

Moddle Area Structure Plan

Prepared in support of a proposal to amend the Land Use Bylaw
(Bylaw C-1725-84) to Redesignate

SW-24-24-3-W5M

from

Agricultural Conservation (2) District (AG-2)
to Country Residential District (CR)

Municipal District of Rocky View No.44

March, 1998

List of Consultants

Planning and Approvals

Martin Grady - Walker Newby & Partners

Geotechnical Engineering

Sabatini Geotechnical
Curtis Engineering Associates

Stormwater Engineering

Westhoff Engineering Resources

Agronomist

Graecam Inc.

Land Development

Moddle Design and Construction Ltd.

Table of Contents		Page
1.0	Introduction	
1.1	Background	6
1.2	Policy Format	6
2.0	Plan Objectives	8
3.0	Plan Context	
3.1	Existing Area Land Use	9
3.2	Access	9
4.0	Site Features	
4.1	Existing Land Use	15
4.2	Topography	15
4.3	Soils	15
4.4	Vegetation	15
4.5	Drainage	16
5.0	Development Proposal	
5.1	Proposed Land Uses	18
5.2	Subdivision Concept	18
5.3	Municipal Reserves	21
5.4	Subdivision Phasing	21
5.5	Stormwater Management	21
6.0	Servicing Proposal	
6.1	Wastewater Treatment	23
6.2	Water Supply and Distribution	23
6.3	Utility Services	23
6.4	Internal Subdivision Roads	23
7.0	Traffic Impact Analysis	
7.1	Existing Traffic Volumes	24
7.2	Future Traffic Volumes	24
8.0	Public Input	26

Table of Contents Continued	Page
-----------------------------	------

9.0 Plan Conformity

9.1 Municipal Statutory Plans and Policy	28
--	----

10 Implementation 29

11 Appendices 30

1. Percolation Test Results
2. Agricultural Capability

Figures		Page
Figure: 1	Location Map	7
Figure: 2	Subject Lands	10
Figure: 3	Context	11
Figure: 4	Surrounding Land Use	12
Figure: 5	Access	14
Figure: 6	Natural Features	17
Figure: 7	Proposed Subdivision	19
Figure: 8	Subdivision Phasing	22

1.0 Introduction

1.1 Background

The subject lands comprise approximately 152.0 acres (64.33 ha.) and are located west of the City of Calgary in the Springbank area of the Municipal District of Rocky View No.44 as shown on Figure 1.

The lands are currently designated for agricultural uses under the Land Use Bylaw (Bylaw C-1725-84). A 5 acre parcel was subdivided from the 1/4 section in 1994.

The owner wishes to facilitate the comprehensive development of a planned residential community and is seeking to redesignate the subject lands to a country residential land use.

1.2 Policy Format

This Plan will provide Council with supporting planning rationale for redesignation of the subject lands from Agricultural Conservation (2) District to Country Residential District (CR) in order to accommodate the development proposal. The Plan will further provide Council with a statutory mechanism to guide and control subdivision through the establishment of policies that provide specific direction for subdivision and development issues identified in the Plan.

Preparation of this document has been guided by the M.D. of Rocky View's Procedure 304 - Preparation and Processing of Concept Plans and Procedures for the Processing of Concept Plans No. 039, and Section 633 (1) of the Municipal Government Act respecting the content of Area Structure Plans.

The Plan begins by identifying objectives in Section 2.0 and then proceeds to describe the surrounding land use context of the subject lands in Section 3.0. Section 4.0 provides a description and analysis of existing natural site features. Section 5.0 and 6.0 present the development and servicing proposals and Section 7.0 provides a Traffic Impact Analysis. Section 8.0 gives an overview of input received from residents within the surrounding community.

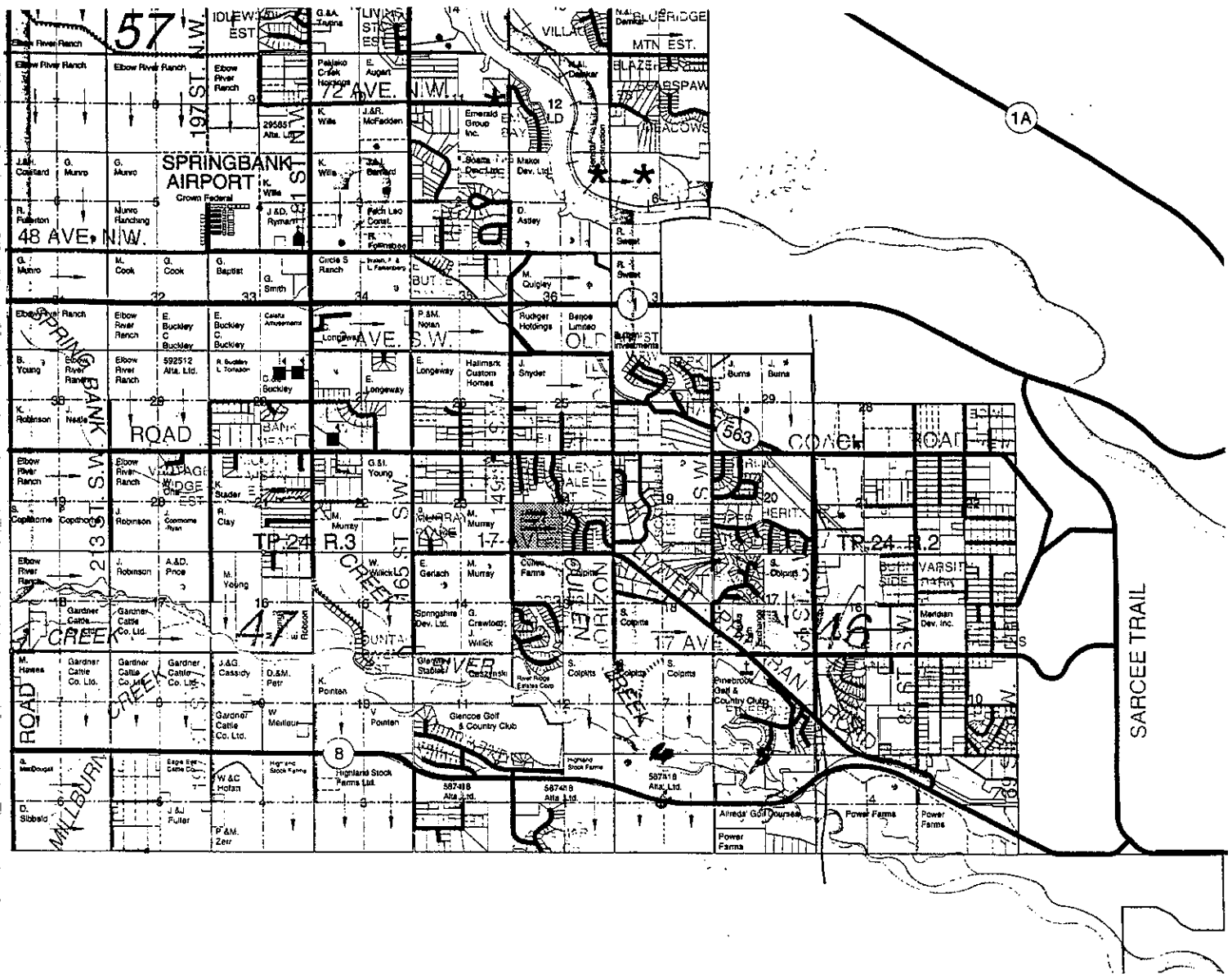


Figure: 1

Location

Proposed Redesignation and
Subdivision

SW 1/4 24-24-03-W5

NORTH
NOT TO SCALE
DO NOT SCALE DRAWING.

WALKER
NEWBY

2.0 Plan Objectives

- To identify development issues within the Plan Area and establish appropriate and comprehensive policies for addressing these issues.
- To establish the appropriateness of the subject lands for the land uses proposed by the Development Proposal.
- To establish Servicing Scenarios appropriate to the Development Proposal and a policy framework for implementation.
- To facilitate subdivision design that maximizes lot yields, servicing efficiencies and development opportunities.
- To address compatibility with adjacent land uses and the surrounding community.
- To gather input from residents within the surrounding community and incorporate these ideas into the planning process.

3.0 Plan Context

The subject lands are identified in Figure 2 and their context with respect to the surrounding community is depicted in Figure 3.

3.1 Existing Area Land Use

The Plan Area is located in a portion of the Springbank community that has experienced extensive subdivision of 2 acre and 4 acre Country Residential parcel sizes. Country residential subdivision has occurred both as comprehensive subdivision projects initiated on previously undeveloped 1/4 sections and through the resubdivision of existing 20 and 40 acre parcels.

Figure 2 provides an illustration of the existing extent of parcel creation in a portion of Springbank between the Elbow River and Highway #1. Within the area shown on Figure 2 there are over 1000 existing parcels that have been created for residential purposes with over 700 of them located within 1 mile north or south of Springbank Road.

In terms of raw acreage, almost 75% of the Springbank Road corridor has been redesignated from agricultural uses to country residential. This represents some 2600 acres of land that have been converted to country residential uses.

There has been recent residential subdivision adjacent to the subject lands to the northwest, north and east. Immediately to the east is the Rosewood development containing 63 two acre parcels. Cullen Creek estates is located adjacent to the east boundary with 47 two acre parcels and an additional 18 lots were recently subdivided to the northwest.

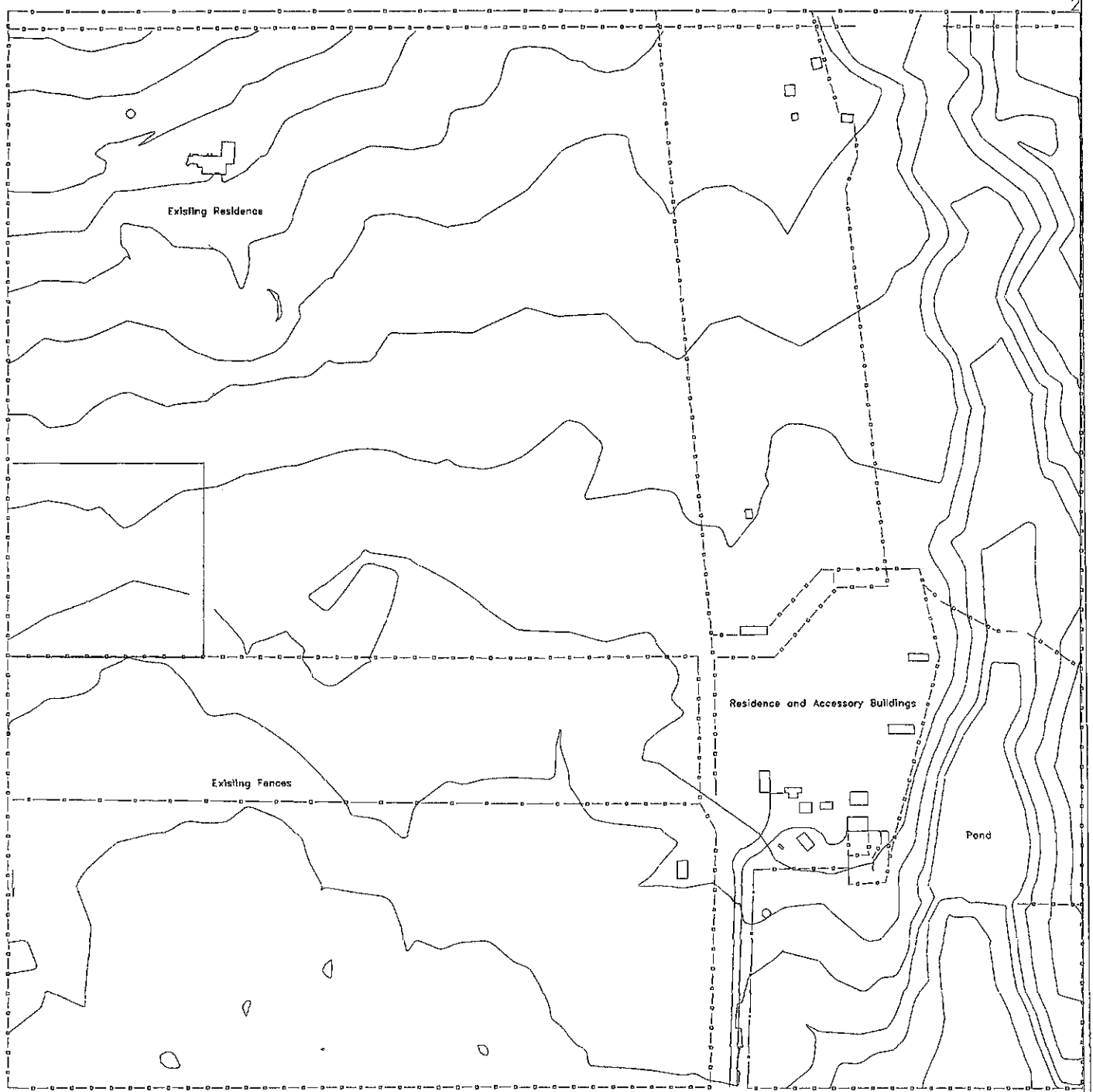
An examination of the subject 1/4 section's land use context indicates that it is surrounded by existing residential development. As such, the opportunity to establish viable agricultural uses on the land is compromised by the proximity of adjacent existing residential development.

Redesignation of these lands is therefore appropriate from a land use planning perspective primarily by virtue of their context within the greater Springbank area which has evolved from an agricultural community to one that is now dominated by country residential land uses and development.

Policy 3.1.1: Proposed land uses shall be compatible with the surrounding residential community.

3.2 Access

The surrounding municipal road network is illustrated on Figure 5. Direct access to the subject lands is available from Lower Springbank Road along the south boundary and 149th Street SW adjacent to the west boundary.



SUBJECT LANDS

FIGURE 2
N.T.S.

WALKER
NEWBY

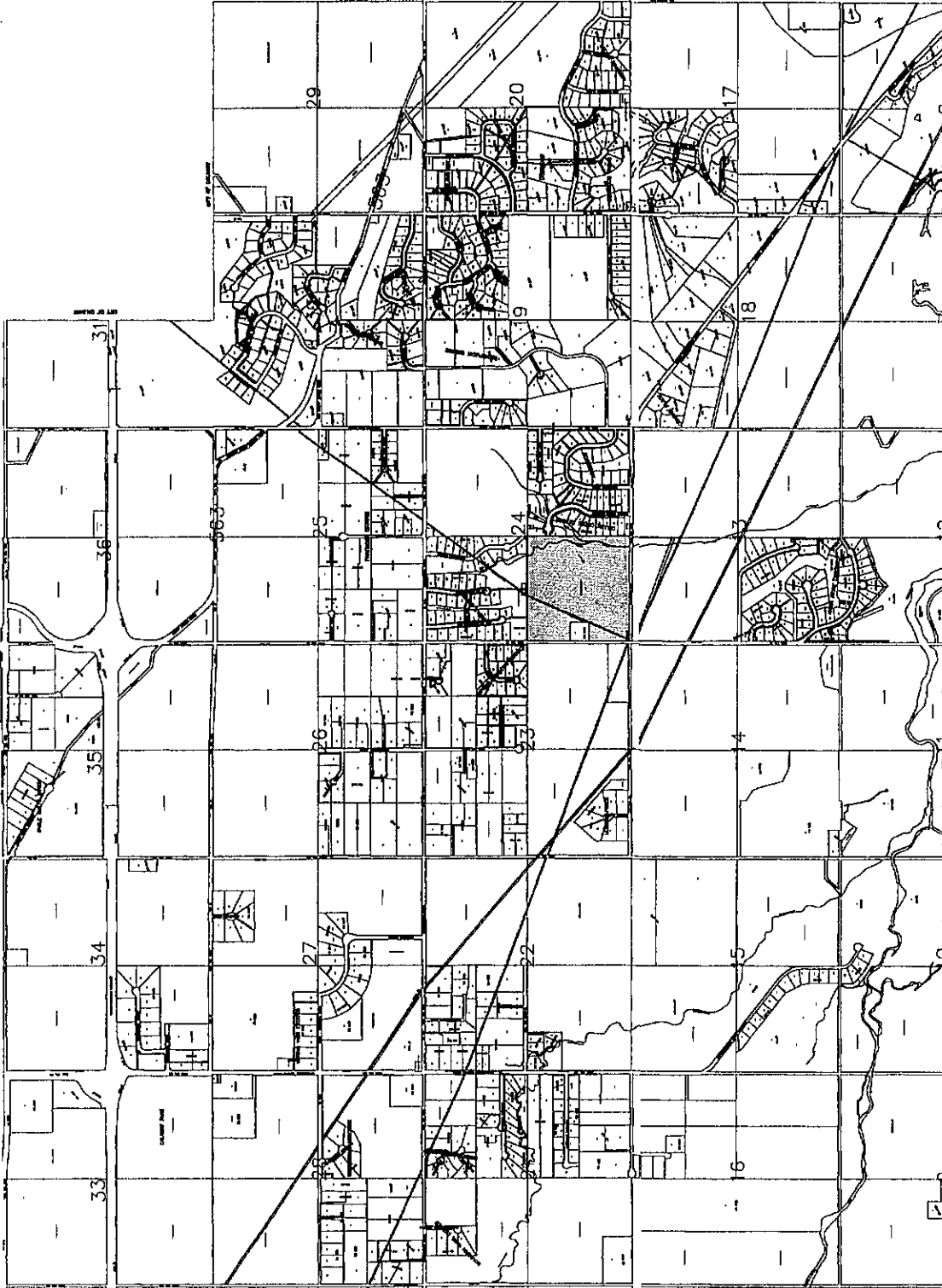
Figure 3

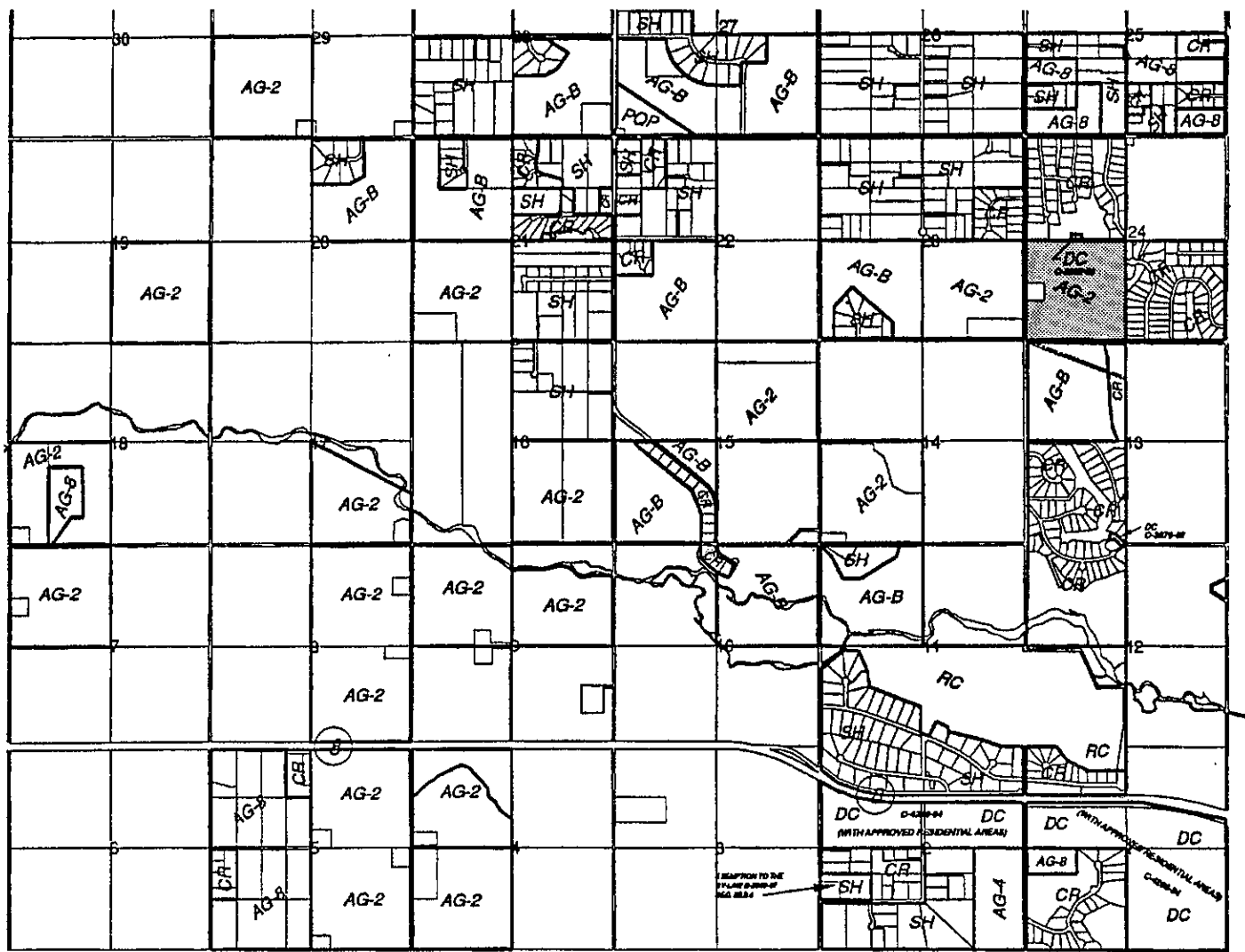
Context

SW-24-24-3-W5M
M.D. of Rocky View

Drawing Notes

1. Legal parcel mapping is derived from Municipal information.





TSUU T'INA NATION RESERVE

ALL LANDS ARE DESIGNATED AG-1 UNLESS NOTED OTHERWISE.

TSUU T'INA NATION RESERVE

AGRICULTURAL CONSERVATION (1) DISTRICT	AG-1
AGRICULTURAL CONSERVATION (2) DISTRICT	AG-2
AGRICULTURAL CONSERVATION (4) DISTRICT	AG-4
AGRICULTURAL CONSERVATION (6) DISTRICT	AG-6
AGRICULTURAL BALANCE DISTRICT	AG-B
AGRICULTURAL COMMERCIAL DISTRICT	AC
AGRICULTURAL & NATURAL RESOURCE INDUSTRY DISTRICT	ANRI
AGRICULTURAL PIPELINE DISTRICT	AG-P
AIRPORT DISTRICT	AP
PUBLIC & QUASI-PUBLIC DISTRICT	POP
DIRECT CONTROL DISTRICT	DC

COUNTRY RESIDENTIAL	CR
SMALL HOLDINGS DISTRICT	SH
RECREATION COMMERCIAL DISTRICT	RC
HIGHWAY COMMERCIAL DISTRICT	H-C
RURAL INDUSTRIAL DISTRICT	RI
PUBLIC SERVICE COMMERCIAL DISTRICT	PSC
HAMLET COMMERCIAL DISTRICT	HC
HAMLET INDUSTRIAL DISTRICT	HI
HAMLET RESIDENTIAL (1) DISTRICT	HR-1
HAMLET RESIDENTIAL (2) DISTRICT	HR-2
HAMLET DIRECT CONTROL DISTRICT	HDC

Figure: 4

Surrounding Land Use

Proposed Redesignation and
Subdivision

SW 1/4 24-24-03-W5



NORTH
NOT TO SCALE
DO NOT SCALE DRAWING.

WALKER
NEWBY

Direct access via major roadways to the City of Calgary is available along Lower Springbank Road, or Springbank Road via 149 Street SW which has been recently widened and upgraded in recognition of it's importance as a main route north to Highway #1. Road widening required to facilitate this upgrade has already been provided.

A traffic impact analysis which includes existing traffic counts and road design capacities is provided in Section 7 of this Plan.

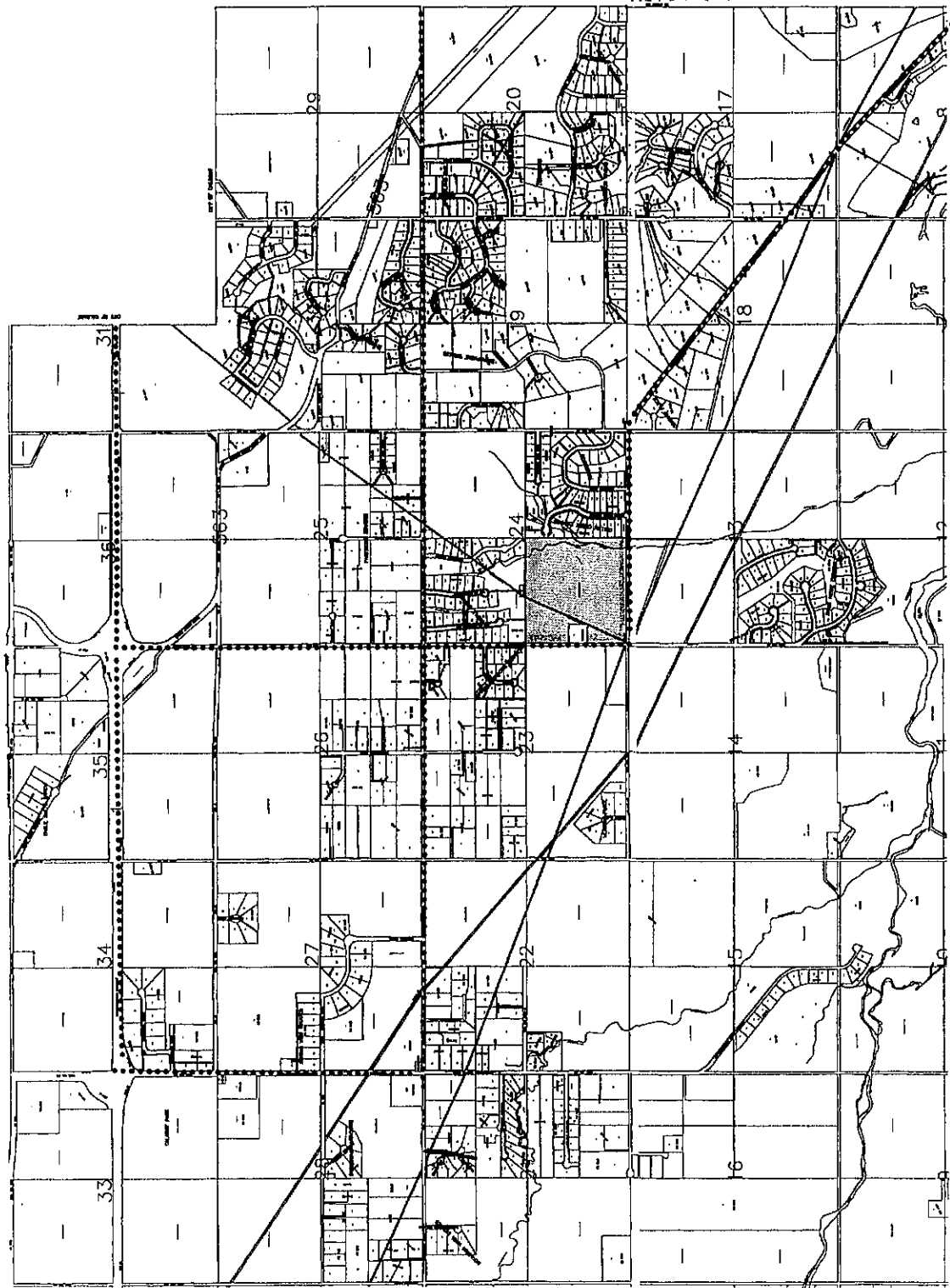


Figure 5

Access

SW-24-24-3-W5M
M.D. of Rocky View

Main Roads

Drawing Notes

1. Legal parcel mapping is derived from Municipal information.

WALKER
NEWBY



to Scale

4.0 Site Features

4.1 Existing Land Use

The subject lands have primarily been used for the pasturing of livestock. Currently there is an existing residence and a variety of accessory buildings typical of a farmstead site located in the southeast portion of the 1/4 section. The balance of the subject lands are vacant with the exception of second residence located in the northwest corner of the 1/4 section.

4.2 Topography

Figure 6 provides an overview of natural features found on the subject lands. The land has a general slope aspect from northeast to southwest and there are no slopes in excess of 15% with exception of localized areas within the Cullen Creek ravine.

The gentle rolling topography presents no constraints to development and combined with a southwest aspect, provides a series of superior building sites that create potential development opportunities for a variety of housing forms.

A significant topographic feature of the lands is a small drainage ravine adjacent to the east boundary of the subject lands. This drainage accommodates the continuation of Cullen Creek through the lands to the south. Although the ravine slopes are steep, the relative elevation from top of bank to the ravine's floor is small and all associated slopes are stable.

4.3 Soils

The majority of the subject lands contain soils identified as Orthic Black Chernozems within the Calgary Urban Perimeter Soil Study prepared by the Alberta Research Council. These soils are characterized as well drained glaciolacustrine deposits.

A detailed inspection of soils and agricultural capability was undertaken by Graecam Inc. in order to provide a more specific assessment of soils, topography and agricultural capability. The results of these investigations are included in Appendix 1 and conclude that 86% of the area proposed for subdivision contains Canada Land Inventory Agricultural Capability classifications of Class 4 soils. The remaining 14% is rated as Class 5, 6 and 7.

4.4 Vegetation

Vegetation over the subject lands consists primarily of grasses typical of non-native pasture. A row of mature poplar trees are located adjacent to the existing driveway accessing onto Lower Springbank Road and a number of smaller trees are associated with the existing residence in the northwest portion of the 1/4 section.

4.5 Drainage and Stormwater Management

Overall, the subject lands are well drained and soils exhibit good infiltration rates. The Cullen Creek drainage and ravine is the only significant, defined drainage course located on the lands. This drainage terminates in a small man-made pond and dam approximately 2 acres in size located in the southeast corner of the subject lands. One small seasonal slough area is located in the southwest corner of the 1/4 section adjacent to Lower Springbank Road.

A comprehensive Stormwater Management Plan has been prepared by Westhoff Engineering Resources and is included in Appendix 2 for reference.

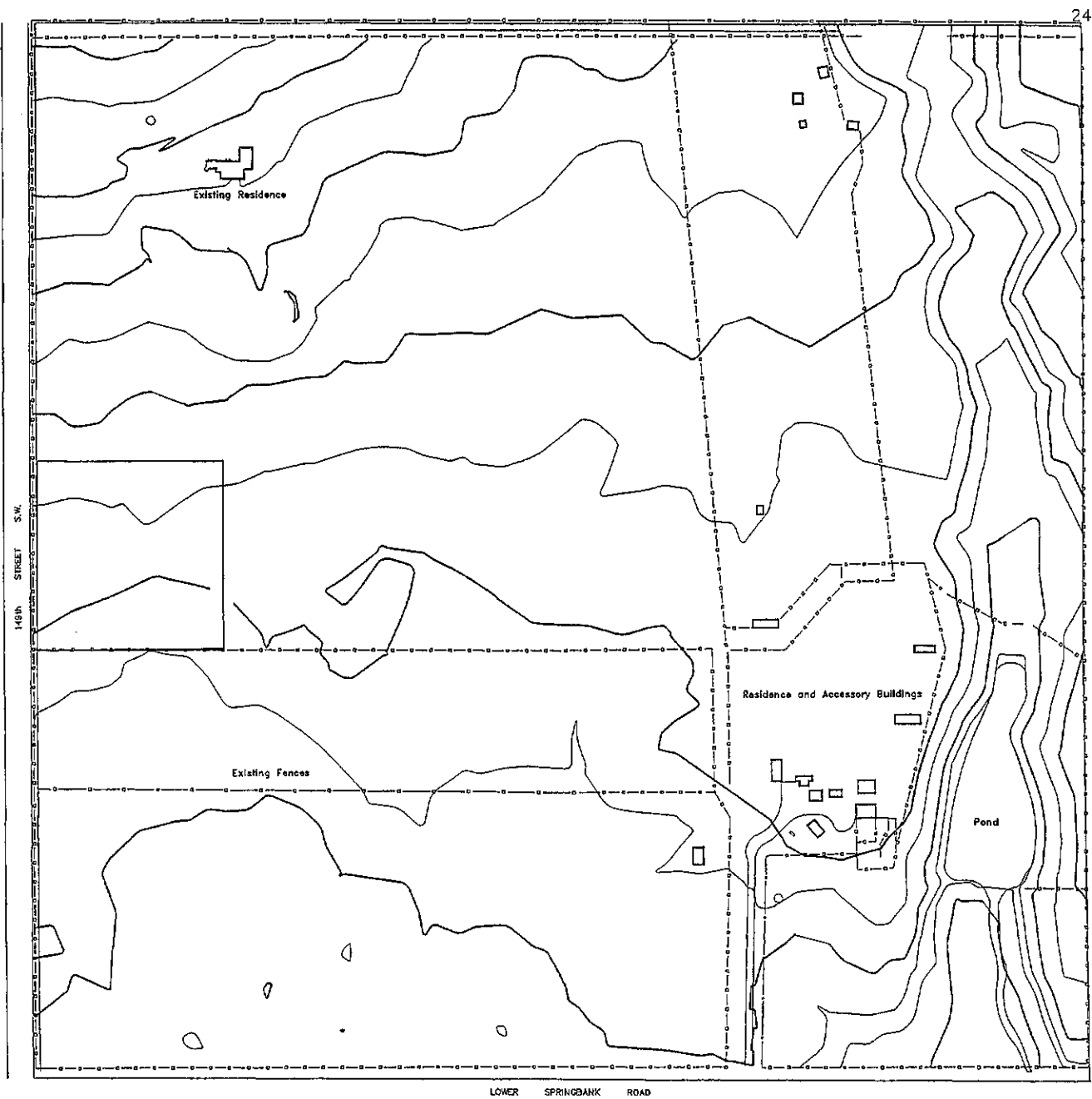
Preservation of the Cullen Creek drainage in terms of flow and quality is a critical component of this Plan and this principal is entrenched in the following Plan Policies:

Policy 4.5.1: The subject lands' natural drainage patterns shall be preserved where possible.

Policy 4.5.2: No contamination of the Cullen Creek drainage from post development discharge sources will be permitted.

Policy 4.5.3: There shall be no increase or decrease in the rate of water flow off-site and downstream along the Cullen Creek drainage.

Policy 4.5.4: Impacts upon the Cullen Creek Drainage upstream of the Plan Area resulting from any alterations through development or improvements, shall not be permitted.



NATURAL FEATURES

FIGURE 6
N.T.S.

WALKER
NEWBY

PHASE 1 SHOWN:

5.0 Development Proposal

5.1 Proposed Land Uses

An examination of site features indicates that there are few natural features that would present a constraint or hazard for development and virtually the entire site is suitable for development, however, the Cullen Creek drainage and its associated ravine is unsuitable for development.

A country residential land use designation is proposed for the subject lands to facilitate subdivision and development for residential purposes.

5.2 Subdivision Concept

Figure 7 provides a proposed tentative plan of subdivision for the 1/4 section. Two acre parcels are proposed for residential development with two larger balance parcels. The subdivision is designed around a single looped roadway and a series of linear park features.

Conceptual Land Use Statistics

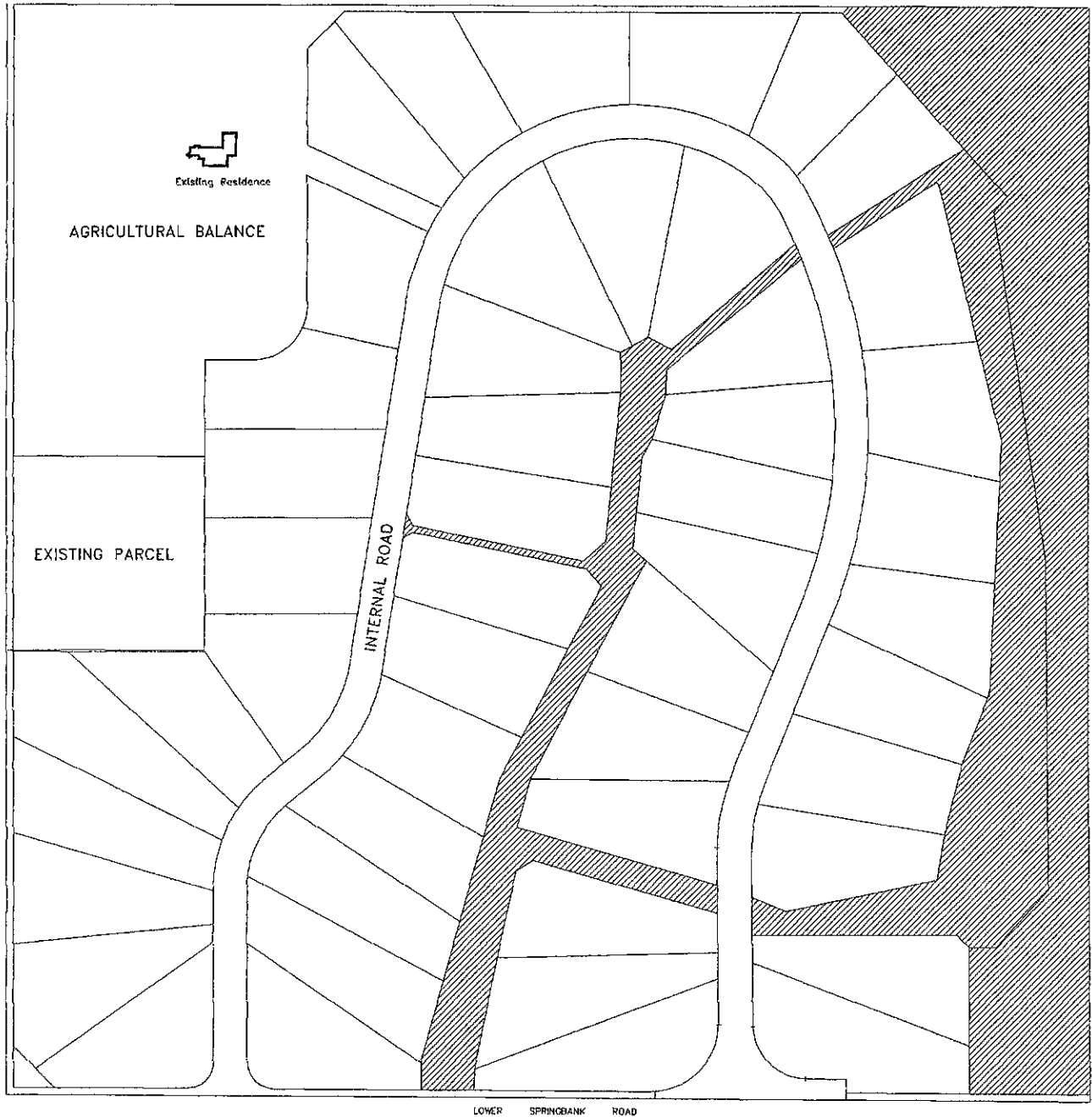
Proposed Population Density: 200

Land Use	Acres	Ha.	%
Residential:	105.7	40.3	69.4
Parks and Open Space:	16.7	6.7	10.9
Balance Parcel:	16.6	6.7	10.9
Roads:	13.0	5.4	8.8
Total Plan Area:	152.00	61.50	100.00

Design of the subdivision has been guided by a careful analysis of the subject land's natural features to maximize the aesthetics of future building sites while preserving and enhancing the most significant natural attributes of the land.



The Cullen Creek ravine is preserved within a private park that encompasses the entire length of the drainage as it passes through the subject lands. The ravine will be enhanced with landscaping and the development of recreational facilities that will include a trail network, picnic areas and a community lake. Channelization and improvements to the creek itself will enhance the ravine environment and create a theme for the development that is focused on water and linear parkways.

The existing pond located at the south end of the creek will be improved through landscaping and aeration of the water to create an amenity for the development. Additional future enhancements may include the construction of picnic shelters.



SUBDIVISION CONCEPT

FIGURE 7
N.T.S.

-  OPEN SPACE
-  RESIDENTIAL

The creek and ravine area will be linked to the balance of the development through the continuation of the park area into the central portions of the subject lands through linkages. An additional 5 acres of land will be set aside through the center of the development for use as a private park.

Winding through the linear parkways will be a pathway and a man-made creek system that features flowing water and smaller ponds to provide a focus for lots in the central portions of the development. An important component of the central park will be the regeneration of an Aspen Parkland ecosystem through the application of natural landscaping techniques. This will establish a habitat for the attraction of wildlife and aquatic birds. The result is the creation of a development that provides a natural landscape and recreation based focus to generate a cohesive residential community linked by the common elements of water, paths and parks.

Ownership of the recreation lands will be conveyed to a resident's association comprised of future owners of the proposed lots. The cost of maintaining and managing the common amenities will be divided proportionally between the residents. It is also anticipated that an opportunity will be extended to existing residents located in the adjacent subdivisions to the east to share in the use of the parks, paths and ponds. This will both enhance the recreational opportunities for existing residents and will integrate the proposed development into the surrounding community.

In addition to the internal private parks and pathways, a perimeter trail will be constructed adjacent to the west and south boundaries of the subject lands within the municipal road allowances. This will provide a further link in the greater Springbank community trail network. A small landscaped linear berm will be constructed between the trail and residences located on adjacent lots to provide a buffer between residences and the adjacent municipal roadways.

In addition, architectural controls, landscaping, signage, fencing and entrance treatments will be carefully designed and controlled to create an integrated aesthetically superior environment. The use of natural materials and colors will be emphasized in the development of all structures to reflect the natural environment and surrounding countryside.

Policy 5.2.1: Subdivision of the Plan area shall be in accordance with the proposed subdivision shown on Figure 7 and forming part of this Plan.

Policy 5.2.2: The Cullen Creek drainage and ravine shall be preserved from residential subdivision and development.

Policy 5.2.4: A Homeowner's Association shall be legally established and charged with the responsibility for the ongoing maintenance of the private Community Park areas shown as proposed Lot 51 on Figure 7.

Policy 5.2.5: Any modifications to the dam and reservoir must be done in accordance with the Water Resources Act.

Policy 5.2.6: Provision of environmental reserve or environmental reserve easement within the Cullen Creek Drainage course and ravine shall be determined at the time of the subdivision approval to the satisfaction of the subdivision approving authority and furthermore, where Environmental Reserve or Environmental Reserve Easement is taken it shall extend from top of bank to top of bank to the satisfaction of the Municipality.

Policy 5.2.7: The subdivision shall be designed such that no residential lot shall extend below the top and break of bank at any point in the the subdivision to the satisfaction of the Municipality.

5.3 Municipal Reserves

Pursuant to the Municipal Government Act, Council as Subdivision Approving Authority, has the opportunity to acquire up to 10% of the gross area of the subject lands as Municipal or School Reserve or require the payment of cash in lieu of the land that would have been dedicated as Reserve.

In consideration of the large quantity of private open space and recreational lands being proposed as amenities for the future residents of the project, a cash-in-lieu payment is the preferred method of satisfying the Municipality's reserve requirements.

Policy 5.3.1: The provision of Municipal Reserves shall be determined at the time of subdivision approval to the satisfaction of the Subdivision Approving Authority.

Policy 5.3.2: The provision of Municipal Reserves for the balance lot are to be deferred by caveat against the title until such time as further subdivision occurs.

5.4 Subdivision Phasing

Phasing within the Plan Area will proceed generally as depicted on the Subdivision Phasing Plan. Development of public roadways, private pathways and common park areas are included in Phase 1 in recognition of their importance as community amenities.

Policy 5.4.1: Phasing within the Plan Area shall proceed in accordance with the Subdivision Phasing Plan attached to and forming part of this Plan.

Policy 5.4.2: The common amenity lot will be constructed as part of the Phase 1 development.

5.5 Stormwater Management

The management of post-development stormwater runoff from the site is a critical component in the protection of the Cullen Creek drainage. A comprehensive stormwater management study was prepared by Westhoff Engineering Resources and is attached to this Plan in Appendix 3.

Post development runoff will be managed on site to insure no net increase in flow. The quality of stormwater discharge into Cullen Creek will be maintained through the use of a purification system using sedimentation ponds as conceptually described in the Stormwater Management report.

Policy 5.5.1: Stormwater Management and the maintenance of water quality in Cullen Creek shall be in accordance with the recommendations provided in the Stormwater Management Study prepared by Westhoff Engineering Resources attached to and forming part of this Plan in Appendix 3, and to the satisfaction of Alberta Environmental Protection and the Municipality.

6.0 Servicing Proposal

6.1 Wastewater Treatment

Sewage treatment and disposal will be managed on site with individual septic tank and tile field installations. Alberta Environmental Protection prefers a minimum of 1 acre (.4 ha.) of developable land on each lot proposed through subdivision to facilitate the proper siting of tile fields and the proposed subdivision has been designed to accomplish this.

Percolation Testing was conducted throughout the entire subject 1/4 section by Sabatini Geotechnical. The results are included in Appendix 1 and indicate that the subject lands are suitable for septic fields.

Policy 6.1.1: Sewage treatment shall be by individual septic tank and tile field for each lot proposed for residential development to the satisfaction of Alberta Labor.

6.2 Water Supply and Distribution

Water will be supplied to each of the proposed parcels via a piped water distribution system. In this regard, the Westridge Water Co-op pipeline is located north of the subject lands. The Water Co-op has provided written confirmation that sufficient capacity is available within their water system to supply the proposed development and it is possible to extend water service to the development.

Policy 6.2.1: The water supply and distribution system required to service subdivision in the plan area shall be via a piped water co-op system constructed, licensed and permitted by Alberta Environmental Protection.

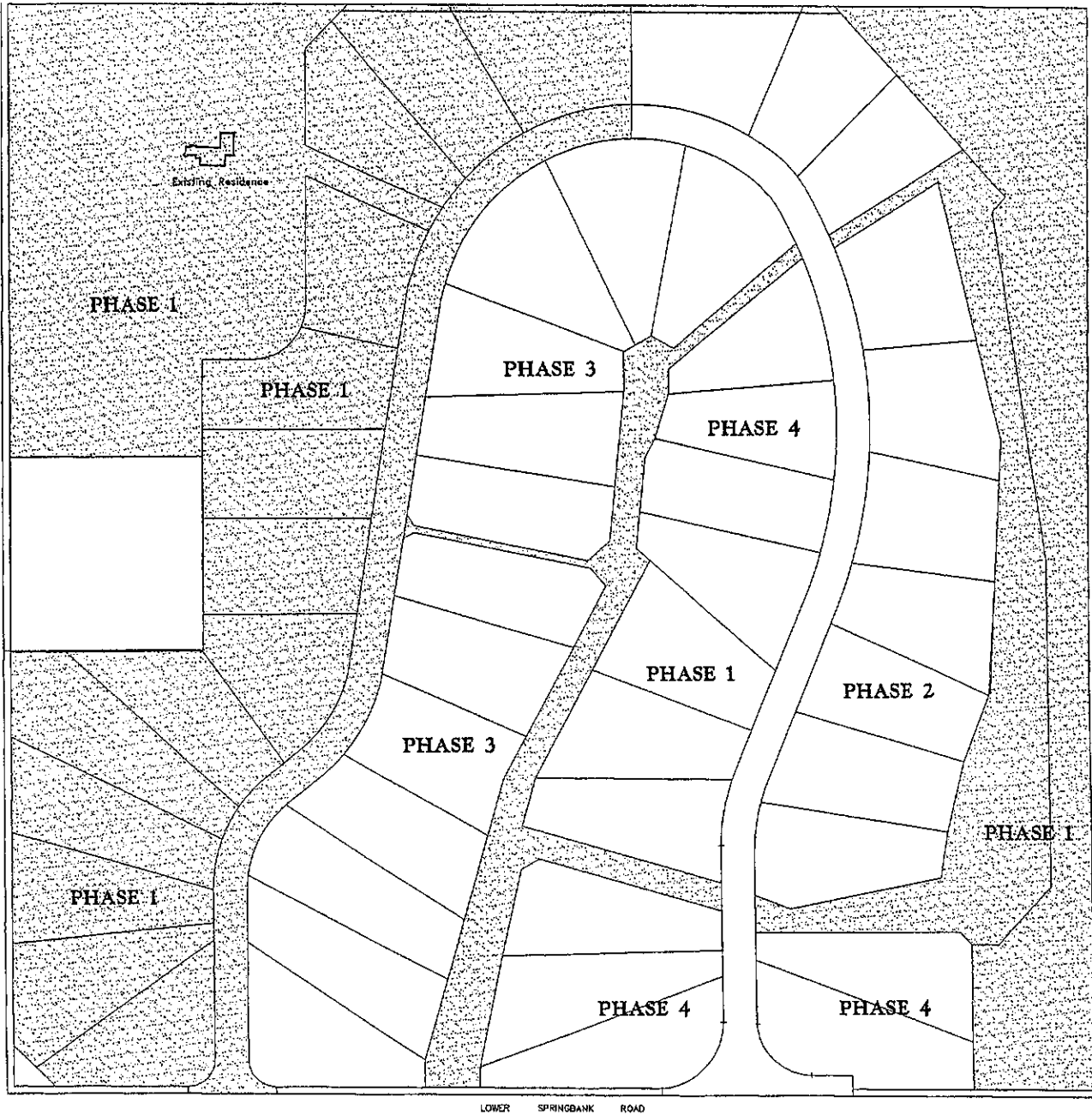
6.3 Utility Services

Power, cable and natural gas are all available in the area with sufficient capacities to service the proposed development.

6.4 Internal Subdivision Roads

All internal subdivision roads will be constructed to full municipal standards. Roads have been located to minimize the need for extensive earthworks and all grades are well below the maximum 7% required by the Municipality. The proposed internal road system provides two separate access points onto the adjacent municipal roads in accordance with the Municipality' Access and Linkages policy.

Policy 6.4.1: Internal subdivision road access shall be via public roadways constructed to full municipal standards.



PHASING CONCEPT

FIGURE 8
N.T.S.

WALKER
NEWBY

PHASE 1 SHOWN: 

7.0 Traffic Impact Analysis

7.1 Existing Traffic Volumes

Lower Springbank Road meets the M.D. of Rocky View's criteria for classification as a Major Collector with a traffic volume capacity of 5000 vehicle trips per day. 149 Street NW has been recently upgraded with subgrade and surface improvements and widening.

Existing traffic volumes were acquired for Lower Springbank Road from traffic counts conducted by the M.D. of Rocky View. Traffic counts are for a 24 hour period and include total vehicle trips traveling in both directions as follows:

Lower Springbank Road

Location	Date	Traffic Count
East of 149 Street	1996	1218
West of 149 Street	1996	364

The traffic counts reflect an increase in volumes along Lower Springbank Road to the east as the number of country residential oriented trips begin to accumulate with the increase in subdivision.

149 Street SW

Location	Date	Traffic Count
South of Springbank Rd	1996	960
North of Springbank Rd	1996	1240

7.2 Future Traffic Volumes

Additional traffic generated by the proposed subdivision can be estimated by observing the rate of trip generation from existing country residential developments and applying this rate to the proposed subdivision on a per dwelling unit basis. Recent studies by Alberta Transportation and Utilities indicate that typical country residential developments generate between 7 and 9 vehicles trips per day per dwelling unit.

This would result in a potential traffic increase from the proposed subdivision of between 343 and 441 vehicle trips per day. By adding these additional traffic volumes to the existing volumes currently occurring on Springbank Road, and 149 Street, the probable

impact of this additional traffic can be assessed by comparing the total expected volumes to the design capacity of the roads: ¹

Lower Springbank Road: Traffic Impact Analysis

Location	Existing Traffic	Additional Traffic	Total Volume	% of Maximum (5000 vehicles)
East of 149 St.	1218	441	1659	33 %

149 Street: Traffic Impact Analysis

Location	Existing Traffic	Additional Traffic	Total Volume	% of Maximum (5000 vehicles)
S.Springbank	1240	441	1681	33%

It should be noted that the higher estimate for additional vehicle trips resulting from the proposed subdivision was used for the Traffic Impact Analysis. Also, the additional traffic was added equally to both Lower Springbank Road and 149 Street to provide an estimate of the maximum impact. In reality, most of the additional traffic resulting from the proposed subdivision will be oriented to Lower Springbank Road as the major collector for the movement of vehicles east into the City of Calgary.

The preceding analysis demonstrates that the impact of additional traffic resulting from the proposed subdivision on the adjacent municipal road network will be minimal. With the estimated additional traffic added to existing volumes, both Springbank Road and 149 St. SW would be operating at approximately 33% of their design capabilities.

¹ M.D. of Rocky View Transportation and Field Services provided traffic count data.

8.0 Public Input

In order to provide more detailed information to the community regarding the proposal, and to acquire input from surrounding residents, landowners within a 1/2 mile radius of the subject 1/4 section were contacted individually.

The results of these discussions are summarized as follows:

Invitations were mailed to individual properties within a 1/2 mile radius of the subject property using the latest Municipal tax role data. In addition, notices were posted at mailboxes and other prominent locations within the community. Approximately 180 invitations were mailed and 28 people attended the open house over the course of the evening. Those attending resided in developments adjacent to the subject lands including:

- Rosewood
- Cullen Creek Estates
- Spring Meadow
- Country Estates
- Allendale

Issues and comments raised by individuals at the Open House are summarized as follows:

1. Cullen Creek drainage should be dedicated as Environmental Reserve and left in it's natural state.
2. Septic fields installed in the proposed development adjacent to Cullen Creek will contaminate the water coop source well for Cullen Creek Estates.
3. Proposal to preserve the Cullen Creek ravine in a park - either private or public - was a good idea.
4. Access points to the proposed development should not be on 149 street, preference for the plan as proposed showing all access points onto Lower Springbank Road.
5. Architectural controls should reflect the aesthetic standards already established in the surrounding community and should be strictly enforced.

Response to Issues Raised

Status of The Cullen Creek Drainage

The proposed ASP contains clear and strict policy regarding the preservation of the Cullen Creek drainage and it's ravine both in terms of maintaining water quality and quantity upstream and downstream of the subject lands in Section 4.5 on page 16.

We believe that the preferred method of accomplishing this is to retain the drainage and it's ravine in private ownership as a park to be maintained by the surrounding community including both the proposed development and the adjacent Cullen Creek Estates.

However, if Council wishes to acquire these lands as Environmental Reserve we have no objection and would presume that the Municipality would become responsible for their maintenance and care including the pond and dam structure should the Environmental Reserve option be preferred. A second option would be to place an Environmental Easement over these lands to ensure their protection while allowing for their private ownership and care.

Under either scenario, the provisions of the ASP requiring protection of the drainage would still be accomplished.

Septic Fields

Geotechnical studies conducted on the site and included in Appendix 1 of the ASP indicate that the lands are suitable for the installation of septic tanks and tile fields. Additional studies were conducted on the site by Curtis Engineering Associates during July, 1998 and these results have been submitted to the Municipality under separate cover.

The source well for the Cullen Creek water coop is located at the northwest corner of the SE 1/4 of Section 24 immediately north of the second last lot in Cullen Creek Estates. The well is 90 to 100 feet deep and as such is finished in a bedrock aquifer.

The opportunity to contaminate this well with raw sewage from septic tanks located on the opposite side of the Cullen Creek drainage almost 250 m away at the closest point is unlikely. The effluent would have to seep vertically downward through multiple layers of soil, clay and glacial till, then penetrate bedrock and travel upslope to the northwest an additional 250 m to enter the aquifer being used by the Cullen Creek Estates well.

We would suggest that the proximity of septic fields within the Cullen Creek Estates development itself, and existing septic fields in Allendale Estates adjacent to the north represent a greater hazard to the well than the subject proposal. The development in Allendale Estates is upslope and upstream of the supply well along the Cullen Creek drainage and there has been no difficulty to date with contamination. Nevertheless, the depth of the well is sufficient to protect it from the unlikely event that there is any potential contamination from untreated sewage effluent.

9.0 Concept Plan Conformity

9.1 Municipal Statutory Plans and Policy

In addition to the planning principles established by this Plan, implementation of the development will be guided by the planning policies adopted by the M.D. of Rocky View in its statutory Plans.

Policy 9.1.1: All subdivision and development within the Plan Area shall conform to:

- *Bylaw C-4840-97 being the Municipal District of Rocky View No. 44 Municipal Development Plan;*
- *Bylaw C-4841-97 being the Municipal District of Rocky View No. 44 Land Use Bylaw; and subsequent or successor Land Use Bylaws and/or Municipal Development Plans.*

10 Implementation

The development of the subject lands is regulated by the provisions of the Country Residential District (CR) pursuant to the *Land Use Bylaw*.

Subdivision of the lands will be guided by the policies contained herein and implemented by Development Agreements imposed through conditions of subdivision approval by the Municipal District of Rocky View No. 44.

11 Appendices

Appendix 1: Percolation Test Results - Sabatini Geotechnical

Appendix 2: Soil Capability Survey - Graecam Inc.

Appendix 3: Stormwater Management Report - Westhoff Engineering Resources Inc.

Appendix 1

SABATINI GEOTECHNICAL INC.

6919 - 32nd AVENUE N.W.
CALGARY, ALBERTA T3B 0K6
TEL: 247-1813
FAX: 247-1814

File: 9702-2039

February 4, 1997

Moddle Homes

Site 37, Box 17, RR 12
Calgary, Alberta
T3E 6W3

Attention: Mr. Jim Moddle

Dear Sir:

Re: Proposed Subdivision - M.D. of Rockyview No 44
SW $\frac{1}{4}$ - Sec 24 - Twp 24 - Rge 3- W5M (Lower Springbank Road)

Introduction

In accordance with authorization received from Mr. Jim Moddle, a geotechnical investigation was carried out at the above noted site (Plate 1 - Site Plan). The purpose of the investigation was to obtain subsurface information regarding suitability of the site for conventional septic fields. The site is slightly hilly and was snow covered at the time of the investigation. Surface vegetation consisted of native grasses.

Details of Investigation

On January 30, 1997, a total of 8 shallow test pits were dug out in the area of the proposed subdivision. Under normal conditions, 0.9m deep holes would be used to conduct a percolation rate test. However, due to the presence of frost in the ground, the field percolation test was not carried out. Four representative samples of soil were obtained for grain size analyses in the laboratory from which percolation rate can be estimated.

Subsurface Conditions

The soil profile to the maximum depth investigated consisted of variable thickness of topsoil (± 250 mm) overlying a silty clay. The clay appears to be a lacustrine (lake) deposit due to the low gravel content.

Test Results

Results of the grain size analysis tests are summarized on the following table. The soil would be classified as silty loam or silty clay loam according to the USDA soil textural classification system.

Grain Size Analyses - SW¼-24-24-3-W5M			
	SAND/GRAVEL	SILT	CLAY
Test Pit			
1	10%	70%	20%
3	10%	57%	33%
6	5%	58%	37%
8	10%	60%	30%

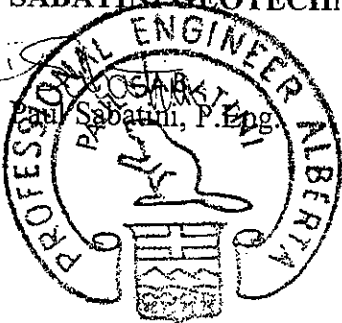
Comments and Recommendations

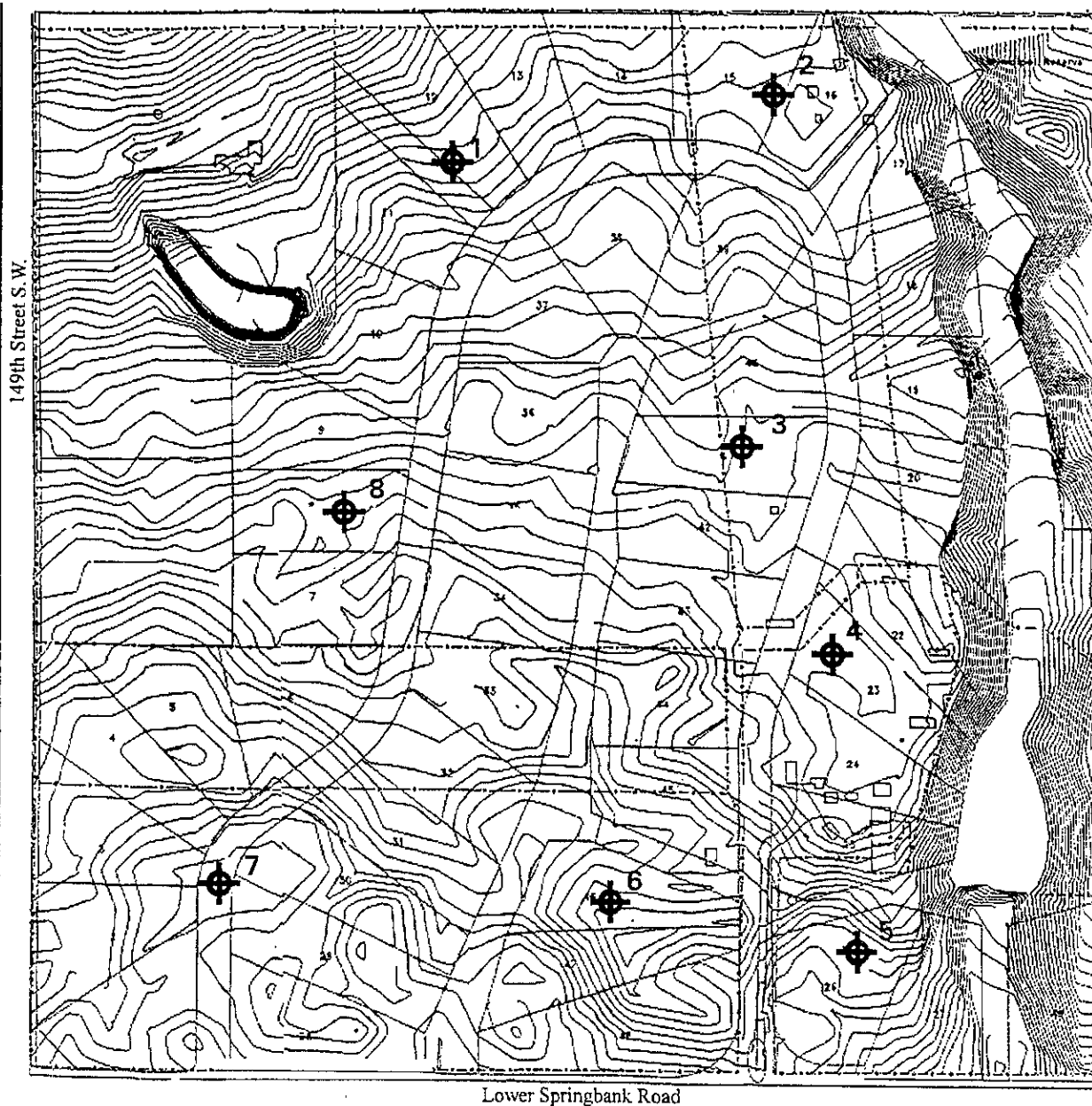
1. The near surface soil at the site of the proposed subdivision consists of a silty loam to silty clay loam for which percolation rates of 30 to 60 minutes per 25mm would be expected. The soil is thus considered acceptable for conventional septic fields. It is recommended that percolation testing be carried out in the spring after frost has left the ground to confirm the suitability of the soil for conventional septic fields particularly in area of test pit 6 where laboratory testing indicates higher content of clay.

Should you have any questions or require further information, please contact the undersigned.

Yours very truly;

SABATINI GEOTECHNICAL INC.





Not to scale

Legend:

 Test Pits Location

SABATINI GEOTECHNICAL INC.

Middle Homes

Country Residential Subdivision- Site Plan

SW1/4-24-24-3-W5M

MD Rocky View, AB

JOB No. 9702-2039

DATE January, 1997

PLATE
1

Appendix 2

February 24, 1997

File # 97-01

Mr. Jim Moddle, B.Arch.
Moddle Homes
Site 37, Box 17, RR # 12
Calgary, Alberta
T3E 6W3

RE: AGRICULTURAL CAPABILITY ASSESSMENT
SW 24-24-3 W5

Dear Mr. Moddle,

Pursuant to discussions with yourself and Martin Grady the following letter report will present the findings of a soil evaluation and Agricultural Capability Assessment according to *Land Capability Classification for Arable Agriculture in Alberta (1987, reprinted 1990)* for the above noted property.

As you are aware I have inspected the soils on the property on two occasions, once in 1990 and once in 1992.

INTRODUCTION

The soil and Agricultural Capability Assessment is based on the site inspection of soils and landscape and the following publications:

Alberta Soils Advisory Committee (ASAC), 1987 reprinted 1990. Land Capability Classification for Arable Agriculture in Alberta (1987). Technical Report prepared by Agricultural Rating System Working Group of the Soil Inventory Subcommittee of the Alberta Soils Advisory Committee and Agrometeorology Working Group of the Alberta Agrometeorology Advisory Committee. Edited by W.W Pettapiece.

MacMillan, R.A., 1985. Soil Survey of the Calgary Urban Perimeter. Alberta Soil Survey Report # 45., Alberta Inst. of Pedology, Edmonton.

The above publications serve as a guide for the assessment of Agricultural Capability in the Calgary area. The maps included in these publications are intended for regional planning purposes and due to their small scale, can be misleading when dealing with small parcels of land such as the property investigated herein. Differences between ratings found in the above documents and those that follow are reflective of the large differences in the scale of the investigations, and the climate zone recalculation provided in ASAC (1987).



BACKGROUND

The Land Capability Classification for Arable Agriculture In Alberta (ASAC) was prepared by representatives of Alberta Agriculture (Land Use Branch), Alberta Energy and Natural Resources (Resource Evaluation and Public Lands Division), Alberta Municipal Affairs (Assessment Services) and Agriculture Canada (Soil Survey). The document was prepared to address concerns that the use of several different systems in the province was leading to unnecessary confusion and conflict. Previous systems employed in the province included the Farmland Assessment Schedule of Municipal Affairs (Department of Municipal Affairs, 1979), the Public Lands System (Storrie (1933) and the CLI - Soil Capability for Agriculture (Brocke 1977, Canada Land Inventory 1965).

The basic concepts of the Canada Land Inventory: Soil Capability for Agriculture (Canada Land Inventory 1965) were adopted, that is a seven class system with Class 1 having the highest capability (least limitations) and Class 7 having the lowest capability (greatest limitations). The ASAC system was designed to accommodate the three major components of climate, soils and landscape. It was agreed that each of these components by themselves could be limiting to agriculture and therefore each should be considered separately and each should be assessed over the total of 0 to 100 points. The final agricultural capability rating would be based on the most limiting of the three, not the accumulated total.

The new system retains a close similarity to the older CLI - soil capability for agriculture system (Canada Land Inventory 1965) but attempts to be more quantitative. In both systems land is grouped into seven classes according to their potentialities and limitations for agricultural use. The definition of the classes are essentially the same as previously defined except that a range of index points is now assigned to each class. The first three classes are capable of sustained production of common cultivated crops, while the fourth class is considered marginal.

CLIMATE FACTORS

The two principal climatic variables are the energy factor and the moisture factor, the most limiting of which determines the basic climatic rating. Four climatic modifiers; spring moisture, fall moisture, fall frost and hail occurrence are recognized as having an effect on the climatic assessment of agricultural capability. Climatic data from over 200 locations throughout Alberta were used to generate the climate maps. A major test of the climate factors and maps was conducted using crop choice to define capability classes.

For the property in question the moisture factor is taken as the precipitation minus the potential evapotranspiration and is approximately -250. For this value a deduction of 19 points is made which gives a climatic rating based only on moisture of 81 points or class 1.

The energy component is based on effective growing degree days (EGDD) which incorporates the length of the season, degree days, day length and diurnal temperature range parameters. The



start of the growing season is taken as the first occurrence of five consecutive days with a mean temperatures above 5° C after March 15. The end of the growing season is represented by the average date of the first occurrence of 0° C after July 15. Climatic data are taken for the period of 1951 to 1980. Translation of EGDD values to agricultural capability is provided below:

1500 EGDD	Should be no limitation. deduction = 0 points
1200 EGDD	This is closer to the point where wheat drops to a minor component in a dominantly barley system. This should be class 3. deduction = 40 points
1100 EGDD	This is near the point where annual crops occupy less than 50% of the cultivated area. This is close to marginal or class 4. Deduction = 50 points
950 EGDD	This marks the edge of arable agriculture which should be class 5. Deduction = 70 points
200 EGDD	Has no agricultural potential. Deduction = 100 points.

The map of Effective Growing Degree Days included in Land Capability for Arable Agriculture in Alberta (ASAC 1987) places the property between the isolines of 1000 to 1100 EGDD. It should be noted that climatic data was most likely obtained from a soil climate monitoring station in NE 3-25-3 W4, approximately 3 miles from the Moddle property as well as from climatic records at Springbank Airport, approximately 4 1/2 miles from the subject property.

A EGDD value of 1050 was estimated for the property. This value for Effective Growing Degree Days results in a deduction of 58 points leaving a rating value of 42 points or class 4 based on the climatic energy component only.

Four climatic modifying factors are available for assessment. Excess spring moisture that delays seeding and therefore shortening the growing season, excess fall moisture which cause a decrease in farming capability, hail index and resultant loss in yield/quality of crops and fall frost which is based on the occurrence of frost prior to the regional average recognized in the EGDD assessment. All of the climatic modifying factors are evaluated as non-limiting and therefore no further deductions that those from the growing season (EGDD) assessment are made.

SOIL CAPABILITY CLASSIFICATION SYSTEM

The classification system does not consider the following:

1. Shrubs, trees, or stumps are not considered as limitations unless it is not feasible to remove them.



2. The soils will be cropped under a largely mechanized system and with good management practices.
3. Soils considered feasible for improvement by practices that can be made by the farmer himself are classified according to their limitations after the improvements are made. Soils requiring improvements beyond the means of the individual operator are classified to their present condition.
4. Distance to market, kind of roads, location, size of farm, characteristics of land ownership, cultural practices and the skill or resources of the operator are not criteria for capability groupings.

SOILS AND TOPOGRAPHY

Soils on the parcel have been previously mapped by MacMillan as Orthic Black Chernozems belonging to the Lloyd Lake series. This soil is well drained and developed on a very silty textured glaciolacustrine deposit. The majority of the parcel is undulating to rolling (2.5 to 13 % slopes) with the exception of areas in proximity to Cullen Creek which is strongly incised with very steep side slopes (28 to 38% slopes). Several soil inspections on the property confirmed the presence of Lloyd Lake soils. Also detected at the higher intensity inspection level herein as compared to MacMillan were imperfectly drained Lloyd Lake soil types in lower slope positions and depressions. The higher intensity level also permitted the delineation of more map units based on slope breaks than possible by MacMillan.

AGRICULTURAL CAPABILITY

The distribution of Agricultural Capability Classes is presented on the attached map. Areas of Agricultural Capability Classes are presented in Table 1 and are to be considered only as an approximation.

Assuming the parcel is best placed in Agro-Climatic Zone 4H, Lloyd Lake soils occurring on slopes less than 9%, have no further limitations than that imposed by the climate zone and are rated as Agricultural Capability Class 4H. Approximately 34.0 ha or 64.5 % of the property is rated as Class 4H.

Areas where topography ranges from 9 to 15% have been rated as class 4T. These areas located in the hummocky southern portion of the parcel, the northwest corner of the parcel and the less steeply sloping sides of the Cullen Creek valley. Approximately 5.8 ha or 11.0 % of the property is rated as Class 4T.

Three areas of Lloyd Lake soils in depressional landscape positions are limited by excessive wetness to Agricultural Capability Class 4W. A total of 4.3 ha of Class 4W land or approximately 8.2 % of the parcel has been mapped.



The creek floor is rated as 5 IW due to the possibility of flooding/inundation (I) and excessive water (W) and occupies 2.1 ha or 4.0 % of the parcel.

Areas of Lloyd Lake soils on slopes greater than 15% are extremely limited by topography and classed as 6T for agriculture. These units form the side walls of Cullen Creek and occupy 5.7 ha or 10.8 % in total.

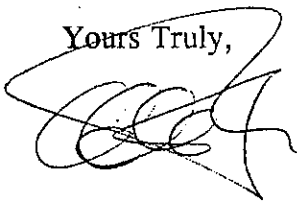
The 0.8 ha pond has no capability for Agriculture and is rated as 7W.

SUMMARY

Approximately 12.0 ha are occupied by the two subdivided lots leaving 52.7 ha of the quarter section that have been rated. Of this 52.7 ha, 44.1 ha or 83.7 % of the rated area is Agricultural Capability Class 4. Approximately 2.1 ha or 4.0 % of the rated area is Agricultural Capability Class 5. Approximately 5.7 ha or 10.8 % of the rated area is Class 6. Class 7 lands occupy 0.8 ha or 1.5 % of the rated area.

I trust you will find this report adequate for your needs. Should you have any questions or require further information please do not hesitate to contact the undersigned.

Yours Truly,



Craig Heath, M.Sc., P. Ag.

-Graecam-
Incorporated



Table 1. Summary of Agricultural Capability Classes		
Agricultural Capability Class	Area Hectares	Percent of Parcel
4 H	34.0	64.5
4 T	5.8	11.0
4 W	4.3	8.2
Total Class 4	44.1	83.7
5 IW	2.1	4.0
6 T	5.7	10.8
7 W	0.8	1.5
Totals	52.7	100



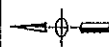
SW-24-24-3-W5M
M.D. of Rocky View

Map by Graecam Inc.
Drafting by Grady Consulting

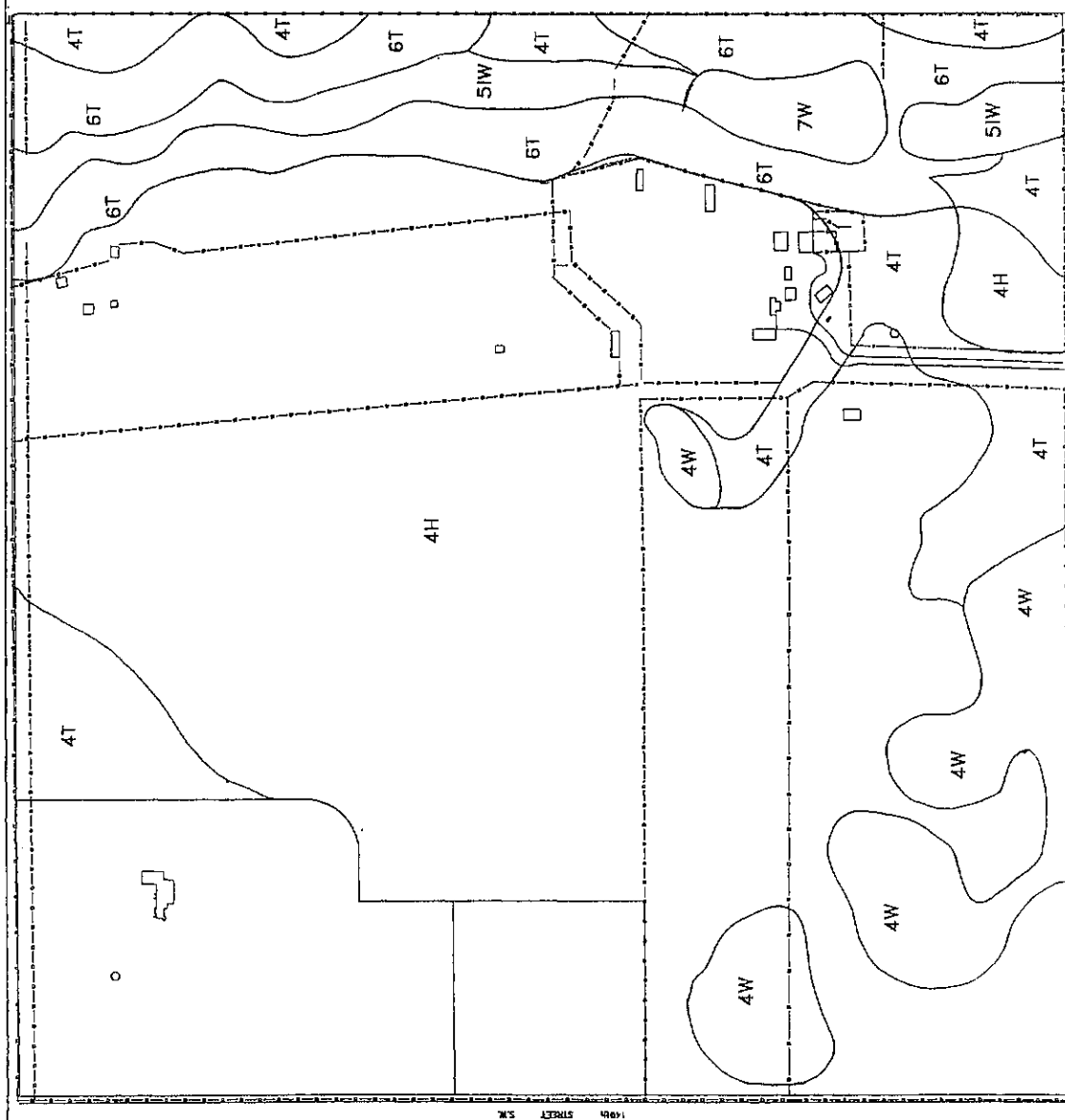
Graecom Inc.
1712-13th Avenue SW
Calgary, Alberta
Tel: 244-3556

Grady Consulting Ltd.
323 - 11 Avenue NE
Calgary, Alberta

Tel: 230-1920
Fax: 230-1921



Not to Scale



Appendix 3

**Westhoff
Engineering
Resources, Inc.**

Water Resources Management Consultants

December 22, 1997
PJ97031

Walker Newby and Partners Ltd.
200, 1212 - 1st Street S.E.
Calgary, Alberta
T2G 2H8

Attention: Mr. Martin Grady

Dear Mr. Grady:

**Re: Stormwater Management for Proposed Acreage Development in Lower Springbank
(SW 1/4 Section 24-24-W4M)**

Westhoff Engineering is pleased to provide you with this letter report detailing our overview of the proposed country residential development of the above noted parcel. This letter report is, in essence, a Master Drainage Plan for the development area.

Our review is based on site visits, topographic maps, and discussions with Alberta Environmental Protection. In addition, the analysis presented in this report is according to the Stormwater Management Guidelines for the Province of Alberta, April, 1997 (referenced further in text as "AEP Guidelines").

Drainage Characteristics

Based on our site visits and review of topographic maps, the study area as shown in Figure 1, can be classified as gently undulating pasture lands generally draining south. The area is within the watershed boundaries of Cullen Creek, which meanders along the east side of the study area. The creek is well defined and there is an existing dam just north of 12th Avenue. At the time of our site visits, there appears to be a breach about in the middle of the dam.

Two country residential properties are existing along the west boundary of the study area (149th Street). Near the residence in the north west corner is a private pond and about 2.5 hectares of this property drains into the pond.

Both 12th Avenue (Lower Springbank Road) and 149th Street have roadside ditches within the road right-of-way.

.../2

Study Approach

The approach of analyzing rainfall-runoff processes for the study area is one of single-event modeling. In essence, the analysis is used to estimate peak runoff from the area under pre-development conditions and to estimate the increase of runoff volume as a result of the proposed country residential development. The analysis is carried out using a synthetic design storm with a return period of 100 years as recommended by the AEP Guidelines.

Analysis

Most of the development area, i.e. excluding a small strip adjacent to Cullen Creek, drains south towards 12th Avenue. This area excluding also the area draining into the existing pond has been analyzed by computer modeling. The composite of the development area analyzed includes:

Country Residential Area = 44.79 hectares	CN* = 64.5
Internal Road System = 3.85 hectares	CN* = 85.0
Predevelopment Drainage Area	CN* = 55.0

The parameter CN* is a modified "Curve Number", as defined by the US Soil Conservation Service as a drainage parameter selected based on a hydrologic soil group, land use, soil cover and antecedent moisture conditions.

The INTERHYMO model was used to simulate rainfall-runoff processes for the development area. The design storm with a 100 year return period, was selected to have a 24 hour duration and of the "CHICAGO" distribution using the Intensity Duration Frequency curve of the Calgary International Airport. Details of the computer model including data files are presented in Appendix A.

Results

The model results show that the study area yields under predevelopment conditions a runoff volume of approximately 13000 m³. The design storm also generated a peak flow of about 900 L/s. These quantities should be maintained in the post-development conditions to provide a zero impact on the receiving water body, i.e. Cullen Creek.

The analysis for the post-development conditions shows that due to the higher impervious rates caused by houses, driveways and roads, the runoff volume is estimated at approximately 19000 m³ and peak flows are at 1460 L/s. Therefore, a total on-site storage of 6000 m³ should be incorporated in the development and flow is to be reduced to pre-development rate of 900 L/s. The required in-development storage converts to about 123 m³ per hectare.

.../3

Proposed Stormwater Management

In country residential developments and, in particular this development, storage of surface runoff is easily managed by incorporating storage along the internal road system and a swale through the common area as shown in Figure 1. Two pictures are shown in Exhibit 1, that illustrate roadside ditches in a typical existing acreage development in the Lower Springbank area. We recommend that this type of distributed storage capacity be incorporated in the development rather than a single pond to temporarily store and attenuate runoff from the development area. Drainage should enter Cullen Creek as shown on Figure 1.

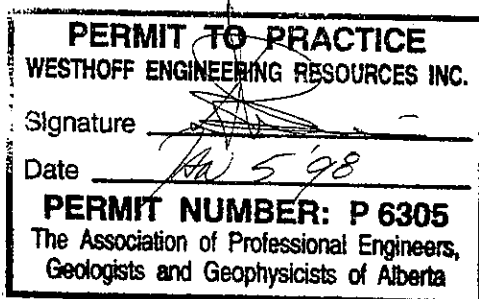
Although no legislation is existing related to urban runoff water quality, the AEP Guidelines encourages that measures are taken to prevent pollution of receiving waterbodies. As such, we recommend that the drainage system incorporates a sedimentation facility prior to discharge into Cullen Creek. Most effective and fitting into the country landscape is the introduction of a small wetland with a sedimentation forebay. A suggested layout is shown in Figure 2.

Closure

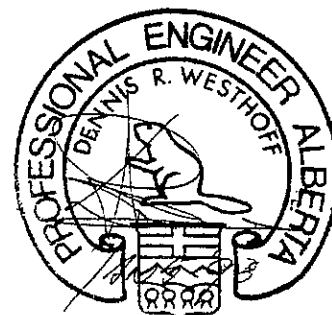
The recommended stormwater management for the development area is of the "storage along the internal roadside ditch" type with a small wetland system at the downstream end, prior to discharge into Cullen Creek. Backyards of lots along the west bank of Cullen Creek include only a small portion of "adjacent to creek areas" for which no special stormwater management works are recommended.

A detailed Stormwater Management Report is required prior to finalizing an Outline Plan for the development area.

This report, prepared by Westhoff Engineering Resources, Inc., is solely intended for the use of the individual, company, government or other entity for which it is prepared, and for the purposes and within the limitations stated in the report.

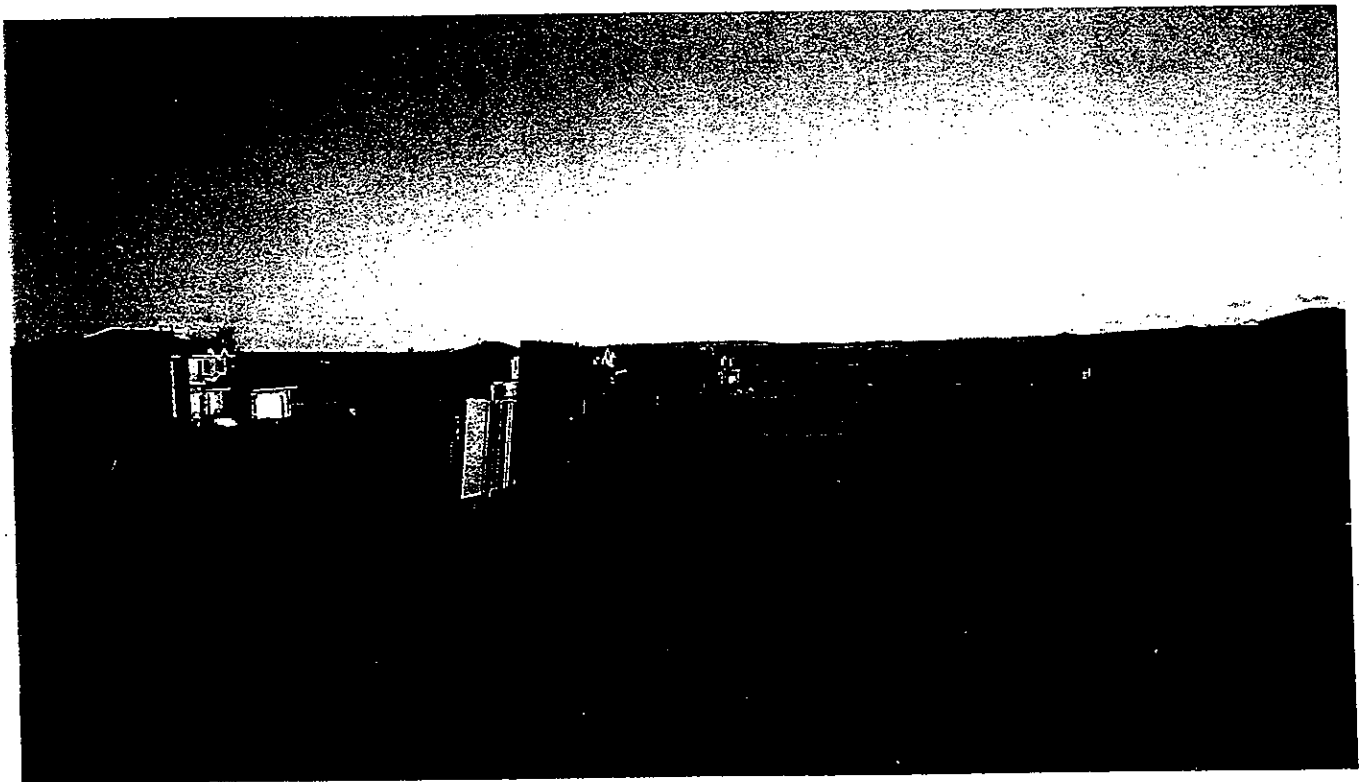


CORPORATE PERMIT



RESPONSIBLE ENGINEER

Westhoff Engineering Resources, Inc.



**Westhoff
Engineering
Resources, Inc.**

Water Resources Management Consultants

TITLE:

TYPICAL ROAD SIDE DITCHES

SCALE:

DATE:

DEC.29.97

DRAWING NO.

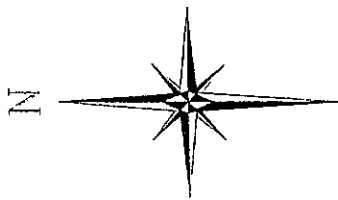
CAD FILE:

PJ97031-002

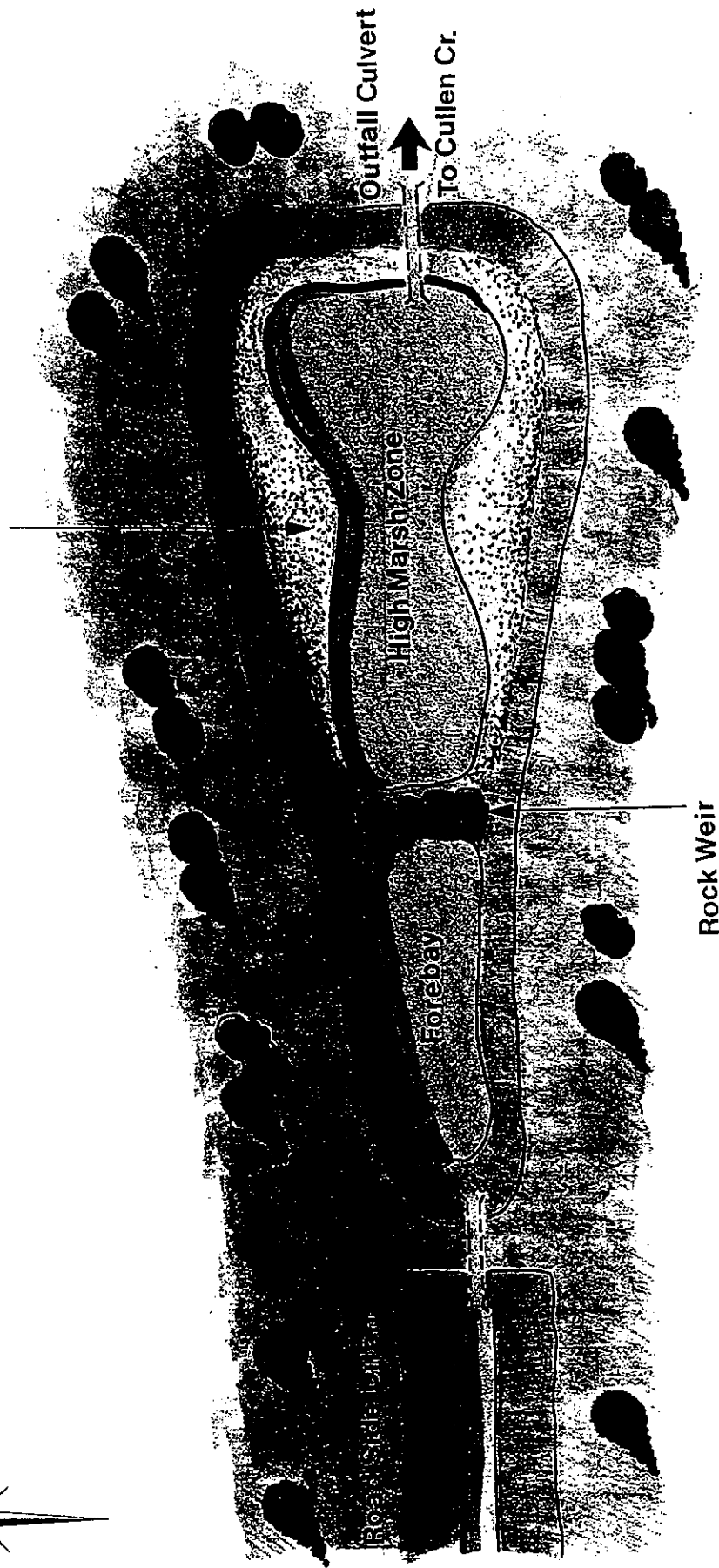
PROJECT NO.

PJ97031

EXHIBIT 1



ED Wetland Zone



**Westhoff
Engineering
Resources, Inc.**
Water Resources Management Consultants

CLIENT:

PROJECT:

TITLE:

PROPOSED WETLAND

SCALE:

DATE: DEC. 31.97

DRAWING NO.

CAD FILE:

.97029-003.DWG

PROJECT NO:

PJ97029

FIGURE 2

APPENDIX A

INTERHYMO Model Data Input/Output Files

2

* WESTHOFF ENGINEERING RESOURCES INC.
* MODEL-HOMES DEVELOPMENT IN LOWER SPRINGBANK
* DRAINAGE ANALYSIS
*
* PRE-DEVELOPMENT AND POST-DEVELOPMENT ANALYSIS
*
* FILE: 97031
* FILE NAME: MODEL.DAT
*

* RAINFALL DISTRIBUTIONS AND DURATIONS FOR THE 1:100 YEAR STORM
* THIS RUN CHICAGO STORM - 24 HOUR STORM - 5 MINUTES INTERVAL
*
* CREATION DATE: DECEMBER 17, 1997
* DATE LAST CHANGE:

*
* RUNDATE: DECEMBER 17, 1997
* RUN BY: DRW - Reviewed by ____
*

*METRIC UNITS

START 0.0 h
DEFAULT VALUES ICASE =1
DEFAULT.VAL

*

* 24 HOUR - 1:100 YEAR CHICAGO STORM (ADJUSTED PARAMETERS A, B AND C)

CHICAGO STORM UNIT=2 (METRIC) DUR=24 hrs R=0.30 INT=5 min ICASE=1
A=859.4175 B=3.004 C=0.746

*

* PRE-DEVELOPMENT ANALYSIS
* TOTAL AREA 48.64 HECTARES

CALIB NASHYD ID=1 NHYD=1001 DT=5 min AREA=48.64 ha
DWF=0 CN(*)=55 IA=1.5 N=3 TP=0.8 h
END=-1

*

* POST-DEVELOPMENT ANALYSIS
* COUNTRY RESEDETIAL DEVELOPMENT IS 44.79 HECTARES
* INTERNAL ROAD SYSTEM IS 3.85 HECTARES

CALIB NASHYD ID=2 NHYD=1002 DT=5 min AREA=44.79 ha
DWF=0 CN(*)=64.5 IA=1.5 N=3 TP=0.8 h
END=-1
CALIB STANDHYD ID=3 NHYD=1003 DT=5 min AREA=3.85 ha
XIMP=0.95 TIMP=0.95 DWF=0 LOSS=2 CN*=85
DPSP=1.5mm SLOPE=1% LGP=100M MNP=0.250 SCP=10min
DPSI=0.8mm SLOPE=1% LGI=100M MNI=0.013 SCI=5 min
END=-1

*

ADD HYD ID=4 NHYD=1004 IDONE=2 IDTWO=3

*

FINISH

```

=====
      OOO      TTTT      TTTT      H      H      Y      Y      M      M      OOO      I N T E R H Y M O
      O      O      T      T      H      H      Y      Y      M M M M      O      O      * * * 1989b * * *
      O      O      T      T      H H H H      Y      M M M M      O      O
      O      O      T      T      H      H      Y      M      M      O      O
      OOO      T      T      H      H      Y      M      M      OOO      E-9516061300255

```

Distributed by the INTERHYMO Centre. Copyright (c), 1989. Paul Wisner & Assoc.
EXCLUSIVE USE TO : WALKER, NEWBY & PARTNERS INC

Input filename: MODEL.DAT
Output filename: MODEL.OUT
Summary filename: MODEL.SUM

DATE: 11-10-1997

TIME: 09:33:13

COMMENTS: _____

```

-----
*****
* WESTHOFF ENGINEERING RESOURCES INC.
* MODEL-HOMES DEVELOPMENT IN LOWER SPRINGBANK
* DRAINAGE ANALYSIS
*
* PRE-DEVELOPMENT AND POST-DEVELOPMENT ANALYSIS
*
* FILE: 97031
* FILE NAME: MODEL.DAT
*
* RAINFALL DISTRIBUTIONS AND DURATIONS FOR THE 1:100 YEAR STORM
* THIS RUN CHICAGO STORM - 24 HOUR STORM - 5 MINUTES INTERVAL
*
* CREATION DATE: DECEMBER 17, 1997
* DATE LAST CHANGE:
*
* RUNDATE: DECEMBER 17, 1997
* RUN BY: DRW - Reviewed by ____
*

```

*METRIC UNITS

```

*****
** SIMULATION NUMBER: 1 **
*****

```

|DEFAULT VALUES |

fname :DEFAULT.VAL

METRIC UNITS 2

----- ENTER YOUR COMMENTS ON THIS LINE AND THE NEXT ONE ---

----- PARAMETER VALUES MUST BE ENTERED AFTER COLUMN 60 ---->

HORTON'S	Max. (initial) infiltration rate	(mm/hr)	FO=	50.000
EQUATION	Min. (final) infiltration rate	(mm/hr)	Fc=	7.500
PARAMETRES	Decay constant	(1/hr)	Dc=	2.000
	Initial accumulated moisture in soil	(mm)	F=	.000
	Depression storage (pervious area)	(mm)	DPSP=	1.500
	Llot	(m)	LOT=	40.000



**Westhoff
Engineering
Resources, Inc.**

Water Resources Management Consultants

TITLE:

TYPICAL ROAD SIDE DITCHES

SCALE:

DATE:

DEC. 29, 97

DRAWING NO.

CAD FILE: PJ97031-002

PROJECT NO. PJ97031

EXHIBIT 1

3.50	1.61	9.50	4.30	15.50	1.63	21.50	1.09
3.58	1.64	9.58	4.19	15.58	1.62	21.58	1.08
3.67	1.67	9.67	4.08	15.67	1.61	21.67	1.08
3.75	1.70	9.75	3.98	15.75	1.60	21.75	1.07
3.83	1.73	9.83	3.88	15.83	1.59	21.83	1.07
3.92	1.76	9.92	3.79	15.92	1.58	21.92	1.06
4.00	1.80	10.00	3.71	16.00	1.56	22.00	1.06
4.08	1.84	10.08	3.62	16.08	1.55	22.08	1.06
4.17	1.88	10.17	3.55	16.17	1.54	22.17	1.05
4.25	1.92	10.25	3.47	16.25	1.53	22.25	1.05
4.33	1.96	10.33	3.40	16.33	1.52	22.33	1.04
4.42	2.00	10.42	3.34	16.42	1.51	22.42	1.04
4.50	2.05	10.50	3.27	16.50	1.50	22.50	1.03
4.58	2.10	10.58	3.21	16.58	1.49	22.58	1.03
4.67	2.16	10.67	3.15	16.67	1.48	22.67	1.03
4.75	2.21	10.75	3.10	16.75	1.47	22.75	1.02
4.83	2.27	10.83	3.04	16.83	1.46	22.83	1.02
4.92	2.34	10.92	2.99	16.92	1.45	22.92	1.01
5.00	2.40	11.00	2.94	17.00	1.44	23.00	1.01
5.08	2.48	11.08	2.89	17.08	1.43	23.08	1.00
5.17	2.56	11.17	2.85	17.17	1.42	23.17	1.00
5.25	2.64	11.25	2.80	17.25	1.42	23.25	1.00
5.33	2.73	11.33	2.76	17.33	1.41	23.33	.99
5.42	2.83	11.42	2.72	17.42	1.40	23.42	.99
5.50	2.94	11.50	2.68	17.50	1.39	23.50	.99
5.58	3.06	11.58	2.64	17.58	1.38	23.58	.98
5.67	3.19	11.67	2.60	17.67	1.37	23.67	.98
5.75	3.34	11.75	2.57	17.75	1.37	23.75	.97
5.83	3.50	11.83	2.53	17.83	1.36	23.83	.97
5.92	3.68	11.92	2.50	17.92	1.35	23.92	.97
6.00	3.88	12.00	2.47	18.00	1.34	24.00	.96

* PRE-DEVELOPMENT ANALYSIS
* TOTAL AREA 48.64 HECTARES

CALIB			
NASHYD (1001)	Area (ha)=	48.64	Curve Number (CN)= 55.0
ID= 1 DT= 5.0 min	Ia (mm)=	1.50	# of Linear Res. (N)= 3.00
	U.H. Tp(hrs)=	.80	

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

Unit Hyd Qpeak (cms)= 2.322

PEAK FLOW (cms)= .894 (i)
TIME TO PEAK (hrs)= 8.167
RUNOFF VOLUME (mm)= 26.746
TOTAL RAINFALL (mm)= 90.618
RUNOFF COEFFICIENT = .295

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

* POST-DEVELOPMENT ANALYSIS
* COUNTRY RESEDINETIAL DEVELOPMENT IS 44.79 HECTARES
* INTERNAL ROAD SYSTEM IS 3.85 HECTARES

CALIB			
NASHYD (1002)	Area (ha)=	44.79	Curve Number (CN)= 64.5
ID= 2 DT= 5.0 min.	Ia (mm)=	1.50	# of Linear Res. (N)= 3.00
	U.H. Tp (hrs)=	.80	

Unit Hyd Qpeak (cms)= 2.138

PEAK FLOW (cms)= 1.107 (i)
TIME TO PEAK (hrs)= 8.167
RUNOFF VOLUME (mm)= 34.693
TOTAL RAINFALL (mm)= 90.618
RUNOFF COEFFICIENT = .383

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB			
STANDHYD (1003)	Area (ha)=	3.85	
ID= 3 DT= 5.0 min	Total Imp(%)=	95.00	Dir. Conn.(%)= 95.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	3.66	.19
Dep. Storage (mm)=	.80	1.50
Average Slope (%)=	1.00	1.00
Length (m)=	100.00	100.00
Mannings n =	.013	.250

Max.eff.Inten.(mm/hr)=	182.12	79.95
over (min)	5.00	10.00
Storage Coeff. (min)=	5.00 (ii)	10.00 (ii)
Unit Hyd. Tpeak (min)=	5.00	10.00
Unit Hyd. peak (cms)=	.21	.11

TOTALS

PEAK FLOW (cms)=	1.31	.03	1.32 (iii)
TIME TO PEAK (hrs)=	7.17	7.25	7.17
RUNOFF VOLUME (mm)=	89.82	59.29	88.29
TOTAL RAINFALL (mm)=	90.62	90.62	90.62
RUNOFF COEFFICIENT =	.99	.65	.97

- (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 85.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

*

ADD HYD (1004)	AREA	QPEAK	TPEAK	R.V.
2 + 3 = 4	(ha)	(cms)	(hrs)	(mm)
ID1= 2 (1002):	44.79	1.11	8.17	34.69
+ ID2= 3 (1003):	3.85	1.32	7.17	88.29
=====				
ID = 4 (1004):	48.64	1.46	7.17	38.94

NOTE: PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.

*

FINISH