COVER SHEET
STANDARD OPERATING PROCEDURE

Operation Title: **Managing Non-Hazardous Petroleum Contaminated Ground Water and Soil at UST Sites**

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1.0 APPLICABILITY

This Standard Operating Procedure (SOP) applies to projects in the Maine Department of Environmental Protection's (MEDEP) Bureau of Remediation and Waste Management (BRWM) contaminated with non-hazardous petroleum products. It is recommended for use by all parties that investigate, mitigate, or remediate petroleum releases.

The on-site or off-site beneficial use of virgin petroleum contaminated soil from Department supervised remedial activities is exempt from the licensing requirements of *Beneficial Use of Solid Wastes*, 06-096 C.M.R. ch. 418 (last revised July 8, 2018), under the terms of §3(O) and §3(R) when the project is conducted in conformance with all applicable provisions of this SOP. (http://www.maine.gov/sos/cec/rules/06/096/096c418.docx).

This SOP is not a rule and is not intended to have the force of law, nor does it create or affect any legal rights of any individual, all of which are determined by applicable statutes and rules. This SOP does not supersede statutes or rules.

2.0 PURPOSE

The purpose of this document is to describe the MEDEP/BRWM procedures for managing ground water and soil primarily at underground storage tank (UST) facilities that have suffered the release of non-hazardous petroleum products. The procedures may be applied in other situations, such as aboveground storage tank facilities and home heating oil spills, where non-hazardous petroleum is the only contaminant. This SOP describes procedures used over short term periods, typically less than 30 days.

Reporting requirements for UST sites are outlined in *Rules for Underground Oil Storage* Facilities, 06-096 C.M.R. ch. 691 (effective date September 16, 1991, amended September 26, 2018-filing 2018-205).

3.0 RESPONSIBILITIES

All MEDEP/BRWM Staff must follow this procedure when managing a UST removal. All Managers and Supervisors are responsible for ensuring that their staff are familiar with and adhere to this procedure. MEDEP/BRWM staff reviewing data by outside parties are responsible for determining if the procedure (or an approved equivalent) was utilized appropriately.

The project leader for a petroleum release site is responsible for:

1. Developing a conceptual site model (CSM) and ascertaining the site's history and current use for MEDEP review and approval at non-MDEP lead sites.
2. Developing media specific remediation goals for MEDEP's review and approval at non-MDEP lead sites that are consistent with the Remedial Action Guidelines (RAGs) and CSM.

3. Establishing and maintaining communications with the:
    a. UST facility owner/operator
    b. Certified tank installer
    c. General contractor (excavator)
    d. Consultant
    e. MEDEP staff who have been assigned to the project from the Response Division; Technical Services Division; Petroleum Management Division; and the Collection, Claims and Recovery Unit.
    f. Landowners
    g. Waste receiving facilities

Utilizing the CSM, professional judgement, and good communications the project leader can choose to leave ground water or soil at the site or follow the procedures of this SOP to treat, dispose, and/or beneficially use it.

4.0 DEFINITIONS and ACRONYMS

4.1 Approved Facility – An in-state facility licensed by the MEDEP or out-of-state facility with similar approvals that accepts petroleum contaminated ground water or soil. Examples include Publicly Owned Wastewater Treatment Plants, Sanitary Sewer Districts, Special Waste Landfills, Soil Processing Facilities.

4.2 Contaminant of Concern (COC) - A contaminant that has been released at a site and risk evaluation indicates that mitigation or remediation is necessary to prevent exposure to the contaminant.

4.3 Compliance and Technical Assistance Unit – The Compliance and Technical Assistance Unit within Bureau of Water Quality, Division of Water Quality Management is composed of wastewater inspectors and engineers responsible for reviewing compliance at wastewater pretreatment facilities and POTW's.

4.4 Construction Fill – As defined in *Maine Solid Waste Management Rules, General Provisions* 06-096 C.M.R. ch. 400 (last revised April 6, 2015): , "Construction fill" means fill that may contain solid waste utilized to provide material for construction projects such as roads, parking lots, buildings or other structures. It does not include fill needed to re-contour an area within a landfill or where no further construction is occurring. If the construction fill contains solid waste other than inert fill, the use of the fill is regulated under 06-096 C.M.R. ch418.

4.5 Dewater - The process of lowering the ground water elevation in an excavated area that is flooded with rainwater or ground water.

4.6 Extractable petroleum hydrocarbons (EPH) - Massachusetts Department of Environmental Protection's Method for the Determination of Extractable Petroleum Hydrocarbons (EPH). https://www.mass.gov/files/documents/2017/12/21/MassDEP%20EPH%20Method%20-%20May%202004%20v1.1.pdf

4.7 Granular Activated Carbon (GAC) - A filter media used to remove dissolved organic and inorganic contaminants from water and remove volatile organics from air to reduce emissions and control indoor air odors. GAC is a form of processed carbon designed to have small, micropores to increase surface areas available for adsorption or chemical reactions. GAC is made from raw organic carbonaceous materials such as coconut shells, nut shells, peat, wood, or coal.

4.8 Inert Fill – As defined in 096 C.M.R. ch. 400, “Inert fill” is clean soil material, including soil from road ditching and sand from winter sand cleanup; rock; bricks; crushed clean glass or porcelain; aged, fully-hardened asphalt; and cured concrete; that are not mixed with other solid or liquid waste, and are not derived from an ore mining activity.

4.9 Leaded Fuels – Fuels that contain lead and lead scavengers. Gasoline known to have been manufactured before 1979 is presumed to be leaded. According to Maine Chapter 691 Rule for Underground Oil Storage Facilities, lead was prohibited in gasoline as of January 1, 1996. Facilities operating prior to 1996 will need to determine the presence or absence of lead and lead scavengers. Lead continues to be used in high octane fuel and certain aviation fuel.

4.10 Light Non-aqueous Phase Liquid (LNAPL) - A liquid having a specific gravity less than one and is composed of one or more organic compounds that are immiscible or sparingly soluble in water and is observable to be separate from water. The term encompasses all potential occurrences of LNAPL including free, residual, mobile, entrapped, and visible petroleum sheen.

4.11 Oil – As defined in *Oil Discharge Prevention and Pollution Control,* 38 M.R.S. §542(6) (2021), “Oil” means petroleum products and their by-products of any kind and in any form including but not limited to, petroleum, fuel oil, oil refuse, oil mixed with other wastes, crude oils and all other liquid hydrocarbons regardless of specific gravity. Oil does not include liquid natural gas.

4.12 Petroleum Contaminated Soil – As defined in 06-096 C.M.R ch 418, “Petroleum contaminated soil” means soil that has been verified through sampling and analysis, and site-specific documentation provided by the generator, to have been contaminated by a discharge/release of petroleum. Petroleum contaminated soil may include soil with naturally occurring concentrations of chemicals (e.g. arsenic); and petroleum additives (e.g. ethanol) except for lead.

4.13 POTW – Publicly owned treatment works. POTW’s can be municipal wastewater treatment plants, sanitary districts, or sewer districts.

4.14 Protected Natural Resource – As defined by *Natural Resources Protection Act* 38 M.R.S. § 480-B (8) (2007), protected natural resouece means coastal sand dune systems, coastal wetlands, significant wildlife habitat, fragile mountain areas, freshwater wetlands,

community public water system primary protection areas, great ponds or rivers, streams or brooks, as these terms are defined in 38 M.R.S. § 480-B.

4.15 Site-specific Remedial Action Guidelines – As defined in the MEDEP Remedial Action Guidelines include:

- Statewide Ground Water & Drinking Water Remediation Guidelines for Petroleum Related Compounds
- Soil Remediation Guidelines Based on Petroleum Leaching to Ground Water
- Soil Remediation Guidelines for Petroleum Target Compounds and Hydrocarbon Fractions
    - Applicable human exposure scenarios:
        - Residential
        - Recreational/park user
        - Outdoor commercial/industrial worker
        - Construction/excavation worker

4.16 Surplus soil – Soil removed from its original location and cannot be re-used on site. Surplus soil known or presumed to be petroleum contaminated can be managed in accordance with this document.

4.17 Underground Storage Tank (UST) - Any container, 10 percent or more of its volume being beneath the surface of the ground and which is used, or intended to be used, for the storage, use, treatment, collection, capture or supply of oil, but does not include any tanks situated in an underground area if these tanks or containers are situated upon or above the surface of a floor and in such a manner that they may be readily inspected. Does not include underground propane storage tanks, wastewater treatment tank systems such as underground oil water separators that are regulated by the Clean Water Act §§ 402 or 307(b) (1972) (33 U.S.C., §1317(b) or §1342 (2016)), storm water and emergency catch basins, and equipment or machinery tanks such as hydraulic lift tanks and electrical equipment tanks. Overflow tanks associated with oil-water separators are still considered an underground oil storage tank.

4.18 Virgin Petroleum Contaminated Soil – Soil that is contaminated with unused refined petroleum oil.

4.19 Volatile petroleum hydrocarbons (VPH) - Massachusetts Department of Environmental Protection's Method for the Determination of Volatile Petroleum Hydrocarbons (VPH) https://www.mass.gov/files/documents/2018/02/23/VPH%20GC%20PIDFID_Revision%202_1_February%202018.pdf

5.0 GUIDELINES AND PROCEDURES

5.1 INTRODUCTION

When a UST facility owner removes, replaces, or repairs the facility, petroleum contaminated ground water or soil may be generated. The UST facility owner is obligated to manage the treatment or disposal of the petroleum contaminated groundwater and soil to ensure protection of human health and the environment. This SOP provides a process for meeting those obligations. Where ground water needs to be removed from the excavation or when soil cannot be returned to its original location or an acceptable on-site location approved by MEDEP; this SOP should be followed if the UST facility owner intends to qualify for exemption from the licensing requirements of 06-096 C.M.R. ch. 418 for soil or treat groundwater removed from the excavation and discharge to the ground or to a sanitary sewer collection system. Following this SOP requires Department staff from BRWM, Division of Petroleum Management or Division of Technical Services direction and supervision when handling soils and groundwater during the UST removal/replacement. The direction and supervision by Department staff will be addressed during the 10-Day notification period in accordance with 06-096 C.M.R. ch. 691 §4.

It is the responsibility of the UST owner to provide the information needed to follow this SOP to Department staff directing the remedial activities as provided in Section 5.2 below. The information can be provided to Department staff prior to or at the beginning of the 10-day notification period. Proper planning is necessary to manage the contaminated media so that all parties involved in the excavation, transport, processing, receiving and disposal are prepared to follow the Department approved plan.. Failure to provide the information will result in the need for the UST facility owner to handle the soil and groundwater as contaminated media requiring proper testing and disposal at a licensed facility. This may impact reimbursements from the Fund Insurance Program, in accordance with RWM-PP-005. Therefore, it is important to include the Collections, Claims, and Recovery Unit in the planning discussions.

When dewatering at a UST site is necessary, the procedures of this SOP, can be used to determine the appropriate management and discharge options for each site including : 1) management of liquids for off-site disposal; 2) filter and discharge treated water on-site; 3) filter and discharge treated water to an approved sanitary sewer collection system; or 4) if the water meets the requirements for direct discharge to an approved sanitary sewer collection system. UST facilities intending to use this SOP for managing water from a UST excavation need to have an approved work plan prior to the starting the removal activities at the UST site.

UST replacement projects may generate surplus soil that cannot be stockpiled or re-used on-site and needs to be moved off-site. This SOP can be used to beneficially use surplus soil off-site as Construction Fill or dispose of the surplus soil at an approved facility.

Alternatively, a site-specific environmental media management plan may be approved by MEDEP as an alternative to the options described below.

5.2 PLANNING

Proper planning and effective communication are the keys to successfully managing surplus soil and groundwater at a UST replacement site. Planning needs to include Department BRWM staff, the UST facility owner/operator, certified tank installer, general contractor (excavator), consultant, landowner, and waste receiving facilities to assure consistency with 06-096 C.M.R. ch. 418 for soils, and compliance with the provisions of this SOP. Proper planning and communication will expedite the project and facilitate the MEDEP's timely review of requests for reimbursement of clean-up costs eligible for coverage under the State's Ground Water and Surface Water Clean-up and Response Fund. Proper planning includes the following elements:
:

1. Requesting a pre-construction meeting with the UST facility owner/operator, certified tank installer, general contractor or consultant, and MEDEP.
2. Developing a Conceptual Site Model (SOP RWM-PP-006) which considers receptors, site history, and current use.
3. Establishing appropriate guidelines for soil and groundwater based on the CSM.
4. Summarizing existing site data and notification levels for UST sites as explained in SOP RWM-PP-004 and 06-096 C.M.R. ch. 691,, Appendix Q 1(B) and 2.
5. Requesting an Oil Spill Debris Form from the MEDEP Response Division as appropriate.
6. Choosing the option(s) for ground water discharge or treatment (see Section 5.3 of this SOP). Specifically:
    a. Estimate the volume of ground water to be discharged or treated.
    b. Obtain the necessary approvals or permits from the receiving Wastewater Treatment Facility.
    c. Notify the Compliance and Technical Assistance Unit.
7. Estimating the volumes of soil to be temporarily stockpiled, transported off-site as "Construction Fill," or disposed at an approved facility. Specifically:
    a. Identify the location and containment measures for temporary on-site or off-site soil stockpiles. (See Appendix B.)
    b. Obtain the necessary approvals or permits from the landowner of the temporary off-site stockpile location.
    c. Describe the proposed sampling intervals and analysis of Slightly Contaminated Surplus Soils. (See Section 5.4 of this SOP and Appendix B.)
    d. Identify the off-site location for surplus soil determined to be "Construction Fill" and obtain the necessary approvals or permits from the landowner receiving it.
    e. Obtain approval from the MEDEP that the surplus soil being transported off-site meets the requirements of "Construction Fill" and its intended location is appropriate.
    f. Provide the name of the approved facility that will accept soil that exceeds the criteria outlined in Section 5.4 of this SOP.
8. Providing the appropriate erosion and sediment control measures in accordance with the Maine Erosion and Sediment Control Practices Field Guide for Contractors, revised 2014.

When plans include possible discharge of water from the excavation, BRWM staff need to notify one or more of the following entities prior to approving the plan:

1) MEDEP's Bureau of Water Quality Compliance and Technical Assistance Unit and Wastewater Licensing Unit; and the affected Municipal or District Wastewater Treatment Facility
2) The MEDEP Regional Wastewater Compliance Manager for any discharge to a POTW.
3) MEDEP Wastewater Licensing Unit Manager for surface discharge permits.

All data and other information gathered during the project should be included in the written report required by 06-096 C.M.R. ch. 691, Appendix P to be submitted to the MEDEP at the conclusion of the project. Additionally, laboratory results should be submitted to the MEDEP as Electronic Data Deliverables (EDD) in MEDEP-approved format.

5.3. GROUND WATER – Discharge Options and Minimum Treatment Standards

Groundwater discharge options can only be selected if the proper planning steps in Section 5.2 are completed and approvals from MEDEP BRWM staff have been provided in writing.

OPTION 1: Off-site Disposal
Water from a UST excavation can be pumped into a fractionation (frac) tank or a vac-truck. All LNAPL and petroleum contaminated water must be transported to an approved facility licensed to accept the waste (e.g. POTW, Centralized Waste Treatment Facility) after approval is received from the facility. Requirements for sampling, analysis, characterization, and manifesting of the material will be dictated by the licenses of the transporter and approved receiving facility. The MEDEP Regional Wastewater Compliance Manager must be notified prior to transport to a POTW.

OPTION 2: On-site Treatment and Discharge to the Ground
The petroleum contaminated water must be determined by laboratory analysis to be suitable for discharge on-site with approvals from MEDEP BRWM and the Wastewater Licensing Unit Manager.

Petroleum contaminated water may be discharged on-site, if the following conditions have been met.

- The baseline filtration system and monitoring protocol described in Appendix A of this SOP must be used or an alternative system may be approved by the MEDEP Technical Services Division.
- Petroleum contaminants are treated below the State-wide Ground Water Guidelines for Petroleum Related Compounds, before infiltration into the ground.
- There will be no discharge of treated water to a surface water body or protected natural resource.

- Erosion and sedimentation control measures must be in place to protect the hydrocarbon filtration system and prevent erosion or siltation from the discharge. (The Maine Erosion and Sediment Control Practices Field Guide for Contractors, revised 2014 contains best practices for dewatering excavations and types of sediment controls.)
- The ground is not frozen.

Option 3: On-site Treatment and Discharge to a Sanitary Sewer Collection System
The petroleum contaminated water must be determined by laboratory analysis to be suitable for discharge to the collection system with approvals from the MEDEP BRWM and the approved facility receiving the wastewater. Notify the MEDEP Regional Compliance Manager.

Petroleum contaminated water may be discharged directly into the sanitary sewer collection system, if the following conditions have been met.

- Petroleum contaminants meet the requirements of the approved facility receiving the wastewater through the sanitary sewer collection system.
- There will be no discharge of treated water to a surface water body or protected natural resource.

5.4 SOIL – Field Screening Criteria, Analytical Methods, and Re-use or Disposal Options

Soil being evaluated for on-site or off-site use should be field screened in accordance with SOP RWM-PP-004 Compendium of Field Testing of Soil Samples for Gasoline and Fuel Oil (TS-004). When a photo ionization detector (PID) is used, detectable results should be evaluated against the Leaching to Ground Water Field Cleanup and Notification Guidelines found in Table 1 of TS-004 for the instrument being used. Diesel, fuel oil, and kerosene contaminated soil can be field-tested with the oleophilic dye test and interpreted as outlined in Section 8.4 of TS-004. The possible result will be “Saturated”, “Positive”, “Slightly Positive”, or “Undetected”.

If laboratory analysis of soil is necessary, using the EPH or VPH analytical methods depends on the petroleum product and age of contamination. See Appendix B of this SOP for recommendations.

Table 1 summarizes the Field Screening Criteria, Analytical Methods, and Re-use or Disposal Options.

Table 1: Field Screening Criteria, Analytical Methods, and Re-use or Disposal Options

Surplus soil is considered:	When:	The soil can be:	
Minimally contaminated	There is no visual or olfactory evidence of petroleum contamination; and The bag-headspace measurements, for gasoline contamination, have PID readings less than 10 parts per million (PPM); or The oleophilic dye test result, for fuel oil contamination, is "Undetected".	Used off-site only as "Construction Fill".	
Slightly contaminated	Has visual or olfactory evidence of petroleum contamination; and The bag-headspace measurements, for gasoline contamination, have PID readings between 10 PPM and the Leaching to Ground Water Field Cleanup Guideline; or The oleophilic dye test result, for fuel oil contamination, is "Slightly Positive".	Disposed at an approved facility (e.g. Special Waste Landfill, Soil Processing Facility); or	
		Stockpiled for up to 30 calendar days pending laboratory results using the EPH and VPH Analytical Methods. (See Appendix B for stockpile criteria and sampling requirements.)	IF all results are below the values in Appendix B - Table 1, use soil as "Construction Fill" with the limitation that it cannot be placed in a residential setting or within a "protected natural resource" as defined by 38 M.R.S. §480-B (8).
			IF any result is above its value in Appendix B - Table 1, soil must be disposed at an approved facility (e.g. Special Waste Landfill, Soil Processing Facility).
Moderately to substantially contaminated	The bag-headspace measurements, for gasoline contamination, have PID readings above the Leaching to Ground Water Notification levels; or The oleophilic dye test result, for fuel oil contamination, is "Saturated or "Positive".	Live-loaded or stockpiled and must be disposed at an approved facility (e.g. Special Waste Landfill, Soil Processing Facility).	

6.0 QUALITY ASSURANCE/QUALITY CONTROL

Data quality objectives (DQOs) should be stated in the SAP. Quality Assurance/Quality Control (QA/QC) samples may be collected if needed to meet DQOs. Typical types of QA/QC samples that may be collected or prepared at the laboratory include replicate Multi-increment samples to allow determination of an upper contaminant level for the decision unit, laboratory control blank spikes, and analysis of reference material containing known concentrations of the target analytes. All analytical data should be reviewed and assessed to determine if DQOs have been met. If review indicates DQOs have not been met, corrective action will be recommended by the reviewer.

7.0 REFERENCES

DRAFT Protocol for the Off-site Beneficial Use of Surplus Soil as Construction Fill at DEP Supervised Projects that are Contaminated with Virgin Petroleum, Maine DEP, Bureau of Remediation & Waste Management, August 2017

Massachusetts Department of Environmental Protection, Division of Environmental Analysis, Office of Research and Standards, Bureau of Waste Site Cleanup (May 2004, Revision 1.1). METHOD FOR THE DETERMINATION OF EXTRACTABLE PETROLEUM HYDROCARBONS (EPH).

Massachusetts Department of Environmental Protection, Bureau of Waste Site Cleanup (February 2018, Revision 2.1). METHOD FOR THE DETERMINATION OF VOLATILE PETROLEUM HYDROCARBONS (VPH) BY GAS CHROMATOGRAPHY/PHOTOIONIZATION DETECTOR/FLAME IONIZATION DETECTOR.

Rules for Underground Oil Storage Facilities, 06-096 C.M.R. ch. 691 (effective date September 16, 1991, amended September 26, 2018-filing 2018-205)

Maine Erosion and Sediment Control Practices Field Guide for Contractors, revised 2014.

RWM-PP-006 Conceptual Site Model
RWM-PP-005 Eligible Cleanup Costs and Fund Insurance Program
RWM-PP-007 Sampling and Analysis Plan
RWM-PP-004 Compendium of Field Testing of Soil Samples for Gasoline and Fuel Oil

US EPA 40 C.F.R Part 280

Appendix A
Sizing Granular Activated Carbon (GAC) Treatment Systems for Short-Term Dewatering at Petroleum Sites

APPENDIX A – SIZING GRANULAR ACTIVATED CARBON (GAC) TREATMENT SYSTEMS for SHORT TERM DEWATERING AT PETROLEUM UST SITES

Introduction

On site, short term, treatment systems for petroleum contaminated groundwater are typically comprised of a settling/separation tank, a particulate bag filter, granular activated carbon (GAC) and sedimentation/erosion control measures for the discharge. This appendix provides recommended processing rates for standard vessel geometries in order to maximize the removal with the minimum amount of GAC. The standard geometries, GAC volume, flow rates, organic capacity, and sample and screen interval, across a range of concentrations are summarized in the attached TABLE 1. (The Maine Erosion and Sediment Control Practices Field Guide for Contractors, revised 2014 contains best practices for dewatering excavations and types of sediment controls.)

Pre and post components of the GAC system, the contaminant concentration, treatment process rate, and total volume of groundwater to be treated are based upon the hydrogeological setting and construction objectives and are to be established in advance of sizing the GAC system.

System Design

A critical factor in maximizing organic removal with the least amount of GAC is to process at the flow rates listed with the geometries in Table 1. Effective operation of GAC treatment is a function of the velocity through the media (referred to as Surface Loading Rate – SLR) and the time in contact with the media (referred to as Empty Bed Contact Time – EBCT). Maintaining a an SLR of at least 2 gallons per minute and maintaining an EBCT of at least 15 minutes increases the utilization and performance of the media. As SLR and EBCT are inversely related, the specified flow rates in TABLE 1 represent the optimum balance for the particular vessel geometry and carbon volume and must be maintained. Selection of a vessel geometry and carbon volume is commitment to the specified flow rate that must be controlled and monitored through pump, valve and metering mechanisms.

The above design parameters are based upon long term treatment operations required for plume control or potability. Dual GAC vessels in series, each sized to provide an EBCT of at least 15 minutes and an SLR of between 2 and 10 gallons per minute is the design basis for long term operations. The second vessel in these systems provide 100 % redundancy as a safety factor and allows for operations to continue when the lead vessel needs to be replaced and the lag vessel becomes the lead.

Dual GAC vessels in series are also the design basis for treatment of groundwater generated during dewatering at UST sites. Considering the short term, one-time, complete use at UST sites, the 15-minute contact time can be met across the two vessels rather than in each vessel.

The GAC life provided in TABLE 1 represents the capacity of one completely utilized vessel but the contact time necessary for complete utilization requires incorporation of the second vessel.

Two beds are necessary so what is the advantage of allowing 7.5 minutes EBCT per bed? In contrast to a potable water supply where breakthrough of the first bed requires rebedding the lead vessel and rotating the lag vessel into the lead position, rebedding is not necessary upon breakthrough of the first vessel for a short-term system.

The capacity is based primarily upon an empirical database referenced by EPA[i]. The capacity from the empirical database was compared to theoretical estimates and data from carbon suppliers. There is no accounting for the native organics in the groundwater and details about the sites in the empirical database were not found so applying it to this situation is appropriate but carries a significant number of unknowns. Not accounting for organics and the unknowns of the database are compensated for with a monitoring schedule that includes analytical testing and field screening/observations.

If evaluating a “package” system supplied by Others, it is helpful to know that a 2-foot-deep GAC bed depth provides both the 7.5-minute EBCT and SLR of 2 gallons per minute per square foot. Cutting the depth to below 2 feet, requires a proportional reduction in EBCT or SLR. Similarly, increasing the depth, proportionally increases either the EBCT or the SLR. This can be seen in Table 1, under the 24-inch diameter vessel where the depth goes from 2 to 4 feet, the EBCT doubles to 15 minutes with the SLR being held constant at 2 gallons per minute per square foot.

System Monitoring

The monitoring schedule in TABLE 1 is one tenth of the estimated capacity (in gallons of contaminated groundwater) of the fully utilized GAC in a single vessel. The screening interval is fixed and required throughout the operation.

The schedule for sampling (for lab analysis) generally coincides with the screening interval. An exception is with process rates above 14 gallons per minute where the daily process volume more than doubles the monitoring interval. At the higher flow rates indicated in TABLE 1, sampling daily is acceptable.

Co-collecting samples for lab analysis during each screening event may be appropriate for the first three events to generate an understanding about the influent, GAC performance and correlation between lab and filed screening. To enhance the correlation study, sampling/screening from all locations is recommended during the first three events.

Subsequent sampling for lab analysis is dependent upon many site and analytical (turnaround) factors and it is recommended that the longer term operational sampling plan be developed on a

site specific basis. After the first three rounds of monitoring, receipt of analytical results, and compilation of the data with the field screening results, the information is to be reviewed and discussed with the DEP representative to identify appropriate modifications in the monitoring scope and schedule. Of course, significant changes in water quality or operations should be brought to DEP's attention as soon as they are identified.

Monitoring locations/components include the excavation(s), the storage tank(s), before, between and after GAC, flow rate, flow volume and pressure. Attention to and interpretation of the excavation water and between GAC units results at each site is important with regard to: catching changes in water quality, developing an understanding of the actual GAC performance, adjusting the monitoring scope and interval based upon actual performance, and setting expectations for if and when carbon change outs or treatment modifications will be necessary. Under stable influent concentrations and maintaining the design flow rate, it is reasonable to use volume processed at the time of breakthrough of the first vessel as an estimate of the remaining capacity of the system. Site specific results and indicators are to be favored over the capacity estimates provided in TABLE 1 and a primary goal of screening and sampling is to identify breakthrough of the first GAC and adjust the monitoring and re-bed schedule accordingly.

The scope of the monitoring is based upon the site particular contaminants of concern. At a gasoline UST site, analysis is predominantly Massachusetts DEP Method for Volatile Petroleum Hydrocarbons (VPH) and can include lead and lead scavengers per EPA Method 8260. Each monitoring event is to include observational screening (appearance, odor) and field screening. Preliminarily acceptable/under consideration field screening methods for petroleum in groundwater include use of a photoionization detector (PID) as presented in Maine DEP's PID Screen for Oil in Water (PIDSOW) and OIL STICKS™. Co-collecting screening and analytical samples and tabulating the results is recommended to determine if a correlation exists and if so, identify how it can serve the monitoring program going forward.

Use and Application of TABLE 1

The following TABLE 1 provides contaminated groundwater capacities (in gallons), along with recommended screening and sampling intervals, across a range of influent concentrations for a few common vessel geometries. There are several approaches to using TABLE 1 but all require understanding of the hydrogeology and construction objectives. Necessary information includes dewatering volume, duration, process rate and concentration. In situations where information is limited, selecting a larger capacity system is recommended with the understanding that a specific treatment flow rate is necessary to effectively utilize the GAC bed. For instance, a system that could be considered a "baseline requirement" on sites with little or no preconstruction information is a 36" diameter vessel with a 4-foot-deep GAC bed which can process 40,000 gallons of 10 PPM contamination at a rate of 14 gallons per minute.

References

Department of the Army Dg 1110-1-2, U.S. Army Corps of Engineers Adsorption Design Guide No. 1110-1-2, 1 March 2001. https://apps.dtic.mil/dtic/tr/fulltext/u2/a403095.pdf

"Cleanup of Releases from petroleum USTs". USEPA/530/UST-88/001, April 1988.

Maine Department of Environmental Protection Bureau of Remediation and Waste Management
SHORT TERM PETROLEUM CONTAMINATED GROUNDWATER MANAGEMENT at UST SITES

APPENDIX A - TABLE 1 - SIZING GRANULAR ACTIVATED CARBON (GAC) SYSTEMS

	DESIGN			GEOMETRY										ESTIMATED GAC CAPACITY (in gallons) and RECOMMENDED SCREENING AND SAMPLING INTERVAL (gallons) OVER a RANGE of PETROLEUM CONCENTRATIONS and GEOMETRIES								
OPTION	**Surface Loading Rate (SLR)**		**EBCT**	**Depth (D) = V/SA**	**Vessel Diameter (DIA)**		**Radius (r) DIA/2**	**Surface Area (SA) 3.14 x r2**	**Volume (V) GAC**			**Process Rate (Q) = SLRxSA**		<1 PPM			<10 PPM			<30 PPM		
	GPM/SF	CFPM/SF	MIN	Feet	Inches	Feet	Feet	SF	CF	Gallons	Pounds	GPM	CFM	Capacity	Screen	Sample	Capacity	Screen	Sample	Capacity	Screen	Sample
24" DIA	2	0.27	7.5	2	24	2	1	3.14	6.3	47.1	173.3	6.3	0.8	200000	20000	20000	20000	2000	2000	INSUFFICIENT CAPACITY		
Double D Same Q	2	0.27	15.0	4	24	2	1	3.14	12.6	94.2	346.5	6.3	0.8	400000	40000	40000	40000	4000	4000	INSUFFICIENT CAPACITY		
Double D Double Q	4	0.53	7.5	4	24	2	1	3.14	12.6	94.2	346.5	12.6	1.7	400000	40000	40000	40000	4000	4000	INSUFFICIENT CAPACITY		
30" DIA	2	0.27	7.5	2	30	2.50	1.25	4.91	10	73.4	269.8	9.8	1.3	200000	20000	20000	20000	2000	2000	INSUFFICIENT CAPACITY		
Double D Same Q	2	0.27	15.0	4	30	2.50	1.25	4.91	20	146.8	539.7	9.8	1.3	400000	40000	40000	40000	4000	4000	20000	2000	2000
Double D Double Q	4	0.53	7.5	4	30	2.50	1.25	4.91	20	146.8	539.7	19.6	2.6	400000	40000	40000	40000	4000	DAILY	20000	2000	DAILY
36" DIA	2	0.27	7.5	2	36	3.00	1.50	7.07	14	105.7	388.6	14.1	1.9	400000	40000	40000	40000	4000	DAILY	20000	2000	DAILY
Double D Same Q	2	0.27	15.0	4	36	3.00	1.50	7.07	28	211.4	777.2	14.1	1.9	400000	40000	40000	40000	4000	DAILY	20000	2000	DAILY
Double D Double Q	4	0.53	7.5	4	36	3.00	1.50	7.07	28	211.4	777.2	28.3	3.8	400000	40000	40000	40000	4000	DAILY	20000	2000	DAILY

NOTES

1 The first "OPTION" listed for each diameter is the "optimum". The "optimum" is minimum amount of GAC in a geometry that provides the minimum recommended velocity (2 gallons per minute per square foot) to prevent channeling and the minimum recommended Empty Bed Contact Time (EBCT) of 15 minutes (two vessels, each providing 7.5 minutes). The second and third configurations for each diameter show the impact on doubling the depth of the carbon bed. With a doubling of the carbon depth, the EBCT can be doubled to provide 15 minutes per vessel (using only one vessel for the entire 15 minute EBCT may be allowed for low volumes), or the flow rate can be doubled with the baseline EBCT per vessel (7.5 min). Vessels providing the diameters (24", 30" and 36")and heights (72" for all 3 diameters) are as supplied by or an equivalent to Pentair.

2 GAC CAPACITY: Literature on an empirical database, experimental theory and from carbon suppliers was reviewed and compared. The capacities in this table are primarily based upon an empirical database referenced in EPA's April 1988 Document EPA/530/UST-88/001 "Cleanup of Releases from Petroleum USTs: Selected Technologies". Generally, the posted capacities are within the order of magnitude and near or below the EPA reported estimated capacities. Carbon life predictions are less reliable with higher concentrations and the 30 PPM capacities are reduced by 1/2 in consideration of the reduced reliability. The capacities are based upon the volume of GAC in a single vessel and should be considered the capacity of the entire 2 vessel system when sizing for a site.

3 SCREENING and SCREENING INTERVAL: Comprehensive screening (excavation, storage tank, before, between and after GAC) is required at "start-up" which is defined as the first hour or 1000 gallons of operation. The ongoing screening interval is set at 1/10th of the estimated capacity. Due to the rate that groundwater must be processed and the turn around time asociated with lab analysis, catching changes in water quality and making operational decisions must be based upon field screening results. Field screening tests with a PID and observations (visual, odor) are to be collected at each screening interval and considered collectively (multiple lines) in decision making.

4 LAB ANALYSIS and SAMPLE INTERVAL: Comprehensive analysis (excavation, storage tank, before, between and after GAC) is required at "start-up" which is defined as the first hour or 1000 gallons of operation. The "DAILY" sample interval recognizes that at the higher processing rate, the screening interval may be reached several times during a day. Daily samples rather than volume interval samples are acceptable with the high flow rates.

Appendix B
Soil Stockpiling and Off-site Use as Construction Fill

APPENDIX B – SOIL

Table 1: Non-hazardous Petroleum Contaminated Soil Suitability for Off-Site Use Guidelines

Compound/Fraction	Value (mg/kg)	Basis*
Gasoline Contaminated Soils		
Benzene	0.51	LTG
Ethylbenzene	0.81	LTG
Methyl tert-Butyl Ether	0.19	LTG
Naphthalene	1.7	LTG
Toluene	8.1	LTG
Xylene	26	LTG
C5-C8 Aliphatics	1400	Res
C9-C12 Aliphatics	2700	Res
C9-C10 Aliphatics	75	LTG
Lead	100	691
Diesel/Kerosene/Heating Oil Contaminated Soils		
2-Methylnaphthalene	3.6	LTG
Acenaphthene	170	LTG
Acenaphthylene	68	LTG
Anthracene	760	Ex/Con
Benzo(a)anthracene	0.86	Rural Bkg
Benzo(a)pyrene	1.5	Rural Bkg
Benzo(b)fluoranthene	1.3	Rural Bkg
Benzo(g,h,i)perylene	750	Res
Benzo(k)fluoranthene	2.6	Res
Chrysene	26	Res
Dibenz(a,h)anthracene	0.28	Urban Bkg
Fluoranthene	1000	Res
Fluorene	120	LTG
Indeno(1,2,3-cd)pyrene	0.4	Rural Bkg
Naphthalene	1.7	LTG
Phenanthrene	97	LTG
Pyrene	750	Res
C9-C18 Aliphatics	2700	Res
C19-C36 Aliphatics	10,000	ceiling
C11-C22 Aromatics	460	LTG

*LTG – Leaching to Groundwater
Res – Residential Direct Contact
Ex/Con – Excavation/Construction Worker Direct Contact
Bkg – Background
691 – Chapter 691 Requirements

Criteria for Temporary Surplus Soil Stockpiles

"Slightly Contaminated" or "Moderately to Substantially Contaminated" soils may be temporarily stockpiled on-site or off-site in conformance with the following criteria:

- On-site: Petroleum contaminated soil that is being evaluated for off-site use may be stockpiled on the site of generation pending the receipt of laboratory results. Surplus soil stockpiled for longer than 2 days should be underlain and covered with an impermeable material that has been secured to minimize the potential for release of contaminants to the environment (e.g. volatilization, leachate generation, runoff, and wind transport). See the Maine Erosion and Sediment Control Practices Field Guide for Contractors, revised 2014 for construction specifications.

- Off-site: In cases where sufficient on-site space is not available, a temporary off-site surplus soil stockpile location may be established provided the following setbacks and operational criteria are met. The distances of each of the setbacks and conformance with the operational criteria must be documented in the final report for the project. Any alternative setback or other deviation from the criteria must be authorized by MEDEP staff prior to the petroleum contaminated soil being stockpiled in an off-site location.

  Off-site petroleum contaminated stockpile(s) must be located:

  1. Greater than 300 feet from a private drinking water supply and greater than 1,000 feet from a public water supply well. These limits may need to be extended if water supplies are shown to be hydraulically down-gradient;

  2. Greater than 300 feet from surface water bodies;

  3. Greater than 300 feet from an occupied residential dwelling, unless the owner of the residence has consented in writing to a reduced setback;

  4. Greater than 100 feet from a sensitive environment such as a wildlife refuge, wetland, 100-year floodplain, or other similar area;

  5. On land with more than 3 feet of soil cover over bedrock;

  6. On land without ponding, springs or groundwater discharge, significant gully erosion or significant drainage onto the stockpile area;

  7. On sites where the water table is more than 3 feet from the ground surface (saturated soil should be considered evidence of the water table);

  8. On slopes less than 5%; and,

  9. On ground that is not covered with snow (frozen ground with no snow cover may be acceptable with DEP approval);

     Additionally:

10. Surplus soil stockpiled for longer than 2 days shall be underlain and covered with an impermeable material that has been secured to minimize the potential for release of contaminants to the environment (e.g. volatilization, leachate generation, runoff, wind transport);

11. Surplus soil shall be stockpiled in accordance with the Maine Erosion and Sediment Control Practices Field Guide for Contractors, revised 2014; and,

12. Public access to the stockpile site shall be restricted; (e.g. by fence, posting, gate or cable).

13. Confirmation sampling is needed once the stockpile is removed to document that all the impacted soils have been removed at the end of the project. The scope of the plan will be site specific based on the project and location of the stockpile.

NON-HAZARDOUS PETROLEUM CONTAMINATED SURPLUS SOIL EVALUATION PLAN

Generator/Owner of Surplus Soil	Temporary Off-Site Stockpile Location
MEDEP Spill #	GPS Coordinates
Source of Soil	Street Address
Generator Name	Landowner Name
Street Address	Contact Phone Number
Contact Name	
Contact Phone Number	

As the generator/owner of the petroleum contaminated soil and the party responsible for compliance with the MEDEP Standard Operating Procedure (SOP) No. RWM-PP-012: Managing Non-Hazardous Petroleum Contaminated Ground Water and Surplus Soil at UST Sites, I hereby certify that all the representations made on this form are true and correct to the best of my knowledge. Further, I hereby certify that the Surplus Soil: (1) will be temporarily stockpiled in accordance with the Maine Erosion and Sediment Control Practices Field Guide for Contractors, revised 2014 and all other MEDEP programs, (2) that all required local, state and other permits/authorizations that pertain to its use will be obtained, and (3) that all of the temporary stockpiling provisions of the (SOP) No. RWM-PP-012: Managing Non-Hazardous Petroleum Contaminated Ground Water and Surplus Soil at UST Sites will be met, and (4) all surplus soil will be removed from the temporary stockpile location within 30 days of receipt of laboratory analyses of the surplus soil.

X _____ X _____

Signature of Soil Generator/Owner or Repre... Title

X _____ X _____

Printed Name Date

As landowner of the temporary stockpile location, I hereby give approval to stockpile, evaluate, and remove the soil described above at the proposed location. I also hereby grant property access to MEDEP investigators for the purpose of inspecting the stockpiled surplus soil at any reasonable time. I understand that the soil must stay at this location until its removal is approved by the MEDEP, and that the site and all soils must remain stabilized to prevent erosion in accordance with Maine Erosion and Sediment Control Practices Field Guide for Contractors, revised 2014.

X _____ X _____

Signature of Landowner Date

X _____

Printed Name

****

X _____ X _____

DEP Authorization Signature Date

X _____

Printed Name

Determining the Suitability of Non-Hazardous Petroleum Contaminated Soils for Off-Site Use as Construction Fill

Sampling Documentation – The following information should be documented as part of the sampling program:

- a map of the stockpile site, with the sample locations marked;
- the volume of petroleum contaminated surplus soil and the type of petroleum contamination in each stockpile;
- the excavation and sampling dates;
- the hard copy laboratory report which includes results, chain-of-custody forms, and laboratory quality assurance/quality control.

Additionally, laboratory results should be submitted to the MEDEP as Electronic Data Deliverables (EDDs) in MEDEP-approved format. The EDDs should include all information listed in the "Analytical Methods" subsection, below.

Number of Laboratory Samples – The number of laboratory samples collected from the stockpile of petroleum contaminated surplus soil depends upon the pile size, as follows (unless multi-incremental sampling methods are being used):

SIZE OF STOCKPILE	NUMBER OF SAMPLES
<100 cubic yards	1
100 to 200 cubic yards	2
201 to 300 cubic yards	3
301 to 400 cubic yards	4
401 to 500 cubic yards	5
>500 cubic yards	5 + 1 additional sample/ 100 cubic yards over 500

Sampling Method – The stockpile of petroleum contaminated surplus soil should be divided into units of 100 cubic yards or less. Each unit will be gridded into 30 roughly equal cells. A single sample will be collected from each unit, comprised of an increment of soil collected from each of the 30 cells. For Volatile Petroleum Hydrocarbons (VPH) samples the increment collected from each cell will be 5 grams, making up a total unit sample volume of 150 grams. For Extractable Petroleum Hydrocarbons (EPH) samples the increment collected from each unit should be 2 ounces, making up a total unit sample volume of 60 ounces. The increments will be collected from the approximate central area of each cell, at varied depths to ensure that the full depth profile of the unit is represented in the final sample. Care should be taken to avoid collecting material with a grain size greater than 2 millimeters.

Analytical Methods – Testing soil using the EPH or VPH analytical methods depends on the petroleum product and age of contamination. The MEDEP Petroleum Remediation Guidelines provide the following recommendations. When leaded gasoline impacted soils are stockpiled, analysis will include lead. A site-specific sample and analysis plan is required for stockpiles that include waste oil impacted soils.

Petroleum Product	VPH	EPH
Gasoline	**X**	
Fresh diesel/#2 fuel oil	**X**	**X**
Weathered diesel/#2 fuel oil		**X**
#3 - #6 fuel oils		**X**
Waste oil	**X**	**X**
Jet fuels/kerosene	**X**	**X**
Unknown oils or sources	**X**	**X**

All laboratory samples of petroleum contaminated surplus soil should be analyzed by a laboratory certified by the Maine Department of Health and Human Services for the laboratory method and meet quality control standards set forth in the analytical method. Lab reports should include:

- Surrogate recoveries in percent
- Method blank results
- Laboratory Control Spike (LCS) results in percent
- Matrix Spike/Matrix Spike Duplicate (MS/MSD) results in percent
- Laboratory methods must have reporting limits (RLs) equal to or less than guidelines listed in Appendix B Table 1.

CERTIFICATE OF BENEFICIAL USE OF NON-HAZARDOUS PETROLEUM CONTAMINATED SURPLUS SOIL

Generator/Owner of Surplus Soil	Beneficial Use Location
MEDEP Spill #	GPS Coordinates
Generator Name	Street Address
Street Address	Landowner Name
Contact Name	Contact Phone Number
Contact Phone Number	

As the generator/owner of the petroleum contaminated soil and the party responsible for compliance with MEDEP Standard Operating Procedure (SOP) No. RWM-PP-012: Managing Non-Hazardous Petroleum Contaminated Ground Water and Surplus Soil at UST Sites, I hereby certify that all the representations made on this form are true and correct to the best of my knowledge.

Further, I hereby certify that the Surplus Soil was (1) only used as construction fill, (2) that it was used in accordance with the Maine Erosion and Sediment Control Practices Field Guide for Contractors, revised 2014 and all other Department programs, (3) that all required local, state and other permits/authorizations that pertain to its use were obtained, and (4) that all of the other provisions of the (SOP) No. RWM-PP-012: Managing Non-Hazardous Petroleum Contaminated Ground Water and Surplus Soil at UST Sites, were met.

X

Signature of Soil Generator/Owner or Repre...

X

Title

X

Printed Name

X

Date

As landowner of the beneficial use location, I hereby certify that I (1) granted the soil generator/owner permission to use the soil on my property, and (2) grant property access to MEDEP investigators for the purpose of inspecting the beneficial use at any reasonable time. I understand that the soil must stay at this location and that the site and all soils must remain stabilized to prevent erosion in accordance with Maine Erosion and Sediment Control Practices Field Guide for Contractors, revised 2014.

X _____ X _____

Signature of Landowner Date

X _____

Printed Name

****

X _____ X _____

DEP Authorization Signature Date

X _____

Printed Name

RWM-PP-012_ManagingContaminatedGroundwaterandSurplusSoils

Final Audit Report 2021-09-08

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