Environmental, Political and Financial Risk Assessment for the Former Canterbury Landfill

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I. Executive Summary

This is a summary of the report that follows. It is the intent of this report to document the potential regulatory, environmental, political and financial liabilities associated with the continued operation of the Canterbury Transfer Station on top of an uncapped landfill. The landfill is currently under a New Hampshire Groundwater Management Permit (GMP) with chapter 108 status allowing it to remain open if it is contained. The landfill has shown persistent groundwater and surface water contamination over more than a decade. The important things to figure out with the data involved are: How severe is the contamination, is it contained, can we build improvements on the location and even if we can, is it a wise thing to do? The data shows that the contamination regularly exceeds the state Ambient Groundwater Quality Standards (AGQS) and Surface Water Quality Criteria (SWQC) for PFAS (a cancer-causing family of chemicals), lead, iron, and manganese.

Key Findings:

- Groundwater contamination with the PFAS chemicals: PFOS, PFOA, and PFHxS has consistently exceeded standards since testing for it began in 2017 reaching as much as ninety two times higher than regulated limits in 2022 (testing site AE-2). Surface water PFAS levels in the wetland below, have reached startling levels, including as much as twelve hundred times higher than health-based guidance limits (testing site SW-1).
- Surface water metals, including lead and iron, have exceeded SWQC nearly every year since at least 2012. The wetland adjacent to the landfill is the most impacted.
- Private well monitoring at 87 Baptist Road has so far shown no contamination, but its inclusion in the GMP signals regulatory concern.
- NHDES correspondence since 2012 has consistently expressed concern over contamination and has requested more proactive mitigation and analysis from Aries Engineering. Delays in compliance with these requests occurred between 2016–2018.
- PFAS regulations were significantly tightened in October 2019, and enforcement pressure is expected to increase as political and public scrutiny grows.
- Any new construction on the current site would need to be outside the boundaries of the land fill. Those boundaries are ambiguous because the original 2005 map of the location shows boundaries twice the size of the 2025 map boundaries. Eyewitness accounts report landfill materials over an even larger area.
- Any new improvements at the current site are financially risky due to potential mitigation and or capping mandates, stranded asset risk, political complications and regulatory limitations related to the GMP.

Regulatory Risks:

- The site's GMP prohibits groundwater degradation that results in surface water contamination (a condition that has already been breached multiple times at SW-1).
- The NHDES has the authority to require corrective actions, mandate site closure, or revoke operating privileges without offering financial assistance.
- New Hampshire's PFAS standards are among the strictest in the nation and exceedance automatically triggers legal exposure, mandatory notifications, and long-term liability.

Financial and Legal Risks:

- Current reserve funding ($100,000) is likely insufficient to cover future closure or mitigation costs, which could exceed half a million dollars.
- The site is now legally recognized as contaminated, complicating grant eligibility and long-term infrastructure planning.
- It is difficult to determine when corrective orders might be given but, if not planned for, they will result in rushed spending, and loss of public trust.

Conclusion:

Canterbury must be very cautious about investing further in infrastructure atop the contaminated landfill. Continued operation at the current site runs the risk of escalating costs, enforcement actions, and political blowback. Transparency, planning, and environmental stewardship are critical to protecting the town's long-term financial and ecological interests.

II. Introduction: How We Got Here

The Solid Waste Committee is charged with studying the town's Transfer Station, improving its processes, and making recommendations to the Board of Selectmen based on environmental and economic considerations.

Before I joined, the committee had already spent a year and a half developing plans to improve the existing site. At that time, the assumption was that the site could be upgraded. Most of us would prefer not to move the facility…many committee members live nearby, and it is both convenient and familiar. The goal has always been improvement, not relocation.

During the research and planning phase, many ideas were explored, including some we are still discussing today: adding bathrooms for OSHA compliance (we are currently not in compliance), adding storage, upgrading compactors, and improving traffic flow and the baling process. Permits and regulations were reviewed, and other facilities were

visited for research and inspiration. The main drawbacks at the time were that the site was somewhat small, shared with the highway department, and would require a costly upgrade to three-phase power to operate more advanced equipment such as compactors. Some estimates for this upgrade exceed $400,000.
Ultimately, the committee's renovation and improvement plan was denied. The reason cited was that DES regulations prohibit new construction on an uncapped landfill. The committee followed up by reviewing these regulations and contacting DES to confirm that interpretation.

One former selectman who was a representative on this committee and three committee members, including myself, personally used the landfill when it was active, over 50 years ago. We remember its boundaries and what was disposed of there. Learning that the landfill was only covered with gravel and loam and seeded…rather than properly capped to protect groundwater and surface water… raised some concerns. We are aware that old landfills have caused significant water problems in recent years, especially when located near wetlands, like this one, which borders a pond. Sites like this also pose political, legal, and financial risks. Environmental stewardship is a growing concern among Canterbury residents, and state and federal agencies such as the EPA and DES have become increasingly active in enforcement.

"Capping" a landfill is a defined, regulated process involving engineering, specific materials, and considerable expense. One estimate for capping this site is $500,000. The existing Transfer Station building is located on top of the landfill. If the landfill were to be capped, the building would need to be demolished, and the entire landfill area would become off-limits to activity and traffic. To many of us on the committee, this turns the current facility into a kind of gamble. While it may be technically possible to make improvements under the current permit, is it wise to invest in this site? Three-phase power alone represents a significant upfront cost. If regulations change or the landfill loses containment, the town risks losing not only the investment, but also facing the cost of capping and the urgent need to find a new waste management solution.

The committee did explore alternatives such as curbside pickup by a company like Casella. However, the ongoing cost of such services is high, after five or so years, the cumulative cost would rival the budget needed to build our own facility. This led to the idea of continuing to manage waste ourselves by relocating the Transfer Station to a site already zoned for commercial use and equipped with three-phase power. While the town already has a capital reserve fund for landfill-related expenses, we proposed creating a new fund, starting with $10,000, to proactively save for long-term relocation

costs. This reserve could grow annually and also serve as a basis for applying for grants or issuing bonds if needed.

The Board of Selectmen forwarded this proposal to the Budget Committee, which denied the request. Their concern was that the committee had not provided enough detail to justify relocation. Instead, they supported a warrant article authorizing access to $6,000 from an existing improvement fund so an engineering firm could assess the potential for improving the current location.

Aries Engineering, our water testing contractor, was contacted, and we recently conducted a site walkthrough with engineer George Holt. During that walkthrough, I asked three key questions:

- **Is there a risk that DES could object to future work at the site?**
  George said his communication with DES produced a "non-answer answer," mostly consisting of permitting guidelines. His interpretation is that DES is unlikely to object as long as we avoid building directly on the landfill footprint.

- **Did he review the 2024 water testing reports before the walkthrough?**
  He replied that the most recent results show no major issues. While iron was detected in surface water and PFAS were present, no PFAS was detected in the nearby residential drinking water well.

- **What part of the property is covered under the Groundwater Management Permit?**
  He confirmed that the entire property is subject to the permit.

My purpose in this presentation is to contribute independent research to balance our desire to remain at the current site with a clear-eyed risk assessment of the financial and political challenges. I plan to review the regulatory framework we operate under, summarize our history of water testing, and track the town's correspondence with NHDES regarding the landfill. While Aries Engineering has indicated that the site may still be safely contained, I've examined these claims and offer some possible "devil's advocate" rebuttals. All sources used are publicly available on the NHDES website.

I now present my findings to the committee, and by extension, to the town, to help ensure that we are conducting our due diligence in making this important decision.

III. Regulatory Background: What Rules Apply

The following are some terms and regulations that are directly related to this subject and location. They will help to properly frame the historical and testing information that will follow.

- Regulations are monitored and enforced by New Hampshire Department of Environmental Services (NHDES or just DES). They follow various legal codes and regulations which give them regulatory power over solid waste and landfill management among other things.
- **Solid Waste Permit Conditions**: Our operating permit prohibits the storage of solid waste (including recyclables) on the site for longer than one year without approval. This takes away some of the advantages of long-term storage.
- **Env-Sw 804.01(b**): Is a NH law that prohibits new construction or significant improvements on any uncapped landfill.
    - This does not include other areas of the lot that are outside the boundaries of the landfill. However, those boundaries will need to be determined accurately, and they appear bigger on the original map than they are on the current map. The original map shows the boundary going all the way to the burn pit. In both cases, the existing building is over the landfill. Eyewitnesses also say that there is unmarked landfill beneath the existing salt shed.
- **Env-Sw 806**: Establishes closure and post-closure care requirements when sites pose a threat to public health or the environment.
    - If the DES forces the landfill to be capped, the existing Transfer station building would likely need to be torn down, and traffic would not be allowed to use the existing loop which travels over the landfill to enter the station and exit the area. Everything would need to be rebuilt into a much smaller slice of the location and traffic flow would need to be changed.
- **NH DES: Env-Wt 100–900, The wetlands protection act: RSA 482-A and the Clean Water Act (Federal, Section 401/402/404)** all protect wetlands from contamination. There is a wetland behind the transfer station, below the landfill as well as channels which flow into Crane Neck Pond. Storm water from the landfill site is directed into this location.
- **Leachate.** This is the contaminated liquid that forms when groundwater mixes with the decomposing trash in the landfill. It carries metals, PFAS and other elements that break down in the landfill over time. Leachate travels through ground water paths, and it can end up in nearby surface water. The goal of groundwater management is to keep it

"stable" so that the contaminated runoff is not reaching levels too far beyond the established standards or travelling past boundaries of the permit.

- **Groundwater Management Permit (GMP**): Groundwater flows downward through the location in an easterly direction toward the wetland. The entire property and some neighboring property owned by the conservation commission has been under the boundaries controlled by the GMP since 2005, triggered by contamination concerns. A GMP places additional monitoring, reporting, and operational restrictions on the town.
    - **Having a GMP is a formal recognition of site contamination** and creates legal, insurance, and grant eligibility complications when it comes to funding improvements.
    - **The GMP Specifically prohibits** degradation of groundwater in connected wetlands or streams. Some interpretations of the testing results might determine that this is already happening.
- **Ambient Groundwater Quality Standards (AGQS**): New Hampshire sets contamination limits for groundwater to protect human health and the environment. Exceeding AGQS thresholds can trigger permit restrictions, mandatory notifications to nearby property owners, and corrective action requirements. Contamination is measured and compared to specific maximum limits. If the contamination is higher than the limit, the location is in "exceedance".
- **Surface Water Quality Criteria (SWQC**): Establish contamination limits for New Hampshire water bodies. Violations of these criteria can trigger enforcement even if groundwater tests are acceptable.
- **Enforcement Authority**: DES has **full authority** to require corrective actions, restrict operations, or mandate closure **even if no state funding is available to assist municipalities.** Enforcement of rules does not require a budget; it requires the stroke of a pen by an environmentally or politically motivated person sitting in the office.

IV. PFAS Regulation:

PFAS is a family of chemicals that never degrade in groundwater, so they are known as "forever chemicals". They dissolve into water and can travel as far as 10-50 miles in surface water where they can be ingested by the wildlife and humans in the immediate area. PFAS can cause cancer and many other health problems for humans and wildlife. For humans many legal firms are now advertising it as a means for compensation for people who ingested PFAS in the water.

PFOS, PFOA and PFHxS are specific PFAS chemicals that are tightly regulated in groundwater. PFOS cannot exceed 15 parts per trillion (ppt) without a Groundwater Management Permit. PFOA cannot exceed 12 ppt. PFHxS cannot exceed 18 ppt. The boundaries of the groundwater management zone are specifically defined in the permit. The permit also stipulates that the contamination cannot spread into standing water that is outside the boundaries of the management zone.

In wetlands there is also a condition where the PFAS and other contaminants are captured into the muck of a wetland as a temporary filtration. This causes it to be less apparent in the surface water. This can build up in hidden parts of the wetland over time where it can be released downstream in more concentrated waves during flooding conditions. This would only be detected by doing core samples of the wetland sediments.

Although PFAS currently lacks formal surface water standards in New Hampshire, **DES and EPA have identified PFAS contamination as an emerging public health and environmental threat** and is actively expanding regulatory oversight. Formal regulations for surface water seem likely in the future. For now, surface water results are compared to groundwater standards as a reference.

NH locations that have been forced into expensive cleanup and capping costs:

> **Merrimack** has been at the forefront of PFAS remediation efforts. In 2019, voters approved a $14.5 million expenditure to filter four public wells contaminated with PFAS. Saint-Gobain Performance Plastics, identified as a primary source of the contamination, agreed to fund filtration for two additional public wells. Despite these measures, residents continue to face health concerns and financial burdens related to the contamination.
>
> **The city of Portsmouth** has allocated approximately $3.19 million to clean up PFAS contamination at Coakley Landfill. Additionally, the city is expected to spend $107,102 to extend a waterline near the contaminated site.
>
> **Dover** has approved a $13.9 million water treatment facility specifically designed to address PFAS contaminants in the city's water supply.
>
> **Pease Airforce Base**. The U.S. Air Force invested $17 million to develop the Pease Water Treatment Facility in Portsmouth. This facility removes PFAS from the Haven Well, which was closed after contamination was discovered.
>
> **Bethlehem, NH** has faced PFAS contamination from the NCES landfill operated by Casella, with elevated PFAS levels found in groundwater and surface water

flowing into the Ammonoosuc River. The landfill has had multiple regulatory violations, including a breached liner and leachate overflows. While exact cleanup costs aren't public, Bethlehem is eligible for part of the state's $65 million PFAS settlement fund.

V. Canterbury Former Landfill Timeline

The following timeline tracks the history of the landfill and the results of the water testing. The source is the publicly available permit applications and the water testing reports created by Aries Engineering and submitted over the years to DES on behalf of the town. These can all be found in the DES OneStop database. I have also constructed tables provided in the supporting materials (Tables 1-3) showing the dates and results where PFAS and metals have exceeded the standards in ground water and surface water. Aries engineering created several testing locations over the years. The groundwater is measured at well locations labeled AE-1 through AE-4. Surface water began with testing only one location, but this has escalated. It is now tested at locations labeled SW-1-through SW-5.

1980s – 2004: Early Landfill History

- Mid-1980s: Landfill ceased operation.
- 1989: Landfill re-graded and seeded.
- Late 1980s-1990s: Incineration Station built partially over landfill, later becoming a transfer station. Incinerator ash is also part of the landfill.
- 2004: Aries Engineering performs first modern site characterization.

2005 – 2010: First Groundwater Management Permit (GMP) is granted.

- 2005: First GMP (GWP-198506031-C-001) issued; testing wells AE-1 to AE-4 are installed on Canterbury Conservation Commission land at the bottom of the landfill. AE-1 through AE-3 are in locations just below the landfill boundary. AE-4 is upstream in the ground water flow just across the road from the trailers at the exit. Surface water testing location **SW-1** is also established at the bottom of the landfill next to well **AE-3**.
- Town applies for **chapter 108 status**, deferring the requirement to cap the landfill under stable monitoring conditions.
- **A landfill boundary map** (see 2007 map in supporting materials) is created and submitted based on test pits. The boundary in this map extends from a large area

down the bank behind the treasure house, all the way across the building where the office and the old incinerator location used to be, past the storage trailers and the dirt piles and ending at the burn pit. It is not documented but eyewitnesses who have dug in the area also claim there is some tin-can landfill beneath the salt shed. The landfill extends over the entire roadway that curves up to the building, and it extends down the bank into the wetland below and into the property owned by Canterbury Conservation Commission (Map 246 Lot 13). A stormwater berm has been constructed at the top of the bank which channels water around the curve and into the burn pit where it is either absorbed in the pit or tops over and runs down the bank into the wetland.

- 2006-2009: Groundwater testing shows a stable leachate signature (chloride, sulfate, iron); surface water (SW-1) shows high iron.

2010: Introduction of Chapter 108

- 2010: Chapter 108 status is still pending, and it is handled by a different department, the Solid Waste Management Bureau under project manager Douglas Kemp: 603-271-0674.

2011 – 2015: Continued Stability and Metals Concern

- 2011 **Groundwater Permit Number GWP-198400084-C-002** is granted.
- Chapter 108 status is granted, deferring the requirement to cap the landfill under stable monitoring conditions.
- 2011-2015: Groundwater stability maintained; **surface water metals** (iron, lead) consistently **exceed Surface Water Quality Criteria** (SWQC) at testing location **SW-1**.
- **Iron** peaks at **120,000 micrograms per liter** (µg/L) which is **120x over the limit** of 1000 µg/L. **Lead** peaks **at 71 µg/L** which is **173x over the limit** of 0.41 µg/L.

2016 – 2017: PFAS Discovery

- **2016: GMP renewed (GWP-198400084-C-003).**
- 2016: surface water **iron** reaches and all time high of **510,000 micrograms per liter** in location **SW-1**. This is **510 times the groundwater standard** of 1000 micrograms per liter.
- 2017: Surface water **lead** in **SW-1** reaches an all-time high of **348 micrograms per liter.** This is **848 times higher than the standard of 0.41 micrograms per liter.**

- November 2017: **PFAS detected at AE-1, AE-2, AE-3** in particular the chemical abbreviated as 'PFOS"
- **PFOS** peaks at **302 parts per trillion** (ppt) at **AE-1** which is **20 times the current limit** of 15ppt.
- **PFOS** peaks at **1030 parts per trillion** (ppt) in **AE-2** which is **68 times the current limit** of 15 ppt.
- **PFOS** peaks at **777 ppt** in **AE-3** which is **51 times the current limit** of 15 ppt.
- These peaks are all for the specific PFAS chemical abbreviated as: "**PFOS**".

2018: Surface Water PFAS Confirmed

- May 2018: **PFAS** detected at **surface water** testing locations: **SW-1, SW-2 and SW-4.** The worst offender is the chemical known as **PFHxS** which peaks at **23,300 parts per trillion** in **SW-1**. There is no current surface water standard for PFAS so it is measured against the groundwater standard as a comparison. **23,300 ppt is 1,200 times over the groundwater limit** of 18 parts per trillion. This indicates massive surface water contamination in this testing round.
- **SW-4**, is further down the grade **into the wetland,** and PFAS is shown at **975 parts per trillion** which is **65x the limit**. Location SW-4 is the furthest the PFAS has been detected downstream to date.
- **SW-2 is outside the groundwater management permit boundary**, indicating that PFAS groundwater is contaminating surface water that is outside the groundwater management zone**.** ***IF/WHEN the official standard for surface water (SWQC) is officially changed to include PFAS, the landfill will be in violation of the permit.***

  "2. The permittee shall not cause groundwater degradation that result in a violation of surface water quality standards (N.H. Admin. Rules Env-Ws 1700) in any surface water body." (Condition #2 of the 2018 GMP.)

- Aries recommends a second round of PFAS surface water testing and DES agrees. Results are not as extreme, but **PFAS** in **SW-1** is still as high as **1244 parts per trillion** (ppt) which is **69x over the groundwater limit** of 18 ppt**. SW-2** has **PFAS at 963 ppt** which is **64x over the groundwater limit** of 15 ppt.
- **Groundwater tests** show contamination in wells **AE-1 (18x over the limit)**, **AE2 (89x over the limit) and AE-3 (55x over the limit)**

- **Iron and lead** are still above the limit. **Iron** is **28,000 milligrams per liter** which is **28x the limit** of 1,000 milligrams per liter, and **Lead** is **2 milligrams per liter** which is **4 times more than the limit** of 0.41 milligrams per liter.

2019: Full Regulatory Recognition of PFAS Contamination

- GMP officially amended to require PFAS monitoring and two new surface water testing locations**: SW-4** (downstream surface water) and **SW-5** (Further downstream)
- **PFAS** in **surface water** site **SW-1** is **672 ppb** which is **44x higher** than the groundwater limit of 15 ppb.
- Groundwater **PFAS** is **21x over the limit** in test well **AE-1**, **49x over the limit** in test well **AE-2** and **54x over the limit** in test well **AE-3**.
- October 2019: **Legally required public notification** from DES to 6 property owners near landfill, under RSA 485-C:14-b.
- **87 Baptist Road** first **private well test**. The well is upstream in the groundwater flow. No PFAS detected.
- **AE-4 stops being tested** at this point. Possibly because the residential well is the new control well.
- Surface water metals are still high. **Iron is 356,000** milligrams per liter (µg/L) in surface water location **SW-1 which is 356x the limit** of 1000 µg/L. **Lead is 318** µg/L which is **775x the limit** of .041 µg/L. However, the focus has changed to PFAS over metals at this point.

2020 – 2022: PFAS Monitoring Intensifies, Metals Fluctuate

- 2020 **Iron surface water** spikes at **43x the limit** at **SW-1** but drops to **20x the limit** in 2021 and **9x the limit** by 2022.
- 2020 **Lead** in surface water sit **SW-1** drops down to **5.2 milligrams per liter** (µg/L) which is much lower but still **12x the limit.** By 2021 it is **1 (µg/L)** which is very low, only **2x the limit** but then it spikes again to **27 (µg/L)** in 2022 which is **65x the limit**.
- 2022 shows Persistent **groundwater PFAS at AE-1 (28x the limit), AE-2 (92x the limit), AE-3 (51x the limit).**
- **Surface water PFAS** persist at **SW-1 (40x the limit);** moderate detections at **SW-2 (11x the limit)** and high levels found in **SW-4 (81x the limit**) in 2022. This is the furthest downstream detection yet.

- 2022: **87 Baptist Road residential well retested** — still no PFAS detected.

2023 – 2024: Current Status and New Complexity

- November 2023: PFAS concentrations slightly increase in groundwater. **AE-1** Peaks at **403 ppt**, **26x over the standard**, **AE-2** Peaks at **1010 ppt**, **67x over the standard**, AE-3 peaks at **482 ppt**, **32x over the standard**.
- 2023 **surface water** shows growing contamination**. SW-1 has 1540 ppt which is 127x the groundwater standard**. **SW-2** is testing at **21 ppt** which is **a little above the groundwater standard. SW 3** was **not tested** in 2022-2024**. SW-4 is 11x the groundwater standard. SW-5** is **down the stream** toward Crane Neck Pond. Results are **3ppt**, **well within the groundwater standard** of 15ppt
- November 2024: PFAS is still high in the groundwater **AE-1 26x, AE-2 54x, AE-3 54x**. SW-2 shows unexpectedly high PFAS, indicating additional migration.
- SW-1, SW-2 and SW-4 remain heavily impacted.

VI. Regulatory Correspondence Timeline:

The following timeline tracks the DES responses to testing data and other comments as permits were renewed over the years. It clearly shows the paper trail that DES has created for the location over the years, clearly documenting their concerns and instructions which escalate as the years progress.

August 2, 2012

Subject: Elevated Surface Water Metals
To: Town of Canterbury (Robert Steenson, Chairman)
From: Paul L Rydel, DES

- DES cites exceedances of lead, cadmium, and chromium in SW-1:

> *"As reported in the Aries cover letter for the April 2012 monitoring results, the Department notes that the metals cadmium, chromium, and lead were recently detected in the surface water sample SW-1 at concentrations that exceed regulatory standards. Of these metals, lead was found at the highest concentration (470 micrograms per liter [ug/l]), and was previously reported at concentrations that exceeded its Water Quality Criteria (0.54 ug/l) in three of the*

prior six monitoring rounds that included analysis for lead (sampling performed between 2004 and 2010). Based on these latest results, the Department has determined that additional assessment will be required to further assess the occurrence of lead and other metals in the small stream/wetland area to the southeast of the landfill site, as currently monitored by the surface water sampling location SW-1."

"…consideration could be given to collecting a second unpreserved/unacidified sample for total metals analysis from location SW-1, and/or inclusion of a second, upstream sampling location from an area not influenced by the site" (the site is now SW-2)

"The laboratory analytical data summary table (Table 2) provided with the April 2012 monitoring results submittal highlights the exceedances of the DES Water Quality Criteria for the metals cadmium, chromium, and lead at SW-1. These exceedances are based on the Water Quality Criteria established for protection of freshwater aquatic life, as also presented in the table. Please confirm that surface water in the wetland and stream (as monitored by SW-1), and Crane Neck Pond which is located downstream from SW-1, are not currently used for consumptive water supply purposes, as this could require that the Water Quality Criteria established for protection of human health also be considered in assessing metals concentrations."

"As part of the November 2012 monitoring round, please review current site operations, and conditions in the areas adjacent to and upstream from SW-1 for any potential conditions that might influence metals concentrations in surface water in this area."

- DES also Emphasizes that **future samples must use total metals protocols** and clarify surface water risks.

June 18, 2013

Subject: Follow up on surface water testing
To: Town of Canterbury (Robert Steenson, Chairman)
From: Paul L Rydel, DES

- Acknowledges Aries' response to 2012 findings.

"Based on the analysis provided in the report, the Department concurs with the analysis and conclusions provided by Aries; wherein the elevated concentrations of metals that

have been intermittently observed in the samples from SW-1 are most likely related to entrained turbidity or suspended sediment in the samples."

- Agrees to lower to once per year testing:

"Finally, in regards to Aries' recommendation that the sampling frequency of the water quality monitoring program be reduced to annually (each November), from the current twice-yearly sampling (in April and November), the Department concurs that an overall reduction in the scope of the monitoring program is warranted at this time based on the monitoring results to date, which demonstrate that site water quality conditions and associated trends are generally well understood. Accordingly, we will plan to revise the February 2011 Permit shortly, to reflect this change."

September 16, 2016

Subject: Permit Renewal and Ongoing Surface Water Exceedances
To: Town of Canterbury (Robert Steenson, Chairman)
From: James W. O'Rourke P.G. Waste Management Division, DES

- New Groundwater Management Permit is issued:

"Please find enclosed Groundwater Management Permit Number GWP-198400084-C-003, approved by the Department of Environmental Services (Department). This permit is issued for a period of 5 years to monitor the groundwater quality at the subject site, and is a renewal of your permit that expired on February 7, 2016."

> *1) The permittee shall not violate Ambient Groundwater Quality Standards adopted by the Department (N.H. Admin. Rules Env-Or 600) in groundwater outside the boundaries of the Groundwater Management Zone, as shown on the referenced site plan.*
>
> *2. The permittee shall not cause groundwater degradation that result in a violation of surface water quality standards (N.H. Admin. Rules Env-Ws 1700) in any surface water body.*
>
> *….*
>
> *9) Within 30 days of discovery of a violation of an ambient groundwater quality standard at or beyond the Groundwater Management Zone boundary, the permittee shall notify the Department in writing. Within 60 days of discovery, the permittee shall submit recommendations to correct the violation. The*

Department shall approve the recommendations if the Department determines that they will correct the violation.

- DES states that **elevated iron and lead persist at SW-1**.

  "The Department notes the continued exceedances of the Surface Water Quality Criteria (SWQC) for iron at monitoring location SW-1. Although concentrations vary, the detections of iron at SW-1 have consistently been in excess of SWQC since 2006. We also note lead has consistently been detected above SWQC for water collected from SW-1. During monitoring rounds in which lead was not detected, the laboratory detection limits have not been below the SWQC; dating back at least 10 years."

- A Third surface water location is required, which is now SW-3

  Due to these continued exceedances, the downgradient surface water sampling location SW-3 has been added to the Permit monitoring schedule for the 2017 and 2020 rounds. ***Please provide an assessment of the iron and lead exceedances reported for SW-1, and any recommended mitigation steps to address the ongoing exceedances at monitoring location SW-1 as part of the Summary Report due in January 2017."*** (bold itallic text was used by DES)

- Requests that Aries provide more details:

  "The Department notes the discussion of the analytical results within the 2015 Biennial Report by Aries was limited to a short summary of exceedances of AGQS or SWQC, and a three sentence summary and conclusions section. Plots representing long-term concentration trends at monitoring locations were not included as part of the report. ***Within future Summary Reports please include expanded discussion and analysis of temporal trends while utilizing charts of select water quality parameters at various monitoring locations"*** (bold itallic text was used by DES)

November 13, 2017

Subject: 2017 Biennial Report Follow-Up — Lack of Action
To: Town of Canterbury (Ken Folsom, Town Administrator)
From: James W. O'Rourke, P.G. Waste Management Division, DES

- DES finds that Aries **did not follow the requested 2016 action items**.
- Notes absence of:
  - Analysis or explanation for **major iron, manganese, TKN spikes** in Nov 2016.

- Proposed mitigation actions.
- Requested temporal trend analysis.

- Demands Aries:
  - **Resubmit with corrective discussion and charts**.
  - Address these items within **45 days** of the November 2017 sampling event.

"As discussed in the September 16, 2016 cover letter for the renewed Permit, NHDES notes the continued exceedances of the Surface Water Quality Criteria (SWQC) and elevated concentrations for analytes at monitoring location SW-1. Within the letter NHDES requested "…an assessment of the iron and lead exceedances reported for SW-1, and any recommended mitigation steps to address the ongoing exceedances at monitoring location SW-1 as part of the Summary Report due in January 2017." Although concentrations vary, the detections of iron at SW-1 have consistently been in excess of SWQC since 2006. We also note lead has consistently been detected at concentrations above SWQC for the samples collected at SW-1. During monitoring rounds in which lead was not detected, the laboratory detection limits have not been below the SWQC; dating back at least 10 years. During the November 2016 round we note concentrations of manganese more than doubled, iron more than quadrupled, and TKN was more than 12 times higher than detected during the previous November monitoring round. NHDES notes within the Aries 2017 Biennial Summary Report the November 2016 monitoring round detections were stated but no analysis, discussion, or recommendations related to the increased concentrations were provided. ***As part of the next submittal, due no later than 45 days after the November 2017 sampling event, provide an assessment of the increased concentrations iron, lead, and TKN reported for SW-1, and recommended mitigation steps to address the ongoing exceedances at monitoring location SW-1."*** (bold italic text was used by DES)

"NHDES notes the following action item, which was also discussed within the NHDES' September 16, 2016 Permit cover letter, and was not addressed in the subject report: "Within future Summary Reports please include expanded discussion and analysis of temporal trends while utilizing charts of select water quality parameters at various monitoring locations." This comment should be addressed as part of the next Summary Report, due January 2019. ***Please address as part of the next Summary Report."*** (bold itallic text was used by DES)

October 23, 2018

Subject: PFAS Exceedance Notification and Data Expectations

- DES formally acknowledges PFAS exceedances in AE-1, AE-2, AE-3 and SW-1 and reports on private water testing:

  "Based on the results of the November 2017 sampling event, PFOA and PFOS individually and/or PFOA+PFOS combined were detected at concentrations exceeding AGQS in the groundwater samples collected from the site monitoring wells AE-1, AE-2, and AE-3. Based on these results, and consistent with NHDES guidance, the neighboring private water supply at Lot 246-14 was sampled for PFAS. Analytical results, as transmitted in the April 18, 2018 March 2018 Water Supply Results Letter, for the off-site private sampling did not detect PFAS."

  "The May 2018 Surface Water Data Transmittal consists of the results of the initial screening for PFAS at the three site surface water locations, as recommended by Aries in their November 2017 Data Transmittal. The scope of the initial surface water PFAS sampling effort included collection of samples from SW-1, SW-2, and SW-3. Results indicate detections of PFAS in two of the three locations sampled; with PFOA and PFOS detected at SW-1 at concentrations of 1,140 ng/L and 13,800 ng/L, respectively, with a combined (PFOA+PFOS) concentration of 14,940 ng/L. Several other PFAS compounds were detected at similarly high concentrations but do not currently have AGQS, the highest being perfluorohexanesulfonic acid (PFHxS) at a concentration of 23,300 ng/L. Two PFAS were detected in the sample from SW-2; PFOS at a concentration of 56 ng/L and PFHxS at a concentration of 57 ng/L. PFAS were not detected in the sample from SW-3 above the method detection limit of 10 ng/L. We note that at this time there is no surface water standard for PFAS."

- Directs Aries to:
  - Continue PFAS monitoring at wells and surface water locations.
  - Begin PFAS data uploads to the **Environmental Monitoring Database (EMD)**.
  - Submit mapped stream channels and add new monitoring points downstream.
  - Add two new surface water testing locations: **SW 4** and **SW-5**

  "Given the elevated concentrations of PFAS detected in surface water at the site the surface water flow direction and downstream extent of impacts from PFAS should be defined. Surface water flow within the Groundwater Management Zone is likely complex and responsive to seasonal variations; however, the positions and reference elevations

for the existing surface water monitoring locations should be confirmed via field survey. The stream channels should also be defined and included on an updated site figure. Recent aerial imagery indicates that SW-3 is located along the main stream channel that eventually flows into Crane Neck Pond; SW-1 and SW-2 are located along a northern stream branch that joins the main channel approximately 200 feet east of the landfill and potentially downstream of SW-3. A minimum of two new monitoring locations should be established to investigate the extent of PFAS impacts, one within the channel of the northern stream branch and one downstream of where the northern stream joins the main stream channel. These locations should be sampled for PFAS as part of the next monitoring event. Surface water monitoring locations should be established as outlined above and sampled for PFAS in conjunction with the November 2018 Permit monitoring round. Results should be submitted to the NHDES with the Periodic Summary Report, due in January 2019, and include an evaluation of the results and recommendations for future monitoring, Permit modifications, or other actions."

October 23, 2018

Subject: Followup on PFAAS instructions, Firefighting Foam Ruled Out as PFAS Source
To: Town of Canterbury (Ken Folsom, Town Administrator)
From: James W. O'Rourke, P.G. Waste Management Division, DES

- PFAS instructions are reiterated.

  "…the Permit will be revised to include PFAS monitoring. ***Sampling for PFAS at monitoring wells AE-1, AE-2, and AE-3 and surface water locations SW-1, SW-2, and SW-3, should be completed as outlined above as part of the November 2018 sampling event. Results should be submitted to the NHDES with the Periodic Summary Report, due in January 2019, and include an evaluation of the results and recommendations for future monitoring, Permit modifications, or other actions.*** (DES added bold italic text)"

  "Given the elevated concentrations of PFAS detected in surface water at the site the surface water flow direction and downstream extent of impacts from PFAS should be defined. Surface water flow within the Groundwater Management Zone is likely complex

and responsive to seasonal variations; however, the positions and reference elevations for the existing surface water monitoring locations should be confirmed via field survey. The stream channels should also be defined and included on an updated site figure."

- **DES acknowledged and documented the conclusion that firefighting foam could not be the cause of the PFAS.**

  "NHDES notes the elevated concentrations of PFOS detected at the site may be the result of wastes disposed of at the landfill; or potentially past or current site practices such as the use of Class-B firefighting foam to extinguish fires. However based on a February 1, 2018 email exchange with the Town Administrator, we understand the potential use of firefighting foam at the landfill was discussed with an ex-Fire Chief with historical knowledge of the site. We understand the Chief does not believe firefighting foam was used for extinguishing or training at the site. Based on his knowledge the Town didn't have foam capabilities until after the transfer station was built and doesn't believe the Town received assistance from an area Fire Department with foam capabilities."

August 19, 2019

Subject: GMP Renewal, scope of testing is increased
To: Town of Canterbury (Ken Folsom, Town Administrator)
From: James W. O'Rourke, P.G. Waste Management Division, DES

- Permit is revised to increase the scope of testing

  "The Permit has been revised to incorporate monitoring for per- and polyfluoroalkyl substances (PFAS). The scope of the PFAS monitoring (detailed below) was developed based on our review of the most-recent water quality monitoring results…"
  …
  "Note that the site water quality monitoring program defined in Condition #7 of the Permit has been revised to incorporate the following specific additions:
  - *The additional surface water sampling stations SW-4 and SW-5, as recently established by Aries, have been added to the site monitoring program;*
  - *One additional round of sampling/analysis for PFAS has been added (in November 2019), and shall include the following sampling locations: monitoring wells AE-1, AE-2, AE-3, and AE-4; and surface water sampling stations SW-1, SW-2, SW-3, SW-4, and SW-5. Please ensure that all future PFAS sampling/analysis is*

completed consistent with current NHDES guidance, as available on our website…"

"Please note that Special Condition #14 has been added to the Permit to require installation of permanent staff gauges at each of the 5 surface water sampling stations, and survey of associated reference elevations (common site datum) for each, as previously recommended in the October 23, 2018 NHDES letter (Item #2 therein)."

October 21, 2019

Subject: Legal Notification of PFAS Contamination to Nearby Residents
To: 6 residences and properties within 500 feet of the landfill and the municipal health officer: Nadine Dahl.
From: Suzanne Connelly, DES

- Triggered by 1,490 ppt PFOS/PFOA at AE-2 (well over the 70 ppt AGQS (at the time).
- Notifies 6 property owners near AE-2 per **RSA 485-C:14-b**.

  "The New Hampshire Department of Environmental Services (NHDES) is required to notify owners of drinking water wells that are located on property that is within 500 feet of a potential source of groundwater contamination. The Notification Program applies to man-made contamination such as gasoline or industrial chemicals and does not apply to naturally occurring contamination such as radon. Please refer to Table 1 below for some basic information about the detected contamination. Please be advised NHDES has recently obtained information that contamination was detected in a groundwater sample collected from a location that is within 500 feet of property owned by you in Canterbury. You are being notified about the contamination because this property meets the distance criterion. You can disregard this notice if you do not have a drinking water well."

- Emphasizes PFAS detections, but clarifies this was informational, not enforcement based.

  "THIS NOTICE IS NOT INTENDED TO ALARM ANYONE – it is for informational purposes only and being sent to satisfy the notification requirement of RSA 485-c:14-b, effective May 17, 2004. Laboratory analysis of your drinking water is the only way to find out if your well has been impacted. Depending on the actions taken on behalf of the above mentioned project, you may have already been contacted for requests to sample your

drinking water. If your well has been sampled as part of an ongoing investigation in the area, you will be informed of the individual analytical results by separate letter. If your well has been sampled as part of an ongoing investigation in the area, you will be informed of the individual analytical results by separate letter…"

- AGQS changed on 10/01/2019. PFAS Chemicals must be below 12-18 ppt
- In the 2019 Groundwater Monitoring Summary **Report Aries begins following the 2016-2017 DES directives to submit trend charts, analysis and mitigation recommendations**

August 31, 2022

Subject: New 5-Year Groundwater Management Permit Issued (GWP-198400084-C-004)
To: Town of Canterbury (Ken Folsom, Town Administrator)
From: James W. O'Rourke, P.G. Waste Management Division, DES

- Permit conditions are modified.

  "Please note the requirements of the site water quality monitoring program, as defined under Condition #7 of the Permit, have changed based on our review of the monitoring results collected to date, and the information and recommendations provided in the Permit Renewal Application. We note the sampling frequency at specific monitoring locations and the suite of parameters included has generally remained the same…

  "We note the Permit Renewal Application did not contain recommendations for per- and polyfluoroalkyl substances (PFAS) monitoring at the site. Based on analytical results and data trends at the site, continued PFAS monitoring of groundwater and surface water to define the limits of the contaminant plume and determine the adequacy of the GMZ has been included in the monitoring schedule under Condition #7 of the Permit."

- New Permit is modified to Add a permanent drinking water test location: DW-1 this is 87 Baptist Road's drinking water well, which will now be use as a monitoring point.

  "To be protective of area occupants using the groundwater, the water supply well serving 87 Baptist Road (Map 246 Lot 14) has been added to the Permit to monitor potential migration of contamination in bedrock, continue to define the limits of the contaminant plume, and evaluate the adequacy of the Groundwater Management Zone (GMZ)."

"Within 45 days of obtaining analytical sampling results for the drinking water supply well(s), the permittee shall submit the results to the NHDES' Waste Management Division and the property owner"

- Permit also Requires:
    - Annual testing of PFAS, metals, and VOCs.
    - Maintenance of staff gauges and surface water elevation benchmarks.
    - Data uploads to EMD.

VII. Risk Factors and Pressure Points:

1. PFAS Groundwater Contamination

- Persistent high PFOS, PFOA, and PFHxS detections at AE-1, AE-2, and AE-3.
- PFAS concentrations consistently exceed NH groundwater standards by factors of 10–100.
- Future regulatory tightening could force active remediation discussions.

2. Surface Water Contamination

- SW-1 remains heavily contaminated with PFAS, iron, and manganese.
- Lead concentrations in SW-1 have exceeded SWQC historically but showed slight improvement recently.
- Groundwater wells AE-1, AE-2, and AE-3 are hydraulically connected to the wetlands where SW-1 is located, and the GMP conditions forbid groundwater degradation from discharging into surface water at levels that violate Surface Water Quality Criteria.

3. SW-2 Surface Water Concern

- PFAS detections at SW-2 (outside GMZ) suggest additional migration.
- SW-2 is outside the GMP zone. Contamination of surface water outside the permit zone is a violation of the permit conditions. For now PFAS is not included in the surface water quality standards but if it is added, the town will be in an awkward position.
- No groundwater well exists at SW-2, so groundwater violation not yet proven.

- Potential pressure from NHDES to expand monitoring or install new wells.

4. Chapter 108 Status Vulnerability

- Currently preserved, but long-term stability depends on:
    - No private well contamination.
    - No confirmed groundwater migration outside Groundwater Management Zone.
    - No confirmed case of groundwater contaminants causing surface water violations.
- Future re-evaluation risk if connections are made.
- Is there a plan in place if these connections are made and chapter 108 status is in jeopardy?

5. Private Well Monitoring

- 87 Baptist Road tested in 2018 and 2022 — no PFAS detected.
- Continued clean status is critical to maintaining Chapter 108 protections.
- NHDES may expect periodic retesting.
- Is there a plan in place if contamination is found and homeowners take civil action?

6. Mapping and Waste Footprint

- Post-2015 maps show a drastically reduced landfill footprint compared to 2005-2007 estimates. Eyewitness accounts recall landfill areas not documented.
- Potential risk that future development could encounter undocumented waste areas if full historic extent is ignored.

7. Political and Regulatory Climate

- State and federal PFAS regulations are tightening.
- Surface water standards may soon include PFAS
- Any shift toward stricter groundwater/surface water protection policies could increase future compliance costs or liabilities.

VIII. Legal, Political and Financial Risk Assessment:

1. Legal Exposure from Environmental Contamination

- Civil lawsuits from private parties (e.g., neighboring well owners, if contamination spreads or is perceived to reduce property value or health).
- Public interest lawsuits (environmental groups suing over contamination of wetlands or protected waters).
- Ambitious law firms are advertising that they will help people sue if PFAS is in water near them.
- New Hampshire's Ambient Groundwater Quality Standards (AGQS) are enforceable. Exceeding these standards, as the Canterbury site repeatedly has, can trigger additional DES-mandated actions including site restrictions, forced closure, or landfill capping.
- "The former Canterbury Landfill's contaminated groundwater is discharging into adjacent wetlands, in direct conflict with the protections afforded by New Hampshire Wetlands Rules (Env-Wt 100–900) and RSA 482-A. The site's current exceedances of Surface Water Quality Criteria for PFAS, iron, and manganese in wetland surface water (SW-1) increase the risk of regulatory enforcement under wetlands protection laws as well as the Groundwater Management Permit conditions."

2. Financial Risk and Costs of Corrective Action

- Any new investments at the existing site (e.g., storage buildings, compactors, infrastructure improvements) risk becoming stranded assets if DES later mandates capping or closure.
- Grants and Bonds for improvement are more limited for a site under a GMP.
- Emergency corrective orders typically cost towns more because they must comply under tight regulatory deadlines without the chance to plan financially.
- Canterbury currently only has $100,000 in the capital reserve fund to manage the landfill liabilities. Capping the landfill could cost $500,000 on top of the cost of moving to a new location.

3. Political Insights

- House Bill 199, currently under consideration, proposes extending the statute of limitations for PFAS-related lawsuits from 6 years to 20 years.

- State Representative Wendy Thomas (D-Merrimack) is one of the major political voices pushing for PFAS accountability after her own community faced widespread water contamination and health problems.
- The growing political attention to PFAS contamination ensures greater regulatory scrutiny, public awareness, and potential legal actions against noncompliant towns.
- Canterbury's Commitment to Environmental Stewardship is very strong and citizens will very likely demand action and seek accountability if these challenges are not addressed in a transparent and proactive manner.
- Mandating a recycling program and composting practices on a site that is actively contaminating the environment has terrible political optics.

4. Regulatory Momentum

- DES has escalated testing, increased reporting requirements and may eventually add PFAS to the standing water quality regulations, putting the town's Chapter 108 status at further risk.
- Towns previously "under the radar" are now facing tougher enforcement, especially when surface water or private drinking water is at risk.

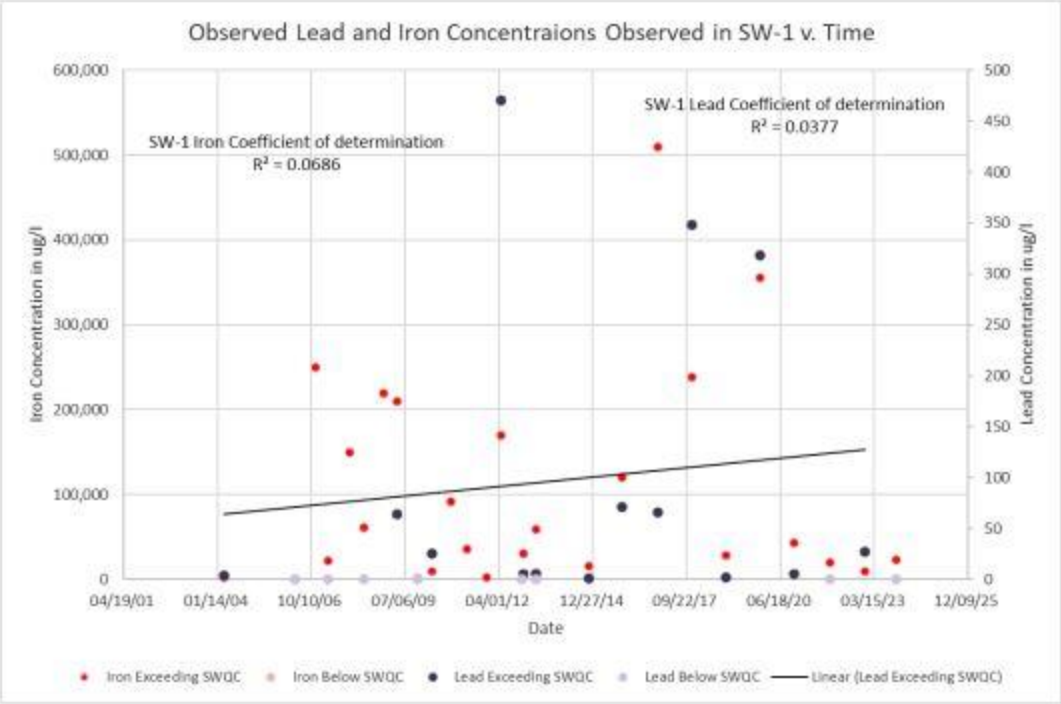
IX. Rebuttal to Aries Engineering Analyses:

In compliance with the 2016 DES directive, Aries has offered the following analysis in the "2023 Groundwater Testing Report" which has also been offered in several earlier reports:

"7.0 - DISCUSSION OF TRENDS

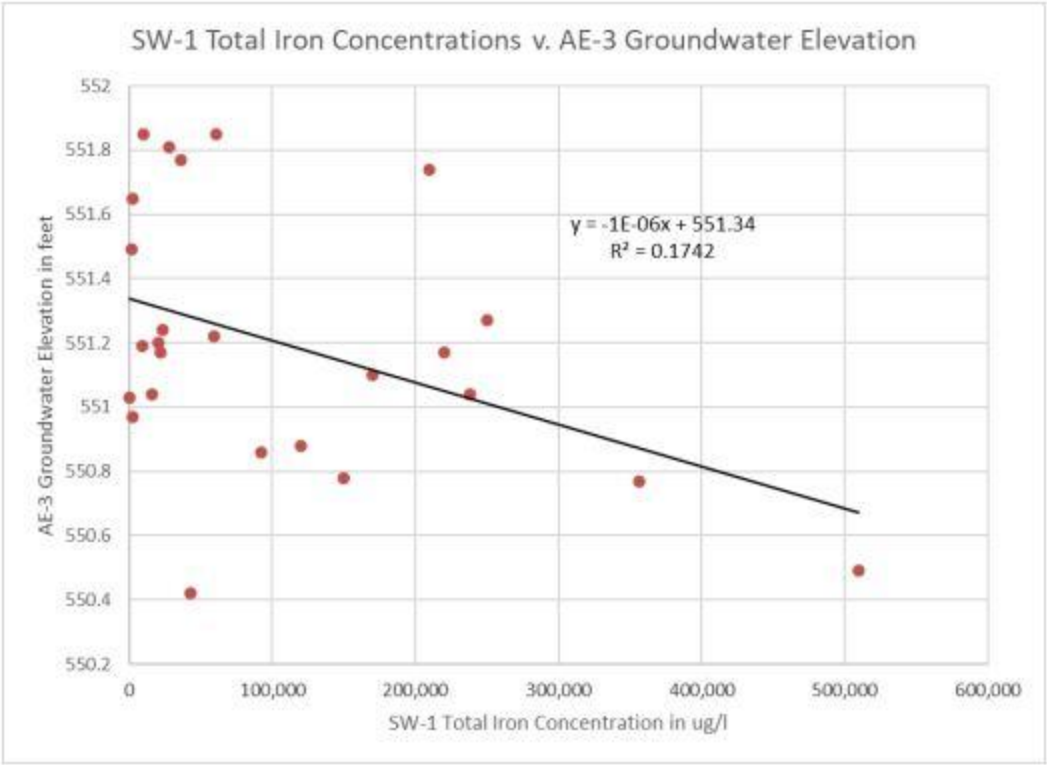
7.1 - Landfill Monitoring Parameters

Manganese concentrations in monitoring wells AE-1 and AE-3 continue to exceed AGQS. Additionally, lead and iron continue to be detected at concentrations above respective SWQC in the SW-1 surface water sample, with the exception of lead during the 2023 sampling round. Aries plotted lead and iron concentrations detected in surface water samples from location SW-1 below.



"***With the exception of a peak iron concentration of 510,000 ug/l in November 2016, iron concentrations detected in surface water samples from location SW-1 have ranged from 300 ug/l to 356,000 ug/l with no discernable trend. Similarly, lead concentrations detected in surface water samples from location SW-1 have generally ranged from concentrations below detection limits to 71 ug/l with no discernable trend. Peak lead concentrations of 470 ug/l, 348 ug/l, and 318 ug/l detected in April 2012, November 2017, and November 2019, respectively, are outliers of the normal detection range. Aries anticipates peak concentrations of lead and iron have occurred during years of low water level in wetlands where surface water becomes concentrated and/or lead and iron-containing sediments are captured in the unfiltered surface waters samples.***

The trend plot below depicts iron concentrations observed in SW-1 and water level measurements taken from the adjacent groundwater monitoring well AE-3. Available site data suggest a slight to modest inverse correlation between groundwater elevation and detected surface water total iron concentrations, where total iron concentration increase with declining groundwater elevations.



Similar trends are anticipated for surface water total lead and other metals concentrations. Based on this inverse relationship, Aries anticipates that the observed elevated metals concentration are not likely related to groundwater contact with landfill wastes, which would typically occur under high groundwater elevation conditions. Oxidation of the dissolved metals is anticipated to bind the metals with wetland and surface water sediments. The heavily vegetated wetland area downstream of SW-1 is anticipated to remove some of the suspended particles in the water column, thereby reducing transport of metals downstream from the landfill.

Based on the available data, PFAS concentrations observed in 2022 and 2023 were consistent with previous PFAS data for the samples collected from the site monitoring wells. Based on recent groundwater sampling data, Aries observed the following trends: 1. PFOS concentrations appear to be increasing slightly in monitoring wells AE-1 and AE-2, but decreasing in monitoring well AE-3. 2. PFOA concentrations appear to be relatively steady in site monitoring wells. 3. PFHxS concentrations appear to be relatively steady in site monitoring wells AE-1 and AE-2, with a slight decreasing trend in monitoring well AE-3. Aries' trend analysis is based on only a few data points. Additional PFAS sampling would need to be conducted to establish a trend over time. Surface water PFAS concentrations decreased by an approximate order of magnitude in the samples collected at surface water sample locations SW-1 and SW-2. Groundwater PFAS concentration trends are depicted in Appendix D. In

general, the surface water total PFAS concentration distribution is highest in samples SW-1, SW-2 and SW-4 collected adjacent to and northeast of the landfill. Aries anticipates that the highly organic wetland soils have a relatively high sorption capacity for PFAS1 and likely contribute to the observed PFAS concentration attenuation in site surface water samples with distance from the landfill." -Aries Engineering 2024

The following are possible "devils advocate" counter points to this analysis for consideration:

Iron and Lead:
Aries Engineering has presented analyses in several reports suggesting that fluctuations in iron and lead concentrations at SW-1 are natural, linked to groundwater elevation changes, and unlikely to pose downstream risks. However, a review of their data and arguments reveals some vulnerabilities:

Persistent Exceedances Despite Fluctuations

- Aries' own data demonstrates chronic exceedances of Surface Water Quality Criteria (SWQC) for iron and lead.
- Statistical analysis shows dubious correlation between groundwater elevation and contaminant concentration (R^2 values of 0.0686 for iron and 0.0377 for lead).
- Regulatory compliance is based on the presence of violations, not on the absence of a statistical trend.

Selective interpretation of Groundwater Elevation Effects

- Aries argues that low groundwater levels reduce landfill contaminant transport.
- However, contaminants can migrate horizontally or through capillary action even under low groundwater conditions.
- Wetlands are dynamic systems, and water level fluctuations do not eliminate contaminant pathways.

Reliance on Wetland Attenuation

- Aries suggests wetlands trap metals and PFAS.
- While wetlands can slow migration, PFAS and dissolved lead can move through wetlands over time.
- Relying on natural attenuation does not eliminate regulatory liability or environmental risk.
- Natural attenuation through wetlands is used to mitigate contamination under strict management using artificial wetlands. Allowing it to be

attenuated naturally uses the attenuation against the wetlands, rather than using the wetlands against contamination.

- PFAS attenuated into a wetland can be invisible to water testing, build up in the muck over time, and then be released at higher levels during a high water or flooding period.

Insufficient Evidence of Containment

- Aries offers no comprehensive hydraulic modeling or long-term migration studies to support claims of containment.
- Downstream monitoring (SW-3, SW-5) shows lower concentrations, but this does not guarantee long-term stability.

Logical Contradiction Regarding Iron

- Aries characterizes elevated iron as a "natural" result of wetland processes.
- Simultaneously, they argue that iron is unlikely to migrate downstream due to wetland trapping.
- If iron were truly a benign natural component, migration would not pose a concern; Aries' own emphasis on containment implies recognition of iron as a harmful contaminant.

Conclusion: Although Aries Engineering acknowledges contamination at SW-1, their trend analyses and mitigation claims are rather optimistic and speculative. Chronic violations of surface water standards, persistent PFAS impacts, and the vulnerability of wetland systems indicate a continuing environmental and regulatory risk that cannot be dismissed by seasonal or statistical explanations.

PFAS Explanations:

Aries Engineering’s 2023 discussion on PFAS trends includes several important observations but also critical limitations:

Limited Data for Trend Conclusions

- Aries states PFAS concentrations appear "consistent" based on 2022-2023 samples.
- However, two years of data are insufficient to establish long-term stability, particularly for slow-moving contaminants like PFAS.
- Regulatory agencies typically require multi-year data sets to establish true trends.

Surface Water PFAS Decrease at SW-1 and SW-2

- Aries notes that PFAS concentrations decreased by roughly an order of magnitude at SW-1 and SW-2.
- Despite reduction, PFAS concentrations remain above proposed and final NH AGQS values.
- Regulatory concern persists as long as any exceedances are present, regardless of relative decreases.

Reliance on Wetland Sorption

- Aries again suggests wetland organic soils are attenuating PFAS migration.
- While sorption can slow movement, it is weak, reversible, and does not eliminate PFAS from the system.
- As stated earlier, accumulated PFAS in wetland soils can be remobilized during high water events or over longer time periods.

Regulatory Gaps in Surface Water Standards

- Aries notes that NHDES had no formal Surface Water Quality Criteria (SWQC) for PFAS in 2022-2023.
- However, the lack of finalized SWQC does not negate environmental concern — and new surface water PFAS criteria are anticipated.
- PFAS detections in surface water reinforce the regulatory and reputational risks Canterbury faces.

Ethical and Professional Considerations

- Aries' emphasis that toxic chemicals like PFAS, lead, and iron are being "attenuated" into the wetland environment mirrors “out of sight is out of mind” arguments that have been found unacceptable to most environmental standards.
- Responsible environmental stewardship demands active management, containment, and mitigation of contamination not passive reporting of escalating results with reliance on passive dispersion into sensitive ecosystems.
- The suggestion that contaminant migration into protected wetlands is acceptable undermines the standards expected of good environmental stewardship.

Conclusion: While Aries Engineering identifies slight PFAS decreases and emphasizes sorption in wetlands, these points do not eliminate the regulatory risk posed by persistent PFAS contamination. Continued monitoring alone does not resolve the liability associated with PFAS

impacts to groundwater, wetlands, and connected surface waters.

X. Report Summary:

- The Canterbury site faces compounding **legal, financial, environmental, and political risks** due to ongoing groundwater and surface water contamination.

- PFAS, lead, and iron **exceed regulatory thresholds** in multiple monitoring wells and wetlands, and the site remains under a **Groundwater Management Permit (GMP)** due to confirmed contamination.

- **DES correspondence has escalated** over time, indicating growing concern. This paper trail is building a historical case that can support future regulatory actions against the town if someone chooses.

- **Delaying action** could result in **stranded infrastructure**, forced closure of existing facilities, and costly emergency compliance measures.

- **New investment** at the current location — including equipment, buildings, or redesigns — carries **high financial and regulatory risk** due to the site's GMP restrictions and environmental liabilities.

- **Proactive planning and relocation** offer the most stable long-term solution to preserve public trust, qualify for grants, and avoid unplanned fiscal burdens.

XI. Responses to Common Statements:

• ***"We are one of many towns with uncapped landfills."***

True, but **very few towns operate active transfer stations directly on top of them** — and even fewer have documented PFAS, lead, and iron exceedances **in both groundwater and surface water**, especially adjacent to wetlands and within proximity of private drinking water wells.

• ***"Water testing has shown everything is fine."***

Not accurate. Earlier testing (pre-2015) did not test for PFAS, but since 2017, **PFAS levels have consistently exceeded AGQS standards**, with **surface water detections over 300 ppt** and **groundwater detections over 1,400 ppt**. Regulatory limits are 12–20 ppt. Iron and lead have also repeatedly exceeded surface water quality criteria.

• ***"DES won't shut us down unless the state can help pay for it."***

Incorrect. DES has **full regulatory authority** to mandate landfill closure or restrict site use at any time, regardless of the town's finances. **Enforcement does not require legislative approval or funding — just a violation.**

• ***"There is no money in the state budget to help close landfills, so DES probably won't act."***

Not accurate. The **2024–2025 NH state budget includes funds for landfill closures and PFAS mitigation**, showing increased state commitment. However, **DES is not required to wait for funding availability to enforce environmental protections.**

Funding Opportunities:

- **NHDES Landfill Closure Grant Program**: Reimburses up to **20%** of closure costs.
- **EPA Solid Waste Infrastructure for Recycling (SWIFR)**: Grant program for rural waste facility upgrades.
- **USDA Rural Development**: Supports solid waste improvements for small towns.
- **NH the Beautiful**: Offers equipment and infrastructure grants for solid waste facilities.

• ***"There's no political will in the state to go after landfills."***

Outdated assumption. Legislative and public pressure is **growing rapidly** around PFAS.

- **House Bill 199** would expand the statute of limitations for PFAS lawsuits from 6 to 20 years.
- **Rep. Wendy Thomas** has made PFAS accountability a statewide issue.
- DES has increased monitoring and pressure on multiple towns with PFAS exceedances — **including Canterbury.**

• ***"It's better not to rock the boat."***

Risky thinking. Avoiding action today could lead to **emergency shutdowns**, forced construction changes, or sudden regulatory orders — all with **higher costs and fewer options**. Planning ahead is the fiscally responsible path.

"The PFAS came from firefighting foam, not the landfill."

Debunked. The town explored this theory in 2018, but DES confirmed there was **no foam used or stored on site prior to PFAS detections**.

- The **Fire Chief confirmed** that foam was acquired *after* the transfer station was built.
- DES officially ruled out foam and attributed the PFAS to **landfill sources**.
- The **wide distribution** of PFAS across multiple wells and wetlands is consistent with **leachate migration**, not a localized spill.

XII. Sources:

1. **Water Testing results for Canterbury Landfill: Aries Engineering reports filed with DES and DES correspondence available from the "OneStop database".**

   https://www4.des.state.nh.us/DESOnestop/BasicSearch.aspx

2. **EPA. Our Current Understanding of the Human Health and Environmental Risks of PFAS. U.S. Environmental Protection Agency.**
   https://www.epa.gov/pfas/our-current-understanding-human-health-and-environmental-risks-pfas

3. **EPA. PFAS Action Plan. U.S. Environmental Protection Agency (February 2019).**
   https://www.epa.gov/sites/default/files/2019-02/documents/pfas_action_plan_021319_508compliant_1.pdf

4. **EPA. PFOA Report 2024: Draft Human Health Water Quality Criteria for PFOA.**
   https://www.epa.gov/system/files/documents/2024-09/pfoa-report-2024.pdf

5. **EPA/NRMRL. Iron Mineralogy and Trace Contaminant Binding in Soils and Wetlands. National Risk Management Research Laboratory.**
   https://cfpub.epa.gov/si/si_public_record_report.cfm?Lab=NRMRL&dirEntryId=321840

6. **Groundwater Monitoring & Remediation (NGWA). Monitored Natural Attenuation to Manage PFAS Impacts to Groundwater.**
   https://ngwa.onlinelibrary.wiley.com/doi/full/10.1111/gwmr.12486

7. **Nature Reviews Earth & Environment. Environmental Chemistry and Transport of PFAS in Wetlands.**
   https://www.nature.com/articles/s41545-023-00274-6

8. **ACS Physical Chemistry Au. PFAS Migration, Remobilization, and Limitations of Sorption-Based Attenuation.**
   https://pubs.acs.org/doi/10.1021/acsphyschemau.4c00092

9. **New Hampshire Department of Environmental Services. Solid Waste Management.**
https://www.des.nh.gov/land/waste/solid-waste-management

10. **NHDES. Solid Waste Facility Closure Guidance.**
https://www.des.nh.gov/land/waste/solid-waste-management/permitting/closure-guidance

11. **NHDES. Wetlands Bureau Overview.**
https://www.des.nh.gov/water/wetlands

12. **EPA. Clean Water Act Section 404.**
https://www.epa.gov/cwa-40

13. **NHDES. Groundwater Management Permits.**
https://www.des.nh.gov/water/groundwater/groundwater-management-permits

14. **NHDES. PFAS and Drinking Water.**
https://www.pfas.des.nh.gov/drinking-water

15. **NHDES. Surface Water Quality Standards.**
https://www.des.nh.gov/water/surface-water-quality-standards

16. **NH State Budget Summary.**

https://www.nhmunicipal.org/sites/default/files/uploads/documents/hb_2_budget.pdf

XIII. Supporting Materials:

Table 1

Canterbury Landfill Surface Water Test Results for Iron				
Location	Year	NH Standard	Test Results	Over Limit
SW-1	2014	1000 µg/L	16000	**16x**
	2015		120000	**120x**
	2016		510000	**510x**
	2017		238000	**238x**
	2018		28000	**28x**
	2019		356000	**356x**
	2020		43000	**43x**
	2021		20300	**20.3x**
	2022		9320	**9.32x**

	2023		23400	**23.4x**

Canterbury Landfill Surface Water Test Results for Lead				
Location	Year	NH Standard	Test Results	Over Limit
SW-1	2014	**0.41 µg/L**	1	2.43x
	2015		71	173x
	2016		66	160x
	2017		348	848x
	2018		2	4.87x
	2019		318	775x
	2020		5.2	12x
	2021		1	2.43x
	2022		27	65x
	2023		1	2.43x

"NH standard" is the Surface Water Quality Criteria (SWQC) measured in micrograms per liter (µg/L)
Iron, while not acutely toxic at low levels, can promote bacterial growth, clogging of aquatic systems, and habitat degradation when present in excess. It can also occur naturally at some levels in wetlands. High iron measurements could be a combination of landfill leachate and natural sediment.
Lead is a persistent bioaccumulative toxicant (PBT) with no known safe exposure threshold for children or wildlife. Even small quantities in surface water can impact ecological health. Lead does not occur naturally in wetlands.
"The permittee shall not cause groundwater degradation that results in a violation of surface water quality standards (N.H. Admin. Rules Env-Wq 1700) in any surface water body." — 2023 Groundwater Management Permit (GWP-198400084-C-004)
While SW-1 was routinely tested for iron and lead, other surface water locations (SW-2 to SW-5) have not been, despite evidence of PFAS migration to these areas. This creates a critical data gap: if metals are present alongside PFAS, we may be underreporting the full scope of contamination

Table 2

PFAS Test Results for Test Wells A1-A3 at the Canterbury Landfill

TESTED		PFOS			PFOA			PFHxS		
Well	Year	NH Standard	Test Result	Over Limit	NH Standard	Test Result	Over Limit	NH Standard	Test Result	Over Limit
AE-1	2017	15	302	20.1x	12	65	5.4x	18	57	3.2x
	2018		273	18.2x		82	6.8x		47	2.6x
	2019		315	21x		86	7.2x		48	2.7x
	2022		428	28.5x		73.6	6.1x		65.8	3.7x
	2023		403	26.9x		62.3	5.2x		29.3	1.6x
	2024		401	26.7x		63	5.2x		28.1	1.6x
AE-2	2017	15	1030	68.7x	12	136	11.3x	18	271	15.1x
	2018		1337	89.1x		153	12.8x		529	29.4x
	2019		736	49.1x		196	16.3x		288	16x
	2022		1380	92x		158	13.2x		510	28.3x
	2023		1010	67.3x		221	18.4x		235	13.1x
	2024		822	54.8x		179	14.9x		273	15.2x
AE-3	2017	15	777	51.8x	12	106	8.8x	18	663	36.8x
	2018		829	55.3x		78	6.5x		517	28.7x
	2019		813	54.2x		109	9.1x		791	43.9x
	2022		777	51.8x		74.6	6.2x		829	46.1x
	2023		482	32.1x		93.1	7.8x		418	23.2x
	2024		821	54.7x		130	10.8x		1600	88.9x

Source: Aries Engineering, Former Canterbury Landfill, 2024 Groundwater Monitoring Report, NHDES One Stop Database

https://www4.des.state.nh.us/DESOnestop/BasicList.aspx

PFOS, PFOA and PFHxS are all regulated chemicals in the "PFAS" family

"NH Standard": is the Ambiant Groundwater Quality Standard (AGQS) which is the maximum allowed ppt. for the chemical

"Test Result": is measured in parts per trillion (ppt) which tells us the concentration of the chemical in the water

"Over Limit": 10x would be 10 times over the allowed limit

Well AE-4 is up hill and has not been tested since 2019. In 2017-2019 the AE-4 test results were below the NH standard.

In 2019 NHDES was required by law to notify 6 properties within 500 feet of the landfill that PFAS was detected.

A residential water well at 87 Baptist Road was tested in 2018 and 2022. PFOS, PFOA and PFHxS were not detected

Table 3

PFAS Test Results for Surface Water Locations SW1-SW5 at the Canterbury Landfill

Tested		PFOS			PFOA			PFHxS		
Site	Year	Groundwater Standard	Test Result	Over Limit	Groundwater Standard	Test Result	Over The Limit	Groundwater Standard	Test Result	Over Limit
SW-1	May-18	15	13800	920x	12	1140	95x	18	23300	1294.4x
	Nov-18		1021	68.1x		116	9.7x		1244	69.1x
	2019		672	44.8x		116	9.7x		808	44.9x
	2022		604	40.3x		49.6	4.1x		476	26.4x
	2023		1540	102.7x		130	10.8x		1460	81.1x
	2024		1410	94x		113	9.4x		816	45.3x
SW-2	May-18	15	56	3.7x	12	<20	unknown	18	57	3.2x
	Nov-18		963	64.2x		29	2.4x		586	32.6x
	2019		132	8.8x		<20	unknown		113	6.3x
	2022		167	11.1x		2.13	not over		54.3	3x
	2023		21.1	1.4x		<2	not over		26.3	1.5x
	2024		3680	245.3x		213	17.8x		4550	252.8x
SW-3	May-18	15	10	not over	12	10	not over	18	10	not over
	Nov-18		4	not over		3	not over		3	not over
	2019		4	not over		2	not over		3	not over
	2022		not tested	unknown		not tested	unknown		not tested	unknown
	2023		not tested	unknown		not tested	unknown		not tested	unknown
	2024		not tested	unknown		not tested	unknown		not tested	unknown
SW-4	May-18	15	975	65x	12	56	4.7x	18	683	37.9x
	Nov-18		not tested	unknown		not tested	unknown		not tested	unknown
	2019		1363	90.9x		181	15.1x		2136	118.7x
	2022		1220	81.3x		38	3.2x		694	38.6x
	2023		170	11.3x		4.39	not over		52.8	2.9x
	2024		1780	118.7x		84	7x		1840	102.2x
SW-5	May-18	15	4	not over	12	2	not over	18	3	not over
	Nov-18		8	not over		4	not over		6	not over
	2019		less than 20	unknown		less than 20	unknown		less than 20	unknown
	2022		3.36	not over		2	not over		2	not over
	2023		3.74	not over		2.31	not over		2	not over
	2024		less than 20	unknown		less than 20	unknown		less than 20	unknown

Source: Aries Engineering, Former Canterbury Landfill, 2024 Groundwater Monitoring Report, NHDES One Stop Database

https://www4.des.state.nh.us/DESOnestop/BasicList.aspx

In 2018 NHDES was alarmed by the May testing results and requested retesting which is why there is an additional test of some sites in November

PFOS, PFOA and PFHxS are all regulated chemicals in the "PFAS" family

"Test Result": is measured in parts per trillion (ppt) which tells us the concentration of the chemical in the water

Groundwater standard is here for comparison only. The Surface Water Quality Criteria (SWQC) does not have formal PFAS standards yet.

"Groundwater Standard": is the Ambiant Groundwater Quality Standard (AGQS) which is the maximum allowed ppt. for the chemical

"Over Limit": 10x would be 10 times over the allowed groundwater limit. Results not over the limit are marked "not over".

"Less than 20": means the test cannot detect low enough to reach the groundwater standard so it is unknown if the result is over the limit

state adopts PFAS into the Surface Water Quality Criteria, the landill will be in violation. This violation may already exist with iron and lead contamination (see that table for details). SW-2 is outside the Groundwater Management Permit boundary with very high levels of PFAS which violates the permit.

2/6/2025

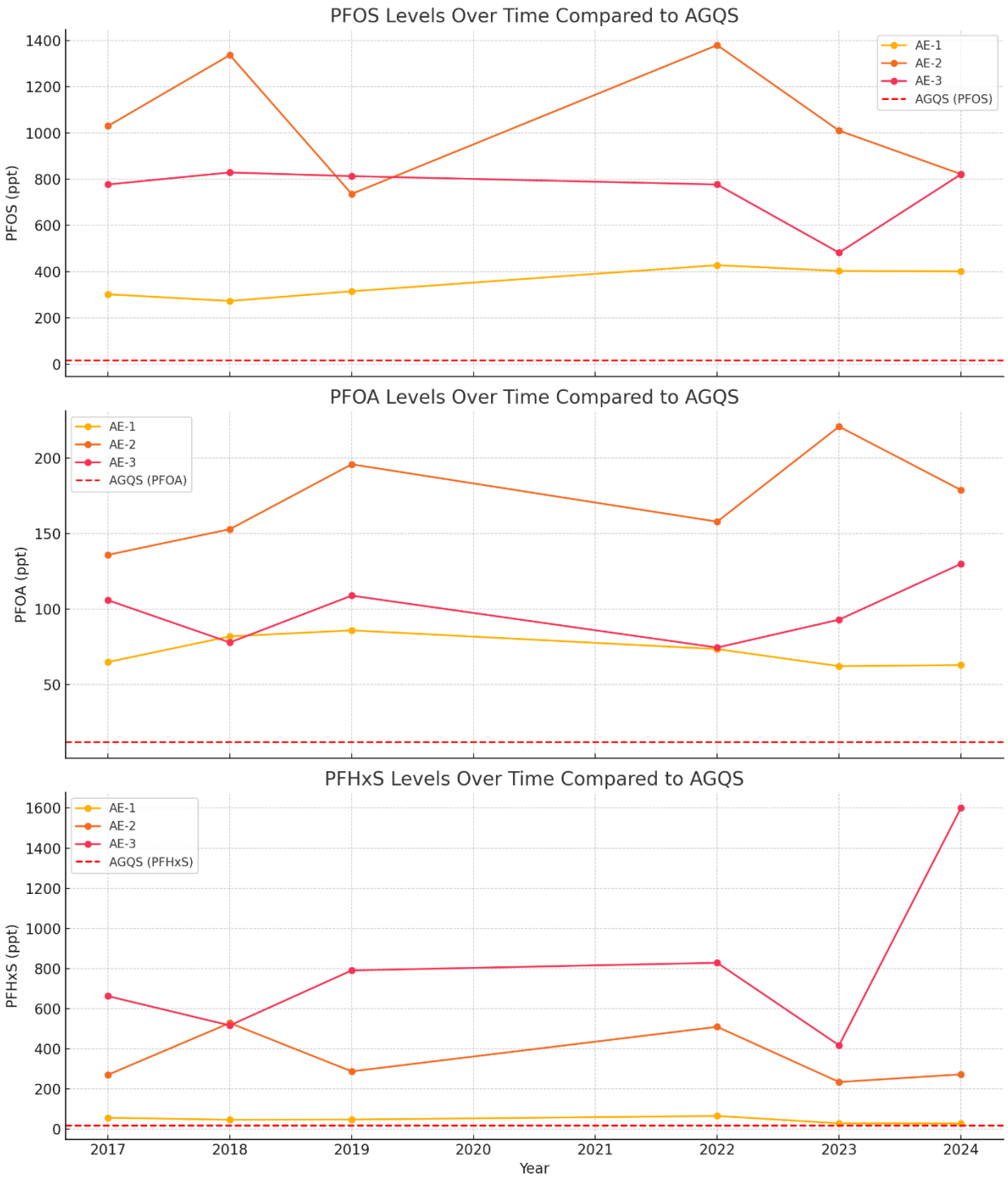
TABLE 1
SITE GROUNDWATER ELEVATION DATA
TOWN OF CANTERBURY
FORMER CANTERBURY LANDFILL
BAPTIST ROAD
CANTERBURY, NEW HAMPSHIRE
NHDES NO. 198400084

Relative Elevation of Top of PVC Riser Pipe (feet)*				
Survey Date	AE-1	AE-2	AE-3	AE-4
11/20/17	558.93	557.98	557.91	580.43
Measured Water Level Below Top of PVC Riser Pipe (feet)				
Date	AE-1	AE-2	AE-3	AE-4
01/06/04	7.73	6.61	6.72	13.24
03/23/04	8.05	6.94	6.94	10.57
04/19/06	8.02	6.88	6.88	13.00
11/27/06	7.77	6.63	6.64	14.45
04/09/07	7.88	6.74	6.74	14.41
11/27/07	8.26	7.11	7.13	20.1
04/24/08	7.21	6.06	6.06	8.23
11/24/08	7.88	6.75	6.74	16.15
04/13/09	6.16	7.33	6.17	9.91
11/16/09	7.58	6.41	6.42	16.57
04/21/10	7.21	6.07	6.06	11.32
11/04/10	8.22	7.05	7.05	20.18
04/30/11	7.29	6.13	6.14	10.14
11/23/11	7.81	6.25	6.26	13.80
04/24/12	7.95	6.79	6.81	15.17
11/30/12	8.25	7.11	7.09	19.83
04/29/13	7.85	6.70	6.69	12.90
11/13/14	7.98	6.88	6.87	18.77
11/05/15	8.14	7.02	7.03	19.42
11/22/16	8.54	7.41	7.42	22.37
11/20/17	7.99	6.82	6.87	16.62
11/14/18	7.25	6.14	6.10	13.62
11/15/19	8.25	7.13	7.14	19.35
11/12/20	8.62	7.49	7.49	19.92
11/29/21	7.83	6.71	6.71	16.53
12/01/22	7.87	6.73	6.72	19.48
11/08/23	7.80	6.67	6.67	16.71
11/19/24	8.53	7.37	7.37	-
Relative Groundwater Elevation (feet)*				
Date	AE-1	AE-2	AE-3	AE-4
01/06/04	551.20	551.37	551.19	567.19
03/23/04	550.88	551.04	550.97	569.86
04/19/06	550.91	551.10	551.03	567.43
11/27/06	551.16	551.35	551.27	565.98
04/09/07	551.05	551.24	551.17	566.02
11/27/07	550.67	550.87	550.78	560.33
04/24/08	551.72	551.92	551.85	572.20
11/24/08	551.05	551.23	551.17	564.28
04/13/09	552.77	550.65	551.74	570.52
11/16/09	551.35	551.57	551.49	563.86
04/21/10	551.72	551.91	551.85	569.11
11/04/10	550.71	550.93	550.86	560.25
04/30/11	551.64	551.85	551.77	570.29
11/23/11	551.12	551.73	551.65	566.63
04/24/12	550.98	551.19	551.10	565.26
11/30/12	550.68	550.87	550.82	560.60
04/29/13	551.08	551.28	551.22	567.53
11/13/14	550.95	551.10	551.04	561.66
11/05/15	550.79	550.96	550.88	561.01
11/22/16	550.39	550.57	550.49	558.06
11/20/17	550.94	551.16	551.04	563.81
11/14/18	551.68	551.84	551.81	566.81
11/15/19	550.68	550.85	550.77	561.08
11/12/20	550.31	550.49	550.42	560.51
11/29/21	551.10	551.27	551.20	563.90
12/01/22	551.06	551.25	551.19	560.95
11/08/23	551.13	551.31	551.24	563.72
11/19/24	558.93	557.98	557.91	580.43

NOTES:
1. Groundwater elevations are referenced to a temporary bench mark (TBM-1), located at the concrete foundation located on the eastern corner of the site recycling building, at an elevation of 584.1 feet interpolated from Light Detection and Ranging (LIDAR) Bare Earth DEM imagery obtained from NHGRANIT.
2. Imagery was generated from data collected on September 14, 2012 by NHGRANIT personnel.
3. Static groundwater elevations were measured using a Solinst electronic water level indicator.

Groundwater PFAS Levels Over Time

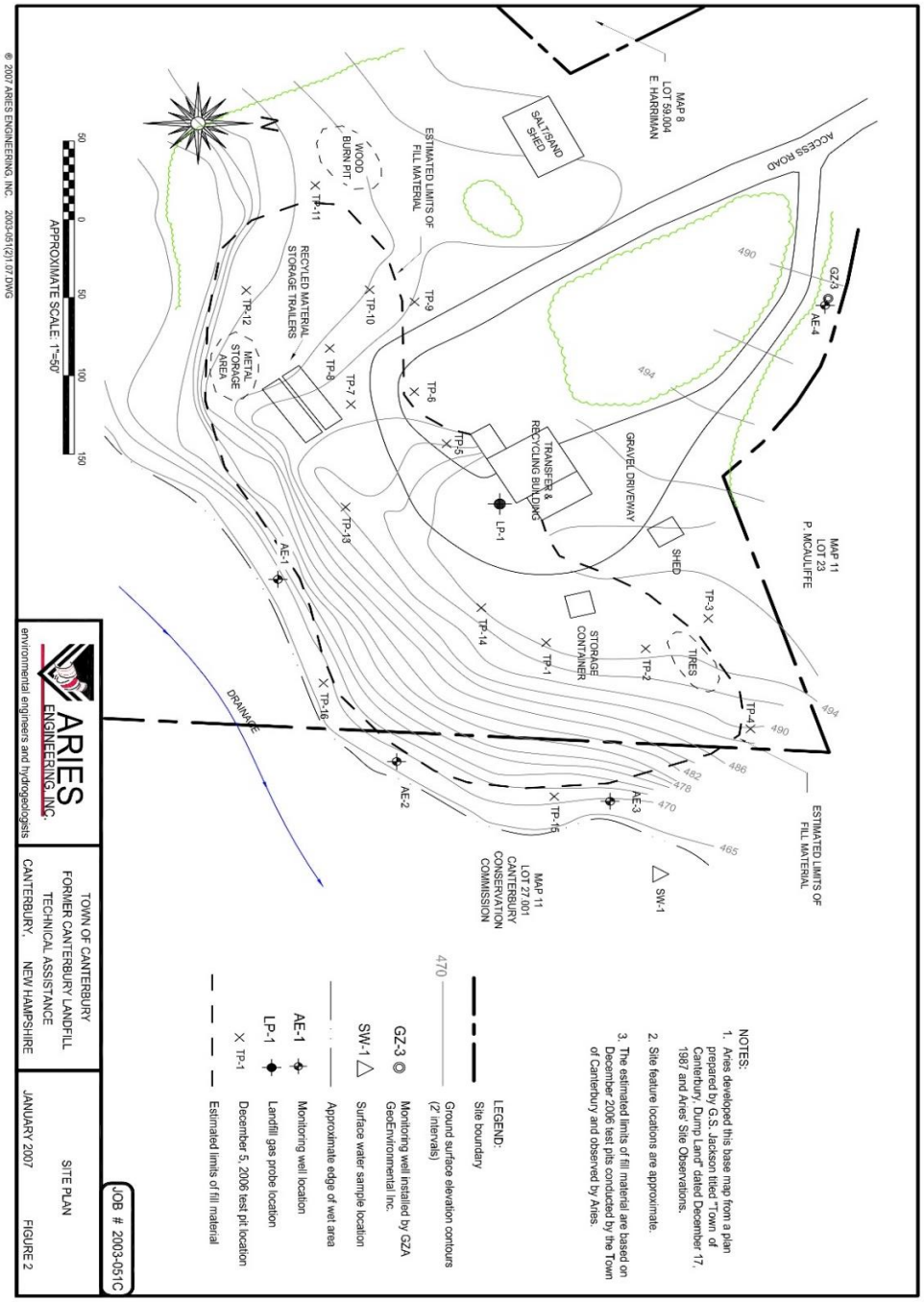
Compared to Ambient Groundwater Quality Standard (Dashed Line)



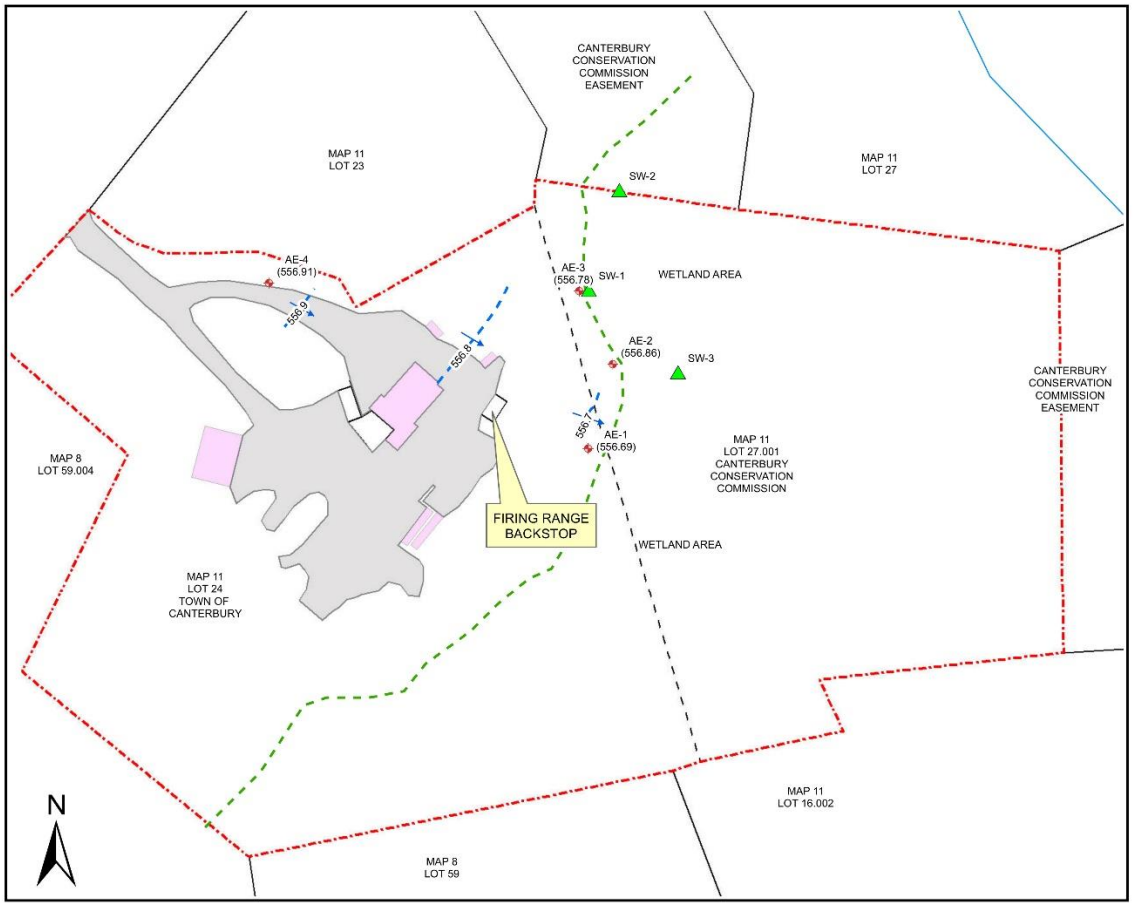
Mapping Note

- 2005-2007 maps showed larger landfill footprint.
- 2015 onward: Site maps show smaller "estimated landfill extent"; original fill area often omitted.

Landfill Map 2007 (large landfill boundary based on dig pit testing)



Landfill Map 2015 (No Landfill Boundary)



NOTES

1. Plan prepared from: a plan entitled "Town of Canterbury - Dump Land", prepared by G.S. Jackson, dated December 17, 1987; Aries' site observations; Town of Canterbury Tax Maps; and a 2010 digital aerial orthophotograph (2010 Multispectral Color Orthophotography at 1' (.3m) resolution) provided by the New Hampshire Geographically Referenced Analysis and Information Transfer System (NH GRANIT) maintained by University of New Hampshire and the NH Office of Energy and Planning.

2. Site boundary and building locations are based on an overlay of the site features on NH GRANIT GIS data. Therefore, all site features are approximately located.

3. This plan is not to be used for construction, survey or boundary purposes.

4. Contours represent inferred lines of equal groundwater elevation based on Aries' November 5, 2015 site observations.

5. Contour lines are approximate and are based on data obtained from widely spaced observation points. Actual contours may vary from those shown.

Legend

- Groundwater Monitoring Well
- Surface Water Sample Location
- gwcont2015
- gwflowdir
- River/Stream
- Approximate Edge of Wetland
- Site Buildings
- Groundwater Management Zone Boundary
- Property Line
- Easement Line
- Gravel Driveway
- (556.69) Groundwater elevation in feet on November 5, 2015

0 50 100 200 300 400 Feet

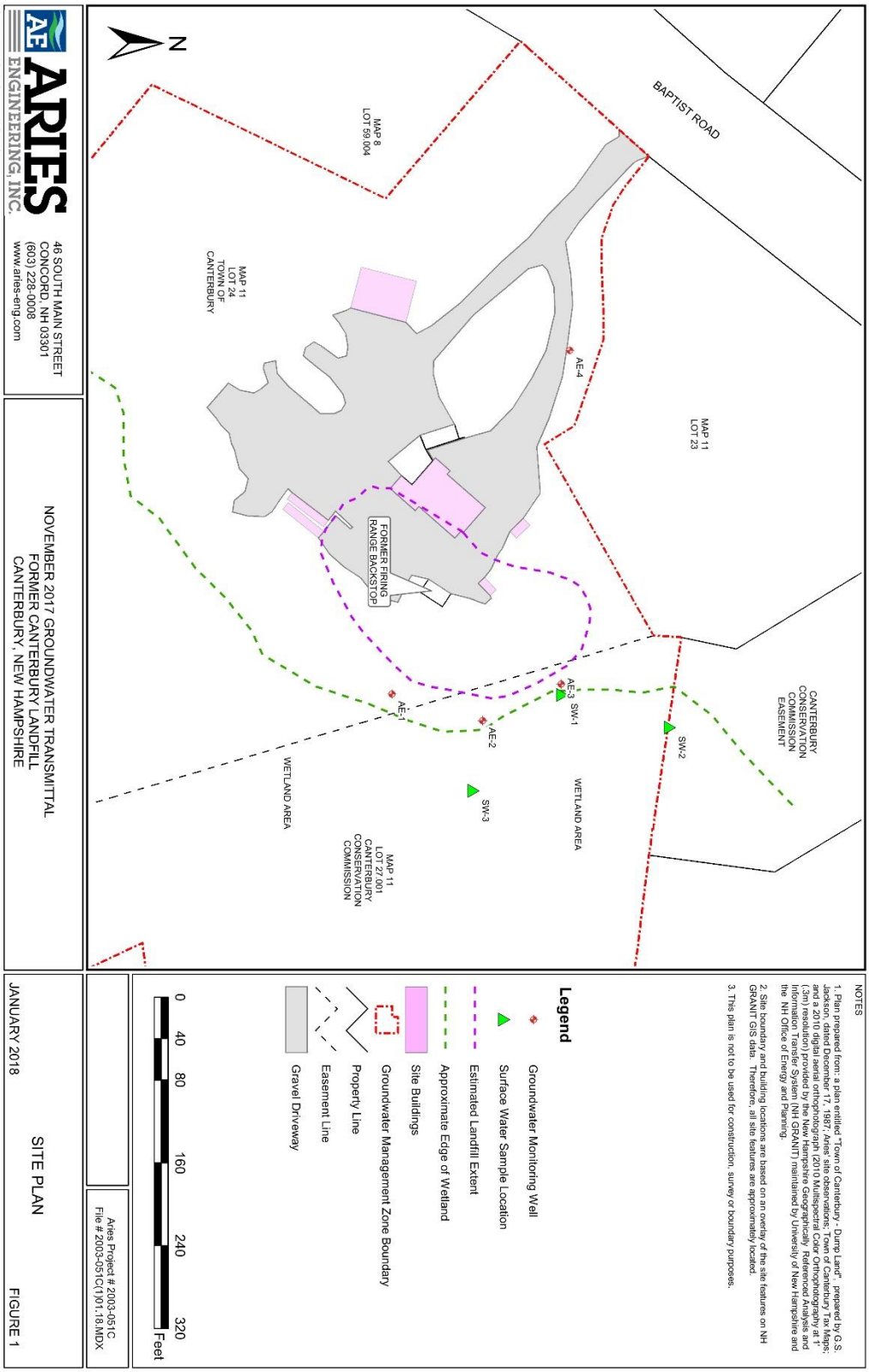
Aries Project # 2003-051C
File # 2003-051C(2)12.15.MDX

ARIES ENGINEERING, INC.
environmental engineers and hydrogeologists

GMP RENEWAL APPLICATION REPORT
FORMER CANTERBURY LANDFILL
CANTERBURY, NEW HAMPSHIRE

SITE PLAN
DECEMBER 2015 FIGURE 2

Landfill Map 2018 (Small Landfill Boundary)



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NOVEMBER 2017 GROUNDWATER TRANSMITTAL
FORMER CANTERBURY LANDFILL
CANTERBURY, NEW HAMPSHIRE

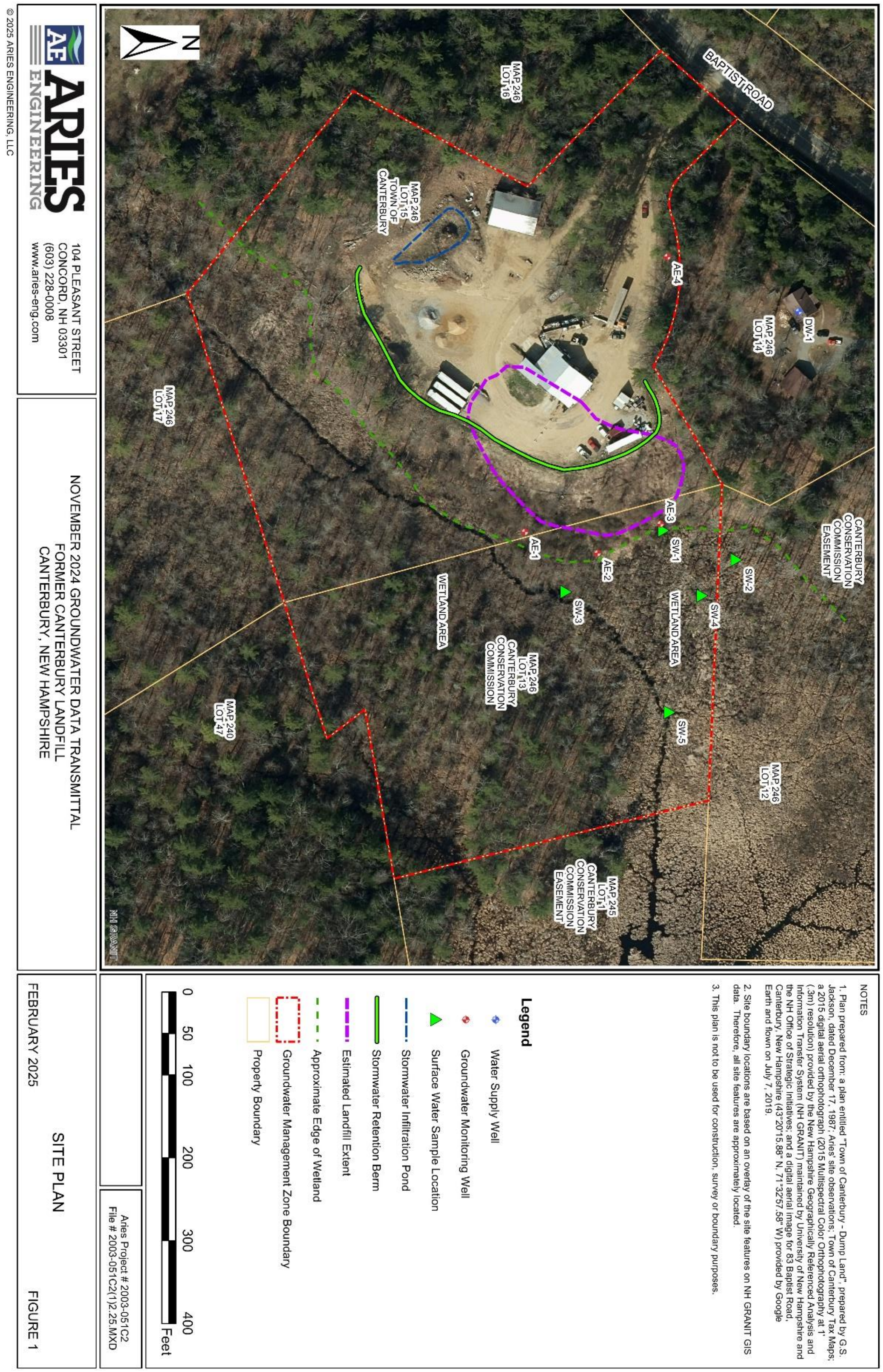
SITE PLAN

JANUARY 2018

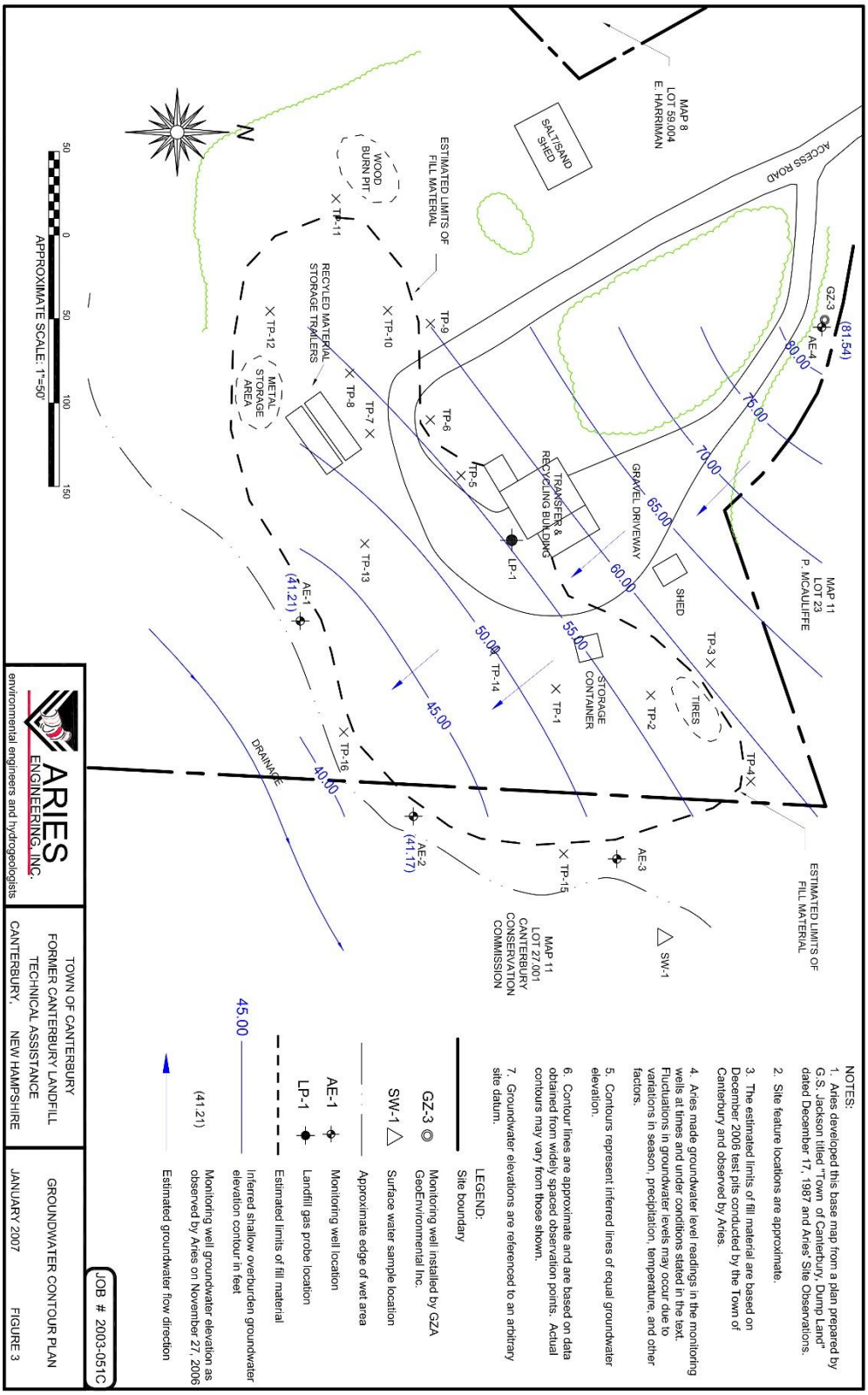
FIGURE 1

Aries Project # 2003-051C
File # 2003-051C(1)01-18.MDX

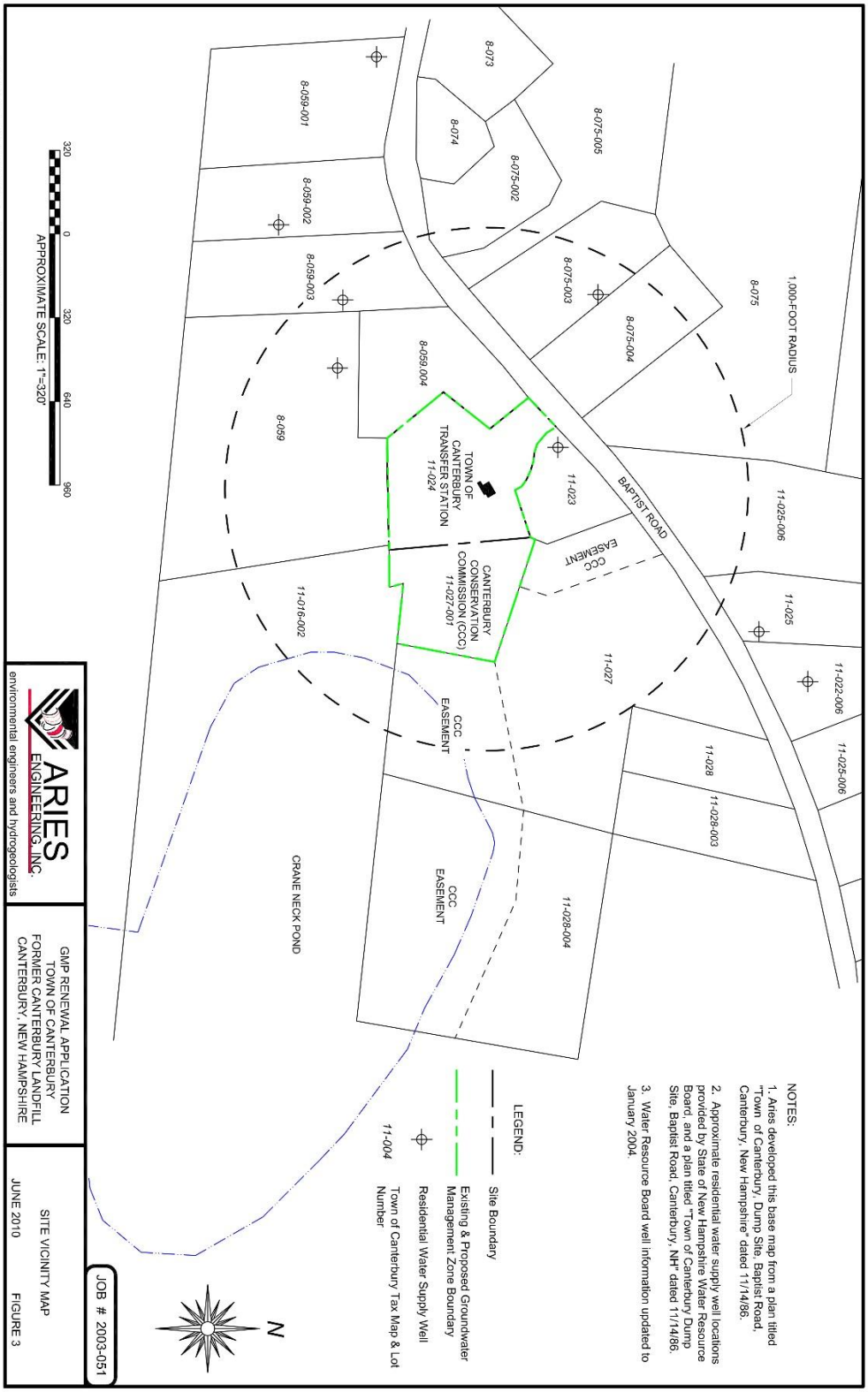
Landfill Map 2024 (Small Boundary over Satellite Map)



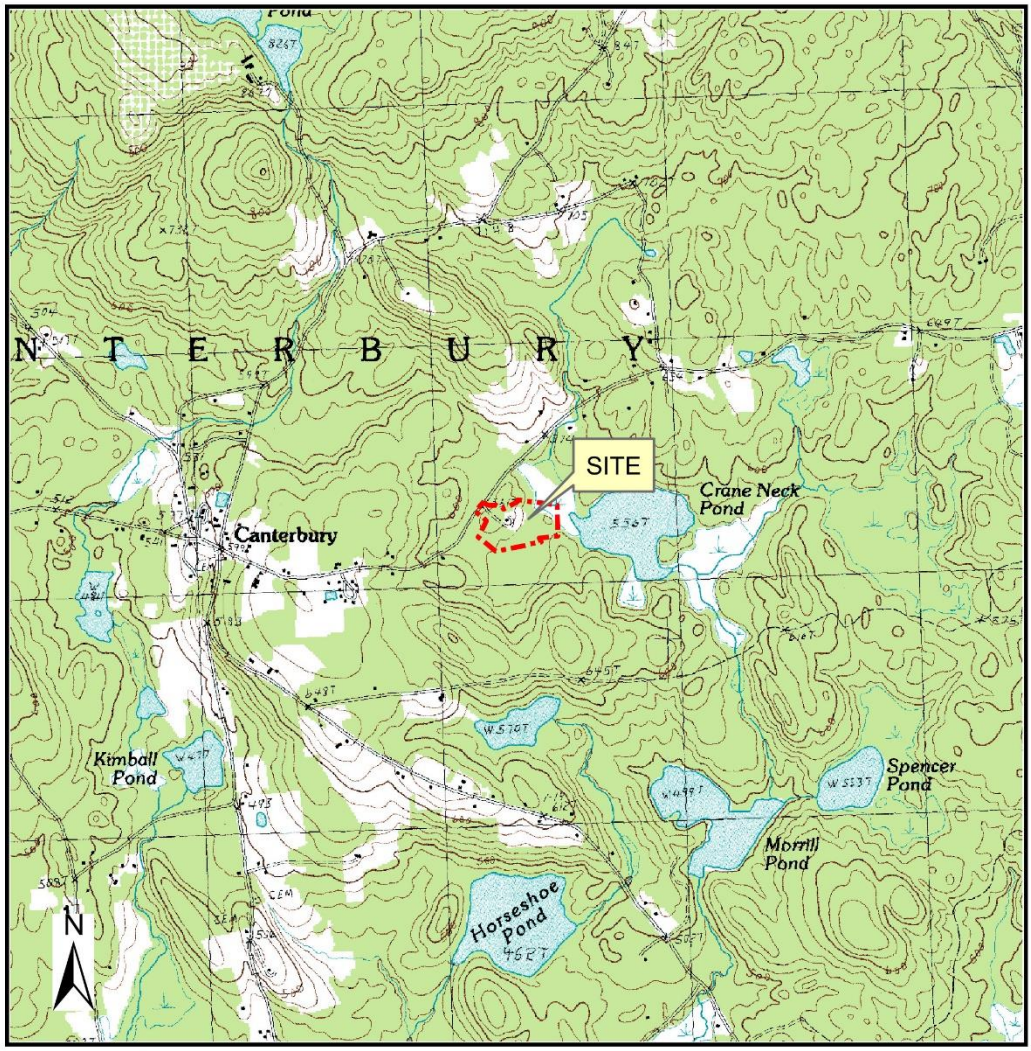
2007 Groundwater Contour Study (shows depth of groundwater and flow direction)



Water Wells and Standing Water Within 500 Foot Boundary of the Landfill



Topographic map of surrounding area



Legend

GMZ Boundary

PREPARED FROM: USGS PENACOOK NEW HAMPSHIRE QUADRANGLE, 1986

2,000 1,000 0 2,000 4,000 Feet

NOTES:
Aries developed the Locus Map from Geographic Information System (GIS) data provided by the New Hampshire Geographically Referenced Analysis and Information Transfer System (NH GRANIT) maintained by University of New Hampshire and the NH Office of Energy and Planning.

Aries Project # 2003-051C
File # 2003-051C(1)6.16.mxd

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environmental engineers and hydrogeologists

GMP RENEWAL APPLICATION REPORT ADDENDUM
FORMER CANTERBURY LANDFILL
CANTERBURY, NEW HAMPSHIRE

LOCUS PLAN

JUNE 2016 FIGURE 1

Facebook Ad


IS YOUR WATER CONTAMINATED?
LINKED TO KIDNEY CANCER & TESTICULAR CANCER
You May Be Eligible for Compensation
Gulf of Mexico
Did You Live Near One of These Areas?
Exposure to Toxic "Forever Chemicals" (PFAS) May Have Put Your Health at Risk
Find Out If You Qualify