Remedy Optimization Team Report for the Bethpage Groundwater Plume Remedy

- Presented to the Southeast Nassau Water District Committee
June 23, 2011

Remedy Optimization
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Remedy Optimization
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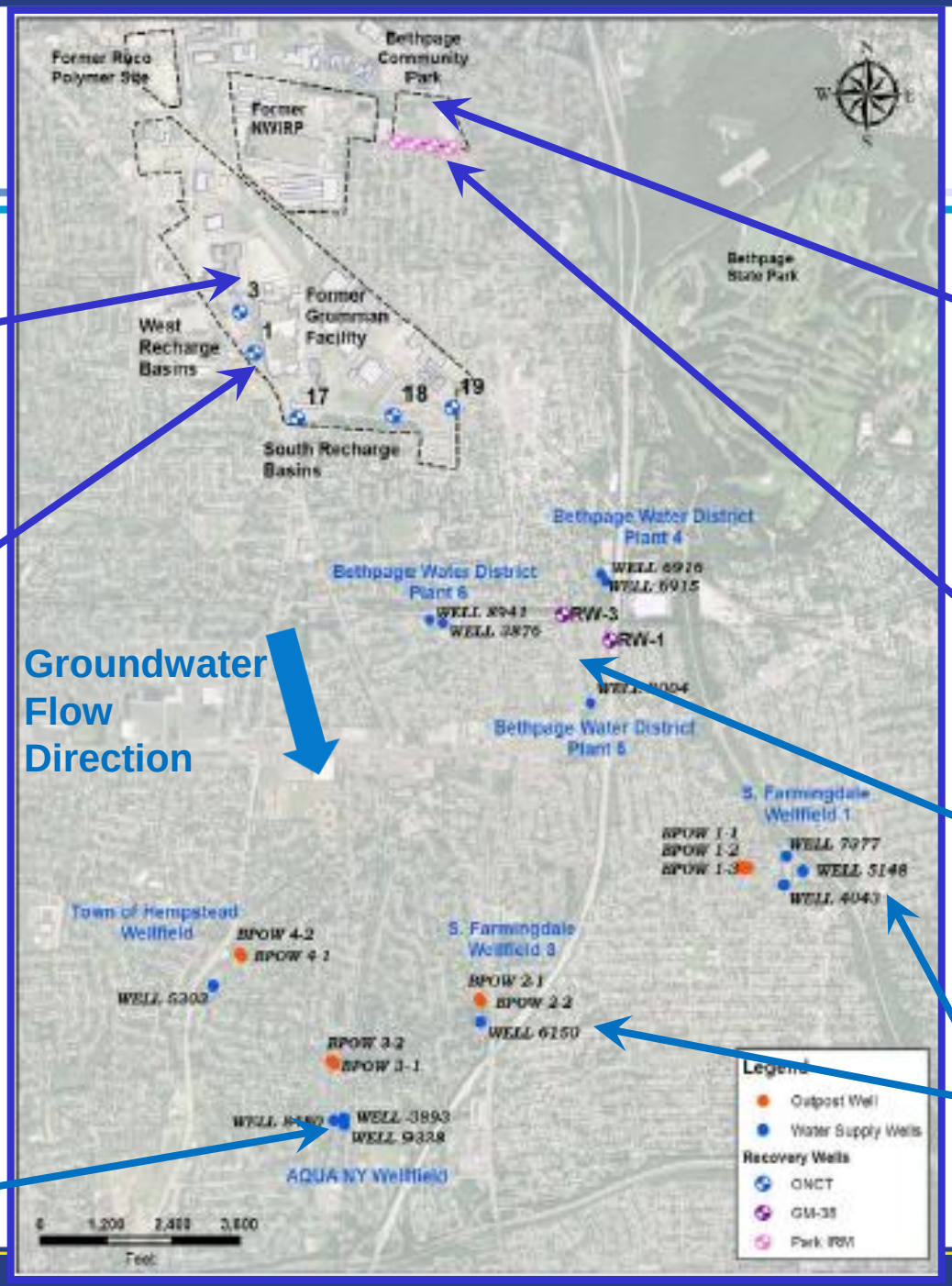
- Kim Parker Brown, M.S., P.E. - Naval Facilities Engineering Command Headquarters

Presentation Outline

- Site background and optimization team objectives
- Conclusions
  - –Past progress
  - –Challenges that lie ahead
- Recommendations
  - –On-site containment
  - –OU-3 Plume off-site hot spot
  - –Modeling
  - –Off-site plume

Site Background



Operable Unit 2 (OU-2)

On-Site Containment System (ONCT)

Groundwater Flow Direction

Aqua NY Supply Well

Operable Unit 3 (OU-3)

Interim Remedial Measure (IRM)

Bethpage Wells

South Farmingdale Wells

Technical Team
- Objectives

- Evaluate the effectiveness of previous and ongoing treatments
- Evaluate the effectiveness of the current well network in monitoring the progress of the plume
- Discuss USGS/EPA review of Northrop Grumman's groundwater modeling

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Conclusions
- Past Progress

- The general strategy of on-site source containment and off-site plume monitoring has succeeded in reducing the impacts to down-gradient public supply wells.
- On-Site Containment System (OU-2) has removed > 150,000 lbs of VOC mass from source areas since 1998, thus reducing down-gradient impacts. Interim Remedial Measure (OU-3) operating since 2009.
- Wellhead treatment at Bethpage Plants 4, 5, and 6 is successfully protecting public health
- Outpost wells at South Farmingdale Water District Plants 1 and 3 provided adequate warning of approaching plume.

Conclusions
-Past progress

- Navy's increased reliance on gathering and using field data to direct future activities has been valuable in navigating some of the complexities of the site
  - –Deeper borings have led to better understanding of the nature and depth of the Lower Magothy and Upper Raritan formations
  - –Clay layers in the Raritan formation are now understood to be deeper
  - –This field investigation approach can be improved

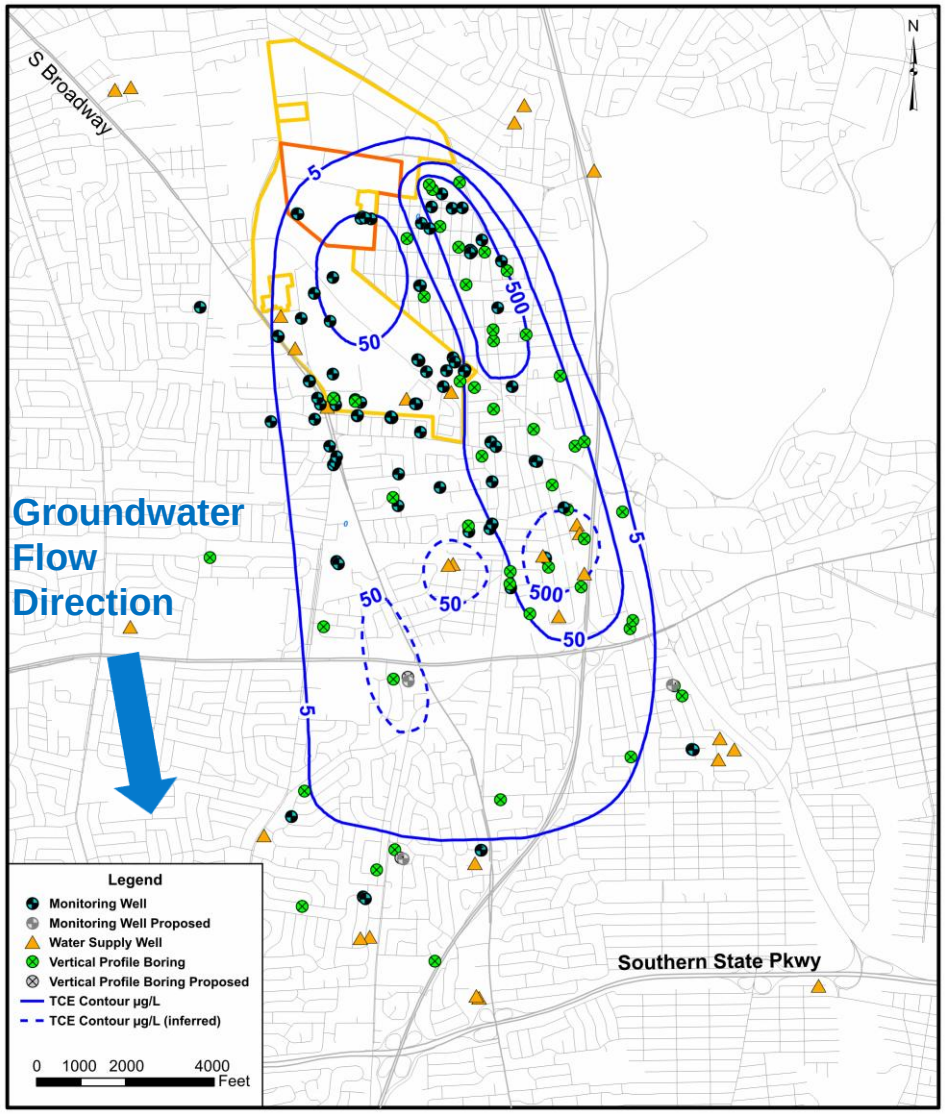
Conclusions
- Challenges that lie ahead

- The Bethpage Plume – A Unique Challenge
- Improving the Outpost Well Strategy

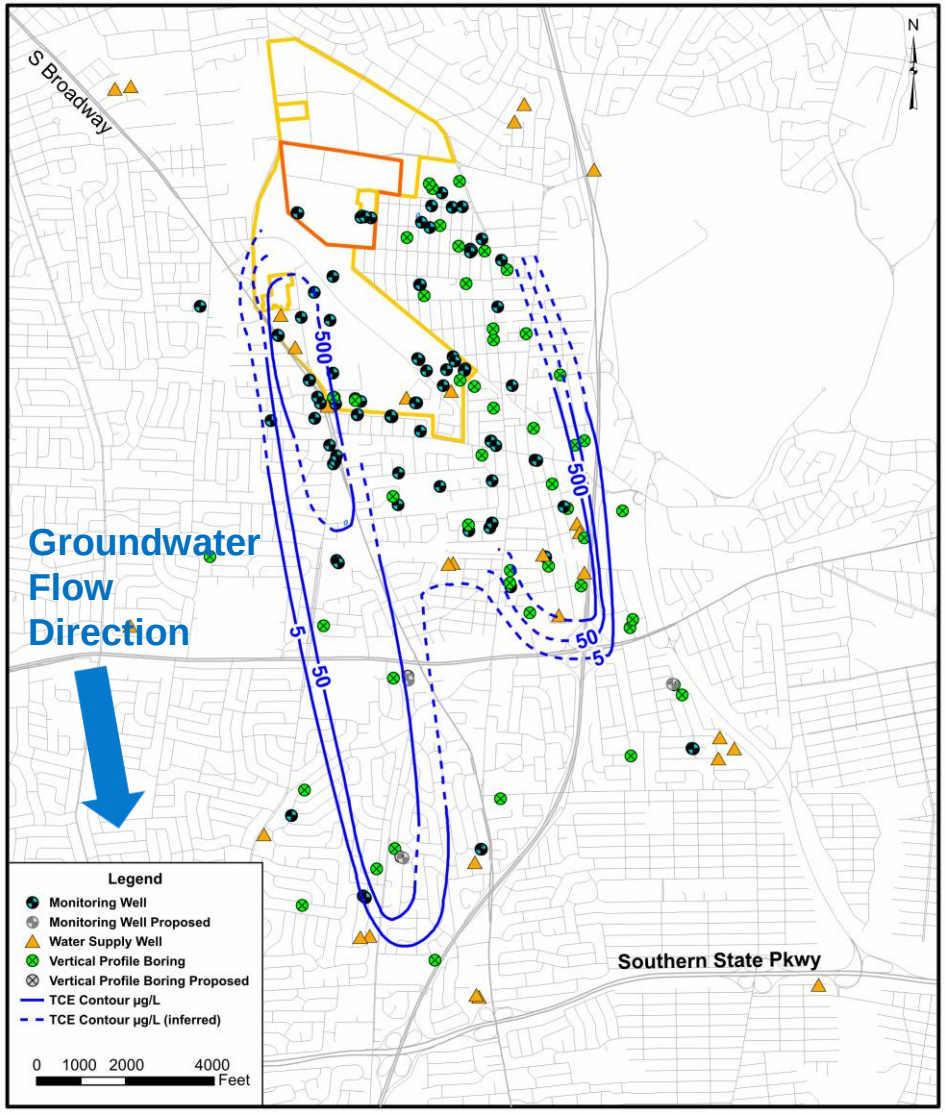
The Bethpage Plume
- A Unique Challenge

- This is a Category 4 site according to National Research Council (NRC, 1994) classification
  - –Likelihood of DNAPL
  - –Aquifer with heterogeneous geologic layers
  - –"*Typical methods used to calculate cleanup time often result in underestimates because they neglect processes that can add years, decades, or even centuries to cleanup*."
- Added challenges at this particular site
  - –Large size of plume: 3.5 miles long and 1 mile wide.
  - –Depth of aquifer: 700-800 ft bgs
  - –Multiple sources
  - –Proximity to water supply wells

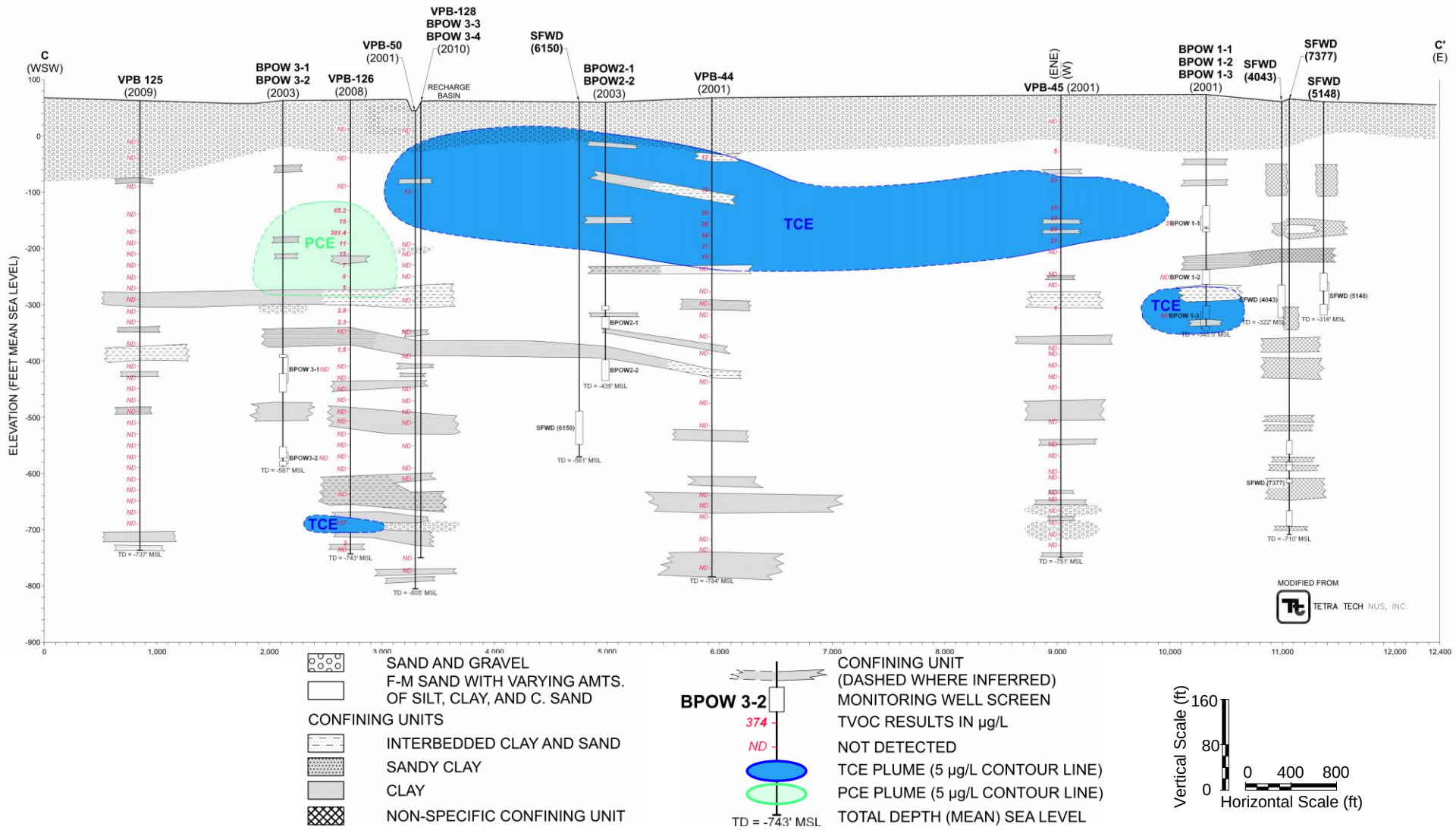
"The Bethpage Plume" – TCE Shallow Plume (Plan View)



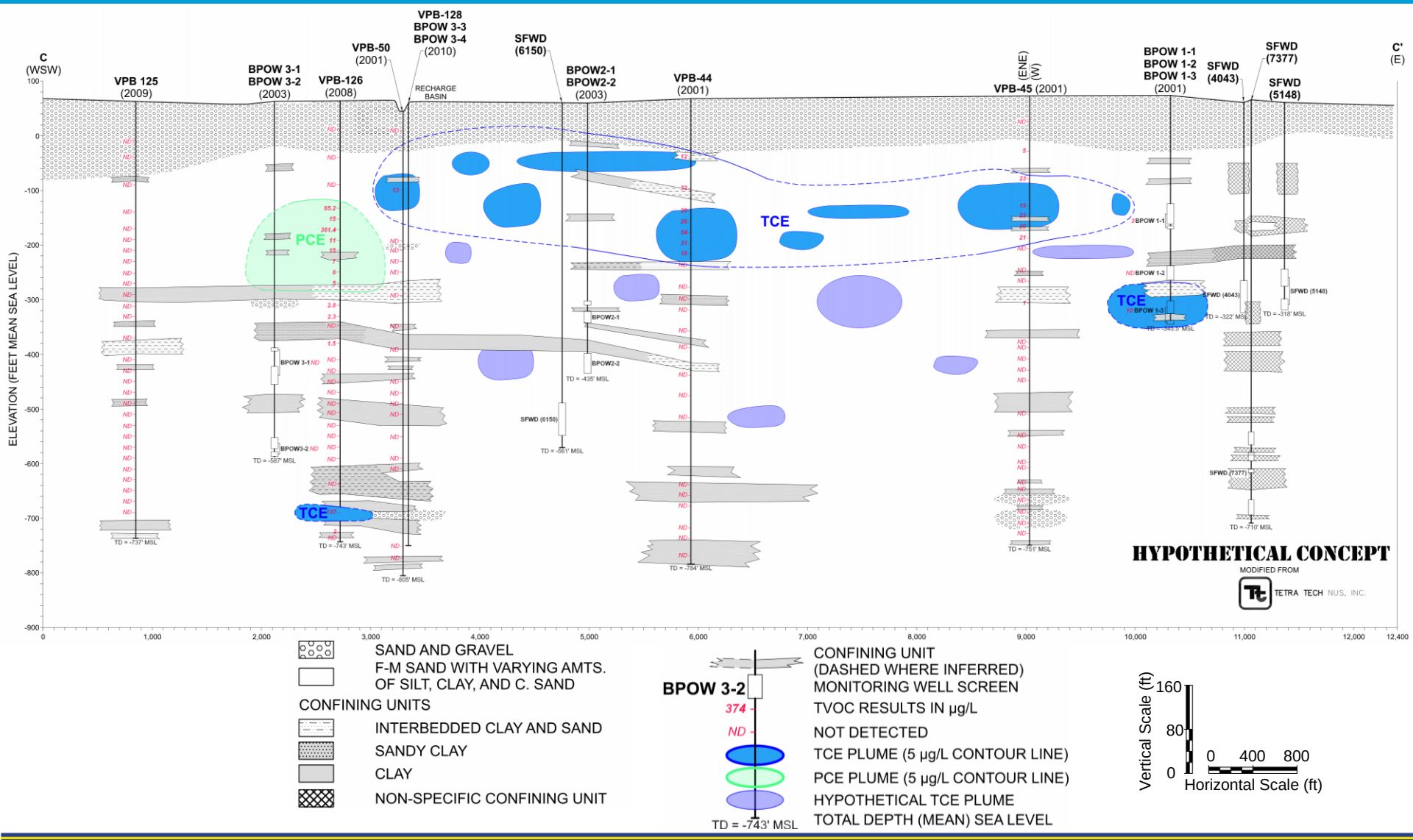
"The Bethpage Plume" – TCE Deep Plume (Plan View)



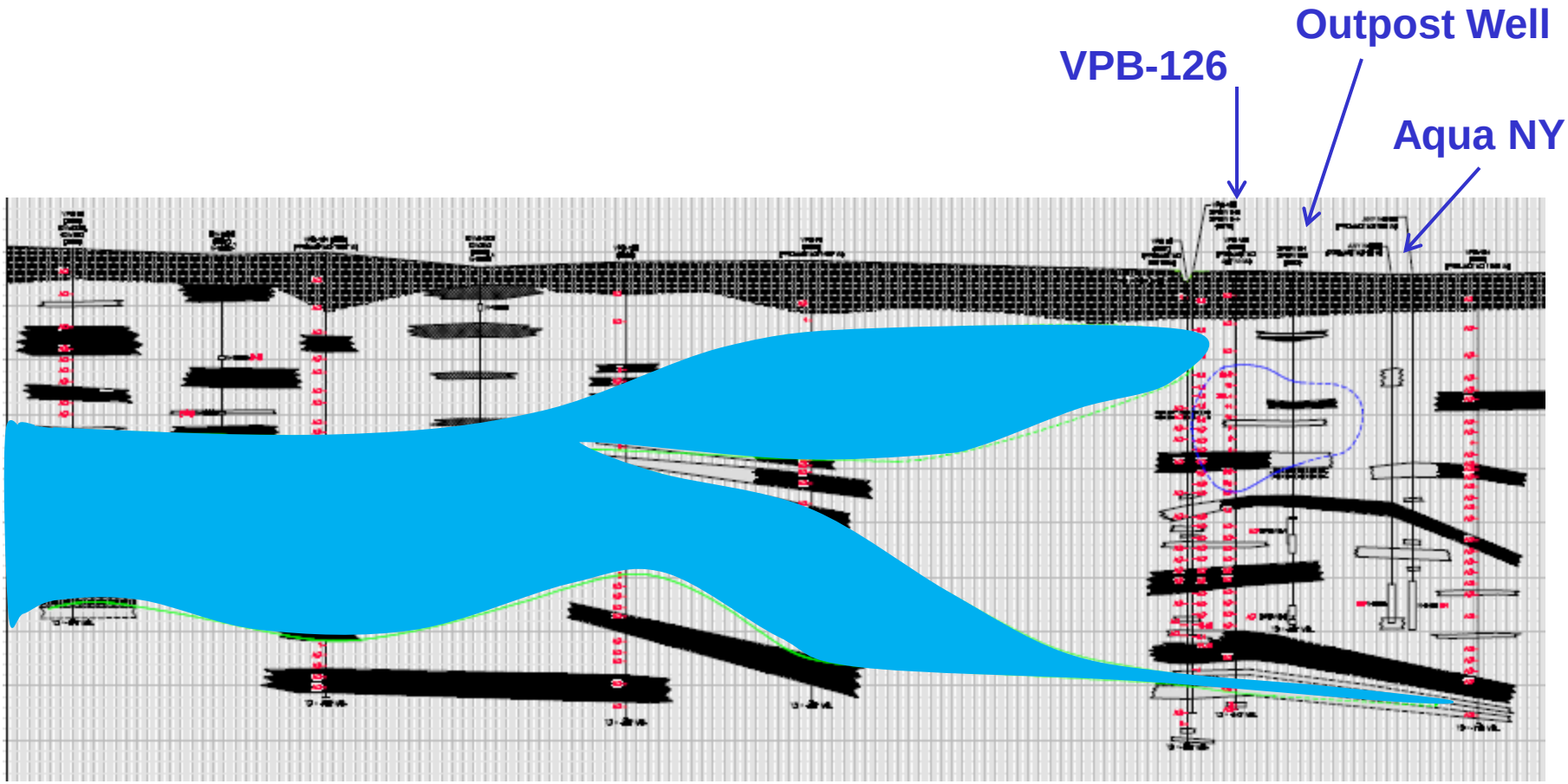
"The Bethpage Plume" – TCE Plume in Vertical Cross-Section CC' (perpendicular to groundwater flow)



Hypothetical Plume Cross-Section
- If much more characterization were possible



Plume appears in Aqua NY, but not in outpost well
- Vertical Cross-Section AA' through long axis of the OU-2 Plume



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Conclusions/Recommendations
- On-Site Containment

- Source remediation versus source containment
  - –Aggressive in-situ treatment of source areas in OU-2 will not remove the need for On-Site Containment System (ONCT) and is not recommended
  - –Limited source remediation planned in shallower OU-3 source areas will remove risk to near-surface activities and is necessary. Any source remediation (shallow or deep) will not remove the need for the Interim Remedial Measure (IRM) or source containment in the foreseeable future.
  - –Potentially deeper sources in both OU-2 and OU-3 should be investigated, so that source containment can be strengthened if required. This is a higher priority need.

Conclusions/Recommendations
- On-Site Containment

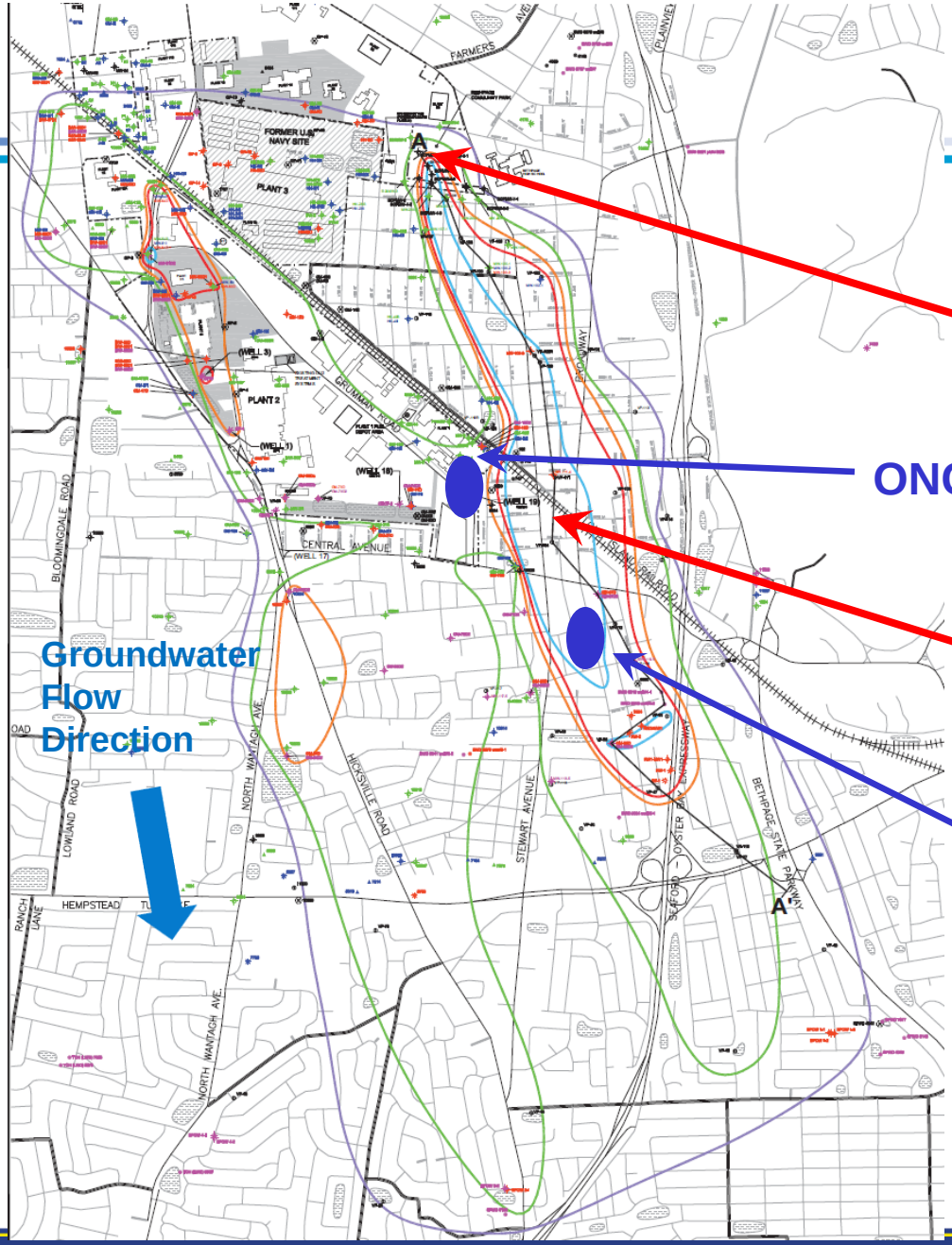
- Effectiveness of On-Site Containment System (OU-2) and Interim Remedial Measure (IRM) needs better evaluation, especially in deeper zones
- Recommend a row of monitoring points immediately south of the capture zones of the OU-2 and OU-3 containment systems. These monitoring points should go deep enough to reach the Lower Magothy/Upper Raritan interface

Conclusions/Recommendations
- OU-3 Plume Off-Site Hot Spot

- The OU-3 Plume has an off-site hotspot that represents much higher contamination than in the rest of the off-site plume
  - –Recommendation: Use a new extraction well(s) upgradient of Bethpage Water District Plants 4, 5, and 6 to reduce mass discharge across a vertical containment cross-section of the Eastern Plume by at least 90%
  - –Recommendation: Avoid reducing the current extraction rate of existing OU-2 well RW-19 to accommodate new extraction wells

Site Background

Source: Northrop Grumman's Draft Feasibility Study (FS) Report, Volume 2, Figure 3-2



Mass discharge as a performance metric for the OU-3 hot spot remedy

- VOC concentrations down-gradient of any containment well(s) are unlikely to reach drinking water standards in the next 30 to 50 years
- Reduction in mass discharge is a measurable and achievable goal in the relatively shorter term
- The recommended 90% target reduction in mass discharge both defines the hot spot and presents an achievable target, based on the Technical Team members' experience
- Mass discharge measurements will require additional vertical and horizontal characterization of the plume in a cross-section through the containment location

Conclusions/Recommendations
- Modeling

- USGS report (Misut, 2011) provides a review of the existing Northrop-Grumman model and identifies the following deficiencies
  - –Limited representation of aquifer heterogeneity
  - –Inability to model changes in hydrologic stresses over time
  - –Lack of adequate calibration
- Optimization Team concurs and adds:
  - –Some of these deficiencies can be rectified by better modeling techniques
  - –Some **uncertainties**** will remain, especially in predicting plume arrival times and concentrations (or plume cleanup times and concentrations)

** *These uncertainties have been well documented in recent independent research (e.g., Konikow, 2010; Eggleston and Rojstaczer, 2000; Payne et al., 2008)*

Conclusions/Recommendations
- Modeling

- Use a well-constructed and properly calibrated model to:
  - Evaluate capture zones of public supply wells (to properly locate outpost wells)
  - Evaluate capture zones of on-site containment wells (to assess source containment)
  - Evaluate target capture zones of new containment well(s) planned for OU-3 hot-spot treatment
- Use a groundwater flow model with particle tracking (supplemented by adequate field characterization) to achieve these objectives

Conclusions/Recommendations
- Off-Site Plume

- Install additional monitoring points to better define the eastern and western boundaries, leading edge, depth of the plume
- Install at least three new multi-level monitoring wells or well clusters approximately midway between the current leading edge of the plume and Massapequa supply wells to track the progress of the plume
  - –Learning from Aqua NY experience, use multi-level wells or well clusters
- Evaluate the technical and economic feasibility of plume containment at the leading edge and of other alternatives

Conclusions/Recommendations
- Miscellaneous

- Develop a more comprehensive conceptual site model that incorporates all the information on OU-2 and OU-3 (and other non-Navy, non-Northrop Grumman sources)
- Share data among various stakeholders (Navy, Northrop Grumman, water districts, etc.) on a timely basis
- Plan, collect, and share not just VOC or plume data, but also relevant hydrogeologic data

In Summary

- Key Recommendations for Path Forward

1. Evaluate source containment in deeper portion of the OU-2 aquifer
2. Evaluate source containment in deeper portion of the OU-3 aquifer
3. Substantially contain the OU-3 Plume hot spot
4. Use a well calibrated model to evaluate capture zone of supply wells and containment wells, as well as to design new containment well(s) for OU-3 plume hot spot
5. Install additional monitoring points to define eastern, western, and southern boundaries, as well as depth of off-site plume
6. Improve outpost well strategy by monitoring multiple depth intervals
7. Install at least three new monitoring wells/clusters midway between leading edge of plume and Massapequa supply wells to monitor plume progress
8. Evaluate technical/economic feasibility of plume containment at current leading edge

Navy Bethpage Project Team's Response

- Presented by Lora Fly, NAVFAC Mid-Atlantic

Navy Bethpage Project Team's Response to Optimization Report -- Lora Fly, Navy RPM

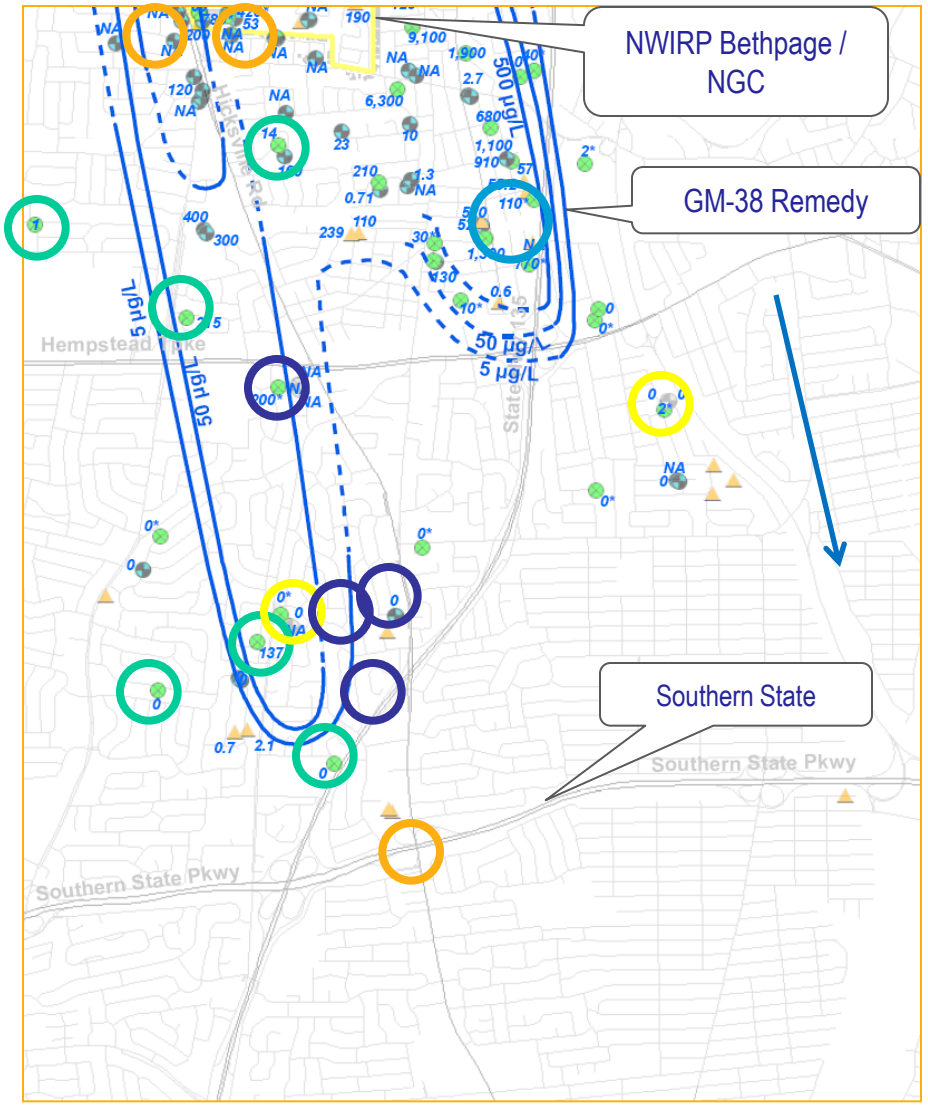
Navy project team has already started implementing higher priority recommendations

1. Installing vertical profile borings and monitoring wells to evaluate containment in deeper portion of the OU-2 aquifer
   - 6 borings in 2009 to delineate boundaries of Western Plume
   - 2 borings and 5 monitoring wells in 2010/ May 2011 for public water supplies
   - 4 borings and 6 monitoring wells planned for 2011/2012 for public water supplies and plume monitoring
   - Borings and wells being evaluated for 2011/2012 for ONCT evaluation
2. Install monitoring wells/clusters midway between leading edge of plume and Massapequa supply wells to monitor plume progress
   - Boring and wells being evaluated for 2011/2012
3. Evaluate technical/economic feasibility of plume containment at current leading edge

Navy will discuss with NYSDEC and NGSC other recommendations.

Navy Bethpage Project Team's Response to Optimization Report -- Lora Fly, Navy RPM

- 2009 VPBs Installed
- 2010/2011 VPBs and Wells Installed
- 2010/2011 VPBs and Wells In progress (6 months)
- 2011/2012 VPBs and Wells Being Evaluated



Questions / Comments