



BIOPHYSICAL IMPACT ASSESSMENT
BURNCO WEST COCHRANE #2 GRAVEL PIT
NE ¼ 14-026-05 W5M TO NE ¼ 15-026-05 W5M

Prepared for:
BURNCO ROCK PRODUCTS LTD.

Prepared by:
MATRIX SOLUTIONS INC.

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Calgary, Alberta

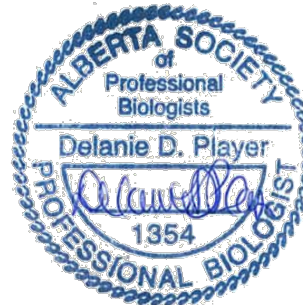
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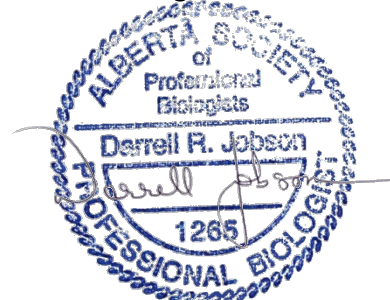
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DISCLAIMER

We certify that this report is accurate and complete and accords with the information available during the site investigation. Information obtained during the site investigation or provided by third parties is believed to be accurate but is not guaranteed. We have exercised reasonable skill, care, and diligence in assessing the information obtained during the preparation of this report.

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1 INTRODUCTION

BURNCO Rock Products Ltd. is currently operating the West Cochrane Gravel Pit that is located approximately 5 km west of Cochrane. This site, located within NW ¼ 13-026-05 W5M, was first opened in 2016 and provides aggregate (sand and gravel) to construction projects in the Cochrane and Calgary areas (Figure 1). Upon depletion of the existing site, BURNCO is proposing to develop the West Cochrane #2 Gravel Pit (the Project), to provide a long-term source of aggregate for the Cochrane and Calgary areas. The disturbance Area refers to the Project boundary, and is located from NE ¼ 14-026-05 W5M to NE ¼ 15-026-05 W5M (Figure 1). It is envisioned that this site will supply aggregate in the years ahead, and will also provide high quality aggregate for use in asphalt and ready-mix production through development of a washing location. It is envisioned that the West Cochrane #2 Gravel Pit will commence operation once the existing West Cochrane Gravel Pit is depleted.

BURNCO retained Matrix Solutions Inc. to complete a biophysical impact assessment (BIA) in association with the proposed Disturbance Area. The BIA is used to guide Project development and to minimize the potential negative effects of development of the Disturbance Area on biophysical resources during planning, design, construction, operations, and reclamation stages. The BIA is also intended to support applications for municipal and provincial permits and authorizations required for the operation of this development.

2 PROJECT DESCRIPTION

Operations at this site will include earth works, extraction of aggregate, crushing, washing, and loading and scaling of trucks to haul materials to market. The aggregate from these lands will be extracted in phases, with progressive reclamation occurring to minimize the amount of open pit area.

The phased development will also allow for a phased approach to site infrastructure. This will include the phased development of a screening berm along Highway 1A. The existing highway access at Range Road 51 will continue to serve as the highway access for the Disturbance Area. Other infrastructure will include a river diversion to provide water for use in washing and dust control. There will also be recharge ponds to allow for dewatering operations.

It is anticipated that the Disturbance Area will have a lifespan of 35 years.

3 OBJECTIVES AND SCOPE OF WORK

The objective of the BIA is to collect site-specific information and characterize existing biophysical resources for the Disturbance Area to assess potential impacts, identify environmental effect and mitigations, and assess residual and cumulative effects of the Project on valued ecosystem components (VECs). The BIA will inform Project planning to minimize impacts of the Project on biophysical resources.

A BIA report that meets the requirements of the *County Servicing Standards* (Rocky View County 2013) is required by Rocky View County. Site-specific information was collected and existing biophysical resources within the Disturbance Area was characterized. The information collected about the existing environment was used to assess potential impacts, identify environmental effects and mitigations, and assess residual and cumulative effects of the Project on VECs.

Potential Project effects on the VECs and cumulative effects are also presented in the BIA. Mitigation measures are provided to guide planning and design, construction, operations, and monitoring activities. The BIA also summarizes regulatory requirements and compensation measures are discussed.

The BIA scope of work included:

- determining the VECs that may interact with the Project
- considering the temporal and spatial boundaries of interactions between the Project and VECs
- describing the current environmental setting for the Project
- predicting the potential effects of the Project on the existing environment through all phases including construction, operation, and decommissioning and abandonment
- identifying or develop feasible and proven mitigation to eliminate or reduce Project effects
- identifying any residual effects and determining their significance

4 METHODS

Initial data on the biophysical resources was collected during a desktop assessment. The results from desktop assessment were then used to identify VECs that could potentially be found in the Disturbance Area. Field work was completed to validate findings of the desktop assessment and confirm the VECs. The following sections provide details for assessing the biophysical resources.

4.1 Desktop Assessment

To determine the VECs that were applicable to the Disturbance Area and to help guide field programs, Matrix completed a desktop review of existing information. Biophysical resources identified during the desktop review included land use, geology, hydrogeology, hydrology, soils and topography, vegetation and wetlands, wildlife, fish, natural areas and environmentally significant areas (ESAs), and historical resources.

4.1.1 Land Use

Land use, vegetation cover, and areas of surface water were initially identified by reviewing aerial imagery of the Disturbance Area. These areas were then ground-truthed during the vegetation field assessments.

4.1.2 Geology

Publically available maps for bedrock and surficial geology were reviewed to establish an understanding of subsurface conditions in the Disturbance Area. LiDAR and aerial imagery datasets were used to classify the local surficial landforms. Two LiDAR datasets were used including a regional 15 m resolution dataset purchased from Altalis, and a local point cloud dataset with variable resolution up to 2 m covering the Disturbance Area collected by BURNCO. Aerial imagery consisted of the most recent available layer from Valtus, under licence.

4.1.3 Hydrology

All potential watercourses and water bodies within and/or adjacent to the Disturbance Area were identified using publically available watercourse maps. Key baseline hydrology characteristics of these watercourses (e.g., contributing drainage areas and estimated flow rates) were estimated by delineating drainage boundaries using available LiDAR topography and estimating flow rates for various return periods based on a flood frequency analysis of historical streamflow data from hydrologically similar creeks.

The desktop review of watercourses and water bodies included the following data sources:

- high resolution satellite imagery (Google, Valtus)
- local point cloud dataset with variable resolution up to 2 m covering the Disturbance Area collected by BURNCO
- publically available topographical data for upstream catchment areas
- historical streamflow data from various Water Survey of Canada stations located within a 25 km radius of the Disturbance Area
- AltaLIS 20K watercourse base maps

4.1.4 Soils and Topography

A desktop review of the Agricultural Region of *Alberta Soil Inventory Database* (AGRASID 3.0; AARD 2016) was completed to identify general topography, geology, terrain, and soils within the Disturbance Area. The desktop review allows for a preliminary identification of potential soil types and terrain features and is used to estimate the number of soil survey locations required during the field survey. The soil desktop review was completed in conjunction with the vegetation and wetland desktop review to assist in identifying different vegetation community areas, including wetlands, and terrain features.

4.1.5 Vegetation and Wetlands

A desktop assessment of vegetation and wetland resources was completed in June 2018 to assess the Disturbance Area prior to field surveys. Additional desktop assessment was completed in October 2021 to ensure the review included current data sources. Available satellite imagery, existing reports, and

publically available data layers were reviewed as part of a desktop assessment to identify vegetation communities, wetlands and potential for sensitive or listed plant and plant communities. Potential wetlands in the Disturbance Area were classified using satellite imagery through consideration of the presence of water; topography and presence of dominant wetland plant (e.g., trees, shrubs, and grasses) visible in the imagery. Desktop delineation and classification of potential wetlands as per the *Alberta Wetland Identification and Delineation Directive* (AEP 2015) was completed prior to the field programs.

Alberta Conservation and Information Management Systems (ACIMS) data was reviewed to determine historic and potential rare plant and rare plant community occurrences within 5 km of the Disturbance Area (AEP 2018a; AEP 2017a; Allen 2014; Government of Canada 2011). Potential noxious and prohibited noxious weeds for the Disturbance Area were also reviewed (Province of Alberta 2016a).

4.1.6 Wildlife and Wildlife Habitat

A review of government and scientific research studies and government database queries were conducted to identify wildlife species, including wildlife species at risk (SAR), and sensitive wildlife areas that may occur in the Disturbance Area. Wildlife SAR are defined as those species listed by:

- the *Alberta Wild Species General Status Listing – 2020* (AEP 2020) as “At Risk,” “May be at Risk,” and “Sensitive”
- the *Alberta Wildlife Act* COSEWIC wildlife species search (Province of Alberta 2020) as “Endangered,” “Threatened,” and “Special Concern”
- *Species at Risk Public Registry, A to Z Species Index* (Government of Canada 2011) as “Endangered,” “Threatened,” and “Special Concern” on Schedules 1, 2, or 3

Identification of sensitive wildlife areas and wildlife species presence was primarily derived from the following sources:

- historical wildlife observation data from the *Fish and Wildlife Internet Mapping Tool* (FWIMT; AEP 2022)
- provincially designated sensitive wildlife ranges, zones, and water bodies (AEP 2018b)
- species range maps (Russell and Bauer 2000; Naughton 2012)

4.1.7 Fish and Fish Habitat

The fish and fish habitat component of the desktop assessment included a review of relevant information from the Bow River from Ghost Dam to 20 km downstream of the Disturbance Area, and three tributary watercourses on the north side of the Bow River in close proximity to the Disturbance Area. The three watercourses include:

- Beaupre Creek that borders the west side of the Disturbance Area
- Grand Valley Creek situated approximately 1 km east of the Disturbance Area

- a small unnamed tributary (UWC1) originating within an area surrounded by the Disturbance Area

The following government and public sources were used to inform the fish and fish habitat desktop assessment:

- a desktop query of the *Fish and Wildlife Management Information Mapping Tool (FWMIT)* database (AEP 2022) to collect historical data on fish species in the three watercourses in close proximity to the Disturbance Area
- the *Alberta Wild Species General Status Listing – 2015* (GoA 2017) as “At Risk,” “May be at Risk,” and “Sensitive”
- the Alberta *Wildlife Act* COSEWIC fish species search (Province of Alberta 2020) as “Endangered,” “Threatened,” and “Special Concern”
- *Species at Risk Public Registry, A to Z Species Index* (Government of Canada 2011) as “Endangered,” “Threatened,” and “Special Concern” on Schedules 1, 2, or 3
- The Government of Alberta *Bull Trout Fish Sustainability Index – Current Adult Density* (GoA 2018a)
- a review of historical reports on the Bow River, including *Nurture, Renew, Protect: A Report on the State of the Bow River Basin* (BRBC 2005)
- a review of aerial imagery of the Disturbance Area

4.1.8 Environmental Significant Areas and Natural Areas

Publicly available data was reviewed including:

- *Environmentally Significant Areas in Alberta: 2014 Update* (Fiera 2014)
- *List of Elements in Alberta – Vascular Plants* (AEP 2018a)
- *Land Use Bylaw C-4841-97* (Rocky View County 2019)

4.1.9 Historical Resources

As historical resources requiring avoidance/Stage 1 studies have been previously identified for the existing operating area, BURNCO has contracted Lifeways of Canada Ltd. to assess and provide reporting on historical resources within the Disturbance Area. The results are presented outside this report.

4.2 Valued Ecosystem Components

Based on a review of the *County Servicing Standards* (Rocky View County 2013) and the desktop review, potential VECs were identified for inclusion in the BIA. The order in which VECs are laid out in this report differs from the BIA Framework, which this report is based on (Rocky View County 2013). The VECs are presented in a hierarchical order as they influence one another.

The VECs selected for assessment in the Disturbance Area are presented in Table 1.

TABLE 1 Valued Ecosystem Components in the Disturbance Area

Valued Ecosystem Components	Why Selected	Rationale
Geology	Terrain, slope stability, potential unique landforms, or other features	Protected by legislation and regulations
Hydrology	Surface and subsurface flows	Flood water risk; erosion protection, surface water protected by legislation and regulations
Soils and topography	Soil quality	Protected by legislation and regulations
Vegetation, including species at risk and special status species, riparian areas	Rare plants and rare plant communities; riparian habitat	Protected by legislation and regulations
Wetlands	Habitat, hydrology, and biodiversity functions	Protected by legislation and regulations
Wildlife and wildlife habitat, including SAR and special status species	SAR, sensitive habitat, and species of management concern	Protected by legislation and regulations
Fish and fish habitat	Fish resources and habitat in tributaries to Bow River and Bow River	Protected by legislation and regulations
Historical and archaeological resources	Presence of historical resources	Protected by legislation and regulations

4.3 Field Surveys

4.3.1 Safety

Matrix personnel were required to comply with legislated, and Matrix health and safety standards. Safety standards and requirements were reviewed and respected during the site visits.

4.3.2 Geology

Desktop information was validated by comparing to background information to local field observations from test hole and groundwater monitoring well drilling completed for the Project.

4.3.3 Hydrology

A site investigation was completed by Matrix personnel on August 17, 2018, to document existing storm drainage infrastructure within and immediately outside of the Disturbance Area, including drainage ditches and culverts, and identify locations where surface water enters and exits the Disturbance Area.

4.3.4 Soils and Topography

A detailed soil survey was conducted within the Disturbance Area on July 24 and 25, 2018, to confirm soils and topography identified in the desktop review. Detailed soil surveys determined soils and their characteristics, identified terrain type, and provided baseline data for determining reclamation success as

described in the *Code of Practice for Pits* (Government of Alberta 2004) and *Soil Quality Criteria Relative to Disturbance and Reclamation (Revised)* (AAFRD 2004).

Soils were classified according to *The Canada Soil Information System (CanSIS): Manual for Describing Soils in the Field, 1982 Revised* (Expert Committee on Soil Survey 1983), *Soil Survey Handbook* (Coen 1987), and *The Canadian System of Soil Classification* (SCWG 1998). The Disturbance Area was accessed by truck and by foot. All soil inspections were conducted with a shovel and hand-held Dutch auger. Soil inspections were conducted to a maximum depth of 100 cm in mineral soils. Each inspection site was described according to topography (slope position, steepness, and aspect), surface expression, parent material, and moisture regime. Soils were assigned a soil subgroup class and a soil series name from the *Alberta Soil Names File (Generation 4), Users Handbook* (Bock 2016).

The following parameters were measured and recorded for each soil horizons:

- depth and horizon morphology
- colour
- texture
- structure
- consistency
- coarse fragments within the profile and surface stoniness
- presence/absence of carbonates and visible salts
- presence/absence of mottles or gleying
- profile drainage

A total of 15 soil inspections were completed within the Disturbance Area (Appendix A). A survey inspection level (SIL) of 2 was completed for the Disturbance Area (Table 2; ASAC 1987). There are no specific density requirements outlined in the *Code of Practice for Pits* (Government of Alberta 2004) and this density was selected based on professional judgement and the uniformity of soils throughout the Disturbance Area.

TABLE 2 Soil Inspection Density

Footprint Component	Size of Disturbance (ha)	Survey Intensity Level 2 (SIL 2)	Total Inspections Completed	Density Completed (ha/SIL)
Gravel Pit	124.91	2 to 20 ha/SIL	15	8.3 ha/SIL

4.3.4.1 Soil Map Units

Soils were mapped to the Disturbance Area boundary. Soil map units (SMUs) for the Disturbance Area identified the dominant soil series (including any modifiers). Topsoil depths were calculated by summing the thickness of the A horizon. Average topsoil depth was calculated from representative soil inspection

locations within a SMU. Topsoil depth range was estimated from the shallowest and deepest topsoil observed in the SMU.

4.3.4.2 Soil Chemistry Analysis

Soil samples were chosen that represented the soil series and map units found within the Disturbance Area. Samples were analyzed to provide baseline soil chemistry for soil classification purposes and to determine baseline land suitability for agriculture, soil suitability for reclamation suitability, and soil sensitivity to wind and water erosion (Appendix B) for the identified soil series. Each major soil series within the Disturbance Area was represented by at least one sample site or ratings from an adjacent area (Matrix 2019) were used. Samples were placed in plastic bags provided by the laboratory, stored in a cooler, and shipped to an accredited laboratory for analysis.

Soil samples were submitted for the following analyses (Appendix C):

- pH (saturation paste extract and 0.01 M calcium chloride solution methods were used)
- electrical conductivity
- sodium adsorption ratio
- soluble ions
- total nitrogen
- total Kjeldahl nitrogen
- total organic carbon
- organic matter
- calcium carbonate equivalent
- particle size and texture

4.3.5 Vegetation and Wetlands

For the BIA, the vegetation and wetland assessment area (VAA) was defined as the Disturbance Area plus a 100 m buffer. Field surveys were completed in 2018 and 2021. Vegetation, wetland, and rare plant surveys were completed within the VAA (Figure 2) June 19 to 21 and July 24 to 25, 2018. On October 13, 2021, a second wetland field assessment was completed for the two confirmed wetlands to fulfill the requirements for the *Water Act* Application.

The vegetation surveys included ecological land classification, wetland surveys, and rare plant surveys following established survey methods. At each survey location moisture and nutrient regimes, percent slope, aspect, landform, and meso-slope position of the site were recorded. Species composition was recorded along with the percent cover of the vegetation strata. The percent groundcover of litter, live plant cover, exposed organic material, and mineral soil was also recorded. GPS coordinates were recorded and photographs were taken. Information was collected at each vegetation survey point, including the

Universal Transverse Mercator coordinates, dominant species, ecosite phase, and wetland classes (if applicable).

Rare plant surveys were completed concurrently with the vegetation surveys. Rare plant surveys followed the recognized sampling guidelines outlined in the *Alberta Native Plant Council (ANPC) Guidelines for Rare Vascular Plant Surveys in Alberta – 2012 Update* (ANPC 2012). Rare plant surveys were targeted in areas of high rare plant potential such as microhabitats, unusual plant assemblages, or ephemeral drainages (ANPC 2012) within the Disturbance Area. Rare plants are defined as vascular and non-vascular plant species that are:

- listed as tracked or watched by the List of Elements in Alberta (AEP 2018a; AEP 2017a) and ranked as:
 - ✦ globally rare (G1, G2, G3)
 - ✦ provincially rare (S1, S2, S3); and/or
 - ✦ presumed extirpated (SX), currently unranked (SNR) or unrankable (SU)
- listed federally under the *Species at Risk Public Registry, Species at Risk Act* (SARA), Schedules 1, 2, or 3 as “Endangered,” “Threatened,” or “of Special Concern” (Government of Canada 2018).

Plant communities of conservation concern are “unusual” or “uncommon” assemblages of species that are rare across a landscape and therefore contribute greatly to local biodiversity (Allen 2014). These natural ecological communities consist of both upland and wetland communities.

Areas identified as potential wetlands during the desktop assessment were assessed for wetland vegetation species and wetland soils, if applicable (AEP 2015). The wetland assessments were completed by ecologists, directly supervised by a qualified wetland scientist (Kelly Ostermann, M.Sc., P.Ag.) who meets the requirements outlined in the *Professional Responsibilities in Completion and Assurance of Wetland Science, Design and Engineering Work in Alberta* (AEP et al. 2017). The wetland boundaries were delineated by foot through the identification of hydric soil and vegetation indicator species for wetlands (AEP 2015).

Vegetation communities were classified and mapped, based on aerial photograph interpretation and field data. Mapping polygons, where applicable, were also classified according to the *Alberta Wetland Classification System* (ESRD 2015).

Weed species, as listed in the *Weed Control Act* (Province of Alberta 2016a) were noted during the rare plant and vegetation surveys. If encountered, the degree of infestation, approximate extent of infestation, and the representative growth stage of the weed was collected.

4.3.6 Wildlife and Wildlife Habitat

Based on a desktop review of provincially designated sensitive wildlife ranges and zones and habitat within and adjacent to the Disturbance Area, Matrix recommended the completion of the following surveys:

- sharp-tailed grouse
- raptor stick nest
- breeding bird

The wildlife assessment area (WAA) was defined as the Disturbance Area plus a 1,000 m buffer (Figure 3). Wildlife surveys were conducted as per the *Sensitive Species Inventory Guidelines* (SSIG; ESRD 2013a). Surveys were carried out under the appropriate research licences/collection permits provided by Alberta Environment and Parks (AEP). As per permit requirements, results of the surveys were submitted to AEP upon completion.

No suitable amphibian breeding habitat was identified during the sharp-tailed grouse surveys, or during the desktop and field wetland assessments. Based on these results, amphibian surveys were not completed for the Project.

Prior to Project commencement, Matrix recommends that sharp-tailed grouse surveys and raptor surveys are repeated, as these surveys generally need to be repeated every 2 years to ensure all features have been identified. In addition, Matrix recommends that a wildlife sweep is completed prior to construction to identify any other feature that may have a setback outlined in the *Master Schedule of Standards and Conditions* (AEP and AER 2021).

4.3.6.1 Sharp-tailed Grouse Survey

Sharp-tailed grouse surveys were completed in the WAA on two separate occasions (May 7 and 8, 2018) by a qualified wildlife biologist. The surveys followed the SSIG area search method, and included the Disturbance Area and a 500 m buffer from the boundaries of the Project. Surveys were conducted from nearby roads and other access points to survey as much of the non-cultivated habitats as possible, based on a 500 m listening and visual scanning radius when using a spotting scope.

Surveys were conducted from 1 hour before local sunrise to 3 hours after local sunrise (approximately 06:00 a.m. to 09:30 a.m.). The surveys were conducted in good weather, with winds less than 20 km/h and no precipitation.

4.3.6.2 Raptor Stick Nest Survey

A raptor stick nest survey was completed in the WAA by a qualified wildlife biologist on May 23, 2018, concurrently with the first breeding bird survey. The survey followed the SSIG (ESRD 2013a), and included surveying all potential nesting sites within 1,000 m of the Disturbance Area. Surveys were conducted from

nearby roads and access points to survey as much of the nesting habitats as possible based on a 1,000 m visual scanning radius when using a spotting scope.

The survey was conducted during daylight hours, a half hour after sunrise to a half hour before sunset. The survey was conducted in suitable weather, with winds less than 50 km/h and no precipitation. All potential nesting sites were assessed to determine if the nest was active, while staying an adequate distance to ensure breeding wildlife are not disturbed. If no birds were noted, the nest was approached (if access was possible) and fully investigated to determine status. If birds are seen in the area, the nesting area was vacated immediately.

4.3.6.3 Breeding Bird Survey

Breeding bird surveys were completed in the WAA on two separate occasions (May 23 and June 4, 2018) by a qualified wildlife biologist. The first survey was completed concurrently with the raptor stick nest survey. The survey followed the SSIG point count method (ESRD 2013a). Points were accessed via truck utilizing existing roads or on foot. A total of five point count locations were surveyed.

A modified fixed radius point count sampling procedure was used, with a detection radius of 50 m and the center point located at least 100 m from a stand edge. Birds were identified from the centre of the fixed radius plot by sight or sound for a period of 5 minutes. The surveys were conducted during daylight hours from a half hour before sunrise to 11:00 a.m. Surveys were conducted during suitable weather, with temperatures above 0°C, with winds less than 20 km/h and no precipitation.

4.3.7 Fish and Fish Habitat

Fish and fish habitat information acquired through the desktop review was used to inform the field component approach for the fish habitat assessment. The fish habitat assessment was conducted by a qualified aquatic environmental specialist on November 8, 2018. Beaupre Creek, Grand Valley Creek, and one unnamed watercourse (U-WC1) was assessed during the site visit. The assessment area was accessed via truck, utilizing existing roads or by foot. The weather was sunny with temperatures below -4°C. Field data was collected to identify and document important fish and fish habitat features within the watercourses, assess the watercourses' sensitivity to the proposed Project activities, and to develop general and site-specific mitigation measures to avoid or mitigate potential impacts to fish and fish habitat.

4.3.8 Historical Resources

Lifeways of Canada Ltd. submitted a Historic Resources Application to the Historical Resources Management Branch (HRMB) for the Project on behalf of BURNCO on April 30, 2018. In response, the HRMB issued a Schedule of Requirements for the Project on June 25, 2018. The requirements included an archaeological historical resources impact assessment (HRIA) of the entirety of high potential, undisturbed lands in the Disturbance Area, and a more focused palaeontological HRIA of landforms adjacent to Grand

Valley Creek and the Bow River. The field work for both archaeological and palaeontological HRIAs was completed in late July 2018. The results are presented outside this report and will be included with the Project application.

5 BIOPHYSICAL INVENTORY

The desktop and field assessments identified a number of VECs within the Disturbance Area. The following sections provide results from both the desktop and field assessments.

5.1 Land Use

The Disturbance Area is located within the Foothills Parkland Natural Subregion of the Parkland Natural Region. This region is characterized by cooler summers and shorter growing seasons, with native grasslands interspersed with aspen woodlands or willow shrublands in low-lying areas of southerly slopes (Natural Regions Committee 2006). Much of the surrounding area is used for agriculture, with cattle grazing, hayland, and crop production. The Town of Cochrane is east of the Disturbance Area.

The Disturbance Area is located on private land. Table 3 summarizes the land use for the Disturbance Area (Figure 2).

TABLE 3 Majority Land Use Areas Within the West Cochrane #2 Gravel Pit

Land Use Type ¹	Associated Vegetation Community	Area (% of Disturbance Area)
Agricultural: Cultivation	Cropland	52.2 ha (42%)
Agricultural: Grazing ¹	Native Grassland	63.6 ha (51%) (
Upland Shrubland	Upland Shrubland	7.4 ha (6%)
Drainage	Seasonal Drainage	1.6 ha (1%)
TOTAL		124.9 ha (100%)

(1) the native grasslands are grazed where cattle have access

5.2 Geology

5.2.1 Bedrock Geology

The Disturbance Area is located at the edge of deformed belt of the Western Canadian Cordillera. Most of the Project overlies deformed (folded and faulted) Cretaceous to Paleogene strata of the Brazeau and Coalspur formations (Prior et al. 2013; Figure 4). Two thrust faults within these units have been mapped trending NNW-SSE within the eastern section of the Disturbance Area. An additional thrust fault has been mapped trending NNW-SSE and lies approximately 1km to the west of the Disturbance Area. All of these bedrock units comprise interbedded layers of shale, sandstone and coal deposited in non-marine fluvial environments (Glass 1990).

5.2.2 Surficial Geology

Surficial deposits overlie bedrock over most of the assessment area, except where bedrock has been exposed by erosional processes. A series of boreholes have been installed in the assessment areas, with surficial sediments thicknesses ranging from 2 m more proximal to recent erosional features, up to 16 m in non-eroded areas.

The main surficial depositional processes in the Disturbance Area is glaciofluvial over bedrock, however, the areas surrounding the Disturbance Area also include glaciolacustrine and recent fluvial deposition of the modern day Bow River (Bayrock and Reimchen 2007; Fisher 1999). Major surficial landforms have been mapped at a regional scale by Bayrock and Reimchen (2007). For this assessment, surficial landforms have been mapped at a local scale according to *The Canadian System of Soil Classification* (SCWG 1998). This data is presented on Figure 5.

5.2.3 Landform Classification

Three major depositional processes were interpreted to have resulted in the surficial deposits present in the study area:

- glaciolacustrine deposition associated with the paleo glacial Lake Calgary
- glaciofluvial deposition post-dating glacial Lake Calgary which occurred in the Bow River Valley during retreat of the Cordilleran ice sheet
- recent Holocene deposition and erosion, dominated by down-cutting and erosion of the modern day Bow River

The resulting landforms illustrated on Figure 5 are not interpreted to be particularly sensitive or unique. Similar depositional processes have been active along the Bow River valley from the Ghost Lake Reservoir to Calgary, and further downstream, which has likely resulted in similar landforms (Fisher 1999).

Glaciolacustrine deposits are interpreted to be present north of the Disturbance Area in topographically higher areas. These deposits are expected to be dominated by fine-grained sediments (silt and clay) of varying thicknesses overlying bedrock. In some cases, recent down-cutting and erosion along tributaries to the Bow River have eroded through these deposits forming inclined gullies (Figure 5).

Relatively coarse-grained (sand and gravel) glaciofluvial deposits are interpreted to be the dominant surficial unit within the Disturbance Area and are the target aggregate resource. These deposits form a series of terraces, which have been sharply incised by recent erosion along tributaries to the Bow River and the main Bow River channel (Figure 5). Based on LiDAR data, escarpment slopes associated with both the terraces and recent gully erosion range from inclined (between 1 to 35 degrees) to very occasionally steep (>35 degrees). In the Disturbance Area, steep slopes are restricted to portions of Beaupre Creek and unnamed watercourse U-WC1.

5.3 Hydrology

As noted above, the Disturbance Area is located within the Bow River watershed. The field and desktop hydrology reviews revealed two major draws that cross Highway 1A via large culverts and run adjacent to the Disturbance Area toward the Bow River: Grand Valley Creek, approximately 0.75 km east of the Disturbance Area; and Beaupre Creek, immediately west of the Disturbance Area.

Beaupre Creek has a large upstream catchment area of 3,096 ha, resulting in high flow during flood events. The flow is carried across Highway 1A via a large diameter culvert (approximately 3,200 mm) before draining south to the Bow River.

The remainder of the drainage from areas north of Highway 1A is conveyed across the highway through several 800 m diameter culverts and cattle crossings along Highway 1A (Figure 6). This drainage flows along the southern highway ditch before being directed south as overland flow at low points along the ditch or via channelized flow through the ditches on either side of existing Range Road 51, which is located immediately east of the Disturbance Area, and parallels the entire eastern boundary.

One unnamed watercourse lies immediately outside of the central portion of the Project boundary; however, the catchment area for this creek is relatively small and the upstream reaches of the watercourse within the Project boundary is not well defined. Further information on this unnamed watercourse is provided in Section 5.7. A summary of the key hydrological features is shown on Figure 6.

5.4 Soils and Topography

5.4.1 Surficial Geology and Landforms

The Disturbance Area is located within the Soil Correlation Area (SCA) 8 - Thick Black Soil Zone of Southwestern Alberta. The area is characterized by level to hummocky surface expression with some steep and terraced areas with slopes ranging from 2% to 30%. The majority of the Disturbance Area contains gently undulating to undulating surface expression with slopes ranging from 0.5% to 5%. Small portions of the Disturbance Area (0.4 ha; approximately 0.3%), have rough broken (steep) surface expressions with slopes between 15% and 35%.

Glaciolacustrine parent material underlies approximately 98.4% (122.9 ha) of the Disturbance Area, while the other 1.6% (2.0 ha) of the Disturbance Area is underlain by glaciofluvial parent material (Table 4).

5.4.2 Soil Description

Soils within the Disturbance Area were classified using field data collected in July 2018. Two soils series were identified within the Disturbance Area and include the Maycroft (MFT) and Lindbrook (LBK) series (98.4 % and 1.6% of Disturbance Area, respectively). Detailed information, including stripping depths for each soil is provided in Section 5.4.2.1 and 5.4.2.2.

TABLE 4 Soil Characteristics in the Disturbance Area

Soil Polygon	Area (ha)	% of Project Area	Soil Series	Soil Classification ^a	Parent Material ^b	Texture Class ^c	Drainage Class	Wind Erosion	Water Erosion	Reclamation Suitability	Land Capability
MFT-ca	122.9	98.4	Maycroft	O.BLC	GLLC	SiL-CL	Well	Low	Slope Dependant	Topsoil: Fair Subsoil: Fair	3 (H,M,T)
LBK-aa	2.0	1.6	Lindbrook	O.R	GLFL	SiL-L	Well	Moderate	Slope Dependant	Topsoil: Poor to Fair	4 (H,M,W,T) to 7 (H,M,E,P)
TOTAL	124.9	100									

(a) O.BLC - Orthic Black Chernozem, O.R - Orthic Regosol

(b) GLLC - Glaciolacustrine, GLFL - Glaciofluvial

(c) L - Loam, CL - Clay Loam, SiL - Silty Loam

5.4.2.1 Maycroft (MFT) Soil Map Unit

The Maycroft soil map unit is a moderately fine-textured soil developed on glaciolacustrine parent material and contains moderately well to well-drained Orthic Black Chernozem and Orthic Regosols (98.4% of the Disturbance Area). Surface expression ranges from gently undulating to undulating, with slope gradients of 0.5% to 5%. This soil map unit was identified as calcerous (ca) indicating that alkaline earth carbonates were found in the B horizon (LCRC et al. 1993).

This soil map unit was rated 3 (H,M,T) for land capability for agriculture indicating the soil in this class has slight limitations that could restrict growth of crops or require additional special management practices due to inadequate heat units (H), moisture (M) and slopes steep enough to incur water erosion or to limit or impede cultivation (T) (Appendix D).

The soil suitability for reclamation for topsoil was rated “fair” based on texture and calcium carbonate and “fair” for subsoil based on reaction (slightly alkaline), texture and consistency (Appendix E). The wind erosion potential for the Maycroft soil series is low and slope dependent for water erosion potential; it is rated low on slope gradients <5%, moderate on slopes 5% to 10% and high on slopes greater than 15%. Slopes greater than 15% are found in conjunction with the terraced river areas (LCRC et al. 1993).

The topsoil and subsoil average depths, including minimum and maximum depths are presented in Table 5, and shown on Figure 7. Details regarding depth of replacement will be outlined in the decommissioning and final land reclamation plan as outlined in the anticipated *Environmental Protection and Enhancement Act* (EPEA) approval.

TABLE 5 Maycroft Soil Map Unit Topsoil and Subsoil Depths

Footprint Component	Soil Map Unit	Map Unit Area (ha)	Average Topsoil Depth (cm) (with minimum and maximum) ^{a,b}	Average Subsoil Depth (cm) (with minimum and maximum) ^a
Disturbance Area	MFTca	122.9	18 (07-36)	22 (13-35)

(a) Topsoil and subsoil depths taken from an average of soil inspection locations within the Disturbance Area

(b) Actual soil depths are anticipated to vary due to the variability observed across the Disturbance Area and the ability to safely salvage topsoil and subsoil from the Disturbance Area.

5.4.2.2 Lindbrook (LBK) Soil Map Unit

The Lindbrook soil map unit is a well-drained Orthic Regosol developed on coarse glaciofluvial sand parent material (1.6% of the Disturbance Area). Regosolic soils do not contain a recognizable B subsoil horizon and are considered weakly developed soils (SCWG 1998). Surface expression ranges from gently undulating to rough broken (steep) with slope gradients of 0.5% to 35%.

This soil map unit has two ratings: Class 4 and 7. Areas rated 4 (H,M,W,T) had limitations such as inadequate heat units (H), moisture (M), excess water limiting to crop production (W) and slopes steep enough to incur water erosion or to limit or impede cultivation (T). Areas with higher stone content were

rated Class 7 (H,M,E,P) due to additional limitation such as a thin A horizon (E), and land is sufficiently stony to limit crop production (P) (Matrix 2019).

The soil suitability for reclamation for topsoil was rated “fair” in areas with reduced stone content based on stoniness and calcium carbonate equivalent. In areas with high stone content, the topsoil was rated “poor” based on stone content and high calcium carbonate equivalent (Matrix 2019). The wind erosion potential for the Lindbrook soil series was moderate and slope dependent for water erosion potential; it is rated low on slope gradients <5%, moderate on slopes 5% to 10% and high on slopes greater than 15% (LCRC et al. 1993).

The topsoil depths, including minimum and maximum depths are presented in Table 6, and shown on Figure 7. Due to the lack of a subsoil horizon, only topsoil depths are provided in the table below. Details regarding depth of replacement will be outlined in the decommissioning and final land reclamation plan as outlined in the anticipated EPEA approval.

TABLE 6 Lindbrook Soil Map Unit Topsoil and Subsoil Depths

Footprint Component	Soil Map Unit	Map Unit Area (ha)	Average Topsoil Depth (cm) ^{a,b} (with minimum and maximum)	Average Subsoil Depth (cm) (with minimum and maximum) ^a
Disturbance Area	LBKaa	2.0	10 (08-12)	N/A

(a) Topsoil depths taken from an average of soil inspection locations outside the Disturbance Area (Matrix 2019).

(b) Actual topsoil depths are anticipated to vary due to the variability observed across outside the Disturbance Area and the ability to safely salvage topsoil and subsoil from the Disturbance Area.

N/A - Not Applicable, soils are Regosols and do not contain a recognizable B horizon.

5.5 Vegetation and Wetlands

5.5.1 Regional Context

The Disturbance Area is located within the Foothills Parkland Natural Subregion of the Parkland Natural Region (Natural Regions Committee 2006). Dry south and west facing slopes are vegetated by mountain rough fescue-bluebunch fescue-needle and thread communities. Moist, well drained northerly slopes support aspen forests with understories of snowberry, silverberry, prickly rose, Saskatoon, and an array of herbs (Natural Regions Committee 2006).

5.5.2 Vegetation and Wetlands Conditions

Eight vegetation communities were observed within the VAA (Figure 2). The most extensive vegetation community within the VAA is native grassland comprising 101.2 ha (54.1%; Table 7; Figure 2). Agricultural land, including cropland, comprised 54.6 ha (29.2%). Dominant species for each vegetation community observed are provided in Table 7.

One seasonal (III) graminoid marsh was observed within the VAA with a total area of 1.2 ha (0.6%; Table 7; Figure 2). This marsh was adjacent to a riparian vegetation community. The footprint included 7.7 ha of riparian area (4.2%; Table 7; Figure 2). Seasonal drainages observed are areas where water may flow during spring runoff, but are not classified as wetlands or watercourses.

TABLE 7 Vegetation Communities and Wetlands in the Disturbance Area and the Vegetation and Wetland Assessment Area¹

Vegetation Community	Dominant Species	Disturbance Area		VAA	
		ha	%	ha	%
Native Grassland	Fescue (<i>Festuca</i> spp.), blue grama (<i>Bouteloua gracilis</i>), June grass (<i>Koeleria macrantha</i>), needle-and-thread grass (<i>Hesperostipa comata</i>), small-leaved everlasting (<i>Antennaria parvifolia</i>)	63.6	50.9	101.2	54.1
Cropland	N/A	52.2	41.8	54.6	29.2
Upland Shrubland ²	Silverberry (<i>Elaeagnus commutata</i>), buckbrush (<i>Symphoricarpos occidentalis</i>), and prairie rose (<i>Rosa arkansana</i>)	7.4	6.0	10.8	5.8
Riparian	Aspen (<i>Populus tremuloides</i>), silverberry (<i>Elaeagnus commutata</i>), buckbrush (<i>Symphoricarpos occidentalis</i>), and Canada buffaloberry (<i>Shepherdia canadensis</i>)	0	0	7.8	4.2
Disturbed	N/A	0	0	9.5	5.1
Seasonal Drainage	Meadow foxtail (<i>Alopecurus pratensis</i>), foxtail barley (<i>Hordeum jubatum</i>), smooth brome (<i>Bromus inermis</i>), buckbrush (<i>Symphoricarpos occidentalis</i>), and prairie rose (<i>Rosa arkansana</i>)	1.6	1.3	1.8	1.0
M.G. III ²	Meadow foxtail (<i>Alopecurus pratensis</i>), wild mint (<i>Mentha arvensis</i>), foxtail barley (<i>Hordeum jubatum</i>), curled dock (<i>Rumex crispus</i>), sedge (<i>Carex</i> sp.)	0	0	1.2	<1.0
TOTAL		124.9	100	186.9	100

N/A - Not Applicable

(1) VAA includes the buffer area shown in Figure 2

(2) Data was collected in areas surrounding the VAA, but is representative of the communities within the VAA

During field surveys, 64 vegetation species were observed. Vegetation species observed according to vegetation community are presented in Appendix F.

5.5.3 Rare Plant and Plant Communities

An ACIMS desktop database search was completed before the field surveys. There were 98 tracked plant species and 8 tracked vegetation communities with the potential to occur in the Foothills Parkland (Appendix G; AEP 2017b). Based on the ACIMS desktop search, marsh gentian (*Gentiana fremontii*) was

previously recorded within and near the Disturbance Area and may occur within the planned area of disturbance. Marsh gentian was not observed during field surveys.

The Disturbance Area is located within AEP wildlife sensitivity ranges for limber pine (*Pinus flexilis*). Limber pine was not observed during field surveys.

During the field surveys, no rare plant species or rare plant communities (AEP 2018a; AEP 2017a) were observed within the VAA. No federally-listed rare species (Government of Canada 2011) were observed in the VAA.

5.5.4 Weeds

Two noxious weeds were observed in the VAA (Figure 2; Table 8), including creeping/Canada thistle (*Cirsium arvense*) and perennial sow-thistle (*Sonchus arvensis*) according to the Alberta *Weed Control Act* (Province of Alberta 2017a). These noxious weeds were scattered throughout the native grassland and shrubland areas. No prohibited noxious weeds were observed.

Other non-native and agronomic species observed include smooth brome (*Bromus inermis*), timothy (*Phleum pratense*), and dandelion (*Taraxacum officinale*).

TABLE 8 Alberta Listed Weeds Observed in the Vegetation and Wetland Assessment Area

Scientific Name	Common Name	Alberta Weed Classification	Number of Populations Observed ¹
<i>Cirsium arvense</i>	Creeping thistle	Noxious	3
<i>Sonchus arvensis</i>	Perennial sow-thistle	Noxious	1

(1) Population does not refer to the number of plants observed but a group of plants in close proximity to each other to be considered a population.

5.6 Wildlife and Wildlife Habitat

5.6.1 Desktop Review

A literature review indicated that 83 wildlife species at risk (SAR) may occur in or near the site, including 3 amphibians, 3 reptiles, 68 birds, and 9 mammals (Appendix H). A review of FWIMT data within approximately 5 km of the Disturbance Area indicated that several wildlife SAR have been historically observed within or adjacent to the Disturbance Area (northern leopard frog, trumpeter swan, bald eagle, prairie falcon, eastern kingbird, western wood-pewee, cougar, grizzly bear; Appendix H; AEP 2018c).

The Disturbance Area passes through three provincially designated wildlife sensitivity zones including:

- sensitive raptor range for bald eagle, golden eagle and prairie falcon
- sharp-tailed grouse survey area
- key wildlife and biodiversity zone (KWBZ) - associated with the Bow River (AEP 2018b)

5.6.2 Wildlife Habitat

Just over 50% (63.6 ha) of the Disturbance Area consists of native grassland which may be suitable habitat for sharp-tailed grouse, breeding birds, small mammals (e.g., badger, ground squirrel), and grazing ungulates. The native grassland habitat has been impacted by grazing, with approximately 80% being heavily grazed. A moderate concentration of ground squirrel burrows were observed during the field assessments. In addition to native prairie, the Disturbance Area includes cropland (52.2 ha, 42%) that may provide habitat for breeding birds, but would be impacted during the breeding season by agriculture activities. Land use of the area is summarized in Section 5.1 and Table 3.

A variety of habitat types exist along the Bow River, outside of the Disturbance Area. There are cliffs which contain suitable habitat for cliff nesting birds, although no cliff nests were identified during the field assessments.

The forested riparian areas, shrubland, and forested banks of the Bow River provide suitable habitat for breeding birds and raptors. They also provide browsing habitat for ungulates, and act as movement corridors for ungulates along the Bow River. However, the site is fenced in areas, creating barriers to movement within the Disturbance Area. Highway 1A also parallels the north boundary of the Project which also is a barrier to movement. Limited ungulate use was identified within the WAA during the field assessments.

A small area located immediately outside of the central portion of the Disturbance Area contains potential amphibian habitat; however, this habitat is of low quality. One seasonal wetland was identified during the wetland assessment, associated with the riparian area associated with unnamed watercourse U-WC1 (Figure 2; Figure 8). This wetland was dry at the time of the wildlife field assessments but held pockets of standing water approximately 5 cm deep during the vegetation and wetland field assessments. This wetland was heavily impacted by cattle and is unlikely to be suitable habitat for breeding amphibians. The riparian areas associated within Beaupre Creek and Grande Valley Creek had pockets of standing water during the terrestrial site reconnaissance; however, the areas are significantly sloped and may flood and have high water flow rates during high precipitation events and seasonal run off events; portions of the riparian areas are also impacted by cattle.

5.6.3 Sharp-tailed Grouse Survey

During the sharp-tailed grouse surveys, no sharp-tailed grouse or leks were observed. No other SAR or important wildlife features (e.g., dens, hibernacula) were detected.

5.6.4 Raptor Stick Nest Survey

During the raptor stick nest survey, a total of 20 raptors of four different species were detected (i.e., American kestrel, bald eagle, red-tailed hawk, Swainson's hawk; Table 9). No other SAR or important wildlife features (e.g., dens, hibernacula) were detected. The raptor survey identified four active raptor

nests (i.e., one bald eagle and three red-tailed hawk; Figure 3; Table 9); however, only one of these nests is within the WAA.

TABLE 9 Raptors and Raptor Nests Detected During Raptor Stick Nest Survey

Common Name	Scientific Name	AEP Status ¹	COSEWIC Status ²	SARA Status ³	Number Observed	Number of Associated Nests Detected	Number of Nests in the WAA
American kestrel	<i>Falco sparverius</i>	Sensitive	-	-	5	0	0
Bald eagle	<i>Haliaeetus leucocephalus</i>	Sensitive	Not at Risk	-	2	1	0
Red-tailed hawk	<i>Buteo jamaicensis</i>	Secure	Not at Risk	-	10	3	1
Swainson's hawk	<i>Buteo swainsoni</i>	Secure	-	-	3	0	0

(1) *Alberta Wild Species General Status Listing - 2015* (GoA 2017)

(2) *Species at Risk Public Registry* (Government of Canada 2011)

(3) SARA (Government of Canada 2018)

5.6.5 Breeding Bird Survey

During the breeding bird surveys, a total of 193 individuals of 27 breeding bird species were detected including three SAR (i.e., barn swallow, eastern kingbird, Sprague's pipit; Table I1 of Appendix I; Figure 3). Approximately 54% of the birds detected were located more than 100 m from a survey point. A least flycatcher was detected just outside the WAA.

Incidental species observations included one bird SAR (i.e., great blue heron). No other SAR or other important wildlife habitat features (e.g., hibernacula, leks) were detected during the surveys. All wildlife species (incidental and target) detected during all surveys are included as Table I2 of Appendix I.

5.7 Fish and Fish Habitat

5.7.1 Regional Context

The Bow River originates in the Canadian Rocky Mountains in Banff National Park and flows past mountains, foothills, rangeland, rural and urban developed lands, forests, and cropland across southern Alberta before joining with the Oldman River to form the South Saskatchewan River (BRBC 2005). The Bow River watershed covers approximately 4% of Alberta, comprising over 25,000 km². The Bow River contributes about 23% of the mean annual flow to the South Saskatchewan River drainage (BRBC 2005). The Bow River watershed is the most densely populated watershed in Alberta with approximately 34% of Alberta's population residing within its drainage area (BRBC 2005).

The Disturbance Area is located on the north side of the Bow River west of Cochrane, Alberta, and between the Ghost Reservoir Dam to Bears paw Dam. The Disturbance Area is less than 500 m from the

river at its closest point. The Ghost Reservoir is located approximately 12 km upstream of the Project site. Ghost Reservoir Dam and Bearspaw Dam have been identified as barriers to fish movement within the Bow River watershed (BRBC 2005). The Bow River provides high quality fish habitat, supporting a wide variety of fish species, and is viewed by many as a world-class fishery downstream of Calgary (McLennan 2008). The Bow River has been a popular destination for fly-fishing for many years, specifically dry fly-fishing for Rainbow and Brown Trout, attracting thousands of visitors a year (McLennan 2008).

5.7.2 Fish Habitat Results

The Bow River, Beaupre Creek, and Grand Valley Creek are mapped and classified as Class C watercourses (ESRD 2013) under the Water (Ministerial) Regulation (AR 205/98) of the *Water Act* (Province of Alberta 2017b; Figure 6). All three of these watercourses are located outside of the Disturbance Area. The uppermost reach (approximately 500 m) of U-WC1 is within an area surrounded on three sides by the Disturbance Area. U-WC1 is unmapped and classified as a Class C watercourse as it is a tributary of the Bow River. Class C habitat is defined as moderate sensitivity with *“habitat areas are sensitive enough to be potentially damaged by unconfined or unrestricted activities within a water body; broadly distributed habitats supporting resident fish species”* (GoA 2013). The fisheries restricted activity period (RAP) for the Bow River, Beaupre Creek, Grand Valley Creek and U-WC1 is September 16 to April 15 (ESRD 2013) for the protection of spring and fall spawning fish species.

A review of aerial imagery of Beaupre Creek, Grand Valley Creek, and U-WC1 did not identify any impediments or barriers to fish migration to the confluence with the Bow River. Resident fish species from the Bow River may migrate into the watercourses under suitable flow conditions. If suitable species specific fish habitat (i.e., spawning, rearing, feeding, or overwintering) exists fish may use these watercourses. Additional information on these three watercourses is provided below.

5.7.2.1 Beaupre Creek

Beaupre Creek has a defined bed and banks with an irregular channel pattern. The creek flows from north to south and is confined within a narrow valley. The creek has a wetted width ranging from 0.75 to 1.5 m with a channel width of approximately 2 to 5 m. Water depths, at the time of the survey, ranged from 0.10 to 0.25 m. Channel substrates are comprised of cobble, coarse gravel and sand/silt. Riparian vegetation and canopy cover is provided by shrubs, trees and surrounding grassland; possibly providing cover for resident fish species, if present.

Flow is provided by groundwater seepage (i.e., springs; Levelton 2014) and likely augmented in the spring by snowmelt and seasonally by rainfall events. Channel units were comprised primarily of shallow run habitat and some riffles. No pool habitat was observed. No barriers to fish migration were observed, however; during periods of low flow, the shallow water depths would impede the migration of large-bodied fish species. Bank stability was considered low to moderate with instability and slumping observed on the outside of meander bends.

The viability of the watercourse to provide spawning habitat for large-bodied fish species resident in the Bow River was considered to be nil to low due to the absence of suitably sized gravel substrate. Spawning habitat for small-bodied and forage fish species was considered low due to the absence of suitable substrate or macrophytes. However, microcosms of suitable habitat may be present in the watercourse. Overwintering habitat for large-bodied fish species was considered to be nil due to the shallow water depths. Overwintering habitat for small-bodied fish species or juvenile large-bodied fish species was considered to be low, and only if groundwater seepage continues below the ice during the winter months.

5.7.2.2 U-WC1: Unnamed Watercourse (LSD 14-026-05 W5M)

U-WC1 exhibits an absence of defined bed and banks the upper one third of its extent between the headwaters and the confluence with the Bow River. This section of the watercourse is confined with a moderately incised valley with terrestrial vegetation and shrubs throughout. Where bed and banks develop in the lower portions of the watercourse the channel is narrow and shallow and exhibits an irregular channel pattern.

Flow is provided by groundwater seepage (i.e., springs; Levelton 2014) and likely augmented in the spring by snowmelt and seasonally by rainfall events. Channel units were comprised primarily of shallow run habitat and some small, shallow riffles. No pool habitat was observed. Within the lower section of the watercourse with defined bed and banks, no barriers to fish migration were observed; however, during periods of low flow, the shallow water depths would impede the migration of large-bodied fish species. Bank stability was considered low to moderate with instability and slumping observed on the outside of meander bends in the downstream reaches of the watercourse.

The viability of the watercourse to provide spawning habitat for large-bodied fish species resident in the Bow River was considered to be nil to low due to the absence of suitably sized gravel substrate and water depth. Spawning habitat for small-bodied and forage fish species was considered low due to the absence of suitable substrate or macrophytes. However, microcosms of suitable habitat may be present in the watercourse. Overwintering habitat for large-bodied fish species was considered to be nil due to the shallow water depths. Overwintering habitat for small-bodied fish species or juvenile large-bodied fish species was considered to be nil to low, and only if groundwater seepage continues below the ice during the winter months.

This watercourse likely freezes to the substrate during winter and would only support viable fish habitat during higher flows following rainfall events or the spring freshet.

5.7.2.3 Grand Valley Creek

Grand Valley Creek has a defined bed and banks with an irregular channel pattern. The creek flows from north to south and is highly confined within a deep valley. The creek had a wetted width ranging from 3 to 8 m with a channel width of approximately 15 to 20 m. Water depths, at the time of the survey, ranged

from 0.10 to 0.30 m. Channel substrates comprised cobble, boulder, sand/silt and isolated pockets of gravel. Riparian vegetation and canopy cover were limited and provided limited overhead cover for fish.

Flow is provided by groundwater seepage (i.e., springs; Levelton 2014) and likely augmented in the spring by snowmelt and seasonally by rainfall events. Channel units were comprised primarily of shallow run habitat and some riffles. No pool habitat was observed. No barriers to fish migration were observed; however, during periods of low flow, the shallow water depths would impede the migration of large-bodied fish species. Bank stability was considered low to moderate with instability and slumping observed on the outside of meander bends.

The viability of the watercourse to provide spawning habitat for large-bodied fish species resident in the Bow River was considered to be low due to the limited abundance of suitably sized gravel substrate. Spawning habitat for small-bodied and forage fish species was considered low to moderate due to the limited abundance of suitable substrate or macrophytes. However, microcosms of suitable habitat may be present in the watercourse. Overwintering habitat for large-bodied fish species was considered to be nil due to the shallow water depths. Overwintering habitat for small-bodied fish species or juvenile large-bodied fish species was considered to be low to moderate, and only if groundwater seepage continues below the ice during the winter months.

5.7.3 Resident Fish Results

Historical fish species data for Beaupre Creek, Grand Valley Creek, or U-WC1 were not available in AEP's FWMIT. However, FWMIT records indicate Rainbow Trout were stocked in Grand Valley Creek just upstream of the confluence with the Bow River in 1964. Historical fish species documented in the Bow River from Ghost Dam to 20 km downstream of the Disturbance Area are presented in Table 10.

The Bow River is designated as "Extirpated, Endangered, or Threatened" for the presence or potential presence of bull trout (Saskatchewan-Nelson rivers populations; DFO 2022); although bull trout were not reported in the FWMIT, they were historically present in the river and may still be present in very low numbers. The current adult density of bull trout in the Bow River watershed in the vicinity of the Disturbance Area is "very low" (2018a) based on the Government of Alberta (2018b) Fish Sustainability Index. Bull trout are provincially considered threatened (GoA 2017), and protected as threatened under the Federal *Species at Risk Act* (Government of Canada 2021).

TABLE 10 Fish Species Reported in the Bow River from Ghost Dam to 20 km Downstream of the Disturbance Area

Common Name	Scientific Name	Spawning Season ¹	AEP Wild Species Status 2015 ²	COSEWIC ³
Brown Trout	<i>Salmo trutta</i>	Fall	Exotic/Alien	Secure
Longnose Dace	<i>Rhinichthys cataractae</i>	Spring/summer	Secure	Secure
Longnose Sucker	<i>Catostomus catostomus</i>	Spring/early summer	Secure	Secure
Mountain Whitefish	<i>Prosopium Williamsoni</i>	Fall	Secure	Secure
Rainbow Trout	<i>Oncorhynchus mykiss</i>	Spring/early summer	At Risk (native populations)	Endangered (only the Athabasca River population, not Bow River population)

Sources:

- (1) FWIMT (AEP 2018c)
- (2) *The Fishes of Alberta* (Nelson and Paetz 1992)
- (3) *Alberta Wild Species General Status Listing - 2015* (GoA 2017)
- (4) *Species at Risk Public Registry* (Government of Canada 2011)

5.8 Environmentally Significant and Natural Areas

The Disturbance Area is not within an ESA; however, there are ESAs to the north, east and south (Figure 9; Fiera 2014). It is also located approximately 850 m from the Wild Cat Island Natural Area (Figure 9).

5.9 Applicable Policies and Legislation

Table 11 summarizes the existing policies and legislations that may direct or influence the Project and its impact on each VEC.

TABLE 11 Applicable Legislation Associated with the Biophysical Impact Assessment of the West Cochrane Property

Valued Ecosystem Components	Applicable Legislation/Policy
Soils and topography	EPEA (Province of Alberta 2017c) <i>Code of Practice for Pits</i> (Government of Alberta 2004) <i>Soil Conservation Act</i> (Province of Alberta 2010)
Vegetation, including SAR and special status species	<i>Weed Control Act</i> (Province of Alberta 2016a) SARA (Government of Canada 2018)
Wetlands and riparian zones	<i>Water Act</i> (Province of Alberta 2017b) <i>Alberta Wetland Policy</i> (ESRD 2013b) <i>Land Use Bylaw C-4841-97</i> (Rocky View County 2019) <i>Wetland Conservation and Management Policy</i> (Rocky View County 2010)
Wildlife and wildlife habitat, including SAR and special status species	<i>Wildlife Act</i> (Province of Alberta 2018) SARA (Government of Canada 2018) <i>Migratory Birds Convention Act</i> (Government of Canada 2017)

Valued Ecosystem Components	Applicable Legislation/Policy
Fish and fish habitat	<i>Fisheries Act</i> (Government of Canada 2016) <i>Water Act</i> (Province of Alberta 2017b) SARA (Government of Canada 2018) <i>Wildlife Act</i> (Province of Alberta 2018) <i>Navigation Protection Act</i> (Bow River only) (Government of Canada 2019)
Hydrology	<i>Water Act</i> (Province of Alberta 2017b) EPEA (Province of Alberta 2017c)
Historical and archaeological resources	<i>Historical Resources Act</i> (Province of Alberta 2016b)
Other	<i>County Servicing Standards</i> (Rocky View County 2013)

6 IMPACT ASSESSMENT

The potential environmental effects of Project construction and operation were predicted, based on experience with previous gravel pits as well as experience gained through assessment of other Projects with similar environmental conditions. Effects are considered to occur where anticipated future conditions resulting from the Project differ from the conditions otherwise expected from natural change, before mitigations are applied. Residual effects are those effects that remain after mitigation measures have been implemented.

6.1 Effects Assessment Criteria

Effects are measured based on a number of criteria: direction of the effect; magnitude of the effect; duration of the effect; frequency of the effect; spatial extent; the reversibility of the effect and probability of the effect occurring. Consideration of these criteria will determine whether an effect will have an impact on a VEC. Descriptions for each of the effects criteria are provided in Table 12. Conclusions for the effects criteria are qualitative and based on professional judgement. The integration of the various effects criteria results in rating a residual effect as significant or not significant.

TABLE 12 Effects Assessment Criteria

Rating	Description
Direction: Describes the direction of the residual effect whether there is a net benefit, net loss, or a net balance.	
Positive	The effect has a net benefit; the effect is desirable.
Neutral	The effect has no net benefit or loss.
Negative	The effect results in a net loss; the effect is considered undesirable or adverse.
Magnitude: Describes the scale and severity of the residual effect.	
Negligible	No discernible change from existing conditions.
Low	Change is detectable but is within acceptable protective standards, if applicable.
High	Change exceeds protective standards, if applicable, and/or causes a detectable change to the resource beyond the range of tolerance.

Rating	Description
Duration: Describes how long the residual effect will persist.	
Immediate	2 days or less
Short-term	Occurs during the construction phase or for less than 1 year during operation.
Medium-term	Occurs during the construction and/or operation phase or between 1 to 10 years.
Long-term	Occurs during the construction and/or operation phase and persists for more than 10 years.
Frequency of Occurrence: Describes how often a residual effect occurs within a set time period.	
Incidental	Effect occurs only as a result of an unanticipated or infrequent event
Isolated	Effect is confined to a specific time or Project activity
Occasional	Effect occurs intermittently and sporadically over the assessment period
Periodic	Effect occurs repeatedly during the assessment period
Continuous	Effect occurs continually during the assessment period
Spatial Extent: Describes the area within which the residual effect occurs.	
Project Area	The area within which direct and indirect effects of the Project are anticipated to occur.
Outside Project Area	The area within and outside of the Disturbance Area where direct and indirect effects are anticipated to occur.
Reversibility: Describes the potential for the recovery or reversibility of a residual effect.	
Reversible immediately	Less than 2 days
Reversible in short-term	Less than 1 year
Reversible in medium-term	1 to 10 years
Reversible in long-term	Greater than 10 years
Irreversible (permanent)	Effect is not reversible
Probability of Occurrence: Describes the likelihood of a residual effect.	
Low	Unlikely to occur
High	Likely to occur
Prediction Confidence: Describes the certainty associated with the significance evaluation and considers data quality, rigor of the assessment/measurement approach, and/or the certainty of prescribed mitigation measures.	
Low	Determination of significance based on an incomplete understanding of cause-effect relationships and coarse, low resolution or incomplete data for the Disturbance Area.
Moderate	Determination of significance based on a good understanding of cause-effect relationships and coarse or low resolution data or high resolution quality data, but poor understanding of cause-effect relationships.
High	Determination of significance based on a good understanding of cause-effect relationships and good quality data for the Disturbance Area.

The potential Project effects for each VEC are discussed in the sections below. Summary of potential impacts to VECs, mitigation strategies and residual impacts is provided in Section 7.

Setbacks and RAPs for various VECs are provided in Table 13 and presented on Figures 10 and 11. These setbacks and RAPs are for environmentally sensitive resources identified during the field surveys and are based on federal, provincial, and county regulatory requirements as well as professional judgement. These setbacks are also integrated into the mitigation strategies provided in Section 7.

TABLE 13 Recommended Setbacks and Restricted Activity Periods

Environmental Sensitivity	Setback and Restricted Activity Periods	Regulatory Requirement
Red-tailed Hawk Nest	100 m setback (year-round)	<i>Alberta Wildlife Act</i> (setback supports due diligence but is not specifically stated in the Act)
Bald Eagle Nest	1,000 m setback (year-round)	<i>Alberta Wildlife Act</i> (setback supports due diligence but is not specifically stated in the Act)
Amphibian Breeding Ponds ¹	100 m setback from the edge of a breeding pond - May require setbacks if activity is in the breeding period (April 1 to July 1) - May require setbacks if young are present (setbacks in effect to October 1)	<i>Alberta Wildlife Act</i> (setback supports due diligence but is not specifically stated in the Act) - SARA - depending on species identified (setback supports due diligence but is not specifically stated in the Act)
Key Wildlife and Biodiversity Zone	RAP = December 15 to April 30	<i>Wildlife Act</i> (RAP supports due diligence but is not specifically stated in the Act)
Migratory Bird	RAP = April 15 to August 31	<i>Migratory Birds Convention Act</i> <i>Wildlife Act</i> (RAP supports due diligence but is not specifically stated in the Act)
Wetland Setbacks	6 m (year-round)	<i>Alberta Wetland Policy</i> (setback supports due diligence but is not specifically stated in the Policy) <i>Alberta Water Act</i> (setback supports due diligence but is not specifically stated in the Act)
Riparian Areas	30 m setback	<i>Rocky View Land Use Bylaw</i> <i>Policy 419: Riparian Protection Policy</i>
Watercourses	60 m from Bow River 30 m from all other watercourses	<i>Code of Practice for Pits</i> <i>Fisheries Act</i> (setback supports due diligence but is not specifically stated in the Act)
Fish and Fish Habitat Setbacks	RAP = September 16 to April 15 -within banks (to top of bank) of all watercourses	<i>Fisheries Act</i> (RAP supports due diligence but is not specifically stated in the Act) <i>Water Act</i>- This RAP is specific to the Class C watercourses

(1) No amphibians have been identified in the Disturbance Area; while there is potential breeding habitat for amphibians it is low quality. Currently, no setbacks apply; however, if breeding ponds are identified in the future, these are the recommended setbacks.

6.2 Geology

Surficial landforms, specifically the glaciofluvial terraces, within the footprint of the proposed Project will be altered through aggregate mining. As discussed in Section 5.2, the landforms in the Disturbance Area are not considered sensitive or unique given the local post-glacial depositional history.

6.3 Hydrology

The key hydrological considerations for this assessment are management of runoff (drainage from external areas that could flow onto the site); management of surface water during pit operations; and management of offsite discharge as required. The Stormwater Management Plan and the Groundwater Assessment, which will be provided with the Project application, will address runoff, surface water, groundwater in the active mining area.

6.3.1 Management of Runoff

Drainage from areas north of Highway 1A will continue to be conveyed across the highway through one of several culverts along Highway 1A. The Project will maintain appropriate setbacks from Beaupre Creek (Figure 9; Table 12) and will not alter or disrupt the hydrology of this watercourse.

Other flows will continue to be conveyed along the southern ditch of Highway 1A and then through the Project site at an appropriate location within the Project boundary to minimize impacts to the existing drainage patterns.

6.3.2 Management of Surface Water During Operations

Project operations will impact surface water flow and drainage within the Project boundaries. One recharge pond will be developed and will be used to store surface water runoff from a 1:10-year rain storm event that falls within the Disturbance Area boundaries. The exact pond location has not been provided in this report, as the recharge pond will likely need to be relocated as development proceeds to facilitate groundwater infiltration and avoid conflict with active mining operations. Groundwater collected in the active mining area of the pits may also be pumped to the recharge pond. Any runoff in excess of the storage capacity of the ponds will be temporarily stored in the sumps of the gravel pits, and pumped into the recharge pond as capacity allows.

6.3.3 Management of Discharge

Temporary authorization for offsite release of excess water may be required for extreme precipitation events that exceed the capacity of the recharge pond and pit sumps. These offsite releases would be subject to meeting water quality criteria. Adequate erosion protection must be provided, and the flow rates during these temporary authorizations may not exceed pre-development flows at the specified discharge locations. Emergency spillways from the recharge ponds will be provided to safely convey water from storm events that exceed the 1:10-year return period back into the pits or onto surrounding lands. No emergency outflow will be directed into wetlands or drainages within or adjacent to the property without suitable authorizations.

6.3.4 Summary of Effects on Hydrology

Overall, the effects of construction and operations related to surface water management will be reviewed and assessed as part of the Stormwater and Drainage Management Plan.

6.4 Topography and Soils

Potential direct and indirect effects from the excavation, abandonment, and reclamation stages of the Disturbance Area can be summarized into two parameters:

- changes in topography
 - ✦ by terrain alterations (e.g., loss of landforms)
 - ✦ by terrain instability created by grading, removing or altering upland soil
 - ✦ by re-contouring to control water flow
- changes in soil quality
 - ✦ by erosion by exposing bare soil to wind or water
 - ✦ by improper soil salvage and admixing of subsoil with topsoil
 - ✦ by compaction and rutting from vehicle traffic, and reduced soil permeability and aeration
 - ✦ by accidental spill of substances (fuel, chemicals, lubricants)

Terrain and soil parameters assessed in the Disturbance Area (land suitability for agriculture, soil suitability for reclamation suitability, and soil sensitivity to wind and water erosion) were assessed to determine a final impact rating to each parameter based on the residual effects.

6.4.1 Topography

Baseline topography conditions were assessed to predict Project effects by evaluating Project activities that could affect slope morphology, surface contours, and water flow changes. Excavation of the Disturbance Area will leave the area at a lower elevation than pre-disturbance conditions. The majority of the area is level and during reclamation the boundaries of the Disturbance Area will be contoured to match surrounding conditions and return the Disturbance Area to pre-existing terrain pattern. Therefore the change in terrain due to loss of landform is expected to be minimal.

The majority of the Project footprint contains slopes from 0% to 5% (nearly level to gently undulating) and is considered stable terrain. Small portions of the Disturbance Area (0.3%) have rough broken (steep) surface expressions with slopes between 15% and 35%. These areas are susceptible to terrain instability and to localized slumps or landslides, and/or could potentially increase erosion over time. However, the Project will maintain appropriate setbacks from surface expressions with steep slopes and minimize any changes in terrain due to terrain instability.

Gravel excavation can produce surface contours in the Disturbance Area that differ from the original contours, potentially redirecting surface water flow. If the ground surface within the Disturbance Area is left higher than the original elevation, surface drainage could be altered, and may result in increased flow toward natural depressional areas and watercourses. Increased water flow within the Disturbance Area can increase erosion and/or increase water percolation, potentially affecting soil moisture content and berm wall stability. During excavation culverts will be constructed to maintain the existing drainage patterns. At closure, the landscape will be contoured to pre-existing drainage patterns.

Overall, residual effects at closure on topography are expected to be negative in direction because there will be loss of landforms; low in magnitude as the terrain will remain relatively level; medium in duration since the construction and operation phase will be between 1 and 10 years due to the implementation of progressive reclamation; continuous in frequency and within the Disturbance Area. The residual effect is irreversible as the aggregate will not be replaced; will have a high probability to occur and is predicted with high confidence. Predicted residual effects on topography are rated as not significant as the topography will remain relatively level.

6.4.2 Soil Quality

Baseline soil parameters were assessed to predict effects of the Project on changes in soil quality. The assessment included an evaluation of Project activities during excavation, abandonment, and reclamation that could affect erosion, soil admixing, and compaction.

Soils may be exposed to both wind and water erosion during soil handling (topsoil stripping, stockpiling, topsoil and subsoil replacement), resulting in potential movement of soil off the Disturbance Area. Soil exposure is greatest for soil handling activities during excavation and reclamation until revegetation is sufficient to mitigate wind and water erosion. Excavation activities can also affect surface drainage and potentially increase soil erosion via water, by increasing sediment movement offsite to drainages or other sensitive areas (e.g., wetlands, watercourses) and private properties.

The potential for wind and water erosion was assessed according to soil texture (moderately-fine to course texture soils) and slope class observed at baseline (Section 5.2.3). The majority of the Project has a low wind erosion risk due to the moderately fine-textured soils (approximately 98.4%). A small portion of the Disturbance Area contains soils with moderate wind erosion rating (approximately 1.6%). Water erosion potential is low for a majority of the Disturbance Area. Areas with slopes between 15% and 35% just east of Beaupre Creek and near U-WC-1 are rated high for water erosion risk but occupy less than 0.3% of the area. In addition, during operation, stockpiles and berms will have a 3:1 slope to minimize water erosion.

Degradation of soil quality from admixing can occur during excavation activities that involve clearing, soil stripping, topsoil salvage, grading and topsoil replacement. Mixing of topsoil and subsoil may occur during stripping in areas where topsoil depths are highly irregular, where topsoil is very thin, where a clear colour distinction between topsoil and subsoil is lacking, when soils with high moisture content are disturbed, or

when heavy equipment is used to strip topsoil. Inadequate separation of topsoil and subsoil stockpiles can cause admixing during storage and soil replacement. In addition, the potential for admixing increases with excavation activities near drainages or wetlands because soil handling (e.g., topsoil stripping) is more difficult on soils with high soil moisture. Soil replacement during reclamation using heavy equipment can also result in admixing if the equipment operator experiences difficulty in spreading topsoil evenly over the reclaimed subsoil without disturbing the subsoil layer.

Admixing adversely affects soil quality by:

- decreasing the reclamation suitability of topsoil as it results in dilution of organic matter through incorporation of subsoil material
- changing soil texture and water holding capacity
- incorporating salts or coarse fragments from the lower horizon into the upper horizon

The greatest potential for admixing within the Disturbance Area is during excavation and reclamation when topsoil and subsoil are stripped and then replaced during replacement. Both soil series have a distinct colour change between the topsoil and subsoil/parent material and an average topsoil thickness greater than 10 cm.

Fine-textured soils dominate the Disturbance Area, and risk of compaction and rutting is high to very high. During all phases of the Project, equipment and vehicle traffic on the Disturbance Area on medium- to fine-textured soils will produce compaction in moist to wet soil conditions. Compaction and rutting adversely affect soil physical properties, impede root penetration, reduce water infiltration, interrupt surface water flow, and increase the risk of erosion. Soils will not be handled when there is a risk of compaction, and decompaction of subsoil and/or topsoil will occur as these materials are replaced in areas being reclaimed.

The potential exists for spills or leaks from heavy equipment to occur during excavation, operations, and reclamation. If contamination occurs, it may result in impacts to soils such as changes in nutrient status; reduction in soil capability; loss of soil structure; or changes in pH. There are measures to control, contain, recover and clean up any releases that occur and which will minimize the potential for adverse environmental effect.

Overall, residual effects at closure on soil quality are expected to be neutral in direction because soil quality will be preserved after mitigations are applied; negligible in magnitude as land suitability for agriculture will be returned to equivalent capability; medium term since the construction and operation phase will be between 1 and 10 years due to the implementation of progressive reclamation; continuous in frequency and within the Disturbance Area. The residual effect is reversible in the long-term; will have a high probability to occur and is predicted with high confidence. Predicted residual effects on soil quality are rated as not significant

6.4.3 Summary of Effects on Topography and Soils

Overall, the residual effects of construction and operations related to topography and soils are rated as not significant as the topography will remain relatively level and soil quality should not be impacted with implementation of mitigation measures.

6.5 Vegetation and Wetlands

6.5.1 Vegetation

Direct effects on vegetation will be limited to active access and operational areas, where vegetation will be cleared. Clearing of vegetation communities will be limited to the Disturbance Area most of which are native grasslands; effects will be negative in direction; high in magnitude with a high probability of occurrence. Effects of vegetation clearing will also be long-term and continuous during operations. With the implementation of progressive reclamation, effects are reversible in the long-term. Native species can be planted in the short- and medium term, but restoring the species diversity will be a long-term effect. Prediction confidence is high based on a good understanding of the impacts of vegetation clearing in native prairie. Predicted residual effects on vegetation are rated as not significant

6.5.2 Riparian Areas

Riparian areas in the Disturbance Area have a setback of 30 m (Rocky View County 2019; Figure 9; Table 12). Mitigation measures include adhering to the riparian setbacks and demarcating riparian zones. No residual effects on riparian areas are anticipated.

6.5.3 Wetlands

One seasonal (III) graminoid marsh was observed immediately outside the central portion of the Disturbance Area. A setback of 6 m has been recommended by Matrix around the marsh; as well, the marsh is within the riparian set back zone. The Project will not directly impact and the riparian setback limits the risk of indirect impacts to this wetland (Figure 9). Additional mitigation measures are provided in Table 14. The wetland will be avoided, resulting in no residual effects.

6.5.4 Rare Plants and Rare Plant Communities

No rare plants or rare plant communities were observed, so currently no residual effects are expected. Much of the existing native grassland is impacted by grazing, and the potential for rare plants is low. The native grassland slopes and riparian areas observed are the areas have the highest rare plant potential. Implementation of the 30 m riparian setback will reduce potential impact to rare plants and rare plant communities, if present in these communities. In the event that rare plants or rare ecological communities are discovered during construction, work will be stopped, and the Construction Supervisor and the Environmental Advisor will be contacted. Mitigation measures will be implemented as required. The potential loss of rare plants during construction is negative in direction with high magnitude,

long-term in duration, isolated in frequency and is irreversible within the Disturbance Area, if it was to occur. Predicted residual effects on rare plants are rated as not significant

6.5.5 Weeds

The introduction and spread of regulated weeds and other non-native invasive species may occur during construction and operations. Effects of introducing weed species during construction or operation are considered negative in direction as invasive species can prevent the recovery of some native plant species or result in an altered native species composition and cover. Weeds are distributed throughout the Disturbance Area, and there is high probability of occurrence for weeds to be spread as a result of the Project. The magnitude is low if BURNCO implements weed control measures. Weed infestations will be isolated to disturbed areas within the Disturbance Area and reversible in the short-term through weed control practices. Predicted residual effects on weed establishment are rated as not significant.

6.5.6 Summary of Effects on Vegetation and Wetlands

Residual effects for vegetation, rare plants, and weed establishment are considered not significant with the implementation of mitigation measures. No residual impacts are expected for wetlands and riparian zones.

6.6 Wildlife Habitat Loss and Alteration

The Project will remove or alter habitat for some wildlife species. The Project footprint is located primarily in agricultural lands (e.g., cultivated and grazed native grasslands). Remaining areas of native grassland are considered suitable habitat for many species of wildlife, including SAR potentially occurring in the Disturbance Area (e.g., raptors, songbirds, and mammals). Most areas of native grassland within the Disturbance Area have been heavily grazed, reducing habitat quality. The area around the Bow River is an important wildlife corridor and winter foraging area for ungulates. There are also other riparian areas that are present immediately adjacent to the Disturbance Area that provide habitat for wildlife. In areas immediately adjacent to the Bow River, activity will be limited to pumping of water, and access to the diversion point and riparian areas will be avoided by the Disturbance Area to reduce the impact to important habitat.

Effects of habitat loss and alteration are considered negative in direction, since clearing for construction will result in a loss of potential habitat within the Disturbance Area. Progressive reclamation back to equivalent land capacity will occur as phases are depleted, and the vegetated areas of the Project footprint will provide habitat for some species. The effect of habitat loss due to the Project will be reversible in the long-term following reclamation in forested areas and reversible in the medium term in pastureland and grassland habitat due to post-construction reclamation. The change in habitat suitability due to clearing is continuous in frequency since operations will be ongoing over the length of the Project. Probability of occurrence is high because habitat will be removed. The magnitude of these effects is low as the Project is avoiding higher quality habitat (e.g., Bow River Valley and riparian areas), the remaining

habitat has been degraded by grazing, the phased approach to the Project will allow for some habitat to remain during the Project life and progressive reclamation will restore disturbed habitat such as pastureland. The prediction confidence is high based on a good understanding of the impacts of habitat loss on wildlife. Predicted residual effects on wildlife habitat loss and alteration due to the Project are rated as not significant.

6.6.1 Sensory Disturbance

An increase in sensory disturbance may occur as a result of Project construction and operations and is considered negative in direction. However, most mammals and birds will avoid construction and operations activities as a result of the sensory disturbance and mitigation can be applied to reduce disturbance (e.g., clearing/construction outside the migratory bird RAP). The effect is long-term as operations will be continuous over the life span of the Project.

The Project is located approximately 2 km west of the recommended setbacks for a bald eagle nest (1,000 m), as per the *Master Schedule of Standards and Conditions* (GoA 2021; Figure 10). Bald eagles and their nests are also protected under the *Alberta Wildlife Act* (Province of Alberta 2018). Given the distance to the nest, no additional mitigations are recommended.

The Disturbance Area is also located within the recommended setback of 100 m from one active red-tailed hawk nest identified during the 2018 raptor stick nest survey (Figure 10; AEP and AER 2018). Two additional active red-tailed hawk nests were identified during the survey, but they are located approximately 1km and 1.5km away from the Disturbance Area, respectively (Figure 10). Depending on the timing of construction within the nest setback, it is recommended that this nest is surveyed for activity prior to construction. If the nest is noted to be active, initial construction of the phases within this setback should occur outside of the raptor breeding season (March 15 to August 30) to avoid impacts to breeding wildlife and birds (ESRD 2013b). If construction occurs during the breeding season and the nest is active, monitoring of the nest(s) may occur during construction to limit the risk of impact to the nesting individuals. If birds are determined to be adversely affected, construction activity will be halted.

Although the riparian areas associated with Beaupre Creek and unnamed watercourse U-WC1 will not be impacted by the Disturbance Area, sensory disturbance may impact breeding amphibians, if present, within these areas. If possible, construction of new phases will take place outside of the amphibian breeding season (April 1 to July 1; ESRD 2013b). If construction must occur within this period, an environmental inspector should investigate the riparian areas and wetlands for signs of sensitive breeding amphibians. If sensitive amphibians are found, a 100 m setback should be enforced from the breeding pond during the breeding season.

Potential effects of sensory disturbance are considered to be continuous. The probability of occurrence of sensory disturbance is high since wildlife will be present during Project construction and operations activity. The effect of sensory disturbance due to the Project will be reversible in the medium to long-term following reclamation of phases throughout the Project lifespan, and after full reclamation of the site.

The prediction confidence is high based on a good understanding of the impacts of sensory disturbance on wildlife. With mitigation, the effects of sensory disturbance to wildlife in the Disturbance Area are low in magnitude. Predicted residual effects on wildlife sensory disturbance are rated as not significant.

6.6.2 Barriers to Movement

An increase in barriers to wildlife movement may occur as a result of Project construction and operations and is considered negative in direction. However, fencing, associated with cattle grazing, is currently present in the area for reducing wildlife movement and most mammals and birds will avoid construction and operations activities as a result of the sensory disturbance. Mitigation can be applied to reduce disturbance (e.g., avoid constructing between December 15 to April 30 in the KWBZ associated with the Bow River; Figure 10). To reduce the potential impacts to wildlife movement, no mining activity will take place in areas immediately adjacent to the Bow River, or within major riparian areas.

The effect of the Project on wildlife movement is long-term as operations will be continuous over the life span of the Project. The probability of occurrence is high since wildlife will likely be present during Project construction and operations activity. The effect of barriers to movement due to the Project will be reversible in the long-term following reclamation. Based on the mitigations such as avoiding clearing/constructing in the KWBZ during the KWBZ RAP, and minimizing Project activity in riparian areas, effects to wildlife movement will be low. The prediction confidence is high based on a good understanding of the impacts of barriers to movement on wildlife. Predicted residual effects on wildlife movement are rated as not significant.

6.6.3 Potential for Direct Mortality

An increase in direct mortality may occur as a result of construction and operations or spills and is considered negative in direction. Most mammals and birds will avoid construction activities as a result of the sensory disturbance and mitigation can be applied to reduce mortality (e.g., construction of a new phase outside the migratory bird RAP). As well, the Project footprint is located primarily in previously disturbed habitat (e.g., cultivation and pasture) potentially reducing overall use of the area by wildlife. Project-related mortalities may occur outside the Disturbance Area due to Project-related traffic using the highway adjacent to the site. BURNCO will discuss the possibility of installing wildlife crossing signs along the highway adjacent to the Disturbance Area with Alberta Transportation. Personnel will be advised to reduce speeds near the Disturbance Area, and limit traffic during high activity periods (i.e., dusk and dawn).

Wildlife sweeps, nest searches and setbacks around active features, if warranted, will reduce mortality effects during construction. The effect of direct mortality due to the Project will be reversible in the medium and long-term following reclamation of phases during the life span of the Project, and after full reclamation is completed. The effect is long-term as operations will be continuous over the life span of the Project. Spills are considered incidental in frequency with a low probability. With mitigation, the effects of direct mortality to wildlife in the area are low in magnitude. The prediction confidence is high

based on a good understanding of potential direct mortality risk to wildlife. Predicted residual effects on direct mortality are rated as not significant.

6.6.4 Summary of Effects on Wildlife and Wildlife Habitat

Predicted residual effects on wildlife habitat loss and alteration, sensory disturbance, movement, and direct mortality due to the Project are rated as not significant.

6.7 Fish and Fish Habitat

Pathways of effects represent cause and effect linkages between Project activities and consequences to fish and fish habitat. Fisheries and Oceans Canada's (DFO) *Pathways of Effects* diagrams identify effects to fish and fish habitat that could result from the proposed activities within the Disturbance Area (DFO 2014) as outlined on Figure 1. Project activities that have potential to affect fish and fish habitat include the use of industrial equipment near watercourses.

DFO's *Pathways of Effects* diagrams (DFO 2014) were reviewed to identify effects related to each Project activity. Each linkage (i.e., cause and effect relationship) between a Project activity and the potential resultant effect was validated as relevant or not relevant for this Project. Each activity and the remaining relevant effects that may come from this Project include:

- change in sediment concentrations
- introduction of contaminant concentrations
- potential mortality of fish or eggs

Potential effects relating to Projects activities are discussed in the following subsections.

6.7.1 Change in Sediment Concentrations

An increase in sediment concentrations may occur as a result of Project construction and operations. Suspended sediment (e.g., fine material dust from stock piles) may affect fish and fish habitat present in the river by filling interstitial spaces in favourable spawning substrates, suffocating developing fish embryos, altering a primary food source (i.e., increased drift of benthic invertebrate community), inhibiting respiration and filter feeding, irritating the gills of aquatic organisms, and reducing visibility for feeding of local fish. Suspended sediment not only affects habitat and fish populations adjacent to the construction area, but can be mobilized and affect habitat and fish populations downstream.

The probability of occurrence of changes in sediment concentrations is low since mitigation measures will be implemented during Project construction and operations activity. Setbacks around watercourses will also reduce or eliminate the change in sediment concentrations effects during construction (Figure 8; Table 12). The magnitude of effects occurring to fish and fish habitat would be negligible and reversible in the short-term. The prediction confidence is high based on a good understanding of best management

practices, recharge ponds to manage water, and applying erosion and sediment control mitigations to prevent overland runoff near watercourses and waterbodies. Monitoring water quality will help to inform how effective mitigations are and if additional management options are required. If mitigation measures are adhered to, no residual effects will result.

6.7.2 Change in Contaminate Concentrations

The potential for change in contaminated concentrations may occur as a result of Project construction and operations. Contamination may enter the watercourse through machinery and spills. Mitigation measures such as: fueling machinery 100 m away from a watercourse, immobile machinery within 100 m (e.g., light stands) will be placed in an isolated area within secondary containment, any equipment used within the active channels of the watercourses must be cleaned. Equipment will also be disinfected according to the standards provided in the *Interim Guidelines for the Disinfection of Fisheries Equipment to Reduce the Spread of Whirling Disease in Southern Alberta* (AEP 2016). With mitigation, changes in contaminated concentrations in the watercourses are predicted to be negligible in magnitude.

The probability of occurrence of changes in contaminated concentrations is low since mitigation measures will be implemented during Project construction and operations activity. Setbacks and containment around watercourses, if warranted, will reduce or eliminate the change in sediment concentrations effects during construction. The prediction confidence is high based on a good understanding of the change in contaminated concentrations disturbance on fish and fish habitat. If mitigation measures are adhered to, no residual effects will result.

6.7.3 Potential Mortality to Fish and Eggs

An increase in direct mortality may occur as a result of instream construction. Most fish species will avoid construction activities as a result of the vibrations and disturbance. Mitigation measures can be applied to reduce mortality through the development and implementation of an Erosion Sediment Control (ESC) Plan for each specific watercourse. With mitigation, the effects of direct mortality to fish in the area are predicted to be negligible in magnitude.

The probability of occurrence of mortality to fish and eggs is low since mitigation measures will be implemented during Project construction and operations activity. Setbacks around watercourses will also reduce or eliminate the risk of fish mortality in watercourses near the Disturbance Area (Figure 8; Table 12). Working outside the fisheries RAP will reduce or eliminate the potential mortality to fish and egg effects during construction. If instream activities must occur, or working within the RAP, appropriate approvals will be acquired and the mitigation measures outlined in Table 14 will be adhered to, which will limit the risk of impact. The prediction confidence is high based on a good understanding of the mortality of fish and egg disturbance on fish and fish habitat. If mitigation measures are adhered to, no residual effects will result.

6.7.4 Summary of Effects on Fish and Fish Habitat

There are no predicted residual effects on fish and fish habitat resulting from changes in sediment concentrations, contaminants, or mortality to fish and to fish eggs due to the Project.

7 ENVIRONMENTAL EFFECTS AND MITIGATION SUMMARY

To ensure that potential environmental effects are reduced or eliminated during Project construction and operation, a number of general and site-specific mitigation measures are recommended and presented in Table 14. Other mitigations are based on requirements and guidelines of federal and provincial regulatory agencies, current industry standards, and professional experience and judgement. Project design, construction techniques, and operational practices are also accounted for as part of these mitigations.

TABLE 14 Potential Impacts, Mitigation Measures, and Residual Effects

Valued Ecosystem Component	Potential Impact	Mitigation Measures	Residual Effects
Geology	Decrease in slope stability	Complete a geotechnical evaluation for the proposed mine plan and ensure appropriate setbacks from existing slopes or other sensitive areas.	Direction: Neutral Magnitude: Negligible Duration: Long-term Frequency: Continuous Extent: Project Area Reversibility: Reversible in the short-term Probability: Low Confidence: High Residual Effect: None
Hydrology	Sedimentation and erosion resulting from surface disturbance	- Develop and implement appropriate mitigation measures and controls as part of a Stormwater Plan and ESC Plan. - Ensure ESC Plan accounts for mitigation of surface water runoff. - Implement and inspect ESC measures.	Direction: Negative Magnitude: Negligible/Low Duration: Long-term Frequency: Periodic Extent: Project Area Reversibility: Reversible in the short-term Probability: Moderate Confidence: Medium Residual Effect: Not significant
Hydrology	Impact to existing drainage patterns	- BURNCO will attempt to complete construction and operations outside of the regulatory setbacks (60 m or 30 m) from watercourses. If these setbacks are encroached upon, the appropriate mitigation measures will be implemented to limit impact. - Provide conveyance structures through screening berm, where required, to allow for natural flows to continue through site. - Provide at least one recharge pond to accommodate water volumes from a 1:10 year storm event and from pit dewatering. - Runoff in excess of the recharge pond will be temporarily stored in the sumps of the pits to be pumped into the recharge ponds. - Temporary authorization for offsite release of excess water may be requested in extreme precipitation events that exceed the capacity of the recharge pond and pit sumps, subject to meeting water quality criteria.	Direction: Negative Magnitude: Negligible/Low Duration: Long-term Frequency: Periodic Extent: Project Area Reversibility: Reversible in the short-term Probability: Moderate Confidence: Medium Residual Effect: Not significant

Valued Ecosystem Component	Potential Impact	Mitigation Measures	Residual Effects
		- Adequate erosion protection will be provided and the flow rates during these temporary authorizations will not exceed pre-development flows at the specified discharge location. Pumping into recharge pond will cease if risk of overflow is high. - Above items to be reviewed and confirmed as part of a Stormwater Plan, ESC Plan, and Groundwater Assessment, which should all be completed for the Project.	
Soils and Topography	Changes to terrain	- Maintain appropriate setbacks from surface expressions with steep slopes. - Contour to match surrounding conditions and return the Disturbance Area to a level landscape. - Implement progressive reclamation. - Orientate and contour gravel pit to maintain natural drainage. - Minimize grading, material removal and material stockpiling. - Ensure drainage is maintained by the use of berms, culverts and other features, as required.	Direction: Negative Magnitude: Low Duration: Medium term Frequency: Continuous Extent: Project Area Reversibility: Irreversible in the long-term Probability: High Confidence: High Residual Effect: Not significant
Soils and Topography	Decrease to soil quality	- Topsoil will be salvaged and reused in the Disturbance Area, where possible. - Minimize stripping or disturbance of soils. - Minimize handling and rehandling of topsoil. - Minimize exposure of soil to rain or wind. - Revegetate soil stockpiles to prevent erosion over the long-term. - Inspect soil piles regularly for regulated weeds. - Implement progressive reclamation. - Suspend soil stripping, salvage, and/or handling during wet conditions or high wind velocities. - Cease vehicular and equipment activity during or immediately after heavy rainfall. - Implement immediate action to control, contain, recover and clean up any release.	Direction: Neutral Magnitude: Negligible Duration: Medium-term Frequency: Continuous Extent: Project Area Reversibility: Reversible in the long-term Probability: High Confidence: High Residual Effect: Not significant

Valued Ecosystem Component	Potential Impact	Mitigation Measures	Residual Effects
Vegetation and Wetlands	Loss of native vegetation and native vegetation communities	- Follow existing roads and overlap cultivated land, minimizing the Project footprint where possible. - Maintain compatible vegetation or vegetated ground mat, to the extent practical. - Maintain native ground cover where possible. - Implement progressive reclamation. - During weed control, reduce uncontrolled overspray and unnecessary damage to native vegetation and/or cultivated land.	Direction: Negative Magnitude: High Duration: Long-term Frequency: Continuous Extent: Project Area Reversibility: Reversible in the medium to long-term Probability: High Confidence: High Residual Effect: Not significant
Vegetation and Wetlands	Loss of riparian areas or reduction in quality of riparian habitat	- No aggregate development shall be located within the County's Riparian Protection Areas (Rocky View County 2019). - Riparian areas will include a 30 m buffer from the center of the watercourse (60 m from bank for Bow River). - Demarcate the riparian area using flagging tape or other visual marker as a means to alert construction traffic to the presence of the riparian, and identify a no driving zone.	If setbacks are adhered to, there will be no residual effects.
Vegetation and Wetlands	Loss of wetland area or reduction in quality of wetland habitat	- Wetland will be avoided. - Maintain compatible vegetation or vegetated ground mat, to the extent practical, particularly within the wetland buffer. - Install erosion control measures upslope of wetlands. - Demarcate the wetland using flagging tape or other visual marker as a means to alert construction traffic to the presence of the wetland, and identify a no driving zone. - The recommended 6 m buffer around the wetlands will not be encroached upon. - In the event that wetlands will be impacted, a <i>Water Act</i> application and associated wetland assessment will be completed.	If setbacks are adhered to, there will be no residual effects.

Valued Ecosystem Component	Potential Impact	Mitigation Measures	Residual Effects
Vegetation and Wetlands	Loss of rare plants and rare communities	- Based on the timing of future construction, additional rare plant surveys may be required. - In the event that rare plants or rare ecological communities are discovered during construction, work will be stopped, and the Construction Supervisor Environmental Advisor will be contacted. Mitigation measures will be implemented as required, and may include avoidance or transplanting.	Direction: Negative Magnitude: High Duration: Long-term Frequency: Isolated Extent: Project Area Reversibility: Irreversible Probability: Low Confidence: High Residual Effect: Not significant
Vegetation and Wetlands	Introduction of new weeds or spread of existing weeds	- Access work areas from approved areas. - Ensure vehicles and equipment are cleaned before being allowed onsite. - Restrict vehicle access over newly seeded areas. - Monitor the disturbed areas for weeds and work with landowners to apply control measures, if required. - Weed control and management will be performed during construction activities to prevent prohibited or noxious weeds from being introduced or spread.	Direction: Negative Magnitude: Low Duration: Long-term Frequency: Isolated Extent: Project Area Reversibility: Reversible in the short-term Probability: High Confidence: High Residual Effect: Not significant
Wildlife and Wildlife Habitat	Wildlife habitat loss/alteration	- Construction of new phases will commence outside of the migratory bird RAP, between April 15 and August 31 (ECCC 2018), where possible. - If construction must take place within the migratory bird RAP, a nest sweep will be completed prior to vegetation clearing to limit the risk of impacting nesting wildlife. - In the event an active nest is found, site-specific mitigation measures should be developed (e.g., clearly marked species specific buffer around the nest or non-intrusive monitoring). Relocate nests following consultations with applicable regulators. - In the event that wildlife and/or specific wildlife habitat features are identified during construction/operations, the features should be flagged and the appropriate mitigation developed, which may require consultation with AEP. - Progressive reclamation will occur once phases are depleted and mining operations within that phase is no longer feasible.	Direction: Negative Magnitude: Low Duration: Long-term Frequency: Continuous Extent: Project Area Reversibility: Reversible in the medium to long-term Probability: High Confidence: High Residual Effect: Not significant

Valued Ecosystem Component	Potential Impact	Mitigation Measures	Residual Effects
		• Footprint avoids of riparian areas. • Mining activities will not take place along the areas immediately adjacent to the Bow River (Figure 1). • Install erosion/sedimentation control along fences adjacent to riparian areas and wetlands. • Based on the timing of future construction, follow-up surveys may be required.	
Wildlife and Wildlife Habitat	Increase in sensory disturbance	• Construction of new phases will commence outside of the migratory bird RAP, between April 15 and August 31 (ECCC 2018), where possible. • If construction must take place within the migratory bird RAP, a nest sweep will be completed prior to vegetation clearing to limit the risk of impacting nesting wildlife. • In the event an active nest is found, site-specific mitigation measures should be developed (e.g., clearly marked species specific buffer around the nest or non-intrusive monitoring). Relocate nests following consultations with applicable regulators. • In the event that wildlife and/or specific wildlife habitat features are identified during construction/operations, the features should be flagged and the appropriate mitigation developed, which may require consultation with Rocky View County and AEP. • Maintain a 100 m buffer from the red-tailed hawk nest when active. • Survey the red-tailed hawk nest prior to construction. If the nest is noted to be active, initial construction of the phases within this setback should occur outside the raptor breeding season (March 15 to August 30). • If construction occurs during the breeding season and the nest is active, monitoring of the nest may occur during construction to limit the risk of impact to the nesting individuals. • If the birds are determined to be adversely affected, construction activity will be halted. • If construction occurs within the amphibian breeding season and within the 100 m of any riparian areas or wetlands amphibian surveys will be completed. If amphibians are identified, a setback from the	Direction: Negative Magnitude: Low Duration: Long-term Frequency: Continuous Extent: Outside Project Area Reversibility: Reversible in the medium to long-term Probability: High Confidence: High Residual Effect: Not significant

Valued Ecosystem Component	Potential Impact	Mitigation Measures	Residual Effects
		breeding pond will be determined in discussion with BURNCO and AEP. • Make efforts to conduct construction during daylight hours to minimize noise disturbance to wildlife during dawn and dusk. • Reduce noise levels of activities, whenever possible, and ensure that noise abatement equipment is in good working order. • Based on the timing of future construction, follow-up surveys may be required.	
Wildlife and Wildlife Habitat	Barriers to movement	• For work that is required in the KWBZ, construction of new phases will not occur between December 15 to April 30. • Footprint avoids of riparian areas. • Mining activities will not take place along the areas immediately adjacent to the Bow River within the KWBZ (Figure 10).	Direction: Negative Magnitude: Low Duration: Long-term Frequency: Continuous Extent: Project Area Reversibility: Reversible in the long-term Probability: High Confidence: High Residual Effect: Not significant
Wildlife and Wildlife Habitat	Potential for direct mortality	• If a SAR is encountered in the Disturbance Area and there is potential for direct mortality, cease construction activities until consultation has occurred with AEP, and appropriate mitigation measures have been implemented (e.g., setbacks, timing restrictions). • A wildlife sweep will be completed prior to starting construction. The sweep will occur within 10 days of construction start and will focus on identifying any features that may have setbacks (e.g., dens, mineral licks). • Construction of new phases will commence outside of the migratory bird RAP, between April 15 and August 31 (ECCC 2018), where possible. • If construction must take place within the migratory bird RAP, a nest sweep will be completed prior to vegetation clearing to limit the risk of impacting nesting wildlife. • In the event an active nest is found, site-specific mitigation measures should be developed (e.g., clearly marked species specific buffer	Direction: Negative Magnitude: Low Duration: Long-term Frequency: Continuous Extent: Outside Project Area Reversibility: Reversible in the medium to long-term Probability: Low Confidence: High Residual Effect: Not significant

Valued Ecosystem Component	Potential Impact	Mitigation Measures	Residual Effects
		around the nest or non-intrusive monitoring). Relocate nests following consultations with applicable regulators. • In the event that wildlife and/or specific wildlife habitat features are identified during construction/operations, the features should be flagged and the appropriate mitigation developed, which may require consultation with AEP. • If sensitive amphibians are identified within the construction area and work will occur when young are present, install silt fence around the wetland and salvage and move the amphibians that are in the construction area to a suitable habitat. • Investigate the possibility of installing wildlife crossing signs at points along the highway where the east and west boundaries of the site are located. • Advise personnel to follow speed limits to improve road safety and reduce risks of wildlife mortality. • Lower speeds during periods of reduced visibility. • Attempt to limit traffic during periods where wildlife tend to be most active (i.e., dawn and dusk) to reduce the risk of wildlife mortality. • Do not harass, feed, or interact with wildlife. • Ensure proper containers are provided for garbage and ensure regular facility maintenance to prevent accumulation of garbage on the ground. • Carry a spill kit and report any vehicle or equipment leaks to the appropriate authority. • Appropriate spill kits will be provided for any onsite fuel storage tanks. • Do not refuel vehicles or equipment within 100 m of a wetland or riparian area. • If immobile machinery is required to be within 100 m of the riparian area (e.g., pumps), then they should be placed in an isolated area within secondary containment capable of containing all fluids in said machinery.	

Valued Ecosystem Component	Potential Impact	Mitigation Measures	Residual Effects
Fish and Fish Habitat	Use of industrial equipment near watercourse that could result in deleterious substances entering the watercourses	• All machinery working near water will be cleaned and free of debris and organic matter before entering the construction site. • All machinery and vehicles will be refuelled a minimum of 100 m away from the watercourse. • If immobile machinery is required to be within 100 m of the watercourse (e.g., pumps), then they should be placed in an isolated area within secondary containment capable of containing all fluids in said machinery. • Any equipment (personal protective equipment, fisheries equipment) used within Beaupre Creek, Grand Valley Creek, or the Unnamed Watercourse must be cleaned and disinfected according to the standards provided in the <i>Interim Guidelines for the Disinfection of Fisheries Equipment to Reduce the Spread of Whirling Disease in Southern Alberta</i> (AEP 2016). • A site-specific spill response plan will be developed before construction occurs.	Direction: Neutral Magnitude: Negligible Duration: Immediate Frequency: Incidental Extent: Outside Project Area Reversibility: Reversible immediately Probability: Low Confidence: High Residual Effect: None
Fish and Fish Habitat	Change in sediment concentrations resulting in poor visibility and altered food sources	• Implement setbacks as specified in Table 12. • Develop and implement an ESC Plan addressing each watercourse if activities occur within the setbacks. • Maintain and inspect ESC measures frequently to ensure effectiveness.	Direction: Neutral Magnitude: Negligible Duration: Immediate Frequency: Incidental Extent: Outside Project Area Reversibility: Reversible immediately Probability: Low Confidence: High Residual Effect: None

Valued Ecosystem Component	Potential Impact	Mitigation Measures	Residual Effects
Fish and Fish Habitat	Potential mortality of fish and eggs resulting from deposition of sediment	• Implement setbacks as specified in Table 12. • Develop and implement an ESC Plan addressing each watercourse if activities occur within the setbacks. • Maintain and inspect ESC measures frequently to ensure effectiveness.	Direction: Neutral Magnitude: Negligible Duration: Immediate Frequency: Incidental Extent: Outside Project Area Reversibility: Reversible immediately Probability: Low Confidence: High Residual Effect: None

ESC – erosion sediment control
 RAP – restricted activity period
 AEP – Alberta Environment and Parks
 KWBZ – key wildlife and biodiversity zone
 SAR – species at risk

8 MONITORING

8.1 Geology

Based on the results of this assessment, no ongoing monitoring for geology indicator parameters is required.

8.2 Hydrology

No hydrology monitoring is required.

8.3 Soil Salvage and Handling

A qualified inspector will be onsite to assist in directing soil salvage activities, as well as monitoring and documenting these activities. The inspector will monitor all topsoil and subsoil stripping activities to ensure that soil quantity and quality are preserved and maintained during the construction phase of the Project. Proper management of soil resources will allow for reclamation objectives to be successfully achieved. Topsoil salvage will be suspended where wet conditions or high wind velocities result in degradation of topsoil quality, or significant erosion of soil.

The topsoil and subsoil will be stored separately with sufficient room in between piles to support stable and non-erodible stockpiles contoured to slopes not exceeding 3:1, as well as to provide a stable stockpile foundation. The stockpiled soil will be set back at least 5 m existing work areas or fencelines and 3 m between stockpiles. During operation, the inspector will complete ongoing monitoring of stockpiles for erosion.

8.4 Vegetation

The Disturbance Area and stockpiles should be monitored for controlled weeds (Province of Alberta 2016a) during construction and operations. When identified, weeds should be controlled in a timely manner with appropriate methods.

8.5 Wildlife and Wildlife Habitat

If the red-tailed hawk nest continues to be active and construction is to occur during the breeding season and is within the 100 m regulatory buffer, following discussion with AEP, monitoring of the nests should occur to limit the risk of nest abandonment by breeding raptors.

As the eagle nest was identified far outside of the Disturbance Area and no construction is expected within the 1,000 m buffer, no monitoring plan is required. If future disturbance intrudes within the 1,000 m buffer Matrix recommends that a AEP is consulted and a monitoring and mitigation plan be developed.

8.6 Fish and Fish Habitat

If the setbacks from the watercourses are encroached upon, BURNCO will discuss monitoring plans with AEP. Monitoring requirements for any work within the setback and or instream may include timing restrictions and water quality monitoring. Any instream work will also require *Water Act* approval.

8.7 Reclamation and Revegetation

The goal for final reclamation is to achieve a sustainable cover of vegetation similar to what existed before disturbance, establishing a successional trajectory toward similar species composition and structure. The target plant communities for reclaimed areas on mineral soils will be consistent with the surrounding vegetation communities in the area and the intended land uses.

Monitoring will be carried out after reclamation to determine the progress and success of reclamation and mitigate any issues arising. The monitoring schedule will depend on additional measures applied to correct post reclamation deficiencies, if any. Reclamation monitoring will document soil, landscape, and vegetation conditions. Environmental monitoring will continue until reclamation achieves the reclamation criteria and any conditions in the approval. All reclamation activities will be documented.

9 DESCRIPTION OF CUMULATIVE EFFECTS

Cumulative effects are changes to the environment that are caused by an action in combination with other past, present, and future human actions. These effects are assessed over a VEC-specific regional study area, over VEC-specific time periods. In assessing potential cumulative effects, the following was considered:

- effects over a larger area
- effects during a longer period of time in the past and into the future
- effects on biophysical resources due to interactions with other actions, and not just the effects of the proposed Project
- inclusion of other past, existing, and future (e.g., reasonably foreseeable) actions
- evaluation of significance in consideration of other than just local, direct effects

The significance of cumulative effects is determined based on the interaction of biophysical resources with activities in the Disturbance Area (i.e., the local Project Area) and other activities being undertaken within VEC-specific spatial boundary (i.e., a surrounding regional area). A temporary boundary of 30 years was selected for the determination of cumulative effects as the Project will be in operation for that period of time. The significance of a cumulative effect can be positive or negative depending on the final outcome of the Project, mitigation measures implemented during and after Project development, and interaction with other Projects in the Disturbance Area and surrounding areas. A cumulative effect is considered

significant if a moderate or high residual effect is identified that is positive or negative. The following activities are expected to occur within the next 30 years.

9.1 Geology

There are no residual effects to geology due to the project; therefore, cumulative affects are not anticipated within the assessment area related to geology or surficial landforms.

9.2 Hydrology

Cumulative effects were considered within the full upstream catchment area of the Project. The main concern for cumulative hydrological effects is the presence of developments in the upstream catchment areas that could alter existing drainage patterns and/or increase flows above pre-development rates. At present, there is minimal activity in the upstream catchment areas that would lead to increased flows to the area; however, the following human activity and developments could affect surface water in this area over the next 30 years:

- Highway 1A parallels the entire north boundary of the Disturbance Area and could be upgraded.
- The Town of Cochrane is located approximately 5 km southeast of the Disturbance Area and expansion is planned over the next 30 years; however, the current expansion limits do not extend into the upstream catchment areas.

The following potential cumulative impacts could occur as part of the proposed Project:

- The proposed Project in combination with other upstream Projects could increase flows either into the Project site or downstream of the Project site. At this time, there are no approved master drainage plans within the upstream catchment area, so potential affects in the upstream catchment area are unknown.
- Any changes to Highway 1A (widening, regrading) could potentially affect the surface water flow through the drainage ditches, which would affect flows into and in the vicinity of the Disturbance Area.

Potential cumulative effects are addressed through the VEC-specific mitigation measures, by maintaining existing drainage patterns and limiting any releases to pre-development rates. It is expected that any future development in the upstream catchment areas would also be required to maintain drainage patterns and limit releases to pre-development flow rates; therefore, cumulative effects as a result of this Project are expected to be minimal.

9.3 Soils and Topography

Cumulative effects were considered within a 5 km radius of the Disturbance Area. The following human activity and developments could affect soils and topography within 5 km, currently, and over the next 30 years:

- Highway 1A parallels the entire north boundary of the Disturbance Area and could be upgraded.
- The Town of Cochrane is located approximately 5 km southeast of the Disturbance Area and expansion is planned over the next 30 years, which will reduce the area used for agriculture.
- A high concentration of oil and gas infrastructure (i.e., pipelines, wells, batteries) are located within 5 km of the Disturbance Area and may increase the risk of potential contamination.
- High amounts of potential aggregate adjacent to the Project could lead to future aggregate developments and reduce the area of soil for agriculture.

The proposed Project in combination with other Projects could increase the amount of terrain and soil disturbance due to increased access and development and create the following potential cumulative impacts:

- a reduction in soils for pasture and/or agriculture practices
- increase the potential for soil contamination thereby reducing soil quality
- a potential increase in terrain instability in the excavation, but the rough broken (steep) and terraced (river) surface expressions with slopes between 15% and 30% will not be impacted

Potential cumulative effects of the Disturbance Area are addressed through the VEC-specific mitigation measures provided in Section 7. Where residual effects are identified, they are determined to be low and localized to the Disturbance Area, or within 1 km of the Disturbance Area; therefore, they are not considered to be significant within a 5 km radius of the Disturbance Area.

9.4 Vegetation and Wetlands

Cumulative effects were considered within a 5 km radius of the Disturbance Area. The following human activity and developments could affect vegetation and wetlands within 5 km, currently, and over the next 30 years:

- Highway 1A parallels the entire north boundary of the Disturbance Area and could be upgraded.
- The Town of Cochrane is located approximately 5 km southeast of the Disturbance Area and expansion is planned over the next 30 years.

- Wildcat Hills Gas Extraction Plant is located 2.5 km to the west of the Disturbance Area.
- A high concentration of oil and gas infrastructure (i.e., pipelines, wells, batteries) are located within 5 km of the Disturbance Area.
- The Stoney First Nation Reserve is located on the south bank of the Bow River adjacent to the Disturbance Area.
- High amounts of potential aggregate adjacent to the Disturbance Area could lead to future aggregate developments.

Existing and future development, in combination with the Project, could lead to potential cumulative impacts to vegetation and wetlands. The proposed Project in combination with other Projects could increase the amount of vegetation disturbance to native vegetation communities, reducing the amount of native habitat available. Increased clearing of native vegetation could lead to negative impacts and disturbance of rare plant species and rare plant communities.

Expansion of the Town of Cochrane could lead to higher human recreational use and impact to riparian areas and other sensitive vegetation communities.

Potential cumulative effects of the Project are addressed through the VEC-specific mitigation measures provided in Section 7. Where residual effects are identified, they are determined to be low and localized to the Disturbance Area, or within 1 km of the Disturbance Area; therefore, they are not considered to be significant within a 5 km radius of the Disturbance Area.

9.5 Wildlife and Wildlife Habitat

Cumulative effects were considered within a 5 km radius of the Disturbance Area and have a reasonable chance of interacting with the Disturbance Area.

The following human activity and developments could affect wildlife and wildlife habitat within 5 km, currently, and over the next 30 years. These activities act as sensory disturbance, increase the potential for mortality, and act as barriers to movement:

- Highway 1A parallels the entire north boundary of the Disturbance Area and could be upgraded.
- The Town of Cochrane is located approximately 5 km southeast of the Disturbance Area and expansion is planned over the next 30 years.
- A Canada Pacific Railway (CP rail) line is located on the south bank of the Bow River and parallels the River south of the Disturbance Area.

- Wildcat Hills Gas Extraction Plant is located 2.5 km to the west of the Disturbance Area.
- A high concentration of oil and gas infrastructure (i.e., pipelines, wells, batteries) is located within 5 km of the Disturbance Area and additional infrastructure may be developed.
- The Stoney First Nation Reserve is located on the south bank of the Bow River adjacent to the Disturbance Area. Additional upgrades or development may occur.
- Multiple range roads are located within 5 km of the Disturbance Area and may be upgraded, maintained, or new ones may be developed.
- High amounts of potential aggregate adjacent to the Project could lead to future aggregate developments.

The following potential cumulative impacts could occur as part of the proposed development:

- The proposed Project in combination with other Projects may increase sensory disturbance in the area. Short-term impacts include construction of new oil and gas projects, road maintenance and construction relating to the Town of Cochrane. Long-term impacts include increased noise due to more residences in the area, new visual disturbances (i.e., houses, well sites) on the landscape, and increased dust in the area due to gravel pit operations, and increased vehicles on gravel roads in the area.
- Barriers to wildlife movement may increase in the long-term as the Town of Cochrane expands westward. New roads and houses may be developed within the KWBZ, reducing the area of the wildlife corridor. New fences may be constructed within the Stoney First Nation Reserve and other private land areas surrounding the Disturbance Area, creating new barriers to movement. Short-term impacts include the construction of pipelines creating new temporary linear impacts in the areas prior to reclamation occurring.
- A reduction in wildlife habitat may occur in the long-term due to the Town of Cochrane expansion, construction of oil and gas infrastructure, future aggregate development, and additional development within the Stoney First Nation Reserve.
- As traffic increases within the area, potential for wildlife mortality increases. As the Town of Cochrane expands, the chances for human-wildlife interaction increase as more habitat is altered.

Potential cumulative effects of the Project are addressed through the VEC-specific mitigation measures provided in Section 7. Where residual effects are identified, they are determined to be low and localized to the Disturbance Area, or within 1 km of the Disturbance Area; therefore, they are not considered to be significant within a 5 km radius of the Disturbance Area.

9.6 Fish and Fish Habitat

Cumulative effects were considered within a 5 km radius of the Disturbance Area and have a reasonable chance of interacting with the Disturbance Area.

The following human activity and developments could affect fish and fish habitat within 5 km, currently, and over the next 30 years:

- Highway 1A parallels the entire north boundary of the Disturbance Area and may be upgraded.
- The Town of Cochrane is located approximately 5 km southeast of the Disturbance Area and expansion is planned over the next 30 years.
- A CP rail line is located on the south bank of the Bow River and parallels the River south of the Disturbance Area.
- Wildcat Hills Gas Extraction Plant is located 2.5 km to the west of the Disturbance Area.
- A high concentration of oil and gas infrastructure (i.e., pipelines, wells, batteries) is located within 5 km of the Disturbance Area.
- The Stoney First Nation Reserve is located on the south bank of the Bow River adjacent to the Disturbance Area.
- Multiple range roads are located within 5 km of the Disturbance Area.

The following potential cumulative impacts could occur as part of the proposed development:

- The proposed Project in combination with other Projects may increase sedimentation into the watercourses in the Disturbance Area. Short-term impacts include construction of new oil and gas Projects, road maintenance and construction relating to the Town of Cochrane. Long-term impacts include increased construction activity and increased dust in the area due to the gravel pit operations, and increased vehicles on gravel roads in the area.
- A reduction in fish habitat may occur in the long-term due to the Town of Cochrane expansion, construction of oil and gas infrastructure, and additional development within the Stoney First Nation Reserve.

Potential cumulative effects of the Project are addressed through the VEC-specific mitigation measures provided in Section 9. Where residual effects are identified, they are determined to be low and localized to the Disturbance Area, or within 1 km of the Disturbance Area; therefore, they are not considered to be significant within a 5 km radius of the Disturbance Area.

9.7 Summary of Cumulative Effects

A summary of residual and cumulative effects and significance is provided in Table 15.

TABLE 15 Potential Residual and Cumulative Effects

Valued Ecosystem Components	Residual Effect	Cumulative Effect	Significance of Cumulative Effects	
			Disturbance Area	Within VEC-specific Spatial Boundary
Geology	No	No	N/A	N/A
Hydrology	No	No	N/A	N/A
Soils and topography	Yes	No	No	No
Vegetation, including SAR and special status species	Yes	Yes	No	No
Wetlands	No	No	N/A	N/A
Wildlife and wildlife habitat, including species at risk and special status species	Yes	Yes	No	No
Fish and fish habitat	No	Yes	No	No

N/A - Not Applicable

10 CONCLUSION

The VECs within the Disturbance Area were identified during desktop and field assessments. Activities related to the Project were determined and potential impacts of those activities on VECs were identified.

Mitigation measures identified in this report are based on information collected during field surveys, best management practices, regulatory requirements for setbacks and RAPs and professional judgement.

The Project will have no residual impacts on geology, wetlands, riparian areas or fish and fish habitat if mitigations measures are implemented. The Project will have residual impacts to hydrology, soils, vegetation, rare plants, weeds, and wildlife. These impacts are considered not significant if mitigation measures are implemented. No cumulative impacts are expected for any of the VECs within the Disturbance Area or within the VEC spatial boundary.

BURNCO will be implementing progressive reclamation during the course of the Project, which will reduce the duration of an impact, as well as the amount of area being impacted. Progressive reclamation also contributes to reducing cumulative effects of the Project.

11 REFERENCES

- Alberta Agriculture and Rural Development (AARD). 2016. *Agricultural Region of Alberta Soil Inventory Database (AGRASID 3.0)*. Alberta Soil Information Centre. Accessed in 2016. [http://www1.agric.gov.ab.ca/\\$Department/deptdocs.nsf/All/sag14652](http://www1.agric.gov.ab.ca/$Department/deptdocs.nsf/All/sag14652)
- Alberta Agriculture, Food and Rural Development (AAFRD). 2004. *Soil Quality Criteria Relative to Disturbance and Reclamation (Revised)*. Soil Quality Criteria Work Group, Soil Reclamation Subcommittee, Alberta Soils Advisory Committee, and Alberta Agriculture. Reprinted November 1993 and September 2004. Edmonton, Alberta. September 2004. <https://open.alberta.ca/publications/soil-quality-criteria-relative-to-disturbance-and-reclamation>
- Alberta Environment and Parks and Alberta Energy Regulator (AEP and AER). 2021. *Master Schedule of Standards and Conditions*. Last amended April 19, 2021. <https://open.alberta.ca/publications/master-schedule-of-standards-and-conditions>
- Alberta Environment and Parks and Alberta Energy Regulator (AEP and AER). 2018. *Master Schedule of Standards and Conditions*. Last amended December 18, 2018. <https://open.alberta.ca/publications/master-schedule-of-standards-and-conditions>
- Alberta Environment and Parks (AEP). 2022. *Fish and Wildlife Internet Mapping Tool (FWIMT)*. Accessed in March 2022. <https://www.alberta.ca/access-fwmis-data.aspx#jumplinks-0>
- Alberta Environment and Parks (AEP). 2020. *Wild Species Status Search*. 2020 Status Listing (XLSX). 2020. <https://extranet.gov.ab.ca/env/wild-species-status/>
- Alberta Environment and Parks (AEP). 2018a. *List of Elements in Alberta - Vascular Plants*. Alberta Conservation Information Management System (ACIMS) database. Updated March 2018. Accessed June 24, 2018. <https://open.alberta.ca/opendata/list-of-elements-in-alberta-vascular-plants>
- Alberta Environment and Parks (AEP). 2018b. *Wildlife Sensitivity Maps - Data Sets*. Updated on February 28, 2018. <https://www.alberta.ca/wildlife-sensitivity-maps.aspx>
- Alberta Environment and Parks (AEP). 2018c. *Fish and Wildlife Internet Mapping Tool (FWIMT)*. Accessed in October 2018. https://maps.srd.alberta.ca/FWIMT_Pub/Viewer/?Viewer=FWIMT_Pub
- Alberta Environment and Parks (AEP). 2017a. *List of Elements in Alberta - Non-vascular Plants*. Alberta Conservation Information Management System (ACIMS). Accessed July 2017. <https://www.albertaparks.ca/albertaparksca/management-land-use/alberta-conservation-information-management-system-acims/download-data/#trackedWatch>

- Alberta Environment and Parks (AEP et al.). 2017. *Professional Responsibilities in Completion and Assurance of Wetland Science, Design and Engineering Work in Alberta*. Prepared by the Professional-10. May 1, 2017. <https://open.alberta.ca/publications/professional-responsibilities-in-completion-and-assurance-of-wetland-science-design-and-engineering>
- Alberta Environment and Parks (AEP). 2017b. *Tracked Elements in Alberta Listed by Natural Subregion*. Natural Regions and Subregions of Alberta (2005) and Alberta Conservation Information System (ACIMS) Element Occurrence data. July 2017. <https://open.alberta.ca/opendata/tracked-elements-in-alberta-listed-by-natural-selection>
- Alberta Environment and Parks (AEP). 2016. *Interim Guidelines for the Disinfection of Fisheries Equipment to Reduce the Spread of Whirling Disease in Southern Alberta*. Version 1.3. September 14, 2016. <http://aep.alberta.ca/fish-wildlife/wildlife-diseases/whirling-disease/documents/InterimWhirlingDiseaseDecontaminationProtocol-Dec2016.pdf>
- Alberta Environment and Parks (AEP). 2015. *Alberta Wetland Identification and Delineation Directive*. Government of Alberta. Water Policy Branch. Water Conservation, 2015, No. 4. Edmonton, Alberta. June 1, 2015. <https://open.alberta.ca/publications/9781460123638>
- Alberta Environment and Sustainable Resource Development (ESRD). 2015. *Alberta Wetland Classification System*. Water Policy Branch, Policy and Planning Division. Edmonton, Alberta. Effective June 1, 2015. <https://open.alberta.ca/publications/9781460122587>
- Alberta Environment and Sustainable Resource Development (ESRD). 2013a. *Sensitive Species Inventory Guidelines*. April 2013. <https://open.alberta.ca/publications/sensitive-species-inventory-guidelines>
- Alberta Environment and Sustainable Resource Development (ESRD). 2013b. *Alberta Wetland Policy*. 25 pp. ISBN: 978-1-4601-1287-8. September 2013. <https://open.alberta.ca/publications/9781460112878>
- Alberta Land Conservation and Reclamation Council, Alberta Reclamation Research Technical Advisory Committee, and Pedocan Land Evaluation Ltd. (LCRC et al.). 1993. *Soil Series Information for Reclamation Planning in Alberta*. RRTAC Report No. 93-7. 1993.
- Alberta Native Plant Council (ANPC). 2012. *Alberta Native Plant Council (ANPC) Guidelines for Rare Vascular Plant Surveys in Alberta - 2012 Update*. Edmonton, Alberta. April 2012.

- Alberta Soils Advisory Committee (ASAC). 1987. *Soil Quality Relative to Disturbance and Reclamation - Revised*. Prepared by the Soil Quality Criteria Working Group Alberta Agriculture. Edmonton, Alberta. Reprinted November 1993 and September 2004. March 1987.
[http://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/sag9469/\\$FILE/sq_criteria_relative_to_disturbance_reclamation.pdf](http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sag9469/$FILE/sq_criteria_relative_to_disturbance_reclamation.pdf)
- Allen L. 2014. *Alberta Conservation Information Management System: Ecological Community Tracking List*. Alberta Tourism, Parks and Recreation. Edmonton, Alberta. 2014. 127 pp.
http://www.albertaparks.ca/media/3259838/tracked_watched_list_ecological_communities_full_report.pdf
- Bayrock L.A. and T.H.F. Reimchen. (Bayrock and Reimchen). 2007. *Surficial Geology, Alberta Foothills and Rocky Mountains - Glacial features (GIS data, line features)*. Digital Data 2007-0078. Alberta Geological Survey and Energy Resources Conservation Board. Accessed March 2007.
<https://open.alberta.ca/opendata/336d8af9-2dc3-44fa-953c-0750027cbdb9>
- Bock, M.D. (Ed.). 2016. *Alberta Soil Names File (Generation 4), User's Handbook*. Alberta Soil Information Centre. Science and Technology Branch, Prairie Region Agriculture and Agri Food Canada. Edmonton, Alberta. December 2016.
[http://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/sag10989/\\$FILE/SNF_Gen_4_Report_01112017_Finalv2.pdf](http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sag10989/$FILE/SNF_Gen_4_Report_01112017_Finalv2.pdf)
- Bow River Basin Council (BRBC). 2005. *Nurture, Renew, Protect: A Report on the State of the Bow River Basin*. Calgary, Alberta. May 2005. 2005.
http://wsow.brbc.ab.ca/index.php?option=com_content&view=article&id=93&Itemid=179
- Coen, G.M. (Ed.). 1987. *Soil Survey Handbook*. Volume 1. Agriculture Canada, Research Branch. Technical Bulletin 1987-9E. Land Resource Research Centre, Contribution No. 85-30. 1987.
- Environment and Climate Change Canada (ECCC). 2018. *General Nesting Periods of Migratory Birds in Canada*. Modified on October 30, 2018. <https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/general-nesting-periods.html>
- Expert Committee on Soil Survey. 1983. *The Canada Soil Information System (CanSIS): Manual for Describing Soils in the Field, 1982 Revised*. Land Resource Research Institute (LRRI), Research Branch, Agriculture Canada. LRRI Contribution No. 82-52. 166 pp. Ottawa, Ontario. 1983.
<https://sis.agr.gc.ca/cansis/publications/manuals/1982-forms/index.html>
- Fiera Biological Consulting Ltd. (Fiera). 2014. *Environmentally Significant Areas in Alberta: 2014 Update*. Prepared for the Government of Alberta. Report Number 1305. Edmonton, Alberta. April 2014.
<https://www.albertaparks.ca/media/5425575/2014-esa-final-report-april-2014.pdf>

Fisher, T.G. 1999. "Sedimentology, stratigraphy, and geomorphology of glacial Lake Calgary at Cochrane, Alberta, Canada." *Canadian Journal of Earth Sciences* 36: 791–803. 1999.

Fisheries and Oceans Canada (DFO). 2022. *Aquatic Species at Risk Map*. Last modified on April 26, 2022. <https://www.dfo-mpo.gc.ca/species-especes/sara-lep/map-carte/index-eng.html>

Fisheries and Oceans Canada (DFO). 2014. *Pathways of Effects*. Last modified on December 1, 2014. <http://www.dfo-mpo.gc.ca/pnw-ppe/pathways-sequences/index-eng.html>

Glass, D.J. (Ed.). 1990. *Lexicon of Canadian Stratigraphy, Volume 4, Western Canada, Including Eastern British Columbia, Alberta, Saskatchewan and Southern Manitoba*. Canadian Society of Petroleum Geologists. Calgary, Alberta. 1990. 772 pp.

Government of Alberta. (GoA). 2018a. *Bull Trout Fish Sustainability Index – Current Adult Density*. April 2018. <https://open.alberta.ca/dataset/ba55dda8-77a7-467f-ad7b-5140e9715fee/resource/5e612d6d-04a5-4e37-94d0-78e4816c63f2/download/bulltroutcurrentdensity-apr2018.pdf>

Government of Alberta. (GoA). 2018b. *Bull Trout Fish Sustainability Index – Historic Adult Density*. April 2018. <https://open.alberta.ca/dataset/ba55dda8-77a7-467f-ad7b-5140e9715fee/resource/d9d049b6-abe6-4582-ab7d-4f0392079a7a/download/bulltrouthistoricdensity-apr2018.pdf>

Government of Alberta (GoA). 2017. *Alberta Wild Species General Status Listing - 2015*. Fish and Wildlife Division. Updated March 1, 2017. <https://open.alberta.ca/publications/alberta-wild-species-general-status-listing-2015>

Government of Alberta (GoA). 2013. *Code of Practice for Watercourse Crossings*. Made under the Water Act and the Water (Ministerial) Regulation. Consolidated to include amendments in force as of June 24, 2013. <http://www.qp.alberta.ca/documents/codes/CROSSING.PDF>

Government of Alberta. 2004. *Code of Practice for Pits*. Alberta Queen's Printer. Edmonton, Alberta. September 1, 2004. <http://www.qp.alberta.ca/documents/Codes/PITS.pdf>

Government of Canada. 2016. *Fisheries Act*. Fisheries Act, R.S.C., 1985. Published by the Minister of Justice. c. F14. Last Amended on April 5, 2016. <https://laws-lois.justice.gc.ca/PDF/F-14.pdf>

Government of Canada. 2021. *Species at Risk Act*. S.C. 2002, c.29. Published by the Minister of Justice. Last amended on April 23, 2021. <http://laws-lois.justice.gc.ca/PDF/S-15.3.pdf>

Government of Canada. 2019. *Navigation Protection Act*. R.S.C., 1985, c. N-22. Current to June 21, 2019. Last amended on June 21, 2019. 2019. <https://laws-lois.justice.gc.ca/eng/acts/n-22/>

Government of Canada. 2018. *Species at Risk Act*. S.C. 2002, c.29. Published by the Minister of Justice. Last amended on May 30, 2018. <http://laws-lois.justice.gc.ca/PDF/S-15.3.pdf>

Government of Canada. 2017. *Migratory Birds Convention Act, 1994*. S.C. 1994, c. 22. Published by the Minister of Justice. Last amended on December 12, 2017. <http://laws.justice.gc.ca/PDF/M-7.01.pdf>

Government of Canada. 2011. *Species at Risk Public Registry, A to Z Species Index*. Last modified on November 29, 2011. http://www.registrelep-sararegistry.gc.ca/sar/index/default_e.cfm

Levelton Consultants Ltd. (Levelton). 2014. *Groundwater Evaluation, Proposed BURNCO McDougall Ranch Gravel Pit and Surrounding Area, N1/2-14, W1/2-13 and NE-15-26-5 W5M*. Prepared for BURNCO Rock Products Ltd. June 25, 2014.

Matrix Solutions Inc. (Matrix). 2019. *Biophysical Impact Assessment, Burnco West Cochrane Gravel Pit, NE ¼ 15-026-05 W5M to SE ¼ 17-026-04 W5M*. Version 1.0. Prepared for BURNCO Rock Products Ltd. Calgary, Alberta. September 2019.

McLennan J. 2008. *Water Marks: Thirty Years of Fly Fishing Insight*. Fusion Books. 2008.

Natural Regions Committee. 2006. *Natural Regions and Subregions of Alberta*. Compiled by Downing D.J. and W.W. Pettapiece. Government of Alberta. Pub. No. T/852. ISBN: 0-7785-4573-3. http://albertaparks.ca/media/2942026/nrsrcomplete_may_06.pdf

Naughton D. 2012. *The Natural History of Canadian Mammals*. Canadian Museum of Nature and University of Toronto Press. Toronto, Ontario. 2012.

Nelson J.S. and M.J. Paetz. 1992. *The Fishes of Alberta*. Second Edition. University of Alberta Press. Edmonton and Calgary, Alberta. 437 pp. 1992.

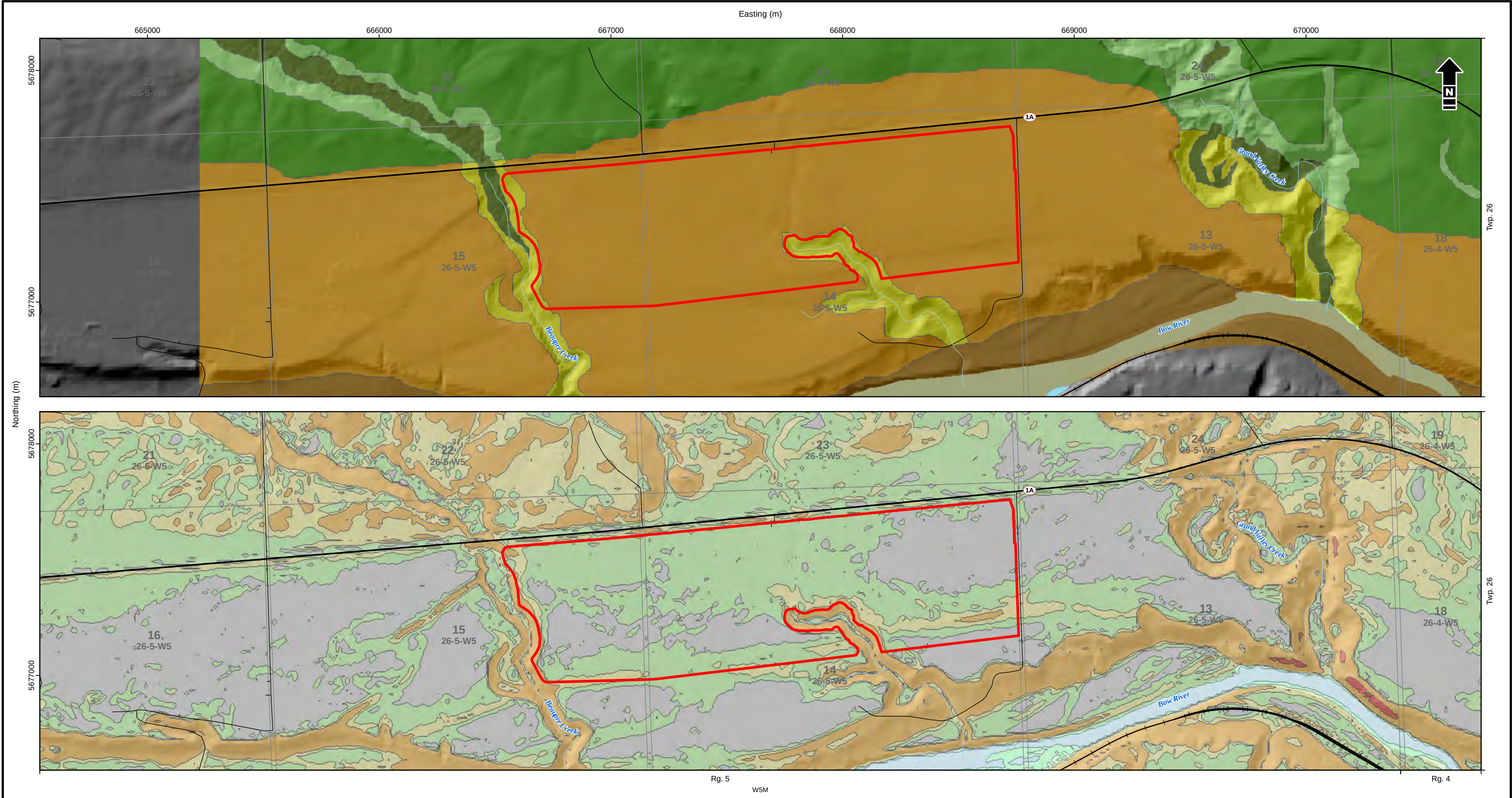
Prior G.J. et al. 2013. *Bedrock Geology of Alberta*. Alberta Energy Regulator (AER) and Alberta Geological Survey (AGS). AGS Map 600. Scale: 1:1,000,000. 2013. http://ags.aer.ca/document/Alberta_geological_map.pdf

Province of Alberta. 2010. *Soil Conservation Act*. Revised Statutes of Alberta 2000, c. S-15. Current as of November 2010. Alberta Queen's Printer, Edmonton, Alberta. November 2010. <http://www.qp.alberta.ca/documents/Acts/S15.pdf>

Province of Alberta. 2020. *Wildlife Act*. Revised Statutes of Alberta 2000, Chapter W-10. Queen's Printer. Current as of August 25, 2020. <https://www.qp.alberta.ca/documents/Acts/W10.pdf>

Province of Alberta. 2018. *Wildlife Act*. Revised Statutes of Alberta 2000, Chapter W-10. Queen's Printer. Current as of February 20, 2018. <http://www.qp.alberta.ca/documents/Acts/W10.pdf>

- Province of Alberta. 2017a. *Weed Control Act*. Statutes of Alberta, 2008, Chapter W-5. Queen's Printer. Current as of December 15, 2017. <https://open.alberta.ca/publications/w05p1>
- Province of Alberta. 2017b. *Water Act*. Revised Statutes of Alberta 2000, Chapter W-3. Current as of December 15, 2017. Queens Printer. Edmonton, Alberta. 2017. <http://www.qp.alberta.ca/documents/Acts/w03.pdf>
- Province of Alberta. 2017c. *Environmental Protection and Enhancement Act*. Revised Statutes of Alberta 2000, Chapter E-12. Queen's Printer. Current as of December 15, 2017. <http://www.qp.alberta.ca/documents/Acts/E12.pdf>
- Province of Alberta. 2016a. *Weed Control Act: Weed Control Regulation*. Alberta Regulation 19/2010. With amendments up to and including Alberta Regulation 125/2016. Edmonton, Alberta. 2016. http://www.qp.alberta.ca/documents/Regs/2010_019.pdf
- Province of Alberta. 2016b. *Historical Resources Act*. Revised Statutes of Alberta 2000, Chapter H-9. Current as of June 13, 2016. Queen's Printer. Edmonton, Alberta. 2016. <http://www.qp.alberta.ca/documents/Acts/h09.pdf>
- Rocky View County. 2019. *Land Use Bylaw C-4841-97*. Adopted by the County Council on September 29, 1998. Updated March 26, 2019. March 2019.
- Rocky View County. 2013. *County Servicing Standards*. Approved by resolution no. 188-13 on May 28, 2013.
- Rocky View County. 2010. *Wetland Conservation and Management, Policy #420*. Infrastructure and Operations. March 30, 2010. <https://www.rockyview.ca/Portals/0/Files/Government/Policies/Policy-C-420.pdf>
- Russell A.P. and A.M. Bauer. 2000. *The Amphibians and Reptiles of Alberta: A Field Guide and Primer of Boreal Herpetology*. Second Edition. University of Calgary Press, Calgary, Alberta. 2000.
- Soil Classification Working Group (SCWG). 1998. *The Canadian System of Soil Classification*. Third Edition. Agriculture and Agri-Food Canada Publication 1646. ISBN: 0-660-17404-9. 187 pp. 1998. <http://sis.agr.gc.ca/cansis/taxa/cssc3/index.html>



Disturbance Area

Water Body

Watercourse (Field-Verified)

Railway

Highway

Road

Terrain Classification (Top Map Pane)

$\frac{csil.b^l}{UR}$ – glaciolacustrine over bedrock

$\frac{csil.b^l.V}{UR}$ – glaciolacustrine over bedrock, gullied

$\frac{sgF.fl^l}{UR}$ – glaciofluvial over bedrock

$\frac{sgF.fl^l.V}{UR}$ – glaciofluvial over bedrock, gullied

$\frac{sgF.fl^A}{UR}$ – recent fluvial over bedrock (Bow River)

$\frac{ssiFl^A}{UR}$ – recent fluvial over bedrock (Creek)

Slope Classification (Bottom Map Pane)

< 1 %

1 - 3 %

3 - 5 %

5 - 35 %

> 35 %

Landform Terrain Reference: Soil Classification Working Group (SCWG). 1998.
The Canadian System of Soil Classification.

1:16,000

metres

150 0 150 300

NAD 1983 UTM Zone 11N

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Burnco West Cochrane #2 Gravel Pit

**Surficial Landform Terrain Classification
and Slope Classification**

Date: May 2022

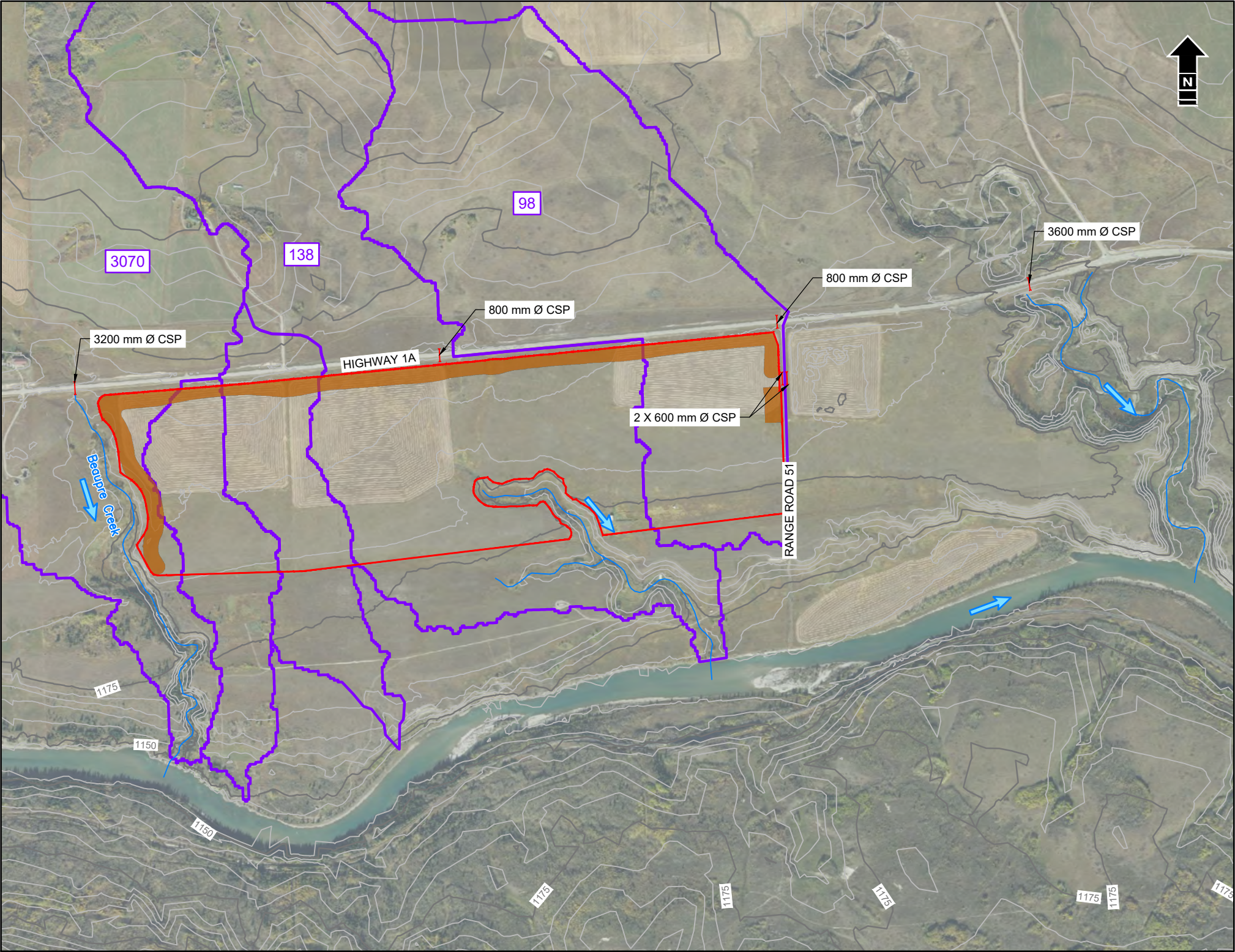
Project: 26388

Submitter: J. Kemper

Reviewer: K. Ostermann

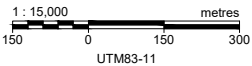
Figure 5

Reference: Data obtained from AltaLIS © Government of Alberta, GeoBase®, and Alberta Energy Regulator / Alberta Geological Survey used under license. GDM transportation infrastructure data provided by IHS © 2022 used under license.



LEGEND

- Disturbance Area
- Predevelopment Catchment Boundary
- Upstream Catchment Area (ha)
- Proposed Screening Berm
- Existing Major Ground Contour (25 m Interval)
- Existing Minor Ground Contour (5 m Interval)
- Existing Culvert
- Flow Direction



Reference: Aerial photograph obtained from Valtus Imagery Services, dated July 20 to October 14, 2013.
Contours derived from LiDAR, provided by Burnco, date unknown.

Note: Figure(s) must be used in conjunction with the attached report and is subject to the limitations and conditions stated in the report.

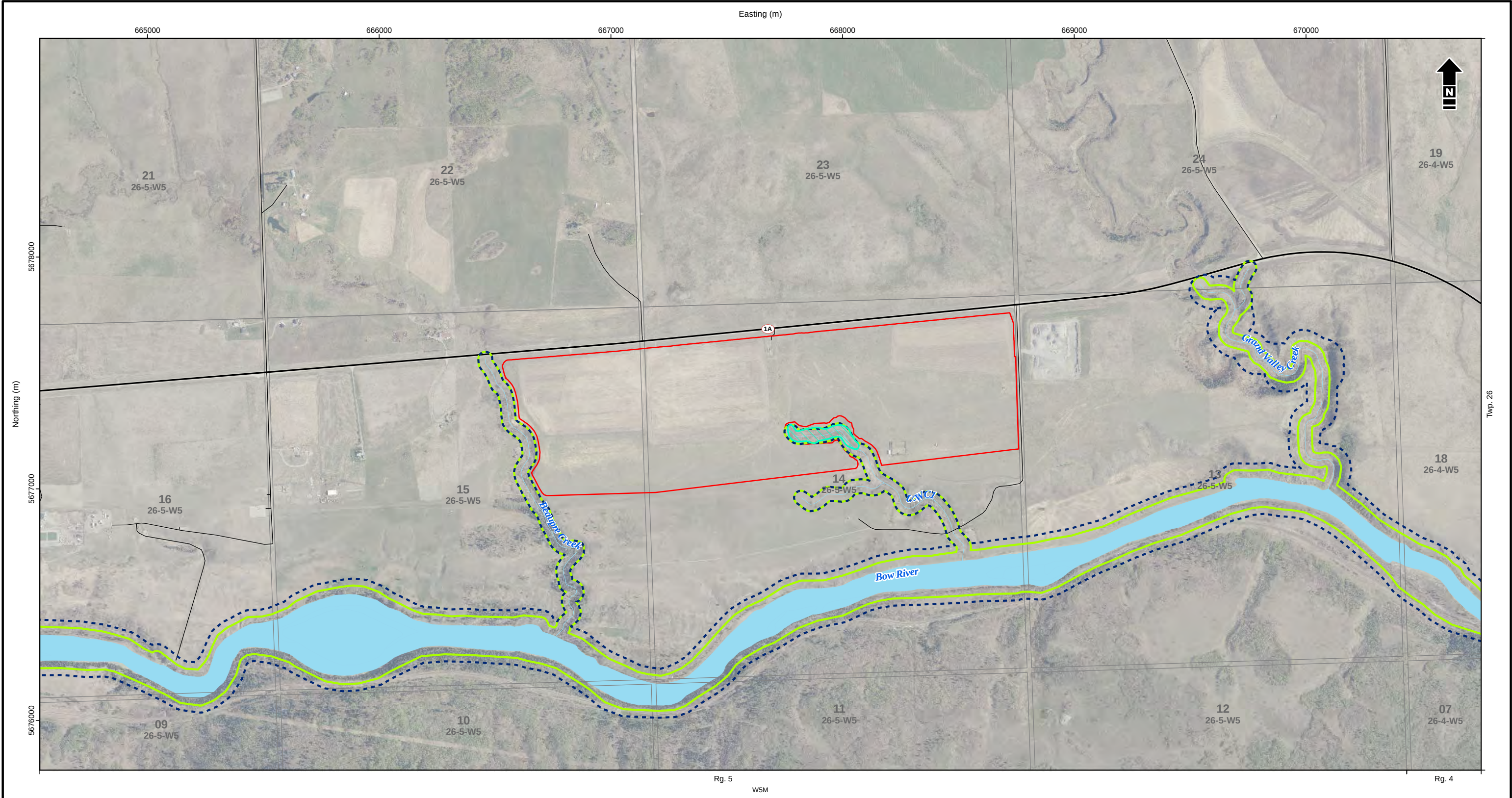


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West Cochrane Gravel Pit #2

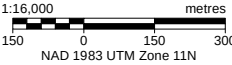
Hydrological Features

Date: MARCH 2022	Project: 26388-SP	Submitter: J. KEMPER	Reviewer: K. OSTERMANN
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			Figure 6



I:\Burnco\26388\Figures\4\Tables\Figures\Watercourse_Riparian_and_Wetland_Setbacks.mxd - Tabloid_L - 18-May-22, 05:42 PM - cahmed - TID004

- Disturbance Area
- Code of Practice for Pits Watercourse Setback (Variable)
- Rocky View Riparian Protection Area Setback (30 m)
- Matrix-Recommended Wetland Setback (6 m)
- Water Body
- Watercourse (Field-Verified)
- Highway
- Road

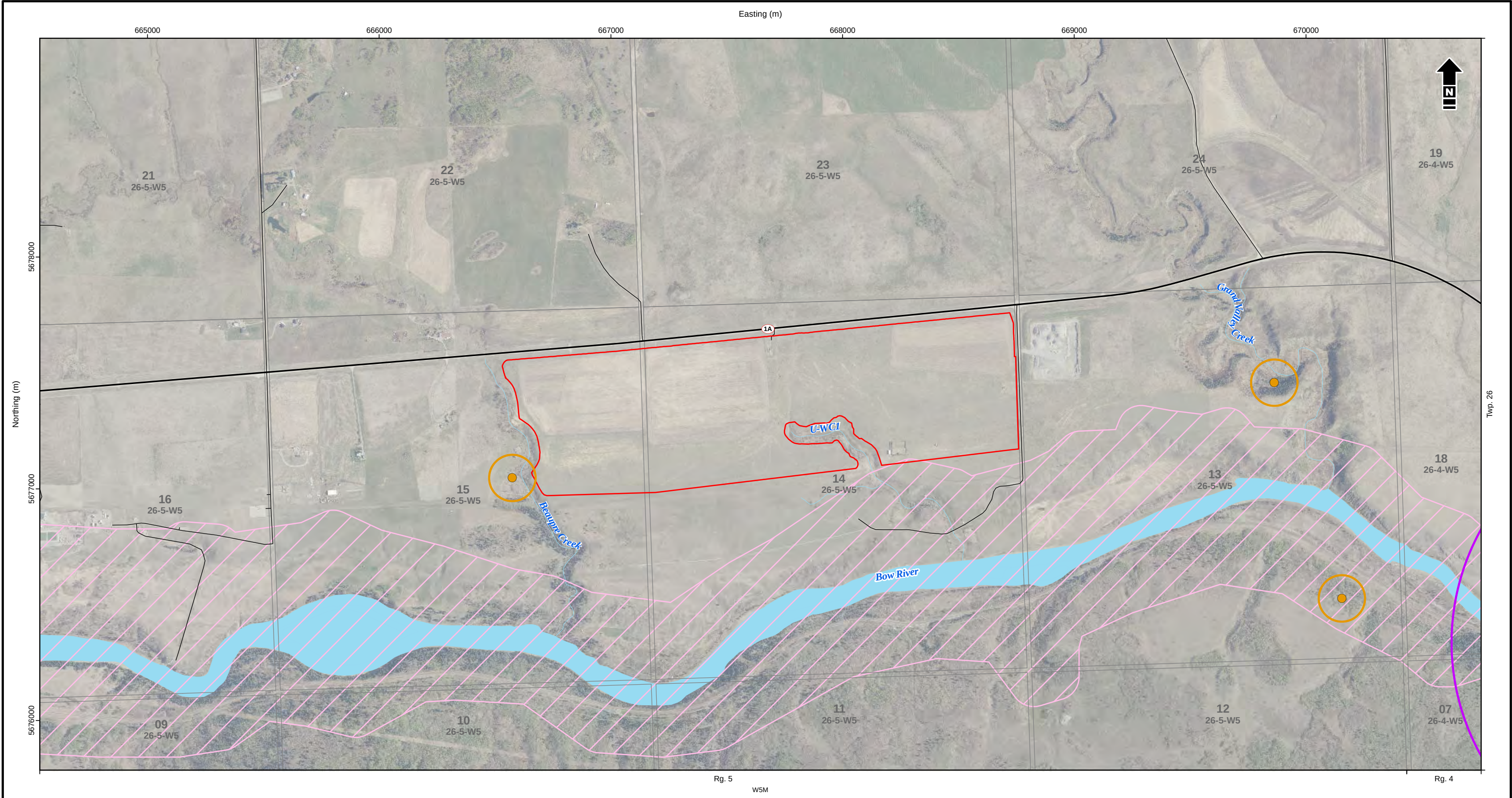


Burnco Rock Products Ltd.
Burnco West Cochrane #2 Gravel Pit

Watercourse, Riparian, and Wetland Setbacks

Date: May 2022	Project: 26388	Submitter: J. Kemper	Reviewer: D. Player
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Disturbance Area

Key Wildlife and Biodiversity Zone

Water Body

Watercourse (Field-Verified)

Highway

Road

Red-tailed Hawk Active Nest

Bald Eagle Nest Setback (1000 m)

Red-tailed Hawk Nest Setback (100 m)

Note: Entire map area sits within the Sharp-tailed Grouse Survey; and the Bald Eagle, Golden Eagle, and Prairie Falcon Ranges.

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Burnco Rock Products Ltd.
Burnco West Cochrane #2 Gravel Pit

**Wildlife Setbacks and
Key Wildlife Biodiversity Zone**

Date: May 2022

Project: 26388

Submitter: J. Kemper

Reviewer: D. Player

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Figure 10

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APPENDIX A

Soil Inspection Locations

TABLE A1 Soil Inspection Locations

Site Number	Easting	Northing	Sample Date	Soil Sub Group	Soil Series	Phase Modifier	Parent Material1	Parent Material2	Depth To Water	Surface Expression	Slope Position	Slope Class	Slope Length	Aspect	Land Use	Surface Stoniness	Drainage	Moisture Regime	Ecosite Phase	AWI Wetland Type
AG004	666710.54	5677460.59	7/24/2018 12:53:54 PM	CA.BLC	BUR	ca, zz	GLFL	-	>100	Gently Undulating	Mid	0.5 to 2%	100 to 500	W	Cultivated	S0 - non stony (<0.01)	Moderately Well	Mesic (SiL-SCL, Well-Mod Well)	Cropland	N/C
AG005	666792.82	5677080.07	7/24/2018 1:21:28 PM	O.R	LBK	aa	GLFL	-	>40	Gently Undulating	Upper	0.5 to 2%	100 to 500	S	Pasture	S2 - moderately stony (0.1 - 3)	Well	Submesic (SL, Rapid-Well)	Modif Past	N/C
AG006	667019.72	5677117.45	7/24/2018 1:40:17 PM	O.BLC	MFT	ca	GLLC	-	>50	Undulating	Upper	0.5 to 2%	100 to 500	S	Pasture	S2 - moderately stony (0.1 - 3)	Well	Submesic (SL, Rapid-Well)	Modif Past	N/C
AG008	667002.64	5677456.36	7/24/2018 2:08:31 PM	O.BLC	MFT	ca	GLLC	-	>100	Undulating	Mid	0.5 to 2%	100 to 500	S	Cultivated	S0 - non stony (<0.01)	Moderately Well	Mesic (SiL-SCL, Well-Mod Well)	Cropland	N/C
AG009	667374.66	5677475.76	7/24/2018 8:43:08 AM	O.BLC	MFT	ca	GLLC	-	>100	Gently Undulating	Mid	0.5 to 2%	100 to 500	SE	Cultivated	S0 - non stony (<0.01)	Moderately Well	Mesic (SiL-SCL, Well-Mod Well)	Cropland	N/C
AG010	667455.26	5677153.38	7/24/2018 9:01:40 AM	O.BLC	MFT	ca	GLLC	-	>70	Gently Undulating	Mid	0.5 to 2%	100 to 500	SE	Pasture	S0 - non stony (<0.01)	Moderately Well	Mesic (SiL-SCL, Well-Mod Well)	Modif Past	N/C
AG012	667698.61	5677170.81	7/24/2018 9:29:15 AM	O.R	LBK	aa	GLFL	-	>30	Gently Undulating	Mid	0.5 to 2%	100 to 500	SW	Pasture	S3 - very stony (3 - 15)	Well	Submesic (SL, Rapid-Well)	Modif Past	N/C
AG013	667666.82	5677491.55	7/24/2018 9:46:04 AM	O.BLC	MFT	ca	GLLC	-	>100	Gently Undulating	Mid	0.5 to 2%	100 to 500	SW	Cultivated	S0 - non stony (<0.01)	Moderately Well	Mesic (SiL-SCL, Well-Mod Well)	Cropland	N/C
AG014	668017.14	5677548.46	7/24/2018 10:15:03 AM	O.BLC	MFT	ca	GLLC	-	>50	Gently Undulating	Mid	0.5 to 2%	100 to 500	SE	Pasture	S0 - non stony (<0.01)	Well	Mesic (SiL-SCL, Well-Mod Well)	Modif Past	N/C
AG015	668352.73	5677590.48	7/24/2018 10:26:35 AM	O.BLC	MFT	ca	GLLC	-	>100	Gently Undulating	Mid	0.5 to 2%	100 to 500	SE	Cultivated	S0 - non stony (<0.01)	Well	Mesic (SiL-SCL, Well-Mod Well)	Cropland	N/C
AG016	668406.85	5677284.54	7/24/2018 10:44:04 AM	O.R	LBK	aa	GLFL	-	>30	Gently Undulating	Lower	0.5 to 2%	100 to 500	SE	Pasture	S3 - very stony (3 - 15)	Well	Submesic (SL, Rapid-Well)	Modif Past	N/C
AG017	668086.67	5677214.5	7/24/2018 11:08:14 AM	O.R	LBK	aa	GLFL	-	>30	Rough Broken (steep)	Upper	15 to 30%	25 to 50	SW	Pasture	S3 - very stony (3 - 15)	Rapidly (S)	Subxeric (LS-SL, Rapid)	Modif Past	N/C
AG018	668589.91	5677629.29	7/24/2018 12:26:58 PM	O.BLC	MFT	ca	GLLC	-	>100	Gently Undulating	Mid	0.5 to 2%	100 to 500	SW	Cultivated	S0 - non stony (<0.01)	Well	Submesic (SL, Rapid-Well)	Cropland	N/C
AG019	668698.13	5677472.88	7/24/2018 12:41:36 PM	O.BLC	MFT	ca	GLLC	-	>100	Gently Undulating	Mid	0.5 to 2%	100 to 500	SW	Pasture	S0 - non stony (<0.01)	Well	Mesic (SiL-SCL, Well-Mod Well)	Modif Past	N/C
AG020	668645.27	5677242.13	7/24/2018 1:25:41 PM	O.BLC	MFT	ca	GLLC	-	>100	Gently Undulating	Mid	2 to 5%	50 to 100	SE	Pasture	S0 - non stony (<0.01)	Well	Submesic (SL, Rapid-Well)	Modif Past	N/C

TABLE A1 Soil Inspection Locations

Site Number	Easting	Northing	Horizon	Upper Depth	Lower Depth	Thickness	Colour Page	Colour Code	Texture	Structure Grade	Structure Class	Structure Kind	Structure	Soil Moisture	Consistence	Coarse Fragment Percent Volume	Coarse Fragment Size	Effervescence	Mottling Abundance	Mottling Contrast	Mottling Size	Mottling	Sampled	Sample ID
AG004	666710.54	5677460.59	Ahks	0	16	16	10YR	2/1	CL	M	M	GR	MMGR	M	FI	0	-	W	-	-	-	---	YES	26388180723001
			Bmk	16	40	24	10YR	4/2	SiCL	M	M	SB	MMSB	M	FR	0	-	M	-	-	-	---	YES	26388180723002
			Ck	40	100	60	2.5Y	5/3	SiC	-	-	MA	--MA	M	FI	0	-	S	-	-	-	---	YES	26388180723003
AG005	666792.82	5677080.07	Ah	0	10	10	10YR	3/1	SiL	M	M	GR	MMGR	D	S	15	<8 cm - Gravel	-	-	-	-	---	NO	-
			Ck	10	40	30	2.5Y	5/2	SiL	-	-	MA	--MA	D	S	25	<8 cm - Gravel	S	-	-	-	---	NO	-
AG006	667019.72	5677117.45	Ah	0	9	9	10YR	3/1	SCL	M	M	GR	MMGR	D	SH	10	<8 cm - Gravel	-	-	-	-	---	NO	-
			Bmk	9	35	26	10YR	4/3	SCL	M	M	SB	MMSB	D	SH	10	<8 cm - Gravel	M	-	-	-	---	NO	-
			Ck	35	50	15	10YR	5/1	LS	-	-	MA	--MA	D	L	20	<8 cm - Gravel	S	-	-	-	---	NO	-
AG008	667002.64	5677456.36	Ahks	0	22	22	10YR	3/1	SiCL	S	M	GR	SMGR	D	SH	0	-	W	-	-	-	---	NO	-
			Bmk	22	43	21	10YR	4/3	SiCL	M	M	SB	MMSB	M	FI	0	-	M	-	-	-	---	NO	-
			Ck	43	100	57	2.5Y	5/3	SiCL	-	-	MA	--MA	M	FI	0	-	S	-	-	-	---	NO	-
AG009	667374.66	5677475.76	Ah	0	28	28	10YR	3/1	SiL	M	M	GR	MMGR	M	FR	0	-	-	-	-	-	---	NO	-
			Bmk	28	60	32	10YR	4/2	SiCL	M	M	SB	MMSB	M	FI	0	-	M	-	-	-	---	NO	-
			Ck	60	100	40	2.5Y	4/3	SL	-	-	MA	--MA	M	FR	0	-	S	-	-	-	---	NO	-
AG010	667455.26	5677153.38	Ah	0	16	16	10YR	3/1	SiCL	M	M	GR	MMGR	D	H	0	-	-	-	-	-	---	NO	-
			Bmk	16	40	24	10YR	4/2	SiCL	M	F	SB	MFSB	D	H	0	-	M	-	-	-	---	NO	-
			Ck	40	70	30	2.5Y	6/2	SiL	-	-	MA	--MA	D	S	0	-	S	-	-	-	---	NO	-
AG012	667698.61	5677170.81	Ah	0	8	8	10YR	3/1	SiL	M	M	GR	MMGR	M	FR	10	<8 cm - Gravel	-	-	-	-	---	NO	-
			Ck	8	30	22	10YR	5/2	SL	-	-	MA	--MA	D	L	30	<8 cm - Gravel	M	-	-	-	---	NO	-
AG013	667666.82	5677491.55	Apks	0	11	11	10YR	3/2	SiCL	M	M	GR	MMGR	D	H	0	-	W	-	-	-	---	NO	-
			Bmk	11	20	9	10YR	4/2	SiCL	S	M	SB	SMSB	D	H	0	-	M	-	-	-	---	NO	-
			Ck	20	100	80	10YR	6/2	SiCL	-	-	MA	--MA	M	FI	0	-	S	-	-	-	---	NO	-
AG014	668017.14	5677548.46	Ahks	0	14	14	10YR	2/2	SiL	M	M	GR	MMGR	D	S	0	-	W	-	-	-	---	NO	-
			Bmk	14	30	16	10YR	4/2	SiCL	W	M	SB	WMSB	D	H	0	-	M	-	-	-	---	NO	-
			Ck	30	50	20	10YR	6/2	SiL	-	-	MA	--MA	D	S	0	-	S	-	-	-	---	NO	-
AG015	668352.73	5677590.48	Apks	0	24	24	10YR	2/2	SiL	M	M	GR	MMGR	M	FR	0	-	W	-	-	-	---	NO	-
			Bmk	24	49	25	10YR	4/2	SiCL	M	M	SB	MMSB	M	FR	0	-	M	-	-	-	---	NO	-
			Ck	49	100	51	2.5Y	6/2	SiCL	-	-	MA	--MA	M	FI	0	-	S	-	-	-	---	NO	-
AG016	668406.85	5677284.54	Ah	0	8	8	10YR	3/2	SiL	M	M	GR	MMGR	D	S	10	<8 cm - Gravel	-	-	-	-	---	NO	-
			Ck	8	30	22	10YR	4/2	SL	-	-	MA	--MA	D	L	40	<8 cm - Gravel	S	-	-	-	---	NO	-
AG017	668086.67	5677214.5	Ah	0	12	12	10YR	2/2	SiCL	M	M	GR	MMGR	D	H	10	<8 cm - Gravel	-	-	-	-	---	NO	-
			Ck	12	30	18	2.5Y	6/2	SiL	-	-	MA	--MA	D	VH	5	<8 cm - Gravel	M	-	-	-	---	NO	-
AG018	668589.91	5677629.29	Apks	0	12	12	10YR	2/2	SiCL	S	M	GR	SMGR	D	H	0	-	W	-	-	-	---	YES	26388180723004
			Bmk	12	25	13	10YR	4/2	SiCL	M	M	SB	MMSB	M	FI	0	-	M	-	-	-	---	YES	26388180723005
			Ck	25	100	75	2.5Y	6/2	SCL	-	-	MA	--MA	M	FI	0	-	S	-	-	-	---	YES	26388180723006
AG019	668698.13	5677472.88	Ahks	0	23	23	10YR	3/1	SiCL	S	M	SB	SMSB	D	H	0	-	W	-	-	-	---	NO	-
			Bmk	23	51	28	10YR	5/3	SCL	W	M	SB	WMSB	D	SH	0	-	M	-	-	-	---	NO	-
			Ck	51	100	49	2.5Y	6/2	SiCL	-	-	MA	--MA	M	FI	0	-	S	-	-	-	---	NO	-
AG020	668645.27	5677242.13	Ahks	0	23	23	10YR	2/2	SiL	M	M	GR	MMGR	D	SH	0	-	M	-	-	-	---	NO	-
			Bmk	23	51	28	10YR	4/2	SL	W	F	SB	WFSB	D	S	0	-	M	-	-	-	---	NO	-
			Ck	51	100	49	2.5Y	5/2	SL	-	-	MA	--MA	D	S	0	-	S	-	-	-	---	NO	-

APPENDIX B

Soils Assessment Methods

APPENDIX B

SOIL ASSESSMENT METHODS

1 LAND SUITABILITY FOR AGRICULTURAL LAND

The *Land Suitability Rating System for Agricultural Crops* (Agronomic Interpretations Working Group 1995) was used to evaluate the pre-disturbance (naturally occurring) soils for agriculture crops. Individual soil and landscape components are rated numerically and the results combined to produce an overall land capability rating. The classification system is intended to be a planning tool for soil salvage and handling for conservation and reclamation. The five land capability classification classes are described in Table B1.

TABLE B1 Relationship of Suitability Class to Index Points

Suitability Class	Index Points	Limitations
1	80-100	None to slight
2	60-79	Slight
3	45-59	Moderate
4	30-44	Severe
5	20-29	Very severe
6	10-19	Extremely severe
7	0-9	Unsuitable

Baseline (pre-disturbance) land capability classes were estimated for each soil series, using the land capability ratings for each of the corresponding site inspections. For each soil inspection, the soil and landscape components were considered separately, and the final land capability rating was based on the most limiting of the two components. Subclasses were assigned to identify the specific limiting factors. For each soil series, the land capability ratings with any identified limiting factors will become the target for achieving equivalent production levels on the reclaimed lands.

2 SOIL SUITABILITY FOR RECLAMATION

The topsoil (upper lift) and upper subsoil (lower lift) of mineral soil in the project area were rated for their reclamation suitability according to *Soil Quality Criteria Relative to Disturbance and Reclamation* (AAFRD 2004). The criteria do not apply to Organic soils or peaty surface horizons; therefore, Organic soils (if there are any) were assigned a rating of not applicable (N/A). These ratings provide an evaluation (good, fair, poor, or unsuitable) of reclamation suitability based on interpretation of physical and chemical properties of the soils. The ratings are based on general predictions of soil performance and do not consider varying requirements of individual plant species or special management input (Table B2).

TABLE B2 Reclamation Suitability Classes

Reclamation Suitability Class	Reclamation Suitability
Good	None to slight limitations that affect use as a reclamation medium.
Fair	Moderate soil limitations that affect reclamation but which can be overcome by proper planning and good soil management.
Poor	Severe soil limitations that make reclamation more challenging. These soils can be used for reclamation but require proper planning and very good soil management.
Unsuitable	Chemical or physical properties of the soils are so severe that reclamation might not be economically feasible or in some cases impossible.

Source: Adapted from AAFRD 2004.

The guidelines rate overall reclamation suitability by interpreting the physical and chemical properties of topsoil and subsoil horizons for various soil types. Each horizon was rated according to its degree of suitability for plant growth. The most limiting rating was used to determine the overall suitability rating.

3 SOIL SENSITIVITY TO WIND AND WATER EROSION

Sensitivity to wind erosion is derived through an equation which accounts for the surface roughness and aggregation, soil resistance to movement, drag velocity of surface wind, soil moisture, shear resistance, and available moisture of the soil surface (Coote and Pettapiece 1989). The resulting ratings are based on soil under agricultural production with no cover. Soils with a sandy texture are more susceptible to wind erosion than those with a clay texture. Organic soils have negligible risk to wind erosion unless they present an open face or are dry. The ratings identified in Table B3, were applied to the soil series based on the soil texture of the surface horizons with reference to the subsoil textures recorded in the field.

TABLE B3 Wind Erosion Risk Classes

Wind Erosion Risk Class	Soil Texture
High	Very fine sand, sand, coarse sand, loamy sand, gravely sand, dry humic organic materials
Moderate	Sandy loam, fine sandy loam, loam, silt loam, sandy clay loam, sandy clay, mesic organic material
Low	Silt, silty clay loam, clay loam, silty clay, clay, heavy clay, fibric organic material

Source: Adapted from Coote and Pettapiece 1989.

Sensitivity to water erosion is estimated through an equation that accounts for erosivity of rainfall and snowmelt, soil erodibility, slope length and steepness, crop cover, and management and conservation practices (Tajek and Coote 1993). Slope length and surficial topography are considered, because very long slopes may increase erosion potential of fine-grained material as steep slopes also increase erosion potential. Soil erodibility (K factor) and the length-slope factor (LS factor) have been estimated for various surficial topographies and slope lengths. The rating system used to evaluate soils is based on the approximate surface roughness factor (R), K, and LS factors outlined by Alberta Land Conservation and Reclamation Council, Alberta Reclamation Research Technical Advisory Committee, Pedocan (1993), and Tajek and Coote (1993) for various soil textures, slopes, and length of slopes. Fine-textured soils in the

silty clay loam to clay loam range have a K factor of approximately 0.060 to 0.065. More sandy soils have a K factor of 0.031. The rating system used for the soils within the Project Area is presented in Table B4.

TABLE B4 Water Erosion Risk Classes

Water Erosion Risk Class	Slope Class	Slope Percent (%)	Slope Length (m)	LS Factor	K Factor
Low	1 to 3	<5	0 to 500	0.5 to 0.8	0.031 to 0.065
Moderate	4	5 to 9	50 to 500	0.8 to 2.2	0.031 to 0.065
High	5+	9+	50 to 500	2.2 to 3.5	0.040 to 0.065

Source: Adapted from Coote and Pettapiece 1989.

4 REFERENCES

- Agronomic Interpretations Working Group. 1995. *Land Suitability Rating System for Agricultural Crops: 1. Spring-seeded Small Grains*. Technical Bulletin 1995-6E. Pettapiece W.W. (Ed.). Centre for Land and Biological Resources Research, Agriculture and Agri Food Canada. Ottawa, Ontario. 1995. <http://sis.agr.gc.ca/cansis/publications/manuals/1995-lsrs/lrs.pdf>
- Alberta Agriculture, Food and Rural Development (AAFRD). 2004. *Soil Quality Criteria Relative to Disturbance and Reclamation (Revised)*. Soil Quality Criteria Work Group, Soil Reclamation Subcommittee, Alberta Soils Advisory Committee, and Alberta Agriculture. Reprinted November 1993 and September 2004. Edmonton, Alberta. September 2004. <https://open.alberta.ca/publications/soil-quality-criteria-relative-to-disturbance-and-reclamation>
- Coote D.R. and W.W. Pettapiece. 1989. *Wind Erosion Risk: Alberta*. Land Resource Research Centre, Research Branch, Agriculture Canada. Ottawa, Ontario. Publication 5255/B. Contribution Number 87 08. 1989.
- Pedocan Land Evaluation Ltd. (Pedocan). 1993. *Soil Series Information for Reclamation Planning in Alberta*. RRTAC Report No. 93-7. Prepared for Alberta Land Conservation and Reclamation Council, Reclamation Research Technical Advisory Committee. 1993.
- Tajek J. and D.R. Coote. 1993. *Water Erosion Risk – Alberta*. Land Research Centre, Research Branch, Agriculture Canada. Publication 5292/B. Contribution Number 92-05 (report and map). 1993.

APPENDIX C

Soil Quality Results

TABLE C1

Soil Quality Results

Burnco Rock Products Ltd.

Burnco West Cochrane Gravel Pit

Sample Point	AG004	AG004	AG004	AG018	AG018	AG018	Alberta Tier 1 - Natural Area*
Depth (m)	Ahk 0-0.16	Bmk 0.16-0.4	Ck 0.4-1	Apk 0-0.12	Bmk 0.12-0.25	Ck 0.25-1	
Sample Date	23-Jul-18	23-Jul-18	23-Jul-18	23-Jul-18	23-Jul-18	23-Jul-18	
MSI Sample Number	26388180723001	26388180723002	26388180723003	26388180723004	26388180723005	26388180723006	
Salinity							
Lab pH CaCl ₂	7.4	7.5	7.7	7.5	7.6	7.7	6-8.5 ^{ES}
Lab EC dS/m	1.14	0.85	0.64	0.98	1	0.52	*
SAR	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	*
TGR tons/ac	---	---	---	---	---	---	NS
Physical and Aggregate Properties							
Total N % dry weight	---	---	---	---	---	---	NS
TKN mg/kg	4630	2070	596	3100	1670	398	NS
TOC %	4.27	2.24	0.76	3.05	2.1	0.53	NS
OM %	---	---	---	---	---	---	NS
Bulk Density kg/L	---	---	---	---	---	---	NS
Wet Bulk Density kg/L	---	---	---	---	---	---	NS
CaCO ₃ Equivalent %	16	50	49.2	17.9	36.2	48.8	NS
CEC meq/100g	37.4	26.5	20	27.7	26	18.6	NS
Sand %	23	17	18	39	32	39	NS
Silt %	44	46	41	30	32	28	NS
Clay %	33	37	41	31	36	33	NS
Classification (CSSC)	Clay Loam	Silt Clay Loam	Silt Clay	Clay Loam	Clay Loam	Clay Loam	NS
Soil Quality Guidelines for Salinity*							
Soil Horizon	Topsoil	Subsoil	Subsoil	Topsoil	Topsoil	Subsoil	-
Salinity Rating	Good	Good	Good	Good	Good	Good	-
Sodicity Rating	Good	Good	Good	Good	Good	Good	-

Notes:

--- - not analyzed

NS - not specified

^{ES} - indicates guideline for Direct Soil Contact (ecological) exposure pathwayCSSC - *The Canadian System of Soil Classification* (SCWG 1998)* - *Alberta Tier 1 Soil and Groundwater Remediation Guidelines* (ESRD 2014)**Good topsoil** - EC <2 dS/m; SAR <4**Fair topsoil** - EC 2 to 4 dS/m; SAR 4 to 8**Poor topsoil** - EC 4 to 8 dS/m; SAR 8 to 12**Unsuitable topsoil** - EC >8 dS/m; SAR >12**Good subsoil** - EC <3 dS/m; SAR <4**Fair subsoil** - EC 3 to 5 dS/m; SAR 4 to 8**Poor subsoil** - EC 5 to 10 dS/m; SAR 8 to 12**Unsuitable subsoil** - EC >10 dS/m; SAR >12

APPENDIX D

Land Capability for Agricultural Land

DATA INPUT DOCUMENT
(Soil and Landscape factors)

1. LOCATION: Rockyview (Burro) NAME: AG018 DATE: Aug 23-25, 2018
MFT

2. LANDSCAPE: (general)

Slope characteristics: (steepness and length) 0.5 to 27.7, 100 to 500 m

Surface stoniness: (size and amount) SO

Pattern: (kind and number of obstacles) —

Flooding: (duration and frequency) —

3. SOILS: (general)

Profile description:

horizon	depth	texture*	structure	consistence	color	
1. Apks	0-12	clay loam	GR	H	10YR	2/2
2. Bmk	12-25	clay loam	SB	Firm	10YR	4/2
3. CK	25-100	clay loam	MA	Firm	2.5Y	6/2
4.						

* for organic soils use % rubbed fibre and % wood.

Depth to limiting horizon =

Laboratory analysis:

horizon	pH	O.C.	CaCO ₃ /E.C.	bulk density	>2 mm	S	Si	C	
1. Apks	7.5	3.05	17.9	1.25	0				
2. Bmk	7.6	2.1	36.2	1.4	0				
3. CK	7.7	0.53	48.8	1.45	0				
4.									

Drainage: (general)

- depth to water table: >100

4. COMMENTS: (variability, etc.)

LAND SUITABILITY RATING DOCUMENT

MAP AREA: _____ NAME: _____ DATE: _____

Map Component 1. <u>Maycoct</u>		SOIL (S) <u>100</u>		2. _____	
	Name	Value	deduction		Name
1. Moisture factor (M)					
texture	<u>CL</u>		<u>10</u>		
subsoil text adj.	<u>CL</u>		<u>0</u>		
water table/% adj.	<u>2100</u>		<u>0</u>		
moisture deduction			<u>10</u>		
2. Surface factors					
structure (D)	<u>G-H</u>		<u>0</u>		
org. C (F)	<u>3.05</u>		<u>0</u>		
depth (E)	<u>12</u>		<u>0</u>		
reaction (V)	<u>2.5</u>		<u>0</u>		
salinity (N)	<u>-</u>		<u>-</u>		
sodicity (Y)	<u>-</u>		<u>-</u>		
peaty (O)	<u>-</u>		<u>-</u>		
Basic Soil Rating = 100 - c			<u>10</u>		
3. Subsoil factors					
impeding layer (D,R)					
struct. (density)	<u>1.45 = 10</u>		<u>10</u>		
depth/% adj.	<u>12 = 100.</u>		<u>0</u>		
non-conform.	<u>-</u>		<u>0</u>		
reaction (V)	<u>2.6</u>		<u>0</u>		
salinity (N)	<u>-</u>		<u>-</u>		
sodicity (Y)	<u>-</u>		<u>-</u>		
Subsoil deduction =			<u>10</u>		
Interim Soil Rating = d - e			<u>80</u>		
4. Drainage factor (W)					
depth water table	<u>2100</u>		<u>15</u>		
hydraul. cond.	<u>15.1</u>		<u>15</u>		
Drainage deduction =			<u>15</u>		
FINAL SOIL RATING (S) = f - g =			<u>66</u>		

LANDSCAPE (L)

Map Component 1. _____		2. _____	
	value	deduction	
1. Slope (T)			
steepness	<u>2</u>		<u>0</u>
landscape type	<u>simple</u>		<u>5</u>
region	<u>2</u>		<u>5</u>
Basic Landscape Rating = 100 -			<u>5</u>
2. Stoniness/Coarse fragment (%) deduction			
stoniness (P)	<u>50</u>		<u>0</u>
gravel (P)	<u>-</u>		<u>-</u>
wood (J)	<u>-</u>		<u>-</u>
C.F. deduction =			<u>0</u>
Interim landscape rating = a - b =			<u>95</u>
3. Other deductions (%)			
pattern (K)	<u>-</u>		<u>-</u>
flooding (I)	<u>-</u>		<u>-</u>
other deductions =			<u>-</u>
FINAL LANDSCAPE RATING (L) = c - d =			<u>95</u>

MAP AREA

Rockyview (Burnco)

NAME:

Lauren.H

DATE:

Nov 15, 2018

AGROCLIMATIC (C)

factor	value	deduction	factor	value	deduction
1. Moisture Component (A)			3. Modifying factors		
P-PE Index	<u>200</u>	<u>10</u>	spring moisture		
A = 100	-	<u>10</u> = <u>90</u>	fall moisture		
2. Energy Component (H)			local frost		
EGDD Index	<u>1100</u>	<u>50</u>	modification deduction = <u> </u> %a = <u> </u> b		
H = 100	-	<u>50</u> = <u>50</u>			
Basic Climate rating is lowest of A or H = <u> </u> a					
FINAL CLIMATE RATING (C) = a - b = <u>50</u>					

ORGANIC SOILS (O)

1. Soil Climate (Z)			4. Subsurface factors		
EGDD Index			struct. (%fibre) (B)		
Organic base rating = 100 - <u> </u> = <u> </u> a			substrate (G)		
2. Moisture factor (M)			texture		
P-PE index			depth		
surface % fibre		<u> </u> b	reaction (V)		
water table			salinity (N)		
subsurf. % fibre		<u> </u> %b = <u> </u> c	Subsurface deduction = <u> </u> %f = <u> </u> g		
Moisture deduction = b - c = <u> </u> d			Interim Organic Rating = f - g = <u> </u> h		
3. Surface factors			5. Drainage factor (W)		
struct. (% fibre) (B)			depth water table		
reaction (V)			subsurf. % fibre		
salinity (N)			Drainage deduction = <u> </u> %h = <u> </u> i		
Surface deduction = <u> </u> e					
Basic Organic Rating = a - d - e = <u> </u> f					
FINAL ORGANIC RATING (O) = h - i = <u> </u>					

FINAL RATING CALCULATION

index	or class	3	factors	%
C = <u>50</u>	or class	<u>3</u>	<u>H</u>	()
S = <u>66</u>	or class	<u>2</u>	<u>DR</u>	()
S = <u> </u>	or class	<u> </u>	<u> </u>	()
O = <u> </u>	or class	<u> </u>	<u> </u>	()
L = <u>95</u>	or class	<u>1</u>	<u>I</u>	()
L = <u> </u>	or class	<u> </u>	<u> </u>	()

Index	Class
80-100	1
60-79	2
45-59	3
30-44	4
20-29	5
10-19	6
0-9	7

Final rating using: average ☐ ; complex ☐ ; most limiting ☒

C	S(O)	L	Symbol	Class	factors	%
<u>3</u>	<u>2</u>	<u>1</u>	<u>H</u>	<u>DR</u>	<u>I</u>	()
classes						

C	S(O)	L	Class	factors	()
<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	()
classes					

Comments

APPENDIX E

Reclamation Suitability

APPENDIX E Reclamation Suitability

Project #:	26388-512
Field Program Dates:	August 23-25, 2018

Site ID	AG004				AG018			
Soil Series	BUR				MFT			
	Topsoil		Subsoil		Topsoil		Subsoil	
Reaction (pH)	7.4	G	7.5	G	7.5	G	7.6	F
Salinity (EC, dS/m)	1.14	G	0.85	G	0.98	G	1	G
Sodicity (SAR)	0.34	G	0.34	G	0.34	G	0.34	G
Saturation (%)	-	-	-	-	-	-	-	-
Stoniness Class (S0,S1...)/Stone Content (%/vol)	S0	G	-	-	S0	G	-	-
Lab Texture	CL	F	SiCL	F	CL	F	CL	F
Moist Consistency	Friable	G	Friable	G	Friable	G	Firm	F
Organic Carbon (%)	4.27	G			3.05	G		
CaCO3 Equivalent (%)	16	F			17.9	F		
Overall		F		F		F		F
Limitations		Texture, CaCO3		Texture		Texture, CaCO3		Reaction, Texture, Consistency

* Values represented by a "-" did not limit the reclamation suitability of the upper or lower lifts.

APPENDIX F
Species Observed During Vegetation Field Surveys by
Vegetation Community

APPENDIX F Species Observed during Vegetation Field Surveys by Vegetation Community

Vegetation Community ¹	Scientific Name	Common Name
Graminoid Marsh	<i>Agrostis scabra</i>	rough hair grass
Graminoid Marsh	<i>Carex aquatilis</i>	water sedge
Graminoid Marsh	<i>Cirsium arvense</i>	creeping thistle
Graminoid Marsh	<i>Elaeagnus commutata</i>	silverberry
Graminoid Marsh	<i>Hordeum jubatum</i>	foxtail barley
Graminoid Marsh	<i>Mentha arvensis</i>	wild mint
Graminoid Marsh	<i>Monarda fistulosa</i>	wild bergamot
Graminoid Marsh	<i>Phleum pratense</i>	timothy
Graminoid Marsh	<i>Rumex crispus</i>	curled dock
Graminoid Marsh	<i>Schoenoplectus pungens</i>	three-square rush
Graminoid Marsh	<i>Sium suave</i>	water parsnip
Graminoid Marsh	<i>Sonchus arvensis</i>	perennial sow-thistle
Graminoid Marsh	<i>Taraxacum officinale</i>	common dandelion
Native Grassland	<i>Antennaria parvifolia</i>	small-leaved everlasting
Native Grassland	<i>Antennaria racemosa</i>	racemose everlasting
Native Grassland	<i>Artemisia frigida</i>	pasture sagewort
Native Grassland	<i>Artemisia ludoviciana</i>	prairie sagewort
Native Grassland	<i>Astragalus agrestis</i>	purple milk vetch
Native Grassland	<i>Bromus inermis</i>	smooth brome
Native Grassland	<i>Campanula rotundifolia</i>	harebell
Native Grassland	<i>Carex sp.</i>	sedge
Native Grassland	<i>Cirsium arvense</i>	creeping thistle
Native Grassland	<i>Dasiphora fruticosa</i>	shrubby cinquefoil
Native Grassland	<i>Erigeron caespitosus</i>	tufted fleabane
Native Grassland	<i>Eriogonum flavum</i>	yellow umbrella-plant
Native Grassland	<i>Gaillardia aristata</i>	gaillardia
Native Grassland	<i>Galium boreale</i>	northern bedstraw
Native Grassland	<i>Geum triflorum</i>	three-flowered avens
Native Grassland	<i>Hedysarum boreale</i>	northern hedysarum
Native Grassland	<i>Hesperostipa comata</i>	needle-and-thread
Native Grassland	<i>Juniperus horizontalis</i>	creeping juniper
Native Grassland	<i>Koeleria macrantha</i>	June grass
Native Grassland	<i>Linum lewisii</i>	wild blue flax
Native Grassland	<i>Lithospermum ruderae</i>	woolly gromwell
Native Grassland	<i>Lupinus sericeus</i>	silky perennial lupine
Native Grassland	<i>Oxytropis sericea</i>	early yellow locoweed
Native Grassland	<i>Oxytropis splendens</i>	showy locoweed
Native Grassland	<i>Peritoma serrulata</i>	bee plant
Native Grassland	<i>Phlox hoodii</i>	moss phlox
Native Grassland	<i>Poa pratensis</i>	Kentucky bluegrass
Native Grassland	<i>Rosa arkansana</i>	prairie rose
Native Grassland	<i>Symphoricarpos occidentalis</i>	buckbrush

APPENDIX F Species Observed during Vegetation Field Surveys by Vegetation Community

Vegetation Community ¹	Scientific Name	Common Name
Native Grassland	<i>Thermopsis rhombifolia</i>	golden bean
Native Grassland	<i>Zizia aptera</i>	heart-leaved Alexanders
Riparian	<i>Actaea rubra</i>	red and white baneberry
Riparian	<i>Amelanchier alnifolia</i>	saskatoon
Riparian	<i>Arctostaphylos uva-ursi</i>	common bearberry
Riparian	<i>Bromus inermis</i>	smooth brome
Riparian	<i>Calamagrostis canadensis</i>	bluejoint
Riparian	<i>Carex spp.</i>	sedge
Riparian	<i>Chamerion angustifolium</i>	common fireweed
Riparian	<i>Cirsium arvense</i>	creeping thistle
Riparian	<i>Cornus stolonifera</i>	red-osier dogwood
Riparian	<i>Dasiphora fruticosa</i>	shrubby cinquefoil
Riparian	<i>Elaeagnus commutata</i>	silverberry
Riparian	<i>Elymus trachycaulus</i>	slender wheatgrass
Riparian	<i>Equisetum arvense</i>	common horsetail
Riparian	<i>Galium boreale</i>	northern bedstraw
Riparian	<i>Geranium richardsonii</i>	wild white geranium
Riparian	<i>Glyceria striata</i>	fowl manna grass
Riparian	<i>Hieracium umbellatum</i>	narrow-leaved hawkweed
Riparian	<i>Juniperus horizontalis</i>	creeping juniper
Riparian	<i>Koeleria macrantha</i>	June grass
Riparian	<i>Mentha arvensis</i>	wild mint
Riparian	<i>Phlox hoodii</i>	moss phlox
Riparian	<i>Platanthera dilatata</i>	tall white bog orchid
Riparian	<i>Poa palustris</i>	fowl bluegrass
Riparian	<i>Populus balsamifera</i>	balsam poplar
Riparian	<i>Populus tremuloides</i>	aspen
Riparian	<i>Rubus idaeus</i>	wild red raspberry
Riparian	<i>Rumex crispus</i>	curled dock
Riparian	<i>Shepherdia canadensis</i>	Canada buffaloberry
Riparian	<i>Sonchus arvensis</i>	perennial sow-thistle
Riparian	<i>Symphoricarpos occidentalis</i>	buckbrush
Upland Shrubland	<i>Artemisia frigida</i>	pasture sagewort
Upland Shrubland	<i>Artemisia ludoviciana</i>	prairie sagewort
Upland Shrubland	<i>Dasiphora fruticosa</i>	shrubby cinquefoil
Upland Shrubland	<i>Elaeagnus commutata</i>	silverberry
Upland Shrubland	<i>Gaillardia aristata</i>	gaillardia
Upland Shrubland	<i>Geranium viscosissimum</i>	sticky purple geranium
Upland Shrubland	<i>Populus balsamifera</i>	balsam poplar
Upland Shrubland	<i>Populus tremuloides</i>	aspen
Upland Shrubland	<i>Ribes oxycanthoides</i>	northern gooseberry
Upland Shrubland	<i>Rosa arkansana</i>	prairie rose

APPENDIX F Species Observed during Vegetation Field Surveys by Vegetation Community

Vegetation Community ¹	Scientific Name	Common Name
Upland Shrubland	<i>Salix sp.</i>	willow
Upland Shrubland	<i>Shepherdia canadensis</i>	Canada buffaloberry
Upland Shrubland	<i>Thalictrum venulosum</i>	veiny meadow rue

¹Species within the Upland Shrubland and Graminoid Marsh communities were observed outside of the Disturbance Area, but remain representative of these communities within the Disturbance Area and were therefore included.

APPENDIX G
Tracked Elements by Natural Subregion -
Foothills Parkland

APPENDIX G Tracked Elements by Natural Subregion - Foothills Parkland

Scientific Name	Common Name	Type	S Rank	N Rank	G Rank
<i>Salix bebbiana</i> / <i>Rubus idaeus</i> / <i>Geranium richardsonii</i> shrubland	beaked willow / wild red raspberry / wild white geranium shrubland	Community	S2	NNR	GNR
<i>Pseudotsuga menziesii</i> - <i>Pinus flexilis</i> / <i>Juniperus communis</i> / <i>Festuca campestris</i> woodland	Douglas-fir - limber pine / ground juniper / mountain rough fescue woodland	Community	S2	NNR	GNR
<i>Schizachyrium scoparium</i> - <i>Calamovilfa longifolia</i> grassland	little bluestem - sand grass grassland	Community	S2	NNR	GNR
<i>Elymus lanceolatus</i> - <i>Hesperostipa comata</i> grassland	northern wheat grass - needle-and-thread grassland	Community	S2	NNR	GNR
<i>Salix bebbiana</i> / <i>Cornus stolonifera</i> shrubland	beaked willow / red-osier dogwood shrubland	Community	S3?	NNR	GNR
<i>Betula occidentalis</i> grassland riparian shrubland	water birch grassland riparian shrubland	Community	S2S3	NNR	GNR
<i>Populus tremuloides</i> / <i>Rubus parviflorus</i> forest	aspen / thimbleberry forest	Community	S2	NNR	G2
<i>Festuca idahoensis</i> - <i>Pseudoroegneria spicata</i> Grassland	Idaho fescue - bluebunch wheat grass grassland	Community	S1S2	NNR	G4
<i>Scapania glaucocephala</i>	glaucous-headed liverwort	Moss	S2S4	NNR	G4G5
<i>Anoetangium aestivum</i>	moss	Moss	S2S3	N4	G4G5
<i>Aulacomnium androgynum</i>	little groove moss	Moss	S2S3	N4N5	G5
<i>Brachythecium frigidum</i>	moss	Moss	S1S2	N4N5	G4G5
<i>Pseudocampyllum radicale</i>	campyllum moss	Moss	S3	N3N4	G3G5
<i>Tortula cernua</i>	narrow-leaved chain-teeth moss	Moss	S1	NNR	G3G5Q
<i>Hennediella heimii</i>	long-stalked beardless moss	Moss	S2S3	N5	G5
<i>Didymodon fallax</i>	fallacious screw moss	Moss	S2S3	N5	G5
<i>Encalypta spathulata</i>	candle-snuffer moss	Moss	S2S3	NNR	G4
<i>Grimmia donniana</i>	Donian grimmia moss	Moss	S1S2	N4	G4G5
<i>Homalothecium nevadense</i>	moss	Moss	S1S2	NNR	G4
<i>Homalothecium pinnatifidum</i>	moss	Moss	S2S3	NNR	G4
<i>Hygroamblystegium tenax</i>	moss	Moss	S1S2	N5	G5
<i>Orthotrichum pumilum</i>	moss	Moss	S2S3	NNR	G5
<i>Physcomitrium hookeri</i>	bladder-cap moss	Moss	S2	NNR	G2G4
<i>Physcomitrium pyriforme</i>	urn moss	Moss	S2	N5	G5
<i>Pterygoneurum ovatum</i>	hairy-leaved beardless moss	Moss	S2S3	N3N4	G5
<i>Rhodobryum ontariense</i>	Ontario Rhodobryum moss	Moss	S1S2	NNR	G5
<i>Seligeria campylopoda</i>	moss	Moss	S2S3	NNR	G3G5
<i>Seligeria donniana</i>	Donian beardless moss	Moss	S2S3	N3N4	G4G5
<i>Syntrichia caninervis</i>	moss	Moss	S1	N3N4	G5?
<i>Schistidium pulvinatum</i>	moss	Moss	SU	N1	G5
<i>Schistidium tenerum</i>	thread bloom moss	Moss	S2S3	N3N4	G5?
<i>Coscinodon cribrosus</i>	sieve-toothed moss	Moss	S1	N3N4	G3G4
<i>Jaffuelobryum raui</i>	moss	Moss	S2	N2	G4?
<i>Jaffuelobryum wrightii</i>	moss	Moss	S1S2	N1N2	G4G5
<i>Chaenotheca chrysocephala</i>	stubble lichen	Lichen	S2	NNR	G4G5
<i>Cyphelium tigillare</i>	soot lichen	Lichen	S2	NNR	G5
<i>Xanthomendoza montana</i>	sunburst lichen	Lichen	S3	NU	GNR
<i>Circinaria hispida</i>	vagabond lichen	Lichen	S2S3	N2N3	G3
<i>Umbilicaria lyngei</i>	rock tripe	Lichen	SU	N3	G3
<i>Polysporina arenacea</i>	cobblestone lichen	Lichen	S2	NNR	GNR

APPENDIX G Tracked Elements by Natural Subregion - Foothills Parkland

Scientific Name	Common Name	Type	S Rank	N Rank	G Rank
<i>Acarospora veronensis</i>	cobblestone lichen	Lichen	S2	NNR	G5
<i>Bacidia hegetschweileri</i>	dot lichen	Lichen	S1	NNR	G2G4
<i>Caloplaca chrysophthalma</i>	firedot lichen	Lichen	S1	NNR	GNR
<i>Caloplaca trachyphylla</i>	desert firedot lichen	Lichen	S2S4	N4	G4G5
<i>Cyphelium notarisii</i>	soot lichen	Lichen	S2	NNR	GNR
<i>Diplotomma alboatrum</i>	lichen	Lichen	SU	NNR	GNR
<i>Flavopunctelia soledica</i>	powder-edged speckled greenshield lichen	Lichen	S2S3	NNR	G3G5
<i>Lepraria lobificans</i>	fluffy dust lichen	Lichen	S2	N5	G5
<i>Melanohalea infumata</i>	smoked camouflage lichen	Lichen	S3	N4N5	G5
<i>Melanohalea olivacea</i>	spotted camouflage lichen	Lichen	S1S2	N4	G4G5
<i>Physconia enteroxantha</i>	frost lichen	Lichen	S3	N4N5	G4G5
<i>Physconia perisidiosa</i>	crescent frost lichen	Lichen	S3	N4N5	G4G5
<i>Toninia tristis ssp. tristis</i>	blister lichen	Lichen	S1?	NNR	G3G5T2T4
<i>Xanthoparmelia camtschadalis</i>	rock-shield lichen	Lichen	SU	NNR	GNR
<i>Rinodina terrestris</i>	pepper-spore lichen	Lichen	S1	NNR	GNR
<i>Placidium lachneum</i>	earthscale lichen	Lichen	S1S2	NNR	G5
<i>Arnica longifolia</i>	long-leaved arnica	Vascular	S2	N2N3	G5
<i>Artemisia borealis ssp. borealis</i>	northern wormwood	Vascular	S2S3	NNR	G5T5
<i>Brickellia grandiflora</i>	large-flowered brickellia	Vascular	S2	N2	G5
<i>Cirsium scariosum</i>	meadow thistle	Vascular	S2	N3	G5
<i>Erigeron flagellaris</i>	creeping fleabane	Vascular	S2	N4	G5
<i>Machaeranthera tanacetifolia</i>	tansy aster	Vascular	S1	NX	G5
<i>Prenanthes sagittata</i>	purple rattlesnakeroot	Vascular	S1	N2	G4
<i>Senecio megacephalus</i>	large-flowered ragwort	Vascular	S1	N3	G4
<i>Pseudognaphalium thermale</i>	white cudweed	Vascular	SH	N4N5	G5T4T5
<i>Mertensia lanceolata</i>	lance-leaved lungwort	Vascular	S2	N3	G5
<i>Corispermum villosum</i>	hairy bugseed	Vascular	S2	N3N4	G4?
<i>Suckleya suckleyana</i>	poison suckleya	Vascular	S3	N4?	G5
<i>Lupinus minimus</i>	least lupine	Vascular	S2	N2	G3G4
<i>Gentiana calycosa</i>	mountain gentian	Vascular	S2	N3	G4
<i>Gentiana fremontii</i>	marsh gentian	Vascular	S3	N2N3	G3G4
<i>Ribes inerme var. inerme</i>	mountain gooseberry	Vascular	S2?	N4	G5T5
<i>Nemophila breviflora</i>	small baby-blue-eyes	Vascular	S3	N4?	G5
<i>Iliamna rivularis</i>	mountain hollyhock	Vascular	S1	N3	G5
<i>Oenothera flava</i>	low yellow evening-primrose	Vascular	S3	N3	G5
<i>Polygonum bistortoides</i>	western bistort	Vascular	S2	N3N4	G5
<i>Polygonum engelmannii</i>	Engelmann's knotweed	Vascular	S2	N2N3	G5T3T5
<i>Phlox alysifolia</i>	blue phlox	Vascular	S2	N3	G5
<i>Montia linearis</i>	linear-leaved montia	Vascular	S2	N4	G5
<i>Potentilla villosa</i>	hairy cinquefoil	Vascular	SU	N5	G5
<i>Potentilla macounii</i>	Macoun's cinquefoil	Vascular	S1	N1	G3?
<i>Potentilla lasiodonta</i>	sandhills cinquefoil	Vascular	S3	N3	G3
<i>Conimitella williamsii</i>	conimitella	Vascular	S2	N2	G4
<i>Lithophragma parviflorum</i>	small-flowered rockstar	Vascular	S2	NNR	G5

APPENDIX G Tracked Elements by Natural Subregion - Foothills Parkland

Scientific Name	Common Name	Type	S Rank	N Rank	G Rank
<i>Viola glabella</i>	yellow wood violet	Vascular	S2	NNR	G5
<i>Pinus flexilis</i>	limber pine	Vascular	S3	N2N3	G4
<i>Carex aperta</i>	open sedge	Vascular	S2	N4	G4
<i>Carex flava</i>	yellow sedge	Vascular	S2S3	N5	G5
<i>Carex vesicaria</i>	blister sedge	Vascular	S1	N5	G5
<i>Iris missouriensis</i>	western blue flag	Vascular	S2	N2	G5
<i>Camassia quamash</i> var. <i>quamash</i>	blue camas	Vascular	S3	N4	G5T4T5
<i>Cypripedium montanum</i>	mountain lady's-slipper	Vascular	S2	N3N4	G4
<i>Festuca subulata</i>	bearded fescue	Vascular	S1	N4	G5
<i>Melica smithii</i>	Smith's oniongrass	Vascular	S2	N4	G4
<i>Melica spectabilis</i>	onion grass	Vascular	S2	N4	G5
<i>Torreyochloa pallida</i> var. <i>pauciflora</i>	few-flowered salt-meadow grass	Vascular	S1	N5	G5T5
<i>Trisetum wolfii</i>	awnless trisetum	Vascular	S2	N2N3	G4
<i>Trisetum canescens</i>	tall trisetum	Vascular	S2	N5	G5
<i>Trisetum cernuum</i>	nodding trisetum	Vascular	S2	N5	G5
<i>Potamogeton nodosus</i>	longleaf pondweed	Vascular	S1	N5	G5
<i>Ruppia cirrhosa</i>	widgeon-grass	Vascular	S3	N4	G5
<i>Pellaea glabella</i> ssp. <i>simplex</i>	smooth cliff brake	Vascular	S2	N3N4	G5T4?
<i>Pellaea gastonyi</i>	Gaston's cliff brake	Vascular	S2	N3	G3
<i>Pteridium aquilinum</i> var. <i>pubescens</i>	bracken fern	Vascular	SU	N5	G5T5
<i>Polypodium hesperium</i>	western polypody	Vascular	S1	N3N4	G5
<i>Selaginella wallacei</i>	Wallace's little club-moss	Vascular	S1	N4	G5

APPENDIX H

Wildlife Species Potentially Occurring in the BURNCO West Cochrane #2 Disturbance Area Including Provincial and Federal Species at Risk Status, and Occurrence

APPENDIX H

WILDLIFE SPECIES POTENTIALLY OCCURRING IN THE BURNCO WEST COCHRANE #2 GRAVEL PIT DISTURBANCE AREA INCLUDING PROVINCIAL AND FEDERAL SPECIES AT RISK STATUS, AND OCCURRENCE

Common Name	Scientific Name	AEP ¹	Wildlife Act ²	COSEWIC ³	SARA ⁴	Historic Observations ⁵	Observed During Field Assessment
Amphibians and Reptiles							
Canadian toad	<i>Anaxyrus hemiophrys</i>	May Be at Risk	-	-	-	-	-
Boreal chorus frog	<i>Pseudacris maculata</i>	Secure	-	-	-	-	-
Wood frog	<i>Lithobates sylvatica</i>	Secure	-	-	-	-	-
Northern leopard frog	<i>Lithobates pipiens</i>	At Risk	-	Special Concern	Schedule 1- Special Concern	X	-
Tiger salamander	<i>Ambystoma mavortium</i>	Secure	Threatened	Special Concern	Schedule 1- Special Concern	-	-
Plains garter snake	<i>Thamnophis radix</i>	Sensitive	-	-	-	-	-
Red-sided garter snake	<i>Thamnophis sirtalis</i>	Sensitive	-	-	-	-	-
Wandering garter snake	<i>Thamnophis elegans</i>	Sensitive	-	-	-	-	-
Birds- Resident							
Canada goose	<i>Branta canadensis</i>	Secure	-	-	-	-	X
Wood duck	<i>Aix sponsa</i>	Secure	-	-	-	-	-
Gadwall	<i>Anas strepera</i>	Secure	-	-	-	-	-
American wigeon	<i>Anas americana</i>	Secure	-	-	-	-	-
Mallard	<i>Anas platyrhynchos</i>	Secure	-	-	-	-	X
Blue-winged teal	<i>Anas discors</i>	Secure	-	-	-	-	-
Cinnamon teal	<i>Anas cyanoptera</i>	Secure	-	-	-	-	-
Northern shoveler	<i>Anas clypeata</i>	Secure	-	-	-	-	-
Northern pintail	<i>Anas acuta</i>	Secure	-	-	-	-	-
Green-winged teal	<i>Anas crecca</i>	Secure	-	-	-	-	-
Canvasback	<i>Aythya valisineria</i>	Secure	-	-	-	-	-
Redhead	<i>Aythya americana</i>	Secure	-	-	-	-	-
Ring-necked duck	<i>Aythya collaris</i>	Secure	-	-	-	-	-
Lesser scaup	<i>Aythya affinis</i>	Secure	-	-	-	-	-
Harlequin duck	<i>Histrionicus histrionicus</i>	Sensitive	Special Concern	-	-	-	-
White-winged scoter	<i>Melanitta deglandi</i>	Sensitive	-	-	-	-	-
Bufflehead	<i>Bucephala albeola</i>	Secure	-	-	-	-	-
Common goldeneye	<i>Bucephala clangula</i>	Secure	-	-	-	-	-
Barrow's goldeneye	<i>Bucephala islandica</i>	Secure	-	-	-	-	-
Common merganser	<i>Mergus merganser</i>	Secure	-	-	-	-	-
Ruddy duck	<i>Oxyura jamaicensis</i>	Secure	-	-	-	-	-
Gray partridge	<i>Perdix perdix</i>	Exotic/Alien	-	-	-	-	-
Ring-necked pheasant	<i>Phasianus colchicus</i>	Exotic/Alien	-	-	-	-	X
Ruffed grouse	<i>Bonasa umbellus</i>	Secure	-	-	-	-	-
Spruce grouse	<i>Falcapennis canadensis</i>	Secure	-	-	-	-	-
Sharp-tailed grouse	<i>Tympanuchus phasianellus</i>	Sensitive	-	-	-	-	-
Common loon	<i>Gavia immer</i>	Secure	-	Not at Risk	-	-	-
Pied-billed grebe	<i>Podilymbus podiceps</i>	Sensitive	-	-	-	-	-
Horned grebe	<i>Podiceps auritus</i>	Sensitive	-	Special Concern	Schedule 1- Special Concern	-	-
Red-necked grebe	<i>Podiceps grisegena</i>	Secure	-	Not at Risk	-	-	-
Eared grebe	<i>Podiceps nigricollis</i>	Sensitive	-	-	-	-	-
Western grebe	<i>Aechmophorus occidentalis</i>	At Risk	Threatened	Special Concern	Schedule 1- Special Concern	-	-
Double-crested cormorant	<i>Phalacrocorax auritus</i>	Secure	-	-	-	-	-
American bittern	<i>Botaurus lentiginosus</i>	Sensitive	-	-	-	-	-
Great blue heron	<i>Ardea herodias</i>	Sensitive	-	-	-	-	X

Common Name	Scientific Name	AEP ¹	Wildlife Act ²	COSEWIC ³	SARA ⁴	Historic Observations ⁵	Observed During Field Assessment
Black-crowned night heron	<i>Nycticorax nycticorax</i>	Sensitive	-	-	-	-	-
White-faced ibis	<i>Plegadis chihi</i>	Sensitive	-	-	-	-	-
Turkey vulture	<i>Cathartes aura</i>	Secure	-	-	-	-	-
Osprey	<i>Pandion haliaetus</i>	Secure	-	-	-	X	-
Bald eagle	<i>Haliaeetus leucocephalus</i>	Sensitive	-	Not at Risk	-	X	X
Northern harrier	<i>Circus cyaneus</i>	Secure	-	Not at Risk	-	-	-
Sharp-shinned hawk	<i>Accipiter striatus</i>	Secure	-	Not at Risk	-	-	-
Cooper's hawk	<i>Accipiter cooperii</i>	Secure	-	Not at Risk	-	-	-
Northern goshawk	<i>Accipiter gentilis</i>	Sensitive	-	-	-	-	-
Swainson's hawk	<i>Buteo swainsoni</i>	Secure	-	-	-	-	X
Ferruginous hawk	<i>Buteo regalis</i>	At Risk	Endangered	Threatened	Schedule 1- Threatened	-	-
Red-tailed hawk	<i>Buteo jamaicensis</i>	Secure	-	Not at Risk	-	-	X
Golden eagle	<i>Aquila chrysaetos</i>	Sensitive	-	Not at Risk	-	-	-
American kestrel	<i>Falco sparverius</i>	Sensitive	-	-	-	-	X
Merlin	<i>Falco columbarius</i>	Secure	-	Not at Risk	-	-	-
Peregrine falcon anatum/tundrius subspecies	<i>Falco peregrinus anatum/tundrius</i>	At Risk	Threatened	Not at Risk	Schedule 1- Special Concern	-	-
Prairie falcon	<i>Falco mexicanus</i>	Sensitive	Special Concern	Not at Risk	-	X	-
Virginia rail	<i>Rallus limicola</i>	Undetermined	-	-	-	-	-
Sora	<i>Porzana carolina</i>	Sensitive	-	-	-	-	-
American coot	<i>Fulica americana</i>	Secure	-	Not at Risk	-	-	-
Killdeer	<i>Charadrius vociferus</i>	Secure	-	-	-	-	X
Black-necked stilt	<i>Himantopus mexicanus</i>	Sensitive	-	-	-	-	-
American avocet	<i>Recurvirostra americana</i>	Secure	-	-	-	-	-
Spotted sandpiper	<i>Actitis macularius</i>	Secure	-	-	-	-	X
Solitary sandpiper	<i>Tringa solitaria</i>	Secure	-	-	-	-	-
Piping Plover	<i>Charadrius melodus</i>	At Risk	Endangered	Endangered	Schedule 1- Endangered	-	-
Willet	<i>Tringa semipalmata</i>	Secure	-	-	-	-	-
Upland sandpiper	<i>Bartramia longicauda</i>	Sensitive	-	-	-	-	-
Long-billed curlew	<i>Numenius americanus</i>	Sensitive	May be at Risk	Special Concern	Schedule 1- Special Concern	-	-
Marbled godwit	<i>Limosa fedoa</i>	Secure	-	-	-	-	-
Wilson's snipe	<i>Gallinago delicata</i>	Secure	-	-	-	-	X
Wilson's phalarope	<i>Phalaropus tricolor</i>	Secure	-	-	-	-	-
Franklin's gull	<i>Larus pipixcan</i>	Secure	-	-	-	-	-
Ring-billed gull	<i>Larus delawarensis</i>	Secure	-	-	-	-	-
California gull	<i>Larus californicus</i>	Secure	-	-	-	-	-
Black tern	<i>Chlidonias niger</i>	Sensitive	-	Not at Risk	-	-	-
Forster's tern	<i>Sterna Forsteri</i>	Sensitive	-	Data Deficient	-	-	-
Rock pigeon	<i>Zenaida macroura</i>	Secure	-	-	-	-	-
Mourning dove	<i>Zenaida macroura</i>	Secure	-	-	-	-	X
Great horned owl	<i>Bubo virginianus</i>	Secure	-	-	-	-	-
Northern pygmy-owl	<i>Glaucidium gnoma</i>	Sensitive	-	-	-	-	-
Burrowing owl	<i>Athene cunicularia</i>	At Risk	Endangered	Endangered	Schedule 1- Endangered	-	-
Barred owl	<i>Strix varia</i>	Sensitive	Special Concern	-	-	-	-
Great gray owl	<i>Strix nebulosa</i>	Sensitive	-	Not at Risk	-	-	-
Long-eared owl	<i>Asio otus</i>	Secure	-	-	-	-	-
Short-eared owl	<i>Asio flammeus</i>	May Be at Risk	-	Threatened	Schedule 1- Special Concern	-	-
Boreal owl	<i>Aegolius funereus</i>	Secure	-	Not at Risk	-	-	-
Northern saw-whet owl	<i>Aegolius acadicus</i>	Secure	-	-	-	-	-
Common nighthawk	<i>Chordeiles minor</i>	Sensitive	-	Threatened	Schedule 1- Threatened	-	-
Ruby-throated hummingbird	<i>Archilochus colubris</i>	Secure	-	-	-	-	-
Calliope hummingbird	<i>Stellula calliope</i>	Secure	-	-	-	-	-
Rufous hummingbird	<i>Selasphorus rufus</i>	Secure	-	-	-	-	-

Common Name	Scientific Name	AEP ¹	Wildlife Act ²	COSEWIC ³	SARA ⁴	Historic Observations ⁵	Observed During Field Assessment
Belted kingfisher	<i>Megaceryle alcyon</i>	Secure	-	-	-	-	-
Yellow-bellied sapsucker	<i>Sphyrapicus varius</i>	Secure	-	-	-	-	-
Red-naped sapsucker	<i>Sphyrapicus nuchalis</i>	Undetermined	-	-	-	-	-
Downy woodpecker	<i>Picoides pubescens</i>	Secure	-	-	-	-	-
Hairy woodpecker	<i>Picoides villosus</i>	Secure	-	-	-	-	-
American three-toed woodpecker	<i>Picoides tridactylus</i>	Secure	-	-	-	-	-
Northern flicker	<i>Colaptes auratus</i>	Secure	-	-	-	-	-
Pileated woodpecker	<i>Dryocopus pileatus</i>	Sensitive	-	-	-	-	-
Olive-sided flycatcher	<i>Contopus cooperi</i>	May Be at Risk	-	Threatened	Schedule 1- Threatened	-	-
Western wood-pewee	<i>Contopus sordidulus</i>	May Be at Risk	-	-	-	X	-
Yellow-bellied flycatcher	<i>Empidonax flaviventris</i>	Undetermined	-	-	-	-	-
Alder flycatcher	<i>Empidonax alnorum</i>	Secure	-	-	-	X	-
Willow flycatcher	<i>Empidonax traillii</i>	Secure	-	-	-	-	-
Least flycatcher	<i>Empidonax minimus</i>	Secure	-	-	-	X	X
Dusky flycatcher	<i>Empidonax oberholseri</i>	Secure	-	-	-	-	-
“Western flycatcher” (Pacific-slope or Cordilleran flycatcher complex)	<i>Empidonax difficilis/Empidonax occidentalis</i>	Undetermined	-	-	-	-	-
Eastern phoebe	<i>Sayornis phoebe</i>	Sensitive	-	-	-	-	-
Say's phoebe	<i>Sayornis saya</i>	Secure	-	-	-	-	-
Western kingbird	<i>Tyrannus verticalis</i>	Secure	-	-	-	-	-
Eastern kingbird	<i>Tyrannus tyrannus</i>	Sensitive	-	-	-	X	X
Cassin's vireo	<i>Vireo cassinii</i>	Undetermined	-	-	-	-	-
Blue-headed vireo	<i>Vireo solitarius</i>	Secure	-	-	-	-	-
Warbling vireo	<i>Vireo gilvus</i>	Secure	-	-	-	-	X
Philadelphia vireo	<i>Vireo philadelphicus</i>	Secure	-	-	-	-	-
Red-eyed vireo	<i>Vireo olivaceus</i>	Secure	-	-	-	-	X
Blue jay	<i>Cyanocitta cristata</i>	Secure	-	-	-	-	-
Black-billed magpie	<i>Pica hudsonia</i>	Secure	-	-	-	-	X
American crow	<i>Corvus brachyrhynchos</i>	Secure	-	-	-	-	X
Common raven	<i>Corvus corax</i>	Secure	-	-	-	-	X
Horned lark	<i>Eremophila alpestris</i>	Secure	-	-	-	-	X
Purple martin	<i>Progne subis</i>	Sensitive	-	-	-	-	-
Tree swallow	<i>Tachycineta bicolor</i>	Secure	-	-	-	-	X
Violet-green swallow	<i>Tachycineta thalassina</i>	Secure	-	-	-	-	-
Northern rough-winged swallow	<i>Stelgidopteryx serripennis</i>	Secure	-	-	-	-	-
Bank Swallow	<i>Riparia riparia</i>	Sensitive	-	Threatened	No Schedule- No Status	-	-
Cliff swallow	<i>Petrochelidon pyrrhonota</i>	Secure	-	-	-	-	-
Barn swallow	<i>Hirundo rustica</i>	May Be at Risk	-	Special Concern	Schedule 1- Threatened	-	X
Black-capped chickadee	<i>Poecile atricapillus</i>	Secure	-	-	-	-	-
Mountain chickadee	<i>Poecile gambeli</i>	Secure	-	-	-	-	-
Boreal chickadee	<i>Poecile hudsonicus</i>	Secure	-	-	-	-	-
Red-breasted nuthatch	<i>Sitta canadensis</i>	Secure	-	-	-	-	X
White-breasted nuthatch	<i>Sitta carolinensis</i>	Secure	-	-	-	-	-
Brown creeper	<i>Certhia americana</i>	Sensitive	-	-	-	-	-
Rock wren	<i>Salpinctes obsoletus</i>	Secure	-	-	-	-	-
House wren	<i>Troglodytes aedon</i>	Secure	-	-	-	-	X
Winter wren	<i>Troglodytes troglodytes</i>	Secure	-	-	-	-	-
Marsh wren	<i>Cistothorus palustris</i>	Secure	-	-	-	-	-
American dipper	<i>Cinclus mexicanus</i>	Secure	-	-	-	-	-
Golden-crowned kinglet	<i>Regulus satrapa</i>	Secure	-	-	-	-	-
Ruby-crowned kinglet	<i>Regulus calendula</i>	Secure	-	-	-	-	-
Mountain bluebird	<i>Sialia currucoides</i>	Secure	-	-	-	-	X

Common Name	Scientific Name	AEP ¹	Wildlife Act ²	COSEWIC ³	SARA ⁴	Historic Observations ⁵	Observed During Field Assessment
Townsend's solitaire	<i>Myadestes townsendi</i>	Secure	-	-	-	-	-
Veery	<i>Catharus fuscescens</i>	Secure	-	-	-	-	-
Swainson's thrush	<i>Catharus ustulatus</i>	Secure	-	-	-	-	-
Hermit thrush	<i>Catharus guttatus</i>	Secure	-	-	-	-	-
American robin	<i>Turdus migratorius</i>	Secure	-	-	-	-	X
Varied thrush	<i>Ixoreus naevius</i>	Secure	-	-	-	-	X
Gray catbird	<i>Dumetella carolinensis</i>	Secure	-	-	-	-	-
Brown thrasher	<i>Toxostoma rufum</i>	Secure	-	-	-	-	-
European starling	<i>Sturnus vulgaris</i>	Exotic/Alien	-	-	-	-	X
Sprague's pipit	<i>Anthus spragueii</i>	Sensitive	Special Concern	Threatened	Schedule 1- Threatened	-	X
Cedar waxwing	<i>Bombycilla cedrorum</i>	Secure	-	-	-	-	-
Chestnut-collared longspur	<i>Calcarius ornatus</i>	At Risk	-	Threatened	Schedule 1- Threatened	-	-
Ovenbird	<i>Seiurus aurocapilla</i>	Secure	-	-	-	-	-
Northern waterthrush	<i>Seiurus noveboracensis</i>	Secure	-	-	-	-	-
Tennessee warbler	<i>Vermivora peregrina</i>	Secure	-	-	-	-	-
Orange-crowned warbler	<i>Vermivora celata</i>	Secure	-	-	-	-	-
Connecticut warbler	<i>Oporornis agilis</i>	Secure	-	-	-	-	-
MacGillvray's warbler	<i>Oporornis tolmiei</i>	Secure	-	-	-	-	-
Common yellowthroat	<i>Geothlypis trichas</i>	Sensitive	-	-	-	-	-
American redstart	<i>Setophaga ruticilla</i>	Secure	-	-	-	-	-
Cape May warbler	<i>Dendroica tigrina</i>	Sensitive	Special Concern	-	-	-	-
Yellow warbler	<i>Dendroica petechia</i>	Secure	-	-	-	-	X
Yellow-rumped warbler	<i>Dendroica coronata</i>	Secure	-	-	-	-	-
Townsend's warbler	<i>Dendroica townsendi</i>	Secure	-	-	-	-	-
Wilson's warbler	<i>Wilsonia pusilla</i>	Secure	-	-	-	-	-
Spotted towhee	<i>Pipilo maculatus</i>	Secure	-	-	-	-	-
Chipping sparrow	<i>Spizella passerina</i>	Secure	-	-	-	-	-
Clay-colored sparrow	<i>Spizella pallida</i>	Secure	-	-	-	-	X
Brewer's sparrow	<i>Spizella breweri</i>	Sensitive	-	-	-	-	-
Vesper sparrow	<i>Poocetes gramineus</i>	Secure	-	-	-	-	X
Savannah Sparrow	<i>Passerculus sandwichensis</i>	Secure	-	-	-	-	X
Grasshopper sparrow	<i>Ammodramus savannarum</i>	Sensitive	-	-	-	-	-
Baird's sparrow	<i>Ammodramus bairdii</i>	Sensitive	-	Special Concern	Schedule 1- Special Concern	-	-
Le Conte's sparrow	<i>Ammodramus leconteii</i>	Secure	-	-	-	-	-
Nelson's sparrow	<i>Ammodramus nelsoni</i>	Secure	-	Not at Risk	-	-	X
Fox sparrow	<i>Passerella iliaca</i>	Secure	-	-	-	-	-
Song sparrow	<i>Melospiza melodia</i>	Secure	-	-	-	-	X
Lincoln's sparrow	<i>Melospiza lincolnii</i>	Secure	-	-	-	-	-
Swamp sparrow	<i>Melospiza georgiana</i>	Secure	-	-	-	-	-
White-throated sparrow	<i>Zonotrichia albicollis</i>	Secure	-	-	-	-	X
White-crowned sparrow	<i>Zonotrichia leucophrys</i>	Secure	-	-	-	-	X
Dark-eyed junco	<i>Junco hyemalis</i>	Secure	-	-	-	-	-
Western tanager	<i>Piranga ludoviciana</i>	Sensitive	-	-	-	-	-
Rose-breasted grosbeak	<i>Pheucticus ludovicianus</i>	Secure	-	-	-	-	-
Lazuli bunting	<i>Passerina amoena</i>	Secure	-	-	-	-	-
Red-winged blackbird	<i>Agelaius phoeniceus</i>	Secure	-	-	-	-	X
Western meadowlark	<i>Sturnella neglecta</i>	Secure	-	-	-	-	X
Yellow-headed blackbird	<i>Xanthocephalus xanthocephalus</i>	Secure	-	-	-	-	-
Brewer's blackbird	<i>Euphagus cyanocephalus</i>	Secure	-	-	-	-	-
Common grackle	<i>Quiscalus quiscula</i>	Secure	-	-	-	-	-
Brown-headed cowbird	<i>Molothrus ater</i>	Secure	-	-	-	-	X
Baltimore oriole	<i>Icterus galbula</i>	Secure	-	-	-	X	-

Common Name	Scientific Name	AEP ¹	Wildlife Act ²	COSEWIC ³	SARA ⁴	Historic Observations ⁵	Observed During Field Assessment
Gray-crowned rosy-finch	<i>Leucosticte tephrocotis</i>	Secure	-	-	-	-	-
Purple finch	<i>Carpodacus purpureus</i>	Secure	-	-	-	-	-
House finch	<i>Carpodacus mexicanus</i>	Secure	-	-	-	-	-
Red crossbill	<i>Loxia curvirostra</i>	Secure	-	-	-	-	-
White-winged crossbill	<i>Loxia leucoptera</i>	Secure	-	-	-	-	-
Pine siskin	<i>Spinus pinus</i>	Secure	-	-	-	-	-
American goldfinch	<i>Spinus tristis</i>	Secure	-	-	-	-	-
Evening grosbeak	<i>Coccothraustes vespertinus</i>	Secure	-	Special Concern	Schedule 1- Special Concern	-	-
House sparrow	<i>Passer domesticus</i>	Exotic/Alien	-	-	-	-	-
Birds- Migratory							
Greater white-fronted goose	<i>Anser albifrons</i>	Secure	-	-	-	-	-
Snow goose	<i>Chen caerulescens</i>	Secure	-	-	-	-	-
Ross's goose	<i>Chen rossii</i>	Secure	-	-	-	-	-
Cackling goose	<i>Branta hutchinsii</i>	Accidental/Vagrant	-	-	-	-	-
Trumpeter swan	<i>Cygnus buccinator</i>	Sensitive	Special Concern	Not at Risk	-	X	-
Tundra swan	<i>Cygnus columbianus</i>	Secure	-	-	-	-	-
Eurasian wigeon	<i>Anas penelope</i>	Accidental	-	-	-	-	-
Greater scaup	<i>Aythya marila</i>	Secure	-	-	-	-	-
Surf scoter	<i>Melanitta perspicillata</i>	Secure	-	-	-	-	-
Long-tailed duck	<i>Clangula hyemalis</i>	Secure	-	-	-	-	-
Hooded merganser	<i>Lophodytes cucullatus</i>	Secure	-	-	-	-	-
Red-breasted merganser	<i>Mergus serrator</i>	Secure	-	-	-	-	-
Red-throated loon	<i>Gavia stellata</i>	Secure	-	-	-	-	-
Pacific loon	<i>Gavia pacifica</i>	Secure	-	-	-	-	-
American white pelican	<i>Pelecanus erythrorhynchos</i>	Sensitive	-	Not at Risk	-	-	-
Broad-winged hawk	<i>Buteo platypterus</i>	Sensitive	-	-	-	-	-
Rough-legged hawk	<i>Buteo lagopus</i>	Secure	-	-	-	-	-
Gyr Falcon	<i>Falco rusticolus</i>	Secure	-	Not at Risk	-	-	-
Sandhill crane	<i>Grus canadensis</i>	Sensitive	-	-	-	-	-
Black-bellied plover	<i>Pluvialis squatarola</i>	Secure	-	-	-	-	-
Semipalmated plover	<i>Charadrius semipalmatus</i>	Secure	-	-	-	-	-
Greater yellowlegs	<i>Tringa melanoleuca</i>	Secure	-	-	-	-	-
Lesser yellowlegs	<i>Tringa flavipes</i>	Secure	-	-	-	-	-
Whimbrel	<i>Numenius phaeopus</i>	Secure	-	-	-	-	-
Hudsonian godwit	<i>Limosa haemastica</i>	Sensitive	-	-	-	-	-
Ruddy turnstone	<i>Arenaria interpres</i>	Secure	-	-	-	-	-
Red knot	<i>Calidris canutus</i>	May be at Risk	-	Endangered	Schedule 1 - Endangered	-	-
Sanderling	<i>Calidris alba</i>	Secure	-	-	-	-	-
Semipalmated sandpiper	<i>Calidris pusilla</i>	Secure	-	-	-	-	-
Western sandpiper	<i>Calidris mauri</i>	Secure	-	-	-	-	-
Least sandpiper	<i>Calidris minutilla</i>	Secure	-	-	-	-	-
White-rumped sandpiper	<i>Calidris fuscicollis</i>	Secure	-	-	-	-	-
Baird's sandpiper	<i>Calidris bairdii</i>	Secure	-	-	-	-	-
Pectoral sandpiper	<i>Calidris melanotos</i>	Secure	-	-	-	-	-
Dunlin	<i>Calidris alpina</i>	Secure	-	-	-	-	-
Stilt sandpiper	<i>Calidris himantopus</i>	Secure	-	-	-	-	-
Buff-breasted sandpiper	<i>Tryngites subruficollis</i>	Secure	-	Special Concern	No Schedule – No Status	-	-
Short-billed dowitcher	<i>Limnodromus griseus</i>	Undetermined	-	-	-	-	-
Long-billed dowitcher	<i>Limnodromus scolopaceus</i>	Secure	-	-	-	-	-
Red-necked phalarope	<i>Phalaropus lobatus</i>	Secure	-	Special Concern	Schedule 1- Special Concern	-	-
Red phalarope	<i>Phalaropus fulicarius</i>	Accidental	-	-	-	-	-
Sabine's gull	<i>Xema sabini</i>	Secure	-	-	-	-	-

Common Name	Scientific Name	AEP ¹	Wildlife Act ²	COSEWIC ³	SARA ⁴	Historic Observations ⁵	Observed During Field Assessment
Bonaparte's gull	<i>Chroicocephalus philadelphia</i>	Secure	-	-	-	-	-
Mew gull	<i>Larus canus</i>	Secure	-	-	-	-	-
Herring gull	<i>Larus argentatus</i>	Secure	-	-	-	-	-
Thayer's gull	<i>Larus thayeri</i>	Secure	-	-	-	-	-
Iceland gull	<i>Larus glaucoides</i>	Accidental	-	-	-	-	-
Glaucous gull	<i>Larus hyperboreus</i>	Secure	-	-	-	-	-
Caspian tern	<i>Hydroprogne caspia</i>	Sensitive	-	-	-	-	-
Common tern	<i>Sterna hirundo</i>	Secure	-	Not at Risk	-	-	-
Eurasian collared-dove	<i>Streptopelia decaocto</i>	Exotic	-	-	-	-	-
Snowy owl	<i>Bubo scandiaca</i>	Secure	-	-	-	-	-
Northern hawk owl	<i>Surnia ulula</i>	Secure	-	Not at Risk	-	-	-
Black swift	<i>Cypseloides niger</i>	May Be at Risk	-	Endangered	Schedule 1 - Endangered	-	-
Black-backed woodpecker	<i>Picoides arcticus</i>	Sensitive	-	-	-	-	-
Hammond's flycatcher	<i>Empidonax hammondii</i>	Secure	-	-	-	-	-
Loggerhead shrike	<i>Lanius ludovicianus</i>	Sensitive	-	Threatened	Schedule 1- Threatened	-	-
Northern shrike	<i>Lanius excubitor</i>	Secure	-	-	-	-	-
Steller's jay	<i>Cyanocitta stelleri</i>	Secure	-	-	-	-	-
Gray-cheeked thrush	<i>Catharus minimus</i>	Undetermined	-	-	-	-	-
American pipit	<i>Anthus rubescens</i>	Secure	-	-	-	-	-
Bohemian waxwing	<i>Bombycilla garrulus</i>	Secure	-	-	-	-	-
Lapland longspur	<i>Calcarius lapponicus</i>	Secure	-	-	-	-	-
Snow bunting	<i>Plectrophenax nivalis</i>	Secure	-	-	-	-	-
Black-and-white warbler	<i>Mniotilta varia</i>	Secure	-	-	-	-	-
Nashville warbler	<i>Vermivora ruficapilla</i>	Secure	-	-	-	-	-
Mourning warbler	<i>Oporornis philadelphia</i>	Secure	-	-	-	-	-
Magnolia warbler	<i>Dendroica magnolia</i>	Secure	-	-	-	-	-
Bay-breasted warbler	<i>Dendroica castanea</i>	Sensitive	-	-	-	-	-
Chestnut-sided warbler	<i>Dendroica pensylvanica</i>	Secure	-	-	-	-	-
Blackpoll warbler	<i>Dendroica striata</i>	Secure	-	-	-	-	-
Black-throated blue warbler	<i>Dendroica caerulescens</i>	Accidental	-	-	-	-	-
Palm warbler	<i>Dendroica palmarum</i>	Secure	-	-	-	-	-
Black-throated green warbler	<i>Dendroica virens</i>	Sensitive	Special Concern	-	-	-	-
Canada warbler	<i>Wilsonia canadensis</i>	May Be at Risk	-	Threatened	Schedule 1 – Threatened	-	-
Yellow-breasted chat	<i>Icteria virens</i>	Secure	-	-	-	-	-
American tree sparrow	<i>Spizella arborea</i>	Secure	-	-	-	-	-
Lark sparrow	<i>Chondestes grammacus</i>	Secure	-	-	-	-	-
Lark bunting	<i>Calamospiza melanocorys</i>	Secure	-	Threatened	Schedule 1- Threatened	-	-
Harris's sparrow	<i>Zonotrichia querula</i>	Secure	-	Special Concern	No Schedule – No Status	-	-
Black-headed grosbeak	<i>Pheucticus melanocephalus</i>	Secure	-	-	-	-	-
Bobolink	<i>Dolichonyx oryzivorus</i>	Sensitive	-	Threatened	Schedule 1- Threatened	-	-
Rusty blackbird	<i>Euphagus carolinus</i>	Sensitive	-	Special Concern	Schedule 1 – Special Concern	-	-
Pine grosbeak	<i>Pinicola enucleator</i>	Secure	-	-	-	-	-
Cassin's finch	<i>Carpodacus cassinii</i>	Secure	-	-	-	-	-
Common redpoll	<i>Carduelis flammea</i>	Secure	-	-	-	-	-
Hoary redpoll	<i>Carduelis hornemanni</i>	Secure	-	-	-	-	-
Mammals							
Pygmy shrew	<i>Sorex hoyi</i>	Secure	-	-	-	-	-
Cinereous shrew	<i>Sorex cinereus</i>	Secure	-	-	-	-	-
Little brown myotis	<i>Myotis lucifugus</i>	May be at Risk	-	Endangered	Schedule 1 - Endangered	-	-
Northern myotis	<i>Myotis septentrionalis</i>	May be at Risk	-	Endangered	Schedule 1 - Endangered	-	-

Common Name	Scientific Name	AEP ¹	Wildlife Act ²	COSEWIC ³	SARA ⁴	Historic Observations ⁵	Observed During Field Assessment
Hoary bat	<i>Lasiurus cinereus</i>	Sensitive	-	-	-	-	-
Eastern red bat	<i>Lasiurus borealis</i>	Sensitive	-	-	-	-	-
Long-eared myotis	<i>Myotis evotis</i>	Secure	-	-	-	-	-
Big brown bat	<i>Eptesicus fuscus</i>	Secure	-	-	-	-	-
Silver-haired bat	<i>Lasionycteris noctivagans</i>	Sensitive	-	-	-	-	-
Western small-footed myotis	<i>Myotis ciliolabrum</i>	Sensitive	-	-	-	-	-
Snowshoe hare	<i>Lepus americanus</i>	Secure	-	-	-	-	-
White-tailed jackrabbit	<i>Lepus townsendii</i>	Secure	-	-	-	-	-
Mountain cottontail	<i>Sylvilagus nuttallii</i>	Secure	-	-	-	-	-
Least chipmunk	<i>Tamias minimus</i>	Secure	-	-	-	-	-
Red squirrel	<i>Tamiasciurus hudsonicus</i>	Secure	-	-	-	-	-
Richardson's ground squirrel	<i>Spermophilus richardsonii</i>	Secure	-	-	-	-	-
Eastern gray squirrel	<i>Sciurus carolinensis</i>	Exotic/Alien	-	-	-	-	-
American beaver	<i>Castor Canadensis</i>	Secure	-	-	-	-	-
Northern pocket gopher	<i>Thomomys talpoides</i>	Secure	-	-	-	-	-
North American porcupine	<i>Erethizon dorsatum</i>	Secure	-	-	-	-	-
Deer mouse	<i>Peromyscus maniculatus</i>	Secure	-	-	-	-	-
House mouse	<i>Mus musculus</i>	Exotic/Alien	-	-	-	-	-
Meadow vole	<i>Microtis pennsylvanicus</i>	Secure	-	-	-	-	-
Southern red-backed vole	<i>Clethrionomys gapperi</i>	Secure	-	-	-	-	-
Western jumping mouse	<i>Zapus princeps</i>	Secure	-	-	-	-	-
Coyote	<i>Canis latrans</i>	Secure	-	-	-	-	-
Least weasel	<i>Mustela nivalis</i>	Secure	-	-	-	-	-
Short-tailed weasel	<i>Mustela erminea</i>	Secure	-	-	-	-	-
Long-tailed weasel	<i>Mustela frenata</i>	May be at Risk	-	-	-	-	-
Mink	<i>Neovision vison</i>	Secure	-	-	-	-	-
Muskrat	<i>Ondatra zibethicus</i>	Secure	-	-	-	-	-
Striped skunk	<i>Mephitis mephitis</i>	Secure	-	-	-	-	-
Northern racoon	<i>Procyon lotor</i>	Secure	-	-	-	-	-
Mule deer	<i>Odocoileus hemonius</i>	Secure	-	-	-	-	-
White-tailed deer	<i>Odocoileus virginianus</i>	Secure	-	-	-	-	-
Elk	<i>Cervus elaphus</i>	Secure	-	-	-	-	-
Moose	<i>Alces alces</i>	Secure	-	-	-	-	-
Bobcat	<i>Lynx rufus</i>	Sensitive	-	-	-	-	-
Grizzly Bear	<i>Ursus arctos</i>	May be at Risk	Endangered	Special Concern	Schedule 1- Special Concern	X	-

AEP- Alberta Environment and Parks
COSEWIC- Committee on the Status of Endangered wildlife in Canada
SARA- Species at Risk Act
¹AEP 2018
²Province of Alberta 2018
³COSEWIC 2018
⁴Government of Canada 2018
- Not assessed

REFERENCES

- Alberta Environment and Parks (AEP). 2018a. *Fish and Wildlife Internet Mapping Tool (FWIMT)*.
https://maps.alberta.ca/FWIMT_Pub/?TermsOfUseRequired=true&Viewer=FWIMT_Pub
- Alberta Environment and Parks (AEP). 2018b. *General Status of Alberta Wild Species 2015*. Fish and Wildlife Division. Edmonton, Alberta. Updated on August 30, 2018.
<http://aep.alberta.ca/fish-wildlife/species-at-risk/albertas-species-at-risk-strategy/general-status-of-alberta-wild-species/default.aspx>
- Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2018. *Canadian Wildlife Species at Risk*. Gatineau, Quebec. Updated August 10, 2018.
http://www.sararegistry.gc.ca/sar/index/default_e.cfm
- Government of Canada. 2018. *Species at Risk Act*. S.C. 2002, c. 29. Published by the Minister of Justice. Last Amended on May 30, 2018. <http://laws-lois.justice.gc.ca/PDF/S-15.3.pdf>
- Province of Alberta. 2018. *Wildlife Act*. Revised Statutes of Alberta 2000, Chapter W-10. Queen's Printer. Edmonton, Alberta. Current as of February 20, 2018.
http://www.qp.alberta.ca/1266.cfm?page=W10.cfm&leg_type=Acts&isbncln=9780779778911

APPENDIX I

Wildlife Survey Results

TABLE I1

Wildlife Species Detected During the Breeding Bird Survey

Burnco Rock Products Ltd.

West Cochrane #2 Gravel Pit

Common Name	Total Number Observed	Observation in 0-50 m	Observation in 50-100 m	Total Number in 100 m	Observation outside 100 m	Observation after 5 minutes
American Crow	3	0	2	2	1	0
American Robin	6	0	1	1	5	0
Barn Swallow	26	0	0	0	26	0
Brown-Headed Cowbird	15	3	12	15	0	0
Clay-Colored Sparrow	17	4	8	12	5	0
Common Raven	2	0	1	1	0	1
Eastern Kingbird	21	0	20	20	1	0
European Starling	2	0	2	2	0	0
Horned Lark	8	4	1	5	3	0
House Wren	1	0	0	0	1	0
Least Flycatcher	5	1	1	2	3	0
Mountain Bluebird	1	0	0	0	1	0
Mourning Dove	2	0	1	1	1	0
Nelson's Sharp-Tailed Sparrow	1	0	1	1	0	0
Red-Eyed Vireo	2	1	0	1	1	0
Red-Winged Blackbird	1	0	0	0	1	0
Savannah Sparrow	8	5	1	6	2	0
Song Sparrow	6	1	0	1	5	0
Sprague's Pipit	2	0	1	1	1	0
Tree Swallow	10	2	1	3	7	0
Unknown Blackbird	11	0	0	0	11	0
Vesper Sparrow	25	4	5	9	16	0
Warbling Vireo	1	0	0	0	1	0
Western Meadowlark	10	0	3	3	7	0
White-Crowned Sparrow	2	0	0	0	2	0
White-Throated Sparrow	1	0	0	0	1	0
Yellow Warbler	4	0	1	1	3	0
Grand Total	193	25	62	87	105	1

Notes:**Bold** - Species at risk

TABLE I2

Wildlife Species Detected During the Breeding Bird Survey

Burnco Rock Products Ltd.
West Cochrane #2 Gravel Pit

Common Name	Scientific Name	AEP Status ¹	COSEWIC Status ²	SARA Status ³	Number Observed
Birds					
American Crow	<i>Corvus brachyrhynchos</i>	Secure	—	—	3
American Robin	<i>Turdus migratorius</i>	Secure	—	—	6
Barn Swallow	<i>Hirundo rustica</i>	May be at Risk	Special Concern	Schedule 1 - Threatened	26
Brown-Headed Cowbird	<i>Molothrus ater</i>	Secure	—	—	15
Clay-Colored Sparrow	<i>Spizella pallida</i>	Secure	—	—	17
Common Raven	<i>Corvus corax</i>	Secure	—	—	2
Eastern Kingbird	<i>Tyrannus tyrannus</i>	Sensitive	—	—	21
European Starling	<i>Sturnus vulgaris</i>	Exotic	—	—	2
Horned Lark	<i>Eremophila alpestris</i>	Secure	—	—	8
House Wren	<i>Troglodytes aedon</i>	Secure	—	—	1
Least Flycatcher	<i>Empidonax minimus</i>	Secure	—	—	5
Mountain Bluebird	<i>Sialia currucoides</i>	Secure	—	—	1
Mourning Dove	<i>Zenaida macroura</i>	Secure	—	—	2
Nelson's Sparrow	<i>Ammodramus nelsoni</i>	Secure	Not At Risk	—	1
Red-Eyed Vireo	<i>Vireo olivaceus</i>	Secure	—	—	2
Red-Winged Blackbird	<i>Agelaius phoeniceus</i>	Secure	—	—	1
Savannah Sparrow	<i>Passerculus sandwichensis</i>	Secure	—	—	8
Song Sparrow	<i>Melospiza melodia</i>	Secure	—	—	6
Sprague's Pipit	<i>Anthus spragueii</i>	Sensitive	Threatened	Schedule 1 - Threatened	2
Tree Swallow	<i>Tachycineta bicolor</i>	Secure	—	—	10
Unknown Blackbird	—	—	—	—	11
Vesper Sparrow	<i>Pooecetes gramineus</i>	Secure	—	—	25
Warbling Vireo	<i>Vireo gilvus</i>	Secure	—	—	1
Western Meadowlark	<i>Sturnella neglecta</i>	Secure	—	—	10
White-Crowned Sparrow	<i>Zonotrichia leucophrys</i>	Secure	—	—	2
White-Throated Sparrow	<i>Zonotrichia albicollis</i>	Secure	—	—	1
Yellow Warbler	<i>Dendroica petechia</i>	Secure	—	—	4

Notes:

- ¹ - Alberta Environment and Parks (2022)
² - Committee on the Status of Endangered Wildlife in Canada (2021)
³ - *Species at Risk Act* (Government of Canada 2017)