Geosyntec consultants

Leachate Issues Panel Discussion

Moderated by:

Kwasi Badu-Tweneboah, Ph.D., P.E., D.GE, F.ASCE

SWANA FL 2021 Virtual Spring Conference
May 10-13, 2021

Panel to Discuss Leachate Treatment and Current Issues

Kwasi Badu-Tweneboah, Ph.D., P.E., D.GE, F.ASCE (Geosyntec)

- Panel Moderator

Richard Tedder, P.E. (Geosyntec, formerly FDEP)

- Regulatory update
- Current leachate management practices
- Changes in leachate management over the last 10+ years

Himanshu Mehta, P.E. (IRC SWDD)

- Challenges facing landfill owners and operators
- Possible solutions to address these

Jason Gorrie, P.E. (JMG Engineering)

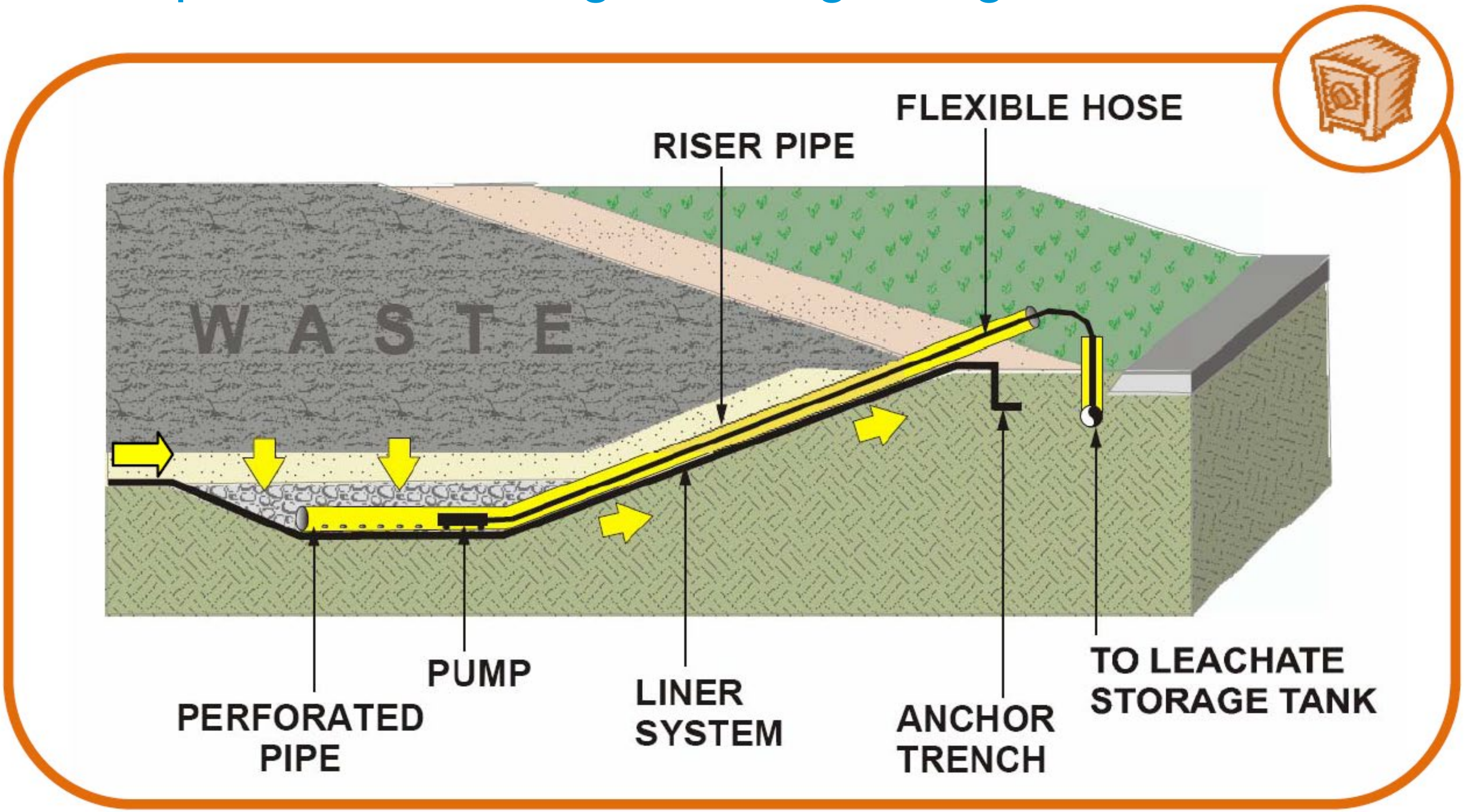
- Underground injection well
- Pasco County's Case Study
  - Past & Present Challenges
  - Viability Assessment
  - Lessons Learned

John Weigold (Heartland Water Technology)

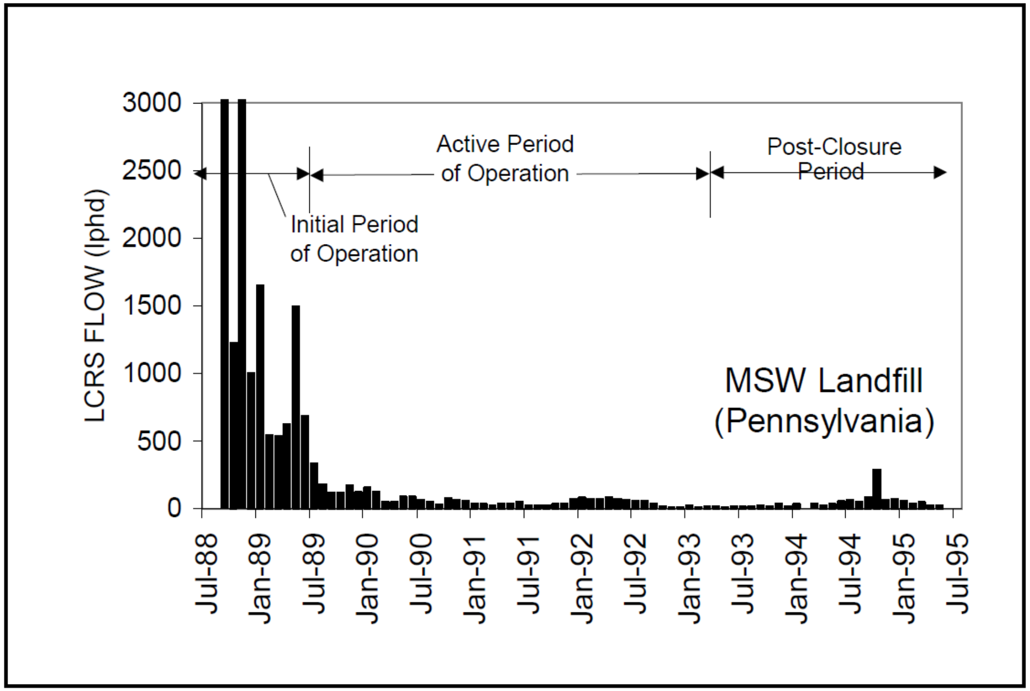
- On-Site Leachate Evaporation Technology
- Heartland Concentrator™
- Case Study Examples

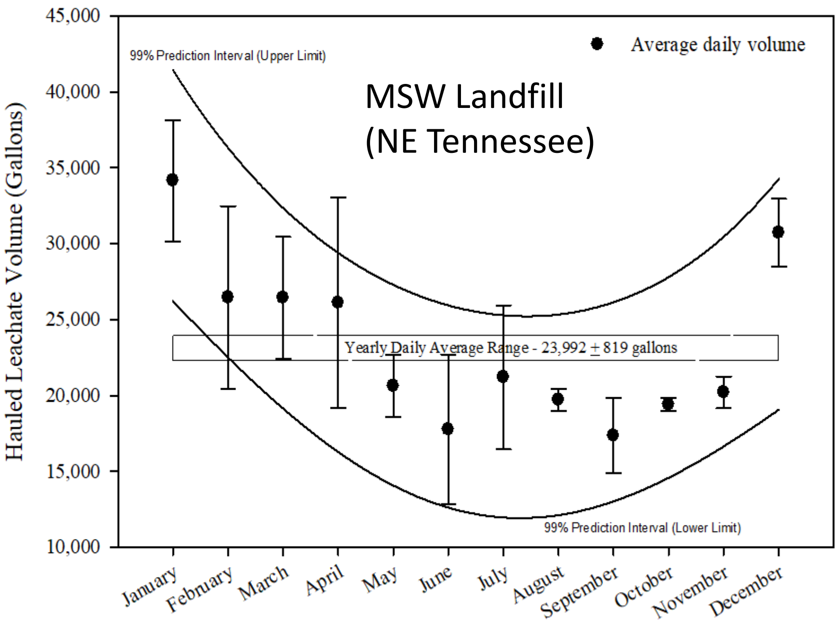
Landfill Leachate, Collection and Removal

- Landfill leachate is formed when rainwater infiltrates and percolates through the degrading waste



Examples of Leachate Flow Rates and Quantity over time





Adapted from Figure E-1.4 from Bonaparte et al. 2002, EPA/600/R-02/099

Courtesy of Herwig Goldemund (Geosyntec)

Leachate Characteristics

Domestic Wastewater vs. Landfill Leachate Characteristics							
Parameter	Unit	Domestic Wastewater[1]		Landfill Leachate		
		Weak/Medium	Strong	Young (<3/4 yrs)	Old (>8 – 10 yrs)	Typical[2]
BOD_5	mg/L	110 – 190	350	2,000 – 30,000	100 – 1,000	500 – 3,300
COD	mg/L	250 – 430	800	3,000 – 60,000	100 - 500	1,800 – 4,350
TOC	mg/L	80 – 140	260	1,500 – 20,000	80 – 160	-
NH_3-N	mg/L	12 – 25	45	10 - 800	200 – 400	150 – 2,250
NO_2/NO_3-N	mg/L	ND	ND	ND	ND	ND
Total P	mg/L	4 – 7	12	5 - 100	5 – 10	3 - 10
TSS	mg/L	120 - 210	400	200 – 2,000	100 - 400	50 - 150
pH	mg/L	-	-	4.5 – 7.5	6.6 - 8	6.8 – 7.8
TDS	mg/L	270 – 500	860	4,000 – 45,000	-	5,000 – 20,000
Alkalinity as $CaCO_3$	mg/L	50 - 100	200	470 – 58,000	-	850 – 8,000
Hardness as $CaCO_3$	mg/L			300 – 45,000	-	-
Chloride	mg/L	30 – 50	100	200 – 4,000	1,000 – 4,000	1,000 – 3,000
Sulfate	mg/L	20 - 30	50	50 – 1,500	20 - 50	10 - 500
VOC/SVOC	mg/L			ND - 2		
Metals	mg/L			ND - 40		

Notes:
1. Adapted from Table 3-15 from Metcalf & Eddy, 4th Edition
2. Leachate collected from onsite storage tanks

Leachate Management / Treatment

- Traditional Methods
  - Off-site POTW (sewer discharge or trucking)
  - Industrial WWTP (trucking)
- Recent POTW treatment and discharge restrictions (e.g., NPDES or local limits) have led to other treatment/management options

- Other options
  - On-site pretreatment
  - Recirculation into the landfill
  - Thermal Evaporation – volume reduction
  - Underground injection well
  - On-site treatment (RO, SBRs, aerated lagoons, constructed wetlands, etc.)

- Next challenge
  - PFAS as emerging contaminants

Presentation by Richard Tedder, P.E.

- Mr. Tedder has 42 years of experience in the environmental field, including over 5 years working for Geosyntec and 33 years working for the FDEP. In his most recent position with the FDEP, Mr. Tedder served as the Administrator for the Solid Waste Section of the Division of Waste Management in Tallahassee, Florida.

- He has been intimately involved in rule development, guidance and policy issues associated with all aspects of waste management for the State of Florida and is well respected throughout the solid waste industry. He has served on the Research Selection Committee of the Hinkley Center for Solid and Hazardous Waste Management for more than 11 years.

- Richard earned a B.S.E. in Chemical Engineering from the University of South Florida, and a B.S. in Psychology (minors in Chemistry & Math) from the Florida State University.

Richard Tedder, P.E.

- Regulatory Update:
  - **Leachate Testing** - There have not been any major changes to leachate regulations in Chapter 62-701, FAC, since leachate testing was removed on August 12, 2012.
- Current management practices:
  - **Off-Site** - The primary (~80%) means of leachate disposal from landfills continues to be discharging to or trucking to a POTW.
  - **On-Site** – On-site treatment continues at a few landfills using a variety of physical, chemical, and/or biological technologies such as reverse osmosis (RO), sequencing batch reactors (SBRs), aerated lagoons, and constructed wetlands.
  - **Leachate Recirculation** - Leachate recirculation continues to be a common method to minimize the volume of leachate sent to a POTW for disposal.

Richard Tedder, P.E.

- Changes in the last 10+ years:
  - **Deep Well Injection** - Over the last decade there has been an increase in the use of deep well injection for the direct disposal of leachate (either on-site or off-site). There are now approximately 8 landfills using this disposal approach in Florida.
  - **Evaporation** - There also appears to be a growing interest again in leachate evaporation as new approaches have been developed to potentially make this technology more viable. If successful, it may also reduce the volume of leachate that is discharged to POTWs.

Richard Tedder, P.E.

- Concerns with current leachate management:
  - **POTW Discharge Limits** - Landfill owners continue to be concerned that concentrations of contaminants in the leachate may cause compliance problems with POTW pretreatment limits (nutrients, metals, salts, etc.).
  - **Emerging Contaminants** - Contaminants such as PFAS in leachate are also of concern since treatment technologies for these contaminants are uncertain.
- Where do we go from here?
  - **Seek New Ways to Reduce Discharge to POTWs** - It is likely that landfill owners will seek more on-site leachate treatment alternatives and attempt to reduce the direct discharge of leachate to POTWs or at least improve the pretreatment of leachate before the discharge.
  - **Leachate Treatment Research** - Research is being supported by the Hinkley Center to treat leachate including new technologies to treat PFAS. Hopefully, this will help with future management of the leachate.

Presentation by Himanshu Mehta, P.E.

- Himanshu Mehta is the Managing Director for the Indian River County Solid Waste Disposal District (SWDD). Himanshu has been working in the Solid Waste / Recycling arena for the past 15 years after spending 2 years in the County's Utilities Department.

- As Managing Director of SWDD, he is responsible for managing the collection, recycling and disposal of solid waste from unincorporated Indian River County and municipalities of Vero Beach, Orchid, Fellsmere, Sebastian, and Indian River Shores.

- Himanshu is a University of Florida graduate with a bachelor's degree in Environmental Engineering. Himanshu worked in the environmental consulting industry for 9 years prior to joining Indian River County.

Challenges Facing Landfill Owners and Operators

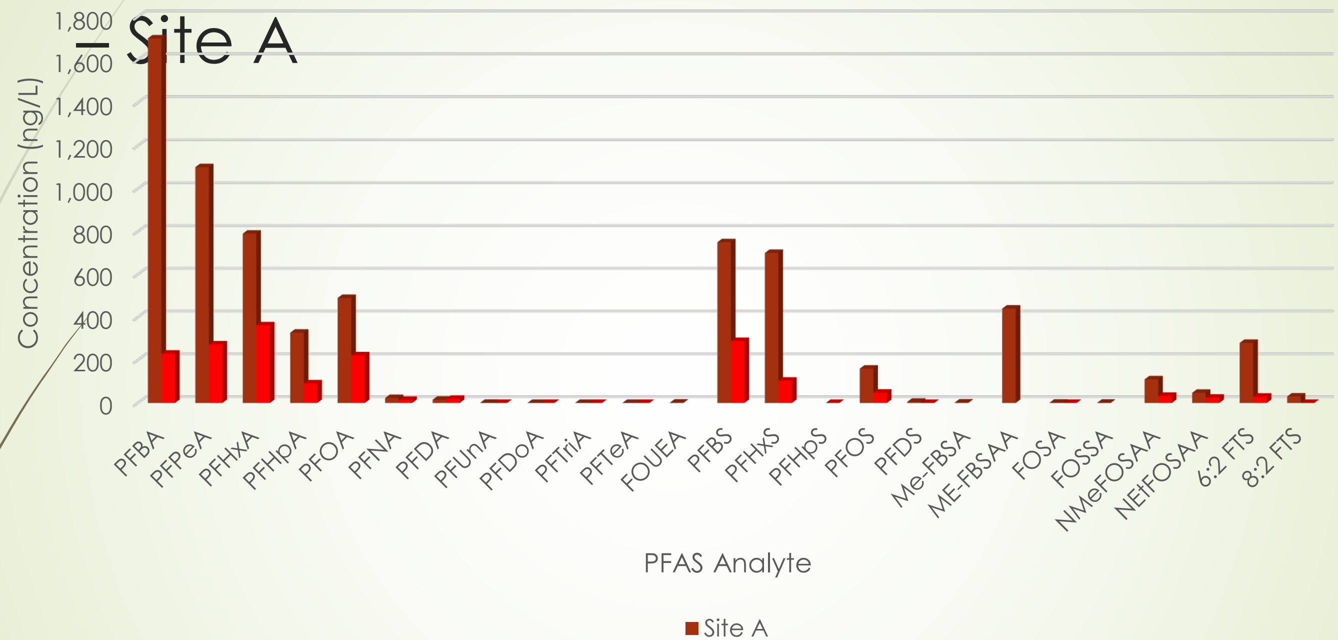
- Indian River County Landfill
  - Historical practice of sending all of the leachate to the County's Wastewater Treatment Plant for over 20 years.
  - Local Industrial Pre-Treatment Standards put in place limiting or prohibiting the acceptance of leachate.
    - Historical exceedances of select analytes
  - Permitting Challenges
  - Higher Costs for Operations & Maintenance (O&M)
  - New Regulations – PFAS
    - Limited test data available

Leachate and Gas Wells Liquids Results

Test Parameter	Analytical Method	Unit	Local Limit[1]	40 CFR 445.21 Effluent Limits (Maximum Daily)	40 CFR 445.21 Effluent Limits (Maximum Monthly Average)	March 2019 Results			April 2019 Results				January 2020 Results	November 2020 Gas Wells Results					
						Leachate	Centrate	Leachate-Centrate	Leachate	Centrate	Centrate-2	Leachate-Centrate	Leachate	GSW-38	GSW-39	GSW-40	GSW-45	GSW-48	GSW-49
General Chemistry																			
BOD, 5 day	SM 5210B	mg/L		140	37	170	69	320					1530	2240	275	879	273	2240	2200
Fats, Oil and Grease	EPA 1664B	mg/L	100			19.2	1.50 U	118		9.89	15.7	322	1.8 I	9.7	16.0	7.2	7.0	16.9	4.6 I
Fluoride	EPA 300.0	mg/L				5.8	0.23	1.7						1.3	2.0	1.4	1.5	1.6	1.8
Ammonia as Nitrogen	EPA 350.1	mg/L		10	4.9	1,200	130	320					1150	3280	1970	1970	2500	2950	2880
Total Kjeldahl Nitrogen	EPA 351.2	mg/L				1,300	150	340					1,260	2980	1790	1920	2390	3020	2510
Nitrogen, NO2 plus NO3	M 4500NO3 H	mg/L				0.53	0.028 I[3]	0.033 I					0.26	0.69	0.50	0.45	0.78	0.33U	0.87
Total Nitrogen	TKN+NOx Calculation	mg/L	40			1,300	150	340		150			1260	2980.69	1790.5	1920.45	2390.78	3020	2510.87
Phosphorus, Total (as P)	EPA 365.4	mg/L	20			11	45	51	13	110	110	110	10.5	31.0	12.1	14.3	26.6	17.0	12.8
Sulfide	SM 4500 S2 F	mg/L				0.45 U	1.7	5.3					18.7 I	40.0	72.0	184	64.0	52.0	48.0
Sulfate	EPA 300.0	mg/L				65	570	450					55.8 I	52.7	145	138	26.5 I	62.8	35.4 I
Total Organic Carbon	SM5310B	mg/L				1,100	80	260					2,610	7140	3910	5280	4960	9340	8160
Total Suspended Solids	SM 2540D	mg/L	300	88	27	20	110	240	16	130	240	280	7.8	248	22.0	76.7	40.0	192	458
Total Dissolved Solids	SM 2540C	mg/L	1,200			9,000	1,100	3,200					10100	19500	12500	13900	14800	20600	19900
Thallium	EPA 200.8	µg/L				0.580 U	0.580 U	0.580 U						5.3U	5.3U	5.3U	5.3U	5.3U	5.3U
Tin	EPA 200.7	µg/L				65.5 I	4.20 U	4.20 U						2000U	2000U	2000U	2000U	2000U	2000U
Vanadium	EPA 200.7	µg/L				293	1.70 U	43.8						45.5U	45.5U	58.1	53.4	45.5U	176
Zinc	EPA 200.7	µg/L	190	200	110	31.5 U	76.5	194	97.2	35.7	53	64.4							
Sodium	EPA 200.7	mg/L				1,700	129	319					1900						

Notes:
(1) Parameters from Section 201.68, Specific Local Limits on Discharge, of the Indian River County Code.
(2) "U" indicates that the compound was analyzed for but not detected.
(3) "I" indicates the reported value is between the laboratory method detection limit (MDL) and the practical quantitation limit (PQL).
(4) "V" indicates that the analyte was detected in both the sample and the associated method blank.
(5) Highlighted colors indicate exceedances of limits of discharge.

Leachate-Centrate Analytical Test Results: PFAS Comparison – Site A



Site	Location	Collection point	Mg refuse per day	Years of operation	Accepts biosolids	Leachate recirculation	Average annual rainfall (cm)	Chloride (mg L^{-1})	Conductivity (mS cm^{-1})	Total organic carbon (mg L^{-1})
A	Gulf Coast	Tank – Enclosed AST	2364	1998-active	Yes	Yes	160	5200	12	22 000
IRCL	**Southea st**	**Leachate-Centrate Source Pipe**	**400-500**	**1978-Presen t**	**Ye s**	**No**	**12 5**	**76 0**	**7. 0**	**26 0**

Possible Solutions:

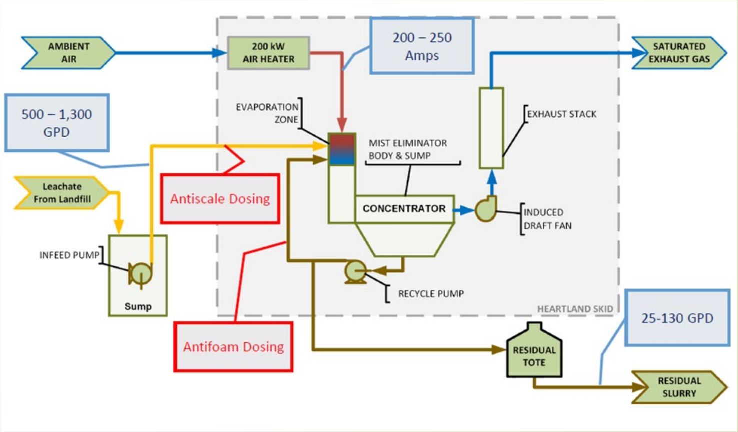
- Off-Site Treatment
- Deep Well Injection
- Evaluate Pre-Treatment Options:
  - Biological
    - Preferable for removal of nitrogen and phosphorus
    - Limited removal of arsenic; not applicable for salinity removal
  - Membrane Technology (NF or RO)
    - May be required to meet TDS limits
    - Costly (Capital and O&M)
    - ~20% reject water (high concentration brine – difficult to manage)

Possible Solutions:

- Mix of Constituents Requires Costly Treatment
  - RO only
    - Likely to meet all standards
    - High cost
    - Challenges with brine management
  - Biological only
    - Will not meet all standards
    - Could be combined with RO
      - Pretreatment facilitates RO and reduces O&M
- Leachate Evaporation
  - Chemistry doesn't really matter
  - No discharge and no permit limits
  - Different configurations and systems available

Pilot Study with Heartland's Leachate Evaporator

1,000 gpd pilot over 5-day trial period   27 – 31 January 2020



Pilot Study Results

- Operational for a total of approximately 95 hours over the 5-day trial period
  - the system was operating 99% of the time
- 5,000 gallons of landfill leachate was processed during the pilot study
- Approximately 87 gallons of concentrated residuals were generated
- >98% cumulative volume reduction was achieved during the pilot trial
- Mulch-stabilized residuals passed both the Paint Filter Liquids Test as well as the TCLP criteria
  - disposed in the Class I Landfill

Next Steps for the County

- Continuing to send Leachate to County's Wastewater Plant
- Currently evaluating 30,000 gpd Heartland Evaporator System
- Possible reconsideration of Deep Well Injection

Presentation by Jason Gorrie, P.E.

- Jason Gorrie is President of JMG Engineering, Inc. He has over 30 years of engineering experience working on various solid waste projects throughout the Southeast. His practice specializes in air quality and solid waste matters, with an emphasis on Waste-to-Energy.

- Mr. Gorrie has worked in the environmental engineering field in various positions throughout his career including the regulatory community (FDEP), the regulated community (Covanta Energy), and the consulting community (JMG Engineering and CDM).

- Jason received a B.S. degree in Environmental Engineering from the University of Florida.

Landfill Leachate Disposal Through Underground Injection

Pasco County's Experience

Jason Gorrie, PE – JMG Engineering, Inc.
Mike Weatherby, PG – HydroGeo Consulting, LLC
Justin Roessler, Ph.D., PE – Pasco County Utilities

Presentation Structure

- Pasco County's Past Struggles with Leachate Disposal
- Pasco County's Concerns with Current Leachate Management Practices
- Plotting the Course: Assessing the Viability of an Injection Well as Primary Disposal Mechanism
- Rubber Meets the Road: Obtaining Permits
- Keeping the Tires on the Road: Construction Challenges
- Approaching the Finish Line: What Pasco County Has Learned

Past Struggles

Pump to Adjacent Wastewater Treatment Facility

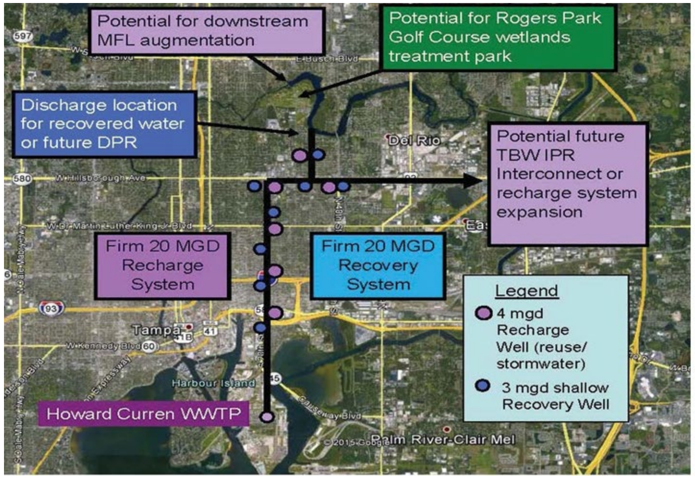
- High salt content contaminated the sprayfield

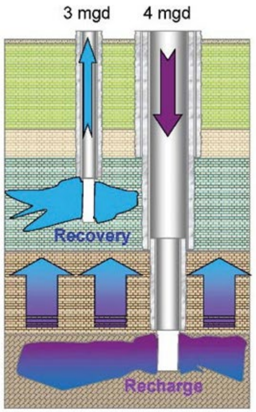
Flash Evaporation Facility

- High corrosion
- Older Technology

Concerns with Current Disposal Practice

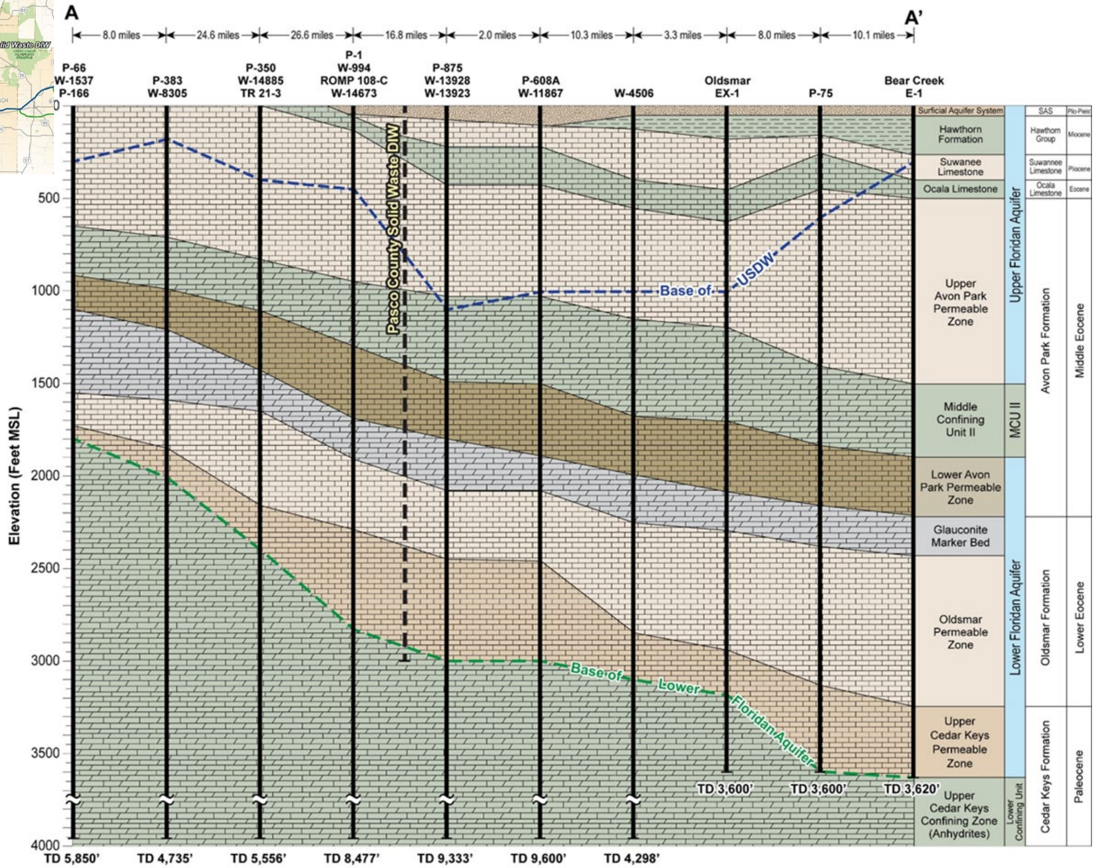
- Current disposal practice is to haul the leachate to the City of Tampa's Advanced Wastewater Treatment Facility
  - POTW's provide biological treatment – dissolved solids are merely diluted
  - Surface Water Discharges are increasingly scrutinized – **<u>watch the fate of Senate Bill 64</u>**!
  - Indirect Potable Reuse being evaluated by COT





Plotting the Course: Assessing the Viability of an Injection Well North of Tampa Bay

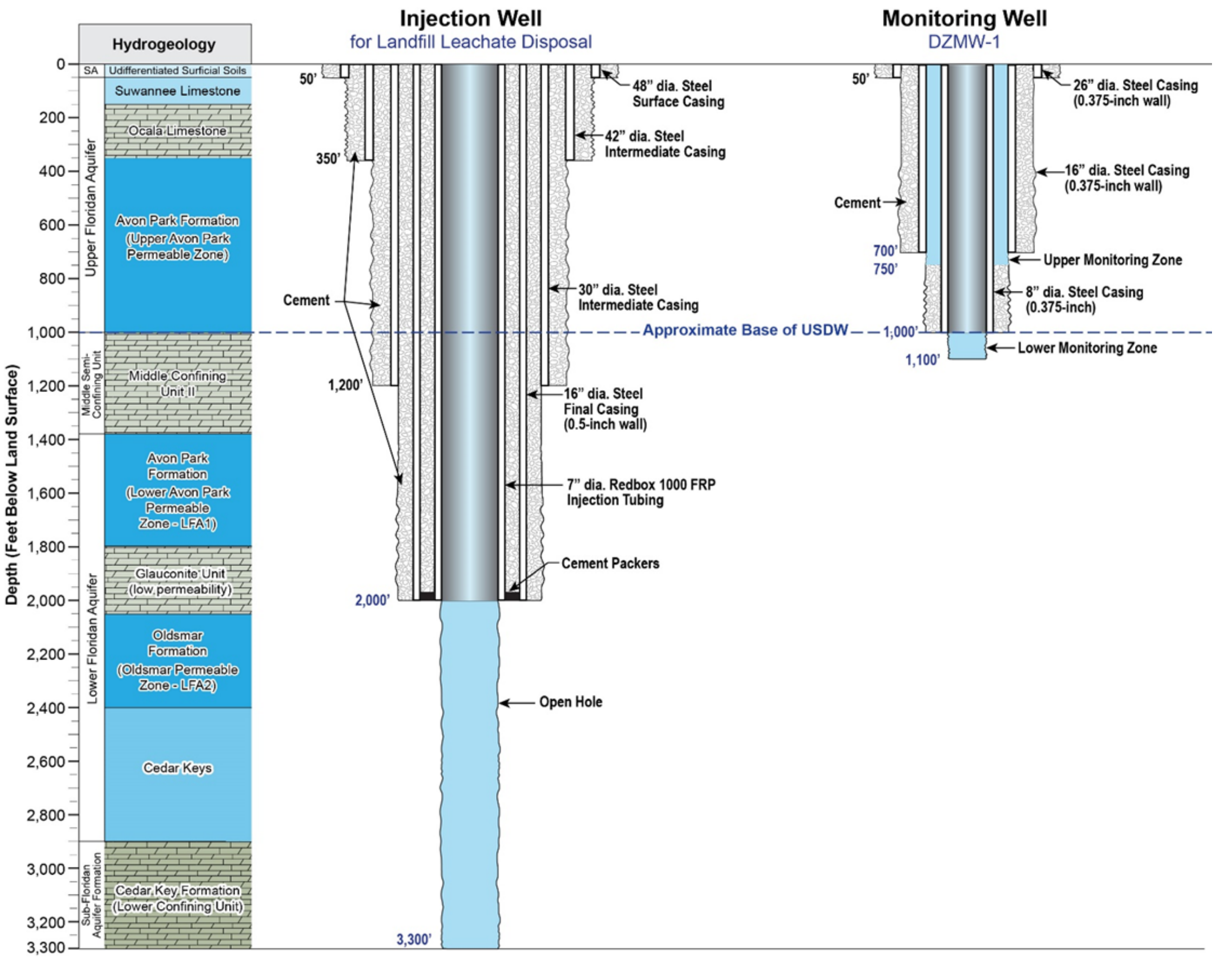
- Is there a viable injection zone?
- How deep is the base of the USDW?
- Are the aquifer conditions suitable for landfill leachate?



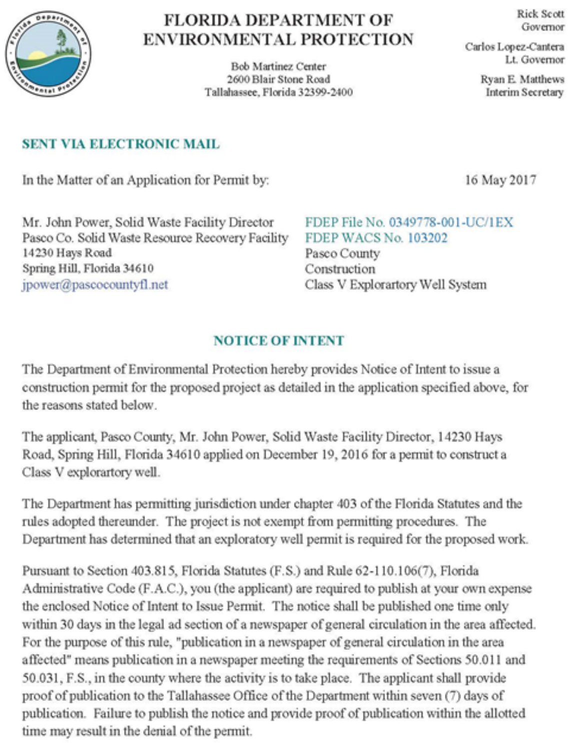
Where the Rubber Meets the Road – Obtaining Permits

- FDEP Underground Injection Control
- UIC APPLICATION OPTIONS
  - Class I – most appropriate for landfill leachate
  - Class II – oil & gas production
  - Class III – mineral extraction
  - Class IV – hazardous waste (banned in Florida)
  - Class V – other wells and exploratory wells
  - Class VI – CO_2 sequestration
- UIC APPLICATION CONTENT
  - Establish the base of the lowest Underground Source of Drinking Water (USDW)
  - Verify adequate aquifer confining intervals
  - Identify adequate injection zone
  - Identify existing legal users of groundwater

Where the Rubber Meets the Road – Injection Well Design



Public Perception



FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Bob Martinez Center
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Rick Scott
Governor

Carlos Lopez-Cantera
Lt. Governor

Ryan E. Matthews
Interim Secretary

SENT VIA ELECTRONIC MAIL

In the Matter of an Application for Permit by: 16 May 2017

Mr. John Power, Solid Waste Facility Director
Pasco Co. Solid Waste Resource Recovery Facility
14230 Hays Road
Spring Hill, Florida 34610
jpower@pascocountyfl.net

FDEP File No. 0349778-001-UC/1EX
FDEP WACS No. 103202
Pasco County
Construction
Class V Explorartory Well System

NOTICE OF INTENT

The Department of Environmental Protection hereby provides Notice of Intent to issue a construction permit for the proposed project as detailed in the application specified above, for the reasons stated below.

The applicant, Pasco County, Mr. John Power, Solid Waste Facility Director, 14230 Hays Road, Spring Hill, Florida 34610 applied on December 19, 2016 for a permit to construct a Class V explorartory well.

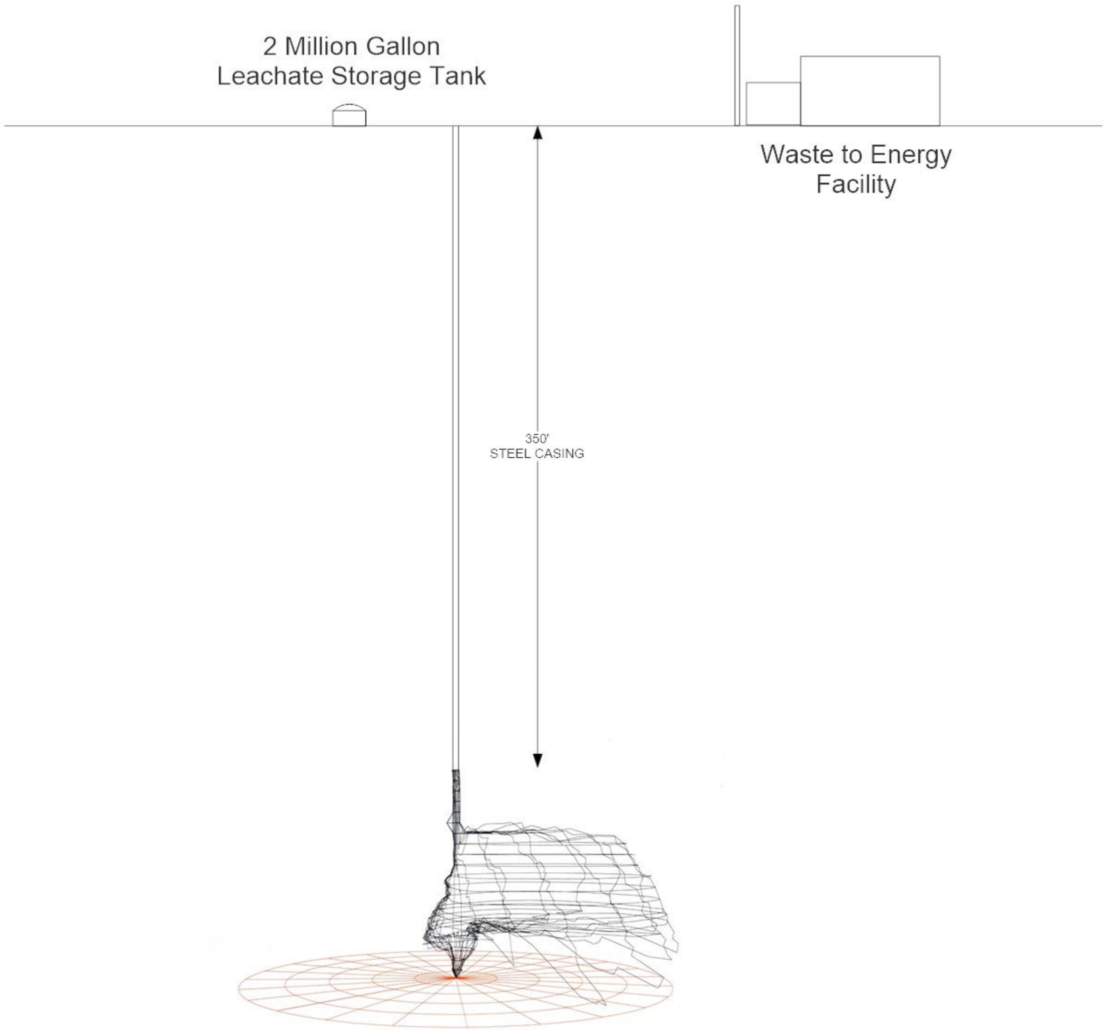
The Department has permitting jurisdiction under chapter 403 of the Florida Statutes and the rules adopted thereunder. The project is not exempt from permitting procedures. The Department has determined that an exploratory well permit is required for the proposed work.

Pursuant to Section 403.815, Florida Statutes (F.S.) and Rule 62-110.106(7), Florida Administrative Code (F.A.C.), you (the applicant) are required to publish at your own expense the enclosed Notice of Intent to Issue Permit. The notice shall be published one time only within 30 days in the legal ad section of a newspaper of general circulation in the area affected. For the purpose of this rule, "publication in a newspaper of general circulation in the area affected" means publication in a newspaper meeting the requirements of Sections 50.011 and 50.031, F.S., in the county where the activity is to take place. The applicant shall provide proof of publication to the Tallahassee Office of the Department within seven (7) days of publication. Failure to publish the notice and provide proof of publication within the allotted time may result in the denial of the permit.

Intent to Issue a UIC Permit isn't the same as Issuing a UIC Permit under Florida's Administrative Procedures Act.

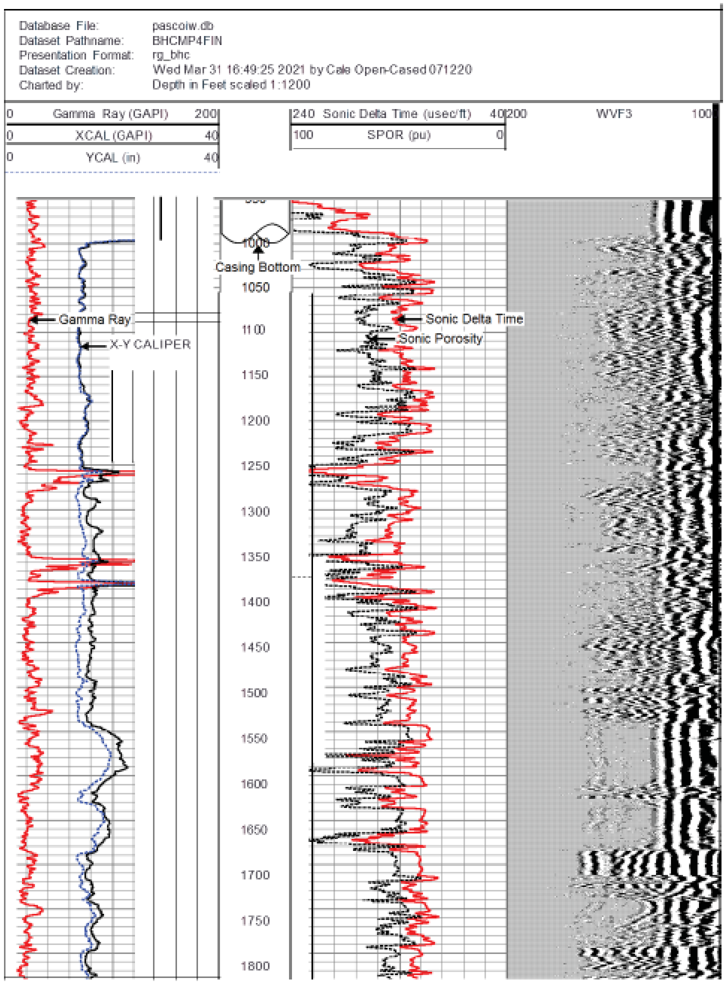
Keeping the Tires on the Road – Challenges During Drilling

As with Real Estate, it is all about LOCATION, LOCATION, LOCATION



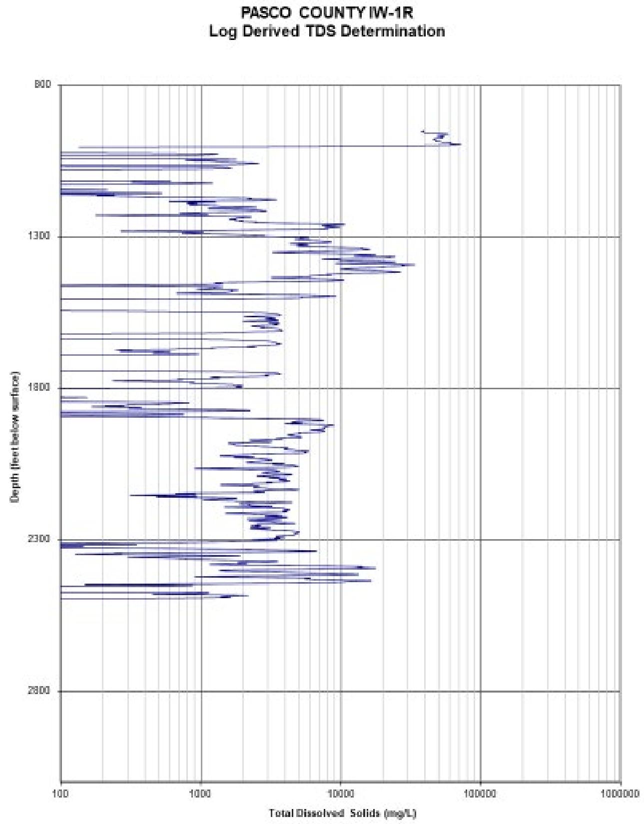
Keeping the Tires on the Road – Challenges During Drilling

Very tight confinement down to 2500' – excellent news for shallow aquifer protection – but a challenge for ultimate well capacity



Keeping the Tires on the Road – Challenges During Drilling

Surprising Water Quality Results



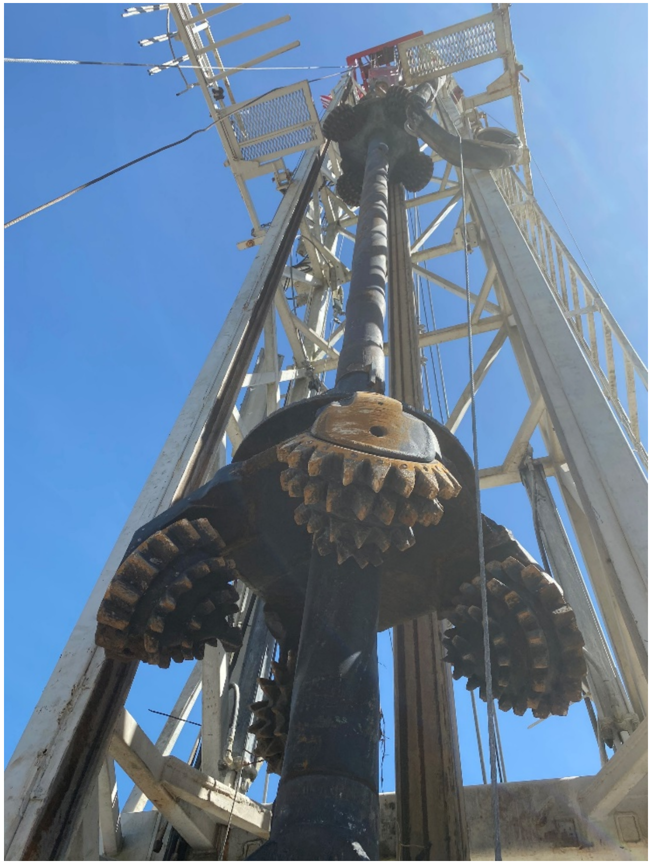
Approaching the Finish Line

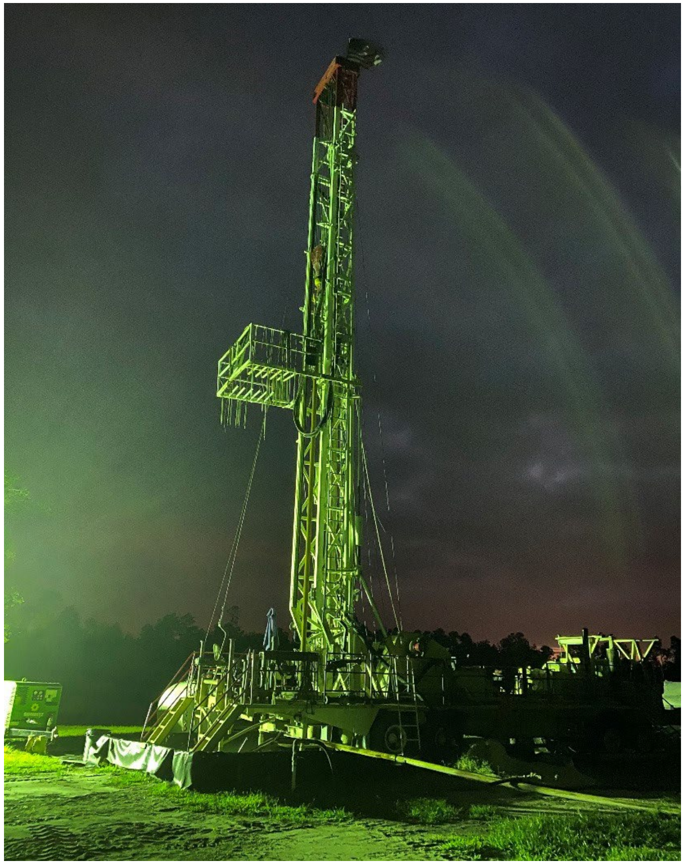
TAKE NOTHING FOR GRANTED

BE FLEXIBLE IN CONTRACT W/ DRILLING CONTRACTOR

IT IS A MARATHON, NOT A SPRINT

Thank You!





Presentation by John Weigold

- John Weigold serves as the Senior Vice President for North American Sales for Heartland Water Technology. In this role, Mr. Weigold has responsibilities for marketing Heartlands reliable, cost-effective wastewater solutions into the oil & gas, solid waste landfill leachate, coal-fired power generation, and other industries.

- Prior to joining Heartland, Mr. Weigold held senior positions in the environmental services, institutional banking, and private equity worlds. Mr. Weigold presents frequently at industry events, is a guest speaker for consulting engineering firms, and serves on panels discussing topics of interest within various industries.

- John received an MBA from Northeastern University and a BS in Management from the State University of New York.

HEARTLAND
WATER TECHNOLOGY

'Controlling Your Destiny'

Proven, Reliable,
On-Site Leachate Evaporation
Technology

SWANA
FLORIDA

5/11/21

Overview

Founded in 2008, Heartland Water Technology ("HT") has patented and commercialized novel technology for treating difficult-to-treat industrial waste waters

The Heartland Concentrator is a direct contact evaporator that sets new benchmarks for reliability, ease of use and cost to treat

Proven technology with tier 1 customers in key applications

WM Think Green! | SENECA RESOURCES | National Fuel | KCP&L | GREAT PLAINS ENERGY | EPRI ELECTRIC POWER RESEARCH INSTITUTE

Proven Applications

- Landfill Leachate
- Flu Gas Desulfurization
- Produced Water
- Enhanced Pond Evaporation

"You're Cutoff!" Now what?

~60% of Leachate is 'treated' with 'solution by dilution'

STP's are increasingly taking action on leachate disposal

1. Increasing price
2. Requiring more and more pre-treatment
3. 1 and 2 above
4. Cutting off leachate completely

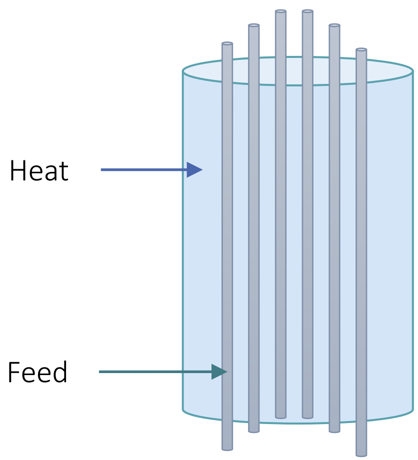
Key Drivers

1. Nutrient loading
2. UV absorption
3. Contaminants of emerging concern

Use of Thermal Evaporation

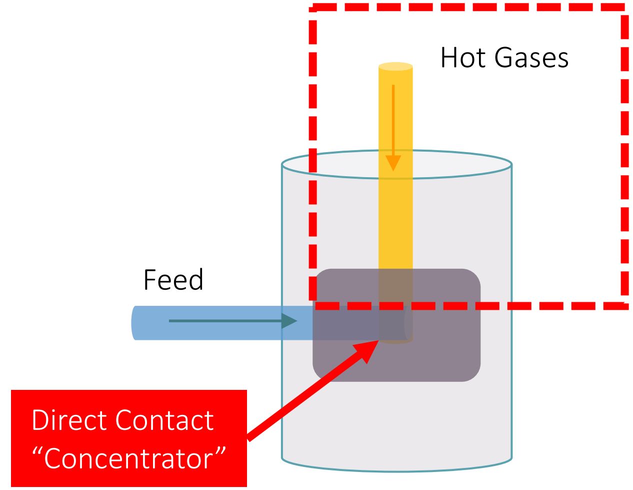
ALTERNATIVE FUELS

Thermal Brine Concentrators



- Feed v r interior t be bundles.
- Heat tra s acr ube bundles.
- Tube bund to fouling, rapid corrosion.
- Requires co ble high-alloy metals.
- Requires c ide pre-treatment and highly experie water rators
- Requi crystallize chieve ZLD

Heartland Concentrator



- **No heat exchange surfaces** or membranes to foul; low-cost materials.
- **Direct use of waste heat** (exhaust gases).
- Patented Gas-Liquid Section creates acres of surface area for rapid evaporation.
- **Require little-to-no pre-treatment** and anyone can be trained to operate
- **Can deliver ZLD in a single unit operation … no crystallizer required**

LM-HT® Heartland Concentrator™

1. Heat Source
2. Evaporation Zone
3. Feed and Recirculation
4. Droplet Separator
5. Sump and Blowdown
6. Exhaust

Sizes	12K to 144K gpd per unit
Applications	MSW, Brine Ponds, O&G, FGD Purge Water, Other
Delivery	6-9 months; Fully skidded, Modular and re-deployable
Flex-Heat	Flare, Recip Engine Exhaust, Recip Engine Jacket, GT, Hybrid
Value Added Solutions	Plume Suppression; Ammonia Management
Lifespan	20+ years

Left: Process fluids as they exit the concentrator.

Right: Solids accumulating in a settling tank. Liquid recycled back to the concentrator.

Case Study Examples

FLARE	CoVAP	Hybrid
Kenai, AK	King George, VA	Pontotoc, MS
Landfill gas flare	Solar Centaur 40 Turbine	Flare & Reciprocating Engine
12K GPD	100K GPD	25K GPD
Installed 2014	Installed 2013	Installed 2019

Industry Leader in Landfill Leachate RO Concentrate Evaporation

Location: Cumberland County, NJ Landfill

Thermal Energy: Waste Heat from Reciprocating Engines

Capacity: 25,000 GPD

Cumberland County Improvement Authority

Energy Power Partners
Renewable Investments With Sustainable Results

Thank you!

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Questions & Answers