Frequently Asked Questions (FAQs) about Petroleum Cleanup and Closure Requirements.

I. Groundwater Contamination and Site Closure

1. ***What is required to close a petroleum release?***

When you use the term "close" or "closure" of a petroleum release site, we specifically mean to categorize the release as "resolved" in accordance with Administrative Rules of Montana (ARM) 17.56.607(4). Montana law stipulates two primary concerns that must be satisfied in order to categorize a release as resolved. First, the department must determine that all cleanup requirements have been met. Second, the department must determine that risks to human health, safety and the environment from any remaining contamination are within acceptable levels. In addition to these requirements, the release must be fully investigated; all DEQ-required cleanup actions, including free product (contamination) removal to the maximum extent practicable, must be completed; and all applicable environmental laws associated with the release must be met.

2. ***What are the most common "risks to human health, safety, and the environment" at a typical petroleum release site?***

The DEQ evaluates all risks when evaluating a petroleum release, but the most common risks arise from: people drinking contaminated water (either from a contaminated aquifer or permeation of a water pipe); human exposure to vapors migrating into buildings; and construction workers contacting petroleum-contaminated soil during excavation work. Other risks can include direct, human contact with contaminated surface or subsurface soil; and contaminated surface water (rivers and lakes) which may impact humans or the environment. Although common petroleum fuels contain a mixture of several hundred different chemicals, long-term exposure risks are commonly associated with exposure to carcinogen (or cancer causing) petroleum constituents such as benzene, ethyl-benzene, and naphthalene.

3. What are the "applicable environmental laws" discussed in FAQ #1 that may affect closure of a petroleum **release site?**

These applicable laws, listed at ARM 17.6.607(4)(e), include, but are not limited to, air quality, drinking water and monitoring well requirements, solid waste management requirements, hazardous waste management requirements, and Montana pollutant discharge elimination system (MPDES) requirements, underground injection controls and standards, UST requirements, noxious weed control, groundwater and surface water quality standards, nondegradation requirements, storm water requirements, and requirements for the protection of endangered species, historic sites, wetlands and floodplains. The most common environmental laws affecting petroleum releases are groundwater quality standards and solid waste requirements.

The Montana Water Quality Act addresses pollution to state waters and directly affects the majority of petroleum releases in Montana. This law provides that: "It is unlawful to cause pollution of any state waters or to place or cause to be placed any wastes where they will cause pollution of any state waters."

4. What is meant by "pollution" in the Water Quality Act ?

Pollution is defined in the Water Quality Act (§ 75-5-103(25)(a) MCA) as: "contamination or other alteration of the physical, chemical, or biological properties of state waters that exceeds that permitted by Montana water quality standards." Water quality standards for many petroleum chemicals are listed in a publication called Circular DEQ-7, Montana Numeric Water Quality Standards, commonly referred to as just "DEQ-7." These numerical standards are adopted as Administrative Rules of Montana and carry the force and effect of law.

> Note: Water quality standards address but are not limited to standards relating to change in temperature, taste, color, turbidity or odor or . . . the discharge, seepage, drainage, infiltration, or flow of liquid, gaseous, solid, radioactive, or other substance into state water that will or is likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, or welfare, to livestock, or to wild animals, birds, fish, or other wildlife.

5. *What is meant by "state waters?"*

State waters are defined at § 75-5-103(29), MCA as "a body of water, irrigation system or drainage system, either surface or underground." This includes all groundwater whether or not it is in an aquifer that is used for drinking water.

6. *So how does Circular DEQ-7 affect closure of a petroleum release site?*

A petroleum release that impacts state waters cannot be categorized as resolved until applicable water quality standards, described in DEQ-7, are met.

7. *Can a petroleum release be closed when groundwater exceeds DEQ-7 standards, but the contaminated groundwater is only located under the gas station property itself and there is no evidence that contaminated groundwater is migrating beyond the property* boundaries?

No. All groundwater, even that located only under the facility that is the source of the release, is state water. Therefore, the release cannot be categorized as resolved until water quality standards are met.

8. What chemicals listed in DEQ-7 affect most closures of petroleum release sites?

Of the chemicals listed in DEQ-7, benzene is typically one of the last chemicals to cleanup to DEQ-7 levels at gasoline release sites. Naphthalene is commonly the chemical that cleans up last at diesel, kerosene, and other "heavier" fuel release sites. Both benzene and naphthalene are considered carcinogens, or cancer causing chemicals, and have very low water quality standards of 5 and 100 micrograms per liter (or parts per billion), respectively. Most other chemicals found in petroleum products are considered simple "toxics" and have much higher limits, or they are very insoluble and don't show up in groundwater.

9. *Does DEQ-7 contain all the chemicals found in gasoline and diesel?*

No. Gasoline, diesel, and other refined petroleum products each contain hundreds of chemicals found in the original crude oil source as well as additives unique to each product and brand. Only about a dozen or so of these chemicals have standards listed in DEQ-7.

10. ***So, what does the DEQ use for groundwater cleanup standards for all those other chemicals that are not listed in DEQ-7?***

The DEQ has developed a method published in Montana Tier 1 Risk-based Corrective Action Guidance for Petroleum Releases (RBCA) to address petroleum chemicals not listed in DEQ-7. RBCA identifies concentrations of petroleum chemicals called "risk-based screening levels" or "RBSLs" to evaluate risks posed to human health and the environment. Petroleum releases cleaned up to levels below RBSLs are determined to be protective of human health and the environment. RBCA has been incorporated by reference into Montana tank rules addressing site closure found at ARM 17.56.608.

11. How do groundwater RBSLs affect closure of petroleum releases?

The RBSLs in RBCA are used to evaluate risk to human health and the environment when surface or subsurface soils, or groundwater may be impacted by petroleum contaminants. For example, the DEQ uses groundwater RBSLs to evaluate risks to human health when groundwater may be used for domestic purposes such as drinking, cooking, and bathing. These RBSLs are not "standards" like the DEQ-7 standards that apply to all state waters. RBSLs are only used to evaluate risks associated with exposure to petroleum contamination in soil or groundwater.

> Note: Montana Tier 1 Risk-based Corrective Action Guidance for Petroleum Releases (RBCA) is incorporated by reference in ARM 17.56.608.

12. So, the DEQ can close a petroleum release site with groundwater contamination above RBSL levels?

Yes, if closure is supported by a site specific risk evaluation that is approved by DEQ. For example, if a site specific risk assessment demonstrates that groundwater cannot be extracted or used for domestic purposes, the site may be categorized as resolved. Remember, releases exceeding only RBSLs can be closed. Releases exceeding DEQ-7 standards cannot be resolved. The site conditions must also meet all the other requirements to be categorized as resolved, such as: being fully investigated; completing all DEQ cleanup requirements, including free product removal; and any residual petroleum must not pose unacceptable risks to human health or the environment.

13. In assessing release sites where contamination exceeding RBSLs in groundwater, how does DEQ determine whether groundwater can be used for domestic purposes?

DEQ evaluates each release on a case-by-case basis to determine whether physical or institutional controls are in place to prevent the extraction and use of groundwater during the time the groundwater contamination is above RBSLs. Physical conditions that may prevent groundwater from being extracted for domestic uses include tight formations like clay and silt, and the availability of public (city) water for domestic purposes. Institutional controls that may be adopted to prevent the use of groundwater include city ordinances, deed notices, restrictions, and covenants, as well as Controlled Groundwater Areas managed by the Department of Natural Resources and Conservation to prohibit drilling water wells.

14. ***Are DEQ-7 standards the same as "drinking water standards?"***

There are some subtle differences between DEQ-7 standards and drinking water standards that are mandated for public water supplies, but for common petroleum contaminants, the DEQ-7

standards and drinking water standards are generally the same. So, ordinarily, petroleum releases must be cleaned up to standards that are consistent with drinking water standards.

15. So if the DEQ cleans some sites up to groundwater RBSLs that are not listed in DEQ-7, then isn't the DEQ requiring cleanup to levels more stringent than drinking water standards?

Not more stringent, but more encompassing. The DEQ uses groundwater RBSLs to determine risk to human health, safety, and the environment. Risks to safety and the environment, such as risk of fire and explosion, are not addressed by drinking water standards or DEQ-7. DEQ-7 also does not contain all potentially harmful chemicals. RBSLs are used to evaluate risks from all petroleum contamination.

II. Soil Contamination and Site Closure

16. We have been talking mostly about groundwater. How does petroleum contamination in soil affect closure of a release site?

Petroleum contamination in soil affects human health through residential or commercial contact with the surface or subsurface soil. For example, construction workers contact surface and subsurface soil in excavations. Soil may also give off gases that migrate into buildings as vapors. This exposure pathway is commonly described as vapor intrusion. Petroleum chemicals can also leach from soil into groundwater. DEQ evaluates all these risks to human health, safety and the environment when determining how to cleanup soil.

17. Are there "standards" for petroleum chemicals in soil like the DEQ-7 standards for water?

No, there are not specific soil standards for petroleum contamination. The DEQ determines soil cleanup requirements for each release based upon its risks to human health. The DEQ has developed risk-based screening levels (RBSLs) for soil to evaluate these risks. Soil RBSLs are conservatively calculated to represent concentrations of the various chemicals that should not cause unacceptable risks to human health through direct contact (ingestion, inhalation and dermal contact) and will not leach into groundwater above DEQ-7 standards or groundwater RBSLs anywhere in Montana. Soil RBSLs vary from surface soil (less than two feet depth) to soil in the subsurface and whether the property will be used for residential or commercial purposes.

18. ***Can soil RBSLs be used as a cleanup level?***

Yes. Soil RBSLs can be used as default cleanup levels for soil. The DEQ may approve other methods to evaluate risks to human health, safety and the environment from residual contamination, or to demonstrate that exposure pathways are incomplete. For typical petroleum release sites in Montana, it is probably quicker and cheaper to use RBSLs published in RBCA as default cleanup values, or conduct groundwater monitoring, rather than perform a site specific risk assessment.

19. Can a site with soil contamination exceeding an RBSL be closed?

Yes. As stated in FAQ #18, DEQ may approve other risk assessment methods to set cleanup standards. DEQ may categorize a release as resolved if a site specific risk assessment demonstrates that current and potential future exposure pathways are incomplete. For example, a groundwater investigation may demonstrate that residual petroleum contaminants in the soil are not leaching to groundwater.

III. Monitored Natural Attenuation

20. Does petroleum naturally degrade if left alone in the environment?

Yes. Many microbes (bacteria and fungus) already present in the soil will naturally consume and break down common petroleum chemicals. Other natural processes such as dilution, dispersion, and evaporation also help to lower contaminant concentrations while not actually destroying the chemicals. These natural processes are typically limited by the amount and concentration of the contaminants and the physical properties of the soil containing the contaminants. For instance, very high concentrations can kill naturally occurring microbes in the soil and tight soils will limit the amount of oxygen and other nutrients getting to the microbes to help them degrade the chemicals. Large petroleum releases from bulk plants, county shops, railroad fueling depots and even many gas stations, can take many decades or even a century or more to clean up by themselves when they are located in tight clay soil. Conversely, small releases in fast-moving gravel aquifers may clean themselves up in a few weeks. Unfortunately, many Montana communities are located over tighter clay and silt formations. Also, microbes cannot effectively degrade some chemicals such as MTBE (a gasoline additive), which can travel great distances and remain in the ground at unacceptable levels while other petroleum chemicals clean up.

21. What can be done to speed up the natural degradation process?

Removal of the contaminant source material is the most effective clean up method to significantly decrease the time needed for petroleum contamination to degrade. To a lesser degree, and only at appropriate sites, the addition of oxygen, nutrients, or other materials may increase microbial activity and speed up the degradation process.

22. *What is considered "source material?"*

Source material refers to contamination in the subsurface that can leach contamination into groundwater. Free product (non-aqueous phase liquid petroleum) and heavily saturated soils are the most common source materials at petroleum release sites. Most petroleum source material is located directly beneath the point from where it leaked or spilled (beneath tanks, pipes, dispensers, or surface spills). A petroleum release will flow downward and contaminate all the soil it migrates through. It may spread out more in tighter soils, or go straight down in sands and gravels. Once it hits the water table it will spread out like a floating puddle on the groundwater like oil on water. Once the contamination comes into contact with groundwater, it is influenced by the seasonal rise and fall of the water level. The floating contamination may spread out and "smear" into the soil right above the water table and out to some distance from the original source.

23. What is a "smear zone?"

A "smear zones" is an area where source contamination is smeared in the aquifer formation within the limits of seasonal water table fluctuations (see FAQ #22). The term "smear zone" is typically used to refer to areas within this seasonal zone where the water table has transported contamination to additional subsurface materials. Much of the smear zone can be located beneath an otherwise clean area (i.e. clean soil is above it). These "smear zones" may become significant source material at larger release sites where leaching into the groundwater occurs just like the original source area material. Smear zones can become fairly thick in areas where the water table rises and falls significantly such as near irrigated farmland. Smear zones are sometimes difficult to remove through excavation either because all the clean soil above, called "over burden," has to be removed first before you can excavate the smear zone, or because it has migrated under buildings and other structures.

24. How can you remove the source material?

It depends on the site conditions. Soils with greater porosity may be more suitable for "*in situ*" cleanup methods where contaminant is removed without disturbing or removing the soil itself. These methods may include pumping oxygen, chemicals, or nutrients into the ground or sucking air or water out of the ground to remove and destroy the petroleum chemicals. These in-situ methods have the advantage of not needing to disturb surface structures or businesses, but they typically take longer, may be just as expensive as excavation in the long run, and may not always work as planned. Excavation of source material may be the most economical cleanup method for small releases or sites in tighter soils. Excavation has the advantage of being relatively quick, but it typically requires the removal of all surface buildings and improvements, it requires a large capital cost up front, and it is difficult in some cases to remove all the source material, particularly smear zones and contamination that has migrated under adjacent structures. Once contaminated soil is excavated it must then be transported and disposed of, or treated.

25. What is "residual contamination?"

Residual contamination is the term typically applied to contamination that remains in the soil or groundwater following excavation or other cleanup actions. Although the term is not specifically defined, most people in the environmental business, consider "residual contamination" to mean a minor amount of contamination that was not removed by an active cleanup system and is now degrading under natural conditions and being addressed through "monitored natural attenuation (MNA)."

26. What is "monitoring?"

The term monitoring refers to regular collection of environmental samples in order to check the location and concentration of contamination, or to track the effectiveness of remedial action at a release site. Soil and groundwater are commonly sampled. Indoor air, soil gas, surface water, sediment, and many other environmental media may also be sampled to investigate the extent and magnitude of a release or to evaluate the effectiveness of a remediation system.

27. When does monitoring take place?

Monitoring is conducted through every step of investigation, cleanup, following cleanup activities, and for final closure confirmation. In fact, there are very few occasions when an

environmental consultant would visit a release site and not collect samples in order to conduct monitoring.

- Monitoring is necessary to investigate the extent and magnitude of a release as well as to measure site parameters necessary to design a cleanup plan.
- Monitoring is used to keep an eye on in-situ remediation systems and measure their effectiveness during operation. It is used, in the case of confirmatory sampling, to determine what levels of contamination remain in the ground following either excavation or in-situ cleanup. Groundwater monitoring is also used for a period following cleanup to ensure contaminants remain at cleanup levels and don't "rebound."
- Long-term groundwater monitoring is used to measure degradation of residual contaminants through time, and to ensure there are no remaining unacceptable impacts to human health, safety and the environment.
- Groundwater monitoring is also used to evaluate the progress of cleanup when residual contamination is undergoing monitored natural attenuation (MNA).

28. Are "long-term monitoring" (LTM), "monitored natural attenuation" (MNA), and "groundwater management" (GWM) the same thing?

Not exactly, but they are closely related.

- Long-term monitoring (LTM) is a general term used when a petroleum release is not being cleaned up by an <u>active</u> system, but the groundwater still exceeds cleanup levels and is being monitored over a long period of time. LTM is most commonly conducted following cleanup, but may also be employed prior to cleanup when cleanup is not scheduled for several years (such as waiting to coincide with a scheduled highway reconstruction or facility remodel). All MNA and GWM sites require LTM.
- Monitored natural attenuation (MNA) refers to an approved cleanup method where site contaminants are being cleaned up through natural degradation processes. MNA approval typically requires removal of source material to the maximum extent practicable, determination of specific cleanup goals, and calculations demonstrating a reasonable timeframe to achieve cleanup. MNA also requires LTM to measure cleanup progress against the predicted timeframes and to ensure existing contaminants do not pose a risk to human health or the environment.
- Groundwater management (GWM) is a formal release categorization for certain sites undergoing cleanup through MNA. Petroleum release sites can be categorized as GWM when multiple criteria stipulated in the law (ARM 17.56.607(7)(a) through (h)) are met. Before a site may be classified as GWM, monitoring results, based on samples collected under fluctuating hydrogeological conditions for at least five years, must demonstrate that the contaminant plume is stable or shrinking and risk pathways have been ruled out. A GWM site is being cleaned up by MNA which requires LTM.

29. Isn't all this monitoring expensive?

The cost of monitoring can become significant, particularly when it may take several years to achieve cleanup goals. This is why the DEQ has policies and procedures to reduce monitoring expenses to a minimum necessary to ensure protection of human health and the environment. MNA and GWM sites demonstrating stable or shrinking contaminant plumes can be monitored as infrequent as every three years. The number of wells is also eventually reduced to just one monitoring well at each source area (some petroleum release sites may have multiple sources

spread across the site) and enough wells necessary to ensure unexpected migration toward a receptor does not occur. Thus, the long term goal for all MNA sites is to reduce monitoring to as few as one or two wells are being sampled every three years as a key step in reaching closure.

References:

Montana Underground Storage Tank Act; Title 75, Chapter 11, Part 5, Montana Code Annotated
http://data.opi.state.mt.us/bills/mca_toc/75_11.htm

Montana Underground Storage Tank Cleanup; Title75, Chapter 11, Part 3, Montana Code Annotated
http://data.opi.state.mt.us/bills/mca_toc/75_11_3.htm

Water Quality Act; Title 75, Chapter 5,
http://data.opi.state.mt.us/bills/mca_toc/75_5.htm

Comprehensive Environmental Cleanup and Responsibility Act (CECRA); Title 75, Chapter 10, Part 7, Montana Code Annotated
http://data.opi.state.mt.us/bills/mca_toc/75_10_7.htm

Administrative Rule of Montana (ARM); Title 17. Chapter 56 Underground Storage Tanks
http://www.deq.state.mt.us/dir/legal/Chapters/Ch56-toc.asp

Circular DEQ-7, Montana Numeric Water Quality Standard.
http://www.deq.mt.gov/wqinfo/Standards/CompiledDEQ-7.pdf

Montana Tier 1 Risk-Based Corrective Action Guidance for Petroleum Releases
http://www.deq.state.mt.us/rem/hwc/rbca/LinksTOC.asp