

## Groundwater Assessment to Set Site - Specific Remedial Objectives for Herbicides (Tebuthiuron)

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A groundwater assessment was conducted to determine the risk and effects of Tebuthiuron on water resources in the area. Tebuthiuron was used at the site lease to control nuisance weeds and grasses. The lease is currently abandoned and being remediated. Tebuthiuron found in the soil on the lease and in a groundwater sample from a monitoring well installed on lease influences the remedial alternatives applicable to the lease site as reclamation proceeds. A lake is located approximately 700 m from the lease site and is an important source of irrigation water in this local area and an aquatic and wildlife habitat

The concern was that the extent of groundwater affected by Tebuthiuron off the lease site was unknown. It was suspected that groundwater from the site contributes water to the lake but this needs to be confirmed through the groundwater assessment.

The objective of the groundwater assessment was to develop site specific criteria that protect soil and groundwater quality. Site specific criteria are expected to result in considerable reduction in the scope of remedial measures and improve the perception of risk of adverse impact to surrounding water resources.

The groundwater assessment was conducted by installing a set of nested piezometers between the site and the lake in each underlying stratigraphic unit (5 monitoring wells at each location). The results showed that the vertical groundwater flow direction from the site is downwards and horizontal groundwater flow is towards the lake. An average linear velocity towards the lake was calculated as 20 m/year.

The off lease soil and groundwater samples analyzed had Tebuthiuron concentrations less than analytical limits.

### Issues and Concerns

The assessment results indicated that there are no offlease issues with regards to Tebuthiuron. The onlease assessment results for Tebuthiuron indicated presence of Tebuthiuron in onlease soil and groundwater, therefore, a site specific clean up criteria protective of the water resources needed

to be developed for the protection of the offlease water receptor (Lake).

### Remedial Objectives

It was assumed that after reclamation, the site will be used as cattle pasture (i.e., agricultural use). In addition, the site may also have residential or recreational or natural area use in the future. Considering the applicable possible future receptors and exposure pathways site specific clean up criteria was calculated by using "AENV Tier 2 Guidelines model for the calculations of soil and groundwater remediation guideline for the protection of groundwater pathways" (AENV Tier 2, 2007).

The model considers four contaminant transport processes involving a dilution factor in each transportation process (e.g., DF1 through DF4) to determine the overall dilution factor.

The result of dilution factors 4 (i.e., - ratio of the concentration of chemical in the groundwater beneath the source to the concentration at some distance "x" downgradient of the source) provides an estimate of the concentrations in the groundwater close to off lease receptors. Therefore, this model was also used to estimate Tebuthiuron concentration in groundwater close to the Lake to assess the potential impacts.

The calculated remediation guideline values for Tebuthiuron for the protection of off lease receptor (Lake) at a distance of 700 m from the site were exceptionally high due to high dilution factor created by the separation distance between the site and the lake.

Tebuthiuron concentration in the groundwater close to the Lake was calculated as less than the analytical detection limit, which suggests that there will be no impacts on the Lake due to leaching of Tebuthiuron from the site to groundwater beneath the site.

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Mr. Shaikh is an environmental consultant with EBA's environmental division. He has had four years of consulting experience in environmental work, focussing on groundwater and soil assessments in upstream oil and gas industry. Mr. Shaikh has conducted Phase 1 environmental site assessments (ESAs) and Phase 2 ESAs, delineated impacted soils, and designed confirmatory sampling programs for both active and reclaimed oil and gas sites in Alberta. Mr. Shaikh is one of the lead consultants in dealing with groundwater exploration, groundwater supply evaluation and hydrogeological impact study projects.

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Mr. Dance is EBA's Principal Consultant for hydrogeology and contaminant hydrogeology. He has more than 30 years of experience as a consultant in assessing soil and groundwater quality and groundwater resources throughout western Canada, Ontario, and Quebec. He has been responsible for numerous Phase 1 ESAs and Phase 2 ESAs, risk assessment and risk management plans on oil and gas production sites, retail properties and refineries, on light commercial and industrial properties, and on abandoned heavy industry sites. On those projects, his role has included direct field supervisor, data evaluator, report writing, project management, senior technical review, and overall program director. He currently is the permit holder for APEGGA for geology and engineering geology and is a registered consultant with APES.