JUNE 2003

Tuba City Community/ Upper and Lower Moenkopi Villages Leaking Underground Storage Tank (LUST) Site

Final cleanup plan considered for Tuba City LUST Site

The U.S. Environmental Protection Agency, in consultation with the Navajo Nation and the Hopi Tribe, have proposed a final cleanup plan for the Tuba City LUST Site.

The proposed final cleanup plan is now before the public for comment. The public comment period extends from June 24, 2003 through August 6, 2003.

Public comments can be submitted in writing to:

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Why is cleanup necessary?

Underground storage tanks (USTs) at the two gas stations at the intersection of Highways 160 and 264 have leaked gasoline. One of the stations, Thriftway, leaked approximately 13,000 gallons. It is not known how much the other station, Sunshine-Western (also known as Superfuels or Tuba City Express), leaked. The leaking USTs have been removed and replaced with new tanks.

The gasoline that leaked from the old tanks soaked into the soil at the gas stations and gasoline chemicals have entered the groundwater. These chemicals have formed a plume of contamination in the groundwater south of the site approximately 1,200 feet in length. The main chemicals of concern are benzene, toluene, ethylbenzene, and xylenes (BTEX), as well as methyl tertiary butyl ether (MTBE), and total petroleum hydrocarbons (TPH).

EPA, the Navajo Nation and the Hopi Tribe have been directing the gas station operators to assess and clean up their petroleum contamination.

Public comments will also be accepted at any of the following meetings:

INFORMATIONAL MEETINGS:

June 24, 2003 – Arizona Time
Upper Moenkopi Community Building,
Upper Moenkopi Village

4 pm to 5 pm	Open House
5 pm to 6:30 pm	Presentations
6:30 pm to 8 pm	Question and Answer Session

(Hopi translation will be provided)

June 25, 2003 – Daylight Savings Time
Tuba City Chapter House, Toh nan"s dizi,
Highway 264, Tuba City, AZ

4 pm to 5 pm	Open House
5 pm to 6:30 pm	Presentations
6:30 to 8 pm	Question and Answer Session

(Navajo translation will be provided)

PUBLIC HEARINGS:

August 5, 2003 – Daylight Savings Time
Tuba City Chapter House, Toh nan"s dizi,
Highway 264, Tuba City, AZ

4 pm to 5 pm	Open House
5 pm to 6:30 pm	Question and Answer Session
6:30 to 8 pm	Public Comments Session

(Navajo translation will be provided)

August 6, 2003 – Arizona Time
Upper Moenkopi Community Building,
Upper Moenkopi Village, AZ

4 pm to 5 pm	Open House
5 pm to 6:30 pm	Question and Answer Session
6:30 pm to 8 pm	Public Comments Session

(Hopi translation will be provided)

The final method of cleanup of soil and groundwater at the site will be selected by U.S. EPA, in consultation with the Navajo Nation and the Hopi Tribe, after the public comment period has ended (August 2003) and the comments have been considered.

What are the options for cleanup?

EPA and the Tribes reviewed several options for cleanup before proposing the final cleanup plan. The following pages describe each of the options, as well as their benefits and limitations.

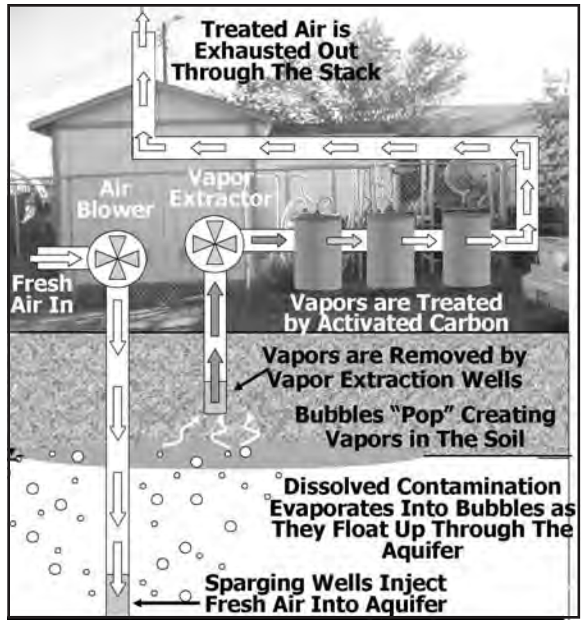
What cleanup has already taken place?

Thriftway Corporation has already started cleaning up parts of the site. A cleanup system at Thriftway #701 has been in operation since September 2000. A second cleanup system was started at the Tuba City Express gas station in October 2002. To date, these systems have successfully removed over 4,800 lbs of contamination from the soil and groundwater. Installation of a third cleanup system, at the Tuba City Truck Stop, is expected in 2003.

The cleanup systems currently in place treat petroleum contamination by injecting air into the groundwater aquifer. As air bubbles rise up through the groundwater, some of the chemicals evaporate from the water into the bubbles. When the bubbles reach the top of the water table, those chemicals are released as vapors into the dry soil in the subsurface. These vapors are collected from the soil by a series of vapor extraction wells. The vapors are then treated at the surface and released to the atmosphere through a stack at levels that are protective of human health.

While you can't see the cleanup system since it's all underground, the cleanup process is working based on quarterly sampling results from surrounding groundwater monitoring wells.

Option #1
Subsurface Volatilization and Ventilation System (SVVS)



Technology Description: The Subsurface Volatilization and Ventilation System (SVVS) process removes petroleum contamination from the soil and groundwater by injecting air into the bottom of the groundwater in the alluvium. As air bubbles up through the groundwater, some of the chemicals evaporate from the water into the bubbles. When the bubbles reach the top of the water table, those chemicals are released as vapors into soil above the groundwater. These vapors are collected from the soil by a series of vapor extraction wells, and the vapors are then treated and/or released at the surface. The SVVS process also adds oxygen to the groundwater to help with the natural breakdown of contamination.

Effectiveness: The SVVS at the Thriftway #701 facility already has successfully removed over 4,200 lbs of contamination from the site. The SVVS process is most effective for removing the volatile chemical components of gasoline from the areas of highest concentration near the sources of contamination.

Costs and Timing: For an average site, SVVS can cost between $100,000 to $300,000. For an average site, SVVS can often achieve cleanup goals within 1 to 4 years.

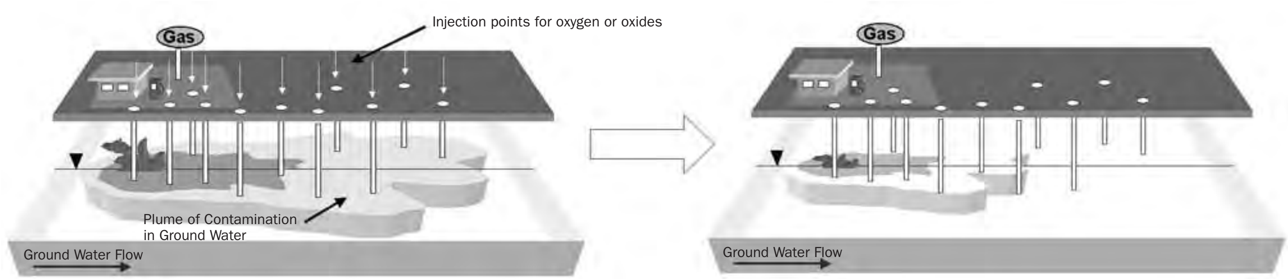
SVVS Advantages:

- Rapidly reduces volatile chemicals from below the groundwater such as benzene, ethylbenzene, toluene, xylenes (BTEX), and methyl tertiary butyl ether (MTBE).
- Adds oxygen to the groundwater which encourages biodegradation of petroleum contamination.
- Enhances the effects of soil vapor extraction.
- Implemented with minimal disturbance to site and business operations.

SVVS Limitations:

- Removes primarily volatile chemicals; 1less volatile chemicals may be cleaned up more slowly as a result of the enhanced biodegradation.
- Can be difficult to control air distribution in groundwater. As a result, some areas may be cleaned up while other areas may remain contaminated.
- In some cases, SVVS can cause contamination to move.
- Contaminant levels may rebound after system is turned off.
- Difficult to install under buildings and roads.

Option #2
Enhanced Bioremediation



Oxygen or oxides are injected throughout the plume to supply oxygen for bacterial growth.

Bacteria break down the contamination and reduce concentrations over time.

Technology Description: Enhanced bioremediation uses injected oxygen to stimulate growth of naturally occurring bacteria underground. These bacteria then break down the petroleum contamination in soil and groundwater. Oxygen can be injected either physically by pumping air into the groundwater or chemically by injecting oxides underground. One of the key challenges is to inject the oxygen into the areas where the contamination is located.

Effectiveness: Enhanced bioremediation is most effective for lighter petroleum hydrocarbons such as benzene, toluene, ethylbenzene, xylenes (BTEX), and polynuclear aromatic hydrocarbons. Enhanced biodegradation can also be effective for MTBE in areas where BTEX chemicals are not present. This is because the bacteria tend to consume BTEX chemicals first, and then consume MTBE. This method is most suitable for lower concentration areas on the margins of the plume or in the final stages of cleanup when concentrations are lower.

Costs and Timing: For an average site, enhanced bioremediation can cost between $200,000 to $500,000. For an average site, enhanced bioremediation can often achieve cleanup goals within 6 months to 4 years, longer times for heavier hydrocarbons.

Enhanced Bioremediation Advantages:

- Can treat contaminants in place without the need for pumping or surface treatment.
- Can achieve lower final cleanup levels than pump and treat in the long run.
- Effective for most petroleum hydrocarbons.
- Implemented with minimal disturbance to site and business operations.

Enhanced Bioremediation Limitations:

- Effectiveness is limited in clay soils; most of the Tuba City site is a combination of sands, silts, and clays.
- The ability to supply oxygen to the contamination may be limited by groundwater mineral content.
- Effectiveness may be limited for less biodegradable compounds such as MTBE in the presence of BTEX.

Option #3
Monitored Natural Attenuation

Technology Description: Monitored natural attenuation (MNA) is similar to enhanced biodegradation in that it relies upon bacteria underground to break down the petroleum contamination in soil and groundwater. However, MNA does not use injected oxygen to stimulate growth of bacteria. Instead, the naturally occurring oxygen is used. As a result, the bacteria tend to grow more slowly and also break down the contamination more slowly. Groundwater concentrations must be monitored to ensure that cleanup is proceeding and that bacteria are continuing breaking down contamination.

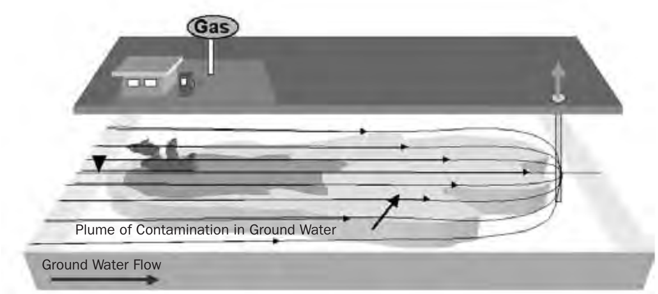
Effectiveness: MNA is most effective for lighter petroleum hydrocarbons such as benzene, toluene, ethylbenzene, xylenes (BTEX), and polynuclear aromatic hydrocarbons. MNA is less effective for MTBE, especially if BTEX chemicals are present. MNA is most suitable for lower concentration areas contaminated by BTEX chemicals on the margins of the plume, or in the final stages of cleanup after more aggressive cleanup methods have been used to remove the majority of contamination from soil and groundwater.

Costs and Timing: For an average site, monitored natural attenuation can cost between $50,000 and $300,000 depending upon the extent and frequency of monitoring. For an average site, monitored natural attenuation can achieve cleanup goals within 3 to 10 years or more depending upon initial concentrations.

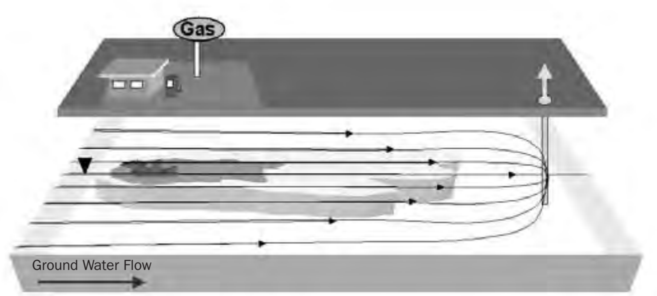
Monitored Natural Attenuation Advantages:
- Can treat contaminants in place without the need for pumping or surface treatment.
- Can achieve lower final cleanup levels than pump and treat in the long run.
- Effective for most petroleum hydrocarbons.
- Implemented with little or no disturbance to site and business operations.

Monitored Natural Attenuation Limitations:
- Effectiveness may be limited for less biodegradable compounds such as MTBE, particularly in the presence of BTEX.

Option #4
Groundwater Pump and Treat or Re-Injection



Contaminated water is pumped out of the ground, treated and either re-injected or discharged to the sewer.



As water is pumped out, the contamination is slowly washed out of the ground along with the water.

Technology Description: Contaminated groundwater is pumped out of the ground using extraction wells. The water is then treated, normally using one or a combination of the following processes: 1) contamination removal using granular activated carbon, ultraviolet (UV) peroxidation, or resins; 2) air stripping; or 3) aboveground bioremediation. The water can then be either discharged to the sanitary sewer system or re-injected back into the aquifer.

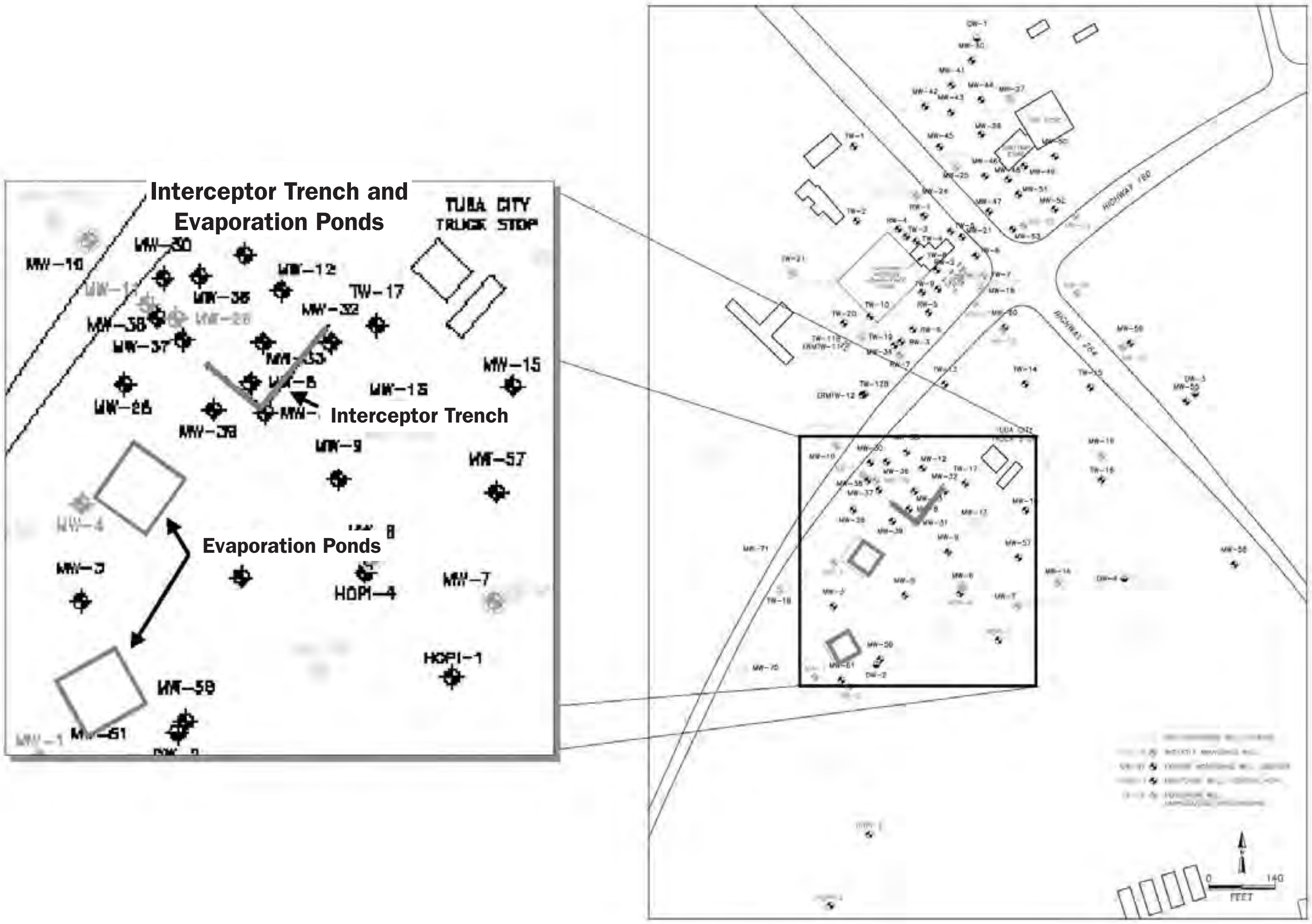
Effectiveness: Pumping and treating groundwater is more effective for chemicals that are easily dissolved in water and are easily treated by one of the methods listed above. MTBE dissolves easily in water but is difficult to treat. BTEX chemicals are easy to treat but do not dissolve easily in water. Pumping can also be used to lower the water level in source areas and help to increase the effectiveness of soil vapor extraction systems. However, this would tend to reduce the effectiveness of air sparging.

Costs and Timing: For an average site, pump and treat can cost between $250,000 to $500,000. For an average site, pump and treat can often achieve cleanup goals within 3 to 10 years or longer.

Pump and Treat Advantages:
- Controls contaminant plume migration and reduces plume concentrations.
- Can be effective for chemicals that are easily dissolved in water.

Pump and Treat Limitations:
- MTBE is difficult to treat after it is pumped out of the ground.
- BTEX chemicals are difficult to remove by pumping.
- Can require expensive and lengthy long-term pumping and treating.
- Difficult to dispose of large volumes of treated water permits may be an issue.
- High iron content/hardness like that found in Tuba City can make water treatment more expensive.

Option #5
Interceptor Trench and Ponds



Site map showing extraction trench and evaporation ponds.

Technology Description: An interceptor trench is another way to collect and extract groundwater. An interceptor trench was dug into the ground southwest of the Tuba City Truck Stop in 1997. Wells were then placed in the trench, the trench was then filled with sand, and contaminated groundwater was pumped out of the trench. The water was discharged to the two evaporation ponds shown in the figure above. The evaporation ponds were insufficient to evaporate all of the water being pumped from the trench. Because disposal permits could not be obtained for the waste water, this cleanup method was discontinued in 1998. There may be a possibility of obtaining discharge permits in the future. However, additional treatment may be required before water from the trench and ponds can be discharged or re-injected.

Effectiveness: The trench and ponds were effective at removing contaminated groundwater. However, the ponds were not effective at evaporating water fast enough to provide treatment. Pumping and treating groundwater is more effective for chemicals that are easily dissolved in water and are easily treated by one of the methods listed above. MTBE dissolves easily in water but is difficult to treat. BTEX chemicals are easy to treat but do not dissolve easily in water.

Cleanup Levels and Timing: For an average site, an interceptor trench and ponds can cost between $250,000 to $500,000. For an average site, an interceptor trench and ponds can often achieve cleanup goals within 3 to 10 years or longer, similar to pump and treat.

Interceptor Trench Advantages:

- Can help control contaminant plume migration and reduce plume concentrations.
- Can be effective for chemicals that are easily dissolved in water.

Interceptor Trench Limitations:

- MTBE is difficult to treat after it is pumped out of the ground.
- BTEX chemicals are difficult to remove by pumping.
- Difficult to dispose of large volumes of treated water.
- Additional treatment needed before considering re-injection.
- Current trench is located in the middle of the plume and can only remove a portion of the contamination.
- Disposal ponds were not effective at evaporating water fast enough to provide treatment.

Option #6
Excavation of Contaminated Soil

Technology Description: Excavation involves removing small volumes of soil in areas of high concentration. Contaminated soil is excavated and trucked to a landfill for disposal or treated on site. Soil may also be treated on site using bioremediation. Some soil has already been excavated at the site during removal and replacement of underground storage tanks and piping.

Effectiveness: Excavation is effective for removing contamination from the site. However, if the soil is then disposed of in a landfill, the contamination is simply moved to another location without treating or destroying the chemicals. Excavation is not cost-effective for large soil volumes or soil with low contaminant concentrations.

Costs and Timing: For an average site, excavation can run $45 to $200 per cubic yard of soil, depending on transportation costs (approximately $2,000 to $9,600 for a 10 x 10 x 10 foot area assuming a 30% post-excavation soil expansion). It is anticipated that transportation from Tuba City would be quite expensive. For an average site, excavation can often achieve cleanup goals in the excavated area within a few days.

Excavation Advantages:
- Can be quick to implement.
- Soil concentrations in the excavated area are reduced immediately (water concentration reductions take longer).

Excavation Limitations:
- Simply moves contaminants from one location to another .
- Can cause major disruption to roads, buildings, and utilities.
- Not cost-effective for large soil volumes or soil with low contaminant concentrations.
- Cannot remove soil from under buildings or roads without major reconstruction.
- May need landfill permits for soil disposal.

Who is paying for the cleanup?

Thriftway Corporation, National Petroleum Marketing, Inc. and Sunshine Western, Inc. are responsible for cleaning up the petroleum contamination at the Tuba City LUST Site. They have been named as the "responsible parties" under an EPA order. The order is an enforceable legal document, and failure to comply with the requirements of the order can result in the assessment of penalties.

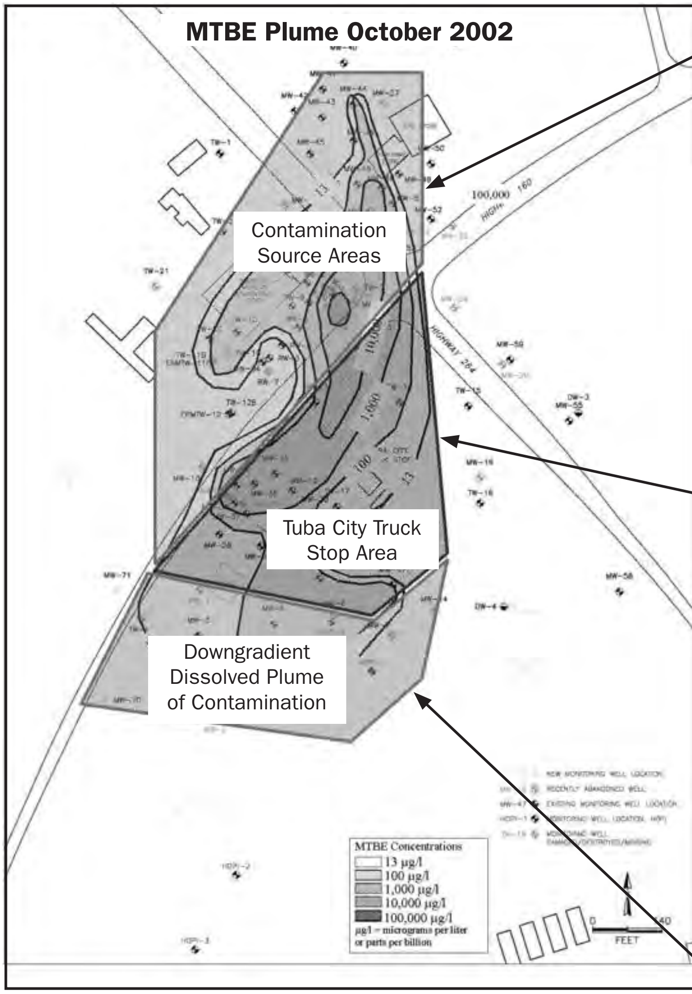
How long will cleanup take?

EPA anticipates that the final cleanup plan will be approved and implemented in late 2003 or early 2004. Once all of the cleanup measures are in place it is estimated that site remediation will take from 3 to 5 years to complete. However, environmental conditions and cleanup speed are difficult to predict. Therefore the cleanup time of 3 to 5 years is only an estimate and not a guarantee.

What is proposed as the final cleanup plan?

The proposed final cleanup plan involves a combination of technologies to clean up different areas of the site.

Proposed Preferred Cleanup Methods (Proposed Preferred Remedial Alternatives)



Proposed Preferred Cleanup Methods and Selection of Final Cleanup Methods: The preferred methods for cleanup of soil and groundwater shown on this poster are being proposed by U.S. EPA working with the Navajo Nation and the Hopi Tribe. Members of the public, regulatory agencies, the gas station operators, and any other interested parties are invited to comment on this proposed overall cleanup strategy. The final strategy for cleanup of soil and groundwater at the site will be selected by U.S. EPA working with the Navajo Nation and the Hopi Tribe after the public comment period has ended and the information submitted during this time has been reviewed. Based on new information or relevant public comments, modifications may be made to the proposed cleanup strategy and/or another cleanup strategy may be selected.

Contamination Source Areas:

SVVS ⇨ Cycling/Biosparging ⇨ MNA

SVVS—the existing SVVS units at the Thriftway and Tuba City Express facilities will continue to operate and remove contamination until concentration removal rates are minimal.

SVVS Cycling and/or Biosparging—when concentration removal rates become minimal the SVVS units will either be cycled on and off to continue to remove contamination directly or will be used to inject air into the groundwater to stimulate bacterial growth and encourage biodegradation of contaminants.

MNA—Outer portions of the contaminant plumes where contaminant concentrations are low will be addressed through monitored natural attenuation.

Tuba City Truck Stop Area:

SVVS ⇨ Cycling/Biosparging ⇨ MNA

SVVS—an additional SVVS unit will be installed to clean up the higher concentration areas at the Tuba City Truck Stop facility and along highway 160. This unit will also be run until removal concentrations are minimal.

SVVS Cycling and/or Biosparging—when concentration removal rates become minimal, the SVVS unit will either be cycled on and off to continue to remove contamination directly or will be used to inject air into the groundwater to stimulate bacterial growth and encourage biodegradation of contaminants.

MNA—Outer portions of the contaminant plumes where contaminant concentrations are low will be addressed through monitored natural attenuation.

Downgradient Dissolved Plume:

Enhanced Bioremediation ⇨ MNA

Enhanced Bioremediation—Underground injection of compounds will provide additional oxygen to enhance the natural breakdown of contaminants. This may require more than one phase of injection.

MNA—Outer portions of the contaminant plumes where contaminant concentrations are low will be addressed through monitored natural attenuation.

Performance Monitoring: Groundwater contamination monitoring must continue until cleanup goals have been achieved, or longer if necessary to verify that the site no longer poses a threat to human health or the environment. Typically, monitoring is continued for a specified period (e.g., one to three years) after cleanup goals have been achieved to ensure that concentration levels are stable and remain below cleanup levels.

THE HOPI TRIBE

Who should I contact for more information?

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