National Aeronautics and
Space Administration

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February 19, 2025

Reply to Attn of: RE-25-028

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Subject: Proposal to Transition NASA White Sands Test Facility (WSTF) 600 Area Perched Groundwater Extraction Pilot Test (PGEPT) Annual Reporting into Projected Targeted Mobile Remediation Process (TMRP) Annual Reporting Following Submittal of the PGEPT – Project Year 12 Report

NASA's perched groundwater extraction pilot test (PGEPT) reporting commenced with submittal of the *600 Area Perched Groundwater Extraction Pilot Test Interim Status Report* on April 17, 2014, and has continued on an annual basis. Most recently, the *600 Area Perched Groundwater Extraction Pilot Test Interim Status Report - Project Year 11* submitted to the New Mexico Environment Department (NMED) on April 18, 2024 was approved by NMED on November 5, 2024. The *600 Area Perched Groundwater Extraction Pilot Test Interim Status Report for Project Year 12* is currently in preparation and will be submitted to NMED on or before April 30, 2025.

NASA is in the process of implementing and developing the Targeted Mobile Remediation Process (TMRP) program at WSTF. This process is designed to extract additional contaminated groundwater from specific target concentrations within the contaminant plume. The *Targeted Mobile Remediation Process Phase 2 Pilot Test Work Plan* submitted to NMED on April 25, 2023, was approved by NMED on May 15, 2024. Of note, PGEPT monitoring well 600-G-138 is one of the additional seven primary wells proposed for inclusion in the TMRP Phase 2 Work Plan. The *NASA WSTF Correction Action Projects; Proposal to Restructure Priorities and Schedule*, Table 1.2 submitted to NMED on December 13, 2024 proposes that the start of TMRP Phase 2 activities be deferred to fiscal year 26 (September 28, 2025 through September 26, 2026).

The majority of elements of the TMRP data collection and reporting process identified in the TMRP Phase 2 Work Plan for well 600-G-138 correspond to the ongoing PGEPT interim status reporting requirements. These elements include 1) records of monthly groundwater

elevations and well performance data, 2) monthly volume of groundwater extracted, 3) systematic collection of groundwater indicator parameters, 4) collection of quarterly groundwater chemical analytical samples and evaluation of data, and 5) a summary of investigation-derived waste management and processing at the Mid-plume Interception and Treatment System in accordance with established WSTF procedures and regulatory requirements.

In order to streamline NASA's reporting process to NMED, NASA proposes that 1) the PGEPT interim status reporting requirement at well 600-G-138 be discontinued following the submittal of the PGEPT – Project Year 12 report, 2) groundwater data components presented in the annual PGEPT report be incorporated as a component of TMRP interim status reporting upon implementation as presented in the NMED-approved *TMRP Phase 2 Pilot Test Work Plan*, and 3) annual TMRP reporting including well 600-G-138 be performed within two months of the completion of each project year as defined in the approved TMRP Work Plan.

Data to support justification of the proposal to transition Well 600-G-138 reporting from PGEPT to TMRP is provided in Attachment 1. The data collected over the 11-year duration of the PGEPT further supports the primary conclusions presented in the original Year 1 Report.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

If you have any questions or comments concerning this submittal, please contact Antonette Doherty of my staff at 575-202-5406.

Timothy Davis

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Attachment 1 – Supporting Data on Proposal to Transition Well 600-G-138 Reporting

1.0 Perched Groundwater Extraction Pilot Test (PGEPT) Reporting Background

NASA initiated the extraction of perched groundwater (PGW) in accordance with the NMED-approved work plan on April 19, 2013, and provided the results of groundwater extraction and associated groundwater and soil vapor monitoring in the first annual *600 Area Perched Groundwater Extraction Pilot Test Interim Status Report* (Report; NASA, 2014). In this report, NASA concluded that the presence of contaminated PGW beneath the 600 Area Closure likely sourced the volatile organic compounds (VOCs) in the overlying vadose zone soil vapor. This was primarily based on 1) using Henry's Law calculations, trichloroethylene (TCE) concentrations in soil vapor directly above the water table that would be in equilibrium with measured TCE concentrations in groundwater were found to be compatible (within the same order of magnitude) with measured concentrations in the lowermost soil vapor ports, and 2) a decline in TCE concentrations was observed upward from the inferred groundwater source through the vadose zone to the ground surface. NMED approved the report on August 14, 2014 (NMED, 2014) and directed NASA to continue PGW extraction and submit additional reports on an annual basis.

In the reports for Project Year 2 (NASA, 2015) and Year 3 (NASA, 2016), NASA concluded that the extraction of PGW had not reduced the thickness of the PGW unit beneath the closure, and that the presence of contaminated PGW continued to contribute to the presence of VOCs in the soil vapor of the vadose zone. NMED approved NASA's reports on July 15, 2015, with modifications (NMED, 2015) and November 17, 2016 (NMED, 2016). On April 26, 2017, NASA submitted the report for Project Year 4 Report (NASA, 2017) recommending discontinuation of PGW extraction from monitoring well 600-G-138 and that monitoring be continued as specified in the approved Groundwater Monitoring Plan (NMED, 2016) and 600 Area Perched Groundwater Extraction Pilot Test Work Plan (NMED, 2013). NMED disapproved and directed NASA to revise the investigation report to continue PGW extraction at monitoring well 600-G-138 (NMED, 2017). As a result, NASA has continued to submit the report on an annual basis. Most recently, the Project Year 11 Report was submitted to NMED on April 18, 2024 (NASA, 2024a) and was approved by NMED on November 5, 2024 (NMED, 2024b). The Project Year 12 Report is in preparation and will be submitted to NMED on or before April 30, 2025.

2.0 TCE Trend Summary for Wells 600-G-138 (Groundwater) and 600-SGW-5 (4 x Soil Vapor Ports)

Figure 1 (groundwater in 600-G-138 and soil vapor in 600-SGW-5-7.5 ft), Figure 2 (groundwater in 600-G-138 and soil vapor in 600-SGW-5-52.5 ft and 102.5 ft), and Figure 3 (groundwater in 600-G-138 and soil vapor in 600-SGW-5-137.5 ft) summarize TCE trends observed for the well pair. A strong relationship between TCE measured in groundwater and soil vapor can be observed over the 11-year reporting period between 2013 and 2024.

- TCE concentrations in groundwater (the single contaminant that exceeds the WSTF Groundwater Monitoring Plan cleanup level at 5 micrograms per liter [µg /L]) have consistently declined over the 11-year PGEPT reporting period from 110 µg/l in 2013 to 35 µg/l in 2024.
- For each of the four soil vapor ports at depths of 7.5, 52.5, 102.5, and 137.5 feet (ft) below ground surface (bgs), TCE soil vapor concentrations from samples collected contemporaneously with groundwater show declining trends (with similar slopes) within the vadose zone over the 11-year PGEPT reporting period.
- The concentrations of TCE in vadose zone soil vapor increase with port depth and proximity to the location of PGW on the top of bedrock.

These data support the conclusions presented in the Year 1 Report (NASA, 2014) that contaminated PGW below the 600 Area Closure is a likely candidate to have sourced TCE in the overlying vadose zone. Similar declines of the TCE concentration within groundwater are observed in the WSTF 200 Area located approximately 3,000 ft upgradient and to the northeast of well 600-G-138. The 200 Area aquifer is interpreted to be the probable source for the PGW based on similarities in VOC contaminant chemistry and concentrations. This relationship was investigated and presented in greater detail in the *600 Area Perched Groundwater Investigation Report* (NASA, 2022). A Phase II follow up investigation described in the *600 Area Perched Groundwater Phase II Abbreviated Investigation Work Plan* (NASA, 2023b) to further investigate PGW has been approved by NMED (NMED, 2024c).

3.0 Statistical Evaluation of Trends

Chemical analytical data and the M-K trends and ordinary least squares (OLS) regressions presented in the Project Year 11 Report (NASA, 2024a) show that the concentrations of TCE, chloride, nitrate/nitrite and chloroform in groundwater have been declining over the 11 years of the PGEPT. Concentrations of nitrate/nitrite in PGW samples from 600-G-138 for Project Year 11 currently approximate the New Mexico maximum concentration limit of 10 milligrams per liter. The nearby former 600 Area Wastewater Lagoons may have contributed to the existence and composition of PGW in the area. Over the 11-year PGEPT there is a declining trend in chloride concentrations by approximately 30 percent, a declining trend in nitrate/nitrite concentrations by approximately 20 percent, and statistically significant decreasing trends shown by the OLS regression and M-K graphs. This implies a lessening in the impact of infiltration from the 600 Area Wastewater Lagoons following their draining by July 2017 (NASA, 2019).

The TCE concentrations in PGW have shown declines of between 60 to 70 percent over the 11-year duration of the PGEPT (from approximately 100 to 110 µg/L in Project Year 1 to 30 to 40 µg/L in Project Year 11; NASA, 2024a), and a statistically significant decreasing OLS regression and M-K trend. The lower the *p*-value, the more confidence in the result, and the TCE OLS regressions (and M-K trend test) had *p*-values at zero (0). Concentrations of TCE in the upgradient aquifer of the 200 Area theorized to be a source of the 600 Area PGW have also declined significantly in recent years. A significant reduction of TCE of approximately 86 percent between 1990 through 2023 has been observed within well 200-D-240, and approximately 74 percent between 2007 through 2023 at adjacent well 200-SG-1 (NASA, 2023a). Chloroform, chloride, and nitrate/nitrite concentrations in PGW measured during the PGEPT also show a decreasing trend over the 11 years of the PGEPT. Tetrachloroethylene and N-nitrosodimethylamine have remained undetected in groundwater at well 600-G-138 throughout the project.

Declining concentrations of the PGW contaminants of concern have influenced a reduction of the concentrations of COC in soil vapor measured at adjacent multiport soil vapor monitoring well 600-SGW-5. Slightly declining concentration trends are shown in soil vapor M-K graphs, which provide graphical summaries of the detected concentrations of TCE and chloroform in soil vapor at well 600-SGW-5 over the duration of PGW extraction at well 600-G-138 (NASA, 2024a). For these two contaminants, well 600-SGW-5 also shows a relationship for increasing contaminant concentrations with depth during single sampling events as evidenced by the plots for individual sampling ports located at 7.5, 52.5, 102.5, and 137.5 ft bgs. This trend would be anticipated due to the confirmed presence of contaminated shallow PGW at this location. Over the 11 project years of the PGEPT, concentrations of TCE, the primary volatile organic compound in soil vapor, trend downward in the monitoring zones at 7.5, 52.5, 102.5, and 137.5 ft bgs. In general, soil vapor chemical analytical data from samples collected at 600-SGW-5 has statistically significantly declined over time for TCE.

4.0 PGW Extraction Activities

The extraction of PGW from well 600-G-138 contributes to the removal of contaminant mass from the 600 Area local aquifer. The cumulative total volume of PGW extracted and treated from WSTF well 600-G-138 by the end of Project Year 11 was 20,909 gallons (NASA, 2024a). Field measurements of the PGW depth in monitoring well 600-G-138 over the 11-year project duration of the PGEPT show that groundwater extraction has not significantly reduced the average thickness of PGW on top of andesite bedrock at approximately 3 ft over the evaluation period. The annual rainfall at WSTF for Project Year 11 in 2023 was below average at 6.10 inches. The thickness of PGW was not affected even during the period of highest precipitation in August (1.36 inches) that accounted for 22 percent of the total annual rainfall.

5.0 Current Status and Recommendations

- NASA has continued the extraction of contaminated PGW from monitoring well 600-G-138 for Project Year 12. The report will be submitted to NMED prior to April 30, 2025.
- PGEPT monitoring well 600-G-138 is one in seven additional primary wells proposed for inclusion in the targeted mobile remediation process (TMRP) Phase 2 Work Plan. NASA submitted a request for the proposed start of TMRP Phase 2 activities (NASA, 2024b) deferred to fiscal year 26 (September 28, 2025, through September 26, 2026).
- The majority of reporting elements for ongoing PGEPT interim status correspond to the TMRP data collection and reporting process described in the TMRP Phase 2 Work Plan. These include 1) records of monthly groundwater elevations and well performance data, 2) monthly volume of groundwater extracted, 3) the collection of groundwater indicator parameters, 4) the collection of quarterly groundwater chemical analytical samples and evaluation of data, and 5) a summary of investigation-derived waste management at the Mid-plume Interception and Treatment System in accordance with established WSTF procedures and regulatory requirements.
- In order to streamline NASA's reporting process to NMED, NASA proposes that 1) the PGEPT interim status reporting requirement at well 600-G-138 be discontinued following the submittal of the PGEPT – Project Year 12 report, 2) groundwater data components presented in the annual PGEPT report be incorporated as a component of TMRP interim status reporting upon implementation as presented in the NMED-approved *TMRP Phase 2 Pilot Test Work Plan* (NASA, 2023b; NMED, 2024a), and 3) annual TMRP reporting including well 600-G-138 be performed within two months of the completion of each project year as defined in the approved TMRP Work Plan.

6.0 References

NASA Johnson Space Center White Sands Test Facility. (2014, April 17). *600 Area Perched Groundwater Extraction Pilot Test Interim Status Report*. Las Cruces, NM.

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NMED Hazardous Waste Bureau. (2024a, May 15). *Approval Targeted Mobile Remediation Process Phase 2 Pilot Test Work Plan*. Santa Fe, NM.

NMED Hazardous Waste Bureau. (2024b, November 5). *Approval Interim Status Report for 600 Area Perched Groundwater Extraction Pilot Test Project Year 11*. Santa Fe, NM.

NMED Hazardous Waste Bureau. (2024c, November 5). *Approval 600 Area Perched Groundwater Phase II Abbreviated Investigation Work Plan*. Santa Fe, NM.

Figure 1 TCE Trends Over Time at Wells 600-G-138 (Groundwater) and 600-SGW-5 (7.5 ft)

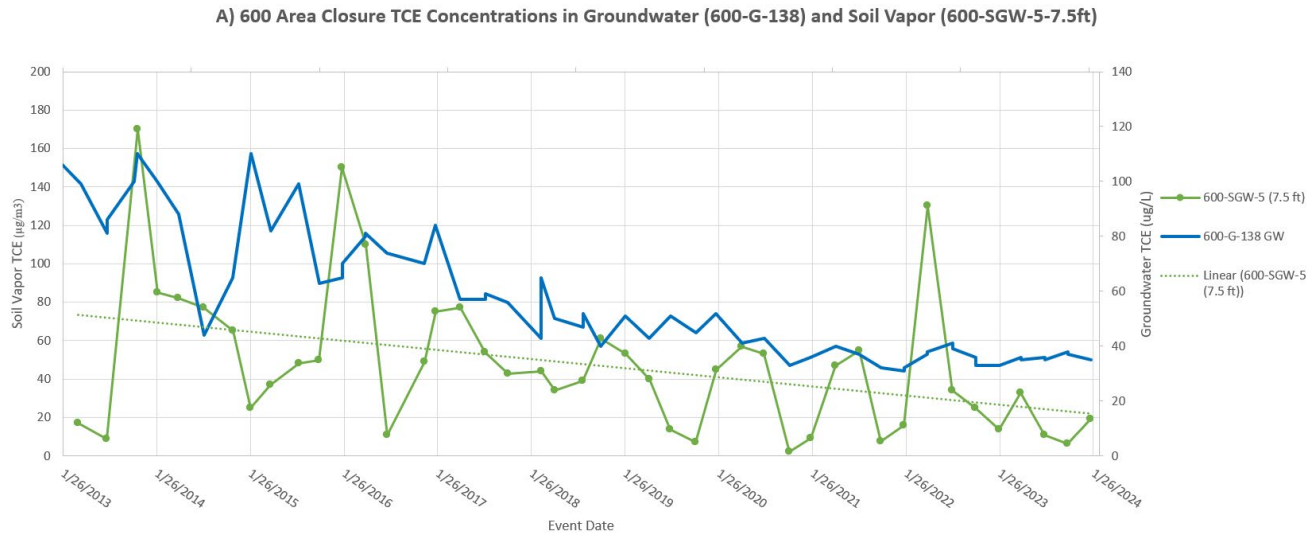


Figure 2 TCE Trends Over Time at Wells 600-G-138 (Groundwater) and 600-SGW-5 (52.5 and 102.5 ft)

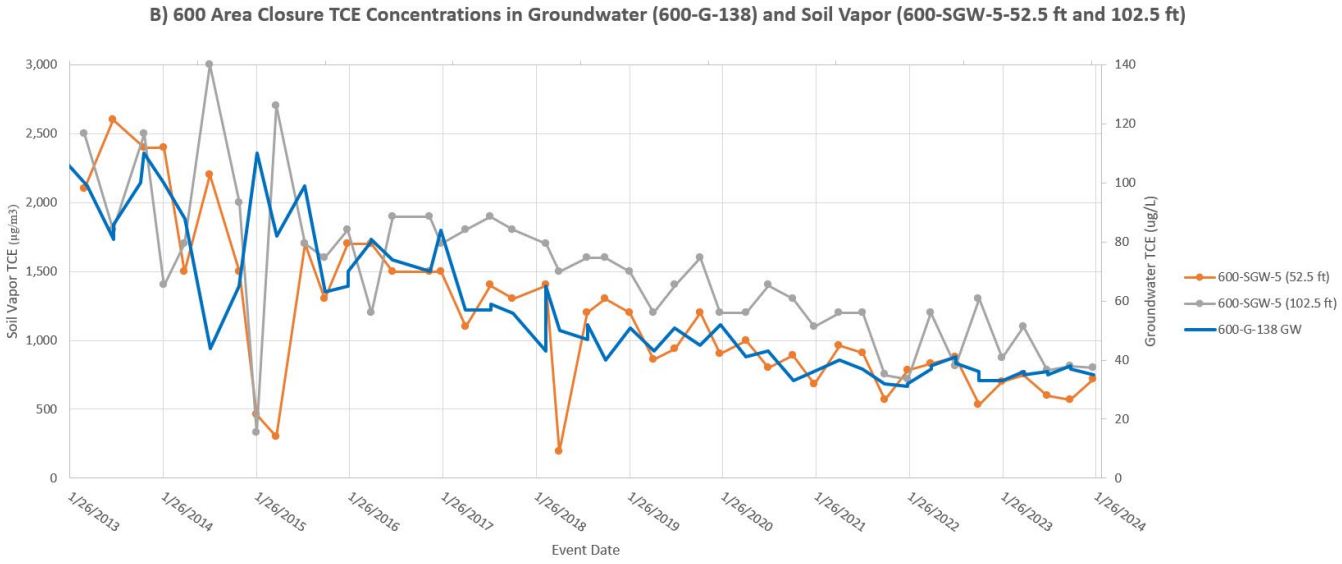


Figure 3 TCE Trends Over Time at Wells 600-G-138 (Groundwater) and 600-SGW-5 (137.5 ft)

