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Soil Quality Guidelines for Selected Trace Metals
Best Practices
PTAC Agreement 15-SGRC-04

DRAFT

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1.0 INTRODUCTION

The Alberta Tier 1 Soil and Groundwater Remediation Guidelines (Alberta Environment and Parks, AEP, 2016) are used for the assessment and remediation of contaminated sites in Alberta; the Canadian Environmental Quality Guidelines (Canadian Council of Ministers of the Environment, CCME, 1999 and updates) are used for Federal Government lands and in several other provinces. Typically, if concentrations of chemical contaminants exceed these guidelines, the contamination requires remediation, risk management, or site-specific risk assessment.

Both the Alberta and CCME soil quality guidelines were derived based on A Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines (CCME, 2006). This protocol describes the approach, assumptions and models for deriving widely applicable soil quality guidelines that are protective of both human and environmental health. However, some substances, particularly certain metals, have not been evaluated using the CCME (2006) protocol or its 1996 precursor, and are still assessed using prior interim guidelines from 1991. Specifically, antimony, beryllium, boron, cobalt, fluoride, molybdenum, silver, sulphur, tin and several organic substances (primarily chlorinated organics and phenolics) do not have modern risk-based guidelines.

In the absence of risk-based guidelines, concentrations of these substances measured during contaminated site investigations cannot be readily related to potential risks to human and environmental health. Without this information, it is unknown whether remediation is necessary to protect human and environmental health, or whether remediating to guidelines will achieve human and environmental health protection. The available options for cost-effective site-specific risk assessment for the metals in particular are also very limited without a risk-based guideline as a starting point. Risk management plans are also difficult to develop, since the 1991 interim guidelines do not provide any information on what receptors or exposure pathways may be affected by different chemical concentrations in soil.

The purpose of the present work is to develop risk-based guidelines consistent with the CCME (2006) protocol for selected trace metals which occur at oil and gas sites, specifically antimony, beryllium, cobalt and molybdenum. The guideline development process for each metal is detailed in a scientific supporting document; a brief summary of the results is provided herein.

2.0 APPLICATION OF PROPOSED GUIDELINES

The proposed guidelines below have been provided to AEP, Health Canada and Environment Canada for review. However, at this time they have not been officially endorsed. Therefore at present any use of these guidelines would be considered site-specific risk assessment.

Where concentrations of antimony, beryllium, cobalt or molybdenum exceed the current Tier 1 guidelines (adopted from the CCME 1991 criteria) the risk-based guidelines below can be used to



inform decision-making, including determining what (if any) receptors may be at risk. Consultation with regulators is likely required to achieve site closure based on remediation to these guidelines at present.

3.0 PROPOSED GUIDELINES

Proposed guidelines are summarized below in Tables 1 through 4.

Pathway	Natural Area	Agricultural	Residential/ Parkland	Commercial	Industrial
Guideline (SQ_F)	120	20	20	70	210
<i>Human health guidelines</i>					
SQ_{GHH}	NA	20	20	70	1400
Direct Contact (SQ _{G_{DH}})	NA	20	20	70	1400
Protection of Indoor Air Quality (SQ _{G_{IAQ}})	NA	NA	NA	NA	NA
Protection of Potable Water (SQ _{G_{PW}})	NA	NA	NA	NA	NA
Off-site migration check (SQ _{G_{OM-HH}})	NA	NA	NA	210	210
Produce, meat & milk check (SQ _{G_{FI}})	NC	NC	NC	NC	NC
<i>Environmental health guidelines</i>					
SQ_{GE}	120	120	120	240	240
Soil contact (SQ _{G_{SC}})	120	120	120	240	240
Soil and food ingestion (SQ _{G_I})	590 ^a	2100 ^a	NA	NA	NA
Protection of freshwater life (SQ _{G_{FL}})	NA	NA	NA	NA	NA
Livestock watering (SQ _{G_{LW}})	NA	NA	NA	NA	NA
Irrigation water (SQ _{G_{IR}})	NA	NA	NA	NA	NA
Nutrient and energy cycling (SQ _{G_{NEC}})	NC	NC	NC	NC	NC
Off-site migration check (SQ _{G_{OM-E}})	NA	NA	NA	1,700	1,700
SQ _{G_M} (non-toxicity considerations)	NA	NA	NA	NA	NA
Interim soil quality criterion (CCME 1991)	20	20	20	40	40

a – provisional value, data requirements for guideline not met



Pathway	Natural Area	Agricultural	Residential/ Parkland	Commercial	Industrial
Guideline (SQ_F)	16	73	75	110	170
<i>Human health guidelines</i>					
SQ_{GHH}	NA	75	75	110	1100/550
Direct Contact (SQ _{G_{DH}})	NA	75	75	110	1400
Direct Contact (Inhalation)					
10-6 ILCR		550	550	550	550
10-5 ILCR		5500	5500	550	5500
Threshold		5300	5300	19,000	19,000
Protection of Indoor Air Quality (SQ _{G_{IAQ}})	NA	NA	NA	NA	NA
Protection of Potable Water (SQ _{G_{PW}})	NA	NA	NA	NA	NA
Off-site migration check (SQ _{G_{OM-HH}})	NA	NA	NA	1100	1100
Produce, meat & milk check (SQ _{G_{FI}})	NC	NC	NC	NC	NC
<i>Environmental health guidelines</i>					
SQ_{G_E}	16	73	85	170	170
Soil contact (SQ _{G_{SC}})	85	85	85	170	170
Soil and food ingestion (SQ _{G_I})	16 ^a	73 ^a	NA	NA	NA
Protection of freshwater life (SQ _{G_{FL}})	NA	NA	NA	NA	NA
Livestock watering (SQ _{G_{LW}})	NA	NA	NA	NA	NA
Irrigation water (SQ _{G_{IR}})	NA	NA	NA	NA	NA
Nutrient and energy cycling (SQ _{G_{NEC}})	NC	NC	NC	NC	NC
Off-site migration check (SQ _{G_{OM-E}})	NA	NA	NA	1,700	1,700
SQ _{G_M} (non-toxicity considerations)	NA	NA	NA	NA	NA
Interim soil quality criterion (CCME 1991)	5	4	4	8	8

a – provisional value, data requirements for guideline not met

Pathway	Natural Area	Agricultural	Residential/ Parkland	Commercial	Industrial
Guideline (SQ_{Gf})	37	37	37	58	83
<i>Human health guidelines</i>					
SQ_{GHH}	NA	42	42	58	390
Direct Contact (SQ _{G_{DH}})	NA	42	42	58	390
Protection of Indoor Air Quality (SQ _{G_{IAQ}})	NA	NA	NA	NA	NA
Protection of Potable Water (SQ _{G_{PW}})	NA	NA	NA	NA	NA
Off-site migration check (SQ _{G_{OM-HH}})	NA	NA	NA	470	470
Produce, meat & milk check (SQ _{G_{FI}})	NC	NC	NC	NC	NC
<i>Environmental health guidelines</i>					
SQ_{GE}	<u>37</u>	<u>37</u>	<u>37</u>	<u>83</u>	<u>83</u>
Soil contact (SQ _{G_{SC}})	37	37	37	83	83
Soil and food ingestion (SQ _{G_I})	880	2950	NA	NA	NA
Protection of freshwater life (SQ _{G_{FL}})	NA	NA	NA	NA	NA
Livestock watering (SQ _{G_{LW}})	NA	NA	NA	NA	NA
Irrigation water (SQ _{G_{IR}})	NA	NA	NA	NA	NA
Nutrient and energy cycling (SQ _{G_{NEC}})	NC	NC	NC	NC	NC
Off-site migration check (SQ _{G_{OM-E}})	NA	NA	NA	400	400
SQ _{GM} (non-toxicity considerations)	NA	NA	NA	NA	NA

Table 4 Soil Quality Guidelines for Molybdenum

Pathway	Natural Area	Agricultural	Residential/ Parkland	Commercial	Industrial
Guideline (SQ_F)	32	15	32	55	55
<i>Human health guidelines</i>					
SQ_{HH}	NA	600	600	910	8,600
Direct Contact (SQ _{GDH})	NA	600	600	910	26,000
Protection of Indoor Air Quality (SQ _{GIAQ})	NA	NA	NA	NA	NA
Protection of Potable Water (SQ _{GPW})	NA	NA	NA	NA	NA
Off-site migration check (SQ _{GOM-HH})	NA	NA	NA	8,600	8,600
Produce, meat & milk check (SQ _{GFI})	NC	NC	NC	NC	NC
<i>Environmental health guidelines</i>					
SQ_{GE}	32	15	32	55	55
Soil contact (SQ _{GSC})	32	32	32	55	55
Soil and food ingestion (SQ _{Gi})	50	15	NA	NA	NA
Protection of freshwater life (SQ _{GFL})	NA	NA	NA	NA	NA
Livestock watering (SQ _{GLW})	NA	NA	NA	NA	NA
Irrigation water (SQ _{GIR})	NA	NA	NA	NA	NA
Nutrient and energy cycling (SQ _{GNEC})	NC	NC	NC	NC	NC
Off-site migration check (SQ _{GOM-E})	NA	NA	NA	200	200
SQ _{GM} (non-toxicity considerations)	NA	NA	NA	NA	NA
Interim soil quality criterion (CCME 1991)	4 (Alberta Tier 1)	5	10	40	40

4.0 REFERENCES

AEP (Alberta Environment and Parks). 2016. Alberta Tier 1 Soil and Groundwater Remediation Guidelines.

Canadian Council of Ministers of the Environment (CCME). 2006. *A protocol for the derivation of environmental and human health soil quality guidelines*. CCME, Winnipeg, MB. Can.