# WELCOME!

Welcome to DES

&

to Today's Workshop

"Groundwater Basics, Landfill Monitoring & Case Histories"

# WHY ARE YOU HERE?

- Required by law and NH Solid Waste Rules.
- Build your resume & accumulate professional development hours.

# WHY THIS WORKSHOP?

- From where do NH's citizens get their water?
  - 60% rely on a well
  - 25% rely on surface waters
  - 15% use both

# DESKTOP MATERIALS & DISPLAYS

- Agenda
- Evaluation
- BMP Manual

# TODAY'S AGENDA

- Groundwater Basics
- Break and Demonstration
- MSW Unlined Landfill Case Study
- Landfill Monitoring Requirements
- SWOT Rule Changes

# Groundwater Basics

February 24, 2015

Paul Rydel, PG
New Hampshire Department of Environmental Services

# Typical Solid Waste Transfer Station w/ Closed Unlined Landfill

# Groundwater Monitoring Well

# Definitions

Groundwater = water which occurs below the land surface (*saturated zone*).

Vadose Zone = zone between the land surface and the groundwater surface or water table (*unsaturated zone*).

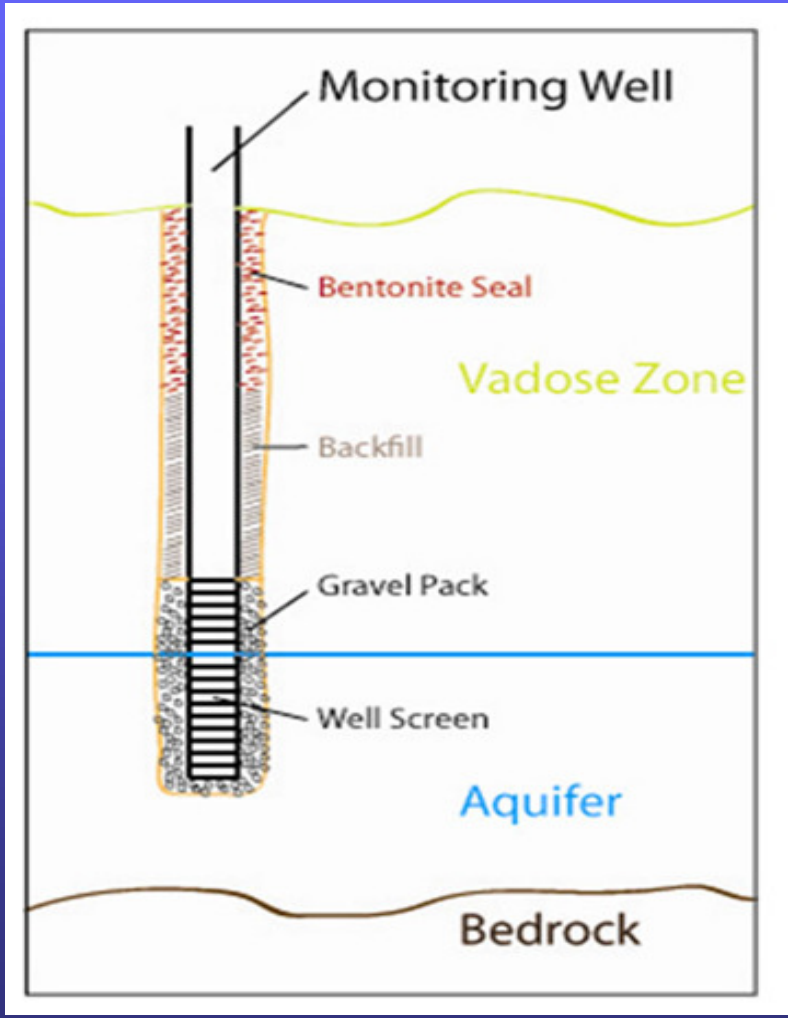
Geology – study of the earth.

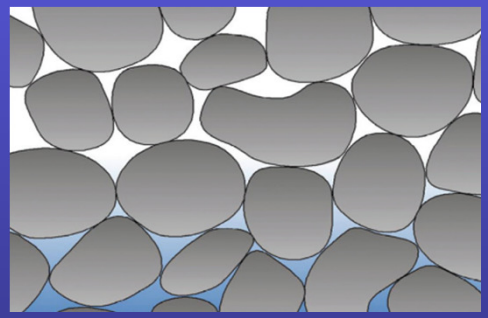
Hydrogeology – geology specific to water resources.

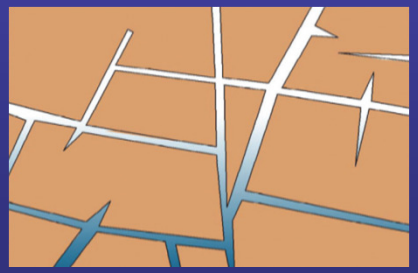
Aquifer – geologic material or unit (soil or bedrock) that yields groundwater to wells in usable quantities.

# Drilling to Install Monitoring Well

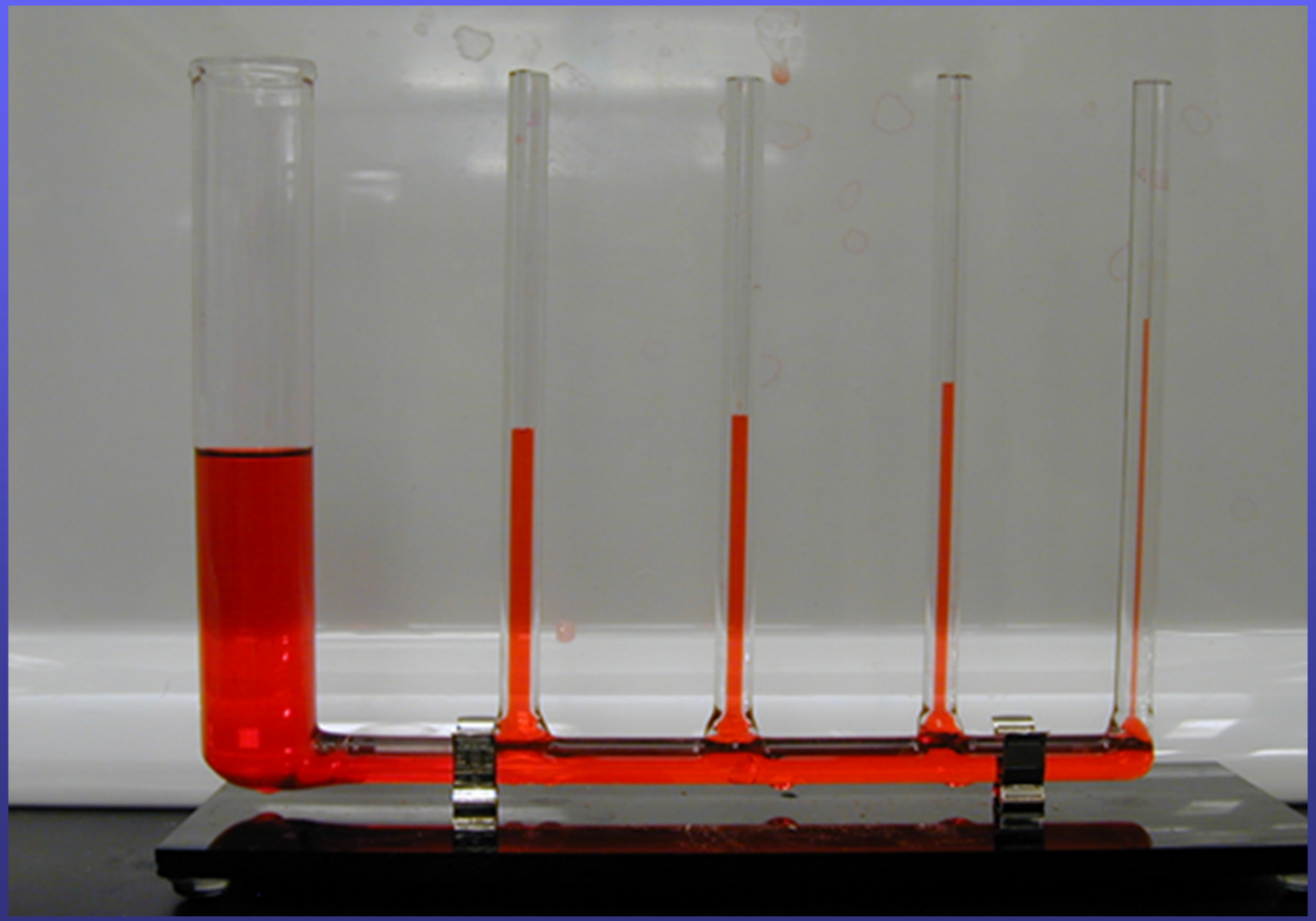
# Monitoring Well Details

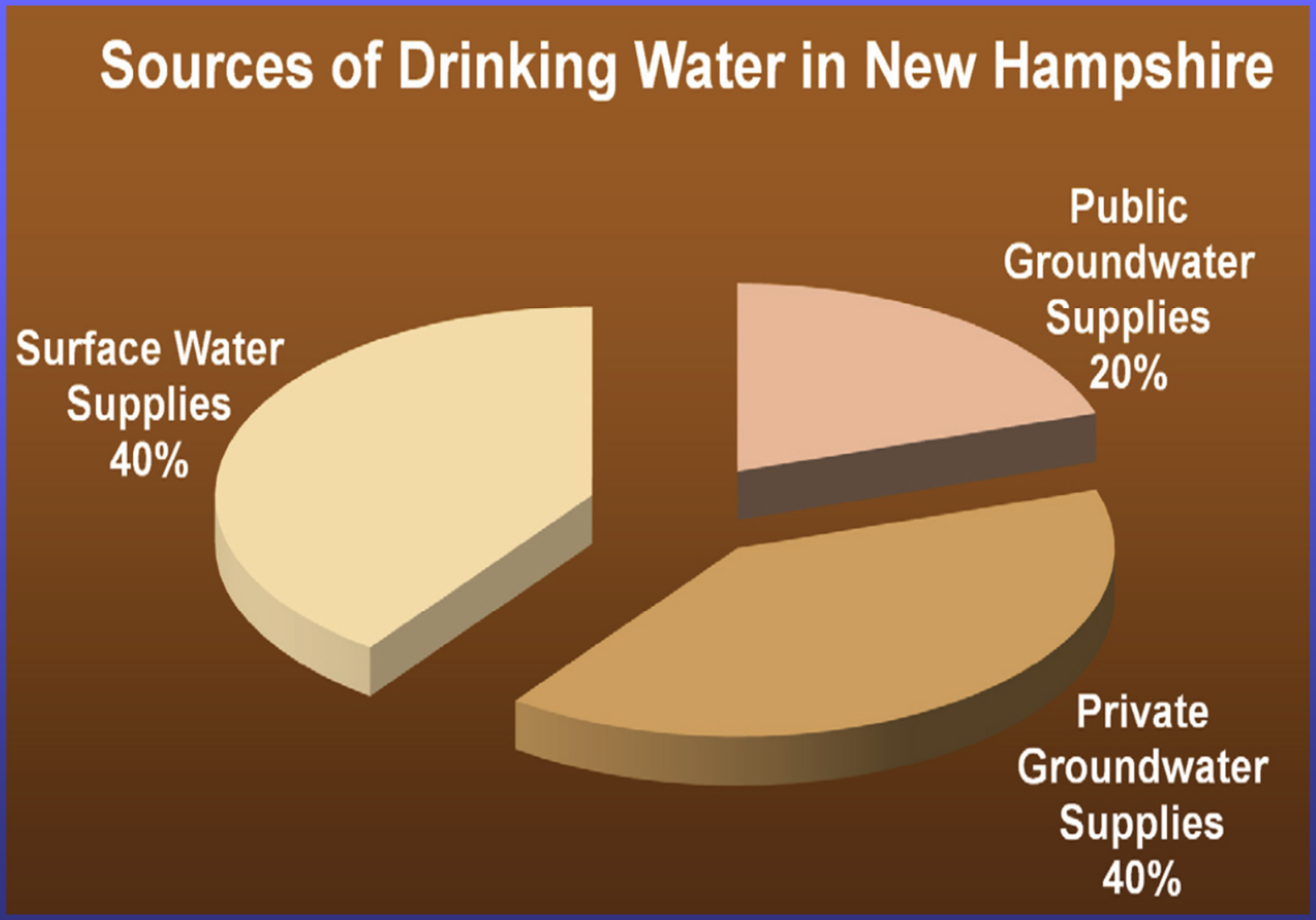


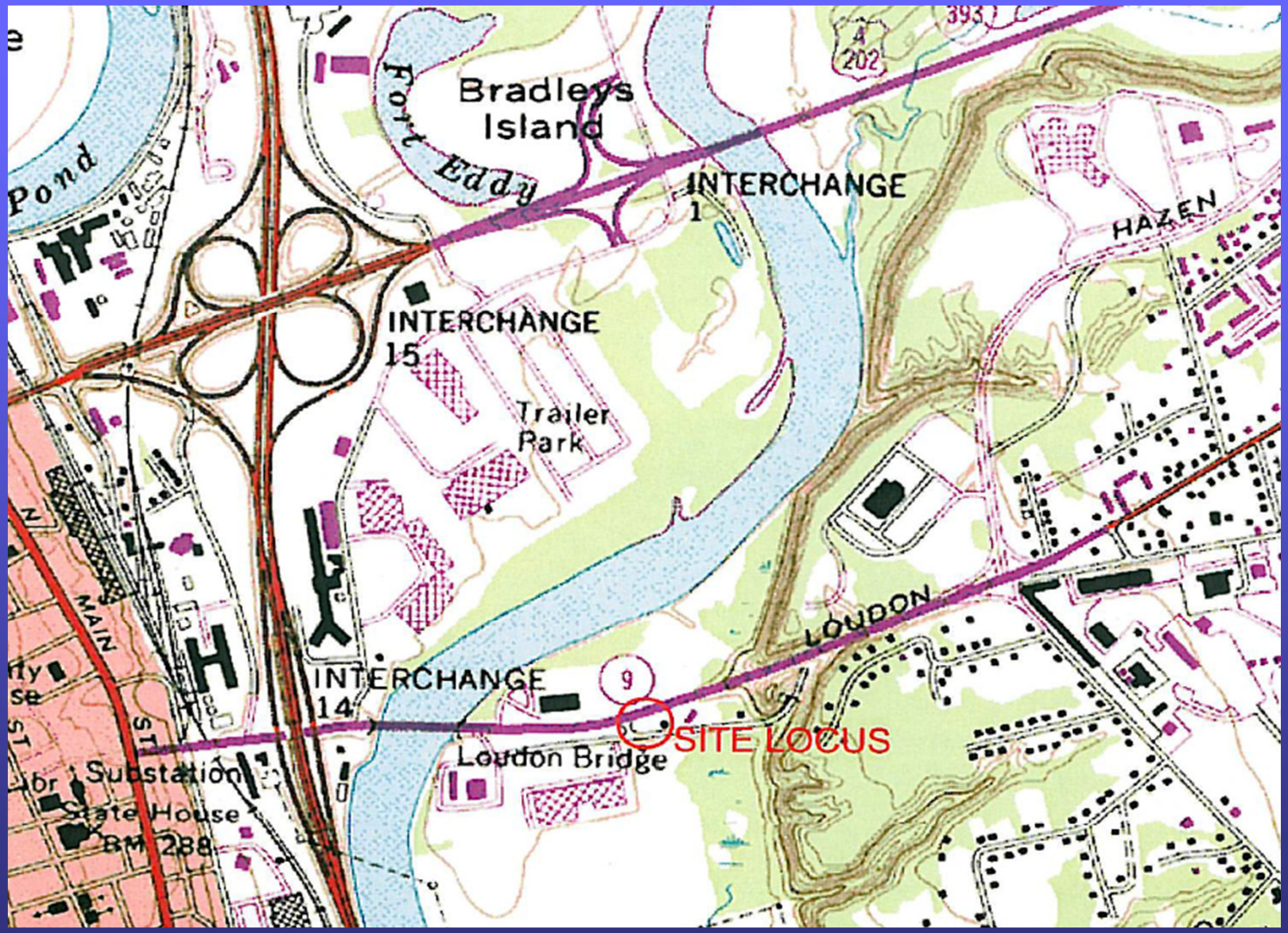



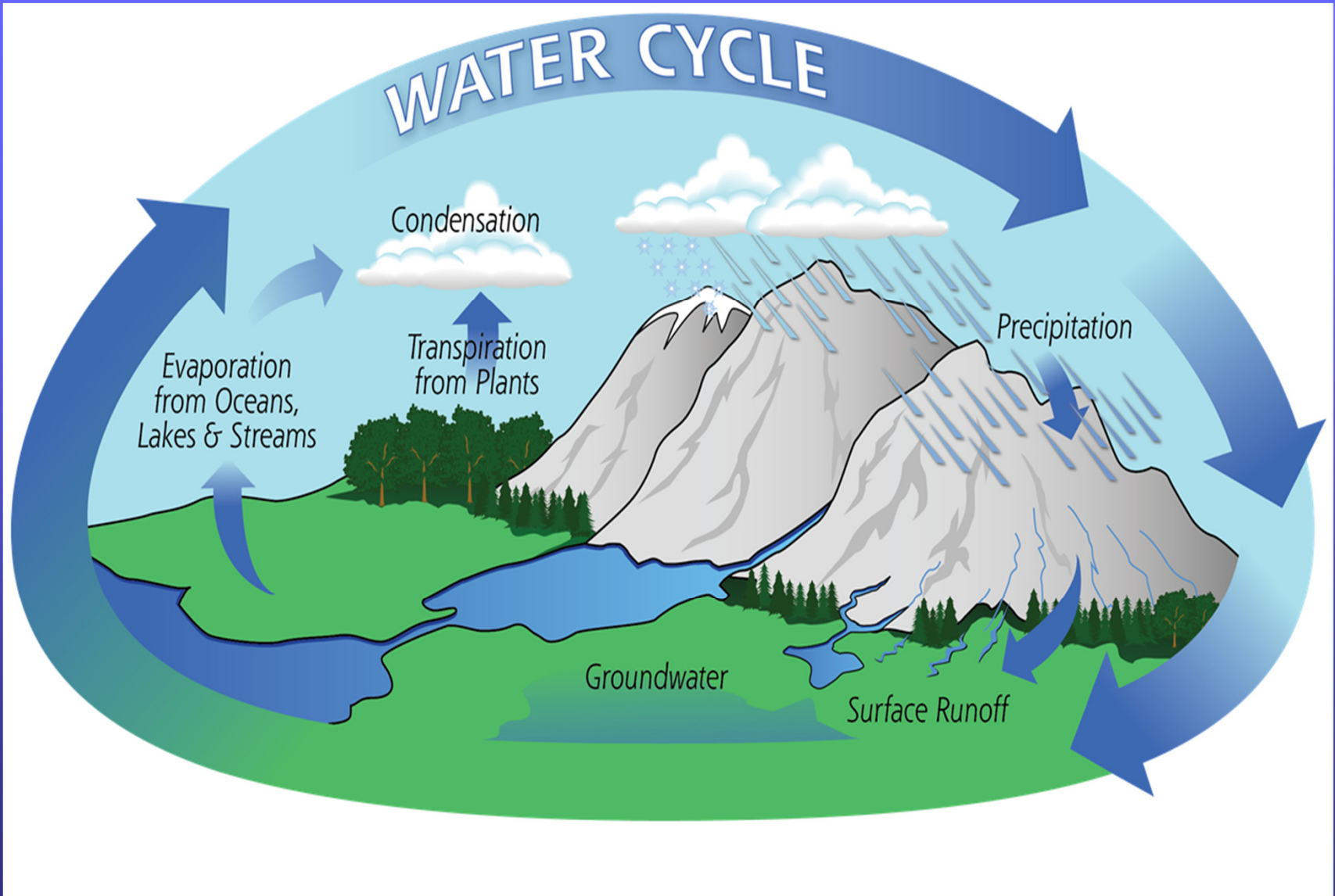


# Capillary Fringe




Sources of Drinking Water in New Hampshire
Public Groundwater Supplies 20%
Surface Water Supplies 40%
Private Groundwater Supplies 40%

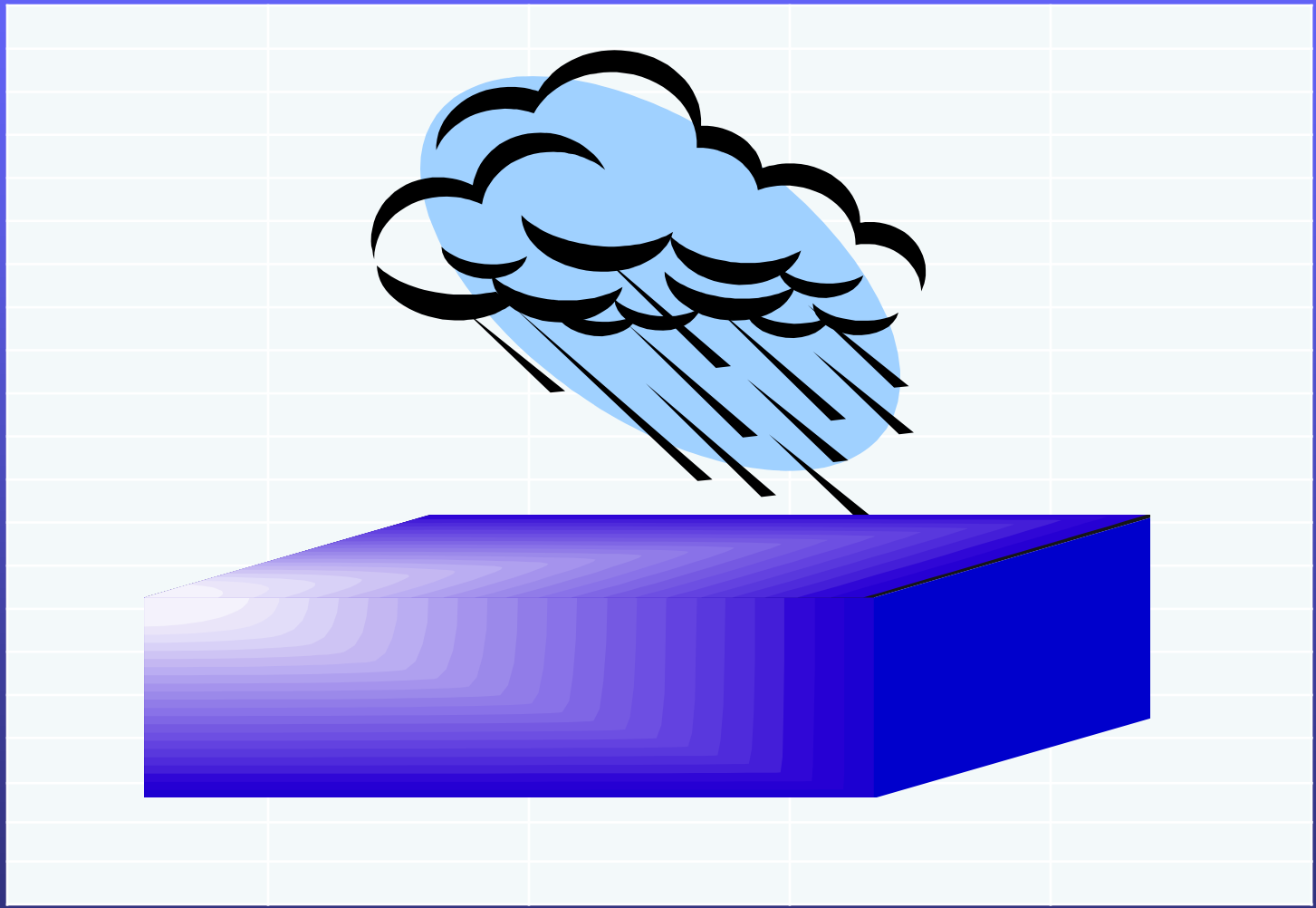

Bradleys Island
Fort Eddy
Pond
INTERCHANGE 1
INTERCHANGE 15
Trailer Park
HAZEN
LOUDON
INTERCHANGE 14
Loudon Bridge
SITE LOCUS
Substation
State House
MAIN ST
393
202
9


WATER CYCLE
Condensation
Evaporation
from Oceans,
Lakes & Streams
Transpiration
from Plants
Precipitation
Groundwater
Surface Runoff

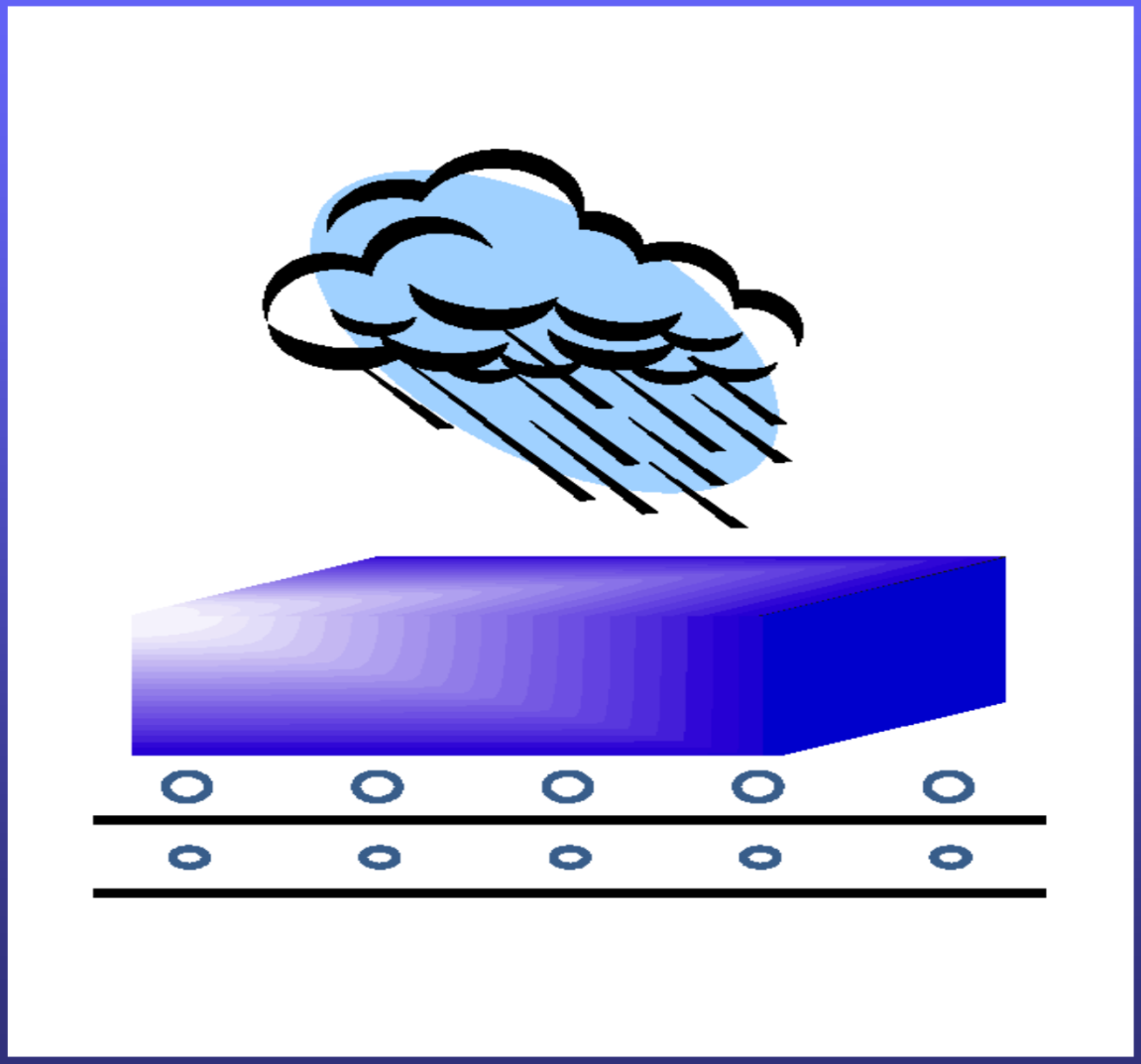
# History of Solid Waste Disposal

# Sanitary Landfill

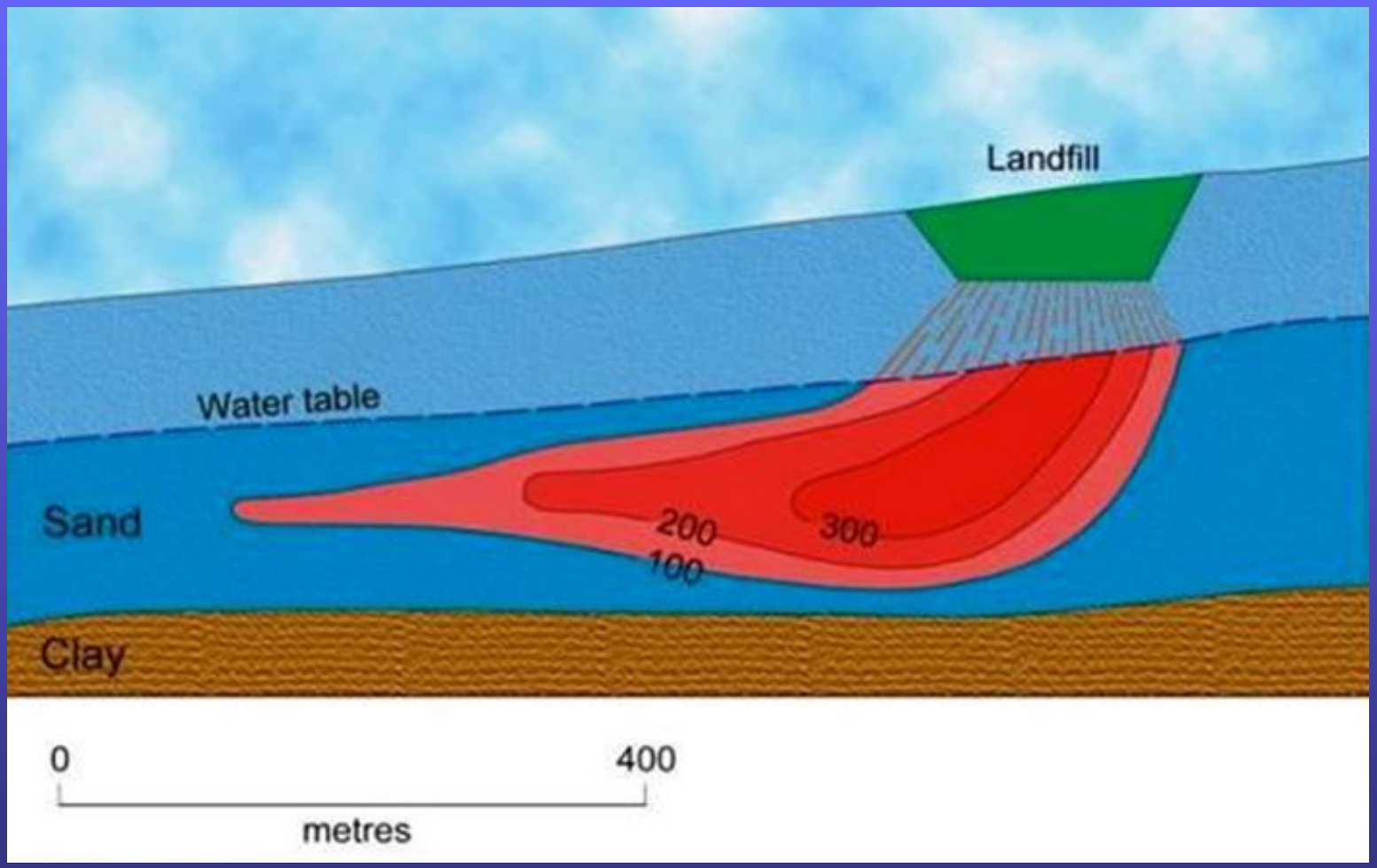
# Unlined Landfill



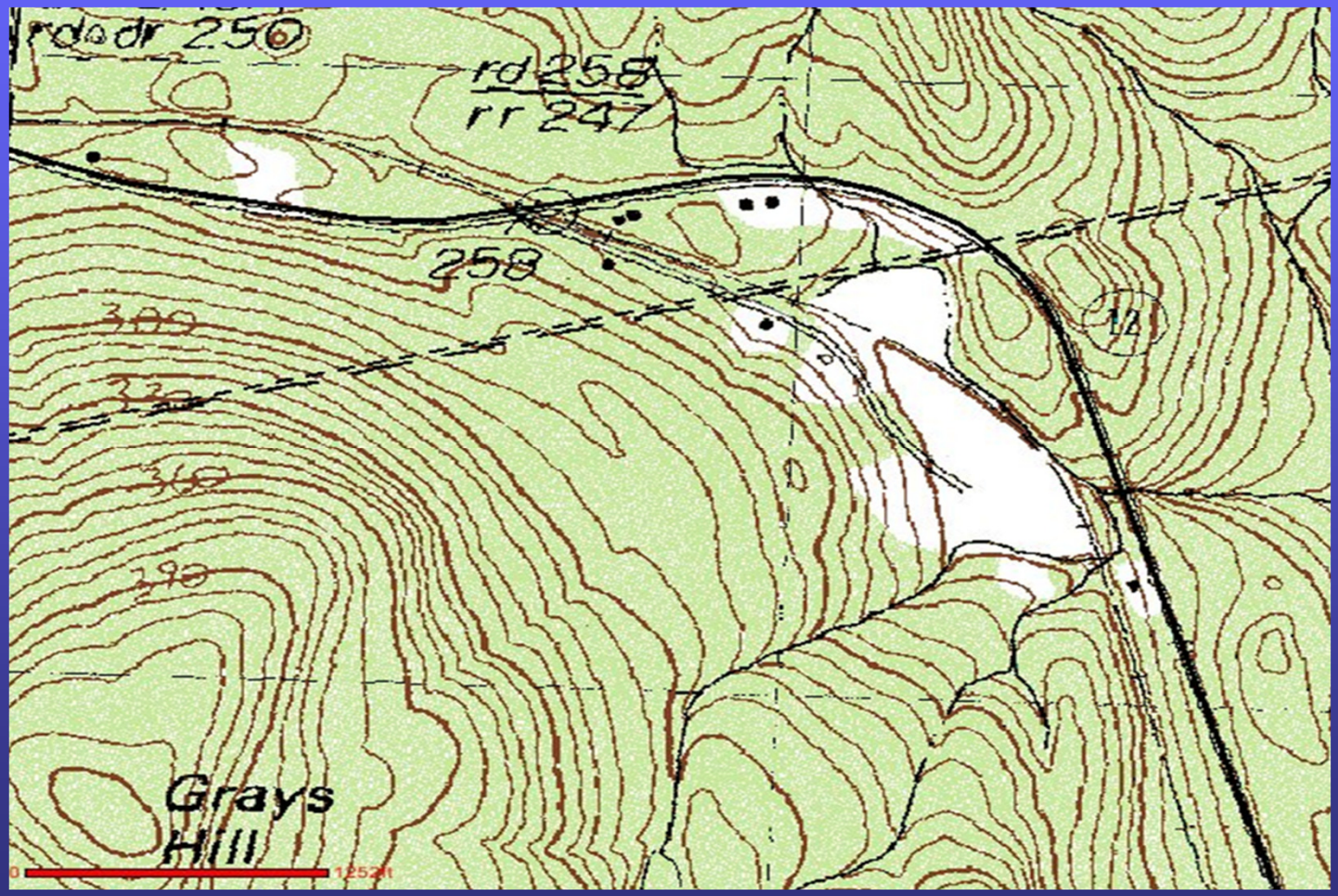
# Lined Landfill



# Groundwater Contamination



# Unlined Landfill Monitoring



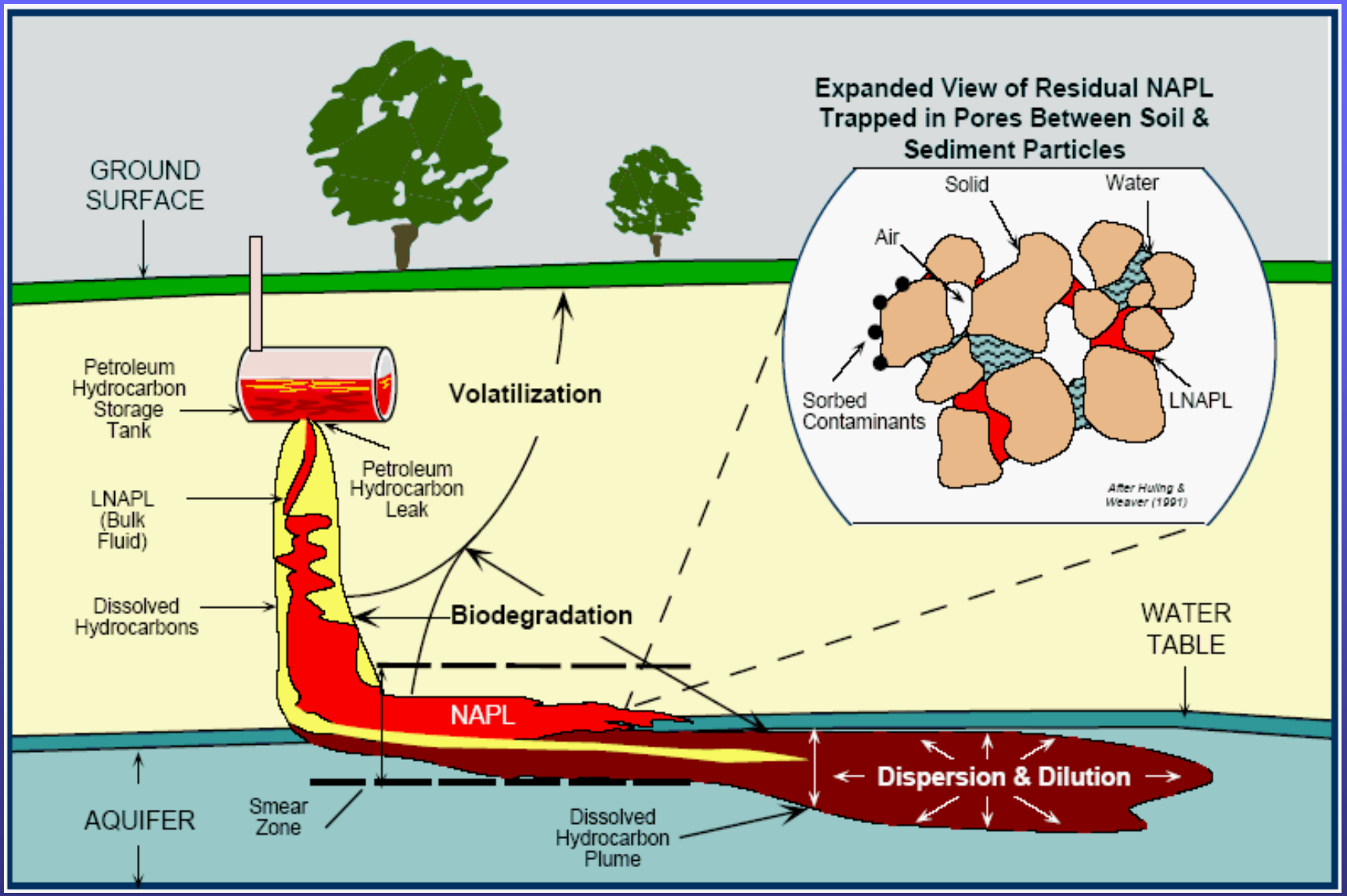
# Unlined Landfill Monitoring

# Groundwater Contaminants

- Volatile organic compounds (VOCs) –petroleum products (benzene, toluene, naphthalene, etc.) and solvents (PCE, TCE) – about 65 compounds;
- Metals (arsenic, iron, manganese, etc.);
- Chloride, nitrate, sulfate.
- Drinking water standards (*safe levels*) established for most common groundwater contaminants

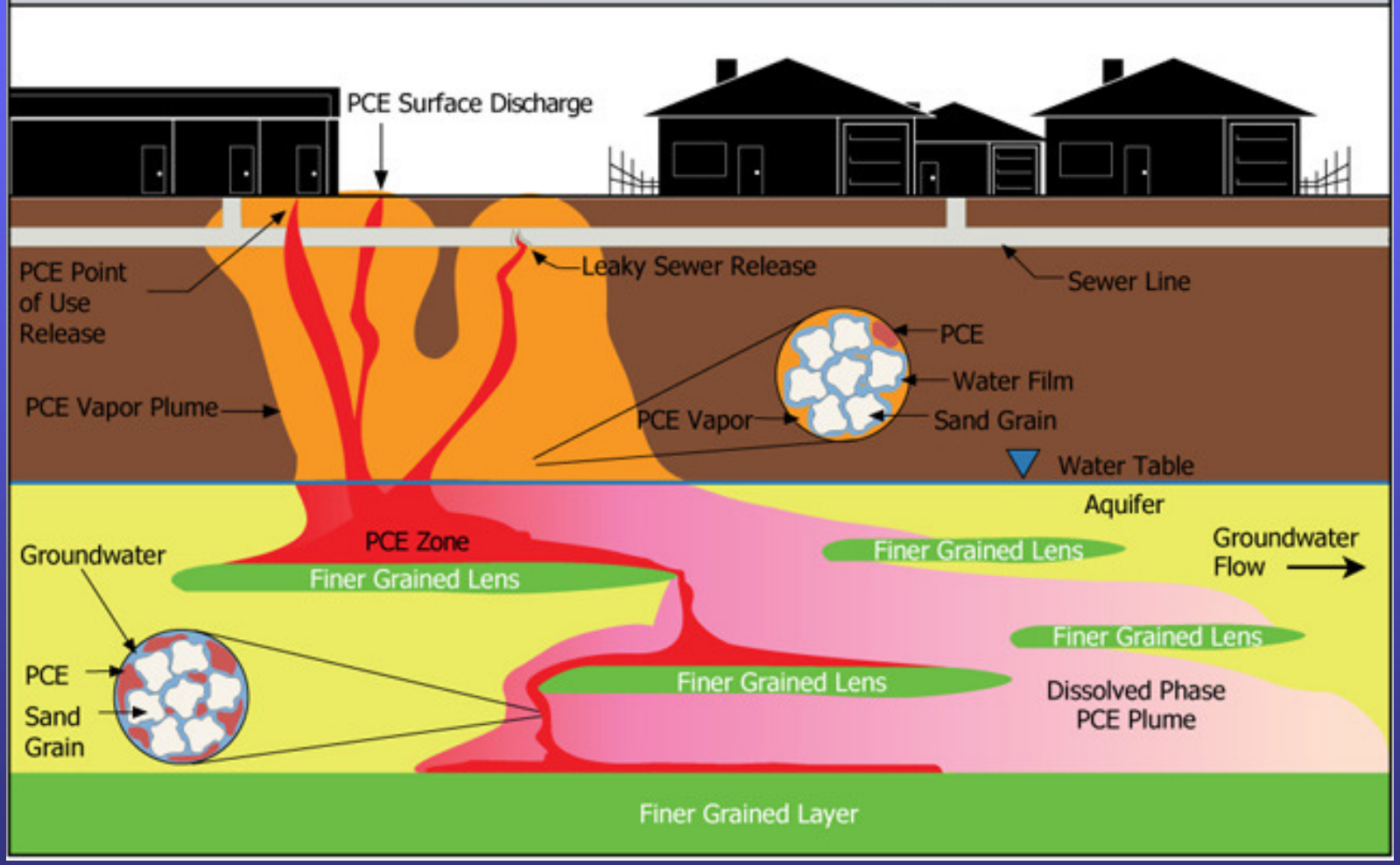
# Concentration Units

- Typical concentration units are parts-per-million or parts-per- billion;
- 60 seconds x 60 minutes x 24 hours = 86,400 seconds in one day – 1,000,000 seconds / 86,400 seconds per day = 11.57 days


Expanded View of Residual NAPL Trapped in Pores Between Soil & Sediment Particles
Solid
Water
Air
Sorbed Contaminants
LNAPL
After Huling & Weaver (1991)
GROUND SURFACE
Petroleum Hydrocarbon Storage Tank
Volatilization
Petroleum Hydrocarbon Leak
LNAPL (Bulk Fluid)
Dissolved Hydrocarbons
Biodegradation
WATER TABLE
NAPL
Dispersion & Dilution
AQUIFER
Smear Zone
Dissolved Hydrocarbon Plume

VIII.b.

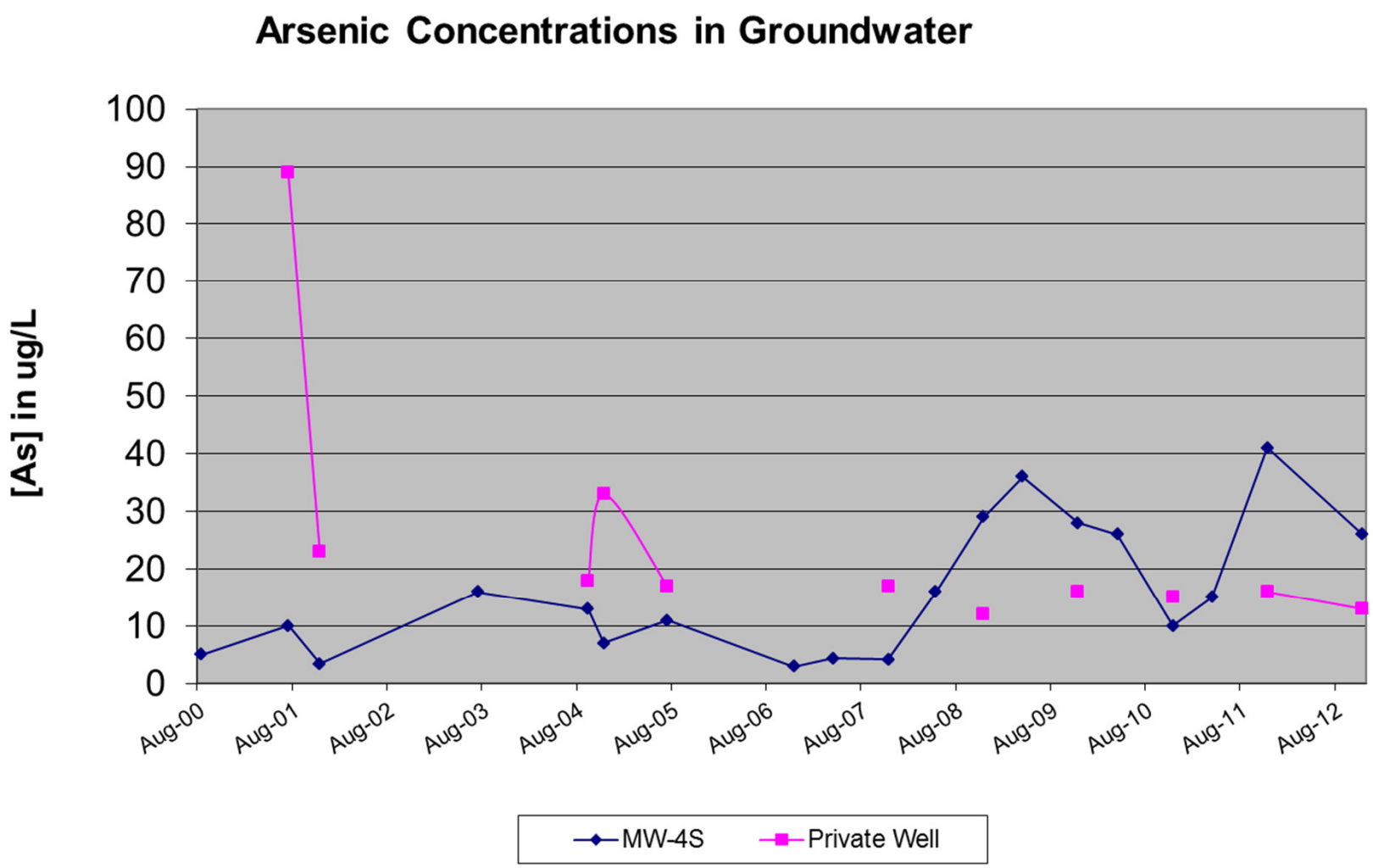
# The PCE Challenge



# Case Study – Groundwater Monitoring at a Closed Unlined Landfill Site

# Groundwater Quality Comparison

| | MW-1 | MW-4S | Private well |
|---|---|---|---|
| Chloride | 2.2 | 112 | 8.6 |
| Iron | 0.25 | 13.8 | 0.47 |
| Manganese | 0.078 | 4.0 | < 0.005 |
| Arsenic | 0.007 | 0.016 | 0.024 |


Arsenic Concentrations in Groundwater
[As] in ug/L
100
90
80
70
60
50
40
30
20
10
0
Aug-00
Aug-01
Aug-02
Aug-03
Aug-04
Aug-05
Aug-06
Aug-07
Aug-08
Aug-09
Aug-10
Aug-11
Aug-12
MW-4S
Private Well

# Contact Information

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New Hampshire Department of Environmental Services

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# Methane Basics and Monitoring - A Closed Landfill Case Study

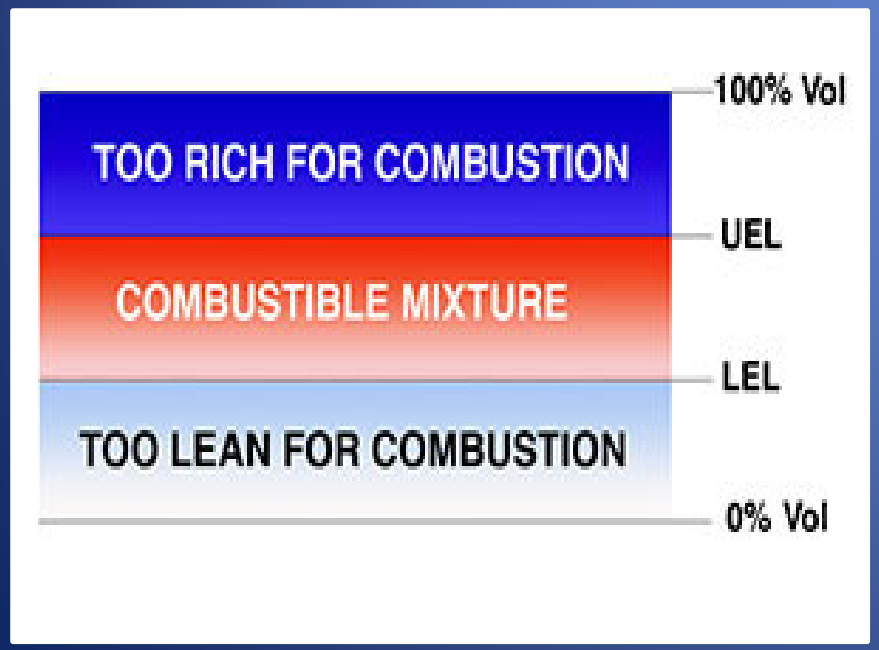
Douglas Kemp
Waste Management Specialist
NHDES - Waste Management Division

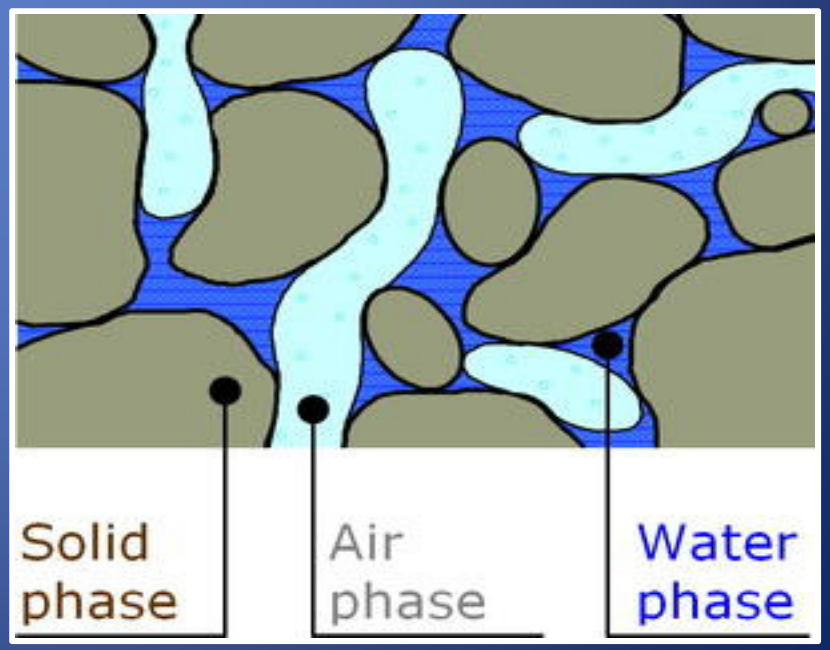
# Landfill Gas

- Composed of mostly methane and carbon dioxide, and hundreds of other gases
- Composition changes over time from mostly carbon dioxide to methane
- Methane forms from bacteria in the landfill
- Landfills can generate methane for decades

# Methane Gas

- Is explosive between 5% to 15% of the total volume of air [LEL = Lower explosive Limit & UEL = Upper Explosive Limit]
- Can migrate horizontally via void spaces in soils
- New Hampton landfill



# Rule Requirements

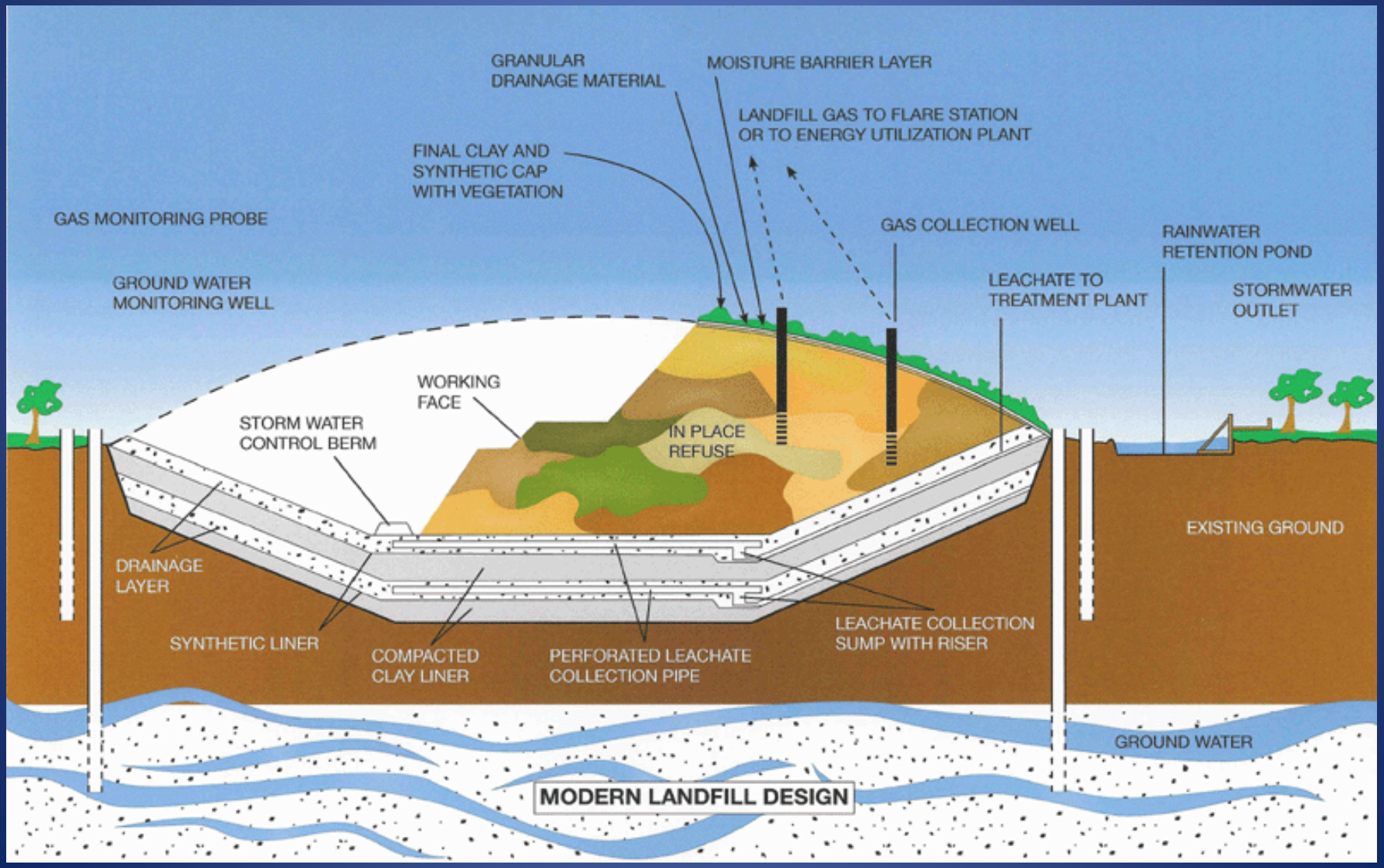
- Landfill gases must be controlled to prevent hazards to human health and safety, and property
- Methane conc. must not exceed 25% of the LEL in structures on or off-site
- Methane conc. must not exceed 50 % of the LEL in the soil at the property line

# Methane % vs LEL %

| SITE ID | DATE | % LEL | % METHANE |
|---|---|---|---|
| TGV-1 | 6/21/2012 | 96 | 4.8 |
| TGV-2 | 6/21/2012 | 220 | 11.0 |
| TGV-3 | 6/21/2012 | 280 | 14.0 |
| TGV-4 | 6/21/2012 | 720 | 36.0 |
| TGV-5 | 6/21/2012 | 54 | 2.7 |
| TGV-6 | 6/21/2012 | 454 | 22.7 |
| TGV-7 | 6/21/2012 | 128 | 6.4 |

- To convert from LEL % to methane % - divide the LEL value by 20
- To convert methane % to LEL % - multiply the methane value by 20
- 100% LEL = 5% methane

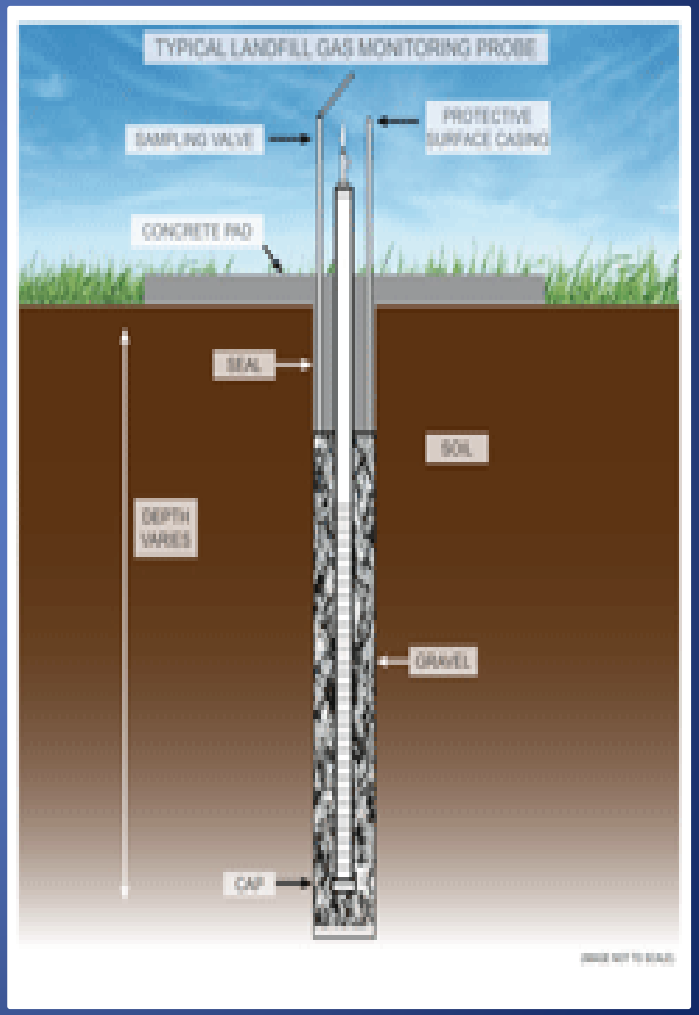
# Closed Landfill Cross Section



# Typical Landfill Gas Vents

# Landfill Gas Monitoring

- Soil gas monitoring
- Ambient air monitoring
- Monitoring inside buildings



# Drilling Equipment

# Constructing Gas Monitoring Well

# Typical Gas Monitoring Wells

# Methane Monitoring In Buildings

# Gas Monitoring Equipment

Monitoring equipment can directly measure methane gas or present its readings as a percentage of the Lower Explosive Level [LEL]

# Methane Migration Case Study

# Closed Hampton Landfill

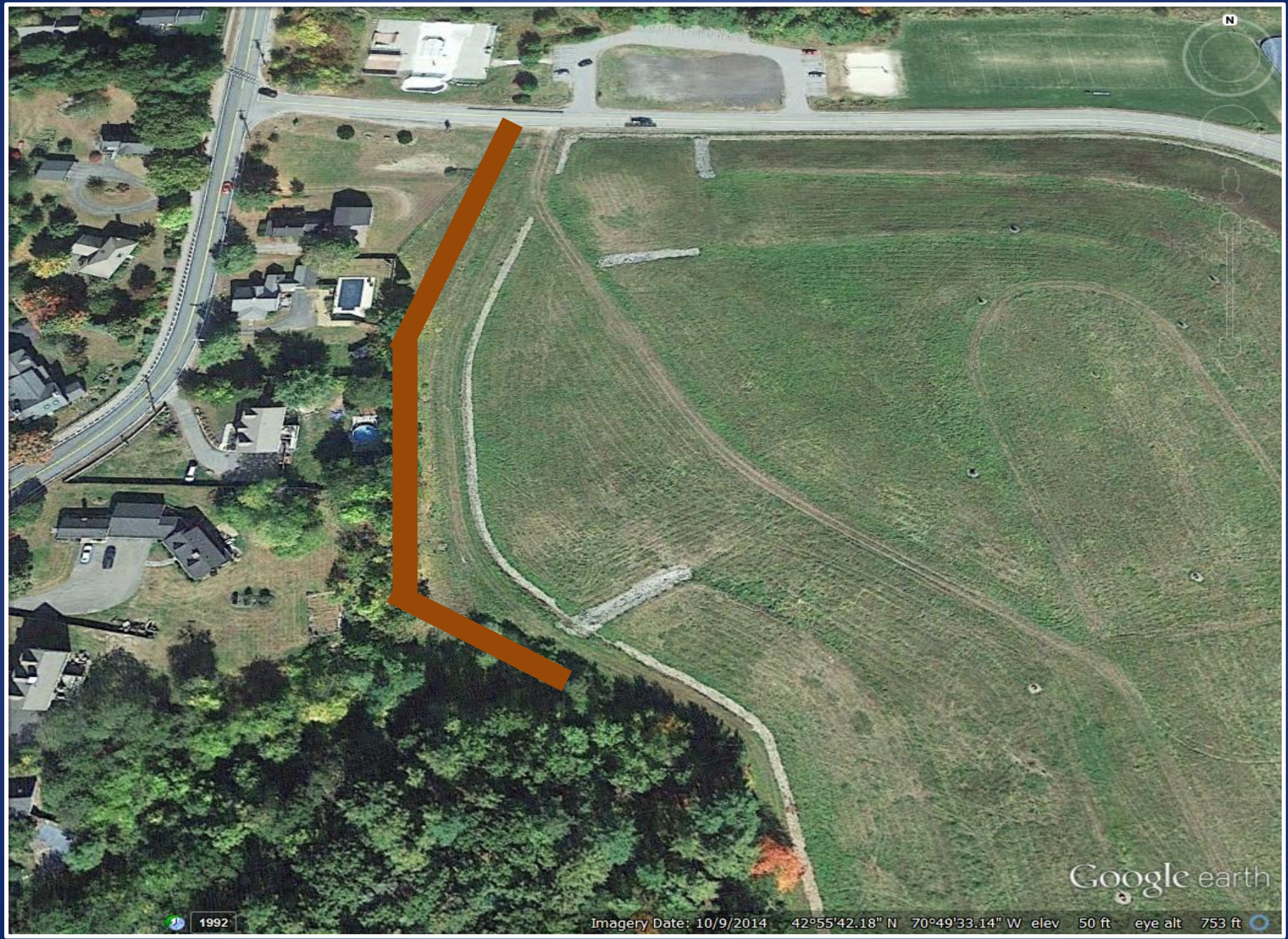
- Approximately 32 acres in total area
- Located in a suburban area
- Stopped accepting waste in 1995
- Capped during 1996 with plastic sheeting [LLDPE]
- Closure costs >$6 million
- Methane was detected >100% LEL in 3 gas wells
- HFD detected >100% LEL at a pipe penetration
- The homeowners were relocated out of the home

# Methane Survey

- The Town conducted a landfill gas survey in 1997, installing 26 temporary gas monitoring wells
- Methane >100% LEL was detected at varying depths in 13 of the 26 soil gas wells sampled in March 1997
- DES approved a trench design on Dec. 19, 1997
- The trench was completed in 1998
- HFD continued to monitor the home

Google earth
1992
Imagery Date: 10/9/2014 42°55'29.04" N 70°49'31.35" W elev 16 ft eye alt 4570 ft

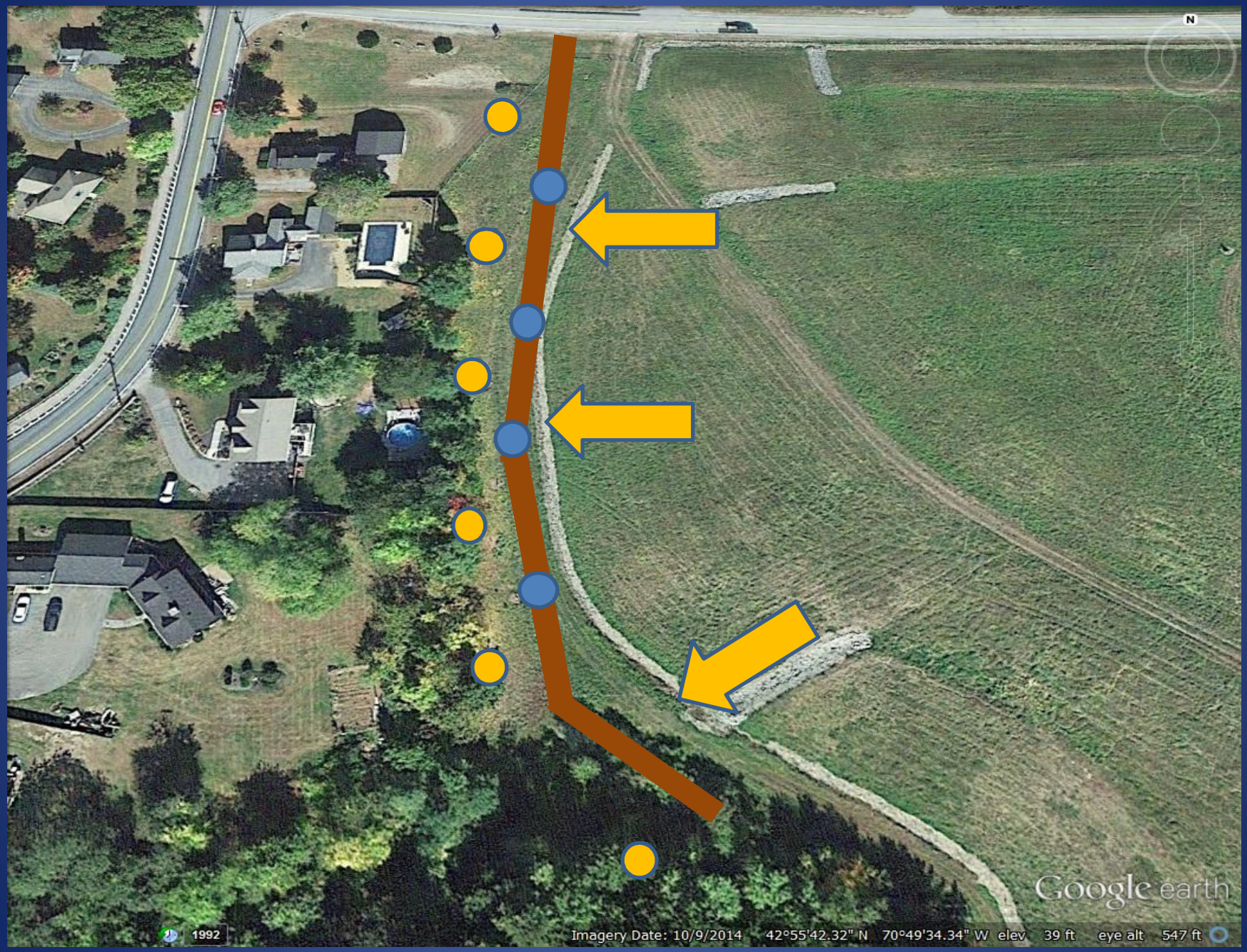
wetland
Google earth
1992
Imagery Date: 10/9/2014 42°55'36.61" N 70°49'23.81" W elev 74 ft eye alt 1559 ft


N
Google earth
1992
Imagery Date: 10/9/2014 42°55'42.18" N 70°49'33.14" W elev 50 ft eye alt 753 ft

# Migration Cut-Off Trench

- Roughly 530 feet long
- Maximum depth of 20 feet
- Excavated to the water table
- Lined with geomembrane & geo-fabric
- Backfilled with crushed stone
- Installed a horizontal, perforated PVC pipe
- Installed 7 PVC Vents every 75 feet

# Trench Construction


N
Google earth
1992
Imagery Date: 10/9/2014 42°55'42.32" N 70°49'34.34" W elev 39 ft eye alt 547 ft

# Results

- Elevated levels of methane continue to be detected in the trench vents
- Low to No methane has been detected in the gas monitoring probes between the trench and adjacent homes
- The home was sold to new owners

# Questions?

# Landfill Monitoring Requirements

Douglas Kemp
Waste Management Specialist
NHDES - Waste Management Division

# Operating Lined Landfills

- Landfill designs follow engineered standards.
- DES staff conduct routine inspections.
- Owners are required to:
  - conduct inspections,
  - monitor air, water, and waste disposal capacity,
  - submit routine reports to DES,
  - submit incident reports and repair any damage.

N
Google earth
1992
Imagery Date: 9/19/2013 43°36'53.27" N 72°19'43.40" W elev 433 ft eye alt 2694 ft

Ammonoosuc River
Trudeau Rd
© 2015 Google
Google earth
1994
Imagery Date: 9/18/2013 44°15'37.65" N 71°37'44.08" W elev 1435 ft eye alt 3748 ft

N
Google earth
1995
Imagery Date: 8/24/2013 42°43'35.36" N 71°31'07.79" W elev 204 ft eye alt 3693 ft

# Closed Unlined Landfills

- Closure designs follow engineered standards.
- Remain a potential threat.
- Roughly 130 landfills have been closed since 1985.
- Vast majority are municipal unlined landfills.
- Closure costs exceeded $1,000,000.
- Post-Closure costs could reach $500,000.

N
Google earth
2003
Imagery Date: 4/7/2013 43°25'21.28" N 71°08'35.26" W elev 540 ft eye alt 1884 ft

bing
© 2015 Microsoft Corporation © 2015 Nokia

Brown Rd
Brown Rd
bing
© 2015 Microsoft Corporation © 2015 Nokia

# Unlined Landfill Closure Process

- The closure process could take 2 plus years
- Hydrogeology study
- Submittal of cap design concept
- Submittal of cap design and post-closure plans
- Cap construction
- Submittal of Record Drawings
- Post-closure monitoring and maintenance period
- The post-closure period is performance driven

# Can You Spot the Landfill?

Google earth
1992
Imagery Date: 10/11/2014 42°59'41.44" N 71°30'05.57" W elev 267 ft eye alt 1219 ft

Google earth
1992
Imagery Date: 10/11/2014 42°59'49.34" N 71°30'12.82" W elev 257 ft eye alt 746 ft

# Landfill Post-Closure Requirements

- Inspect, monitor, and repair any damage
- Achieve the "performance standards" in the NH Solid Waste Rules:
  - Stop generating leachate,
  - Stop generating methane,
  - Achieve maximum settlement,
  - Remove harmful impacts to air and water,
  - Remove threat to human health and the environment.

# Post-Closure Inspections

- Protect the closure system from damage:
  - Landfill slopes,
  - Vegetation,
  - Gas management system,
  - Drainage system,
  - Fencing, signage, and
  - Groundwater and gas monitoring wells.

- http://des.nh.gov/organization/divisions/waste/swmb/css/categories/forms.htm

Limit of Cap
RESTRICTED
ACCESS
Per the New Hampshire Department of
Environmental Services and
The City of Franklin
Town Landfill
Potential Presence
of
Landfill Gases
603-934-3900

# Post-Closure Summary

- If one or more of the performance standards is <u>not</u> met, must continue to monitor
- If one or more of the performance standards is met, submit a <u>permit modification</u> to change a post-closure requirements
- To alter the report submittal frequency or other Rule requirement, submit a <u>waiver</u> request
- Contact DES prior to using the landfill site for other purposes

# Questions?

# SOLID WASTE FACILITY OPERATOR WORKSHOP

## SWOT Rule Revisions
## Effective July 1, 2014

# OPERATOR TYPES

Establishes two types of operators:

*1. Principal operator*

- Attend basic training and pass the exam.
- May be in supervisory/management position.

# OPERATOR TYPES

2. *Assistant operator*
   - Attend basic training, but do <u>not</u> take/pass the exam.
   - Must work under supervision of principal operator.

# OPERATOR QUALIFICATIONS

- No more minimum education/experience requirements.
- Employers determine who is competent, not DES.

# TRANSITION FROM LEVEL TO STEP

- *Attendant in Training → Assistant Operator*
- *Level 1 → Principal Operator, Step 1*
- *Level 2 → Principal Operator, Step 2*
- *Level 3 → Principal Operator, Step 3*
- *Level 4 → Principal Operator, Step 4*

# SENIOR PRINCIPAL OPERATOR

*To recognize those individuals who have 20 years of <u>continuous</u> certification, we have designated them as Senior Principal Operators.*

# STEPS

- Recognition for continuing professional development.
- Awarded automatically with renewal.
- Step increases with hours of accrued training starting July 1, 2014.

# PRINCIPAL OPERATOR STEPS

| Step | Hours of Accumulated Continuing Professional Development |
|---|---|
| 1 | 2.5 total |
| 2 | 12.5 total |
| 3 | 25 total |
| 4 | 37.5 total |
| Senior | 50 total |

# ASSISTANT OPERATOR STEPS

- Assistant Operators advance in steps according to years of certification.

| Years Certified | Step |
|---|---|
| One to 4 total | 1 |
| 5 to 9 total | 2 |
| 10 to 14 total | 3 |
| 15 or more total | 4 |

# PROFESSIONAL DEVELOPMENT

- "Continuing Professional Development" means professional or technical instruction that imparts information and instruction relevant to waste management and solid waste facility operations to individuals who have already attended basic training.

# PROFESSIONAL DEVELOPMENT

- 2.5 hour minimum for annual renewal for **ALL** designations.
- Must be completed in the 12 months in-between expiration dates before you are considered late.

# PROFESSIONAL DEVELOPMENT

- Repeated courses do not qualify for certification renewal or step increases.
- In-house and third party training count, provided the topic is waste-related.
- If you aren't sure if the training you want to take will count, call and ask us before you go.

# GRACE PERIOD

- There is a 90-day grace period for renewal applications
- A $25 late fee will be assessed if your complete renewal application is received within 90 days after your certification expiration date

# BEYOND THE GRACE PERIOD

- If you miss the grace period, you must start over.
  - Come back to Basic Training; and
  - Take the test again

# SIGNATURE

- The operator's signature shall certify:
  - the information is true, complete and not misleading;
  - the operator understands s/he is subject to penalties of law for false swearing; and
  - the operator understands s/he is required to comply with RSA 149-M and SW Rules.