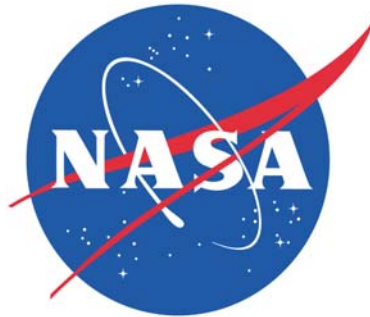


Remedial Action Completion Report

Former Fire Training Area Site

NASA Wallops Flight Facility

Wallops Island, Virginia



**National Aeronautics and Space
Administration**

**Goddard Space Flight Center
Wallops Flight Facility**

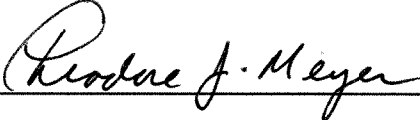
December 2011

CERTIFICATION

The enclosed document was prepared, and is being submitted, in accordance with the requirements of the Administrative Agreement On Consent between the United States Environmental Protection Agency and the National Aeronautics and Space Administration [U.S. EPA Docket Number RCRA-03-2004-0201TH].

I certify that the information contained in or accompanying this document is true, accurate, and complete.

I certify under penalty of law that this document and all attachments were prepared in accordance with procedures 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, or the immediate supervisor of such person(s), 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 fines and imprisonment for knowing violations.

Signature: 

Name: Mr. Theodore J. Meyer

Title: NASA Project Coordinator

**REMEDIAL ACTION COMPLETION REPORT
FORMER FIRE TRAINING AREA SITE**

**NASA WALLOPS FLIGHT FACILITY
WALLOPS ISLAND, VIRGINIA**

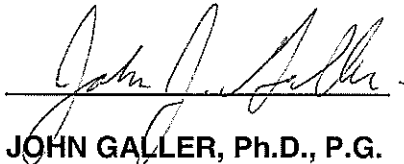
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December 2011

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FIGURES

NUMBER

- 1-1 Site Location Map
1-2 Study Area Location Map
4-1 Monitoring Well/DPT/Injection Point Locations

ACRONYMS

AAOC	Administrative Agreement on Consent
bgs	below ground surface
COC	Chemical of Concern
DO	dissolved oxygen
DPT	direct push technology
EPA	United States Environmental Protection Agency
FFTA	Former Fire Training Area
FS	Feasibility Study
ft	feet or foot
GIS	Geographic Information System
GSFC	Goddard Space Flight Center
HI	hazard index
LTM	long-term monitoring
LUC	Land Use Control
MCL	Maximum Contaminant Level
µg/L	micrograms per liter
mg/L	milligrams per liter
NASA	National Aeronautics and Space Administration
ORC	oxygen release compound
ORP	oxidation-reduction potential
RA	Remedial Action
RAC	Remedial Action Completion
RAO	Remedial Action Objectives
ROD	Record of Decision
SVOC	Semivolatile Organic Compound
TOC	total organic carbon
VDEQ	Virginia Department of Environmental Quality
VOC	Volatile Organic Compound
WFF	Wallops Flight Facility

1.0 INTRODUCTION

This Remedial Action Completion (RAC) Report has been prepared by Tetra Tech for the National Aeronautics and Space Administration (NASA) under Contract Task Order 012 issued by the Naval Facilities Engineering Command Mid-Atlantic under the Comprehensive Long-Term Environmental Action Navy contract number N62472-03-D-0057. This report reviews the remedial action requirements, documents completion of remedial actions, and presents the initial assessment of the remedial action performance at the Former Fire Training Area (FFTA) site at the NASA Goddard Space Flight Center (GSFC) Wallops Flight Facility (WFF) located in Accomack County, Virginia (Figure 1-1 and Figure 1-2).

1.1 PURPOSE

The purpose of this RAC Report is to provide documentation that the remedial actions implemented at the FFTA site are consistent with the plans approved by the U.S. Environmental Protection Agency (EPA) and comply with the requirements established in the Record of Decision (ROD). Preparation and submittal of this RAC Report is a requirement of the Administrative Agreement on Consent (AAOC) executed between NASA and EPA (U.S. EPA Docket Number: RCRA-03-2004-0201TH). As required by the AAOC, this report also provides a preliminary assessment of the remedial action performance.

1.2 REPORT ORGANIZATION

Section 1.0 presents this introduction and states the purpose of this report. Section 2.0 describes the ROD requirements. Section 3.0 presents the land use control (LUC) implementation. Section 4.0 describes remedial action implementation. Section 5.0 details the long-term monitoring (LTM) implementation and initial assessment of the remedial action performance. Section 6.0 provides the conclusions.

2.0 ROD REQUIREMENTS

The remedial action objectives (RAOs) presented in the ROD provide a general description of what the cleanup will accomplish, and are summarized as follows:

- Prevent the exposure to and use of the FFTA-contaminated groundwater, which presents an unacceptable risk associated with the hypothetical future residential use of shallow groundwater.
- Restore FFTA-impacted groundwater to drinking water standards and attain cleanup levels established in the ROD.

As a part of the ROD requirements, performance standards were developed as cleanup goals as presented below.

Analyte	Cleanup Goal
Benzene	5 µg/L
Cis-1,2-DCE	70 µg/L
Vinyl Chloride	2 µg/L
4-Methylphenol	27 µg/L
Naphthalene	16 µg/L
Arsenic	10 µg/L
Manganese	124 µg/L

2.1 LAND USE CONTROL REQUIREMENTS

As outlined in the ROD (TtNUS, 2007), Land Use Controls (LUCs) for the FFTA consist of prohibiting use of groundwater from the Columbia Aquifer for domestic purposes and restricting other uses until cleanup levels are met. The ROD requires the control of these activities through restrictions documented in NASA's Facility Master Plan and deed notices if the property is transferred. The ROD requires that a remedial design for LUCs be submitted to and approved by EPA, and that the LUCs be implemented and maintained by NASA until concentrations of hazardous substances in the shallow groundwater are at levels that allow for unlimited use and unrestricted exposure.

2.2 REMEDIAL ACTION REQUIREMENTS

2.2.1 Injection

The ROD specifies that an oxygen release compound (ORC) would be injected into the Columbia Aquifer to enhance the growth of native microorganisms to increase the rate of aerobic biodegradation and create favorable conditions to break down the chlorinated solvent and semivolatile organic compounds (SVOCs) into nontoxic forms. The conceptual design in the Feasibility Study (FS) assumed that the groundwater plume containing mostly benzene, cis-1,2-DCE, 4-methylphenol, and naphthalene would be treated by an ORC. The oxygen-rich zone created by the ORC injection was expected to cause arsenic and manganese in the groundwater to transform from soluble compounds to insoluble oxidized compounds that do not readily mix with groundwater.

2.2.2 Monitoring

The ROD requires that regular groundwater monitoring at the FFTA to (1) assess the performance of treatment and (2) verify that Chemicals of Concern (COCs) are not migrating. The ROD stated that 14 wells would be included in the monitoring plan. However, well FFTA-MW54S was replaced by FFTA-MW108, and wells FFTA-MW106 and FFTA-MW107 were added for a total of 16 wells. Groundwater samples would be analyzed for certain volatile organic compounds (VOCs) (benzene, cis-1,2-DCE, tetrachloroethene, and vinyl chloride), SVOCs (4-methylphenol, naphthalene, and pentachlorophenol), and total and dissolved arsenic and manganese.

The ROD also stated that the groundwater samples would be analyzed for indicator compounds necessary to monitor the performance and effectiveness of the remedial action. An LTM plan requiring EPA approval and Virginia Department of Environmental Quality (VDEQ) concurrence would need to be developed.

Five-Year Reviews will be conducted to evaluate site status, assess the continued adequacy of remedial activities, and determine whether further action is necessary.

3.0 LAND USE CONTROL IMPLEMENTATION

In July 2008, NASA submitted the Draft FFTA LUC Remedial Design for EPA and VDEQ review. The final plan was submitted in October 2008 and approved on December 2, 2008. The details of the LUCs were entered into the Facility Master Plan, and implemented in the WFF Geographic Information System (GIS) for controlling activities throughout the base (see Appendix A). The LUCs include annual inspections to confirm ongoing consistent implementation of the LUCs (inspections are documented on inspection forms (Appendix A). The LUCs implemented for the FFTA are as follows:

- No use of groundwater as a source of drinking water until concentrations of hazardous substances in groundwater are at such levels to allow for unrestricted use and exposure.
- No use of groundwater other than for environmental testing is permitted without an approved plan. For information regarding this restriction and the plan requirements contact the Environmental Office, Code 250.
- Construction and/or development of commercial or residential buildings is prohibited.
- This is a controlled area undergoing Environmental Remediation. Any planned use or activity in this area must be approved by the NASA WFF Environmental Office, Code 250.

The LUCs will be maintained until concentrations of hazardous substances in shallow groundwater are at such levels to allow for unlimited use and unrestricted exposure.

The property has not been transferred, and there are no plans for transfer. Therefore, deed restrictions are not necessary. However, this requirement has been entered into the Facility Master Plan, and if some or all of the site property is transferred, NASA will notify EPA 90 days prior to transfer, or within 7 days of the decision to transfer the property if 90-days notice is not possible. Deed restriction notices for subsequent owners detailing that groundwater is not potable until the cleanup levels are met will be prepared and recorded prior to any transfer.

4.0 REMEDIAL ACTION IMPLEMENTATION

4.1 BASELINE GROUNDWATER SAMPLING

Baseline sampling of 20 wells occurred on December 3 through 11, 2008, prior to the ORC injection. Low-flow sampling methodology was utilized. A water quality meter with a flow-through cell and separate turbidity meter were used during purging to collect field readings for turbidity, dissolved oxygen (DO), pH, specific conductivity, and oxidation-reduction potential (ORP). Groundwater samples were collected after these water quality parameters stabilized. The groundwater samples were analyzed for vinyl chloride, cis-1,2-dichloroethene, benzene, tetrachloroethene, 3&4-methylphenol, naphthalene, pentachlorophenol, total and dissolved arsenic, and total and dissolved manganese. Field test kits were used to measure DO, alkalinity, dissolved carbon dioxide, ferrous iron, and hydrogen sulfide.

4.2 PILOT STUDY

On December 11, 2008, three direct-push technology (DPT) soil boring injection points were used to inject the Regenesis ORC[®] slurry (Figure 4-1). Each injection point received a slurry consisting of 13 gallons of water with 45 pounds of ORC at 0.9 gallons of slurry per vertical foot (ft). In total, 135 pounds of ORC and 39 gallons of water were injected. The process consisted of pumping the ORC through a DPT rod inserted at the target depth of 30 ft below ground surface (bgs) and incrementally raised to 20 ft bgs. After the injection, the soil boring injection points were backfilled with bentonite and capped with coarse sand up to the ground surface. Following the pilot study, post-injection sampling events were conducted at 1 day, 1 week and 1 month.

The data from the post-injection sampling events supported the conclusion that a full-scale injection of ORC at the site was not necessary (TtNUS, 2009b).

4.3 FREE PRODUCT

During baseline sampling for the pilot study, free product was encountered at monitoring wells FFTA-MW55S and FFTA-MW101S. Measurement and removal of free product occurred on a weekly basis until a free product monitoring plan was developed in February (TtNUS, 2009a). Free product monitoring in wells FFTA-MW55S and FFTA-MW101S continued on a monthly basis until December 2010. Free product was last observed in FFTA-MW101S in March 2009. At well FFTA-MW55S, other than thicknesses of 0.02 ft in June 2010 and 0.01 ft in August 2010, free product was not detected since March 2009.

4.4 FINDINGS

Based on the results of the pilot study (TtNUS, 2009b) and baseline sampling, it was determined with EPA and VDEQ concurrence that no further injections were needed. Well FFTA-MW54S had been damaged, so it was abandoned and replaced with well FFTA-MW108. Two additional wells (FFTA-MW106 and FFTA-MW107) were installed to help monitor the site groundwater. It was agreed that the site was ready for LTM.

5.0 LONG-TERM MONITORING IMPLEMENTATION

5.1 LTM PLAN

NASA submitted the LTM Plan for regulatory review in July 2010. The LTM Plan was approved on March 31, 2011. The LTM Plan details periodic groundwater monitoring within the contaminant plume to assess the performance of ORC injection, as well as downgradient of the leading edge of the plume to verify that COCs are not migrating. Monitoring consists of collecting groundwater samples from 16 existing wells. The LTM wells consist of the following: FFTA-MW55S, FFTA-MW55D, FFTA-MW56D, FFTA-MW57S, FFTA-MW-58S, FFTA-MW61I, FFTA-MW101S, FFTA-MW102D, FFTA-MW103S, FFTA-MW103I, FFTA-MW103D, FFTA-MW105D, FFTA-MW106 (new well, not included in ROD), FFTA-MW107 (new well, not included in ROD), FFTA-MW108 (replaced well FFTA-MW54S), and 14-MW004. Samples will be analyzed for benzene, tetrachloroethene, cis-1,2-dichloroethene, vinyl chloride, 3- and 4-methylphenol, pentachlorophenol, naphthalene, and total and dissolved arsenic and manganese. Field test kits will be used to measure DO, alkalinity, dissolved carbon dioxide, ferrous iron, and hydrogen sulfide.

5.2 PERFORMANCE STANDARDS

The cleanup levels established in the ROD for the COCs and the basis for each are as follows:

- Benzene - 5 µg/L (Maximum Contaminant Level [MCL])
- cis-1,2-Dichloroethene - 70 µg/L (MCL)
- Vinyl chloride - 2 µg/L (MCL)
- 4-Methylphenol - 27 µg/L (non-cancer risk based on target organ Hazard Index [HI] of 0.5)
- Naphthalene - 16 µg/L (non-cancer risk based on target organ HI of 0.5)
- Total Arsenic - 10 µg/L (MCL)
- Total Manganese - 124 µg/L (non-cancer risk based on target organ HI of 0.5)

Monitoring and reporting will be conducted in accordance with the updated LTM Plan (TtNUS, 2011). The monitoring frequency will be, at a minimum, quarterly during the first year (beginning in March 2010) and semi-annual thereafter. A data report will be prepared after each monitoring event. Monitoring will continue until concentrations meet cleanup levels in all LTM wells during four consecutive monitoring events, after which the site will be closed out (no further action). The LTM Program may be modified (with EPA concurrence). Annual reports will present cumulative site data, evaluate temporal data, and potentially recommend modifications to the LTM Program or remedy.

5.3 MONITORING ACTIVITIES

Groundwater monitoring events were conducted at FFTA in March, June, September and December 2010. Data summary reports were submitted for the March, June and September events (TtNUS, 2010a, 2010b, 2010c), while an annual report was prepared and submitted following the December monitoring event. Data from the LTM events confirm that VOC concentrations continue to be below cleanup goals, other COCs are decreasing in concentration and extent, and there is no migration off-site.

6.0 CONCLUSIONS

The ROD outlined the objectives for this RA to implement LUCs, conduct an ORC injection, and establish an LTM program. All components of the remedy have been fully implemented and are in place. The costs to complete the RA fell within the National Contingency Plan Explanation of Significant Differences requirements (-30% < cost < +50%). In addition, the LTM Plan allows for additional actions and revisions to address uncertain conditions. The initial assessment of the RA data indicates it has fulfilled the ROD requirements and all appropriate processes are in place.

REFERENCES

TtNUS, 2007. Record of Decision, Former Fire Training Area, NASA Wallops Flight Facility, Wallops Island, Virginia. August.

TtNUS, 2009a. Free Product Monitoring Plan, Former Fire Training Area Site. NASA Wallops Flight Facility, Virginia. February.

TtNUS, 2009b. Final Pilot Study Report, Former Fire Training Area Site. NASA Wallops Flight Facility, Virginia. July.

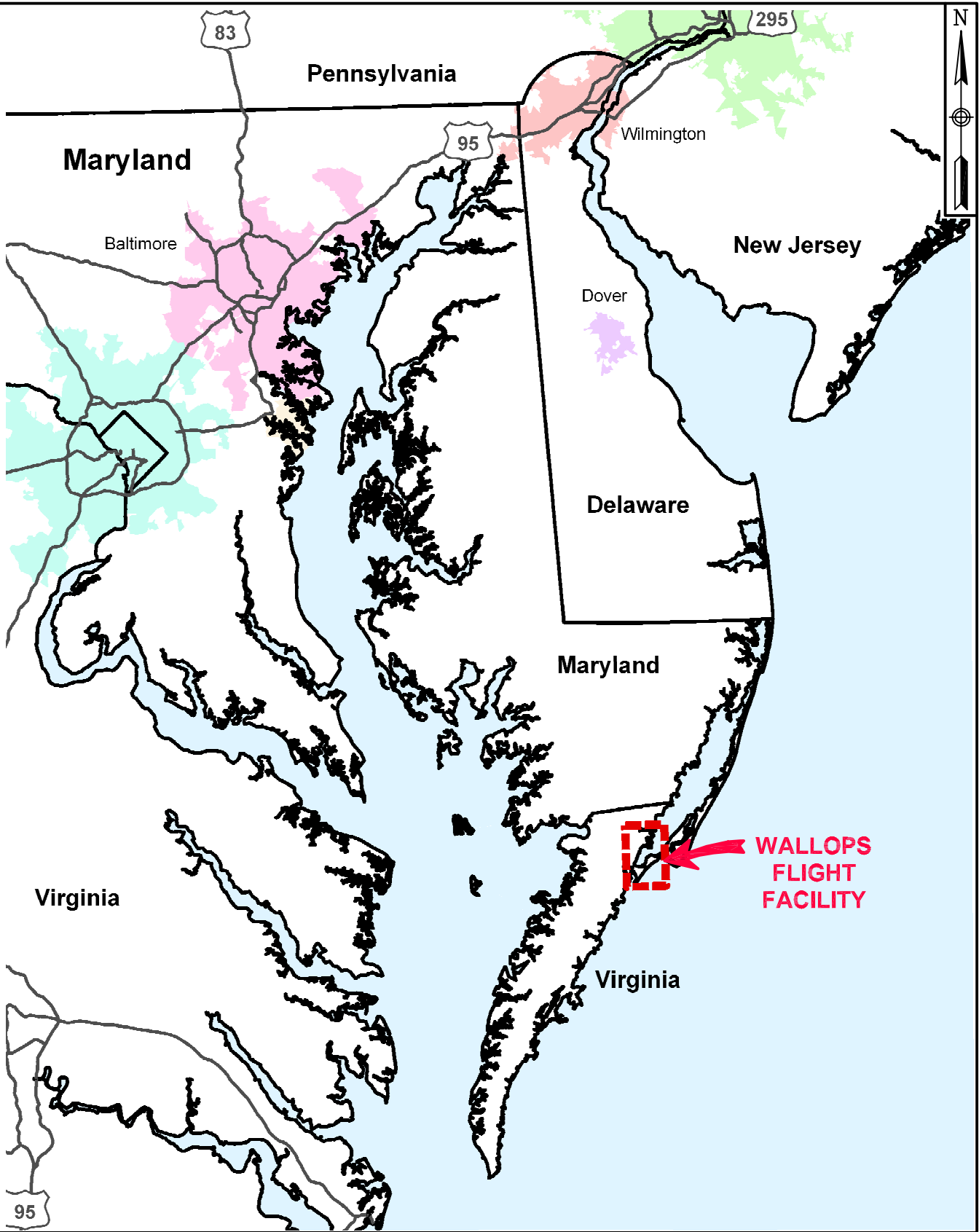
TtNUS, 2010a. Data Summary Report, Former Fire Training Area Site. NASA Wallops Flight Facility, Virginia. April.

TtNUS, 2010b. Data Summary Report, Former Fire Training Area Site. NASA Wallops Flight Facility, Virginia. August.

TtNUS, 2010c. Data Summary Report, Former Fire Training Area Site. NASA Wallops Flight Facility, Virginia. December.

TtNUS, 2011. Updated Long Term Monitoring Plan, Fire Training Area Site. NASA Wallops Flight Facility, Virginia. November.

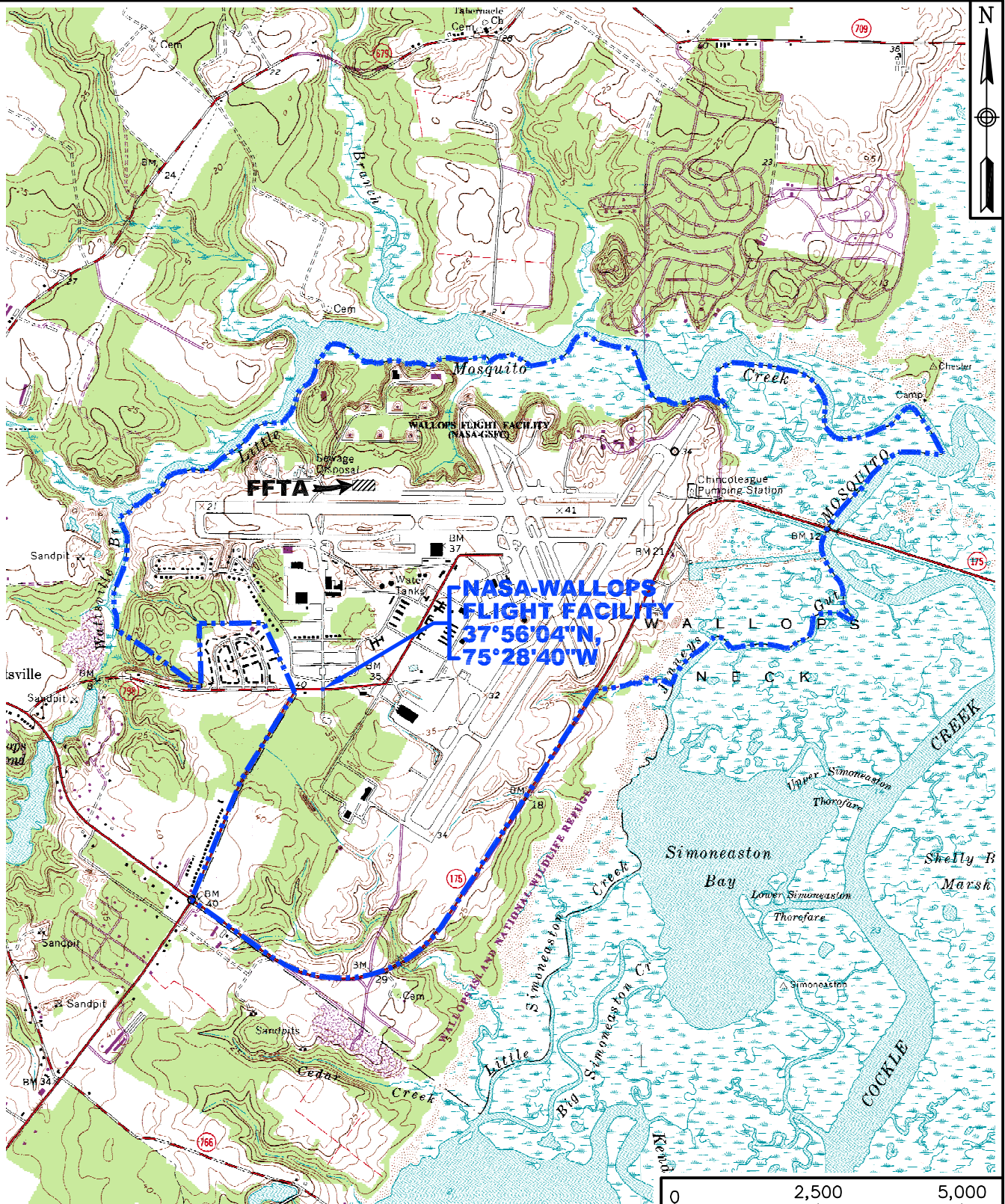
FIGURES



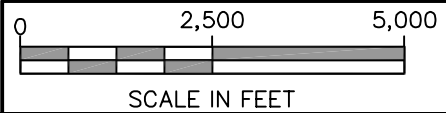
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FACILITY LOCATION MAP
 NASA WALLOPS FLIGHT FACILITY
 WALLOPS ISLAND, VIRGINIA

SCALE AS NOTED	
FILE 112GN1612CM01	
REV 0	DATE 01/16/08
FIGURE NUMBER FIGURE 1-1	

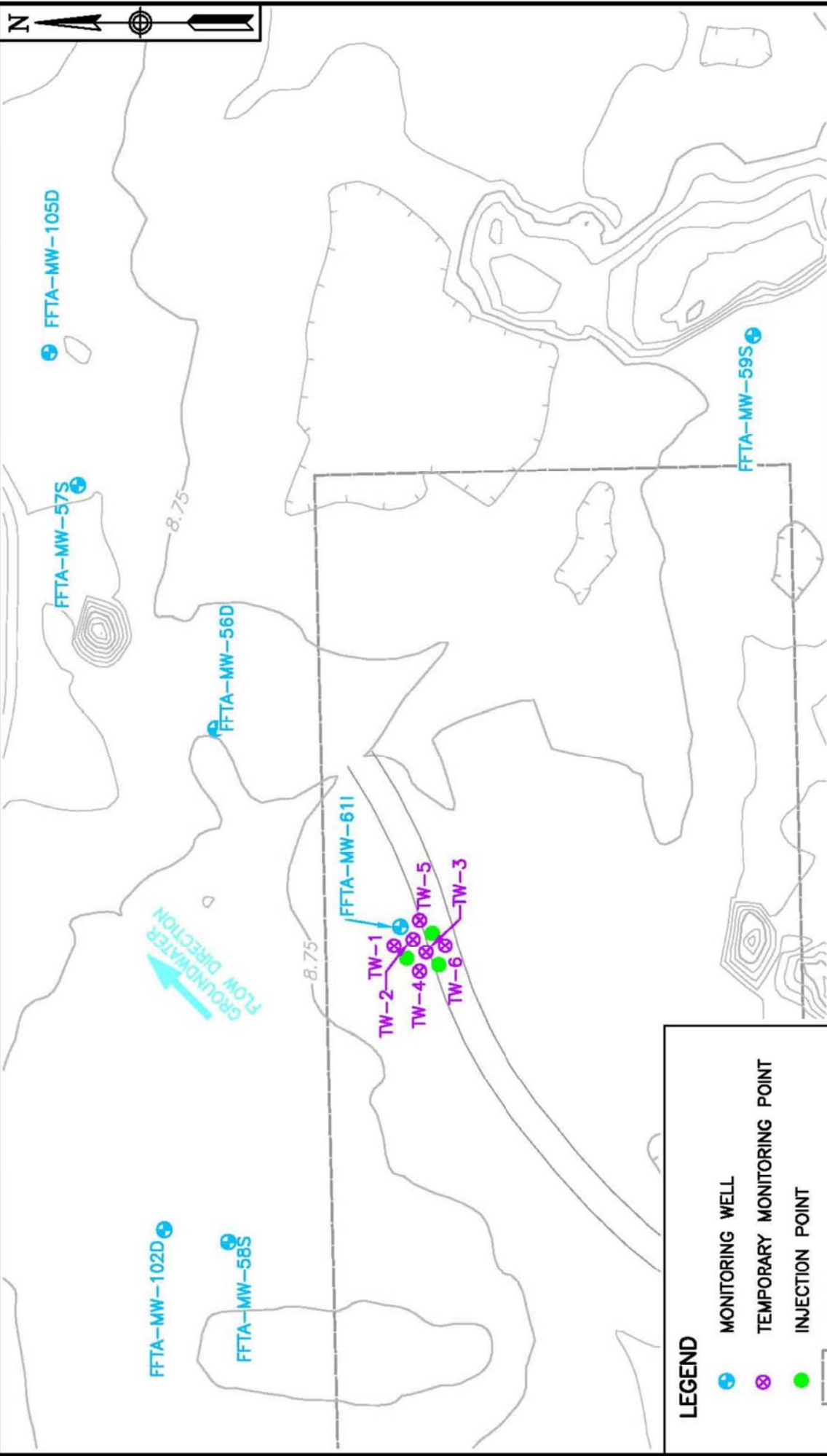


SOURCE: U.S.G.S. 7.5' QUADRANGLE MAP, CHINCOTEAGUE WEST, VA., (37075-H4-TF-024) PHOTOINSPECTED 1989.



STUDY AREA LOCATION MAP OF
NASA WALLOPS FLIGHT FACILITY
WALLOPS ISLAND, VIRGINIA

SCALE AS NOTED	
FILE 112GN1612BM01.DWG	
REV 0	DATE 02/12/08
FIGURE NUMBER FIGURE 1-2	



LEGEND

- MONITORING WELL
- ⊗ TEMPORARY MONITORING POINT
- INJECTION POINT
- FORMER FIRE TRAINING AREA

NOTE
ELEVATION CONTOURS ARE METRIC

0 40 80
SCALE IN FEET

SCALE AS NOTED
FILE 1612GM04
REV 0
DATE 03/20/09
FIGURE NUMBER FIGURE 4-1

FORMER FIRE TRAINING AREA
DPT/INJECTION POINT LOCATIONS
NASA Wallops Flight Facility
Wallops Island, Virginia



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APPENDIX A

**DOCUMENTATION OF LAND USE CONTROL (LUC)
and LAND USE INSPECTION FORM**

TABLE 1
 FORMER FIRE TRAINING AREA
 NASA WALLEPS FLIGHT FACILITY
 WALLEPS ISLAND, VIRGINIA
 ANNUAL POST-CLOSURE INSPECTION REPORT

LEAD INSPECTOR NAME: _____ POST-CLOSURE YEAR: _____

SIGNATURE: _____ DATE OF INSPECTION: _____

WEATHER/SITE CONDITIONS: _____

COMPONENT	WHAT TO INSPECT	FINDING	OBSERVATIONS/COMMENTS
Land area	presence of drinking water wells		
Land area	presence of wells for purposes other than Environmental Monitoring		
Land area	presence of structures or buildings		
Facility Planning Documents/Tools	Maintenance of LUC in Facility Managements System		

