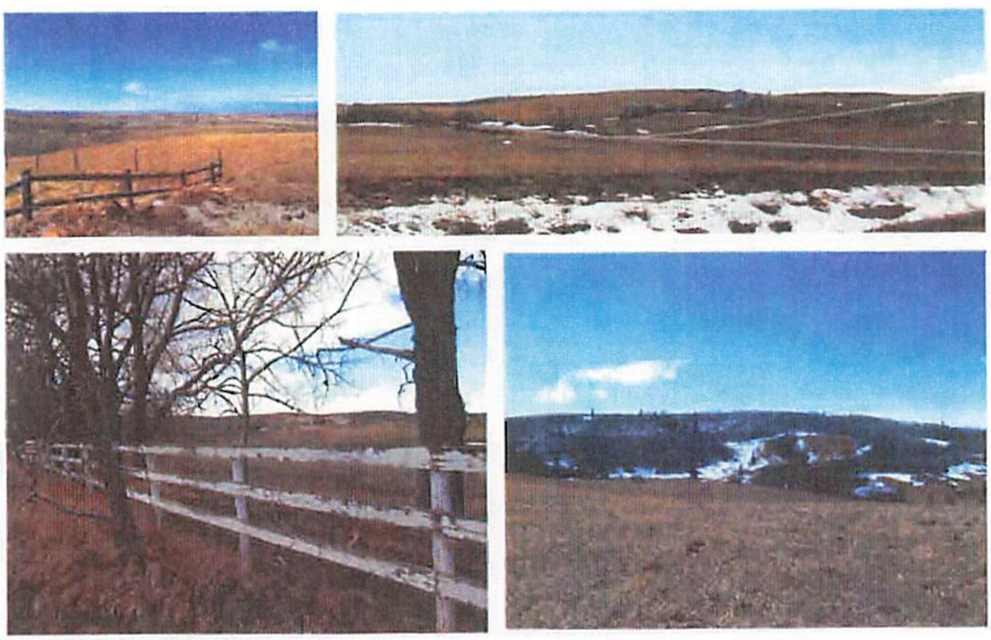
the Red Willow Estates Area Structure Plan



Municipality:
M.D. of Foothills No. 31

Landowner:
Bavarian Land Corporation

Consultants:
Brown and Associates Planning Group
Kellam Berg Engineering & Surveys Ltd.
EBA Engineering Consultants Ltd.

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1.0 INTRODUCTION

1.1 Purpose of the Plan

The Red Willow Estates Area Structure Plan (ASP) has been prepared pursuant to provincial legislation and the M.D. of Foothills Municipal Development Plan. The purpose of the Area Structure Plan is to provide for the orderly development of a country residential subdivision within the Plan Area. An Area Structure Plan is more detailed than the Municipal Development Plan (MDP) and is intended to provide a more specific municipal policy framework to guide subsequent land use redesignation, subdivision, and development approvals within the Plan Area.

1.2 Background to the Area Structure Plan

The Plan Area contains the major portion (108 hectares/268 acres as measured from Certificates of Title) of the East half of Section 20, Township 22, Range 2, West of the 5th Meridian. The Plan Area is located adjacent to the south side of Highway 22X approximately 1.6 kilometres west of the City of Calgary limits.

The property is located in the Lloyd Lake/Priddis area of northwest Foothills; an area that has been experiencing significant demand for country residential development. This area provides the features that are highly valued by residents such as rolling topography, long range views toward the Rocky Mountain foothills, and proximity to the City. While close to the City, the Red Willow Estates property is not located in a planned future growth corridor of the City of Calgary.[1] In this respect, future use of the property should provide an appropriate transition between traditional rural land uses and expanding urban fringe uses closer to the edge of the City. Recognized wildlife movement corridors and topographical features need to be incorporated sensitively into the design of any development for the site in accordance with MD of Foothills MDP policies while recognizing the surrounding development and roadway context. Ideally, the key natural features of the site can be incorporated into an environmentally appropriate site development that will complement and enhance existing and future uses in the general vicinity.

1.3 The Approval Process

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[1] The property is not located within the City of Calgary/M.D. of Foothills Intermunicipal Development Plan boundaries. Land use and development proposals for this site are not subject to the Intermunicipal referral policies of the Intermunicipal Development Plan.

The M.D. of Foothills requires Municipal Council approval of an Area Structure Plan (ASP) as a prerequisite to country residential development. Preparation of the Red Willow Estates Area Structure Plan commenced with a thorough review of existing technical studies and previous applications. Additional information was prepared where gaps were identified in previous studies. The conceptual plan was reviewed to ensure the best possible blend of current development practices and concepts for the site. Finally a revised Draft ASP (May 2002) was prepared for circulation and discussion with all local stakeholders, the M.D. of Foothills, and Alberta Transportation.

A public open house meeting was held on September 25th, 2002 to discuss the Draft Area Structure Plan (May 2002) with residents of the local community. About 40 residents attended the open house held at the Red Deer Lake Community Hall. All input from key stakeholders and the general public was considered and incorporated into this Proposed Red Willow Estates Area Structure Plan wherever appropriate.

The Proposed Red Willow Estates Area Structure Plan (November 2002) was formally submitted to the M.D. of Foothills in November 2002. The Plan in its final statutory bylaw form is the result of a statutory Public Hearing of Foothills Council, and subsequent adoption by Council as an Area Structure Plan bylaw.

1.4 Plan Implementation

The Red Willow Estates Area Structure Plan, adopted by bylaw in accordance with Part 633 of the Municipal Government Act, will become a statutory document of the Municipal District of Foothills No. 31. The ASP does not supercede, repeal, replace, regulate, or otherwise diminish the M.D. of Foothills Municipal Development Plan or other statutory plans in effect in the Plan Area.

To be fully implemented, the Area Structure Plan may have to be incorporated into other municipal planning documents. These documents include the M.D. of Foothills Municipal Development Plan, and the M.D. of Foothills Land Use Bylaw. In practice, this ASP will be implemented through commitments to public and private improvements that are embodied in the Area Structure Plan policies contained herein.

1.5 Plan Review and Amendment

Changing considerations may necessitate periodic review and occasional amendment of the ASP. Council, through monitoring of subdivision and development approvals, may initiate amendment of the ASP in accordance with the Municipal Government Act. In addition, the landowner or the landowner's agents may request amendment of the ASP in accordance with application requirements and procedures of the same Act.

1.6 Legislative Framework

Municipal Government Act

Pursuant to Part 633 of the Municipal Government Act (MGA), the Council of a municipality is permitted via by-law to adopt an ASP as a statutory document. Section 633 of the MGA states that:

1. *For the purpose of providing a framework for subsequent subdivision and development of an area of land, a council may, by bylaw, adopt an area structure plan.*
2. *An area structure plan*
   a) *must describe*
      i. *the sequence of development proposed for the area,*
      ii. *the land uses proposed for the area, either generally or with respect to specific parts of the area,*
      iii. *the density of population proposed for the area either generally or with respect to specific parts of the area, and*
      iv. *the general location of major transportation routes and public utilities,*
   b) *may contain any other matters the council considers necessary.*

The Municipal Development Plan

The M.D. of Foothills adopted a new Municipal Development Plan (MDP) in 1998 to guide future growth throughout the municipality. The MDP establishes long range goals, objectives, and policies that summarize the M.D.'s intentions respecting this growth and development. The Red Willow Estates Area Structure Plan has been prepared to be consistent with, and conform to the policies of the Municipal Development Plan.

The MDP defines an Area Structure Plan as a *"statutory plan, adopted by bylaw, which provides a land use strategy for subsequent redesignation, subdivision and development of a specific area of land in the municipality"*. Pursuant to Part 5.3.5 of the Municipal Development Plan:

> *"An Area Structure Plan drafted in accordance with the Guidelines adopted by the Municipality shall be required as part of a Country Residential proposal that would create 8 new lots or more and for proposals of less than 8 new lots an Area Structure plan may be required if in the opinion of Council one is necessary due to*
>
> a) *the impact the proposal may have on adjoining lands;*
> b) *the need to review, in greater detail, the infrastructure requirements of this proposal;*
> c) *the proposal being a continuation of an existing subdivision and leads to a density greater than 8 lots per quarter section;*

d) *the proposal, in the opinion of Council, being phase 1 of a development that will create 8 new lots or more."*

1.7 Interpretation

In this Area Structure Plan, the following interpretations shall apply:

"**General Agriculture**" and "**Intensive Agriculture**" means those agricultural uses as defined in Section 10.13.1 of the M.D. of Foothills Land Use Bylaw.

"**ASP**" or "**Plan**" means the Red Willow Estates Area Structure Plan.

"**Council**" means the Council of the Municipal District of Foothills No. 31.

"**Developer**" means the registered owner of lands within the Area Structure Plan boundary.

"**Landowner**" means the registered owner of lands within the Area Structure Plan boundary.

"**M.D.**" means the Municipal District of Foothills No. 31.

"**MDP**" means the Municipal District of Foothills No. 31 Municipal Development Plan.

"**MGA**" means the Municipal Government Act.

"**Qualified Professional**" means a professional engineer, geologist, or geophysicist licensed to practice in the Province of Alberta.

"**Subdivision Approving Authority**" means the Council of the Municipal District of Foothills No. 31.

"**Tentative Plan Preparation Stage**" means that stage of the land development process in which detailed site analysis is undertaken, local planning needs and development philosophy are identified, and site specific subdivision design is prepared.

"**Tentative Plan**" means a detailed proposal for development of the lands or of any portion thereof, which may form the basis for an application for subdivision.

2.0 THE PLAN AREA

2.1 Regional / Municipal Location

Figure 1: Municipal Setting, illustrates the Plan Area within the broader context of Highway 22X between the City of Calgary and lands to the west. This area has been the location of a significant amount of country residential development during the past decade. The rolling topography and wooded landscape provide an ideal setting for rural residential lifestyles while Highway 22X provides convenient access to locations throughout the region including the City of Calgary to the east and Kananaskis Country to the west.

Country residential subdivisions have occurred on Sections to the east and west of the Plan Area. These residential subdivisions have typically been for large lots in the order of 10 to 20 acres in size. More recently, many of these large lots have started to experience pressure for infill development. In particular, subdivisions in Sections 21 and 22 to the east of the Plan Area have begun to resubdivide to accommodate more efficient lots of 4 to 5 acres in size. Lots of approximately 4 acres in size are more in line with current municipal policy which encourages smaller more efficient residential lots to be clustered together.

Agricultural uses in this part of Foothills have been limited primarily to grazing of animals and equestrian operations. Cultivation of soils for crop production has been limited by the relatively steep slopes, rocky soil profile, and limited soil quality for agriculture.

Figure 1 also illustrates the boundary of the City of Calgary/M.D. of Foothills Intermunicipal Development Plan (IDP). The Red Willow Estates ASP is not located within the IDP boundary. Therefore development of the Red Willow Estates land is not subject to IDP policies and future growth of the City of Calgary is not expected to directly affect planning for development of the site. Planning for the site will be indirectly affected by the proximity of the City, for example where Highway 22X is upgraded to accommodate traffic flows to/from the City.

Another significant land use in the vicinity of the Plan Area is the Ann and Sandy Cross Conservation Area (ASCCA). The ASCCA is dedicated to the principles of habitat protection for native wildlife and conservation education for young people. The ASCCA has set aside approximately 8,400 acres (7.5 square miles) of aspen foothills vegetation. In recognition of the importance of this resource, and the Environmental Policies of the M.D. of Foothills MDP, it will be important for development of the Red Willow Estates ASP to support the continued ecological viability of the ASCCA. One way that development in the

Plan Area can do this, is by identifying and setting aside any key wildlife connections or corridors that provide access to or from the ASCCA.

2.2 Boundaries of the Plan Area

The Red Willow Estates Area Structure Plan incorporates 108 hectares (268 acres) of land comprising the majority of the East Half of Section 20, Township 22, Range 2, West of the 5th Meridian. The east half of Section 20 has been subdivided on four previous occasions.

1. In 1979 a 3.8-acre parcel was created adjacent to the west side of 160th Street SW, north of 186 Avenue SW, to accommodate a single-family dwelling (see Block 1, Plan 791 0185 on Figure 2). This "Country Residential District" parcel is in separate ownership and has direct access to a municipal roadway. Therefore, it is not contained within the ASP boundary.
2. In 1980 a 23.5-acre small holding parcel was subdivided off the west side of the site, adjacent to the north-south centre section line (see Plan 8085 FG on Figure 2). This "Agricultural District" parcel is in separate ownership and has access to Highway 22X via a 20-foot access right-of-way along the west edge of the Plan Area (NE ¼ Section 20). Therefore, this parcel is not contained within the ASP boundary.
3. In 1989 a 30-metre service road running parallel to Highway 22X west of 160 St. SW containing 6.84 acres +/- was created (see Service Road Plan 891 0344 on Figure 2). This service road has not yet been constructed. The parent quarter section includes land located between the service road allowance and Highway 22X. This land accommodates an Atco Gas transmission line. Therefore the area of the public road allowance and the on-site gas transmission line is contained within the boundary of this ASP.
4. In 1997 the Municipal Government Board (MGB) approved a country residential subdivision comprised of 6 "Country Residential District" lots averaging 3.5 acres in size, a "Municipal Reserve District" lot of 2.4 acres and a 30-metre country residential roadway within the northeast quarter of Section 20 on the west side of 160th Street SW (see Plan 971 2345 on Figure 2). These lots were built as Phase 1 of the Red Willow Estates subdivision and will be carefully integrated with proposed new development. The Phase 1 lots are in separate ownerships and are not included within the boundary of this ASP.

Detailed boundaries of the Area Structure Plan are illustrated in Figure 2. The boundaries and immediately adjacent land uses can be generally described as follows:

- Provincial Highway #22X on the north;

- the existing 160th Street municipal road alignment and a mix of country residential and agricultural land uses on the east;
- the Ann and Sandy Cross Conservation Area to the south; and
- the west limit of the area in Title and a mix of residential and agricultural parcels to the west.

Land contained within the Plan Area includes the following areas and titles.

NE ¼ and SE ¼ of Section 20-22-2-5	Bavarian Lion Company Ltd. Title #971 351 315 +7	105.38 hectares	260.6 acres
Service Road Plan 891 0334	Province of Alberta (highway frontage road)	2.77 hectares	6.84 acres
Total Plan Area		108.15 hectares	267.44 acres

2.3 General Physical Description

Existing Land Use and Access

The Plan Area is currently designated Agricultural District (A) under the M.D. of Foothills Land Use Bylaw. The purpose of the Agricultural District is to allow for a broad range of agricultural uses on the property. Existing and historical agricultural use of the property has been limited to marginal grazing of cattle. The only buildings within the Plan Area are those associated with a small farmstead located just south of Highway 22X (See Figure 3: Airphoto).

The existing farmstead has driveway access to 160th Street. Access to 160th Street is also available from the Plan Area via the 30-metre country residential roadway serving the 6-country residential lots previously created in the NE ¼ of Section 20 as Phase 1 of Red Willow Estates. 160th Street is a graveled 20-metre municipal roadway. Portions of 160th Street have been widened by 5-metres where adjacent subdivision has occurred in recent years. Where subdivision has occurred on both sides of the road, the road allowance is currently 30-metres in width.

Access to the Plan Area is also available via the highway service road plan that has been registered but not developed. The service road plan extends across the northeast corner of the Plan Area to connect with 160th Street. A highway frontage service road has been constructed east of 160th Street. This frontage road, known as 178th Ave. W currently serves about 10 country residential parcels located in NW 21-22-2-5.

Soil Capability for Agriculture

The majority of the Plan Area is classified as marginal agricultural land and Class 5 – Very Severe Limitations under the Canada Land Inventory (CLI) Capability for Agriculture rating system. Under the generalized CLI rating maps a smaller area of about 40 acres adjacent to Highway 22X at the northeast corner of the site is rates as Class 3 soil.

Detailed soil capability analysis has been undertaken for the site by EBA. The EBA report concludes that:

> *The parcel is dominated (74.8%) by Land Capability Class 4 land, with mostly well-drained Black Chernozemic solids and minor inclusions of less developed Rego, Gleyed, and calcareous Black Chernozems in the low-lying wet areas. Limiting factors for agriculture are climate and sometimes topography. Land on steeper slopes (18.8%) is rated as Land Capability Class 5. Land in low lying areas (6.3%) was rated as Class 6 due to the excessive wetness.*[2]

CLI ratings, detailed site-specific soil analysis, and historical use of the property demonstrate that the land is not productive for cultivated crops and marginally productive for cattle grazing.

Topography and Vegetation

Figure 4 illustrates areas of significant natural vegetation within the Plan Area and adjacent lands. The Plan Area is in a transitional zone between the Foothills Parkland and the Foothills Grassland natural regions. The land is drained through a small intermittent creek that flows northward and eventually discharges to Fish Creek. Most of the site consists of brome and Kentucky bluegrass grasslands that are grazed by cattle and have replaced the original fescue grasslands. A portion of the southwest corner of the site corresponding with the steeper slopes contains an aspen forest stand that is continuous with similar forest located to the south in the Ann and Sandy Cross Conservation Area.

The plan area is comprised of mixed topography ranging from relatively flat lands in the north part of the site to variably sloping land in the south part of the site. Figure 5 illustrates slope gradients within the Plan Area for three major categories of slope:

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[2] Soil Survey and Agricultural Capability Rating, E1/2 20-22-02, W5M Millarville, Alberta, September, 1999. EBA Engineering Consultants Inc.

1) Less than 15%. These slopes are generally considered to be developable for country residential purposes. MD of Foothills policies require a minimum area of 1-acre on each lot with slopes in this category.
2) Slopes of 15 to 22%. These slopes can be incorporated into lots. A geotechnical study should demonstrate that slopes are stable.
3) Slopes of More than 22%. These steep slopes are located in the southwest corner of the property and although stable, are not considered suitable for development.

Highway 22X Access

The Plan Area lies adjacent to Highway #22X a provincial highway owned and maintained by the Province of Alberta. There are a number of provincial statutes and directives that give the Province of Alberta direct control over development of land adjacent to provincial highways.

In particular the Alberta Land Use Policies[3] encourage municipalities to contribute to a safe, efficient, and cost effective transportation network by identifying key transportation corridors and facilities in consultation with Alberta Transportation and by establishing compatible land use patterns in areas surrounding these transportation corridors and facilities.

Sections 14 and 15 of the Subdivision and Development Regulation requires that subdivisions within 800 metres of a highway with a posted speed of 80 km:

- must be contained and permitted within an area structure plan satisfactory to the Minister of Transportation; and that
- a service road satisfactory to the Minister of Transportation must be provided.[4]

3 Approved by Order in Council 522/96 pursuant to Section 622 of the Municipal Government Act.

4 Alberta Regulation 212/95, Subdivision and Development Regulation, Section 14(e) and 15(2). Section 16 allows these conditions to be varied by a local subdivision authority with the written approval of the Minister of Transportation.

3.0 PLAN GOALS AND PRINCIPLES

3.1 Plan Goal and Vision Statement

The goal of the Red Willow Estates ASP is to provide a framework for orderly and efficient development of a country residential subdivision that is consistent with the environmental features of the site and compatible with the anticipated land use and transportation patterns along the Highway 22X corridor in northwest Foothills.

> *Red Willow Estates demonstrates economical and environmentally-appropriate rural residential development on land with varied and interesting topography. High quality homes provide residents with direct views and access to the aspen foothills natural environment. State-of-the-art rural utility servicing methods complement and support the protection of natural drainage channels and wildlife movement corridors in a linear Environmental Protection area. Existing woodlands are retained permanently on the site and new indigenous vegetation is introduced wherever possible to complement and enhance the natural foothills landscape character of the subdivision. Red Willow Estates residents share in a community responsibility for ongoing environmental maintenance and enhancement initiatives.*

3.2 Principles of Development

Pattern of Development

All development shall be in accordance with statutory policy and municipal standards in effect at the time development is approved.

Patterns of development should reflect the natural form and character of the land, in particular the sloping foothills topography and views.

Land uses on the site should be configured to protect the existing and future function of Highway #22X.

Country residential development should be visually and acoustically buffered from the adjacent highway.

Natural Environment

The natural landform of the site should be retained wherever possible and reasonable. Site grading should be limited to that which is required for roadways, home building sites and utility services.

Distinctive natural features on the site of the site should be retained and incorporated into the site plan where feasible.

Site design should maintain significant ecological systems and linear wildlife movement corridors wherever possible while minimizing wildlife/vehicle conflicts on Highway 22X.

An appropriate natural interface should be maintained with the adjacent Ann and Sandy Cross Conservation Area.

Character of Development

Comprehensive design of local roads, open space and homes should provide a uniform high quality character that will give the Red Willow Estates subdivision a distinctive identity within the broader area.

Site development should create a positive image and identity for the Municipal District of Foothills at this visually prominent location adjacent to Highway #22X

All country residential lots should have equal potential for usage. Keeping of intensive livestock should not be permitted regardless of lot size.

Community Integration

Landscaping with indigenous natural shrubs, trees, and grasses will be encouraged along 160th Street to ensure that 160th Street remains as an attractive public roadway access to the Ann and Sandy Cross Conservation Area visitor facilities.

The plan should accommodate a planned frontage road that will link all properties along the south side of Highway #22X.

Public pedestrian access should be provided to municipal reserve land on the site. Municipal road allowances and/or dedicated public pedestrian trails may provide appropriate pedestrian access to and through the site.

Infrastructure

Infrastructure shall be provided in accordance with municipal standards to ensure adequate capacity for all proposed country residential lots.

Infrastructure should be designed to minimize impacts to the environment and to surrounding residential properties.

Phasing

Development should be phased in a logical and efficient manner to reflect market demand, minimize disruption to existing area residents, and conform to the growth objectives of the M.D. of Foothills No. 31.

4.0 PLAN POLICIES

4.1 The Plan Concept

Red Willow Estates is proposed to be a country residential subdivision and natural area that is comprehensively designed to be compatible with the function of the adjacent Highway #22X and to provide permanently protected natural areas that complement the function of the adjacent Ann and Sandy Cross Conservation Area as a wildlife and ecological preserve.

Figure 6 and Figure 7 illustrate the Red Willow Estates Land Use Plan. The Concept identifies two major land use components.

a) Country Residential areas include the relatively flat lands adjacent to Highway #22X and higher elevation lands adjacent to 160th Street. These higher elevation lands are suitable for country residential uses because they provide excellent long range views and do not have high potential as grazing lands.

b) Environmental Protection areas include the steep treed lands at the south end of the property adjacent to the Cross Conservation Area and lands on either side of the existing seasonal drainage course. These treed lands provide a buffer to the adjacent conservation area and permanent protection for a portion of an existing secondary wildlife movement corridor connection between the Conservation Area and Fish Creek Provincial Park to the north. A proposed Municipal Reserve parcel at the northwest corner of the property fronts onto the Highway #22A frontage road and complements the private Environmental Protection lands.

Key considerations that have been built into the plan include the following:

- Dedication of land for a future Highway #22X frontage road across the entire frontage of the property.
- Access provided for two distinct cells of developable land. The upper elevation lands are served by an internal loop road or "crescent" with connections to 160th Street SW at two locations. The lower lands adjacent to Highway #22X will be served by a highway frontage road providing access to Highway #22X at 160th Street. Additional highway access options will be available in the future with extension of the highway frontage road to the west of the site.
- Maintaining the existing farm buildings on the larger remanant or "balance" parcel. These buildings and surrounding lands will be

designated Agriculture District to allow for continued agricultural activities.

- Protection of natural areas, particularly areas at the southern end of the "balance parcel" through an Environmental Protection District land use designation under the MD of Foothills Land Use Bylaw. A Management Plan will be submitted at the Land Use Redesignation stage to assist in identifying the final boundary and activities that delineate the agricultural uses at the north end of the Balance Parcel from the environmental protection uses at the south end of the Balance Parcel.
- Dedication of a Municipal Reserve parcel at the northwest corner of the property. This parcel is ideally located on the future Highway #22X frontage road for access from throughout the broader Priddis and Red Deer Lake area. Specific facilities for this public land have not been identified at this time. However it is anticipated the property will be maintained primarily as natural open space that will complement the adjacent Agricultural and Environmental Protection lands.
- Design of country residential cells is based on the "clustering" principle whereby smaller lots are located in the most appropriate development cells of a property, thereby reserving other lands for public uses and/or natural area protection.
- A phasing plan provides for phased development of the higher elevation loop road lots as appropriate based on availability of servicing. Development of the lower cell, adjacent to Highway 22X and the proposed frontage road will be a long-term development cell with development timing being contingent on appropriate servicing and build-out of previous phases of development. In the interim, and possibly in the long-term future this area will maintain the existing farmstead buildings and operations.

A breakdown of land use areas for the Ultimate Development Concept as illustrated in Figure 8, Development Concept is provided in the following table.

LAND USE	HECTARES	ACRES	%
Phase 2 Country Residential Phase 3 Country Residential	34.45 10.35	85.12 25.57	
Total Country Residential Areas	44.80	110.69	42%
Municipal Reserve Lot *(13% of Country Residential Area)*	5.71	14.11	5%
Environmental Protection Areas	47.69	117.84	45%
Local Roads	3.65	9.02	3%
Highway Frontage Road and Ex. Gas Line	3.88	9.59	4%
TOTAL PLAN AREA *(as measured from conceptual plan)*	105.73	261.26	100%

PLAN CONCEPT POLICIES

4.1.1 When considering applications for redesignation, subdivision, or development applications within the Plan Area, the Municipality shall confirm that such applications conform to the land use concept shown in Figure 6 and is compatible with the policies of this Plan.

4.1.2 Any application in the Plan Area that is contrary to the land use concept and policies contained within this Plan shall require a formal amendment to this Plan.

4.2 Environmentally Significant Areas

The Ann and Sandy Cross Conservation Area provides a permanently protected natural area of unique proportions and significance. The MD of Foothills Municipal Development Plan contains policies that encourage the preservation of unique or significant natural environments, water supplies and wildlife habitat and corridors. In particular, the MDP defines Environmentally Significant Areas to include "areas that provide an important linking function and permit the movement of wildlife over considerable distances, including migration corridors and migratory stopover points". The Red Willow Estates Plan Area contains lands that are most suitable for permanent protection as natural areas that complement the environmental objectives of the MD of Foothills and the natural resources of the adjacent Conservation Area.

For purposes of this Plan, Environmentally Significant Areas include:

a) Steeply sloped and forested "Buffer Lands" adjacent to the Cross Conservation Area; and

b) "Corridor Land" along the seasonal drainage course that extends from the Conservation Area toward Highway #22X, through the west half of the Plan Area.

Studies of existing wildlife movements between the Cross Conservation Area and across Highway #22X toward Fish Creek Provincial Park have identified heavily used corridors along more vegetated drainage courses to the west and to the east of the Red Willow Estates property. These same studies have identified a moderately used existing wildlife movement corridor along the less heavily vegetated drainage course that traverses the Plan Area.[5] The exact boundaries of the proposed Environmental Protection District will be established at the land use redesignation and subdivision stages. As shown in this Plan, Environmental Protection Areas will represent a balance between the objective of providing perpetual protection for wildlife movements and the need to set aside land that is appropriate for continued agricultural use and development of country residential homes. Both of the wildlife studies noted above recognize that options exist for country residential development that addresses planning for wildlife.

Alberta Community Development, Cultural Facilities and Historical Resources Division, has indicated that the plan area may contain potential historic resources. Any materials of potential historic significance uncovered during construction are to be reported to Alberta Community Development.

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[5] "Wildlife Habitat Management Options Associated with the proposed development of the Red Willow Estates Property", by Axys Environmental Consulting, September 2000. Also, "The Ann and Sandy Cross Conservation Area Wildlife Movement Patterns Study" by Neil Gilson and Lois Pittaway, EVDS 783.24, Faculty of Environmental Design, University of Calgary.

ENVIRONMENTALLY SIGNIFICANT AREA POLICIES

4.2.1 Appropriate Environmental Protection areas as illustrated in Figure 6, Land Use Concept will be protected as permanent natural areas to accommodate wildlife movements and provide a buffer to the adjacent Ann and Sandy Cross Conservation Area.

4.2.2 An Environmental Protection Area as generally illustrated in Figure 5, shall be appropriately designated under the MD of Foothills Land Use Bylaw prior to approval of country residential lots.

4.2.3 The Municipality may require the proponent, in support of a proposal for redesignation, subdivision, or development, and at their sole expense, prepare, and submit a Environmental Protection Area Management Plan prepared by a qualified professional. The report should address, but not be limited to:

a) Country residential development design initiatives to minimize the impact of development on wildlife movements in the adjacent corridor;

b) Environmental initiatives within the wildlife movement corridor to promote its use by wildlife;

c) Standards to ensure that human use of Environmental Protection Areas is limited to a level compatible with the intended primary function of the area.

4.2.4 Landscaping initiatives to enhance the capability of the land for accommodating wildlife may be permitted within the Environmental Protection area. Initiatives may include enhancements such as:

a) Planting of wind rows along upper slopes of the Environmental Protection Area between residential dwellings and the drainage course;

b) Provision of dugouts to retain water adjacent to the drainage course as a supply of drinking water for wildlife.

4.2.5 The Municipality may require the proponent, in support of a proposal for redesignation, subdivision, or development, and at their sole expense, prepare and submit the following in a form and content satisfactory to the Municipality, and in accordance with all pertinent Alberta Environmental Protection guidelines or requirements of the appropriate Provincial Departments

a) A Geotechnical report pursuant to the provisions of the Municipal Development Plan.

b) An Archaeological and/or Historical Resources Impact Assessment pursuant to the provisions of the Municipal Development Plan and to the satisfaction of Alberta Culture.

4.3 Country Residential Areas

A "Phase 2" Country Residential development cell is located in the east-central part of the Plan Area adjacent to 160th Street. This cell is a continuation of the existing Phase 1 development area where 6 lots and a municipal reserve park lot already exist. Phase 2 residential development includes a maximum of 22 residential lots on a "loop" or "crescent" road system that provides access to 160th Street at two locations. The Phase 2 loop road system has been carefully designed to follow existing grades, conform to MD of Foothills standards for gradient on municipal roads, and minimize the need for grading. Likewise, the proposed design of new lots will ensure that all new dwellings have driveways with a moderate slope to allow for safe access all year-round. Lot sizes are intended to be as small as possible while respecting MD density policy, topographical constraints and servicing requirements. Smaller lot depths are intended to maintain the number of lots while maximizing the amount of land available for designation as Environmental Protection area.

A separate Phase 3 residential development cell is identified adjacent to Highway #22X and a proposed highway frontage road. This cell currently accommodates a number of farmstead buildings associated with agricultural grazing use of the Plan Area. This cell has long-term residential development potential similar to residential development that has occurred along the highway immediately east of the Plan Area. Development of this cell should only occur once Phase 2 residential development has been substantially built-out and subject to provision of appropriate servicing. Phase 3 residential development includes a maximum of five country residential lots with access to a highway frontage road. The Phase 3 highway frontage land provides the only soils within the Plan Area that are productive for agricultural use beyond marginal grazing. Therefore this area will be retained in agricultural use as long as possible pending future residential development.

When fully built out, maximum development of twenty two (22) Phase 2 country residential lots and five (5) Phase 3 country residential lots are anticipated within the Plan Area. This represents an ultimate total of 27 new dwelling units and a population of approximately 75-95 residents. The ultimate Development Concept is illustrated in Figure 8[6].

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[6] Population estimate is based on occupancy of 2.8 to 3.5 persons per dwelling unit.

In accordance with Alberta Environment guidelines and MD of Foothills policies, each lot shown in Figure 8 has been designed to include a minimum contiguous area of 1 acre of developable land where the slope does not exceed 15%.

COUNTRY RESIDENTIAL POLICIES

4.3.1 The minimum residential lot size shall be 2 acres in conformity with MD of Foothills policies. In order to provide "clustered" development, the maximum residential lot size should not exceed 4 acres, except to the extent reasonably necessary to accommodate topographic conditions, meet MD guidelines for developable area, and/or meet utility servicing requirements.

4.3.2 Residential lots shall support single family dwellings only. No agricultural uses shall be permitted within designated residential areas regardless of lot size. This will ensure equal potential for usage of all lots within residential areas.

4.3.3 Development on country residential lots shall comply with the terms of a Restrictive Covenant to be registered against the Title of each lot. Terms of the Restrictive Covenant are subject to finalization at the Land Use Redesignation and Subdivision stage of the approval process.

4.3.4 Residential lots shall have direct access to a surfaced road in accordance with the Municipal Internal Subdivision road policies.

4.3.5 In accordance with Transportation Policies contained in Section 4.5, a Traffic Impact Analysis may be required at the time of redesignation or subdivision for residential purposes.

4.3.6 In accordance with the Subdivision and Development Regulations, the Red Willow Estates Area Structure will be approved by the Minister of Transportation.

4.3.7 No direct residential driveway access shall be allowed onto 160th Street. All residential lots will front onto an internal residential subdivision road.

4.3.8 Site grading should be strictly minimized to retain the existing slopes. Wherever possible site grading should be limited to roadways, driveways and other grading that is required to meet municipal servicing and development standards.

4.3.9 The need for additional highway noise and/or visual buffering for residential lots within the Phase 3 area shall be assessed at the land use redesignation and subdivision phase.

4.3.10 Development of country residential lots in Red Willow Estates should enhance and extend the function of the adjacent natural areas through enforcement of on-site landscaping and development guidelines within the Restrictive Covenant. Guidelines should include:

a. Solid fencing and manicured landscaping to be located only within a designated 1-acre developable area of each lot;

b. Fencing of rear yard areas adjacent to Environmental Protection Areas to be discouraged, and where provided, to be strictly limited to low-height, open-styles of fencing that can be navigated by wildlife. A 1.0 meter two-post fence is an example of appropriate fencing to delineate property boundaries with minimal interference with wildlife movement.

c. Subject to policy "a" above, retention of existing grasslands and/or introduction of supplemental natural vegetation typical of the Foothills Parkland ecological region should be encouraged on all country residential lots. Introduced vegetation should be self-sustaining; not require significant input of water or fertilizer by residents. A list of recommended species shall be prepared by the developer and provided to all new residents of Red Willow Estates.

4.3.11 Special attention should be given to the interface of residential development with 160th Street to ensure that the approach to the Cross Conservation Area maintains a rural and natural area character.

4.3.12 A geotechnical report proving the suitability of building sites in accordance with municipal policies shall be prepared and submitted to the Municipality by the developer, as a prerequisite to third reading of a Land Use Bylaw amendment allowing the creation of any new country residential lots. In particular such geotechnical study shall address policies related to development of any land that falls within 30-metres of slopes of 15% or greater as a prerequisite to development.

4.4 Environmental and Municipal Reserve Lands

Pursuant to the Municipal Government Act (MGA), a subdivision authority may require the provision of Environmental Reserve land at the time of subdivision. At the discretion of the subdivision authority, land that consists of a natural drainage course, or that is subject to flooding, or is unstable in its natural state may be required to be dedicated to the municipality as public Environmental Reserve land. The steep, treed lands at the south end of the Plan Area have been tested and all slopes have been found to be stable. Therefore these sloped lands do not qualify for dedication as public Environmental Reserve land under the terms of the MGA. The only lands in the Plan Area that qualify as Environmental Reserve under the statutory provisions of the MGA are those lands associated with the seasonal drainage course that traverses the west side of the Plan Area.

In addition to Environmental Reserve land, the Municipal Government Act provides for the dedication of Municipal and School Reserve land at the time of subdivision. Up to 10% of the gross area of the land to be subdivided, after dedication of any Environmental Reserve land is deducted, may be required as land for public parks and schools, or as cash-in-lieu of municipal reserve land.

The Ultimate Development Plan as presented in this ASP designates approximately 123 acres as a Balance Parcel for agricultural and environmental protection land uses in accordance with a Council-approved Management Plan. These lands incorporate the drainage channel that would otherwise quality as Environmental Reserve land. In addition, the Concept Plan proposes dedication of developable land as Municipal Reserve land. The proposed Municipal Reserve parcel is well situated on a highway frontage road at the northwest corner of the Plan Area. This location provides good accessibility for a regional recreation property and provides for public open space that will be complementary to the adjacent Agricultural and Environmental Protection lands.

RESERVE LAND POLICIES

4.4.1 Protection of natural areas as wildlife movement corridors and as buffer lands adjacent to the Cross Conservation Area will require an Environmental Protection Area that is significantly larger than normal Environmental Reserve and Municipal and School Reserve lands as contemplated and authorized under the provincial MGA. Protection of additional lands should be pursued through cooperative arrangements between the landowner and the MD of Foothills.

4.4.2 The MD of Foothills will require Municipal Reserve land or cash-in-lieu of municipal reserve land to be provided on 10% of the total residential lands to be subdivided. The preferred location for municipal reserve land will be at the northwest corner of the Plan Area adjacent to the highway frontage road and the proposed Environmental Protection area. Alternatively Council may require cash-in-lieu of municipal reserve land. In the latter case lands shown in Figure 6 and Figure 7 as Municipal Reserve land will be treated as a country residential policy area and reserve land calculations would be adjusted accordingly.

4.4.3 In lieu of Environmental Reserve dedication, the existing natural drainage course will be protected under the MD of Foothills Land Use Bylaw as part of the Environmental Protection District, and an associated Council-approved Management Plan for these lands.

4.5 Transportation

Highway 22X has been identified as a potential future freeway. When that upgrading occurs, the at-grade intersection at Highway 22X and 160 Street SW may be eliminated. Access to the plan area will then be from a service road running parallel to the south side of 22X and connecting to 22X at a future, grade-separated interchange. An interchange location is confirmed at Highway 22 (about 3 miles to the west). A possible interchange at 144th Street (one mile to the east) has been shown in the approved MD of Foothills/City of Calgary Intermunicipal Plan. The 144th Street intersection has not been confirmed by Alberta Transportation since long-term functional plans for Highway 22X in this area are not yet available.

Internal Roadways and Driveways

As illustrated in Figure 7, the Phase 2 country residential lands will be served by a local loop road connecting from 160 Street through the development area and back to 160 Street further to the south. A short cul-de-sac connects additional lots to the loop road. All residential lots will take access to new internal subdivision roadways. Intersections of the Phase 2 loop road with the municipal road system at 160th have been located to provide good separation from Highway #22X (600 metres) and between the north and the south loop road intersections (600 metres).

The longer-term country residential lands adjacent to Highway 22X will be served by a new 30-metre wide highway service road. Portions of a future service road allowance have already been registered along the south side of Highway 22X within the Plan Area and adjacent to the Plan Area. The highway service road system will be secured through registration of a caveat at the land use and subdivision stage of development. A narrow strip of land between the planned service road allowance and the existing highway right-of-way currently contains an ATCO Gas pipeline right-of-way. It would be appropriate for this strip of land to be acquired by Alberta Infrastructure on an opportunity basis and consolidated with the Highway 22X and future service road rights-of-way.

New roads will not exceed a grade of 7% at any point. All new roads will be designed and constructed to M.D. of Foothills standards by the developer, complete with a culvert and an approach to each lot. Attachment 2 illustrates road grades associated with the Phase 2 loop road alignment. The steepest road grade is associated with the existing Phase 1 subdivision road. All future phases of the loop road will provide a moderate slope that allows for safe year-round access.

The lotting design has been prepared to ensure that all residential lots can be served by a gently sloping driveway that allows for safe all-weather access. Conceptual studies show that all lots can be served by driveways with slopes in the range of 0 to 5 percent slope.

External Roadways

In the longer term future, access to Highway 22X at 160th Street may be closed. Access at that time will be provided by the future highway service road described above.

Until such time as the 160th Street/Highway 22X intersection is closed, access from the Plan Area will be directly from 160th Street to Highway 22X. 160th Street is currently built as a gravel surface municipal road within a 20-metre road allowance. An additional 5-metre road widening has been provided on both sides of the road in conjunction with existing country residential subdivisions. The existing intersection at 160th Street and Highway 22X is a fully-paved surface intersection with acceleration and deceleration turning bays for all turning movements and a safe lay-by area in the centre of the intersection between the eastbound and the westbound highway lanes. The intersection is located at a long flat stretch of the highway and provides excellent sight distances in all directions.

The existing 160th Street road allowance will provide access to Highway 22X for development in the Red Willow Estates Plan Area and other developments in the vicinity which include country residential dwellings in NW Section 21, and the Ann and Sandy Cross Conservation Area. Given the number of lots proposed, the portion of 160th Street providing access to Red Willow Estates will require upgrading to a paved road, by the developer, in accordance with MD of Foothills road standards.

TRANSPORTATION POLICIES

4.5.1 An appropriate extension of the existing service road alignment parallel to Highway 22X shall be dedicated and registered at such time as required by Alberta Transportation and/or the MD of Foothills.

4.5.2 No direct vehicular access shall be allowed to 160th Street or to Highway 22X.

4.5.3 All roadways required to give access to the development shall be designed and built to M.D. of Foothills standards and to the satisfaction of Council. The M.D. of Foothills may require the preparation of an infrastructure assessment by a qualified professional when considering a redesignation, subdivision, or development application. Where local roadways are to be dedicated as public roads, the Municipality will assume long-term maintenance of the roadway upon issuance of a Final Acceptance Certificate to the developer.

4.5.4 In addition to Municipal Building and Development Permits, an application within 0.8 kilometres (1/2 mile) of the right-of-way of Highway 22 may require a Roadside Development Permit from Alberta Transportation.

4.5.5 Alberta Transportation may request a Traffic Impact Analysis (TIA) be prepared at the time of redesignation or subdivision. Any roadway improvements that the TIA finds are necessary to serve the proposed development shall be borne by the developer. The TIA shall be prepared by a qualified transportation engineer, at the sole expense of the applicant. The TIA should include, but is not limited to, an analysis and evaluation of:

a) The impact of the proposed subdivision and/or development on the existing transportation network; and

b) A program of future expansion and improvement of the transportation network to accommodate the proposed growth and to preserve the function and integrity of provincial Highway 22X.

4.5.6 The developer will be required to make a contribution toward maintenance and upkeep of external roads through payment of an infrastructure levy fee at the time of land use bylaw redesignation for each new lot. Infrastructure levy fees shall be paid in accordance with the standard fee schedule in effect at the time of redesignation.

4.6 Utility Servicing

Water supply and sewage disposal for country residential development will be established without creating adverse impacts on the natural environment or the groundwater aquifer in the vicinity of the Plan Area. All utilities necessary to service each lot will be provided to Provincial and Municipal standards at the expense of the developer or builder.

Water Supply

Groundwater testing was undertaken by EBA Engineering Consultants Ltd. to locate and evaluate the groundwater supply for domestic subdivision purposes at Red Willow Estates.[7] EBA constructed 3 water wells, conducted 24-hour

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[7] Groundwater Evaluation, Red Willow Estates, EH 20-22-02 W5M, October 1999, EBA Engineering Consultants Ltd.

pumping tests with a recovery test on one of the wells, evaluated aquifer properties and quantity, and analyzed water characteristics.

Three 12-hour pumping tests on 3 wells at the north end of the property concluded the aquifer could sustain a safe yield of 35,865 m^3 per year (15 gpm). The Alberta Water Act requires a well to provide 1250m^3 per year to each lot. Therefore, a 26 lot subdivision requires 32,500m^3 per year or 13.5gpm. A minimum pumping rate of 13.5gpm is required to service 26 lots.

The EBA report concludes that:

- recharge to the aquifer is likely from infiltrating precipitation.
- The "material in which the well was drilled" is capable of sustaining a rate of 35,865 m^3 per year of 15 gpm.
- The quality of the groundwater is acceptable for use as a domestic water supply.

Long-Term Capacity of Local Aquifers

In response to concerns about the ability of the aquifer to supply consistent long term water to the proposed development, a Hydrogeological Study was undertaken by EBA Engineering to review water well records and determine the geometry, homogeneity, and "isotrophic properties" of local groundwater aquifers. This study was intended to address the overall medium and long-term cumulative impact of proposed development on the local aquifer.

The Alberta Environment (AE) database was reviewed for all wells within 6.5 km of the Plan Area. The estimated area extent and vertical thickness of water bearing units was estimated in order to determine which units may be affected by proposed subdivision wells. The study found 4 somewhat distinct water bearing units.

The thickness of the aquifers in the Fish Creek sub-basin was found to vary from place to place and consequently the well yield also varies from place to place. The long-term yield must be established on a well-by-well basis. The theoretical 20-year safe yield (Q_{20}) is a means of projecting the safe well yield. A new development has the right to commence and continue to divert water for household purposes if it can be shown that each household can divert 1250 m^3 per year per lot for household purposes without interfering with the existing users. The current water balance within the Fish Creek sub-basin is approximately 12.6% of the estimated volume of recharge. The demand for the proposed subdivision is approximately 1.3% of the estimated volume of recharge.

The study concluded that:

- The "lithology" throughout the area is relatively continuous.
- Water balance calculations show "there is sufficient groundwater to meet the water supply requirements of the subdivision".

Geotechnical Evaluation

A Geotechnical review of soils and slopes within the Plan Area was undertaken by EBA Engineering Consultants to assess the stability of slopes and the ability of soils to meet percolation and near-surface water table requirements for sewage disposal systems[8]. 10 boreholes were drilled to 6-metres to identify slope stability and geotechnical parameters for development. PVC standpipes were installed in all boreholes to assess groundwater levels. 27 test holes were drilled to 3 metres or auger refusal to evaluate near surface groundwater and /or bedrock that might affect construction of conventional septic fields. 40 percolation test holes were completed on the site to a depth of 0.9 metres.

The study found that:

- The Plan Area typically contains 90-510 mm (3.5-20 inches) of topsoil over 2-4 metres of subsoil. The shallower 2-metre subsoil depths are generally located in the south half of the site. Depth to bedrock varies from 0.1 metre to greater than 6.1 metres (0.3 -20 feet). Bedrock elevation reflects topography and is highest beneath the hill in the east-central part of the site.
- 20 standpipes were dry 11 days after completion of drilling and boreholes BH4 and BH9 had water at 1.3 and 4.5 metres below ground. BH4 and 9 are located near the base of the ravine running along the western edge of the site.
- Shallow bedrock beneath several central lots in the development will require some special construction of septic disposal fields
- Groundwater levels and surface drainage conditions are not expected to be a severe concern for the development; however some common control measures may be required.
- Slopes on the site are naturally stable. No signs of historical or active instability have been observed onsite. The existing and post development factors of safety are in excess of 1.5 for all slopes; therefore no setbacks are required.

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[8] Geotechnical Evaluation, Red Willow Estates E1/2-20, 2 W5M, EBA Engineering Consultants Ltd., September 1999.

- No evidence of any significant erosion was found on the site. Grading and landscaping should be designed to prevent erosion of slopes by concentrated water runoff. Alternatively, surface drainage features such as swales could be constructed along slopes to collect and control surface water.
- Cut and fill slopes of no greater than 3H: 1V are suitable for permanent cuts or fills in the native clay till.
- With the exception of BH04, all standpipes indicated depth to groundwater table conditions which meet AEP Guidelines and Standard of Practice requirements for sewage disposal. BH04 is located adjacent to the seasonal drainage course within the proposed Environmental Protection area under this Area Structure Plan.
- Despite favourable soil percolation rates, the presence of shallow bedrock will restrict the use of conventional septic fields in some blocks. Standard of Practice requires a minimum vertical separation of 1.5 metres between the bottom of a septic disposal trench and bedrock and septic disposal trenches are required to be a minimum of 0.6 metres deep, indicating bedrock must be at least 2.1 metres below ground surface.
- Bedrock was encountered at a depth of less than 2.1 metres in a number of locations on higher ground in the east central part of the Plan Area. Some lots in this area will require alternative disposal methods or specifically engineered on-site disposal locations.

The study concludes that "in general the site is suitable for development from a geotechnical perspective. No development setbacks from slopes are necessary. Existing groundwater and surface drainage are not expected to be a severe concern for development; however some design measures including subdrainage (weeping tile) systems may be required."

SERVICING AND UTILITIES POLICIES

4.6.1 Development of country residential lots will require proof of a suitable groundwater supply in conformity with the Provincial Water Act. Individual wells or a system of communal wells and piped distribution system may be appropriate. In either case, the proposed water supply shall be to the satisfaction of MD of Foothills Council.

4.6.2 All necessary Alberta Environment approvals, permits, and licenses will be obtained for water supply wells or systems.

4.6.3 A Restrictive Covenant shall be registered against all country lots to provide, among other things:

a) For the encouragement of specific water conservation methods;

b) For the prohibition of chemical or salt-based water softeners or similar additives that could be harmful if released back to the soils;

c) For the prohibition of methods of open discharge from a septic tank and/or non-evaporative lagoons;

d) For solid waste from the Red Willows Estates development to be to be the responsibility of individual landowners. Solid waste should be hauled by individual landowners or by an association of local landowners, to an appropriate transfer site.

4.6.4 To maintain water quality in local aquifers, consideration must be given to proper disposal of sanitary and sewer waste from all country residential dwellings. An Engineered Tank and Field system will be the minimum requirement for septic treatment. On-site sewage disposal systems shall meet the standards of the Municipality and the Alberta Private Sewage Systems Standard of Practice and these shall be considered the minimum required.

4.6.5 The Municipality may support the use of alternative technological systems of sewage disposal, particularly where the use of traditional septic tile fields would be impractical or marginal relative to regulatory standards. Alternate systems, including but not necessarily limited to slow sand "trickle" filters, septic mounds or modified tile field designs, a centralized wastewater treatment plant, and individual "package" wastewater treatment plants may be considered at the discretion of the Municipality and Alberta Labour.

4.6.6 The existing seasonal drainage course will be maintained in its existing configuration within the Environmental Protection Area.

4.6.7 Storm water runoff from developed areas shall be contained within the developable portions of the Plan Area wherever possible. No surface water shall be directed to highway ditches. Storm water will be retained primarily in open ditches within the rights-of-way of local subdivision roads.

4.6.8 In order maintain the natural character of the landscape, flows from country residential lots that are not intercepted by a roadway will be permitted to irrigate the intervening natural area as they flow toward the natural drainage course. These flows will not be significantly greater than existing pre-development flow rates.

4.6.9 Erosion prevention measures, including site grading, ditch checks and landscaping, shall be employed as required and as appropriate throughout the Plan Area.

4.5.6 The MD of Foothills may request a Stormwater Management Plan (SMP) be prepared at the time of redesignation or subdivision. The

SMP shall be prepared by a qualified engineer, at the sole expense of the applicant.

4.6.10 The impact of the proposed subdivision and/or development on the existing transportation network;

4.6.11 Electrical and telephone services shall be provided underground.

4.6.12 The provision of shallow utilities shall be at the sole expense of the developer to the extent required in the Municipal Standard Development Agreement.

4.7 Protective Services

Country residential development within the Plan Area will be covered by a 911 Emergency Service. Fire fighting response will be provided from the Priddis Station with back up from The City of Calgary. The Royal Canadian Mounted Police, Okotoks detachment, and the M.D. of Foothills Special Constables will provide police services to the Plan Area.

PROTECTIVE SERVICES POLICIES

4.7.1 Applications for redesignation, subdivision, and development shall demonstrate that proper emergency vehicle access is provided to MD of Foothills standards and the satisfaction of Council.

4.7.2 New country residential subdivisions shall meet MD of Foothills standards for on-site fire fighting measures.

5.0 PLAN IMPLEMENTATION

5.1 Approval Process

Adoption of the Red Willow Estates Area Structure Plan (ASP) as a Council approved bylaw is the first step toward implementation of development within the Plan Area. The ASP provides a framework of land use policies that must be met prior to approval of subsequent land use redesignation (zoning) bylaws and subdivision plans for specific lots with the Plan Area. The Red Willow Estates ASP is adopted only after endorsement by the provincial Minister of Transportation, a statutory Public Hearing of MD of Foothills Council, and appropriate consultation with key stakeholders including nearby landowners and municipal staff. All development within the plan area must be consistent with the policies of the approved area structure plan.

At the time of land use redesignation, additional technical information may be required in order to confirm the technical feasibility and design of the proposed land uses. Details of water supply and septic tank and field design for specific lots would be provided in accordance with MD policies and requirements, including the policies and requirements of this ASP. Following a statutory Public Hearing of Council, the MD of Foothills Land Use Bylaw #01-99 would be amended to reflect the land uses as proposed, and generally as illustrated in this Area Structure Plan. A Development Agreement between the MD of Foothills and the landowner/developer will be a condition of land use redesignation approval to ensure the provision of roadway and utility infrastructure in accordance with municipal standards.

A legal subdivision application will be submitted to the MD of Foothills Council after appropriate land use bylaw amendments are in place to accommodate the planned land uses. Subdivision approval may be phased over time to correspond with a logical and efficient sequencing of infrastructure and development.

APPROVAL PROCESS POLICIES

5.1.1 The policies contained within this ASP shall be reviewed and implemented by the Municipal District of Foothills Council at its discretion.

5.2 Phasing of Development

Phase 1 of development is outside the current ASP boundary and was approved in 1997. Phase 1 consisted of 6 Country Residential lots and one municipal reserve parcel.

Phase 2 of development will include all Country Residential lands in the east-central part of the Plan Area with access to the proposed loop road and 160th Street. Development within this Phase 2 Country Residential cell is expected to contain a maximum of 22 lots as illustrated in Figure 6 – Phase 2 Land Use Plan and in Figure 8 – Ultimate Development Concept. Subdivision of the entire Phase 2 country residential "block" should occur during Phase 2 in order to ensure alternative access is available via the loop road for any country residential lots created. Within this Phase 2 "block", the actual subdivision and registration of lots may occur in subphases to the satisfaction of MD of Foothills Council.

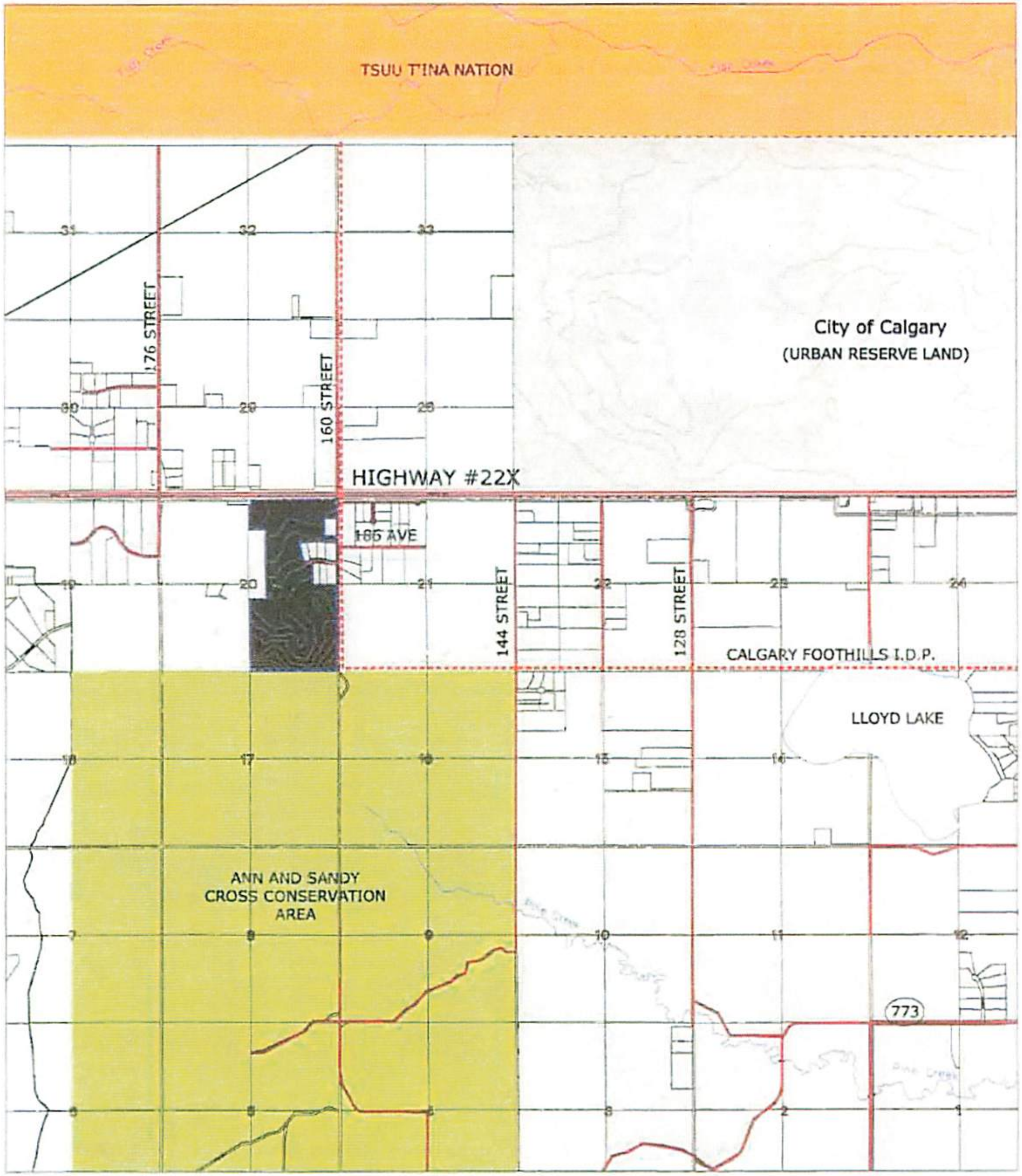
Phase 3 of development will include subdivision of the block immediately south of Highway #22 for country residential lots. Phase 3 is expected to contain a maximum of 5 lots as illustrated in Figure 7 – Phase 3 Land Use Plan and Figure 8 – Ultimate Development Concept. This is expected to be a long-term development phase. Subdivision could occur prior to, or following the need to construct a highway service road along the north edge of the Plan Area. In the interim, and possible long-term period this Phase 3 block will retain its existing farmstead buildings, its Agriculture (A) designation, and will continue to function as a small holding agricultural property adjacent to Highway #22.

PHASING POLICIES

5.2.1 All lands related to the steeply sloping, treed lands at the south end of the site, and certain lands related to the seasonal drainage course that traverses the Plan Area, shall be designated as Environmental Protection Area prior to development of Country Residential land uses. Protection of these lands as natural areas shall be established under the MD of Foothills Land Use Bylaw and managed under a Management Plan prepared to the satisfaction of M.D. of Foothills Council.

5.2.2 The existing farmstead buildings and associated country residential land at the north end of the property should remain in Agricultural use.

5.2.3 Within the Phase 2 country residential block, land use redesignation and/or subdivision approvals may occur in subphases where determined appropriate by M.D. of Foothills Council.



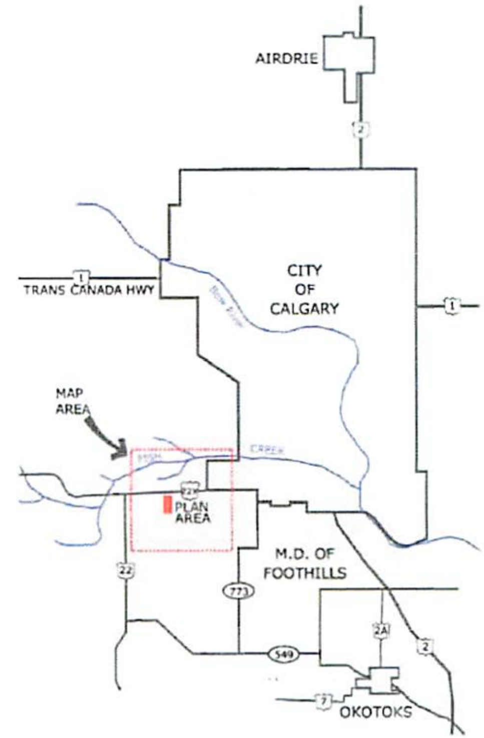


FIGURE 1:

MUNICIPAL SETTING

M.D. OF FOOTHILLS

N

N.T.S.

BROWN AND ASSOCIATES PLANNING GROUP

KELLAM BERG ENGINEERING & SURVEYS LTD.

JUNE 2003

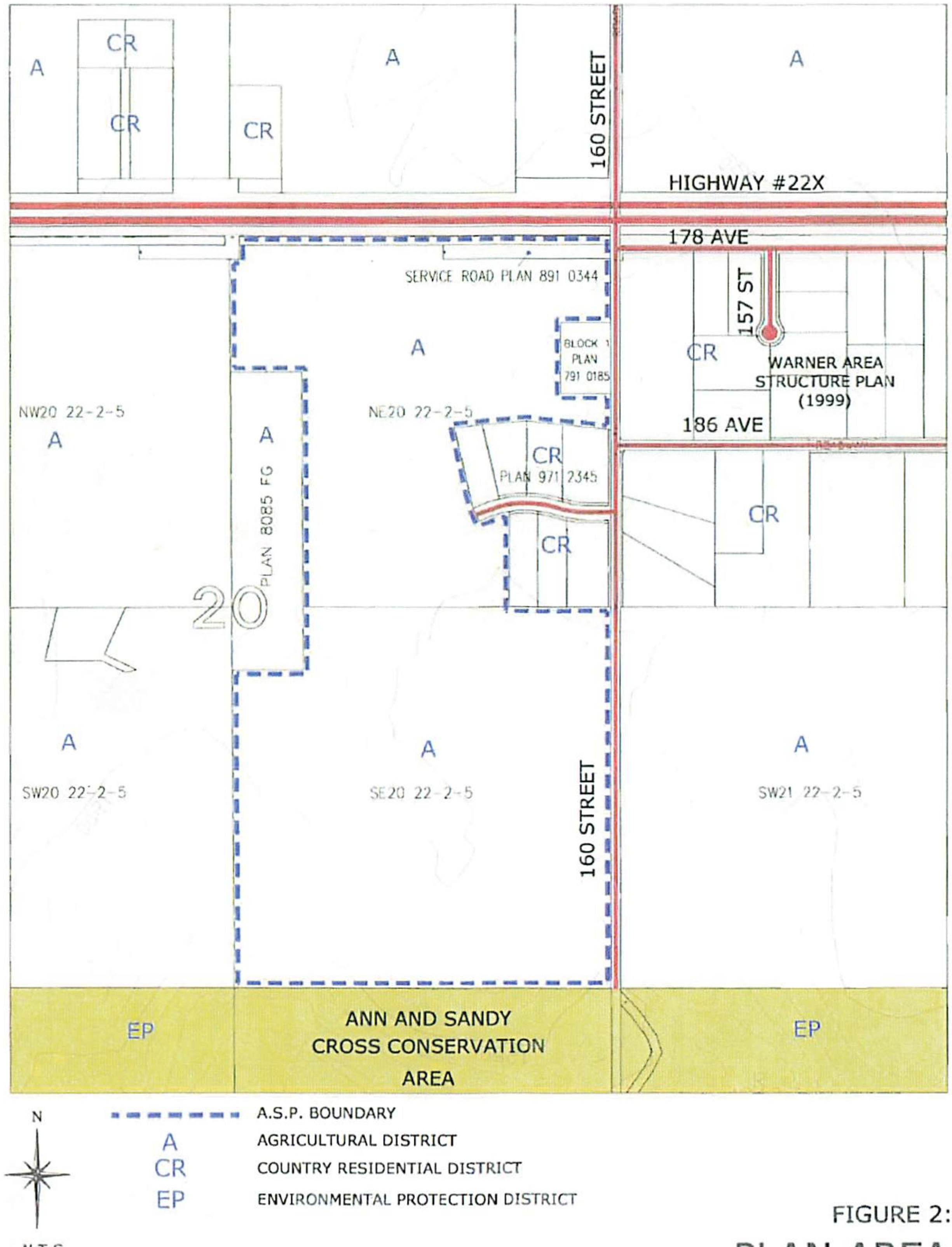


FIGURE 2:
PLAN AREA

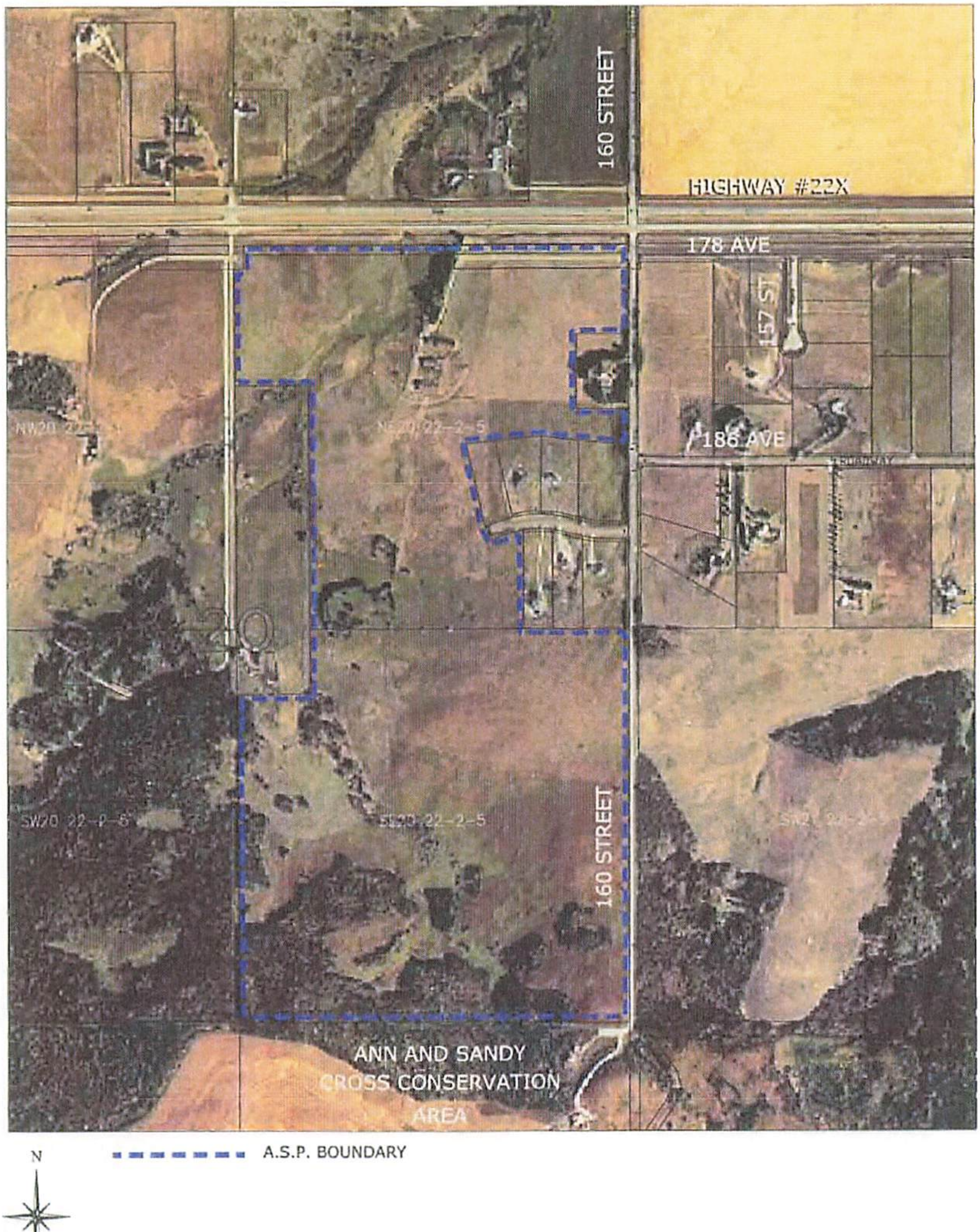


FIGURE 3:
AIRPHOTO

RED WILLOW ESTATES AREA STRUCTURE PLAN
KELLAM BERG/BROWN AND ASSOCIATES

JUNE 2003

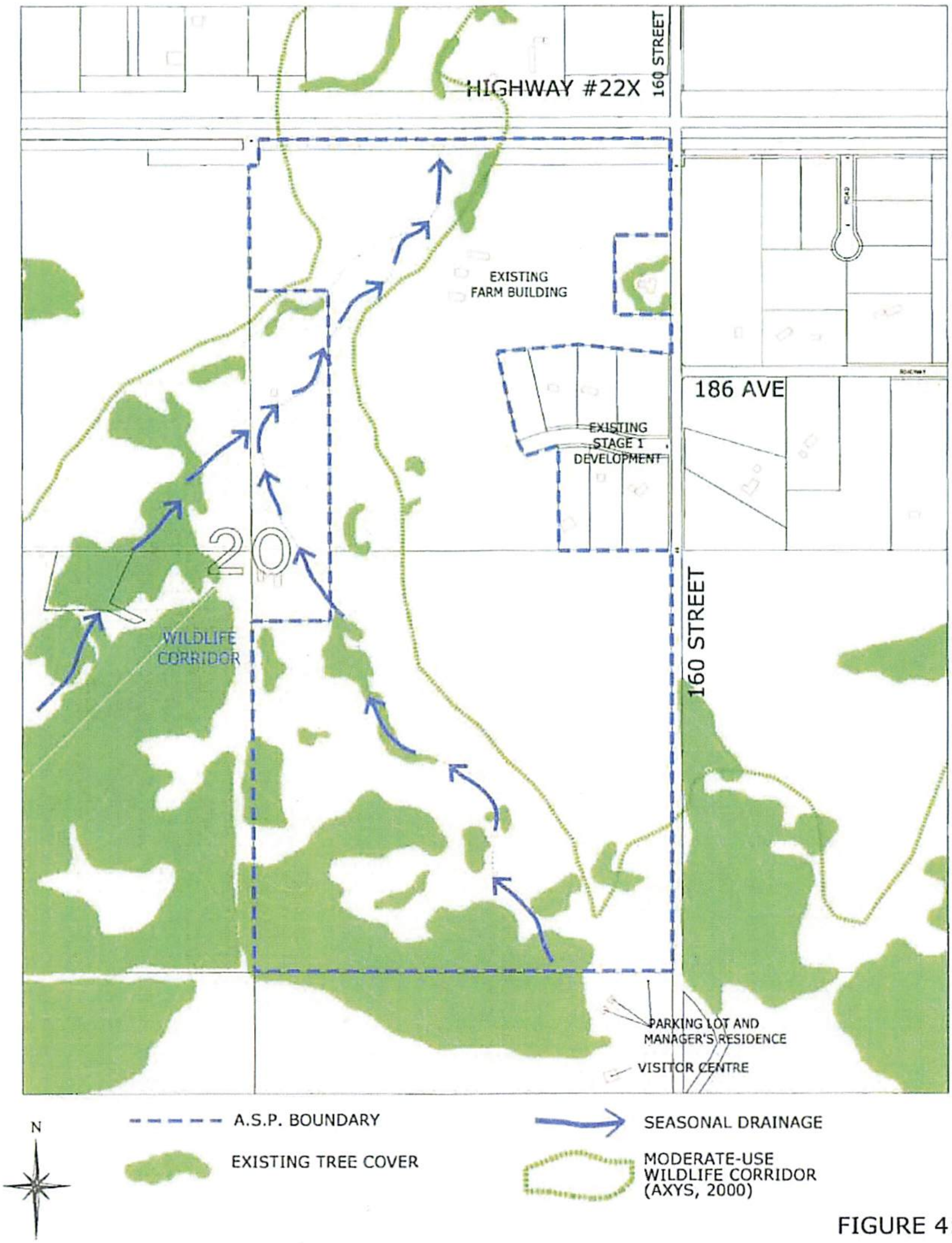


FIGURE 4:

EXISTING SITE FEATURES

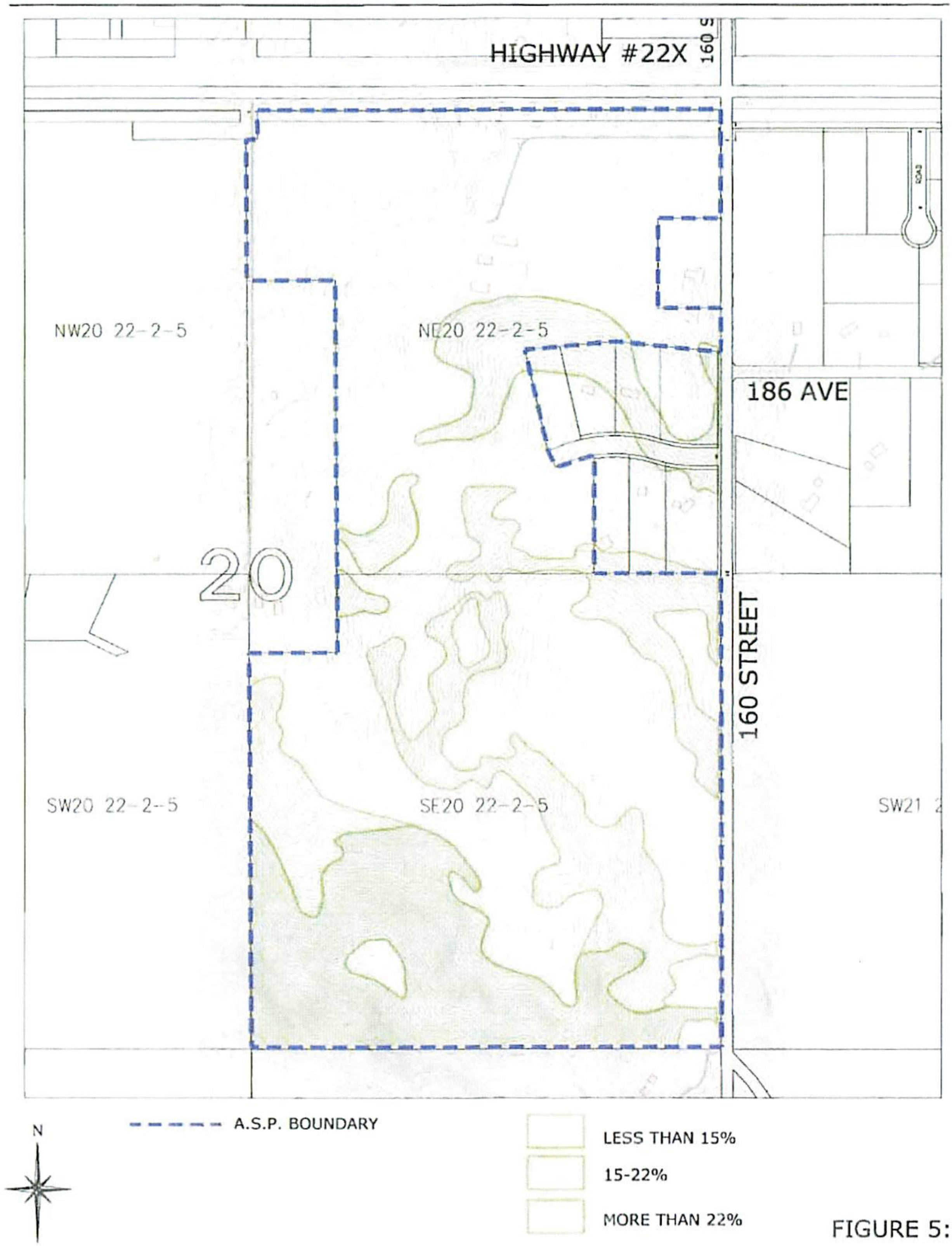


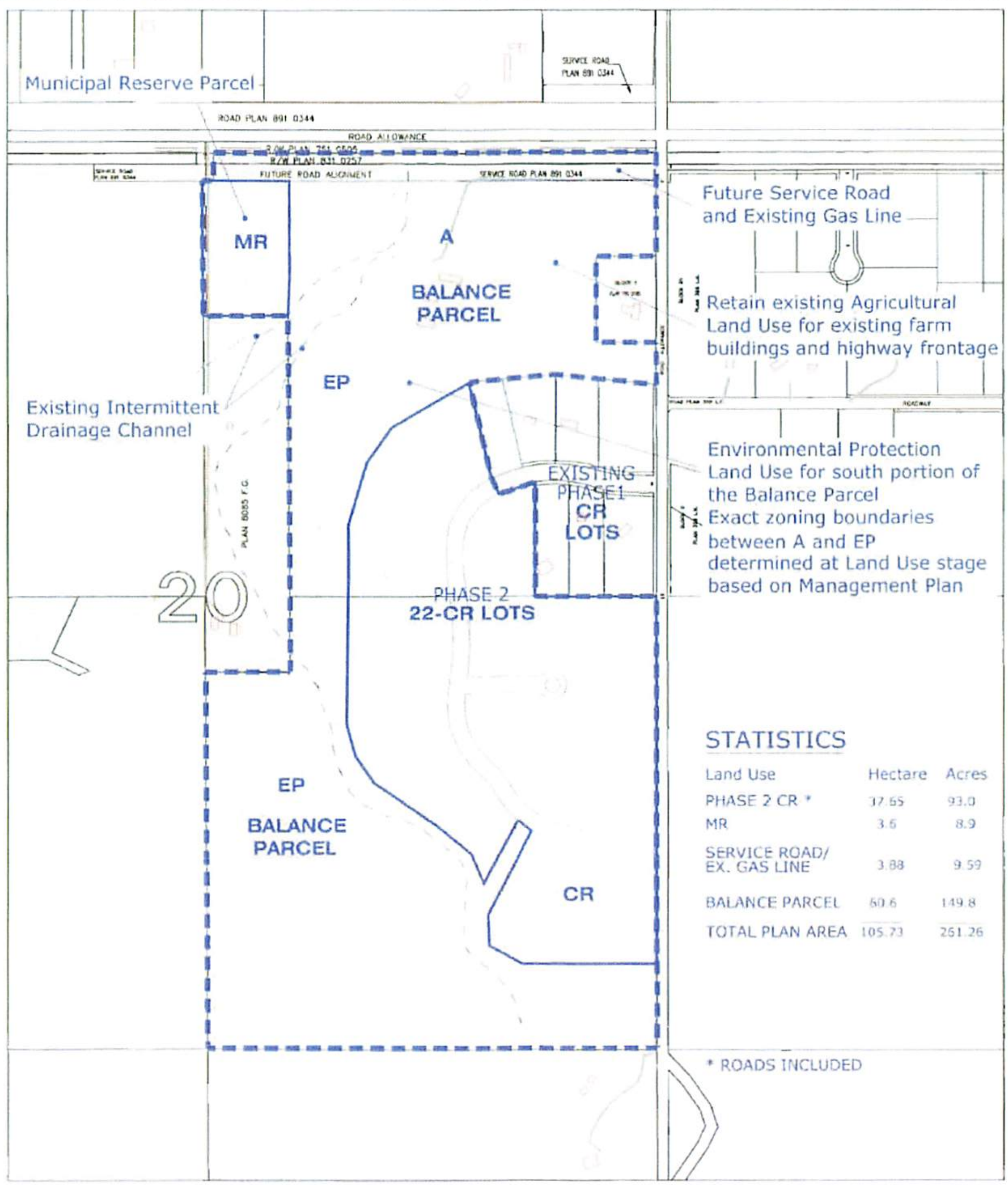
FIGURE 5:

SLOPE ANALYSIS

RED WILLOW ESTATES AREA STRUCTURE PLAN

KELLAM BERG/BROWN AND ASSOCIATES

JUNE 2002



STATISTICS

Land Use	Hectare	Acres
PHASE 2 CR *	37.65	93.0
MR	3.6	8.9
SERVICE ROAD/ EX. GAS LINE	3.88	9.59
BALANCE PARCEL	60.6	149.8
TOTAL PLAN AREA	105.73	261.26

* ROADS INCLUDED

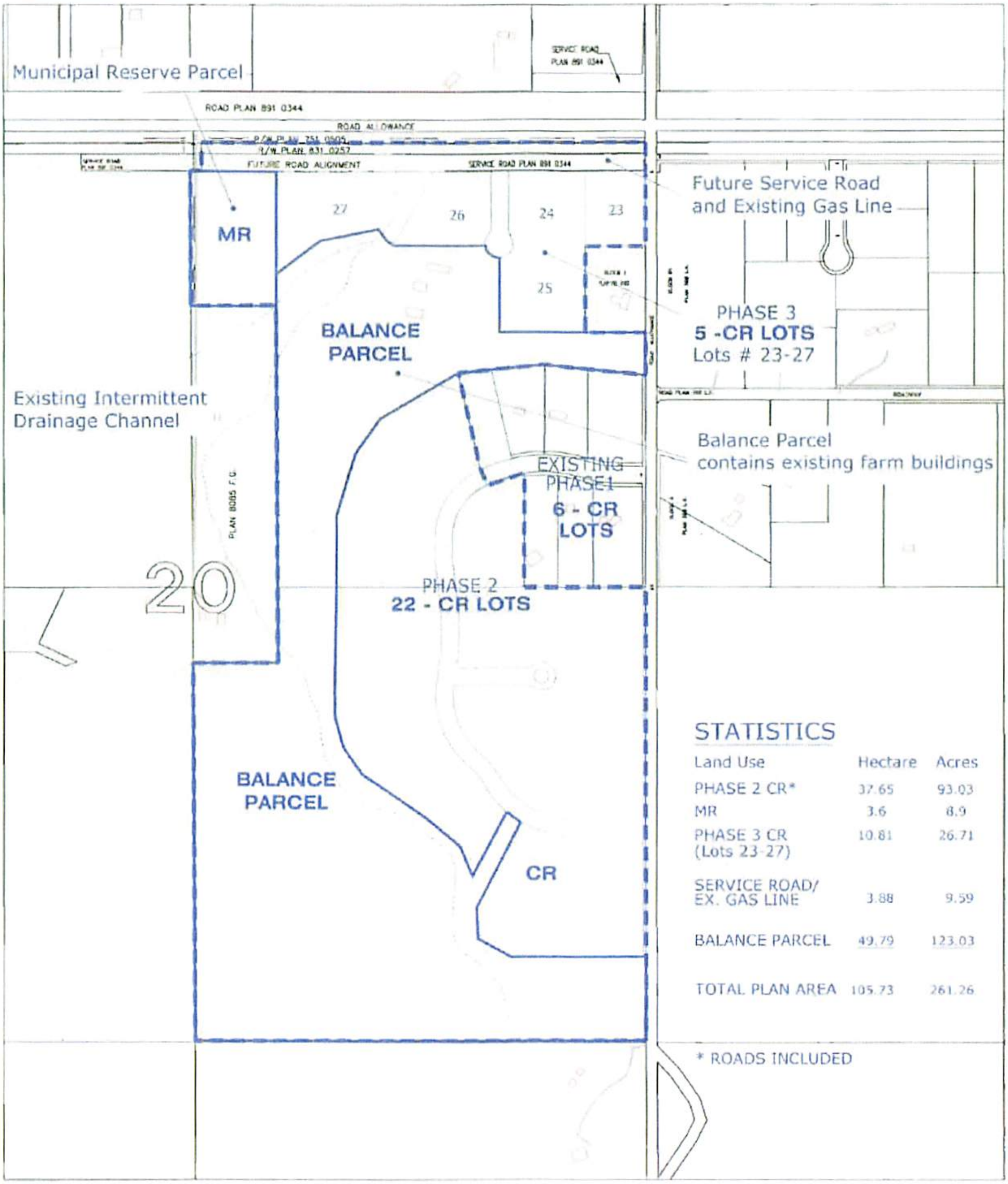
N

N.T.S.

- - - -	A.S.P. BOUNDARY
CR	COUNTRY RESIDENTIAL
EP	ENVIRONMENTAL PROTECTION
MR	MUNICIPAL RESERVE
A	AGRICULTURE

FIGURE 6:
PHASE 2 LAND USE PLAN

Note: Land Use Redesignation & Subdivision of lots may occur in sub phases where appropriate



STATISTICS

Land Use	Hectare	Acres
PHASE 2 CR*	37.65	93.03
MR	3.6	8.9
PHASE 3 CR (Lots 23-27)	10.81	26.71
SERVICE ROAD/ EX. GAS LINE	3.88	9.59
BALANCE PARCEL	49.79	123.03
TOTAL PLAN AREA	105.73	261.26

N

A.S.P. BOUNDARY

CR COUNTRY RESIDENTIAL

MR MUNICIPAL RESERVE

N.T.S.

FIGURE 7:
PHASE 3 LAND USE PLAN

Note: Land Use for the Balance Parcel to be determined at the Redesignation stage based on a Management Plan

FIGURE 8:

ULTIMATE DEVELOPMENT CONCEPT

RED WILLOW ESTATES AREA STRUCTURE PLAN

KELLAM BERG/BROWN AND ASSOCIATES

JUNE 2003

RED WILLOW ESTATES ASP
TECHNICAL SUPPORTING INFORMATION

Attachment 1: Illustrative Development Plan (11x17 map)

Attachment 2: Map: Roadway Grades
Map: Water Wells and Testholes (updated overlay of proposed lotting on 1999 test wells and boreholes)

Attachment 3: Waste Water Disposal Recommendations
Letter report from EBA Engineering Consultants, November 13, 2002.

Attachment 4: Use of Communal Wells. Letter report from EBA Engineering Consultants, October 7, 2002.

Attachment 5: Percolation and Near Surface Groundwater Testing for Phase 3 Lots 22, 23, 24, 25 and 26. Letter report from EBA Engineering Consultants, November 5, 2002.

Attachment 6: Soil Survey and Agricultural Capability Rating Report / EBA Engineering Consultants / September 1999 /

Attachment 7: Geotechnical Evaluation / EBA Engineering Consultants / September 1999

Attachment 8: Groundwater Evaluation / EBA Engineering Consultants / October 1999

Attachment 9: Hydrogeological Study / EBA Engineering Consultants / May 2001

Attachment 10: Wildlife Habitat Management Options / Axys Environmental Consulting / September 2000

RED WILLOW ESTATES ASP
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Attachment 6: Soil Survey and Agricultural Capability Rating Report / EBA Engineering Consultants / September 1999 /

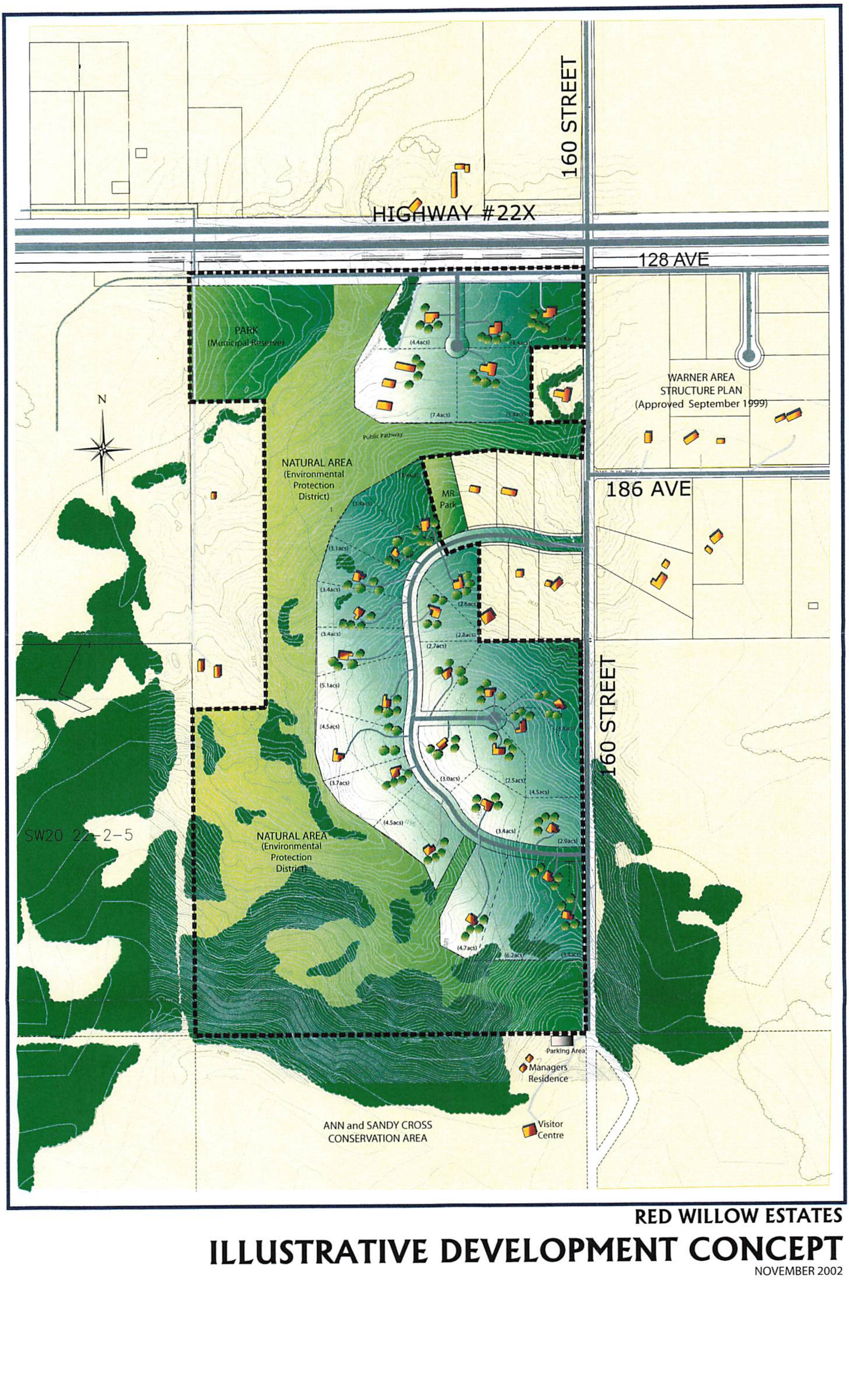
Attachment 7: Geotechnical Evaluation / EBA Engineering Consultants / September 1999

Attachment 8: Groundwater Evaluation / EBA Engineering Consultants / October 1999

Attachment 9: Hydrogeological Study / EBA Engineering Consultants / May 2001

Attachment 10: Wildlife Habitat Management Options / Axys Environmental Consulting / September 2000

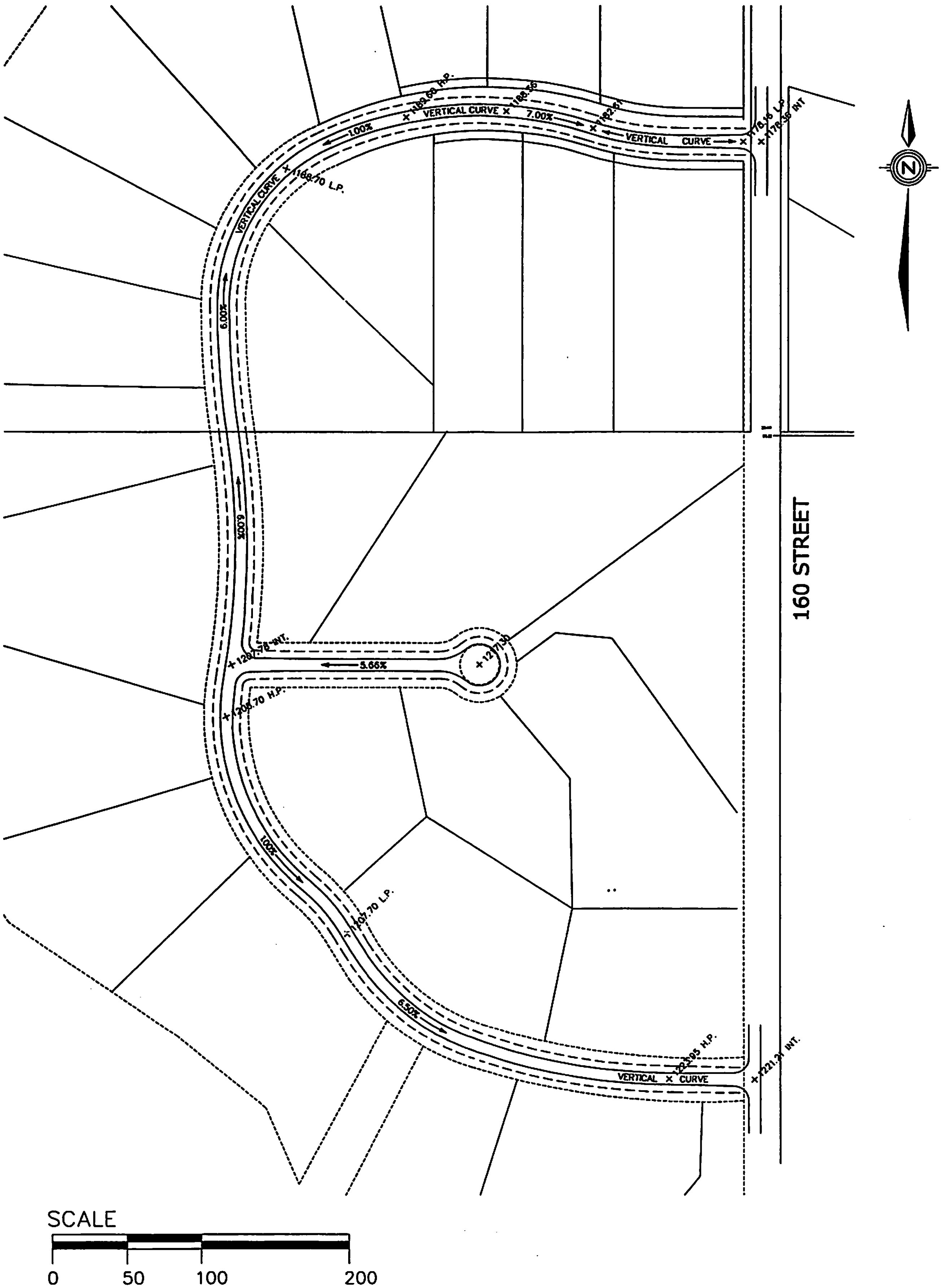
1



RED WILLOW ESTATES

ILLUSTRATIVE DEVELOPMENT CONCEPT

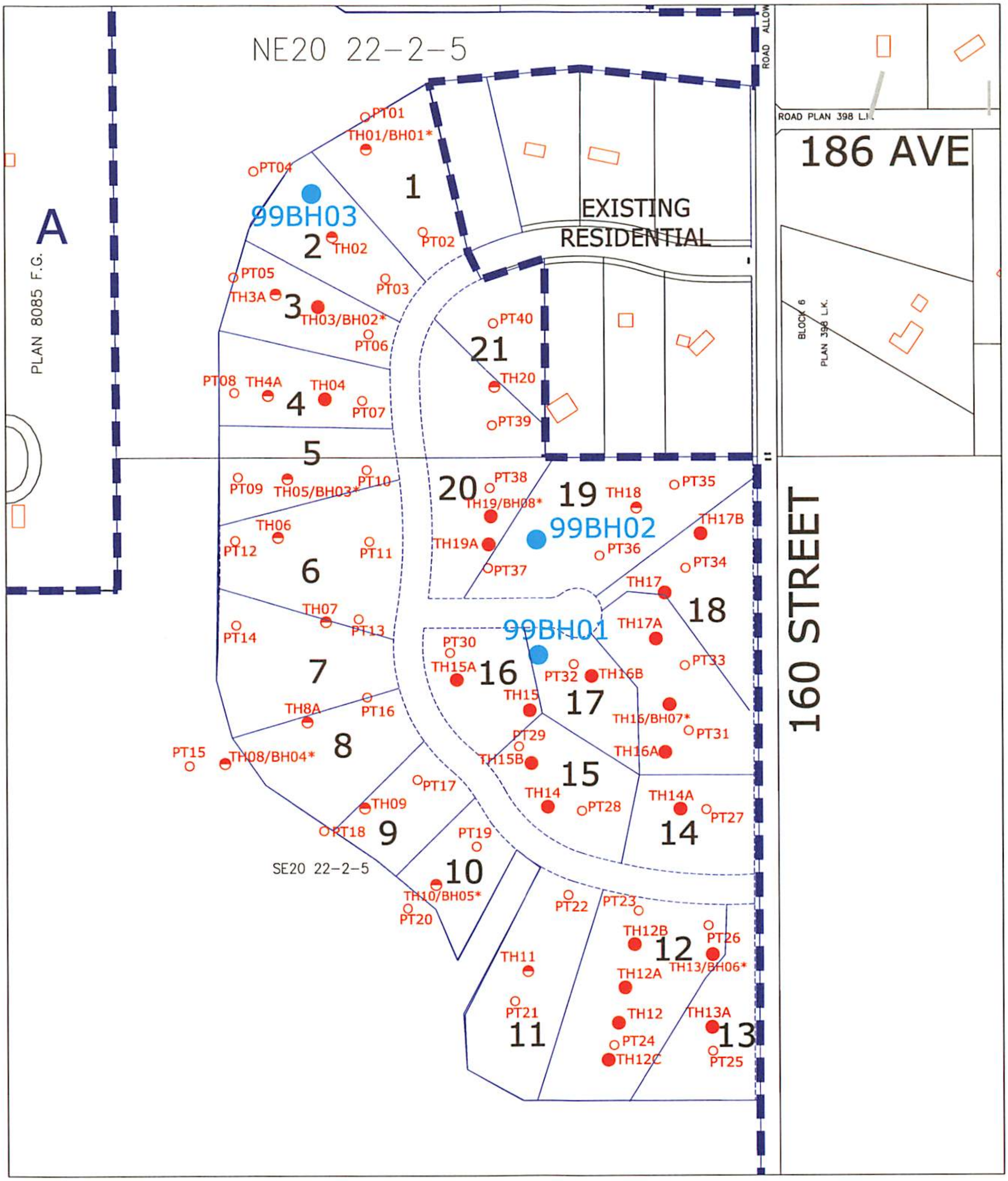
NOVEMBER 2002



RED WILLOWS ESTATES - ROAD GRADES

KELLAM BERG ENGINEERING & SURVEYS LTD.

2



A.S.P. BOUNDARY

WATER WELLS

PERCOLATION TEST

SHALLOW WATER TABLE TESTHOLES WITH 3m STANDPIPE

TESTHOLE WITH BEDROCK AT <2.1m

* GEOTECHNICAL BOREHOLE TO 6m OR BEDROCK

N

N.T.S.

WATER WELLS & TESTHOLE LOCATIONS

RED WILLOW ESTATES AREA STRUCTURE PLAN

KELLAM BERG/BROWN AND ASSOCIATES

NOVEMBER 2002

3

EBA Engineering Consultants Ltd.

Creating and Delivering Better Solutions

November 13, 2002 EBA File No.: 304-7300043

Kellam Berg Engineering and Surveys Ltd.
[redacted]

Attention: Mr. Patrick Maier

Dear Sir:

Subject **Wastewater Disposal**
Red Willow Estates
NE ¼ SE ¼ Section 20-22-2-5

1.0 INTRODUCTION

EBA Engineering Consultants Ltd. (EBA) was retained by Kellam Berg Engineering Ltd. to prepare an assessment of wastewater disposal options for Bavarian Lion Company. This work was completed following geotechnical evaluations and a hydrogeological assessment. The former included percolation testing as a prelude to assessment and septic field disposal of household wastewater.

The proposed development is known as Red Willow Estates and comprises a rural residential development. The proposed development site is located at the southwest corner of Highway 22X and 160 Street West intersection outside Calgary's city limit within the Municipal District of Foothills, Alberta. A site location plan is presented as Figure 1. The general location of each residence is approximately located. The likely location of septic disposal field for the lots have yet to be determined.

2.0 DISCUSSION

The Lot Layout Plan indicates an arrangement similar to that considered in the geotechnical investigation of September 1999. The lots are arranged around an access road.

Lots 1 to 11 could be addressed by conventional septic fields. The measured percolation rates are within acceptable limits and the water table is sufficiently deep to permit treatment by septic fields at each residence.

Lots 12 to 22 are underlain by bedrock at shallow depths. In these instances, bedrock is present in the depth range that would ordinarily function as a septic field. The Alberta Guidelines

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preclude forming septic fields within bedrock and so these lots are unsuited to conventional septic fields.

As an alternative to a conventional septic field, a septic mound could be created at each location. These mounds would be formed by placing fill in selected areas. Since the bedrock is present close to the ground surface in the area, this would mean the entire field would be created for each property above existing grade. The creation of a septic mound each of these locations poses issues of lot grading, the selection of suitable fill material and ensuring post treatment infiltration to the bedrock. These issues are surmountable but offer challenges.

Lots 23 to 27 are suited to septic disposal of wastewater as previously discussed by EBA.

3.0 ALTERNATIVES TO SEPTIC DISPOSAL

There are two principle means of disposal to meet the long-term needs of householders other than septic disposal. These are:

- centralised wastewater treatment plant(s); and
- individual "package" wastewater treatment plants.

A centralised plant could be established to meet the needs of some or all of the proposed subdivision. This facility would be established early in the development process to meet the needs of the first lots to be developed. Out-fall of the treated water would be to the seasonal drainage course that passes to the north. Alternatively, infiltration or "dry" wells could be considered to permit the treated water to pass into the ground.

Centralised wastewater treatment has the following advantages:

- wastewater treated is to a known standard;
- maintenance is handled at one location; and
- the facility can be located away from residences.

The disadvantages include:

- capital cost, including installation of collections lines from each household;
- issues of ownership amongst householders;
- co-operation amongst householders is necessary;
- output water flows are concentrated at a point source; and
- operating and maintenance costs must be shared equitably.

The package plant solution has become feasible in recent years because of development in containment and understanding of the processes involved. Plants are now available that will permit the needs of individual households to be met and they require little maintenance. The units would be located adjacent to each home and is buried below grade.

The output water can be safely disposed without further treatment. The quality of output water is sufficient to allow infiltration into the ground.

Package plants are available at relatively modest costs and can be installed with conventional construction equipment on each lot. They must be available for maintenance but should not detract significantly from the use of the lot.

The main drawback from such systems is financial. The capital cost of such systems is greater than that of a septic field.

4.0 CONCLUSION

About half of the proposed lots are suited to septic disposal. Shallow rock precludes the use of septic fields in the eastern portion of the proposed development area. It is recommended that individual package plants be considered for these lots. Alternatively a centralised plant could be considered for use by some or all of the lots to be developed.

Sincerely,

EBA Engineering Consultants, Ltd.

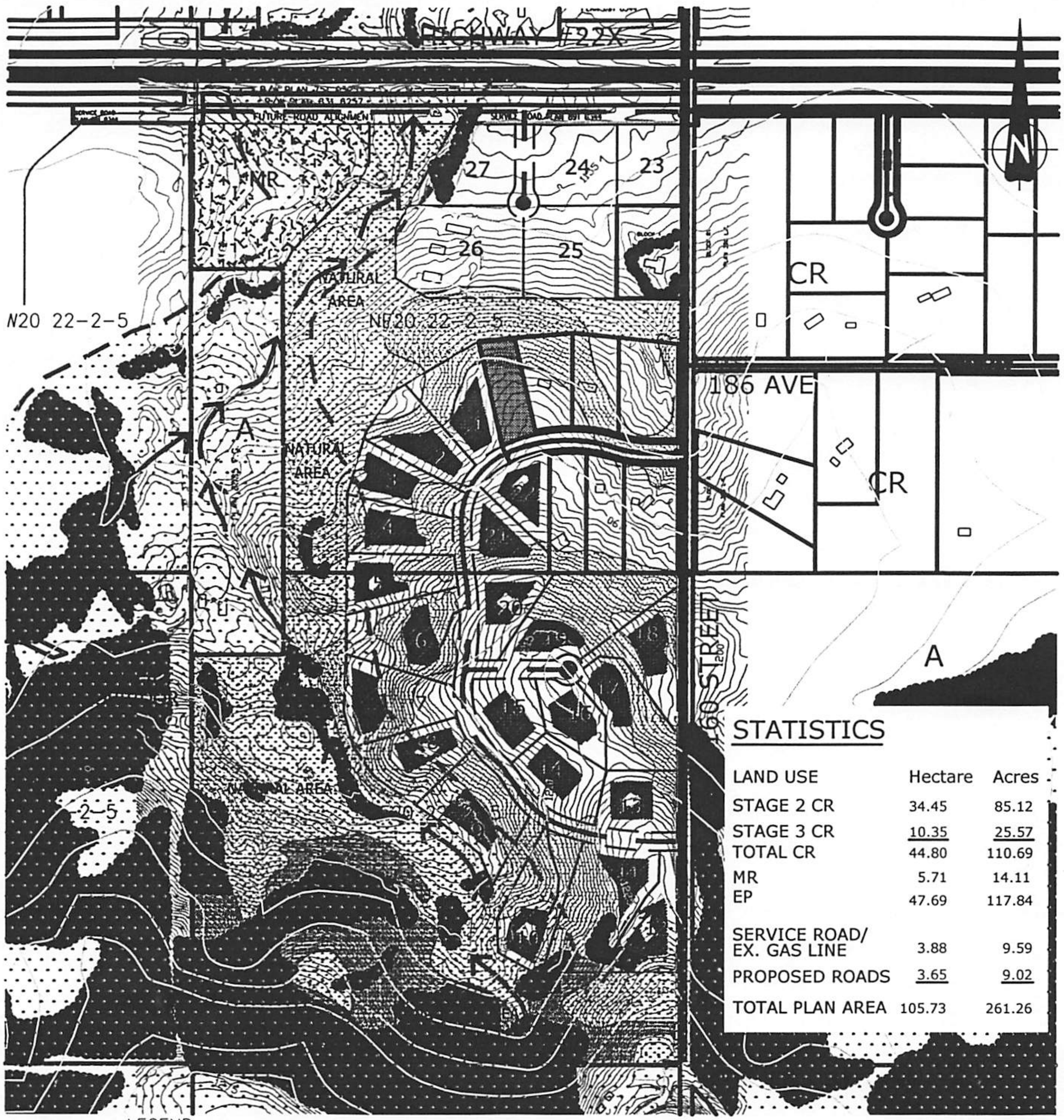
[redacted]

Paul A. Evans, P.Eng., MBA
Senior Engineer

[redacted]

PAE\hlk

Attachment (1) Figure 1 - Site Plan



STATISTICS

LAND USE	Hectare	Acres
STAGE 2 CR	34.45	85.12
STAGE 3 CR	10.35	25.57
TOTAL CR	44.80	110.69
MR	5.71	14.11
EP	47.69	117.84
SERVICE ROAD/ EX. GAS LINE	3.88	9.59
PROPOSED ROADS	3.65	9.02
TOTAL PLAN AREA	105.73	261.26

LEGEND

- - - - - A.S.P. BOUNDARY

EXISTING ROADS

PROPOSED ROADS

1 ACRE BUILDING SITE

LOT NUMBER

SITE PLAN REFERENCED FROM:
KELLAM BERG/BROWN AND ASSOCIATES

CLIENT/PROJECT DESCRIPTION
RED WILLOW ESTATES AREA STRUCTURE PLAN

EBA Engineering Consultants Ltd.

SCALE/EBA PROJECT NO.
N.T.S.
7300043

DATE/DRAWN BY:
02/11/13
DDo/PAE

TITLE/EBA DRAWING NO.
DEVELOPMENT CONCEPT SHOWING LOT NUMBERS
FIGURE 1

4

EBA Engineering Consultants Ltd.

Creating and Delivering Better Solutions

October 7, 2002 EBA File No.: 0304-99-31058011

Kellam-Berg Engineering
[redacted]

Attention: Mr. R. Kellam, P.Eng.

Dear Mr. Kellam:

Subject: Use of Communal Wells
Red Willow Estates
Bavarian Lion Company Ltd.

EBA Engineering Consultants Ltd. (EBA) undertook evaluations of the availability of groundwater at the proposed Red Willow Estates in October of 1999 and May of 2001. Those evaluations involved:

- a drilling and well testing program to assess the availability of groundwater to supply the proposed development; and
- a hydrogeological study of the surrounding region to assess the overall capability of the region to support the development.

Those evaluations determined that:

- individual wells completed within the estate were capable of providing yields of approximately 35,000 m^3/year (equivalent to 98 m^3/day or 15 IGPM); and
- there is sufficient groundwater within the basin to support the proposed development of 26 lots without affecting the availability of groundwater to other users.

However, the testing portion of the evaluation also demonstrated that properties of the aquifer from which the groundwater was withdrawn are different from place to place. Although these differences will not affect the overall performance of the aquifer, they will affect the yield available from individual wells completed in the water bearing zone (depth of 55 m to 65 m). At the time of testing, the ground surface elevation of the well was not surveyed and consequently, the elevation of the producing zone has not been provided.

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Because the aquifer beneath a particular lot in the subdivision may not be capable of yielding sufficient water to supply an individual household (approximately 2 m^3/day or 400 gpd), use of a communal well capable of providing water to several households may be preferred.

The existing well 99BH03 was tested and found to yield approximately 98 m^3/day or 15 IGPM on a 20 year basis as recommended by Alberta Environment. Using a water requirement of about 2 m^3/day or 400 IGPD for a typical household, the well completed at this location is capable of providing water to nearly 50 households. However, use of a communal supply well needs to consider that at peak usage times (e.g., the early morning, dinner, supper hours and the like), the actual water requirement will greatly exceed a pumping rate of 98 m^3/day. To support this increased peak water demand, tank storage may be necessary close to the well head. The tank will need to be maintained in such a way that it does not freeze in colder winter months.

The well at 99BH03 is constructed of 6.5" diameter steel casing and is suitable for most domestic water supply needs. This casing may be insufficient to support the type of pumping equipment necessary to supply the water system and may need to be replaced.

The location of 99BH03 is well suited to the development of the first seven lots as described in the area structure plan. Additional lots, located further up-slope from 99BH03 may be better served by additional wells.

We trust that the preceding information is sufficient for your immediate concerns and are looking forward to working with you on as this development proceeds.

Respectfully submitted,

EBA Engineering Consultants Ltd.

[redacted]

J.T. (Tom) Dance, M.Sc., P.Geol.
Senior Contaminant Hydrogeologist
[redacted]

JTD/jsf

Cc: Brown and Associates

5

November 5, 2002 EBA File: 7300043

Kellam Berg Engineering and Surveys Ltd.
5800 1A Street SW
Calgary AB T2H 0G1

Attention: Mr. Patrick Majer

Dear Sir:

Subject: Percolation and Near Surface Groundwater Testing
Red Willow Estates – Stage 3
Lots 22, 23, 24, 25 and 26
NE ¼ SE ¼ Section 20-22-2-5

EBA Engineering Consultants Ltd. (EBA) has conducted percolation tests and installed near surface groundwater monitoring standpipes on the above-noted property. This letter report presents the results of the percolation tests and near surface groundwater monitoring. The object of this work was to evaluate the site suitability for sewage treatment using conventional septic fields. Authorization to proceed with this work was received from Mr. Patrick Majer of Kellam Berg Engineering and Surveys Ltd. (Kellam Berg) on September 11, 2002.

The proposed development is part of a Red Willow Estate (Stage 3) and consists of five residential lots (designated as Lot 22 through Lot 26). The proposed development site is located at the southwest corner of Highway 22X and 160 Street intersection outside the Calgary's city limit within the Municipal District of Foothills, Alberta. A site location plan is presented as Figure 1. The precise location of each residence, and subsequently each septic disposal field, for the lots has yet to be determined. Figure 2 presents a site plan depicting the locations of percolation testholes and near surface shallow groundwater boreholes.

1.0 NEAR SURFACE GROUNDWATER TABLE MEASUREMENTS

Five near surface (shallow) groundwater boreholes were advanced at selected locations on September 17, 2002, using a solid stem auger drill rig. The boreholes were advanced to a depth of 3 m below the existing ground surface. Slotted 25 mm PVC standpipes were installed in all the boreholes. The near surface groundwater borehole logs are presented in Table 1.

The groundwater was measured in the standpipes on September 18 and 24, 2002. The highest groundwater level was recorded at 2.16 m and 2.01 m below the existing ground surface in boreholes BH-02 and BH-04 respectively. All other boreholes (BH-06, BH-08 and BH-10) were

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dry and are acceptable for sewage treatment. The depths to groundwater recorded in the near surface groundwater boreholes are summarized in Table 2. Groundwater levels observed in the area of boreholes BH-02 and BH-04 were marginally (between 0.24 m and 0.39 m) above the maximum level of 2.4 m below the existing grade allowed by AEP Guidelines for the period from the end of August to spring thaw. However, groundwater levels observed in the area of boreholes BH-02 and BH-04 are acceptable for sewage treatment according to AEP Guidelines if the final grade of the septic fields were raised by 0.24 m and 0.39 m respectively. The fill materials should be assessed in order to meet the AEP Guidelines for percolation rates.

2.0 PERCOLATION TESTING

Percolation testing was conducted on September 18, 2002. Testing was conducted in accordance with the following documents.

- Alberta Environmental Protection (AEP) Land Use Branch File 3000-G1-S1, "Interim Guidelines for the Evaluation of Water Table Conditions and Soil Percolation Rate for Unserviced Residential Subdivisions". April 1994 (AEP Guidelines).

- "Alberta Private Sewage Systems Standard of Practice". Safety Codes Council, 1999 (Standard of Practice).

In accordance with specifications provided in the above-noted documents, all percolation testholes were 200 mm in diameter, and 900 mm deep.

The results of the percolation testing are summarized in Table 3, and percolation testhole log data is shown in Table 4. A review of the percolation test results indicates that native (clay till) soils within the lots tested have percolation rates ranging from 3.3 min/cm to 16.7 min/cm. Fill soils in the area of PT-06 have percolation rate of 2.0 min/cm. Silt soils in area of PT-03 exhibited a soil percolation rate in excess of 0.5 min/cm to 2.0 min/cm. The AEP Guidelines and Standard of Practice consider soil percolation rates in the range of 2.0 min/cm to 23.6 min/cm to be suitable for sewage disposal.

The percolation test results indicated that soils in the vicinity of all the test locations with the exception of PT-03 are considered suitable for sewage disposal by conventional septic fields. If these locations are not acceptable to the owner, then additional percolation testing could be conducted in an attempt to find other suitable locations. Alternative methods of sewage treatment, such as treatment mounds or sand filters could also be considered.

Based on the percolation test results in the vicinity of PT-03 for Lot 23, the native soil is not considered suitable for sewage disposal by conventional septic fields. However, conventional septic fields may be installed within the native soil in the vicinity of PT-04 for the same lot.

It is understood that aquifer testing will be conducted at the site. At that time, water samples should be obtained and submitted to an appropriate laboratory to be tested for Sodium Adsorption Ratio (SAR). If the SAR of the household water supply is greater than eight, additional analyses, and/or remedial measures may be required.

3.0 CLOSURE

We trust this information satisfies your present requirements. If you have any questions, please contact our office at (403) 236-9700.

Respectfully submitted,

EBA Engineering Consultants Ltd.

[redacted]

[redacted]

for ✓ Ranjanesh (Ram) Ram, R.E.T.
Senior Project Technologist

S. Joseph Yonan, Ph.D., P.Eng.
Senior Project Engineer

RR:SJY:wgs

PERMIT TO PRACTICE
EBA ENGINEERING CONSULTANTS LTD.

Signature [redacted]

Date Nov 5, 2002

PERMIT NUMBER: P245
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

FIGURES

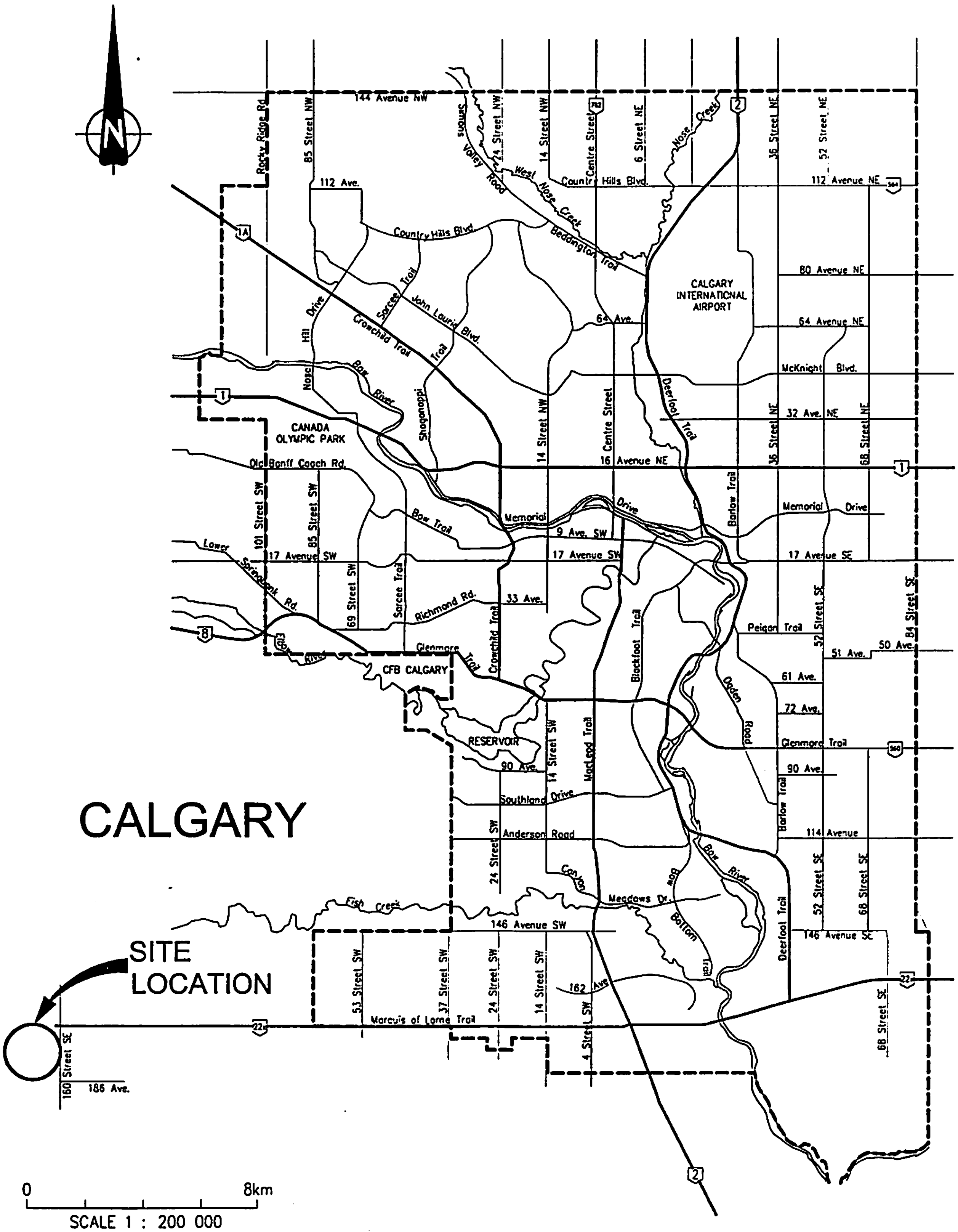

Figure 1

Site Location Plan

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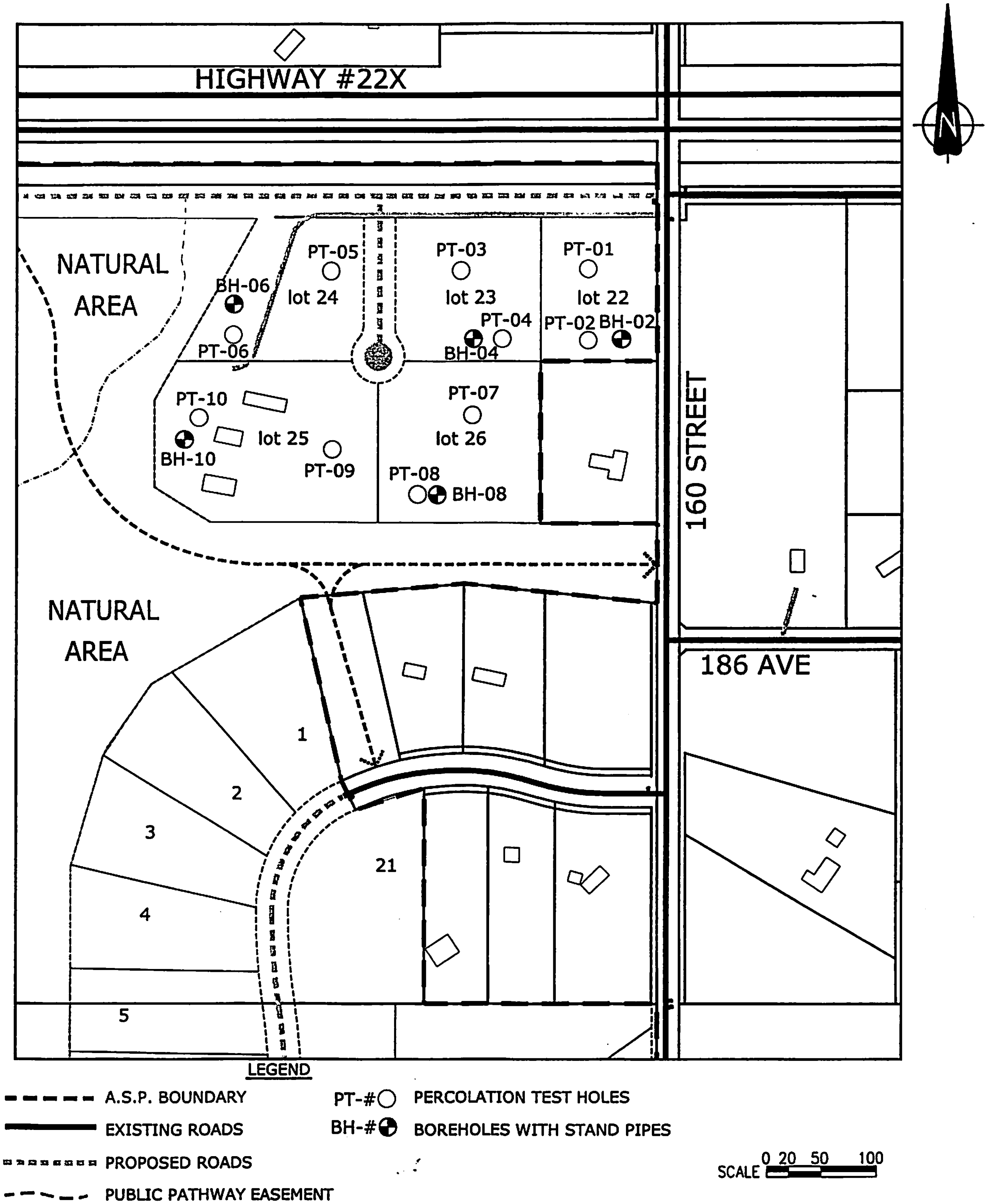

Figure 2
Percolation Test And Near Surface Groundwater Borehole Locations Plan

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TABLES

TABLE 1
SOIL LOGS FOR NEAR SURFACE GROUNDWATER BOREHOLES
RED WILLOW ESTATES – STAGE 3
HIGHWAY 22X AND 160 STREET SW
M.D. OF FOOTHILLS, ALBERTA

SOIL LOG FOR BH-02

DEPTH	SOIL
0	TOPSOIL – organics, moist, black.
0.2	CLAY (TILL) – silty, trace sand and gravel, very stiff, low plastic, moist, brown, oxides, coal specks.
2.1	Moist to very moist.
3.0	End of Hole.

SOIL LOG FOR BH-04

DEPTH	SOIL
0	TOPSOIL – organics, rootlets, black.
0.15	CLAY (TILL) – silty, trace sand, trace gravel, very stiff, low plastic, moist, brown, oxides, coal specks.
2.4	Firm, moist to very moist.
3.0	End of Hole.

SOIL LOG FOR BH-06

DEPTH	SOIL
0	TOPSOIL – organics, rootlets, black.
0.35	SILT (FILL) – sandy, trace clay, trace gravel, organics, loose damp, brown black.
1.4	CLAY (TILL) – silty, trace sand and gravel, very stiff, low plastic, moist, brown, oxides, coal specks.
3.0	End of Hole.

TABLE 1
(continued)
SOIL LOGS FOR NEWAR SURAFACE GROUNDWATER BOREHOLES
RED WILLOW ESTATES – STAGE 3
HIGHWAY 22X AND 160 STREET SW
M.D. OF FOOTHILLS, ALBERTA

SOIL LOG FOR BH-08

DEPTH (m)	SOIL
0	TOPSOIL – organics, rootlets, black.
0.2	SILT – sandy, trace clay, loose, damp, brown.
0.3	CLAY (TILL) – silty, trace sand and gravel, very stiff, low plastic, moist, brown, oxides, coal specks.
2.1	Sand lenses.
3.0	End of Hole.

SOIL LOG FOR BH-10

DEPTH (m)	SOIL
0	CLAY (FILL) – silty, trace sand, trace to some gravel, moist, brown.
0.76	TOPSOIL – organics, rootlets, black.
1.1	CLAY (FILL) – silty, trace sand, trace gravel, organics, fibres, moist, brown black.
1.7	CLAY (TILL) – silty, trace to some sand, moist, brown grey.
2.1	Soft, moist to very moist, brown.
3.0	End of Hole.

TABLE 2
GROUNDWATER LEVELS
RED WILLOW ESTATES – STAGE 3

Lot No.	Borehole No.	Depth of Standpipe (m)	Groundwater Depth Below Existing Ground Surface (m)	
			September 18, 2002	September 24, 2002
22	BH-02	3	2.17	2.16
23	BH-04	3	2.16	2.01
24	BH-06	3	DRY	Dry
26	BH-08	3	DRY	Dry
25	BH-10	3	DRY	Dry

TABLE 3
PERCOLATION TEST RESULTS

Lots	Percolation Test	Soil Type	Percolation Rate (min/cm)
22	PT-01	Native	16.7
	PT-02	Native	10.0
23	PT-03	Native	0.5*
	PT-04	Native	5.9
24	PT-05	Native	3.3
	PT-06	Fill	2.0
25	PT-09	Native	3.3
	PT-10	Native	10.0
26	PT-07	Native	4.1
	PT-08	Native	4.0

*Indicates soil percolation rate, which does not meet Standard of Practice requirements.

TABLE 4
PERCOLATION TESTHOLE LOGS AND RESULTS
RED WILLOW ESTATES - STAGE 3

Test No.	Depth (mm)	Soil Description	Soil Percolation Rate (min/cm)
PT-01	0 - 150 150 - 900 900	TOPSOIL - organics, rootlets, black. CLAY (TILL) - silty, trace sand and gravel, low plastic, damp to moist, brown. End of Hole.	16.7
PT-02	0 - 250 250 - 900 900	TOPSOIL - organics, rootlets, black. CLAY (TILL) - silty, trace sand, stiff, low to medium plastic, moist, brown, oxides. End of Hole.	10
PT-03	0 - 300 300 - 600 600 - 900 900	TOPSOIL - organics, rootlets, black. SILT - sandy, trace clay, loose, damp, brown. CLAY (TILL) - silty, trace sand and gravel, low plastic, moist, brown, oxides. End of Hole.	0.5*
PT-04	0 - 250 250 - 450 450 - 900 900	TOPSOIL - organics, rootlets, black. SILT - sandy, trace clay, loose, damp, brown. CLAY (TILL) - silty, trace sand, stiff, low plastic, moist, brown. End of Hole.	5.9
PT-05	0 -150 150 - 900 900	TOPSOIL - organics, rootlets, black. CLAY (TILL) - silty, trace sand and gravel, stiff, low plastic, damp to moist, brown, oxides. End of Hole.	3.3
PT-06	0 - 350 350 - 900 900	TOPSOIL - organics, rootlets, black. SAND AND GRAVEL (FILL) - silty, trace organics, trace clay, damp, brown black. End of Hole.	2
PT-07	0 - 250 250 - 900 900	TOPSOIL - organics, rootlets, black. CLAY (TILL) - silty, trace to some sand, firm, low plastic, damp, brown. End of Hole.	4.1
PT-08	0 - 200 200 - 450 450 - 900 900	TOPSOIL - organics, rootlets, black. SILT - sandy, trace clay, loose, damp, brown. CLAY (TILL) - silty, trace sand, trace gravel, stiff, low plastic, damp to moist, brown, oxides. End of Hole.	4
PT-09	0 - 500 500 - 900 900	TOPSOIL - organics, rootlets, black. CLAY (TILL) - silty, trace sand and gravel, firm, low plastic, damp, brown. End of Hole.	3.3
PT-10	0 - 300 300 - 600 600 - 900 900	FILL - decomposing material, woodchips, fibres and rootlets. TOPSOIL - organics, rootlets, black. CLAY (TILL) - silty, trace sand and gravel, firm, low plastic, moist, brown. End of Hole.	10

* Indicates soil percolation rate did not meet Standard of Practice requirements.

6

EBA Engineering Consultants Ltd.

SOIL SURVEY AND AGRICULTURAL
CAPABILITY RATING
E ½ 20-22-02 W5M
MILLARVILLE, ALBERTA

Project No: 0304-31058.02

SEPTEMBER 1999

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Tel: (403) 203-3355 - Fax: (403) 203-3301 Internet: calgary@eba.ca - Web Site: http//www.eba.ca

EBA Engineering Consultants Ltd.

SOIL SURVEY AND AGRICULTURAL
CAPABILITY RATING
E ½ 20-22-02 W5M
MILLARVILLE, ALBERTA

COPY

Submitted to:

KELLAM BERG ENGINEERING & SURVEYS LTD.
Calgary, Alberta

Prepared by:

EBA ENGINEERING CONSULTANTS LTD.
Calgary, Alberta

Project No. 0304-31058.02

SEPTEMBER 1999

Riverbend Atrium One, 270, 200 Rivercrest Dr. S.E., Calgary, Alberta T2C 2X5
Tel: (403) 203-3355 - Fax: (403) 203-3301 Internet: calgary@eba.ca - Web Site: http//www.eba.ca

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1.0 INTRODUCTION

EBA Engineering Consultants Ltd. (EBA) was retained by Kellam Berg Engineering & Surveys Ltd. (Kellam) to conduct a Soil Survey and Land Capability Classification for the proposed subdivision on E ½ 20-22-02 W5M (herein referred to as the parcel). This parcel is located approximately 20 km southwest of Calgary (Figure 1). The parcel assessed excluded the subdivided lots on the east side, and a privately owned portion of land on the west side of the half section (Figure 2, 3).

The scope of work for this investigation included:

- conduct a detailed soil survey;
- classify soil to the series level;
- complete a land capability rating of the soil units; and
- present the results of the above tasks in a letter report.

Authorization to proceed with this investigation was provided by Mr. Ron Kellam, P.Eng. of Kellam. This work was completed under EBA's standard terms and conditions provided in Appendix A.

2.0 METHODS

A detailed soil survey (Level I) of this parcel was completed on August 20, 1999. This assessment included soil classification using the Canadian System of Soil Classification (Agriculture Canada, 1998) at 39 locations throughout the parcel. Soil profiles were inspected using a shovel to 50 cm and Dutch Hand Auger to 100 cm, or refusal. At each soil inspection site, slope was measured in percent using a clinometer and also calculated using topographical contours on Figure 3. Landscape information about aspect, stoniness, and drainage was also collected at each site.

Following field assessment for soil and landscape classification, soil mapping of the parcel was completed at a scale of 1:5,000 (Figure 2). Soil mapping is based on the philosophy of pedology – that soils are natural bodies that reflect the influence of their environment. Point observations of soils can be extrapolated to areas by using principles of geomorphology and geology, combined with vegetation pattern and drainage indicators. Since soil is a continuum, and adjacent soils seldom have sharp boundaries, soil units are defined as having a certain range of properties. These soil units are delineated on the basis of parent geologic material and landform, soil profile, and soil moisture conditions.

The areas delineated on Figure 2 are soil map units. These were determined using the information gathered from the soil survey in conjunction with 1:30,000 stereo aerial photographs. The aerial photographs were used to discern differences in landscape units. The soil units were correlated to the reconnaissance Soil Survey of the Calgary Urban Perimeter (MacMillan, 1987).

Land Capability rating of the soil units was completed in accordance with the Soil Capability for Agriculture in Alberta (Alberta Environment and Pedology Consultants, 1977) and Land Capability for Arable Agriculture in Alberta [Alberta Soils Advisory Committee (ASAC), 1987]. Ratings within each soil unit were established using dominant topography, soil chemical and physical properties, drainage, climate and surface stoniness. Soil chemical information was inferred from indicators in the field as well as information from the Soil Survey of the Calgary Urban Perimeter (MacMillan, 1987) and Soil Series Information for Reclamation Planning in Alberta (ACRC, 1993).

Agricultural land capability classification of soil utilizes seven rating categories based on soil limitations for dryland farming (Alberta Soils Advisory Committee, 1987). Land in Classes one to three is considered to have no significant limitations in use for cropping to moderately severe limitations restricting the range of crops. The fourth Class represents land which has severe limitations restricting the range of crops or land which requires special conservation practices. Subsequent classes are arranged with decreasing potential for production of perennial forage crops to Class seven which is incapable for use in cultivated agriculture or permanent pasture. Letter modifiers are used with the class designation to define specific land limitations. These are described in Table 3.

3.0 RESULTS

3.1 Land Use

At the time of the site investigation, the majority of the parcel was being used for grazing of cattle. A small area in the north portion of the parcel was used for a farmstead and access. This area was fenced to prevent cattle grazing.

A portion of the half section has been previously subdivided and at the time of this assessment, six houses were present in that area. The entire half section with the exception of the developed area is zoned as "agricultural conservation." The developed land is zoned as "permitted use."

3.2 Vegetation

Plant growth throughout the parcel was dominated by agronomic species in variable composition. These species included brome grass, timothy, alfalfa, clover and various weedy species including Canada thistle and dandelion. Vegetation in the southern extreme of the parcel included native aspen forest. In all areas, the vegetation was dense (100% ground cover), however, the height and mixture of species differed throughout the parcel due to grazing rotations.

3.3 Soils

Soils in this region are Black Chernozems and are typically well drained with minor occurrences of poorly drained areas. These soils typically have a dark A horizon (topsoil) enriched in organic matter representative of grassland or grassland-forest communities. Subsoil (B horizon) is often prismatic in structure and is underlain by a C horizon that has massive structure. Parent material at nearly all soil inspection sites was till.

The soils of this parcel have been mapped on a 1:5,000 scale (Figure 2). The legend is provided in Table 1 and on Figure 2.

The main soil unit in this parcel was composed of Dunvargan soil series. Soils in this series are Orthic Black Chernozems and are developed on steeply sloping terrain (Topography Class 5 with some inclusions of Class 3). The next most extensive soil unit was composed of the Antler soil series. These soils are also Orthic Black Chernozems, however they are developed on slightly different till and were found on undulating landforms (Topography Class 3). Summaries of the characteristics of these units can be found in Appendix B. Characteristics of individual inspection sites are provided in Table 2.

A drainage channel and creek traverses the parcel on the west side. The soils in this area were mapped as the Tweedsmuir unit. Soils in this unit were found on nearly level to gently sloping terrain in low landscape positions (Topography Class 2-3). They were poorly drained and in some areas had standing water on the surface. The development of these soils was affected by water – some were Gleysols, while others were Rego, Gleyed or Orthic Black Chernozems.

In the southernmost section of the parcel, soils were developed under Aspen forest cover. These soils were dominated by Dark Gray Luvisols and were mapped as the Leighton Center soil unit. These soils were also developed on strongly sloping terrain (Topography Class 6) with till parent material.

4.0 AGRICULTURAL LAND CAPABILITY RATING

A summary of map units and their agricultural capability based on the ASAC method is provided in Table 3 along with calculations of the area in each unit. Agricultural land classification worksheets are included in Appendix C.

Figure 3 shows that the soils in the most northern portion of the parcel (Antler series) are Land Capability Class 4 soils with adverse climatic conditions being the most limiting factors to dryland agriculture. This Land Capability Class 4 land comprises 15.5% of the parcel.

South of the Antler unit, soils were mapped as the Dunvargan unit. These soils ranged from Topography Class 3 (2.5% to 5% slopes) to Class 5 (10% to 15.% slopes). Soils in Topography Class 3 were placed in Land Capability Class 4 with adverse climatic conditions being the most limiting factor. These soils comprised 3.2% of the parcel. The majority (56.1%) of the parcel consisted of Dunvargan soils on Class 5 topography. These soils were placed in Land Capability Class 4 and were limited by the steep (10% to 15%) topography of the area.

In the southernmost portion of the parcel, soils were mapped as the Leighton Center Unit. These soils were on the steepest topography in the parcel [Topography Class 6 (16% to 30%)] and were rated as Land Capability Class 5 due to the steep slopes. This area comprised 18.8% of the parcel.

A small creek traverses the parcel on the northwest and southwest side. Soils in this area developed on nearly level (Topography Class 2) to very gentle (Topography Class 3) slopes in low lying areas and were mapped as the Tweedsmuir Unit. These soils were poorly drained and were therefore placed in Land Capability Class 6. These soils comprised 3.9% in the northwest and 2.4% in the southwest portion of the parcel.

These classifications generally correspond with the Land Capability Ratings using the older system that are provided in the reconnaissance soil survey (MacMillan 1987). MacMillan rated Dunvargan soils on Class 5 topography as Land Capability Class 4T and Leighton Centre soils on Class 6 topography as Land Capability Class 5T. However, Antler soils on Class 2 and 3 topography were rated as Land Capability Class 2. Since the parcel is at the edge of an agro-climatic area, site-specific climatic information would be necessary to clarify the rating of the Antler Soils on this parcel. Tweedsmuir soils were not rated in terms of Land Capability in the reconnaissance soil survey.

The portion of the parcel on Figure 3 where block numbers appear was assessed by Enviro-Field Services Inc. in 1995. They determined this land to be Land Capability Class 4 with topography being the most limiting factor. This was in general agreement with the classifications determined by EBA.

5.0 SUMMARY AND CONCLUSIONS

This parcel is dominated (74.8%) by Land Capability Class 4 land, with mostly well drained Black Chernozemic soils and minor inclusions of less developed Rego, Gleyed, and calcareous Black Chernozems in the low-lying wet areas. Limiting factors for agriculture are climate and sometimes topography. Land on steeper slopes (18.8%) is rated as Land Capability Class 5. Land in the low lying areas (6.3%) was rated as Class 6 due to the excessive wetness.

6.0 CLOSURE

We trust that this information meets your requirements. Should you have any further questions, please contact our office at (403) 203-3355.

Respectfully submitted,

EBA Engineering Consultants Ltd.

[redacted]OPY

[redacted]

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Marla Publicover, M.Sc., A.Ag.
Soil Scientist

Kathryn Bessie, P. Ag.
Soil Scientist

MDP:KJB:ks

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TABLES

TABLE 1
SOIL LEGEND
E ½ 20-22-02 W5M

a) MAP UNIT:

DVG1 ⟶ Soil Unit Name
2 ⟶ Topography Class

SOIL UNIT NAME:

Soil Unit	Soil Series	Soil Classification		Parent Material	Topography Class
		Dominant[1]	Inclusions[2]		
ATL1	Antler	Orthic Black Chernozem	n/a	till	3
DVG1	Dunvargan	Orthic Black Chernozem	n/a	till	5, 3
LTC1	Leighton Center	Dark Gray Luvisol	Orthic Gray Luvisol	till	6
TWS1	Tweedsmuir	Orthic Black Chernozem	Humic Gleysols	recent fluvial	2, 3

b) TOPOGRAPHY CLASSES:

1	0 – 0.5 %	level
2	0.5 – 2.5 %	nearly level
3	2.5 – 5 %	very gentle slopes
4	6 – 9 %	gentle slopes
5	10 – 15 %	moderate slopes
6	16 – 30 %	strong slopes
7	31 – 45 %	very strong slopes
8	46 – 70 %	extreme slopes
9	71 – 100 %	steep slopes
10	> 100 %	very steep slopes

[1]Dominant – A map unit which contains at least 40% of an identified soil.

[2]Inclusion – Soils identified in less than 15% of a soil map unit.

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TABLE 2

SUMMARY OF SOIL INSPECTION SITES
E ½ 20-22-02 W5M

Site ID	Soil Unit Mapped as	Classification	Parent Material	Dominant Texture	Slope (%)	Slope Position	Topographic Classification	Drainage Classification	Surface Stoniness	Avg. Topsoil Depth (cm)
1	ATL1	O.BLC	T	CL	5	lower	3	W	S1	24
2	ATL1	R.BLC	T	CL	4	lower	3	MW	S1	20
3	ATL1	O.BLC	T	CL	3	lower level	3	MW	S1	28
4	ATL1	R.BLC	T	CL	3	lower	3	MW	S1	35
5	ATL1	R.BLC	T	CL	3	lower level	3	MW	S1	29
6	ATL1	O.BLC	T	CL	4	crest	3	W	S1	32
7	ATL1	R.BLC	GL	CL	4	mid slope	3	I	S1	36
8	DVG1	O.BLC	T	CL	5	lower	3	W	S1	28
9	TWS1	caR.BLC	rF	SiL	2	lower level	2	I	S1	95
10	ATL1	O.BLC	T	CL	5	mid slope	3	W	S1	30
11	DVG1	O.BLC	T	CL	7	mid slope	4	W	S1	55
12	DVG1	O.BLC	T	CL	9	mid slope	4	W	S1	18
13	DVG1	O.BLC	T	CL	11	mid slope	5	W	S1	20
14	DVG1	O.BLC	T	CL	12	crest	5	W	S1	36
15	DVG1	O.BLC	T	CL	9	mid slope	4	W	S1	24
16	DVG1	O.BLC	T	CL	11	mid slope	5	W	S1	19
17	DVG1	O.BLC	T	CL	12	mid slope	5	W	S1	26
18	DVG1	O.BLC	T	SiL	13	mid slope	5	W	S1	20
19	DVG1	O.BLC	T	SiCL	12	upper slope	5	W	S1	22
20	DVG1	O.BLC	T	CL	12	mid slope	5	W	S1	26
21	DVG1	O.BLC	T	CL	12	mid slope	5	W	S1	50
22	DVG1	O.BLC	T	CL	5	lower	3	MW	S1	33
23	TWS1	G. BLC	T	CL	4	depressional	3	I	S1	23
24	DVG1	O.BLC	T	SiL	12	crest	5	W	S1	21
25	DVG1	O.BLC	T	SiCL	10	mid slope	5	W	S1	38
26	DVG1	O.BLC	T	SiL	5	mid slope	3	W	S1	36
27	DVG1	O.BLC	T	SiCL	15	mid slope	5	W	S1	24
28	DVG1	O.BLC	T	SiCL	15	mid slope	5	W	S1	13
29	DVG1	O.BLC	T	SiCL	15	mid slope	5	W	S1	30
30	DVG1	O.BLC	T	SiCL	15	mid slope	5	W	S1	20
31	TWS1	R.BLC	rF	SiL	2	lower level	2	I	S1	55
32	DVG1	O.BLC	T	CL	10	mid slope	5	W	S1	19
33	LTC1	D.GL	T	SiL	15	mid slope	5	MW	S1	15
34	TWS1	O.BLC	T	SiCL	3	depressional	3	I	S1	40
35	DVG1	O.BLC	T	SiCL	15	mid	5	MW	S1	20
36	DVG1	O.BLC	T	SiCL	15	upper slope	5	MW	S1	10
37	DVG1	O.BLC	T	SiCL	15	crest	5	MW	S1	10
38	LTC1	D.GL	T	SiL	15	mid slope	5	MW	S1	17
39	LTC1	O.GL	T	CL	18	mid slope	6	MW	S1	10

Key to abbreviations:

<u>Classification</u>

O.BLC	Orthic Black Chernozem
R.BLC	Rego Black Chernozem
G.BLC	Gleyed Black Chernozem
ca R.BLC	calcareous Rego Black Chernozem
D.GL	Dark Gray Luvisol
O.GL	Orthic Gray Luvisol

<u>Drainage</u>

MW	Moderately Well
I	Imperfectly

<u>Soil Texture</u>

SL	Sandy Loam
CL	Clay Loam
SiL	Silty Loam
SiCL	Silty Clay Loam

<u>Topography Class</u>

1	0 – 0.5 %	Level
2	0.5 – 2.5 %	Nearly level
3	2 – 5 %	Very gentle slope
4	6 – 9 %	Gentle slope
5	10 – 15 %	Moderate slope

<u>Stoniness Class</u>

S1	Slightly stony

<u>Parent Material</u>

T	Till
GL	Glaciolacustrine
rF	recent Fluvial

TABLE 3

AGRICULTURE CAPABILITY RATINGS

E ½ 20-22-02 W5M

Map Unit	Topography Class	Hectares	Acres	% Area	Agricultural Land Capability Rating*
ATL 1	3	1660	4099	15.5	4H
DVG1	3	341	841	3.2	4H
	5	6002	14,819	56.1	4T
LTC 1	6	2011	4965	18.8	5T
TWS1	2	420	1038	3.9	6W
	3	259	639	2.4	6W

*Modifiers appear in order of influence.

Agricultural Capability Class

1 No significant limitations in use for crops

2 Moderate limitations restricting the range of crops

3 Moderate sever limitations restricting the range of crops or require special conservation practices

4 Severe limitations that restrict the range of crops or require special conservation practices

5 Very severe limitations that restrict the capability of soils to produce perennial forage crops, and improvement practices as feasible

6 Soils capable of producing perennial forage crops, and improvement practices are feasible

7 No capability for agriculture or permanent pasture

0 Organic soils

Agricultural Capability Subclass

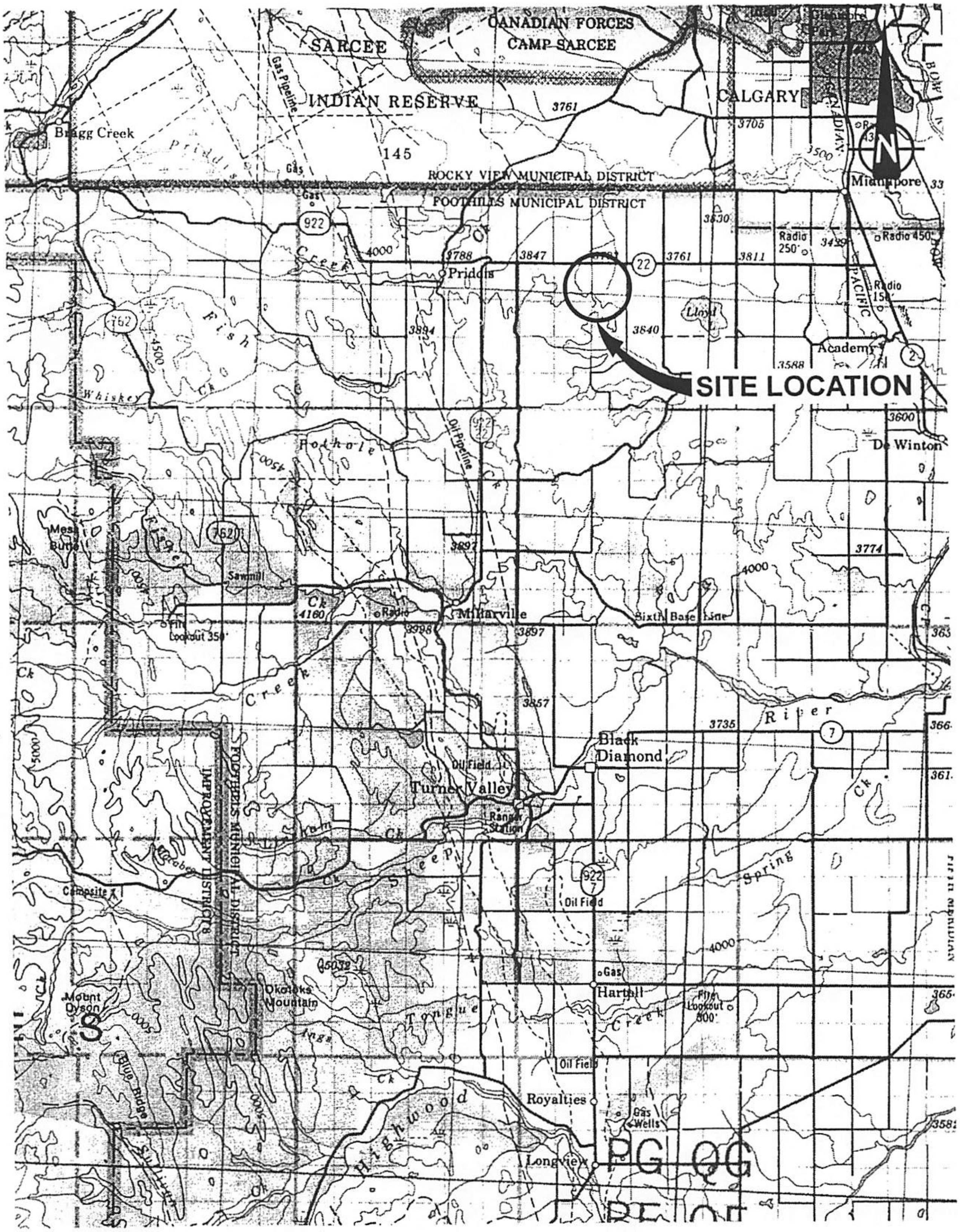
H Adverse energy conditions

M Texture limitations

T Slope limitations

W Drainage limitations

FIGURES



0 5 10 15km

SCALE 1:250,000

Figure 1

Site Location Plan
E1/2 20-22-02-W5M

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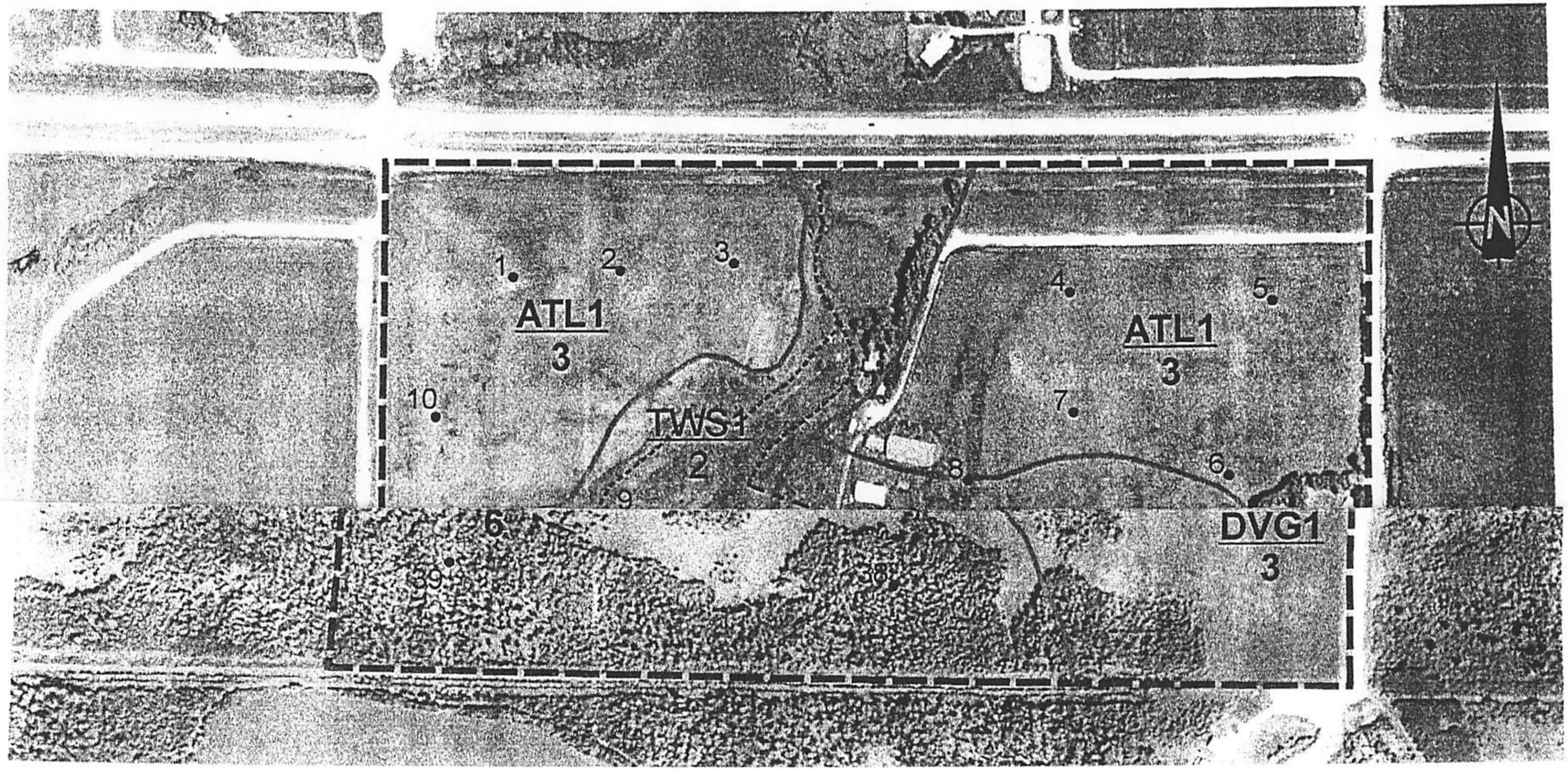

LEGEND

DVG1 ← SOIL UNIT

3 ← TOPOGRAPHY CLASS

SLOPE BREAK

CREEK

AREA SURVEYED

NOTE: ABBREVIATIONS ON TABLE 1 OF REPORT.

0 100 200 300

APPROXIMATE SCALE (m)

Figure 2

Soils Map

E1/2 20-22-02-W5M

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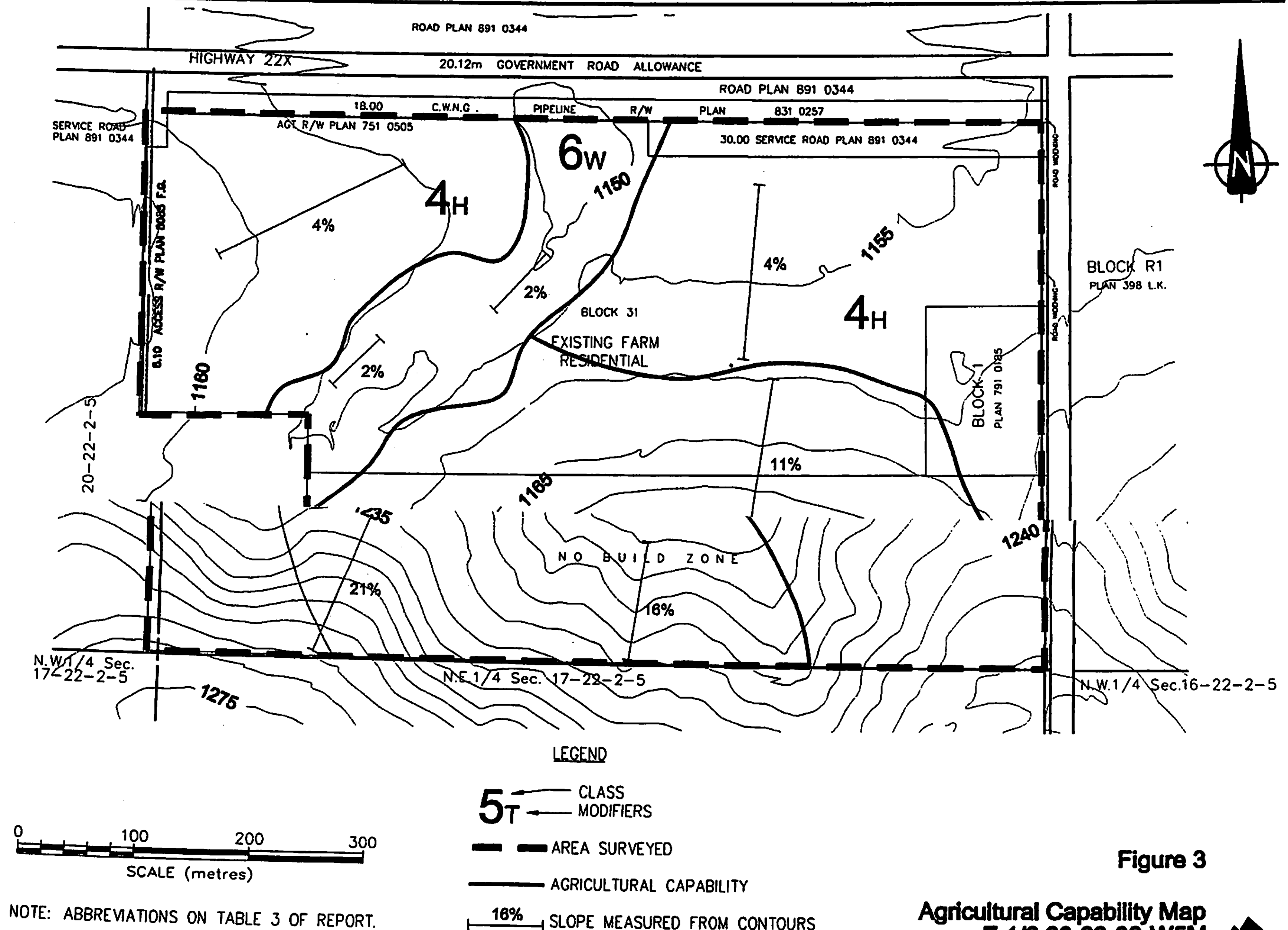

Figure 3

Agricultural Capability Map
E 1/2 20-22-02-W5M

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APPENDIX A

ENVIRONMENTAL REPORT – TERMS AND CONDITIONS

EBA Engineering Consultants Ltd. (EBA)
ENVIRONMENTAL REPORT - GENERAL CONDITIONS

This report incorporates and is subject to these "General Conditions".

A.1 USE OF REPORT

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 EBA's client. 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 EBA's client unless otherwise authorized in writing by EBA. Any unauthorized use of the report is at the sole risk of the user.

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This report is based solely on the conditions which existed on site at the time of EBA's investigation. The client, and any other parties using this report with the express written consent of the client and EBA, acknowledge that conditions affecting the environmental assessment of the site can vary with time and that the conclusions and recommendations set out in this report are time sensitive.

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The client acknowledges that EBA is neither qualified to, nor is it making, any recommendations with respect to the purchase, sale, investment or development of the property, the decisions on which are the sole responsibility of the client.

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During the performance of the work and the preparation of this report, EBA may have relied on information provided by persons other than the client. While EBA endeavors to verify the accuracy of such information when instructed to do so by the client, EBA accepts no responsibility for the accuracy or the reliability of such information which may affect the report.

A.3 LIMITATION OF LIABILITY

The client recognizes that property containing contaminants and hazardous wastes creates a high risk of claims brought by third parties arising out of the presence of those materials. In considerations of these risks, and in consideration of EBA providing the services requested, the client agrees that EBA's liability to the client, with respect to any issues relating to contaminants or other hazardous wastes located on the subject site shall be limited as follows:

(1) With respect to any claims brought against EBA by the client arising out of the provision or failure to provide services hereunder shall be limited to the amount of fees paid by the client to EBA under this Agreement, whether the action is based on breach of contract or tort;

(2) With respect to claims brought by third parties arising out of the presence of contaminants or hazardous wastes on the subject site, the client agrees to indemnify defend and hold harmless EBA from and against any and all claims, action or actions, demands, damages, penalties, fines, losses, costs and expenses of every nature and kind whatsoever, including solicitor-client costs, arising or alleged to arise either in whole or part out of services provided by EBA, whether the claim be brought against EBA for breach of contract or tort.

A.4 JOB SITE SAFETY

EBA is only responsible for the activities of its employees on the job site and is not responsible for the supervision of any other persons whatsoever. The presence of EBA personnel on site shall not be construed in any way to relieve the client or any other persons on site from their responsibility for job site safety.

A.5 DISCLOSURE OF INFORMATION BY CLIENT

The client agrees to fully cooperate with EBA with respect to the provision of all available information on the past, present, and proposed conditions on the site, including historical information respecting the use of the site. The client acknowledges that in order for EBA to properly provide the service, EBA is relying upon the full disclosure and accuracy of any such information.

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Services performed by EBA for this report have been conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions in the jurisdiction in which the services are provided. Engineering judgement has been applied in developing the conclusions and/or recommendations provided in this report. No warranty or guarantee, express or implied, is made concerning the test results, comments, recommendations, or any other portion of this report.

A.7 EMERGENCY PROCEDURES

The client undertakes to inform EBA of all hazardous conditions, or possible hazardous conditions which are known to it. The client recognized that the activities of EBA may uncover previously unknown hazardous materials or conditions and that such discovery may result in the necessity to undertake emergency procedures to protect EBA employees, other persons and the environment. These procedures may involve additional costs outside of any budgets previously agreed to. The client agrees to pay EBA for any expenses incurred as a result of such discoveries and to compensate EBA through payment of additional fees and expenses for time spent by EBA to deal with the consequences of such discoveries.

A.8 NOTIFICATIONS OF AUTHORITIES

The client acknowledges that 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 EBA in its reasonably exercised discretion.

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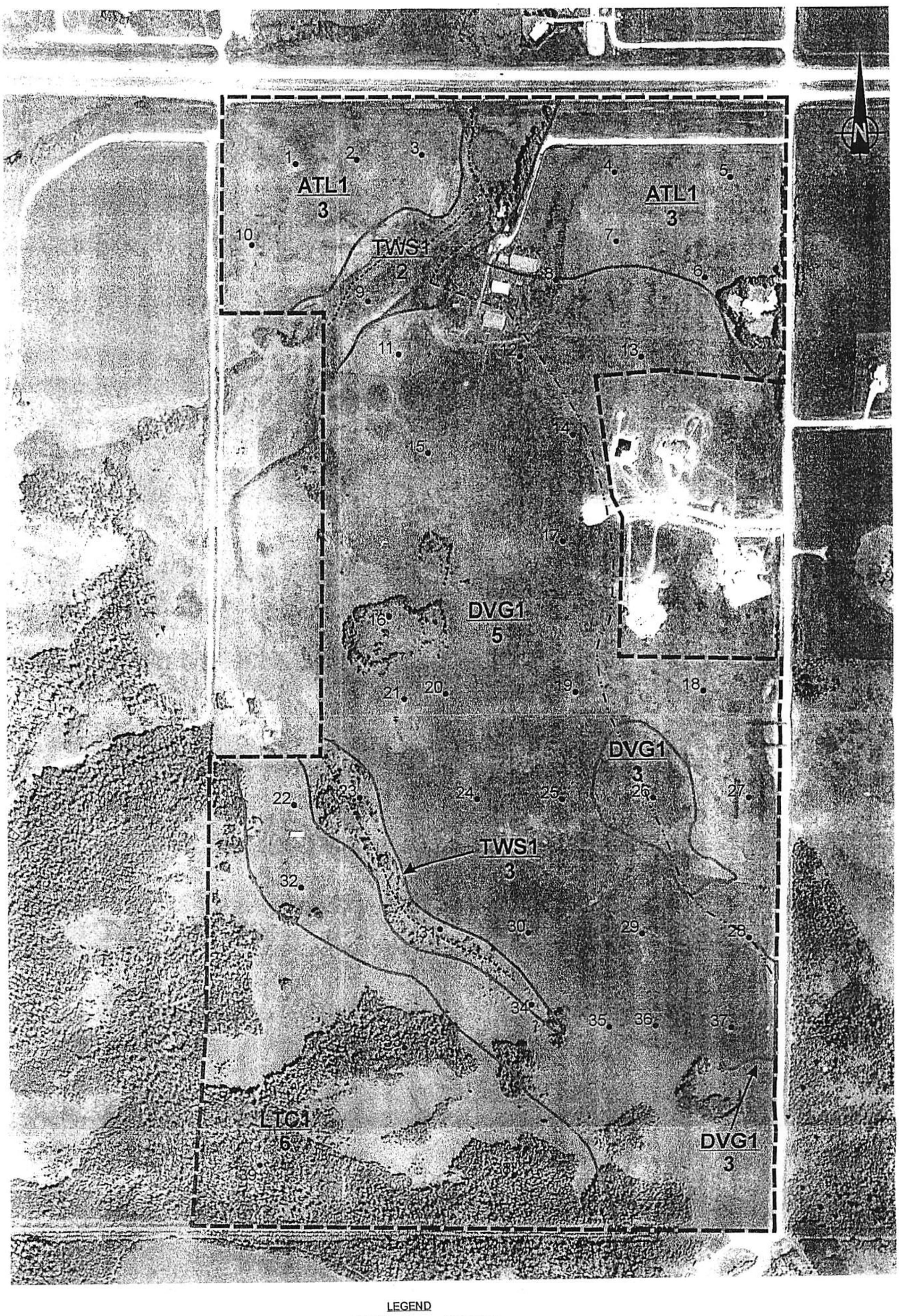

LEGEND

DVG1 ← SOIL UNIT

3 ← TOPOGRAPHY CLASS

SLOPE BREAK

CREEK

AREA SURVEYED

NOTE: ABBREVIATIONS ON TABLE 1 OF REPORT.

0 100 200 300

APPROXIMATE SCALE (m)

Figure 2

Soils Map

E1/2 20-22-02-W5M

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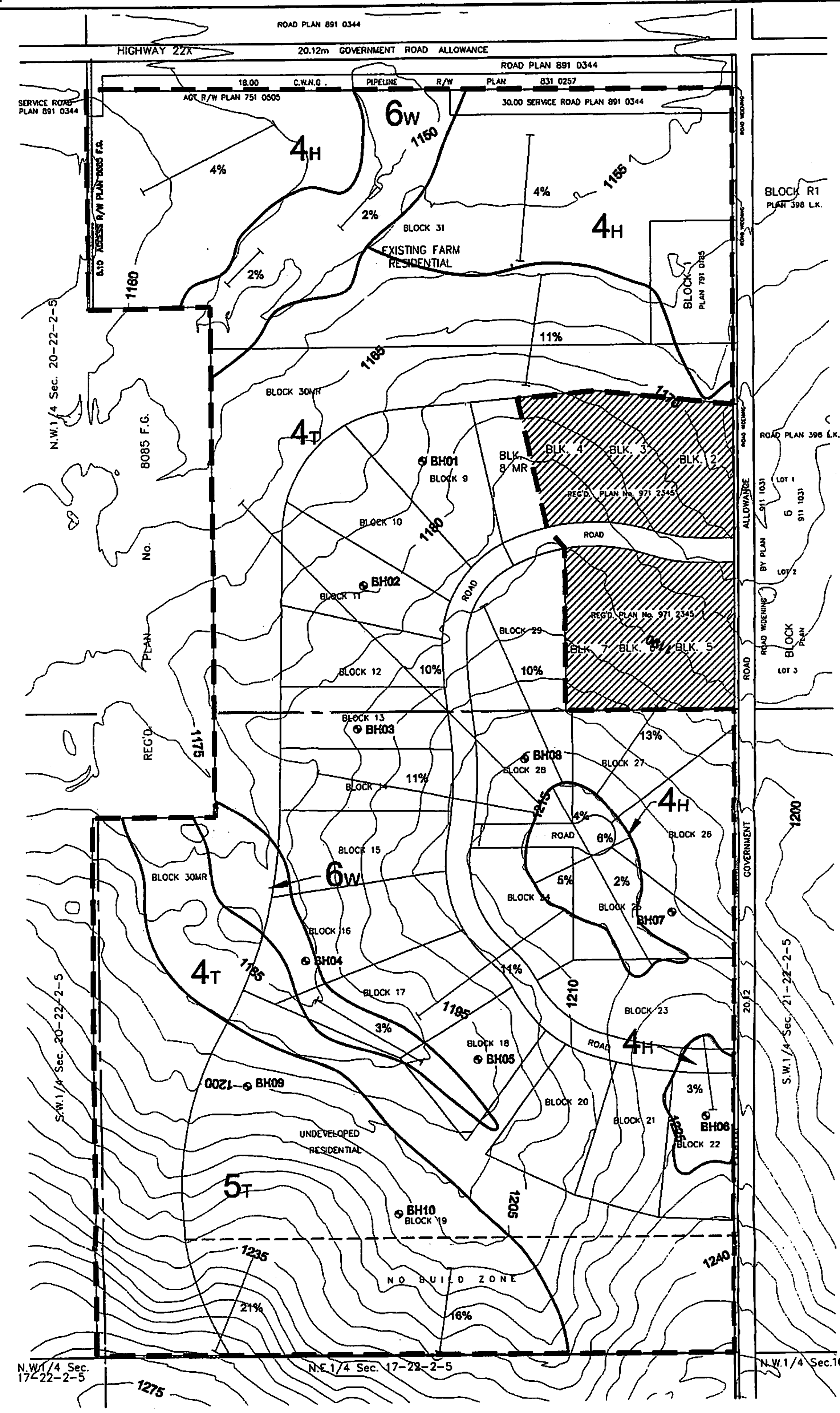

LEGEND

5T — CLASS, MODIFIERS

AREA SURVEYED

AGRICULTURAL CAPABILITY

16% SLOPE MEASURED FROM CONTOURS

0 100 200 300
SCALE (metres)

NOTE: ABBREVIATIONS ON TABLE 3 OF REPORT.

Figure 3

Agricultural Capability Map
E 1/2 20-22-02-W5M

31058S02C.dwg

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7

EBA Engineering Consultants Ltd.

GEOTECHNICAL EVALUATION
RED WILLOW ESTATES
E ½-20-2 W5M, ALBERTA

Project No. 0304-99-31058

COPY

SEPTEMBER 1999

6111 – 36 Street SE, Calgary, Alberta T2C 3W2 - Tel: (403) 236-9700 - Fax: (403) 236-7033
Internet: calgary@eba.ca - Web Site: http//www.eba.ca

EBA Engineering Consultants Ltd.

GEOTECHNICAL EVALUATION
RED WILLOW ESTATES
E ½-20-2 W5M, ALBERTA

COPY

Submitted to:

Bavarian Lion Company Ltd.
c/o Kellam Berg Engineering & Surveys Ltd.
Calgary, Alberta

Prepared by:

EBA Engineering Consultants Ltd.
Calgary, Alberta

Project No. 0304-99-31058

SEPTEMBER 1999

6111 – 36 Street SE, Calgary, Alberta T2C 3W2 - Tel: (403) 236-9700 - Fax: (403) 236-7033
Internet: calgary@eba.ca - Web Site: http//www.eba.ca

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1.0 INTRODUCTION

This report presents the results of a geotechnical evaluation conducted by EBA Engineering Consultants Ltd. (EBA) for the proposed Red Willow Estates subdivision development located southwest of Calgary, Alberta. This evaluation was undertaken at the request of Mr. Ron Kellam of Kellam Berg Engineering & Surveys Ltd. (Kellam Berg) and with the authorization of the Bavarian Lion Company Ltd.

The objective of this evaluation was to address the Geotechnical Report requirements of the Municipal District of Foothills No. 31. The scope of work included:

- Present a general geotechnical assessment of the site,
- Assess the stability of slopes on the subject and adjacent lands which exceed 10% grade; and,
- Evaluate whether past instability, subsidence, erosion, seepage or previous land uses are in evidence.
- Conduct percolation testing and near surface water table testing.
- Conduct soil sampling and laboratory testing sufficient to determine soil classifications.

A geotechnical assessment of the site was prepared by G Tech Environmental Inc. in 1995. Where possible, information from the previous geotechnical assessment has been used to supplement the information provided herein.

EBA has also completed a groundwater evaluation and soil survey for the site. These are reported under separate cover.

2.0 PROJECT DETAILS

2.1 Site Description

The proposed Red Willow Estates subdivision is located within the east half of Section 20, Township 22, Range 2 West of the 5th Meridian. It is bounded to the immediate north by Alberta Highway 22X, to the east by City of Calgary 160 Street SW, to the west by agricultural pasture land, and to the south by the Ann and Sandy Cross Conservation Area. Figure 1 is presented as a Site Location Plan.

The project is understood to comprise the design and construction of 20 country residential lots, in addition to six lots currently developed onsite. The proposed new subdivision area is currently undeveloped. The majority of the site is vegetated with grasses, with deciduous and some evergreen trees chiefly at the south end of the site, and in a seasonal drainage course along the west boundary of the site. The site is currently utilized as pasture. Site topography is rolling, with main landforms which trend northwest - southeast. A site plan showing the proposed development outline is presented as Figure 2, and a topographic plan is presented as Figure 3.

Topographic features of particular note to this evaluation include the slopes along the south side of the site, which have grades of up to 36% (2.8H:1V), and a large hill which dominates the east-central portion of the site, and has surface grades of up to 20% (5H:1V).

3.0 FIELD AND LABORATORY WORK

Field investigations were carried out between August 20 and September 4, 1999. A truck mounted solid stem auger drill rig contracted from Beck Drilling and Environmental Services Ltd. of Calgary, Alberta was used for all drilling. The two principal components of the field investigation included drilling to support a general geotechnical assessment of the site, and installation and testing of percolation testholes, and shallow groundwater monitoring standpipes.

3.1 General Geotechnical Investigation

A total of ten boreholes were advanced to a depth of 6 m or bedrock to provide information necessary for the slope stability assessment of the site, as well as general geotechnical parameters for the design and construction of the proposed development. The locations of geotechnical boreholes are indicated on Figure 3. Borehole logs are presented in Appendix B.

Disturbed bulk soil samples were recovered at regular intervals from the solid stem augers. Standard Penetration Tests (SPTs) were conducted in selected boreholes to assess soil strength. Slotted 25 mm PVC standpipes were installed in all boreholes to allow future monitoring of groundwater levels.

Classification and index tests were subsequently performed in the laboratory on samples collected from the boreholes to aid in selection of engineering properties. Laboratory tests included the following:

- Natural moisture content
- Atterberg Limits
- Soluble Sulphate Concentration

Laboratory test results are presented on the borehole logs in Appendix B.

3.2 Percolation and Near Surface Groundwater Testing

Twenty-seven testholes were drilled to a depth of 3 m or auger refusal, both to evaluate site conditions for near surface groundwater and/or bedrock which might affect the construction of conventional septic fields, and to supplement the geotechnical information provided by the deep boreholes. Slotted PVC standpipes were installed in all shallow groundwater testholes, with the exception of some additional holes which were drilled in the east-central portion of the site to provide a more detailed assessment of depth to bedrock.

A total of 40 percolation testholes were also completed onsite (two per lot). All percolation testholes were 0.20 m in diameter, and were drilled to a depth of 0.9 m.

The locations of percolation tests and shallow groundwater/shallow bedrock testholes are indicated on Figure 2. Soil descriptions for the shallow groundwater/shallow bedrock testholes are presented in Appendix C.

Percolation testing was conducted between September 1 and September 4, 1999. Testing was conducted in accordance with the following documents:

- "Interim Guidelines for the Evaluation of Water Table Conditions and Soil Percolation Rate for Unserviced Residential Subdivisions", Alberta Environmental Protection Land Use Branch File 3000-G1-S1. 1994. (AEP Guidelines).
- "Alberta Private Sewage Systems Standard of Practice", Safety Codes Council. 1999. (Standard of Practice).

Prior to conducting the percolation testing, percolation holes were pre-soaked for a minimum of 15 hours, and then maintained at a water level of 45 cm below ground for four hours before starting the test. The results of the percolation testing are discussed in Section 7.0.

4.0 GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Regional Geology

According to Alberta Research Council Bulletin No. 53 "Surficial Geology of the Calgary Urban Area" by S. R. Moran (1986), soils at the site consist of glacial till of the Spy Hill Drift overlying nonmarine bedrock of the Cretaceous Porcupine Hills Formation. Moran interpreted the overall thicknesses of the till to be generally less than 2 m in the south half of the site, and 2 m to 4 m in the north half of the site. Soils encountered by EBA are described below.

4.2 Subsurface Conditions

4.2.1 Soil

Surface soils (topsoil) ranging from approximately 90 mm to 510 mm thick were encountered across the site. The agricultural potential of these has been assessed by EBA and is reported under separate cover.

The subsurface soils encountered during EBA's field investigations are in general agreement with the reported regional geology discussed above. The soils typically consist of low to medium plastic clay till with trace to some sand and gravel, and some silt. Weathered sandstone, siltstone and shale bedrock underlie the till.

Depth to bedrock was variable, ranging from less than 0.1 m to greater than 6.1 m below ground. In general, bedrock elevation reflects topography, and is highest beneath the hill in the east-central area of the site, dropping towards the north and west, as well as in the low lying area which separates the central hill from the steep slopes along the south boundary of the site.

4.2.2 Groundwater

At the time of drilling, seepage was not encountered in any of the 37 boreholes/testholes. Each of the 22 standpipes installed onsite was dry on completion. Approximately 11 days after completion of drilling, groundwater was measured in BH04 and BH09, at depths of 1.32 m and 4.52 m below ground, respectively. The remaining 20 standpipes were dry 11 days after completion of drilling.

5.0 SITE RECONNAISSANCE

A site reconnaissance was carried out on August 20, 1999 by EBA's representative, Mr. Robin Zabek, P.Eng., to observe and record evident rock outcrops, current drainage conditions, and slope stability issues.

Most of the site is covered in grasses ranging in height from a few centimetres to over 1 m. Deciduous and evergreen trees vegetate the southernmost portion of the property, chiefly in the designated "No Build Zone" and in Block 19 shown on Figure 3, as well as in a natural drainage course which lies along the west side of the property. Treed areas and the drainage course, which was dry at the time of the site work are evident on a 1998 aerial photograph of the site that is presented as Figure 4.

Slopes onsite vary from approximately 2.8H:1V (33%) to less than 6.7H:1V (15%). The steepest slopes lie within the No-Build Zone and in Block 19 along the south boundary of the site. Slopes in this area have a maximum height of about 60 m. While the gradient of the slopes in this area varies, the maximum gradient identified by topographic mapping is about 2.8H:1V.

The maximum slopes noted in the proposed development area lie within Blocks 20, 21 and 22. These have typical gradients of about 5H:1V (20%), and a maximum elevation change of 16 m across a single block.

In general, the slopes appear stable. No evidence of slope movement, failures, or significant erosion was observed during the site reconnaissance. The slopes are generally free of erosion scars.

Five of the six existing residential lots, are developed with single family residences; the sixth is currently undeveloped. Each house is understood to have a water supply well and a septic disposal field.

6.0 GEOTECHNICAL ASSESSMENT

6.1 General

In general, the soil and groundwater conditions encountered onsite are considered favourable with respect to the proposed residential development. However, the presence of shallow bedrock beneath several central lots in the development will require some special considerations in the construction of septic disposal fields. This is discussed in greater detail in subsequent sections. Groundwater levels and surface drainage conditions are not expected to be a severe concern for the development; however, some common control measures may be required.

6.2 Slope Stability Assessment

The Municipal District of Foothills No. 31 requires assessment of the stability of slopes which exceed 15%. EBA's assessment has included a review of historical airphotos, site reconnaissance, geotechnical subsurface sampling and testing, and stability analyses using Slope/w computer methods that are accepted as industry standards throughout southern Alberta.

EBA interprets that the slopes onsite are naturally stable. No signs of historical or active slope instability have been observed onsite.

Three cross sections were prepared to evaluate the stability of the slopes and determine any requirements for development setbacks. These sections, identified below, are considered representative of the steepest slopes which are present within or adjacent to the development area. The cross section locations are shown on Figure 3.

- Section A-A': South End of Property – 2.8H:1V
- Section B-B': Blocks 20, 21, 22 – 5H:1V
- Section C-C': Blocks 24 and 16 – 5.2H:1V maximum. Thickest till section identified onsite by drilling.

Soil and groundwater parameters assumed for the analyses were inferred from the subsurface soil and groundwater investigation, and are based on classification, plasticity, grain size, and EBA's experience in Calgary and the surrounding area. The soil parameters used are as follows:

	Soil Effective Stress Shear Strength Parameters		
Soil Type	**Unit Weight (km/m^3)**	**Cohesion, C (kPa)**	**Friction Angle ϕ (degrees)**
Clay Till	19	5	25
Bedrock	20	20	40

The slope stability analyses considered both the existing groundwater conditions as well as assumed post development conditions. Residential development of the proposed type often increases soil moisture and groundwater levels through irrigation, and infiltration from septic fields. The increased soil moisture and groundwater levels can reduce the stability of slopes. For Cross Sections A-A' and B-B', the post development groundwater condition was conservatively assumed to be the greater of 2 m below ground surface, or 2 m above bedrock surface. A post development groundwater table as shallow as 1 m below ground surface was assumed for Cross Section C-C', to account for shallow water table conditions encountered near the toe of the slope in this area.

Cross section A-A' was also analysed using a thickened till layer (2 m thicker than interpreted conditions) overlying bedrock, in order to account for some variability in thickness of the till unit. These are the conditions discussed below for Cross Section A-A', and depicted on Figure 5.

The slope stability analyses were conducted using the computer program "Slope/W" (Version 4.2) and the simplified Bishops and Morgenstern-Price methods for circular failures.

6.3 Slope Stability Analysis Results

Stability analyses completed for the above-noted cross sections indicate minimum existing and post-development factors of safety in excess of 1.5. Consequently, no development setbacks from the crests or toes of natural slopes will be required. The cross sections and results of the stability analyses are presented on Figure 5.

If any significant grading of the site is proposed, a post development slope stability assessment should be conducted. The post development assessment will include confirmation of development setbacks, as well as analyses of cut and fill slopes if required. General recommendations for cut and fill slopes are provided in Section 6.6.

6.4 Groundwater Assessment

Groundwater was only encountered by one of the boreholes (BH04) drilled within the proposed development area, and one borehole (BH09) in Block 19 at the south end of the site. The results of the field investigation indicate that groundwater may be locally perched on top of bedrock. It is EBA's experience that in areas where bedrock is known or suspected (from terrain) to be within 3.75 m of final grade, the use of groundwater control measures may be required. Shallow bedrock was encountered over much of the site, particularly in the east-central portion of the site.

It is recommended that groundwater control measures consisting of a perimeter subdrain system installed at footing level be provided around basements for all of the proposed residences.

6.5 Surface Water Assessment

Surface water streams and other water sources (springs and seepage zones) are directly related to the existing groundwater levels and will be impacted by future development. At the time of the site reconnaissance, no flowing surface water was noted onsite. However, a seasonal drainage course lies along the west side of the site, (see Figure 4). As development plans are currently understood, this drainage course will be maintained.

During EBA's site reconnaissance, no evidence of surface seepage was observed. However, should areas of surface seepage be identified during site development, it may be necessary to install seepage control measures such as service collector drains, french drains, finger drains, or other facilities to control the water.

Although no evidence of significant erosion was noted onsite, site grading and landscaping should be designed to prevent erosion of slopes by concentrated surface runoff. Alternatively, surface drainage features such as swales could be constructed along the slopes to collect and control surface water. Areas of the slopes which are disturbed during construction should be revegetated as quickly as possible to reduce the potential for erosion.

6.6 Cut and Fill Slopes

Based on the results of the stability analyses and on EBA's experience, slopes no steeper than 3H:1V are considered suitable for permanent cuts in the native clay till onsite. Fill slopes utilizing the native soils onsite should also be designed at no steeper than 3H:1V.

If the measured or anticipated groundwater level is expected to intersect the slope face, or where cut or fill slopes will be greater than 6 m in height, the above recommendations should be re-evaluated on a site by site basis.

7.0 ASSESSMENT OF SEPTIC FIELD POTENTIAL

7.1 Groundwater Table Measurements

On September 4, 1999, each of the standpipes installed onsite were checked for groundwater. At that time, static water levels of 4.52 m and 1.32 m below ground were measured in BH09 and BH04, respectively. The remaining standpipes were dry.

With the exception of BH04, located in the rear half of Block 16, all standpipes indicate depth to groundwater table conditions which meet AEP Guidelines and Standard of Practice requirements for sewage disposal.

7.2 Percolation Test Results

The acceptable range of percolation rates for sewage disposal, as specified by the 1999 Standard of Practice varies from 2.0 min/cm to 24 min/cm (five minutes per 25 mm to sixty minutes per 25 mm). A review of the percolation test results indicates that soils, or in some cases weathered upper bedrock within the lots tested generally have percolation rates ranging from 2.0 min/cm to 21.5 min/cm, with the following exceptions:

- Percolation Test 36, in Block 27, had a percolation rate of 30.7 min/cm, indicating a soil percolation rate which is too low for a conventional septic field.
- Percolation Test 13, in Block 15, had a percolation rate of 0.4 min/cm, indicating a soil percolation rate which is too rapid for a conventional septic field.
- Testing could not be completed at Percolation Test locations 4 and 35 (Blocks 10 and 27). Percolation testholes in these locations intersected subsurface fractures or animal burrows, resulting in excessively high drainage rates.

The test results indicate that a majority of the soils have percolation rates that are considered suitable for sewage treatment, according to the 1999 Standard of Practice. At least one test exhibiting a suitable percolation rate was completed in each of the proposed Blocks, with the exception of Block 27. Additional percolation testing may be required in Block 27 to identify a suitable location for septic disposal, or, an alternative method of sewage treatment may be required for this block.

It should be noted that despite favourable soil percolation rates, the presence of shallow bedrock will restrict the use of conventional septic fields in some blocks. This is discussed in detail in the following section.

Percolation test results and shallow groundwater monitoring results are summarized below.

Block	Percolation Test	Percolation Rate (min/cm)	Associated Water Table Testhole	Water Level (m below ground) September 4/99
9	PT01	3.3	TH01	Dry
	PT02	15.3	TH01	Dry

Block	Percolation Test	Percolation Rate (min/cm)	Associated Water Table Testhole	Water Level (m below ground) September 4/99
10	PT03	4.1	TH02	Dry
	PT04	NT	TH02	Dry
11	PT05	7.9	TH3A	Dry
	PT06	9.1	TH03	Dry
12	PT07	6.5	TH04	Dry
	PT08	2.5	TH4A	Dry
13	PT09	2.6	TH05	Dry
	PT10	9.4	TH05	Dry
14	PT11	7.1	TH06	Dry
	PT12	6.4	TH06	Dry
15	PT13	0.4*	TH07	Dry
	PT14	5.7	TH07	Dry
16	PT15	8.6	TH08	1.32
	PT16	6.7	TH8A	Dry
17	PT17	4.1	TH09	Dry
	PT18	4.3	TH09	Dry
18	PT19	4.5	TH10	Dry
	PT20	8.9	TH10	Dry
20	PT21	7.4	TH11	Dry
	PT22	4.8	TH11	Dry
21	PT23	12.7	TH12A/12B	Dry
	PT24	4.9	TH12/12C	Dry
22	PT25	8.9	TH13A	Dry
	PT26	4.7	TH13	Dry
23	PT27	21.5	TH14A	Dry
	PT28	7.8	TH14	Dry
24	PT29	9.9	TH15/15B	Dry
	PT30	4.4	TH15A	Dry
25	PT31	15.9	TH16/16A	Dry
	PT32	5.9	TH16B	Dry
26	PT33	8.1	TH17A	Dry
	PT34	4.6	TH17/17B	Dry
27	PT35	NT	TH18	Dry
	PT36	30.9*	TH18	Dry
28	PT37	6.8	TH19A	Dry
	PT38	6.7	TH19	Dry

Block	Percolation Test	Percolation Rate (min/cm)	Associated Water Table Testhole	Water Level (m below ground) September 4/99
29	PT39	4.7	TH20	Dry
	PT40	2.0	TH20	Dry

*Indicate test results which do not meet 1999 Standard of Practice.
NT – Not Tested. Excessively fast drainage due to fractures or burrows.

At the time of this submission, water supply wells had not been drilled on the subject Blocks. When water wells are installed, the driller should submit water samples to an appropriate laboratory to be tested for Sodium Adsorption Ratio (SAR). According to the AEP Guidelines and the 1999 Standard of Practice, if the SAR of the household water supply is greater than 8, additional analyses, and/or remedial measures may be required.

7.3 Depth to Bedrock

As discussed above, the use of conventional septic fields on this site will be restricted in some blocks by the occurrence of shallow bedrock. The Standard of Practice requires a minimum vertical separation between the bottom of a septic disposal trench and bedrock of 1.5 m. Septic disposal trenches are required to be a minimum of 0.6 m deep, indicating that bedrock must be at least 2.1 m below ground surface for sewage treatment by a conventional septic field.

Of the 20 residential blocks in the proposed development, bedrock was encountered at a depth of less than 2.1 m in 9 blocks. Areas with sufficiently deep bedrock for sewage disposal were subsequently identified by additional drilling in two of the blocks (Block 11 and Block 12). Additional drilling carried out in the remaining seven blocks (Blocks 21 to 26, 28) did not identify any areas in which bedrock was sufficiently deep for the use of conventional septic fields.

Alternative methods of sewage treatment will be required for areas in which bedrock is too shallow for conventional septic fields. It is understood that Sylvester Enterprises Ltd. of Sherwood Park, Alberta has been retained to provide recommendations regarding the design of suitable sewage treatment facilities for these areas.

Depth to bedrock is indicated on the testhole soil logs presented in Appendix C.

7.4 Overall Site Suitability for Sewage Disposal

The following table summarizes the factors influencing the use of septic disposal fields for each block in the proposed development, and provides an overall ranking of suitability for conventional septic disposal in each block.

Block	Soil Percolation Rate	Depth to Groundwater	Depth to Bedrock	Suitability for Conventional Septic Field
9	Suitable	Suitable	Suitable	Suitable
10	Suitable	Suitable	Suitable	Suitable
11	Suitable	Suitable	Suitable(3)	Suitable
12	Suitable	Suitable	Suitable(3)	Suitable
13	Suitable(1)	Suitable	Suitable	Suitable
14	Suitable	Suitable	Suitable	Suitable
15	Suitable	Suitable	Suitable	Suitable
16	Suitable	Suitable(2)	Suitable	Suitable
17	Suitable	Suitable	Suitable	Suitable
18	Suitable	Suitable	Suitable	Suitable
20	Suitable	Suitable	Suitable	Suitable
21	Suitable	Suitable	Not Suitable	Not Suitable(4)
22	Suitable	Suitable	Not Suitable	Not Suitable(4)
23	Suitable	Suitable	Not Suitable	Not Suitable(4)
24	Suitable	Suitable	Not Suitable	Not Suitable(4)
25	Suitable	Suitable	Not Suitable	Not Suitable(4)
26	Suitable	Suitable	Not Suitable	Not Suitable(4)
27	Not Suitable	Suitable	Suitable	Not Suitable(5)
28	Suitable	Suitable	Not Suitable	Not Suitable(4)
29	Suitable	Suitable	Not Suitable	Not Suitable(4)

(1) Suitable percolation rate identified in west half of block.
(2) Suitable water table conditions identified in east half of block.
(3) Suitable depth to bedrock identified in west halves of blocks.
(4) Alternative sewage treatment method to be designed.
(5) Additional percolation testing or alternative sewage treatment method required.

8.0 CONSTRUCTION RECOMMENDATIONS

8.1 Site Preparation and Construction Excavations

Prior to construction, all organic topsoil and vegetation should be removed from areas within proposed building envelopes, parking lots, and roadways.

The composition and consistencies of the soils and upper bedrock encountered onsite are such that conventional hydraulic excavators should be able to remove these materials. Should deep excavations in bedrock be required, some excavation difficulties could be encountered. However, it should be noted that auger drill holes were extended up to 2.6 m below the rock surface in some cases. That suggests conventional excavators will be able to remove the bedrock in most areas without excessive effort.

Groundwater was only encountered by one of the boreholes drilled within the proposed development area. However, it is expected that groundwater may seasonally be perched on the shallow bedrock which was encountered in many areas of the site. Seepage may be encountered in construction excavations in these areas. When planning earthworks, appropriate temporary dewatering facilities should be considered for areas with potential high groundwater levels or shallow bedrock.

8.2 Backfill Materials and Compaction

Backfill to bring the site to subgrade level should be "general engineered fill" as defined in Appendix C, compacted to meet M.D. of Foothills No. 31 specifications. Fill to replace over-excavated load bearing soils, or to support structures with footing loads in excess of 100 kPa should be "structural fill" as defined in Appendix C, compacted to a minimum of 98% Standard Proctor Maximum Dry Density (SPMDD).

The existing site soils comprising inorganic clay till are suitable for use as "general engineered fill" as defined in Appendix D. However, it should be noted that existing soils onsite have some potential for frost heave if exposed to water, and should not be used in areas where they may become frozen and where frost heaving would be unacceptable. In addition, the consolidation characteristics of fill with thickness greater than 2 m may require special considerations. Although significant fills are not anticipated on this site, this should be confirmed when final grades are established.

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

8.3 Building Foundations

Conventional spread and/or strip footings are considered suitable to support the proposed single family residences onsite. The allowable static bearing pressure for the design of footings may be taken as 100 kPa on native undisturbed clay till, or on general engineered fill, subject to the other recommendations in this report. The allowable static bearing pressure for the design of footings placed on structural fill may be taken as 150 kPa, and on weathered bedrock as 300 kPa, subject to the other recommendations in this report. Footings must not rest in any organic material or in fill that was not placed in accordance with the recommendations for engineered fill presented in Appendix D. Minimum footing dimensions are provided by the Alberta Building Code.

The bottoms of footing excavations must be thoroughly cleaned of loosened or softened soil prior to placing concrete. Loose or soft soil removed should be replaced with lean concrete or compacted gravel meeting the requirements for structural fill given in Appendix D.

Footing excavations must be protected at all times from freezing temperatures and the ingress of free water. Bearing surfaces will deteriorate rapidly if exposed to water. Foundation excavations should be protected with a mud slab if foundations are not constructed immediately after approval of the bearing surface.

8.4 Concrete Type

Four tests were conducted to determine the water soluble sulphate content of soil samples recovered from this site. All tests indicated sulphate concentrations of 0.01%. The potential for sulphate attack on concrete is therefore considered to be "negligible." This information is supplemented by six tests conducted by G Tech Environmental Inc. in their 1995 assessment of the site, the results of which also indicated negligible potential for sulphate attack.

Accordingly, the use of Type 10 Portland Cement is considered suitable for this site. A maximum water/cementing materials ratio by mass of 0.55 is recommended. Air entrainment of 4% to 7% (for 20 mm maximum aggregate size) and a minimum specified 28-day compressive strength of 25 MPa is recommended for all concrete exposed to freezing temperatures, native soils and/or groundwater. Stricter recommendations may be required due to structural or other considerations.

For further information regarding concrete in contact with sulphates, please refer to Clause 15.5 of the Canadian Standards Association CAN/CSA-23.1-M94 (Table 90).

Should any imported fill be placed in contact with concrete, that fill should be tested for water soluble sulphate content and the above recommendations re-evaluated.

8.5 Frost Protection

For protection against frost action, perimeter footings in heated structures should be extended to such depth as to provide a minimum soil cover of 1.4 m. Isolated or exterior footings in unheated structures should have a minimum soil cover of 2.1 m, unless provided with equivalent insulation. Interior footings within a heated structure should be provided with at least 0.6 m of soil cover.

Grade beams should be provided with the same soil cover as for footings. Grade beams that do not have adequate soil cover for frost protection should have a minimum of 100 mm void space on the underside of the grade beam to reduce the risk of interaction with the underlying soil.

Pipes buried with less than 2 m of soil cover should be protected with insulation to avoid damage or breakage as a result of frost action.

8.6 Site Grading and Drainage

It is recommended that final site grading be provided to direct water to areas remote from proposed structures. Minimum landscape gradients of 1.5% are recommended to reduce the risk of runoff ponding in localized areas. Parking areas or landscaping within a zone of approximately 2 m of the exterior perimeter of any structures should be graded to drain away from the structures at a minimum gradient of 2%. Downspouts should be directed away from buildings.

As discussed above under the subheading "Surface Water Assessment", efforts should be made to control surface runoff and direct it away from permanent slopes. Failure to control surface water may result in extensive erosion and/or failure of slopes.

9.0 DESIGN AND CONSTRUCTION GUIDELINES

Recommended general design and construction guidelines are provided in Appendix D, under the following headings.

- Backfill Materials and Compaction
- Construction Excavations
- Shallow Foundations

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 D, the main text should govern.

10.0 CONCLUSION

EBA's geotechnical assessment of the site concludes that in general it is suitable for development from a geotechnical perspective. The results of the slope stability analyses indicate that natural slopes on and adjacent to the site have a factor of safety in excess of 1.5 under existing, and assumed conservative post-development conditions. No development setbacks from either the crests or toes of slopes are considered necessary. The existing groundwater levels and surface drainage conditions are not expected to be a severe concern for the development; however, some design measures including subdrainage (weeping tile) systems may be required.

If significant grading of the site is planned, a post development slope stability assessment should be carried out once the site grades and lot layouts have been established. EBA should also be given the opportunity to review details of the design and specifications of the proposed construction related to geotechnical aspects of this project.

11.0 LIMITATIONS

This geotechnical evaluation is based upon the findings from a total of 37 boreholes and on published regional geological data. The conditions encountered during the fieldwork are considered to be reasonably representative of the site. If, however, conditions other than those reported are noted during subsequent phases of the project, EBA should be notified and given the opportunity to review our current recommendations in light of new findings.

This report has been prepared for the exclusive use of Kellam Berg and their client, Bavarian Lion Company Ltd, for specific application to the development described in this report. It has been prepared in accordance with generally accepted soil and foundation engineering practices. No warranty is either expressed or implied. For further limitations, refer to the General Conditions in Appendix A of this report.

12.0 CLOSURE

We trust this information meets your present requirements. Should you have any questions, please contact our office.

Respectfully submitted,

EBA Engineering Consultants Ltd.

[redacted]

[redacted]

99-9-22

COPY

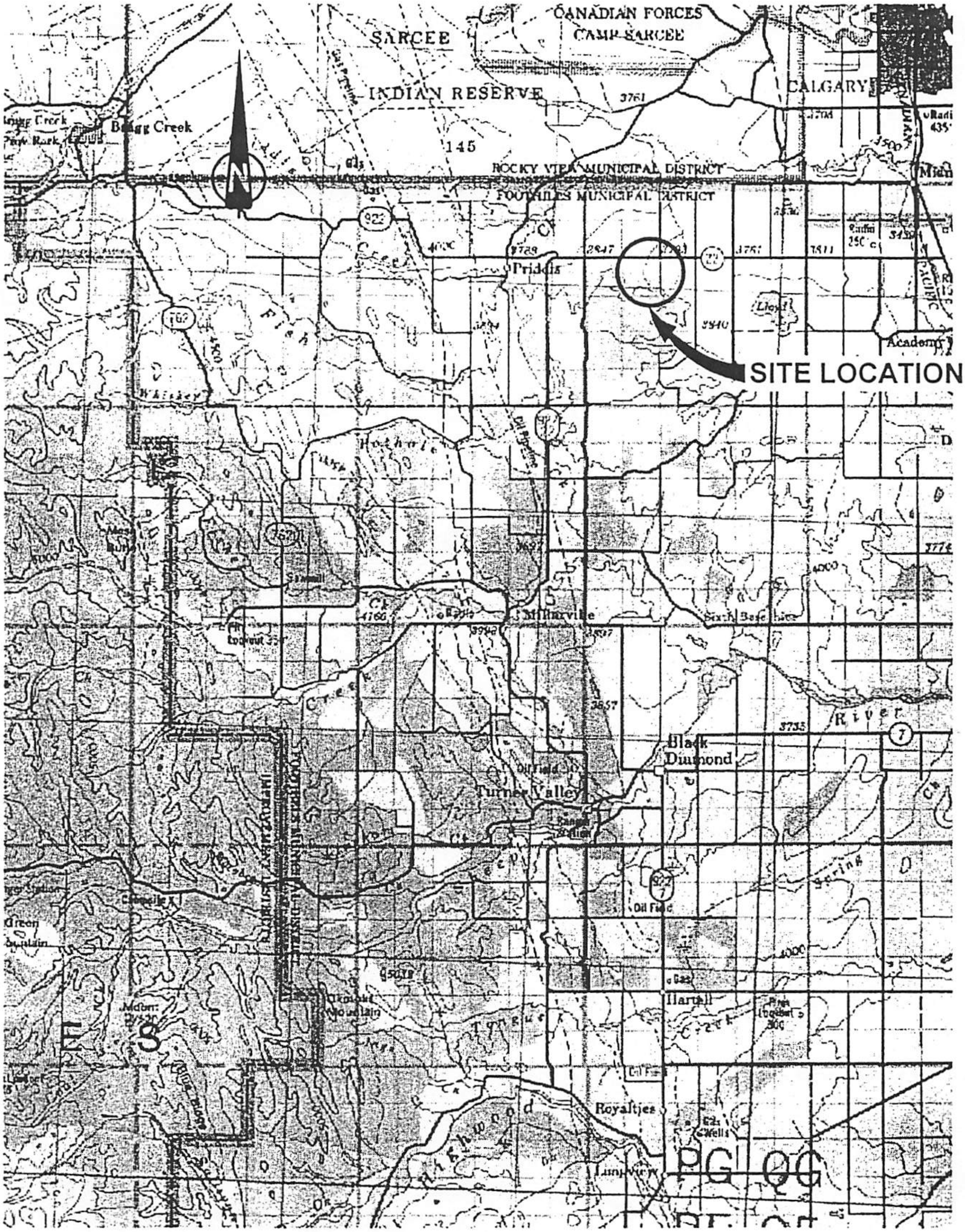
Robin S. Zabek, P.Eng.
Project Engineer

Neil R. MacLeod, P.Eng.
Senior Project Engineer

RSZ:NRM:mvf

PERMIT TO PRACTICE
EBA ENGINEERING CONSULTANTS LTD.
Signature [redacted]
Date 22-9-99
PERMIT NUMBER: P245
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

FIGURES



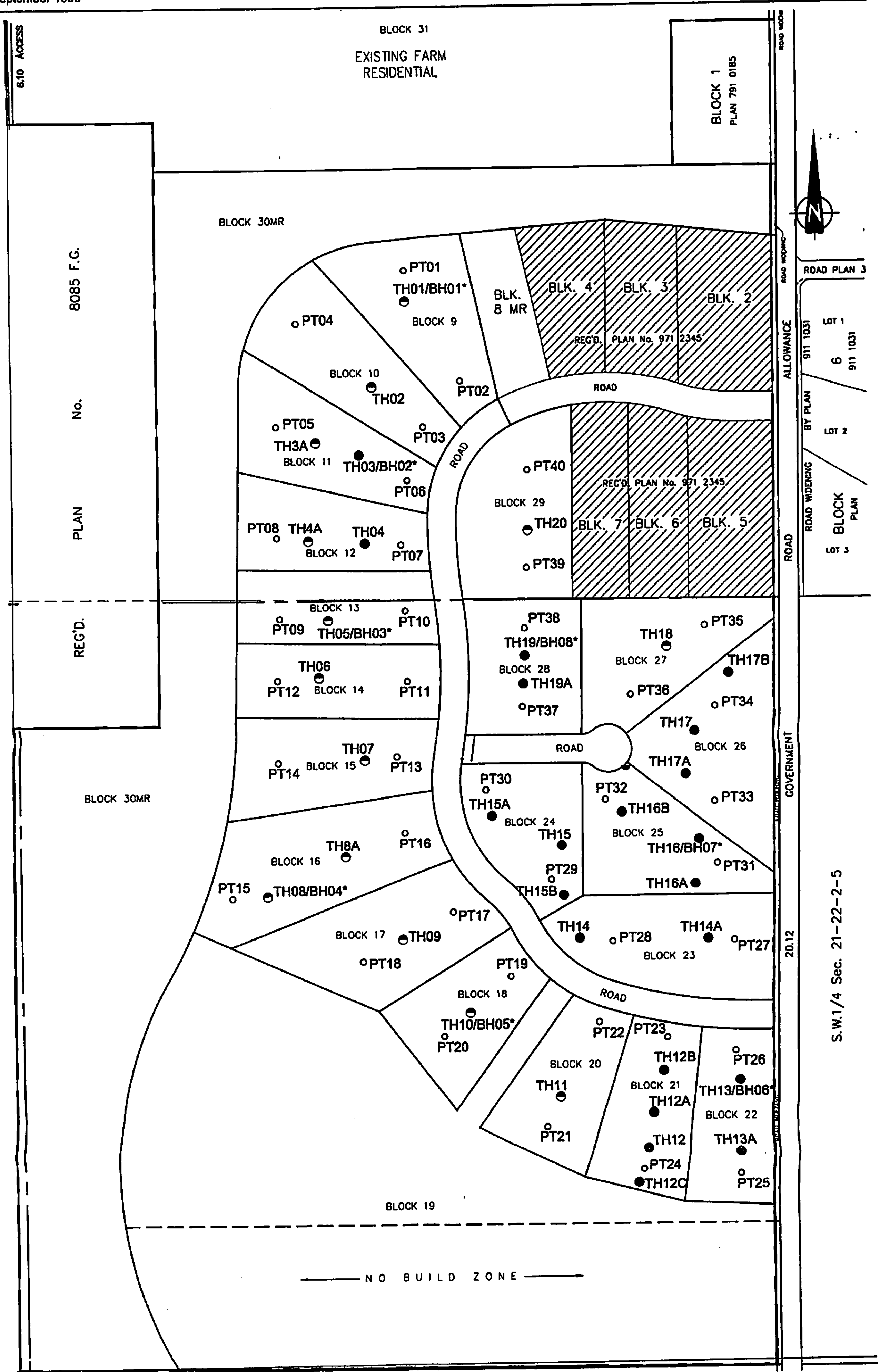
0 5 10 15km

SCALE 1:250,000

Figure 1

Site Location Plan

31058\1C1a.cdr



LEGEND

o - PERCOLATION TEST
◐ - SHALLOW WATER TABLE TESTHOLE WITH 3m STANDPIPE
● - TESTHOLE WITH BEDROCK AT < 2.1m
* - GEOTECHNICAL BOREHOLE TO 6m OR BEDROCK
▨ - EXISTING LOTS

0 100 200 300
SCALE (metres)

Figure 2
Site Plan Showing
Percolation & Testhole Locations

31058S01b.dwg

eba

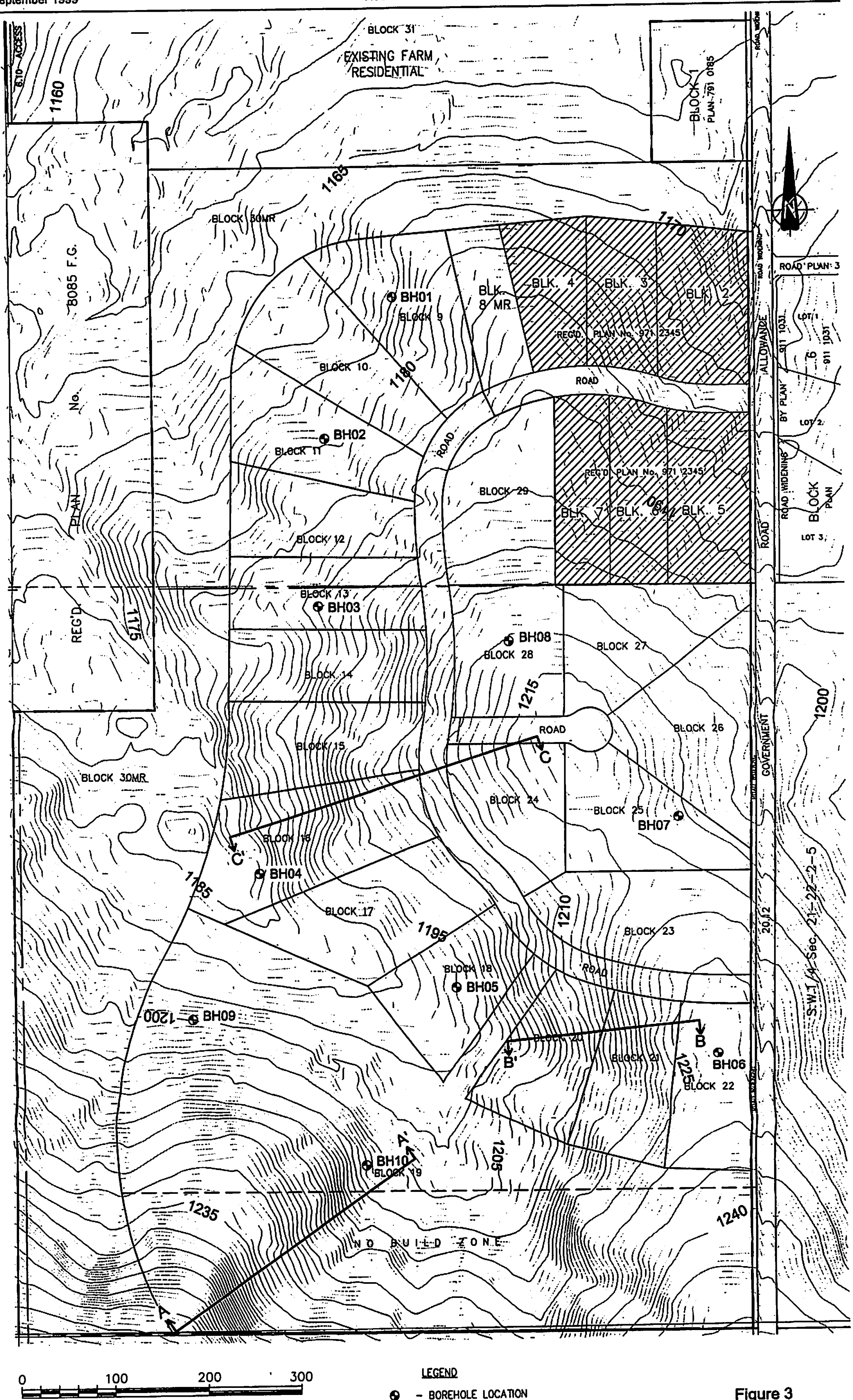


Figure 3
Site Plan Showing
Geotechnical Borehole Locations

31058S01b.dwg

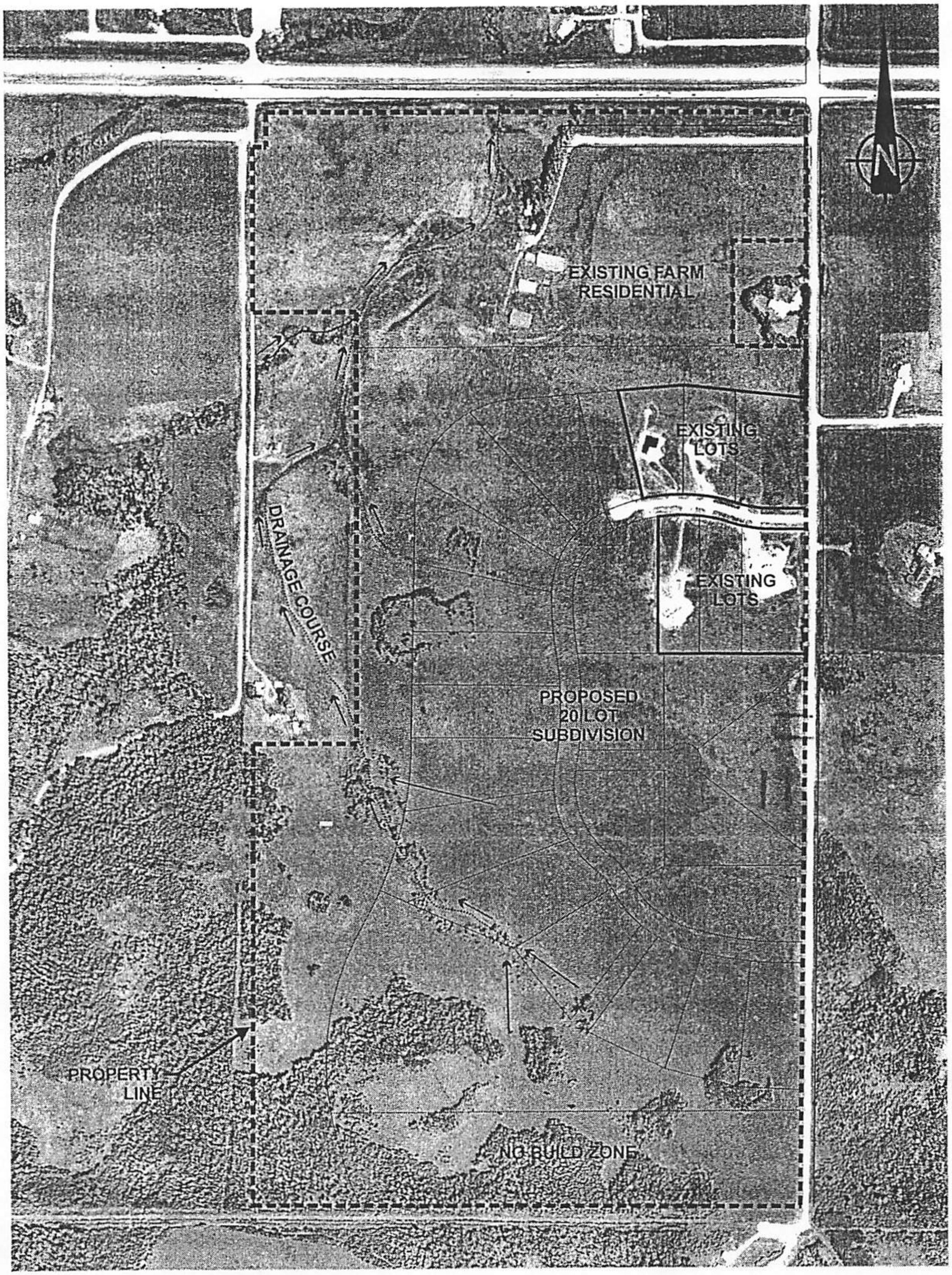


Figure 4

1998 Aerial Photograph

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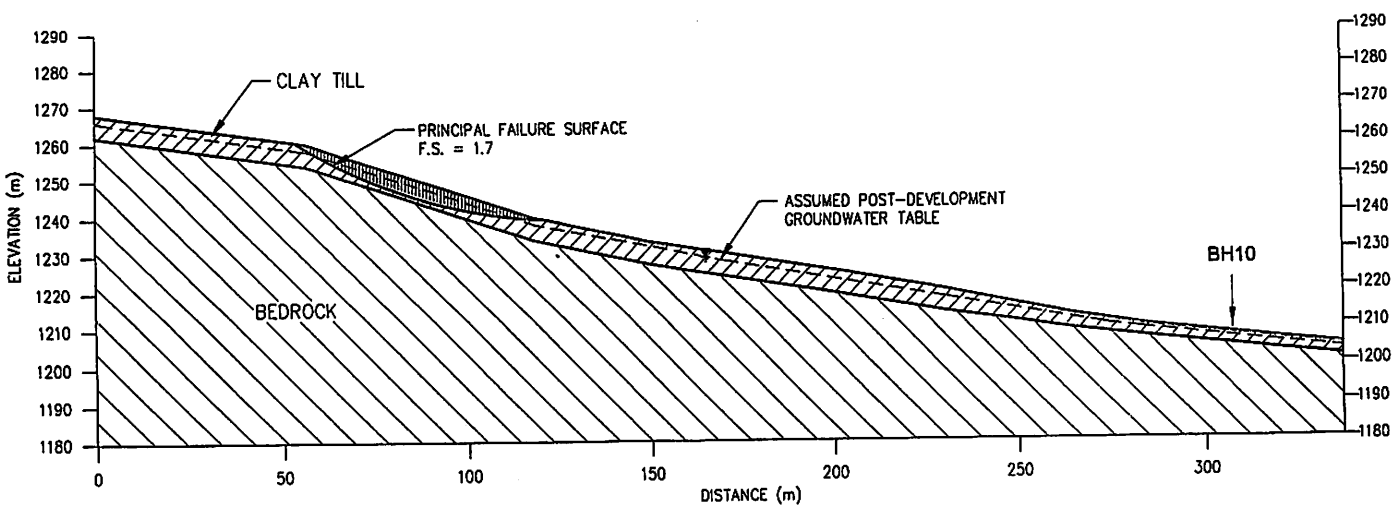
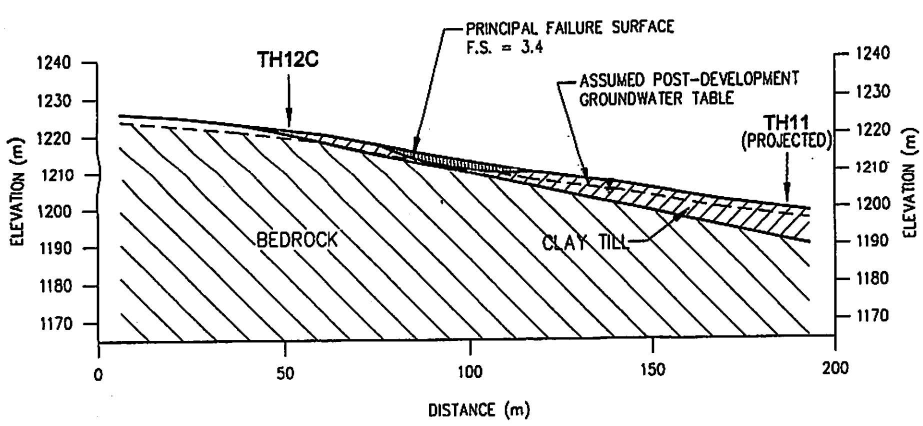
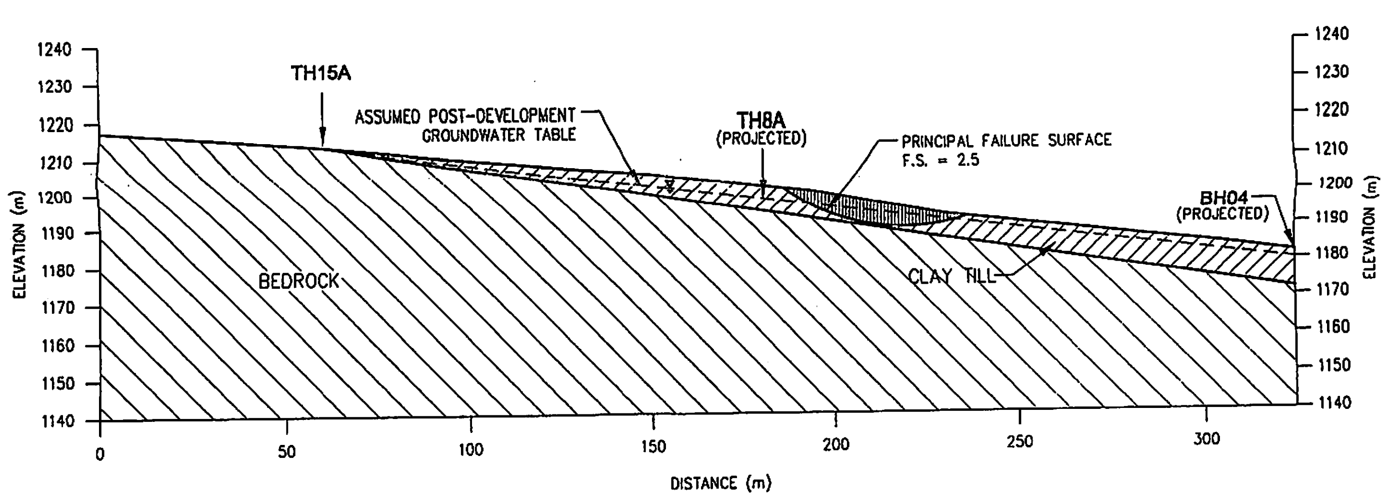


SECTION A – A'



SECTION B – B'



SECTION C – C'

Figure 5

Cross Sections

APPENDIX A

GEOTECHNICAL REPORT

TERMS AND CONDITIONS

This report incorporates and is subject to these "General Conditions".

A.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 EBA's client. EBA 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 EBA's client unless otherwise authorized in writing by 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 EBA. Additional copies of the report, if required, may be obtained upon request.

A.2 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. EBA 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.

A.3 LOGS OF TEST HOLES

The test hole 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.

A.4 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes 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. EBA 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.

A.5 SURFACE WATER AND GROUNDWATER CONDITIONS

Surface and groundwater conditions mentioned in this report are those observed at the times recorded in the report. These conditions vary with geological detail between observation sites; annual, seasonal and special meteorologic conditions; and with development activity. Interpretation of water conditions from observations and records is judgmental and constitutes an evaluation of circumstances as influenced by geology, meteorology and development activity. Deviations from these observations may occur during the course of development activities.

A.6 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.

A.7 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.

A.8 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.

A.9 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.

A.10 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.

A.11 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.

A.12 SAMPLES

EBA 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.

A.13 STANDARD OF CARE

Services performed by EBA for this report have been conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practising under similar conditions in the jurisdiction in which the services are provided. Engineering judgement has been applied in developing the conclusions and/or recommendations provided in this report. No warranty or guarantee, express or implied, is made concerning the test results, comments, recommendations, or any other portion of this report.

A.14 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, EBA 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.

A.15 ALTERNATE REPORT FORMAT

Where EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed EBA's instruments of professional service), the Client agrees that only the signed and sealed hard copy versions shall be considered final and legally binding. The hard copy versions submitted by EBA shall be the original documents for record and working purposes, and, in the event of a dispute or discrepancies, the hard copy versions shall govern over the electronic versions. Furthermore, the Client agrees and waives all future right of dispute that the original hard copy signed version archived by EBA shall be deemed to be the overall original for the Project.

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

The Client recognizes and agrees that electronic files submitted by EBA have been prepared and submitted using specific software and hardware systems. EBA makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

APPENDIX B

GEOTECHNICAL 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

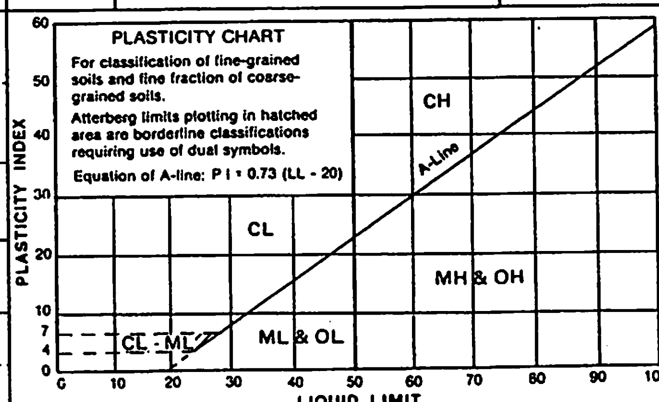
NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above, because of planes of weakness or cracks in the soil.

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.

UNIFIED SOIL CLASSIFICATION †

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES	CLASSIFICATION CRITERIA		
COARSE-GRAINED SOILS More than 50% retained on No. 200 sieve *	GRAVELS 50% or more of coarse fraction retained on No. 4 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 No. 200 sieve GW, GP, SW, SP; More than 12% Pass No. 200 sieve GM, GC, SM, SC; 5% to 12% Pass No. 200 sieve 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 and plasticity index greater than 7	
	SANDS More than 50% of coarse fraction passes No. 4 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 and plasticity index greater than 7	
FINE-GRAINED SOILS 50% or more passes No. 200 sieve *	SILTS AND CLAYS Liquid limit 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands	PLASTICITY CHART (see below)		
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays			
			OL	Organic silts and organic silty clays of low plasticity			
	SILTS AND CLAYS Liquid limit greater than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts			
			CH	Inorganic clays of high plasticity, fat clays			
			OH	Organic clays of medium to high plasticity			
HIGHLY ORGANIC SOILS			Pt	Peat, muck and other highly organic soils			



* Based on the material passing the 3-in. (75-mm) sieve

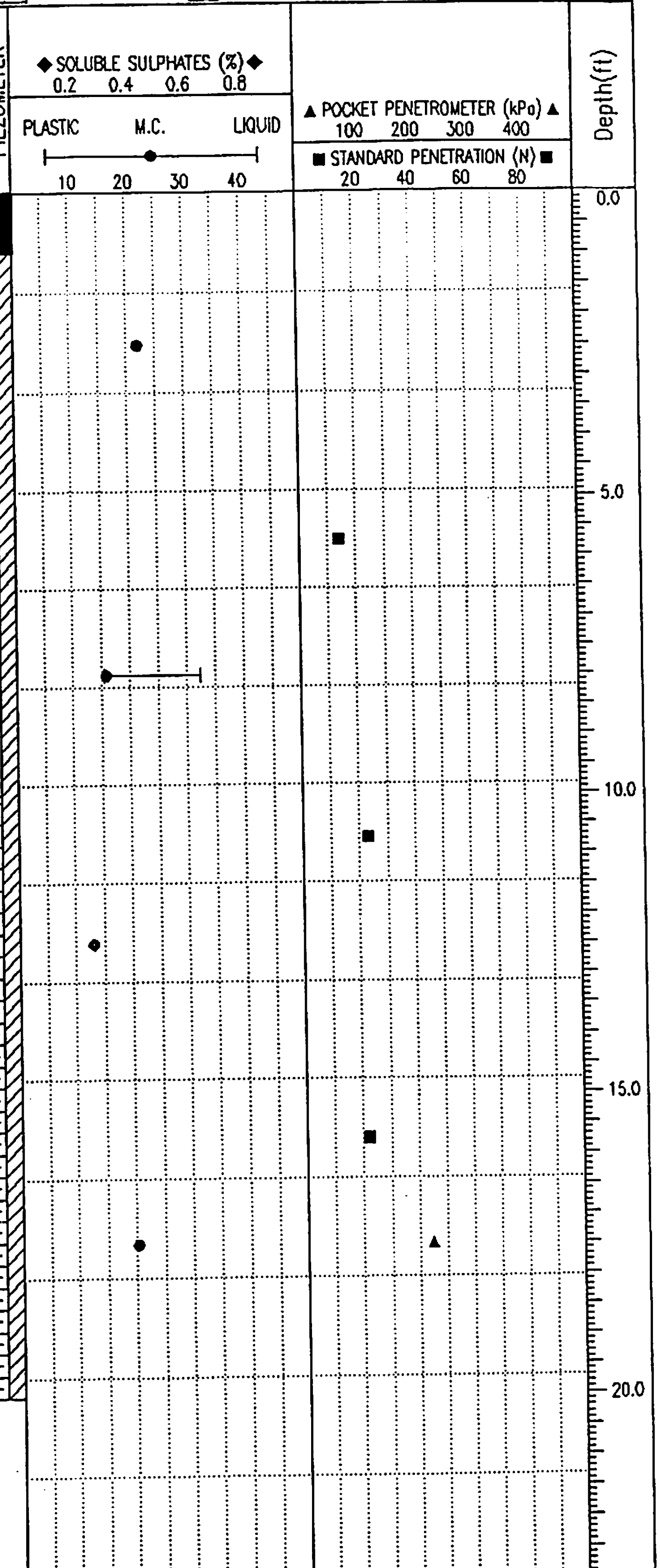
† ASTM Designation D 2487

RED WILLOW ESTATES	E1/2-20-22-02-W5M	BOREHOLE NO: 31058-BH01
KELLAM BERG ENGINEERING & SURVEYS LTD.	PRIDDIS, ALBERTA	PROJECT NO: 0304-31058
DRILL TYPE: SOLID STEM AUGER		ELEVATION:

SAMPLE TYPE: SHELBY TUBE, NO RECOVERY, SPLIT SPOON, DISTURBED, DYNAMIC CONE, CORE

BACKFILL TYPE: BENTONITE, PEA GRAVEL, SLOUGH, GROUT, DRILL CUTTINGS, SAND

Depth(m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT(N)	SLOTTED PIEZOMETER
0.0	TOPSOIL				
	CLAY (TILL) – silty, some sand, trace gravel (max. diameter 50mm), stiff, low plastic, damp, light brown, trace oxides and coal specks.				
		Disturbed	B-1		
		Split spoon	S-1	14	
		Disturbed	B-2		
3.0	– very stiff.	Split spoon	S-2	23	
		Disturbed	B-3		
		Split spoon	S-3	22	
		Disturbed	B-4		
6.0	END OF HOLE @ 6.1m. 25mm Standpipe installed. Dry on completion.				



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LOGGED BY: K. LESTER	COMPLETION DEPTH: 6.1 m
REVIEWED BY: N. MACLEOD	COMPLETE: 08/21/99
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RED WILLOW ESTATES	E1/2-20-22-02-W5M	BOREHOLE NO: 31058-BH02
KELLAM BERG ENGINEERING & SURVEYS LTD.	PRIDDIS, ALBERTA	PROJECT NO: 0304-31058
DRILL TYPE: SOLID STEM AUGER		ELEVATION:

SAMPLE TYPE: SHELBY TUBE, NO RECOVERY, SPLIT SPOON, DISTURBED, DYNAMIC CONE, CORE

BACKFILL TYPE: BENTONITE, PEA GRAVEL, SLOUGH, GROUT, DRILL CUTTINGS, SAND

Depth(m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT(N)	SLOTTED PIEZOMETER	◆ SOLUBLE SULPHATES (%) ◆ 0.2 0.4 0.6 0.8 / PLASTIC M.C. LIQUID 10 20 30 40	▲ POCKET PENETROMETER (kPa) ▲ 100 200 300 400 / ■ STANDARD PENETRATION (N) ■ 20 40 60 80	Depth(ft)
0.0	TOPSOIL							0.0
	CLAY (TILL) – some silt, trace sand and gravel (max. diameter 25mm), firm, low to medium plastic, damp to moist, olive brown, trace oxides and coal specks.		B-1					
1.0	SHALE (BEDROCK) – weathered, weak, dry to damp, yellow brown, interbedded with siltstone.		S-1	58				5.0
2.0			B-2					
	END OF HOLE @ 2.3m.(AUGER REFUSAL) 25mm Standpipe installed. Dry on completion.							
3.0								10.0
4.0								
								15.0
5.0								
6.0								20.0
7.0								

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RED WILLOW ESTATES	E1/2-20-22-02-W5M	BOREHOLE NO: 31058-BH03
KELLAM BERG ENGINEERING & SURVEYS LTD.	PRIDDIS, ALBERTA	PROJECT NO: 0304-31058
DRILL TYPE: SOLID STEM AUGER		ELEVATION:

SAMPLE TYPE: SHELBY TUBE, NO RECOVERY, SPLIT SPOON, DISTURBED, DYNAMIC CONE, CORE

BACKFILL TYPE: BENTONITE, PEA GRAVEL, SLOUGH, GROUT, DRILL CUTTINGS, SAND

Depth(m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT(N)	SLOTTED PIEZOMETER	◆ SOLUBLE SULPHATES (%) ◆ 0.2 0.4 0.6 0.8 / PLASTIC M.C. LIQUID 10 20 30 40	▲ POCKET PENETROMETER (kPa) ▲ 100 200 300 400 / ■ STANDARD PENETRATION (N) ■ 20 40 60 80	Depth(ft)
0.0	TOPSOIL							0.0
	SAND – medium grained, trace silt, dry to damp, light brown, sandstone inclusions.							
1.0		Disturbed	B-1					
	CLAY (TILL) – very silty, some sand, trace gravel (max. diameter 50mm), hard, low plastic, damp, light olive brown, trace oxides.	Split spoon	S-1	57				5.0
2.0		Disturbed	B-2					
3.0	– rock fragments.	Split spoon	S-2					10.0
	END OF HOLE @ 3.1m (AUGER REFUSAL). 25mm Standpipe installed. Dry on completion.							
4.0								
5.0								15.0
6.0								20.0
7.0								

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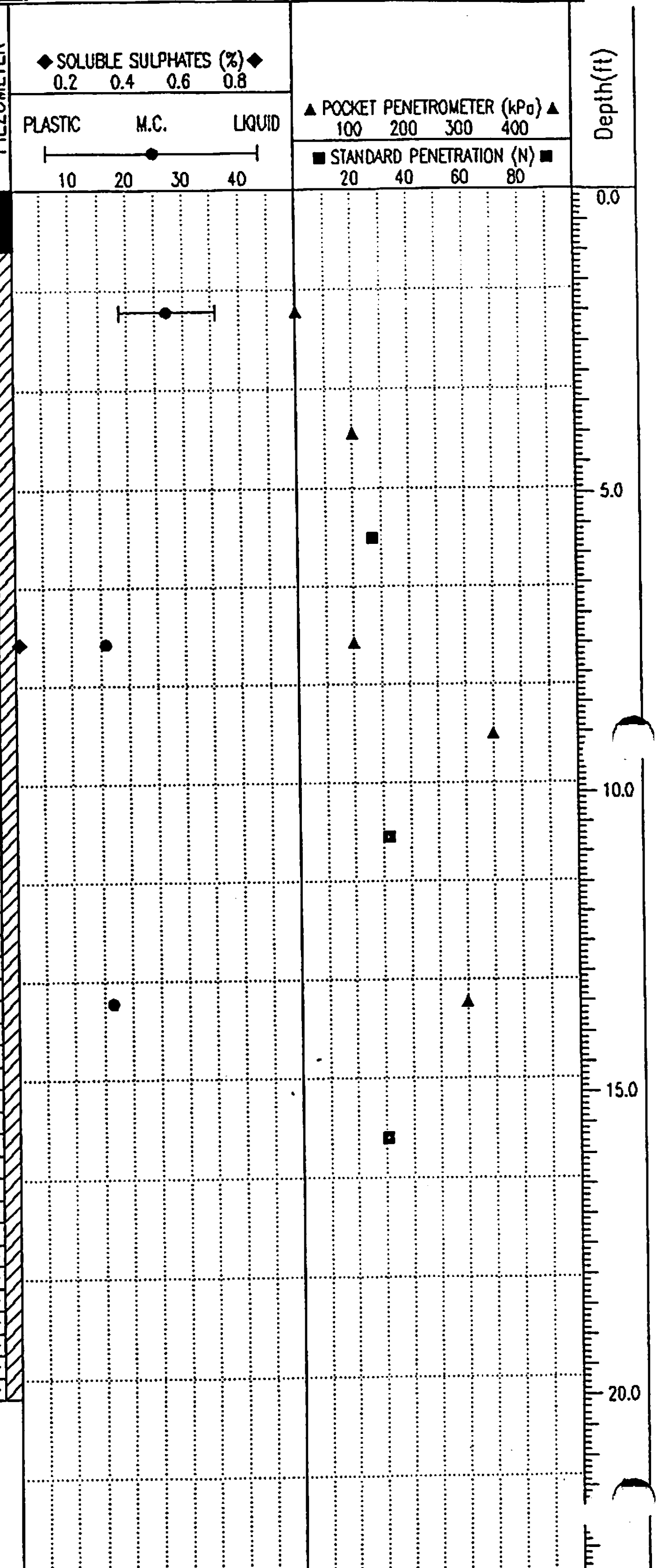
RED WILLOW ESTATES	E1/2-20-22-02-W5M	BOREHOLE NO: 31058-BH04
KELLAM BERG ENGINEERING & SURVEYS LTD.	PRIDDIS, ALBERTA	PROJECT NO: 0304-31058
DRILL TYPE: SOLID STEM AUGER		ELEVATION:

SAMPLE TYPE: SHELBY TUBE, NO RECOVERY, SPLIT SPOON, DISTURBED, DYNAMIC CONE, CORE

BACKFILL TYPE: BENTONITE, PEA GRAVEL, SLOUGH, GROUT, DRILL CUTTINGS, SAND

Depth(m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT(N)	SLOTTED PIEZOMETER
0.0	TOPSOIL				
	CLAY (TILL) – some silt, trace sand and gravel (max. diameter 50mm), medium to low plastic, soft, moist, olive brown, trace oxides and coal specks.	DISTURBED	B-1		
1.0	– silty to some silt, some sand to trace sand, firm, low plastic.	SPLIT SPOON	S-1	27	
2.0		DISTURBED	B-2		
	– very stiff to hard, damp.				
3.0		SPLIT SPOON	S-2	32	
4.0		DISTURBED	B-3		
		SPLIT SPOON	S-3	31	
5.0					
6.0	END OF HOLE @ 6.1m. 25mm Standpipe installed. Dry on completion.				
7.0					



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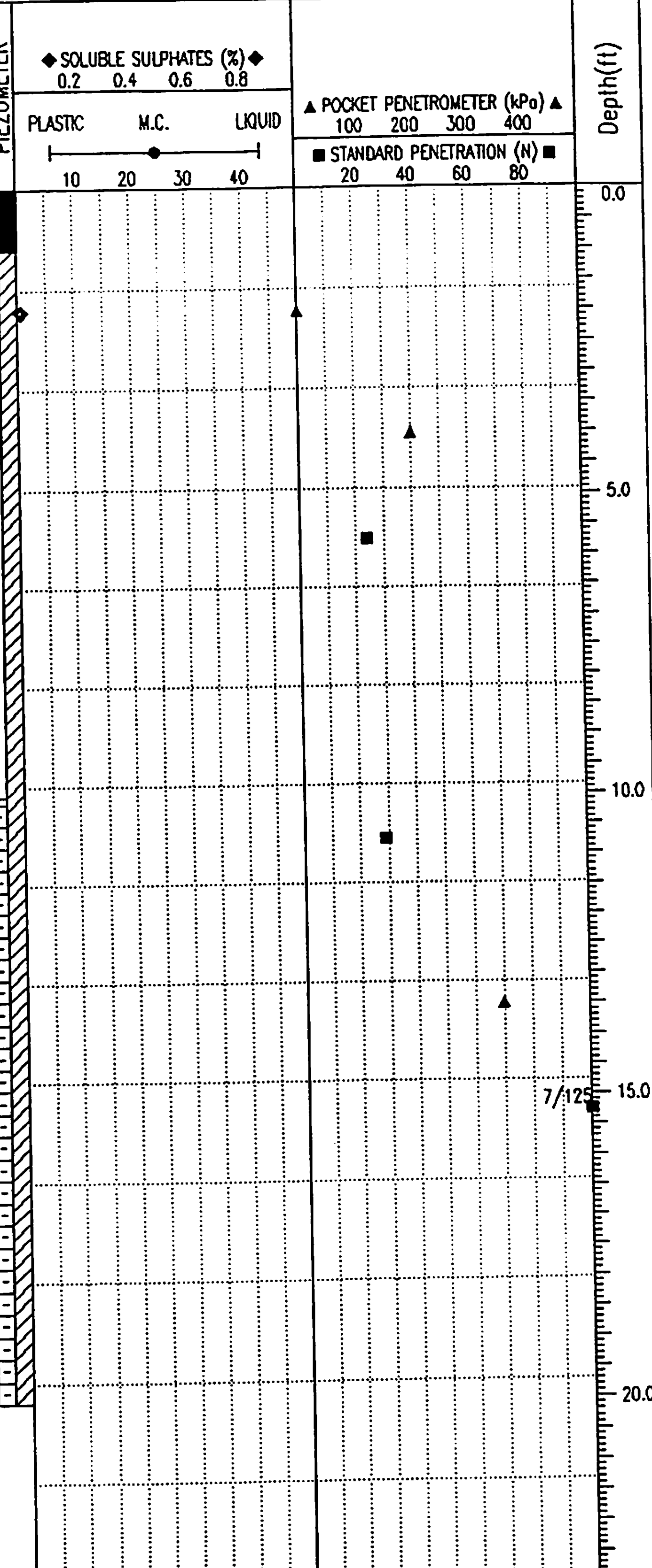
KELLAM BERG ENGINEERING & SURVEYS LTD.	PRIDDIS, ALBERTA	PROJECT NO: 0304-31058
DRILL TYPE: SOLID STEM AUGER		ELEVATION:

SAMPLE TYPE: SHELBY TUBE, NO RECOVERY, SPLIT SPOON, DISTURBED, DYNAMIC CONE, CORE

BACKFILL TYPE: BENTONITE, PEA GRAVEL, SLOUGH, GROUT, DRILL CUTTINGS, SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT(N)	SLOTTED PIEZOMETER
0.0	TOPSOIL				
	SILT (TILL) – some sand, trace to some gravel, trace clay, dry to damp, light olive brown.	Disturbed	B-1		
1.0	CLAY (TILL) – silty, some sand, trace gravel, stiff to very stiff, low plastic, damp, olive brown, trace oxides, coal specks.	Split spoon	S-1	24	
2.0		Disturbed	B-2		
3.0		Split spoon	S-2	29	
	– some gravel.				
4.0		Disturbed	B-3		
		Split spoon	S-3	7/125	
5.0	SILTSTONE (BEDROCK) – weathered, weak, dry to damp, light brown.	Disturbed	B-4		
6.0	END OF HOLE @ 6.1m. 25mm Standpipe installed. Dry on completion.				
7.0					



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RED WILLOW ESTATES	E1/2-20-22-02-W5M	BOREHOLE NO: 31058-BH06
KELLAM BERG ENGINEERING & SURVEYS LTD.	PRIDDIS, ALBERTA	PROJECT NO: 0304-31058
DRILL TYPE: SOLID STEM AUGER		ELEVATION:

SAMPLE TYPE: SHELBY TUBE, NO RECOVERY, SPLIT SPOON, DISTURBED, DYNAMIC CONE, CORE

BACKFILL TYPE: BENTONITE, PEA GRAVEL, SLOUGH, GROUT, DRILL CUTTINGS, SAND

Depth(m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT(N)	SLOTTED PIEZOMETER	◆ SOLUBLE SULPHATES (%) ◆ 0.2 0.4 0.6 0.8 / PLASTIC M.C. LIQUID 10 20 30 40	▲ POCKET PENETROMETER (kPa) ▲ 100 200 300 400 / ■ STANDARD PENETRATION (N) ■ 20 40 60 80	Depth(ft)
0.0	TOPSOIL							0.0
	SHALE (BEDROCK) – weathered, weak, damp, stained orange. – light olive brown.							
1.0								5.0
2.0		DISTURBED	B-1					
3.0	SANDSTONE (BEDROCK) – moderately strong, dry, light brown.							10.0
	END OF HOLE @ 3.0m.(AUGER REFUSAL) 25mm Standpipe installed. Dry on completion.							
4.0								
5.0								15.0
6.0								20.0
7.0								

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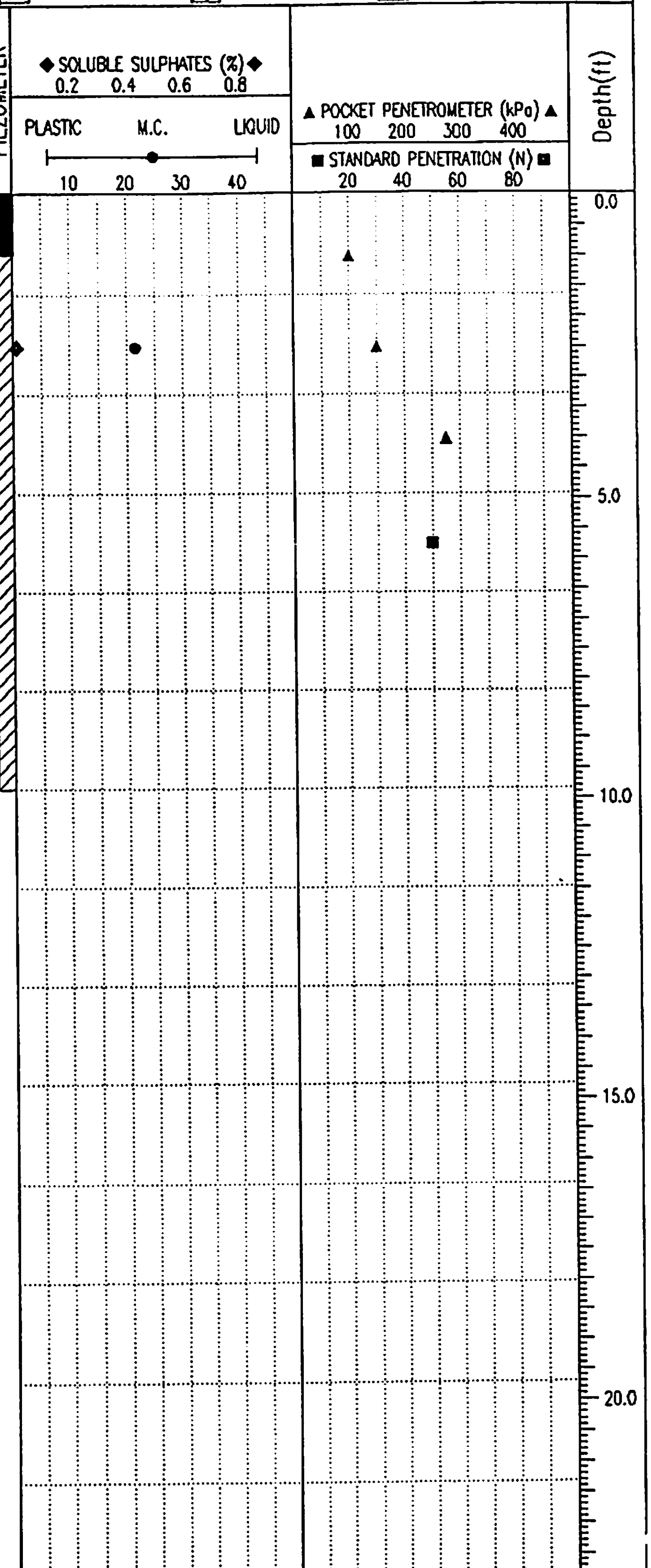
RED WILLOW ESTATES	E1/2-20-22-02-W5M	BOREHOLE NO: 31058-BH07
KELLAM BERG ENGINEERING & SURVEYS LTD.	PRIDDIS, ALBERTA	PROJECT NO: 0304-31058
DRILL TYPE: SOLID STEM AUGER		ELEVATION:

SAMPLE TYPE: SHELBY TUBE, NO RECOVERY, SPLIT SPOON, DISTURBED, DYNAMIC CONE, CORE

BACKFILL TYPE: BENTONITE, PEA GRAVEL, SLOUGH, GROUT, DRILL CUTTINGS, SAND

Depth(m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT(N)	SLOTTED PIEZOMETER
0.0	TOPSOIL				
	CLAY (TILL) – silty to some silt, trace sand, firm to stiff, low plastic, damp, olive brown, trace oxides and coal specks.	Disturbed	B-1		
	– very stiff.	Split spoon	S-1	50	
2.0	SHALE (BEDROCK) – weathered, weak, damp, light, brown.	Disturbed	B-2		
3.0	END OF HOLE @ 3.0m. 25mm Standpipe installed. Dry on completion.				



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RED WILLOW ESTATES	E1/2-20-22-02-W5M	BOREHOLE NO: 31058-BH08
KELLAM BERG ENGINEERING & SURVEYS LTD.	PRIDDIS, ALBERTA	PROJECT NO: 0304-31058
DRILL TYPE: SOLID STEM AUGER		ELEVATION:

SAMPLE TYPE: SHELBY TUBE, NO RECOVERY, SPLIT SPOON, DISTURBED, DYNAMIC CONE, CORE

BACKFILL TYPE: BENTONITE, PEA GRAVEL, SLOUGH, GROUT, DRILL CUTTINGS, SAND

Depth(m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT(N)	SLOTTED PIEZOMETER	◆ SOLUBLE SULPHATES (%) ◆ 0.2 0.4 0.6 0.8 / PLASTIC M.C. LIQUID 10 20 30 40	▲ POCKET PENETROMETER (kPa) ▲ 100 200 300 400 / ■ STANDARD PENETRATION (N) ■ 20 40 60 80	Depth(ft)
0.0	TOPSOIL							0.0
	CLAY (TILL) – silty, some sand, trace gravel (max. diameter 25mm), stiff to very stiff, low plastic, damp, stained orange, trace oxides and coal specks. – light olive brown.							
1.0	SHALE (BEDROCK) – weathered, weak, dry to damp, yellow brown, interbedded with siltstone.	DISTURBED	B-1					
		SPLIT SPOON	S-1	47			■ 47	5.0
2.0		DISTURBED	B-2					
	SILTSTONE (BEDROCK) – moderately strong, dry, light yellow.							
	END OF HOLE @ 2.4m.(AUGER REFUSAL) 25mm Standpipe installed. Dry on completion.							
3.0								10.0
4.0								
								15.0
5.0								
6.0								20.0
7.0								

EBA Engineering Consultants Ltd. Calgary, Alberta	LOGGED BY: K. LESTER	COMPLETION DEPTH: 2.4 m
	REVIEWED BY: N. MACLEOD	COMPLETE: 08/20/99
		Page 1 of 1

99/09/15 09:33AM (31058SS)

RED WILLOW ESTATES	E1/2-20-22-02-W5M	BOREHOLE NO: 31058-BH09
KELLAM BERG ENGINEERING & SURVEYS LTD.	PRIDDIS, ALBERTA	PROJECT NO: 0304-31058
DRILL TYPE: SOLID STEM AUGER		ELEVATION:

SAMPLE TYPE: SHELBY TUBE, NO RECOVERY, SPLIT SPOON, DISTURBED, DYNAMIC CONE, CORE

BACKFILL TYPE: BENTONITE, PEA GRAVEL, SLOUGH, GROUT, DRILL CUTTINGS, SAND

◆ SOLUBLE SULPHATES (%) ◆ 0.2 0.4 0.6 0.8

PLASTIC M.C. LIQUID 10 20 30 40

▲ POCKET PENETROMETER (kPa) ▲ 100 200 300 400

■ STANDARD PENETRATION (N) ■ 20 40 60 80

Depth(m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT(N)
0.0	TOPSOIL			
	CLAY (SLOPE WASH SEDIMENT) – some silt, trace sand, low to medium plastic, firm, damp, light brown, trace roots.	Disturbed	B-1	
	CLAY (TILL) – silty, some sand, trace gravel (max. diameter 25mm), very stiff, low plastic, damp, olive brown, trace oxides and coal specks.	Disturbed	B-2	
		Split spoon	S-1	23
	– some gravel (max. diameter 50mm).	Disturbed	B-3	
		Split spoon	S-2	31
	SHALE (BEDROCK) – weathered, weak, dry to damp, light olive brown.	Disturbed	B-4	
		Split spoon	S-3	25
5.0	END OF HOLE @ 5.0m. 25mm Standpipe installed. Dry on completion.			

Depth(m): 0.0, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0

Depth(ft): 0.0, 5.0, 10.0, 15.0, 20.0

SLOTTED PIEZOMETER

EBA Engineering Consultants Ltd. Calgary, Alberta	LOGGED BY: K. LESTER	COMPLETION DEPTH: 5 m
	REVIEWED BY: N. MACLEOD	COMPLETE: 08/20/99
		Page 1 of 1

RED WILLOW ESTATES	E1/2-20-22-02-W5M	BOREHOLE NO: 31058-BH10
KELLAM BERG ENGINEERING & SURVEYS LTD.	PRIDDIS, ALBERTA	PROJECT NO: 0304-31058
DRILL TYPE: SOLID STEM AUGER		ELEVATION:

SAMPLE TYPE: SHELBY TUBE, NO RECOVERY, SPLIT SPOON, DISTURBED, DYNAMIC CONE, CORE

BACKFILL TYPE: BENTONITE, PEA GRAVEL, SLOUGH, GROUT, DRILL CUTTINGS, SAND

Depth(m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	SPT(N)	SLOTTED PIEZOMETER
0.0	TOPSOIL				
	CLAY (TILL) – silty, some to trace sand, trace gravel (max. diameter 25mm), very stiff, low plastic, damp, olive brown, trace oxides and coal specks.	Disturbed	B-1		
		Split spoon	S-1	20	
		Disturbed	B-2		
3.0		Split spoon	S-2	50/127	
	SANDSTONE (BEDROCK) – moderately strong, dry, light olive brown.				
	END OF HOLE @ 3.4m (AUGER REFUSAL). 25mm Standpipe installed. Dry on completion.				

Depth scale (m): 0.0, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0

◆ SOLUBLE SULPHATES (%) ◆ 0.2 0.4 0.6 0.8

PLASTIC M.C. LIQUID 10 20 30 40

▲ POCKET PENETROMETER (kPa) ▲ 100 200 300 400

■ STANDARD PENETRATION (N) ■ 20 40 60 80

50/127

Depth(ft): 0.0, 5.0, 10.0, 15.0, 20.0

EBA Engineering Consultants Ltd. Calgary, Alberta	LOGGED BY: K. LESTER	COMPLETION DEPTH: 3.4 m
	REVIEWED BY: N. MACLEOD	COMPLETE: 08/20/99
		Page 1 of 1

APPENDIX C

SHALLOW GROUNDWATER TESTHOLE LOGS

SOIL LOG FOR WATER TABLE TEST HOLES
RED WILLOW ESTATES

SOIL LOG FOR TH01 (Block 9)

Depth (m)	Soil
0	TOPSOIL
0.23	CLAY (TILL) - silty, some sand, trace gravel (max. diameter 50mm), stiff, low plastic, damp, light brown, trace oxides and coal specks.
3.0	- very stiff.
6.1	END OF HOLE

SOIL LOG FOR TH02 (Block 10)

Depth (m)	Soil
0	TOPSOIL
0.18	CLAY (TILL) - silty, trace sand and gravel (max. diameter 25mm), stiff to very stiff, low plastic, damp, light brown, trace oxides and coal specks.
1.7	- olive brown.
3.0	END OF HOLE

SOIL LOG FOR TH03 (Block 11)

Depth (m)	Soil
0	TOPSOIL
0.33	CLAY (TILL) - some silt, trace sand and gravel, (max. diameter 25mm), firm, medium plastic, damp to moist, olive brown, trace oxides and coal specks.
1.2	SHALE (BEDROCK) - weathered, weak, dry to damp, yellow brown, interbedded with siltstone.
2.3	END OF HOLE (AUGER REFUSAL)

SOIL LOG FOR WATER TABLE TEST HOLES
RED WILLOW ESTATES

SOIL LOG FOR TH3A (Block 11)

Depth (m)	Soil
0	TOPSOIL
0.28	CLAY (TILL) - silty, some sand, trace gravel, low plastic, damp, light brown, trace oxides and coal specks.
1.8	- very stiff.
3.0	END OF HOLE

SOIL LOG FOR TH04 (Block 12)

Depth (m)	Soil
0	TOPSOIL
0.51	CLAY (TILL) - silty, some sand, trace gravel, hard, low plastic, damp, light olive brown, trace oxides and coal specks.
0.3	- light brown.
1.7	SHALE (BEDROCK) - weathered, weak, dry to damp, light olive brown.
3.0	END OF HOLE

SOIL LOG FOR TH4A (Block 12)

Depth (m)	Soil
0	TOPSOIL
0.18	CLAY (TILL) - silty, some sand, trace gravel, very stiff, low plastic, damp, orange staining, trace oxides and coal specks.
0.3	- light brown.
2.6	SHALE (BEDROCK) - weathered, weak, dry to damp, light yellow.
3.0	END OF HOLE

SOIL LOG FOR WATER TABLE TEST HOLES
RED WILLOW ESTATES

SOIL LOG FOR TH05 (Block 13)

Depth (m)	Soil
0	TOPSOIL
0.38	SAND - medium grained, trace silt, dry to damp, light brown, sandstone inclusions.
1.5	CLAY (TILL) - very silty, some sand, trace gravel (max. diameter 50mm), hard, low plastic, damp, light olive brown, trace oxides.
3.1	END OF HOLE (AUGER REFUSAL - on bedrock or boulder)

SOIL LOG FOR TH06 (Block 14)

Depth (m)	Soil
0	TOPSOIL
0.25	CLAY (TILL) - very silty to silty, some sand, trace gravel, low plastic, dry to damp, light olive brown.
1.8	- occasional sand lenses up to 300mm thick.
3.0	END OF HOLE

SOIL LOG FOR TH07 (Block 15)

Depth (m)	Soil
0	TOPSOIL
0.20	CLAY (TILL) - silty, trace sand and gravel, very stiff, damp, medium plastic, orange staining, trace oxides and coal specks.
0.7	- low plastic, light olive brown.
2.5	SHALE (BEDROCK) - weathered weak, dry to damp, light olive brown.
3.0	END OF HOLE

SOIL LOG FOR WATER TABLE TEST HOLES
RED WILLOW ESTATES

SOIL LOG FOR TH08 (Block 16)

Depth (m)	Soil
0	TOPSOIL
0.18	CLAY (TILL) - some silt, trace sand and gravel, very soft, medium to low plastic, moist, olive brown, trace oxides and coal specks.
1.2	- silty to some silt, some sand to trace sand, firm, low plastic, damp.
2.7	- very stiff to hard.
6.1	END OF HOLE

SOIL LOG FOR TH8A (Block 16)

Depth (m)	Soil
0	TOPSOIL
0.15	CLAY (TILL) - silty, trace sand and gravel, low plastic, damp, olive brown, trace oxides and coal specks.
3.0	END OF HOLE

SOIL LOG FOR TH09 (Block 17)

Depth (m)	Soil
0	TOPSOIL
0.43	SILT (TILL) - some sand, trace gravel (max. diameter 25mm) and clay, dry, light olive brown.
1.8	CLAY (TILL) - silty, trace sand and gravel (max. diameter 25mm), low plastic, damp olive brown, trace oxides and coal specks.
3.0	END OF HOLE

SOIL LOG FOR WATER TABLE TEST HOLES
RED WILLOW ESTATES

SOIL LOG FOR TH12A (Block 21)

Depth (m)	Soil
0	TOPSOIL
0.25	CLAY (TILL) - very silty, some sand, trace gravel, low plastic, dry, light olive brown, trace oxides and coal specks.
1.7	SHALE (BEDROCK) - weathered, weak, dry to damp, light brown.
3.0	END OF HOLE - no standpipe installed.

SOIL LOG FOR TH12B (Block 21)

Depth (m)	Soil
0	TOPSOIL
0.10	CLAY (TILL) - silty, trace sand and gravel, low plastic, dry to damp, light olive brown, trace oxides and coal specks.
0.4	SHALE (BEDROCK) - weathered, weak, dry to damp, light brown.
3.0	END OF HOLE - no standpipe installed.

SOIL LOG FOR TH12C (Block 21)

Depth (m)	Soil
	SHALLOW BEDROCK TESTHOLE
1.5	SILTSTONE (BEDROCK) - weathered, weak, dry, yellow brown.
3.0	END OF HOLE

SOIL LOG FOR WATER TABLE TEST HOLES
RED WILLOW ESTATES

SOIL LOG FOR TH13 (Block 22)

Depth (m)	Soil
0	TOPSOIL
0.10	SHALE (BEDROCK) - weathered, weak, damp, orange stained.
0.5	- light olive brown.
2.9	SANDSTONE (BEDROCK) - moderately strong, dry, light brown.
3.0	END OF HOLE (AUGER REFUSAL)

SOIL LOG FOR TH13A (Block 22)

Depth (m)	Soil
0	TOPSOIL
0.09	SHALE (BEDROCK) - weathered, weak, dry to damp, light brown.
1.5	END OF HOLE - no standpipe installed.

SOIL LOG FOR TH14 (Block 23)

Depth (m)	Soil
0	TOPSOIL
0.18	SHALE (BEDROCK) - weathered, weak, dry to damp, light brown.
1.5	END OF HOLE - no standpipe installed.

SOIL LOG FOR TH14A (Block 23)

Depth (m)	Soil
0	TOPSOIL
0.13	SHALE (BEDROCK) - weathered, weak, dry to damp, light olive brown.
3.0	END OF HOLE

SOIL LOG FOR WATER TABLE TEST HOLES
RED WILLOW ESTATES

SOIL LOG FOR TH15 (Block 24)

Depth (m)	Soil
0	TOPSOIL
0.25	SHALE (BEDROCK) - weathered, weak, dry to damp, light brown.
1.5	END OF HOLE - no standpipe installed.

SOIL LOG FOR TH15A (Block 24)

Depth (m)	Soil
0	TOPSOIL
0.18	SHALE (BEDROCK) - weathered, weak, dry to damp, light brown.
1.5	END OF HOLE - no standpipe installed.

SOIL LOG FOR TH15B (Block 24)

Depth (m)	Soil
	SHALLOW BEDROCK TESTHOLE
0.8	SILTSTONE (BEDROCK) - weathered, weak, dry to damp, yellow brown, interbedded with mudstone.
3.0	END OF HOLE

SOIL LOG FOR TH16 (Block 25)

Depth (m)	Soil
0	TOPSOIL
0.20	CLAY (TILL) - silty, to some silt, trace sand, firm to stiff, low plastic, damp, olive brown, trace oxides and coal specks.
1.2	- very stiff.
2.0	SHALE (BEDROCK) - weathered, weak, damp, light brown.
3.0	END OF HOLE

SOIL LOG FOR WATER TABLE TEST HOLES
RED WILLOW ESTATES

SOIL LOG FOR TH17B (Block 26)

Depth (m)	Soil
0	TOPSOIL
0.23	SANDSTONE (BEDROCK) - very weathered, weak, dry to damp, yellow brown, interbedded with mudstone.
2.1	SHALE (BEDROCK) - weathered, weak, dry to damp, light brown.
3.0	END OF HOLE

SOIL LOG FOR TH18 (Block 27)

Depth (m)	Soil
0	TOPSOIL
0.28	CLAY (TILL) - silty, trace to some sand, trace gravel, firm to stiff, low plastic, damp, light olive brown, trace oxides and coal specks.
0.9	- occasional sand lenses.
3.0	END OF HOLE

SOIL LOG FOR TH19 (Block 28)

Depth (m)	Soil
0	TOPSOIL
0.20	CLAY (TILL) - silty, some sand, trace gravel (max. diameter 258mm), stiff to very stiff, low plastic, damp, orange staining, trace oxides and coal specks.
0.3	- light olive brown.
0.5	SHALE (BEDROCK) - weathered, weak, dry to damp, yellow brown, interbedded with siltstone.
2.1	SILTSTONE (BEDROCK) - moderately strong, dry, light yellow.
2.4	END OF HOLE (AUGER REFUSAL)

SOIL LOG FOR WATER TABLE TEST HOLES
RED WILLOW ESTATES

SOIL LOG FOR TH19A (Block 28)

Depth (m)	Soil
0	TOPSOIL
0.20	CLAY (TILL) - silty, some sand, trace gravel, low plastic, damp, orange staining, trace coal specks.
0.3	SHALE (BEDROCK) - weathered, weak, dry to damp, light brown.
1.5	END OF HOLE - no standpipe installed.

SOIL LOG FOR TH20 (Block 29)

Depth (m)	Soil
0	TOPSOIL
0.41	CLAY (TILL) - some silt to silty, trace sand and gravel, very stiff, low plastic, damp, orange staining, trace oxides and coal specks.
0.6	- light olive brown.
2.5	SHALE (BEDROCK) - weathered, weak, dry to damp, light brown.
3.0	END OF HOLE

APPENDIX D

DESIGN AND CONSTRUCTION GUIDELINES

BACKFILL MATERIALS AND COMPACTION

Maximum density, as used in this section, means Standard Proctor Maximum Dry Density (ASTM Test D698) unless specifically noted otherwise. Optimum moisture content is as defined in this text.

"General engineered fill" materials should comprise clean, well-graded granular soils or inorganic, low-plastic cohesive soils. Such material should be placed in compacted lifts not exceeding 200 mm and compacted to not less than 98% of maximum density, at a moisture content at or slightly above optimum.

"Structural fill" materials should comprise clean, well-graded inorganic granular soils. Such fill should be placed in compacted lifts not exceeding 150 mm and compacted to not less than 98% of maximum density, at a moisture content near or slightly above optimum.

"Landscape fill" material may comprise soils without regard to engineering quality. Such soils should be placed in compacted lifts not exceeding 300 mm and compacted to a density of not less than 90% of maximum density.

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

Backfill supporting structural loads should comprise structural fill materials as defined above.

Backfill adjacent to exterior footings, foundation walls, grade beams and pile caps and within 300 mm of final grade should comprise low-plastic cohesive general engineered fill as defined above. Such backfill should provide a relatively impervious surface layer to reduce seepage into the sub-soil.

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 deflection is 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 500 mm of retaining walls or basement walls.

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

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

Bonding should be provided between backfill lifts, if the previous lift has become desiccated. For the fine-grained materials, the previous lift should be scarified to 75 mm in depth followed by proper moisture conditioning and recompaction.

Recommendations for the specifications for various backfill types are presented below.

"Pit-run gravel" should conform to the following grading:

Sieve Sizes (Square Openings)	Percent Passing By Weight
200 mm	100 of Total Sample
150 mm	96 - 100 of Total Sample
75 mm	60 - 80 of Total Sample
25 mm	70 - 100 of Material Passing 75 mm Sieve
4.75 mm	25 - 63 of Material Passing 75 mm Sieve
1.18 mm	14 - 41 of Material Passing 75 mm Sieve
0.60 mm	7 - 30 of Material Passing 75 mm Sieve
0.15 mm	3 - 18 of Material Passing 75 mm Sieve
0.075 mm	2 - 9 of Material Passing 75 mm Sieve

Any grading variation from the above should be at the discretion of the Engineer; however, the percent of material passing the 0.075 mm sieve should not exceed 2/3 of the material passing the 0.6 mm sieve. The pit-run gravel should be free of any form of coating and any gravel containing clay, loam or other deleterious materials should be rejected. No oversized material should be tolerated.

"Crushed gravel" should conform to the following grading:

Sieve Sizes (Square Openings)	Percent Passing by Weight		
	Nominal Gravel Size		
	100 mm	50 mm	25 mm
100 mm	100	—	—
75 mm	90 – 100	—	—
50 mm	—	100	—
40 mm	60 - 80	90 - 100	—
25 mm	—	—	100
20 mm	40 - 66	50 - 75	95 - 100
10 mm	25 - 54	25 - 52	60 - 80
4.75 mm	15 - 43	15 - 40	40 - 60
2.36 mm	10 - 35	10 - 33	28 - 48
0.60 mm	5 - 23	5 - 23	13 - 29
0.30 mm	—	—	9 - 21
0.15 mm	3 - 12	2 - 14	6 - 15
0.075 mm	2 - 10	1 - 10	4 - 10

Gravel:

100 mm Crushed Gravel: At least 13% by weight of the material retained on the 4.75 mm sieve should have two more fractured faces.

50 mm Crushed Gravel: At least 13% by weight of the material retained on the 4.75 mm sieve should have two more fractured faces.

25 mm Crushed Gravel: At least 50% by weight of the material retained on the 4.75 mm sieve should have two more fractured faces.

Any gravel containing deleterious material should be rejected.

"Coarse gravel" for bedding and drainage should conform to the following grading:

Sieve Sizes (Square Openings)	Percent Passing By Weight (Nominal Gravel Size)	
	50 mm	40 mm
50 mm	100	—
40 mm	90 - 100	100
25 mm	—	95 - 100
20 mm	35 - 70	—
15 mm	—	25 - 60
10 mm	10 - 30	—
4.75 mm	0 - 5	0 - 10
2.36 mm	—	0 - 5

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

Sieve Sizes (Square Openings)	Percent Passing By Weight
10 mm	100
4.75 mm	95 – 100
2.36 mm	80 – 100
1.18 mm	50 - 85
0.60 mm	25 - 60
0.30 mm	10 - 30
0.15 mm	2 - 10

"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 agencies.

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

Shallow excavations up to 3 m depth may use temporary side slopes 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 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. 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° from a horizontal, from the base of foundations of adjacent structures, intersects the extent of the proposed excavation, then 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 charges 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.

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 0.45 m and 0.9 m for strip and square footings, respectively.

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. Recompaction of disturbed or loosened bearing surface may be required.

Foundation excavation and bearing surfaces should be protected from rain, snow, freezing temperatures, drying and the ingress of free water, 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 and provide a working surface for construction, should immediate foundation construction not be intended.

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 observed by a qualified geotechnical engineer to confirm that the recommendations contained in this report have been followed and that soil conditions are consistent with those assumed in the design.

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 under the separate heading "Backfill Materials and Compaction."

8

EBA Engineering Consultants Ltd.

COPY

GROUNDWATER EVALUATION
RED WILLOW ESTATES
EH 20-22-02 W5M

Project No. 0304-31058.01

OCTOBER 1999

Riverbend Atrium One, 270, 200 Rivercrest Dr. S.E., Calgary, Alberta T2C 2X5
Tel: (403) 203-3355 - Fax: (403) 203-3301 Internet: calgary@eba.ca - Web Site: http//www.eba.ca

EBA Engineering Consultants Ltd.

GROUNDWATER EVALUATION
RED WILLOW ESTATES
EH 20-22-02 W5M

Submitted to:

Bavarian Lion Co Ltd.
Care of
Kellam Berg Engineering and Surveys Ltd.
Calgary, Alberta

Prepared by:

EBA ENGINEERING CONSULTANTS LTD.
Calgary, Alberta

Project No. 0304-31058.01

October 1999

EXECUTIVE SUMMARY

EBA Engineering Consultants Ltd. (EBA) was retained by Kellam Berg Engineering and Surveys Ltd. (Kellam) of Calgary, agents for Bavarian Lion Company Ltd., to locate and evaluate a groundwater supply for domestic (subdivision) purposes at the proposed Red Willow Estates subdivision at EH 20-22-02 W5M in the M.D. of Foothills.

The scope of work for this project included:

- constructing three water supply wells within the quarter section, to test the potential availability of groundwater;
- conducting a pumping and recovery test on one of the water supply wells using a second well as an observation well;
- evaluating the aquifer properties on the basis of the pumping test results;
- sampling the well during the pumping test, noting the time of sampling and analysing the sample for total dissolved solids (TDS), Ca, Mg, Na, K, CO_3, HCO_3, SO_4, Cl, NO_3, F, Fe, Mn, pH, hardness, alkalinity, and bacteriological parameters; and`
- preparing a report presenting the data and an interpretation of the data.

Three water wells (99BH01, 99BH02 and 99BH03) were completed to depths of approximately 47.24 m, 71.62 m and 60.96 m, respectively. A 24 hour pumping test followed by a recovery test was conducted on 99BH03. An average aquifer transmissivity of 6,680 m^2/year was calculated.

Analysis of the test data indicates that the aquifer, at the location tested, is capable of providing the required 32,279 m^3/year (13.5 gallons per minute).

The water quality of the groundwater based on the samples collected during the pumping test from 99BH03 is within the Canadian Drinking Water Quality Guidelines.

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1.0 INTRODUCTION

EBA Engineering Consultants Ltd. (EBA) was retained by Kellam Berg Engineering and Surveys Ltd. (Kellam) of Calgary, agents for Bavarian Lion Company Ltd., to locate and evaluate a groundwater supply for domestic (subdivision) purposes at the proposed Red Willow Estates subdivision at EH 20-22-02 W5M in the M.D. of Foothills.

The scope of work for this project included:

- constructing three water supply wells within the quarter section, to test the potential availability of groundwater;
- conducting a 24 hour pumping test followed by a recovery test on one of the water supply wells;
- evaluating the aquifer properties on the basis of the pumping test results to assess the presence of a groundwater supply of sufficient quantity to meet an anticipated demand of 1,250 m^3/year (0.52 gpm, i.e., the typical demand for a single domestic residence) per lot for a total of 26 lots;
- sampling the well during the pumping test, noting the time of sampling and analysing the sample for total dissolved solids (TDS), Ca, Mg, Na, K, CO_3, HCO_3, SO_4, Cl, NO_3, F, Fe, Mn, pH, hardness, alkalinity and bacteriological parameters; and
- preparing a report presenting the data and an interpretation of the data.

The results of this work are described in Sections 2 to 5 of this report. Section 2 describes selected background information available for the area. Section 3 describes the drilling program and results and Section 4 describes the pumping test program and results. Section 5 provides conclusions and recommendations for water supply development.

2.0 BACKGROUND

This section describes the site and the regional geologic and hydrogeologic conditions.

2.1 Site Description

The site is located southwest of Calgary. It is bounded to the north by Highway 22X and to the south by the Sandy Cross Conservation Area. The land-surface elevation in EH 20-22-2 W5M ranges from 1,156 m above sea level in the north to approximately 1,265 m above sea level in the southeast. Access to the site is from a gravel road, south of

Highway 22X, located east of the property. The proposed subdivision plan within the EH 20-22-02 W5M is shown on Figure 2.

2.2 Regional Geology

The surficial geology of the area comprises less than 2 m of Quaternary Spy Hill Till, a pebble loam till, lying on the eroded bedrock surface. The underlying bedrock consists of non-marine sandstone and siltstone of the Tertiary Porcupine Hills Formation. Locally, the Porcupine Hills Formation may be underlain by clayey sandstone of the non-marine Tertiary Horseshoe Canyon Formation

2.3 Regional Hydrogeology

The hydrogeological map for the area (Bourneuf, 1979) indicates that in Township 22 Range 2, W5M the groundwater probability indicates a yield of 3,156 to 12,623 m^3/year (1 to 5 gallons per minute). This general yield value may be greater locally as a result of increased fracturing, dissolution channels in carbonate or the presence of sand and gravel.

The AEP Groundwater Information Centre (GIC) database provided information on 189 water wells within a 1.6 km radius of the site (Appendix A). The well locations are shown on Figure 1. (The database contains information on 451 waterwells within the whole township, these are all noted on Figure 1).

The AEP GIX water well database suggests the chemistry of the regional shallow groundwater is as follows:

- a Total Dissolved Solids (TDS) concentration of approximately 770 mg/L;
- ranging from sodium and potassium dominated to calcium and sodium dominated; and
- the water type is generally of a bicarbonate mixed cation type.

Field verification of wells in the general vicinity of the study site was hampered by a lack of information obtained from well owners in response to requests for information from EBA staff. This included door-to-door visits, drop-off of information request forms and telephone calls. Of the well owners contacted only 12 provided some information on their water wells (Table 1).

Groundwater Exploration and Research Ltd. (GERL) conducted three 12 hour pumping tests on three wells at the north end of the property. They concluded that the aquifer in which the wells were completed could sustain a safe yield of 35,865 m^3/year (15 gpm). This translates to a yeild fo 1.14 L/sec. However the wells did not achieve complete recovery during the recovery portion of the tests.

3.0 DRILLING PROGRAM AND RESULT

We understand that the proposed wells are to be used for domestic purposes. The testhole locations for the production wells were chosen at sites that were considered convenient for their proposed use and also based on the available hydrogeological data at the time of testhole construction.

3.1 Well Installation

As part of this program three testholes were advanced by Aaron Drilling of DeWinton, Alberta, to depths of 47.24 m (155 ft), 71.62 m (235 ft) and 60.96 m (200 ft) within the EH 20-22-02 W5M using an air rotary drilling rig. The locations of the testholes are shown on Figure 2. The depth of the testholes was determined during drilling based on the presence of groundwater supply (greater than approximately 32,279 m^3/year (13.5 gallons per minute). All three wells were completed in interbedded sandstone and shale units.

Testhole logs for the completed wells are provided in Appendix B. Well construction details are summarised in Table 2.

Well 99BH01 was completed with 0.165 m (6.5 inch) diameter steel surface casing to a depth of 11.58 m (38 ft). A 0.127 m diameter PVC (Schedule 40) liner was set in the testhole from 10.66 m (35 ft) to 60.96 m (200 ft). The liner was perforated from 35.05 m (115 ft) to 60.96 m (200 ft). Slots were cut by saw, each approximately 0.15 m (6 inches) long by 0.003 m (1/8 inch) wide. Bentonite was used to seal the testhole in the upper 5 m (16.4 ft). This well was perforated in a sandstone unit.

Well 99BH02 was completed with 0.165 m (6.5 inch) diameter steel surface casing to a depth of 11.58 m (38 ft). A 0.127 m diameter PVC (Schedule 40) liner was set in the testhole from 10.66 m (35 ft) to 71.62 m (235 ft). The liner was perforated from 59.43 m (195 ft) to 71.62 m (235 ft). Slots were cut by saw, each approximately 0.15 m (6 inches) long by 0.003 m (1/8 inch) wide. Bentonite was used to seal the testhole in the upper 5 m (16.4 ft). This well was perforated in a sandstone unit.

Well 99BH03 was completed with 0.165 m (6.5 inch) diameter steel surface casing to a depth of 11.58 m (38 ft). A 0.127 m diameter PVC (Schedule 40) liner was set in the testhole from 10.66 m (35 ft) to 47.24 m (155 ft). The liner was perforated from 35.05 m (115 ft) to 47.24 m (155 ft). Slots were cut by saw, each approximately 0.15 m (6 inches) long by 0.003 m (1/8 inch) wide. Bentonite was used to seal the testhole in the upper 5 m (16.4 ft). This well was perforated in a sequence of sandstone and shale units.

3.2 Site Geology

The lithology noted in the three testholes consists of:

- a thin layer of topsoil (0.2 m);
- till (0.2 m to 1 m); and
- alternating sequence of brown to gray sandstone and shale varying in thickness from approximately 1 m to 5 m (1 m to bottom of the testholes).

Although the sequence of materials in the three testholes was similar it was difficult to correlate the units between the three testholes.

A cross-section constructed along a north-south line through the property and extending south through the Sandy Cross Conservation Area (Figure 3) indicates that the sandstone and shale units from which water is withdrawn by the water wells in the area extend at least 2 to 3 kilometres. However the nature of the geology and structure in the Foothills (i.e., thrust faulting is common) suggests that these water-bearing units may not be continuous nor hydraulically well connected at the local scale.

4.0 PUMPING TEST PROGRAM AND RESULTS

The pumping test on 99BH03 was conducted to determine the transmissivity and storativity of the aquifer as well as to assess the ability of the aquifer to supply the required amount of groundwater and of the well to deliver the required quantity of water. These quantities are used to estimate the drawdown expected in the well over time and the extent of the impact as a result of pumping from this well on other, neighbouring wells.

4.1 Pumping Test and Recovery Test on 99BH03

The pumping test was conducted on 99BH03. A step drawdown test conducted on well 99BH03 at 15,302 m^3/year, 24,867 m^3/year and 35,865 m^3/year (6.4, 10.4 and 15 gpm) indicated that it was able to supply 35,865 m^3/year (15 gpm). The Water Act specifies that each water well should be able to supply 1250 m^3/year per lot that the well services. To adequately assess whether the aquifer could supply enough groundwater for 26 lots on the proposed subdivision a minimum pumping rate of at least 32,500 m^3/year (13.59 gpm) was required.

Aaron Drilling of DeWinton, Alberta, conducted the pumping test on 99BH03. The data obtained from the step-pumping test are provided in Appendix C. Water was pumped from 99BH01 using a Gould submersible pump. The pumping rate was monitored by recording the time required to fill a 22.7 L (5 gallon) bucket during the pumping test. A pre-existing well in the northeast corner of the property (refer to Figure 2) was used as an observation well during the pumping test. The water levels in the pumping well and the observation well were monitored using In-Situ Troll data loggers/transducers. During the test the weather conditions remained relatively consistent – clear skies and daytime temperatures of 5°C.

The pumping test on 99BH03 commenced at 17:00 on October 14, 1999. The flow rate during the test was 35,865 m^3/year (15 gallons/min). After 1010 minutes of pumping at 35,865 m^3/year, the pumping rate was increased to 67,991 m^3/year (28.4 gpm) due to circumstances beyond our control. The pumping portion of the test was terminated at 17:00 on October 15, 1999 after 24 hours. The maximum drawdown during the test was 5.4 m. The water level recovered 94% of its pre-pumping level after 1200 minutes of recovery. The data obtained from the pumping test are provided in Appendix D.

Other groundwater use in the area during the pumping test included domestic use by several residences. The nearest water well in use to the pumping well was approximately 200 m to the east. The observation well (#418358) was impacted by the pumping from well 99BH03. The total drawdown in the observation well during the pumping test was 0.124 m. However this drawdown was also impacted by additional pumping from the aquifer, likely from the 5 residential wells in the vicinity of the observation well. Wells 99BH01 and 99BH02 were monitored periodically during the pumping test but showed no drawdowns resulting from the pumping test.

4.2 Aquifer Properties

The results of the test yielded an average transmissivity value of 6,680 m^2/year for the materials in which the 99BH03 is completed (Table 3). It was not possible to calculate a storativity from the water level data collected from the observation well because of the influence of pumping from the nearby residential wells.

The water bearing units consist of sandstone. These units are generally less than 5 m thick. They tend to be bounded above and below by shale units of equivalent thickness. The extent of these units is not known; they are however, believed to be extensive within the zone influenced by the test.

The recharge to the aquifer is likely from infiltrating precipitation.

Based on the materials (sandstone and shale) present in this confined aquifer Driscoll (1986) suggests a storativity value of 0.00001, however this material is fractured (refer to borehole logs). Therefore a storativity of approximately 1 x 10^{-7} was chosen based on matching calculated drawdown with the observed drawdown. The recovery curve for the pumping test was also steeper than predicted by the Theis model – this is the result of the presence of fractures in the bedrock. The drawdown at various distances from the pumping well and at various times have been calculated, based on the Theis equation, and are presented in Table 4. These calculations, for 1, 2, 5, 10 and 20 years of continuous pumping, assume that the aquifer is of infinite extent and that no recharge to the aquifer occurs.

The projected drawdown after 20 years of continuous pumping from 99BH03 at the rate of 35,865 m^3/year (15 gpm) is 0.27 m at the well and only 0.11 m at a distance of 1000 m from the pumping well.

4.3 Water Quality

A groundwater sample was collected from 99BH01 after approximately 22 hours of pumping. Another groundwater sample was collected from the well 99BH03 during the step pumping test after approximately 3 hours of pumping. The sample was submitted to Enviro-Test Laboratories (ETL) of Calgary for analysis. The laboratory analytical results are summarised in Table 5 and are presented in Appendix E.

A Piper plot of the major ions (Figure 4) shows that the groundwater from the well is chemically hard and is of a Calcium-Sodium-Bicarbonate type with no dominant cation. The regional water quality, obtained from the AEP Groundwater Information Centre plotted on a Piper plot (Figure A.4) indicates that the water from this well is comparable to other wells completed in the sandstone and shale at similar depths.

The sample collected from 99BH03, analyzed for coliforms, returned a value of 150 cfu/100 ml which exceeds the Guidelines for Canadian Drinking Water Quality. This well should be sampled again after the well has been disinfected and after a permanent pump has been installed, before commencement of production, to confirm this value. It was possible that the coliforms may have been introduced from an external source.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The material in which 99BH03 is completed is capable of sustaining the rate at which the well was pumped (35,865 m^3/year or 15 gpm).

The quality of the groundwater is acceptable for use as a domestic water supply. However the quality of the groundwater may differ from place to place in the subdivision and it is recommended that the water be tested on each well that is constructed for potable water supply.

6.0 LIMITATIONS OF LIABILITY

Conclusions and recommendations presented herein are based on an authorised groundwater assessment as described in Section 1.0. This report has been prepared for the use of Kellam Berg Engineering and Surveys Ltd. and their approved agents for the specific application described above. It has been prepared in accordance with generally accepted environmental engineering practises. No other warranty is made either expressed or implied. EBA's Environmental Report – General Conditions under which this work was performed are provided in Appendix F.

7.0 CLOSURE

We trust the information presented herein satisfies your present requirements. Should you have any questions or require further elaboration, please contact us at our Calgary Riverbend office at (403) 203-3355.

Respectfully submitted,

EBA Engineering Consultants Ltd.

[redacted]

COPY

David van Everdingen, Ph.D., P.Geol.
Hydrogeologist

Reviewed By:

[redacted]

J.T. Dance, M.Sc., P.Geol.
Senior Contaminant Hydrogeologist

PERMIT TO PRACTICE
EBA EN[redacted]TANTS LTD.
Signature [redacted]
Date 08 25 1999
PERMIT NUMBER: P245
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

DAV:kls

REFERENCES

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Freeze, R.A. and Cherry, J.A. 1979. Groundwater. Prentice Hall, Englewood Cliffs, N.J.

Green, R. 1970. Geological Map of Alberta. Scale 1:1,267,000. Alberta Research Council.

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TABLES

TABLE 1
FIELD VERIFICATION OF SELECTED WATER WELLS
RED WILLOW ESTATES
0304-31058.01

LSD	AEP-GIC Well ID	Well Depth [m]	Water Level [m]	Pump Depth [m]	Available Drawdown [m]
NE-17	377587	67.056	38	56.05	18.05
NE-19	?	-	45	-	-
NE-19	377369	30	-	-	-
NW-19		30			
NW-21	?	91.44	-	-	-
NW-21	377502?	50.292	29.8	57.95	28.15
NW-21	?	-	6.3	-	-
SE-21	?	-	37.2	45.1	7.9
SE-21	349668	67.056	38.18	59.4	21.22
NE-28	377982	48.768	-	-	-
NE-28	377977	54.864	17.3	30	12.7
NE-29	377964?	77.724	-	-	-

TABLE 2
WELL CONSTRUCTION DETAILS
RED WILLOW ESTATES
0304-31058.01

Parameter	Units	99BH01	99BH02	99BH03
Location	[LSD]	SE-20-22-02 W5M	SE-20-22-02 W5M	SE-20-22-02 W5M
Total Depth	[m]	47.24	71.62	60.96
Construction Completed	[dd/mm/yy]	7-Sep-99	8-Sep-99	6-Oct-99
Casing Bottom	[mBTOC]	11.58	11.58	11.58
Casing Type	[-]	Steel	Steel	Steel
Casing Diameter	[m]	0.165	0.165	0.165
Screen Interval Top	[mBTOC]	35.05	59.43	35.05
Screen Interval Bottom	[mBTOC]	47.24	71.62	71.62
Screen Type	[-]	Saw cut Sched. 40 PVC	Saw cut Sched. 40 PVC	Saw cut Sched. 40 PVC
Material at Screen	[-]	Gray sandstone and shale	Gray sandstone	Sandstone

eba

TABLE 2
HYDRAULIC PROPERTIES CALCULATED FROM AQUIFER TESTING
RED WILLOW ESTATES
0304-31058.01

Method	Transmissivity [m²/min]	Transmissivity [m²/day]
Pumping Test: 99BH03		
Cooper-Jacob (AQTESOLV)	0.02	30.1
Theis (AQTESOLV)	0.01	16.0
Recovery Test: 99BH03		
Residual Drawdown Calculation	0.01	14.1
Time-Recovery Calculation	0.01	14.4
Theis Recovery (AQTESOLV)	0.02	28.5
Geometric Mean (omitting the Cooper-Jacob result)	**0.0127**	**18.3**
Hydraulic Conductivity, K* in m/s	2.E-05	

* assuming the aquifer thickness, b, is 10 m, K=T/b

TABLE 4
DRAWDOWNS AT VARIOUS TIMES AND DISTANCES
RED WILLOW ESTATES
0304-31058.01

PUMPING WELL 99BH03

Conditions: Pumping rate used during pumping test

Storativity =	1.00E-07		**Well radius=**		0.057 m
Pumping rate=	1.14E-03	m^3/s	15.0	g.p.m.	
Trans.=	1.27E-02	m^2/s	18.3	m^2/day	

Time		Distance [m]				
Years	Seconds	0.057	100	500	1000	5000
1	3.16E+07	0.25	0.15	0.12	0.11	0.09
2	6.31E+07	0.26	0.15	0.13	0.12	0.10
5	1.58E+08	0.26	0.16	0.14	0.13	0.10
10	3.16E+08	0.27	0.16	0.14	0.13	0.11
20	6.31E+08	0.27	0.17	0.15	0.14	0.11

TABLE 5
GROUNDWATER CHEMISTRY
RED WILLOW ESTATES
0304-31058.01

Parameter	Other Units	Well I.D. 99BH01	Well I.D. 99BH03	CCME Drinking Water Criteria*
Date Sampled	-	14-Sep-99	14-Oct-99	-
Well Depth	m	47.24	60.96	-
Alkalinity, Total (T Alk)	mg/L		567	NC
Balance	%	96	103	NC
Bicarbonate (HCO3)	mg/L	482	692	NC
Calcium (Ca)	mg/L	70.9	38	NC
Carbonate (CO3)	mg/L	<5	<5	NC
Chloride (Cl)	mg/L	1.5	4.1	250
Conductance (EC)	uS/cm	672	994	NC
Fluoride	mg/L	0.2	0.3	1.5
Hardness	mg/L	352	190	NC
Hydroxide in Water	mg/L	<5	<5	NC
Iron (Fe)	mg/L	<0.01	<0.01	0.3
Magnesium (Mg)	mg/L	42.4	23.1	NC
Manganese (Mn)	mg/L	<0.01	0.02	0.05
Nitrate+Nitrite (N)	mg/L	1	<0.05	45
pH in Water	pH	7.2	7.5	NC
Potassium (K)	mg/L	5.5	3.9	NC
Sodium (Na)	mg/L	39	187	200
Sulfate (SO4)	mg/L	22.8	45.6	500
TDS (Calculated)	mg/L	420	<u>642</u>	500
Total Coliform	CFU/100 mL	0	<u>150</u>	10
Fecal Coliform	CFU/100 mL	0	0	0

Notes:
CCME - Canadian Council For Ministers of the Environment (1991).
for drinking water.
NC = No criterion available.

FIGURES

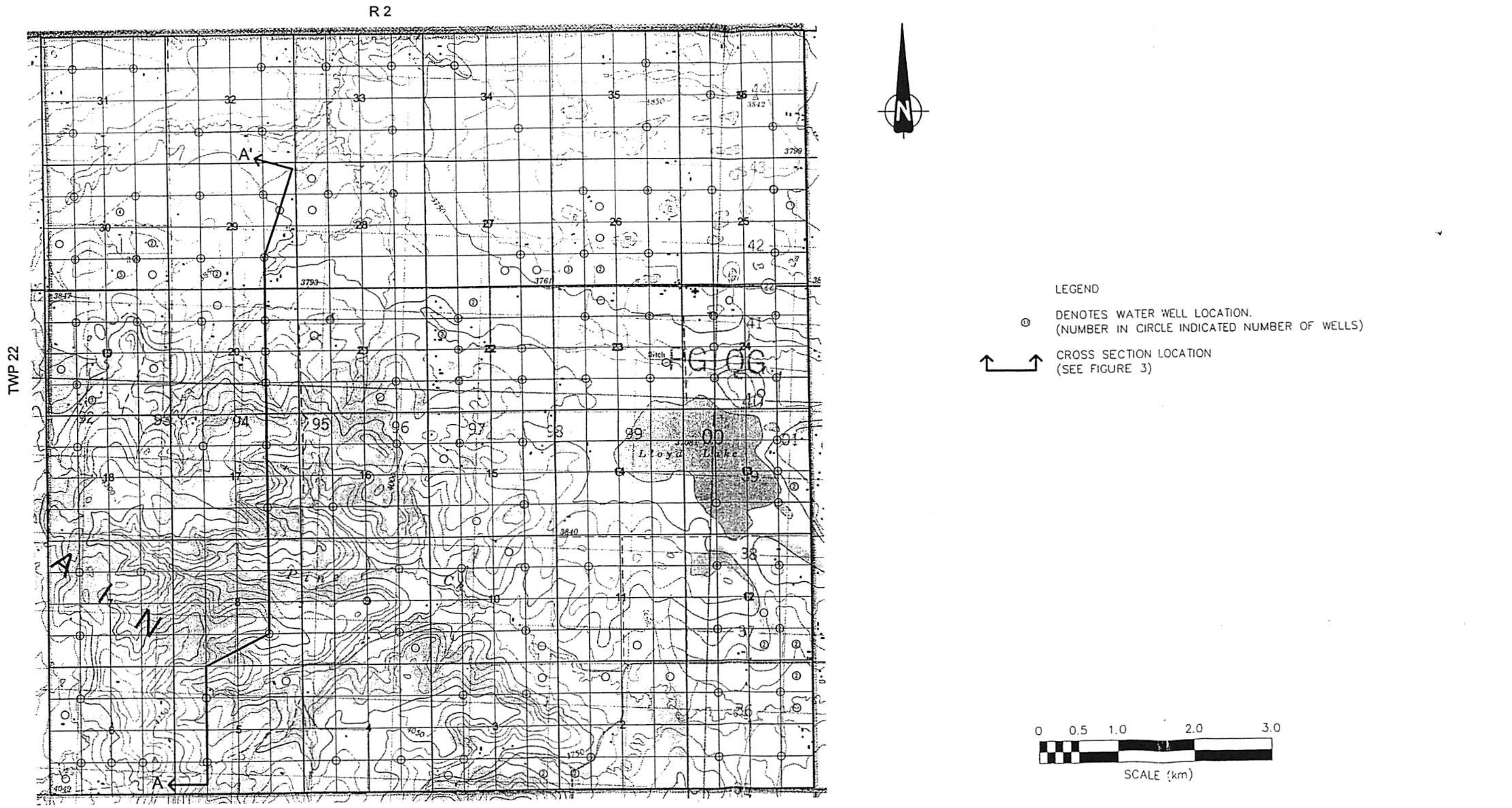
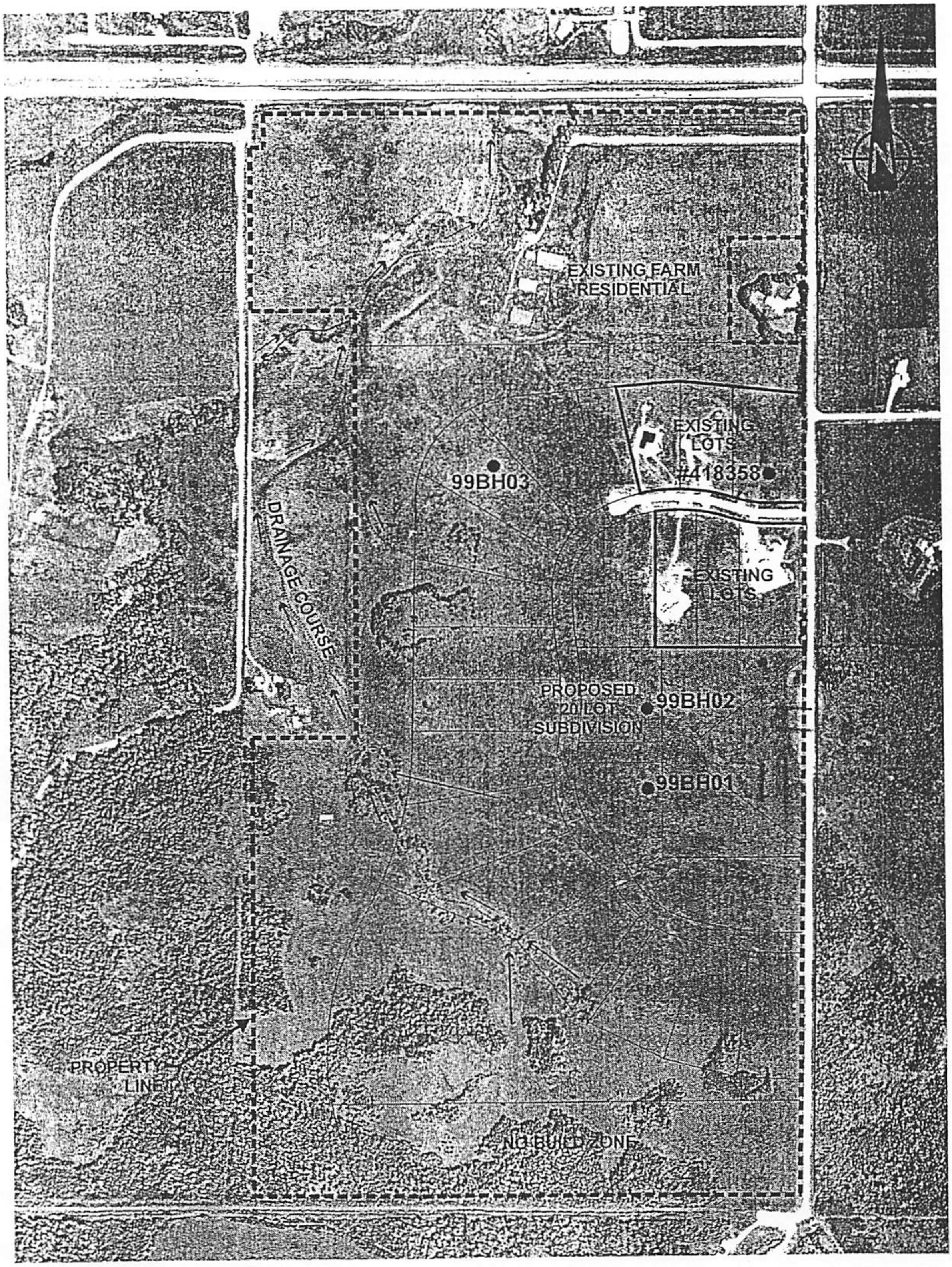


Figure 1

Site Location

31058S01A.dwg



● - Water wells used in this investigation

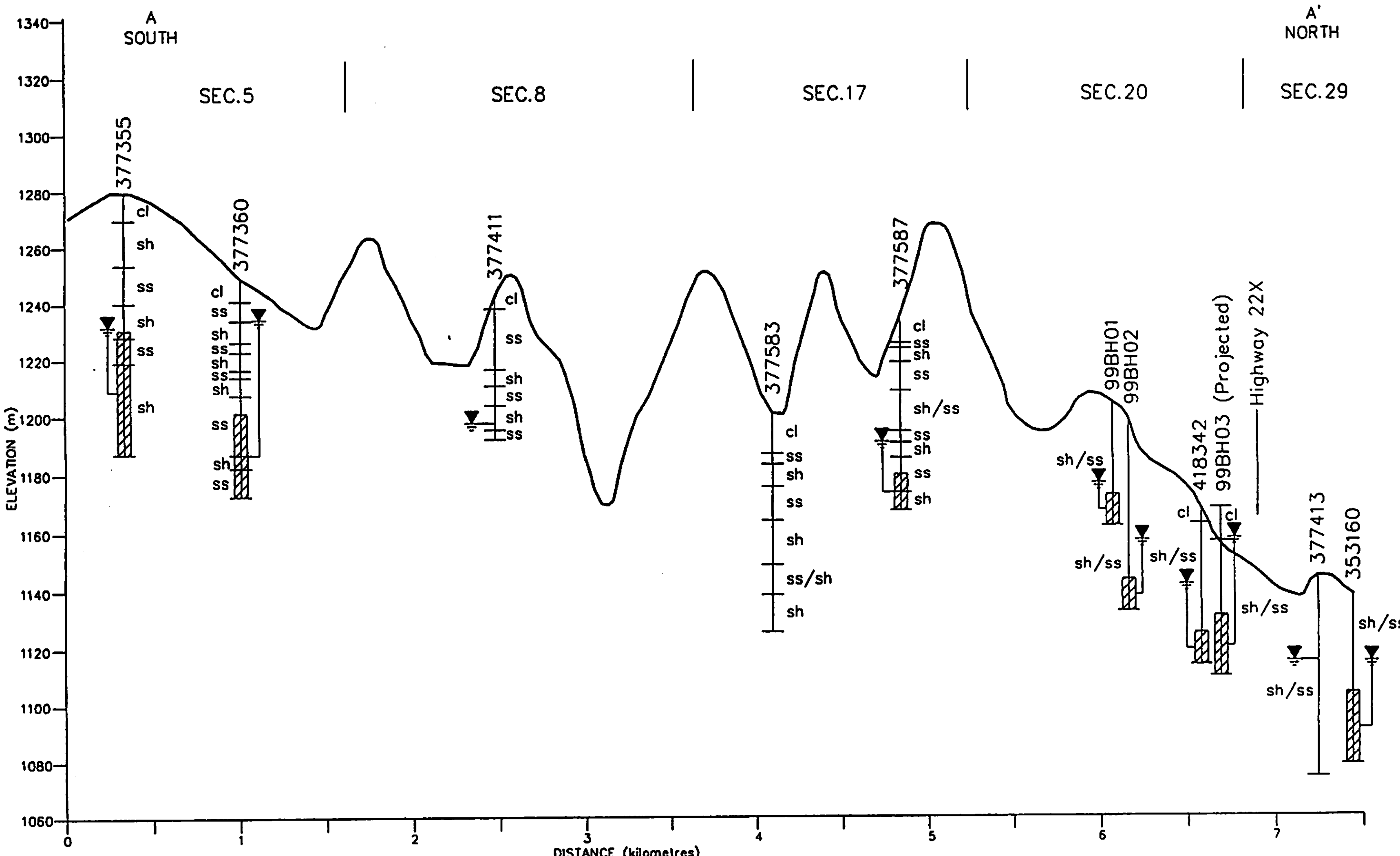
0 100 200 400

SCALE (metres)

(1998 aerial photograph base)

Figure 2

31058P01c.cdr



THE GEOLOGIC AND STRATIGRAPHIC SECTIONS SHOWN ON THIS DRAWING ARE INTERPRETED FROM BOREHOLE LOGS. STRATIGRAPHY IS KNOWN WITH CERTAINTY ONLY AT THE BOREHOLE LOCATIONS. ACTUAL STRATIGRAPHY AND GEOLOGIC CONDITIONS BETWEEN BOREHOLES MAY VARY FROM THAT INDICATED ON THIS DRAWING.

SCALE AS SHOWN
VERTICAL EXAGGERATION APPROXIMATELY 20x

LEGEND

- WATER LEVEL (AT TIME OF CONSTRUCTION)
- PERFORATED INTERVAL

377411 - REFER TO AEP GROUNDWATER INFORMATION CENTRE WATER WELL RECORDS

cl - CLAY
ss - SHALE
sh - SANDSTONE

Figure 3

Cross Section A-A'

31058X02b.dwg

eba

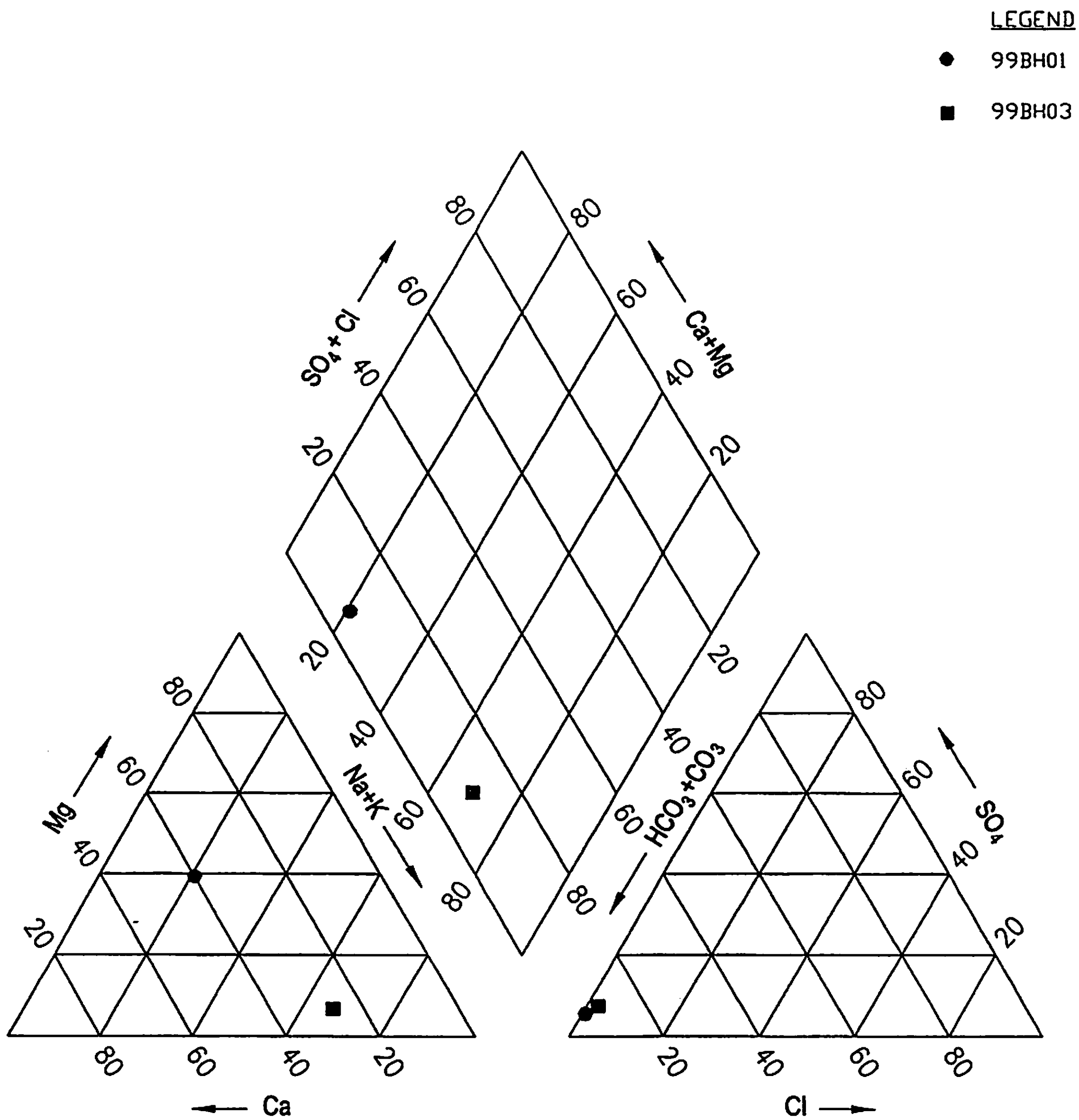


Figure 4

Piper Plot
Local Well Chemistry

31058002c.dwg

APPENDIX A

AEP – GIC WATER WELL INFORMATION

APPENDIX A - TABLE 1
ALBERTA ENVIRONMENT PROTECTION - SUMMARY OF REGIONAL WATER WELLS
RED WILLOW ESTATES
0304-31058.01

	Owner	Address	Current Owner	LSD	Sec	Twp	Rng	Mer	Elev	Well Depth [m]	Perforated From [m]	Perforated To [m]	Static W.L. [m]	Chem Avail.	Chem on D.B.	Lithology at Screen (if no perforations then lithology is from bottom of hole)	Proposed Use
377348	CROSS, A.R.	RR8, ROTHNEY FARM, CALGARY	Cross Consv. Area	SE	04	022	02	5	#####	28.4	19.8	28.0	21.34	No			Stock
377352	ROTHNEY FARMS	SITE2, RR8, CALGARY 57 T2S 2T9	Cross Consv. Area	SW	04	022	02	5		109.7	48.8	77.7	48.77	No		Gray shale	Stock
377355	CROSS, A.R.	RR8, ROTHNEY FARMS, CALGARY T2J 2T9	Cross Consv. Area	SW	05	022	02	5	#####	91.4	48.8	89.9	48.77	No		Blue shale,Gray shale,Light water bearing sandstone,Gray shale,Blue shale	Stock
377360	CROSS, A.R.	RR8, ROTHNEY FARMS, CALGARY T2J 2T9	Cross Consv. Area	NW	05	022	02	5	#####	76.2	48.8	75.0	17.98	No		Light gray water bearing sandstone,Gray shale & sandstone,Light gray sandstone	Stock
377366			Cross Consv. Area	16	05	022	02	5	#####	0.0	0.0	0.0	no w.l.	Yes	1		
377367	ELHATTON, L.	1339-6A ST NW, CALGARY	Cross Consv. Area	SE	06	022	02	5		44.8	0.0	0.0	13.41	No		Water bearing sand	Unknown
377372	STANDISH, LLOYD		Cross Consv. Area	SW	06	022	02	5		39.9	0.0	0.0	21.34	No		Water bearing sand	Domestic and Stock
377376	ROBERTSON, DON & PAT	RR8, CALGARY 4	Cross Consv. Area	SW	06	022	02	5		0.0	0.0	0.0	no w.l.	Yes			Domestic
377377	STANDISH, J.L.	RR8, CALGARY	Cross Consv. Area	04	06	022	02	5	#####	27.4	21.3	27.4	21.34	Yes	1		Unknown
377381	HERGOTT, DARLENE	SITE 2, RR8, CALGARY T2J 2T1	Cross Consv. Area	NW	06	022	02	5		0.0	0.0	0.0	no w.l.	Yes			Unknown
377383	GROSE, JIM	616 MCINTOSH RD, CALGARY	Cross Consv. Area	12	06	022	02	5	#####	35.7	26.5	35.1	26.21	No		Blue shale,Gray shale,Light sandstone	Domestic
378875	ATKINS, JOHN	RR8, CALGARY	Cross Consv. Area	SW	06	022	02	5	#####	31.7	22.3	25.3	22.86	Yes	1	Sandstone,Blue shale,Sandstone	Domestic and Stock
379180	ABBOTT, MARSHALL	SITE 2 RR8, CALGARY 24 T2J 2T9	Cross Consv. Area	SE	06	022	02	5		109.7	54.9	61.0	67.06	No		Shale,Sandstone	Domestic
360065	PROKOPY, TERRY	RR9 CALGARY	Cross Consv. Area	NE	07	022	02	5		38.1	32.0	38.1	17.68	No		Blue sandstone,Blue shale,Blue water bearing shale,Blue shale,Blue water bearing shale,Blue shale	Domestic
377389	ROYAL TRUST, C/O CROSS, A.R	600-7 AVE SW, CALGARY	Cross Consv. Area	SW	07	022	02	5	#####	41.2	34.4	39.9	33.22	Yes	1	Gray shale,Light sandstone,Gray shale	Domestic
377397	CROSS, A.R.	RR8, ROTHNEY, CALGARY	Cross Consv. Area	SW	07	022	02	5	#####	32.9	21.3	31.7	20.73	No		Brown fractured sandstone,Gray shale	Domestic
377408	WENGATZ CONSTRUCTION		Cross Consv. Area	NW	07	022	02	5	#####	51.8	44.8	48.8	40.23	No		Gravel	Domestic
377411	MACKLIN, P.T.	MIDNAPORE	Cross Consv. Area	SE	08	022	02	5	#####	45.7	0.0	0.0	42.37	No		Water bearing unknown	Domestic
377415	LESEBERG, H.	1747-36 AVE SW, CALGARY	Cross Consv. Area	SE	09	022	02	5		30.5	0.0	0.0	no w.l.	Yes	2		Unknown
377417	PINCH	SITE 4, RR8, CALGARY 8	Cross Consv. Area	SE	09	022	02	5		0.0	0.0	0.0	no w.l.	Yes			Domestic
377420	TYNAN, NANCY	SITE 4, TRR8, CALGARY 1	Cross Consv. Area	NE	09	022	02	5		0.0	0.0	0.0	no w.l.	Yes			Domestic
377421	SUN OIL CO		Cross Consv. Area	00	09	022	02	5		13.7	0.0	0.0	no w.l.	No		Clayey sandstone & rocks	Industrial
378778	ROTHNEY FARMS	RR8, SITE 2, CALGARY 57 T2J 2T9	Cross Consv. Area	01	09	022	02	5	#####	0.0	0.0	0.0	no w.l.	Yes	1		Domestic
77578	ROTHNEY FARMS	SITE 2, RR8, CALGARY 57 T2J 2T9	Cross Consv. Area	NE	16	022	02	5		106.7	0.0	0.0	no w.l.	No		Dark gray shale	Stock
81	ROTHNEY FARMS	SITE 2, RR8, CALGARY 57	Cross Consv. Area	NE	16	022	02	5		79.9	0.0	0.0	no w.l.	No		Dark gray shale	Unknown
377582	ROTHNEY FARMS	SITE 2, RR8, CALGARY 57	Cross Consv. Area	NE	16	022	02	5		91.4	64.0	90.5	50.29	No		Gray shale & sandstone,Gray shale,Light water bearing sandstone,Gray shale,Coal,Gray shale,Light soft sandstone	Stock
377583	ROTHNEY FARMS	SITE 2, RR8, CALGARY 57 T2J 2T9	Cross Consv. Area	SE	17	022	02	5		76.2	0.0	0.0	no w.l.	No		Gray shale	Stock
377584	ROTHNEY FARMS	RR8, CALGARY	Cross Consv. Area	NW	17	022	02	5		76.2	59.4	74.7	58.52	No		Light gray sandstone,Gray shale,Light gray water bearing sandstone	Stock
377587	THE NATURE CONSERVANCY OF CDN	422-33RD AVE NW, CALGARY T2K 0B4	Cross Consv. Area	NE	17	022	02	5		67.1	54.9	67.1	42.67	No		Siltstone,Brown fine grained sandstone,Salt & pepper fractured sandstone,Gray shale	Domestic
377590	CROSS, A.R.	RR8, ROTHNEY FARMS, CALGARY	Cross Consv. Area	NW	18	022	02	5	#####	54.9	36.6	53.3	29.87	No		Brown sandstone,Gray shale,Dark gray water bearing sandstone	Stock
354338	FINNIS, TIM	SITE 2 RR8, CALGARY 8 T2P 2T9		SW	19	022	02	5		47.2	41.2	47.2	30.18	Yes		Gray shale,Fine grained sandstone,Brown wet sandstone,Coarse grained sandstone	Domestic
354772	KNAPP, BRENT	SITE 2 RR8, CALGARY 2 T2J 2T9		SW	19	022	02	5		0.0	0.0	0.0	no w.l.	Yes			Domestic
359987	VAN WIELINGEN, GUS WELL #	STE 2628 1 CAL PLACE 330 5 AVE SW CALGAR T2P 0L4		NW	19	022	02	5		73.2	42.7	73.2	34.14	Yes		Brown shale & sandstone ledges,Blue water bearing shale & sandstone ledges	Domestic
377337	SKELETON, G.	RR8 CALGARY		SW	19	022	02	5		11.9	0.0	0.0	no w.l.	Yes	1		Domestic
377339	FINNIS, F.	9816 ALBERNI RD SW, CALGARY		SW	19	022	02	5	#####	25.9	0.0	0.0	17.98	No		Gray shale	Domestic and Stock
377342	BONSRTA, BRIAN	302A S HAMPTON DR, CALGARY		SW	19	022	02	5	#####	25.0	15.2	18.3	12.8	No		Brown shale,Gray shale,Gray water bearing sandstone	Domestic
377343	SURE HOLDINGS LTD.	RR8 CALGARY		SW	19	022	02	5	#####	42.7	32.0	42.7	16.76	No		Sandy clay,Sandstone	Domestic and Stock
377345	FLANOGAN, H.C.	RR8 CALGARY		00	19	022	02	5		30.5	0.0	0.0	24.99	No		Sandstone & Shale Ledges	Domestic
377346	PFEIFFER, TY	912 WOODVIEW CRESC SW, CALGARY		SW	19	022	02	5		73.2	33.5	64.0	30.48	No		Clay & Rocks,Blue shale & sandstone	Domestic
377357	LAMB, E.J.	RR8 CALGARY		03	19	022	02	5	#####	15.2	0.0	0.0	6.1	Yes	1		Domestic
377359	HILL, C.G.	RR8 CALGARY 5		NW	19	022	02	5		45.7	0.0	0.0	no w.l.	Yes	1		Domestic
377361	HILL, DOROTHY	S2 RR8, CALGARY 5		NW	19	022	02	5		62.5	0.0	0.0	no w.l.	Yes			Domestic
377369	FLEMMING, DON	PRIDDIS		NE	19	022	02	5	#####	30.5	6.1	7.3	5.49	No		Gravelly clay,Sandstone	Domestic
377380	FLEMING, DON	1404 BEVERLY PL SW, CALGARY		NE	19	022	02	5	#####	48.8	38.1	41.2	27.43	No		Shale	Domestic
377385	FLEMING, DON	1404 BEVERLY PL SW, CALGARY		NE	19	022	02	5	#####	85.3	57.9	61.0	56.39	No		Shale	Domestic
377388	KRAUSERT	S14 RR8, CALGARY 2		NE	19	022	02	5	#####	67.1	0.0	0.0	no w.l.	Yes	1		Domestic
377393	HOPE ROSS, BILL	S14 RR8 CALGARY 13		NE	19	022	02	5		54.9	35.1	50.3	34.14	Yes		Shale,Fractured shale,Shale,Fractured shale,Shale,Shale & Sandstone,Shale,Shale & Sandstone	Domestic
378629	UPLAND DEV CO. LTD.	SUITE 3003, LONDON HOUSE, CALGARY		SW	19	022	02	5	#####	30.5	21.3	30.5	16.76	Yes	2	Sandy clay,Brown clay & shale,Gray shale	Domestic
378630	FLEMING, DON	1404 BEVERLY PL SW, CALGARY		NE	19	022	02	5	#####	79.3	71.6	74.7	45.72	Yes	1	Shale	Domestic
7795	SOUTHERN, N.	SITE 14 RR8, CALGARY 2 T2J 2T9		08	19	022	02	5		79.3	60.4	66.5	22.86	No		Shale,Sandstone	Stock
469147	DALTON, RICK/LILLIAN	SITE 2 RR8, CALGARY 2		03	19	022	02	5		39.6	33.5	39.6	22.89	No		Gray shale,Gray water bearing sandstone	Domestic
469148	PFEIFER, TY	PRIDDIS 75 T0L 1W0		05	19	022	02	5		43.3	37.2	43.3	12.5	No		Gray shale,Gray water bearing sandstone	Domestic
490025	FLANAGAN, HERB	SITE 2 RR8, CALGARY 13 T2J 2T9		03	19	022	02	5		29.6	23.5	29.6	no w.l.	No		Gray shale	Domestic
360064	DAVIES, DAVE #1674	SITE 24 RR8, CALGARY 7 T2J 2T9		NW	20	022	02	5		45.7	33.5	42.7	32.	No		Brown sandy shale,Gray shale,Brown water bearing sandstone	Domestic and Stock
377469	KINCH, MIKE	S24 RR8 CALGARY 4 T2J 2T9	Bav. Lion Co.	SE	20	022	02	5		0.0	0.0	0.0	no w.l.	Yes			Domestic

APPENDIX A - TABLE 1
ALBERTA ENVIRONMENT PROTECTION - SUMMARY OF REGIONAL WATER WELLS
RED WILLOW ESTATES
0304-31058.01

Well ID	Owner	Address	Current Owner	LSD	Sec	Twp	Rng	Mer	Elev	Well Depth [m]	Perforated From [m]	To [m]	Static W.L. [m]	Chem Avail.	Chem on D.B.	Lithology at Screen (if no perforations then lithology is from bottom of hole)	Proposed Use
377472	GRAHAM, VIOLA RUTH	RR8 CALGARY	Bav. Lion Co	SE	20	022	02	5	#####	9.1	0.0	0.0	no w.l.	Yes	1		Domestic
377474	DAVIES, DAVE	S24 RR8, CALGARY 7		NW	20	022	02	5		45.7	33.5	42.7	32.	No		Brown sandy shale,Gray shale,Brown water bearing sandstone	Domestic and Stock
377479	PETERS, WILLIAM	RR8 S14, CALGARY 19	Bav. Lion Co.	NE	20	022	02	5		0.0	0.0	0.0	no w.l.	Yes			Domestic
377481	STANTON, D	RR8 CALGARY	Bav. Lion Co.	EH	20	022	02	5	#####	30.5	0.0	0.0	21.34	Yes	1		Domestic
378631	DAVIES, DAVE	MIDNAPORE		NW	20	022	02	5	#####	16.5	0.0	0.0	4.27	Yes		Sandrock	Domestic
378632	DAVIES, DAVE	RR8, CALGARY		14	20	022	02	5		7.6	0.0	0.0	3.66	Yes	1	Water bearing shale	Domestic
418340	BAVARIAN LION CO C/O JANZ,ROLF	SITE 23 RR8, CALGARY 7 T2J 2T9	Bav. Lion Co.	NE	20	022	02	5		40.2	25.9	34.1	21.03	No		Thin shale & sandstone ledges,Thin shale & sandstone ledges	Domestic
418342	BAVARIAN LION CO LTD	SITE 23 RR8, CALGARY 7 T2J 2T9	Bav. Lion Co.	NE	20	022	02	5		58.5	41.2	57.9	26.7	No		Shale & Sandstone Ledges,Shale & Sandstone Ledges	Domestic
418345	BAVARIAN LION CO C/O JANZ,ROLF	SITE 23 RR8, CALGARY 7 T2J 2T9	Bav. Lion Co	NE	20	022	02	5		46.3	29.0	40.5	21.31	No		Shale & Sandstone,Sandstone,Shale & Sandstone Ledges	Domestic
437389	BAVARIAN LION CO LTD	SITE 23 RR8, CALGARY 7 T2J 2T9	Bav. Lion Co.	NE	20	022	02	5		53.0	25.9	46.9	24.08	No		Shale,Shale & Sandstone,Sandstone,Shale,Sandstone,Shale & Sandstone	Domestic
437392	BAVARIAN LION CO LTD JANZ, ROL	SITE 3 RR8, CALGARY 7 T2J 2T9	Bav. Lion Co.	NE	20	022	02	5		36.0	22.0	35.7	15.54	No		Shale & Sandstone Ledges,Sandstone,Thin shale & sandstone ledges,Shale & Sandstone Ledges,Sandstone,Thin shale & sandstone ledges	Domestic
437393	BAVARIAN LION CO LTD/JANZ,ROLF	SITE 3 RR8, CALGARY 7 T2J 2T9	Bav. Lion Co.	NE	20	022	02	5		40.2	18.3	33.5	12.19	No		Shale,Shale & Sandstone Ledges,Shale,Shale,Shale & Sandstone Ledges,Shale	Domestic
349668	WOODS, MR & MRS #2480	SITE 4 RR #8, CALGARY 8 T2J 2T9		SE	21	022	02	5		67.1	57.9	67.1	38.68	No		Brown sandstone,Gray shale,Gray water bearing sandstone,Gray shale	Domestic
351791	O'HANLON HARRY #1417	SITE 4 RR8, CALGARY 8		SE	21	022	02	5		42.7	30.5	42.7	19.81	Yes		Clay,Gray shale & sandstone,Gray siltstone,Gray water bearing sandstone	Stock
354339	MARTINI, RAY	C/O 3 6125 12 ST. SE CALGARY T2H 2K1		NW	21	022	02	5		29.0	0.0	0.0	no w.l.	Yes			Domestic
356347	MCINTOSH, L	SITE 23 RR9 CALGARY 11 T2J, 2T9		NW	21	022	02	5		34.4	0.0	0.0	no w.l.	Yes			Domestic
359988	O'HANLON, HARRY	13046 SITE 6 RR8 CALGARY T2J 2T9		SE	21	022	02	5		50.6	41.2	50.6	30.48	Yes		Clay,Brown sandstone & shale ledges	Domestic
377482	CHANLON, HARRY	S6 RR8, CALGARY 6		SE	21	022	02	5		47.2	36.6	47.2	13.72	Yes		Gray shale,Gray water bearing sandstone,Gray shale	Domestic and Stock
377487	O'HANLON, HARRY	S4 RR8, CALGARY 8		SE	21	022	02	5		3.1	0.0	0.0	no w.l.	Yes			Domestic
377488	O'HANLON, HARRY	S4 RR8, CALGARY 8		SE	21	022	02	5		42.7	30.5	42.7	19.81	Yes		Clay,Gray shale & sandstone ledges,Gray siltstone,Gray water bearing sandstone	Stock
377492	O'HANLON, HARRY	S6 RR8, CALGARY 6 T2J 2T9		02	21	022	02	5		50.6	0.0	0.0	30.48	Yes		Brown sandstone & shale strg's	Domestic
377496	BAKER, ROLAND	440 QUEEN ALEXANDRA WAY, CALGARY		NW	21	022	02	5	#####	59.4	0.0	0.0	0.	Yes	1	Brown unknown	Domestic
377502	WESTWARD CONSTRUCTION	760 CEDARCLE WAY SW, CALGARY		NW	21	022	02	5		48.8	42.7	48.8	15.24	No		Clay & Rocks,Sandstone & Shale Ledges	Domestic
377503	CLAYDON	RR8, CALGARY		NW	21	022	02	5		59.4	51.8	59.4	0.	No		Clay & Rocks,Sandstone & Shale Ledges	Domestic
377505	OLMAND	S8 RR9, CALGARY 4		NW	21	022	02	5	#####	23.8	0.0	0.0	11.28	No		Blue sandstone	Domestic
377507	IRVING DON	12120 14 ST SW, CALGARY		NW	21	022	02	5	#####	34.4	24.4	33.2	12.8	Yes	1	Light blue sandstone,Siltstone	Domestic
377510	MCPHAIL, COLIN	111 LAKE LUCERNE CLOSE SE, CALGARY		NW	21	022	02	5		45.7	32.0	44.2	31.7	Yes	1	Light gray sandstone,Gray shale,Light gray water bearing sandstone	Domestic
377511	GULA, DR.	S23 RR8, CALGARY 4		NW	21	022	02	5		61.0	0.0	0.0	no w.l.	No		Black shale	Domestic
377515	GULA, DR.	RR8 CALGARY 4		NW	21	022	02	5		70.1	33.5	39.6	19.81	No		Clay	Domestic
377522	FRONTIER GEOPHYSICAL LTD 174-2			12	21	022	02	5	#####	463.3	0.0	0.0	no w.l.	No			Industrial
377523	MIDDLETON, V.	RR8 CALGARY		00	21	022	02	5	#####	42.7	33.5	42.7	30.48	Yes	1		Domestic
349929	DAWSON, HAL #2982	SITE 6 RR8, CALGARY 6 T2J 2T9	North of 22X	NW	28	022	02	5		46.9	22.6	28.7	4.24	No		Brown sandstone,Shale,Sandstone	Domestic
349930	DAWSON, HAL	SITE 6 RR8, CALGARY 6 T2J 2T9	North of 22X	NW	28	022	02	5		85.3	0.0	0.0	30.48	No		Gray shale	Domestic
351447	DOUBLE E.FARMS #1295	MIDNAPORE 10	North of 22X	NW	28	022	02	5		71.6	53.3	71.6	12.19	No		Blue shale,Gray sandy shale,Gray shale,Gray sandstone,Blue sandstone,Gray shale	Domestic
351448	DOUBLE "E" FARMS #1305	MIDNAPORE 10	North of 22X	NW	28	022	02	5		57.3	45.1	57.3	10.06	No		Gray shale,Blue fractured shale,Gray shale,Sandstone,Gray shale	Domestic
361157	HAGEL, GERRY	RR2 CROSSFIELD T0M 0S0	North of 22X	13	28	022	02	5		18.3	0.0	0.0	4.57	No		Shattered sandstone	Domestic and Stock
377946	OHANLON, H.	MIDNAPORE 99	North of 22X	NW	28	022	02	5	#####	33.5	0.0	0.0	0.	No		Shale & Sandstone	Domestic and Stock
377955	DOUBLE E FARMS	MIDNAPORE 10	North of 22X	NW	28	022	02	5		71.6	53.3	71.6	12.19	No		Blue gray shale,Gray sandy shale,Blue gray shale,Gray sandstone,Blue water bearing sandstone,Gray shale	Domestic
377958	DOUBLE E FARMS	MIDNAPORE 10	North of 22X	NW	28	022	02	5		57.3	45.1	57.3	10.06	No		Blue gray shale,Blue fractured shale,Blue gray shale,Water bearing sandstone,Gray shale	Domestic
377960	OHANLON, H.	MIDNAPORE 99	North of 22X	NE	28	022	02	5		18.3	0.0	0.0	no w.l.	No		Sand	Domestic and Stock
377962	SUN OIL CO.	805 8TH AVE SW, CALGARY	North of 22X	NE	28	022	02	5	#####	54.9	0.0	0.0	48.77	Yes	1		Unknown
377964	OHANLON, H.	MIDNAPORE 99	North of 22X	NE	28	022	02	5	#####	76.2	0.0	0.0	3.66	No		Shale & Sandstone Ledges	Domestic
377966	OHANLON, H.	MIDNAPORE 99	North of 22X	NE	28	022	02	5	#####	61.0	0.0	0.0	4.57	No		Shale & Sandstone	Domestic and Stock
377967	OHANLON, H.	MIDNAPORE 99	North of 22X	NE	28	022	02	5		131.1	0.0	0.0	no w.l.	No		Shale & Sandstone	Domestic and Stock
377969	OHANLON, H.	MIDNAPORE 99	North of 22X	NE	28	022	02	5		33.5	0.0	0.0	0.	No		Shale	Domestic and Stock
377972	OHANLON, H.	MIDNAPORE 99	North of 22X	NE	28	022	02	5	#####	61.0	0.0	0.0	no w.l.	No		Hard shale	Unknown
377974	ERICKSON, B.	1088 ALADIA DR SE, CALGARY	North of 22X	NE	28	022	02	5	#####	30.5	0.0	0.0	no w.l.	No		Blue clay	Domestic
377976	OHANLON, H.	MIDNAPORE 99	North of 22X	NE	28	022	02	5		61.0	0.0	0.0	no w.l.	No		Shale & Sandstone	Domestic and Stock
377977	LAMONTAGUE, ARTHUR & HECK R.	MIDNAPORE 488 T0L 1J0	North of 22X	NE	28	022	02	5		54.9	42.7	54.9	18.29	Yes		Blue shale,Shale & Sandstone Ledges,Soft sandstone,Shale	Domestic
377980	HECK, RONALD	MIDNAPORE 488 T0C 1J0	North of 22X	NE	28	022	02	5		67.1	0.0	0.0	no w.l.	No		Black shale	Domestic
377982	HECK, RONALD D.	MIDNAPORE 488 T0C 1J0	North of 22X	NE	28	022	02	5		48.8	36.6	48.8	9.14	No		Blue shale,Blue shale & sandstone ledges,Sandstone,Blue shale,Blue shale & sandstone ledges	Domestic
378636	OHANLON, H.F.	MIDNAPORE 99	North of 22X	12	28	022	02	5		58.8	0.0	0.0	4.88	No		Gray shale	Domestic and Stock
349129	KOTERA JOHN	SITE 23 RR8, CALGARY 12 T2J 2T9	North of 22X	NE	29	022	02	5		109.7	0.0	0.0	60.96	No		Hard sandstone & shale strg's	Domestic
349131	KOTERA JOHN #2	SITE 23 RR8, CALGARY 12 T2J 2T9	North of 22X	NE	29	022	02	5		73.2	0.0	0.0	60.96	No		Gray hard shale	Domestic

APPENDIX A - TABLE 1
ALBERTA ENVIRONMENT PROTECTION - SUMMARY OF REGIONAL WATER WELLS
RED WILLOW ESTATES
0304-31058.01

	Owner	Address	Current Owner	LSD	Sec	Twp	Rng	Mer	Elev	Well Depth (m)	Perforated From (m)	To (m)	Static W.L. (m)	Chem Avail.	Chem on D.B.	Lithology at Screen (if no perforations then lithology is from bottom of hole)	Proposed Use
349132	KOTERA JOHN #3	SITE 23 RR8, CALGARY 12 T2J 2T9	North of 22X	NE	29	022	02	5		73.2	0.0	0.0	15.24	No		Gray sandy shale & sandstone ledges	Domestic
349460	LIVINGSTON,LYAL	SITE 24,RR8,CALGARY ALTA 1	North of 22X	SE	29	022	02	5		35.1	22.9	35.1	12.19	No		Gray shale,Blue gray shale,Gray water bearing shale & sandstone,Gray shale	Domestic and Stock
352788	TANG, SONY #1497	2 FLOOR 1104 12 AVE SW, CALGARY	North of 22X	SE	29	022	02	5		30.5	18.3	30.5	7.62	No		Gray sandstone,Gray shale,Gray water bearing sandstone,Gray shale	Domestic
353160	KOTERA, JOHN	SITE 23 RR8, CALGARY 12 T2J 2T9	North of 22X	09	29	022	02	5		61.0	35.1	59.4	24.38	No		Gray fine grained sandstone,Moist sandstone,Carbonaceous shale,Siltstone,Fine grained sandstone,Carbonaceous clay & rocks,Siltstone,Fractured sandstone,Siltstone	Domestic
353405	KROMM, KIM	SITE 6 RR8, CALGARY 4 T2J 2T9	North of 22X	NW	29	022	02	5		35.4	29.3	35.4	7.32	Yes		Shale,Wet sandstone,Shale	Domestic and Stock
356349	YATES, LISA/HANK	SITE 23 RR8 CALGARY 17	North of 22X	SE	29	022	02	5		0.0	0.0	0.0	no w.l.	Yes			Domestic
364653	PHIL'S INDUSTRIES OF CANADA	RR8 SITE 6 CALGARY 7 T2J 2T9	North of 22X	SE	29	022	02	5		70.1	51.8	70.1	3.66	No		Shale,Shale & Sandstone Ledges,Sandstone,Shale & Sandstone Ledges	Domestic
364654	TELRAULT, PHIL M	RR8 SITE 6 CALGARY 7 T2J 2T9	North of 22X	SE	29	022	02	5		73.8	25.0	37.2	18.29	No		Clay & Boulders	Domestic
367195	PHILS INDUSTRIES OF CANADA	RR8 SITE 6 CALGARY 7 T2J 2T9	North of 22X	SE	29	022	02	5		97.5	54.9	73.2	18.29	No			Industrial
377379	PRAIRIE BREEDERS	SITE 6, RR8, CALGARY 1	North of 22X	SE	29	022	02	5		30.5	21.3	26.2	12.19	Yes	1	Brown till,Brown shale,Water bearing sandstone	Domestic and Stock
377382	HART, W.F.	RR8, CALGARY	North of 22X	SE	29	022	02	5		36.6	0.0	0.0	no w.l.	Yes	1		Domestic
377386	THOROGOOD, J.	RR8, CALGARY	North of 22X	SE	29	022	02	5		3.7	0.0	0.0	no w.l.	Yes	1		Domestic
377387	HART, BILL	SITE 6, RR8, CALGARY 1	North of 22X	SE	29	022	02	5		25.6	21.3	25.0	13.72	No		Brown shale,Gray shale,Brown shale,Water bearing sandstone	Stock
377390	PRAIRIE BREEDERS	SITE 6, RR8, CALGARY 1	North of 22X	SE	29	022	02	5		61.0	0.0	0.0	no w.l.	Yes	1		Domestic and Stock
377394	LIVINGSTON, LYAL #2734	SITE 24, RR8, CALGARY 1	North of 22X	SE	29	022	02	5		35.4	22.9	35.1	12.19	No		Gray shale,Blue gray shale,Gray water bearing shale & sandstone	Domestic and Stock
377395	ANDERSON, S.E.	SITE 22, RR8, CALGARY 9	North of 22X	SE	29	022	02	5		29.0	0.0	0.0	no w.l.	Yes	1		Domestic
377399	TETRAULT, PHIL M.-E&P SALERS	SITE 6, RR8, CALGARY 7	North of 22X	SE	29	022	02	5		61.0	0.0	0.0	18.29	No		Gray shale & sandstone ledges	Domestic
377407	E7P SALER RANCH	RED DEER LAKE	North of 22X	SE	29	022	02	5		73.2	42.7	73.2	24.38	No		Brown shale,Shale & Sandstone Ledges,Sandstone,Shale,Shale & Sandstone Ledges	Industrial
377412	DOMKE, HANS	CALGARY	North of 22X	SW	29	022	02	5		39.6	35.1	39.6	14.94	No		Shale,Sandstone,Shale	Domestic
377413	MACLEOD TRAIL AUTO BODY/DOMKE	320-39 AVE SW, CALGARY	North of 22X	SW	29	022	02	5		70.1	0.0	0.0	32.	Yes		Shale	Domestic
377418	LECHNER, WALTER	72 BRAMPTON CR SW, CALGARY T2W 0X4	North of 22X	SW	29	022	02	5		27.4	12.2	25.9	12.19	No		Brown shale & sandstone ledges,Brown sandstone,Gray shale,Light gray water bearing sandstone	Domestic
377422	LECHNER, WALTER	72 BRAMPTON CR SW, CALGARY T2W 0X4	North of 22X	SW	29	022	02	5		30.5	9.1	29.0	6.71	No		Brown till,Gray shale & sandstone	Stock
377423	KROMM, JIM	RR8, CALGARY	North of 22X	NW	29	022	02	5		36.6	30.5	36.6	18.29	Yes	1	Sandstone,Blue water bearing shale & sandstone	Domestic
425	SMART-ABBEY	112 WOODVIEW PL SW, CALGARY	North of 22X	NW	29	022	02	5		32.0	25.9	32.0	18.29	No		Sandstone,Black shale,Sandstone,Black shale	Domestic
8	PRAIRIE BREEDERS	RR8, CALGARY	North of 22X	NE	29	022	02	5		33.5	28.4	31.4	9.14	No		Brown hard shale,Gray shale,Water bearing sandstone	Domestic
377431	PRAIRIE BREEDERS	RR8, CALGARY	North of 22X	NE	29	022	02	5		67.1	28.4	31.4	no w.l.	No			Stock
377433	KOTERA, J.C.	SITE 23, RR8, CALGARY 12	North of 22X	NE	29	022	02	5		79.3	54.9	61.0	16.76	Yes		Blue shale,Water bearing sandstone	Domestic and Stock
399656	NOBLE, JAN/MAWANI, SALIM	144 1935 32 AVE NE, CALGARY T2E 7C8	North of 22X	03	29	022	02	5		61.0	51.8	59.7	27.22	No		Gray sandstone,Gray thin shale & sandstone ledges,Gray sandstone,Gray thin shale & sandstone ledges	Domestic
399661	NOBLE, JAN/MAWANI, SALIM	144 1935 32 AVE NE, CALGARY T2E 7C8	North of 22X	03	29	022	02	5		67.1	34.8	37.8	30.91	No		Gray hard sandstone,Gray shale,Gray water bearing sandstone,Gray hard sandstone,Gray shale,Gray water bearing sandstone	Domestic
349126	PARKSIDE MGMT #1937	SITE 14 RR8, CALGARY 21 T2J 2T9	North of 22X	SW	30	022	02	5		38.1	25.9	38.1	16.46	No		Gray clay,Blue gray shale & sandstone ledges,Greenish gray coarse grained sandstone,Blue gray hard shale & sandstone	Domestic
349208	REHMAN MEL	620 146 AVE SW, CALGARY	North of 22X	NW	30	022	02	5	0.0	57.9	0.0	0.0	4.57	No		Black shale	Domestic
349985	PARKSIDE MANAGEMENT #1532	SITE 14 R R 8, CALGARY 21	North of 22X	NE	30	022	02	5		54.9	42.7	54.9	20.42	No		Blue gray hard shale & siltstone,Gray sandstone,Brown fractured sandstone,Blue gray sandstone	Domestic
350731	ARTHURS, ROBIN	PRIDDIS 28 T0L 1W0	North of 22X	SE	30	022	02	5		61.0	19.8	59.4	19.81	No		Brown sandstone,Gray shale,Gray shale & sandstone,Light gray water bearing sandstone,Gray shale & sandstone,Gray sandstone	Domestic
351139	TRABER, DALE #1375	SITE 14 RR8, CALGARY 21	North of 22X	SW	30	022	02	5		42.7	0.0	0.0	33.53	No			Domestic
351140	PEARSON KEN C/O TRABER DALE	SITE 14 RR8, CALGARY 21	North of 22X	SW	30	022	02	5		21.3	16.2	19.2	9.14	No		Sand & Gravel,Gray sandstone	Domestic
351844	ARTHURS, ROBIN	PRIDDIS 28 T0L 1W0	North of 22X	SE	30	022	02	5		61.0	38.1	59.4	37.19	No		Light gray fractured sandstone,Gray shale & sandstone,Light gray water bearing sandstone,Gray shale,Light gray water bearin sandstone	Domestic
352991	TRABER, DALE #1503	SITE 14 RR8, CALGARY 21	North of 22X	SW	30	022	02	5		25.9	13.7	25.9	10.67	No		Brown sandstone,Gray sandy shale,Gray water bearing sandstone,Gray shale	Domestic
352992	TRABER, DALE #1504	SITE 14 RR8, CALGARY 21	North of 22X	NE	30	022	02	5		48.8	36.6	48.8	13.72	No		Gray shale,Gray sandstone,Gray shale	Domestic
356160	BAYLY, VIC	1475 550 6 AVE SW, CALGARY	North of 22X	NE	30	022	02	5		76.2	0.0	0.0	38.1	No		Gray sandstone	Domestic
357254	BAYLY, VIC #1590	1475-550 5 AVE SW, CALGARY	North of 22X	NE	30	022	02	5		54.9	42.7	54.9	15.24	No		Clay & Rocks,Shale & Sandstone Ledges,Sandstone,Gray shale	Domestic
358514	PARKSIDE MGMT #1634	SITE 14 RR8, CALGARY 21 T2J 2T9	North of 22X	10	30	022	02	5		24.4	12.2	24.4	10.36	No		Clay & Rocks,Gray shale,Gray water bearing sandstone,Gray shale	Domestic
358515	PARKSIDE MGMT #1633	SITE 14 RR8, CALGARY 21 T2J 2T9	North of 22X	10	30	022	02	5		32.0	19.8	32.0	14.63	No		Gray sandstone,Gray shale,Water bearing sandstone,Shale	Domestic
358516	PARKSIDE MGMT #1642	SITE 14 RR8, CALGARY 21 T2J 2T9	North of 22X	10	30	022	02	5		24.4	13.7	24.4	8.53	No		Gray sandstone,Gray shale,Gray sandstone,Gray shale,Gray wate bearing sandstone,Gray shale	Domestic
358915	BAILEY, VIC	SITE 14 RR8, CALGARY 23 T2J 2T9	North of 22X	NE	30	022	02	5		61.0	0.0	0.0	no w.l.	No	2	Gray shale	Domestic
359023	BAILEY, VIC	SITE 14 RR8, CALGARY 23 T2J 2T9	North of 22X	NE	30	022	02	5		9.1	7.6	9.1	1.77	Yes		Clay & Rocks,Wet sand & gravel	Domestic
359814	PARKSIDE MGMT #1630	SITE 14 RR8, CALGARY 21 T2J 2T9	North of 22X	10	30	022	02	5		73.2	54.9	73.2	14.63	No		Gray shale,Gray sandstone,Greenish gray shale,Yellow shale,Gray shale,Gray sandstone,Greenish gray shale,Yellow shale,Gray shale	Domestic
361424	HOUSTON, CORRINE	SITE 14 RR8 CALGARY 6 T2J 2T9	North of 22X	SE	30	022	02	5		0.0	0.0	0.0	no w.l.	Yes			Domestic
238	SERIN, ROGER	1230 407 2 ST SW CALGARY T2P 2Y3	North of 22X	SW	30	022	02	5		16.8	0.0	0.0	no w.l.	Yes			Domestic
335	ADAMS, S.	SITE 14 RR 8, CALGARY 7 T2J 2T9	North of 22X	02	30	022	02	5		25.9	13.7	25.9	8.23	No		Weathered claystone,Gray fine grained sandstone,Claystone,Moist sandstone,Gray carbonaceous shale,Tan moist sandstone,Tan water bearing siltstone,Gray siltstone,Bentonitic shale stringers	Domestic
365036	NELSON, STEVE	SITE 14 RR8 CALGARY 18 T2J 2T9	North of 22X	02	30	022	02	5		26.2	7.9	26.2	9.14	No		Tan siltstone,Gray fine grained sandstone,Fine grained sandstone,Shale,Gray claystone,Water bearing sandstone,Siltstone,Water bearing sandstone,Gray claystone,Water bearing sandstone,Shale,Water bearing sandstone,Tan water bearing sandstone,Tan medium gra	Domestic

APPENDIX A - TABLE 1
ALBERTA ENVIRONMENT PROTECTION - SUMMARY OF REGIONAL WATER WELLS
RED WILLOW ESTATES
0304-31058.01

Well ID	Owner	Address	Current Owner	LSD	Sec	Twp	Rng	Mer	Elev	Well Depth [m]	Perforated From [m]	Perforated To [m]	Static W.L. [m]	Chem Avail.	Chem on D.B.	Lithology at Screen (If no perforations then lithology is from bottom of hole)	Proposed Use
369030	HORSEY, IRWIN		North of 22X	08	30	022	02	5		25.3	0.0	0.0	5.79	No			Domestic
375015	NELSON, S.	SITE 18 RR9, CALGARY 18 T2J 2T9	North of 22X	02	30	022	02	5		56.4	44.2	56.4	32.61	No		Shale,Siltstone,Shale,Fine grained sandstone,Water bearing sandstone,Fine grained siltstone & sandstone	Domestic
375016	ADAMS, S.-C.O NELSON, S	SITE 14 RR8, CALGARY 18 T2J 2T9	North of 22X	02	30	022	02	5		19.8	12.2	19.8	7.92	No		Claystone,Fine grained siltstone,Brown water bearing siltstone,Brown coarse grained sandstone,Brown fine grained siltstone	Domestic
377434	DEMICELL, BARNEY	SITE 14, RR8, CALGARY 2	North of 22X	SE	30	022	02	5		35.7	29.9	35.4	29.26	No		Gray shale,Brown shale,Gray shale,Water bearing coal,Gray shale	Domestic
377435	DEMICELL, BARNEY	PRIDDIS	North of 22X	SE	30	022	02	5		50.0	39.6	49.7	37.8	Yes		Old Well,Gray shale,Light water bearing sandstone	Domestic
377436	EVANS, ED	100 LAKE LINNET CLOV, CALGARY	North of 22X	SE	30	022	02	5		41.2	35.1	41.2	6.1	No		Clay & Rocks,Shale & Sandstone	Domestic
377437	DEMICELLE, D.	RR8, CALGARY	North of 22X	SE	30	022	02	5		38.1	0.0	0.0	21.34	Yes	1		Domestic
377438	HARFIELD, D.D.	2708-18 ST NW, CALGARY	North of 22X	SE	30	022	02	5		30.5	0.0	0.0	15.24	Yes	1		Domestic
377439	CALALTA REALTY B THOMAS	5343 LAKEVIEW DR, CALGARY	North of 22X	SE	30	022	02	5		36.6	30.5	36.6	no w.l.	No		Clay & Rocks,Shale & Sandstone	Domestic
377440	ARTHURS, ROBIN	MIDNAPORE 32	North of 22X	SE	30	022	02	5		45.7	36.6	44.8	0.	No		Brown sandstone & shale strg's,Light gray sandstone,Gray shale,Dark sandstone	Domestic
377441	ARTHURS, ROBIN	MIDNAPORE 32 T0L 1J0	North of 22X	SE	30	022	02	5		57.9	39.6	56.4	39.62	No		Old Well,Gray shale,Light gray water bearing sandstone	Domestic
377442	CAMERON, W.	RR8, CALGARY T2J 2T9	North of 22X	SE	30	022	02	5		34.8	0.0	0.0	9.14	Yes	1		Domestic
377443	ISAAK, GRACE	SITE 14, RR8, CALGARY 5	North of 22X	SE	30	022	02	5		34.1	0.0	0.0	no w.l.	Yes	1		Domestic
377444	STELLA HOLDINGS LTD	5,4215-61 ST SE, CALGARY	North of 22X	SE	30	022	02	5		39.6	27.4	39.6	16.76	No		Brown hard shale,Blue gray hard shale & sandstone	Domestic
377445	STELLA HOLDINGS LTD	5,4215-61 AVE SE, CALGARY	North of 22X	SE	30	022	02	5		44.2	30.5	44.2	16.76	No		Coal,Blue gray hard shale & sandstone ledges	Domestic
377446	STELLA HOLDINGS LTD	5,4215-61 AVE SE, CALGARY	North of 22X	SE	30	022	02	5		47.2	32.0	47.2	13.72	No		Brown shale & sandstone,Blue gray hard shale & sandstone	Domestic
377447	HUME, JAMES B.	SITE 14, RR8, CALGARY 5	North of 22X	SE	30	022	02	5		13.7	0.0	0.0	no w.l.	Yes			Domestic
377448	HARRIS, BOB	SITE 14, RR8, CALGARY, T2J 2T9 18	North of 22X	SE	30	022	02	5		61.0	48.8	61.0	36.58	No		Green shale,Gray shale,Water bearing sandstone,Gray shale,Sandstone,Gray shale	Domestic and Stock
377449	WILSON, MARILYN	SITE 14, RR8, CALGARY 8	North of 22X	SE	30	022	02	5		45.7	0.0	0.0	no w.l.	Yes			Domestic
377450	RAMCHARAN	RR8, CALGARY	North of 22X	01	30	022	02	5		31.7	0.0	0.0	no w.l.	Yes	1		Domestic
377451	PARSONAGE, SHANE	GENERAL DELIVERY, PRIDDIS	North of 22X	SW	30	022	02	5		22.9	11.9	16.8	8.84	Yes		Water bearing gravel,Gray shale,Light gray sandstone	Domestic and Stock
377452	MACKENZIE, DON	CALGARY	North of 22X	NW	30	022	02	5		18.6	0.0	3.7	15.24	No			Domestic
377453	MACKENZIE, W.D.C.	RR8, CALGARY	North of 22X	NW	30	022	02	5		16.5	14.6	16.5	2.13	Yes	1	Blue clay,Gray shale,Sandstone	Domestic
377454	CAMERON, WM	RR8, CALGARY	North of 22X	NE	30	022	02	5	#####	35.1	0.0	0.0	12.19	No		Sandrock	Domestic
377455	GLASSEN, G.		North of 22X	05	30	022	02	5		32.0	24.4	30.5	10.67	No		Shale,Sandstone	Domestic
378637	WIESE, RAY	S14 RR8, CALGARY 6	North of 22X	02	30	022	02	5	#####	59.4	27.4	30.5	9.45	Yes	1		Domestic and Stock
378638	BARKER, N.S.	1120 PROSPECT AVE NE, CALGARY	North of 22X	SW	30	022	02	5	#####	42.7	0.0	0.0	33.53	No		Blue gray shale	Domestic and Stock
378639	TRABER, DALE	S14 RR8, CALGARY 21	North of 22X	SW	30	022	02	5	#####	42.7	0.0	0.0	33.53	No		Predrilled	Domestic
384970	MCCAUGHAM, DELMER	SITE 14 RR8, CALGARY 28 T2J 2T9	North of 22X	SE	30	022	02	5		39.6	15.2	21.3	11.06	No		Sandstone	Domestic
405139	HORSEY, IRWIN	SITE 14 RR8, CALGARY 20 T2J 2L9	North of 22X	08	30	022	02	5		25.3	10.1	22.3	4.88	No		Moist sandstone,Shale,Gray water bearing sandstone,Siltstone,Water bearing sandstone,Shale	Domestic

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APPENDI[illegible]BLE 2
SUMMARY OF AVAILABLE REGI[illegible]AL WATER WELL CHEMISTRY
RED WILLOW ESTATES
0304-31058.01

M	Twp	Rge	Sec	LSD	Well ID	Depth	SITENAME	Sample Date	TDS	Ionic Balance	Ca	Mg	K	Na	NO2_N	NO3_N	Cl	SO4	CO3	HCO3	Total Alk.	F	SiO2	2_NO3	Fe	Mn
5	22	2	5	16	377366	0	UNKNOWN	7/24/75	408		78.00	37.02	3.80	37.48		3.30	2.00	31.30		467.94	374.40	0.20	8.10		0.10	0.20
5	22	2	6	SW	378875	104	SPARKES, ROBIN		444	0.92	32.00	31.02	3.90	92.95			6.00	35.00		487.94	400.00	0.29	7.90	0.84	0.03	
5	22	2	6	04	377377	90	STANDISH, J.L.	5/29/75	504		64.00	37.02	5.00	75.96		7.30	9.00	33.60	9.61	524.94	435.90	0.30	8.30		0.10	0.30
5	22	2	7	04	377389	135	CROSS, A.R.	5/29/75	370		59.00	32.02	4.60	42.98		9.60	5.00	31.80		414.95	332.00	0.30	7.70		0.10	0.30
5	22	2	9	SE	377415	100	LISEBERG, M.	12/14/71	570		18.00	12.01					3.00	25.00			485.00	1.30			0.90	
5	22	2	9	SE	377415	100	LESEBERG, H.	9/11/67	616								4.00	46.00			492.00				0.95	
5	22	2	9	01	378778	0	ROTHNEY FARMS	5/28/75	428		77.00	33.02	5.40'	38.98		8.50	5.00	38.10	12.01	431.95	365.50	0.30	9.70			0.30
5	22	2	19	NW	377359	150	HILL, C.G.	7/31/74	560	1.02	25.00	10.00	3.50	192.90			5.00	36.00		574.93	471.00	0.71				
5	22	2	19	SW	377337	39	SKELETON, G.	8/16/72	568		58.00	36.02					1.00	35.00			348.00	0.37		0.40		
5	22	2	19	NE	378630	260	CRANMER,	6/8/78	733	0.98		1.00	1.10	282.86				172.00		554.94	455.00	1.56	7.60			
5	22	2	19	NE	377388	220	KRAUSERT,	4/21/82	374	1.03	74.00	36.02	5.20	24.99			2.00	10.00		449.95	369.00	0.20	9.80			
5	22	2	19	SW	378629	100	FALKENBERG, TERRY	6/26/86	422	1.03	89.00	35.02	3.60	30.98			12.00	18.00		471.95	387.00	0.15	8.30	0.35	0.05	
5	22	2	19	SW	378629	100	FALKENBERG, TERRY L.	11/24/78	402	0.97	74.00	37.02	2.90	29.98			9.00	19.00	9.01	445.95	381.00	0.17	8.40	0.42	0.11	
5	22	2	19	03	377357	50	LAMB, E.J.	5/28/75	364		29.00	21.51	5.00	89.95		1.60	5.00	23.50		419.95	336.00	0.30	6.80		0.20	0.10
5	22	2	20	EH	377481	100	STANTON, D.	6/17/76	595	1.00	4.00	1.00	1.40	241.88				57.00		579.93	484.00	0.50			0.10	
5	22	2	20	NW	378632	25	HARASYMUK, M.	10/21/85	443	0.97	54.00	23.01	4.10	89.95			2.00	18.00		511.94	420.00	0.26	7.70		2.23	
5	22	2	20	01	377472	30	GRAHAM, VIOLA	6/3/75	524		17.40	5.60	2.50	179.91		7.50	6.00	41.00		516.94	413.60	0.50	0.80		0.30	0.20
5	22	2	21	NW	377496	196	BAKER, ROLAND	4/5/76	591	0.93	20.00	10.00	2.40	188.91			3.00	116.00	6.01	494.94	417.00	0.84				
5	22	2	21	NW	377510	150	McPNAIL, COLIN	8/12/86	591	0.99	13.00	8.00	1.70	217.89			16.00	40.00	11.01	552.93	472.00	0.53	5.20	2.60	0.03	
5	22	2	21	NW	377507	113	TRVING, KELLY	3/15/81	537	0.94	6.00	8.00	1.30	192.90			3.00	72.00	11.01	490.94	421.00	0.22	6.80		1.26	
5	22	2	21	00	377523	140	MIDDLETON, V.	5/28/75	660		22.20	13.21	3.30	208.90		8.90	3.00	172.00		499.94	400.00	0.60	6.50		0.20	0.30
5	22	2	28	NE	377962	180	SUN OIL CO.	8/3/71	1390		21.00	3.00				0.10	5.00	860.01			415.00					
5	22	2	29	SE	377386	12	THOROGOOD, M.J.	8/11/71	640		19.00	30.02					17.00	50.00			430.00	0.39				
5	22	2	29	SE	377382	120	HART, W.F.	8/16/72	2704		26.00	6.00					34.00	1275.02			573.00	0.88				
5	22	2	29	NW	377423	120	KROMM, KIM		519	0.98	25.00	13.01	1.80	166.92			2.00	48.00	29.03	470.95	434.00	0.57	6.70	0.35		
5	22	2	29	SE	377395	95	ANDERSON, S.E.	7/9/84	2409	0.98	42.00	9.00	3.10	759.62			22.00	1300.02		553.94	454.00	0.63	6.40		0.13	
5	22	2	29	SE	377379	100	PRAIRIE BREEDERS	3/21/77	2038	1.04	15.00	5.00	2.20	716.64			3.00	972.02		654.92	538.00	0.34	8.00		0.34	
5	22	2	29	SE	377390	200	PRAIRIE BREEDERS	1/18/83	1855	1.00	77.00	37.02	4.20	514.74			11.00	900.01		630.93	518.00	0.28	6.10		9.60	
5	22	2	30	SE	377450	104	RAMCHARAN,	2/9/76	650	0.97	14.00	4.00	2.30	242.88			6.00	70.00	9.01	611.93	517.00	1.28				
5	22	2	30	SE	377438	100	HARFIELD, D.D.		570		32.00	43.02					6.00	35.00			425.00			0.60		
5	22	2	30	SE	377442	114	CAMERON, W.	5/15/78	614	0.95	9.00	3.00	1.90	238.88	0.37			37.00		649.92	535.00	0.35	7.50	0.58	0.09	
5	22	2	30	SE	377437	125	DEMICELLE, D.	8/8/73	444	0.91	97.00	21.01	4.70	35.98		0.20	3.00	26.00		512.94	420.00	0.17			0.10	
5	22	2	30	SE	377443	112	ISAAK, GRACE	4/28/81	604	0.93	5.00	2.00	1.90	234.88			2.00	46.00	16.02	603.93	521.00	0.38	6.80		0.13	
5	22	2	30	SE	378637	195	LINNINGTON, A.	12/5/72	1587		25.00	35.02						547.01			587.00	0.75		0.10	0.20	
5	22	2	30	NW	377453	54	MACKENZIE, W.D.C.	12/13/71	560		7.00	3.00					2.00	25.00			495.00				0.60	
								Number of samples:	35	19	33	34	26	26	1	9	31	35	9	26	35	31	21	9	23	7
								Maximum:	2704.00	1.04	97.00	43.02	5.40	759.62	0.37	9.60	34.00	1300.02	29.03	654.92	587.00	1.56	9.80	2.60	9.60	0.30
								Average:	779.66	0.98	37.20	18.87	3.19	198.88	0.37	5.22	6.90	207.47	12.52	522.40	443.47	0.50	7.20	0.69	0.78	0.24
								Minium:	364.00	0.91	4.00	1.00	1.10	24.99	0.37	0.10	1.00	10.00	6.01	414.95	332.00	0.15	0.80	0.10	0.03	0.10

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TABLE A.3

REGIONAL WATER WELL DATA
SOURCE: AEP GROUNDWATER INFORMATION CENTRE
RED WILLOW ESTATES
0304-31058.01

Well ID	Owner	Address	LSD	Sec	Twp	Rng	Mer	Elev	Well Depth [m]	Static W.L. [m]	Chem Avail.	Proposed Use	Well Depth [m]	Pump Depth [m]	V[illegible] [illegible]
377348	CROSS, A.R.	RR8, ROTHNEY FARM, CALGARY	SE	04	022	02	5	1202.4	28.4	21.34		Stock			
377352	ROTHNEY FARMS	SITE2, RR8, CALGARY 57 T25 2T9	SW	04	022	02	5		109.7	48.77		Stock			
377360	CROSS, A.R.	RR8, ROTHNEY FARMS, CALGARY T2J 2T9	NW	05	022	02	5	1226.2	76.2	17.98		Stock			
377355	CROSS, A.R.	RR8, ROTHNEY FARMS, CALGARY T2J 2T9	SW	05	022	02	5	1289.3	91.4	48.77		Stock			
377377	STANDISH, J.L	RR8, CALGARY	04	06	022	02	5	1257.3	27.4	21.34	1	Unknown			
378875	ATKINS, JOHN	RR8, CALGARY	SW	06	022	02	5	1257.3	31.7	22.86	1	Domestic and Stock			
377383	GROSE, JIM	616 MCINTOSH RD, CALGARY	12	06	022	02	5	1287.8	35.7	26.21		Domestic			
377372	STANDISH, LLOYD		SW	06	022	02	5		39.9	21.34		Domestic and Stock			
377367	ELHATTON, L.	1339-6A ST. NW, CALGARY	SH	06	022	02	5		44.8	13.41		Unknown			
379180	ABBOTT, MARSHALL	SITE 2 RR8, CALGARY 24 T2J 2T9	SE	06	022	02	5		109.7	67.06		Domestic			
377397	CROSS, A.R.	RR8, ROTHNEY, CALGARY	SW	07	022	02	5	1271.0	32.9	20.73		Domestic			
360065	PROKOPY, TERRY	RR9 CALGARY	NE	07	022	02	5		38.1	17.68		Domestic			
377389	ROYAL TRUST, C/O CROSS, A.R.	600-7 AVE SW, CALGARY	SW	07	022	02	5	1272.5	41.2	33.22	1	Domestic			
377408	WENGATZ CONSTRUCTION		NW	07	022	02	5	1310.6	51.8	40.23		Domestic			
377411	MACKLIN, P.T.	MIDNAPORE	SE	08	022	02	5	1188.7	45.7	42.37		Domestic			
377421	SUN OIL CO		00	09	022	02	5		13.7	no w.l.		Industrial			
377415	LESEBERG, H.	1747-36 AVE SW, CALGARY	SE	09	022	02	5		30.5	no w.l.	2	Unknown			
377581	ROTHNEY FARMS	SITE 2, RR8, CALGARY 57	NE	16	022	02	5		79.9	no w.l.		Unknown			
377582	ROTHNEY FARMS	SITE 2, RR8, CALGARY 57	NE	16	022	02	5		91.4	50.29		Stock			
377578	ROTHNEY FARMS	SITE 2, RR8, CALGARY 57 T2J 2T9	NE	16	022	02	5		106.7	no w.l.		Stock			
377587	THE NATURE CONSERVANCY OF CDN	422-33RD AVE NW, CALGARY T2K 0B4	NE	17	022	02	5		67.1	42.67		Domestic			
377584	ROTHNEY FARMS	RR8, CALGARY	NW	17	022	02	5		76.2	58.52		Stock			
377583	ROTHNEY FARMS	SITE 2, RR8, CALGARY 57 T2J 2T9	SE	17	022	02	5		76.2	no w.l.		Stock			
377590	CROSS, A.R.	RR8, ROTHNEY FARMS, CALGARY	NW	18	022	02	5	1219.2	54.9	29.87		Stock			
377337	SKELETON, G.	RR8 CALGARY	SW	19	022	02	5		11.9	no w.l.	1	Domestic			
377357	LAMB, E.J.	RR8 CALGARY	03	19	022	02	5	1237.5	15.2	6.1	1	Domestic			
377342	BONSRTA, BRIAN	302A S HAMPTON DR, CALGARY	SW	19	022	02	5	1188.7	25.0	12.8		Domestic			
377339	FINNIS, F.	9816 ALBERNI RD SW, CALGARY	SW	19	022	02	5	1155.2	25.9	17.98		Domestic and Stock			
490025	FLANAGAN, HERB	SITE 2 RR8, CALGARY 13 T2J 2T9	03	19	022	02	5		29.6	no w.l.		Domestic			
377345	FLANOGAN, H.C.	RR8 CALGARY	00	19	022	02	5		30.5	24.99		Domestic			
377369	FLEMMING, DON	PRIDDIS	NE	19	022	02	5	1196.3	30.5	5.49		Domestic			
378629	UPLAND DEV CO. LTD.	SUITE 3003, LONDON HOUSE, CALGARY	SW	19	022	02	5	1207.0	30.5	16.76	2	Domestic			
469147	DALTON, RICK/LILLIAN	SITE 2 RR8, CALGARY 2	03	19	022	02	5		39.6	22.89		Domestic			
377343	SURE HOLDINGS LTD.	RR8 CALGARY	SW	19	022	02	5	1207.0	42.7	16.76		Domestic and Stock			
469148	PFEIFER, TY	PRIDDIS 75 T0L 1W0	05	19	022	02	5		43.3	12.5		Domestic			
377359	HILL, C.G.	RR8 CALGARY 5	NW	19	022	02	5		45.7	no w.l.	1	Domestic			
354338	FINNIS, TIM	SITE 2 RR8, CALGARY 8 T2P 2T9	SW	19	022	02	5		47.2	30.18		Domestic			
377380	FLEMING, DON	1404 BEVERLY PL SW, CALGARY	NE	19	022	02	5	1188.7	48.8	27.43		Domestic			

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[illegible]l ID	Owner	Address	LSD	Sec	Twp	Rng	Mer	Elev	Well Depth [m]	Static W.L. [m]	Chem Avail.	Proposed Use	Well Depth [m]	Pump Depth [m]	Water Level [m]
377393	HOPE ROSS, BILL	S14 RR8 CALGARY 13	NE	19	022	02	5		54.9	34.14		Domestic			
377361	HILL, DOROTHY	S2 RR8, CALGARY 5	NW	19	022	02	5		62.5	no w.l.		Domestic			
377388	KRAUSERT	S14 RR8, CALGARY 2	NE	19	022	02	5	1188.7	67.1	no w.l.	1	Domestic			
359987	VAN WIELINGEN, GUS WELL #1	STE 2628 1 CAL PLACE 330 5 AVE SW CALGAR T2P 0L4	NW	19	022	02	5		73.2	34.14		Domestic			
377346	PFEIFFER, TY	912 WOODVIEW CRESC SW, CALGARY	SW	19	022	02	5		73.2	30.48		Domestic			
467795	SOUTHERN, N.	SITE 14 RR8, CALGARY 2 T2J 2T9	08	19	022	02	5		79.3	22.86		Stock			
378630	FLEMING, DON	1404 BEVERLY PL SW, CALGARY	NE	19	022	02	5	1188.7	79.3	45.72	1	Domestic			
377385	FLEMING, DON	1404 BEVERLY PL SW, CALGARY	NE	19	022	02	5	1188.7	85.3	56.39		Domestic			
378632	DAVIES, DAVE	RR8, CALGARY	14	20	022	02	5		7.6	3.66	1	Domestic			
377472	GRAHAM, VIOLA RUTH	RR8 CALGARY	SE	20	022	02	5	1188.7	9.1	no w.l.	1	Domestic			
378631	DAVIES, DAVE	MIDNAPORE	NW	20	022	02	5	1158.2	16.5	4.27		Domestic			
377481	STANTON, D.	RR8 CALGARY	EH	20	022	02	5	1196.3	30.5	21.34	1	Domestic			
437392	BAVARIAN LION CO LTD/JANZ, ROL	SITE 3 RR8, CALGARY 7 T2J 2T9	NE	20	022	02	5		36.0	15.54		Domestic			
418340	BAVARIAN LION CO C/O JANZ,ROLF	SITE 23 RR8, CALGARY 7 T2J 2T9	NE	20	022	02	5		40.2	21.03		Domestic			
437393	BAVARIAN LION CO LTD/JANZ,ROLF	SITE 3 RR8, CALGARY 7 T2J 2T9	NE	20	022	02	5		40.2	12.19		Domestic			
[illegible]50064	DAVIES, DAVE #1674	SITE 24 RR8, CALGARY 7 T2J 2T9	NW	20	022	02	5		45.7	32.		Domestic and Stock			
[illegible]474	DAVIES, DAVE	S24 RR8, CALGARY 7	NW	20	022	02	5		45.7	32.		Domestic and Stock			
418345	BAVARIAN LION CO C/O JANZ,ROLF	SITE 23 RR8, CALGARY 7 T2J 2T9	NE	20	022	02	5		46.3	21.31		Domestic			
437389	BAVARIAN LION CO LTD	SITE 23 RR8, CALGARY 7 T2J 2T9	NE	20	022	02	5		53.0	24.08		Domestic			
418342	BAVARIAN LION CO LTD.	SITE 23 RR8, CALGARY 7 T2J 2T9	NE	20	022	02	5		58.5	26.7		Domestic			
377487	OHANLON, HARRY	S4 RR8, CALGARY 8	SE	21	022	02	5		3.1	no w.l.		Domestic			
377505	OLMAND	S8 RR9, CALGARY 4	NW	21	022	02	5	1158.2	23.8	11.28		Domestic			
354339	MARTINI, RAY	C/O 3 6125 12 ST, SE CALGARY T2H 2K1	NW	21	022	02	5		29.0	no w.l.		Domestic			
356347	MCINTOSH, L	SITE 23 RR9 CALGARY 11 T2J 2T9	NW	21	022	02	5		34.4	no w.l.		Domestic			
377507	IRVING DON	12120 14 ST SW, CALGARY	NW	21	022	02	5	1158.2	34.4	12.8	1	Domestic			
377523	MIDDLETON, V.	RR8 CALGARY	00	21	022	02	5	1158.2	42.7	30.48	1	Domestic			
351791	O'HANLON HARRY #1417	SITE 4 RR8, CALGARY 8	SE	21	022	02	5		42.7	19.81		Stock			
377488	OHANLON, HARRY	S4 RR8, CALGARY 8	SE	21	022	02	5		42.7	19.81		Stock			
377510	MCPHAIL, COLIN	111 LAKE LUCERNE CLOSE SE, CALGARY	NW	21	022	02	5		45.7	31.7	1	Domestic			
377482	CHANLON, HARRY	S6 RR8, CALGARY 6	SE	21	022	02	5		47.2	13.72		Domestic and Stock			
377502	WESTWARD CONSTRUCTION	760 CEDARCLE WAY SW, CALGARY	NW	21	022	02	5		48.8	15.24		Domestic			
377492	OHANLON, HARRY	S6 RR8, CALGARY 6 T2J 2T9	02	21	022	02	5		50.6	30.48		Domestic			
359988	O'HANLON, HARRY	13046 SITE 6 RR8 CALGARY T2J 2T9	SE	21	022	02	5		50.6	30.48		Domestic			
[illegible]7496	BAKER, ROLAND	440 QUEEN ALEXANDRA WAY, CALGARY	NW	21	022	02	5	1167.4	59.4	0.	1	Domestic			
377503	CLAYDON	RR8, CALGARY	NW	21	022	02	5		59.4	0.		Domestic			
377511	GULA, DR.	S23 RR8, CALGARY 4	NW	21	022	02	5		61.0	no w.l.		Domestic			
349668	WOODS, MR & MRS #2480	SITE 4 RR #8, CALGARY 8 T2J 2T9	SE	21	022	02	5		67.1	38.68		Domestic			

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377515	GULA, DR.	RR8 CALGARY 4	NW	21	022	02	5		70.1	19.81		Domestic			
377522	FRONTIER GEOPHYSICAL LTD 174-2		12	21	022	02	5	1154.6	463.3	no w.l.		Industrial			
361157	HAGEL, GERRY	RR2 CROSSFIELD T0M 0S0	13	28	022	02	5		18.3	4.57		Domestic and Stock			
377960	OHANLON, H.	MIDNAPORE 99	NE	28	022	02	5		18.3	no w.l.		Domestic and Stock			
377974	ERICKSON, B.	1088 ALADIA DR SE, CALGARY	NE	28	022	02	5	1143.0	30.5	no w.l.		Domestic			
377969	OHANLON, H.	MIDNAPORE 99	NE	28	022	02	5		33.5	0.		Domestic and Stock			
377946	OHANLON, H.	MIDNAPORE 99	NW	28	022	02	5	1127.8	33.5	0.		Domestic and Stock			
349929	DAWSON, HAL #2982	SITE 6 RR8, CALGARY 6 T2J 2T9	NW	28	022	02	5		46.9	4.24		Domestic			
377982	HECK, RONALD D.	MIDNAPORE 488 T0C 1J0	NE	28	022	02	5		48.8	9.14		Domestic			
377962	SUN OIL CO.	805 8TH AVE SW, CALGARY	NE	28	022	02	5	1127.8	54.9	48.77	1	Unknown			
377977	LAMONTAGUE, ARTHUR & HECK R.	MIDNAPORE 488 T0L 1J0	NE	28	022	02	5		54.9	18.29		Domestic			
351448	DOUBLE "E" FARMS #1305	MIDNAPORE 10	NW	28	022	02	5		57.3	10.06		Domestic			
377958	DOUBLE E FARMS	MIDNAPORE 10	NW	28	022	02	5		57.3	10.06		Domestic			
378636	OHANLON, H.F.	MIDNAPORE 99	12	28	022	02	5		58.8	4.88		Domestic and Stock			
377966	OHANLON, H.	MIDNAPORE 99	NE	28	022	02	5	1147.6	61.0	4.57		Domestic and Stock			
377972	OHANLON, H.	MIDNAPORE 99	NE	28	022	02	5	1147.6	61.0	no w.l.		Unknown			
377976	OHANLON, H.	MIDNAPORE 99	NE	28	022	02	5		61.0	no w.l.		Domestic and Stock			
377980	HECK, RONALD	MIDNAPORE 488 T0C 1J0	NE	28	022	02	5		67.1	no w.l.		Domestic			
351447	DOUBLE E.FARMS #1295	MIDNAPORE 10	NW	28	022	02	5		71.6	12.19		Domestic			
377955	DOUBLE E FARMS	MIDNAPORE 10	NW	28	022	02	5		71.6	12.19		Domestic			
377964	OHANLON, H.	MIDNAPORE 99	NE	28	022	02	5	1127.8	76.2	3.66		Domestic			
349930	DAWSON, HAL	SITE 6 RR8, CALGARY 6 T2J 2T9	NW	28	022	02	5		85.3	30.48		Domestic			
377967	OHANLON, H.	MIDNAPORE 99	NE	28	022	02	5		131.1	no w.l.		Domestic and Stock			
377386	THOROGOOD, J.	RR8, CALGARY	SE	29	022	02	5		3.7	no w.l.	1	Domestic			
377387	HART, BILL	SITE 6, RR8, CALGARY 1	SE	29	022	02	5		25.6	13.72		Stock			
377418	LECHNER, WALTER	72 BRAMPTON CR SW, CALGARY T2W 0X4	SW	29	022	02	5		27.4	12.19		Domestic			
377395	ANDERSON, S.E.	SITE 22, RR8, CALGARY 9	SE	29	022	02	5		29.0	no w.l.	1	Domestic			
352788	TANG, SONY #1497	2 FLOOR 1104 12 AVE SW, CALGARY	SE	29	022	02	5		30.5	7.62		Domestic			
377379	PRAIRIE BREEDERS	SITE 6, RR8, CALGARY 1	SE	29	022	02	5		30.5	12.19	1	Domestic and Stock			
377422	LECHNER, WALTER	72 BRAMPTON CR SW, CALGARY T2W 0X4	SW	29	022	02	5		30.5	6.71		Stock			
377425	SMART-ABBEY	112 WOODVIEW PL SW, CALGARY	NW	29	022	02	5		32.0	18.29		Domestic			
377428	PRAIRIE BREEDERS	RR8, CALGARY	NE	29	022	02	5		33.5	9.14		Domestic			
349460	LIVINGSTON,LYAL	SITE 24,RR8,CALGARY ALTA 1	SE	29	022	02	5		35.1	12.19		Domestic and Stock			
353405	KROMM, KIM	SITE 6 RR8, CALGARY 4 T2J 2T9	NW	29	022	02	5		35.4	7.32		Domestic and Stock			
377394	LIVINGSTON, LYAL #2734	SITE 24, RR8, CALGARY 1	SE	29	022	02	5		35.4	12.19		Domestic and Stock			
377423	KROMM, JIM	RR8, CALGARY	NW	29	022	02	5		36.6	18.29	1	Domestic			
377382	HART, W.F.	RR8, CALGARY	SE	29	022	02	5		36.6	no w.l.	1	Domestic			

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377412	DOMKE, HANS	CALGARY	SW	29	022	02	5		39.6	14.94		Domestic			
399656	NOBLE, JAN/MAWANI, SALIM	144 1935 32 AVE NE, CALGARY T2E 7C8	03	29	022	02	5		61.0	27.22		Domestic			
353160	KOTERA, JOHN	SITE 23 RR8, CALGARY 12 T2J 2T9	09	29	022	02	5		61.0	24.38		Domestic			
377390	PRAIRIE BREEDERS	SITE 6, RR8, CALGARY 1	SE	29	022	02	5		61.0	no w.l.	1	Domestic and Stock			
377399	TETRAULT, PHIL M./E&P SALERS	SITE 6, RR8, CALGARY 7	SE	29	022	02	5		61.0	18.29		Domestic			
399661	NOBLE, JAN/MAWANI, SALIM	144 1935 32 AVE NE, CALGARY T2E 7C8	03	29	022	02	5		67.1	30.91		Domestic			
377431	PRAIRIE BREEDERS	RR8, CALGARY	NE	29	022	02	5		67.1	no w.l.		Stock			
364653	PHIL'S INDUSTRIES OF CANADA	RR8 SITE 6 CALGARY 7 T2J 2T9	SE	29	022	02	5		70.1	3.66		Domestic			
377413	MACLEOD TRAIL AUTO BODY/DOMKE	320-39 AVE SW, CALGARY	SW	29	022	02	5		70.1	32.		Domestic			
349131	KOTERA JOHN #2	SITE 23 RR8, CALGARY 12 T2J 2T9	NE	29	022	02	5		73.2	60.96		Domestic			
349132	KOTERA JOHN #3	SITE 23 RR8, CALGARY 12 T2J 2T9	NE	29	022	02	5		73.2	15.24		Domestic			
377407	E7P SALER RANCH	RED DEER LAKE	SE	29	022	02	5		73.2	24.38		Industrial			
364654	TELRAULT, PHIL M	RR8 SITE 6 CALGARY 7 T2J 2T9	SE	29	022	02	5		73.8	18.29		Domestic			
377433	KOTERA, J.C.	SITE 23, RR8, CALGARY 12	NE	29	022	02	5		79.3	16.76		Domestic and Stock			
367195	PHILS INDUSTRIES OF CANADA	RR8 SITE 6 CALGARY 7 T2J 2T9	SE	29	022	02	5		97.5	18.29		Industrial			
349129	KOTERA JOHN	SITE 23 RR8, CALGARY 12 T2J 2T9	NE	29	022	02	5		109.7	60.96		Domestic			
023	BAILEY, VIC	SITE 14 RR8, CALGARY 23 T2J 2T9	NE	30	022	02	5		9.1	1.77		Domestic			
377447	HUME, JAMES B.	SITE 14, RR8, CALGARY 5	SE	30	022	02	5		13.7	no w.l.		Domestic			
377453	MACKENZIE, W.D.C.	RR8, CALGARY	NW	30	022	02	5		16.5	2.13	1	Domestic			
364238	SERIN, ROGER	1230 407 2 ST SW CALGARY T2P 2Y3	SW	30	022	02	5		16.8	no w.l.		Domestic			
377452	MACKENZIE, DON	CALGARY	NW	30	022	02	5		18.6	15.24		Domestic			
375016	ADAMS, S./C/O NELSON, S.	SITE 14 RR8, CALGARY 18 T2J 2T9	02	30	022	02	5		19.8	7.92		Domestic			
351140	PEARSON KEN C/O TRABER DALE	SITE 14 RR8, CALGARY 21	SW	30	022	02	5		21.3	9.14		Domestic			
377451	PARSONAGE, SHANE	GENERAL DELIVERY, PRIDDIS	SW	30	022	02	5		22.9	8.84		Domestic and Stock			
358514	PARKSIDE MGMT #1634	SITE 14 RR8, CALGARY 21 T2J 2T9	10	30	022	02	5		24.4	10.36		Domestic			
358516	PARKSIDE MGMT #1642	SITE 14 RR8, CALGARY 21 T2J 2T9	10	30	022	02	5		24.4	8.53		Domestic			
369030	HORSEY, IRWIN		08	30	022	02	5		25.3	5.79		Domestic			
405139	HORSEY, IRWIN	SITE 14 RR8, CALGARY 20 T2J 2L9	08	30	022	02	5		25.3	4.88		Domestic			
365035	ADAMS, S.	SITE 14 RR 8, CALGARY 7 T2J 2T9	02	30	022	02	5		25.9	8.23		Domestic			
352991	TRABER, DALE #1503	SITE 14 RR8, CALGARY 21	SW	30	022	02	5		25.9	10.67		Domestic			
365036	NELSON, STEVE	SITE 14 RR8 CALGARY 18 T2J 2T9	02	30	022	02	5		26.2	9.14		Domestic			
377438	HARFIELD, D.D.	2708-18 ST NW, CALGARY	SE	30	022	02	5		30.5	15.24	1	Domestic			
377450	RAMCHARAN	RR8, CALGARY	01	30	022	02	5		31.7	no w.l.	1	Domestic			
77455	GLASSEN, G.		05	30	022	02	5		32.0	10.67		Domestic			
58515	PARKSIDE MGMT #1633	SITE 14 RR8, CALGARY 21 T2J 2T9	10	30	022	02	5		32.0	14.63		Domestic			
377443	ISAAK, GRACE	SITE 14, RR8, CALGARY 5	SE	30	022	02	5		34.1	no w.l.	1	Domestic			
377442	CAMERON, W.	RR8, CALGARY T2J 2T9	SE	30	022	02	5		34.8	9.14	1	Domestic			

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377454	CAMERON, WM	RR8, CALGARY	NE	30	022	02	5	1066.8	35.1	12.19		Domestic			
377434	DEMICELL, BARNEY	SITE 14, RR8, CALGARY 2	SE	30	022	02	5		35.7	29.26		Domestic			
377439	CALALTA REALTY/ B. THOMAS	5343 LAKEVIEW DR, CALGARY	SE	30	022	02	5		36.6	no w.l.		Domestic			
377437	DEMICELLE, D.	RR8, CALGARY	SE	30	022	02	5		38.1	21.34	1	Domestic			
349126	PARKSIDE MGMT #1937	SITE 14 RR8, CALGARY 21 T2J 2T9	SW	30	022	02	5		38.1	16.46		Domestic			
377444	STELLA HOLDINGS LTD	5,4215-61 ST SE, CALGARY	SE	30	022	02	5		39.6	16.76		Domestic			
384970	MCCAUGHAM, DELMER	SITE 14 RR8, CALGARY 28 T2J 2T9	SE	30	022	02	5		39.6	11.06		Domestic			
377436	EVANS, ED	100 LAKE LINNET CLOV, CALGARY	SE	30	022	02	5		41.2	6.1		Domestic			
351139	TRABER, DALE #1375	SITE 14 RR8, CALGARY 21	SW	30	022	02	5		42.7	33.53		Domestic			
378638	BARKER, N.S.	1120 PROSPECT AVE NE, CALGARY	SW	30	022	02	5	1172.0	42.7	33.53		Domestic and Stock			
378639	TRABER, DALE	S14 RR8, CALGARY 21	SW	30	022	02	5	1172.0	42.7	33.53		Domestic			
377445	STELLA HOLDINGS LTD	5,4215-61 AVE SE, CALGARY	SE	30	022	02	5		44.2	16.76		Domestic			
377440	ARTHURS, ROBIN	MIDNAPORE 32	SE	30	022	02	5		45.7	0.		Domestic			
377449	WILSON, MARILYN	SITE 14, RR8, CALGARY 8	SE	30	022	02	5		45.7	no w.l.		Domestic			
377446	STELLA HOLDINGS LTD	5,4215-61 AVE SE, CALGARY	SE	30	022	02	5		47.2	13.72		Domestic			
352992	TRABER, DALE #1504	SITE 14 RR8, CALGARY 21	NE	30	022	02	5		48.8	13.72		Domestic			
377435	DEMICELL, BARNEY	PRIDDIS	SE	30	022	02	5		50.0	37.8		Domestic			
349985	PARKSIDE MANAGEMENT #1532	SITE 14 R R 8, CALGARY 21	NE	30	022	02	5		54.9	20.42		Domestic			
357254	BAYLY, VIC #1590	1475-550 5 AVE SW, CALGARY	NE	30	022	02	5		54.9	15.24		Domestic			
375015	NELSON, S.	SITE 18 RR9, CALGARY 18 T2J 2T9	02	30	022	02	5		56.4	32.61		Domestic			
349208	REHMAN MEL	620 146 AVE SW, CALGARY	NW	30	022	02	5	0.0	57.9	4.57		Domestic			
377441	ARTHURS, ROBIN	MIDNAPORE 32 T0L 1J0	SE	30	022	02	5		57.9	39.62		Domestic			
378637	WIESE, RAY	S14 RR8, CALGARY 6	02	30	022	02	5	1182.6	59.4	9.45	1	Domestic and Stock			
358915	BAILEY, VIC	SITE 14 RR8, CALGARY 23 T2J 2T9	NE	30	022	02	5		61.0	no w.l.	2	Domestic			
350731	ARTHURS, ROBIN	PRIDDIS 28 T0L 1W0	SE	30	022	02	5		61.0	19.81		Domestic			
351844	ARTHURS, ROBIN	PRIDDIS 28 T0L 1W0	SE	30	022	02	5		61.0	37.19		Domestic			
377448	HARRIS, BOB	SITE 14, RR8, CALGARY, T2J 2T9 18	SE	30	022	02	5		61.0	36.58		Domestic and Stock			
359814	PARKSIDE MGMT #1630	SITE 14 RR8, CALGARY 21 T2J 2T9	10	30	022	02	5		73.2	14.63		Domestic			
356160	BAYLY, VIC	1475 550 6 AVE SW, CALGARY	NE	30	022	02	5		76.2	38.1		Domestic			

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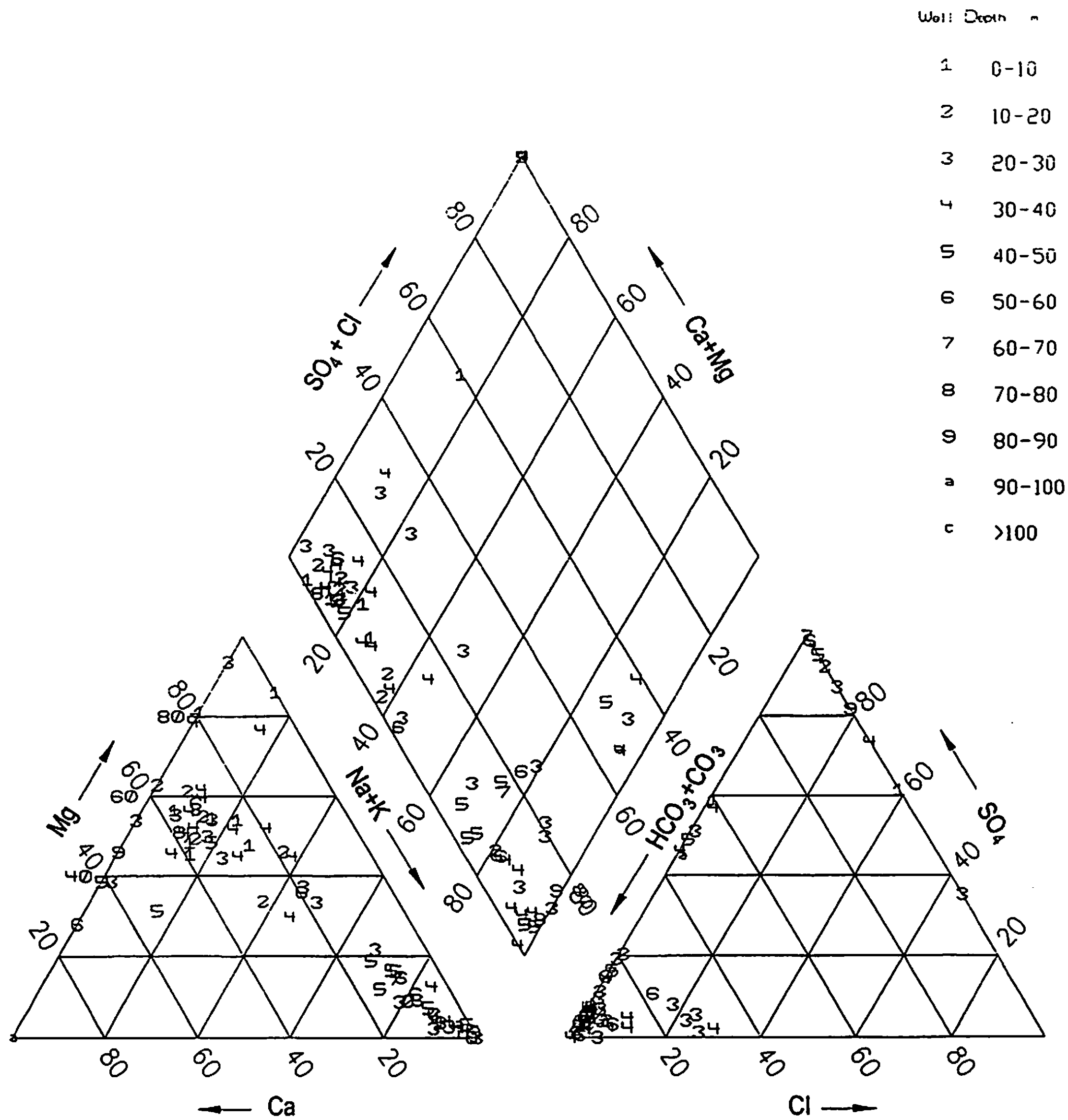
Well Depth m
1 0-10
2 10-20
3 20-30
4 30-40
5 40-50
6 50-60
7 60-70
8 70-80
9 80-90
a 90-100
c >100
SO4 + Cl
Ca+Mg
Mg
Na+K
HCO3+CO3
SO4
Ca
Cl

APPENDIX B

DRILLERS REPORTS / BOREHOLE LOGS

PROJECT: Red Willow Estates	EH 20-22-02 W5M	BOREHOLE NO: 31058-99-01
CLIENT: Bavarian Lion Company		PROJECT NO: 0304-31058.01
DRILL TYPE: Air rotary, Aaron Drilling		ELEVATION:

SAMPLE TYPE: SHELBY TUBE | NO RECOVERY | SPILT SPOON | DISTURBED | DYNAMIC CONE | CONE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth(m)	Soil Description	SAMPLE TYPE	SAMPLE NO	WELL INSTALLATION	COMMENTS
0.0	TOPSOIL				
1.0	TILL				
2.0	SHALE				
3.0	SANDSTONE – brown, fine/med. grained				
4.0	SHALE – medium brown to light gray		13		
5.0	SANDSTONE		16		
5.0–10.0	SHALE – dark brown		30		
11.0	SANDSTONE – brown, medium grained				
12.0	SHALE – dark gray		40		
13.0	SHALE – dark brown				
14.0	SANDSTONE – dark brown, fine grained (coarser at 14 m)				WELL CONSTRUCTION DETAILS –
16.0	SHALE – dark gray				Steel surface casing 6.5" diam. set from 0.6 m above ground to 11.58 m below ground. Schedule 40 PVC (0.127 m diam) set from 10.66 m to 47.24 m. PVC perforated from 35.05 to 47.24 m (Perforations 0.15 m long; 0.003 m wide)
17.0	SANDSTONE – brown, fine grained				
18.0–21.0	SHALE – light gray		60		
22.0–24.0	SANDSTONE – brown, fine/medium grained (quartz 50%, feldspar 45%, black mineral (?) 5%)		70		
24.0	SHALE – dark gray, some sandstone interbeds		80		
26.0	SANDSTONE – brown, medium grained				
27.0–31.0	SHALE		90		
31.0	SANDSTONE		100		
32.0–35.0	SHALE		100		
36.0	SANDSTONE – gray, fine grained				
37.0	SHALE		120		
38.0–40.0	SANDSTONE – gray, medium grained (water bearing)		130		

Depth(ft): 0.0 – 130.0

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Calgary(R). Alberta

LOGGED BY: DAV	COMPLETION DEPTH: 47.24 m
REVIEWED BY: DAV	COMPLETE: 07/09/99
Fig. No: 99-01	

99/10/20 08:16AM (31058)

PROJECT: Red Willow Estates	EH 20-22-02 W5M	BOREHOLE NO: 31058-99-01
CLIENT: Bavarian Lion Company		PROJECT NO: 0304-31058.01
DRILL TYPE: Air rotary, Aaron Drilling		ELEVATION:

SAMPLE TYPE: SHELBY TUBE, NO RECOVERY, SPILT SPOON, DISTURBED, DYNAMIC CONE, CONE

BACKFILL TYPE: BENTONITE, PEA GRAVEL, SLOUGH, GROUT, DRILL CUTTINGS, SAND

Depth(m)	Soil Description	SAMPLE TYPE	SAMPLE NO	WELL INSTALLATION	COMMENTS	Depth(ft)
40.0	SHALE – gray to dark gray (carbonaceous)					
42.0–43.0			140			
44.0	SANDSTONE – brown, fine/medium grained					
45.0	SHALE – dark gray					
46.0	SANDSTONE – brown, fine/medium grained					
47.0	SHALE					
48.0	EOH at 47.24 m					
49.0	Water level (8-Sep-99) 31.490 m					

Depth scale (m): 40.0 – 80.0; Depth scale (ft): 135.0 – 260.0

PROJECT: Red Willow Estates	EH 20-22-02 W5M	BOREHOLE NO: 31058-99-02
CLIENT: Bavarian Lion Company		PROJECT NO: 0304-31058.01
DRILL TYPE: Air rotary, Aaron Drilling		ELEVATION:

SAMPLE TYPE: SHELBY TUBE, NO RECOVERY, SPILT SPOON, DISTURBED, DYNAMIC CONE, CONE

BACKFILL TYPE: BENTONITE, PEA GRAVEL, SLOUGH, GROUT, DRILL CUTTINGS, SAND

Depth(m)	Soil Description	SAMPLE TYPE	SAMPLE NO	WELL INSTALLATION	COMMENTS
0.0	TOPSOIL				
1.0	TILL				
2.0	SHALE – brown				
3.0	SANDSTONE – brown, fine/med grained				
5.0	SHALE – dark gray				
7.0	SANDSTONE – brown, fine grained				
9.0	SHALE – gray				
10.0	SANDSTONE – brown, fine grained, v.hard, rare flint-like particles		10		
12.0	SHALE – gray				WELL CONSTRUCTION DETAILS: Steel surface casing 6.5" diam. set from 0.6 m above ground to 11.58 m below bround. Schedule 40 PVC (0.127 m diam) set from 10.66 m to 71.62 m. PVC perforated from 59.43 to 71.62 m (Perforations 0.15 m long; 0.003 m wide)
15.0	SHALE – brown				
16.0	SANDSTONE – brown, fine grained				
17.0	SHALE – gray				
20.0	SANDSTONE – gray, fine/medium grained		20		
22.0	SHALE – gray				
28.0	SANDSTONE – brown, fine grained				
29.0	SHALE – gray		30		
38.0	SANDSTONE – brown				

Depth(m) scale: 0.0 – 40.0; Depth(ft) scale: 0.0 – 130.0

EBA Engineering Consultants Ltd. Calgary(R), Alberta	LOGGED BY: DAV	COMPLETION DEPTH: 71.62 m
	REVIEWED BY: DAV	COMPLETE: 08/09/99
	Fig. No: 99-02	Page 1 of 2

99/10/20 08:16AM (31058)

PROJECT: Red Willow Estates	EH 20-22-02 W5M	BOREHOLE NO: 31058-99-02
CLIENT: Bavarian Lion Company		PROJECT NO: 0304-31058.01
DRILL TYPE: Air rotary, Aaron Drilling		ELEVATION:

SAMPLE TYPE: SHELBY TUBE, NO RECOVERY, SPILT SPOON, DISTURBED, DYNAMIC CONE, CONE

BACKFILL TYPE: BENTONITE, PEA GRAVEL, SLOUGH, GROUT, DRILL CUTTINGS, SAND

Depth(m)	Soil Description	SAMPLE TYPE	SAMPLE NO	WELL INSTALLATION	COMMENTS	Depth(ft)
40.0			40			
41.0						135.0
42.0	SHALE – (no sample recovery)					140.0
44.0	SANDSTONE – (no sample recovery)					145.0
45.0	SHALE – (no sample recovery)					150.0
46.0	SANDSTONE – (no sample recovery)					155.0
47.0	SHALE – (no sample recovery)					
48.0	SANDSTONE – brown, fine/medium grained					160.0
50.0	SHALE		50			165.0
52.0	SANDSTONE					170.0
53.0	SHALE					175.0
54.0	SANDSTONE – (no sample recovery)					180.0
60.0	SHALE		60			195.0
61.0	SANDSTONE – gray, fine/medium grained					200.0
70.0			70			230.0
72.0	EOH at 71.62 m Water level (8-Sep-99) 44.160 m					235.0
80.0						260.0

EBA Engineering Consultants Ltd.
Calgary(R), Alberta

LOGGED BY: DAV	COMPLETION DEPTH: 71.62 m
REVIEWED BY: DAV	COMPLETE: 08/09/99
Fig. No: 99-02	Page 2 of 2

99/10/20 08:16AM (31058)

PROJECT: Red Willow Estates	EH 20-22-02 W5M	BOREHOLE NO: 31058-99-03
CLIENT: Bavarian Lion Company		PROJECT NO: 0304-31058.01
DRILL TYPE: Air rotary, Aaron Drilling		ELEVATION:

SAMPLE TYPE	SHELBY TUBE	NO RECOVERY	SPILT SPOON	DISTURBED	DYNAMIC CONE	CONE
BACKFILL TYPE	BENTONITE	PEA GRAVEL	SLOUGH	GROUT	DRILL CUTTINGS	SAND

Depth(m)	Soil Description	SAMPLE TYPE	SAMPLE NO	WELL INSTALLATION	COMMENTS
0.0	TOPSOIL				
1.0	TILL – brown, rock fragments 1%		10		
2.0					
3.0					
4.0	TILL – grey, coal fragments, iron oxides		16		
5.0	– wet grey clay		20		
6.0					
7.0			30		
8.0	COAL SEAM				
9.0	TILL – dark gray				
10.0			36		
11.0	SHALE – sandy grey				
12.0	SANDSTONE – grey, grained				
13.0	SHALE – dark gray		50		WELL CONSTRUCTION DETAILS –
14.0	SANDSTONE – brown, fine grained,				
15.0	interbedded on .3 m scale with shale				Steel surface casing 6.5" diam. set from 0.6 m above ground to 11.58 m below ground. Schedule 40 PVC (0.127 m diam) set from 10.66 m to 60.96 m. PVC perforated from 35.05 to 60.96 m (Perforations 0.15 m long; 0.003 m wide)
16.0	SHALE – light gray, fractured (Fe oxides		60		
17.0	on fracture surfaces)				
18.0	SANDSTONE – grey, fine/medium grained				
19.0	SHALE – dark gray, minor coal				
20.0	SANDSTONE – grey, fine grained		70		
21.0	SHALE – to fine siltstone, fractured				
22.0					
23.0			80		
24.0					
25.0	– encounter approx 12 gpm water				
26.0			90		
27.0					
28.0					
29.0			100		
30.0					
31.0					
32.0			110		
33.0					
34.0	SANDSTONE – grey, fine grained				
35.0	SHALE		120		
36.0					
37.0	– highly fractured				
38.0			130		
39.0					
40.0			140		

Depth(ft): 0.0, 5.0, 10.0, 15.0, 20.0, 25.0, 30.0, 35.0, 40.0, 45.0, 50.0, 55.0, 60.0, 65.0, 70.0, 75.0, 80.0, 85.0, 90.0, 95.0, 100.0, 105.0, 110.0, 115.0, 120.0, 125.0, 130.0

EBA Engineering Consultants Ltd. Calgary(R), Alberta	LOGGED BY: DAV	COMPLETION DEPTH: 60.96 m
	REVIEWED BY: DAV	COMPLETE: 06/10/99
	Fig. No: 99-03	Page 1 of 2

99/10/20 08:17AM (31058)

PROJECT: Red Willow Estates	EH 20-22-02 W5M	BOREHOLE NO: 31058-99-03
CLIENT: Bavarian Lion Company		PROJECT NO: 0304-31058.01
DRILL TYPE: Air rotary, Aaron Drilling		ELEVATION:

SAMPLE TYPE: SHELBY TUBE | NO RECOVERY | SPILT SPOON | DISTURBED | DYNAMIC CONE | CONE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth(m)	Soil Description	SAMPLE TYPE	SAMPLE NO	WELL INSTALLATION	COMMENTS	Depth(ft)
40.0–43.0	SANDSTONE – blue grey, fine to medium grained		140			135.0, 140.0
43.0–44.5	SHALE – grey		150			145.0
44.5–45.3	SANDSTONE					150.0
45.3–61.0	SHALE		160			155.0
49.0	– black, with minor sandstone lenses		170, 180, 190, 200			160.0–200.0
61.0	EOH at 60.96 m Water level (6-Oct-99) 8.53 m					

Depth(m) scale: 40.0 – 80.0; Depth(ft) scale: 135.0 – 260.0

EBA Engineering Consultants Ltd.
Calgary(R), Alberta

LOGGED BY: DAV	COMPLETION DEPTH: 60.96 m
REVIEWED BY: DAV	COMPLETE: 06/10/99
Fig. No: 99-03	

99/10/20 08:17AM (31058)

APPENDIX C

STEP PUMPING TEST EVALUATION FOR 99BH03

TABLE C.1
STEP 1 PUMPING TEST DATA (99BH03)
RED WILLOW ESTATES
0304-31058.01

Well ID	99BH03	Start Date:	14 October 1999
Step Test	1		

Static Water level:	8.535 mBTOC	
Weather during test:	Sunny, clear, 5 deg C	
Data personnel:	Val with Aaron Drilling, DeWinton, AB	
Data collection by:	Manual measurements with water level tape	
Pump:	Gould 4" diameter pump	
Pumping rate:	6.4 gpm	15302 m^3/yr
Test starting time:	9:07	

PUMPING			RECOVERY		
Time [min]	Water Level [mBTOC]	Drawdown [m]	Time [min]	Water Level [mBTOC]	Drawdown [m]
0.5	8.890	0.355	0.25	9.400	0.865
1	8.880	0.345	0.5	9.360	0.825
2	8.810	0.275	1	9.320	0.785
2.5	8.808	0.273	2	9.250	0.715
3	8.805	0.270	3	9.200	0.665
4	8.840	0.305	4	9.150	0.615
4.5	8.850	0.315	5	9.120	0.585
5	8.880	0.345	6	9.085	0.550
5.5	8.905	0.370	7	9.050	0.515
6	8.950	0.415	8	9.030	0.495
6.5	9.005	0.470	9	9.000	0.465
7	9.020	0.485	10	8.975	0.440
8	8.980	0.445	12	8.940	0.405
9	9.095	0.560	15	8.890	0.355
10	9.125	0.590	20	8.825	0.290
12.5	9.180	0.645	25	8.780	0.245
15	9.220	0.685	30	8.740	0.205
20	9.295	0.760	35	8.710	0.175
25	9.355	0.820	40	8.685	0.150
30	9.410	0.875	45	8.665	0.130
35	9.460	0.925	50	8.650	0.115
40	9.495	0.960	55	8.630	0.095
45	9.525	0.990	60	8.620	0.085
50	9.550	1.015			
55	9.575	1.040			
60	9.590	1.055			

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FIGURE C.1
STEP 1 PUMPING TEST DATA (99BH03)
RED WILLOW ESTATES
0304-31058.01

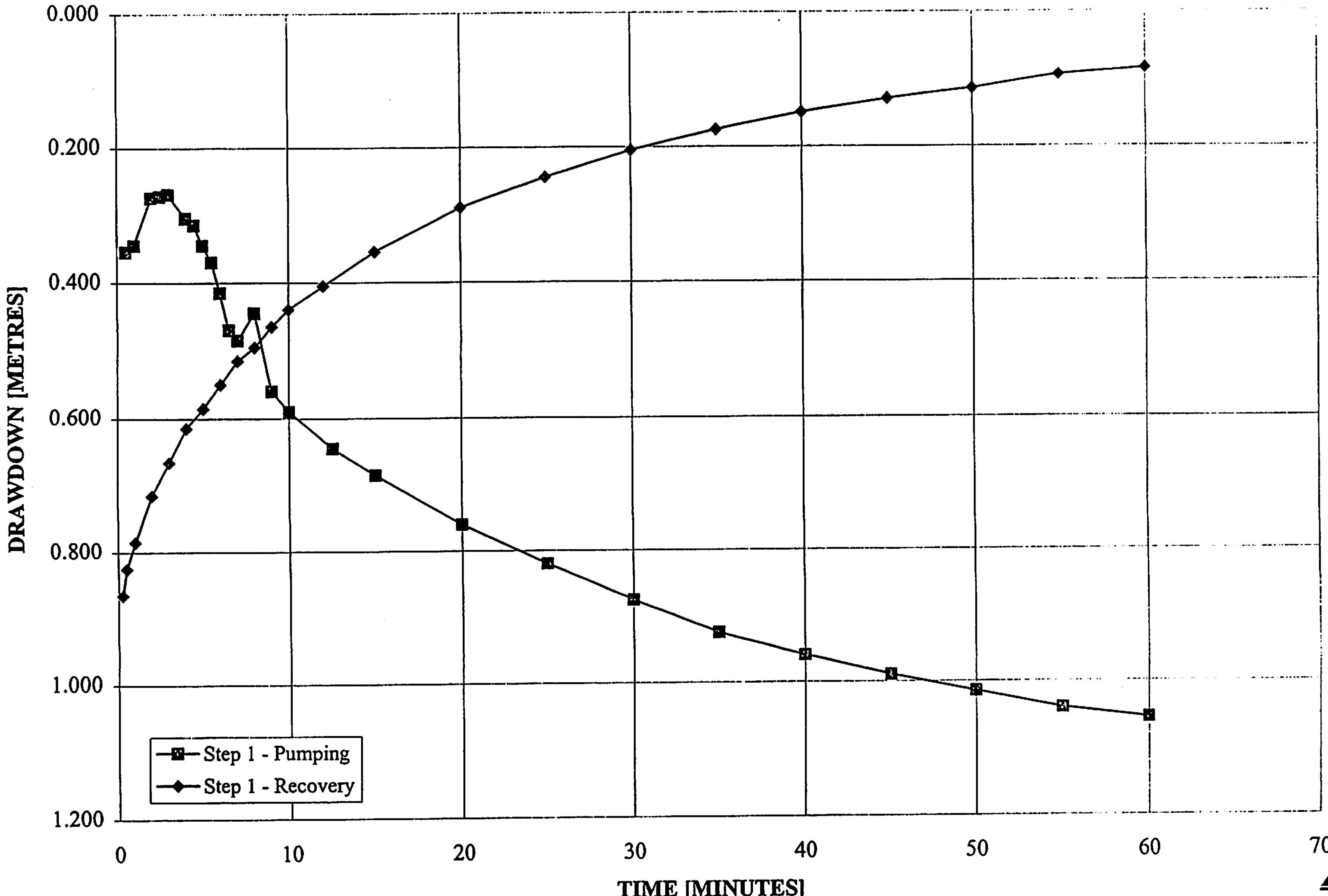

TABLE C.2
STEP 2 PUMPING TEST DATA
RED WILLOW ESTATES
0304-31058.01

Well ID	99BH03	Start Date:	14 October 1999
Step Test	2		

Static Water level:	8.535 mBTOC	
Weather during test:	Sunny, clear, 5 deg C	
Data personnel:	Val with Aaron Drilling, DeWinton, AB	
Data collection by:	Manual measurements with water level tape	
Pump:	Gould 4" diameter pump	
Pumping rate:	10.4 gpm	24867 m^3/yr
Test starting time:	11:30	

PUMPING			RECOVERY		
Time [min]	Water Level [mBTOC]	Drawdown [m]	Time [min]	Water Level [mBTOC]	Drawdown [m]
0.25	8.640	0.105	0.5	9.890	1.355
0.5	8.850	0.315	1	9.790	1.255
1	8.970	0.435	1.5	9.725	1.190
1.5	9.045	0.510	2	9.700	1.165
2	9.100	0.565	3	9.625	1.090
3	9.207	0.672	4	9.560	1.025
4	9.290	0.755	5	9.500	0.965
5	9.350	0.815	6	9.450	0.915
6	9.415	0.880	7	9.410	0.875
7	9.460	0.925	8	9.370	0.835
8	9.500	0.965	9	9.330	0.795
9	9.540	1.005	10	9.300	0.765
10	9.575	1.040	12	9.240	0.705
12	9.635	1.100	15	9.160	0.625
15	9.710	1.175	20	9.055	0.520
20	9.820	1.285	25	8.985	0.450
25	9.905	1.370	30	8.930	0.395
30	9.997	1.462	35	8.880	0.345
35	10.025	1.490	40	8.840	0.305
40	10.070	1.535	45	8.805	0.270
45	10.110	1.575	50	8.785	0.250
50	10.150	1.615	55	8.760	0.225
55	10.180	1.645	60	8.740	0.205
60	10.205	1.670			

eba

FIGURE B.2

STEP PUMPING TEST
RED WILLOW ESTATES
0304-31058.01

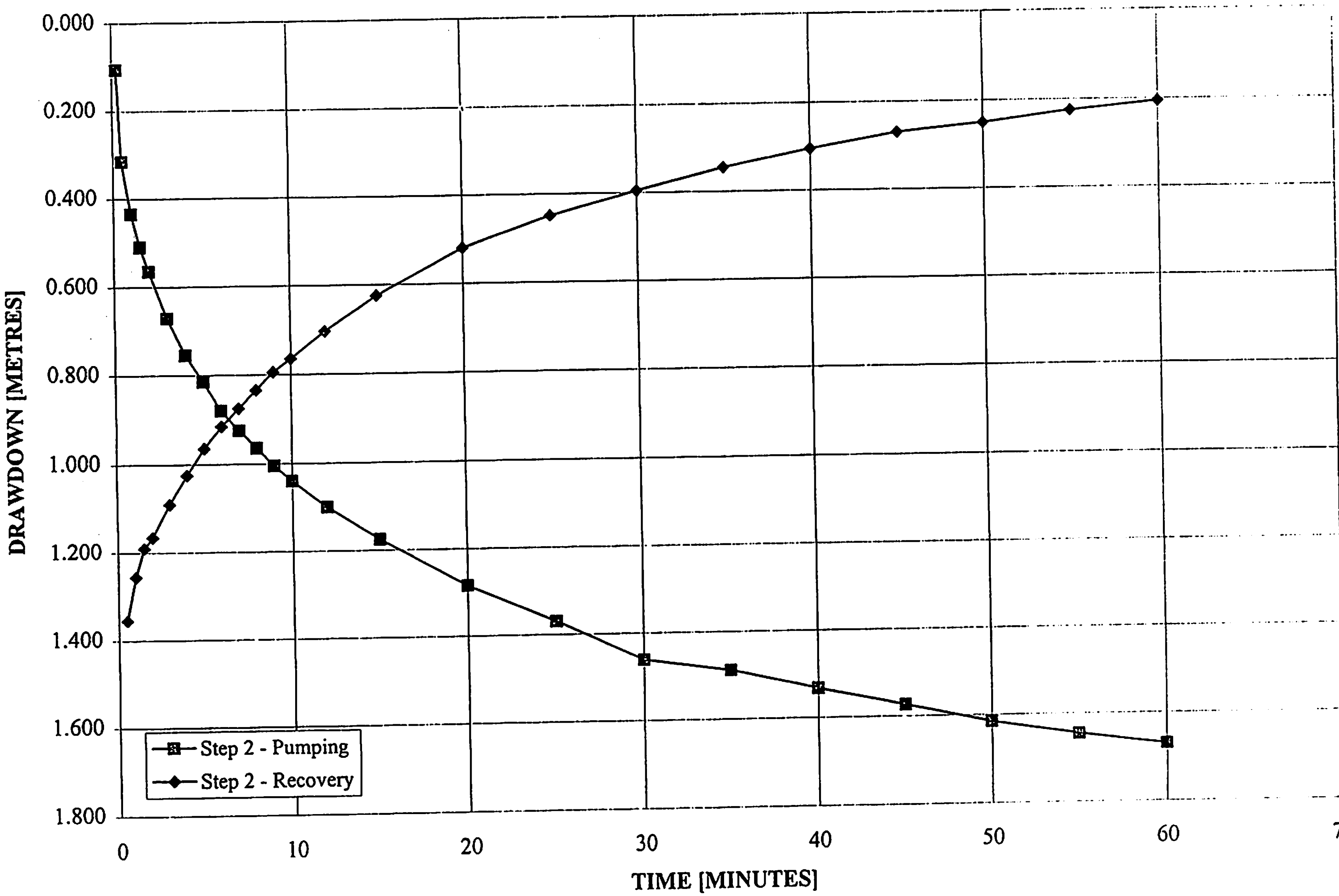

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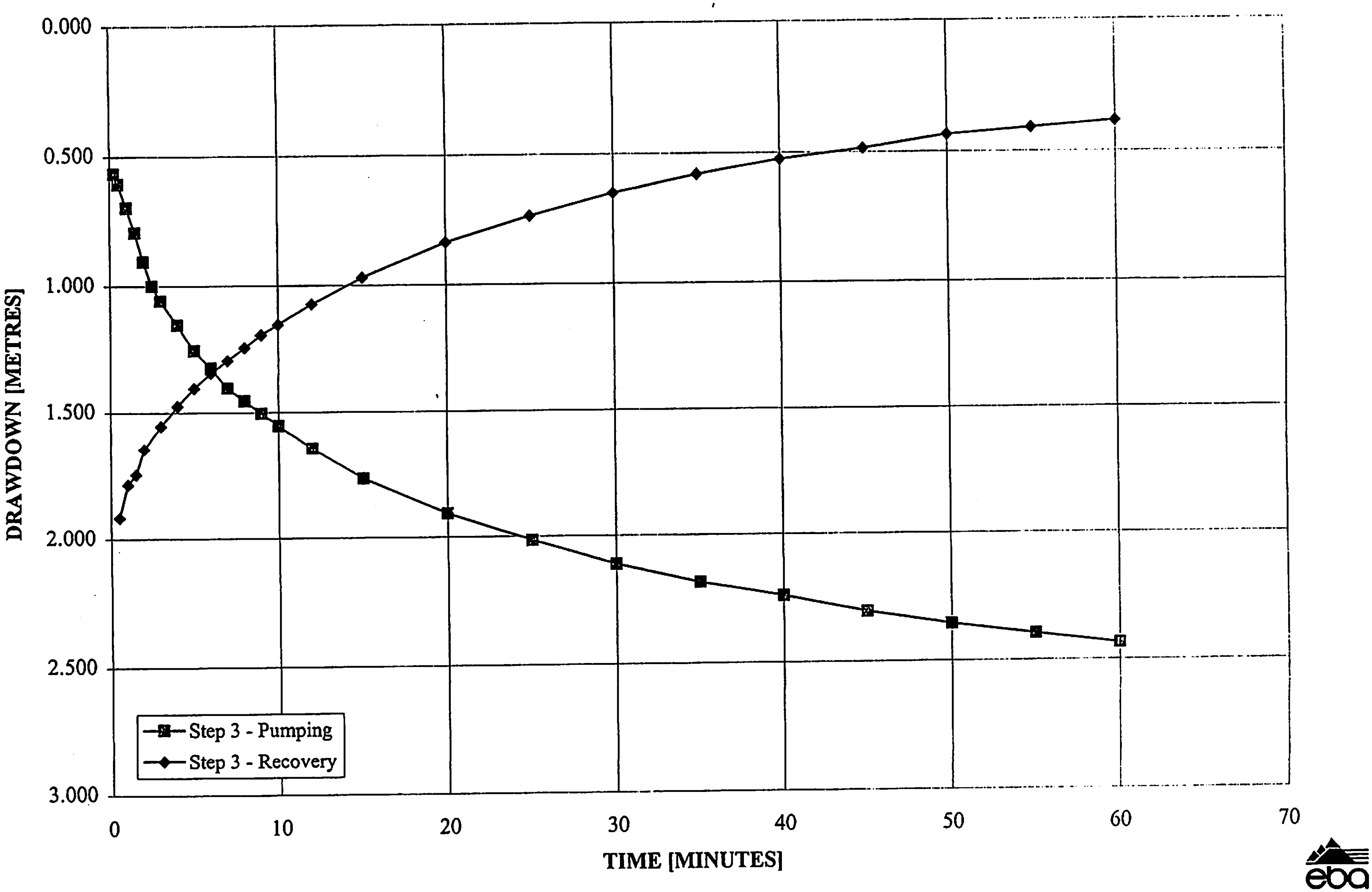
TABLE C.3
STEP 3 PUMPING TEST DATA
RED WILLOW ESTATES
0304-31058.01

Well ID 99BH03 | Start Date: 14 October 1999
Step Test 3

Static Water level: 8.535 mBTOC
Weather during test: Sunny, clear, 5 deg C
Data personnel: Val with Aaron Drilling, DeWinton, AB
Data collection by: Manual measurements with water level tape
Pump: Gould 4" diameter pump
Pumping rate: 15 gpm | 35865 m^3/yr
Test starting time: 13:45

PUMPING			RECOVERY		
Time [min]	Water Level [mBTOC]	Drawdown [m]	Time [min]	Water Level [mBTOC]	Drawdown [m]
0.25	9.100	0.565	0.5	10.450	1.915
0.5	9.140	0.605	1	10.320	1.785
1	9.230	0.695	1.5	10.280	1.745
1.5	9.325	0.790	2	10.180	1.645
2	9.440	0.905	3	10.090	1.555
2.5	9.535	1.000	4	10.010	1.475
3	9.595	1.060	5	9.940	1.405
4	9.690	1.155	6	9.880	1.345
5	9.790	1.255	7	9.830	1.295
6	9.860	1.325	8	9.780	1.245
7	9.940	1.405	9	9.730	1.195
8	9.990	1.455	10	9.690	1.155
9	10.040	1.505	12	9.610	1.075
10	10.090	1.555	15	9.505	0.970
12	10.180	1.645	20	9.370	0.835
15	10.300	1.765	25	9.270	0.735
20	10.440	1.905	30	9.185	0.650
25	10.550	2.015	35	9.115	0.580
30	10.645	2.110	40	9.060	0.525
35	10.720	2.185	45	9.020	0.485
40	10.775	2.240	50	8.970	0.435
45	10.840	2.305	55	8.945	0.410
50	10.890	2.355	60	8.920	0.385
55	10.930	2.395			
60	10.970	2.435			

FIGURE C.3
STEP 3 PUMPING TEST DATA (99BH03)
RED WILLOW ESTATES
0304-31058.01



APPENDIX D

PUMPING TEST RESULTS FOR 99BH03

TABLE D.1
PUMPING TEST DATA (99BH03)
RED WILLOW ESTATES
0304-31058.01

Pumping Well 99BH03

Start Date: 14 October 1999

Static Water level: 8.537 mBTOC
Weather during test: Sunny, clear, 5 deg C
Data personnel: Val with Aaron Drilling, DeWinton, AB
Data collection by: In-Situ Troll data logger
Pump: Gould 4" diameter pump
Pumping rate: 15 gpm | 35865 m^3/min
Test starting time: 17:00

Date [dd-mmm-yy]	Elapsed Time, t [min]	Time After Stopped, t'	t/t' [-]	Water Level [ftBTOC]^A	Water Level [mBTOC]^A	Drawdown [m]	Comments
10/14/99 16:57	0			28.010	8.537	0.000	Pump on at 14/10/1999 17:00
10/14/99 16:59	2			30.169	9.196	0.659	Pumping rate 15 gpm
10/14/99 17:01	4			31.281	9.534	0.997	
10/14/99 17:03	6			31.318	9.546	1.009	
10/14/99 17:05	8			31.945	9.737	1.200	
10/14/99 17:07	10			32.300	9.845	1.308	
10/14/99 17:09	12			32.619	9.942	1.405	
10/14/99 17:11	14			32.716	9.972	1.435	
10/14/99 17:13	16			33.066	10.079	1.542	
10/14/99 17:15	18			33.099	10.089	1.552	
10/14/99 17:17	20			33.260	10.138	1.601	
10/14/99 17:21	24			33.403	10.181	1.644	
10/14/99 17:25	28			33.850	10.317	1.780	
10/14/99 17:29	32			33.994	10.361	1.824	
10/14/99 17:33	36			34.261	10.443	1.906	
10/14/99 17:37	40			34.579	10.540	2.003	
10/14/99 17:41	44			34.741	10.589	2.052	
10/14/99 17:45	48			34.722	10.583	2.046	
10/14/99 17:49	52			34.981	10.662	2.125	
10/14/99 17:53	56			34.787	10.603	2.066	
10/14/99 17:57	60			35.202	10.730	2.193	
10/14/99 18:27	90			35.617	10.856	2.319	
10/14/99 18:57	120			36.060	10.991	2.454	
10/14/99 19:27	150			36.157	11.021	2.484	
10/14/99 19:57	180			36.060	10.991	2.454	
10/14/99 20:27	210			36.443	11.108	2.571	
10/14/99 20:57	240			36.605	11.157	2.620	
10/14/99 21:27	270			36.572	11.147	2.610	
10/14/99 21:57	300			36.411	11.098	2.561	
10/14/99 22:57	360			36.775	11.209	2.672	
10/14/99 23:57	420			36.632	11.165	2.628	
10/15/99 0:57	480			36.983	11.272	2.735	
10/15/99 1:57	540			37.080	11.302	2.765	
10/15/99 2:57	600			36.891	11.244	2.707	
10/15/99 3:57	660			37.048	11.292	2.755	
10/15/99 4:57	720			36.951	11.263	2.726	
10/15/99 5:57	780			37.144	11.321	2.784	
10/15/99 6:57	840			37.061	11.296	2.759	

TABLE D.1
PUMPING TEST DATA (99BH03)
RED WILLOW ESTATES
0304-31058.01

Date [dd-mmm-yy]	Elapsed Time, t [min]	Time After Stopped, t'	t/t' [-]	Water Level [ftBTOC]^A	Water Level [mBTOC]^A	Drawdown [m]	Comments
10/15/99 7:57	900			37.223	11.346	2.809	
10/15/99 8:57	960			37.334	11.379	2.842	
10/15/99 9:37	1000			37.366	11.389	2.852	
10/15/99 9:39	1002			37.352	11.385	2.848	
10/15/99 9:41	1004			37.287	11.365	2.828	
10/15/99 9:43	1006			37.048	11.292	2.755	
10/15/99 9:45	1008			37.223	11.346	2.809	
10/15/99 9:47	1010			37.126	11.316	2.779	Increase pumping rate to 28 gpm
10/15/99 9:49	1012			37.430	11.409	2.872	
10/15/99 9:51	1014			39.419	12.015	3.478	
10/15/99 9:53	1016			40.817	12.441	3.904	
10/15/99 9:55	1018			41.329	12.597	4.060	
10/15/99 9:57	1020			41.901	12.771	4.234	
10/15/99 10:01	1024			42.381	12.918	4.381	
10/15/99 10:05	1028			42.362	12.912	4.375	
10/15/99 10:09	1032			42.934	13.086	4.549	
10/15/99 10:13	1036			43.109	13.140	4.603	
10/15/99 10:17	1040			43.174	13.159	4.622	
10/15/99 10:21	1044			43.525	13.266	4.729	
10/15/99 10:25	1048			43.428	13.237	4.700	
10/15/99 10:29	1052			43.511	13.262	4.725	
10/15/99 10:33	1056			43.908	13.383	4.846	
10/15/99 10:37	1060			44.115	13.446	4.909	
10/15/99 11:07	1090			44.272	13.494	4.957	
10/15/99 11:37	1120			44.863	13.674	5.137	
10/15/99 12:07	1150			44.973	13.708	5.171	
10/15/99 12:37	1180			45.098	13.746	5.209	
10/15/99 13:07	1210			45.324	13.815	5.278	
10/15/99 13:37	1240			45.435	13.849	5.312	
10/15/99 14:07	1270			45.642	13.912	5.375	
10/15/99 14:37	1300			45.481	13.863	5.326	
10/15/99 15:37	1360			45.416	13.843	5.306	
10/15/99 16:37	1420			44.909	13.688	5.151	
10/15/99 17:03	1446			45.656	13.916	5.379	Pump off at 15/10/1999 17:03
10/15/99 17:05	1448			37.523	11.437	2.900	
10/15/99 17:07	1450			36.983	11.272	2.735	
10/15/99 17:09	1452			36.568	11.146	2.609	
10/15/99 17:11	1454			36.213	11.038	2.501	
10/15/99 17:13	1456			35.880	10.936	2.399	
10/15/99 17:15	1458			35.562	10.839	2.302	
10/15/99 17:17	1460			35.294	10.758	2.221	
10/15/99 17:19	1462			35.027	10.676	2.139	
10/15/99 17:21	1464			34.769	10.598	2.061	
10/15/99 17:23	1466			34.547	10.530	1.993	
10/15/99 17:27	1470			34.150	10.409	1.872	
10/15/99 17:31	1474			33.786	10.298	1.761	
10/15/99 17:35	1478			33.468	10.201	1.664	
10/15/99 17:39	1482			33.182	10.114	1.577	
10/15/99 17:43	1486			32.942	10.041	1.504	

TABLE D.1
PUMPING TEST DATA (99BH03)
RED WILLOW ESTATES
0304-31058.01

Date [dd-mmm-yy]	Elapsed Time, t [min]	Time After Stopped, t'	t/t' [-]	Water Level [ftBTOC]^A	[mBTOC]^A	Drawdown [m]	Comments
10/15/99 17:47	1490			32.734	9.977	1.440	
10/15/99 17:51	1494			32.526	9.914	1.377	
10/15/99 17:55	1498			32.370	9.866	1.329	
10/15/99 17:59	1502			32.208	9.817	1.280	
10/15/99 18:03	1506			32.065	9.773	1.236	
10/15/99 18:33	1536			31.304	9.541	1.004	
10/15/99 19:03	1566			30.824	9.395	0.858	
10/15/99 19:33	1596			30.524	9.304	0.767	
10/15/99 20:03	1626			30.284	9.231	0.694	
10/15/99 20:33	1656			30.109	9.177	0.640	
10/15/99 21:03	1686			29.966	9.134	0.597	
10/15/99 21:33	1716			29.855	9.100	0.563	
10/15/99 22:03	1746			29.758	9.070	0.533	
10/15/99 23:03	1806			29.583	9.017	0.480	
10/16/99 0:03	1866			29.472	8.983	0.446	
10/16/99 1:03	1926			29.380	8.955	0.418	
10/16/99 2:03	1986			29.316	8.936	0.399	
10/16/99 3:03	2046			29.251	8.916	0.379	
10/16/99 4:03	2106			29.219	8.906	0.369	
10/16/99 5:03	2166			29.154	8.886	0.349	
10/16/99 6:03	2226			29.140	8.882	0.345	
10/16/99 7:03	2286			29.108	8.872	0.335	
10/16/99 8:03	2346			29.094	8.868	0.331	
10/16/99 9:03	2406			29.062	8.858	0.321	
10/16/99 10:03	2466			29.057	8.857	0.320	
10/16/99 11:03	2526			29.043	8.852	0.315	
10/16/99 12:03	2586			29.043	8.852	0.315	
10/16/99 13:03	2646			29.043	8.852	0.315	

Note that this table is a filtered subset of the raw data set which had a sampling interval of 2 minutes (1375 data values)

FIGURE D.1
PUMPING TEST DATA (99BH03)
RED WILLOW ESTATES
0304-31058.01

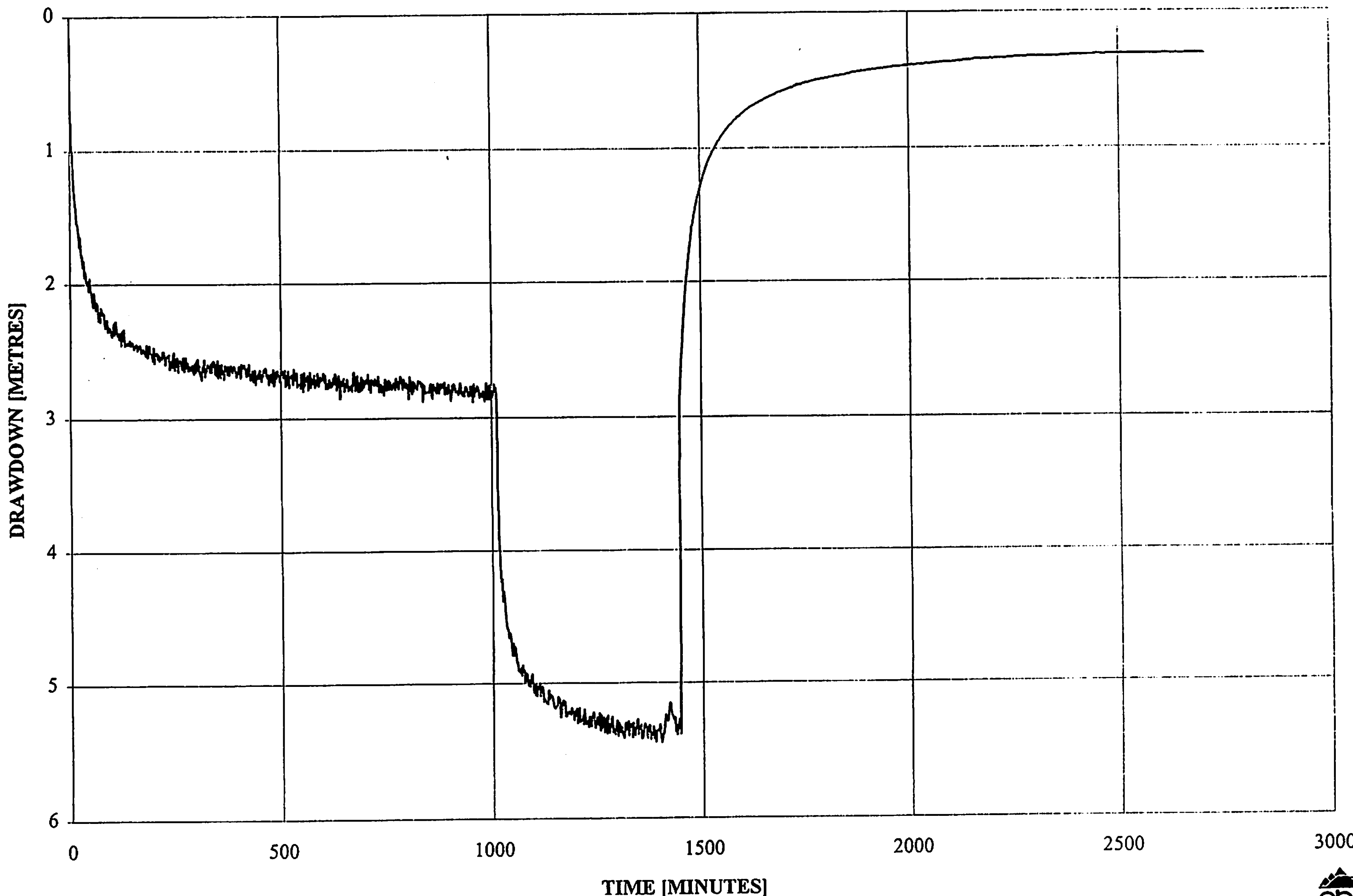


TABLE D.2
OBSERVATION WELL DATA (#418358)
RED WILLOW ESTATES
0304-31058.01

Observation Well #418358

Start Date: 14 October 1999

Static Water level: 26.7 mBTOC
Weather during test: Sunny, clear, 5 deg C
Data personnel: Val with Aaron Drilling, DeWinton, AB
Data collection by: In-Situ Troll data logger

Test starting time: 17:00

Date [dd-mmm-yy]	Elapsed Time, t [min]	Time After Start Pump	Water Level [ftBTOC]^A	Water Level [mBTOC]^A	Drawdown [m]	Comments
10/14/99 16:16	10	-31	87.591	26.698	-0.002	Pump on at 14/10/1999 17:00
10/14/99 16:36	30	-11	87.600	26.700	0.000	Pumping rate 15 gpm
10/14/99 16:56	50	9	87.614	26.705	0.005	
10/14/99 17:16	70	29	87.600	26.700	0.000	
10/14/99 17:36	90	49	87.600	26.700	0.000	
10/14/99 17:56	110	69	87.614	26.705	0.005	
10/14/99 18:16	130	89	87.600	26.700	0.000	
10/14/99 18:36	150	109	87.600	26.700	0.000	
10/14/99 18:56	170	129	87.614	26.705	0.005	
10/14/99 19:16	190	149	87.614	26.705	0.005	
10/14/99 19:36	210	169	87.614	26.705	0.005	
10/14/99 19:56	230	189	87.628	26.709	0.009	
10/14/99 20:16	250	209	87.628	26.709	0.009	
10/14/99 20:36	270	229	87.628	26.709	0.009	
10/14/99 20:56	290	249	87.628	26.709	0.009	
10/14/99 21:16	310	269	87.646	26.715	0.015	
10/14/99 21:36	330	289	87.646	26.715	0.015	
10/14/99 21:56	350	309	87.660	26.719	0.019	
10/14/99 22:16	370	329	87.646	26.715	0.015	
10/14/99 22:36	390	349	87.678	26.724	0.024	
10/14/99 22:56	410	369	87.678	26.724	0.024	
10/14/99 23:16	430	389	87.692	26.729	0.029	
10/14/99 23:36	450	409	87.692	26.729	0.029	
10/14/99 23:56	470	429	87.692	26.729	0.029	
10/15/99 0:16	490	449	87.692	26.729	0.029	
10/15/99 0:36	510	469	87.706	26.733	0.033	
10/15/99 0:56	530	489	87.706	26.733	0.033	
10/15/99 1:16	550	509	87.706	26.733	0.033	
10/15/99 1:36	570	529	87.706	26.733	0.033	
10/15/99 1:56	590	549	87.725	26.739	0.039	
10/15/99 2:16	610	569	87.725	26.739	0.039	
10/15/99 2:36	630	589	87.725	26.739	0.039	
10/15/99 2:56	650	609	87.725	26.739	0.039	
10/15/99 3:16	670	629	87.738	26.743	0.043	
10/15/99 3:36	690	649	87.738	26.743	0.043	
10/15/99 3:56	710	669	87.757	26.748	0.048	
10/15/99 4:16	730	689	87.771	26.753	0.053	
10/15/99 4:36	750	709	87.771	26.753	0.053	

TABLE D.2
OBSERVATION WELL DATA (#418358)
RED WILLOW ESTATES
0304-31058.01

Date	Elapsed Time, t	Time After Start Pump	Water Level		Drawdown	Comments
[dd-mmm-yy]	[min]		[ftBTOC]^A	[mBTOC]^A	[m]	
10/15/99 4:56	770	729	87.771	26.753	0.053	
10/15/99 5:16	790	749	87.771	26.753	0.053	
10/15/99 5:36	810	769	87.785	26.757	0.057	
10/15/99 5:56	830	789	87.785	26.757	0.057	
10/15/99 6:16	850	809	87.785	26.757	0.057	
10/15/99 6:36	870	829	87.785	26.757	0.057	
10/15/99 6:56	890	849	87.803	26.762	0.062	
10/15/99 7:16	910	869	87.803	26.762	0.062	
10/15/99 7:36	930	889	87.817	26.767	0.067	
10/15/99 7:56	950	909	87.803	26.762	0.062	
10/15/99 8:16	970	929	87.817	26.767	0.067	
10/15/99 8:36	990	949	87.835	26.772	0.072	
10/15/99 8:56	1010	969	87.835	26.772	0.072	Increase pumping rate to 28 gpm
10/15/99 9:16	1030	989	87.835	26.772	0.072	
10/15/99 9:36	1050	1009	87.849	26.776	0.076	
10/15/99 9:56	1070	1029	87.868	26.782	0.082	
10/15/99 10:16	1090	1049	87.868	26.782	0.082	
10/15/99 10:36	1110	1069	87.868	26.782	0.082	
10/15/99 10:56	1130	1089	87.868	26.782	0.082	
10/15/99 11:16	1150	1109	87.881	26.786	0.086	
10/15/99 11:36	1170	1129	87.881	26.786	0.086	
10/15/99 11:56	1190	1149	87.895	26.790	0.090	
10/15/99 12:16	1210	1169	87.895	26.790	0.090	
10/15/99 12:36	1230	1189	87.914	26.796	0.096	
10/15/99 12:56	1250	1209	87.914	26.796	0.096	
10/15/99 13:16	1270	1229	87.914	26.796	0.096	
10/15/99 13:36	1290	1249	87.928	26.800	0.100	
10/15/99 13:56	1310	1269	87.928	26.800	0.100	
10/15/99 14:16	1330	1289	87.946	26.806	0.106	
10/15/99 14:36	1350	1309	87.928	26.800	0.100	
10/15/99 14:56	1370	1329	87.946	26.806	0.106	
10/15/99 15:16	1390	1349	87.960	26.810	0.110	
10/15/99 15:36	1410	1369	87.974	26.814	0.114	
10/15/99 15:56	1430	1389	87.974	26.814	0.114	
10/15/99 16:16	1450	1409	87.974	26.814	0.114	
10/15/99 16:36	1470	1429	87.974	26.814	0.114	
10/15/99 16:56	1490	1449	87.992	26.820	0.120	
10/15/99 17:16	1510	1469	88.006	26.824	0.124	Pump off at 15/10/1999 17:03
10/15/99 17:36	1530	1489	87.992	26.820	0.120	
10/15/99 17:56	1550	1509	87.992	26.820	0.120	
10/15/99 18:16	1570	1529	88.006	26.824	0.124	
10/15/99 18:36	1590	1549	88.024	26.830	0.130	
10/15/99 18:56	1610	1569	88.038	26.834	0.134	
10/15/99 19:16	1630	1589	88.024	26.830	0.130	
10/15/99 19:36	1650	1609	88.038	26.834	0.134	
10/15/99 19:56	1670	1629	88.038	26.834	0.134	
10/15/99 20:16	1690	1649	88.057	26.840	0.140	

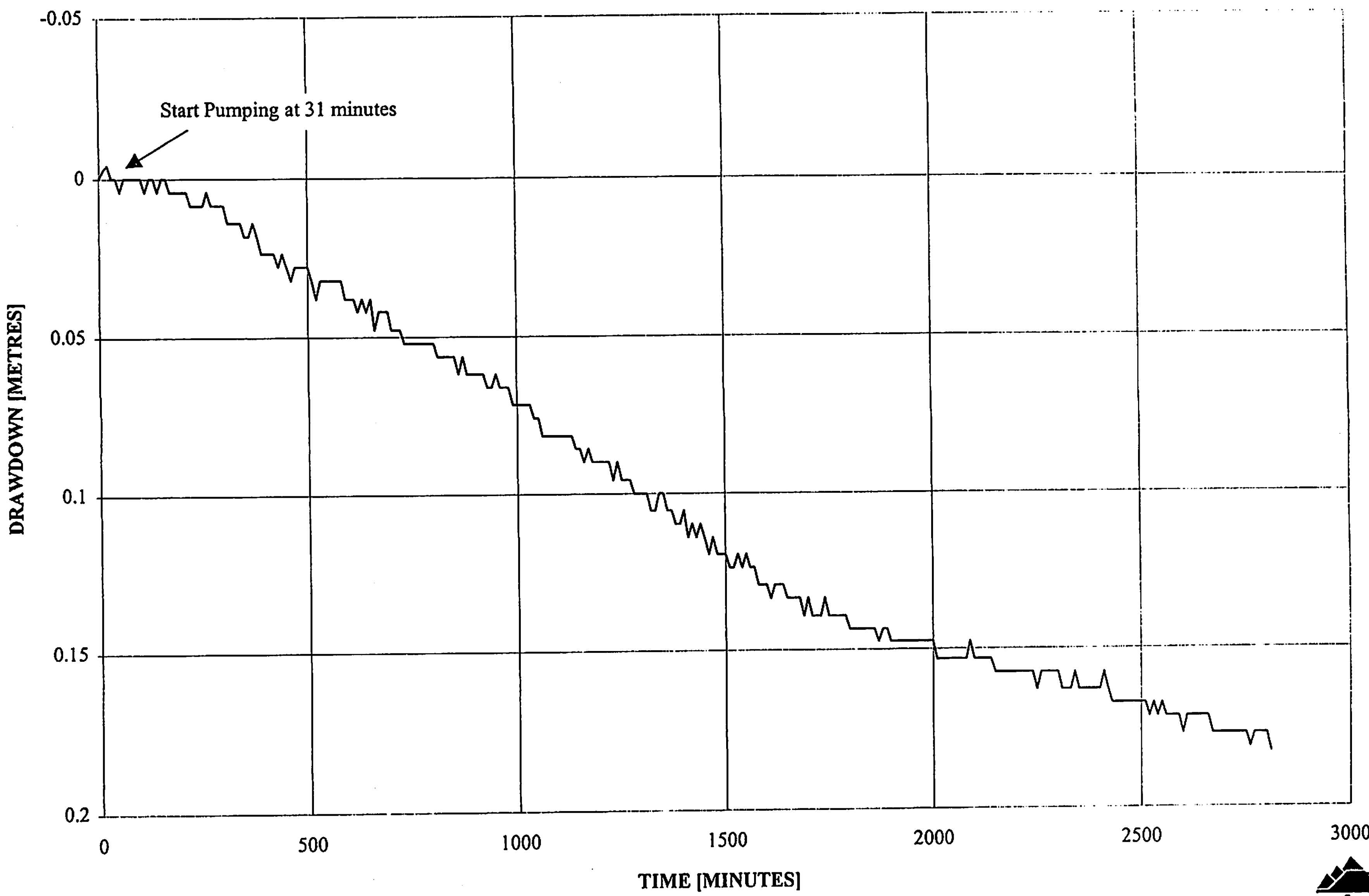
TABLE D.2
OBSERVATION WELL DATA (#418358)
RED WILLOW ESTATES
0304-31058.01

Date [dd-mmm-yy]	Elapsed Time, t [min]	Time After Start Pump	Water Level [ftBTOC]^A	Water Level [mBTOC]^A	Drawdown [m]	Comments
10/15/99 20:36	1710	1669	88.057	26.840	0.140	
10/15/99 20:56	1730	1689	88.057	26.840	0.140	
10/15/99 21:16	1750	1709	88.057	26.840	0.140	
10/15/99 21:36	1770	1729	88.057	26.840	0.140	
10/15/99 21:56	1790	1749	88.057	26.840	0.140	
10/15/99 22:16	1810	1769	88.071	26.844	0.144	
10/15/99 22:36	1830	1789	88.071	26.844	0.144	
10/15/99 22:56	1850	1809	88.071	26.844	0.144	
10/15/99 23:16	1870	1829	88.084	26.848	0.148	
10/15/99 23:36	1890	1849	88.071	26.844	0.144	
10/15/99 23:56	1910	1869	88.084	26.848	0.148	
10/16/99 0:16	1930	1889	88.084	26.848	0.148	
10/16/99 0:36	1950	1909	88.084	26.848	0.148	
10/16/99 0:56	1970	1929	88.084	26.848	0.148	
10/16/99 1:16	1990	1949	88.084	26.848	0.148	
10/16/99 1:36	2010	1969	88.103	26.854	0.154	
10/16/99 1:56	2030	1989	88.103	26.854	0.154	
10/16/99 2:16	2050	2009	88.103	26.854	0.154	
10/16/99 2:36	2070	2029	88.103	26.854	0.154	
10/16/99 2:56	2090	2049	88.084	26.848	0.148	
10/16/99 3:16	2110	2069	88.103	26.854	0.154	
10/16/99 3:36	2130	2089	88.103	26.854	0.154	
10/16/99 3:56	2150	2109	88.117	26.858	0.158	
10/16/99 4:16	2170	2129	88.117	26.858	0.158	
10/16/99 4:36	2190	2149	88.117	26.858	0.158	
10/16/99 4:56	2210	2169	88.117	26.858	0.158	
10/16/99 5:16	2230	2189	88.117	26.858	0.158	
10/16/99 5:36	2250	2209	88.135	26.864	0.164	
10/16/99 5:56	2270	2229	88.117	26.858	0.158	
10/16/99 6:16	2290	2249	88.117	26.858	0.158	
10/16/99 6:36	2310	2269	88.135	26.864	0.164	
10/16/99 6:56	2330	2289	88.135	26.864	0.164	
10/16/99 7:16	2350	2309	88.135	26.864	0.164	
10/16/99 7:36	2370	2329	88.135	26.864	0.164	
10/16/99 7:56	2390	2349	88.135	26.864	0.164	
10/16/99 8:16	2410	2369	88.117	26.858	0.158	
10/16/99 8:36	2430	2389	88.149	26.868	0.168	
10/16/99 8:56	2450	2409	88.149	26.868	0.168	
10/16/99 9:16	2470	2429	88.149	26.868	0.168	
10/16/99 9:36	2490	2449	88.149	26.868	0.168	
10/16/99 9:56	2510	2469	88.149	26.868	0.168	
10/16/99 10:16	2530	2489	88.149	26.868	0.168	
10/16/99 10:36	2550	2509	88.149	26.868	0.168	
10/16/99 10:56	2570	2529	88.163	26.872	0.172	
10/16/99 11:16	2590	2549	88.163	26.872	0.172	
10/16/99 11:36	2610	2569	88.163	26.872	0.172	
10/16/99 11:56	2630	2589	88.163	26.872	0.172	

TABLE D.2
OBSERVATION WELL DATA (#418358)
RED WILLOW ESTATES
0304-31058.01

Date [dd-mmm-yy]	Elapsed Time, t [min]	Time After Start Pump	Water Level [ftBTOC][A]	Water Level [mBTOC][A]	Drawdown [m]	Comments
10/16/99 12:16	2650	2609	88.163	26.872	0.172	
10/16/99 12:36	2670	2629	88.181	26.878	0.178	
10/16/99 12:56	2690	2649	88.181	26.878	0.178	
10/16/99 13:16	2710	2669	88.181	26.878	0.178	
10/16/99 13:36	2730	2689	88.181	26.878	0.178	
10/16/99 13:56	2750	2709	88.181	26.878	0.178	
10/16/99 14:16	2770	2729	88.181	26.878	0.178	
10/16/99 14:36	2790	2749	88.181	26.878	0.178	
10/16/99 14:56	2810	2769	88.200	26.883	0.183	

FIGURE D.2
OBSERVATION WELL DATA (#418358)
RED WILLOW ESTATES
0304-31058.01



eba

H:\WPFILES\0304\99-31058\01\T01.xls

APPENDIX E

LABORATORY ANALYTICAL REPORTS

ENVIRO-TEST LABORATORIES
A Division of ETL Chemspec Analytical Limited.

BAY 3 1313 44 AVE NE, CALGARY, ALBERTA, T2E 6L5
TEL: (403) 291-9897
FAX: (403) 291-0298

ENVIRO-TEST FAST FAXED ANALYSIS REPORT

PROJECT INFORMATION:

Company: EBA ENG CONSULTANTS LTD
Attention: ROB REIMER
Lab Work Order #: E909675
Project Reference: 0304-31058.01
Project P.O.#: NOT SUBMITTED
Sampled By: DUE
Date Received: 09/14/99

Fax Number: 203-3301

Technical Questions: RON MINKS

Sender: TRACY

# of Pages: 5

Message:
PRELIMINARY RESULTS

IF YOU REQUIRE RESULTS COURIERED IMMEDIATELY, CHECK ____ AND RETURN BY FAX.

ALL RESULTS WILL BE MAILED UNLESS OTHERWISE NOTIFIED.
ALL COURIERED RESULTS WILL BE BILLED DIRECTLY AT COST.

IF YOU DID NOT RECEIVE ALL PAGES, PLEASE NOTIFY (403) 291-9897 AS SOON AS POSSIBLE.

E909675 CONT
PAGE 2

ENVIRO-TEST CHEMICAL ANALYSIS REPORT

LAB ID	SAMPLE ID	TEST DESCRIPTION	RESULT	D.L.	UNITS	EXTRACTED	ANALYZED	BY
E909675-01	99BH01							
Sample Type:WATER								
Collected:09/14/99								
		Total & Fecal Coliforms	Attached		CFU/100mL		09/16/99	WSH
		Major Ions, F, Fe and Mn						
		Balance	98		%		09/17/99	JCG
		Bicarbonate (HCO3)	482	5	mg/L		09/15/99	DDN
		Calcium (Ca)	70.9	0.5	mg/L		09/15/99	JCG
		Chloride (Cl)	1.5	0.5	mg/L		09/14/99	SWW
		Carbonate (CO3)	<5	5	mg/L		09/15/99	DDN
		Conductance (EC)	672	3	uS/cm		09/15/99	DDN
		Fluoride	0.2	0.1	mg/L		09/14/99	SWW
		Hardness	352	1	mg/L		09/17/99	JCG
		Iron (Fe)	<0.01	0.01	mg/L		09/15/99	JCG
		Manganese (Mn)	<0.01	0.01	mg/L		09/15/99	JCG
		Potassium (K)	5.5	0.1	mg/L		09/15/99	JCG
		Magnesium (Mg)	42.4	0.1	mg/L		09/15/99	JCG
		Nitrate+Nitrite (N)	1.00	0.05	mg/L		09/14/99	SWW
		Sodium (Na)	39	1	mg/L		09/15/99	JCG
		Hydroxide in Water	<5	5	mg/L		09/15/99	DDN
		pH in Water	7.2		pH		09/15/99	DDN
		Sulfate (SO4)	22.8	0.5	mg/L		09/14/99	SWW
		Alkalinity, Total (T Alk)	395	5	mg/L		09/15/99	DDN
		TDS (Calculated)	420	1	mg/L		09/17/99	JCG

N.D. - NOT DETECTED, LESS THAN THE DETECTION LIMIT

THIS IS THE FINAL PAGE OF THE REPORT
NOT INCLUDING APPENDICES

WSH Labs (1992) LTD.

3851B - 21 Street N.E.
Calgary, Alberta
Canada T2E 6T5
Ph: (403) 250-9164
Fax: (403) 291-4597

Sept 16, 1999

Enviro - Test Laboratories
1313 - 44 Ave N.E.
Calgary, Alberta
T2E 6L5

Attention : Ron Minks
Sample Type : Water

Date Received : Sept 14, 1999
Date Reported : Sept 16, 1999

RESULTS OF WATER ANALYSIS

LAB NO.	SAMPLE I.D.	TOTAL COLIFORM	FECAL COLIFORM
25032	E909675-01B	0	0

Q C Summary

*Coliforms (Presence / Absence) : Presence
*Fecal Coliforms (Presence / Absence) : Presence
Dilution Blank : 0

* Source of QC Coli/Fecal - Primary Sewage Effluent of Bonnybrook Sewage Treatment Plant, Calgary.

Note :

1. 0 - Less Than 1 CFU / 100 mL
2. Coliforms / Fecal Coliforms In CFU / 100 mL
3. TNTC - Too Numerous To Count (Confluent Growth)

Per
Bill Wong.

Appendix A Test Methodologies

Balance

Instrumental Method:Sum(Anions meq/L)/Sum(Cations meq/L)*100
Method Reference:APHA 1030 F

Bicarbonate (HCO3)

Instrumental Method: Calculated from Alkalinity
Method Reference: APHA 2320B

Chloride (Cl)

Preparation Method: 0.45μ filtration if turbid
Instrumental Method: Ion Chromatography
Method Reference: APHA 4110 B

Carbonate (CO3)

Instrumental Method: Calculated from Alkalinity
Method Reference: Carbonate APHA 2320B

Conductance (EC)

Instrumental Method: Conductivity Meter
Method Reference: Conductance APHA 2510B

Lab Filtered & Preserved

Fluoride

Preparation Method: 0.45u filtration if turbid.
Instrumental Method: Ion Chromatography
Method Reference: APHA 4110 B

Hardness

Instrumental Method: Calculated from Ca+Mg as CaCO3
Method Reference: Hardness APHA 2340 B

Routine Cations

PREPARATION METHOD: Filter through 0.45u if turbid
INSTRUMENTAL METHOD: Ion Chromatography OR Inductively Coupled Plasma (ICP)
METHOD REFERENCE: EPA 300.7 OR 200.7

CATIONS	DETECTION LIMITS
Calcium (Ca)	0.5
Magnesium (Mg)	0.1
Potassium (K)	0.1
Sodium (Na)	1

ICP Metals

PREPARATION METHOD:

Dissolved: Filter through 0.45u and preserve with nitric acid
Extractable: Preserve with nitric acid
Total: Preserve with nitric acid; digest with nitric/hydrochloric acid

INSTRUMENTAL METHOD: ICP Spectrophotometry
METHOD REFERENCE: APHA 3120B/3030F, Standard Methods; 18th ed.

Routine Metals

Metals, Dissolved
Preparation Method: Filter through 0.45u; preserve with nitric acid
Instumental Method: ICP Spectrophotometry

Appendix A Test Methodologies

Method Reference: APHA 3120 B, Standards Methods, 18thEdition

Nitrate+Nitrite (N)

Preparation Method: filtration
Instrumental Method: Ion Chromatography
Method Reference: APHA 4110 B

Hydroxide In Water

Method Reference: Hydroxide APHA 2320 B

pH in Water

Instrumental Method: pH Meter
Method Reference: APHA 4500-H+ B

Sulfate (SO4)

Preparation Method: 0.45u filtration if turbid.
Instrumental Method: Ion Chromatography
Method Reference: APHA 4110 B

Alkalinity, Total (T Alk)

Instrumental Method: Titration performed to pH 8.3 and 4.5 endpoint using autotitrator or manual technique.

Method Reference: T ALK APHA 2320B

TDS (Calculated)

Instrumental Method: Calculated from the sum of ions
Method Reference: TDS APHA 1030 F

Total & Fecal Coliforms

ENVIRO-TEST LABORATORIES
A Division of ETL Chemspec Analytical Limited.

BAY 3 1313 44 AVE NE, CALGARY, ALBERTA, T2E 6L5
TEL: (403) 291-9897
FAX: (403) 291-0298

RECEIVED OCT 20 1999 BY:

ENVIRO-TEST FAST FAXED ANALYSIS REPORT

PROJECT INFORMATION:

Company:	EBA ENG CONSULTANTS LTD
Attention:	DAVID VAN EVERDINGEN
Lab Work Order #:	E910832
Project Reference:	0304 31058.01
Project P.O.#:	NOT SUBMITTED
Sampled By:	D.A.V.E
Date Received:	10/14/99
Fax Number:	203-3301
Technical Questions:	RON MINKS
Sender:	TRACY
# of Pages:	7

Message:
PRELIMINARY RESULTS

IF YOU REQUIRE RESULTS COURIERED IMMEDIATELY, CHECK _____ AND RETURN BY FAX.

ALL RESULTS WILL BE MAILED UNLESS OTHERWISE NOTIFIED.
ALL COURIERED RESULTS WILL BE BILLED DIRECTLY AT COST.

IF YOU DID NOT RECEIVE ALL PAGES, PLEASE NOTIFY (403) 291-9897 AS SOON AS POSSIBLE.

ETL Enviro·Test
A DIVISION OF ETL CHEMSPEC ANALYTICAL LIMITED

...onton (Main)
9936 - 67 Avenue
Edmonton, AB
T6E 0P5
Phone: (780) 413-5227
Fax: (780) 437-2311

Edmonton (Downtown)
2nd Flr, 10158 - 103 Street
Edmonton, AB
T5J 0X6
Phone: (780) 413-5265
Fax: (780) 424-4602

Calgary
Bay 2, 1313 - 44th Ave. N.E.
Calgary, AB
T2E 6L5
Phone: (403) 291-9897
Fax: (403) 291-0298

Grande Prairie
9505 - 111 Street
Grande Prairie, AB
T8V 5W1
Phone: (780) 539-5196
Fax: (780) 513-2191

Saskatoon
124 Veterinary Road
Saskatoon, SK
S7N 5E3
Phone: (306) 668-8370
Fax: (306) 668-8383
1-800-667-7645

Winnipeg
745 Logan Avenue
Winnipeg, MB
R3E 3L5
Phone: (204) 945-3705
Fax: (204) 945-0763

Thunder Bay
1081 Barton Street
Thunder Bay, ON
P7B 5N3
Phone: (807) 623-6463
Fax: (807) 623-7598

Canada Wide Phone:
1-800-668-9878

Western Canada Fax:
...-286-7319

CHEMICAL ANALYSIS REPORT

EBA ENG CONSULTANTS LTD
270 200 RIVERCREST DR SE
CALGARY AB T2C 2X5

DATE: October 20, 1999

ATTN: DAVID VAN EVERDINGEN

Lab Work Order #: E910832

Sampled By: D.A.V.E

Project Reference: 0304 31058.01

Date Received: 10/14/99

Project P.O.#: NOT SUBMITTED

Comments:

APPROVED BY: [redacted]
Project Manager

ACCREDITATIONS: STANDARDS COUNCIL OF CANADA (SCC), IN COOPERATION WITH THE CANADIAN ASSOCIATION FOR ENVIRONMENTAL ANALYTICAL LABORATORIES (CAEAL): FOR SPECIFIC TESTS AS REGISTERED BY THE COUNCIL (EDMONTON, CALGARY)
AMERICAN INDUSTRIAL HYGIENE ASSOCIATION (AIHA): FOR INDUSTRIAL HYGIENE ANALYSIS (EDMONTON)
AGRICULTURE CANADA: UNDER THE CANADIAN FERTILIZER QUALITY ASSURANCE PROGRAM (SASKATOON)

E910832 CONT.
PAGE 2

ENVIRO-TEST CHEMICAL ANALYSIS REPORT

LAB ID	SAMPLE ID	TEST DESCRIPTION	RESULT	D.L.	UNITS	EXTRACTED	ANALYZED	BY
E910832-01 Sample Type:WATER Collected:10/14/99 14:36	99BH03							
		Total & Fecal Coliforms	Attached		CFU/100mL		10/17/99	WSH
		Major Ions, F, Fe and Mn						
		Balance	103		%		10/20/99	JCG
		Bicarbonate (HCO3)	692	5	mg/L		10/15/99	DDN
		Calcium (Ca)	38.0	0.5	mg/L		10/18/99	JCG
		Chloride (Cl)	4.1	0.5	mg/L		10/15/99	SWW
		Carbonate (CO3)	<5	5	mg/L		10/15/99	DDN
		Conductance (EC)	994	3	uS/cm		10/15/99	DDN
		Fluoride	0.3	0.1	mg/L		10/15/99	SWW
		Hardness	190	1	mg/L		10/20/99	JCG
		Iron (Fe)	<0.01	0.01	mg/L		10/18/99	JCG
		Manganese (Mn)	0.02	0.01	mg/L		10/18/99	JCG
		Potassium (K)	3.9	0.1	mg/L		10/18/99	JCG
		Magnesium (Mg)	23.1	0.1	mg/L		10/18/99	JCG
		Nitrate+Nitrite (N)	<0.05	0.05	mg/L		10/15/99	SWW
		Sodium (Na)	187	1	mg/L		10/18/99	JCG
		Hydroxide in Water	<5	5	mg/L		10/15/99	DDN
		pH in Water	7.5				10/15/99	DDN
		Sulfate (SO4)	45.6	0.5	mg/L		10/15/99	SWW
		Alkalinity, Total (T Alk)	567	5	mg/L		10/15/99	DDN
		TDS (Calculated)	642	1	mg/L		10/20/99	JCG

N.D. - NOT DETECTED. LESS THAN THE DETECTION LIMIT

THIS IS THE FINAL PAGE OF THE REPORT
NOT INCLUDING APPENDICES

WSH Labs (1992) LTD.
3851B - 21 Street N.E.
Calgary, Alberta
Canada T2E 6T5
Ph: (403) 250-9164
Fax: (403) 291-4597

October 17, 1999

Enviro - Test Laboratories
1313 - 44 Ave N.E.
Calgary, Alberta
T2E 6L5

Attention : Ron Minks Date Received : Oct 15, 1999
Sample Type : Water Date Reported : Oct 17, 1999

RESULTS OF WATER ANALYSIS

LAB NO.	SAMPLE I.D.	TOTAL COLIFORM	FECAL COLIFORM
25326	E910832-01B	150	0

Q C Summary

***Coliforms (Presence / Absence) : Presence**
***Fecal Coliforms (Presence / Absence) : Presence**
Dilution Blank : 0

* Source of QC Coli/Fecal - Primary Sewage Effluent of Bonnybrook Sewage Treatment Plant, Calgary.

Note :

1. 0 - Less Than 1 CFU / 100 mL
2. Coliforms / Fecal Coliforms In CFU / 100 mL
3. [redacted]erous To Count (Confluent Growth)

Pe[redacted]
Bill Wong

Appendix A Test Methodologies

Balance

Instrumental Method:Sum(Anions meq/L)/Sum(Cations meq/L)*100
Method Reference:APHA 1030 F

Bicarbonate (HCO3)

Instrumental Method: Calculated from Alkalinity
Method Reference: APHA 2320B

Chloride (Cl)

Preparation Method: 0.45μ filtration if turbid
Instrumental Method: Ion Chromatography
Method Reference: APHA 4110 B

Carbonate (CO3)

Instrumental Method: Calculated from Alkalinity
Method Reference: Carbonate APHA 2320B

Conductance (EC)

Instrumental Method: Conductivity Meter
Method Reference: Conductance APHA 2510B

Lab Filtered & Preserved

Fluoride

Preparation Method: 0.45u filtration if turbid.
Instrumental Method: Ion Chromatography
Method Reference: APHA 4110 B

Hardness

Instrumental Method: Calculated from Ca+Mg as CaCO3
Method Reference: Hardness APHA 2340 B

Routine Cations

PREPARATION METHOD: Filter through 0.45u if turbid
INSTRUMENTAL METHOD: Ion Chromatography OR Inductively Coupled Plasma (ICP)
METHOD REFERENCE: EPA 300.7 OR 200.7

CATIONS	DETECTION LIMITS
Calcium (Ca)	0.5
Magnesium (Mg)	0.1
Potassium (K)	0.1
Sodium (Na)	1

ICP Metals

PREPARATION METHOD:

Dissolved: Filter through 0.45u and preserve with nitric acid
Extractable: Preserve with nitric acid
Total: Preserve with nitric acid; digest with nitric/hydrochloric acid

INSTRUMENTAL METHOD: ICP Spectrophotometry
METHOD REFERENCE: APHA 3120B/3030F, Standard Methods; 18th ed.

Routine Metals

Metals, Dissolved
Preparation Method: Filter through 0.45u; preserve with nitric acid
Instumental Method: ICP Spectrophotometry

Appendix A Test Methodologies

Method Reference: APHA 3120 B, Standards Methods, 18thEdition

Nitrate + Nitrite (N)

Preparation Method: filtration
Instrumental Method: Ion Chromatography
Method Reference: APHA 4110 B

Hydroxide in Water

Method Reference: Hydroxide APHA 2320 B

pH in Water

Instrumental Method: pH Meter
Method Reference: APHA 4500-H+ B

Sulfate (SO4)

Preparation Method: 0.45u filtration if turbid.
Instrumental Method: Ion Chromatography
Method Reference: APHA 4110 B

Alkalinity, Total (T Alk)

Instrumental Method: Titration performed to pH 8.3 and 4.5 endpoint using autotitrator or manual technique.

Method Reference: T ALK APHA 2320B

TDS (Calculated)

Instrumental Method: Calculated from the sum of ions
Method Reference: TDS APHA 1030 F

Total & Fecal Coliforms

EnviroTest LABORATORIES

9936 - 67th Avenue, Edmonton, Alberta T6E 0P5
Edmonton Toll Free Line
1313 - 44th Avenue N.E., Calgary, Alberta T2E 6L5
9505 - 111th Street, Grande Prairie, Alberta T8V 5W1
General Purpose Bldg., 124 Veterinary Road, Saskatoon, Saskatchewan S7N 5E3
745 Logan Avenue, Winnipeg, Manitoba R3E 3L5
1081 Barton Street, Thunder Bay, Ontario P7B 5N3

Telephone: (780) 413-5220 Fax: (780) 437-2311
Telephone: 1-800-668-9878 Fax: 1-800-286-7319
Telephone: (403) 291-9897 Fax: (403) 291-0298
Telephone: (780) 539-5196 Fax: (780) 513-2191
Telephone: (306) 668-8370 Fax: (306) 668-8383
Telephone: (204) 945-3705 Fax: (204) 945-0763
Telephone: (807) 623-6463 Fax: (807) 623-7598

CHAIN OF CUSTODY / ANALYTICAL REQUEST FORM

DATE: 14 October 1999 DATE REQUIRED: Oct 21/99 AM

SERVICE REQUESTED:
☒ REGULAR ☐ PRIORITY (50% SURCHARGE) ☐ EMERGENCY (100% SURCHARGE)

PRICING: (Check one)
AS PER QUOTE #: EBA ☐
AS PER LIST PRICE: ☐

ANALYSIS REQUESTED:

SAMPLE ID	SAMPLED BY	DATE / TIME SAMPLED	SAMPLE TYPE	ROU3W(J)	Total + fecal												SAMPLE RECEIVED (Y OR N)	SAMPLE BROKEN (Y OR N)	LAB SAMPLE NO.
99BH03	D.A.V.E.	14OCT99 1436	WATER	✓	✓														E910832
			PRESERVED / FILTERED																

NOTES & CONDITIONS
1. Quote number must be provided to ensure proper pricing.
2. Turnaround times will vary dependant on complexity of analysis & lab workload at time of submission. Please contact the lab to confirm turnaround times.
3. All hazardous samples submitted must be labeled to comply with WHMIS regulations. This must include the nature of the hazard, as well as a contact name & phone number that the lab can contact for further information.

NOTE: Failure to properly complete all portions of this form may delay analysis.

NOTE: Shaded areas MUST be completed in full by client for sample processing to occur.

CLIENT: EBA
CONTACT: David van Everdingen
REPORT ADDRESS: 270-200 Rivercrest Drive SE
BILLING ADDRESS: c/o [illegible]
email: dvan[illegible]dingen@eba.ca

NO. SAMPLES SUBMITTED: one
NO. BOTTLES / SAMPLES: two
PHONE: 203-3355
FAX: 203-3301
P. O. NO.:
JOB NO.: 0304 31058.01

RELINQUISHED BY:	DATE / TIME	RECEIVED BY:	DATE / TIME
[redacted]	DATE: 14 Oct 99 TIME: 17:30	[redacted] ETL	DATE: 10/14/99 TIME: 17:25
RELINQUISHED BY:	DATE: TIME:	RECEIVED BY: ETL LAB:	DATE: TIME:

SAMPLE CONDITION UPON RECEIPT:
FROZEN: ____ COLD: ✓ AMBIENT: ____
OTHER: (BREAKAGE, LEAKAGE, ETC.)

WHITE – Report Copy
PINK – File Copy
W – Customer Copy

APPENDIX F

EBA'S ENVIRONMENTAL REPORT - GENERAL CONDITIONS

EBA Engineering Consultants Ltd. (EBA)
ENVIRONMENTAL REPORT – GENERAL CONDITIONS

This report incorporates and is subject to these "General Conditions".

A.1 USE OF REPORT

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 EBA's client. 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 EBA's client unless otherwise authorized in writing by 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 EBA. Additional copies of the report, if required, may be obtained upon request.

A.2 LIMITATIONS OF REPORT

This report is based solely on the conditions which existed on site at the time of EBA's investigation. The client, and any other parties using this report with the express written consent of the client and EBA, acknowledge that conditions affecting the environmental assessment of the site can vary with time and that the conclusions and recommendations set out in this report are time sensitive.

The client, and any other party using this report with the express written consent of the client and EBA, also acknowledge that the conclusions and recommendations set out in this report are based on limited observations and testing on the subject site and that conditions may vary across the site which, in turn, could affect the conclusions and recommendations made.

The client acknowledges that EBA is neither qualified to, nor is it making, any recommendations with respect to the purchase, sale, investment or development of the property, the decisions on which are the sole responsibility of the client.

A.2.1 Information Provided to EBA by Others

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

A.3 LIMITATION OF LIABILITY

The client recognizes that property containing contaminants and hazardous wastes creates a high risk of claims brought by third parties arising out of the presence of those materials. In consideration of these risks, and in consideration of EBA providing the services requested, the client agrees that EBA's liability to the client, with respect to any issues relating to contaminants or other hazardous wastes located on the subject site shall be limited as follows:

(1) With respect to any claims brought against EBA by the client arising out of the provision or failure to provide services hereunder shall be limited to the amount of fees paid by the client to EBA under this Agreement, whether the action is based on breach of contract or tort;

(2) With respect to claims brought by third parties arising out of the presence of contaminants or hazardous wastes on the subject site, the client agrees to indemnify, defend and hold harmless EBA from and against any and all claim or claims, action or actions, demands, damages, penalties, fines, losses, costs and expenses of every nature and kind whatsoever, including solicitor-client costs, arising or alleged to arise either in whole or part out of services provided by EBA, whether the claim be brought against EBA for breach of contract or tort.

A.4 JOB SITE SAFETY

EBA is only responsible for the activities of its employees on the job site and is not responsible for the supervision of any other persons whatsoever. The presence of EBA personnel on site shall not be construed in any way to relieve the client or any other persons on site from their responsibility for job site safety.

A.5 DISCLOSURE OF INFORMATION BY CLIENT

The client agrees to fully cooperate with EBA with respect to the provision of all available information on the past, present, and proposed conditions on the site, including historical information respecting the use of the site. The client acknowledges that in order for EBA to properly provide the service, EBA is relying upon the full disclosure and accuracy of any such information.

A.6 STANDARD OF CARE

Services performed by EBA for this report have been conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions in the jurisdiction in which the services are provided. Engineering judgement has been applied in developing the conclusions and/or recommendations provided in this report. No warranty or guarantee, express or implied, is made concerning the test results, comments, recommendations, or any other portion of this report.

A.7 EMERGENCY PROCEDURES

The client undertakes to inform EBA of all hazardous conditions, or possible hazardous conditions which are known to it. The client recognizes that the activities of EBA may uncover previously unknown hazardous materials or conditions and that such discovery may result in the necessity to undertake emergency procedures to protect EBA employees, other persons and the environment. These procedures may involve additional costs outside of any budgets previously agreed upon. The client agrees to pay EBA for any expenses incurred as a result of such discoveries and to compensate EBA through payment of additional fees and expenses for time spent by EBA to deal with the consequences of such discoveries.

A.8 NOTIFICATION OF AUTHORITIES

The client acknowledges that 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 EBA in its reasonably exercised discretion.

A.9 OWNERSHIP OF INSTRUMENTS OF SERVICE

The client acknowledges that all reports, plans, and data generated by EBA during the performance of the work and other documents prepared by EBA are considered its professional work product and shall remain the copyright property of EBA.

A.10 ALTERNATE REPORT FORMAT

Where EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed EBA's instruments of professional service), the Client agrees that only the signed and sealed hard copy versions shall be considered final and legally binding. The hard copy versions submitted by EBA shall be the original documents for record and working purposes, and, in the event of a dispute or discrepancies, the hard copy versions shall govern over the electronic versions. Furthermore, the Client agrees and waives all future right of dispute that the original hard copy signed version archived by EBA shall be deemed to be the overall original for the Project.

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

The Client recognizes and agrees that electronic files submitted by EBA have been prepared and submitted using specific software and hardware systems. EBA makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

APPENDIX B

OPPONENTS' LETTERS OF CONCERNS

VHM
& Associates Ltd.

c/o Box 6, Site 23, R. R. 8, Calgary, AB. T2J 2T9

June 3, 1999

RECEIVED
JUN 11 1999

The Municipal District of Foothills No. 31
Box 5605,
High River, AB. T1V 1M7

Attention: **Ms. Kelley Fiske-Nielsen, Subdivision Officer**

Subject: **PROPOSED AREA STRUCTURE PLAN E ½ 20-22-02-W5th / RED WILLOWS ESTATES**

I have reviewed the subject proposal dated May 28th, 1999 and wish to comment as follows:

I am concerned about the building density with respect to the following:

Overall impact on our area water supply. We have not experienced any well water supply problems over the past twenty plus years. We haven't, so far, with the additional five (5) newly developed lots. However, with the densities and number of lots proposed in the above application, I have serious concerns.

Sewage disposal is a concern with the lack of porosity of the soil in this area, particularly on the west side, upper level, areas due to wind erosion over the years.

I suggest the developer be required to drill a minimum of 250 ft. for an aquafier source for each new parcel and that from ground down to the 250 ft depth be cased (no perforations allowed). One or two central wells with say a 500 ft depth and the piping distribution system might suffice. With respect to the sewage, this kind of density must have a central enclosed (architecturally compatible with surrounding development) mechanical aeration system before liquids are allowed to be dispersed within surrounding soils.

I understand Mr. & Mrs. Quinn (Block 1 of this development) cannot use their well as the water is unacceptable now. Their location at the bottom of the development likely has a lot to do with this. I know this well was an acceptable source a few years back however.

Sincerely,

[redacted]

Victor H. Middleton, P. Eng.

(concerned landowner)

Sandy
CROSS
CONSERVATION FOUNDATION

Managing the Ann & Sandy Cross Conservation Area

MD of Foothills #31- Council Members
Box 5605
High River, Alberta
T0L 1B0

June 17, 1999

Dear Members of Council:

The Sandy Cross Conservation Foundation respectfully submits this letter to you regarding the Area Structure Plan (ASP) proposed by the Bavarian Lion Company. As an adjacent landowner, the Cross Conservation Area feels it is our duty to indicate our concerns regarding the environmental impacts of the proposed development. As Council is aware the purpose of the Conservation Area is to offer conservation education programs to youth and to provide habitat for native species of wildlife. Wildlife are valuable to everyone and do not stay confined to one location, therefore a landscape-based or regional approach to this development is required.

We would like to note the following points for Council consideration:

Density

Although the new Municipal Plan states that a density of 32 houses per quarter section is allowable, we do not feel that it is appropriate to approximate this density on the doorstep of an environmentally valuable Conservation Area. We are concerned that even 29 houses, with the resulting families and their pets, will have an adverse impact on wildlife, the Conservation Area and the Bavarian Lion lands.

Water

The installation of twenty-nine individual wells has the potential to exhaust the local aquifer. Our well has become seasonally weak over the last few years and the pressure of 29 wells is sure to take its toll. We feel that any development on the Bavarian Lion land should be based on an aquifer study, not individual well logs or tests. An aquifer study will provide a better picture of the cumulative effects of water draw-down. To reduce the environmental impacts of water use, development on Bavarian Lion lands should also consider including water supply and water treatment co-ops.

Municipal Reserve lands and Wildlife corridors

The Bavarian Lion Company is to be commended for allocating more Municipal Reserve (MR) than is required by law, however we have concerns regarding the purpose and use of the MR lands.

According to work undertaken by the U of C (commissioned by the Cross Conservation Area) and Komex International (commissioned by the Bavarian Lion Company), the MR lands along the west side of the proposed subdivision are intended SEPATE to be a wildlife migration corridor. We respectfully submit that the width shown on the ASP is not adequate to fulfill the needs of ungulates, being the largest species likely to use the corridor. Based on our research and discussions with wildlife consultants, wildlife corridors suitable for ungulates, and consequently many smaller animals, should be a minimum of 300 metres of undisturbed natural environment. The wildlife corridor shown on the subdivision plan is approximately 75 metres at its narrowest location.

Box 20, Site 23, RR8, Calgary, Alberta T2J 2T9 Phone: (403) 931-3377 Fax: (403) 931-2726 email: crosscons@lexicom.ab.ca

The north to south portion of the MR lands are shown taking a turn to the east at the north end of the subdivision. Our research indicates that the wildlife corridor should continue north across other lands owned by Bavarian Lion. The way it is presented now the wildlife corridor <u>will lead animals into the existing subdivision</u> on the east side of 160 St.

NOT LIKELY

A community path is shown trending through the middle of the MR lands and again we commend Bavarian Lion for their community support, however all science to date has indicated that human use and wildlife corridors do not mix. If a community path is to be constructed the wildlife corridor needs to be wider and the recreational path should be on the development side of the wildlife corridor, i.e. closest to the disturbed area. The ASP also shows the community path ending at the boundary of the Conservation Area in a location where access is not permitted.

Environment Committee

As Council is aware, an Environment Committee of seven residents of the MD has been charged with preparing guidelines for Council's consideration and identifying environmentally important lands within the MD. We are pleased that Council had the foresight to create the Environment Committee and look forward to reading the first report, being prepared in conjunction with the U of C, at the end of September 1999. This report would help to provide a landscape/regional context for the Bavarian Lion land.

Buffer CCA had its own buffer added

The U of C Wildlife Movement Pattern Study, commissioned by the Cross Conservation Area, recommends a buffer of approximately 400-500 metres between the Cross Conservation Area and any development on the Bavarian Lion lands. The Wildlife Assessment study undertaken by Komex International on behalf of the Bavarian Lion Company recommends a buffer of at least 250 metres. <u>This ASP does not allow for any buffer.</u> Instead the subdivision map shows that lot # 19 will include a 150 metre "no-build zone". We question how an unregulated "no build zone" on private property can give any assurance of a buffer. We would also like to point out that the size of the "no build zone" does not even provide the 250 metre buffer recommended by the Bavarian Lion's own consultant. 300

New Municipal Development Plan

The proposed ASP refers to the outdated General Municipal Plan rather than conforming to the new Municipal Development Plan adopted by Council in September of 1998. To Council's credit, the new Municipal Development Plan takes a much more regional approach to subdivision planning, requests planners to consider environmental impacts, and imposes stricter guidelines for the preparation of ASP's. For instance, the MDP states that it is important for the developer of an ASP to meet with key stakeholders. The Cross Conservation Area is a major landholder to the south of this proposed ASP and as of this date we have not been approached by the developer in relation to this proposal. It is our opinion that more work is required by the developer to adequately address the issues and environmental components described within the new MDP and ASP guidelines.

Past refusal by Council

In 1995 the MD Council denied Bavarian Lion a development due to "strongly sloping topography and high quality agricultural soils" (Minutes from Council, March 25, 1995). It was also noted that other country residential proposals in the area were denied due to similar slope constraints. These features have not changed and should be considered with regards to this proposal.

EBA STUDY SAYS NOT THAT GREAT.

Thank you for your time and consideration of our concerns. We realize that there will be development in this general area but hope that it will always consider the integrity of the environment and that of the Cross Conservation Area as its adjacent neighbour.

Sincerely,

[redacted]

Jacquie [redacted] Cross Conservation Area

cc All Board members of the Sandy Cross Conservation Foundation, excepting Mr. Al Taylor, MD Councilor

[redacted]

June 17, 1999

The Municipal District of Foothills No. 31
Box 5605
High River, AB T1V 1M7

Attention: Council

Re: Application for Proposed Area Structure Plan
Twp 22 Rge 2 W5M: E ½ Sec 20
<u>Red Willow Estates</u>

In response to your Notice dated May 28, 1999 regarding the above captioned matter, we wish to express a number of concerns that we have with regard to the proposed further development of the subject lands. Our interest in same is by virtue of the fact that we own the immediately offsetting quarter section being the SW ¼ 20-22-2 W5M.

1. **<u>Water Supply</u>**

We have concerns with regard to the impact of this proposed development on the Natural Aquifer supplying the water wells in the immediate area. Our concerns are confined to the medium to long-term impact. It is our position that the report prepared by Groundwater Exploration & Researchers Ltd. does not conclusively demonstrate that the existing conditions of the Aquifer supplying the related water wells is not homogeneous and isotropic. It is our opinion that the only conclusive way to establish this is by way of a comprehensive ground water study incorporating all area wells within a reasonable distance. Further, the said report does not provide analysis for non-domestic use such as water supply for cattle, horses etc. and its impact on area landowners in this regard. Please note that we would be prepared to participate in a ground water study as proposed above.

2. **<u>Wildlife Conservancy</u>**

The cross-conservancy lies immediately to the south of the applicants land and our quarter section. There are numerous wildlife corridors that extend onto adjacent land holdings. It is important to the writer and many of the residents in this area that the uniqueness of this wildlife habitat be preserved and protected during our lifetime and for future generations. Accordingly, we would be remiss to not do our best to determine the extent to which such a development would have on wildlife corridors on adjacent lands. We note that the proposed plan does consider to some degree this impact but ignores a large part of the wildlife buffer zone as established by the conservancy study. It is unclear as to whether the applicant has determined what the impact of its' plan on the wildlife corridors will be (i.e. will the proximity to more population force the wildlife to establish new corridors?)

.../2-

The Municipal District of Foothills No. 31
June 17, 1999
Page 2

3. **Road Access**

Has the North-South conservancy road been adequately designed and prepared for the proposed level of traffic?

160 St.

4. **Quality of Life**

While quality of life issues are more subjective in nature, they are never the less the basis for which many of us have chosen to live where we do. These quality of life issues are as follows:

I got mine

   a. Quiet Enjoyment
   We enjoy a natural setting now with the abundant presence of wildlife where offending noise levels are at a minimum. This application threatens this way of life.

   b. Population Density
   This application if approved significantly increases the population density in the immediate area. This is not a desirable objective for most of the area residents.

   c. Traffic Level
   Will increase substantially in the immediate vicinity. This is neither desirable nor positive.

   d. Trespass
   The risk of trespass on area land holdings becomes much greater as population density increases as proposed by this application.

   e. Air Quality
   Will this proposal have any negative impact on our air quality. Our objective should not be to duplicate some of the problems that exist within the City of Calgary on many days.

5. **Recommendation**

That Council give consideration to establishing a buffer zone of a minimum of one half (½) to one (1) mile from the boundary of the conservancy whereby only minimal development will occur.

We trust that council will proceed cautiously having due regard for the sensitivity of the lands surrounding the cross Conservancy. In summary, I wish to express my appreciation to Council for allowing me the privilege to express some concerns and/or questions that we have over this specific application.

[redacted]

June 17, 1999

The Honourable Members of Council
The Municipal District of Foothills No. 31
Box 5605
High River, Alberta
T1V 1M7

Re: Proposed Area Structure Plan
E ½ 20-22-02 W5 Red Willow Estates

Dear Members of Council,

We are a community of landowners residing near the lands listed above and as such, are affected landowners. Collectively, our community has been active in supporting efforts which ensured well planned development in our community, and have been pro-active in identifying local concerns where development has been proposed.

The undersigned have met and reviewed facts relating to the proposed Area Structure Plan and wish to identify the following concerns:

The document which is used to identify the plans of the Developer refers to this initiative as an Area Concept Plan. It is our understanding that an Area Structure Plan as you have identified it, is the required application for a proposed sub-division of more than eight lots.

The applicant has completely ignored the information in two Wildlife Habitat Studies, one of which was in fact authored by consultants acting on behalf of the applicant. These studies have identified in unmistakable form, that lands on the west boundary of the subject property and contained within the borders of proposed lots are a vital wildlife corridor. Both studies prescribed that lands should not be developed within a minimum of 250 metres of the cover area identified in each of the two studies.

The pathway which is identified in the map was offered at the suggestion of those of us in the community who see a concern with so many new residents participating in our primary form of recreation, walking, on a single gravelled, dusty roadway. We respect the attempt to comply with this suggestion, however, the trail was suggested as an attempt to create linear green space which would connect with other such walkways on future developments. The trail offered, interferes with the wildlife corridor and fails to offer a future beyond the boundaries of these lands.

east of 160 St.
west ? future

The "Buffer" between the proposed development and the Cross Conservancy is identified as deeded land no long term assurance that interference with the conservancy will not occur. No less than three studies identify the need to restrict development in close proximity to the Conservancy. This lot seems to offer little more than an architectural control. These lands should absolutely be dedicated permanently as Environmental Reserve.

The roadway (160 Street) leading to the Cross Conservancy, is now subject to considerable traffic and produces excessive dust. This road must be improved prior to increasing traffic beyond the current level.

While we have no experience in determining the density of lots, it would seem that the number of lots be determined by dividing useable acreage remaining by the average lot size after all Environmental, Municipal and Buffer reserves have been dedicated. It would appear that this applicant has made an extreme effort toward achieving a lot tally, regardless of the environmental and visual consequences.

Thank you for considering these issues.

Respectfully submitted,

[redacted]

[redacted]

[redacted]

[redacted]

APPENDIX C

ANALYTICAL REPORT

NORWEST LABS
Agri-Food & Environmental Group
Calgary Edmonton Winnipeg Lethbridge Surrey

Bay 6, 2712-37 Avenue N.E.
Calgary, AB. T1Y-5L3
Phone: (403) 291-2022
Fax: (403) 291-2021

Analytical Report

Bill to: EBA Engineering Consulting Ltd
Report to: EBA Engineering Consulting Ltd

270. 200 Rivercrest Drive S. E.
Calgary, AB, Canada
T2C 2X5
Attn: Brian Tsang

Sampled By T. Swaren

Project ID: 0304-31058-01
Name: Red Willow Estates
Location:
LSD: NE-20-22-2 W5M
P.O.:
Acct. Code: 0304-31058-01

NWL Lot ID: 101374
Control Number: E 43215
Date Received: Jan 10, 2001
Date Reported: Jan 16, 2001
Report Number: 143877

		NWL Number:	101374-1	101374-2		
		Sample Date:	Jan 10, 2001	Jan 10, 2001		
		Sample Description:	1st Sample	2nd Sample		
Analyte		**Units**	**Results**	**Results**	**Results**	**Detection Limit**
Microbiological Analysis						
Total Coliforms	Membrane Filtration	CFU/100 mL	<2	<2		
Fecal Coliforms	Membrane Filtration	CFU/100 mL	<2	<2		
Physical and Aggregate Properties						
Temperature of observed pH		°C	19.6	19.6		
R..tine Water						
pH			7.65	7.72		
Conductivity		uS/cm	915	936		0.1
Calcium	Dissolved	mg/L	44.2	41.4		0.2
Magnesium	Dissolved	mg/L	20.7	18.4		0.05
Sodium	Dissolved	mg/L	213	219		0.4
Potassium	Dissolved	mg/L	3.9	3.5		0.4
Iron	Dissolved	mg/L	0.016	<0.003		0.003
Manganese	Dissolved	mg/L	0.0325	0.0304		0.0002
Chloride	Dissolved	mg/L	28.5	22.2		0.5
Nitrate - N		mg/L	<0.004	<0.004		0.004
Nitrite - N		mg/L	<0.002	<0.002		0.002
Nitrate and Nitrite - N		mg/L	<0.006	<0.006		0.006
Sulphate	Dissolved	mg/L	48.5	49.8		0.03
Hydroxide		mg/L	<5	<5		5
Carbonate		mg/L	<6	<6		5
Bicarbonate		mg/L	783	788		5
P-Alkalinity		mg CaCO3/L	<5	<5		5
T-Alkalinity		mg CaCO3/L	642	646		5
Total dissolved solids	Dissolved	mg/L	744	742		1
Hardness	Dissolved	mg CaCO3/L	196	179		
Ionic Balance	Dissolved	%	91	90		

Approved by [redacted]

NORWEST LABS
Agri-Food & Environmental Group
Calgary Edmonton Winnipeg Lethbridge Surrey

Methodology and Notes

Bay 6, 2712-37 Avenue N.E.
Calgary, AB. T1Y-5L3
Phone: (403) 291-2022
Fax: (403) 291-2021

Bill to: EBA Engineering Consulting Ltd
Report to: EBA Engineering Consulting Ltd
270, 200 Rivercrest Drive S. E.
Calgary, AB, Canada
T2C 2X5
Attn: Brian Tsang
Sampled By: T. Swaren

Project ID: 0304-31058-01
Name: Red Willow Estates
Location:
LSD: NE-20-22-2 W5M
P.O.:
Acct. Code: 0304-31058-01

NWL Lot ID: 101374
Control Number: E 43215
Date Received: Jan 10, 2001
Date Reported: Jan 16, 2001
Report Number: 143877

Method of Analysis:

Test	Reference	Method	Date of Analysis	Location	Analyst
Alkalinity, pH, and EC in water	APHA	Electrometric Method, 4500-H+ B	Jan 15, 2001	Norwest Edmonton	Darren Crichton
		Laboratory & Field Methods, 2550 B	Jan 15, 2001	Norwest Edmonton	Darren Crichton
		Laboratory Method, 2510 B	Jan 15, 2001	Norwest Edmonton	Darren Crichton
		Titration Method, 2320 B	Jan 15, 2001	Norwest Edmonton	Darren Crichton
Anions (Routine) by Ion Chromatography	APHA	Single-Column Ion Chromatography with Electronic Suppression, 4110 C	Jan 12, 2001	Norwest Edmonton	Darren Crichton
Chloride in Water	APHA	Automated Ferricyanide Method, 4500-Cl- E	Jan 12, 2001	Norwest Edmonton	Jesse Dang
Fecal Coliforms - MF	APHA	Fecal Coliform Membrane Filter Procedure, 9222 D	Jan 11, 2001	Norwest Calgary	Tony Greco
Metals Trace (Dissolved) in water	APHA	Inductively Coupled Plasma (ICP) Method, 3120 B	Jan 15, 2001	Norwest Edmonton	Lang Que Tran
			Jan 16, 2001	Norwest Edmonton	To Thong
Total Coliforms - MF	APHA	Standard Total Coliform Membrane Filter Procedure, 9222 B	Jan 11, 2001	Norwest Calgary	Tony Greco

References:

APHA — Standard Methods for the Examination of Water and Wastewater

Comments:

APPENDIX D

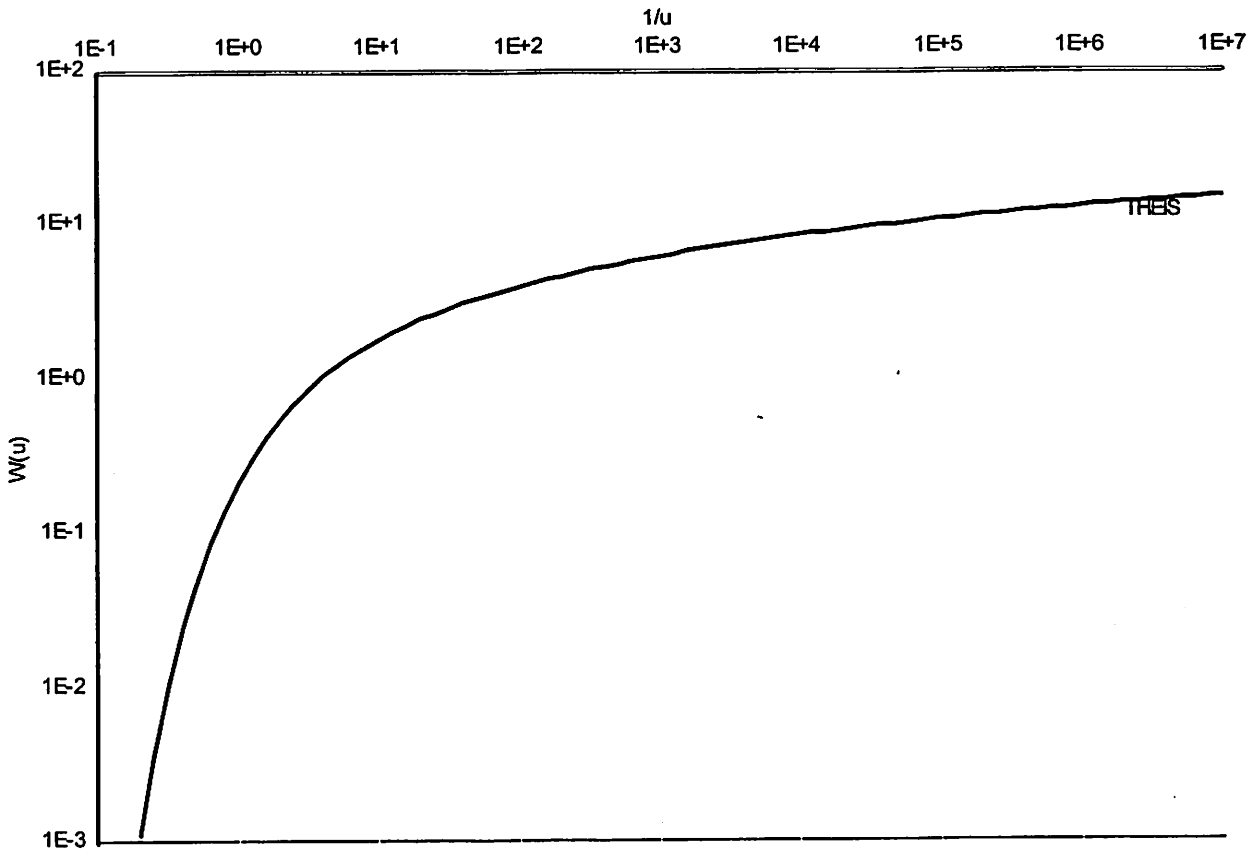
HYDRAULIC CONDUCTIVITY ANALYSIS

EBA Engineering Consultants Ltd.
270, 200 Rivercrest Drive SE
Calgary, Alberta T2C 2X5
Phone: (403) 203-3355

Pumping test analysis	
No:	99-31058.01
Project:	Red Willows
Client:	Bavarian Lion Company

Location: EH-20-22-2 W5M	Pumping test: 99BH03 Step 3	Pumping well: 99BH03

Test performed by:	D.A.v.E.	Evaluated by:	BT
Test date:	10/14/99	Evaluation date:	4/12/01
Analysis method:	THEIS	Aquifer thickness:	12
		Discharge rate:	0.0011371 [m³/s]



Transmissivity: 9.05×10^{-5} [m²/s]

Conductivity: 7.54×10^{-6} [m/s]

Storativity: 5.74×10^{-5}

Aquifer thickness =12 m; fully penetrating well

APPENDIX E

ENVIRONMENTAL REPORT – GENERAL CONDITIONS

EBA Engineering Consultants Ltd. (EBA)
ENVIRONMENTAL REPORT – GENERAL CONDITIONS

This report incorporates and is subject to these "General Conditions".

A.1 USE OF REPORT

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 EBA's client. 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 EBA's client unless otherwise authorized in writing by 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 EBA. Additional copies of the report, if required, may be obtained upon request.

A.2 LIMITATIONS OF REPORT

This report is based solely on the conditions which existed on site at the time of EBA's investigation.

The client, and any other parties using this report with the express written consent of the client and EBA, acknowledge that conditions affecting the environmental assessment of the site can vary with time and that the conclusions and recommendations set out in this report are time sensitive.

The client, and any other party using this report with the express written consent of the client and EBA, also acknowledge that the conclusions and recommendations set out in this report are based on limited observations and testing on the subject site and that conditions may vary across the site which, in turn, could affect the conclusions and recommendations made.

The client acknowledges that EBA is neither qualified to, nor is it making, any recommendations with respect to the purchase, sale, investment or development of the property, the decisions on which are the sole responsibility of the client.

A.2.1 Information Provided to EBA by Others

During the performance of the work and the preparation of this report, EBA may have relied on information provided by persons other than the client.

While EBA endeavours to verify the accuracy of such information when instructed to do so by the client, EBA accepts no responsibility for the accuracy or the reliability of such information which may affect the report.

A.3 LIMITATION OF LIABILITY

The client recognizes that property containing contaminants and hazardous wastes creates a high risk of claims brought by third parties arising out of the presence of those materials. In consideration of these risks, and in consideration of EBA providing the services requested, the client agrees that EBA's liability to the client, with respect to any issues relating to contaminants or other hazardous wastes located on the subject site shall be limited as follows:

(1) With respect to any claims brought against EBA by the client arising out of the provision or failure to provide services hereunder shall be limited to the amount of fees paid by the client to EBA under this Agreement, whether the action is based on breach of contract or tort;

(2) With respect to claims brought by third parties arising out of the presence of contaminants or hazardous wastes on the subject site, the client agrees to indemnify, defend and hold harmless EBA from and against any and all claim or claims, action or actions, demands, damages, penalties, fines, losses, costs and expenses of every nature and kind whatsoever, including solicitor-client costs, arising or alleged to arise either in whole or part out of services provided by EBA, whether the claim be brought against EBA for breach of contract or tort.

A.4 JOB SITE SAFETY

EBA is only responsible for the activities of its employees on the job site and is not responsible for the supervision of any other persons whatsoever. The presence of EBA personnel on site shall not be construed in any way to relieve the client or any other persons on site from their responsibility for job site safety.

A.5 DISCLOSURE OF INFORMATION BY CLIENT

The client agrees to fully cooperate with EBA with respect to the provision of all available information on the past, present, and proposed conditions on the site, including historical information respecting the use of the site. The client acknowledges that in order for EBA to properly provide the service, EBA is relying upon the full disclosure and accuracy of any such information.

A.6 STANDARD OF CARE

Services performed by EBA for this report have been conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions in the jurisdiction in which the services are provided. Engineering judgement has been applied in developing the conclusions and/or recommendations provided in this report. No warranty or guarantee, express or implied, is made concerning the test results, comments, recommendations, or any other portion of this report.

A.7 EMERGENCY PROCEDURES

The client undertakes to inform EBA of all hazardous conditions, or possible hazardous conditions which are known to it. The client recognizes that the activities of EBA may uncover previously unknown hazardous materials or conditions and that such discovery may result in the necessity to undertake emergency procedures to protect EBA employees, other persons and the environment.

These procedures may involve additional costs outside of any budgets previously agreed upon. The client agrees to pay EBA for any expenses incurred as a result of such discoveries and to compensate EBA through payment of additional fees and expenses for time spent by EBA to deal with the consequences of such discoveries.

A.8 NOTIFICATION OF AUTHORITIES

The client acknowledges that 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 EBA in its reasonably exercised discretion.

A.9 OWNERSHIP OF INSTRUMENTS OF SERVICE

The client acknowledges that all reports, plans, and data generated by EBA during the performance of the work and other documents prepared by EBA are considered its professional work product and shall remain the copyright property of EBA.

A.10 ALTERNATE REPORT FORMAT

Where EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed EBA's instruments of professional service), the Client agrees that only the signed and sealed hard copy versions shall be considered final and legally binding. The hard copy versions submitted by EBA shall be the original documents for record and working purposes, and, in the event of a dispute or discrepancies, the hard copy versions shall govern over the electronic versions.

Furthermore, the Client agrees and waives all future right of dispute that the original hard copy signed version archived by EBA shall be deemed to be the overall original for the Project.

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

The Client recognizes and agrees that electronic files submitted by EBA have been prepared and submitted using specific software and hardware systems. EBA makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

9

EBA Engineering Consultants Ltd.

HYDROGEOLOGICAL STUDY
RED WILLOW ESTATES
E½ 20-22-02 W5M

Project No. 0304-01-31058.01

MAY 2001

COPY

Riverbend Atrium One, 270, 200 Rivercrest Dr. S.E., Calgary, Alberta T2C 2X5
Tel: (403) 203-3355 - Fax: (403) 203-3301 Internet: calgary@eba.ca - Web Site: http://www.eba.ca

EBA Engineering Consultants Ltd.

HYDROGEOLOGICAL STUDY
RED WILLOW ESTATES
EH 20-22-02 W5M

COPY

Submitted to:

BAVARIAN LION CO LTD.
Care of
KELLAM BERG ENGINEERING AND SURVEYS LTD.
Calgary, Alberta

Prepared by:

EBA ENGINEERING CONSULTANTS LTD.
Calgary, Alberta

Project No. 0304-99-31058.01

MAY 2001

Riverbend Atrium One, 270, 200 Rivercrest Dr. S.E., Calgary, Alberta T2C 2X5
Tel: (403) 203-3355 - Fax: (403) 203-3301 Internet: calgary@eba.ca - Web Site: http://www.eba.ca

EXECUTIVE SUMMARY

EBA Engineering Consultants Ltd. (EBA) was retained by Kellam Berg Engineering and Survey Ltd. (Kellam) of Calgary to prepare a groundwater evaluation report for Bavarian Lion Company (EBA, 1999). That report described the results of a groundwater supply evaluation for domestic (subdivision) purposes at the proposed Red Willow Estates subdivision at EH 20-22-02 W5M in the M.D. of Foothills. Since completion of the original report, Kellam provided EBA with letters from opponents of the proposed development that identified some concerns that were beyond the original scope of work for the groundwater assessment.

Bavarian Lion Company retained EBA Engineering Consultants Ltd. (EBA) to prepare a hydrogeological study to review and address concerns raised by opponents' letters; extensively review water well records to determine the geometry of aquifers; provide a hydrogeologic report to better address the concerns; and decontaminate and sample 99BH03.

The Alberta Environmental Protection-Groundwater Information Centre (AEP-GIC) water well database has been reviewed in detail for the Fish Creek sub-basin. Four relatively distinct water bearing units (i.e., aquifers) have been identified using information in the water well database describes physical descriptions of materials encountered during well installation, reported pumping rates, groundwater chemistry and well screen or perforated intervals.

The wells installed by Bavarian Lion Company and the other wells installed in the area have similar lithological descriptions of the material within the screened interval [borehole logs (EBA, 1999) and drillers' reports in the AEP-GIC database], suggesting that the lithology throughout the area is relatively homogeneous.

A water balance has been estimated for the area using meteorological information. The current estimated volume of recharge within the Fish Creek sub-basin is estimated at 2,540,307 m^3 per year. The existing annual demand is estimated at 320,000 m^3 per year (i.e., 12.6% of the estimated volume of recharge) based on 1,250 m^3 per year for the 256 registered domestic and stock water wells within the Fish Creek sub-basin. The estimated demand for the proposed subdivision is 32,500 m^3 per year (i.e., 1.3% of the estimated volume of recharge) based on 1,250 m^3 per year for 26 lots. Based on the information summarized to estimate the water balance for the Fish Creek sub-basin, there is sufficient groundwater to meet the water supply requirements for the proposed subdivision.

Using the thickness of the appropriate water bearing unit the revised value for transmissivity (approximately 2,850 m^2/year) is 43% of the transmissivity calculated by EBA (1999). The long-term well yield must be established on a well-by-well basis. The theoretical 20-year safe yield (Q_{20}) is a means of projecting the safe well yield.

Analytical testing of 99BH03 indicates that measured taken to disinfect the well have been effective in destroying the bacterial colonies. It is recommended that the water be tested on each well that is constructed for potable water supply.

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1.0 INTRODUCTION

EBA Engineering Consultants Ltd. (EBA) was retained by Kellam Berg Engineering and Survey Ltd. (Kellam) of Calgary to prepare a groundwater evaluation report for Bavarian Lion Company (EBA, 1999). That report described the results of a groundwater supply evaluation for domestic (subdivision) purposes at the proposed Red Willow Estates subdivision at EH 20-22-02 W5M in the M.D. of Foothills. The original groundwater evaluation report has been included as Appendix A.

Since completion of the original report, Kellam provided EBA with letters from opponents of the proposed development that identified some concerns that were beyond the original scope of work for the groundwater assessment. Letters of objection were presented to the M.D. Foothills Council at a meeting on June 17, 1999. Copies of their letters have been included as Appendix B.

Bavarian Lion Company retained EBA Engineering Consultants Ltd. (EBA) to prepare a hydrogeological study to:

- review of concerns raised by the opponents;
- review water wells within an approximate 3 km to 5 km distance;
- provide a hydrogeologic report addressing these concerns; and
- re-test 99BH03 that was previously identified as having poor quality.

The results of this work are described in Sections 2.0 to 4.0 of this report. Section 2.0 summarizes the concerns raised by the opponents letters to the M.D. of Foothills. Section 3.0 describes the aquifer characteristics and the long-term water supply potential for the area. Section 4.0 describes the method used to disinfection the well and the quality of the water in the well.

2.0 OPPONENTS CONCERNS

Opponents letters provided to Kellam were reviewed. The main concerns identified in the opponents letters included:

1. The homogeneity and isotropic properties of the aquifer were not demonstrated.

2. The overall impact to the water supply to the area was not assessed. The medium and long-term cumulative effects of water extraction by the proposed development on the existing domestic and non-domestic groundwater users were to be included in the assessment. Further, it was considered that development of Bavarian Lion land should be based on an aquifer study demonstrating the homogeneity and isotropic properties of the aquifer.

To address these concerns, the following section describes how information available in the files of Alberta Environment was evaluated to estimate the size, homogeneity and isotropic properties of the aquifer. Meteorological data available from Environment Canada was used to calculate a water balance for the area and to estimate the potential long-term effects of water extraction by the proposed subdivision.

3.0 AQUIFER CHARACTERISATION

To assess the homogeneity and isotropic properties of the aquifer and the overall impact to the water supply to the area, the AEP-GIC water well database was used to evaluate the hydrogeological properties of the aquifers affected by development of Bavarian Lion land. All wells within a reasonable distance have been included in the process. The results of the aquifer characterisation are provided in Sections 3.1 and 3.2.

3.1 Aquifer Study

Drillers' reports in the AEP-GIC water well database include some information describing; the location of the well; lithology of the materials encountered during well installation; recommended pumping rates; groundwater chemistry; and screened or perforated intervals. This information was used to identify water-bearing units based on the properties of the material within the completion interval of the wells. An understanding of the affected aquifers is required to assess the effect of water extraction by the proposed subdivision.

Water wells found within an approximate 6.5 km radius of the site are summarized in Table 1. These wells are used for domestic, stock, industrial or other purposes (i.e., not defined when the water well report was filed).

3.1.1 Aquifer Geometry

This section describes the process used to estimate the areal extent and vertical thicknesses of water bearing units. The purpose for defining the aquifer dimensions is twofold. The first is to identify which aquifers are affected by water extraction for the proposed subdivision (i.e., those wells that may be affected by long-term effects of water extraction by the proposed subdivision). The second is to demonstrate the isotropic and homogeneity of the aquifers acting as the source of water for the proposed subdivision.

It is assumed that only wells within the Fish Creek watershed would be affected by additional demands for the proposed subdivision. Within the Fish Creek watershed, only wells within the Fish Creek sub-basin were included in the aquifer study (Table 2). The extent of the Fish Creek sub-basin (Figure 1) was estimated as follows:

- North boundary: Fish Creek (coincident with surface water divide)
- West boundary: Fish Creek and local groundwater divide (coincident with topography sloping to the east)
- South boundary: Local groundwater divide (coincident with topography sloping to the north)
- East boundary: Local groundwater divide (coincident with topography sloping to the west)

The Fish Creek sub-basin boundaries to the south and east are in good agreement with the Fish Creek watershed boundary provided by Alberta Environment (unpublished data). The northern and western boundaries were set based on shallow groundwater divides estimated by topographic high points.

The water bearing units in the area were estimated by grouping water wells within the Fish Creek sub-basin according to the elevation of the reported well screen or perforated intervals, recommended pumping rates and groundwater geochemistry (Table 3). The screen or perforated intervals were used to estimate the average thickness of the water bearing units.

The elevation of the screen or perforated intervals was calculated using the reported elevation of the wells and the top and bottom of the screen intervals. If the elevation of the well was not reported, then a value was assigned based on the elevations shown on the 1:50,000 topographic map for the area.

Recommended pumping rates were included on some of the drillers' reports in the AENV water well database. These pumping rates have been included for selected wells in Table 3. Reported pumping rates average 0.54 L/s (7 Igpm) and range from 0.15 to 1.14 L/s (2 to 15 Igpm).

Four somewhat distinct water bearing units have been identified based on lithology, pumping test data and groundwater chemistry (Table 3). Characteristic properties of each unit are summarized in Table 5. For the purposes of this report, it is assumed that the thickness of the water bearing units represents the thickness of the aquifers. However, the thickness varies from place to place, based on the variability of screen or perforated intervals of the water wells, making this a liberal assumption. The range in aquifer thickness is tabulated below.

Aquifer	Number of Wells	Average Thickness (m)	Maximum Thickness (m)	Minimum Thickness (m)	Standard deviation (m)
1	7	15	31	6	9
2	51	11	40	3	7
3	100	12	61	2	9
4	47	13	56	1	10

AEP-GIC water well records suggest that eight wells owned by Bavarian Lion Company are screened within Aquifer 3. One is screened within Aquifer 2.

Re-evaluation of the pumping test data for 99BH03 (Appendix D) indicates a transmissivity value estimated at approximately 2,850 m^2/year (9.05 x 10^{-5} m^2/sec). EBA (1999) estimated the average transmissivity at 6,680 m^2/year for the same data. Using the thickness of the appropriate aquifer (#3), the pumping test data indicates the revised value for transmissivity is approximately 43% of the transmissivity calculated by EBA (1999).

The extents of the aquifers are shown on Figure 3. This figure shows the aquifer distribution where it is known with certainty using the information available in the AEP-GIC water well database. Some drillers' reports in the database have incomplete information, such as lacking screen or perforated intervals. These wells were not included in the estimation of the areal extents of the aquifers. This does not imply that the aquifers are not present in these areas but merely that a conservative approach has been undertaken to estimate the areas of the aquifers.

Groundwater chemistry data are available for selected wells listed in Table 3. This data is summarized in Table 4. The types of water chemistry can be dominated by sodium-bicarbonate, sodium-bicarbonate-sulphate, calcium-magnesium-sulphate or calcium-magnesium-carbonate waters. A Piper diagram showing the relative ratios of major ions is provided as Figure 2. However, the small number of chemical analyses available in the database limits the accuracy of the aquifer assignment based on groundwater chemistry characteristics.

3.1.2 Aquifer Homogeneity and Isotropic Properties

Another concern raised by the opponents' letters is that the homogeneity and isotropic properties of the aquifer has not been demonstrated. The letters indicate that a comprehensive groundwater study is required.

The lithology described in the drillers' reports for material within the screened interval is included in Table 3 and summarized in Table 5. The typical lithology has been summarized for aquifers that were delineated in the previous section.

Aquifer 1 is typically described as both a glacial till or interbedded sandstone and shale. Aquifer 2 is typically described as composed of blue to gray shale, fractured shale or blue/brown/gray sandstone. Aquifer 3 is typically gray shale and sandstone or brown sandstone. Aquifer 4 is gray and blue shale, interbedded with brown and gray sandstone. However, it is important to note that these materials act as a single hydrogeologic unit.

The drillers' reports and borehole logs for wells installed by EBA (1999) indicate that the geologic materials are interbedded sand and shale units (Table 3). The areal extent of the aquifers have been estimated (Figure 3). A geological cross section of the site showing the average thickness of the aquifers has also been prepared (Figure 4). The site is located outside of the main Cordilleran deformation area, suggesting that the stratigraphic units beneath the site have not been structurally deformed and are laterally continuous (MacKay, 1992 and Hamilton et al. 1999).

The thickness of the aquifers within the Fish Creek sub-basin varies from place to place, given the variability of the screen and perforated intervals of the water wells in the area and consequently the well yield also varies from place to place. The long-term well yield must be established on a well-by-well basis. The theoretical 20-year safe yield (Q_{20}) is a means of projecting the safe well yield.

3.2 Water Balance

One of the concerns raised by the opponents' letters is that the overall impact to the water supply in the area has not been addressed. The concerns focus on the medium and long-term cumulative effects of water drawdown by the proposed development on the existing domestic and non-domestic groundwater users.

To better assess the long-term effects of water extraction by the proposed subdivision on the water supply for the area, a water balance has been estimated for the aquifers affected. A water balance is a mathematical technique for keeping track of the water input to storage, water outputs to the atmosphere and for characterising the active features at the ground surface that influence the percolation of water into the soil (e.g., surface runoff, evapotranspiration and infiltration). Percolation recharges the soil, ultimately resulting in groundwater replenishment. The water balance described in this section has been compiled using the method described by McBean et al. (1995).

This section describes how the basin yield (i.e., water supply) was calculated for the Fish Creek sub-basin. The existing water usage required for sustaining current water usage (i.e., water demand) is also discussed in this section. A water balance was used to evaluate the potential medium and long-term effects of water extraction by the proposed development on the existing water supply and demand.

3.2.1 Basin Yield/Water Supply

The water balance was used to estimate the water supply and hence the basin yield for the Fish Creek sub-basin described in previous sections. The boundary of the watershed was estimated using the method discussed in previous sections.

Precipitation and daily mean temperatures for weather stations at the University of Calgary and Calgary Elbow View, Alberta were used to estimate the water balance for the site. Both data sets are in good agreement, indicating that the water balance is comparable for similar soil profiles and physiography. The University of Calgary data set was used for the water balance.

Figure 5 shows the water balance (calculated percolation and actual evapotranspiration) estimated for the site. The process used to generate this figure is summarized in Table 6. The water balance was developed for granular materials where a main wetting front exists as the water percolates downwards. The water balance method used assumes plug flow or idealized conditions, where each layer reaches field capacity before water is passed downward to the next layer. Phenomena such as fracture flow where water migrates downward by specific routes without moving the wetted front downward is not accounted for in the water balance. As water "short-circuits" downward through fracture flow, rather than moving more slowly as a wetting front, the deeper aquifers can recharge more quickly. The water balance used here is therefore a conservative approach.

The annual recharge per unit area is calculated by summing the difference between actual evapotranspiration (AET) from percolation (PERC) for those months with a net surplus of water (PERC>AET) and subtracting AET for months of water deficit (AET<0). The total annual recharge is estimated at approximately 92 mm per unit area.

The recharge and discharge areas were mapped on Figure 1. It is assumed that recharge coincides with topographic high areas and discharge coincides with topographically low areas (Domenico and Schwartz, 1990). The recharge areas for the various aquifers within the Fish Creek sub-basin are tabulated below. A conservative area was estimated using the areal extents of the aquifers shown on Figure 5 within the recharge area. A conservative estimate was made because recharge from Fish Creek was not considered.

Assigned aquifer #	Area of recharge (m^2)	Volume of recharge (m^3)*
2	8,445,708	774,174
3	20,640,363	1,897,995
4	8,617,268	789,900
Fish Creek Sub-basin	27,713,000	2,540,307

*Calculated based on total annual recharge of 92 mm per unit area

3.2.2 Water Demand

Any pre-existing groundwater users are allocated a given volume of water on a priority basis as stated in Section 27 of the Water Act (Province of Alberta, 1996). For household users, the maximum volume of water may not exceed 1,250 m^3 per year per household for the purposes of human consumption, sanitation, fire prevention and watering animals, gardens, lawns and trees.

The demand on the existing water supply (i.e., the volume of water allocated to the existing users) has been estimated using the AEP-GIC water well database.

Assigned aquifer #	Known number of wells within aquifer*	Existing water demand (m^3)**
2	51	63,750
3	100	125,000
4	47	58,750
Fish Creek sub-basin	256	320,000

* Some wells are not included in this estimate because these wells could not be assigned an aquifer number
** Water demand estimated based on 1,250 m^3 per well per year

The proposed Bavarian Lion Company development has the right to commence and continue to divert water for household purposes if it can be shown that each household (lot) can divert 1,250 m^3 per year per lot for household purposes without interfering with the existing users. Based on the current proposed development of 26 lots, a minimum volume of water of 32,500 m^3 per year is required

3.2.3 Water Balance

The current water demand within the Fish Creek sub-basin is approximately 12.6% of the estimated volume of recharge. The demand for the proposed subdivision is approximately 1.3% of the estimated volume of recharge.

	Current water supply (m^3)	Existing water demand (m^3)	Proposed water demand (m^3)*
Fish Creek Sub-basin	2,540,307	320,000	32,500

Based on the information summarized to estimate the water balance for the Fish Creek sub-basin, there is sufficient groundwater to meet the water supply requirements for the proposed subdivision.

4.0 WATER QUALITY OF 99BH03

A groundwater sample collected from 99BH03 was analyzed for coliforms during the step pumping test performed on October 14, 1999. The analytical results indicated that the well contained 150 cfu/100 mL of coliforms which exceeds the Guidelines for Canadian Drinking Water Quality.

Aaron Drilling disinfected the well under the supervision of EBA personnel on January 9, 2001. Hypochlorite was added to the well and was flushed with 850 gallons of water. The well was pumped at 12 gpm for 135 minutes after sitting overnight. A sample of the water was collected after 800 gallons had been pumped from the well. Another sample was collected at the end of pumping (after 1,620 gallons had been pumped from the well). The analytical report is presented in Appendix C.

Comparison of the chloride concentrations for the samples collected after well disinfection with EBA (1999) data indicates that the well has been flushed of the hypochlorite solution. Total and fecal coliform data indicate that the bacterial colonies have been destroyed.

5.0 CONCLUSIONS

The concerns raised by the opponents' letters of concern have been reviewed. The main concerns identified in the letters indicated that the homogeneity and isotropic properties of the aquifer were not demonstrated and that the overall impact to the water supply to the area was not assessed.

To evaluate the homogeneity and isotropic properties of the aquifer, the Alberta Environmental Protection-Groundwater Information Centre water well database was reviewed in detail for the Fish Creek sub-basin. Four relatively distinct water bearing units (i.e., aquifers) have been identified using information in the water well database using physical descriptions of materials encountered during well installation, reported pumping rates, groundwater chemistry and well screen or perforated intervals.

Comparison of the drillers' reports in the AEP-GIC database for the wells in the area and the borehole logs of the wells installed by Bavarian Lion Company (EBA, 1999) have similar lithological descriptions of the material within the screened interval, suggesting that the lithology throughout the area is relatively homogeneous. The site is located outside of the main Cordilleran deformation zone suggesting that the stratigraphic units and hence the hydrogeological units have not been structurally deformed and are likely laterally continuous (MacKay, 1992 and Hamilton et al. 1999).

A water balance has been estimated for the area using meteorological information estimated for the area to estimate the potential long-term effects of water extraction by the proposed subdivision. The current water supply within the Fish Creek sub-basin is estimated at 2,511,294 m^3 per year. The existing annual demand is estimated at 320,000 m^3 per year (i.e., 12.7% of the current estimated supply) based on 1,250 m^3 per year for the 256 registered domestic and stock water wells within the Fish Creek sub-basin. The estimated demand for the proposed subdivision is 32,500 m^3 per year (i.e., 1.3% of the current estimated supply) based on 1,250 m^3 per year for 26 lots. Based on the information summarized to estimate the water balance for the Fish Creek sub-basin, there is sufficient groundwater to meet the water supply requirements for the proposed subdivision.

Reevaluation of the pumping test data for 99BH03 indicates a transmissivity value estimated at approximately 2,850 m^2/year (Appendix D). EBA (1999) estimated the average transmissivity at 6,680 m^2/year for the same data. Using the thickness of the appropriate water bearing unit, the pumping test data indicates the revised value for transmissivity is approximately 43% of the transmissivity calculated by EBA (1999).

Analytical testing of 99BH03 indicates that measured taken to disinfect the well have been effective in destroying the bacterial colonies. It is recommended that the water be tested on each well that is constructed for potable water supply.

6.0 LIMITATIONS OF LIABILITY

Conclusions and recommendations presented herein are based on an authorized groundwater assessment as described in Section 1.0. This report has been prepared for the use of Bavarian Lion Company and their approved agents for the specific application described above. It has been prepared in accordance with generally accepted environmental engineering practices. No other warranty is made either expressed or implied. EBA's Environmental Report – General Conditions under which this work was performed are provided in Appendix E.

7.0 CLOSURE

We trust this information meets your present requirements. Should you have any questions, please contact our Calgary Riverbend office at (403) 203-3355.

[redacted]

Brian Tsang, M.Sc.
Hydrogeologist, Environmental Services

IONAL GEOLOGIST
J.T. Dance

[redacted]

COPY

Reviewed by:
J.T. Dance, M.Sc., P.Geol.
Senior Contaminant Hydrogeologist

BT:JTD\jsb

PERMIT TO PRACTICE
EBA ENGINEERING CONSULTANTS LTD.

Signatu[redacted]

Date May 16, 2001

PERMIT NUMBER: P245
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

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TABLES

TABLE 4
GROUNDWATER CHEMISTRY DATA
RED WILLOW ESTATES

		Aquifer 2			
Parameter	Units	378002	377586	377589	378003
pH		8.5	8.2	8.8	8.5
EC	uS/cm	1380	1733	920	1280
Na	mg/L	316	343	221	275
K	mg/L	0.7	2.6	1	3
Mg	mg/L	1	8	1	12
Ca	mg/L	13	21	-2	18
Fe	mg/L	0.9	0.86	0.42	-0.02
P	mg/L	3.31	0.84	3.58	1.45
Cl	mg/L	15	3	4	45
SO4	mg/L	366	609	45	66
N02-N	mg/L	-0.099	-0.05	-0.099	-0.05
N02 +N03	mg/L	-0.099	-0.05	-0.099	0.249
HC03	mg/L	353	298	466	675
CO3	mg/L	15	0	13	12
SiO2	mg/L	0	6.7	7.4	5.7
Bal		0.99	0.94	1.05	0.98
TDS	mg/L	908	1133	516	764
T. Alk	mg/L	315	245	404	573
T. Hardness	mg/L	37	85	8	94
Water Type		Na-SO4-HCO3	Na-HCO3	Na-HCO3	Na-HCO3

		Aquifer 3						
Parameter	Units	378630	377379	377510	377423	377945	377949	377507
pH		8.1	7.4	8.5	8.9	8.2	8.5	8.7
EC	uS/cm	1206	2900	1024	853	1520	1700	907
Na	mg/L	283	717	218	167	0	0.099	193
K	mg/L	1.1	2.2	1.7	1.8	0	0	1.3
Mg	mg/L	1	5	8	13	4	5	8
Ca	mg/L	-2	15	13	25	15	20	6
Fe	mg/L	-0.05	0.34	0.03	-0.02	0	-0.1	1.26
P	mg/L	1.56	0.34	0.53	0.57	1.12	1.36	0.22
Cl	mg/L	-1	3	16	2	13	14	3
SO4	mg/L	172	972	40	48	80	390	72
N02-N	mg/L	-0.05	-0.099	-0.05	-0.05	0	0	-0.5
N02 +N03	mg/L	-0.05	-0.099	2.6	0.35	0	0	-0.05
HC03	mg/L	555	655	553	471	0	0	491
CO3	mg/L	0	0	11	29	0	0	11
SiO2	mg/L	7.6	8	5.2	6.7	0	0	6.8
Bal		0.98	1.04	0	0.98	0	0	0.94
TDS	mg/L	733	2038	591	519	910	730	537
T. Alk	mg/L	455	538	472	434	600	295	421
T. Hardness	mg/L	8	59	65	116	55	70	-48
Water Type		Na-HCO3-SO4	Na-SO4-HCO3	Na-HCO3	Na-HCO3	Ca-Mg-SO4-C	SO4	Na-HCO3

		Aquifer 3 (cont.)						
Parameter	Units	378015	377554	377561	352992	377453	497042	497050
pH		8.5	8.4	8.2	0	8.4	7.2	7.2
EC	uS/cm	850	1924	1328	1620	910	672	994
Na	mg/L	173	435	288	0	0	39	187
K	mg/L	1	1.6	2.1	0	0	5.5	3.9
Mg	mg/L	7	4	2	0	3	42.4	23.1
Ca	mg/L	14	8	20	0	7	70.9	38
Fe	mg/L	-0.05	0.08	0.05	41	0.6	<0.01	<0.01
P	mg/L	0.6	1.9	0.66	0	0	0.2	0.3
Cl	mg/L	11	10	-1	4	2	1.5	4.1
SO4	mg/L	53	615	230	9	25	22.8	45.6
N02-N	mg/L	-0.099	-0.05	-0.05	0	0	0	0
N02 +N03	mg/L	2.1	-0.05	0.2	0	-0.099	1	<0.05
HC03	mg/L	462	452	584	0	0	482	692
CO3	mg/L	11	-5	0	0	0	<5	<5
SiO2	mg/L	4.2	4.5	5.9	0.08	0	0	0
Bal		0.92	0.95	0.95	1054	0	0.96	1.03
TDS	mg/L	502	1299	832	967	560	420	642
T. Alk	mg/L	388	376	479	0	495	0	567
T. Hardness	mg/L	62	36	58	0	30	352	190
Water Type		Na-HCO3	Na-SO4-HCO3	Na-HCO3	Fe-SO4	Ca-Mg-SO4	Ca-Mg-HCO3	Na-HCO3

		Aquifer 4			
Parameter	Units	378629	377789	377765	377769
pH		7.8	8.6	8.4	8.6
EC	uS/cm	772	720	880	960
Na	mg/L	30.98	180	241	250
K	mg/L	3.6	2.9	1	1.2
Mg	mg/L	35.02	0.1	-1	-1
Ca	mg/L	89	0.3	-1	-2
Fe	mg/L	0.05	0	0.15	0
P	mg/L	0.15	0.3	2.1	0.93
Cl	mg/L	12	1	-1	3
SO4	mg/L	18	22.7	61	41
N02-N	mg/L	-0.05	1	-0.099	0.2
N02 +N03	mg/L	0.35	0	-0.099	0.2
HC03	mg/L	471.95	442	555	454
CO3	mg/L	0.	14.4	12	34
SiO2	mg/L	8.3	0.1	0	0.2
Bal		1.03	0	0.97	1.16
TDS	mg/L	422	446	589	557
T. Alk	mg/L	387	7.1	475	430
T. Hardness	mg/L	366	1	2	7
Water Type		Ca-Mg-HCO3	Na-HCO3	Na-HCO3	Na-HCO3

Blank = No data collected

TABLE 5
SUMMARY OF AQUIFER CHARACTERISTICS
RED WILLOW ESTATES

Aquifer #	Range of Elevation for the Perforated Interval (mAMSL)		Lithology at Screen	Average Pumping Rates	Average Pumping Rates	Water Chemistry Type
	Average Top of Screen	Averge Bottom of Screen		(L/s)	(gpm)	
1	822	807	Till or interbedded sandstone and shale	N.A.	N.A.	N.A.
2	1099	1088	Blue to gray shale, fractured shale, blue/brown/gray sandstone	0.47	6.2	Na-HCO3/SO4
3	1140	1128	Gray shale and sandstone, brown sandstone	0.59	7.7	Na-HCO3 or Na-HCO3/SO4 or Ca-Mg-SO4
4	1200	1187	Gray and blue shale, interbedded brown and gray sandstone	0.45	6.0	Na or Ca/Mg - HCO3

Notes:
N.A. = Not Available.
Number of wells with reported pumping rates = 0, 9, 18, and 1, for Aquifers 1, 2, 3, and 4, respectively.

TABLE 6
WATER BALANCE
RED WILLOW ESTATES

WEATHER STATI

	January	February	March	April	May	June	July	August	September	October	November	December	Year	Source
Actual Potential Evaporation (inches of water)	0.00	0.00	0.00	1.18	2.52	1.77	1.69	1.85	0.12	0.00	0.00	0.00	9.13	
Actual Potential Evapor (mm of water)	0.00	0.00	0.00	30.00	64.00	45.00	43.00	47.00	3.00	0.00	0.00	0.00	232.00	Summer potential evapotranspiration for Aspen Parkland from Strong and Leggat (1992)
Average Monthly water)		0.54	0.73	1.17	2.33	2.95	2.69	2.13	1.91	0.65	0.56	0.63	17.00	
Average M water)		13.7	18.6	29.6	59.1	75.0	68.4	54.2	48.5	16.5	14.1	15.9	431.9	Environment Canada Website http://www.cmc.ec.gc.ca/climate/normals/ALTAU001.HTM (University of Calgary Weather Station)
R		95	0.95	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.95	0.95		McBean, Rovers, and Farquhar (1995). Solid Waste Landfill Engineering and Design (Table C.1)
			0.70	0.17	0.35	0.44	0.40	0.32	0.29	0.10	0.53	0.59	5.09	
			0.04	0.99	1.98	2.51	2.29	1.81	1.62	0.55	0.03	0.03		
			0.93	25.16	50.24	63.75	58.14	46.07	41.23	14.03	0.71	0.80	302.64	
			[illegible].04	-0.19	-0.54	0.74	0.60	-0.04	1.50	0.55	0.03	0.03		
			[illegible]	-0.19	-0.73	0.01	0.60	0.57	2.07					
				4.51	3.96	4.70	5.00	2.48	3.98	4.54	4.56	4.60		McBean, Rovers, and Farquhar (1995). Solid Waste Landfill Engineering and Design (Table 7.7 and Appendix C.4)
				0.19	0.54	-0.74	-0.30	2.52	-1.50	-0.55	-0.03	-0.03	0.00	
				0.80	1.44	1.77	1.69	-0.71	0.12	0.00	0.00	0.00	5.11	
				20.32	36.47	45.00	43.00	-17.94	3.00	0.00	0.00	0.00	129.85	
				0.00	0.00	1.48	0.89	0.00	3.01	1.10	0.06	0.06	6.80	
				0.00	0.00	37.50	22.72	0.00	76.45	28.05	1.41	1.59	172.78	
				0.00	0.00	0.00	0.00	-17.94	73.45	28.05	1.41	1.59	91.62	
				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Calculation check

ater balance.

TAB.

ALBERTA ENVIRONMENT - SUMMARY OF REGIONAL WATER WELLS
RED WILLOW ESTATES

Well ID	Owner	Address	Current Owner	LSD	Sec	Twp	Rng	Mer	WellDepth	PerfFrom	PerfTo	Elev	StaticWL	Lithology at Screen	Proposed Use
377352	ROTHNEY FARMS	SITE2, RR8, CALGARY 57 T2J 2T9	Cross Conv. Area	SW	4	22	2	5	109.7	48.8	77.7		48.77	Gray shale	Stock
377360	CROSS, A.R.	RR8, ROTHNEY FARMS, CALGARY T2J 2T9	Cross Conv. Area	NW	5	22	2	5	76.2	48.8	75.0	1226.2	17.98	Light gray water bearing sandstone,Gray shale & sandstone,Light gray sandstone	Stock
377355	CROSS, A.R.	RR8, ROTHNEY FARMS, CALGARY T2J 2T9	Cross Conv. Area	SW	5	22	2	5	91.4	48.8	89.9	1289.3	48.77	Blue shale,Gray shale,Light water bearing sandstone,Gray shale,Blue shale	Stock
377383	GROSE, JIM	616 MCINTOSH RD, CALGARY	Cross Conv. Area	12	6	22	2	5	35.7	26.5	35.1	1287.8	26.21	Blue shale,Gray shale,Light sandstone	Domestic
379180	ABBOTT, MARSHALL	SITE 2 RR8, CALGARY 2A T2J 2T9	Cross Conv. Area	SE	6	22	2	5	109.7	54.9	61.0		67.06	Shale,Sandstone	Domestic
377367	ELHATTON, L.	1339-6A ST. NW, CALGARY	Cross Conv. Area	SH	6	22	2	5	44.8	0.0	0.0		13.41	Water bearing sand	Unknown
378475	ATKINS, JOHN	RR8, CALGARY	Cross Conv. Area	SW	6	22	2	5	31.2	22.3	25.3	1257.3	22.86	Sandstone,Blue shale,Sandstone	Domestic and Stock
377372	STANDISH, LLOYD		Cross Conv. Area	SW	6	22	2	5	39.9	0.0	0.0		21.34	Water bearing sand	Domestic and Stock
360065	PROKOPY, TERRY	RR8 CALGARY	Cross Conv. Area	NE	7	22	2	5	38.1	32.0	38.1		17.68	Blue sandstone,Blue shale,Blue water bearing shale,Blue shale,Blue water bearing shale,Blue shale	Domestic
377408	WENGATZ CONSTRUCTION		Cross Conv. Area	NW	7	22	2	5	51.8	44.8	48.8	1310.6	40.23	Gravel	Domestic
377397	CROSS, A.R.	RR8, ROTHNEY, CALGARY	Cross Conv. Area	SW	7	22	2	5	32.9	21.3	31.7	1271.0	20.73	Brown fractured sandstone,Gray shale	Domestic
377389	ROYAL TRUST, C/O CROSS, A.R.	600-7 AVE SW, CALGARY	Cross Conv. Area	SW	7	22	2	5	41.2	34.4	39.9	1272.5	33.22	Gray shale,Light sandstone,Gray shale	Domestic
377411	MACKLIN, P.T.	MIDNAPORE	Cross Conv. Area	SE	8	22	2	5	45.7	0.0	0.0	1188.7	42.37	Water bearing unknown	Domestic
377421	SUN OIL CO		Cross Conv. Area	00	9	22	2	5	13.7	0.0	0.0			Clayey sandstone & rocks	Industrial
377581	ROTHNEY FARMS	SITE 2, RR8, CALGARY 57	Cross Conv. Area	NE	16	22	2	5	79.9	0.0	0.0			Dark gray shale	Unknown
377582	ROTHNEY FARMS	SITE 2, RR8, CALGARY 57	Cross Conv. Area	NE	16	22	2	5	91.4	64.0	90.5		50.29	Gray shale & sandstone,Gray shale,Light water bearing sandstone,Gray shale,Coal,Gray shale,Light soft sandstone	Stock
377578	ROTHNEY FARMS	SITE 2, RR8, CALGARY 57 T2J 2T9	Cross Conv. Area	NE	16	22	2	5	106.7	0.0	0.0			Dark gray shale	Stock
377587	THE NATURE CONSERVANCY OF CDN	422-33RD AVE NW, CALGARY T2K 0B4	Cross Conv. Area	NE	17	22	2	5	67.1	54.9	67.1		42.67	Siltstone,Brown fine grained sandstone,Salt & pepper fractured sandstone,Gray shale	Domestic
377584	ROTHNEY FARMS	RR8, CALGARY	Cross Conv. Area	NW	17	22	2	5	76.2	59.4	74.7		58.52	Light gray sandstone,Gray shale,Light gray water bearing sandstone	Stock
377583	ROTHNEY FARMS	SITE 2, RR8, CALGARY 57 T2J 2T9	Cross Conv. Area	SE	17	22	2	5	76.2	0.0	0.0			Gray shale	Stock
377590	CROSS, A.R.	RR8, ROTHNEY FARMS, CALGARY	Cross Conv. Area	NW	18	22	2	5	54.9	56.6	53.3	1219.2	29.87	Brown sandstone,Gray shale,Dark gray water bearing sandstone	Stock
377345	FLANOGAN, H.C.	RR8 CALGARY		00	19	22	2	5	30.5	0.0	0.0		24.99	Sandstone & Shale Lodges	Domestic
490025	FLANAGAN, HERB	SITE 2 RR8, CALGARY 13 T2J 2T9		03	19	22	2	5	29.6	23.5	29.6			Gray shale	Domestic
469147	DALTON, RICK/LILLIAN	SITE 2 RR8, CALGARY 2		03	19	22	2	5	39.6	33.5	39.6		22.89	Gray shale,Gray water bearing sandstone	Domestic
469148	PFEIFER, TY	PRIDDIS 75 T0L 1W0		03	19	22	2	5	43.3	37.2	43.3		12.50	Gray shale,Gray water bearing sandstone	Domestic
467795	SOUTHERN, N.	SITE 14 RR8, CALGARY 2 T2J 2T9		08	19	22	2	5	79.3	60.4	66.5		22.86	Shale,Sandstone	Stock
377309	FLEMMING, DON	PRIDDIS		NE	19	22	2	5	30.5	6.1	7.3	1196.3	5.49	Gravelly clay,Sandstone	Domestic
377380	FLEMING, DON	1404 BEVERLY PL SW, CALGARY		NE	19	22	2	5	48.8	38.1	41.2	1188.7	27.43	Shale	Domestic
377393	HOPE ROSS, BILL	S14 RR8 CALGARY 13		NE	19	22	2	5	54.9	35.1	50.3		34.14	Shale,Fractured shale,Shale,Fractured shale,Shale,Shale & Sandstone,Shale,Shale & Sandstone	Domestic
377630	FLEMING, DON	1404 BEVERLY PL SW, CALGARY		NE	19	22	2	5	79.3	71.6	74.7	1188.7	45.72	Shale	Domestic
377385	FLEMING, DON	1404 BEVERLY PL SW, CALGARY		NE	19	22	2	5	82.3	37.5	61.0	1188.7	56.39	Shale	Domestic
359987	VAN WIELINGEN, GUS WELL #1	STE 2028 1 CAL PLACE 330 5 AVE SW CALGAR T2P 0L4		NW	19	22	2	5	73.2	42.7	73.2		34.14	Brown shale & sandstone ledges,Blue water bearing shale & sandstone ledges	Domestic
377342	BONERTA, BRIAN	302A 8 HAMPTON DR, CALGARY		SW	19	22	2	5	25.0	15.2	18.3	1188.7	12.80	Brown shale,Gray shale,Gray water bearing sandstone	Domestic
377339	FINNIS, F.	9616 ALBERNI RD SW, CALGARY		SW	19	22	2	5	25.9	0.0	0.0	1155.2	17.98	Gray shale	Domestic and Stock
378629	UPLAND DEV CO LTD.	SUITE 3001, LONDON HOUSE, CALGARY		SW	19	22	2	5	30.5	21.3	30.5	1207.0	16.76	Sandy clay,Brown clay & shale,Gray shale	Domestic
377343	SURE HOLDINGS LTD.	RR8 CALGARY		SW	19	22	2	5	42.7	32.0	42.7	1207.0	16.76	Sandy clay,Sandstone	Domestic and Stock
354338	FINNIS, TIM	SITE 2 RR8, CALGARY 8 T2P 2T9		SW	19	22	2	5	47.2	41.2	47.2		20.11	Gray shale,Fine grained sandstone,Brown wet sandstone,Coarse grained sandstone	Domestic
377346	PFEIFFER, TY	912 WOODVIEW CRESC SW, CALGARY		SW	19	22	2	5	73.2	35.5	64.0		30.48	Clay & Rocks,Blue shale & sandstone	Domestic
377632	DAVIES, DAVE	RR8, CALGARY		14	20	22	2	5	7.6	0.0	0.0		3.66	Water bearing shale	Domestic
437592	BAVARIAN LION CO LTD/JANZ, ROL	SITE 3 RR8, CALGARY 7 T2J 2T9	Bav. Lion Co.	NE	20	22	2	5	36.0	22.0	35.7		15.54	Shale & Sandstone Ledges,Sandstone,Thin shale & sandstone ledges,Shale & Sandstone Ledges,Sandstone,Thin shale & sandstone ledges	Domestic
437593	BAVARIAN LION CO LTD/JANZ,ROLF	SITE 3 RR8, CALGARY 7 T2J 2T9	Bav. Lion Co.	NE	20	22	2	5	40.2	18.3	33.5		12.19	Shale,Shale & Sandstone Ledges,Shale,Shale,Shale & Sandstone Ledges,Shale	Domestic
418340	BAVARIAN LION CO C/O JANZ,ROLF	SITE 23 RR8, CALGARY 7 T2J 2T9	Bav. Lion Co.	NE	20	22	2	5	40.2	25.9	34.1		21.03	This shale & sandstone ledges,This shale & sandstone ledges	Domestic
418345	BAVARIAN LION CO C/O JANZ,ROLF	SITE 23 RR8, CALGARY 7 T2J 2T9	Bav. Lion Co.	NE	20	22	2	5	46.3	29.0	40.5		21.31	Shale & Sandstone Ledges,Sandstone,Shale & Sandstone Ledges	Domestic
437589	BAVARIAN LION CO LTD	SITE 23 RR8, CALGARY 7 T2J 2T9	Bav. Lion Co.	NE	20	22	2	5	53.0	25.9	46.9		24.08	Shale,Shale & Sandstone,Sandstone,Shale,Sandstone,Shale & Sandstone	Domestic
418343	BAVARIAN LION CO LTD.	SITE 23 RR8, CALGARY 7 T2J 2T9	Bav. Lion Co.	NE	20	22	2	5	58.5	41.2	57.9		26.70	Shale & Sandstone Ledges,Shale & Sandstone Ledges	Domestic
378631	DAVIES, DAVE	MIDNAPORE		NW	20	22	2	5	16.5	0.0	0.0	1158.2	4.27	Sandrock	Domestic
360064	DAVIES, DAVE #1474	SITE 24 RR8, CALGARY 7 T2J 2T9		NW	20	22	2	5	45.7	33.5	42.7		32.00	Brown sandy shale,Gray shale,Brown water bearing sandstone	Domestic and Stock
377474	DAVIES, DAVE	S24 RR8, CALGARY 7		NW	20	22	2	5	45.7	33.5	42.7		32.00	Brown sandy shale,Gray shale,Brown water bearing sandstone	Domestic and Stock
497043	Bavarian Lion Co.			NE	20	22	2	5	71.8	59.4	71.6	3825.0			
497042	Bavarian Lion Co.			NE	20	22	2	5	47.2	35.1	47.2	3825.0			
497050	Bavarian Lion Co.			NE	20	22	2	5	59.4	35.1	57.9	3825.0			
377492	OHANLON, HARRY	S6 RR8, CALGARY 6 T2J 2T9		02	21	22	2	5	30.6	0.0	0.0		30.48	Brown sandstone & shale strg's	Domestic
377505	OLMAND	S8 RR8, CALGARY 4		NW	21	22	2	5	25.0	0.0	0.0	1158.2	11.28	Blue sandstone	Domestic
377507	IRVING DON	12120 14 ST SW, CALGARY		NW	21	22	2	5	30.5	24.4	30.2	1158.2	12.80	Light blue sandstone,Siltstone	Domestic
377510	MCPHAIL, COLIN	111 LAKE LUCERNE CLOSE SE, CALGARY		NW	21	22	2	5	45.7	32.0	44.2		31.70	Light gray sandstone,Gray shale,Light gray water bearing sandstone	Domestic
377502	WESTWARD CONSTRUCTION	760 CEDARCLE WAY SW, CALGARY		NW	21	22	2	5	48.8	42.7	48.8		15.24	Clay & Rocks,Sandstone & Shale Lodges	Domestic
377496	BAKER, ROLAND	449 QUEEN ALEXANDRA WAY, CALGARY		NW	21	22	2	5	59.4	0.0	0.0	1167.4	0.00	Brown unknown	Domestic
377503	CLAYDON	RR8, CALGARY		NW	21	22	2	5	59.4	51.8	59.4		0.00	Clay & Rocks,Sandstone & Shale Lodges	Domestic
377513	GULA, DR.	S23 RR8, CALGARY 4		NW	21	22	2	5	61.0	0.0	0.0			Black shale	Domestic
377515	GULA, DR.	RR8 CALGARY 4		NW	21	22	2	5	70.1	33.5	39.6		19.81	Clay	Domestic
377498	OHANLON, HARRY	S4 RR8, CALGARY 8		NE	21	22	2	5	42.7	30.5	42.7		19.81	Clay,Gray shale & sandstone ledges,Gray siltstone,Gray water bearing sandstone	Stock
351795	OHANLON HARRY #1417	SITE 4 RR8, CALGARY 8		SE	21	22	2	5	42.7	30.5	42.7		19.81	Clay,Gray shale & sandstone,Gray siltstone,Gray water bearing sandstone	Stock
377482	OHANLON, HARRY	S6 RR8, CALGARY 6		SE	21	22	2	5	47.2	36.6	47.2		13.72	Gray shale,Gray water bearing sandstone,Gray shale	Domestic and Stock
359988	OHANLON, HARRY	13046 SITE 6 RR8 CALGARY T2J 2T9		SE	21	22	2	5	50.6	41.2	50.6		30.48	Clay,Brown sandstone & shale ledges	Domestic
349668	WOODS, MR & MRS #2480	SITE 4 RR #8, CALGARY 8 T2J 2T9		SE	21	22	2	5	67.1	57.9	67.1		28.68	Brown sandstone,Gray shale,Gray water bearing sandstone,Gray shale	Domestic
377680	ZSCHOCKETT, LOTHAR	S4 RR8, CALGARY 14		00	22	22	2	5	23.8	0.0	0.0		8.23	Shale	Domestic
356215	VERNA, ROME	SITE 4 RR8, CALGARY 11 T2J 2T9		12	22	22	2	5	24.4	19.5	23.2		11.89	Gray sandstone,Gray shale,Hard sandstone,Gray sandstone,Gray shale,Hard sandstone	Domestic
369968	VERNA, ROME	SITE 4 RR8, CALGARY 11 T2J 2T9		12	22	22	2	5	51.8	21.3	24.4		7.50	Brown sandstone,Gray water bearing sandstone,Brown sandstone,Gray water bearing sandstone	Domestic
377579	SMITH, ERNIE	RR8 CALGARY		14	22	22	2	5	56.4	0.0	6.1	1136.9	0.00	Sandstone	Unknown
377654	KUT, STEVE	S5 RR8, CALGARY 23		16	22	22	2	5	61.0	0.0	0.0		18.29	Gray shale	Domestic
377675	BRUKETA, STEVE	RED DEER LAKE		EH	22	22	2	5	30.5	9.1	12.2		19.81	Sandstone,Blue clay	Stock
377576	DRAGER, JACK	43 CHEVRON DR, CALGARY 9		NW	22	22	2	5	16.8	7.9	14.6	1143	3.35	Yellow clay & rocks,Sandstone,Fractured sandstone,Yellow sandstone	Domestic
356543	KAT, STEVE/SHIRLEY	SITE 5 RR8 CALGARY 2 T2J 2T9		NW	22	22	2	5	36.6	18.3	36.6		3.49	Gray shale,Shale & Sandstone Lodges	Domestic
377656	ELFORD, VIC	RR8 CALGARY		NW	22	22	2	5	36.6	30.5	36.6		6.10	Gray shale,Gray water bearing sandstone,Gray shale	Domestic
356542	KAT, STEVE/SHIRLEY	SITE 5 RR8 CALGARY 2 T2J 2T9		NW	22	22	2	5	48.8	36.6	48.8		4.57	Sandstone,Blue shale,Sandstone,Shale & Sandstone Ledges,Sandstone,Shale & Sandstone Ledges	Domestic
349454	KUT, STEVE	SITE5 RR8,CALGARY ALTA 20 T2J 2T9		NW	22	22	2	5	61.0	0.0	0.0		18.29	Gray shale	Domestic
378633	BRIDGEWATER	205 STOCKYARD BLDG, CALGARY		NW	22	22	2	5	77.7	0.0	0.0		7.62	Shale & Sandstone	Domestic
377660	ARMSTRONG, HOWARD, #2460	S5 RR8, CALGARY 12		NW	22	22	2	5	85.3	70.1	85.3		10.67	Sandstone,Gray shale,Water bearing sandstone,Gray shale	Domestic and Stock
377682	KUT, STEVE	RR8 CALGARY		NW	22	22	2	5	97.5	0.0	0.0		11.89	Black shale & sandstone ledges	Domestic
377527	BRUKETA, STEVE	S5 RR8, CALGARY 8		SE	22	22	2	5	15.2	6.7	12.2		3.35	Water bearing gravel	Stock
282143	GLENDALE FARM (BRUKETA, DAVID)	SITE 5 RR8 CALGARY 18 T2J 2T9		SE	22	22	2	5	24.4	18.3	24.4		12.19	Blue water bearing sandstone,Blue shale,Blue water bearing sandstone,Blue shale,Blue sandstone,Blue clay	Stock
377529	BRUKETA, DAVID	S5 RR8, CALGARY 19		SE	22	22	2	5	54.9	33.5	36.6		18.29	Dark blue clay & shale,Blue gray fine grained shale & sandstone ledges	Stock
377539	BROOKS, DON	1424 147 AVE SW, MIDNAPORE 133		SW	22	22	2	5	18.3	0.0	0.0	1172.48	11.58	Shale	Domestic
377541	TAYLOR, IRENE	RR8 CALGARY		SW	22	22	2	5	29.9	0.0	0.0		15.24	Blue shale	Domestic
377543	BROOKS, DON	MIDNAPORE 133		SW	22	22	2	5	35.0	24.4	30.8		12.80	Blue shale	Domestic
377537	HEBENTON, DAVID	1448 SOATHDALE CLOSE SW, CALGARY		SW	22	22	2	5	45.2	27.4	41.2	1172.48	11.34	Sandstone,Shale	Domestic
377536	HEBENTON, DAVID	1448 SOATHDALE CLOSE SW, CALGARY		SW	22	22	2	5	47.2	41.2	47.2	1172.48	15.24	Shale,Sandstone	Domestic
377533	MOTZ, ERVIN	919 DERBY AVE NE, CALGARY		SW	22	22	2	5	54.9	48.8	54.9	1165.86	0.00	Clay,Shale & Sandstone	Domestic
351446	MELS PICKUP & DELIVERY LTD	4217 14A ST, SE CALGARY T2G 3T9		SW	22	22	2	5	72.8	27.4	42.7		28.96	Shale,Brown fine grained sandstone,Shale,Gray siltstone,Shale,Gray siltstone,Black shale,Gray coarse grained sandstone,Fractured shale,Gray siltstone	Domestic
377574	MOTZ, ERVIN R.	RED DEER LAKE		SW	22	22	2	5	109.7	18.3	109.7		36.58	Clay & Rocks,Blue shale & sandstone ledges	Domestic
377559	BRIDGEWATER	205 STOCKYARD BLVD, CALGARY 21		WH	22	22	2	5	24.4	18.3	24.4		4.57	Clay & Rocks,Shale & Sandstone	Domestic
377571	BRIDGEWATER	205 STOCKYARD BLDG, CALGARY 21		WH	22	22	2	5	27.4	21.3	27.4		4.57	Clay & Rocks,Soft sandstone & shale ledges	Domestic
377552	BRIDGEWATER	205 STOCKYARD BLDG, CALGARY 21		WH	22	22	2	5	27.4	21.3	27.4		5.49	Clay & Rocks,Shale & Sandstone	Domestic
377565	BRIDGEWATER	205 STOCKYARD BLDG, CALGARY 21		WH	22	22	2	5	30.5	24.4	30.5	1138.24	4.57	Clay & Rocks,Shale & Sandstone	Domestic
377678	BRIDGEWATER	205 STOCKYARD BLDG, CALGARY 21		WH	22	22	2	5	30.5	24.4	30.5		0.00	Clay & Rocks,Sandstone & Shale Ledges	Domestic
377568	BRIDGEWATER	205 STOCKYARD BLDG, CALGARY 21		WH	22	22	2	5	32.0	25.9	32.0		3.05	Soft sandstone & shale ledges	Domestic
377554	BRIDGEWATER	205 STOCKYARD BLDG		WH	22	22	2	5	39.6	33.5	39.6		4.57	Clay & Rocks,Shale & Sandstone	Domestic
377573	BRIDGEWATER	205 STOCKYARD BLDG, CALGARY 21		WH	22	22	2	5	42.7	36.6	42.7		19.81	Sandstone & Shale Ledges	Domestic
377558	BRIDGEWATER	205 STOCKYARD BLDG, CALGARY 21		WH	22	22	2	5	76.2	27.4	33.5		4.57	Clay & Rocks	Domestic
377713	HEAD, DON	2312 LANCING AVE, CALGARY		00	23	22	2	5	15.9	0.0	0.0		4.69	Sandstone	Unknown
443030	THOMSON, A.	RR1, OKOTOKS T0L 1T0		08	23	22	2	5	47.2	36.6	42.7		20.12	Shale	Domestic
377701	LUCAS, PHIL	S23 RR8, CALGARY 7		14	23	22	2	5	42.7	21.3	42.7	1135.38	18.29	Gray clay,Water bearing sandstone,Gray clay,Gray water bearing clay & sandstone layers	Domestic and Stock
364117	495531 ALTA LTD C/O WALTA, D	SITE 5 RR8, CALGARY 33 T2J 2T9		NW	23	22	2	5	24.4	18.3	22.9		0.03	Shale,Sandstone,Shale,Sandstone & Shale Ledges,Shale,Sandstone,Shale,Sandstone & Shale Ledges	Domestic
377700	LUCAS, P.	VULCAN		NW	23	22	2	5	39.6	0.0	0.0		0.00	Sandstone	Domestic and Stock
377697	LUCAS, PHIL	RR8, CALGARY		NW	23	22	2	5	45.7	33.5	45.7	1143	15.24	Shale,Hard shale,Hard sandstone,Shale & Sandstone Ledges,Hard sandstone	Domestic and Stock
377699	LUCAS, PHIL	RR8, CALGARY		NW	23	22	2	5	48.8	41.2	47.6		13.72	Brown sandy clay & gravel	Domestic and Stock
369590	TEES DALE RIDING SCHOOL	C/O BRETT WALTA SITE 5 RR8, CALGARY 33 T2J 2T9		NW	23	22	2	5	61.0	27.4	39.6		0.00	Shale,Sandstone,Shale,Shale,Shale & Sandstone	Domestic and Stock
349570	TEESDALE STABLES	SITE 5 RR #8, CALGARY 33		NW	23	22	2	5	61.0	48.8	61.0		27.43	Gray shale,Water bearing sandstone,Gray shale,Brown sandstone,Gray shale	Domestic and Stock
377704	TEESDALE STABLES	S5 RR8, CALGARY 33		NW	23	22	2	5	61.0	48.8	61.0		27.43	Gray shale,Water bearing sandstone,Gray shale,Brown sandstone,Gray shale	Domestic and Stock
377693	DOUBLE E FARMS	48046 MIDLAKE BLVD SE, CALGARY		SE	23	22	2	5	61.0	21.3	27.4		8.53	Blue sandstone,Blue gray shale,Gray water bearing sandstone	Domestic
359628	DOUBLE E FARMS #1541	48046 MIDLAKE BLVD SE, CALGARY T2X 3C7		SE	23	22	2	5	61.0	21.3	27.4		8.53	Blue sandstone,Blue gray shale,Gray sandstone,Blue sandstone,Blue gray shale,Gray sandstone	Domestic
377684	DOUBLE E FARMS	48046 MIDLAKE BLVD SE, CALGARY		SE	23	22	2	5	97.5	0.0	0.0		9.14	Shale & Sandstone Lodges	Investigation
359427	DOUBLE E FARMS	48046 MIDLAKE BLVD SE, CALGARY T2X 3C7		SE	23	22	2	5	97.5	0.0	0.0		9.14	Shale & Sandstone Lodges	Unknown
377695	GOODWIN, R.D.	RR8, CALGARY		SW	23	22	2	5	10.4	0.0	0.0	1149.1	7.62	Sand & Shale	Stock
377719	DEPLAEDT HOLDINGS LTD.	RR1 DEWINTON		02	24	22	2	5	108.8	91.4	107.6		53.64	Shale,Hard sandstone,Sandstone	Domestic
352725	SKINNER, PAUL	852 WOODPARK WAY, SW CALGARY T2W 2V8		14	24	22	2	5	13.1	7.0	13.1		2.44	Weathered mudstone,Water bearing sandstone,Shale	Domestic
357364	WADDELL, A.	RR9 SITE 1 CALGARY 14		NE	24	22	2	5	24.4	18.3	24.4		9.14	Clay & Rocks,Yellow clay & gravel,Yellow water bearing shale,Gray clay	Domestic
353985	BEECHINOR, CAROLINE	C/O WADDELL A 52 SUNHURST RD SE, CALGARY T2X 1T1		NE	24	22	2	5	30.5	12.2	30.5		11.89	Clay & Rocks,Brown shale,Shale & Sandstone,Shale,Sandstone,Shale,Fractured sandstone,Shale	Domestic
377776	FOOTHILLS SCHOOL DIV #38	HIGH RIVER		NE	24	22	2	5	61.0	30.5	36.6		10.06	Sandstone,Shale,Sandstone,Shale	Municipal
360066	NORRIE, W.J.	SITE 1 RR9 CALGARY 16 T2J 5G5		NE	24	22	2	5	62.5	56.4	62.5		41.76	Blue hard shale,Blue clay & shale,Blue water bearing sandstone,Blue clay & shale	Domestic
377758	RED DEER LAKE UNITED CHURCH			NW	24	22	2	5	16.8	10.7	13.7		9.14	Yellow clay & gravel,Yellow shale	Domestic
377752	RED DEER LAKE SCHOOL	HIGH RIVER		NW	24	22	2	5	17.1	0.0	0.0	1158.24	3.66	Clay	Domestic
377755	FOOTHILLS SCHOOL DIV #38	RED DEER LAKE SCHOOL		NW	24	22	2	5	21.3	10.4	20.7	1147.57	3.96	Brown clay & rocks,Brown shale,Blue clay,Gray shale,Blue clay	Municipal
351116	FOOTHILLS EQUESTRIAN CTR #1351	SITE 22 RR8, CALGARY 4		NW	24	22	2	5	22.9	12.2	21.3		12.19	Brown clay,Green shale,Sandstone	Domestic
377760	FOOTHILLS EQUESTRIAN CENTRE	822 RR8, CALGARY 4		NW	24	22	2	5	22.9	12.2	21.3		12.19	Brown clay,Green shale,Water bearing sandstone	Domestic
349835	HEFFERING INVESMENT GROUP 2861	#630 999 8 ST SW, CALGARY T2R 1O5		NW	24	22	2	5	33.5	21.3	33.5			Brown clay & rocks,Green fractured shale,Brown water bearing sandstone,Gray shale,Gray sandstone,Gray shale	Domestic
349836	HEFFERING INVESTMENT GROUP2857	#630 999 8 ST SW, CALGARY T2R 1O5		NW	24	22	2	5	35.1	22.9	35.1			Gray sandstone,Gray shale,Brownish gray water bearing sandstone,Gray shale,Gray sandstone,Gray shale,Gray sandstone,Gray bar't shale	Domestic
394244	OCCONNOR, JOHN B.	RED DEER		SE	24	22	2	5	17.4	13.1	17.4		9.14	Brown sandstone,Brown shale & sandstone	Domestic
377732	RED DEER LAKE COMMUNITY ASSOC.	RR8, CALGARY		SW	24	22	2	5	61.0	21.3	59.4		6.10	Blue shale,Light gray water bearing sandstone	Municipal
377722	PRIDDIS & RED DEER LAKE REC.	RR8, CALGARY 25		SW	24	22	2	5	73.2	0.0	0.0	1150.62		Gray shale	Unknown
377727	PRIDDIS & RED DEER LAKE REC.	RR8 CALGARY 25 T2J 2T9		SW	24	22	2	5	85.3	0.0	0.0	1150.62		Gray shale	Unknown
377736	DEVONIAN FOUNDATION	EDMONTON		WH	24	22	2	5	53.3	41.2	51.8	1143	2.74	Gray shale,Gray sandstone,Black shale,Gray shale	Municipal
378636	OHANLON, H.F.	MIDNAPORE 99	North of 22X	12	28	22	2	5	18.9	0.0	0.0		4.88	Gray shale	Domestic and Stock
361157	HAGEL, GERRY	RR2 CROSSFIELD T0M 0S0	North of 22X	13	28	22	2	5	18.3	0.0	0.0		4.57	Shattered sandstone	Domestic and Stock
377960	OHANLON, H.	MIDNAPORE 99	North of 22X	NE	28	22	2	5	18.3	0.0	0.0			Sand	Domestic and Stock
377974	ERICKSON, B.	1088 ALADIA DR SE, CALGARY	North of 22X	NE	28	22	2	5	30.5	0.0	0.0	1143.0		Blue clay	Domestic
377969	OHANLON, H.	MIDNAPORE 99	North of 22X	NE	28	22	2	5	33.5	0.0	0.0		0.00	Shale	Domestic and Stock
377982	HECK, RONALD D.	MIDNAPORE 488 T0C 1J0	North of 22X	NE	28	22	2	5	48.8	36.6	48.8		9.14	Blue shale,Blue shale & sandstone ledges,Sandstone,Blue shale,Blue shale & sandstone ledges	Domestic
377977	LAMONTAGUE, ARTHUR & HECK R.	MIDNAPORE 488 T0L 1J0	North of 22X	NE	28	22	2	5	54.9	42.7	54.9		18.29	Blue shale,Shale & Sandstone Ledges,Soft sandstone,Shale	Domestic
377966	OHANLON, H.	MIDNAPORE 99	North of 22X	NE	28	22	2	5	61.0	0.0	0.0	1147.6	4.57	Shale & Sandstone	Domestic and Stock
377976	OHANLON, H.	MIDNAPORE 99	North of 22X	NE	28	22	2	5	61.0	0.0	0.0			Shale & Sandstone	Domestic and Stock
377972	OHANLON, H.	MIDNAPORE 99	North of 22X	NE	28	22	2	5	61.0	0.0	0.0	1147.6		Hard shale	Unknown
377980	HECK, RONALD	MIDNAPORE 488 T0C 1J0	North of 22X	NE	28	22	2	5	67.1	0.0	0.0			Black shale	Domestic
377964	OHANLON, H.	MIDNAPORE 99	North of 22X	NE	28	22	2	5	76.2	0.0	0.0	1127.8	3.66	Shale & Sandstone Lodges	Domestic
377967	OHANLON, H.	MIDNAPORE 99	North of 22X	NE	28	22	2	5	131.1	0.0	0.0			Shale & Sandstone	Domestic and Stock
377946	OHANLON, H.	MIDNAPORE 99	North of 22X	NW	28	22	2	5	33.5	0.0	0.0	1127.8	0.00	Shale & Sandstone	Domestic and Stock
349929	DAWSON, HAL #2982	SITE 6 RR8, CALGARY 6 T2J 2T9	North of 22X	NW	28	22	2	5	46.9	22.6	28.7		4.24	Brown sandstone,Shale,Sandstone	Domestic
377958	DOUBLE E FARMS	MIDNAPORE 10	North of 22X	NW	28	22	2	5	57.3	45.1	57.3		10.06	Blue gray shale,Blue fractured shale,Blue gray shale,Water bearing sandstone,Gray shale	Domestic
351448	DOUBLE E FARMS #1305	MIDNAPORE 10	North of 22X	NW	28	22	2	5	57.3	45.1	57.3		10.06	Gray shale,Blue fractured shale,Gray shale,Sandstone,Gray shale	Domestic
377955	DOUBLE E FARMS	MIDNAPORE 10	North of 22X	NW	28	22	2	5	71.6	53.3	71.6		12.19	Blue gray shale,Gray sandy shale,Blue gray shale,Gray sandstone,Blue water bearing sandstone,Gray shale	Domestic
351447	DOUBLE E FARMS #1295	MIDNAPORE 10	North of 22X	NW	28	22	2	5	71.6	53.3	71.6		12.19	Blue shale,Gray sandy shale,Gray shale,Gray sandstone,Blue sandstone,Gray shale	Domestic
349930	DAWSON, HAL	SITE 6 RR8, CALGARY 6 T2J 2T9	North of 22X	NW	28	22	2	5	85.3	0.0	0.0		30.48	Gray shale	Domestic
399656	NOBLE, JAN/MAWANI, SALIM	144 1935 32 AVE NE, CALGARY T2E 7C8	North of 22X	03	29	22	2	5	61.0	51.8	59.7		27.22	Gray sandstone,Gray thin shale & sandstone ledges,Gray sandstone,Gray thin shale & sandstone ledges	Domestic
399661	NOBLE, JAN/MAWANI, SALIM	144 1935 32 AVE NE, CALGARY T2E 7C8	North of 22X	03	29	22	2	5	67.1	34.8	37.8		30.91	Gray hard sandstone,Gray shale,Gray water bearing sandstone,Gray hard sandstone,Gray shale,Gray water bearing sandstone	Domestic

TAB.
ALBERTA ENVIRONMENT - SUMMARY OF REGIONAL WATER WELLS
RED WILLOW ESTATES

Well ID	Owner	Address	Current Owner	LSD	Sec	Twp	Rng	Mer	WellDepth	PerfFrom	PerfTo	Elev	StaticWL	Lithology at Screen	Proposed Use
353160	KOTERA, JOHN	SITE 23 RR8, CALGARY 12 T2J 2T9	North of 22X	09	29	22	2	5	61.0	35.1	59.4		24.38	Grey fine grained sandstone,Moist sandstone,Carbonaceous shale,Siltstone,Fine grained sandstone,Carbonaceous clay & rocks,Siltstone,Fractured sandstone,Siltstone	Domestic
377428	PRAIRIE BREEDERS	RR8, CALGARY	North of 22X	NE	29	22	2	5	33.5	28.4	31.4		9.14	Brown hard shale,Grey shale,Water bearing sandstone	Domestic
349131	KOTERA JOHN #2	SITE 23 RR8, CALGARY 12 T2J 2T9	North of 22X	NE	29	22	2	5	73.2	0.0	0.0		60.96	Grey hard shale	Domestic
349132	KOTERA JOHN #3	SITE 23 RR8, CALGARY 12 T2J 2T9	North of 22X	NE	29	22	2	5	73.2	0.0	0.0		15.24	Grey sandy shale & sandstone ledges	Domestic
377433	KOTERA, J.C.	SITE 23, RR8, CALGARY 12	North of 22X	NE	29	22	2	5	79.3	54.9	61.0		16.76	Blue shale,Water bearing sandstone	Domestic and Stock
349129	KOTERA JOHN	SITE 23 RR8, CALGARY 12 T2J 2T9	North of 22X	NE	29	22	2	5	109.7	0.0	0.0		60.96	Hard sandstone & shale strg's	Domestic
377425	SMART ABBEY	112 WOODVIEW PL SW, CALGARY	North of 22X	NW	29	22	2	5	32.0	25.9	32.0		18.29	Sandstone,Black shale,Sandstone,Black shale	Domestic
353405	KROMM, KIM	SITE 6 RR8, CALGARY 4 T2J 2T9	North of 22X	NW	29	22	2	5	35.4	29.3	35.4		7.32	Shale,Wet sandstone,Shale	Domestic and Stock
377423	KROMM, JIM	RR8, CALGARY	North of 22X	NW	29	22	2	5	36.6	30.5	36.6		18.29	Sandstone,Blue water bearing shale & sandstone	Domestic
377387	HART, BILL	SITE 6, RR8, CALGARY 1	North of 22X	SE	29	22	2	5	25.6	21.3	25.0		13.72	Brown shale,Grey shale,Brown shale,Water bearing sandstone	Stock
352788	TANG, SONY #1497	2 FLOOR 1104 12 AVE SW, CALGARY	North of 22X	SE	29	22	2	5	30.5	18.3	30.5		7.62	Grey sandstone,Grey shale,Grey water bearing sandstone,Grey shale	Domestic
377379	PRAIRIE BREEDERS	SITE 6, RR8, CALGARY 1	North of 22X	SE	29	22	2	5	30.5	21.3	26.2		12.19	Brown till,Brown shale,Water bearing sandstone	Domestic and Stock
349460	LIVINGSTON,LYAL	SITE 24,RR8,CALGARY ALTA 1	North of 22X	SE	29	22	2	5	35.1	22.9	35.1		12.19	Grey shale,Blue grey shale,Grey water bearing shale & sandstone,Grey shale	Domestic and Stock
377394	LIVINGSTON, LYAL #2734	SITE 24, RR8, CALGARY 1	North of 22X	SE	29	22	2	5	35.4	22.9	35.1		12.19	Grey shale,Blue grey shale,Grey water bearing shale & sandstone	Domestic and Stock
377399	TETRAULT, PHIL M./EAP SALERS	SITE 6, RR8, CALGARY 7	North of 22X	SE	29	22	2	5	61.0	0.0	0.0		18.29	Grey shale & sandstone ledges	Domestic
364653	PHIL'S INDUSTRIES OF CANADA	RR8 SITE 6 CALGARY 7 T2J 2T9	North of 22X	SE	29	22	2	5	70.1	51.8	70.1		3.66	Shale,Shale & Sandstone Ledges,Sandstone,Shale & Sandstone Ledges	Domestic
377407	E7P SALER RANCH	RED DEER LAKE	North of 22X	SE	29	22	2	5	73.2	42.7	73.2		24.38	Brown shale,Shale & Sandstone Ledges,Sandstone,Shale,Shale & Sandstone Ledges	Industrial
364654	TELRAULT, PHIL M	RR8 SITE 6 CALGARY 7 T2J 2T9	North of 22X	SE	29	22	2	5	73.8	25.0	37.2		18.29	Clay & Boulders	Domestic
377418	LECHNER, WALTER	72 BRAMPTON CR SW, CALGARY T2W 0X4	North of 22X	SW	29	22	2	5	27.4	12.2	25.9		12.19	Brown shale & sandstone ledges,Brown sandstone,Grey shale,Light grey water bearing sandstone	Domestic
377422	LECHNER, WALTER	72 BRAMPTON CR SW, CALGARY T2W 0X4	North of 22X	SW	29	22	2	5	30.5	9.1	29.0		6.71	Brown till,Grey shale & sandstone	Stock
377412	DOMKE, HANS	CALGARY	North of 22X	SW	29	22	2	5	39.6	35.1	39.6		14.94	Shale,Sandstone,Shale	Domestic
377413	MACLEOD TRAIL AUTO BODY/DOMKE	320-39 AVE SW, CALGARY	North of 22X	SW	29	22	2	5	70.1	0.0	0.0		32.00	Shale	Domestic
375016	ADAMS, S./C/O NELSON, B.	SITE 14 RR8, CALGARY 18 T2J 2T9	North of 22X	02	30	22	2	5	19.8	12.2	19.8		7.92	Claystone,Fine grained siltstone,Brown water bearing siltstone,Brown coarse grained sandstone,Brown fine grained siltstone	Domestic
365035	ADAMS, S.	SITE 14 RR 8, CALGARY 7 T2J 2T9	North of 22X	02	30	22	2	5	25.9	13.7	25.9		8.23	Weathered claystone,Grey fine grained sandstone,Claystone,Moist sandstone,Grey carbonaceous shale,Tan moist sandstone,Tan water bearing siltstone,Grey siltstone,Bentonitic shale stringers	Domestic
365036	NELSON, STEVE	SITE 14 RR8 CALGARY 18 T2J 2T9	North of 22X	02	30	22	2	5	26.2	7.9	26.2		9.14	Tan siltstone,Grey fine grained sandstone,Fine grained sandstone,Shale,Grey claystone,Water bearing sandstone,Siltstone,Water bearing sandstone,Grey claystone,Water bearing sandstone,Shale,Water bearing sandstone,Tan water bearing sandstone,Tan medium gr	Domestic
375015	NELSON, S.	SITE 18 RR9, CALGARY 18 T2J 2T9	North of 22X	02	30	22	2	5	56.4	44.2	56.4		32.61	Shale,Siltstone,Shale,Fine grained sandstone,Water bearing sandstone,Fine grained siltstone & sandstone	Domestic
377433	GLASSEN, O.		North of 22X	05	30	22	2	5	32.0	24.4	30.5		10.67	Shale,Sandstone	Domestic
405139	HORSEY, IRWIN	SITE 14 RR8, CALGARY 20 T2J 2L9	North of 22X	08	30	22	2	5	25.3	10.1	22.3		4.88	Moist sandstone,Shale,Grey water bearing sandstone,Siltstone,Water bearing sandstone,Shale	Domestic
358514	PARKSIDE MGMT #1634	SITE 14 RR8, CALGARY 21 T2J 2T9	North of 22X	10	30	22	2	5	24.4	12.2	24.4		10.36	Clay & Rocks,Grey shale,Grey water bearing sandstone,Grey shale	Domestic
358516	PARKSIDE MGMT #1642	SITE 14 RR8, CALGARY 21 T2J 2T9	North of 22X	10	30	22	2	5	24.4	13.7	24.4		8.53	Grey sandstone,Grey shale,Grey sandstone,Grey shale,Grey water bearing sandstone,Grey shale	Domestic
358515	PARKSIDE MGMT #1633	SITE 14 RR8, CALGARY 21 T2J 2T9	North of 22X	10	30	22	2	5	32.0	19.8	32.0		14.63	Grey sandstone,Grey shale,Water bearing sandstone,Shale	Domestic
359814	PARKSIDE MGMT #1630	SITE 14 RR8, CALGARY 21 T2J 2T9	North of 22X	10	30	22	2	5	73.2	54.9	73.2		14.63	Grey shale,Grey sandstone,Greenish grey shale,Yellow shale,Grey shale,Grey sandstone,Greenish grey shale,Yellow shale,Grey shale	Domestic
359023	BAILEY, VIC	SITE 14 RR8, CALGARY 23 T2J 2T9	North of 22X	NE	30	22	2	5	9.1	7.6	9.1		1.77	Clay & Rocks,Wet mud & gravel	Domestic
377454	CAMERON, WM	RR8, CALGARY	North of 22X	NE	30	22	2	5	35.1	0.0	0.0	1066.8	12.19	Sandrock	Domestic
352992	TRABER, DALE #1504	SITE 14 RR8, CALGARY 21	North of 22X	NE	30	22	2	5	48.8	36.6	48.8		13.72	Grey shale,Grey sandstone,Grey shale	Domestic
357254	BAYLY, VIC #1590	1475-550 5 AVE SW, CALGARY	North of 22X	NE	30	22	2	5	54.9	42.7	54.9		15.24	Clay & Rocks,Shale & Sandstone Ledges,Sandstone,Grey shale	Domestic
349985	PARKSIDE MANAGEMENT #1532	SITE 14 R.R.8, CALGARY 21	North of 22X	NE	30	22	2	5	54.9	42.7	54.9		20.42	Blue grey hard shale & siltstone,Grey sandstone,Brown fractured sandstone,Blue grey sandstone	Domestic
358915	BAILEY, VIC	SITE 14 RR8, CALGARY 23 T2J 2T9	North of 22X	NE	30	22	2	5	61.0	0.0	0.0			Grey shale	Domestic
356160	BAYLY, VIC	1475 550 5 AVE SW, CALGARY	North of 22X	NE	30	22	2	5	76.2	0.0	0.0		38.10	Grey sandstone	Domestic
377453	MACKENZIE, W.D.C.	RR8, CALGARY	North of 22X	NW	30	22	2	5	16.5	14.6	16.5		2.13	Blue clay,Grey shale,Sandstone	Domestic
349208	REHMAN MEL	620 146 AVE SW, CALGARY	North of 22X	NW	30	22	2	5	57.9	0.0	0.0	0.0	4.57	Black shale	Domestic
377434	DEMICELL, BARNEY	SITE 14, RR8, CALGARY 2	North of 22X	SE	30	22	2	5	35.7	29.9	35.4		29.26	Grey shale,Brown shale,Grey shale,Water bearing coal,Grey shale	Domestic
377439	CALALTA REALTY/ B. THOMAS	5343 LAKEVIEW DR, CALGARY	North of 22X	SE	30	22	2	5	36.6	30.5	36.6			Clay & Rocks,Shale & Sandstone	Domestic
384970	MCCAUGHAM, DELMER	SITE 14 RR8, CALGARY 28 T2J 2T9	North of 22X	SE	30	22	2	5	39.6	15.2	21.3		11.06	Sandstone	Domestic
377444	STELLA HOLDINGS LTD	5,4215-61 ST SE, CALGARY	North of 22X	SE	30	22	2	5	39.6	27.4	39.6		16.76	Brown hard shale,Blue grey hard shale & sandstone	Domestic
377436	EVANS, ED	100 LAKE LINNET CLOV, CALGARY	North of 22X	SE	30	22	2	5	41.2	35.1	41.2		6.10	Clay & Rocks,Shale & Sandstone	Domestic
377445	STELLA HOLDINGS LTD	5,4215-61 AVE SE, CALGARY	North of 22X	SE	30	22	2	5	44.2	30.5	44.2		16.76	Coal,Blue grey hard shale & sandstone ledges	Domestic
377440	ARTHURS, ROBIN	MIDNAPORE 32	North of 22X	SE	30	22	2	5	45.7	36.6	44.8		0.00	Brown sandstone & shale strg's,Light grey sandstone,Grey shale,Dark sandstone	Domestic
377446	STELLA HOLDINGS LTD	5,4215-61 AVE SE, CALGARY	North of 22X	SE	30	22	2	5	47.2	32.0	47.2		13.72	Brown shale & sandstone,Blue grey hard shale & sandstone	Domestic
377435	DEMICELL, BARNEY	PRIDDIS	North of 22X	SE	30	22	2	5	50.0	39.6	49.7		37.80	Old Well,Grey shale,Light water bearing sandstone	Domestic
377441	ARTHURS, ROBIN	MIDNAPORE 32 T0L 1J0	North of 22X	SE	30	22	2	5	57.9	39.6	56.4		39.62	Old Well,Grey shale,Light grey water bearing sandstone	Domestic
350731	ARTHURS, ROBIN	PRIDDIS 28 T0L 1W0	North of 22X	SE	30	22	2	5	61.0	19.8	59.4		19.81	Brown sandstone,Grey shale,Grey shale & sandstone,Light grey water bearing sandstone,Grey shale & sandstone,Grey sandstone	Domestic
351844	ARTHURS, ROBIN	PRIDDIS 28 T0L 1W0	North of 22X	SE	30	22	2	5	61.0	38.1	59.4		37.19	Light grey fractured sandstone,Grey shale & sandstone,Light grey water bearing sandstone,Grey shale,Light grey water bearing sandstone	Domestic
377448	HARRIS, BOB	SITE 14, RR8, CALGARY, T2J 2T9 18	North of 22X	SE	30	22	2	5	61.0	48.8	61.0		36.58	Green shale,Grey shale,Water bearing sandstone,Grey shale,Sandstone,Grey shale	Domestic and Stock
351140	PEARSON KEN C/O TRABER DALE	SITE 14 RR8, CALGARY 21	North of 22X	SW	30	22	2	5	21.3	16.2	19.2		9.14	Sand & Gravel,Grey sandstone	Domestic
377451	PARSONAGE, SHANE	GENERAL DELIVERY, PRIDDIS	North of 22X	SW	30	22	2	5	22.9	11.9	16.8		8.84	Water bearing gravel,Grey shale,Light grey sandstone	Domestic and Stock
352991	TRABER, DALE #1503	SITE 14 RR8, CALGARY 21	North of 22X	SW	30	22	2	5	25.9	13.7	25.9		10.67	Brown sandstone,Grey sandy shale,Grey water bearing sandstone,Grey shale	Domestic
349126	PARKSIDE MGMT #1537	SITE 14 RR8, CALGARY 21 T2J 2T9	North of 22X	SW	30	22	2	5	38.1	25.9	38.1		16.46	Grey clay,Blue grey shale & sandstone ledges,Greenish grey coarse grained sandstone,Blue grey hard shale & sandstone ledges	Domestic
378639	TRABER, DALE	814 RR8, CALGARY 21	North of 22X	SW	30	22	2	5	42.7	0.0	0.0	1172.0	33.53	Predrilled	Domestic
378638	BARKER, N.S.	1120 PROSPECT AVE NE, CALGARY	North of 22X	SW	30	22	2	5	42.7	0.0	0.0	1172.0	33.53	Blue grey shale	Domestic and Stock
377551	EDGAR, GEORGE	SITE 2, CALGARY 11		NE	31	22	2	5	61.0	30.5	61.0		13.72	Grey shale,Grey shale & sandstone,Brown shale,Grey shale,Blue shale & sandstone,Coal,Sandstone,Coal,Brown shale	Domestic
377554	SHAW, KINNAIRD	MIDNAPORE 28		NE	31	22	2	5	91.4	29.6	90.2		23.77	Brownish grey shale,Grey shale,Light water bearing sandstone,Grey shale,Grey shale & sandstone ledges,Grey shale,Dark sandstone,Grey shale,Blue shale,Grey shale,Dark sandstone,Grey water bearing shale & sandstone ledges	Domestic
377557	EDGAR, GEORGE	SITE 2, CALGARY 11		NE	31	22	2	5	36.6	7.0	34.6		18.29	Old Well,Green shale,Blue shale,Grey shale,Sand	Domestic
377561	SHAW, KINNAIRD	MIDNAPORE 28		NE	31	22	2	5	23.5	12.8	21.3		12.80	Brown clay & rocks,Shale,Sandstone,Shale,Sandy shale & sandstone ledges	Domestic and Stock
377564	SHAW, KINNAIRD	MIDNAPORE 28		NE	31	22	2	5	195.1	0.0	0.0		no w.l.	Sandstone	Domestic and Stock
349903	DIXON, TONI & HOWIE	SITE 2 RR8, CALGARY 5 T2J 2T9		NW	31	22	2	5	121.9	0.0	0.0		91.44	Grey shale	Domestic
358239	THOMPSON, MARGRET #1572	2507 CHATEAU PL NW, CALGARY T2M 4K8		NW	31	22	2	5	22.9	13.7	22.9		12.19	Clay & Rocks,Grey shale,Brown water bearing sandstone,Grey shale	Domestic and Stock
361693	THOMPSON, MARGRET #1572	2507 CHATEAU PL NW, CALGARY T2M 4K8		NW	31	22	2	5	54.9	42.7	54.9		15.54	Blue grey shale,Blue sandy shale,Blue sandstone,Blue grey shale,Blue sandy shale,Blue sandstone,Blue grey shale	Domestic
377456	LA GRANDE VUE RANCH	1204 BELAVISTA CR SW, CALGARY		NW	31	22	2	5	24.4	13.7	19.8		17.07	Clay & Rocks	Stock
377457	KERSHAW, WM. H.	1204 BELAVISTA CR SW, CALGARY		NW	31	22	2	5	27.4	7.9	10.7		3.05	Yellow clay & boulders,Yellow sandstone	Domestic
377458	GOODWIN, B.K.	RR8, CALGARY T2J 2T9		NW	31	22	2	5	44.8	36.6	42.7		21.95	Water bearing sandrock,Blue shale	Domestic
377459	EDGAR, GEORGE	PRIDDIS		NW	31	22	2	5	76.2	33.5	76.2		20.42	Black shale,Grey shale,Grey water bearing sandstone,Black shale,Grey shale	Domestic and Stock
349046	SMITH, KEN #1892	#5,6143 - 4TH ST SE, CALGARY T2H 2H9		SW	31	22	2	5	41.8	29.6	41.8		17.68	Grey sandstone,Grey hard shale,Grey water bearing sandstone,Grey shale,Grey sandstone	Domestic
351845	GILL, S	RR8 SITE 2, CALGARY 67 T2J 2T9		SW	31	22	2	5	70.1	48.8	68.6		27.74	Grey shale & sandstone,Light grey water bearing sandstone	Stock
466058	ANDERSEN, M.	SITE 8 RR1, PRIDDIS 7 T0L 1W0		SW	31	22	2	5	45.7	21.3	44.2		17.98	Grey shale,Brown sandstone,Blue shale,Light grey sandstone	Domestic
377575	KROMM, FRED	RR8, CALGARY		NE	32	22	2	5	55.2	0.0	0.0		41.15	Blue clay	Domestic
377575	KROMM, FRED	RR8, CALGARY		NE	32	22	2	5	55.2	0.0	0.0		41.15	Blue clay	Domestic
377577	KROMM, FRED	RR8, CALGARY		NE	32	22	2	5	24.4	0.0	0.0	1127.8	no w.l.	no borehole description	Domestic
357365	DAWSON, HAL #1591	SITE 6 RR8, CALGARY 6		SE	32	22	2	5	33.5	27.4	33.5		16.76	Grey shale & sandstone ledges,Grey water bearing sandstone,Grey shale	Domestic
377567	MACQUARRIE, J.	43 SIDNEY DR SW, CALGARY		SE	32	22	2	5	38.1	27.4	36.6		15.54	Blue clay	Domestic
359989	SILVER, BRIAN	STE 512 1040 7 AVE SW, CALGARY		SE	32	22	2	5	54.9	42.7	54.9		14.63	Grey shale,Brown sandstone,Grey water bearing sandstone,Grey shale,Grey sandstone,Green shale,Grey sandstone,Grey shale	Domestic
357365	DAWSON, HAL #1591	SITE 6 RR8, CALGARY 6		SE	32	22	2	5	33.5	27.4	33.5		16.76	Grey shale & sandstone ledges,Grey water bearing sandstone,Grey shale	Domestic
359989	SILVER, BRIAN	STE 512 1040 7 AVE SW, CALGARY		SE	32	22	2	5	54.9	42.7	54.9		14.63	Grey shale,Brown sandstone,Grey water bearing sandstone,Grey shale,Grey sandstone,Green shale,Grey sandstone,Grey shale	Domestic
377567	MACQUARRIE, J.	43 SIDNEY DR SW, CALGARY		SE	32	22	2	5	38.1	27.4	36.6		15.54	Blue clay	Domestic
377570	RODGERS, W.J.	RR8, CALGARY 5		SE	32	22	2	5	18.3	0.0	0.0	1130.8	no w.l.	no borehole description	Domestic
361225	DURANTE, KATHY HOLE #2	2107 7 ST NE CALGARY T2E 4C7		SW	32	22	2	5	59.4	42.7	45.4		18.29	Dark shale	Stock
354340	DURANTE, JOE	C/O 3 6125 12 ST, SE CALGARY T2H 2K1		SW	32	22	2	5	59.4	48.2	52.7		9.14	Blue shale	Domestic
377572	DURANTE, JOE	2107-7 ST NE, CALGARY T2E 4C7		SW	32	22	2	5	77.7	0.0	0.0			Shale	Stock
354340	DURANTE, JOE	C/O 3 6125 12 ST, SE CALGARY T2H 2K1		SW	32	22	2	5	59.4	48.2	52.7		9.14	Blue shale	Domestic
361225	DURANTE, KATHY HOLE #2	2107 7 ST NE CALGARY T2E 4C7		SW	32	22	2	5	59.4	42.7	45.4		18.29	Dark shale	Stock
377572	DURANTE, JOE	2107-7 ST NE, CALGARY T2E 4C7		SW	32	22	2	5	77.7	0.0	0.0		no w.l.	Shale	Stock
377593	GREGG, J.W.	520-46 AVE SW, CALGARY		NE	33	22	2	5	54.3	0.0	0.0		no w.l.	no borehole description	Domestic
377594	UNITED FEEDS LTD	14910-4 ST SW, MIDNAPORE		NE	33	22	2	5	21.3	17.7	21.0		13.72	Clay & Sandstone	Industrial
377595	GREGG, J.W.	915-48AVE SW, CALGARY		NE	33	22	2	5	53.3	36.6	51.8		33.53	Brown shale,Brown water bearing shale & sandstone ledges	Domestic
466057	GREGG, ALAN	SITE 4 RR8, CALGARY 32 T2J 2T9		NE	33	22	2	5	54.9	48.8	54.9		34.11	Blue shale & sandstone ledges,Grey sandstone	Domestic
377586	EAP SALERS RANCHES	6173-6 ST SE, CALGARY		NW	33	22	2	5	42.7	34.1	41.8		15.54	Grey silty shale,Grey firm shale,Grey hard sandstone	Domestic and Stock
377588	EAP SALERS RANCHES	6173-6 ST SE, CALGARY		NW	33	22	2	5	30.5	23.8	29.6		5.49	Grey firm shale	Domestic and Stock
377589	EAP SALERS RANCHES	6173-6 ST SE, CALGARY		NW	33	22	2	5	39.6	32.9	38.7		4.57	Grey sandy shale,Grey water bearing sandstone	Domestic and Stock
377591	EAP SALERS RANCHES	6173-6 ST SE, CALGARY		NW	33	22	2	5	45.7	38.7	44.8		1.22	Light grey hard sandstone,Light grey shale,Grey water bearing sandstone	Stock
377592	MADER	SITE 6, RR8, CALGARY 10		NW	33	22	2	5	18.3	0.0	0.0		no w.l.	no borehole description	Domestic
377580	RILEY, DOUG			SE	33	22	2	5	45.7	0.0	0.0		no w.l.	Shale & Sandstone	Domestic
377585	CALALTA REALTY/ BILL GOODWIN	7810 MACLEOD TR, CALGARY		SE	33	22	2	5	32.0	25.9	32.0		12.19	Clay & Rocks,Shale & Sandstone	Domestic
355961	HARVEY, JACK	RR8, CALGARY		NW	34	22	2	5	43.3	37.2	43.3		37.80	Clay & Gravel,Grey clay & shale,Water bearing sandstone,Blue clay & shale	Domestic and Stock
466059	RUNGE, DON	SITE 1 RR1, PRIDDIS 8 T0L 1W0		SE	34	22	2	5	59.4	51.8	57.9		16.76	Grey shale	Stock
377597	BRODYLO, R.	MIDNAPORE		NE	35	22	2	5	54.9	0.0	0.0	1176.5	no w.l.	no borehole description	Domestic
377598	HUDSON'S BAY OIL & GAS# SP153			NE	35	22	2	5	0.0	0.0	0.0		no w.l.	no borehole description	Industrial
377596	STEWART, W.W.	PRIDDIS		SE	35	22	2	5	30.5	0.0	0.0		no w.l.	no borehole description	Domestic
377606	ELIUK, GEORGE	MIDNAPORE 142		0	36	22	2	5	54.9	0.0	0.0		no w.l.	no borehole description	Domestic
377599	HALL, LINDA	RR8, CALGARY		SE	36	22	2	5	24.4	0.0	0.0		no w.l.	no borehole description	Domestic
377600	HILTON BROS	MIDNAPORE		SE	36	22	2	5	10.7	0.0	0.0		6.71	Yellow sandstone	Stock
377601	HILTON BROS	MIDNAPORE		SE	36	22	2	5	22.3	0.0	0.0		7.92	Grey clay & shale	Domestic
377602	SANDILANDS, WILLIAM	RR9, CALGARY T2J 5G5		SE	36	22	2	5	61.0	42.7	59.4		42.06	Brown clay & sandstone layers,Grey shale & sandstone ledges,Light grey water bearing sandstone	Stock
377603	SANDILANDS, BILL	RR9, CALGARY T2J 5G5		SE	36	22	2	5	30.5	9.1	15.2		7.62	Shale,Water bearing sandstone	Domestic and Stock
377604	CLARK, BOB	SITE 32, RR9, CALGARY 1 T2J 5G5		WH	36	22	2	5	0.0	0.0	0.0		no w.l.	no borehole description	Domestic
377605	CLARK, BOB	SITE 32, RR9, CALGARY 1 T2J 5G5		WH	36	22	2	5	0.0	0.0	0.0		no w.l.	no borehole description	Domestic
400740	SARCEE NATION ADMIN	3700 ANDERSON RD SW, CALGARY		SE	5	23	2	5	41.2	35.1	41.2		23.77	Wet sandstone,Blue grey shale,Wet sandstone,Grey shale	Domestic
400739	G&G PLUMBING	67 KLAMOTH PL SW, CALGARY		8	5	23	2	5	39.3	30.5	38.4		21.64	Grey till,Light sandstone,Grey sandstone & shale strg's	Domestic
469152	HARVEY, PAT	SITE 15 RR1, PRIDDIS 4 T0L 1W0		01	1	22	3	5	16.8	12.5	16.8		6.43	Fractured sandstone,Blue water bearing shale & sandstone ledges	Domestic
469150	HARVIE, PAT	SITE 15 RR1, PRIDDIS 4 T0L 1W0		01	1	22	3	5	18.6	15.5	18.6		9.24	Yellow clay,Grey water bearing shale,Brownish grey water bearing sandstone	Domestic
469149	HARVIE, PAT	SITE 15 RR1, PRIDDIS 4 T0L 1W0		02	1	22	3	5	23.5	20.7	23.5		6.71	Blue clay,Brown water bearing sand,Water bearing sand & gravel	Domestic
469151	HARVIE, PAT	SITE 15 RR1, PRIDDIS 4 T0L 1W0		02	1	22	3	5	26.5	24.4	26.5		11.61	Yellow clay,Grey water bearing clay,Brown water bearing sandstone	Domestic
377608	HARVIE, PAT	SITE 6, RR1, PRIDDIS 4		SE	1	22	3	5	22.9	12.2	19.8		9.14	Brown till,Brown water bearing sandstone	Domestic and Stock
350732	BEARY, BRIAN	SITE 2 RR1, CALGARY 20 T2J 2T9		SE	1	22	3	5	22.9	12.2	21.3		7.32	Brown shale,Brown fractured sandstone,Blue shale	Domestic
356161	LAILEY, BOB/JUNE	PRIDDIS 85 T0L 1W0		SE	1	22	3	5	24.4	12.2	22.9		11.58	Grey clay & rocks,Grey till,Grey sandstone	Domestic
377609	CRESTVIEW RANCHES	901-10 AVE SW, CALGARY		SW	1	22	3	5	16.5	12.2	16.5		4.27	Yellow clay,Blue clay,Coarse grained sand & gravel	Domestic
377611	HARVEY, PAT & ELAINE	GENERAL DELIVERY, PRIDDIS		SW	1	22	3	5	25.3	15.2	25.3		4.27	Clay,Sand,Water bearing sandstone,Grey shale,Water bearing sandstone	Domestic
377613	FRILEY, W.A SKYLAND RANCHES	3, 3315 RIDEAU PL SW, CALGARY# WELL 2 T2S 2T1		NE	2	22	3	5	61.0	30.5	36.6		28.96	Till & Rocks,Silty clay & gravel	Stock
377612	FRILEY, W.A. SKYLAND RANCHES	3, 3315 RIDEAU PL SW, CALGARY T2S 2T1		SE	2	22	3	5	30.5	24.4	30.5		11.58	Till & Rocks,Shale,Water bearing sandstone	Stock
377636	RASKO, GARY	27 CEDARVALE RD SW, CALGARY		NE	10	22	3	5	18.3	0.0	0.0		7.01	Grey shale	Domestic
377637	CARSCALLEN, JOHN	655 WOODPARK BLVD SW, CALGARY T2W 3L8		NE	10	22	3	5	67.7	0.0	0.0			Shale & Sandy Stringers	Domestic and Stock
377726	DAY, TOM	RR2, CALGARY		NE	11	22	3	5	20.4	12.2	19.5		3.05	Grey clay,Brown shale,Dark sandstone	Stock
377640	PRICE, J.E.	1919-25A ST SW, CALGARY T3E 1Y6		NW	11	22	3	5	45.7	15.2	44.2		14.33	Grey shale,Light grey sandstone,Grey shale,Grey shale & sandstone ledges,Light grey sandstone	Stock
377639	MEDALS LANDS FARMS LTD	5913-MACLEOD TR, CALGARY		NW	11	22	3	5	49.1	24.4	47.6		7.62	Brown shale,Grey water bearing shale,Dark shale,Grey shale,Dark water bearing shale,Brown shale,Dark shale,Sandstone,Dark shale	Domestic
378921	MILLICAN, HAROLD	7016 KENNEDY DR. SW, CALGARY		NE	12	22	3	5	44.5	29.0	43.9	1271.54	29.57	Grey shale,Sandstone,Grey shale,Brown shale,Grey shale,Sandstone,Grey shale,Water bearing sandstone	Domestic
350864	HARVIE, PAT	SITE 6 RR1, PRIDDIS 4 T0L 1W0		NW	12	22	3	5	22.9	7.6	21.3		7.62	Unknown,Grey shale,Light grey water bearing sandstone	Domestic and Stock
377739	HARVEY, PAT	SITE 6, PRIDDIS 4		NW	12	22	3	5	24.4	15.2	24.4		7.92	Water bearing sandstone,Grey shale	Domestic and Stock
349378	HARVEY, PAT	SITE 6 PRIDDIS, ALTA 4		NW	12	22	3	5	24.4	15.2	24.4		7.92	Water bearing sandstone,Grey shale	Domestic and Stock
377734	CRESTVIEW RANCH	901-10 AVE SW, CALGARY T2R 0B5		SW	12	22	3	5	32.0	25.9	32.0		9.14	Sandstone,Sand & Shale	Domestic and Stock
353621	HARVIE, PAT	RR1, PRIDDIS T0L 1W0		SW	12	22	3	5	39.6	24.4	38.1		11.28	Grey shale	Stock
365555	SINGLE, WARREN	127 PARKVIEW GREEN SE CALGARY T2J 4N4		14	13	22	3	5	42.7	36.6	42.7		27.43	Dark grey sandstone,Dark grey shale,Grey sandstone,Water bearing sandstone	Domestic
377789	STANFIELD, M.J.	8330-FAIRMOUNT DR SE, CALGARY		NE	13	22	3	5	28.0	24.4	27.4		13.41	Grey sandstone & shale strg's,Hard sandstone,Grey water bearing sandstone	Domestic

TABL..

ALBERTA ENVIRONMENT - SUMMARY OF REGIONAL WATER WELLS

RED WILLOW ESTATES

Well ID	Owner	Address	Current Owner	LSD	Sec	Twp	Rng	Mer	WellDepth	PerfFrom	PerfTo	Elev	StaticWL	Lithology at Screen	Proposed Use
377769	CORAL CONSTRUCTION	1520 MERIDIAN RD NE, CALGARY		NE	13	22	3	5	31.7	9.5	12.2		7.01	Blue clay,Gray sandstone	Domestic
350067	MURRAY, JOHN #3412	SITE 2 RR8, CALGARY 32 T2J 2T9		NE	13	22	3	5	38.1	25.9	36.6		20.60	Brown sandy shale,Gray shale,Gray sandstone,Dark gray shale,Gray shale,Gray sandstone,Gray shale,Gray sandstone	Domestic
377787	GRAY, BOB	980, 250-6 AVE SW, CALGARY T2P 3H7		NE	13	22	3	5	38.1	25.9	38.1		18.29	Gray shale,Gray water bearing sandstone,Black shale	Domestic and Stock
377785	RIETZE, HOWARD	3232-35 ST SW, CALGARY		NE	13	22	3	5	39.6	12.2	18.3		7.62	Till,Brown sandstone	Domestic
377775	WATSON, DON	1135-120 AVE SE, CALGARY		NE	13	22	3	5	40.8	18.3	25.9		14.33	Gray sandstone,Gray clay	Domestic
467110	JEFFERS, HAROLD	SITE 2 RR8 CALGARY 36 T2J 2T9		NE	13	22	3	5	41.2	16.8	19.8		3.05	Gray shale,Gray water bearing sandstone,Gray shale,Gray water bearing sandstone	Domestic
349994	LYONS, LAUCHLIN #3216	BOX 30332, CHINOOK RPO, CALGARY 0000 T2H 2W1		NE	13	22	3	5	42.7	30.5	42.7		21.49	Gray shale,Gray fractured sandstone,Gray water bearing sandstone,Gray shale,Gray sandstone,Gray sandy shale	Domestic
377772	STANFIELD	8350 FAIRMOUNT DR SE, CALGARY		NE	13	22	3	5	45.7	0.0	0.0			Shale	Unknown
377788	GOODWIN, RON	SITE 2, RR8, CALGARY 18		NE	13	22	3	5	45.7	21.3	44.5		19.81	Gray shale,Light gray water bearing sandstone,Gray shale,Light gray water bearing sandstone,Gray shale,Light gray sandstone	Unknown
377777	DON-LEB XRAY MANAGEMENT	RR8, CALGARY 32		NE	13	22	3	5	54.6	0.0	0.0			Gray shale	Unknown
377767	WATSON, DON	1135-120 AVE SE, CALGARY		NE	13	22	3	5	61.0	0.0	0.0			Gray clay & shale	Unknown
377784	RIETZE, HOWARD	SITE 2, RR8, CALGARY 39		NE	13	22	3	5	63.7	27.4	62.5		12.80	Brown shale,Gray shale,Gray sandstone,Gray shale,Light sandstone,Light gray shale,Dark gray shale,Dark water bearing sandstone,Dark gray shale,Dark water bearing sandstone,Dark gray shale,Water bearing coal	Domestic and Stock
377782	WATSON, DON	SITE 2, RR8, CALGARY 32		NE	13	22	3	5	70.7	12.2	68.6		11.58	Brown sandstone,Gray shale,Light gray water bearing sandstone,Gray shale,Gray shale & sandstone ledges	Domestic
377783	STANDISH, JOHN	PRIDDIS		NW	13	22	3	5	36.6	0.0	0.0		16.76	Blue shale	Domestic
377756	PHOTO ZENITH TUBE OBSERVATORY	PRIDDIS		NW	13	22	3	5	37.5	0.0	0.0		18.29	Blue firm shale	Domestic
377762	MCLAREN, ED	GEN DEL, MILLARVILLE T0L 1K0		NW	13	22	3	5	42.7	24.4	41.2		21.34	Gray shale,Gray shale & sandstone ledges,Light gray water bearing sandstone,Gray shale,Light gray water bearing sandstone	Domestic and Stock
351874	MACLARIN, ED	PRIDDIS 32		NW	13	22	3	5	54.6	36.6	54.6		20.48	Fractured sandstone,Clayey sandstone,Shale	Domestic
349635	WADDOCK, TERRY	14816 PARKLAND BLVD, CALGARY, ALTA		SE	13	22	3	5	35.1	19.8	35.1		18.29	Fractured limestone,Gray shale,Water bearing sandstone,Gray shale	Domestic
377749	WADDOCK, TERRY	14816 PARKLAND BLVD, CALGARY		SE	13	22	3	5	35.1	19.8	35.1		18.29	Fractured limestone,Gray shale,Water bearing sandstone,Gray shale	Domestic
365488	WADDOCK, TERRY	PRIDDIS 42 T0L 1W0		SE	13	22	3	5	37.2	25.9	32.6		24.99	Shale & Sandstone Ledges,Sandstone,Shale,Shale & Sandstone Ledges,Sandstone,Shale	Domestic
467797	WADDOCK, TERRY	PRIDDIS 42 T0L 1W0		SE	13	22	3	5	42.7	30.5	39.6		24.69	Cemented sandstone,Sandstone	Domestic
467796	WADDOCK, TERRY	PRIDDIS 42 T0L 1W0		SE	13	22	3	5	54.9	33.5	51.8		17.65	Shale	Domestic
467799	WADDOCK, TERRY	PRIDDIS 41 T0L 1W0		SE	13	22	3	5	54.9	36.6	51.8		33.16	Clay & Rocks,Shale,Sandstone	Domestic
467798	WADDOCK, TERRY	PRIDDIS 42 T0L 1W0		SE	13	22	3	5	73.2	51.8	70.1		38.10	Clay,Shale & Sandstone Ledges	Domestic
363481	WADDOCK, TERRY	PRIDDIS 42 T0L 1W0		SE	13	22	3	5	74.7	41.2	47.2		64.47	Shale & Sandstone Ledges,Sandstone	Domestic
490027	WADDOCK, TERRY	PRIDDIS 42 T0L 1W0		SE	13	22	3	5	98.2	38.1	54.9			Sandstone,Shale & Sandstone Ledges,Shale & Sandstone	Domestic
355276	WATSON, DON HOLE #2	MILLARVILLE		NE	14	22	3	5	36.6	14.3	24.4		14.02	Clay,Sandstone	Domestic
355275	WATSON, DON HOLE #1	MILLARVILLE		NE	14	22	3	5	37.5	13.7	24.4		15.54	Sandstone,Water bearing sandstone,Soft shale	Domestic
377794	FESSOR, M.	STN F, GEN DEL, CALGARY T2J 2V1		SE	14	22	3	5	39.6	12.2	39.6		6.10	Brown soft shale,Blue shale & sandstone	Domestic
378945	FRANCIS, J.R.	4719 CORONATION DR, CALGARY		NE	15	22	3	5	25.2	0.0	0.0	1181.1	9.75	Gray shale	Domestic
377809	FRANCIS, J.R.	35, 1812-4 ST SW, CALGARY		NE	15	22	3	5	24.4	19.5	22.9		9.14	Water bearing gravel	Stock
377810	M/J RANCH C/O BOB FRANCIS	GEN DEL, PRIDDIS		NE	15	22	3	5	25.9	14.9	24.4		10.67	Gravel,Light gray sandstone	Stock
377808	GRIFFITH, JIM	PRIDDIS		NW	15	22	3	5	12.2	4.9	9.1		5.18	Clay,Silty clay & gravel,Sandstone,Dark brown shale	Domestic
377807	CARPENTER, W.B.	CALGARY		NW	15	22	3	5	45.7	0.0	0.0			Gray soft shale	Domestic
377797	GRAHAM, D.J.	PRIDDIS		SE	15	22	3	5	11.0	0.0	0.0		5.79	Blue shale	Domestic
377800	BATENBURG, ADOLF	GEN DEL, PRIDDIS		SE	15	22	3	5	18.3	14.6	16.8		6.71	Gravel	Domestic
377799	POWELL, D.	GEN DEL, PRIDDIS		SE	15	22	3	5	18.3	15.5	18.3		13.11	Till,Sand & Gravel	Domestic
378943	SCOTT, JIM	GEN DEL, PRIDDIS		SE	15	22	3	5	21.3	18.3	19.8	1188.72	10.36	Water bearing gravel	Domestic
352479	STEWART, ROD	GEN DEL, PRIDDIS T0L 1W0		SE	15	22	3	5	23.2	0.0	0.0		19.81	Silty gravel,Gravel	Domestic
378930	MCLEAN, STU	RR5, ANDERSON RD SW, CALGARY		SE	15	22	3	5	24.4	16.2	20.4	1188.72	13.72	Brown water bearing till,Water bearing gravel,Brown till	Domestic
401570	WATSON, JOHN	PRIDDIS 60 T0L 1W0		SE	15	22	3	5	24.4	21.3	22.9		3.05	Gray till,Water bearing shale & gravel,Gray till,Water bearing shale & gravel	Domestic
377795	MCLEAN, STU	RR5, ANDERSON RD SW		SE	15	22	3	5	25.9	15.2	22.9		15.24	Brown sandy clay,Gray till,Gravel	Domestic
363255	MCLEAN, STUART WELL #2	RR5 ANDERSON ROAD SW CALGARY		SE	15	22	3	5	26.5	19.2	24.4	1188.72	16.15	Gray till,Water bearing gravel	Domestic
377802	SCOTT, JIM	GEN DEL, PRIDDIS		SE	15	22	3	5	27.4	16.2	27.4		14.33	Gray till,Water bearing gravel,Light gray sandstone,Gray shattered shale	Domestic
401569	WATSON, JOHN	PRIDDIS 60 T0L 1W0		SE	15	22	3	5	36.6	0.0	0.0			Gray shale	Domestic
377805	PAWLIW, RANDY # HOLE 3	PRIDDIS		SW	15	22	3	5	22.9	0.0	0.0			Black shale	Unknown
377804	PAWLIW, RANDY # HOLE 2	PRIDDIS		SW	15	22	3	5	45.7	0.0	0.0			Black shale	Unknown
377803	PAWLIW, RANDY # HOLE 1	PRIDDIS		SW	15	22	3	5	76.2	0.0	0.0			Black shale	Domestic
377891	MCNIVEN, GINGER	PRIDDIS		00	22	22	3	5	48.8	24.4	30.5		6.10	Clay & Gravel	Domestic
377855	LINDSAY, BOB	GEN DEL PRIDDIS		01	22	22	3	5	30.5	24.4	29.0	1161.29	13.72	Gray sandy shale,Gray shale	Domestic
467111	SPRUCE VALLEY RANCHES	PRIDDIS 9 T0L 1N0		01	22	22	3	5	66.1	60.1	66.1		11.80	Gray shale,Light gray sandstone,Gray shale,Gray sandstone,Gray shale	Domestic
377869	WARWICK, R.	PRIDDIS		05	22	22	3	5	18.3	0.0	0.0	1182.62	1.52	Dark shale	Domestic
377867	MARSHALL, ROSS	GEN DEL PRIDDIS		07	22	22	3	5	42.7	6.7	41.2	1021.08	1.52	Blue shale,Dark gray sandstone,Gray shale,Light gray sandstone,Gray shale,Coal,Gray shale,Light gray sandstone,Gray shale & sandstone	Unknown
469154	MUZYCKA, MIKE	110 SIERRA VISTA CLSE SW, CALGARY T3H 3B8		12	22	22	3	5	26.5	14.3	20.4		2.93	Brown consolidated sandstone,Gray shale,Gray shale & sandstone	Domestic
469153	MUZYCHKA, MIKE	110 SIERRA VISTA CLSE, CALGARY T3H 3B8		12	22	22	3	5	30.5	6.1	7.3		2.35	Sand & Gravel	Domestic
350535	SPRUCE VALLEY RANCH #2	PRIDDIS 9 T0L 1W0		15	22	22	3	5	30.5	25.0	26.5		8.53	Clay & Sand	Domestic
350534	SPRUCE VALLEY RANCH #1	PRIDDIS 9 T0L 1W0		15	22	22	3	5	30.5	26.5	28.0		7.01	Clay & Sand	Domestic
405049	WILLIAMS, TERRY/SPRUCE VALLEY	PRIDDIS 9 T0L 1W0		15	22	22	3	5	91.4	64.0	91.4		13.23	Light gray fine grained sandstone,Gray shale,Gray fine grained sandstone,Soft shale,Fine grained sandstone,Gray shale,Gray hard sandstone,Gray shale,Gray hard sandstone,Gray soft shale,Gray hard sandstone,Gray soft shale,Blue gray sandstone,Dark grey sha	Domestic
377879	PARK, G.	PRIDDIS		NE	22	22	3	5	14.3	0.0	0.0		2.53	Shale	Domestic
349081	ARDO MARV #1227	PRIDDIS 10		NE	22	22	3	5	16.8	7.6	16.8	0	3.05	Gray shale,Gray sandstone,Gray shale	Stock
349061	TOOTHILL BOB #1875	PRIDDIS 76 T0L 1W0		NE	22	22	3	5	16.8	14.9	16.8		2.44	Gray shale,Gray sandstone,Gray shale	Domestic
377878	CRESTVIEW SECURITIES	901-10 AVE SW, CALGARY		NE	22	22	3	5	23.2	4.6	22.0	1164.34	0.00	Gray shale,Brown shale,Gray shale,Light sandstone	Domestic
377881	COPITHORNE, RALPH	PRIDDIS		NE	22	22	3	5	26.8	9.1	25.9	1168.91	4.88	Gray hard shale,Gray shale,Dark sandstone,Gray shale,Dark sandstone	Domestic
377884	PRIDDIS COMMUNITY ASSOC.	GEN DEL, C/O SUE DUNNE, PRIDDIS		NE	22	22	3	5	27.4	7.0	25.9		3.05	Gray till,Gray shale,Light gray water bearing sandstone,Gray shale & sandstone	Domestic
377888	PRIDDIS COMMUNITY ASSOC	PRIDDIS		NE	22	22	3	5	45.7	5.2	44.2		3.05	Gravel,Gray shale & sandstone	Domestic
354343	ARDO, MARVIN #1216	PRIDDIS 10 T0L 1W0		NE	22	22	3	5	65.5	29.0	35.1		9.14	Blue shale & sandstone ledges,Sandstone	Domestic
377886	CARPENTER, W.B.	10507 BRADBURY DR. SW, CALGARY		NE	22	22	3	5	68.6	24.7	67.1		11.89	Water bearing gravel,Light gray sandstone,Gray shale & sandstone,Gray shale & coal	Domestic
350078	HAYLEY, DARREL #3458	169 DOUGLAS GLEN HEATH, CALGARY T2Z 2N1		NE	22	22	3	5	73.2	21.3	73.2		11.98	Clay & Rocks,Gray fractured shale,Sandstone,Green shale,Sandstone,Green shale,Sandstone,Gray shale,Sandstone,Gray shale,Sandstone,Green shale,Sandstone,Green shale,Sandstone,Green shale,Sandstone,Green shale,Sandstone,Green shale,Sandstone,Gray shale	Domestic
350044	CARPENTER, BILL #3311	123 LAKE PLACID PL. SE, CALGARY T2J 5R6		NW	22	22	3	5	22.9	0.0	0.0		15.70	Gray clay,Silty gravel	Domestic
377871	CARPENTER, W.B.	10507 BRADBURY DR. SW, CALGARY		NW	22	22	3	5	27.4	0.0	0.0			Blue clay	Domestic
377870	CARPENTER, W.B.			NW	22	22	3	5	32.0	0.0	0.0	1175	12.19	Blue clay	Domestic
377875	DEPT. OF ENV C/O DR. CARPENTER	EDMONTON		NW	22	22	3	5	36.6	19.2	34.4	1175	11.89	Sandy clay,Gray clay & boulders,Water bearing gravel,Shale & Sandstone Ledges,Pea gravel	Unknown
377872	COWAN, J.P.	2704-MARQUETTE ST., CALGARY		NW	22	22	3	5	57.9	0.0	0.0			Dark shale	Unknown
377873	COWAN, J.L.	2704-MARQUETTE ST., CALGARY		NW	22	22	3	5	67.1	0.0	0.0			Dark shale	
377850	JOHNSTON, GEORGE	PRIDDIS		SE	22	22	3	5	15.2	12.2	13.7		3.05	Sandy shale,Gray shale,Water bearing formation	Stock
351556	GIVEN, ED #1367	1803 2127 90 AVE SW, CALGARY		SE	22	22	3	5	16.8	7.6	16.8		3.05	Gray shale,Gray sandstone,Black shale	Domestic
377863	ALLIED BLDG SERVICES LTD	STATION F, CALGARY #428 T2J 2V5		SE	22	22	3	5	18.3	12.2	18.3		3.05	Old Well,Sandstone	Domestic
377866	GIVEN, W. ED	803-2127 90 AVE SW, CALGARY T2V 0X6		SE	22	22	3	5	22.9	6.1	22.9		3.66	Sand & Gravel,Gray shale,Sandstone,Gray shale,Sandstone,Gray shale	Domestic and Stock
361013	ZANG, RON	613 34 AVE SW CALGARY T2S 0T3		SE	22	22	3	5	30.5	4.6	6.1		4.57	Gravel	Domestic
377848	LAWSON, K. (KENJO ENTERPRISES)	OKOTOKS 353		SE	22	22	3	5	32.0	21.3	32.0	1170.43	7.62	Sandstone,Shale & Sandstone	Domestic
377865	SHARON WILLIAMS	GEN DEL PRIDDIS		SE	22	22	3	5	39.6	6.4	38.1		3.35	Gray till	Domestic
377852	MCNAUGHTON, BILL	PRIDDIS		SE	22	22	3	5	46.6	0.0	0.0	1188.72	0.00	Blue shale	Domestic
355932	WOODMAN, RICHARD #1543	344 WOODBINE BLVB, CALGARY		SE	22	22	3	5	47.2	35.1	47.2		7.92	Blue shale,Gray shale & sandstone,Gray water bearing sandstone,Gray shale	Domestic
400990	HUDY, SIMON	SITE 15 RR1, PRIDDIS 9 T0L 1W0		SE	23	22	3	5	54.9	33.5	53.3		1.52	Blue shale	Domestic and Stock
377917	FORAN, MACK	PRIDDIS		13	23	22	3	5	27.4	22.9	26.8	1188.72	15.24	Brown sandstone,Gray sandstone	Domestic
377912	FORAN, MACK	132 HALLBROOK D.R. SW, CALGARY		NW	23	22	3	5	45.7	33.5	45.7	1173.48	21.34	Blue clay,Shale & Sandstone	Domestic
377907	SWANSEN, H.A.	PRIDDIS		SE	23	22	3	5	15.5	13.4	15.5	1234.44	6.10	Clay & Sandstone,Blue clay,Water bearing sandstone	Domestic
364826	MONTEITH, BILL	STN F CALGARY 8106 T2J 5S7		SE	23	22	3	5	56.4	44.2	54.9		21.64	Dark gray shale,Dark gray shale & sandstone ledges	Domestic and Stock
377920	STANDISH, GRANT	RR8, CALGARY		SW	24	22	3	5	16.8	9.5	16.8	1211.58	3.96	Brown clay,Gray shale,Blue shale,Light sandstone,Blue shale,Dark sandstone,Gray shale	Domestic
349559	RADKE,ART	SITE2 RR8,CALGARY ALTA 51		NE	25	22	3	5	22.9	16.8	22.9		4.57	Clay & Gravel,Hard sandstone,Sandstone,Hard sandstone	Domestic
361723	HUGILL, JACK #1270	SITE 2 RR8, CALGARY 12		NE	25	22	3	5	33.5	15.2	33.5	1150.62	12.19	Old Well	Domestic
377941	BRIDGEWATER	205 STOCKYARD BLDG, CALGARY		NE	25	22	3	5	33.5	27.4	33.5	1158.24	5.49	Clay & Rocks,Shale & Sandstone	Unknown
378012	MACINNES, DON	SITE 2, RR8, CALGARY 33		NE	25	22	3	5	36.6	24.4	36.6		18.29	Gray shale,Unknown,Water bearing sandstone,Sandstone	Domestic and Stock
349477	MAC INNES,DON	SITE2 RR8,CALGARY, ALTA 33		NE	25	22	3	5	36.6	24.4	36.6		18.29	Gray shale,Sandstone	Stock
378001	CONINX, GEO			NE	25	22	3	5	36.6	30.5	36.6		4.57	Clay,Shale & Sandstone	Domestic
378004	CONINX, GEO			NE	25	22	3	5	39.6	0.0	0.0		6.10	Shale & Sandstone	Unknown
378005	CONONX, GEO			NE	25	22	3	5	41.2	0.0	0.0			Shale & Sandstone	Unknown
378007	CONINX, GEO			NE	25	22	3	5	41.2	0.0	0.0			Shale & Sandstone	Unknown
377949	BOOTH, ROBERT	RR8, CALGARY 21		NE	25	22	3	5	41.2	29.0	41.2		6.10	Clay & Rocks,Shale & Sandstone	Domestic
377953	BROOKWELL, AL			NE	25	22	3	5	41.2	30.5	41.2		5.49	Sandy clay & rocks,Sandy shale & sandstone	Domestic
377945	BROOKWELL, JERRY			NE	25	22	3	5	42.7	30.5	42.7		6.10	Sandy clay & rocks,Sandy shale & sandstone	Domestic
364287	HOWARTH, FLORENCE	SITE 2 RR8 CALGARY 25 T2J 2T9		NE	25	22	3	5	45.7	16.2	18.0		10.06	Gray till,Gravel	Domestic
378950	DEANS, RUTH A.	68 HALLBROOK PL. SW, CALGARY		NE	25	22	3	5	45.7	39.6	45.7		0.00	Clay & Rocks,Shale & Sandstone	Domestic
361719	RADKE, ART	SITE 2 RR8, CALGARY 51		NE	25	22	3	5	47.2	41.2	47.2	1150.62	4.57	Blue shale,Gray shale,Gray coarse grained shale & sandstone	Domestic
349558	RADKE,ART	SITE 2 RR8,CALGARY, ALTA 51		NE	25	22	3	5	47.2	41.2	47.2		0.00	Blue shale,Gray shale,Gray shale & sandstone	Domestic
349458	LEIBE,WALTER	SITE 2 RR 8,CALGARY, ALTA 59 T2J 2T9		NE	25	22	3	5	51.8	27.4	51.8		10.06	Sandstone,Gray shale,Sandstone,Gray shale,Water bearing sandstone,Gray shale	Domestic and Stock
378008	LEIBE, WALTER	SITE 2, RR8, CALGARY 59 T2J 2T9		NE	25	22	3	5	51.8	27.4	51.8		10.06	Sandstone,Gray shale,Water bearing sandstone,Gray shale,Water bearing sandstone,Gray shale	Domestic and Stock
374870	HOWARTH, BERT	SITE 2 RR8, CALGARY 25 T2J 2T9		NE	25	22	3	5	51.8	40.5	50.3		14.94	Gray shale,Light gray water bearing sandstone	Domestic
378006	CONONX, GEO			NE	25	22	3	5	53.3	0.0	0.0			Shale & Sandstone	Unknown
382989	HOWARTH, FLORENCE	SITE 2 RR8, CALGARY 25 T2J 2T9		NE	25	22	3	5	61.0	45.7	59.4		12.50	Gray shale & sandstone ledges,Light gray water bearing sandstone	Domestic
377951	BOOTH, ROBERT	RR8, CALGARY 21		NE	25	22	3	5	61.0	54.9	61.0		7.32	Clay & Rocks,Shale & Sandstone	Domestic
378002	HOWARTH, A.S.	2021-27 AVE SW, CALGARY		NE	25	22	3	5	62.5	56.4	62.5	1152.14	9.14	Clay & Rocks,Shaly sandstone & coal	Domestic
378003	KUBOTA, ED	STATION F, CALGARY 8384 T2J 2V5		NE	25	22	3	5	70.1	48.8	68.9	1164.34	9.45	Gray shale,Gray shale & sandstone,Gray shale,Light sandstone	Unknown
378009	MCCLEVIN, GEORGE/ WHITE, M.	SITE 2, RR8, CALGARY 10 T2J 2T9		NE	25	22	3	5	79.3	0.0	0.0		0.00	Gray shale	Domestic
377929	KUNDERT SERVICE	RR8, CALGARY 20		SE	25	22	3	5	36.6	0.0	0.0	1173.48	6.10	Shale & Sandstone	Domestic
418121	MONTEITH, BILL	SITE 2 RR1, CALGARY 42 T2J 2T9		SE	25	22	3	5	36.6	21.3	35.1		5.79	Light gray sandstone,Gray shale,Light gray water bearing sandstone	Domestic
387008	MONTEITH, BILL	RR1, CALGARY 42 T2J 2T9		SE	25	22	3	5	54.9	19.8	53.3		7.92	Gray sandy till,Gray sandy till	Domestic
377937	RENNER, RUTH	RR1, PRIDDIS T0L 1W0		WH	25	22	3	5	45.7	21.3	44.2		5.49	Brown shale,Gray shale	Stock
389927	CASS INVESTMENTS	9615 52 ST SE, CALGARY		11	26	22	3	5	29.0	22.9	25.9		1.62	Dark gray siltstone	Domestic
378033	SUN OIL CO			13	26	22	3	5	18.3	0.0	0.0			Shale & Sandstone	Industrial
378034	SUN OIL CO			13	26	22	3	5	24.4	0.0	0.0	1164.34		Shale & Sandstone	Industrial
394676	STEWART, MARIE	LACOMBE 364 T0C 1S0		16	26	22	3	5	36.6	27.4	36.6		1.89	Dark gray shale,Gray shale,Dark gray sandstone	Domestic
378037	ARMITAGE, RICHARD	RR1, PRIDDIS T0L 1W0		NE	26	22	3	5	41.2	27.4	39.6	1158.24	11.58	Light gray sandstone,Gray shale,Dark gray water bearing sandstone,Gray shale,Dark gray water bearing sandstone	Stock
378036	ARMITAGE, R.E.	1102 FRONTENAC AVE, CALGARY		NE	26	22	3	5	56.4	24.4	54.9	1165.86	14.63	Gray shale,Blue shale,Dark sandstone,Gray shale,Coal,Blue shale,Gray shale	Unknown
349206	PULLIN CHRIS & EDEE #1006	822 5 AVE SW, CALGARY		NW	26	22	3	5	22.9	10.7	22.9	0	5.49	Sand & Gravel,Sandstone,Gray water bearing shale,Sandstone	Domestic
367062	WERRY, BRIAN	245 AVONBURN RD SE CALGARY T2H 1N9		NW	26	22	3	5	24.4	6.1	24.4		3.05	Gravel,Clay & Boulders,Shale,Sandstone,Green shale,Sandstone	Domestic
367063	WERRY, BRIAN	245 AVONBURN RD SE T2H 1N9		NW	26	22	3	5	24.4	12.2	24.4		3.05	Black shale,Sandstone,Shale,Sandstone	Domestic
366135	KERUNSKY, GLEN	17 4041 74 AVE SE CALGARY		NW	26	22	3	5	24.4	12.2	24.4		0.00	Blue shale,Blue shale & sandstone ledges	Domestic
364194	KERUNSKY, GLEN	PARCEL A 17 4041-74 AVE, SE CALGARY		NW	26	22	3	5	24.4	12.2	24.4		2.74	Brown sandstone,Blue shale,Brown sandstone,Blue shale,Brown sandstone,Blue shale,Brown sandstone	Domestic
352129	MALOWNEY, BRENT WELL #3	STE 100 801 6 AVE SW T2P 3W2		NW	26	22	3	5	24.4	12.2	24.4		3.05	Sandstone,Blue shale & sandstone	Domestic
352127	MALOWNEY, BRENT HOLE #1	STE 100 801 6 AVE SW T2P 3W2		NW	26	22	3	5	24.4	12.2	24.4		1.83	Sandstone,Shale & Sandstone	Domestic
367061	WERRY, BRIAN	245 AVONBURN RD SE CALGARY		NW	26	22	3	5	27.4	15.2	27.4		12.19	Blue shale,Sandstone,Blue shale,Sandstone,Blue shale,Sandstone	Domestic
378026	PRIDALTA CHAROLAIS FARM	PRIDDIS		NW	26	22	3	5	27.7	0.0	0.0	1164.34	10.67	Blue sandstone	Domestic
467112	WERRY, BRIAN	LAKE PLACID DR SE, CALGARY T2J 5H1		NW	26	22	3	5	29.0	13.7	25.9		1.71	Shale,Sandstone,Shale & Sandstone,Sandstone	Domestic
352128	MALOWNEY, BRENT HOLE #2	STE 100 801 6 AVE SW T2P 3W2		NW	26	22	3	5	30.5	12.2	30.5		4.57	Blue shale,Blue shale & sandstone	Domestic
378030	BROWN, FRANK #2	RR1, PRIDDIS		NW	26	22	3	5	38.1	32.3	37.2	1158.24	23.16	Gray shale,Light gray water bearing sandstone	Domestic
366136	KERUNSKY, GLEN	17 4041 74 AVE SE CALGARY		NW	26	22	3	5	39.6	27.4	39.6		1.52	Blue shale,Blue sandstone	Domestic
366134	KERNUSKY, GLEN (CASS INVESTMT)	17 4041 74 AVE SE CALGARY		NW	26	22	3	5	42.7	30.5	42.7		0.91	Blue shale,Blue sandstone,Blue shale,Blue shale & sandstone ledges	Domestic
378024	STRANO, MARK #1	7613-35 AVE NW, CALGARY		NW	26	22	3	5	73.2	0.0	0.0	1158.24		Shale & Sandstone	Domestic
378025	STRANO, MARK	7613-35 AVE NW, CALGARY		NW	26	22	3	5	79.3	0.0	0.0	1158.24		Shale & Sandstone	Unknown
378015	DEPT. OF ENV. C/O W. RENNER	10040-104 ST, EDMONTON		SE	26	22	3	5	24.4	6.1	24.4		3.05	Clay & Boulders,Hard clay & sand,Shale,Sandstone	Domestic and Stock
378017	MERRETTE, BOB	GEN DEL, PRIDDIS		SE	26	22	3	5	27.7	21.6	26.5	1181.1	11.58	Gravel	Domestic
359990	BROWN, KEN	1136 LAKEWAPTA WAY SE, CALGARY T2J 2N7		SW	26	22	3	5	10.7	0.0	0.0		1.83	Gray till	Domestic
378022	BALFOUR, DAVE	4411-14A ST. SW, CALGARY		SW	26	22	3	5	11.3	0.0	0.0	1188.72	3.35	Sandy shale	Domestic and Stock
378954	DADDS, JOHN	PRIDDIS		SW	26	22	3	5	16.2	14.6	15.9			Brown silty shale,Silty sand,Brown coarse grained sand	Stock
378021	BALFOUR, DAVE	4411-14A ST. SW, CALGARY		SW	26	22	3	5	35.1	0.0	0.0	1188.72	25.91	Gray shale	Unknown
378023	BROWN, FRANK #1	RR1, PRIDDIS		WH	26	22	3	5	35.1	15.9	34.1	1213.1	14.63	Gray till,Dark gray sandstone,Gray shale,Light gray water bearing sandstone,Gray shale,Dark gray shale	Domestic
378056	SUN OIL CO			00	27	22	3	5	18.3	0.0	0.0	1196.34		Shale & Sandstone	Industrial
378138	SUN OIL CO			00	27	22	3	5	24.4	0.0	0.0	1196.34		Shale & Sandstone	Industrial
378054	SUN OIL CO			00	27	22	3	5	27.4	0.0	0.0	1196.34		Shale & Sandstone	Industrial
378050	GOETT, KEITH	RR1, PRIDDIS T0L 1W0		NW	27	22	3	5	34.1	21.3	33.5		12.50	Brown sandy shale,Wet sandstone,Shale & Coal,Brown sandy shale,Wet sandstone,Shale & Coal	Domestic and Stock
378047	GOETH, DONNA	RR1, PRIDDIS		NW	27	22	3	5	42.7	32.3	41.2	1219.2	29.57	Light gray sandstone,Gray shale,Dark gray water bearing sandstone	Domestic
361261	GOETT, DONA/KIETH	RR1 PRIDDIS T0L 1W0		NW	27	22	3	5	47.2	41.5	46.9		35.66	Coal,Brownish gray sandy shale,Wet shale & sandstone,Coal,Brownish gray sandy shale,Wet shale & sandstone	Domestic and Stock
349125	MULLEN, ROLAND	RR1, PRIDDIS		NW	27	22	3	5	50.3	0.0	0.0			Gray shale	Unknown

TABLE
ALBERTA ENVIRONMENT - SUMMARY OF REGIONAL WATER WELLS
RED WILLOW ESTATES

WellID	Owner	Address	Current Owner	LSD	Sec	Twp	Rge	Mer	WellDepth	PerfFrom	PerfTo	Elev	StaticWL	Lithology at Screen	Proposed Use
361733	GOETT, DONA	RR1 PRIDDIS T0L 1W0		NW	27	22	3	5	39.6	41.5	47.2		34.56	Grey shale,Old Well	Domestic and Stock
372048	SMITH, LAURA	RR1 PRIDDIS T0L 1W0		NW	27	22	3	5	61.0	0.0	0.0		12.19	Sandstone	Domestic
369134	POWELL, HUGH	RR1 PRIDDIS T0L 1W0		SE	27	22	3	5	21.3	10.7	19.8		3.66	Brown till,Light grey sandstone	Domestic
378038	LOWERY, DALE	RR1 CALGARY		SE	27	22	3	5	30.5	13.5	29.9		10.67	Sandy clay & gravel,Grey water bearing sandstone,Grey firm shale,Grey water bearing sandstone,Grey firm shale,Grey hard sandstone,Grey firm shale	Stock
379812	MALLETT, FORD	GEN DEL, PRIDDIS		SW	27	22	3	5	19.2	16.8	19.8		3.05	Clay & Gravel,Gravel & Boulders,Water bearing gravel	Domestic
378042	MALLETT, FORD	GEN DEL, PRIDDIS		SW	27	22	3	5	19.8	16.8	19.8		3.81	Stony gravel,Gravel & Boulders,Water bearing gravel	Domestic
378039	ELVES	7307-KELSEY PLACE, CALGARY		SW	27	22	3	5	27.7	15.2	26.5	1196.34	7.32	Green clay,Light sandstone,Dark sandstone,Blue shale,Light sandstone,Dark shale,Light sandstone,Blue shale,Light sandstone	Domestic
368445	MULLEN, ROLAND #1217	RR1 PRIDDIS T0L 1W0		NW	27	22	3	5	23.8	21.9	22.6		16.76	Grey shale,Grey sandstone,Grey shale	Domestic
378041	MALLETT, FORD	PRIDDIS		SW	27	22	3	5	32.6	24.4	30.2	1132.72	15.24	Blue grey clay,Brown clay,Water bearing gravel	Domestic
378042	MULLEN, ROLAND	RR1 PRIDDIS		SW	27	22	3	5	[illegible]	0.0	0.0			Shale	Domestic and Stock
378043	MULLEN, ROLAND	PRIDDIS		SW	27	22	3	5	23.5	15.2	20.5		17.98	Sandstone	Domestic and Stock
373790	KLINGE, LAURA	RR1 PRIDDIS T0L 1W0		NE	34	22	3	5	23.5	13.5	22.0		12.19	Brown till,Grey shale	Domestic and Stock
467122	COOPER, LAURA#096236 AB LTD	PRIDDIS T0L 1W0		NE	34	22	3	5	30.5	12.2	29.0		6.71	Brownish grey sandstone stringers,Brown sandstone,Grey sandstone,Brown sandstone,Brownish grey sandstone stringers,Brown sandstone,Grey sandstone,Brown sandstone	Domestic
373833	KLINGE, LAURA	RR1, PRIDDIS 1 T0L 1W0		NE	34	22	3	5	30.5	23.3	29.6		28.72	Brown sandstone	Domestic and Stock
467121	COOPER, LAURA#096236 AB LTD	PRIDDIS T0Z 1W0		NE	34	22	3	5	32.0	9.8	31.7		9.45	Brown sandstone,Grey sandstone,Brown sandstone,Grey shale,Light grey sandstone stringers,Grey shale,Light grey sandstone,Brown sandstone,Grey sandstone,Brown sandstone,Grey shale,Light grey sandstone stringers,Grey shale,Light grey sandstone	Domestic
469162	COOPER, LAURA#096256 ALTA LTD	PRIDDIS T0L 1W0		NE	34	22	3	5	32.0	21.3	30.5		29.57	Grey clay & rocks,Grey shale & sandstone ledges,Light grey water bearing sandstone	Domestic
466060	COOPER, L#096236 ALTA LTD #3	RR1, PRIDDIS T0L 1W0		NE	34	22	3	5	23.1	19.8	23.5		6.10	Blue shale,Grey shale & sandstone ledges,Light grey water bearing sandstone	Domestic
469163	COOPER, LAURA#096256 ALTA LTD	PRIDDIS T0C 1W0		NE	34	22	3	5	33.1	13.3	36.6		7.92	Brown clay & sandstone,Grey shale & sandstone ledges,Light grey water bearing sandstone	Domestic
467116	COOPER, LAURA#096236 AB LTD	PRIDDIS T0L 1W0		NE	34	22	3	5	41.2	19.8	39.6		7.32	Blue shale,Grey shale & sandstone ledges,Light grey water bearing sandstone	Domestic
466161	COOPER, LAURA#096236 ALTA LTD	PRIDDIS T0L 1W0		NE	34	22	3	5	43.7	14.9	42.1		4.21	Brown sandy clay & boulders,Grey shale,Grey shale & sandstone ledges	Domestic
467120	COOPER, LAURA#096236 AB LTD	PRIDDIS T0L 1W0		NE	34	22	3	5	50.3	12.2	48.8		3.66	Grey shattered shale,Blue shale,Grey shale & sandstone,Grey shale,Light grey sandstone,Grey shale	Domestic
373813	COOPER, LAURA#096236 ALTA LTD	RR1, PRIDDIS T0L 1W0		NE	34	22	3	5	57.9	42.7	36.4		2.83	Grey clay & rocks	Domestic
469160	COPPER, LAURA#096296 ALTA LTD	PRIDDIS T0L 1W0		NE	34	22	3	5	39.4	39.6	37.9		5.33	Dark grey shattered shale,Grey shale,Light grey water bearing sandstone,Grey shale,Light grey sandstone	Domestic
467723	COOPER, LAURA#096236 AB LTD	PRIDDIS T0L 1W0		NE	34	22	3	5	61.0	21.3	39.4		9.14	Grey shale,Light grey water bearing sandstone,Grey shale,Light grey water bearing sandstone	Domestic
462315	COOPER, LAURA#096236 ALBERTA	PRIDDIS T0L 1W0		NE	34	22	3	5	61.0	22.9	39.4		12.95	Light grey sandstone,Grey shale,Light grey water bearing sandstone,Light grey sandstone,Grey shale,Light grey water bearing sandstone	Domestic
466065	COOPER, L#096236 ALTA LTD #2	RR1, PRIDDIS T0L 1W0		NE	34	22	3	5	61.0	42.8	39.4		11.58	Grey shale & sandstone ledges,Light grey water bearing sandstone	Domestic
469130	COPPER, LAURE#096236 ALTA LTD	PRIDDIS T0L 1W0		NE	34	22	3	5	62.5	0.0	0.0			Grey shale	Domestic
462127	COOPER, LAURA#096236 AB LTD	PRIDDIS T0L 1W0		NE	34	22	3	5	76.2	0.0	0.0			Dark grey shale	Domestic
378169	KLINGE, ROY	RR1, PRIDDIS T0L 1W0		NW	34	22	3	5	42.7	21.3	39.6		19.81	Clay,Grey shale,Green shale,Brown shale & sandstone	Domestic
378113	KLINGE, ROY # TH2	SITE 2, RR1, PRIDDIS 1		NW	34	22	3	5	61.0	0.0	0.0			Black shale	Domestic
378113	KLINGE, ROY	PRIDDIS		NW	34	22	3	5	61.0	0.0	0.0			Grey shale & sandstone ledges	Unknown
378117	KLINGE, ROY # HOLE 2	PRIDDIS T0L 1W0		NW	34	22	3	5	61.0	42.7	61.0		4.71	Grey shale,Sandstone,Grey shale,Grey shale & sandstone,Grey shale	Domestic
378116	KLINGE, ROY	SITE 2, RR1, PRIDDIS 1 T0L 1W0		NW	34	22	3	5	78.1	64.0	78.1		30.46	Grey shale,Grey shale,Grey shale & sandstone ledges	Domestic
378114	KLINGE, ROY # HOLE 1	SITE 2, RR1, PRIDDIS 1 T0L 1W0		NW	34	22	3	5	73.5	0.0	0.0			Grey shale	Domestic
378111	KLINGE, GORDON	ROUTE 1, PRIDDIS 1		NW	34	22	3	5	76.2	18.3	74.7		30.18	Blue shale,Brown sandstone,Dark grey sandstone,Grey shale & sandstone ledges,Brown sandstone,Grey shale & sandstone ledges,Dark grey shale,Grey shale,Light grey sandstone,Grey shale,Dark grey sandstone,Blue shale,Grey shale,Light grey sandstone,Grey shal	Standby
378163	KLINGE, ROY # HOLE 3	RR1, PRIDDIS T0L 1W0		NW	34	22	3	5	76.8	0.0	0.0			Black shale & sandstone	Dewatering
378106	KLINGE, DON # TH1	PRIDDIS 8		SE	34	22	3	5	91.4	0.0	0.0		18.39	Black shale	Domestic
378107	KLINGE, DON # TH2	PRIDDIS 8		SE	34	22	3	5	91.4	0.0	0.0		50.29	Black shale	Domestic
378108	MATTERHORN RANCH	PRIDDIS		SW	34	22	3	5	79.3	0.0	0.0		15.24	Blue shale	Domestic
364719	STEWART	LACOMBE 364 T0C 1S0		SE	35	22	3	5	30.5	24.4	30.5		3.35	Grey sandstone,Grey shale,Grey sandstone,Grey shale	Domestic
370233	MAGNUSSON, DON	SITE 1 RR1, PRIDDIS 3 T0L 1W0		02	35	22	3	5	54.9	39.6	42.7		8.53	Black shale & sandstone	Domestic
372191	MACKENZIE, TIM	RR1, PRIDDIS		NE	35	22	3	5	30.5	9.1	23.6		5.79	Brown sandstone,Blue shale,Light grey sandstone,Grey shale,Light grey sandstone	Stock
467134	MACKENZIE, JOHN	RR1, PRIDDIS T0L 1W0		NE	35	22	3	5	61.0	18.3	39.4		8.83	Grey clay & rocks,Grey shale,Dark grey shattered shale,Grey shale	Domestic
378189	WALLAWITZ, GEORGE	PRIDDIS ESTATES, PRIDDIS		NW	35	22	3	5	18.9	0.0	0.0		11.58	Water bearing sand & gravel	Domestic
378188	COOPER, DON	RR1, PRIDDIS		NW	35	22	3	5	39.0	18.3	39.0		15.24	Clay & Rocks,Water bearing sandstone,Grey shale	Stock
378189	COOPER, DON	RR1, PRIDDIS 1		NW	35	22	3	5	70.1	0.0	0.0			Grey shale	Unknown
378190	COOPER, DON	RR1, PRIDDIS 1		NW	35	22	3	5	76.2	0.0	0.0			Grey shale	Unknown
401571	PRIDDIS VIEW FARMS	SITE 1 RR1, PRIDDIS 4 T0L 1W0		SW	35	22	3	5	32.0	16.8	30.5		14.33	Grey clay,Brownish grey shale & sandstone ledges,Brown sandstone	Domestic and Stock
378175	NYSTROM & UNGER ESTATES/HOLE 2	PRIDDIS		SW	35	22	3	5	33.5	21.9	32.0		18.29	Grey shale,Grey sandy shale,Water bearing sandstone	Domestic
376273	CHURCHER, A.C.	CALGARY 200 T2P 2N3		SW	35	22	3	5	34.1	18.3	33.2		17.37	Light sandstone,Grey shale,Brown sandstone,Brown sandstone,Brown sandstone,Grey shale & sandstone,Brown sandstone,Grey shale,Light sandstone	Domestic
378176	NYSTROM & UNGER ESTATES/WELL 3	PRIDDIS		SW	35	22	3	5	57.9	51.8	57.9		24.38	Grey shale,Grey sandy shale,Water bearing sandstone,Grey shale	Domestic
378177	CHURCHER, A.C.	CALGARY 200 T2P 2N3		SW	35	22	3	5	61.0	0.0	0.0			Grey shale	Domestic
378183	CLARK & SWANEY # TH1	6123-1A ST SW, CALGARY		SW	35	22	3	5	67.1	0.0	0.0			Black shale & sandstone ledges	Domestic
378187	ROYAL BANK MAIN BRANCH	21 FLR, 335-8 AVE SW, CALGARY T2P 2N3		SW	35	22	3	5	66.6	0.0	0.0		7.62	Grey shale	Unknown
378174	NYSTROM & UNGER ESTATES/WELL 4	PRIDDIS		SW	35	22	3	5	70.1	0.0	0.0		24.33	Dark grey shale	Domestic
378172	[illegible]	CALGARY		SW	35	22	3	5	38.1	42.9	42.8		24.38	Blue water bearing shale	Domestic
340531	POFFENROTH, DON	7270 233 3 AVE SW, CALGARY ALTA		SW	35	22	3	5	38.1	42.9	42.8		24.38	Blue water bearing shale	Domestic
378173	NYSTROM & UNGER ESTATES/WELL 5	PRIDDIS		SW	35	22	3	5	70.1	63.6	70.1		24.38	Water bearing sandstone,Grey shale	Domestic
378181	ROYAL BANK C/O GARY MURRY	24 FLR, 335-8 AVE SW, CALGARY T2P 2N3		SW	35	22	3	5	71.6	30.5	42.7		12.19	Grey shale & sandstone ledges,Grey shale,Water bearing sandstone	Domestic
378184	CLARK SWANEY CO LTD	6120-1A ST SW, CALGARY		SW	35	22	3	5	73.2	0.0	0.0			Black shale & sandstone ledges	Domestic
378182	CLARK SWANEY CO LTD# HOLE 1	6120-1A ST SW, CALGARY		SW	35	22	3	5	91.4	0.0	0.0			Black shale	Domestic
378225	MCLAWS, D.P.	25, 301-8 AVE SW, PRIDDIS		NE	36	22	3	5	46.9	0.0	0.0		33.53	Grey sandstone	Unknown
378227	MACOLEN RANCHES	PRIDDIS		NE	36	22	3	5	47.6	31.4	46.9		35.05	Gravel,Grey shale,Blue shale,Light water bearing sandstone	Domestic and Stock
378229	CHARTWEST LTD	818-5 AVE SW, CALGARY		NE	36	22	3	5	72.2	51.8	57.9		40.23	Sandstone,Shale & Sandstone Ledges,Sandstone	Stock
378223	CHARTWEST LTD	818-5 AVE SW, CALGARY		NE	36	22	3	5	85.3	41.2	45.1		38.79	Shale,Sandstone	Domestic and Stock
363857	PLANTINGA, JOHN & SHARON			NW	36	22	3	5	11.9	5.2	10.7		1.22	Grey till,Grey till	Domestic
378218	FILLIK, JACK	SITE 5, RR1, PRIDDIS 8 T0L 1W0		NW	36	22	3	5	25.6	19.8	23.4		3.66	Fine grained sandstone,Shale,Moist sandstone,Grey water bearing sandstone,Shale	Domestic
363833	SHILOH RANCH	SITE 5, RR1, PRIDDIS 4		NW	36	22	3	5	30.5	12.2	29.0		3.13	Old Well,Grey shale	Domestic
378190	FILLIK, JACK	SITE 5, RR1, PRIDDIS 8		NW	36	22	3	5	33.1	12.5	33.5		4.27	Grey till,Grey shale	Domestic
378197	SHILOH RANCH	SITE 5, RR1, PRIDDIS 9 T0L 1W0		NW	36	22	3	5	36.6	13.9	33.1		6.52	Grey till	Domestic
378216	FILLIK, JACK & CAROL	SITE 5, RR1, PRIDDIS 8 T0L 1W0		NW	36	22	3	5	37.8	28.7	37.8		5.79	Sandstone,Laminated siltstone,Fine grained sandstone,Grey water bearing sandstone,Brownish grey coarse grained sandstone	Domestic
378221	FILLIK, JACK & CAROL	SITE 5, RR1, PRIDDIS 8 T0L 1W0		NW	36	22	3	5	90.0	19.5	90.0		6.10	Shale,Grey fine grained sandstone,Shale,Water bearing siltstone & sandstone,Water bearing sandstone,Sandstone & Shale Seg's,Sandstone,Shale & Siltstone,Shale,Siltstone	Domestic
378192	WILLIAMSON, RON			SE	36	22	3	5	32.1	22.9	29.0		9.14	Shale,Sandstone	Domestic
378195	PAISLEY, JANET	SITE 2, RR2, CALGARY 27 T2J 2T9		SE	36	22	3	5	43.7	24.4	25.9		0.53	Shale	Domestic
378235	WILLIAMSON, R.A.# WELL 1	RR2, CALGARY		SW	36	22	3	5	32.4	19.8	29.0		8.23	Shale,Sandy shale & sandstone	Domestic
378194	WILLIAMSON, R.A.	RR2, CALGARY		SW	36	22	3	5	38.0	18.3	23.0		6.40	Clay & Boulders	Stock
400977	SARCEE NATION ADMIN	3700 ANDERSON RD SW, CALGARY		NE	1	23	3	5	53.6	22.9	34.9		18.59	Old Well,Light grey shale,Light water bearing sandstone,Light grey shale,Dark grey shale,Light grey shale,Brown shale,Light grey shale,Light grey water bearing sandstone,Light grey shale	Domestic and Stock
400151	CODDINGHORSE, LYLE/TSUU TINA N	9913 CHULA BLVD SW, CALGARY		SE	1	23	3	5	142.9	36.6	42.7		3.33	Brown sandy clay & rocks,Grey medium grained sandstone,Grey water bearing sandstone	Domestic
400932	SARCEE NATION #143			SE	1	23	3	5	51.8	45.7	51.8		10.36	Fractured sandstone,Shale,Fractured shale,Wet sandstone,Fractured sandstone	Domestic
400914	WHITNEY, LAWRENCE	SARCEE		SW	1	23	3	5	18.3	0.0	0.0	1158.24	0.30	Gravel	Domestic
400913	ASTLEY, DAVID	RR2, CALGARY		SW	1	23	3	5	35.7	0.0	0.0	1143		Grey till	Domestic
400915	ASTLEY, D.	440 TRAFFORD DR, CALGARY		SW	1	23	3	5	85.3	77.7	85.3		8.80	Blue shale,Grey shale,Dark sandstone,Grey shale	Domestic
400916	ASTLEY, DAVID	RR2, CALGARY		SW	1	23	3	5	94.5	70.1	94.5	1122.47	66.55	Grey shale & sandstone,Blue shale,Brown shale & sandstone,Grey shale,Brown sandstone,Grey shale,Light sandstone,Grey shale,Light sandstone,Grey shale	Domestic
400925	SARCEE NATION ADMIN	3700 ANDERSON RD SW, CALGARY		NW	3	23	3	5	17.1	11.0	17.1		3.49	Dark grey shale,Grey wet sandstone,Dark blue shale	Domestic
400928	SARCEE NATION ADMIN	3700 ANDERSON RD SW, CALGARY		SE	3	23	3	5	17.7	11.6	17.7		5.18	Brown wet sandstone,Grey coarse grained sandstone,Grey shale,Grey wet sandstone,Grey shale,Grey medium grained sandstone	Domestic
400931	MEQUINIS, BRIAN JOB#79-10	SARCEE		03	10	23	3	5	27.4	21.3	27.4	1239.62	7.62	Sandstone,Shale & Sandstone	Domestic
400936	MEQUINIS, BRIAN	3700 ANDERSON RD SW, CALGARY		11	10	23	3	5	18.6	8.2	17.7		5.49	Brown till,Grey shale,Dark grey water bearing sandstone,Fractured shale	Domestic
400935	MEQUINIS, BRIAN	3700 ANDERSON RD SW, CALGARY		11	10	23	3	5	61.0	0.0	0.0			Dark grey shale	Domestic
400934	MEQUINIS, MICHAEL	SARCEE		NW	10	23	3	5	27.4	21.3	25.9	1196.34	9.75	Sandstone	Domestic
400949	CROWCHILD, C	SARCEE		SE	10	23	3	5	18.3	13.7	16.8	1219.2	5.49	Blue shale	Domestic
400133	CROWCHILD, CALVIN/TSUU TINA NA	9911 CHULA BLVD SW, CALGARY		SE	10	23	3	5	39.4	18.7	36.8		2.29	Brown coarse grained sandstone	Domestic
400922	STARLIGHT, LARRY	SARCEE		SW	10	23	3	5	22.9	13.2	21.3	1234.44	6.71	Shale	Domestic
400950	BIG PLUME, JOE	SARCEE		SW	10	23	3	5	36.6	30.5	36.6		12.19	Shale,Sandstone	Domestic
380092	STARLIGHT, LUCKY	SARCEE		NW	10	23	3	5	67.1	61.0	67.1		20.40	Shale,Sandstone	Domestic
400957	CROWCHILD, CALVIN	RR2, CALGARY 15		01	11	23	3	5	36.6	30.5	36.6	1194.82	6.71	Sandstone	Domestic
380093	CODDINGHORSE, HENRY	SARCEE		NW	11	23	3	5	62.5	21.3	25.9		5.18	Sandstone	Domestic
400928	WOLF, IRVING	6420-72 ST NW, CALGARY		SW	11	23	3	5	51.8	42.7	50.3	1222.25	39.62	Brown shale,Grey shale,Sandstone,Grey shale,Sandstone	Domestic
400923	[illegible]	SARCEE		NW	12	23	3	5	17.6	14.3	17.4	1173.48	13.01	Clay & Boulders,Gravel	Domestic
400900	CROWCHILD, HAROLD	SARCEE		SE	12	23	3	5	22.0	0.0	0.0	1111.1	6.10	Blue shale	Domestic
400901	BIG PLUME, [illegible]	SARCEE		SE	12	23	3	5	36.6	30.5	36.6		11.34	Shale & Sandstone,Sandstone	Domestic
463134	BIG PLUME, TRUDY/TSUU TINA NAT	9911 CHULA BLVD, TSUU TINA T2W 6H6		SW	12	23	3	5	34.1	22.9	34.1		5.21	Black shale,Grey water bearing sandstone,Dark grey shale	Domestic
363712	SARCEE NATION ADMIN	3700 ANDERSON RD SW CALGARY T2W 3C4		SW	12	23	3	5	36.6	24.4	36.6		19.20	Boulders,Grey shale,Light grey sandstone,Light grey shale,Light grey sandstone,Grey shale	Domestic
363206	SARCEE NATION	3700 ANDERSON RD CALGARY T2W 3C4		SW	12	23	3	5	54.9	30.5	48.5		21.96	Grey sandstone	Domestic
400932	SARCEE NATION EMCH WELL	3700 ANDERSON RD SW, CALGARY		SW	12	23	3	5	61.5	33.5	61.5		15.47	Old Well,Grey sandy shale,Grey wet sandstone	Domestic

TAB[illegible]
WATER WELLS LOCATED WITHIN 6.5 KM [illegible]US INSIDE FISH CREEK WATERSHED
RED WILLOW ESTATES

Well ID	Owner	Address	LSD	Sec	Twp	Rge	Mer	WellDepth	PerfFrom	PerfTo	Elev	StaticWL	Lithology at Screen	Proposed Use
378874	BECKER, ALLAN	136 PARKVIEW PL SW, CALGARY T2J 4W5	16.0	3	22	2	5	42.67	30.48	41.76		28.96	Old Well,Shale,Sandstone	Domestic
466054	BECKER, AL	SITE 5 RR8, CALGARY 12 T2J 2T9	NE	3	22	2	5	22.86	15.24	19.81		7.32	Shale,Sandstone,Shale,Sandstone	Domestic
466055	BECKER, AL	SITE 5 RR8, CALGARY 12 T2J 2T9	NE	3	22	2	5	37.8	15.24	32		10.06	Clay & Rocks,Shale & Sandstone,Sandstone,Shale & Sandstone,Clay & Rocks,Shale & Sandstone,Sandstone,Shale & Sandstone	Domestic
379180	ABBOTT, MARSHALL	SITE 2 RR8, CALGARY 24 T2J 2T9	SE	6	22	2	5	109.73	54.86	60.96		67.06	Shale,Sandstone	Domestic
378875	ATKINS, JOHN	RR8, CALGARY	SW	6	22	2	5	31.7	22.25	25.3	1257.3	22.86	Sandstone,Blue shale,Sandstone	Domestic and Stock
377578	ROTHNEY FARMS	SITE 2, RR8, CALGARY 57 T2J 2T9	NE	16	22	2	5	106.7	0	0			Dark gray shale	Stock
377581	ROTHNEY FARMS	SITE 2, RR8, CALGARY 57	NE	16	22	2	5	79.9	0	0			Dark gray shale	Unknown
377582	ROTHNEY FARMS	SITE 2, RR8, CALGARY 57	NE	16	22	2	5	91.4	64	90.5		50.29	Gray shale & sandstone,Gray shale,Light water bearing sandstone,Gray shale,Coal,Gray shale,Light soft sandstone	Stock
377587	THE NATURE CONSERVANCY OF CDN	422-33RD AVE NW, CALGARY T2K 0B4	NE	17	22	2	5	67.1	54.9	67.1		42.67	Siltstone,Brown fine grained sandstone,Salt & pepper fractured sandstone,Gray shale	Domestic
377584	ROTHNEY FARMS	RR8, CALGARY	NW	17	22	2	5	76.2	59.4	74.7		58.52	Light gray sandstone,Gray shale,Light gray water bearing sandstone	Stock
377590	CROSS, A.R.	RR8, ROTHNEY FARMS, CALGARY	NW	18	22	2	5	54.9	36.6	53.3	1219.2	29.87	Brown sandstone,Gray shale,Dark gray water bearing sandstone	Stock
377345	FLANOGAN, H.C.	RR8 CALGARY	00	19	22	2	5	30.5	0	0		24.99	Sandstone & Shale Ledges	Domestic
469147	DALTON, RICK/LILLIAN	SITE 2 RR8, CALGARY 2	03	19	22	2	5	39.6	33.5	39.6		22.89	Gray shale,Gray water bearing sandstone	Domestic
490025	FLANAGAN, HERB	SITE 2 RR8, CALGARY 13 T2J 2T9	03	19	22	2	5	29.6	23.5	29.6			Gray shale	Domestic
469148	PFEIFER, TY	PRIDDIS 75 T0L 1W0	05	19	22	2	5	43.3	37.2	43.3		12.50	Gray shale,Gray water bearing sandstone	Domestic
467795	SOUTHERN, N.	SITE 14 RR8, CALGARY 2 T2J 2T9	08	19	22	2	5	79.3	60.4	66.5		22.86	Shale,Sandstone	Stock
377369	FLEMMING, DON	PRIDDIS	NE	19	22	2	5	30.5	6.1	7.3	1196.3	5.49	Gravelly clay,Sandstone	Domestic
377380	FLEMING, DON	1404 BEVERLY PL SW, CALGARY	NE	19	22	2	5	48.8	38.1	41.2	1188.7	27.43	Shale	Domestic
377385	FLEMING, DON	1404 BEVERLY PL SW, CALGARY	NE	19	22	2	5	43.3	37.9	61	1188.7	36.39	Shale	Domestic
377393	HOPE ROSS, BILL	S14 RR8 CALGARY 13	NE	19	22	2	5	54.9	35.1	50.3		34.14	Shale,Fractured shale,Shale,Fractured shale,Shale,Shale & Sandstone,Shale,Shale & Sandstone	Domestic
377630	FLEMING, DON	1404 BEVERLY PL SW, CALGARY	NE	19	22	2	5	79.3	71.6	74.7	1188.7	43.72	Shale	Domestic
359987	VAN WIELINGEN, GUS WELL #1	STE 2628 1 CAL PLACE 330 5 AVE SW CALGAR T2P 0L4	NW	19	22	2	5	73.2	42.7	73.2		34.14	Brown shale & sandstone ledges,Blue water bearing shale & sandstone ledges	Domestic
354338	FINNIS, TIM	SITE 2 RR8, CALGARY 8 T2P 2T9	SW	19	22	2	5	47.2	41.2	47.2		30.18	Gray shale,Fine grained sandstone,Brown wet sandstone,Coarse grained sandstone	Domestic
377339	FINNIS, F.	9816 ALBERNI RD SW, CALGARY	SW	19	22	2	5	25.9	0	0	1155.2	17.98	Gray shale	Domestic and Stock
377342	BONSRTA, BRIAN	302A S HAMPTON DR, CALGARY	SW	19	22	2	5	25	15.2	18.3	1188.7	12.80	Brown shale,Gray shale,Gray water bearing sandstone	Domestic
377343	SURE HOLDINGS LTD.	RR8 CALGARY	SW	19	22	2	5	42.7	32	42.7	1207.0	16.76	Sandy clay,Sandstone	Domestic and Stock
377346	PFEIFFER, TY	912 WOODVIEW CRESC SW, CALGARY	SW	19	22	2	5	73.2	33.5	64		30.48	Clay & Rocks,Blue shale & sandstone	Domestic
378629	UPLAND DEV CO. LTD.	SUITE 3003, LONDON HOUSE, CALGARY	SW	19	22	2	5	30.5	21.3	30.5	1207.0	16.76	Sandy clay,Brown clay & shale,Gray shale	Domestic
378632	DAVIES, DAVE	RR8, CALGARY	14	20	22	2	5	7.6	0	0		3.66	Water bearing shale	Domestic
418340	BAVARIAN LION CO C/O JANZ,ROLF	SITE 23 RR8, CALGARY 7 T2J 2T9	NE	20	22	2	5	40.2	25.9	34.1		21.03	Thin shale & sandstone ledges,Thin shale & sandstone ledges	Domestic
418342	BAVARIAN LION CO LTD.	SITE 23 RR8, CALGARY 7 T2J 2T9	NE	20	22	2	5	58.5	41.2	57.9		26.70	Shale & Sandstone Ledges,Shale & Sandstone Ledges	Domestic
418345	BAVARIAN LION CO C/O JANZ,ROLF	SITE 23 RR8, CALGARY 7 T2J 2T9	NE	20	22	2	5	46.3	29	40.5		21.31	Shale & Sandstone,Sandstone,Shale & Sandstone Ledges	Domestic
437389	BAVARIAN LION CO LTD	SITE 23 RR8, CALGARY 7 T2J 2T9	NE	20	22	2	5	53	25.9	46.9		24.08	Shale,Shale & Sandstone,Sandstone,Shale,Sandstone,Shale & Sandstone	Domestic
437392	BAVARIAN LION CO LTD/JANZ, ROL	SITE 3 RR8, CALGARY 7 T2J 2T9	NE	20	22	2	5	36	22	35.7		15.54	Shale & Sandstone Ledges,Sandstone,Thin shale & sandstone ledges,Shale & Sandstone Ledges,Sandstone,Thin shale & sandstone ledges	Domestic
437393	BAVARIAN LION CO LTD/JANZ,ROLF	SITE 3 RR8, CALGARY 7 T2J 2T9	NE	20	22	2	5	40.2	18.3	33.5		12.19	Shale,Shale & Sandstone Ledges,Shale,Shale,Shale & Sandstone Ledges,Shale	Domestic
497043	Bavarian Lion Co.		NE	20	22	2	5	71.6	59.4	71.6	3825			
497042	Bavarian Lion Co.		NE	20	22	2	5	47.2	35.1	47.2	3825			
497050	Bavarian Lion Co.		NE	20	22	2	5	59.4	35.1	57.9	3825			
360064	DAVIES, DAVE #1674	SITE 24 RR8, CALGARY 7 T2J 2T9	NW	20	22	2	5	45.7	33.5	42.7		32.00	Brown sandy shale,Gray shale,Brown water bearing sandstone	Domestic and Stock
377474	DAVIES, DAVE	S24 RR8, CALGARY 7	NW	20	22	2	5	45.7	33.5	42.7		32.00	Brown sandy shale,Gray shale,Brown water bearing sandstone	Domestic and Stock
378631	DAVIES, DAVE	MIDNAPORE	NW	20	22	2	5	16.5	0	0	1158.2	4.27	Sandrock	Domestic
377492	OHANLON, HARRY	S6 RR8, CALGARY 6 T2J 2T9	02	21	22	2	5	50.6	0	0		30.48	Brown sandstone & shale strg's	Domestic
377502	WESTWARD CONSTRUCTION	760 CEDARCLE WAY SW, CALGARY	NW	21	22	2	5	48.8	42.7	48.8		15.24	Clay & Rocks,Sandstone & Shale Ledges	Domestic
377503	CLAYDON	RR8, CALGARY	NW	21	22	2	5	59.4	51.8	59.4		0.00	Clay & Rocks,Sandstone & Shale Ledges	Domestic
377505	OLMAND	S8 RR8, CALGARY 4	NW	21	22	2	5	23.8	0	0	1158.2	11.28	Blue sandstone	Domestic
377507	IRVING DON	12120 14 ST SW, CALGARY	NW	21	22	2	5	34.4	24.4	33.2	1158.2	12.80	Light blue sandstone,Siltstone	Domestic
377510	MCPHAIL, COLIN	111 LAKE LUCERNE CLOSE SE, CALGARY	NW	21	22	2	5	45.7	32	44.2		31.70	Light gray sandstone,Gray shale,Light gray water bearing sandstone	Domestic
377511	GULA, DR.	S23 RR8, CALGARY 4	NW	21	22	2	5	61	0	0			Black shale	Domestic
377515	GULA, DR.	RR8 CALGARY 4	NW	21	22	2	5	70.1	33.5	39.6		19.81	Clay	Domestic
349668	WOODS, MR & MRS #2480	SITE 4 RR #8, CALGARY 8 T2J 2T9	SE	21	22	2	5	67.1	57.9	67.1		38.68	Brown sandstone,Gray shale,Gray water bearing sandstone,Gray shale	Domestic
351791	OHANLON HARRY #1417	SITE 4 RR8, CALGARY 8	SE	21	22	2	5	42.7	30.5	42.7		19.81	Clay,Gray shale & sandstone,Gray siltstone,Gray water bearing sandstone	Stock
359988	OHANLON, HARRY	13046 SITE 6 RR8 CALGARY T2J 2T9	SE	21	22	2	5	50.6	41.2	50.6		30.48	Clay,Brown sandstone & shale ledges	Domestic
377482	OHANLON, HARRY	S6 RR8, CALGARY 6	SE	21	22	2	5	47.2	36.6	47.2		13.72	Gray shale,Gray water bearing sandstone,Gray shale	Domestic and Stock
377488	OHANLON, HARRY	S4 RR8, CALGARY 8	SE	21	22	2	5	42.7	30.5	42.7		19.81	Clay,Gray shale & sandstone ledges,Gray siltstone,Gray water bearing sandstone	Stock
378636	OHANLON, H.F.	MIDNAPORE 99	12	28	22	2	5	58.8	0	0		4.88	Gray shale	Domestic and Stock
361157	HAGEL, GERRY	RR2 CROSSFIELD T0M 0S0	13	28	22	2	5	18.3	0	0		4.57	Shattered sandstone	Domestic and Stock
377960	OHANLON, H.	MIDNAPORE 99	NE	28	22	2	5	18.3	0	0			Sand	Domestic and Stock
377964	OHANLON, H.	MIDNAPORE 99	NE	28	22	2	5	76.2	0	0	1127.8	3.66	Shale & Sandstone Ledges	Domestic
377966	OHANLON, H.	MIDNAPORE 99	NE	28	22	2	5	61	0	0	1147.6	4.57	Shale & Sandstone	Domestic and Stock
377967	OHANLON, H.	MIDNAPORE 99	NE	28	22	2	5	131.1	0	0			Shale & Sandstone	Domestic and Stock
377969	OHANLON, H.	MIDNAPORE 99	NE	28	22	2	5	33.5	0	0		0.00	Shale	Domestic and Stock
377972	OHANLON, H.	MIDNAPORE 99	NE	28	22	2	5	61	0	0	1147.6		Hard shale	Unknown
377974	ERICKSON, B.	1088 ALADIA DR SE, CALGARY	NE	28	22	2	5	30.5	0	0	1143.0		Blue clay	Domestic
377976	OHANLON, H.	MIDNAPORE 99	NE	28	22	2	5	61	0	0			Shale & Sandstone	Domestic and Stock
377977	LAMONTAGUE, ARTHUR & HECK R.	MIDNAPORE 488 T0L 1J0	NE	28	22	2	5	54.9	42.7	54.9		18.29	Blue shale,Shale & Sandstone Ledges,Soft sandstone,Shale	Domestic
377980	HECK, RONALD	MIDNAPORE 488 T0C 1J0	NE	28	22	2	5	67.1	0	0			Black shale	Domestic
377982	HECK, RONALD D.	MIDNAPORE 488 T0C 1J0	NE	28	22	2	5	48.8	36.6	48.8		9.14	Blue shale,Blue shale & sandstone ledges,Sandstone,Blue shale,Blue shale & sandstone ledges	Domestic
349929	DAWSON, HAL #2982	SITE 6 RR8, CALGARY 6 T2J 2T9	NW	28	22	2	5	46.9	22.6	28.7		4.24	Brown sandstone,Shale,Sandstone	Domestic
349930	DAWSON, HAL	SITE 6 RR8, CALGARY 6 T2J 2T9	NW	28	22	2	5	85.3	0	0		30.48	Gray shale	Domestic
351447	DOUBLE E FARMS #1295	MIDNAPORE 10	NW	28	22	2	5	71.6	53.3	71.6		12.19	Blue shale,Gray sandy shale,Gray shale,Gray sandstone,Blue sandstone,Gray shale	Domestic
351448	DOUBLE E FARMS #1305	MIDNAPORE 10	NW	28	22	2	5	57.3	45.1	57.3		10.06	Gray shale,Blue fractured shale,Gray shale,Sandstone,Gray shale	Domestic
377946	OHANLON, H.	MIDNAPORE 99	NW	28	22	2	5	33.5	0	0	1127.8	0.00	Shale & Sandstone	Domestic and Stock
377955	DOUBLE E FARMS	MIDNAPORE 10	NW	28	22	2	5	71.6	53.3	71.6		12.19	Blue gray shale,Gray sandy shale,Blue gray shale,Gray sandstone,Blue water bearing sandstone,Gray shale	Domestic
377958	DOUBLE E FARMS	MIDNAPORE 10	NW	28	22	2	5	57.3	45.1	57.3		10.06	Blue gray shale,Blue fractured shale,Blue gray shale,Water bearing sandstone,Gray shale	Domestic
399656	NOBLE, JAN/MAWANI, SALIM	144 1935 32 AVE NE, CALGARY T2E 7C8	03	29	22	2	5	61	51.8	59.7		27.22	Gray sandstone,Gray thin shale & sandstone ledges,Gray sandstone,Gray thin shale & sandstone ledges	Domestic
399661	NOBLE, JAN/MAWANI, SALIM	144 1935 32 AVE NE, CALGARY T2E 7C8	03	29	22	2	5	67.1	34.8	37.8		30.91	Gray hard sandstone,Gray shale,Gray water bearing sandstone,Gray hard sandstone,Gray shale,Gray water bearing sandstone	Domestic
353160	KOTERA, JOHN	SITE 23 RR8, CALGARY 12 T2J 2T9	09	29	22	2	5	61	35.1	59.4		24.38	Gray fine grained sandstone,Moist sandstone,Carbonaceous shale,Siltstone,Fine grained sandstone,Carbonaceous clay & rocks,Siltstone,Fractured sandstone,Siltstone	Domestic
349129	KOTERA JOHN	SITE 23 RR8, CALGARY 12 T2J 2T9	NE	29	22	2	5	109.7	0	0		60.96	Hard sandstone & shale strg's	Domestic
349131	KOTERA JOHN #2	SITE 23 RR8, CALGARY 12 T2J 2T9	NE	29	22	2	5	73.2	0	0		60.96	Gray hard shale	Domestic
349132	KOTERA JOHN #3	SITE 23 RR8, CALGARY 12 T2J 2T9	NE	29	22	2	5	73.2	0	0		15.24	Gray sandy shale & sandstone ledges	Domestic
377428	PRAIRIE BREEDERS	RR8, CALGARY	NE	29	22	2	5	33.5	28.4	31.4		9.14	Brown hard shale,Gray shale,Water bearing sandstone	Domestic
377433	KOTERA, J.C.	SITE 23, RR8, CALGARY 12	NE	29	22	2	5	79.3	54.9	61		16.76	Blue shale,Water bearing sandstone	Domestic and Stock
355405	KROMM, KIM	SITE 8 RR8, CALGARY 4 T2J 2T9	NW	29	22	2	5	35.4	29.3	35.4		7.32	Shale,Wet sandstone,Shale	Domestic and Stock
377423	KROMM, JIM	RR8, CALGARY	NW	29	22	2	5	36.6	30.5	36.6		18.29	Sandstone,Blue water bearing shale & sandstone	Domestic
377425	SMART-ABBEY	112 WOODVIEW PL SW, CALGARY	NW	29	22	2	5	32	25.9	32		18.29	Sandstone,Black shale,Sandstone,Black shale	Domestic
349460	LIVINGSTON, LYAL	SITE 24,RR8,CALGARY 4 T2J 2T9	SE	29	22	2	5	35.1	22.9	35.1		12.19	Gray shale,Blue gray shale,Gray water bearing shale & sandstone,Gray shale	Domestic and Stock
352788	TANG, SONY #1497	2 FLOOR 1104 12 AVE SW, CALGARY	SE	29	22	2	5	30.5	18.3	30.5		7.62	Gray sandstone,Gray shale,Gray water bearing sandstone,Gray shale	Domestic
364653	PHIL'S INDUSTRIES OF CANADA	RR8 SITE 6 CALGARY 7 T2J 2T9	SE	29	22	2	5	70.1	51.8	70.1		3.66	Shale,Shale & Sandstone Ledges,Sandstone,Shale & Sandstone Ledges	Domestic
364654	TELRAULT, PHIL M.	RR8 SITE 6 CALGARY 7 T2J 2T9	SE	29	22	2	5	73.8	25	37.2		18.29	Clay & Boulders	Domestic
377379	PRAIRIE BREEDERS	SITE 6, RR8, CALGARY 1	SE	29	22	2	5	30.5	21.3	26.2		12.19	Brown till,Brown shale,Water bearing sandstone	Domestic and Stock
377387	HART, BILL	SITE 6, RR8, CALGARY 1	SE	29	22	2	5	25.6	21.3	25		13.72	Brown shale,Gray shale,Brown shale,Water bearing sandstone	Stock
377394	LIVINGSTON, LYAL #2734	SITE 24, RR8, CALGARY 1	SE	29	22	2	5	35.4	22.9	35.1		12.19	Gray shale,Blue gray shale,Gray water bearing shale & sandstone	Domestic and Stock
377399	TETRAULT, PHIL M/E&P SALERS	SITE 6, RR8, CALGARY 7	SE	29	22	2	5	61	0	0		18.29	Gray shale & sandstone ledges	Domestic
377407	E7P SALER RANCH	RED DEER LAKE	SE	29	22	2	5	73.2	42.7	73.2		24.38	Brown shale,Shale & Sandstone Ledges,Sandstone,Shale,Shale & Sandstone Ledges	Industrial
377412	DOMKE, HANS	CALGARY	SW	29	22	2	5	39.6	35.1	39.6		14.94	Shale,Sandstone,Shale	Domestic
377413	MACLEOD TRAIL AUTO BODY/DOMKE	320-39 AVE SW, CALGARY	SW	29	22	2	5	70.1	0	0		32.00	Shale	Domestic
377418	LECHNER, WALTER	72 BRAMPTON CR SW, CALGARY T2W 0X4	SW	29	22	2	5	27.4	12.2	25.9		12.19	Brown shale & sandstone ledges,Brown sandstone,Gray shale,Light gray water bearing sandstone	Domestic
377422	LECHNER, WALTER	72 BRAMPTON CR SW, CALGARY T2W 0X4	SW	29	22	2	5	30.5	9.1	29		6.71	Brown till,Gray shale & sandstone	Stock
365035	ADAMS, S.	SITE 14 RR 8, CALGARY 7 T2J 2T9	02	30	22	2	5	25.9	13.7	25.9		8.23	Weathered claystone,Gray fine grained sandstone,Claystone,Moist sandstone,Gray carbonaceous shale,Tan moist sandstone,Tan water bearing siltstone,Gray siltstone,Bentonitic shale stringers	Domestic
365036	NELSON, STEVE	SITE 14 RR8 CALGARY 18 T2J 2T9	02	30	22	2	5	26.2	7.9	26.2		9.14	Tan siltstone,Gray fine grained sandstone,Fine grained sandstone,Shale,Gray claystone,Water bearing sandstone,Siltstone,Water bearing sandstone,Gray claystone,Water bearing sandstone,Shale,Water bearing sandstone,Tan water bearing	Domestic
375015	NELSON, S.	SITE 18 RR9, CALGARY 18 T2J 2T9	02	30	22	2	5	56.4	44.2	56.4		32.61	Shale,Siltstone,Shale,Fine grained sandstone,Water bearing sandstone,Fine grained siltstone & sandstone	Domestic
375016	ADAMS, S/C/O NELSON, S.	SITE 14 RR8, CALGARY 18 T2J 2T9	02	30	22	2	5	19.8	12.2	19.8		7.92	Claystone,Fine grained siltstone,Brown water bearing siltstone,Brown coarse grained sandstone,Brown fine grained siltstone	Domestic
377455	GLASSEN, G.		05	30	22	2	5	32	24.4	30.5		10.67	Shale,Sandstone	Domestic
405139	HORSEY, IRWIN	SITE 14 RR8, CALGARY 20 T2J 2L9	08	30	22	2	5	25.7	10.1	22.3		4.88	Moist sandstone,Shale,Gray water bearing sandstone,Siltstone,Water bearing sandstone,Shale	Domestic
358514	PARKSIDE MGMT #1634	SITE 14 RR8, CALGARY 21 T2J 2T9	10	30	22	2	5	24.4	12.2	24.4		10.36	Clay & Rocks,Gray shale,Gray water bearing sandstone,Gray shale	Domestic
358515	PARKSIDE MGMT #1633	SITE 14 RR8, CALGARY 21 T2J 2T9	10	30	22	2	5	32	19.8	32		14.63	Gray sandstone,Gray shale,Water bearing sandstone,Shale	Domestic
358516	PARKSIDE MGMT #1642	SITE 14 RR8, CALGARY 21 T2J 2T9	10	30	22	2	5	24.4	13.7	24.4		8.53	Gray sandstone,Gray shale,Gray sandstone,Gray shale,Gray water bearing sandstone,Gray shale	Domestic
359814	PARKSIDE MGMT #1630	SITE 14 RR8, CALGARY 21 T2J 2T9	10	30	22	2	5	73.2	54.9	73.2		14.63	Gray shale,Gray sandstone,Greenish gray shale,Yellow shale,Gray shale,Gray sandstone,Greenish gray shale,Yellow shale,Gray shale	Domestic
349985	PARKSIDE MANAGEMENT #1532	SITE 14 R R 8, CALGARY 21	NE	30	22	2	5	54.9	42.7	54.9		20.42	Blue gray hard shale & siltstone,Gray sandstone,Brown fractured sandstone,Blue gray sandstone	Domestic
352992	TRABER, DALE #1504	SITE 14 RR8, CALGARY 21	NE	30	22	2	5	48.8	36.6	48.8		13.72	Gray shale,Gray sandstone,Gray shale	Domestic
356160	BAYLY, VIC	1475 550 6 AVE SW, CALGARY	NE	30	22	2	5	76.2	0	0		38.10	Gray sandstone	Domestic
357254	BAYLY, VIC #1590	1475-550 5 AVE SW, CALGARY	NE	30	22	2	5	54.9	42.7	54.9		15.24	Clay & Rocks,Shale & Sandstone Ledges,Sandstone,Gray shale,Gray shale	Domestic
358915	BAILEY, VIC	SITE 14 RR8, CALGARY 23 T2J 2T9	NE	30	22	2	5	61	0	0			Gray shale	Domestic
359023	BAILEY, VIC	SITE 14 RR8, CALGARY 23 T2J 2T9	NE	30	22	2	5	9.1	7.6	9.1		1.77	Clay & Rocks,Wet sand & gravel	Domestic
377454	CAMERON, WM	RR8, CALGARY	NE	30	22	2	5	35.1	0	0	1066.8	12.19	Sandrock	Domestic
349208	REHMAN MEL	620 146 AVE SW, CALGARY	NW	30	22	2	5	57.9	0	0	0.0	4.57	Black shale	Domestic
377453	MACKENZIE, W.D.C.	RR8, CALGARY	NW	30	22	2	5	16.5	14.6	16.5		2.13	Blue clay,Gray shale,Sandstone	Domestic
350731	ARTHURS, ROBIN	PRIDDIS 28 T0L 1W0	SE	30	22	2	5	61	19.8	59.4		19.81	Brown sandstone,Gray shale,Gray shale & sandstone,Light gray water bearing sandstone,Gray shale & sandstone,Gray sandstone	Domestic
351844	ARTHURS, ROBIN	PRIDDIS 28 T0L 1W0	SE	30	22	2	5	61	38.1	59.4		37.19	Light gray fractured sandstone,Gray shale & sandstone,Light gray water bearing sandstone,Gray shale,Light gray water bearing sandstone	Domestic
377434	DEMICELL, BARNEY	SITE 14, RR8, CALGARY 2	SE	30	22	2	5	35.7	29.9	35.4		29.26	Gray shale,Brown shale,Gray shale,Water bearing coal,Gray shale	Domestic
377435	DEMICELL, BARNEY	PRIDDIS	SE	30	22	2	5	50	39.6	49.7		37.80	Old Well,Gray shale,Light water bearing sandstone	Domestic
377436	EVANS, ED	100 LAKE LINNET CLOV, CALGARY	SE	30	22	2	5	41.2	35.1	41.2		6.10	Clay & Rocks,Shale & Sandstone	Domestic
377439	CALALTA REALTY/ B. THOMAS	5343 LAKEVIEW DR, CALGARY	SE	30	22	2	5	36.6	30.5	36.6			Clay & Rocks,Shale & Sandstone	Domestic
377440	ARTHURS, ROBIN	MIDNAPORE 32	SE	30	22	2	5	45.7	36.6	44.8		0.00	Brown sandstone & shale strg's,Light gray sandstone,Gray shale,Dark sandstone	Domestic
377441	ARTHURS, ROBIN	MIDNAPORE 32 T0L 1J0	SE	30	22	2	5	57.9	39.6	56.4		39.62	Old Well,Gray shale,Light gray water bearing sandstone	Domestic
377444	STELLA HOLDINGS LTD	5,4215-61 ST SE, CALGARY	SE	30	22	2	5	39.6	27.4	39.6		16.76	Brown hard shale,Blue gray hard shale & sandstone	Domestic
377445	STELLA HOLDINGS LTD.	5,4215-61 AVE SE, CALGARY	SE	30	22	2	5	44.2	30.5	44.2		16.76	Coal,Blue gray hard shale & sandstone ledges	Domestic
377446	STELLA HOLDINGS LTD	5,4215-61 AVE SE, CALGARY	SE	30	22	2	5	47.2	32	47.2		13.72	Brown shale & sandstone,Blue gray hard shale & sandstone	Domestic
377448	HARRIS, BOB	SITE 14, RR8, CALGARY, T2J 2T9 18	SE	30	22	2	5	61	48.8	61		36.58	Green shale,Gray shale,Water bearing sandstone,Gray shale,Sandstone,Gray shale	Domestic and Stock
384970	MCCAUGHAM, DELMER	SITE 14 RR8, CALGARY 28 T2J 2T9	SE	30	22	2	5	39.6	15.2	21.3		11.06	Sandstone	Domestic
349126	PARKSIDE MGMT #1937	SITE 14 RR8, CALGARY 21 T2J 2T9	SW	30	22	2	5	38.1	25.9	38.1		16.46	Gray clay,Blue gray shale & sandstone ledges,Greenish gray coarse grained sandstone,Blue gray hard shale & sandstone ledges	Domestic
351140	PEARSON KEN C/O TRABER DALE	SITE 14 RR8, CALGARY 21	SW	30	22	2	5	21.3	16.2	19.2		9.14	Sand & Gravel,Gray sandstone	Domestic
352991	TRABER, DALE #1503	SITE 14 RR8, CALGARY 21	SW	30	22	2	5	25.9	13.7	25.9		10.67	Brown sandstone,Gray sandy shale,Gray water bearing sandstone,Gray shale	Domestic
377451	PARSONAGE, SHANE	GENERAL DELIVERY, PRIDDIS	SW	30	22	2	5	22.9	11.9	16.8		8.84	Water bearing gravel,Gray shale,Light gray sandstone	Domestic and Stock
378638	BARKER, N.S.	1120 PROSPECT AVE NE, CALGARY	SW	30	22	2	5	42.7	0	0	1172.0	33.53	Blue gray shale	Domestic and Stock
377551	EDGAR, GEORGE	SITE 2, CALGARY 11	NE	31	22	2	5	60.96	30.48	60.96		13.72	Gray shale,Gray shale & sandstone,Brown shale,Gray shale,Blue shale & sandstone,Coal,Sandstone,Coal,Brown shale	Domestic
377554	SHAW, KINNAIRD	MIDNAPORE 28	NE	31	22	2	5	91.44	29.57	90.22		23.77	Brownish gray shale,Gray shale,Light water bearing sandstone,Gray shale,Gray shale & sandstone ledges,Gray shale,Dark sandstone,Gray shale,Blue shale,Gray shale,Dark sandstone,Gray water bearing shale	Domestic
377557	EDGAR, GEORGE	SITE 2, CALGARY 11	NE	31	22	2	5	36.58	7.01	36.58		18.29	Old Well,Green shale,Blue shale,Gray shale,Sand	Domestic

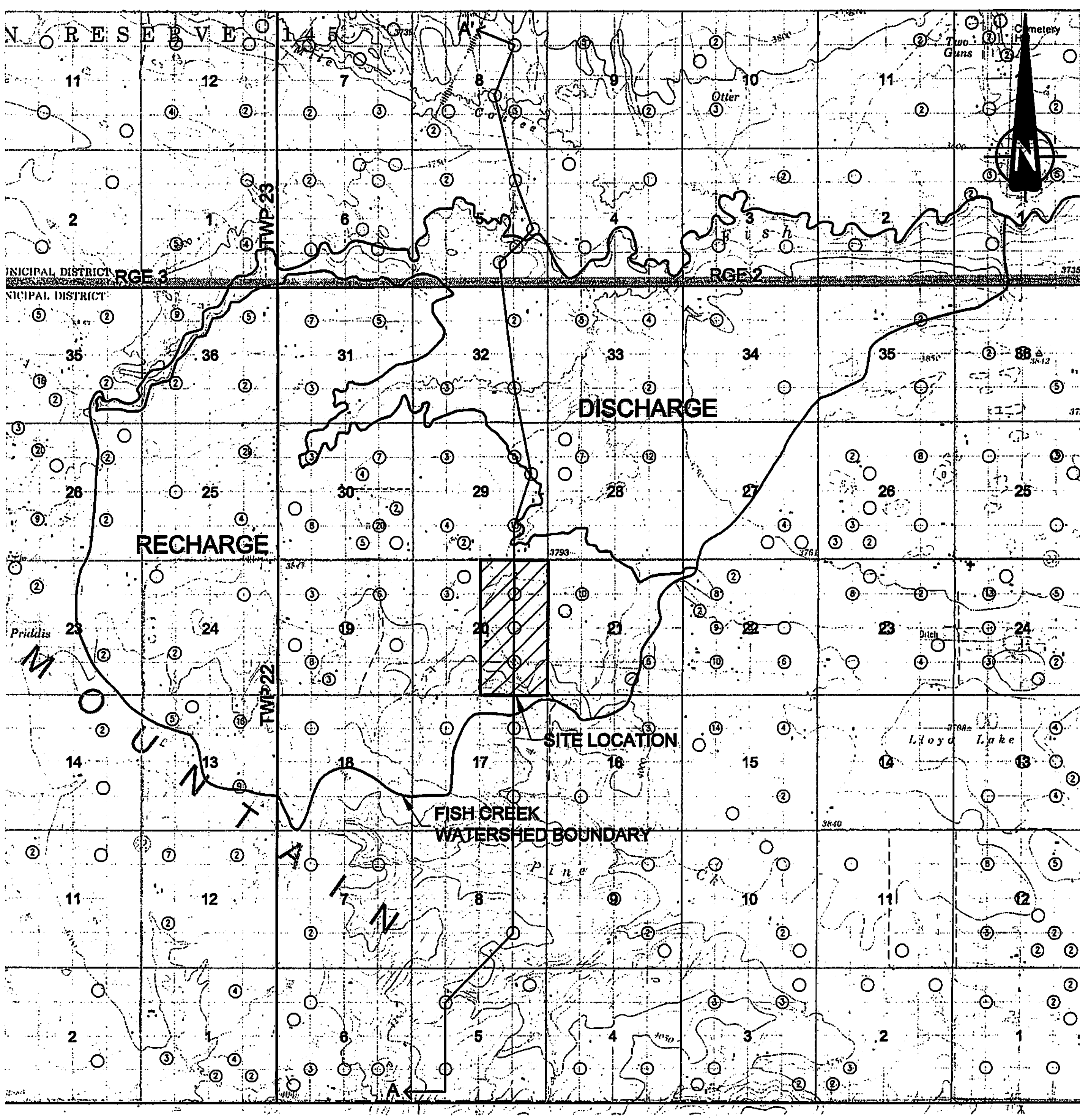
TA[illegible]
WATER WELLS LOCATED WITHIN 6.5 KM [illegible]DIUS INSIDE FISH CREEK WATERSHED
RED WILLOW ESTATES

Well ID	Owner	Address	LSD	Sec	Twp	Rge	Mer	WellDepth	PerfFrom	PerfTo	Elev	StaticWL	Lithology at Screen	Proposed Use
377561	SHAW, KINNAIRD	MIDNAPORE 23	NE	31	22	2	5	123.47	[illegible]	[illegible]	[illegible]	12.80	Brown clay & rocks,Shale,Sandstone,Shale,Sandy shale & sandstone ledges	Domestic and Stock
377564	SHAW, KINNAIRD	MIDNAPORE 23	NE	31	22	2	5	193.07	0	0		no w.l.	Sandstone	Domestic and Stock
349920	DIXON, TONI & HOWIE	SITE 2 RR1, CALGARY 5 T2J 2T9	NW	31	22	2	5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Grey shale	Domestic
358239	THOMPSON, MARGRET #1572	2507 CHATEAU PL NW, CALGARY T2M 4X8	NW	31	22	2	5	22.86	13.72	22.86		12.19	Clay & Rocks,Grey shale,Brown water bearing sandstone,Grey shale	Domestic and Stock
361093	THOMPSON, MARGRET #1572	2507 CHATEAU PL NW, CALGARY T2M 4X8	NW	31	22	2	5	154.84	42.67	154.83		18.54	Blue grey shale,Blue sandy shale,Blue sandstone,Blue grey shale,Blue sandy shale,Blue sandstone,Blue grey shale	Domestic
377436	LA GRANDE VUE RANCH	1204 BELAVISTA CR SW, CALGARY	NW	31	22	2	5	24.38	13.72	19.81		17.07	Clay & Rocks	Stock
377437	KERSHAW, WM H	1204 BELAVISTA CR SW, CALGARY	NW	31	22	2	5	27.43	7.92	10.67		3.05	Yellow clay & boulders,Yellow sandstone	Domestic
377433	GOODWIN, B.K.	RR1, CALGARY T2J 2T9	NW	31	22	2	5	44.81	34.53	42.67		21.95	Water bearing sandrock,Blue shale	Domestic
377439	EDGAR, GEORGE	PRIDDIS	NW	31	22	2	5	[illegible]	[illegible]	[illegible]		[illegible]	Black shale,Grey shale,Grey water bearing sandstone,Black shale,Grey shale	Domestic and Stock
349046	SMITH, KEN #1292	#5,6143 - 4TH ST SE, CALGARY T2H 2H9	SW	31	22	2	5	41.76	29.57	41.76		17.68	Grey sandstone,Grey hard shale,Grey water bearing sandstone,Grey shale,Grey sandstone	Domestic
331845	[illegible]	RR1 SITE 2, CALGARY 67 T2J 2T9	NW	31	22	2	5	[illegible]	[illegible]	[illegible]		22.74	Grey shale & sandstone,Light grey water bearing sandstone	Stock
466053	ANDERSEN, M.	SITE 8 RR1, PRIDDIS 7 T0L 1W0	SW	31	22	2	5	43.72	21.34	44.2		17.98	Grey shale,Brown sandstone,Blue shale,Light grey sandstone	Domestic
377575	KROMM, FRED	RR1,CALGARY	NE	32	22	2	5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Blue clay	Domestic
377577	KROMM, FRED	RR1, CALGARY	NE	32	22	2	5	24.38	0	0	1127.8	no w.l.	no borehole description	Domestic
[illegible]	DAWSON, HAL #1391	SITE 6 RR1, CALGARY 8	NE	32	22	2	5	[illegible]	[illegible]	[illegible]		16.78	Grey shale & sandstone ledges,Grey water bearing sandstone,Grey shale	Domestic
359989	SILVER, BRIAN	STE 512 1040 7 AVE SW, CALGARY	SE	32	22	2	5	54.9	42.7	54.9		14.63	Grey shale,Brown sandstone,Grey water bearing sandstone,Grey shale,Grey sandstone,Green shale,Grey sandstone,Grey shale	Domestic
377567	MACQUARRIE, I.	43 SIDNEY DR SW, CALGARY	NE	32	22	2	5	[illegible]	27.4	[illegible]		13.54	Blue clay	Domestic
377570	RODGERS, W.J.	RR3, CALGARY 5	SE	32	22	2	5	18.29	0	0	1130.8	no w.l.	no borehole description	Domestic
354340	DURANTE, JOE	C/O 1 6125 12 ST, SE CALGARY T2H 2K1	SW	32	22	2	5	59.4	[illegible]	[illegible]		9.14	Blue shale	Domestic
361225	DURANTE, KATHY HOLE #2	2107 7 ST NE CALGARY T2E 4C7	SW	32	22	2	5	59.4	42.7	45.4		18.29	Dark shale	Stock
377572	DURANTE, JOE	2107-7 ST NE, CALGARY T2E 4C7	SW	33	22	2	5	73.7	0	0			Shale	Stock
377593	GREGG, J.W.	520-46 AVE SW, CALGARY	NE	33	22	2	5	34.25	0	0		no w.l.	no borehole description	Domestic
377594	UNITED FEEDS LTD	14910-4 ST SW, MIDNAPORE	NE	33	22	2	5	21.34	17.68	21.03		13.72	Clay & Sandstone	Industrial
377595	GREGG, J.W.	915-48AVE SW, CALGARY	NE	33	22	2	5	53.34	36.53	51.82		33.53	Brown shale,Brown water bearing shale & sandstone ledges	Domestic
466057	GREGG, ALAN	SITE 4 RR8, CALGARY 12 T2J 2T9	NE	33	22	2	5	54.86	48.77	54.86		34.11	Blue shale & sandstone ledges,Grey sandstone	Domestic
377586	E&P SALERS RANCHES	6173-6 ST SE, CALGARY	NW	33	22	2	5	42.67	34.14	41.76		15.54	Grey silty shale,Grey firm shale,Grey hard sandstone	Domestic and Stock
377588	E&P SALERS RANCHES	6173-6 ST SE, CALGARY	NW	33	22	2	5	30.48	23.77	29.57		5.49	Grey firm shale	Domestic and Stock
377589	E&P SALERS RANCHES	6173-6 ST SE, CALGARY	NW	33	22	2	5	39.62	32.92	38.71		4.57	Grey sandy shale,Grey water bearing sandstone	Domestic and Stock
377591	E&P SALERS RANCHES	6173-6 ST SE, CALGARY	NW	33	22	2	5	45.72	[illegible]	44.81		1.22	Light grey hard sandstone,Light grey shale,Grey water bearing sandstone	Stock
377592	MADER	SITE 6, RR8, CALGARY 10	NW	33	22	2	5	18.29	0	0		no w.l.	no borehole description	Domestic
377580	RILEY, DOUG		SE	33	22	2	5	45.72	0	0		no w.l.	Shale & Sandstone	Domestic
377533	CALALTA REALTY/ BILL GOODWIN	7310 MACLEOD TR, CALGARY	SE	33	22	2	5	32	23.91	32		12.19	Clay & Rocks,Shale & Sandstone	Domestic
[illegible]	HARVEY, JACK	RR8, CALGARY	NW	34	22	2	5	[illegible]	37.19	[illegible]		37.80	Clay & Gravel,Grey clay & shale,Water bearing sandstone,Blue clay & shale	Domestic and Stock
466059	RUNGE, DON	SITE 1 RR1, PRIDDIS 8 T0L 1W0	SE	34	22	2	5	59.44	51.82	57.91		16.76	Grey shale	Stock
377597	BRODYLO, [illegible]	MIDNAPORE	NE	35	22	2	5	54.86	0	0	1176.5	no w.l.	no borehole description	Domestic
377598	HUDSON'S BAY OIL & GAS# SP153		NE	35	22	2	5	0	0	0		no w.l.	no borehole description	Industrial
[illegible]	[illegible] GEORGE	MIDNAPORE 143	SE	36	22	2	5	[illegible]	0	0		no w.l.	no borehole description	Domestic
377599	HALL, LINDA	RR8, CALGARY	SE	36	22	2	5	24.38	0	0		no w.l.	no borehole description	Domestic
377600	HILTON BROS	MIDNAPORE	SE	36	22	2	5	[illegible]	0	0		4.71	Yellow sandstone	Stock
377601	HILTON BROS	MIDNAPORE	SE	36	22	2	5	22.25	0	0		7.92	Grey clay & shale	Domestic
377602	SANDELANDS, WILLIAM	RR8, CALGARY T2J 5G5	SE	36	22	2	5	60.96	42.67	[illegible]		42.06	Brown clay & sandstone layers,Grey shale & sandstone ledges,Light grey water bearing sandstone	Stock
377603	SANDELANDS, BILL	RR8, CALGARY T2J 5G5	SE	36	22	2	5	30.47	9.14	15.24		7.62	Shale,Water bearing sandstone	Domestic and Stock
377604	CLARK, BOB	SITE 21, RR8, CALGARY	[illegible]	36	22	2	5	0	0	0		no w.l.	no borehole description	Domestic
377605	CLARK, BOB	SITE 21, RR8, CALGARY 1 T2J 5G5	[illegible]	36	22	2	5	0	0	0		no w.l.	no borehole description	Domestic
400722	SIMEON, JIM	401 CUSTOMS BLDG, CALGARY		1	23	2	5	41.15	0	0	1033.6	22.61	Blue shale	Domestic
400723	SIMEON, JIM	SARCEE RESERVE		1	23	2	5	54.86	42.77	53.34	1033.6	28.71	Sand,Grey shale,Water bearing sandstone	Domestic
400726	SARCEE NATION ADMIN #145	3700 ANDERSON RD SW, CALGARY		[illegible]	23	2	5	[illegible]	[illegible]	[illegible]		14.76	Grey medium grained sandstone,Dark grey shale,Grey wet sandstone,Black shale,Grey medium grained sandstone,Grey coarse grained sandstone & shale strg's,Grey shale	Domestic
400731	SARCEE BAND HOUSING AUTH	CALGARY	SW	1	23	2	5	36.58	12.19	36.58		14.76	Clay & Rocks,Shale & Sandstone	Domestic
400732	CROWCHILD, CHARLES	3700 ANDERSON RD SW, CALGARY 81 T2W 3C4	[illegible]	[illegible]	23	2	5	[illegible]	68.19	92.57		68.58	Sandstone & Shale Strg's,Lost Circulation	Domestic
400734	BIG PLUM, GODFREY	SARCEE	SE	2	23	2	5	39.62	33.02	39.62	1143	13.72	Shale,Sandstone	Domestic
[illegible]	LITTLELIGHT, [illegible]	SARCEE	[illegible]	2	23	2	5	[illegible]	[illegible]	[illegible]	[illegible]	0.30	Shale,Sandstone	[illegible]
400741	AMERADA HESS CORP [illegible]			2	23	2	5	12.19	0	0	1127.8	no w.l.	no borehole description	Industrial
400739	[illegible] PLUMBING	[illegible] PL SW, CALGARY		2	23	2	5	[illegible]	[illegible]	[illegible]		21.64	Grey till,Light sandstone,Grey sandstone & shale strg's	Domestic
400740	SARCEE NATION ADMIN	3700 ANDERSON RD SW, CALGARY		2	23	2	5	41.15	33.05	41.15		23.77	Wet sandstone,Blue grey shale,Wet sandstone,Grey shale	Domestic
[illegible]	WHITNEY, LAWRENCE	[illegible] CALGARY	[illegible]	[illegible]	23	2	5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Grey shale,Brown shale,Light grey sandstone,Grey shale,Dark sandstone,Brown sandstone,Grey shale	Domestic
400747	WHITNEY, JOHN	PRIDDIS 9	SW	4	23	2	5	67.06	27.43	67.06		28.21	Clay,Blue grey shale & sandstone	Domestic
[illegible]	[illegible]	[illegible] CALGARY	[illegible]	[illegible]	[illegible]	[illegible]	5	[illegible]	[illegible]	[illegible]		27.43	Dark grey sandstone,Dark grey shale,Grey sandstone,Water bearing sandstone	Domestic
349994	LYONS, LAUCHLIN #3216	BOX 30332, CHINOOK RPO, CALGARY 0000 T2H 2W1	NE	13	22	3	5	42.7	30.5	42.7		22.49	Grey shale,Grey fractured sandstone,Grey water bearing sandstone,Grey sandstone,Grey sandy shale	Domestic
350067	MURRAY, KEN #3412	SITE 2 RR8,CALGARY 25 T2J 2T9	NE	13	22	3	5	38.1	25.9	36.6		20.60	Brown sandy shale,Grey shale,Grey sandstone,Dark grey shale,Grey shale,Grey sandstone,Grey shale,Grey sandstone	Domestic
377765	RISTZE, HOWARD	3333-30 ST SW, CALGARY	NE	13	22	3	5	39.6	12.2	[illegible]		7.62	Till,Brown sandstone	Domestic
377767	WATSON, DON	1132-120 AVE SE, CALGARY	NE	13	22	3	5	41	0	0			Grey clay & shale	Unknown
377769	CORAL CONSTRUCTION	1520 MERIDIAN RD NE, CALGARY	NE	13	22	3	5	31.7	9.5	12.2		7.61	Blue clay,Grey sandstone	Unknown
377771	STANFIELD	5330 FAIRMOUNT DR SE, CALGARY	NE	13	22	3	5	45.7	0	0			Shale	Unknown
377773	WATSON, DON	1132-120 AVE SE, CALGARY	NE	13	22	3	5	40.8	13.3	25.9		14.33	Grey sandstone,Grey clay	Unknown
[illegible]	DON-LEX CRAY MANAGEMENT	[illegible]	NE	13	22	3	5	[illegible]	0	0			Grey shale	Unknown
377780	GOODWIN, RON	SITE 2, RR8, CALGARY 13	NE	13	22	3	5	45.7	21.3	44.5		19.81	Grey shale,Light grey water bearing sandstone,Grey shale,Light grey water bearing sandstone,Grey shale	Unknown
377782	WATSON, DON	SITE 2, RR8, CALGARY 33	NE	13	22	3	5	[illegible]	[illegible]	[illegible]		11.58	Brown sandstone,Grey shale,Light grey water bearing sandstone,Grey shale,Grey shale & sandstone ledges	Domestic
377784	RISTZE, HOWARD	SITE 2, RR8, CALGARY 39	NE	13	22	3	5	63.7	27.4	62.5		12.80	Brown shale,Grey shale,Grey sandstone,Grey shale,Light sandstone,Light grey water bearing sandstone,Dark grey shale,Dark water bearing sandstone,Dark grey shale,Dark water bearing sandstone,Dark grey	Domestic and Stock
377787	GRAY, BOB	300, 230-8 AVE SW, CALGARY T2P [illegible]	NE	13	22	3	5	38.1	25.9	38.1		13.29	Grey shale,Grey water bearing sandstone,Black shale	Domestic and Stock
377789	STANFIELD, M.J.	5330 FAIRMOUNT DR SE, CALGARY	NE	13	22	3	5	25	24.4	27.4		13.41	Grey sandstone & shale strg's,Hard sandstone,Grey water bearing sandstone	Domestic
461110	JEFFERS, HAROLD	SITE 2 RR8, CALGARY 53 T2J 2T9	NE	13	22	3	5	[illegible]	[illegible]	19.8		3.05	Grey shale,Grey water bearing sandstone,Grey shale,Grey water bearing	Domestic
351874	MACLAREN, ED	PRIDDIS 32	NW	13	22	3	5	54.6	36.6	54.6		30.48	Fractured sandstone,Clayey sandstone,Shale	Domestic
[illegible]	STANDISH, [illegible]	PRIDDIS [illegible]	NW	13	22	3	5	[illegible]	[illegible]	[illegible]		16.76	Blue shale	Domestic
377756	PHOTO ZENITH TUBE OBSERVATORY	PRIDDIS	NW	13	22	3	5	37.5	0	0		13.29	Blue firm shale	Domestic
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		21.34	Grey shale,Grey shale & sandstone ledges,Light grey water bearing sandstone,Grey shale,Light grey water bearing sandstone	Domestic and Stock
349633	WADDOCK, TERRY	14016 PARKLAND BLVD,CALGARY, ALTA	SE	13	22	3	5	33.1	19.8	33.1		13.29	Fractured Sandstone,Grey shale,Water bearing sandstone,Grey shale	Domestic
343481	WADDOCK, TERRY	PRIDDIS 42 T0L 1W0	SE	13	22	3	5	[illegible]	41.2	[illegible]		[illegible]	Shale & Sandstone Ledges,Sandstone	Domestic
343482	WADDOCK, TERRY	PRIDDIS 42 T0L 1W0	SE	13	22	3	5	37.2	25.9	36.6		24.99	Shale & Sandstone Ledges,Sandstone,Shale,Shale & Sandstone Ledges,Sandstone	Domestic
[illegible]	WADDOCK, TERRY	[illegible] PARKLAND BLVD, CALGARY	SE	13	22	3	5	[illegible]	[illegible]	[illegible]		13.29	Fractured Sandstone,Grey shale,Water bearing sandstone,Grey shale	Domestic
467796	WADDOCK, TERRY	PRIDDIS 42 T0L 1W0	SE	13	22	3	5	54.9	33.5	[illegible]		17.65	Shale	Domestic
467797	WADDOCK, TERRY	PRIDDIS 42 T0L 1W0	SE	13	22	3	5	[illegible]	30.5	[illegible]		24.69	Cemented sandstone,Sandstone	Domestic
467798	WADDOCK, TERRY	PRIDDIS 42 T0L 1W0	SE	13	22	3	5	73.2	51.8	70.1		30.10	Clay,Shale & Sandstone Ledges	Domestic
467799	WADDOCK, TERRY	PRIDDIS 42 T0L 1W0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	36.6	51.8		23.16	Clay & Rocks,Shale,Sandstone	Domestic
490027	WADDOCK, TERRY	PRIDDIS 42 T0L 1W0	SE	13	22	3	5	58.2	38.1	54.9			Sandstone,Shale & Sandstone Ledges,Shale & Sandstone	Domestic
335275	WATSON, DON HOLE #1	MILLARVILLE	NE	14	22	3	5	[illegible]	[illegible]	24.4		15.54	Sandstone,Water bearing sandstone,Soft shale	Domestic
335276	WATSON, DON HOLE #2	MILLARVILLE	NE	14	22	3	5	36.6	14.3	17.4		14.02	Clay,Sandstone	Domestic
344625	MONTEITH, BILL	SITE 2 CALGARY [illegible]	[illegible]	23	22	3	5	[illegible]	[illegible]	[illegible]		21.64	Dark grey shale,Dark grey shale & sandstone ledges	Domestic and Stock
377907	SWANSEN, H.A.	PRIDDIS	SE	23	22	3	5	15.5	13.4	15.5	1234.44	6.10	Clay & Sandstone,Blue clay,Water bearing sandstone	Domestic
377920	STANDISH, GRANT	RR1, CALGARY	SW	23	22	3	5	[illegible]	[illegible]	[illegible]	[illegible]	3.96	Brown clay,Grey shale,Blue shale,Light sandstone,Blue shale,Dark sandstone,Grey shale	Domestic
349458	LEEDE, WALTER	SITE 2 RR 8,CALGARY, ALTA 59 T2J 2T9	NE	23	22	3	5	51.8	27.4	51.8		10.06	Sandstone,Grey shale,Sandstone,Grey shale,Water bearing sandstone,Grey shale	Domestic and Stock
349472	MACINNES, DON	SITE 2 RR8,CALGARY, ALTA 33	NE	23	22	3	5	[illegible]	24.4	36.6		13.29	Grey shale,Sandstone	Stock
349153	RADKE, ART	SITE 2 RR8, CALGARY, ALTA 51	NE	23	22	3	5	47.2	41.2	47.2		0.00	Blue shale,Grey shale,Grey shale & sandstone	Domestic
[illegible]	RADKE, ART	SITE 2 RR8,CALGARY, ALTA 51	NE	23	22	3	5	[illegible]	[illegible]	[illegible]		4.57	Clay & Gravel,Hard sandstone,Sandstone,Hard sandstone	Domestic
361719	RADKE, ART	SITE 2 RR8, CALGARY 51	NE	23	22	3	5	47.2	41.2	47.2	1150.62	4.57	Blue shale,Grey shale,Grey coarse grained shale & sandstone	Domestic
[illegible]	HOWARTH, FLORENCE	SITE 2 RR8 CALGARY 23 T2J 2T9	[illegible]	23	22	3	5	[illegible]	[illegible]	[illegible]		10.06	Grey till,Gravel	Domestic
374370	HOWARTH, BERT	SITE 2 RR8, CALGARY 23 T2J 2T9	NE	23	22	3	5	31.8	40.5	30.3		14.94	Grey shale,Light grey water bearing sandstone	Domestic
377941	BRIDGEWATER	205 STOCKYARD BLDG, CALGARY	NE	23	22	3	5	33.5	27.8	[illegible]	1153.24	[illegible]	Clay & Rocks,Shale & Sandstone	Unknown
377943	BROOKWELL, JERRY		NE	23	22	3	5	42.7	30.5	42.7		6.10	Sandy clay & rocks,Sandy shale & sandstone	Domestic
[illegible]	BOOTH, ROBERT	RR8, CALGARY 21	NE	23	22	3	5	41.2	[illegible]	41.2		6.10	Clay & Rocks,Shale & Sandstone	Domestic
377951	BOOTH, ROBERT	RR8, CALGARY 21	NE	23	22	3	5	61	54.9	61		7.32	Clay & Rocks,Shale & Sandstone	Domestic
377953	BROOKWELL, AL		NE	23	22	3	5	41.2	30.5	41.2		5.49	Sandy clay & rocks,Sandy shale & sandstone	Domestic
378001	CONINX, GEO		NE	23	22	3	5	36.6	30.5	36.6		4.57	Clay,Shale & Sandstone	Domestic
378002	HOWARTH, A.S.	[illegible] 21 AVE SW, CALGARY	NE	23	22	3	5	62.5	[illegible]	61.5	[illegible]	9.14	Clay & Rocks,Shaly sandstone & coal	Domestic
378003	KUBOTA, ED	STATION F, CALGARY 8334 T2J 2V5	NE	23	22	3	5	70.1	[illegible]	68.9	1164.34	9.45	Grey shale,Grey shale & sandstone,Grey shale,Light sandstone	Unknown
378004	CONINX, GEO		NE	23	22	3	5	[illegible]	0	0		6.10	Shale & Sandstone	Unknown
378005	CONINX, GEO		NE	23	22	3	5	41.2	0	0			Shale & Sandstone	Unknown
378006	CONINX, GEO		NE	23	22	3	5	[illegible]	0	0			Shale & Sandstone	Unknown
378007	CONINX, GEO		NE	23	22	3	5	41.2	0	0			Shale & Sandstone	Unknown
378008	LEIDE, WALTER	SITE 2, RR8, CALGARY 59 T2J 2T9	NE	23	22	3	5	[illegible]	27.4	[illegible]		10.06	Sandstone,Grey shale,Water bearing sandstone,Grey shale,Water bearing sandstone,Grey shale	Domestic and Stock
378009	MCCLEVIN, GEORGE / WHITE, M.	SITE 2, RR8, CALGARY 10 T2J 2T9	NE	23	22	3	5	79.3	0	0		0.00	Grey shale	Domestic
378012	MACINNES, DON	SITE 2, RR8, CALGARY 33	NE	23	22	3	5	[illegible]	[illegible]	[illegible]		13.29	Grey shale,Unknown,Water bearing sandstone,Sandstone	Domestic and Stock
378930	DEANS, RUTH A.	68 HALLBROOK PL. SW, CALGARY	NE	23	22	3	5	41.7	39.6	41.2		0.00	Clay & Rocks,Shale & Sandstone	Domestic
[illegible]	HOWARTH, FLORENCE	SITE 2 RR8, CALGARY 23 T2J 2T9	NE	23	22	3	5	[illegible]	[illegible]	[illegible]	[illegible]	12.50	Grey shale & sandstone ledges,Light grey water bearing sandstone	Domestic
377929	XUNDERT SERVICE	RR8, CALGARY 22	SE	23	22	3	5	36.6	0	0	[illegible]	6.10	Shale & Sandstone	Domestic
347008	MONTEITH, BILL	RR1, CALGARY 42 T2J 2T9	SE	23	22	3	5	54.9	19.8	53.3		7.92	Grey sandy till,Grey sandy till	Domestic
413121	MONTEITH, BILL	SITE 2 RR1, CALGARY 42 T2J 2T9	SE	23	22	3	5	36.6	21.3	35.1		5.79	Light grey sandstone,Grey shale,Light grey water bearing sandstone	Domestic
377937	RENNER, RUTH	RR1, PRIDDIS, T0L 1W0	[illegible]	23	22	3	5	45.7	21.3	44.2		5.49	Brown shale,Grey shale	Stock
394676	STEWART, MARIE	LACOMBE 354 T0C 1S0	16	26	22	3	5	36.6	27.4	36.6		1.89	Dark grey shale,Grey shale,Dark grey sandstone	Domestic
378036	ARMITAGE, R.B.	1303 FRONTENAC AVE, CALGARY	NE	26	22	3	5	[illegible]	24.4	54.9	[illegible]	14.63	Grey shale,Blue shale,Dark sandstone,Grey shale,Coal,Blue shale,Grey shale	Unknown
378037	ARMITAGE, RICHARD	RR1, PRIDDIS T0L 1W0	NE	26	22	3	5	41.2	27.4	39.6	1153.24	11.58	Light grey sandstone,Grey shale,Dark grey water bearing sandstone,Grey shale,Dark grey water bearing sandstone	Stock
378015	DEPT OF ENV C/O W. RENNER	10040-104 ST, EDMONTON	SE	26	22	3	5	[illegible]	[illegible]	[illegible]		[illegible]	Clay & Boulders,Hard clay & sand,Shale,Sandstone	Domestic and Stock
378217	MERRETTE, BOB	GEN DEL, PRIDDIS	SE	26	22	3	5	27.7	21.6	26.5	1131.1	11.32	Gravel	Domestic
378223	MCLAWS, D.P.	25, 301-6 AVE SW, PRIDDIS	NE	36	22	3	5	46.9	0	0		33.53	Grey sandstone	Unknown
378225	CHARTWEST LTD	313-5 AVE SW, CALGARY	NE	36	22	3	5	[illegible]	41.2	45.1		30.78	Shale,Sandstone	Domestic and Stock
378227	MACGDEN RANCHES	PRIDDIS	NE	36	22	3	5	[illegible]	[illegible]	[illegible]		[illegible]	Gravel,Grey shale,Blue shale,Light water bearing sandstone	Domestic and Stock
378229	CHARTWEST LTD	313-5 AVE SW, CALGARY	NE	36	22	3	5	73.2	51.8	57.9		40.23	Sandstone,Shale & Sandstone Ledges,Sandstone	Stock
378197	SHILOH RANCH	SITE 5, RR1, PRIDDIS 4 T0L 1W0	NW	36	22	3	5	[illegible]	[illegible]	[illegible]		[illegible]	Grey till	Domestic
[illegible]	FILLIK, JACK	SITE 5, RR1, PRIDDIS 8	NW	36	22	3	5	[illegible]	[illegible]	[illegible]		4.57	Grey till,Grey shale	Domestic
378216	FILLIK, JACK & CAROL	SITE 5, RR1, PRIDDIS 8 T0L 1W0	NW	36	22	3	5	[illegible]	[illegible]	[illegible]		[illegible]	Sandstone,Laminated siltstone,Fine grained sandstone,Grey water bearing sandstone,Brownish grey coarse grained sandstone	Domestic
378213	FILLIK, JACK	SITE 5, RR1, PRIDDIS 8 T0L 1W0	NW	36	22	3	5	25.6	19.5	25.6		3.66	Fine grained sandstone,Shale,Moist sandstone,Grey water bearing sandstone,Shale	Domestic
[illegible]	FILLIK, JACK & CAROL	SITE 5, RR1, PRIDDIS 8 T0L 1W0	NW	36	22	3	5	[illegible]	[illegible]	30		6.10	Shale,Grey fine grained sandstone,Shale,Water bearing siltstone & sandstone,Water bearing sandstone,Sandstone & Shale Strg's,Sandstone,Shale & Siltstone,Shale,Siltstone	Domestic
332657	PLANTINGA, JOHN & SHARON		NW	36	22	3	5	[illegible]	[illegible]	10.7		1.22	Grey till,Grey till	Domestic
[illegible]	SHILOH RANCH	SITE 5, RR1, PRIDDIS 4	NW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	Old Well,Grey shale	Domestic
378192	WILLIAMSON, RON		SE	36	22	3	5	33.1	22.9	29		9.14	Shale,Sandstone	Domestic
[illegible]	PAISLEY, JARED	SITE 2, RR1, CALGARY 47 T2J 2T9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	Shale	Domestic
378194	WILLIAMSON, R.A.	RR3, CALGARY	SW	36	22	3	5	36	12.3	29		6.40	Clay & Boulders	Stock
[illegible]	WILLIAMSON, R.A. WELL 1	RR3, CALGARY	SW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	Shale,Sandy shale & sandstone	Domestic
400912	SARCEE NATION #145		SE	1	23	3	5	51.8	45.7	51.8		10.36	Fractured sandstone,Shale,Fractured shale,Wet sandstone,Fractured sandstone	Domestic
[illegible]	DODGINGHORSE, LYLE [illegible]	[illegible] BLVD SW, CALGARY [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5	42.7	36.6	42.7		[illegible]	Brown sandy clay & rocks,Grey medium grained sandstone,Grey water bearing sandstone	Domestic

TAL
AQUIFER ASSIGNMENT
RED WILLOW ESTATES

Well ID	Registered Owner	LSD	Sec	Twp	Rng	Mer	Total Well Depth [m]	Elevation of bottom of borehole [m]	Top of Screen Elevation [mAMSL]	Bottom of screen elevation [mAMSL]	Elevation [mAMSL]	Static Water Level [m]	Lithology at Screen	Proposed Use	Recommended pumping rate (gpm)	Recommended pumping rate (L/s)	Assigned Water Bearing Unit
378187	SHILOH RANCH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			1
378159	FELIX, JACK	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			1
378214	FELIX, JACK & CAROL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			1
378218	FELIX, JACK	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			1
378221	FELIX, JACK & CAROL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			1
383657	PLANTINGA, JOHN & SHARON	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			1
383230	SHILOH RANCH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			1
377384	ROTINEY FARMS	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
497043	BAVARIAN LION CO LTD.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
377442	OHANLON, HARRY	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
377502	WESTWARD CONSTRUCTION	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
377505	CLAYDON	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
349668	WOODS, DR & SONS	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
349929	DAWSON, HAL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
355445	DOUBLE B FARMS #1295	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
355446	DOUBLE B FARMS #1300	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
377923	DOUBLE B FARMS	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
377926	DOUBLE B FARMS	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
355160	KOTERA, JOHN	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
377935	KOTERA, J.C.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
364623	PHIL'S INDUSTRIES OF CANADA	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
364636	TELFAULT, PHIL M	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
379218	D.P. FALER RANCH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
377412	DONKE, HANS	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
358616	PARKSIDE MGMT #1630	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
351845	GILL, S	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
357765	DAWSON, HAL #1391	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
359484	SILVER, BRIAN	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
377392	MACQUARRIE, I.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
354340	DURANTE, JOE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
361225	DURANTE, KATHY HOLE #2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
377394	UNITED FEEDS LTD	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
377395	ORSOLI, J.W.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
466057	ORSOLI, ALAN	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
377396	D&P FALERS RANCHES	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
377368	D&P FALERS RANCHES	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
377369	D&P FALERS RANCHES	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
377393	CALALTA REALTY/BILL GOODWIN	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
353961	HARVEY, JACK	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
466029	RUMOR, DON	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
400721	SARCEE BAND HOUSING AUTH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
400734	BIG PLUM, GODFREY	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
400753	LITTLE LITE, BEDFORD	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
400759	O&O PLUMBING	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
400763	SARCEE NATION ADMIN	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
400765	WHITNEY, LAWRENCE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
400767	WHITNEY, JOHN	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
361719	RADKE, ART	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
374650	HOWARTH, BERT	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
377951	BOOTH, ROBERT	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
378002	HOWARTH, A.E.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
378069	KUBOTA, ED	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
358499	HOWARTH, FLORENCE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
364676	STEWART, MARGE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
378229	CHARTWEST LTD	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
400913	SARCEE NATION #148	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			2
409181	DODGINGHORSE, LYLE/THUU TINA H	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
468143	PFEIFFER, TY	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3
377380	FLEMING, DON	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			3
377383	FLEMING, DON	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			3
377430	FLEMING, DON	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			3
359067	VAN WIELINGEN, CUR WELL #1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			3
354338	FENNIS, TIM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3
418341	BAVARIAN LION CO C/O JANZ, ROLF	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			3
418342	BAVARIAN LION CO LTD	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3
418345	BAVARIAN LION CO C/O JANZ, ROLF	NE	20	22	1	5	46	1120	1137	1123	1166	23.31	Shale & Sandstone, Sandstone, Shale & Sandstone Ledges	Domestic	10	0.76	3
417389	BAVARIAN LION CO LTD	NE	20	22	1	5	35	1112.86	1139.86	1118.86	1165.86	24.08	Shale, Shale & Sandstone, Sandstone, Shale, Sandstone, Shale & Sandstone	Domestic	10	0.76	3
437382	BAVARIAN LION CO LTD/JANZ, ROL	NE	20	22	1	5	36	1130	1144	1130	1166	12.54	Shale & Sandstone Ledges, Sandstone, Thin shale & sandstone ledges, Shale & Sandstone Ledges, Sandstone, Thin shale & sandstone ledges	Domestic	10	0.76	3
437391	BAVARIAN LION CO LTD/JANZ, ROLF	NE	20	22	1	5	40.1	1125.66	1147.56	1132.36	1165.86	12.19	Shale, Shale & Sandstone Ledges, Shale, Shale, Shale & Sandstone Ledges, Shale	Domestic			3
497042	BAVARIAN LION CO LTD.	NE	20	22	1	5	47	1119	1131	1119	1166				10	0.76	3
497050	BAVARIAN LION CO LTD	NE	20	22	1	5	39.4	1106.46	1110.78	1107.96	1165.86				15	1.14	3
360064	DAVIES, DAVE #1674	NW	20	22	1	5	46	1128	1140	1131	1175	12.00	Brown sandy shale, Grey shale, Brown water bearing sandstone	Domestic and Stock			3
377474	DAVIES, DAVE	NW	20	22	1	5	43.7	1127.78	1139.98	1130.78	1175.48	12.00	Brown sandy shale, Grey shale, Brown water bearing sandstone	Domestic and Stock			3
377507	IRVING DON	NW	21	22	1	5	34	1124	1156	1125	1158	12.80	Light blue sandstone, Siltstone	Domestic			3
377510	MCPHAIL, COLIN	NW	21	22	1	5	45.7	1112.54	1126.24	1114.04	1158.24	21.70	Light grey sandstone, Grey shale, Light grey water bearing sandstone	Domestic			3
377515	OLLA, DR.	NW	21	22	1	5	70	1088	1135	1119	1158	19.81	Clay	Domestic			3
331791	OHANLON HARRY #1417	SE	21	22	1	5	42.7	1130.78	1142.98	1130.78	1173.48	19.81	Clay, Grey shale & sandstone, Grey siltstone, Grey water bearing sandstone	Stock	7	0.53	3
355998	OHANLON, HARRY	SE	21	22	1	5	51	1123	1152	1123	1173	20.45	Clay, Brown sandstone & shale ledges	Domestic			3
377492	OHANLON, HARRY	SE	21	22	1	5	47.2	1126.28	1136.88	1126.28	1173.48	13.72	Grey shale, Grey water bearing sandstone, Grey shale	Domestic and Stock			3
377488	OHANLON, HARRY	SE	21	22	1	5	43	1131	1143	1131	1173	15.81	Clay, Grey shale & sandstone ledges, Grey siltstone, Grey water bearing sandstone	Stock	7	0.53	3
399656	NOBLE, JAN/MAWANI, SALIM	03	29	22	1	5	61	1112.48	1121.68	1115.78	1173.48	27.22	Grey sandstone, Grey thin shale & sandstone ledges, Grey sandstone, Grey thin shale & sandstone ledges	Domestic			3
399661	NOBLE, JAN/MAWANI, SALIM	03	29	22	1	5	67	1106	1119	1116	1173	30.91	Grey hard sandstone, Grey shale, Grey water bearing sandstone, Grey hard sandstone, Grey shale, Grey water bearing sandstone	Domestic			3
377428	PRAIRIE BREEDERS	NE	29	22	1	5	33.5	1109.50	1114.6	1111.6	1143	9.14	Brown hard shale, Grey shale, Water bearing sandstone	Domestic			3
353405	KROMM, KIM	NW	29	22	1	5	35	1123	1129	1123	1158	7.52	Shale, Wet sandstone, Shale	Domestic and Stock			3
377413	KROMM, JIM	NW	29	22	1	5	36.6	1121.64	1127.74	1121.64	1158.24	18.29	Sandstone, Blue water bearing shale & sandstone	Domestic			3
377415	SMART-ABBEY	NW	29	22	1	5	33	1136	1152	1126	1158	18.29	Sandstone, Black shale, Sandstone, Black shale	Domestic			3
344460	LIVINGSTON, LYAL	SE	29	22	1	5	35.1	1107.90	1120.1	1107.9	1143	12.19	Grey shale, Blue grey shale, Grey water bearing shale & sandstone, Grey shale	Domestic and Stock			3
352748	TANG, BONY #1492	SE	29	22	1	5	31	1112	1135	1112	1143	7.62	Grey sandstone, Grey shale, Grey water bearing sandstone, Grey shale	Domestic			3
377379	PRAIRIE BREEDERS	SE	29	22	1	5	30.5	1112.50	1121.7	1116.8	1143	12.19	Brown till, Brown shale, Water bearing sandstone	Domestic and Stock			3
377387	HART, BILL	SE	29	22	1	5	26	1117	1132	1116	1143	13.72	Brown shale, Grey shale, Brown shale, Water bearing sandstone	Stock			3
377394	LIVINGSTON, LYAL #2734	SE	29	22	1	5	35.4	1107.60	1120.1	1107.9	1143	12.19	Grey shale, Blue grey shale, Grey water bearing shale & sandstone	Domestic and Stock			3
377418	LECHNER, WALTER	SW	29	22	1	5	27	1116	1131	1117	1143	12.19	Brown shale & sandstone ledges, Brown sandstone, Grey shale, Light grey water bearing sandstone	Domestic			3
377422	LECHNER, WALTER	SW	29	22	1	5	30.5	1112.50	1133.9	1114	1143	4.71	Brown till, Grey shale & sandstone	Stock			3
373015	NELSON, B.	02	30	22	1	5	34	1152	1163	1152	1189	21.61	Shale, Siltstone, Shale, Fine grained sandstone, Water bearing sandstone, Fine grained siltstone & sandstone	Domestic			3
377435	GLASSEN, G.	05	30	22	1	5	32	1126.24	1133.84	1127.74	1158.24	10.67	Shale, Sandstone	Domestic			3
405138	HORSEY, IRWIN	04	30	22	1	5	25	1148	1163	1151	1173	4.88	Moist sandstone, Shale, Grey water bearing sandstone, Siltstone, Water bearing sandstone, Shale	Domestic			3
358314	PARKSIDE MGMT #1634	10	30	22	1	5	24.4	1133.84	1146.04	1133.84	1158.24	10.36	Clay & Rocks, Grey shale, Grey water bearing sandstone, Grey shale	Domestic	2	0.15	3
358315	PARKSIDE MGMT #1633	10	30	22	1	5	22	1136	1138	1136	1158	14.63	Grey sandstone, Grey shale, Water bearing sandstone, Shale	Domestic	10	0.76	3
358316	PARKSIDE MGMT #1642	10	30	22	1	5	24.4	1133.84	1144.34	1133.84	1158.24	8.53	Grey sandstone, Grey shale, Grey sandstone, Grey shale, Grey water bearing sandstone, Grey shale	Domestic			3
349985	PARKSIDE MANAGEMENT #1552	NE	30	22	1	5	35	1154	1166	1154	1189	20.42	Blue grey hard shale & siltstone, Grey sandstone, Brown fractured sandstone, Blue grey sandstone	Domestic			3
352992	TRABER, DALE #1504	NE	30	22	1	5	48.8	1139.92	1152.12	1139.92	1188.72	13.72	Grey shale, Grey sandstone, Grey shale	Domestic			3
357234	BAYLY, VIC #1590	NE	30	22	1	5	55	1134	1146	1134	1189	15.24	Clay & Rocks, Shale & Sandstone Ledges, Sandstone, Grey shale	Domestic			3
377433	MACKENZIE, W.D.C.	NW	30	22	1	5	16.5	1111.26	1113.16	1111.26	1127.76	2.13	Blue clay, Grey shale, Sandstone	Domestic			3
351644	ARTHURS, ROBIN	SE	30	22	1	5	61	1128	1181	1129	1189	37.19	Light grey fractured sandstone, Grey shale & sandstone, Light grey water bearing sandstone, Grey shale, Light grey water bearing sandstone	Domestic			3
377434	DEMCELL, BARNEY	SE	30	22	1	5	35.7	1153.02	1158.82	1153.32	1188.72	29.26	Grey shale, Brown shale, Grey shale, Water bearing sand, Grey shale	Domestic			3
377435	DEMCELL, BARNEY	SE	30	22	1	5	60	1129	1149	1129	1189	27.43	Old Well, Grey shale, Light water bearing sandstone	Domestic			3
377436	EVANS, ED	SE	30	22	1	5	41.2	1147.52	1153.62	1147.52	1188.72	6.10	Clay & Rocks, Shale & Sandstone	Domestic			3
377439	CALALTA REALTY/B. THOMAS	SE	30	22	1	5	57	1132	1158	1133	1189	[illegible]	Clay & Rocks, Shale & Sandstone	Domestic			3
377440	ARTHURS, ROBIN	SE	30	22	1	5	45.7	1143.02	1152.12	1143.92	1188.72	0.00	Brown sandstone & shale strgs, Light grey sandstone, Grey shale, Dark sandstone	Domestic			3
377441	ARTHURS, ROBIN	SE	30	22	1	5	58	1131	1149	1132	1189	39.62	Old Well, Grey shale, Light grey water bearing sandstone	Domestic			3
377444	STELLA HOLDINGS LTD	SE	30	22	1	5	39.6	1149.12	1161.32	1149.12	1188.72	16.76	Brown hard shale, Blue grey hard shale & sandstone	Domestic			3
377445	STELLA HOLDINGS LTD	SE	30	22	1	5	44	1145	1151	1145	1189	16.76	Coal, Blue grey hard shale & sandstone ledges	Domestic			3
377446	STELLA HOLDINGS LTD	SE	30	22	1	5	47.2	1141.52	1156.72	1141.52	1188.72	13.72	Brown shale & sandstone, Blue grey hard shale & sandstone	Domestic			3
377448	HARRIS, BOB	SE	30	22	1	5	61	1129	1140	1128	1189	16.54	Green shale, Grey shale, Water bearing sandstone, Grey shale, Sandstone, Grey shale	Domestic and Stock			3
349126	PARKSIDE MGMT #1957	SW	30	22	1	5	38.1	1135.38	1147.58	1135.38	1173.48	16.46	Grey clay, Blue grey shale & sandstone ledges, Greenish grey coarse grained sandstone, Blue grey hard shale & sandstone ledges	Domestic	10	0.76	3
381140	PEARSON KEN C/O TRADER DALE	SW	30	22	1	5	21	1152	1157	1154	1175	9.14	Sand & Gravel, Grey sandstone	Domestic	10	0.76	3
352991	TRABER, DALE #1503	SW	30	22	1	5	25.9	1147.58	1159.78	1147.58	1173.48	10.67	Brown sandstone, Grey sandy shale, Grey water bearing sandstone, Grey shale	Domestic			3
377431	PARSONAGE, SHANE	SW	30	22	1	5	23	1151	1163	1157	1175	8.84	Water bearing gravel, Grey shale, Light grey sandstone	Domestic and Stock			3
377551	EDGAR, GEORGE	NE	31	22	1	5	60.96	1112.52	1143	1112.52	1173.48	13.72	Grey shale, Grey shale & sandstone, Brown shale, Grey shale, Blue shale & sandstone, Coal, Sandstone, Coal, Brown shale	Domestic	2	0.15	3
377534	SHAW, KINNAIRD	NE	31	22	1	5	91	1082	1144	1082	1173	24	Brownish grey shale, Grey shale, Light water bearing sandstone, Grey shale, Grey shale & sandstone ledges, Grey shale, Dark sandstone, Grey shale, Blue shale, Grey shale, Dark sandstone, Grey water bearing shale & sandstone ledges	Domestic			3
377557	EDGAR, GEORGE	NE	31	22	1	5	36.58	1136.90	1166.47	1136.9	1173.48	18.29	Old Well, Green shale, Blue shale, Grey shale, Sand	Domestic			3
377561	SHAW, KINNAIRD	NE	31	22	1	5	23	1150	1161	1152	1173	15	Brown clay & rocks, Shale, Sandstone, Shale, Sandy shale & sandstone ledges	Domestic and Stock			3
358239	THOMPSON, MARGRET #1572	NW	31	22	1	5	22.86	1150.62	1159.76	1150.62	1173.48	12.19	Clay & Rocks, Grey shale, Brown water bearing sandstone, Grey shale	Domestic and Stock			3
361893	THOMPSON, MARGRET #1572	NW	31	22	1	5	55	1118	1131	1119	1173	18	Blue grey shale, Blue sandy shale, Blue sandstone, Blue grey shale, Blue sandy shale, Blue sandstone, Blue grey shale	Domestic	4	0.30	3
377436	LA GRANDE VUE RANCH	NW	31	22	1	5	24.38	1149.10	1159.76	1151.67	1173.48	17.07	Clay & Rocks	Stock			3
377437	KERSHAW, WM. H.	NW	31	22	1	5	27	1146	1166	1163	1173	3	Yellow clay & boulders, Yellow sandstone	Domestic			3
377438	GOODWIN, B.K.	NW	31	22	1	5	44.81	1128.67	1136.9	1130.81	1173.48	21.95	Water bearing sandrock, Blue shale	Domestic			3
377439	EDGAR, GEORGE	NW	31	22	1	5	76	1097	1140	1097	1173	20	Black shale, Grey shale, Grey water bearing sandstone, Black shale, Grey shale	Domestic and Stock			3
349046	SMITH, KEN #1892	SW	31	22	1	5	41.76	1116.48	1128.67	1116.48	1158.24	17.68	Grey sandstone, Grey hard shale, Grey water bearing sandstone, Grey shale, Grey sandstone	Domestic	3	0.23	3
466033	ANDERSEN, M.	SW	31	22	1	5	44	1113	1137	1114	1158	18	Grey shale, Brown sandstone, Blue shale, Light grey sandstone	Domestic			3
364436	MONTEITH, BILL	SE	23	22	1	5	56.4	1117.08	1129.28	1118.58	1173.48	21.64	Dark grey shale, Dark grey shale & sandstone ledges	Domestic and Stock			3
349438	LEISE, WALTER	NE	23	22	1	5	52	1106	1131	1106	1158	10.06	Sandstone, Grey shale, Sandstone, Grey shale, Water bearing sandstone, Grey shale	Domestic and Stock			3
349477	MAC INNES, DON	NE	23	22	1	5	36.6	1121.64	1133.84	1121.64	1158.24	18.29	Grey shale, Sandstone	Stock			3
349538	RADKE, ART	NE	23	22	1	5	47	1111	1117	1111	1158	0.00	Blue shale, Grey shale, Grey shale & sandstone	Domestic			3
349539	RADKE, ART	NE	23	22	1	5	22.9	1135.34	1141.44	1135.34	1158.24	4.57	Clay & Gravel, Hard sandstone, Sandstone, Hard sandstone	Domestic			3
364289	HOWARTH, FLORENCE	NE	23	22	1	5	46	1113	1142	1140	1156	10.06	Grey till, Gravel	Domestic			3
377941	BRIDGEWATER	NE	23	22	1	5	33.5	1124.74	1130.84	1124.74	**1158.24	3.49	Clay & Rocks, Shale & Sandstone	Unknown			3
377945	BROCKWELL, JERRY	NE	23	22	1	5	43	1115	1128	1116	1158	6.10	Sandy clay & rocks, Sandy shale & sandstone	Domestic			3
377949	BOOTH, ROBERT	NE	23	22	1	5	41.2	1117.04	1129.24	1117.04	1158.24	6.10	Clay & Rocks, Shale & Sandstone	Domestic			3
377953	BROCKWELL, AL	NE	23	22	1	5	41	1117	1128	1117	1158	5.49	Sandy clay & rocks, Sandy shale & sandstone	Domestic			3
378001	CONNIX, GEO	NE	23	22	1	5	36.6	1121.64	1127.74	1121.64	1158.24	4.57	Clay, Shale & Sandstone	Domestic			3
378008	LEISE, WALTER	NE	23	22	1	5	52	1106	1131	1106	1158	10.06	Sandstone, Grey shale, Water bearing sandstone, Grey shale, Water bearing sandstone, Grey shale	Domestic and Stock			3
378012	MACINNES, DON	NE	23	22	1	5	36.6	1121.64	1133.84	1121.64	1158.24	18.29	Grey shale, Unknown, Water bearing sandstone, Sandstone	Domestic and Stock			3
378050	DEANE, RUTH A.	NE	23	22	1	5	46	1113	1118	1113	1158	0.00	Clay & Rocks, Shale & Sandstone	Domestic			3
387008	MONTEITH, BILL	SE	23	22	1	5	34.9	1118.58	1153.68	1120.18	1173.48	7.92	Grey sandy till, Grey sandy till	Domestic	4	0.30	3
418121	MONTEITH, BILL	SE	23	22	1	5	37	1127	1132	1128	1173	5.79	Light grey sandstone, Grey shale, Light grey water bearing sandstone	Domestic	3	0.23	3
377917	RENNER, RUTH	WH	23	22	1	5	45.7	1112.54	1126.94	1114.04	1158.24	5.49	Brown shale, Grey shale	Stock			3
378056	ARMITAGE, R.B.	NE	26	22	1	5	56	1108	1141	1113	1164	14.63	Grey shale, Blue shale, Dark sandstone, Grey shale, Coal, Blue shale, Grey shale	Unknown			3
378057	ARMITAGE, RICHARD	NE	26	22	1	5	41.2	1117.04	1130.84	1118.64	1158.24	11.58	Light grey sandstone, Grey shale, Dark grey water bearing sandstone, Grey shale, Dark grey water bearing sandstone	Stock			3
378015	DEPT. OF ENV. C/O W. RENNER	SE	26	22	1	5	24	1134	1152	1134	1158	2.05	Clay & Boulders, Hard clay & sand, Shale, Sandstone	Domestic and Stock			3
378017	MERRETTE, BOB	SE	26	22	1	5	27.7	1133.40	1159.5	1154.6	1161.1	11.58	Gravel	Domestic			3
378225	CHARTWEST LTD	NE	26	22	1	5	85	1073	1117	1113	1158	30.78	Shale, Sandstone	Domestic and Stock			3
378227	MACOLEN RANCHES	NE	26	22	1	5	47.6	1110.64	1119.84	1111.34	1158.24	35.05	Gravel, Grey shale, Blue shale, Light water bearing sandstone	Domestic and Stock			3
378192	WILLIAMSON, RON	SE	26	22	1	5	55	1118	1131	1144	1173	8.14	Shale, Sandstone	Domestic			3
378195	PAISLEY, JARED	SE	26	22	1	5	45.7	1127.78	1149.08	1147.58	1173.48	8.53	Shale	Domestic			3
378194	WILLIAMSON, R.A.	SW	26	22	1	5	36	1122	1140	1129	1158	6.40	Clay & Boulders	Stock			3
378193	WILLIAMSON, R.A.# WELL 1	SW	26	22	1	5	35.4	1122.84	1128.44	1129.24	1158.24	8.23	Shale, Sandy shale & sandstone	Domestic			3
377582	ROTINEY FARMS	NE	16	22	1	5	91	1159	1186	1159	1250	30.29	Grey shale & sandstone, Grey shale, Light water bearing sandstone, Grey shale, Coal, Grey shale, Light soft sandstone	Stock			4
377587	THE NATURE CONSERVANCY OF CDN	NE	17	22	1	5	67.1	1182.58	1194.78	1182.58	1249.68	42.67	Siltstone, Brown fine grained sandstone, Salt & pepper fractured sandstone, Grey shale	Domestic			4
377590	CROSS, A.R.	NW	18	22	1	5	55	1164	1181	1166	1219	29.87	Brown sandstone, Grey shale, Dark grey water bearing sandstone	Stock			4
469147	DALTON, RICK/LILLIAN	01	19	22	1	5	39.6	1225.32	1231.42	1225.32	1264.92	22.89	Grey shale, Grey water bearing sandstone	Domestic			4
490025	FLANAGAN, HERB	01	19	22	1	5	30	1235	1241	1235	1265		Grey shale	Domestic			4
467795	SOUTHERN, N.	08	19	22	1	5	79.3	1135.14	1174.06	1162.94	1224.44	22.86	Shale, Sandstone	Stock	6	0.45	4
377369	FLEMMING, DON	NE	19	22	1	5	31	1166	1190	1189	1196	3.49	Gravelly clay, Sandstone	Domestic			4
377391	HOPE ROSS, BILL	NE	19	22	1	5	54.9	1164.30	1184.1	1168.9	1219.2	34.14	Shale, Fractured shale, Shale, Fractured shale, Shale, Shale & Sandstone, Shale, Shale & Sandstone	Domestic			4
377342	BONSATA, BRIAN	SW	19	22	1	5	25	1164	1174	1170	1189	12.50	Brown shale, Grey shale, Grey water bearing sandstone	Domestic			4
377343	SURE HOLDINGS LTD.	SW	19	22	1	5	42.7	1164.30	1175	1164.3	1207	16.76	Sandy clay, Sandstone	Domestic and Stock			4
377346	PFEIFFER, TY	SW	19	22	1	5	75	1131	1170	1160	1206	30.48	Clay & Rocks, Blue shale & sandstone	Domestic			4
378429	UPLAND DEV CO. LTD.	SW	19	22	1	5	30.5	1176.50	1183.7	1176.5	1207	16.76	Sandy clay, Brown clay & shale, Grey shale	Domestic			4
377977	LAMONTAGUE, ARTHUR & HECK R.	NE	21	22	1	5	55	1164	1177	1164	1219	18.29	Blue shale, Shale & Sandstone Ledges, Soft sandstone, Shale	Domestic			4
377982	HECK, RONALD D.	NE	21	22	1	5	48.8	1170.40	1182.4	1170.4	1219.2	9.14	Blue shale, Blue shale & sandstone ledges, Sandstone, Blue shale, Blue shale & sandstone ledges	Domestic			4
343018	ADAMS, B.	02	30	22	1	5	26	1163	1175	1169	1189	2.23	Weathered claystone, Grey fine grained sandstone, Claystone, Moist sandstone, Grey carbonaceous shale, Tan moist sandstone, Tan water bearing siltstone, Grey siltstone, Bentonitic shale [illegible]	Domestic			4
365036	NELSON, STEVE	02	30	22	1	5	26.2	1162.52	1180.82	1162.52	1188.72	9.14	Tan siltstone, Grey fine grained sandstone, Fine grained sandstone, Shale, Grey claystone, Water bearing sandstone, Siltstone, Water bearing sandstone, Grey claystone, Water bearing sandstone, Shale, Water bearing sandstone, Tan water bearing sandstone, Tan medium gr	Domestic			4
375016	ADAMS, B.C/O NELSON, S.	02	30	22	1	5	30	1159	1177	1159	1189	7.92	Claystone, Fine grained siltstone, Brown water bearing siltstone, Brown coarse grained sandstone, Brown fine grained siltstone	Domestic			4
359023	BAILEY, VIC	NE	30	22	1	5	9.1	1179.62	1181.12	1179.62	1188.72	1.77	Clay & Rocks, Wet sand & gravel	Domestic			4
350731	ARTHURS, ROBIN	SE	30	22	1	5	61	1128	1169	1128	1189	19.81	Brown sandstone, Grey shale, Grey shale & sandstone, Light grey water bearing sandstone, Grey shale & sandstone, Grey sandstone	Domestic			4
344970	MCCAUGHAM, DELMER	SE	30	22	1	5	39.6	1149.12	1173.52	1147.42	1188.72	11.06	Sandstone	Domestic			4
365353	SINGLE, WARREN	14	19	22	1	5	41	1222	1228	1222	1263	27.43	Dark grey sandstone, Dark grey shale, Grey sandstone, Water bearing sandstone	Domestic			4
349994	LYONS, LAUCHLIN #3214	NE	13	22	1	5	42.7	1176.50	1188.7	1176.5	1219.2	22.49	Grey shale, Grey fractured sandstone, Grey water bearing sandstone, Grey shale, Grey sandstone, Grey sandy shale	Domestic			4
350067	MURRAY, JOHN #3412	NE	13	22	1	5	38	1181	1193	1183	1219	20.80	Brown sandy shale, Grey shale, Grey sandstone, Dark grey shale, Grey shale, Grey sandstone, Grey shale, Grey sandstone	Domestic			4
377765	RIETZE, HOWARD	NE	13	22	1	5	39.6	1179.60	1207	1200.9	1219.2	7.62	Till, Brown sandstone	Domestic			4
377769	CORAL CONSTRUCTION	NE	13	22	1	5	33	1186	1210	1207	1219	7.01	Blue clay, Grey sandstone	Domestic			4
377775	WATSON, DON	NE	13	22	1	5	40.8	1178.40	1200.9	1193.3	1219.2	14.33	Grey sandstone, Grey clay	Domestic			4
377780	GOODWIN, RON	NE	13	22	1	5	48	1174	1188	1175	1219	18.81	Grey shale, Light grey water bearing sandstone, Grey shale, Light grey water bearing sandstone, Grey shale, Light grey sandstone	Unknown			4
377782	WATSON, DON	NE	13	22	1	5	70.7	1148.50	1207	1150.6	1219.2	11.58	Brown sandstone, Grey shale, Light grey water bearing sandstone, Grey shale, Grey shale & sandstone ledges	Domestic			4
377784	RIETZE, HOWARD	NE	13	22	1	5	64	1156	1192	1157	1219	12.80	Brown shale, Grey shale, Grey sandstone, Grey shale, Light sandstone, Light grey shale, Dark grey shale, Dark water bearing sandstone, Dark grey shale, Dark water bearing sandstone, Dark grey shale, Water bearing sand	Domestic and Stock			4
377787	GRAY, BOB	NE	13	22	1	5	38.1	1181.10	1193.3	1181.1	1219.2	18.29	Grey shale, Grey water bearing sandstone, Black shale	Domestic and Stock			4
377789	STANFIELD, M.J.	NE	13	22	1	5	28	1191	1193	1192	1219	12.41	Grey sandstone & shale strgs, Hard sandstone, Grey water bearing sandstone	Domestic			4
467110	JEFFERS, HAROLD	NE	13	22	1	5	41.2	1178.00	1202.4	1199.4	1219.2	3.05	Grey shale, Grey water bearing sandstone, Grey shale, Grey water bearing sandstone	Domestic			4
351874	MACLAREN, ED	NW	13	22	1	5	59	1191	1211	1193	1250	30.48	Fractured sandstone, Clayey sandstone, Shale	Domestic			4
377762	MCLAREN, ED	NW	13	22	1	5	42.7	1206.98	1223.28	1208.48	1249.68	21.34	Grey shale, Grey shale & sandstone ledges, Light grey water bearing sandstone, Grey shale, Light grey water bearing sandstone	Domestic and Stock			4
349635	WADDOCK, TERRY	SE	15	22	1	5	35	1215	1220	1215	1250	18.29	Fractured limestone, Grey shale, Water bearing sandstone, Grey shale	Domestic			4
363481	WADDOCK, TERRY	SE	15	22	1	5	74.7	1174.98	1208.48	1202.48	1249.68	64.47	Shale & Sandstone Ledges, Sandstone	Domestic			4
363488	WADDOCK, TERRY	SE	15	22	1	5	37	1213	1234	1217	1250	24.39	Shale & Sandstone Ledges, Sandstone, Shale, Shale & Sandstone Ledges, Sandstone, Shale	Domestic			4
377768	WADDOCK, TERRY	SE	15	22	1	5	35.1	1214.58	1229.88	1214.58	1249.68	18.29	Fractured limestone, Grey shale, Water bearing sandstone, Grey shale	Domestic			4
467796	WADDOCK, TERRY	SE	15	22	1	5	53	1195	1216	1198	1250	17.68	Shale	Domestic			4
467797	WADDOCK, TERRY	SE	15	22	1	5	42.7	1206.98	1219.18	1210.08	1249.68	24.69	Cemented sandstone, Sandstone	Domestic			4
467798	WADDOCK, TERRY	SE	15	22	1	5	75	1176	1213	1180	1250	18.10	Clay, Shale & Sandstone Ledge	Domestic			4
467799	WADDOCK, TERRY	SE	15	22	1	5	54.9	1194.78	1213.08	1197.88	1249.68	33.14	Clay & Rocks, Shale, Sandstone	Domestic			4
490027	WADDOCK, TERRY	SE	15	22	1	5	59	1191	1212	1192	1250		Sandstone, Shale & Sandstone Ledges, Shale & Sandstone	Domestic			4
355275	WATSON, DON HOLE #1	NE	14	22	1	5	37.5	1212.18	1233.98	1225.28	1249.68	15.54	Sandstone, Water bearing sandstone, Soft shale	Domestic			4
355276	WATSON, DON HOLE #2	NE	14	22	1	5	37	1213	1235	1232	1250	14.02	Clay, Sandstone	Domestic			4
377997	SWANSEN, H.A.	SE	23	22	1	5	15.5	1218.94	1221.04	1218.94	1234.44	6.10	Clay & Sandstone, Blue clay, Water bearing sandstone	Domestic			4
377920	STANDISH, GRANT	SW	24	22	1	5	17	1195	1202	1197	1212	3.96	Brown clay, Grey shale, Blue shale, Light sandstone, Blue shale, Dark sandstone, Grey shale	Domestic			4

FIGURES



0 0.5 1.0 1.5 2.0 2.5km
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LEGEND

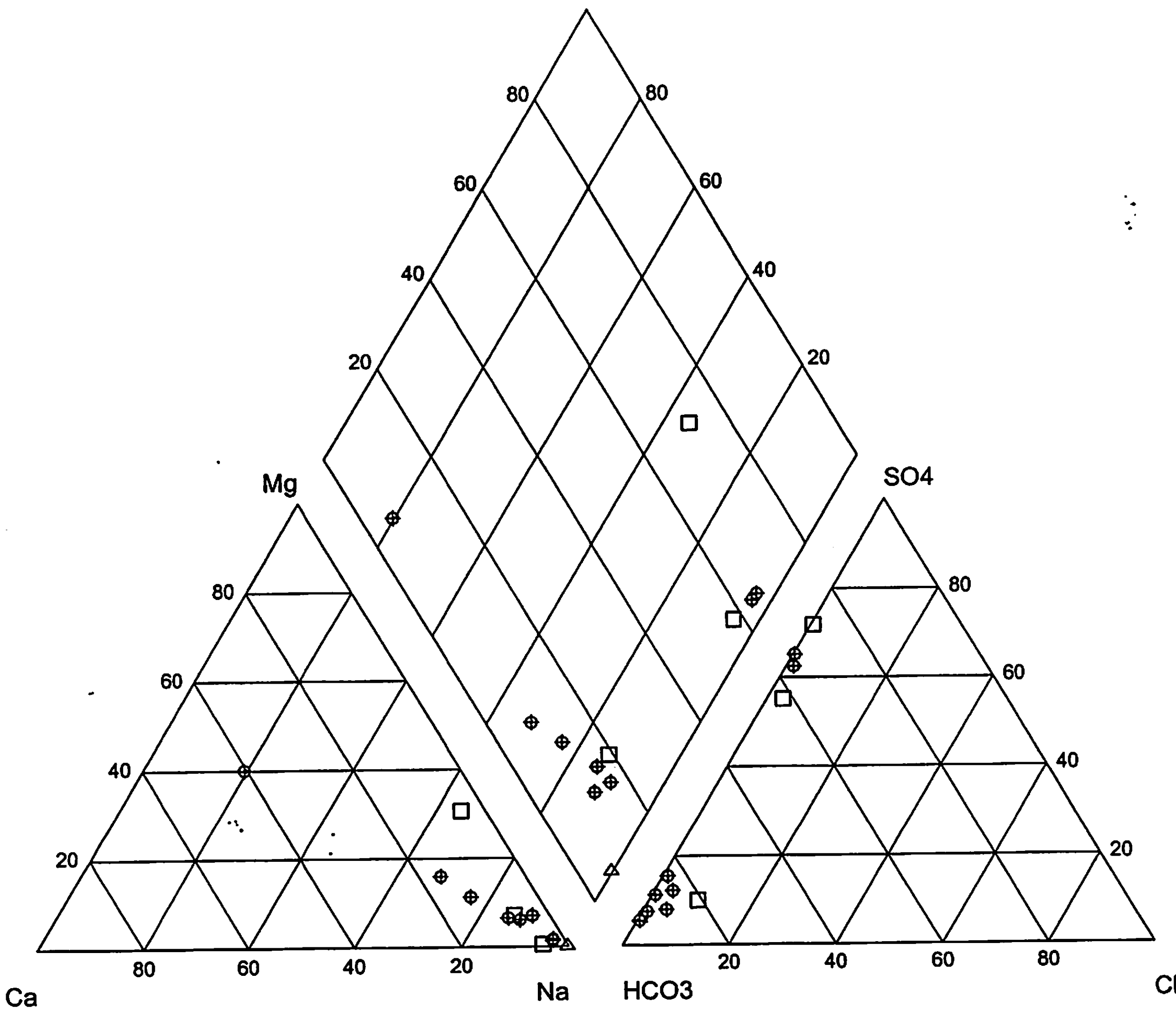
② DENOTES WATER WELL LOCATION (NUMBER IN CIRCLE INDICATED NUMBER OF WELLS)

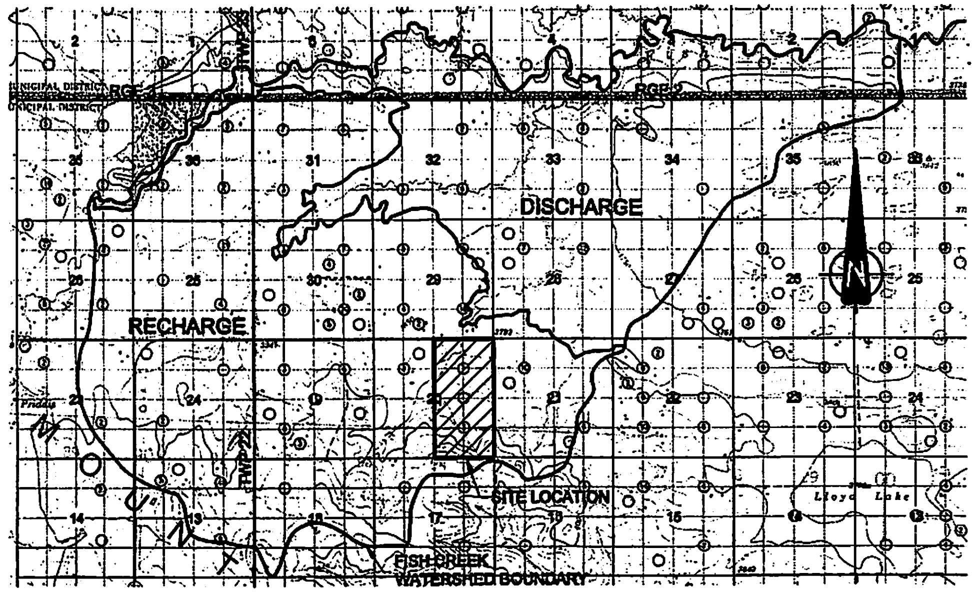
CROSS SECTION LOCATION (SEE FIGURE 4)

FIGURE 1
FISH CREEK SUB-BASIN

Figure 2. Piper diagram of major ions
Bavarian Lion Company

Group 2
Group 3
Group 4





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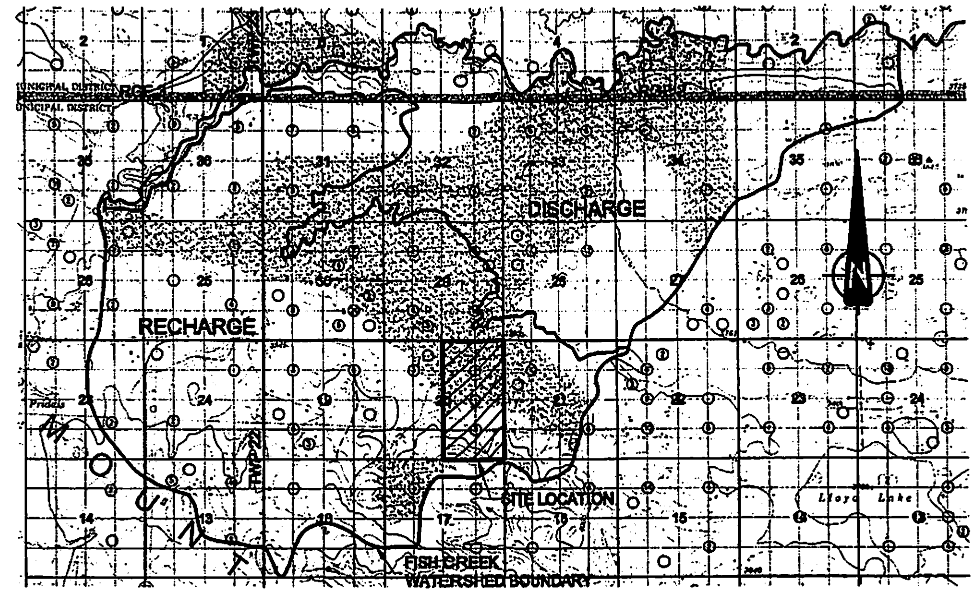

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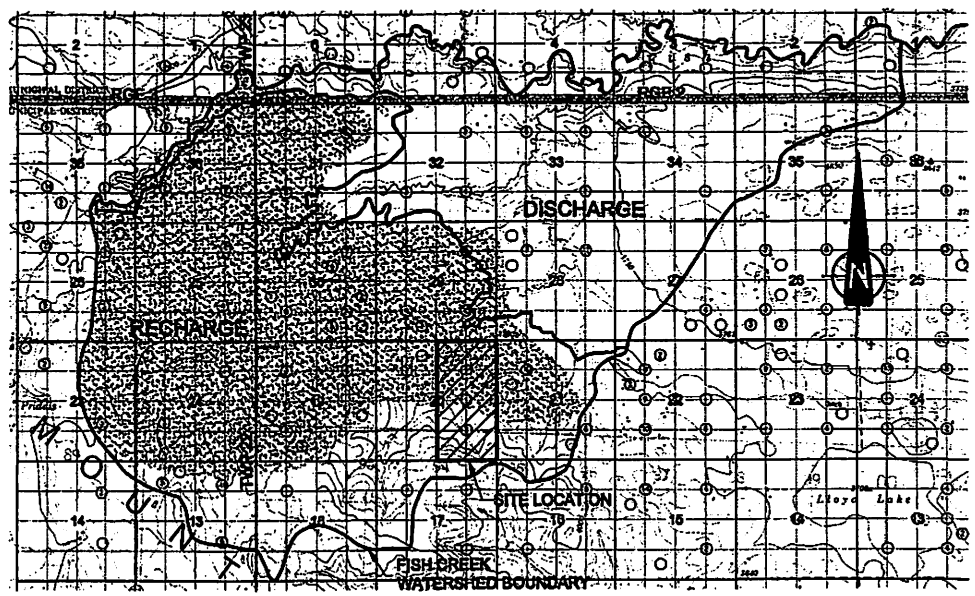

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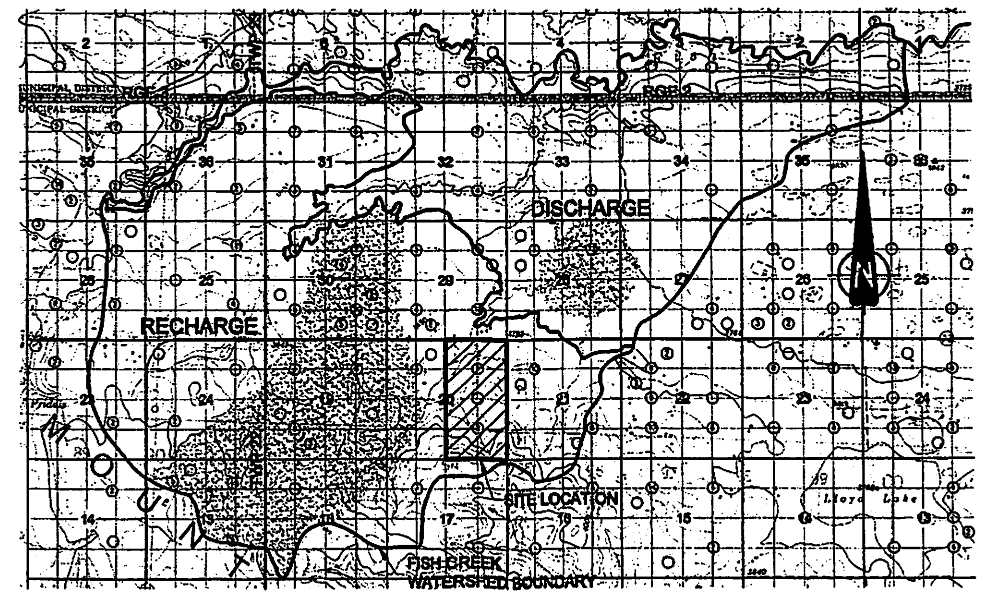

AQUIFER 4

0 10 20 40km
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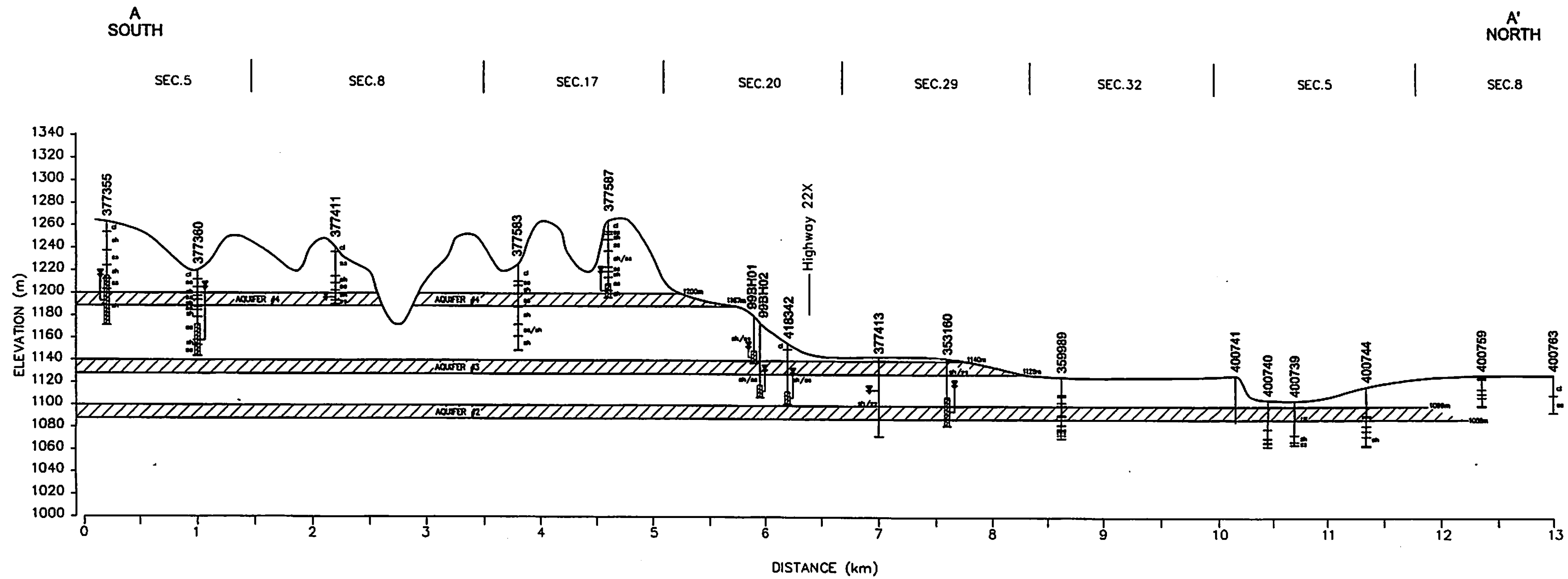
LEGEND

⑪ DENOTES WATER WELL LOCATION. (NUMBER IN CIRCLE INDICATED NUMBER OF WELLS)

FIGURE 3
AQUIFER MAPS



LEGEND

- WATER LEVEL (AT TIME OF CONSTRUCTION)
- PERFORATED INTERVAL

377411 – REFERS TO AEP GROUNDWATER INFORMATION CENTRE WATER WELL RECORDS

cl – CLAY

ss – SHALE

sh – SANDSTONE

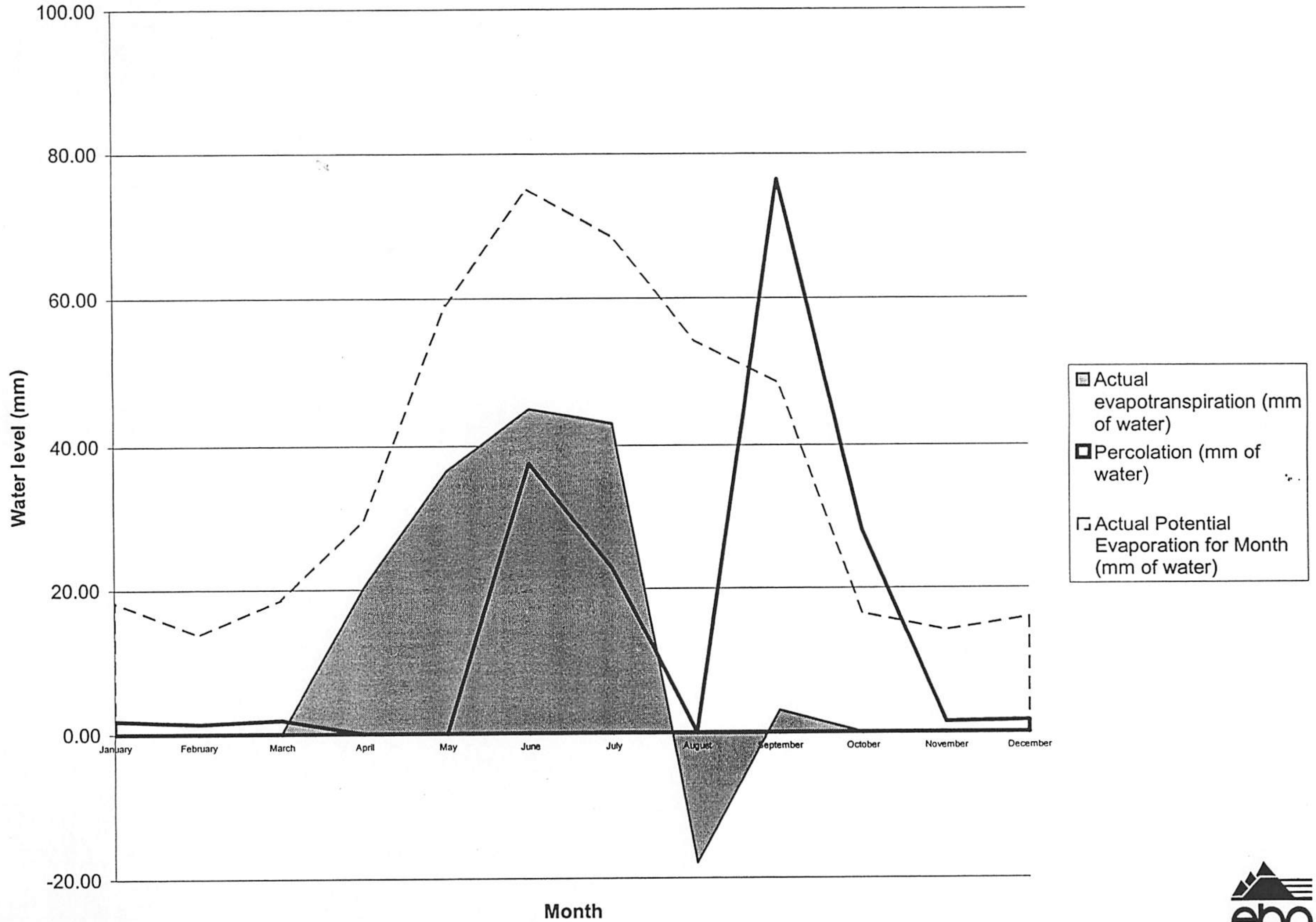
THE GEOLOGIC AND STRATIGRAPHIC SECTIONS SHOWN ON THIS DRAWING ARE INTERPRETED FROM BOREHOLE LOGS. STRATIGRAPHY IS KNOWN WITH CERTAINTY ONLY AT THE BOREHOLE LOCATIONS. ACTUAL STRATIGRAPHY AND GEOLOGIC CONDITIONS BETWEEN BOREHOLES MAY VARY FROM THAT INDICATED ON THIS DRAWING.

SCALE AS SHOWN
VERTICAL EXAGGERATION APPROXIMATELY 10x

FIGURE 4
GEOLOGICAL CROSS SECTION A-A'

FIG E 5

WATER BALANCE



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APPENDIX A

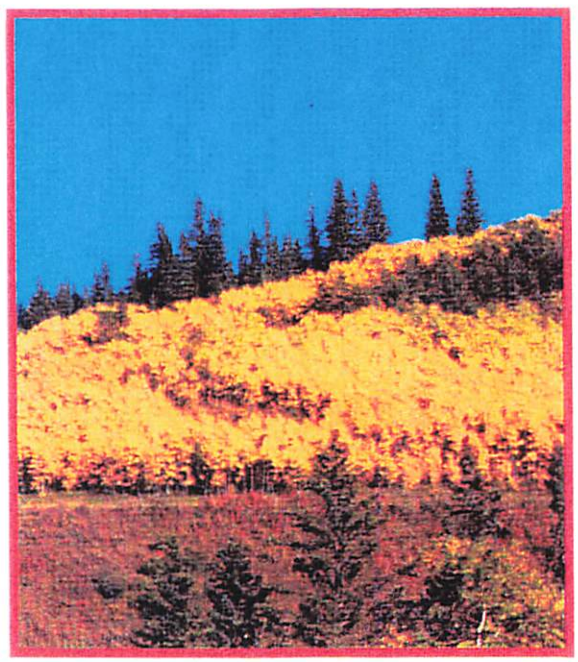
EBA Engineering Consultants Ltd. (1999)
Groundwater Evaluation
Red Willow Estates
EH-20-22-02 W5M

10

Wildlife habitat management options

associated with the proposed development

of the Red Willow Estates property



Prepared for Kellam Berg:

Consulting Engineers, Land Surveyors and Planners

Prepared by:

AXYS Environmental Consulting Ltd.

September 2000

AXYS

Environmental Consulting Ltd

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1.0 INTRODUCTION

The Bavarian Lion Company Ltd. (BLCL) wishes to develop its Red Willow Estates property located immediately south of Calgary, Alberta. The proposed development is south of Highway 22X with the north-east corner of the property situated at the junction of Highway 22X and 160 Street S.W. (NE/SE 1/4 20-22-2 W5M) (Figure 1).

There are a number of interested parties that have a stake in the future development of the Red Willow Estates property. The list of stakeholders includes, but is not necessarily limited to:

- the Municipal District of Foothills including its Environment Committee
- the Bavarian Lion Company Ltd.
- the Board of Directors of the Sandy Cross Foundation
- the General Manager of the Ann and Sandy Cross Conservation Area
- the Fish and Wildlife Department of the Alberta Government
- the owners of properties that adjoin the Red Willow Estates Property
- prospective buyers of the lots at the Red Willow Estates Development (if approved)

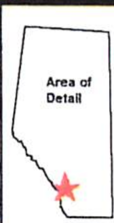
Some of these stakeholders have formally stated their concerns with respect to the plans for the development of this property. Some of these concerns relate to the potential effect of the proposed project on wildlife and wildlife habitat. As a result, specific studies were conducted to assess the wildlife use and develop possible mitigation measures to minimize disturbance to the habitat (Komex, 1996). Since this initial report was prepared in 1996, the project team has been restructured with Kellam Berg Engineering and Surveys Ltd. being retained to complete the development plans.

AXYS Environmental Consulting Ltd. has been retained by Kellam Berg to provide an assessment of the potential impacts of the proposed project on wildlife and wildlife habitat. AXYS was also requested to provide recommendations for the development of the property that would act to minimize the potential impacts of the development on wildlife habitat and maintain the character and nature of the original landscape.

Therefore, the purpose of this report is to provide recommendations for the management of wildlife habitat on the Red Willow Estates property that is based on an analysis of the potential impacts of the proposed project on wildlife and wildlife habitat.

RED WILLOW ESTATES

Red Willow Estates Property



NORTH

200 0 200 400 600

Scale in metres

Acknowledgements.
Prepared by AXYS Environmental Consulting Ltd.

AXYS

AXYS Environmental Consulting Ltd.

DATE	SCALE	
September 1999	1:18,000	

DRAWN	CHECKED	FIGURE NO	REV
LG	RR	1	0
REVIEWED	PROJECT		
KAL	CP 550		

It is in the best interest of all parties that the property be developed through a process of careful planning that will result in the maintenance of as much of the natural value of the property as is reasonably possible. It is in the best interest of the owners of the individual estate lots since they have selected a place to live that is not only surrounded by the natural habitats of this transitional zone between the Foothills Parkland Ecoregion and the grasslands of the Alberta prairies (Gilson 1998), but also has a long term real estate value that is directly correlated with the biodiversity that the area will have now and in the future. It is in the best interest of the Bavarian Lion Corporation since they will continue to be seen as a land developer with a progressive vision and they will be able to point to Red Willow Estates as testimony to that vision. It is in the best interest of the Municipality of Foothills to establish a District that is home not just to people but to wildlife as one of the indicators of a healthy environment. It is in the best interests of the Conservancy since the Board of Directors for the Conservancy wishes to see the integrity of a Conservation Area maintained in immediate proximity to a City that is undergoing significant growth. The Red Willow Estates is private property and subject to the approval of the M.D. has been zoned for the development of residential estate lots.

The analysis in this report suggests that it is possible for the developer of this particular property to not only maintain a significant proportion of the property in a natural state but in several cases to improve it. These areas are the riparian zone and wetland habitats, the wildlife migration corridor and the representative areas of natural brome grasslands.

2.0 BACKGROUND

2.1 History of the Red Willow Estates Property

BLCL has been active in pursuing the necessary permits to complete the proposed development of Red Willow Estates for several years. BLCL are the owners of this property and are proceeding with a planning process in good faith with the Municipal District. Kellam Berg, with agreement from BLCL, has made an initial determination to set aside a Buffer Zone as a Municipal Reserve that represents 20 percent of the property; which is double the amount required by the Municipal District.

2.2 The Ann and Sandy Cross Conservation Area

The Ann and Sandy Cross Conservation Area (ASCCA) consists of 1940 hectares in the Foothills Aspen Parkland Ecoregion (Strong 1992) and is situated just south of Highway 22X on 160 St. SW. The T'suu Tina Reserve lies three miles to the north of the Conservancy and deer and elk that are migrating through the Conservancy may also travel to the Reserve Lands on a seasonal basis. The area was donated to the province of Alberta in 1987 and has been operational since 1992 under the direction of the General Manager reporting to a management board cooperating with the Nature Conservancy of Canada (Gilson and Pittaway 1996). The ASCCA consists of immature and mature aspen forest as well as grasslands that are dominated by smooth brome and Kentucky bluegrass (AGRA 1997). The large mammals that use the area include mule deer, whitetail deer, elk, moose, cougar, black bear and coyote.

2.2.1 Guiding Principles

The guiding principles of the Ann and Sandy Cross Conservation Area are stated as follows (ASCAA 1997):

The Ann and Sandy Cross Conservation Area is dedicated to:

1. *Protecting habitat and providing space for native wildlife;*
2. *Offering conservation education programs, particularly to young people, without jeopardizing area wildlife and habitat;*
3. *Managing human use of the area through entry by appointment only.*

2.2.2 Habitat Management Goal

To protect native biological diversity and the ecological patterns and processes that maintain that diversity within the administrative boundaries of the Conservation Area while integrating with other initiatives that contribute to holistic ecosystem management approach.

2.2.3 Habitat Management Objectives

1. Sustain or approximate key geomorphological, hydrological, ecological, biological and evolutionary processes within normal ranges of variation;
2. Maintain or restore viable populations of all native species in natural patterns of abundance and distribution;
3. Accommodate human uses that are compatible with the maintenance of ecological integrity.

2.3 The Municipal District of Foothills Municipal Development Plan

The Municipal District of Foothills has developed a Municipal Development Plan to meet the requirements of the Municipal Government Act and to provide an understandable guide to future development within the municipality. The Vision Statement for this plan is as follows:

To recognize that the Municipal District of Foothills No. 31 is a unique rural landscape where agriculture is the predominant land use and should remain so in the future. However, the Municipal District of Foothills No. 31 is subject to development pressures as a result of being located in an area of substantial urban activity and therefore must take proactive steps to manage development.

Three of the ten goals of the Plan are relevant to the considerations with respect to wildlife habitats on the Red Willow Estates Property:

- to maintain, conserve and/or enhance natural landscapes, Environmentally Significant Areas, wildlife areas, fish habitats;
- to minimize any noise and/or visual impact development may have, and;
- to manage Country Residential Development in order to maintain the Municipal District of Foothills No. 31's unique rural landscape.

3.0 CURRENT CONDITIONS

The Red Willow Estates property lies within the Foothills Parkland natural region and is part of the transitional zone between the foothills and the foothills grasslands natural regions. The property is drained through a small intermittent creek that represents one of the tributaries of the headwaters of Fish Creek. Most of the 105-hectare property consists of brome (*Bromus inermis)* and Kentucky bluegrass (*Poa pratensis*) grasslands that have replaced the original fescue (*Festuca scabrella*) grasslands as a result of agricultural activities.

The Red Willow Estates lie immediately north of the 1940 ha Ann and Sandy Cross Conservation Area which is mostly aspen (*Populus tremuloides*) forest interspersed with fescue grass communities. The biophysical history of the conservancy has been described in detail by Gilson (1998) and this history generally applies to the Red Willow Estates property as well.

Elk, mule deer and whitetail deer in the region will be subject to hunting pressure in 1999 during the following seasons (all of the RSA is within Wildlife Management Unit 212, with the exception of the area south of Higway 22 X and west of the Priddis Road which is in Wildlife Management Unit 312) (AEP 1999):

Table 3.0-1

Wildlife Management Unit	Elk	Whitetail	Mule deer
212	Archery: Sept. 8 to Nov. 30[1]	Archery: Sept. 8 to Nov. 30	Archery: Sept. 8 to Nov. 30
312	Archery Sept. 8 to Oct. 24 Rifle: Oct. 25 to Nov. 30	Archery: Sept. 8 to Oct. 31 Rifle: Nov. 1 to Nov. 30	Archery Sept. 8 to Oct. 31 Rifle: Nov. 1 to Nov. 30

[1] Seasons are generally the same every year.

4.0 POTENTIAL IMPACTS

4.1 Local Study Area

The local study area was defined as the 105 hectares associated with the Red Willow Estates (Figure 1). Assuming 0.6 hectares will be directly disturbed on each lot for development purposes there will be a direct loss of habitat of 28 hectares (26%) of local study area. Additionally, there will be a reduction in habitat effectiveness around the development. Habitat effectiveness refers to the fact that while there may be habitat available within an area, wildlife may choose not to utilize the area due to human activities and disturbance such as noise. The reduction in habitat effectiveness was not calculated, as this tends to be species specific since different species behave in different manners to disturbance.

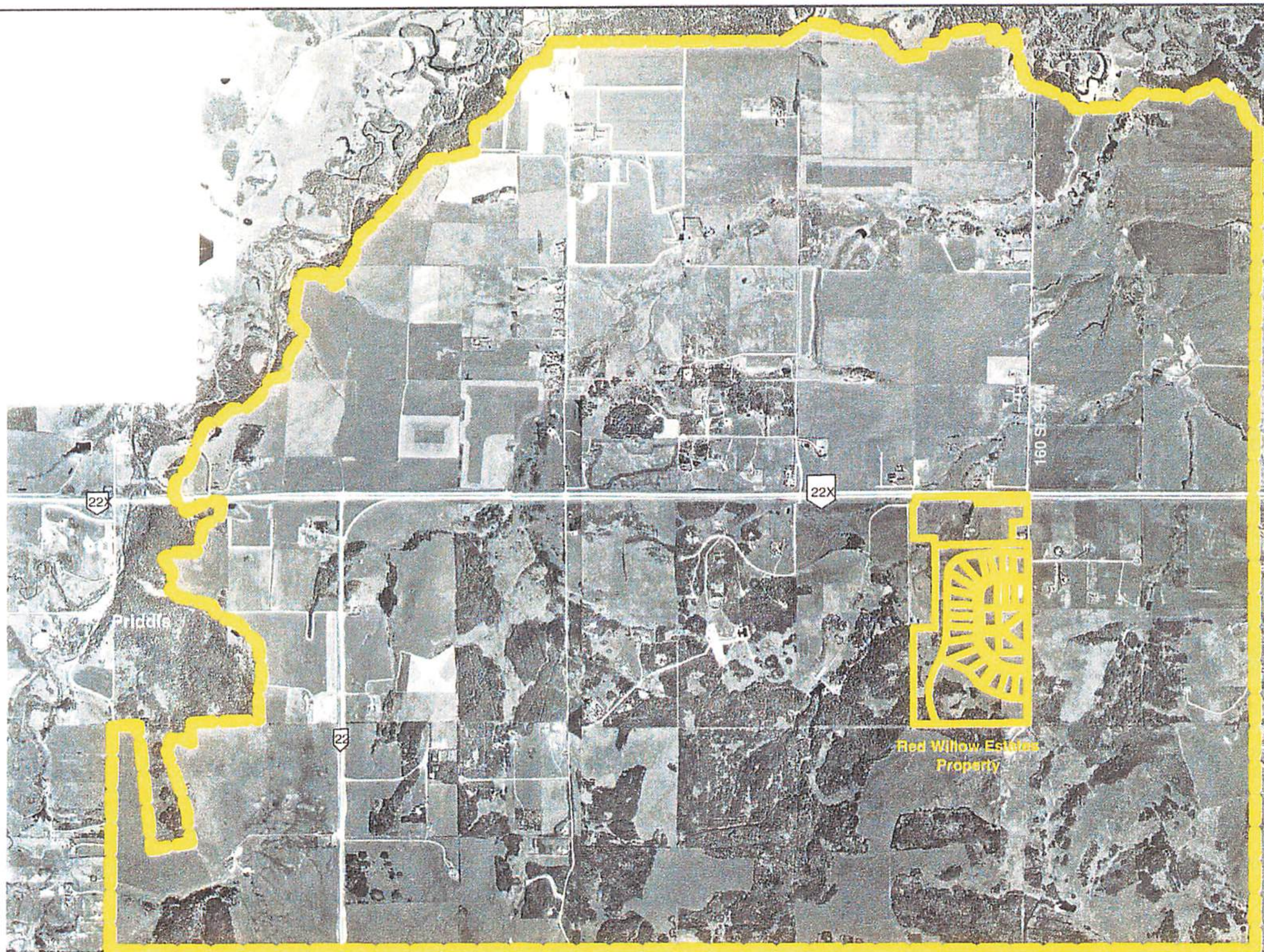
4.2 Regional Study Area

To consider potential impacts to wildlife in a regional context, a Regional Study Area (RSA) was chosen to look at connectivity of the Ann and Sandy Cross Conservation Area (ASCCA) immediately to the south of Red Willow Estates to the Fish Creek watershed located to the west and north (Figure 2). The RSA is approximately 4600 ha in size. Connectivity between the ASCCA and the Fish Creek watershed was the focus of this regional assessment, therefore only the northern portion of the Cross Conservation area to the Fish Creek drainage was included for consideration. Major habitat types were delineated within the RSA (Table 4.2-1) and consist of 10.4 % mature aspen, 8.8 % immature aspen, 25.9 % grassland/pasture, 52.3% cultivated land, and 2.6 % of shrub dominated habitats (Table 4.2-1).

Connectivity and wildlife movement corridors within the RSA are discussed in Section 5.3

Table 4.2-1 Area and proportion of general habitat types within the local and regional study areas.

Habitat Type	Red Willow Estates (ha)	% of Local Study Area	Regional Study Area	% of Regional Study Area
Mature Aspen (>50 Years)	0.0	0	479	10.4
Immature Aspen (<50 years)	13.7	13.0	407	8.8
Grassland/Pasture	89.6	85.3	1191	25.9
Cultivated Areas	0.0	0.0	2404	52.3
Shrub	1.7	1.6	121	2.6
Total	**105**	**100**	**4602**	**100**



RED WILLOW ESTATES

Regional Study Area

NORTH

500 0 500 1000 1500

Scale in metres

Acknowledgements:
Prepared by AXYS Environmental Consulting Ltd.

AXYS Environmental Consulting Ltd

DATE		SCALE	
September 1999		1:45,000	
DRAWN LG	CHECKED RR	FIGURE NO 2	REV 1
REVIEWED KAL	PROJECT CP 550		

5.0 OPPORTUNITIES FOR FUTURE LANDSCAPE MANAGEMENT ON THE RED WILLOW ESTATES PROPERTY

There is a considerable opportunity for the developer of Red Willow Estates to implement a Landscape Management Plan that will maximize the opportunity to not only maintain but also in some locations improve many of the natural features. If the developer continues to take a balanced approach to the detailed planning and construction of the individual lots and the property as a whole, there is every possibility that the Red Willow Estates will come to be viewed as a model community for this region. Many other developments on the outskirts of Calgary claim to have an environmental focus to their developments yet fail to really achieve anything of significance.

The Bavarian Lion Company Ltd. has demonstrated its willingness to proceed with the development of the Red Willow Estates through a process of careful planning and consultation. The development of the estates could proceed through consultation with the Municipal District with attention being given to the vision of the Ann and Sandy Cross Conservation Area as expressed through their Guiding Principles which, again, are:

- Protecting habitat and providing space for native wildlife;
- Offering conservation education programs, particularly to young people, without jeopardizing area wildlife and habitat;
- Managing human use of the area through entry by appointment only.

A set of specific recommendations for the next stage of the proposed development is provided in Section 6. The following section provides a general discussion with respect to the opportunities to conserve the five primary habitats on the property.

5.1 Aspen Forest

There are 13.7 ha of immature aspen forest on the southwestern corner of the property (Figure 1). The characteristic species of this forest have been described by AGRA 1997 as follows:

Table 5.1-1

Scientific Name	Common Name	Percent Cover
Tree		
Populus tremuloides	aspen	50
Shrub		
Populus tremuloides	aspen	5
Amelanchier alnifolia	saskatoon berry	+
Herb		
Cirisium arvense	Canada thistle	5
Geranium viscosissimum	sticky purple geranium	+
Galium boreale	northern bedstraw	+
Heracleum lanatum	cow parsnip	+

Lathyrus venosus *Osmorhiza depauperata* *Taraxacum officinale* *Vicea americana*	wild peavine sweet cicely common dandelion American vetch	+ + + +
Grass *Bromus inermis* *Poa pratensis* *Phleum pratensis*	 smooth brome Kentucky bluegrass timothy	 30 30 5

The proposal for the development by the Bavarian Lion Corporation limits the amount of development on the southern side of the property by defining a single large lot (Lot 19), which will have a single family dwelling established on the lot. In addition, there will be a 100 metre buffer established as a perpetual easement between the fence line with the Conservancy and any development on Lot 19.

This 13.7 ha of natural habitat is contiguous with similar habitat on the Conservancy and so the decision to leave this in a natural state will mean that there will be one continuous block of immature aspen forest in this area that will succeed into mature aspen forest over time. This will contribute to the management goals of the Conservancy for aspen that are to:

- ensure that aspen regeneration is adequate to replace decadent old growth stands
- balance the availability of aspen browse with ungulate populations

Once this aspen stand has matured, management intervention may be required so that this stand does not revert to grassland (see for example, p. 138 of Gilson 1998). This stand of immature aspen will evolve into a mature aspen stand over time with the following characteristics (see Table 5.1-2, following).

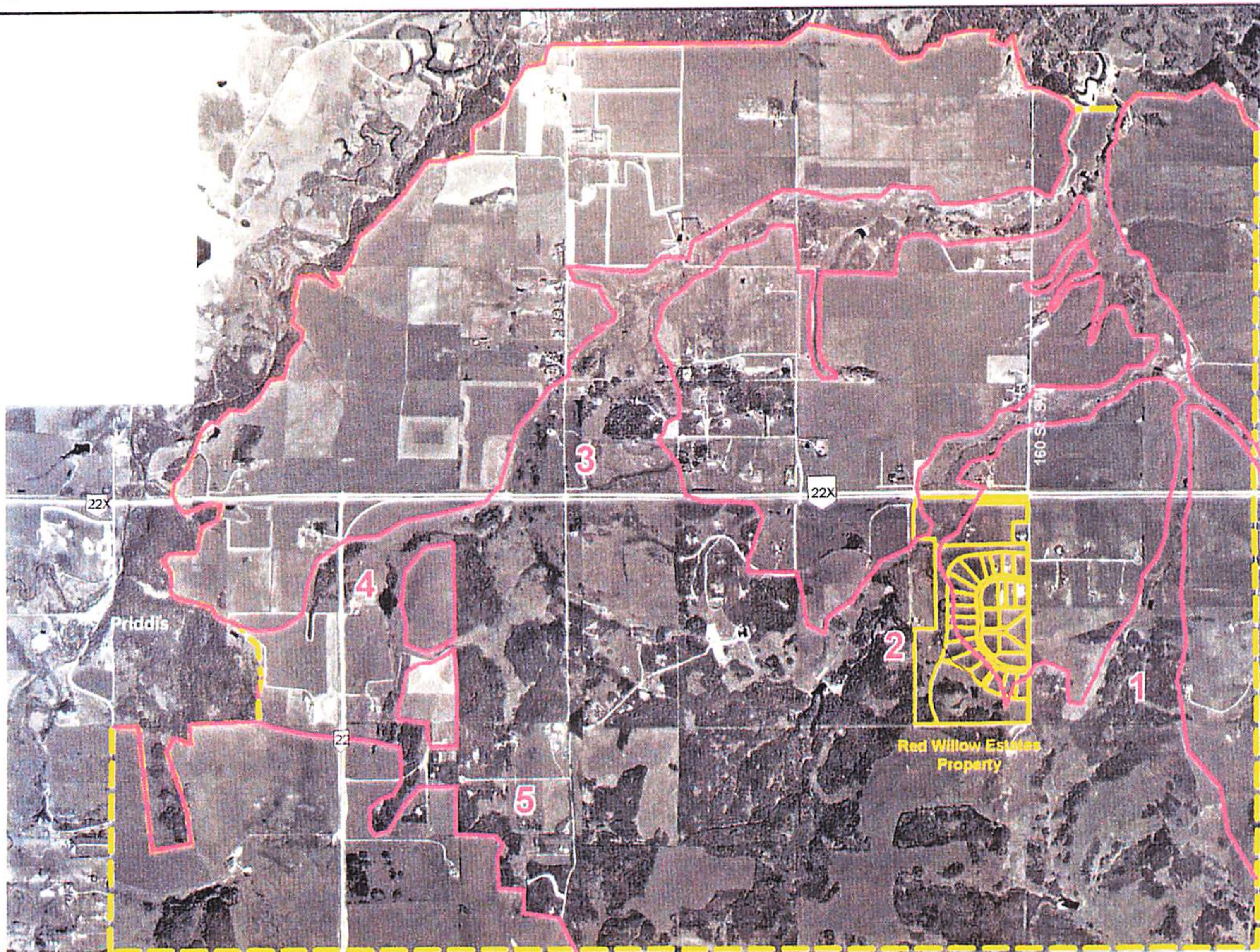
Table 5.1-2

Scientific name	Common name	Percent cover
Tree		
Populus tremuloides	aspen	30
Populus balsamifera	balsam poplar	8
Picea glauca	white spruce	+
Shrub		
Amelanchier alnifolia	saskatoon berry	10
Rosa acicularis	prickly rose	5
Sheperdia canadensis	Canada buffaloberry	5
Viburnum edule	low bush cranberry	5
Lonicera diocia	twining honeysuckle	+
Symphoricarpos occidentalis	western snowberry	+
Herb		
Arnica cordifolia	heart-leaved arnica	+
Aster ciliolatus	Lindley's aster	+
Delphinium glaucum	tall larkspur	+
Epilobium angustifolium	fireweed	+
Galium boreale	northern bedstraw	+
Lathyrus ochroleucus	cream-coloured peavine	+
Smilicina stellata	star-flowered Solomon's seal	+
Thalitricuim venulosum	veiny meadow rue	+
Vicea americana	American vetch	+
Grass		
Calamagrostus canadensis	marsh reed grass	5

5.2 Wetlands and Riparian Habitats

There are approximately 1.7 ha of wetland and riparian habitats on the Red Willow Estates property along an intermittent water course. The area of the riparian zone was calculated using a 15 metre buffer on each side of the water course. Neither AGRA (1997) nor Gilson (1998) summarize the range of plant species that occur in association with wetlands in the Conservancy. Instead, Gilson (1998) identifies total vegetation cover and native vs. non-native vegetation cover as well as other indicators to monitor the success of efforts to meet the goals for riparian habitats in the Conservancy which are:

1. Manage so that stream flow and spring flow characteristics are unimpeded by human development or activity
2. Maintain or enhance the quality of native riparian vegetation by preventing the invasion of exotic species and by mimicking natural disturbance processes
3. Manage the riparian zone to maintain habitat for the full diversity of native animal wildlife.



RED WILLOW ESTATES

Wildlife Movement Corridors Identified in the Regional Study Area

NORTH

500 0 500 1000 1500

Scale in metres

Acknowledgements:
Prepared by AXYS Environmental Consulting Ltd.

AXYS Environmental Consulting Ltd.

DATE September 1999		SCALE 1:45,000	
DRAWN LG	CHECKED RR	FIGURE NO 3	REV 1
REVIEWED KAL	PROJECT CP 550		

5.2.1 Opportunities for Improvements

To address the above management goals, there is an opportunity to enhance the existing wetlands in the area by implementing new wetland areas and/or dugouts within the Red Willow Estates property. This enhancement will act to increase biodiversity of the riparian zone (i.e, reptiles, waterfowl, passerines, vegetation species, amphibians) towards improving the overall biophysical health of the property and neighboring properties. Dugouts on the Conservancy are used by waterfowl and aquatic mammals, such as muskrat as well as diving ducks. Dugouts provide a drinking water source for animals and can support a variety of riparian and aquatic vegetation

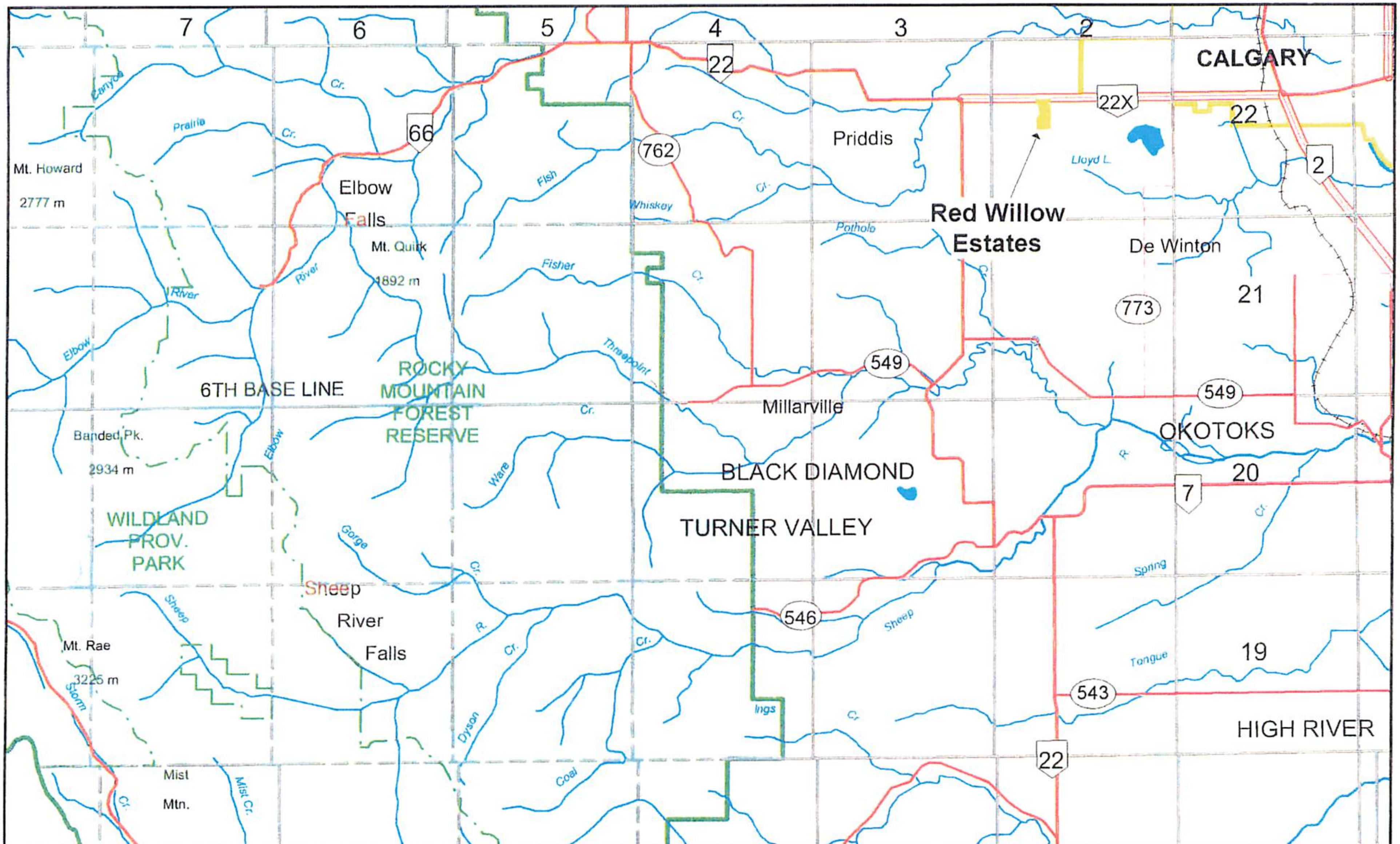
5.3 Wildlife Movement Corridor

Wildlife movements in the area of the proposed development were previously studied by Gilson and Pittaway (1996). This work provides a useful beginning to developing an understanding of movement patterns in this region of the Foothills Municipal District. The authors acknowledged that their study has some limitations in that the study was conducted in only one year (January to April 1996), there was a lack of snow cover, there were some personal time constraints and wildlife movements may have been influenced by a mid-winter elk harvest.

We have attempted to build on the results of the study by Gilson and Pittaway (1996) through the interpretation of air photos and we present these results here while recognizing that further monitoring will clarify the extent to which there are movements across Highway 22X at various locations.

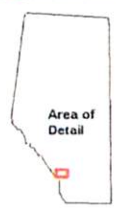
Noss (1995) states that the basic framework for corridor analysis consists of identifying habitat suitability for the species in question including such factors as: vegetation, topography and distance to water. He further states that planning for wildlife corridors should centre on: existing migratory routes and trails, areas of minimal human development and landscape elements that form natural linkages between areas

To determine the relative importance of existing wildlife corridors northward from the Conservancy to the Fish Creek Valley, five potential corridors were identified from air photo interpretation based on the following factors and assumptions (Figure 3). The Red Willow Estates property is shown in its regional context in Figure 4.



RED WILLOW ESTATES

Red Willow Estates Property in Regional Context



NORTH

3 0 3 6 9

Scale in kilometres

Acknowledgements:
Basemap provided by Alberta Environment
Prepared by AXYS Environmental Consulting Ltd.

AXYS — AXYS Environmental Consulting Ltd.

DATE: September 2000		SCALE: 1:300,000	
DRAWN: LG	CHECKED: KAL	FIGURE NO: 4	REV: 0
REVIEWED: PM	PROJECT: CP 635		

- the two Wildlife Management Units in the Regional Study Area (#'s 312 and 212) are subjected to bow hunting (212) and bow and rifle hunting (312) and, as a result, wildlife species and especially ungulates within the study area are assumed to behave similarly to other populations that are hunted. As a result, cover in the form of deciduous and coniferous trees and shrubs have a strong influence on the selection of habitats for movement by wildlife.
- where possible, wildlife species will select low lying areas such as river and creek valleys as movement corridors and avoid the exposure that is associated with travel along ridges.
- movement to and from the Fish Creek Valley and the Conservancy may be important for wildlife especially during winter periods.
- wildlife will avoid open terrain and select the minimum distance of exposure when moving from one patch of cover to another.
- the width of each section of forest and shrub cover is not factored into this analysis.
- the ranking criteria are not weighted (each set of criteria has the same degree of influence on the aggregate rank).
- the ranking assumes that all barriers are permeable and that there are no absolute barriers to movement for wildlife.

Each of the five potential corridors was ranked according to the relative values associated with the following factors:

- **Corridor length:** the shortest possible available route within each of the five designated corridors between the Conservancy and the Fish Creek Valley that maximize use of terrain and cover.
- **Proportion of cover along each corridor:** The proportions of high, moderate and low cover along the corridor.
- **Frequency of barriers to movement:** the number of barriers to movement (including open terrain greater than 200 metres in width, fences, primary and secondary roads, and buildings).

An aggregate rank was assigned to each of the corridors based on unweighted rankings for each of the above criteria to determine the overall importance of the corridor to wildlife.

5.3.1 Corridor Length

The length of each potential corridor was measured from the nearest border within the Conservancy to the first point of continuous treed cover with the Fish Creek Valley (Figure 2). The corridor was measured assuming an animal would select a route that maximizes the proportion of the route that is screened by shrubs and trees.

Table 5.3-1

Corridor Number	Total length (metres) of shortest route	Rank
1	5040	3
2	5520	4
3	8940	5

4	4160	2
5	3470	1

5.3.2 Proportion of Cover Along Corridor

The proportion of cover and open terrain along each of the corridors was determined from the air photo stereo pairs. Treed habitats greater than 6 m and greater than 20% canopy cover were assumed to provide the best cover in the study area. Open treed stands and shrub cover >2.5 m in height was considered moderate in cover value for wildlife. Low shrub habitats <2 meters were considered low cover and open terrain was considered to have no cover value. Rankings based on overall cover are shown in Table 5.3-2, below.

Table 5.3-2

Corridor Number	Good Cover	Moderate Cover	Low Cover	Open Terrain	Rank
1	15.9	30.4	10.3	43.4	4
2	17.6	12.7	27.2	42.5	3
3	13.8	32.9	38.1	15.2	1
4	70.9	9.6	0	19.5	2
5	63.8	0	0	36.2	4

5.3.3 Frequency of Barriers to Movement

The disturbances that are associated with human activities can cause wildlife species to avoid certain areas or deflect their movements. To assess the potential influence of barriers to movements along each of the corridors, we determined the number of potential barriers along each of the routes from the air photos. It was assumed that as the frequency of occurrence of these features increased, the " relative friction" to movement also increased. The potential barriers to movements included the number of times open terrain would have to be crossed, the number of primary and secondary roads, the number of fences and the number of human features such as residential housing and farms along the route.

Table 5.3-3

Corridor number	Number of times open terrain is encountered	Number of primary and secondary roads encountered	Number of human features encountered	Number of fence lines	Rank
1	4	2	3	8	1
2	5	3	6	12	4
3	3	8	6	15	4
4	3	3	4	8	2
5	4	3	5	12	3

The aggregate rank of the variables is as follows:

Table 5.3-4 Aggregate Rank

Corridor number	Corridor length	Proportion of cover	Barrier frequency	Overall rank
1	3	4	1	2
2	4	3	4	4
3	5	1	4	3
4	2	2	2	1
5	1	4	3	2

The results of this analysis demonstrate that the wildlife movement corridor that passes through the Red Willow Estates property (Corridor 2, Figure 3) has the lowest aggregate rank of the five corridors in the Regional Study Area. As stated elsewhere in this report, the potential impacts of the proposed Red Willow Estates development can be mitigated with the implementation of the proposed Landscape Management Plan. With effective mitigation, Corridor 2 will continue to be available to accommodate wildlife movements, recognizing that animals have other options available to move between the habitats to the south of the Conservancy and the Fish Creek watershed.

5.4 Grasslands

There are approximately 90 ha of grasslands in the form of modified pasture on the Red Willow Estates property.

Table 5.4-1

Scientific name	Common name	Percent cover
Herb		
Cirsium arvense	Canada thistle	5
Achillia millefolium	common yarrow	+
Anemone multifolia	cut-leaved anemone	+
Artemesia ludoviciana	prairie sage	+
Galium boreale	northern bedstraw	+
Geranium viscosissimum	sticky purple geranium	+
Lathyrus ochroleucus	cream-coloured peavine	+
Taraxacum officinale	common dandelion	+
Vicea americana	American vetch	+
Grass		
Bromus inermis	awnless/smooth brome	30
Poa pratensis	Kentucky bluegrass	30
Denthonia parryi	parry oat grass	+
Festuca scabrella	rough fescue	+

Restoration and conservation of the rough fescue habitat type is not an option. To undertake this work would require an ongoing program combining a fire management program and the application of a weed control product (e.g. Round-up) . Brome is a very aggressive species and it will continually out compete the fescue.

It is possible to maintain areas on the Red Willow estates property where wild brome can be interplanted with rhizomatous forbs like golden rod, lupine, fireweed, yarrow, bedstraw and golden bean. These areas could be established on affordable, attractive closed terraces. These species could be non-manicured and non-irrigated.

6.0 RECOMMENDATIONS

6.1 Windrow

The potential impacts of the development of Blocks 12 through 19 on wildlife corridor number 2 could be reduced by establishing a visual barrier in the form of a vegetated windrow, consisting of deciduous and coniferous trees as well as fast growing shrubs. Adding a hedge parallel to the windrow could enhance the effectiveness of this specific mitigative measure by adding to the aesthetic quality and noise control. A Landscape Architectural firm could assist with the detailed design of such a windrow between the boundaries of the individual property lots and the buffer zone.

6.2 Landscape Management Plan (LMP)

If this development proceeds, it should be guided by a Landscape Management Plan. The BLCL could retain a Landscape Architectural firm to work with AXYS to further refine plans for the development and implementation of the LMP. The LMP will identify the criteria that need to be met if wildlife values are to be maintained (AXYS) and translate these criteria into a blueprint that will govern the design of the landscape. Elements of the Landscape Management Plan could include provisions to retain native cover and plant native vegetation where practical.

6.3 Environmental Management System (EMS)

The BLCL could adopt an Environmental Management System or EMS for its Red Willow Estates Property. The EMS could outline the approach that will be taken to, for example:

- feeding of wildlife - - bird feeders and baths OK, bird houses OK, but zero tolerance towards all other feeding of wildlife
- application of salt on all roads and driveways prohibited
- pets - - dogs outside of the fenced portions of properties are to be on a leash
- handling of garbage - - cans with secure lids, timing of pickups - problems with bears
- floodlights
- noise

6.4 Environmental Protection Plan (EPP)

If construction proceeds on the proposed project it should be guided by the application of an Environmental Protection Plan. Such a Protection Plan could identify those area that are not to be disturbed and to clearly mark these areas prior to construction to avoid any impacts to the riparian buffer zones or to the identified existing vegetation.

6.5 Habitat Improvements

The developer should consider the opportunity to improve the buffer zone (BZ) in terms of its value as a natural area, as riparian habitat, as wetland habitat and as a wildlife migration corridor as follows:

6.5.1 Natural Area

- all trees and shrubs to be planted should be selected from a recommended list
- existing natural vegetation should be maintained wherever possible

6.5.2 Wildlife Movement Corridor

- increase the value of the buffer by shielding the housing lots from the Pine Creek riparian zone through the establishment of a new windrow and hedge
- the new shelterbelt will also function as a wind break for winds from the west; a shelterbelt could also be established along the northern boundary of the Estates property line to serve a windbreak for northerly winds
- a mixture of coniferous trees, deciduous trees and shrubs could be staggered along three parallel lines to create a visual barrier between the development and the movement corridor
- landowners to the north of Highway 22X could also improve the migration corridor and preserve the linkage between the natural regions to the south of Highway 22X and the lands to the north including the T'suu Tina Reserve
- all trees and shrubs to be planted should be selected from a recommended list
- planting of trees and shrubs will require careful scheduling, sourcing and preordering
- future plans for the widening of Highway 22X - - underpass at cross point of corridor may be required, Swareflex reflectors may be required to channel wildlife movements towards the underpass

6.5.3 Fencing

The Landscape Management Plan could include provisions with respect to the fencing of individual lots. For example, lot owners could be entitled to fence the first 20 metres of their backyards according to a set of guidelines on fencing height and fencing materials. They could also enclose this portion of their backyard with a baseline fence. The remaining property line could be left undefined or could be defined with stones, a short rock wall or with a line of shrubs.

6.5.4 Lot 19

The pad for the house on Lot 19 should be situated so that the impact on the environment is minimal. This can be accomplished by optimizing the precise location of the lot for the house with respect to terrain and environmental variables so that there is limited infringement on the immature aspen forest. A careful approach to the development of this lot will maximize the aesthetic value and enjoyment of the lot and maximize its long term resale value.

7.0 CONCLUSIONS

The Bavarian Lion Corporation Limited is proposing to develop its Red Willow Estates property by developing estate lots with spectacular views of the south Calgary region. The property is within commuting distance of the City of Calgary and is located within an area that retains some of the original nature and character of this region of Alberta. The BLCL has a major opportunity to develop its Red Willow Estates Property in ways that will preserve the character of the area and therefore generate and maintain high property values in the long term.

The property is adjacent to the Ann and Sandy Cross Conservancy, which provides the general public with an opportunity to experience the natural setting of the region. BLCL has identified important habitats on the property that can be maintained in a natural state and in some cases enhanced to provide continuity within this natural area. A Property Owners Association could be established whereby the landowners act as stewards of the Red Willow Estates property. The Association could represent a committed force that would oversee the planning, planting, monitoring and maintenance of the estate as a whole.

8.0 LITERATURE CITED

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