



Community Meeting September 21st, 2023

CEDAR HILLS High BTU Gas Plant Landfill Gas Collection and Arsenic Issues



BEW Presentation

- **Reduction in Landfill Gas Collection**
- **Arsenic in Landfill Gas**
- **Lost Opportunity Costs**
- **Questions and Answers**

- **Representing BEW**
 - **Kevin Singer, Plant Manager**
 - **Chuck Packard, CEO**
 - **Bob Rauch, outside counsel for BEW**



Reduced Landfill Gas Collection

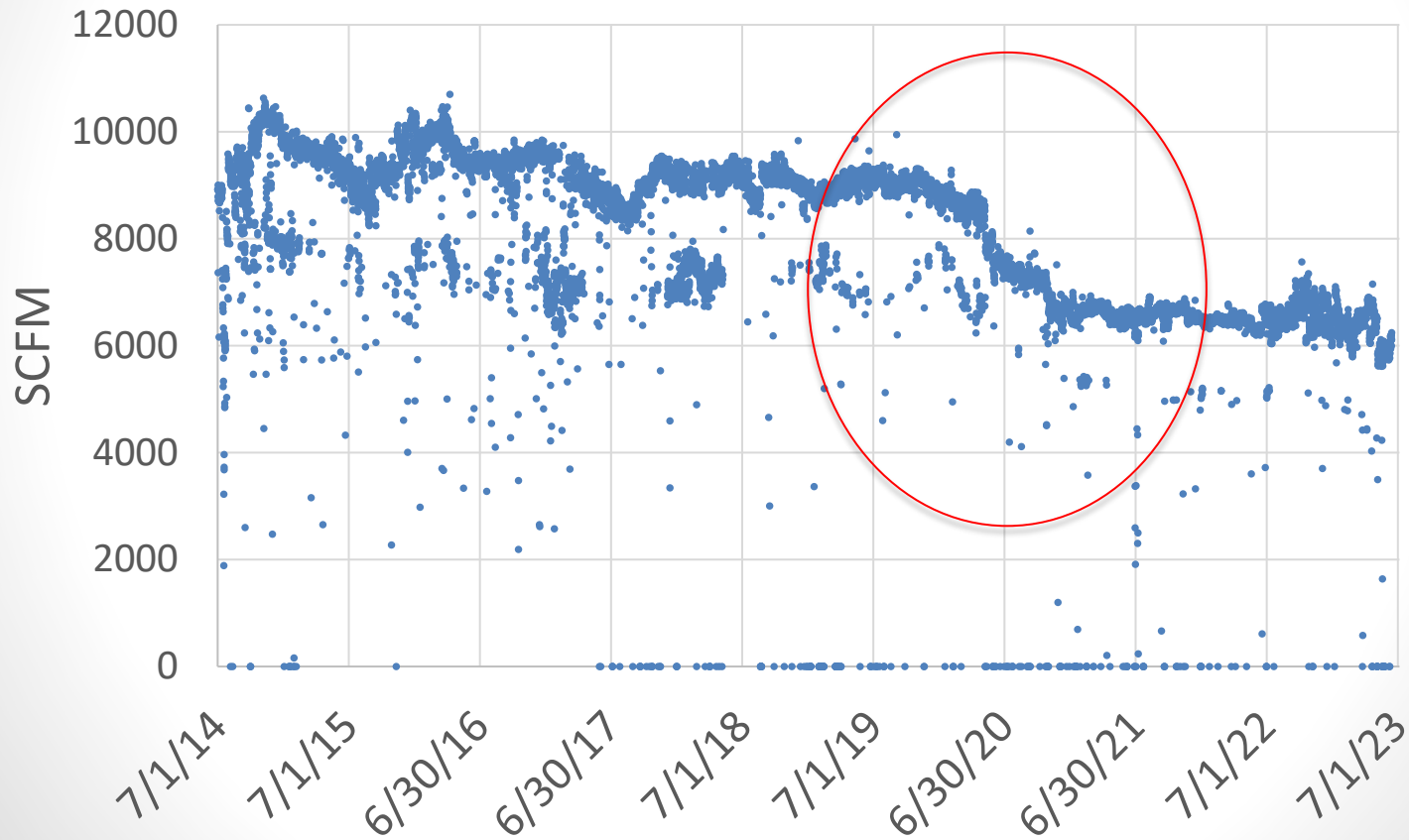
- County was collecting over 10,000 standard cubic feet per minute (SCFM) of Landfill Gas
- BEW plant was initially built to process up to 11,000 SCFM
- At one time, County said that they expected 12,000 SCFM based on future levels of waste in place

Steep Decline in Gas Production

- Landfill Gas production generally falls over time after a landfill ceases to accept waste material
- Cedar Hills remains an open landfill continuously receiving waste
- Landfilled waste volume & composition did not change
- At the end of 2019, the Landfill Gas production at Cedar Hills began a relatively steep decline which continued for approximately one year before stabilizing at a lower level

Reduced Landfill Gas Collection

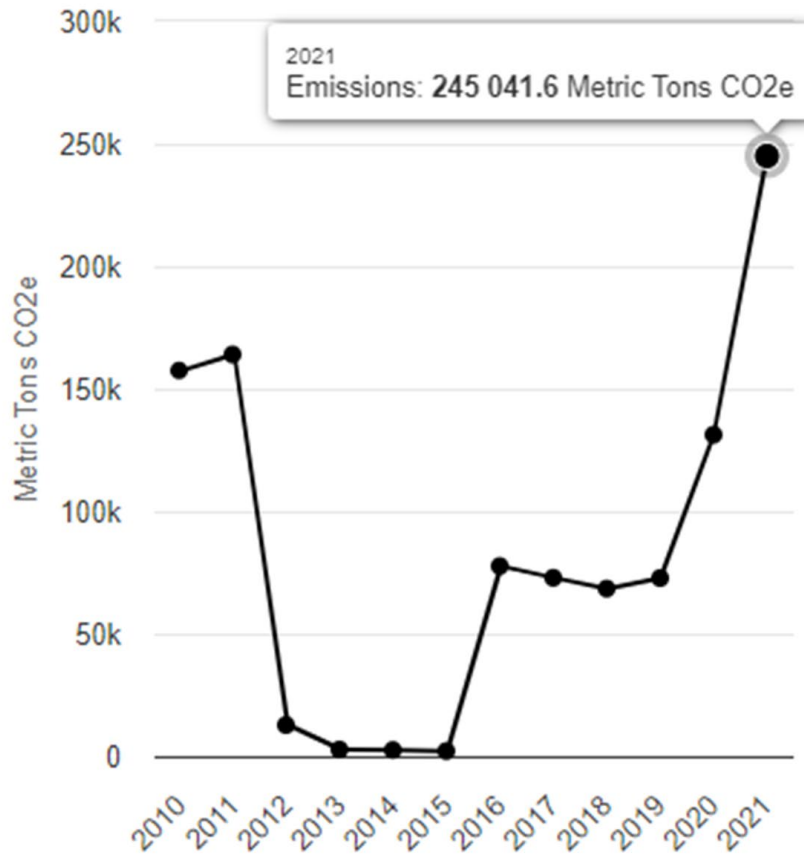
Landfill Gas Flow to BEW



Increased GHG Emissions

Facility Information

Facility Emissions by Year



Why did Gas Flow Decline?

- As a closed landfill ages, normal gas production from waste does not decrease quickly and then stop declining
- County's collection system is impaired
 - King County uses horizontal collection “wells”
 - These pipes develop water “traps” due to natural waste settlement
 - Water traps function like plumbing traps under a sink: they stop gas flow
- Most landfills use vertical gas wells which do not develop such traps

Gas Collection Pipe



LFG completely water blocked.

Where is the Missing Landfill Gas?

- On January 19th 2021, BEW hired Pergram Technical Services to conduct a landfill overflight using a methane detecting drone
- This is the same technology used by pipeline companies to detect natural gas leaks
- Results of the overflight revealed considerable methane leakage from the Cedar Hills landfill

Results of Drone Overflight

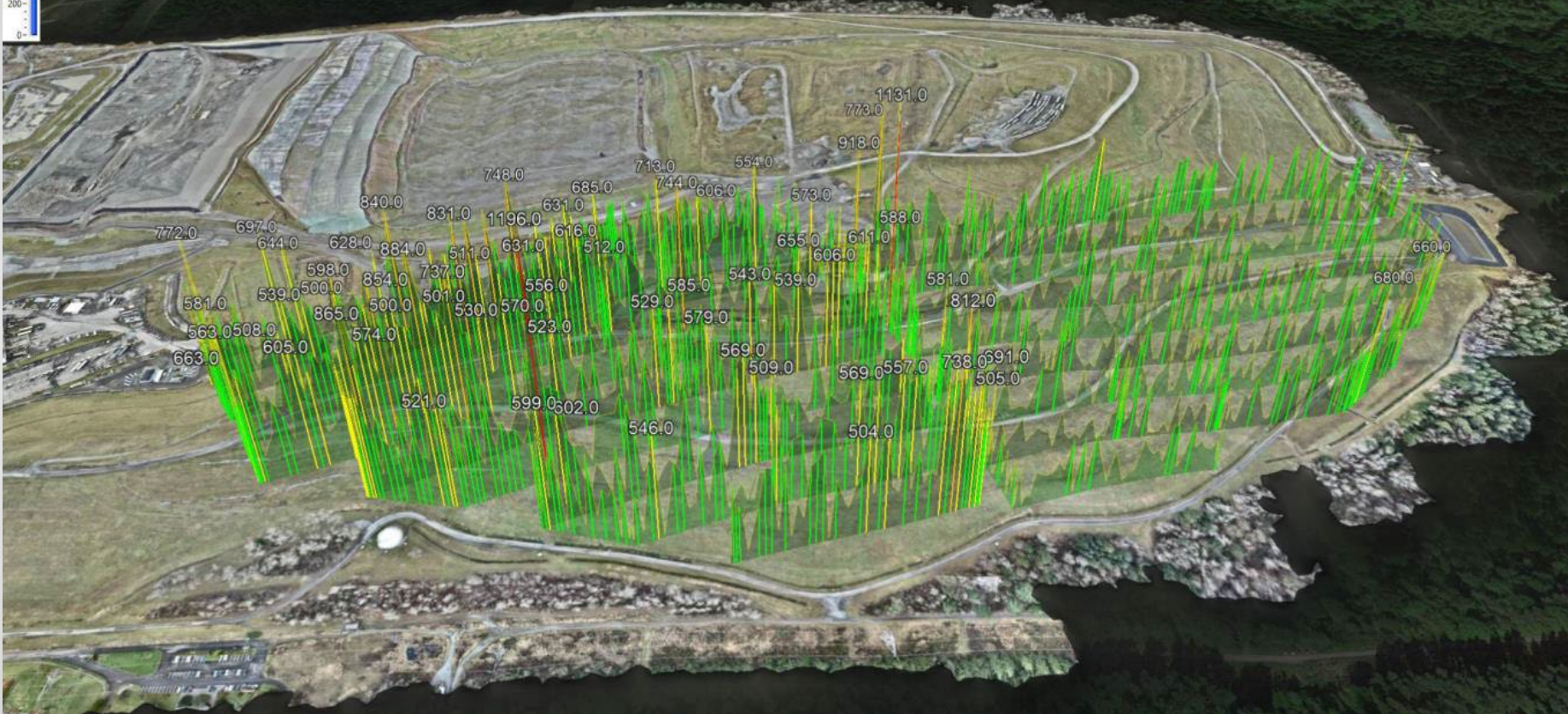
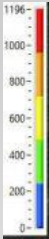
- The County has to measure the Landfill Gas leakage at the surface of the landfill
- Readings of over 500 ppm of methane is considered excessive leakage and are reportable
- The drone measured methane at the surface but also in the air over the landfill
- There were 188 measurements over 500 ppm in landfill Area 7 and 811 over 500 ppm in Area 8

The Drone Found the Missing Gas



Cedar Hills Regional Landfill

Zone 3 - Temp 37F Wind 6MPH From the South.

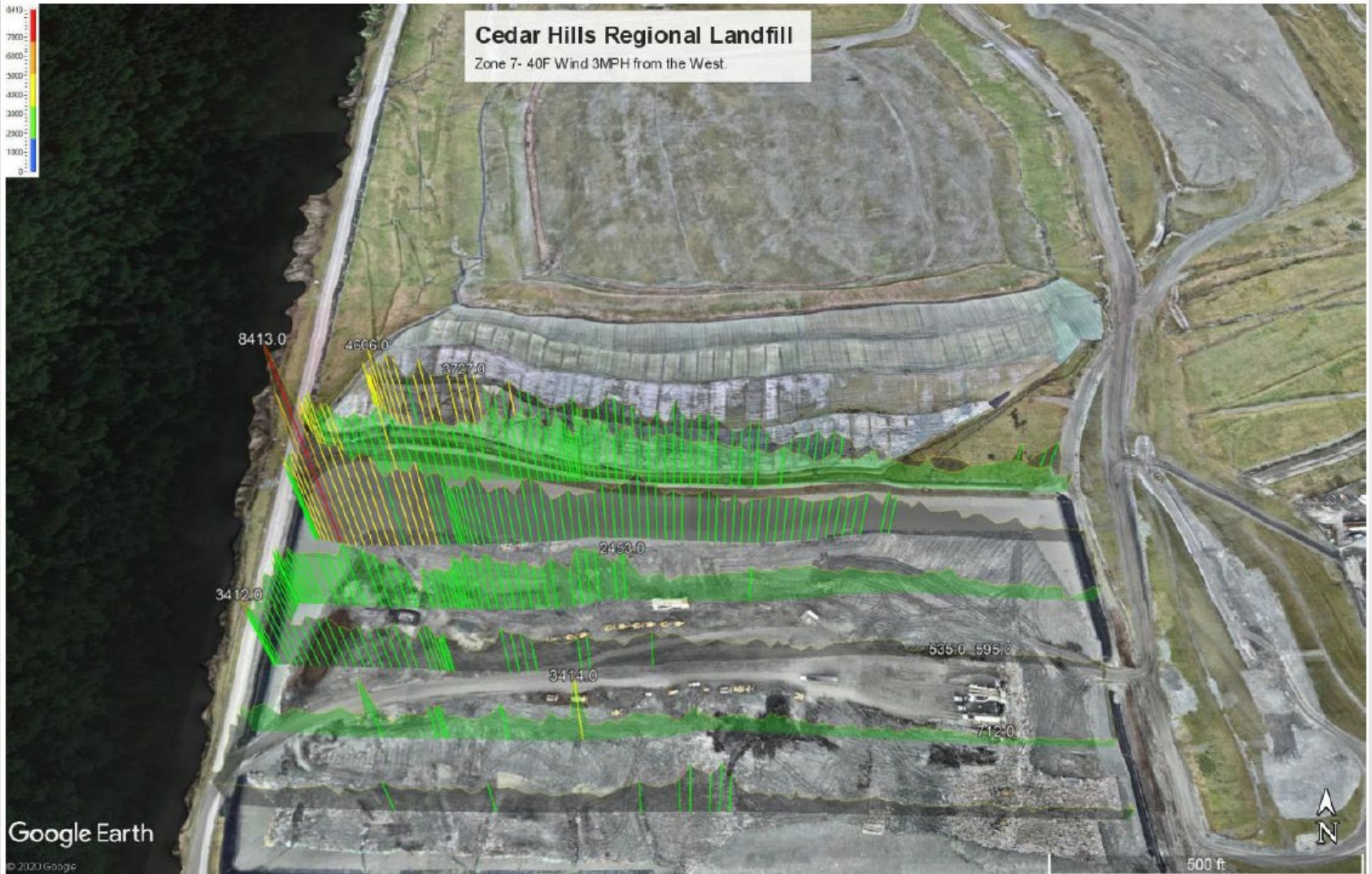


Google Earth

© 2020 Google



800 ft





County Uses the Pergam Report

- We understand that the County was able to use the Pergam report to identify landfill gas leaks and subsequently make repairs in its gas collection system – a good thing and a good use of Drone data
- One year later, BEW wanted to conduct a second drone overflight to again measure landfill gas leakage
- County threatened BEW with criminal trespass if we conducted a second overflight

County has No Apparent Interest in More Data

- Laura Belt stated at a community meeting that the County was going to conduct its own drone overflight to measure methane leakage
- To date, BEW has no knowledge of the County conducting any such flight
- It would appear that the County does not want to know how much gas is escaping from its landfill

Effects of Landfill Gas Leakage

- Leaking Landfill Gas is a source of the odor that many people smell coming from the landfill
- Landfill Gas leakage poses a potential public health risk
- Increased Greenhouse Gas Emissions – Both Carbon dioxide (CO₂) and Methane (CH₄)

Effects of Landfill Gas Leakage

- Rather than improve the performance of the gas collection system, the County uses a perfume system in an attempt to cover up the smell coming from the landfill
- The County is forfeiting considerable revenue from Landfill Gas which is not collected
- This amounts to millions of dollars annually.

Arsenic in the Landfill Gas

- Landfill gas contains a “chemical dictionary” of compounds and chemicals
- Many of these “drop out” in landfill gas condensate
- Gas compression and cooling creates landfill gas condensate
- It is impossible to process landfill gas without creating condensate

Arsenic Compounds in Landfill Gas

• Species Name	Abbreviation	Chemical Formula
• Arsenite (Arsenous acid)	As (III)	As(OH) ₃
• Arsenate (Arsenic acid)	As (V)	AsO(OH) ₃
• Monomethylarsonous acid	MMA (III)	CH ₃ AsO(OH) ₂
• Monomethylarsonic acid	MMA (V)	CH ₃ AsO(OH) ₂
• Dimethylarsinous acid	DMA (III)	(CH ₃) ₂ AsOH
• Dimethylarsinic acid	DMA (V)	(CH ₃) ₂ AsO(OH)
• Dimethylmonothioarsinic acid	DMMTA (V)	(CH ₃) ₂ SAsO(OH)
• Dimethyldithioarsinic acid	DMDTA (V)	(CH ₃) ₂ S ₂ AsO(OH)
• Arsenobetaine	AsB	(CH ₃) ₃ As+CH ₂ COO-
• Arsenobetaine-2	AsB-2	(CH ₃) ₃ As+CH ₂ CH ₂ COO-
• Arsenocholine	AsC	(CH ₃) ₃ As+CH ₂ CH ₂ OH

Arsenic Compounds in Landfill Gas

• Trimethylarsine oxide	TMAO	$(\text{CH}_3)_3\text{AsO}$
• Arsine -		AsH_3
• Methylarsine -		$\text{As}(\text{CH}_3)\text{H}_2$
• Dimethylarsine -		$\text{As}(\text{CH}_3)_2\text{H}$
• Trimethylarsine	TMA (III)	$\text{As}(\text{CH}_3)_3$
• Dimethylethylarsine -		$\text{As}(\text{CH}_3)_2(\text{C}_2\text{H}_5)$
• Diethylmethylarsine -		$\text{As}(\text{CH}_3)(\text{C}_2\text{H}_5)_2$
• Triethylarsine -		$\text{As}(\text{C}_2\text{H}_5)_3$
• Arsenic trioxide -		As_2O_3
• Monosodiummethylarsonate	MSMA	$\text{HAsO}_3\text{CH}_3\text{Na}$
• Disodiummethylarsonate	DSMA	$\text{Na}_2\text{AsO}_3\text{CH}_3$
• Phenylarsonic acid	PAA	$\text{C}_6\text{H}_5\text{AsO}(\text{OH})_2$
• <i>p</i> -Arsanilic acid	<i>p</i> -ASA	$\text{NH}_2\text{C}_6\text{H}_4\text{AsO}(\text{OH})_2$
• 4-nitrophenylarsonic acid	4-NPAA	$\text{NO}_2\text{C}_6\text{H}_4\text{AsO}(\text{OH})_2$
• 4-hydroxy-3-nitrophenylarsonic acid	3-NHPAA	$\text{NO}_2(\text{OH})\text{C}_6\text{H}_4\text{AsO}(\text{OH})_2$
• <i>p</i> -ureidophenylarsonic acid	<i>p</i> -UPAA	$\text{NH}_2\text{CONHC}_6\text{H}_4\text{AsO}(\text{OH})_2$

Source:

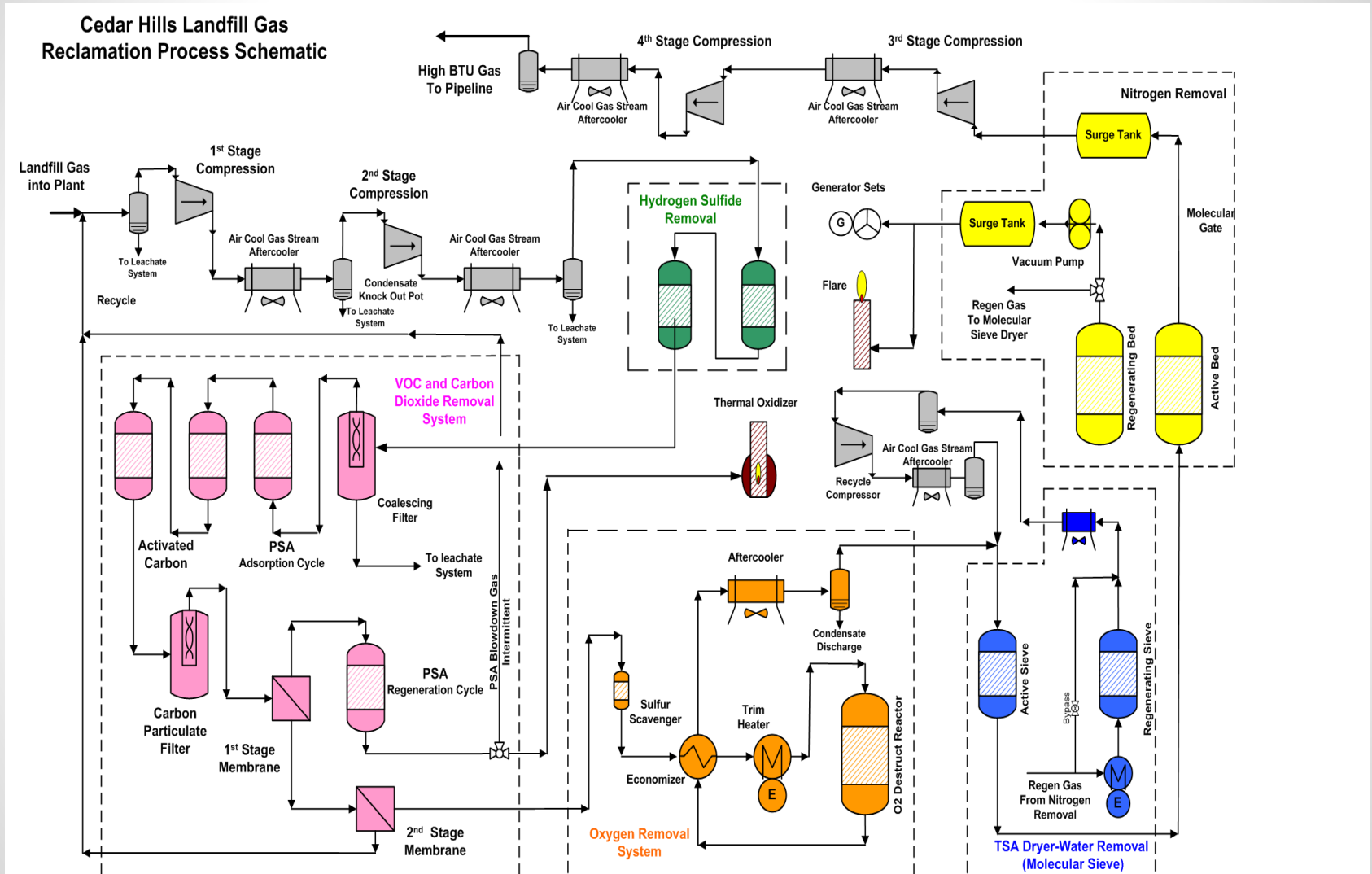
Comparison of Physicochemical Methods to Remove Arsenic from
Landfill Leachate and Gas Condensate

Surbhi Malik University of Washington 2020





The BEW Process

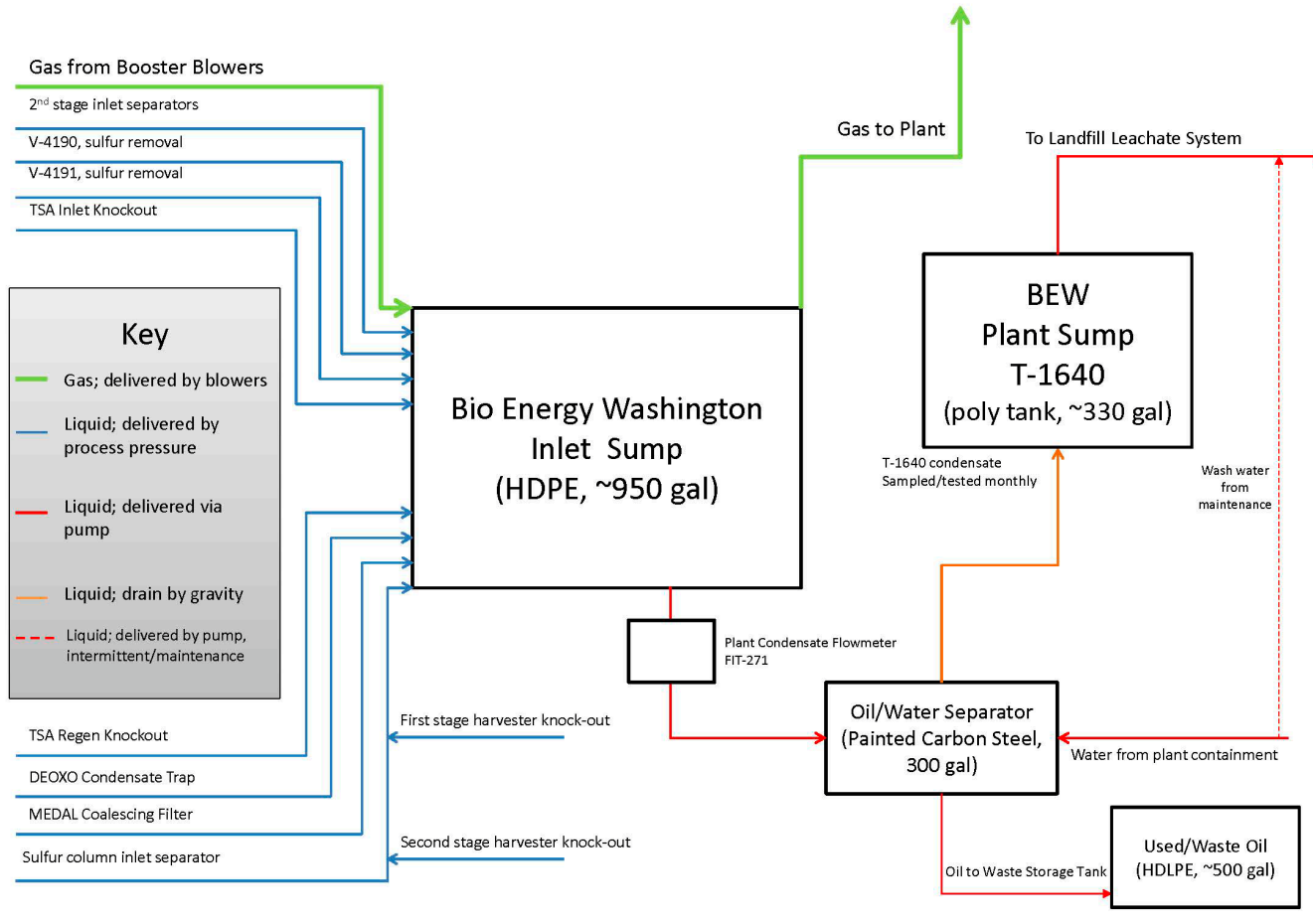


How the BEW Process Works

- The Landfill Gas is compressed and then cooled for processing
- This creates Landfill Gas condensate
- BEW's Project Development Agreement with King County provides that the County is responsible for accepting this condensate from BEW and legally disposing of it
- King County also generates Landfill Gas condensate from its various sumps

BEW Condensate Flow

Condensate Overview – Bio Energy Washington



Condensate Disposal

- King County Solid Waste Division (KCSWD) has for years accepted the BEW condensate and put it in its leachate lagoon, along with all its other waste water
- After treatment and settling, the waste water is discharged to the Publicly Owned Treatment Works (POTW) sewer
- In 2015, King County discovered that the Landfill Gas condensate from both the County and BEW contained relatively high levels of Arsenic

Wastewater Discharge Permit

- King County's Solid Waste Division has a discharge permit that authorizes discharge of its waste water, subject to certain limits.
- BEW has no process discharge and therefore has no discharge permit.
- The County permit specified that KCSWD could discharge up to 0.4 lbs per day of arsenic to the POTW
- In 2018, the Arsenic limit was lowered from 0.4 to 0.27 lbs. per day.

Consent Decree from Dept of Ecology

- KCSWD has been in violation of its Arsenic discharge limits since at least 2017
- KCSWD has been operating under a consent agreement with the County's Industrial Wastewater Division
- KCSWD planned to install water treatment systems to remove the Arsenic from its wastewater
- One of these systems was to be installed at the BEW plant site

County Reverses Position

- Some time in 2022, KCSWD apparently had a change of plans, and decided to blame BEW for its Arsenic issue
- The County solicited help from the Department of Ecology to have the BEW condensate declared “dangerous waste” under Washington law
- Then the County told BEW it could no longer accept the BEW condensate

Physics and Economics

- There is no way physically that BEW (or anyone) can process Landfill Gas without producing condensate – the gas has too much moisture
- Under the County's plan, if BEW were to continue to process Landfill Gas it would become a major generator of hazardous or dangerous waste
- Disposing of this condensate as hazardous waste would cost BEW as much as \$4 million dollars per year and would make the BEW plant uneconomic

Arsenic is Not BEW's Problem

- BEW does not create Arsenic in its process
- All Arsenic comes from the Landfill Gas
- The County refuses to accept responsibility for the Arsenic in its Landfill Gas
- Instead, the County wants BEW to bear the cost of disposing of the County's Arsenic
- BEW is an energy company, not a waste company
- KCSWD is a waste disposal entity

No Progress to Date

- BEW has been trying to resolve this issue with the County for months
- The County spent years attempting to deal with this issue, and yet, in the end, blames BEW
- Bob Rauch, BEW counsel, has considerable experience in dealing with the EPA from previous jobs he has held
- Bob has written numerous letters to both the Department of Ecology and the Attorney General

To date, both agencies have been

STONE-WALLING

Bob's efforts

Feel free to contact:

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Lacey, Washington 98503

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Assistant Attorney General
Attorney General of Washington
Department of Ecology Division
P.O. Box 40117
Olympia, Washington 98504



Current Situation

- If BEW does not process the Landfill Gas, the County is required to flare it
- The County has been flaring landfill gas at its North Flare Station for approximately two months
- Flaring is normally an acceptable way to destroy landfill gas
- In this case, however, the County is flaring arsenic-laden landfill gas

Current Situation

- The County has a permit to flare gas
- This permit has no specific Arsenic limit
- However, the County is governed by federal and state law regarding airborne arsenic emissions
- These laws limit the amount of airborne Arsenic emissions to **4 lbs per year**

Where Does the Arsenic Go?

- “Because metals such as arsenic only change forms (chemical and physical states) and are never destroyed during combustion, the amount of arsenic in the original fuel or waste will be the amount of arsenic found in the ash or emitted from stacks”

Source:

LOCATING AND ESTIMATING AIR EMISSIONS FROM SOURCES OF ARSENIC AND ARSENIC COMPOUNDS, June 1998, EPA-454/R-98-013

Arsenic Air Emissions

- If the County only flares gas with 0.27 lbs of Arsenic per day (the wastewater discharge limit) the 4 lb annual limit on airborne emissions was reached in less than:

15 Days

Opportunity Costs

- King County has always acknowledged that it has a responsibility to maximize the value of the County's assets for the benefit of the County residents
- I have personally been reminded of this on many occasions by Pat McLaughlin

Tipping Fees by State/Region (2020)

- Region/State Average Tipping Fee (per ton)

Alaska	\$142.33 (\pm 69.52)
Arizona	\$44.89 (\pm 10.9)
California	\$58.48 (\pm 24.78)
Hawaii	\$114.33 (\pm 4.04)
Idaho	\$59.02 (\pm 63.48)
Nevada	\$39.9 (\pm 19.52)
Oregon	\$71.53 (\pm 18.67)
Washington	\$95.99 ($\pm$ 37.94)

King County Tipping Fee

Disposal fees

Find information on the current rates, accepted payment methods, and CleanUp Lift discount at King County solid waste facilities.

SOLID WASTE FEES*

Garbage

The total minimum fee is rounded to the nearest \$0.25 (King County Code 10.12.030)

\$180.80/ton

King County has some of the highest (if not THE highest) tipping fees in the region, yet the County wants BEW to pay for disposal of the County's Arsenic

Monetizing Landfill Gas

- BEW processes the County's Landfill Gas into highly valuable Renewable Natural Gas (RNG)
- Since 2009 BEW had been selling the RNG to Puget Sound Energy (PSE)
- In turn, PSE was reselling the RNG into profitable markets and sharing the revenue with both BEW and King County
- King County was earning millions of dollars annually from this gas which had been going to waste

Poor Management

- The County's agreement with PSE expired on June 30th, 2023 after negotiations to extend the agreement failed
- The County has done nothing to monetize the value of the RNG that BEW produces
- Therefore, County residents are losing millions of dollars each year
- The County is NOT being a good steward of County assets

Conclusions

- The County is definitely not collecting all the Landfill Gas available, thereby causing numerous problems: excessive odors, public health risks, and damaging GHG emissions
- BEW cannot operate its facility without producing condensate from the Landfill Gas
- Therefore, BEW has been forced to suspend operations until the condensate issue is resolved

Conclusions

- The County has attempted to saddle BEW with huge costs for the disposal of Arsenic which is the County's responsibility
- Arsenic is now being released into the air at the North Flare Station
- The County is wasting millions of dollars in the value of the RNG that BEW would normally produce

Solution

- This entire Arsenic issue would be resolved if the County simply returns to the *status quo ante*
- The County should accept BEW's condensate as it has done for years
- The County should reinstate its agreement with PSE or otherwise monetize the RNG
- BEW will then resume processing RNG and the County can stop flaring gas