INTEGRATED CONTINGENCY PLAN (ICP) AND STORMWATER POLLUTION PREVENTION PLAN (SWP3) TRAINING

2018

ICP/SWP3 - Agenda

- Safety Topics
- Laws and Regulations
- Integrated Contingency Plan (ICP)
- Storm Water Pollution Prevention Plan (SWP3)
- WFF's Environmental Management System (EMS)

Laws and Regulations

- Federal
  - Clean Water Act – 1972 - Wastewater
  - Oil Pollution Act (OPA) – 1990 – Big Spill
  - Resource Conservation and Recovery Act (RCRA) – 1976 Hazardous Waste
- State DEQ regs

Why have an Integrated Contingency Plan?

- >1,320 gallons aboveground oil storage.
- As of January 2018, WFF has over 200,000 gallons of fuel in aboveground storage and over 300,000 gallons total for all petroleum products.

ICP Applies To

Any container ≥ 55 gallons which contains oil

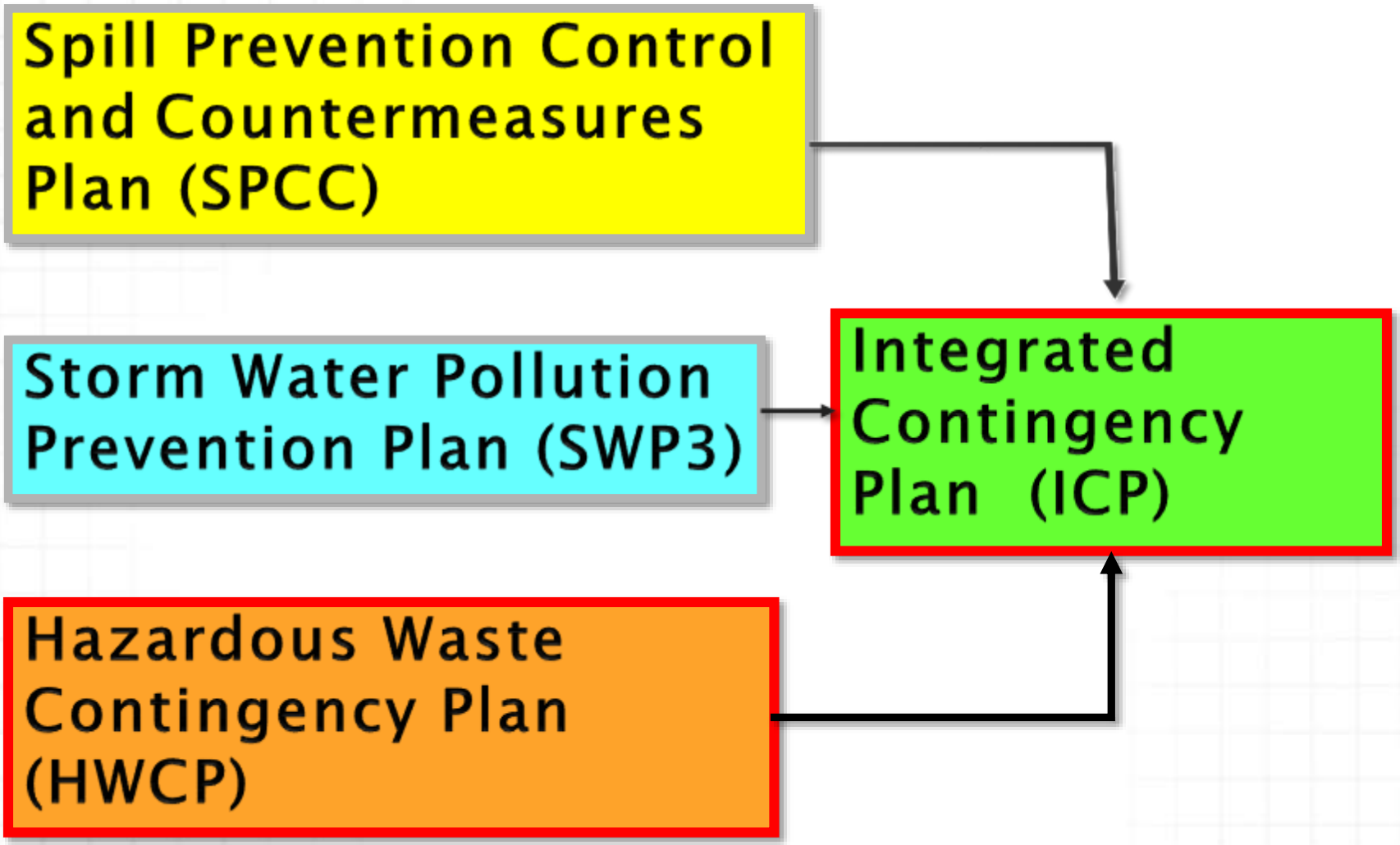
This includes:

- Drums
- Tanks (aboveground and underground)
- Transformers
- Mobile Re-fuelers when parked
- Other oil storing equipment

ICP Overview

- Goal to:
  - Minimize hazards to humans and the environment from any release of oil or hazardous substance at WFF
- Coordinates efforts with:
  - WFF personnel
  - Local fire and police departments
  - Outside contractors
  - Department of Environmental Quality (DEQ)
  - Environmental Protection Agency (EPA)

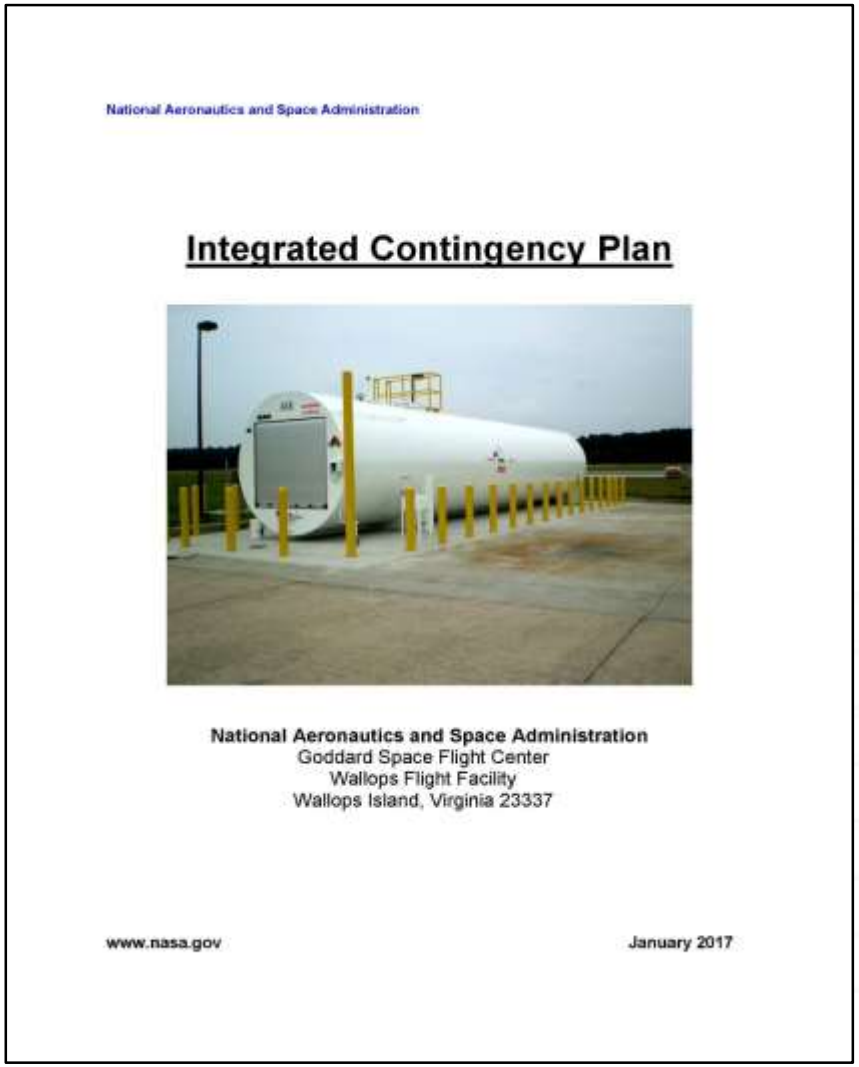
ICP Overview



2018 Edition

Available at:

http://sites.wff.nasa.gov/code250



National Aeronautics and Space Administration

Integrated Contingency Plan

National Aeronautics and Space Administration
Goddard Space Flight Center
Wallops Flight Facility
Wallops Island, Virginia 23337

www.nasa.gov

January 2017

CALL 911

Emergency Contacts for WFF

IN CASE OF A SPILL, FIRE OR EXPLOSION AT THIS FACILITY, CALL 911 IF ON-SITE, OR CALL 757-824-1333 IF OFF-SITE

EMERGENCY PHONE NUMBERS

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)
GODDARD SPACE FLIGHT CENTER (GSFC)
WALLOPS FLIGHT FACILITY (WFF)
WALLOPS ISLAND, VIRGINIA 23337

On-Site Phone Numbers:

EMERGENCY DIAL 911 757-824-1333 (for mobile phones or when off-site)

Emergency Coordinators:

Member	Facility Phone	After Hours Phone	Radio Page
Captain On-Duty	911	911	Fire Dispatch
Fire Station #1	911	911	Fire Dispatch
Fire Station #2	911	911	Fire Dispatch

Environmental Coordinators:

Member	Facility Phone	Mobile Phone	Home Address
Theodore J. Meyer, Associate Chief (Code 250) Medical & Environmental Division	Ext. 1987	(443) 366-2268	30170 Providence Drive Salisbury MD 21804
R. Owen Hooks, Environmental Engineer (Code 250)	Ext. 1941	(443) 523-2697	31490 Shavox Rd. Salisbury, MD 21804

Off-Site Phone Numbers:

National Response Center	800-424-8802
U.S. Environmental Protection Agency Region 3 Office	215-814-5000
	800-438-2474
Virginia Department of Environmental Quality Tidewater Regional Office – Main Number	757-518-2000
Virginia Department of Emergency Management (24 hours)	800-468-8892
Eastern Shore Hazardous Material Response Team	911
Virginia Hazardous Material Coordinator	757-363-3891

ICP Table of Contents

1. Plan Administration
2. Facility Description & Bulk Storage Container Information
3. Discharge Prevention
4. Discharge Response Equipment and Training
5. Spill Countermeasures
6. Worst Case Scenerio
7. Facility Inspections, Tests, and Records
8. Integrated Contingency Plan Deviations

ICP Appendices

Appendix A	Certification of the Applicability of the Substantial Harm Criteria
Appendix B	Wallops Flight Facility Site Maps
Appendix C	Underground Storage Tanks and Oil Storage Summaries
Appendix D	Tank and Potential Discharge Data
Appendix E	Hazardous Waste Accumulation Areas and Evacuation Routes
Appendix F	Controlled Drainage Discharge Log
Appendix G	Supplies and Equipment Inventory of Spill Response
Appendix H	Sample Incident Plan / Briefing
Appendix I	Incident Report Form and Follow-up Report Template
Appendix J	Decontamination of Emergency Equipment
Appendix K	Spill Response Contractors and Agreements
Appendix L	Sample Training Certificate
Appendix M	Site Inspection Checklists
Appendix N	Safety Data Sheets
Appendix O	Storage Tank Piping Diagrams
Appendix P	Storm Water Pollution Prevention Plan
Appendix Q	Fuel Delivery Standard Operating Procedures

Storage Tanks

- Outdoor Aboveground Fuel Tanks

D-9A&B

D-1

Rentals

D-50

F-26

Storage Tanks

- Indoor Aboveground Fuel Tanks

NOAA

Mobile Generator

V-3

Z-62

Storage Tanks

- Underground Storage Tanks
- Oil Filled Equipment

R-30

N-161

MARS Pad 0-A

Oil-Filled Containers

E-2

N-223

- Containers with 55 gallon capacity or greater
- Includes cooking oil

Storage Tanks

Large Spill Kit
(95-gallon spill kit absorbs up to 63 gallons; neon green color for high visibility and a snap on lid for easy access)

Anti-Siphon Valve
(Prevents fuel from exiting tank if a line is broken or leaking)

Spill Basket
(Used to catch any fuel that spills during filling of the tank)

Long Bolts on Manway Opening
(The long bolts allow the manway cover to lift up and relieve pressure in the tank)

Tank Grounding System
(Used to discharge the tank in the event of a charge build up from lightning)

Adequate Lighting
(There should be adequate lighting 24 hours a day so that any individual can easily see if the tank is leaking or if a spill has occurred)

Neoprene Rubber Piping
(Needs to be replaced due to dry rotting and rubbing against objects)

Seal Concrete Dike
(The concrete dike must be sealed liquid-tight to prevent any fuel contamination in the event of a leaking tank)

Storage Tanks

Replace Plastic Travel Cap with Painted Steel Cap
(Plastic will degrade in the presence of petroleum and needs to be replaced with steel cap)

Spill Basket Lock
(Placed on all tanks to prevent individuals from stealing or contaminating the fuel)

Driver Delivery Signs
(Present by all tanks and must be visible for the fuel delivery driver)

Proper Tank Identification
(Present on all tanks and must be visible for the fuel delivery driver; to verify proper tank identification please contact WFF Environmental Office)

Tank Capacity and Inches Signs
(Present on all tanks and must be visible for the fuel delivery driver; to verify proper capacity and inches please contact WFF Environmental Office)

No Smoking Signs
(Present on all tanks and must be visible for the fuel delivery driver)

Label Piping
(Helpful in the event of a leaking pipe or during pipe maintenance)

NFPA Label
(Present on all visible sides of the tank; color coded, numerical system for indicating the health(B), flammability(R), reactivity hazards(Y), and special precautions (W); 4 is extreme and 0 is minimal)

Vehicle Fueling

- No Smoking. Turn off engine. Leave electronic devices in vehicle. Discharge static electricity before fueling. If a fire starts, use the emergency stop button (ESTOP) to stop pumping fuel.
- Do not leave pump unattended when in use.

Fuel Deliveries

- Shut off engine unless used for transfer operation.
  - Set brakes, chock wheels prior to fuel transfers.
    - Check for sorbent material in delivery truck.
      - Protect adjacent storm drains.
- Perform bonding/grounding prior to fuel transfers, if necessary.
  - Use drip pails below hose connections.
    - No smoking during fuel transfers.

Fuel Deliveries

- Confirm that the tank or vehicle being filled can accept delivered volume.
- Maintain an unobstructed view of cargo tank and hose at all times.
- Inspect delivery vehicle for leaks prior to loading and prior to vehicle departure.
- Verify complete disconnect of hoses and bonding / grounding prior to removal of wheel chocks.

Fuel Deliveries

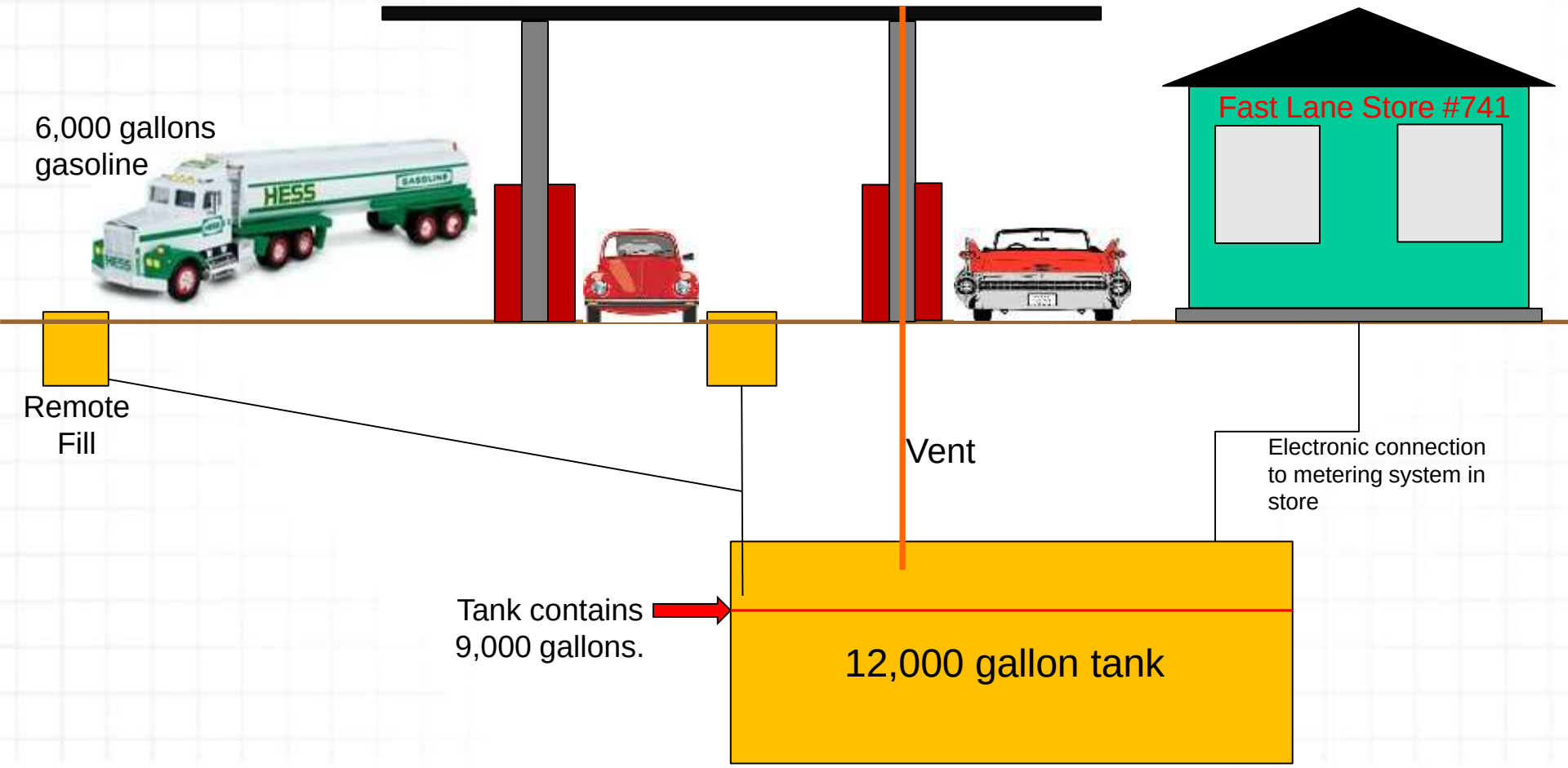
Before Fueling

Fuel Deliveries

Fuel delivery drivers AND tank owners are responsible for spill prevention.

2016 – Rt. 90 and Brady Drive in Biloxi, MS.

Filling Station Design



Disaster waiting to happen…

Why Should You Care?

Discharges

- Immediately notify the WFF Fire Department. Use internal fire alarm if available.
- Eliminate potential spark sources.
- Stop the flow.
- Contain the liquid with sorbent booms, etc.
- Debris from cleanup containerized properly.
- The FD and EO will complete applicable incident reports.
- Environmental Coordinator makes appropriate notifications of a reportable discharge:
  - Spreads beyond the immediate discharge area;
  - Enters water or has the potential to enter the water;
  - Spreads beyond WFF boundaries;
  - Requires special equipment or training to clean up;
  - Poses a hazard to human health or safety; or
  - There is a fire or explosion or the danger that one may occur.

Waters of Virginia

"The discharged material enters water or has the potential to enter the water" applies to:

Surface Waters

Groundwater

Wetlands

Storm sewer systems

Refugio State Beach, California May 18, 2015

- Crystal Clear Water
- Incredible Waves
- Beautiful Scenery
- Exceptional Wildlife Viewing

Refugio State Beach California May 19, 2015

An estimated 20,000-100,000 gallons (less than 1% of Valdez spill) of crude oil spilled from a broken pipeline, pouring into the ocean for several hours. Two separate oil slicks covered nine miles of coastline in widths up to four miles.

Wallops Island Launch Pad OA

One tank at WFF containing 30,000 gallons of RP-1 (kerosene) is located just a few hundred feet from the Atlantic Ocean and over 300,000 gallons of petroleum products total at WFF.

Be safe, be alert, and report spills or concerns ASAP!

Refugio State Beach, California

May 20, 2015

Clean up by hundreds of volunteers and government employees took approximately two months

July 17, 2015

Countermeasures

Countermeasures to contain and divert spills from entering waters of the Commonwealth of Virginia include the following:

- Elimination of the source of the spill (i.e., shutting valves, banding piping, plugging ruptured tanks, etc.);
- Strategic placement of sorbent materials around or on top of spilled material;
- Placement of booms around proximate storm drain inlets and sanitary sewer manholes; and
- Construction of earthen dikes in the immediate area or downstream of the spill.

Note: Procedures can be found in Section 5

Protect Storm Drains

Call 911

Countermeasures

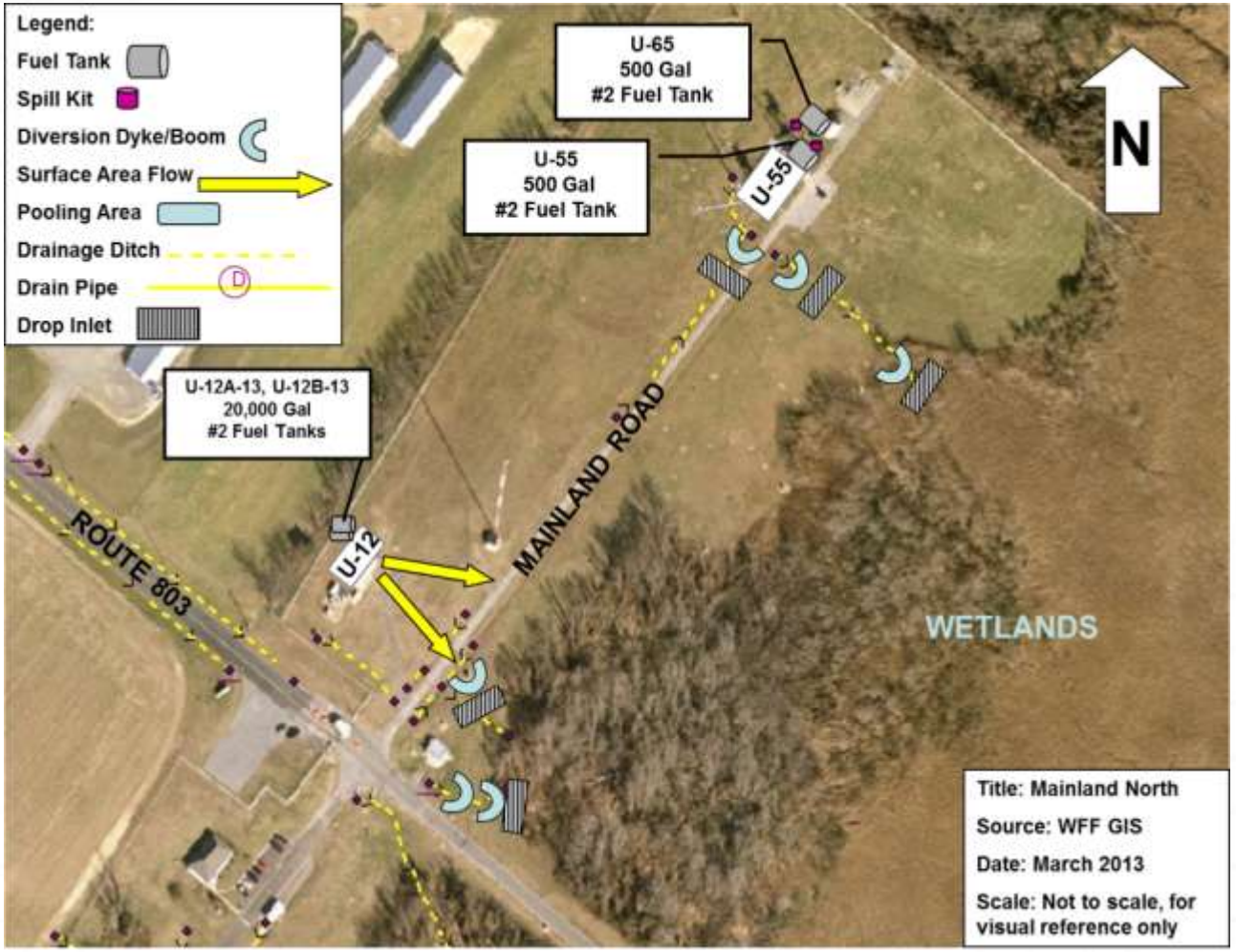
Worst Case Scenario

Spill Drill Exercise

Note: Worst Case Scenerios are described in Section 6.

Countermeasures

Incident Briefing Plans



Note: Incident Briefing Plans can be found at the WFF Fire Department.

Weekly AST Inspection

Daily & Weekly Inspection is required for:

D-1

D-9A

D-9B

F-26-1A

F-26-1B

U-12A&B

MARS 33

Note: Procedures found in Section 7.

Forms found in Appendix M.

WEEKLY INSPECTION FORM
ABOVEGROUND STORAGE TANK SYSTEMS:

Facility: Goddard Space Flight Center
Wallops Flight Facility
Wallops Island, Virginia 23337

Date: _____
Completed By: _____
Company: _____

SYMBOLS: Y – Yes N – No S – Satisfactory U – Unsatisfactory NA – Not Applicable
D – Diesel Oil J – Jet Fuel MO – Motor Oil UO – Used Oil

ITEM	CONDITIONS	COMMENTS(1)	REFERRED TO
TANK ID: _____			
Tank Condition			
Support Condition			
Staining on concrete or adjacent surfaces			
Tank area clear of debris			
Secondary containment free of oil, water and debris			
AST label appropriate and legible (not faded)			
Threaded fill caps kept closed when not in use			
Evidence of fuel spillage at remote fill and/or direct fill			
Fuel leaks visible on top of the tank or from piping			
Fuel gauge functioning properly			
All vent systems operational			
Status of spill kit supplies			
Is corrosion (rust) present on exterior surface of tanks, fittings or other equipment?			

(1) Provide comments below or attach additional sheets as necessary. Be sure to note the item you are commenting on.

_____
_____
_____

KEEP ON FILE FOR FIVE (5) YEARS.
MAKE AVAILABLE TO REGULATORY PERSONNEL UPON REQUEST.

Daily AST Inspection

Daily Inspections are required for D-9A/B tanks. Inspection records maintained by plant operations office.

Inspectors receive on-the-job training and utilize the Daily Inspection Checklist (available in Bldg. D-8) to perform inspections.

Month:

Year :

Daily Inspection Checklist
Aboveground Storage Tanks D-9A, D-9B

Instructions:

- The person conducting the daily visual inspection must also complete this log.
- Check (√) box if ok. For problems, **X** box and explain on the reverse.
- Describe any event, (spills, cracked or compromised containment, non-functional safety equipment, etc.) and corrective actions on the reverse.
- Report spills or leaks to 1333 immediately.

Day	Inspector	Time	Walk-through of the facility indicated no hazardous conditions exist	Inspection of ground surface showed no signs of leakage, spillage, or discolored soils	Inspection of piping, valves, and flanges showed no signs of leakage	Inspection of exterior tank showed no signs of leakage	Containment checked for excessive accumulation of water or sheen; Controlled Drainage Discharge Log completed if drained	Comment: **X** box and explain on reverse.
1								
2								
3								
4								
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6								
7								
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30								
31								

Comments, Observations and Corrective Action Taken: Describe the actions taken to correct each deficiency noted above, and note date each action was taken.

Monthly AST Inspection

Monthly Inspection is required for all aboveground storage tanks.

MONTHLY ABOVEGROUND STORAGE SYSTEM INSPECTION CHECKLIST				
Building Number	**Tank Number**	**Facility Name/Address**	**Inspected By**	**Date**
Were any issues found? Circle: YES or NO			**Was Task Order issued? Circle: YES or NO**	

CATEGORY	DESCRIPTION		
TANK COMPONENTS		**Y, N, or N/A**	**COMMENTS**
Condition of Tank	Is paint in good shape?		
	Is concrete pad or dike in good condition?		
	Does tank have adequate vehicle protection?		
Overfill Prevention	Does the tank have an overfill alarm and is it working properly?		
	Is the tank equipped with a functioning overfill prevention valve?		
Tank Gauge	Is the tank gauge legible, accurate, and working properly?		
Tank Ladders or Stairs	Is the tank ladder or stairs in good condition?		
Secondary Containment	Is the secondary containment area dry? (Interstitial or Concrete Dike)		
Interstitial Leak Detection	Have the leak sensors been physically activated/tested? (Remove leak sensor and physically raise the rod. Should perform once annually. Place date completed within comments.)		
Concrete Containment	Are the drain holes free of debris?		
Leaks	Is the tank area clean with no evidence of any leaks or spills? (Wipe areas clean.)		
Tank Saddles	Are the saddles in good condition with no evidence of corrosion where the tank meets the tank saddles?		
Vent	Are the primary and emergency vents unrestricted and working properly?		
Signage	Does the tank have proper signage: Hazard Diamond, Product, Working and Design Capacity, Deliver Driver Instructions, and Tank Number?		
TANK FILL AREA		**Y, N, or N/A**	**COMMENTS**
Spill Containment Manhole (Spill Bucket)	Is the spill bucket free of dirt, trash, water, or product?		
Fill Pipe	Is the fill cap in good condition, seals tightly, and locked?		
Spill Kit	Is the spill kit in place and properly stocked?		
PIPING		**Y, N, or N/A**	**COMMENTS**
Condition of Piping	Is paint in good shape and no corrosion present?		
Support	Is the piping properly supported?		
Leaks	Are there visible stains or leaks present? (All stains should be wiped clean.)		

Instructions: If certain equipment is not required and/or not present, make a notation in the "COMMENTS" column. Describe the issues in the "COMMENTS" section and notify the appropriate person to request a task order be issued.
ADDITIONAL COMMENTS:

Monthly Drum Inspection

Monthly inspection is required for all 55 gallon drums.

MONTHLY INSPECTION FORM
DRUM STORAGE AREA

Facility: Goddard Space Flight Center
Wallops Flight Facility
Wallops Island, Virginia 23337

Date: _____
Completed By: _____
Company: _____

ITEM	CONDITIONS	COMMENTS(1)	REFERRED TO
DRUM STORAGE AREA _____			
Containment area conditions			
Labels appropriate and legible			
Staining on concrete floor – evidence of leaks/spills			
Adequate spill kit supplies			

(1) Provide comments below or attach additional sheets as necessary. Be sure to note the item you are commenting on.

_____
_____
_____
_____
_____
_____
_____
_____

KEEP ON FILE FOR FIVE (5) YEARS.
MAKE AVAILABLE TO REGULATORY PERSONNEL UPON REQUEST.

Quarterly Transformer Inspection

Quarterly inspection is required for all transformers, including those in storage.

WFF Integrated Contingency Plan					**37.01.01.16402**			
	REQUIRED QUARTERLY INSPECTION FORM FOR TRANSFORMER TANKS							
Facility:	**Goddard Space Fight Center**		**Month:**					
	Wallops Flight Facility		**Completed By:**					
	Wallops Island, Virginia 23337		**Company:**	**LJT & ASSOCIATES**				
CREW	SWITCH / XFMR #	OIL CAPACITY FROM NAME PLATE (GAL)	IS THERE ANY OIL LEAKING FROM TANK	EQUIP CONDITION / NEW / GOOD / NEEDS REPAIR / NEEDS TO BE REPLACE	HAS OIL SAMPLE BEEN TAKEN FROM XFMR	HAS PM BEEN PERFORMED ON XFMR/SWITCH	DID YOU PLACE RODENT CONTROL	NOTE ANY REPAIRS NEEDED
	MAINBASE CIRCUIT 2							
	S/S 2A3							
	TR-F-3-1 112.5 KVA TRANSFORMER	195						
	TR-F-4 & F-5 150 KVA TRANSFORMER	184						
	MAINBASE CIRCUIT 3							
	S/S 3B1							
	TR-F007 225 KVA TRANSFORMER #1	137						
	S/S 3A6							
	TR-F010-4 500 KVA TRANSFORMER	191						
	S/S 3A6							
	TR-F011-1 & F009 & WELL 75 KVA XFMR	146						

Inspections

In the Event of an Emergency

For ALL spills and releases, notify the

Wallops Fire Department at:

Ext. 911

or

757-824-1333

(if using a mobile phone)

In the Event of an Emergency

Jet fuel tank at D-1 transfers fuel at over 2 gallons/second.

High level alarms can malfunction.

Being aware of capacities and flow rate alleviated a potential release.

Reporting a Spill

Provide:

Time of spill

Location of spill

Type/name of material spilled

Estimated quantity

Status of spill

Cause of spill

Name and code of reporting party

OB Area Contingency Plan

Identify all sources of groundwater contamination

- Operations – ejected fuel
- Non operations – vehicle leak
- Emergency – fire fighting water
- Groundwater monitoring – spill into open well

In the event of an emergency at the Open Burn Area:

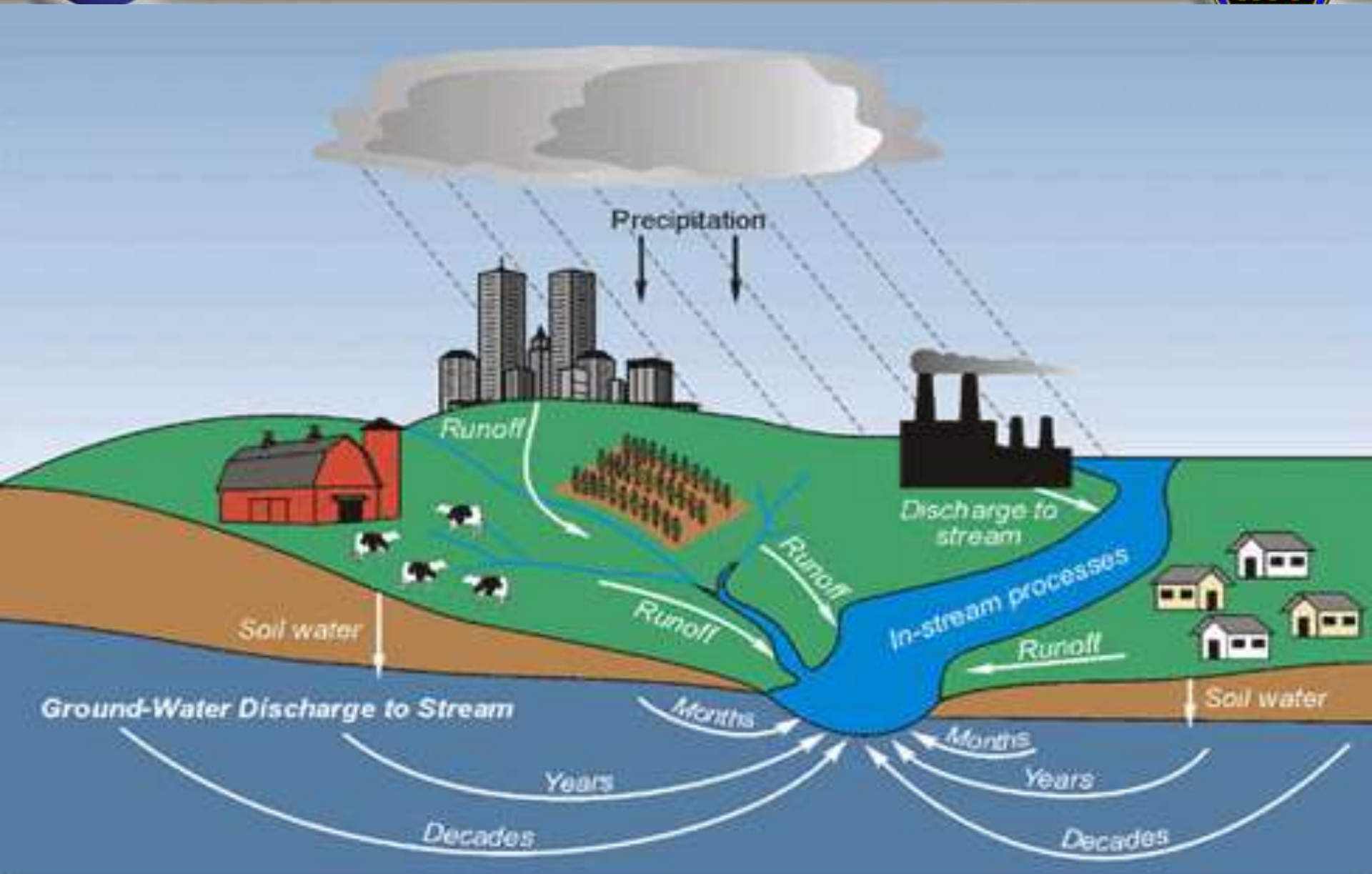
- Evacuate the area
- Spread the alarm verbally
- Call 911

SWP3

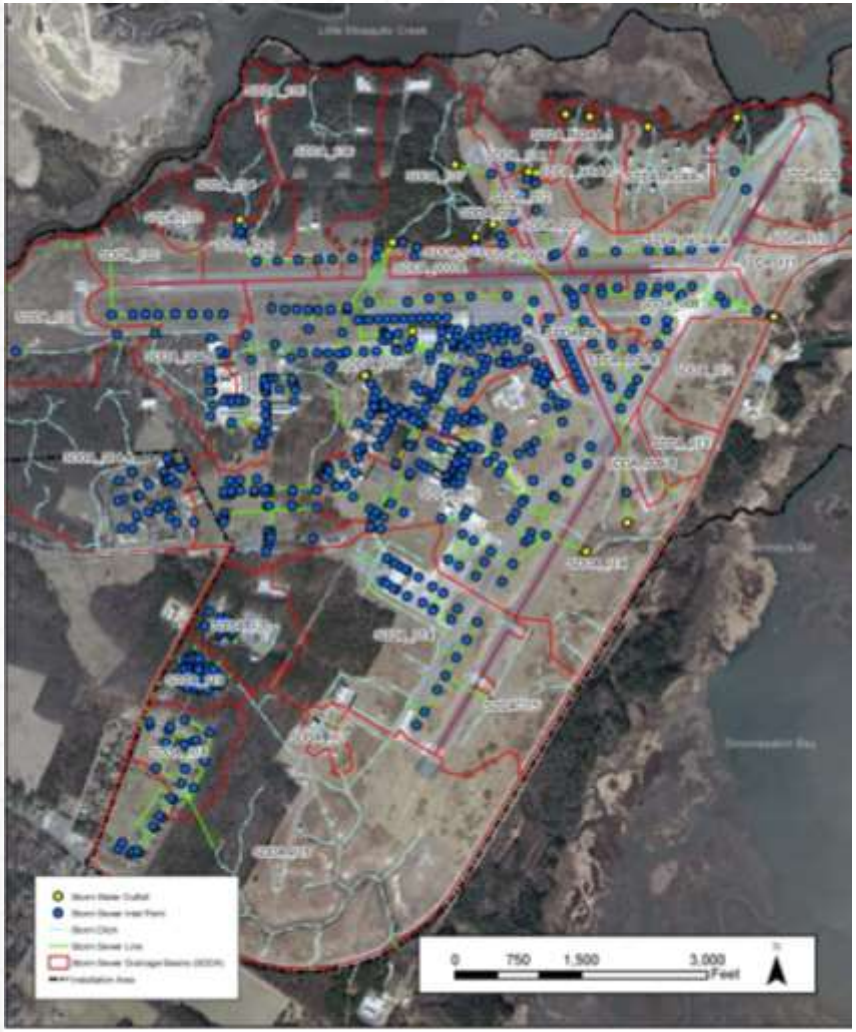
The Stormwater Pollution Prevention Plan (SWP3):

- Is required by the Virginia Pollutant Discharge Elimination System (VPDES) permit
- Goal is to minimize the potential pollutants which could be carried away in stormwater discharge.

Sources of Pollutants



Main Base Drainage Features



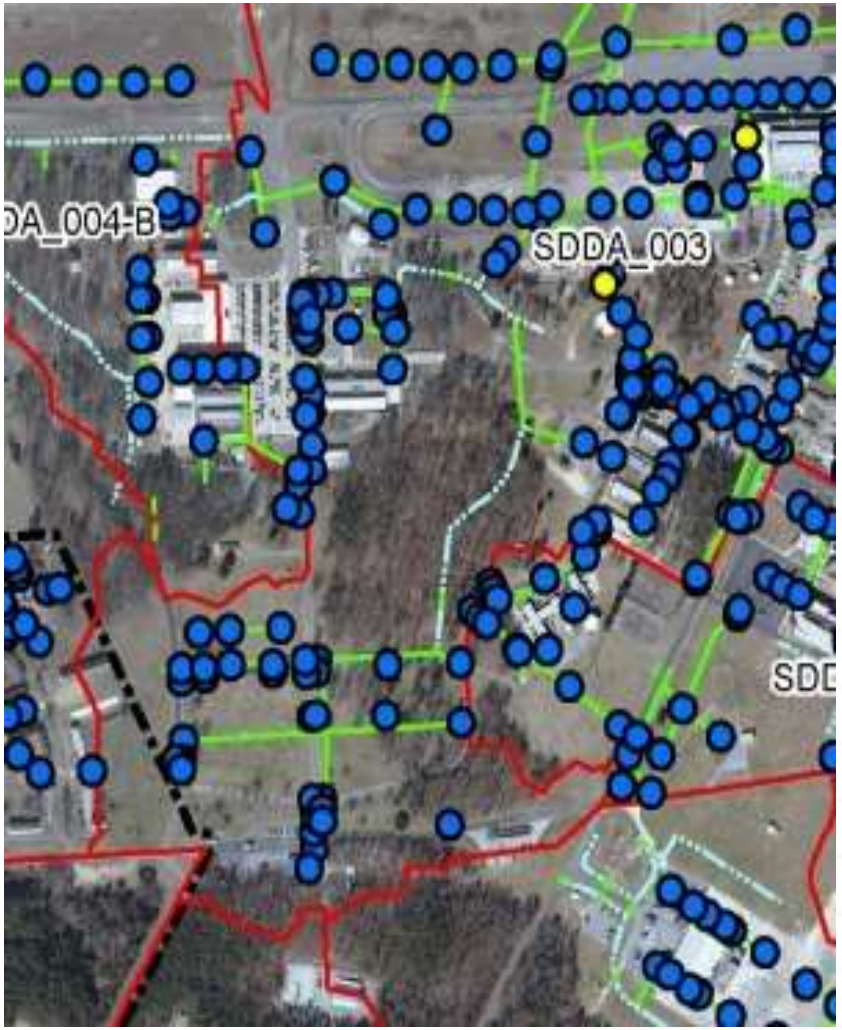


Figure B.3.1 WFF Main Base Drainage Features

Mainland and Island Drainage Features

Potential Pollutant Sources

Activities at WFF Addressed in SWP3:

- Petroleum Storage
- HW Accumulation Areas
- WFF Section 313 Water Priority Chemicals
- Vehicle Maintenance Facility
- Aircraft Runways
- Rocket Motor Storage Areas
- Environmental Areas of Concern
- Outdoor Drum Storage Areas
- Construction/Land Clearing
- Launch Support

BMP HW and Petroleum

Hazardous Waste Accumulation, Petroleum Storage, Drum Storage

- Store 55 gallon containers on secondary containment
- Attend ICP/SWP3 Training
- Complete monthly drum or HW inspection
- Limit outdoor storage of all containers and materials including materials such as scrap metal which may have residual oil
- Use good housekeeping practices (clean-up small spills, sweep-up and containerize spill material and metal shavings, pick up trash, etc.)

WFF Section 313 Chemicals Water Priority Chemicals

WFF reports for Section 313 Water Priority Chemical Lead and Lead Compounds

- Lead sheet metal – F10 Machine Shop
  - Separately containerize scrap indoors
  - Notify Environmental of machine and cutting fluid where lead was machined
- Lead Solder – WFF
  - Keep solder scraps properly contained in HW container
  - Call Environmental for a pick-up when full
- Rocket motor propellant
  - Containerize ejected propellant, label and store in Satellite Accumulation Area

BMP Vehicle Maintenance

Preventive maintenance

Sorbent pads while working

Cover storm drains during outdoor repairs

BMP Equipment Washing

Management of Runoff

Wash oversize vehicles only at the D-1 Hangar Wash Rack

BMP Aircraft Runways

- Inspecting fuel delivery trucks
- Training
- Covering storm drains when fueling
- Sweeping and vacuuming of runways – FOD removal
- Grass buffers between runways and drop inlets

Stormwater and the Construction Industry

Protect Natural Features

- Minimize clearing.
- Minimize the amount of exposed soil.
- Identify and protect areas where existing vegetation, such as trees, will not be disturbed by construction activity.
- Protect streams, stream buffers, wild woodlands, wetlands, or other sensitive areas from any disturbance or construction activity by fencing or otherwise clearly marking these areas.

Construction Phasing

- Sequence construction activities so that the soil is not exposed for long periods of time.
- Schedule or limit grading to small areas.
- Install key sediment control practices before site grading begins.
- Schedule site stabilization activities, such as landscaping, to be completed immediately after the land has been graded to its final contour.

Vegetative Buffers

- Protect and install vegetative buffers along waterbodies to slow and filter stormwater runoff.
- Maintain buffers by mowing or replanting periodically to ensure their effectiveness.

Silt Fencing

- Inspect and maintain silt fences after each rainstorm.
- Make sure the bottom of the silt fence is buried in the ground.
- Securely attach the material to the stakes.
- Don't place silt fences in the middle of a waterway or use them as a check dam.
- Make sure stormwater is not flowing around the silt fence.

Maintain your BMPs!

www.epa.gov/npdes/menuofbmps

Site Stabilization

- Vegetate, mulch, or otherwise stabilize all exposed areas as soon as land alterations have been completed.

Construction Entrances

- Remove mud and dirt from the tires of construction vehicles before they enter a paved roadway.
- Properly size entrance BMPs for all anticipated vehicles.
- Make sure that the construction entrance does not become buried in soil.

Slopes

- Rough grade or terrace slopes.
- Break up long slopes with sediment barriers, or under drain, or divert stormwater away from slopes.

Dirt Stockpiles

- Cover or seed all dirt stockpiles.

Storm Drain Inlet Protection

- Use rock or other appropriate material to cover the storm drain inlet to filter out trash and debris.
- Make sure the rock size is appropriate (usually 1 to 2 inches in diameter).
- If you use inlet filters, maintain them regularly.

BMP AOC

Sediment and Erosion Control during work at Environmental Areas of Concern (AOC)

BMP Housekeeping

- Wash mats or rugs in mop sinks.
- Don't empty mop buckets outside.

BMP Facility-wide

Visual Inspections of Storm Drains

ICP/SWP3 Points of Contact

If you have ANY questions or concerns:

Owen Hooks – x1941

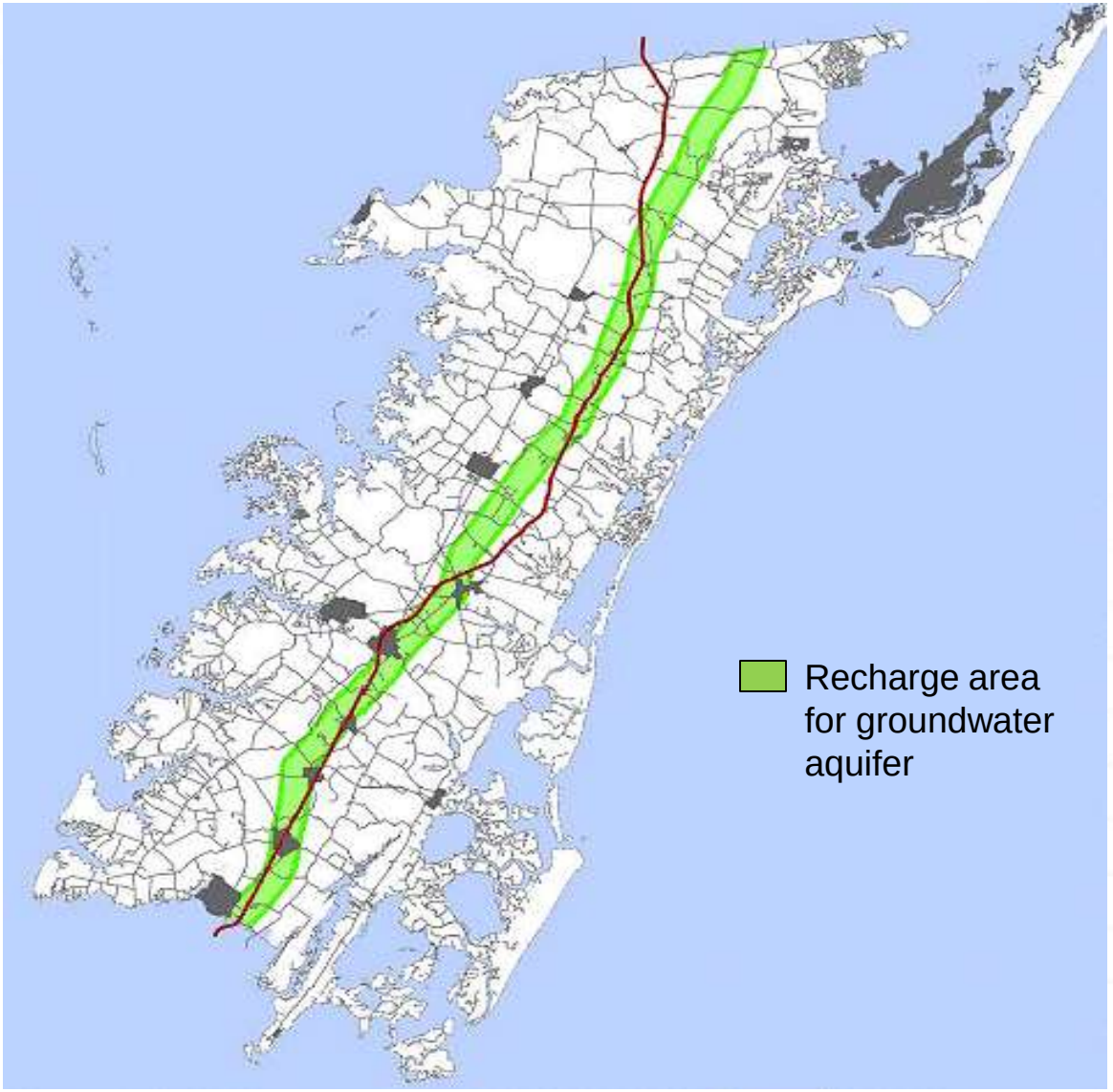
Marianne Simko – x2127

Shane Whealton –x1090

Hazardous Waste Line – x1718

Water Conservation

Eastern Shore of Virginia is an EPA designated "Sole Source Aquifer"



Water Conservation

What we do…

- Low-flow water fixtures
- Participate in Regional Groundwater Meetings
- Drinking water aquifer not used for cooling towers

What you can do…

- Report leaks to HELP Desk
- Consider ways to reduce water use in your work

Environmental Policy

The Goddard Space Flight Center (GSFC) missions expand knowledge of the Earth and its environment, the solar system, and the universe. To maintain our nation's leadership in this endeavor, GSFC commits to conducting missions in a manner that promotes environmental stewardship. As an integral part of all mission planning and implementation, GSFC's environmental policy is to:

a. Comply with all applicable Federal, state, and local laws and regulations, Executive Orders, NASA policies, and other requirements;

b. Prevent pollution, conserve natural resources, and consider the environmental impacts of Center actions during planning;

c. Implement pragmatic and cost effective solutions to environmental challenges;

d. Communicate with the GSFC community, our partners, and the public;

e. Continue to improve our environmental performance by:

(1) Promoting awareness through education and training;

(2) Integrating environmentally sustainable best management practices into our daily work activities;

(3) Exploring advances in environmental technology; and

(4) Providing a framework for setting goals, objectives and targets through our Environmental Management System (EMS).

These commitments demonstrate GSFC's environmental stewardship in our community.

WFF EMS

High Priorities for FY2018:

- Environmental Planning
- Natural Resources
- Site Restoration
- Sustainability
- Air Emissions

- Comments?
- Suggestions?
- Recommendations?

Marianne.f.Simko@nasa.gov

Charles.s.ward@nasa.gov

THE END

1989 Exxon Valdez
Prince William Sound

2012 Oriental Nicety
India