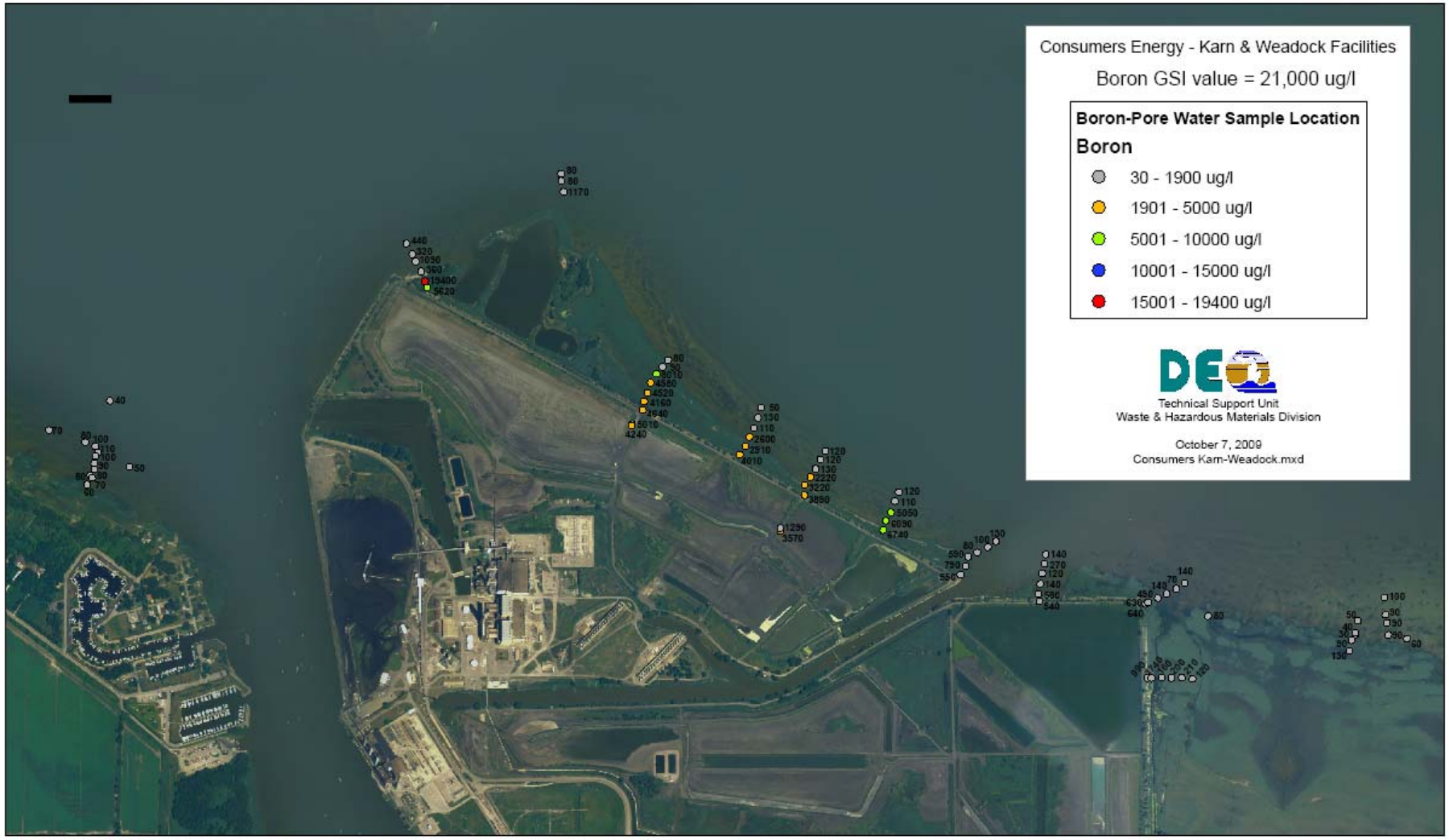
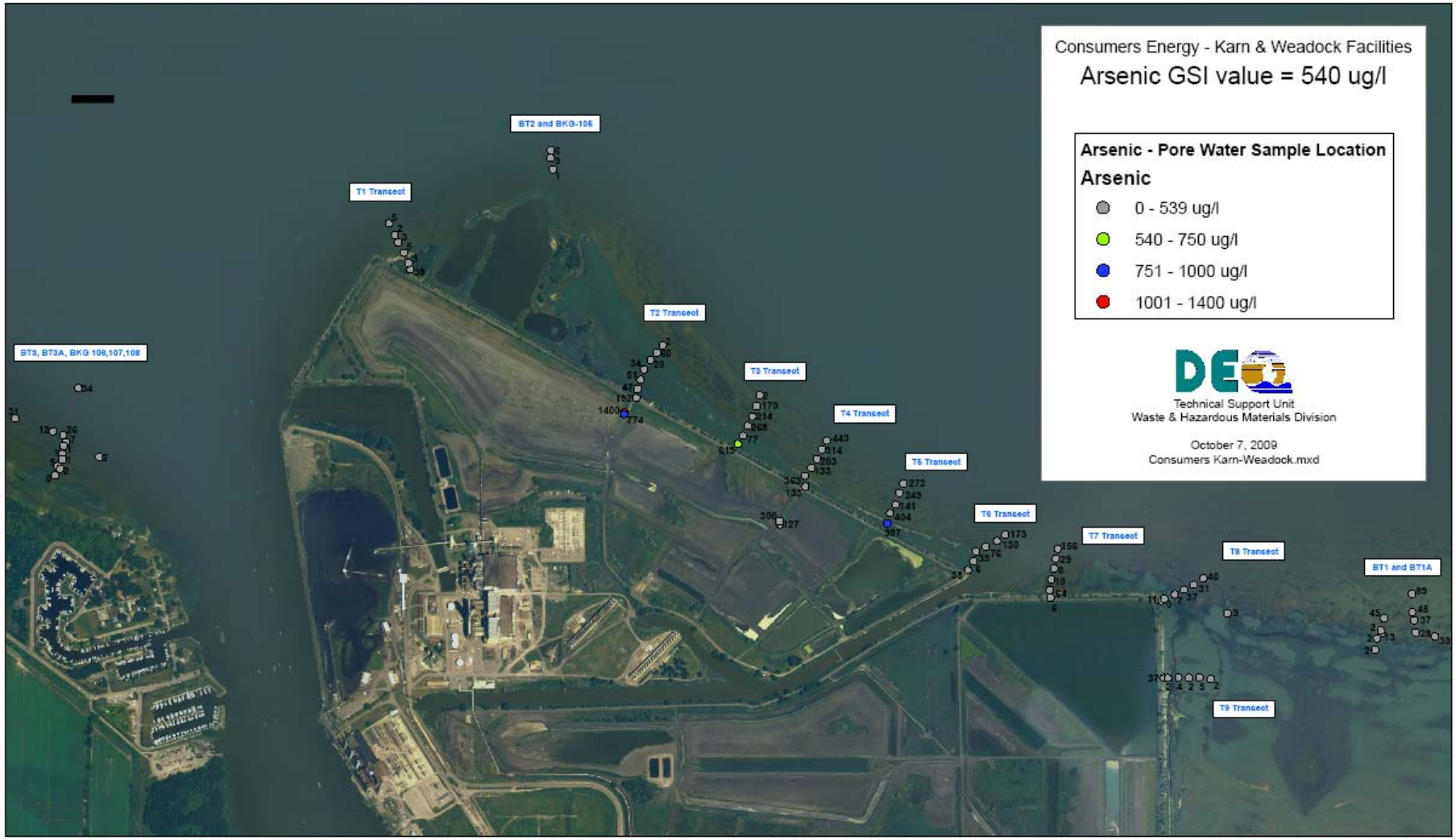
GSI Mixing Zone Monitoring

- Monitoring performed at the GSI for Boron, Arsenic, Phosphorus and Mercury.
- During GW Investigation: Boron ranged from 30 to 19400 µg/l. Highest results near Transect 1 which is also near the Karn berm and the mouth of Saginaw River
- The mixing zone criteria for boron is 21,000 µg/l for Saginaw Bay.


Consumers Energy - Karn & Weadock Facilities
Boron GSI value = 21,000 ug/l
Boron-Pore Water Sample Location
Boron
30 - 1900 ug/l
1901 - 5000 ug/l
5001 - 10000 ug/l
10001 - 15000 ug/l
15001 - 19400 ug/l
DEQ
Technical Support Unit
Waste & Hazardous Materials Division
October 7, 2009
Consumers Karn-Weadock.mxd

GSI Mixing Zone Monitoring

- Arsenic mixing zone criteria calculated at 540 µg/l.
- Arsenic ranged from ND to 1400 µg/l in groundwater and leachate. Highest levels are from leachate wells inside Karn Landfill. All transect sampling during GW Study showed variable results; highest concentrations along the berm and lower results out at the GSI.


Consumers Energy - Karn & Weadock Facilities
Arsenic GSI value = 540 ug/l
Arsenic - Pore Water Sample Location
Arsenic
0 - 539 ug/l
540 - 750 ug/l
751 - 1000 ug/l
1001 - 1400 ug/l
Technical Support Unit
Waste & Hazardous Materials Division
October 7, 2009
Consumers Karn-Weadock.mxd
BT2 and BKG-105
T1 Transect
T2 Transect
T3 Transect
T4 Transect
T5 Transect
T6 Transect
T7 Transect
T8 Transect
T9 Transect
BT1 and BT1A
BT3, BT3A, BKG 106,107,108

GSI Mixing Zone Monitoring

- Mercury criteria is 0.0013 µg/l or 1.3 ng/l Mercury sampling performed along transects found highly variable results for the high-level laboratory test method. The high-level test method has a detection limit of 200 ng/l.
- Currently, low-level mercury testing is being performed by Consumers on the coal ash leachate and has been performed in the transect sampling background areas.

GSI Mixing Zone Monitoring and Phase I and II Groundwater Study

- The transect background areas were impacted by low-level mercury concentrations that ranged from 1.4 to 13.0 ng/l. These background areas were outside the landfill groundwater venting areas.
- Consumers Energy will be collecting additional mercury data from the landfill leachate, groundwater and at the GSI as part of the monitoring program improvements.

GSI Mixing Zone Monitoring and Phase I and II Groundwater Study

- Phosphorus mixing zone criteria is 1000 µg/l
- Consumers will be collecting additional phosphorus data evaluating compliance with mixing zone criteria. Phosphorus leachate data are variable ranging from 400 to 1100 µg/l. The GSI criteria is set at 1000 µg/l.

GSI Mixing Zone Monitoring and Phase I and II Groundwater Study

- The new monitoring programs and landfill improvements are substantial investments and environmental protection improvements.
- Long term groundwater and GSI conditions will be further characterized and trends tracked. Groundwater monitoring under Part 115 requires long-term monitoring for at least 30 years beyond site closure.

Break

Karn and Weadock Landfill Sampling Program Overview

- **Currently** monitoring 4 wells at Karn and Weadock Landfills for changes in discharge in accordance with Part 31 authorization for venting groundwater.
- **New monitoring programs under these licenses** will include approximately:
  - 36 Monitoring wells installed along landfill berms and in the ash to study hydraulic water levels.
  - 4 Leachate wells installed in the coal ash at Karn and Weadock to define field leachate chemical quality.
  - 9 Groundwater Surface water Interface (GSI) monitoring locations to define groundwater conditions venting to Saginaw Bay and Saginaw River.

The Purpose of Monitoring

1. To protect waters of the State and environment. This includes the groundwater/surface water interface (GSI) pathway. The GSI pathway monitoring and criteria are designed to protect organisms living at the GSI.

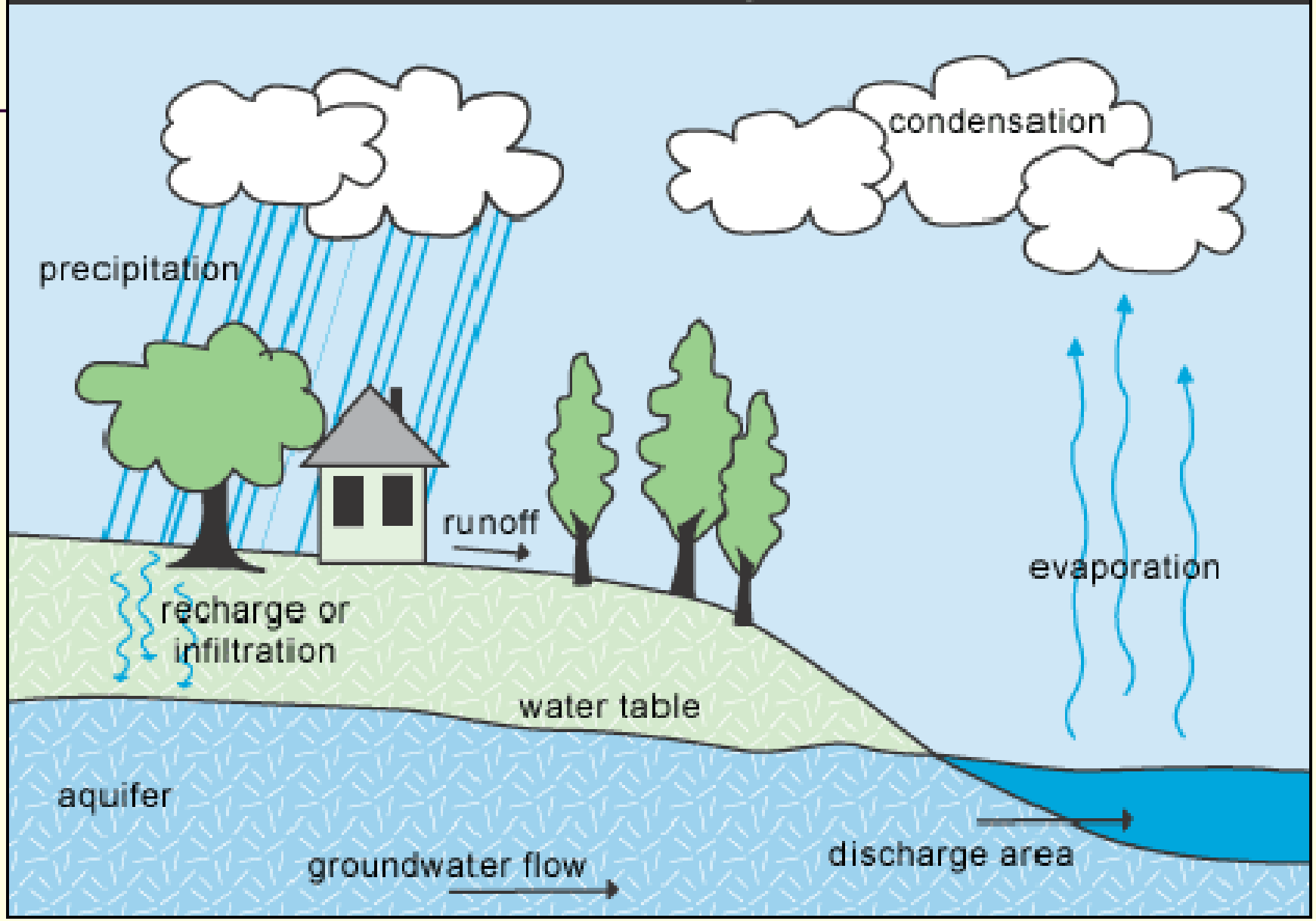
2. Detect any new groundwater and GSI issues from both landfills. Both landfills vent groundwater and site improvements have been made to reduce future venting discharges.

The Purpose of Monitoring Con't

3. Evaluate the groundwater mixing zone and determine if the continued discharge meets the required mixing zone criteria at the GSI compliance locations over time.

- The mixing zone criteria are designed to be protective of human health and the environment.

Water Cycle


condensation
precipitation
runoff
evaporation
recharge or
infiltration
water table
aquifer
groundwater flow
discharge area

Draft Monitoring Parameters

Appendix A-1
Sampling Program Parameters
DE Karn Solid Waste Disposal Area

Parameter	GSI Sampling Program	GSI Indicator Parameters	Porewater Sampling Program	Field Leachate Sampling Program	Laboratory Leachate Sampling Program
Aluminum				X	X
Antimony				X	X
Arsenic	X		X	X	X
Barium				X	X
Bicarbonate			X	X	X
Boron	X	X	X	X	X
Cadmium				X	X
Chromium				X	X
Cobalt				X	X
Copper				X	X
Dissolved Oxygen	X	X	X	X	
Eh/ORP	X	X	X	X	
Iron			X	X	X
Lead				X	X
Lithium	X	X		X	X
Magnesium				X	X
Manganese				X	X
Mercury (low-level)	X			X	
Molybdenum	X		X	X	X
Nickel				X	X
pH	X	X	X	X	X
Phosphorous	X			X	X
Selenium				X	X
Sodium				X	X
Specific Conductivity	X	X	X	X	

Draft Monitoring Parameters

Parameter	GSI Sampling Program	GSI Indicator Parameters	Porewater Sampling Program	Field Leachate Sampling Program	Laboratory Leachate Sampling Program
Sulfate			X	X	X
Temperature	X	X	X	X	
Thallium				X	X
Ammonia – Nitrogen					X
Nitrate – Nitrogen					X
Nitrite – Nitrogen					X
Total Inorganic Nitrogen					X
Vanadium	X		X	X	X
Zinc				X	X

Authority to Discharge

- Consumers Energy was authorized by the Water Resources Commission in 1986 to vent groundwater to an unusable aquifer, which vents to Saginaw Bay.

- Part 115, Rule 309(4) for industrial waste impoundments **allows free liquids to be discharged in accordance with a permit which is issued under part 31 of the act and which considers the effect of the discharge on surface and groundwater.**

Authority to Discharge Con't

- Part 115, Rule 318(2)(b) states, "that a discharge to uppermost aquifer will occur, but such discharge is authorized and monitored under a permit issued pursuant to the provisions of part 31 of the act."
- Both landfills have a current Part 31 GW discharge authorization.

GW and SW Protection

- Part 115, Rule 306(2) states, “The design, siting and operation of a type III landfill shall ensure that all requirements for the protection of surface and groundwater that are contained in Part 31 of the act and rules promulgated under Part 31 of the act shall be met.”

What will Monitoring Show Us?

- Evaluate if the groundwater quality is improving over time. Trend tests will be performed to define if chemical trends are changing over time.
- The additional monitoring, landfill and monitoring well upgrades are all designed to protect the GSI pathway.

What will Monitoring Show Us?

- The monitoring results will provide further answers. Are the site improvements working?
- The site improvements to be evaluated include: Weadock Slurry Wall, possible future Karn Landfill containment system, dry ash handling system, monitoring well and program upgrades at both landfills.

Complexity of Monitoring

- These landfill locations are not the easiest locations to monitor. The Saginaw Bay and River are known areas of environmental impact from various sources.
- Groundwater environment is also likely influenced by complex chemical and microbial mediated reactions.

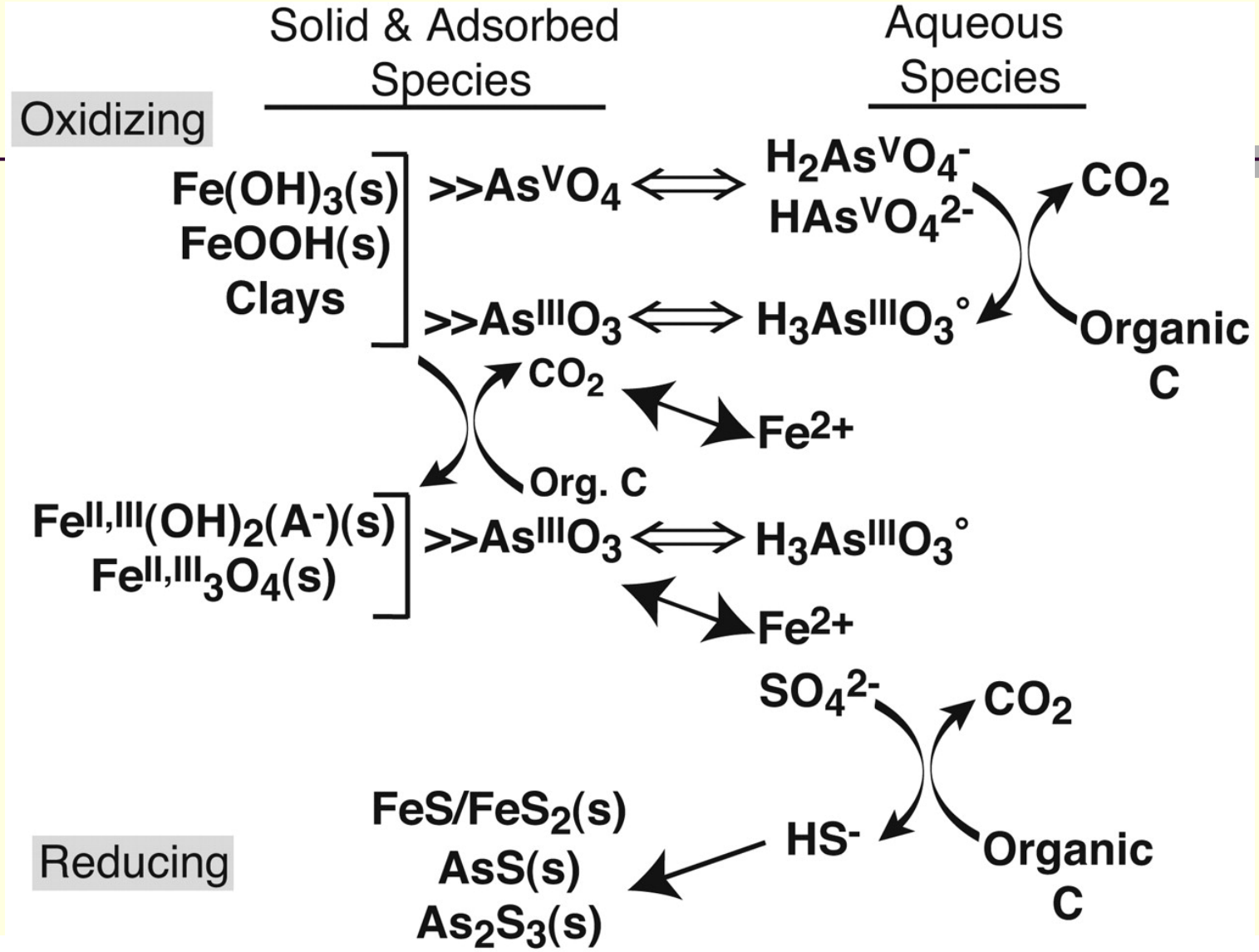
What is Biogeochemistry?

- In a nutshell, biogeochemistry can influence the concentrations, transformation and potentially the movement of metals in organic-rich near shore environments. These reactions can be influenced by various chemical reactions in the aquifer and at the GSI; including possible interaction with various bacteria.

Biogeochemistry Con't

- Changes in aquifer chemical reduction and oxidation conditions (REDOX) can also potentially lead to increased mobility, transformation and various site-specific chemical reactions <u>depending on very site-specific conditions.</u>
- Example: Changes in REDOX can shift As(V) to As (III) via chemical and/or bacteria interactions. This is important because As (III) is more mobile in GW and more toxic.

Biogeochemical model



O'Day P A et al. PNAS 2004;101:13703-13708

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PNAS

Biogeochemistry Wrap-up

- The product of the groundwater quality at both landfill sites is a function of the site-specific aquifer's environment, interaction with contaminants from various natural and/or man-made source(s) <u>and</u> biogeochemical reactions along the groundwater pathway.

The End Results

- Consumers Energy in conjunction with DEQ staff are currently working diligently on designing a very comprehensive monitoring program to define these complex site conditions.

Thank You

- I would like to thank the residents in attendance for their attention and interest in these landfills. I would also like to thank Consumers Energy for the commitment and allocation of staff and financial resources to make these studies and landfill improvements possible.

- I would also like to thank DEQ staff for attending the meeting tonight and working diligently on these complex sites.