Attachment to Notice of Public Scoping
Possible Updates and Revisions to
DEC Regulations for Petroleum Cleanup Levels
18 AAC 75 and 18 AAC 78

The following sections discuss some of the changes under consideration by the department with respect to petroleum cleanup levels. DEC seeks input from the public on these possible changes but also alternatives to these changes, as well as suggestions for other modifications to the regulations related to petroleum cleanups. Key points are numbered to facilitate commenting. In addition, a number of background documents and other resources are provided on the SPAR Division's regulations page which are referenced or were consulted in developing this scoping effort.

1. Soil Cleanup Levels; General Requirements [18 AAC 75.340]

1.1 The department may consider changes to this section to make it consistent with any subsequently proposed changes to the petroleum cleanup levels as well as from comments and input offered by interested parties in response to this notice.

1.2 18 AAC 75.340(c) is proposed to be amended to include method one.

2. Method One Petroleum Cleanup Levels [18 AAC 75.341(a) and (b)]

The department is considering revising the method one approach for petroleum hydrocarbon soil cleanup levels by repealing the matrix Table A1 and soil cleanup levels in Table A2. The matrix table and soil cleanup levels in Tables A1 and A2 have not been updated or replaced in the last 24 years. These tables are based on conservative and generalized assumptions that are not field verified or backed up by scientific studies. Therefore the tables are proposed to be replaced with a single table of cleanup levels for GRO, DRO and RRO for the Arctic Zone, Under 40-Inch Zone, Over 40-Inch Zone, and Migration to Groundwater for non-Arctic zones.

The new method one approach would resemble a simplified version of the current method two cleanup levels for petroleum, but using an updated risk-based, surrogate toxicity approach that accounts for exposure through dermal contact, ingestion, and outdoor inhalation. For migration to groundwater and the inhalation route, a 3-phase partitioning model would be used.

For the Arctic zone, soil cleanup levels protective of human health exposures have been found to not always be sufficiently protective of sensitive tundra environments or of adjacent surface waters. Therefore the Arctic zone cleanup levels in the Method one table may include cleanup levels that have been demonstrated to be appropriate for gravel fill and the tundra environment in the Arctic zone, based on past field observations and leachability studies (see support documents for this notice), or the Arctic zone levels may be footnoted to stipulate that more stringent levels may be required on a site specific basis to account for these receptors. Footnotes may be added to stipulate that sampling for water quality parameters may be required to verify that concentrations in gravel fill and tundra do not exceed water quality standards. The department seeks specific input on the development and application of petroleum cleanup levels appropriate for the Arctic Zone.

2.1 In accordance with the inclusion of method one under 18 AAC 75.340(c) the following list highlights clarifications or changes for a revised method one approach:

2.1.1 A footnote would be added to the method one cleanup levels table to state: "migration to groundwater" means the potential for hazardous substances to leach to groundwater where they may result in a completed human exposure pathway at or above levels listed in Table C at 18 AAC 75.345(b)(1); soil cleanup levels protective of migration to surface water must be determined on a site-specific basis.

2.1.2 18 AAC 340 (j) will need to be modified to address to include soil cleanup levels for gravel pads and tundra in the Arctic zone.

2.1.3 Groundwater is required meet updated Table C values for GRO, DRO, and RRO.

2.1.4 Surface water quality criteria are required be met where groundwater is not present, such as in the Arctic zone.

2.1.5 Sampling and meeting cleanup levels for petroleum related compounds in Table B1, including BTEX and PAHs would be required.

2.1.6 Table B1 in Method Two would apply to all other compounds detected at a site being addressed under Method One.

2.1.7 When calculating cumulative risk for individual compounds, the risk from the GRO, DRO and RRO ranges would not be included.

2.1.8 Analytical methods (AK 101, 102, and 103) would need to be updated to match the updated carbon ranges, if this approach is taken (see **Section 6.)**

Table 1 shows the proposed 13 individual aliphatic and aromatic fractions, with the proposed percentages based on fresh Alaska fuels, along with the updated percentages for calculating the total values for GRO, DRO and RRO. Proposed percentages for the aliphatic and aromatic fractions would add up to 100% for each range to account for risk from both fractions, rather than assuming a total fraction of 120% and dismissing the remaining fraction as is currently the case.

Table 2 shows how the cleanup levels might be presented. The equation that follows shows how the total GRO, DRO, RRO cleanup level would be calculated.

2.1.9 Table 1 Proposed Petroleum Hydrocarbon Ranges[1]

Individual fractions	Percentage (%)	Method One Percentages for Total Aromatics and Aliphatics
Gasoline (GRO)		
BTEX C5-C8	39	Gasoline Range (GRO) (C5-C10) 50% Aliphatic/ 50% Aromatic
Aromatic >C8-C10	11	
Aliphatic C5-C6	32	
Aliphatic >C6-C8	2	
Aliphatic >C8-C10	16	
Diesel (DRO)		
Aromatic >C10-C12	2	Diesel (DRO) (C10-C21) 86% Aliphatic/ 14% Aromatic
Aromatic >C12-C16	5	
Aromatic >C16-C21	7	
Aliphatic >C10-C12	20	
Aliphatic >C12-C16	38	
Aliphatic >C16-C21	28	
Residual (RRO)		
Aromatic >C21-C35	30	Residual Range (RRO) (C21-C35) 70% Aliphatic / 30% Aromatic
Aliphatic >C21-C35	70	

2.1.10 Calculation for Total Cleanup Levels:

$$\textbf{GRO Cleanup Level}\left(\frac{mg}{kg}\right) = \frac{1}{\frac{\%\ aromatic}{BTEX\ C5-C8} + \frac{\%\ aromatic}{aromatic\ C8-C10} + \frac{\%\ aliphatic}{aliphatic\ C5-C6} + \frac{\%\ aliphatic}{aliphatic\ C6-C8} + \frac{\%\ aliphatic}{aliphatic\ C8-C10}}$$

[1] The percentages are based on information about Alaska fuels presented in: Geosphere, Inc. and CH2MHill, 2006. *Hydrocarbon Characterization for Use in the Hydrocarbon Risk Calculator and Example Characterizations of Selected Alaskan Fuels--Technical Background Document and Recommendations.* Alaska Statement of Cooperation Working Group. 72 pp. The file is accessible at: http://dec.alaska.gov/spar/regulation_projects/cs18AAC75and18AAC78.htm.

2.1.11 Table 2 Example Proposed Method One Cleanup Levels Table

Petroleum Hydrocarbon Range	Arctic Zone		Under 40 Inch Zone	Over 40 Inch Zone	Migration to Groundwater
	Pads and Tundra (mg/kg)	Human Health (mg/kg)	Human Health (mg/kg)	Human Health (mg/kg)	(mg/kg)
C5-C10 GRO					
C10-C21 DRO					
C21-C35 RRO					

2.1.12 A footnote may be added to the Method One table that states:

> For the Arctic Zone, the department may determine the cleanup levels for **fresh spills to undisturbed tundra or other undisturbed native vegetation** on a site-specific basis, depending upon whether a cleanup action would cause more severe or long-term damage than would the discharge or release alone. Please refer to the Tundra Treatment Guidelines, Third Edition (ADEC, 2010) for additional information.[2]

3. Method Two Petroleum Cleanup Levels [18 AAC 75.341(d)]

The department is considering several changes to the method two petroleum cleanup levels in Table B2.

3.1 Cleanup levels may be calculated for 13 individual aliphatic and aromatic carbon fractions as corresponding to a Hazard Quotient (HQ) of 1. The cleanup levels would use an updated surrogate toxicity approach with a weighted average, chemical parameters and the same equations and exposure parameters used to calculate cleanup levels for table B1. For migration to groundwater and the inhalation route, a 3-phase partitioning model would be used. The toxicity values and chemical parameters assigned to each fraction are presented in **Table 3** and **Table 4** with the source cited. However, other approaches and sources may also be considered for quantifying the risk in each fraction.

[2] Available at: http://dec.alaska.gov/spar/regulation_projects/cs18AAC75and18AAC78.htm

3.2 Table 3 Toxicity Values for the Aromatic and Aliphatic Fractions[3]

Fractions	RfD	RfC	Surrogate	Source	Tier
BTEX C5-C8	0.04	0.03	Benzene = 7.5% toluene = 39.6% ethylbenzene= 9.2% and xylenes =43.7%	IRIS	1
Aromatic >C8-C10	0.1	0.4	Isopropyl benzene (Cumene)	IRIS	1
Aliphatic C5-C6	0.3	2.7	RfD= State of Washington RfC = Cyclohexane (IRIS) (1.7 mg/kg/ day); n- hexane higher range 16% from TPHCWG IRIS with the remainder cyclohexane	State of Washington IRIS TPHCWG	3 1 3
Aliphatic >C6-C8	0.3	2.7	RfD= State of Washington RfC = Cyclohexane 84 %(IRIS) (1.7 mg/kg/ day); n- hexane higher range 16% from TPHCWG IRIS	State of Washington IRIS TPHCWG	3 1 3
Aliphatic >C8-C10	0.1	0.2	Dearomatized White Spirits	State of Massachusetts	3
Aromatic >C10-C12	0.02	0.003	Naphthalene	IRIS	1
Aromatic >C12-C16	0.5	0.0004	1,1 Biphenyl	IRIS (RfD) PPRTV (RfC)	1 1
Aromatic >C16-C21	0.03	NA	Pyrene	IRIS	1
Aliphatic >C10-C12	0.1	0.2	Dearomatized White Spirits	State of Massachusetts	3
Aliphatic >C12-C16	0.1	0.2	Dearomatized White Spirits	State of Massachusetts	3
Aliphatic >C16-C21	2	NA	Mineral Spirits	State of Massachusetts	3
Aromatic >C21-C35	0.04	NA	Fluoranthene	IRIS	1
Aliphatic >C21-C35	2	NA	White Mineral Oil	TPHCWG	3

IRIS: Integrated Risk Information System
TPHCWG: Total Petroleum Hydrocarbon Criteria Working Group
PPRTV: Provisional Peer Reviewed Toxicity Value
RfD: Reference Dose
RfC: Reference Concentration

[3] The percentages are based on information about Alaska fuels presented in: Geosphere, Inc. and CH2MHill, 2006. *Hydrocarbon Characterization for Use in the Hydrocarbon Risk Calculator and Example Characterizations of Selected Alaskan Fuels--Technical Background Document and Recommendations.* Alaska Statement of Cooperation Working Group. 72 pp. The file is accessible at: http://dec.alaska.gov/spar/regulation_projects/cs18AAC75and18AAC78.htm.

3.3 Table 4 Physical Chemical Properties for the Aromatic and Aliphatic Fractions

	Mean Carbon	Molecular Weight (g/mole)	Vapor Pressure (atm)	Water Solubility (mg/L)	H'	Koc	Diffusivity in Air	Diffusivity in Water	Kp	Kow
Aromatic C5-C8 BTEX	6.5	92.5	1.12E-01	2.16E+02	1.96E+00	8.91.E+02	0.1	0.00001	8.45.E-03	1.03.E+02
Aromatic C9-C10	9.5	118.3	3.55E-03	5.07E+01	3.38E-01	1.78.E+03	0.1	0.00001	9.05.E-03	2.05.E+02
Aromatic >C10-C12	11	130.1	6.31E-04	2.45E+01	1.37E-01	2.51.E+03	0.1	0.00001	9.52.E-03	2.90.E+02
Aromatic >C12-C16	14	152.2	4.79E-05	5.75E+00	5.18E-02	5.01.E+03	0.1	0.00001	1.08.E-02	5.78.E+02
Aromatic >C16-C21	18.5	182.5	1.15E-06	6.53E-01	1.31E-02	1.41.E+04	0.1	0.00001	1.36.E-02	1.63.E+03
Aromatic >C21-C35	28	238.9	4.37E-10	6.61E-03	6.45E-04	1.26.E+05	0.1	0.00001	2.48.E-02	1.45.E+04
Aliphatic C5-C6	5.5	80.9	3.55E-01	2.99E+01	3.93E+01	8.04.E+02	0.1	0.00001	9.38.E-03	9.26.E+01
Aliphatic >C6-C8	7	102.3	6.31E-02	4.47E+00	5.90E+01	3.80.E+03	0.1	0.00001	1.90.E-02	4.38.E+02
Aliphatic >C8-C10	9	130.5	6.31E-03	3.55E-01	9.49E+01	3.02.E+04	0.1	0.00001	4.89.E-02	3.48.E+03
Aliphatic >C10-C12	11	158.5	6.31E-04	2.82E-02	1.45E+02	2.40.E+05	0.1	0.00001	1.26.E-01	2.77.E+04
Aliphatic >C12-C16	14	200.3	4.79E-05	6.31E-04	6.21E+02	5.37.E+06	0.1	0.00001	5.25.E-01	6.19.E+05
Aliphatic >C16-C21	18.5	262.5	1.15E-06	2.11E-06	5.83E+03	5.69.E+08	0.1	0.00001	4.50.E+00	6.56.E+07
Aliphatic >C21-C35	28	392.4	NA	NA	NA	1.07.E+13	NA	NA	4.27.E+02	1.24.E+12

Equivalent Carbon Range = the mean carbon fraction was used in the calculation:

- Water Solubility (mg/L) = for aromatics: log10S = -0.21* EC + 3.7 (R2 = 0.89); for aliphatics: log10S = -0.55* EC + 4.5 (R2 = 0.94).
- Organic Carbon Partitioning Coefficient, Kow (ml/g)
- for aromatics: log10 Koc = 0.10* EC + 2.3 (R2 = 0.81)
- for aliphatics: log10 Koc = 0.45* EC + 0.43 (R2 = 0.94)

Vapor Pressure:

- for EC<= 12: log10VP = -0.50* EC + 2.3 (R2 = 0.99)
- for EC> 12: log10 Vp = -0.36* EC + 0.72 (R2 = 0.96)

Molecular Weight (g/mole)

- for aromatics: lnMW = 0.65* ln(EC) + 3.31
- for aliphatics: lnMW = 0.97* ln(EC) + 2.74

Henry's Law Constant (cm^3/cm^3): the Henry's Law constant used in the hydrocarbon risk calculator is calculated from the vapor pressure and solubility values, as per its definition, rather than using a regression equation):

- H = (VP*MW) / (S* R * T)
- where EC = equivalent carbon number
- H = Henry's Constant (cm^3/cm^3)
- VP = vapor pressure (atm)
- MW = molecular weight (g/mole)

- S = solubility (mg/L)
- R = gas constant (0.08205 L*atm / mole* oK)
- T = temperature (oK)

3.4 This approach would generate 13 fraction-specific soil cleanup levels for human health for each climate zone that accounts for exposure through dermal contact, ingestion, and outdoor inhalation, consistent with Table B1, along with statewide migration to groundwater cleanup levels for each of the fractions, back-calculated from updated groundwater cleanup levels (see **Section 4.**). See **Table 5** for an example of how the cleanup levels for method two would be presented.

3.5 Other considerations for Method Two:

3.5.1 The 13-fraction approach would require different analytical methods (extractable petroleum hydrocarbons (EPH) and volatile petroleum hydrocarbons (VPH) than the AK Series to report concentrations for each fraction (see **Section 6.**).

3.5.2 AK 101, 102, and 103 for GRO, DRO and RRO may still need to be run in Method Two in order to assess the polar fraction of the petroleum that is typically stripped out in the EPH/VPH Analyses. Research indicates the polar fractions may be toxic to human health and to ecological receptors.

3.5.3 Ecoscoping may be a required step for all Method two cleanups to address ecological risks from polar compounds.

3.5.4 Eliminating the 3-phase migration to groundwater cleanup levels entirely and requiring site-specific 4-phase calculations or a synthetic precipitation leaching procedure study to show that the pathway is not complete.[4]

3.5.5 Eliminating the Arctic Zone from Method two petroleum cleanup levels, since human health cleanup levels are not protective enough for the receiving environment and human health receptors are typically not present.

3.5.6 The department seeks comments and justification on retaining, modifying or repealing the saturation based cleanup levels referred to as Maximum Allowable Concentrations.

3.5.7 The department seeks comments on the assessment of risk from polar compounds and how best to quantify the presence of polar compounds in the individual fractions.

[4] See for example, approaches used in State of New Jersey or Texas Commission on Environmental Quality; accessible at: http://dec.alaska.gov/spar/regulation_projects/cs18AAC75and18AAC78.htm

3.5.8 Table 5 Example of how method two fraction-specific cleanup levels would be presented:

Petroleum Hydrocarbon Range	Arctic Zone	Under 40 Inch Zone	Over 40 Inch Zone	Migration to Groundwater
	Human Health (mg/kg)	Human Health (mg/kg)	Human Health (mg/kg)	(mg/kg)
Gasoline				
BTEX C5-C8				
Aromatic >C8-C10				
Aliphatic C5-C6				
Aliphatic >C6-C8				
Aliphatic >C8-C10				
Diesel				
Aromatic >C10-C12				
Aromatic >C12-C16				
Aromatic >C16-C21				
Aliphatic >C10-C12				
Aliphatic >C12-C16				
Aliphatic >C16-C21				
Residual				
Aromatic >C21-C35				
Aliphatic >C21-C35				

3.5.9 Footnotes may be added to the Method Two table that cover the following:

For the Arctic Zone, the human health values may not be appropriate for the sensitive tundra environment. An evaluation of site receptors and the receiving environment may be required. The department may determine the cleanup levels for **fresh spills to undisturbed tundra or other undisturbed native vegetation** on a site-specific basis, depending upon whether a cleanup action would cause more severe or long-term damage than would the discharge or release alone. Please refer to the Tundra Treatment Guidelines, Third Edition (ADEC, 2010) for additional information. [5]

[5] Available at: http://dec.alaska.gov/spar/regulation_projects/cs18AAC75and18AAC78.htm

4. Method Three Cleanup levels for Petroleum [18 AAC 75.340(e)]

Three options are provided in 18 AAC 75.340(e) for proposing site-specific soil cleanup levels for petroleum under Method 3:

1) Using site-specific data and DEC's cleanup level equations to modify the migration to groundwater or human health levels;

2) Using site-specific data and a fate and transport model to modify the migration to groundwater levels; and

3) Using commercial or industrial exposure parameters to modify the human health levels.

4.1 The department seeks public input on whether to allow Method One cleanup levels for petroleum to be modified using these three options.

4.2 For option 2), the department is developing a 4-phase risk calculator to allow responsible parties to propose site-specific cleanup levels using a 4-phase equilibrium partitioning model for the migration to groundwater and inhalation pathways.

5. Groundwater Cleanup Levels for Petroleum [18 AAC 75.345(b)]

The department is considering updates to the groundwater cleanup levels for petroleum to conform to the tentative carbon ranges described above, using the same surrogate based toxicity approach and fraction percentages as for soil described above. The same equations used to calculate cleanup levels for all other Table C compounds would be used.

5.1 To provide flexibility for the regulated community, cleanup levels would be calculated for each of the 13 fractions in method two and also for the three petroleum ranges in method one (see **Table 6**).

Table 6

Example of how revised groundwater cleanup levels would be presented

Petroleum Hydrocarbon Range	Cleanup Levels by Fraction µg/L	Cleanup Levels by Ranges µg/L
Gasoline		**GRO C5-C10**
BTEX C5-C8		
Aromatic >C8-C10		
Aliphatic C5-C6		
Aliphatic >C6-C8		
Aliphatic >C8-C10		
Diesel		**DRO C10-C21**
Aromatic >C10-C12		
Aromatic >C12-C16		
Aromatic >C16-C21		
Aliphatic >C10-C12		
Aliphatic >C12-C16		
Aliphatic >C16-C21		
Residual		**RRO C21-C35**
Aromatic >C21-C35		
Aliphatic >C21-C35		

5.2 Because of the changes to the ranges, the analytical methods for petroleum analyses in groundwater would need to be revised or replaced with other methods (see **Section 6.**).

5.3 The department seeks comments and justification on retaining, modifying or repealing the petroleum cleanup levels that are capped at solubility. Although these values may be lower than the calculated human health risk-based value, the capped concentrations reduce the levels remaining in the environment to those that limit present of free-phase product that would otherwise cause unacceptable degradation and pollution of the environment, impact the taste and odor of groundwater used for human consumption, or impacts to natural resources. Furthermore, these capped and human health values may not be adequately protective of ecological receptors or all potential uses of groundwater and additional evaluation and cleanup may be required to address these factors.

5.4 Odor and taste thresholds may be exceeded for the petroleum fractions even though contaminant concentrations are below groundwater cleanup levels (18 AAC 75.345, Table C). Since odor is considered a secondary maximum contaminant level (MCL) for a public water system, the department may repeal taste and odor language currently in regulation and defer to existing regulatory language that allows consideration of a secondary MCL on a site-specific basis. Alternatively, the department may consider new language to address taste, odor, aesthetics and welcomes input on analytical methods for evaluating taste and odor in groundwater.[6]

6. Laboratory Methods in the Underground Storage Tanks (UST) Procedures Manual [18 AAC 78.007]

6.1 If petroleum ranges for GRO, DRO, and RRO are modified, the department would seek to revise the Alaska analytical methods for GRO (AK101), DRO (AK102), and RRO (AK103) to report the new ranges for both soil and groundwater. Comment is requested on this change, including whether this would impact how new analytical results would compare to past data generated by existing versions of the AK Series. In this regard, the department is considering that it would choose to accept and compare older site data on GRO, DRO and RRO to any new GRO, DRO, and RRO method one cleanup levels regardless of the analytical method or the changes to the fractions and percentages. However, old data for these ranges would not be comparable to a new fraction specific set of cleanup levels.

6.2 The 13-fraction approach would require different analytical methods than the AK Series to report concentrations for each fraction. Therefore the department would seek to repeal methods AK101AA, AK102AA, and AK103AA and potentially adopt currently available analytical methods for volatile petroleum hydrocarbons (VPH) for the aromatic fractions and extractable petroleum hydrocarbons (EPH) for the aliphatic fractions to report concentrations in each of the 13 fractions. Analytical costs for VPH and EPH currently total approximately three and a half times the cost of running AK101/8021B and

[6] See: WHO 2005 Petroleum Products in Drinking Water: Background document for development of WHO Guidelines for Drinking Water Quality, accessible at: http://dec.alaska.gov/spar/regulation_projects/cs18AAC75and18AAC78.htm

AK102/AK103. Under proposed Method 2, the AK Series analyses may be required to be run in addition to the EPH and VPH analyses in order to assess the polar fraction, adding to the overall costs.

6.3 The department seeks comment and input on the possible adoption of other approved methods for total petroleum ranges in lieu of updating and maintaining the Alaska methods, AK101, AK102, and AK 103 for soil and groundwater. Selecting other approved methods may require changes to the carbon ranges for GRO, DRO and RRO in method one and for groundwater, which may impact the respective numeric cleanup levels as well as comparability with older site data.

6.4 The department also seeks comment and input from the public on whether it should repeal and replace the adopted by reference UST Procedures Manual with the department's Field Sampling Guidance in both 18 AAC 75 and 18 AAC 78, shifting petroleum analytical methods requirements and other information from the UST Procedures Manual to the updated Field Sampling Guidance, (or maintaining the methods in a standalone document) or if the public prefers that two guidance documents continue to be maintained, with updates made to the UST Procedures Manual to conform to any and all changes made to the cleanup levels and analytical methods where they are referenced throughout the guidance document.

7. Definitions [18 AAC 78.995] and other conforming changes throughout 18 AAC 75 and 78. The definitions at 18 AAC 78.995 concerning the carbon ranges would need to be updated if any changes to the ranges are made. Any other conforming changes throughout 18 AAC 75 and 18 AAC 78 would also need to be made.