

Pinelands Commission Landfill Closure Assessment Program

Policy and
Implementation
Committee
Meeting

February 24, 2023



N.J.A.C. 7:50-6.75 Landfills

(c) All landfills that ceased operation on or after September 23, 1980 if located in the Preservation Area or on or after January 14, 1981 if located in the Protection Area shall be capped with an ***impermeable material*** unless it can be clearly demonstrated that:

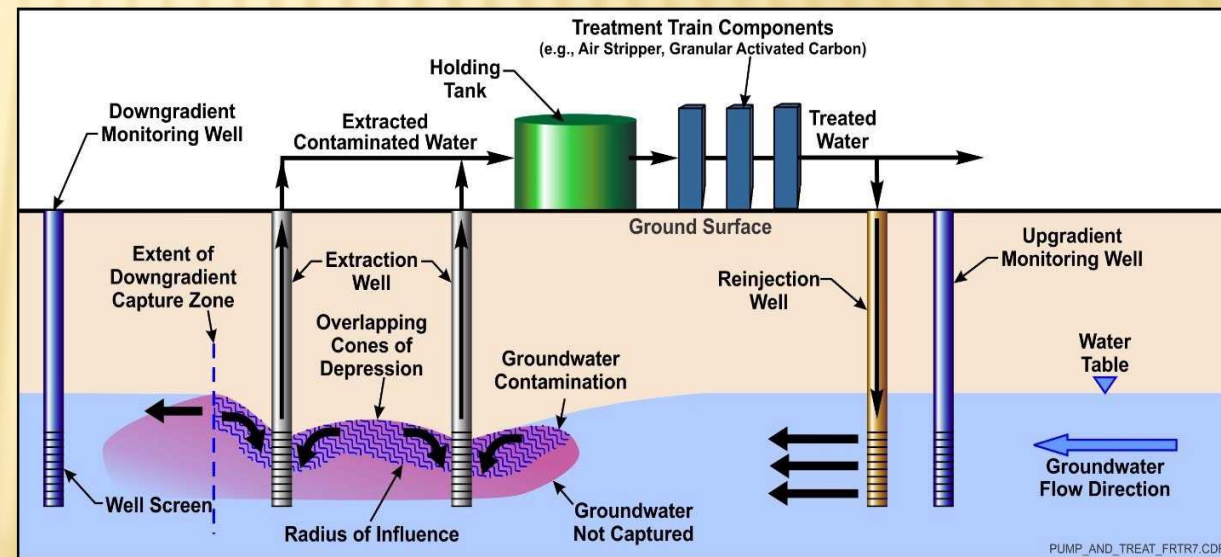
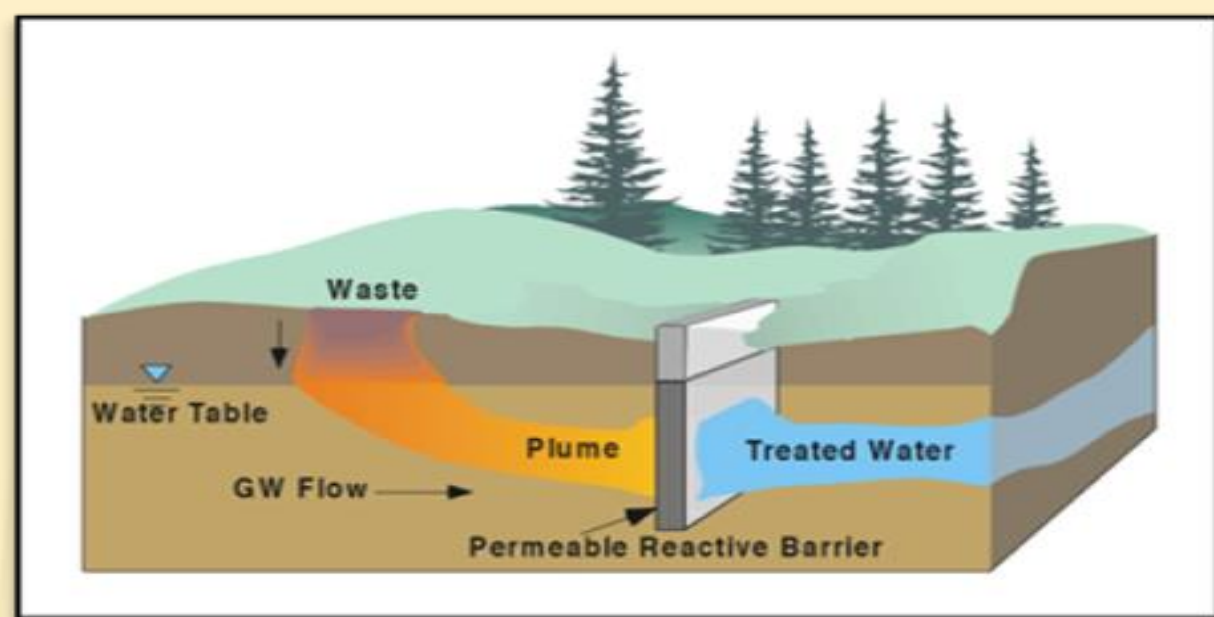
1. The landfill accepted only vegetative waste or construction debris for disposal;
2. An ***alternative means of addressing the public health and ecological risks*** associated with the landfill is available that will **afford an equivalent level of protection** of the resources of the Pinelands than would be provided if the landfill were capped with an impermeable material;
3. No leachate plume associated with the landfill exists and the landfill is not generating leachate; or
4. ***A leachate plume associated with the landfill exists but poses no significant ecological risk to wetlands.***



Impermeable material cap is the standard presumptive remedy ($K=1 \times 10^{-7}$ cm/sec) Typ. 40 mil HDPE heat or solvent welded seams

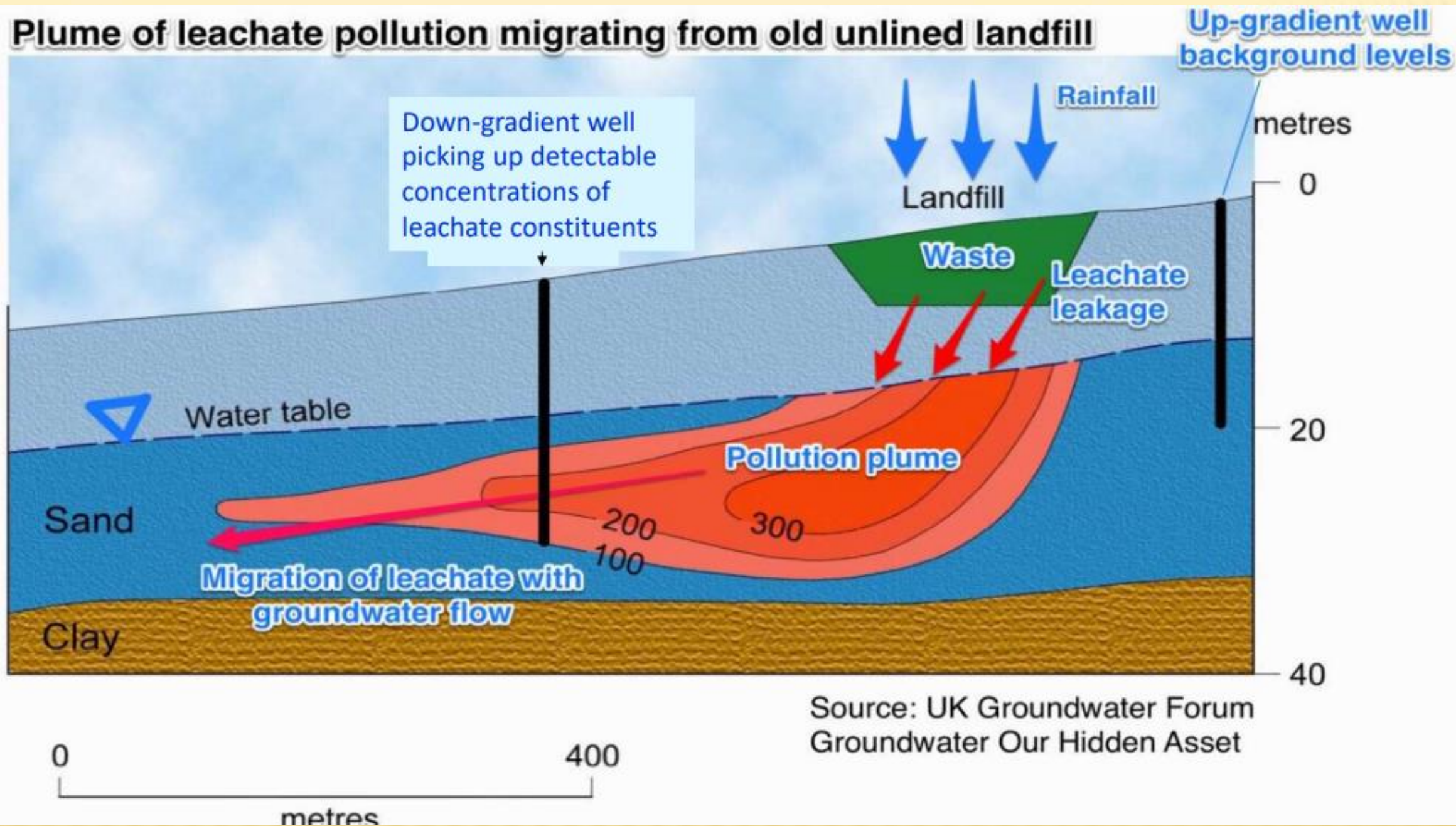


Permeable soil cover (Typ. 2' thick) is not an alternate means of addressing a public health or ecological risk – **used where no such risk exists**



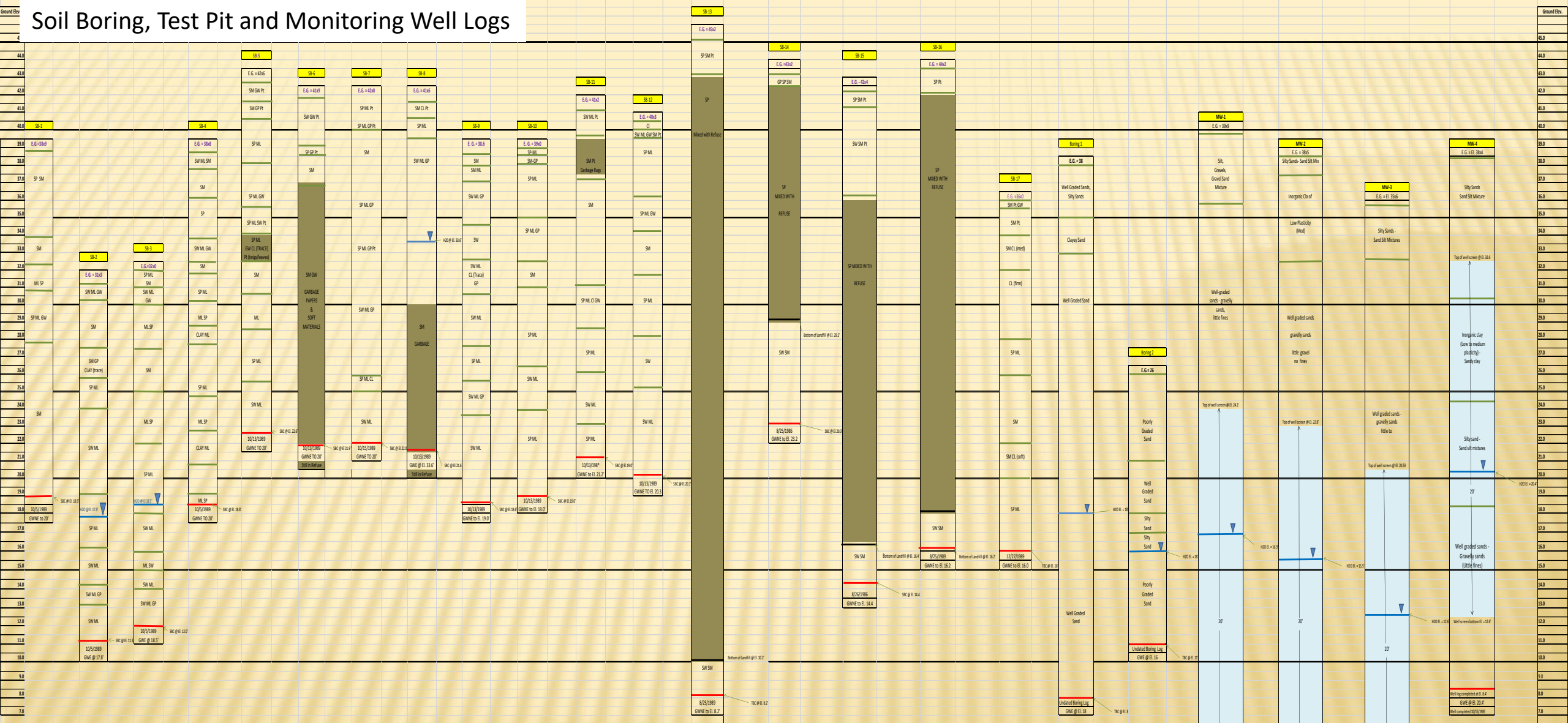
Permeable Reactive Barrier and Groundwater Pump and Treat Systems are examples of EPA approved *alternative means to addressing public health or ecological risks*

Plume of leachate pollution migrating from old unlined landfill



Source: UK Groundwater Forum
Groundwater Our Hidden Asset

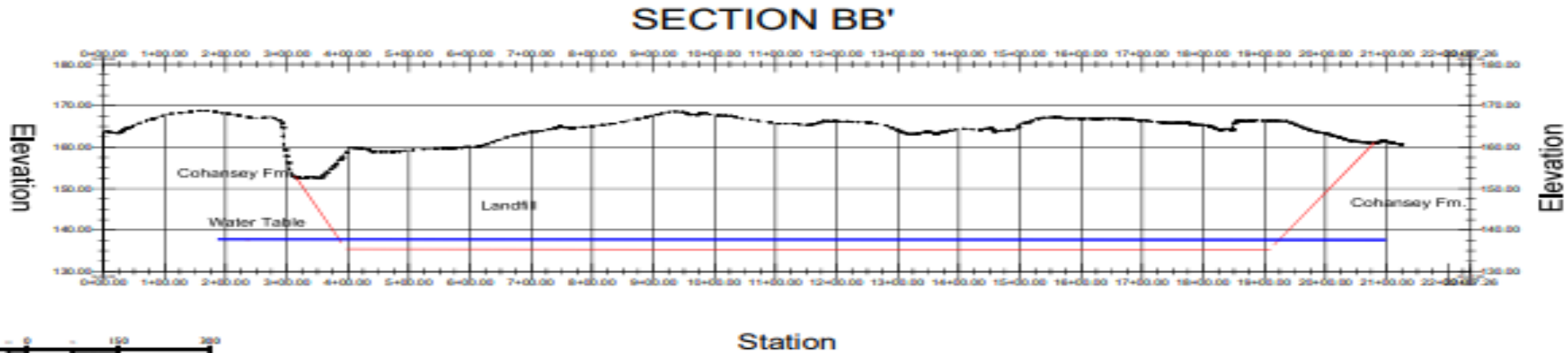
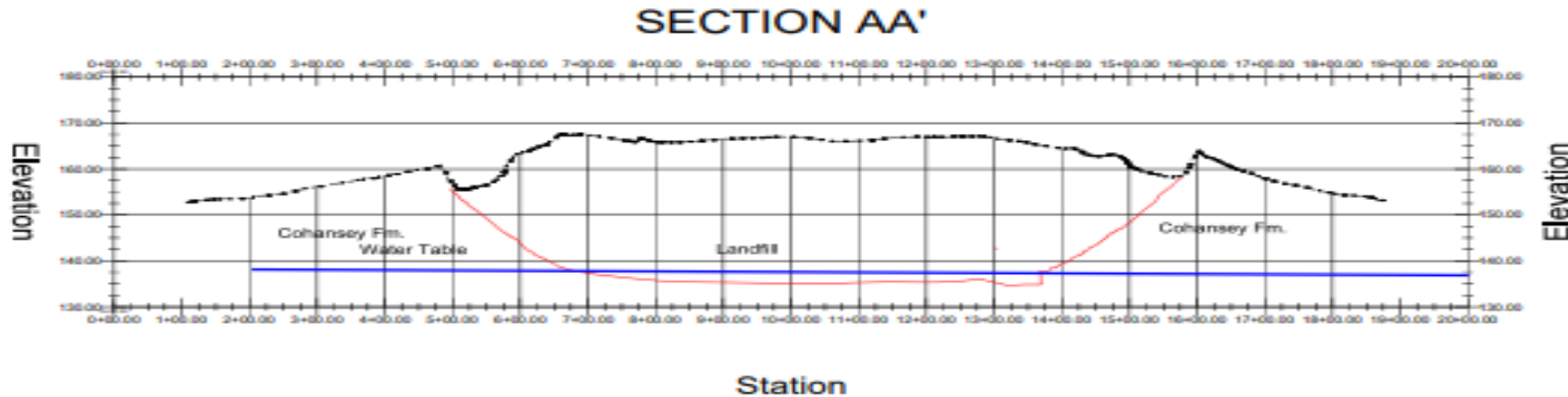
Soil Boring, Test Pit and Monitoring Well Logs



NOTE: SB-1 through SB-17 information was taken from a plan entitled: Bouough [sic] of South Toms River, Soil Borings, prepared by Mackie Associates (undated). Boring No. 1 and Boring No. 2 information taken from a plan entitled: Proposed Finished Grades, Existing Municipal Landfill, prepared by Mackie Associates, dated July 31, 1971

Provides cross sectional view of subsurface soil strata, refuse depth, monitoring well screened intervals, and depth of groundwater - all tied to a common benchmark elevation.

Longitudinal cross sections depict surface elevation depth (elevation) of refuse and elevation of the water table – components of the hydrogeologic site model



Estimating Groundwater Flow Direction

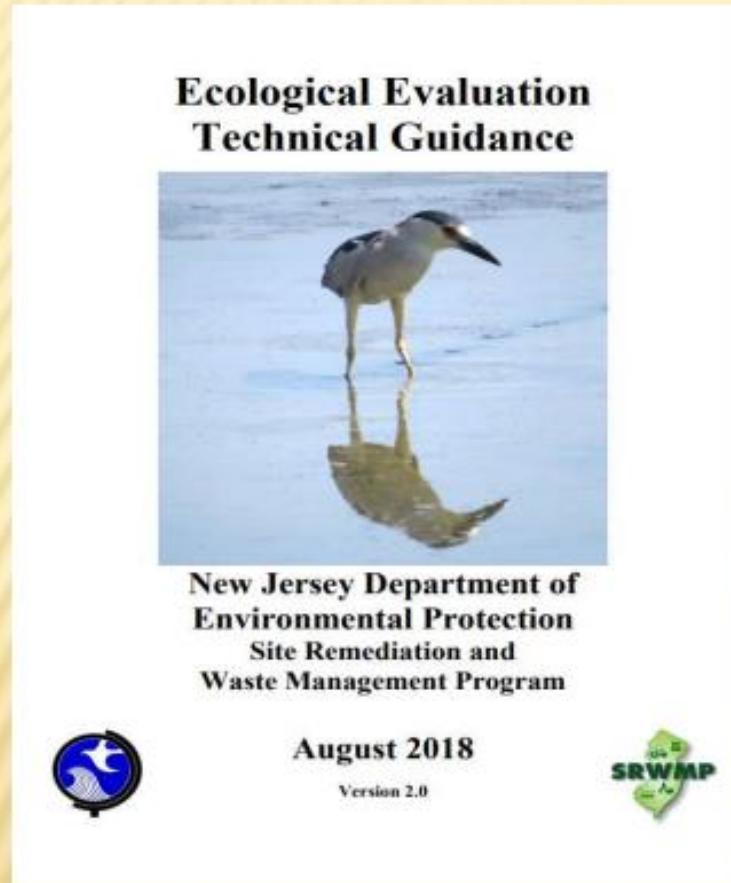
- Minimum of three water table surface (piezometric) elevations are required.

- Several water level readings taken during multiple seasons is best.



MW-5 and MW-3 are upgradient wells
MW-1 and MW-4 are side-gradient wells
MW-2 is the downgradient well

Determination of “No Significant Risk to Wetlands” (Ecological Receptors)



Technical guidance on how to conduct an Ecological Evaluation and Ecological Risk Assessment (per NJAC 7:26E-1.16 and 7:26E-4.8) for environmentally sensitive natural resources associated with contaminated sites.



Detailed technical training by senior staff from NJDEPs Site Remediation and Waste Management Program, Bureau of Environmental Evaluation and Risk Assessment, and private consultants

Determination of “No Significant Risk to Wetlands”

(Wetlands = Ecological Receptors = Environmentally Sensitive Natural Resources)



- Environmentally Sensitive Natural Resources (ESNR)
ESNRs are defined as environmentally sensitive areas pursuant to the, the Pinelands Protection Act, the Pinelands Comprehensive Management Plan
- Contaminants of Potential Ecological Concern (COPEC) -Present in groundwater monitoring wells –The list of these COPECs continues to evolve PFAS, Personal Care Products, Pharmaceuticals, EDCs, etc.
- Area of Concern (Landfilled area boundary)

Determination of “No Significant Risk to Wetlands”

- The Ecological Evaluation (EE) seeks to identify the presence or absence of contaminant migration pathways
- Concentration values from ground water monitoring wells are compared to ESC or Ecological Screening Criteria values
- ESC values are NJDEP values for individual contaminants that were usually derived by dosing experiments and that are mainly based on the no observed adverse effect level
- The ESC are generally conservative levels designed to protect the target organisms based on direct exposure.



Prescribing Leachate Constituent Testing Parameters

- NJPDES permits issued when the Pinelands Area landfills ceased operating prescribe groundwater monitoring requirement by frequency (quarterly/annually) and by parameter specificity.

Typical (old) Landfill NJPDES list

Aldrin/Dieldrin	Lindane
*Ammonia N	Manganese
Arsenic & compounds	Mercury & compounds
Barium	Methoxychlor
Benzidine	*Nitrate N
BOD	pH
Cadmium	Phenols
COD	PCBs
Chloride	Selenium
Chromium (hex & compounds)	Silver & compounds
Coliform bacteria	Sodium
Copper	Spec Cond.
Cyanide	Sulfate
DDT & metabolites	TDS
Endrin	Total organic halogen
Fecal coliform	Total VOC
Fluoride	Toxaphene
Hardness	Zinc and Compounds
Iron	2,4-D
Lead & compounds	2,4,5-TP (Fenoprop/Silvex)

* Often cited as "Landfill Signature" Chemicals

Updated testing requirements required by the PC

- Target Compound List + 30 (TCL+30) and Target Analyte List (TA) parameters including:
- Sixty-six (66) Semi-Volatile Organic Compounds – many are likely human carcinogens
- Twenty-two (22) TAL metals more extensive with some duplication
- Contaminants of Emerging Concern, including:
- PFAS compounds commonly referred to as "forever chemicals". (NETFOSAA, NMEFOSAA, PFBS, PFDA, PFDaA, PFHpA, PFHxA, PFNA, PFOS, PFOA, PFTeA, PFTriA, PFUnAPFNA, PFOS, PFOA). USGS research finds that these may be present in landfill leachate. May be limitations on sampling older monitoring wells that often contain Teflon (PFAS) tubing
- Endocrine Disrupting Chemicals (EDCs) – Bisphenol E, Bisphenol F, Bisphenol A, Bisphenol AF, Bisphenol B, Bisphenol S, 17 alpha-Dihydroequilin, Equilenin, Equilin, 17 beta-Estradiol, Estriol, Estrone, 17 alpha-Ethinyl-Estradiol
- General Chemistry Parameters

NJDEP Ecological Screening Criteria

Toxic Substance	CAS Number	Surface Water (ug/L)						Sediment (mg/kg)				Soil (mg/kg)						
		Fresh Water (FW2) Criteria			Saline Water (SE & SC) Criteria			Fresh Water Criteria		Saline Water Criteria		Wildlife PRGs (flora and fauna)	Terrestrial Plant Tox Benchmarks	EcoSSLs ²⁰				
		Aquatic		Human Health	Aquatic		Human Health	Lowest Effects Level (LEL) ¹	Severe Effects Level (SEL) ²	Effects Range Low (ER-L) ⁴	Effects Range Medium (ER-M) ⁵			Plants	Soil Invertebrates	Avian	Mammalian	
		Acute	Chronic		Acute	Chronic												
Acenaphthene	83-32-9		38 ⁸	670(h)			990(h)	See Saline Criteria ³ 0.0067 ¹³		0.016	0.500	20 ⁹						
Acenaphthylene	208-96-8		4840 ⁸					See Saline Criteria ³ 0.00587 ¹³		0.044	0.640	682 ⁹						
Acrolein	107-02-8		0.19 ⁸	6.1(h)			9.3(h)	0.0000152 ²				5.27 ⁹						
Acrylonitrile	107-13-1		66 ⁸	0.051(hc)			0.25(hc)	0.0012 ²				0.0239 ⁸						
Aldrin	309-00-2	3	0.017 ²	0.000049(hc)	1.3		0.000050(hc)	0.002	8	See Freshwater Criteria ⁶		0.00332 ²						
Aluminum	7429-90-5							2.55% ¹⁵			1.8% ¹⁵		50					
Ammonia, un-ionized	7664-41-7	See N.J.A.C. 7:9B-1.14(e)			See N.J.A.C. 7:9B-													
Anthracene	120-12-7		0.035 ⁸	8,300(h)			40,000(h)	0.22	0.0572 ²	370	0.085	1.1	1,480 ⁹					
Antimony	7440-36-0		80 ⁸	5.6(h)(T)			640(h)(T)		3 ¹⁵			9.3 ¹⁵	5 ⁹	5		78	0.27	
Arsenic	7440-38-2	340(d)(s)	150(d)(s)	0.017(hc)(T)	69(d)(s)	36(d)(s)	0.061(hc)(T)	6	9.9790 ²	33	8.2	70	9.9 ^{9,10}	10	18		43	46
Asbestos	1332-21-4			7x10 ⁷ fibers/L >10um(h)														
Barium	7440-39-3		220 ⁸	2,000(h)(T)								48 ¹⁵	283 ¹¹	500		330		2,000
Benz(a)anthracene	56-55-3		0.025 ⁸	0.038(hc)			0.18(hc)	0.320	0.108 ⁸	1,480	0.261	1.6	5.21 ⁹					
Benzene	71-43-2		114 ⁸	0.15(hc)			3.3(hc)	See Saline Criteria ³ 0.142 ²		0.34 ⁷		0.255 ⁸						
Benzidine	92-87-5		824 ¹⁰	0.000086(hc)			0.00020(hc)											
3,4-Benzofluoranthene (Benzo(b)fluoranthene)	205-99-2		9.07 ⁸	0.038(hc)			0.18(hc)	10.4 ⁸				1.800 ¹⁵	59.8 ⁸					
Benzo(k)fluoranthene	207-08-9			0.38(hc)			1.8(hc)	0.240	1,340	See Freshwater Criteria ⁶			148 ⁸					
Benzo(g,h,i)perylene	191-24-2		7.64 ⁸					0.170	320	See Freshwater Criteria ⁶			119 ⁸					
Benzo(a)pyrene (BaP)	50-32-8		0.014 ⁸	0.0038(hc)			0.018(hc)	0.37	1,440	0.430	1.6	1.52 ²						
Beryllium	7440-41-7		3.6 ⁸	6.0(h)(T)			42(h)(T)					10 ⁸	10		40			21
BHC (Benzohexachloride)								0.003	12	See Freshwater Criteria ⁶								
alpha-BHC (alpha-HCH)	319-84-6		12.4 ⁸	0.0026(hc)			0.0049(hc)	0.006	10				0.0994 ⁸					
beta-BHC (beta-HCH)	319-85-7		0.495 ⁸	0.0091(hc)			0.017(hc)	0.005	21				0.00398 ⁸					
gamma-BHC (gamma-HCH/Lindane)	58-89-9	0.95	0.026 ⁸	0.98(h)	0.16		1.8(h)	0.003	1				0.00500 ⁸					
Biphenyl	92-52-4												60 ⁹					
Bis(2-chloroethyl) ether	111-44-4		1900 ⁸	0.030(hc)			0.53(hc)	3.520 ²					23.7 ²					
Bis(2-chloroisopropyl) ether	108-60-1			1,400(h)			65,000(h)						19.9 ⁸					
Bis(2-ethylhexyl) phthalate	117-81-7		0.3 ⁸	1.2(hc)			2.2(hc)	0.182 ²	0.750 ¹⁵	0.18216 ¹⁵	2.64651 ¹⁵	0.925 ⁸						
Boron	7440-42-8											0.5 ⁹	0.5					
Bromine	7726-95-6											10 ⁸	10					
Bromodichloromethane (Dichlorobromomethane)	75-27-4			0.55(hc)			17(hc)						0.540 ⁸					
Bromoform	75-25-2		230 ⁸	4.3(hc)			140(hc)	0.492 ²				15.9 ²						

Identification of an appropriate landfill closure strategy is based on the presence or absence of contaminants of environmental concern and the presence or absence of a contaminant migration pathway.

- Concentrations of landfill leachate constituents, if detected in groundwater nearest the wetlands are compared to the published Ecological Screening Criteria (ESC) values.
- If detections are below the ESC values, or there is no migration pathway, we would conclude the landfill does not pose a significant ecological risk to the wetlands.
- If detections are above the ESC values, and a migration pathway exists, we would conclude that the landfill poses a significant ecological risk to the wetlands requiring an impermeable cap or an alternative means of addressing the ecological risk to the wetlands



Photo by Joel Mott

Questions and Discussion