

**ATTACHMENT 15**

**LABORATORY ANNUAL SAMPLE PLAN**



National Aeronautics and  
Space Administration

**John C. Stennis Space Center**  
Stennis Space Center, MS 39529-6000

**SSOP-8530-0052-ENV Rev 12**

**April 2014**

**John C. Stennis Space Center**  
**Science Laboratory Annual**  
**Sample Plan**

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## APPROVAL/CONCURRENCE

<u>T. Butler</u>	<u>04/04/14</u>	<u>Nestor Torres</u>	<u>04/14/14</u>
Originator	Date	Quality	Date
<u>T. Butler</u>	<u>04/04/14</u>	<u>S. Varnado</u>	<u>04/14/14</u>
Supervisor	Date	Safety	Date
<u>Kimberlee Palmer</u>	<u>04/14/14</u>		
SSC Tech Doc	Date		

## Document History Log

Status/Change/Revision	Change Date	Originator/Phone	Description
0	01/26/2005	T. Butler/ 8-2065	Initial Release
1	2/2/05	T. Butler/8-2065	Corrected header
2	12/2005	T. Butler	Added new outfall and 2 new Area A wells for baseline. Also added underground storage tank groundwater monitoring. Added monthly pump and treat calibrations section.
3	4/2006	T. Butler	Added the Landfill Wells as a semi-annual sampling event. Added requirement for Field Scientist to look for presence of foam at all NPDES outfalls.
4	2/2007	T. Butler	Table H, EDB-DBCP was changed to Semi-Annual Sampling, other minor spelling etc. revisions.
5	8/2007	T. Butler	Building 2418 changed to 2413
6	4/2008	T. Butler	Added MW-1 & MW-B to Annual monitoring list, reduced discretionary monitoring frequency per NASA direction

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7	2/18/2009	T. Butler	Made changes in accordance to Long Term and Operational Monitoring Plan May 2008
8	02/24/2010	T. Butler/ 8-2065	Removed UST 2501 for annual collection, added GPS point for outfall 011 sample point,
9	07/20/2011	J. Richard/8-2053	Updated all tables in document to comply with SPR 1400.1. Update references to reflect most current LTOMP and correct document numbers. Updated AGT to A2Research. Updated number formatting for all sections throughout document. BOD changed to CBOD for permitted outfalls. In section 5.3.3.1 notation was made as to the changing of drinking water collection from building 3407 to 3418. In section 5.6.1 identified damaged monitoring well. Made any required changed in accordance to LTOMP October 2010. Added quarterly landfill sedimentation basin sample collection in section 5.0.
10	01/03/2012	Jeanette Richard, x82053	Updated document dates from FY 2011 to FY 2012; updated section 3.2 to reflect current LTOMP plan in TechDoc; updated section 5.1.2 to reflect the completion of the quarterly discretionary sampling of the landfill sedimentation basin sample; changed sampling frequency in table 5.2.2.1 to monthly for the collection of CBOD at lagoon 1 and 2 influents for one year beginning December 2011; modified

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			section 5.8 and table 5.8.3.1 to reflect the completion of conversion of monitoring well 18-13 to extraction well 9 for area B as of early 2011; updated section 5.12.2 to offer explanation for conversion of 4 extraction wells (EX) to retrofit wells (RW).
11	4/2013	T.butler/8-2065	Removed annual influent collection at lagoon 1 and 2 for C-BOD, added permit MS0040797 to Plan for monitoring under NASA, section 5.2.2 and added table 5.2.2.6
12	4/2014	T.Butler/8-2065	Added 3202 quarterly monitoring wells, section 5.15, changed parameters for Area 9000 permit to reflect new permit issued February 2014

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**SAFETY HAZARDS INVOLVED – YES/NO**

**1.0 Purpose**

1.1 The purpose of the plan is to document the planned annual sampling events for the Environmental Science Laboratory.

**2.0 Applicability**

2.1 This procedure applies to all laboratory personnel.

**3.0 References<sup>1</sup>**

3.1 Mississippi Department of Environmental Quality, State of Mississippi Water Pollution Control Permit, MS0021610

3.2 Mississippi Department of Environmental Quality, State of Mississippi Water Pollution Control Permit # MS0040797

3.3 SPLN-8500-0088, Long Term and Operational Monitoring Requirements

3.4 Groundwater Monitoring System Plan for Solid Waste Management, March 2007

3.5 Current Microbiological and Disinfection Byproduct Sample Site Plan

3.6 A2R-SPLN-8730-0006, A2R Safety and Health Plan

<sup>1</sup> *All references are to be the latest version unless otherwise indicated*

**4.0 Roles and Responsibilities**

4.1 It is the responsibility of laboratory management to work closely with NASA Environmental office to maintain and track this document. The sample plan is very dynamic and changes per NASAs requirements. All changes should be tracked and documented in this procedure.

4.2 As applicable during the support of this plan, A2 Research (A2R) Laboratory Sciences personnel shall follow safety and health requirements per SPLN-8730-0006, *A2R Safety and Health Plan*.

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## 5.0 Procedure / Sampling Plan

### 5.1 Discretionary Runoff Monitoring Sampling Schedule

5.1.1 Currently, SSC Science Laboratory Services collects and analyzes five (5) points for runoff contamination. Non-point sources (run-off) include agricultural runoff, mine drainage, urban and highway runoff, and runoff from lawns and natural areas. Non-point source pollution accounts for 80 percent of the degradation of waters in the United States. If left unchecked, non-point source pollution can damage the quality of receiving surface and ground waters. The table below lists the collection points, frequency of sampling per year, and analytical parameters of interest.

Table 5.1.1.1 – Discretionary Runoff Monitoring Sampling Schedule

Runoff Water Collection Sites		Army Ditch	Locks	Landfill Ditch	Pearl River		Total Analyses
Method Numbers	Parameters				North	South	
360.1	DO	0	0	0	2	2	4
SM2550B	Temperature	4	4	1	2	2	13
150.1	pH	4	4	1	2	2	13
405.1	BOD	4	0	1	2	2	9
160.2	TSS	4	4	1	2	2	13
SM 2540C	TDS	4	0	1	2	2	13
SM9222D	Fecal Coliform	0	0	0	2	2	4
ASTM D5176	TKN	4	0	1	2	2	9
300	Br, Cl, Fl, NO3 NO2, PO4, SO4	0	0	0	2	2	4
180.1	Turbidity	0	0	0	2	2	4
SM 2510B	Conductivity	0	0	0	2	2	4
200.7/200.8	Metals I	4	0	1	2	2	9
8260b	VOC	4	0	1	2	2	9
415.1	TOC	4	0	1	2	2	9
1664	Oil and grease	0	4	0	0	0	4

- Number in Column indicates the number of samples collected annually ( for example 4 = quarterly collection)
- **Metals I** list consists of the following metals: Silver, Cadmium, Chromium, Copper, Nickel, Total Phosphorus, Lead, and Zinc

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5.1.2 Discretionary quarterly sampling of the landfill sedimentation basin as requested by the NASA Environmental Office has been completed. The quarterly sampling was conducted September 2010 to October 2011; analyzed parameters included those listed in Code of Federal Regulations Title 40, part 258, appendix I.

5.2 NPDES Sampling Schedule for FY 2014

5.2.1 As authorized by the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States. Point sources are discrete conveyances such as pipes or man-made ditches. Industrial, municipal, and other facilities must obtain permits if their discharges go directly to surface waters. In most cases, the NPDES permit program is administered by authorized states. Since its introduction in 1972, the NPDES permit program is responsible for significant improvements to our Nation's water quality. Currently SSC has two NPDES permits, number MS0021610, and MS0040797.

5.2.2 The NASA permit MS0021610 authorizes discharge from outfalls 001, (Sanitary Wastewater, Cooling and Wash Water, Water from Pump and Treat, and Photo Lab Water), 002, (Sanitary Wastewater, Cooling and Landfill Leachate, Wash Water and Water from Pump and Treat) Outfall 008 (Sanitary Wastewater at South Entrance), 010 (Sanitary Wastewater at North Entrance), 011 (Deluge Water from Rocket Test Stands). A copy of the permit is maintained by both the laboratory and NASA Environmental Office. The following table lists the permitted collection points, frequency of sampling annually, and analytical parameters of interest. Field Scientists have been informed to look for the presence of foam at all Effluent Outfalls. If visible foam is present a notation will be made in the field log and the FOSC Environmental contractors will be notified via phone or e-mail.

5.2.3 The permit MS0040797 authorizes discharge from Outfall 002 at the Industrial complex known as the 9000 Complex, formerly the Mississippi Army Ammunition Plant. See Table 5.2.2.6 for specific parameters and frequency.

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Table 5.2.2.1 – NPDES 001 Outfall Sampling Schedule

NPDES Collection Sites		Outfall 001 (Lagoon 1)	Outfall 001 (Lagoon 1)	Outfall 001 (Lagoon 1)	
Method Numbers	Parameters	Influent	Effluent Composite	Effluent	Total Analyses
Not applicable	Flow Rate	0	0	24	24
150.1	pH	2	0	24	26
SM2550B	Temperature	2	0	24	26
5210B	BOD, Carbonaceous	2	*24	0	26
160.2	TSS	2	*24	0	26
SM9222D	Fecal Coliform	0	0	*24	24
SM 2540C	IDS	2	2	0	4
ASTM D5176	TKN	2	2	0	4
200.7	TP	2	2	0	4
350.3	NH3	2	0	2	4
200.7/200.8	Metals I	2	2	0	4
415.1	TOC	2	2	0	4

Table 5.2.2.2 – NPDES 002 Outfall Sampling Schedule

NPDES Collection Sites		Outfall 002 (Lagoon 2)	Outfall 002 (Lagoon 2)	Outfall 002 (Lagoon 2)	
Method Numbers	Parameters	Influent	Effluent Composite	Effluent	Total Analyses
n/a	Flow Rate	0	0	*24	24
150.1	pH	2	0	*24	26
SM2550B	Temp	2	0	24	26
5210B	BOD, Carbonaceous	2	*24	0	26
160.2	TSS	2	*24	0	26
SM9222D	Fecal Coliform	0	0	*24	24
SM 2540C	IDS	2	2	0	4
ASTM D5176	TKN	2	2	0	4
200.7	TP	2	2	0	4
350.3	NH3	2	0	2	4
200.7/200.8	Metals I	2	2	0	4
415.1	TOC	2	2	0	4

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Table 5.2.2.3 – NPDES 008 Outfall Sampling Schedule

NPDES Collection Sites Method Numbers	Parameters	Outfall 008 (South Gate) Effluent	Outfall 008 (South Gate) Effluent Composite	Total Analyses
n/a	Flow Rate	1	0	1
150.1	pH	1	0	1
SM2550B	Temp	1	0	1
5210B	BOD, Carbonaceous	0	1	1
160.2	TSS	0	1	1
SM9222D	Fecal Coliform	1	0	1
SM 2540C	IDS	0	1	1
ASTM D5176	TKN	0	1	1
200.7	TP	0	1	1
350.3	NH3	1	0	1
200.7/200.8	Metals I	0	1	1
415.1	TOC	0	1	1

Table 5.2.2.4 – NPDES 010 Outfall Sampling Schedule

NPDES Collection Sites Method Numbers	Parameters	Outfall 010 (North Gate) Effluent	Outfall 010 (North Gate) Effluent Composite	Total Analyses
n/a	Flow Rate	1	0	1
150.1	pH	1	0	1
SM2550B	Temp	1	0	1
5210B	BOD, Carbonaceous	0	1	1
160.2	TSS	0	1	1
SM9222D	Fecal Coliform	1	0	1
SM 2540C	IDS	0	1	1
ASTM D5176	TKN	0	1	1
200.7	TP	0	1	1
350.3	NH3	1	0	1
200.7/200.8	Metals I	0	1	1
415.1	FOC	0	1	1

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Table 5.2.2.5 – NPDES 011 Outfall Sampling Schedule for FY 2013

NPDES Collection Sites	Parameters	Outfall 011 (Spillway)	Outfall 011 (Spillway) Composite	Total Analyses
n/a	Flow Rate	estimation	0	24
150.1	pH	24	0	24
SM2550B	Temp	24	0	24
160.2	TSS	24	0	24
1664	Oil and Grease	24	0	24

- Items highlighted in grey are discretionary non-permitted parameters.
- (\*) This number indicates the minimum number of samples required by the permit
- **Metals 1** list consists of the following metals Silver, Cadmium, Chromium, Copper, Nickel, Total Phosphorus, Lead, and Zinc
- **011 Outfall** is collected twice a month in the canal near the spillway. Outfall 011 replaces the discretionary sample formerly referred to as the monthly spillway sample.
- **GPS co-ordinates for 011 Outfall area Latitude 30 21'27.005"N, Longitude 89 34'24.21" W**
- **Outfall 011 Flow data** is received from the water plant and entered into the report as an estimation.

Table 5.2.2.6 – NPDES 002 9000 Complex, Permit MS0040797, Outfall Sampling Schedule

NPDES Collection Sites	Parameters	002 Effluent	002 Effluent Composite	Total Analyses
n/a	Flow Rate	1	0	1
150.1	pH	1	0	1
SM2550B	Temp	1	0	1
5210B	BOD	0	1	1
160.2	TSS	0	1	1
SM9222D	Fecal Coliform	1	0	1
350.3	NH3	0	1	1
200.7/200.8	Total Aluminum	0	1	1
4500-O	DO	1	0	1

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### 5.3 Drinking Water Sampling Schedule

- 5.3.1 The Mississippi State Department of Health provides the written instructions and sample containers which must be sent back to the state for analysis of parameters and sampling frequencies as set forth by the state. All such samplings are analyzed in-house resulting in a split sample. Upon receipt of the report from the state, the results are compared for accuracy and reproducibility.
- 5.3.2 The Mississippi State Department of Health submits sample containers for required collections of Haloacetic acids and Trihalomethanes on an annual basis. The State submits containers for volatiles once each quarter from entry point TF101 and once every six years from TF102. Split samples are also collected for Cyanide and Inorganics every three years from each entry point, with Nitrate/Nitrite annually from each entry point. Every three years, lead and copper samplings are required to be sent to the state office for analysis. NASA has a Lead and Copper Plan which is available on file with the NASA Environmental Office. The buildings designated for sampling are within the Lead and Copper Plan. An unofficial copy of the plan is available on file in the laboratory.
- 5.3.3 In addition to the required state split samplings, Science Laboratory Services collects monthly drinking water samples from 18 locations for analysis and monitoring of a variety of primary and secondary analytes. The following tables contain building numbers collected, frequency of sampling annually, and parameters analyzed from each collection point. The sample locations are spread out throughout the month instead of collected all at once for total coliform. The Total Coliform rule is driving the weekly collections rather than one sampling event due to the population of Stennis. The microbiological sample plan and a letter were submitted and approved by the state detailing the schedule of drinking water collections; a copy of the letter is on file with laboratory management.
- 5.3.3.1 Collection of building 3407 has been replaced by the collection of drinking water from building 3418 as determined by the MSDH, June 2011. Building 3418 is the new Cryogenics Control Center Building.

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Table – 5.3.3.1 Drinking Water Collection

Building Number	Method Numbers	Parameters	4400 Reservoir	1100 Kitchen	3312 Main Well #1	7001 North Gate	3101 South Gate	2425 Rouchon House
SM2550B		Temperature	12	12	12	12	12	12
SM9222B		Total Coliform	12	12	12	12	12	12
SM4500-C1 G		Residual Cl	12	12	12	12	12	12
150.1		pH	12	12	12	12	12	12
405.1		BOD	2	2	2	2	2	2
160.2		TSS	2	2	2	2	2	2
SM 2540C		TDS	2	2	2	2	2	2
ASTM D5176		TKN	2	2	2	2	2	2
200.7		TP	2	2	2	2	2	2
300		NO3	2	2	2	2	2	2
300		SO4	2	2	2	2	2	2
300		Fl	2	2	2	2	2	2
300		Cl	2	2	2	2	2	2
180.1		Turbidity	2	2	2	2	2	2
200.7/200.9/200.8		Metals	2	2	2	2	2	2
525.2		SEMIS	2	2	2	2	2	2
524.2		THM	4	4	4	4	4	4
524.2		VOC	12	12	12	12	12	12
415.1		TOC	2	2	2	2	2	2
4500-CLO2 D		Chlorine Dioxide	12	12	12	12	12	12
		Chloramine	12	12	12	12	12	12
552.1		Haloacetic Acids	4	4	4	4	4	4
300/300.1		Bromide†	14	14	14	14	14	14
300		Nitrite	2	2	2	2	2	2
300		Phosphate	2	2	2	2	2	2
300.1		Chlorate	12	12	12	12	12	12
300.1		Chlorite	12	12	12	12	12	12
300.1		Bromate	12	12	12	12	12	12
504.1		EDB/DBCP	2	2	2	2	2	2

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Table (continued) – 5.3.3.1 Drinking Water Collection

Building Number Method Numbers	Parameters	2411 Cypress House	1009 NRL Area	3202 Boeing SSME	4120 A-1 Stand	4220 B-1 Stand	1002 NAVO
SM2550B	Temperature	12	12	12	12	12	12
SM9222B	Total Coliform	12	12	12	12	12	12
SM4500-Cl G	Residual Cl	12	12	12	12	12	12
150.1	pH	12	12	12	12	12	12
405.1	BOD	2	2	2	2	2	2
160.2	TSS	2	2	2	2	2	2
SM 2540C	TDS	2	2	2	2	2	2
ASTM D5176	TKN	2	2	2	2	2	2
200.7	TP	2	2	2	2	2	2
300	NO3	2	2	2	2	2	2
300	SO4	2	2	2	2	2	2
300	Fl	2	2	2	2	2	2
300	Cl	2	2	2	2	2	2
180.1	Turbidity	2	2	2	2	2	2
200.7/200.9/200.8	Metals	2	2	2	2	2	2
525.2	SEMIS	2	2	2	2	2	2
524.2	THM	4	4	4	4	4	4
524.2	VOC	12	12	12	12	12	12
415.1	TOC	2	2	2	2	2	2
4500-CLO2 D	Chlorine Dioxide	12	12	12	12	12	12
	Chloramine	12	12	12	12	12	12
552.1	Haloacetic Acids	4	4	4	4	4	4
300/300.1	Bromide†	14	14	14	14	14	14
300	Nitrite	2	2	2	2	2	2
300	Phosphate	2	2	2	2	2	2
300.1	Chlorate	12	12	12	12	12	12
300.1	Chlorite	12	12	12	12	12	12
300.1	Bromate	12	12	12	12	12	12
504.1	EDB/DBCP	2	2	2	2	2	2

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Table (continued) – 5.3.3.1 Drinking Water Collection

Building Number Method Numbers	Parameters	3418 CRYO	2437 Magnetics	2201 Fire Dept.	8201 Horn Bldg.	5005 ASRM	5100 LMTO
SM2550B	Temperature	12	12	12	12	12	12
SM9222B	Total Coliform	12	12	12	12	12	12
SM4500-CI G	Residual Cl	12	12	12	12	12	12
150.1	pH	12	12	12	12	12	12
405.1	BOD	2	2	2	2	2	2
160.2	TSS	2	2	2	2	2	2
SM 2540C	TDS	2	2	2	2	2	2
ASTM D5176	TKN	2	2	2	2	2	2
200.7	TP	2	2	2	2	2	2
300	NO3	2	2	2	2	2	2
300	SO4	2	2	2	2	2	2
300	FI	2	2	2	2	2	2
300	Cl	2	2	2	2	2	2
180.1	Turbidity	2	2	2	2	2	2
200.7/200.9/200.8	Metals	2	2	2	2	2	2
525.2	SEMIS	2	2	2	2	2	2
524.2	THM	4	4	4	4	4	4
524.2	VOC	12	12	12	12	12	12
415.1	TOC	2	2	2	2	2	2
4500-CLO2 D	Chlorine Dioxide	12	12	12	12	12	12
	Chloramine	12	12	12	12	12	12
552.1	Haloacetic Acids	4	4	4	4	4	4
300/300.1	Bromide†	14	14	14	14	14	14
300	Nitrite	2	2	2	2	2	2
300	Phosphate	2	2	2	2	2	2
300.1	Chlorate	12	12	12	12	12	12
300.1	Chlorite	12	12	12	12	12	12
300.1	Bromate	12	12	12	12	12	12
504.1	EDB/DBCP	2	2	2	2	2	2

†Bromide is analyzed monthly for a preserved sample aliquot and semi-annually for an unpreserved sample aliquot from each sample point.

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5.4 NASA has tasked the laboratory with monitoring of the SSC Landfill per the SSC document, "Groundwater Monitoring System Plan for Solid Waste Management". The laboratory follows the guidelines established in this document. Currently, monitoring consists of 15 shallow wells. The sampling frequency has been reduced to a semi-annual collection. The following table lists the analytical parameters and well identifications associated with the landfill monitoring activities.

Table 5.4.1 – Semi-Annual Landfill Monitoring

Monitoring Well Number Method Numbers	Parameters	02-01MW See note below	02-03MW	02-04MW	02-05MW	02-13MW	02-20MW
150.1	pH	2	2	2	2	2	2
SM 2510B	Conductivity	2	2	2	2	2	2
SM2550B	Temperature	2	2	2	2	2	2
200.7/200.8/200.9	Metals*	2	2	2	2	2	2
8260b	VOCs*	2	2	2	2	2	2
8150A	Herbicides*	2	2	2	2	2	2
8081/8082	Pesticides*	2	2	2	2	2	2
	Water Level	2	2	2	2	2	2
Monitoring Well Number Method Numbers	Parameters	02-21MW	02-22MW	02-23MW	02-24MW See note below	02-25MW	02-26MW
150.1	pH	2	2	2	2	2	2
SM 2510B	Conductivity	2	2	2	2	2	2
SM2550B	Temperature	2	2	2	2	2	2
200.7/200.8/200.9	Metals*	2	2	2	2	2	2
8260b	VOCs*	2	2	2	2	2	2
8150A	Herbicides*	2	2	2	2	2	2
8081/8082	Pesticides*	2	2	2	2	2	2
	Water Level	2	2	2	2	2	2
Monitoring Well Number Method Numbers	Parameters	02-27MW	02-28MW	02-29MW			
150.1	pH	2	2	2			
SM 2510B	Conductivity	2	2	2			
SM2550B	Temperature	2	2	2			
200.7/200.8/200.9	Metals*	2	2	2			
8260b	VOCs*	2	2	2			
8150A	Herbicides*	2	2	2			
8081/8082	Pesticides*	2	2	2			
	Water Level	2	2	2			

\*Full list of parameters listed in the Groundwater Monitoring System Plan for Solid Waste Management or 40 CFR 258 Appendix I

- Note for 02-01MW; April 2006, it was discovered that 02-01MW was destroyed during storm clean-up efforts
- Note for 02-24MW; Monitoring Well 02-24MW destroyed sometime between April 2008 collection and the October 2008 collection; believed to be due to logging activity

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5.5 Waste Characterization

5.5.1 Nearly everything we do leaves behind some kind of waste. Industrial and manufacturing processes create solid and hazardous waste. The Office of Solid Waste (OSW) regulates all this waste under the Resource Conservation and Recovery Act (RCRA).

5.5.2 RCRA's goals are to:

5.5.2.1 Protect humans from the hazards of waste disposal

5.5.2.2 Conserve energy and natural resources by recycling and recovery

5.5.2.3 Reduce or eliminate waste

5.5.2.4 Clean up waste, which may have spilled, leaked, or been improperly disposed.

5.5.3 Hazardous waste comes in many shapes and forms. RCRA tightly regulates all hazardous waste from "cradle to grave." RCRA also controls garbage and industrial waste. Common garbage is municipal waste, which consists mainly of paper, yard trimmings, glass, and other materials. Industrial waste is process waste that comes from a broad range of operations. Some wastes are managed by other federal agencies or state laws. Examples of such wastes are animal waste, radioactive waste, and medical waste.

5.5.4 Stennis Space Center is responsible for proper management of waste generated by NASA operations and all contractors. Process knowledge is used for managing some waste streams; however, analysis is necessary when the process knowledge is not sufficient for waste characterization. Leachate testing is performed on a variety of wastes. Such wastes streams consists of, but are not limited to, soils, waters, waste oils, used antifreeze, and spent carbon filters. The purpose for testing is to estimate the leaching potential of constituents of concern to water sources. It is important to estimate leaching potential in order to accurately estimate the quantity of chemicals that could potentially reach groundwater or surface water resources (drinking water supply wells, waters used for recreation). Each year, the laboratory analyzes a wide variety of unknown wastes for characterization and disposal purposes. Table 5.5.4.2, on the following page, lists the TCLP regulatory analytes and the limits.

5.5.4.1 Other hazardous waste characterization performed in the laboratory include: Method 9010B, Reactive Cyanide; Method 9215, Reactive Sulfide; Method 1010 Flashpoint/Ignitability; Method 150.1, Corrosivity.

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Table 5.5.4.2 – TCLP Regulatory Limits

<b>Semivolatiles</b>	<b>Reg. Limit mg/L</b>
o-Cresol	200
m-Cresol	200
p-Cresol	200
1,4-dichlorobenzene	7.5
2,4-dinitrotoluene	0.13
Hexachlorobenzene	0.13
Hexachloroethane	3
Nitrobenzene	2
Pentachlorophenol	100
Pyridine	5
2,4,5, Trichlorophenol	400
2,4,6, Trichlorophenol	2
<b>Volatiles</b>	<b>Reg. Limit mg/L</b>
Benzene	0.5
Carbon Tetrachloride	0.5
Chlorobenzene	100
Chloroform	6
1,4 Dichlorobenzene	7.5
1,2 Dichlorobenzene	0.5
2 Butanone, MEK	200
Tetrachloroethylene	0.7
Trichloroethylene	0.5
Vinyl Chloride	0.2
<b>Metals</b>	<b>Reg. Limit mg/L</b>
Arsenic	5
Barium	100
Cadmium	1
Chromium	5
Lead	5
Mercury	0.2
Selenium	1
Silver	5

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## 5.6 Underground Storage Tank Groundwater Monitoring

5.6.1 Currently, our laboratory is tasked with an annual collection of monitoring wells near underground storage tanks. There are four wells near the gas pumps at building 2201: G-1, G-2, G3 and G4. These four wells are collected and analyzed for volatiles and TOC on an annual basis, usually during the month of November, and reported in the December NPDES deliverable, EN03. Instructions were given in March of 2008 to begin annual collection (within the first quarter of the year) and analysis of two other wells for volatiles: MW-1 and MW-B located at the NEXCOM station, formerly APG. Due to the removal of the underground storage tanks at the NEXCOM station, MW-B was destroyed; monitoring of the remaining existing wells (including MW-1) will continue on an annual basis according to the schedule described in this section.

## 5.7 Area A – Air Force Disposal Site and Pesticide Operations

5.7.1 Groundwater remediation for Area A includes using a RCRA Cap/Barrier Wall and Passive Treatment Wall. Remedial duration for Area A began May 2002 and ended August 2008.

5.7.2 Sampling during the remedial duration, which was conducted under previous LTOMPs, was conducted quarterly for the first year and annually thereafter. Samples were analyzed for VOCs and water quality parameters. Samples were also analyzed for SVOCs and perchlorates on a quarterly basis for one year (April 2003-April 2004). Groundwater samples from select wells were also analyzed for dioxins.

5.7.3 When present, groundwater seep, sediment, and surface water samples were collected and analyzed during the remediation period to monitor the discharge of contaminants to Mike's River and the associated ecological risks. The surface water and sediment samples were taken from the same area.

5.7.4 During post-remediation, which began officially in August 2009, the following wells in WBZ-1 will be sampled: 07-107MW and 07-139MW will monitor up gradient and down gradient of Plume A, respectively; and 07-04MW and 07-136MW will monitor up gradient and down gradient of Plume B, respectively. For WBZ-2, monitor wells 07-113MW and 07-135MW will be used to monitor up gradient of Plume C, and well 07-133MW will be used to monitor down gradient of Plume C. Wells 07-121MW (WBZ-1) and 07-122MW (WBZ-2) will be used to monitor background data

5.7.5 The following table (5.7.5.1) outlines the wells sampled, frequency of sampling annually, and parameters analyzed.

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Table 5.7.5.1 – Area A Monitoring Wells – Post Remediation

Water Bearing Zone 1 Method Numbers	Area A Well ID Parameters	07-04	07-107	07-121	07-136	07-139
8260b	VOC	1	1	1	1	1
150.1	pH	1	1	1	1	1
SM 2550B	Temperature	1	1	1	1	1
SM 2510B	Conductivity	1	1	1	1	1
SM 2580B	REDOX	1	1	1	1	1
SM 2320B	Alkalinity	1	1	1	1	1
360.1	Dissolved Oxygen	1	1	1	1	1
180.1	Turbidity	1	1	1	1	1
SM 2540C	Total Dissolved Solids	1	1	1	1	1
160.2	Total Suspended Solids	1	1	1	1	1
300	Chloride	1	1	1	1	1
200.7	Total Phosphorus	1	1	1	1	1
300	Ortho-Phosphate	1	1	1	1	1
410.4	Filtered COD	1	1	1	1	1
410.4	Non Filtered COD	1	1	1	1	1
2150	Ferrous Iron	1	1	1	1	1
Water Bearing Zone 2 Method Numbers	Area A Well ID Parameters	07-113	07-122	07-133	07-135	
8260b	VOC	1	1	1	1	
150.1	pH	1	1	1	1	
SM 2550B	Temperature	1	1	1	1	
SM 2510B	Conductivity	1	1	1	1	
SM 2580B	REDOX	1	1	1	1	
SM 2320B	Alkalinity	1	1	1	1	
360.1	Dissolved Oxygen	1	1	1	1	
180.1	Turbidity	1	1	1	1	
SM 2540C	Total Dissolved Solids	1	1	1	1	
160.2	Total Suspended Solids	1	1	1	1	
300	Chloride	1	1	1	1	
200.7	Total Phosphorus	1	1	1	1	
300	Ortho-Phosphate	1	1	1	1	
410.4	Filtered COD	1	1	1	1	
410.4	Non Filtered COD	1	1	1	1	
2150	Ferrous Iron	1	1	1	1	

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5.8 Area B Remediation Monitoring

5.8.1 Groundwater monitoring at Area B consists of sampling 17 existing monitoring wells, 9 extraction wells, and 11 additional monitoring wells in WBZ-1. Twelve of the existing monitoring wells are located in WBZ-1 and the other six are located in WBZ-2. The extraction wells are located in WBZ-1 with the exception of EX-9 which is in WBZ-2. All of the groundwater wells were sampled once at startup of the groundwater treatment system. Sampling during the remedial duration which was conducted under previous LTOMPs was conducted quarterly. Samples were also analyzed for SVOCs and perchlorates on a quarterly basis for one year (April 2003-April 2004).

5.8.2 Beginning calendar year 2009, an additional 5 years of remediation were added to Area B. All existing wells will continue to be sampled but the frequency has been reduced from quarterly down to semi-annually. New wells in water bearing zone 1 (WBZ-1) were added for the duration of the 5 year remedial period. The new wells were sampled quarterly for 2 years (2009 and 2010), and are to be reduced to semi-annual collection beginning calendar year 2011. Early in 2010 NASA was scheduled to convert 18-13MW in WBZ-2 to an extraction well, to be named EX-9. The conversion of 18-13MW to EX-9 was completed in 2011 resulting in 17 monitoring wells and 9 extraction wells. Table 5.8.3.1 below reflects the most current information, including the conversion of monitoring well 13 to extraction well 9.

5.8.3 The following table (5.8.3.1) outlines the wells sampled, the new sampling frequency of the wells which is semi-annually beginning 2011, and parameters analyzed.

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Table 5.8.3.1 – Area B Wells

Water Bearing Zone 1 Method Numbers	Area B Well ID Parameters	12-03MW	12-05MW	12-06MW	12-07MW	12-11MW	18-09MW
8260b	VOC	2	2	2	2	2	2
405.1	BOD	2	2	2	2	2	2
415.1	TOC	2	2	2	2	2	2
EPA Tech. Paper	Methane	2	2	2	2	2	2
EPA Tech. Paper	Ethane	2	2	2	2	2	2
EPA Tech. Paper	Ethylene	2	2	2	2	2	2
SM 4500-S2 F	Sulfide	2	2	2	2	2	2
300	Nitrates	2	2	2	2	2	2
150.1	pH	2	2	2	2	2	2
SM 2550B	Temperature	2	2	2	2	2	2
SM 2510B	Conductivity	2	2	2	2	2	2
SM 2580B	REDOX	2	2	2	2	2	2
SM 2320B	Alkalinity	2	2	2	2	2	2
360.1	Dissolved Oxygen	2	2	2	2	2	2
180.1	Turbidity	2	2	2	2	2	2
SM 2540C	TDS	2	2	2	2	2	2
160.2	TSS	2	2	2	2	2	2
300	Chloride	2	2	2	2	2	2
200.7	Total Phosphorus	2	2	2	2	2	2
300	Ortho-Phosphate	2	2	2	2	2	2
410.4	Filtered COD	2	2	2	2	2	2
410.4	Non Filtered COD	2	2	2	2	2	2
2150	Ferrous Iron	2	2	2	2	2	2

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Table 5.8.3.1 (continued) – Area B Wells

Water Bearing Zone 1 Method Numbers	Area B Well ID Parameters	18-07MW	18-01MW	18-05MW	19-02MW	19-05MW	19-12MW
8260b	VOC	2	2	2	2	2	2
405.1	BOD	2	2	2	2	2	2
415.1	TOC	2	2	2	2	2	2
EPA Tech. Paper	Methane	2	2	2	2	2	2
EPA Tech. Paper	Ethane	2	2	2	2	2	2
EPA Tech. Paper	Ethylene	2	2	2	2	2	2
SM 4500-S2 F	Sulfide	2	2	2	2	2	2
300	Nitrates	2	2	2	2	2	2
150.1	pH	2	2	2	2	2	2
SM 2550B	Temperature	2	2	2	2	2	2
SM 2510B	Conductivity	2	2	2	2	2	2
SM 2580B	REDOX	2	2	2	2	2	2
SM 2320B	Alkalinity	2	2	2	2	2	2
360.1	Dissolved Oxygen	2	2	2	2	2	2
180.1	Turbidity	2	2	2	2	2	2
SM 2540C	TDS	2	2	2	2	2	2
160.2	TSS	2	2	2	2	2	2
300	Chloride	2	2	2	2	2	2
200.7	Total Phosphorus	2	2	2	2	2	2
300	Ortho-Phosphate	2	2	2	2	2	2
410.4	Filtered COD	2	2	2	2	2	2
410.4	Non Filtered COD	2	2	2	2	2	2
2150	Ferrous Iron	2	2	2	2	2	2

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Table 5.8.3.1 (continued) – Area B Wells

Water Bearing Zone 1	Area B Well ID - Newer Wells	12-08MW	12-10MW	12-15MW	12-16MW	12-17MW	18-04MW
Method Numbers	Parameters						
8260b	VOC	2	2	2	2	2	2
405.1	BOD	2	2	2	2	2	2
415.1	TOC	2	2	2	2	2	2
EPA Tech. Paper	Methane	2	2	2	2	2	2
EPA Tech. Paper	Ethane	2	2	2	2	2	2
EPA Tech. Paper	Ethylene	2	2	2	2	2	2
SM 4500-S2 F	Sulfide	2	2	2	2	2	2
300	Nitrates	2	2	2	2	2	2
150.1	pH	2	2	2	2	2	2
SM 2550B	Temperature	2	2	2	2	2	2
SM 2510B	Conductivity	2	2	2	2	2	2
SM 2580B	REDOX	2	2	2	2	2	2
SM 2320B	Alkalinity	2	2	2	2	2	2
360.1	Dissolved Oxygen	2	2	2	2	2	2
180.1	Turbidity	2	2	2	2	2	2
SM 2540C	TDS	2	2	2	2	2	2
160.2	TSS	2	2	2	2	2	2
300	Chloride	2	2	2	2	2	2
200.7	Total Phosphorus	2	2	2	2	2	2
300	Ortho-Phosphate	2	2	2	2	2	2
410.4	Filtered COD	2	2	2	2	2	2
410.4	Non Filtered COD	2	2	2	2	2	2
2150	Ferrous Iron	2	2	2	2	2	2

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Table 5.8.3.1 (continued) – Area B Wells

Water Bearing Zone 1 Method Numbers	Area B Well ID - Newer Wells Parameters	18- 06MW	18- 10MW	18- 11MW	18- 14MW	19- 07MW
8260b	VOC	2	2	2	2	2
405.1	BOD	2	2	2	2	2
415.1	TOC	2	2	2	2	2
EPA Tech. Paper	Methane	2	2	2	2	2
EPA Tech. Paper	Ethane	2	2	2	2	2
EPA Tech. Paper	Ethylene	2	2	2	2	2
SM 4500-S2 F	Sulfide	2	2	2	2	2
300	Nitrates	2	2	2	2	2
150.1	pH	2	2	2	2	2
SM 2550B	Temperature	2	2	2	2	2
SM 2510B	Conductivity	2	2	2	2	2
SM 2580B	REDOX	2	2	2	2	2
SM 2320B	Alkalinity	2	2	2	2	2
360.1	Dissolved Oxygen	2	2	2	2	2
180.1	Turbidity	2	2	2	2	2
SM 2540C	TDS	2	2	2	2	2
160.2	TSS	2	2	2	2	2
300	Chloride	2	2	2	2	2
200.7	Total Phosphorus	2	2	2	2	2
300	Ortho-Phosphate	2	2	2	2	2
410.4	Filtered COD	2	2	2	2	2
410.4	Non Filtered COD	2	2	2	2	2
2150	Ferrous Iron	2	2	2	2	2

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Table 5.8.3.1 (continued) – Area B Wells

Water Bearing Zone 2 Method Numbers	Area B Well ID Parameters	12-14MW	12-20MW	18-12MW	18-16MW	18-17MW
8260b	VOC	2	2	2	2	2
405.1	BOD	2	2	2	2	2
415.1	TOC	2	2	2	2	2
EPA Tech. Paper	Methane	2	2	2	2	2
EPA Tech. Paper	Ethane	2	2	2	2	2
EPA Tech. Paper	Ethylene	2	2	2	2	2
SM 4500-S2 F	Sulfide	2	2	2	2	2
300	Nitrates	2	2	2	2	2
150.1	pH	2	2	2	2	2
SM 2550B	Temperature	2	2	2	2	2
SM 2510B	Conductivity	2	2	2	2	2
SM 2580B	REDOX	2	2	2	2	2
SM 2320B	Alkalinity	2	2	2	2	2
360.1	Dissolved Oxygen	2	2	2	2	2
180.1	Turbidity	2	2	2	2	2
SM 2540C	TDS	2	2	2	2	2
160.2	TSS	2	2	2	2	2
300	Chloride	2	2	2	2	2
200.7	Total Phosphorus	2	2	2	2	2
300	Ortho-Phosphate	2	2	2	2	2
410.4	Filtered COD	2	2	2	2	2
410.4	Non Filtered COD	2	2	2	2	2
2150	Ferrous Iron	2	2	2	2	2

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Table 5.8.3.1 (continued) – Area B Wells

Water Bearing Zone 1 Method Numbers	Area B Well ID Parameters	EX-1	EX-2	EX-3	EX-4	EX-5	EX-6	EX-7	EX-8	EX-9
8260b	VOC	2	2	2	2	2	2	2	2	2
405.1	BOD	2	2	2	2	2	2	2	2	2
415.1	TOC	2	2	2	2	2	2	2	2	2
EPA Tech. Paper	Methane	2	2	2	2	2	2	2	2	2
EPA Tech. Paper	Ethane	2	2	2	2	2	2	2	2	2
EPA Tech. Paper	Ethylene	2	2	2	2	2	2	2	2	2
SM 4500-S2 F	Sulfide	2	2	2	2	2	2	2	2	2
300	Nitrates	2	2	2	2	2	2	2	2	2
150.1	pH	2	2	2	2	2	2	2	2	2
SM 2550B	Temperature	2	2	2	2	2	2	2	2	2
SM 2510B	Conductivity	2	2	2	2	2	2	2	2	2
SM 2580B	REDOX	2	2	2	2	2	2	2	2	2
SM 2320B	Alkalinity	2	2	2	2	2	2	2	2	2
360.1	Dissolved Oxygen	2	2	2	2	2	2	2	2	2
180.1	Turbidity	2	2	2	2	2	2	2	2	2
SM 2540C	TDS	2	2	2	2	2	2	2	2	2
160.2	TSS	2	2	2	2	2	2	2	2	2
300	Chloride	2	2	2	2	2	2	2	2	2
200.7	Total Phosphorus	2	2	2	2	2	2	2	2	2
300	Ortho-Phosphate	2	2	2	2	2	2	2	2	2
410.4	Filtered COD	2	2	2	2	2	2	2	2	2
410.4	Non Filtered COD	2	2	2	2	2	2	2	2	2
2150	Ferrous Iron	2	2	2	2	2	2	2	2	2

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5.9 Area C Remediation Monitoring

5.9.1 Area C groundwater monitoring consists of the sampling and analysis of eleven (11) existing monitoring wells and five (5) extraction wells. Eight of the monitoring wells are located in WBZ-1 and the other three are located in WBZ-2. The extraction wells are located in WBZ-1. Upon start-up of the pump and treat facility in February 2002, all monitoring wells were collected and analyzed. Sampling during the remedial duration which was conducted under previous LTOMPs was conducted quarterly. Samples were also analyzed for SVOCs and perchlorates on a quarterly basis for one year, April 2003-April 2004.

5.9.2 The first five year review conducted in November 2007 resulted in a reduction from quarterly sampling of the monitoring wells at Area C down to semi-annual sampling beginning calendar year 2009. Semi-annual collections are to continue in accordance to the current LTOMP. Table 5.9.2.1 below lists the frequency of sampling annually, well identifications, and parameters of interest for the monitoring wells associated with area C.

Table 5.9.2.1 – Area C Wells

Water Bearing Zone 1 Method Numbers	Area C Well ID Parameters	32-01MW	32-02MW	32-03MW	32-04MW	32-06MW	32-08MW	32-10MW	32-11MW
8260b	VOC	2	2	2	2	2	2	2	2
150.1	pH	2	2	2	2	2	2	2	2
SM2550B	Temp	2	2	2	2	2	2	2	2
SM 2510B	Conductivity	2	2	2	2	2	2	2	2
SM2580.B	REDOX	2	2	2	2	2	2	2	2
SM 2320B	Alkalinity	2	2	2	2	2	2	2	2
360.1	DO	2	2	2	2	2	2	2	2
180.1	Turbidity	2	2	2	2	2	2	2	2
SM 2540C	TDS	2	2	2	2	2	2	2	2
160.2	TSS	2	2	2	2	2	2	2	2
300	Chloride	2	2	2	2	2	2	2	2
200.7	Total Phosphorus	2	2	2	2	2	2	2	2
300	Ortho-Phosphate	2	2	2	2	2	2	2	2
410.4	Filtered COD	2	2	2	2	2	2	2	2
410.4	Non Filtered COD	2	2	2	2	2	2	2	2
2150	Ferrous Iron	2	2	2	2	2	2	2	2
	Water Level	2	2	2	2	2	2	2	2

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Table 5.9.2.1 (continued) – Area C wells

Water Bearing Zone 1 & 2	Area C Well ID	WBZ-1	WBZ-1	WBZ-1	WBZ-1	WBZ-1	WBZ-2	WBZ-2	WBZ-2
Method Numbers	Parameters	EX-1	EX-2	EX-3	EX-4	EX-5	32-05MW	32-07MW	32-09MW
8260b	VOC	2	2	2	2	2	2	2	2
150.1	pH	2	2	2	2	2	2	2	2
SM2550B	Temp	2	2	2	2	2	2	2	2
SM 2510B	Conductivity	2	2	2	2	2	2	2	2
SM2580.B	REDOX	2	2	2	2	2	2	2	2
SM 2320B	Alkalinity	2	2	2	2	2	2	2	2
360.1	DO	2	2	2	2	2	2	2	2
180.1	Turbidity	2	2	2	2	2	2	2	2
SM 2540C	TDS	2	2	2	2	2	2	2	2
160.2	TSS	2	2	2	2	2	2	2	2
300	Chloride	2	2	2	2	2	2	2	2
200.7	Total Phosphorus	2	2	2	2	2	2	2	2
300	Ortho-Phosphate	2	2	2	2	2	2	2	2
410.4	Filtered COD	2	2	2	2	2	2	2	2
410.4	Non Filtered COD	2	2	2	2	2	2	2	2
2150	Ferrous Iron	2	2	2	2	2	2	2	2
	Water Level	0	0	0	0	0	2	2	2

## 5.10 Area D Remediation Monitoring

5.10.1 Area D groundwater monitoring consists of the sampling and analysis of eleven (11) existing monitoring wells and five (5) extraction wells. Seven of the monitoring wells are located in WBZ-2 and the other four are located in WBZ-3 (WBZ-1 is absent at this site). The extraction wells are located in WBZ-2. Upon start-up of the pump and treat facility in February 2003, all monitoring wells were collected and analyzed. Sampling during the remedial duration which was conducted under previous LTOMPs was conducted quarterly. Samples were also analyzed for SVOCs and perchlorates on a quarterly basis for one year, April 2003-April 2004.

5.10.2 The first five year review conducted in November 2007, resulted in a reduction from quarterly sampling of the monitoring wells at Area D down to semi-annual sampling beginning Calendar year 2009. Semi-annual collections are to continue in accordance to the current LTOMP. Table 5.10.2.1 below lists the frequency of sampling annually, well

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identifications, and parameters of interest for the monitoring wells associated with area D.

Table 5.10.2.1 – Area D wells

Water Bearing Zone 2 Method Numbers	Area D Well ID Parameters	06-02MW	06-03MW	06-08MW	06-09MW	06-13MW	06-14MW	*06-17MW <small>See below</small>
8260b	VOC	2	2	2	2	2	2	2
150.1	pH	2	2	2	2	2	2	2
SM2550B	Temp	2	2	2	2	2	2	2
SM 2510B	Conductivity	2	2	2	2	2	2	2
SM2580.B	REDOX	2	2	2	2	2	2	2
SM 2320B	Alkalinity	2	2	2	2	2	2	2
360.1	DO	2	2	2	2	2	2	2
180.1	Turbidity	2	2	2	2	2	2	2
SM 2540C	TDS	2	2	2	2	2	2	2
160.2	TSS	2	2	2	2	2	2	2
300	Chloride	2	2	2	2	2	2	2
200.7	Total Phosphorus	2	2	2	2	2	2	2
300	Ortho-Phosphate	2	2	2	2	2	2	2
410.4	Filtered COD	2	2	2	2	2	2	2
410.4	Non Filtered COD	2	2	2	2	2	2	2
2150	Ferrous Iron	2	2	2	2	2	2	2
	Water Level	2	2	2	2	2	2	2

  

Water Bearing Zone 2 Method Numbers	Area D Well ID Parameters	EX-1	EX-2	EX-3	EX-4	EX-5
8260b	VOC	2	2	2	2	2
150.1	pH	2	2	2	2	2
SM2550B	Temp	2	2	2	2	2
SM 2510B	Conductivity	2	2	2	2	2
SM2580.B	REDOX	2	2	2	2	2
SM 2320B	Alkalinity	2	2	2	2	2
360.1	DO	2	2	2	2	2
180.1	Turbidity	2	2	2	2	2
SM 2540C	TDS	2	2	2	2	2
160.2	TSS	2	2	2	2	2
300	Chloride	2	2	2	2	2
200.7	Total Phosphorus	2	2	2	2	2
300	Ortho-Phosphate	2	2	2	2	2
410.4	Filtered COD	2	2	2	2	2
410.4	Non Filtered COD	2	2	2	2	2
2150	Ferrous Iron	2	2	2	2	2

\* 06-17MW was destroyed in 2005 during Hurricane Katrina

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Table 5.10.2.1 (continued) – Area D wells

Water Bearing Zone 3 Method Numbers	Area D Well ID Parameters	06- 11MW	06- 12MW	06- 19MW	06- 20MW
8260b	VOC	2	2	2	2
150.1	pH	2	2	2	2
SM2550B	Temp	2	2	2	2
SM 2510B	Conductivity	2	2	2	2
SM2580.B	REDOX	2	2	2	2
SM 2320B	Alkalinity	2	2	2	2
360.1	DO	2	2	2	2
180.1	Turbidity	2	2	2	2
SM 2540C	TDS	2	2	2	2
160.2	TSS	2	2	2	2
300	Chloride	2	2	2	2
200.7	Total Phosphorus	2	2	2	2
300	Ortho-Phosphate	2	2	2	2
410.4	Filtered COD	2	2	2	2
410.4	Non Filtered COD	2	2	2	2
2150	Ferrous Iron	2	2	2	2
	Water Level	2	2	2	2

## 5.11 Area E Remediation Monitoring

5.11.1 Area E groundwater monitoring consists of the sampling and analysis of eight (8) existing monitoring wells and six (6) extraction wells. Upon start-up of the pump and treat facility in February 2002, all monitoring wells were collected and analyzed. Four of the existing monitoring wells and all extraction wells are located in WBZ-1; four wells are located in WBZ-2. The first five year review, conducted in November 2007, resulted in the addition of 5 monitoring wells to Area E collections; the additional wells are located in WBZ-1.

5.11.2 Quarterly sampling during the remedial duration was conducted under previous LTOMPs. Samples were also analyzed for SVOCs and perchlorates on a quarterly basis for one year, April 2003-April 2004. The existing wells have been reduced to semi-annual monitoring beginning calendar year 2009. The newer wells were implemented in 2009 and collected quarterly through 2010 to obtain baseline data; monitoring was reduced to semi-annually in 2011. Table 5.11.2.1 below lists the frequency of sampling

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annually, well identifications, and parameters of interest for the monitoring wells associated with area E.

Table 5.11.2.1 – Area E Wells

Water Bearing Zone 1 Method Numbers	Area E Well ID Parameters	37-02MW	37-04MW	37-12MW	37-13MW	EX-1	EX-2	EX-3	EX-4	EX-5	EX-6
8260b	VOC	2	2	2	2	2	2	2	2	2	2
150.1	pH	2	2	2	2	2	2	2	2	2	2
SM2550B	Temp	2	2	2	2	2	2	2	2	2	2
SM 2510B	Conductivity	2	2	2	2	2	2	2	2	2	2
SM2580.B	REDOX	2	2	2	2	2	2	2	2	2	2
SM 2320B	Alkalinity	2	2	2	2	2	2	2	2	2	2
360.1	DO	2	2	2	2	2	2	2	2	2	2
180.1	Turbidity	2	2	2	2	2	2	2	2	2	2
SM 2540C	TDS	2	2	2	2	2	2	2	2	2	2
160.2	TSS	2	2	2	2	2	2	2	2	2	2
300	Chloride	2	2	2	2	2	2	2	2	2	2
200.7	Total Phosphorus	2	2	2	2	2	2	2	2	2	2
300	Ortho-Phosphate	2	2	2	2	2	2	2	2	2	2
410.4	Filtered COD	2	2	2	2	2	2	2	2	2	2
410.4	Non Filtered COD	2	2	2	2	2	2	2	2	2	2
2150	Ferrous Iron	2	2	2	2	2	2	2	2	2	2
	Water Level	2	2	2	2	0	0	0	0	0	0

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Table 5.11.2.1 (continued) – Area E Wells

Water Bearing Zone 1 & 2 Method Numbers	Area E Well ID (* newer well) Parameters	WBZ-1	WBZ-1	WBZ-1	WBZ-1	WBZ-1	WBZ-2	WBZ-2	WBZ-2	WBZ-2
		*37-06MW	*37-10MW	*37-11MW	*37-15MW	*37-18MW	37-05MW	37-07MW	37-09MW	37-17MW
8260b	VOC	2	2	2	2	2	2	2	2	2
150.1	pH	2	2	2	2	2	2	2	2	2
SM2550B	Temp	2	2	2	2	2	2	2	2	2
SM 2510B	Conductivity	2	2	2	2	2	2	2	2	2
SM2580.B	REDOX	2	2	2	2	2	2	2	2	2
SM 2320B	Alkalinity	2	2	2	2	2	2	2	2	2
360.1	DO	2	2	2	2	2	2	2	2	2
180.1	Turbidity	2	2	2	2	2	2	2	2	2
SM 2540C	TDS	2	2	2	2	2	2	2	2	2
160.2	TSS	2	2	2	2	2	2	2	2	2
300	Chloride	2	2	2	2	2	2	2	2	2
200.7	Total Phosphorus	2	2	2	2	2	2	2	2	2
300	Ortho-Phosphate	2	2	2	2	2	2	2	2	2
410.4	Filtered COD	2	2	2	2	2	2	2	2	2
410.4	Non Filtered COD	2	2	2	2	2	2	2	2	2
2150	Ferrous Iron	2	2	2	2	2	2	2	2	2
	Water Level	2	2	2	2	2	2	2	2	2

## 5.12 Area F Remediation Monitoring

5.12.1 Area F groundwater monitoring consists of sampling and analysis of nineteen (19) existing monitoring wells and four (4) extraction wells. Monitoring wells are located in WBZ-1 and WBZ-2. The extraction wells are located in WBZ-1. Contaminated groundwater from Area F is transported to the pump and treat facility at B2211. Startup of Area F wells began in June 2004, at which time the wells were sampled. Quarterly sampling was scheduled during the remedial duration for 2 years. The data was evaluated in June 2006, and pumping continued until VOC concentrations leveled off. Quarterly samples were also analyzed for SVOCs and perchlorate during the first year of remediation, from June 2004 – June 2005.

5.12.2 Remediation continued at Area F through the end of 2009, at a reduced sampling frequency of semi-annually. At the end of this period area F entered post-remediation in January 2010 with a reduced sampling frequency of annually. Post remediation will be conducted for a minimum period of 3 years. Sampling data will be evaluated at the end of post-remediation and if acceptable contaminant levels are observed, NASA plans to submit a “No Further Action” (NFA) request and closure for Area F in the near future. Table 5.12.2.1 below lists the frequency of sampling annually, well identifications, and

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parameters of interest for the monitoring wells associated with area F. Those wells highlighted were formerly identified as extraction wells but were converted to retrofitted wells (RW) June 2011 through the removal of well pumps.

Table 5.12.2.1 – Area F Wells

Water Bearing Zone 1 & 2 Method Numbers	Area F Well ID Parameters	WBZ-2 05-09MW	WBZ-2 05-10MW	WBZ-2 05-18MW	WBZ-2 05-19MW	WBZ-1 RW-1	WBZ-1 RW-2	WBZ-1 RW-3	WBZ-1 RW-4
8260b	VOC	1	1	1	1	1	1	1	1
150.1	pH	1	1	1	1	1	1	1	1
SM2550B	Temp	1	1	1	1	1	1	1	1
SM 2510B	Conductivity	1	1	1	1	1	1	1	1
SM2580.B	REDOX	1	1	1	1	1	1	1	1
SM 2320B	Alkalinity	1	1	1	1	1	1	1	1
360.1	DO	1	1	1	1	1	1	1	1
180.1	Turbidity	1	1	1	1	1	1	1	1
SM 2540C	TDS	1	1	1	1	1	1	1	1
160.2	TSS	1	1	1	1	1	1	1	1
300	Chloride	1	1	1	1	1	1	1	1
200.7	Total Phosphorus	1	1	1	1	1	1	1	1
300	Ortho-Phosphate	1	1	1	1	1	1	1	1
410.4	Filtered COD	1	1	1	1	1	1	1	1
410.4	Non Filtered COD	1	1	1	1	1	1	1	1
2150	Ferrous Iron	1	1	1	1	1	1	1	1
	Water Level	1	1	1	1	1	1	1	1

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Table 5.12.2.1 (continued) – Area F Wells

Water Bearing Zone 1 Method Numbers	Area F Well ID Parameters	05-01MW	05-02MW	05-03MW	05-04MW	05-05MW	05-06MW	05-07MW	05-08MW
8260b	VOC	1	1	1	1	1	1	1	1
150.1	pH	1	1	1	1	1	1	1	1
SM2550B	Temp	1	1	1	1	1	1	1	1
SM 2510B	Conductivity	1	1	1	1	1	1	1	1
SM2580.B	REDOX	1	1	1	1	1	1	1	1
SM 2320B	Alkalinity	1	1	1	1	1	1	1	1
360.1	DO	1	1	1	1	1	1	1	1
180.1	Turbidity	1	1	1	1	1	1	1	1
SM 2540C	TDS	1	1	1	1	1	1	1	1
160.2	TSS	1	1	1	1	1	1	1	1
300	Chloride	1	1	1	1	1	1	1	1
200.7	Total Phosphorus	1	1	1	1	1	1	1	1
300	Ortho-Phosphate	1	1	1	1	1	1	1	1
410.4	Filtered COD	1	1	1	1	1	1	1	1
410.4	Non Filtered COD	1	1	1	1	1	1	1	1
2150	Ferrous Iron	1	1	1	1	1	1	1	1
	Water Level	1	1	1	1	1	1	1	1

  

Water Bearing Zone 1 Method Numbers	Area F Well ID Parameters	05-11MW	05-12MW	05-13MW	05-14MW	05-15MW	05-16MW	05-17MW
8260b	VOC	1	1	1	1	1	1	1
150.1	pH	1	1	1	1	1	1	1
SM2550B	Temp	1	1	1	1	1	1	1
SM 2510B	Conductivity	1	1	1	1	1	1	1
SM2580.B	REDOX	1	1	1	1	1	1	1
SM 2320B	Alkalinity	1	1	1	1	1	1	1
360.1	DO	1	1	1	1	1	1	1
180.1	Turbidity	1	1	1	1	1	1	1
SM 2540C	TDS	1	1	1	1	1	1	1
160.2	TSS	1	1	1	1	1	1	1
300	Chloride	1	1	1	1	1	1	1
200.7	Total Phosphorus	1	1	1	1	1	1	1
300	Ortho-Phosphate	1	1	1	1	1	1	1
410.4	Filtered COD	1	1	1	1	1	1	1
410.4	Non Filtered COD	1	1	1	1	1	1	1
2150	Ferrous Iron	1	1	1	1	1	1	1
	Water Level	1	1	1	1	1	1	1

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5.13 Area G Remediation Monitoring

5.13.1 Groundwater monitoring at Area G consists of sampling and analysis of twenty (20) existing monitoring wells and five (5) extraction wells. Monitoring wells are located in WBZ-1 and WBZ-2. All of the extraction wells are located in WBZ-1, except for 31-05EX, which is located in WBZ-2. Contaminated groundwater from Area G is transported to the PTF at B3308. Startup of Area G wells began in June 2004, at which time the wells were sampled. Sampling during the remedial duration was conducted under previous LTOMPs quarterly. Samples were also analyzed for SVOCs and perchlorates on a quarterly basis during the first year of remediation, from June 2004-June 2005. In June 2007 the data was evaluated to determine if VOC concentrations had leveled off. Once leveling of SVOCs was achieved, the natural attenuation process was to take over for an estimated 3 years (post-remediation).

5.13.2 Table 5.13.2.1 below lists the frequency of sampling semi-annually, well identifications, and parameters of interest for the monitoring wells associated with area G.

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Table 5.13.2.1 – Area G Wells

Water Bearing Zone 1 Method Numbers	Area G Well ID Parameters	31-01MW	31-02MW	31-03MW	31-04MW	31-05MW	31-06MW
8260b	VOC	2	2	2	2	2	2
150.1	pH	2	2	2	2	2	2
SM2550B	Temp	2	2	2	2	2	2
SM 2510B	Conductivity	2	2	2	2	2	2
SM2580.B	REDOX	2	2	2	2	2	2
SM 2320B	Alkalinity	2	2	2	2	2	2
360.1	DO	2	2	2	2	2	2
180.1	Turbidity	2	2	2	2	2	2
SM 2540C	TDS	2	2	2	2	2	2
160.2	TSS	2	2	2	2	2	2
300	Chloride	2	2	2	2	2	2
200.7	Total Phosphorus	2	2	2	2	2	2
300	Ortho-Phosphate	2	2	2	2	2	2
410.4	Filtered COD	2	2	2	2	2	2
410.4	Non Filtered COD	2	2	2	2	2	2
2150	Ferrous Iron	2	2	2	2	2	2
	Water Level	2	2	2	2	2	2

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Table 5.13.2.1 (continued) – Area G Wells

Water Bearing Zone 1 Method Numbers	Area G Well ID Parameters	31-07MW	31-08MW	31-10MW	31-11MW	31-12MW	31-01EX	31-02EX	31-03EX	31-04EX	
8260b	VOC	2	2	2	2	2	2	2	2	2	
150.1	pH	2	2	2	2	2	2	2	2	2	
SM2550B	Temp	2	2	2	2	2	2	2	2	2	
SM 2510B	Conductivity	2	2	2	2	2	2	2	2	2	
SM2580.B	REDOX	2	2	2	2	2	2	2	2	2	
SM 2320B	Alkalinity	2	2	2	2	2	2	2	2	2	
360.1	DO	2	2	2	2	2	2	2	2	2	
180.1	Turbidity	2	2	2	2	2	2	2	2	2	
SM 2540C	TDS	2	2	2	2	2	2	2	2	2	
160.2	TSS	2	2	2	2	2	2	2	2	2	
300	Chloride	2	2	2	2	2	2	2	2	2	
200.7	Total Phosphorus	2	2	2	2	2	2	2	2	2	
300	Ortho-Phosphate	2	2	2	2	2	2	2	2	2	
410.4	Filtered COD	2	2	2	2	2	2	2	2	2	
410.4	Non Filtered COD	2	2	2	2	2	2	2	2	2	
2150	Ferrous Iron	2	2	2	2	2	2	2	2	2	
	Water Level	2	2	2	2	2	0	0	0	0	
Water Bearing Zone 2 Method Numbers	Area G Well ID Parameters	31-13MW	31-14MW	31-15MW	31-16MW	31-17MW	31-18MW	31-19MW	31-21MW	31-22MW	*31-05EX
8260b	VOC	2	2	2	2	2	2	2	2	2	2
150.1	pH	2	2	2	2	2	2	2	2	2	2
SM2550B	Temp	2	2	2	2	2	2	2	2	2	2
SM 2510B	Conductivity	2	2	2	2	2	2	2	2	2	2
SM2580.B	REDOX	2	2	2	2	2	2	2	2	2	2
SM 2320B	Alkalinity	2	2	2	2	2	2	2	2	2	2
360.1	DO	2	2	2	2	2	2	2	2	2	2
180.1	Turbidity	2	2	2	2	2	2	2	2	2	2
SM 2540C	TDS	2	2	2	2	2	2	2	2	2	2
160.2	TSS	2	2	2	2	2	2	2	2	2	2
300	Chloride	2	2	2	2	2	2	2	2	2	2
200.7	Total Phosphorus	2	2	2	2	2	2	2	2	2	2
300	Ortho-Phosphate	2	2	2	2	2	2	2	2	2	2
410.4	Filtered COD	2	2	2	2	2	2	2	2	2	2
410.4	Non Filtered COD	2	2	2	2	2	2	2	2	2	2
2150	Ferrous Iron	2	2	2	2	2	2	2	2	2	2
	Water Level	2	2	2	2	2	2	2	2	2	0

\* 31-05EX is the only extraction well in Water Bearing Zone 2

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5.14 Pump and Treat Operational Monitoring

5.14.1 The pump and treat facilities are monitored for performance on a weekly, monthly and quarterly basis. The evaluations are necessary to assess the performance of the systems. Carbon filters must be monitored for effectiveness and changed out when necessary. The data collected from the laboratory is essential to the decision-making processes and proper maintenance of the systems.

5.14.2 Once a month a calibration of the pH meters at each facility is performed and documented. A copy of the calibration data is forwarded to FOSC Environmental for their records. Area B (B2211) has four probes that are calibrated monthly as does Area E (B3308). Areas C (B2208) and D (B 2413) each have two probes requiring monthly calibrations. Please note that in July 2007 area D building number 2418 was changed to building number 2413.

5.14.3 Hydrogen Peroxide pumps are calibrated for Area B (B2211) and area E (B3308) on a semi-annual basis; once in April and once in October.

5.14.4 Samples for operational monitoring will be collected at frequencies indicated in the following tables or at frequencies directed by NASA Environmental Management depending on the need to collect baseline data/establish trends and evaluate system performance.

5.14.5 Weekly operation system sampling is outlined in Table 5.14.5.1.

Table 5.14.5.1

Weekly Sample Points - B2211, B2208, B2413, B3308	Parameters	Frequency	Duration
Effluent for all (after secondary Carbon)	VOCs	Weekly (52 sampling events)	**

\*\*per LTOMP provided in techdoc per FOSC contractor

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5.14.6 Monthly operation system sampling for B2211 and B3308 is outlined in Table 5.14.6.1.

Table 5.14.6.1

Monthly Sample Points B2211 and B3308	Parameters	Frequency	Duration
Influent 1 (EQ Tank)	COD, TOC, VOCs	Monthly	**
Influent 2 (before UV)	COD, VOCs	Monthly	**
Before Primary Carbon (after UV)	COD, VOCs	Monthly	**
Between Carbons 1 and 2	COD, VOCs	Monthly	**
Effluent (after secondary Carbon)	COD, VOCs	Monthly	**
Monthly Sample Points B2208 and B2413	Parameters	Frequency	Duration
Influent 1 (EQ Tank)	COD, TOC, VOCs	Monthly	**
Influent 2 (before UV)	COD, VOCs	Monthly	**
Between Carbons 1 and 2	COD, VOCs	Monthly	**
Effluent (after secondary Carbon)	COD, VOCs	Monthly	**

\*\* per SPLN-8500-0088-ENV Revision B December 2013

5.14.7 Quarterly operation system sampling is outlined in Table 5.14.7.1.

Table 5.14.7.1

Quarterly Sample Points ***B2211 and B3308	Parameters	Frequency	Duration
Influent 1 (EQ Tank)	VOCs, *Metals & Water Quality	Quarterly	**
Influent 2 (before UV)	VOCs, *Metals & Water Quality	Quarterly	**
Before Primary Carbon (after UV)	VOCs, *Metals & Water Quality	Quarterly	**
Between Carbons 1 and 2	VOCs, *Metals & Water Quality	Quarterly	**
Effluent (after secondary Carbon)	VOCs, *Metals & Water Quality	Quarterly	**
Quarterly Sample Points B2208 and B2413	Parameters	Frequency	Duration
Influent 1 (EQ Tank)	VOCs, *Metals & Water Quality	Quarterly	**
Influent 2 (before UV)	VOCs, *Metals & Water Quality	Quarterly	**
Between Carbons 1 and 2	VOCs, *Metals & Water Quality	Quarterly	**
Effluent (after secondary Carbon)	VOCs, *Metals & Water Quality	Quarterly	**

- \* Metals & Water Quality parameters are outlined in Table 5.14.7.2.
- \*\* per SPLN-8500-0088-ENV Revision B December 2013
- \*\*\*Additional analytes are determined quarterly for area B / B2211 and are outlined in Table 5.14.7.3.

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Table 5.14.7.2

Metals for Pump and Treat Monitoring - All Areas Method Numbers	Metals
200.7 / 200.8 / 200.9	Target Analyte List
	Iron (soluble/insoluble)
	Manganese (soluble/insoluble)
	Hardness
Water Quality for Pump and Treat Monitoring - All Areas Method Numbers	Parameter
150.1	pH
SM2550B	Temperature
120.1	Conductivity
SM 2580 B	Redox potential
310.2	Alkalinity
360.1	Dissolved Oxygen
180.1	Turbidity
160.1	TDS
160.2	TSS
300	Chloride
200.7	Total Phosphorus
300	Orthophosphate
410.1	COD (soluble/insoluble)
2150	Ferrous Iron
415.1	TOC*

Table 5.14.7.3

Additional Quarterly Analytes for Area B / B2211 Method Numbers	Parameters
405.1	BOD
QUALITATIVE	Methane
QUALITATIVE	Ethane
8260B	Ethylene
Std. Method 4500-S2F	Sulfides
300	Nitrates

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5.15 Building 3202

In the fall of 2011 NASA completed a remedial investigation of a PCB release near B3202. The PCB site was determined to have localized contamination. The remedy included the removal and proper disposal of contaminated soil, which was conducted in March 2013. The remedial objective was to remove soils that contained levels of Aroclor 1260 (a toxic component in PCBs) in excess of the proposed remediation level (PRL) of 1.28 parts per million (ppm). Confirmation soil sampling conducted after the soil excavation indicated that although total PCB levels were acceptable, the level of Aroclor 1260 in some subsurface soil samples (4-5 feet below ground surface) slightly exceeded the PRL near the southwest corner of B3202. Currently, this part of the building contains a transformer (non-PCB) room that is walled-off and isolated from the rest of the building. The electrical equipment in the room is only accessed during occasional maintenance activities and therefore falls under 40 CFR §761.3.

5.15.2 After the contaminated soils were removed, PermeOx was applied to the shallow groundwater to stimulate active bioremediation of volatile organic compounds (VOCs) detected in groundwater "hotspot" areas. It is believed that by removing the source area soil and aggressively treating the groundwater as described, contaminant values will be low enough for the site to be considered for MNA. Baseline groundwater data will be collected for two years (2013-2015) and evaluated to determine the effectiveness of the treatment and whether or not groundwater remediation for VOCs is warranted.

5.15.3 Groundwater monitoring at B3202 consists of sampling six monitoring wells all of which are located in WBZ-1 as listed in Table 9. Wells 3202-01MW through 3202-05MW were installed on 4/29/13. Well 3202-06MW was installed on 11/15/13 as requested by MDEQ to monitor groundwater down gradient of the contaminant area.

Required Sampling at 3202 PCB site

<b>Table 9</b>			
<b>B3202/PCB Site Sampling Summary</b>			
<b>Well</b>	<b>Analysis</b>	<b>Frequency</b>	<b>Timeframe</b>
3202-01MW	VOCs	Quarterly	2013 - 2015
3202-02MW			
3202-03MW			
3202-04MW			
3202-05MW			
3202-06MW			