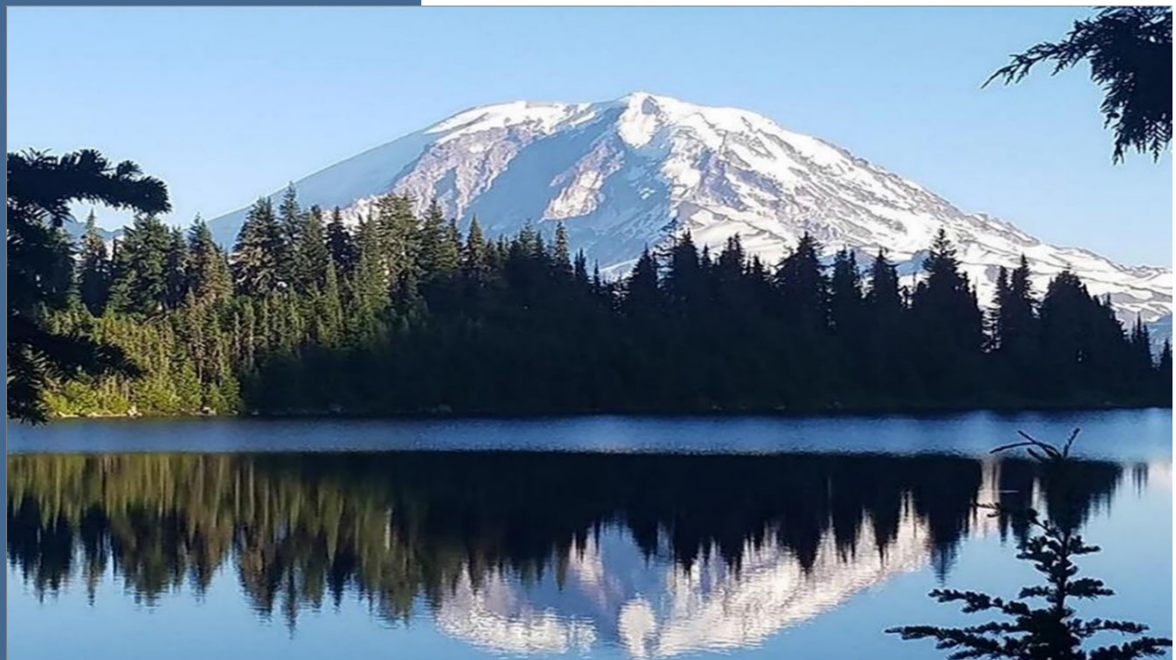

WAC 173-180 Implementation Guidance for Class 1 Facilities

Spill Prevention, Preparedness, and Response Program

Washington State Department of Ecology

Olympia, Washington

February 2024, Publication 24-08-003

Publication Information

This document is available on the Department of Ecology's website at:
https://apps.ecology.wa.gov/publications/summarypages/2408003.html

Cover photo credit

- Standard Ecology image, 2019

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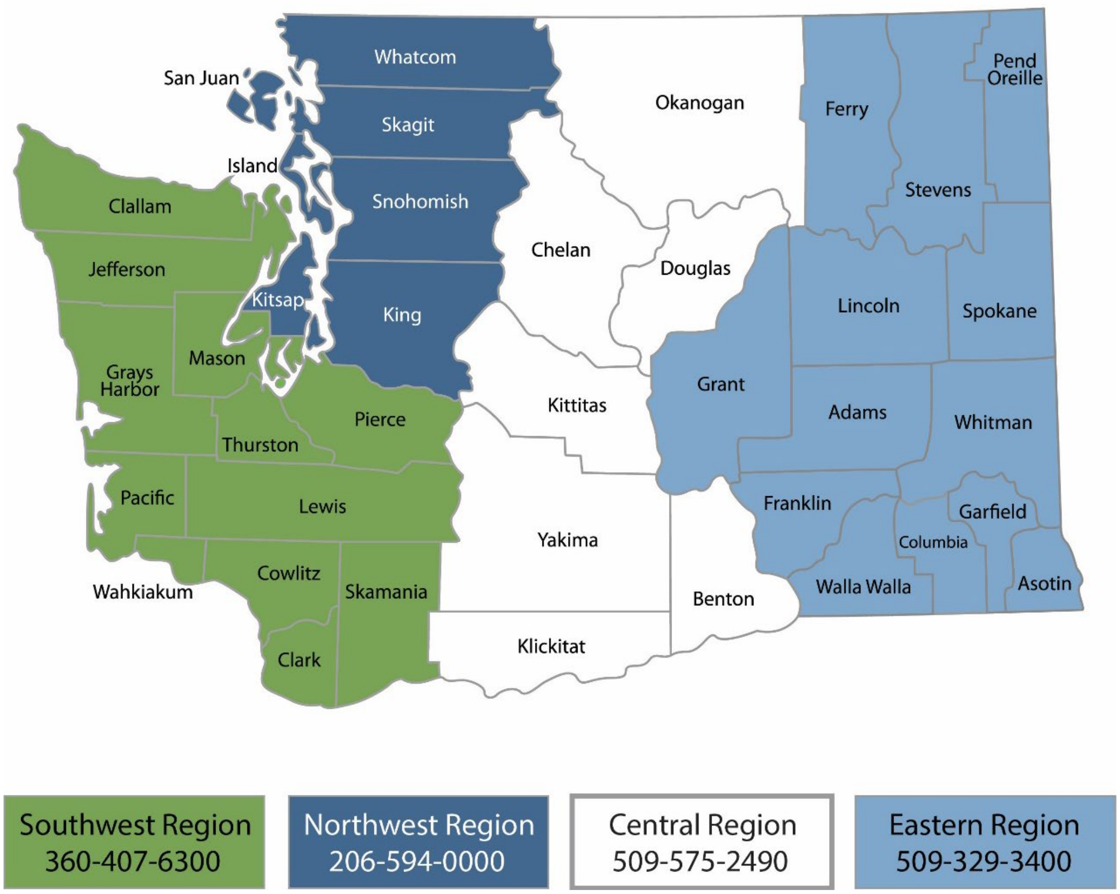
Map of Counties Served



Region	Counties served	Mailing Address	Phone
Southwest	Clallam, Clark, Cowlitz, Grays Harbor, Jefferson, Mason, Lewis, Pacific, Pierce, Skamania, Thurston, Wahkiakum	PO Box 47775 Olympia, WA 98504	360-407-6300
Northwest	Island, King, Kitsap, San Juan, Skagit, Snohomish, Whatcom	PO Box 330316 Shoreline, WA 98133	206-594-0000
Central	Benton, Chelan, Douglas, Kittitas, Klickitat, Okanogan, Yakima	1250 W Alder St Union Gap, WA 98903	509-575-2490
Eastern	Adams, Asotin, Columbia, Ferry, Franklin, Garfield, Grant, Lincoln, Pend Oreille, Spokane, Stevens, Walla Walla, Whitman	4601 N Monroe Spokane, WA 99205	509-329-3400
Headquarters	Across Washington	PO Box 46700 Olympia, WA 98504	360-407-6000

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Spill Prevention, Preparedness, and Response Program
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Olympia, WA

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Table of Contents

List of Figures and Tables 6

Executive Summary 7

Seismic protection measures for existing storage tanks and transfer pipelines 8

Approval for seismic measures proposed by a facility 8

Verification of Seismic Measures 9

General Guidance for Each Seismic Protection Measure Requirement 9

Calculating Intrinsic Permeability and Permeability Rate 13

Permeability Reference Scales 15

Important Criteria (Tank Footing, Groundwater Table) 16

Important External Factors 16

How to Empirically Test for Permeability 17

Calculating Time to Tank Footing and Groundwater 18

Introduction 20

Risk Analysis Content Requirements 22

List of Figures and Tables

Figures

Figure 1. Permeability Calculation Flow Chart.. 18

Tables

Table 1. Hydraulic Conductivity Reference Scale. 15
Table 2. Intrinsic Permeability Reference Scale.. 15

Executive Summary

In June 2023, Ecology adopted changes to Washington Administrative Code (WAC) 173-180, Facility Oil Handling Standards. These changes took effect in July 2023. The purpose of this guidance is to assist Class 1 facilities in meeting these requirements and to make Ecology's review and approval process more transparent. This guidance provides Ecology's policy statement about how we interpret and apply the regulations.

Significant changes to our regulations include:

- WAC 173-180-330(2) and WAC 173-180-340(3),(5) regulate design standards for storage tanks and transfer pipelines at Class 1 Facilities. Ecology added required seismic protection measures for new and existing storage tanks and transfer pipelines.
- WAC 173-180-630(10)(g) expands Prevention Plan requirements for describing secondary containment. The goal of this requirement is to demonstrate the ability of each containment system to contain oil and allow enough time to remove the released oil to prevent it from reaching waters of the state, including groundwater.
- WAC 173-180-630(13) expands the description and requirements of risk analyses that are included in Prevention Plans. The risk analysis must be used to evaluate the risks onsite of an oil spill in addition to other smaller changes.
- WAC 173-180-900 adds out of service requirements for storage tanks and transfer pipeline.

If you have questions about these requirements, or any of the requirements in WAC 173-180, please contact your Spills Program engineer, the Spills Program Lead Engineer, or the Prevention Section manager. Contact information is available on our website, or by calling 360-407-7455.

Seismic Protection Measures for Storage Tanks and Transfer Pipelines

WAC 173-180-330 and WAC 173-180-340 describe seismic protection measures for new and existing storage tanks and transfer pipelines at Class 1 facilities. Storage tanks and transfer pipelines built after July 2023 must meet the requirements of WAC 173-180-330(3) and WAC 173-180-340(5). Storage tanks and transfer pipelines built before July 2023 must meet the requirements of WAC 173-180-330(2) and WAC 173-180-340(3).

Seismic protection measures for existing storage tanks and transfer pipelines

Storage tanks built before July 2023 must include protective measures that are designed, installed, and maintained to reduce risk from seismic events and that include one or more of the following (WAC 173-180-330(2)):

- Flexible mechanical device(s) between storage tank and piping or sufficient piping flexibility to protect the tank and pipe connection and prevent the release of product;
- Foundation driven pilings;
- Anchored storage tanks; or
- Another seismic protection measure proposed by the facility and approved by ecology, as long as such protection measure equals or exceeds those required in this section. This may include demonstrating the storage tank meets API Standard 650 (2020) seismic design requirements, including Annex E and section E.7.3 Piping Flexibility.

Transfer pipelines built before July 2023 must include protective measures that are designed, installed, and maintained to reduce risk from seismic events and include one or more of the following, and are also installed under the provisions of chapter 57 of the 2021 International Fire Code (IFC), where applicable (WAC 173-180-340(3):

- (a) Flexible mechanical device(s) between storage tank and piping or sufficient piping flexibility to protect the tank and pipe connection and prevent the release of product;
- (b) Flexible mechanical device(s) or adequate pipeline flexibility between pipes;
- (c) Pipeline supports that protect against seismic motion;
- (d) Automatic emergency isolation shutoff valves that are triggered to close during seismic events; or
- (e) Another seismic protection measure proposed by the facility and approved by ecology, as long as such protection measure equals or exceeds those required in this section.

Approval for seismic measures proposed by a facility

When a Class 1 Facility is proposing an alternative seismic protection measure under WAC 173-180-330(2)(d), WAC 173-180-340(3)(e), or WAC 173-180-340(5)(c)(iv), the proposed alternative must be submitted to Ecology's Spills Program for review. Facilities are advised not to commit resources or begin installation of proposed alternatives until approval is received from Ecology. If the proposal is not approved, the facility would need to modify their proposal or propose a different alternative. Facilities should send proposals to Ecology for review at least 120 days prior to the planned implementation or construction date, to allow Ecology to provide a timely response.

The Spills Program's Facility Inspection Unit (FIU) will conduct a technical review of proposals. Proposed measures are approved by the Spills Prevention Section Manager.

Process

1. Submit your proposed alternative seismic protection measure to your assigned Spills Program engineer. Make sure to include any applicable documents such as seismic analyses, engineering plans, specifications, calculations, or reports. If you do not know your assigned engineer, contact the Spills Program lead engineer. Contact information is maintained on our website.
2. The FIU will conduct an objective review of the proposal, which could include checking API 650 code requirements, conducting literature reviews, researching the proposed measure, and reviewing design calculations. The purpose of our review is to determine whether the proposal meets the requirements of WAC 173-180. We may contact you for more information during our review.
3. Once the FIU completes the review, the lead engineer will forward the proposal to the Prevention Section Manager with a recommendation that the measure be approved or disapproved.
4. The Prevention Section Manager may approve the proposal, ask for more information, or disapprove the proposal.
5. The Spills Program will send a letter to the facility documenting the approval or disapproval of the proposal.
6. If the proposal is approved, the Spills Program will review implementation of the measure during our inspections of your facility.
7. If the proposal is disapproved, the facility must determine another method to meet the requirements of WAC 173-180-330 and WAC 173-180-340, within the compliance schedule specified in WAC 173-180-080.

Verification of Seismic Measures

Spills FIU engineers will verify implementation of the seismic measures for your facility during inspections. This includes approved alternative measures, and measures listed in WAC 173-180-330(2), WAC 173-180-340(3), and WAC 173-180-340(5). We may request additional information to verify compliance, such as seismic analyses, engineering plans, specifications, or reports.

General Guidance for Each Seismic Protection Measure Requirement

WAC 173-180 requires seismic protection measures to be implemented and a seismic evaluation of storage tanks in accordance with API 650, API 653, and applicable requirements of 2021 IBC. While these two actions may be performed separately, the Spills Program encourages Class 1 Facilities to use the seismic evaluation to choose a seismic protection measure that is most conducive to each tank and pipeline. Due to the complex and unpredictable nature of earthquakes, simply installing a given seismic protection measure may not be prudent or consistent with best engineering practice. Without proper analysis or evaluation prior to design and installation, seismic protection measures may not reduce the risk of damage as a result of a seismic event. Facilities should evaluate each location based on its risk level such as soil type, type of earthquakes likely to occur, and distance to nearby fault lines as each Class 1 Facility is likely to have different risk levels based on site-specific conditions.

With respect to two specific design parameters within API 650, Seismic Use Group and Site Classification, keep the following in mind when performing an evaluation to determine seismic protection measures or to show if the tank meets current API 650 standards:

- Facilities may determine whether to design their tanks to SUG 1 or SUG 2. SUG 2 is normally reserved for hospitals, fire departments, and utilities. However, most hospitals, fire departments, and utilities such as water or wastewater treatment plants usually have at most day tanks or just the fuel reservoir in the backup generators they own and so do not actually have any long-term oil storage as SUG 2 assumes. It may be beneficial for regional emergency response for facilities to consider steps such as contacting their local emergency services to discuss fuel supplies for critical services, and potentially designing 1 or 2 tanks onsite to the SUG 2 requirements.
- Facilities must provide a geotechnical report with soil site classification. Otherwise Ecology will use worst case values from Washington State's Department of Natural Resources (DNR) Washington Geologic Information Portal (Earthquakes>Ground Response>NEHRP Seismic Site Class) to evaluate compliance with WAC 173-180-330(2)(d). For example, if a seismic report uses the default site classification D and provides no geotechnical report and the DNR website states the location has site class D or E, Ecology will assume that location is a site class E.

Flexible Mechanical Devices or Sufficient Piping Flexibility at Tanks

While typically not considered a transfer pipeline under WAC 173-180-025, the piping directly connected to each storage tank is a common seismic casualty. Before installing flexible mechanical devices or more flexible piping, an evaluation should be performed to see how much the tank is expected to move during an earthquake and the results should then be used to see if the existing piping has enough flexibility. For example, if an analysis shows that the expected uplift of a tank at the nozzle is 4 inches, but the piping connected to the nozzle allows for 6 inches of radial movement, the piping may have enough flexibility if the piping also has enough flexibility longitudinally.

If a tank has multiple pipe connections, each needs flexible mechanical devices or sufficient piping flexibility in order to meet WAC 173-180 requirements. This includes roof drain piping that runs into and out of the tank. This is particularly a concern for external floating roof storage tanks.

If after the analysis is performed, the existing piping does not have enough flexibility, evaluate what flexible mechanical device or changes to the piping to increase flexibility are needed. Ecology recommends that facilities submit engineering plans or drawings for review prior to installation.

Foundation Driven Pilings

Foundation driven pilings are one option to help combat high likelihood of soils liquefying based on location and type of soils used or present. However, they are also the costliest seismic protection measure and typically are only installed when the tank is first installed or if a particular need arises. As such, it is likely that verification of this particular requirement will consist of demonstrating an existing tank has foundation driven pilings that are capable of resisting or reducing damage from seismic events. This could include engineering drawings and specifications of the pilings installed at each applicable tank. If pilings are installed for an existing storage tank, the review will be similar and will include a review of the seismic analyses, engineering drawings, specifications, as well as engineering design calculations.

Anchored Storage Tanks

Storage tanks may be anchored, assuming a ringwall is present, in order to meet API 650, Annex E requirements for seismic anchorage. Self-anchored tanks may be used to meet this requirement if the tank in question meets all of Annex E's Section E.6.2.1.1 include 5) which requires that piping flexibility requirements are satisfied; however, this generally means that self-anchored tanks could just as easily just be altered and updated to meet the sufficient piping flexibility requirement under WAC 173-180-330(2)(a) instead. Make sure when deciding to add new anchorage that the annulus will be appropriate per Annex E. Ecology recommends that facilities submit engineering plans or drawings for review prior to installation.

Flexible Mechanical Device(s) or Adequate Pipeline Flexibility Between Pipes

This measure applies to the aboveground portion of the transfer pipeline. Similar to the flexibility requirement for tanks, before installing flexible mechanical devices or more flexible piping for the transfer pipeline, an evaluation should be performed to see how much the transfer pipeline is expected to move radially and longitudinally during an earthquake and the results should then be used to see if the existing piping has enough flexibility. Make sure to consider all rigid connections including where the pipeline goes under or above ground or through secondary containment earthen berms. Ecology recommends that facilities submit engineering plans or drawings for review prior to installation.

Pipeline Supports That Protect Against Seismic Motion

Seismic pipeline supports include a variety of devices that allow the pipe to flex horizontally and longitudinally. Common measures include low-friction pads and hanging supports. Similar to adequate pipeline flexibility, an evaluation should be performed to see how much the transfer pipeline is expected to move horizontally and longitudinally on existing supports during an earthquake and then the results should be used to determine if the existing supports are sufficient and if not, what changes need to be made. Again, make sure to consider all rigid connections including where the pipeline goes under or above ground or through secondary containment earthen berms.

Automated emergency isolation shutoff valves

Automated emergency isolation shutoff valves that close automatically during seismic events can be used to meet the seismic protection measures requirements of WAC 173-180-340. The goal of this measure is to prevent an oil release at any point prior to the first valve in secondary containment, especially when near or at surface water. There should be a minimum of two isolation valves of this type per transfer pipeline, but depending on length of transfer pipeline and/or configuration, more may be needed. The facility should consider the oil spill volume potential when considering how many and where the isolation valves are installed. Water hammer, existing product flow conditions, and the potential for automatic pump shutdowns should also be considered when evaluating these seismic protection measures. Ecology recommends that facilities provide a report on the proposed system including drawings and a written description of how the system prior to installation.

Secondary Containment Permeability

WAC 173-180-320 describes requirements for secondary containment requirements for storage tanks. These include:

> *(1) Storage tanks must be located within secondary containment areas. Secondary containment systems must be:*
>
> *(a) Designed, constructed, maintained, and operated to prevent discharged oil from entering waters of the state at any time during use of the tank system;*
>
> *(b) Capable of containing oil throughout the entire containment system, including walls and floor;*
>
> *(c) Constructed to prevent any discharge from a primary containment system (e.g., tank) from escaping the secondary containment system before cleanup occurs;*
>
> *(d) Constructed with materials that are compatible with stored material to be placed in the tank system;*
>
> *(e) Soil may be used for the secondary containment system, provided that any spill onto the soil will be sufficiently contained, readily recoverable, and will be managed in accordance with chapter 173-303 WAC;*

WAC 173-180-630(10)(i) requires facilities to describe the permeability of all containment systems onsite, and to calculate the time in which the oil reaches the tank footing and waters of the state. The goal of this requirement is to demonstrate the ability of each containment system to contain oil and allow enough time to remove the released oil to prevent it from reaching waters of the state, including groundwater.

Calculating Intrinsic Permeability and Permeability Rate

"Permeability" first needs to be defined. Depending on the source or topic, "permeability" can mean the intrinsic permeability (k) or the hydraulic conductivity (K). K is also referred to as coefficient of permeability or permeability rate. Intrinsic permeability is a measure of the ability of a porous material to allow fluids to pass through it and has units of length^2 (ft^2 or m^2). In contrast, hydraulic conductivity is the rate at which a certain fluid passes through a porous material and has units of distance/time (ft/s, ft/day, cm/s, etc). Make sure, when discussing this term, that all parties discussing permeability are using the same term as it is quite common to see either application and in many different units.

Intrinsic permeability is a property of the soil media's pore size. Hydraulic conductivity is a property of both the liquid's viscosity and ability to move through the soil's pores. As a result, intrinsic permeability is a better term when discussing soil media regardless of the fluid in question while hydraulic conductivity is a better term when only one fluid is being considered and the rate is the more important issue.

WAC 173-180-025 defines permeability as intrinsic permeability (k) and this is useful for comparing soil types at a single location or at multiple locations. Intrinsic permeability or the empirically derived hydraulic conductivity data, which uses water as the test media, can be converted to hydraulic conductivity of the specific oil. This specific hydraulic conductivity can then be used to calculated the time requirement of WAC 173-180-630(10).

For reference, below is the mathematical relationship between k and K:

$K = k\, g \,/\, v$ Equation 1[2]

where

- K = hydraulic conductivity (m/s, ft/s)
- k = intrinsic permeability (m^2, ft^2)
- g = gravitational constant (9.81 m/s^2, 32.17 ft/s^2)
- v = kinematic viscosity of the fluid (m^2/s, ft^2/s)

This relationship can also be expressed as:

$K = k\frac{\rho g}{\mu}$ or $k = K\frac{\mu}{\rho g}$ Equation 2[3]

where

- K = hydraulic conductivity, m/s
- k = intrinsic permeability, m^2
- ρ = density of the fluid, kg/m^3
- g = gravitational constant (9.81 m/s^2, 32.17 ft/s^2)
- μ = dynamic viscosity of the fluid, Pa·s (Pa = kg/ms^2)

Using either above mathematical equation, you can convert between k and K as long as you know the kinematic or dynamic viscosity of the fluid in question. Facilities are advised to carefully check units, however, as some reports include a mix of units (e.g., US, metric) and timescales (e.g., seconds, hours, days). Also, use an appropriate and constant temperature as higher temperature result in higher kinematic or dynamitic viscosities and as a result, higher hydraulic conductivities.

[2] Note: equation 1 is derived from equation 2.
[3] Hydrogeologic properties of earth materials and principles of groundwater flow / William W. Woessner, Eileen P. Poeter – Guelph, Ontario, Canada, 2020. 205 p.

A simple expression that helps convert one liquid's hydraulic conductivity to another liquid's hydraulic conductivity is shown below. This expression is derived algebraically from Equation 1 above by setting intrinsic permeability equal to itself.

$$K_1 = K_2 * \left(\frac{v_2}{v_1}\right) \qquad \text{Equation 3}$$

where

- K = hydraulic conductivity (m/s, ft/s)
- v = kinematic viscosity of the fluid (m^2/s, ft^2/s)

Permeability Reference Scales[4]

Below are reference scales for both hydraulic conductivity, K, and intrinsic permeability, k:

Hydraulic Conductivity	**Pervious**				**Semi-Pervious**				**Impervious**				
***K* (cm/s)**	100	10	1	0.1	0.01	10^{-3}	10^{-4}	10^{-5}	10^{-6}	10^{-7}	10^{-8}	10^{-9}	10^{-10}
K* (ft/day)	10^{5}	10,000	1,000	100	10	1	0.1	0.01	0.001	10^{-4}	10^{-5}	10^{-6}	10^{-7}
Aquifer	Good					Poor				None			
Soils	Clean gravel		Clean sand or sand and gravel			Very fine sand, silt, loess, loam, solonetz							
					Peat		Stratified clay			Unweathered clay			
Rocks					Oil rocks			Sandstone		Good limestone, dolomite		Breccia, granite	

Table 1. Hydraulic Conductivity Reference Scale. Note that K in ft/day is multiples of 2.83*n. For example, the listed values of 105 and 10,000 ft/day are actually 2.83x10-5 and 28,346 ft/day respectively.

Intrinsic Permeability	**Pervious**				**Semi-pervious**				**Impervious**				
***k* (cm^2)**	0.001	10^{-4}	10^{-5}	10^{-6}	10^{-7}	10^{-8}	10^{-9}	10^{-10}	10^{-11}	10^{-12}	10^{-13}	10^{-14}	10^{-15}
***k* (m^2)**	10^{-7}	10^{-8}	10^{-9}	10^{-10}	10^{-11}	10^{-12}	10^{-13}	10^{-14}	10^{-15}	10^{-16}	10^{-17}	10^{-18}	10^{-19}
***k* (millidarcy)**	10^{+8}	10^{+7}	10^{+6}	10^{+5}	10^{+4}	1,000	100	10	1	0.1	0.01	10^{-3}	10^{-4}
Aquifer	Good					Poor				None			
Soils	Clean gravel		Clean sand or sand and gravel			Very fine sand, silt, loess, loam, solonetz							
					Peat		Stratified clay			Unweathered clay			
Rocks					Oil rocks			Sandstone		Good limestone, dolomite		Breccia, granite	

Table 2. Intrinsic Permeability Reference Scale.

[4] Bear, Jacob, 1972. Dynamics of Fluids in Porous Media, Dover. ISBN 0-486-65675-6

Important Criteria (Tank Footing, Groundwater Table)

To determine the required intrinsic permeability for the soil media used in secondary containment, there are two main important criteria to use: the depth of the storage tank footing and the depth to groundwater. Depth of the footing is critical because if any oil contaminates soil near the foundation of a tank, any removal of that soil past the tank's footing can put the structural integrity of that tank in jeopardy. Depth of footings will vary, but most are in the range of 2 – 3 feet below ground.

Groundwater is also an important criteria to consider when determining intrinsic permeability. The definition of "waters of the state" in WAC 173-180-025 includes underground water, i.e., groundwater. If oil reaches groundwater through soil, it is a spill to waters of the state. Groundwater levels can vary considerably with coastal regions seeing groundwater near ground level while desert regions of Washington State will have groundwater tables farther below ground level. Some locations have the ground water table at 2 or 3 feet below ground while others have it as far down as 50 feet.

Important External Factors

How fast facility staff and response contractors can respond to a release and clean up the liquids is an important factor to consider when trying to determine how much time passes before the liquid is cleaned up and then the soil, if contaminated, can be excavated. The longer the released liquid is in contact with the soil, the longer it can infiltrate into and through that media. Likewise, the longer it is allowed to infiltrate, the deeper the liquid will travel and potentially hit groundwater.

Similar to tank footings and ground water depths, this issue needs to be analyzed on a case-by-case basis. Some facilities have response contractors onsite fulltime, others have them available only on an on-call basis. Depending on the number of contracts in place with different companies and the facility's location, the number of available response contractors and response equipment will vary.

Another factor to consider is if the spilled liquid is gasoline or any other flammable petroleum derivative. These types of liquids require extra safety precautions such as monitoring LEL's (lower explosive limit) before cleanup can even begin. Consequently, cleanup of these liquids can be longer than other liquids.

Facilities also need to consider the potential size of a spill (i.e., the worst-case spill volume as defined in WAC 173-180), and any factors such as areas of aboveground piping, that would complicate response efforts.

Ecology may ask facilities for information describing their ability to respond to a spill to secondary containment. When evaluating a facility's ability to respond, Ecology is seeking to determine whether it is reasonable that a spill could be cleaned up before oil reaches waters of the state.

How to Empirically Test for Permeability

Facilities need to conduct empirical permeability testing in each secondary containment system. Due to the different configurations and number of tank farms at Class 1 facilities, refineries are advised to test at least 1 location per secondary containment system and non-refinery oil terminals are advised to test 3 locations per secondary containment system. Refer to ASTM Methods D7664-10 (2018) and D5126-16 (2016) for applicable test methods. Facilities can propose other methods if they believe it is more appropriate for their location.

We recommend Class 1 facilities provide a scope of work to Spills before finalizing the testing plan; this allows us to provide feedback on sample locations and test methods. In general, when using a field-testing method, the test equipment should not be setup more than 1 foot below the surface of the secondary containment floor in order to best represent how the containment floor will behave in worst case spill scenarios.

Calculating Time to Tank Footing and Groundwater

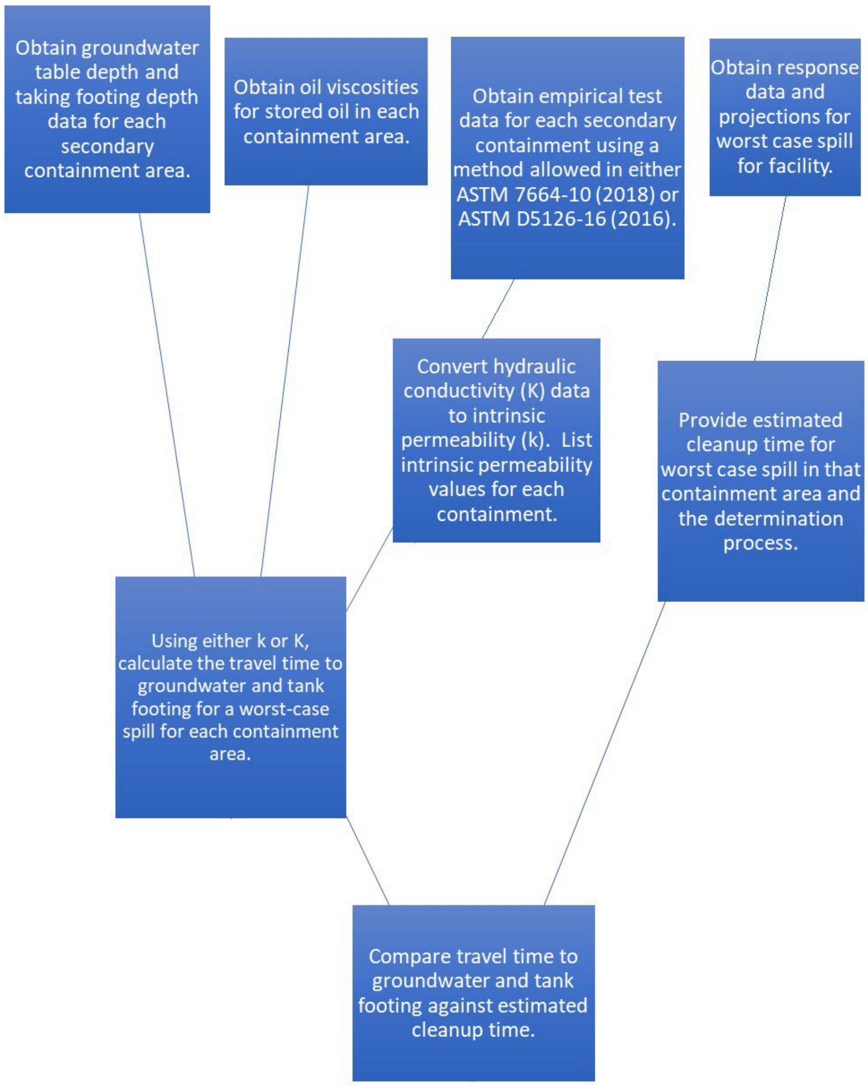

Figure 1. Permeability Calculation Flow Chart

Once all the above data is gathered, the travel time to groundwater or tank footing can be calculated (see Figure 1). This then should be compared in the Prevention Plan against the estimated cleanup time for a worst-case spill in that specific containment area.

If more than one oil type is stored in that containment area, the travel time for the least viscous, or fastest moving, oil should be calculated to show that the containment floor permeability is sufficient for multiple stored oils in that containment area. If the least viscous oil is not stored in the largest tank within a secondary containment system, then the times for both tanks must be calculated.

WAC 173-180-630(g) states that permeability must meet the requirements in WAC 173-180-320(1)(e). If the results of these calculations indicate the permeability of secondary containment does not meet these requirements, the facility will need to discuss with Ecology how they plan to achieve compliance. This compliance plan, when agreed to with Ecology, should be documented in the secondary containment section of the Prevention Plan.

Risk Analysis

Introduction

A Risk Analysis is a comprehensive evaluation of facility spills risks and are a content requirement in Prevention Plans under WAC 173-180-630(13). A Risk Analysis must be done for each facility since the requirements in WAC 173-180-630(13)(a) pertain to each facility separately. The Risk Analysis must also be done regardless of perceived risk and even if the expected likelihood of spills are extremely low. Make sure to analyze tanks, piping, and other equipment and operational concerns, equipment failure, as well as human error, not just the shelf life of that particular piece of equipment. Spill history should also be taken into consideration.

Abnormal conditions or causes that lead to spills or oil releases that should be considered include, but are not limited to:

- harsh weather, such as freezing temperatures, particularly at pipe dead legs
- over-pressurization of hoses or pipes
- strikes or hitting of objects by heavy equipment like forklifts or backhoes
- poor or improper maintenance
- pump/mixer seal leaks
- valve packing failure
- overfills
- corrosion issues
- poor welds
- misaligned valves
- instrumentation errors
- valves inadequately closing
- oil handling equipment or other assets that have a history of multiple operational or maintenance issues such as a pump that requires to be rebuilt multiple times.

What is "risk"?

A risk is a measure of the probability and severity of an oil spill to state waters. Risk is often estimated by the mathematical expectation of the consequences of an adverse event occurring (i.e., the product of "probability x consequence").[5]

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[5] Definition of Risk from October 1992 document: Guidelines for Preparation and Review of Facility Oil Spill Prevention Plans.

What is “probability”?

Probability is a measure of how likely it is that an incident will occur during some time period. In some cases, this term is equivalent to “likelihood” or “frequency.”

What is “consequence”?

The risk analysis’s goal is to analyze the risk of spills to waters of the state. With that in mind, consequence is the combination of spill quantity and potential severity of impact to the environment and/or waters of the state. In some cases, this term is equivalent to “severity.”

What is meant by “evaluate”?

The risk analysis must estimate, based on spill data, spill history, and implemented safeguards, the likelihood and consequences of spills due to construction materials used or design, age, corrosion, inspection and maintenance, and operations of each item evaluated. These evaluations can be done by a ranking or scoring system, but must result in identification of potential oil spill hazards, failure modes, weak links, suggested modifications to reduce oil spill risk, and a set of priorities for measures to reduce incident probability and consequences. A typically used tool to help display ranks or scores is the use of a likelihood/consequence or frequency/severity risk matrix. This may be more commonly known as a Risk Register. Make sure to provide the basis of each score for each item reviewed; it’s not enough to just provide a spill frequency. The basis of each score should have a description or explanation.

Likelihood or frequency is sometimes ranked by terms such as frequent, probable, occasional, remote, or improbable or on a scale from 1-5, 5 being frequent. Standard practice for rating consequence or severity is ranking from 1-5, with 5 being the highest risk, or from Very High, High, Moderately High, and Moderate to Low Risk.

What is the goal of a risk analysis?

The results of a risk analysis can be used by a decision-maker to help judge the acceptability of risk and aid in choosing between potential risk-reduction, preventative measures. From the decision-maker’s perspective, the principal benefits of risk analysis are:

- Identification of potential oil spill hazards
- Identification of potential facility or system failure modes
- Quantitative risk statements
- Identification of the important contributors to oil spill risk and weak links in the system
- Suggested modifications to reduce oil spill risk
- Deeper understanding of the system
- Comparison of risks to those of other similar systems or technologies
- Identification of uncertainties that are generally implicit in risk analysis

- Help in establishing priorities for expenditures on improved safety or spill risk reduction measures[6]

The risk analysis, under WAC 173-180-630, is meant to be an iterative process with a goal of continuous improvement. Identification of hazards as well as failure modes and weak links are important steps to establishing priorities for improvement. Paired with the 5-year review and approval cycle of a Prevention Plan, the risk analysis is meant to be a risk review of how risks have changed in those five years and how improvements or safeguards impacted those risks.

What is a safeguard?

Safeguards are anything that will effectively prevent or mitigate a hazardous consequence. Some different types of safeguards include:

- Basic process control systems
- Pressure safety valves
- Secondary containment
- Alarms with operator actions.

Safeguards and best achievable protection measures are required by WAC 173-180-630(13)(b)(iii),(iv) and must be identified as part of the formal process (-630(a)(v)) to reduce the risk of the hazardous consequence.

Risk Analysis Content Requirements

Risk Analysis content requirements were updated in June 2023. The Risk Analysis must have one member of the team who has experience with, and knowledge of, the processes being evaluated. The Risk Analysis should list who did the Risk Analysis, include a narrative of their applicable experience, and state that the analyst(s) visited the site. If the person preparing the Risk Analysis holds a Washington State Professional Engineers license, they must stamp the analysis.

There are three main required parts to the Risk Analysis: formal process evaluation, required risk analysis criteria, and adopted measures to reduce risks identified during the risk analysis. The formal process must be used to evaluate the facility based on information required in the Prevention Plan but also including the API 653 seismic inspection results which are requirements in WAC 173-180-330(4). This formal process can be a HAZOP (hazard and operability study), Process Hazard Analysis, or any other formal process, but must:

(i) Define the system being assessed, which includes storage tanks, transfer pipelines, and oil transfer equipment, and other possible areas of concern;

[6] Principal benefits of a risk analysis are from the October 1992 document: Guidelines for Preparation and Review of Facility Oil Spill Prevention Plans.

(ii) Identify abnormal conditions that could lead to an oil discharge;
(iii) Examine the consequences and causes;
(iv) Calculate the unmitigated and residual risks; and
(v) Identify safeguards and recommendations.

The required risk analysis criteria are listed under WAC 173-180-630(13)(b) and include construction, age, corrosion, inspection, maintenance, operation, and oil spill risk. These criteria need to be applied to the transfer, production, storage systems, spill minimization systems, and spill containment systems in the facility and should include piping, tanks, pumps, valves, and associated equipment. Each containment system at the facility should also be evaluated for a discharge of 1 percent and 100 percent of the worst-case spill volume for that particular system.

Lastly, but most importantly, the risk analysis should discuss what measures and safeguards will be adopted to provide protection against the identified risks. Since the Prevention Plan, and as a result, the Risk Analysis, is submitted on a 5-year cycle, the success of each past implemented measures should be tracked and its impact on reducing risks evaluated. If the facility is already undertaking all known safeguards to reduce the highest identified risks, it should be stated as such and those safeguards should be listed for the highest identified risks.

Out of Service and Decommissioning Requirements for Transfer Pipelines and Storage Tanks

Tanks and transfer pipelines that have not been used to store or transfer oil respectively are considered out of service. Out of Service tanks and transfer pipelines must be maintained as if they were in service according to WAC 173-180-910(1)(a). Otherwise, they have to be decommissioned according to the requirements of WAC 173-180-910(1)(b). Note that the owner or operator must submit an electronic notification to ecology 30 calendar days prior to decommissioning transfer pipelines or storage and returning them to service. The notification must include the actions taken to decommission and return equipment to service.