

# Initial Response to Release

## Initial Actions

- Immediately drained tank
- Provided initial release response report to DOH
- Coordinated response with DOH, EPA, and BWS
- Increased frequency of sampling at the drinking water and groundwater monitoring wells
- Increased frequency of oil-water interface monitoring
- Increased frequency of soil vapor sampling beneath the tank



Inspection of bottom of emptied and cleaned tank



Monthly sampling of potable water

## Continuing Actions

- Continue sampling drinking water and monitoring wells, oil-water interface, and soil vapors
- Install additional sentinel groundwater monitoring wells
- Characterize extent of release of petroleum product beneath the tank
- Conduct vertical migration modeling to predict how contamination might travel through the basalt
- Update and validate contaminant fate and transport model and groundwater flow model
- Evaluate remedial action alternatives
- Update the Groundwater Protection Plan

***FOLLOWING REGULATIONS AND SOUND ENGINEERING PRACTICES***

# Thorough Tank Inspection

## Initial Visual Testing

- Initial visual testing consisted of thorough inspection inside of Red Hill Fuel Facility Tank #5
- Visual testing took two months to complete
- Inspectors were suspended in a man-basket while conducting a panel by panel visual inspection
- Further anomalies required additional testing using non-destructive means



Location of repair with patch removed



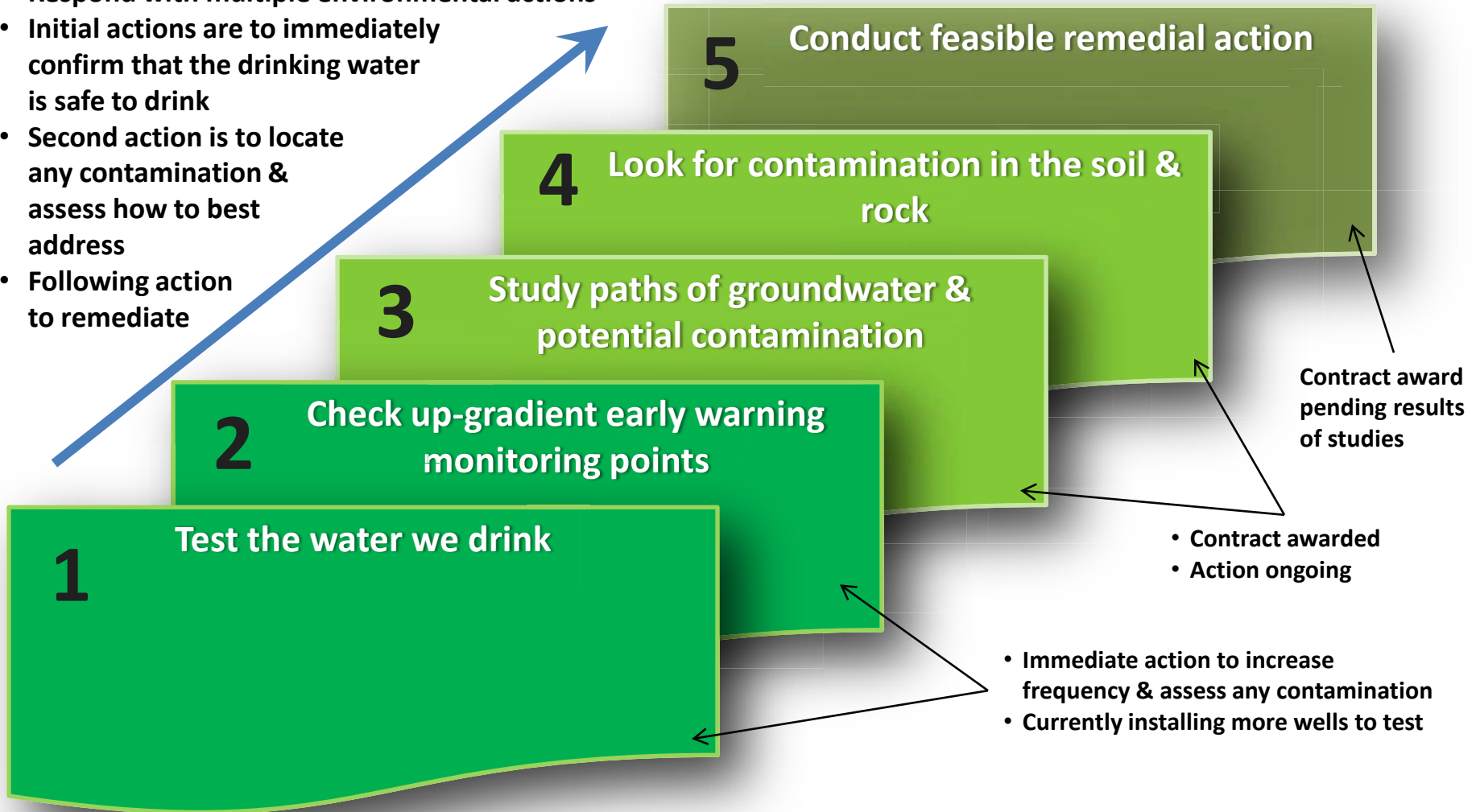
Vacuum box testing conducted at identified location

## Non-Destructive Testing (NDT)

- After identifying initial anomalies, subsequent NDT was conducted using the vacuum box method
- Visually inaccessible inlet and outlet piping was subjected to hydrostatic pressure testing

# Multi-Tiered Environmental Approach

- Respond with multiple environmental actions
- Initial actions are to immediately confirm that the drinking water is safe to drink
- Second action is to locate any contamination & assess how to best address
- Following action to remediate



**TEST – CHARACTERIZE – REMEDIATE**





# 2 – Check Up-Gradient Monitoring Points for Early Warning

## Red Hill Drinking Water Shaft

- Shaft is sampled for all regulatory contaminants
- Additional samples taken to look for fuel constituents
- All results meet Federal and State standards

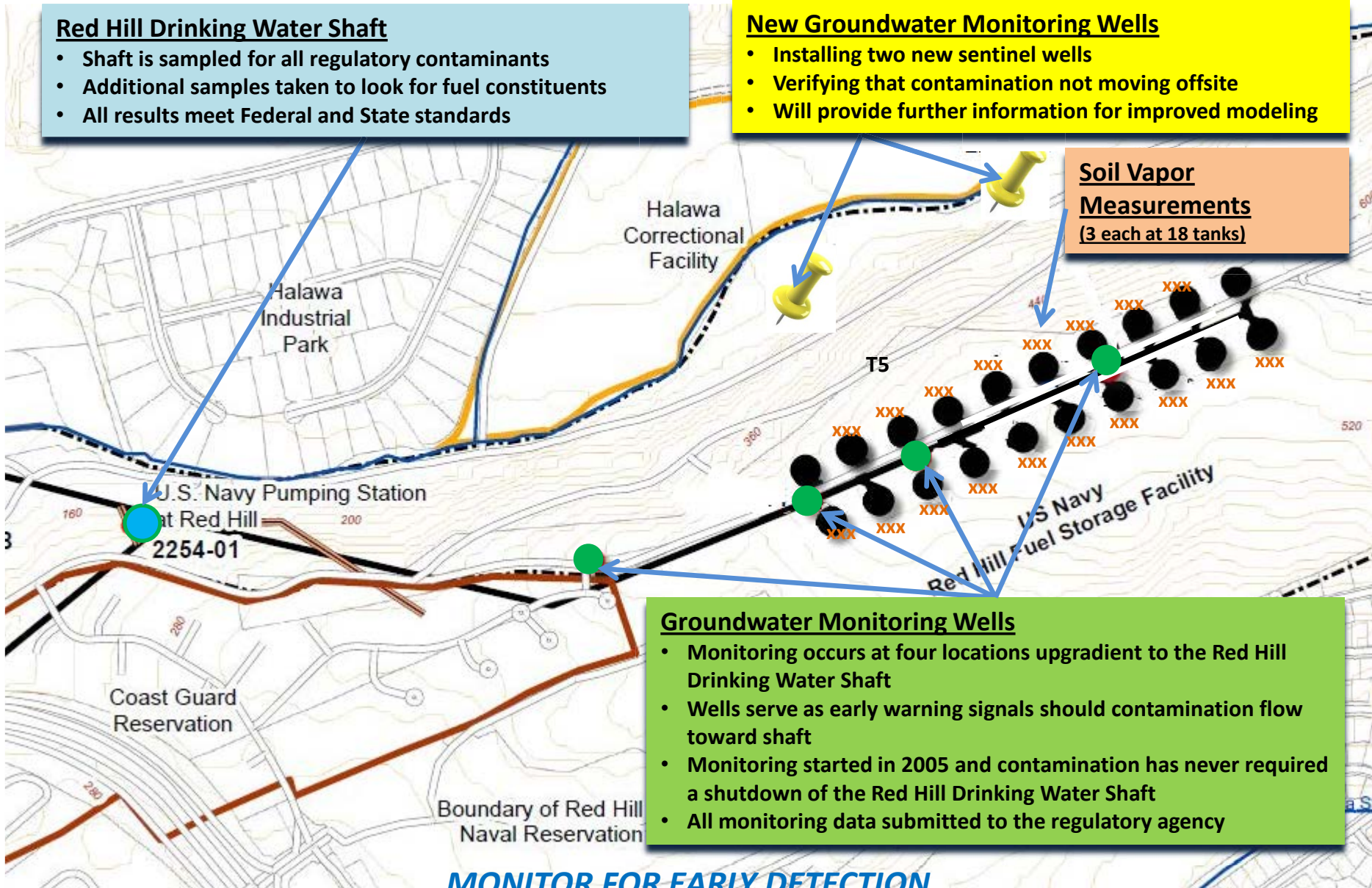
## New Groundwater Monitoring Wells

- Installing two new sentinel wells
- Verifying that contamination not moving offsite
- Will provide further information for improved modeling

## Soil Vapor Measurements (3 each at 18 tanks)

## Groundwater Monitoring Wells

- Monitoring occurs at four locations upgradient to the Red Hill Drinking Water Shaft
- Wells serve as early warning signals should contamination flow toward shaft
- Monitoring started in 2005 and contamination has never required a shutdown of the Red Hill Drinking Water Shaft
- All monitoring data submitted to the regulatory agency



**MONITOR FOR EARLY DETECTION**

# 3 - Study Paths of Groundwater & Potential Contamination

- Computer modeling is used to simulate groundwater flow
- Modeling results help in decision-making for the protection of drinking water
- Initial modeling study completed in 2007 and reevaluated in 2010
  - Results used in development of Navy Groundwater Protection Plan
- A new modeling study is planned to reevaluate previous studies with updated data points, including information from the new monitoring wells

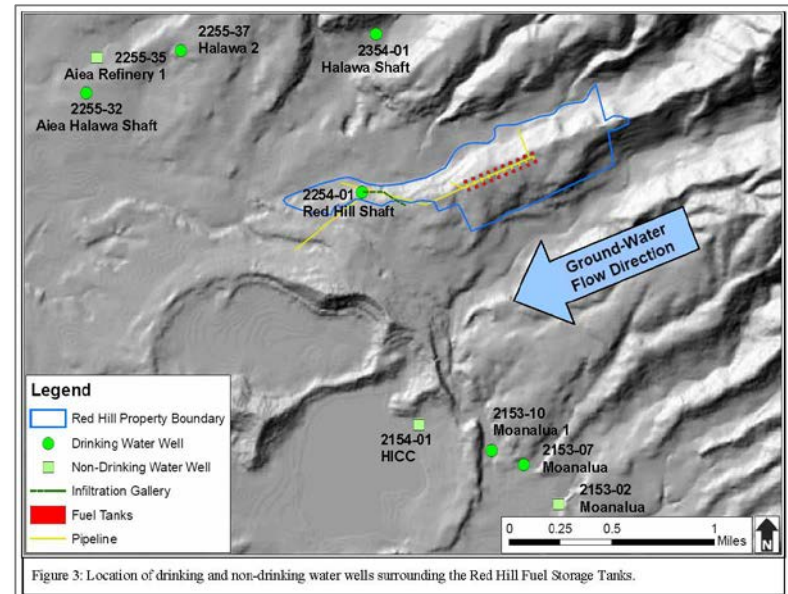
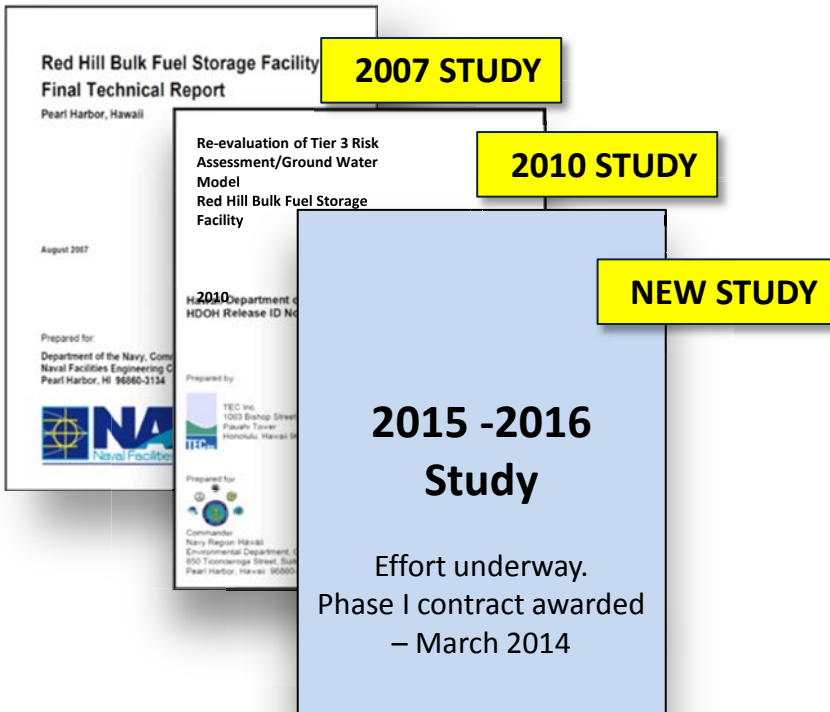


Figure 3: Location of drinking and non-drinking water wells surrounding the Red Hill Fuel Storage Tanks.

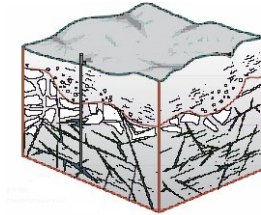
**PROTECT GROUNDWATER SOURCES AND VALIDATE GROUNDWATER MOVEMENT**



# 4 – Look for Contamination in Soil and Rock

## Groundwater and Subsurface Characteristics at Red Hill

- Subsurface is primarily fractured basalt
- Groundwater path flows through subsurface saturated fractured basalt
- The path for groundwater (and potentially fuel) through this saturated zone is complex
- Path is determined by direction and orientation of fractures, lava tubes, pores, and voids, all of which may vary widely
- The geology of Red Hill presents unique challenges to determining extent of contamination



Flow controlled by fractures, voids



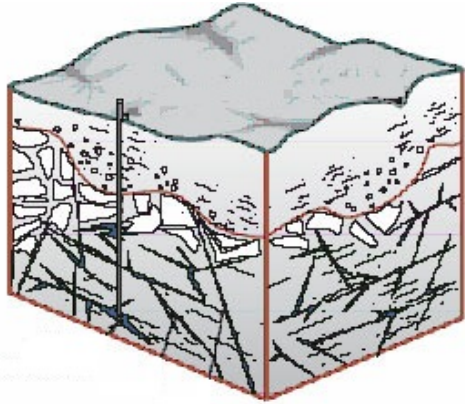
Exposed fractured basalt- Red Hill roadside



Basalt cores showing variable fracturing and voids

***COLLECT SAMPLE DATA FOR MODELS AND DECISION-MAKING***

# 5 – Conduct Feasible Remedial Action



## Drilling/Sampling planned to assess extent of petroleum beneath Tank 5

- Results will be used to evaluate /select most effective option(s):
  - Removal
  - Bioventing/bioremediation
  - Containment



Typical air pump system



Control unit for successful remediation of fuel at Hickam Petroleum Pipeline Site

***SELECT BEST ACTIONS TO PROTECT OUR DRINKING WATER***



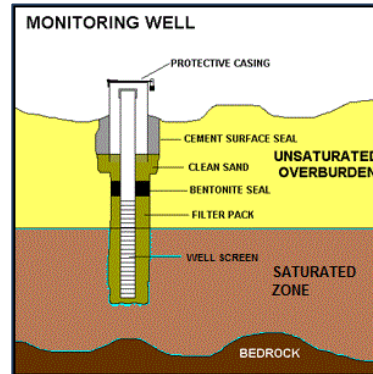
# New Monitoring Wells

## Additional groundwater monitoring wells at Red Hill

- Although no fuel contamination has been detected in nearby drinking water wells, two new groundwater monitoring wells will be installed
- Wells will be used to help improve modeling groundwater movement
- Wells sampled regularly to detect potential groundwater contamination
- Well groundwater levels measured to evaluate groundwater flow direction



Planned new well location



Generalized monitoring well construction



Previous drilling at Red Hill



Installation to avoid impacting the endangered Hawaiian hoary bats



Groundwater monitoring well being sampled

# Environmental Action Plan

- *FOLLOW REGULATIONS AND SOUND ENGINEERING PRACTICES*
- *KEEP OUR DRINKING WATER SAFE*
- *MONITOR FOR EARLY DETECTION*
- *PROTECT GROUNDWATER SOURCES AND VALIDATE GROUNDWATER MOVEMENT*
- *COLLECT SAMPLING DATA FOR MODELS AND DECISION-MAKING*
- *SELECT BEST ACTIONS TO PROTECT OUR DRINKING WATER*

