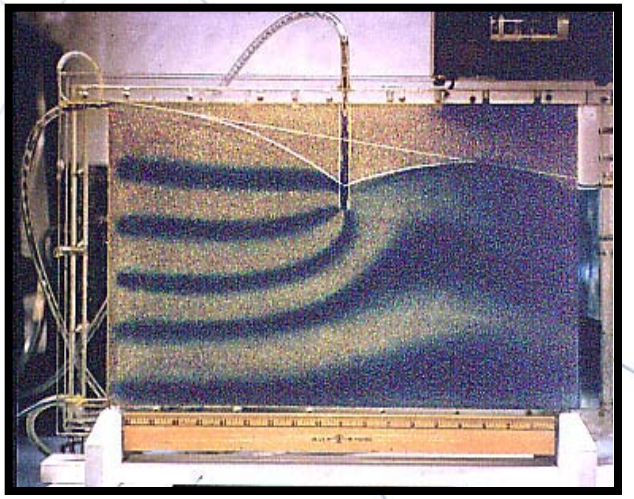
Management Strategies Implemented at Navy Large Dilute Plumes

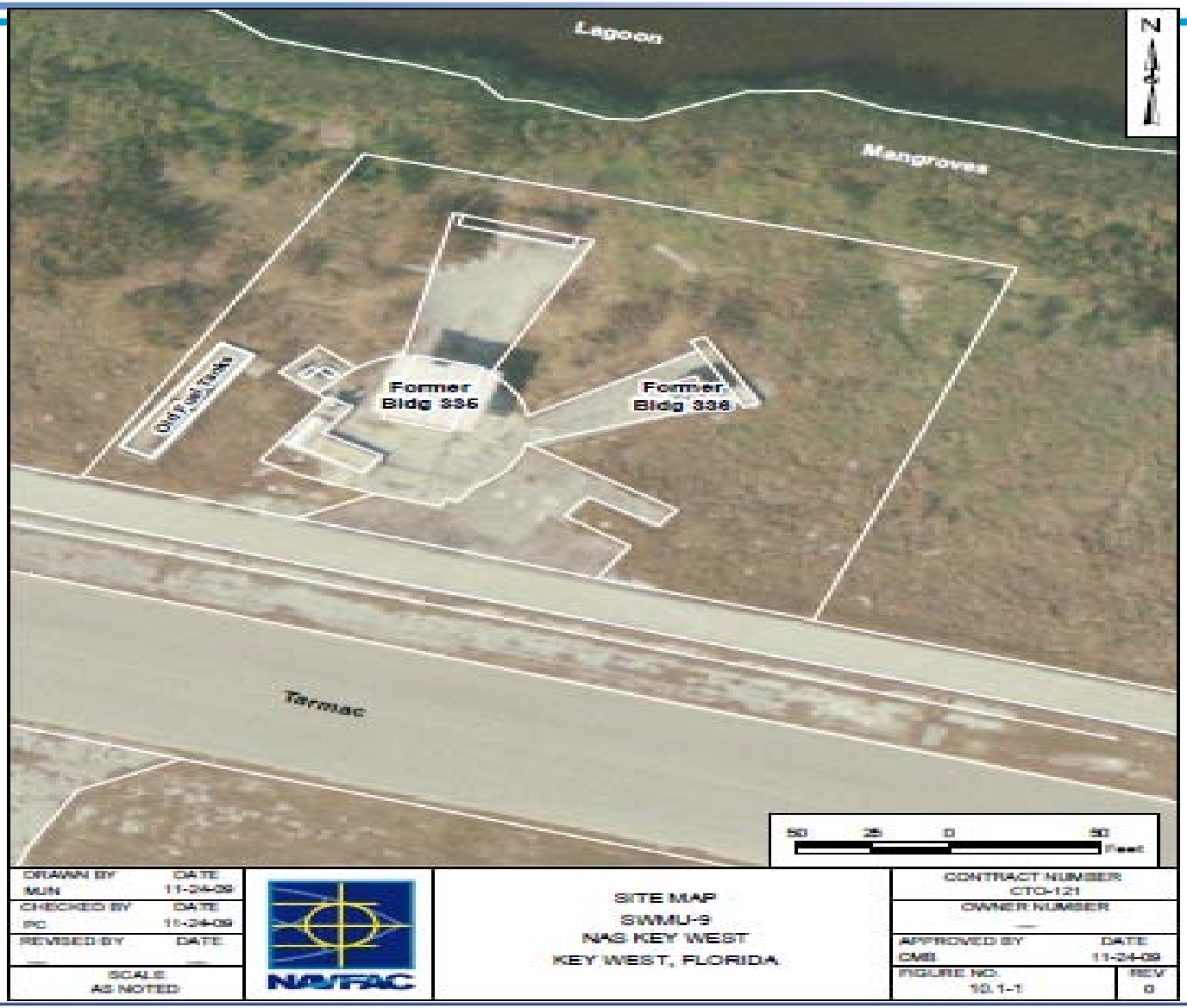


Kenneth Bowers
NAVFAC Atlantic
June 20, 2012

Objectives

- **What is the best overall management approach?**
  - **No unacceptable risk**
- **Three similar sites**
- **3 very different solutions**

Test Engine Cell – SWMU 9



Site History

- **Petroleum and organic solvent used**
- **Removed source**
- **Groundwater plume**
- **Groundwater is non-potable**
  - **Per Florida regulations**

Statement of Basis

- **Human Health Baseline Risk Assessment**
  - **No unacceptable risk**

- **Ecological Risk Assessment**
  - **No unacceptable risk to terrestrial receptors**
  - **Concern that groundwater contaminant migration to surface water could occur and pose unacceptable risk to aquatic receptors**

Statement of Basis

- **Recommended that site groundwater be treated to reduce concentrations of organic compounds, which would reduce the possibility of future site-related risks to aquatic receptors.**

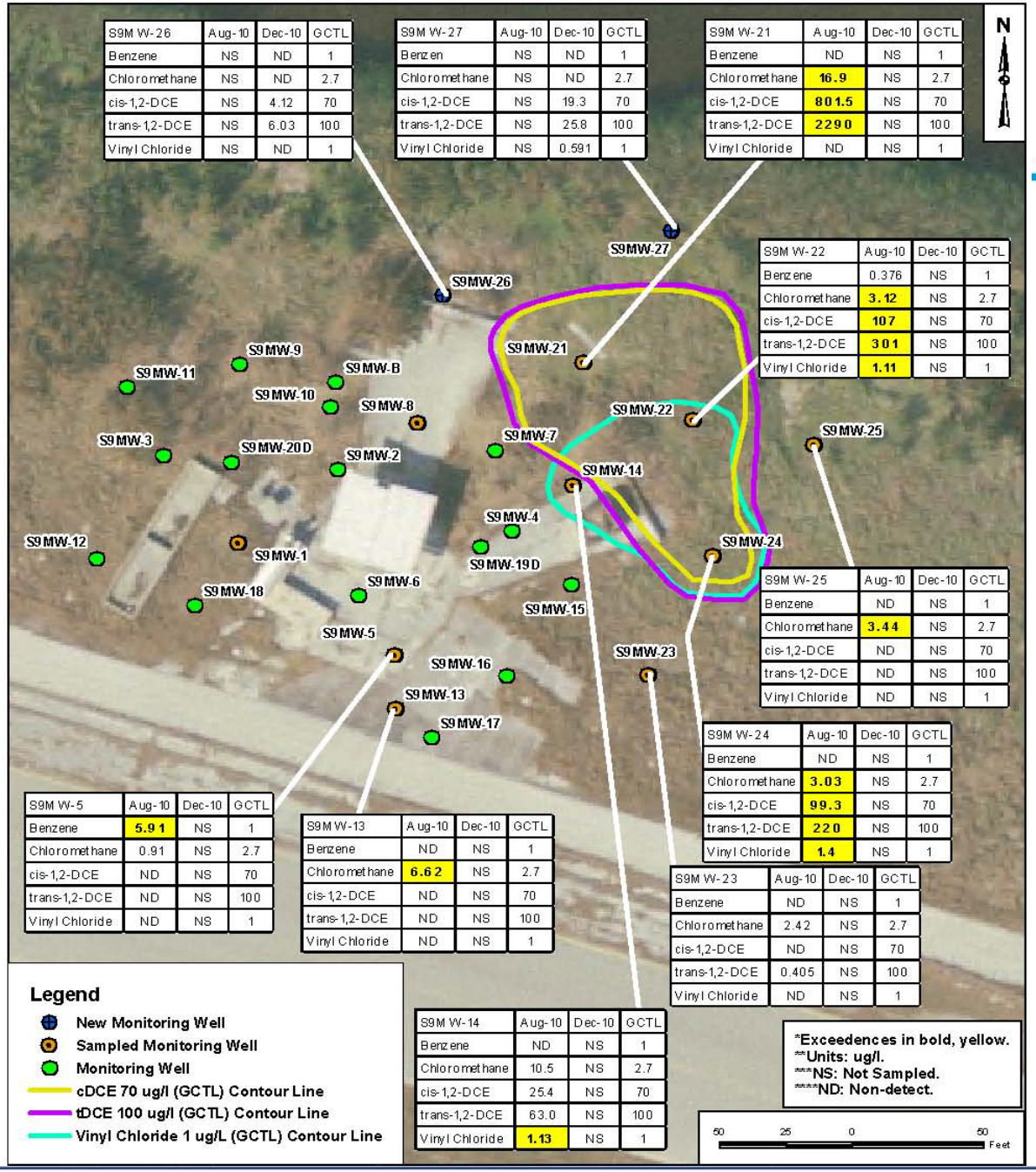
Selected Remedy

- **Interim removal action**
- **Enhanced bioremediation with performance monitoring**
  - **Groundwater treated with Oxygen Releasing Compound (ORC) and Hydrogen Releasing Compound (HRC) in 2001**
- **Review groundwater results after 5 years**

5 Year Review

- **Benzene, Cis and Trans 1,2-DCE and vinyl chloride greater than Florida's Groundwater Cleanup Target Level (GCTL)**

- **Install two additional monitoring wells to further bound the plume**


S9M W-26 | Aug-10 | Dec-10 | GCTL
Benzene | NS | ND | 1
Chloromethane | NS | ND | 2.7
cis-1,2-DCE | NS | 4.12 | 70
trans-1,2-DCE | NS | 6.03 | 100
Vinyl Chloride | NS | ND | 1
S9M W-27 | Aug-10 | Dec-10 | GCTL
Benzen | NS | ND | 1
Chloromethane | NS | ND | 2.7
cis-1,2-DCE | NS | 19.3 | 70
trans-1,2-DCE | NS | 25.8 | 100
Vinyl Chloride | NS | 0.591 | 1
S9M W-21 | Aug-10 | Dec-10 | GCTL
Benzene | ND | NS | 1
Chloromethane | 16.9 | NS | 2.7
cis-1,2-DCE | 801.5 | NS | 70
trans-1,2-DCE | 2290 | NS | 100
Vinyl Chloride | ND | NS | 1
N
S9MW-26
S9MW-27
S9MW-21
S9 MW-9
S9 MW-11
S9 MW-B
S9 MW-10
S9 MW-8
S9 MW-3
S9 MW-20D
S9 MW-2
S9 MW-7
S9 MW-22
S9 MW-25
S9 MW-14
S9 MW-4
S9 MW-12
S9 MW-1
S9 MW-19D
S9 MW-24
S9 MW-6
S9 MW-18
S9 MW-15
S9 MW-5
S9 MW-23
S9 MW-16
S9 MW-13
S9 MW-17
S9M W-22 | Aug-10 | Dec-10 | GCTL
Benzene | 0.376 | NS | 1
Chloromethane | 3.12 | NS | 2.7
cis-1,2-DCE | 107 | NS | 70
trans-1,2-DCE | 301 | NS | 100
Vinyl Chloride | 1.11 | NS | 1
S9M W-25 | Aug-10 | Dec-10 | GCTL
Benzene | ND | NS | 1
Chloromethane | 3.44 | NS | 2.7
cis-1,2-DCE | ND | NS | 70
trans-1,2-DCE | ND | NS | 100
Vinyl Chloride | ND | NS | 1
S9M W-24 | Aug-10 | Dec-10 | GCTL
Benzene | ND | NS | 1
Chloromethane | 3.03 | NS | 2.7
cis-1,2-DCE | 99.3 | NS | 70
trans-1,2-DCE | 220 | NS | 100
Vinyl Chloride | 1.4 | NS | 1
S9M W-23 | Aug-10 | Dec-10 | GCTL
Benzene | ND | NS | 1
Chloromethane | 2.42 | NS | 2.7
cis-1,2-DCE | ND | NS | 70
trans-1,2-DCE | 0.405 | NS | 100
Vinyl Chloride | ND | NS | 1
S9M W-5 | Aug-10 | Dec-10 | GCTL
Benzene | 5.91 | NS | 1
Chloromethane | 0.91 | NS | 2.7
cis-1,2-DCE | ND | NS | 70
trans-1,2-DCE | ND | NS | 100
Vinyl Chloride | ND | NS | 1
S9M W-13 | Aug-10 | Dec-10 | GCTL
Benzene | ND | NS | 1
Chloromethane | 6.62 | NS | 2.7
cis-1,2-DCE | ND | NS | 70
trans-1,2-DCE | ND | NS | 100
Vinyl Chloride | ND | NS | 1
S9M W-14 | Aug-10 | Dec-10 | GCTL
Benzene | ND | NS | 1
Chloromethane | 10.5 | NS | 2.7
cis-1,2-DCE | 25.4 | NS | 70
trans-1,2-DCE | 63.0 | NS | 100
Vinyl Chloride | 1.13 | NS | 1
Legend
New Monitoring Well
Sampled Monitoring Well
Monitoring Well
cDCE 70 ug/l (GCTL) Contour Line
tDCE 100 ug/l (GCTL) Contour Line
Vinyl Chloride 1 ug/L (GCTL) Contour Line
*Exceedences in bold, yellow.
**Units: ug/l.
***NS: Not Sampled.
****ND: Non-detect.
50 25 0 50
Feet

Cleanup Target Levels

- **Florida Groundwater Cleanup Target Levels (GCTLs)**
- **The concern, as outlined in the Statement of Basis, was to aquatic receptors**
  - **Marine Surface Water Criteria is the proper criteria for evaluation per the site model under F.A.C.**

Comparison

Analyte	Primary Groundwater Criteria 62-550	Marine Surface Water Criteria 62-777 62-302
Benzene	1 ppb	71.3 ppb
Cis-1,2-DCE	70 ppb	NA
Trans-1,2-DCE	100 ppb	11,000 ppb
Vinyl Chloride	1 ppb	2.4 ppb

Conclusion

- **The selected remedy has been successful**
- **The enhanced bioremediation has reduced site contaminant concentrations and also the risk to aquatic receptors**
- **Current data**
  - **Below Marine Surface Water Criteria**

Recommendations

- **Propose Risk Management Option Level II – No Further Action with institutional controls**

Results

Before

12 Monitoring wells – Annually since 2000

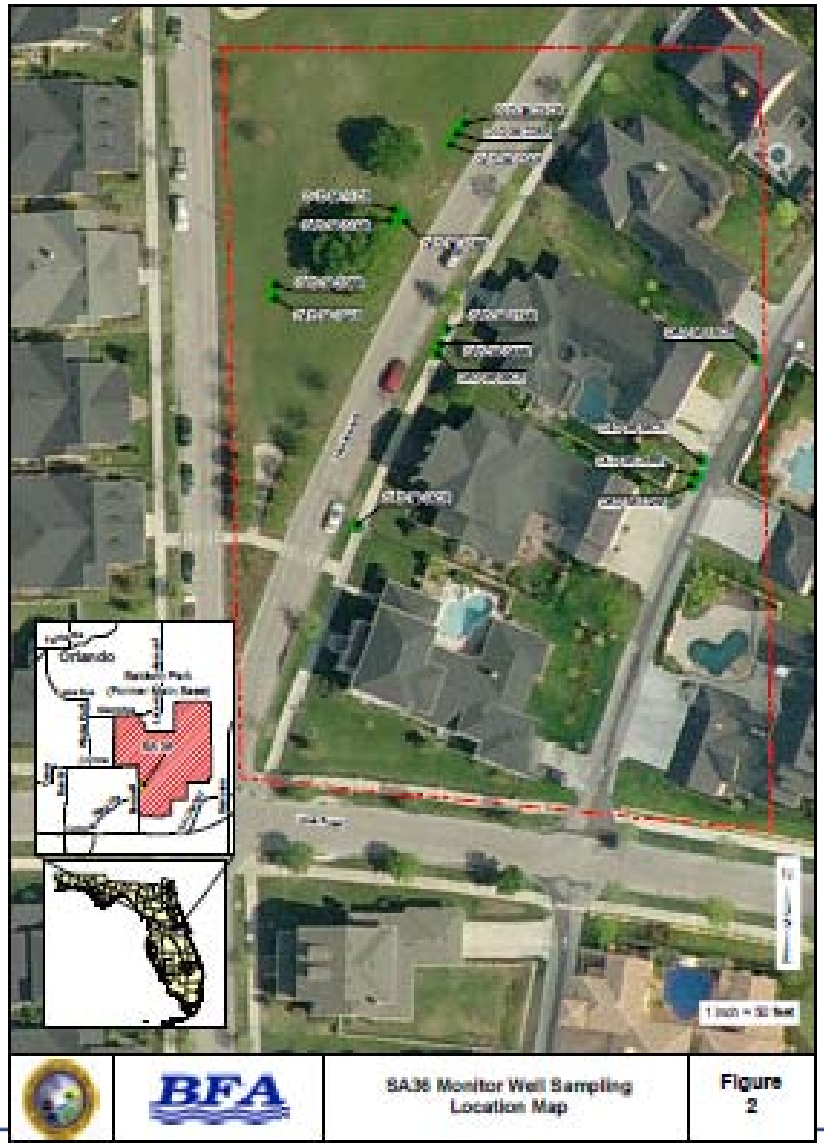
VOCs – 8260

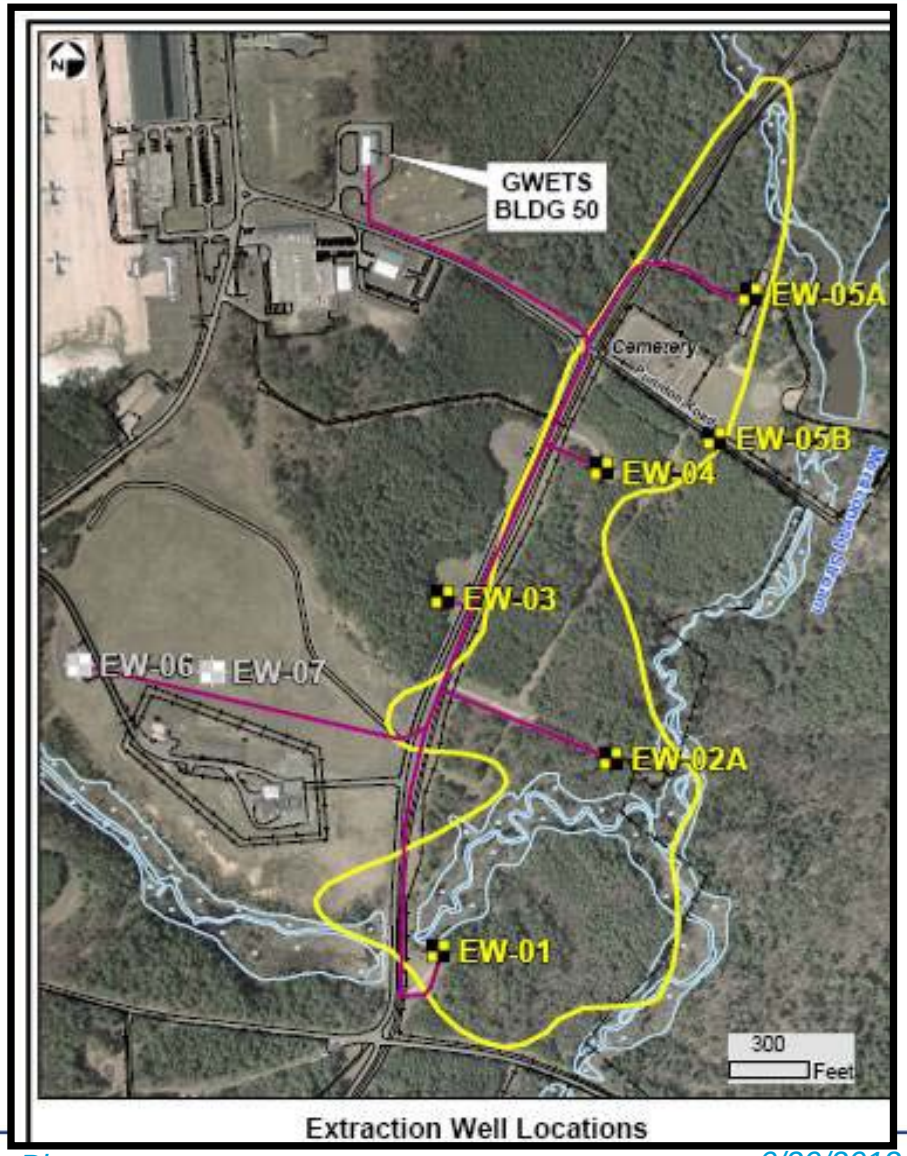
TAL metals

After

No Further Action!!

Two Navy Sites – Florida and Maine





Similarities

- Dilute plumes
- No unacceptable risk from groundwater
  - Land Use Controls
- Source has been removed
- Historically active remediation to treat plume
- Currently above ARARs

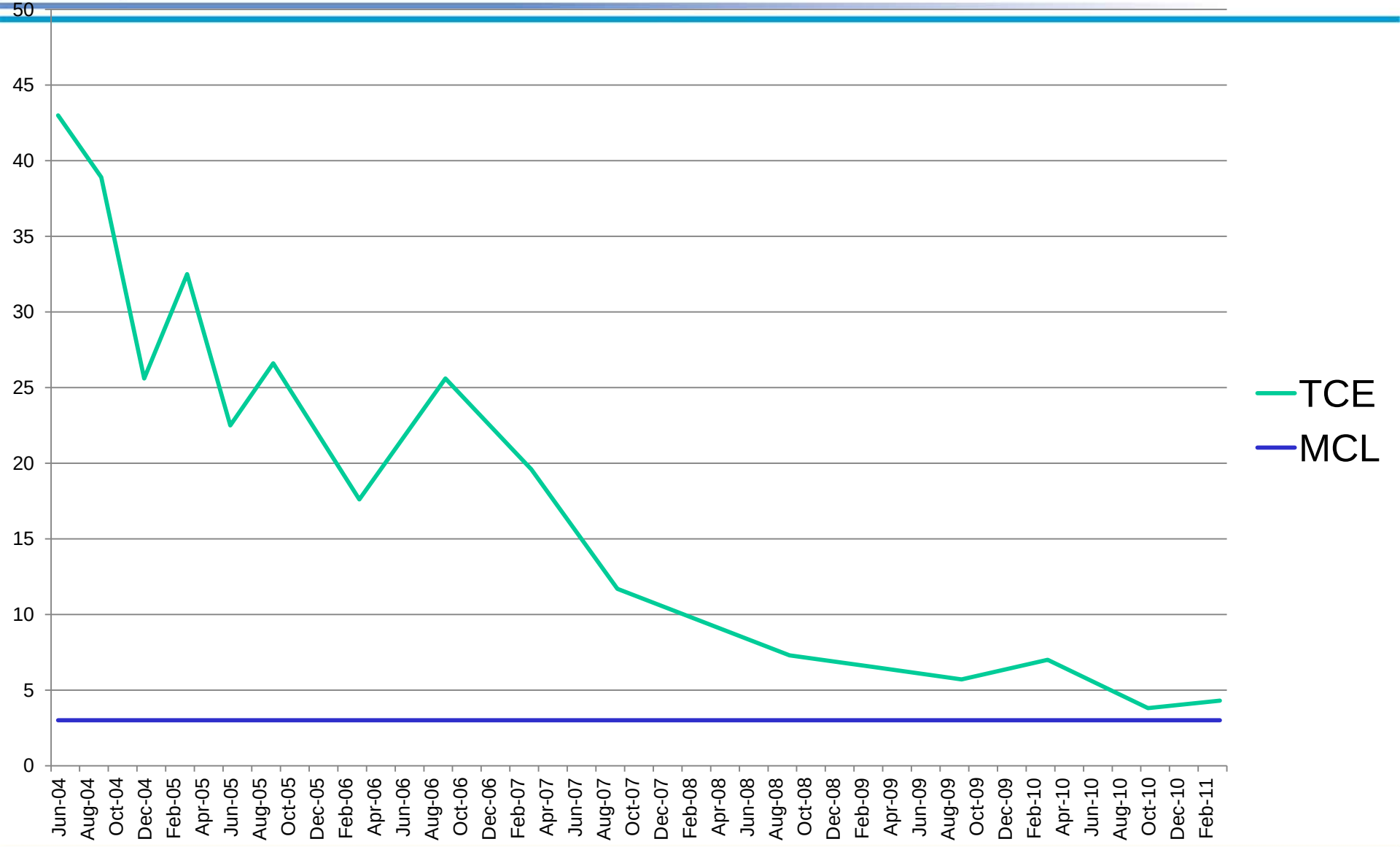
Differences

- **Location – Florida and Maine**
- **Plume migration**
  - **Stationary - Florida**
  - **Surface water discharge - Maine**
- **Maine Stakeholders have more concerns**
- **Selected remedies**
  - **MNA – Florida**
  - **P&T - Maine**

Florida Site

- **Land Use Controls preventing exposure to groundwater**
  - **–No unacceptable risk**
- **Monitored Natural Attenuation**
  - **–Stakeholder concern – minimal**
  - **–Effectiveness**
    - Showing a downward trend

TCE Concentration - Florida



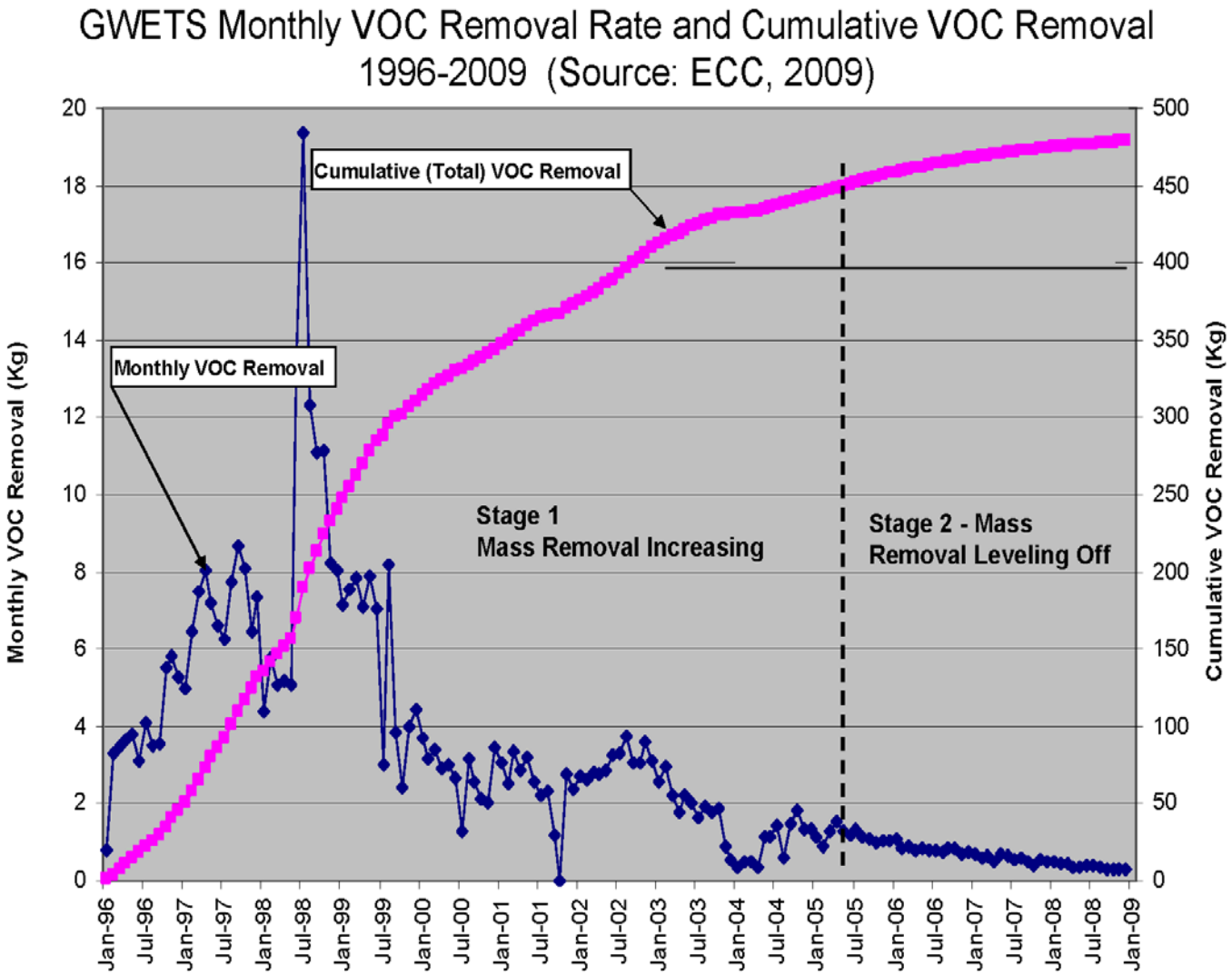
Maine Site

- **Dilute plume**

- **Land Use Controls preventing exposure to groundwater**
  - **No unacceptable risk**
- **Surface water**
  - **Below surface water criteria**
  - **No unacceptable risk**

- **Pump and Treat**
  - **Stakeholder concern – high**
  - **Effectiveness?**
    - Faster in theory
    - Treating “clean” water
    - Contaminant removal vs. costs

Pump and Treat Results



Cost per Gallon

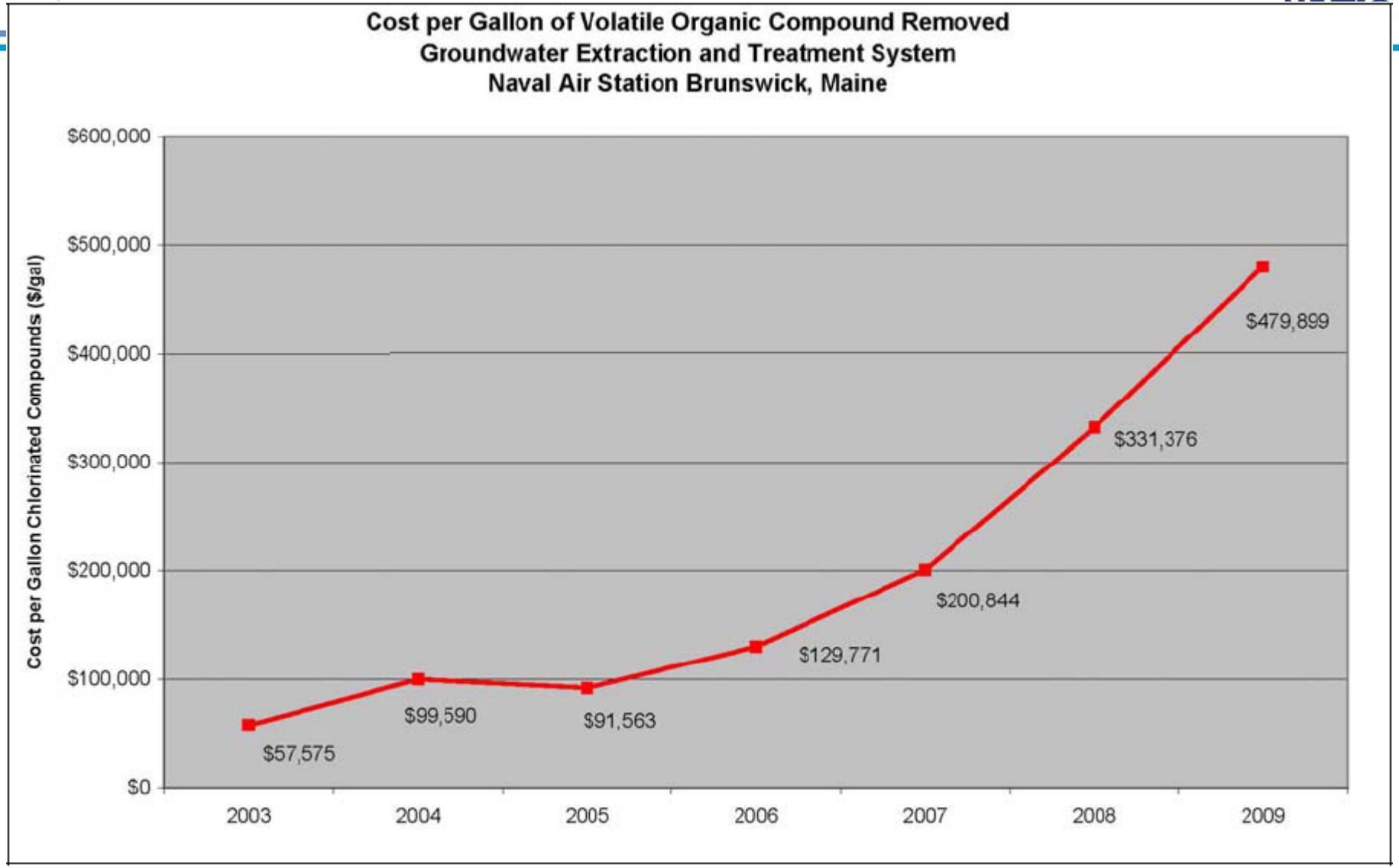


Figure 10. Cost Increase over Time Due to Reduced VOC Concentrations (ECC, 2009c)

Treatment Issues

- **High costs and technical difficulties involved in treating large volumes of water dispersed over large areas**
- **Sometimes plumes are too deep for cost-effective containment (no PRBs)**
- **Concentrations will exceed standards for a long time with or without treatment and may not be significantly different**
- **Much of the contaminant mass within some plumes can be in relatively immobile forms, resulting in low but persistent concentrations even long after the source is removed**
- **Control of the geochemical environment over an entire plume can be very difficult and expensive**

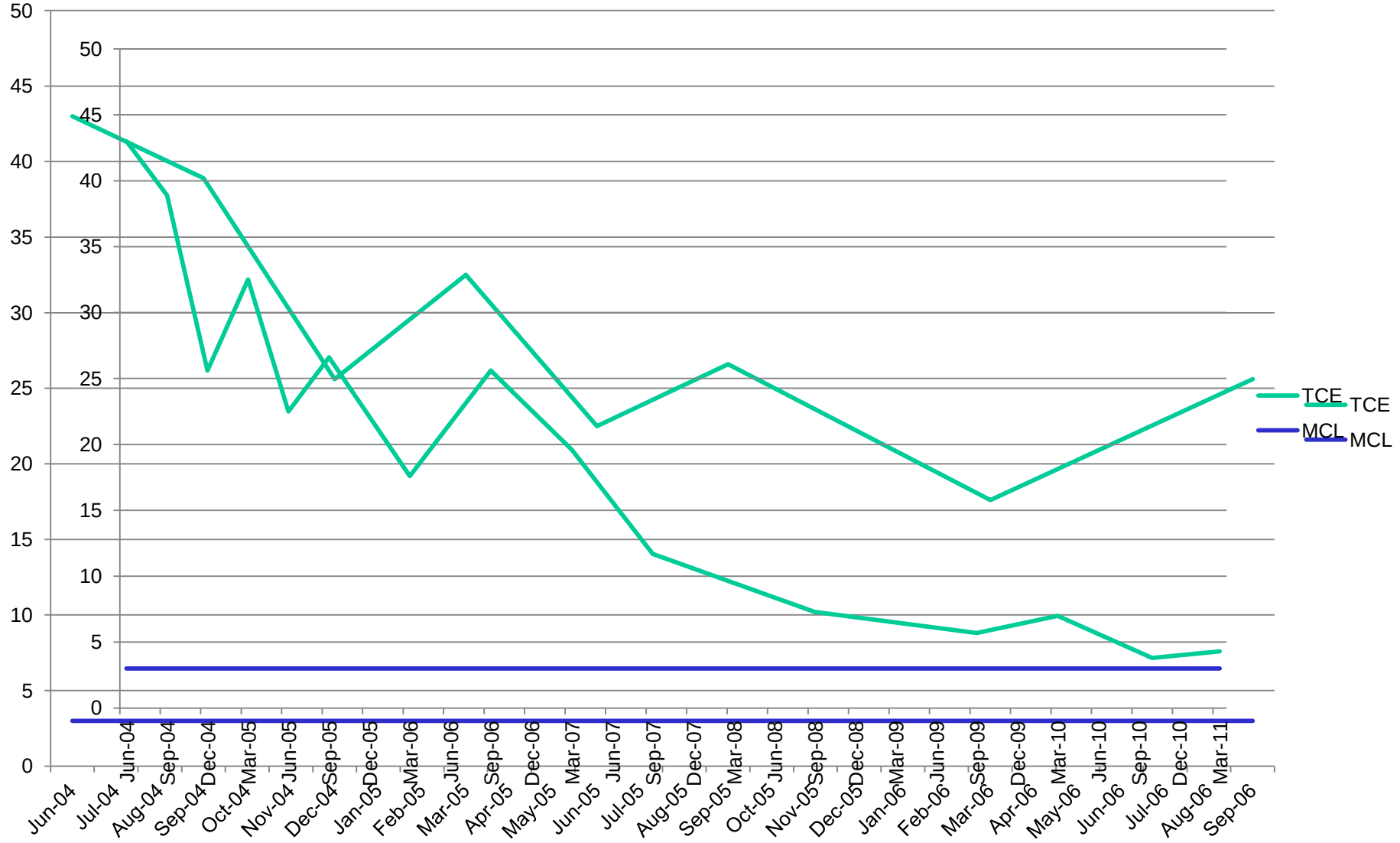
Issues

- **Develop a consistent approach for dilute plumes**
  - **No unacceptable risk**

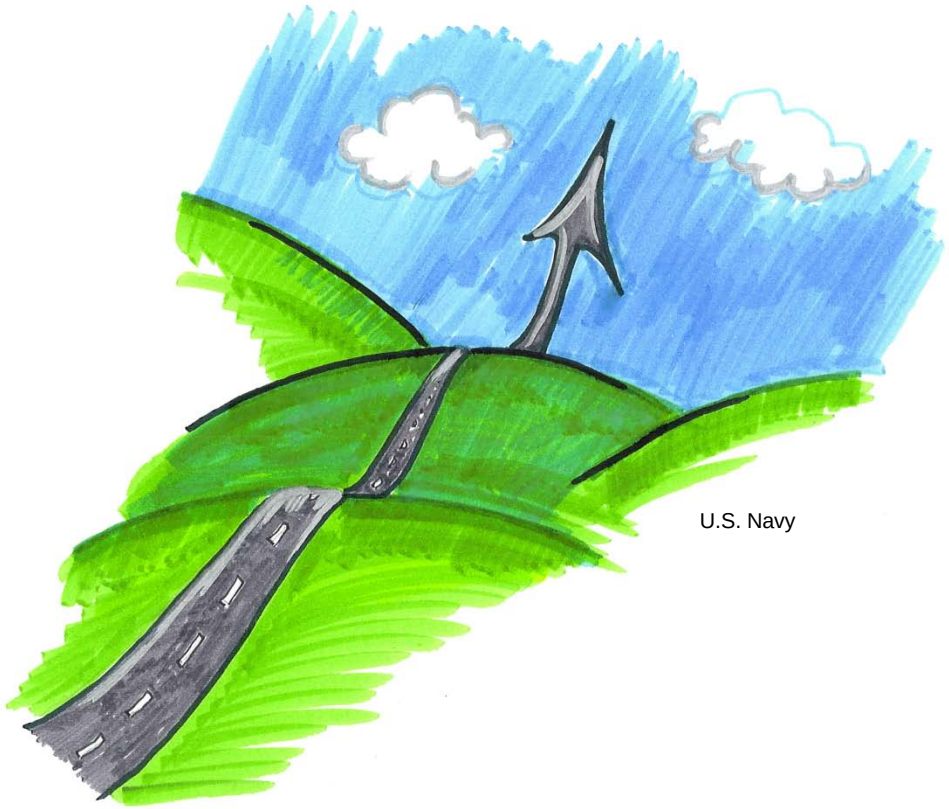
- **Some states consider all groundwater drinking water**
  - **Must show progress towards MCLs**
  - **What does "progress" mean?**
  - **We need a long term perspective**
  - **Attenuation often has peaks and valleys**
  - **Not a linear relationship**
  - **Resist temptation for active remediation**
    - No unacceptable risk

- **Stakeholder pressure for active remediation**
  - **What has been gained if still above MCLs?**

What is Your Perspective?



On the Right Road



U.S. Navy