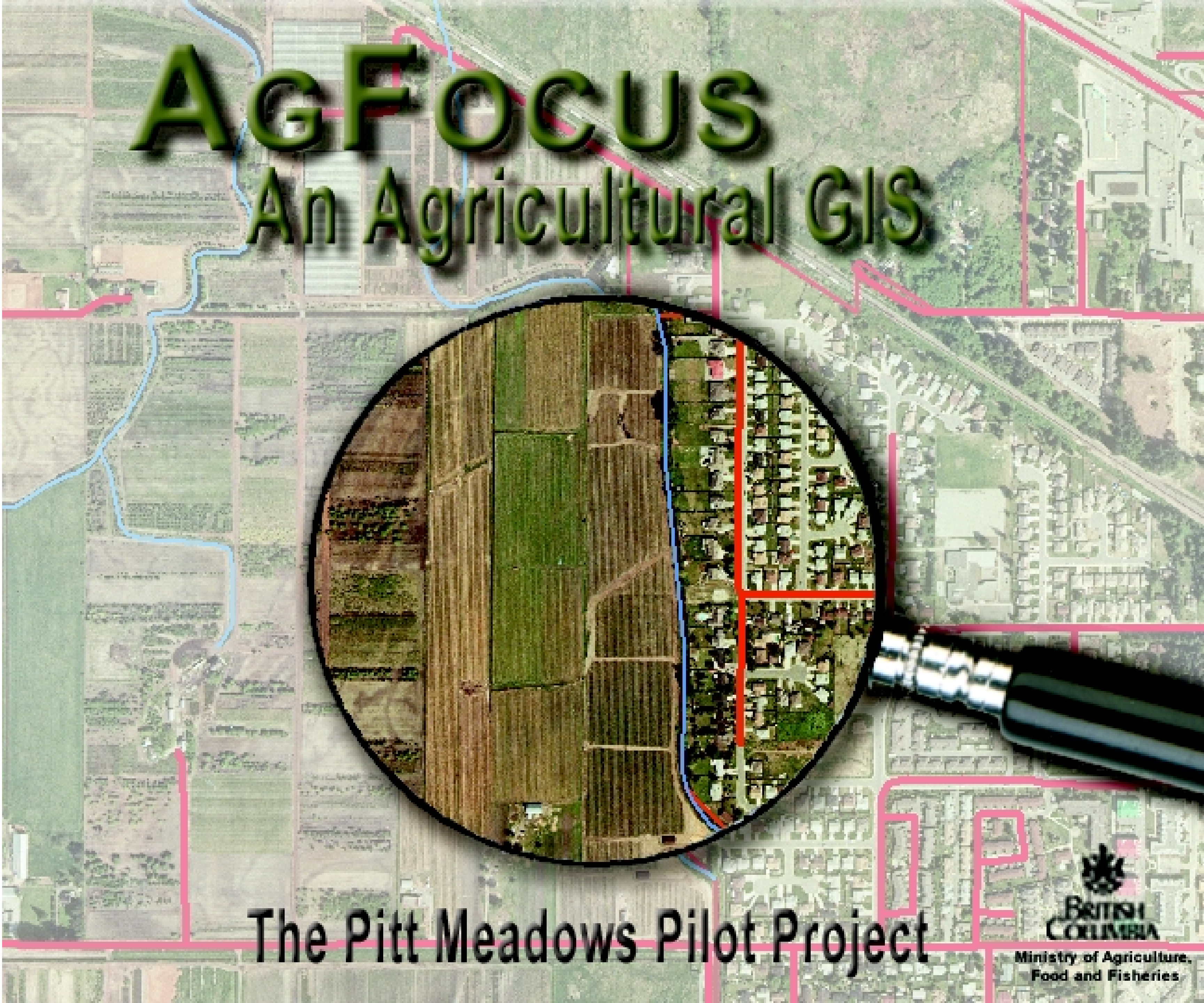
# AgFocus

## An Agricultural GIS



## The Pitt Meadows Pilot Project

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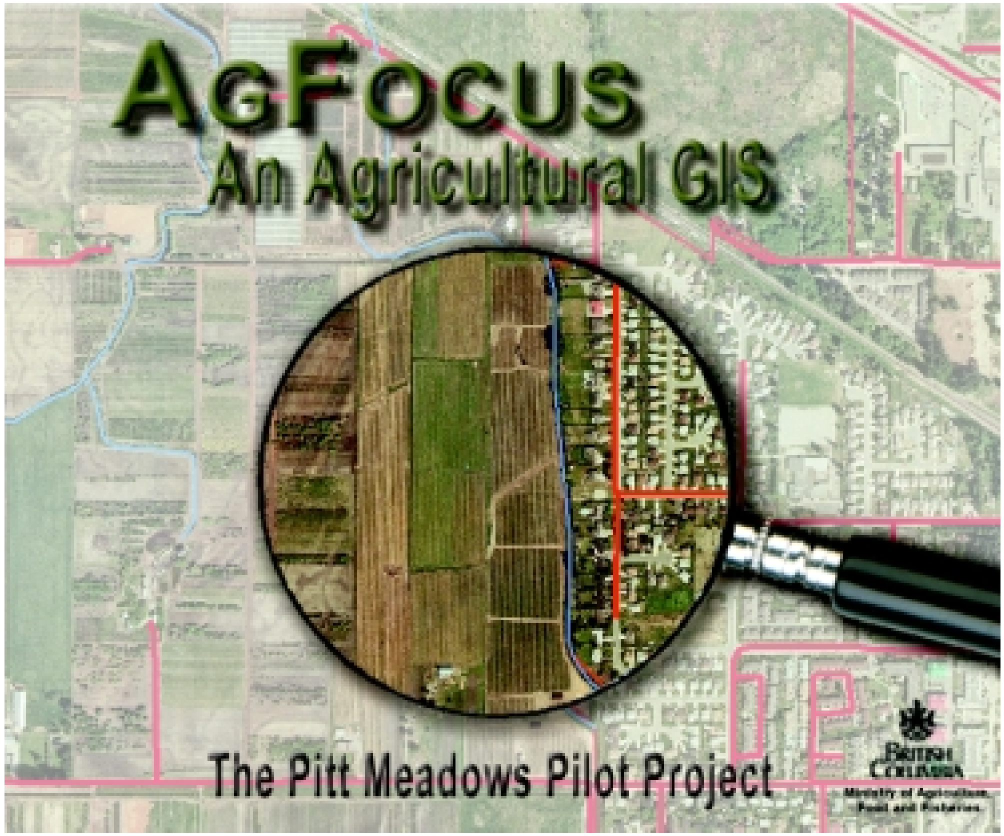


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## List of Acronyms

ALC: Agricultural Land Commission
ALR: Agricultural Land Reserve
BCA: B.C. Assessment
CAPMAP: Capability Mapping
FISS: Fisheries Information Summary System
FLR: Forest Land Reserve
FPPA: Farm Practises Protection Act
GIS: Geographic Information Systems
LRC: Land Reserve Commission
MAFF: Ministry of Agriculture, Food and Fisheries
OCP: Official Community Plan
RLUB: Rural Land Use Bylaw
TRIM: Terrain Resource Inventory Mapping
WSA: Watershed Atlas

# Preface

British Columbia's geography has created unique land use planning challenges compared to the rest of Canada. With over 90% of B.C. made up of mountainous terrain, a variety of land uses including agriculture, must compete for a limited habitable land base. Most of B.C.'s farmland is located within the Agricultural Land Reserve (ALR), which makes up only 5% of the province. The ALR faces increasing pressure from both urban development and competing resource uses. To add to the pressure, much of B.C.'s agriculture is intertwined with urban land uses and forms a lengthy, irregular rural-urban interface, which can give rise to compatibility issues

Many local governments actively encourage and support agricultural development in a number of ways. However, in order for agriculture to be sustained for future generations, proactive planning is needed to integrate settlement and resource planning in a meaningful way and promote compatibility. If a long term commitment and investment in agriculture is to be ensured, it will be important that the farm community has the opportunity to operate in a stable environment.

Several new planning opportunities are now in place following the enactment of the *Farm Practices Protection (Right to Farm) Act* (FPPA) and consequential amendments to the *Municipal Act* and *Land Title Act*. These legislative changes improve opportunities for local governments to develop a supportive regulatory climate for agriculture within their plans and bylaws, thereby helping to address compatibility issues.

A tool that complements these legislative initiatives and can contribute to effective planning for agriculture within the ALR and along the rural/urban interface is a Geographic Information System (GIS). GIS technology can ensure a better understanding of agricultural and adjacent land uses in a community. This understanding can assist in dealing with negative impacts on farming that can result from urban, rural residential and other non-farm use encroachments. It can also help examine the impacts of regulations on the farm industry, or in promoting farming in the community.

The Pitt Meadows Pilot Project was undertaken to explore the benefits of adding agricultural data and tools to a GIS. It provided an opportunity to demonstrate how GIS technology can be combined with resource information to strengthen farming in B.C. communities.

# Introduction

Agriculture plays a vital role in B.C.'s economy, directly em ploying nearly 30,000 people[1] and generating over $2 billion in farm cash receipts[2]. Currently, B.C. produces the equivalent of about one-half of the province's food requirements. Tremendous potential exists for farming to play an even greater role in feeding an expanding B.C. population, providing local employment and enhancing the prosperity of farm families and rural communities.

Presently, 78% of all farm cash receipts are generated from 2.7% of B.C.'s land base. This same area is home to 79% of British Columbians, most of whom live within an urban environment[3]. As B.C.'s residents become more urbanized they are increasingly disconnected from agriculture. This can lead to misunderstandings of how modern farms operate. Agricultural activities and infrastructure that are a normal part of food and fibre production may be viewed as disturbances by some people.

Since much of the farming activity in B.C. takes place in close proximity to urban areas, farmers and their neighbours need to establish understanding relationships. New land use policies have been introduced in recent years to help develop 'good neighbour' strategies as well as encourage local governments to effectively plan for the broadest possible range of farming activities, especially within the ALR.

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[1] The entire food industry employs over 260,000 people.

[2] Statistics Canada Census of agriculture statistics 1995$; B.C. Ministry of Agriculture and Food, "Fast Stats", 1999.

[3] Planning for Agriculture, Provincial Agricultural Land Commission, 1998, p. 2.

Comprehensive planning is becoming increasingly important to reduce or avoid land use conflict. Recent legislative changes have given rise to a new era of planning for agriculture and an increasing number of local governments are acting on these new opportunities. Starting with several amendments to the *Agricultural Land Commission Act* in 1994 and the subsequent enactment of the *Farm Practices Protection (Right to Farm) Act* and the *Growth Strategies Statutes Amendment Act* in 1995, legislation has been developed to ensure a sustainable future for agriculture.

Both the *Land Title Act* and the *Municipal Act* have been amended to encourage and enable local governments to support farming in plans and bylaws and at the time of subdivision. Under the *Land Title Act*, approving officers are equipped with new powers to guide proposed subdivisions near farmland in a manner that will improve compatibility.

**Photo 1: Western edge of the Pitt Meadows highlands / agriculture interface**

The *Municipal Act* provides for the designation of development permit areas between farming and urban uses to be established on the urban side in order to protect farming. In addition, standards for the agriculture-related sections of zoning and rural land use bylaws have been developed along with provision for a review process to update these bylaws. Also, farm bylaws can be created to improve compatibility between land uses[4] .

As part of the ongoing effort to help plan for and strengthen farming, the Ministry of Agriculture, Food and Fisheries (MAFF) and the Land Reserve Commission (LRC) have developed a variety of support documents including:

- ***Planning for Agriculture – Resource Materials;***
- ***Guide for Bylaw Development in Farming Areas;***
- ***Farm Practices in British Columbia Reference Guide;***
- ***Landscaped Buffer Specifications;***
- ***Subdivision Near Agriculture – Guide for Approving Officers;***
- ***Planning Subdivisions near Agriculture;*** and
- ***The Countryside and You: Understanding Farming***

[4] Farm bylaws require the approval of the Minister of Agriculture, Food and Fisheries.

The amendments and new acts foster partnerships, policy consistency, and integration of settlement and resource planning. These legislative changes open up new planning opportunities in agricultural areas. As in any planning effort, information is key. It will be critical to have in place innovative means to analyze information and understand its implications so that effective decisions can be made, conflicts can be resolved, and opportunities can be realized.

To enhance our understanding of farming areas and effectively identify and handle issues important to strengthening, sustaining, and promoting agricultural development, the application of a Geographic Information System (GIS) holds considerable promise. Many local governments have already developed GIS to meet their urban planning needs. This tool can also be used in the planning and development of agriculture.

The Ministry of Agriculture, Food and Fisheries, with the assistance of the District of Pitt Meadows and the Land Reserve Commission, undertook a pilot project to build a GIS that could be used to support the planning and development of agriculture. Through this project, the benefits of adding agricultural data and tools to the District's GIS were explored.

This document provides some insight into the flexibility of GIS and how it can be used to help strengthen farming. It also gives more detailed instruction on how to begin to build an agricultural GIS. There are three parts to this document:

**Part 1** examines the general benefits of using GIS to plan for and promote the development of agriculture;

**Part 2** describes the GIS model that was designed for Pitt Meadows. It outlines the goals, objectives, and deliverables of the project and discusses the outcome; and

**Part 3** provides a data summary of an agricultural GIS, steps the reader through the components and explains how each component works, and finishes with a discussion on a possible process for building agricultural GIS tools.

**A word of caution –** GIS is very useful for providing quick overview information about a municipality. It can also be applied to give a first indication of the status and possible management of individual parcels or areas of farmland. However, GIS-generated information should not replace on-site inspection and personal knowledge where available.

# Part I. The Benefits of an Agricultural GIS

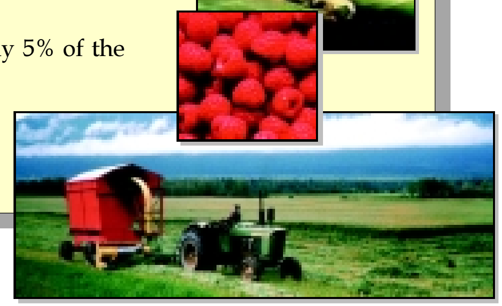
## B.C. Agriculture[5]

The hallmark of British Columbia agriculture is its outstanding diversity – from small vegetable farms in the Lower Mainland to large grain farms in the Peace to huge cattle ranches in the Interior. With nearly 22,000 farms and ranches in B.C., almost every part of the province makes a contribution to our agri-food sector. The wide selection of products that are generated around B.C. include berries, tree fruits, vegetables, dairy, beef, poultry, grain and oilseed, and forage crops.

B.C. not only leads the nation in production of certain commodities, they have an international reputation. Over 90% of Canadian cranberries are grown in B.C., and the southwest part of the province – centred in Abbotsford – is one of the world's most important areas for producing raspberries. Over 100 years of farming experience combined with the Okanagan's soil and climate have made this region renowned for tree fruit and grape production. Other important agriculture sectors include the ginseng industry in the Interior and the rapidly growing greenhouse vegetable and floriculture industry in the Lower Mainland. Langley is home to half of all the mushroom bed area in B.C.

B.C. agriculture is a strong contributor to the province's economy. 2000 estimates of farmers' cash receipts stood at more than $1.9 billion. Many of the over 200 different commodities produced in B.C. are exported around the world. Export sales of agricultural products across Canada and to over 100 countries are valued at more than $2 billion. Economic spin-offs are also generated by almost 1000 food processing businesses in the province.

Due to its physiography, most of B.C. is unsuitable for agriculture — only 5% of the province is within the Agricultural Land Reserve. However, this small area has some of the highest quality agricultural land in Canada. This combination of scarcity and quality makes B.C. farmland an exceedingly valuable resource, from a social, environmental and economic perspective.



5 **Sources** include: Marsh, James, H., (Ed.) The Canadian Encyclopedia, 2nd Ed. Hurtig Publishers, Edmonton, 1988, p. 207; Statistics Canada, 1996 Census of Agriculture Profile Data - British Columbia, Table 12; Ministry of Agriculture and Food, Fast Stats, p. 4; Ministry of Agriculture and Food, British Columbia 2000 Year-End Farm Income: Highlights, p. 2; and Ministry of Agriculture, Food and Fisheries, Industry Profile, http://www.gov.bc.ca/agf/.

# 1 An Agricultural GIS – Overview

An agricultural GIS is a tool that can assist a community to plan for and promote agriculture, while at the same time ensuring a proper balance between competing resource values. It can enhance the accessibility and flexibility of information and it can improve the linkages and understanding of relationships between different types of information. By having a more complete understanding of an area's land use dynamics and relationships, more effective land use decisions can be made.

The role of a GIS is to help capture, store, analyze and display geographic information. Any information that can be depicted on a map can make up a data layer. Layers can be visualized as "transparencies" which allow the user to view and analyze information selectively by theme. Figure 1 shows some of the layers which are of particular interest to agriculture, including

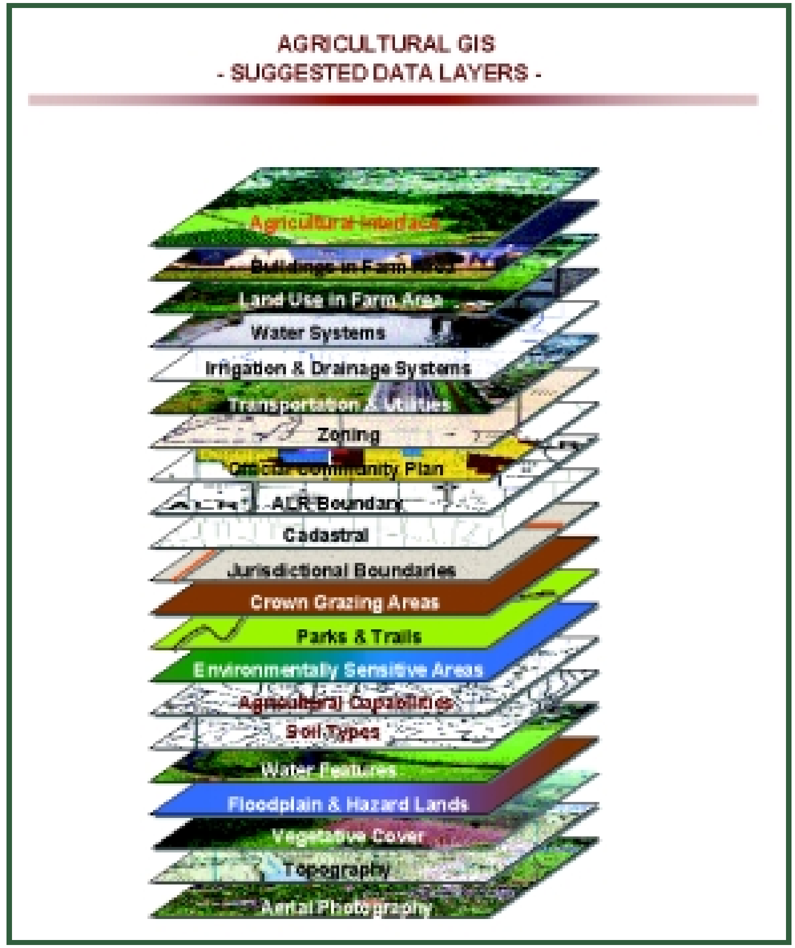



**Figure 1: An example of data layers**

topography, vegetative crop cover, soil types, agricultural capability, environmentally sensitive areas, legal lot lines (the cadastre), transportation corridors, water systems, land use, and buildings in a farm area.

Data layers can be displayed alone or in combination with other layers. Figure 2 shows a GIS "view", which is an interactive map screen that lets the user display, query, and analyze geographic data[6]. Several layers have been added to the view, including cadastral information, roads, rivers, rail lines, and agricultural capability. Lots have been labelled by their primary land use, and capability has been colour-coded. These basic layers can help give decision-makers a clearer understanding of what exists in a particular area. Different layers can be added and statistical information generated to illustrate and assess land use and land use suitability. The number of layers and level of detail will vary depending on the questions that need to be answered.

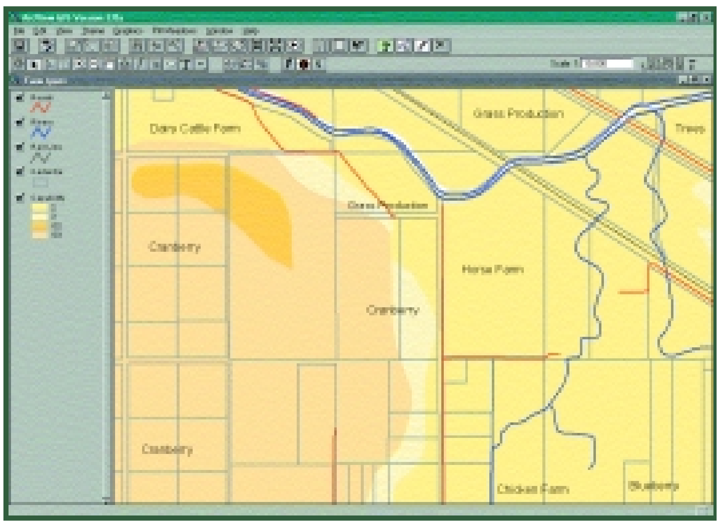



**Figure 2: An example of using several data layers**

While GIS can improve the overall understanding of the agricultural land base from a biophysical, jurisdictional, and activity perspective, ultimately, it can help strengthen agriculture in BC communities by:

- assisting in the development of plans and bylaws that affect agricultural areas;
- supporting agriculture industry development; and
- aiding land use decision-making processes in agricultural areas.

There are a wide variety of possible applications for an agricultural GIS. To provide some practical examples, Part I draws on the experience gained in the Pitt Meadows Pilot Project, and examines in detail some of the applications associated with planning for and promoting agriculture.

[6] For greater detail on GIS components see Part 3, Section 11, page 49.

# 2 Plan & Bylaw Development in Agricultural Areas with GIS

A key way GIS can aid in the development of plans and bylaws that affect agricultural areas is by demonstrating the impacts of proposed policy or regulation on farm activities. For example, it can help to assess the effects of setback distances or commodity restrictions. The results of this examination can then guide the update or development of plans or bylaws[7]. Urban land use data within a specific distance from the farm edge can also be identified with GIS. This data could then be used to help select the most appropriate setback distances, building standards, and farm management practices within a specified area from urban edge.

Another way in which an agricultural GIS can be used is in the assessment of development and rezoning proposals next to farmland. Information gained through the assessment could be used to determine the suitability of urban development proposals near the ALR boundary.

Following are just three examples of how an agricultural GIS can be used to examine the effects of setback distances and commodity restrictions, and identify edge land use patterns.

## 2.1 Examining the Effects of Setback Distances

Decision-makers are often faced with developing policies or regulations that can help prevent or minimize land use conflict. Establishing setback distances in bylaws is one form of regulation that is used to separate neighbouring uses as a means to enhance compatibility. Setbacks, however, have the potential to significantly impact agricultural production. This section describes how a GIS can be used to analyze the impacts of setbacks.

[7] The plans and bylaws that would particularly benefit from the application of an agricultural GIS would be official community plans, agricultural area plans, zoning and farm bylaws.

### 2.1.1 Setbacks from Lot Lines

The following example looks at the impact of a proposed regulation requiring farm buildings to be set back either 15 or 30 metres from lot boundaries. GIS is used to identify buildings that would be made non-conforming if either setback were applied.

The *Setback Tool*, developed for the Pitt Meadows Pilot Project, takes the user through a series of steps in order to display setback distances of specified widths around features of their choice. Here the tool has been used to create setbacks from lot lines at two distances. As shown by the thin lines, Figure 3 illustrates setbacks of 15 metre and 30 metre distances from lot boundaries. As evident from the GIS view, the buildings of Farm A do not conform to either setback. Farm B conforms to both setbacks, whereas Farm C conforms to a 15 metre but not a 30 metre setback.

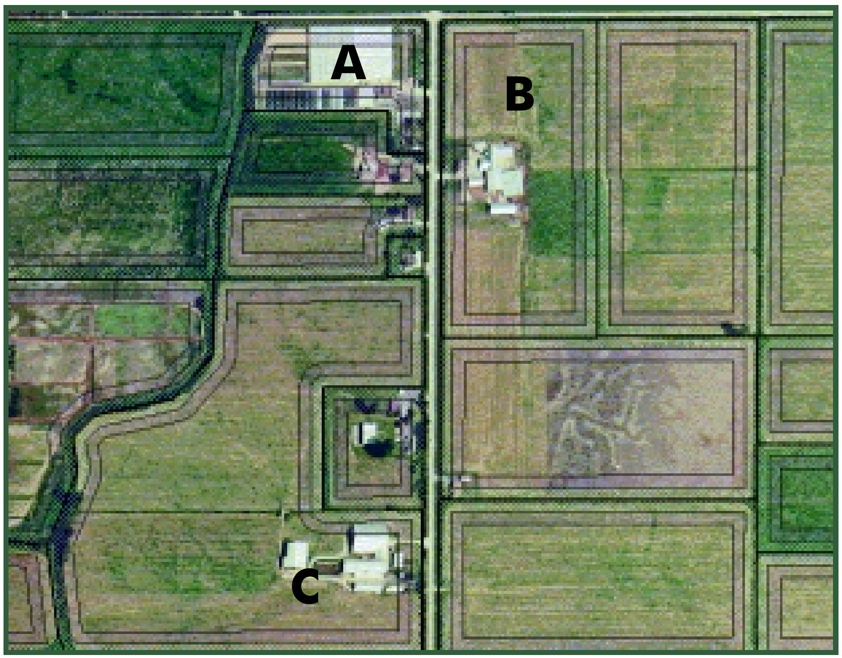



Figure 3: Effect of setbacks on three farms


Understanding the impacts that proposed setback regulations may have can assist in determing the most appropriate setback distance.

Although this is a brief demonstration of one type of analysis, it is evident that GIS has significant potential for helping decision-makers build a zoning bylaw that is both effective and supportive of agriculture by better understanding the 'on-ground' implications of a variety of possible land use regulations.

### 2.1.2 Setbacks from Watercourses

The *Setback Tool* can also be used to demonstrate the effect that a proposed setback from watercourses may have on agricultural properties, in terms of the amount of land taken out of production. The GIS view in Figure 4 displays a watercourse running through several farm parcels in the District of Pitt Meadows.

When the *Setback Tool* is activated the user can select the watercourse features of interest and a buffering distance – 15 metres in this example[8]. In Figure 5, the purple area represents the 15 metre setback along the watercourse.

**Figure 4: Testing the effect of watercourse setbacks on farm parcels**

**Figure 5: Area of potential impact**

[8] It is assumed in this example that all farm activities and buildings are prohibited within 15 metres of the watercourse. Several different distances could be sampled to explore the effects of increasing and decreasing the size of the buffer.

To help understand the impact of this setback, the tool can generate statistics about the land affected. After the setback layer is generated, the user is asked if they would like to "clip" another data layer by the new layer. In Figure 6, the legal lot lines of each parcel have been added to the view, and the watercourse setback layer "clipped" to the lot lines. This allows us to examine just the setback area that is within a given property.

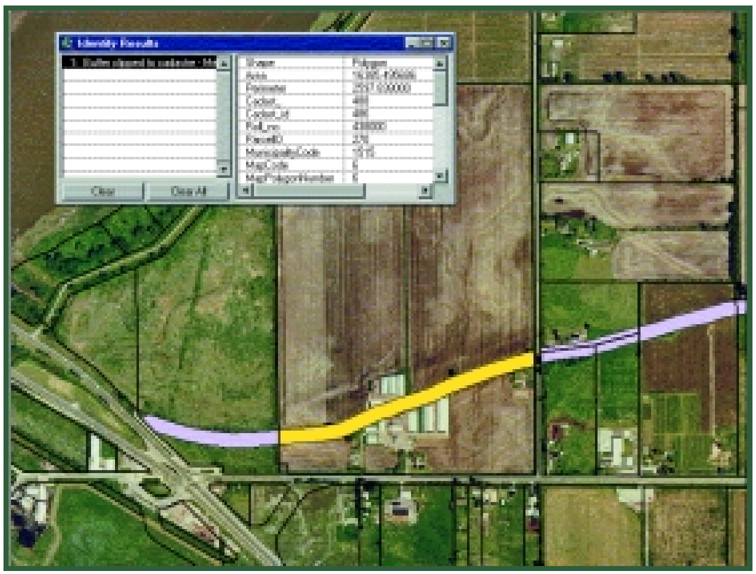


**Figure 6: Querying the attributes of a 15 metre setback**

The text box in Figure 6 displays attributes for the yellow polygon. This polygon represents the area within the 15 metre watercourse setback affecting the 41 hectare parcel. The text box indicates that 16,385 square metres (1.6 hectares) of the farm property are located within this setback area.

If this 15 metre setback were actually established, 1.6 hectares of the property would not be available for agricultural production[9]. This could have significant implications for a farm operator. If a 15 metre watercourse setback were applied throughout the Pitt Meadows ALR, approximately 630 hectares of land would not be available for agricultural production. This represents about 9 % of the ALR in Pitt Meadows. These statistics can be further refined to display information for different types of watercourses, commodities, soil types and agricultural capabilities within the affected area.

[9] For a discussion on concerns about the data and its usage, see Part II, Section 8.5, page 37.

## 2.2 Examining the Effects of Commodity Restrictions

The *Commodity Restriction Tool* developed for the Pitt Meadows Pilot Project can reveal the effect of regulations within the ALR when, for example, a minimum parcel size is established for a specific commodity. In the example below, the tool is used to evaluate the impact of a proposed regulation to restrict poultry operations from locating on parcels that are less than 4 hectares in size. By activating this tool, a parcel size can be selected and a summary is automatically generated. This summry includes the number of properties in the ALR that are smaller than the given size, the percent of all ALR parcels affected, the total area, and the percent of Pitt Meadows' ALR area affected.

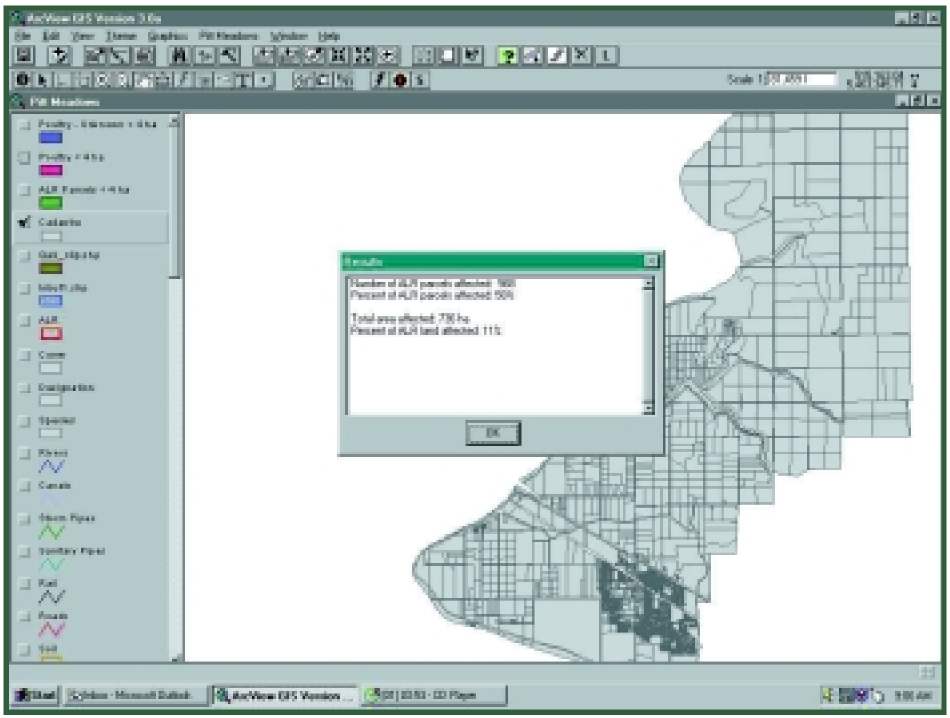


**Figure 7: Statistics concerning farm parcels of less than 4 hectares.**

A new theme is automatically added to the screen, titled "ALR Parcels < 4 ha". At this stage the user can choose to examine a specific commodity. In Figure 8, the commodity group 'poultry' is selected.

Once this selection is made, another information screen appears, listing the number of parcels less than 4 hectares throughout the ALR with existing poultry operations and the total area of the affected parcels (Figure 9).

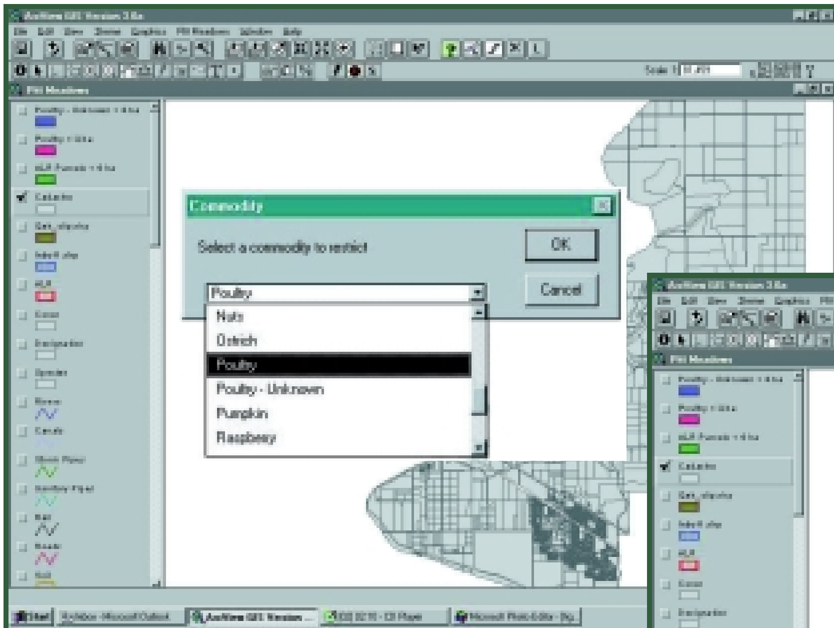



**Figure 8: Selecting a commodity for further examination**

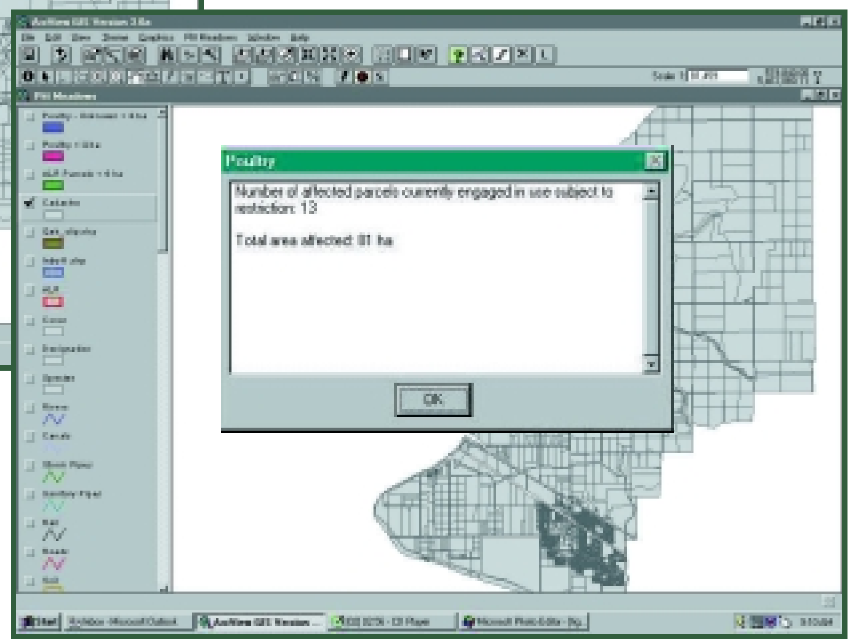



**Figure 9: Statistics concerning ALR parcels < 4 hectares that have poultry**

Selecting 'OK' adds, a new theme to the screen indicating the farm parcels that are less than 4 hectares and have poultry. Figure 10 shows a close-up view of the two new themes. Parcels highlighted in light green are less than 4 hectares and parcels highlighted in dark green are less than 4 hectares, with poultry.

By applying this tool, the user can quickly determine the effect that a commodity restriction would have on the farming industry and any expansion of the selected commodity. If a minimum lot size of 4 hectares were established as in this example, thirteen parcels would become legally non-conforming[10] under the proposed bylaw. As shown in Figure 7, 568 parcels or 11% of all land within the ALR in Pitt Meadows would be restricted from establishing poultry operations.

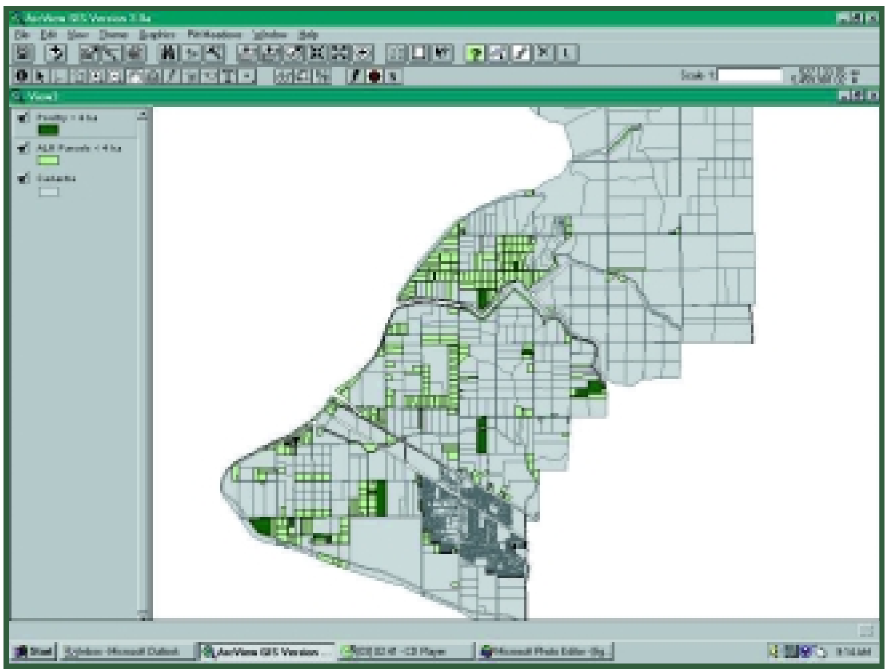


**Figure 10: Close-up view of new themes**

[10]Legally non-conforming is with reference to Section 911 of the *Local Government Act*.

## 2.3 An Aid to Edge Planning

GIS can be used to examine land use patterns along different interfaces. Figure 11 displays an agriculture/urban edge. The *Setback Tool* is used to outline a 300 metre area on the urban side, and a 500 metre area on the agriculture side of the ALR boundary. Detailed information can then be obtained on the existing types of land uses, the density of the use (e.g. single family, multi-family), future land use designations, the location of existing vegetation and natural features, and the orientation of the buildings and roads. If historical data were available, one could also examine how land use in the farm area has changed over time.

**Figure 11: Urban-side and agriculture-side zoning and land use patterns within 300 and 500 metres respectively of the edge**

Having this information will allow potential conflict areas and special management needs to be determined and further the concept of 'shared responsibility' in an effort to improve land use compatibility[11]. More specifically the information can aid in the design and siting of urban and rural buildings, as well as in the application of landscaped buffers and special management techniques. Additionally, GIS could assist in the development of an 'awareness' program for urban and farm residents located within a defined edge area. It is hoped that these ideas will be explored more fully in future projects. Please see Section 9.2 (page 40) for further discussion.

[11] For a more detailed discussion on the application of the *Setback Tool* for edge planning, please see the case study in Appendix 3, page 75.

# 3 Exploring Agricultural Development Options with GIS

Many communities have programs designed to promote economic development. These programs help individuals or companies learn about the potential for starting up a business, be it commercial or industrial, and can provide information on the availability and characteristics of potential sites and regulatory considerations. The majority of these programs do not, however, provide information on the potential for agricultural business development.

By incorporating data into a GIS which people can use to investigate the possibilities of starting or expanding a farm business, communities will be better equipped to support agricultural development. GIS can also provide information that can assist an operator in making management decisions.

## 3.1 Potential Development

In the Pitt Meadows project, the *Potential Development Tool* was created to explore the agricultural development options of a specific area. The cadastre mapping of the municipality is the starting point from which the user applies the tool to find areas of potential development for a specific agricultural commodity. The user is taken through a simple series of steps that allows them to explore the potential of different crops, like blueberries, cranberries, cole crops or other types of vegetables (Figure 12).

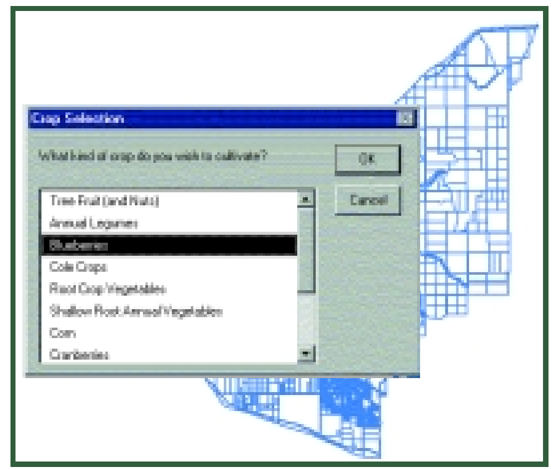



**Figure 12: Crop choices**

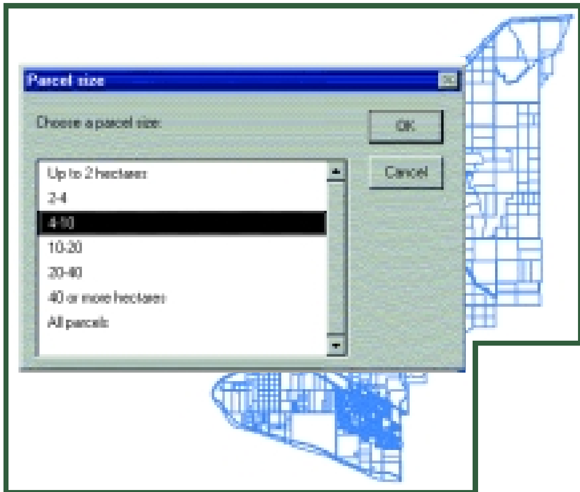



**Figure 13: Selecting the desired parcel size**

Once a commodity is selected (blueberries in this example – Figure 12), the tool prompts the user to select the desired parcel size (Figure 13).

After selecting the parcel size, a new data layer is generated that displays all the parcels of the selected size (Figure 14). The map below shows parcels of 4 to 10 ha in Pitt Meadows that are particularly suitable for growing blueberries.

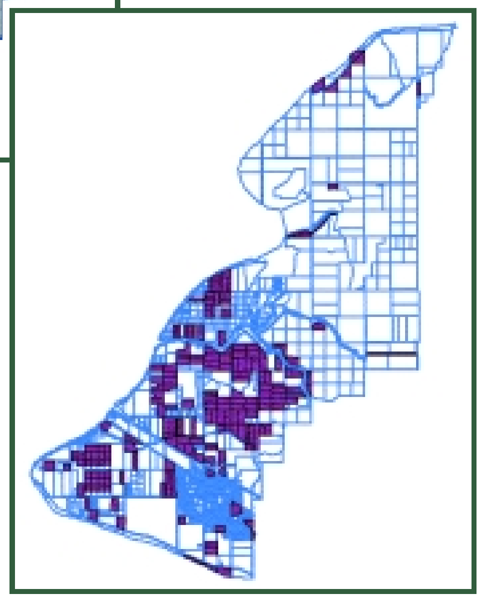


**Figure 14: Parcels suitable for blueberry production**

GIS BENEFIT

This is a quick way to locate areas of crop suitability within a municipality. It would not be the best means however to determine the management of an individual property, since the information has been generalized. Once a desired location has been determined using the *Potential Development Tool*, the user can get more detailed information about the soil type and the suitable crops for that location.

The *Potential Development* tool demonstrated here is investigating the soil type and property size, to assist in determining the suitability of specific cropping options. Although not present in this example, the tool could be enhanced to consider several other development factors such as zoning provisions, water availability, drainage, current land use and proximity to non-farm uses and environmentally sensitive areas.This would provide a more comprehensive review of factors affecting cropping options.

To get more complete information about a particular property or area, the user can activate the *Soil Query Tool* and click on a particular location. The tool will superimpose on the orthophoto soil polygons (black lines in Figure 15) and display a text box listing two categories of crops - well-suited and suited[12]. A description of the area's soil type is also provided.

GIS BENEFIT

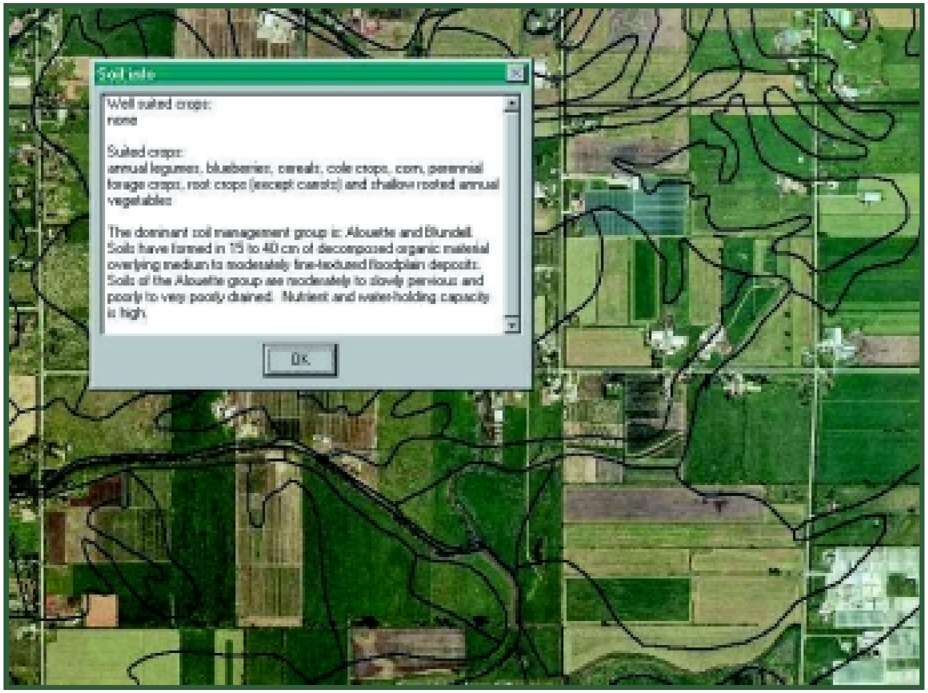



**Figure 15: Detailed soil information for a specific polygon**

[12]The information generated with this tool originates from the Soil Management Handbook for the Lower Fraser Valley. "Well suited crops" are defined as those for which a low to moderate level of management inputs are required to achieve an acceptable level of production. "Suited crops" require a moderate to high level of management inputs to achieve an acceptable level of production.

## 3.2 Management Inputs

Another tool can be used to help determine what management inputs are needed to improve the agricultural capability of a particular area. In Figure 16, agricultural capability polygons are being queried with the *Management Inputs Tool,* which gives the dominant improved and unimproved agricultural capability and subclasses for the selected location.

If 'Yes' is selected on the first screen, a second screen provides more detail on capability as well as management inputs that could be applied to a given area to improve overall productivity of the land, as shown in Figure 17.

A hot link has also been created between the Capability theme and a document that explains the capability classes. At the click of a button the user can access a text document describing class 1 to 7 agricultural capability rating which includes consideration of both soil and climate characteristics.

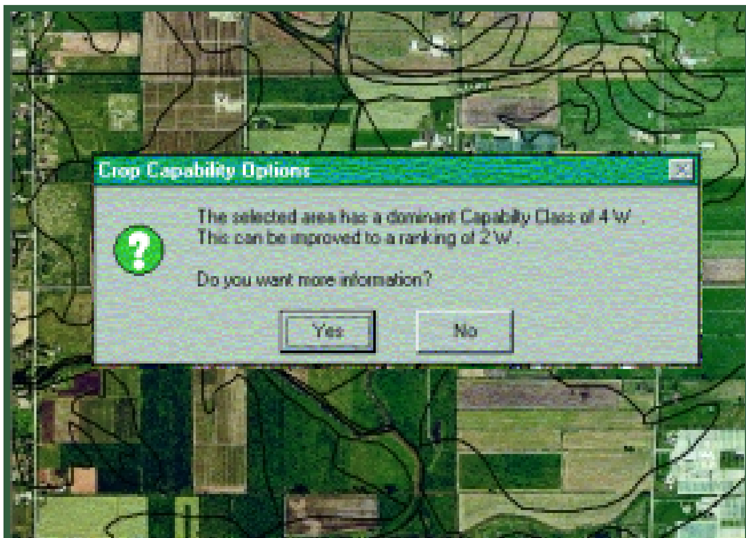



**Figure 16: Using the *Management Inputs Tool* to query a specific area**

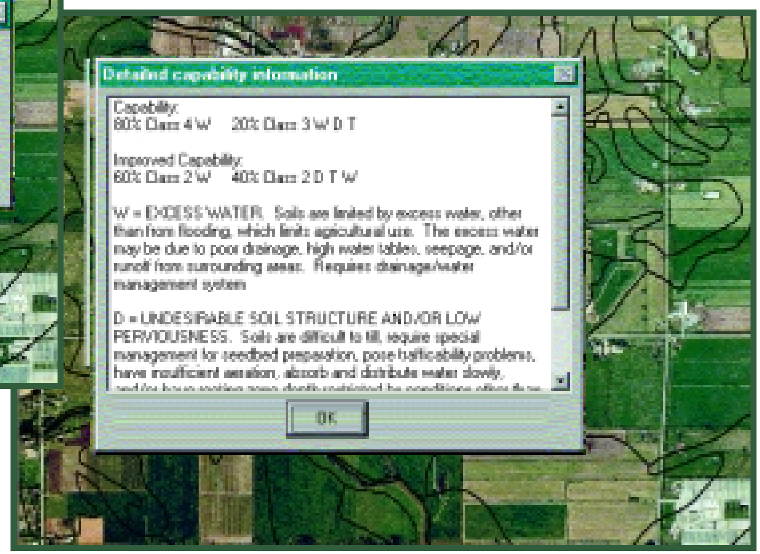



**Figure 17: Agricultural Capability & Management**

GIS BENEFIT

The *Potential Development*, *Soil Query*, and *Management Inputs Tools* provide an excellent start for someone who has agricultural land and would like to expand their production or learn more about their property's crop capabilities and the different means that can be used to enhance productivity. These tools also help local governments understand their agricultural land base and the opportunities for business development.

Photos 2 & 3 demonstrate an example of applying management inputs (in this case drainage improvements) to enhance productivity.

**Photo 2: Blueberry fields before drainage improvements**

**Photo 3: Blueberry fields after drainage improvements**

# 4 Examining Proposed Land Use Changes with GIS

An agricultural GIS can assist with general land use decision-making processes. For instance, proposals for subdivision or non-farm uses in an agricultural area can be assessed using GIS.

While the subdivision of agricultural land usually reduces agricultural options and viability, it is a fairly common proposal that councils and boards routinely must consider. In the following example, a proposal to subdivide an 8 hectare parcel into four, 2 hectare lots is explored; the proposal may be in association with an ALR or re-zoning application. Spatial and attribute information associated with the property and the land surrounding it can be examined to answer a number of queries.

## 4.1 Understanding the Study Area

In this example a study area (outlined in red) was selected surrounding the subject property. Figure 18 illustrates the value of the orthophoto base in providing an overview of land uses within the study area. The size of the study area was randomly selected and can be larger or smaller as desired. To gain additional details on land use for an individual parcel in the study area, land use inventory data (as discussed in Section 8.1, page 33) can be queried through an Access database.


**Figure 18: The study area (red) and subject parcel outlined on the ortho photos**

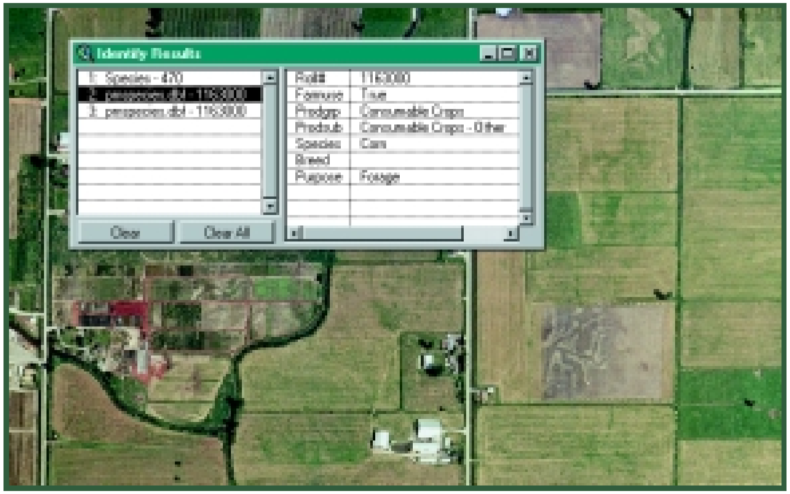



**Figure 19: Information about the parcel found in the land use database**

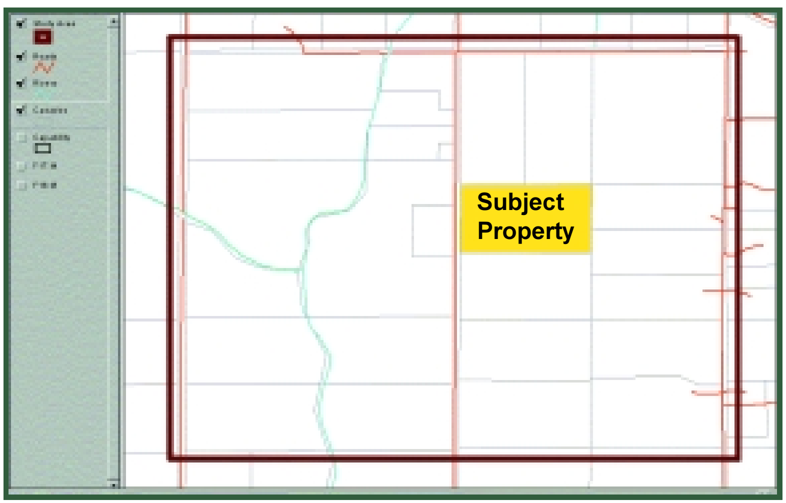



**Figure 20: Watercourses, roads and properties within study area**

The database provides information on the different types of vegetation and structures that exist on the parcel as well as the type of farm activity taking place (Figure 19). At the time the data was acquired, the subject property was growing corn and grass for forage. Other parcels in the study area were producing commodities such as forage crops, beef cattle, dairy cattle, greenhouse and nursery products, mushrooms, and Christmas trees.

A variety of GIS data layers can also be displayed to help analyze the proposal. For example, roads, water lines, drainage systems, watercourses, soil capability, vegetative cover, zoning and OCP designations, and topography can also be examined. Figure 20 displays watercourses and roads on top of the cadastral base map.

The cadestral data can also help to provide information on the area's subdivision pattern. The size of the subject property and the proposed new parcels can be compared with surroundings parcels. The bar graph in Figure 21 shows the range of parcel sizes within the study area. This gives an indication of how typical the subject parcel's size is compared to neighbouring properties, and if the subdivision proposal is consistent with the area's subdivision pattern.

## 4.2 Drawing Some Conclusions

With different queries the user can determine that the study area consists of 26 parcels comprising of approximately 189 hectares in total. The average lot size is 7.25 hectares. There are only two parcels that are currently 2 hectares or less in size. Lots that are less than 4 hectares account for about 5 percent of the study area.

From this examination, it is evident that lots in the study area are being actively farmed and the improved soil capability rating is Class 2 and 3. The subject property is well served by local roads and contains no watercourses. Finally, the proposed subdivision size of 2 hectares would be well below the average property size of 7.25 hectares.

GIS BENEFIT

Having easy access to spatial, attribute and statistical information can provide important background data to assist the decision-making process.

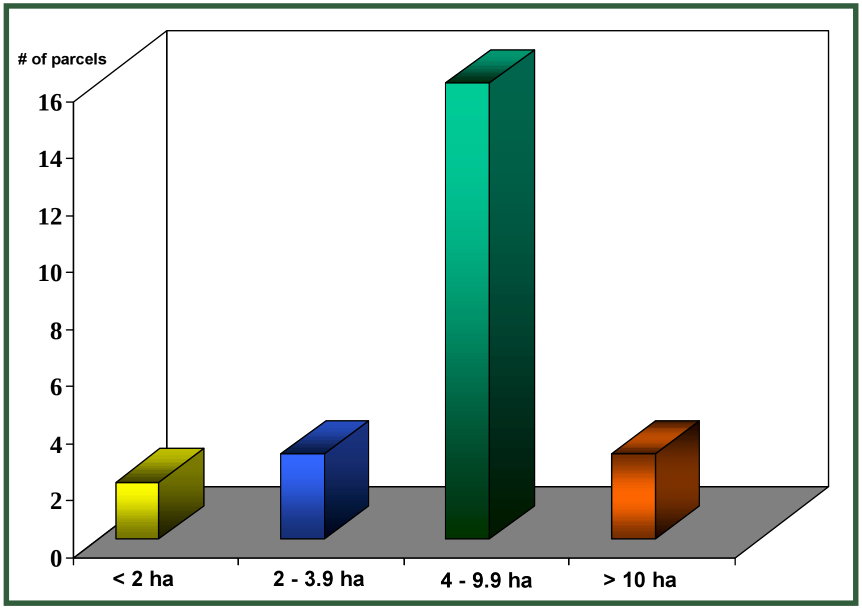



Figure 21: Range of parcel sizes within the study area

# 5 Summary

Applying GIS to an agricultural setting has a wide range of benefits, providing an effective way to put elected officials, land use advisors and others in touch with the farm community.

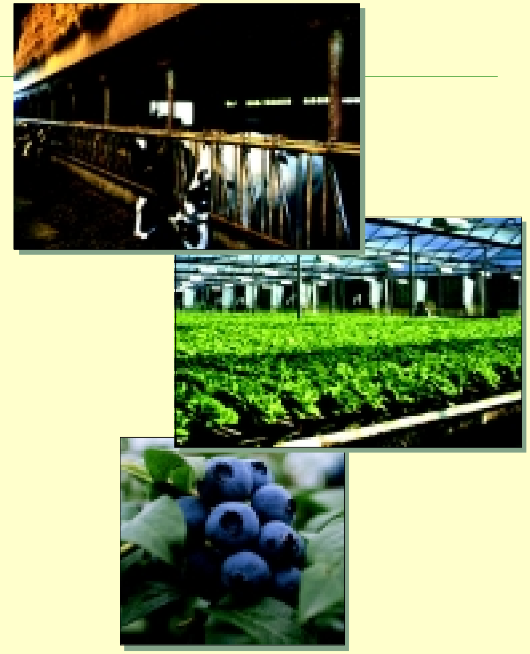
In Part I tools developed for the Pitt Meadows Pilot Project were used to demonstrate some of the benefits of applying GIS to agricultural issues. The *Setback Tool* helps examine how the establishment of setback regulations from lot lines and watercourses might impact the siting of farm buildings or land taken out of production. It can also benefit planning along the interface between agriculture and urban or other non-farm uses. The *Commodity Restriction Tool* assists in understanding the potential effect of restrictions of specific commodities.

The *Potential Development, Soil Query* and *Management Inputs Tools* were created to illustrate examples of how GIS can explore agricultural development options. The abilities of GIS in day-to-day land use decision making were also demonstrated through the subdivision proposal example.

These examples illustrate only a few of the many possible applications of GIS for agriculture. Part II expands on the possibilities for enhancing existing tools and creating new ones, to broaden the application of GIS within an agricultural setting. On a final note, it is important to recognize that although GIS is helpful in understanding relationships between land and resource uses, GIS is a decision-support tool, not a decision-making tool.

# Part II. Pitt Meadows GIS Pilot Project

## Pitt Meadows Agriculture



Pitt Meadows is an important agricultural area of the province and provided an excellent cross-section of different farm enterprises for consideration in the Pilot Project. In 1996, over 3,000 hectares of the Pitt / Fraser River floodplain were being farmed in the municipality. By and large Pitt Meadows has very distinct farm / non-farm boundaries, with the majority of the population residing in the 'Highlands' urban area in the southern portion of the municipality.

The almost 180 farms in Pitt Meadows produce a wide range of agricultural products. There are significant areas planted in cranberries, almost 20% of the province's land in blueberry production and several dairy and poultry operations.[13] In recent years, greenhouse production has grown significantly. In 1999, Pitt Meadows was home to 8% of B.C.'s greenhouse vegetable production.[14]

Locally, farming makes a significant economic contribution. In 1995, the community's annual gross farm receipts were nearly $60 million, representing 12% of Greater Vancouver Regional District's total.[15]

[13] Statistics Canada, *1996 Census of Agriculture Profile Data – British Columbia*.

[14] Ministry of Agriculture, Food and Fisheries.

[15] Statistics Canada, *1996 Census of Agriculture Profile Data – British Columbia*.

# 6 The Project – Overview

The 1996 enactment of the *Farm Practices Protection (Right to Farm) Act* (FPPA) and subsequent changes to the *Municipal Act* and *Land Title Act* provide new planning opportunities for local governments and the Ministry of Agriculture, Food and Fisheries to pursue. The Ministry and the District of Pitt Meadows took advantage of these new opportunities and in 1996 agreed to work on a joint GIS project. The Pitt Meadows Pilot Project was used to explore the capabilities of GIS when utilizing farm and other data from an agricultural area. For the Ministry, the pilot project served to test methodologies, verify hardware, software and data requirements, and determine the expertise and information needed to assist local governments in planning for agriculture. At the same time, the project provided the District with a system that can increase access to local agriculture sector information, act as a tool to enhance decision-making, and assist in the promotion of farming in the community. In addition, applying GIS to the District's farming area can provide information that will be useful in future updates of Pitt Meadows' official community plan and bylaws.

Part II delves into the Pilot Project. It describes the process for undertaking the project, discusses the outcomes and outlines some possible projects that could be undertaken in the future to enhance the agricultural GIS.

# 7 Project Description

This section outlines the overall approach and identifies the project participants. The goals, objectives and the deliverables of the project are also discussed.

## 7.1 Approach

The purpose of the project was to identify data needs and capture and integrate this information. In order to acquire this information, a team was established that included major stakeholders. It was important to have participation from all the stakeholders throughout the project so that an understanding was gained of the processes and agencies normally involved in planning for agriculture.

The study area of the project included the ALR lands within the District of Pitt Meadows and non-ALR lands directly adjacent to the Pitt Meadows ALR boundary. Land use inventory data was acquired for Pitt Meadows, and existing plans and bylaws for Pitt Meadows were referenced.

## 7.2 Participants

The project team participants included: MAFF staff from the Resource Management Branch, the South Coastal Region, and the former Information Technology Branch; planning and technical staff from the District of Pitt Meadows; and planning and technical staff from the LRC. See Appendix 4 (page 83) for a list of contacts.

Project consultants and information sources included: Agriculture and Agri-Food Canada; B.C. Assessment; Crown Lands Registry Services; Greater Vancouver Regional District Strategic Planning Department; the Ministry of Environment, Lands and Parks; Pitt Meadows Farmers Institute; and Statistics Canada.

## 7.3 Goal & Objectives

The goal of the project was to identify information, technology, and associated processes as well as human resources needed to support planning for agriculture and industry development.

There were four key objectives of this project:

1. to evaluate a means of communicating awareness of agricultural activities and supporting local governments in the development and review of official community plans, bylaws, and agricultural area plans;
2. to develop and evaluate various scenarios that may be used in planning along the interface between rural and urban land uses;
3. to evaluate the availability and usefulness of resource information and land use data for identifying opportunities and constraints for agriculture industry development;
4. to evaluate the usefulness of the technology in terms of strengthening farming and applicability to other areas of the province.

## 7.4 Deliverables

There were six main deliverables identified:

1. complete a land use inventory within the ALR and adjacent urban land uses;
2. collect digital inventories;
3. integrate digital layers of land use, cadastre and aerial ortho-photos registered to provincial TRIM[16] standard;
4. complete the following planning scenarios to aid zoning and bylaw development by:
   - evaluating the effects of lot line and watercourse setbacks;
   - evaluating the effects of prohibition on commodities (eg. hectares out of production);
   - evaluating the effects of buffering on the edge using the ALC Landscaped Buffer Specifications Handbook as well as examining how buffering impacts the agricultural land base and adjacent urban lands, and;
   - identifying farming/marketing/employment opportunities and constraints, and current trends in land use and ownership patterns.

[16] Terrain Resource Inventory Mapping.

5. evaluate the availability and usefulness of the data – soils, agricultural capability, land use designations, topography, drainage, roads & utility corridors, watercourses, environmentally sensitive areas, irrigation/drainage systems, domestic water intakes;

6. develop a procedural document to guide local governments and MAFF in the use of data and data analysis tools to support planning for agriculture and other GIS applications.

**Photo 4: Dairy farm, west side of Neaves Road and south side of North Alouette River**

# 8 Evaluation of Deliverables

In general, the data collected , tools designed and the processes that were developed helped to achieve the objectives of the project. The data allowed tools to be created that can promote local industry development and help determine the impact of policy and regulatory decisions that may be under consideration. A discussion of each deliverable follows:

## 8.1 Land Use Inventory

A land use inventory was conducted by MAFF in the summer of 1996. Staff undertook a 'windshield' survey, recording data such as buildings, crops, livestock, and other land use information for each cadastral parcel. The data was transferred from master legal maps to an Access database, which was linked to the cadastral GIS layer by the parcel's roll number. Also entered into the database was information obtained from the B.C. Assessment database, which includes information such as address, legal descriptions, designated and actual land uses, building types, and land and improvement values.

**Photo 5: Cranberry fields in south-western area of Pitt Meadows**

## 8.2 Collecting Digital Layers

Several data layers were collected, then viewed and analyzed using the GIS software ArcView. Colour orthophotos at 1 metre resolution were purchased. These are aerial photographs with distortions removed. The District of Pitt Meadows provided several information layers including cadastre, infrastructure, zoning, and Official Community Plan (OCP) designations. The Commission provided ALR boundaries, agricultural capability, and soils. Base data such as streams and roads came from TRIM, or Terrain Resource Inventory Mapping. This is a provincial data set of digital base mapping at a 1:20 000 scale. TRIM can be purchased from Geographic Data B.C.

## 8.3 Integrating Digital Layers

The data layers were registered to provincial TRIM standard, so that they fit together when overlaid. Some problems arose when integrating layers of different scales and therefore different accuracy. The TRIM base data was designed for use at a scale of 1:20 000 and therefore is not always very useful at the scale of an individual property. For example, smaller streams in the TRIM water features coverage are depicted by a single line and therefore have no area. This means their setbacks can only be calculated from the centre-line and not the top of the bank. In the example in Section 2.1.2 (page 7), the value calculated using the top of bank (as digitized from the orthophoto) for the setback area within the farm is less than one-hundredth of a hectare different than the value generated from the TRIM data. In other locations, however, the discrepancy could be much greater.

With regard to the attribute data, some difficulties arose in the process of linking the cadastre layer to the attribute database through the parcel's roll number. In some cases more than one parcel had the same roll number. This occurred when a person owned two or more parcels. This means the roll number was not always a unique identifier, preventing a "one-to-one" relationship between the data. Each polygon in a layer should have a unique identifier that will link it correctly to its database.

Other attribute data problems resulted because the database was more recent than the spatial coverage. Recent changes such as subdivisions or new ownership were reflected in the database but not in the coverage. When this occurred the two data sets were not a perfect match. This problem can be significantly reduced if the spatial and attribute data are from the same time period.

## 8.4 Planning Scenarios

Several planning scenarios were examined and in some cases special tools were developed to automate procedures for the user. These customized tools were designed using the ArcView scripting language 'Avenue'. The first scenario, lot line and watercourse setbacks, is examined using the *Setback Tool* which is demonstrated in Part 1, Section 2.1 (page 5).

The information that can currently be acquired from this tool is highly effective in helping to formulate different planning scenarios and support the decision-making process.

To address the second scenario, the prohibition of commodities, the *Commodity Restriction Tool* was developed. This tool calculates how much area would be affected if a plan or bylaw prohibited a specific commodity and can generate a map of the area, as demonstrated in Section 2.2 (page 9). This allows decision-makers to quickly evaluate the impacts of a proposed policy or regulatory change.

Further work still needs to be undertaken to develop the Setback Tool so that it can address the buffering scenario, by suggesting buffering specifications along the ALR edge. The buffering scenario is discussed in Section 2.3 (page 12).

**Photo 6: Slough - south side of McNeil Road – Pitt Meadows**

Section 3 addresses the scenario of identifying farming opportunities and constraints, with the *Potential Development*, *Soil Query*, and *Management Inputs Tools.* These tools allow the user to display farm development options and recommend management inputs to help optimize yields for a selected piece of land.

In addition to the original scenarios, a case study was undertaken to demonstrate how GIS can help with general land use decisions. Section 4, in Part I (page 19), illustrates how GIS may assist in understanding quickly and clearly the impact of a proposed land use change – in this case a proposed subdivision. The same methodology used to examine the subdivision proposal could also be used to examine non-farm use and other proposals.

Further development of the tools could enable planners and other decision-makers to understand the rural / urban edge more thoroughly and establish policy and regulations that would help mitigate land use conflicts, and at the same time allow the widest range of farming opportunities to occur in the community. More ideas for future GIS development have been outlined in Section 9 (page 39) "Future Steps".

**Photo 7: Turf operation, north side of Windsor Road – Pitt Meadows**

## 8.5 Availability and Usefulness of the Data

Several data sets proved to be extremely useful for the project. Orthophotos were often used in order to verify other data sets and to give a detailed visual picture of land and water features. The land use inventory was needed in order to understand what structures currently exist on the land base and which commodities are being produced. Cadastral lot lines were the base used for the inventory, plus they enabled factors such as parcel size and lot line setbacks to be examined. Assessing the impact of watercourse setbacks required the stream coverage. Soils and agricultural capability data are an important part of understanding why and where certain crops are grown, and where crops could be grown in the future. Also useful for understanding current land use patterns and predicting future patterns are the ALR boundary, infrastructure, zoning and OCP data. A more detailed description of useful coverages in an agricultural GIS can be found in Part III, Section 11 (page 49).

One major gap in the data is the lack of an accurate and large-scale polygon coverage of buildings. With such a coverage the impacts of adjusting setbacks could be more accurately determined. The TRIM point coverage of buildings is problematic and was determined not to be useful in the examination of setbacks from lot lines (Section 2.1.1, page 6). The position of the data points in TRIM is often not accurate enough to use at a large scale such as at the level of an individual property. An improved building coverage could be created manually by tracing the buildings from orthophotos, which would be quite time-consuming. It might also be possible to create a building coverage from remote sensing, once the appropriate software is purchased.

When dealing with data collection, both spatial and attribute data should be kept as current as time and money allow, given the frequency of land use changes. The appropriate level of detail needs to be determined beforehand, since too little information will not produce useful results, and too much information is a waste of time, effort and storage space. Data should be collected and stored in a standardized way, and should include a data dictionary to help others locate and interpret it.

**Figure 22: Orthophotos provide a detailed visual picture of land and water features**

## 8.6 Procedural Document

As a final deliverable of the Project, the need for a procedural document was identified. Part III of this report contains the elements of a procedural document and has been written to assist local governments wishing to implement or enhance their own agricultural GIS.

**Photo 8: Greenhouse lettuce – Pitt Meadows**

# 9 Future Steps

This section describes actions that could be taken in order to further the GIS work in Pitt Meadows as well as to implement this type of project in other jurisdictions. It also describes projects that could be undertaken with GIS in the future to further use the data.

## 9.1 Roles and Responsibilities

The Pitt Meadows Pilot Project demonstrated that GIS can enhance agricultural awareness and aid in the planning and development of agriculture. This technical tool can be an asset to local governments, MAFF, and other agencies such as B.C. Assessment and the LRC when applied to an agricultural area. In order to get the best use out of this tool, there needs to be a commitment by all these parties to work together and exchange information and knowledge.

For this project to be pursued further, a copy of the GIS software ArcInfo would be an asset to the Ministry. This software has more capabilities than ArcView, and will allow new scenarios to be examined. Acquisition of the TRIM II data set, ALR boundaries for the entire province, and province-wide soil and agricultural capability and land use survey data would also be very beneficial. By acquiring a complete set of agricultural data in the province, the data would then be applicable to all regions of the province and of use to all local governments.

A process for updating land use inventory information also needs to be established by the Ministry. Consideration is currently being given to the development of standards to guide land use inventory work in agricultural areas.

In most cases greater efficiencies and cost savings will result from collaborative efforts involving several partners sharing information. A clear challenge is to ensure that data collection is undertaken in a manner that satisfies the varying needs of all the partners involved. Thus, co-ordinating efforts with B.C. Assessment, local governments and other agencies, should be considered to improve the effectiveness of data collection.

MAFF will ensure the model and operating manual are made available to local governments, and technical support is provided as required along with available soils and agricultural capability information.

Local governments that would like to develop an agricultural GIS need to allocate the necessary resources to build the system and maintain the land use inventory and GIS. Most municipalities in the Lower Mainland have been contacted regarding the potential to add the agricultural GIS extension to their systems. There was substantial interest in applying the agricultural GIS tool to their systems. A majority of the municipalities have ArcView and/or ArcInfo and all have their cadastre digitized. In addition, many municipalities have conducted a farm inventory, although all municipalities believed their inventory should be updated.

**Photo 9: In 1996, Pitt Meadows accounted for nearly 20% of all land in B.C. under blueberry cultivation**

## 9.2 Future Projects

This document demonstrates only a few of the many possible applications of GIS in an agricultural area. The opportunities for developing new tools or enhancing existing tools within the model are numerous. Below is a list of some ideas for future projects.

### *Identify Marketing & Employment Opportunities*

Building on the tools that have already been created to promote agriculture development (*Potential Development* and *Management Input Tools*), census information could be combined with existing database information to examine both the opportunities and constraints associated with marketing and employment.

For example, Census of Agriculture information and other industry indicators may identify a trend towards increased blueberry production. GIS could assist in determining the potential for the municipality to accommodate increased production of this commodity. Data could be used to indicate those areas suitable for blueberry production. This information could then be cross referenced with current land use data indicating those lands that are already in blueberry production or otherwise used for purposes that may not allow for blueberry production in the foreseeable future (e.g.

golf courses). From this data a better understanding of the potential to accommodate more blueberry production, market share and spin-off employment could be assessed.

### *Identify Trends in Land Use and Ownership Patterns*

Farm operations commonly include land that is owned by the operator, as well as land that is leased or rented.[17] Combining land use inventory information with B.C. Assessment data in a GIS would be useful in identifying links or patterns associated with land use and ownership. Leasing opportunities could be identified and relationships between land use and ownership could be assessed, with specific reference to land owned by interests not directly associated with or living in the farm community. It will be important to clearly define what is meant by persons not living permanently outside of the farm area, outside the municipality or regional district or outside the province? Once defined, a method could be explored with B.C. Assessment to develop means to indicate the degree to which land ownership patterns may impact the level of farm use, application of management techniques (e.g. farm improvements) and tenure.

### *Changes to the ALR and Application History*

For most farming areas the ALR has important land use implications. The LRC is currently considering developing means to record changes to the ALR, through the use of GIS and a database. This would allow an understanding of historical modifications with temporal and geographic (jurisdiction) links. The development of this capability would make an important contribution to an agricultural GIS. In the long term, it will also serve as a valuable planning tool with its ability to link ALR applications for subdivision, land use change or exclusion to a cadastral base. Because LRC decisions normally are tied to the land rather than the land owners, the application history will also assist with on-going decision making concerning the same or similar properties in a specific area and provide reference to conditions applied to any particular decision. In the case of applications adjacent to or in close proximity to the ALR boundary, having ready access to the application history can assist in determining any buffering conditions that may apply.

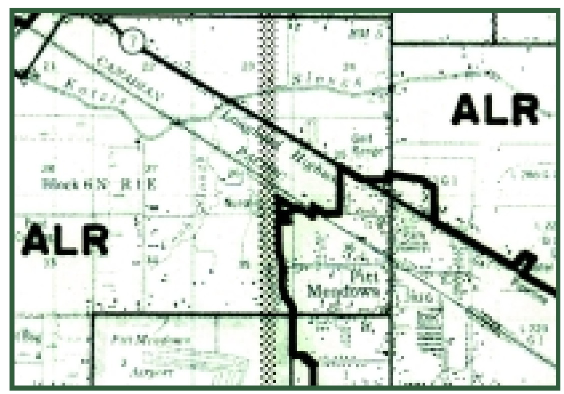


Figure 23: Sample of a portion of Pitt Meadows ALR map (not to scale)

[17] In 1996, of all land being farmed in BC, 62% was operator owned and 38% was leased or rented – Statistics Canada.

### *Identify Location of Nuisance Complaints*

Integrating information about nuisance complaints into a GIS could enable their spatial patterns to be examined. This could aid in the understanding of why and under what circumstances complaints emerge. In turn, this could help in the development of the most effective policy or regulatory solutions. The GIS could help answer the questions:

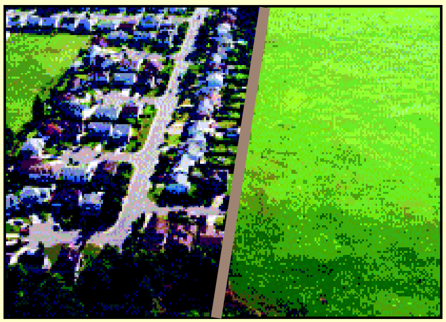
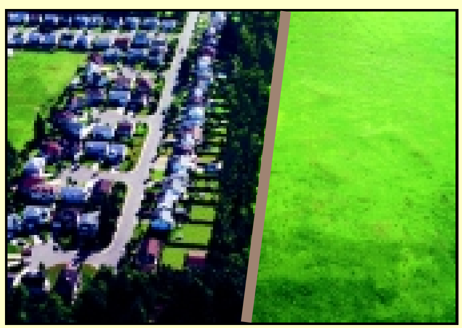



**Figure 24**

**Figure 25**



**Example of how buffering might occur along an urban/farm edge and the elimination of a road ending abutting the ALR.**

- is there a pattern to the complaints (e.g. do they all lie down wind of a farm)?
- are there management options that become easily apparent when the situation is viewed spatially (e.g. will a landscaped buffer help mitigate the problem)?
- what other options exist in terms of urban design or the location of residences?
- are there commodities or farm management practices that are more suitable for parcels next to the urban area?

### *Applying Buffers Along the Urban/ Rural Edge*

With the 1996 amendments to the *Land Title Act* [Sections 86(1)(c)(x) and (xi)], there are now opportunities to achieve more effective buffering. Improved land use compatibility could be achieved without utilizing farmland for buffering purposes if new urban developments incorporated moderate separation distances between residential uses and farm areas, applied permanent landscaped buffers and fencing and eliminate unnecessary road endings when proposed next to farm areas (figures 24 and 25).

As discussed in Section 2.3 (page 12), to effectively promote compatibility through buffering, both sides of the interface must be closely examined. Urban-side buffers should be based on an individual assessment of an area's sensitivity to farming. There are several different ways that GIS, combined with the appropriate information, could aid edge/buffer planning.

As shown in Figure 26, a tool could be developed to help determine buffering distances and specifications for urban properties on the edge of the ALR. This example draws upon the *ALC Landscaped Buffer Specifications*. The GIS would display factors such as the type of urban development, type of agricultural production, size, location and orientation of the properties, siting of buildings, and any topographical or climatic influences. It would then provide information on the types of buffers (with the specific information like buffer size, materials, species types, etc.) that would be appropriate for the particular site to enhance land use compatibility.

Other improvements to this tool could lead to the generation of suggestions for the orientation of buildings and distances needed for building setbacks on both sides of the edge, and suggestions for types of farm management practices that could be employed to promote compatibility.

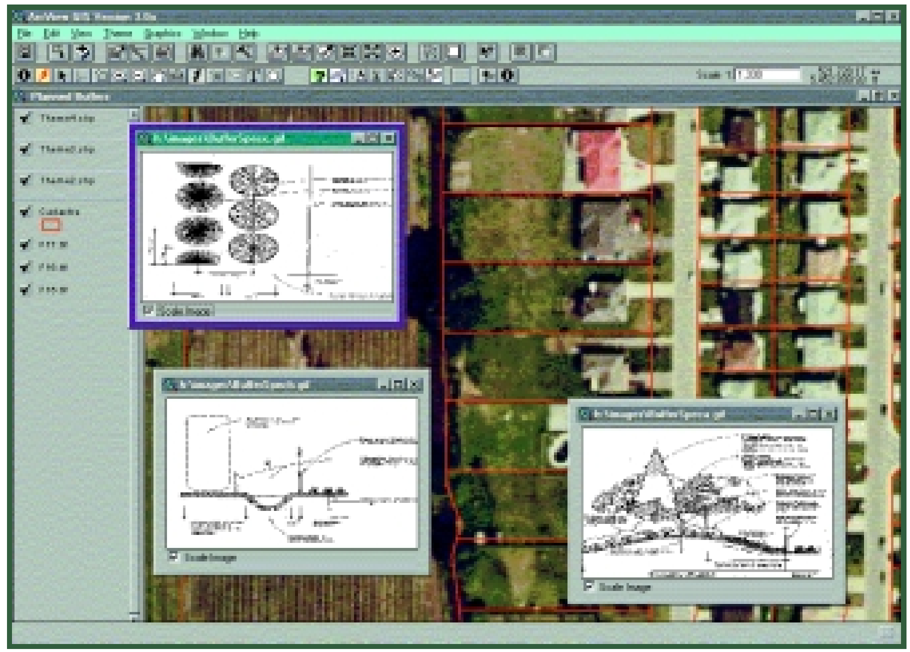


**Figure 26: Example of possible buffer specifications for an area along the urban edge**

## *Orthophotos for Crop Insurance*

Orthophotos can be used to determine the amount of land that was planted during the growing season. As is shown with the distance testing of the orthophotos (Appendix 2, page 73), these measurements are accurate within a few metres and would, therefore, be suitable for estimating the number of hectares in production. The cost of aerial photography depends on the resolution of the photos and the number of buyers who initially purchase the data. Furthermore, crop type could be identified through the use of infrared imagery (Figure 27) or satellite imagery. A LandSat7 image would cover an area of 180 by 170 kilometres – large enough to cover most regional districts. LandSat data would then need to be updated at least twice a year to allow for crop identification. LandSat images have a resolution of 15 metres whereas photos can have 0.5 or 1 metre resolution.

**Figure 27: Colour infrared photo for analysis of crops**

# 10 Summary

The Pitt Meadows Pilot Project provided a means for developing and evaluating planning scenarios within the ALR and along the ALR edge. It also provided an opportunity to evaluate the usefulness and availability of resource information and land use data for identifying opportunities and constraints for agriculture industry development. The six deliverables were achieved, although more detailed analysis could be pursued. This work has laid the foundation from which to continue building tools that can be used to communicate awareness of agricultural activities and support local governments in developing and reviewing official community plans, agricultural area plans, and zoning and farm bylaws.

GIS combined with agricultural land use information should prove effective in helping to strengthen farming in Pitt Meadows and can be applied to other communities throughout B.C.. Further development of the agricultural GIS will help to improve the understanding of the rural/urban interface and will aid in establishing policy and regulations that can effectively promote the widest range of farming opportunities while at the same time mitigating land use conflicts.

**Photo 10: Blueberry farm – south side of Alouette River / east of Harris Road – Pitt Meadows**

# Part III. Building Blocks for an Agricultural GIS


# Components of an Agricultural GIS

A GIS is made up of several components:

- Software
- Data
- Data Dictionary
- Tools

Based on the experience gained in the Pitt Meadows Pilot Project, a discussion of these components is provided in Part III. The information offered is intended to be used by local governments wishing to use GIS to strengthen farming in their communities.

## 11.1 Software

The software used in the project was ESRI's ArcView. It was chosen because it is user-friendly and relatively inexpensive. Extensions such as Spatial Analyst can be purchased to increase ArcView's capabilities.

Although not used for the Pitt Meadows Pilot Project, satellite image interpretation could provide insight into agricultural activities. Software for this purpose includes ER Mapper, or the Arcview extension, Image Analysis. Image Analysis adds many new capabilities to ArcView including vegetation identification, the ability to manipulate data, and other tools for automatically extracting new layers of data from the images.

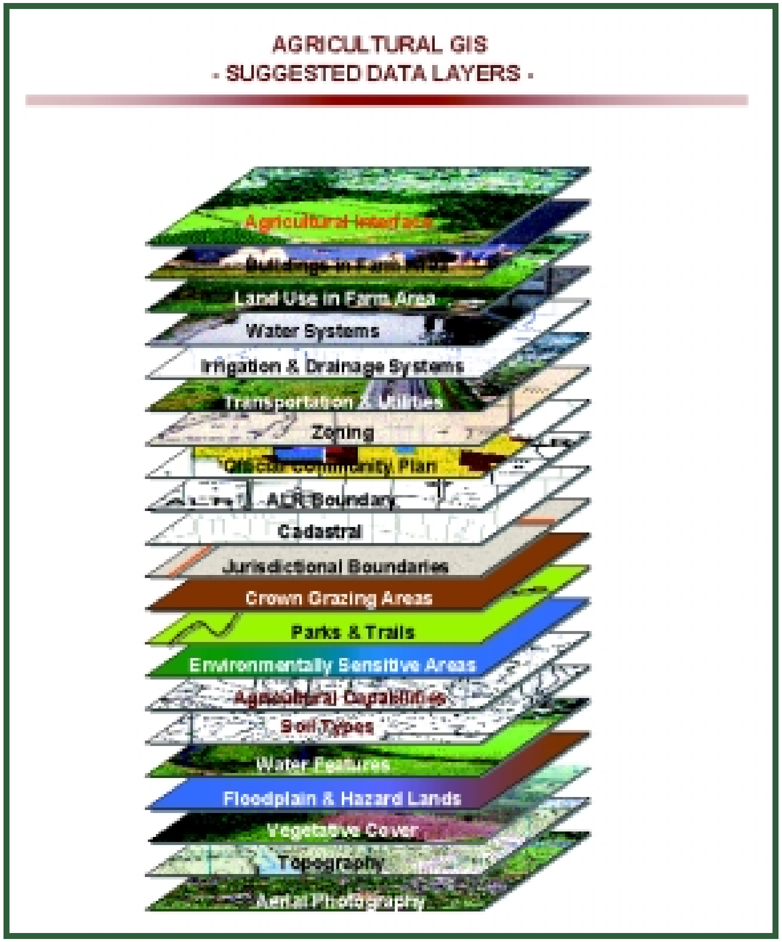



**Figure 28: Suggested data layers**

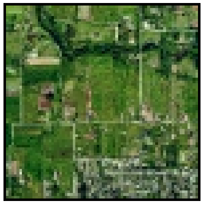
## 11.2 Data Layers for an Agricultural GIS

In the project, layers of data (*individual data themes with a spatial and attribute component*) were overlaid and cross-referenced to display several different situations and to explore various policies.

Figure 28 contains a list of suggested data layers for an agricultural GIS. Beginning on the next page, each layer and its use is discussed.

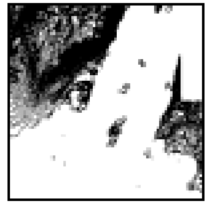
### 11.2.1 Spatial Data

#### *Aerial Photography*



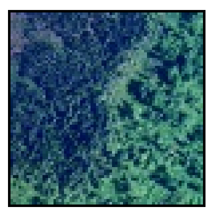
These images add context to most maps and can help to consider policy implications in a completely new way. There is also the potential to determine land use data directly from orthophotos, cutting costs for survey teams. Photos for the Pitt Meadows Pilot Project were purchased from Triathlon Mapping Corporation. These photos were taken in 1995 for the entire Lower Mainland. With a resolution of 1 metre per pixel, maps can be plotted at a scale of 1:5000 with a sharp image. Field studies found points from TRIM standards data and orthophotos were within 2-4 metres of each other (see Appendix 2, page 73 for methodology). A more recent option is the half-metre resolution photography flown by McElhanney Consulting Services Ltd. in 1999.

#### *Topography*



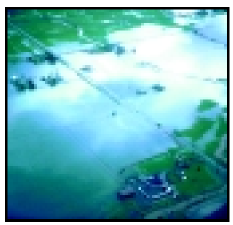
Although not used in the Pitt Meadows Pilot Project due to the low relief within the farm area, topographic data is a valuable layer. Understanding where the natural breaks occur in the landscape can help in the design of buffers and in the consideration of appropriate separation distances between land uses. This data layer can also assist in understanding farm management challenges that may be associated with topography. In particular, one can identify possible drainage implications such as areas prone to flooding, erosion and increased runoff, especially when farm areas are in close proximity to urban development. Topographic data is available as part of TRIM.

#### *Vegetative Cover*



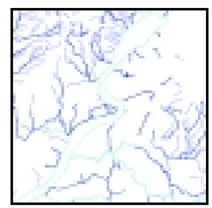
A vegetative cover layer represents a broad sub-set of non structural land use. Categories of cover may include forest, brush, hedgerows/ windbreaks/ shelterbelts, wetlands/ marshes/ bogs, unimproved and improved fields, land in crops, and orchards/ plantations. Understanding the basic features of vegetative cover in a farmed area can assist in understanding relationships between natural features and farming activity. The vegetative cover layer may reveal important habitat areas and wildlife corridors, as well as provide insight into new agricultural opportunities. While some of this information can be found in TRIM, a complete vegetative cover layer can be built from a combination of air photo interpretation and ground surveys.

### *Floodplain & Hazard Lands*



Mapping floodplain and other hazard lands can have implications for structural development. Understanding the relationships between farming areas in floodplains, local hydrology and urban and other non-farm development forms an important basis for considering flood prevention requirements. Floodplain mapping, linked with infrastructure data such as dikes, (noting differences in diking standards) the local road system, pump facilities, land uses and structural development on the water side of the diking system can be a valuable data set during emergency planning. The mapping of other hazard lands such as areas with potential for slope failure, earthquakes and high risk of forest fires is also important. GIS can assist the understanding of relationships between hazard land conditions, potential impacts on farming areas and mitigative measures necessary to avert disaster when people, property and livestock are threatened. In ranching areas, for example, the mapping of lands with a high risk of forest fires is equally important in emergency planning as the mappling of floodplain areas. The Ministry of Forests is developing digitized mapping of forest fire hazard areas in the Vancouver, Kootenay and Kamloops Forest Regions.

### *Water Features*



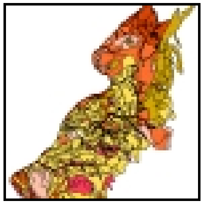
Water is an important consideration in most farming areas particularly where irrigation is a necessary production input or where natural wetness limitations require drainage. Additionally, there can be important environmental considerations when farming in close proximity to watercourses or over aquifers. Key features that should be considered in mapping water features include watercourses and water bodies, watersheds, fish bearing streams, aquifers and aquifer recharge areas, ground water sources including well sites[18], irrigation sources including ditches, drainage patterns and areas of high impact from upland flooding, and water licenses.

In the case of the Pitt Meadows Pilot Project, watercourses and streams were obtained from the TRIM database. Alternatively, the Watershed Atlas (WSA) is available free of charge from the B.C. Environment GIS home page (www.elp.gov.bc.ca/gis/), at 1:50,000 scale. A useful feature of the WSA is that it can be linked to the FISS database, so fish bearing streams can be identified. This could be useful for determining buffers and setbacks to protect sensitive areas and species.

### *Soil Types*

This data set is important for determining crop suitability, management considerations and prevention of erosion. However, this is a difficult data set to acquire. Although soils have been mapped for most of the province, this data set remains in the old CAPAMP format for much of B.C. The Resource Planning Branch of MAFF has some digital data available, as does the LRC.

### *Agricultural Capability*



Agricultural capability, which combines soil and climate data, can be used to identify the range of cropping possibilities (Classes 1 through 7), and can indicate limiting factors such as topography, stoniness and excessive wetness.

Compared to soils data, the agricultural capability portion of the CAPAMP data base is easier to acquire. The LRC has translated this data set for use as a layer of information in a GIS.

### *Environmentally Sensitive Areas*

A growing number of local governments have undertaken programs to map environmentally sensitive areas. In other cases, wildlife and ecological reserves have been designated provincially. Understanding relationships between environmentally sensitive areas, farming and specific farm practices can be critical in certain circumstances.

[18] Well location data could be combined with well quantity and quality information.

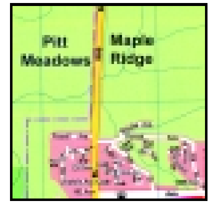
### *Parks & Trails*

Various levels of government can designate parks, park reserves and linear trail systems. When these largely natural features are located near or through farming areas, they can have both positive and negative impacts. Parks and trails may act to provide buffering and separation from other land uses, but can also focus recreational users in close proximity to farming, presenting several interface management challenges.

### *Crown Grazing Areas*

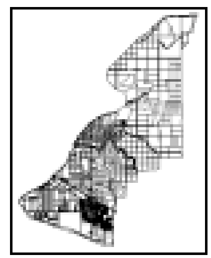
Crown grazing areas, as a sub-set of jurisdictional boundaries, is a necessary data set in ranching areas of the province. The relationships between crown grazing areas and forestry and wildlife considerations, depending upon location within the province, may be of particular importance.

### *Jurisdictional Boundaries*




There are a variety of different jurisdictional boundaries that can be included in a GIS, such as municipal and / or regional districts and electoral area boundaries. Other jurisdictional boundaries may include diking, water, improvement, and school districts, Indian Reserves / First Nations lands, federal lands, forestry reserves and the Forest Land Reserve (FLR).

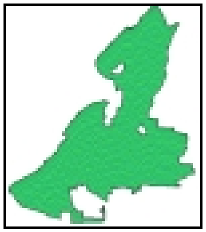
### *Cadastral*



Cadastral mapping provides a fundamental framework for analysis. It allows for detailed analysis of land use and parcelization. It also provides the basis for investigating a host of policy scenarios. This data layer can help determine which parcels are within a given distance of a point or edge. It can also help determine appropriate setbacks as well as the impact of existing and proposed regulations.

A unique identifier such as B.C. Assessment roll numbers or survey ID numbers should exist in order to link land use inventory data to legal parcels. Most municipalities already have this data for their area.

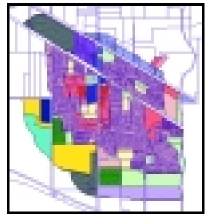
### *ALR Boundaries*



The Agricultural Land Reserve (ALR) establishes the boundaries for much of the agricultural land in B.C. and is an important starting point in distinguishing the farm / urban interface for edge planning purposes. The ALR also has important policy and land use regulatory implications.

The LRC has completed a project to fit the ALR boundaries to TRIM standards throughout the province. The LRC provided the digital ALR data for the Pitt Meadows Pilot Project.

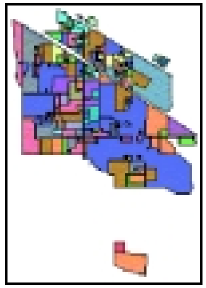
### *Official Community Plan Designation*



Most municipalities and many portions of regional districts have adopted official community plans (OCPs), establishing local land use policy and direction. The OCP is an important tool in analyzing existing and future land use, land use interfaces, relationships with the ALR, and zoning designations.

Where they exist, regional growth strategies should also be considered as another important information layer in an agricultural GIS.

## *Zoning Designation*



Most, but not all, farming areas in the province are subject to local government zoning bylaws or rural land use bylaws (RLUB)[19]. In contrast to the longer-term vision normally contained in an OCP, zoning and RLU bylaws set out current land use regulations. A zoning layer allows the regulatory implications of an existing bylaw and any proposed text or zoning designation amendments to be analyzed. Relationships can be drawn with land use inventory data, the ALR and OCP designations.

## *Transportation & Utilities*

Transportation routes have a number of potentially serious implications in farming areas and the placement of underground or overhead utilities such as gas, water, sewer and hydro facilities can have important impacts on farm management if not properly planned and installed. Besides the road network, undeveloped road rights of way, railways, ports, ferry and airport facilities should also be included. Transportation features are part of TRIM.

## *Irrigation & Drainage Systems*

Irrigation and drainage are important to farming and ranching in B.C. In building this layer, major components of the systems should be identified, but minor components such as on-farm sub-surface drainage are also useful. A field survey is needed to aquire this data.

[19] Within regional districts throughout the province a number of rural land use bylaws have been adopted that combine elements of an OCP and a zoning bylaw. With proclamation of the *Local Government Act* new rural land use bylaws will not be created. However, existing RLUBs will continue and where they exist, they should be treated in a similar manner to OCPs and zoning bylaws for inclusion in an agricultural GIS.

### *Water Systems*

The B.C. Ministry of Environment has created a layer of aquifers for the entire province. This layer, which has been completed at a 1:20 000 scale, is constantly being updated as new estimates of aquifers are completed.

Depending on water scarcity (which was not an issue in the Pitt Meadows Pilot Project), each parcel can either be individually assessed or a spatial layer created that shows the distance a parcel is from an aquifer, watercourse or domestic water system.

### *Land Use in the Farm Area*

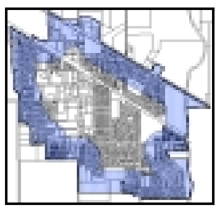
A land use layer, which even in a farming area can change from year to year, provides a useful 'snap-shot' of current land use and can serve as a bench mark to allow future analysis of land use change. Some basic data sources for land use information are aerial photography, B.C. Assessment data and on-ground land use inventories. Land use data can included such things as buildings and structures, crop type, livestock, non-farm uses, and vegetation. In the Pitt Meadows Pilot Project a land use inventory was undertaken and is outlined in Section 8.1 (page 33).

Having agricultural land use information increases people's understanding of what kinds of farming exist in their community. It also allows for areas of potential land use conflict to be highlighted. From here local planners can work to find solutions to farm/non-farm conflicts. In addition, comparisons can be made between land use data and the ALR, OCP and zoning designations. Land use data may be supplemented in the future with data from ALR records, particularly those involving decisions to permit non-farm uses or the subdivision of land in the ALR and any conditions, such as buffering, that may be part of a LRC decision.

### *Buildings in the Farm Area*

A coverage of buildings is useful for examining scenarios such as the effect of lot line setbacks. A buildings point coverage layer exists in the TRIM layer, although (as discussed more fully in Section 8.5, page 37) its usefulness is limited in the measuring of setbacks and is often inaccurate when applied to individual parcels.

### *Agricultural Interface*



A characteristic of much of B.C. agriculture is its close proximity to urban and other non-farm land uses. Edge planning along agriculture's interface is an important part of sustaining agriculture in most communities. In the Pitt Meadows Pilot Project, an area of 800 metres in total depth was examined, encompassing both sides of the interface. A distance of 300 metres was chosen on the urban side of the interface, and 500 metres on the farm side. The distance of 300 metres on the urban side was based on the City of Surrey's development permit area which was established to protect farming. This 300 metre distance provides an area within which existing and potential urban uses, along with existing and potential buffering techniques can be investigated.

The distance of 500 metres on the farm side was selected because it appeared to be a reasonable distance within which to consider particular farm management techniques and setbacks that may contribute to enhancing land use compatibility and could form part of a farm bylaw. Also, this same distance is currently being used as a similar study area in the municipalities of Langley and Delta as part of their bylaw reviews.

A detailed explanation of how this scenario was created is provided in Appendix 3 (page 75). While Appendix 3 explores urban / agricultural edges in Pitt Meadows, these same techniques should prove useful in considering the application of buffering techniques in rural residential situations and where other non-farm uses are located in the ALR.

### 11.2.2 Attribute Data

In the Pitt Meadows Pilot Project, a wide variety of attribute data was tied to the cadastral layer. This information helped to answer questions regarding agricultural development and planning. Most of these attributes come from the B.C. Assessment database.

#### *Parcel Identifier*

A unique identifier is necessary to link attribute information to spatial features for each parcel. For the Pitt Meadows project, B.C. Assessment data was linked to the cadastral layer via the B.C. Assessment Roll Number[19]. The Parcel ID, or PID, could also be used for this purpose.

#### *Address*

This attribute is part of the B.C. Assessment database, which supplies each parcel with an address and a legal description.

#### *Land Ownership*

The B.C. Assessment database lists the owner(s) of a parcel. This attribute may list a person's name, a company name, a level of government, etc.

#### *Leased Land*

The B.C. Assessment database records whether or not a parcel is leased. Alternatively, a survey of local farmers could help to compile this information.

#### *Absentee Land Owner*

The B.C. Assessment database does not specifically state whether a land owner is an 'absentee' land owner. In the Pitt Meadows Pilot Project, this data was constructed by comparing the property address to the registered owner's address (both found in the B.C. Assessment database). If a difference was found between the two addresses, and they were not in close proximity[20] to each other, the owner was deemed to be an absentee. See Part II, Section 9.2 (page 41) for a discussion on the reasons for pursuing this information to determine whether there is a relationship between unused or under utilized farm-land and the type of ownership.

[19] Problems arose in this process and are discussed in Part II, Section 8.3, page 34.

[20] In this case, 'close proximity' was considered to be within approximately 1 kilometre.

### *Livestock Numbers*

Data on the type of livestock can be collected through a land use survey, although air photo analysis of farm structures may provide an indication of operation type. It is difficult to obtain information on livestock numbers due to reasons of confidentiality (i.e. farmers may not want the numbers reflected in a public GIS). However, livestock numbers may have implications for issues such as waste management or the need for additional dwellings for farm employees.

### *Value Estimate*

B.C. Assessment's database provides land value and improvement values for each parcel. The use of this information on a public GIS should be considered with care due to confidentiality reasons. Nevertheless, the internal use of this information could be helpful in projecting patterns of land costs and would help determine where local investments are being made. For purposes of analysis, this data can be divided by area to determine spatial patterns based on value per hectare.

## 11.3 Data Dictionary

Given the large number of data layers, it is recommended that GIS data be stored in logical and understandable directories, with a Data Dictionary to help others locate and understand the data. The Data Dictionary should be kept up to date. In addition to telling GIS users where the data is located, it also provides "meta-data", or background information about each data layer. Meta-data includes such things as the source, accuracy, contact names, scale, and any modifications that have been made, as well as any caveats on how the data should be used or interpreted.

## 11.4 Tools

Designing customized tools for a GIS is a good way to automate procedures and to make carrying out common tasks easy and quick. Part I of this document demonstrates several of the specialized tools which were designed for the Pitt Meadows Pilot Project. For further information on how the tools were developed, see Appendix 1, page 65. A summary of the tools begins on page 67.

**Photo 11: Greenhouses – east side of Rippington Road – PittMeadows**

# 12 Working Together

The Ministry of Agriculture, Food and Fisheries will continue to work with Pitt Meadows to implement the existing tools of the project, evaluate new scenarios and provide support as required. MAFF is also interested in working with and supporting other local governments wishing to use GIS to undertake inventory work in their farming areas, develop agricultural area plans, update bylaws and generally promote and plan for agriculture as a part of more comprehensive sustainability programs. Several local government planning departments throughout B.C. have expressed an interest in using GIS to improve their knowledge of the local agriculture industry.

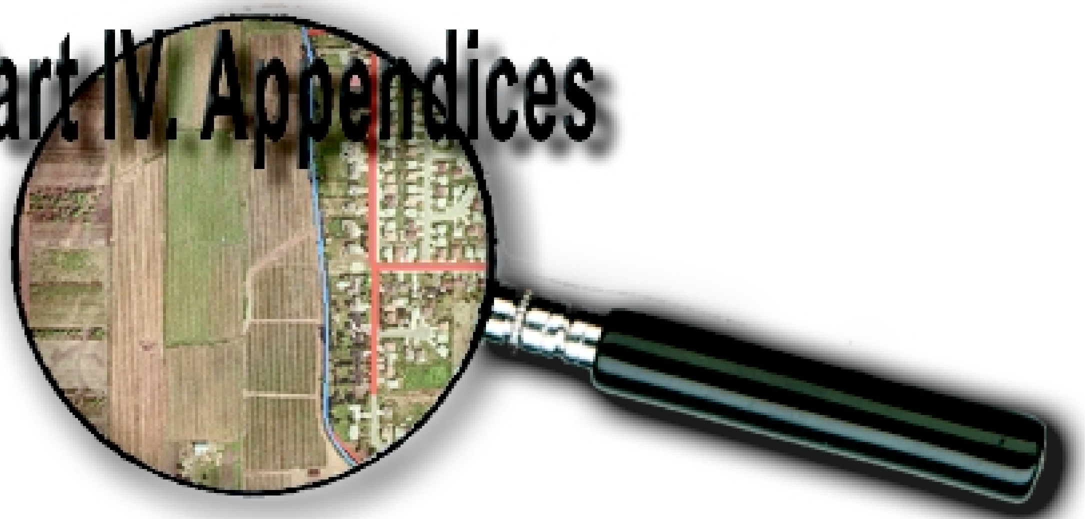
MAFF is working with the City of Richmond on a land use inventory project. Besides updating land use inventory within the City's farming areas, a primary purpose of the project is to examine inventory methodology. This includes integrating on-site inventory work with orthophotos, exploring the most efficient means of data collection and storage, determining the types of information that should be collected and the most appropriate level of detail, and designing GIS tools to easily retrieve information from the inventory. Other important objectives of the project are to ensure that methodologies are compatible with local governments' technical capabilities and to document the findings in order to share the results with other local governments that may wish to undertake land use inventory work in their agricultural areas.

It is anticipated that a spin-off project will also be undertaken involving several other provincial and federal agencies. This project will help the different agencies to better understand each other's land and water inventory needs and allow the exchange of information more readily. The objective will be to explore inventory methodologies that will accommodate the needs of several users and ensure the most cost-effective means are used to collect, store and share information through the application of GIS.

To discuss your ideas and future projects, please feel free to contact the Resource Management Branch staff listed in Appendix 4 (page 83) at the back of this booklet or your local MAFF or LRC provincial Agri-Team person.

**Photo 12: Wrapped silage in field south of McNeil Road – Pitt Meadows**

# Part IV. Appendices



# Appendix 1: Agricultural GIS Tools For Pitt Meadows

Several tools were created for the Pitt Meadows Pilot Project, many of which are demonstrated in Part 1. In order to create the tools, scripts were written in ArcView's programming language "Avenue". The scripts are activated by customized buttons added to the ArcView screen. Some of the scripts are modifications of scripts found on ESRI's homepage (www.esri.com).

The following section discusses the land use data developed for the project, then describes the tools that were designed. The scripts behind the tools are available from MAFF to interested parties. Since they are tailored to work with specific data sets, alterations are needed to make them work properly for each municipality's data.

## Land Use Data

The land use inventory (as discussed in Section 8.1 page 33) for Pitt Meadows was originally entered into MS Access using a data entry tool. The data was then exported into .dbf files and loaded into ArcView. There are three different tables:

- land covers (e.g. barn, pasture, single-family dwelling)
- land designation (e.g. beef cattle farm, greenhouse operation, residential use)
- commodities (e.g. berries, hazelnuts, poultry)

A sample of the commodities table is shown below.

Each row in the table contains information about a recorded commodity as well as the parcel's roll number. The roll number is used to link the data table to the polygon attribute table of the cadastral GIS coverage.

The data can be queried in two different ways. One is a bottom-up query, where the user selects a parcel and finds all the land covers, land designations, or commodities recorded for that parcel. The other is a top-down query, where the user selects a land use and finds all parcels which contain that land use.

## GIS Tools

This section contains a description of the tools. For each tool there is a list of what scripts are involved, what data is needed, how to set up the tool, and how to use it. When setting up tools, note the technical distinction between *buttons* and *tools* – buttons are found on the second row of controls in ArcView. They have a Click event, meaning an action occurs as soon as the button is activated. Tools are found on the third row of controls. They are an Apply event, meaning an action occurs once the tool is activated and a feature in the view is selected with the mouse.

pmspecies.dbf

| Roll# | Prodgroup | Prodsubg | Species | Purpose |
|---|---|---|---|---|
| 8000 | Conventional Livestock | Conventional Livestock | Cattle | Dairy |
| 13000 | Consumable Crops | Grass - Consumable | Consumable Grass - Unknown | Forage |
| 14000 | Non-Consumable Crops | Non-Consumable Crops - Unknown | Non-Consumable Crop - Unknown | Ornamental |
| 42000 | Conventional Livestock | Conventional Livestock | Cattle | Dairy |
| 88000 | Non-Consumable Crops | Shrubs | Rhododendron | |
| 88100 | Consumable Crops | Grass - Consumable | Consumable Grass - Unknown | Forage |
| 88100 | Consumable Crops | Consumable Crops - Other | Corn | Forage |

### *Link Tool*

This tool creates a link between the cadastre coverage's attribute table and one of the .dbf files. The link must be created before the bottom-up query can be performed.

**Scripts used:** Ag.One2Many

**Data needed:** Cadastre coverage, table of land uses including a linking field

**Setting up the tool:** Create a new *button* with Ag.One2Many as its Click event.

**Using the tool:** since the land use database will return numerous results for each parcel, a "single to many relationship" exists between the parcel and the database. This prevents the Join command – a common tool for joining data to a spatial database – from being useful, since only one of the many records will actually be joined to the spatial data.

However, a GIS can also link data. This process allows the user to select a record in one data set (e.g. a parcel in the cadastre coverage) and have the corresponding records automatically be selected in another table (e.g. the land inventory).

To use the tool, first make sure the cadastre coverage is present and is the active coverage. Then click on the *Link Tool* to initiative the process of creating a link between the active coverage and the desired database. The user will be prompted through a series of dialogue boxes which ask what table to use and what fields to link. After a link is set up, linked records can be accessed with the Smart Info tool.

### *Smart Info Tool*

**Scripts used:** Ag.IdMany

**Data needed:** Cadastre coverage which has been linked to data tables using the *Link Tool*

**Setting up the tool:** Create a new *tool* with Ag.IdMany as its Apply event and View.TabularThemesUpdate as its Click event.

**Using the tool:** ArcView's information tool does not display linked information, so a smarter version of this tool has been created. Once a link has been established using the *Link Tool*, the database can be queried with the *Smart Info Tool*. When a parcel is selected with the Smart Info cursor, both the information associated with the spatial table and the linked table will be returned in an information box.

**Warning:** If too many links are saved using the *Link Tool*, queries become very time intensive, as all linked tables must also be updated. This can be avoided by opening the table and selecting *Remove all Links* from the *Table* pulldown menu.

### *Land Use Query*

This tool allows the user to do a top-down query of the land use inventory, in order to locate properties which have a specified land use.

**Script used:** Ag. Landuse Query

**Data needed:** Cadastre coverage, table of land uses including a linking field

**Setting up the tool:** Create a new *button* with Ag. Landuse Query as its Click event

**Using the tool:** make sure the Cadastre coverage is present then activate the tool. When prompted, choose the table you wish to query, then choose the specific type of land use to look for. Parcels from the cadastral coverage will be selected which have that specific land use. To make a new coverage of only these parcels, go to "Convert to shape file" on the Theme menu.

### *Commodity Restriction Tool*

The Commodity Restriction Tool demonstrated in Part I is similar to the Land Use Query Tool. It was designed to demonstrate the effect of a commodity restriction on parcels which are smaller than a certain size.

**Script used:** Ag.Restrict Commodity

**Data needed:** Cadastre coverage, ALR coverage, table of commodities including a linking field

**Setting up the tool:** Create a new *button* with Ag.Restrict Commodity as its Click event.

**Using the tool:** First make sure the view units are set – go to Properties in the View menu and set the map units to metres. Then make sure there is a theme titled "ALR" present and a theme titled "Cadastre". When activated, the tool will ask what size to limit – enter a value in hectares. A list of statistics is generated, then the user is asked if they wish to examine a specific commodity. If a commodity is selected another list of statistics is generated concerning parcels of the selected size which are currently producing the selected commodity.

### *Setback Tool*

This tool allows the user to create setbacks, or "buffers" around selected features. Please note, for users of ArcView 3.2, a "Create Buffers Wizard" already exists. If this version is being used, the *Setback Tool* will not be needed.

**Scripts used:** Ag.Setback Tool Version 2.0, Ag.Outside Setback, Ag.Inside/Outside Setback, Ag.Clip, Ag.Process

**Data needed:** can be applied to any coverage

**Setting up the tool:** Create a new *button* with Ag.Setback Tool Version 2.0 as its Click event.

**Using the tool:** First make sure the view units are set - go to Properties in the View menu and set the map units to metres. Then make sure the features you wish to buffer are selected. When the tool is activated it will ask which theme to buffer, then which buffer type is to be used.

If an arc or point coverage has been selected choose "Outside Only" to create a buffer around the theme. For a polygon coverage the user can choose to buffer only the outside, or choose "Inside and Outside" to buffer on both sides of the polygons.

Next the user is prompted to set the distances to buffer, then asked whether to dissolve adjoining buffers. If "yes" is selected then overlapping buffer polygons will be merged. If "no" is selected all overlaps will be visible, as graphic features rather than as a new coverage.

The "Outside Only" option will produce one coverage - *Buf(Theme).* The "Inside and Outside" option will create four covers:
***Core*:** The area within polygons that is not within a buffer.
***Inbuf*:** The buffered area on the inside edge of polygons.
***Outbuf*:** The buffered area on the outside edge of polygons.
***All*:** The entire area from the far edge of the outside buffer to the centre of the polygons.

When the new buffer coverage(s) have been completed, the tool will ask if there are any coverages to clip by the new buffers. Select covers to be clipped. In the example in Section 2.1.2 (page 7) the cadastral coverage was clipped by the new watercourse buffers.

## *Soil Query Tool*

This tool helps translate the Soils layer into an understandable guide.

**Script used:** Ag.Soil_Query

**Data needed:** Soils, Soil Management Handbook for the Lower Fraser Valley.

**Setting up the tool:** Create a new *tool* with Ag.Soil Query as its Apply event.

**Using the tool:** To use the tool, select an area of interest and investigate its soil type and crop suitability by clicking on a polygon with the *Soil Query Tool*. For this tool to work, the soils coverage must be in the view and must be named "Soils".

### ***Management Inputs Tool***

This tool helps translate the Agricultural Capability layer into an understandable guide.

**Script used:** Ag.Capability Info

**Data needed:** Capability, Land Capability Classification for Agriculture in B.C..

**Setting up the tool:** Create a new *tool* with Ag.Capability Info as its Apply event.

**Using the tool:** To use the tool, select an area of interest and investigate its management options by clicking on the capability polygon with the *Capability Tool*. For this tool to work, the agricultural capabilities coverage must be in the view and must be named "Capability".

### ***Potential Development Tool***

This tool selects parcels of land that are suitable to grow a certain crop, and are of a selected size. The selection is added to the view as a new theme.

**Scripts used:** Ag.Select Crop, Ag.Merge, Ag.Select By Percent

**Data needed:** crop suitability – creating this coverage requires a cadastral layer, a soils layer and the Soil Management Handbook.

To create the crop suitability coverage used in the Pitt Meadows project, the soils and cadastre layers were overlaid. The Soil Management Handbook was used to determine which soils are suited to grow certain crops. A cadastral parcel was assumed to be suitable to grow a certain crop if 90% of the parcel area has a suitable soil type for that crop (determined using the Ag.Select By Percent script). The end result is a Crops coverage. This has the same linework as the cadastral coverage, with the various crop types as field names. To find areas suitable for a certain crop, the tool looks for parcels where that crop field has a value of 'True'.

**Setting up the tool:** Create a new *button* with Ag.Select Crop as its Click event.

**Using the tool:** Make sure the Crops layer is present in the view. Then click on the *Select Crop Tool*. Follow the dialogue boxes by selecting a crop and parcel size range. When prompted, save your file in a local directory with a suitable name.

# Appendix 2: Orthophoto Accuracy Methodology

Maps that displayed the orthophoto and a few TRIM reference layers were created by the GIS. By using TRIM roads, watercourses and buildings, references were given to the orthophotos. These references were then the basis of many of the distances measured although distances were also taken to edges and centres of several features displayed on the orthophoto.

It was found that the orthophotos 'bleed' as much as two pixels in some areas. This led to a distortion of up to two metres for some features in the orthophotos. Further error resulted due to the difficulty of trying to reference an exact location on the ground to its identical area on the orthophoto. Much of this error was due to the 'bleeding' but some was also due to the low resolution of features at a scale larger then 1:1 000. The measurement tools introduced another metre of inaccuracy. The laser distances used provided accurate measures within one metre.

The cumulative effect of these inaccuracies was as great as 8 metres. All measured distances were under this difference or were off by 2 – 4 metres. This was the accuracy reported on page 51 under "Spatial Data – Aerial Photography."

# Appendix 3: Analysis of Pitt Meadows Urban/Rural Edge

Part of the Pitt Meadows GIS Pilot Project involved exploring methodologies for examining land use and potential impacts along the urban /rural edge. The objective was to determine how a GIS might best contribute to planning along an agricultural interface and in particular, determine ways to enhance compatibility between farm and non-farm uses. The following tools were used to aid in this process: the User Specified Information button , the Link Tool , the Smart Information Tool , and the Setback Tool .

These tools were used to analyze the ALR edge along the north-west portion of the Pitt Meadows Highlands. Based on the theory of 'shared responsibility' for lessening the potential for land use conflict, a study area straddling the ALR boundary of 800 metres in width was delineated. This included an area of 300 metres on the urban-side and 500 metres on the farm-side of the ALR boundary.

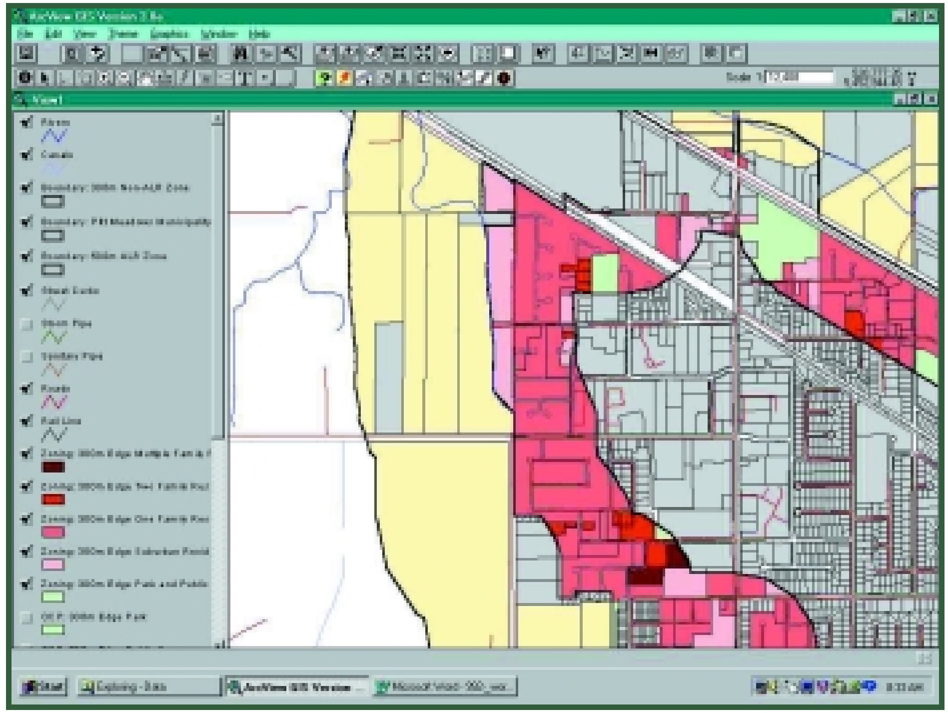


**Figure 29: Land use comparison along the ALR edge for conflict avoidance.**

Two factors that can contribute to urban / rural conflict - incompatible land uses and the lack of landscaped buffering - were examined with the tools.[21]

In the GIS, land uses within the 300m non-ALR area were examined. The urban-side study area has an OCP designation of Residential and is zoned Suburban Residential (Figure 29). The urban land uses were then analyzed for their degree of compatibility with farming activities located within the 500 m farm side study area.

[21] For the Pilot Project only the two factors of adjacent land uses and buffering were examined. However, there are several other means that can contribute to lessening the potential for conflict such as farm management techniques, enhanced awareness of agriculture and normal farm practices, urban storm water management and siting considerations.

There are, of course, several different zoning designations in the Highlands area of Pitt Meadows. As shown on Figure 30, the light pink polygons represent areas that are zoned Suburban Residential. The dark rose polygons represent One Family Residential zoning, the red polygons show Two Family Residential zoning, the dark red polygons indicate Multiple Family Residential zoning, the green polygons show areas zoned for Parks, and the yellow polygons represent farms. The thick brown line illustrates the ALR boundary and the black lines indicate the outer edges of the 500 m farm-side and 300 m urban-side study areas.

Compared to several other land uses such as natural wooded greenbelt areas, park uses, warehousing or industrial uses; residential development abutting farmland can pose a serious challenge when striving to ensure long-term compatibility.

Within the area of Pitt Meadows examined, the placing of a Suburban Residential designation next to the ALR boundary does have some advantages compared to other residential alternatives. Firstly, it allowed for somewhat less urban density next to the ALR. With a minimum lot size of 0.2 hectares (2,000 $m^{2,}$ ), suburban residential lots are relatively large, allowing for a greater separation distance between residential and farm uses. Also, with larger lots, sufficient area is available for the inclusion of permanent landscape buffering on the urban-side of the boundary. In addition, the Suburban Residential area, serves as a form of land use buffer between the farming area and higher density urban development within the community.

On the ALR side of the edge, the farm types are, at present, primarily berry farms and nurseries with one inactive dairy farm located in the middle of the area. With the exception of noise from propane cannons used to scare birds from crops and possibly farm vehicle movement through the urban area, it would appear that activity from these farm types has a relatively low negative impact on the urban community. However, a sensitivity impact assessment to compare nuisance levels between different farm types and different standards of operation has not been conducted to provide a guide with respect to what farms are generally more suitable for close proximity to urban development[22].

[22] A study was done by the Ministry of Agriculture and Food to determine distance as a tool for reducing farm/neighbour conflict. The farm types used were livestock and poultry and it was found that particular farm types had more complaints over distance than others (Van Kleeck, 1985).

Based on this limited amount of analysis, the GIS has been able to depict the planning and zoning regulations apparent in the urban side of the study area[23] and demonstrate the types of farming currently taking place along the edge as well as the types of urban development that exist. This information can aid decision-makers in planning for future urban development and farm activities that are most compatible and they can ultimately promote agricultural and urban development that minimizes urban/rural edge conflicts.

After examining the urban area as a whole, it is useful to look at a particular area in more detail. If the Suburban Residential zone can be considered to act as a land use buffer for the rest of the urban community, how can farming impacts, if they are apparent, be reduced on the residents in this zone? Landscaped buffers can cushion disturbances from farm activities by providing visual, acoustic and physical barriers. At the same time, buffering can reduce urban impacts on farming such as trespass, theft of livestock, harassment and equipment damage. Applying water management techniques at the time of urban development can also greatly reduce the potential for flooding of farmland. The use of landscaped buffers in this area was analyzed by looking at aerial photography .

The GIS can readily identify existing features that may contribute to buffering such as streams, natural vegetation and elevation changes. A slough runs between the Suburban Residential zone and farms as seen in Figure 30. Although this slough can be thought of as a buffer, it does not possess any notable landscaped buffer characteristics. However, the slough does tend to provide a physical barrier, increases the separation distance as well as establishes a clear "psychological" break between land uses. Existing vegetation such as trees and shrubs were marked and traced with the Draw Polygon tool  .

[23] It is recommended that given the availability of information, the GIS should include official community plan and zoning bylaw data related to both sides of the interface.

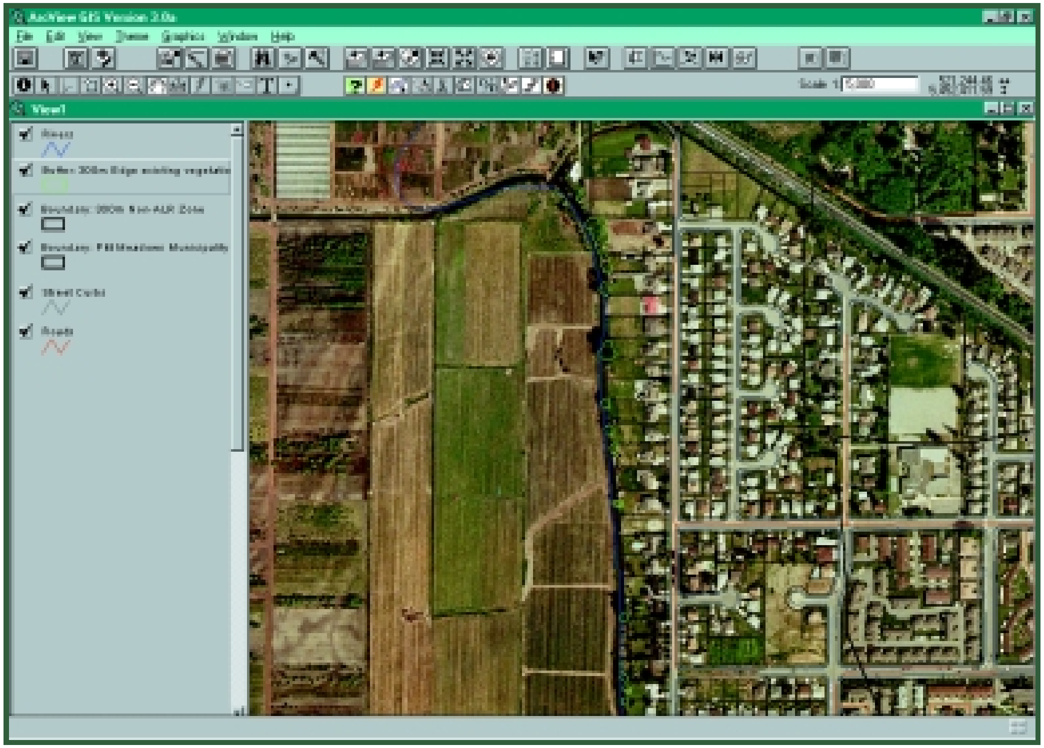


**Figure 30: Existing vegetation along the ALR edge (urban side) in the 300 m non-ALR area**

In Figure 30, the green polygons outline the vegetative cover along the suburban residential edge, while the blue line shows the slough dividing the farm land in the ALR from Suburban Residential zone in the Highlands. Although there is some random vegetation along the edge, it does not appear to act as a highly effective buffer. Figure 31 gives a close up view of the buffers and shows that the vegetation is placed only in a single row and is sparsely spaced within that row.

Using the *Setback Tool*, a setback distance of 15 metres from the slough was created inside selected suburban residential parcels. A 15 metre buffer represents an A3 buffer type found in the *ALC Landscaped Buffer Specifications Handbook* (ALC, 1992). The buffer was then clipped against a created polygon coverage (Figure 32).

Figure 32 shows that the buffer need not take up an excessive amount of space, especially on these larger suburban residential lots. The buffer would provide a visual separation[24] as well as assist in reducing noise and dust from adjoining farms.

In terms of an analysis for suitable buffers, the GIS is able to augment digital aerial photographs by adding new coverages that display examples of different buffer distances and types with fairly accurate precision. With an aerial photograph, one can determine if a particular buffer distance or type is suitable for a specified property or area.

This brief analysis of two factors that can contribute to urban/rural conflicts (land use incompatibility and a lack of landscaped buffers) only begins to illustrate what a GIS can do to help decision-makers promote land use compatibility. New information from future surveys can be attached to parcels and viewed with the *Link* and *Smart Information* *Tools*. Specific zoning, OCP, farm-use or other type of data can be selectively viewed with the User *Specified Information Tool*. With the *Setback Tool*, any type of distance can be generated to examine the impact and location of setbacks.

The use of GIS as an aid to edge planning would be most effective at the time of initial urban or farm-side development. However, as this analysis has demonstrated, GIS can also quickly bring into focus existing interface situations in order to understand the features currently in place that can contribute to enhancing land use compatibility. In addition, GIS can assist in determining the possible need and potential to "retro-fit" additional buffering (e.g. new fencing or additional landscape features) to improve an existing situation.

In conclusion, utilizing these tools and given the availability of necessary data, GIS can play an important role in supporting edge planning and provide a range of analysis with relative ease.

[24] A study undertaken by Van Kleeck (1985) indicated that compatibility can be enhanced because it was found that farms that could not be seen had fewer complaints than farms that could be seen.

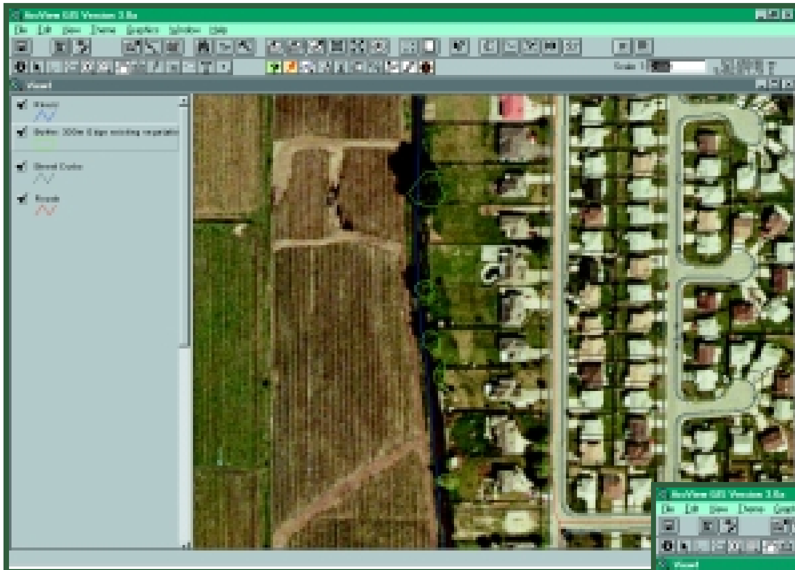


**Figure 31: Close up view of the existing vegetation along the ALR/urban edge**

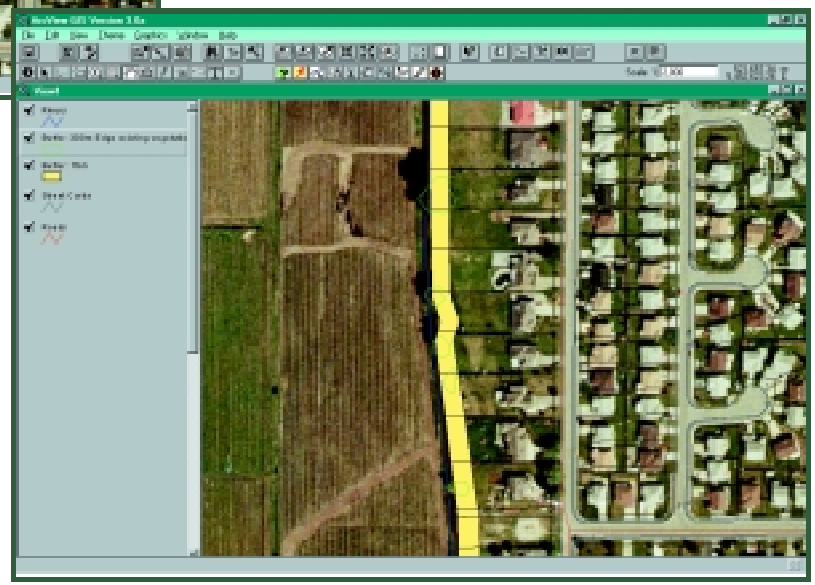


**Figure 32: View of an A3 (15 m) buffer type relative to suburban residential parcels.**

# Appendix 4: Contacts

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|---|---|---|---|
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# Glossary

**Accuracy**:
the degree to which objects on a map or in a digital database are positioned at the true ground locations.

**Aerial photography**:
photographs of a part of the earth's surface taken by a camera mounted for mapping purposes.

**ALR**:
Agricultural Land Reserve.

**Arc**:
lines representing a linear features. Data such as roads and streams are stored as arcs.

**ArcInfo**:
a GIS software produced by ESRI.

**ArcView**:
a GIS software produced by ESRI.

**Attribute**:
descriptive, or non-graphic, data related to a specific map feature.

**Cadastre, cadastral**:
a system that defines the legal characteristics of property such as ownership, title issues, values, etc.

**Clip:**
the spatial extraction of those features from one coverage that reside entirely within a boundary defined by features in another coverage (called the clip coverage)-clipping works much like a cookie cutter.

**Coverage**:
see "Layer".

**Database**:
a collection of inter-related information.

**.dbf file**:
a dbase file format.

**ESRI**:
Environmental Systems Research Institute, Inc. – a manufacturer of GIS software (for more information see *www.esri.com*)

**Digitize**:
the process of converting source materials, prepared manually, into digital data that is stored and processed by computers. Digitizing involves tracing map features into a computer using a tablet and mouse.

**GIS**:
an organized collection of computer hardware, software, geographic data and personnel designed to effectively capture, store, update, manipulate, analyze and display all forms of geographically referenced information.

**Infrared**:
electromagnetic radiation located in the portion of the spectrum just beyond visible light. The primary source of infrared radiation is heat.

**LANDSAT**:
the generic name for a series of earth resource scanning satellites launched by the United States.

**LRC**:
Land Reserve Commission with the responsibility of administering the ALR. (Formerly the Agricultural Land Commission and Forest Land Commission.)

**Layer, cover, coverage**:
one of a series of data themes, such as zoning or streams, in a GIS with spatial and attribute data related to that topic. Coverages can contain point, line, or polygon information.

**Orthophoto**:
an aerial photograph in which the distortions due to camera tilt and topographic relief have been removed. An orthophoto has consistent scale throughout and can be used as a map.

**Polygon**:

a multi-sided figure representing an area. Data such as soil type and zoning are stored as polygons.

**Resolution**:

the smallest detectable distance between features.

**Satellite imagery**:

digital data obtained from sensors carried in satellites. It includes data both in the visible and non-visible portions of the electromagnetic spectrum.

**Scale**:

the relationship existing between a distance on a map and the corresponding distance on the earth's surface. e.g. A scale of 1:2000 means that 1 cm on a map represents 2000 cm, or 20 metres on the ground.

**Spatial**:

refers to features or phenomenon distributed in space and thus having physical, measurable dimensions.

**Topography**:

the relief, elevation or shape of the earth in a given area.

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