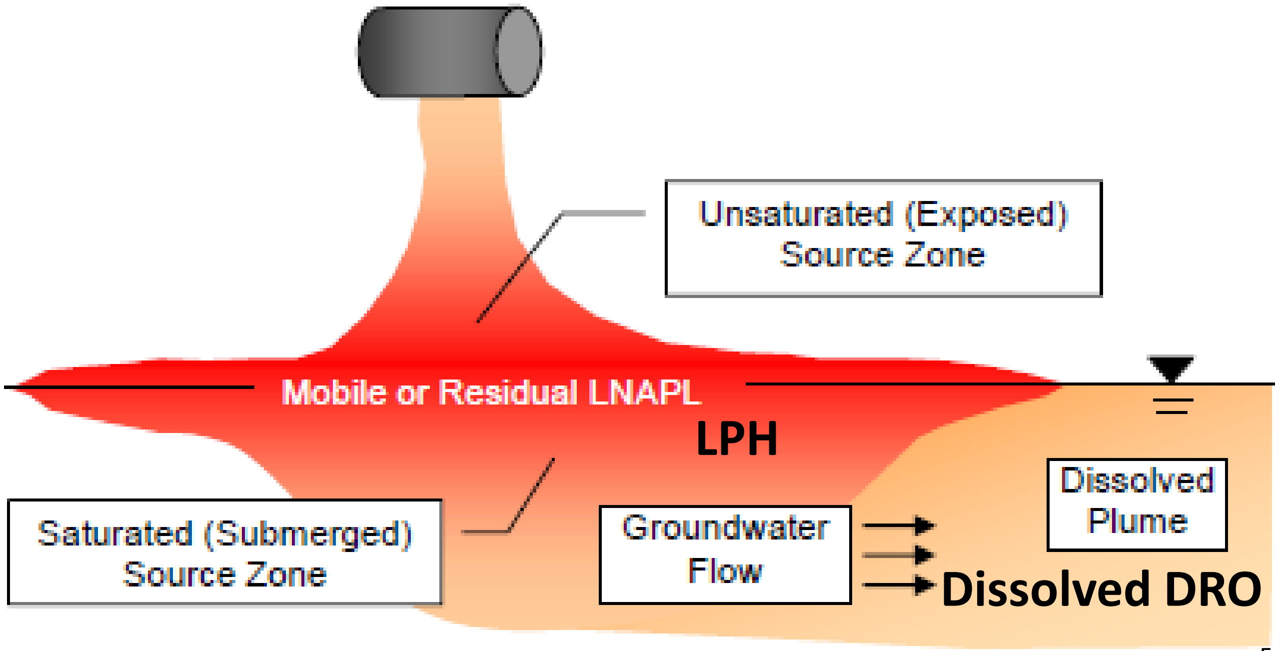
Glen Somes, PG
Sr Hydrogeologist

- 44 years experience
- Professional Geologist
- BS, Geology
- Directed design/operation of > 200 remediation systems
- Expert witness for soil & groundwater contamination matters
- Aquifer studies for municipal and industrial water supplies

2. Status of Compliance

- MDE Settlement Agreement/Consent Order – May 2016
- Town Agreement – June 2016
- MDE Correspondence
- Permits
- COMAR Regulations

Dissolved DRO in Groundwater Versus Liquid-Phase Hydrocarbons (LPH)



From ITRC, 2009

3. Status of Groundwater Containment System

- Six (6) recovery wells pumping groundwater
- Flow rate is ~ 70 gallons per minute creating a **broad groundwater capture zone**
- Installed Autodialer/Telemetry System – calls out on alarm
- Optimized the system, purchased standby pumps
- Collected individual recovery well data
- Opinion: System has reached point of diminishing return - pilot test shut down is next phase with MDE approval

Legend

- Town Wells
- Pumping Wells
- Monitoring Wells
- Extent of Groundwater Containment System Capture Zone
- TPH-DRO Plume
- Maryland Parcels

Shore Regional Health Groundwater Containment Map

Chestertown, Kent County, Maryland

0 100 200 300 400

Feet

N

Gannett Fleming

Legend

- Town Wells
- Pumping Wells
- Monitoring Wells
- Extent of Groundwater Containment System Capture Zone
- TPH-DRO Plume
- Maryland Parcels

Shore Regional Health
Well Location Map
Chestertown, Kent County, Maryland

0 30 60 90 120
Feet

Gannett Fleming

Photo 1: Influent and effluent sample ports as well as bypass piping.

Photo 3: Sample ports installed on influent lines from each recovery well.

Recovery Well Analytical Data

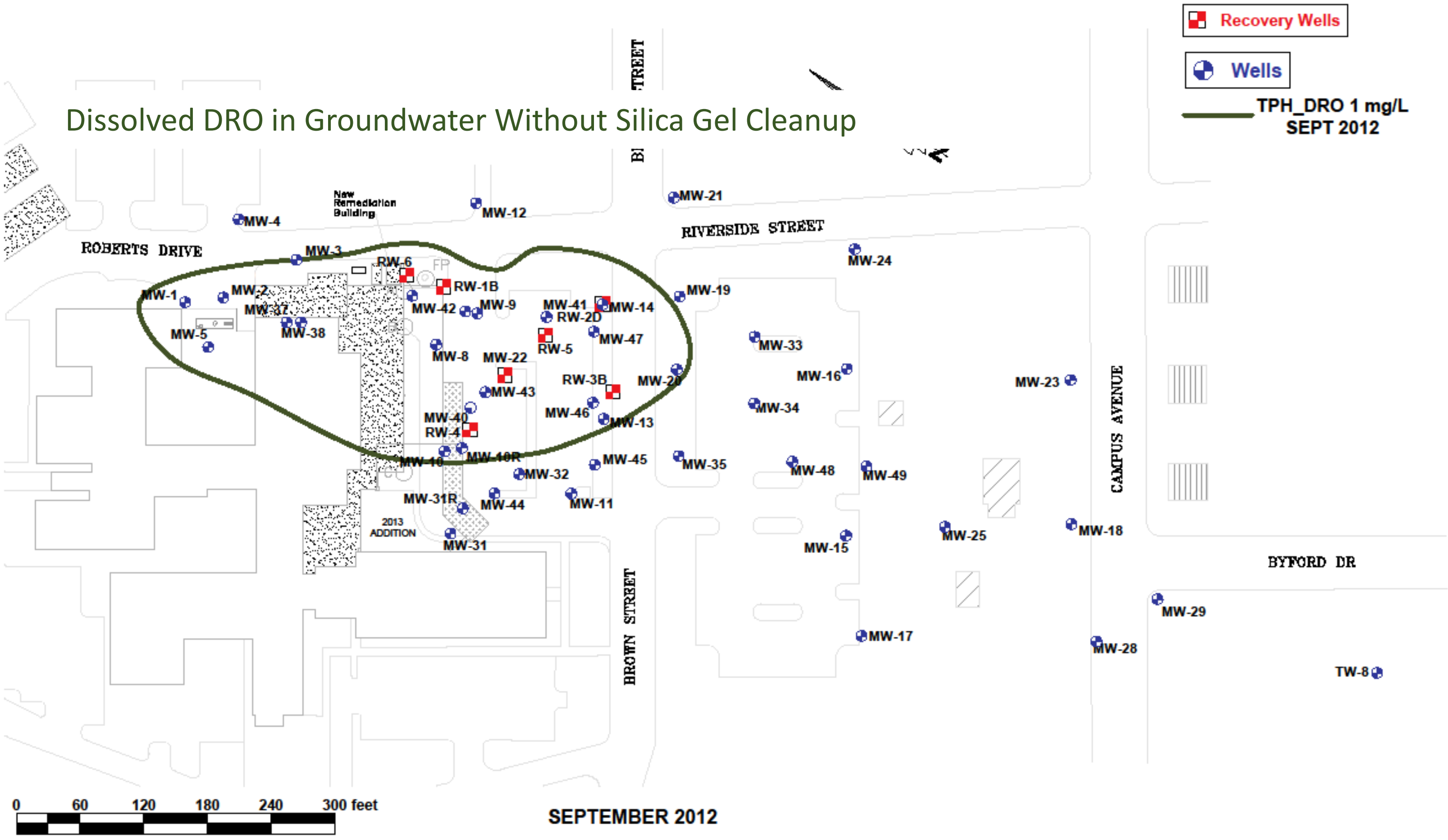
Well	DATE	Average Flow Rate (Gallons per minute)	Benzene (ug/L) parts per billion	Toluene (ug/L) parts per billion	Ethylbenzene (ug/L) parts per billion	Xylenes (ug/L) parts per billion	Total BTEX (ug/L) parts per billion	MTBE (ug/L) parts per billion	TPH-DRO (mg/L) parts per million	TPH-GRO (mg/L) parts per million	Naphthalene (ug/L) parts per billion
Recovery Wells											
RW-2D	10/22/20	14	<1.0	<1.0	<1.0	<3.0	<6.0	<1.0	<0.10	NS	2.7
RW-3B	10/22/20	17	<1.0	<1.0	<1.0	<3.0	<6.0	<1.0	<0.10	NS	<1.0
RW-4	10/22/20	12	<1.0	<1.0	<1.0	<3.0	<6.0	<1.0	<0.10	NS	1.7
RW-5	10/23/20	9	<1.0	<1.0	<1.0	<3.0	<6.0	<1.0	0.18	NS	<1.0
RW-6	10/22/20	12	<1.0	<1.0	<1.0	<3.0	<6.0	<1.0	<0.10	NS	1.5
MW-22	10/22/20	4	<1.0	<1.0	<1.0	<3.0	<6.0	<1.0	0.11	NS	2.6
System Influent	10/21/20	NA	<1.0	<1.0	<1.0	<3.0	<6.0	<1.0	<0.10	NS	2.0
System Effluent	10/21/20	NA	<1.0	<1.0	<1.0	<3.0	<6.0	<1.0	<0.10	<0.10	1.6
General Discharge Permit Limits		Monitor Only-No Limit	5	Monitor Only-No Limit	Monitor Only-No Limit	Monitor Only-No Limit	100	Monitor Only-No Limit	15	N/A	Monitor Only-No Limit

Note- TPH-DRO: Total Petroleum Hydrocarbons- Diesel Range Organics

4. Status of Groundwater Conditions – October 2020

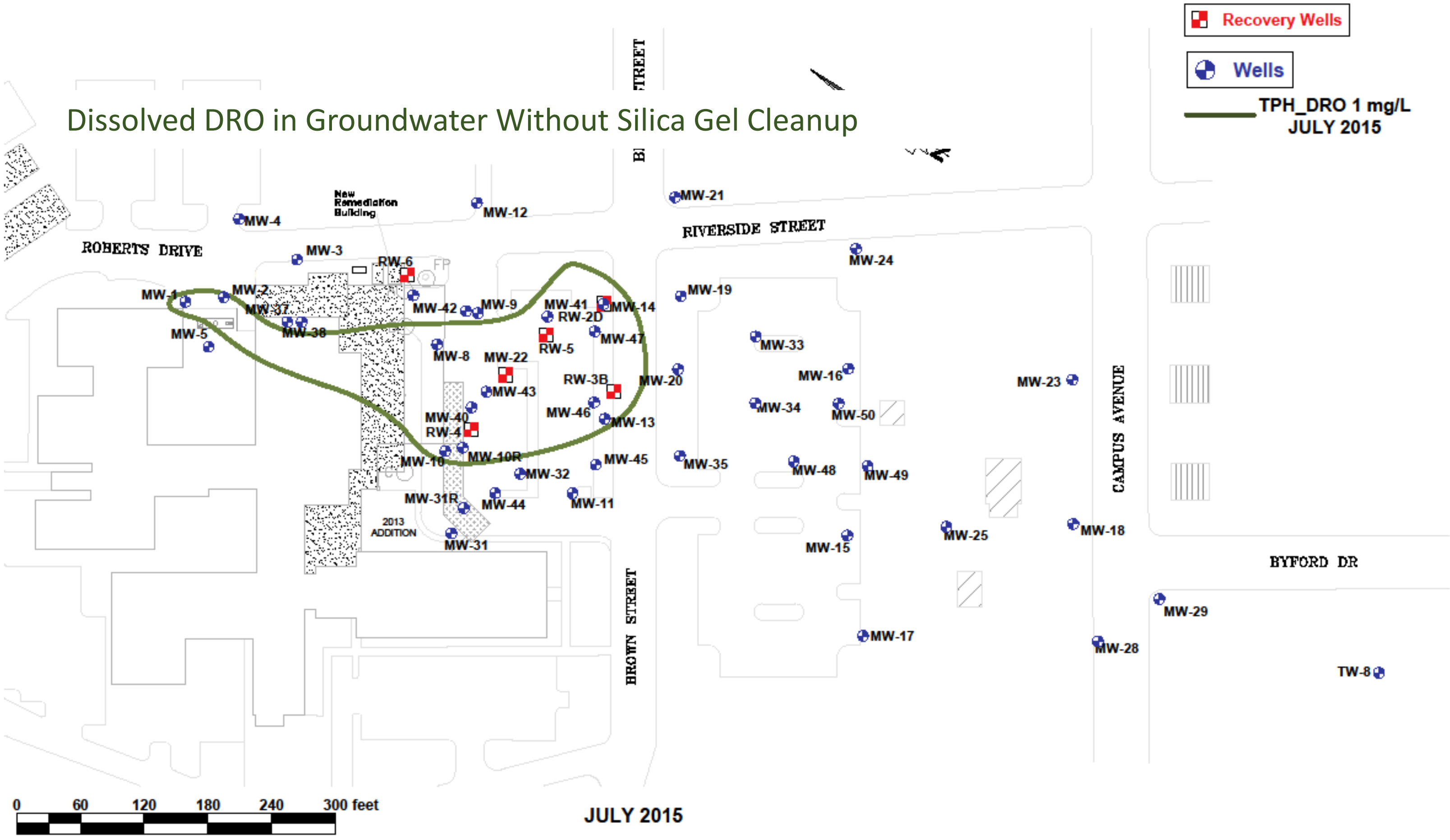
- No current exposure pathways
- No risk to people or the environment
- 37 of 55 wells are **Non detect** for DRO
- 18 wells have Dissolved DRO detected
- 9 of 18 wells Dissolved DRO > 1 ppm Without SGC (High is 4.6 ppm at MW-47)
- 0 of 18 wells Dissolved DRO > 1 ppm With SGC
- Dissolved DRO Biodegradation is occurring, reducing DRO mass
- **Dissolved DRO plume is shrinking**

Dissolved DRO in Groundwater Without Silica Gel Cleanup

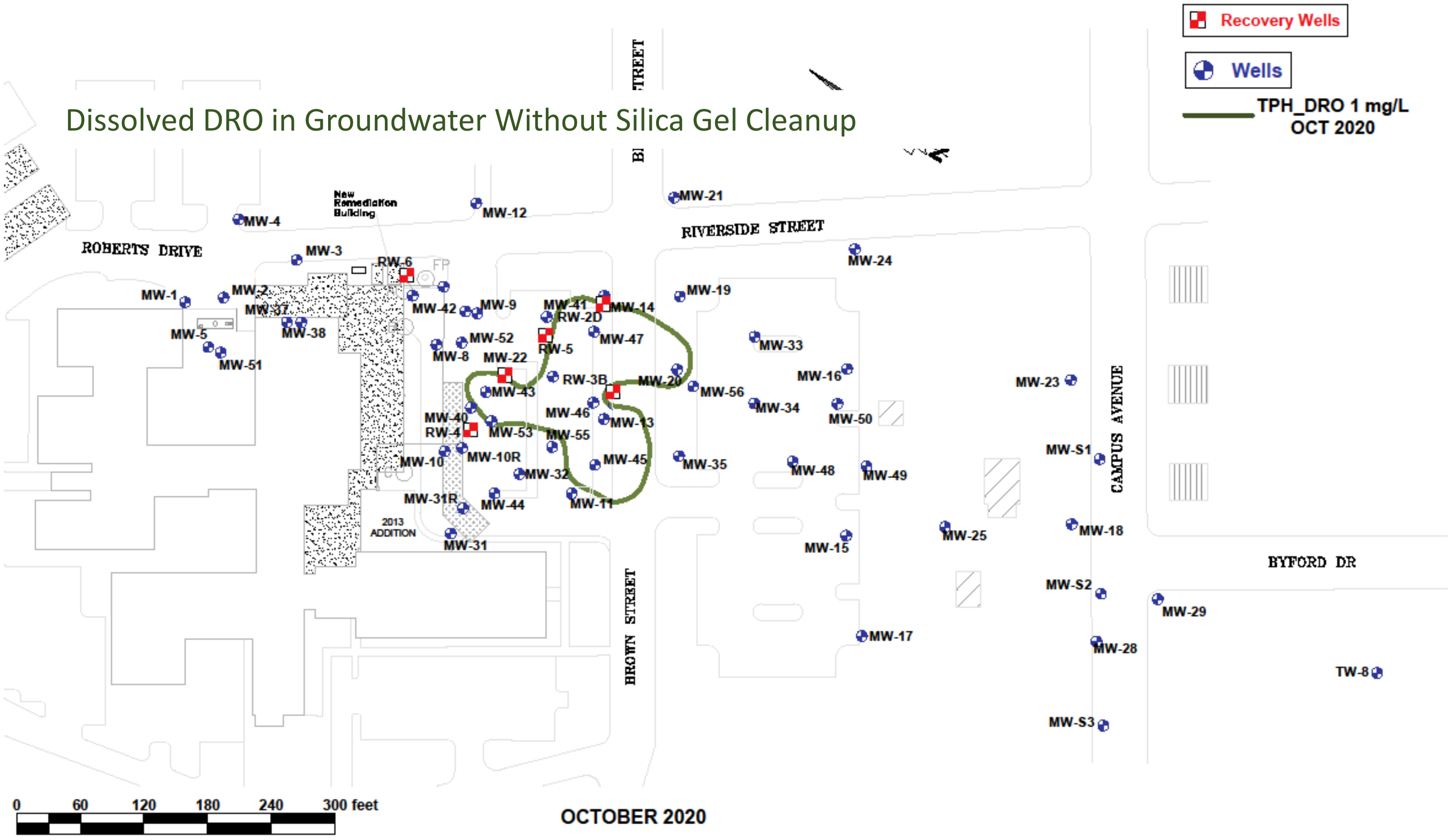


SEPTEMBER 2012

Dissolved DRO in Groundwater Without Silica Gel Cleanup



Dissolved DRO in Groundwater Without Silica Gel Cleanup



5. Paleochannel Study

- Concern Raised: A paleochannel could exist that could be a pathway for DRO to migrate to Town wells
- Gannett Fleming Sr. Hydrogeologist Glen Somes, PG - Lead Investigator
- Study
  - Reviewed Source Water Assessment Reports
  - Reviewed Literature – Maryland Geologic Survey
  - Reviewed 30 Soil Boring Logs for wells drilled on site
- Conclusion: No evidence that paleochannels exist in the Aquia aquifer beneath the site

Literature Review: Maryland Geologic Survey

1. Bulletin # 21 “The Water Resources of Cecil, Kent, and Queen Anne’s Counties”
2. Report of Investigations # 68 “Hydrogeology, Simulation of Ground-Water Flow, and Ground-Water Quality of the Upper Coastal Plain Aquifers in Kent County, Maryland
3. Open File Report # 93-02-07 “Stratigraphy of Upper Cretaceous and Tertiary Sediments in a Core-Hole Drilled near Chesterville, Kent Country, Maryland”
4. Report of Investigations # 51 “Hydrogeology, Brackish-Water Occurrence, and Simulation of flow and Brackish-Water Movement in the Aquia Aquifer in the Kent Island Area, Maryland”
5. Open File Report # 12-02-20 “Maryland Coastal Plain Aquifer Information System: Hydrogeologic Framework”

Paleochannel

A Paleochannel is a preferential groundwater flow pathway consisting of sand and gravels deposited by:

(1) Flowing water in terrestrial streams and rivers (FRESH WATER)

OR

(2) Debris flows from canyons in deep marine settings (OCEAN)

Paleochannel Study Facts

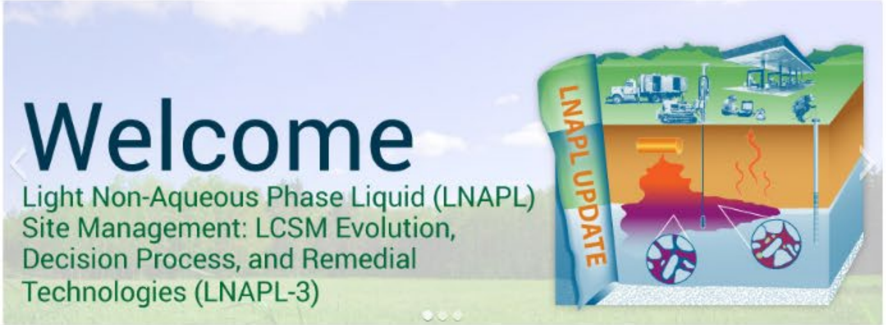
- Paleochannels form in flowing waters
- Groundwater plume is in the Aquia Formation
- Aquia was formed under marine conditions (ocean)
- Aquia is glauconitic quartz sands
- Glauconitic sands are deposited in quiescent (calm) water, not flowing water
- No evidence of "glauconitic-free" sands in soil boring logs
- No evidence of graded bedding in soil boring logs
- Conclusion: No evidence of paleochannel at this site

6. Recoverable Liquid-Phase Hydrocarbon (LPH) Study

- Concern is remaining LPH/oil can mobilize towards Town wells
- Sr. Hydrogeologist Glen Somes, PG – Lead Investigator
- Review Literature
  - Interstate Technology & Regulatory Council documents
  - LPH Saturation Papers
- Review LPH thickness data
- Conclusion: No evidence of a reservoir of mobile LPH.
  - Data suggests the LPH/oil is at residual saturation
  - Immobile LPH – not migrating

Interstate Technology and Regulatory Council (ITRC)

- A State-led coalition working to reduce barriers to the use of innovative air, water, waste, and remediation environmental technologies and processes
- Produces documents and training that broaden and deepen technical knowledge
- Program of the Environmental Research Institute of the States (ERIS), a 501(c)(3) organization managed by the Environmental Council of the States (ECOS)
- Eight (8) member Board – all State Regulators
- Provided training to thousands of consultants and regulators



1. How to Use the Document

In 2009, ITRC published LNAPL-1: Evaluating Natural Source Zone Depletion at Sites with LNAPL (ITRC 2009b) and LNAPL-2: Evaluating LNAPL Remedial Technologies for Achieving Project Goals (ITRC 2009a) to aid in the understanding, cleanup, and management of LNAPL at thousands of sites with varied uses and complexities. These documents have been effective in assisting implementing agencies, responsible parties, and other practitioners to identify concerns, discriminate between LNAPL composition and saturation-based goals, to screen remedial technologies efficiently, to better define metrics and endpoints for removal of LNAPL to the "maximum extent practicable," and to move sites toward an acceptable resolution and eventual case closure.

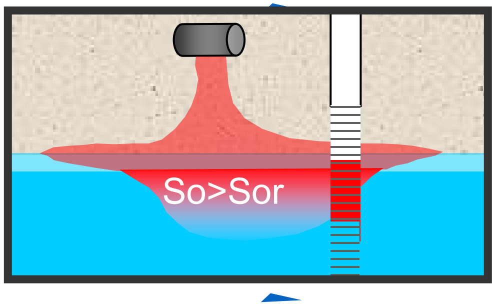
Light Non-Aqueous Phase Liquid (LNAPL) Management is the process of LNAPL site assessment, monitoring, LNAPL Conceptual Site Model development, identification and validation of relevant LNAPL concerns, and the possible application of remediation technologies. The presence of LNAPL can create challenges at any site. In the subsurface, LNAPL can be difficult to assess or recover accurately and can lead to:

- human health, ecological risk, and exposure concerns (e.g., vapor, groundwater, and soil contamination)
- acute-risk concerns (e.g., explosive conditions)
- migration or occurrence concerns (e.g., regulations

Saturation versus Residual Saturation

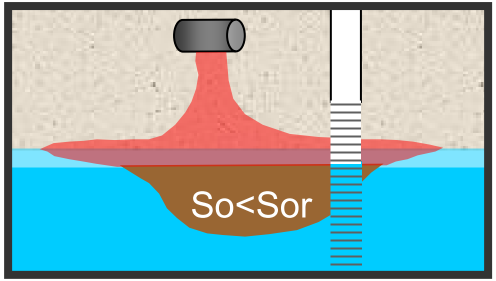
LNAPL Saturation (So)

Fraction of pore space occupied by LNAPL



Residual LNAPL Saturation (Sor)

Fraction of pore space occupied by LNAPL that cannot be mobilized under an applied gradient



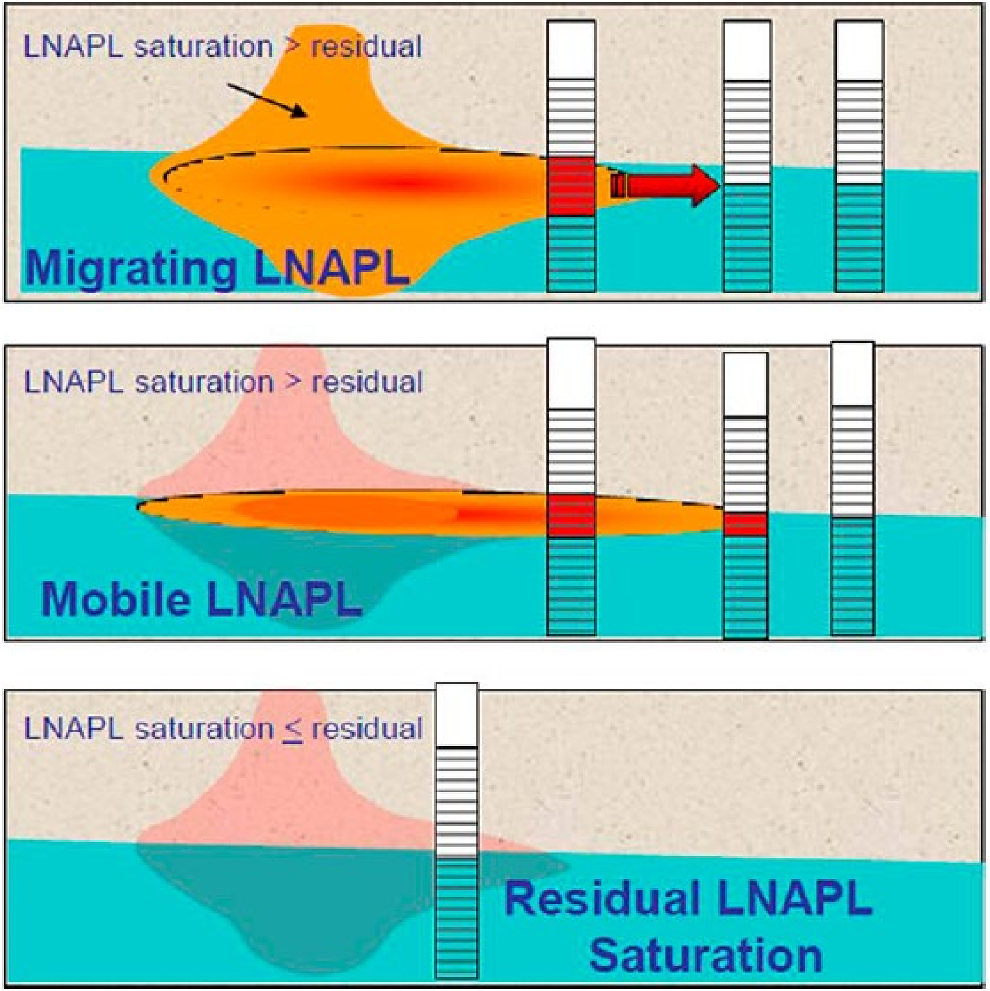
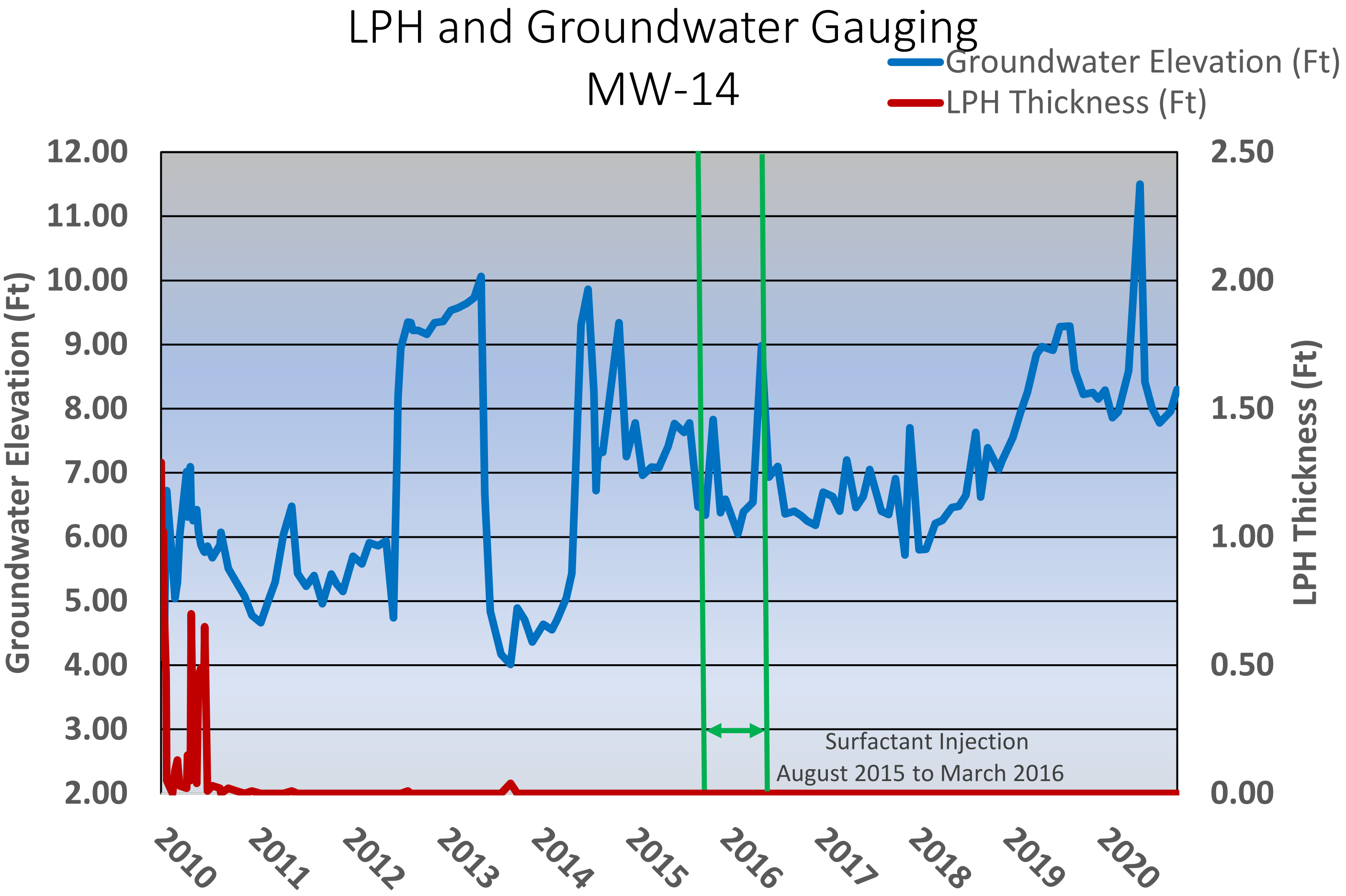
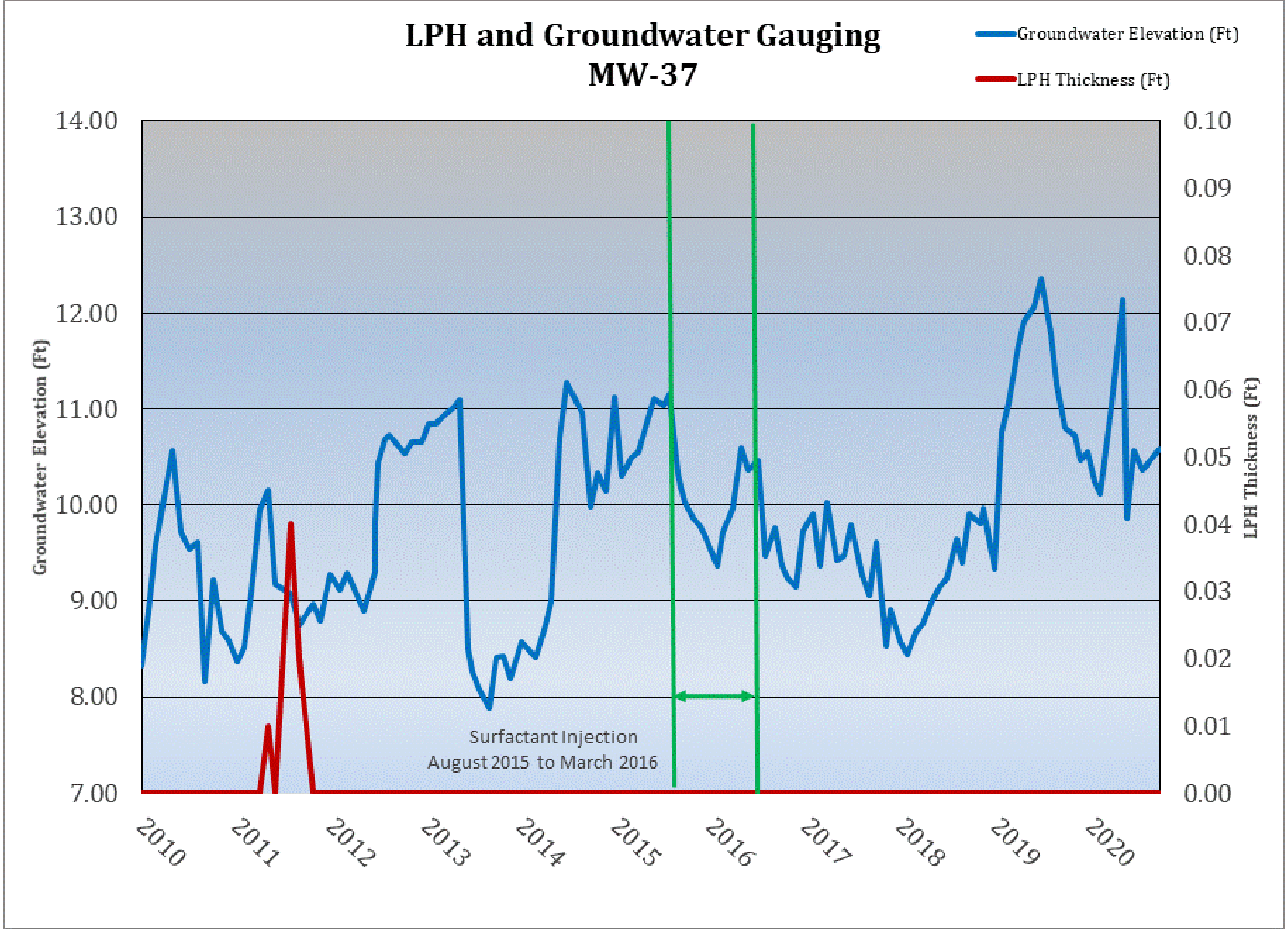


Figure 3-8. Three LNAPL conditions (ITRC 2009a).

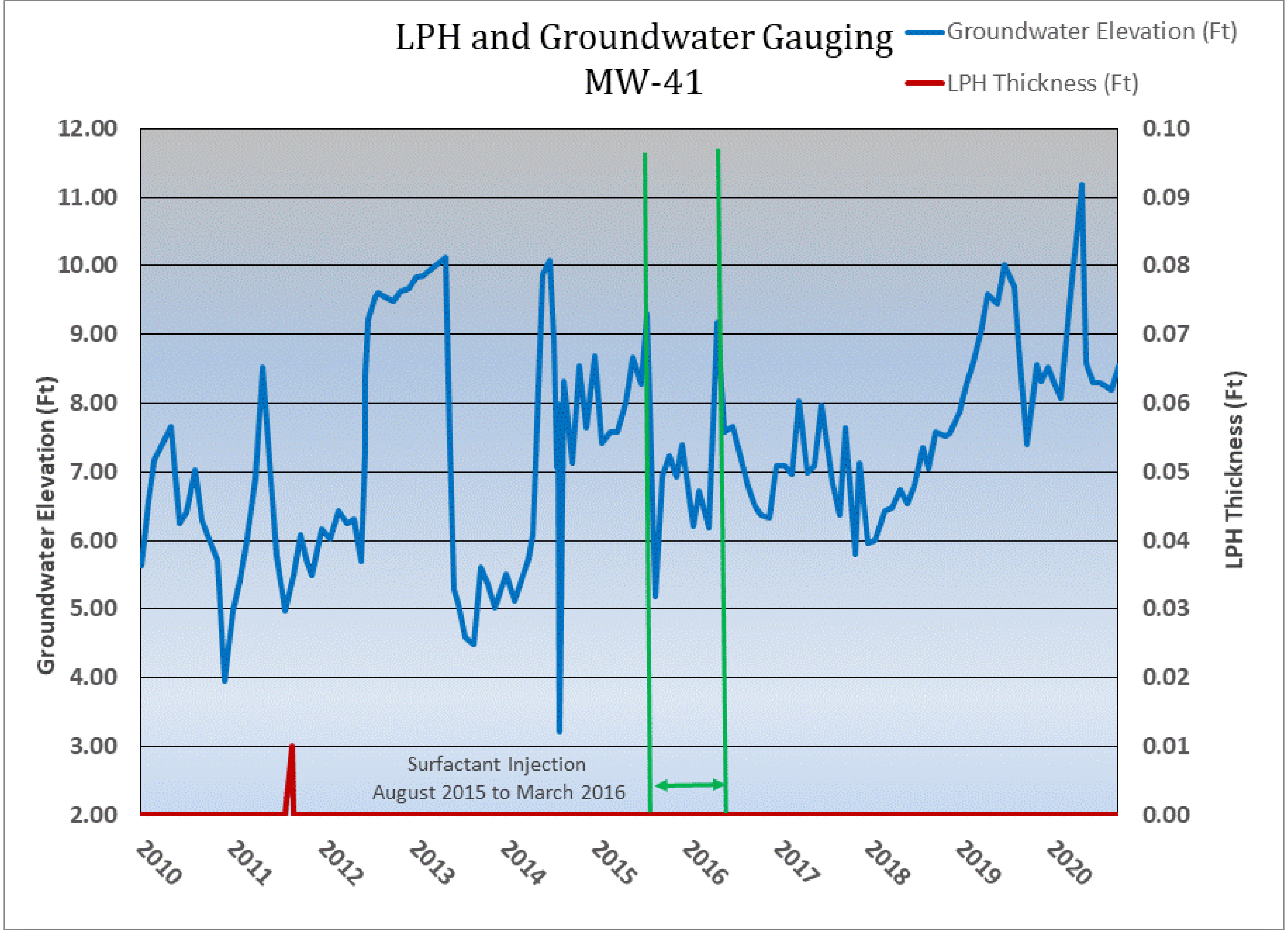
Shore Regional Health Site



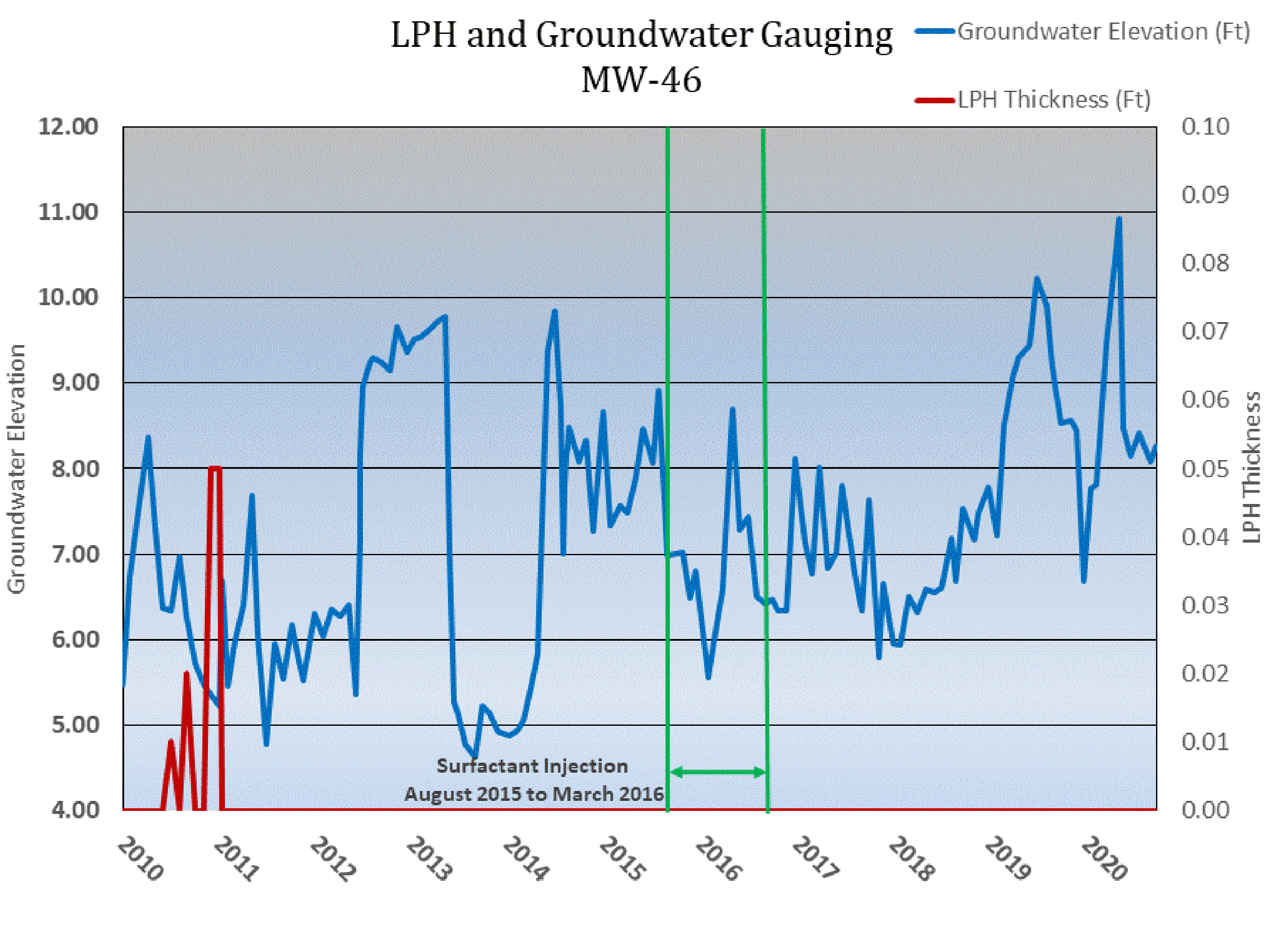
LPH and Groundwater Gauging
MW-14
Groundwater Elevation (Ft)
LPH Thickness (Ft)
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
2.50
2.00
1.50
1.00
0.50
0.00
Groundwater Elevation (Ft)
LPH Thickness (Ft)
Surfactant Injection
August 2015 to March 2016
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020



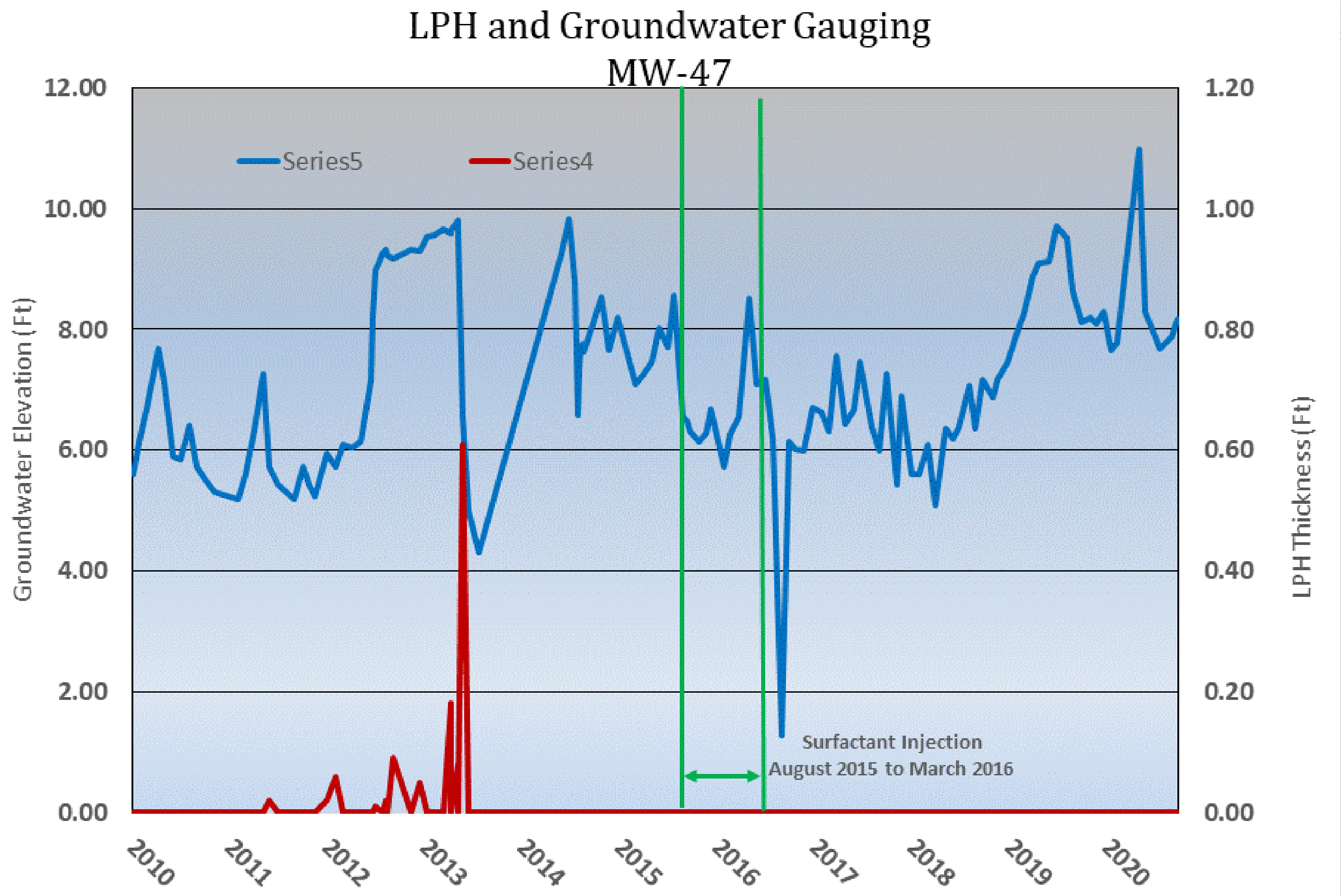
LPH and Groundwater Gauging
MW-37
Groundwater Elevation (Ft)
LPH Thickness (Ft)
14.00
13.00
12.00
11.00
10.00
9.00
8.00
7.00
Groundwater Elevation (Ft)
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
LPH Thickness (Ft)
Surfactant Injection
August 2015 to March 2016
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020



LPH and Groundwater Gauging
MW-41
Groundwater Elevation (Ft)
LPH Thickness (Ft)
Groundwater Elevation (Ft)
LPH Thickness (Ft)
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Surfactant Injection
August 2015 to March 2016



LPH and Groundwater Gauging
MW-46
Groundwater Elevation (Ft)
LPH Thickness (Ft)
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
Groundwater Elevation
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
LPH Thickness
Surfactant Injection
August 2015 to March 2016
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020



LPH and Groundwater Gauging
MW-47
Series5
Series4
Groundwater Elevation (Ft)
LPH Thickness (Ft)
12.00
10.00
8.00
6.00
4.00
2.00
0.00
1.20
1.00
0.80
0.60
0.40
0.20
0.00
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Surfactant Injection
August 2015 to March 2016

Liquid Phase Hydrocarbons Study Facts

- Rule of thumb: ~ 50% of LPH can be removed by pumping in sandy soils
- ~ 84,000 gallons LPH recovered via pumping
- Additional gallons of LPH were recovered via surfactant
- LPH is at residual saturations – immobile
- LPH detected 11 times out of 2,726 measurements taken (0.4%) since January 2017
- LPH not detected in MWs during low water tables last 7 years

Liquid Phase Hydrocarbons Conclusions

- LPH recovery has reached the point of diminishing return.
- LPH remaining in the soil is at residual saturation and is being depleted by natural forces.
- Residual LPH remaining in the soil is not migrating – it is immobile
- Residual LPH poses no risk to the Town wells, to people, or to the environment.

7. Silica Gel Cleanup (SGC) Method Purpose & Results

- EPA allows states to approve/use SGC
- MDE approves use of SGC as extra information in addition to the DRO data
- DRO and SGC results suggest biodegradation metabolites in groundwater

8. Wrap Up - Key Points

- Progressive remediation techniques have been successful removing LPH
- Current remediation system is recovering minimal petroleum hydrocarbons
- The dissolved DRO plume is shrinking
- No evidence of a paleochannel
- No evidence of mobile LPH
- Residual LPH remaining in the soil is:
    - Immobile, and
    - poses no risk to the Town wells, people, or the environment.
- DRO and SGC results both suggest biodegradation metabolites in groundwater - Biodegradation of DRO is occurring

Questions?

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