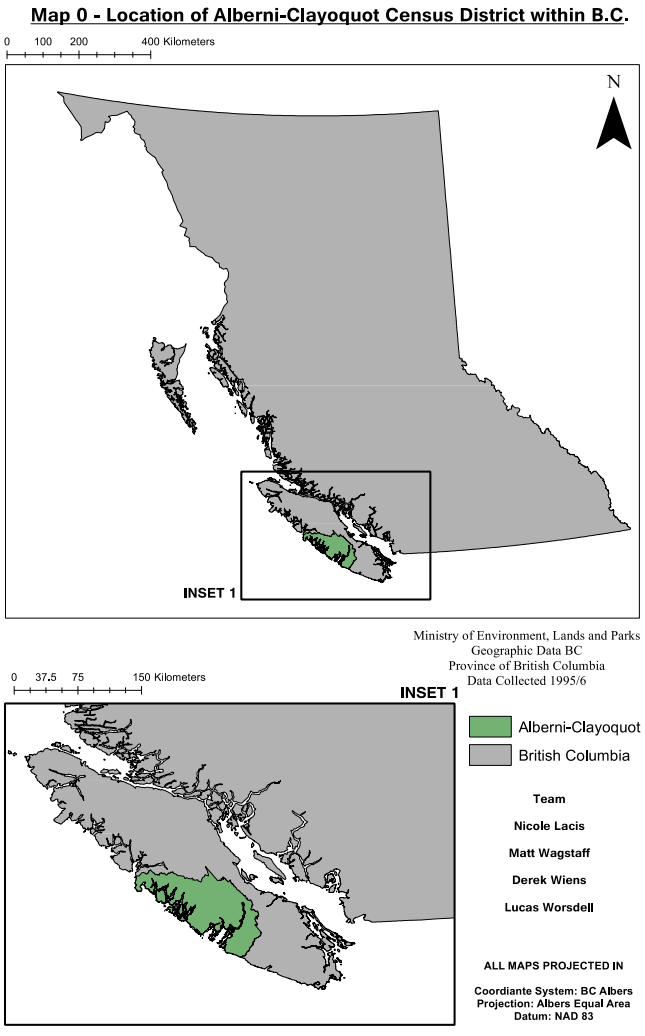
ALBERNI-CLAYOQUOT

A Geospatial Analysis of the Agricultural Land Reserves in the Alberni-Clayoquot Region



Nicole Lacis, Matthew Wagstaff, Derek Wiens, Lucas Worsdell

Geob 270 L1A, November 2015

TABLE OF CONTENTS

EXECUTIVE SUMMARY

This report provides an analysis and evaluation of the current quantity and quality of Agricultural Land Reserve (ALR) in the Alberni-Clayoquot region. By focusing on a subset of the total ALR in British Columbia, we hope to relieve some of the uncertainties around ALR land estimation and provide a more accurate description of the total ALR in this region. Through the use of ArcGIS, our team conducted a series of analyses on a variety of geospatial data, including, but not limited to: population statistics, demographics and spatial data such as roads, rivers, soil types and census area boundaries. Methods of analyses included both re-projecting and transforming various datasets, as well as a variety of polygon overlays such as the unioning, intersecting and clipping of various layers. Many individual features, such as roads, required buffering, and a series of queries were performed. Reclassifying data layers based on certain variables (such as slope) was also required along with the conversion of some layers from raster to vector and line to polygon. Results of the data lead us to conclude that current estimates of the total hectares of Agricultural Land Reserves in British Columbia exceed reality. Our estimates for Alberni-Clayoquot, using different practices than the Agricultural Land Commission, differ by current ALC official estimates by 75%. Recommendations include thorough re-examination and GIS analysis applied to all Agricultural Land Reserve sub-regions in BC, as well as future research and data collection that considers additional factors not currently utilized by the Agricultural Land Commission.

This report also acknowledges that there are many limitations involved in the analysis provided. Some of the limitations include: both error and uncertainty in data obtained and therefore in the resulting maps and findings, lack of current data, lack of certainty regarding how land is being used within the ALR, and the inaccuracy of the commonly cited area of total land in the ALR (4,760,000 hectares).

INTRODUCTION

As urban development continues to spread its reach across the province, agricultural land preservation in British Columbia (BC) has become increasingly important. The Agricultural Land Reserve (ALR) in BC is not only important for food security, but also in ensuring that our environment is not entirely lost to the threat of development. The ALR is a provincial land use zone wherein agriculture is recognized as the priority use. Currently, 4.6% of the land base in BC is reserved as agricultural land.

In this project, we sought to analyze the extent of ALR in the Alberni-Clayoquot region, with questions in mind such as: How much land is classified as ALR in this region? How does this amount compare to agricultural land calculated through a series of geospatial analyses? More specifically, what area of the current ALR is left after extracting non-agricultural areas such as rivers and roads? And, finally, how much land included in the current ALR is in fact not used for farming purposes, such as raising livestock or cultivating crops?

The Alberni-Clayoquot region is on the Southwestern coast of Vancouver Island. With a population of 30,876 in 2014 (BC Development Region, Regional District and Municipalities Population Estimates, 2014), the Alberni-Clayoquot region is on the smaller side of census districts in British Columbia. The relatively small size both geographically and population-wise made finding data for this project slightly difficult. Most of our vector data (roads, rivers, parks, etc.) was collected from the Terrain Resource Information Management Program – (TRIM) and our Digital Elevation Model (DEM) was collected from the Canadian Digital Elevation Model Mosaic – (CDEM). All of our datasets were sourced from the provincial or federal governments. A benefit of working with government data is that there is metadata that accompanies it; however, as will become apparent in this report, there is a tendency for this data to exclude certain details.

OVERVIEW

The total area of the Alberni-Clayoquot census district is 688,333ha. Before we excluded certain areas of land, the total ALR land within the region was 7,776ha (or 1.1% of the total census district). A map representing the subset of ALR land within the entire region can be found in Appendix C (Map 1, Appendix C). The Alberni Valley Agricultural Plan (2011) claims that 3,171ha of the ALR is actively farmed.

BIOGEOGRAPHICAL

Our first Biogeographical analysis involved the determination of different land cover types within the ALR of our region. We then calculated the area of each land cover type in hectares, as well as the percentage of the total area it represents (Table 1). A map version of these results can be found in Appendix C (Map 2, Appendix C).

Land Cover Type	Area (Hectares)	Percentage of Total Area
Water	6ha	0.08%
Exposed Land	34ha	0.40%
Developed Land	1020ha	13.0%
Shrubs	4ha	0.05%
Wetland	56ha	0.72%
Herb	1480ha	19.0%
Annual Crops	82ha	1.10%
Perennial Crops	1134ha	14.5%
Coniferous Forest	3832ha	49.3%
Broadleaf Forest	91ha	1.20%

Table 1 – Calculated area of various land cover types in the Alberni-Clayoquot region, relative to the total ALR area.

After applying a 10m buffer to all water features, including rivers and lakes, there is 143ha of water within the Alberni-Clayoquot ALR region. This is equivalent to 1.8% of the total 7,776ha. This buffer was applied because areas within 5m of a body of water are not suitable for agricultural purposes. The land close to water may be at risk to erosion, and growing crops using pesticides may contaminate the water body. We therefore excluded this land from the total ALR area.

A similar analysis was done to determine the soil types found in our region, as well as the percentage of total area each soil class composes. We found that most land in Alberni-Clayoquot is either Class 3 or 4, as summarized in Table 2:

Soil Class	Area (Hectares)	Percentage of Total Area
2	5ha	0.06%
3	3600ha	47.2%
4	2300ha	30.0%
5	1082ha	14.1%
6	31ha	0.40%
7	319ha	4.12%
O	312ha	4.10%

Table 2 – Calculated area of for each soil class in the Alberni-Clayoquot region, relative to the total ALR area.

According to the Agricultural Capability Classification in BC Report put forth by the Agricultural Land Commission (2013), there are seven classes of land capability for agriculture. The productiveness of the soil decreases from a maximum in class 1 to a minimum in class 7. Class 1, therefore, describes "land that either has no or only very slight limitations that restrict its use for the production of common agricultural crops". According to Table 2 as well as Map 3 (Appendix C), there is no class 1 land in the Alberni-Clayoquot ALR. The other classes are described (ALC, 2013) in Table 3.

Soil Class	Description
2	Minor limitations, requires good ongoing management or crop range restriction
3	Limitations that require moderately intensive management or moderate crop range restriction
4	Limitations that require special management and severe restriction of crop range
5	Limitations restricting capability to produce perennial crops
6	Land in this class is non-arable but capable of producing native/uncultivated crops
7	Land in this class has no capability of growing crops
O	Organic Soil

Table 3 – BC Agricultural Land Commission's Soil Classification scheme

In addition to water features and soil type, slope steepness was another important biogeographical factor that was addressed. While steep land may still be classified as ALR land, it is clearly not usable for agricultural purposes (due to farm equipment limitations, etc). Using 30 degrees as a maximum slope angle, we concluded that approximately 2.4ha of land within the ALR was greater than 30 degrees; roughly 0.03%. By reclassifying our digital elevation model, we were able to visually represent this in Map 4 (Appendix C).

To avoid placing too much emphasis on land not suitable for agriculture within the Alberni-Clayoquot ALR, we also investigated agricultural activity occurring on more arable land. According to the 2011 Census of Agriculture, the Alberni-Clayoquot region contains 93 total farms: this is less than 0.1% of the total number of farms reported across Canada. Of these 93 farms, 28 are smaller than 10 acres and only one is larger than 1000 acres, while the total market value of these farms is $92,439,065. To get a sense of the relatively small scale of agricultural output in this region, we discovered that only 71 farms own tractors and the average number of tractors per farm is less than 3 (195 in total). In addition, a surprisingly small number of farms have crop rotation practises (12) or nutrient management planning (11).

There is no wheat production in the Alberni-Clayoquot region, however there is production of various other agricultural goods. 23 farms reported egg production in the latest Census of Agriculture (2011), with a total of 27,544 dozens of eggs produced per year. 9 farms produce chickens for a total of 3,929kg per year, and 6 farms produce turkey. There are 1,011 cattle in Alberni-Clayoquot on 34 total farms; 23 farms produce beef cows while 3 raise dairy cows. For a look at additional smaller scale agricultural crops and products originating from this region, refer to Table 4:

Agricultural Product	Total Production (ha)
Grapes	4.9
Carrots	2.0
Tomatoes	2.0
Apples	1.6
Cucumbers	1.6
Sweet Corn	1.6
Broccoli	1.2
Pears	0.8
Greenhouse Flowers	.02
Honeybee Colonies	3 Total Farms (other data withheld)

Table 4 – Small-scale agricultural products produced in the Alberni-Clayoquot Region.

SOCIAL

The first 'social' aspect of our analyses was to exclude the road network from the total calculation of ALR area in Alberni-Clayoquot. We were able to determine the length of each type of road in our ALR area. There are technically only three types of roads in our ALR area – gravel, paved and rough – but they are also classified by the number of lanes they have, leading to five total classifications. Because of its high level of detail, this dataset is an example of very descriptive data, something that was lacking in some other analyses we conducted (refer to Error and Uncertainty). When added together, there is approximately 208.7 km of roads in our ALR area, with 'rough road' making up the majority (Table 5).

Road Type	Number of Lanes	Total Area (km)
Gravel Road	1	31.7km
Gravel Road	2	35.0km
Paved Road	1	38.2km
Paved Road	2	49.3km
Rough Road	N/A	54.5km

Table 5 – Road classifications with width and total length, in the Alberni-Clayoquot Region.

Much like the water features, roads were also buffered. This was performed as areas within 5m of roads are not suitable for agricultural purposes. The close proximity to roads can cause crop damage, and soil close to roads is often highly disturbed from road construction. After buffering the roads by 5m on either side, the total area unsuitable for agriculture due to their presence is 171.3ha. This means that approximately 2.2% of the ALR area is classified as road. A map representing this can be found in Appendix C (Map 5, Appendix C).

An additional land classification type that was excluded from our calculations of ALR land area was parks. There are no National Parks within our area, but there are two provincial parks: Sproat Lake Provincial Park and Stamp River Provincial Park. Together they occupy

268 ha of the total 7,776 ha, or 3.4%. We also found a single golf course in our ALR, which on its own occupies 36 ha. A map representing both parks and golf courses can be found in Appendix C (Map 6, Appendix C).

Finally, all of the non-farm uses identified were presented on a single map (Map 7, Appendix C). This map displays all of the uses within our ALR that are not in fact agricultural. Cumulatively when accounting for overlap of map layers (eg. between forests and parks), these areas add up to 6,685 ha.

In order to evaluate the agricultural potential of Alberni-Clayoquot, it was important to investigate the demographics of the region. As stated earlier, there are 30,876 people living in the Alberni-Clayoquot census district, according to the Government of British Columbia's Regional and Municipalities Population Estimates in 2014. There are 13,516 households in total (BCStats, Ministry of Technology, 2015); additional demographic information can be found in Table 6:

Demographic	Amount or Percentage
% of Population aged 15+	84%
Median Age of Population	45 years
Married or living with partner	14,995
Average number of people/household	2.7
Number of people speaking English	27,400
Number of people from Aboriginal Descent	4,250
Canadian Descent	8,385
British Descent	9,965
Size of agricultural, forestry, fishing and hunting labour force	1,055
Average Individual Income (2010)	$31,740
Average Household Income	$32,239

Table 6 – Selected demographic information in the Alberni-Clayoquot census district. Source: Statistics Canada Census 2011

After researching the Alberni-Clayoquot ALR region, we were able to find a few potential threats to the ALR. According to the Alberni Valley Agricultural Plan, the greatest job growth from 2001-2006 occurred in industries such as finance, insurance, real estate, management and administration. The plan also claims that there has been a shift away from agriculture towards tourism, especially in areas such as Tofino and Ucluelet. We fear that the growth in these other industries will lead them to proliferate into the ALR area. In the future, real estate development will also encroach on ALR land due to the rising population of the region. In addition, the population of the area over 65 is projected to rise by 68% by the year 2027. The majority of people above the age of 65 are unlikely to participate in agricultural activities.

In terms of labour and maintenance requirements, because the area has hot dry summers and cool wet winters, most perennial crops require year-round attention. Irrigation is often needed throughout the summer, and drainage may be needed during the wet season. The infrastructure required to carry out these tasks is highly expensive, and would be difficult for many farms to afford, considering that the average revenue on farms has been constantly declining since 1995 (Alberni Valley Agricultural Plan, 2011).

The Vancouver Island Coast Regional Agriculture Framework for Action (2011) also highlights low profitability as being a major issue for farmers in this region. Both this report, as well as the Alberni Valley Agricultural Plan (2011), show that agriculture in this area is not a major industry, and that many farmers simply cannot afford to practice agriculture. As more and more farmers move into different sectors, there may be opportunity for other industries to expand into the no longer actively used ALR area.

SUMMARY

After conducting our analysis, we discovered only 76ha of land classified as annual cropland and 1,085ha of land classified as perennial cropland or pasture in our ALR region. This is represented visually in Map 8 (Appendix C), where all areas of identified non-agricultural use of the ALR area was erased. Combined, this makes up a mere 1,161ha of agricultural land, compared to the initial total of 7,776ha. After eliminating the buffered water features and transportation routes (roads and railways), the golf course and parks, and the airfield that happened to fall within our area classified as agricultural use, we were left with only 15% of our initial ALR area. In total, the buffered water features measured 143ha, the buffered roads 171ha, parks 268ha, the golf course 36ha, as well as 2.4ha of land too steep for reasonable cultivation.

After reaching these conclusions, we feel that the current estimates of Agricultural Reserved Land in British Columbia are inaccurate. Judging by how much land was eliminated from our study area alone, there is the strong possibility that the total hectares estimated by the government is greater than the total determined by GIS analysis. It is clear that the Agricultural Land Commission did not take into account many of the factors that discount proper agricultural land highlighted in this report.

ERROR & UNCERTAINTY

The very nature of GIS imposes both error and uncertainty. Because GIS is a model of reality, it is impossible to create one that is essentially error free. Error can be introduced to the data through sampling, collection, measurement and analysis. A simple confusion of numbers or missing a single ridge whilst constructing a DEM can significantly obscure results. Similarly, entering the data into the computer through key coding can easily introduce error. Although we as a group did not collect, calculate or enter the data we used, there is the possibility that those who did may have introduced human error.

In terms of data analysis, we encountered error and uncertainty on multiple occasions. Firstly, when converting "landcover" TRIM data from lines to polygons, we discovered that many of the resulting polygons were incomplete and not closed. The new layer had to be discarded, as it was full of undershoots and sliver polygons. Secondly, there was a significant difference in area between our 'water features' and our 'water land cover' category. This uncertainty may have arisen due to the way that water was classified in each of these datasets. For example land cover classified as 'water' may have been limited to anthropocentric and recreational uses. Similarly, 'water features' were exclusive to rivers and lakes, which are seemingly more common in the Alberni-Clayoquot region. Another interesting uncertainty came from land use data. This dataset was particularly vague, although it was downloaded from a government source. In particular, the 'Developed' land use category is extremely vague in nature, as it is hard to explicitly determine what developed land entails.

A large proportion of the government data we collected is largely outdated. For example, our data from the Ministry of Environment was last updated in 1996. It seems quite likely that there have been many changes to the Alberni-Clayoquot region in the last 20 years, some of which may not have been captured in our project. For example when reviewing satellite imagery of the region it is clear the location of the airport has changed since our landuse dataset was created. This, combined with the limited amount of data collected in our region, may have altered our results.

FURTHER RESEARCH & RECOMMENDATIONS

We first recommend that there should be new, more detailed, data gathered for the Alberni-Clayoquot region. The current estimates of the total area of Agricultural Land Reserves in Canada are likely inaccurate. It is clear that the Government of British Columbia and the Agricultural Land Commission have not eliminated various types of land in the ALR, and if this had been done more accurately, the estimates of total hectares of ALR in British Columbia would have likely been less than they currently are. In addition, using 20-year old data will undoubtedly create inaccurate results.

The vagueness regarding the kinds of 'developed' land in our ALR region also caused concern during our analysis. More specific data detailing exactly what kind of land falls within this nominal category is needed, for example residential versus industrial land. This uncertainty not only skews our results, but prevents the public from being well-informed about what the ALR actually consists of. We also recommend that the Agricultural Land Commission explicitly state that they currently include features such as rivers and roads within the ALR areas. Not only are these entities themselves inadequate for agricultural purposes, their surrounding areas also cannot be used for agricultural purposes.

Furthermore, we encountered several issues when trying to project and transform the government data within ArcGIS. Perhaps increased collaboration between data collectors, ArcGIS (ESRI), and other popular GIS providers should be formed in order to create more universally used standards for features such as projections and datums. Nation-wide or even provincial standards would facilitate both easier data analysis and maintenance. This would also facilitate the sharing of newly collected data, as it would all be conforming to the same standards. The easier data is to transfer and understand, the better informed the public will be.

APPENDIX-A: References

Agricultural Land Commission, Government of British Columbia. (2014). *Agricultural land capability in BC.* http://www.alc.gov.bc.ca/assets/alc/assets/library/agricultural-capability/agriculture_capability_classification_in_bc_2013.pdf

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Government of Canada. (2011). Census of agriculture. http://www2.gov.bc.ca/gov/content/industry/agriculture-seafood/about-agriculture-and-seafood-in-bc/statistics/census-of-agriculture

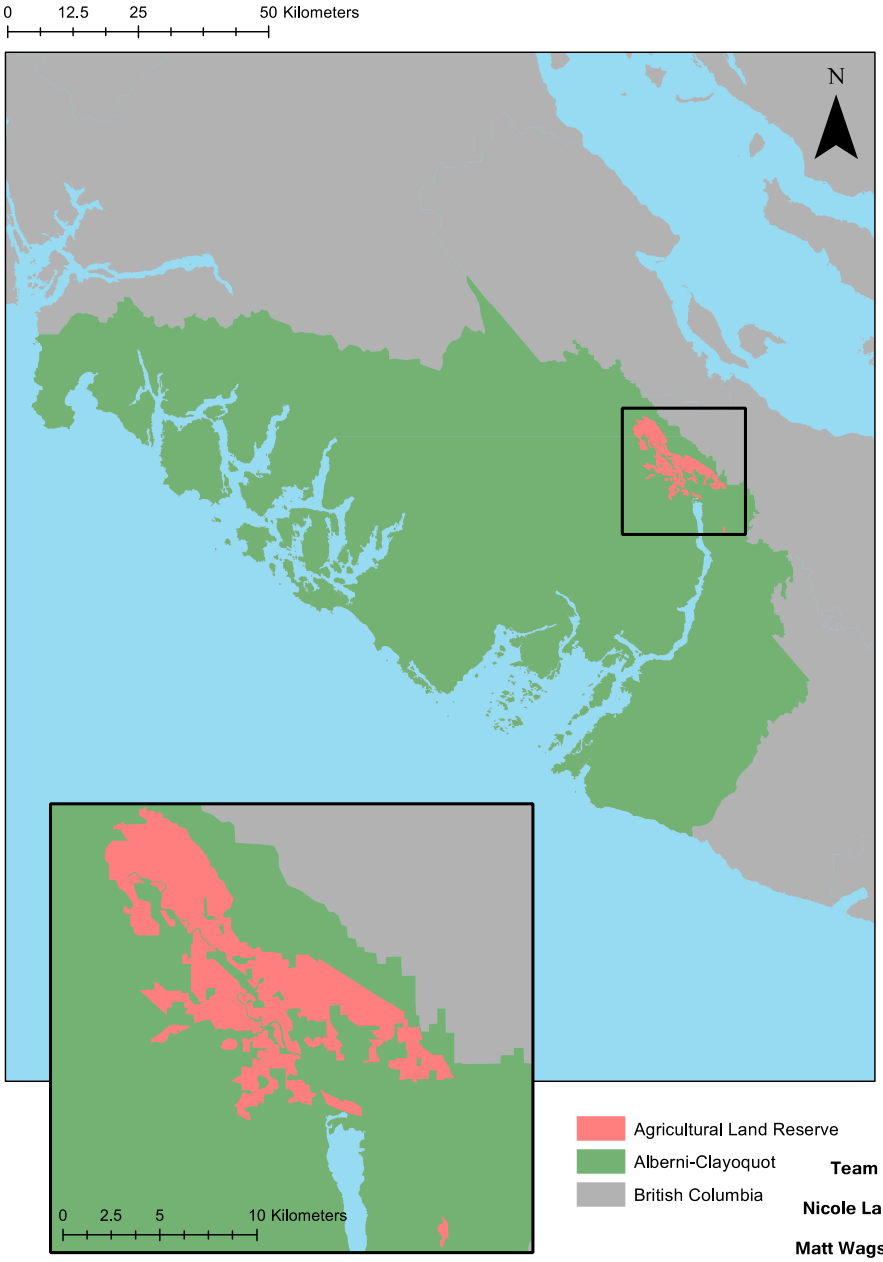
Statistics Canada, Government of Canada. (2011). Alberni-clayoquot census profile. Retrieved from http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/prof/details/page.cfm?Lang=E&Geo1=CD&Code1=5923&Geo2=PR&Code2=59&Data=Count&SearchText=Alberni-Clayoquot&SearchType=Begins&SearchPR=01&B1=All&Custom=&TABID=1

APPENDIX-B: List of Data Sources

- Government of British Columbia
    - Terrain Resource Information Management Data
    - Ministry of Environment, Land and Parks
    - Terrestrial Ecosystem Mapping
    - Geographic Data BC
    - Agricultural Land Commission of British Columbia
    - Ministry of Technology, Innovation and Citizens' Services
- Government of Canada
    - Environment Canada
    - National Soil Database
    - Canadian Digital Elevation Model
    - Statistics Canada

APPENDIX-C: Maps

Map 1 - Area Calculations of the ALR within Alberni-Clayoquot Census District



Total Area of Alberni-Clayoquot Census District: 688332.6 Ha

Total Area of the Agricultural Land Reserve: 7776.7 Ha

Percentage ALR of Total Area of Alberni-Clayoquot: 1.13%

Team

Nicole Lacis

Matt Wagstaff

Derek Wiens

Lucas Worsdell

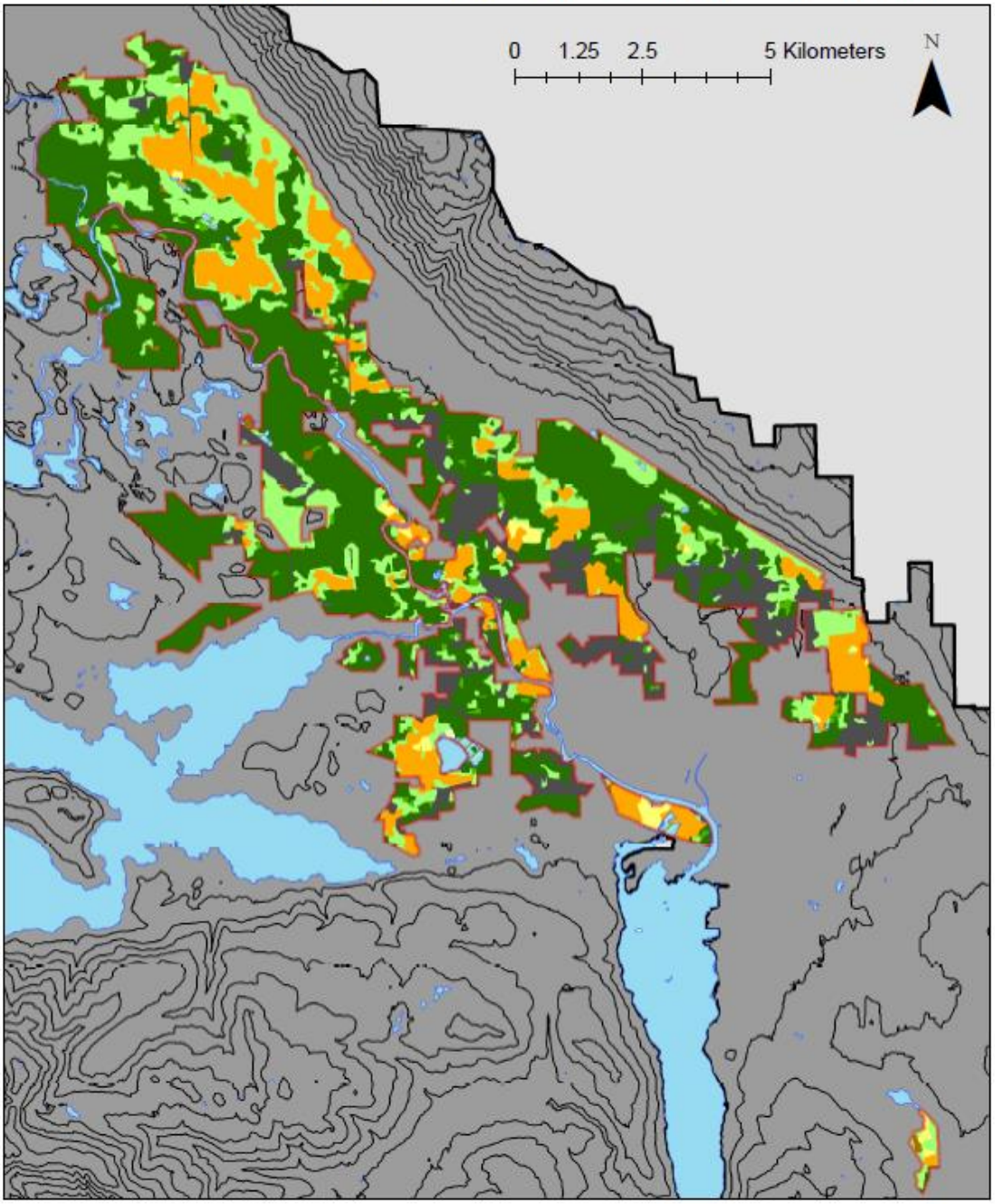
2015

Agricultural Land Commison
Province of British Columbia
Data Collected 2015

Ministry of Environment, Lands and Parks
Geographic Data BC
Province of British Columbia
Data Collected 1995/6

Map 2 - Analysis of Land Use within the ALR in Alberni-Clayoquot

Team Nicole Lacis Matt Wagstaff Derek Wiens Lucas Worsdell



Water: 6 ha
Exposed Land 34 ha
Developed 1020 ha
Shrub: 4 ha
Wetland: 56 ha
Herb: 1480 ha
Annual Crops: 82 ha
Perennial Crops: 1134 ha
Coniferous 3832 ha
Broadleaf: 91 ha

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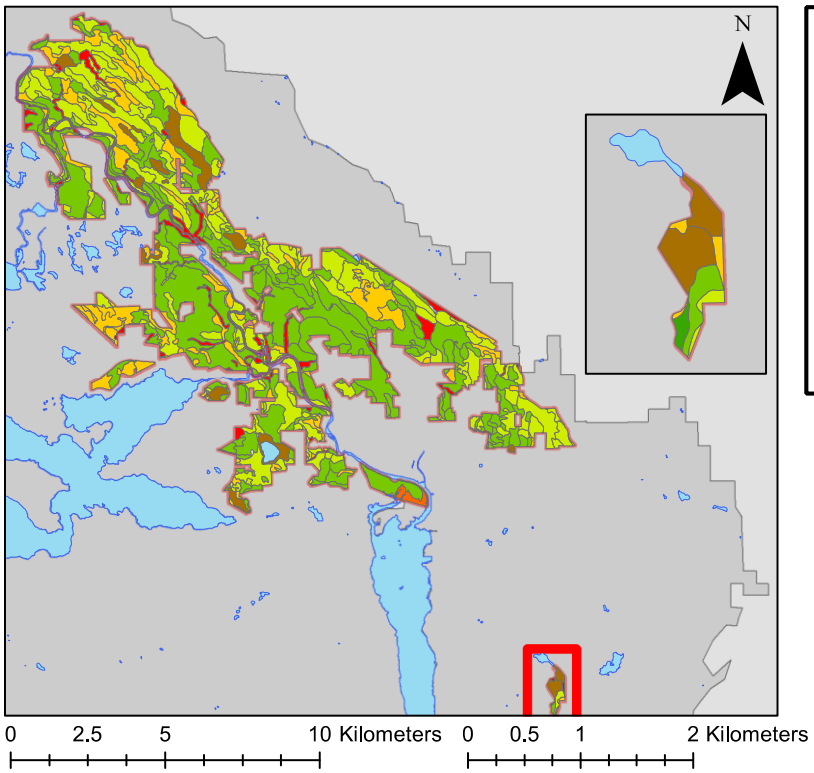
Agric ultural Land Commis on Provinc e of Britis h Columbia Data Collec ted 2015

Minis try of Environment, Lands and Parks Geograp hic Data BC Provinc e of Britis h Columbia Data Collec ted 1995/6

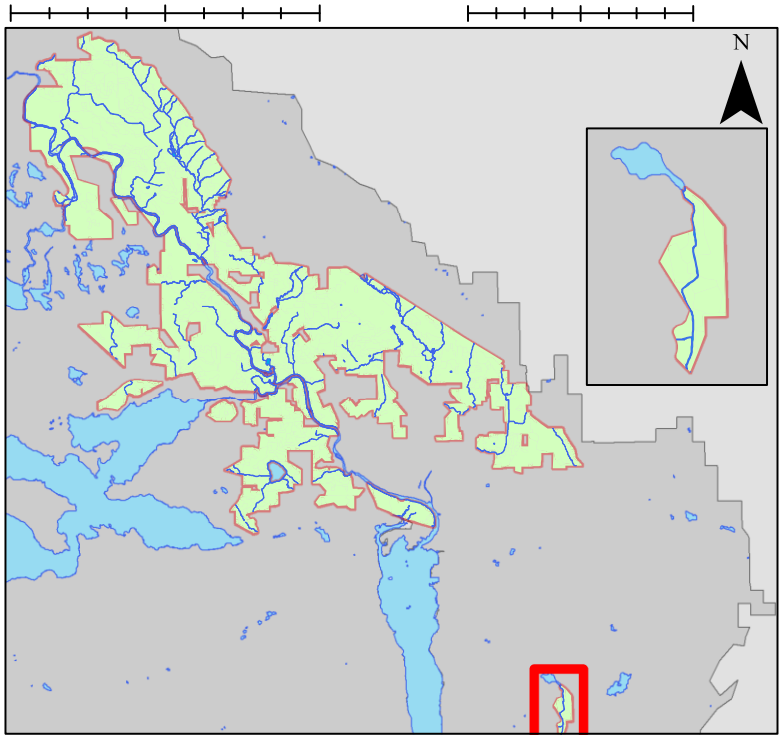
Map 3 - River and Soil analysis of the ALR in Alberni-Clayoquot

Team Nicole Lacis Matt Wagstaff Derek Wiens Lucas Worsdell



Soil Type

- 2: 5 ha 0.06%
- 3: 3600 ha 47.2%
- 4: 2300 ha 30%
- 5: 1082 ha 14.1%
- 6: 31 ha 0.40%
- 7: 319 ha 4.12%
- O: 312 ha 4.1%



- Water in ALR: 143 ha 1.8%
- Agricultural Land Reserve

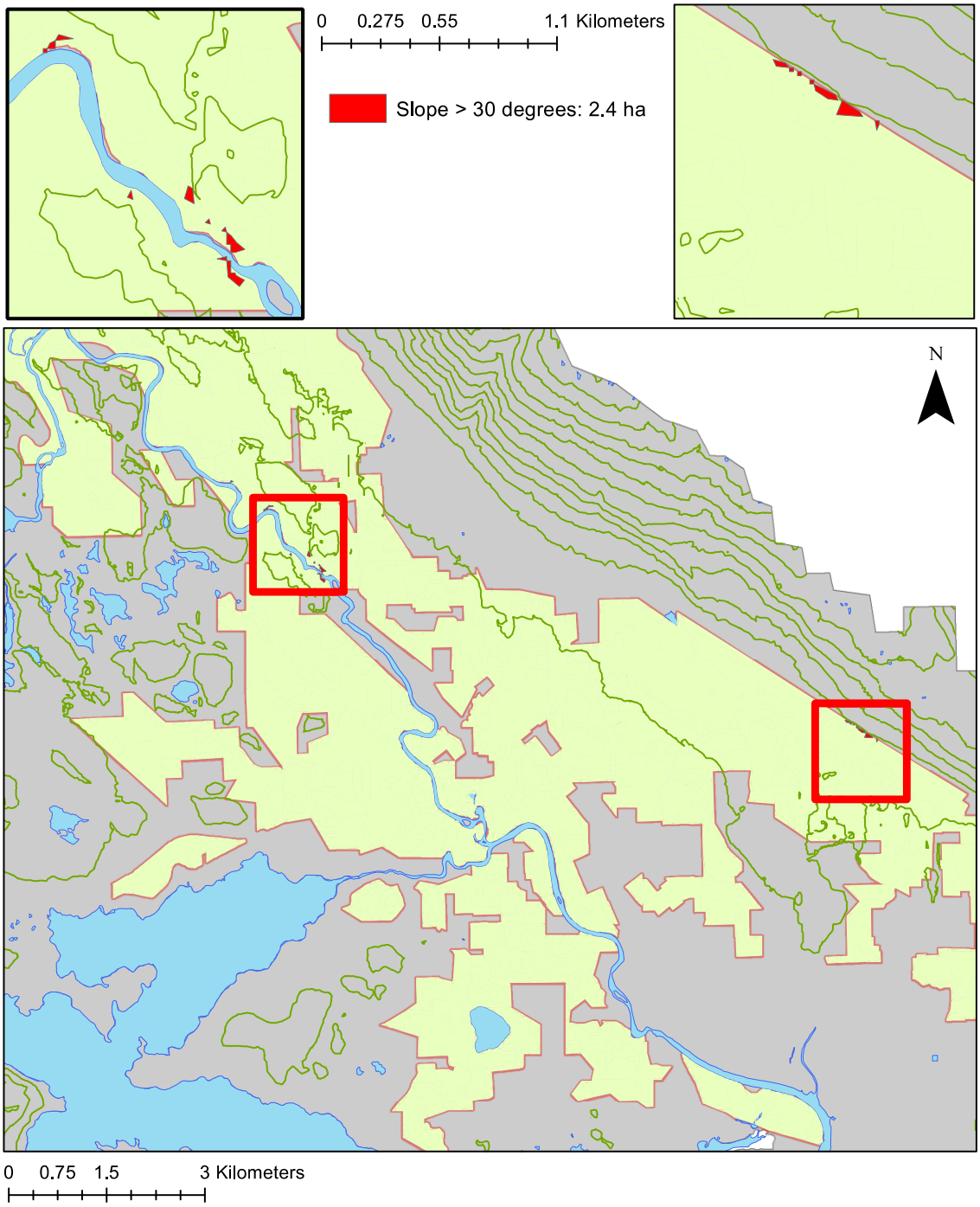
Environment Canada
The National Soil Database
Government of Canada
Data Collected 2015

Ministry of Environment, Lands and Parks
Geographic Data BC
Province of British Columbia
Data Collected 1995/6

Agricultural Land Commison
Province of British Columbia
Data Collected 2015

Map 4 - An Analysis of Slope - Slopes >30 degrees

Team Nicole Lacis Matt Wagstaff Derek Wiens Lucas Worsdell

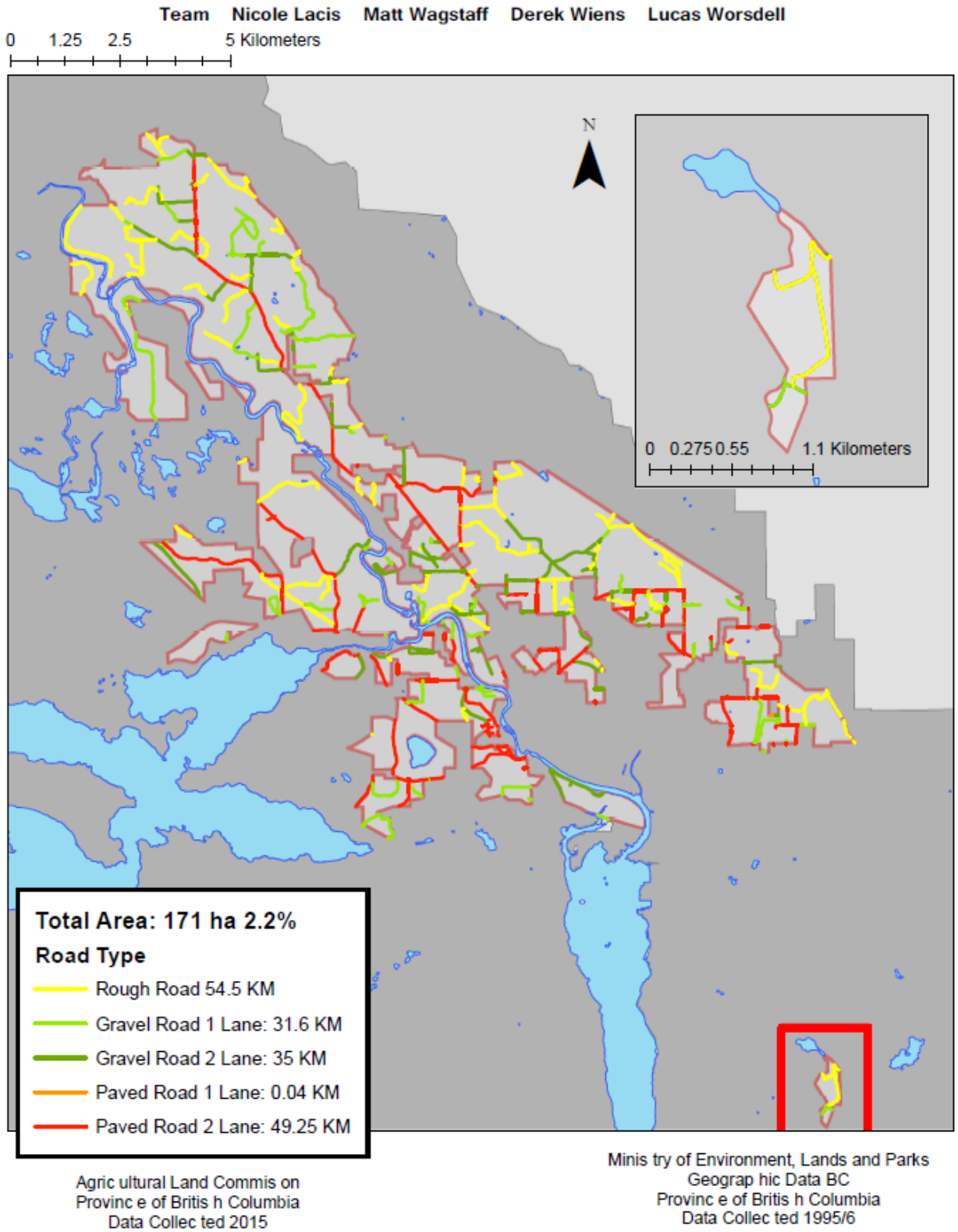


National Resources Canada
Canadian Digital Elevation Model/Slope
Government of Canada
Data Collected 1987

Agricultural Land Commison
Province of British Columbia
Data Collected 2015

Ministry of Environment, Lands and Parks
Geographic Data BC
Province of British Columbia
Data Collected 1995/6

Map 5 - Roads wintin the ALR Alberni-Clayoquot (Length in KM)



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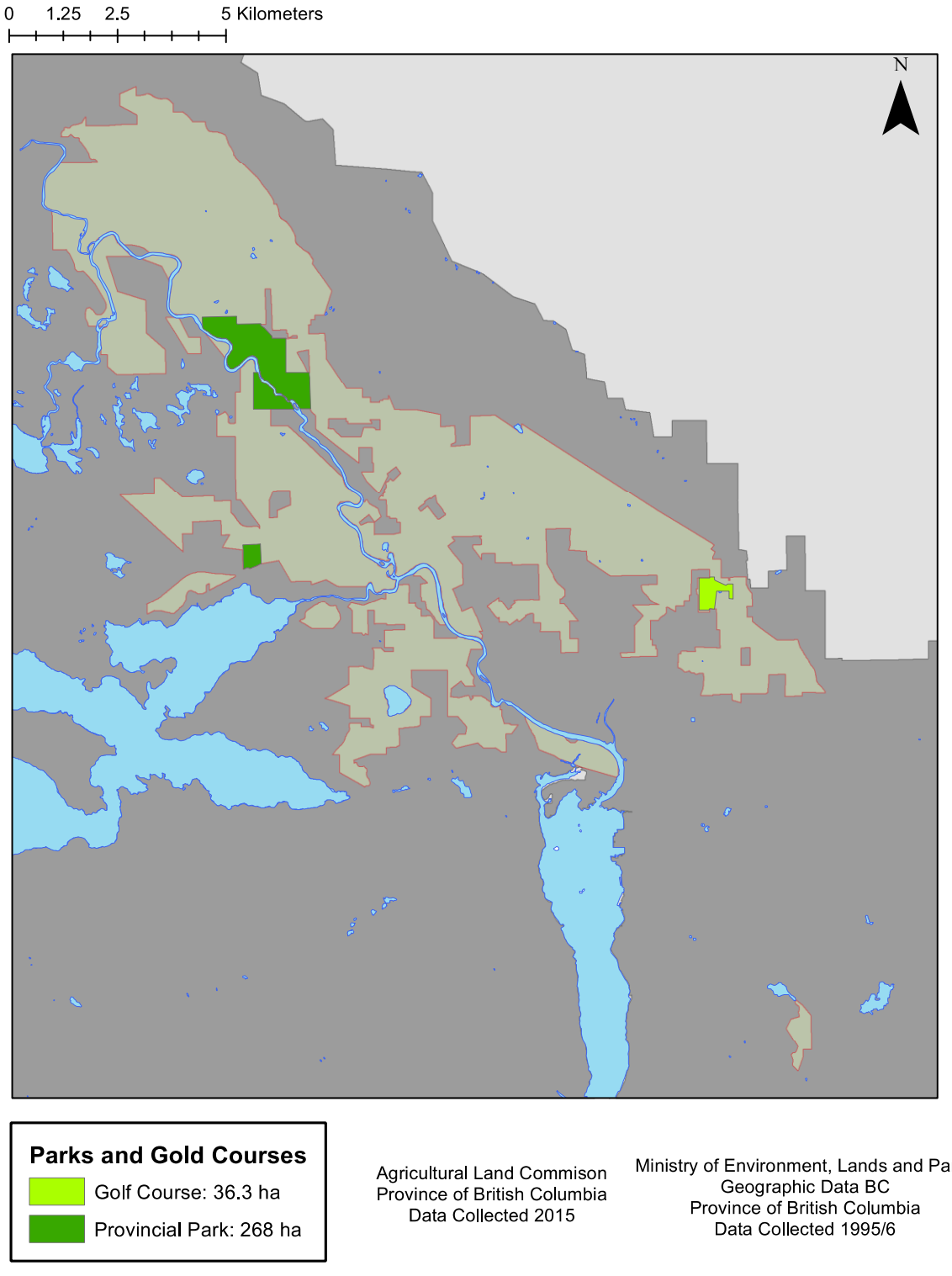
Data Collec ted 2015

Minis try of Environment, Lands and Parks
Geograp hic Data BC
Provinc e of Britis h Columbia
Data Collec ted 1995/6

Map 6 - Parks and Golf Course analysis of the ALR in Alberni-Clayoquot

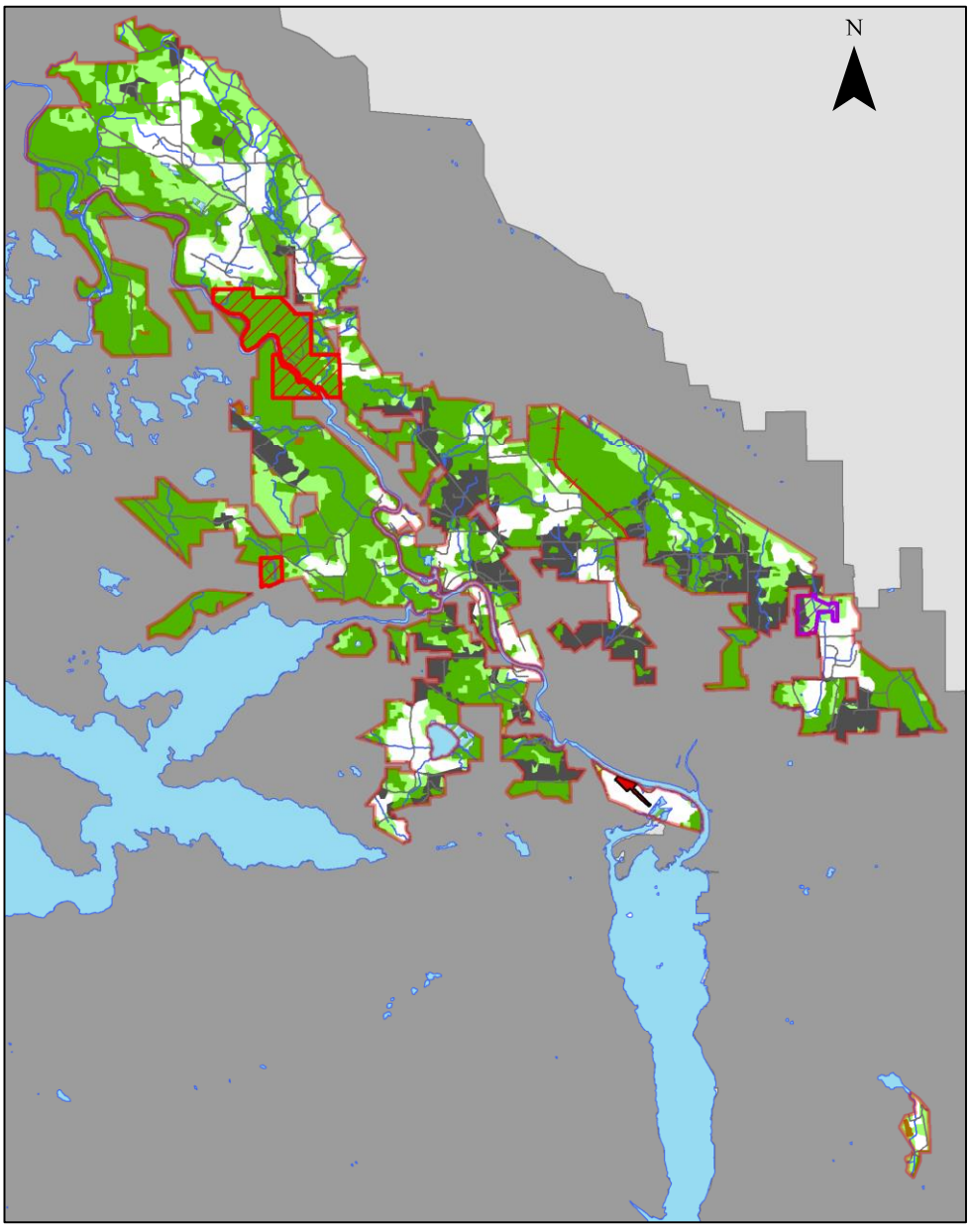
Team Nicole Lacis Matt Wagstaff Derek Wiens Lucas Worsdell



Map 7 - Analysis of Non-Farm Use of the ALR in Alberni-Clayoquot

Team Nicole Lacis Matt Wagstaff Derek Wiens Lucas Worsdell

0 1.5 3 6 Kilometers



- Railway: 3.2 ha
- Golf Course: 36.3 ha
- Provincial Park: 268 ha
- Roads: 171 ha
- Water: 149 ha
- Exposed Land 34 ha
- Developed 1020 ha
- Shrub: 4 ha
- Wetland: 56 ha
- Herb: 1480 ha
- Coniferous 3832 ha
- Broadleaf: 91 ha
- Air Field: 8.1 ha

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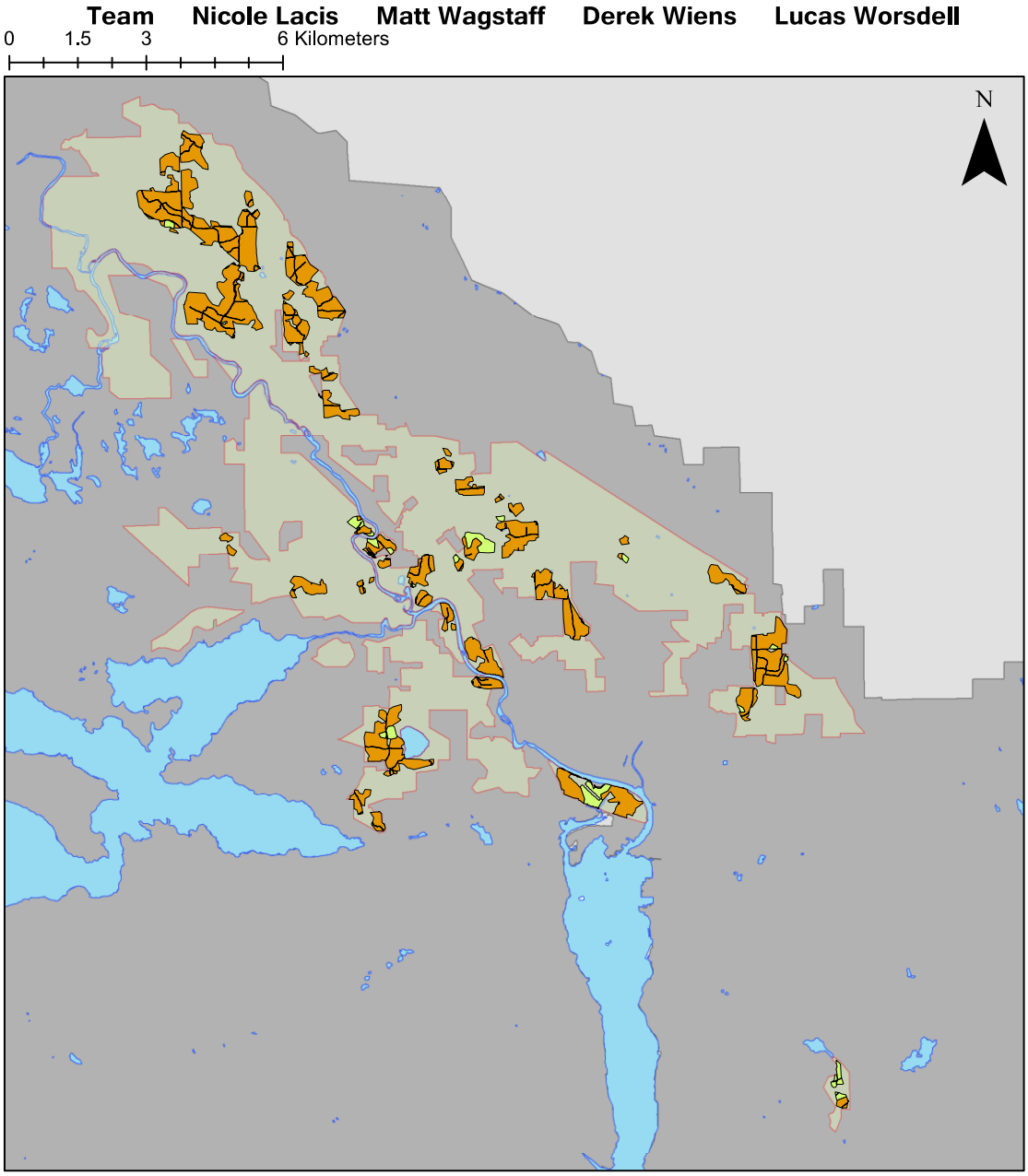
Agric ultural Land Commis on Provinc e of Britis h Columbia Data Collec ted 2015

Minis try of Environment, Lands and Parks Geograp hic Data BC Provinc e of Britis h Columbia Data Collec ted 1995/6

Map 8 - Analysis of Farm Use of the ALR in Alberni-Clayoquot

Team Nicole Lacis Matt Wagstaff Derek Wiens Lucas Worsdell



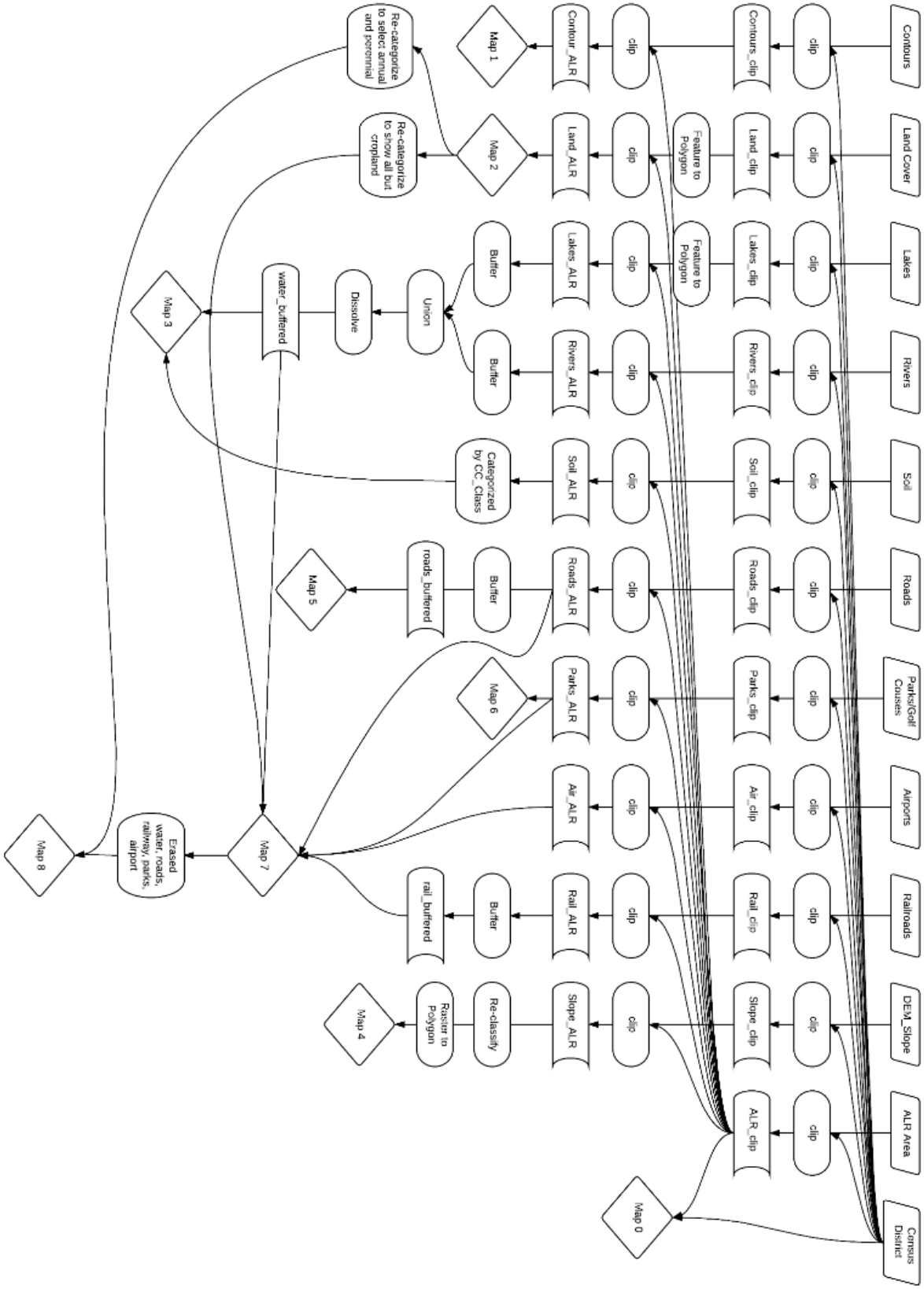
Farm Use: Total % = 15%

- Annual Crops: 76.4 ha 1%
- Perennial Crops: 1085 ha 14%

Ministry of Environment, Lands and Parks
Geographic Data BC
Province of British Columbia
Data Collected 1995/6

Agricultural Land Commison
Province of British Columbia
Da ta Collec ted 2015

APPENDIX-D: Flowchart of Analysis



APPENDIX-E: Review of Team Member Contributions

After consideration, we decided to change the original division of labour within our group. Matt and Lucas led the GIS analysis, while Nicole and Derek focused more on writing the final report and making the flow chart. We found this was an effective way to put everyone's individual strengths to good use. We communicated effectively when we encountered individual problems, and were helpful in all aspects of the project, even those that were not our assigned responsibility. Thus, we were all involved in every part of the project at some point or another. Matt and Lucas worked effectively, and were considerate in finishing the analysis as soon as they could so that Derek and Nicole could review it, make some contributions and get started on the final report. After Derek and Nicole finished their initial draft, Matt and Lucas helped wrap everything up.