DEQ Montana Department of Environmental Quality

REMEDIATION DIVISION
Petroleum Cleanup Section

Permeation of Waterlines by Petroleum Constituents Technical Guidance Document

This guidance was developed to assist with remediation and cleanup actions at petroleum releases overseen by the Petroleum Tank Cleanup section.

Executive Summary
There are many documented instances of permeation of petroleum hydrocarbons into water, sewer, and storm water lines. If permeation has occurred in a plastic pipe, it will need to be removed and replaced with an impermeable metal pipeline. This replacement may incur a large cost. To limit future liabilities, owners of water supply systems need to perform a thorough environmental assessment prior to implementing the construction, rehabilitation, and repair of water mains. The environmental assessment will enable the owner of the utility to negotiate with the party responsible for the contamination in regards to extra costs associated with installing petroleum resistant materials. The extra costs incurred to replace a threatened section with petroleum resistant materials versus more common plastic piping during scheduled construction are minimal compared to the costs associated with replacing an impacted system. In addition, by being proactive the owners of the water and sewer lines will limit any future liabilities associated with petroleum permeation. If you are planning to conduct utility work or if you encounter contamination during utility work, do not hesitate to contact the Department of Environmental Quality (DEQ) at (406) 841-5000.

Introduction
The construction, rehabilitation, and repair of water mains are common activities that occur on a regular basis in all water systems. There are a myriad of risks to consider if proper procedure and existing standards are not followed. This technical guidance document is designed to educate utility workers in regards to risks associated with installing waterlines near petroleum releases.

The DEQ has documented instances within the state and nationally where residual petroleum contamination has permeated through waterlines and impacted public drinking water. DEQ considers it a high priority to investigate utility corridors to ensure that they are not providing an exposure route for contaminants and adversely affecting human health. It is imperative that utility workers notify DEQ whenever they encounter petroleum hydrocarbon contamination so that the threat to human health may be minimized.

Background

There are three ways that volatile organic compounds (VOCs) can pass through waterlines and contaminate drinking water supplies. VOCs may pass through mechanical defects, such as cracks and holes in the pipe walls or joints. VOCs may also be released or leached from the pipe material itself after the pipe material sorbs contaminants for a period of time. Finally, VOCs may pass through the pipe from an outside source, otherwise known as pipe permeation. It is imperative to understand that contamination from common sources can contaminate drinking water supplies through permeation of pipes and gaskets. As of February 15, 2005, in Montana alone there have been 4,195 known petroleum releases from Underground Storage Tank Systems (USTs), of which 1,588 releases are still active. The majority of these releases have some residual soil contamination and many of these releases have impacted utility corridors. Therefore, it is likely that there is petroleum contamination in the near vicinity of a portion of any sizable waterline project. The DEQ-PRS encourages cities and townships to diligently perform an environmental assessment to identify potential contamination prior to installing or replacing a waterline.

A variety of pipe materials are especially vulnerable to permeation. Both polybutylene (PB) and polyethylene (PE) are easily susceptible to permeation. Polyvinyl chloride (PVC) pipe is also vulnerable. VOCs have even permeated newly installed asbestos cement pipe materials. Joint gaskets also have a high permeability that should be considered even though their mass transfer area is relatively minor. Gaskets are also easily chemically degraded by petroleum hydrocarbons. There are instances where gaskets have become so degraded by contaminants that the waterlines have failed.

It is important to note that pipe wall thickness will not prevent permeation of VOCs through PB, PE, and PVC pipe material. It is also important to realize that once breakthrough has occurred that the problem will not be solved through flushing. Once compromised, permeated plastic piping must be replaced since the piping will retain its swollen porous state after permeation and chemical degradation. Petroleum contamination includes many constituents that have designated Maximum Contaminant Levels (MCLs) for drinking water. It is dangerous to rely on odor and taste thresholds, for many MCLs are based on carcinogenic effects. For example, the MCL for Benzene is 5 parts per billion (ppb) while the taste and odor threshold is 500-4,500 ppb. Therefore the public may be exposed to benzene concentrations above the risk threshold for cancer without noticing anything peculiar in the water. Even if the tap water is supplanted by bottled water for the supply of drinking water, there will still be exposure pathways through adsorption through the skin and inhalation of vapors while using tap water for showering, dishwashing, and other everyday ordinary tasks utilizing the impacted tap water.

Backfill in utility trenches is generally more porous than the surrounding soil. This is especially true in lithologies consisting of silts and clays. Contamination will follow the path of least resistance within the more porous soil. Therefore, many utility trenches act as a corridor for migrating petroleum contamination and vapors. Waterlines do not have to be in contact with petroleum product to be susceptible to permeation. Waterlines in contact with contaminated groundwater or soil may also be permeated. Contamination does not have to be fresh to pose a threat. In some cases petroleum vapors have even permeated piping and gasket material. Therefore waterlines and gaskets don't necessarily even need to be in contact with contaminated soil or groundwater to be at risk if vapors are present.

The majority of documented impacted waterlines occurs in smaller diameter service lines, where water may pool and remain stagnant for a period of time. This allows for contaminant levels to accumulate within the stagnant water in that line. It is more difficult to ascertain impacts to

larger diameter water mains where water is constantly moving through the pipe. The main may be impacted but the petroleum contamination levels may be reduced through dilution. It is a myth that the positive pressure exerted from the water flowing within the pipe will reduce permeation rates. Any plastic pipe exposed to petroleum impacted soil, groundwater, and vapors are at risk.

Sewer lines

The majority of this Technical Guidance Document refers to waterlines, but it is also applicable to sewer and storm water lines. Permeation of petroleum hydrocarbons into sewer lines has been known to cause severe vapor issues within nearby residences. There are both health and explosion concerns regarding petroleum vapors. In addition, permeation into the sewer line may cause adverse affects for the sewage treatment system. Permeation of storm water lines will provide a direct pathway for contamination to migrate to surface water. Therefore equivalent care must be provided for the installation of sewer and storm water lines in contact with petroleum contaminated soils, groundwater, and vapors.

Best Management Practices

he best management practice is to avoid petroleum contamination altogether and not place waterlines in high-risk areas. High-risk areas would include industrial areas, areas near former sites of gasoline stations or dry cleaners, areas near active gasoline stations, and areas near waste ponds. It is not always feasible to avoid all high-risk areas.

If the utility must be placed near contamination hot spots, DEQ recommends that appropriate piping be selected to mitigate the problem. The pipeline within the contaminated zone should be constructed out of ductile iron or some other impermeable metal pipe. Petroleum resistant nitrile gaskets should be utilized. Since contamination is known to migrate along utility corridors, impermeable clay bentonite barriers should be installed within the utility corridor before the metal piping connects back to plastic material.

It is recommended that the contaminated soil be removed from the utility corridor and properly disposed. However, this action alone is not sufficient to mitigate the problem because it is likely that contamination may continue to migrate back into the utility corridor. Please remember that flushing of the plastic pipes will not solve the permeation problem. Again, caution should be utilized. DEQ recommends that impermeable metal piping such as ductile iron be utilized in all hot spots to reduce the liability associated with adverse impacts to human health and the environment.

Need for Assessment and Potential Liability

Under state and federal law, owners and operators of UST systems are responsible for petroleum releases stemming from their systems (40 C.F.R. 280.62 and ARM 17.56.602). Therefore city municipalities with waterlines that are threatened or impacted by petroleum contamination are generally considered impacted 3rd parties. However, if the waterline is repaired, constructed, or replaced within known petroleum contamination without exercising best management practices, the owner of that impacted waterline may lose their 3rd party status and become partly liable if the waterline is impacted in the future. Therefore, it is imperative that a proper environmental assessment is performed prior to conducting the actual work. A proper environmental assessment will identify potential environmental problems before construction; enabling the owner of the impacted waterline to negotiate reimbursement of additional expenses associated with implementing best management practices in contaminated areas with the responsible party.