NEW HAMPSHIRE DEPARTMENT OF Environmental Services

Coakley Landfill Site
North Hampton and Greenland
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The Coakley Landfill Superfund Site (Site) is located in the towns of North Hampton and Greenland and abuts the town of Rye to the east. Situated on the southernmost portion of a 92-acre parcel, the landfill itself is approximately 27 acres and received municipal and industrial wastes from 1972 to 1982. From 1982 to 1985, when land-filling activities terminated, the Site received incinerator residue from the Portsmouth Refuse-to-Energy Facility located at Pease Air Force Base, which accepted municipal waste from Rye, North Hampton, Portsmouth, New Castle, Newington, and Derry, among others.

In 1983, the State received a complaint from residents, living near the southeastern corner of the landfill, about the quality of water coming from their water supply wells. Water samples were taken and the results of the chemical analyses reported the presence of volatile organic compounds (VOCs) in several residential wells. Water lines from three local utility companies were promptly extended into the area and, by the end of 1983, most of the homes and businesses east of the Site were connected to public water supplies.

The Site was listed on the National Priorities List in December of 1983, identifying the following contaminants of concern: benzene, tetrachloroethene, arsenic, 2-butanone, phenol, diethyl phthalate, chlorobenzene, dichloroethene, chromium and nickel. The subsequent remedial investigation and feasibility study (RI/FS) was completed in 1989. The findings of the RI/FS identified the landfill as the source of contamination in local surface waters, groundwater and, to an unknown extent, in wetlands to the west of the landfill.

The first Record of Decision (ROD) for the Site, signed in June of 1990, required constructing a landfill cap and treating contaminated groundwater. It separated response actions to be taken in the immediate vicinity of the landfill (i.e., source control) from those taken to address contamination outside the landfill footprint (i.e., management of migration).

Operable Unit 1 (OU-1) is a source control action intended to minimize further degradation of the environment by isolating the contaminant sources. The ROD for OU-1 includes consolidating sediments on the landfill, consolidating refuse material within the landfill footprint, constructing a multi-layered landfill cap over the landfill, treating groundwater and landfill gases, and long-term monitoring. Pre-design studies began in the summer of 1992. Construction of the landfill cap began in the fall of 1996 and was completed in August 1998.

Due to limited information concerning off-site contamination of wetlands, a second operable unit (OU-2) required further evaluation of Site conditions in order to determine the most appropriate response action. A second ROD for the Site to address management of migration

was issued in September 1994. The ROD for OU-2 calls for groundwater monitoring over the next thirty years while contamination naturally attenuates, and the elimination of potential threats posed by the future ingestion of contaminated groundwater by implementing institutional controls restricting the use of the groundwater.

Following completion of the landfill cap, the limited plume of VOC-contaminated groundwater stabilized and began attenuating. Consequently, EPA issued an Explanation of Significant Differences on September 29, 1999, that removed the requirement to extract and treat groundwater directly beneath the landfill.

EPA's Second Five-Year Review for the Site was finalized in September 2006. A site-wide protectiveness determination could not be made in this review due to sporadic violations of off-site methane gas levels. Follow-up actions included continued quarterly monitoring of compliance boundary gas probes and installation of gas alarm systems in adjacent buildings/homes that may be at risk. Since 2006, methane levels have decreased significantly with no exceedance of regulatory standards in compliance boundary probes since 2011. In December 2015, the Potentially Responsible Parties (PRPs) submitted a proposal for reduced landfill gas monitoring. The Department subsequently approved a decrease in sampling frequency from quarterly to annually.

The September 2011 Third Five-Year Review concluded that the remedy remained protective of human health and the environment in the short-term. Long-term protectiveness had also been achieved at OU-1 based on continued maintenance of the landfill cap, long-term monitoring, and use restrictions being in-place. Long-term protectiveness will also be achieved at OU-2 when interim groundwater cleanup levels for all contaminants of concern are met and restrictions on the use of groundwater within OU-2 can be removed. Monitoring of the Site will continue until cleanup levels for the contaminants of concern are met.

On August 4, 2015, EPA released an Explanation of Significant Differences that formally incorporated 1,4-dioxane as a Site contaminant of concern, required the implementation of institutional controls over a defined area to prohibit or restrict the installation of new wells or the increased use of existing wells, and several minor changes.

The September 2016 Fourth Five-Year Review concluded that the OU-1 remedy remained protective. However, a protectiveness statement for OU-2 was deferred until the following actions are taken: (1) sampling existing or installing and sampling new monitoring wells in the southern area of the GMZ for all COCs and PFAS; (2) sampling private drinking water wells that may exist within the southern area of the GMZ for all COCs and PFAS; and (3) submitting validated data to the agencies from the aforementioned sampling efforts. Sampling of well cluster FPC-3 in the southern GMZ has been completed and reported to support compliance in this area, however, further evaluation of the compliance boundary was determined to be warranted, as noted below. Access to sample an existing drinking water supply well within the southern GMZ area has not been secured; therefore, alternative investigations may be required to fully delineate southern plume boundaries.

Sampling Site groundwater for the emerging contaminants 1,4-dioxane and PFAS in 2009 and 2016, respectively, confirmed their presence at the Site and prompted extensive follow-on

investigations. Follow-on sampling of area private water supply wells, many of which source potable water from the deep bedrock aquifer, identified a potential exposure pathway for contaminant migration from the Site. This exposure pathway had not previously been thoroughly investigated due to historically limited consideration of bedrock groundwater flow paths at superfund sites in general as a result of state-of-the-science limitations. In addition, considerable expansion of residential and commercial development in Greenland east of I-95, where there is currently no public water available, has increased utilization of bedrock groundwater for potable water supplies. Consequently, in January 2018, EPA ordered the CLG to perform a Deep Bedrock Investigation with the overall objective to better understand groundwater conditions in the deep bedrock in the vicinity of the Site and further develop the conceptual site model to advance the understanding of groundwater flow pathways in overburden and bedrock aquifers such that the potential for migration of Site-related contaminants, particularly recently identified emerging contaminants, to local receptors via groundwater flow can be better assessed.

EPA's Fifth Five-Year Review for the Site was published in September 2021. The short-term protectiveness determination from this report concluded that the Site remedies currently protect human health and the environment because remediation has addressed the contaminant source and institutional controls, and access controls are in place that prevent exposure to the landfill contents and downgradient groundwater contamination. Access to surface water that exceeds risk-based screening levels is limited by property access, inhospitable Site conditions, and warning signs. Additionally, a risk evaluation of surface water data that exceeds screening levels found that the non-cancer risk estimates for perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS) individually, as well as PFOA and PFOS combined, were all below the EPA acceptable hazard quotient (HQ) of 1.0, and that there are currently no unacceptable risks to a recreator through exposure to surface water. For the remedy to be protective over the long term, the following actions need to be taken: (1) Complete the deep-bedrock investigations to delineate the extent of contamination in bedrock groundwater, as well as fate and transport of PFAS compounds and Site COCs in groundwater and determine if further action is warranted, and (2) Design and implement a background study, including sampling and analysis, as necessary, to determine if the concentrations of arsenic and manganese are reflective of background conditions or rather are the result of mobilization due to the reducing conditions created by the landfill. Results from the background study will be used to assess natural attenuation and time to cleanup for arsenic and manganese.

The Coakley Landfill is located near the hydraulic divide of two watershed boundaries: (1) Berrys Brook to the north and (2) Little River to the south (see Figure 2.2 in the Deep Bedrock Investigation Final Report – Figure's Volume). Bailey Brook is located east of the landfill and is a sub watershed of the Berrys Brook Watershed with the divide between the two occurring east of the landfill. The majority of the Coakley Landfill is located within the Berrys Brook Watershed, meaning that surface water and stormwater originating at the landfill predominantly flow into the Berrys Brook wetland which culminate into Berrys Brook and migrates as an intermittent stream into broader wetland areas north from its origins in Greenland through the southeast corner of Portsmouth then into Rye where it discharges to the Piscataqua River estuary near Brackett Road.

The engineered cap of the landfill conveys stormwater runoff collected by the cap system into two unlined stormwater retention basins, one each near the northeast and northwest corners of the landfill, both within the Berrys Brook Watershed. The drainage features of the cap are comprised of above-ground and below-ground water collection systems. The above-ground system consists of a series of perimeter drainage ditches and rip-rap let-down structures located on the landfill surface that direct overland stormwater runoff into one of the two retention basins. The below-ground water collection system is comprised of sand/gravel layers, a geonet drainage fabric, and perforated drainage piping that collects stormwater that infiltrates the cap and directs it into a retention basin on the east side of the landfill and to a direct discharge to land surface on the west side of the landfill. Stormwater collected in the retention basins is allowed to infiltrate into the shallow groundwater or, for larger storm events, is directed to an overflow outlet structure in each basin that discharges to adjacent wetland areas.

Landfill stormwater sampling and sampling of the landfill cap construction materials performed by the CLG in 2019 (see the September 2019 Stormwater Investigation Report and the EPA comments on this report submitted to NHDES on November 26, 2019), identified the presence of PFAS and a general lack of other contaminants typically associated with the landfill (i.e., VOCs and 1,4-dioxane) originating from the landfill cover. Based on cap matrix sampling and analysis, the topsoil placed above the cap contains elevated levels of PFAS. The topsoil that was placed on the landfill cap at the time of cap construction in 1997/98 was augmented with composted biosolids and sand to promote vegetative growth on the landfill surface. PFAS is known to be associated with certain compost materials that originate from wastewater treatment sludge. The augmented landfill cap was constructed according to common practice at the time, before PFAS was identified as an emerging contaminant. The presence of elevated levels of PFAS in surface water prompted concerns for public safety when traveling along the former rail corridor west of the Site. EPA subsequently developed Site-Specific Screening Levels for surface water that would assist in the management of potential exposure risk, as further discussed below.

Due to elevated levels of PFAS identified in Berrys Brook, EPA directed the Coakley Landfill Group in 2018 to sample fish collected from Berrys Brook and analyze collected specimens for PFAS in a letter submitted to NHDES on February 22, 2018. The June 2018 Revised Fish Tissue Sampling Work Plan submitted on July 11, 2018 and Fish Tissue Sampling Results submitted on September 7, 2019 are available on NHDES' OneStop database. The results of that investigation concluded that the risk of consuming fish caught recreationally from Berrys Brook was lower than EPA's risk limit that existed at the time, as documented in EPA's March 2019 Comments to Fish Tissue Sampling Results (submitted on March 20, 2019) . EPA continues to analyze contaminant concentration data from Berrys Brook and evaluate human health risk based on updated toxicity information and anticipates updating the previously established site-specific screening levels for fish tissue using the more recent toxicity values, previously mentioned. Further investigation may be determined necessary based on this evaluation.

As previously mentioned, in 2018, EPA required the CLG to conduct a Deep Bedrock Investigation with the overall objective to develop an understanding of groundwater flow pathways in overburden and bedrock aquifers and better understand groundwater conditions in the deep bedrock in the vicinity of the Site such that the potential for migration of Site-

related contaminants, particularly recently identified emerging contaminants, to local receptors via groundwater flow can be better assessed. In November 2022, EPA issued agency comments on, and conditional approval of, the September 16, 2022, Deep Bedrock Investigation Final Report (the "Final Report" occurs in three submitted and uploaded volumes: TEXT & TABLES, FIGURES, and APPENDICIES and subsequent Addendum) prepared and submitted by Wood Environment & Infrastructure Solutions, Inc., on behalf of the CLG. The Final Report documents the deep bedrock investigation undertaken by the CLG at the Site between April 2017 and October 2021. The Final Report was revised and submitted in response to EPA's March 16, 2022, comments on the December 2021 Draft Deep Bedrock Investigation Final Report (the "Draft Report") submitted by Haley Ward, Inc., on behalf of the CLG. EPA's conditional approved of the Final Report identified a number of data gaps that the Final Report revealed and would require follow-on actions. Specifically, EPA's conditional approval requires the CLG to develop three work plans and complete work already initiated to establish a southern plume compliance boundary well to further investigate areas of uncertainty where additional data are needed to refine specific conceptual site model components and confirm compliance boundary locations.

1. Well Completions Work Plan – CLG prepared a work plan to perform existing well completions in bedrock boreholes and installation of two new overburden wells, submitted on March 15, 2023. The purpose of this work is to complete permanent groundwater monitoring wells in existing open bedrock boreholes at the Site to monitor groundwater quality within discrete bedrock intervals, eliminate the potential for vertical migration between fractures within the open boreholes, and allow for characterization of vertical groundwater gradients. In addition, two new overburden monitoring wells will be installed near an adjusted northwest GMZ boundary to monitor compliance at that location.

2. Eastern Flow and Contaminant Fate and Transport Work Plan – After evaluating data from new wells established as described in #1 above, the CLG will prepare a work plan that will define actions to further characterize the hydrologic flow dynamic and the extent of contamination in groundwater east of the landfill and assess the nature and extent of contamination in marine deposits, as well as the potential for back diffusion and transport of contaminants in groundwater east of the landfill.

3. Surface Water-Groundwater Interaction Work Plan – CLG submitted a revised work plan in April 2023 and EPA provided comments in an August letter. The work plan provides an approach and investigation protocols for the collection and analysis of additional data relative to the migration of contaminants such as PFAS from stormwater originating from the landfill cap materials and shallow groundwater discharge to Berrys Brook. This work effort will refine the conceptual site model as it relates to the interaction between surface water, stormwater discharge from the landfill cap drainage system, and area shallow groundwater beyond the landfill cap footprint.

4. Southern Plume Compliance Boundary Verification – Prior to the completion of the Deep Bedrock Investigation Final Report, NHDES issued a letter in March 2022, pursuant to Env-Or 607 (Groundwater Management Permits), requiring CLG to submit a work plan to further investigate the extent of Site-related contaminants migrating south of

the Site within the Little River watershed. CLG submitted a Bedrock Well Installation Work Plan in June 2022 and EPA issued comments in a July 2022 letter. CLG subsequently made attempts to gain access to a 103-acre parcel that lies between the Little River / Berrys Brook watershed flow divide to the north and North Road to the south. Unfortunately, access to this parcel was denied by the landowner. However, the CLG successfully gained access to private lots located further south of North Road. A surface geophysical survey was performed to support siting of a new bedrock monitoring well targeting a suspected hydraulically active area of the bedrock trough in the area south of North Road. The new well is scheduled to be installed in early 2024 followed by collection of borehole geophysical data that will guide interval packer sampling that will in turn support well construction design. Data collected from this effort will be used to evaluate the appropriateness of the existing southern GMZ boundary and the potential for further migration of contamination and impact to receptors south of North Road.

As described in this summary and the documents referenced herein, contaminant migration from the Coakley Landfill continues to be monitored and involves movement of stormwater, surface water, and groundwater (both in overburden and fractured rock aquifers) in a complex, inter-related hydrogeologic system. Numerous measures are in place to prevent human exposure to Site contaminants sourced from the landfill. Additional investigations are underway by CLG to further evaluate contaminant migration pathways and potential for exposure. The agencies, with assistance from their technical consultants, will continue to be diligent in evaluating new data to ensure the continued protection of public health and the environment.