

# Arsenic & Old Landfills

## What we have learned from post-closure groundwater monitoring at inactive landfills in NY State

Presented by Steven Parisio of NYSDEC

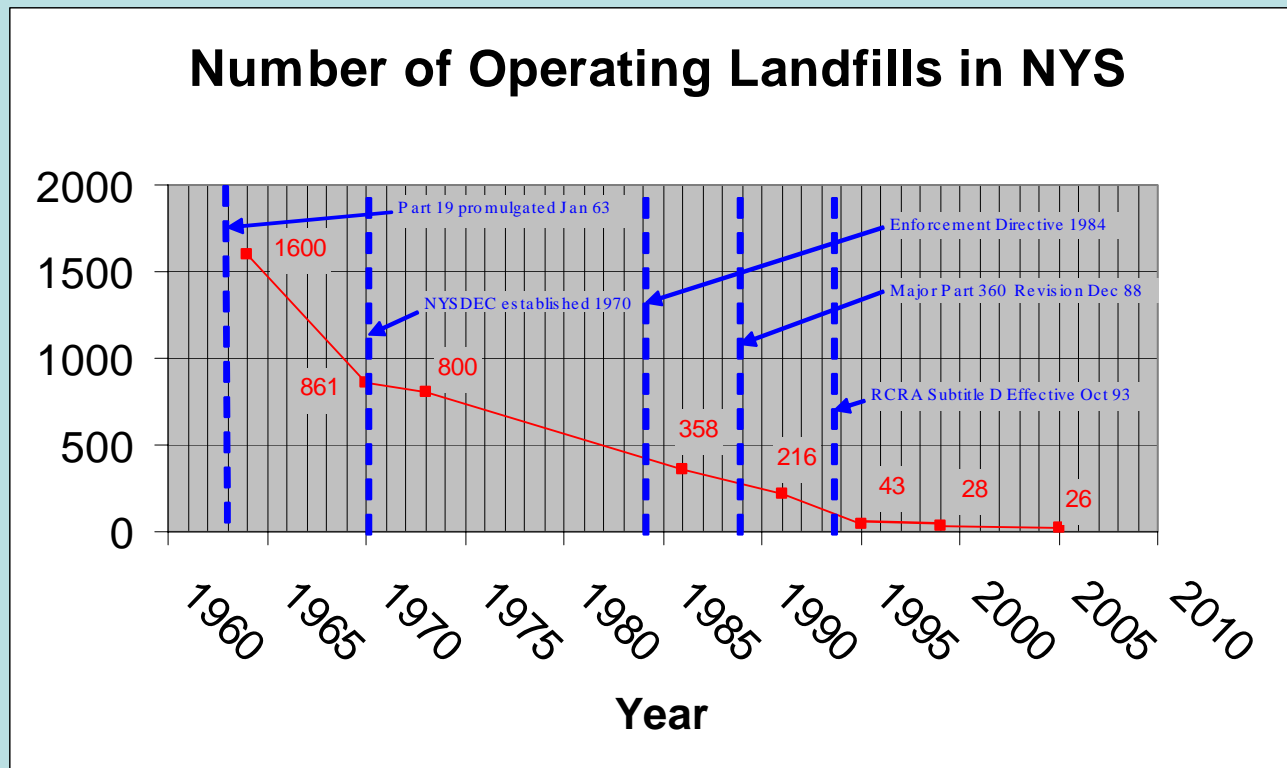
at the SBRP Workshop on

*Arsenic and Landfills: Protecting Water Quality*

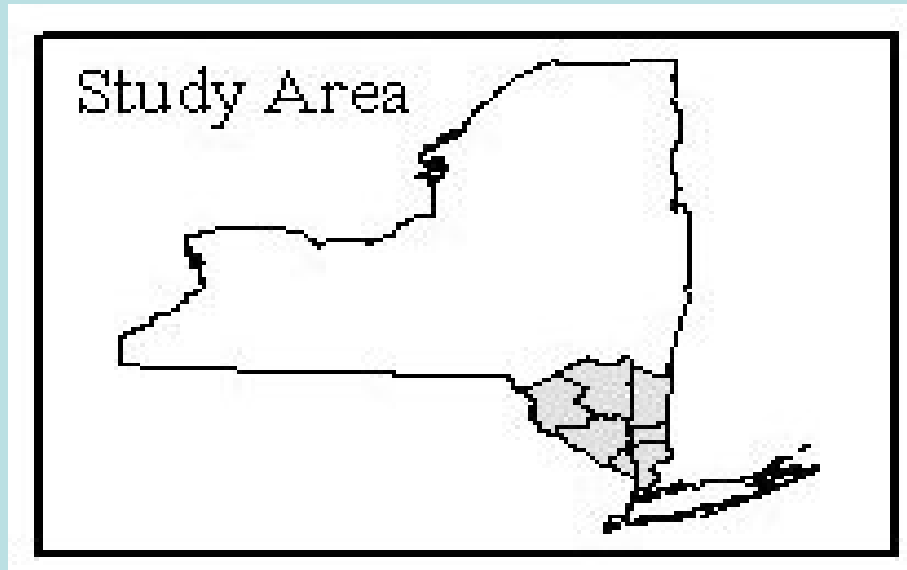
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# Where have all the Landfills Gone ?



**Due to actions taken by the NYSDEC and other factors, the number of operating landfills in NY State has decreased from about 1600 in 1964 to 26 in 2005. Most of these now inactive landfills are unlined and may be adversely impacting groundwater quality. In general, only those closed as a result of the enforcement action starting in the mid-1980s have engineered caps and groundwater monitoring wells. The majority are unlined, inadequately capped and unmonitored.**



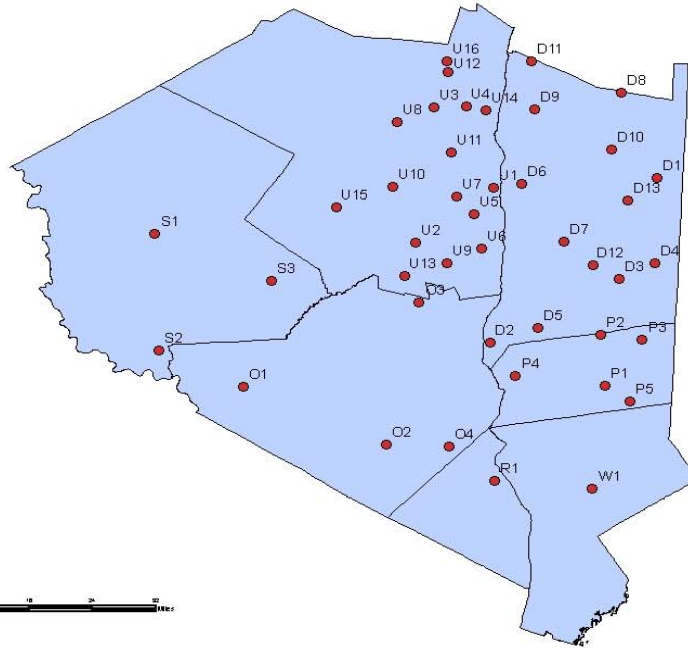
The Region 3 Office of the New York State Department of Environmental Conservation administers seven counties in the lower Hudson Valley of southeastern NY State.

Within this area, there are about 200 inactive landfills and approximately 50 sites with engineered caps and groundwater monitoring programs.

Region 3 Ground Water Quality Monitoring Sites

Monitored Sites

- D1 Harlem Valley
- D2 Bescon
- D3 Beekman
- D4 Dover
- D5 Fishkill / East Fishkill
- D6 Hyde Park
- D7 James Baird Park
- D8 Fine Plains
- D9 Rhinebeck
- D10 Stanford
- D11 Tivoli
- D12 Union Vale
- D13 Washington
- O1 Greenville
- O2 Mumroe
- O3 Montgomery
- O4 Youmans Flats
- P1 Carmel
- P2 Kent
- P3 Patterson
- P4 Phillipstown
- P5 Southeast
- R1 Haverstraw
- S1 Bethel
- S2 Lumberland
- S3 Mamakating
- U1 Esopus
- U2 Gardiner
- U3 Hurley
- U4 Jockey hill
- U5 Lloyd
- U6 Marlborough
- U7 New Paltz
- U8 Olive
- U9 Plattekill
- U10 Rochester
- U11 Rosendale
- U12 Saugerties
- U13 Shawangunk
- U14 Ulster
- U15 Wawarsing
- U16 Woodstock
- W1 Mount Kisco



Based on data derived from DEC Master Habitat Database  
 Btl P arco 5/10/06



At the Region 3 Office, groundwater quality monitoring data was compiled for 42 sites. This data was collected by private environmental consulting firms and submitted on behalf of the landfill operators which were primarily municipalities.

# Elements of a Typical Landfill Groundwater Monitoring Program

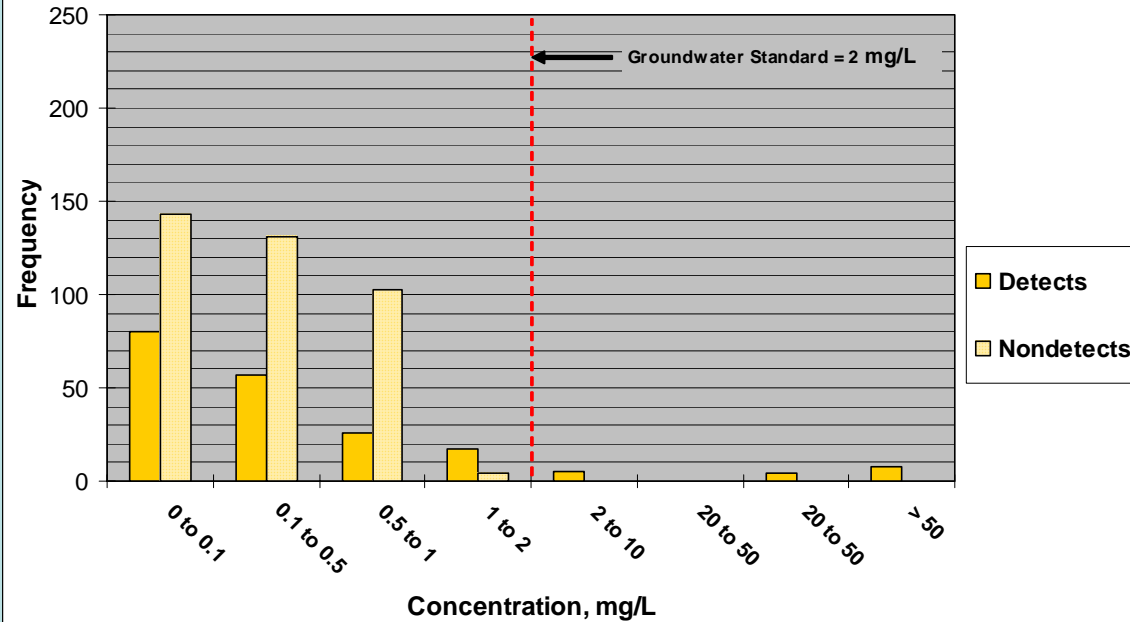
- 1 or 2 upgradient wells
- 3 to 8 downgradient wells
- 10 to 25 rounds of sampling completed
- Analysis includes 21 routine parameters, 39 baseline parameters (not counting VOCs)
- This translates into thousands of individual measurements per site



Ammonia is considered to be the best overall indicator of water quality impact attributable to unlined municipal solid waste landfills. These graphs were made by pooling data from upgradient (top slide) and downgradient (lower slide) monitoring wells at 42 unlined MSW landfills. Ammonia exceeds the standard in about 3 % of the upgradient samples and in 54 % of downgradient samples. (The lighter colored bars represent non-detects which are assigned a numeric value equal to the lab reporting limit.)

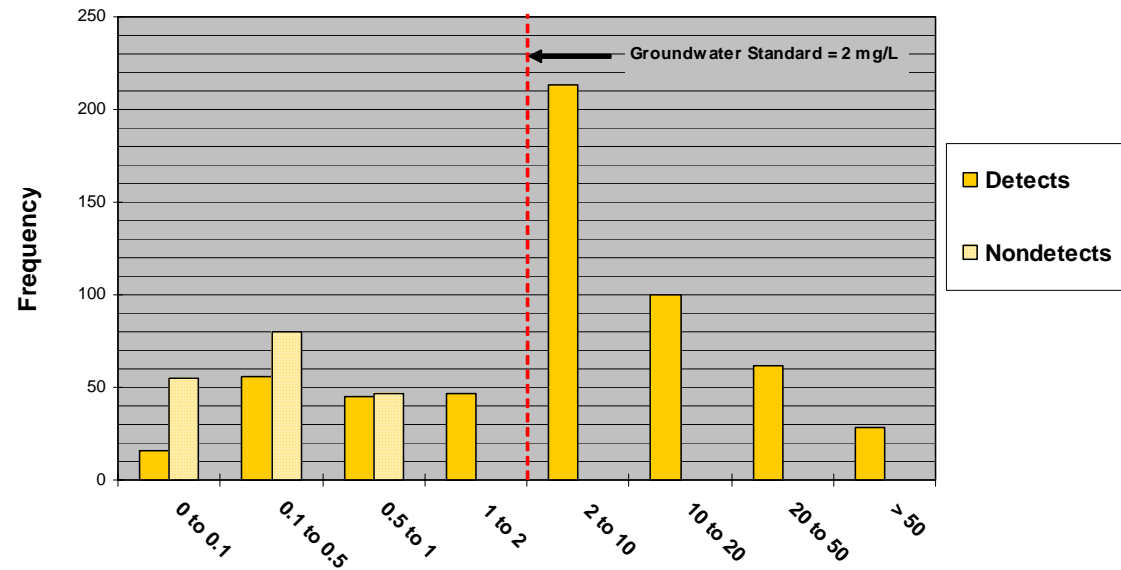
### Upgradient Ammonia Concentrations

(Based on 578 measurements)



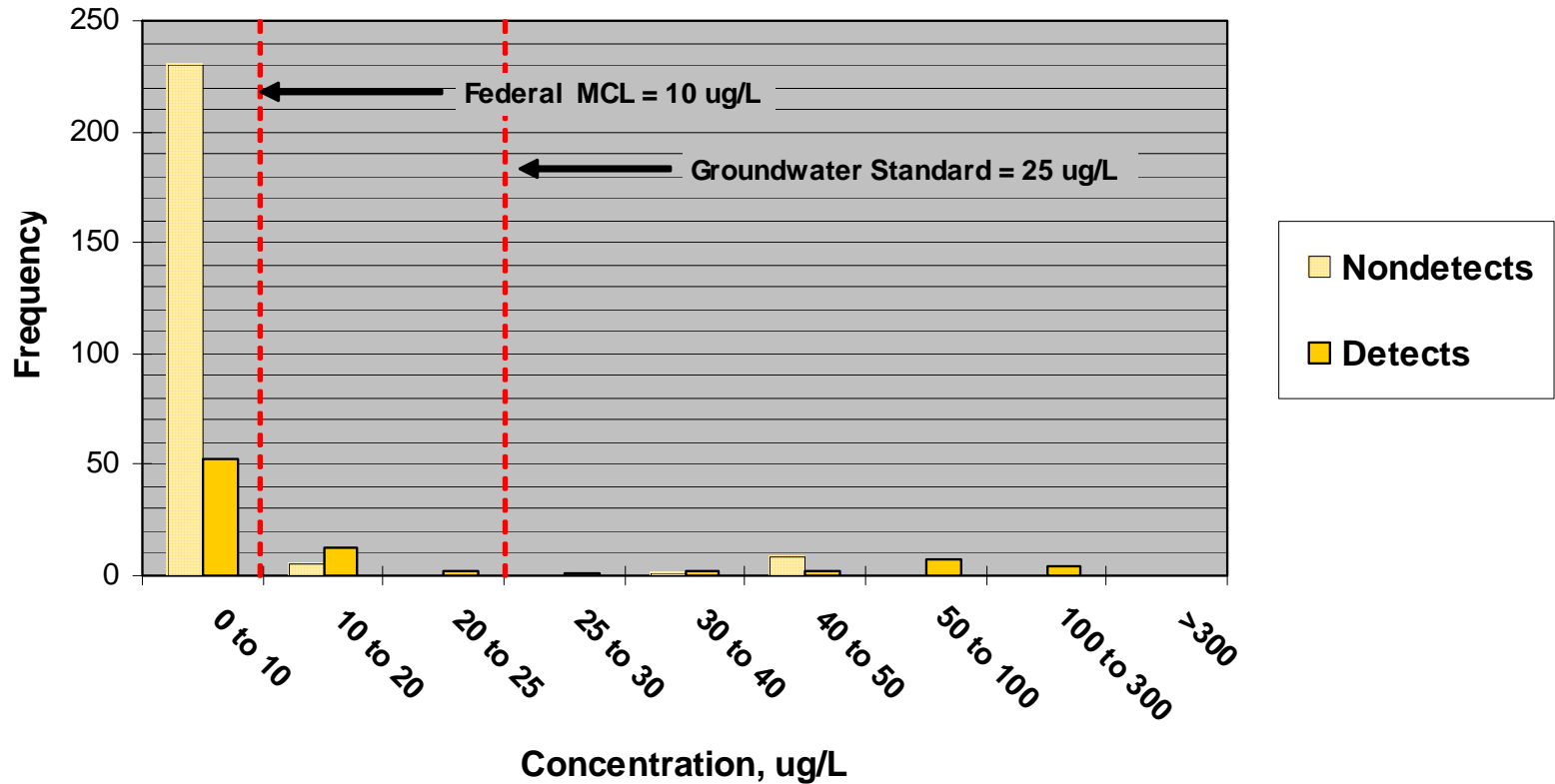
### Downgradient Ammonia Concentrations

(Based on 749 measurements)



## Upgradient Arsenic Concentrations

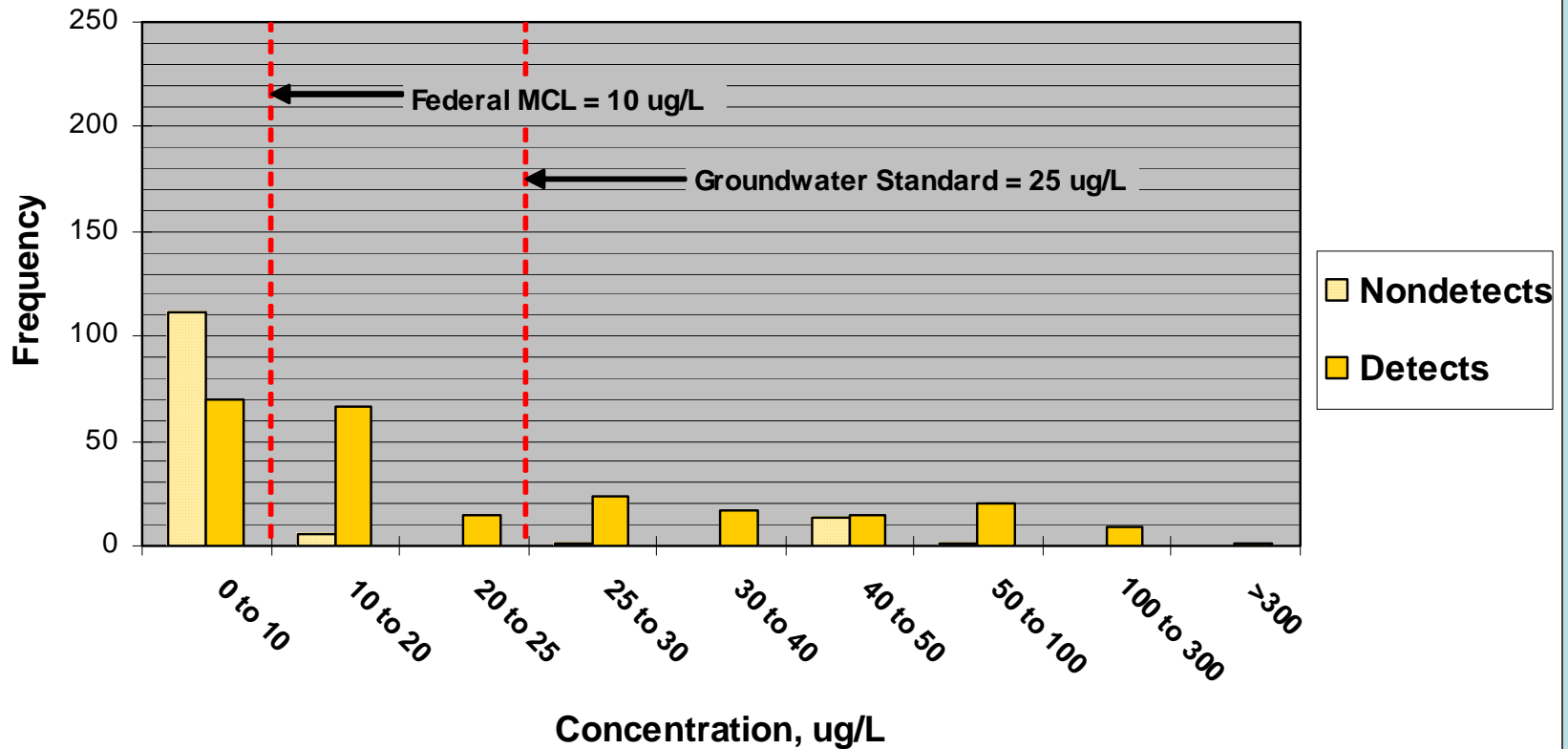
(Based on 326 measurements)



**In the case of background arsenic, most of the data are non-detects with reporting limits at or below the federal MCL. About 7 % of the data exceed the federal MCL.**

## Downgradient Arsenic Concentrations

(Based on 371 measurements)



**By contrast, data collected in downgradient monitoring wells show arsenic at levels which exceed the federal MCL about 50 % of time.**



How prevalent is elevated arsenic as a characteristic of background groundwater quality ?

At 3 out of 42 monitored landfill sites (7%), the median upgradient concentration of arsenic exceeds the federal MCL for drinking water (10 ug/L).

# How prevalent is elevated arsenic as a component of landfill-derived groundwater contamination ?

At 19 of the 42 monitored sites (45%), the median downgradient arsenic concentration exceeds the federal MCL for drinking water (10 ug/L).

Can arsenic contamination in groundwater downgradient of inactive landfills pose a threat to public health ?

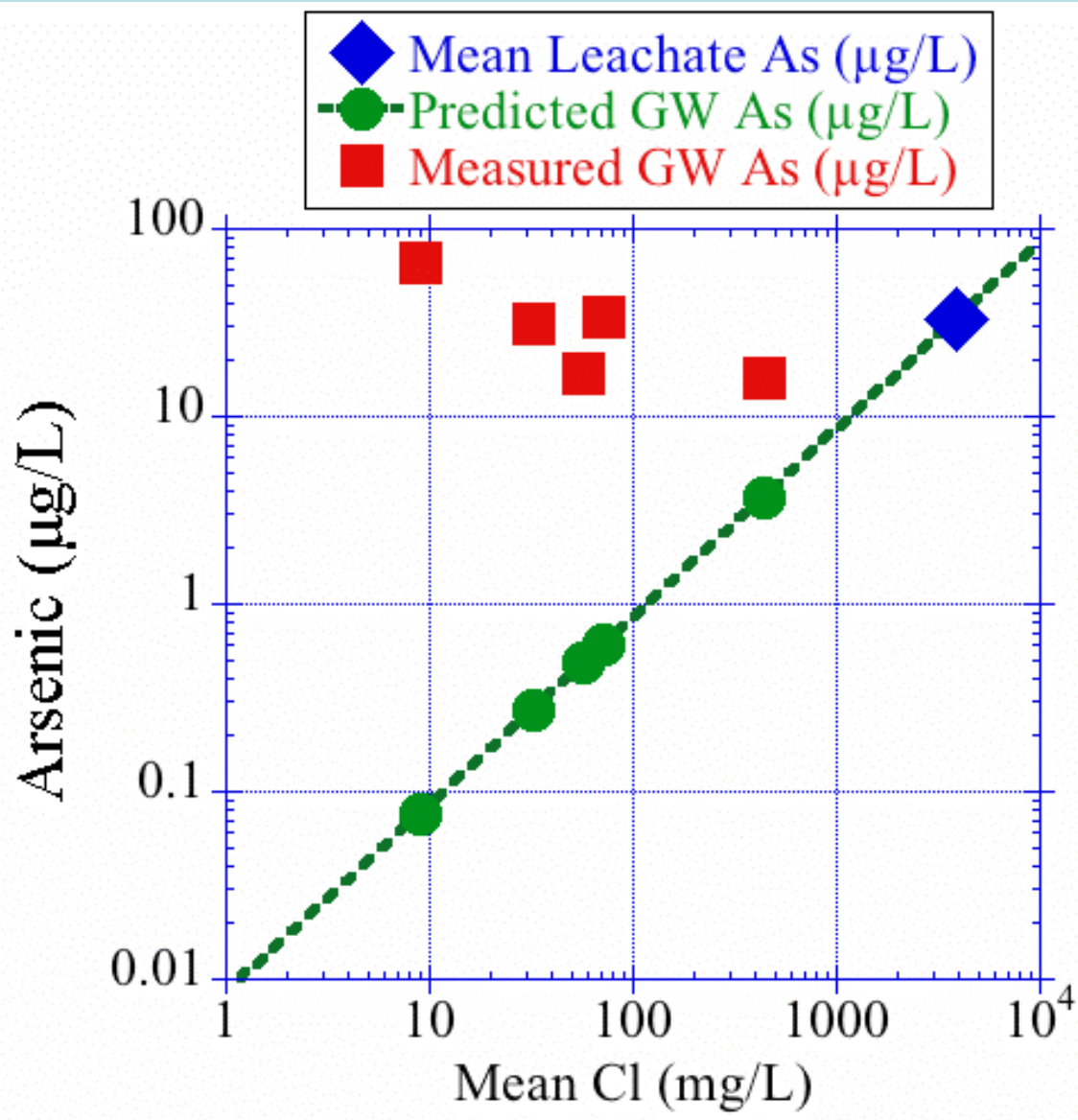


**2001 Orthophoto of Saugerties Landfill (width of frame is 0.5 miles) The blue arrow shows the direction of groundwater flow. The yellow arrow points to an arsenic-contaminated residential water supply well. A corrective measures assessment was required resulting in replacement of the residential water supply well. (Other wells in the subdivision have shown elevated leachate indicators such as iron, manganese and/or total dissolved solids.)**

## Does arsenic in leachate-impacted groundwater originate within the landfill as a constituent of leachate ?

At the Al Turi Landfill, in Orange County NY: Mean concentration of chloride in leachate is 3914 mg/L Mean concentration of arsenic in leachate is 33 ug/L				
Monitoring Wells:	MW-6s	MW-17s	MW-28s	MW-9s
Mean concentration of chloride in GW, mg/L	9.0	32.5	71.4	72.1
Dilution Factor leachate/GW:	436	120	55	54
Predicted arsenic concentration based on arsenic concentration in leachate divided by DF, ug/L	0.076	0.27	0.60	0.61
Actual mean arsenic concentration in GW, ug/L:	66	31	34	34

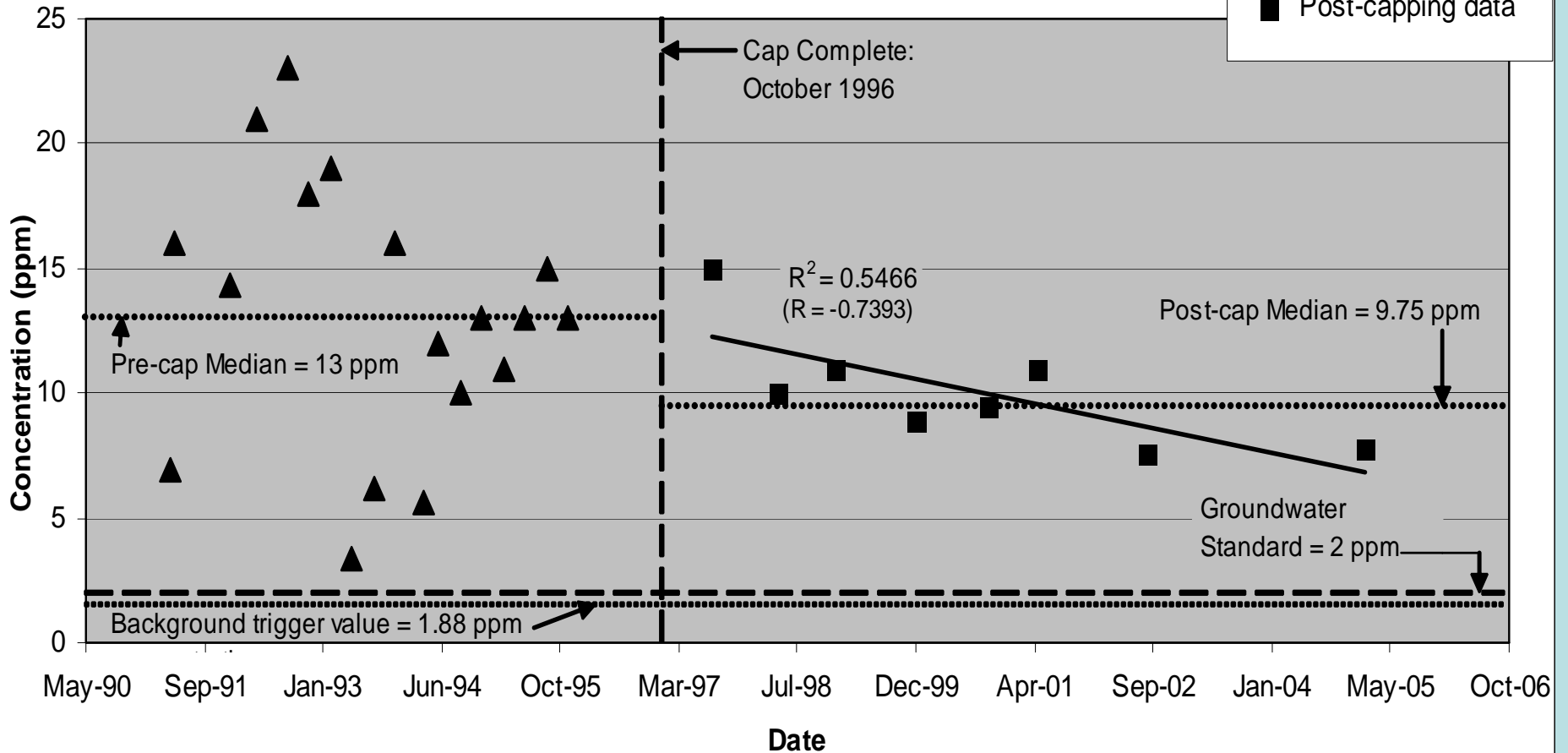
**This example, using leachate and groundwater monitoring data from the Al Turi Landfill, shows that the concentrations of arsenic observed in leachate-impacted groundwater are too high to be explained by leaching of arsenic from wastes disposed of in the landfill.**



This figure, prepared by Steve Chillrud of LDEO, is based on the data from the previous table and shows graphically how, at the Al Turi Landfill, the concentration of arsenic in leachate impacted-groundwater is consistently higher than what would be predicted if the source was limited to leaching from arsenic-bearing wastes which were disposed of in the landfill.

# Hurley Landfill, Ammonia in Downgradient Groundwater

- ▲ Pre-capping data
- Post-capping data



**This slide shows an example from an evaluation of landfill cap effectiveness which is just underway. In this case, there is an apparent improving trend with respect to ammonia after installation of the cap. Such trends will be more difficult to evaluate in the case of arsenic because there is less data (annual rather than quarterly monitoring) and more uncontrolled sources of variability (redox and turbidity sensitive parameter).**

# Arsenic-related Efforts

## Contemplated or Underway

- Use available data to evaluate the effectiveness of landfill caps in mitigating groundwater contamination (including arsenic) downgradient of unlined landfills.
- Evaluate the potential impact of arsenic-containing iron flocs on wildlife and wildlife habitat.
- Identify potentially at risk residential water supply wells downgradient of inactive unlined landfills and coordinate with NYSDOH to develop a testing program.
- Characterize contaminant levels (including arsenic) in C&D debris which is proposed for beneficial use.
- Revise NYS Solid Waste Management Facilities Regulations to provide increased focus on arsenic by increasing the required frequency of monitoring in groundwater and by adding a requirement for sampling iron flocs in surface waters downgradient of landfills.