CONSTRUCTING LOCAL FOOD SYSTEMS: LAND AND LIVELIHOODS IN THE BELLA COOLA VALLEY

by

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Abstract

In the 20th century, advocates of the dominant mode of agricultural production advanced the key question, 'how do we feed the world'. Critics of this Productionist paradigm assert that the resulting scarcity of farmers translates into a reduction of essential land-based knowledge and skills, and that centrally controlled solutions are inadequate to address the complex agro- and socio-ecological challenges of the 21st century. Interdisciplinary scholars are now looking beyond a narrow focus on production, and using a broader systems perspective to study the regeneration of food systems in local contexts.

This dissertation contributes a case study of the agricultural food systems in the Bella Coola Valley in British Columbia, framed by the question, 'how do we feed ourselves'. The research approach was a combined historical analysis and university-community partnership. The university-community partnership achieved the following main objectives during fieldwork in the Bella Coola Valley: we identified the biophysical resources for sustainable agriculture, surveyed current local food production, and explored the potential for increasing participation in agricultural production.

Three key lessons emerged from this dissertation for initiatives aiming to regenerate agricultural food systems. First, because agricultural food systems form over time in specific places, it is crucially important to understand the formative historical processes. These include the evolution of indigenous food systems, dispossession and resettlement of land through settler colonialism, adaptation of livelihoods due to outside economic forces, and development of transportation networks. Second, redefining and reframing agriculture are important in

colonial and small-scale contexts in order to see the diversity of agricultural activities. For the Bella Coola Valley, these activities include mixed homegardens, potlatch potato gardens, mixed small orchards, vine and berry patches, greenhouse and hothouse production, and livestock tending. Third, regenerating agricultural food systems is a continual and dynamic process, requiring an ongoing engagement between local leaders and outsiders, and between local, indigenous, and scientific forms of knowledge.

Preface

UBC Behavioural Research Ethics Board Number: H06-80427

PRINCIPAL INVESTIGATOR: Arthur A Bomke

DEPARTMENT: Land and Food Systems/Agroecology

- Identification and design of the research project based in the Bella Coola Valley was collaborative. Research supervisor and principal investigator, Art Bomke, guided the research project and made the initial connection with community members. Alejandro Rojas guided the initial thesis proposal process. Coll Thrush helped to distinguish between the issues identified by the project work, and the contextualization and analysis required of the dissertation.
- Key contacts and community partners also played a significant role in identifying issues and priorities under investigation.
- Terry Lewis and Hans Granander generated mapping products for the Bella Coola Valley Foodshed Project. Specifically, Terry Lewis conducted the soil inventory and Hans Granander carried out the GPS mapping on the TRIM 1:20,000 base map. Gary Runka and Joan Sawicki contributed to and edited the crop suitability report and agricultural land use map.
- I conducted all the relevant literature reviews and archival research for the dissertation, consulted with university and community partners during the proposal writing stages of the project, assisted with the soil survey objectives and crop

suitability reporting, facilitated the workshops and garden tours, and performed the fieldwork research for the soil fertility study and food production inventory. Additionally, I reviewed and revised portions of the fieldwork data in consultation with community partners, and Terry Lewis for the purposes of reporting to funders, and for analyzing the data for the dissertation.

- I will prepare any manuscript that may arise from this research.

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Glossary

A**griculture –** The Oxford English Dictionary (2012) shows the etymology from classical Latin as *agricultūra* from field (*ager*, or acre) and *cultūra* as the cultivation of the land and its derived senses, and usage of this term documented from the mid-14th century, primarily as the "theory or practice of cultivating the soil to produce crops". Salient to the soil capability classification for agriculture undertaken as part of the Foodshed Project initiatives in this dissertation, a "largely mechanized system of agriculture" with cultivation of the soil assumed was central to the definition of agriculture for the Canada Land Inventory in 1972 (p. 5). This meaning of the term continues to have a contemporary influence in policy, research, and practice, although a more flexible, systems-based definition as suggested by C.R.W. Spedding is a better fit for the rethinking of the set of food producing activities demonstrated in the case study of this dissertation (1988: p.39): "… a set of *activities* carried out by *humans* with the purpose of producing *products*, and under some degree of *control"*.

Agroecology— Following Gliessman (2007: p.18) this is a "new approach to agriculture", and for the purposes of this dissertation, this approach provides the foundation for understanding and applying the "resource-conserving aspects of traditional, local, and small-scale agriculture while at the same time drawing on modern ecological knowledge and methods". In addition, the proposed definition of agroecology as "the integrative study of the ecology of the entire food system, encompassing ecological, economic, and social dimensions" as suggested by Francis (et al., 2003: p.100) provided one of the key conceptual frames for the research in this dissertation.

Alluvium — The working definition applied in this thesis follows Brady and Weil (2002: p.912): "A general term for all the detrital material deposited or in transit by streams, including gravel, sand, silt, clay, and all variations and mixtures of these".

Arable — *or arable land* denotes land that is suitable for ploughing and *arable crops* are those which are cultivated on ploughed land, usually annual crops, including cereals, root crops, and other vegetables and small fruits (Stephens, 1990).

Brunisolic soil order — In the Canadian system of soil classification, soils from this order have undergone only moderate development from the original parent material, yet these soils have sufficient development to "exclude them from the Regosolic order, but they lack the degree or kind of horizon development specified for soils of other orders" (Soil Classification Working Group, 1998: p.53). These soils are typically formed under forest and have brownish coloured Bm horizons, and have either a Bm, Btj, or Bfj horizons at least 5 cm thick, or a Bf horizon less than 10 cm in thickness (Soil Classification Working Group, 1998; B.C. Ministry of Environment, Lands, & Parks, 1998).

Colluvium — The working definition applied in this thesis follows Brady and Weil (2002: p.916): "A deposit of rock fragments and soil material accumulated at the base of steep slopes as a result of gravitational action".

Collaboration — An approach to the research defined for the purposes of this dissertation following Margerum (2007: p.135) as way to address "natural resource and public policy problems in which stakeholders build consensus and work jointly on solving complex problems".

Colonialism — Given the interdisciplinary scope of this dissertation, I drew upon on a fraction of the established literature on colonialism and colonial discourse analysis. Cole Harris (1996: xiii-xvii) introduced the elements of colonialism most influential to the arguments presented in this dissertation with the following set of brief characterizations of colonialism:

- "…turned on the common assumptions about the superiority of European civilization to the ways of the non-European world"
- "…depended on force to achieve its essential purpose: the transfer of land from one people to another"

- "…is an ongoing set of relationships based on the fact that newcomers established themselves here, and refashioned a strange place, making it their own"
- Although colonialism had the power to create a "…new society with its own values and momentum", the territory colonialism in British Columbia dispossessed was always contested, and the peoples never completely overridden.

Composite sampling — was the soil fertility sampling method followed in the 2006 soil fertility study of the Bella Coola Valley detailed in Chapter Six. This sampling method provides results that are derived as an average of soil cores taken either with a soil probe or shovel, with cores of soil removed from 12-20 scattered places within the land area to be represented. These core samples are not to be taken from unusual spots, such as low-lying areas within a field, and once gathered in a clean, plastic bucket, these cores should be mixed together, then air dried without sun or heat, then packaged and sent to the soil lab (Brady and Weil, 2002: p. 721).

Fan – From the *Field Manual for Describing Terrestrial Ecosystem* for British Columbia, a landform or surface expression of the soil landscape that denotes a "segment of a cone, up to 15^{o}" (B.C. Ministry of Environment, Lands & Parks, 1998: p. 12).

Ferro-humic podzol — According to the Canadian system of soils classification, soils in this subgroup of the Podzolic order are defined as follows: "The soils have a dark coloured podzolic B horizon with a high content of organic C and an appreciable amount of extractable Fe and Al. They occur typically in the more humid part of the region of Podzolic soils under forest vegetation, or forest with heath or moss undercover" (Soils Classification Working Group, 1998: p.112).

Gleysolic soil order — According to the Canadian system of soil classification, soils of this order are defined on the basis of colour and mottling (Soils Classification Working Group, 1998: p.81), and soils within this order are saturated with water for long periods of the year, evidenced by the appearance within their profiles of reducing conditions, and indicated by direct measurements of the water table and the oxidation-reduction status (B.C. Ministry of Environment, Lands, & Parks, 1998).

Informal economy — As described by Ommer and Turner (2004:p.128), indications of an informal economy are **"**sets of economic activities that operate outside the formal legalized structures". These activities, which may include "production, distribution and consumption of goods and services that have economic value" (Menzies, Mattson & Butler, 200: p.5) often make use of a range of ecological niches for sustenance, and depend on varied types of place-based, community or family reciprocities for exchange (Ommer & Turner, 2004).

Lime (agricultural), or liming materials — Material applied to neutralize soil acidity of a given soil or field, as defined by Brady and Weil (2002: p.923) "containing the carbonates, oxides, and/or hydroxides of calcium and/or magnesium".

Mapping scale — The unit of measurement on a map in relation to the measurement on the ground. For example with a 1:20,000 mapping scale 1 unit of measurement on the map equals 20,000 of the same unit of measurement on the ground, so a mapped unit area of 1.0 cm^2 would be 4.0 hectares on the ground (B.C. Resources Inventory Committee, 1995: p.10).

Minimum size map delineation — The smallest area that can be easily discerned by a map user, or the smallest delineation inside which a single map unit symbol can be printed (B.C. Resources Inventory Committee, 1995: pp.9-10).

Newcomer-settler — In this dissertation, this term is used to indicate people who were not indigenous to the Bella Coola Valley or Nuxalk Territory.

Nuxalk — Since the 1980s, the term Nuxalk has replaced the 'Bella Coola' as the all-encompassing name for the indigenous people occupying the territory claimed by the Nuxalk Nation.

Nuxalkmc — Indigenous inhabitants of the villages of the Bella Coola Valley in Nuxalk Territory (Kennedy & Bouchard, 199: p.328)

Organic soil order — According to the Canadian system of soil classification, soils of this order include most of the soils known commonly as peat, muck, or bog and fen. These soils are typically saturated with water for prolonged periods, and contain more than 17% organic C by weight (Soil Classification Working Group, 1998: p. 97).

Parent material — Brady and Weil (2002: p.927) define this as the "unconsolidated and more or less chemically weathered mineral and organic matter" from which the upper part of the soil profile is developed.

Participatory research — For the purposes of this dissertation, the three distinguishing attributes of this research approach given by Kemmis and McTaggert (2000: p 568) provide a basic understanding of the mode of inquiry pursued in the pages that follow: shared ownership or research projects, community-based analysis of research problems and priorities, and an orientation towards action.

Pedon, pedology — Brady and Weil (2002: p.927) defined a pedon as the smallest three-dimensional volume that can be called a soil, and explained this as a volume that extends downward to the depths of the plant roots or to the lower limit of the genetic soil horizons; and *pedology* is that "science that deals with the formation, morphology, and classification of soil bodies as landscape components".

Podzolic soil order — Soils of the Podzolic order have parent materials which are mostly coarse textured and well-drained, and B-horizons in which the dominant accumulation product is amorphous material composed mainly of humified organic matter combined in varying degrees with Al and Fe (B.C. Ministry of Environment, Lands & Parks, 1998: p. 107).

Positivist approach — An approach to research that typically employs the "language of objectivity, distance, and control" and assumes that observable data are the basis of knowledge (Greenwood & Levin, 2000: pp. 92-94).

Regosolic soil order — According to the Canadian system of soil classification, soil of this order, "do not contain a recognizable B horizon at least 5 cm thick and are therefore referred to as weakly developed" (Soil Classification Working Group, 1998: p. 117). Factors in the lack of pedogenic development may include that these soils may have developed on very young geological materials, such as river alluvium or coastal beaches, that these materials are instable, such as constantly eroding slopes or shifting sand dunes, that the nature of the parent material was not conducive to horizon development or weathering, such as nearly pure quartz sand, or that the soils developed in dry, cold climate conditions.

Settler colonialism – According to Cole Harris (2004: p, 169) access to land was the central assumption of settler colonialism, and this access was achieved by dispossessing native people with techniques that included physical violence, the power of the imperial state, and the momentum of colonial culture. The strength of ideas such as the binary of savagery and civilization, or the superiority of Europeans over natives, engendered assumptions as well as an" implicit consensus that underlay policies toward Native lands" (Harris, 2002: p47).

Soil — The definition presented by Brady and Weil (2002: p.931) provides a two-part understanding of soil as follows:

(1) A dynamic natural body composed of mineral and organic solids, gases, liquids, and living organisms which can serve as a medium for plant growth. (2) The collection of natural bodies occupying parts of the Earth's surface capable of supporting plant growth that has properties resulting from the integrated effects of climate and living organisms acting upon parent material, as conditioned by topography, over periods of time.

Soil order — The Canadian soil classification system recognizes nine soil orders, grouped to reflect the nature of the soil forming processes for the pedons classified within that group (Valentine, Sprout, Baker, & Lavkulich, 1978: p. 60). Brady and Weil (2002: p.86) provide a list of twelve soil orders given in the soil taxonomy of the global soil classification system, with placement into a given order based similarly on properties reflected by soil development and on the presence or absence of major diagnostic soil horizons.

Soil pH — The relative degree of acidity or alkalinity of a soil expressed in terms of the pH scale, which Brady and Weil (2002: p.928) define as "the negative logarithm of the hydrogen ion activity of a soil", often determined by a glass or electrode indicator at a specified moisture content or soil-to-water ratio. For the 2006 soil fertility study detailed in this dissertation, the specific ratio was a 1:1 soil to distilled water.

Soil survey — or soil inventory are used interchangeably and refer to systematic "examination, description, classification, mapping and specified use interpretations of the various soils in an area (B.C. Resources Inventory Committee, 1995: p.2). These activities and the knowledge produced provides scientific information regarding the potential and limitations of each soil for a specified land use, and are usually carried out for four basic purposes: land use planning, site specific land evaluation, land appraisal, or environmental protection (B.C. Resources Inventory Committee, 1995: pp.5-6).

Soil texture, and textural class — Brady and Weil (2002: p.932) define texture as the relative proportions of various soil separates (sand, silt, clay) in a given soil, and the textural class as a grouping of soil textural units based on the relative proportions. Listed from coarsest to finest in texture, these groupings are sand, loamy sand, sandy loam, loam, silt loam, silt, silty clay, and clay, though several subclasses of these textural classes can be derived based on the dominant particle size of the sand fraction.

Surficial (genetic) soil material — According to Ryder (1978: p. 11) these materials formed from geological parent materials and are "unconsolidated sediments that have been deposited in geologically recent time".

Terrace – From the *Field Manual for Describing Terrestrial Ecosystem* for British Columbia, this is a surface expression in the soil landscape that depicts a "step-like topography" (B.C. Ministry of Environment, Lands & Parks, 1998: p. 12).

Territory — Foucault (1972: p.68) expressed the basic meaning of this term as "the area controlled by a certain kind of power".

Thin veneer — From the *Field Manual for Describing Terrestrial Ecosystem* for British Columbia, this surface expression appears as a "dominance of very thin surficial materials about 2-20 cm thick" (B.C. Ministry of Environment, Lands & Parks, 1998: p. 12).

Veneer — From the *Field Manual for Describing Terrestrial Ecosystem* for British Columbia, this surface expression appears as a "mantle of unconsolidated material 0.1 to 1.0 metres thick" (B.C. Ministry of Environment, Lands & Parks, 1998: p. 12).

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I share that common experience among many PhD students of weathering several humbling stretches in the process of working through this dissertation, and it was only with the support offered by so many that completion was possible. I have tremendous gratitude to offer in return. Generous hosts and friends in the Bella Coola Valley are the first I would like to thank- especially Gary, Joan, and Terry, and those who shared their homes and so much of their time, Carol, Kristeva, and Dayna.

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Chapter 1: Introduction

1.1 Global significance

Fewer farmers and centrally controlled, industrial scale farming operations means the knowledge and skills required to grow food in challenging contexts is disappearing. The loss of this essential knowledge, coupled with the accelerating demands for productive soil, water, and food are key issues in the population-resources debate. Agricultural scientists and a broad range of interdisciplinary scholars who accept global change and limits as a basic premise, frame the key question in the population-resources debate, or food security dialogue, this way:

> Given planetary limits and changes, how do we sustainably intensify agricultural production on the land base suitable for cultivation, and meet the growing absolute demand for food, as well as accommodate shifting diets?[1]

North American farmers have been disappearing since the 1930s. The trend is similar in many of the founding countries of the Organisation for Economic Cooperation and Development (OECD): there are fewer farmers and larger farm operations.[2] On the positive side of this trend, or what agricultural economists refer to as restructuring, technological innovations and increased scales of operations have contributed to a fairly steady growth in crop yields and livestock output. Agricultural statistics from the United States (US)

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[1] This question is a paraphrase of the central issues debated in a range of high-impact interdisciplinary journals with panel scholarship on global change and sustainable intensification (e.g. Godfray et al., 2010; Pretty et al., 2010; Foley et al., 2011).

[2] See Bollman (2007) for an analysis of the changes to the agricultural sector and the rural landscape. See also the OECD website for indicators and statistics in the agricultural sector of OECD countries, available here: http://www.oecd.org/statistics/

Department of Agriculture show an increase of 142 percent in the production of 17 major crop commodities from the years 1938-1980 (Borlaug, 1986). Since the 1960s, aggregate world production of agricultural commodities has grown by 145 percent (Pretty, 2008).

For agricultural scientists, agricultural producers, and policy-makers, the key question that rationalized their emphasis on production was 'How do we feed the world?' Exemplified through decades of post World War II policy interventions, the introduction of Public Law 480 in 1954, also known as the "Food for Peace" agricultural act, stands out as one of the major US policy instruments that provided subsidies to farmers for export surpluses (Federico, 2005). Agricultural policies provided a few trade-offs to consumers and producers as part of the restructured modes of agricultural production and associated reductions in the number of active farmers. According to economic historian Giovanni Federico (2005), in the US these trade-offs were lower food prices to the consumer and some income support for the remaining agricultural producers. Of the OECD countries active in state interventions to agriculture through regulation, the US and other "low cost" countries, set a minimum price for food commodities and dumped any excess onto world markets (Federico, 2005).[3] Agricultural policies and agricultural practices underwritten by state-supported programs in the US, Canada, and other industrialized countries, have since come under fire from consumers and a host of organized alternative agriculture and food movements (e.g. Friedmann & McNair, 2008; Holt-Giménez, 2009; Wezel et al., 2009).

[3] Other policy analysts have referred to the "low cost" countries as the "Washington Consensus" (e.g. Chang, 2009).

In addition to debates and counter-movements centering on policy effects and the vanishing farmer, contested and critiqued impacts from the paradigmatic focus on increased agricultural production include: ecological fallout from intensive farming practices (e.g. Carson, 1962; Vandermeer, 1995; Gliessman, 2007), changes to the rural landscape and disconnection from the land (e.g. Buttel, 1980; Jackson, 1980,1994; Kloppenburg, et al., 1996), human health concerns (e.g. Buttel, 2003: Alavanja, Hoppin, & Kamel, 2004; Lang & Heasman, 2004), and social justice issues linked with land tenure and food sovereignty (e.g. Desmarais, 2007; Anderson, 2008; Patel, 2009; Wittman, 2009). Critics of the Productionist paradigm assert that a scarcity of farmers translates to a reduction in crucial land-based knowledge and skills, and that centrally controlled solutions are simply inadequate to address the complex, agro- and socio-ecological challenges of the 21st century (e.g. Pretty et al., 2010; Horlings & Marsden, 2011). Importantly, the distribution of benefits from increased agricultural productivity has largely accrued in those parts of the world with good soils, reliable water, and good access to roads, markets, and input supplies (Pretty, 1995).

In the 1990s, Jules Pretty (1995) presented a series of case studies from places where the benefits from the top-down 'feed the world' approach were missed. These were places still untouched by the high-yielding cereals grown with packaged technologies of fertilizers, pesticides, and irrigation of the Green Revolution. Instead, they were places with complex and diverse agricultural systems, remote from services and roads, and out of reach from the outside capital that would be needed for the Green Revolution inputs. This group of farmers around the globe is numerically significant, typically producing food on land holdings of less than two hectares (Pretty, 2003). Pretty (1995) characterized his vision for agriculture in these places as “regenerative agriculture”.

At the same time, Kenneth Dahlberg (as cited in DeLind, 2010) urged researchers to look beyond a narrow focus on production, and encompass a broader systems perspective, inclusive of ecology, history, and political power through contextual analyses of “regenerative food systems”. Characteristic of these food systems studies, other places and people in North America concerned about losing farm stewards, connections to the land, and vitality in their food choices, responded with a range of projects that featured more democratic forms of participation in both agricultural production and consumption. Gail Feenstra (2002) characterized the projects supported by the Sustainable Agriculture Research and Education Program as sustainable community food systems initiatives. Others have adopted the general term of relocalization efforts (e.g. Hendrickson & Heffernan, 2002; Ilbery et al., 2006) or followed the evocative metaphor and call to action of the foodshed (e.g. Kloppenburg et al 1996; Peters et al 2008). These initiatives have attempted to respond to changes in the global food system with a reframed series of questions that shifted ‘how do we feed the world’ to ‘where does our food come from’ and ‘how do we feed ourselves’.

1.2 Personal context

I am a farmer. I have been called the ‘beet lady’, ‘salad girl’, and ‘carrot queen’ in bustling, hurried exchanges across the stacks of produce at my farmers’ market stand. For twelve years, I made my living growing and selling vegetables, fruits, and flowers directly to consumers at farmers’ markets and through community supported agriculture programs on two farms in California and Missouri. I learned from experienced growers, from trial and error, and from limited coursework how to nurture the soil with attention to tillage practices, crop rotations, cover crops, and on-farm composts. I learned from the relentless demands of this work the importance of making connections with people who showed an interest in what was happening on the farm.

One of the ways I attempted to create opportunities for people to learn about and connect with farmland was to create an apprentice program. This experience quickly showed me the limits of my own knowledge about farming systems, and I enrolled in graduate school with the hope of learning to be a better farming mentor. The opportunity to contribute to a university-community partnership project focusing on agriculture in the Bella Coola Valley sent me flying off to the central coast of British Columbia with a tangle of imported expectations about what I would find and how I might lend a hand.

1.3 Research context, questions, and objectives

Like the places described by Pretty (1995), the Bella Coola Valley is another place where the dominant, industrial mode of agricultural production never took hold. The landscape encountered in the valley, with its open stretches of hayfields and lesser-used permanent pastures, craggy, moss-covered orchards, and scatter of chicken coops and home gardens, provides a visual testimony of agriculture both past and present. The distance by road from services and the urban centre of Vancouver is magnified by the formidable topography of the Coast Mountains. By water or air, transportation options are costly and limited by weather and seasonal service. This coastal valley in North America is home to an indigenous population and a population of newcomer settlers, each disproportionately affected by a restructured economy and diet-related chronic diseases (Michalos et al., 2005; Patenaude et al., 2005; Thommasen, et al.,2004; Thommasen & Zhang, 2006).

In the context of the Bella Coola Valley, and in many similar places outside the bounds for agricultural land uses focused on export and commodity production, the more pressing uncertainty is ‘how do we feed ourselves’. The unique local expressions of agriculture in the valley are one part of a complex indigenous and settler food system, diverse in its sources of coastal, mountain, and valley habitat and supply. Each of these ecological systems have supported livelihoods in this territory for millennia, yet salmon runs are dwindling, the eulachon have nearly disappeared, and other sources of traditional foods have been depleted (Turner, Harvey, Burgess & Kuhnlein, 2009).

Despite the presence of an agricultural landscape, long-term dependency on the global food system to deliver plentiful, low cost food to people living in the valley has depleted the much of the knowledge and skills required to grow that food in valley soils, and other lifestyle changes have “decreased time available for hunting, fishing, and berry picking” (Howard, 2006; Turner et al., 2006: p.25). Floods and landslides are a recurring challenge to the single road connection that delivers food and supplies from Vancouver, Calgary, and the rest of the world (Septer, 2006). Though there have been some historical efforts to initiate technical assistance with agriculture, agricultural research and support for place appropriate practices of food production are almost non-existent in the Bella Coola Valley.

The diversity of expression and tradition in the Bella Coola Valley food system make this a particularly challenging place to regenerate agriculture. Contested territorial land claims and colonialism have shaped the lived experiences of Nuxalk as well as the newcomers,[4] yet adaptations of agricultural practices are a shared part of the past and present in the Bella Coola Valley. The two main objectives of the university-community partnership project that served as a case study for this dissertation were to identify the biophysical resources for sustainable agricultural development and explore the potential for increasing participation in agricultural production in the Bella Coola Valley. In essence, the research sought to answer the question: How do you regenerate agriculture in the Bella Coola Valley?

Following the contextual analyses proposed by Dahlberg (as cited in DeLind, 2010), the challenge of regenerating agriculture in the Bella Coola Valley required an exploration of the histories of agriculture as well as an interrogation of context-specific ways of describing agricultural potential. Understanding and encouraging participation with the regeneration of an agricultural food system required looking at what kinds of agriculture characterized this particular place in the past. Similarly, this kind of analysis and call to action required a careful look at what agriculture means, and what information is necessary to regenerate meaningful agriculture and food systems. Finally, this kind of analysis required consideration

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[4] Since the 1980s, the term Nuxalk has replaced the 'Bella Coola' as the all-encompassing name for the indigenous people occupying the territory claimed by the Nuxalk Nation. Indigenous peoples from surrounding valleys and watersheds within this territory, the *Talyumx,* of *Sucłmx,* and of the *K'ʷałnamx* as well as the *Nuxalkmc* of the Bella Coola Valley are members of the Nuxalk First Nation. See Chapter Two section 2.3 for a more detailed description of the territory and place names. In this dissertation, I will be using the terms, newcomers and newcomer-settlers to depict the non-indigenous people who arrived to resettle the Bella Coola Valley as part of the planned colonization of 1894, or as part of later waves of immigration and resettlement into the 20th and 21st century.

of the process of sharing information and encouraging participation. Thus, my key research questions are:

- What are the histories of agriculture in the Bella Coola Valley
- What does agriculture mean in the Bella Coola Valley?
- What information is important to an exploration of agricultural potential?
- How do you share information about agriculture and food systems as part of increasing participation in regenerating agriculture?

Several characteristics of the Bella Coola Valley make this research significant. Though this place has a relatively small population and represents a land area of roughly 70 square kilometers, the Bella Coola Valley is an edge of cultural and ecological diversity, where contests over territory and values on land and water make headlines. This is the shared home of the Nuxalk Nation, of a Coastal temperate rainforest known internationally as the "Great Bear Rainforest", and this is the home of strong, adaptive individuals who organized farmer relief efforts from the 2010 flood, some who support and others who lament the availability on the local market of "bear and predator friendly produce". In these ways and more, the Bella Coola Valley is a vibrant microcosm of the dialogue that asks 'what is the way of life we want to sustain' (Allen, Tainter, & Hoekstra, 2003: p.26).

Not all of these characteristics need to apply for the contributions of this research to have significance beyond the Bella Coola Valley. For example, as recently outlined by Pingali (2012) in his retrospective overview of places excluded by the successes of the Green Revolution, these four characteristics speak to the Bella Coola Valley context and beyond:

- Inequitable land distribution, and/or insecure ownership
- Poorly developed input, credit and/or output markets

- Policies, research, and extension (knowledge sharing) that discriminate against smallholders
- Slow growth (or decline) in non-farm economy.

The findings of this research apply to other places in North America, and around the globe where smallholder agriculture and diverse food systems are part of the response to sustaining livelihoods connected to the land. Similarly, the findings of this research demonstrate the ways agriculture and food systems can adapt in places that are isolated from reach of the dominant centres of production and distribution. These findings suggest that isolated places have the potential to become central in regenerating food systems with an emphasis on the regional.

Many parts of the world share legacies and a continuing context of settler colonialism. As Pauline Peters (2004: p.269) observed in the case of Africa, where the common image of a place is a "land rich and sparsely populated", looming conflicts over land and deepening social rifts beg for closer attention. In all of these colonial contexts, an exploration of the meanings and histories of agriculture need to be a careful part of efforts to regenerate agriculture and agricultural food systems. Ultimately, this dissertation focuses on 1) places with histories of small-scale modes of agricultural production and 2) on the production of knowledge for people interested in how to regenerate agriculture on smallholdings. I analyse the tools and information that are appropriate for this audience and the considerations for regenerating agriculture in the context of Nuxalk Territory.

1.4 Dissertation structure

For the remainder of this chapter, I examine in greater detail the interdisciplinary literatures that form the conceptual framework of this dissertation. These literatures manifest different approaches to understanding the global food and agriculture crises in local contexts, and provide a foundation for investigating the combined indigenous and settler food system of Nuxalk Territory and the Bella Coola Valley.

Following this chapter, the dissertation is organized in two parts. In Part I (Chapters Two and Three) I address the questions: what are the histories and meanings of agriculture in the Bella Coola Valley? In Chapter Two I utilized archival evidence and secondary sources to investigate these histories, including Department of Indian Affairs records, hearings and reports from the McKenna-McBride Commission and the Royal Commission on Agriculture, settler diaries and correspondence between Hudson Bay Post traders, voters' records, and published accounts in the fields of ethnobotany, historical geography, and anthropology. This chapter explores the contested narratives of agriculture and intertwined systems of land use and food systems in the Bella Coola Valley. Chapter two focuses on answering 'how did we feed ourselves', and argues that an understanding of agricultural histories as food system histories is vital for contemporary initiatives to regenerate agriculture in colonial contexts. Chapter three examines agricultural history through the lens of transportation, specifically, from the multiple perspectives that emerge with the outward gaze of an export and trade orientation compared with that of inward, more self-sufficient intentions. In this chapter, I argue that agriculture, as defined by the characteristics that came to prescribe agriculture in post-world war II North America, never took hold in the Bella Coola Valley.

Part II (Chapters Four-Six) focuses on the university-community partnership and fieldwork portion of my research. It takes up the questions of how to regenerate agriculture in the Bella Coola Valley and how to explore agricultural potential in a colonial context. Chapter Four outlines the approach to and methods of research on the ground with the Bella Coola Valley Sustainable Agriculture Society (BCVSAS)-University of British Columbia (UBC) partnership project. This chapter also initiates a set of reflections on the project methodology, and introduces the contest of *for whom* in the process of negotiating representation among research partners. Chapter Five addresses the objective of biophysical identification of agricultural resources for the Bella Coola Valley context. This chapter presents the findings and a discussion of the 1:20,000-scale soil survey and interpretive soil capability for agriculture and crop suitability maps. Using a set of reflections linked to the specific methodologies and epistemologies of soil inventory and classification, at the close of this chapter, I argue that the information generated in this technical survey presented specific challenges to knowledge sharing in the Bella Coola Valley. Chapter six explores the questions of how to regenerate agriculture and how to produce knowledge about food systems that can be applied to this process. This chapter provides details of the relationships between the people of the Bella Coola Valley and their knowledge of soils and agroecosystems in practice on the land. Connected with this exploration, chapter six presents and summarizes the findings from the soil fertility study, the agricultural land use mapping, and food production inventory.

The final chapter brings together the discussions and reflections of the previous chapters and offers a final summary and conclusion to the dissertation. It discusses the limitations of the research presented and offers considerations for future research assessing agricultural potential within colonial contexts.

1.5 Feed the world

For 20th century North American agriculture, the dominant paradigm was characterized as part of the industrial ideal (e.g. Winson, 1993; Fitzgerald, 2002), as the triumph (or failure) of high modernism (Scott, 1998), and as the embodiment of productionism (e.g. Thompson, 1997; Lang & Heasman, 2004). Increasing agricultural output with human ingenuity pitted against the challenges of nature has been the rallying call for agricultural scientists and agricultural producers since the Progressive Era of the late 19th and early 20th century (e.g. Hays, 1959; Worster, 1985).[5] Harnessed to the mandate of increased production in this mode of agricultural production are the inputs of technology and capital.

Norman Borlaug was one of the most recognized spokespersons for agricultural research and technology in service of increased production, perhaps most famous as the developer of Green Revolution wheat. Borlaug (1986) summarized the history of U.S. agriculture with respect to the changes in farm mechanization in the early decades of the 20th century this

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[5] Food analysts (e.g. Pelto & Pelto, 1983) and food system historians (e.g. Richard Wilk, 2007) argue that the influences and effects of industrialized food and urbanization have been underway since the late 18th century. Delocalization of the diet is not a new phenomenon introduced by globalization, rather a long-term product of the legacy of colonialism.

way: Widespread adoption of farm machinery brought modest increases to agricultural productivity through: 1) increases in the area that could be cultivated, 2) improved seed bed preparation and 3) better weed control. According to Borlaug (1986), after World War II, rapid expansion of infrastructure for inputs such as fertilizer, weed killers, pesticides, and machinery brought spectacular yield production increases through all three decades of the 1950s, 1960s, and 1970s. With the statistical data of increased agricultural productivity in the U.S. as his baseline, Borlaug (1986) hypothesized that because the cultivated area only increased three percent during those measured decades of rapid productivity increases, that improved technologies were a substitute for land area.

Borlaug (1986; 2002) advocated for packaged technology that could be transferred to that part of the world where agricultural productivity in his view, was lagging behind that of industrialized nations. The Green Revolution technology and this kind of approach to agricultural development generated a great deal of response and a well-established critical literature (e.g. Conway & Barbier, 1990; Clark, 1995; Pretty, 1995).[6] Though these critical ideas about the relationships to the production of knowledge were largely focused in contexts outside of North America and Europe, the reflections from researchers focused on social and environmental impacts of the Green Revolution are reminders of the colonial context, of similar power imbalances, and of biophysical constraints that do characterize places in North America and Commonwealth Countries. In other words, so-called marginal production environments, and uneven or imbalanced social benefits continue to exist where the

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[6] The so-called groundnut scheme in East Africa also generated a literature critical of this kind of approach to development (e.g. Rizzo, 2006).

dominant modes of production are industrial, yet the coupled human-environment calls for more reflexive efforts to regenerate agriculture and food systems.

1.6 Feed ourselves

During the last decades of the 20th century, Friedman and McMichael (1989; 1994: and others) depicted the crisis in agriculture and food systems as global in magnitude, with concerns shared across the spectrum of international economies, environments, and social structures. The main themes connecting places otherwise seen as worlds apart were the issues of livelihoods and land. This coupled human and environment interface meant that the kinds of issues coming forward could not be addressed as 'simple' problems with a linear or reductionist approach (Warkentin, 1992).[7] The turn to interdisciplinary and collaborative approaches was part of the response to problems identified at the far end of the complexity scale often characterized as 'wicked' (Warkentin, 1992). Another crucial aspect of this shift is a focus on knowledge and skills in contrast to the spotlight on technology and capital of the Productionist paradigm.

Resistance to the industrial mode of agricultural production and to the restructuring of the global food system has been called the alternative agriculture movement, or simply the food movement, and the list of producer and consumer-oriented social interest groups that have emerged is staggering. William Friedland and colleagues (et al 2010) introduced a collection

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[7] One approach to the 'wicked' problems seen in the coupled human and environment interface is known as post-normal science, though this approach is not limited to food systems studies, the approach has a growing literature in the environmental sciences (e.g. Frame & Brown, 2008; Turner & Robbins, 2008; Turnpenny, Lorenzoni & Jones, 2009).

of articles on the alternative agrifoods movement that focused on the concept of reflexivity for the scholarly audience of rural sociologists. The collection included articles analyzing the researchers' positions with respect to organics, fair trade, Slow Food, localism, farmers' markets, community supported agriculture, food sovereignty, animal welfare, and anti-genetically modified organisms (Friedland, Ransom & Wolf, 2010).

Another form of scholarly response to the contest over global-local agriculture and food issues was the food chain literature, which illuminated the corporate agri-food restructuring and the potential "spaces" for relocalization in this anti-globalization contest (e.g. Marsden, Murdoch & Morgan, 1999; Hendrickson & Heffernan, 2002). The food chain literature was inspired in no small part by the ecological parable and land ethic contributed by Aldo Leopold (1949). Similarly, William Cronon (1991) applied the "thought experiment" of Johann von Thünen to the spatial relationships and economic linkages between the city and country in his classic, *Nature's Metropolis*. Cronon's (1991) method of exploring the commodity flows and mapping space-time relationships explained how Chicago became the central city of the "Great West". Cronon (1991: p.50) expressed his interest in Von Thünen's idealized "isolated state" as follows: The ways people value the products of the soil, and decide how much it costs to get those products to the market, together shape the landscape we inhabit".

Ideas about the spatial ordering and valuation of agricultural production, as well as the land ethic proposed by Leopold have been widely featured in the social movements and academic literatures recognized as relocalization of the food system (e.g. Selfa & Qazi, 2005). Allied with these notions, an underground classic by the agricultural economist W.P. Heddon (1929) contributed to the conceptual development of the "foodshed" by Jack Kloppenburg and his colleagues (Hendrickson & Stevenson, 1996). In *How Great Cities are Fed,* Heddon (1929) provided a detailed study of the transportation systems supporting the New York food supply that included physical distance zones and economic barriers demarcated for perishable foodstuffs through watersheds, milksheds, and foodsheds.

Despite the encouraging achievements of producers, consumers, and scholars dedicated to resistance and change against what Friedmann (2005) referred to as international food regimes, a growing critical literature focused on questions about 'localism' and the local food movement has begun to reshape the scholarly discourse. Like the critical literatures centering on sustainable and organic agriculture before it, the areas of concern regarding 'the local' include:

- Questions about the lack of conceptual clarity and agreement on a normative definition of 'local' (e.g. Feagan, 2007; Blake, Mellor & Crane, 2010);
- Case studies that aim to show that the simple construction of food miles does not capture the costs and embedded energy of food production and distribution, as would a life cycle assessment approach (e.g. Wallgreen, 2006; Weber & Matthews, 2008);
- Challenges associated with linking the majority of relocalization initiatives with markets based solutions (e.g. DeLind, 2010);
- Limitations of the potential of localism to benefit more than elite consumers and niche markets (DuPuis & Goodman, 2005);
- Concerns that neoliberalism plays too decisive a role in places where social safety nets protect against food insecurity (Allen, 1999).

An additional point examined at length in this dissertation has a limited presence in the literature, but draws on insights previously explored by Claire Hinrichs and Patricia Allen (2008) and Laura DeLind and Jim Bingen (2007; and DeLind, 2010). Namely, that unreflective promotion of a local place without an understanding of local history, fails to account for the potential reality that social and political injustices are embedded in that place. This crucial oversight has the potential to undermine the participation or emancipation of would-be actors in efforts to regenerate agriculture and food systems. DeLind (& Bingen, 2007; DeLind, 2010) in particular interrogates the linkages between Thomas Lyson's (2004) concept and vision for a "civic agriculture" and the possibilities and contradictions of local food systems supported by specific communities and individuals.

1.7 Chapter summary: Seeing livelihoods

This dissertation is exploratory and descriptive in scope, drawing from the insights of historical geography, environmental history, agroecology, and rural sociology for its main themes and findings. Several works by the celebrated historical geographer, Cole Harris (1996; 2002; 2004) provided a sense of the process he framed as "resettlement" in British Columbia, as well as nudged me toward a much closer look into the implications of "land and livelihood" in colonial contexts. Harris (2004) drew on Foucault's (1972) *Power & Knowledge* and Said's (1978) *Orientalism* to locate the central goal of colonial discourse theory and to identify the assumptions and representations of colonial culture. Harris' (2004) investigation of the techniques and momentum of colonial dispossession were part of a project to recognize contemporary manifestations of colonialism. In this dissertation focused on efforts to regenerate agriculture, the concepts embedded in histories and ideologies of science, as well as ideas about colonial discourse theory, play a role in the analysis of the research findings.

Similarly, the contributions of environmental historians dislodged some of my previously held notions about agriculture, wilderness, and the relationships between people and nature. Classics on indigenous and settler land use by William Cronon (1983) and Richard White (1980) shaped my understanding of this process. In rethinking the role of biophysical inventory in assessing agricultural potential, I found themes on the agency of nature (Worster, 1979; White, 1995) and on the fallacies of centralized power and legibility (e.g. Scott, 1998) particularly resonant. The work of applied agroecologists and rural sociologists provided many of the case studies and much of the scholarly literature reviewed briefly in the preceding sections on ‘feeding the world’ and ‘feeding ourselves’.

Building from these reviews, recent additions to the livelihood or household approach to regenerating food systems provided the useful conceptual frames of a ‘livelihood portfolio’ and ‘livelihood landscapes’ (Cinner & Bodin, 2010), as well as delineated multifunctional agriculture for smallholders in developing countries (Amekawa et al., 2010). The classic account of smallholders and householders contributed by Robert Netting (1968) described a particular context where farmers did not need to convert to industrial agriculture to survive, instead innovation and diversity as well as an appreciation of the cultural and ecological edge values were the keys. This dissertation attempts to bring the insights from contexts outside of industrial countries, back to the places where seeing agriculture includes seeing smallholders, householders, and diverse, multifunctional landscapes.

As Vaclav Smil described it back in 2000, the magnitude of the complex and interconnected issues of agriculture, the environment, and human health have generated extreme narratives: "catastrophists" predict the wholesale doom of permanent global food crises, and the "cornucopians" proclaim endless optimism in technology and human inventiveness. In fact, some of the cornucopians extend their version of confidence as far as an unshakeable belief that food and agricultural resources have no long-term limits. Paul Ehrlich (1970) and Lester Brown (1995) are frequently cited spokespersons for the catastrophists, and Julian Simon (1981; 1996) was an avid cornucopian, perhaps best known for challenging predictions of Malthusian doom. Smil (2000) presented his take on the challenge, and went on to contribute a detailed assessment of how to feed the world focused on the possibilities of biophysical constraints and opportunities.

Though specific tools for measuring and predicting soil-climate-water and environmental interactions at a global scale are fresh and far-reaching, assessments of the potential for agricultural production are not new.[8] In British Columbia (BC), the Royal Commission on Agriculture of 1913 appointed a group of seven gentlemen farmers and lawmakers to look into the prospects for the growth of an agricultural industry in this province (British Columbia, 1914). The commissioners travelled internationally as well as across provincial borders within Canada to investigate the most up-to-date 20th century farming models and methods that then shaped their recommendations for increased agricultural production in BC

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[8] See Foley (et al., 2011) and Sanchez (et al., 2009) for review and examples of technological innovations designed to predict and problem solve with global change dilemmas.

(British Columbia, 1914). Moving from the approach and direction of the 1913 Royal Commission to the BC Agriculture Plan of 2008, the vision for the future of farming in this province highlighted "local foods for healthy eating" with leadership and province-wide consultation that reflected changed values, and a consumer-driven approach.[9]

Identifying tools and an approach to measuring agricultural potential inherently consists of a set of assumptions, values, and definitions integrated into the process by the people conducting the investigation. Recognizing this in response to the contentious population-resources debate over three decades ago, David Harvey (1974) observed that science is not ethically neutral. Thomas Kuhn (1970) put forward the concept of a paradigm, and characterized this as a process of constructing scientific understandings, shaping intellectual thought, promoting common beliefs and actions, and in particular, generating new knowledge based on worldviews and specific assumptions. The brief literature review centred on 'feeding the world' and 'feeding ourselves' offered above is intended to acknowledge these shifting concepts and values, and to place the dissertation within a framework that marks a middle landscape between 'feeding ourselves' and 'seeing livelihoods'.[10]

[9] See http://www2.news.gov.bc.ca/news_releases_2005-2009/2008AL0004-000208.htm# for the provincial government's press release and http://www.agf.gov.bc.ca/publicat/index.htm (BC Agriculture Plan, February 2008) for the full report.
[10] The 'middle landscape' is a reference to the contest between mechanization and agrarian values in Leo Marx's (1964) classic *The Machine in the Garden.*

Chapter 2: Agricultural histories of the Bella Coola Valley

Q: What are you doing with the land, are you cultivating it at all?
A: Yes, we grow potatoes, turnips, and hay.
Q: How much hay do you grow? Show me on the plan where you grow hay.
A: We got 18 tons of hay this year off this part (indicating lots 16,17 and 18 on the plan).
Q: How do you cut your hay?
A: With a mowing machine
Q: How many mowing machines have you got?
A: Only one.
Q: And you all use it?
A: Yes.
Q: Have you any ploughs?
A: Yes.
Q: How many ploughs?
A: About twelve ploughs.
Q: Have you any barrows?
A: Yes.
Q: Have you got lots of horses?
A: Some have horses.
Q: About how many horses are there altogether?
A: Twenty horses.
(Excerpt from testimony given by Albert King (A), one of the spokespersons for the Nuxalk, to Mr. Young (Q), one of the examiners on the board of the Royal Commission on Indian Affairs, at the Bella Coola Reserve on August 16, 1913.)

2.1 Introduction

The purpose of this chapter is to demonstrate why the histories of land use and food systems in Nuxalk Territory and in the Bella Coola Valley are important to contemporary efforts to regenerate agriculture here. In basic terms, understanding the historical contexts of this place is essential for appreciating contested meanings and uses for agricultural land. Nuxalk histories are as intertwined with agricultural history and the history of food production in this place, as are any histories that have arrived here with the newcomer settlers in 1894. Connecting the purpose of this chapter to the specific arguments developed in the pages that follow, this chapter establishes a foundation for one of the key findings of this dissertation: Despite lingering colonial notions that ‘Indians are a vanishing race’, and despite prevalent ideas about the disappearance of farmers due to the impacts of globalization, neither the Nuxalkmc[11] nor Bella Coola Valley farmers have vanished, and the two are not now, nor were they historically, mutually exclusive. Agriculture in the Bella Coola Valley did not serve to erase the other important livelihood practices of the Nuxalk, nor did it provide a means of industrial development and urbanization for the newcomer settlers. The pages that follow offer stories about the adoption and growth of farming practices in a place where the scale of these activities has remained close to home for over one hundred years.

This chapter is organized as a rough chronology of land use for food production in this place. The Nuxalk trace their relationship to the lands and waters of their territory back to time immemorial. Deep time, or a time referred to as the beginning, is the chronological marker for the opening of the sections devoted to Nuxalk Territory. Section 2.2 provides a brief geographical and ecological description of Nuxalk Territory, as well as a place setting for that part of the territory where contemporary human habitation is concentrated along roadways, knit together as the unincorporated small towns of the Bella Coola Valley. A number of Northwest Coast ethnobotanists and anthropologists have contributed rich descriptions of Nuxalk foodways and land use practices prior to and since colonization, and selected portions of this literature are presented here to clarify the breadth of indigenous land

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[11] Following the standard given in Kennedy and Bouchard (1990) Nuxalk, as distinct from Nuxalkmc, will be used to indicate all of the people of Nuxalk Territory, though many of the *Talyumx,* of *Sucłmx,* and of the *K'ʷałnamx* people now live on reserves within the Bella Coola Valley, their villages were largely depopulated through the impacts of colonialism and disease. See the descriptions given in text for further details.

and food practices prior to the introduction and adoption of imported plant crops and livestock. Additionally, this section establishes the ways Nuxalk observed ownership and control in their territory prior to dispossession. Section 2.3 offers a brief account of outpost gardening along the Northwest Coast and in Bella Coola during the maritime fur trade of the mid-19th century. Section 2.4 places in context the stated goals of colonization as manifest in the vision for the planned colony of Bella Coola. As well, this section documents the transition away from aspirations of commercial or export-focused agriculture in the Bella Coola Valley. The final section focuses on two Royal Commissions of 1913-the Royal Commission on Indian Affairs and on Agriculture for the province of British Columbia. With the key objectives of the inquiries directed by the commissioners towards political solutions to “Indian” and “Agricultural” land questions, these provincial hearings served as pivotal markers in the histories of agriculture in the Bella Coola Valley.

Before moving any further forward in undertaking any form of contextual navigation through Nuxalk Territory, or through the Bella Coola Valley for that matter, I want to place before you a clear statement that the reader’s guide through this territory is an outsider. In fact, this outsider belonged to that category of parachuted in outsiders affiliated with a university. In roughly equal parts despite and because of this affiliation, the people I encountered in this place treated me to a mixed sort of welcome that was both generous and circumspect. The support provided for the field research project that took place in the Bella Coola Valley as part of the investigation for this dissertation did not cover ethnographic interviews, but did offer a small training stipend for local research assistants. The learning exchange with this opportunity, as well as the participant observation I carried out through the course of interactions with Nuxalk and non-Nuxalk[12] residents provided the basis for my understanding of the people and place that developed during the timeframe of the investigation. During the course of my research outside of the Bella Coola Valley, I encountered a wealth of published journals penned by explorers, surveyors, and salvage ethnographers who have made relatively brief passages through Nuxalk Territory, and still succeeded in shaping understandings of the Nuxalkmc and Nuxalk Territory with their impressions and observations.[13]

The Nuxalk do not necessarily share the understandings advanced by outsiders that effectively simplify information about themselves and about their home territories, and importantly, Nuxalk knowledge shared with outsiders is not static or uniformly agreed upon or discounted by individual members of the Nuxalk community. In a background statement that provides some explanatory power for this ambivalence, Nuxalk author, Jacinda Mack (2006) expresses the need to reverse the colonial gaze and empower voices from within indigenous communities. Mack notes that for too long, indigenous peoples “were simple objects of study” and too “little consideration of the social, political, cultural, and economic framing of research” has impacted the indigenous involved in the research (2006: p.16).

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[12] The contemporary demographics of the Bella Coola Valley include some of the descendants of the planned colonists who arrived in 1894, as well as descendants from later waves of immigration, descendants from intermarriage among Nuxalk, Ulkatcho, Heiltsuk, and newcomers, and many other combinations representative of present-day multi-cultural migrations. I have chosen the term newcomer-settler over non-Nuxalk in the remainder of this dissertation because of the complex layers of intermarriage and identity present in this small population.

[13] See Sean Carleton (2011) for an excellent reflection on Chief Dan George’s comments at the commemoration of 100 years of B.C. confederation, specifically, on the power of textbooks to reshape the lives of indigenous through racist stereotyping.

Salient to the arguments of this dissertation, several of the outsiders referenced in this chapter carried predetermined ideas about agriculture and land use into the Bella Coola Valley, drew survey lines and other boundaries in the name of agriculture that have had long term effects in Nuxalk Territory.

2.2 Land use and food systems in Nuxalk Territory

The idea that Northwest Coast people did not develop agricultural systems within their land base was a foundational assumption advanced by explorers, agents of colonialism, and nineteenth century anthropologists alike (Deur & Turner, 2005; Harris, 2004;Lutz, 2008). This idea, supported by the colonial discourses that shaped the resettlement of British Columbia, continues to be one of the most enduring myths about agriculture on the Northwest Coast of North America (Knight, 1996; Harris, 1997; Deur & Turner, 2005; Lutz, 2008). Documentation of correspondence presented in the *Papers connected with the Indian Land Question* (1875) make clear that this was the dominant position held by the colonial officers of the province of British Columbia.[14] The solutions associated with making space for settlers were directly tied to ideas about cultural evolution, positivist science, and ideas about the inevitability of colonization (Martin, 2010; Harris, 2002). Land given over to

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[14] The report signed by Geo. A. Walkem in this collection of provincial correspondence (dated August 17, 1875) indicated the three classes of Indians were recognized by the colonial government-province. Fishermen and hunters, stock-breeders and farmers on a small scale, and labourers composed the full range of possible categories given by the provincial government at that time. The 30,000 'Coast Indians' recognized by the province were exclusively fishermen and hunters and would not need large, or any tracts of agricultural lands. This was the key rationale given for the argument that 'no basis of acreage for Indian Reserves be fixed for the Province as a whole'—meaning instead of the 80 acres urged by and set as precedent in the Dominion, the Province of British Columbia would not give any systematic quantity of land as a means of settling the Indian Land Question.

preemption for settlers of the colony of British Columbia was seen, as colonial lands elsewhere, as empty or underutilized, and on the coast, colonizers believed the surplus catch from the waters of the Pacific, and the many rivers, inlets and streams feeding it, precluded any interest in or need for activities associated with agriculture (Harris, 2001). Though the carefully presented evidence in Deur and Turner's (2005) *Keeping it Living* has substantially revised this history, many of the key messages from this work have not reached an audience of scholars and practitioners of the agricultural sciences.[15]

2.3 Place names and the socio-ecological setting of Nuxalk Territory

Nuxalk Territory precedes and geographically surrounds the less firmly fixed areas of habitation that stretch from the mouth of the Bella Coola River, hug the road along the narrow valley to Hagensborg, cross the bridge to the sunny Saloompt, wind into the canyon of the mountains at Firvale, and reach the headwaters at the conjoining of the Atnarko and Talchako rivers at Stuie. The unincorporated settlements of Bella Coola, Hagensborg, Firvale, and Stuie as well as the places currently designated as Indian Reserve, and now called the Townsite and 4 Mile, form the populated boundaries for the study detailed in this research. All of these inhabited places together will be called the Bella Coola Valley in this dissertation, and all are surrounded by and included in Nuxalk Territory. Unless otherwise indicated, this dissertation utilizes the naming and spelling conventions adopted by Kennedy & Bouchard (1990) and by Turner (et al., 2009) for Nuxalk food names. The identification of

[15] See also M. Kat Anderson's (2005: p.1) *Tending the Wild* for a detailed account of land management practices of indigenous peoples in California from "coppicing, pruning harrowing, sowing, weeding, burning, digging, and selective harvesting". Published simultaneous with *Keeping it Living*, Anderson's work also intends to dispel the myth of empty land, and suggests a redefinition of agriculture, and human-nature relationships.

selected traditional foods will place a vernacular identification in the text, with the Nuxalk and binomial, scientific designation in parenthesis.

Since roughly 1980, the designation Nuxalk has replaced Bella Coola as the all encompassing name for people who inhabited the villages of the *Nuxalkmc* of the Bella Coola Valley, and for the people of the villages of *Talyumx*, of *Sucłmx,* and of the *K'ʷałnamx* (Kennedy & Bouchard, 1990: p.328). The Nuxalk Nation exerts land claims over this territory that precede colonialism and the arrival of the fur traders and explorers in 1793. Time immemorial is the starting point for the histories and traditions of the Nuxalk in their territory. The map provided on the website hosted by the Nuxalk Nation provides an updated, publically available depiction of this geographical territory, and is included below in Figure 2.1. A Master's thesis published in the 1980s during the height of a collaborative research endeavor with Nuxalk leaders, ethnobotanists, and nutritionists, documented over 100 known villages and encampments throughout Nuxalk Territory (Lepofsky, 1985). Kennedy & Bouchard (1990) list 61 verified permanent villages throughout the territory. For a few reference points in terms of the geographical area claimed as Nuxalk Territory, this 18,000 square kilometers is larger than the Willamette Valley in Oregon (14,900 km^2), more than twice the area of the Ottawa valley (7645 km^2), or more than six times the land area of burgeoning metropolitan Vancouver[16].

[16] These numbers are based on 2012 web available information: http://ccira.ca/site/communities/nuxalk.html for information on Nuxalk Territory; http://en.wikipedia.org for the Willamette and Ontario valleys, and metropolitan Vancouver areas compared, all retrieved August 22, 2012.

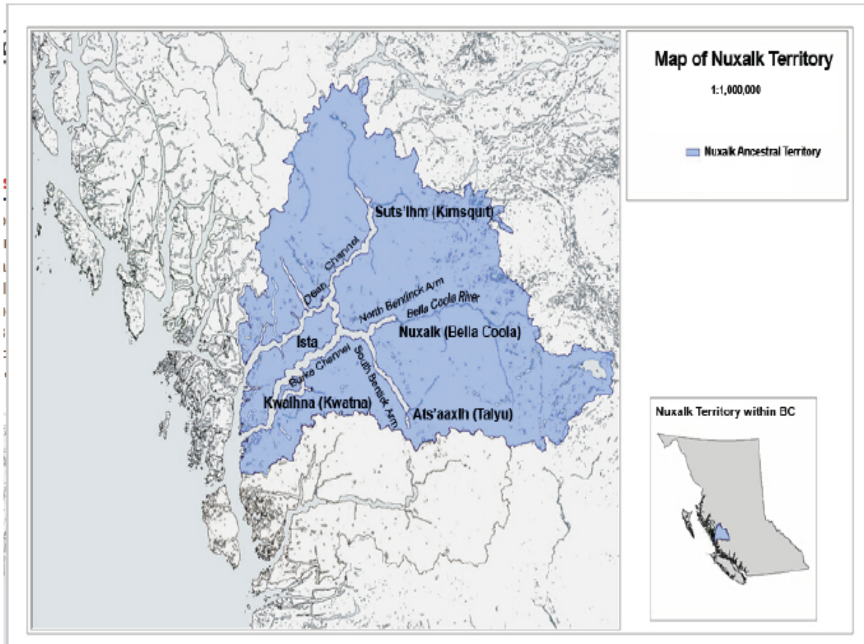

Figure 2.1 Map of Nuxalk Territory from the Nuxalk nation website 2012. Five main village sites are given in bold text, territorial boundaries in blue. Note the spelling conventions offered in Kennedy and Bouchard (1990) differ from those listed here. For example, the village inhabited by the Talyumx people was rendered Talio in Kennedy and Bouchard (1990) and named as Ats' aaxlh (Talyu) by the Nuxalkmc maintaining this website in 2011.
http://www.nuxalknation.org/content/blogcategory/16/40/

Dana Lepofsky's (1985) thesis provides detailed settlement patterns for the Nuxalkmc of the Bella Coola Valley, as well as insights into the determinants for location of these settlements from the presence of a range of food resources to cultural and other resource availability. From ethnographic and ecological data, as well as an ethnohistoric and archeological literature review, Lepofsky placed 54 of these villages and camps in the Bella Coola Valley from the mouth of the Bella Coola and Necleetsconnay rivers to the headwaters of the Atnarko and Talchako rivers (1985: p.52). In areas of high site density, Lepofsky grouped villages of the Bella Coola Valley into 20 distinct village units to recognize the challenges associated with precise locations of settlements in a dynamic landscape with major changes to the location of river flow and channels occurring with periodic flooding events (1985: p.105).[17]

As part of the Northwest Coastal region, Nuxalk Territory fits the general climatic characterizations given for a temperate rainforest, with relatively mild temperatures moderated by the marine environment encircled by the Coast mountain range and the Chilcotin Plateau. Similar to other First Nations' Territories within this region, Nuxalk Territory exhibits tremendous environmental variation and enjoys rich marine and tidewater habitats, alluvial floodplains, many rivers and fast moving streams, protected inlets, ponds, marshes, and steep, rocky mountainsides (Deur & Turner, 2005; Turner et al., 2009). The environmental variation creates temporal and spatial distributions of ecological resources characterized as patchy and uneven, which have, in turn, greatly influenced the foodways, settlement patterns, and land management within the region and within Nuxalk Territory (Deur & Turner, 2005).

Current biogeoclimatic mapping indicates four distinct zones for the area shown in Figure 2.1. Superimposing this system of classification over the map of the full range of Nuxalk Territory provides a set of biogeoclimatic classifications that include the Coastal Western Hemlock, Interior Douglas-fir, Engelmann Spruce-Subalpine Fir, and Coastal Mountain-

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[17] Bella Coola river flooding events in the 1920s and 1930s washed away roads and bridges and forced the relocation main Nuxalk village ("fenced or stockaded place", *ʔałqlaxł)* as well as the settlers' Bella Coola Townsite to the south side of the river (Septer, 2006). In the flood of January 1968, the Bella Coola River changed its course again (Septer, 2006). Citing geologist A.J. Baer (1973) who reviewed the previous geological studies of the area, the mouth of the Bella Coola River has moved eastward "almost one mile since the turn of the century" (c.f. Lepofsky, 1985; Leaney & Morris, 1981).

heather Alpine.[18] The Nuxalk villages shown in Figure 2.1, and the majority of the Bella Coola Valley study area are mapped within the Coastal Western Hemlock zone, though the Interior Douglas-fir and Engelmann Spruce are situated at the eastern edge as the topography transitions from river valley to the leeward slopes of the Coast Mountains, to the higher elevation, steep, rocky terrain of the subalpine zones. These ecological edges within Nuxalk Territory, according to Turner, Davidson-Hunt & O'Flaherty (2003:p. 443) provide flexibility and multiple opportunities for resource use given the wide variety of "microsites and habitat interfaces". See Meidinger & Pojar (1991) for detailed descriptions of these ecological classifications, and Pojar & MacKinnon (1994) for a pictorial reference of the coastal vegetation characteristic of this region.

Ocean inlets in Nuxalk Territory are significant sources of food, supplying a diversity of sea mammals, fish and shellfish. The rivers of this territory support all five common species of Pacific salmon and steelhead, as well as the spawning areas for the oily, eulachon (sputc, *Thaleichthys pacificus*) smelt fish (Turner et al., 2009). Estuarine and tidal marsh sites were also important locations for village sites with their rich habitat for root vegetables, and prime hunting grounds for "ducks, geese, deer, and bear" (Turner et al., 2009). The edible starchy roots of springbank clover (t'wsus,*Trifolium wormsskoldii*) and pacific silverweed (uq'al, *Potentilla anserine spp.pacific*) exemplify the rewards and the governance of gardening

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[18] See the British Columbia Biogeoclimatic Ecosystem Classification Program website for a downloadable map with the current version, 8.0 published in October 2011, and click on the link that follows for brief descriptions of the biogeoclimatic zones:
http://www.for.gov.bc.ca/hre/becweb/resources/maps/CurrentVersion.html
http://www.for.gov.bc.ca/hfd/library/documents/treebook/biogeo/biogeo.htm

activities in these "complexly subdivided plots" at the mouths of the river where fresh meets salt water (Deur, 2005: p.296; Turner & Kuhnlein, 1982; Turner et al., 2009). Valley bottomlands provided numerous sites for berry harvesting and tending, as well as habitat for greens, shoots, and other plant resources. The upper slopes of the mountains at the eastern end of the valley transition to different types of available berry patches and continue to provide hunting grounds for mountain goat (yaki, qwwaax, *Oreamnos americanus*) (Turner et al., 2009). For a full listing with Nuxalk names of the traditional foods included in the collaborative study on Nuxalk dietary transition, see Table 2.1 in the summary report on the Nuxalk Food and Nutrition Program, 1981-2006 (Turner et al., 2009: pp.32-33).

2.4 Ownership and control in Nuxalk Territory and the Northwest Coast

A considerable portion of the collection of essays in Deur and Turner's (2005) *Keeping it Living* argues for the reconsideration of aboriginal plant use and redefinition of cultivation practices. This rethinking is intended to illuminate previously overlooked human alterations and improvements within First Nations' territories. The scholarly literature on this topic is now well established, and what is presented here is a brief exploration of land tenure and ownership patterns among Northwest Coast First Nations as compared with the Nuxalk of the Bella Coola Valley. Inclusion of this discussion here is intended to demonstrate the crucial linkage between the evidence of territoriality in Northwest Coast First Nations and aboriginal title. The range of time and evidence provided for these ownership patterns follows that outlined and provided by Deur and Turner (2005), and their colleagues in the field who relied on the words of contemporary elders, as well as the early 20th century reconstructive ethnographic descriptions.[19] Other methods for identifying territoriality include ecological arguments, linguistic and archaeological evidence, as well as historical documentation (Deur & Turner, 2005; Sutton, 1975). As a foreground to section 2.6 that focuses on agricultural initiatives of the early settlers in the planned colony of Bella Coola, the last paragraphs of this section contextualize the Euro-Canadian and American settlers' views of nature, "wilderness",[20] and the agrarian ideal in a way that contrasts notions of stewardship embedded within indigenous ownership and control patterns as outlined in Deur and Turner (2005).

In characterizing land ownership and aboriginal title, Turner, Smith and Jones (2005) cite the appeal of the Gitxsan and Wet'suwet'en hereditary chiefs in the 1997 Supreme Court hearing of *Delgamuukw v. British Columbia*:

> For us, the ownership of territory is a marriage of chief and the land. Each Chief has an ancestor who encountered and acknowledged the life of the land. From such encounters come power. The land, the plants, the animals and people all have spirit-they all must be shown respect. That is the basis of our law…By following the law, the power flows from the land to the people through the chief; by using the wealth of the territory, the House feasts its Chief so he can properly fulfill the law. This cycle has been repeated on my land for thousands of years. (Gisday Wa and Delgamuukw 1989:7-8, cited in Deur & Turner, 2005: p. 171)

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[19] Examples specific to the Nuxalk are Lepofsky (1985) and McIlwraith (1948), and on the Northwest Coast more broadly are McDonald (2005) and Suttles,(2005).

[20] "Wilderness" as punctuated here signifies a well-established set of arguments within the literature of environmental history showing the intertwined histories of humans and places previously seen as 'pristine wilderness' (e.g. Nash, 1967; Cronon, 1995; White, 1995).

Drawing from a range of scholars, Turner and Jones (2000) provide a detailed overview and comparison of patterns of territoriality and ownership among Northwest Coast cultural and linguistic groups. From this, Turner and Jones (2000) depict two models of land and resource proprietorship with varying degrees of access and control over those resources. Following Suttles' (1987: p.57) working hypothesis of a south-to-north gradient of an "increasing tightness of structure", we can begin to relate the more punctuated seasonal abundance of the northern traditional territories with their correspondingly more rigid and "kin-group" ownership patterns (Deur & Turner, 2005: p.175). Turner (et al., 2005: p.152) identify the range of these ownership rights as moving from a "general recognition of communal territory defined by seasonal movements" to "authority over specific resource sites and locations". Also within Northwest Coast indigenous ownership patterns are rights held by individuals, kinship groups, larger village and ethnic groupings (Turner, et al., 2005). Underlying these ownership rights, as documented by Turner (et al., 2005) for the indigenous people of the Northwest Coast are the contingencies of stewardship, sustainable management, and equitable distribution.

McIlwraith (1948) explained the land tenure among the Nuxalk as intrinsically linked with ancestral family names.[21] Observed by McIlwraith in the salvage ethnography that would become the classic approach of its day, Nuxalk gave sacred sanction to land ownership and possession:

> On reaching this earth the first people are believed to have prospected for suitable settlement sites, places where salmon and olachen could be caught, and if possible,

[21] See also Turner (et al., 2005) for linkages between ownership of territory and family names.

> near side valleys where berries were abundant. Here they released the animals and plants, which they had brought with them, on which they thenceforth subsisted, in accordance with the supreme deity's instructions (McIlwraith, 1948: p. 131).

Among the Nuxalk, hereditary chiefs had greater access and control over the production and distribution of food resources than the remainder of the population (Lepofsky, 1985). These preferred food resource territories distributed by the first peoples became the property of their immediate descendants, or their offspring (McIlwraith, 1948: p.131). Lepofsky (1985) attributes the locations of settlements in the Bella Coola Valley to those preferred sites with an abundance of salmon, other aquatic resources, plant resources, animal resources, mineral resources, trade, shelter from the elements and protection from raids. The river's mouth and lower valley represented the greatest concentration of resources for the Nuxalk, therefore maximized energy (Lepofsky, 1985). In this respect, these preferred territorial settlements of the Nuxalk would be socially and geographically comparable to the Gitxsan and Witsuwit'en, in that ownership would have been maintained through a House group and often followed watershed boundaries (Deur & Turner, 2005). According to the patterns of ownership and control, these settlements would have been owned and controlled by descent groups with a common ancestor as determined from a single origin story with authority invested in a chief or other designates (Turner & Jones 2000; Deur & Turner, 2005). Disruption to the system of traditional ownership and control over resources for the Nuxalk came with the loss of their sovereign territory:

> Since the concentration of the tribe on a small reserve and the beginning of agriculture, a system of individual ownership of cultivated land has sprung up. It is realized that if a man clears and cultivates a field, the produce is his own, and he can will this land to whomever he pleases. Likewise a man who rings a tree for firewood

> is the sole owner…The Bella Coola regard land as almost inalienable. Though a man does not own the land of his wife's ancestral family, he can use it and his children have full rights to it. Conversely, a wife can gather berries on her husband's land, though it is not hers (McIlwraith 1948: pp.132-133).

For the Nuu-Chah-Nulth, *ha̱ẖuulhi* indicates sovereignty, and is used by hereditary chiefs for aboriginal right, ownership, and territory (Deur & Turner, 2005: p.151).[22] *H̱aẖuulhi* also signifies reciprocal rights and responsibilities to steward the land and people within the territory (Deur & Turner, 2005: 163). Among several groups of Coast Salish speakers, a suffix meaning "of or belonging to", */-ulh/,* identifies specific locations within a group's territory (Turner et al., 2005: p. 155). These ownership rights were seen as conceptually different from Euro-Canadian notions of exclusive property, and were generally group inclusive (Turner et al., 2005: p.155). Tsimshian elder, Lucy Hayward used the term, *laxyuup,* with its traditional meaning of 'House lands and estates' to also depict a storage box of food (McDonald 2005: 242 citing interview, 1980). Similarly, the Nuxalk terms for preferred resource territories are *sol' loam or sixsnimsta*, which means "food supply" (McIlwraith, 1948: p.131).[23]

In *Keeping it Living,* Turner and colleagues make the case through linguistic, ethnographic, and ecological evidence that intrinsic to the ownership rules among the Northwest Coast First Nations, was a respect for the limits of their food (and other) resources as well as an

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[22] This usage of *ẖaẖuulhi* cites Ahousaht Hereditary Chief Earl Maquinna George.
[23] See Thomas Thornton's (1995) doctoral dissertation, *Place and being among the Tlingit* of southeastern Alaska on the concept of *ḵwáan* for the power of place, also Brian Thom's (2005) dissertation *Coast Salish senses of place* for an ethnography situated linguistically and geographically quite close to Nuxalk Territory.

understanding of strategies to enhance productivity and distribute resources without hoarding (Turner et al., 2005: 175; McDonald, 2005: p.245). Turner and Peacock (2005: p.130) draw the following conclusion from their ethnobotanical evidence:

> Whether recognized at the community level or at the level of the clan, family, or individual, the rights to harvest and to control the harvest of other people at highly valued places for high-value resources were widely established. Such proprietorship resulted in intensive monitoring, harvesting, and managing of sites and resources, and, we would argue, ultimately led to sustainable resource use.

In stark contrast, Dunlap (1999: p.46) describes the push from nineteenth century settlers as an imposition of European models into new lands and uncharted territory:

> In less than a century Americans and Canadians built towns and farms across two-thirds of a continent, Australians and New Zealanders pastoral empires across their lands. Farmers and ranchers pushed into new country with high hopes and little information. Some were ruined by drought, frost, or heat, others failed as their farming or grazing techniques exhausted the land.

While Nuu-chah-nulth speak of *hishuk ish ts'awalk* (Turner et al., 2005: p.176), meaning the equality of all life forms, Euro-Canadian and American settlers were driven by the Biblical injunction that praised dominion over nature and subordination of wilderness.

> Seen through European eyes, neither the Aboriginal peoples' use of the land, nor their ownership of it was considered valid or legitimate, perhaps because it was so different from their own. In most cases, the newcomers recognized only large, permanent settlements and highly visible agricultural modification as criteria for land ownership. This demonstrates the important connections between land ownership and the question of cultivation and land management (Turner et al., 2005: p.172).

To draw parallels from land tenure and ownership patterns of Northwest Coast First Nations to that of indigenous ownership patterns elsewhere, Sutton (1975) characterizes these patterns in terms of how the land is held, and in terms of the rights of use or permission of others to use. An exercise of caution is a minimal prerequisite for drawing universal conclusions from generalized systems for indigenous land ownership and tenure. However, from the literature briefly reviewed here, evidence suggests that underlying indigenous ownership patterns are a fundamentally different worldview and system of values than those of Euro-Canadian and American property rights.

The Douglas Treaties (1850-1854), in which traditional territories of Northwest Coast First Nations were surrendered, laid the legal framework for overlooking and undervaluing indigenous knowledge and stewardship of vital resource territories in the name of what would become industrial agriculture and resource extraction (Turner et al., 2005:p.172). Euro-Canadians and Americans largely saw "agriculture"[24] as a necessary beginning for true civilization and part of a blueprint for a progressive development that mirrored natural law (Lewis, 1994: p. 9). Henry Rowe Schoolcraft claimed:

> Civilization…cannot permanently exist without the cultivation of the soil. It seems to have been the fundamental principle on which the species were originally created, that they should derive their sustenance and means of perpetuation from this industrial labor (cited in Lewis 1994: p. 9).

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[24] "Agriculture" as punctuated here signifies a push for redefinition or reconsideration of this term in parallel with the rethinking about our ideas of "wilderness" as outlined in the previous footnote.

Deur and Turner's *Keeping it Living* (2005) unpacks the misconception that Northwest Coast peoples were limited in their subsistence practices to hunting and gathering and wandered about in *terra nullis.* Rather, the collection asserts that there is strong evidence of sophisticated ownership and knowledge systems, as well as deeply embedded cultivation and stewardship of traditional territories. McDonald (2005: p.269) summarizes the subsequent changes to Tsimshian traditional territory as the creation of a "new wilderness" and defines the myth of empty lands as follows:

> The stereotype of the great Pacific wilderness is a colonial concept that blinds a new nation (Canada) to the sovereign control of an older nation (Tsimshian) and allows governments in Ottawa and Victoria to disregard the rights of the Tsimshian, as if the lands were truly *terra nullis*, an empty land.

The sentiment was echoed by the first governor of the Massachusetts Bay Colony, John Winthrop, who claimed the Indians ignored God's dictum to "improve the land" and left the lands as a *vacuum domicilium,* or wilderness waiting to be properly possessed and settled (Lewis, 1994: p.11). The land laws that sprung up around the newcomers to the North American continent intended to recognize only those claims of ownership that served the new regime (Dunlap, 1999). Historian Paige Raibmon (2008) characterized this as part of the genealogy of settler practice, and referred to the refashioning of indigenous territory as "settlement lands".

While settlers everywhere made virtue of their individual efforts and domestication of the wilderness, Dunlap (1999) concludes this taming and subordination was a means of taking nature to the market for an expanding industrial society. A significant contribution from the collection of essays from within Deur and Turner's (2005) *Keeping it Living* with respect to the establishment of aboriginal title then, is the extensive catalogue of evidence for the ownership, maintenance, and enhancement of important plants throughout the traditional territories of Northwest Coast First Nations (Turner et al., 2005: p. 176).

2.5 Outpost farming

Though the scholarship on agricultural history within the province of British Columbia is sparse, the recognized account of this history starts the clock for tilling the land and sowing of seeds in 1786 at Nootka Sound by Captain James Strange (Ormsby, 1945; Gibson, 1985). Margaret Ormsby (1945) characterizes efforts to develop agriculture in British Columbia prior to the gold rushes and railroads boom as sporadic, and limited to small plots planted at the posts of the Canadian fur traders. James Gibson (1985) provides a detailed description of the establishment of "post farming" in the Columbia River region within the context of the competition for dominance of trade and resources on the Pacific slope.[25] According to Gibson (1985: p. 7), it was Governor George Simpson's cost-saving reforms that emphasized the establishment of gardens, livestock tending, and increased self-sufficiency over the food supply at the posts that opened the agricultural frontier "this side of the mountains". On inspection of the Hudson's Bay Posts in the Pacific Slope in 1825, Simpson found the company men received European provisions of up to six boatloads including "500 bushels of

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[25] The geographic extent of Hudson's Bay Posts in the 'Columbia region' of the period covered by Gibson (1985: p.7) included "the country between the Rocky Mountains and the Pacific" with six establishments on the coast and sixteen in the interior. See Gibson's (1985) account for detailed maps of the region and dates the forts were established. The nearest of these forts to the Bella Coola Valley was Ft. McLoughlin, located in close proximity to present day Bella Bella. Ft.Langley in the Fraser Valley and Ft. Victoria (previously known as Ft. Camosun) on Vancouver Island were also situated within this region of trade.

Indian corn, 100 bushels of Indian corn meal, 3,550 pounds of tobacco, 2,912 pounds of sugar, 2,000 pounds of rice", though in his view, "the river and a garden" would have maintained the men with ample supplies of "fish and potatoes" (Gibson, 1985: p.16).

Similar to the "post farming" detailed in Gibson's (1985) account of *Farming the frontier* in the Columbia River region, "outpost agriculture", as defined by Francis (1967) in Alaska grew from the historical necessity to supply Russian traders and merchants with a few fresh products for local consumption and to reduce the costs and total dependence on imported, bulky food supplies from "outside". Perhaps coinciding with the introduction of nonlocal crop plants as part of the maritime fur trade from the late eighteenth and into the mid-nineteenth centuries, a great deal of scholarly energy has been devoted to exploring the question of when and how Northwest Coast indigenous peoples became so adept at the cultivation of tobacco, potatoes, and other root crops (e.g. Suttles, 1987; Moss, 2005; Deur & Turner, 2005). Suttles (1987) and Gibson (1985) discussed intermarriage between men of the posts and indigenous women of the region as strong potential linkages in the spread of these horticultural practices, and Deur & Turner (2005) argued that pre-existing trade routes and inter-group contact among Coastal and Interior First Nations of western North America were primary. For the purposes of this dissertation, the significance lies in the established evidence that indigenous peoples of the Coast were practicing agroecological improvements such as "clearing, tilling, sowing, tending, weeding, fertilizing, transplanting, and maintaining garden plots" for a number of decades during the peak and decline of the maritime fur trade and prior to the influx of immigrant settlers in the 1880s and 1890s (Moss, 2005: p. 284; Harris & Demeritt, 1996).

The development of these skills and of the knowledge associated with cultivation of nonlocal plants was a useful adaptation to changes and disruptions in the indigenous economies and of the food supply on the Northwest Coast. Not unlike the Chicago depicted in mid-nineteenth century by William Cronon (1991: p .26), Bella Coola and the Northwest Coast were "polyglot worlds" tied to "vast trading networks" where indigenous and Euroamerican land practices mixed.[26] In 1877, almost two decades prior to the establishment of the planned colony of Bella Coola, the Hudson's Bay Post agent stationed there wrote to his counterpart at Ft. McLoughlin (near present-day Bella Bella) that his supply of onions and potatoes that was provided in part by Nuxalk gardeners, was more than sufficient for the winter months (Kennedy, 1877). Unlike the abundant harvests reported for the Bella Coola post, the experiment with post farming at Ft. McLouglin was of limited success; the country provisions for the men of the post there prior to the establishment of the post at Bella Coola were "fish in great abundance and variety, venison and potatoes" (Gibson, 1985: p. 66). From this correspondence and from more than a decade of Department of Indian Affairs annual reports, the company men of the trading posts as well as the agents of colonialism viewed the patches of cleared land and small garden patches at the river mouth of the Bella Coola Valley as some of the best areas for agriculture on the Northwest Coast.

[26] Mixtures of livelihood practices were not limited to the land. Cronon (1991) noted the role of intermarriage and the subsequent advantages that emerged for the offspring of these intermarried cultures in exchange relationships.

Hudson's Bay Post traders and the Nuxalk cultivated imported nonlocal food crops in the Bella Coola Valley by the latter half of the nineteenth century.[27] Peter O'Reilly, the Indian Reserve Commissioner from 1881-1898, characterized the land of the Bella Coola Valley as "a rich alluvial deposit" and reported the cultivation of "potatoes and other vegetables" as central to Nuxalk livelihoods during his visit to inspect and determine the principal boundaries of the reserve (O'Reilly, 1883). O'Reilly further estimated 40-50 acres of the land was already under cultivation in distinct patches by the Nuxalk at the time of his visit, and that more land, up to "several hundred" acres more could be made available (O'Reilly, 1883: p.5-114):

> The chief (On-chan-ny) said he wanted a large piece of land, as they made their living by the sale of potatoes and vegetables…I told him that the Government had no wish to curtail the land necessary for their use, on the contrary, were anxious that every place worth cultivating should be given to them, as well as their village sites, fisheries and enough timber lands for all their requirements. He then accompanied me while I made an exhaustive examination of the surrounding country, and with his entire concurrence, and evidently to his satisfaction, I made the following reserves…[28]

2.6 The planned colony of Bella Coola: Changes in the land and food systems

The Victoria *Daily Colonist* newspaper of October 18, 1894 ran a column with the title, "In preference to Oregon". The article described the journey of Norwegian farmers en route to the Bella Coola Valley, "where they intend to establish an agricultural and industrial colony",

[27] Wilde (2004) dates the establishment of the Hudson's Bay Post in Bella Coola as 1869, with regular calls to pick up furs by the company's steamship beginning in the early 1860s.
[28] See also Bruce Stadfeld (1998) for arguments that natives on Vancouver Island (exemplified by a case he cited in Oyster Bay) were aware of the colonial government's partiality towards cultivation, and made use of potato patches and other forms of "improvements" as grounded evidence in confrontations and counter-claims to settlers' preemptions.

and further claimed that the valley was selected due to its promising agricultural resources after all the "favorite farming districts" of Oregon and Washington had been visited ("In preference to Oregon", 1894: p.6). Although Bella Coola was planned and promoted as the northernmost agricultural colony of the province of British Columbia, in little more than two decades, the majority of newcomer settlers no longer identified themselves as farmers. Maintaining household gardens, small orchards, and hay crops remained vital to the way of life in the Bella Coola Valley, but by 1913, settlers who established the Bella Coola Farmers' Institute claimed the high costs of transportation meant the markets for farm produce were out of reach (Bonavia, 1936; Demeritt, 1992). Settler diaries depict wage work outside of the valley in commercial fisheries, and road building within the colony as reliable strategies used to earn the capital required for clearing and "improving" the resettled land in the Bella Coola Valley. By 1920, the majority of newcomer-settlers no longer identified agriculture as their main occupation. See Table 2.1 below for details.

Table 2.1 Numbers of Bella Coola voters who identified farming as their main occupation, 1898-1968 Data sourced directly from Canadian Voters' Lists for the dates 1898-1920. Information from 1935-1968 sourced and adapted from Halverson (1973).

Year	Farm operators	Fishing & related	Logging	Other occupations	Total voting (Male, non-reserve) population	% Farmers
1898	44	0	0	5	49	90
1909	77	9	1	23	110	70
1920	65	28	16	39	148	43
1935	72	50	18	59	199	36
1945	57	51	11	49	168	30
1953	37	80	101	89	307	12
1962	27	38	103	141	309	8.8
1968	9	31	70	143	253	3.6

Settler diaries and the historical reconstructions of the Norwegian-American scholar, Kenneth Bjork (1971; 1972; 1974) characterize the initial colonial encounters, and provide background to the recruitment and planning processes that launched the Bella Coola colony. On October 30, 1894, the chartered steamboat, *Princess Louise,* arrived in the inlet of the Bella Coola River at the head of North Bentinck Arm with 84 immigrant settlers of Norwegian descent (Torliev, 1950). This arrival marks the establishment of the planned colony of Bella Coola. A few Euro-Canadian traders, and the entrepreneurial land agent and colonial recruiter, Fillip Jacobsen, were on hand to greet the colonists when they arrived (Torliev, 1950). Though downplayed in certain accounts of the first days of the colony, according to Department of Indian Affairs records, more than 200 Nuxalk populated the valley in the June 1894 agency census (Department of Indian Affairs, 1895: p.280).[29]

Viken Torliev, one of these original 84 newcomer settlers, recalled a song that depicted the uncertainty and challenge faced by the colonists as they struggled to make homes in the Bella Coola Valley (1950). The song, translated from Norwegian, was created to mark the first anniversary of the Bella Coola colony in 1895 (Torliev, 1950: p.8):

> Menacing, bare, wild and strange was the picture that unfolded as we eyed
> Bella Coola's glaciers.
> Courage almost sank, toilsome it appeared to clear, till, and build homes amid forest, tangle, and rock strewn slopes.

[29] Two published reconstructions of the first encounters between the newcomer settlers and the Nuxalk exemplify this tendency to overlook that the Nuxalk population was greater than that of the first colonists: Wilde (2004:p.87) and Kopas (1972: pp.241-245).

Iver Fougner, another newcomer who served as recording secretary for the colony's managing committee, inscribed his less than encouraged initial impressions of the physical landscape of the valley this way: "Out of the sea rose the almost perpendicular mountains dark with evergreens, their tops hidden by fog; to eastward we could see the valley, which seemed like a mere fissure in the immense mountain masses" (cited in Scott, 1997: p.53).

The newcomers left behind high prairie farms and the economic hardship of the Red River Valley, Minnesota to resettle land in Canada officials had set aside for them as the agricultural colony of Bella Coola. Bjork (1958, 1971, 1972, 1974), documented the migration of the Scandinavian colonists to the Pacific Coast and Prairie Provinces of Canada, and observed the significant influence of government recruitment efforts combined with organized transportation company activities. In addition, Bjork's (1958) richly detailed account of this migration from 1847-1893, also depicted the role played by thousands of letters of correspondence between newly resettled Norwegian-Americans and their distant families, as well as the similar effects of numerous promotional letters published in Norwegian language newspapers.[30]

Drawing on Bjork's previous scholarship, Lovoll (2001) presents an interesting, parallel account of a different group of Norwegian-American colonists who, like the Bella Coola colonists, also departed Crookston, Minnesota in 1894 to establish an agricultural

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[30] In the case of the Bella Coola colony, Fillip Jacobsen wrote to the Norwegian newspapers in America.

community. This group too, boarded Canadian Pacific Railway trains at a specially discounted price, and with the free homesteading available through the Canada Land Act, they preempted land in Alberta, and renamed their chosen place near Beaver Lake 'Bardo', after their original homeland in Norway (Lovoll, 2001).

Rationale for the migration away from 1890s Minnesota for both groups had a practical component: "increasing costs of production, a shortage of capital, rapidly rising land prices, and the likelihood of remaining renters for the remainder of their lives" (Bjork cited in Lovoll, 2001: p.361). In the case of the Norwegian-Americans bound for Bella Coola, their charismatic religious leader, Reverend Christian Saugstad, along with his small group of followers, merged the desire for land ownership with an ideological urge to detach from disputes within the Lutheran church (Scott, 1997). Reverend Saugstad and the "free" Lutherans enshrined their ideological and religious values in the colony constitution, and screened would-be colonists for "satisfactory evidence of a good moral character, working ability, and possession of necessary means to cover travelling expenses and provisions for one year" (Scott, 1997: p.52). Terms of the immigration lease for the Bella Coola colony included the provision that the newcomers must have a minimum number of thirty families or mature adults, that each would receive 160 acres, and each must have $300 in cash; settlers had to demonstrate regular residence on the land, and make improvements valued at $5/acre on their lands within five years (Scott, 1997; Wilde, 2004). The Bella Coola colony was the first specially selected tract of land where Immigration leases were tied to plans for resettlement, and they became part of British Columbia's strategy for recruiting desirable settler-colonists from 1894 until 1899 (Scott, 1997).

The Bella Coola colony constitution and by-laws, drawn up September 11, 1894 stated the purpose of the colony was, “to induce moral, industrious and loyal Norwegian farmers, mechanics, and businessmen to come to Bella Coola and make their homes there under the laws of British Columbia”.[31] With the exceptions of “sacramental, medical, mechanical, and chemical uses”, the colonists further pledged to abstain from the use of intoxicating drinks (Kopas: 1970: p. 246). Accounts of the settlers’ journey from Minnesota to Vancouver, then Victoria for provisioning, and aboard the *Princess Louise* to Bella Coola noted the removal of one, Ole Olsen from the accepted group of ‘moral’ farmers for his lack of discretion with intoxicating beverages (Kopas, 1970; Scott, 1997). These accounts then described the method of land distribution that took place on board as an organized lottery (Kopas; 1970; Scott; 1997; Wilde, 2004).[32] From Fougner’s diary of the journey, we can compare a listing of goods purchased in Victoria in 1894 for the provisioning of the Norwegian colonists, with the European provisions Governor Simpson observed his men consumed at the Hudson’s Bay Posts back in 1825: 147 sacks of flour, coal oil, soap, sugar, tobacco, tools, stoves, ‘Japan tea’, custom-made tents, and 332 pounds of coffee (Fougner cited in Scott, 1997: p.52).

The Norwegian settlers arrived in one of the wettest months of the year, and struggled to

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[31] The Bella Coola colony constitution is available from numerous print and digital sources. The Bella Coola Museum offers a scanned .pdf of the original constitution here: http://www.bellacoolamuseum.ca/en/digital_heritage/norwegian/index.php
See also *The Canadian magazine*, (February 1897, and reprinted in Kopas, (1970: pp.246-247).

[32] The narrative of the “Coming of the Norwegians” detailed in Kopas (1970) was a self-described ‘romantic’ history, interwoven with fact and fancy. Scott (1997) and Wilde (2004) attribute their archival sources and rely particularly on documented correspondence between Saugstad and Baker, colony fonds, and settler diaries.

acclimatize from "treeless, level prairies" to the rainy weather, engulfed by "gigantic, snow-capped mountains, lofty firs and cedars".[33] The work of clearing these trees and establishing makeshift encampments in the 'menacing' landscape was too much for 12 out of the original 84 colonists, who departed with the first steamship out of Bella Coola.[34] As mentioned, the method of claiming the immigrant leases among the Norwegian settlers was by drawing lots. Specifically, four men or four families drew one square mile of land, subdivided this land as they saw fit, and worked together that first winter to build shelters, then houses for each section of claimed land (Scott, 1997; "Bella Coola", February 23, 1895). Peter Leech, the government surveyor, travelled with the newcomers from Victoria to Bella Coola to assist with determining the land boundary lines and to reduce conflicts (Scott, 1997). With this system of determining the colonists' land claim locations along the narrow, Bella Coola River valley, some settlers lucked into favourable locations, and others were disappointed. Soils better suited to cultivation, sunnier locations, and higher land, located out of the flood plain were limited.[35]

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[33]Excerpts from letter written by Iver Fougner reprinted in the Victoria *Daily Colonist*, (February 23, 1895: p 006), retrieved from University of Victoria Digital Collections http://www.britishcolonist.ca/display.php?issue=18950214&pages=008,&terms=colony,bella,coola,

[34] Two sources document this early forfeiture of membership in the colony: Viken Torliev's (1950) translated account of the first days lists 'Tom Olson with his wife and six children, Sven Marven, Ole Solem, T.O. Sandness, and Peder Pederson'; a letter from the colony secretary, H.B. Christenson to the Daily Colonist (February 23, 1895) listed 4 departures and cited seclusion and the insufficient mail facilities. Given that men were the only colonists eligible to receive land, this seems the likely source of discrepancy between the two in terms of who 'counted' as departing colonists.

[35] See also White (1980) for a detailed account of the consequences later settlers to Island County Washington endured in their attempts to establish market agriculture in a place, like the Bella Coola Valley, where soils suited to cultivation were limited.

For most of the first decade after the colony of Bella Coola was established, Iver Fougner recorded the minutes for the meetings of the colony's managing committee. The minutes of these meetings detailed the main issues and priorities discussed by the colonists' leaders. Frequently cited concerns within the collection of minutes centered on communication with the provincial government, and often this correspondence between colony leaders and the provincial government reminded the government contacts of their promise to provide funding for transportation.[36] One month after arrival in Bella Coola, Reverend Saugstad wrote to Minister Baker and reported the overall safety of the colonists, then lodged a specific complaint regarding the $100 paid to the Nuxalk for transportation by canoe from the colonists' chartered steamship to dry land (Wilde, 2004). Saugstad (cited in Wilde, 2004: p.98) explained:

> "(O) ne thing is the life question of our colony and that is the road…It is impossible to bring anything up over land further than six to eight kilometers above the Indian reservation. The bush is so dense and thick that a person would have to crawl to get through and climb over windfalls up to three metres high".

As early as 1899, the Norwegian colonists discussed the financial barriers that existed to building a road out of the Bella Coola Valley and through the "Great Slide".[37] At the same time, promotion of the Bella Coola colony by way of displays of farm and garden produce appeared as one of the key strategies for outreach and general development of the

[36] See the B.C. Archives (n.d.) for the Bella Coola colony fonds (BCARS MS-1878). The wagon road, bridges, mail service, and financial support for dynamite to clear the land of trees and log jams in the river were frequently mentioned in the colony minutes.
[37] BCARS MS-1878 (January 7, 1899); See Chapter Three for more details on the "Great Slide" area in the Bella Coola Valley.

settlement.[38]

2.7 Farmers Institutes and Fall Fairs

William J. Bonavia (1936a; 1936b), a long-time superintendant of British Columbia Farmers' Institutes, compiled two brief, histories of the Farmers' Institutes of British Columbia in the early decades of the twentieth century. The first focused on the origin and development of the institutes from 1895-1916, and the second characterized the period from 1917-1936 as a political and social movement for the institutes (Bonavia, 1936a; 1936b). For Bonavia (1936a; 1936b), major items of concern among the membership of the farmers' institutes often resulted in successful revision to or creation of provincial policy from focused pressure and lobbying by the farmers' institutes. Hard-won examples of the institutes' persuasive influence over provincial policy in the early decades were: government assistance with the large-scale purchasing of stumping power for clearing land, of limestone for improving land, of the many delegates to the Royal Commission of 1913, and the ultimate appointment of an advisory board to the provincial government (Bonavia, 1936a).

Effective means of clearing and improving land were major preoccupations of immigrant settlers on the Northwest Coast (e.g. White, 1980; Harris & Demeritt, 1997). The Farmers' Institute and Co-operation Act (1897) provided for the organization of institutes throughout the province by petition, given these petitions were signed by 15 persons resident in the

[38] See the Bella Coola colony fonds held in the B.C. Archives (BCARS) under MS-1878, specifically, meeting minutes recorded for these dates connect the promotion of agriculture in exhibitions held in New Westminster and Prince Rupert with the growth of the Bella Coola colony: September 28, 1898; March 25, 1899; March 10, 1900; January 4, 1902; September 13, 1902; January 10, 1903.

district, with the purpose of "encouragement and improvement of agriculture, horticulture, arboriculture, manufactures, and the other useful arts" (Bonavia, 1936a: p.12). The first official B.C. Farmers' Institute was Surrey-Langley, established in August of 1897, then Delta, Comox, Kent, Chilliwack, Alberni, Maple Ridge, Kamloops, Naniamo, Matsqui, and the Okanagan institutes formed in 1898 (Bonavia, 1936a).

Chris Carlson, residing president of the Bella Coola colony in 1902, appealed both to the colony membership and to the Department of Agriculture for instruction and guidance on the development of agriculture in the Bella Coola Valley with a request for competent speakers and information on the following topics:

> a) How to obtain the best breed of cattle, b) erect a co-op creamery, c) information about fruit raising, d) market for our products and how to obtain best prices for same, e) loan of cheap money that we aught to use to clear land in a systematic and cooperative manner, f) organization of a farmers' institute. I would desire that the colony take these points into serious consideration, as agriculture is the main purpose of our endeavors, and we must exert ourselves to keep up with the times (B.C. Archives, n.d.; *Bella Coola Courier*, January 4, 1902).

Not long after this appeal at the colony's annual general meeting in 1902, Albert Hammer submitted an application for authority to organize a Bella Coola Farmers' Institute (Bonavia, 1936a). Documentation from the Central Farmers' Institute acknowledged the request from Bella Coola was initially held in abeyance, with much discussion over the "practical impossibility" of supplying speakers given the limited transportation connections to the distant colony (Bonavia, 1936a:p.12).[39] Later that year, however, an order-in-council passed that created a new institute district for Bella Coola, known as the North Division (Bonavia, 1936a). In the years prior to this, minutes of the Bella Coola colony's managing committee cited concerns over the high costs of freight for farmers, and recorded their follow-up activities as: petitioning the government for better transportation, putting articles in the Victoria *Daily Colonist* and the *Skeena River News,* and displaying agricultural products at New Westminster and throughout the province (B.C. Archives, n.d.). By 1905, Hammer brought the concerns of the Bella Coola Farmers' Institute forward as a delegate to the Central Farmers' Institute convention held in Victoria (Bonavia, 1936a). Specifically, Hammer appealed to the province-wide institute members for a resolution that would request government assistance for the construction of a sleigh road to the interior, a road that would open needed markets for the agricultural settlers (Bonavia, 1936a: p.22).

Government publications provide few detailed records of the newcomer-settlers' agricultural production in the first decades, yet the Bella Coola colony minutes, settlers' diary accounts, archived photographs, and early newspaper articles attest to prize-winning potatoes, cabbage, carrots, hay crops, cattle, and horses. In 1899, the colony's leaders struck a special committee to display farm produce at the Bella Coola "Colony Festival" that fall, and to "show what can be produced" at the popular New Westminster Exhibition of the Lower Mainland (B.C. Archives, n.d.). At the same time, the expensive, heavy work of clearing the coastal

[39] Farmers' Institute requirements stated that each institute must hold two annual meetings with official speakers on topics relating to 'scientific agriculture'. Though the CPR and E&N railways granted free transportation to institute lecturers during the early years, these railroads did not reach the Bella Coola Valley (Bonavia, 1936a).

forestland, of building wagon roads and bridges occupied most of the settlers' energies (Torliev, 1950). Much of the labour to build the roads and infrastructure of the colony was provided by the settlers themselves, and paid for by the provincial government (Torliev, 1950). Compared with the costs associated with establishing two other planned colonies on Vancouver Island, provincial figures for the colony of Bella Coola, including recruiting immigrant settlers, building roads, bridges, trails, a wharf, and schools, were more than $27, 600 compared with $4,600 for Quatsino and $2,800 for Cape Scott (Bjork, 1972). When these provincial funds tapped out, several of the men left for work in fisheries at Rivers Inlet, and returned with "money in their pockets and courage in their hearts to return to clearing land" (Torliev, 1950).

Though the Central Farmers' Institute leadership in Victoria had initially feared the high costs of transportation to Bella Coola would hamper the ability of qualified agricultural lecturers to reach the distant valley, assistant provincial horticulturalist, A.H. Tomlinson made regular speaking tours and visits from 1913 to 1916. The prolific local newspaper of the day, the *Bella Coola Courier* published reports of his lectures at the Farmers' Institute meetings, listed prizes he awarded at the Fall Fairs, and printed a range of articles with his recommendations for crop cultivar selection, soil management, orchard practices, strawberry culture, and more.[40] Tomlinson also made regular tours of Le C. Grant's farm, where the provincial government provided experimental seeds and orchard crop cultivars to test the suitability in various soils and climates around the province (Courier, July 24, 1915).

[40] See Bella Coola Courier, dates: (e.g. August, 30, 1913; May 15, 1915; October 23, 1915; March 2, 1916; April 22, 1916)

Tomlinson's recommendations of cultivars that were successful at the Grant farm began to distinguish orchard crops that worked in the "lower" or western end of the Bella Coola Valley (Courier, July 24, 1915). For apples, these were early maturing Yellow Transparents, Duchess, Gravenstein, King David, Blenheim Orange, Lord Suffield, and Beauty of the Bath (ibid).[41] Small grains that Tomlinson reported as doing well in the trials were Prelude, Marquis, and Fife spring wheat, Banner and Danbenay oats, and hulless barley, either as green feed or to ripen (ibid).[42] In all cases of grains growing in the Bella Coola Valley, Tomlinson recommended sowing quick maturing varieties as early as possible (ibid).

2.8 Royal Commissions and the road to 20th century agriculture

Roughly two decades after the planned colony of Bella Coola was established, the Royal Commission on Indian Affairs (also known as the McKenna-McBride Commission) scheduled hearings to settle disputes over British Columbia's Indian reserve policies. Struggles between the provincial and dominion governments over the question of land title and the size and placement of the Indian reserves had already marked decades of abeyance and countless lived examples of lost livelihood resources for First Nations (Harris, 2002; UBCIC, 2005). At the same time, the Royal Commission on Agriculture was appointed to enquire, "into the conditions affecting the various branches of agriculture" (British Columbia, 1914: p.1). The concern common to both investigations was that the Indian reserve boundaries might contain large areas of fertile land. The shared assumption was and

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[41] The article also lists recommended varieties of sour and sweet cherries, and plums that also produced well on the Grant farm in 1915. (July 24, 1915).
[42] The Fife wheat was likely a Red Fife cultivar, and the 'Danbenay' oats would be more widely recognized as Daubenay.

remains one of the most enduring “Indian” myths – that Indians are culturally predisposed against agriculture, and that these fertile agricultural lands would remain unimproved wastelands unless given over to the settler-colonists for development.

The inventory of agricultural holdings and practices gathered as evidence by McKenna-McBride during the Royal Commission hearings at the Bella Coola Agency demonstrates that Nuxalk were cultivating land, maintaining orchards, and tending livestock as a means of ‘feeding themselves’. Despite the knotty issues to untangle before taking the text of these hearings as simple statements of fact, the evidence provides one of the best available records of an early 20th century Bella Coola Valley agricultural inventory. The most immediate issues to untangle are the imbalance of power and the translated testimony. Cole Harris (2002: pp. 231-236) provides an in-depth discussion of the process of these hearings as a “theatre of power”. Harris (2002) clarifies this power imbalance and the techniques employed by McKenna-McBride as a body of related ideas, assumptions, and practices embedded within the maps, plans, and environment of the hearings.

In part because Bella Coola was overlooked as one of the sites of the Royal Commission on Agriculture’s public hearings, that commission’s final report provided only a general outline of the agricultural conditions for the settlers of Bella Coola (British Columbia, 1914). The key issue vocalized by the representative of Bella Coola Valley farmers at their regional Royal Commission hearings was that existing transportation limited their access to outside markets (British Columbia, 1914; Demeritt, 1992). The settlers wanted a railroad and better, or cheaper steamship connection. With the exception of occupational listings provided by the official voter's registry, no other government-derived publications of this time period provide a picture of how Bella Coola settler-colonists envisioned changes to the prospects and realities of their agricultural livelihoods. The scope of market-based activities and the sparse population of the Bella Coola Valley kept these farmers outside the official census accounts until 1931 (Canada, 1935).[43]

Agriculture in 20th century North America was increasingly defined as a large-scale enterprise with commercial intentions. The limited evidence of "seeing" agriculture in the Bella Coola Valley as documented by official government enumeration, says something about the limited political power given to places with relatively small populations, and the increasingly limited interest by the state to recognize modes of agriculture that contributed to a household, rather than a market economy. At a national level, the Ministry of Agriculture carried out the early 20th century dominion censuses in Canada until 1911 (Canada, 1924). The dominion censuses of 1921 began to distinguish between quantities and values of farm products intended for sale compared with those products of the farm intended for household consumption, and defined a farm as a tract of land of one acre or more with crops of any kind with a value of $50 or more (Canada,1924).

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[43] As part of investigating the histories of the Bella Coola Valley, I conducted a one hundred year scan of the Dominion of Canada's decennial census records for the farming population of the Bella Coola Valley. Because the location of the study area in this dissertation (the Bella Coola Valley) did not precisely fit census subdivisions and shifting political boundaries from 1901-2001, and because of the multiple changes to the census definition of agriculture for that time period, this data is not tabulated in the text or appendices.

2.8.1 McKenna-McBride and the Indian Land Question

In 1912, the Royal Commission on Indian Affairs for the province of British Columbia, known as the McKenna-McBride commission, was appointed to impose a final solution to what had been formally documented as the *Indian Land Question* (British Columbia, 1875; Tennant, 1990; Harris, 2002; UBCIC, 2005). Questions about land reserved for the Indians and land to be opened to preemption and to settlement of a preferred group of immigrant colonists had remained unresolved since the Douglas treaties of 1850 (British Columbia, 1875; Harris, 2002). While immigrant settlers slowly made their way into the province, fur traders, outpost merchants, and gold miners disrupted and altered indigenous exchange economies (Harris, 1997; Harris & Demeritt, 1997;Turkel, 2007). With new economies and exchange introduced, both immigrant settlers and the indigenous inhabitants here tested the land for raising crops and livestock (Knight, 1996; Lutz, 2008).[44] Settlers disputed the initial reserve surveys on the mainland of the province of British Columbia that were carried out by William Cox under Governor Douglas, and subsequent provincial governments ultimately reduced or reversed land decisions in favour of the settlers' thirst for land (Harris, 2002). Key to the settlers' disputes and the momentum of the colonial dispossession taking place, was the conviction that the indigenous peoples were non-agricultural, though according to Department of Indian Affairs income estimates for the early decades of the twentieth century,

[44] See the previous section on "Outpost farming" and also Sarah Carter's (1990: pp. 11-14) *Lost Harvests* for an excellent review of the literature on the early successes of Indian Agriculture in Canada. Carter's (1990) work reconsiders the long-standing notion that Indians were culturally predisposed against agriculture with historical evidence of the greater influence of government policy on the failure of reserve agriculture specific to the Plains Indians during the early reserve period.

the agricultural sector “supplied more income to B.C. Indians than any other” (Lutz, 2008: p. 210).

Complaints and unrest from aboriginals regarding specific instances of lost land and livelihood went essentially unheard in the province and, in the words of historian Paige Raibmon (2008: p. 65), “as it played out on the ground, even the claims of settlers who flouted land laws took precedence over Aboriginal claims”. The majority of land was not surveyed at the time of preemption, and in many places settlers took advantage of limited government oversight to side-step residency and improvement requirements (Sandwell, 1999; Raibmon, 2008). Quoting the Minister of the Interior in 1877, anxiety over conflict or threat of an Indian war seemed near enough to warrant this telegram sent from the dominion to provincial authorities:

> Indian rights to soil in British Columbia have never been extinguished. Should any difficulty occur, steps will be taken to maintain the Indian claims to all the country where rights have not been extinguished by treaty. Don’t desire to raise the question at present but local government must instruct Commissioners to make reserves so large as to completely satisfy the Indians (In Duff, 1997:p.93).

Organizing as a political entity rather than through armed conflict, in 1910, delegates from First Nations reached out to the dominion government in Ottawa and to Premier McBride in Victoria, and the matter was finally referred to the courts for judicial reference (Harris, 2002; UBCIC, 2005). The designation of appointees to the McKenna-McBride Commission was intended to balance the power between the province and dominion, with two commissioners chosen to represent the dominion, two to represent the province, and a chair selected by the group (Harris, 2002). Along with the “theatre of power” (Harris, 2002: p. 231) that was the summoning of witnesses and hearing of testimonies under oath, a crucial material accompaniment of the power to dispossess were the surveys and maps (Brealey, 1995). To this end, the commissioners also appointed a technical officer, Ashdown Greene, to carry out the surveys and map the land designated for reserves (Harris, 2002). As the balance of power between the province and dominion was carefully orchestrated, and a simple majority vote by the commission sufficient to determine the fate of the reserves, the imbalance of power between the commissioners and the witnesses who testified would have been a palpable indication of the process as a whole (Harris, 2002).

Decisions of this commission were to be imposed materially in the form of reserve maps that confirmed, cut-off, or added new reserves to the map of the province of British Columbia. Harris (2002) details several cases where commissioners decided to support existing reserves, and under which political conditions or otherwise, commissioners voted to reduce reserve lands as cut-offs or add new reserves.[45] After three exhaustive years of hearings around the province, and the final report of the commission submitted, an organized coalition of First Nations' chiefs known as the Allied Tribes rejected the McKenna-McBride minutes of decision first published in 1916 (Duff, 1997). With this rejection and in the political climate of the day, eight more years of negotiation between Ottawa and Victoria intervened until a modified version of the 1916 report was approved in 1924 (Harris, 2002).

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[45] See Harris (2002: p.247) Table 8.1 and in digital format, the UBCIC (2005) reserves summary: http://www.ubcic.bc.ca/Resources/final_report.htm#axzz24rCVA65N

Moving from a brief background to the process of the McKenna-McBride commission hearings summarized above, to the specific case of these hearings in Nuxalk Territory, the question of title to the land appeared as the primary issue for Nuxalk spokespersons. Captain Schooner, a respected elder spoke first and spoke freely about the loss of land:

> We are telling you our troubles. The white people are not doing justice to us. We have lost a lot of land up the river. From the day the government took our land, as we say, we did not get any treaty (British Columbia, 1913: Bella Coola Agency testimony, p.10).

The commission chairman's response was unequivocal on the matter of title. Their working assumption was that title to "these lands" (Nuxalk Territory) is "in the Crown", and commissioners had no authority to address any questions or complaints connected with the issue (British Columbia, 1913: p.11). Continuing their testimony through two Methodist missionary interpreters, Nuxalk spokespersons Albert King, Tom Henry, and Captain Schooner outline their complaints of loss of access to berry picking lands, to fishing, hunting, and trapping lines, and appeal to the Commissioners for 100 acres per man (British Columbia, 1913: pp. 11-12). Albert King provides a clear description of the connections between the access to land and the capacity for the Nuxalk to feed themselves and their growing families:

> We realize too, that the foods which our father used to eat are being done away with. We cannot get the native food as in the olden days. Our means of getting these foods are curtailed. We have to have sufficient land that we may be able to provide ourselves and our children with food. About 10 or 14 years ago we used to have a lot of cattle on our land, but our land was too small to allow us to have both cattle and gardens, as the cattle used to destroy the gardens and we found that we could not keep the cattle and have the gardens at the same time.

(British Columbia, 1913: p.15).

The Commissioners continue questioning Albert King as part of establishing through testimony the land use and livelihood practices of the Nuxalk people on the reserve lands. Commissioner Young asks Albert King specific and pointed questions about the area of the three different reserves in the Bella Coola Agency, and though he was not trained as a surveyor, Mr. Young questions him closely about the quality and quantity of the land on the maps (British Columbia, 1913). Albert King's testimony provides information that would be required for a basic inventory of agricultural practices and land use for the year of these hearings. Table 2.2 presents this inventory as a reference point for the food production inventory and land use mapping that took place in the Bella Coola Valley nearly one hundred years subsequent to these hearings.[46]

Table 2.2 Inventory of agricultural land use and practices given by Nuxalk spokesperson, Albert King to the Royal Commissioners at the McKenna-McBride hearings held on reserve in Bella Coola, August 16, 1913.

Area of surveyed reserve confirmed by Nuxalk	**Area of reserve reported by Nuxalk as "good land fit for cultivation"**	**Land use**	**Farming equipment**	**Livestock inventory**	**Types of tree fruits**
Reserve No. 1 3663 acres	2000 acres (800 hectares)	Cultivated crops: potatoes, turnips, hay	Mowing machine, ploughs, barrows, horses	10 cows 0 pigs 500 chickens	Apples, plums, cherries

[46] See the food production inventory and agricultural land use mapping results from 2007 in Chapter Six.

Though the McKenna-McBride Commissioners ultimately failed to create a uniform or rational agreement, the information they gathered in the course of testimony at hearings in Bella Coola provides strong evidence that farming activities contributed to the overall portfolio of livelihood practices in Nuxalk Territory at the time. Commissioners created a series of data tables as part of the material they presented in their final report. In “Table B” of the Bella Coola Agency report, commissioners organized their view of the reserve lands under investigation with information about the “character of the soil”, and a split column to compare the estimated proportion of the land utilized. For the Bella Coola Reserve Number 1, the character of the soil was given as: “Greater part good fertile land; lightly timbered, level and easily cleared; a minor portion subject to overflow; about one-third mountainous and timbered, generally non-cultivable” (British Columbia, 1916: p.232). From Albert King’s testimony, activities that earned cash for the Nuxalk were fishing, trapping, and logging, yet King and the Reverend Gibson clearly state the Nuxalk have a strong interest in farming and securing land for farming (British Columbia, 1913: pp.18; 23). In testimony that stands out for its themes and assumptions when read in the context of the 21st century, Reverend Gibson characterizes the Nuxalk people’s desire to farm as part of a general ‘back to the land’ tendency:

> Q: What are the causes which lead you to state that the young men want to become farmers?
>
> A (Reverend Gibson): Well, they are getting tired of having to go away outside to work.
>
> Mr. McKenna: They want to remain on the reserve with their on people as far as possible?
>
> A (Reverend Gibson): Yes.

> Mr. Young: Are there other causes which are bringing them to the land?
> A (Reverend Gibson): Well, I don't know, except the general tendency "back to the land", and of course, a number of the people have quite large families and they have arrived at the conclusion that it is better to work at home and have a place to live on, then to go away logging. I myself certainly think this is best as it keeps the families together better. (British Columbia, 1913: p. 23).

The McKenna-McBride Commissioners concentrated their questions on accounts of agricultural activities and on evidence of the material conditions and livelihoods on reserve, with one question to Albert King about the availability of agricultural wage work. According to King, there were no Nuxalk working for white farmers up the valley (British Columbia, 1913: p. 17). Phillip Jacobsen, an entrepreneur credited with the recruitment of the Norwegian-American settlers to the colony of Bella Coola, provided the only other mention of agricultural efforts underway with the settlers in Bella Coola at the time of these hearings. Jacobsen described a failed attempt to cultivate hops that he had envisioned as a means of employment for the Nuxalk in connection to his sworn testimony (British Columbia, 1913: pp.35-36). In a section outlined in the testimony contents as the "Jacobsen explanation" (British Columbia, 1913: pp. 35-38), he gave his testimony in answer to complaints by the Nuxalk spokespersons about unpaid rent to land he leased on reserve twenty years prior.

2.8.2 The Royal Commission on Agriculture and settler-colonialism

Royal Commissioners appointed to investigate the prospects for the development of settler agriculture in British Columbia held public hearings in key agricultural locales throughout the province from January through August of 1913 (British Columbia, 1914). Bella Coola was one of the six areas not visited by the Royal Commissioners who investigated the agricultural conditions for most other sections of the province. Also listed in their final report as having potential for agricultural development, but not prioritized for public hearings or inspection by the commission were: the Queen Charlotte Islands, the Nass River Valley, the Bulkley Valley, the districts east of the Bulkley Valley near Francois Lake, and the South Fork of the Fraser River that was surveyed for preemption (British Columbia, 1914: pp.65-69). Available climate data was foremost in the descriptions of agricultural conditions for each district, followed by a summary of information about the soils, the status of land clearing, of drainage and irrigation requirements or projects underway, of available labour, distance to markets and existing transportation were also included for each area (British Columbia, 1914). Where available, commissioners reported on the status of co-operative marketing and purchasing efforts, on average land prices, and on the status of the modernizing forces of telephones and telegraphs (ibid).

On August 11th and 12th, 1913, roughly one week prior to the McKenna-McBride hearings in Bella Coola, commissioners hosted public sessions on agricultural development in Prince Rupert. Some 500 kilometers west and north along the B.C. coast, Prince Rupert was the port city then looked upon as the "principal outside market" for the Bella Coola Valley (British Columbia, 1914: p.66). These were the nearest hearings of this Royal Commission for the farmers of the Bella Coola Valley, and a single representative of the settler-colonists and Bella Coola Farmers' Institute travelled by steamship to Prince Rupert and provided an account of their agricultural prospects and concerns (*Bella Coola Courier*, August 23, 1913). Phillip Jacobsen emphasized the high costs of land clearing and challenges of transportation to markets to the Royal Commissioners in Prince Rupert (Demeritt, 1992). At these hearings, Jacobsen declared of the Bella Coola farming situation, “we can not compete” (cited in Demeritt, 1992: p. 15).

In terms of their timing, the two Royal Commission hearings of August 1913 were scheduled nearly simultaneously for the public sessions available to Nuxalk and settler-colonists. Appointed commissioners in both cases carried the mandate of making recommendations that linked land with livelihoods, though these recommendations were framed quite differently in the final reports of the two Royal Commissions. Based on Jacobsen’s testimony, the agricultural commissioners included this summary of the general prospects for the Bella Coola Valley agriculture in their final report:

> The agricultural lands in the valley are said to be all taken up and held at prices ranging from $45 to $250 an acre for uncleared land, the clearing of which costs from $50 to $250 an acre. The soil is generally fertile sandy loam…The Government is building a wharf at the harbour and a steamer calls weekly. The settlers make part of their living by fishing and keep cattle, hogs, poultry, grow some hay, potatoes, vegetables, and fruit; the conditions for all of these seem reasonably favourable (British Columbia, 1914: p.66).

The similarities reported for the Nuxalk and the settlers’ means of earning their living by McKenna-McBride and agricultural commissioners are striking. Recall now the terms of the immigration lease given to the recruited Norwegian colonists, specifically, ‘that each would receive 160 acres’. Nuxalk spokespersons requested 100 acres per male head of household of the Indian Reserve commissioners (British Columbia, 1913: p.13). In their minutes of decision, McKenna-McBride commissioners placed this request in a data table. Filed under the column heading, “status of land desired”, this requested land was described as an “indefinite territorial claim”, and in the next column, commissioners registered their decision on this request as “not entertained” (British Columbia, 1916: p.244).[47] The per capita land allocated for Bella Coola Reserve #1 confirmed by the decisions in this report was 18.25 acres (British Columbia, 1916). The differences in the opportunities to establish a livelihood on agricultural land given to the settlers and taken from the Nuxalk, then, are also striking.

The Royal Commissions revealed much about British Columbia’s public values and agricultural assumptions in the early decades of the 20th century. While the commissioners gathered information about soils, climate, and crops, the testimonies at the hearings generated recommendations that ranged from increased investments in agricultural education, more favourable tax laws and preemption regulations, an urgent need of low interest loans to farmers, and additional, if slightly altered opportunities for paid public road work for settlers. Racially motivated issues included in the commissioners final report included “nuisances arising” from Indian reserves, and undesirable competition from “Oriental” truck farmers and “Hindu” dairymen (British Columbia, 1914: pp.14-15). The enthusiasm for telephones coupled with the faith in the overall necessity of increasing, and modernizing agricultural production inscribed in this report neatly fits the “industrial ideal” outlined by Deborah Fitzgerald’s (2003) *Every Farm a Factory*.

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[47] UBCIC supports a digital repository of scanned documents associated with land decisions made by the province. See this site for the Royal Commission on Indian Affairs (McKenna-McBride) final report and minutes of decision, and the Bella Coola Agency Report, additional lands applications (reference number 6, p.244) See the link that follows: http://www.ubcic.bc.ca/Resources/final_report.htm#axzz24rCVA65N

Partially as a response to increased investments in agricultural education, a few other provincial agriculturalists came to call on the Bella Coola Valley within a few years of the Royal Commission on Agriculture.[48] Several visited the fall fair, spoke on dairying, and gave farmers' institute lectures on purebred livestock - but by 1920, farming was no longer considered the principal source of livelihood for the majority of newcomer landowners who had resettled the Bella Coola Valley. Table 2.1 above provides a simple overview of the percentage of the Bella Coola Valley population who identified themselves as farm operators (or ranchers) from 1898 to 1968. Data for this table is sourced from Canadian voters' lists for the years cited. These lists are the best available resource that I could find for documentation of livelihood occupations for this time period. They are far from an ideal record of historical participation in agricultural activities because they only take account of people with the franchise power of the vote. For the first few decades of this time period, this power was limited to white male colonists. With few exceptions, white male colonists would also have had exclusive access to land title during this time period. The missing information about women, indigenous peoples, and other immigrant groups who were not given the vote absolutely misses people who engaged in farming and gardening, and these people also missed opportunities to access agricultural land. Emphasizing this last point, the voters' lists do not miss many potential land preemptors or "farm operators" as they were defined in

[48] The UBC Library offers a digitized repository of historical newspapers from the late 19th into the 20th century: http://historicalnewspapers.library.ubc.ca/
The *Bella Coola Courier* was published from September 1912 to October 1917, and provides an excellent resource for reports of agricultural speakers fall fair announcements, etc.

agricultural census for the earliest decades of the 20th century[49].

2.9 Conclusion

Nuxalk Territory and the Bella Coola Valley are places with multiple histories of agriculture and food production. In thinking about and organizing a call to regenerate agriculture in this place, I found understanding the historical context of contested territorial claims was of primary importance. This historical context has a contemporary dynamic, in that the contest over territory and over livelihoods has not been erased. Moreover, the past and present meanings of agriculture and of agricultural food systems have significance for people who would be called upon as actors and participants in the regeneration initiatives. Colonialism dispossessed the Nuxalk of a large portion of their territory to create space for newcomer settlers, who brought in new forms of governance, new forms of land ownership, new economies, and new foods. The colonial encounters depicted in this chapter represent only a very partial range of lived experiences associated with the loss of territory and the loss of lives that resulted from what Wilson Duff (1997) referred to as "the impact of the white man".

Prior to the arrival of the newcomer-settlers, the Nuxalkmc and Hudson's Bay Company traders established "outpost gardening" as a way to supplement the changed and changing food system. Both the Nuxalk and newcomers developed knowledge and skills intimately connected with the challenges of establishing household gardens, tending livestock, raising

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[49] See this overview given by Statistics Canada of the changes to the definition of a census farm in Canada from 1921-2006: http://www.statcan.gc.ca/pub/95-629-x/2007000/4123857-eng.htm

hay and maintaining orchards within the biophysical limits of the Bella Coola Valley. The evidence of outpost gardening and of active adaptations to settler agriculture into the 20th century by the Nuxalk exposed the myth that Nuxalk were culturally predisposed against cultivation, and instead expressed an active interest in food production that supplemented their livelihood and in securing land that made multiple strategies for a livelihood possible.

Beginning in 1894, Norwegian-American colonists resettled the Bella Coola Valley on terms of specially designated immigration lease agreements with the nascent province of British Columbia. From the evidence presented by the Farmers' Institute and Bella Coola colony records, farming was seen as an important contribution to the establishment of the colony, and the farming way of life was valued as such. These newcomers struggled to hew homesteads from the dense, coastal forests, and many turned to road building and commercial fishing in efforts to raise the capital needed to clear land and meet the "improvement" terms of their leases. Within a few decades of establishing the Bella Coola colony and their title to land in the valley, the majority of male newcomer-settlers no longer identified agriculture as their primary occupation.

The reserve space allotted to the Nuxalk and ultimately confirmed in the McKenna-McBride and Royal Commission processes did not set up equivalent access to land compared with the immigration lease arrangements set up between the provincial government and the recruited settlers. Colonists were given an opportunity to lease 160 acres per household, and the Nuxalk reserve space was roughly 18 acres per household.

Evidence from the two Royal Commission hearings of 1913 suggested: 1) that Nuxalk spokespersons envisioned securing title to land as a first priority, and that agricultural activities on their reserve lands were important adaptations to changed socio-ecological and political realities; and 2) that a representative of Bella Coola settlers viewed better transportation access to outside markets as a primary concern.

In summary, this chapter contributes to an understanding of the meanings and histories of agriculture in the Bella Coola Valley by discussing the colonial techniques of dispossession in Nuxalk Territory with the narratives of establishing Bella Coola as an agricultural colony. Similarly, the evidence presented here highlights the active role Nuxalk played in pioneering Bella Coola Valley agricultural land uses, despite historically uneven access to land since the period of colonization.

Two contemporary examples of initiatives to regenerate food systems in the Bella Coola Valley serve to explore the intertwined histories of indigenous and settler food systems in this context: the first was the Nuxalk Food and Nutrition Program, and the second was the BCVSAS-UBC partnership initiative called the Foodshed Project. The long-term collaborative research partnership exemplified by the Nuxalk Food and Nutrition Program (1981-2006) characterized the traditional food system of the Nuxalk and demonstrated an interest by Nuxalk participants in regenerative indigenous food systems. In the words of Nuxalk elder, Dr. Margaret Siwallace, “the old foods are the new foods” (cited in Turner, Harvey, Burgess & Kuhnlein, 2009).

Part Two of this dissertation explores the second initiative, catalyzed by the Foodshed Project of the BCVSAS-UBC partnership. In terms of the community dialogue that inspired the university-community partnership, the Bella Coola Valley Sustainable Agricultural Society (BCVSAS) was organized as a follow-up to a series of Town Hall Meetings a few years after the turn of the 21st century. Founding members came from backgrounds that shared interests in food, land, and nutrition, and included health care and social services providers, small-scale agricultural entrepreneurs, members of the Nuxalk Nation, and regional district government representatives. With a few important exceptions that stemmed from their unique local, historical context, this organization promoted a vision shared by their North American contemporaries in the community food security movements. The broad goals in their efforts to regenerate agriculture in the Bella Coola Valley included connecting and building capacity for producers and consumers, as well as preserving agricultural land.

The chapter that follows builds on the agricultural histories of the Bella Coola Valley provided here, and continues to explore the contest between 'feeding ourselves' and 'feeding the world' in the Bella Coola Valley.

Chapter 3: The road

In the beginning *Wiaqaii* came to the earth as a man on Mount *Nuya*, near *Stuıx.* He seated himself on the mountaintop and slid down to the valley, clearing a smooth track as he went, which is still bare like the path of a landslide. He was all alone and built for himself a house of evergreen boughs, *kwals*, to which he gave the name *Kwalsänt.* After sojourning there for some time he decided to marry; so he set off up the valley to find out if there were any people living above him. He travelled over a series of parallel ridges, from the top of one of which he saw before him a number of men, also going upstream. Around their heads they wore light-coloured bands. They disappeared over the next rises and when *Wiaqaii* reached the summit of this he saw in the hollow below him, not a number of men, but a pack of wolves, preceding him on the trail. The wolves passed over the next ridge out of sight, but when *Wiaqaii* gained on the crest he saw in front of him, not wolves, but the men again with the bands around their heads.
(McIlwraith, 1948, pp. 307-308)

In the sharp morning sunlight of September 14, 1952, the Graham "Cat" (a new D6 Caterpillar tractor with an angle blade) bit into the eastern edge of the wilderness, its destination the Pacific Ocean, its route not yet completely explored. The man at the controls, a tall, soft-spoken rancher who wore a mechanic's cap and a pair of Indian made buckskin moccasins, was Alf Bracewell and his directions were to follow the blazes on the trees and keep going.
"I'm told to go to blazes," Alf grinned.
More specifically, he was told to build a road through thirty miles of jack-pine jungle, find his footing along the lip of the canyons, some of them three thousand feet deep, then bring his machine from the top of a mile-high mountain to the floor of the Bella Coola valley, thereby piercing the Canadian Coast Range, and giving North America another outlet to the sea.
(Kopas, 1970, p. 279)

3.1 Introduction

The preceding vignettes direct the reader's attention towards the eastern end of what we have been calling the Bella Coola Valley, and evoke images of this place as a point of connection and change. The first was part of a Nuxalk origin story, shared by Mrs. Willie Mack, translated and later published by one of Canada's greatest salvage ethnographers, T.F. McIlwraith (1948). The latter was part of a romantic retelling of the origins of the Freedom Road, written by Bella Coola road booster, Cliff Kopas (1970). Both accounts describe difficult and uncertain terrain, and hint at the rewards of persevering the trail or leveling the wilderness. For the Nuxalk god-as-man, *Wiaqaii,* the promise of a wife made dilemmas encountered along the trail acceptable. For the buckskin wearing heavy equipment operator, Alf Bracewell, visions of taming the backwoods and opening the territory seemed to outweigh the dangers of falling with his machine from the mile high mountain to the valley floor. See Figure 3.2 at the end of this section for a map of the Bella Coola Valley.

Drawing from lessons provided by William Cronon (1992), the stories we tell about places and events reveal a good deal about the values and meanings we attach to them. Stories, more than simple chronologies, can provide a moral compass and, in the case of a particularly compelling or well-told tale, can "change the way we act in the world" (Cronon, 1992: p.1375). This chapter, devoted to stories about the paths in and out of the Bella Coola Valley, provides a new way of understanding the histories and the potential for agriculture in this place. As the previous chapter demonstrated, agricultural histories here are multifaceted, complicated by dissimilar opportunities for ownership and control of the land from the colonial period and into the 20th century. For the latter half of the 20th century, Bella Coola road stories epitomize the diverging ways of thinking and practicing agriculture. These stories can offer robust insights into the Productionist 'feed the world' paradigm, as well as the more socio-ecologically grounded 'feeding ourselves' approach.

The road stories that cut through the place we call the Bella Coola Valley are numerous and notorious for their switchbacks. Long before newcomers arrived with compass, sextant, chronometer, and a strong desire to establish trade and transportation routes to and from the Pacific, grease trails marked the networks of trade that connected Coastal peoples with inland communities.[50] For the indigenous peoples of the plateau and coast, there was no single road connection, rather, a "lived mesh of trails and cyclicity and seasonality of travel" (Turkel, 2007: p.109). In 1793, Alexander Mackenzie made his famous journey along what he referred to as the "Great Road", guided by Carrier (Dené) and Ulkatcho and into Nuxalk Territory. Central to his mission, this great road Mackenzie and his men travelled along was already a well-established trade route (Lutz, 2008: p.120).

Jennifer Kramer (2006), an anthropologist focused on art and identity, invokes the term 'switchbacks' as a metaphor for the convergence of the physical and cultural landscapes prompted by her journey along the road to her research site in Nuxalk Territory. Kramer (2006) asserts that the switchbacks in the road stood as a physical means of delineating the insider-outsider dichotomy that she argued creates contemporary Nuxalk identity in art.

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[50] See the prologue in *First Man West,* Walter Sheppe's (1962) annotated account of Alexander Mackenzie's journal for a detailed outline of the personalities, politics, and economic forces driving the search for better transportation and trade routes through the Northwest and to the Pacific. My understanding of multiple narratives along the Grease Trails was strongly influenced by the "Grease Trails" chapter in William Turkel (2007: pp. 108-135). See also Birchwater (1994) for a rich source of perspectives and elders' stories of the trails collected by the Ulkatcho curriculum committee.

Driving the switchbacks in different direction, this chapter explores four kinds of Bella Coola road stories for the purpose of clarifying tensions that have been central in the struggle to establish agriculture in this place. These tensions, examined at great length in the environmental and agricultural history literatures as the transition from self-sufficient farming to commercial, or industrial agriculture, are revealed thematically as connection and self-reliance (e.g. Parks, 1972; Cronon, 1991; Stoll, 2002).

Connection signifies physical ties to the varied landscapes of valley, mountain, and plateau, as well as cultural and familial ties, business and political relationships. Following Kloppenburg (et al., 1996: p. 38), self-reliance as implied here denotes “the reduction of dependence on other places, but does not deny the desirability or necessity of external trade relationships.” Highlighted by the themes of connection and self-reliance are the relationships between the systems of knowledge deployed in road building, in the best routes for the road, and the markets and exchange that open and close with the road connection**.**

Stories of the “Great Road” and the grease trails are part of the oral histories of the Nuxalk and Ulkatcho, intertwined by millennia of exchange at the boundaries of their territories. These crucial networks of trade and connectivity between coastal-valley and interior-plateau peoples draw attention to the deeply rooted indigenous knowledge of place. When the once abundant centre of this trade, the eulachon, became scarce in the 1990s to the point of disappearance in early 21st century, Nuxalk and neighbouring peoples of the Coast and Interior came together to remember, and to organize. Recollections of the grease trails and of the eulachon provide the beginning point for the road stories of this chapter.

The second kind of road story explored in this chapter climaxes with the opening of the Bella Coola highway connection. This particular story of progress is a published account of the road building project that provided newcomers a way out of Bella Coola and into the rest of the province. In this story, Cliff Kopas, the "one man chamber of commerce" for 20th century Bella Coola, presents the reader with a plot line that rises with the triumphant achievement of the settlers in their struggles to join the modernizing forces of the world outside of the valley (French, 1994: p.198). Once the road was completed, the last sentence of his epic exclaims, "Now we are part of the world!" (Kopas, 1970: p.291). To the newcomers, the connecting road was known variously as the Freedom Road, Alexander Mackenzie Memorial Highway, Bella Coola/Chilcotin Road, and Highway 20. After nearly sixty years of regular petitions and correspondence with the provincial government for transportation support to and through the Bella Coola Valley, many residents celebrated the connection to provincial Highway 20 "in a fiercely victorious mood" with "horns blowing" (Kopas, 1970: p.289). Cherished by the sons and daughters of the road boosters and settlers, the Freedom Road story was the first to reach worldwide audiences as a full exhibit on the digital heritage project pages of the Bella Coola Valley Museum website.[51]

The third type of road story reviewed in this chapter is one that takes a more tragic or "declensionist" turn.[52] In these stories marked with decline, the golden years and abundance are behind rather than in front of the plot line, and all signs point to something lost or

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[51] http://www.bellacoolamuseum.ca/en/digital_heritage/index.php
[52] Following Cronon (1992: p.1352) the progressive and declensionist narrative provides a means of shedding light on the project or persuasive intent of the storyteller.

vanished. Road closures and the threat of interrupted supplies brought in from the highway connection present a kind of crisis narrative to the people living in the Bella Coola Valley. In this way, 'how do we feed ourselves' takes on a sense of urgency. These stories are lived experiences, retold in local and provincial newspapers, summarized in reports and hearings to provincial agencies, and ultimately repeated in efforts to gain some voice with policymakers.[53] Connecting these stories with those in the next section on the disappearance of the eulachon, scarcity or decline in the river and ocean environments figure as prominently in food systems issues as the closures to the Bella Coola highway.

The fourth and final section of this chapter offers a brief reflection on a different kind of road story—road reports written by and for people from outside. Since Alexander MacKenzie arrived in the summer of 1793, specialists of one type or another have made the journey into the valley with the agenda of mapping their journey or taking inventory of the stocks and stores observed. These encounters required the assistance of the Nuxalk or initiated newcomers, and, viewed together, offer a continuum of reflections on different systems of knowledge.

Notions of connection and self-reliance are intended as lenses on a shift, or perceived shift, from agriculture as an integral part of the household economy to agriculture as a commercial pursuit with targeted, external markets as its dominant rationale. In their efforts to

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[53] See for examples (e.g. Chapman (2007) Thompson (2007ab), and Tallio (2007) for stories in the contemporary Bella Coola Valley newspaper, *Coast Mountain News*; Lee (2004) and Hume (2007) for stories in provincial and national newspapers; and Sayers, Lenci, and Clark (2008) for provincial health policy forum hosted by Bella Coola Valley health and social services providers)

communicate with the provincial government and external agricultural institutions, Bella Coola Valley farmers argued that roads were an essential link to their marketplace, yet improvements to the road brought cheaper food than valley farmers could produce. Together these road stories provide insights to the perceived directionality of progress or decline for the Bella Coola Valley agriculture and food systems.

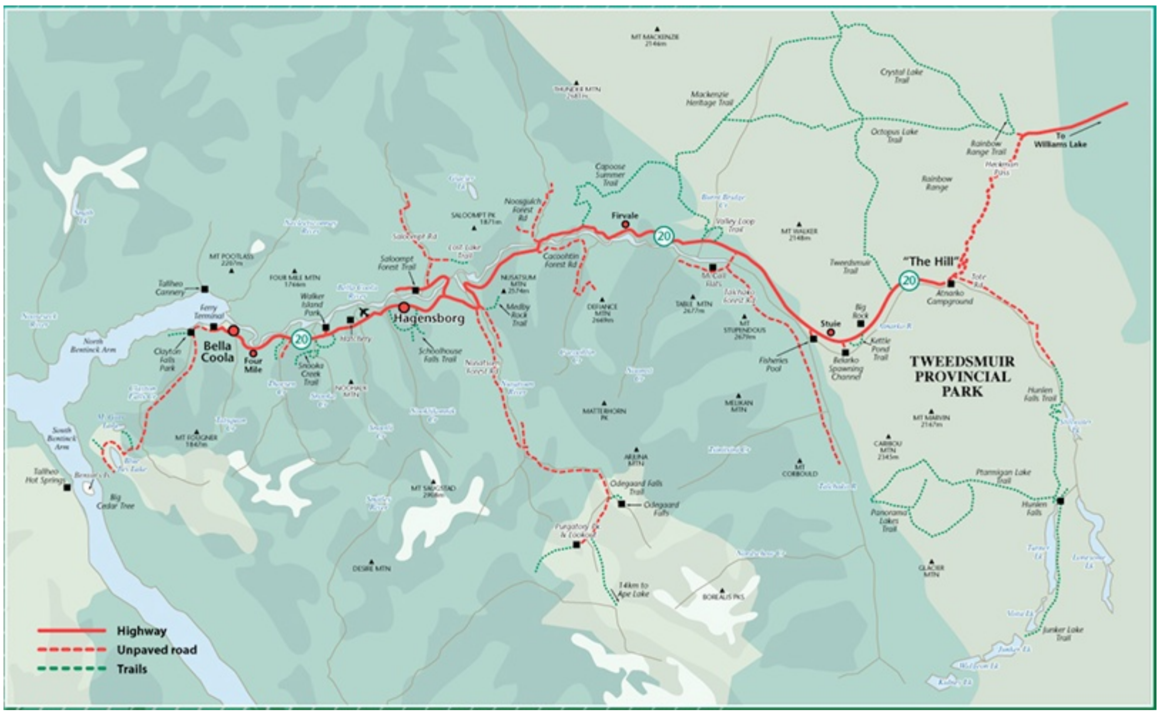

Figure 3.2 Map of the Bella Coola Valley from the Bella Coola Valley Tourism website. The unincorporated villages of Bella Coola, Hagensborg, Firvale and Stuie are listed here, as well as the 4 Mile reserve area. http://www.bellacoola.ca/valley-maps/

3.2 Stories of abundance and scarcity: Grease trails

Transportation and connection are vitally important to the Nuxalkmc, who have inhabited the Bella Coola Valley for millennia prior to the arrival of the Hudson's Bay traders and

Norwegian-American colonists. On July 18, 1793, during his journey to the Pacific, Mackenzie noted in his journal the abilities demonstrated by the Nuxalkmc on the Bella Coola River: “I had imagined the Canadians who accompanied me were the most expert canoe-men in the world, but they are very inferior to these people…in conducting those vessels” (Sheppe, 1962: p. 219). Despite the difficulties and confusion Mackenzie recorded as a consequence of his dependence on translators and guides through multiple First Nations’ territories, he and his men traversed well-worn trail(s), encountered numerous villages and encampments, and learned of their guides’ desire to depart for their own active trading journeys across the region.[54]

According to John Sutton Lutz, in his *New History of Aboriginal and White Relations*, eight to ten thousand years ago the “great road” was a trade route that “linked the Pacific coast to a vast portion of North America” (2008: p. 121). On this road, the two most valuable items for exchange from the coast were eulachon grease and dentalia shells (Lutz, 2008). For the Nuxalk and Ulkatcho, the geology in the area of the Great Slide and at the Western terminus of the Great Road was also a source of wealth. In contrast with the physical separation the newcomers and settlers experienced, the mountainous terrain, like the valley bottomlands, rivers, and ocean below, provided usable means of connection and self-reliance for people with intimate knowledge of and connections to the grease trails. For example, obsidian, a black volcanic rock with the structure to hold a sharp edge, was a widely dispersed trade item derived from only a few sites in western North America (Lutz, 2008: p.122; Turkel, 2007:

[54] See Mackenzie’s journal edited by Walter Sheppe (1962: pp.190-232), especially the dates he entered as July 8-20, 1793; also see Turkel (2007: pp.93-94) and Lutz (2008: p.120).

pp.112-115). Chemical analyses of obsidian found at archeological sites from the west coast to the Alberta prairies trace the deposit source to three important sites near present-day Anahim Peak, an area that borders and overlaps both Nuxalk and Ulkatcho Territories (Lutz, 2008). Down these steep, volcanic mountains and into Nuxalk Territory was also an important greenstone quarry, where Nuxalkmc extracted trade materials used elsewhere for adzes and chisel blades (Lutz, 2008: p.123). Similarly, Nuxalkmc made use of the flora and fauna in the full range of their territory, including these higher elevation areas where men hunted mountain goats and caribou and women picked berries (Turkel, 2007; Lutz, 2008; Turner, Davidson-Hunt, & O'Flaherty, 2003; Turner & Turner, 2008).

The rendered oil of the eulachon (sputc, *Thaleichthys pacificus*) fish gave the well-worn grease trails their name and indigenous groups with controlling access to eulachon runs held power and wealth connected with this highly-prized, nutritious trading good (Turkel 2007; Lutz 2008). Nuxalk fished eulachon in the Bella Coola, Klinaklini, Kimsquit, and Dean Rivers and traded along two trails from Kimsquit and five trails from Bella Coola to the interior (Turkel, 2007). In 2008, Nuxalk fisheries biologist Megan Moody (2008) published her Masters' Thesis on the past and present of the eulachon.[55] Eulachon once thrived from California to southeastern Alaska, and were the first staple food source to return after the long winter (Hume, 2007; Moody, 2008). Since the mid 1990s, eulachon spawning and harvestable catch have seen severe declines in nearly all of the ninety-five rivers along the Pacific Coast where they have had historic returns (Moody, 2008). The rivers favoured by the

[55] Available through the UBC electronic thesis and dissertation services repository: https://circle.ubc.ca/handle/2429/676

eulachon, including the Fraser, Bella Coola, Stikine, Skeena, Kitimat, and Kitlope in British Columbia, characteristically drain from glaciers and have spring freshets (Hume, 2007; Moody, 2008). Crucially important for connection, exchange, and transport, these rivers, as deftly summarized by Richard White, “bonded the material and the social”.[56]

Nuxalk author Nusqumata (Jacinda Mack) eloquently acknowledged the end of an era in her brief report on the June 2007 Eulachon Gathering in Bella Coola. The event brought people together from neighbouring villages and territories, as well as visitors from international non-government organizations, interdisciplinary scholars, and national news media in hopes of understanding the factors and impacts in the loss of this keystone species.

> Springtime in the Nuxalk village of Qomqots (Bella Coola) has always been marked by the arrival of the Sputc, or eulachon, to our river. That is, until about 10 years ago, when they suddenly and sadly disappeared. Local residents, including eagles, gulls and people, still wait on the banks of the river, hoping to catch a glimpse of the silver and black fish that once filled spoon canoes to within an inch of the water. Cooking boxes and shacks are overgrown and decayed from lack of use, and personal stores of Grease are guarded like gold. What once marked the end of a cold winter has turned from celebration to condemnation. (Mack, 2007)

Though the eulachon was not seen as commercially important, the cultural and ecological significance of this small, oily smelt was captured in the heart-felt words of elders, and in the volumes of scientific documentation presented during and following the gathering (e.g.

[56] White’s (1995) comments here are derived from his discussion of the Columbia River, another of the eulachon rivers in decline since 1993. In this particular passage (p.12), White was focused on describing the energy and human labour that has historically connected humans with the river.

Mack, 2007; Thompson, 2007a; Hume, 2007, Senkowsky, 2007). This tragic example of the disappearance of a keystone species and staple food source echoes the narrative of Plenty Coups, recounted in Cronon's (1992) "Place for stories". The 1930 autobiography of the Crow Indian chief tells of a boyhood vision that described a terrible storm and ended with the destruction and loss of the bison herds: "When the buffalo went away the hearts of my people fell to the ground, and they could not lift them up again. After this nothing happened" (cited in Cronon, 1992: p. 1366).

Plenty Coups is recounting much more than a series of events in these closing lines of his story. The consequence of the loss of the buffalo was nothingness, an end with no stories remaining to tell. The consequence of vanished eulachon for Nusqumata (Jacinda Mack), the eagles, the gulls, and people of Bella Coola was cold condemnation, a loss of connection, and self-reliance.

3.3 Stories of progress: Constructing the Freedom Road

The story behind the road-building project that provided the "third outlet to the Pacific" and connected Bella Coola with the rest of the province brings to life the human actors and the nonhuman entities that challenged their progress (Kopas, 1970). Cliff Kopas wrote a romantic history of the Bella Coola Valley that detailed the heroic struggles of the Bella Coola Board of Trade, bulldozer operators, and dynamite men as they built a connecting road through the mountain pass. A few years after the publication of this story of progressive sons of pioneers, a Master's student who conducted his research as a summer resident of the valley observed that, for at least a portion of the Bella Coola Valley population, the building of the Freedom Road served as *the* great example of local initiative and achievement (Halverson, 1973).[57] Kopas' (1970: p. vii) road story was a self-proclaimed "fusion of fact and fancy", written in anecdotal style drawn from stories shared among friends, newspaper clippings, letters, photos, and diaries. Despite the self-proclaimed limits on his historical accuracy, Kopas' account has enjoyed multiple reprintings and gained a certain authority in subsequent publications about the Bella Coola Valley.[58] Likewise, the Freedom Road exhibit and archive housed by the Bella Coola Museum is based substantially on Kopas' material contributions to the road story.[59]

Kopas' (1970) narrative begins in the "dim past" and culminates with the "pygmies and the mountain pass", a structure which readily conforms to the ascending plotline described by Cronon (1992) in his insightful comparison of progressive and declensionist narratives of the Dust Bowl.[60] Like the Great Plains heroes in Paul Bonnifield's story of the 1930s, the victory

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[57] See Halverson (1973: pp.106-112) for his account of the assumptions locals made about the focus of his research. Halverson asserts that the road stories retold by locals during his research residence served as the "great example" of a community that "does things for itself" (1973: p.105).

[58] In addition to the overlaps in detail offered in French's (1993) road history and in Paula Wilde's (2005) more recent historical account, the Halverson thesis (1973) draws heavily from Kopas' account. Kopas also appears in numerous government publication and technical reports such as Fisheries and Oceans/Environment Canada Special Estuary Series No.10 (1981), and a 2006 Ministry of Environment report on "Flooding and landslide events in Northern B.C." (2006). In the scholarly anthropological literature, Kopas (1970) is cited in Barker and Cole's (2003) introduction to McIlwraith's field letters and in Kramer (2006).

[59] In celebration of the 50th anniversary of the completion of Freedom Road, visitors to the museum website in 2012 can view digitized photographs and a PowerPoint presentation under the exhibits link on the museum web pages.
http://www.bellacoolamuseum.ca/en/exhibits/freedom_road/50th_anniversary.php

[60] Evoking Cronon's (1992) review of the narrative strategies employed by environmental historians is not intended to suggest Kopas consciously engaged this strategy with an aim to limit his audience to scholarly readers or historians of any stripe.

over the mountain and ultimate marriage of the Bella Coola and Chilcotin roads meant that "(T)heir success in that struggle was a triumph of individual and community spirit" (Cronon, 1992: p. 1348). That the opening scenes devoted to a brief acknowledgement of Nuxalk presence are "dim" signals to the reader that the central agents of the story have yet to arrive. The sons of Norway do arrive, and the "glorious summer of growth" begins.[61] Kopas' plot of progress begins with resettlement and the sweep of history follows upward with railroad fever, completion of the telegraph line, the fortunes of the fishing fleet and logging companies, and "dreams of a road" (1970: p. 275).

Kopas' account conveys the importance the Norwegian settlers placed on matters of transportation and markets. Noteworthy in the first sections of his narrative was the colonists' celebration of the first anniversary of their landing with 20 miles (32 kilometers) of wagon road construction through the valley completed during the summer months of their first year (Kopas, 1970). Viken Torliev, one of the first colonists, describes the summer similarly: "the summer (of 1895) passed with busy road work and bridge building and some modest gardening about the houses, with planting potatoes and vegetables (which) grew very well when ashes burned from the trees was used as fertilizer" (Torliev, 1950). The province provided funds in the way of wages for colonists to build their own roads and bridges.

[61] "Glorious summer of growth" is a reference to a quote given by the editor of the Bella Coola Courier, Sept. 14, 1912 which proclaimed, "…the long winter of pioneer life in an out of the way place is going to give way to the glorious summer of growth and all that follows in its path." The "summer" portion of this quote was picked up by Paula Wilde (2006: p 116-131) and used as a chapter title that described early settler progress in the Bella Coola Valley.

According to Kopas (1970: p.274), different cross-sections of the citizens of Bella Coola called on the provincial government for assistance with the construction of the road out of Bella Coola: “The Liberal Club, the Conservative Club, the Citizen’s Welfare League, the Business Men’s Association all presented their pleas and all met delays that amounted to refusals”.[62] With the vast majority of Freedom Road narratives influenced by his account, it is clear that Clifford Kopas was a central voice in the promotion of Bella Coola as the province’s “third outlet to the sea” (French, 1994: p. 186; Wild, 2004: p.192). Kopas was elected president of the Business Association in 1947, a group that later reformed as the Bella Coola Board of Trade and focused on constructing what would become the Freedom Road (French, 1994; Wild, 2004).

For the Board of Trade, political and financial connections sufficient to ensure the completion of the road construction project were found outside of the valley. Four logging operators, four businessmen, the local highways superintendant, and a farmer made up the core Board of Trade directors and leadership for the road project (Halverson, 1973). In Kopas’ description, Bella Coola residents simply did not accept that their fate was to be disconnected, and for these road boosters, “the conquering of that barrier became almost an obsession” (1970: p.275). Also of note with this leadership was that half of the men were born outside of the valley and several had joined the armed forces in WWII and left the valley for that period of time (Halverson, 1973). Interviewed just after the 50th anniversary of the opening of the Freedom Road, Wilf Christensen, one of the members of this board recalled:

[62] See also French (1994: pp.185-186)

> The [Bella Coola District] Board of Trade was pretty well the governing body here. It could do so much more than just two or three individuals. It really had a lot of clout…We got an award three years in a row for being the most outstanding board of trade in the province (Cited in Wilde, 2006: p. 191).

At key moments in the story of building the Freedom Road, the leaders of the project appealed to outside connections for funding and to insider knowledge for locating the best way to connect the roads from the east and west. Thomas Squinas, described in the Kopas' (1970) account as a wolf hunter and in French's (1994) as a trapper and guide straddling the native and non-native communities of the Chilcotin, showed the Board of Trade emissary Elijah Gurr the best way through the "thirty-odd miles of muskeg and jackpine jungle between Anahim and the Bunch Grass Trail" (Kopas, 1970: pp.278-279). From horseback, Squinas notched the trees with his axe, while Gurr and Alf Bracewell on the bulldozer following behind. In addition to the regular appeals for financial support to keep the construction project afloat, at two more important logistical junctures in the road building, an Ulkatcho (Jamiss Jack) and Ole Nicoli, of mixed Ulkatcho-settler parentage, stepped into the action to keep the road crews supplied with dynamite, diesel fuel, and food (Kopas, 1970).

With over thirty miles cleared, the road crew quit for the winter. The Board of Trade called in a logging superintendant, who persuaded a government engineer and ultimately the Minister of Public Works to provide a $10,000 grant to continue with a new road route that would follow Young Creek (French 1994; Kopas 1970). The political leadership of the province had changed in favour of public works projects under Premier W.A.C. Bennett and

Minister of Highways P.A. Gaglardi (Kopas, 1970; Wilde, 2004). Bennett, remembered for his own stories of progress, shared the values promoted by the Bella Coola Board of Trade:

> [Ours is] the story of development, of the building of a…homogenous province; of a god-fearing pioneer people, dedicated to progress, strengthened by their contest with a great land at first reluctant to yield its full resources (W.A.C. Bennett cited in Wynn, 2004: p.6).

The organizations headed by newcomers, whether under the name of the Business Men's Association or the Board of Trade, hoped to boost the Bella Coola economy with connections to the rest of the province, and to declare at last, "Now we're part of the world!" (Kopas, 1970: p.291). The final accounting of the construction costs for the Freedom Road project was a point of pride for the road boosters, with the in-kind planning, management, and supervision by the Board of Trade estimated at $20,000, the public donations recorded as $4000, and the provincial government's contributions as $58,000.[63]

The landscape that separated Bella Coola from the interior of the province presented a formidable physical barrier to the forms of commerce newcomers understood as the inevitable sweep of progress. The sheer magnitude of rock, however, stood resolutely against the men, their machines, and explosives. Interviewed in 1999 by a Vancouver newspaper reporter, Alf Bracewell explained the conditions and the risks of building the switch-backed trail down the rocky, perpendicular mountainside in simple terms: "we had to blow a bunch of stuff and push trees over the side of the cliff" and, "everyone was responsible for their

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[63] From Kopas' (1970:p.290) accounting for the project, most of the narratives of the Freedom Road construction costs agree within $1000-$5000 of the totals listed here: French (1994: p. 193); Wilde (2004: p.200); Nanton (1999).

own neck" (Nanton, 1999). A crucial point of passage in Kopas' (1970: p. 285) narrative portrays the struggle in these dramatic terms:

> Winter gave way to spring, and still the mountainside fought the men for every foot of territory gained. What looked like easy sections of earth or rubble were found to be solid rock with an overburden of gravel, sand, and moss. Progress was measured in feet per day, and the struggle became one of ants moving boulders or of pygmies challenging giants. Men shrank in size and the mountain grew.

The Freedom Road story promotes visions of progress and growth as the inevitable destiny of settler-colonialism for the Bella Coola Valley. This story pits the self-reliant settlers against the state, and against the vast, mountainous landscape engulfing their homesteads. Though settler-colonists believed better transportation connections to the outside world meant markets for Bella Coola Valley agricultural goods in the early decades of the 20th century, with faster highways and long haul trucking, the directionality of food production shifted out of the valley.

3.4 Stories of decline: The end (of the road) is near

> During the 1960s and 1970s, Highway 20 may not have been the worst road in Canada, it may not even have been the worst road in the province, but its reputation as the longest worst road anywhere has never been challenged. (French, 1994: p.241)

Decidedly different in its narrative structure, Diane French's (1993) tribute to the Bella Coola-Chilcotin Road followed Kopas' Freedom Road story a few decades later. Woven with tales of breakdowns, bootleggers, and a touch of lonesome highway lore, French sums up Highway 20 as "three hundred miles of back road to nowhere much" (1994: p. ix). French, like Kopas before her, was a part-time local journalist. She moved to the Chilcotin as a teacher, then married a son of Chilcotin pioneers who was hired on to the road maintenance crew between Alexis Creek and Anahim Lake just above the hill that switchbacks into the Bella Coola Valley (French, 1994). With an insider's view of the road's complicated politics and maintenance, and with many stories drawn from life on this infamous stretch of highway, French explains the knowledge and skills needed for navigating the road in all-weather conditions: "An experienced traveler carried an axe, jack, shovel, and chains. Truckers carried chains for each wheel, cables, and enough spare parts to rebuild the vehicle" (1980: pp. 215-216).[64]

From the latter half of the 20th century onwards, the vast majority of food, farming supplies, and freight have entered the Bella Coola Valley from the Highway 20 connection (B. Harestad, personal communication June 28, 2007; R. Brandt, personal communication July 24, 2007).[65] Not long after the road was completed in 1953, the trip to Vancouver on the steamship cost $250 per person and took one week's time (French, 1994; Wilde, 2005). Diane French saw no comparison between those costs and the adventure found on the Freedom road during the 1950s: "a carload of people with enough nerve could make the trip (to Vancouver) in three days for $30 worth of gas." (1994: p. 197). By the 1960s, French (1994) estimated the travel time in good weather between Williams Lake and Anahim by car

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[64] See French (1994, pp. 199-222) for detailed accounts of the personalities, resourceful methods, and the local to provincial politics involved in maintaining the Bella Coola-Chilcotin Highway from the 1950s through the 1970s.

[65] Detailed coverage of the Union Steamships and the role they played as a 'lifeline' to B.C. coastal communities is provided by Rushton, G.A. (1974 and 1993); See also Wilde (2004: p.195).

was more than seven hours. Now the trip from Williams Lake all the way west to Bella Coola is said to take less than six hours, if the weather and road conditions are favourable (French, 1994: p. 254). If your destination is Vancouver, driving a passenger vehicle along the Bella Coola-Chilcotin Highway remains the most affordable and most reliable of the three options to valley residents—air, sea, or land.

Connection and self-reliance play a prominent role in the dialogue continuing into the 21st century among people interested in including some form of an agricultural livelihood as part of sustaining a Bella Coola Valley household. These issues are intimately linked with the road and are explored in this section of the chapter. With the main connection to a regular imported food supply limited to a single, notorious highway, the relationship between the prospect of food scarcity and efforts to rebuild portions of a cultivated and indigenous food supply comes into sharp relief. Moreover, the threat of road closures that would impede regular delivery of food and other essentials from the outside, coupled with the narrative of the loss of active farmland and skilled farmers, sparked the research collaboration between the Faculty of Land and Food Systems and the Bella Coola Valley Sustainable Agricultural Society in 2006.

Rural sociologist Jack Kloppenburg and his colleagues John Hendrickson and G.W. Stevenson (1996) championed the foodshed concept as a response to what they viewed as disconnection from the land and the skills to grow food from the land, driven by the global food system. These authors problematized the energy required to transport agricultural goods from field to table, and suggested the experience created distance between the "biological and social realities of living on the land in a place we can call home" (Kloppenburg et al., 1996: p.33). In 2002, Feenstra provided an overview of the development and maintenance of local, sustainable food systems projects in California. These projects were initiated on the assumption that, "(p)eople have become disconnected from the sources of their sustenance—the land, the people who grow and harvest their food and fiber, and from the taste and quality of the food itself" (Feenstra, 2002: p.100).

More than a thousand kilometers up the coast from California, registered dietitian in Canada and Bella Coola Valley resident, Elizabeth Howard, completed the Bella Coola Valley Food Action Plan in 2006 in consultation with a focus group of concerned local residents. Funded by the provincial health authority, the lead local organization identified in the Action Plan was the BCVSAS. The report traces the historical roots and a portion of the responsibility for the valley's compromised health status to the completion of the road connection to the provincial highway system (Howard, 2006). The report also cites the trucking in of foods from the outside along the road, new refrigeration technology, and reliance on an outside economy as key factors affecting the experience of disconnection.

> The 1950s saw many changes in the Bella Coola Valley's food system. The completion of the road to Williams Lake in 1953 enabled food to be trucked in. New refrigeration technology lengthened produce storage time and processed, convenience foods were promoted as highly desirable commodities. When the road improved and the wharf burned down, refrigerated trucks came more frequently. The reliance on local agriculture shifted to a food-based economy that is controlled outside of the valley and is largely in the hands of a few transnational food corporations. Many residents may be experiencing disconnection from the land and do not know where and how their food is grown" (Howard, 2006: p.10).

The key ideas put forward by the Food Action Plan in 2006 galvanized another set of initiatives for the BCVSAS—the objectives of the Bella Coola Valley Foodshed Project that formed the basis of my field work and are described in Part Two of this dissertation. The essence of the food system envisioned in the report was, "gardens, greenhouses, salmon, clean water, supportive policies, healthy, happy people, no food banks, a barter and trade system, respect for [our] foodshed, and storage facilities" (Howard, 2006: p.2). The problem statement, or crisis narrative, placed at the front of this vision was that Nuxalk and newcomers have lost connections with the land and lost the knowledge and skills required to feed themselves from the indigenous and local resources.

> The Nuxalkmc thrived on local and traded foods before crops were grown in the valley. The Nuxalkmc and early settlers created a prosperous agricultural community that fed locals and communities to the west and south. The relatively quick change from a local healthy food system to one that created dependency and presently provides massive quantities of artificially cheap, non-nutritious foods is part of the reason for the poor health status of valley residents (Howard, 2006: p.5)

In 2004, meat inspection regulations enacted as part of a provincial Food Safety Act sparked controversy and political action in the Bella Coola Valley and in other coastal communities in response to the threat of the loss of locally raised livestock (Chapman, 2007; Thompson, 2007; Innes, 2011). In the *Coast Mountain News* a few months before the regulations were to come into effect in 2007, Dayna Chapman, the Food Security Coordinator hired as part of the implementation of the Food Action Plan, put forward a call for action and clarified the potential cascade of effects the regulations could have on local farming and food systems.

> Most meat producers have decided to slaughter before September 30, and will not be raising meat animals for consumption by their neighbours afterward. This means less

> local food, more farmers unable to support themselves doing the important work of helping to feed their communities, fewer options for local consumers attempting to support the local economy and eat well. The impact of this policy will also be felt by small mixed farms, as the organic material obtained from the manure will be unavailable to fertilize crops (Chapman, 2007).

Organizations with an interest in food and farming around the province rallied around the plight of smaller-scale livestock operations where the distance from an inspected slaughter facility meant the end of farmgate sales.[66] In Bella Coola, this issue ignited concerns that reached across the spectrum of food production, processing, and consumption practices valued by people who called the valley home. By September 2008, an organized team of public and mental health care professionals from the Bella Coola General Hospital hosted a two-day forum to initiate a process that would assert the "rural and remote community" voice to policy-makers and their academic partners (Sayers, Lenci & Clark, 2008). This forum, officially called "The impact of provincial health policy on rural living", invited health care administrators and policy-makers from urban centres, a team of university partners, food processing industry representatives, Nuxalk and Heiltsuk elders and band council members, regional food security coordinators and wellness professionals to discuss the issues and

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[66] See the BC Food Systems Network documents and position papers related to the meat inspection regulations here: http://fooddemocracy.org/policy.php
Regional press picked up the story online and in print (e.g. Ramsay, February 8, 2006; Pablo, May 22, 2008). See the Ministry of Health and the BC Food Processors web pages for details of the regulation:
http://www.health.gov.bc.ca/protect/meat-regulation/regulation_description.html
http://www.bcfpa.ca/programs/meat-industry-enhancement-strategy/bc-meat-inspection-regulation

establish closer communication on the heated issues of regulating local food production practices.

Coastal communities to the north and south of the Bella Coola Valley, with similar distances by road or ferry to provincially inspected slaughter facilities and markets, connected with each other and requested visits by the urban policy-makers. In Powell River, getting animals to an inspected abattoir would have required two days and hundreds of dollars. Members of the Farmers' Institute there called a similar meeting in hopes of changing the regulations they saw as 'illogical' (Innes, 2011). One of the shared strategies organized people in all of these places used was to request the policy-makers make their way into or out of town by travelling the same route the farmers and livestock would need to in order to comply with the imposed meat inspection regulations of the Food Safety Act (Sayers et al., 2008; Innes, 2011; Thompson, 2007a; 2008).

Some thirty years prior to these events, Douglas Halverson, who studied local level politics in rural B.C., noted that in the Bella Coola Valley, "local dairying and slaughtering are impeded by health regulations" (1973: p.142). With only 19 farms counted in the decennial census of 1971, agriculture as a livelihood was at its lowest point for Bella Coola Valley farmers when Halverson made his assessment (Statistics Canada, 1971). With the Freedom Road completed, and Bella Coola connected with the rest of the province and ultimately, the global economy, this closer integration with the economy outside of the valley impacted the practices of growing food for the local market. For the people of the Bella Coola Valley who added their voices to the *Food Action Plan* and the policy forum, the consequences of cheap, imported foods from outside the valley and of provincial regulations conceived in urban centers were a loss of connection to the land, and ultimately, a loss of health and self-reliance. The successful reconnection celebrated in nine remote B.C. communities in 2010, was the announcement of exemptions to the regulations “in favour of safe and accessible local food” (Innes, 2011: p.4).[67]

3.5 Outside knowledge: Experts and imports on the road

From Alexander Mackenzie in July 1793 and from the Royal Engineer Lt. Henry Spencer Palmer in July 1862, outside readers are warned of the dangers of inclement and rapidly changing weather and narrow passageways through the rugged mountainous terrain (Sheppe, 1962; Palmer, 1863). In both cases, these outsiders required assistance navigating their way in and out of the Bella Coola Valley from Nuxalkmc and from the Carrier-Dené peoples of the hill and plateau (Turkel, 2007; Sheppe, 1962; Palmer, 1863). Regional historians trace the origins of the road out of Bella Coola to Palmer’s survey, as part of the competition for the most favoured transportation route to the Cariboo Gold Rush.[68] Palmer, like Mackenzie before him, was an outsider with specialized knowledge who jumped from his own social and economic context into unfamiliar territory to make a series of rapid assessments that would impact the way subsequent outsiders evaluated the potential of the Bella Coola

[67] See the evaluation report of the Vancouver Coastal Health Community Food Action Initiative (October 2011) compiled by Social Planning and Research Council of BC for details of the graduated licensing approach at two levels of slaughter operation for retail and direct producer to local consumer sales www.sparc.bc.ca

[68] Wilde (2004: p.194) and French (1994: pp.6-7) cite Alfred Waddington’s ambitions to establish a steamship connection to Victoria and up the Butte Inlet to the goldfields as part of this competition.

Valley.[69]

Nearly one hundred years after Lt. Palmer's report was submitted to the Royal Engineers, R.H. Spilsbury (1950) of the British Columbia Forest Service prepared a "Land use report of the Bella Coola Valley" with indications of soils, topography, forest cover types, climate characterization, and land use recommendations. The striking features of this report are its parallels with the road boosters' narrative and the methods of assessment used to gather information for the report. Spilsbury, perhaps taking a cue from the Bella Coola Board of Trade reported (1950: p.2):

> Although it is not joined to the interior, only 14 miles of new road construction are necessary to link this valley with the highway running from Prince George through Williams Lake to Vancouver. These are most important considerations bearing upon future land use. […] The isolated position of the Bella Coola valley is somewhat of an advantage, for the surrounding non-agricultural communities should offer an unrestricted market for all kinds of farm produce.

Significant to the case study on the potential for agriculture described in the second half this dissertation are what Spilsbury observed during his "brief reconnaissance" driving the main road from the mouth of the Bella Coola river to Stuie. During what would have been the golden years of agriculture in the Bella Coola Valley, Spilsbury observed (1950: p.1):

> Farms contain from 5 to 40 acres of cleared land. Practically all crops suitable to a temperate climate can be successfully grown though potatoes are the only crop commercially grown at present. Some beef and sheep are raised.

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[69] Lt. Palmer's (1863: p.22) report did not recommend building a road through the Bella Coola Valley as access to the goldfields of the Cariboo largely due to what he viewed as "the graver questions of soil and pasturage", or lack of feed for the horses along the route.

Though the Spilsbury (1950) report gives no indication of assistance he may have received from residents of the Bella Coola Valley, it does provide an optimistic outlook for the biophysical basis of agriculture. He saw the potential for commercial agriculture, but observed farming as an occupation was secondary, that markets weren't developed, and transportation was lacking (Spilsbury, 1950: pp.2-3). A few decades after Spilsbury's report, the team of pedologists working for the British Columbia Canada Land Inventory carried out another set of soil surveys in the Bella Coola Valley using similar methods as those described by Spilsbury (Runka, 1973). In their footsteps, another team of outsiders, including myself, made a series of assessments of the biophysical potential for agriculture in the Bella Coola Valley. The chapters that follow provide details and findings of the surveys conducted in 2007. I, like Palmer, Mackenzie, Spilsbury, Kramer, and the policy-makers invited to the Bella Coola forum, made that journey along the road freighted with particular systems of knowledge. The subsequent journey of unpacking that knowledge and making sense of the converged meanings and values is the story of the chapters that follow.

3.6 Conclusion

Although the completion of the Freedom Road in 1953 became synonymous to boosters as *the* great example of self-sufficiency and local achievement, the connection with the provincial highway system did not increase the agricultural land area or the numbers of people engaged in agricultural livelihoods in the Bella Coola Valley[70]. Within one

[70] See the Halverson (1973) thesis for a discussion of the road-building project as "the great example". Halverson presents the Bella Coola Valley as a case study of a metropolis-satellite

generation of connection between the Freedom Road and the provincial highway system, the count of Bella Coola Valley farmers dropped to its lowest point from its peak in 1941. The stories of change and self-reliance in this chapter are suggestive of tensions between the Bella Coola Valley as a central place, and the Bella Coola Valley as a distant frontier, or hinterland in need of connection. The Freedom Road did not of itself close the agricultural frontier in the Bella Coola Valley, and perhaps what's missing here is not an explanation for vanishing farmers, rather a long-awaited redefinition of what counts as agriculture and food production in places like the Bella Coola Valley.

Connecting this call for redefinition to similar regional research, Philip Loring presented strong parallels with the cropping traditions and dietary shifts of Nuxalk, Tlingit, and Haida of the Northwest Coast in his "reverse foodshed" study of the Athabascan people in Alaska (Loring, 2007). Loring, and his colleague Craig Gerlach (2010) found a unique agricultural history in geographically remote Alaska, and following Francis (cited in Loring, 2007), he characterized this as "outpost agriculture". When the models of industrial agriculture promoted by the Alaskan Department of Agriculture largely failed, or were outcompeted by low-priced imported foods, outpost agriculture emerged as the successful strategy for "coping with natural variability and the uncertainty of living in the remote territory"(Loring & Gerlach, 2010: p.184). For the Alaska Native communities of this case study, like the Nuxalk and newcomers to the Bella Coola Valley, these "informal family and community gardens planted for the purposes of local economic diversity and food security" (Loring &

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political relationship, with local politics and, in particular, momentum for the completion of local projects, dependant on connections to provincial institutions.

Gerlach, 2010: p.184), are a tried and true form of food production for people living at the end of a long road, and in a hub of active local exchange.

As exemplified by Cronon (1992), progressive and declensionist narratives can be utilized to make sense of the same event. If the classic North American environmental crisis story of the early 20th century was the soil erosion of the Dust Bowl as exemplified above by Cronon (1992), the global environmental crisis story of the 21st century is the phenomenon of climate change. The scholarly and public attention focused on the shifting patterns from what was perceived as climate averages over discrete periods of time to more frequent and severe weather events is filling volumes of journals and capturing international headlines (e.g. Turner & Clifton, 2009, many others). The application of this story to the Bella Coola Valley can be found factored into the disappearance of the eulachon, and as another kind of food security threat when weather related road closures force interruptions to the imported food supply.[71] Highway 20 is the definitive supply corridor for the Bella Coola Valley, and lengthy closures would require a chain of responses from public officials to private contractors to establish alternate supply routes using BC Ferries and/or a network of privately owned barges and tugs.[72]

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[71] Some would argue that beyond food security threats, limited availability of the land to grow foods and limited access to culturally appropriate foods pose a threat to food sovereignty (e.g. Tallio, 2007). Sina Robert Tallio, the Nuxalkmc who held the agriculture portfolio in the elected Nuxalk Band Council during the course of this study, wrote this article for the *Coast Mountain News* in November of 2007 that outlined his thoughts and working definition for food sovereignty in Nuxalk Territory.

[72] See the Bella Coola Emergency Response Plan, 2005: http://www.ccrd-bc.ca/services/emergency-plan.php

Recognizing the power and impacts of weather related events, in 2006 a Ministry of Environment employee prepared a report on the written documentation of flooding and landslides in northern British Columbia from 1820-2006 (Septer, 2006). The author of this report found that for the Bella Coola Valley, the heaviest flooding generally occurred in October and November (Septer, 2006). Synthesis of the flooding and landslide data provided a picture of the frequency and duration of road closures, bridge washouts, and changes to the course of the river and locations of the major settlements of the valley over the period of the last one hundred years. From these findings and from current Ministry of Highways officials, the Bella Coola road closes one to two times annually for an average duration of 24-48 hours, usually due to a natural event such as a fallen rock or landslide (Septer, 2006; T. Hubner, personal communication, May 15, 2012). Not covered in the report were road closures due to fires, such as the ones experienced at Nuxalk Mountain in 2009, and at Heckman Pass near Tweedsmuir Park in 2010.[73] According to Todd Hubner, the current Cariboo District Manager of the Ministry of Highways and Transportation, the Bella Coola Valley has had only one natural disaster of large enough magnitude in his twelve years of service that warranted a Highway 20 closure of long enough duration to force emergency barged-in food and supplies. That was the "one to two hundred year flood of September 2010" (T. Hubner, personal communication, May 15, 2012).

Just as Jennifer Kramer (2006) evoked the switchbacks on the road as a kind of "territorial trope", the direction of the stories reviewed in this chapter tells us something about the

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[73] Forest Service of BC, Wildfire Management Branch: Summary of previous fire seasons retrieved from http://bcwildfire.ca/History/SummaryArchive.htm#2010

relationships Nuxalkmc, newcomers, and outsiders have with the past and present. In terms of their relationship to indigenous food systems, Nuxalk organized a public gathering to acknowledge the importance of a non-commercial fish food and medicine, the eulachon. This gathering was a form of resistance to the outside forces understood as contributing to the dwindling eulachon runs. It was also a public declaration that the knowledge and power of this particular food source is significant enough to warrant a dedication of energy and action that would change the future. The newcomers as presented in this chapter, are actively resisting provincial regulations that impact access to locally raised and slaughtered livestock. The grass-roots community food security movement in the Bella Coola Valley suggests that the road is linked to a decline in the numbers of people engaged in farming, and their efforts to regenerate agriculture are also directed towards portraying the value of a particular way of life. Outside experts have speculated on the potential for trade and transportation connections through the Bella Coola Valley since Alexander Mackenzie's trek to the Pacific in 1793. Most of these observations have been rapid appraisals, often aided by unseen or unheard local hosts.

The values and meanings attached to stories about food serve to connect those physical and cultural landscapes, and point to anxieties about change and aspirations for reconnection. The example presented by the Nuxalk Eulachon Gathering expressed a particular disquiet about the threat to their food fish, and created an opportunity to reconnect with other Coastal First Nations experiencing the same loss. For this part of the Bella Coola Valley food system, the rivers, estuary, ocean, and all that touches them characterize the 'landscape'. For the combined indigenous and settler food system, the Bella Coola Valley Health Forum also exemplified a public expression of concern and an organized effort to resist through closer relationships with policy-makers. Nuxalk and newcomer spokespersons at this forum depicted places for berry picking and the landscape of small farms. Together, these public events provide a background for the presentation of the methods and findings of the BCVSAS-UBC research partnership in the chapters that follow.

Chapter 4: Fieldwork methodology

4.1 Introduction

In addition to the historical analyses presented in Part One, this dissertation contributes the findings and an analysis of the Bella Coola Foodshed Project. The approach and methods for this research project are the focus of this chapter. The Faculty of Land and Food Systems at the University of British Columbia (UBC) was approached by the Bella Coola Valley Sustainable Agricultural Society (BCVSAS) to assist with reconnecting the people of the Bella Coola Valley with knowledge and skills to improve agriculture, food, and health.[74] University-community partnerships are a method of co-generative inquiry that place equal value on local and professional knowledge, but are explicitly not a retreat from science (Greenwood &Levin, 2000).[75] In the case of the BCVSAS-UBC Foodshed Project, the research approach was a type of participatory action research (PAR) in which partners and participants wanted to make thoughtful and realistic change (Kemmis & McTaggert, 2000).[76] The fieldwork research objectives listed here emerged as part of the dialogue between the university and community partners:

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[74] The initial request came from a hereditary chief of the Nuxalk Nation who played a role in the establishment and vision for the BCVSAS.
[75] Greenwood and Levin (2000) provide a working definition of co-generative inquiry, describe the characteristics of integrating theory and praxis through action research, and clarify the relationships between positivist science and the scientific validity of action research. More recently, Rojas, Sipos, and Valley (2012) refined the concepts at the heart of university-community partnerships along a continuum of community-inquiry to community-engaged scholarship.
[76] For additional background on PAR, see also the seminal works of Chambers (1983) and Pretty (1995: pp.183-186), as well as the guiding principles of Ernest Stringer (1999).

- Identify the biophysical resources for sustainable agricultural development of the Bella Coola Valley.
- Explore the potential for increasing participation in agricultural production in this challenging North American context.

To complete an introduction to the university-community partnership with brief responses to the basic what, when, where and who of the Bella Coola Foodshed Project, project participants and the research setting are described in the paragraphs that follow.

Organizing people

The BCVSAS Board of Directors, in partnership with the UBC's Faculty of Land and Food Systems guided the project activities, from the soil fertility study, production of maps and collection of data, to performance of the workshops and tours. The professional Geographic Information Systems (GIS) mapping consultant assembled the maps from data collected in the field. This mapmaker was Hans Granander, who was trained in forestry, and makes his home in the Bella Coola Valley. Gary Runka, born in the Peace Region in northeastern British Columbia and now residing in the Bella Coola Valley, served as the chair of the foodshed sub-committee of the BCVSAS Board and directed the mapping project. Joan Sawicki, wife and partner to Gary in their land consulting business, contributed to editing and finalizing the maps. Terry Lewis, the professional pedologist hired to conduct the soil survey, had extensive survey and mapping experience within the coastal ecosystems of the province, but was not a Bella Coola Valley resident. Liz Howard and Dayna Chapman, introduced in the previous chapter, were both active contributors to the BCVSAS and more broadly, to initiatives focused on community food security within the Bella Coola Valley. Gail Moody, the chairperson of the BCVSAS Board during the Foodshed Project timeline, served as an amiable bridge between the Nuxalk and contemporary settler communities up the valley. Andrew Flegel and Sina Robert Tallio joined the project team as local research assistants in 2007, and lent hands in the service of the soil survey and food production inventory fieldwork. Both grew up in the valley, and had begun their pursuit of post-secondary education outside of Bella Coola. Their participation was key in terms of longer-terms goals to build knowledge and skills focused on Bella Coola soils and agriculture with Bella Coola Valley youth. I served as project facilitator, and performed the soil fertility study, coordinated the workshops, carried out the food production inventory, assisted with the agricultural use inventory, the soil survey fieldwork, and the crop suitability interpretation.

Organizing places

The Bella Coola Valley is itself a unifying concept, and an attempt at placemaking.[77] We defined the geographical scope of the BCVSAS-UBC Foodshed Project as the area from the tideflats west of the village of Bella Coola to Burnt Bridge Creek, or the western boundary of Tweedsmuir Provincial Park along Highway 20. For a person living in the valley, this would be about as far as you would drive to visit family or friends; go to school, one of the stores, restaurants, or post office; pay a visit to the hospital; or meet someone at the airport. Beyond

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[77] Placemaking as a concept and practice crosses disciplinary and professional boundaries. Schneekloth and Shibley (1995: p.1) assert: "Placemaking is the way in which all human beings transform the places they find themselves into the places where they live". The foodshed concept, as articulated by Kloppenburg (et al., 1996) remade this notion of placemaking in the service of rebuilding small-scale agricultural ventures and rural communities.

this zone, the habitats and identities shift from valley to plateau or from valley to outer coast island.

The area within the boundaries of the foodshed study include the unincorporated villages of Bella Coola, Hagensborg, and Firvale, as well the areas known off the maps as Old Town, the Townsite, and 4 Mile Reserve (See Figure 3.2 in previous chapter). The Bella Coola Valley and foodshed study areas do not conform well to current political boundaries, census subdivisions, or registered geographical place names for British Columbia. As stated in Chapter Two, this valley is within Nuxalk territory, but does not represent all of the villages and places mapped as reserves or claimed as ancestral and contemporary territory by the Nuxalk.

Though the foodshed study area and Bella Coola Valley do not represent a provincially mapped reality, what is included does represent a social reality, and a practical reality of regular access. For people living in this place, the main gathering spots are included in our study area: the Nuxalk Hall, Lobelco Hall, the churches, rodeo grounds, fall fair grounds, and the Centennial Pool. Each of the places in between and along the way has its own name, or set of names and associations: the Snootli Stretch, Old Hayden place, Mrs. Sew and Sew's. If you hear someone referring to the Bella Coola Valley, or more often than not, read about it as such, you will find the reference is most often there to make sense of the place for outsiders and tourists.[78]

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[78] Kramer (2006) uses the convention, Bella Coola valley; McMillan & Hutchinson (2002) use both Bella Coola valley and Bella Coola Valley; in general, the Bella Coola Valley

The boundaries we drew, and the scale we chose for our set of agricultural resource maps, did not correspond in a holistic way with the wider ecosystems or watershed, but rather more closely to the flow of transported food and people. Though the foodshed concept is intended to (re) build notions of the seasonal round, and to unify the social and ecological potential as analogous to a watershed or bioregional association, we constructed our boundaries based on contemporary practical access to the farms, gardens, and home sites, and within a reasonable set of distances to promote events and to attract groups of people. In effect, we privileged the cleared and settled areas of the river valley, and specifically, those areas believed to have strong potential for agricultural cultivation and currently accessible by road.

Digging into the Bella Coola Valley

To begin the process of building relationships in and out of the valley, we conducted an initial soil fertility study in 2006. With the combined knowledge of the researchers based in the Faculty of Land and Food Systems, and the specialist background of Gary Runka with the BCVSAS, we conducted an initial scan of government publications focused on the soils and climate of the area. Though soil survey work had been previously carried out, it was not implemented at the level of detail or with the updated technologies required for informed agricultural decision-making. Our university-community partnership viewed soil fertility

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signifies the combined unincorporated communities of Bella Coola, Hagensborg, Firvale, and Stuie (Cullen, 2006), and this convention is utilized by social organizations with members residing these places, such as the Bella Coola Valley Sustainable Agricultural Society, the Bella Coola Valley Tourism Society, Bella Coola Valley Watershed Conservation Society. Importantly, each of these organizations carries an outward looking vision for fundraising and socioeconomic development.

sampling, soil survey, and land-use mapping as valuable tools in our quest to identify baseline agricultural resources of the Bella Coola Valley, and, importantly, we had human resources experienced with these methods. Each of these methods has evolved from the empirical tradition, and several members of our research team had the technical background to deliver rigorous scientific results from the field.

In 2007, additional project funding provided support for two additional professional contractors who implemented the soils inventory and generated the GIS mapping products. We completed the main objectives of the Foodshed Project fieldwork in September 2007, and then delivered the final open workshop with an overview of the completed maps and inventory of the Bella Coola Valley Foodshed in March 2010. Many unnamed participants from the university and from Bella Coola made important contributions to the Foodshed Project, and their contributions are gratefully acknowledged.

The main aims of the Foodshed Project were to catalyze interest in and build knowledge and local skills with respect to the productive capacity of Bella Coola Valley soils. Key components of the project were:

- The soil fertility study [2006]
- The demonstration garden [2006]
- The soil survey [2007]
- The agricultural land use mapping and food production inventory [2007]
- The interpretive land capability and crop suitability mapping [2008]
- Integrating local research assistants with fieldwork activities [2006-2007]
- Volunteer service learning [2006-2008]
- Community workshops and edible farm and garden tours [2007-2010]

Augmenting the positivist approach, our research design was collaborative and valued participation, inclusion, and knowledge transfer. Each of the preceding values were articulated and reinforced during BCVSAS Board meetings, annual general meetings, and in our proposals and reports to funders. The objectives we built into the research initiative most directly linked with these values were the open workshops held in the Bella Coola Valley, the hiring of local research assistants, and the multiple efforts to engage other students from the university in service learning and volunteer activities in our host community. These activities and associated lessons learned are detailed in sections 4.5.3 and 4.6.

The Foodshed Project research objectives emerged as part of the dialogue between the university and community partners. The partners negotiated and prioritized the activities in the field setting of the Bella Coola Valley that corresponded to the strongest areas of interest for the BCVSAS-UBC university-community partnership. Not all of these fieldwork activities directly corresponded to the dissertation research objectives, but nearly all of the fieldwork and presence in the Bella Coola Valley contributed to a better grasp of the unique context. The dissertation research objectives and guiding questions listed in Chapter One are products of an iterative process, and reflect the culmination of ideas, action, and research.

This chapter builds from the contributions of the previous chapters, though the acknowledgement of scholarly indebtedness shifts toward locating a set of explicit approaches to the fieldwork research. Organization of the chapter follows the key activities that took place as part of the university-community partnership project from 2006-2010. The methods followed for the soil fertility study are found in section 4.2. Section 4.3 describes the aims and objectives of the demonstration garden. In section 4.4 the design and methods of the soil survey are detailed. The design, data considerations, and contributions of the agricultural land use mapping and food production inventory are featured in section 4.5. Integral to the knowledge sharing and capacity-building objectives of the project, section 4.6 presents the approach and methods of the community workshops and garden tours. Once the on-the-ground soil survey and inventory activities were completed, interpretive mapping synthesized data from the Bella Coola Valley with climate and soil management information sourced from outside of the valley. Section 4.7 concludes the Foodshed Project approach and methods with an outline of the interpretive maps created to present information on land capability for agriculture and crop suitability for the Bella Coola Valley. Sections 4.8 and 4.9 offer a set of reflections and a summary conclusion to the chapter.

4.2 Soil fertility study

The subsections that follow detail the collaborative design, implementation, and methods of the soil fertility study carried out in the Bella Coola Valley in 2006. This was the first fieldwork initiative of the university-community partnership and represented our first efforts towards the production and promotion of knowledge about the agricultural resources of the Bella Coola Valley. Description of the sampling methods in the site-specific contexts of hayfields, pastures, gardens, lawns, and uncultivated areas provides a foundation for the subsequent findings presented in Chapter Six.

4.2.1 Project design and promotion

Prior to my arrival in the Bella Coola Valley for the first summer of fieldwork in June 2006, the BCVSAS Board of Directors submitted funding proposals to the Coast Sustainability Trust and to the Community Futures Development Corporation for project tasks articulated as phase one of a 'Comprehensive Agricultural Profile'. The BCVSAS, my research supervisor Dr. Art Bomke, and I collaborated on the focus and design of the soil fertility study in the Bella Coola Valley. The project tasks described in the proposal were: sampling soil from fifty locations; asking questions about crop history at each site; and sending these samples for a laboratory analysis of ten nutrients, relative acidity (pH), percent organic matter (OM%), and salinity (measured as electrical conductivity). Other objectives and proposed benefits of this study were summer employment and training for Nuxalk youth.

As a next step, members of the BCVSAS Board drafted a promotional flyer and introduced the project in their April 2006 newsletter. One complimentary soil fertility analysis per location was offered, and additional sampling and laboratory analysis would be offered for a cost of $40 per test. Irrigation water testing and the installation and hosting of microclimate weather stations were also listed as possible ways of participating in the study, though the limited available funding meant that these objectives did not produce findings with an adequate sample size or accurate recoverable data.

In an attempt to invite participation from all residents, volunteers from the Board who circulated the flyers and newsletter followed a regularly practiced means of promoting upcoming local events in Bella Coola. The volunteers stuffed all of the Bella Coola and

Hagensborg post office boxes with the printed materials entitled “Attention Farmers, Ranchers, Gardeners, and Agricultural Property Owners: Help us assist you!” The flyer was designed to gather contact information and create a means of communicating with Bella Coola Valley residents who expressed interest in garden or field soil testing.

Communication at all stages of the fieldwork, between the research partners, BCVSAS Board and members at large, and with interested residents living in the Bella Coola Valley was a key challenge. There was some confusion with the details listed on the flyer for would-be participants. Funding had not been secured for all of the tasks envisioned for this stage of the project, and the roles of two of the BCVSAS members most directly associated with drafting these proposals shifted before the first tasks were implemented. The priorities of including the additional $40 soil tests, and the irrigation water testing were moving and changing during BCVSAS board meetings, and in their guidance to me throughout the summer of fieldwork. With this shift in leadership, another funding proposal, one that targeted the training and mentorship of a Nuxalk summer student as part of carrying out the phase one tasks, went unfunded. The operating budget that remained covered only seven irrigation water tests, and fifty-four soil fertility analyses. There were no funds available during this phase of the research for the purchase or installation of portable weather stations.

4.2.2 Soil sampling methods

Gary Runka, a professional agrologist and experienced land-use consultant, guided me during the soil sampling at the first location selected in the soil fertility study. While we took great care to follow proper sampling procedures, the objectives and scope at this point did not include taking sufficient replicates, grid sampling, or sampling sufficient locations to capture a statistically representative characterization of soils throughout the valley. The goals of the soil fertility study in Foodshed Project terms were to provide a service to interested participants, make observations about soil management and land-use practices, and build initial relationships.

We followed standard soil sampling procedures, with the following additions or modifications.[79] The soil fertility study field team, including the local research assistant and myself, made sure the sampling equipment was clean each time we collected a new composite sample. The sampling equipment included plastic buckets and an Oakfield probe, shovel, measuring tape, and soil knife to cut away the turf or organic debris. The record keeping method for the samples included double-bagging the samples, labeling the sealable plastic bags inside and outside, and maintaining a logbook of sites. From the interactions with farmers or gardeners at the site, I recorded field notes with information on crop history and previous management and listed any questions they may have asked about plant diseases or pests.

Sample depth

The depth of samples for the study was fifteen centimeters. This is a standard depth for general sampling, as the greatest abundance of nutrients, biological activity, and roots are concentrated in this zone. Connected with this, an overarching goal as expressed in the *Bella*

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[79] See Brady and Weil (2002: pp.720-723) for a North American standard soil analysis sampling procedure, and Poon and Schmidt (2010) for the step-wise soil sampling guidance offered to British Columbia agricultural producers.

Coola Valley Food Action Plan and in the BCVSAS vision statements was increased production of local vegetables and fruits. For this reason, we sampled at the depth of root growth and tillage for a wide range of annual vegetables and small fruits. Depending on the sampling condition, which changed from site to site and as the summer progressed, either an Oakfield probe or a shovel was used to obtain the sample core at this depth. With taller grass or hay or harder ground, the shovel made sampling easier. When the ground was compacted, we used the shovel to make a triangular hole. We removed the grass and surface roots with the serrated side of the soil knife, and lifted a slice thicker than a centimeter and to our intended depth of 15 centimeters into the clean bucket. We followed this procedure for each of the twenty core samples taken for the field composite, mixed these in the bucket, removed stones and surface litter debris, and put a mixed amount of about one cup into the clean plastic sample bag.

At the end of each sampling day, I laid out the samples for air-drying, and updated my field notes journal with additional observations. The sampling schedule was weather and participant dependent. If conditions were too wet and rainy, maintaining clean sampling equipment and clear labels was impractical and participation and relationship building were hampered. The sampling schedule was based on successful phone contact with participants who had returned the promotional flyer for the soil fertility study. In a few cases, participants had heard about the study through word-of-mouth or read about the project in the local newspaper.

Timing

For the purposes of the overall investigation of agriculture in the Bella Coola Valley, we took samples when field conditions and participation in the study permitted. The samples we collected represented a range of managed soils in the Bella Coola Valley, though this range was based on interest and participation in the study, and not inherent soil characteristics or the entire range of soil fertility conditions in the Bella Coola Valley. Our objectives were to gauge skill and interest levels in soils-based food production, and to provide as much information as a proxy for agricultural or horticultural extension services as was within my own experience as a commercial grower. People who returned the promotional flyers would be my first introduction to the range of horticultural and other food production or agricultural skills found at large in the valley.

The date range of the samples collected included most of my summer residence in the Bella Coola Valley from June to August 2006. On more than one occasion, a farmer or gardener asked about the factor of timing when submitting soil samples for future tests. The advice I repeated was that the timing depended on the objective of the test and on the climate and soils conditions of a given field at certain times of the year (Brady & Weil, 2002). Some of the hay growers kept previous records of their soil tests, and sampled earlier in the spring as a general practice. Their objectives were to target the optimal application of fertilizer or lime for their fields. This type and timing of sampling is known as predictive, or pre-plant soil sampling for nutrient management. In support of this practice, I advised these growers to take their samples at the same time each year for better consistency and to monitor for trends with soil fertility analysis from a given soils laboratory (Brady & Weil 2002:p. 721).

In recent decades, significant agro-environmental research focused on groundwater contamination and other environmental impacts from fertilizer and manure applications has recommended adjustments to timing and rates of nutrient applications as part of an overall strategy to reduce these impacts.[80] Given the timing for the initiation of the soil fertility study, we were not able to sample prior to liming and nutrient applications at many of the locations included in the study. Further, the study limitations meant that we did not provide pre-sidedress or post-harvest soil nitrate testing as might be recommended in certain cropping situations (Poon & Schmidt, 2010). Related to the timing, as well as the handling of the samples, the data we collected during the soil sampling procedures were particularly limited in terms of the ability to interpret nitrogen levels (Brady & Weil, 2002; Poon & Schmidt, 2010).

PSAI laboratory in Richmond, B.C. analyzed the soil samples at the end of the field season.[81]

Composite samples in larger fields

Composite samples were used when sampling larger hay fields and pastures. A *composite sample* is the result of an average of soil cores taken within this same area and mixed together (Brady & Weil, 2002). Following the advice of Gary Runka, I used my experience with field preparation combined with visual cues to make decisions about where to take

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[80] For an overview of agro-environmental impacts from excessive nitrogen and phosphorus in soils see for examples: Diaz (2001); Sharpley (et al., 2003); Macdonald & Bennett (2009); Robertson & Vitousek (2009); and see Poon & Schmidt (2010) for updated best management practices to minimize these impacts in British Columbia.

[81] See appendices for PSAI laboratory methods and complete results from the soil analyses carried out in the soil fertility study of 2006.

sample cores. I scanned fields for spots that appeared representative of the whole field and avoided sampling in topographically higher or lower, or wetter or drier areas. I took cores in a zigzag pattern of twenty representative spots to comprise a composite sample. A single composite sample in a large field would not represent all of the possible variation, but given the uniform management for the fields and other limitations of the soil fertility study already mentioned, we followed this simplified method of composite sampling. We were, in effect, taking a snapshot with the soil fertility sampling and subsequent laboratory testing.

Gardens, lawns, and uncultivated areas

The goal of increasing the production of soils-based food in the Bella Coola Valley was directly connected with our focus on gauging and building interest in garden and orchard-grown vegetables and fruits. The *Bella Coola Valley Food Action Plan* (2006) was written by a licensed nutritionist and supported by provincial health promotion programming aimed to increase consumption of fruits and vegetables. The BCVSAS board had strong representation from professionals working on community level health and social services programming. Households with an interest in garden soil fertility dominated preliminary responses to the promotional flyer: household-scale gardeners represented 12 of the 18 returned flyers. The remaining six flyers returned were households with an interest in samples and analysis of both garden and field soils.

Monthly meetings of the BCVSAS board and with the subcommittee assigned to oversee this phase of the project were notable for the wide range of opinions expressed about how best to prioritize which places and which types of soil at these places—garden, field, or uncultivated—would be offered the complementary soil tests. This was an early challenge to my relationship building with the BCVSAS board and to relationships I was building with valley farmers and gardeners. Moreover, these discussions revealed some of the challenges associated with working with a sparse population scattered along the road in multiple communities, with multiple histories, combined with the well-intentioned attempts by the university-community partnership at all-inclusive outreach. The Board had offered one free test per household in the flyer, but the terms were unclear and several of the respondents requested both garden and field soil samples. By the second week of sampling in late June, the local newspaper article and word-of-mouth had generated more than enough requests to fill the budgeted 50 soil tests.

As mentioned in the section on timing above, the sampling continued through the main growing season for garden annuals. Sampling gardens in August posed particular challenges. Ideally, these samples would have been taken at an earlier growth stage or prior to planting. As the growing season peaked, I found myself tiptoeing around zucchini plants, and trying not to sabotage tomatoes while sampling to root depth with the probe. I took extra care to cover and fill the sample holes, as these were much more visible than any left in a hay field. In addition, I reduced the number of sample cores from twenty to fifteen in these backyard household-scale gardens.

In several areas in the valley, there was a preference for raised bed gardens over ground-level gardens. Particularly in the lower valley and on reserve, I sampled in garden beds constructed with landscape timbers or other materials, raised to a height above the lawn, and filled with a range of soils dug from adjacent areas and/or purchased soil blends or amendments. These were usually small areas, dictated by the size of the landscape timbers. In these instances, I used the Oakfield probe and reduced the number of sample cores for the composite to fifteen.

A few households requested a sample in an area that was managed as lawn grass. After I gathered the samples, questions often followed about what kinds of additional perennial fruits, vegetables, or tree fruits might be suited to that area. This opportunity for dialogue on increased food production fit well with our hope of providing a service and promoting the growth of additional fruits and vegetables. As practiced for the hay field and pasture samples, either the Oakfield probe or the shovel were used for the lawn areas, and the method followed was the same as outlined above. If the ground was moist enough, I used the probe instead of the shovel as it created fewer disturbances to the turf.

From within the BCVSAS Board there was a desire to take samples from uncultivated areas as well as gardens and fields. One board member wished to test his hypothesis that the pH would increase from west to east up the valley. This board member wanted our study to include a few samples of uncultivated areas that had not received agricultural lime or fertilizers. Though the number of samples and methods followed limited the possibility of a statistically representative characterization of valley soils, I was asked to include samples from uncultivated areas in the lower, mid, and upper valley within our complete set of roughly fifty samples. The method of sampling these areas followed the basic outline described above, however, the step of removing surface litter in forest soils, rocks and debris from a hillside required greater care.

4.3 Demonstration garden

The demonstration garden was established to meet two project goals: 1) to determine if the soils and climate in the Bella Coola Valley were favorable for a wide range of garden crops, and 2) to increase the number of gardens and people growing food. There was an additional personal dimension with learning through doing in this way: I was keen to grow produce and to learn first-hand about Bella Coola growing conditions. This was the first summer in 12 years that I was not actively managing a commercial market farm. I needed to dig-in, quite literally, and hoped to bridge my experience gap with local growing conditions by observing a set of cultivated crops from germination to harvest. The acts of establishing and maintaining this garden would provide some answers to basic questions I was already fielding from other beginning Bella Coola Valley gardeners: What steps would I need to take to nurture the beets and carrots? How successful would I be with heat-loving crops in this coastal valley?

A board member arranged a place where I could grow garden crops near where I was staying for the summer in the Snooka Creek area. This garden, on the north side of the road, had better sun exposure than my summer residence on the south side. I learned that places and people in Bella Coola often carried several names. This spot was spoken of as “Karen’s garden” and “Mrs. Sew-and-Sew’s”, and if recognition did not come with one, I tried the other name when describing where I was gardening that summer. As far as the terms for my use of the garden, the usual residents were away for the summer and did not mind someone around to keep an eye on the property and the weeds out of the garden.

The inputs to establishing the planted area in the demonstration garden were fuel for the rototilling, one wheelbarrow of chicken manure from the neighbours across the road, and several hours of hand digging, hoeing and shaping raised beds. I used a salvaged ten by ten foot sheet of black plastic in a section where I transplanted tomatoes and cucumbers, and under this plastic, placed a soaker hose for irrigation. I brought leftover seed from my personal 2004 and 2005 seed inventory, and sowed arugula, lettuce, Asian greens, beets, carrots, daikon, zucchini, and zinnias. I purchased and planted out tomato, cucumber, broccoli, and cabbage transplants and seed potatoes from the two nurseries commercially operating in the valley.

The demonstration garden crossed boundaries of experiential learning and community service learning. Specifically, the garden, as a place of learning and approach to research, also created opportunities for dialogue and informal exchange of harvested produce with new friends and neighbours. I harvested produce from the demonstration garden and supplied donations to the food bank, shared produce at potlucks and social events, and used this produce as a display and conversation starter at the booth I operated for the BCVSAS at the Sunday farmers' market each week. The demonstration garden gave me one season's experience with growing the kinds of foods we promoted in the project. My challenge in this new environment was growing these crops with limited inputs from outside the valley. As noted above, though, seeds and some of the plant materials and equipment came from outside.

Two concrete examples of the learning opportunities provided by the demonstration garden are provided here as a reference points for comparison with other methods of knowledge sharing and engagement. This first example was connected with the proximity of the demonstration garden site. The location was central in the valley, in easy view of the road, and attracted some curious onlookers. A neighbour saw that I was preparing the ground by hand and brought over his rototiller. He also shared some of his chicken manure and quickly became a great friend and resource. Locals know him as "Cougar Clarence", as he made international news as a survivor of a cougar attack. He is an avid storyteller, gardener, poultry keeper, and much more; he is one of the personalities who makes Bella Coola a memorable place.

The second example was an opportunity to learn about local knowledge of pests and diseases. In terms of one of the key disease and nutrient management challenges, several local growers and both nursery operators warned me about late blight *(Phytophthora infestans)* with the tomatoes, and advised that I get these under some type of greenhouse covering before September. The BCVSAS Board member who arranged for the gardening spot warned me of possible boron deficiency in the soil. These exchanges of knowledge and experience, and the visual point of reference offered by the demonstration garden, were tangible contributions to this relationship building and background stage of the fieldwork.

4.4 Soil survey

The subsections that follow describe the development, implementation, and methods, of the soil survey. I also briefly describe the negotiation of the fieldwork objectives. These activities, mostly undertaken in 2007, were central to the university-community partnership known as the Bella Coola Valley Foodshed Project.

4.4.1 Project design and promotion

BCVSAS board member Gary Runka, UBC professor and principle investigator Art Bomke, and I planned and applied for funding for the soil survey and mapping. We searched for previously completed agriculture capability mapping for the Bella Coola Valley and found what we described in the funding proposals as a gap in the information required for agricultural development. In 1975, provincial soil survey staff completed a 1:50,000 scale agricultural land capability map of the Bella Coola Valley and with their ratings, roughly 5,000 hectares of land were included in the Agricultural Land Reserve (ALR) zone for the valley. The ALR is a provincial zoning system, established in 1973, to preserve farmland in a province with a rapidly urbanizing population and recognized topographic and other land and climate based limitations for arable farming.[82] In the Bella Coola Valley, the ALR covers nearly all of the settled sections along the road and includes a large portion of what is

[82] The ALR is an example of contested land tenure and land use planning in BC that has generated a broad response in the literature as well as a long history of public debate (e.g. Hanna, 1997; Garrish, 2002).

provincially mapped as Bella Coola Indian Reserve #1 on the north side of the Bella Coola River.[83]

The proposed soil survey would update the previous mapping with digitized imagery, make the information more web-accessible through GIS technology, and increase the detail of soil survey information to a mapping scale of 1:20,000.[84] The inventory was meant to cover all areas of the valley that were thought to be arable, or suited to growing crops, which was estimated as approximately 7,000 hectares.[85] The terms of reference for the pedology component of the soil inventory described the project as follows (G. Runka, January 7, 2007, personal communication, unpublished terms of reference for project contractor):

- General geographic area to be mapped to comprise valley bottom lands from Burnt Bridge Creek (western boundary of Tweedsmuir Park) to the Bella Coola estuary. (Private land owners will be apprised of this work via local media and postings.)
- Soil mapping fieldwork to be carried out to technical standards consistent with federal "A Soil Mapping System for Canada" and provincial standards.
- Sampling (shovel/auger excavation) density to be based on the variability of soil parent material (geomorphology), soil texture and drainage.
- Soil map units to be delineated in the field on air photograph (Contractor to obtain suitable photography) or working map base that can be used for direct GIS input. (Plotting of soil mapping from air photographs or working map base will be the

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[83] Scanning, digitizing, and making publically web accessible maps of archived land resource maps has been an active project of multiple provincial ministries over the years of fieldwork investigation for this project (2006-2010). As of 2011, a digitized map of agricultural capability within the ALR for Bella Coola Valley that was completed by Talisman Projects, Inc in 1979 was made available here: http://www.env.gov.bc.ca/esd/distdata/ecosystems/TEI_Scanned_Maps/I15/I15-3194

[84] See the Soil Inventory Methods for B.C. (1995: Table 2.1 p.10) for background on mapping scales and intensity of survey details as conducted in this province.

responsibility of a separate GIS contractor. Meeting with this GIS contractor prior to commencing soil survey work is a responsibility under these Terms of Reference.)

- An expanded legend to accompany the soils map to include map unit identifier (number or other), landform/soil parent material, texture (range), drainage (range), topography (slope class) and stoniness.
- Map and expanded legend to be in suitable format to enable combination with climate information to facilitate preparation of other GIS interpretive map layers, including land suitability for specific crops.

4.4.2 Soil survey methods

After requests for proposals were sent to professionals with the qualifications deemed necessary, the BCVSAS board hired Terry Lewis to lead the soil survey. He had worked with the Soil Survey Division of British Columbia from 1968-1970 and contributed to soil survey and land capability mapping in four regions of British Columbia. In 2007, his practice as a soils and land use consultant spanned 34 years and included work related to agriculture, archeology and cultural resources, forestry, mining, recreation, settlement and urban areas, transportation and utilities, integrated resource management, and education (T.Lewis, 2007, unpublished résumé).

Terry made preliminary hypotheses about soil boundaries and soil types by reviewing an updated set of aerial photos before he arrived. Beyond my preparatory review of the *Soil Inventory Methods for B.C.* (1995) and an afternoon of orientation by way of driving the road part way through the valley with Gary and Terry, I was not part of the pre-field activities for the soil survey. Soil sampling and additional laboratory analyses were beyond the scope of our project objectives, though on the days I accompanied Terry, I did gather samples with the intention of expanding and better supporting the soil fertility study carried out in 2006.

With a portion of the project budget, we hired two part-time research assistants who were living in the Bella Coola Valley. Both had completed a year or more of coursework away at a provincial college, and each was raised at different ends of the valley. Andrew Flegel's family lived in an area known as Glacier-View at the eastern end of the valley. Sina Robert Tallio's family lived on the 4 Mile Reserve, at the western end. At times, the research assistants cleared the way for more open access to the land and more comfortable conversation with neighbours and family friends. Andrew and Sina had many years at home in the Bella Coola Valley, but neither had experienced the view from the ground up. We carried out several other simultaneous project activities while Terry led the soil survey. As the schedule and field conditions permitted, a research assistant worked with me on the separate project objective of the agriculture land-use and food production inventory, and another assisted Terry with the soil survey. When we worked with Terry, each of us benefited from an opportunity to learn about the techniques of soil survey from an accomplished, still practicing professional pedologist. Our field duties were fairly simple: we assisted with navigation, dug soil pits, and learned about the process and predictions of the soil survey. Terry's fieldwork for the soil survey totaled 27 days.

Locating soil pits and recording information

Terry selected the locations of the soil pits, using a combination of his pre-inventory work and the standard methodology referenced above, and his experience at delineating soil boundaries while reading the accessible landscape within the bounds of our soil survey study area. In larger fields, we often dug and compared two or more pits 20 metres apart to determine soil boundaries. If the soil pits revealed similar horizon formation and characteristics, only one pit was measured and described. At each site, one pit was sited outside of the cultivated area to determine the horizon of the uncultivated soils.

We used the following procedure to dig the soil pits.

1. Clear surface debris.
2. Direct shovel straight into profile.
3. Dig pit as deep and wide as to allow a comfortable view of the soil profile.[86]
4. Clear and smooth one flat side of the pit with a knife. If roots are present, cut away with clippers to keep a straight edge on the soil pit.
5. Measure and record information.
6. Replace soil and turf.

Terry created a custom coding form to record all of the information on the soil pits, including:[87]

- Soil pit a number and code
- Depth of the soil pit
- Depth to any observable change in texture or visible horizon
- Location
- Elevation
- Slope
- Surrounding topography and terrain

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[86] We did not use a standard width and depth for the soil pits. The highly variable conditions and landforms of the Bella Coola Valley and the project objectives meant that we only dug as deep and wide a hole as necessary to obtain…

[87] See appendices for selections from the expanded legend and datasheet created for the 2007 Bella Coola Valley soil survey.

- Time required for groundwater to seep into the pit

Determining soil polygons and map units

Using the field data, Terry determined the location and extent of the polygons and map units and created an expanded legend and spreadsheet. The soils data spreadsheet describes twenty aspects for a single map unit. Many of the map units Terry described in the dynamic soil landscape of the Bella Coola Valley are complexes, and he included a range of textures and depth of a listed component, for up to three components of the soil in a map unit. Further details on the expanded legend and on the soils data spreadsheet are found in Chapter Five. The GPS data, entered at the location of each described pit, and the draft soil map layer created by Terry went to a separate GIS contractor. Terry and the GIS contractor communicated for several months subsequent to the completed fieldwork until the editing process for the soil map layers was completed.

4.5 Agricultural land-use mapping and food production inventory

In contrast to the technical inventory data provided by the soil survey, the agricultural land use mapping and food production Inventory accounted for lifestyles and livelihoods expressed in the landscape. This map and inventory depicted present land-use and spotlighted places where cultivated food production activities were underway in 2007. Combined with the other GIS map layers, the land use and food production map illustrates the linkages between the soil and land capability, and the on the ground presence of agricultural activities as observed during the Foodshed Project.

The initial vision for this land-use assessment came during an orientation session with Gary in the first summer of fieldwork in June 2006. After we had passed several of the valley's hayfields and cleared pastures, Gary and I noticed the wide range of small-scale food production efforts, dispersed, it appeared, with remarkable regularity near homes and settled places up and down the valley. We were looking for connections between agriculture, health, livelihoods, and community food security, and finding these meant engaging growers of food at a level of detail much finer than what residents had been reporting to the agricultural census. To capture this detail and inventory the food production strategies on the ground in the Bella Coola Valley, we would need to rethink categories that defined agriculture as income generating or as a census farm operation.

The food production inventory also met some of the goals outlined in the Bella Coola Valley *Food Action Plan* (2006). The Food Action Plan clearly expressed a concern with the state of food insecurity for many of the valley's residents and called for increased food production at the scale of household and community gardens. Yet, the exact numbers of gardens and fruit trees were unknown. Activities associated with the Food Action Plan and later, with the Foodshed Project provided increased opportunities to share the accumulated knowledge of locally practicing food producers and preservers. In the context of the Bella Coola Valley, assumptions about what constituted agricultural land-use and local food production invited closer investigation.

In 2001, as the technology and users of GIS-based inventory were expanding, the Ministry of Agriculture, Food and Fisheries began conducting this type of agricultural use inventory, and publishing a series of guidebooks in hopes of inviting others to contribute to the information base.[88] Provincial agricultural and resource specialists developed the inventory database and methods of collection as part of their “Strengthening Agriculture” program, and targeted users at the municipality, regional district, and agency-level for the guidebook (B.C. Ministry of Agriculture, Forestry, and Food, BCMAFF, 2004: p.2). The methods we adopted for the Bella Coola Valley Agricultural Land Use and Food Production Inventory shared much of the rationale and intended benefits proposed by Ministry specialists. Objectives common to those outlined in the provincial guidebook included:

- Provide a record of land uses in farming or ranching areas and act as a benchmark for monitoring land use change;
- Improve the understanding of land use and resource relationships;
- Identify impacts of proposed policies and regulations;
- Improve the information base to assist land use decision-making;
- Help identify challenges and opportunities to enhance agriculture; and
- Identify opportunities for greater land use and resource compatibility (BCMAFF, 2004, p.4)

While much of the cleared and settled landscape of this valley appeared to be maintained as farmland, beyond the hayfields and horse pastures, the strategies for soils-based food production were not documented or well understood. The available agriculture census data reinforced the narrative of disappearing farmers and reduced the main crop history of the Bella Coola Valley to hay and fodder almost exclusively. The key contribution of the food production inventory was the documentation of a wide-range of farming and gardening

[88] See http://www.agf.gov.bc.ca/resmgmt/sf/Publications.htm#GIS for the AgFocus publications and guidebooks

activities previously unaccounted for with the assumptions and working definitions for agriculture promoted by the state.

4.5.1 Project design

The 2007 agricultural land use map of the Bella Coola Valley focused on land-based activities intended to produce food for humans or feed for livestock. For most of the populated areas of the Bella Coola Valley, the windshield survey method described in the AgFocus guideline was a good fit (BCMAFF, 2004). The equipment we used to conduct the agricultural land use and food production inventory were: photocopies of a 2006 aerial photo mosaic of the valley, a basic GPS device, a clipboard with a pre-coded checklist of land use activities, a tape measure, and a laptop. The data entry template promoted by the guidebook required several readjustments to fit the Bella Coola Valley context and our project objectives. We followed the guidelines provided by the provincial *AgFocus* (BCMAFF, 2004) publication on agricultural land use mapping with the following adaptations required for the Bella Coola Valley context:

- Instead of a cadastral map with provincially provided land title and property boundaries, we utilized an updated set of aerial photographs and a base TRIM map at 1:20,000 scale to cross-check our position in the valley.
- We created a custom inventory checklist for every accessible residence, dwelling, and associated food production activity in the study area.
- Our inventory checklist included a confidence column to indicate the level of interaction with available landowners or caretakers at a given site and to indicate places where visibility or access was limited.
- In areas where food production activities were too diverse to document from inside the vehicle, we walked and recorded our observations as a team: one person made the

food production observations and the other recorded these on the clipboard and checklist.

4.5.2 Data represented

The completed agricultural land use maps included selected information from the food production inventory. See these maps in appendices K and L of this dissertation. The food production inventory appeared on the map as GPS point data and in a sidebar as a legend of documented sites representative of the food production activities observed. Encountered at each of these points on the map were people with a range of food production skills. These were places where we witnessed actively growing fruit trees, vegetable gardens, vine and berry crops, season extension techniques, and livestock tending.

Not all of the places included in the complete food production inventory appeared on the agricultural land use map. Limitations of the mapping scale are the key explanation for this. Specifically, the minimum polygon size for the 1:20,000 scale mapping was .8 hectare (+/- 2 acres), an area larger than many of the household-scale food production strategies we observed. This minimum unit size determined the smallest boundaries we drew for each of the seven categories of generalized land use on the maps. The mapping scale also determined how closely we could space the GPS points that were representative of the range and scale of food production activities. To assure legibility of the map at this scale, only selected locations from the complete food production inventory appear as point data on the agricultural land use map.

Experienced in agricultural land use mapping in other parts of the province, Joan Sawicki contributed oversight and editing to the maps and inventory. With Joan’s organizational insights for example, we created an additional land use category listed as ‘R/A’, or residential-agricultural to account for the combination of rural residential and smaller-scale food production activities. The geographic area mapped and assessed in the agricultural use inventory conformed to the boundaries of the soil survey. Ultimately, the landscape of hayfields and pasture remained definitive of the spatial extent of agricultural use in our 2007 mapping.

Though not spatially bounded on the map, we also inventoried in rich detail the food production activities observed in small-scale gardens and home site orchards, with backyard brambles, protected vines, mixed livestock tending, greenhouses and other season extension practices. Representative of the relative scale and intensity of these activities, we created the food production categories of ‘HF’, household food production, ‘EN’, extended household production, or ‘MA’ market-oriented agriculture, and placed a number of these sites on the maps with GPS point data.

Our custom food production inventory checklist included an abbreviated form of these questions as unique columns:

- Were there any fruit trees? If so, how many and what types?
- Was there a cultivated vegetable and fruit garden? If so, what was the approximate size of the cultivated area? What types of crop were present?
- Were there any vines or berry crops? If so, what types?
- Was a greenhouse or other season extension activity present? If so, what was the approximate size of the structure or kind of season extension activity?
- Was there any evidence of livestock tending such as housed or visible animals? If so, what types of livestock are present?

4.5.3 Contributions of the local research assistants

We departed from the windshield survey method in the four residential areas of the valley with denser settlement. From east to west, these were: the Gibbs Road-Smith subdivision, 4 Mile Reserve, Townsite Reserve, and downtown Bella Coola. In each of these areas, we slowed the pace to a walk. On the 4 Mile and Townsite Reserves, as well as in downtown Bella Coola, the local research assistant who lived in this end of the valley, Sina Robert Tallio, assisted me. At that time, Sina was a recently elected Nuxalk Councilor and held the agriculture portfolio. He had work experience with the previous census in the Ocean Falls area and was familiar with the kind of door-to-door coverage we featured in the food production inventory. For both reserve neighbourhoods, Sina provided a photocopied map of the streets and house numbers. At the eastern end of the valley, Andrew Flegel provided comfortable access and knowledge of places near his parents and neighbours. Andrew had some familiarity with GIS equipment and a strong academic interest in resource management.

Though many houses did not have visible addresses or associated names, we documented our east-to-west progress down the valley and along the road in a comprehensive way with the inventory checklist and a door-to-door approach. The small resident population, and mostly accessible to the road settlement pattern of the Bella Coola Valley, made this a feasible approach for our time and budget. Both research assistants made significant contributions to the land use inventory with their local knowledge and established networks of family and friends. They knew which houses we observed were abandoned or seasonal in use, and in some cases, they knew and felt comfortable with long driveways and large dogs. The soil fertility fieldwork of the previous season also contributed a sense of familiarity with landowners, gardens, and field sites.

4.6 Workshops and garden-tours

The provincial foundations that financially supported the Foodshed Project approved funding for three open workshops to return results from the fieldwork to all interested members of the Bella Coola Valley.[89] The first workshop focused on the results from the 2006 soil fertility study. The second workshop was organized as an edible garden tour and local foods feast. Our final project workshop, held in March of 2010, returned the results of the completed mapping and inventory research to Bella Coola residents who wished to understand how to apply the research to the private and shared land resources of the valley. With each of these public workshops, our intention was to make our findings useful to the people who participated. Our assumption was that the workshop format was the best available method for facilitating an exchange of scientific and local knowledge on the topic of increased soils-based food production. Additionally, each of these workshops and public events served to communicate and build interest in the research within the community.

Soil fertility workshop

The purpose of the soil fertility workshop was to deliver the soil test results back to the participants in the study. As project facilitator, I was responsible for preparing the individual soil test interpretations and reports for each soil sample, designing the workshop agenda, promoting the workshop, organizing the venue and catering, and coordinating the details of

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[89] See acknowledgement page for recognition for these foundations.

the workshop. I circulated an evaluation form among participants and summarized the results for myself and project stakeholders. Finally, I wrote a follow-up article for the local newspaper.

As this event was perceived as an opportunity for agricultural extension and outreach, three professional agrologists attended: Gary Runka, Art Bomke, and Jammi Kummar. Each gave a brief presentation and together they formed a response panel for a scheduled question and answer period. Jammi Kummar, an agrologist with previous project experience with the Nuxalk Nation and BCVSAS partners, addressed “community food systems” with his presentation. He tied together the longer-term goals of increased community health with increased participation and skills building in soil management and agricultural food production. Gary Runka provided background on the Foodshed project, and the context of soils and soil project work in the Bella Coola Valley and province. Art Bomke presented an overview of soil fertility testing fundamentals. I presented and discussed the overall results of the Bella Coola Valley soil fertility and irrigation water testing. In a separate presentation, I introduced the upcoming soil survey and linked it with the preliminary findings from the soil fertility study. The workshop closed with a more informal one-on-one session between participants, the panelists, and the project facilitator.

Central to our project objectives was the opportunity with this workshop to feature locally grown and prepared foods. We hired a resident caterer with access to frozen and fresh foods from the Bella Coola Valley, and enjoyed a shared meal with Bella Coola berries baked into muffins, root crops and moose meat combined in a hearty stew, and mint tea gathered from local gardens.

Edible garden tour and local foods feast

The second workshop in our series, aimed at knowledge transfer and increased participation with farming and gardening activities, was scheduled during the peak Bella Coola Valley growing season. As with the soil fertility workshop, Foodshed Project funding covered the associated expenses, though this multi-faceted event benefited from additional human resources and collaborative planning. Dayna Chapman, the Community Food Security Coordinator, was central to event design, coordination, and promotion.

The planning team for the edible garden tour included Dayna, her summer student Kirsten Tallio, my research assistant Sina, and me. Fortuitously, we discovered that a similar event, the Bella Coola Valley Garden Tour, which had an established following, would not be scheduled that season. Lead organizers for the Garden Tour gave us the nod to replace that event with the Bella Coola Valley Edible Garden Tour. The Edible Garden Tour was developed to showcase the range of skills and food production practices in the valley, and to provide support and inspiration to participating growers.

The first annual Bella Coola Valley Edible Garden Tour and Local Foods Feast took place on Sunday, July 15, 2007. We arranged school bus transportation from the Sunday farmers' market parking lot to seven tour stops. The final stop, the Lonesome Duck Ranch, was also the venue for the Local Foods Feast. The edible garden tour stops included market gardens, greenhouses, a community-demonstration garden, an orchard and table grape vineyard, a specialty livestock venture, a restaurant garden, and a commercial nursery. The range of skills and practices demonstrated at these seven sites covered innovations with raised bed cultivation, alternative mulches, pruning and grafting expertise, trellising, greenhouse and season extension systems design, predator fencing, and chicken tractors. Art Bomke was emcee of the tour and at each site; he led the question, answer, and highlight session with the host of the tour stop. Terry Lewis attended and gave an introduction to his soil survey fieldwork that was just underway.

An overall theme for the event was the celebration of local foods. The tour provided an opportunity to encourage connections between local producers and local food service businesses. We approached all currently operating restaurants in the Bella Coola Valley and invited them to participate with a donated dish that featured local foods. In the summer of 2007, there were four full-service restaurants and an artisan bakery café in operation. We encountered several obstacles to full participation from the businesses. Though the local foods movement was popular and growing in the province and North America, provincial food safety policies concerned the business owners. Added to these concerns were the tight operating margins of these businesses and limited resources to handle our unusual request. We ultimately overcame these with a willingness to provide produce or local ingredients from our participating growers, and to pick-up, deliver, and promote their chosen dish for the feast.

Foodshed Mapping Workshop

The final workshop of the Foodshed project took place in March 2010. Dayna Chapman located the funding and organized the speakers for this open workshop. The event was scheduled as part of the BCVSAS Annual General Meeting and, similar to the previous workshops, was designed to return project results to the community. The workshop's goals were to promote the new information on Bella Coola Valley agricultural resources and instruct residents on the use of the maps.

Gary Runka, Joan Sawicki, and I gave presentations on the series of maps and the inventory work carried out in 2007 and 2008. Gary gave an overview of the Foodshed project objectives and presented a summary and discussion of the soil survey and interpretive map series. He reviewed the definitions and applications of agricultural capability and crop suitability and provided a sense of the interrelationships between the maps. Joan introduced the agricultural land use inventory and described the series of maps as a story, or narrative, of the land. I presented a brief photo documentary of food production innovations encountered as part of the inventory work and research in the valley and launched a dialogue with participants with the question: "How can we use the soil and agriculture resource maps to grow more food in the Bella Coola Valley?"

4.7 Interpretive mapping: Land capability and crop suitability

From the baseline data of the soil survey conducted in the valley, and from climate information available via Environment Canada, Foodshed Project partners created interpretive maps that portrayed the land capability and crop suitability for agriculture in the

Bella Coola Valley. The methods of interpretation are prescribed in five federal and provincial guidelines published from the 1960s through the early 1990s.[90] In contrast to the soil survey map, the interpretive maps rely both on a prescribed system for grouping inherent soil properties, and on a system of climate classification for agriculture. The data used to derive the climate ratings are drawn from thirty-year averages and gathered from equipment rated with World Meteorology Standards (Climatology Division, 1981). The parameters defined within this classification system for thermal and moisture potential and limitations to agriculture are described as: freeze-free period, growing degree-days, effective growing degree-days for Coastal areas, and moisture deficit or surplus (Climatology Division, 1981: p. 2). For the first project report to funders and partners submitted in early 2007, I compiled the climate data for these agro-meteorological parameters recorded by three Bella Coola Valley weather stations and archived in Environment Canada Climate Normals (1971-2000).[91] Later in 2007, we utilized these summaries to determine the climatic class range for the study area, and applied this to the land capability and crop suitability interpretations.[92]

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[90] The national standard, the *Canadian Soil Capability Classification for Agriculture* was first published in 1965, updated in 1969 and 1972. The provincial methodologies for the *Land Capability Classification for Agriculture* were published in (Runka, 1973) and updated in (Kenk & Cotic) 1983. Methods for crop suitability interpretations published in this province were published in (Bertrand, Hughes-Games & Nikkel, 1991). *Climate Capability Classification for Agriculture in British Columbia*, an important first step in the crop suitability interpretations were published in 1981.

[91] The three stations are found using this search tool and link on the Environment Canada "National Climate Data and Information Archive", Climate Normals & Averages web page: http://www.climate.weatheroffice.gc.ca/climate_normals/index_e.html

[92] See appendices G and H for land capability maps and appendices I and J for the crop suitability maps, and appendix M for the crop suitability report.

Land Capability

For the first map set, Terry drafted the land capability for agriculture ratings from his extended legend and spreadsheet data, coupled with the climate capability classification. This interpretation of land-use for the purpose of agriculture is fundamentally based on: inherent soil properties, climate characteristics, potential for and limitations within a range of crops, and relative intensity of conservation and management.[93]

The capability class ratings are numerical from 1 to 7, with the best potential for sustained agricultural production found within classes 1 to 4. Class 1 soils require the least modification for sustained production of common cultivated field crops and class 2 to 4 lands require increased management interventions, from minor to moderate to special practices for the 4th class capability. Class 5 lands are capable of use only for perennial forage lands or for specially adapted crops; class 6 lands are capable only of sustained natural grazing of domestic livestock; and class 7 lands are incapable of either arable culture or grazing (Kenk & Cotic, 1983). The land capability methodology specifies that additional limitations or hazards to agriculture be given an alphabetical subclass code (Kenk and Cotic, 1983; Runka, 1973). With the exception of class 1 land, the subclass code is applied to indicate the kind of agricultural management challenge characteristic of the soil unit.

The land capability system detailed in earlier publications does not include tree fruits, cranberries, blueberries, and ornamental crops within the category of commonly cultivated

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[93] See Environment Canada (1972: p.5); Runka (1973: p.1); Kenk and Cotic (1983: p.3).

field crops. It also does not include a set of factors that may be crucial to the economic viability or feasibility for commercial agricultural production: "distance to market, type of ownership, cultural patterns, skill or resources of individual operators, and hazard of crop damage by storm" (Kenk & Cotic, 1983: p.6). Though tree fruits, cranberries, blueberries, and ornamental crops, all increasingly characteristic of agricultural production in B.C., are not included in the earlier capability ratings, Kenk and Cotic (1983) added a modified classification system for tree fruits and grapes.[94] The rating system applied to the *Bella Coola Valley Land Capability for Agriculture* map series did not specifically note these updates in areas where tree fruits or grapes were part of present land-use, though the modified system could be carefully derived for the steeper and stonier lands of the Bella Coola Valley.

The agricultural capability ratings depicted for each soil map unit on the Bella Coola Valley Land Capability for Agriculture maps, and in the legend, are improved ratings. In earlier versions of this classification system for BC, soil survey mapmakers included two ratings: "one for dry farming and a second for irrigated conditions" (Runka, 1973: p.7). Improved ratings "indicate the capability after existing limitations and/or hazards have been adequately alleviated" (Kenk & Cotic, 1983: p.39). With this rating system, the mapmakers assume improvements to drainage and the availability of and access to irrigation water.

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[94] According to the 2001 BC agriculture census, top crops in B.C. agriculture as defined by revenue generated include dairy, floriculture and nursery, poultry, beef, berries and grapes, and tree fruit. See the following link to a Ministry of Agriculture website for this overview at the turn of the 21st century: http://www.agf.gov.bc.ca/aboutind/profile.htm

Crop suitability

For the crop suitability interpretations, Gary, Terry, and I applied the accumulated climate data, soil survey fieldwork, consultations with active Bella Coola Valley land managers, and our combined experience within the framework of the crop suitability interpretations found in the *Soil Management Handbook for the Lower Fraser Valley* (Bertrand et al., 1991). The crop suitability report and the *Bella Coola Valley Crop Suitability* map series received additional input from Joan Sawicki and the GIS mapping contractor, Hans Granander. Joan vetted the written report drafts, communicated with all of the preliminary contributors, and worked directly with Gary to finalize the crop suitability interpretations. See appendices I and J for the crop suitability maps and appendix M for the 2008 crop suitability report.

Hans created the crop suitability maps and coordinated these with each of the previous GIS map layers he had received: the Terrain Resource Inventory Mapping (TRIM) base map, shape files, polygons, or soil map units.[95] Hans used ESRI Arcview 9.1 software to generate the shape files and spatially adjusted the base air photos to a TRIM base at 1:20,000 scale. He manually digitized the polygons identified by Terry on his aerial photo set. The shape files are projected in NAD 1983 Albers coordinates and in GCS 1983 North American geographic coordinates. The estuary and Bella Coola Townsite are included in the mapped polygon area, but not described in the soils legend or interpreted for either agriculture capability or crop suitability.

[95] These base maps at the 1:20,000-scale were used with permission of the CCRD and Integrated Cadastral Information Society.

Similar to the combined soil management groups found in the *Soil Management Handbook for the Lower Fraser Valley,* Terry grouped the soils of the Bella Coola Valley into nine distinct units. These soil groupings are descriptive of **parent materials, texture**, drainage, flooding or stoniness limitations, and, in some cases, landform characteristics.[96] The names given for these soil groups point to the relative levels of management inputs or challenges to agricultural use. For example, the soil map units found in the "high capability fluvial soils" group consisted of the highest rated soils for agriculture in the valley. These soil units were all 1st and 2nd class soils and, with only two exceptions, were placed within the highest rated soil units for crop suitability.[97] As a further example, the soil units within the "regularly inundated" and "stony, coarse textured fans" tended to fall within an agriculture capability class of either 5 or 7.

4.8 Mapping the mapmakers: Reflections on the methodology

Timothy Pyrch (1998) inspired the sub-title of this section with an article called "Mapmakers on Mapmaking". His article was intended as a reflective survey of esteemed thinkers and practitioners of the PAR interdisciplinary approach to inquiry. Given the visibility of the agricultural resource maps generated as a product of this research, I viewed 'the mapmakers' as an appropriate focal point for reflection. The mapmakers described here are the contributors to the Bella Coola Valley Foodshed Project. They are the people and organizing

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[96] See Bertrand (et al 1991) for a list of defining characteristics and soil management groups in the Lower Fraser Valley.
[97] The map units included in the "high capability fluvial soils" with moderate to low crop suitability ratings were F41 and T42.

concepts directly engaged with the university-community partnership detailed in this dissertation. The project was initiated by a request for support from the Nuxalk Nation, and later the BCVSAS Board. As the university-community partnership evolved, the collaborators further refined the project to fit budget limitations and human resource constraints. The results of those decisions are the maps and inventory products included as the publically available information generated by project. Though regularly discussed, for example, we did not have the human resources for, and did not pursue the addition of a GIS map layer depicting Nuxalk traditional food resources.[98] Instead, our maps and inventory depicted soils, land capability for agriculture, cultivated crop suitability, and agricultural land use.

The maps we drew of the Bella Coola Valley spotlighted soils and agriculture. As we collected data and surveyed the field, I endeavored to broaden my very limited understanding of the historical contexts of the Bella Coola Valley. The chronology for the research centered outside of the Bella Coola Valley was in a sense, reversed. Within three months of my arrival to British Columbia and enrollment in the graduate research program at UBC, I flew to Bella Coola for an introduction at the first BCVSAS annual general meeting. This visit officially initiated fieldwork activities for the university-community partnership. During the winters and springs of the BCVSAS-UBC Foodshed Project, I resided in Vancouver and conducted follow-up laboratory work and literature reviews in pursuit of the overall research and

[98] See also geographer Mensah (1996) on the potential for GIS technologies, in the service of First Nations' land claims negotiations. Mensah (1996) cautioned GIS users to explicitly recognize the views and aspirations of Aboriginal people, and noted specific challenges (scale, complexity of information, and the sacred nature of certain sites) to data collection and data integrity.

dissertation objectives. I encountered, for the first time, an extensive literature on the discourses of colonialism, on the resettlement of British Columbia, and on traditional ecological knowledge.[99] I found that one of the many techniques of dispossession and sources of differentiated power and knowledge was a critical perspective of maps as ‘ideological weapons’ (Foucault, 1972:pp.74-75; Brealey, 1995; Harris, 2002). Maps and charts had been deployed precisely within the bounds of Nuxalk Traditional Territory as a way of representing resources and location, and mapping “out”, or excluding people and histories of that place (Brealey, 1995). Similarly, the insights of Cole Harris (1997, 2002) and William Turkel (2007) prompted me to dig deeper for ‘ground truths’ we would not portray with our science-based, technical maps of soils, agriculture capability, and crop suitability.

Ground truthing, as described by Turkel (2007: pp. 82-83), is a process of working back from information lost by a particular representation—whether on a map, aerial photo, or satellite image—and checking whether that representation accurately lines up with the details of place. Our research team carried out this activity as a part of our fieldwork methods for the land-use maps, and in this form, it is described in section 4.5. More figuratively, ground truthing the assumptions embedded in the fieldwork project and those embedded in the dissertation were the springboards for exploring the agricultural histories of the valley.

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[99] On the discourses of colonialism see Chapter Two, and especially Harris (2002, 2004, 2008); See Harris (1997) and Harris and Demeritt (1997) for the collection of essays that establish the basis for the term “resettlement” in British Columbia; See Menzies (2006) on traditional ecological knowledge. See also White (1980) for a regional study that served as a model for broadening the biophysical to the social and historical change aspects of this research dissertation.

With an awareness of the power inequities and benefits that often accrue to university researchers working *with*, *among,* and *for* vulnerable communities, I framed my official role in the university-community partnership as research facilitator (Menzies, 2001). Unofficially, I was an outsider to the multiple communities and complex interrelationships I was encountering. At the time, there appeared to be limited, solid guidance in the academic literature for either managing or articulating the regular confrontations I was experiencing.[100] The initial tensions seemed to be thematic of representation and inclusion, pressures of reporting and timelines emerged subsequently.

As I continued with the project fieldwork and conducted additional literature reviews, I found a wealth of PAR case studies in peer-reviewed journals of sustainable agricultural development and natural resource management. Particularly helpful was a review article contributed by Lilja and Bellon (2008) which articulated and responded to the questions: when should participatory research be used, how should it be applied, what are common challenges, and what are the costs and benefits? Similarly, El Ansari (2005) and Margerum (2007) outlined challenges and constraints to collaborative research partnerships from the perspectives of professionals working in *Public Health* and *Society and Natural Resources*.

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[100] Exceptions to this are Markey (2005) on competing forces and complexities attached to the community economic development model pursued in their own case study of the Nuxalk and forestry resources, as well as Bopp & Bopp (2004) for lessons learned working within the social contexts of the Nuxalk and Bella Coola Valley, and most recently a new conceptual framework for stakeholder participation in agricultural projects by Neef and Neubert (2010).

El Ansari (2005) presented his collaborative research experience from a South African context, and suggested the following as five considerable challenges.

- The value systems of the collaborators
- Costs and benefits of the stakeholders
- Issues of empowerment and capacity transfer
- The need for multidisciplinary approaches
- A prerequisite of clarity with respect to the researcher's and the community's role with the research

Richard Margerum (2007) cited catchment group research in Australia and watershed councils in Oregon as the basis for his five summary constraints to local level collaborative research initiatives.

- Transaction costs
- Limited perspectives of locally based collaborative groups
- Organizational stability
- Policy issues, particularly institutional scale and jurisdictional constraints
- Adequacy of representation

The costs of transportation, as an example of transaction costs for the university partners, factored into difficulties with communication between the BCVSAS and UBC research partners, though the summer-length residence during 2006 and 2007 provided some relief and a better sense of locally-based constraints. In the case of the BCVSAS-UBC Foodshed project, multiple perspectives were voiced within the local partner organization, but this was a relatively new organization within the local community, and as such, the BCVSAS lacked stability. Relationship building was required both for the community organization and the representation of the research project. Given the limited time scope for the project objectives and the investigation, this presented a set of constraints for capacity building and knowledge transfer objectives. Confirming most of the constraints listed by Margerum (2007) in the case of the Bella Coola Valley Foodshed Project, I observed that not all voices within the Nuxalk and valley communities could be adequately represented by the BCVSAS organization.

4.9 Conclusion

In conclusion, this chapter provided details on the approach and the methods utilized to carry out the objectives of the Bella Coola Valley Foodshed Project. The intention of the university-community partnership was to reconnect the people of the Bella Coola Valley to the possibilities of improved health through increased participation in agricultural food production. The complexity and dynamics of the participatory research process presented challenges unique to the Bella Coola Valley context, as well as challenges identified as characteristic of this approach to research outside of the Bella Coola Valley. Chapters Five and Six that follow present the findings that emerged from the methods detailed here. Ways forward and further discussion of the limitations of the research approach pursued are found in Chapter Seven.

Chapter 5: Soils of the Bella Coola Valley

5.1 Introduction

The BCVSAS-UBC partnership set out to explore the potential for increased agricultural interest, participation, and production in the Bella Coola Valley with the Foodshed Project soil survey. The partnership deemed the available soil inventory information to be lacking sufficient detail, and aimed to contribute updated 1:20,000 scale soil mapping. The findings from the soil survey included three sets of maps that depicted the western and eastern ends of the Bella Coola Valley, with colour-coded and delineated information on the following: 1) the soil survey 2) land capability for agriculture, and 3) crop suitability. The soil survey and accompanying mapping, legends, and reports were significant priorities for the Foodshed Project, envisioned as essential tools for building agricultural capacity in the Bella Coola Valley.[101]

In this chapter, I present those findings from the soil mapping activities that directly connect with the identification of the biophysical resources for the Bella Coola Valley, and offer a set of reflections on the greater challenge of increasing agricultural participation. The soils maps characterize major landforms and place soils within defined polygon units, and the interpretive maps delineate areas of soils with characteristics capable of sustained mechanical cultivation, and those areas of the valley well-suited to a wide range of non-local cultivated

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[101] See the Central Coast Regional District website for a full set of Bella Coola Valley soils, land capability for agriculture, crop suitability, and agricultural land use maps. http://www.ccrd-bc.ca/mapping/agricultural.php

crops. The soils maps are found in appendices E and F, and the interpretive land capability and crop suitability maps are found in appendices G-J. Responding to the second objective of the fieldwork research project, I argue that the biophysical mapping tools and information are useful contributions, but there are methodological and epistemological challenges to utilizing these tools to increase participation in agricultural production in the context of the Bella Coola Valley.

5.2 Brief history of soil information on the Bella Coola Valley

Beginning in the 1920s, universities in the prairie provinces of Canada with soil science departments initiated systematic soil surveys, often with support from provincial and federal departments of agricultures (McKeague & Stobbe, 1978). At the same time, C.F. Marbut of the U.S. Department of Agriculture developed a classification system based on the idea of soil as a natural body (Brady & Weil, 2002). Benno Warkentin (1992) characterized this period in the history of soil science as one in which soil mapping, and contributions from geology and chemistry were applied to questions about the exploitation and allocation of natural resources.

At this time in British Columbia, the Forest Service started a program to establish permanent forest reserves, and carried out soil surveys to separate arable from nonarable lands (McKeague & Stobbe, 1978). Soil surveys conducted in the Prince George, Sicamous, and North Thompson Valley regions from 1927 to 1929 were used to inform the first sustained yield policy in Canada for forest resources (McKeague & Stobbe, 1978). In the summers of 1926 and 1928, Blanche MacAvoy (1931) carried out the first documented ecological survey of the Bella Coola Valley. The audience for the information she gathered was the *Botanical Gazette*, and though some synthesis of then available information on geology and climate was included, the focal points of the survey were the identification of forest tree species given their potential economic importance, and the broad identification and distribution of botanical species given her audience.

Contemporary with the above soil and ecological survey developments, an agricultural economist from the U.S. Department of Agriculture, Oliver E. Baker (1931) contributed a multi-part series characterizing the agricultural regions of North America to the journal *Economic Geography*. For Baker (1931: p. 109) the Bella Coola Valley was part of the North Pacific Hay and Pasture Region, "located mostly in the valley bottoms and adjacent foothill slopes of the long structural trough which extends from the Siskiyou Mountains on the California–Oregon boundary to Queen Charlotte Sound and beyond". At this time, Baker (1931) estimated 100,000 acres (40,000+ hectares) in the Bella Coola and Skeena River Valleys were suitable for agriculture. Published in the same journal a few decades later, Donald Kerr (1952) provided a more detailed analysis of the physiography, climate, and soil of British Columbia as determinants to the possible expansion of agriculture in the province. Kerr (1952) observed that fewer than 20,000 acres (8,000+ hectares) of farmland had been improved within the coastal valleys of the B.C. mainland. Kerr (1952) depicted the Bella Coola Valley as typical of the isolated pockets of arable land in these areas with only 3.5 percent of the occupied farmland planted in crops, and concluded that physical factors placed a limit on agricultural expansion, but that lack of markets and the scattered, sparse populations of the area were the most restrictive factors.

Though not directly attributed, Kerr's (1952) assessment of agricultural land use and potential arable land area in the Bella Coola Valley was likely based on the reconnaissance level soil survey of R.H. Spilsbury (1950), carried out in the Bella Coola Valley a few years prior. By the 1950s, Spilsbury had decades of experience in soil survey as a representative of the federal Department of Agriculture, and as a surveyor for the B.C. Forest Service (McKeague & Stobbe, 1978). Findings from Spilsbury's (1950) *Land Use Report for the Bella Coola Valley* are depicted in Table 5.3 below. Spilsbury (1950) described his methods of assessment as limited to study of the air photographs, examination of the soils along the accessible main and side roads "from the mouth of the river to Stuie", similar to the extent of our 2008 soil survey study area described in the section that follows.

Table 5.3 R.H. Spilsbury presented the following estimates of the "kind, extent, and development" of the Bella Coola Valley soil resource in his 1950 land use report.

Arable valley bottom of alluvial soil (Includes some non-arable sloughs, gravel bars, and some fans)	6169 hectares (15,245 acres[102])
Non-arable fans of tributary creeks	1,052 hectares (2,600 acres)
Non-arable bench lands	399 hectares (985 acres)
Total	7,620 hectares (18,830 acres)
Cultivated	558 hectares (1,380 acres)

Three separate provincial agencies carried out soil and agricultural land use assessments of the Bella Coola Valley in the 1970s, and each one was at a mapping scale of 1:50,000.[103] In

[102] The unit of area provided in the original was an acre, and this unit is included here given the continuing practices of providing both Imperial and Metric units in government prepared extension information to agricultural producers.

review and summary of the previously published soils information in 1981, Leaney and Morris listed the five different soils present in the Bella Coola Valley as "eluviated dystric brunisols, ortho-humo-ferric podzols, eutric brunisols, regohumic gleysols, and ortho regosols", and concluded that soils information on the Bella Coola area was "very limited" (p. 17).[104] The survey and mapping carried out by Neville Gough in the Bella Coola Valley as part of the British Columbia Land Inventory (BCLI) at the 1:50,000 scale, provided the basis for areas included in the Agriculture Land Reserve (ALR) maps in 1974. For the whole of the regional district, the initial ALR area was 4,453 hectares.[105]

The study of estimated agricultural land use within the ALR carried out in 1978 on behalf of the Select Standing Committee on Agriculture suggested: 1) that forage and grains production made up the largest single type of agricultural land use in the Bella Coola Valley with 289 hectares 2) that grassland and pasture characterized the second largest agricultural land use with 149 hectares; and 3) as shown in Table 5.4, there was effectively no area within the Bella Coola Valley devoted to horticultural land use.[106] This study also pointed out the limited accuracy of the information was due to methodological drawbacks (Select Standing Committee on Agriculture, 1978). Specifically for places like the Bella Coola Valley seen as

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[103] These provincial agencies and the dates of the completed maps and reports were: B.C. Forest Service (1979), Ministry of Agriculture (Gough, 1973), and the Select Standing Committee on Agriculture (1979).

[104] See the Soil Classification Working Group (1998: pp.53-133) publication for descriptions of these subgroups according to the Canadian system of soils classification.

[105] Two areas of ALR lands within this regional district are outside of the Foodshed Project study area: eastern sections of Tweedsmuir Park are the larger of the two areas, and a small ALR section near the Nooseseck River and Green Bay make up ALR lands outside the 2008 project bounds described in the sections that follow.

[106] See Table 5.4 for the excerpted area summary of agricultural capability and land use in the Bella Coola Valley from the Select Standing Committee on Agriculture (1978).

an “isolated” pocket of the ALR, those limitations were linked with missing agricultural capability mapping, and with the existing mapping based solely on interpretations of the air photographs with limited or no on the ground field checking (Select Standing Committee on Agriculture, 1978: p. 151).

Table 5.4 Excerpt from the legend of the Agriculture Capability and Land Use map of the Bella Coola Valley created for the 1978 Select Standing Committee on Agriculture. Land use symbols are H for horticulture; G for Forage and grains; P for grassland and pasture; F for forest cover; NP for non-productive lands; and W for water.
http://www.env.gov.bc.ca/esd/distdata/ecosystems/TEI_Scanned_Maps/I15/I15-3194/

AREA SUMMARY
(hectares)

LAND USE	B.C.L.I. LAND CAPABILITY CLASSES							TOTAL
	1	2	3	4	5	6	7	
H	0	0	0	0	0	0	0	0
G	5	55	197	14	15	0	3	289
P	1	21	91	5	14	0	17	149
F	23	380	713	380	128	0	164	1788
NP	0	23	57	0	0	0	3	83
TOTAL	29	479	1058	399	157	0	187	2309
W								71

5.3 Soil survey

Soil surveys, also referred to as soil inventory, identify the different soils of an area, group and classify these soils based on a national soil classification system, and finally, delineate these soils into polygons set down on a map base that shows their extent and distribution on the ground (G.Runka, personal communication: November 1, 2006). Leadership from within the Foodshed Project estimated the area of the valley suited for cultivated crops was 7,000 hectares. Connected with the purposes of the soil survey for the BCVSAS-UBC partnership, the focus was on soils bounded within the previously cleared valley bottomlands near the estuary at the mouth of the Bella Coola River to the western boundary of Tweedsmuir Park near Stuie. Steeply sloped side valley areas, many areas difficult to access by road, unsettled areas, the Bella Coola Townsite and estuary were not included. By the time the project team completed the soil survey fieldwork and GIS mapping, the *Soils of the Bella Coola Valley* map series depicted 6,747 hectares at the prescribed 1:20,000 scale. See appendices E and F.

The soil survey data gathered in the field was based on the descriptions of 320 soil pits with details organized into an expanded legend.[107] These maps characterize the valley soils as comprised of three main landforms: fans, floodplains, or terraces.[108] Soils described as part of a fan landform comprise a 1905-hectare area. The total area of the floodplain map units is 1726 hectares. Terrace map units make up the largest single landform area of the Bella Coola Valley soils map with 2780 hectares.

Ryder (1978) presents a detailed discussion of the formation and physiographic character of the landforms found in British Columbia, and a brief sketch is provided here as a reference

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[107] The Townsite and estuary areas were not included in the soils inventory and descriptions, but the 336.4 hectares of these two areas were included in the total mapped area given as 6747 hectares. See Appendix A for a full listing of map units and areas.
[108] The soil classification methods follow a conceptual framework known as the state factors of soil formation. Hans Jenny (1941) introduced the idea of CLORPT (climate, organisms, relief/topography, parent materials, and time) to an English-speaking audience of pedologists in the middle of the 20th century following Dokuchaev's (1883) ideas about soil forming factors.

point for our findings. The interaction of three factors- rock type, tectonic history, and climate- influenced the present landforms as well as the distribution of **surficial materials** (Ryder, 1978: p.11). Geological **parent materials** and structure for the Coast Mountain physiographic region, where the Bella Coola Valley is located, are generally “granitic rocks with minor gneiss and schist” (Ryder, 1978: p.14). Recent peer-reviewed geological research on the area provided additional insights on the soil forming parent materials of the valley, as well as on the glacial-geological chronology (Mahoney et al., 2009).[109] The geologists place the Bella Coola Valley within the “Coast Plutonic Complex” and identify the rocks dominating this system as quartz diorite, tonalite, and diorite, representing, in terms of the tectonic history, “nearly 140 m.y. of continuous, subduction-related magmatism” (Mahoney et al., 2009: p.1362). That is, collisions of the oceanic and continental plates within this region have created belts of characteristically volcanic and sedimentary rocks, and the mountains and valley of this study area are on the move.[110]

The majority of the 40 distinct fan map units are dominantly comprised of parent materials described as gravelly coarse and medium sands, with cobbles and stones completing a good portion.[111] Deposits within the fan landforms of the valley include unconsolidated **alluvium** and **colluvium,** and, worthy of note, the highest slope ranges recorded for all three landforms (15-25%) are located within roughly one quarter of the fan map units.

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[109] See also Desloges (1989, 1990) for details of the neoglacial history of the Coast Mountains near Bella Coola, and for an analysis of the lithology of sandy-gravel sediments for the alluvial fill of the Bella Coola River.
[110] See McMillan and Hutchinson (2002) for an ethnohistory that interweaves paleoseismic events of the region with oral histories of indigenous peoples of the Northwest Coast.

In general, streams and rivers transported the surficial materials of the floodplain map units.[112] Typical of the multiple side-streams and tributary rivers found in the valley of the Bella Coola River, these floodplain areas are a complex of braided channels with stratified and medium sands, and areas away from or adjacent to active channels, where flood-deposited fine sands and silts underlay low terraces and backwater areas.[113] The two most common parent materials of the 60 floodplain map units are: fine sand over very gravelly medium and coarse sands at horizon depths ranging from 25-75 centimeters, and very fine and fine stone-free sands with horizon depths greater than one meter.

Landform areas that comprise the 51 terrace map units are the most diverse in terms of the range of terrace-type landforms, and in terms of the surficial parent materials observed. The terraces are dominantly fluvial terrace landforms, but developed on multiple levels; sometimes observed as low, medium, and old, high terraces, and as fluvial terraces with several levels within a single map unit. Less frequently, levees, colluvial veneer, and overlain fan aprons also comprise the terrace map units. Parent materials include very fine and stratified sands, and range to the finer textured silts and clayey silts. In fact, 2 out of the 51 terrace map units consist of the finest materials observed in the study area: parent materials of T11 and T24 at the eastern end of the valley were observed with silt and silty clays in the first component with the dominant textural class of T24 documented as a silt loam, and T11

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[112] Glaciers also contributed significantly to the surficial material transport in the area, but the floodplain landforms were predominantly influenced by the mechanisms of fluvial transport.

[113] See Ryder (1978: pp.23-24) for a generalized description of floodplain materials deposition.

with a texture class ranging from silt loams and fine sandy loams in the first component. Figures 5.3 and 5.4 are provided below to illustrate the placement of these two terrace landforms within the landscape of steep topography and tributary streams that factored in their formation .[114]

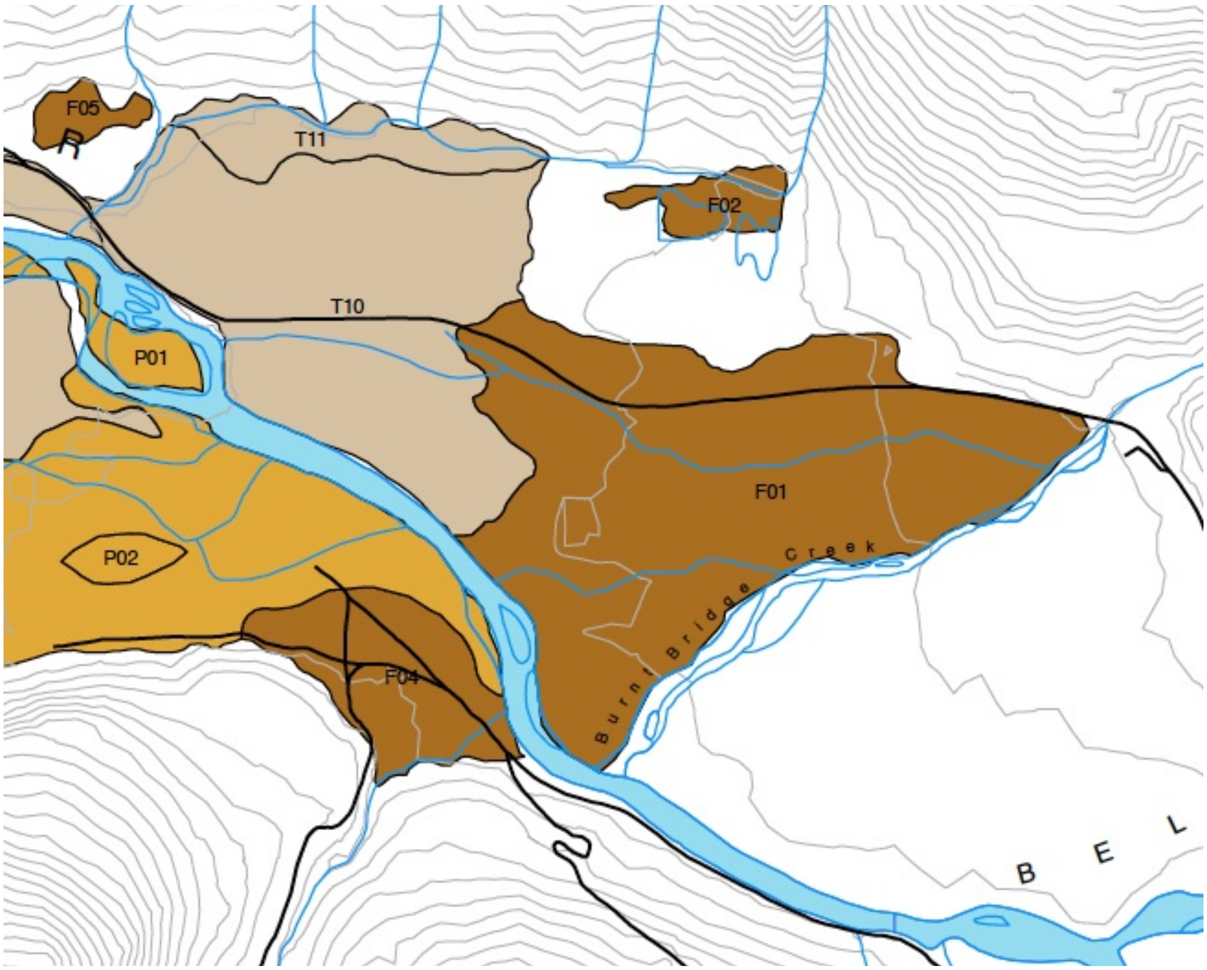

Figure 5.3 Selected view of Bella Coola Valley soil map unit T11 (top left centre, tan) from map 2 the Soils of the Bella Coola Valley map series. F for fan landforms are shown in dark brown, P for floodplains in golden brown, and T for terrace landforms are shown in tan. Bella Coola River and tributaries are shown in blue colour.

[114] T11 is an example of a soil map unit with complex soil associations. Unlike soil map unit T24, T11 required three working pit descriptions, and with these, 70% of the first component textural range, or first horizon depth, was identified as a silt loam. The remaining area and two of the three pits were described with a textural class of fine sandy loam.

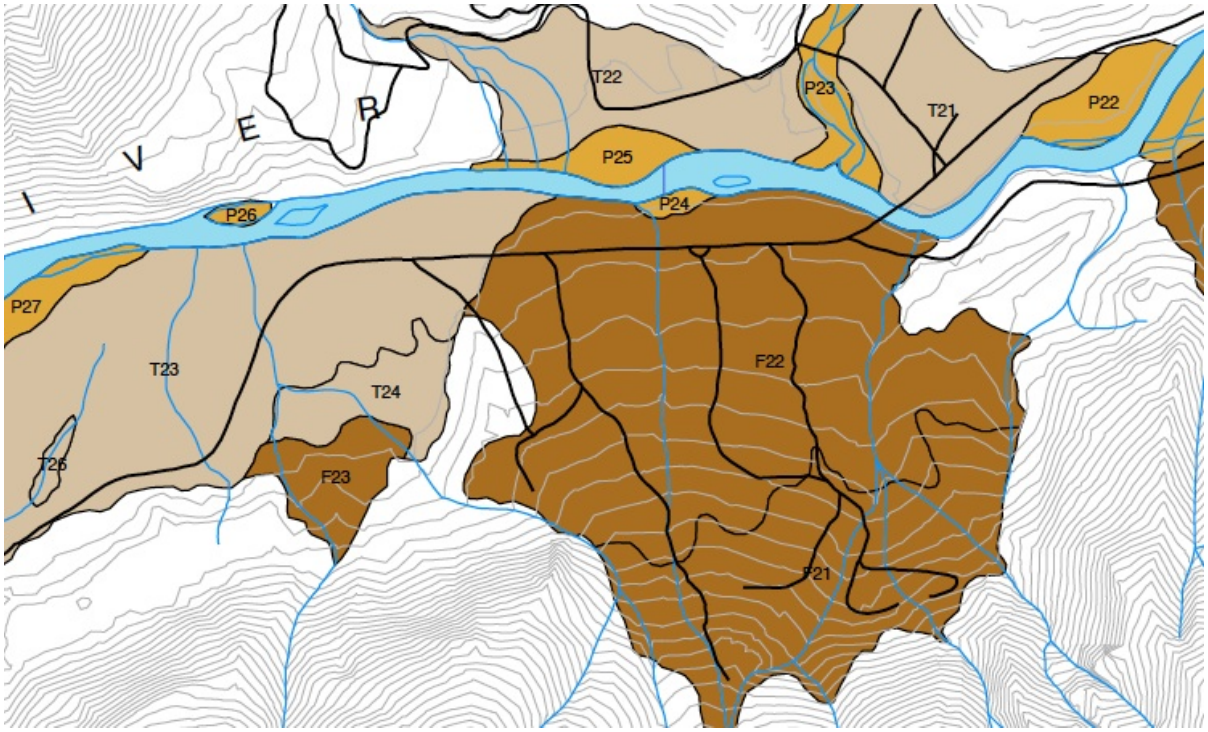

Figure 5.4 Selected view of Bella Coola Valley soil map unit T24 (left centre, tan) from map 2 the Soils of the Bella Coola Valley map series. F for fan landforms are shown in dark brown, P for floodplains in golden brown, and T for terrace landforms are shown in tan. Bella Coola River and tributaries are shown in blue colour.

The predominant soil parent materials of the valley observed in the soil survey are medium to fine sands. Finer textured silts with any appreciable clay content were outliers, with the total area represented by both T11 and T24 map units measured as just over 37 hectares. The working pit and site descriptions data that supported the expanded soils legend showed the most prevalent range of textural classes for valley soils are sandy loams or sands, and in limited locations, the textural classes range from loamy sands to silty loams (Terry Lewis, personal communication: July 19, 2010). Information contained in this map series and in the extended legend with great significance for soil management and stewardship includes the range of slopes, drainage, and textural class data.[115]

Comparing the information from the 2008 soil inventory with the previously carried out surveys from the 1970s, at the level of the soil order, no **podzols** were included or described within the 1:20,000 scale update of Bella Coola Valley soils.[116] Although this region is understood to be part of the **ferro-humic podzol** soil landscape of the Coast Mountains and Islands, the scale and focus of the Foodshed Project mapping explain this apparent discrepancy (Jungen & Lewis, 1978)[117]. At the scale given on the generalized British Columbia soils maps, the smaller soil landscapes of the Bella Coola Valley, and in particular, those of the arable soils, are missed. With the generalized maps, this region mapped as characteristically ferro-humic podzol soils, supported "some of the most productive forest land" in the province (Jungen & Lewis, 1978:p.103).

With the 1:20,000 scale soil inventory, soil map units in the Bella Coola Valley fall within three soil orders of the Canadian soil classification system: **Regosolic, Gleysolic, and Brunisolic.**[118] The number of map units and the area of soils within the Regosolic order were by far the most predominant. Orthic regosols are the most prominent subgroup

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[115] See (Bertrand, Hughes-Games, and Nikkel, 1991: pp. 32-88) for recommended soil practices on coarse textured and/or sloping soils.

[117] See the glossary for a taxonomic description of this soil subgroup, and reference the Soils Classification Working Group (1998) for detailed descriptions of soil orders and subgroups given by the Canadian System of Soil Classification.

[118] See the glossary for working definitions of these soil orders, and the Agriculture and Agri-Food Canada web page provided below for a cross comparison of Canadian, U.S. and F.A.O. soil classification systems: http://sis.agr.gc.ca/cansis/taxa/cssc3/chpt16.html

characterization documented in all three landforms, and are almost completely dominant in the floodplain. Soils with the dominant percentage of the first component observed within the Gleysolic and Brunisolic orders were roughly equal in terms of the numbers of map units characterized, though slightly more were Gleysolic and within a subgroup of the Gleysolic order grading towards the Regosolic. Though orthic regosols are still most common, regic gleysols appear with greater frequency in the terrace landform, particularly on low or wet terraces. Those within the Brunisolic order were often documented as a subgroup grading towards the Regosolic order. Orthic dystric brunisols were most common in the fans, and were found in close association with eluviated dystric brunisols or orthic regosols.

5.4 Land capability for agriculture

The Canadian Department of the Environment published national guidelines for soil capability classification for agriculture in 1972, and Gary Runka (1973), then of the Soil Survey Division within the Department of Agriculture in B.C., wrote the corresponding methodology with certain modifications for this province. Gary (Runka, 1973) pointed out that a “thorough understanding” of the assumptions of the national classification was essential for any users of the land capability for agriculture maps. As described in the previous chapter, the focus on soil capability in this classification system does not account in any way for economic viability, other socio-economic factors, or for the potential of yield per area. The key assumptions for interpreting the soil capability for agriculture as applied across Canada and in the province of British Columbia are as follows:

> Good soil management practices that are feasible and practical under a largely mechanized system of agriculture are assumed.[119]

Much can be said about this assumption with respect to the now, well-documented critique of this 20th century model of agriculture and of agricultural development efforts carried into colonial contexts.[120] For the purposes of this section of the chapter, the important focal points are the area of the valley and forms of food production excluded from view with this assumption. Perennial horticulture, including tree fruits and grapes, is a major contributor to food production and to commercial agriculture within the province and Canada at present. With the assumption of mechanized cultivation, steeper and stonier sections of the Bella Coola Valley with good potential capability for a diverse range of food production were likely underrepresented on the agricultural capability maps. Similarly, in these steeper, stonier sections viable commercial operations focused on non-timber forest products would also be excluded.

Terry Lewis interpreted the soil capability for Bella Coola Valley agriculture using his preliminary research with air photos and landforms, the fieldwork and findings organized in the soil survey, his experience with the Coast-Mountain ecosystems, and the climate information. The methodology he used followed the national and provincial guidelines with the key exception of the depiction of the ratings given on the maps. Unlike the 1:50,000-scale reconnaissance level Bella Coola soils survey mapped by provincial agrologists in the 1970s

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[119] Environment Canada (1972: p.5)
[120] See the Chapter One for a review of the literature with a critique of this model of agriculture, and see the final section of this chapter for additional discussion.

given unimproved and improved ratings, the 2008 Bella Coola Valley Land Capability for Agriculture map series shows only improved agriculture capability ratings. With the greater time invested on the ground, larger scale 1:20,000 map, updated GIS technology, and rating system that assumed improvements, the 2008 map series show an increased area of higher capability soils compared with previous soil inventory work.

The main findings presented here will be focused on those mapped areas interpreted with an agricultural capability class 1 through 4, as those soils require the least modification and have the best potential for sustained agricultural production based on the assumptions of the classification system. The total mapped area of soils in the Bella Coola Valley with agricultural capability given an improved rating in the classes 1 through 4 was 4273 hectares. Class 5 soils made up an area of 1299 hectares, and there were no class 6 soils documented.[121] Those soils comprising a land area within the soil survey interpreted as class 7 and 'incapable of either arable culture or grazing' made up 839 hectares.

The main subclass limitations found within the mapped units with agricultural capability classes 2 through 4 were soil moisture deficiency, and soil moisture deficiency limitation in combination with topographical limitations.[122] There were a few soil map units given 2 through 4 agricultural capability classifications with a subclass limitation of excess water and

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[121] See Chapter Four for description of the land capability for agricultural capability classes.
[122] Class 1 soils do not have any subclass limitations. See the subclass limitations coded on the land capability for agriculture maps as A (soil moisture deficiency, rendered in previous maps as AWSC, or available water storage capacity) and T (topography).

very limited areas within this range of agricultural capability with a limitation of stoniness.[123] On the whole, the agricultural capability findings show soil moisture deficiency as the greatest limitation for the largest number of map units, followed by the combination of limitations connected to soil moisture deficiency and topography, and finally, stoniness, and excess water.

Bella Coola Valley soils given an improved agricultural capability class rating of 1 were limited to a total area just under 300 hectares. The largest continuous area of class one soils is located on the north side, near the mouth of the Bella Coola River. The two terrace and floodplain soil map units given this class one designation, T76 and P69, together form 248 hectares. Since Peter O'Reilly visited and surveyed the area in 1883, this area has been designated on provincial maps as Bella Coola Indian Reserve #1.[124] Also in the western, or lower section of the Bella Coola Valley, is an area of roughly 38 hectares of class 1 soils, where the Le C. Grant experimental orchard and farm were located.[125] Further east and up the valley, near the confluence of the Nusatsum and Bella Coola Rivers, is the only other area given an improved class 1 soil capability rating (12.9 hectares).

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[123] These subclass limitations are coded on the land capability for agriculture maps as W (excess water) and P (stoniness).
[124] Though Ashdown Greene and subsequent surveyors have come to Bella Coola since O'Reilly made this area designation, with few exceptions, little change in the overall area of the reserve has been made. See Chapter Two for a previous reference to O'Reilly and the McKenna-McBride hearings that took place in Bella Coola as part of the process of fixing the reserve boundaries in the 20th century.
[125] See Chapter 3 for a previous reference to Le C. Grant.

5.5 Crop suitability

> Based on (the) climatic class definitions, the available climate data, and the observed range and performance of crops actually grown, the range of climatic classes found in the Bella Coola Valley is best described as Class 1b+ to 1.[126]

This excerpt from the crop suitability report (Appendix M) summarizes the climate classification given to the Bella Coola Valley that resulted from the Foodshed Project activities in 2008. The best available climate data were from three weather stations located within the valley tabulated with thirty-year climate normals (1972-2001). The project team found the climate data represented a limitation to the crop suitability interpretations applied from west to east in the complex landscape and topography of the valley, and recommended an updated date range and better precision with the climate data, specifically, more detailed solar-shading and microclimate work for future research.

The purpose of the crop suitability mapping as stated in the report that accompanied the maps was to "identify the biophysical opportunities for increased range and production of soil-based food products in the Bella Coola Valley".[127] As part of his contribution to the project team and these objectives, Terry designated nine soil groups from correlations with the mapped soil polygons or units. These groupings emerged from the synthesis of information required for the interpretive land capability for agriculture and crop suitability mapping processes. Though not designated in terms of formal soil taxonomy, the nine soil groups are

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[126] *The Bella Coola Valley Crop Suitability Report* (found in Appendix M) lists the provincial climatic capability classes and delimits the range of 1b to 1 as "better than 1b,but not quite 1c".

largely **pedons** developed from similar parent materials with a narrow range of similar features. The groups most closely resemble the categorization of soil management groups found in the *Soil Management Handbook of the Lower Fraser Valley,* with agriculturally important features such as drainage, topography, stoniness, and types of soil parent materials used to distinguish and form each group (Bertrand et al., 1991). [128] Table 5.5 provides a list of these nine soil groups and shows the total mapped area of each group. In addition, Table 5.5 places these Bella Coola Valley soil groups in the most comparable soil management group described in the *Soil Management Handbook for the Lower Fraser Valley*, and provides a brief overview of recommended management inputs for agricultural production based on the handbook model.

Table 5.5 Bella Coola Valley soil groups compared with soil management groups of the Lower Fraser Valley. No soil management group comparison or inputs given for soil groups where agricultural soil management is highly restricted or risk prone.

Bella Coola Valley Soil Group	Total mapped area of soil group (ha.)	Comparable soil management group	Key management inputs
High capability fluvial soils	1157.5	Monroe	Irrigation system for summer months
Sandy fluvial soils	1976.9	Grevell	Irrigation system, lime &/or fertilizer and organic matter incorporation, water management system
Fluvial soils with water table	594.2	Page, Pitt & Prest	Water management system
Old high terraces	445.7	Columbia & Sunshine	Irrigation, lime &/or fertilizer and organic matter incorporation, stone removal
Stony, coarse-textured fans	1381.7	Bose, Buntzen, Capilano, Coghlan, Harrison, Sardis, & Shalish	Stone removal, irrigation system, lime &/or fertilizer and organic matter incorporation
Acidic wet organic soils	48.4	Triggs	*Crop suitability limited to blueberries and cranberries
Very wet terraces	100.5	X	**See crop suitability map
Regularly inundated soils	313.8	X	**See crop suitability map
Active floodplain soils	391.8	X	Cropping not recommended

The area mapped in darker green on the crop suitability maps showed the widest range of cropping options with dominantly high and moderately high crop suitability, and totaled 2336 hectares. As an example of how to apply the crop suitability maps to a specific location, the terrace map unit, T76 that also exhibited class 1 soil capability for agriculture, was found highly suitable for growing nearly all of the crops listed in the legend. With the interpretation given in the maps, the highly suitable crops for this area located near the mouth of the Bella Coola River ranged from annual legumes, root crops, shallow rooted annual vegetables, cole crops, corn, asparagus, cereal grains, perennial forage, blueberries and currants, strawberries, raspberries, and nursery stock. Only tree fruits and hazelnuts were listed as moderately suitable, with cranberries not listed, hence unsuitable.

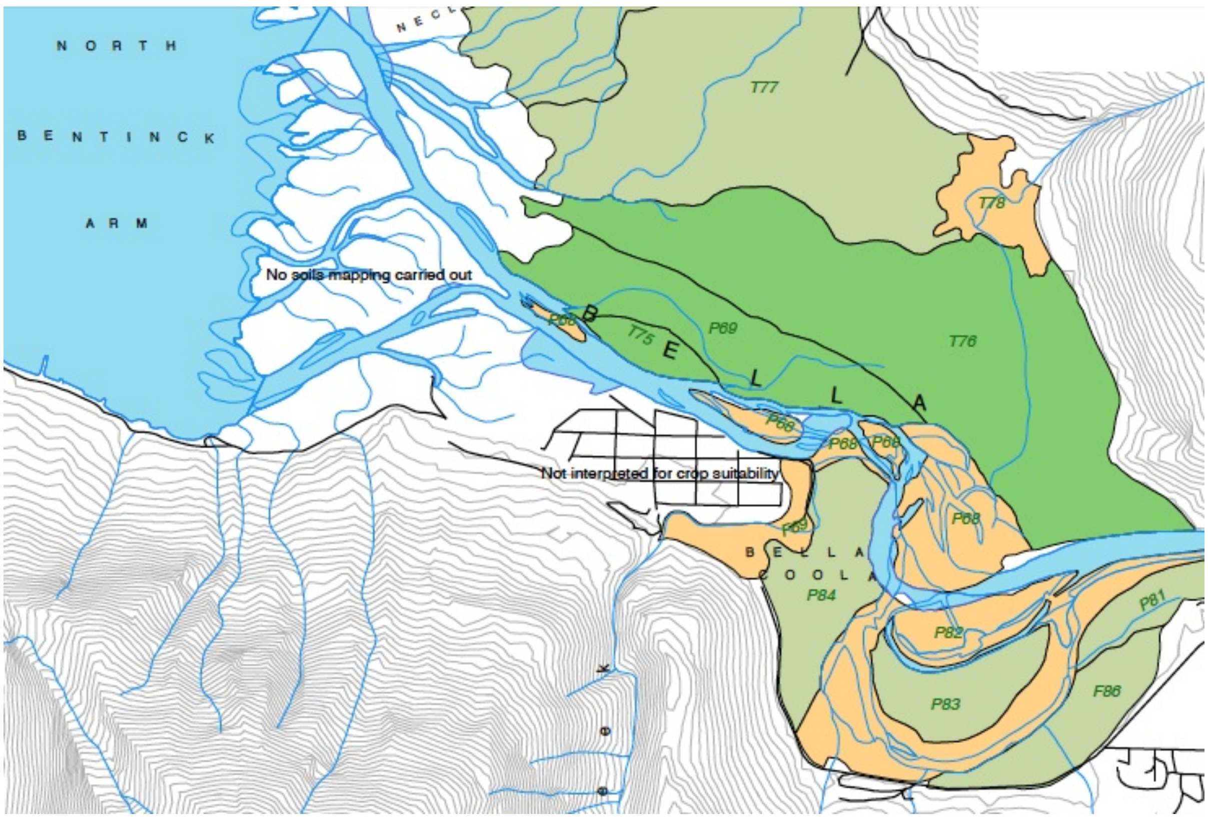

Figure 5.5 Selected view of Bella Coola Valley soil map unit T76 (right centre, dark green) from map 1 of the Bella Coola Valley Crop Suitability map series. The Bella Coola River and all bodies of water are shown in blue colour.

Similarly, the area mapped in lighter green on the crop suitability maps with a wide range of cropping options, but with dominantly moderate and low crop suitability totaled 1662 hectares. The largest single map unit area with this designation was the old, high terrace unit T46. This area, located just west of the confluence of the Nusatsum and Bella Coola Rivers, was listed with 60% of the 289 hectare unit given high suitability for strawberries, raspberries, and nursery crops, and 60% of the unit given moderate suitability for annual legumes, root crops, shallow rooted annual vegetables, cole crops, asparagus, cereal grains, perennial forage, blueberries and currants, tree fruits, and hazelnuts. The same 60% area of T46 was listed with a low suitability for growing corn.[129]

Table 5.6 below connects the crop suitability mapping with the land capability for agriculture maps and soil groups. This table shows the total area mapped with the highest capability for agriculture compared with the total area mapped with the widest range of suitable crops. In contrast to the agricultural capability rating, the crop suitability quantifies the climate capability in a more prescribed way, with mapped results that depicted roughly 1900 fewer hectares with the designation of the widest range of crops with high to moderate suitability.

Table 5.6 Comparison of interpretive mapping results: Highest agricultural capability classes and widest range of highly to moderately suitable crops in a given soil group.

Classification	Bella Coola Valley Soil Group					Units (ha.)
	High capability fluvial soils	**Sandy fluvial soils**	**Fluvial soils with water table**	**Old, high terrace soils**	**Stony coarse textured fans**	**Total area**
Agriculture capability class 1-4	1157.5	1976.9	594.2	412.2	131.7	4272.5
Widest range of suitable crops	1125.8	796.8	290.6	122.9	0	2336.1

[129] The remaining 40% of the map unit comprises the tabulated data listed on the crop suitability. The 20% printed on the map is a printing error. See appendices I and J for the crop suitability maps.

5.6 Reflections on soils methodology, epistemology

The previous reflective section on 'mapmakers' provided an overview of the methodological challenges associated with carrying out mapping and survey objectives: 1) with the intended participatory approach, and 2) in this context where colonial dispossession reshaped land tenures and territorial title. I offer a set of reflections as part of this chapter on the soils of the Bella Coola Valley with the intention of unearthing conflicts and limitations tied directly to the soil survey and interpretive mapping findings.

Briefly described in preceding sections of this chapter, the professionals who organized and carried out soil survey and interpretive agricultural land use mapping in this province have called attention to a set of methodological assumptions and limitations to the application of soil inventory and interpretive mapping.[130] Methodological limitations highlighted by the Select Standing Committee on Agriculture (1978) resonate with some of the challenges we faced associated with the mapping objectives in 2007-2008. The members of this committee who reviewed the agricultural land use in the Bella Coola Valley ALR and around the province in 1978, found that available climate information was not optimal or detailed enough. As we assessed the available climate data in 2007, the information to determine the climate capability classification on which the soil capability classification depends was limited to three climate stations and thirty years of climate averages for these stations. A stronger basis for an accurate climate classification of the Bella Coola Valley would include a longer date range and a better representation of lower and upper valley microclimates. In

[130] See the Select Standing Committee on Agriculture (1978: pp.17-31) and Runka (1973: pp.9-10).

addition, the climate data utilized to make the crop suitability interpretations does not include important details on solar shading. This information may be a significant factor for crop suitability in certain sections of the valley, where one side of the road or river could be predictive of advantageous crop suitability with favourable aspects and south facing slopes, or disadvantageous with nearly vertical mountains and little solar or heat gain.

The crucial disconnect between the national and provincial soil capability for agriculture methodology and the findings presented here for the Bella Coola Valley that are based on that approach, is that, in this context, mechanical cultivation of non-local commodity crops may not be the most appropriate set of baseline assumptions for increased participation in food production. As demonstrated in Chapter Two, Nuxalk knowledge of and cultivation practices with useful, imported crops have emerged with the changes imposed by dispossession of their lands by the colonial settlers. A simple binary of non-cultivating Nuxalk and actively cultivating newcomer settlers does not fit the historical or contemporary evidence. Rather, the model of agriculture defined by mechanized, often industrial-scaled and export-oriented commercial production has not played a significant role in the histories of agriculture of the Bella Coola Valley. Moreover, the discussion presented in Chapter Four suggests this is not the model of food production for the valley envisioned in the *Food Action Plan*, nor is it the model of agriculture most frequently observed in the present land use and food production inventory of 2007 presented in Chapter Six. And finally, areas with good soil capability and climate suitability for perennial horticulture, as well as areas suited to non-timber forest products were likely overlooked or underrepresented with this assumption.

On an epistemological level, the scientific method deployed to implement the soil survey imposes a particular world-view in a context with multiple and differing world-views. Moreover, as Warkentin (1992) pointed out in his survey of the four epistemological eras of soil science, the scientific approach emphasizes a linear approach suited to solve a simple, technical problem, while the complex issues of regenerating agriculture (or rural opportunity more broadly) are more accurately described as wicked problems. The information contained in the maps and extended legend contains complex coding and rating systems, and may not be readily understood or embraced by the general population we intended to spark with an interest in the production of vegetables and fruits.[131] Instead, the data was readily accessible to an audience of professional land use planners, soil scientists, and resource managers; an audience which shares a world view placing value and authority on data derived from within an empirical tradition, often to the exclusion of other forms of knowing. This presented some conflicts with our project objectives and some limitations with respect to the effective reach of the information generated by the Foodshed Project. Our funding provided some support for open community events, which brought together a broader audience for the findings of the research project. We found the workshops and tours essential for reaching the farmers and gardeners, and for clarifying our overall objectives with residents of community.

5.7 Conclusion

Findings from the soil inventory and interpretive mapping objectives of the BCVSAS-UBC Foodshed Project are the main focus of this chapter. A brief overview of the published

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[131] I am basing this assertion on interactions I had with BCVSAS members and residents of the BCV who attended the public events and open workshops where I asked or was approached with follow-up questions about the maps.

history of information on the Bella Coola Valley soils provides context for the contributions of the 1:20,000 scale soil, agricultural land use, and crop suitability map series. Spilsbury (1950) and Kerr (1952) suggested that biophysical factors have played a role in the limited historical agricultural production of the Bella Coola Valley, but that these were not the most limiting factors to growth. Environmental scientists (Leaney & Morris, 1981) working on compiling relevant information for the preservation of the Bella Coola estuary in the 1980s, concluded, as did our research team in 2006, that detailed soils information on the Bella Coola Valley was lacking.

The soils of the Bella Coola Valley mapped as part of the Foodshed Project objective are comprised of three main landforms, fans, floodplains, and terraces, and together these soils cover an area mapped in total as 6,747 hectares. The area of soils interpreted with agricultural capability classes most conducive to mechanical cultivation with the least amount of management inputs (improved classes 1-4) was mapped as 4,273 hectares. Soil moisture deficiency and the combined subclass limitation of soil moisture deficiency and disadvantageous topography were the most prevalent limiting factors for the Bella Coola Valley soils' capability for agriculture on the whole. The crop suitability report and accompanying data tables depict nine soil groups with distinctions comparable to soil management groups defined in the *Soil Management Handbook of the Lower Fraser Valley*. High capability fluvial soils is the soil management group which would require the fewest soil management inputs, and the characteristics of this group closely resembles the Monroe soil management group of the Lower Fraser Valley. The crop suitability map shows an area with the widest range of crops with high to moderate suitability to be 2336 hectares in total for the Bella Coola Valley.

With respect to the exploration of increased soils-based food production, the updated and detailed biophysical resource information has made valuable contributions to knowledge of the Bella Coola Valley soils. Methodological and epistemological challenges may limit the potential these tools have to contribute directly to increased participation in agricultural production, though in terms of interest from the outside of the valley, and from a specific set of resource and land use planners, these tools may position the Bella Coola Valley squarely, ‘on the map’.

Chapter 6: Feeding ourselves: The case of the Bella Coola Valley

6.1 Introduction

This chapter presents the findings from the soil fertility study and food production inventories carried out as part of the Bella Coola Valley Foodshed Project. In addition, the discussion contributes to an understanding of the relationships between differing systems of knowledge exchanged during the research and learning activities, particularly with respect to soils based food production in the Bella Coola Valley. The main purpose of this chapter is to illustrate the contemporary relationships between Bella Coola Valley residents, soils, and their **agroecosystem.**[132]Building from the evidence of the previous chapter, I argue that the identification of the biophysical resources for agricultural production are an important, but preliminary part of the overall process of reconnecting people with livelihoods from the land. Striking a balance between knowledge and power in the case of the Bella Coola Valley is the greater challenge facing initiatives to catalyze regenerative agriculture, and, by extension, in places similar to the Bella Coola Valley where legacies of colonialism persist**.**

The chapter organization follows the chronological sequence of fieldwork objectives, with the results of the soil fertility study from 2006 in the opening sections, and a summary of results from the 2007 food production inventory in the sections that follow. Similar to the soil

[132] Following Gliessman's (2007) definition of agroecology included in the glossary, an agroecosystem indicates a whole system of farming and food systems practices encompassing a complex set of biological, physical, chemical, ecological, and cultural interactions.

survey and interpretive mapping, raw data generated from the two project objectives covered in this chapter is extensive and beyond the scope of a discussion centered on exchanges of knowledge that emerged as part of the research process.

6.2 The test of fertility

The soil fertility study was the initial objective of the BCVSAS-UBC partnership project. In the summer of 2006, we collaborated to raise funds and carry out soil sampling and laboratory analyses in as many locations in the valley as possible. Our funding covered roughly 50 laboratory soil analyses, and I gathered the samples for these analyses at 35 different locations in the valley. Bella Coola Valley residents who participated in the study received complimentary soil sampling at their chosen location, laboratory analyses, and interpretations of their soil test results. Results from the soil fertility analyses contribute to the overall characterization of Bella Coola Valley soils knowledge, though the more significant results from this study are the initial connections between people and their relationships, practices, and knowledge of soils in the Bella Coola Valley. In terms of building relationships between the project partners and residents of the valley, during the soil sampling site visit, the participants often requested additional information about the BCVSAS-UBC project or other soil-plant-pest issues of interest. My own participant observation in the field and during these exchanges shaped the characterizations of current practices and land-use in the paragraphs that follow.

Appendix C presents a selected set of soil fertility analyses results from the summer 2006 sampling activities. This set of 49 samples was the most consistent in terms of a uniform sampling procedure and timing of sampling, and is presented for the purposes of a closer examination and comparison across these selected categories of land use. I organized the results with information about the type of cultivation or land use present at the sampling site during the 2006 fieldwork, and, in terms of location, correlated each sampled site with the 2008 soil map unit and the contemporary, or vernacular place name that I associated with each. For ease of locating the sampled sites on the maps, and to give a sense of the range of the soil fertility results from the western to the eastern ends of the valley, I arranged the table in a geographically sequential progression from the Bella Coola River mouth at the western end of the valley, to the final sample site, roughly 64 kilometers east of the village of Bella Coola in Tweedsmuir Park. The soil analyses procedures followed standard laboratory methods, and were carried out in a facility with decades of regionally correlated soil analyses data and experience. A key to the abbreviations and units used with the soil analyses results and brief descriptions of each nutrient extraction method are provided in Appendix D.

In the soil fertility study, I found eight general categories of present land use at the locations where participants and the project partners requested soil samples.[133] Table 6.7 presents the averaged results for the land use categories for: organic matter percentage (OM%), relative soil acidity (pH), and available phosphorus (P) and potassium (K). Arranged from least to most intensive cultivation and food production practices, these land use categories are: uncultivated sites, fields with no current agricultural land use, pastures, hayfields, lawns and lawns with orchard or bramble crops, gardens, blueberry field, and raised bed gardens.

[133] These eight general land use categories are listed in the descriptions column in the soil fertility results Appendix C.

Uncultivated sites were not currently producing cultivated crops and were reported as not having been under production within a decade or more.[134] BCVSAS project partners and the project participants expressed two reasons for requesting samples and soil analyses at uncultivated sites: 1) to serve as a comparison with nearby sites with some form of management activity or production goal and, 2) as a way of exploring and supporting participants' interest in the feasibility of modifying these sites for potential food production. For example, at the uncultivated sites at Thorsen Creek, in the Snooka Creek area, and near South Brothen Road, the caretakers expressed interest in exploring the possibility of establishing a specialty crop or set of specialty crops in these locations.

The field sites with no observed agricultural land use in 2006 were either in use as a recreational cleared area, basically managed as a large, rural lawn, or a recently cleared, piled and burned field, that was also projected for use as a large recreational lawn area. In some cases, the sampled lawns were planted in small or relatively larger sections with brambles and tree fruits, and in other cases, the landowners expressed an interest in converting some areas of their lawn to cultivated edible crops. Pasture areas observed also had multiple purposes: some had fenced tree fruits, others derelict and unmanaged orchard plantings; some pastures were dedicated to horses only, and those without further description were observed as range for mixed cattle and horses. Hayfields included in the 2006 study produced

[134] Current landowners or caretakers expressed their knowledge of these uncultivated sites in terms of their own memory or experience with these sites. Uncultivated as a land use category is not intended to suggest these locations were 'pristine' and/or have never been intentionally modified or impacted by land use change or production of some unknown type.

either hay or silage crops that year. Gardens as a broad category of land use, described those sampled sites with cultivated, soil based food production with the exception of the summer fallow garden site. Arranged roughly in order of larger to smaller scale and by the stated purpose of the gardens, these sites were managed as: a market garden; a crop of potatoes grown for sharing at a specific potlatch feast; a demonstration garden for teaching and produce sharing; mixed homegardens with a diverse range of sizes and crops; and the summer fallow garden area. Raised bed gardens were a hybrid category with sampled sites predominantly constructed of raised timbers and established with some combination of purchased bagged soils and amendments.

Within the first year of fieldwork, I found there are locally known differences in microclimate and soils from west to east up the valley, as well as differences in philosophy with respect to best forage blends, best sources of soil amendments, and best means of establishing and maintaining a stand of grass. Importantly, the Bella Coola Valley is a place where hayfields and pasture dominate the agricultural landscape, but no single set of practices or motivations seems to dominate the local agroecosystem. In the sub-sections that follow, I present selected results from the soil fertility analyses and a discussion of the observed relationships between people, soils, and the Bella Coola Valley agroecosystem.

Table 6.7 Selected soil fertility study average results for grouped land use categories: uncultivated and field sites; hayfields and pasture lands; lawns and lawn-orchard sites, mixed gardens, blueberry field; and raised bed gardens.

	Selected average values from soil fertility test results (n=49)			
Land use	OM%	pH	P (ppm)	K (ppm)
Uncultivated & field sites (n=8)	5.0	5.2	78.1	61.4
Hayfields & pastures (n=14)	5.1	5.4	77.0	88.9
Lawns, gardens, blueberry field (n=21)	5.4	5.7	125.5	111.9
Raised bed gardens (n=6)	8.2	6.2	270.1	185.8

6.3 Hayfields and pastures/farmers and ranchers

The 2006 Census of Agriculture listed 32 farm operations in the whole of the Central Coast Regional District, with tame hay and fodder crops by far the most dominant in area of farmland use.[135] By comparison, the same census listed 19,844 farms in the province and 229,373 farms across Canada.[136] Using the farm-typing categories of the North American Industry Classification System (NAICS), cattle ranching and farming was the dominant farm type in the Bella Coola Valley, British Columbia, and Canada.[137] The average age of farm operators at each of these three geographic scales was also strikingly similar, with Bella

[135] See this link to the 2006 Central Coast Regional District "Ag in Brief Factsheet" http://www.agf.gov.bc.ca/resmgmt/sf/agbriefs_2006census/AgInBriefFactsheet_CentralCoast.pdf

[136] See Statistics Canada 2006 Census of Agriculture http://www.statcan.gc.ca/ca-ra2006/index-eng.htm

[137] See the same web source for Statistics Canada, 2006 listed in the previous footnote.

Coola Valley and British Columbia farm operators documented as roughly 54 years of age, and, in 2006, farmers across Canada on average were 52.[138]

In the past, some hay farmers have burned their fields as part of the set of strategies to establish a forage stand and boost the productivity (M. Gurr, personal communication, July 23, 2007).[139] More recently, farmers have ploughed, then disked, harrowed, and used a roller to pack the forage seed (B. Harestad, personal communication, March 18, 2008). One farmer reported he might undertake this field renewal or reseeding on average every eight to ten years (B. Harestad, personal communication, March 18, 2008). Timothy (*Phleum pratense*), orchard grass (*Dactylis glomerata),* and Reed canary grass (*Phalaris arundinacea*) are sown for hay in the western end of the Bella Coola Valley, with the Reed canary found on lower, wetter sites (ibid.; R. Ratcliff, personal communication, July 22, 2007). Also mentioned by growers who participated directly in our 2006 study were clover (*Trifolium repens*) and tall fescue (*Festuca arundinacea*), though this list of grasses is not complete or comprehensive for all hayfields and pastures in the valley.

Some of the hay farmers make more than one cut of their hay crops in a given season if the weather allows, though the yields for the second cut tend to be much lower (D. Blewett, personal communication, June 25, 2010). At least one of the hay growers reported leaving his second growth of hay as a standing crop each year as a deliberate fertility and

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[138] Statistics Canada, 2006 Census of Agriculture, Farm Data and Farm Operator Data:
http://www.statcan.gc.ca/pub/95-629-x/1/4123801-eng.htm
http://www.statcan.gc.ca/pub/95-629-x/1/4123801-eng.htm#59

[139] This practice was believed to boost the available potash in the soil.

maintenance strategy, though a wet summer might force other hay growers in the valley to do the same (M. Gurr, personal communication, July 23, 2007). Still another hay grower manages multiple fields from Hagensborg and eastward up to Jourdenais without baling at all; his approach is strictly to cut the forage and make silage (E.Thiesen, personal communication, July 23, 2007).

BCVSAS members advised me before I began any secondary research from archived weather data or any sampling for soil fertility, that I could expect more rainfall, less sunshine, and more acidic soils in lower Bella Coola than the upper valley sites east of Hagensborg.[140] Members of the Bella Coola Farmers Institute gathered at the weekly farmers markets shared similar insights and stories with me. These accounts were informal and informed of decades of experience with the particulars of people and places within the valley. The details these farmers shared were attuned to a range of local factors, and retold in tidbits such as who was known to be early with mowing the hay, where you might find a better stand of clover in the forage mix.

One valley farmer explained his hayfield-pasture system this way: he had one field area where he focused on hay production, and other areas where he fed and pastured the cattle. From the first winter snow to some time in late April, he kept the cattle in protected areas not far from his home and barnyard, and during the summer and early fall he grazed them on Crown Lands and his own pastures (D. Blewett, personal communication, June 25, 2010). None of the farmers or ranchers who participated in the soil fertility study and fieldwork in

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[140] D. Lewis fieldnotes: April, May, and June 2006

2006 reported that they applied additional manure or stockpiled organic matter to pasture or hayfields as a regular practice beyond what the livestock spread while they grazed.[141] A few of the farmers did apply manure or small amounts of stockpiled and aged manure to their home gardens.

Out of the total 49 sites in the 2006 soil fertility study, the hayfields and pastures numbered 14. Nine of these were managed to cut and harvest a crop of hay, and five were kept as pasture for horses, cattle, or both. For the purposes of the community workshop on soil fertility, I prepared individual test reports and interpretations for each participant in the study, and presented the findings that appeared significant for public discussion.[142] I based the soil fertility analyses interpretations on reference materials published by the British Columbia Ministry of Agriculture from the 1980s and 1990s.[143] There have been no previous soil test interpretations carried out and calibrated in the field for the Bella Coola Valley, and very few within the province of British Columbia in recent decades, so the interpretations were limited to the available information and experience of the BCVSAS-UBC research partners.

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[141] D. Lewis fieldnotes: April, May, and June 2006

[142] The soil fertility workshop was free to the public, and was held downtown Bella Coola on March 10, 2007.

[143] See edited manuals and proceedings of the B.C. Ministry of Agriculture: Neufeld (1980), Kowalenko, (1993), and Gough (1991), as well as a recently published synthesis of available nutrient management information, Poon & Schmidt (2010).

Many of the test results across all eight categories of present land use indicated very low pH, low nutrient levels, and low organic matter percentages[144]. For the hayfields and pastures categories, a brief discussion of selected results is presented in the paragraphs that follow.

Low soil pH results

The pH results for hayfields and pastures signaled high relative levels of soil acidity within the sampled composite areas of the study.[145] In an exchange at one of the sites, one hay grower claimed that application of lime and fertilizers above a certain quantity, as well as the cattle he raised in the Bella Coola Valley, "just didn't pencil out" (R. Stewart, personal communication, August 16, 2006). Several of the hay growers identified themselves first as retired fishermen or loggers; their farming operation was carried out as a sideline, or part of a set of routines, which kept them socially engaged and physically active.[146] Nearly all of the farmers within this group reported that they regularly applied some amount of fertilizers and liming materials, but in the general terms expressed by the small group of farmers who participated, the amounts and frequency of applications of fertilizers and liming materials varied widely from farm to farm and field to field.

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[144] For the hayfields-pastures group, there were a few samples that returned higher than expected levels of phosphorus (P), and high levels of potassium (K). Based on follow-up inquiries with the farm operators, these inputs were not regularly applied. Higher levels of these nutrients found in the analyses of the composite samples may have been the result of sampling error or other issues with handling of the sample.
[145] See Neufeld (1980) for an indication of recommended liming rates for B.C. soils and the dissertation glossary for definition of liming materials.
[146] D. Lewis fieldnotes: Bella Coola Valley Farmers Market, August 20, 2006

Though several crops and traditional food plants of the Bella Coola Valley thrive in more acidic soil conditions, the majority of tame hay crops and grasses tend to produce better results with a pH above 5.5. Nine of the 14 hayfields-pasture sites returned pH results below 5.5 and two of these sites tested below a pH of 5.0. Follow-up field calibration with soil test pH levels from lower and upper valley sites would provide an empirical basis for marking an optimal pH zone for Bella Coola Valley hayfields and pasture. Until these kinds of tests are carried out within the valley, buffer pH values from the soil laboratory, local experience and regional production guidebooks created with field calibration tests, offer the best integration of recommended soil nutrient management strategies and empirically tested knowledge.

As cited in a regional forage management guidebook, soil acidity is a common cause of reduced productivity in hayfields and pasturelands.[147] Our results, coupled with this regional agronomic research, suggest that continued close monitoring and management for more optimal pH would contribute to improved nutrient availability and fertilizer efficiency. Examples of increased nutrient availability and associated soil quality benefits connected with improved liming practices include the following:

- Increased phosphorus availability
- Increased nitrogen and organic matter
- Increased production by stimulating mineralization and nitrification
- Reduced phytotoxic levels of soluble aluminum and manganese

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[147] See this publication by the Pacific Field Corn Association (1999), available in downloadable format on the Farmwest webpage*:* http://www.farmwest.com/advanced-forage-management

- Enhanced survival and productivity of legumes, either forage or horticultural.

Low available nutrient levels

Though nitrogen (N) is one of the three most widely recognized essential plant nutrients and "the predominant fertilizer required for coastal British Columbia" (Kowalenko, 2000: p.2), I offered no interpretation or recommendation for the total Kjeldahl N values returned with the individual soil test result reports. I found no direct interpretations for similar soils within the literature published by Ministry of Agriculture representatives for the N measurement or sample depth in our study. For British Columbia soils and crops, Kowalenko (1993) explained that soil test based recommendations for N application have not been carried out in field tested calibration studies, only crop response studies in certain areas of the province, and general N recommendations were available.[148]

Available N in soils is difficult to test accurately for a number of reasons, though its processes, in terms of cycling, and its inherent mobility are key. Soil scientists articulated these factors in a recent soil nutrient survey of the Fraser Valley as the "complex and dynamic nature of nitrogen transformations and transport" (Kowalenko, Schmidt, & Hughes-Games, 2007: p. 23). Basically, the driving forces of N at the field scale are climate, described in terms of water and heat, and crop management practices (Kowalenko, 2000). Knowledge of recent crop management history, green manuring, fertilization, and compost

[148] Along with the published proceedings of the British Columbia Soil and Tissue Testing Council cited here (1993), I attended the Annual General Meeting of British Columbia Agrologists in March 17, 2007. Several of the presenters gave an overview of still unsettled issues with laboratory methods and lack of field-test calibration for yield (e.g. A.A. Bomke's presentation, "Laboratory Support for Soil Science in B.C."; Geoff Hughes-Games, "What is the current and future state of agricultural soil testing in B.C.?").

additions would offer a better sense of the relative abundance and availability of N for growing crops than our measured nitrogen percentage alone suggested.

For soil test levels of phosphorus (P) and potassium (K), there have been field studies carried out within British Columbia, and interpretations based on these calibrations are available.[149] In British Columbia, the wide range of soil parent materials and taxonomic classes within and across the major growing regions have factored in multiple soil test methods and a debate over standardization of these. Since the 1980s, agrologists have published interpretations and held professional workshops in hopes of communicating the most reliable methods and interpretations (e.g. Kowalenko, 1993; 2010). As listed in Appendix D the soil-testing laboratory utilized for our study extracts for available P with the Bray P1 method, and quantifies available K with an ammonium acetate extraction.

Half of the hayfields-pasture lands returned soil test results that indicated low levels of P. This means that these fields would likely see a beneficial response to additional inputs of this nutrient. Only three of the nine hayfields showed P levels that indicated no additional phosphorus would be recommended. At the range of low P levels observed on the sampled sites, Neufeld (1980) recommended fertilizer P (as P_2O_5) inputs in the range of 28-134 kilograms/hectare (25-120 lbs/acre). Three sampled sites found with excessive levels of P were each managed with livestock rotations, and those higher test levels appear to be more indicative of sampling error or bias in a feeding area, than of excessive intentional inputs of P

[149] See Neufeld (1980), Gough (1991) and Poon & Schmidt (2010) for soil fertility interpretations for British Columbia.

fertilizer. Ten out of the fourteen sampled hayfields and pastures showed low K levels, and in none of the samples was available K high enough to recommend reduced K fertilization. Fertilization with K can cause crop magnesium (Mg) deficiencies if Mg containing fertilizers such as langbeinite or magnesium sulphate are not applied. Elevated levels of K relative to Mg can negatively impact cattle health, but nothing was found in the 2006 soil fertility study to indicate this was an issue in the Bella Coola Valley.[150]

In fact, low input levels of inorganic and manure-based fertilizers differentiate the Bella Coola Valley farming area from others within the intensive agricultural regions of North America, Europe, and Asia. The dominant form of agricultural operations on these continents is industrialized, and recent decades have seen much more P applied on a routine basis than was removed by harvested crops (Brady, 2002, p.592). Soil scientists tested this theory in the intensive agriculture areas of southwestern British Columbia with the "Fraser Valley Soil Nutrient Study" of 2005 (Kowalenko, Schmidt & Hughes-Games, 2007). They found,"80% of all fields were in the high to very high environmental risk class" for P in the surface horizon of the soils (Kowalenko, Schmidt & Hughes-Games, 2007: p. 13).

The role of P in agroecosystems is also of major concern with global to community-scale food security initiatives. Soil specialists and other agricultural science experts cite P deficiency as a decisive factor in sub-Saharan African countries' decline in per-capita food production and soil productivity (Brady, 2002). If farmers and gardeners in the Bella Coola Valley are cooperating to source manures and make composts from locally available

[150] For a description of key causes of elevated potassium in forages, See Poon & Schmidt (2010)

livestock, hay, and bedding, the low levels of available nutrients in hayfields and pasturelands shown in the soil fertility study can affect the agroecosystem as a whole. The system is impacted because the available nutrient levels in the soil where hay and silage are produced, affect the nutrient levels in the feed and bedding of livestock that ends up in composts and manures as additions to homegardens. This low available nutrient situation might force farmers to purchase supplemental grains or import hay to boost the available nutrient levels, or push gardeners to purchase nutrients from outside the valley agroecosystem.

6.4 Gardens and gardeners

In contrast to the hayfields and pastures group of samples examined above, the samples taken from Bella Coola Valley gardens and raised bed gardens were gathered in composite areas where, in the majority of locations, the surface of the soil had been recently cultivated. Most of the gardeners I encountered owned or borrowed a walk behind rototiller to prepare their in-ground garden for planting. Three of the gardens from this sample set were prepared with a tractor mounted rototilling implement. All of the raised bed gardens were prepared and blended with hand tools, and three of the gardens that were in-ground had been prepared and maintained exclusively with hand tools. Because of the small number of samples in the raised bed garden category, it is not clear that the construction of raised beds is exclusively a strategy for gardeners on sites with stony or poorly drained soils, as three of the six total raised bed sites were located on terrace landforms, two were located on fan, and none were located in the floodplain landforms or map units.[151]

Similar to the soil fertility results for the hayfields and pastures sites, soil pH, nutrient and organic matter levels were focal points for the public discussion of the analyses and interpretations. Not surprisingly, organic matter (OM) levels for Bella Coola Valley gardens were higher, on average, than for larger scaled and less intensively managed hayfields and pastures. In fact, two of the raised garden samples and the summer fallow garden sample showed double-digit OM percentages. This level of OM would contribute positively to both nutrient and water holding capacities, and enhance the potential productivity at these locations.[152] Average pH levels were also higher for gardens, compared with hayfields-pastures. Only eight of the 21 garden (and raised bed) sites fell below the 5.5 pH mark. The smaller sub-set of raised bed gardens showed the highest average pH of all land use categories in the study. Though the limited sample size and composite methods of the full study set is worthy of mention here, these comparative results are not surprising given the relative scales and management across the land use groups. The raised bed gardens received the most inputs per unit of area, hence the higher pH, OM% and nutrient levels.

In contrast to the hayfields-pasture results, 16 out of the 21 gardens-raised bed garden samples showed high levels of available P, and one of the raised bed samples showed an

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[151] One of the raised bed garden sample sites was outside of the described soil landforms and map unit area, known within the valley as Jourdenais Road.
[152] The length of time from clearing and establishment of the gardens and relative intensity of the cultivation practices may have also played a role in the wide variation in OM% levels.

excessive level of K. As part of this study, I observed and recorded a wide range of soil fertility improvement practices for Bella Coola Valley gardeners. Table 6.8 summarizes these observations for the 2006 soil fertility study, and quantifies the numbers of sites or gardeners utilizing these strategies. Reported examples of materials incorporated as OM to gardens and raised bed gardens ranged from horse manure and sheep manure, to peat moss, food scrap compost, manure tea, and reed canary grass. Clearly, the diverse range of inputs and practices indicated strong interest in experimentation and in applying adaptations suited to the local conditions.

The results of the soil fertility study presented a limited set of insights into Bella Coola Valley soil characteristics, and facilitated preliminary exchanges of information and observations on contemporary cultivation and soil improvement practices. In general, the soils were relatively acidic, low in available nutrients, and low in organic matter. Despite the limitations of 1) a small sample set with uneven representation of landforms or soil groups, 2) composite samples intended to represent a range of field areas, in some cases from fields larger than 25 acres, and in other cases with a combination of constructed raised garden beds at a single site, and 3) sampling at different times of the year, with differing types of cultivation and input practices, the soil fertility study accomplished the Foodshed Project objective of building relationships between the BCVSAS-UBC research partnership and participating residents of the Bella Coola Valley. The soil fertility workshop held in March 2007 returned the results of the 2006 fieldwork and exemplified an exchange between scientific and place-based, or vernacular knowledge.

The food production inventory and agricultural land use mapping activities of 2007 took shape from these initial project objectives, and are described in the section that follows. A final set of reflections and discussion of the limitations of the 2006 and 2007 fieldwork are found in the concluding section of the chapter.

Table 6.8. Gardeners' soil fertility improvement practices observed in the Bella Coola Valley Soil Fertility Study, 2006

Methods of soil fertility improvement	Type and (number) of sites
Summer fallow as part of extensive rotation with other cultivated garden sites	Mixed homegarden and potato-potlatch gardens (3)
Horse manure or other animal manure based composts from Bella Coola Valley sources incorporated with rototiller	Mixed in-ground homegardens (4)
Borax applied as boron source, food scrap and yard trimmings compost	Mixed homegarden (1)
Peat moss, topsoil dug or relocated from valley sources, locally sourced sheep and horse manure; Purchased pre-bagged topsoil and amendments	Raised bed gardens (4)
Synthetic fertilizer, purchased insecticide	Potato garden (1)
Low grade liquid fertilizer with seaweed product; combined with granular fertilizer	Blueberry garden (1)
Food scrap and yard trimmings compost, compost tea, summer cover crops as annual rotation areas, rain barrel for warmer irrigation water	Mixed homegarden (1)
Hand-dug raised beds, locally sourced compost amendments	Raised bed garden (1)
Reed canary grass chopped and incorporated, urea fertilizer applied in early spring	Mixed homegarden (1)
Perennial crops, permanent vegetation	Raised bed garden (1)
Fish heads and guts, incorporation of chum salmon with rototiller or other mechanized cultivator	Reported as previous practice for potato-potlatch and mixed homegardens, not observed during sampling
Winter cover crops of mixed cereals and legumes	Introduced as part of community service learning, not observed during 2006 fieldwork

6.5 Seeing food production

The agricultural land use mapping and food production inventory activities took place while the soil inventory and interpretative mapping activities of the Foodshed Project were also taking place, from the summer of 2007 and into the spring of 2008. To document the continuum of agricultural and horticultural practices observed at a more intensive scale than our 1:20,000 base maps would portray, we developed an approach that detailed the ways people had chosen to modify the landscape for a myriad of food production purposes. The Bella Coola Valley Agricultural Land Use Inventory map series shown in appendices K and L provides a set of visual reference points for the findings of the paragraphs that follow. To clarify and provide a more user-friendly explanation of codes depicted on the maps, I offer a brief overview of the categories presented as the generalized land use inventory, and present the distinguishing characteristics of the food production categories we created. Additionally, I summarize the significant findings of the food production inventory, and connect these findings with the interrelationships between the interpretations of agricultural land use and community food security.

Agricultural land use areas mapped in the darker green polygons were those areas observed with some type of present forage or pastureland use, though cleared fields with some evidence of previous forage production were included in these sections of the map. The windshield method accounted for most of the ground truthing and delineating of fields in use for forage production or pasture, but several residences around larger fields contained active gardens and orchards. At these locations, verification of the food production inventory checklist required a great deal of stopping, walking, and talking to capture the range of present activities.

Residential areas (yellow shaded areas of the map) appeared in the more densely settled portions of the valley, such as the Bella Coola Townsite Reserve, small sections of downtown Bella Coola, on the 4 Mile Reserve, and in sections of Hagensborg and the Nusatsum area. The approach in these mapped areas matched the complexity and density of small-scaled food production activities. These were the areas we observed exclusively on-foot. At many of the sites in these areas, we interacted with interested residents, responded to their questions and walked through the range of fruit tree plantings, gardens, bramble and berry patches, and more. The intermixed use areas with residential plus significant associated food production activities, shown with the R/A designation in lighter green on the maps, were less densely populated, but with the diversity of activities, and spatially scattered pockets of food production observed at these sites, we slowed the inventory to a walk in most of these mapped areas as well.

Compared with the categories of agricultural land use depicted on the maps produced by the Select Standing Committee on Agriculture in 1978, the 2007 Agricultural Use Inventory for the Bella Coola Valley generalized "agricultural" as forage, grains, grassland, and pasture. The 1978 land use inventory included the categories of horticulture, forest, non-productive and water, and at the reconnaissance mapping scale of that inventory, their results showed no horticultural activity and the majority of land use as forest cover. At the 1:20,000 mapping scale compared with the 1:50,000 mapping scale, the Bella Coola Valley present land use depicted a minimum polygon size of .8 hectare (+/- 2 acres), whereas at the 1:50,000 scale, the smallest map unit accurately portrayed was 2 hectares (5 acres). Neither of the maps captured the presence of food production activities that were horticultural in the land use units, though this information was included in the food production inventory and as representative point data on the 2007 map series. Given the focus on agriculture and food production in the 2007 Foodshed Project, these maps did not include forest cover as a land use.

The point data of representative food production sites depicted on the Bella Coola Valley Agricultural Land Use Inventory map series, and the data included in the complete food production inventory, show that food production activities were present in all three categories of generalized land use summarized above: Agricultural (A), Residential (R), and in the Residential/Agricultural (R/A) areas. Although the point data and the unmapped information from the complete food production inventory cannot provide a spatially bounded depiction of Bella Coola Valley food production activities on the ground, the area depicted by the combined A, R, and R/A mapped polygons exhibited a continuum from agricultural as forage and pasture land, and food production as diverse horticultural land uses. These combined areas, as documented in the food production inventory, contain food production activities connected with the land of much greater complexity and diversity than would be included in the narrowly defined agricultural land use category alone.

The food production inventory categories given on the map legend and below capture the relative scale and purpose of the food production activities in the study.[153] Based on the analyses of the inventory data collected, and from the expansion of observations gathered during the 2006 soil fertility study, the definitions of the Bella Coola Valley food production inventory categories are as follows:

- **HF** Household scale food production included any instance of observed food production in any category, usually at a smaller scale of planting or of a smaller sized greenhouse, or livestock operation.
- **EN** Extended network food production sites had three or more categories of food production, or at least one larger scaled category of food production activity with no apparent or reported intent to sell surplus products commercially.
- **MA** Market oriented food production sites were those places observed with the intent to sell produce or some type of food or farm product.

Tables 6.9 and 7.0 summarize the 2007 Bella Coola Valley food production inventory in two ways: Table 6.9 depicts the full inventory with a tally of categorized food production sites compared with the mapped GPS point data; and Table 7.0 shows the total number of places inventoried with some presence (Yes column) of fruit trees, vines and berries, vegetable garden, brambles, livestock, or a greenhouse. The total number of sites in Table 6.9 does not match the totals in the 'Yes' column in Table 7.0 because many sites had multiple food production activities, and 240 observed sites had no presence of these activities.

The inventory team described a total of 698 sites in an effort to provide a nearly comprehensive picture of accessible food production activities associated with a dwelling in

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[153] See appendices K and L .

the Bella Coola Valley during the summer of 2007. We crossed land tenure boundaries that would have included Crown, private, and reserve lands. A few practical limitations, as mentioned briefly in Chapter Four, challenged our goal of comprehensive coverage with the inventory. The Bella Coola Valley is the seasonal home for many part-time residents, and we encountered a handful of long driveways with locked entry gates, as well as a small number of menacing dogs. Despite these challenges, the full inventory accounted for 650 sites observed as an active dwelling, less vacant houses, or storage lots, commercial spaces, or social services centres in 2007.[154] Compared with this, the total number of representative food production sites portrayed on the Agricultural Land Use Inventory Maps was 135.

The observations at the sites tallied during the food production inventory provided information about the presence of fruit trees, vegetable gardens, greenhouses or other season extension activities, vine or berry crops, brambles, or livestock.[155] For fruit trees, vegetable gardens, and greenhouses, a simple comparative scale was also recorded: greater than or equal to 10 fruit trees was a larger scaled planting for a given site; greater than or equal to 465 square metres was a larger scaled vegetable garden; and greater than or equal to 10 square metres was a larger scaled greenhouse or hot house.

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[154] Statistics Canada information from the 2011 census showed 712 usual dwellings in Central Coast Regional District Electoral Areas D, C, and Bella Coola Indian Reserve #1 combined. These areas are geographically much broader than the road accessible food production inventory, but correspond closely with the Bella Coola Valley settlement patterns and our inventory access.

[155] The inventoried types and numbers of sites with these types of livestock were: horses (34); poultry (23); beef (9); other/specialty livestock (8). Summer crown land grazing, a typical practice in this region, would have reduced the numbers of sites or fields with cattle we observed within the accessible Bella Coola Valley bottomlands.

Exclusive of the hayfields and pasturelands, fruit trees and vine and berry plantings were the predominant forms of food production strategies observed in the landscape of the Bella Coola Valley. Combined with the number of sites observed with plantings of bramble crops, this strong on the ground preference for perennial food production over cultivated annual crops speaks to the greater suitability of these crops for these soils and climate. In parallel, larger-scaled cultivated vegetable gardens were found in only 12 of the 698 inventoried sites. Though the total number of observed sites with a presence of either livestock or a greenhouse was nearly equivalent, the spatial extent bounded in dark green as either forage or pasturelands was significantly greater.

The observed diversity and extent of food production activities in the Bella Coola Valley were the most striking findings of the inventory. Almost 300 of the 650 observed sites with an active dwelling had some type of observed food production activity. In other words, what we could not portray with the minimum sized mapping units were, literally hundreds of households engaging in some type of food production, and in many cases, in some type of exchange indicative of an **informal economy.**[156] The category of food production that emerged as most suggestive of a set of livelihood strategies connected with the biophysical and social resources of the Bella Coola Valley was the extended network (EN). Extended network sites appeared much more frequently on the ground than those tallied in the market-oriented category for the Bella Coola Valley. From observations and interactions gleaned during Foodshed Project workshops, garden tours, the local foods feast, and during

[156] See Ommer & Turner (2004) for a detailed description of places with an informal rural economy.

community service learning activities, the level of engagement with cultivated foods typified by EN sites provided a good base of exchange with indigenous foods, particularly salmon and gathered berries (Dowling, 2007).

6.6 Summary and conclusion

Bella Coola Valley gardeners participated in greater numbers compared with farmers and ranchers in the soil fertility study of 2006. Though the sample size in the study was not large enough to be representative of the valley overall, results showed hayfields and pastures sampled were typically lower in soil pH and in available nutrients than the more intensively managed and modified garden sites, and uncultivated sites and recreational fields were the lowest overall in terms of organic matter percentages, relative acidity (soil pH) and generally lowest in available nutrients. Of the three landforms characterized in the Soils of the Bella Coola Valley map series, the soil fertility study showed a much stronger representation of terrace map units compared with fan or floodplain landforms.[157] This meant that personal interactions and soil fertility information connected with the 2006 study was more prevalent in areas with this landform compared with fan or floodplain soil units. Follow-up informal interviews, 2007 inventory fieldwork and workshops created the opportunity to verify and further build an understanding of contemporary practices in hayfields, pastures, and mixed household gardens.

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[157] See appendices E and F for the maps, and see appendices A for map unit areas and B for selected descriptions from the extended soils legend.

The 2007 agricultural land use mapping and food production inventory illustrated the need for a redefinition of "agricultural" land use in the context of the Bella Coola Valley. What we observed on the ground were food production activities that were often much smaller in area than the mapping scale could portray. Together, the food production activities included in the 2007 inventory showed the majority of residences in the Bella Coola Valley expressed some mode of food production, whether at the household, extended network, or market oriented scale. Household scale food production activities were the most frequently observed in the inventory, with nearly 300 identified sites out of 650. The diversity and extent of extended network food production sites exemplified connections between the land and livelihoods that were not reflected in the agricultural land use maps, and appeared approximately four times more frequently in the landscape of the Bella Coola Valley than the market oriented sites. From the Foodshed Project objectives reviewed in this and the previous chapter, the BCVSAS-UBC partnership produced knowledge in the form of updated and larger scaled agricultural resource mapping, and facilitated the exchange of knowledge with hundreds of interactions about soils and the agroecosystem between: 1) local research assistants and their neighbours, 2) project partners and Bella Coola Valley residents, 3) showcased farmers and gardeners with their neighbours and project participants.[158]

[158] See the Chapter Four for a description of participatory research objectives linked with local research assistants, community workshops, the edible garden tour and local foods feast, and community service volunteer learning.

Table 6.9 Comparison of the complete food production inventory data set and the mapped point data portrayed on the 1:20,000 scale Agricultural Land Use Inventory maps. Inventory categories are consistent with the mapped legend: HF is household scale food production; EN is extended network; and MA is market oriented food production. Vacant or abandoned sites and sites with a commercial or social service purpose were not included in the referenced total of 650 active usual dwellings mentioned in text.

	Total number of sites		**Mapped totals**
Full inventory	**698**	**Represented on map**	**135**
HF	297	Mapped HF	49
EN	90	Mapped EN	64
MA	23	Mapped MA	22
Vacant/abandoned	20		
Commercial/social svc.	28		
No food production activity observed	240		

Table 7.0 Summary of results from the 2007 Bella Coola Valley Food Production Inventory. The 'Yes' column indicates the presence of and total numbers for a specific food production activity. Reference numbers for the comparative scales of food production activity are given in parenthesis.

	(Yes) Total # of sites	**(Small scale) Total # of sites**	**(Larger scale) Total # of sites**
Fruit trees	373	($<$10) 318	($\geq$10) 55
Vine & berries	300		
Mixed garden	177	($<465m^2$) 165	($\geq 465m^2$) 12
Brambles	139		
Livestock	74		
Greenhouse/hothouse	67	($<10m^2$) 42	($\geq 10m^2$) 25

Chapter 7: Discussion and conclusion

7.1 Introduction

The point of departure for this dissertation was the premise that, at the turn of the 21st century, people in the Bella Coola Valley had an interest in regenerating their agriculture and local food systems. I examined the histories of late 19th and early 20th century agriculture in the Bella Coola Valley as part of uncovering 'how we fed ourselves' and addressing how to regenerate agriculture. An exploration of the meanings and practices of agriculture in the Bella Coola Valley context were additionally central to the investigation. Finally, a quantitative approach to identifying the biophysical potential for agriculture was embedded in a participatory research initiative that served as a case study for the contextual analyses. Findings from the BCVSAS-UBC Foodshed Project, as well as reflections on the process and approach to the research comprised a major portion of the lessons learned and detailed in this dissertation.

Three key lessons emerged from this dissertation for initiatives aiming to regenerate agricultural food systems. First, because agricultural food systems form over time in specific places, it is crucially important to understand the formative historical processes, including the evolution of indigenous food systems, dispossession and resettlement of land through settler colonialism, adaptation of livelihoods due to outside economic forces, and development of transportation networks. Second, redefining and reframing agriculture are important in colonial and small-scale contexts in order to see the diversity of agricultural activities. Third, regenerating agricultural food systems is a continual and dynamic process, requiring an ongoing engagement between local leaders and outsiders, and between local, indigenous, and scientific knowledges.

The exploration of the histories and meanings of agriculture revealed multiple narratives and differing sets of assumptions about land tenure and land use in the Bella Coola Valley. Namely, that settler-colonialism served to redistribute a portion of the land within the area claimed as Nuxalk Territory for the planned colony of Bella Coola. Clearing and cultivating the colony to fit the predominant vision of agricultural improvement and land use gave immigrant settlers claim to this land for homesteads and a range of resource-based livelihoods. Despite the evidence of cultivation and livestock tending witnessed by the McKenna-McBride Commissioners, the political momentum of confirming the Indian Reserve boundaries and settling the "Indian land question" in favour of immigrant settlers to Bella Coola and British Columbia, meant that the request for additional land by the Nuxalk spokespersons went unheard.

Much of the focus of North American alternative agriculture and food systems initiatives has been limited to resistance to industrial-scaled farming operations without reference to the potential reality that social and political injustices may also lie at the heart of contested land tenures in a specific place. This dissertation argues that acknowledgement of the multiple ways of reading history and of seeing livelihoods tied to territory is an essential first step in regenerating agriculture and food systems in a North American context. Recognition of contested land claims and of historical social and political injustices is one way forward in efforts to encourage greater participation and emancipation of would-be actors in regenerating agriculture and food systems.

Agriculture as defined in the 20th century came to prescribe a set of fixed understandings about the mode of production and about the intention to commercially market and distribute the products of the farm. Although quantification of household consumption was included in the earliest decennial censuses of the Dominion of Canada, by the 1950s the definition and assumed purposes of agriculture had made the shift to industrial and export-oriented production. In contrast, as depicted by Robert Netting (1968) and the 2007 Bella Coola Valley food production inventory, contexts where smallholders and householders persist are not limited to a binary of pre-industrial to industrial farming.

The 2007 food production inventory demonstrated that the majority of efforts to grow and distribute food in the Bella Coola Valley are outside of a formal market economy and more closely resemble a network of extended household, community, and familial exchange. In the Bella Coola Valley particularly, the innovation and extensive, small-scale adaptations reflect individual and community level efforts to stay in place, despite the socio-economic and other pressures that signal its time to move to another area with better services and a stronger economy. Without an adaptive vision of agriculture that includes activities taking place at a household and extended household scale, most of the livelihood strategies related to the cultivation of non-local food crops in the Bella Coola Valley would be missed.

The BCVSAS-UBC Foodshed Project activities took place within the 2006-2010 timeframe. Many community-driven activities related to regenerating the Bella Coola Valley food system preceded and followed the research initiative described in this dissertation. Key limitations I observed in the course of this investigation were sharing the scientific knowledge and thoughtfully integrating the science-based inventory findings with the local knowledge of soils and indigenous knowledge of the territory. In practical terms, though we endeavored to include multiple communities within the Bella Coola Valley, the scope of our project was limited in terms of its financial and human resources support. Our scientific contributions provided baseline information and our participatory efforts provided specific, short-term events located within the community research setting.

As expressed by Margerum (2007), reaching out to more than one institution within the local community and/or partnering with more than one university, may have served to overcome some of the constraints to the research collaboration described in this dissertation. Necessarily, an expansion of the research partners would have required a greater commitment of time and resources. And, as exemplified by the collaborative research partnership documented by Turner (et al., 2009) in the Nuxalk Food and Nutrition Program, this decades-long commitment to a specific set of capacity building and knowledge transfer goals, has a great deal of traction and momentum for the community-based researchers. The return and revisit of the Nuxalk Food and Nutrition Program twenty years after its initiation with elders and leaders provided an opportunity to document and understand changes and impacts over time (Turner et al., 2009).

I organized this dissertation in two parts to delineate the sequencing of quantitative, qualitative, participatory, and historical findings. Though the historical analyses and discussion of the colonial context are at the forefront, the understanding of multiple histories and multiple meanings of agriculture in the Bella Coola Valley came after the first season of fieldwork was completed. The sections that follow outline the main arguments and conclusions of each chapter, present limitations and further reflections on the research, and summarize recommendations for future research and ways forward with regenerating agriculture in the Bella Coola Valley and beyond.

7.2 Discussion summary

The subsections that follow review each chapter of this dissertation in terms of the main arguments and provide a discussion of key points presented in detail in the preceding chapters.

7.2.1 Chapter two

Chapter two shed light on the multiple histories of agriculture and food systems in the Bella Coola Valley. Outpost gardening was the initial mode of producing non-local food crops, and Nuxalk and newcomer-settlers adopted this form and scale of production as a useful strategy of household provision and exchange. Prior to the establishment of the planned colony of Bella Coola, the colonial powers of the British Empire, and their provincial representation in the nascent government of British Columbia dispossessed the Nuxalk of a large portion of their territory to create space for settlers who brought in new forms of governance, land use, ownership, economies, and foods.

The agents of colonialism who fixed the reserve boundaries made favourable comparisons between the Nuxalk and other coastal indigenous peoples in terms of their observed efforts to cultivate potatoes, cut hay, and tend livestock, yet the land area fixed first by O'Reilly and later confirmed by the McKenna-McBride Commission was a fraction of Nuxalk Territory. Though there was no clear population to land formula, colonial agents estimated the mapped reserve area for the Nuxalk would provide a little more than 18 acres per male head of household. In contrast, the immigration leases provided to the Norwegian-American colonists who resettled the Bella Coola Valley beginning in 1894 were 160 acres per household.

Despite the promise of title to land, the labour required for clearing and establishing houses, and the isolation from the familiar meant that many of the first colonists did not remain in Bella Coola. Newcomer settlers sent displays of agricultural produce to provincial expositions as a way of promoting the growth of their colony. Colony records indicated that outreach to the provincial government and other institutions was organized to secure assistance for road-building and infrastructure projects. Clearing the coastal forests and establishing roads required time-consuming labour and significant expense, and when it was available, the colonists relied on provincial funds to support their efforts.

The Royal Commissions of 1913, known separately as the McKenna-McBride Commission on Indian Affairs and the Royal Commission on Agriculture, can be seen as public expressions of the discourse of settler colonialism in BC at the turn of the 20th century. Both of these commissions intended to respond to the "land question", and in doing so, the commission hearings manifested a theatre of power in favour of making space for white settlers. Despite the promotion and recruitment of immigrant settlers to establish Bella Coola as the northernmost agricultural colony of BC in 1894, and the momentum of settler-colonial discourse manifested by the Royal Commissions, by 1920 the majority of male, newcomer settlers in the Bella Coola Valley no longer identified themselves as farmers.

7.2.2 Chapter three

Chapter three demonstrates that farming for an outside market has a limited history in the Bella Coola Valley. This chapter analyzes multiple narratives to illustrate the tensions between differing meanings and modes of agriculture. Specifically, with the progressive and declensionist narratives, this chapter juxtaposes agriculture defined for its potential to contribute to external markets, and food systems valued for their contributions to a community that are not part of a commercial market. To push past the binary of progress and decline, or economic development versus ecological preservation, the four kinds of narrative presented in this chapter locate the middle landscape of small-scale producers and consumers who want to maintain connection to the outer world and who want to work towards re-centering the food system to the ecological and social realities of home. Also embedded in this middle landscape, are researchers and specialists working outside of their own social landscape with the university-community partnership approach.

The grease trails and "Great Road" that traversed the Bella Coola Valley and linked Nuxalk territory with Ulkatcho, Heiltsuk, Interior and Outer Coast Territories are part of the living history of the Nuxalk. Ecological and social changes have impacted the availability of the eulachon (sputc,*Thaleichthys pacificus*) that gave these grease trails their name. In addition to the eulachon, Nuxalk knowledge of foods and materials that formed an important part of the exchange on the "Great Road" included items that no longer have commercial value in 20th century terms. Regeneration of the indigenous food system will require attention to sharing food system knowledge and skills and support for the cultural and ecological values of this system.

The story of the construction of the Freedom Road focused on the self-reliance and know-how of the progressive pioneers of Bella Coola. Woven through this narrative is the recognition of the contributions from scientific, local, and indigenous knowledge. Though the 'local' knowledge of the newcomer settlers was centre stage, provincial surveyors and engineers as well as indigenous backcountry guides and trackers came through at pivotal moments. The agency of the jack pine jungle, as well as the mile high mountains and rockslides also challenged the progress of the road connection. Against the backdrop of historical speculation that Bella Coola would become a transportation route to the Cariboo goldfields, and the railroad depot for the Pacific Grand Trunk, the completion of the Freedom Road and connection to provincial Highway 20 was a story of triumph for the newcomer settlers of the Bella Coola Valley.

At the turn of the 21st century, advocates of community food security in the Bella Coola Valley understood the influx of cheaper, transported foods from long-haul trucking to be a contributor to the significant problems of poor health and disconnection from the land. Moreover, dependence on this food system from outside sources meant the loss of knowledge and skills required to regenerate food systems based on the ecological and social contexts of the Bella Coola Valley. These unintended consequences of the Freedom Road were spelled out in terms that would be familiar to Lyson's (2004) civic agriculture and Wilkin's (2009) civic dietetics. Successful resistance to the provincial health regulations and food policies that excluded small-scale production and distribution demonstrated that strong actors and strong advocate networks had organized in support of regenerating local and regional food systems.

Explorers and outside experts of many stripes have made the journey into the Bella Coola Valley in search of, among other things, transportation routes, resources to extract, and vanishing cultures to salvage. Much of the knowledge generated by outside experts has catered to an audience of scientists, policy-makers and specialists. In a few cases, knowledge generated by outsiders has become a cherished and useable part of the living history in the Bella Coola Valley. One example of this, despite its assumptions about static or essential knowledge, is McIlwraith's (1948) classic salvage ethnography *The Bella Coola Indians*. Both volumes of this anthropological epic are visible on bookshelves up and down the valley and recognized locally as the "Nuxalk Bible". Despite McIlwraith's adherence to many of the cultural assumptions of his day, his approach included combining his scientific-ethnographic method with the valuable indigenous knowledge he sought to collect. Not well known to people living in contemporary Bella Coola Valley, or available on the bookshelves at the local library, are the technical reports produced by soil scientists and surveyors that sought to assess the quantity and quality of the valley landscape suited to mechanical cultivation.

7.2.3 Chapter four

Chapter four is the first of the chapters focused on reviewing the methods and findings of the BCVSAS-UBC Foodshed Project. This chapter opens Part Two of the dissertation, and shifts from the identification of the historical to the biophysical contexts of the Bella Coola Valley. The approach and methods for the fieldwork initiatives are detailed in this chapter, as well as reflections on the complexity and challenges inherent to the collaborative and participatory research process. Navigating the sequencing of scientific methods and quantitative results with the qualitative results emerging from the active creation of participatory knowledge sharing events was the key analytical feature of this chapter. In other words, the participatory events of the Foodshed Project explicitly sought to blend scientific, local, and indigenous knowledge of Bella Coola Valley soils and food production. Overall, these efforts to regenerate agriculture intended to contribute an inclusive reframing of Bella Coola Valley agriculture to Bella Coola Valley food systems with the promotion of soils knowledge as one entry point for that dialogue.

7.2.4 Chapter five

Chapter five demonstrated that information on Bella Coola Valley soils in terms legible to soil scientists and resource managers was limited and lacked detail prior to the contributions of the 2007 soil survey. Drawing from the review of the dominant meanings and modes of production of 20th century agriculture from Part One of the dissertation, this information gap indicated that the surveyors and specialists associated with the provincial government saw limited prospects for export-oriented and industrial agriculture in the Bella Coola Valley. The updated and detailed information on the biophysical context of the Bella Coola Valley has the potential to reposition the valley as a location suited to a wide range of agricultural land uses and non-local crops.

The 1:20,000 scale soil map and interpretive land capability for agriculture and crop suitability maps contribute detailed biophysical information on 6747 hectares of soils in the valley bottomlands. The three main landforms of the valley are terraces, fans, and floodplains, and of the nine soil groupings, six have some area that falls within the agricultural capability classification range that indicates sustained mechanical cultivation is feasible. These six Bella Coola Valley soil groups are: 1) high capability fluvial soils, 2) sandy fluvial soils, 3) fluvial soils with a water table, 4) old high terraces, 5) stony, coarse textured fans, and 6) acidic, wet organic soils. Each of these six soil groups has a comparable soil management group delineated and described in the *Lower Fraser Valley Soil Management Handbook (*Bertrand, Hughes-Games & Nikkel, 1991).

Using an improved rating system for the soil capability for agriculture interpretation, the survey found close to 4300 hectares of class 1 to 4 soils and depicted these on the *Soils of the Bella Coola Valley* map series. With the updated survey equipment and more intensive ground checking, the 2007 soil survey identified roughly 300 hectares of class one agricultural capability soils. The largest area of these class one soils is not currently accessible by bridge or road, and is located in an area designated on provincial and federal maps as “Bella Coola Indian Reserve #1”.

The most common soil textures described in the soil survey were sands and sandy loams, and connected with this the most common subclass limitation for agricultural capability was limited available water storage capacity. The implications for longer-term soil management are that irrigation systems and systems to renew and replenish the soil organic matter are required inputs for sustained cultivation. The fluvial soils with water table group that represented close to 600 hectares would require attention to drainage and some form of water management system if sustained cultivation was incorporated in these areas of the valley. Another specific set of management inputs needed for the roughly 1400 hectares of the stony coarse-textured fan soil group included stone removal, an irrigation system, liming, and regular organic matter and nutrient inputs.

7.2.5 Chapter six

Chapter six returned additional quantitative results as part of the identification of the soil chemistry and made the case that contested meanings and practices of agriculture can be read in the landscape of the Bella Coola Valley. The soil fertility study, food production inventory, workshops and garden tours all created opportunities for knowledge exchange. For example, each participant in the soil fertility study requested sampling and chemical analysis of particular sites, and each participant provided some site input and management history. The workshops featured soils experts and forum discussions with the participants. The garden tour showcased selected valley growers, and provided opportunities that did not otherwise exist for locals to observe other local growing practices and experimentation.

The results of the soil fertility study showed that mixed gardens and raised bed gardens had higher levels of organic matter, soil pH, and nutrient levels compared with hayfields, pastures, and uncultivated or recreational fields. Bella Coola Valley farmers and ranchers who participated in the soil fertility study reported a wide range of input practices and objectives with respect to management of their hayfields and pasturelands. The accounts given by the farmers do not express a strong link between maintaining their hayfields and pastures and receiving a significant economic return. Reinforcing this, the soil test results indicated levels of soil acidity and available nutrients that would be responsive to increased inputs of lime and fertilizers. Anecdotal reports from the informal gatherings at the farmers' market further underscored the common belief behind the limited practice of regular liming and fertilizing. Namely, that transport and other costs associated with maintaining recommended levels of agricultural inputs keep these hayfield and pasture systems at low thresholds of fertility.

Observed in the workshops, garden tours, and in the Bella Coola Valley Health Forum, gardeners and advocates of small-scale and locally produced livestock do place a value on the continued presence of the hayfields and livestock pasture operations. The observed and reported practices for maintaining soil fertility in the mixed gardens exemplified the interrelationships between scientific, local, and indigenous knowledge.

Animal manures, fish heads, food scraps, and synthetic fertilizers were all reported as inputs intended to boost soil fertility. With the general trends of the soil fertility results opened as part of a public discussion, gardeners expressed an interest in obtaining the best locally sourced and the most cost effective purchased inputs.

The food production inventory provided hundreds of opportunities to exchange information about the soils and regeneration of agriculture in the Bella Coola Valley. Conducting this inventory with research assistants hired from within the valley also created the opportunity to inspire some regeneration of interest with local youth. Though both of the research assistants had many relatives and neighbours living near their homes, the activities associated with the inventory meant that they were seeing their valley in a different way. They were also an active part of an intergenerational exchange of local knowledge and skills with this inventory.

The food production inventory accounted for the presence of horticultural activities at a scale that could not be captured with the 1:20,000 agricultural land use maps. Because many of these activities took place in areas smaller than .8 hectares, only representative or selected GPS point data was portrayed on the maps. Within the inventory of 650 active food production sites, the majority had some type of food production strategy that fell within the classification of household (HF), extended network (EN), or market oriented (MA) production. The household was the most commonly observed scale of activity with 46% of the observed sites. Extended network sites comprised 14% of the food production inventory; a finding that indicated certain surplus distribution strategies were in place. In fact, this relatively large number of diverse and active food production sites was the most significant indicator of already in place food system knowledge and skills. These expressions in the landscape of the Bella Coola Valley demonstrate how people in the Bella Coola Valley feed themselves.

7.3 Limitations

This dissertation attempted to examine how to regenerate agricultural food systems on the premise that a robust contextual analysis could be initiated from historical and biophysical vantage points. Social, ecological, and economic aspects, particularly as they relate to a livelihoods framework, were integral parts of this whole, however, the key limitation of pursuing this broad-based contextual analysis is that each of these areas of inquiry are bounded in scope. The paragraphs that follow offer a discussion of these limitations.

For Part I of the dissertation, the key limitations to the findings of the historical analyses was the reliance on secondary sources, and the loss of depth in engaging with such a broad range of interdisciplinary literatures. The contributions of regionally focused historical geographers and environmental historians provided the foundation for initiating the archival research, and provided a framework for the kinds of questions to ask, and documents to seek. Another crucial weakness inherent in this approach is that the archives housed by the province and the university, have a strong collections bias in favour of records generated by settlers, merchants, and agents of colonialism. The archival records and documents held in Bella Coola also reflect the preservation of knowledge and artifacts almost exclusively generated by the settler-colonists. Similarly, the presentation of road stories in Chapter Four does not in any way capture the full range of perspectives on the indigenous and settler food systems, or on the relative priority of regenerating those food systems among other important social, ecological, and economic goals.

In Part II, reflection and discussion of the limitations are incorporated to the extent relevant to the arguments of the chapter. I present a more pointed review and discussion here to connect with the dissertation as a whole, and to link directly with suggestions for future research in the section that follows. The issues expressed by the community partners in their invitation to collaborate as part of a university-community partnership in the Bella Coola Valley were multi-causal and called for attention on a number of fronts. The disciplinary backgrounds and range of knowledge and skills represented from the BCVSAS-UBC research partners determined to a large degree the research design and priority objectives. As is the fate with many research initiatives, limited available sources of funding limited the scope of the activities, the time for follow-up, feedback, and analyses.

With respect to the soil survey and interpretive mapping, the set of information that emerged from the Bella Coola Valley Foodshed Project was published on the Internet in 2009 and returned to the community in the form of an open workshop in 2010. The importance of the background assumptions and approach in generating these materials cannot be overstated. Additionally, technical issues, generally known as 'wobble' from GPS equipment, and fit from shape files to the base map, meant that there were inaccuracies with the map unit areas. I discovered a few of these in the process of analyzing the data, and revised areas were sent from the research partners in 2009. Given the volume of data and descriptions for the working soil pits, and the nature of transferring and sharing data from pedologist to GIS contractor and back, there may be additional discrepancies, particularly in the smaller map units.

The soil fertility study was not representative of each mapped soil unit of the valley, and the small numbers of each land use type in the soil fertility study further limited the utility of quantitative analyses from these results. Only one soil fertility sample was analysed from the floodplain landform, and only six of the forty mapped fan landform units were tested. Soil sampling took place over a period of several months and the composite sampling technique could not have represented the full range of soil types present at some of the larger hayfield and pasture sites.

The food production inventory was limited by my own ability to "see" and enumerate diverse forms of food production that were not part of the settler-colonial food system. The inventory checklist was modified from provincial agriculture land use methods and favoured non-local crops of the field and garden. Assorted patches of indigenous berries that were tended on the edges of a home site or field were not included. Similarly, I observed many other material forms of the indigenous food system regularly, such as drying racks, smokehouses, cutting tables, and reclaimed bathtubs used for containing salmon. Unlike the greenhouses of the food production inventory, none of these structures made it on the list for household food production sites.

7.4 Ways forward and future research

The findings of this dissertation suggest that individuals and organizations based in the Bella Coola Valley do have an interest in regenerating their food systems. Previous collaborative research on the traditional foodways of the Nuxalk, and the present study show a combination of adaptations to an indigenous and a settler food system is in place. Future research to address potential synergies and conflicts between these two food systems has the potential to contribute to an overall regeneration of the food system in the Bella Coola Valley. For example, the availability of food fish and moose meat were regularly expressed priorities of Nuxalk at public events and feasts I attended. A detailed study of the ways agricultural land uses, and land tenures more broadly have an impact on availability or accessibility of these indigenous foods would be a good first step in reconciling these food systems. Similarly, the non-local cultivated crops of strawberries and potatoes were strongly represented and valued at these public gatherings, as well as visible on the ground in the soil fertility study and food production inventory. Increased efforts to provide information about scaling-up the production of these crops in terms of fertility, disease, and pest issues would go a long way towards filling a requested agricultural information gap.

The policy implications that emerged from community food security initiatives organized in the Bella Coola Valley and throughout the province speak to the agency of the community activists and the networks supporting them. Well-established literatures on actor-network theory and on ‘other’ actors engaged in policy discourse explore the social movements and political ecology of resistance to dominant food regimes, but few of these studies take a longer-term look at the historical assumptions and evidence embedded in those policies or regulations that discriminate against smallholders or small-scale agriculture. A historical review of policies with respect to land, land tenure, and land assessments would contribute to a better understanding of the crucial aspect of the space and place for food production activities.

Not directly explored in this dissertation are the market-based approaches to regenerating agriculture. Implied by the findings and observations in this research are that market-based solutions don't work everywhere. Future research in those contexts where smallholder and small scale agriculture is thriving outside of conventional and alternative markets would contribute to a better understanding of the linkages between livelihoods, markets, and landscapes.

The food production inventory was a low cost participatory activity that provided a snapshot of 2007 food production, otherwise missed by the agricultural census and conventional land use inventory methods. Enhancing both spatial and temporal aspects of the food production inventory would contribute to the value of these results. Increasing the survey intensity and mapping scale to 1:10,000 or 1:5,000 for more densely settled sections of the valley would allow those small-scale activities taking place in areas less than .8 hectares to take shape on the maps. Baseline knowledge of the spatial extent of these activities would provide a better sense of whether engagement in food production was shrinking if the inventory was repeated on a five to ten year basis.

Boosting the level of engagement with participatory activities, particularly with respect to mapping and inventory activities, would translate to more evenly dispersed knowledge sharing. Examples of community-engaged participatory GIS mapping on Vancouver Island and with the Cowichan First Nation demonstrate the feasibility of this approach (Harrington, n.d.; Thom, 2005). Bioregional and foodshed mapping placed directly in the hands of participants has a strong potential to promote knowledge sharing and skills building compared with the top-down approach of creating maps by specialists. Salient to the lessons learned and highlighted with this dissertation, the way forward in this tangle of collaborative, interdisciplinary, quantitative, and qualitative approaches as articulated by DeLind and Bingen is highlighted by this quote (2007: p.149):

"Our challenge is to create opportunities for communities to find and learn their own language(s) of power and place".

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Appendices

Appendix A Soils of the Bella Coola Valley: Map unit areas with agricultural capability and soil group

Map Unit	Ag Capability	Soil Group	Area (hectares)
T81	5WF	Acidic, wet organic soils	48.4
P1	7AP	Active floodplain soils	138.3
P1	7AP	Active floodplain soils	5.6
P1	7AP	Active floodplain soils	2.7
P1	7AP	Active floodplain soils	3.2
P1	7AP	Active floodplain soils	7.0
P1	7AP	Active floodplain soils	0.8
P43	7PE	Active floodplain soils	96.8
P50	7PE	Active floodplain soils	6.9
P50	7PE	Active floodplain soils	2.0
P50	7PE	Active floodplain soils	2.5
P50	7PE	Active floodplain soils	4.1
P50	7PE	Active floodplain soils	6.3
P50	7PE	Active floodplain soils	6.0
P50	7PE	Active floodplain soils	10.7
P50	7PE	Active floodplain soils	2.8
P50	7PE	Active floodplain soils	27.5
P50	7PE	Active floodplain soils	7.2
P50	7PE	Active floodplain soils	9.1
P50	7PE	Active floodplain soils	6.1
P50	7PE	Active floodplain soils	4.2
P50	7PE	Active floodplain soils	1.8
P50	7PE	Active floodplain soils	8.7
P50	7PE	Active floodplain soils	2.6
P50	7PE	Active floodplain soils	10.1
T25	7P	Active floodplain soils	18.8
Estuary		Estuary	83.2
Estuary		Estuary	111.0
Estuary		Estuary	68.0
Estuary		Estuary	21.5
F44	3W	Fluvial soils with water table	70.2
F80	4W	Fluvial soils with water table	58.4
F85	4W	Fluvial soils with water table	7.9
F85	4W	Fluvial soils with water table	1.6
F86	4W	Fluvial soils with water table	28.6
P54	3W	Fluvial soils with water table	1.9
P84	3W	Fluvial soils with water table	40.2
T11	3W	Fluvial soils with water table	13.8
T23	2AT	Fluvial soils with water table	128.6
T40	3W	Fluvial soils with water table	54.1
T5	2AT	Fluvial soils with water table	107.9
T6	3AT	Fluvial soils with water table	10.9

Map Unit	Ag Capability	Soil Group	Area (hectares)
T7	3W	Fluvial soils with water table	27.2
T70	3W	Fluvial soils with water table	42.9
F41	2AT	High capability fluvial soils	2.9
F65	2A	High capability fluvial soils	42.7
P69	1	High capability fluvial soils	57.1
T10	2A	High capability fluvial soils	82.0
T41	2AT	High capability fluvial soils	40.4
T42	2AT	High capability fluvial soils	28.8
T43	1	High capability fluvial soils	12.9
T48	2A	High capability fluvial soils	70.9
T49	2AT	High capability fluvial soils	57.6
T50	2AT	High capability fluvial soils	55.0
T54	2A	High capability fluvial soils	28.5
T57	2AT	High capability fluvial soils	83.6
T58	2AT	High capability fluvial soils	33.2
T61	2AT	High capability fluvial soils	160.5
T67	2A	High capability fluvial soils	122.1
T69	1	High capability fluvial soils	37.6
T75	2A	High capability fluvial soils	10.2
T76	1	High capability fluvial soils	191.0
T82	2W	High capability fluvial soils	12.3
T9	2W	High capability fluvial soils	28.2
T21	5P	Old, high terraces	33.6
T46	3A	Old, high terraces	289.3
T47	3A	Old, high terraces	46.5
T53	3A	Old, high terraces	43.8
T71	3A	Old, high terraces	32.6
F69	5IW	Regularly inundated soils	15.0
P22	5I	Regularly inundated soils	8.6
P45	5I	Regularly inundated soils	5.2
P45	5I	Regularly inundated soils	1.8
P45	5I	Regularly inundated soils	3.7
P45	5I	Regularly inundated soils	1.8
P5	5W	Regularly inundated soils	5.4
P62	5I	Regularly inundated soils	149.0
P68	5I	Regularly inundated soils	3.1
P68	5I	Regularly inundated soils	32.8
P68	5I	Regularly inundated soils	2.8
P68	5I	Regularly inundated soils	5.0
P68	5I	Regularly inundated soils	3.5
P68	5I	Regularly inundated soils	1.6
P82	5I	Regularly inundated soils	74.3
F11	3A	Sandy fluvial soils	25.0
F2	3A	Sandy fluvial soils	6.3
F43	3A	Sandy fluvial soils	10.8
F5	3A	Sandy fluvial soils	3.7
F63	3A	Sandy fluvial soils	144.0
F82	3A	Sandy fluvial soils	106.0
P10	3AT	Sandy fluvial soils	4.1
P11	3AT	Sandy fluvial soils	24.0
P2	4A	Sandy fluvial soils	3.4
P21	3AT	Sandy fluvial soils	16.7

Map Unit	Ag Capability	Soil Group	Area (hectares)
P23	3AT	Sandy fluvial soils	9.1
P24	3AT	Sandy fluvial soils	1.4
P25	2AT	Sandy fluvial soils	6.4
P26	4A	Sandy fluvial soils	1.2
P27	3AT	Sandy fluvial soils	8.8
P28	4A	Sandy fluvial soils	2.3
P29	3AT	Sandy fluvial soils	9.8
P3	4A	Sandy fluvial soils	51.8
P3	4A	Sandy fluvial soils	42.9
P3	4A	Sandy fluvial soils	15.1
P30	4A	Sandy fluvial soils	5.4
P30	4A	Sandy fluvial soils	4.6
P30	4A	Sandy fluvial soils	8.1
P31	3AT	Sandy fluvial soils	16.6
P32	3AT	Sandy fluvial soils	10.2
P33	4AT	Sandy fluvial soils	44.5
P34	3AT	Sandy fluvial soils	8.1
P35	4A	Sandy fluvial soils	0.8
P36	3AT	Sandy fluvial soils	2.1
P4	4A	Sandy fluvial soils	10.0
P41	3AT	Sandy fluvial soils	22.8
P42	4A	Sandy fluvial soils	2.5
P42	4A	Sandy fluvial soils	1.6
P44	3AT	Sandy fluvial soils	2.4
P46	3AT	Sandy fluvial soils	16.1
P47	3AT	Sandy fluvial soils	11.2
P48	3AT	Sandy fluvial soils	4.9
P49	3AT	Sandy fluvial soils	1.2
P51	4A	Sandy fluvial soils	63.7
P52	3AT	Sandy fluvial soils	40.3
P53	3AT	Sandy fluvial soils	96.1
P55	3AT	Sandy fluvial soils	4.4
P56	3AT	Sandy fluvial soils	10.6
P57	3AT	Sandy fluvial soils	1.8
P58	3AT	Sandy fluvial soils	15.5
P59	3AT	Sandy fluvial soils	1.7
P59	3AT	Sandy fluvial soils	5.9
P6	4A	Sandy fluvial soils	38.3
P61	3AT	Sandy fluvial soils	7.8
P61	3AT	Sandy fluvial soils	37.1
P63	4A	Sandy fluvial soils	16.3
P64	4A	Sandy fluvial soils	6.1
P64	4A	Sandy fluvial soils	5.4
P64	4A	Sandy fluvial soils	8.8
P65	3AT	Sandy fluvial soils	57.7
P66	3AT	Sandy fluvial soils	8.6
P67	3AT	Sandy fluvial soils	14.5
P7	4A	Sandy fluvial soils	10.2
P70	3A	Sandy fluvial soils	81.9
P8	3AT	Sandy fluvial soils	3.1
P81	3AT	Sandy fluvial soils	16.2
P83	3AT	Sandy fluvial soils	26.1

Map Unit	Ag Capability	Soil Group	Area (hectares)
P9	3AT	Sandy fluvial soils	6.5
T1	3A	Sandy fluvial soils	79.6
T1	3A	Sandy fluvial soils	5.7
T2	3AT	Sandy fluvial soils	16.8
T22	3A	Sandy fluvial soils	38.2
T3	3AT	Sandy fluvial soils	8.5
T3b	3AT	Sandy fluvial soils	3.2
T4	3A	Sandy fluvial soils	33.1
T44	3A	Sandy fluvial soils	37.7
T56	3A	Sandy fluvial soils	52.6
T65	3A	Sandy fluvial soils	136.5
T68	3AT	Sandy fluvial soils	119.4
T77	3A	Sandy fluvial soils	195.0
F1	5P	Stony, coarse textured fans	114.3
F10	5P	Stony, coarse textured fans	159.7
F12	5P	Stony, coarse textured fans	15.0
F13	5P	Stony, coarse textured fans	2.9
F20	7P	Stony, coarse textured fans	36.7
F21	7PE	Stony, coarse textured fans	67.9
F22	5P	Stony, coarse textured fans	145.7
F23	7P	Stony, coarse textured fans	12.0
F24	7P	Stony, coarse textured fans	59.3
F25	5P	Stony, coarse textured fans	3.6
F3	7P	Stony, coarse textured fans	41.5
F4	7P	Stony, coarse textured fans	23.3
F40	5P	Stony, coarse textured fans	1.5
F42	5P	Stony, coarse textured fans	5.9
F60	4P	Stony, coarse textured fans	83.5
F61	4P	Stony, coarse textured fans	48.2
F62	7PE	Stony, coarse textured fans	18.0
F64	5P	Stony, coarse textured fans	63.1
F66	5AP	Stony, coarse textured fans	17.5
F67	5AP	Stony, coarse textured fans	3.2
F68	5AP	Stony, coarse textured fans	3.4
F7	7P	Stony, coarse textured fans	55.3
F8	7P	Stony, coarse textured fans	41.1
F81	5AP	Stony, coarse textured fans	101.6
F83	5P	Stony, coarse textured fans	189.6
F84	5P	Stony, coarse textured fans	24.1
F87	7PE	Stony, coarse textured fans	17.7
F9	7P	Stony, coarse textured fans	26.5
Townsite		Townsite	52.7
T24	5W	Very wet terraces	10.5
T24	5W	Very wet terraces	13.0
T26	5W	Very wet terraces	1.6
T45	5W	Very wet terraces	5.2
T51	5WI	Very wet terraces	3.0
T52	5WI	Very wet terraces	8.2
T55	5WI	Very wet terraces	10.6
T62	5W	Very wet terraces	7.7
T63	5W	Very wet terraces	3.4
T66	5W	Very wet terraces	18.2

Map Unit	Ag Capability	Soil Group	Area (hectares)
T78	5W	Very wet terraces	19.0
TOTAL			**6746.9**

Appendix B Soils of the Bella Coola Valley: selected data from extended legend

This selected data represents the information described in the first component of the associated soil map unit, including the landform category, slope range, parent materials of the first component, drainage, soil classification subgroup type, and the percent of the first component (%) that fits the given description. Subgroup abbreviations are as follows: Orthic Regosol (OR); Eluviated Dystric Brunisol (E DYB); Dystric Brunisol (DYB); Orthic Dystric Brunisol (O DYB); Rego Gleysol (R GL); Orthic Sombric Brunisol (O SB); Fera Gleysol (FE GL); Gleyed Regosol (GL R); Humic Gleysol (H GL); Typic Fibrisol (TY F)

Map Unit	Landform	Slope Range	Materials- 1^{st} component	Drainage	Subgroup	%
F01	FF	2-5	Gravelly coarse and medium sands with 16-30% cobbles and stones	W	O R	60
F02	FF	3-8	25-75 cm of fine sand, very fine sand and silt overlying gravelly medium sands	W	O R	100
F03	FF	7-10	Gravelly coarse and medium sands with >30% cobbles and stones	R	O R	100
F04	FF	5-?	Gravelly coarse and medium sands with >30% cobbles and stones	R	O R	100
F05	FF	2-4	Fine sand and loamy fine sand over stratified fine, very fine sand and silt	MW	O R	70
F07	FF	15-25	Very gravelly coarse and medium sands with >30% cobbles and stones	R	E DYB & O R	100
F08	FF	15-25	Very gravelly coarse and medium sands with >30% cobbles and stones	R	O R	100
F09	FF, active portion	2-4	Very gravelly coarse and medium sands with >30% cobbles and stones	R	O R	100
F10	FF, inactive portion	4-10	Gravelly coarse and medium sands with 16-30% cobbles and stones	W - R	E DYB & O R	60
F11	FF apron	2-6	25-75 cm of fine sands overlying gravelly coarse and medium sands	W - MW	O R	90
F12	FF	10-15	Gravelly coarse and medium sands with 16-30% cobbles and stones	W	O R	70
F13	FF	10-15	Gravelly coarse and medium sands with 16-30% cobbles and stones	W	O R	100
F20	FF	15-25	Very gravelly coarse and medium sands with >30% cobbles and stones	R	O R	70

Map Unit	Landform	Slope Range	Materials- 1st component	Drainage	Subgroup	%
F21	FF prone to snow avalanching	15-25	Very gravelly coarse and medium sands with >30% cobbles and stones	R	O R	100
F22	FF	5-15	Gravelly coarse and medium sands with 16-30% cobbles and stones	W	O DYB & E DYB	70
F23	FF	15-25	Very gravelly coarse and medium sands with >30% cobbles and stones	R	O R	60
F24	FF	15-25	Very gravelly coarse and medium sands with >30% cobbles and stones	R	O R	70
F25	FF	3-15	Gravelly coarse and medium sands with 16-30% cobbles and stones	W	O R	80
F40	FF	3-15	Gravelly coarse and medium sands with 16-30% cobbles and stones	W	O R	80
F41	FF	3-10	25-100 cm of fine sands overlying gravelly coarse and medium sands	W - MW	O R	60
F42	FF	5-15	Gravelly coarse and medium sands with 16-30% cobbles and stones	W	O R	60
F43	FF apron	1-3	Stratified very fine to medium sands over medium to coarse sands; often with very fine sand to silt river alluvium at depth	W - MW	O DYB & O R	100
F44	FF apron over fluvial terrace	1-3	>1 m of stratified very fine and fine sands; stone-free	MP	R GL	70
F60	FF	3-8	25-50 cm of medium and fine sands overlying gravelly, medium and coarse sands with variable cobble and stone content up to 60%	W	E DYB	90
F61	FF	3-8	25-50 cm of medium and fine sands overlying gravelly, medium and coarse sands with variable cobble and stone content up to 60%	W	E DYB	90
F62	FF, active dyked portion	3-8	Gravelly coarse and medium sands with >30% cobbles and stones	R	O R	100
F63	FF apron	1-3	Stratified very fine to medium sands over medium to coarse sands; often with very fine sand to silt river alluvium at depth	W - MW	O DYB & O R	80
F64	FF	3-8	'15-50 cm of medium and fine sands over coarse sands with 41-60% cobbles and stones	W	O DYB	100
F65	FF apron	1-3	>1 m of stratified very fine, fine	W - MW	O R, often	100

	over fluvial terrace		and medium sands; locally silt; all stone-free		tending to O DYB	
Map Unit	Landform	Slope Range	Materials- 1st component	Drainage	Subgroup	%
F66	FF	15-25	Very gravelly medium and coarse sands, locally with 16-30% cobbles and stones	R	O R	100
F67	FF	15-25	Very gravelly medium and coarse sands, locally with 16-30% cobbles and stones	R	O R	100
F68	FF	15-25	Very gravelly medium and coarse sands, locally with 16-30% cobbles and stones	R	O R	100
F69	FF, active portion	3-10	25-75 cm of fine sands overlying medium and coarse sands and gravels	P, regularly inundated	R GL	80
F80	FF apron	1-3	75 cm - >1 m of silt and fine sand overlying fluvial sands and gravels	MP - P	R GL	70
F81	FF	3-20	Gravelly coarse and medium sands with 16-30% cobbles and stones	W	O R	70
F82	FF apron	1-8	Variably stratified medium, fine and very fine sands; stone-free	W	O DYB & O R	80
F83	FF	3-8	15-50 cm of medium and fine sands over coarse sands and gravels with 16-30% cobbles and stones	W	E DYB & O SB	80
F84	FF	3-6	15-50 cm of medium and fine sands over coarse sands and gravels with 16-30% cobbles and stones	W	E DYB	80
F85	FF apron	0.5-2	25-75 cm of fine and very fine sands overlying coarse sands and gravels	P	R GL	80
F86	FF apron	1-3	15-50 cm of medium and coarse sands over stratified fine and very fine sands; stone-free	P	FE GL	100
F87	FF, active dyked portion	3-6	Gravelly coarse and medium sands with >30% cobbles and stones	R	O R	100
P01	Braided FP, active portion	0.5-8, r & s	Very gravelly and cobbly materials with coarse interstitial sands	R	O R	70
P02	FP, low terrace >2 m above regular inundation	0.5-1	25-50 cm of fine sand over very gravelly medium and coarse sands	W	O R	100
P03	FP, low terraces	0.5-8, r & s	25-75 cm of fine sand over very gravelly medium and coarse sands	W	O R	90
P04	FP	0.5-8, r & s	25-50 cm of fine sand over very gravelly medium and coarse	W	O R	90

			sands			
Map Unit	Landform	Slope Range	Materials- 1st component	Drainage	Subgroup	%
P05	FP	0-1	25-50 cm of silt over very fine and fine sands; stone-free	P	R GL	90
P06	FP	0.5-8, r & s	25-50 cm of fine sand over very gravelly medium and coarse sands	W	O R	90
P07	FP	0.5-8, r & s	25-50 cm of fine sand over very gravelly medium and coarse sands	W	O R	90
P08	FP, low terrace	0.5-8, r & s	>1 m of very fine and fine sands; stone-free	W	O R	100
P09	FP, low terrace	0.5-8, r & s	>1 m of very fine and fine sands; stone-free	W	O R	90
P10	FP	0.5-8, r & s	>1 m of very fine and fine sands; stone-free	W	O R	90
P11	FP, low terraces	0.5-8, r & s	>1 m of very fine and fine sands; stone-free	W	O R	70
P21	FP, low terraces	2-10, r & s	>1 m of very fine and fine sands; stone-free	W	O R	80
P22	FP-I, low terrace	0.5-8, r & s	>1 m of stratified very fine sand, silt and fine sand; stone-free	W	O R	90
P23	FP	0.5-8	25-75 cm of fine and very fine sands over very gravelly medium and coarse sands	W	O R	60
P24	FP, low terrace	0.5-8, r & s	>1 m of stratified very fine sand, silt and fine sand; stone-free	MW	O R	100
P25	FP, low terrace	0.5-8, r & s	>1 m of stratified silt, very fine sand and fine sand; stone-free	MW	O R	70
P26	FP	0.5-8, r & s	25-50 cm of fine sand over very gravelly medium and coarse sands	W	O R	70
P27	FP, low terraces	0.5-8, r & s	>1 m of stratified silt, very fine sand and fine sand; stone-free	W - MW	O R	90
P28	FP	0.5-8, r & s	25-50 cm of fine sand over very gravelly medium and coarse sands	W	O R	80
P29	FP, low terraces	0.5-8, r & s	>1 m of stratified silt, very fine sand and fine sand; stone-free	W	O R	90
P30	Braided FP	0.5-8, r & s	25-75 cm of fine and very fine sands over very gravelly medium and coarse sands	W	O R	80
P31	FP, low terrace	0.5-8, r & s	>1 m of very fine and fine sands; stone-free	W	O R	60
P32	FP, low terrace	0.5-8, r & s	>1 m of stratified silt, very fine sand and fine sand; stone-free	W	O R	90
P33	FP	0.5-8, r & s	25-75 cm of fine and very fine sands over very gravelly medium and coarse sands	W	O R	80
P34	FP, low terrace	0.5-8, r & s	>1 m of stratified silt, very fine sand and fine sand; stone-free	W	O R	100

P35	FP	0.5-2	25-50 cm of fine sand over very gravelly medium and coarse sands	W - R	O R	60
Map Unit	Landform	Slope Range	Materials- 1st component	Drainage	Subgroup	%
P36	FP, low terrace	0.5-8, r & s	>1 m of stratified silt, very fine sand and fine sand; stone-free	W	O R	100
P41	FP, low terrace	0.5-8, r & s	>1 m of stratified silt, very fine sand and fine sand; stone-free	W - MW	O R	50
P42	FP, island	0.5-8, r & s	25-50 cm of fine sand over very gravelly medium and coarse sands	W - R	O R	80
P43	Braided FP, mostly active	2-6	0-50 cm of medium and fine sands over cobbly, gravelly medium and coarse sands	W - R	O R	100
P44	FP, low terrace	0.5-8, r & s	25-75 cm of fine sands over very gravelly medium and coarse sands	W	O R	80
P45	FP, including islands	0.5-2	25-50 cm of fine sand over very gravelly medium and coarse sands	W - R	O R	60
P46	FP, low terraces	0.5-8, r & s	>1 m of stratified very fine sand and fine sand; stone-free	W	O R	90
P47	FP, low terraces	0.5-8, r & s	25-75 cm of fine and very fine sands over very gravelly medium and coarse sands	W	O R	90
P48	FP, low terrace	0.5-8, r & s	>1 m of stratified silt, very fine sand and fine sand; stone-free	W - MW	O R	90
P49	FP, low terrace	0.5-8, r & s	25-75 cm of fine and very fine sands over very gravelly medium and coarse sands	W	O R	50
P50	Braided FP, bars & islands	0.5-2	0-50 cm of medium and fine sands over cobbly, gravelly medium and coarse sands	W - R, regularly inundated	O R	100
P51	FP; part braided, part low terraces	0.5-8	25-75 cm of fine and very fine sands over very gravelly medium and coarse sands	W	O R	60
P52	FP, low terraces	0.5-8, r & s	50 cm to >1 m of stratified fine sand, very fine sand and medium sand, stone-free; over very gravelly medium and coarse sand	W	O R	60
P53	FP, low terraces	0.5-8, r & s	50 cm to >1 m of stratified fine sand, very fine sand and medium sand over very gravelly medium and coarse sands	W	O R	70
P54	FP, low terrace	0.5-1	>1 m of stratified very fine sand and fine sand; stone-free	MP	R GL	100
P55	FP	0.5-2	50-75 cm of stratified medium, fine and very fine sands over cobbly, gravelly sands	W	O R	90
P56	FP	0.5-8, r & s	50 cm to >1 m of stratified fine sand, very fine sand and	W	O R	70

			medium sand, stone-free; over gravelly or cobbly medium and coarse sand			
Map Unit	Landform	Slope Range	Materials- 1st component	Drainage	Subgroup	%
P57	FP	0.5-2	50-75 cm of stratified medium, fine and very fine sands over cobbly, gravelly sands	W	O R	100
P58	FP, low terraces	0.5-8, r & s	50-75 cm of stratified fine and very fine sands over cobbly, gravelly medium and coarse sands	W	O R	70
P59	FP, low terraces	0.5-8, r & s	50-75 cm of stratified medium, fine and very fine sands over cobbly, gravelly sands	W	O R	90
P61	FP, low terraces	0.5-8, r & s	25-75 cm of fine and very fine sands over very gravelly medium and coarse sands	W	O R	60
P62	FP, frequent channels	0.5-8, r & s	25-75 cm of fine and very fine sands over very gravelly medium and coarse sands	W - I	O R	80
P63	FP, low terraces	0.5-8, r & s	25-75 cm of fine and very fine sands over very gravelly medium and coarse sands	W	O R	70
P64	FP	0.5-8, r & s	25-75 cm of fine and very fine sands over very gravelly medium and coarse sands	W	O R	90
P65	FP, 2 large channels	0.5-8, r & s	50 cm to >1 m of stratified fine sand, stone-free; over very gravelly medium and coarse sand	W	O R	80
P66	FP, low terrace island	0.5-8, r & s	25-75 cm of fine and very fine sands over very gravelly medium and coarse sands	W	O R	90
P67	FP, low terraces	0.5-8, r & s	50 cm to >1 m of stratified fine and medium sands, stone-free; over very gravelly medium and coarse sand	W	O R	90
P68	Braided FP	0.5-8, r & s	0-50 cm of medium and fine sands over cobbly, gravelly medium and coarse sands	W - R	O R	80
P69	FP, inundates 1-2x/century	0.5-2	40 cm - >1 m of stone-free, very fine sand and silt over gravelly medium sands	MW	O R	90
P70	FP, part braided, part low terraces	1-3	25-75 cm of fine and very fine sands over very gravelly medium and coarse sands	W	O R	70
P81	FP, low terrace	0.5-8, r & s	50 cm to >1 m of stratified fine and medium sands, stone-free; over very gravelly medium and coarse sand	W	O R	90
P82	FP, braided &	0.5-8, r & s	0-50 cm of medium and fine sands over cobbly, gravelly	W - R	O R	60

	channeled; ox-bows & marshes		medium and coarse sands			
Map Unit	Landform	Slope Range	Materials- 1st component	Drainage	Subgroup	%
P83	FP, low terrace island	0.5-8, r & s	50 cm to >1 m of stratified fine and medium sands, stone-free; over very gravelly medium and coarse sand	W	O R	90
P84	FP, low terrace	0.5-4, r & s	>1 m of stratified, very fine and fine sands; stone-free	I - W	GL R & O R	80
T01	Fluvial Terrace	1-4	very fine sand over stratified very fine and fine sand, with very gravelly medium and coarse sands at depths >75 cm	MW	O R	60
T02	Fluvial Terrace	2-5	very fine sand over stratified very fine and fine sand, with very gravelly medium and coarse sands at depths >75 cm	MW	O R	90
T03	FT	2-5	very fine sand over stratified very fine and fine sand, with very gravelly medium and coarse sands at depths >75 cm	MW	O R	90
T04	FT	1-4	very fine sand over stratified very fine and fine sand, with very gravelly medium and coarse sands at depths >75 cm	MW	O R	60
T05	FT	1-4	>1 m of stratified silt, very fine sand and fine sand; stone-free	MW - W	O R	70
T06	Levee on outer part of Fluvial Terrace	2-4	very fine sand and silt overlying fine and medium sands at +/- 1 m; all stone-free	Well	O R	70
T07	FT in part overlain by fan apron	1-2	>1 m of stratified silt, very fine sand and fine sand; stone-free	MP - I	R GL & GL R	80
T09	FT	1-2	>1 m of stratified very fine sand, silt and fine sand; stone-free	MW - I	O R & GL R	100
T10	FT with variable, thin veneer of fan apron	0.5-3	stratified very fine sand, silt, fine sand, medium sand and clayey silt; mostly stone- and gravel-free for >1 m	MW - W	O R	70
T11	FT with variable, thin veneer of fan apron	0-1	silt overlying silty clay at 35-75 cm	MP	HU GL	70
T21	High FT	1-3	thin, discontinuous veneer (0-25 cm) of fine and medium sand over very gravelly coarse sands	W	O DYB	70
T22	Low FT	0.5-4, ridge &	>1 m of stratified very fine sand, fine sand and silt; stone-	W - MW	O R & O DYB	100

		swale	free			
Map Unit	Landform	Slope Range	Materials- 1st component	Drainage	Subgroup	%
T23	FT	0.5-4	>1 m of stratified very fine sand, fine sand and silt; stone-free	MW - MP	O R & R GL	60
T24	FT	0-1	> 1 m of silty and silty clay vertical accretions	P	O GL	100
T25	Colluvial veneer over FT	5-30	variable thickness veneer of a blocky slide deposit atop fluvial materials; colluvial blocks to 3 m diameter	W	O DYB	100
T26	FT	0-1	>1 m of stratified very fine sand, fine sand and silt; stone-free	P - VP	R GL	100
T40	FT	1-3	50 cm to >1 m of silt over fine or medium sands; stone-free	MP - MW	R GL, O R & GL R	100
T41	High FT overlain by fan aprons	3-5	silt and very fine sand, stone-free; overlying stratified very fine and fine sands; localized 10-20% gravel and cobble content	MW-W	O R	100
T42	FT	2-5	>1 m of very fine sand and silt; stone-free	MW - I	O R & GL R	60
T43	FT	1-3	>1 m of silt and very fine sand; stone-free	MW	O R	100
T44	Low FT	1-3	>1 m of stratified very fine sand, fine sand and silt; stone-free	W - MW	O R	100
T45	Low FT	0-1	>1 m of stratified very fine sand, fine sand and silt; stone-free	P - VP	R GL	100
T46	High FT	1-8	>1 m of stratified very fine, fine, medium and coarse sands; coarser with depth; stone- and gravel-free depth ranges from 0 to >1 m	W - MW	O DYB, E DYB & O R	100
T47	High FT	1-3	>1 m of stratified fine, medium and coarse sands; coarser with depth; stone- and gravel-free depth ranges from 0 to >1 m	W - R	O DYB	100
T48	FT	1-3	>1 m of stratified silt, very fine sand and fine sand; stone-free; medium and coarse sands at depth	I - MW	GL R & O R	100
T49	FT, several levels	1-8	25-75 cm of stratified silt, very fine sand and fine sand; stone-free; over coarse sands or cobbly, gravelly coarse sands	W	O R & O DYB	80
T50	FT, several levels	1-8	25-75 cm of stratified silt, very fine sand and fine sand; stone-free; over coarse sands or cobbly, gravelly coarse sands	W	O R & O DYB	80
T51	FT	0-1	> 1 m of silt and very fine sand;	P	R GL	100

			stone-free			
Map Unit	Landform	Slope Range	Materials- 1st component	Drainage	Subgroup	%
T52	FT	0-1	> 1 m of silt and very fine sand; stone-free	P	R GL; some Peaty	100
T53	High FT	1-2	50 cm to 1 m of medium and fine sands, stone-free; over gravelly coarse sands with 16-30% cobbles and stones	W	O DYB	100
T54	FT	1-2	50 cm to >1 m of fine sand, stone-free; over cobbly, gravelly coarse sand with 16-30% cobbles and stones	MW	O R	100
T55	FT	0-1	> 1 m of silt and very fine sand; stone-free	P	R GL; some Peaty	100
T56	Medium FT	1-5	>1 m of stratified fine sand, very fine sand and silt; stone-free; medium and coarse sands at depth	W - MW	O DYB & O R	90
T57	FT	0.5-4, ridge & swale	>1 m of stratified silt, very fine sand and fine sand; stone-free	W - MP	O R, GL R & R GL	80
T58	Low FT	0.5-4, ridge & swale	>1 m of stratified silt, very fine sand and fine sand; stone-free	W - MP	O R, GL R & R GL	100
T61	FT	0.5-4	>1 m of stratified silt, very fine sand and fine sand; stone-free	W - MP	O R, GL R & R	100
T62	FT	0-1	>1 m of stratified silt, very fine sand and fine sand; stone-free	P - VP	R GL	100
T63	FT	0-1	>1 m of stratified silt, very fine sand and fine sand; stone-free	P - VP	R GL	100
T65	FT	0.5-8, r & s	>1 m of stratified very fine, fine and medium sands; stone-free	W - MW	O R	60
T66	FT	0-1	>1 m of stratified sands including thin layers of moderately decomposed organic peat; stone-free	P - VP	R GL	100
T67	Medium FT	0-3	50 cm to >1 m of stratified very fine and fine sand with minor silt, stone-free; over very gravelly fine, medium and coarse sands	MW - W	O DYB	100
T68	Low FT	0.5-8, r & s	>1 m of stratified fine sand, very fine sand and silt; stone-free	W	O R	90
T69	FT	0-3	>1 m of stratified silt and very fine sand, stone-free	MW - I	O R & GL R	100
T70	FT	0-1	>1 m of stratified silt and very fine sand, stone-free	I - VP	GL R & R GL	100
T71	High FT	0-3	25 cm to >1 m of very fine and fine sands, with minor silt, all stone-free; over gravelly sands	W - MW	O DYB & E DYB	100
T75	FT	0-2	>1 m of stratified silt, fine sand and very fine sand; stone-free	MW	O R	100

Map Unit	Landform	Slope Range	Materials- 1st component	Drainage	Subgroup	%
T76	FT	0-2	>1 m of stratified silt, fine sand and very fine sand; stone-free	MW - MP	O R & R GL	100
T77	FT	0-3	25 cm to >1 m of fine and very fine sands over very gravelly medium and coarse sands	W - I	O R & GL R	100
T78	FT	0-1	25-75 cm of fine and very fine sands over very gravelly medium and coarse sands	P - VP	R GL	100
T81	FT	0-1	Variable accumulation (25 cm to >1 m) of peat overlying silts and sands	VP - P	Peaty R GL & TY F	100
T82	FT	0-2	>1 m of stratified silt, fine sand and very fine sand; stone-free	MW - I	O R & GL R	100

Appendix C

2006 Bella Coola Valley Soil Fertility Study Results

Description of soil sampling site given as present land use(s); location includes soil map unit and vernacular place name. To conform with legibility and formatting requirements, selected results presented do not include results for micronutrient levels except for B. Soil laboratory analyses abbreviations and methods given in Appendix D; units given as percentage (%) or parts per million (ppm).

Description, location	Date sampled	OM (%)	pH	EC (dS m^{-1})	N (%)	P (ppm)	B (ppm)	K (ppm)	Ca (ppm)	Mg (ppm)
Garden, potato-potlatch (T75, Old Town Reserve)	8/22/06	3.3	5.4	0.19	0.14	16.6	0.45	50	350	35
Garden, demonstration (F69, Townsite Reserve)	8/14/06	6.5	5.1	0.23	0.18	97	0.12	65	300	27
Garden, mixed homegarden (F69, Townsite Reserve)	8/10/06	2.9	5.5	1.02	0.13	477	22.3	115	550	60
Uncultivated area (F83, Tonquin Road)	8/12/06	4.1	4.9	0.13	0.06	56.4	0.05	50	200	40
Raised bed garden (F83, 4Mile Reserve)	8/15/06	9.6	5.3	0.57	0.2	153.8	0.29	275	550	145
Garden, potato-potlatch (F83, 4 Mile Reserve)	8/10/06	2.8	5.2	0.15	0.08	43.5	0.09	65	250	25
Garden, potato-potlatch (T82, 4 Mile Reserve)	7/11/06	4.2	5.4	0.35	0.14	87	0.13	70	550	45
Uncultivated area (F85, Thorsen Creek)	8/10/06	3.7	5.3	0.21	0.1	72	0.08	80	350	14
Blueberry field (T70, N Grant Road)	8/25/06	4.6	4.9	0.24	0.18	13	0.12	55	250	19
Garden, potato-potlatch (T68, N Grant Road)	7/11/06	2.8	5	0.22	0.12	14	0.22	55	250	21
Garden, mixed homegarden (T68, N Grant Road)	7/11/06	3.8	6	0.34	0.14	87	0.17	50	800	55
Hayfield (T68, N Grant Road)	7/10/06	2.7	5.2	0.22	0.09	11	0.01	55	300	32
Garden, mixed homegarden (T68, N Grant Road)	7/10/06	3.2	5.9	0.32	0.14	77	0.2	70	650	45

Description, location	Date sampled	OM (%)	pH	EC (dS $m^{-1)}$	N (%)	P (ppm)	B (ppm)	K (ppm)	Ca (ppm)	Mg (ppm)
Pasture – orchard (T69, McClellan Road)	8/25/06	3.4	5.2	0.49	0.17	22	0.15	140	350	40
Hayfield (T67, Snooka Creek Area)	8/18/06	7.2	4.9	0.24	0.24	13	0.14	50	300	17
Uncultivated area (F66, Snooka Creek Area)	6/28/06	2.2	5.2	0.18	0.08	56	0.09	50	200	13
Orchard - lawn (T67, Snooka Creek Area)	6/28/06	7.5	5.4	0.44	0.28	56	0.28	95	750	60
Lawn (T67, Snooka Creek Area)	8/24/06	9.3	5.9	0.35	0.32	205	0.3	65	1550	75
Raised bed garden (T67, Snooka Creek Area)	8/24/06	10.3	6.7	0.38	0.29	662	0.6	215	2400	180
Lawn (T61, Airport Road)	8/24/06	2.8	5.5	0.24	0.13	92	0.12	60	350	32.5
Uncultivated area (F63, S Brothen Road)	7/06/06	4.5	4.7	0.45	0.12	236	0.12	60	350	40
Raised bed garden (T56, Hagensborg)	6/21/06	3.1	6.1	0.3	0.12	92	0.33	60	550	70
Pasture - horses (T56, Hagensborg)	6/26/06	2.7	5.1	0.29	0.13	12	0.12	70	300	40
Garden, mixed homegarden (T56, Hagensborg)	6/26/06	5.7	6.2	0.98	0.21	67	0.28	220	800	110
Hayfield (T57, Hagensborg)	6/23/06	4.6	4.8	0.44	0.17	25	0.14	55	350	16
Hayfield (T56, Hagensborg)	6/23/06	4.7	5.2	0.15	0.16	38.5	0.1	55	400	40
Garden, mixed homegarden (T56, Hagensborg)	6/21/06	6.2	5.9	0.32	0.21	87	0.45	260	750	80
Pasture - horses (T54, Saloompt)	6/29/06	4	5.2	0.34	0.17	16	0.14	55	500	45
Garden, summer fallow (T54, Saloompt)	6/29/06	11.8	6.3	0.61	0.41	584	0.52	160	2850	145
Lawn – brambles (T47, Saloompt)	6/23/06	3.7	6.4	0.23	0.14	36	0.34	195	1400	190
Field, recreational (T48, Saloompt)	8/22/06	7.4	5.8	0.17	0.2	18	0.19	80	1150	105
Garden, mixed homegarden (T42, Nusatsum)	6/24/06	4.2	5.1	0.4	0.1	82	0.1	100	400	40
Field, recently cleared (T42, Nusatsum)	6/24/06	7.5	5.1	0.21	0.12	62	0.18	60	500	70
Uncultivated area (P42, Nusatsum)	6/27/06	4.1	4.7	0.42	0.17	12	0.09	31	450	60
Raised bed garden (T40, Nusatsum)	6/27/06	8.3	6.8	1.33	0.3	277	1.05	410	2450	235
Garden, market garden (T41, Nusatsum)	8/16/06	6.5	6.6	0.27	0.15	277	0.26	105	1300	85

Description, location	**Date sampled**	**OM (%)**	**pH**	**EC** (dS m^{-1})	**N (%)**	**P (ppm)**	**B (ppm)**	**K (ppm)**	**Ca (ppm)**	**Mg (ppm)**
Raised bed garden (NA, Jourdenais Road)	8/09/06	16	5.9	0.21	0.33	323	0.26	95	500	200
Pasture (T07, Canoe Crossing)	8/23/06	6.5	6.6	0.27	0.15	277	0.26	105	1300	85
Pasture – orchard (T06, Canoe Crossing)	8/23/06	8.6	5.8	0.28	0.35	108	0.81	160	1100	150
Hayfield (T05, Firvale)	6/21/06	5.5	6	0.15	0.16	14	0.15	125	1050	55
Garden, mixed homegarden (T05, Firvale)	6/21/06	8.4	5.8	0.19	0.23	51	0.4	160	1150	105
Lawn (T05, Firvale)	6/20/06	4.9	5.8	0.15	0.15	28	0.18	140	750	75
Uncultivated area (F07, Firvale)	6/20/06	6.1	6.1	0.17	0.11	113	0.3	80	1250	85
Raised bed garden (F07 Firvale)	6/20/06	1.7	6.3	0.61	0.04	113	0.1	60	500	40
Hayfield (T11, W Burnt Bridge)	6/14/06	9.1	5.4	0.23	0.31	17	0.18	65	1050	70
Garden, mixed homegarden - orchard (T10, W Burnt Bridge)	7/01/06	8.4	5.8	0.52	0.31	159	0.4	195	2250	135
Hayfield (T10, W Burnt Bridge)	7/01/06	5.6	5.5	0.34	0.19	174	0.24	140	850	150
Hayfield (T10, W Burnt Bridge)	7/01/06	2.8	5.4	0.16	0.07	523	0.04	100	350	40
Hayfield (NA, Tweedsmuir Park)	8/16/06	6.3	5.7	0.27	0.2	8	0.08	60	750	65

Appendix D   Soil Fertility Analyses Extraction Methods

These are the standard laboratory methods published by Pacific Soil Analysis (PSAI) of Richmond, B.C. for extraction of the soil nutrients and quantification of the soil pH and organic matter percentage for the 2006 Bella Coola Valley Soil Fertility Study.

Soil Fertility Test Results Key	Pacific Soil Analysis (PSAI) Laboratory Methods
OM% *Organic Matter* **Expressed as a percentage**	OM% reported here is the measured total Carbon multiplied by 1.724; Carbon measured with a LECO CR 12 Carbon analyser
pH *Power of Hydrogen*	Determined potentiometrically using a Radiometer pH meter on a 1:1 soil to distilled water slurry
EC *Electrical Conductivity*	Measured on a saturated paste extract in units of (dSm^{-1})
N% *Total Kjeldahl Nitrogen* **Expressed as a percentage**	Determined colorimetrically using a Technicon Autoanalyser, on a semi-micro Kjeldahl digest
P (ppm) *Available Phosphorus* **Units are parts per million**	*Bray method* Determined colormetrically using the ascorbic acid color development method on a 1:10 soil to Bray (NH_4F) extract
K (ppm) *Available Potassium* **Units are parts per million**	Determined by Perkin-Elmer Atomic Absorption Spectrophotometer on a 1:5 soil to ammonium acetate extract
B (ppm) *Available Boron* **Units are parts per million**	Available Boron determined on a hot water soluble extract using the azomethine-H method.
Ca (ppm) *Available Calcium* **Units are parts per million**	Determined by Perkin-Elmer Atomic Absorption Spectrophotometer on a 1:5 soil to ammonium acetate extract
Mg (ppm) *Available Magnesium* **Units are parts per million**	Determined by Perkin-Elmer Atomic Absorption Spectrophotometer on a 1:5 soil to ammonium acetate extract

Methods source manuals as listed by Pacific Soil Analysis

L.M. Lavkulich, (1977). *Methods Manual*, Pedology Laboratory, Department of Soil Science, UBC
L.M. Lavkulich, (1978). *Methods Manual*, Pedology Laboratory, Department of Soil Science, UBC
J.A. McKeague (1987). Manual of Soil Sampling and Methods of Analysis, British Columbia.
Martin R. Carter, editor (1993). Soil Sampling and Methods of Analysis, British Columbia.

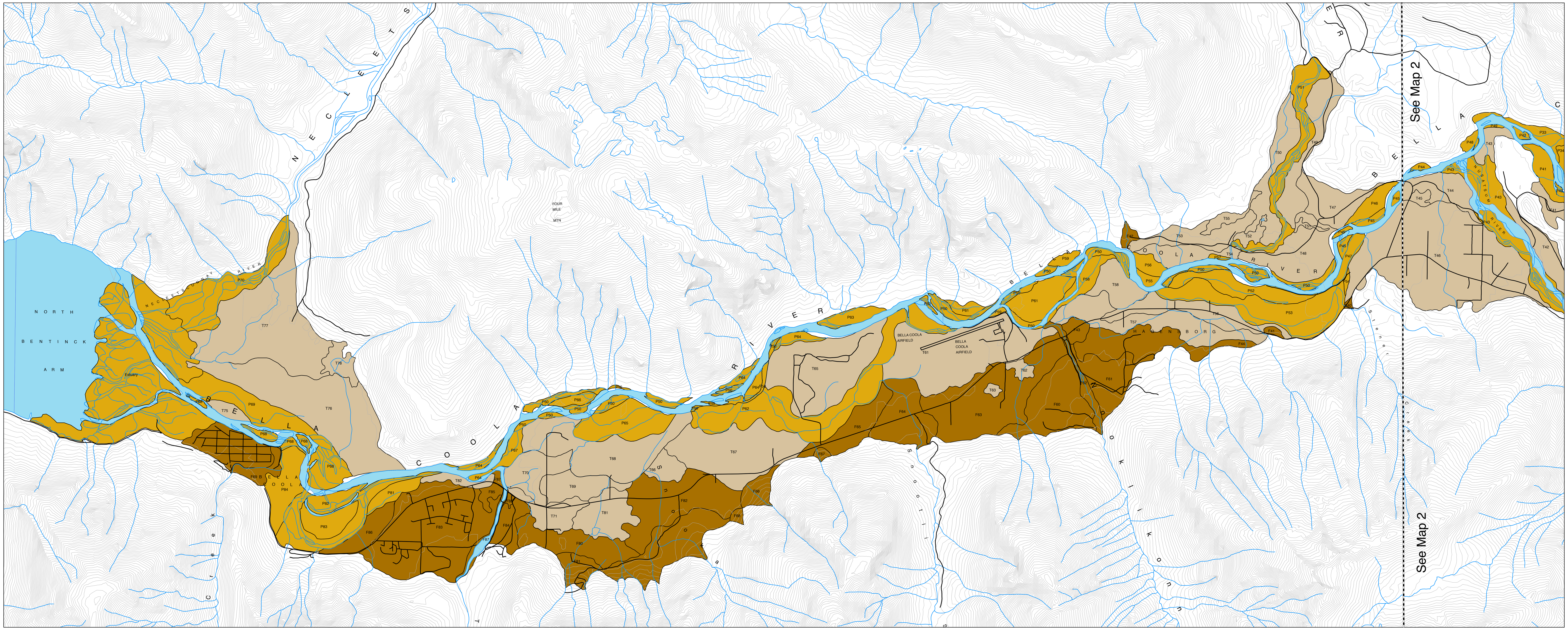
Additional Comments on the PSAI Laboratory Methods

All soil samples are air dried or dried at less than 40 C, crushed and sieved through a 2 mm sieve.
* Available nutrients indicate an index of availability correlated with regional soil fertility data.

Appendix E Soils of the Bella Coola Valley, Map 1

Soils of the Bella Coola Valley

A Project of the Bella Coola Valley Sustainable Agricultural Society



0 625 1,250 2,500 3,750 5,000 Meters

1:20,000

N

This map should be used in conjunction with 'Soils of the Bella Coola Valley' (2007) Expanded Legend and Data Spreadsheet.

Base Maps: 93D 36 - 40, 45 - 50

Map 1 of 2

Legend

Landform

F - Fan

P - Floodplain

T - Terrace

Road

20 m contour

River / Ocean

Project Coordination:
Gary Runka, P.Ag., BCVSAS Foodshed Subcommittee Chair

Landform and Soils Mapping by:
Terence Lewis, Ph.D., P.Ag., P.Geo.

Funding provided by:
Investment Agriculture Foundation
Real Estate Foundation of BC

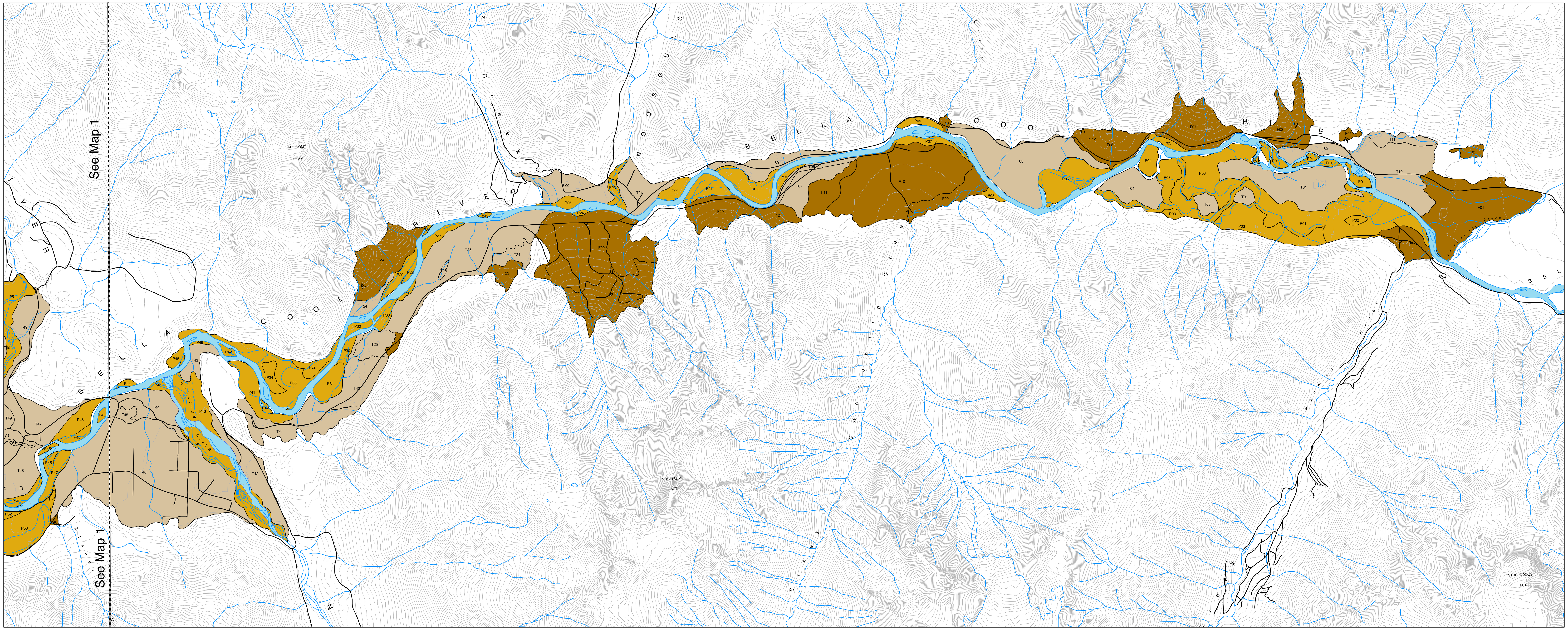
TRIM base maps permission of:
Central Coast Regional District,
member of Integrated Cadastral Information Society

Map created by :
Hans Granander, RPF
Frontier Resource Management Ltd.
November, 2007

Appendix F Soils of the Bella Coola Valley, Map 2

Soils of the Bella Coola Valley

A Project of the Bella Coola Valley Sustainable Agricultural Society



0 625 1,250 2,500 3,750 5,000 Meters

1:20,000

This map should be used in conjunction with 'Soils of the Bella Coola Valley' (2007) Expanded Legend and Data Spreadsheet.

Base Maps: 93D 36 - 40, 45 - 50

Map 2 of 2

Legend

Landform

- F - Fan
- P - Floodplain
- T - Terrace
- Road
- 20 m contour
- River / Ocean

Project Coordination:
Gary Runka, P.Ag., BCVSAS Foodshed Subcommittee Chair

Landform and Soils Mapping by:
Terence Lewis, Ph.D., P.Ag., P.Geo.

Funding provided by:
Investment Agriculture Foundation
Real Estate Foundation of BC

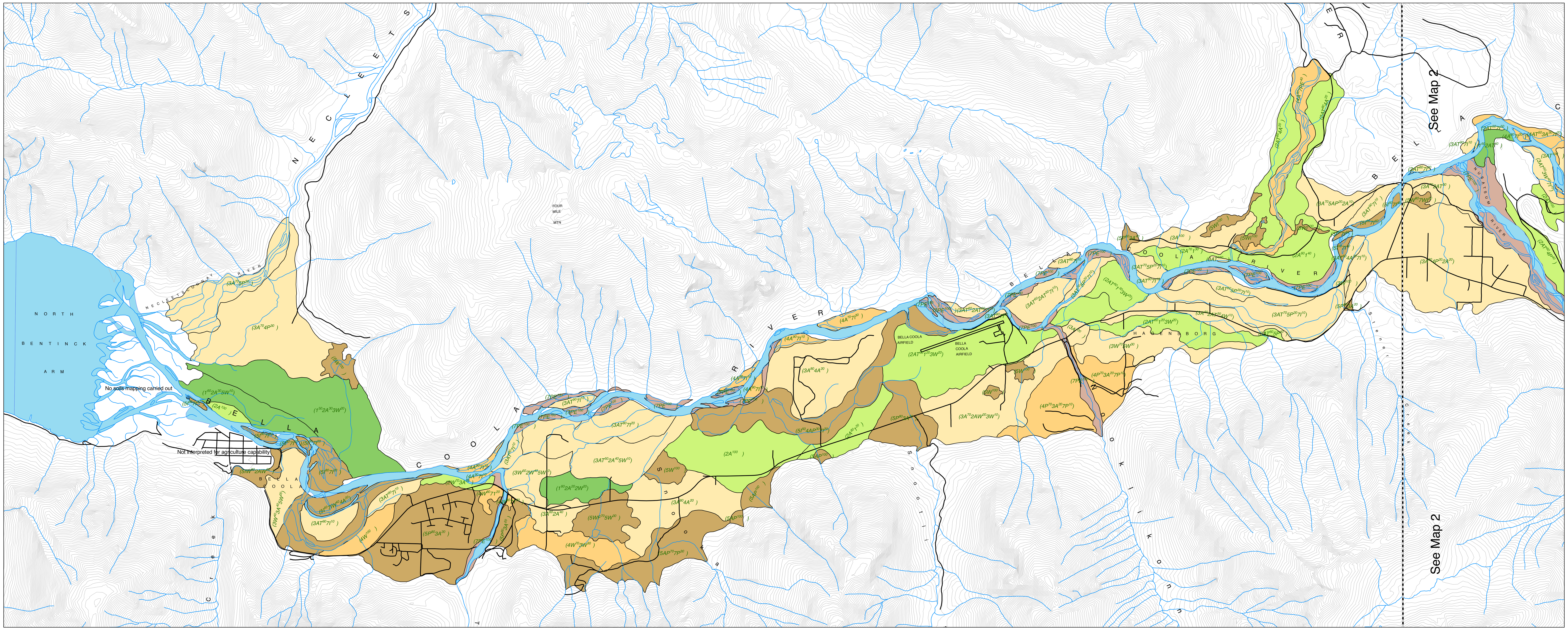
TRIM base maps permission of:
Central Coast Regional District,
member of Integrated Cadastral Information Society

Map created by :
Hans Granander, RPF
Frontier Resource Management Ltd.
November, 2007

Appendix G Bella Coola Valley Land Capability for Agriculture, Map 1

Bella Coola Valley Land Capability for Agriculture

A Project of the Bella Coola Valley Sustainable Agricultural Society



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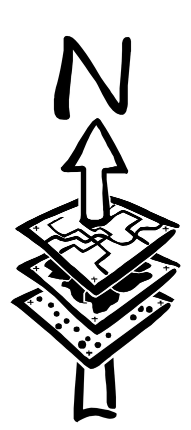
1:20,000



This map should be used in conjunction with 'Soils of the Bella Coola Valley' (2007) Expanded Legend and Data Spreadsheet.

Base Maps: 93D 36 - 40, 45 - 50

Map 1 of 2

Legend

Dominant Agriculture Capability Class

- Class 1
- Class 2
- Class 3
- Class 4
- Class 5
- Class 7
- Road
- 20 m contour
- River / Ocean

LAND CAPABILITY FOR AGRICULTURE CLASSIFICATION[1]

In this classification, mineral and organic soils are each grouped into 7 classes, according to their potentials and limitations for agricultural use. Capability ratings consist of two components. The capability class indicates the relative degree of limitations to agricultural use; the capability subclass indicates the type of limitation or hazards that restrict the range of crops and/or increase the required intensity of management.

The classification is based on an interpretation of soil and climate characteristics for agricultural use. Ratings give no indication of specific crop suitability, productivity or present land use.

Class

1 Has no or only very slight limitations that restrict its use for the production of common agricultural crops.
2 Has minor limitations that require good ongoing management practices or slightly restrict the range of crops, or both.
3 Has limitations that require moderately intensive management practices or moderately restrict the range of crops or both.
4 Has limitations that require special management practices or severely restrict the range of crops, or both.
5 Has limitations that restrict its capability to producing perennial forage crops or other specially adapted crops.
6 Is non-arable but is capable of producing native and/or uncultivated perennial forage crops.
7 Has no capability for arable culture or sustained natural grazing.
() Improved rating; that is, capability after limitations have been addressed through appropriate management.

Subclasses

A	Soil Moisture Deficiency	**E**	Erosion
N	Salinity	**T**	Topography
C	Adverse Climate	**F**	Fertility
P	Stoniness	**W**	Excess Water
D	Undesirable Soil Structure and/or Low Perviousness	**I**	Inundation
R	Depth to Solid Bedrock and/or Rockiness		

Sample Map Legend

improved rating
% of map unit (i.e. 60% & 40%)
60 40
(2A 4 W)
I
soil capability class
subclass limitation

1. Taken from Land Capability Classification for Agriculture in British Columbia MOE Manual 1, Ministry of Environment and Ministry of Agriculture and Food, Kelowna, 1983.

Project Coordination:
Gary Runka, P.Ag., BCVSAS Foodshed Subcommittee Chair

Land Capability for Agriculture Rating by:
Terence Lewis, Ph.D., P.Ag., P.Geo.

Funding provided by:
Investment Agriculture Foundation
Real Estate Foundation of BC

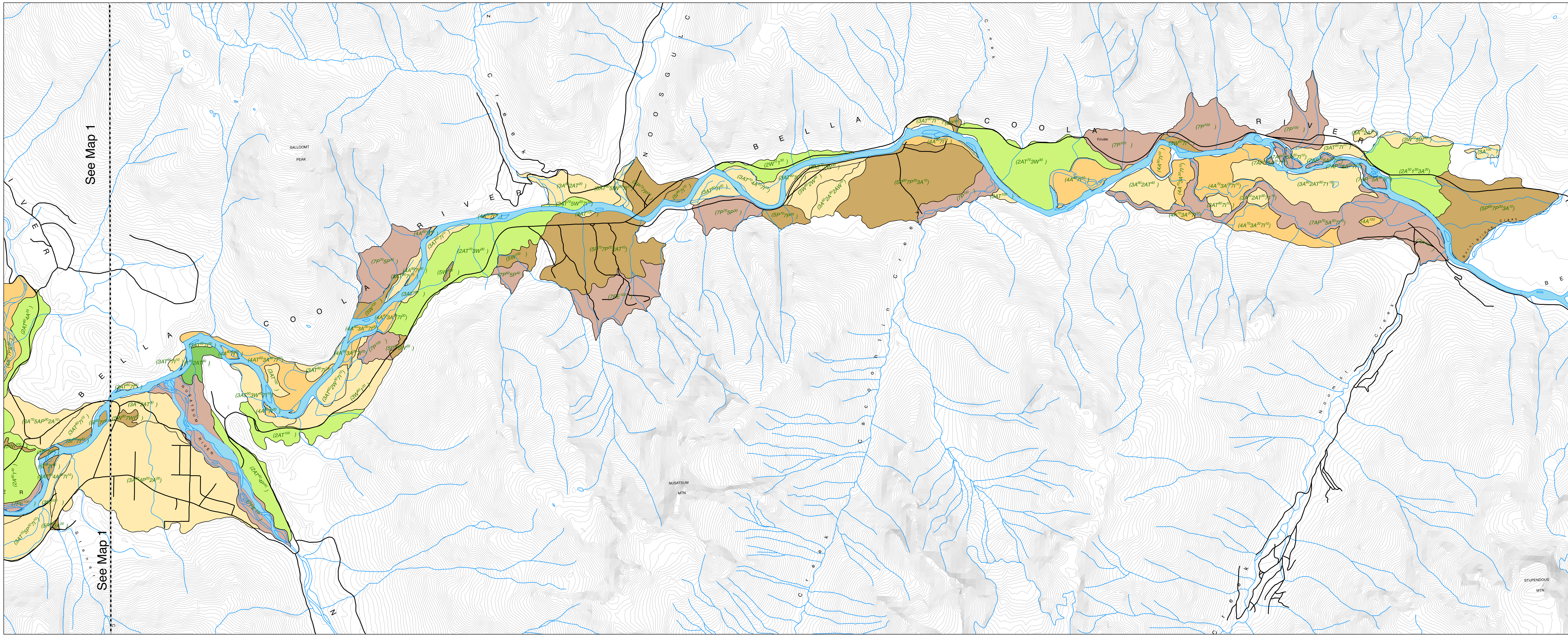
TRIM base maps permission of:
Central Coast Regional District, member of Integrated Cadastral Information Society

Map created by :
Hans Granander, RPF
Frontier Resource Management Ltd.
March, 2008

Appendix H Bella Coola Valley Land Capability for Agriculture, Map 2

Bella Coola Valley Land Capability for Agriculture

A Project of the Bella Coola Valley Sustainable Agricultural Society



0 625 1,250 2,500 3,750 5,000 Meters

1:20,000

N

This map should be used in conjunction with 'Soils of the Bella Coola Valley' (2007) Expanded Legend and Data Spreadsheet.

Base Maps: 93D 36 - 40, 45 - 50

Map 2 of 2

Legend

Dominant Agriculture Capability Class

- Class 1
- Class 2
- Class 3
- Class 4
- Class 5
- Class 7
- Road
- 20 m contour
- River / Ocean

LAND CAPABILITY FOR AGRICULTURE CLASSIFICATION[1]

In this classification, mineral and organic soils are each grouped into 7 classes, according to their potentials and limitations for agricultural use. Capability ratings consist of two components. The capability class indicates the relative degree of limitations to agricultural use; the capability subclass indicates the type of limitation or hazards that restrict the range of crops and/or increase the required intensity of management.

The classification is based on an interpretation of soil and climate characteristics for agricultural use. Ratings give no indication of specific crop suitability, productivity or present land use.

Class

1	Has no or only very slight limitations that restrict its use for the production of common agricultural crops.
2	Has minor limitations that require good ongoing management practices or slightly restrict the range of crops, or both.
3	Has limitations that require moderately intensive management practices or moderately restrict the range of crops or both.
4	Has limitations that require special management practices or severely restrict the range of crops, or both.
5	Has limitations that restrict its capability to producing perennial forage crops or other specially adapted crops.
6	Is non-arable but is capable of producing native and/or uncultivated perennial forage crops.
7	Has no capability for arable culture or sustained natural grazing.
()	Improved rating; that is, capability after limitations have been addressed through appropriate management.

Subclasses

A	Soil Moisture Deficiency	**E**	Erosion
N	Salinity	**T**	Topography
C	Adverse Climate	**F**	Fertility
P	Stoniness	**W**	Excess Water
D	Undesirable Soil Structure and/or Low Perviousness	**I**	Inundation
R	Depth to Solid Bedrock and/or Rockiness		

Sample Map Legend

improved rating — % of map unit (i.e. 60% & 40%)

$$(2A^{60}\ 4W^{40})$$

soil capability class — subclass limitation

1. Taken from Land Capability Classification for Agriculture in British Columbia MOE Manual 1, Ministry of Environment and Ministry of Agriculture and Food, Kelowna, 1983.

Project Coordination:
Gary Runka, P.Ag., BCVSAS Foodshed Subcommittee Chair

Land Capability for Agriculture Rating by:
Terence Lewis, Ph.D., P.Ag., P.Geo.

Funding provided by:
Investment Agriculture Foundation
Real Estate Foundation of BC

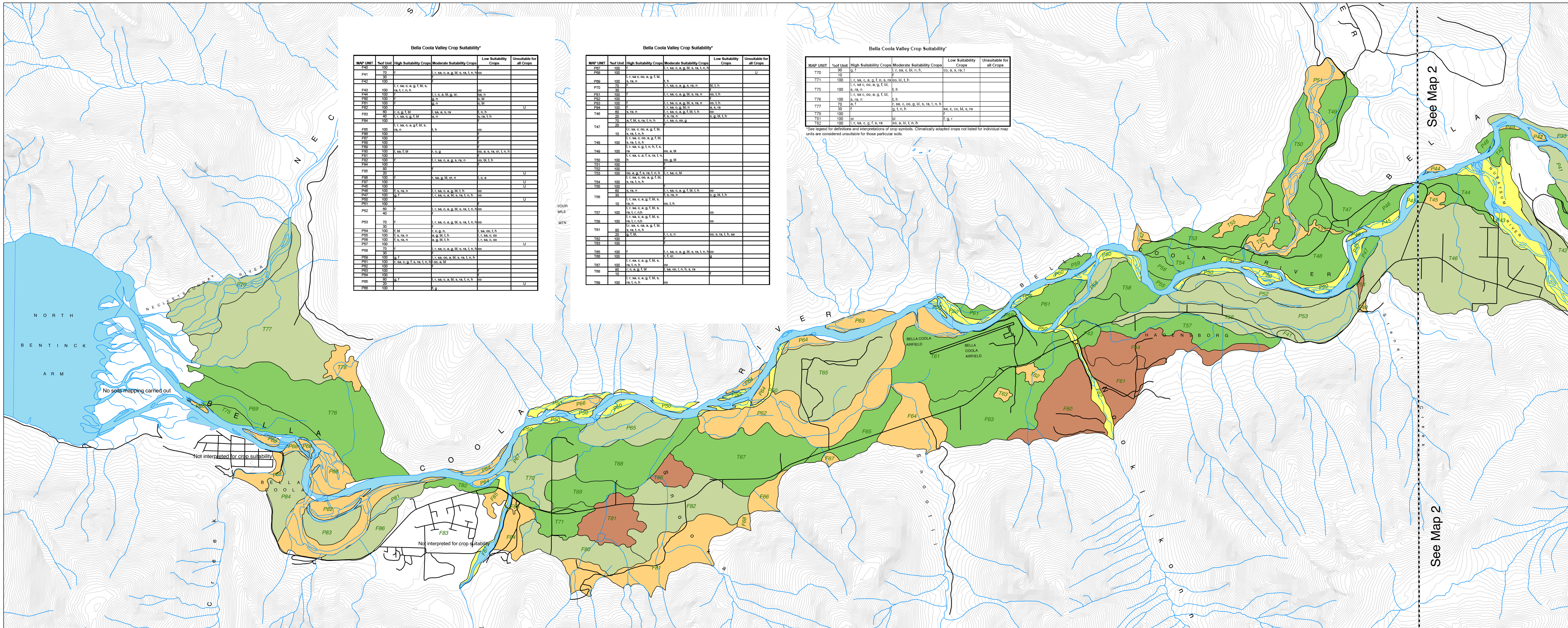
TRIM base maps permission of:
Central Coast Regional District,
member of Integrated Cadastral Information Society

Map created by :
Hans Granander, RPF
Frontier Resource Management Ltd.
March, 2008

Appendix I   Bella Coola Valley Crop Suitability, Map 1

Bella Coola Valley Crop Suitability

A Project of the Bella Coola Valley Sustainable Agricultural Society



0 625 1,250 2,500 3,750 5,000 Meters

1:20,000

N

This map should be used in conjunction with Bella Coola Valley Crop Suitability report as amended March 2008 and 'Soils of the Bella Coola Valley' (2007) Expanded Legend and Data Spreadsheet.

Base Maps: 93D 36 - 40, 45 - 50

Map 1 of 2

Legend

Generalized Crop Suitability

- Wide range of cropping options with dominantly high and moderate crop suitability
- Wide range of cropping options with dominantly moderate and low crop suitability
- Moderate range of cropping options
- Narrow range of cropping options or dominantly low crop suitability
- No cropping options
- Road
- 20 m contour
- River / Ocean

Crop Suitability*

H **High suitability** indicates those crops that are well suited to the soils and climate and require few management inputs to achieve an acceptable level of production.

M **Moderate suitability** indicates those crops that are moderately well suited to the soils and climate and require some management inputs to achieve an acceptable level of production.

L **Low suitability** indicates those crops that are not well suited to the soils and climate and require a considerable degree of management inputs to achieve an acceptable level of production.

U **Unsuitable for all crops**

Climatically Suited Crops**

l **Annual Legumes** (peas, beans)

r **Root Crops** (beets, carrots, parsnips, potatoes, radishes, bulb onions and turnips)

sa **Shallow Rooted Annual Vegetables** (salad crops, including lettuce, spinach, parsley, celery and green onions)

c **Cole Crops** (broccoli, Brussel sprouts, cabbage, cauliflower, and kale)

co **Corn**

a **Asparagus**

g **Cereal Grains** (barley, fall rye, oats, wheat and winter wheat)

f **Perennial Forage Crops** (grass and grass clover)

bl **Blueberries and Currants**

s **Strawberries**

cr **Cranberries**

ra **Raspberries** (including blackberries, loganberries and tayberries)

t **Tree Fruits** (apples, cherries, plums and pears)

n **Nursery Stock and Christmas Trees**

h **Hazelnuts**

* Crop suitability definitions and interpretations based on and adapted from 'Soil Management Handbook of the Lower Fraser Valley' (Second Edition), BC Ministry of Agriculture, Fisheries and Food, Abbotsford, 1991. (N.B. Crop suitability is not an interpretation of economic feasibility for commercial production.)

** Excluding those crops considered limited to small scale, home or hobby garden production. See Bella Coola Valley Crop Suitability report as amended March 2008.

Project Coordination:
Gary Runka, P.Ag., BCVSAS Foodshed Subcommittee Chair

Crop Suitability Interpretation by:
Gary Runka P.Ag. and Joan Sawicki

Funding provided by:
Investment Agriculture Foundation
Real Estate Foundation of BC

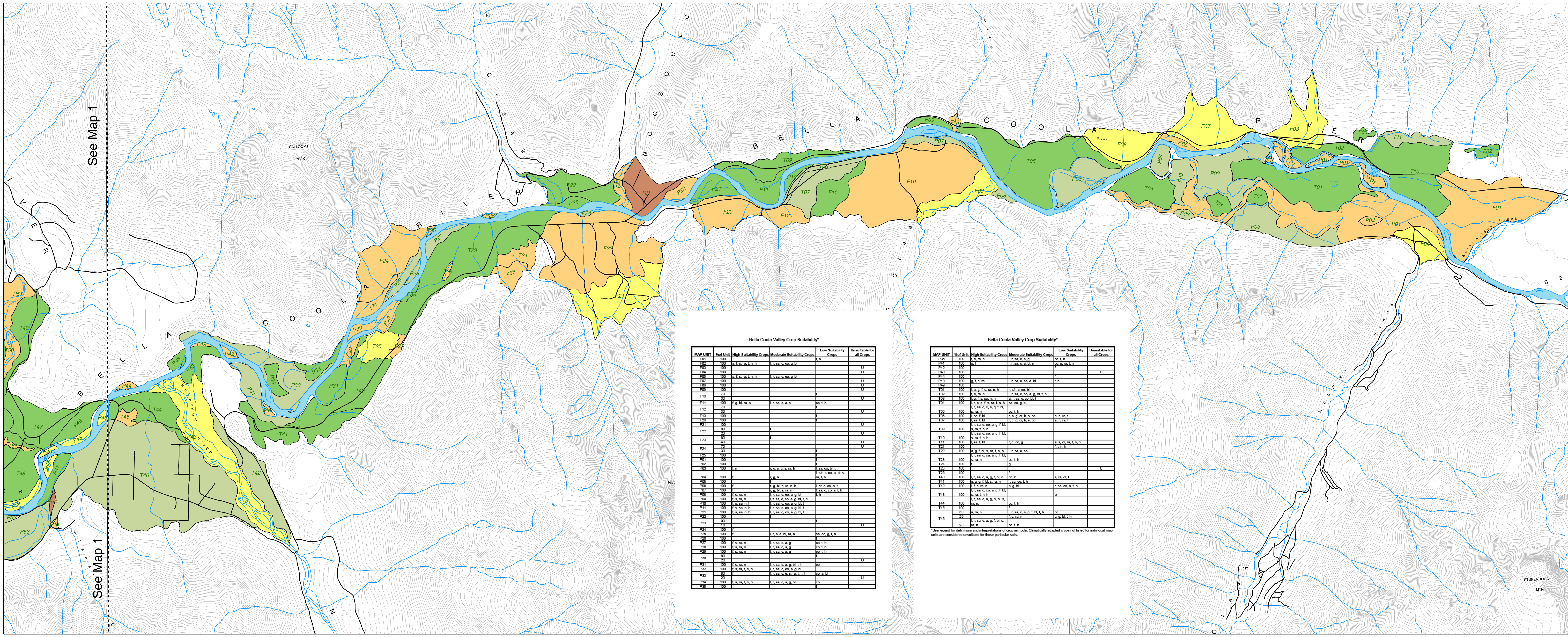
TRIM base maps permission of:
Central Coast Regional District, member of Integrated Cadastral Information Society

Map created by :
Hans Granander, RPF
Frontier Resource Management Ltd.
April, 2008

Appendix J Bella Coola Valley Crop Suitability, Map 2

Bella Coola Valley Crop Suitability

A Project of the Bella Coola Valley Sustainable Agricultural Society



0 625 1,250 2,500 3,750 5,000
Meters

1:20,000

This map should be used in conjunction with Bella Coola Valley Crop Suitability report as amended March 2008 and 'Soils of the Bella Coola Valley' (2007) Expanded Legend and Data Spreadsheet.

Base Maps: 93D 36 - 40, 45 - 50

Map 2 of 2

Legend

Generalized Crop Suitability

- Wide range of cropping options with dominantly high and moderate crop suitability
- Wide range of cropping options with dominantly moderate and low crop suitability
- Moderate range of cropping options
- Narrow range of cropping options or dominantly low crop suitability
- No cropping options

Road

20 m contour

River / Ocean

Crop Suitability*

H **High suitability** indicates those crops that are well suited to the soils and climate and require few management inputs to achieve an acceptable level of production.

M **Moderate suitability** indicates those crops that are moderately well suited to the soils and climate and require some management inputs to achieve an acceptable level of production.

L **Low suitability** indicates those crops that are not well suited to the soils and climate and require a considerable degree of management inputs to achieve an acceptable level of production.

U **Unsuitable for all crops**

Climatically Suited Crops**

l **Annual Legumes** (peas, beans)

r **Root Crops** (beets, carrots, parsnips, potatoes, radishes, bulb onions and turnips)

sa **Shallow Rooted Annual Vegetables** (salad crops, including lettuce, spinach, parsley, celery and green onions)

c **Cole Crops** (broccoli, Brussel sprouts, cabbage, cauliflower, and kale)

co **Corn**

a **Asparagus**

g **Cereal Grains** (barley, fall rye, oats, wheat and winter wheat)

f **Perennial Forage Crops** (grass and grass clover)

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s **Strawberries**

cr **Cranberries**

ra **Raspberries** (including blackberries, loganberries and tayberries)

t **Tree Fruits** (apples, cherries, plums and pears)

n **Nursery Stock and Christmas Trees**

h **Hazelnuts**

* Crop suitability definitions and interpretations based on and adapted from 'Soil Management Handbook of the Lower Fraser Valley' (Second Edition), BC Ministry of Agriculture, Fisheries and Food, Abbotsford, 1991. (N.B. Crop suitability is not an interpretation of economic feasibility for commercial production.)

** Excluding those crops considered limited to small scale, home or hobby garden production. See Bella Coola Valley Crop Suitability report as amended March 2008.

Project Coordination:
Gary Runka, P.Ag., BCVSAS Foodshed Subcommittee Chair

Crop Suitability Interpretation by:
Gary Runka P.Ag. and Joan Sawicki

Funding provided by:
Investment Agriculture Foundation
Real Estate Foundation of BC

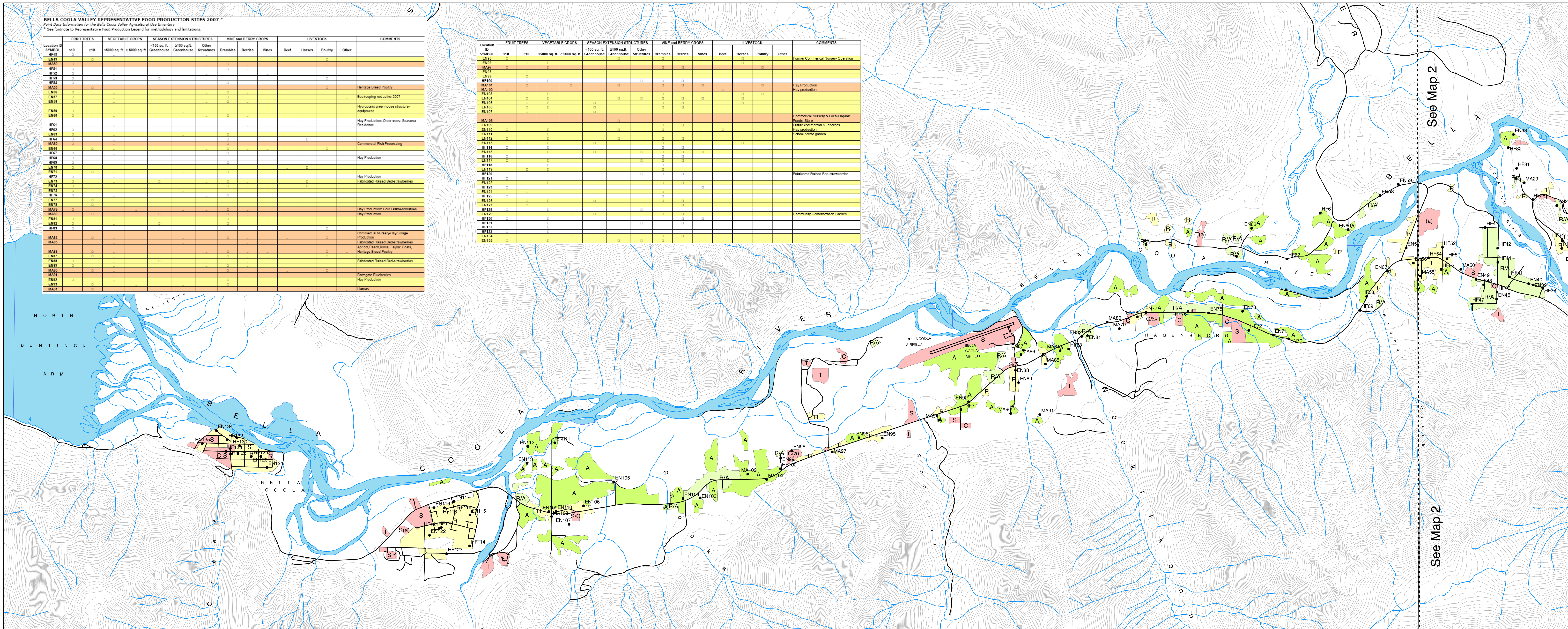
TRIM base maps permission of:
Central Coast Regional District, member of Integrated Cadastral Information Society

Map created by :
Hans Granander, RPF
Frontier Resource Management Ltd.
April, 2008

Appendix K Bella Coola Valley Agriculture Use & Food Production Inventory, Map 1

Bella Coola Valley Agricultural Use Inventory

A Project of the Bella Coola Valley Sustainable Agricultural Society



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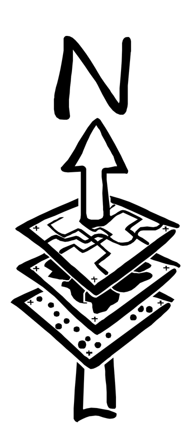
1:20,000



Legend

- Road
- 20 m contour
- River / Ocean

Base Maps: 93D 36 - 40, 45 - 50

Map 1 of 2

Generalized Land Use Inventory

A **Agricultural** (dominantly forage with associated residential and including vacant cleared land with evidence of previous forage use)

R **Residential** (dominantly residential with associated small-scale food production and/or home business)

R/A **Residential/Agricultural** (intermixed use areas and/or residential use with significant associated agricultural activity)

C **Commercial** (retail goods and services, including private campgrounds)

S **Service/Institutional** (including schools, airport, fish hatchery and other public buildings or facilities)

I **Industrial** (including aggregates)

T **Recreational** (including public picnic areas and rodeo grounds)

(a) **Abandoned** former use

*NOTE:
1. This generalized land use inventory was carried out at a scale of 1:20,000, using 2006 air photograph interpretation, a ± 2 acre (0.8 ha) minimum polygon size and limited ground truthing.
2. The primary focus was on cleared land with evidence of food production or agricultural activity; the map does not reflect forested grazing use nor all forested residential uses.
3. Given the scale of mapping and small-scale nature of most food production within the study area, this map should be used in conjunction with associated point data representative of food production and agricultural activity during the 2007 growing season.

Representative Food Production 2007*

- HF32 GPS point ID symbol

HF (Household Food Production) – food production at a predominantly household scale of endeavour

EN (Extended Network Food Production) – a diversity of agricultural activities and/or food production sufficient for extended family or neighbourhood sharing with periodic surplus product available for sale

MA (Market-oriented Agriculture) – significant food production and/or agricultural activity on a scale intended to generate product for off-farm sale

* NOTE:
1. This food production survey was carried out utilizing roadside observation methods (via vehicle over most of the study area; via foot in the more settled portions) and personal interviews wherever possible.
2. Sites recorded on the map are only intended to be representative of scale and scope of food production and do not include all sites documented in the survey.
3. Given the limitations of point data surveys, this information should be used in conjunction with associated land use mapping, which identifies general areal extent of lands used for agricultural/food production purposes in 2007.

Project Coordination:
Gary Runka, P.Ag., BCVSAS Foodshed Subcommittee Chair

Representative Food Production Site Inventory by:
DeLisa A Lewis, Ph. D. candidate, UBC

Generalized Land Use Inventory by:
Joan Sawicki, Gary Runka and DeLisa Lewis

Funding provided by:
Investment Agriculture Foundation
Real Estate Foundation of BC

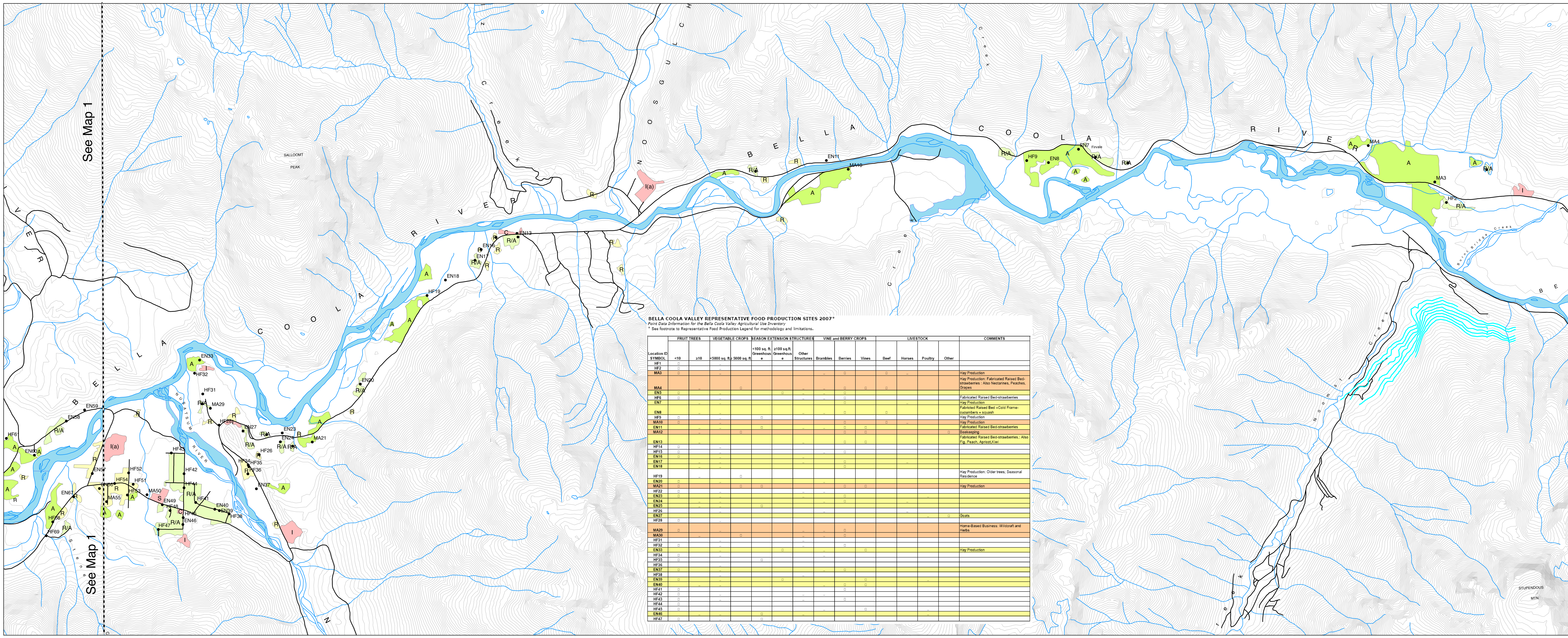
TRIM base maps permission of:
Central Coast Regional District,
member of Integrated Cadastral Information Society

Map created by :
Hans Granander, RPF
Frontier Resource Management Ltd.
July, 2008

Appendix L Bella Coola Valley Agriculture Use & Food Production Inventory, Map 2

Bella Coola Valley Agricultural Use Inventory

A Project of the Bella Coola Valley Sustainable Agricultural Society



0 625 1,250 2,500 3,750 5,000 Meters

1:20,000

Legend

- Road
- 20 m contour
- River / Ocean

N

Base Maps: 93D 36 - 40, 45 - 50

Map 2 of 2

Generalized Land Use Inventory

A **Agricultural** (dominantly forage with associated residential and including vacant cleared land with evidence of previous forage use)

R **Residential** (dominantly residential with associated small-scale food production and/or home business)

R/A **Residential/Agricultural** (intermixed use areas and/or residential use with significant associated agricultural activity)

C **Commercial** (retail goods and services, including private campgrounds)

S **Service/Institutional** (including schools, airport, fish hatchery and other public buildings or facilities)

I **Industrial** (including aggregates)

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(a) **Abandoned** former use

*NOTE:

1. This generalized land use inventory was carried out at a scale of 1:20,000, using 2006 air photograph interpretation, a ± 2 acre (0.8 ha) minimum polygon size and limited ground truthing.
2. The primary focus was on cleared land with evidence of food production or agricultural activity; the map does not reflect forested grazing use nor all forested residential uses.
3. Given the scale of mapping and small-scale nature of most food production within the study area, this map should be used in conjunction with associated point data representative of food production and agricultural activity during the 2007 growing season.

Representative Food Production 2007*

- HF32 GPS point ID symbol

HF (Household Food Production) – food production at a predominantly household scale of endeavour

EN (Extended Network Food Production) – a diversity of agricultural activities and/or food production sufficient for extended family or neighbourhood sharing with periodic surplus product available for sale

MA (Market-oriented Agriculture) – significant food production and/or agricultural activity on a scale intended to generate product for off-farm sale

* NOTE:

1. This food production survey was carried out utilizing roadside observation methods (via vehicle over most of the study area; via foot in the more settled portions) and personal interviews wherever possible.
2. Sites recorded on the map are only intended to be representative of scale and scope of food production and do not include all sites documented in the survey.
3. Given the limitations of point data surveys, this information should be used in conjunction with associated land use mapping, which identifies general areal extent of lands used for agricultural/food production purposes in 2007.

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Appendix M Bella Coola Valley Crop Suitability Report

Compiled as a project deliverable for the Bella Coola Valley Foodshed Analysis

A project of the Bella Coola Valley Sustainable Agricultural Society and UBC Faculty of Land and Food Systems

January 21, 2008
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(As amended March, 2008)

<u>Introduction</u>

The 2007 'Foodshed Analysis' area comprises the valley bottom landforms within the Bella Coola Valley from the boundary of Tweedsmuir Provincial Park at Burnt Bridge Creek westward to the estuary of the Bella Coola River at North Bentinck Arm. The study area comprises 6,276 ha (15,509 acres). The crop suitability component of the Foodshed Analysis is intended to identify the biophysical opportunities for increased range and production of soil-based food products in the Bella Coola Valley.

This report provides basic crop suitability information for soil/climate combinations within the study area, based on climate and 1:20,000 soil survey inventory and mapping conducted in 2007. Climate suitability for specific crops was determined from both long-term and recently established valley climate station data. Long-term data is summarized by Environment Canada's thirty-year (1971- 2001) climate normals for three stations: [159] "Bella Coola" located on North Grant Road, "Bella Coola A" located at the airport, and "Stuie/Tweedsmuir Lodge" located at the eastern end of the Bella Coola valley just beyond the Foodshed project area. Recently established climate stations include new stations on north Grant Road and on Hammer Road.

Reference was also made to experience elsewhere and to the <u>Soil Management Handbook of the Lower Fraser Valley</u>[160] and the technical paper, *Climatic Capability Classification for Agriculture in British Columbia*[161]

As part of a project that is grounded in a community-based research methodology, local experience was also utilized in determining crop suitability, including that gained through agriculture land use mapping carried out within the study area during the 2007 growing season.

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[159] http://www.climate.weatheroffice.ec.gc.ca/climate_normals/index_e.html
[160] Bertrand, R.A., Hughes-Games, G.A., Nikkel, D.C. <u>Soil Management Handbook of the Lower Fraser Valley</u> (Second Edition), B.C. Ministry of Agriculture, Fisheries and Food, Abbotsford, 1991.
[161] Climatology Unit, Ministry of Environment. *Climatic Capability Classification for Agriculture in British Columbia* (APD Technical Paper 4), Victoria, 1981.

Climatic Capability Classes for the Bella Coola Valley

The *Climatic Capability Classification for Agriculture in British Columbia* (1981) defines climatic classes on the basis of freeze-free period, accumulated growing degree-days above 5C and climatic moisture deficit.

A moderate coastal climate dominates the Bella Coola Valley; consequently it is the accumulation of growing degree-days rather than freeze-free period that limits the range of climate-adapted crops. The coastal influence does, however, decrease with distance from North Bentinck Arm, and a decidedly Interior climatic influence becomes apparent in the easternmost part of the study area. In addition, local sites have topographic advantages or disadvantages depending on slope and aspect, and the extent and duration of valley shading - factors that significantly influence the accumulation of heat units.

Assuming irrigation, the Bella Coola Valley lies entirely within Climatic Class 1 (or better), which, for the Coast, is defined as:

> Freeze-free period is greater than 150 days and effective growing degree-days above 5C are greater than 825.

Provincial modifications to reflect growing degree-days as the key determinant of crop suitability in coastal BC (over and above freeze-free period) has resulted in additional climatic classification categories as follows:

> **Class 1c**: freeze-free period >150 days; growing degree days above 5C are 2060 to 2225; examples of the range of suitable crops include apricots, peaches, cherries, pears, plums, apples, strawberries, raspberries, grapes, cucumbers, melons, beans, peppers, asparagus, tomatoes, lettuce, potatoes, corn, carrots, beets, radishes, peas, onions, leeks, spinach, cauliflower, cabbage, broccoli, turnips, Brussels sprouts, cereal grains and forage crops.

> **Class 1b**: freeze-free period >150 days; growing degree days above 5C are 1780 to 2059; examples of the range of suitable crops include hardy apples, strawberries, raspberries, cucumbers, melons, beans, peppers, asparagus, tomatoes, lettuce, potatoes, corn, carrots, beets, radishes, peas, onions, leeks, spinach, cauliflower, cabbage, broccoli, turnips, Brussels sprouts, Swiss chard, cereal grains and forage crops.

> **Class 1a**: freeze-free period is 120 to 150 days; growing degree days above 5C are 1505 to 1779; examples of the range of suitable crops include hardy apples, strawberries, raspberries, beans, asparagus, tomatoes, lettuce, potatoes, corn, carrots, beets, radishes, peas, onions, leeks, spinach, cauliflower, cabbage, broccoli, turnips, Brussels sprouts, Swiss chard, cereal grains and forage crops.

Based on these climatic class definitions, the available climate data, and the observed range and performance of crops actually grown, the range of climatic classes found in the Bella Coola Valley is best described as Class 1b+ (i.e. better than 1b, but not quite 1c) to 1.

The range of crops climatically suitable for the Bella Coola Valley (i.e. without consideration of soils) as listed in the following section assumes irrigation.

Climatically Suited Crops or Crop Groups for the Bella Coola Valley

Annual Legumes: peas, beans

Blueberries and Currants

Cereal Grains: barley, fall rye, oats, wheat and winter wheat

Cole Crops: unlimited range including broccoli, Brussels sprouts, cabbage, cauliflower, and kale

Corn: sweet corn (Note: Cool, wet climate conditions at time of planting risks poor stands. Some additional season extension, fertility management and careful selection of climatically appropriate varieties may be necessary to produce reliable yields. Best results in areas with well-drained soils.)

Nursery Stock and Christmas Trees: crops grown in the ground, rather than in containers

Perennial Forage Crops: grass and grass clover

Raspberries, Blackberries, Loganberries and Tayberries

Root Crops: beets, carrots, parsnips, potatoes, radishes, bulb onions and turnips

Shallow Rooted Annual Vegetables: 1) unlimited range of salad crops including lettuce, spinach, parsley, celery and green onions plus 2) more limited range of crops that require sufficient heat units during the growing season includes cucumbers, peppers, tomatoes, pumpkins and squash, where yields and reliability would be limited to small scale, home or hobby garden production.

Strawberries

Tree Fruits: 1) apples, cherries, plums and pears plus 2) apricots, nectarines and peaches, but with this group, yields and reliability limited to small scale, home or hobby garden production, and best on sites with favorable slope and aspect.

Hazelnuts
Asparagus
Cranberries

Grapes and Hardy Kiwifruit: Yields and reliability limited to small scale, home or hobby garden production, and best on sites with favorable slope and aspect.

Crop Suitability based on Soil/Climate Combinations

This section of the report should be used in conjunction with *Soils of the Bella Coola Valley, Maps 1 and 2* (2007) and *Expanded Legend and Data Spreadsheet* (2008), as prepared by Dr. Terence Lewis, P. Ag. and *Bella Coola Valley Crop Suitability Maps 1 and 2* (2008) as prepared by Gary Runka, P. Ag. and Joan Sawicki, both of which are projects of the Bella Coola Valley Sustainable Agricultural Society.

Interpretations of the suitability of climatically adapted crops to the various soils of the Bella Coola Valley were carried for the 199 individually mapped soil units. For the purposes of this report, the soils have been generalized into 9 groupings and rated as dominantly High, Moderate, Low or Unsuited for the climatically adapted crops listed above, excluding those crops indicated as only suitable for home or hobby garden production.

NOTE: Crop suitability ratings were only carried out on those areas for which soil mapping was completed. That is, interpretations were not done for Bella Coola Townsite or the Estuary. This does not imply an absence of agricultural capability or crop suitability in these areas.

Soil groupings for crop suitability interpretation (See Appendix A for the correlation between these soil groups and individually mapped soil polygons):

- **High capability fluvial soils**
- **Sandy fluvial soils**
- **Fluvial soils with high water table**
- **Old, high terraces**
- **Very wet terraces**
- **Regularly inundated soils**
- **Active floodplain soils**
- **Stony, coarse textured fans**
- **Acidic, wet organic soils**

Crop suitability ratings are defined as follows:

High suitability indicates those crops that are well suited to the soils and climate and require few management inputs to achieve an acceptable level of production.

Moderate suitability indicates those crops that are moderately well suited to the soils and climate and require some management inputs to achieve an acceptable level of production.

Low suitability indicates those crops that are not well suited to the soils and climate and require a considerable degree of management inputs to achieve an acceptable level of production.

Unsuited indicates those crops that are not suited to the soils

NOTE: The generalized table of suitability below is based on Soil Management Handbook of the Lower Fraser Valley (1991) methodology. Suitability for climatically adapted crops assumes a sufficient and appropriate level of management inputs. For Bella Coola Valley soils, sufficient and appropriate level of management inputs would most often include, but not be limited to, drainage and/or irrigation improvements and organic matter build-up to increase water-holding capacity and soil fertility.

GENERALIZED SUITABILITY OF CLIMATICALLY ADAPTED CROPS IN THE BELLA COOLA VALLEY

SOIL GROUP	SUITABILITY			
	DOMINANTLY HIGH	DOMINANTLY MODERATE	DOMINANTLY LOW	DOMINANTLY UNSUITABLE
High capability fluvial soils	*Annual legumes (peas & beans), blueberries and currants, cereal grains, cole crops, corn, nursery and Christmas trees, perennial forage crops, raspberries, blackberries, loganberries, tayberries, root crops, shallow rooted annual vegetables, strawberries, apples, cherries, plums and pears, hazelnuts, asparagus*			*Cranberries*
Sandy fluvial soils	*Raspberries, blackberries, loganberries, tayberries, strawberries, apples, cherries, plums and pears, hazelnuts, asparagus, perennial forage crops, nursery and Christmas trees*	*Annual legumes (peas & beans), cole crops, corn, root crops, shallow rooted annual vegetables, blueberries and currants, cereal grains*		*Cranberries*

SOIL GROUP	**SUITABILITY**			
	Dominantly High	**Dominantly Moderate**	**Dominantly Low**	**Unsuitable**
Fluvial soils with water table	*Annual legumes (peas & beans), blueberries and currants, shallow rooted annual vegetables, perennial forage crops*	*Cole crops, corn, root crops, cereal grains*	*Apples, cherries, plums and pears, raspberries, blackberries, loganberries, tayberries, strawberries, hazelnuts, cranberries, asparagus, nursery and Christmas trees*	
Old, high terraces	*Raspberries blackberries, loganberries, tayberries, strawberries, apples, cherries, plums and pears, hazelnuts, asparagus, perennial forage crops, nursery and Christmas trees*	*Annual legumes (peas & beans), cole crops, corn, root crops, shallow rooted annual vegetables, blueberries and currants, cereal grains*		*Cranberries*
Very wet terraces		*Perennial forage crops*		*All other climatically adapted crops unsuitable due to poor drainage*
Regularly inundated soils		*Perennial forage crops*		*All other climatically adapted crops unsuitable due to flooding risk*

SOIL GROUP	**SUITABILITY**			
	Dominantly High	**Dominantly Moderate**	**Dominantly Low**	**Unsuitable**
Stony, coarse textured fans	*Christmas trees*	*Perennial forage crops, nursery and Christmas trees*	*Apples, cherries, plums and pears, depending on micro-climate*	*Annual legumes, blueberries and currants, cereal grains, cole crops, corn, raspberries, blackberries, Loganberries, tayberries, root crops, shallow rooted annual vegetables, strawberries, hazelnuts, asparagus, cranberries*
Acidic, wet organic soils		*Perennial forage crops, blueberries, currants and cranberries*	*Annual legumes (peas & beans), corn, shallow rooted annual vegetables, cole crops, root crops, cereal grains*	*Raspberries, blackberries, loganberries, tayberries, strawberries, asparagus, hazelnuts, apples, cherries, plums and pears, nursery and Christmas trees*