



## COGCC OPERATOR GUIDANCE

### RULE 915.a - SOIL CONCENTRATIONS - DETERMINATION OF PATHWAY TO GROUNDWATER

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#### Rule Citation

**915.a. Soil Concentrations.** Operators will adhere to the concentrations for soil cleanup in Table 915-1. Operators will use Residential Soil Screening Level Concentrations as cleanup levels unless required otherwise by the Director. The Director will require adherence to the Protection of Groundwater Soil Screening Levels when a pathway to Groundwater exists. When the Director has reasonable cause to believe that oil and gas exploration-related compounds or parameters other than those listed in Table 915-1 may be present, the Director may require additional analyses of compounds included in the EPA RSLs, as incorporated by reference in Rule 901.b.

#### Purpose of Rule

Rule 915.a sets different cleanup standards for soil based on the presence or absence of a pathway to groundwater. In accordance with Rule 915.a and Table 915-1 Operators will adhere to the United States Environmental Protection Agency's ("EPA") Residential Soil Screening Levels ("Residential SSLs") in areas where no pathway to Groundwater exists. If a pathway to Groundwater is present then Operators will adhere to EPA's Groundwater Soil Screening Levels ("Protection of Groundwater SSLs").

The use of the Residential Soil Screening Levels ("Residential SSLs") and of Protection of Groundwater SSLs reflect and are consistent with the Colorado Department of Public Health & Environment Hazardous Materials and Waste Management Division ("CDPHE HMWMD") uses of the EPA's RSLs.

Additional information can be found in the following COGCC Guidance documents:

- 615.e.1 - Model Sampling and Analysis plan
- 913 - Site Investigation Remediation and Closure
- 913.b.(5)B i-v - Remediation Standards
- 915.e.(2) - Soil Sampling and Analysis

## RULE 915.a GUIDANCE

### Rule 915.a. Guidance

Determination of whether the Residential SSL or Protection of Groundwater SSLs will be applied to a Spill or Release will be considered on a case-by-case basis. Near-surface geology, depth to Groundwater, and secondary containment practices vary across the state, between and even within basins and should be considered and evaluated at each Spill or Release. As part of reporting a Spill or Release, the Operator will present site specific information and data for Staff to consider in making a determination if a pathway to Groundwater is present.

Table 915-1 includes a Residential SSL Concentration and Protection of Groundwater SSL Concentration for Organic Compounds and Metals in Soil. COGCC Staff will apply the Residential SSL to Spills and Releases of Exploration and Production Waste (“E&P Waste”) where site-specific evidence demonstrates that a pathway to Groundwater does not exist.

Note: If Residential SSL’s are to be applied to a subsurface spill Operators are still required to define the vertical and lateral extent of impacts. Operator may also collect and analyze a background soil sample in order to determine if Metals in Soil do not apply to the characterization of the release.

COGCC considers the Protection of Groundwater SSLs to be secondary to measured concentrations of Organic Compounds in Groundwater when Groundwater is in contact with or proximate to impacted soil. Operator may demonstrate that the Protection of Groundwater SSL for Organic Compounds or Metals in Soil do not apply by conducting Groundwater monitoring that demonstrates concentrations of Organic Compounds in Groundwater do not exceed the Cleanup Concentrations in Table 915-1 and Water Quality Control Commission (“WQCC”) Regulation 41. Additional site-specific information that may be required for relief from application of Protection of Groundwater SSLs at a site includes:

1. Characterization of soils at or under a Spill or Release such as grain size, infiltration rates, and mineralogy;
2. Characterization of soils within the capillary fringe or smear zone where present;
3. Depth to Groundwater and determination of any impermeable zones above and below Groundwater when present;
4. Presence and condition of secondary containment devices (particularly the presence of containment that limits vertical migration).

The General Notes below provide examples of Spills which may demonstrate the lack of a pathway to Groundwater. **However, when a pathway to Groundwater is determined to be present at a Spill or Release the Protection of Groundwater SSLs are the**

## RULE 915.a GUIDANCE

default thresholds for Cleanup Concentrations during Remediation activities as they are protective concentrations implemented to protect Groundwater from residual soil impacts. Figure 1 is an example of a generic Spill of E&P Waste liquids.

### General Notes

**Example 1.** The diagram included as Figure 1 shows an idealized conceptual model for a Spill or Release to the subsurface discovered during removal of one tank from the Facility. In this example of site investigation and Remediation activities, the spilled crude oil or condensate has migrated downward toward the Groundwater table as shown by the dark gray shaded zone beneath the tank battery's above ground storage tanks ("ASTs"). Because of the size of this Spill and based on the concept that the Spill is not recent, the released fluids in this scenario are considered to have a potential pathway to Groundwater through the sandy vadose zone directly above the saturated zone. As a Spill migrates vertically and horizontally, the hydrocarbon liquids may partition into a vapor phase, may adhere to the soil particles, and eventually may dissolve into the Groundwater as shown by the arrows labeled leaching/migration.

Upon discovery, the Operator commonly removes the visibly impacted soil through excavation. When the Operator believes the impacts have been removed and/or technical limitations prevent further excavation, the Operator will collect soil samples from the soil left in place, represented by the green and red stars in the diagram. This soil may or may not have varying degrees of residual contaminants listed in Table 915-1. In this case, the green stars are samples that comply with the Table 915-1 Groundwater pathway concentration levels for organic compounds, and the red stars are samples that show residual impacts exceeding the Protection of Groundwater SSL threshold concentrations for five organic compounds.

If residual impacts are greater than the default Protection of Groundwater SSL, as represented by the red stars, additional investigation of the site characteristics and impacts are likely necessary to determine the actual or potential threat to Groundwater, *depending* on soil type, Groundwater flow direction, and depth to Groundwater. For example, in a 20 foot thick sandy soil with Groundwater present at about 18 feet below the surface, additional investigation steps will likely be required to determine the degree to which the contamination migrated. Whereas the same size and duration Spill occurring in a sandy zone above a 15 foot thick silty clay zone with Groundwater 25 feet or greater from the base of the residual contaminants may result in determination of no likely pathway to Groundwater by the Director. In that case the Residential SSLs for organic contaminants of concern would be appropriate remedial thresholds.

## RULE 915.a GUIDANCE

Groundwater sampling may be required to demonstrate that Groundwater has not been impacted by the residual contamination in soil, and in fact Groundwater sampling is likely the best evaluation mechanism for the Operator to demonstrate there is no pathway of migration of residual soil impacts to reach Groundwater. The two blue vertical lines in the diagram represent monitoring wells an Operator may install to further investigate the residual impacts in soil and/or Groundwater. In many cases more than two monitoring wells will be needed to determine Groundwater flow direction(s) under or in contact with a Spill. If it can be shown over time that Groundwater has not been impacted by contamination greater than the WQCC Regulation 41 and Table 915-1 thresholds for Groundwater, then a No Further Action (“NFA”) Determination may be issued even if the residual soil impacts are greater than the Protection of Groundwater SSL but are less than the Residential SSLs.

**Example 2.** A Spill of a lesser volume of hydrocarbon liquids occurs from crude oil tanks as discussed in Example 1. A major difference was that adequate secondary containment was in place under the ASTs. A synthetic liner and adequate berms under and around the tanks limited horizontal and vertical migration of the hydrocarbon liquids to inside the berms and liner. Sampling and analysis indicate that only a portion of the sand and gravel materials serving as a base for the tanks were impacted by the Spill. Assuming the liner is determined to be intact when any impacted materials inside the liner are removed then the site investigation and remedial action may consist of disposing the impacted materials at a landfill permitted to accept such waste as determined by appropriate characterization and also completing washing residual hydrocarbons from the liner with appropriated disposal of rinsate liquids.

**Example 3.** A permitted lined earthen Pit receives produced water from a coal bed methane (“CBM”) Well. The synthetic liner develops a tear along one side of the Pit which allows produced water to be spilled/released to the environment. Operator discovers the tear near the bottom of the Pit when the Well is out of service for a month but is not certain when the Spill or Release was initiated. Production records (water) and trucking records of water removal from the Pit show a mass balance for all but the last month of production. Operator determines that possibly 400 barrels of produced water spilled from the Pit in the last month of operation from the difference between the sum of produced water in that time (2,000bbls) and the sum of water trucked to a nearby Class II UIC well (20 X 80bbl truckloads =1,600bbls).

Operator discovers no indications of surface transport of the spilled produced water in soils surrounding the Pit, particularly downhill from the Pit. The liner was removed, and the soils beneath the liner were not water saturated but were fairly dry. This indicates the released fluids infiltrated the soils/bedrock below the Pit and have

## RULE 915.a GUIDANCE

migrated from the Pit in the subsurface. The release described would be reported as posing a threat to Groundwater and, unless the Operator can demonstrate conclusively that no pathway to Groundwater exists the more restrictive Protection of Groundwater SSLs would normally be assumed to apply to contaminants of concern in soils impacted by this Spill or Release. However, sampling and analysis of CBM produced water from the Well shows that of the organics and metals in the Table 915-1 soils threshold only benzene was detected at concentrations which might create residual soil impacts.

**Example 4.** An above ground pipe from a separator cracks resulting with a spray of hydrocarbon condensates to the surrounding area. The pressure in the system is such that the spray of hydrocarbon liquids extends outside the metal-bermed, synthetically lined secondary containment area around the separator. The weather was clear and cold and the top six inches of surface soils are frozen with a few inches of snow cover on top of the frozen soil. The Spill was stopped shortly after it initiated with approximately 5 barrels having been sprayed over an area of 10 feet width by 50 feet length. Data and observation gathered during the site investigation and Remediation activities indicate the hydrocarbon liquids sprayed outside the containment area stayed in the top inch or two of the soil with much of the impact being to the few inches of snow cover. There were no impacts or threats to impacts to surface water or jurisdictionally mapped wetlands. In this instance, the Operator could use the observations and data gathered to request application of the Residential SSLs, rather than the Protection of Groundwater SSLs, with no likely pathway to Groundwater at the Spill under the conditions observed.

### Document Change Log

Change Date	Description of Changes
February 18, 2021	Document Finalized

## RULE 915.a GUIDANCE

**Table 1. Portion of Table 915-1**

Contaminant of Concern	Concentrations	
	Residential Soil Screening Level Concentrations (mg/kg) <sup>7</sup>	Protection of Groundwater Soil Screening Level Concentrations (mg/kg) Risk Based (R) and MCL Based (M) <sup>7,8</sup>
<b>Organic Compounds in Soils<sup>6, 9, 10</sup></b>		
benzene	1.2	0.0026 (M)
toluene	490	0.69 (M)
ethylbenzene	5.8	0.78 (M)
xylene (sum of o-, m- and p- isomers = total xylenes)	58	9.9 (M)
1,2,4-trimethylbenzene	30	0.0081 (R)
1,3,5-trimethylbenzene	27	0.0087 (R)
acenaphthene	360	0.55 (R)
anthracene	1800	5.8 (R)
benz(a)anthracene	1.1	0.011 (R)
benzo(b)fluoranthene	1.1	0.3 (R)
benzo(k)fluoranthene	11	2.9 (R)
benzo(a)pyrene	0.11	0.24 (M)
chrysene	110	9 (R)
dibenzo(a,h)anthracene	0.11	0.096 (R)
fluoranthene	240	8.9 (R)
fluorene	240	0.54 (R)
indeno(1,2,3-cd)pyrene	1.1	0.98 (R)
1-methylnaphthalene	18	0.006 (R)
2-methylnaphthalene	24	0.019 (R)
naphthalene	2	0.0038 (R)
pyrene	180	1.3 (R)
<b>Metals in Soils<sup>1, 6, 9, 10, 11</sup></b>		
arsenic	0.68	0.29 (M)
barium	15000	82 (M)
cadmium	71	0.38 (M)
chromium (VI)	0.3	0.00067 (R)
copper	3100	46 (M)
lead	400	14 (M)
nickel	1500	26 (R)
selenium	390	0.26 (M)
silver	390	0.8 (R)
zinc	23000	370 (R)

# RULE 915.a GUIDANCE

Figure 1. Conceptual Model of Potential Pathway to Groundwater

