GREENWOOD ESTATES
AREA STUCTURE PLAN

LOT 1 BLOCK 15 PLAN 0614136
IN
SW 1/4 – 21 – 9 – 22 – 4
IN
TOWN OF COALHURST

Prepared for: **Greenwood Homes**

Prepared by: **MARTIN GEOMATIC CONSULTANTS LTD.**

PROJECT 166773CE

January 2017

Consolidated to Bylaw No. 433-22, August 2023

Town of Coalhurst Greenwood Estates Area Structure Plan – Amendments

Bylaw No.	Amendment Description	Legal Description	Passed
433-22	Amendment to increase the maximum driveway width from 5.5 metres (18 feet) to 5.8 metres (19 feet).		15-Aug-2023

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1. INTRODUCTION

a. PURPOSE OF THE PLAN

i. The purpose of the Greenwood Estates Area Structure Plan (ASP) is to provide a comprehensive planning framework for development of the land within a portion of S.W. ¼ Sec. 21-9-22-W4. The Plan Area is located in the Town of Coalhurst and is shown on **Figure 1.** Prior to consideration of subdividing or re-subdividing a property, the Town of Coalhurst requires the preparation of an Area Structure Plan to address all planning issues related thereto. The purpose of this area structure plan is thus to provide all pertinent information to the Town and its advisors that will enable subdivision of the subject property.

b. BACKGROUND TO THE AREA STRUCTURE PLAN

i. The subject property containing approximately 9.78 acres (3.95 ha) more or less is proposed for re-zoning from Residential (R) to Small Lot Residential (SLR). This will allow the developer to proceed with subdivision of the plan area into smaller parcels with a minimum lot size of 11.0 meters wide by 30.5 meters long and 334.4 square meters in area.

c. THE APPROVAL PROCESS

i. The Town of Coalhurst requires submission of planning documents that are of sufficient detail and clarity to permit comprehensive review by the various agencies, government departments, and utility companies which provide community planning advice to the Town.

ii. The plan is submitted for approval according to provincial statutory requirements. This plan will also support a land use reclassification pursuant to The Town of Coalhurst Land Use Bylaw #354-12.

d. PLAN PREPARATION

i. PRELIMINARY CONSULTATION

(a) Prior to commencing the preparation of the area structure plan document, Martin Geomatic Consultants Ltd.(MGCL) met with

(i) the landowner of the proposed plan area,

(ii) the Town of Coalhurst staff,

(iii) the Town's planning representatives (ORRSC),

(iv) the Town's engineering representatives (MPE Engineering Ltd.),

(v) Alberta Environment and Parks staff, and

(vi) ATCO Gas Staff.

(b) MGCL assessed the "as-built" situation to identify any issues that need to be addressed in undertaking the residential subdivision. Issues that were identified, relating to existing services and access will be discussed under the appropriate headings of this plan.

e. LEGISLATIVE FRAMEWORK

i. THE MUNICIPAL GOVERNMENT ACT

(a) The Greenwood Estates Area Structure Plan has been produced in accordance with Section 633 of the Municipal Government Act. It is the intention of this plan to create a framework for the subdivision of a portion of S.W. ¼ Sec. 21-9-22-W4 into Small Lot Residential classified area. In particular, this document will outline

(i) the sequence of development,

(ii) the proposed land uses,

(iii) the proposed population density,

(iv) the access and circulation,

(v) the location of public utilities, and

(vi) other related matters.

ii. TOWN LAND USE BYLAW

(a) The Small Lot Residential Land Use District (SLR) is intended to provide for a high quality residential environment with an appropriate range of housing types that comply with standards outlined in the land use district.

(b) The minimum lot size is 334.4 square meters (3,600 square feet).

(c) The minimum lot width is 11.0 meters (36 feet).

(d) The minimum lot depth is 30.5 meters (100 feet).

(e) The minimum front yard setback is 6.1 meters (20 feet).

(f) The minimum side yard setback is 1.2 meters (4 feet).

(g) The minimum rear yard setback is 5.5 meters (18 feet).

(h) Additional requirements are outlined in Land Use Bylaw No. 354-12.

(i) Additional requirements of the Land Use Bylaw will be noted in subsequent sections of the plan where necessary.

f. INTERPRETATION

i. This document shall be referred to as "*The Greenwood Estates Area Structure Plan"*.

ii. All terms referred to in this Bylaw shall have the same meaning as in the Municipal Government Act, the Municipal Development Plan or the Land Use Bylaw unless otherwise indicated.

2. THE PLAN AREA

a. LOCATION AND DEFINITION OF PLAN AREA

i. The plan area is located in the Town of Coalhurst within S.W. ¼ Sec. 21-9-22-W4. It is bordered on the north and south by existing residential developments; on the east by a Lethbridge Northern Irrigation District (LNID) lateral canal; and on the west by Canada Pacific Railway (CPR) and Provincial Highway #3 *(refer to **Figure 2**)*. The plan area includes one land parcel: Lot 1 Block 15 Plan 0614136, 3.958 hectares (9.78 acres).

b. GENERAL PHYSICAL DESCRIPTION

I. The site is relatively flat with prairie grass and weed cover, and drains north and east. There are no building structures in the plan area.

3. PLAN GOALS AND OBJECTIVES

a. PLAN GOALS

i. The Greenwood Estates Area Structure Plan will respond to the needs, issues and requirements identified by the owners, the Town of Coalhurst as well as those agencies and organizations having an interest in the planning of this area.

ii. When adopted by the Town Council, this Area Structure Plan will create the framework for subdividing and developing the subject property.

iii. This document will function as the required plan and as such will outline

(a) the sequence of development,

(b) the proposed land use,

(c) the proposed lot layout,
(d) the access and circulation,
(e) the location of public utilities, and
(f) other related matters.

b. PLAN OBJECTIVES

i. The Greenwood Estates Area Structure Plan will adhere to the following objectives:
(a) create lots with a minimum size of 334.4 square meters,
(b) institute a storm water management system for the planned development,
(c) utilize potable water from the Town of Coalhurst distribution system,
(d) convey wastewater to the Town of Coalhurst collection system, and
(e) provide a public road network for access and circulation for the development.

4. SITE ANALYSIS

a. SITE CHARACTERISTICS

i. The total plan area is 3.958 hectares (9.78 acres). The land ownership Certificate of Title is included in the attached Appendix.

ii. Access to the plan area is from three existing municipal roads (Aspen Road and Aspen Rise to the north, and Aspen Road to the south) which are local road classification, and are paved and stubbed at or near the property boundary.

iii. LNID's canal runs along the east boundary of the plan area and serves as a buffer that separates the plan area from the large parcel of undeveloped land located in the central area of Town.

iv. The north boundary of the plan area borders a gravel lane that provides rear access to the lots along Spruce Drive. The western portion of the lane is located in public property while the east portion of the lane is located on private land within the plan area. A man-made ditch runs parallel to the lane draining surface water from east to west and into the Towns storm sewer at Aspen Rise.

v. The west boundary of the plan area borders a topsoil berm that provides a buffer from the CPR line and the Highway.

vi. The south boundary of the plan area borders the rear property lines of the lots along Sundance Dr.

b. SOILS

i. According to the Alberta Soils Information System, the site's soils are characterized as "Orthic Dark Brown Chernozem on medium textured ([loam], [silt-loam]) sediments deposited by wind and water".

ii. A Confirmatory Sampling Program was conducted by Tetra Tech EBA (TT) and is included in the Appendix. Two test pits were dug to 1.5 meters depth at the west end of the site, which found 0.3 meters of topsoil above clay till with no evidence of groundwater to 1.5 meters in depth. The clay is described as undisturbed, silty with trace sand, damp and very stiff.

iii. A Geotechnical Evaluation was completed by Tetra Tech EBA (TT) and is included in the Appendix. Three boreholes were drilled on-site to depths of 6.1 to 6.6 meters, which found topsoil above clay fill, clay, and clay till. Groundwater depths were observed at 3.6 to 3.7 meters.

c. TOPOGRAPHY

i. The site is relatively flat with ground slopes at 0.5 % to 5 %. The high point in the plan area is located at the southeast corner at elevation 936.25 m, and the low point is at 932.40 m at the southwest corner. A slight ridge splits the site into two general drainage areas as shown in **Figure 3**:

(a) Northwest: drains northerly to a manmade ditch flowing westerly along the south side of the gravel lane, in the north area of the site. At the west end of the channel there is an existing catchbasin that connects to the Town's storm sewer system at Aspen Rise.

(b) Southeast: drains easterly to a depression that is located adjacent to the LNID canal and behind the lots along Sundance Drive.

d. WATER AND HYDROLOGY

i. There are no natural bodies of water within the plan area.

ii. A LNID canal exists along the east side of the site. This canal flows southerly and supplies irrigation water to the City of Lethbridge.

iii. Storm runoff from the plan area is currently directed to two outlets and conveyed offsite. The north outlet is the Town's storm sewer system at Aspen Rise and the east outlet is overland sheet flow to the Canal Right of Way.

iv. Groundwater was observed at depths of 3.6 to 3.7 meters below the surface (elevations 929.7m to 929.9m) at the time of borehole drilling. Ground water was not observed at one location to a depth of 6.6m (refer to the attached Appendix).

e. HABITAT AND VEGETATION

i. The plan area consists mainly of mixed grasses and weeds on clay that is covered with about 0.2m of organic topsoil. The plan area is isolated from the natural habitat due to the surrounding residential developments and the highway, rail line and canal.

f. ENVIRONMENTAL, HISTORICAL AND ARCHAEOLOGICAL SIGNIFICANCE

i. The "Phase 1 Environmental Site Assessment Plan 0614136, Block 15, Lot 1 and Lot 2, Coalhurst, Alberta", TT, February 2016, and "Confirmatory Sampling Program, Lot 1, Block 15, Plan 0614136, Coalhurst, Alberta", TT, April 2016 (refer to the attached Appendix) indicates that:

(a) The site was historically used as cultivated land.

(b) The site was owned by various coal mining companies from 1916 to 1942, however, no evidence of coal mining operations has been found.

(c) The site was owned by various private investors from 1942 until 2006.

(d) The site was owned by the Town of Coalhurst from 2015 to 2016.

(e) A rail line may have transected the western portion of the plan area, however, confirmatory sampling found no evidence of coal or shale fill.

(f) Analytical results of sampling indicate that concentrations of metals and hydrocarbons are within allowable limits.

(g) No evidence of environmental impairment associated with the site.

g. EXISTING LAND USE

i. The site is currently undeveloped with no buildings.

ii. A temporary fence extends around portions of the property.

iii. The properties surrounding the plan area are zoned as followed *(refer to **Figure 4**)*:

1. North (Spruce Dr.): Residential (R).
2. East (LNID): Parks and Recreation (PR).
3. South (Sundance): Small Lot Residential (SLR), Residential (R), Multi-Unit Residential (MUR).
4. West (CPR / Hwy): Parks and Recreation (PR).

5. CONSTRAINTS & OPPORTUNITIES

a. Constraint Evaluation

i. Soil Capability for Residential Development

(a) A geotechnical investigation was completed to provide information on the ground and/or sub-surface characteristics that are necessary for determining the general suitability of the proposed development. This investigation found no information that would indicate that the site is not suitable for development. This report is included in the Appendix.

ii. Topography

(a) The gentle slope of the site will require careful grading of the lots as well as the swales/ditches to ensure proper drainage is achieved and runoff is directed towards the designated discharge points within the storm water management system.

iii. Traffic Impact & Access Considerations

(a) The plan area is located adjacent to Highway #3 approximately 5 km driving distance northwest of Lethbridge City limits.

(b) Access to the plan area will be via three existing municipal local roads which will be extended through the development.

(c) Due to the infill nature of the site, it is expected that Town administration has anticipated the ultimate development of the plan area and has likely accounted for the resulting traffic impact in the overall transportation plan of the Town. Therefore a Traffic Impact Analysis (TIA) is not necessary.

iv. AGRICULTURAL CONSIDERATIONS

(a) The proposed development of the plan area will not constrain any existing agricultural land use.

v. NATURAL RESOURCE DEVELOPMENT

(a) There is no known natural resource development within the vicinity of the study area which can either restrict or be impacted by the proposed subdivision development.

b. DEVELOPMENT OPPORTUNITIES

i. LOCATION

(a) The proposed development is located within the Town of Coalhurst, which offers access to educational, commercial, recreational and community services.

(b) The proposed development is located 5 km from the City of Lethbridge which is the economic center of the area.

ii. HOUSING CHOICE

(a) The proposed development provides for a type of residential land use that would allow families to build and live in a community offering urban lifestyle.

iii. LAND USE RE-CLASSIFICATION

(a) The Town Land Use Bylaw Amendment will be required to re-designate the plan area for a small lot residential development.

iv. EASE OF DEVELOPMENT

(a) All of the basic utilities are at or near the site boundary which will make it generally simple and inexpensive to service and develop the new lots.

6. PROPOSED LAND USE & DESIGN

a. PROPOSED LAND USE

i. A total of approximately 53 lots each with a minimum size of 334.4 square meters will be created on the proposed development which is proposed to be re-zoned as a small lot residential area shown on **Figure 4**. The public road right of ways will extend through the development from Aspen Road and Aspen Rise. The stormwater detention ponds will be located at the east end

and west end of the development and be rezoned as parks and recreation land.

ii. The proposed lot sizes are intended to create a transition from the smaller southern lots to the larger northern lots as follows (*See **Figure 5***):

(a) South Boundary:

The existing small lots directly south of the plan area (along Sundance Dr.) are zoned SLR and are typically 11.0 meters wide, which is the minimum size in the zoning bylaw. These existing small lots will back directly on to the proposed southern lots in the development area which are typically 12.2 meters wide or 1.2 m wider than the existing small lots. Along the southern boundary of the plan area there are 29 existing lots zoned SLR, 1 zoned R, and 1 Multi-Unit Residential (MUR). There are 28 proposed SLR lots included within the development along this boundary. The proposed lots are typically 34.71 meters deep which is 4.21 meters greater than the minimum depth of 30.50 meters. A concrete drainage swale is anticipated at the south boundary, running parallel to the common rear property lines between the existing lots and the proposed lots. The swale will be located in a drainage easement and will convey runoff from the back of lots and discharge to the designated outlets at the roadways and parks. The swale will also provide grade control for these lots.

(b) North Boundary:

The existing lots to the north of the development (along Spruce Dr.) are zoned Residential (R) and are typically 15.0 m wide. There is a lane along the rear of these lots with existing garages along this boundary which back onto both an existing lane and onto private property. The existing gravel lane does not meet current standards. The proposed development includes a paved lane along the entire length of the North boundary and dedicated land to Public Right of Way. This will improve the access and drainage conditions and provide benefits to the established residents. The proposed lots backing onto the lane within the development are typically 12.8 meters wide, whereas the existing lots backing on to the lane are

generally 15.0 meters wide. There are 22 existing lots that border the lane and there are 22 lots proposed along the lane.

b. PHASING
   i. The Greenwood Estates subdivision will be undertaken in one single phase of construction.

c. DENSITY AND POPULATION
   i. The housing density within the proposed development comprises 53 lots or 13 units per hectare of net area,
   ii. Based on an average occupancy of 3 persons per household, the population within the plan area is estimated to be approximately 159 persons.

d. RESERVE REQUIREMENTS
   i. MUNICIPAL RESERVE
      (a) The land within the proposed area structure plan dedicated for municipal reserve is located at the east and west boundaries. Additional municipal reserve may be dedicated as cash-in-lieu to the Town of Coalhurst as determined by the subdivision plan.
   ii. ENVIRONMENTAL
      (a) There is no apparent need for environmental reserve within the plan area.

e. TRANSPORTATION
   i. SITE ACCESS AND CIRCULATION
      (a) Access into the proposed development area will be on Aspen Road and Aspen Rise. The extension of Aspen Road will provide a road connection between the Sundance community and the established neighborhoods including the downtown to the north. The Aspen Road connection will also provide a more direct route for vehicles travelling between the core area of the Town to the 45 Avenue (East) entrance to the Town. The proposed road network is shown on **Figure 6**.
   ii. SITE PARKING
      (a) The Town of Coalhurst is considered a “Bedroom Community” with the majority of the Town’s residents commuting to the City of Lethbridge daily for work and play. It is expected that there is a higher than average vehicle

per capita ratio in Coalhurst due to the commuter population. Therefore parking for the residents and their visitors in the proposed development is given special attention to address the expected high demand for vehicle parking. The following solutions are proposed to address parking in the plan area (*See **Figure 6.1***):

ø·÷Off-Street Private Parking:

All lots will include a double attached front garage with a double wide driveway. This accounts for 2 off-street parking spaces per lot. All front driveways will be 5.8 meters wide and a minimum length of 6.7 meters. The Northern lots which back onto the lane may also include a detached rear garage and/or driveway for additional parking. There are 24 lots with rear lane access.

ø··÷ On Street Public Parking:

Wherever possible, driveways will be paired and staggered such that each common side property line will have either two driveways or no driveways. The side with no driveways will typically allow for one or two parking spaces on the street which are not blocking the driveway access.

ø···÷ Parking Statistics:

Based on the proposed concept plan and estimated population of 159 persons, the following summarizes the parking counts for the plan area (front attached garages, rear parking pads, and rear detached garages would be in addition to this):

- Off-street private parking:
  - 106 spaces, 2 spaces per lot.
- On-street public parking:
  - 74 spaces, 1.4 spaces per lot.
- Combined total parking:
  - 180 spaces, 3.4 spaces per lot, 1.1 spaces per person.

f. SERVICING

i. WATER DISTRIBUTION

(a) Domestic Water and Fire Protection Requirement for ASP Area (*See **Figure 7***):

(i) The Town of Coalhurst is supplied with potable water from the City of Lethbridge through a pressurized transmission main.

(ii) The treated water requirements for the subdivision will be supplied by the Town of Coalhurst with extensions to the water distribution system. The proposed development will give an improvement to the Towns water network by providing an additional looped connection between Sundance via Aspen Road. This will provide redundancy and an improved level of service to the communities surrounding the plan area.

(iii) Fire protection will be by provided by the Town of Coalhurst volunteer Fire Department and may also be provided by the City of Lethbridge forces. Hydrants will be included with the proposed development per current standards.

ii. WASTEWATER

(a) Wastewater Collection Requirement for ASP Area (*Refer to **Figure 8***):

(i) The City of Lethbridge provides sewage treatment and disposal for the Town of Coalhurst. A pressurized forcemain conveys raw sewage from the Town to the City's wastewater treatment plant.

(ii) Wastewater collection will be provided in the new development through extensions to the Town's gravity mains at Aspen Road and Aspen Rise.

iii. STORM WATER MANAGEMENT

(a) EXISTING CONDITION

(i) The plan area includes two existing drainage catchments which are comprised of the both land within the development and land outside of the development. Runoff from outside of the development (offsite runoff) will be accommodated in the stormwater management system

to be built with the proposed development. The existing catchments are described as:

- Northwest: is 4.0 hectares in area which includes the majority of the land within the plan area as well as the rear lot drainage from Sundance Drive. Runoff presently drains to a manmade ditch flowing westerly along the south side of the northern gravel lane and into an existing catchbasin that connects to the Town's storm sewer system at Aspen Rise.
- Southeast: is 1.3 hectares in area for which the runoff presently drains easterly to an offsite depression located adjacent to the LNID canal.

(b) PROPOSED DRAINAGE CONCEPT

(i) The proposed stormwater management concept includes both minor and major storm systems. The minor system consists of catchbasins, manholes and pipes, and conveys runoff resulting from a 1 in 5 year storm event. The major system handles runoff from a 1 in 100 year storm, which includes the overland flow routes along the roads and lanes and the stormwater detention facilities.

(ii) Two stormwater detention facilities or dry ponds are proposed in the development. The purpose of the dry ponds is to mitigate the effects of runoff resulting from developing the land and increasing the hard surfaces, such as roads, driveways and roofs. The dry ponds store the runoff during storm events and attenuate flows, which lowers the peak flow rate leaving the site. The two ponds are located at the west end and the east end of the development. The ponds are normally empty and dry to function as parkland for the surrounding residents.

(iii) The dry ponds drain to the north at a controlled release rate in to the Town's storm sewer system at the designated locations at Aspen Rise and Aspen Road. From here the storm sewer flows easterly and into a wet pond where water quality improvements are achieved before ultimately discharging in to the Oldman River. The Stormwater

management system is outlined in **Figure 9** and in **Figure 10**.

(iv) In addition to the pond storage volumes that are required to service the development area, it may be possible to provide additional storage in the dry ponds to the Town's benefit.

(c) SITE GRADING

(i) The subdivision is graded to be consistent with the overall stormwater management system. Individual lots are graded such that all surface runoff is directed to the roads, swales and lanes which carry the stormwater runoff into the stormwater detention facilities and towards the designated outlets. The site grading plan is shown on **Figure 11**.

g. UTILITIES

i. ELECTRICITY

(a) Enmax is the electricity provider for the Town of Coalhurst and the distributor is Fortis Alberta. All necessary applications for the detailed design and installation of electric utilities will be submitted to Fortis for their approval.

ii. NATURAL GAS

(a) Natural gas is available through ATCO Gas. An existing domestic gas line is located within the plan area running along the North property boundary.

iii. TELECOMMUNICATIONS/CABLE SERVICE

(a) Telus and Shaw Communications provides telephone and cable service for the area. Cellular phone service is also available at the site.

iv. SOLID WASTE MANAGEMENT

(a) Waste management services are provided by the Town of Coalhurst.

(b) Weekly garbage bin collection is provided.

(c) Basic recycling is available to drop off at the Town depot.

h. PROTECTIVE SERVICES

i. FIRE PROTECTION

(a) The Town of Coalhurst has a volunteer Fire Department stationed in the Town that can be called upon if needed. Further fire protection may provided by the City of Lethbridge forces.

ii. POLICE PROTECTION

(a) Policing in the Town of Coalhurst is provided by the R.C.M.P. which has detachments located in the City of Lethbridge.

7. DEVELOPMENT CONTROL

a. Purchasers must apply for development approval according to the process in effect for the appropriate Land Use District in the Town of Coalhurst Land Use Bylaw # 354-12.

8. DEVELOPMENT AGREEMENT

a. The Developer will enter into a Development Agreement with the Town of Coalhurst regarding the proposed development.

9. BUILDING CONTROL STANDARDS

a. INDIVIDUAL SITE DEVELOPMENT

i. Individual site development will utilize a basic level of control to achieve quality within the development site as well as to protect property values.

b. BUILDING CONTROL ELEMENT

i. HOUSING FORM

(a) Single detached houses will be the dwelling type allowed within the development,

(b) Move-in homes and modular homes will not be allowed within the development.

ii. HOUSE SIZE

(a) Primary dwellings within the subdivision will be required to have a minimum footprint of 800 square feet (74.3 m²) in area.

iii. SITE DESIGN FEATURES

(a) HOUSE DESIGN

(i) Residents will be encouraged to work with a designer in the planning and design of their homes to ensure that a consistent level of development is achieved,

(ii) Proper setbacks are to be maintained per the Town of Coalhurst Land Use Bylaws.

(iii) All houses will include a double attached front garage and double wide

front driveway with a maximum width of 5.8 meters.

(b) ACCESSORY BUILDINGS

(i) Accessory buildings, such as garages may be allowed subject to the appropriate control guidelines and approval by the Town of Coalhurst development authority.

(c) BUILDING MATERIALS

(i) Residents will be encouraged to co-ordinate the finishing materials for their homes in order to achieve a unified appearance within the development site.

10. IMPLEMENTATION

a. This Area Structure Plan will become a Bylaw of the Town of Coalhurst.
b. Development applications, within the boundaries of the plan area, must comply with the requirements of the respective land use districts for which they are proposed.
c. Building permits must be reviewed through a safety codes process approved by the Town of Coalhurst.
d. The developer of Greenwood Estates subdivision will establish a level of architectural standards and development limitations in order to achieve the desired results within the proposed subdivision. These standards and limitations are beyond the normal statutory requirements of the Town of Coalhurst and will thus be administered by either the Developers or agents acting on their behalf and within their legal authority.
e. The Town of Coalhurst may utilize other bylaws and policies that will regulate aspects of activity within the boundaries of the Area Structure Plan.

FIGURES (MAPS)

Greenwood Estates

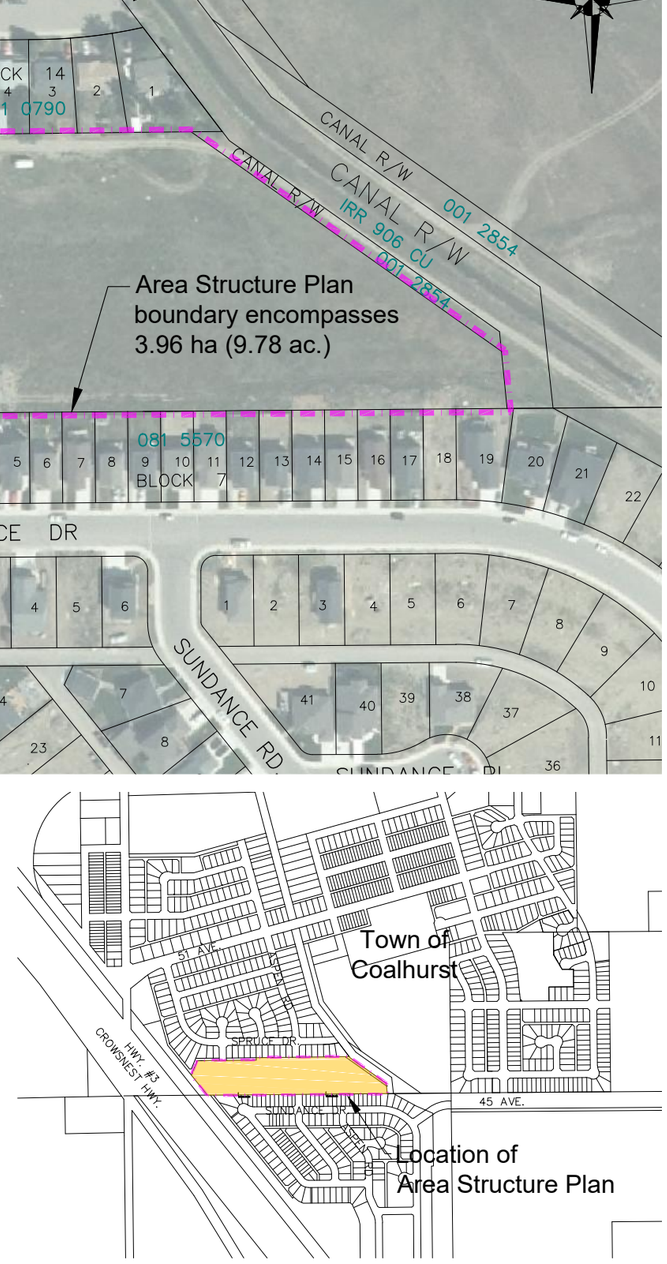
AREA STRUCTURE PLAN

LEGEND:

ASP BOUNDARY

1.0	GENERAL LOCATION PLAN
2.0	LAND OWNERSHIP MAP
3.0	EXISTING LAND CONDITIONS
4.0	LAND USE CONCEPT
5.0	LOT LAYOUT
6.0	ROAD LAYOUT
6.1	PARKING
7.0	WATER DISTRIBUTION
8.0	SANITARY SEWER SYSTEM
9.0	STORM MINOR SYSTEM
10.0	STORM MAJOR SYSTEM
11.0	SITE GRADING PLAN

Area Structure Plan boundary encompasses 3.96 ha (9.78 ac.)



TOWN MAP

GENERAL LOCATION PLAN
FIGURE 1.0

MARTIN GEOMATIC CONSULTANTS LTD

SCALE:	1:2,000
DRAWN:	RJM
DATE:	Dec. 02, 2016
JOB #:	166773CE

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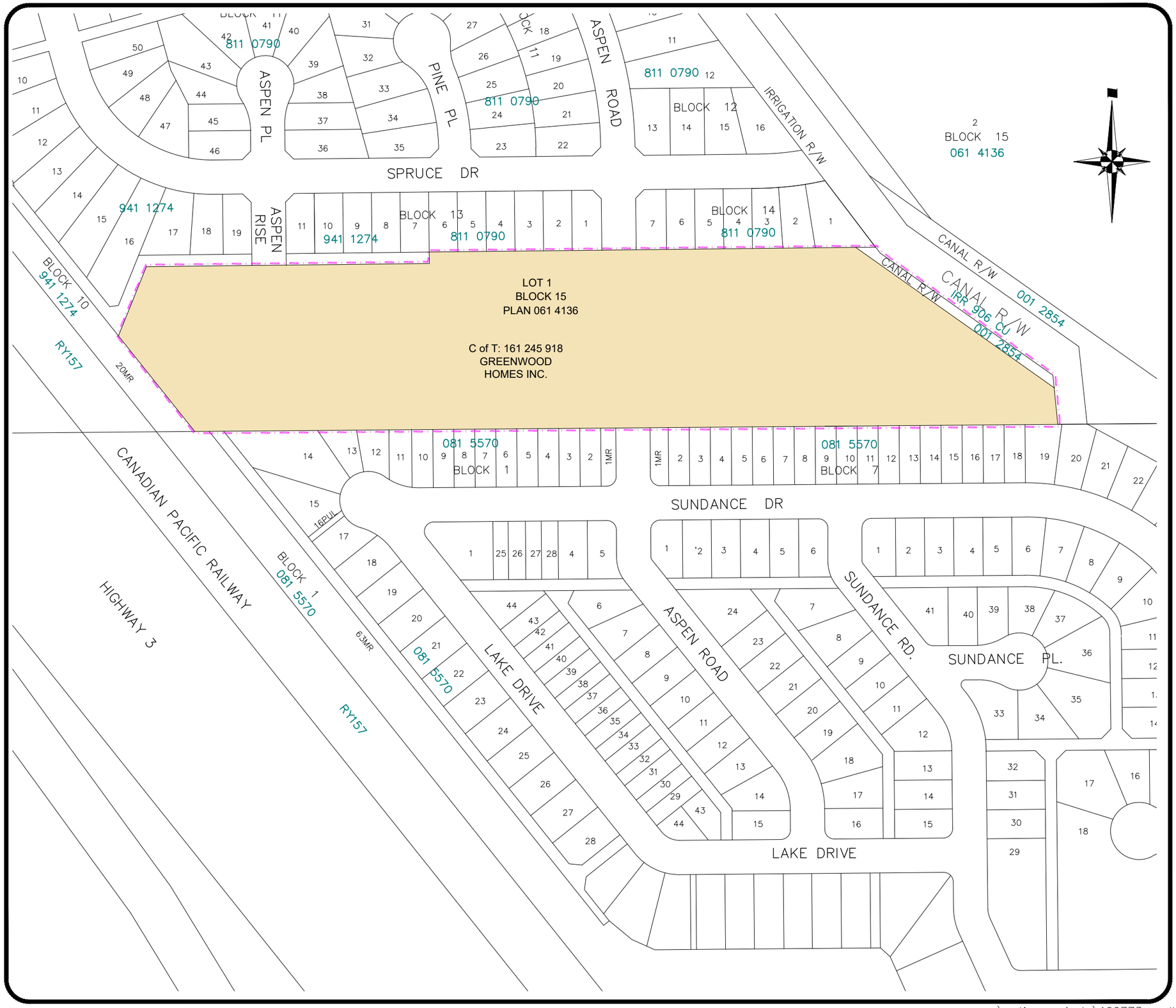

Greenwood Estates

AREA STRUCTURE PLAN

LEGEND:

ASP BOUNDARY

CofT 161 245 918 – GREENWOOD HOMES INC.

LAND OWNERSHIP MAP
FIGURE 2.0

MARTIN GEOMATIC CONSULTANTS LTD

SCALE:	1:2,000
DRAWN:	RJM
DATE:	January 17, 2017
JOB #:	166773CE

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Greenwood Estates

AREA STRUCTURE PLAN

LEGEND:

- ASP BOUNDARY
- PP — POWER POLE w/ OH LINE
- EX GRASS SWALE
- EX. GAS LINE
- EX. TEMPORARY FENCE
- EX. PERMANENT FENCE
- 900.00 — EX. MAJOR CONTOUR LINE
- 900.00 — EX. MAJOR CONTOUR LINE
- O/H — EX. OH POWER LINE
- E — EX. ELECTRICAL LINE
- EX. SIDEWALK & CURB & GUTTER
- EX. WATERLINE
- EX. SANITARY PIPE
- EX. STORM PIPE

EXISTING LAND CONDITIONS
FIGURE 3.0

MARTIN GEOMATIC CONSULTANTS LTD

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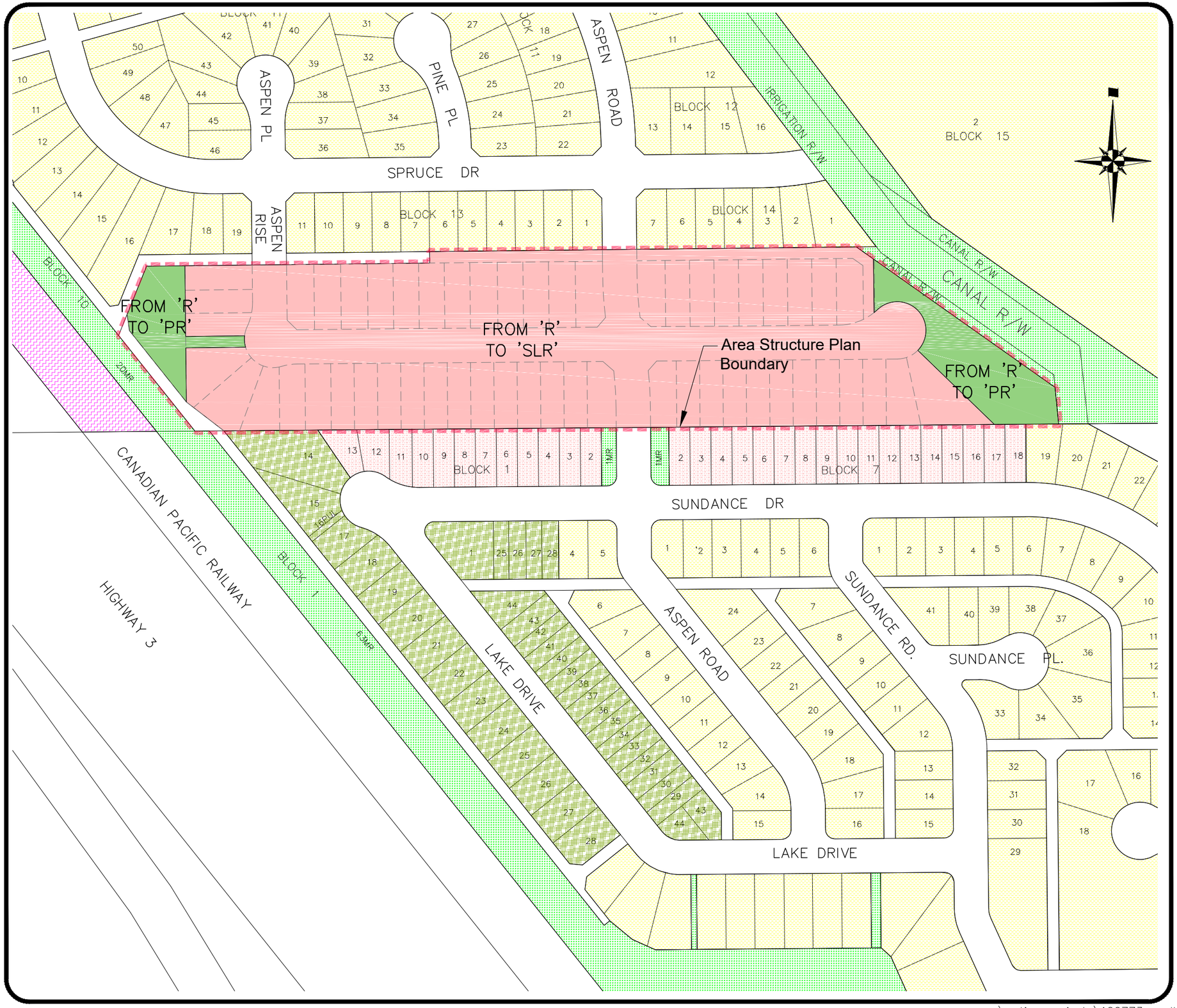

Greenwood Estates

AREA STRUCTURE PLAN

LEGEND:

ASP BOUNDARY

- FROM: Residential (R) TO: Parks and Recreation (PR)
- FROM: Residential (R) TO: Small Lot Residential (SLR)
- EXISTING: Residential (R)
- EXISTING: Small Lot Residential (SLR)
- EXISTING: Multi-Unit Residential (MUR)
- EXISTING: Parks and Recreation (PR)
- EXISTING: Business Industrial (BI)

LAND USE CONCEPT

FIGURE 4.0

MARTIN GEOMATIC CONSULTANTS LTD

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DATE:	January 17, 2017
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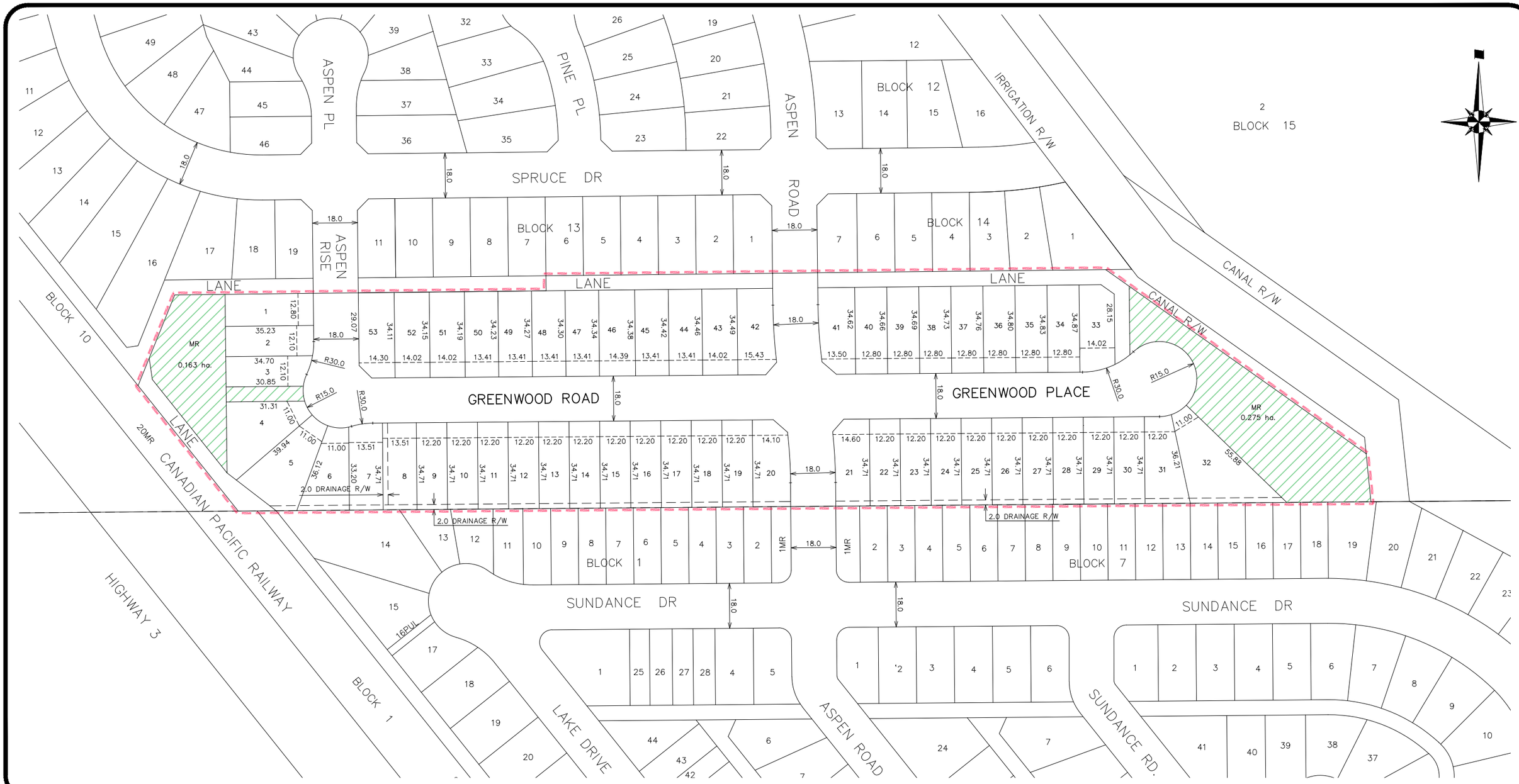

LEGEND:

ASP BOUNDARY

SUBDIVISION SUMMARY

TOTAL LOTS:	53	
FRONTAGE (m): AT 6.1m SETBACK)	676.5	
TOTAL AREA:	9.78ac. (3.96ha.)	
ROAD AREA:	2.63ac. (1.06ha.)	26.8%
MR AREA:	1.08ac. (0.44ha.)	11.1%
LOT AREA:	6.08ac. (2.46ha.)	62.1%

Greenwood Estates
AREA STRUCTURE PLAN

LOT LAYOUT
FIGURE 5.0

MARTIN GEOMATIC CONSULTANTS LTD

SCALE:	1:1,500
DRAWN:	RJM
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JOB #:	166773CE

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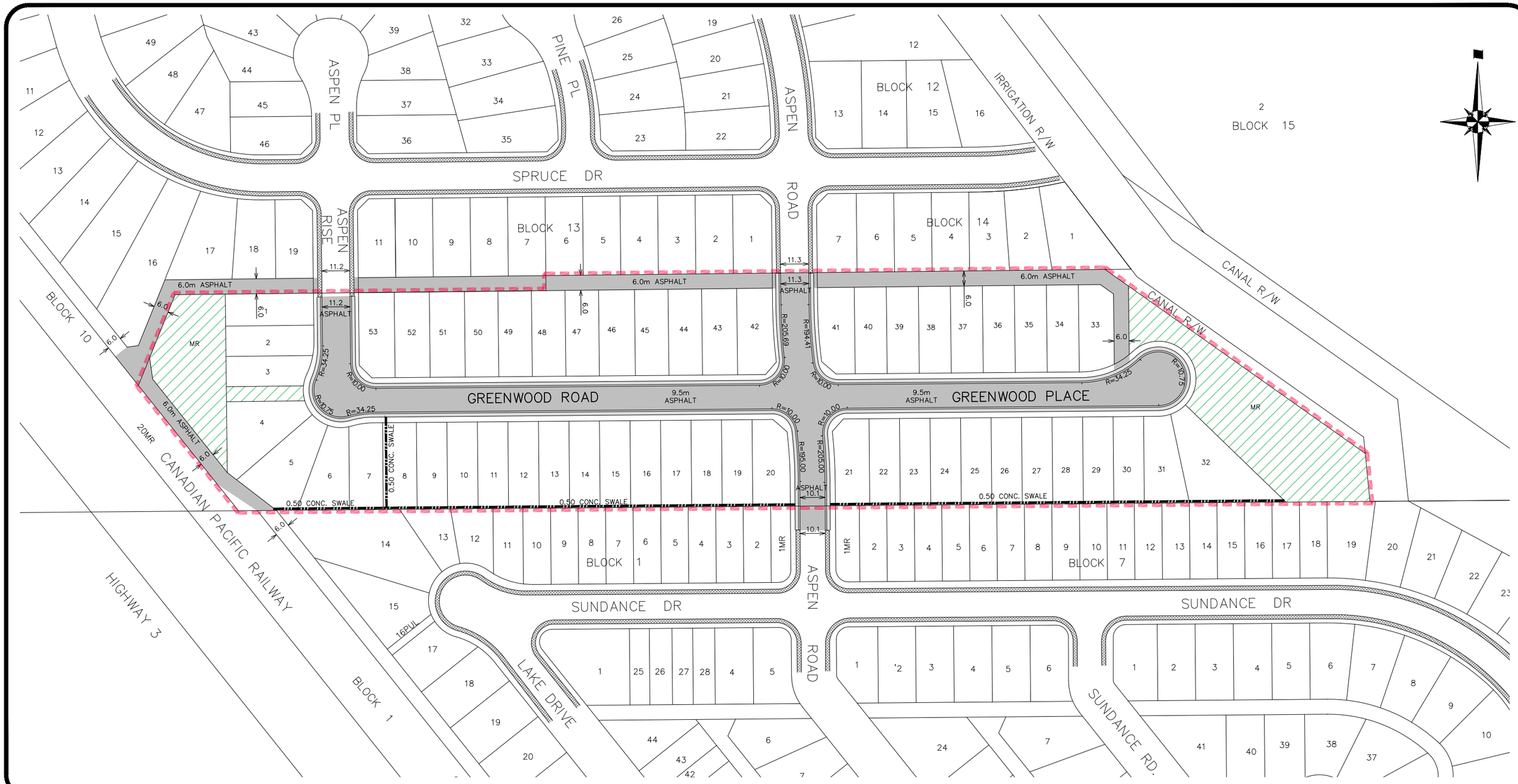

LEGEND:

- ASP BOUNDARY
- 2.0 MONOWALK
- EXISTING MONOWALK
- PROPOSED ASPHALT

LOCAL ROAD STRUCTURE

- 90mm TYPE III ASPHALT
- 250mm GRANULAR BASE COURSE

LANE STRUCTURE

- 80mm TYPE III ASPHALT
- 200mm GRANULAR BASE COURSE

Greenwood Estates
AREA STRUCTURE PLAN

ROAD LAYOUT
FIGURE 6.0

MARTIN GEOMATIC CONSULTANTS LTD

SCALE:	1:1,500
DRAWN:	RJM
DATE:	January 17, 2017
JOB #:	166773CE

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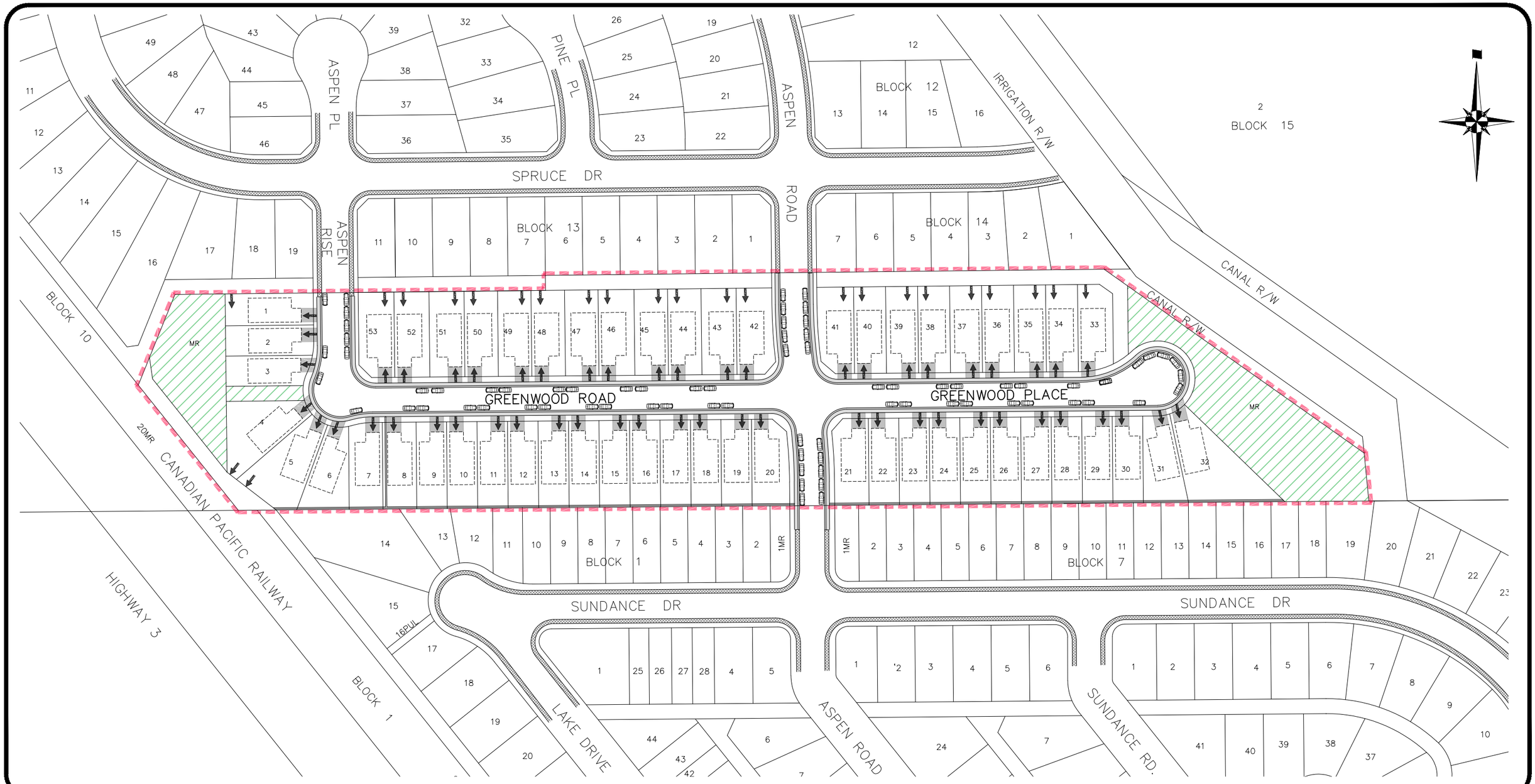

LEGEND:

- ASP BOUNDARY
- ON-STREET PARKING SPACE
- 2.0 MONOWALK
- HOUSE & DRIVEWAY (DOUBLE WIDE GARAGE)

NOTE:

1. TYPICAL DRIVEWAYS SHOWN ARE 5.8m WIDE
2. TYPICAL VEHICLES SHOWN ARE 5.0m LONG
3. HOUSE FOOTPRINTS SHOWN ARE APPOX. 70ft x 32ft (ILLUSTRATIVE ONLY)

Greenwood Estates
AREA STRUCTURE PLAN

PARKING
FIGURE 6.1

MARTIN GEOMATIC CONSULTANTS LTD

SCALE:	1:1,500
DRAWN:	RJM
DATE:	January 17, 2017
JOB #:	166773CE

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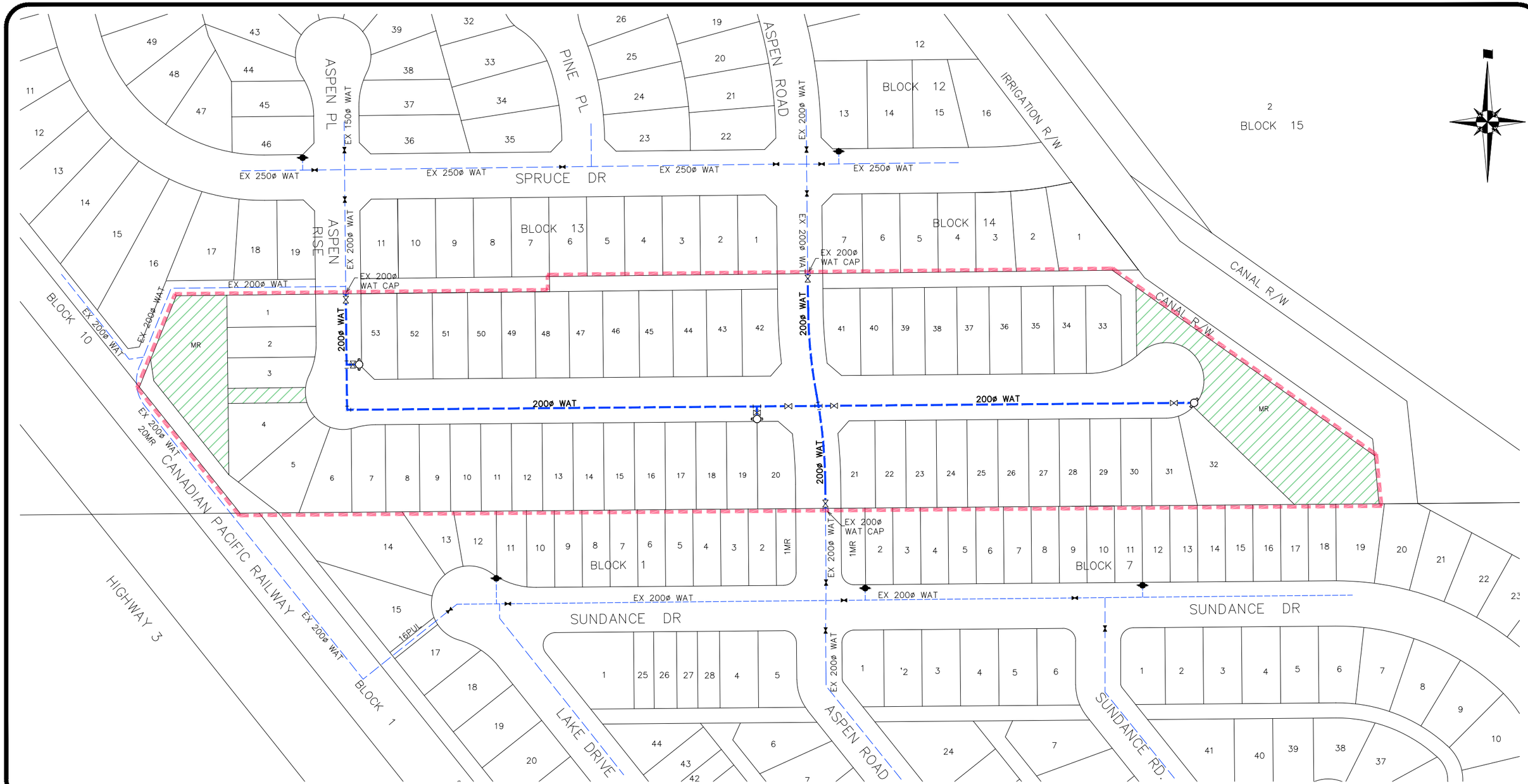

LEGEND:

ASP BOUNDARY

EXISTING		PROPOSED
⊔	WATER CAP	⊔
⋈	WATER VALVE	⋈
●	FIRE HYDRANT	○
– – – –	WATER PIPE	▬▬▬

Greenwood Estates
AREA STRUCTURE PLAN

WATER DISTRIBUTION
FIGURE 7.0

MARTIN GEOMATIC CONSULTANTS LTD

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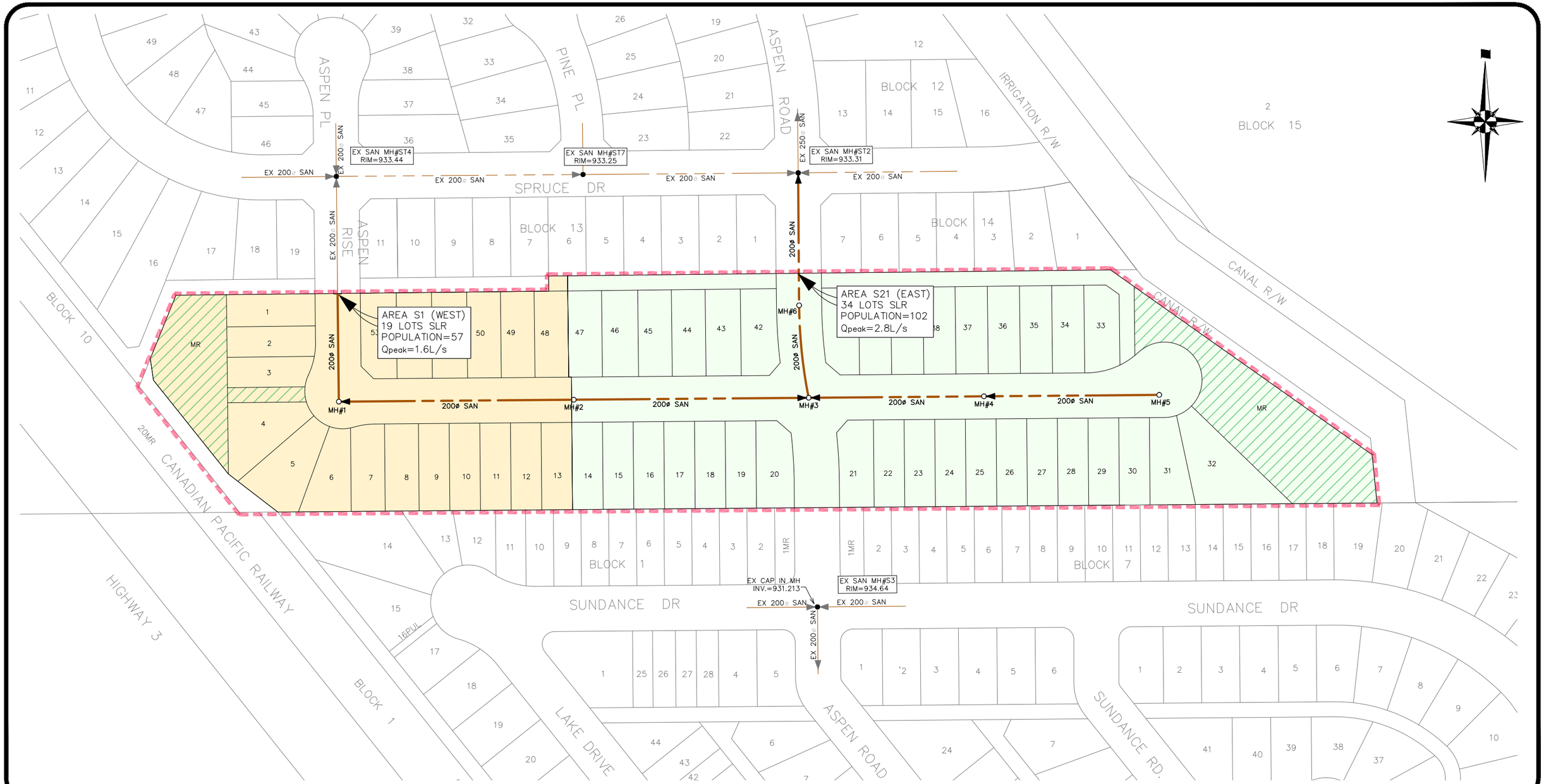

LEGEND:

ASP BOUNDARY

EXISTING		PROPOSED
•	SAN MANHOLE	○
———	SAN PIPE	———

Greenwood Estates
AREA STRUCTURE PLAN

SANITARY SEWER SYSTEM
FIGURE 8.0

MARTIN GEOMATIC CONSULTANTS LTD

SCALE:	1:1,500
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DATE:	January 17, 2017
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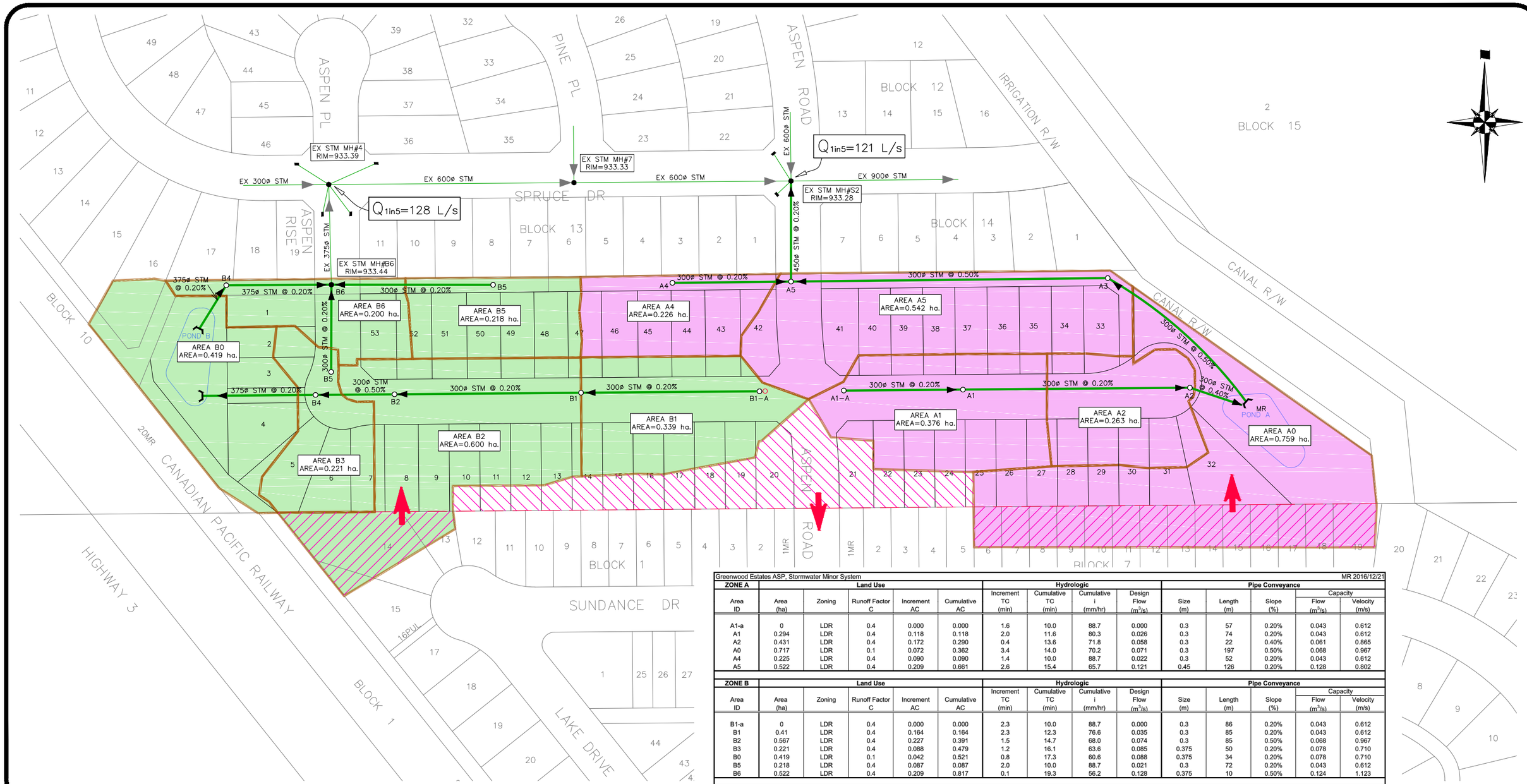

Greenwood Estates ASP, Stormwater Minor System — MR 2016/12/21

ZONE A	Land Use					Hydrologic				Pipe Conveyance				
													Capacity	
Area ID	Area (ha)	Zoning	Runoff Factor C	Increment AC	Cumulative AC	Increment TC (min)	Cumulative TC (min)	Cumulative i (mm/hr)	Design Flow (m^3/s)	Size (m)	Length (m)	Slope (%)	Flow (m^3/s)	Velocity (m/s)
A1-a	0	LDR	0.4	0.000	0.000	1.6	10.0	88.7	0.000	0.3	57	0.20%	0.043	0.612
A1	0.294	LDR	0.4	0.118	0.118	2.0	11.6	80.3	0.026	0.3	74	0.20%	0.043	0.612
A2	0.431	LDR	0.4	0.172	0.290	0.4	13.6	71.8	0.058	0.3	22	0.40%	0.061	0.865
A0	0.717	LDR	0.1	0.072	0.362	3.4	14.0	70.2	0.071	0.3	197	0.50%	0.068	0.967
A4	0.225	LDR	0.4	0.090	0.090	1.4	10.0	88.7	0.022	0.3	52	0.20%	0.043	0.612
A5	0.522	LDR	0.4	0.209	0.661	2.6	15.4	65.7	0.121	0.45	126	0.20%	0.128	0.802

ZONE B	Land Use					Hydrologic				Pipe Conveyance				
													Capacity	
Area ID	Area (ha)	Zoning	Runoff Factor C	Increment AC	Cumulative AC	Increment TC (min)	Cumulative TC (min)	Cumulative i (mm/hr)	Design Flow (m^3/s)	Size (m)	Length (m)	Slope (%)	Flow (m^3/s)	Velocity (m/s)
B1-a	0	LDR	0.4	0.000	0.000	2.3	10.0	88.7	0.000	0.3	86	0.20%	0.043	0.612
B1	0.41	LDR	0.4	0.164	0.164	2.3	12.3	76.6	0.035	0.3	85	0.20%	0.043	0.612
B2	0.567	LDR	0.4	0.227	0.391	1.5	14.7	68.0	0.074	0.3	85	0.50%	0.068	0.967
B3	0.221	LDR	0.4	0.088	0.479	1.2	16.1	63.6	0.085	0.375	50	0.20%	0.078	0.710
B0	0.419	LDR	0.1	0.042	0.521	0.8	17.3	60.6	0.088	0.375	34	0.20%	0.078	0.710
B5	0.218	LDR	0.4	0.087	0.087	2.0	10.0	88.7	0.021	0.3	72	0.20%	0.043	0.612
B6	0.522	LDR	0.4	0.209	0.817	0.1	19.3	56.2	0.128	0.375	10	0.50%	0.124	1.123

LEGEND:

MINOR SYSTEM CATCHMENT

EXISTING — STM MANHOLE, STM PIPE

PROPOSED

* Q_{1in5} IS THE PEAK RELEASE RATE FROM THE GREENWOOD ESTATES SITE TO THE TOWN'S MINOR SYSTEM DURING A 1 IN 5 YEAR STORM

ZONE 'A'

ZONE 'B'

OFFSITE RUNOFF AREA FROM SUNDANCE TO GREENWOOD =0.401 ha

OFFSITE RUNOFF AREA FROM GREENWOOD TO SUNDANCE =0.371 ha

Greenwood Estates AREA STRUCTURE PLAN

STORM MINOR SYSTEM FIGURE 9.0

MARTIN GEOMATIC CONSULTANTS LTD

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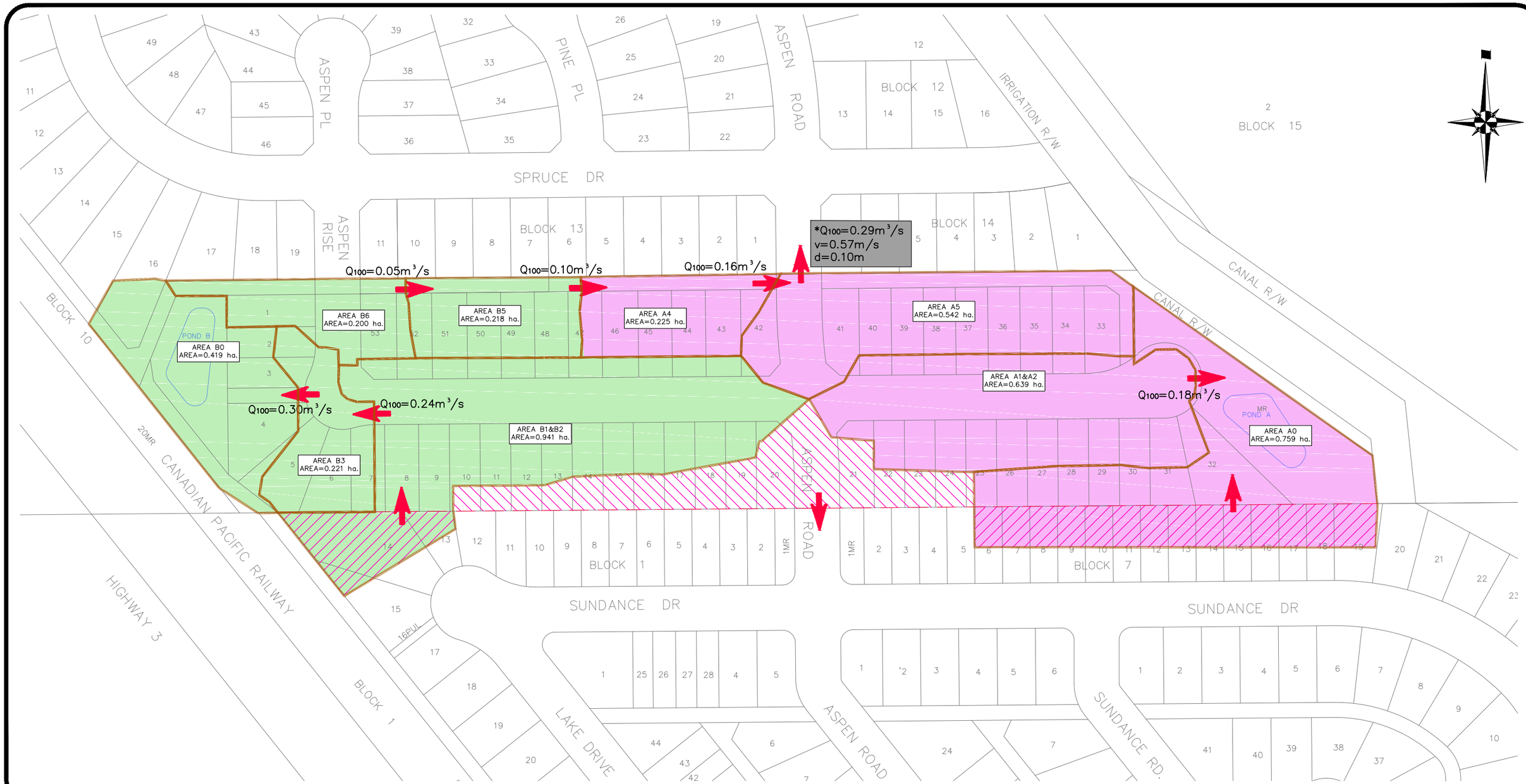

LEGEND:

- MAJOR SYSTEM CATCHMENT
- ZONE 'A'
- ZONE 'B'
- OFFSITE RUNOFF AREA FROM SUNDANCE TO GREENWOOD =0.401 ha
- OFFSITE RUNOFF AREA FROM GREENWOOD TO SUNDANCE =0.371 ha

* Q_{100} IS THE PEAK RELEASE RATE, VELOCITY AND DEPTH FROM THE GREENWOOD ESTATES SITE TO THE TOWN'S OVERLAND DRAINAGE SYSTEM DURING A 1 IN 100 YEAR STORM

Greenwood Estates
AREA STRUCTURE PLAN

STORM MAJOR SYSTEM
FIGURE 10.0

MARTIN GEOMATIC CONSULTANTS LTD

SCALE:	1:1,500
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DATE:	January 17, 2017
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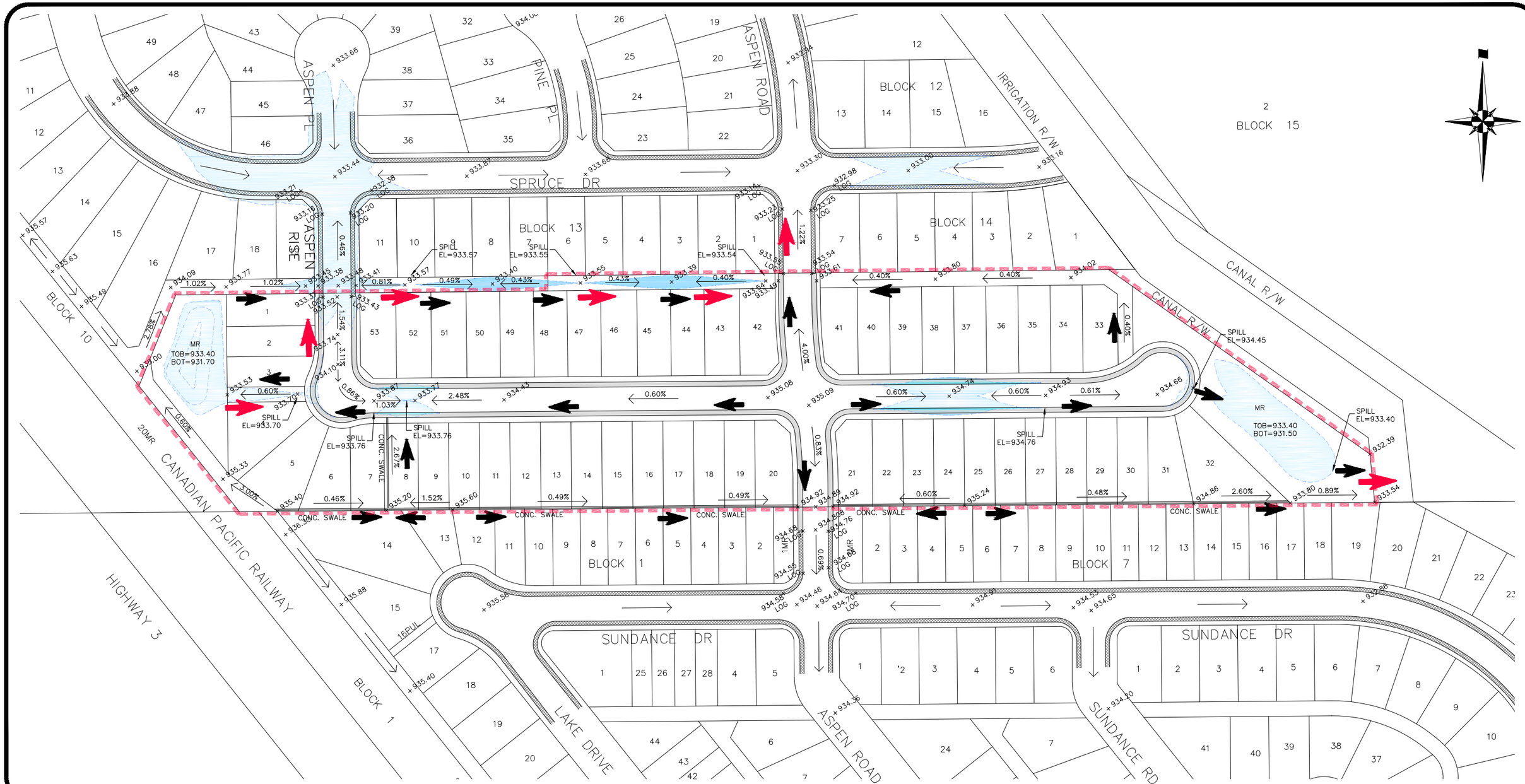

ASP BOUNDARY

PROPOSED MONOWALK

EXISTING MONOWALK

0.46% GRADE AND FLOW DIRECTION

+935.20 DESIGN ELEVATION

OVERLAND DRAINAGE SYSTEM ROUTE

EMERGENCY DRAINAGE SYSTEM ROUTE

TRAPLOW AREAS

Greenwood Estates
AREA STRUCTURE PLAN

SITE GRADING PLAN
FIGURE 11.0

MARTIN GEOMATIC CONSULTANTS LTD

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APPENDIX

APPENDIX 1 ~ PROPERTY OWNERSHIP [TITLES]

LAND TITLE CERTIFICATE

S

LINC	SHORT LEGAL	TITLE NUMBER
0032 044 570	0614136;15;1	161 245 918

LEGAL DESCRIPTION

DESCRIPTIVE PLAN 0614136
BLOCK 15
LOT 1
EXCEPTING THEREOUT ALL MINES AND MINERALS
AREA: 3.958 HECTARES (9.78 ACRES) MORE OR LESS

ATS REFERENCE: 4;22;9;21;SW
ESTATE: FEE SIMPLE

MUNICIPALITY: TOWN OF COALHURST

REFERENCE NUMBER: 151 331 564

REGISTERED OWNER(S)

REGISTRATION	DATE(DMY)	DOCUMENT TYPE	VALUE	CONSIDERATION
161 245 918	17/10/2016	TRANSFER OF LAND	$437,000	CASH

OWNERS

GREENWOOD HOMES INC.
OF RR 8, SITE 34, BOX 12
LETHBRIDGE
ALBERTA T1J 4P4

ENCUMBRANCES, LIENS & INTERESTS

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
741 091 031	27/09/1974	IRRIGATION ORDER/NOTICE THIS PROPERTY IS INCLUDED IN THE LETHBRIDGE NORTHERN IRRIGATION DISTRICT
941 115 635	06/05/1994	CAVEAT RE : SEE CAVEAT CAVEATOR - THE VILLAGE OF COALHURST.

(CONTINUED)

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
		BOX 456, COALHURST ALBERTA T0L0V0 AGENT - DAVID A VERES
061 477 312	16/11/2006	CAVEAT RE : DEFERRED RESERVE CAVEATOR - TOWN OF COALHURST. OLDMAN RIVER REGIONAL SERVICES COMMISSION 3105 16TH AVENUE NORHT LETHBRIDGE ALBERTA T1H5E8
151 331 565	17/12/2015	MORTGAGE MORTGAGEE - CANADA FINANCE CORPORATION LIMITED. 417, 5920-1A ST SW CALGARY ALBERTA T2H0G3 ORIGINAL PRINCIPAL AMOUNT: $150,000

TOTAL INSTRUMENTS: 004

THE REGISTRAR OF TITLES CERTIFIES THIS TO BE AN ACCURATE REPRODUCTION OF THE CERTIFICATE OF TITLE REPRESENTED HEREIN THIS 18 DAY OF OCTOBER, 2016 AT 02:53 P.M.

ORDER NUMBER: 31641895

CUSTOMER FILE NUMBER: 166773LS

END OF CERTIFICATE

THIS ELECTRONICALLY TRANSMITTED LAND TITLES PRODUCT IS INTENDED FOR THE SOLE USE OF THE ORIGINAL PURCHASER, AND NONE OTHER, SUBJECT TO WHAT IS SET OUT IN THE PARAGRAPH BELOW.

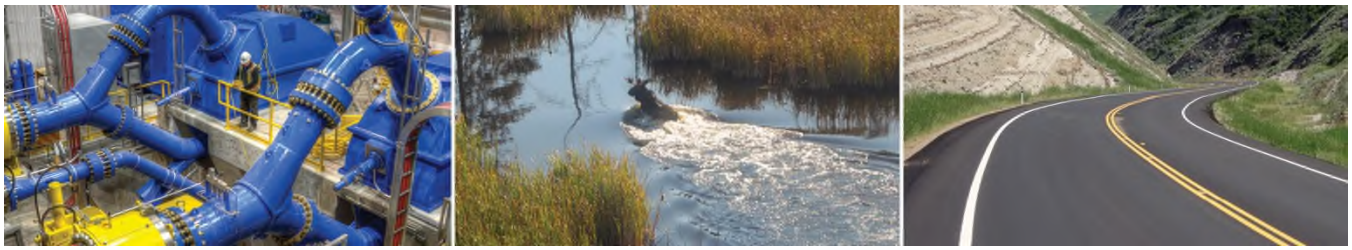
THE ABOVE PROVISIONS DO NOT PROHIBIT THE ORIGINAL PURCHASER FROM INCLUDING THIS UNMODIFIED PRODUCT IN ANY REPORT, OPINION, APPRAISAL OR OTHER ADVICE PREPARED BY THE ORIGINAL PURCHASER AS PART OF THE ORIGINAL PURCHASER APPLYING PROFESSIONAL, CONSULTING OR TECHNICAL EXPERTISE FOR THE BENEFIT OF CLIENT(S).

APPENDIX

APPENDIX 2 ~ ENVIRONMENTAL SITE ASSESSMENT

TETRA TECH EBA

Phase I Environmental Site Assessment
Plan 0614136, Block 15, Lot 1 and Lot 2
Coalhurst, Alberta



PRESENTED TO
The Town of Coalhurst

FEBRUARY 2016
ISSUED FOR USE
FILE: ENV.CENV03051-01

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Tetra Tech EBA Inc.
442 - 10 Street N.
Lethbridge, AB T1H 2C7 CANADA
Tel 403.329.9009 Fax 403.328.8817

EXECUTIVE SUMMARY

Foreword

The Town of Coalhurst (Coalhurst) retained Tetra Tech EBA Inc. (Tetra Tech EBA) to conduct a Phase I Environmental Site Assessment (ESA) on two adjoining properties located in Coalhurst, Alberta, legally described as Plan 0614136, Block 15, Lots 1 and 2, within the SW 21-009-22 W4M. Within this report, the properties will be referred to as Lot 1 or Lot 2, and collectively as the site. No municipal addresses are associated with the properties.

The objective of the Phase I ESA is to comment on whether any past or present land use, either off site or on site, may have a potential to cause environmental impairment of the site. Tetra Tech EBA understands that Coalhurst owns the site and requires this environmental investigation as a part of its due diligence to support further development.

The site consists of Lot 1 and Lot 2, adjoining parcels of land separated by an irrigation canal. Lot 1 is an irregular shaped property consisting of 9.78 acres and is zoned residential. Lot 2 is an irregular shaped property consisting of 22.71 acres and is zoned residential. Both lots are currently undeveloped land with no aboveground infrastructure. Historically, coal mine infrastructure including rail lines and a scalehouse were located on the northern and eastern portion of Lot 2. Two underground utility rights-of-way (ROWs) transect Lot 2 in a general north to south, and east to west direction.

In general terms, there are two distinct types of potential environmental risk to any property. The first type of risk is from potential contamination from on-site land use. This would include potential accidental spills or site practices that may contaminate the property directly. The second type of risk is from contamination caused by adjacent property owners, which might then be transported through the subsurface soils by groundwater, or in overland runoff onto the site.

Potential for Impairment from On and Off-site Source

There was one source of potential environmental impairment from current and historical on and off-site land uses identified during this assessment. The following table outlines this source.

Table Potential On and Off-Site Source of Environmental Impairment

APEC	Source of Potential Impairment	Source of Information	Tetra Tech EBA Evaluation
1	Historic coal mine operations	Site interviews, land titles, aerial photographs, museum archives, coal mine atlas, and other archival sources.	According to historical records, portions of the Coalhurst Imperial mine historically had operations and/or infrastructure located on the site (Lot 2) including former rail lines (spurs) and a ‘cinder dump’. Rail lines were historically constructed of coal ash and cinder. There is a potential for polycyclic aromatic hydrocarbon (PAH) and metal impacts to the soil on the north and northeastern portion of Lot 2. A portion of the cinder dump on Lot 2 was also capped with uncharacterized fill material which may potentially be a source of environmental impairment.

Further Action Rendering an Opinion

Based on the Phase I ESA, further intrusive environmental investigation is warranted.

Tetra Tech EBA provides the following for consideration:

- It is noted that a rail line may have transected the most western portion of Lot 1, however, the overlay of the 1918 insurance plan on to the current day site plan may be skewed and this rail line may have been further west of the site.
- If buried debris or staining are encountered during future ground disturbance, a qualified environmental professional should be contacted.
- If soil containing organics are encountered during future investigation or ground disturbance, they should be removed from building footprints and not be reburied; a qualified environmental professional should be contacted.

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LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of the Town of Coalhurst and their agents. Tetra Tech EBA Inc. (Tetra Tech EBA) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than the Town of Coalhurst, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this report is subject to the terms and conditions stated in Tetra Tech EBA's Services Agreement. Tetra Tech EBA's General Conditions are provided in Appendix A of this report.

1.0 INTRODUCTION

1.1 General

The Town of Coalhurst (Coalhurst) retained Tetra Tech EBA Inc. (Tetra Tech EBA) to conduct a Phase I Environmental Site Assessment (ESA) on two adjoining properties located in Coalhurst, Alberta, legally described as Plan 0614136, Block 15, Lots 1 and 2, within the SW 21-009-22 W4M. Within this report, the properties will be referred to as Lot 1 or Lot 2, and collectively as the "site". No municipal addresses are associated with the properties.

The objective of the Phase I ESA is to comment on whether any past or present land use, either off site or on site, may have a potential to cause environmental impairment of the site. Tetra Tech EBA understands that Coalhurst owns the site and requires this environmental investigation as a part of its due diligence to support further development.

The Phase I ESA was completed in general accordance with the methods outlined in the document titled "Canadian Standards Association Standard (CSA) Z768-01 Phase ESA", published by the CSA (reaffirmed 2012).

1.2 Authorization

Mr. Kevin Lewis, Director of Operations with Coalhurst, provided written authorization to proceed with the present study to Tetra Tech EBA on January 11, 2016.

1.3 Scope of Work

To meet the objectives stated in Section 1.1, Tetra Tech EBA conducted the following scope of work:

- Conducted a record review for the site and surrounding properties for a minimum search distance of 100 m. The records review included the following current and historical information searches:
  - Provincial regulatory information, including: the Petroleum Tank Management Association of Alberta (PTMAA), Alberta Energy Regulator (AER) information through the Abacus DataGraphics database (AbaData), Spatial Information System (SPIN2), and Alberta Environment and Parks (AEP) Environmental Site Assessment Repository (ESAR), Online Water Well database, and Approval/Authorization Viewer.
  - Alberta Health Services.
  - Regional and Municipal regulatory information, including the Galt Museum Archives.
  - Historical information sources (e.g., land titles and historical aerial photographs).
  - Geologic and hydrogeological information, including internal Tetra Tech EBA and published topographic, geologic, soils and groundwater maps, and reports.
- Conducted a site visit to evaluate the extent and manner that past, present, and surrounding activities may impact upon the site and the environment. Intrusive sampling was not conducted as part of the Phase I ESA.
- Conducted interviews with persons familiar with the site and surrounding properties.
- Evaluated the results and prepared this report discussing the subject site history and identified the potential for environmental concerns resulting from past or present land use on site and in the surrounding area.

1.4 Qualifications of Assessors

Mr. Brad Calder, B.Sc., ATT, conducted the historical research, site visit, records review, and prepared this report. Mr. Calder is an Environmental Scientist with Tech EBA's Environment Practice. He has over three years of experience in the environmental industry.

Mr. Jaymes Going, B.Sc., EP, performed the intermediate review of this report. Mr. Going is an Environmental Consultant with Tetra Tech EBA's Environmental Practice and has over seven years of experience in the environmental industry.

Ms. Mandi Parker, P.Ag., performed the senior review of this report. Ms. Parker is a Senior Environmental Consultant – Team Lead with Tetra Tech EBA's Environment Practice. Ms. Parker has over 15 years of experience as an environmental consultant, including Phase I, II and III ESAs, site remediation, and risk management planning in Alberta, Saskatchewan, Northwest Territories, Yukon, and Nunavut.

1.5 General Site Details

The site consists of Lot 1 and Lot 2, adjoining parcels of land separated by an irrigation canal. Lot 1 is an irregular shaped property consisting of 9.78 acres and is zoned residential. Lot 2 is an irregular shaped property consisting of 22.71 acres and is zoned residential. Both lots are currently undeveloped land with no aboveground infrastructure. Historically, coal mine infrastructure including rail lines and a scalehouse were located on the northern and eastern portion of Lot 2. Two underground utility rights-of-way (ROWs) transect Lot 2 in a general north to south, and east to west direction.

Lot 1 is bound to the north and south by residential housing, to the east by an irrigation canal (followed by Lot 2), and to the west by undeveloped land, followed by the Canadian Pacific (CP) rail line and Highway No. 3. Lot 2 is bound to the north by residential housing and the Coalhurst elementary school, to the south by residential housing and agricultural land, to the east by an irrigation canal and residential housing (and Lot 1) and to the west by residential housing.

Figure 1 shows the site location plan and Figure 2 shows the detailed site plan showing surrounding land use. Photographs (photos) of the site are provided in Appendix B.

2.0 RECORDS REVIEW

The results of regulatory searches are provided in Appendix C.

2.1 Municipal Address, Legal Land Description, Land Use, and Ownership

The site is located within the Town of Coalhurst, Alberta. The municipal address, legal land description, land use, and ownership are summarized in Table A.

Table A: Municipal Address, Legal Land Description, Land Use, and Ownership

Municipal Address	Legal Land Description	Land Use*	Owner*
No municipal address associated with either Lot 1 or Lot 2	Plan 0614136, Block 15, Lot 1	9.78 acres	Town of Coalhurst
	Plan 0614136, Block 15, Lot 2	22.71 acres	Town of Coalhurst

* Size and ownership obtained from the current land title.

Copies of the current titles are provided in Appendix C.

2.2 Historical Records Review

A historical records review was undertaken for this site and surrounding properties and are discussed in the following sections.

2.2.1 Historical Land Title Records

The current and historical land titles are summarized in Table B below.

Table B: Land Titles Summary Plan - 0614136, Block 15, Lot 1 and Lot 2

Year(s) of Ownership	Owner(s)	Tetra Tech EBA Evaluation
2015 to Current	Town of Coalhurst	No obvious potential for environmental concern.
2006 to 2015	Canada Finance Corporation Limited	
2001 to 2006	Nissen Industries Ltd.	
1992 to 2001	477228 Alberta Ltd.	
1985 to 1992	Caisse Populaire	
1979 to 1985	Borgata Ventures Ltd.	
1978 to 1979	Cairns Homes Limited	
1976 to 1978	Frandsen Developments Ltd.	
1972 to 1976	William Earnest Pontarolo	
1951 to 1972	Paul Pontarolo	
1942 to 1951	Domenico Tedesco	
1935 to 1942	Lethbridge Collieries Limited	Based on the names, there is the potential for environmental impairment to the site from historic coal mining activities.
1928 to 1935	Prairie Coal Land Limited	
1916 to 1928	North American Collieries Limited	

From 1916 through 1942 the site was owned by various Coal Companies. Coal Mine Operations have various potentials for environmental concern. After 1942 to present, there were various individuals and development companies that owned the site.

2.2.2 Aerial Photographs

Aerial photographs provide visual evidence of site occupancy, operational activities, and general site details. Aerial photographs capture a view of the site and the surrounding areas at a given time. Table C provides a detailed historical review of the aerial photographs.

Table C: Historical Aerial Photograph Summary

Year	Scale	Observations
1950	1:40,000	**On site:** The irrigation canal is visible bi-secting the two lots. Lot 1 appears to be cultivated and portion of a rail line may be located on the southwestern portion. The rail line transects the northern portion of Lot 2 and what appears to be the former location of the scale house is visible. Areas of discoloration are visible on the eastern portion of Lot 2 (possibly waste material from the former mine operations).
		Off site: Roads and buildings are visible north of the site in the current location of Coalhurst. Numerous features are visible east of the site (location of the former coal mine operations) and agricultural land is also visible. South of the site is agricultural land and to the west is the CP rail line followed by Highway No. 3 and agricultural land.
1961	1:31,680	**On Site:** Lot 1 is generally similar to the 1950 aerial photograph with the exception that the rail line is not as pronounced. Similar to Lot 1, the rail line is less pronounced on Lot 2. The discolored area is still visible on the northeastern portion of Lot 2 and irregular linear features are visible (possibly trails).
		Off Site: The surrounding land is generally the same as the 1950 aerial photograph.
1970	1:31,680	**On site:** Lot 1 and Lot 2 are generally similar to the 1961 aerial photograph. The discolored area on Lot 2 is not as visible and the southern portion of Lot 2 appears to be cultivated.
		Off site: The surrounding land is generally the same as the 1961 aerial photograph, with the exception that development has occurred on the western portion of Coalhurst.
1981	1:60,000	**On site:** Lot 1 is similar to the 1970 aerial photograph, although does not appear to be cultivated. Lot 2 appears as vacant land and the discolored areas is not as visible. There is linear feature in a diagonal orientation across the portion of Lot 2.
		Off site: Significant development has occurred north of the site within Coalhurst. The structures associated with the former coal mine operations are no longer visible to the west of the site. South and west of the site is still agricultural land and Highway No. 3 has been twinned.
1991	1:30,000	**On site:** Lot 1 and Lot 2 are generally similar to the 1981 aerial photograph.
		Off site: Additional residential development is visible adjacent to the north boundary of Lot 1 and adjacent to a portion of the east boundary of Lot 2. The Coalhurst elementary school has been constructed north of Lot 2.
1999	1:30,000	**On site:** Lot 1 and Lot 2 are generally similar to the 1991 aerial photograph with the exception that a fairly large 'black' area is visible on the north portion of Lot 2, south of the elementary school. The diagonal linear feature identified in the 1981 aerial photograph on Lot 2 is no longer visible.
		Off site: Additional residential development has occurred north of Lot 1 and east of Lot 2.
2005*	Various	**On site:** Lot 1 appears similar to the 1999 aerial photograph. What appears to be a soil stockpile is visible on the approximate middle of Lot 2.
		Off site: The surrounding land appears similar to the 1999 aerial photograph.
2014*	Various	**On site:** Lot 1 and Lot 2 appear similar to the 2005 satellite imagery.
		Off site: A residential subdivision is visible south of Lot 1, and additional residential housing is visible east of Lot 2. The remaining surrounding land is generally similar to the 2005 satellite imagery.

Notes:

The aerial photographs are enlarged (where possible) for the review.
Aerial photographs were obtained from Alberta Environment and Parks
* 2005 and 2014 imagery obtained via Google Earth.

2.2.3 Museum Archives

Tetra Tech EBA searched the Galt Museum archives for indications of historical land use at the site and the surrounding area. Museum personnel provided access to the 1918 North American Ltd. Lethbridge Colliery insurance plan, referred to as the Coalhurst Imperial Mine (Mine No. 0174). The 1918 insurance plan provides coverage of the site and surrounding area, and includes historic details on the locations of infrastructure related to the mine operations (rail lines, shaft locations, buildings, etc.), and the original street layout of Coalhurst.

Figure 3 provides the current site boundaries overlaid on the 1918 insurance plan.

Tetra Tech EBA also has a copy of the site plan from 1927 for the Coalhurst Imperial Mine acquired from the Glenbow Museum. This site plan is similar to the 1918 insurance plan with the exception that the location of a 'cinder dump' is provided. This cinder dump encompassed a portion of the northeastern site of Lot 2.

Further information of the historic mine operations are provided in Section 2.4.2.

2.2.4 Business Directories

There were no business directories available for Tetra Tech EBA to review for the site or surrounding properties.

2.2.5 Fire Insurance Plans

There were no fire insurance plans available for Tetra Tech EBA to review for the site or surrounding properties; however, an insurance plan from 1918 was reviewed and is discussed in Section 2.2.3.

2.3 Other Archival Records

The Atlas of Alberta Railways was reviewed to determine if any historic rail lines were located at or near the Lot 1 and Lot 2. The review indicated that a former rail line (spur) was located from the main CP rail line west of the site to the Coalhurst Imperial Mine. This rail line was constructed in 1912 and transected a portion of Lot 2.

Tetra Tech EBA also reviewed two local history books as part of this assessment:

- Our Treasured Heritage, A History of Coalhurst and District (1984); and
- Lethbridge, Its Coal Industry (1989).

These books provided general information on the history of Coalhurst and Lethbridge with regards to historic mining operations and provided the location of the Coalhurst Mine; located within Sections 15-17 and 20-22, Township 009, Range 22, W4M.

No additional archival records were reviewed for the site.

2.4 Provincial Regulatory Information

This section describes the results of provincial regulatory searches. Copies of the search results and correspondence are provided in Appendix C.

2.4.1 Petroleum Tank Management Association of Alberta [PTMAA]

Tetra Tech EBA contacted the Petroleum Tank Management Association of Alberta (PTMAA) regarding the potential for registered petroleum storage tanks (PSTs) at the site. The PTMAA response indicated that no records exist for the site (Plan 0614136, Block 15, Lots 1 and 2) or within SW 21-009-22 W4M.

The PTMAA requires that all underground storage tanks (USTs) be registered; however, only above-ground storage tanks (ASTs) with a capacity greater than 2,500 L are required to be registered. The database is based on a limited survey conducted in 1992 and voluntary information submitted thereafter; therefore, it is not considered a comprehensive inventory of tanks in Alberta.

2.4.2 Alberta Energy Regulator

Tetra Tech EBA acquires Alberta Energy Regulator (AER) database information through AbaData. The AbaData database was searched to determine if oil/gas wells and/or pipelines exist or have existed at the site. No oil/gas pipelines exist on the site and no reported spills occurred on the site or surrounding area. AbaData also identifies the irrigation canal ROW that separates Lot 1 and Lot 2, and the utility ROW on Lot 2 that trends in a north to south direction. Several other utility ROWs are visible on the surrounding properties.

High pressure pipeline and well information provided by AbaData is current to December 24, 2015 and information on low pressure pipelines is current to November 1, 2005.

The AER Coal Mine Atlas was reviewed to determine if any coal mines existed at the site. The Coalhurst Imperial Mine (Mine No. 0174) was located at the site and the surrounding area. The Mine operated from 1908 to 1936. The mine was operated by various owners including Rogers Coal Co. (1908), Lethbridge Collieries Ltd. (1910 to 1913 and 1935 to 1936), Canadian Coal and Coke Co. Ltd. (1913 to 1915), North American Collieries Ltd. (1916 to 1928), Coal Producers Ltd. (1928 to 1934), and Royalties Oil and Share Corp. Ltd. (1934 to 1935). The mine was abandoned in 1936 following the Coalhurst Mine Disaster (a gas explosion and subsequent cave-in).

The mine produced 3,775 thousand tonnes of coal from 1911 to 1936, from a depth of approximately 192 m below ground level. The mine was an extensive underground mine, underlying the southeast portion of Coalhurst. It is understood that the mine used a room and pillar mining arrangement. It is believed that the mine entrances for the mine included a number of shafts, two of which are located approximately 150 metres east from the site, within the Imperial Meadows Park and municipal reserve lands.

2.4.3 Alberta Environment and Parks

2.4.3.1 Environmental Site Assessment Repository

The Alberta Environment and Parks (AEP) Online ESAR is a searchable database that provides scientific and technical information about assessed sites throughout Alberta. The Environmental Site Assessment Repository (ESAR) was searched for ESAs on the site and surrounding land. The ESAR search indicated that there were no records for the site or immediate surrounding properties within 100 m. Reports were available for two locations; the former Coalhurst Food and Gas located approximately 120 m north of Lot 2, and for the Coalhurst Shell located approximately 400 m west of Lot 2 and approximately 280 m north of Lot 1. Due to the distance from the site, these are not considered to be a concern.

2.4.3.2 Online Approval Viewer

The AEP Online Approval Viewer allows the public to view approvals, licenses, registrations, and permits issued under the Water Act and Environmental Protection and Enhancement Act (EPEA). A search of the AEP Online Approval Viewer found no records available for the site (Plan 0614136, Block 15, Lot 1 or Lot 2), or for the SW 21-009-22 W4M.

2.4.3.3 Water Well Information Database

The AEP Water Well Database has two (2) records for water wells located within 500 m of the site. The following table (Table D) outlines the water well information.

Table D: Water Well Information

Section Location	Water Well ID	Owner	Year Drilled	Direction to Site	Depth (m)
02-21-009-22 W4M	109578	N Amer Co	Unknown	East.	180.75 m
21-009-22 W4M	109583	Hamlet of Coalhurst	1972	North.	6.10 m

Note: Specific well locations may potentially be located at any point within the quarter section provided as the database will place the well in the center of the quarter section if no specific location is provided in the drilling reports.

2.4.4 SPIN 2

The Alberta Government SPIN 2 Website provides information pertaining to legal land locations, ownership, and transportation and utility ROWs. SPIN 2 shows the same ROWs identified previously through AbaData in Section 2.4.2. The current land title was also obtained from the SPIN 2 website.

2.5 Regional and Municipal Regulatory Information

This section describes the result of municipal regulatory searches. Copies of the search results and correspondence are provided in Appendix C.

2.5.1 Alberta Health Services

Alberta Health Services (AHS) was contacted for information regarding any environmental information for the site and for surrounding land within a 100 m radius of the site. A response from AHS had not been received at the time of report issuance. If the response indicates that the findings or recommendations will change, an addendum letter will be issued.

2.5.2 Town of Coalhurst

Tetra Tech EBA reviewed the Coalhurst Land Use Districts Map Bylaw 354-12, dated July 10, 2012 which provided the land use zoning for the site and surrounding area. Coalhurst personnel also provided maps indicating the location of the underground utilities located at the site and surrounding area. Two utility ROWs transect Lot 2 in a north-south and east-west direction. The irrigation canal bi-secting Lot 1 and lot 2 was also indicated.

Coalhurst personnel familiar with the site were also interviewed and are discussed in Section 4.0.

2.6 Landforms and Geology

2.6.1 Topography

Surface topography can influence the direction of migration of contaminants at the soil surface. The local topography describes the landscape at the site; whereas, regional topography applies to the overall expression of the land surface in a given region. The surface topography of the site is generally flat and the regional topography in the area is flat to gently undulating and slopes east towards the Oldman River.

2.6.2 Geology

Surficial soils consist of hummocky moraine glacial till deposits with sporadic lenses of gravel and silt (Shetson 1987). Prairie level at the site is approximately at geodetic elevation 926 m.

The stratigraphy of the Coalhurst area is generally comprised of 65 m to 70 m of surficial deposits overlying bedrock.

Bedrock in the Coalhurst area consists of strata from the Belly River Formation, which consists of stratified sandstone, with bentonite, coal, green shale concretionary beds, which is of the late Cretaceous Age (Tokarsky 1973). The bedrock has a relatively flat surface dipping slightly to the southwest and is locally encountered generally at about geodetic elevation 850 m. The bedrock strata consist of thin beds of predominantly shale, and sandstones with occasional bentonite and coal seams.

2.6.3 Hydrology and Hydrogeology

Groundwater is of significance as a potential means of contaminant transport. Regional groundwater flow is the overall direction of groundwater flow in a given region. There may be local groundwater flow within a region that is in a different direction from the regional flow and that is controlled by topography and/or subsurface soil conditions.

The Oldman River is approximately 4 km east of the site, and an irrigation canal bi-sects Lot 1 and Lot 2. The nearest body of water, aside from the irrigation canal is a man-made storm water retention pond located approximately 300 m south of Lot 1.

Regional groundwater flow is expected to flow easterly towards the Oldman River, local groundwater flow direction is unknown, and may be influenced by the irrigation canal near the site. Perched groundwater tables have also been encountered in many areas of southern Alberta. The depth to these perched tables can vary from approximately 2 m below ground level to considerable depths within gravel, sand, and/or silt seams. The flow of these perched tables can also vary in any direction or be still, dependent on the horizontal and vertical dip, and the extent of the sand and/or silt seams.

It should be noted that topography, geologic materials, land development, and soil disturbances influence localized variances in groundwater movement and pattern. Also, groundwater levels will fluctuate seasonally and in response to climatic conditions.

2.7 Other Information Sources

There were no other reports or information sources available to Tetra Tech EBA for review for this assessment.

3.0 SITE VISIT

Mr. Brad Calder of Tetra Tech EBA visited the site on January 17, 2015. Full access to all areas of the site was granted. The site was snow covered at the time of the site visit, therefore, visual observations were limited by the presence of the snow cover.

3.1 Building Details

There are currently no buildings on the site. Historically, a scale house associated with the former coal mine activities would have been located on the northern portion of Lot 2. During the site visit, portions of a concrete foundation were encountered that may be associated with this former building.

3.2 Site Servicing

Table E outlines the services and utilities currently on the site. It suspected that during future development, municipally owned infrastructure would service the site.

Table E: Site Servicing

Item	Present	Type	Comments
Water Supply	No	N/A	No water supply infrastructure was identified at the site with the exception of the irrigation canal that bi-sects the site.
Storm Sewer	Yes	Municipal	Multiple storm sewer catch basins (manholes) were identified at the site at the time of the site visit, within Lot 2.
Sanitary Sewer	No	Municipal	A sanitary sewer line transects Lot 2 site.
Other Storage	No	Not observed	N/A
Pits	No	N/A	N/A
Lagoons	No	N/A	N/A

3.3 Special Attention Items

Some construction materials, which may be present in buildings, may be hazardous to building occupants or users of the site. Table F summarizes these special attention items. Further background information on these materials is provided in Appendix D.

Table F: Special Attention Items

Item	Presence/ Potential	Comments
Asbestos	Low	No buildings were observed at the site at the time of the site visit.
Polychlorinated Biphenyls (PCBs)	Low	No transformers or source of PCBs were identified at the time of the site visit. A pole mounted transformer was observed north of Lot 2.
Lead	Low	There was no lead containing materials observed at the site.
Ozone-depleting Substances (ODS)	Low	No ODS equipment was identified at the site at the time of the site visit.

Table F: Special Attention Items

Item	Presence/ Potential	Comments
Urea Formaldehyde Foam Insulation (UFFI)	Low	There was no UFFI observed at the site.
Radon	Low	There was no radon gas testing reported for the site; however, natural radon concentrations are low in Alberta and radon gas concentrations are usually well below target limits set for Canada. Additionally, there were no anthropogenic sources of radon gas identified.
Mould	Low	The personnel interviewed indicated that they were not aware of complaints related to potential mould and there were no obvious signs of mould (i.e., visible mould growth larger than 1 m^2) observed during the site visit.
Methane	Moderate	There was no methane gas testing reported for the site. Based upon information collected during this investigation, there could potentially be buried organics or coal material at the site that could produce methane. Refer to Section 3.3.5 regarding potential fill areas.
Electromagnetic Fields (EMF)	Low	There were no high-tension transmission lines or electrical substations that could generate significant EM fields identified within 100 m of the site. No EM assessment was completed by Tetra Tech EBA for the site.
Noise and Vibration	High	A CP rail line and Highway No. 3 is located west of Lot 1.

3.4 Site Observations

This section describes observations made of the site during the site visit.

3.4.1 Surficial Stains

No surficial stains were observed during the site visit; however, the site was snow covered at the time of the site visit limiting visual observations.

3.4.2 Vegetation

Vegetation at the site consists of domestic grasses and forbs. There was no evidence of stressed vegetation at the site at the time of the site visit, however, the site was snow covered and vegetation was in a dormant state.

3.4.3 Ponding of Water

There was no evidence of ponded water observed on the site during the site visit. The irrigation canal that bi-sects Lot 1 and Lot 2 is expected to contain water during warmer months.

3.4.4 Washouts and Erosion

There was no evidence of washouts or erosion observed during the site visit.

3.4.5 Fill Areas and Soil Conditions

There was no evidence of fill areas observed during the site visit at Lot 1.

Information was provided that fill material was imported to the site to provide a cap over the coal ash which was historically stockpiled at the northeastern corner of Lot 2.

3.4.6 Oil/Gas Wells and Pipelines

There were no wells or pipelines observed at the site or in the surrounding area.

Refer to Section 2.4.2 for AER information.

3.4.7 Waste Storage

There were no hazardous chemicals or large drums observed at the site.

3.4.8 Sumps and Drains

No sumps or drains were observed at the site during the site visit other than the storm sewer catch basins on Lot 2.

3.4.9 Chemical Storage

There were no hazardous chemicals or large drums observed at the site during the site visit.

3.4.10 Transformers

There was one pole mounted transformer observed north of Lot 2 near the residential properties. The transformer appeared to be in fair condition, and no staining was visible.

3.4.11 Hydraulic Elevators and Hoists

There were no hydraulic elevators or hoists observed at the site during the site visit.

3.4.12 Vent Pipes and Underground Storage Tanks

No vent pipes or USTs were observed during the site visit. The PTMAA search has no records of USTs present at the site. Please refer to Section 2.4.1 for further information on USTs in the surrounding area.

3.4.13 Above-ground Storage Tanks and Drum Storage

No ASTs were observed during on the site during the site visit. The PTMAA search has no records of ASTs present at the site. Please refer to Section 2.4.1 for further information on ASTs in the surrounding area.

3.4.14 General Housekeeping

The general housekeeping of Lot 1 and Lot 2 could be improved as there was evidence of illegal dumping observed during the site visit. Concrete, wood, and steel debris was observed at each Lot at the time of the site visit.

3.5 Off-site Observations

Tables G and H summarizes the surrounding land use for Lot 1 and Lot 2.

Table G: Surrounding Land Use Lot 1

Direction	Business Name/Land Use	Zoning*	Tetra Tech EBA Evaluation
North	Residential	Residential	Based on the current surrounding land use, no obvious potential for environmental concern has been identified.
East	Irrigation canal and vacant land (Lot 2)	Residential	
South	Residential	Residential	
West	CP rail line and Highway No. 3	Transportation	

* Zoning provided by Coalhurst Land Use Districts Map Bylaw 354-12.

Table H: Surrounding Land Use Lot 2

Direction	Business Name/Land Use	Zoning*	Tetra Tech EBA Evaluation
North	Residential and Coalhurst Elementary School	Residential and Public Institutional	Based on the current surrounding land use, no obvious potential for environmental concern has been identified.
East	Residential	Residential	
South	Residential and Agricultural	Residential and Agricultural	
West	Irrigation canal, residential, and vacant land (Lot 1)	Residential	

* Zoning provided by Coalhurst Land Use Districts Map Bylaw 354-12.

4.0 PERSONNEL INTERVIEWS

Tetra Tech EBA interviewed the following personnel during the Phase I ESA. The findings of the personnel interview, which have been incorporated into this report, are in general agreement with the records review conducted for the site. Table I summarizes the interviews.

Table I: Interview Summary

Item	Interviewee #1	Interviewee #2
Interviewee	Town of Coalhurst Personnel	Andy Veeres
Length of Involvement with Site	Approximately 5 years	Approximately 80 years
Information Provided	▪ Provided general information about the history of the site. ▪ Utilities information ▪ North American Collieries Ltd. Mine area in relation to site boundary. ▪ Suspected coal mine infrastructure located at the site. ▪ Construction of nearby residential communities.	▪ Indicated potential location of buried coal waste at Lot 2. ▪ Described blowing coal dust and legal action taken by residents of the neighboring subdivision of Imperial Meadows Subdivision Phase I. ▪ Indicated approximate location of Coalhurst mine and associated buildings. ▪ Provided history of the Community of Coalhurst and mining history.

Table I: Interview Summary

Item	Interviewee #1	Interviewee #2
Tetra Tech EBA Evaluation	Identified former coal mining infrastructure, rail line spurs, and utility ROWs.	Identified the buried coal waste within Lot 2 and subsequent capping.

5.0 DISCUSSION AND CONCLUSIONS

5.1 General

In general terms, there are two distinct types of potential environmental risk to any property. The first type of risk is from potential contamination from on-site land use. This would include potential accidental spills or site practices that may contaminate the property directly. The second type of risk is from contamination caused by adjacent property owners, which might then be transported through the subsurface soil by groundwater, or in overland runoff onto the site.

5.2 Potential for Impairment from On and Off-site Source

There was one source of potential environmental impairment from current and historical on and off-site land uses identified during this assessment. Table J outlines this source.

Table J: Potential On and Off-Site Source of Environmental Impairment

APEC	Source of Potential Impairment	Source of Information	Tetra Tech EBA Evaluation
1	Historic coal mine operations	Site interviews, land titles, aerial photographs, museum archives, coal mine atlas, and other archival sources.	According to historical records, portions of the Coalhurst Imperial mine historically had operations and/or infrastructure located on the site (Lot 2) including former rail lines (spurs) and a 'cinder dump'. Rail lines were historically constructed of coal ash and cinder. There is a potential for polycyclic aromatic hydrocarbon (PAH) and metal impacts to the soil on the north and northeastern portion of Lot 2. A portion of the cinder dump on Lot 2 was also capped with uncharacterized fill material which may potentially be a source of environmental impairment.

6.0 FURTHER ACTION RENDERING AN OPINION

Based on the Phase I ESA, further intrusive environmental investigation is warranted.

Tetra Tech EBA provides the following for consideration:

- It is noted that a rail line may have transected the most western portion of Lot 1, however, the overlay of the 1918 insurance plan on to the current day site plan may be skewed and this rail line may have been further west of the site.

- If buried debris or staining are encountered during future ground disturbance, a qualified environmental professional should be contacted.
- If soils containing organics are encountered during future investigation or ground disturbance, they should be removed from building footprints and not be reburied; a qualified environmental professional should be contacted.

7.0 CLOSURE

We trust this report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
Tetra Tech EBA Inc.

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REFERENCES

ABACUS DataGraphics Website. Updated December 24, 2015. AbaData database http://www.abacusdatagraphics.com/.

Alberta Energy Regulator. (Date of last update not available). http://www.aer.ca/data-and-publications/publications/maps-and-mapviewers.

Alberta Environment and Parks. (Date of last update not available). Authorization/Approval Viewer. http://www3.gov.ab.ca/env/water/approvalviewer.html.

Alberta Environment and Parks. (Date of last update not available). Environmental Site Assessment Repository. http://www.esar.alberta.ca/esarmain.aspx.

Alberta Environment and Parks. (Data of last update not available). Water Well Database. http://www.telusgeomatics.com/tgpub/ag water/.

Alberta Environment and Parks. (Date of last update not available). Aerial Photo Record System. http://secureexnet.env.gov.ab.ca/aprs/index.html

Alberta Registries. 2016. Land Title Certificates, Calgary Land Title Office.

Atlas of Alberta Railways. (Date of last update not available). http://railways.library.ualberta.ca/

Canada Standards Association. 2012. Z768-01, Phase I Environmental Site Assessment. Publishes November 2001, reaffirmed 2012.

Coalhurst Historical Society. 1984. Our Treasured Heritage, A History of Coalhurst and District.

Johnston, A., Gladwyn, K., Ellis, L., 1989. The Lethbridge: Its Coal Industry. The City of Lethbridge, Alberta.

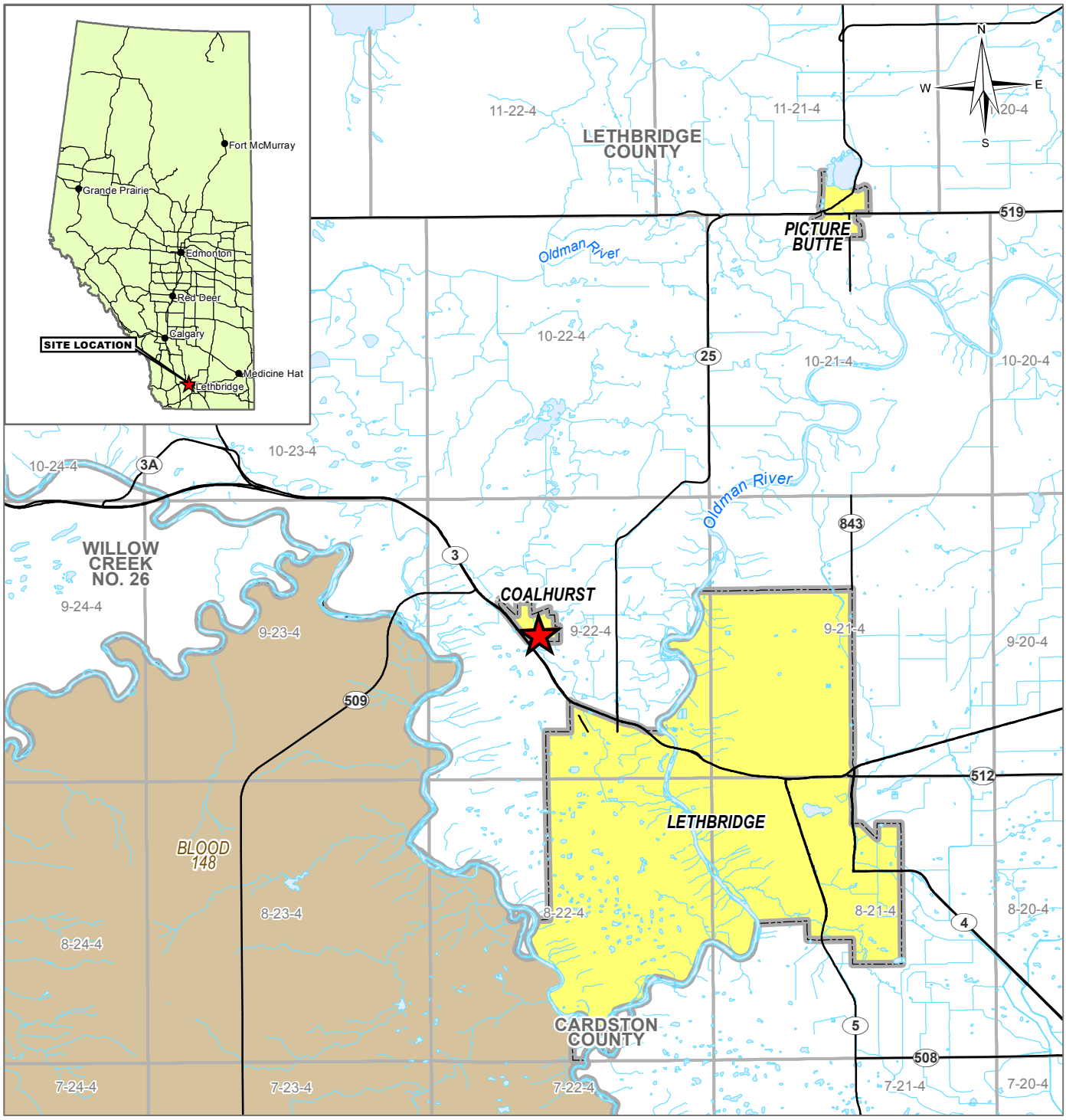
Shetson, I. 1981. Surficial Geology Lethbridge, Alberta. Alberta Research Council, Edmonton, Alberta.

The Alberta Government Spin II Website. (Date of last update not available). https://alta.registries.gov.ab.ca/spinii/logon.aspx

Tokarsky, O. 1973. Hydrogeological Map – Lethbridge-Fernie, Alberta (NTS 82G-H). Alberta Research Council, Edmonton, Alberta.

FIGURES

Figure 1 Site Location Plan
Figure 2 Detailed Site Plan Showing Surrounding Land Use
Figure 3 Site Plan Showing North American Collieries Ltd. 1918 Insurance Plan



LEGEND

- Site Location
- Road
- Watercourse
- Waterbody
- County Boundary
- Urban Area
- First Nation's Reserve

NOTES
Base data source: CanVec (1:50,000) & ESRI base data

STATUS
ISSUED FOR REVIEW

PHASE I ENVIRONMENTAL SITE ASSESSMENT PLAN 0614136, BLOCK 15, LOTS 1 AND 2

Site Location Plan

PROJECTION	DATUM	CLIENT
UTM Zone 12	NAD83	Town of Coalhurst

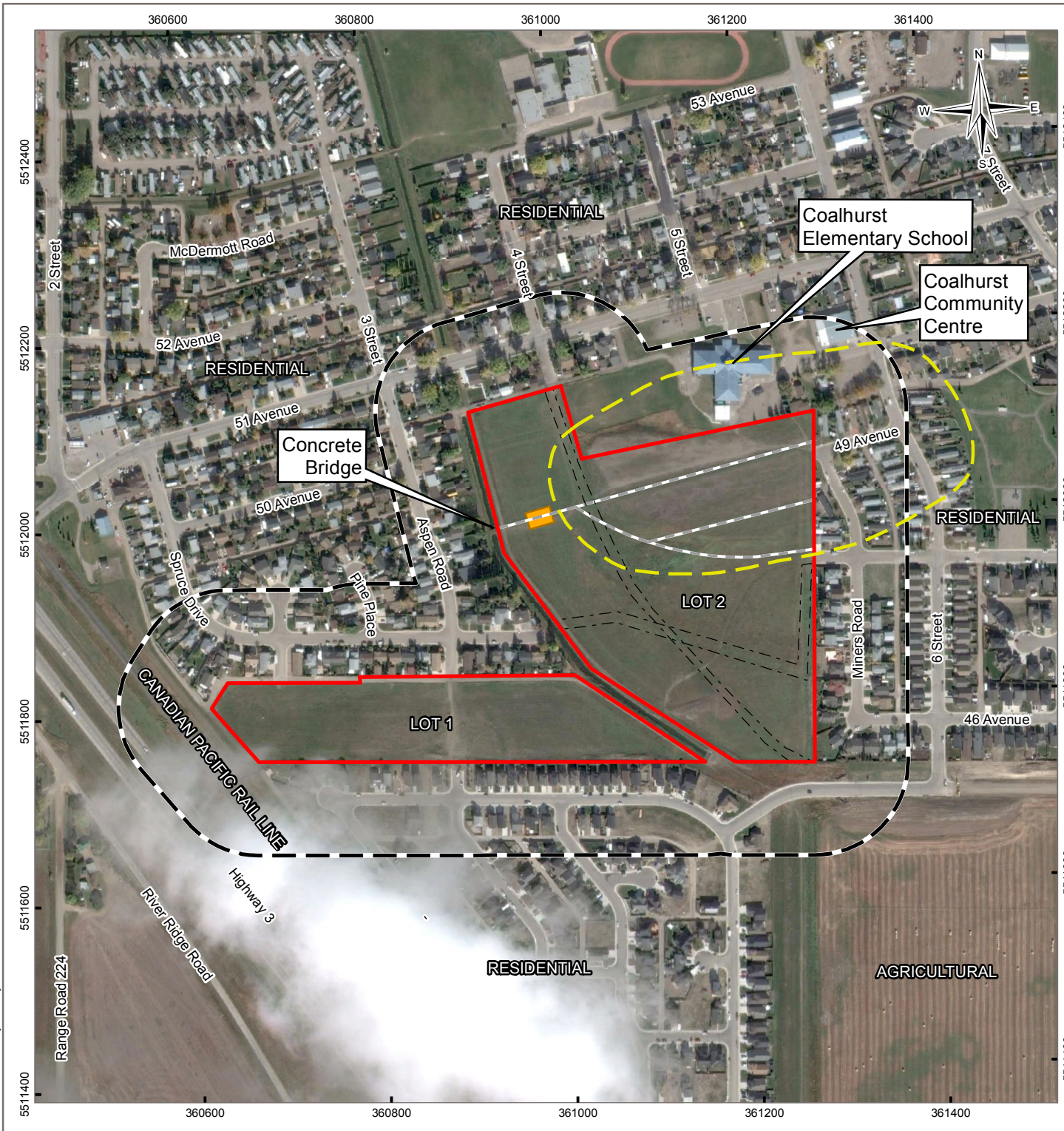
Scale: 1:200,000
2 1 0 2 4
Kilometres

TETRA TECH EBA

FILE NO.				
CENV03051_FIG1.mxd				
PROJECT NO.	**DWN**	**CKD**	**APVD**	**REV**
CENV03051-01	BB	MS	BC	0
OFFICE	**DATE**			
Tt EBA-CAL	February 1, 2015			

Figure 1

M:\ENVIRONMENTAL\CENV\CENV03051\Maps\CENV03051_FIG1.mxd modified 2/1/2016 by Brittney.Bietz



LEGEND

- Approximate Location of Former Rail Spur
- Approximate Location of Concrete Foundation
- Approximate Location of Coal Waste
- Site Boundary
- Utility Right of Way
- 100m Search Radius

NOTES
Base data source: CanVec (1:50,000)
Imagery: Google Earth Pro (2014)

STATUS
ISSUED FOR REVIEW

PHASE I ENVIRONMENTAL SITE ASSESSMENT PLAN 0614136, BLOCK 15, LOTS 1 AND 2

Detailed Site Plan Showing Surrounding Landuse

PROJECTION UTM Zone 12				**DATUM** NAD83	**CLIENT** Town of Coalhurst
Scale: 1:6,000 — 100 50 0 100 Metres					TETRA TECH EBA
FILE NO. CENV03051_FIG2.mxd					
PROJECT NO. CENV03051-01	**DWN** BB	**CKD** MS	**APVD** BC	**REV** 0	**Figure 2**
OFFICE Tt EBA-CAL	**DATE** January 2016				

M:\ENVIRONMENTAL\CENV\CENV03051\Maps\CENV03051_FIG2.mxd modified 2/1/2016 by Brittney.Bietz



LEGEND

- Site Boundary
- 100m Search Radius

NOTES
Base data source: CanVec (1:50,000)
Imagery: Google Earth Pro (2014)
Site boundary is approximate
Insurance drawing has been distorted

STATUS
ISSUED FOR REVIEW

PHASE I ENVIRONMENTAL SITE ASSESSMENT
PLAN 0614136, BLOCK 15, LOTS 1 AND 2

Site Plan Showing North American Collieries Ltd. 1918 Insurance Plan

PROJECTION	DATUM	CLIENT
UTM Zone 12	NAD83	Town of Coalhurst

Scale: 1:6,000
100 50 0 100
Metres

FILE NO. CENV03051_FIG3.mxd

PROJECT NO.	DWN	CKD	APVD	REV
CENV03051-01	BB	MS	BC	0

OFFICE	DATE
Tt EBA-CAL	January 2016

TETRA TECH EBA

Figure 3

M:\ENVIRONMENTAL\CENV\CENV03051\Maps\CENV03051_FIG3.mxd modified 2/1/2016 by Brittney.Bietz

APPENDIX A
TETRA TECH EBA'S GENERAL CONDITIONS

GENERAL CONDITIONS

ENVIRONMENTAL PHASE I REPORT

This report incorporates and is subject to these “General Conditions”.

1.0 USE OF REPORT AND OWNERSHIP

This report pertains to a specific site, a specific development, and a specific scope of work. It is not applicable to any other sites.

This report and the assessments and recommendations contained in it are intended for the sole use of Tetra Tech EBA’s Client unless otherwise authorized in writing by Tetra Tech EBA. Any unauthorized use of the report is at the sole risk of the user.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of Tetra Tech EBA. Additional copies of the report, if required, may be obtained upon request.

2.0 ALTERNATE REPORT FORMAT

Where Tetra Tech EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed Tetra Tech EBA’s instruments of professional service), only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by Tetra Tech EBA shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of Tetra Tech EBA’s instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except Tetra Tech EBA. Tetra Tech EBA’s instruments of professional service will be used only and exactly as submitted by Tetra Tech EBA.

Electronic files submitted by Tetra Tech EBA have been prepared and submitted using specific software and hardware systems. Tetra Tech EBA makes no representation about the compatibility of these files with the Client’s current or future software and hardware systems.

3.0 NOTIFICATION OF AUTHORITIES

In certain instances, the discovery of hazardous substances or conditions and materials may require that regulatory agencies and other persons be informed and the Client agrees that notification to such bodies or persons as required may be done by Tetra Tech EBA in its reasonably exercised discretion.

4.0 INFORMATION PROVIDED TO TETRA TECH EBA BY OTHERS

During the performance of the work and the preparation of the report, Tetra Tech EBA may rely on information provided by persons other than the Client. While Tetra Tech EBA endeavours to verify the accuracy of such information when instructed to do so by the Client, Tetra Tech EBA accepts no responsibility for the accuracy or the reliability of such information which may affect the report.

APPENDIX B
SITE PHOTOGRAPHS



Photo 1: View facing east from the western boundary of Lot 1.



Photo 2: View facing northwest from the site northwestern boundary. The Canadian Pacific rail line and Crowsnest Highway No. 3 is visible.



Photo 3: View facing southeast toward the centre of Lot 1.



Photo 4: Debris identified at Lot 1.



Photo 5: View facing northwest from the southeastern boundary of Lot 1.



Photo 6: View facing southwest along western boundary of Lot 1, the irrigation canal is visible.



Photo 7: View of irrigation canal infrastructure near southern boundary of Lot 1.



Photo 8: View facing northeast from southwestern boundary of Lot 2. The Coalhurst Elementary school and residential properties east of Lot 2 are visible.



Photo 9: View facing east toward the north portion of Lot 2. The Coalhurst Elementary school and surrounding residential properties is visible.



Photo 10: View of concrete structure (bridge) over the irrigation canal, located at the western boundary of Lot 2.



Photo 11: View facing southeast across Lot 2 from the western site boundary.



Photo 12: View facing east toward concrete foundation located on the western portion of Lot 2.



Photo 13: View facing northwest across Lot 2 from eastern site boundary.

APPENDIX C

PHASE I ENVIRONMENTAL SITE ASSESSMENT INFORMATION

LAND TITLE CERTIFICATE

S

LINC	SHORT LEGAL	TITLE NUMBER
0032 044 570	0614136;15;1	151 331 564

LEGAL DESCRIPTION

DESCRIPTIVE PLAN 0614136
BLOCK 15
LOT 1
EXCEPTING THEREOUT ALL MINES AND MINERALS
AREA: 3.958 HECTARES (9.78 ACRES) MORE OR LESS

ATS REFERENCE: 4;22;9;21;SW
ESTATE: FEE SIMPLE

MUNICIPALITY: TOWN OF COALHURST

REFERENCE NUMBER: 111 276 937

REGISTERED OWNER(S)

REGISTRATION	DATE (DMY)	DOCUMENT TYPE	VALUE	CONSIDERATION
151 331 564	17/12/2015	TRANSFER OF LAND		SEE INSTRUMENT

OWNERS

TOWN OF COALHURST.
OF P.O.BOX 456
COALHURST
ALBERTA T0L 0V0

ENCUMBRANCES, LIENS & INTERESTS

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
741 091 031	27/09/1974	IRRIGATION ORDER/NOTICE THIS PROPERTY IS INCLUDED IN THE LETHBRIDGE NORTHERN IRRIGATION DISTRICT
941 115 635	06/05/1994	CAVEAT RE : SEE CAVEAT CAVEATOR - THE VILLAGE OF COALHURST.

(CONTINUED)

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
		BOX 456, COALHURST ALBERTA T0L0V0 AGENT - DAVID A VERES
061 477 312	16/11/2006	CAVEAT RE : DEFERRED RESERVE CAVEATOR - TOWN OF COALHURST. OLDMAN RIVER REGIONAL SERVICES COMMISSION 3105 16TH AVENUE NORHT LETHBRIDGE ALBERTA T1H5E8
151 331 565	17/12/2015	MORTGAGE MORTGAGEE - CANADA FINANCE CORPORATION LIMITED. 417, 5920-1A ST SW CALGARY ALBERTA T2H0G3 ORIGINAL PRINCIPAL AMOUNT: $150,000

TOTAL INSTRUMENTS: 004

THE REGISTRAR OF TITLES CERTIFIES THIS TO BE AN ACCURATE REPRODUCTION OF THE CERTIFICATE OF TITLE REPRESENTED HEREIN THIS 14 DAY OF JANUARY, 2016 AT 09:00 A.M.

ORDER NUMBER: 29934191

CUSTOMER FILE NUMBER:

END OF CERTIFICATE

THIS ELECTRONICALLY TRANSMITTED LAND TITLES PRODUCT IS INTENDED FOR THE SOLE USE OF THE ORIGINAL PURCHASER, AND NONE OTHER, SUBJECT TO WHAT IS SET OUT IN THE PARAGRAPH BELOW.

THE ABOVE PROVISIONS DO NOT PROHIBIT THE ORIGINAL PURCHASER FROM INCLUDING THIS UNMODIFIED PRODUCT IN ANY REPORT, OPINION, APPRAISAL OR OTHER ADVICE PREPARED BY THE ORIGINAL PURCHASER AS PART OF THE ORIGINAL PURCHASER APPLYING PROFESSIONAL, CONSULTING OR TECHNICAL EXPERTISE FOR THE BENEFIT OF CLIENT(S).

LAND TITLE CERTIFICATE

S

LINC	SHORT LEGAL	TITLE NUMBER
0032 044 588	0614136;15;2	151 331 564 +1

LEGAL DESCRIPTION

DESCRIPTIVE PLAN 0614136
BLOCK 15
LOT 2
EXCEPTING THEREOUT ALL MINES AND MINERALS
AREA: 9.192 HECTARES (22.71 ACRES) MORE OR LESS

ATS REFERENCE: 4;22;9;21;SW
ESTATE: FEE SIMPLE

MUNICIPALITY: TOWN OF COALHURST

REFERENCE NUMBER: 111 276 937 +1

REGISTERED OWNER(S)

REGISTRATION	DATE(DMY)	DOCUMENT TYPE	VALUE	CONSIDERATION
151 331 564	17/12/2015	TRANSFER OF LAND		SEE INSTRUMENT

OWNERS

TOWN OF COALHURST.
OF P.O.BOX 456
COALHURST
ALBERTA T0L 0V0

ENCUMBRANCES, LIENS & INTERESTS

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
741 091 031	27/09/1974	IRRIGATION ORDER/NOTICE THIS PROPERTY IS INCLUDED IN THE LETHBRIDGE NORTHERN IRRIGATION DISTRICT
941 115 635	06/05/1994	CAVEAT RE : SEE CAVEAT CAVEATOR - THE VILLAGE OF COALHURST.

(CONTINUED)

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
		BOX 456, COALHURST ALBERTA T0L0V0 AGENT - DAVID A VERES
131 218 178	30/08/2013	UTILITY RIGHT OF WAY GRANTEE - TOWN OF COALHURST.
131 218 215	30/08/2013	DISCHARGE OF UTILITY RIGHT OF WAY 131218178 PARTIAL EXCEPT PLAN/PORTION: 1312267
151 331 565	17/12/2015	MORTGAGE MORTGAGEE - CANADA FINANCE CORPORATION LIMITED. 417, 5920-1A ST SW CALGARY ALBERTA T2H0G3 ORIGINAL PRINCIPAL AMOUNT: $150,000

TOTAL INSTRUMENTS: 005

THE REGISTRAR OF TITLES CERTIFIES THIS TO BE AN ACCURATE REPRODUCTION OF THE CERTIFICATE OF TITLE REPRESENTED HEREIN THIS 22 DAY OF JANUARY, 2016 AT 08:17 A.M.

ORDER NUMBER: 29981793

CUSTOMER FILE NUMBER:

END OF CERTIFICATE

THIS ELECTRONICALLY TRANSMITTED LAND TITLES PRODUCT IS INTENDED FOR THE SOLE USE OF THE ORIGINAL PURCHASER, AND NONE OTHER, SUBJECT TO WHAT IS SET OUT IN THE PARAGRAPH BELOW.

THE ABOVE PROVISIONS DO NOT PROHIBIT THE ORIGINAL PURCHASER FROM INCLUDING THIS UNMODIFIED PRODUCT IN ANY REPORT, OPINION, APPRAISAL OR OTHER ADVICE PREPARED BY THE ORIGINAL PURCHASER AS PART OF THE ORIGINAL PURCHASER APPLYING PROFESSIONAL, CONSULTING OR TECHNICAL EXPERTISE FOR THE BENEFIT OF CLIENT(S).

Petroleum Tank Management
Association of Alberta
Suite 980, 10303 Jasper Avenue
Edmonton, Alberta T5J 3N6
PH: (780)425-8265 or 1-866-222-8265
FAX: (780)425-4722

January 19, 2016

Brad Calder
Tetra Tech EBA Inc.
442 10 Street N
Lethbridge, AB
T1H 2C7

Dear Brad Calder:

As per your request, the PTMAA has checked the registration of active tank sites and inventory of abandoned tank sites and there are no records for the properties with the legal land description:

Plan 0614136, Block 15, Lot 1 & 2
SW 21-9-22-W4

Please note that both databases are not complete. The main limitation of these databases is that they only include information reported through registration or a survey of abandoned sites completed in 1992 and should not be considered as a comprehensive inventory of all past or present storage tank sites. The PTMAA **cannot** guarantee that tanks do not or have not existed at this location. Information in the databases is based on information supplied by the owner and the PTMAA cannot guarantee its accuracy. Information on storage tanks or on past or present contaminant investigations may be filed with the local Fire Department or Alberta Environment.

Yours truly,

Connie Jacobsen
PTMAA



Wellheads

- Abandoned Wellhead
- Suspended Gas Wellhead
- Suspended Oil Wellhead
- Flowing Gas Wellhead
- Location Wellhead
- Flowing Oil Wellhead
- Miscellaneous Wellhead
- Water Wellhead
- Well Downhole Location
- Newly Licenced Well
- Newly Spudded Well

High Pressure Pipelines

- Gas Pipeline
- Oil Pipeline
- Water Pipeline
- LVP/HVP Pipeline
- Foreign Pipeline (Only when a company is specified.)

Low Pressure Pipelines

- Gas Co-op Pipeline

Quick Links

- Environmental Hotline 1-800-222-6514
- Air Quality Health Index
- Climate Change
- Harvie Passage
- River Basins
- River Level Advisories
- Drinking Water Quality
  - Electronic Submission of Drinking Water Quality Information Secure Entry
- Access to information
- Authorization Viewer

Questions and Comments

- Website feedback

Authorization Viewer | Traditional Agriculture Registration Viewer | Help

Authorization Viewer - Search Results

The Search Used the Following Values:	
Legal Land Location:	SW 21-009-22-W4
Act / Document Type:	Water Act, EPEA
Show Inactive Authorizations:	Yes

The resulting Authorizations based on the search criteria will be displayed below. A will appear next to the Authorization when documentation is available for viewing or downloading. Please click Viewer Help if you encounter problems viewing the Authorization document.

0 Result(s)

Clear & Return

Comments regarding the Authorization Viewer page may be directed to the Regulatory Approvals Centre
RAC.Environment@gov.ab.ca

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Quick Links

- Environmental Hotline 1-800-222-6514
- Air Quality Health Index
- Climate Change
- Harvie Passage
- River Basins
- River Level Advisories
- Drinking Water Quality
  - Electronic Submission of Drinking Water Quality Information Secure Entry
- Access to information
- Authorization Viewer

Questions and Comments

- Website feedback

Authorization Viewer | Traditional Agriculture Registration Viewer | Help

Authorization Viewer - Search Results

The Search Used the Following Values:

Area Parcel:	Plan 0514136 Block: 15 Lot: 1
Act / Document Type:	Water Act, EPEA
Show Inactive Authorizations:	Yes

The resulting Authorizations based on the search criteria will be displayed below. A PDF will appear next to the Authorization when documentation is available for viewing or downloading. Please click Viewer Help if you encounter problems viewing the Authorization document.

0 Result(s)

Clear & Return

Comments regarding the Authorization Viewer page may be directed to the Regulatory Approvals Centre RAC.Environment@gov.ab.ca.

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Quick Links

- Environmental Hotline 1-800-222-6514
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- Drinking Water Quality
  - Electronic Submission of Drinking Water Quality Information Secure Entry
- Access to information
- Authorization Viewer

Questions and Comments

- Website feedback

Authorization Viewer | Traditional Agriculture Registration Viewer | Help

Authorization Viewer - Search Results

The Search Used the Following Values:

Area Parcel:	Plan: 0614136 Block: 15 Lot: 2
Act / Document Type:	Water Act, EPEA
Show Inactive Authorizations:	Yes

The resulting Authorizations based on the search criteria will be displayed below. A PDF will appear next to the Authorization when documentation is available for viewing or downloading. Please click Viewer Help if you encounter problems viewing the Authorization document.

0 Result(s)

Clear & Return

Comments regarding the Authorization Viewer page may be directed to the Regulatory Approvals Centre RAC.Environment@gov.ab.ca.

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Alberta Environment and Parks

The ESA marker represents an approximate location of a site where the Government of Alberta has received scientific and/or technical information. The marker is an arbitrary, 40 meter diameter circle centered on the property for which this information is attached. For locations or other site information, see the document results table.

Spatial Search provided by the Alberta Land Titles SPIN 2 System

Search Form | Map Search

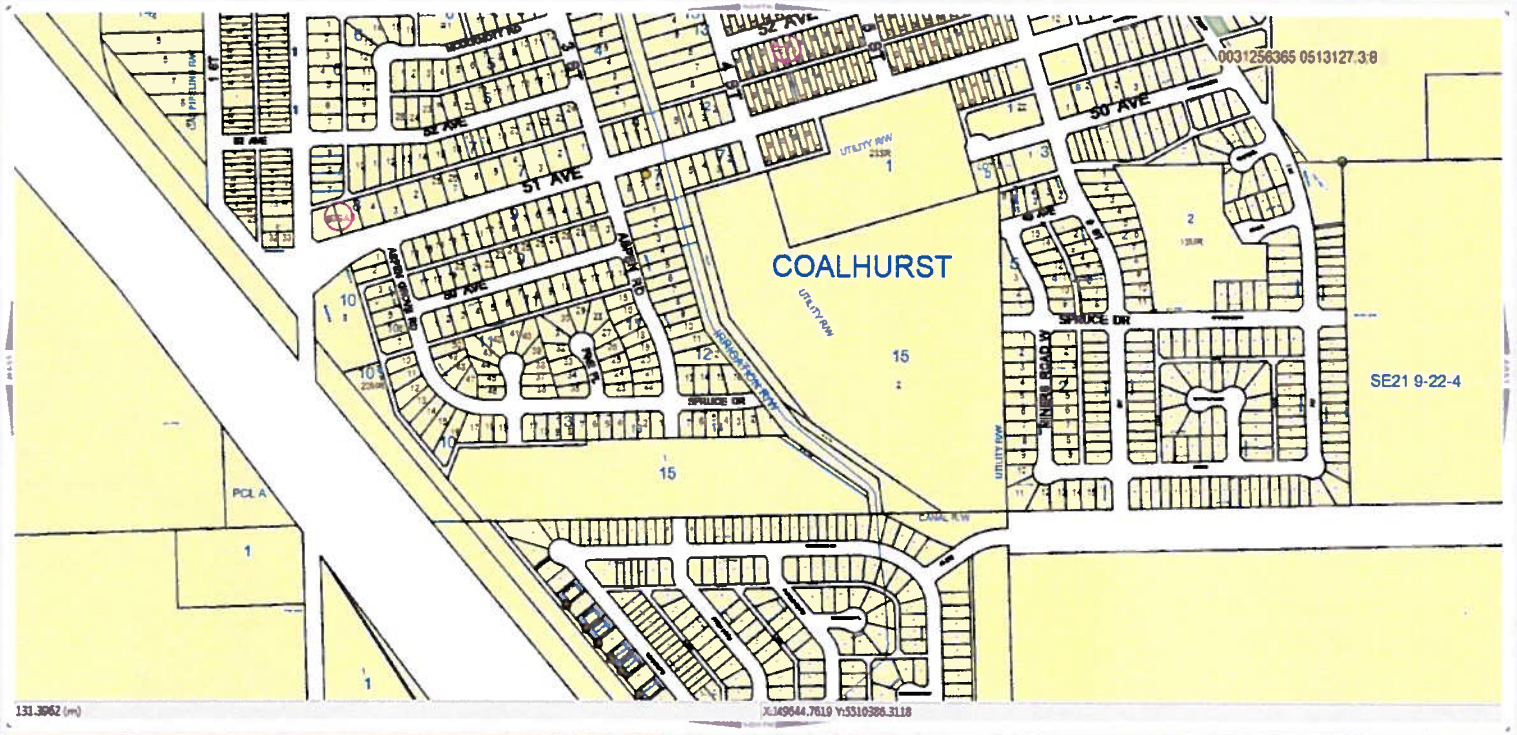
A designated location identifies a site where Alberta Environment has received scientific or technical information for that site and does not imply anything regarding the current state or condition of the site. Please refer to the studies and reports to determine the condition of the site

ATS

Meridian W -	4
Range	22
Township	009
Section	21
[Quarter]	

Search

- PBL
- Address
- Place Name
- Coordinate
- Help with Map



Map Views | Map Information | Map Navigation | Map Tools

Alberta Water Well Information Database Map



Alberta Water Well Information Database Map

Projection
Web Mercator (Auxillary Sphere)

Datum
WGS 84

Date
1/27/2016 8:48:01 AM

Legend
- Groundwater Drilling Report
- Baseline Water Well Report

http://groundwater.alberta.ca/WaterWells/d/

Information as depicted is subject to change, therefore the Government of Alberta assumes no responsibility for discrepancies at time of use.
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Water Well Drilling Report

View in Imperial | Export to Excel

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GOWN ID

GIC Well ID: 109578
GoA Well Tag No.:
Drilling Company Well ID:
Date Report Received:

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
N AMER CO					

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	02	21	009	22	4				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 49.743774 Longitude -112.922720
How Location Obtained: Not Verified

Elevation 931.77 m
How Elevation Obtained: Estimated

Drilling Information

Method of Drilling: Unknown

Type of Work: Test Hole

Proposed Well Use: Unknown

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description
4.88		Sandy Clay
22.86		Brown Soft Clay
39.01		Blue Sandy Clay
48.16		White Sandy Clay
52.43		Very Fine Grained Sand
57.91		Clay & Boulders
65.53		Fine Grained Sand
68.88		Blue Soft Clay
76.81		Gravel
134.72		Shale
135.94		Blue Shale
139.90		Shale
144.17		Black Shale
146.30		Blue Shale
169.47		Black Shale
169.77		Coal
170.38		Black Hard Shale
170.69		Coal
175.56		Blue Hard Shale
175.87		Hard Rocks
176.78		Black Shale
178.31		Coal
180.75		Black Hard Shale

Yield Test Summary

Measurement in Metric

Recommended Pump Rate: L/min

Test Date	Water Removal Rate (L/min)	Static Water Level (m)

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
180.75 m			

Borehole

Diameter (cm)	From (m)	To (m)
0.00	0.00	180.75

Surface Casing (if applicable)

Size OD: 0.00 cm
Wall Thickness: 0.000 cm
Bottom at: 0.00 m

Well Casing/Liner

Size OD: 0.00 cm
Wall Thickness: 0.000 cm
Top at: 0.00 m
Bottom at: 0.00 m

Perforations

From (m)	To (m)	Diameter or Slot Width (cm)	Slot Length (cm)	Hole or Slot Interval(cm)

Perforated by

Annular Seal

Placed from 0.00 m to 0.00 m
Amount

Other Seals

Type	At (m)

Screen Type

Size OD: 0.00 cm

From (m)	To (m)	Slot Size (cm)

Attachment
Top Fittings
Bottom Fittings

Pack

Type
Grain Size
Amount

Contractor Certification

Name of Journeyman responsible for drilling/construction of well: UNKNOWN NA DRILLER

Certification No: 1

Company Name: UNKNOWN DRILLER

Copy of Well report provided to owner

Date approval holder signed

Water Well Drilling Report

View in Imperial | Export to Excel

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GOWN ID

GIC Well ID 109578
GoA Well Tag No.
Drilling Company Well ID
Date Report Received

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
N AMER CO					

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	02	21	009	22	4				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 49.743774 Longitude -112.922720
How Location Obtained
Not Verified

Elevation 931.77 m
How Elevation Obtained
Estimated

Additional Information

Measurement in Metric

Distance From Top of Casing to Ground Level ____ cm
Is Artesian Flow ____
Rate ____ L/min

Is Flow Control Installed ____
Describe ____

Recommended Pump Rate ____ L/min
Recommended Pump Intake Depth (From TOC) ____ m

Pump Installed ____ Depth ____ m
Type ____ Make ____ H.P. ____
Model (Output Rating) ____

Did you Encounter Saline Water (>4000 ppm TDS) ____ Depth ____ m
Gas ____ Depth ____ m

Well Disinfected Upon Completion ____
Geophysical Log Taken ____
Submitted to ESRD

Sample Collected for Potability ____ Submitted to ESRD ____

Additional Comments on Well

Yield Test

Taken From Ground Level | Measurement in Metric

Test Date	Start Time	Static Water Level
		m

Method of Water Removal

Type ____
Removal Rate ____ L/min
Depth Withdrawn From ____ m

If water removal period was < 2 hours, explain why

Water Diverted for Drilling

Water Source	Amount Taken	Diversion Date & Time
	L	

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Certification No
1

Company Name
UNKNOWN DRILLER

Copy of Well report provided to owner | Date approval holder signed

Water Well Drilling Report

View in Imperial | Export to Excel

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GOWN ID

GIC Well ID: 109583
GoA Well Tag No.:
Drilling Company Well ID:
Date Report Received: 1972/08/18

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
COALHURST, HAMLET OF					

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
		21	009	22	4				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 49.749198 Longitude -112.925513
How Location Obtained: Not Verified

Elevation m
How Elevation Obtained: Not Obtained

Drilling Information

Method of Drilling: Hand Dug
Proposed Well Use: Domestic
Type of Work: Chemistry

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description

Yield Test Summary

Measurement in Metric

Recommended Pump Rate: 0.00 L/min

Test Date	Water Removal Rate (L/min)	Static Water Level (m)
1972/07/31		1.83

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
6.10 m			

Borehole

Diameter (cm)	From (m)	To (m)
0.00	0.00	6.10

Surface Casing (if applicable)
Size OD: 0.00 cm
Wall Thickness: 0.000 cm
Bottom at: 0.00 m

Well Casing/Liner
Size OD: 0.00 cm
Wall Thickness: 0.000 cm
Top at: 0.00 m
Bottom at: 0.00 m

Perforations

From (m)	To (m)	Diameter or Slot Width (cm)	Slot Length (cm)	Hole or Slot Interval(cm)

Perforated by

Annular Seal
Placed from 0.00 m to 0.00 m
Amount

Other Seals

Type	At (m)

Screen Type
Size OD: 0.00 cm

From (m)	To (m)	Slot Size (cm)

Attachment
Top Fittings
Bottom Fittings

Pack
Type
Grain Size
Amount

Contractor Certification

Name of Journeyman responsible for drilling/construction of well: UNKNOWN NA DRILLER
Certification No: 1
Company Name: UNKNOWN DRILLER
Copy of Well report provided to owner
Date approval holder signed

Water Well Drilling Report

View in Imperial | Export to Excel

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GOWN ID

GIC Well ID 109583
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1972/08/18

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
COALHURST, HAMLET OF					

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
		21	009	22	4				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 49.749198 Longitude -112.925513
How Location Obtained: Not Verified

Elevation m
How Elevation Obtained: Not Obtained

Additional Information

Measurement in Metric

Distance From Top of Casing to Ground Level: cm
Is Artesian Flow:
Rate: L/min
Is Flow Control Installed:
Describe:

Recommended Pump Rate: 0.00 L/min
Recommended Pump Intake Depth (From TOC): 0.00 m
Pump Installed: Depth: m
Type: Make: H.P.:
Model (Output Rating):

Did you Encounter Saline Water (>4000 ppm TDS): Depth: m
Gas: Depth: m
Well Disinfected Upon Completion:
Geophysical Log Taken:
Submitted to ESRD:
Sample Collected for Potability:
Submitted to ESRD: Yes

Additional Comments on Well:

Yield Test

Taken From Ground Level
Depth to water level

Measurement in Metric

Test Date	Start Time	Static Water Level
1972/07/31	12:00 AM	1.83 m

Drawdown (m)	Elapsed Time Minutes:Sec	Recovery (m)

Method of Water Removal
Type:
Removal Rate: L/min
Depth Withdrawn From: 0.00 m

If water removal period was < 2 hours, explain why:

Water Diverted for Drilling

Water Source	Amount Taken	Diversion Date & Time
	L	

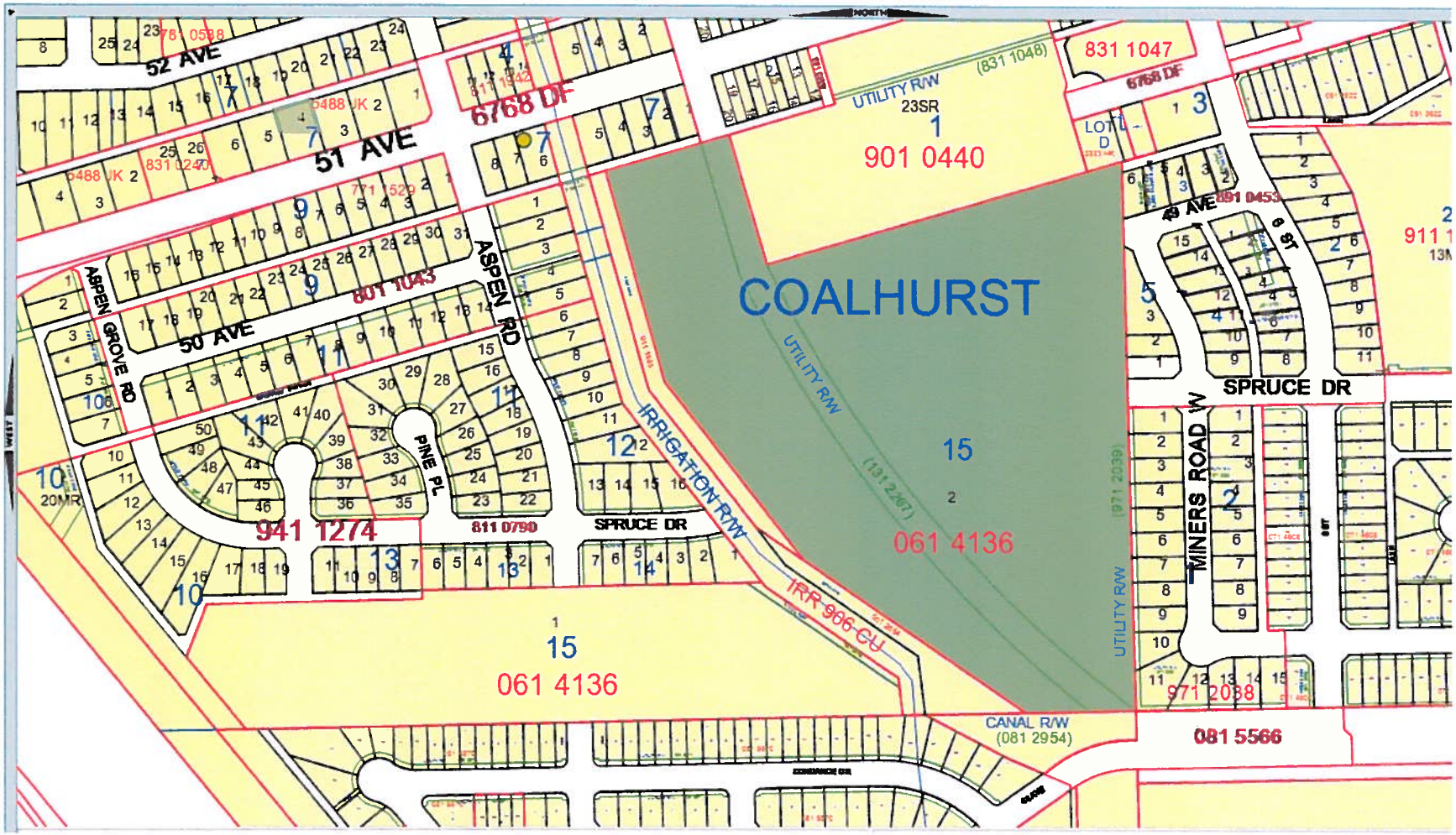
Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Certification No
1

Company Name
UNKNOWN DRILLER

Copy of Well report provided to owner | Date approval holder signed



COALHURST
901 0440
061 4136
061 4136
941 1274
831 1047
6768 DF
6768 DF
52 AVE
51 AVE
50 AVE
49 AVE
ASPEN RD
ASPEN GROVE RD
PINE PL
SPRUCE DR
SPRUCE DR
MINERS ROAD W
UTILITY R/W
UTILITY R/W
UTILITY R/W
IRRIGATION R/W
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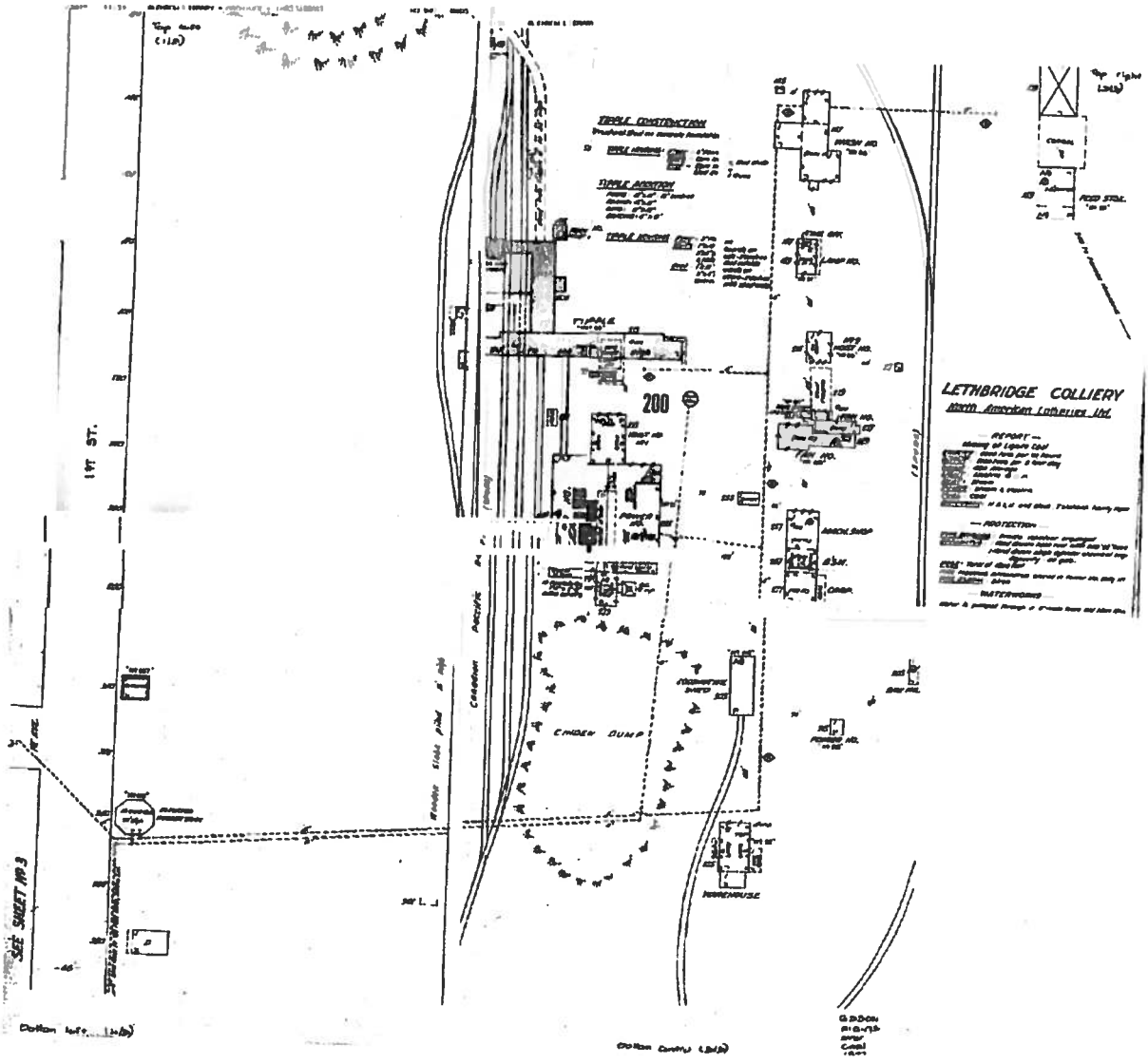
801 1043
811 0790
831 0240
781 0588




LETHBRIDGE COLLIERY
North American Collieries Ltd.
200
1ST ST.
CINDER DUMP
SEE SHEET NO 3

APPENDIX D

SPECIAL ATTENTION ITEMS – BACKGROUND INFORMATION

BACKGROUND INFORMATION

ASBESTOS

Construction materials used prior to the late 1970s were known to possibly contain asbestos (e.g., ceiling or floor tiles, drywall, and insulation for the walls, boiler, piping, and/or ducts). Asbestos is considered a health hazard if it is friable, airborne, and exposed to humans.

POLYCHLORINATED BIPHENYLS

The federal Environmental Contaminants Act (1976) has restricted the use and controlled the phase out of polychlorinated biphenyls (PCBs) in Canada. Additionally, the storage and disposal of PCBs is regulated. The Act prohibited the use of PCBs in electrical equipment installed after July 1, 1980. PCBs are commonly found in light ballasts, electrical transformers (pole-mounted or ground-mounted) and various other types of electrical equipment (i.e., rectifiers) dating back to the early 1980s or earlier.

PCB containing light ballasts or electrical equipment should be disposed of appropriately at the end of their useful life.

OZONE-DEPLETING SUBSTANCES

In December of 1998, The Government of Canada enacted the Ozone-depleting Substances (ODS) Regulations, which governs the use, handling and release of ODS. ODS may include, but are not limited to, chlorofluorocarbons (CFCs), halons, carbon tetrachloride, and methyl bromide. ODS are usually associated with operations such as: fire extinguishing systems; foam manufacturing; fumigant and pesticide application; prescription metered dose inhalers; refrigeration and air conditioning units; and solvent cleaning and degreasing facilities. ODS are not a health issue for people in the building, but are more a maintenance issue to limit or prevent their release. This is accomplished by regular maintenance by trained personnel.

LEAD

Lead can be associated with paints, plumbing solder, pipes, and other products such as wall shielding in x-ray rooms. Lead-based paint was withdrawn from the market in the late 1970s. If present, lead-based paint is typically concealed beneath multiple layers of paint applied over the years during renovations. Lead-based paint and plumbing equipment are not a direct health risk when concealed (sealed behind layers of non-lead paint) and/or in good condition. It should; however, be considered when planning future renovations, when particles from lead-based paint could be released and/or ingested in the course of the work.

UREA FORMALDEHYDE FOAM INSULATION

Insulation materials used during the 1970s and 1980s were known to possibly contain urea formaldehyde foam insulation (UFFI). UFFI was banned in 1980 under the federal Hazardous Products Act.

RADON

Radon gas is a product of the decay series that begins with uranium. Radon is produced directly from radium that is often found in bedrock that contains black shale and/or granite. The gas and its by-products occur naturally everywhere, in soil, water, and air, but usually in concentrations too low to pose a threat. Radon gas can migrate through the ground and enter buildings through porous concrete or fractures. Certain building materials including concrete and gyprock can also release radon. Natural radon concentrations are low in Alberta and radon gas concentrations are usually well below target limits set for Canada. Potential anthropogenic sources of radon gas should be considered.

METHANE

Methane gas is a product of anaerobic decomposition of organic material (e.g., buried fill high in organic material). Methane is also associated with natural gas deposits. Methane gas can migrate through the ground and enter buildings through porous concrete, joints, or fractures. Methane presents a potential explosive hazard when it accumulates to concentrations greater than the lower explosive limit (LEL) in the presence of an ignition source.

MOULD

Mould can be found anywhere in a building; however, it is usually associated with enclosed, damp areas. If the personnel interviewed indicated that they were not aware of complaints related to potential mould in the building, and/or there were no obvious signs of mould (i.e., visible mould growth larger than 1 m^2) observed during the site visit, a mould assessment is not typically conducted within the scope of a Phase I environmental site assessment.

APPENDIX

APPENDIX 3 ~ CONFIRMATORY SAMPLING PROGRAM

TETRA TECH EBA

Confirmatory Sampling Program
Lot 1 , Block 15, Plan 0614136
Coalhurst, Alberta





PRESENTED TO
Town of Coalhurst

APRIL 2016
ISSUED FOR USE
FILE: ENV.CENV03051-02.001

CONSULTING ENGINEERS & SCIENTISTS · www.eba.ca

Tetra Tech EBA Inc.
442 - 10 Street N.
Lethbridge, AB T1H 2C7 CANADA
Tel 403.329.9009 Fax 403.328.8817

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1.3 Authorization 1
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Figure 2 Site Plan Showing Testpit Locations

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Appendix B Testpit Logs
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LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of the Town of Coalhurst and their agents. Tetra Tech EBA Inc. (Tetra Tech EBA) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than the Town of Coalhurst, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this report is subject to the terms and conditions stated in Tetra Tech EBA's Services Agreement. Tetra Tech EBA's General Conditions are provided in Appendix A of this report.

1.0 INTRODUCTION

1.1 General

Tetra Tech EBA Inc. (Tetra Tech EBA) was retained by the Town of Coalhurst (the Town) to conduct a confirmatory sampling program at a property located in Coalhurst, Alberta, legally described as Lot 1, Block 15, Plan 0614136, within SW 21-009-22 W4M (Figure 1), hereinafter referred to as the 'site'. No municipal address is currently associated with the site.

The confirmatory sampling program was initiated based on the results of a Phase I Environmental Site Assessment (ESA) conducted at the site in February 2016 (Tetra Tech EBA File No. ENV.CENV03051-01, dated February 2016). The Phase I ESA identified a former rail line that may have transected the most northwestern portion of the site and that the rail line was likely associated with the former Coalhurst Imperial mine that was historically located to the east of the site.

Tetra Tech EBA understands that the Town currently owns the site and requires this environmental investigation as part of its due diligence to support site redevelopment.

The confirmatory sampling program was conducted in general accordance with the Canadian Standards Association (CSA) Standard Z769-00 (2013 update). The project was completed under Tetra Tech EBA's Geoenvironmental Report – General Conditions for conducting environment work. A copy of these conditions is provided in Appendix A.

1.2 Project Objective

The objective of the confirmatory sampling program was to assess the chemical quality of the soil related to the former rail line that may have transected the northwest portion of the site.

1.3 Authorization

Mr. Kevin Lewis, Director of Operations with the Town, provided written authorization to Tetra Tech EBA to proceed with the present study on Feburary 16, 2016.

1.4 Scope of Work

The scope of work for the confirmatory sampling program included the following:

- Requested Alberta One-Call to conduct utility locates prior to commencing ground disturbance activities;
- Prepared a health and safety plan for the confirmatory sampling program using Tetra Tech EBA's in-house safe work form (SWF). A safety meeting, including a field level risk assessment, was conducted on site prior to the start of work;
- Conducted testpitting at two locations using a rubber tire backhoe to a maximum depth of 1.5 metres below grade (mbg);
- Obtained representative soil samples at regular intervals during testpitting. Described the soil according to the Unified Soil Classification System (USCS);
- Conducted combustible vapour concentration (CVC) measurements on soil samples using an RKI Eagle II Hydrocarbon Surveyor (RKI). Submitted select soil samples to Maxxam Analytics Inc. (Maxxam) in Calgary, Alberta for chemical analysis of polyaromatic hydrocarbons (PAHs), regulated metals and/or particle size analysis (PSA); and

- Prepared this confirmatory sampling report discussing the field observations and analytical results and compared the results to the 2014 Alberta Environment and Sustainable Resource Development (ESRD)[1] Alberta Tier 1 Soil and Groundwater Remediation Guidelines (Tier 1 Guidelines).

1.5 Qualifications of Assessors

Mr. Jamie LaMontagne EP, conducted the fieldwork and prepared this report. Mr. LaMontagne is an Environmental Technologist with Tetra Tech EBA's Environment Practice based in Lethbridge, Alberta. He has over 15 years of experience in environmental site assessments, upstream and downstream Phase I and Phase II assessments, contaminated site assessments, environmental monitoring, sampling techniques, data interpretation, and report writing.

Mr. Jaymes Going, B.Sc., EP, was the overall project manager and conducted the intermediate review of this report. Mr. Going is an Environmental Scientist with Tetra Tech EBA's Environment Practice based in Lethbridge, Alberta. He has over eight years of experience in the environment industry focusing on contaminated sites management.

Mr. Henri Carriere, P.Eng., M.N.R.M., acted as Senior Technical Reviewer of the fieldwork and this report. Mr. Carriere is a Senior Project Engineer with Tetra Tech EBA's Environment Practice based in Calgary, Alberta. He has been providing environmental services in western Canada for the last 25 years. His environmental experience has been derived from the upstream sector of the oil and gas industry, and at commercial, industrial, and residential developments. His experience includes project management, technical advice and program management of environmental site assessments and remediation, environmental liability assessments, land reclamation, waste management planning, environmental impact and baseline assessments, socio-economic assessments and environmental audits. Mr. Carriere has developed a strong understanding of the environmental implications of projects in western Canada with the exposure to several hundred projects since 1993.

2.0 METHODS

This section summarizes the methods applied by Tetra Tech EBA during the confirmatory sampling program.

2.1 Utility Locates

Tetra Tech EBA coordinated utility locates with Alberta One-Call (Ticket # 20160801825) to identify above-ground and underground utilities at the site including, but not limited to, telecommunications lines, power lines, and potential buried objects.

Ground disturbance activities were not conducted within 5 m of a buried marked utility or within 7 m from any overhead utility.

2.2 Safe Work Procedures

A pre-job hazard assessment and SWF were completed prior to the initiation of the fieldwork and applicable safe work procedures were reviewed. The SWF was reviewed on site and signed off by Tetra Tech EBA representatives and the contractor.

[1] Currently Alberta Environment and Parks.

2.3 Drilling Program

The testpitting program was conducted on February 24, 2016. The Town supplied a rubber tire backhoe to conduct the assessment. Testpit locations were selected by Tetra Tech EBA based on the areas of concern identified during the Phase I ESA.

Two testpits were excavated to a depth of 1.5 mbg (15TP15 and 15TP16). Tetra Tech EBA described soil profiles at each testpit location according to the modified USCS with additional comments on CVCs and visible stains and/or debris.

Figure 2 is a site plan showing the testpit locations. Testpit logs are included in Appendix B.

2.4 Field Screening

Soil samples were collected directly from the bucket of the backhoe at regular intervals (0.5 m) and/or at changes in lithology or apparent impact conditions. Bagged soil samples were screened for CVCs using an RKI. CVC results are provided on the testpit logs included in Appendix B.

2.5 Soil Sampling and Analytical Testing

Based on visual observations made during testpitting, two soil samples were submitted for chemical analysis. Soil samples were placed in bags and laboratory-supplied 250 mL glass jars with Teflon™-lined lids, kept cool in coolers, and transported to Maxxam under chain-of-custody (COC). The location, analysis, and depth is indicated in Table A below.

Table A: Soil Sampling Location, Analysis, and Depth

Location	Analysis	Depth
15TP15	PAHs and Regulated Metals	0.6 m and 1.2 m

3.0 RESULTS

3.1 Data Evaluation

The 2014 soil analytical results were compared to the Alberta Tier 1 Guidelines (ESRD 2014) for residential/parkland land use. The Tier 1 Guidelines approach is based on the assumption that all exposure pathways and receptors relevant to a particular land use are actually present. The site is located within the Town of Coalhurst, Alberta and is zoned Residential (R) by the Town. The predominant soil encountered was clay, therefore, the Alberta Tier 1 Guidelines for residential/parkland land use for fine-textured soil are deemed appropriate for the site.

3.2 Soil Stratigraphy

The soil stratigraphy was consistent at 15TP15 and 15TP16 and consisted of a layer of topsoil fill (0.3 m thick) over clay to a depth of 1.5 m). The topsoil was described as clayey, silty, with some sand, damp and firm, with an abundance of roots and traces of red shale inclusions. The clay beneath the topsoil appeared undisturbed and was described as silty, with a trace of sand, damp and very stiff, light greyish brown to greyish brown, with white precipitates and traces of root hairs (to 0.9 mbg). No evidence of groundwater bearing soil was encountered in the testpits.

3.3 Analytical Results

Soil analytical results are presented in the following sections and are summarized in Table 1. Laboratory certificates, including methods of analyses, are attached in Appendix C. It is noted that the attached laboratory certificates include analytical results for the adjacent property to the east (Lot 2, Block 15, Plan 0614136), which are reported under separate cover.

3.3.1 Field Screening Results

CVC measurements for all soil samples collected during this assessment were less than the instrument detection limits.

3.3.2 Soil Analytical Results

Soil samples at 15TP15 (0.6 mbg and 1.2 mbg) were less than the referenced Tier 1 Guidelines for all regulated metal parameters analyzed, and concentrations of all PAH parameters were less than the laboratory analytical detection limits.

4.0 DISCUSSION

Two testpits were advanced (approximately 20 m apart) in an area where it was suspected that a former rail line had transected the site. No evidence of a coal or shale fill layer was encountered in either testpit to a depth of 1.5 mbg. The analytical results of the confirmatory sampling program indicate that concentrations of all metals and PAH parameters analyzed in the soil at the locations tested were less than the Tier 1 Guidelines for residential/parkland land use and/or the analytical detection limit.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the confirmatory sampling program, no evidence of environmental impairment was noted at the locations tested at the site and, therefore, no further work is warranted at this time. Should any areas of environmental impact, buried organics, or evidence of hydrocarbons be encountered during site redevelopment, an environmental professional should be consulted.

6.0 CLOSURE

We trust this report meets your present requirements. If you have any questions or comments, please contact Mr. Jaymes Going in our Lethbridge office.

Respectfully submitted,
Tetra Tech EBA Inc.

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Reviewed by:
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PERMIT TO PRACTICE
TETRA TECH EBA INC.
Signature _____
Date April 5 2016
PERMIT NUMBER: P245
The Association of Professional Engineers and Geoscientists of Alberta

/sy

TABLES

Table 1 Soil Analytical Results

Table 1: Soil Analytical Results

Parameter	Unit	Alberta Tier 1 Residential/Parkland Guideline[1]	15TP15	
			0.6 m	1.2 m
			24-Feb-2016	24-Feb-2016
Routine				
Moisture	%	NG	14	11
Metals				
Antimony	mg/kg	20	<0.50	<0.50
Arsenic	mg/kg	17	5.9	6.1
Barium	mg/kg	500	250	240
Beryllium	mg/kg	5	0.76	0.76
Boron (hot water soluble)	mg/kg	2	0.58	0.76
Cadmium	mg/kg	10	0.33	0.37
Chromium	mg/kg	64	21	22
Chromium (hexavalent)	mg/kg	0.4	<0.080	<0.080
Cobalt	mg/kg	20	7.3	7.1
Copper	mg/kg	63	17	16
Lead	mg/kg	140	9.5	12
Mercury	mg/kg	6.6	0.060	0.061
Molybdenum	mg/kg	4	0.78	0.74
Nickel	mg/kg	50	21	22
Selenium	mg/kg	1	<0.50	0.63
Silver	mg/kg	20	<0.20	<0.20
Thallium	mg/kg	1	0.20	0.20
Tin	mg/kg	5	<1.0	<1.0
Uranium	mg/kg	23	0.92	1.0
Vanadium	mg/kg	130	34	34
Zinc	mg/kg	200	62	80
Polycyclic Aromatic Hydrocarbons (PAHs)				
Benzo[a]pyrene equivalency	mg/kg	NG	<0.10	<0.10
2-methylnaphthalene	mg/kg	NG	<0.0050	<0.0050
Acenaphthene	mg/kg	0.32	<0.0050	<0.0050
Acenaphthylene	mg/kg	NG	<0.0050	<0.0050
Acridine	mg/kg	NG	<0.010	<0.010
Anthracene	mg/kg	0.0046	<0.0040	<0.0040
Benz(a)anthracene	mg/kg	0.070	<0.0050	<0.0050
Benzo(a) pyrene	mg/kg	0.70	<0.0050	<0.0050
Benzo(b+j)fluoranthene	mg/kg	NG	<0.0050	<0.0050
Benzo(c)phenanthrene	mg/kg	NG	<0.0050	<0.0050
Benzo(e)pyrene	mg/kg	NG	<0.0050	<0.0050
Benzo(g,h,i)perylene	mg/kg	NG	<0.0050	<0.0050
Benzo(k)fluoranthene	mg/kg	NG	<0.0050	<0.0050
Chrysene	mg/kg	NG	<0.0050	<0.0050
Dibenz(a,h)anthracene	mg/kg	NG	<0.0050	<0.0050
Fluoranthene	mg/kg	0.032	<0.0050	<0.0050
Fluorene	mg/kg	0.29	<0.0050	<0.0050
Indeno(1,2,3-c,d)pyrene	mg/kg	NG	<0.0050	<0.0050
Naphthalene	mg/kg	0.014	<0.0050	<0.0050
Perylene	mg/kg	NG	<0.0050	<0.0050
Phenanthrene	mg/kg	0.051	<0.0050	<0.0050
Pyrene	mg/kg	0.034	<0.0050	<0.0050
Quinoline	mg/kg	NG	<0.010	<0.010
Laboratory Work Order Number			B614507	B614507
Laboratory Identification Number			OE4256	OE4257

Notes:

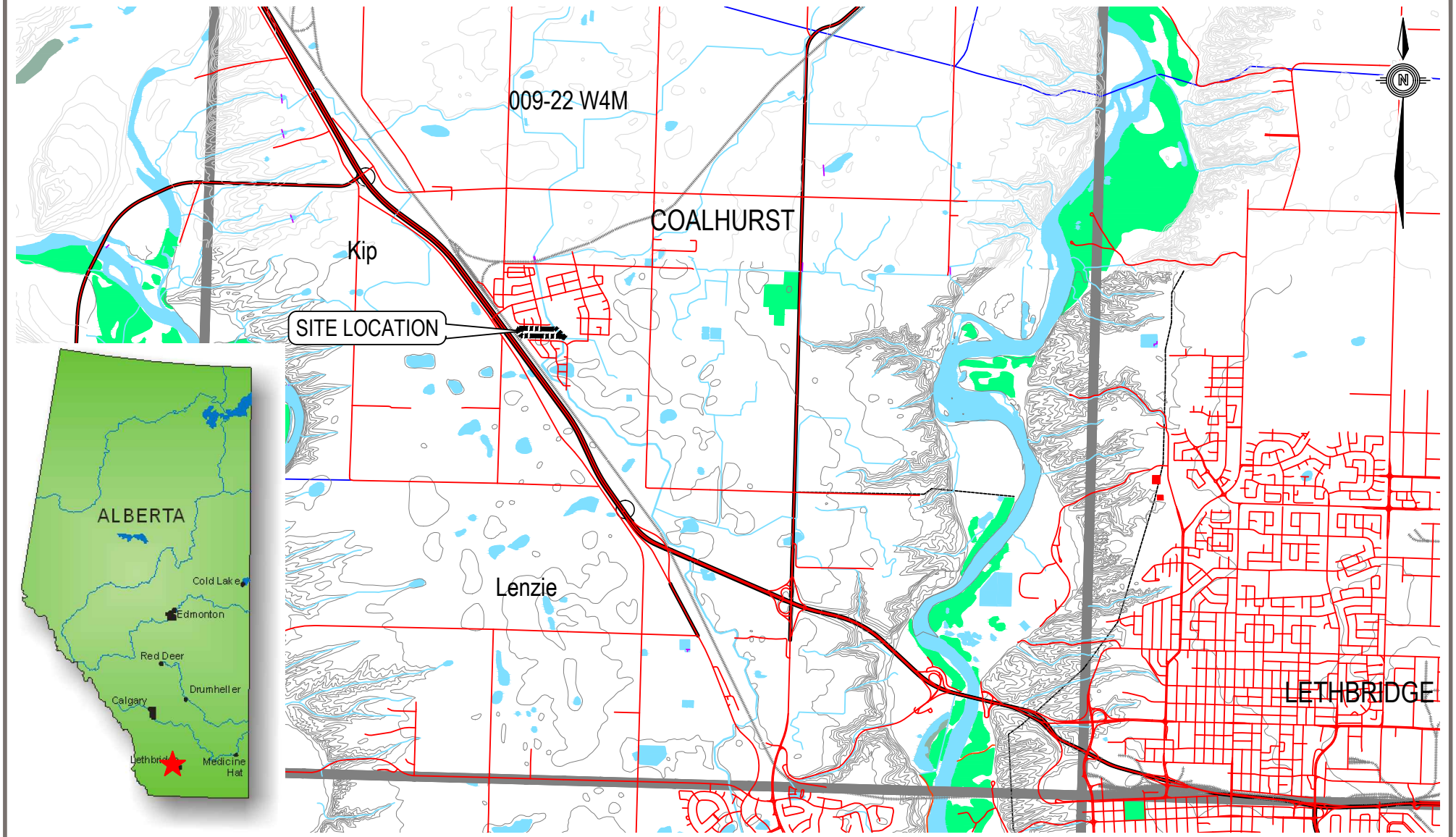
[1] Alberta Environment and Sustainable Resource Development (ESRD). 2014. Alberta Tier 1 Soil and Groundwater Remediation Guidelines. Land and Forestry Policy Branch, Policy Division. 195 pp. Referenced guidelines are for fine textured soil under Residential/Parkland land use.

NG - No guideline.

FIGURES

Figure 1 Site Location Plan
Figure 2 Site Plan Showing Testpit Locations

C:\Riverbend\Drafting\ENV.CENV\CENV03051\02\CENV03051-02-001 Figure 1.dwg [FIGURE 1] March 31, 2016 - 9:31:30 pm (BY: HUGHES, LEANNE)



NOTES

DRAWING PROVIDED BY "© Department of Natural Resources Canada. All rights reserved."

0 3 km

Scale: 1:60,000 @ 8.5"x11"

CLIENT

Town of Coalhurst

CONFIRMATORY SOIL SAMPLING
LOT 1, BLOCK 15, PLAN 0614136

SITE LOCATION PLAN

TETRA TECH EBA

PROJECT NO.	DWN	CKD	REV
CENV03051-02.001	LCH	JL	0

OFFICE	DATE
CALGARY	March 2016

Figure 1

C:\Riverbend\Drafting\ENV.CENV\CENV03051\02\CENV03051-02-001 Figure 2,3.dwg [FIGURE 2] March 31, 2016 - 9:54:34 pm (BY: HUGHES, LEANNE)



LEGEND

APPROXIMATE SITE BOUNDARY

TESTPIT LOCATION

0 200m

Scale: 1:4,000 @ 8.5"x11"

CLIENT

Town of Coalhurst

CONFIRMATORY SOIL SAMPLING
LOT 1, BLOCK 15, PLAN 0614136

SITE PLAN SHOWING TESTPIT LOCATIONS

TETRA TECH EBA

PROJECT NO.	DWN	CKD	REV
CENV03051-02.001	LCH	JL	0

OFFICE	DATE
CALGARY	March 2016

Figure 2

APPENDIX A
TETRA TECH EBA'S GENERAL CONDITIONS

GENERAL CONDITIONS

GEOENVIRONMENTAL REPORT

This report incorporates and is subject to these “General Conditions”.

1.0 USE OF REPORT AND OWNERSHIP

This report pertains to a specific site, a specific development, and a specific scope of work. It is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site or proposed development would necessitate a supplementary investigation and assessment.

This report and the assessments and recommendations contained in it are intended for the sole use of Tetra Tech EBA’s client. Tetra Tech EBA does not accept any responsibility for the accuracy of any of the data, the analysis or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than Tetra Tech EBA’s Client unless otherwise authorized in writing by Tetra Tech EBA. Any unauthorized use of the report is at the sole risk of the user.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of Tetra Tech EBA. Additional copies of the report, if required, may be obtained upon request.

2.0 ALTERNATE REPORT FORMAT

Where Tetra Tech EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed Tetra Tech EBA’s instruments of professional service), only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by Tetra Tech EBA shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of Tetra Tech EBA’s instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except Tetra Tech EBA. The Client warrants that Tetra Tech EBA’s instruments of professional service will be used only and exactly as submitted by Tetra Tech EBA.

Electronic files submitted by Tetra Tech EBA have been prepared and submitted using specific software and hardware systems. Tetra Tech EBA makes no representation about the compatibility of these files with the Client’s current or future software and hardware systems.

3.0 NOTIFICATION OF AUTHORITIES

In certain instances, the discovery of hazardous substances or conditions and materials may require that regulatory agencies and other persons be informed and the client agrees that notification to such bodies or persons as required may be done by Tetra Tech EBA in its reasonably exercised discretion.

4.0 INFORMATION PROVIDED TO TETRA TECH EBA BY OTHERS

During the performance of the work and the preparation of the report, Tetra Tech EBA may rely on information provided by persons other than the Client. While Tetra Tech EBA endeavours to verify the accuracy of such information when instructed to do so by the Client, Tetra Tech EBA accepts no responsibility for the accuracy or the reliability of such information which may affect the report.

APPENDIX B
TESTPIT LOGS

TOWN OF COALHURST, ALBERTA

Borehole No: 15TP15

Project: CONFIRMATORY SAMPLING PROGRAM	Project No: 704-ENV.CENV03051-02.001
Location: LOT 1 / BLOCK 15 / PLAN 0614136	
COALHURST, ALBERTA	PROJECT SCIENTIST: JAYMES GOING

Depth (m)	Method	Soil Description	Sample Type	Sample Number	Vapour readings (ppmv) 200 400 600 800	Notes and Comments	Depth (ft)
0		TOPSOIL - clayey, silty, some sand, damp, loose, dark black, roots, trace red shale inclusions.		B1			0
		CLAY - silty, trace sand, damp, very stiff, medium plastic, light greyish brown, trace white precipitates, trace root hairs.		B2			1
1		... moist, firm, greyish brown.		B3			2
		End of Test Pit at 1.5 m					3
2							4
							5
							6
3							7
							8
							9
							10
							11
							12
4							13
							14
							15
							16
5							17
							18
							19
6							

TETRA TECH EBA

Contractor: TOWN OF COALHURST	Completion Depth: 1.5 m
Drilling Rig Type: BACKHOE	Start Date: February 24, 2016
Logged By:	Completion Date: February 24, 2016
Reviewed By:	Page 1 of 1

TOWN OF COALHURST, ALBERTA

Borehole No: 15TP16

Project: CONFIRMATORY SAMPLING PROGRAM	Project No: 704-ENV.CENV03051-02.001
Location: LOT 1 / BLOCK 15 / PLAN 0614136	
COALHURST, ALBERTA	PROJECT SCIENTIST: JAYMES GOING

Depth (m)	Method	Soil Description	Sample Type	Sample Number	Vapour readings (ppmv) 200 400 600 800	Notes and Comments	Depth (ft)
0		TOPSOIL - clayey, silty, some sand, damp, loose, dark black, roots, trace red shale inclusions.		B1			0
		CLAY - silty, trace sand, damp, very stiff, medium plastic, light greyish brown, trace white precipitates, trace root hairs.		B2			1
1		... moist, firm, greyish brown.		B3			2
		End of Test Pit at 1.5 m					3
2							4
							5
							6
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TETRA TECH EBA

Contractor: TOWN OF COALHURST	Completion Depth: 1.5 m
Drilling Rig Type: BACKHOE	Start Date: February 24, 2016
Logged By:	Completion Date: February 24, 2016
Reviewed By:	Page 1 of 1

APPENDIX C
LABORATORY CERTIFICATES

Maxxam
A Bureau Veritas Group Company

Success Through Science®

Your Project #: ENV.CENV03003-01
Site#: COALHURST, AB TEST PITTING
Site Location: LOT 1 & 2 / BLOCK 15 / PLAN 0614136
Your C.O.C. #: 1 OF 2, 2 OF 2

Attention:JAYMES GOING

TETRA TECH EBA INC.
442-10 STREET NORTH
LETHBRIDGE, AB
CANADA T1H 2C7

Report Date: 2016/03/16
Report #: R2143929
Version: 3 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

MAXXAM JOB #: B614507
Received: 2016/02/26, 08:35

Sample Matrix: Soil
Samples Received: 13

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Boron (Hot Water Soluble)	10	2016/02/29	2016/02/29	AB SOP-00034 / AB SOP-00042	EPA 200.7 CFR 2012 m
Hexavalent Chromium	10	2016/03/01	2016/03/01	AB SOP-00063	SM 22 3500-Cr B m
Hexavalent Chromium	3	2016/03/12	2016/03/12	AB SOP-00063	SM 22 3500-Cr B m
Elements by ICPMS - Soils	10	2016/02/29	2016/02/29	AB SOP-00001 / AB SOP-00043	EPA 200.8 R5.4 m
Elements by ICPMS - Soils	3	2016/03/10	2016/03/12	AB SOP-00001 / AB SOP-00043	EPA 200.8 R5.4 m
Moisture	10	N/A	2016/02/27	AB SOP-00002	CCME PHC-CWS
Moisture	3	N/A	2016/03/09	AB SOP-00002	CCME PHC-CWS
Benzo[a]pyrene Equivalency	10	N/A	2016/02/29	AB SOP-00003	Auto Calc
Benzo[a]pyrene Equivalency	3	N/A	2016/03/10	AB SOP-00003	Auto Calc
PAH in Soil by GC/MS	10	2016/02/27	2016/02/27	AB SOP-00036 / AB SOP-00003	EPA 8270d m
PAH in Soil by GC/MS	3	2016/03/09	2016/03/09	AB SOP-00036 / AB SOP-00003	EPA 8270d m
Particle Size by Sieve (75 micron)	6	N/A	2016/03/01	AB SOP-00022	ASTM D422-63 2007 m
Ca,Mg,Na,K,SO4 (Soluble)	3	2016/03/10	2016/03/11	AB SOP-00033 / AB SOP-00042	EPA 200.7 CFR 2012 m
Soluble Paste	3	2016/03/10	2016/03/11	AB SOP-00033	Carter 2nd ed 15.2 m

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

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Your Project #: ENV.CENV03003-01
Site#: COALHURST, AB TEST PITTING
Site Location: LOT 1 & 2 / BLOCK 15 / PLAN 0614136
Your C.O.C. #: 1 OF 2, 2 OF 2

Attention:JAYMES GOING

TETRA TECH EBA INC.
442-10 STREET NORTH
LETHBRIDGE, AB
CANADA T1H 2C7

Report Date: 2016/03/16
Report #: R2143929
Version: 3 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

MAXXAM JOB #: B614507
Received: 2016/02/26, 08:35

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Ioana Stoica, Project Manager
Email: IStoica@maxxam.ca
Phone# (403)735-2227

==========

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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Maxxam Job #: B614507
Report Date: 2016/03/16

TETRA TECH EBA INC.
Client Project #: ENV.CENV03003-01
Site Location: LOT 1 & 2 / BLOCK 15 / PLAN 0614136
Sampler Initials: JL

REGULATED METALS (CCME/AT1) - SOILS

Maxxam ID		OE4243		OE4244	OE4244		OE4245		
Sampling Date		2016/02/24		2016/02/24	2016/02/24		2016/02/24		
COC Number		1 OF 2		1 OF 2	1 OF 2		1 OF 2		
	UNITS	15TP01 @ 0.4M	QC Batch	15TP01 @ 1.0M	15TP01 @ 1.0M Lab-Dup	QC Batch	15TP03 @ 0.3M	RDL	QC Batch
Elements									
Soluble (Hot water) Boron (B)	mg/kg	12	8203469	N/A	N/A	8203469	4.5	0.10	8203469
Hex. Chromium (Cr 6+)	mg/kg	<0.080	8204954	<0.080	N/A	8215192	<0.080	0.080	8204954
Total Antimony (Sb)	mg/kg	1.0	8203462	<0.50	<0.50	8213607	0.77	0.50	8203462
Total Arsenic (As)	mg/kg	7.1	8203462	5.1	5.4	8213607	6.2	1.0	8203462
Total Barium (Ba)	mg/kg	600	8203462	190	220	8213607	380	1.0	8203462
Total Beryllium (Be)	mg/kg	0.75	8203462	0.59 (1)	0.57	8213607	0.67	0.40	8203462
Total Cadmium (Cd)	mg/kg	0.17	8203462	0.43	0.44	8213607	0.19	0.050	8203462
Total Chromium (Cr)	mg/kg	11	8203462	18	19	8213607	15	1.0	8203462
Total Cobalt (Co)	mg/kg	9.0	8203462	6.7	7.1	8213607	4.9	0.50	8203462
Total Copper (Cu)	mg/kg	26	8203462	14	15	8213607	18	1.0	8203462
Total Lead (Pb)	mg/kg	15	8203462	8.3	8.6	8213607	14	0.50	8203462
Total Mercury (Hg)	mg/kg	0.17	8203462	0.096	<0.050	8213607	0.36	0.050	8203462
Total Molybdenum (Mo)	mg/kg	2.4	8203462	<0.40	<0.40	8213607	1.6	0.40	8203462
Total Nickel (Ni)	mg/kg	30	8203462	19	20	8213607	19	1.0	8203462
Total Selenium (Se)	mg/kg	0.84	8203462	<0.50	<0.50	8213607	0.86	0.50	8203462
Total Silver (Ag)	mg/kg	<0.20	8203462	<0.20	<0.20	8213607	<0.20	0.20	8203462
Total Thallium (Tl)	mg/kg	0.13	8203462	0.18	0.18	8213607	0.12	0.10	8203462
Total Tin (Sn)	mg/kg	<1.0	8203462	<1.0	<1.0	8213607	<1.0	1.0	8203462
Total Uranium (U)	mg/kg	2.0	8203462	0.47	0.50	8213607	1.5	0.20	8203462
Total Vanadium (V)	mg/kg	32	8203462	33	36	8213607	22	1.0	8203462
Total Zinc (Zn)	mg/kg	38	8203462	57	60	8213607	29	10	8203462

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable
(1) Matrix spike exceeds acceptance limits due to matrix interference.

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Maxxam Job #: B614507
Report Date: 2016/03/16

TETRA TECH EBA INC.
Client Project #: ENV.CENV03003-01
Site Location: LOT 1 & 2 / BLOCK 15 / PLAN 0614136
Sampler Initials: JL

REGULATED METALS (CCME/AT1) - SOILS

Maxxam ID		OE4246		OE4247	OE4248	OE4250		
Sampling Date		2016/02/24		2016/02/24	2016/02/24	2016/02/24		
COC Number		1 OF 2		1 OF 2	1 OF 2	1 OF 2		
	UNITS	15TP03 @ 0.8M	QC Batch	15TP05 @ 1.5M	15TP05 @ 2.4M	15TP08 @ 1.5M	RDL	QC Batch
Elements								
Soluble (Hot water) Boron (B)	mg/kg	N/A	8203469	7.6	3.0	88	0.10	8203469
Hex. Chromium (Cr 6+)	mg/kg	<0.080	8215192	<0.080	<0.080	<0.080	0.080	8204954
Total Antimony (Sb)	mg/kg	<0.50	8213607	<0.50	<0.50	0.84	0.50	8203462
Total Arsenic (As)	mg/kg	4.9	8213607	7.6	5.4	10	1.0	8203462
Total Barium (Ba)	mg/kg	350	8213607	280	190	93	1.0	8203462
Total Beryllium (Be)	mg/kg	0.67	8213607	0.75	0.75	1.5	0.40	8203462
Total Cadmium (Cd)	mg/kg	0.54	8213607	0.31	0.31	0.32	0.050	8203462
Total Chromium (Cr)	mg/kg	24	8213607	11	24	11	1.0	8203462
Total Cobalt (Co)	mg/kg	8.1	8213607	5.8	7.2	6.3	0.50	8203462
Total Copper (Cu)	mg/kg	19	8213607	19	16	16	1.0	8203462
Total Lead (Pb)	mg/kg	9.6	8213607	7.7	8.6	14	0.50	8203462
Total Mercury (Hg)	mg/kg	<0.050	8213607	0.28	0.19	0.25	0.050	8203462
Total Molybdenum (Mo)	mg/kg	0.77	8213607	1.8	0.52	3.3	0.40	8203462
Total Nickel (Ni)	mg/kg	26	8213607	21	23	23	1.0	8203462
Total Selenium (Se)	mg/kg	<0.50	8213607	1.2	<0.50	1.7	0.50	8203462
Total Silver (Ag)	mg/kg	<0.20	8213607	<0.20	<0.20	<0.20	0.20	8203462
Total Thallium (Tl)	mg/kg	0.18	8213607	0.22	0.19	0.28	0.10	8203462
Total Tin (Sn)	mg/kg	<1.0	8213607	<1.0	<1.0	<1.0	1.0	8203462
Total Uranium (U)	mg/kg	0.85	8213607	1.4	0.52	2.7	0.20	8203462
Total Vanadium (V)	mg/kg	35	8213607	26	36	35	1.0	8203462
Total Zinc (Zn)	mg/kg	62	8213607	48	56	44	10	8203462

RDL = Reportable Detection Limit
N/A = Not Applicable

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Maxxam Job #: B614507
Report Date: 2016/03/16

TETRA TECH EBA INC.
Client Project #: ENV.CENV03003-01
Site Location: LOT 1 & 2 / BLOCK 15 / PLAN 0614136
Sampler Initials: JL

REGULATED METALS (CCME/AT1) - SOILS

Maxxam ID		OE4251		OE4252	OE4253	OE4254		
Sampling Date		2016/02/24		2016/02/24	2016/02/24	2016/02/24		
COC Number		1 OF 2		1 OF 2	2 OF 2	2 OF 2		
	UNITS	15TP08 @ 2.2M	QC Batch	15TP09 @ 0.5M	15TP09 @ 1.2M	15TP14 @ 1.0M	RDL	QC Batch
Elements								
Soluble (Hot water) Boron (B)	mg/kg	N/A	8203469	5.1	1.5	1.0	0.10	8203469
Hex. Chromium (Cr 6+)	mg/kg	<0.080	8215192	<0.080	<0.080	<0.080	0.080	8204954
Total Antimony (Sb)	mg/kg	<0.50	8213607	<0.50	<0.50	<0.50	0.50	8203462
Total Arsenic (As)	mg/kg	4.0	8213607	6.1	6.2	7.9	1.0	8203462
Total Barium (Ba)	mg/kg	310	8213607	200	190	340	1.0	8203462
Total Beryllium (Be)	mg/kg	0.53	8213607	0.84	0.83	0.85	0.40	8203462
Total Cadmium (Cd)	mg/kg	0.48	8213607	0.32	0.30	0.33	0.050	8203462
Total Chromium (Cr)	mg/kg	14	8213607	22	28	20	1.0	8203462
Total Cobalt (Co)	mg/kg	6.2	8213607	7.5	7.7	8.0	0.50	8203462
Total Copper (Cu)	mg/kg	13	8213607	17	16	14	1.0	8203462
Total Lead (Pb)	mg/kg	7.6	8213607	8.9	9.1	9.7	0.50	8203462
Total Mercury (Hg)	mg/kg	<0.050	8213607	0.14	0.092	0.063	0.050	8203462
Total Molybdenum (Mo)	mg/kg	0.42	8213607	0.49	0.55	0.88	0.40	8203462
Total Nickel (Ni)	mg/kg	18	8213607	23	25	24	1.0	8203462
Total Selenium (Se)	mg/kg	<0.50	8213607	<0.50	<0.50	1.3	0.50	8203462
Total Silver (Ag)	mg/kg	<0.20	8213607	<0.20	<0.20	<0.20	0.20	8203462
Total Thallium (Tl)	mg/kg	0.13	8213607	0.21	0.20	0.19	0.10	8203462
Total Tin (Sn)	mg/kg	<1.0	8213607	<1.0	<1.0	<1.0	1.0	8203462
Total Uranium (U)	mg/kg	1.2	8213607	0.61	0.85	1.9	0.20	8203462
Total Vanadium (V)	mg/kg	26	8213607	39	40	35	1.0	8203462
Total Zinc (Zn)	mg/kg	49	8213607	60	60	64	10	8203462

RDL = Reportable Detection Limit
N/A = Not Applicable

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Maxxam Job #: B614507
Report Date: 2016/03/16

TETRA TECH EBA INC.
Client Project #: ENV.CENV03003-01
Site Location: LOT 1 & 2 / BLOCK 15 / PLAN 0614136
Sampler Initials: JL

REGULATED METALS (CCME/AT1) - SOILS

Maxxam ID		OE4254	OE4256	OE4257		
Sampling Date		2016/02/24	2016/02/24	2016/02/24		
COC Number		2 OF 2	2 OF 2	2 OF 2		
	UNITS	15TP14 @ 1.0M Lab-Dup	15TP15 @ 0.6M	15TP15 @ 1.2M	RDL	QC Batch
Elements						
Soluble (Hot water) Boron (B)	mg/kg	1.0	0.58	0.76	0.10	8203469
Hex. Chromium (Cr 6+)	mg/kg	N/A	<0.080	<0.080	0.080	8204954
Total Antimony (Sb)	mg/kg	<0.50	<0.50	<0.50	0.50	8203462
Total Arsenic (As)	mg/kg	7.9	5.9	6.1	1.0	8203462
Total Barium (Ba)	mg/kg	320	250	240	1.0	8203462
Total Beryllium (Be)	mg/kg	0.91	0.76	0.76	0.40	8203462
Total Cadmium (Cd)	mg/kg	0.31	0.33	0.37	0.050	8203462
Total Chromium (Cr)	mg/kg	21	21	22	1.0	8203462
Total Cobalt (Co)	mg/kg	8.1	7.3	7.1	0.50	8203462
Total Copper (Cu)	mg/kg	14	17	16	1.0	8203462
Total Lead (Pb)	mg/kg	10	9.5	12	0.50	8203462
Total Mercury (Hg)	mg/kg	<0.050	0.060	0.061	0.050	8203462
Total Molybdenum (Mo)	mg/kg	0.92	0.78	0.74	0.40	8203462
Total Nickel (Ni)	mg/kg	24	21	22	1.0	8203462
Total Selenium (Se)	mg/kg	1.4	<0.50	0.63	0.50	8203462
Total Silver (Ag)	mg/kg	<0.20	<0.20	<0.20	0.20	8203462
Total Thallium (Tl)	mg/kg	0.20	0.20	0.20	0.10	8203462
Total Tin (Sn)	mg/kg	<1.0	<1.0	<1.0	1.0	8203462
Total Uranium (U)	mg/kg	1.9	0.92	1.0	0.20	8203462
Total Vanadium (V)	mg/kg	36	34	34	1.0	8203462
Total Zinc (Zn)	mg/kg	65	62	80	10	8203462

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable

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Maxxam Job #: B614507
Report Date: 2016/03/16

TETRA TECH EBA INC.
Client Project #: ENV.CENV03003-01
Site Location: LOT 1 & 2 / BLOCK 15 / PLAN 0614136
Sampler Initials: JL

RESULTS OF CHEMICAL ANALYSES OF SOIL

Maxxam ID		OE4243		OE4244		OE4245		
Sampling Date		2016/02/24		2016/02/24		2016/02/24		
COC Number		1 OF 2		1 OF 2		1 OF 2		
	UNITS	15TP01 @ 0.4M	QC Batch	15TP01 @ 1.0M	QC Batch	15TP03 @ 0.3M	RDL	QC Batch
Soluble Parameters								
Soluble Boron (B)	mg/L	N/A	8214301	1.8	8214301	N/A	0.10	8214301
Saturation %	%	N/A	8213396	54	8213396	N/A	N/A	8213396
Physical Properties								
Moisture	%	17	8202773	18	8212353	21	0.30	8202773

RDL = Reportable Detection Limit
N/A = Not Applicable

Maxxam ID		OE4246		OE4247	OE4248	OE4250		
Sampling Date		2016/02/24		2016/02/24	2016/02/24	2016/02/24		
COC Number		1 OF 2		1 OF 2	1 OF 2	1 OF 2		
	UNITS	15TP03 @ 0.8M	QC Batch	15TP05 @ 1.5M	15TP05 @ 2.4M	15TP08 @ 1.5M	RDL	QC Batch
Soluble Parameters								
Soluble Boron (B)	mg/L	2.8	8214301	N/A	N/A	N/A	0.10	8214301
Saturation %	%	58	8213396	N/A	N/A	N/A	N/A	8213396
Physical Properties								
Moisture	%	16	8212353	20	20	17	0.30	8202773
Sieve - Pan	%	N/A	N/A	40	88	30	0.20	8204099
Sieve - #200 (>0.075mm)	%	N/A	N/A	60	12	70	0.20	8204099
Grain Size	%	N/A	N/A	COARSE	FINE	COARSE	0.20	8204099

RDL = Reportable Detection Limit
N/A = Not Applicable

Maxxam Analytics International Corporation o/a Maxxam Analytics Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Maxxam Job #: B614507
Report Date: 2016/03/16

TETRA TECH EBA INC.
Client Project #: ENV.CENV03003-01
Site Location: LOT 1 & 2 / BLOCK 15 / PLAN 0614136
Sampler Initials: JL

RESULTS OF CHEMICAL ANALYSES OF SOIL

Maxxam ID		OE4251		OE4252	OE4253	OE4254	OE4256		
Sampling Date		2016/02/24		2016/02/24	2016/02/24	2016/02/24	2016/02/24		
COC Number		1 OF 2		1 OF 2	2 OF 2	2 OF 2	2 OF 2		
	UNITS	15TP08 @ 2.2M	QC Batch	15TP09 @ 0.5M	15TP09 @ 1.2M	15TP14 @ 1.0M	15TP15 @ 0.6M	RDL	QC Batch
Soluble Parameters									
Soluble Boron (B)	mg/L	2.0	8214301	N/A	N/A	N/A	N/A	0.10	8214301
Saturation %	%	40	8213396	N/A	N/A	N/A	N/A	N/A	8213396
Physical Properties									
Moisture	%	22	8212353	19	19	18	14	0.30	8202773
Sieve - Pan	%	N/A	N/A	83	84	92	N/A	0.20	8204099
Sieve - #200 (>0.075mm)	%	N/A	N/A	17	16	8.4	N/A	0.20	8204099
Grain Size	%	N/A	N/A	FINE	FINE	FINE	N/A	0.20	8204099

RDL = Reportable Detection Limit
N/A = Not Applicable

Maxxam ID		OE4257		
Sampling Date		2016/02/24		
COC Number		2 OF 2		
	UNITS	15TP15 @ 1.2M	RDL	QC Batch
Physical Properties				
Moisture	%	11	0.30	8202773

RDL = Reportable Detection Limit

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Maxxam Job #: B614507
Report Date: 2016/03/16

TETRA TECH EBA INC.
Client Project #: ENV.CENV03003-01
Site Location: LOT 1 & 2 / BLOCK 15 / PLAN 0614136
Sampler Initials: JL

SEMIVOLATILE ORGANICS BY GC-MS (SOIL)

Maxxam ID		OE4243		OE4244		OE4245		
Sampling Date		2016/02/24		2016/02/24		2016/02/24		
COC Number		1 OF 2		1 OF 2		1 OF 2		
	UNITS	15TP01 @ 0.4M	QC Batch	15TP01 @ 1.0M	QC Batch	15TP03 @ 0.3M	RDL	QC Batch
Polycyclic Aromatics								
Acenaphthene	mg/kg	<0.0050	8202457	<0.0050	8211707	<0.0050	0.0050	8202457
Benzo[a]pyrene equivalency	mg/kg	<0.10	8202112	<0.10	8211510	<0.10	0.10	8202112
Acenaphthylene	mg/kg	<0.0050	8202457	<0.0050	8211707	<0.0050	0.0050	8202457
Acridine	mg/kg	<0.010	8202457	<0.010	8211707	<0.010	0.010	8202457
Anthracene	mg/kg	<0.0040	8202457	<0.0040	8211707	0.0077	0.0040	8202457
Benzo(a)anthracene	mg/kg	0.016	8202457	<0.0050	8211707	0.029	0.0050	8202457
Benzo(b&j)fluoranthene	mg/kg	0.016	8202457	<0.0050	8211707	0.030	0.0050	8202457
Benzo(k)fluoranthene	mg/kg	<0.0050	8202457	<0.0050	8211707	0.0082	0.0050	8202457
Benzo(g,h,i)perylene	mg/kg	<0.0050	8202457	<0.0050	8211707	0.011	0.0050	8202457
Benzo(c)phenanthrene	mg/kg	<0.0050	8202457	<0.0050	8211707	<0.0050	0.0050	8202457
Benzo(a)pyrene	mg/kg	0.0070	8202457	<0.0050	8211707	0.016	0.0050	8202457
Benzo[e]pyrene	mg/kg	0.0066	8202457	<0.0050	8211707	0.014	0.0050	8202457
Chrysene	mg/kg	0.015	8202457	<0.0050	8211707	0.028	0.0050	8202457
Dibenz(a,h)anthracene	mg/kg	<0.0050	8202457	<0.0050	8211707	<0.0050	0.0050	8202457
Fluoranthene	mg/kg	0.028	8202457	<0.0050	8211707	0.056	0.0050	8202457
Fluorene	mg/kg	<0.0050	8202457	<0.0050	8211707	<0.0050	0.0050	8202457
Indeno(1,2,3-cd)pyrene	mg/kg	<0.0050	8202457	<0.0050	8211707	0.013	0.0050	8202457
2-Methylnaphthalene	mg/kg	0.076	8202457	<0.0050	8211707	0.14	0.0050	8202457
Naphthalene	mg/kg	0.024	8202457	<0.0050	8211707	0.039	0.0050	8202457
Phenanthrene	mg/kg	0.034	8202457	<0.0050	8211707	0.060	0.0050	8202457
Perylene	mg/kg	0.011	8202457	<0.0050	8211707	0.015	0.0050	8202457
Pyrene	mg/kg	0.036	8202457	<0.0050	8211707	0.068	0.0050	8202457
Quinoline	mg/kg	<0.010	8202457	<0.010	8211707	<0.010	0.010	8202457
Surrogate Recovery (%)								
D10-ANTHRACENE (sur.)	%	85	8202457	86	8211707	89	N/A	8202457
D8-ACENAPHTHYLENE (sur.)	%	89	8202457	86	8211707	90	N/A	8202457
D8-NAPHTHALENE (sur.)	%	87	8202457	83	8211707	87	N/A	8202457
TERPHENYL-D14 (sur.)	%	90	8202457	83	8211707	90	N/A	8202457

RDL = Reportable Detection Limit
N/A = Not Applicable

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Maxxam Job #: B614507
Report Date: 2016/03/16

TETRA TECH EBA INC.
Client Project #: ENV.CENV03003-01
Site Location: LOT 1 & 2 / BLOCK 15 / PLAN 0614136
Sampler Initials: JL

SEMIVOLATILE ORGANICS BY GC-MS (SOIL)

Maxxam ID		OE4246		OE4247	OE4248	OE4250		
Sampling Date		2016/02/24		2016/02/24	2016/02/24	2016/02/24		
COC Number		1 OF 2		1 OF 2	1 OF 2	1 OF 2		
	UNITS	15TP03 @ 0.8M	QC Batch	15TP05 @ 1.5M	15TP05 @ 2.4M	15TP08 @ 1.5M	RDL	QC Batch
Polycyclic Aromatics								
Acenaphthene	mg/kg	<0.0050	8211707	<0.0050	<0.0050	<0.0050	0.0050	8202457
Benzo[a]pyrene equivalency	mg/kg	<0.10	8211510	<0.10	<0.10	<0.10	0.10	8202112
Acenaphthylene	mg/kg	<0.0050	8211707	<0.0050	<0.0050	<0.0050	0.0050	8202457
Acridine	mg/kg	<0.010	8211707	<0.010	<0.010	<0.010	0.010	8202457
Anthracene	mg/kg	<0.0040	8211707	<0.0040	<0.0040	0.029	0.0040	8202457
Benzo(a)anthracene	mg/kg	<0.0050	8211707	0.016	<0.0050	0.0078	0.0050	8202457
Benzo(b&j)fluoranthene	mg/kg	<0.0050	8211707	0.012	<0.0050	<0.0050	0.0050	8202457
Benzo(k)fluoranthene	mg/kg	<0.0050	8211707	<0.0050	<0.0050	<0.0050	0.0050	8202457
Benzo(g,h,i)perylene	mg/kg	<0.0050	8211707	<0.0050	<0.0050	<0.0050	0.0050	8202457
Benzo(c)phenanthrene	mg/kg	<0.0050	8211707	<0.0050	<0.0050	<0.0050	0.0050	8202457
Benzo(a)pyrene	mg/kg	<0.0050	8211707	<0.0050	<0.0050	<0.0050	0.0050	8202457
Benzo[e]pyrene	mg/kg	<0.0050	8211707	<0.0050	<0.0050	<0.0050	0.0050	8202457
Chrysene	mg/kg	<0.0050	8211707	0.016	<0.0050	0.017	0.0050	8202457
Dibenz(a,h)anthracene	mg/kg	<0.0050	8211707	<0.0050	<0.0050	<0.0050	0.0050	8202457
Fluoranthene	mg/kg	<0.0050	8211707	0.028	<0.0050	0.073	0.0050	8202457
Fluorene	mg/kg	<0.0050	8211707	<0.0050	<0.0050	<0.0050	0.0050	8202457
Indeno(1,2,3-cd)pyrene	mg/kg	<0.0050	8211707	<0.0050	<0.0050	<0.0050	0.0050	8202457
2-Methylnaphthalene	mg/kg	<0.0050	8211707	0.11	<0.0050	0.0083	0.0050	8202457
Naphthalene	mg/kg	<0.0050	8211707	0.034	<0.0050	0.019	0.0050	8202457
Phenanthrene	mg/kg	<0.0050	8211707	0.041	<0.0050	0.18	0.0050	8202457
Perylene	mg/kg	<0.0050	8211707	0.0096	<0.0050	<0.0050	0.0050	8202457
Pyrene	mg/kg	<0.0050	8211707	0.044	<0.0050	0.091	0.0050	8202457
Quinoline	mg/kg	<0.010	8211707	<0.010	<0.010	0.045	0.010	8202457
Surrogate Recovery (%)								
D10-ANTHRACENE (sur.)	%	81	8211707	90	97	98	N/A	8202457
D8-ACENAPHTHYLENE (sur.)	%	81	8211707	92	97	93	N/A	8202457
D8-NAPHTHALENE (sur.)	%	80	8211707	87	92	91	N/A	8202457
TERPHENYL-D14 (sur.)	%	79	8211707	91	94	97	N/A	8202457

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Maxxam Job #: B614507
Report Date: 2016/03/16

TETRA TECH EBA INC.
Client Project #: ENV.CENV03003-01
Site Location: LOT 1 & 2 / BLOCK 15 / PLAN 0614136
Sampler Initials: JL

SEMIVOLATILE ORGANICS BY GC-MS (SOIL)

Maxxam ID		OE4251		OE4252	OE4253	OE4254		
Sampling Date		2016/02/24		2016/02/24	2016/02/24	2016/02/24		
COC Number		1 OF 2		1 OF 2	2 OF 2	2 OF 2		
	UNITS	15TP08 @ 2.2M	QC Batch	15TP09 @ 0.5M	15TP09 @ 1.2M	15TP14 @ 1.0M	RDL	QC Batch
Polycyclic Aromatics								
Acenaphthene	mg/kg	<0.0050	8211707	<0.0050	<0.0050	<0.0050	0.0050	8202457
Benzo[a]pyrene equivalency	mg/kg	<0.10	8211510	<0.10	<0.10	<0.10	0.10	8202112
Acenaphthylene	mg/kg	<0.0050	8211707	<0.0050	<0.0050	<0.0050	0.0050	8202457
Acridine	mg/kg	<0.010	8211707	<0.010	<0.010	<0.010	0.010	8202457
Anthracene	mg/kg	<0.0040	8211707	<0.0040	<0.0040	<0.0040	0.0040	8202457
Benzo(a)anthracene	mg/kg	<0.0050	8211707	<0.0050	<0.0050	<0.0050	0.0050	8202457
Benzo(b&j)fluoranthene	mg/kg	<0.0050	8211707	<0.0050	<0.0050	<0.0050	0.0050	8202457
Benzo(k)fluoranthene	mg/kg	<0.0050	8211707	<0.0050	<0.0050	<0.0050	0.0050	8202457
Benzo(g,h,i)perylene	mg/kg	<0.0050	8211707	<0.0050	<0.0050	<0.0050	0.0050	8202457
Benzo(c)phenanthrene	mg/kg	<0.0050	8211707	<0.0050	<0.0050	<0.0050	0.0050	8202457
Benzo(a)pyrene	mg/kg	<0.0050	8211707	<0.0050	<0.0050	<0.0050	0.0050	8202457
Benzo[e]pyrene	mg/kg	<0.0050	8211707	<0.0050	<0.0050	<0.0050	0.0050	8202457
Chrysene	mg/kg	<0.0050	8211707	<0.0050	<0.0050	<0.0050	0.0050	8202457
Dibenz(a,h)anthracene	mg/kg	<0.0050	8211707	<0.0050	<0.0050	<0.0050	0.0050	8202457
Fluoranthene	mg/kg	<0.0050	8211707	<0.0050	<0.0050	<0.0050	0.0050	8202457
Fluorene	mg/kg	<0.0050	8211707	<0.0050	<0.0050	<0.0050	0.0050	8202457
Indeno(1,2,3-cd)pyrene	mg/kg	<0.0050	8211707	<0.0050	<0.0050	<0.0050	0.0050	8202457
2-Methylnaphthalene	mg/kg	<0.0050	8211707	<0.0050	<0.0050	<0.0050	0.0050	8202457
Naphthalene	mg/kg	<0.0050	8211707	<0.0050	<0.0050	<0.0050	0.0050	8202457
Phenanthrene	mg/kg	<0.0050	8211707	<0.0050	<0.0050	<0.0050	0.0050	8202457
Perylene	mg/kg	<0.0050	8211707	<0.0050	<0.0050	<0.0050	0.0050	8202457
Pyrene	mg/kg	<0.0050	8211707	<0.0050	<0.0050	<0.0050	0.0050	8202457
Quinoline	mg/kg	<0.010	8211707	<0.010	<0.010	<0.010	0.010	8202457
Surrogate Recovery (%)								
D10-ANTHRACENE (sur.)	%	87	8211707	91	90	90	N/A	8202457
D8-ACENAPHTHYLENE (sur.)	%	86	8211707	89	86	89	N/A	8202457
D8-NAPHTHALENE (sur.)	%	82	8211707	86	84	87	N/A	8202457
TERPHENYL-D14 (sur.)	%	85	8211707	89	87	90	N/A	8202457

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Maxxam Job #: B614507
Report Date: 2016/03/16

TETRA TECH EBA INC.
Client Project #: ENV.CENV03003-01
Site Location: LOT 1 & 2 / BLOCK 15 / PLAN 0614136
Sampler Initials: JL

SEMIVOLATILE ORGANICS BY GC-MS (SOIL)

Maxxam ID		OE4256	OE4257		
Sampling Date		2016/02/24	2016/02/24		
COC Number		2 OF 2	2 OF 2		
	UNITS	15TP15 @ 0.6M	15TP15 @ 1.2M	RDL	QC Batch
Polycyclic Aromatics					
Acenaphthene	mg/kg	<0.0050	<0.0050	0.0050	8202457
Benzo[a]pyrene equivalency	mg/kg	<0.10	<0.10	0.10	8202112
Acenaphthylene	mg/kg	<0.0050	<0.0050	0.0050	8202457
Acridine	mg/kg	<0.010	<0.010	0.010	8202457
Anthracene	mg/kg	<0.0040	<0.0040	0.0040	8202457
Benzo(a)anthracene	mg/kg	<0.0050	<0.0050	0.0050	8202457
Benzo(b&j)fluoranthene	mg/kg	<0.0050	<0.0050	0.0050	8202457
Benzo(k)fluoranthene	mg/kg	<0.0050	<0.0050	0.0050	8202457
Benzo(g,h,i)perylene	mg/kg	<0.0050	<0.0050	0.0050	8202457
Benzo(c)phenanthrene	mg/kg	<0.0050	<0.0050	0.0050	8202457
Benzo(a)pyrene	mg/kg	<0.0050	<0.0050	0.0050	8202457
Benzo[e]pyrene	mg/kg	<0.0050	<0.0050	0.0050	8202457
Chrysene	mg/kg	<0.0050	<0.0050	0.0050	8202457
Dibenz(a,h)anthracene	mg/kg	<0.0050	<0.0050	0.0050	8202457
Fluoranthene	mg/kg	<0.0050	<0.0050	0.0050	8202457
Fluorene	mg/kg	<0.0050	<0.0050	0.0050	8202457
Indeno(1,2,3-cd)pyrene	mg/kg	<0.0050	<0.0050	0.0050	8202457
2-Methylnaphthalene	mg/kg	<0.0050	<0.0050	0.0050	8202457
Naphthalene	mg/kg	<0.0050	<0.0050	0.0050	8202457
Phenanthrene	mg/kg	<0.0050	<0.0050	0.0050	8202457
Perylene	mg/kg	<0.0050	<0.0050	0.0050	8202457
Pyrene	mg/kg	<0.0050	<0.0050	0.0050	8202457
Quinoline	mg/kg	<0.010	<0.010	0.010	8202457
Surrogate Recovery (%)					
D10-ANTHRACENE (sur.)	%	91	76	N/A	8202457
D8-ACENAPHTHYLENE (sur.)	%	89	71	N/A	8202457
D8-NAPHTHALENE (sur.)	%	88	73	N/A	8202457
TERPHENYL-D14 (sur.)	%	89	75	N/A	8202457

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Maxxam Job #: B614507
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TETRA TECH EBA INC.
Client Project #: ENV.CENV03003-01
Site Location: LOT 1 & 2 / BLOCK 15 / PLAN 0614136
Sampler Initials: JL

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	7.3°C

Report reissued with corrected data for B by saturated paste - samples OE4246 (15TP03 @ 0.8m) and OE4251 (15TP08 @ 2.2m)
2016/03/16

Results relate only to the items tested.

Maxxam Analytics International Corporation o/a Maxxam Analytics Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

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Report Date: 2016/03/16

TETRA TECH EBA INC.
Client Project #: ENV.CENV03003-01
Site Location: LOT 1 & 2 / BLOCK 15 / PLAN 0614136
Sampler Initials: JL

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
8202457	SJ1	Matrix Spike	D10-ANTHRACENE (sur.)	2016/02/27		96	%	50 - 130
			D8-ACENAPHTHYLENE (sur.)	2016/02/27		85	%	50 - 130
			D8-NAPHTHALENE (sur.)	2016/02/27		93	%	50 - 130
			TERPHENYL-D14 (sur.)	2016/02/27		95	%	50 - 130
			Acenaphthene	2016/02/27		94	%	50 - 130
			Acenaphthylene	2016/02/27		85	%	50 - 130
			Acridine	2016/02/27		56	%	50 - 130
			Anthracene	2016/02/27		95	%	50 - 130
			Benzo(a)anthracene	2016/02/27		102	%	50 - 130
			Benzo(b&j)fluoranthene	2016/02/27		91	%	50 - 130
			Benzo(k)fluoranthene	2016/02/27		84	%	50 - 130
			Benzo(g,h,i)perylene	2016/02/27		95	%	50 - 130
			Benzo(c)phenanthrene	2016/02/27		96	%	50 - 130
			Benzo(a)pyrene	2016/02/27		97	%	50 - 130
			Benzo[e]pyrene	2016/02/27		102	%	50 - 130
			Chrysene	2016/02/27		95	%	50 - 130
			Dibenz(a,h)anthracene	2016/02/27		108	%	50 - 130
			Fluoranthene	2016/02/27		101	%	50 - 130
			Fluorene	2016/02/27		98	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2016/02/27		91	%	50 - 130
			2-Methylnaphthalene	2016/02/27		90	%	50 - 130
			Naphthalene	2016/02/27		91	%	50 - 130
			Phenanthrene	2016/02/27		92	%	50 - 130
			Perylene	2016/02/27		89	%	50 - 130
			Pyrene	2016/02/27		102	%	50 - 130
			Quinoline	2016/02/27		106	%	50 - 130
8202457	SJ1	Spiked Blank	D10-ANTHRACENE (sur.)	2016/02/27		98	%	50 - 130
			D8-ACENAPHTHYLENE (sur.)	2016/02/27		97	%	50 - 130
			D8-NAPHTHALENE (sur.)	2016/02/27		98	%	50 - 130
			TERPHENYL-D14 (sur.)	2016/02/27		99	%	50 - 130
			Acenaphthene	2016/02/27		97	%	50 - 130
			Acenaphthylene	2016/02/27		97	%	50 - 130
			Acridine	2016/02/27		64	%	50 - 130
			Anthracene	2016/02/27		98	%	50 - 130
			Benzo(a)anthracene	2016/02/27		105	%	50 - 130
			Benzo(b&j)fluoranthene	2016/02/27		94	%	50 - 130
			Benzo(k)fluoranthene	2016/02/27		97	%	50 - 130
			Benzo(g,h,i)perylene	2016/02/27		97	%	50 - 130
			Benzo(c)phenanthrene	2016/02/27		99	%	50 - 130
			Benzo(a)pyrene	2016/02/27		107	%	50 - 130
			Benzo[e]pyrene	2016/02/27		106	%	50 - 130
			Chrysene	2016/02/27		99	%	50 - 130
			Dibenz(a,h)anthracene	2016/02/27		111	%	50 - 130
			Fluoranthene	2016/02/27		107	%	50 - 130
			Fluorene	2016/02/27		102	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2016/02/27		93	%	50 - 130
			2-Methylnaphthalene	2016/02/27		94	%	50 - 130
			Naphthalene	2016/02/27		95	%	50 - 130
			Phenanthrene	2016/02/27		96	%	50 - 130
			Perylene	2016/02/27		93	%	50 - 130
			Pyrene	2016/02/27		108	%	50 - 130
			Quinoline	2016/02/27		106	%	50 - 130

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Maxxam Job #: B614507
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TETRA TECH EBA INC.
Client Project #: ENV.CENV03003-01
Site Location: LOT 1 & 2 / BLOCK 15 / PLAN 0614136
Sampler Initials: JL

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
8202457	SJ1	Method Blank	D10-ANTHRACENE (sur.)	2016/02/27		94	%	50 - 130
			D8-ACENAPHTHYLENE (sur.)	2016/02/27		93	%	50 - 130
			D8-NAPHTHALENE (sur.)	2016/02/27		94	%	50 - 130
			TERPHENYL-D14 (sur.)	2016/02/27		100	%	50 - 130
			Acenaphthene	2016/02/27	<0.0050		mg/kg	
			Acenaphthylene	2016/02/27	<0.0050		mg/kg	
			Acridine	2016/02/27	<0.010		mg/kg	
			Anthracene	2016/02/27	<0.0040		mg/kg	
			Benzo(a)anthracene	2016/02/27	<0.0050		mg/kg	
			Benzo(b&j)fluoranthene	2016/02/27	<0.0050		mg/kg	
			Benzo(k)fluoranthene	2016/02/27	<0.0050		mg/kg	
			Benzo(g,h,i)perylene	2016/02/27	<0.0050		mg/kg	
			Benzo(c)phenanthrene	2016/02/27	<0.0050		mg/kg	
			Benzo(a)pyrene	2016/02/27	<0.0050		mg/kg	
			Benzo[e]pyrene	2016/02/27	<0.0050		mg/kg	
			Chrysene	2016/02/27	<0.0050		mg/kg	
			Dibenz(a,h)anthracene	2016/02/27	<0.0050		mg/kg	
			Fluoranthene	2016/02/27	<0.0050		mg/kg	
			Fluorene	2016/02/27	<0.0050		mg/kg	
			Indeno(1,2,3-cd)pyrene	2016/02/27	<0.0050		mg/kg	
			2-Methylnaphthalene	2016/02/27	<0.0050		mg/kg	
			Naphthalene	2016/02/27	<0.0050		mg/kg	
			Phenanthrene	2016/02/27	<0.0050		mg/kg	
			Perylene	2016/02/27	<0.0050		mg/kg	
			Pyrene	2016/02/27	<0.0050		mg/kg	
			Quinoline	2016/02/27	<0.010		mg/kg	
8202457	SJ1	RPD	Acenaphthene	2016/02/27	NC		%	50
			Acenaphthylene	2016/02/27	NC		%	50
			Acridine	2016/02/27	NC		%	50
			Anthracene	2016/02/27	NC		%	50
			Benzo(a)anthracene	2016/02/27	NC		%	50
			Benzo(b&j)fluoranthene	2016/02/27	NC		%	50
			Benzo(k)fluoranthene	2016/02/27	NC		%	50
			Benzo(g,h,i)perylene	2016/02/27	NC		%	50
			Benzo(c)phenanthrene	2016/02/27	NC		%	50
			Benzo(a)pyrene	2016/02/27	NC		%	50
			Benzo[e]pyrene	2016/02/27	NC		%	50
			Chrysene	2016/02/27	NC		%	50
			Dibenz(a,h)anthracene	2016/02/27	NC		%	50
			Fluoranthene	2016/02/27	NC		%	50
			Fluorene	2016/02/27	NC		%	50
			Indeno(1,2,3-cd)pyrene	2016/02/27	NC		%	50
			2-Methylnaphthalene	2016/02/27	NC		%	50
			Naphthalene	2016/02/27	NC		%	50
			Phenanthrene	2016/02/27	NC		%	50
			Perylene	2016/02/27	NC		%	50
			Pyrene	2016/02/27	NC		%	50
			Quinoline	2016/02/27	NC		%	50
8202773	TL0	Method Blank	Moisture	2016/02/27	<0.30		%	
8202773	TL0	RPD	Moisture	2016/02/27	0.46		%	20
8203462	PC5	Matrix Spike [OE4254-01]	Total Antimony (Sb)	2016/02/29		83	%	75 - 125
			Total Arsenic (As)	2016/02/29		91	%	75 - 125

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TETRA TECH EBA INC.
Client Project #: ENV.CENV03003-01
Site Location: LOT 1 & 2 / BLOCK 15 / PLAN 0614136
Sampler Initials: JL

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Barium (Ba)	2016/02/29		NC	%	75 - 125
			Total Beryllium (Be)	2016/02/29		103	%	75 - 125
			Total Cadmium (Cd)	2016/02/29		96	%	75 - 125
			Total Chromium (Cr)	2016/02/29		93	%	75 - 125
			Total Cobalt (Co)	2016/02/29		88	%	75 - 125
			Total Copper (Cu)	2016/02/29		85	%	75 - 125
			Total Lead (Pb)	2016/02/29		90	%	75 - 125
			Total Mercury (Hg)	2016/02/29		89	%	75 - 125
			Total Molybdenum (Mo)	2016/02/29		95	%	75 - 125
			Total Nickel (Ni)	2016/02/29		87	%	75 - 125
			Total Selenium (Se)	2016/02/29		91	%	75 - 125
			Total Silver (Ag)	2016/02/29		93	%	75 - 125
			Total Thallium (Tl)	2016/02/29		87	%	75 - 125
			Total Tin (Sn)	2016/02/29		99	%	75 - 125
			Total Uranium (U)	2016/02/29		88	%	75 - 125
			Total Vanadium (V)	2016/02/29		NC	%	75 - 125
			Total Zinc (Zn)	2016/02/29		NC	%	75 - 125
8203462	PC5	QC Standard	Total Arsenic (As)	2016/02/29		97	%	53 - 147
			Total Barium (Ba)	2016/02/29		96	%	80 - 119
			Total Chromium (Cr)	2016/02/29		92	%	59 - 141
			Total Cobalt (Co)	2016/02/29		90	%	58 - 142
			Total Copper (Cu)	2016/02/29		90	%	83 - 117
			Total Lead (Pb)	2016/02/29		97	%	79 - 121
			Total Nickel (Ni)	2016/02/29		99	%	79 - 121
			Total Vanadium (V)	2016/02/29		96	%	79 - 121
			Total Zinc (Zn)	2016/02/29		94	%	79 - 121
8203462	PC5	Spiked Blank	Total Antimony (Sb)	2016/02/29		91	%	75 - 125
			Total Arsenic (As)	2016/02/29		89	%	75 - 125
			Total Barium (Ba)	2016/02/29		91	%	75 - 125
			Total Beryllium (Be)	2016/02/29		91	%	75 - 125
			Total Cadmium (Cd)	2016/02/29		89	%	75 - 125
			Total Chromium (Cr)	2016/02/29		86	%	75 - 125
			Total Cobalt (Co)	2016/02/29		85	%	75 - 125
			Total Copper (Cu)	2016/02/29		84	%	75 - 125
			Total Lead (Pb)	2016/02/29		85	%	75 - 125
			Total Mercury (Hg)	2016/02/29		97	%	75 - 125
			Total Molybdenum (Mo)	2016/02/29		89	%	75 - 125
			Total Nickel (Ni)	2016/02/29		85	%	75 - 125
			Total Selenium (Se)	2016/02/29		86	%	75 - 125
			Total Silver (Ag)	2016/02/29		87	%	75 - 125
			Total Thallium (Tl)	2016/02/29		84	%	75 - 125
			Total Tin (Sn)	2016/02/29		88	%	75 - 125
			Total Uranium (U)	2016/02/29		87	%	75 - 125
			Total Vanadium (V)	2016/02/29		86	%	75 - 125
			Total Zinc (Zn)	2016/02/29		85	%	75 - 125
8203462	PC5	Method Blank	Total Antimony (Sb)	2016/02/29	<0.50		mg/kg	
			Total Arsenic (As)	2016/02/29	<1.0		mg/kg	
			Total Barium (Ba)	2016/02/29	<1.0		mg/kg	
			Total Beryllium (Be)	2016/02/29	<0.40		mg/kg	
			Total Cadmium (Cd)	2016/02/29	<0.050		mg/kg	
			Total Chromium (Cr)	2016/02/29	<1.0		mg/kg	
			Total Cobalt (Co)	2016/02/29	<0.50		mg/kg	

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TETRA TECH EBA INC.
Client Project #: ENV.CENV03003-01
Site Location: LOT 1 & 2 / BLOCK 15 / PLAN 0614136
Sampler Initials: JL

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Copper (Cu)	2016/02/29	<1.0		mg/kg	
			Total Lead (Pb)	2016/02/29	<0.50		mg/kg	
			Total Mercury (Hg)	2016/02/29	<0.050		mg/kg	
			Total Molybdenum (Mo)	2016/02/29	<0.40		mg/kg	
			Total Nickel (Ni)	2016/02/29	<1.0		mg/kg	
			Total Selenium (Se)	2016/02/29	<0.50		mg/kg	
			Total Silver (Ag)	2016/02/29	<0.20		mg/kg	
			Total Thallium (Tl)	2016/02/29	<0.10		mg/kg	
			Total Tin (Sn)	2016/02/29	<1.0		mg/kg	
			Total Uranium (U)	2016/02/29	<0.20		mg/kg	
			Total Vanadium (V)	2016/02/29	<1.0		mg/kg	
			Total Zinc (Zn)	2016/02/29	<10		mg/kg	
8203462	PC5	RPD [OE4254-01]	Total Antimony (Sb)	2016/02/29	NC		%	35
			Total Arsenic (As)	2016/02/29	1.1		%	35
			Total Barium (Ba)	2016/02/29	5.7		%	35
			Total Beryllium (Be)	2016/02/29	NC		%	35
			Total Cadmium (Cd)	2016/02/29	5.6		%	35
			Total Chromium (Cr)	2016/02/29	3.3		%	35
			Total Cobalt (Co)	2016/02/29	1.3		%	35
			Total Copper (Cu)	2016/02/29	0.47		%	35
			Total Lead (Pb)	2016/02/29	3.2		%	35
			Total Mercury (Hg)	2016/02/29	NC		%	35
			Total Molybdenum (Mo)	2016/02/29	NC		%	35
			Total Nickel (Ni)	2016/02/29	0.45		%	35
			Total Selenium (Se)	2016/02/29	NC		%	35
			Total Silver (Ag)	2016/02/29	NC		%	35
			Total Thallium (Tl)	2016/02/29	NC		%	35
			Total Tin (Sn)	2016/02/29	NC		%	35
			Total Uranium (U)	2016/02/29	4.4		%	35
			Total Vanadium (V)	2016/02/29	3.5		%	35
			Total Zinc (Zn)	2016/02/29	0.80		%	35
8203469	MAP	Matrix Spike [OE4254-01]	Soluble (Hot water) Boron (B)	2016/02/29		95	%	75 - 125
8203469	MAP	Spiked Blank	Soluble (Hot water) Boron (B)	2016/02/29		97	%	75 - 125
8203469	MAP	Method Blank	Soluble (Hot water) Boron (B)	2016/02/29	<0.10		mg/kg	
8203469	MAP	RPD [OE4254-01]	Soluble (Hot water) Boron (B)	2016/02/29	0.22		%	35
8204099	MN0	QC Standard	Sieve - Pan	2016/03/01		100	%	75 - 125
			Sieve - #200 (>0.075mm)	2016/03/01		101	%	75 - 125
8204099	MN0	RPD	Sieve - Pan	2016/03/01	8.4		%	35
			Sieve - #200 (>0.075mm)	2016/03/01	33		%	35
8204954	KP9	Matrix Spike	Hex. Chromium (Cr 6+)	2016/03/01		112	%	75 - 125
8204954	KP9	Spiked Blank	Hex. Chromium (Cr 6+)	2016/03/01		112	%	80 - 120
8204954	KP9	Method Blank	Hex. Chromium (Cr 6+)	2016/03/01	<0.080		mg/kg	
8204954	KP9	RPD	Hex. Chromium (Cr 6+)	2016/03/01	NC		%	35
8211707	LZ3	Matrix Spike	D10-ANTHRACENE (sur.)	2016/03/09		72	%	50 - 130
			D8-ACENAPHTHYLENE (sur.)	2016/03/09		76	%	50 - 130
			D8-NAPHTHALENE (sur.)	2016/03/09		75	%	50 - 130
			TERPHENYL-D14 (sur.)	2016/03/09		72	%	50 - 130
			Acenaphthene	2016/03/09		69	%	50 - 130
			Acenaphthylene	2016/03/09		72	%	50 - 130
			Acridine	2016/03/09		54	%	50 - 130
			Anthracene	2016/03/09		73	%	50 - 130
			Benzo(a)anthracene	2016/03/09		68	%	50 - 130

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TETRA TECH EBA INC.
Client Project #: ENV.CENV03003-01
Site Location: LOT 1 & 2 / BLOCK 15 / PLAN 0614136
Sampler Initials: JL

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Benzo(b&j)fluoranthene	2016/03/09		65	%	50 - 130
			Benzo(k)fluoranthene	2016/03/09		64	%	50 - 130
			Benzo(g,h,i)perylene	2016/03/09		71	%	50 - 130
			Benzo(c)phenanthrene	2016/03/09		69	%	50 - 130
			Benzo(a)pyrene	2016/03/09		75	%	50 - 130
			Benzo[e]pyrene	2016/03/09		71	%	50 - 130
			Chrysene	2016/03/09		72	%	50 - 130
			Dibenz(a,h)anthracene	2016/03/09		75	%	50 - 130
			Fluoranthene	2016/03/09		75	%	50 - 130
			Fluorene	2016/03/09		73	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2016/03/09		74	%	50 - 130
			2-Methylnaphthalene	2016/03/09		68	%	50 - 130
			Naphthalene	2016/03/09		68	%	50 - 130
			Phenanthrene	2016/03/09		68	%	50 - 130
			Perylene	2016/03/09		70	%	50 - 130
			Pyrene	2016/03/09		75	%	50 - 130
			Quinoline	2016/03/09		98	%	50 - 130
8211707	LZ3	Spiked Blank	D10-ANTHRACENE (sur.)	2016/03/09		88	%	50 - 130
			D8-ACENAPHTHYLENE (sur.)	2016/03/09		88	%	50 - 130
			D8-NAPHTHALENE (sur.)	2016/03/09		86	%	50 - 130
			TERPHENYL-D14 (sur.)	2016/03/09		89	%	50 - 130
			Acenaphthene	2016/03/09		83	%	50 - 130
			Acenaphthylene	2016/03/09		82	%	50 - 130
			Acridine	2016/03/09		58	%	50 - 130
			Anthracene	2016/03/09		87	%	50 - 130
			Benzo(a)anthracene	2016/03/09		85	%	50 - 130
			Benzo(b&j)fluoranthene	2016/03/09		79	%	50 - 130
			Benzo(k)fluoranthene	2016/03/09		77	%	50 - 130
			Benzo(g,h,i)perylene	2016/03/09		85	%	50 - 130
			Benzo(c)phenanthrene	2016/03/09		84	%	50 - 130
			Benzo(a)pyrene	2016/03/09		88	%	50 - 130
			Benzo[e]pyrene	2016/03/09		83	%	50 - 130
			Chrysene	2016/03/09		86	%	50 - 130
			Dibenz(a,h)anthracene	2016/03/09		88	%	50 - 130
			Fluoranthene	2016/03/09		85	%	50 - 130
			Fluorene	2016/03/09		84	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2016/03/09		88	%	50 - 130
			2-Methylnaphthalene	2016/03/09		78	%	50 - 130
			Naphthalene	2016/03/09		78	%	50 - 130
			Phenanthrene	2016/03/09		84	%	50 - 130
			Perylene	2016/03/09		84	%	50 - 130
			Pyrene	2016/03/09		85	%	50 - 130
			Quinoline	2016/03/09		98	%	50 - 130
8211707	LZ3	Method Blank	D10-ANTHRACENE (sur.)	2016/03/09		89	%	50 - 130
			D8-ACENAPHTHYLENE (sur.)	2016/03/09		84	%	50 - 130
			D8-NAPHTHALENE (sur.)	2016/03/09		83	%	50 - 130
			TERPHENYL-D14 (sur.)	2016/03/09		88	%	50 - 130
			Acenaphthene	2016/03/09	<0.0050		mg/kg	
			Acenaphthylene	2016/03/09	<0.0050		mg/kg	
			Acridine	2016/03/09	<0.010		mg/kg	
			Anthracene	2016/03/09	<0.0040		mg/kg	
			Benzo(a)anthracene	2016/03/09	<0.0050		mg/kg	

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TETRA TECH EBA INC.
Client Project #: ENV.CENV03003-01
Site Location: LOT 1 & 2 / BLOCK 15 / PLAN 0614136
Sampler Initials: JL

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Benzo(b&j)fluoranthene	2016/03/09	<0.0050		mg/kg	
			Benzo(k)fluoranthene	2016/03/09	<0.0050		mg/kg	
			Benzo(g,h,i)perylene	2016/03/09	<0.0050		mg/kg	
			Benzo(c)phenanthrene	2016/03/09	<0.0050		mg/kg	
			Benzo(a)pyrene	2016/03/09	<0.0050		mg/kg	
			Benzo[e]pyrene	2016/03/09	<0.0050		mg/kg	
			Chrysene	2016/03/09	<0.0050		mg/kg	
			Dibenz(a,h)anthracene	2016/03/09	<0.0050		mg/kg	
			Fluoranthene	2016/03/09	<0.0050		mg/kg	
			Fluorene	2016/03/09	<0.0050		mg/kg	
			Indeno(1,2,3-cd)pyrene	2016/03/09	<0.0050		mg/kg	
			2-Methylnaphthalene	2016/03/09	<0.0050		mg/kg	
			Naphthalene	2016/03/09	<0.0050		mg/kg	
			Phenanthrene	2016/03/09	<0.0050		mg/kg	
			Perylene	2016/03/09	<0.0050		mg/kg	
			Pyrene	2016/03/09	<0.0050		mg/kg	
			Quinoline	2016/03/09	<0.010		mg/kg	
8211707	LZ3	RPD	Acenaphthene	2016/03/09	NC		%	50
			Acenaphthylene	2016/03/09	NC		%	50
			Acridine	2016/03/09	NC		%	50
			Anthracene	2016/03/09	NC		%	50
			Benzo(a)anthracene	2016/03/09	NC		%	50
			Benzo(b&j)fluoranthene	2016/03/09	NC		%	50
			Benzo(k)fluoranthene	2016/03/09	NC		%	50
			Benzo(g,h,i)perylene	2016/03/09	2.0		%	50
			Benzo(c)phenanthrene	2016/03/09	NC		%	50
			Benzo(a)pyrene	2016/03/09	NC		%	50
			Benzo[e]pyrene	2016/03/09	12		%	50
			Chrysene	2016/03/09	NC		%	50
			Dibenz(a,h)anthracene	2016/03/09	NC		%	50
			Fluoranthene	2016/03/09	NC		%	50
			Fluorene	2016/03/09	NC		%	50
			Indeno(1,2,3-cd)pyrene	2016/03/09	NC		%	50
			2-Methylnaphthalene	2016/03/09	NC		%	50
			Naphthalene	2016/03/09	NC		%	50
			Phenanthrene	2016/03/09	NC		%	50
			Perylene	2016/03/09	NC		%	50
			Pyrene	2016/03/09	NC		%	50
			Quinoline	2016/03/09	NC		%	50
8212353	TL0	Method Blank	Moisture	2016/03/09	<0.30		%	
8212353	TL0	RPD	Moisture	2016/03/09	1.3		%	20
8213396	EH2	QC Standard	Saturation %	2016/03/11		103	%	75 - 125
8213396	EH2	RPD	Saturation %	2016/03/11	3.5		%	12
8213607	PC5	Matrix Spike [OE4244-01]	Total Antimony (Sb)	2016/03/14		76	%	75 - 125
			Total Arsenic (As)	2016/03/14		82	%	75 - 125
			Total Barium (Ba)	2016/03/14		NC	%	75 - 125
			Total Beryllium (Be)	2016/03/14		72 (1)	%	75 - 125
			Total Cadmium (Cd)	2016/03/14		80	%	75 - 125
			Total Chromium (Cr)	2016/03/14		91	%	75 - 125
			Total Cobalt (Co)	2016/03/14		80	%	75 - 125
			Total Copper (Cu)	2016/03/14		79	%	75 - 125
			Total Lead (Pb)	2016/03/14		77	%	75 - 125

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Client Project #: ENV.CENV03003-01
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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Mercury (Hg)	2016/03/14		100	%	75 - 125
			Total Molybdenum (Mo)	2016/03/14		83	%	75 - 125
			Total Nickel (Ni)	2016/03/14		82	%	75 - 125
			Total Selenium (Se)	2016/03/14		81	%	75 - 125
			Total Silver (Ag)	2016/03/14		79	%	75 - 125
			Total Thallium (Tl)	2016/03/14		75	%	75 - 125
			Total Tin (Sn)	2016/03/14		82	%	75 - 125
			Total Uranium (U)	2016/03/14		76	%	75 - 125
			Total Vanadium (V)	2016/03/14		NC	%	75 - 125
			Total Zinc (Zn)	2016/03/14		NC	%	75 - 125
8213607	PC5	QC Standard	Total Arsenic (As)	2016/03/14		77	%	53 - 147
			Total Barium (Ba)	2016/03/14		87	%	80 - 119
			Total Chromium (Cr)	2016/03/14		91	%	59 - 141
			Total Cobalt (Co)	2016/03/14		85	%	58 - 142
			Total Copper (Cu)	2016/03/14		88	%	83 - 117
			Total Lead (Pb)	2016/03/14		91	%	79 - 121
			Total Nickel (Ni)	2016/03/14		94	%	79 - 121
			Total Vanadium (V)	2016/03/14		91	%	79 - 121
			Total Zinc (Zn)	2016/03/14		91	%	79 - 121
8213607	PC5	Spiked Blank	Total Antimony (Sb)	2016/03/11		91	%	75 - 125
			Total Arsenic (As)	2016/03/11		88	%	75 - 125
			Total Barium (Ba)	2016/03/11		87	%	75 - 125
			Total Beryllium (Be)	2016/03/11		88	%	75 - 125
			Total Cadmium (Cd)	2016/03/11		90	%	75 - 125
			Total Chromium (Cr)	2016/03/11		89	%	75 - 125
			Total Cobalt (Co)	2016/03/11		91	%	75 - 125
			Total Copper (Cu)	2016/03/11		89	%	75 - 125
			Total Lead (Pb)	2016/03/11		88	%	75 - 125
			Total Mercury (Hg)	2016/03/11		103	%	75 - 125
			Total Molybdenum (Mo)	2016/03/11		90	%	75 - 125
			Total Nickel (Ni)	2016/03/11		90	%	75 - 125
			Total Selenium (Se)	2016/03/11		95	%	75 - 125
			Total Silver (Ag)	2016/03/11		88	%	75 - 125
			Total Thallium (Tl)	2016/03/11		87	%	75 - 125
			Total Tin (Sn)	2016/03/11		86	%	75 - 125
			Total Uranium (U)	2016/03/11		90	%	75 - 125
			Total Vanadium (V)	2016/03/11		90	%	75 - 125
			Total Zinc (Zn)	2016/03/11		91	%	75 - 125
8213607	PC5	Method Blank	Total Antimony (Sb)	2016/03/12	<0.50		mg/kg	
			Total Arsenic (As)	2016/03/12	<1.0		mg/kg	
			Total Barium (Ba)	2016/03/12	<1.0		mg/kg	
			Total Beryllium (Be)	2016/03/12	<0.40		mg/kg	
			Total Cadmium (Cd)	2016/03/12	<0.050		mg/kg	
			Total Chromium (Cr)	2016/03/12	<1.0		mg/kg	
			Total Cobalt (Co)	2016/03/12	<0.50		mg/kg	
			Total Copper (Cu)	2016/03/12	<1.0		mg/kg	
			Total Lead (Pb)	2016/03/12	<0.50		mg/kg	
			Total Mercury (Hg)	2016/03/12	<0.050		mg/kg	
			Total Molybdenum (Mo)	2016/03/12	<0.40		mg/kg	
			Total Nickel (Ni)	2016/03/12	<1.0		mg/kg	
			Total Selenium (Se)	2016/03/12	<0.50		mg/kg	
			Total Silver (Ag)	2016/03/12	<0.20		mg/kg	

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Thallium (Tl)	2016/03/12	<0.10		mg/kg	
			Total Tin (Sn)	2016/03/12	<1.0		mg/kg	
			Total Uranium (U)	2016/03/12	<0.20		mg/kg	
			Total Vanadium (V)	2016/03/12	<1.0		mg/kg	
			Total Zinc (Zn)	2016/03/12	<10		mg/kg	
8213607	PC5	RPD [OE4244-01]	Total Antimony (Sb)	2016/03/12	NC		%	35
			Total Arsenic (As)	2016/03/12	6.5		%	35
			Total Barium (Ba)	2016/03/12	11		%	35
			Total Beryllium (Be)	2016/03/12	NC		%	35
			Total Cadmium (Cd)	2016/03/12	2.0		%	35
			Total Chromium (Cr)	2016/03/12	5.7		%	35
			Total Cobalt (Co)	2016/03/12	5.9		%	35
			Total Copper (Cu)	2016/03/12	3.4		%	35
			Total Lead (Pb)	2016/03/12	3.3		%	35
			Total Mercury (Hg)	2016/03/12	NC		%	35
			Total Molybdenum (Mo)	2016/03/12	NC		%	35
			Total Nickel (Ni)	2016/03/12	5.2		%	35
			Total Selenium (Se)	2016/03/12	NC		%	35
			Total Silver (Ag)	2016/03/12	NC		%	35
			Total Thallium (Tl)	2016/03/12	NC		%	35
			Total Tin (Sn)	2016/03/12	NC		%	35
			Total Uranium (U)	2016/03/12	NC		%	35
			Total Vanadium (V)	2016/03/12	9.7		%	35
			Total Zinc (Zn)	2016/03/12	5.4		%	35
8214301	MAP	Matrix Spike	Soluble Boron (B)	2016/03/11		95	%	75 - 125
8214301	MAP	Spiked Blank	Soluble Boron (B)	2016/03/11		96	%	80 - 120
8214301	MAP	Method Blank	Soluble Boron (B)	2016/03/11	<0.10		mg/L	
8215192	KP9	Matrix Spike	Hex. Chromium (Cr 6+)	2016/03/12		98	%	75 - 125
8215192	KP9	Spiked Blank	Hex. Chromium (Cr 6+)	2016/03/12		105	%	80 - 120
8215192	KP9	Method Blank	Hex. Chromium (Cr 6+)	2016/03/12	<0.080		mg/kg	
8215192	KP9	RPD	Hex. Chromium (Cr 6+)	2016/03/12	NC		%	35

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than 2x that of the native sample concentration).

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (one or both samples < 5x RDL).

(1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

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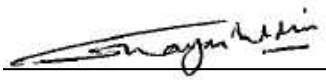
Maxxam Job #: B614507
Report Date: 2016/03/16

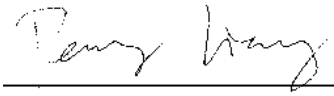
TETRA TECH EBA INC.
Client Project #: ENV.CENV03003-01
Site Location: LOT 1 & 2 / BLOCK 15 / PLAN 0614136
Sampler Initials: JL

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



Ghayasuddin Khan, M.Sc., B.Ed., P.Chem, Scientific Specialist



Harry (Peng) Liang, Senior Analyst



Jingyuan Song, Organics – Senior Analyst



Veronica Falk, Scientific Specialist

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CHAIN OF CUSTODY RECORD

673

Invoice Information		Report Information (if differs from invoice)		Project Information		Turnaround Time (TAT) Required
Company :	TETRA TECH EBA INC.	Company:		Quotation #:		[X] 5 - 7 Days Regular (Most analyses)
Contact Name:	JAYMES GOING	Contact Name:		P.O. #/ AFE#:		PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	442 - 10th Street North	Address:				Rush TAT (Surcharges will be applied)
	Lethbridge, AB T1H 2C7			Project #:	ENV.CENV03003-01	[ ] Same Day [ ] 2 Days
Phone:	403.634.3566	Phone:		Site Location:	Lot 1 & 2 / Block 15 / Plan 0614136	[ ] 1 Day [ ] 3-4 Days
Email:	jgoing@eba.ca	Email:		Site #:	Coalhurst, AB Test Pitting	Date Required:
Copies:	jlamontagne@eba.ca	Copies:		Sampled By:	Jamie Lamontagne 403.634.3566	Rush Confirmation #:

Laboratory Use Only

	YES	NO	Cooler ID	Temp			
Seal Present		✓					
Seal Intact		✓					
Cooling Media		✓					
	YES	NO	Cooler ID	Temp			
Seal Present							
Seal Intact							
Cooling Media							
	YES	NO	Cooler ID	Temp			
Seal Present							
Seal Intact							
Cooling Media							

Depot Reception

Analysis Requested

	Sample Identification	Depth (Unit)	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	# of containers	BTEX F1 ☐ VOC	BTEX F1-F2	BTEX F1-F4	Routine Water	Regulated Metals ☐ Tot ☐ Diss	Mercury Total ☐ Dissolved	Salinity 4	Sieve (75 micron)	Texture (% Sand, Silt, Clay)	Basic Class II Landfill	PAH's	METALS	HOLD - DO NOT ANALYZE
1	15TP01	0.4 m	2016/FEB/24	am	Soil	2											X	X	
2	15TP01	1.0 m	2016/FEB/24	am	Soil	2													X
3	15TP03	0.3 m	2016/FEB/24	am	Soil	2											X	X	
4	15TP03	0.8 m	2016/FEB/24	am	Soil	2													X
5	15TP05	1.5 m	2016/FEB/24	am	Soil	2								X			X	X	
6	15TP05	2.4 m	2016/FEB/24	am	Soil	2								X			X	X	
7	15TP05	3.6 m	2016/FEB/24	am	Soil	2													X
8	15TP08	1.5 m	2016/FEB/24	am	Soil	2								X			X	X	
9	15TP08	2.2 m	2016/FEB/24	am	Soil	2													X
10	15TP09	0.5 m	2016/FEB/24	pm	Soil	2								X			X	X	

Please indicate Filtered, Preserved or Both (F, P, F/P) →

Regulatory Criteria

- [X] AT1/CCME
- [ ] Drinking Water
- [ ] Saskatchewan
- [ ] D50 (Drilling Waste)
- [ ] Other:

Special Instructions

Relinquished by: (Signature/ Print)	DATE (YYYY/MM/DD)	Time (HH:MM)	Received by: (Signature/ Print)	DATE (YYYY/MM/DD)	Time (HH:MM)
JAMIE LAMONTAGNE	2016/FEB/25	15:00	David Middlemiss	2016/02/26	08:35
	403.634.3566				

26-Feb-16 08:35
Ioana Stoica
B614507
FL5 INS-0031

AB FCD-00331/6

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CHAIN OF CUSTODY RECORD

Page 2 of 2

Invoice Information		Report Information (if differs from invoice)		Project Information		Turnaround Time (TAT) Required
Company :	TETRA TECH EBA INC.	Company:		Quotation #:		[X] 5 - 7 Days Regular (Most analyses)
Contact Name:	JAYMES GOING	Contact Name:		P.O. #/ AFE#:		PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	442 - 10th Street North	Address:				Rush TAT (Surcharges will be applied)
	Lethbridge, AB T1H 2C7			Project #:	ENV.CENV03003-01	[ ] Same Day [ ] 2 Days
Phone:	403.634.3566	Phone:		Site Location:	Lot 1 & 2 / Block 15 / Plan 0614136	[ ] 1 Day [ ] 3-4 Days
Email:	jgoing@eba.ca	Email:		Site #:	Coalhurst, AB Test Pitting	Date Required:
Copies:	jlamontagne@eba.ca	Copies:		Sampled By:	Jamie Lamontagne 403.634.3566	Rush Confirmation #:

Laboratory Use Only

	YES	NO	Cooler ID			
Seal Present		✓	Temp	6	9	7
Seal Intact		✓				
Cooling Media						
	YES	NO	Cooler ID			
Seal Present			Temp			
Seal Intact						
Cooling Media						
	YES	NO	Cooler ID			
Seal Present			Temp			
Seal Intact						
Cooling Media						

Depot Reception

Analysis Requested

	Sample Identification	Depth (Unit)	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	# of containers	BTEX F1 [ ] VOC [ ]	BTEX F1-F2	BTEX F1-F4	Routine Water	Regulated Metals Tot [ ] Diss [ ]	Mercury Total [ ] Dissolved [ ]	Salinity 4	Sieve (75 micron)	Texture (% Sand, Silt, Clay)	Basic Class II Landfill	PAH's	METALS	HOLD - DO NOT ANALYZE
1	15TP09	1.2 m	2016/FEB/24	pm	Soil	2								X			X	X	
2	15TP14	1.0 m	2016/FEB/24	pm	Soil	2								X			X	X	
3	15TP14	2.0 m	2016/FEB/24	pm	Soil	2													X
4	15TP15	0.6 m	2016/FEB/24	pm	Soil	2											X	X	
5	15TP15	1.2 m	2016/FEB/24	pm	Soil	2											X	X	
6																			
7																			
8																			
9																			
10																			

Please indicate Filtered, Preserved or Both (F, P, F/P) →

Regulatory Criteria

- [X] AT1/CCME
- [ ] Drinking Water
- [ ] Saskatchewan
- [ ] D50 (Drilling Waste)
- [ ] Other:

Special Instructions

Relinquished by: (Signature/ Print)	DATE (YYYY/MM/DD)	Time (HH:MM)	Received by: (Signature/ Print)	DATE (YYYY/MM/DD)	Time (HH:MM)
JAMIE LAMONTAGNE	2016/FEB/25	15:00	David Whitemans	2016/02/26	08:35

26-Feb-16 08:35
Ioana Stoica
B614507
FL5 INS-0031

AB FCD-00331/6

APPENDIX

APPENDIX 4 ~ GEOTECHNICAL EVALUATION

Geotechnical Evaluation
Greenwood Homes Subdivision
Coalhurst, Alberta





PRESENTED TO

Greenwood Homes Inc.

DECEMBER 2016
ISSUED FOR USE
FILE: ENG.LGEO03342-01

Tetra Tech EBA Inc.
442 - 10 Street N.
Lethbridge, AB T1H 2C7 CANADA
Tel 403.329.9009 Fax 403.328.8817

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Appendix B Borehole Logs
Appendix C Recommended General Design and Construction Guidelines

LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of Greenwood Homes Inc., and their agents. Tetra Tech EBA Inc. (Tetra Tech) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Greenwood Homes Inc., or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Tetra Tech's General Conditions are provided in Appendix A of this report.

1.0 INTRODUCTION

This report presents the results of a geotechnical evaluation conducted by Tetra Tech EBA Inc. (Tetra Tech) for the proposed Greenwood Homes Subdivision project, located in Coalhurst, Alberta. The legal description of the site address is Lot 1 Block 15 Plan 0614136.

The scope of work for this evaluation was outlined in an email proposal to Mr. Matt Redgrave, of Martin Geomatic Consultants Ltd. (MGCL), on November 25, 2016. The objective of this work was to determine the general subsurface conditions in the area of the proposed development and to develop recommendations for the geotechnical aspects of design and construction for the project.

Authorization to proceed with the evaluation was provided by Mr. Redgrave through a signed Services Agreement on December 1, 2016.

2.0 PROJECT DETAILS AND SCOPE OF WORK

Based on the information provided by MGCL, it is understood that the project will involve the development of 54 residential lots with a total area of 40,000 m². The development will also have underground facilities, a stormwater management facility (dry pond), and paved roads in consideration. It is understood that a shallow footing system is the typical foundation type used for residential structures in this area.

The scope of work for this evaluation comprised the drilling of three (3) boreholes, a laboratory program to assist in classification of the subsurface soils, and this report providing the following foundation design and construction recommendations:

- Design parameters for shallow foundation systems and below-grade structures.
- Design and construction of floor systems including slabs-on-grade.
- General site grading.
- Recommendations for special considerations if fill is encountered.
- Classification of site for seismic design purposes according to Table 4.1.8.4A of the Alberta Building Code 2014.
- Recommendations for subgrade preparation, backfill materials, and compaction.
- Recommended construction provisions for control of groundwater.
- Recommendations for concrete type in contact with soils.
- Recommendations for pavement structures.

3.0 GEOTECHNICAL FIELD AND LABORATORY WORK

The fieldwork for this evaluation was carried out on December 2, 2016 using a truck-mounted drill rig contracted from Chilako Drilling Services Ltd. of Coaldale, Alberta. The rig was equipped with 150 mm diameter solid stem continuous flight augers. Tetra Tech's field representative was Mr. Stuart Smith.

Three (3) boreholes (referenced as 16BH001, 16BH002, and 16BH003) were drilled to depths of 6.6 m below ground surface across the site. The approximate borehole locations are shown on Figure 1. From the boreholes, disturbed grab samples were obtained at approximate 600 mm intervals. In addition, Standard Penetration Tests (SPTs) were generally performed at depth intervals of 1.5 m within the boreholes. All soil samples were visually classified in the field and the individual soil strata and the interfaces between them were noted. The borehole logs are presented in Appendix B. An explanation of the terms and symbols used on the borehole logs is also included in Appendix B.

Slotted 25 mm diameter PVC standpipes were installed in the boreholes to monitor groundwater levels. Auger cuttings were backfilled around the standpipes and were sealed at ground surface with bentonite chips.

The ground surface geodetic elevations were surveyed by MGCL and included on the borehole logs.

Classification tests, including natural moisture content, Atterberg Limits, and soluble sulphate content were performed in a laboratory on soil samples to aid in the determination of engineering properties. The results of the laboratory tests are presented on the borehole logs.

4.0 SITE AND SOIL CONDITIONS

4.1 Site Conditions

The proposed site is vacant land, bounded to the east by an irrigation cannel, to the west by Highway 3 (Crowsnest highway), and to the north and south by existing residential subdivisions. The site is relatively flat with no evident drainage pattern noted during the field drilling.

Historical aerial photographs and Google imagery were examined in roughly 10 year intervals ranging from 1950 to 2014. The site had been farmland, with the irrigation cannel to the east noted since 1950. The site was vacant without farming activities noted since 1981 when the residential subdivision to the north was developed. Some ground disturbance (e.g., stockpiles of materials and storage) was noted in a 1999 aerial photograph but not visible in the 2005 Google image. Site grading was evident with some equipment noted in a 2012 Google image. The site presented its current condition with few changes noted in subsequent Google images after 2012.

4.2 Historical Mine Workings

The EUB (previously Alberta Energy and Utility Board) Coal Mine Atlas (Atlas) was reviewed to determine if any coal mines existed at the site. The information from the Atlas indicated that the Coalhurst Imperial Mine (Mine No. 0174) was located under the site and the surrounding area and operated from 1908 to 1936. The mine produced 3,775 thousand tonnes of coal from a 1.4 m thick coal layer at a depth of between 153 m and 192 m below ground level.

This was an extensive underground mine, underlying the entire site and in all directions surrounding the site. It is understood that the typical mining practice used was likely a room and pillar arrangement where typically the majority of the pillars were removed prior to mine closure. The locations of mine access and ventilation shafts were not indicated in the records.

Based on Tetra Tech's review of mine subsidence studies, subsidence at ground surface due to collapse of mine workings (not including shafts) generally occurs within 5 years following closure of the mine, with relatively small levels of surface strain thereafter. Therefore, it is unlikely that the proposed development area would be unduly affected by subsidence due to mine collapse.

The presence of mine shafts has not been confirmed at this time. Should the location of historical mine shafts be discovered within the proposed development area, a more detailed review should be undertaken.

Due to coal mine subsidence, there may be localized tension cracks across the site which may require special attention if encountered below the bearing surfaces. This typically does not affect the geotechnical capacity of the site soils. It is recommended that any cracks encountered be over excavated to remove any softened infill soil and backfilled with compacted general engineered fill (cohesive soils).

In addition, in the event of residual mine subsidence, there is a possibility of small amounts of ground surface strain that could theoretically be experienced in a worst-case scenario should an old mine section collapse in the future. Local studies (by others) are available on such strains from mine subsidence. Closer engineering examination by a structural engineer and more detailed geotechnical review is recommended for any buildings higher than two stories in height. The review is intended to verify that the type of structures proposed can structurally accommodate the added strain.

4.3 Soil Stratigraphy

The general subsurface stratigraphy at the borehole locations comprised a surficial layer of topsoil, underlain by clay fill, clay, and clay till deposits. The following sections provide a summary of the stratigraphic units encountered at the specific borehole locations. A more detailed description is provided on the borehole logs provided in Appendix B.

4.3.1 Topsoil

Topsoil was encountered at all borehole locations. The topsoil was sandy and silty clay with roots and organics, ranging between 100 mm to 300 mm in thickness.

4.3.2 Clay Fill

Clay fill was encountered at the borehole locations, extending to depths ranging between 0.4 m and 1.6 below ground surface. The clay fill was generally described as silty, some sand, trace gravel, damp to moist, very stiff, medium plastic, and brown with root hairs and trace organics. Moisture contents of the clay fill ranged between 13% and 17%.

4.3.3 Clay

Clay was encountered underlying the clay fill at all borehole locations, extending to depths ranging between 5.0 m and 6.4 m below ground surface. The clay was generally described as silty, some sand, damp to very moist, firm to hard, medium plastic, and brown with occasional sand pockets. Moisture contents of the clay ranged between 10% and 30%. Atterberg Limits testing (two tests) indicated Plastic Limits of 12%, and Liquid Limits of 40% and 41%.

4.3.4 Clay Till

Clay till was encountered beneath the clay, extending to borehole termination depths. The clay till was generally described as silty, trace to some sand, trace gravel, moist to very moist, firm to very stiff, medium to high plastic, and brown with coal and oxide specks, and occasional silt and sand pockets. Moisture contents of the clay till ranged between 13% and 21%. Atterberg Limits testing (one test) indicated a Plastic Limit of 16%, and a Liquid Limit of 55%.

4.4 Groundwater Conditions

At the time of drilling, no sloughing were encountered within the boreholes and seepage was only encountered in 16BH001. The groundwater level at the borehole locations was measured on December 9, 2016. Table A summarizes the groundwater monitoring data.

Table A: Groundwater Monitoring Data – December 9, 2016

Borehole Number	Depth of Standpipe (m)	Borehole Elevation (m)	Depth to Groundwater (m)	Groundwater Elevation (m)
16BH001	6.1	933.43	3.71	929.72
16BH002	6.6	934.75	Dry	-
16BH003	6.6	933.50	3.58	929.92

The groundwater is likely to be perched within sandy layers and may fluctuate seasonally and in response to climatic conditions. Further comments regarding groundwater issues are provided in the subsequent sections.

5.0 GEOTECHNICAL RECOMMENDATIONS

The recommendations that follow offer varying options intended to aid in the development of project concepts and specifications. The recommendations are provided on the understanding and condition that Tetra Tech will be retained to review the relevant aspects of the final design (drawings and specifications) and to conduct such field reviews as are necessary to ensure compliance with the geotechnical aspects of the Alberta Building Code (2014), this report, and the final plans and specifications. Tetra Tech accepts no liability for any use of this report in the event that Tetra Tech is not retained to provide these review services.

5.1 General

Specific recommendations that apply to this project are provided in the following subsections for shallow footings, basement construction and floor slabs, general site development and lot grading, groundwater issues, trench excavation and backfill, and concrete type (including commentary on concrete surfacing). Pavement structures for this development should be designed and constructed to the City of Lethbridge Design Standards. Recommendations for subgrade preparation within the proposed asphalt concrete surfaced roadways are provided.

It was noted that the soil conditions in 16BH002 were very dry with high SPT blow counts, which is abnormal conditions significantly different from those encountered in the other two boreholes. Due to its medium plasticity with high swelling potential, such soils in dry conditions may experience excessive expansion and soil movement with moisture increase, which will cause damages to light loaded structures including floor slabs-on-grade and even some footings. Precaution, including using structural floor slab instead of floor slabs-on-grade, should be provided

for development adjacent to 16BH002. It is recommended that more investigation be conducted to determine the boundaries of areas with abnormal soil conditions.

All topsoil must be completely removed prior to site grading. Full-time monitoring by experienced personnel is recommended in order to avoid over-stripping and to ensure appropriate mixing and placement. Topsoil thickness should be expected to vary across the property.

Subgrade preparation is recommended for all grade-supported structures including slabs-on-grade, pavements, sidewalks, etc. Subgrade preparation should include removal of any unsuitable materials (if encountered) and conditioning and compaction of the existing clay fill soils. The existing clay fill, clay, and clay till soils (not containing deleterious matter) are adequate for use as general engineered fill, but may require moisture conditioning in order to achieve the required moisture specification. Proof-rolling (where practical) to detect soft areas is also recommended.

All foundation design recommendations presented in this report are based on the assumption that an adequate level of monitoring will be provided during construction and that all construction will be carried out by suitably qualified contractors, experienced in foundation and earthworks construction. An adequate level of monitoring is considered to be as follows:

- For shallow foundations, inspection of bearing surfaces prior to placement of concrete or mudslab and design review during construction.
- For earthworks, full-time monitoring and compaction testing.

Suitably qualified persons, independent of the contractor, should carry out all such monitoring. One of the purposes of providing an adequate level of monitoring is to check that recommendations, based on data obtained at discrete borehole locations, are relevant to other areas of the site.

5.2 Subdivision Development Recommendations

5.2.1 Lot Grading

In general terms, the lot grading should be designed and carried out to the current City of Lethbridge Design Standards or equivalent. The particulars for this development are discussed in this section.

All lots should be initially graded for drainage at a minimum gradient of 2.0%. The existing surficial site soils comprising medium plastic clay and clay fill (not containing deleterious materials) are suitable for use as ‘landscape fill’ or for use as ‘general engineered fill’ for lot grading, as defined in Appendix C. Deleterious fill, if encountered, must be removed from developed areas as noted. The moisture content of the near surface soils generally appears to be below the anticipated optimum moisture content (OMC) for these soils in most areas. It is anticipated therefore, that moisture conditioning consisting of wetting will be required at the site for proper compaction. Although soil moisture variability should be expected, the earthwork contractor should make his own estimate of the requirements and should consider such factors as weather and construction procedures.

General engineered cohesive fill for lot grading should be moisture conditioned to within a range of 0% to +2% of the OMC prior to compaction, and compacted to a minimum of 98% of Standard Proctor Density (SPD). Granular fill placed as “general engineered fill” should be compacted with moisture conditioning within a range of -2% to +1% of the OMC; however, the use of any granular fill should be reviewed by a geotechnical engineer prior to use.

Further recommendations regarding backfill materials and compaction are contained in Appendix C.

5.2.2 Surface Grading and Drainage

Drainage of surface water away from residences should be maintained during and after construction. The finished grade of the proposed residences should be designed so that surface water is drained away from residence structures by the shortest route. All drains should discharge well clear of residence structures. For construction of roof drains, caution should be taken where downspouts discharge due to the high probability of ice forming in the winter. Downspouts may be discharged onto landscaped areas, provided the water is carried, by means of a concrete splash pad or extendable section so the point of discharge of the water is at least 2 m from the residence structures. Landscaped surfaces adjacent to buildings should be graded to slope away from the building at a gradient of at least 5% within 2 m of the residence structures' perimeter. General landscaped areas should have grades of no less than 2% to minimize ponding.

5.2.3 Excavations and Trench Backfill

Excavations should be carried out in accordance with Alberta Occupational Health and Safety Regulations. For this project, the depth for the majority of the trench excavations is assumed to be less than 3.0 m below existing ground surface. The following recommendations notwithstanding, the responsibility of all excavation cutslopes resides with the Contractor, who should take into consideration site-specific conditions regarding soil stratigraphy and groundwater. All excavations should be reviewed by the Contractor prior to personnel working within the base of the excavation.

Based on the findings of the drilling program, firm to very stiff clay soils with moisture contents ranging from damp to very moist are anticipated to be encountered in most areas within 3.0 m below grade during excavation. Short-term excavations within firm to stiff clay soils which are to be deeper than 1.5 m should have the sides shored and braced or the slopes should be cut back no steeper than 1.0 horizontal to 1.0 vertical (1.0H:1.0V). In areas where weaker clay soils are encountered or if the excavation is to be open for more than one month, a flatter cutslope should be considered.

Trenches must be backfilled in such a way as to minimize the potential differential settlement and/or frost heave movements. A minimum density of 95% of SPD is recommended for all trench backfill, at the moisture content described in Section 5.2.1. The compacted thickness of each lift of backfill should not exceed 150 mm. The upper 1.5 m of service trenches should be cut back at a maximum slope of 1.0H:1.0V to avoid an abrupt transition between backfill and in situ soil. A minimum density of 98% of SPD is recommended for the upper 1.5 m compaction.

It should be noted that the ultimate performance of the trench backfill is directly related to the uniformity of the backfill compaction. The lift thickness and compaction criteria must be strictly enforced to achieve this uniformity.

Spill piles or temporary surcharge loads should not be allowed within a distance equal to the depth of the excavation from an unsupported excavation face, while mobile equipment should be kept back at least 3.0 m. All excavations should be checked regularly for signs of sloughing, especially after rainfall periods. Small earth falls from the sideslopes are a potential danger to workers and must be guarded against.

General recommendations regarding construction excavations are contained in Appendix C.

5.3 Pavements

5.3.1 Subgrade Preparation

Within all roadway areas, following stripping of topsoil, the exposed subgrade should be proof-rolled to assess the soil's support characteristics. Following the proof-roll, a minimum subgrade preparation depth of 300 mm is recommended in all areas in order to improve subgrade uniformity. Where softer soils are encountered, subgrade preparation of up to 600 mm may be necessary. Subgrade preparation includes scarification, moisture conditioning to within 2% of OMC, and uniform compaction to a minimum of 98% of SPD.

Backfill to raise the subgrade level should be general engineered fill, as defined in Appendix C, moisture conditioned and compacted as noted previously. The subgrade should be prepared and graded to allow drainage into drainage ditches or catchbasins. Proof-rolling of the prepared surface is recommended to identify localized soft areas and for an indication of overall subgrade support characteristics. The native clay and clay fill are considered suitable as general engineered fill materials.

It is imperative that positive surface drainage be provided to prevent ponding of water within the roadway structure and subsequent softening and loss of strength of the subgrade soils. Surrounding landscaping should be such that runoff water is prevented from ponding beside paved areas in order to avoid softening and premature failure of the pavement surface.

5.3.2 Subsurface Drainage

For asphalt paved surfaces, the design should include provisions for subsurface drainage of the pavement granular layers. This may be achieved by installing subdrains longitudinally along the edge of the pavement structure. Subdrains will provide a means of draining water that infiltrates the pavement structure, either through cracks and vertical details (i.e., face of gutter), or from peripheral surface runoff. The subdrains should consist of a perforated flexible plastic drain pipe (minimum 100 mm diameter), complete with filter sock. The drains should be placed along the edge of the pavement section in a recessed area of the prepared subgrade. Positive outfall of the drains should be provided at catchbasin locations or other stormwater outfalls.

5.3.3 Recommended Pavement Structures

The pavement structures presented below are not based on detailed design, and do not take into consideration site-specific traffic loading conditions; as such data was not available at the time of report preparation. The pavement structures are provided as a general guideline, are not intended to have a specific design life, and are based on the assumption that good subgrade support can be achieved. In the absence of good traffic loading data, Tetra Tech recommends the use of the following "Local" pavement structure taken from the City of Lethbridge 2014 Design Standards, for use in lightly loaded areas:

- Type III Asphalt Surfacing - 75 mm
- Granular Base Course - 200 mm
- Subgrade Preparation - 300 mm

For heavy duty access ways, the following “Minor Collector” pavement structure taken from the City of Lethbridge 2014 Design Standards is recommended:

- Type I Asphalt Surfacing - 60 mm
- Type II Asphalt Base Course - 60 mm
- Granular Base Course - 100 mm
- Granular Sub-base - 150 mm
- Subgrade Preparation - 300 mm

For heavy duty loading aprons and refuse collection pads, the use of a Portland Cement concrete pavement is recommended, with a minimum thickness of 180 mm and 200 mm of crushed granular base course.

The recommended pavement layer thicknesses generally refer to average values and recognize typical construction variability. As-constructed layer thicknesses should satisfy the thickness tolerances identified in the City of Lethbridge 2014 Design Standards (or equivalent) for granular materials and asphalt concrete.

5.4 Foundation Design

5.4.1 Limit States Design

The design parameters provided in the following sections may be used to calculate the ultimate foundation capacity in each case. For the Limit States Design (LSD) methodology, in order to calculate the factored load capacity, the appropriate Soil Resistance Factors must be applied to each loading condition as follows:

Factored Capacity = Ultimate Capacity x Soil Resistance Factors

In general, the soil resistance factors in Table B should be incorporated into the foundation design. These factors are considered to be in accordance with the Canadian Foundation Engineering Manual (CFEM) (2006) as well as the Alberta Building Code (2014).

Table B: Soil Resistance Factors – Shallow Foundations

Item	Soil Resistance Factor
Bearing Resistance	0.5
Passive Resistance	0.5
Horizontal Resistance (Sliding)	0.8
Horizontal Passive Resistance	0.5

Under LSD methodology, foundations should be designed on the basis of factored Ultimate Limit State (ULS) parameters. In order to determine the applicable working capacity, Serviceability Limit State (SLS) must also be considered.

5.4.2 Shallow Foundations

Shallow foundations are considered feasible for the residence structure development and should be constructed approximately 1.4 m below the final design exterior ground surface (frost protection requirement). At this depth the foundation subgrade soil generally consists of stiff to very stiff, damp to moist, medium plastic clay. In some instances the depth of fill may exceed the depth of the footing foundations. In these cases it is imperative that the footings extend to native undisturbed soil. If soft native soils are encountered, it may be necessary to either increase the footing size or lower the footing elevation to more competent soils.

The ultimate static bearing pressure for the design of strip and spread footings at this depth may be taken as 225 kPa on native, undisturbed, clay soils; subject to other recommendations in this report. The ultimate static bearing pressure is based on correlation with SPT 'N' values. Footing dimensions should be in accordance with the minimum requirements of the Alberta Building Code 2014. Bearing certification is recommended to ensure that the footings are placed on competent native clay soils.

It is recommended to use a smooth edge-trimming bucket or Grade-All for final excavation to the foundation subgrade elevation to minimize disturbance of the founding soils. The foundation concrete should be placed immediately following excavation to protect the bearing surface from disturbance. If footing foundations cannot be poured immediately following excavation, the bearing surface should be protected by a layer of lean mix concrete.

Settlement of footings designed and constructed in accordance with the above recommendations should be within 25 mm total and 15 mm differential.

Recommendations for minimum depth of cover for footings are presented under the heading 'Frost Protection' below (Section 5.5). Further recommendations regarding shallow foundations are given in Appendix C.

5.4.3 Foundation Perimeter Drainage Requirements

It is recommended that a weeping tile and sump system be constructed around the outside perimeter of the residence structures (at the base of the footings) to maintain a relatively consistent moisture profile of the subgrade soils. The weeping tile system should comprise a perforated weeping tile, in turn surrounded with a minimum of 150 mm thick blanket of washed rock (maximum size 20 mm) with the granular layer wrapped in non-woven geotextile. The weeping tile should have a minimum 0.5% slope leading to a sump.

5.4.4 Below-Grade Walls

All below-grade walls should be designed to resist lateral earth pressures in an "at-rest" condition. This condition assumes a triangular pressure distribution and may be calculated using the following expression:

$$P_o = K_o (\gamma H + Q)$$

Where: P_o = Lateral earth pressure "at-rest" condition (no wall movement occurs at a given depth).

K_o = Coefficient of earth pressure "at-rest" condition (use 0.5 for cohesive backfill and 0.45 for sand and gravel backfill).

γ = Bulk unit weight of backfill soil (use 19 or 21 kN/m³ for cohesive or granular backfill, respectively).

H = Depth below final grade (m).

Q = Surcharge pressure at ground level (kPa).

It is assumed that drainage is provided for all below-grade walls through the installation of the weeping tile (discussed in Section 5.4.3), and hydrostatic pressures will not be a factor in design.

Backfill around concrete walls should not commence before the concrete has reached a minimum two thirds of its design strength and first floor framing is in place or the walls are laterally braced. Only hand-operated compaction equipment should be employed within 600 mm of the concrete walls. Caution should be used when compacting backfill to avoid high lateral loads caused by excessive compactive effort. A compaction standard of 95% of SPD is recommended. To avoid differential wall pressures, the backfill should be brought up evenly around the walls. A minimum 600 mm thick clay cap should be placed at the ground surface to reduce the infiltration of surface water.

5.4.5 Floor Slab System

5.4.5.1 Basement Floor Slabs

Slabs-on-grade construction for basements is considered feasible provided certain precautions are undertaken. Basement floor slabs should be supported by a minimum of 150 mm compacted, clean, free draining granular material.

Any light columns in the basement designed to support the main floor should be of the adjustable "telepost" type, supported on spread footings, bearing on native soil. If partitions are constructed in the basement, provision should be made so that, if the basement floor slab heaves, the partitions do not raise the main floor. As a general rule, a minimum allowance of 25 mm should be left between the top plates of basement partitions and the floor above them to accommodate heaving of the floor slab. In addition, the soils at the site generally have a moderate to high potential for volumetric changes with changes in moisture.

5.4.5.2 Floor Slabs-on-Grade

Construction of slabs-on-grade (outside of basements) for this project should consider the following precautions and construction recommendations. Constructing the slabs-on-grade as follows will reduce the potential for subgrade movements and these procedures are intended to limit total and differential floor slab movements to 25 mm and 15 mm, respectively. Slabs-on-grade should be separated from bearing members to allow some differential movement. If this range of differential movement is unacceptable, the owner should consider a structurally supported floor.

Following removal of the topsoil and/or any unsuitable soils encountered, a minimum 300 mm subgrade preparation should be conducted. The recommended standard for clay subgrade preparation is a minimum of 98% of SPD with a moisture content of 0% to +2% of the OMC. The compaction thickness should be less than 150 mm for each lift. For granular backfill, moisture conditioning to within ±1% of OMC is recommended.

Long-term slab performance is dependent on subgrade uniformity. Care must be taken to ensure that the depth of subcut is relatively uniform across the entire floor area. Backfill operations should be conducted such that lift thickness, moisture content, and compaction effort are constant and uniform across the site. It is recommended that subcut and backfill operations be completed prior to construction of foundation elements.

The final prepared subgrade should be proof-rolled and any soft or loose pockets detected should be reconditioned as recommended above or over-excavated and replaced with general engineered fill.

The prepared subgrade beneath slabs-on-grade should be protected at all times from moisture or exposure which may cause softening or desiccation of the subgrade soils. This applies during and after the construction period (and before and after replacement of the required engineered fill). Should the exposed surface become saturated or desiccated, it should be reworked to achieve the above moisture and density standards.

It is recommended that the exposed subgrade be observed by a qualified geotechnical engineer prior to backfilling, and the finished subgrade observed prior to slabs-on-grade placement.

A levelling course of clean, well-graded crushed gravel, at least 150 mm in compacted thickness, is recommended directly beneath all slabs-on-grade unless a thicker course is required for structural purposes.

Recommended procedures for backfill materials and further recommendations for slabs-on-grade construction are included in Appendix C.

5.4.5.3 Structural Slabs

If slab movements cannot be tolerated, a structurally supported floor slab system is recommended as the preferred option for this development.

However, with a structurally supported floor slab system there is a risk of ground movement relative to the slab. This relative movement can lead to problems if piping and other utilities that are connected to the slab are embedded within the ground beneath the slab. Utilities beneath structurally supported ground floor slabs should be protected from differential movement by placing utilities within boxes suspended from the structural slab. In addition, a void form is recommended below the floor slab in order to prevent transfer of uplift pressures due to swelling clay soils.

5.4.6 Seismic Design

The site classification recommended for seismic site response is Classification D, as noted in Table 4.1.8.4.a of the Alberta Building Code (2014).

5.4.7 Cement Type

Based on soluble sulphate concentration test results from selected samples taken during the field program and Tetra Tech's experience on local soils, the properties of concrete for foundations in contact with soil shall meet the requirements of the Canadian Standards Association (CSA) A23.1-14, Class S-2 exposure including water/cementing materials (w/cm) ratio of 0.45, air entrainment of 4% to 7% (for 14 mm to 20 mm nominal maximum aggregate size), and a minimum specified 56-day compressive strength of 32 MPa.

For this exposure classification, alternatives include the usage of Type HS (sulphate-resistant) Portland Cement or blends of cement and supplementary cementing materials conforming to Type HSb cements.

5.5 Frost Protection

For protection against frost action, all perimeter footings must be placed a minimum of 1.4 m below final grade for heated structures, or 2.1 m for unheated structures.

Pipes buried with less than 2.1 m of soil cover should be protected with insulation to avoid frost effects that might cause damage to, or breakage of, the pipes.

5.6 Stormwater Dry Pond Development

Design and construction of the stormwater management facility should in accordance with the requirements of sections of the "Stormwater Management Guidelines for the Province of Alberta", dated March 2013, and prepared by the Municipal Program Development Branch of Alberta Environmental Protection.

Stormwater dry ponds (one of typical stormwater management methods used in Lethbridge urban areas), are understood to be considered for this development. Such facilities are normally constructed as an excavation below surface grade to provide overland stormwater storage, in accordance with municipal regulations.

Based on Tetra Tech's understanding of a typical stormwater management facility design, a dry pond typically has a base elevation of approximately 2 m to 3 m below the final surrounding ground surface. Once the operational water level elevation of the wet pond is designed, it is recommended that the maximum interior sideslopes for a dry pond be 4H:1V to 5H:1V, with a minimum slope in the bottom of the pond of 1% (2% is preferred). The maximum exterior sideslopes should be3H:1V.

Consideration should always be given to local municipal jurisdictional requirements for such type of facilities.

6.0 RECOMMENDED DESIGN AND CONSTRUCTION GUIDELINES

General design and construction guidelines are provided in Appendix C, under the following supplemental headings:

- Shallow Foundations
- Construction Excavations
- Backfill Materials and Compaction
- Floor Slabs-on-Grade

These guidelines are intended to present standards of good practice. Although supplemental to the main text of this report, they should be interpreted as part of the report. Design recommendations presented herein are based on the premise that these guidelines will be followed. The design and construction guidelines are not intended to represent detailed specifications for the works although they may prove useful in the preparation of such specifications. In the event of any discrepancy between the main text of this report and Appendix C, the main text should govern.

7.0 CLOSURE

We trust this report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Tetra Tech Inc.



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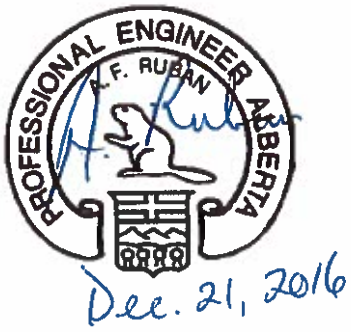

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/tlp

PERMIT TO PRACTICE
TETRA TECH EBA INC.
Signature
Date DECEMBER 21, 2016
PERMIT NUMBER: P245
The Association of Professional Engineers and Geoscientists of Alberta

FIGURES

Figure 1 Borehole Location Plan

C:\Lethbridge\Drafting\ENG.LGEO\LGEO03342\LGEO03342-01 Figure 1.dwg [FIGURE 1] December 15, 2016 - 2:18:56 pm (BY: HUGHES, LEANNE)



LEGEND

BOREHOLE LOCATION

NOTES
GOOGLE EARTH IMAGERY DATED 2012

0 150m

Scale: 1:3,000 @ 8.5"x11"

CLIENT

Greenwood Homes Inc.

GREENWOOD HOMES SUBDIVISION COALHURST, ALBERTA

BOREHOLE LOCATION PLAN

TETRA TECH

PROJECT NO.	DWN	CKD	REV
LGEO03342-01	LCH	SS	0

OFFICE	DATE
LETHBRIDGE	December 2016

Figure 1

APPENDIX A

TETRA TECH'S GENERAL CONDITIONS

GENERAL CONDITIONS

GEOTECHNICAL REPORT

This report incorporates and is subject to these “General Conditions”.

1.1 USE OF REPORT AND OWNERSHIP

This geotechnical report pertains to a specific site, a specific development and a specific scope of work. It is not applicable to any other sites nor should it be relied upon for types of development other than that to which it refers. Any variation from the site or development would necessitate a supplementary geotechnical assessment.

This report and the recommendations contained in it are intended for the sole use of TETRA TECH’s Client. TETRA TECH does not accept any responsibility for the accuracy of any of the data, the analyses or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than TETRA TECH’s Client unless otherwise authorized in writing by TETRA TECH. Any unauthorized use of the report is at the sole risk of the user.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of TETRA TECH. Additional copies of the report, if required, may be obtained upon request.

1.2 ALTERNATE REPORT FORMAT

Where TETRA TECH submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed TETRA TECH’s instruments of professional service); only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by TETRA TECH shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of TETRA TECH’s instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except TETRA TECH. TETRA TECH’s instruments of professional service will be used only and exactly as submitted by TETRA TECH.

Electronic files submitted by TETRA TECH have been prepared and submitted using specific software and hardware systems. TETRA TECH makes no representation about the compatibility of these files with the Client’s current or future software and hardware systems.

1.3 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, TETRA TECH has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site.

1.4 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. TETRA TECH does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

1.5 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

1.6 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of testholes and/or soil/rock exposures. Stratigraphy is known only at the locations of the testhole or exposure. Actual geology and stratigraphy between testholes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. TETRA TECH does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

1.7 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

1.8 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

1.9 INFLUENCE OF CONSTRUCTION ACTIVITY

There is a direct correlation between construction activity and structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques are known.

1.10 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, as well as the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

1.11 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

1.12 BEARING CAPACITY

Design bearing capacities, loads and allowable stresses quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition assumed. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions assumed in this report in fact exist at the site.

1.13 SAMPLES

TETRA TECH will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.

1.14 INFORMATION PROVIDED TO TETRA TECH BY OTHERS

During the performance of the work and the preparation of the report, TETRA TECH may rely on information provided by persons other than the Client. While TETRA TECH endeavours to verify the accuracy of such information when instructed to do so by the Client, TETRA TECH accepts no responsibility for the accuracy or the reliability of such information which may affect the report.

APPENDIX B

BOREHOLE LOGS

TERMS USED ON BOREHOLE LOGS

TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS (major portion retained on 0.075mm sieve): Includes (1) clean gravels and sands, and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as inferred from laboratory or in situ tests.

DESCRIPTIVE TERM	RELATIVE DENSITY	N (blows per 0.3m)
Very Loose	0 TO 20%	0 to 4
Loose	20 TO 40%	4 to 10
Compact	40 TO 75%	10 to 30
Dense	75 TO 90%	30 to 50
Very Dense	90 TO 100%	greater than 50

The number of blows, N, on a 51mm O.D. split spoon sampler of a 63.5kg weight falling 0.76m, required to drive the sampler a distance of 0.3m from 0.15m to 0.45m.

FINE GRAINED SOILS (major portion passing 0.075mm sieve): Includes (1) inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as estimated from laboratory or in situ tests.

DESCRIPTIVE TERM	UNCONFINED COMPRESSIVE STRENGTH (KPA)
Very Soft	Less than 25
Soft	25 to 50
Firm	50 to 100
Stiff	100 to 200
Very Stiff	200 to 400
Hard	Greater than 400

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above, because of planes of weakness or cracks in the soil.

GENERAL DESCRIPTIVE TERMS

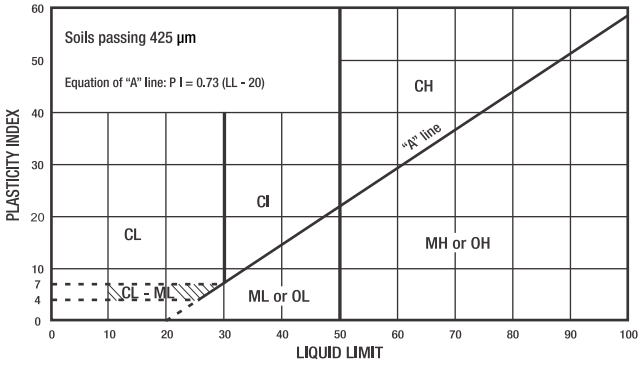
Slickensided - having inclined planes of weakness that are slick and glossy in appearance.
Fissured - containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.
Laminated - composed of thin layers of varying colour and texture.
Interbedded - composed of alternate layers of different soil types.
Calcareous - containing appreciable quantities of calcium carbonate.;
Well graded - having wide range in grain sizes and substantial amounts of intermediate particle sizes.
Poorly graded - predominantly of one grain size, or having a range of sizes with some intermediate size missing.

Data presented hereon is for the sole use of the stipulated client. Tetra Tech EBA is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of EBA. The testing services reported herein have been performed to recognized industry standards, unless noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, EBA will provide it upon written request.

MODIFIED UNIFIED SOIL CLASSIFICATION

MAJOR DIVISION			GROUP SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA
COARSE-GRAINED SOILS More than 50% retained on 75 µm sieve*	GRAVELS 50% or more of coarse fraction retained on 4.75 mm sieve	CLEAN GRAVELS	GW	Well-graded gravels and gravel-sand mixtures, little or no fines	Classification on basis of percentage of fines: Less than 5% Pass 75 µm sieve; More than 12% Pass 75 µm sieve; 5% to 12% Pass 75 µm sieve. GW, GP, SW, SP GM, GC, SM, SC Borderline Classification requiring use of dual symbols. $C_U = D_{60} / D_{10}$ Greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines	Not meeting both criteria for GW
		GRAVELS WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures	Atterberg limits plot below "A" line or plasticity index less than 4 — Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mixtures	Atterberg limits plot above "A" line or plasticity index greater than 7
	SANDS More than 50% of coarse fraction passes 4.75 mm sieve	CLEAN SANDS	SW	Well-graded sands and gravelly sands, little or no fines	$C_U = D_{60}/D_{10}$ Greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
			SP	Poorly graded sands and gravelly sands, little or no fines	Not meeting both criteria for SW
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures	Atterberg limits plot below "A" line or plasticity index less than 4 — Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
			SC	Clayey sands, sand-clay mixtures	Atterberg limits plot above "A" line or plasticity index greater than 7
FINE-GRAINED SOILS (by behavior) 50% or more passes 75 µm sieve*	SILTS Liquid limit <50		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands of slight plasticity	For classification of fine-grained soils and fine fraction of coarse-grained soils.
	SILTS Liquid limit >50		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts	
	CLAYS Above "A" line on plasticity chart negligible organic content — Liquid limit <30		CL	Inorganic clays of low plasticity, gravelly clays, sandy clays, silty clays, lean clays	
	CLAYS Above "A" line on plasticity chart negligible organic content — Liquid limit 30-50		CI	Inorganic clays of medium plasticity, silty clays	
	CLAYS Above "A" line on plasticity chart negligible organic content — Liquid limit >50		CH	Inorganic clays of high plasticity, fat clays	
	ORGANIC SILTS AND CLAYS Liquid limit <50		OL	Organic silts and organic silty clays of low plasticity	
	ORGANIC SILTS AND CLAYS Liquid limit >50		OH	Organic clays of medium to high plasticity	
HIGHLY ORGANIC SOILS			PT	Peat and other highly organic soils	

PLASTICITY CHART



*Based on the material passing the 75 mm sieve
Reference: ASTM Designation D2487, for identification procedure see D2488. USC as modified by PFRA

SOIL COMPONENTS

FRACTION	SIEVE SIZE PASSING	SIEVE SIZE RETAINED	DEFINING RANGES OF PERCENTAGE BY MASS OF MINOR COMPONENTS: PERCENTAGE	DESCRIPTOR
GRAVEL				
coarse	75 mm	19 mm	>35 %	"and"
fine	19 mm	4.75 mm	21 to 35 %	"y-adjective"
SAND				
coarse	4.75 mm	2.00 mm	10 to 20 %	"some"
medium	2.00 mm	425 µm		
fine	425 µm	75 µm	>0 to 10 %	"trace"
SILT (non plastic) or CLAY (plastic)	75 µm		as above but by behavior	

OVERSIZE MATERIAL

Rounded or subrounded	
COBBLES	75 mm to 300 mm
BOULDERS	> 300 mm
Not rounded	
ROCK FRAGMENTS	>75 mm
ROCKS	> 0.76 cubic metre in volume

Tt_Modified Unified Soil Classification.cdr

TETRA TECH

BOREHOLE KEYSHEET

Water Level Measurement

 Measured in standpipe, piezometer or well

 Inferred

Sample Types

 A-Casing

 Core

 Disturbed, Bag, Grab

 HQ Core

 Jar

 Jar and Bag

 NQ Core

 No Recovery

 Split Spoon/SPT

 Tube

Backfill Materials

 Asphalt

 Bentonite

 Cement/ Grout

 Drill Cuttings

 Grout

 Gravel

 Sand

 Slough

 Topsoil Backfill

Lithology - Graphical Legend[1]

 Asphalt

 Bedrock

 Cobbles/Boulders

 Clay

 Coal

 Concrete

 Fill

 Gravel

 Limestone

 Mudstone

 Organics

 Peat

 Sand

 Sandstone

 Shale

 Silt

 Siltstone

 Till

 Topsoil

1. The graphical legend is an approximation and for visual representation only. Soil strata may comprise a combination of the basic symbols shown above. Particle sizes are not drawn to scale

TETRA TECH EBA

CLIENT: Greenwood Homes

Borehole No: **16BH001**

Project: GREENWOOD HOMES SUBDIVISION	Project No: 704-ENG.LGEO03342-01
Location: LOT 1 BLOCK 15 PLAN 0614136	Ground Elev: 933.43 m
COALHURST, AB I N: 5511778, E: 0361047	PROJECT ENGINEER: TREVOR CURTIS

Depth (m)	Method	Soil Description	Sample Type	Sample Number	SPT (N)	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	SPT (N) (20 40 60 80) / Pocket Pen. (kPa) (100 200 300 400)	Elevation (m)
0	Solid stem auger	TOPSOIL - clay, sandy, silty, moist, dark brown, roots, organics							933
		CLAY (FILL) - silty, some sand, trace gravel, damp, very stiff, medium plastic, brown, root hairs							
		CLAY - silty, some sand, damp, very stiff, medium plastic, brown, trace root hairs		B1		11.1			
1				B2		11.5			932
		... trace precipitates ... damp to moist, stiff to very stiff		D1	16				
2		... moist, stiff ... soluble sulphate content = 1.0% @ 2.0 m		B3		18.2			
				B4		20.1			931
3		... very moist, firm		D2	6				
				B5		27.3			930
4				B6		30.3			929
				D3	7				
5				B7		22.5			
		... coal and oxide		B8					928
		CLAY (TILL) - silty, some sand, trace gravel, very moist, firm to stiff, medium plastic, brown, coal and oxide specks, silt and sand pockets, trace gypsum crystals							
6		... moist to very moist, stiff		D4	10	20.6			927
		End of Borehole @ 6.6 m							
7		No Seepage, Sloughing to 3.0 m Upon Completion Slotted 25 mm PVC Standpipe Installed to 6.1 m Indicated Water Level Measured on December 9, 2016							926
8									

12/9/2016

TETRA TECH

Contractor: CHILAKO DRILLING SERVICES LTD.	Completion Depth: 6.6 m
Drilling Rig Type: 150mm SOLID STEM AUGER	Start Date: December 2, 2016
Logged By: SS	Completion Date: December 2, 2016
Reviewed By: JZ	Page 1 of 1

CLIENT: Greenwood Homes

Borehole No: **16BH002**

Project: GREENWOOD HOMES SUBDIVISION	Project No: 704-ENG.LGEO03342-01
Location: LOT 1 BLOCK 15 PLAN 0614136	Ground Elev: 934.75 m
COALHURST, AB I N: 5511786, E: 0360885	PROJECT ENGINEER: TREVOR CURTIS

Depth (m)	Method	Soil Description	Sample Type	Sample Number	SPT (N)	Moisture Content (%)	Elevation (m)
0	Solid stem auger	TOPSOIL - clay, sandy, silty, moist, dark brown, roots, organics					
		CLAY (FILL) - silty, some sand, trace gravel, damp, very stiff, medium plastic, brown, coal and oxide specks, trace organics, trace root hairs					
		CLAY - silty, some sand, damp, hard, medium plastic, brown, white precipitates		B1		12.1	934
1		... soluble sulphate content = 2.6% @ 1.2 m		B2		10.6	
		... silt and sand lenses		D1	47		933
2		... damp to moist		B3		12.6	
		... trace high plastic clay inclusions		B4		12.9	
		... moist					932
3				D2	36		
		... trace gypsum crystals		B5		12.5	931
4				B6			
				D3	35		930
5		CLAY (TILL) - silty, some sand, trace gravel, moist, very stiff, medium plastic, brown, coal specks, trace oxide staining, silt and sand pockets		B7		13.2	
				B8		14.1	
6							929
		... trace sand, high plastic, gypsum crystals		D4	19		
		End of Borehole @ 6.6 m					928
7		No Seepage or Sloughing Upon Completion Slotted 25 mm PVC Standpipe Installed to 6.6 m Borehole Measured Dry on December 9, 2016					
8							927

Plastic Limit / Moisture Content / Liquid Limit: 20 40 60 80

SPT (N): 20 40 60 80

Pocket Pen. (kPa): 100 200 300 400

TETRA TECH

Contractor: CHILAKO DRILLING SERVICES LTD.	Completion Depth: 6.6 m
Drilling Rig Type: 150mm SOLID STEM AUGER	Start Date: December 2, 2016
Logged By: SS	Completion Date: December 2, 2016
Reviewed By: JZ	Page 1 of 1

CLIENT: Greenwood Homes

Borehole No: **16BH003**

Project: GREENWOOD HOMES SUBDIVISION	Project No: 704-ENG.LGEO03342-01
Location: LOT 1 BLOCK 15 PLAN 0614136	Ground Elev: 933.5 m
COALHURST, AB I N: 5511783, E: 0360706	PROJECT ENGINEER: TREVOR CURTIS

Depth (m)	Method	Soil Description	Sample Type	Sample Number	SPT (N)	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	SPT (N) (20 40 60 80) / Pocket Pen. (kPa) (100 200 300 400)	Elevation (m)
0	Solid stem auger	TOPSOIL - clay, sandy, silty, moist, dark brown, roots, organics							
		CLAY (FILL) - silty, some sand, trace gravel, damp, very stiff, medium plastic, brown, trace roots		B1		13.4			933
1		... moist							
		... trace organics		B2		17.2			932
		... organics							
		CLAY - silty, some sand, moist, stiff, medium plastic, brown		D1	12				
2				B3		20.8			
				B4		22			931
3				D2	11				
									930
		... trace sand, high plastic, gypsum crystals		B5		23.4			
4									
				B6		26.8			929
				D3	13				
5				B7					
				B8		22.6			928
		... sand pockets							
6									
				D4	25	25			927
		CLAY (TILL) - silty, some sand, trace gravel, moist, very stiff, medium plastic, brown, coal and oxide specks, sand pockets							
		End of Borehole @ 6.6 m							
7		No Seepage or Sloughing Upon Completion Slotted 25 mm PVC Standpipe Installed to 6.6 m Indicated Water Level Measured on December 9, 2016							926
8									

12/9/2016

TETRA TECH

Contractor: CHILAKO DRILLING SERVICES LTD.	Completion Depth: 6.6 m
Drilling Rig Type: 150mm SOLID STEM AUGER	Start Date: December 2, 2016
Logged By: SS	Completion Date: December 2, 2016
Reviewed By: JZ	Page 1 of 1

APPENDIX C

RECOMMENDED GENERAL DESIGN AND CONSTRUCTION GUIDELINES

SHALLOW FOUNDATIONS

Design and construction of shallow foundations should comply with relevant Building Code requirements.

The term ‘shallow foundations’ includes strip and spread footings, mat slab, and raft foundations.

Minimum footing dimensions in plan should be in accordance with the applicable design code of the local jurisdiction.

No loose, disturbed or sloughed material should be allowed to remain in open foundation excavations. Hand cleaning should be undertaken to prepare an acceptable bearing surface.

Foundation excavations and bearing surfaces should be protected from rain, snow, freezing temperatures, excessive drying, and the ingress of free water before, during, and after footing construction.

Footing excavations should be carried down into the designated bearing stratum.

After the bearing surface is approved, a mud slab should be poured to protect the soil against inclement weather and provide a working surface for construction.

All constructed foundations should be placed on unfrozen soils, which should be at all times protected from frost penetration.

All foundation excavations and bearing surfaces should be inspected by a qualified geotechnical engineer to check that the recommendations contained in this report have been followed.

Where over-excavation has been carried out through a weak or unsuitable stratum to reach into a suitable bearing stratum or where a foundation pad is to be placed above stripped natural ground surface such over-excavation may be backfilled to subgrade elevation utilizing either structural fill or lean-mix concrete. These materials are defined below:

- “Structural engineered fill” should comprise clean, well-graded granular soils.
- “Lean-mix concrete” should be low strength concrete having a minimum 28-day compressive strength of 3.5 MPa.

CONSTRUCTION EXCAVATIONS

Construction should be in accordance with good practice and comply with the requirements of the responsible regulatory agencies.

All excavations greater than 1.5 m deep should be sloped or shored for worker protection.

Shallow excavations up to about 3 m depth may use temporary sideslopes of 1H:1V. A flatter slope of 2H:1V should be used if groundwater is encountered. Localized sloughing can be expected from these slopes.

Deep excavations or trenches may require temporary support if space limitations or economic considerations preclude the use of sloped excavations.

For excavations greater than 3 m depth, temporary support should be designed by a qualified geotechnical engineer. The design and proposed installation and construction procedures should be submitted to Tetra Tech EBA for review.

The construction of a temporary support system should be monitored. Detailed records should be taken of installation methods, materials, in situ conditions and the movement of the system. If anchors are used, they should be load tested. Tetra Tech EBA can provide further information on monitoring and testing procedures if required.

Attention should be paid to structures or buried service lines close to the excavation. For structures, a general guideline is that if a line projected down, at 45 degrees from the horizontal from the base of foundations of adjacent structures intersects the extent of the proposed excavation, these structures may require underpinning or special shoring techniques to avoid damaging earth movements. The need for any underpinning or special shoring techniques and the scope of monitoring required can be determined when details of the service ducts and vaults, foundation configuration of existing buildings and final design excavation levels are known.

No surface surcharges should be placed closer to the edge of the excavation than a distance equal to the depth of the excavation, unless the excavation support system has been designed to accommodate such surcharge.

BACKFILL MATERIALS AND COMPACTION (GENERAL)

1.0 DEFINITIONS

"Landscape fill" is typically used in areas such as berms and grassed areas where settlement of the fill and noticeable surface subsidence can be tolerated. "Landscape fill" may comprise soils without regard to engineering quality.

"General engineered fill" is typically used in areas where a moderate potential for subgrade movement is tolerable, such as asphalt (i.e., flexible) pavement areas. "General engineered fill" should comprise clean, granular or clay soils.

"Select engineered fill" is typically used below slabs-on-grade or where high volumetric stability is desired, such as within the footprint of a building. "Select engineered fill" should comprise clean, well-graded granular soils or inorganic low to medium plastic clay soils.

"Structural engineered fill" is used for supporting structural loads in conjunction with shallow foundations. "Structural engineered fill" should comprise clean, well-graded granular soils.

"Lean-mix concrete" is typically used to protect a subgrade from weather effects including excessive drying or wetting. "Lean-mix concrete" can also be used to provide a stable working platform over weak subgrades. "Lean-mix concrete" should be low strength concrete having a minimum 28-day compressive strength of 3.5 MPa.

Standard Proctor Density (SPD) as used herein means Standard Proctor Maximum Dry Density (ASTM Test Method D698). Optimum moisture content is defined in ASTM Test Method D698.

2.0 GENERAL BACKFILL AND COMPACTION RECOMMENDATIONS

Exterior backfill adjacent to abutment walls, basement walls, grade beams, pile caps and above footings, and below highway, street, or parking lot pavement sections should comprise "general engineered fill" materials as defined above.

Exterior backfill adjacent to footings, foundation walls, grade beams and pile caps and within 600 mm of final grade should comprise inorganic, cohesive "general engineered fill". Such backfill should provide a relatively impervious surficial zone to reduce seepage into the subsoil against the structure.

Backfill should not be placed against a foundation structure until the structure has sufficient strength to withstand the earth pressures resulting from placement and compaction. During compaction, careful observation of the foundation wall for deflection should be carried out continuously. Where deflections are apparent, the compactive effort should be reduced accordingly.

In order to reduce potential compaction induced stresses, only hand-held compaction equipment should be used in the compaction of fill within 1 m of retaining walls or basement walls. If compacted fill is to be placed on both sides of the wall, they should be filled together so that the level on either side is within 0.5 m of each other.

All lumps of materials should be broken down during placement. Backfill materials should not be placed in a frozen state, or placed on a frozen subgrade.

Where the maximum-sized particles in any backfill material exceed 50% of the minimum dimension of the cross-section to be backfilled (e.g., lift thickness), such particles should be removed and placed at other more suitable locations on site or screened off prior to delivery to site.

Excavation and construction operations expose materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration of performance. Unless otherwise specifically indicated in this report, the walls and floors of excavations, and stockpiles, must be protected from the elements, particularly moisture, desiccation, frost, and construction activities. Should desiccation occur, bonding should be provided between backfill lifts. For fine-grained materials the previous lift should be scarified to the base of the desiccated layer, moisture-conditioned, and recompacted and bonded thoroughly to the succeeding lift. For granular materials, the surface of the previous lift should be scarified to about a 75 mm depth followed by proper moisture-conditioning and recompaction.

3.0 COMPACTION AND MOISTURE CONDITIONING

“Landscape fill” material should be placed in compacted lifts not exceeding 300 mm and compacted to a density of not less than 90% of SPD unless a higher percentage is specified by the jurisdiction.

“General engineered fill” and “select engineered fill” materials should be placed in layers of 150 mm compacted thickness and should be compacted to not less than 98% of SPD. Note that the contract may specify higher compaction levels within 300 mm of the design elevation. Cohesive materials placed as “general engineered fill” or “select engineered fill” should be compacted at 0 to 2% above the optimum moisture content. Note that there are some silty soils which can become quite unstable when compacted above optimum moisture content. Granular materials placed as “general engineered fill” or “select engineered fill” should be compacted at slightly below (0 to 2%) the optimum moisture content.

“Structural engineered fill” material should be placed in compacted lifts not exceeding 150 mm in thickness and compacted to not less than 100% of SPD at slightly below (0 to 2%) the optimum moisture content.

4.0 “GENERAL ENGINEERED FILL”

Low to medium plastic clay is considered acceptable for use as “general engineered fill,” assuming this material is inorganic and free of deleterious materials.

Materials meeting the specifications for “select engineered fill” or “structural engineered fill” as described below would also be acceptable for use as “general engineered fill.”

5.0 “SELECT ENGINEERED FILL”

Low to medium plastic clay with the following range of plasticity properties is generally considered suitable for use as “select engineered fill”:

Liquid Limit	= 20 to 40%
Plastic Limit	= 10 to 20%
Plasticity Index	= 10 to 30%

Test results should be considered on a case-by-case basis.

“Pit-run gravel” and “fill sand” are generally considered acceptable for use as “select engineered fill.” See exact project or jurisdiction for specifications.

The “pit-run gravel” should be free of any form of coating and any gravel or sand containing clay, loam or other deleterious materials should be rejected. No material oversize of the specified maximum sieve size should be tolerated. This material would typically have a fines content of less than 10%.

The materials above are also suitable for use as “general engineered fill.”

6.0 "STRUCTURAL ENGINEERED FILL"

Crushed gravel used as "structural engineered fill" should be hard, clean, well graded, crushed aggregate, free of organics, coal, clay lumps, coatings of clay, silt, and other deleterious materials. The aggregates should conform to the requirement when tested in accordance with ASTM C136 and C117. See exact project or jurisdiction for specifications. This material would typically have a fines content of less than 10%.

In addition to the above, further specification criteria identified below should be met:

"Structural Engineered Fill" – Additional Material Properties

Material Type	Percentage of Material Retained on 5 mm Sieve having Two or More Fractured Faces	Plasticity Index (<400 μm)	L.A. Abrasion Loss (percent Mass)
Various sized Crushed Gravels	See exact project or jurisdiction for specifications	See exact project or jurisdiction for specifications	See exact project or jurisdiction for specifications

Materials that meet the grading limits and material property criteria are also suitable for use as "select engineered fill."

7.0 DRAINAGE MATERIALS

"Coarse gravel" for drainage or weeping tile bedding should be free draining. Free-draining gravel or crushed rock generally containing no more than 5% fine-grained soil (particles passing No. 200 sieve) based on the fraction passing the 3/4-inch sieve or material with sand equivalent of at least 30.

"Coarse sand" for drainage should conform to the following grading limits:

"Coarse Sand" Drainage Material – Percent Passing by Weight

Sieve Size	Coarse Sand*
10 mm	100
5 mm	95 – 100
2.5 mm	80 – 100
1.25 mm	50 – 90
630 μm	25 – 65
315 μm	10 – 35
160 μm	2 – 10
80 μm	0 – 3

* From CSA A23.1-09, Table 10, "Grading Limits for Fine Aggregate", Class FA1

Note that the "coarse sand" above is also suitable for use as pipe bedding material. See exact project or jurisdiction for specifications.

8.0 BEDDING MATERIALS

The "Coarse Sand "gradation presented above in Section 7.0 is suitable for use as pipe bedding and as backfill within the pipe embedment zone, however see exact project or jurisdiction for specifications.

FLOOR SLABS-ON-GRADE

All soft, loose or organic material should be removed from beneath slab areas. If any local 'hard spots' such as old basement walls or abandoned pile foundation are revealed beneath the slab area, these should be over-excavated and removed to not less than 0.9 m below underside of slab level. The exposed soil should be proof-rolled and the final grade restored by engineered fill placement. If proof-rolling reveals any soft or loose spots, these should be excavated and the desired grade restored by engineered fill placement. The subgrade should be compacted to a depth of not less than 0.3 m to a density of not less than 98 percent Standard Proctor Maximum Dry Density (ASTM Test Method D698).

If, for economic reasons, it is considered desirable to leave low quality material in-place, such as existing fills, beneath a slab-on-grade, special ground treatment procedures may be considered, Tetra Tech EBA could provide additional advice on this aspect if required.

A levelling course of well graded granular fill (with maximum size of 20 mm), at least 150 mm in compacted thickness, is recommended directly beneath all slabs-on-grade. The type of granular fill should be selected based on the design floor loadings. Alternatively a minimum thickness of 150 mm of 80 mm pit-run gravel overlain by a minimum thickness of 50 mm of 20 mm crushed gravel may be used. Coarse gravel particles larger than 25 mm diameter should be avoided directly beneath the slab-on-grade to limit potential stress concentrations within the slab. All levelling courses directly under floor slabs should be compacted to 100 percent of Standard Proctor Maximum Dry Density (ASTM Test Method D698).

Engineered fill, pit-run gravel and crushed gravel are defined under the heading 'Backfill Materials and Compaction' elsewhere in this Appendix.

The excavated subgrade beneath slabs-on-grade should be protected at all times from rain, snow, freezing temperatures, excessive drying and the ingress of free water. This applies before, during, and after the construction period.